CALPUFF Modeling System
Version 6
User Instructions

April 2011

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1. OVERVIEW

1.1 CALPUFF Version 6 Modeling System

Version 6 of the CALPUFF modeling system is a full update to Version 5 of the system that allows sub-hourly temporal resolution of both source characteristics and input meteorological fields, and sub-hourly temporal resolution of modeled output fields. It incorporates all of the modules and features of Version 5, which is a *Guideline Model* (Federal Register, 2003) recognized for regulatory use by the U.S. Environmental Protection Agency (EPA). When data and simulations are made with a 1-hour timestep, Version 6 is equivalent to Version 5. However, with effectively unlimited temporal resolution it provides greater flexibility in modeling situations with complex source distributions that evolve over short timescales.

Such a complex source treatment was needed in 1999 when a project-specific version of the CALPUFF dispersion model was developed with funding from the National Aeronautics and Space Administration (NASA). It was designed to accept non-gridded meteorological data and source data at sub-hourly intervals (at time-scales as short as seconds), and to report concentrations for user-specified averaging times as short as several minutes. Identified as CALPUFF Version 6.0, it was based on the 1-hour version of the model that was in use at the time, CALPUFF Version 5.0. This implementation was designed specifically for applications involving the Space Shuttle. As a result, it did not fully address all source types available in the modeling system or any postprocessor other than CALPOST, nor did it include the meteorological model CALMET and its preprocessors.

Significant advances had been made to CALPUFF since 1999, so CALPUFF Version 6.0 did not include the technical enhancements and other capabilities present in the current versions of CALPUFF in 2005 when the USDA Forest Service expressed interest in coupling the CALPUFF Modeling System to its AGDISP aerial spray dispersion model to extend its modeling capability for assessing the fate of material that drifts downwind of application areas. Therefore, the USDA Forest Service funded the preparation of a new version of the system that can accept variability in the meteorological fields as well as source characteristics at sub-hourly intervals. The sub-hour time-varying structures implemented in CALPUFF Version 6.0 have been adapted to the current version of CALPUFF and its postprocessors, making this feature available for all options, including the ability to treat sub-hourly meteorological inputs and to modify the output data file structures for the concentration, wet deposition flux and dry deposition flux files to accommodate sub-hourly output. This has produced CALPUFF Version 6.1, which will become the platform for all future model development efforts. Postprocessors modified include APPEND, CALSUM, CALPOST, and POSTUTIL.

Sub-hourly time-varying structures were also designed and implemented in CALMET Version 6.0 and those preprocessors that are needed to prepare the input datasets required by CALMET. This includes the introduction of a sub-hourly time step within the model for purposes of computing solar radiation, wind fields and boundary layer parameters and the modification of the structure of the output data file produced by CALMET to allow for hourly or sub-hourly time steps. The preprocessor programs now produce CALMET input files that contain the full begin-time / end-time structures with times resolved to the second. However, they operate on standard available datasets that do not include sub-hourly data. Users who have meteorological monitoring programs that report data more frequently than hourly can readily format those data for input to CALMET using the new file formats. These formats are fully described in this document.

The CALMET postprocessor PRTMET was also modified to deal with the additional temporal information provided by the updated CALMET model. PRTMET allows the gridded CALMET meteorological fields to be viewed.

The latest version of the CALPUFF Graphical User Interface (GUI) system (CALPRO) which includes the CALVIEW plotting and visualization interface was modified to accept sub-hourly time steps.

From the perspective of current users of the system, the most notable change in using the new system is the way time periods are identified. Version 5 had adopted nomenclature that is based on hourly periods. All of the data coming into the system varied by the hour (or multiples of hours), and within the system the hour was identified by the time at the end of the hour being simulated. Version 6 allows times to be identified to the second, and most importantly, the basic time step is no longer fixed at one hour so it is also characterized to the second. Each period is defined by both a start time and an end time. In cases where a timestamp contains a single time, it is the time at the start of a period, not the end. For example, the files that are generated by CALPOST and PRTMET for visualization contain a date, time, and averaging period in the filename. The date-time is the starting time. The averaging period implicitly identifies the ending time. Similar files produced by Version 5 placed the ending time in the filename.

The remainder of this introduction provides a brief history of the development of the modeling system and an overview of all of the components in the system. Details for running each component in the system are provided in subsequent sections. Users interested in preparing variable source emission files will find the specifications in Sections 9.3 through 9.6. Formats for CALMET meteorological input files are presented in Sections 8.3 through 8.6.

1.2 Historical Background

As part of a study to design and develop a generalized non-steady-state air quality modeling system for regulatory use, Sigma Research Corporation developed the CALPUFF dispersion model and related models and programs, including the CALMET meteorological model. The original development of CALPUFF and CALMET was sponsored by the California Air Resources Board (CARB). Systems

Application, Inc. (SAI) served as a subcontractor to Sigma Research with the responsibility for developing the wind field modeling component of the system.

The original design specifications for CALPUFF included: (1) the capability to treat time-varying sources, (2) suitability for modeling domains from tens of meters to hundreds of kilometers from a source, (3) predictions for averaging times ranging from one-hour to one year, (4) applicability to inert pollutants and those subject to linear removal and chemical conversion mechanisms, and, (5) applicability for rough or complex terrain situations. The modeling system developed to meet these objectives consisted of three components:

- CALMET, a meteorological modeling package with both diagnostic and prognostic wind field generators
- CALPUFF, a Gaussian puff dispersion model with chemical removal, wet and dry deposition, complex terrain algorithms, building downwash, plume fumigation, and other effects
- CALPOST and other postprocessing programs for the output fields of meteorological data, concentrations and deposition fluxes.

In July, 1987, CARB initiated a second project with Sigma Research to upgrade and modernize the Urban Airshed Model (UAM) to include state-of-the-science improvements in many of the key technical algorithms including the numerical advection and diffusion schemes, dry deposition, chemical mechanisms, and chemical integration solver. The new photochemical model, called CALGRID (Yamartino et al., 1992; Scire et al., 1989), was integrated into the CALMET/CALPUFF modeling framework to create a complete modeling system for both reactive and non-reactive pollutants. A third component of the modeling system, a Lagrangian particle model called the Kinematic Simulation Particle (KSP) model (Strimaitis et al., 1995; Yamartino et al., 1996), was developed under sponsorship of the German Umweldbundesamt. All three models (CALPUFF, CALGRID, and KSP) are designed to be compatible with the common meteorological model, CALMET, and share preprocessing and postprocessing programs for the display of the modeling results.

CALMET, CALPUFF, and CALPOST have been substantially revised and enhanced over time, and the modeling system has achieved regulatory status. The U.S. EPA has designated the CALPUFF modeling system as a *Guideline* ("Appendix A") model for regulatory applications involving long range transport, and on a case-by-case basis for near-field applications where non-steady-state effects (situations where factors such as spatial variability in the meteorological fields, calm winds, fumigation, recirculation or stagnation, and terrain or coastal effects) may be important.

In the early 1990s, the Interagency Workgroup on Air Quality Modeling (IWAQM) reviewed various modeling approaches suitable for estimating pollutant concentrations at Class I areas, including the individual and cumulative impacts of proposed and existing sources on Air Quality Related Values (AQRVs), Prevention of Significant Deterioration (PSD) increments, and National Ambient Air Quality Standards (NAAQS). IWAQM consists of representatives from the U.S. Environmental Protection Agency (EPA), U.S. Forest Service, National Park Service, and U.S. Fish and Wildlife Service. IWAQM released a Phase I report (EPA, 1993) which recommended using the MESOPUFF II dispersion model and MESOPAC II meteorological model on an interim basis for simulating regional air quality and visibility impacts. These recommendations were to apply until more refined (Phase 2) techniques could be identified and evaluated. As part of the development of the Phase 2 recommendations, IWAQM reviewed and intercompared diagnostic wind field models, tested the use of coarse gridded wind fields from the Penn State/NCAR Mesoscale Model with four dimensional data assimilation (MM4) as input into the diagnostic models, and evaluated the MESOPUFF II and CALPUFF modeling systems using tracer data collected during the Cross-Appalachian Tracer Experiment (CAPTEX). The CAPTEX evaluation results (EPA, 1995) indicated that by using the CALMET/ CALPUFF models with MM4 data, performance could be improved over that obtained with the interim Phase I modeling approach. The Phase 2 IWAQM report (EPA, 1998) recommends the use of the CALMET and CALPUFF models for estimating air quality impacts relative to the National Ambient Air Quality Standards (NAAQS) and Prevention of Significant Deterioration (PSD) increments.

The CALMET and CALPUFF models have been substantially revised and enhanced as part of work for IWAQM, U.S. EPA, the USDA Forest Service, the US Department of the Interior Minerals Management Service (MMS), the Environmental Protection Authority of Victoria (Australia), and private industry in the U.S. and abroad. The improvements to CALMET included modifications to make it more suitable for regional applications such as the use of a spatially variable initial guess field, an option for using hourly MM4 or MM5 gridded fields as a supplement to observational data, the ability to compute Lambert conformal map factors, a modified mixing height scheme, an option to use similarity theory to vertically extrapolate surface wind observations, an enhanced algorithm to compute the three-dimensional temperature fields over water bodies, improved initialization techniques, a refined slope flow parameterization, and an optional PC-based Graphical User Interface (GUI) to facilitate model setup and execution and to provide access to on-line Help files. Improvements to CALPUFF include new modules to treat buoyant rise and dispersion from area sources (such as forest fires), buoyant line sources, volume sources, an improved treatment of complex terrain, additional model switches to facilitate its use in regulatory applications, enhanced treatment of wind shear through puff splitting, use of a probability density function (pdf) to describe dispersion during convective conditions, and an optional GUI. CALPUFF has been coupled to the Emissions Production Model (EPM) developed by the Forest Service through an interface processor. EPM provides time-dependent emissions and heat release data for use in modeling controlled burns and wildfires.

The most recent update of the system was prepared for the MMS in late 2005 as part of a multi-year study to develop an updated regulatory model for evaluating air quality impacts from emission sources located on federal waters of the Outer Continental Shelf (OCS). Its focus was to modify and/or enhance an existing model so that it can be appropriately applied to overwater transport and dispersion simulations using the most current knowledge, and is versatile enough to be used in short-range as well as long-range regulatory applications. Changes to the system that were designed and implemented for OCS applications include ease-of-use features as well as new and modified subroutines in both the CALMET meteorological model and the CALPUFF dispersion model:

- CALMET Updates
  - An option is provided to use the COARE (Coupled Ocean Atmosphere Response Experiment) overwater flux model, Version 2.6bw, with or without wave data.
  - A convective (rather than mechanical) overwater boundary layer height is computed for $L<0$ (positive surface heat flux). Note that the overwater mixing height is computed only when it is not provided in a SEA.DAT file.
  - A new convective mixing height parameterization option is provided.
  - Surface winds are adjusted from anemometer height to 10m (middle of CALMET layer 1).
  - Consistent similarity profile equations are used throughout system.

- CALPUFF updates
  - A building downwash adjustment is introduced for elevated (platform) structures with an open area between the surface and the bulk of the structure. This platform height is provided for point sources, and applies to the ICS downwash option.
  - An option is provided for computing turbulence profiles using the AERMOD subroutines
  - A <u>diagnostic</u> option is provided to test a Lagrangian time-scale for lateral plume growth functions that is computed from boundary layer scales.
  - An option is provided to accept the AERMET version of SURFACE and PROFILE meteorological data files.
  - An option is provided to include an adjustment for turbulence advection from regions of larger turbulence velocity into regions of smaller turbulence velocity. This adjustment is applied to computed (not measured) turbulence.
  - The minimum lateral turbulence velocity (σ_v) allowed is partitioned to distinguish values appropriate for over-land cells and over-water cells.

- BUOY processor
  - This new processor creates revised SEA.DAT files for CALMET with wave data for the COARE overwater flux option.
  - Data files readily obtained from NODC and NDBC web sites are read.

- Graphical user interface (GUI) updates
  - The CALPRO system for geophysical and meteorological preprocessors and CALPOST and PRTMET postprocessors was extensively revised and enhanced.
  - A GUI for the BUOY processor was developed and integrated into CALPRO.
  - A GUI option was added to CALPRO for extracting a subset from the surface meteorological data, precipitation data, and ozone data from the Gulf of Mexico dataset for a user's CALMET domain.
  - The CALVIEW display system for meteorological fields and concentration/deposition fields using the SURFER® contouring package was extensively revised and enhanced.

- Standard Gulf of Mexico Meteorology and Ozone Dataset
    - Meteorological, geophysical and ozone data required for CALMET/CALPUFF simulations within the MMS Gulf of Mexico region were prepared for year 2003.
    - USGS terrain elevation files with 90m resolution and USGS land use data files with 200m resolution were assembled for the domain.
    - Buoy stations in the domain were processed into 13 SEA.DAT files (1 station/file).
    - Upper-air stations in the domain were processed into 21 UP.DAT files (1 station/file).
    - 230 NWS hourly surface meteorological stations in the domain were processed into the SURF.DAT file.
    - 271 NWS precipitation stations in the domain were processed into the PRECIP.DAT file.
    - 201 ozone data stations in the domain were processed into the OZONE.DAT file.
    - One full year (2003) of gridded prognostic meteorological output fields from the Rapid Update Cycle (RUC) mesoscale weather model were reformatted into 50 tiles (90 RUC grid-points/tile), for the portion of the 20km RUC grid that covers the MMS Gulf of Mexico domain.
    - The RUCDECODE program was created to assemble RUC grid cell data from one or more tiles into a 3D.DAT file for a user's CALMET domain.

1.3 Overview of the Modeling System

The CALPUFF Modeling System includes three main components: CALMET, CALPUFF, and CALPOST and a large set of preprocessing programs designed to interface the model to standard, routinely-available meteorological and geophysical datasets. In the simplest terms, CALMET is a meteorological model that develops wind and temperature fields on a three-dimensional gridded modeling domain. Associated two-dimensional fields such as mixing height, surface characteristics, and dispersion properties are also included in the file produced by CALMET. CALPUFF is a transport and dispersion model that advects "puffs" of material emitted from modeled sources, simulating dispersion and transformation processes along the way. In doing so it typically uses the fields generated by CALMET, or as an option, it may use simpler non-gridded meteorological data much like existing plume models. Temporal and spatial variations in the meteorological fields selected are explicitly incorporated in the resulting distribution of puffs throughout a simulation period. The primary output files from CALPUFF contain either concentrations or deposition fluxes evaluated at selected receptor locations. CALPOST is used to process these files, producing tabulations that summarize the results of the simulation, identifying the highest and second highest 3-hour average concentrations at each receptor, for example. When performing visibility-related modeling, CALPOST uses concentrations from CALPUFF to compute extinction coefficients and related measures of visibility, reporting these for selected averaging times and locations.

To enhance the functionality of the modeling system, a PC-based GUI is provided for nearly every component. The GUIs can be used to prepare the control file that configures a run, execute the corresponding component model, and conduct file management functions. The GUIs also contain an extensive help system that makes much of the technical information contained in this manual available to the user on-line. The modeling system may also be setup and run without the aid of the GUIs. The control file for each component is simply a text file that is readily edited, and it contains extensive information about model options, default values, and units for each variable.

In addition to CALMET, CALPUFF, CALPOST, and their corresponding GUIs, the modeling system interfaces to several other models, which is facilitated by several preprocessors and utilities. Figure 1-1 displays the overall modeling system configuration. Four of the models shown in Figure 1-1 are external models that are not included in the CALPUFF system, but they can be interfaced with CALPUFF modules:

> **MM5/MM4** (Penn State/NCAR Mesoscale Model) is a prognostic wind field model with four dimensional data assimilation (Anthes et al., 1987; Grell et al., 1996). The interface program (CALMM5) converts the MM5 data into a form compatible with CALMET.
>
> **NAM(formerly Eta)** (North American Mesoscale model), and the **WRF** (Weather Research and Forecasting) model are NCEP operational weather models. Eta/NAM/WRF model output files are produced for use by the Advanced Weather Interactive Processing System (AWIPS) in various AWIPS grids. The interface program CALETA converts the NAM and CALWRF converts the WRF output data into forms compatible with CALMET.
>
> **RUC** (Rapid Update Cycle) model is an NCEP operational weather model with high-frequency (every hour) short-range weather model forecasts (out to 12+ hours). The interface program CALRUC converts the RUC output data into a form compatible with CALMET.
>
> **RAMS** (Regional Atmospheric Modeling System, Version 4.3) model is a NOAA Air Resources Laboratory (ARL) numerical weather model that can be run at global, mesoscale, and local scales. The interface program CALRAMS converts the RAMS output data into a form compatible with CALMET.
>
> **TAPM** (The Air Pollution Model) is a CSIRO (Commonwealth Scientific Industrial Research Organisation) Lagrangian Part-Puff model, (Hurley 1998, 1999). The interface CALTAPM converts the TAPM output data into a form compatible with CALMET.
>
> **CSUMM** (a version of the Colorado State University Mesoscale Model) is a primitive equation wind field model (Kessler, 1989) which simulates mesoscale airflow resulting from differential surface heating and terrain effects. Various options for using CSUMM output with CALMET are provided.

CALGRID is an Eulerian photochemical transport and dispersion model which includes modules for horizontal and vertical advection/diffusion, dry deposition, and a detailed photochemical mechanism. The output from CALMET may be used in CALGRID.

KSP is a multi-layer, multi-species Lagrangian particle model that simulates transport, dispersion, and deposition using explicit kinematic simulation (KS) of the larger transportive and dispersive eddies in the atmosphere. The output from CALMET may be used in KSP.

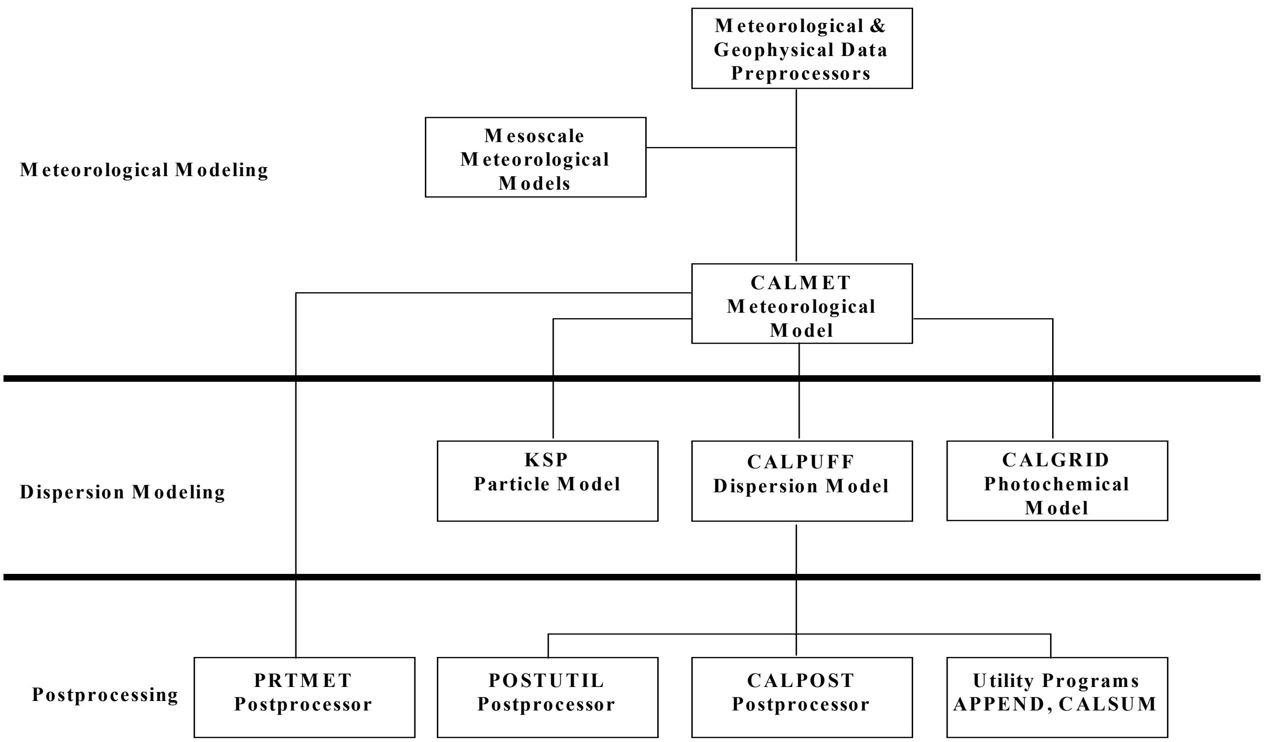

Figure 1-1: Overview of the program elements in the CALMET/CALPUFF modeling system. Also shown are the associated CALGRID photochemical model, the KSP particle model, and mesoscale meteorological models that may include MM5/MM4, NAM(Eta), WRF, RUC, RAMS, TAPM and CSUMM.

The components in Figure 1-1 that are included in the system are:

CALMET is a meteorological model which includes a diagnostic wind field generator containing objective analysis and parameterized treatments of slope flows, kinematic terrain effects, terrain blocking effects, and a divergence minimization procedure, and a micro-meteorological model for overland and overwater boundary layers.

CALPUFF is a non-steady-state Lagrangian Gaussian puff model containing modules for complex terrain effects, overwater transport, coastal interaction effects, building downwash, wet and dry removal, and simple chemical transformation.

CALPOST is a postprocessing program with options for the computation of time-averaged concentrations and deposition fluxes predicted by the CALPUFF and CALGRID models. CALPOST computes visibility impacts in accordance with IWAQM recommendations and the current Federal Land Managers' Air Quality Related Values Workgroup (FLAG) recommendations.

PRTMET is a postprocessing program which displays user-selected portions of the meteorological data file produced by the CALMET meteorological model.

APPEND is a postprocessor which appends two or more sequential CALPUFF concentration, wet flux, dry flux or relative humidity (visibility) files in time.

CALSUM is a postprocessor which sums and scales concentrations or wet/dry fluxes from two or more source groups from different CALPUFF runs.

POSTUTIL is a postprocessor which operates on one or more CALPUFF concentration and wet/dry flux files to create new species as weighted combinations of modeled species; to sum wet and dry deposition fluxes; to merge species from different runs into a single output file; to sum and scale results from different runs; to repartition nitric acid/nitrate based on total available sulfate and ammonia; and to add time/space-varying background.

Preprocessors and utilities provided with the modeling system for use with CALMET include:

METSCAN is a meteorological preprocessor which performs quality assurance checks on the hourly surface meteorological data in the U.S. National Climatic Data Center (NCDC) CD-144 format which may be used as input to the SMERGE program.

READ62 is a meteorological preprocessor which extracts and processes upper air wind and temperature data from the standard NCDC TD-6201 data format or the NCDC CD-ROM FSL rawinsonde data format.

SMERGE is a meteorological preprocessor that processes hourly surface observations from a number of stations in NCDC CD-144 format, NCDC TD3505 format, NCDC TD9956 format, ISHWO format, or generic comma delimited format file, or NCDC CD-ROM format, and reformats the data into a single file with the data sorted by time rather than station. The CD-ROM format contains data in either the Solar and Meteorological Surface Observational Network (SAMSON) format or the Hourly U.S. Weather Observations (HUSWO) format.

PXTRACT is a meteorological preprocessor which extracts precipitation data for stations and a time period of interest from a fixed length, formatted precipitation data file in NCDC TD-3240 format.

PMERGE is a meteorological preprocessor responsible for reformatting the precipitation data files created by the PXTRACT program. PMERGE resolves "accumulation periods" into hourly values and flags suspicious or missing data. The output file can be formatted or binary, which can be directly input into the CALMET model, containing the precipitation data sorted by hour rather than station.

TERREL is a terrain preprocessor which coordinates the allocation of terrain elevation data from several digitized databases to a user-specified modeling grid.

CTGCOMP is a preprocessor used to compress the data file format of a USGS land use CTG data file.

CTGPROC is a land use preprocessor which reads compressed CTG land use data files, USGS Global Dataset format land use data files, USGS NLCD files, or two types of generic land use format, and computes the fractional land use for each grid cell in the user-specified modeling domain.

PRLND1 is a land use preprocessor which reads the ARM3 data base of land use data and computes fractional land use for each grid cell in the user-specified modeling domain.

MAKEGEO is the final preprocessor which reads the fractional land use data, user inputs which define land use category mapping, and values relating each of the surface parameters to land use, and (optionally) the gridded terrain data file, and produces a GEO.DAT file ready for input to CALMET.

CALMM5 is a processor that extracts and interprets data in the output file from MM5 (Version 3), and creates a file of meteorological data for direct input to CALMET in either the preferred 3D.DAT format or the MM4.DAT format.

CALETA is a processor that extracts and interprets data in selected output files from NAM(Eta), and creates a file of meteorological data for direct input to CALMET in its 3D.DAT format.

CALWRF is a processor that extracts and interprets data in selected output files from WRF (the Weather Research and Forecasting Model), and creates a file of meteorological data for direct input to CALMET in its 3D.DAT format.

CALRUC is a processor that extracts and interprets data in selected output files from RUC, and creates a file of meteorological data for direct input to CALMET in its 3D.DAT format.

CALRAMS is a processor that extracts and interprets data in selected output files from RAMS, and creates a file of meteorological data for direct input to CALMET in its 3D.DAT format.

CALTAPM is a processor that extracts and interprets data in selected output files from the CSIRO's TAPM Model (The Commonwealth Scientific and Industrial Research Organisation; The Air Pollution Model), and creates a file of meteorological data for direct input to CALMET in its 3D.DAT format.

Preprocessors and utilities provided with the modeling system for use with CALPUFF include:

OPTHILL is a processor program which uses topographical data (such as terrain maps) to develop hill shape factors that are used in the subgrid scale complex terrain (CTSG) module in CALPUFF.

FEPS2BAEM is a conversion utility which creates a time-varying emissions file for buoyant forest fire area sources based on the output from the U.S.D.A Forest Service Fire Emissions Production Simulator Model (FEPS).

The meteorological modeling with the CALMET model is detailed in Figure 1-2. Note that the preprocessors for the raw meteorological data are written to accommodate the U.S. National Climatic Data Center (NCDC) file formats. Figure 1-3 is the schematic of the CALPUFF dispersion model indicating the model input and output files. The postprocessing approach for the meteorological and dispersion modeling results is shown in Figure 1-4 and Figure 1-5.

A series of reports and user's guides describe the components of the modeling system. The technical formulation for CALPUFF (Version 5) and CALPOST (Version 5) is contained in Scire et al. (2000a), and that for CALMET (Version 5) and the meteorological and geophysical preprocessing programs are contained in Scire et al. (2000b). The updates for OCS applications are described in USMMS (2006a,b,c). The CSUMM prognostic wind field model is described in a report by Kessler (1989). A stand-alone version of the Diagnostic Wind Model (DWM) used as the original wind field module in CALMET is discussed by Douglas and Kessler (1988). The CALGRID model is documented in a paper by Yamartino et al. (1992) and reports by Yamartino et al. (1989) and Scire et al. (1989). The KSP model is described by Strimaitis et al., (1995) and Yamartino et al. (1996).

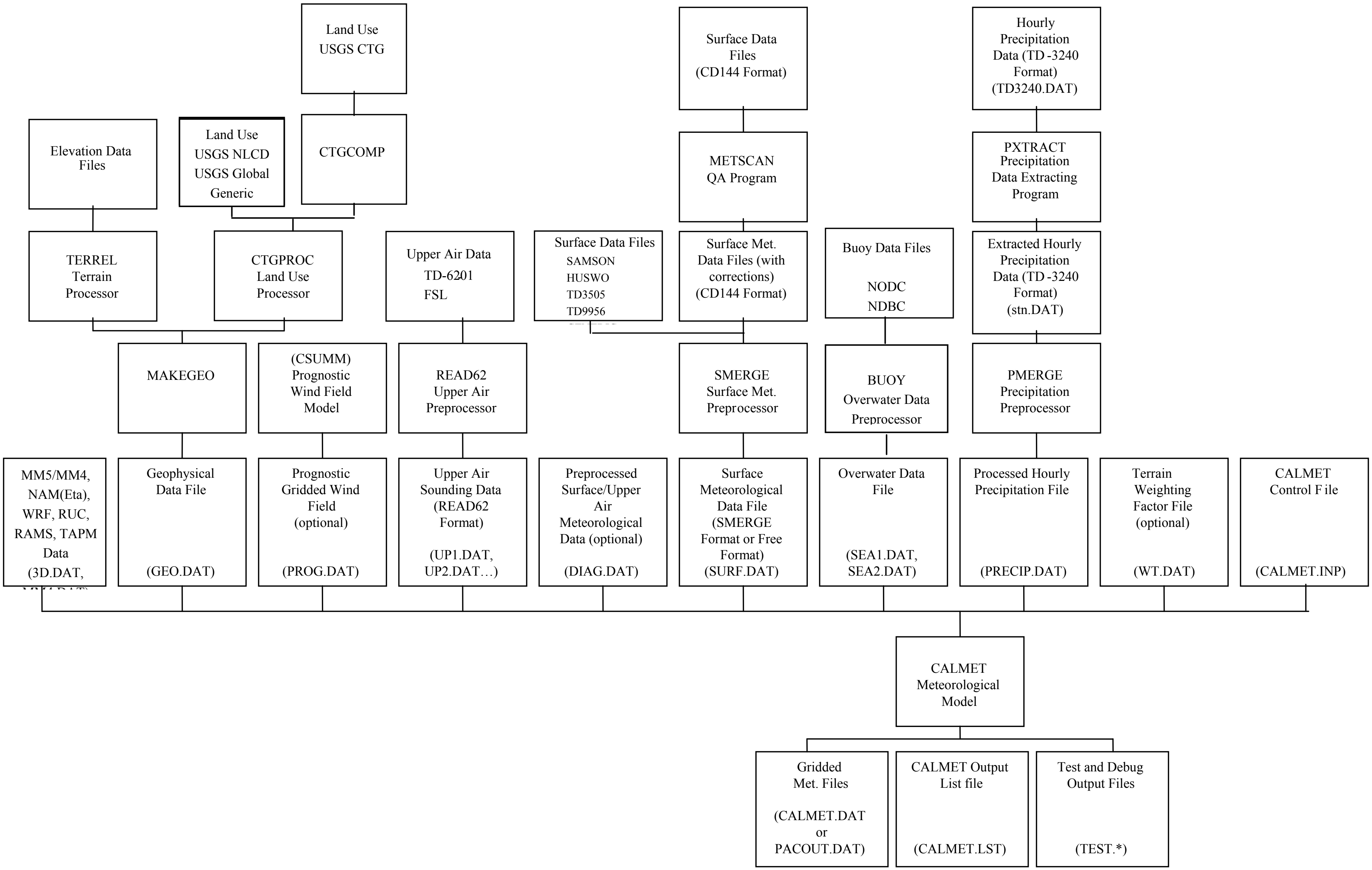

Figure 1-2: Meteorological modeling: CALMET modeling flow diagram.

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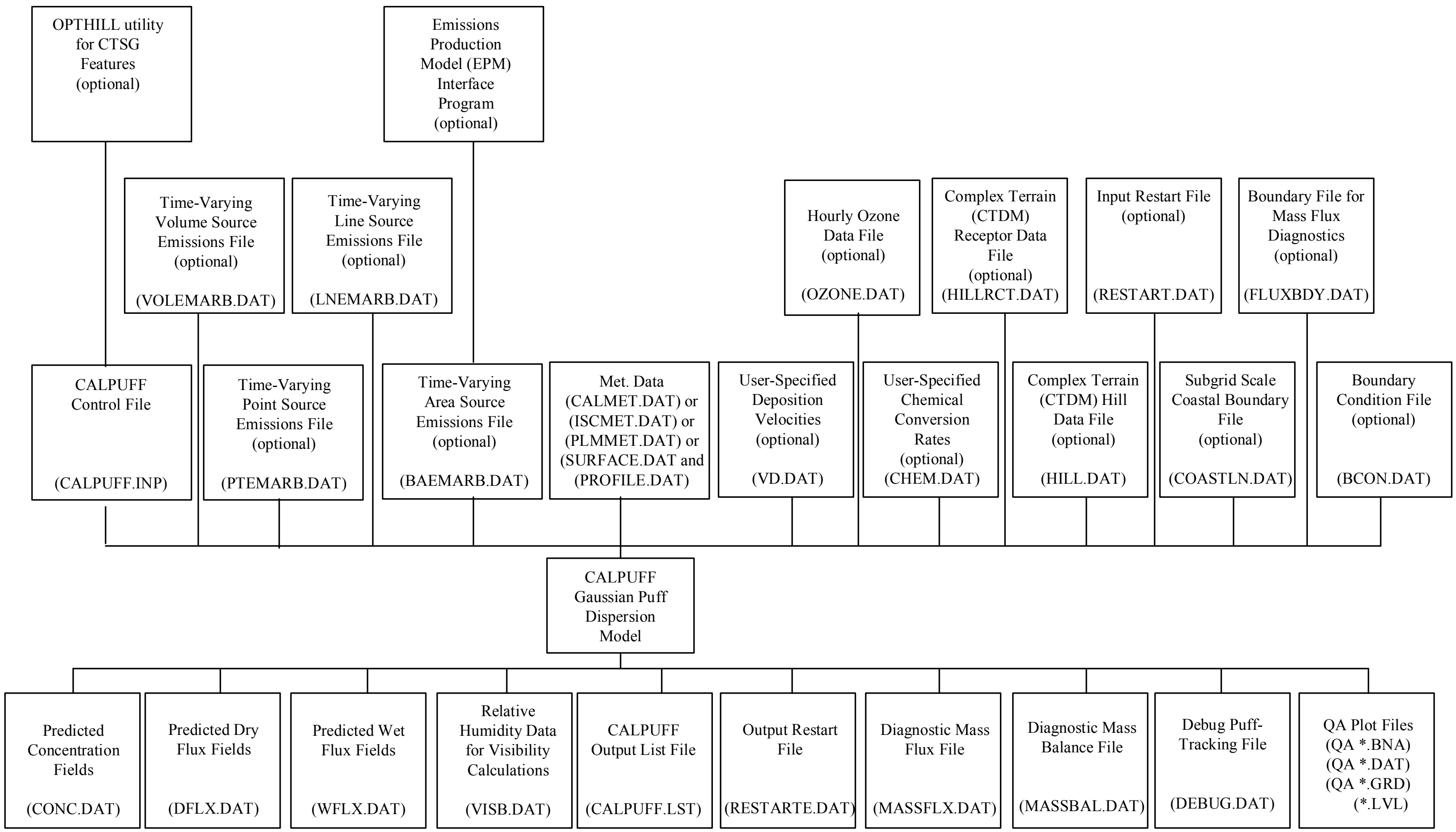

Figure 1-3: Dispersion Modeling: CALPUFF modeling flow diagram.

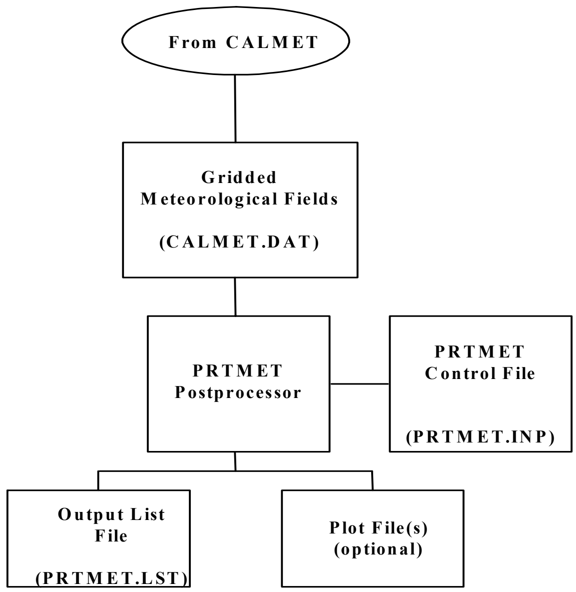

Figure 1-4: Postprocessing: PRTMET postprocessing flow diagram.

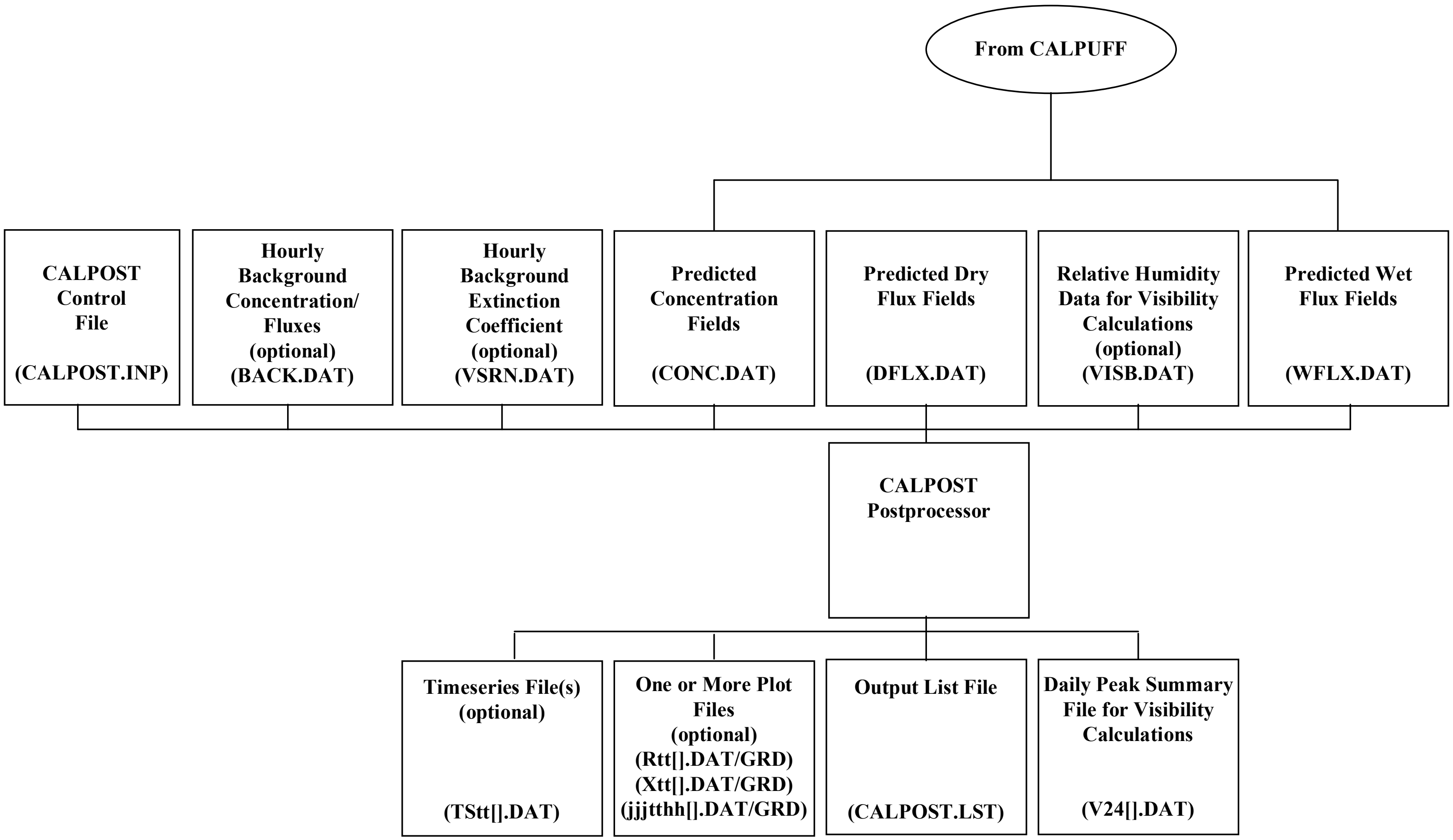

Figure 1-5: Postprocessing: CALPOST postprocessing flow diagram.

1.4 Major Model Algorithms and Options

1.4.1 CALMET

The CALMET meteorological model consists of a diagnostic wind field module and micro-meteorological modules for overwater and overland boundary layers. The major features and options of the meteorological model are summarized in Table 1-1. When using large domains, the user has the option to adjust input winds to a Lambert Conformal Projection coordinate system to account for the Earth's curvature.

The diagnostic wind field module uses a two-step approach to the computation of the wind fields (Douglas and Kessler, 1988), as illustrated in Figure 1-6. In the first step, an initial-guess wind field is adjusted for kinematic effects of terrain, slope flows, and terrain blocking effects to produce a Step 1 wind field. The second step consists of an objective analysis procedure to introduce observational data into the Step 1 wind field to produce a final wind field.

An option is provided to allow gridded prognostic wind fields to be used by CALMET, which may better represent regional flows and certain aspects of sea breeze circulations and slope/valley circulations. Wind fields generated by the CSUMM prognostic wind field model can be input to CALMET as either the initial guess field (pathway A in Figure 1-6) or the Step 1 wind field (pathway B in Figure 1-6). MM4/MM5, NAM(Eta), WRF, RUC, RAMS and TAPM model output fields can be introduced into CALMET in one of three different ways:

- as a replacement for the initial guess wind field (pathway A in Figure 1-6).
- as a replacement for the Step 1 field (pathway B); or
- as "observations" in the objective analysis procedure (pathway C).

The techniques used in the CALMET model are briefly described below. The recommended approach is pathway A.

Step 1 Wind Field

<u>Kinematic Effects of Terrain</u>: The approach of Liu and Yocke (1980) is used to evaluate kinematic terrain effects. The domain-scale winds are used to compute a terrain-forced vertical velocity, subject to an exponential, stability-dependent decay function. The kinematic effects of terrain on the horizontal wind components are evaluated by applying a divergence-minimization scheme to the initial guess wind field. The divergence minimization scheme is applied iteratively until the three-dimensional divergence is less than a threshold value.

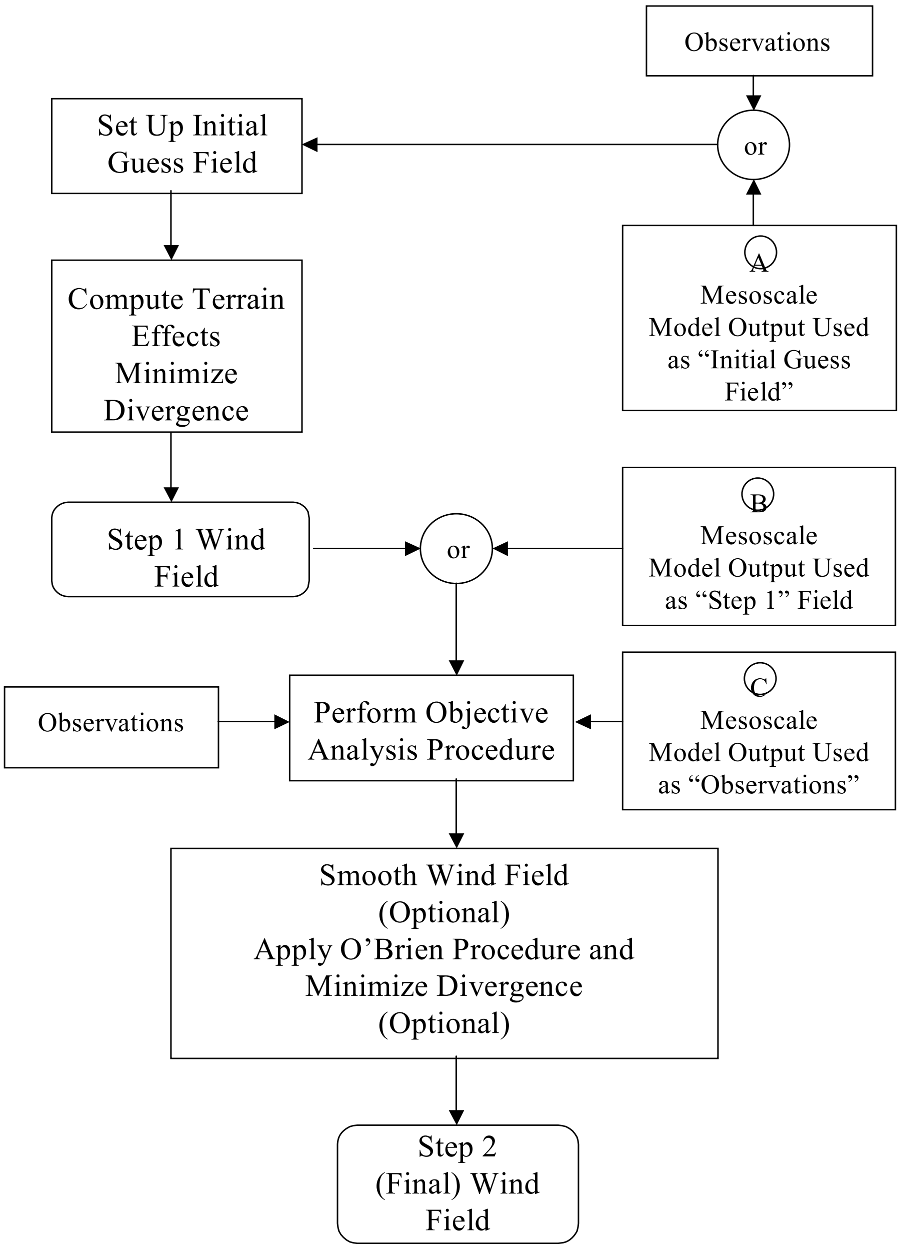

Figure 1-6: **Flow diagram of the diagnostic wind model in CALMET. Winds derived from mesoscale models MM4/MM5, NAM(Eta), WRF, RUC, RAMS, TAPM or CSUMM can be introduced as the initial guess field A, or the Step 1 field B. Mesoscale model wind data (except CSUMM) can also be treated as "observations" C. Path A is recommended.**

Table 1-1: Major Features of the CALMET Meteorological Model

- **Boundary Layer Modules of CALMET**

    - Overland Boundary Layer - Energy Balance Method
    - Overwater Boundary Layer - Profile Method
    - Produces Gridded Fields of:
        - Surface Friction Velocity
        - Convective Velocity Scale
        - Monin-Obukhov Length
        - Mixing Height
        - PGT Stability Class
        - Air Temperature (3-D)
        - Precipitation Rate

- **Diagnostic Wind Field Module of CALMET**

    - Slope Flows
    - Kinematic Terrain Effects
    - Terrain Blocking Effects
    - Divergence Minimization
    - Produces Gridded Fields of U, V, W Wind Components
    - Inputs Include Domain-Scale Winds, Observations, and (optionally) Coarse-Grid Prognostic Model Winds
    - Lambert Conformal Projection Capability

Slope Flows: Slope flows are computed based on the shooting flow parameterization of Mahrt (1982). Shooting flows are buoyancy-driven flows, balanced by adjective of weaker momentum, surface drag, and entrainment at the top of the slope flow layer. The slope flow is parameterized in terms of the terrain slope, distance to the crest and local sensible heat flux. The thickness of the slope flow layer varies with the elevation drop from the crest.

Blocking Effects: The thermodynamic blocking effects of terrain on the wind flow are parameterized in terms of the local Froude number (Allwine and Whiteman, 1985). If the Froude number at a particular grid point is less than a critical value and the wind has an uphill component, the wind direction is adjusted to be tangent to the terrain.

Step 2 Wind Field

The wind field resulting from the adjustments described above of the initial-guess wind is the Step 1 wind field. The second step of the procedure involves the introduction of observational data into the Step 1 wind field through an objective analysis procedure. An inverse-distance squared interpolation scheme is used which weighs observational data heavily in the vicinity of the observational station, while the Step 1 wind field dominates the interpolated wind field in regions with no observational data.

The resulting wind field is subject to smoothing, an optional adjustment of vertical velocities based on the O'Brien (1970) method, and divergence minimization to produce a final Step 2 wind field.

Introduction of Prognostic Wind Field Results

The CALMET model contains an option to allow the introduction of gridded wind fields generated by MM4/MM5, NAM(Eta), WRF, RUC, RAMS and TAPM (or the CSUMM model) as input fields. The procedure permits the prognostic model to be run with a significantly larger horizontal grid spacing and different vertical grid resolution than that used in the diagnostic model. This option allows certain features of the flow field such as the sea breeze circulation with return flow aloft, which may not be captured in the surface observational data, to be introduced into the diagnostic wind field results. An evaluation with CAPTEX tracer data indicated that the better spatial and temporal resolution offered by the hourly MM4 fields can improve the performance of the dispersion modeling on regional scales (EPA, 1995).

If the prognostic wind data are used as the initial guess field, the coarse grid scale data are interpolated to the CALMET fine-scale grid. The diagnostic module in CALMET will then adjust the initial guess field for kinematic effects of terrain, slope flows and terrain blocking effects using fine-scale CALMET terrain data to produce a Step 1 wind field. A second approach is to use prognostic wind data directly as the Step 1 wind field. This field is then adjusted using observational data, but additional terrain adjustments are not made. A third available option in CALMET is to treat the gridded prognostic data as "observations" in the objective analysis procedure.

CALMET Boundary Layer Models

The CALMET model contains two boundary layer models for application to overland and overwater grid cells.

Overland Boundary Layer Model: Over land surfaces, the energy balance method of Holtslag and van Ulden (1983) is used to compute hourly gridded fields of the sensible heat flux, surface friction velocity, Monin-Obukhov length, and convective velocity scale. Mixing heights are determined from the computed hourly surface heat fluxes and observed temperature soundings using either a modified Carson (1973) method based on Maul (1980), or the method of Batchvarova and Gryning (1991,1994) which has a newer formulation for computing the temperature jump across the entrainment zone at the top of the layer and an explicit term for the “spin-up” growth early in the development of the mixed layer. Gridded fields of PGT stability class and optional hourly precipitation rates are also determined by the model.

Overwater Boundary Layer Model: The aerodynamic and thermal properties of water surfaces require a different method for calculating the boundary layer parameters in the marine environment. A profile technique, using air-sea temperature differences, is used to compute the micro-meteorological parameters in the marine boundary layer. Two options are provided: one is similar to that developed for OCD (Hanna et al., 1985), and the other is the Coupled Ocean Atmosphere Response Experiment (COARE) bulk flux model (Bradley et al., 2000; Fairall et al., 2002). Once the surface fluxes are computed, the same mixing height options used over land are applied over water.

An upwind-looking spatial averaging scheme is optionally applied to the mixing heights and 3-dimensional temperature fields in order to account for important adjective effects.

1.4.2 CALPUFF

CALPUFF is a multi-layer, multi-species non-steady-state puff dispersion model which can simulate the effects of time- and space-varying meteorological conditions on pollutant transport, transformation, and removal. CALPUFF can use the three dimensional meteorological fields developed by the CALMET model, or simple, single station winds in a format consistent with the meteorological files used to drive the ISCST3 (EPA, 1995), AUSPLUME (Lorimer, 1976), CTDMPLUS (Perry et al., 1989) or AERMOD (EPA 2004) steady-state Gaussian models. However, single-station ISCST3, CTDMPLUS, AUSPLUME or AERMOD winds should be used with caution, because they do not allow CALPUFF to take advantage of its capabilities to treat spatially-variable meteorological fields.

CALPUFF contains algorithms for near-source effects such as building downwash, transitional plume rise, partial plume penetration, subgrid scale terrain interactions as well as longer range effects such as pollutant removal (wet scavenging and dry deposition), chemical transformation, vertical wind shear, overwater transport and coastal interaction effects. It can accommodate arbitrarily-varying point source and gridded area source emissions. Most of the algorithms contain options to treat the physical processes at different levels of detail depending on the model application.

The major features and options of the CALPUFF model are summarized in Table 1-2. Some of the technical algorithms are briefly described below.

Dry Deposition: A full resistance model is provided in CALPUFF for the computation of dry deposition rates of gases and particulate matter as a function of geophysical parameters, meteorological conditions, and pollutant species. Options are provided to allow user-specified, diurnally varying deposition velocities to be used for one or more pollutants instead of the resistance model (e.g., for sensitivity testing) or to by-pass the dry deposition model completely.

Wet Deposition: An empirical scavenging coefficient approach is used in CALPUFF to compute the depletion and wet deposition fluxes due to precipitation scavenging. The scavenging coefficients are specified as a function of the pollutant and precipitation type (i.e., frozen vs. liquid precipitation).

Chemical Transformation: CALPUFF includes options for parameterizing chemical transformation effects using the five species scheme (SO_2, $SO_4^=$, NO_x, HNO_3, and NO_3^-) employed in the MESOPUFF II model or a set of user-specified, diurnally-varying transformation rates.

Subgrid Scale Complex Terrain: The complex terrain module in CALPUFF is based on the approach used in the Complex Terrain Dispersion Model (CTDMPLUS) (Perry et al., 1989). Plume impingement on subgrid scale hills is evaluated using a dividing streamline (H_d) to determine which pollutant material is deflected around the sides of a hill (below H_d) and which material is advected over the hill (above H_d). Individual puffs are split into up to three sections for these calculations.

Puff Sampling Functions: A set of accurate and computationally efficient puff sampling routines are included in CALPUFF which solve many of the computational difficulties with applying a puff model to near-field releases. For near-field applications during rapidly-varying meteorological conditions, an elongated puff (slug) sampling function is used. An integrated puff approached is used during less demanding conditions. Both techniques reproduce continuous plume results exactly under the appropriate steady state conditions.

Wind Shear Effects: CALPUFF contains an optional puff splitting algorithm that allows vertical wind shear effects across individual puffs to be simulated. Differential rates of dispersion and transport occur on the puffs generated from the original puff, which under some conditions can substantially increase the effective rate of horizontal growth of the plume.

Building Downwash: The Huber-Snyder and Schulman-Scire downwash models are both incorporated into CALPUFF. An option is provided to use either model for all stacks, or make the choice on a stack-by-stack and wind sector-by-wind sector basis. Both algorithms have been implemented in such a way as to allow the use of wind direction specific building dimensions. The more advanced treatment of the PRIME downwash model is also incorporated as an option. This includes treating representative streamline patterns and diffusion rates in both the near and far wakes and recirculation effects in the cavity zone.

Overwater and Coastal Interaction Effects: Because the CALMET meteorological model contains both overwater and overland boundary layer algorithms, the effects of water bodies on plume transport, dispersion, and deposition can be simulated with CALPUFF. The puff formulation of CALPUFF is designed to handle spatial changes in meteorological and dispersion conditions, including the abrupt changes that occur at the coastline of a major body of water. A subgrid TIBL option is also provided to better resolve the relationship between the coastline and source locations during periods conducive to onshore fumigation events.

Dispersion Coefficients: Several options are provided in CALPUFF for the computation of dispersion coefficients, including the use of turbulence measurements (σ_v and σ_w), the use of similarity theory to estimate σ_v and σ_w from modeled surface heat and momentum fluxes, or the use of Pasquill-Gifford (PG) or McElroy-Pooler (MP) dispersion coefficients, or dispersion equations based on the Complex Terrain Dispersion Model (CDTM). Options are provided to apply an averaging time correction or surface roughness length adjustments to the PG coefficients. When similarity theory is used to compute turbulence-based dispersion coefficients, an option is also provided for a PDF treatment of dispersion in the convective boundary layer.

Table 1-2: Major Features of the CALPUFF Model

- **Source types**
  - Point sources (constant or variable emissions)
  - Line sources (constant or variable emissions)
  - Volume sources (constant or variable emissions)
  - Area sources (constant or variable emissions)

- **Non-steady-state emissions and meteorological conditions**
  - Gridded 3-D fields of meteorological variables (winds, temperature)
  - Spatially-variable fields of mixing height, friction velocity, convective velocity scale, Monin-Obukhov length, precipitation rate
  - Vertically and horizontally-varying turbulence and dispersion rates
  - Time-dependent source and emissions data

- **Efficient sampling functions**
  - Integrated puff formulation
  - Elongated puff (slug) formulation

- **Dispersion coefficient (σ_y, σ_z) options**
  - Direct measurements of σ_v and σ_w
  - Estimated values of σ_v and σ_w based on similarity theory
  - PDF treatment of dispersion in convective boundary layers
  - Pasquill-Gifford (PG) dispersion coefficients (rural areas)
  - McElroy-Pooler (MP) dispersion coefficients (urban areas)
  - CTDM dispersion coefficients (neutral/stable)

- **Vertical wind shear**
  - Puff splitting
  - Differential advection and dispersion

- **Plume rise**
  - Partial penetration
  - Buoyant and momentum rise
  - Stack tip effects
  - Vertical wind shear
  - Building downwash effects

- **Building downwash**
  - Huber-Snyder method
  - Schulman-Scire method
  - PRIME method

(Continued)

Table 1-2 (Concluded)
Major Features of the CALPUFF Model

- **Subgrid scale complex terrain**
  - Dividing streamline, H_d:
    - Above H_d, puff flows over the hill and experiences altered diffusion rates
    - Below H_d, puff deflects around the hill, splits, and wraps around the hill

- **Interface to the Emissions Production Model (EPM)**
  - Time-varying heat flux and emissions from controlled burns and wildfires

- **Dry Deposition**
  - Gases and particulate matter
  - Three options:
    - Full treatment of space and time variations of deposition with a resistance model
    - User-specified diurnal cycles for each pollutant
    - No dry deposition

- **Overwater and coastal interaction effects**
  - Overwater boundary layer parameters
  - Abrupt change in meteorological conditions, plume dispersion at coastal boundary Plume fumigation
  - Option to introduce subgrid scale Thermal Internal Boundary Layers (TIBLs) into coastal grid cells

- **Chemical transformation options**
  - Pseudo-first-order chemical mechanism for SO_2, $SO_4^{=}$, NO_x, HNO_3, and NO_3^{-} (MESOPUFF II method)
  - Pseudo-first-order chemical mechanism for SO_2, $SO_4^{=}$, NO, NO_2, HNO_3, and NO_3^{-} (RIVAD method)
  - User-specified diurnal cycles of transformation rates
  - No chemical conversion

- **Wet Removal**
  - Scavenging coefficient approach
  - Removal rate a function of precipitation intensity and precipitation type

- **Graphical User Interface**
  - Point-and-click model setup and data input
  - Enhanced error checking of model inputs
  - On-line Help files

1.5 Summary of Data and Computer Requirements

CALMET Data Requirements

The input data requirements of the CALMET model are summarized in Table 1-3. The modeling system flow diagrams (Figures 1-1 through 1-4) provide an overview of the various input data sets required by the model as well as the preprocessing steps used to produce them. CALMET is designed to require only routinely-available surface and upper air meteorological observations, although special data inputs can be accommodated. For example, twice-daily sounding data (e.g., at the standard sounding times of 00 and 12 GMT) are needed as a minimum, but if soundings at more frequent (even arbitrarily spaced) intervals are available, they will be used by the model.

CALMET reads time-varying surface observations of wind speed, wind direction, temperature, cloud cover, ceiling height, surface pressure, relative humidity, and precipitation type codes (optional, used only if wet removal is to be modeled). Hourly measurements of these parameters are available from National Weather Service surface stations. The preprocessors are designed to use data in the National Climatic Data Center's (NCDC) standard data formats (e.g., CD-144 format for the surface data). However, the data can also be input into the model by way of free-formatted, user-prepared files. This option is provided to eliminate the need for running the preprocessors to prepare the data files for short CALMET runs for which the input data can easily be input manually.

Missing values of temperature, cloud cover, ceiling height, surface pressure, and relative humidity at surface stations are allowed by the program. The missing values are internally replaced by values at the closest station with non-missing data. However, one valid value of each parameter must be available from at least one station for each time period of the run. Missing values of the precipitation code are passed through to the output file, since CALPUFF contains logic to handle missing values and CALGRID does not use this parameter.

The upper air data required by CALMET include vertical profiles of wind speed, wind direction, temperature, pressure, and elevation. As noted above, routinely-available NWS upper air data (e.g., in TD-5600 and TD-6201 format) or non-standard sounding data can be used. The use of non-standard data formats would require a user-prepared reformatting program to convert the data into the appropriate CALMET format.

Table 1-3: Summary of Input Data Required by CALMET

Surface Meteorological Data

Hourly (or more frequent) observations of:
- wind speed
- wind direction
- temperature
- cloud cover
- ceiling height
- surface pressure
- relative humidity

Hourly (or more frequent) precipitation data:
- precipitation rates
- precipitation type code (part of surface data file)

Upper Air Data

Twice-daily (or more frequent) vertical profiles of:
- wind speed
- wind direction
- temperature
- pressure
- elevation

Hourly gridded wind fields (optional)
- MM4/MM5 output
- NAM(Eta) output
- WRF output
- RUC output
- RAMS output
- CSUMM output

Overwater Observations (optional)

- air-sea temperature difference
- air temperature
- relative humidity
- overwater mixing height
- wind speed
- wind direction
- overwater temperature gradients above and below mixing height

Geophysical Data

Gridded fields of:
- terrain elevations
- land use categories
- surface roughness length (optional)
- albedo (optional)
- Bowen ratio (optional)
- soil heat flux constant (optional)
- anthropogenic heat flux (optional)
- vegetative leaf area index (optional)

If the upper air wind speed, wind direction, or temperature is missing, CALMET will interpolate to replace the missing data. Actually, the interpolation of wind data is performed with the u and v components, so both the wind speed and direction must be present for either to be used. Because the program does not extrapolate upper air data, the top valid level must be at or above the model domain and the lowest (surface) level of the sounding must be valid.

For modeling applications involving overwater transport and dispersion, the CALMET boundary layer model requires observations of the air-sea temperature difference, air temperature, relative humidity and overwater mixing height (optional) at one or more observational sites. The model can accommodate overwater data with arbitrary time resolution (e.g., sub-hourly, hourly, daily, or seasonal values). The location of the overwater stations is allowed to vary in order to allow the use of observations made from ships. CALMET optionally can use only land stations to calculate temperatures over land and only overwater stations to calculate temperatures over water. If this option is used, vertical temperature lapse rate information may be included at the overwater observational sites.

If the wet removal algorithm of the CALPUFF model is to be applied, CALMET can be made to produce gridded fields of precipitation rates from precipitation observations. The routinely available NCDC precipitation data in TD-3240 format or a free-formatted, user-prepared file of precipitation rates can be used as input to CALMET.

CALMET also requires geophysical data including gridded fields of terrain elevations and land use categories. Gridded fields of other geophysical parameters, if available, may be input to the model. The optional inputs include surface roughness length, albedo, Bowen ratio, a soil heat flux parameter, anthropogenic heat flux, and vegetation leaf area index. These parameters can be input as gridded fields or specified as a function of land use. Default values relating the optional geophysical parameters to land use categories are provided within CALMET.

As described in the previous section, CALMET contains an option to read as input gridded wind fields produced by the prognostic wind field models. The CSUMM prognostic wind field model generates a file called PROG.DAT which can be directly input into CALMET, or if using the MM4/MM5, NAM(Eta), WRF, RUC, RAMS or TAPM derived data, a file called 3D.DAT (MM4.DAT is also accepted, but not recommended) is required.

One of the options in CALMET is to by-pass the boundary layer model and compute only gridded wind fields (i.e., produce U, V wind components only without the micro-meteorological variables such as friction velocity, Monin-Obukhov length, etc.). Although the CALPUFF and CALGRID models cannot be executed with such a file, there may be some applications in which only the wind components are of interest. For example, a postprocessor (CAL2UAM) can be used to convert the CALMET winds into a format suitable for input into the UAM model. If CALMET is to be run in this mode, an option is provided to allow preprocessed surface and upper air observations to be input. The preprocessed input file, DIAG.DAT, is compatible with the stand-alone version of the diagnostic wind field model developed by Douglas and Kessler (1988).

CALMET reads the user's inputs from a "control file" with a default name of CALMET.INP. This file contains the user's selections of the various model options, input variables, output options, etc.

CALPUFF Data Requirements

The input data sets used by CALPUFF are summarized in Table 1-4 (also see the modeling system flow diagram, Figure 1-1). CALPUFF reads user inputs from a "control file" with a default name of CALPUFF.INP. This file contains the user's selections for the various model options, technical input variables, output options, and other user-controllable options.

A meteorological data file (CALMET.DAT) contains hourly or sub-hourly gridded fields of micro-meteorological parameters and three-dimensional wind and temperature fields. The meteorological data file also contains geophysical data such as terrain heights and land use which are required by both the meteorological model (e.g., for terrain adjustment of the wind fields) and by the CALPUFF model. The contents of the CALMET.DAT input file and the other input data bases are summarized in Table 1-5. Options also exist for using single-station meteorological data in ISCST3, CTDMPLUS, AERMOD, or AUSPLUME data format.

Five files are provided for the input of emissions data. The control file, CALPUFF.INP includes point, line, volume and area source data for sources with constant emission parameters or those that can be described by a cycle based on time of day (24 factors), month (12 factors), hour and season (24 x 4 factors), wind speed and stability class (6 x 6 factors), or temperature (12 factors). Separate scaling factors can be specified for each source-species combination. Arbitrarily-varying source data may be provided in files for point sources (default name PTEMARB.DAT), area sources (default name BAEMARB.DAT), line sources (default name LNEMARB.DAT), and volume sources (default name VOLEMARB.DAT).

Hourly or sub-hourly observations of ozone data are used in the calculation of SO_2 and NO_x transformation rates if the MESOPUFF II chemical transformation scheme is selected. Ozone data for one or more ozone stations are read from a data file called OZONE.DAT.

Table 1-4: Summary of CALPUFF Input Files

Default File Name	Contents	Unit* Number	Type
RESTARTB.DAT	Input restart file containing a dump of all puff parameters sufficient to allow a model run to continue (optional)	IO3	Unformatted
CALPUFF.INP	Control file inputs	IO5	Formatted
CALMET.DAT	Geophysical and time-varying meteorological data, created by the CALMET meteorological model	IO7	Unformatted
or ISCMET.DAT	Single-station ASCII meteorological data in ISCST3-format	IO7	Formatted
or PLMMET.DAT	Single-station ASCII meteorological data in AUSPLUME format	IO7	Formatted
BCON.DAT	Boundary condition concentration file (optional)	IO15	Formatted
PTEMARB.DAT	Source and emissions data for point sources with arbitrarily-varying emission parameters (optional)	IO16	Formatted or unformatted
BAEMARB.DAT	Emissions data for area sources with arbitrarily-varying emission parameters. Can be derived from EPM model files (optional)	IO17	Formatted
VOLEMARB.DAT	Emissions data for volume sources with arbitrarily- varying emission parameters (optional)	IO18	Formatted or unformatted
LNEMARB.DAT	Emission data for line sources with arbitrarily-varying line source emissions (optional)	I019	Formatted
VD.DAT	User-specified deposition velocities (optional)	IO20	Formatted
OZONE.DAT	Ozone measurements at one or more ozone stations (optional)	IO22	Formatted
H202.DAT	H202 monitoring data (optional)	IO23	formatted
CHEM.DAT	User-specified chemical transformation rates (optional)	IO24	Formatted
COASTLN.DAT	Subgrid scale coastal boundary file (optional)	IO25	Formatted
HILL.DAT	Hill specifications from CTDMPLUS terrain processor (optional)	IO28	Formatted
HILLRCT.DAT	CTSG Receptors from CTDMPLUS processor (optional)	IO29	Formatted
PROFILE.DAT	Single-station ASCII meteorological tower data as prepared for CTDMPLUS/AERMOD (optional)	IO31	Formatted
SURFACE.DAT	CTDMPLUS/AERMOD surface layer parameters (optional)	IO32	Formatted

FLUXBDY.DAT	Boundary Data for Mass flux (optional)	IO35	Formatted

* Variable shown is the parameter controlling the FORTRAN unit number associated with the file. Usually, the value assigned to the parameter is consistent with the name (i.e., IO7 = 7). However, the value can be easily changed in the parameter file to accommodate reserved unit numbers on a particular system.

Table 1-5: Summary of Input Data Used by CALPUFF

Geophysical Data (CALMET.DAT)

Gridded fields of:

- surface roughness lengths (z_o)
- land use categories
- terrain elevations
- leaf area indices

Meteorological Data (CALMET.DAT)

Gridded fields of:

- u, v, w wind components (3-D)
- air temperature (3-D)
- surface friction velocity (u_*)
- convective velocity scale (w_*)
- mixing height (z_i)
- Monin-Obukhov length (L)
- PGT stability class
- Precipitation rate

Values of the following parameters at surface met. stations:

- air density (ρ_a)
- air temperature
- short-wave solar radiation
- relative humidity
- precipitation type

Meteorological Data (ISCMET.DAT)

Hourly or sub-hourly values (standard content)

- wind speed, flow direction
- temperature, stability class
- mixing height (z_i) for rural/urban

Hourly or sub-hourly values (extended content)

- surface friction velocity (u_*), Monin-Obukhov length (L)
- surface roughness (z_o)
- precipitation code and rate
- potential temperature gradient

- wind speed profile power-law exponent
- short-wave solar radiation
- relative humidity

(Continued)

Table 1-5 (Continued): Summary of Input Data Used by CALPUFF

Meteorological Date (PLMMET.DAT)

Hourly values (standard content)

- wind speed, wind direction
- temperature, stability class
- mixing height (z_i)
- turbulence (σ_2)
- wind speed profile power-law exponent
- potential temperature gradient

Hourly values (extended content)

- precipitation code and rate
- short-wave solar radiation
- relative humidity

Meteorological Data (SURFACE.DAT, PROFILE.DAT)

Hourly or sub-hourly values (SURFACE.DAT - standard content)

- mixing height (z_i)
- surface friction velocity (u_*), Monin-Obukhov length (L)
- surface roughness (z_o)

Hourly or sub-hourly values (SURFACE.DAT - extended content)

- precipitation code and rate
- short-wave solar radiation
- relative humidity

Hourly or sub-hourly values at multiple levels (PROFILE.DAT)

- height
- wind speed (scalar, vector)
- wind direction
- temperature
- turbulence (σ_v/σ_2, σ_w)

Restart Data (RESTARTB.DAT)

Model puff data generated from a previous run (allows continuation of a previous model run)

(Continued)

Table 1-5 (Continued): Summary of Input Data Used by CALPUFF

Emissions Data (CALPUFF.INP, PTEMARB.DAT, BAEMARB.DAT, VOLEMARB.DAT, LNEMARB.DAT)

Point source emissions:

- Source and emissions data for point sources with constant or cyclical emission parameters (CALPUFF.INP)
- Source and emissions data for point sources with arbitrarily-varying emission parameters (PTEMARB.DAT)

Area source emissions

- Emissions and initial size, height, and location for area sources with constant or cyclical emission parameters (CALPUFF.INP)
- Gridded emissions data for buoyant area sources with arbitrarily-varying emission parameters (BAEMARB.DAT)

Volume source emissions

- Emissions, height, size, and location of volume sources with constant or cyclical emission parameters (CALPUFF.INP)
- Emissions data for volume sources with arbitrarily-varying emission parameters (VOLEMARB.DAT)

Line source emissions

- Source and emissions data, height, length, location, spacing, and orientation of buoyant line sources with constant or cyclical emission parameters (CALPUFF.INP)
- Emissions data for buoyant line sources with arbitrarily-varying emission parameters (LNEMARB.DAT)

Boundary Condition Data (BCON.DAT)

- Concentration of each species specified by air-mass
- Air-mass types mapped to segments along boundary of computational grid

Deposition Velocity Data (VD.DAT)

- Deposition velocity for each user-specified species for each hour of a diurnal cycle

Ozone Monitoring Data (OZONE.DAT)

- Hourly or sub-hourly ozone measurements at one or more monitoring stations

H_2O_2 Monitoring Data (H2O2.DAT)

- Hourly or sub-hourly H_2O_2 measurements at one or more monitoring stations

Chemical Transformation Data (CHEM.DAT)

- Species-dependent chemical transformation rates for each hour of a diurnal cycle

Table 1-5 (Concluded): Summary of Input Data Used by CALPUFF

Hill Data (HILL.DAT)

- Hill shape and height parameters in CTDMPLUS format for use in the subgrid-scale complex terrain module (CTSG)

CTSG Receptors (HILLRCT.DAT)

- Receptor locations and associated hill ID in CTDMPLUS format

Subgrid Scale Coastal Boundary Data (COASTLN.DAT)

- File containing X,Y coordinates of subgrid scale coastlines to be treated by CALPUFF

Boundary Data for Diagnostic Mass Flux Option (FLUXBDY.DAT)

- File containing X,Y coordinates of boundaries used to evaluate mass transport

Because of the similarity between CTDMPLUS and the CTSG option within CALPUFF, an input option is provided for hill data and the associated receptor data in files produced for CTDMPLUS. These files, HILL.DAT and HILLRCT.DAT can be read by CALPUFF without modification, to specify all CTSG input requirements.

Two additional input files, VD.DAT and CHEM.DAT, contain diurnal cycles of user-specified deposition velocities and chemical transformation rates, respectively. These files are necessary only if the user wishes to substitute the values normally computed internally by the deposition and chemical models with sets of time-varying but spatially-uniform externally specified values.

The optional input file, PROFILE.DAT in the CTDMPLUS or AERMOD format can also be used to provide vertical profiles of observations of σ_v and σ_w. These parameters can be used to compute the plume dispersion coefficients σ_y and σ_z.

CALPUFF can continue a previous simulation using an optional restart file (RESTARTB.DAT). The restart file contains all of the puff variables at the end of the previous run needed to allow the model to continue the simulation. The restart file used as input of a continuation run must be generated as the output restart file in the previous CALPUFF simulation. The restart file is an optional file.

CALPUFF contains a subgrid scale coastal effects module that allows a parameterization of the Thermal Internal Boundary Layer (TIBL) at scales smaller than the grid spacing. The user inputs the X,Y coordinates of one or more coastlines in an optional file called COASTLN.DAT.

The CALPUFF output files are summarized in Table 1-6. The list file contains a copy of the inputs used in the run, optional output fields of gridded and discrete receptor concentrations, wet deposition fluxes, and dry deposition fluxes and other run data. The CONC.DAT, WFLX.DAT, and DFLX.DAT files contain the output concentrations, wet and dry fluxes, respectively, in an unformatted form suitable for further processing by the postprocessing program, CALPOST. The VISB.DAT file contains relative humidity information which is required by CALPOST in order to perform certain visibility-related computations. The model can generate an optional output restart file (RESTARTE.DAT) containing all the puff parameters needed to continue the CALPUFF simulation. The output restart file can be generated at regular intervals of the simulation to protect against loss of the simulation resulting from power failures or other interruptions. The output restart file of a run serves as the input restart file of the next (continuation) run.

Three additional files may be produced for diagnostic purposes. When CALPUFF is run with the debug switch set to true, much information about specific puffs is written to the list file for specific sampling steps. Summary information for these puffs is also written to the file DEBUG.DAT. Because of the volume of information written to list file, the debug option is generally used for very short periods. Options to characterize changes in pollutant mass report results to the files MASSFLX.DAT and

Table 1-6: Summary of CALPUFF Output Files

Default File Name	Contents	Unit* Number	Type
RESTARTE.DAT	Output restart file containing a dump of all puff parameters sufficient to allow a model run to continue (optional)	IO4	Unformatted
CALPUFF.LST	List file produced by CALPUFF	IO6	Formatted
CONC.DAT	Time-averaged concentrations (g/m^3) at the gridded and discrete receptors for species selected by the user in the control file (optional)	IO8	Unformatted
DFLX.DAT	Time-averaged dry deposition fluxes (g/m^2/s) at the gridded and discrete receptors for species selected by the user in the control file (optional)	IO9	Unformatted
WFLX.DAT	Time-averaged wet deposition fluxes (g/m^2/s) at the gridded and discrete receptors for species selected by the user in the control file (optional)	IO10	Unformatted
VISB.DAT	Relative humidity data required for visibility-related postprocessing (optional)	IO11	Unformatted
TK2D.DAT	2D temperature output file	IO13	Unformatted
RHO2D.DAT	2D density output file	IO14	Unformatted
FOG.DAT	Water saturation information at receptors for use with fog analysis postprocessors (optional)	IO12	Unformatted
DEBUG.DAT	Tables of detailed puff/slug data useful for debugging (optional)	IO30	Formatted
MASSFLX.DAT	Mass flux into and out of regions defined by the boundaries in the FLUXBDY.DAT file, each timestep	IO36	Formatted
MASSBAL.DAT	Changes in mass of all species modeled, each timestep	IO37	Formatted
QATERR.GRD	gridded terrain elevations (mMSL) in SURFER GRD format, created when CALMET.DAT is used with variable topography	IOQA	Formatted
QALUSE.GRD	gridded land use in SURFER GRD format, created when CALMET.DAT is used	IOQA	Formatted

QAGRID.BNA	borders (km) for the METEOROLOGICAL, COMPUTATIONAL, and SAMPLING (when LSAMP=T) grid domains, in Atlas Boundary File format	IOQA	Formatted
QARECD.DAT	x,y coordinates (km), elevation (m), and height above ground (m) of discrete receptors, created only when discrete receptors are used (NREC>0)	IOQA	Formatted

Table 1-6 (Concluded):
Summary of CALPUFF Output Files

Default File Name	Contents	Unit* Number	Type
QARECG.DAT	x,y coordinates (km), and elevation (m) of gridded receptors, created only when gridded receptors are used (LSAMP=T)	IOQA	Formatted
QARECT.DAT	x,y coordinates (km), and elevation (m) of CTSG receptors, created only when CTSG receptors are used (NCTREC>0)	IOQA	Formatted
QAPNTS.DAT	x,y coordinates (km), elevation (m), and source index of point sources, created only when point sources are used	IOQA	Formatted
QAVOLS.DAT	x,y coordinates (km), elevation (m), and source index of volume sources, created only when volume sources are used	IOQA	Formatted
QAAREA.BNA	outlines (km) for area sources, in Atlas Boundary File format, created only when area sources are used	IOQA	Formatted
QALINE.BNA	segments (km) for buoyant line sources, in Atlas Boundary File format, created only when line sources are used	IOQA	Formatted
LUSE.CLR	Default land-use color map file for SURFER, always created	IOQA	Formatted

* Variable shown is the parameter controlling the FORTRAN unit number associated with the file. Usually, the value assigned to the parameter is consistent with the name (i.e., IO8 = 8). However, the value can be easily changed in the parameter file to accommodate reserved unit numbers on a particular system.

MASSBAL.DAT. MASSFLX.DAT reports the mass of selected species that cross into and out of regions defined by the user in the file FLUXBDY.DAT. MASSBAL.DAT reports changes in the mass of all modeled species throughout the modeling domain.

A sequence of 'QA' files is produced during the setup phase of a run. These are designed to allow a user to make one or more maps displaying geographical aspects of the run, including the modeling domain, terrain elevations, gridded land use, source locations, and receptor locations. Maps of this type convey the key spatial relationships of the model application.

Computer Requirements

The memory management scheme used in CALMET and CALPUFF is designed to allow the maximum array dimensions in the model to be easily adjusted to match the requirements of a particular application. An external parameter file contains the maximum array size for all of the major arrays. A re-sizing of the program can be accomplished by modifying the appropriate variable or variables in the parameter file and re-compiling the program. All appropriate arrays in the model will be automatically re-sized by the updated parameter values. For example, the maximum number of horizontal grid cells allowed in the model, MXNX and MXNY, are two of the variables which can be adjusted within the parameter file. However, no change to the parameter file is necessary if a particular application requires a smaller array size than the maximum values specified in the parameter file.

The memory management scheme used in CALMET and CALPUFF is designed to allow the maximum array dimensions in the model to be easily adjusted to match the requirements of a particular application. An external parameter file contains the maximum array size for all of the major arrays. A re-sizing of the program can be accomplished by modifying the appropriate variable or variables in the parameter file and re-compiling the program. All appropriate arrays in the model will be automatically re-sized by the updated parameter values. For example, the maximum number of horizontal grid cells allowed in the model, MXNX and MXNY, are two of the variables which can be adjusted within the parameter file. However, no change to the parameter file is necessary if a particular application requires a smaller array size than the maximum values specified in the parameter file.

The memory required by CALPUFF will be a strong function of the specified maximum array dimensions in the parameter file. However, as an example, CALPUFF required approximately 300 K bytes of memory for a test run with a 10 x 10 horizontal grid, with 5 vertical layers, and a maximum number of puffs of 100. This type of configuration may be suitable for ISC-mode simulations of a small number of point sources. For more typical studies, memory requirements will typically be at least 32 megabytes, with more required for simulations involving large numbers of sources.

The run time of CALPUFF will vary considerably depending on the model application. Variations of factors of 10-100 are likely depending of the size of the domain, the number of sources, selection of technical options, and meteorological variables such as the mean wind speed. Because each puff is treated independently, any factor which influences the number and residence time of puffs on the computational grid, and the model sampling time step will affect the run time of the model. As an example of the range of runtimes, an annual simulation of CALPUFF in ISC-mode for 2 sources and 64 receptors required less than one minute on a 500 MHz PC. A visibility application involving 218 sources and 425 receptors for an annual period required approximately 9 hours of runtime for CALMET and 95 hours for CALPUFF.

Program Execution

CALPUFF (Version 4.0 and above) can be executed with the following DOS command line:

CALPUFF filename

where it is assumed that the executable file is called CALPUFF.EXE and the "filename" is the name of the file (up to 70 characters in length) containing all of the input information for the run. The default input file name is CALPUFF.INP. The first input group in CALPUFF.INP contains all of the other input and output (I/O) filenames used in the run. Within this group the user can change the name of any of the input and output files from their default names, and change the directory from which the files will be accessed by specifying the file's full pathname.

Similarly, CALMET (Version 3.0 and above) can be executed with the following DOS command line:

CALMET filename

where the default input filename is CALMET.INP, and the executable file is assumed to be called CALMET.EXE.

2. GEOPHYSICAL DATA PROCESSORS

The GEO.DAT data file contains the geophysical data inputs required by the CALMET model. These inputs include land use type, elevation, surface parameters (surface roughness length, albedo, Bowen ratio, soil heat flux parameter, and vegetation leaf area index) and anthropogenic heat flux. The land use and elevation data are entered as gridded fields. The surface parameters and anthropogenic heat flux can be entered either as gridded fields or computed from the land use data at each grid point. A series of programs have been developed to process the terrain and land use data and produce a GEO.DAT file containing gridded fields of terrain, land use, and land use weighted fields of surface parameters and heat flux. Creating the GEO.DAT is a three step process. The first two steps involve processing the relevant terrain and land use data and then, in the third step, the processed files are combined into a final file (GEO.DAT) that can be read by CALMET. The following preprocessors are used to generate a GEO.DAT file:

TERREL is a terrain preprocessor which coordinates the allocation of terrain elevation data from several digitized data bases to a user-specified modeling grid.

CTGPROC is a land use preprocessor which reads the following datasets; (1) compressed Composite Theme Grid (CTG) land use data, (2) USGS Global LU Dataset, (3) National Land Cover Data set, (4) a generic format where specific Land Use categories are mapped internally to USGS Land Use categories and (5) a second generic format which allows the user to use any Land Use categories and map accordingly. CTGPROC computes the fractional land use for each grid cell in the user-specified modeling domain. If required, the preprocessor CTGCOMP, can first be used to compress the data file format of a USGS land use data file in Composite Theme Grid (CTG) format prior to using CTGPROC.

MAKEGEO is the final preprocessor which reads the fractional land use data, user inputs which define land use category mapping, and values relating each of the surface parameters to land use and optionally, the gridded terrain file, and produces a GEO.DAT file ready for input to CALMET. Note: if the gridded terrain data file is not incorporated into MAKEGEO, it must be hand-edited into the GEO.DAT file before running CALMET.

The complete process is illustrated in Figure 2-1 and further described in the following sections.

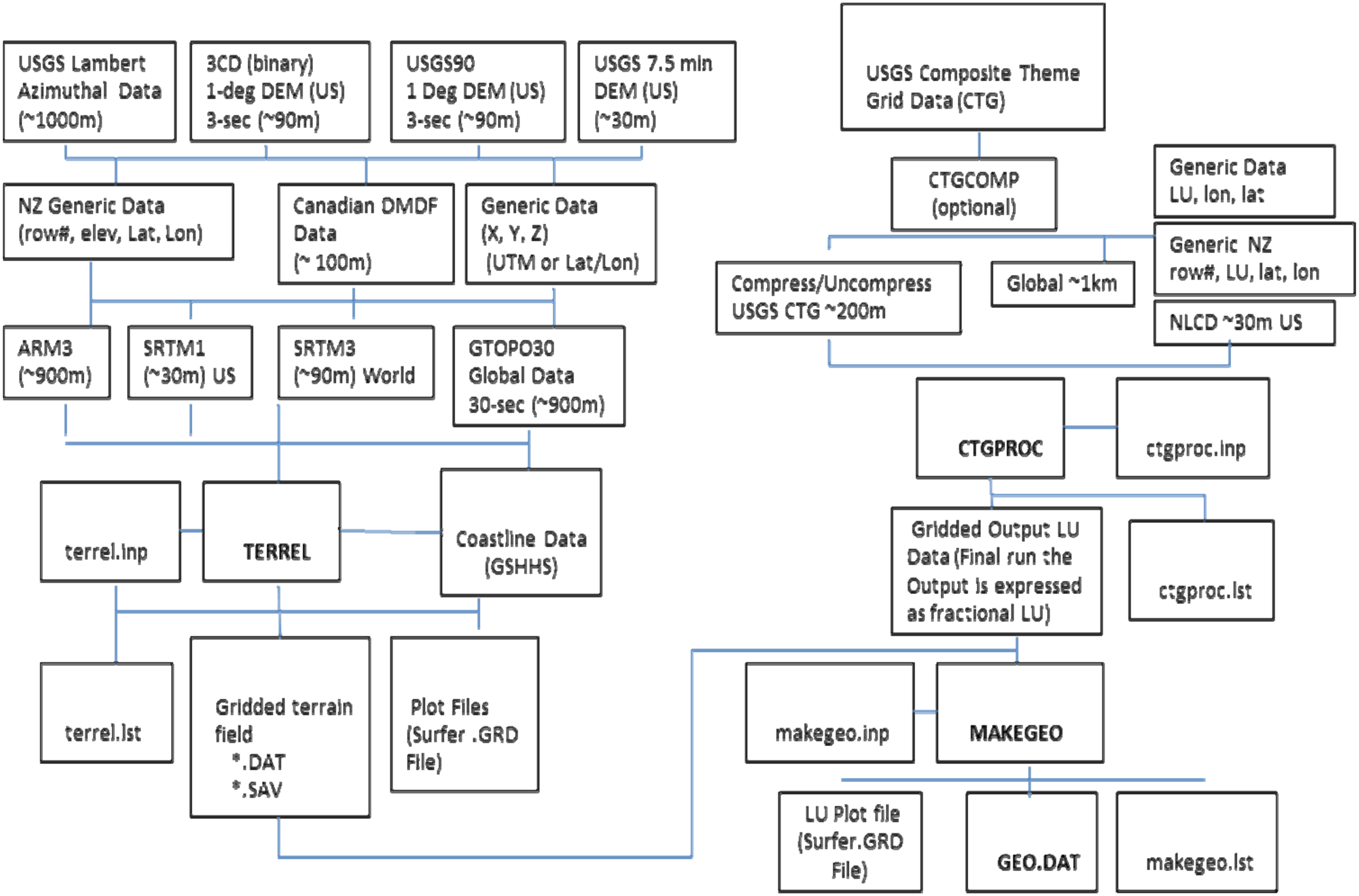

Figure 2-1: Processing Geophysical Data

2.1 TERREL Terrain Preprocessor

TERREL is a preprocessing program that extracts and reformats Digital Elevation Model (DEM) terrain data according to the options selected by the user (domain, resolution, etc.). Eleven DEM formats are currently supported. TERREL has the ability to produce Cartesian gridded fields of terrain elevations or a polar grid of terrain elevations. For the Cartesian gridded field option, TERREL averages all of the terrain data points which fall within the grid cell to obtain the elevation assigned to the center of the user-specified grid cell. When using the polar grid option, TERREL uses the maximum terrain elevation in the area either from the current ring out to the next ring (user input switch - SCREEN) or halfway between adjacent rings (user input switch - NORMAL) and halfway between the adjacent radials. TERREL can produce terrain data files in the formats compatible with the following models: CALMET, MESOPAC, NUATMOS, and ISC3. TERREL requires at least one input file and produces four output files. TERREL can first be run without any data files and the program will indicate for the user the latitude and longitude of the four corners of the area required to cover the user-specified domain. A message indicates how many terrain data files of each type are required based on the domain parameters supplied by the user. This is helpful, for example, when only UTM coordinates are known, but not the latitude and longitude of the corners of the modeling domain. Once the appropriate data files are obtained, the TERREL input file must be modified to reflect the names and types of the data files and TERREL must be run again to process the terrain data. This could be done in one run or as an iterative process, where intermediate results are stored in a binary file (e.g., TERREL.SAV) and incorporated into the next TERREL run using the next set of digital terrain input data. The .SAV file option is helpful if the user doesn't have the available disk space to store all of the raw terrain files at once.

TERREL has an input (ITHRES) which is used for quality assurance purposes. ITHRES is a whole number (%) identifying the acceptable threshold of variance from the average number of data points ('hits') per cell. If a particular grid cell had less than ITHRES percent of the average number of data 'hits' per cell, a warning message is written to alert the user to check the results. If using a mix of 1-degree DEM data and 30 meter DEM data, the grid cells using the 30 meter data will have many more 'hits' than the 1-degree DEM grid cells. The user might want to adjust the value of ITHRES to reduce the number of warning messages written.

TERREL has the option (variable PMAP) to define the gridded output fields for a number of map projections. Note that CALMET currently supports Universal Transverse Mercator (UTM) grid, Lambert Conformal Projection (LCC) and Tangential Transverse Mercator (TTM). Lambert Conformal Projection should be used when the modeling domain is large, (> 300 km), because a Lambert Conformal grid accounts for the earth's curvature. If the LCC option is specified, TERREL uses the user-specified standard parallels (latitudes) and reference longitude to calculate a "cone constant" and the east-west distance from the reference longitude. The reference longitude is the longitude at which true north and map north are defined to be the same. It also defines where x=0 in the Lambert Conformal grid. The reference latitude defines where y=0 in the Lambert Conformal grid.

TERREL INPUT:

1. **Terrain Database**: Table 2-1 defines the types of terrain databases which can be processed by TERREL. Eleven types of terrain data can be read, corresponding to different resolutions and formats: 30 arc-seconds (–900 m spacing, GTOPO30, USGSLA, or ARM3 format), 3 arc-seconds (–90m spacing, USGS DEM, SRTM3, or Rocky Mtn. Communications (3CD) format), 1 arc-second (–30m spacing, SRTM1 format), 30 meters (7.5 minute USGS DEM format), and Canadian Digital Map Data Format (DMDF) data (~100 m resolution). Two are generic formats, one based on a system used in New Zealand (NZGEN), based on row#, elevation (m), latitude, longitude and one designed to enable a user to reformat existing gridded terrain files into a simple format for TERREL (GEN) based on (X, Y, Z) format. The terrain data ordered from the USGS can be obtained through file transfer protocol (FTP) access, on CD-ROM, or on magnetic tape, or follow the direct links from www.src.com. Attachment 2-A contains a complete description of the USGS Digital Elevation Models taken fromhttp://eros.usgs.gov/#/Guides/dem.Attachment 2-G describes the Canadian DMDF format and Attachment 2-B describes the SRTM format.

2. **Obtaining the Data: Links to downloading all the terrain data can be found on** http://www.src.com/datasets/. 3 arc-second terrain data are also available from the USGS site (http://edc2.usgs.gov/geodata/)with file names corresponding to the 1:250,000-scale map names followed by -e or -w for the eastern and western portions respectively. In some regions, 30m data are also available with the names corresponding to the 1:100,000-scale map names. The user must first identify the names of the quadrants encompassed by the domain. A copy of the USGS website is provided in Attachment 2-C.

   The Shuttle RADAR Topography Mission (SRTM) data are available in 1arc-second (30m), 3 arc-second (90m), and 30arc-second (1000m) resolutions. The 30 arc-second data are combined with the GTOPO30 data and processed by TERREL in the same way as the GTOPO30 data, so these data files should be presented as GTOPO30. The 1 and 3 arc-second data files must be processed as type SRTM1 and SRTM3, respectively. The SRTM data are available from links to the USGS site directly from the ASG website at http://www.src.com/datasets/datasets_terrain.html documentation is available at the Jet Propulsion laboratory, California Institute of Technology, at http://www2.jpl.nasa.gov/srtm/and is included in Attachment 2-B.

   30 arc-second terrain data for the globe are available from the USGS WWW site:

   (http://eros.usgs.gov/#/Find_Data/Products_and_Data_Available/GTOPO30).

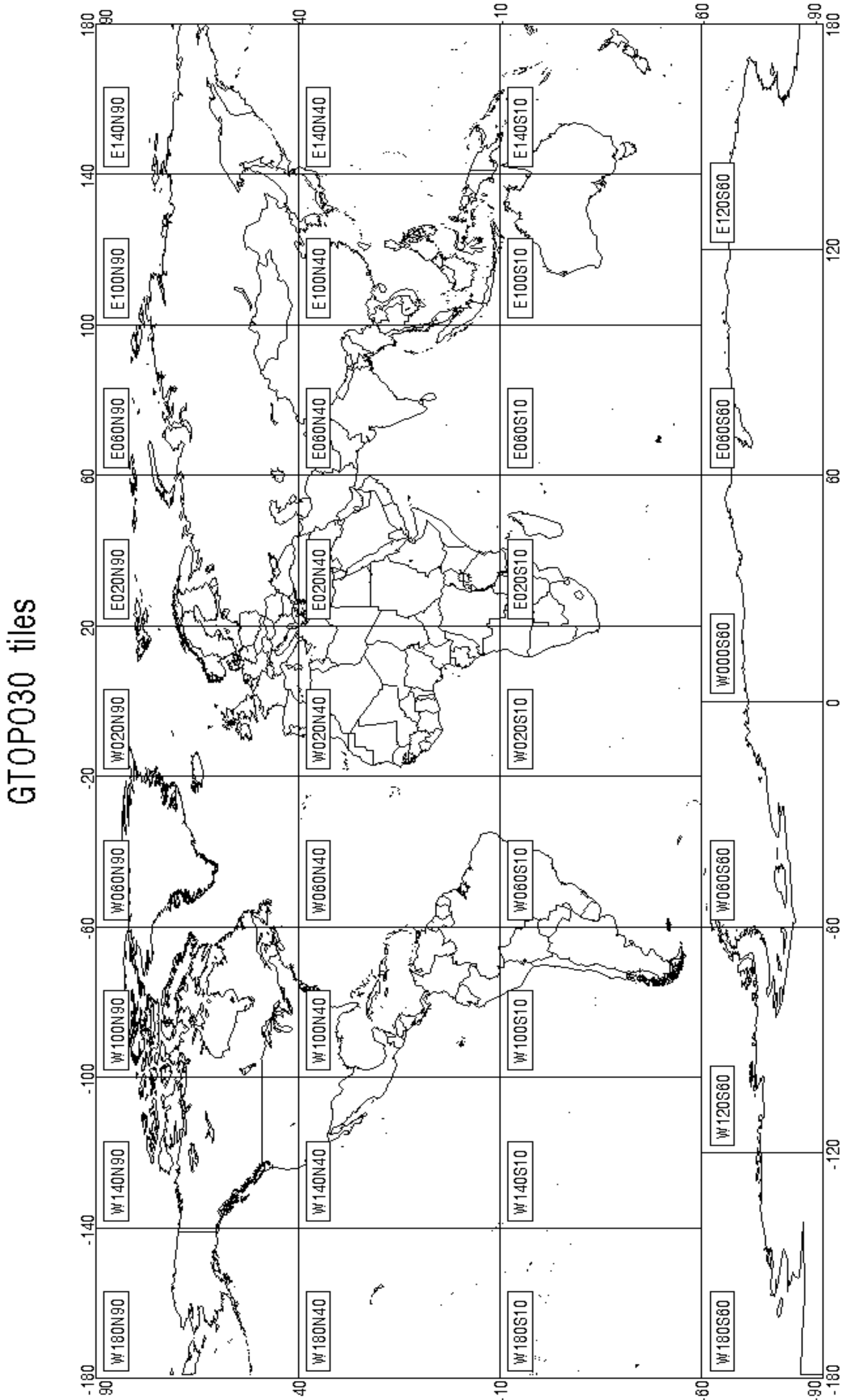

Figure 2-2:   Spatial coverage of each GTOPO30 tiles (files).

The GTOPO30 data set is divided into files (or tiles), where each file covers 40 degrees of longitude and 50 degrees of latitude, except for in the Antarctica region where each file covers 60 degrees of longitude and 30 degrees of latitude.

Figure 2-2 shows the spatial coverage of the data files. Each file is either 57,600,000 (non-Antarctica) or 51,840,000 bytes (Antarctica) in size. These DEM data are provided in 16-bit signed integers in a simple binary raster, with no imbedded header or trailer bytes and no internal indexing. The data are stored in Motorola byte order, which stores the most significant byte first, i.e., *big endian*. The Motorola, SUN, HP, and SGI platforms use *big endian*; whereas the Intel (PC) and DEC platforms use *little endian*. Therefore, the user must be careful regarding the intended platform for TERREL. The code uses a logical flag, LBIGENDIAN (set in subroutine SETGLOB), to define whether the intended platform is *big endian* or *little endian*. LBIGENDIAN=.FALSE. is for *little endian*, and LBIGENDIAN=.TRUE. is for *big endian*. The flag enables the porting of TERREL across different machine platforms.

3. **User control file** (TERREL.INP): this input file specifies the filenames and type of databases being processed and the modeling domain related parameters. The format of the TERREL control input file follows the same rules as those used in the CALMET.INP file (refer to the CALMET section for details). Only data within the delimiter characters (!) are processed. The input data consist of a leading delimiter followed by the variable name, equals sign, input value or values, and a terminating delimiter (e.g., !XX = 12.5!). A sample file is shown in Table 2-2 and a description of each input variable is provided in Table 2-3. Detailed information on the input variables is included in the default input file itself.

   TERREL.INP may be created/edited directly using a conventional editor, or it may be created/edited indirectly by means of the PC-based, Windows-compatible Graphical User Interface (GUI) developed for the geophysical preprocessors (CALPro).

4. **Save file**: this input data file contains the binary results from an intermediate run of TERREL. It is read as input to the current run.

TERREL OUTPUT:

1. **List File**: echoes the selected options, reports errors and provides a listing of the gridded terrain elevations and the number of raw data points ('hits') used to compute the terrain elevation for each grid cell (e.g., TERREL.LST).

2. **Plot File**: can be read directlyCALPro's CALVIEW or by a contouring software package such as SURFER (e.g., TERREL.GRD).

3. **Save File**: contains the intermediate binary output (e.g., TERREL.SAV).

4. **Terrain Elevation Output File**: an ASCII file in the format specified by the user. For example, choosing the model option 'CALMET' produces a gridded terrain file which can be directly read by MAKEGEO (e.g., TERREL.DAT) for use in CALMET.

Table 2-1: Terrain Databases

Database Type	Description	Source	File Format	Reference System	Spatial Resolution (m)
USGS90	1-deg DEM 3 arc-second data	USGS	ASCII	Geographic (lat/lon)	~90
USGS30	7.5 min USGS quadrangle	USGS	ASCII	UTM	30
3CD	1-deg DEM 3 arc-second data	Rocky Mtn Communications CD-ROM	Binary	Geographic (lat/lon)	~90
SRTM1	1-deg HGT format 1 arc-second data covering USA	USGS	Binary	Geographic (lat/lon)	~30
SRTM3	3-deg HGT format 3 arc-second data covering world	USGS	Binary	Geographic (lat/lon)	~90
GTOPO30 (SRTM30)	30 second DEM 40Elon. by 50Elat. covering world	USGS	Binary	Geographic (lat/lon)	~900
ARM3	30 second data 4 N-S sheets covering U.S.	CALPUFF CD-ROM (available from NTIS)	ASCII	Geographic (lat/lon)	~900
DMDF	7.5 min Alberta DEM	Alberta Environ. Protection	ASCII	UTM	~100
USGSLA	30 sec DEM	USGS	Binary	Lambert Azimuthal	~1000
NZGEN	Generic file format	Misc.	ASCII	Geographic (lat/lon)	Arbitrary

GEN	Generic File format	Misc.	ASCII	UTM or Lambert Conformal	Arbitrary

Table 2-2: Sample TERREL Control File Inputs (TERREL.INP)

```
-------------------------------------------------------------------------------

                 TERREL PROCESSOR CONTROL FILE
                 -----------------------------

  TERREL accepts terrain surface elevation data from a number of
  digital data bases and forms grid-cell averages or point-values for
  use in particular dispersion modeling systems.  For the CALPUFF
  system, TERREL produces a gridded terrain file for the MAKEGEO
  processor, and it produces a file of point-values for discrete
  receptors for CALPUFF.  Use TERREL one or more times to build the
  requested file.

-------------------------------------------------------------------------------

INPUT GROUP: 0 -- Input and Output Files
--------------

-------------
Subgroup (0a)
-------------

     Number of Terrain Data Files provided in Subgroup 0b

     By default, no data files are expected, and running TERREL
     without input data files will allow it to complete its set-up
     procedures, and report the number of data files needed to cover
     the specified modeling domain.  This information can be helpful
     when assembling the data files for an application.

     (NTDF)                    Default: 0      ! NTDF = 4 !


     Other Input and Output files:
     -----------------------------

     Default Name    Type        File Name
     ------------    ----        ---------
    TERREL.DAT       output    ! OUTFIL = terr1km.dat      !
    TERREL.LST       output    ! LSTFIL = terr1km.lst      !
    TERREL.GRD       output    ! PLTFIL = qaterr.grd      !
    RAWECHO.DAT      output    ! RAWECHO = rawdata5.dat      !
    ------------------------------------------------------------
    (Save-files)
    PREV.SAV         input     * PREVFIL =                 *
    TERREL.SAV       output    ! SAVEFIL = terr1km.sav     !
    ------------------------------------------------------------
    (Discrete (X,Y) Point Files)
    XYINP.DAT        input     * XYINP =                  *
    XYOUT.DAT        output    * XYOUT =                  *
    ------------------------------------------------------------
    (Coastline Data)
       USGS Global Self-consistent Hierarchical High-resolution
       Shoreline Database (GSHHS)
    GSHHS_F.B        input     ! GSHHSIN  = GSHHS_F.B   !
       Processed coastline polygons for
```

```
       TERREL grid (BLN)
    COAST.BLN        input or  ! COASTBLN = coast.bln   !
                     output

     --------------------------------------------------------------------------
     Raw elevation data from the database file(s) can be echoed to an ASCII
     file (defined above as RAWECHO.DAT).  X and Y coordinates are in grid
     units (km), and elevations are unfiltered.
     (LRAWECHO)                 Default: F      ! LRAWECHO = T !

     All file names will be converted to lower case if LCFILES = T
     Otherwise, if LCFILES = F, file names will be converted to UPPER CASE
(LCFILES)                  Default: T      ! LCFILES = F !
T = lower case
        F = UPPER CASE

     NOTE: file/path names can be up to 70 characters in length

!END!
```

Table 2-2 (continued)
Sample TERREL Control File Inputs
(TERREL.INP)

```
-------------
Subgroup (0b)
-------------

     The following NTDF Terrain Data Files are processed.
     Enter NTDF lines identifying the file name for each,
     followed by a group terminator.  The type of data base
     for each file is designated by the assignment name:

    (USGS90)   designates USGS 1-deg DEM files (~90m)
    (USGS30)   designates USGS 7.5-min DEM files (typically 30m)
    (ARM3)     designates ARM3 terrain data files(~900m)
    (3CD)      designates 3CD (binary) 1-deg DEM files (~90m)
    (DMDF)     designates Canadian DMDF files (~100m)
    (SRTM1)    designates 1-sec Shuttle RADAR Topo Mission files (~30m)
    (SRTM3)    designates 3-sec Shuttle RADAR Topo Mission files (~90m)
    (GTOPO30)  designates GTOPO30 30-sec data (~900m)
    (USGSLA)   designates USGS Lambert Azimuthal data (~1000m)
    (NZGEN)    designates New Zealand Generic data files
    (GEN)      designates Generic data files
(GEOTIFF)  designates GEOTIFF data files

     1 !USGS90 = portland.e!     !END!
     2 !USGS90 = portland.w!     !END!
     3 !USGS90 = lewiston.w!     !END!
     4 !USGS90 = lewiston.e!     !END!


-------------
Subgroup (0c)
-------------

     Datum-Region
     ------------

     The Datum-Region for coordinates in each of the input Terrain Data Files
     may be identified in the header records of the file.  Check the file
     documentation and change these defaults if needed.  The list of Datum-Regions
     with official transformation parameters provided by the National Imagery and
     Mapping Agency (NIMA).

     Datum-region for input Terrain Data File coordinates
    (DUSGS90)       Default: WGS-72  ! DUSGS90  = WGS-72    !
    (DUSGS30)       Default: NAS-C   ! DUSGS30  = NAS-C     !
    (DARM3)         Default: NAS-C   ! DARM3    = NAS-C     !
    (D3CD)          Default: WGS-72  ! D3CD     = WGS-72    !
    (DDMDF)         Default: NAS-C   ! DDMDF    = NAS-C     !
    (DSRTM1)        Default: WGS-96  ! DSRTM1   = WGS-96    !
    (DSRTM3)        Default: WGS-96  ! DSRTM3   = WGS-96    !
    (DGTOPO30)      Default: WGS-84  ! DGTOPO30 = WGS-84    !
    (DUSGSLA)       Default: ESR-S   ! DUSGSLA  = ESR-S     !
    (DNZGEN)        Default: WGS-84  ! DNZGEN   = WGS-84    !
    (DGEN)          Default: WGS-84  ! DGEN     = WGS-84    !
(DGEOTIFF)      Default: WGS-84  ! DGEOTIFF = WGS-84    !

     Datum-region for input GSHHS Coastal Data File coordinates
    (DWVS)          Default: WGS-84  ! DWVS     = WGS-84 !

!END!
```

```
--------------------------------------------------------------------------------

INPUT GROUP: 1 -- Processing Options
--------------

   Intermediate data for the terrain grid are saved in a binary
   file for subsequent applications of TERREL.  When TERREL is
   applied more than once (with different terrain data files), the
   save file must be used to pass previous results along.

     Previous SAVE file used to start this run?
     (LPREV)                    Default: F      ! LPREV = F !
        T = PREV.SAV file is used
        F = PREV.SAV file is NOT used
```

Table 2-2 (continued)
Sample TERREL Control File Inputs
(TERREL.INP)

```
TERREL constructs gridded terrain elevations (m MSL), and may also
estimate the terrain elevation at discrete points by selecting the
peak elevation within a prescribed distance (km) from each point.
When processing discrete points, the XYINP.DAT provides the grid
coordinates (km) of each point, and may also include a height above
ground (m) for each point (e.g. for elevated receptors).  The
structure of the XYINP.DAT file is a free-format text file with
either 2 columns (X,Y) or 4 columns (X,Y,Elevation,Height).  When
the 4-column form is used, data in the 3rd column are replaced
with the elevations obtained from the terrain data base files.

Report elevations for discrete (X,Y) points?
  (LXY)                      Default: F      ! LXY = F !
  T = Yes (XYINP.DAT and XYOUT.DAT files are used)
  F = No  (XYINP.DAT and XYOUT.DAT files are NOT used)

Interpolate elevations for discrete points?
  (Used only if LXY=T)
  (LINTXY)                   Default: F      ! LINTXY = T !
  T = Yes (elevations will be interpolated)
  F = No  (elevations will be terrain peaks)

Number of data columns in XYINP.DAT file
  (Used only if LXY=T)
  (NXYCOL)                   Default: 4      ! NXYCOL = 2 !

Search radius (km) about each (X,Y) for locating terrain peak
  or for carrying out interpolation
  (Used only if LXY=T)
  (XYRADKM)                  No Default      ! XYRADKM = 0.15 !

Some terrain data sets contain void areas where the data are
missing.  Others may contain areas where data are inaccurate (noisy).
Both situations occur mostly over oceans or large lakes, but for SRTM
data it can also occur over land due to the data set still evolving.
These void (missing) or noisy input data can be replaced in several
ways.

Noisy Data ---
Noise affects SRTM data for oceans and lakes and the adjacent shores,
due to the scattering effects of water on radar measurements.
The most obvious occurence of noise is negative elevations for water
and adjacent land points.  This can be filtered with the specification
of a minimum acceptable elevation by water/land type.  Extracted
elevations that are greater than this minimum are retained, while those
lower than this minimum value can be re-defined as missing for
subsequent treatment by the missing values processing, or can be
replaced with either the minimum value or with another default value
defined for treatment of void (missing) data.  The minimum values must
be chosen judiciously for the region being treated since some regions
have valid elevations below MSL.

Missing data ---
Cells with missing elevations can be interpolated from surrounding
cells with valid values, and a maximum search radius is defined.
Also, if coastline processing has been used, default elevations for
each water/land type can be defined and used in place of voids.
This replacement can be carried out as the final step before output
on a cell-by-cell and receptor-by-receptor basis, or can be carried
out for values extracted from the terrain files as missing.  This
```

latter option is best used only for oceans and lakes. For oceans and lakes it is also possible to not use extracted elevations but only use the default.

Coastline data are used to define coarse water/land type by point or cell, for several of the options available for treating missing or noisy data. Coarse water/land type definitions currently available in TERREL are:

1 = ocean
2 = mainland and marine islands

Table 2-2 (continued)
Sample TERREL Control File Inputs
(TERREL.INP)

```
Coastline data are accepted in the form of either the USGS Global
Self-consistent Hierarchical High-resolution Shoreline (GSHHS) Database
file, or a BLN file produced in a previous application for the modeling
domain (it must have correct grid limits and polygon headers).  The
processed coastline (BLN) file for the domain is automatically created
when the GSHHS database is input.  No BLN is created when an existing
BLN file is input.

  Process coastline data?
  (LCOAST)                 Default: F      ! LCOAST = F !
    T = Process coastline data
    F = Do not process coastline data

  Read pre-processed coastline data (existing BLN file)?
  (LBLNREAD)               Default: F      ! LBLNREAD = F !
    T = Use pre-processed coastline data
    F = Process raw coastline data

Noisy Data Replacement Options
------------------------------

--Filtering with minimum elevations by water/land type (2 values)
  (INOISEREP)              Default: 0,0
     0 = Do not check for noise
     1 = Set values lower than minimum to missing
     2 = Replace values lower than minimum with minimum value
     3 = Replace values lower than minimum with default value
         (set in TERDEF below)

  Minimum terrain elevations (m) for noise detection (2 values)
  (ZNOISE)                 Default: 0.,1.

                    |      |mainland |
                    |      |& marine |
                    |ocean |islands  |
                    ------ --------- -
       ! INOISEREP =   0,      0     !
       !    ZNOISE =   0.,     1.    !

Missing Data Replacement Options
--------------------------------

--Application of default elevations by water/land type (2 values)
  (ITERREP)                Default: 3,0
     0 = Do not replace voids
     1 = Replace voids on output only
     2 = Replace void point values on extraction and voids on output
     3 = Always replace all values for this water type with default
         (only valid for oceans and lakes)

  Default terrain elevations (m) (2 values)
  (TERDEF)                 Default: 0.,0.

                    |      |mainland |
                    |      |& marine |
                    |ocean |islands  |
                    ------ --------- -
         ! ITERREP =   3,      0     !
         !  TERDEF =   0.,     0.    !
```

```
   --Carry out interpolation to fill void cells?
     (LVOIDFILL)                Default: F      ! LVOIDFIL = F !
       T = Try interpolation to fill void cells
       F = Do not try interpolation to fill void cells

   --Search radius (km) around grid cells for interpolation to fill
     voids   (Should be several times larger than DGRIDKM)
     (Used only if LVOIDFIL=T)
     (CELLRADKM)                No Default       ! CELLRADKM = 5. !


   Terrain data may be prepared for one of several models, and the
   structure of the output data file varies accordingly.

     Structure of output TERREL.DAT file
     (IMODEL)                   Default: 1      ! IMODEL = 1 !
        1 = CALMET        (grid-cell-average elevations)
        2 = MESOPAC       (grid-cell-average elevations)
        3 = ISC POLAR     (grid-cell-peak elevations)
        4 = ISC CARTESIAN (grid-cell-peak elevations)
        5 = NUATMOS       (grid-cell-average elevations)
        6 = Generic       (grid-cell-average elevations)

   Warnings are posted to the list file if grid cells contain fewer
   data points than ITHRES(%) of the mean for all cells.  Such a
   warning may indicate that insufficient data coverage is provided by
   the terrain data files that are processed.

     Threshold (%) of the average number of data points in a cell
     (ITHRES)                   Default: 75     ! ITHRES = 75 !

Several data file types contain elevation data that are stored at a fixed
  interval of latitude and longitude in fractional degrees.  Prior to
  TERREL v3.69 the method employed to map the (latitude,longitude) locations
  to the output grid coordinates (x,y) transformed the coordinates at the
  4 corners of a data-sheet (e.g., a 1-degree square), and then interpolated
  the interior points between these.  The method introduced in TERREL v3.69
  transforms the location of each individual data point read from the file.
  Either method may be selected using MSHEET.  Datasets affected include:
     USGS90     USGS 1-deg DEM files (~90m)
     ARM3       ARM3 terrain data files(~900m)
     3CD        3CD (binary) 1-deg DEM files (~90m)
     CDED       Canadian DEM files (3 and 0.75 arcsec)
     SRTM1      1-sec Shuttle RADAR Topo Mission files (~30m)
     SRTM3      3-sec Shuttle RADAR Topo Mission files (~90m)
     GTOPO30    GTOPO30 30-sec data (~900m)

    (MSHEET)                   No Default      ! MSHEET = 0 !
       0 = Transform 4 corners of data sheet and interpolate
           --- Method used prior to TERREL v3.69
       1 = Transform each data point in sheet from (latitude,longitude) to (x,y)
           --- Preferred (more accurate) method
!END!

--------------------------------------------------------------------------------
INPUT GROUP: 2 -- Map Projection and Grid Information for Output
--------------

     Projection
     ----------

     Map projection for all X,Y (km)
     (PMAP)                     Default: UTM    ! PMAP = UTM !

         UTM :  Universal Transverse Mercator
         TTM :  Tangential Transverse Mercator
         LCC :  Lambert Conformal Conic
```

```
    PS  :  Polar Stereographic
    EM  :  Equatorial Mercator
    LAZA:  Lambert Azimuthal Equal Area

False Easting and Northing (km) at the projection origin
(Used only if PMAP= TTM, LCC, or LAZA)
(FEAST)                    Default=0.0     ! FEAST  = 0.0 !
(FNORTH)                   Default=0.0     ! FNORTH = 0.0 !

UTM zone (1 to 60)
(Used only if PMAP=UTM)
(IUTMZN)                   No Default      ! IUTMZN = 19 !

Hemisphere for UTM projection?
(Used only if PMAP=UTM)
(UTMHEM)                   Default: N      ! UTMHEM = N !
    N   :  Northern hemisphere projection
    S   :  Southern hemisphere projection

Latitude and Longitude (decimal degrees) of projection origin
(Used only if PMAP= TTM, LCC, PS, EM, or LAZA)
(RLAT0)                    No Default      * RLAT0 =   *

(RLON0)                    No Default      * RLON0 =   *

    TTM :  RLON0 identifies central (true N/S) meridian of projection
           RLAT0 selected for convenience
    LCC :  RLON0 identifies central (true N/S) meridian of projection

           RLAT0 selected for convenience
    PS  :  RLON0 identifies central (grid N/S) meridian of projection
           RLAT0 selected for convenience
    EM  :  RLON0 identifies central meridian of projection
```

Table 2-2 (continued)
Sample TERREL Control File Inputs
(TERREL.INP)

```
RLAT0 is REPLACED by 0.0N (Equator)
         LAZA:  RLON0 identifies longitude of tangent-point of mapping plane
                RLAT0 identifies latitude of tangent-point of mapping plane



     Matching parallel(s) of latitude (decimal degrees) for projection
     (Used only if PMAP= LCC or PS)
     (RLAT1)                    No Default      * RLAT1 =  *
     (RLAT2)                    No Default      * RLAT2 =  *

         LCC :  Projection cone slices through Earth's surface at RLAT1 and RLAT2
         PS  :  Projection plane slices through Earth at RLAT1
                (RLAT2 is not used)

     ----------
     Note:  Latitudes and longitudes should be positive, and include a
            letter N,S,E, or W indicating north or south latitude, and
            east or west longitude.  For example,
35.9  N Latitude  =  35.9N
            118.7 E Longitude = 118.7E

Datum-Region
     ------------

     The Datum-Region for the output coordinates is identified by a character
     string.  Many mapping products currently available use the model of the
     Earth known as the World Geodetic System 1984 (WGS-84).  Other local
     models may be in use, and their selection in TERREL will make its output
     consistent with local mapping products.  The list of Datum-Regions with
     official transformation parameters is provided by the National Imagery
     and Mapping Agency (NIMA).

     Datum-region for output coordinates
     (DATUM)                    Default: WGS-84    ! DATUM = NAS-C  !


     Grid
     ----

     Grid type
     (IGRID)                    Default: 1      ! IGRID = 1 !
        1 = Cartesian, with reference point at Lower Left CORNER
            of cell (1,1)    --- CALMET Convention ---
        2 = Cartesian, with reference point at CENTER of cell (1,1)
        3 = Polar, with reference point at center of rings
     ----------
     Note: cell (1,1) is at the SW corner of the grid

     Reference point coordinates X,Y (km) for grid
     where X is Easting, Y is Northing
     (XREFKM)                   No Default      ! XREFKM = 310.0  !
     (YREFKM)                   No Default      ! YREFKM = 4820.0 !

     Cartesian grid definition
     (Used only if IGRID=1,2)
     No. X grid cells (NX)      No default      ! NX =   99  !
     No. Y grid cells (NY)      No default      ! NY =   99  !
     Grid Spacing (km)(DGRIDKM) No default      ! DGRIDKM = 1. !

     Polar grid definition -- enter ring distances and ray angles
```

```
                              in Input Group 3
     (Used only if IGRID=3)
     No. of rings (NRING)       No default      ! NRING =   0  !
     No. of radials (NRAYS)     No default      ! NRAYS =   0  !

     Elevation processing method for polar grid
     (Used only if IGRID=3)
     (IPROC)                    Default: 2      ! IPROC = 2 !
        1 = NORMAL: terrain data for point at the intersection of ring
                    and ray is extracted from the region bounded by
                    rings and radials halfway to the adjacent rings and
                    radials
        2 = SCREEN: terrain data for point at the intersection of ring
                    and ray is extracted from the region bounded by the
                    current ring and the next larger ring, and radials
                    halfway to the adjacent radials
!END!
```

Table 2-2 (concluded)
Sample TERREL Control File Inputs
(TERREL.INP)

```
--------------------------------------------------------------------------------

INPUT GROUP: 3 -- Polar Grid Ring Distances (km) and Ray Angles (deg)
--------------

     Enter NRING lines identifying the radius (DISKM) of each ring in
     the polar grid, using a group terminator on each line.
     (Enter only if IGRID=3)
     * DISKM =  1.5  *   *END*
     * DISKM =  3.0  *   *END*


     Enter NRAYS lines identifying the angle (ANGDEG) from North of
     each radial in the polar grid, using a group terminator on each line.
     (Enter only if IGRID=3)
     * ANGDEG =   0.  *   *END*
     * ANGDEG =  45.  *   *END*
     * ANGDEG =  90.  *   *END*

--------------------------------------------------------------------------------
NIMA Datum-Regions  (Documentation Section)
--------------------------------------------------------------------------------
     WGS-84    WGS-84 Reference Ellipsoid and Geoid, Global coverage (WGS84)
     NAS-C     NORTH AMERICAN 1927 Clarke 1866 Spheroid, MEAN FOR CONUS (NAD27)
     NAR-C     NORTH AMERICAN 1983 GRS 80 Spheroid, MEAN FOR CONUS (NAD83)
     NWS-84    NWS 6370KM Radius, Sphere
     ESR-S     ESRI REFERENCE 6371KM Radius, Sphere
```

Table 2-3: TERREL Control File Inputs

Input Group	Variable	Type	Description
(0a)	NTDF	integer	Number of data files to process
	OUTFIL	character*70	Output file name of terrain elevations (ASCII) for input to MAKEGEO
	LSTFIL	character*70	List file name.
	PLTFIL	character*70	Plot file (.GRD format) name.
	RAWECHO	character*70	Raw elevation dataecho file name.
	PREVFIL	character*70	Previous run binary output file (.SAV). Used only if it is a continuation run.
	SAVEFIL	character*70	Output binary save file name.
	XYINP	character*70	Input file containing discrete location coordinates (x,y) in km, (and if NXYFIELD=4, ground elevation placeholder and flagpole height (m))
	XYOUT	character*70	Output file containing (x,y, elevation, flagpole height, with elevation filled in by TERREL).
	GSHHSIN	character*70	Input USGS Global Self-consistent Hierarchical High-resolution Shoreline Database (GSHHS) (See Attachment 2-I)
	COASTBLN	character*70	Processed coastline polygons for the current TERREL grid (BLN format): output when a GSHHS file is used, or may be input in place of a GSHHS file if available.
	LRAWECHO	logical	Echo raw data? (T or F)
	LCFILES	logical	Conversion to upper (F) or lower (T) case

(0b)	USGS90 USGS30 ARM3 3CD DMDF CDED SRTM1 SRTM3 GTOPO30 USGSLA NZGEN GEN GEOTIFF	character*70	Assignment of input data file names of type USGS90, ARM3,… (as many lines as the number of files of each type – the total number must be NTDF)

Table 2-3 (continued)
TERREL Control File Inputs

Input Group	Variable	Type	Description
(0c)	DUSGS90 DUSGS30 DARM3 D3CD DDMDF DCDED DSRTM1 DSRTM3 DGTOPO30 DUSGSLA DNZGEN DGEN DGEOTIFF	character*8	Assignment of DATUM Code for each type of input data file listed in sub-group 0b. Note that the USGS GSHHS database file (See Attachment 2-I) contains information from two distinct databases, each with its own datum. These are the World Vector Shoreline (WVS) for "salt water" coasts, and the World Data Base II (WDBII) for fresh water coasts.
	DWVS	logical	Datum-region for input GSHHS Coastal Data File coordinates
(1)	LPREV	logical	Continuation run flag (F=no, T=yes).
	LXY	logical	Process discrete (x,y) locations (F=no, T=yes)
	LINTXY	logical	Interpolate elevation at discrete (x,y) locations (F= no – take nearest maximum terrain elevation, T= yes)
	NXYCOL	integer	No. columns in receptor file
	XYRADKM	real	Search radius (km) around (x,y) for determining maximum terrain elevation, or for selecting elevations for interpolation
	LCOAST	logical	Process coastline data? (T=yes, F=no)
	LBLNREAD	logical	Read pre-processed coastline data (existing BLN file)? (T=yes, F=no)

INOISEREP	integer	Filtering with minimum elevations by water/land type (5 values) 0 = Do not check for noise 1 = Set values lower than minimum to missing 2 = Replace values lower than minimum with minimum value 3 = Replace values lower than minimum with default value (set in TERDEF)
ZNOISE	real	Minimum terrain elevations (m) for noise detection (5 values)

Table 2-3 (continued)
TERREL Control File Inputs

Input Group	Variable	Type	Description
	ITERREP	integer	Application of default elevations by water/land type (5 values) 0 = Do not replace voids 1 = Replace voids on output only 2 = Replace void point values on extraction and voids on output 3 = Always replace all values for this water type with default (only valid for oceans and lakes)
	TERDEF	integer	Default elevation (m) for cells or discrete points that cannot be assigned valid data (5 values)
	LVOIDFIL	logical	Carry out interpolation to fill void cells? (T=yes, F=no)
	CELLRADKM	real	Search radius (km) around grid cells for interpolation to fill voids (Should be several times larger than DGRIDKM) (Used only if LVOIDFIL=T)
	IMODEL	integer (1,..,6)	Meteorological or dispersion model using terrain data; options are: (1) CALMET, (2) MESOPAC, (3) ISC3 polar grid receptor terrain format, (4) ISC3 discrete receptor format; (5) NUATMOS, or (6) GENERIC.
	ITHRES	integer	Threshold flag in % of the average number of data 'hits' per cell used for QA reporting.
	MSHEET	integer	Choice of mapping terrain elevations. Transform 4 corners of data sheet and interpolate, or, transform each data point in the sheet from lat, lon to x,y. Preferred method MSHEET = 1. Data sets affected; USGS90, ARM3, 3CD, CDED, SRTM1, SRTM3, GTOPO30.

(2)	PMAP *	character*8	Map projection for grid: UTM : Universal Transverse Mercator TTM : Tangential Transverse Mercator LCC : Lambert Conformal Conic PS : Polar Stereographic EM : Equatorial Mercator LAZA: Lambert Azimuthal Equal Area
	FEAST	real	False Easting (km) for PMAP = TTM, LCC, or LAZA

Table 2-3 (concluded)
TERREL Control File Inputs

Input Group	Variable	Type	Description
	FNORTH	real	False Northing (km) for PMAP = TTM, LCC, or LAZA
	IUTMZN	integer	UTM zone for PMAP = UTM
	UTMHEM	character*1	Use (N) northern or (S) southern hemisphere for UTM projection
	RLAT0, RLON0	character*16	Reference latitude and longitude (degrees) for PMAP = TTM, LCC, PS, EM, or LAZA. Enter numeric degrees and either N or S for latitude, or E or W for longitude.
	RLAT1, RLAT2	character*16	Two standard parallels of latitude for PMAP= LCC or PS. Enter numeric degrees and either N or S.
	DATUM	character*8	Datum Code for output grid
	IGRID	Integer	Grid definitions are: (1) Cartesian-corner, (2) Cartesian-Center, (3) Polar. For CALMET, IGRID should be set to (1).
	XREFKM, YREFKM	Real	Reference X and Y coordinates origin (km) of the output grid.
	NX, NY	integer	Number of grid cells in X and Y directions (if IGRID=1 or 2).
	DGRIDKM	Real	Horizontal grid spacing (km).
	NRING, NRAYS	integer	Number of rings and radials (if IGRID=3).
	IPROC	integer	Terrain extraction approach for polar grid only: (1) NORMAL=Terrain data extracted from the region extending halfway to previous ring and halfway to next ring. (2) SCREEN=Terrain data extracted from the region extending from the current ring out to the next ring distance.

(3)	DISKM	Real (nring lines)	Distance of concentric rings for polar grid (km). Read only if IGRID=3.
	ANGDEG	real (nray lines)	Polar grid radials (degrees). Read only if IGRID=3.

2.2 Land Use Data Preprocessors (CTGCOMP and CTGPROC)

This section explains how to obtain and process Land Use data. CTGPROC, the Land Use pre-processor currently supports 5 different formats of Land Use data. The USGS Land Use and Land Cover data in Composite Theme Grid (CTG) format, the USGS Global Data Format, two generic formats and, the US National Land Cover Dataset 1992 (NLCD92).

Composite Theme Grid (CTG) Land Use and Land Cover (LULC) data. CTG files are sequential ASCII files which consist of five header records and then one grid cell per logical record. The land use code is defined at the center point of each cell which are usually spaced 200 meters apart in both east-west and north-south directions. The points are oriented to the UTM projection. Because these files were historically seen to be quite large (~ 38 MB for one quadrant), the first step in processing these land use data was to compress the data file (CTGCOMP) and then to work (CTGPROC) with the much smaller compressed file (~ 0.5 MB). However, this step is often ignored now since computers are easily able to handle many large file sizes at a time.

USGS Global Data Format. USGS Global Land Use. The US Geological Survey (USGS), the University of Nebraska-Lincoln, and the European Commission's Joint Research Centre have generated a 1-km resolution Global Land Cover Characteristics database. Data base is available in Lambert Azimuthal Equal Area, has a 1-km nominal spatial resolution, and are based on 1-km Advanced Very High Resolution Radiometer (AVHRR) data spanning April 1992 through March 1993.

Generic formats. CTGPROC is able to process two different formats of Generic Data. The first Generic data format, reads the data in the form of, Land Use category, latitude and longitude in a comma delimited format. Numeric values of Land Use are not random and specific values need to be provided whereafter an internal translation table converts the input data codes to the USGS codes used by the model. The second type of generic data format allows random Land Use input data and allows the user to map each Land Use category to specific surface parameters, that do not have to use the USGS defaults in the model.

National Land Cover Dataset 1992 (NLCD 1992). This dataset was derived from the early to mid-1990s Landsat Thematic Mapper satellite data, the NLCD is a 21-class land cover classification scheme applied consistently over the United States. The spatial resolution is 30 meters and mapped in the Albers Conic Equal Area projection, NAD-83.

2.2.1 Obtaining the Data

2.2.1.1 USGS Global Land Use Data

Follow the links on www.src.com for the Global Land Cover Database Land Use and Land Cover Data are available from the USGS at the 1:250,000-scale with file names corresponding to the 1:250,000-scale map names. In some regions, land use data are also available at the 1:100,000-scale. Land use and land cover types are divided into 37 categories. A description of the USGS LULC data is provided in Attachment 2-B.

The user must first identify the names of the quadrants encompassed by the domain. These names are listed in a USGS map index as well as on the WWW home page of the USGS. A copy of the USGS webpage is provided in Attachment 2-C. Select the "250K FTP via Graphics" in the LULC section to view a map of the US and the names of the quadrants.

2.2.1.2 Composite Theme Grid (CTG)

Follow the links on www.src.com for the USGS CTG Land Use/Land Cover (LULC) data. The LULC data consists of historical land use and land cover classification data that was based primarily on the manual interpretation of 1970's and 1980's aerial photography. Secondary sources included land use maps and surveys. A copy of the webpage is shown in Attachment 2-E and a copy of the readme file for the 1:250,000 maps is shown in Attachment 2-F. Note that the CTG files (named 'grid_cell') do not contain record delimiters; the latter must be added as described in Attachment 2-E for the GIRAS files.

CTG LULC data are available by anonymous ftp from: edcftp.cr.usgs.gov, or can be downloaded from the WWW site: http://edcftp.cr.usgs.gov/pub/data/LULC. FTP File Access information is presented in Attachment 2-E.

2.2.1.3 Generic Data set

CTGPROC supports two types of generic data formats where the Land Use data does not conform to eitherNLCD, USGS CTG or global Land Use cover. The formats of these files are described in more depth in Section 2.2.4. The first data set is of the form; row number, Land Use category, latitude (negative for Southern Hemisphere) and, longitude (negative for Western Hemisphere). This data set uses non-random Land Use categories which are mapped to the USGS categories. The second data set is of the form; Land Use category, longitude (negative for Western Hemisphere) and, latitude (positive for Northern Hemisphere). This data set uses random Land Use categories and the user can map the random Land Use values to the appropriate default or user defined surface parameters independently of the model's default USGS categories.

2.2.1.4 National Land Cover Dataset (NLCD)

Follow the links on www.src.com for the 1992 National Land Cover Dataset (NLCD). Then click on the link "Click here to link to the NLCD 92 data by state" which takes you to (http://edcftp.cr.usgs.gov/pub/data/landcover/states/) . The data are distributed on a state by state basis. The NLCD data have been compressed using gzip utility and are stored as generic binary 'flat files'.

These files are directly compatible with the CALPro GUI. A description of the NLCD data set is easily accessed from http://landcover.usgs.gov/natllandcover.php.

2.2.2 CTGCOMP - the CTG land use data compression program

CTG LULC data files retrieved from the ftp/web sites are ASCII files which are quite large, and it is useful to compress the data. CTGCOMP reads an uncompressed CTG file and produces a compressed CTG file. Both files are in ASCII format. Table 2-4 gives details of this file format.

CTGCOMP requires an input file called "CTGCOMP.INP" in which the user specifies the uncompressed CTG land use data file name and the compressed output file name. A list file (CTGCOMP.LST) is created which echoes the header records of the land use data file and provides summary information about the run. CTGCOMP must be run for each CTG data file. CTGCOMP.INP may be created/edited directly using a conventional editor, or it may be created/edited indirectly by means of the PC-based, Windows-compatible Graphical User Interface (GUI) developed for the geophysical preprocessors (CALPRO).

2.2.3 CTGPROC - the land use preprocessor

CTGPROC currently supports five different formats of Land Use data. The USGS Land Use and Land Cover data in Composite Theme Grid (CTG) format, the USGS Global Data Format, two generic formats and, the National Land Cover Dataset 1992 (NLCD92).

CTGPROC is able to process multiple files in one run and from more than one data set in a single run. However, there is also the option to perform multiple applications of CTGPROC, a typical example may be insufficient hard drive space to store all large ASCII Land Use files. When this option is invoked all runs must be written in a continuation format, except for the final run which must be written in the fractional Land Use format that MAKEGEO expects as input.

CALMET grid cells are often large enough to include more than one land use data point: CTGPROC keeps track of the number of process 'hits' of each land use category for each grid cell and in the final run of an iteration compiles final fractional land use categories for each grid cell. A hit is a Land Use datapoint from one of the Land Use datasets that falls within a grid cell defined by CTGPROC. If the number of hits for a given grid cell is less than a user-specified threshold of the domain average number of hits, the program flags possibly missing data in a list file (or possibly incorrectly specified domain parameters).

Input: The user can access the user input control file of CTGPROC through the ‘Geophysical Data’ on the front screen of the CALPro GUI. The control file can either be created from within the GUI or independently using an editor. The user control input file, CTGPROC.INP (whose grid definition parameters must be compatible with those used in TERREL), and one or more of a compressed CTG data file, global data file, NLCD data file or generic format file must be read. The format of the CTGPROC control input file follows the same rules as those used in the CALMET.INP file (refer to the CALMET section for details). Only data within the delimiter characters (!) are processed. The input data consist of a leading delimiter followed by the variable name, equals sign, input value or values, and a terminating delimiter (e.g., !XX = 12.5!). If the user wants to first compress the CTG Land Use data files (seldom used), the compressing utility, CTGCOMP.INP may be created/edited directly using a conventional editor, or it may be created/edited indirectly by means of the CALPro GUI. The PC-based, Windows-compatible Graphical User Interface (GUI) developed for the geophysical preprocessors. An example of the input file and a description of the input variables are shown in Tables 2-5 and 2-6, respectively.

Output: a list file (CTGPROC.LST), and a gridded land use data file. A sample list file is shown in Table 2-7.

2.2.4 Generic Land Use Data set – (non random Land Use categories mapped to USGS defaults)

A generic data set of the form; row number, Land Use category, latitude (negative for Southern Hemisphere), longitude (negative for Western Hemisphere), can be created by the user if own Land Use data is used, regardless of Land Use resolution. The program CTGPROC converts the latitude and longitude information into grid kilometers and converts the Land Use categories detailed in Table 2-9 into the equivalent USGS directly suitable for CALMET. A sample Generic Land Use data file is included in Table 2-10 and the internal translation table that maps the non-random LU categories to the model default USGS categories is shown in Table 2-11.

2.2.5 Generic Land Use Data set – (random Land Use categories not mapped to USGS defaults)

A generic data set of the form; Land Use category, longitude (negative for Western Hemisphere), latitude (negative for Southern Hemisphere), can be created by the user if own Land Use data is used, regardless of Land Use resolution. The program CTGPROC converts the latitude and longitude information into grid kilometers and reads random Land Use categories to compute the fractional Land Use per cell. A sample Generic Land Use data file is included in Table 2-13and file inputs described in Table 2-12.

The user is required to map the unique random Land Use categories to surface parameters, albedo, roughness length, Bowen ratio, leaf area index and anthropogenic heat flux in MAKEGEO.

Table 2-4: Sample CTGCOMP Control File Inputs(CTGCOMP.INP)

```
-------------------------------------------------------------------------------

                 CTGCOMP PROCESSOR CONTROL FILE
                 ------------------------------

     USGS Composite Theme Grid (CTG) format Land Use and Land Cover
     (LULC) data files must be compressed prior to use in the CTGPROC
     utility processor.  Use CTGCOMP to compress the data file.

-------------------------------------------------------------------------------

INPUT GROUP: 0 -- Input and Output File Names
--------------

Default Name  Type          File Name
------------  ----          ---------
CTG.DAT        input   ! CTGFIL  =ctgin.dat  !
CTGCOMP.DAT   output   ! COMPFIL =ctgout.dat  !
CTGCOMP.LST   output   ! COMPLST =ctgcomp.lst  !

--------------------------------------------------------------------------------
All file names will be converted to lower case if LCFILES = T
Otherwise, if LCFILES = F, file names will be converted to UPPER CASE

             T = lower case                    ! LCFILES = F !
             F = UPPER CASE

NOTE: file/path names can be up to 70 characters in length

!END!
```

Input Group	**Variable**	**Type**	**Description**
(0)	CTGFIL	character*70	Name of uncompressed CTG land use data file (input)
	COMPFIL	character*70	Name of compressed CTG land use data file (output)
	COMPLST	character*70	Name of list file (output)

Table 2-5: Sample CTGPROC Control File Inputs(CTGPROC.INP)

```
-------------------------------------------------------------------------------
                 CTGPROC PROCESSOR CONTROL FILE
                 ------------------------------

  CTGPROC reads a Land Use and Land Cover (LULC) data file and determines
  fractional land use for each grid cell in a user-specified gridded
  domain.  If the domain requires multiple files, CTGPROC is applied
  iteratively (continuation option) to build the land use grid
  incrementally.  The LULC file must be either a compressed USGS
  Composite Theme Grid (CTG) format (available for the U.S.), a
  USGS Global format, or the New Zealand Generic format.

-------------------------------------------------------------------------------
INPUT GROUP: 0 -- Input and Output Files
--------------

-------------
Subgroup (0a)
-------------

     Number of Land Use Data Files provided in Subgroup 0b

     (NDBF)                    Default: 0      ! NDBF = 2 !


     Other Input and Output files:
     -----------------------------

     Default Name  Type          File Name
     ------------  ----          ---------
     PREV.DAT      input    * PREVDAT =             *
     LU.DAT        output   ! LUDAT   =lulc1kmo.dat  !
     CTGPROC.LST   output   ! RUNLST  =ctgproco.lst  !
    -------------------------------------------------------
    (Coastline Data)
       USGS Global Self-consistent Hierarchical High-resolution
       Shoreline Database (GSHHS)
    GSHHS_F.B      input    ! GSHHSIN  = GSHHS_F.B   !
       Processed coastline polygons for
       CTGPROC grid (BLN)
    COAST.BLN      input or ! COASTBLN = coast.bln   !
                   output
    -------------------------------------------------------

     All file names will be converted to lower case if LCFILES = T
     Otherwise, if LCFILES = F, file names will be converted to UPPER CASE
     (LCFILES)                 Default: T      ! LCFILES = F !
        T = lower case
        F = UPPER CASE

     NOTE: File/path names can be up to 70 characters in length;
           PREV.DAT is used only if LPREV=T (Input Group 1)

!END!

-------------
Subgroup (0b)
-------------

     The following NDBF Land Use Data Files are processed.
     Enter NDBF lines identifying the file name for each,
```

```
     followed by a group terminator.  The type of data base
     for each file is designated by the assignment name:

(CTG)     designates USGS CTG (compressed)
    (GEN)     designates Generic (no USGS translation is done)
    (NZGEN)   designates New Zealand Generic
    (GLAZNA)  designates USGS Global (Lambert Azimuthal) for North America
    (GLAZSA)  designates USGS Global (Lambert Azimuthal) for South America
    (GLAZEU)  designates USGS Global (Lambert Azimuthal) for Eurasia - Europe
    (GLAZAS)  designates USGS Global (Lambert Azimuthal) for Eurasia - Asia
    (GLAZAF)  designates USGS Global (Lambert Azimuthal) for Africa
    (GLAZAP)  designates USGS Global (Lambert Azimuthal) for Australia-Pacific
    (USGSLA)  designates USGS Lambert Azimuthal data (~1000m)
```

Table 2-5 (continued)
Sample CTGPROC Control File Inputs
(CTGPROC.INP)

```
 (NLCD92)  designates USGS NLCD 1992
    (NLCDTF)  designates National Land Cover Dataset 1992 GeoTIFF
    (NLCD01)  designates National Land Cover Dataset 2001 GeoTIFF
    (GLC2K)   designates Global Land Cover 2000 GeoTIFF
    (UMDGLC)  designates Univ. of Maryland Global Land Cover GeoTIFF
    (MODIS)   designates Boston Univ. Modis Global Land Cover

    ! CTG  = c:\calpuff\demo\ctgproc\lewiston.cmp   !  !END!
    ! CTG  = c:\calpuff\demo\ctgproc\portland.cmp   !  !END!

--------------------------------------------------------------------------------

INPUT GROUP: 1 -- Run control parameters
--------------

     When multiple applications of CTGPROC are needed, the gridded land
     use data file (LU.DAT) must be written in a continuation format rather
     than in the fractional land use format expected by MAKEGEO.  This
     applies to all applications except the FINAL application, which must
     be in the fractional land use format.  Futhermore, if the application
     is not the first one in a series, then a PREVIOUS LU.DAT file must
     be identified.

     Is this the final run?
     (LFINAL)                  Default: T      ! LFINAL = T !
        T = LU.DAT file written in fractional land use format
        F = LU.DAT file written in continuation format

     Is a previous LU.DAT output file used to start this run?
     (LPREV)                   Default: F      ! LPREV = F !
        T = PREV.DAT file is used
        F = PREV.DAT file is NOT used

     Control for distributing input land use within its cell to improve
     the sampling density.  A mesh density greater than one is used to
     split each input cell into a finer grid of cells.  A density of 2
     creates 2 cells per side; 3 creates 3 cells per side.  The input
     land use is assigned to the center of each of the new cells.
     Specify a mesh density for CTG and USGS GLAZ file types:
     (MESHCTG)                 Default=1       ! MESHCTG  = 1 !
     (MESHGLAZ)                Default=1       ! MESHGLAZ = 1 !

     The coordinates of the center of each input landuse "cell", both
     before and after applying the mesh density factor, can be written
     to QA plot files named QACTG.DAT, QAGLAZ.DAT, and QAMESH.DAT.
     These files can become very large for large domains.
     Create QA plot files of land use data points?
     (LQACELL)                 Default: F      ! LQACELL = F !
        T = QA files are created
        F = QA files are not created

Daily Snow Data Processing
      ---------------------------
      Snow grids of USA SNODAS daily snow data can be resolved for
      CALMET and LU grids, so that daily snow information can be used
      in MAKEGEO to create daily variable geo.dat.

          Process snow grids?
```

```
     (LSNOW)                  Default: F     ! LSNOW = F  !
     T = Process SNODAS snow data
     F = Do not process SNODAS snow data

Marine Coastline Processing
---------------------------
Land use data may be augmented with coastline information.  Coastline
data are used to determine whether a particular point lies offshore,
so that it may be given a marine (ocean) land use code.

Process coastline data?
(LCOAST)                  Default: F      ! LCOAST = F !
  T = Process coastline data
  F = Do not process coastline data

Coastline processing method for points offshore may SWAP a land use
type as it is read from an input data file with the type for ocean,
```

Table 2-5 (continued)
Sample CTGPROC Control File Inputs
(CTGPROC.INP)

```
and it may FILL empty marine cells at the end of a run with the
type for ocean.

(LMARSWAP)                Default: F      ! LMARSWAP = T !
(Used only if LCOAST=T)
  T = Replace land use type read from data file with type IOCEAN
  F = Use land use type read from data file

(LMARFILL)                Default: T      ! LMARFILL = T !
(Used only if LCOAST=T and LFINAL=T)
  T = Fill empty marine grid cells with land use type IOCEAN
  F = Maintain empty grid cells

Marine land use type:
(Used only if LCOAST=T)
(IOCEAN)                  Default: 55     ! IOCEAN = 55 !

Read pre-processed coastline data (existing BLN file)?
(Used only if LCOAST=T)
(LBLNREAD)                Default: F      ! LBLNREAD = F !
  T = Use pre-processed BLN coastline data
  F = Process GSHHS coastline data and create BLN

   Input(Datum - Region)
     ------------------
     The Datum-Region for coordinates in the input LULC Data File may be
     identified in the header records of the file.  Check the file documentation
     and change these defaults as needed.  The list of Datum-Regions with
     official transformation parameters is provided by the National Imagery and
     and Mapping Agency (NIMA).

     Datum-region for input LULC Data File coordinates

     (DCTG)                    Default: NAS-C     ! DCTG     = NAS-C  !
     for LULC = 1: USGS CTG (compressed)

     (DUSGSLA)                 Default: ESR-S     ! DUSGSLA  = ESR-S  !
     for LULC = 2: USGS Global (Lambert Azimuthal)

     (DNZGEN)                  Default: WGS-84    ! DNZGEN   = WGS-84 !
     for LULC = 3: New Zealand Generic
```

```
        (DNLCD)                    Default: NAR-C     ! DNLCD    = NAR-C  !
        for LULC = 4,5, or 6: National Land Cover Dataset

        (DGLC2K)                   Default: WGS-84    ! DGLC2K   = WGS-84 !
        for LULC = 8: Global Land Cover 2000

        (DUMDGLC)                  Default: WGS-84    ! DUMDGLC  = WGS-84 !
        for LULC = 9: Global Land Cover 2000

        (DMODIS)                   Default: ESR-R     ! DMODIS   = ESR-R  !
        for LULC = 10: Global Land Cover 2001

        Note: the input Datum-Region for LULC = 11, the GENERIC format, has
              no default, and is provided in the header of the file

        QA threshold (% of average number of data points/grid cell)
        for reporting cells with poor data coverage
        (ITHRESH)                  Default: 75     ! ITHRESH = 75 !

        !END!
--------------------------------------------------------------------------------

INPUT GROUP: 2 -- Map Projection and Grid Information for Output
--------------

     Projection
     ----------

     Map projection for all X,Y (km)
     (PMAP)                     Default: UTM    ! PMAP = UTM !

         UTM :  Universal Transverse Mercator
         TTM :  Tangential Transverse Mercator
```

Table 2-5 (continued)
Sample CTGPROC Control File Inputs
(CTGPROC.INP)

```
         LCC :  Lambert Conformal Conic
         PS  :  Polar Stereographic
         EM  :  Equatorial Mercator
         LAZA:  Lambert Azimuthal Equal Area

     False Easting and Northing (km) at the projection origin
     (Used only if PMAP= TTM, LCC, or LAZA)
     (FEAST)                    Default=0.0     ! FEAST  = 0.0 !
     (FNORTH)                   Default=0.0     ! FNORTH = 0.0 !

     UTM zone (1 to 60)
     (Used only if PMAP=UTM)
     (IUTMZN)                   No Default      ! IUTMZN = 19 !

     Hemisphere for UTM projection?
     (Used only if PMAP=UTM)
     (UTMHEM)                   Default: N      ! UTMHEM = N !
         N   :  Northern hemisphere projection
         S   :  Southern hemisphere projection

     Latitude and Longitude (decimal degrees) of projection origin
     (Used only if PMAP= TTM, LCC, PS, EM, or LAZA)
     (RLAT0)                    No Default      ! RLAT0 = 40.0N !
     (RLON0)                    No Default      ! RLON0 = 70.0W !

         TTM :  RLON0 identifies central (true N/S) meridian of projection
```

```
           RLAT0 selected for convenience
    LCC :  RLON0 identifies central (true N/S) meridian of projection
           RLAT0 selected for convenience
    PS  :  RLON0 identifies central (grid N/S) meridian of projection
           RLAT0 selected for convenience
    EM  :  RLON0 identifies central meridian of projection
           RLAT0 is REPLACED by 0.0N (Equator)
    LAZA:  RLON0 identifies longitude of tangent-point of mapping plane
           RLAT0 identifies latitude of tangent-point of mapping plane

Matching parallel(s) of latitude (decimal degrees) for projection
(Used only if PMAP= LCC or PS)
(RLAT1)                    No Default      ! RLAT1 = 30.0N !
(RLAT2)                    No Default      ! RLAT2 = 60.0N !

    LCC :  Projection cone slices through Earth's surface at RLAT1 and RLAT2
    PS  :  Projection plane slices through Earth at RLAT1
           (RLAT2 is not used)

----------
Note:  Latitudes and longitudes should be positive, and include a
       letter N,S,E, or W indicating north or south latitude, and
       east or west longitude.  For example,
       35.9  N Latitude  =  35.9N
       118.7 E Longitude = 118.7E


Output Datum-Region
-------------------

The Datum-Region for the output coordinates is identified by a character
string.  Many mapping products currently available use the model of the
Earth known as the World Geodetic System 1984 (WGS-84).  Other local
models may be in use, and their selection in TERREL will make its output
consistent with local mapping products.  The list of Datum-Regions with
official transformation parameters is provided by the National Imagery
and Mapping Agency (NIMA).

Datum-region for output coordinates
(DATUM)                    Default: WGS-84    ! DATUM = NAS-C !


Grid
----

Reference coordinates X,Y (km) assigned to the southwest corner
of grid cell (1,1)  (lower left corner of grid)
(XREFKM)                   No Default      ! XREFKM = 310.0  !
(YREFKM)                   No Default      ! YREFKM = 4820.0 !
```

Table 2-5 (continued)

Sample CTGPROC Control File Inputs

(CTGPROC.INP)

```
Cartesian grid definition
No. X grid cells (NX)      No default      ! NX =   99  !
No. Y grid cells (NY)      No default      ! NY =   99  !
Grid Spacing (DGRIDKM)     No default      ! DGRIDKM = 1. !
in kilometers

!END!

-------------------------------------------------------------------------------
NIMA Datum-Regions  (Documentation Section)
```

```
-------------------------------------------------------------------------------
     WGS-84    WGS-84 Reference Ellipsoid and Geoid, Global coverage (WGS84)
     NAS-C     NORTH AMERICAN 1927 Clarke 1866 Spheroid, MEAN FOR CONUS (NAD27)
     NAR-C     NORTH AMERICAN 1983 GRS 80 Spheroid, MEAN FOR CONUS (NAD83)
     NWS-84    NWS 6370KM Radius, Sphere
     ESR-S     ESRI REFERENCE 6371KM Radius, Sphere
```

Table 2-6: Control File Inputs (CTGPROC.INP)

Input Group	Variable	Type	Description
(0a)	NDBF	integer	Number of data files to process
	PREVDAT	character*70	Previous CTGPROC output data file used as input if the run is a continuation run, (used only if it is a continuation run)
	LUDAT	character*70	Name of the gridded LU output file
	RUNLST	character*70	Name of the output list file
	GSHHSIN	character*70	Input USGS Global Self-consistent Hierarchical High-resolution Shoreline Database (GSHHS)
	COASTBLN	character*70	Processed coastline polygons for the current TERREL grid (BLN format): output when a GSHHS file is used, or may be input in place of a GSHHS file (See Attachment 2-I) if available.
	LCFILES	logical	Filename converted to lower case (T) or upper case (F)
(0b)	CTG GEN NZGEN GLAZNA GLAZSA GLAZEU GLAZAS GLAZAF GLAZAP USGSLA NLCD92 NLCDTF NLCD01 GLC2K UMDGLC MODIS	character*70	Assignment of input data file names of type CTG, NZGEN, … (as many lines as the number of files of each type – the total number must be NDBF)

Table 2-6 (continued)
Control File Inputs (CTGPROC.INP)

Input Group	Variable	Type	Description
(1)	LFINAL	logical	Final run flag (F=not a final run, T=yes, a final run)
	LPREV	logical	Use a previous LUDAT file? (F=no, T=yes)
	MESHCTG	Integer	Control for distributing land use (CTG) within a cell to improve sampling density
	MESHGLAZ	Integer	Control for distributing land use (USGS GLAZ) within a cell to improve sampling density
	LQACELL	Logical	Create QA Plot files of Land Use data points
	LSNOW	Logical	Process SNODAS snow data (T=yes, F=no)
	LCOAST	logical	Process coastline data? (T=yes, F=no)
	LMARSWAP	Logical	Replace land use type read from data file with type IOCEAN
	LMARFILL	Logical	Fill empty marine cells with Land Use type IOCEAN
	IOCEAN	Integer	Marine land use type
	LBLNREAD	logical	Read pre-processed coastline data (existing BLN file)? (T=yes, F=no)
	DCTG	character*8	DATUM Code for USGS CTG
	DUSGSLA	character*8	DATUM Code for USGS Global Lambert Azimuthal files (GLAZNA, GLAZSA, GLAZEU, GLAZAS, GLAZAF, GLAZAP)
	DNZGEN	character*8	DATUM Code for New Zealand Generic
	DNLCD	character*8	DATUM Code for USGS NLCD 1992
	DGLC2K	character*8	DATUM Code for Global Land Cover 2000
	DUMDGLC	character*8	DATUM Code for Global Land Cover 2000
	DMODIS	character*8	DATUM Code for Global Land Cover 2001

ITHRESH	Integer	Threshold flag in % of the average number of data 'hits' per cells

Table 2-6 (concluded)
Control File Inputs (CTGPROC.INP)

Input Group	Variable	Type	Description
(2)	PMAP *	character*8	Map projection for grid: UTM : Universal Transverse Mercator TTM : Tangential Transverse Mercator LCC : Lambert Conformal Conic PS : Polar Stereographic EM : Equatorial Mercator LAZA: Lambert Azimuthal Equal Area
	FEAST	real	False Easting (km) for PMAP = TTM, LCC, or LAZA
	FNORTH	real	False Northing (km) for PMAP = TTM, LCC, or LAZA
	IUTMZN	integer	UTM zone for PMAP = UTM
	UTMHEM	character*1	Use (N) northern or (S) southern hemisphere for UTM projection
	RLAT0, RLON0	character*16	Reference latitude and longitude (degrees) for PMAP = TTM, LCC, PS, EM, or LAZA. Enter numeric degrees and either N or S for latitude, or E or W for longitude.
	RLAT1, RLAT2	character*16	Two standard parallels of latitude for PMAP= LCC or PS. Enter numeric degrees and either N or S.
	DATUM	character*8	Datum Code for output grid
	XREFKM, YREFKM	real	Reference X and Y coordinates origin (km) of the output grid.
	NX, NY	integer	Number of grid cells in X and Y directions (if IGRID=1 or 2)
	DGRIDKM	real	Horizontal grid spacing (km)

* PMAP = PS, EM, and LAZA is NOT AVAILABLE in CALMET

Table 2-7: Sample CTGPROC Output List File(CTGPROC.LST) - Partial Listing

```
                        CTGPROC OUTPUT SUMMARY
                   VERSION:  2.67         LEVEL:  060519

Internal Coordinate Transformation by  ---  COORDLIB   Version: 1.96   Level: 051010

 --------------------------
     SETUP Information
 --------------------------

 Control File Used -----
ctgproc.inp

 Processing Options -----
 Continues Previous Run? :   F
 Final Run in Series?    :   T
Snow grid processing?   =   F
 Coastline processing?   =   F

 Mesh Density for CTG files  =   1
 Mesh Density for GLAZ files =   1

 QA Threshold (%)        =   75

 Input Land Use File(s) -----

luindat: LEWISTON.CMP
 (USGS CTG - compressed)

luindat: PORTLAND.CMP
 (USGS CTG - compressed)

 Default Datum-Region for each File Type --------
CTG     : NAS-C
 USGSLA  : ESR-S
 NZGEN   : WGS-84
 NLCD92  : NAR-C
 NLCD01  : NAR-C
 GLC2000 : WGS-84
 UMDGLC  : WGS-84
 BUMODIS : ESR-R
 GSHHS   : WGS-84

 Output File Names -------------
runlst  : CTGPROC.LST
ludat   : LULC1KM.DAT
 (LUDAT written in fractional land use format)

 Grid data (for output) ---------------------
 datum  : NAS-C
pmap   : UTM
 Hemisphere : N
 UTM zone   :  19
xorigin:  310.000000
yorigin:  4820.00000
izone  :  19
dgrid  :  1.00000000
nx     :  99
ny     :  99
```

Table 2-7 (concluded)
Sample CTGPROC Output List File
(CTGPROC.LST) - Partial Listing

```
 --------------------------
     PROCESS Information
 --------------------------
  Land use data file: LEWISTON.CMP
  Header of Compressed CTG data file:

       575    884064       808    0  200    4   17   19    1   7874016      1973
    1    1  808  575    0  556   21    0  415   13  809   20  802  575  401  373
    440000    720000    450000    720000    450000    710000    450000    700000
    440000    700000    440000    710000    259500   4987100     84180
LEWISTON, ME VT NH 1:250,000 QUAD LU PB CN HU

 Number of records read:  73693
 Number of data points read:  442039
 Number of data points used to update grid:  113089
 Number of data points with missing LU:  225

  Land use data file: PORTLAND.CMP

   Header of Compressed CTG data file:
       570    757734       822    0  200    4   17   19    1   7874016      1973
    1    1  822  570    0  556   20    1  421   13  822   20  815  576  408  380
    430000    720000    440000    720000    440000    710000    440000    700000
    430000    700000    430000    710000    255500   4876100     84180
PORTLAND, ME NH 1:250,000 QUAD LU PB CN HU

 Number of records read:  89863
 Number of data points read:  379005
 Number of data points used to update grid:  129519
 Number of data points with missing LU:  321

 Number of CTG land use cell hits

 Multiply all values by 10 **   0

 99 I 25  25  25  25  25  25  25  25  25  25  25  25  25  25  25  25  25  25  25  25  25  25  25  25  25  25  25  25  25
    I  +   +   +   +   +   +   +   +   +   +   +   +   +   +   +   +   +   +   +   +   +   +   +   +   +   +   +   +   +
 98 I 25  25  25  25  25  25  25  25  25  25  25  25  25  25  25  25  25  25  25  25  25  25  25  25  25  25  25  25  25
    I  +   +   +   +   +   +   +   +   +   +   +   +   +   +   +   +   +   +   +   +   +   +   +   +   +   +   +   +   +
 97 I 25  25  25  25  25  25  25  25  25  25  25  25  25  25  25  25  25  25  25  25  25  25  25  25  25  25  25  25  25
    I  +   +   +   +   +   +   +   +   +   +   +   +   +   +   +   +   +   +   +   +   +   +   +   +   +   +   +   +   +
 96 I 25  25  25  25  25  25  25  25  25  25  25  25  25  25  25  25  25  25  25  25  25  25  25  25  25  25  25  25  25
    I  +   +   +   +   +   +   +   +   +   +   +   +   +   +   +   +   +   +   +   +   +   +   +   +   +   +   +   +   +

 Number of land use hits low in       104 Cells
 with fewer than    18 hits per cell.
 INVESTIGATE cells that are partially filled.

 POTENTIAL ERROR: Number of Grid Cells with no defined land use =         88
 This should NOT be your LAST run unless these cells are PROPERLY filled in
 with the missing value (IMISS) used in the next processing step (MAKEGEO).
 Consult the gridded table printed above to identify the cells.

 Land Use Processing Complete.

 End of run -- Clock time: 07:58:57
                     Date: 05-19-2006
        Elapsed Clock Time:        1.0 (seconds)

                  CPU Time:        1.0 (seconds)
```

Table 2-8: NZ Generic Land Use Input File (Translation to USGS categories is conducted internally)

Input Group	Variable	Type	Description
	NOBS	Integer	Row number of observations
	NZLU	Integer	Land Use Category (should be of the form see table 2-10)
	RNLAT	Real	Latitude (decimal degrees, negative for Southern Hemisphere)
	RELON	Real	Longitude (decimal degrees, negative for (Western Hemisphere)

Table 2-9: Sample File of NZ Generic Land Use Data set (comma delimited file)

```
1,30,-35.5173137156338,174.409732258548
2,30,-35.5172985229084,174.410834392973
3,30,-35.5172833200875,174.411936526922
4,20,-35.5172681071709,174.413038660396
5,20,-35.5172528841586,174.414140793393
6,20,-35.5172376510503,174.415242925913
7,20,-35.5172224078459,174.416345057955
8,20,-35.5172071545452,174.417447189519
9,20,-35.5171918911481,174.418549320603
10,20,-35.5171766176543,174.419651451208
```

Table 2-10: Non Random Specific Land Use Categories for the NZ Generic Land Use Input File

0	Sea
1	Sea
10	Urban
11	Urban Open Space
20	Primarily Pastoral
21	Primarily Horticultural
30	Indigenous Forest
31	Planted Forest
40	Scrub
43	Mangrove
50	Inland Water
60	Inland Wetlands
61	Coastal Wetlands
70	Mines and Dumps
71	Coastal Sands
72	Bare Ground

Table 2-11: Translation Table of Non Random Specific Land Use Categories to USGS Equivalent Categories(done internally within CTGPROC)

Generic Land Use Numeric Value	Generic Land Use Description	USGS LU Equivalent Numeric Value	Default USGS LU Description	Description 14 USGS LU Categories used in model	14 USGS LU Categories used in model
0	Sea	55	ocean	50	water
1	Sea	55	ocean	50	water
10	Urban	16	mixed urban/built up land	10	urban
11	Urban Open Space	14	transport communication utilities	10	urban
20	Primarily Pastoral	21	cropland and pasture	20	irrigated agriculture
21	Primarily Horticultural	22	orchards/groves/vineyard/nursery	20	irrigated agriculture
30	Indigenous Forest	43	mixed forest land	40	forest land
31	Planted Forest	43	mixed forest land	40	forest land
40	Scrub	32	Shrub and bush rangeland	30	rangeland
43	Mangrove	61	forested wetland	60	wetland
50	Inland Water	52	lakes	50	water
60	Inland Wetlands	62	non forested wetlands	60	wetland
61	Coastal Wetlands	62	non forested wetlands	60	wetland
70	Mines and Dumps	75	strip mines, quarries,gravel pits	70	barren land
71	Coastal Sands	72	beaches	70	barren land
72	Bare Ground	74	bare exposed rock	74	barren land

Table 2-12: Generic Land Use Input File (no internal translation to USGS categories)

Input Group	Variable	Type	Description
First Line	DATASET	character*16	Dataset name (Generic.Landuse)
	DATAVER	character*16	Dataset version (1.0)
	DATAMOD	character*64	Dataset message field
Second Line	NCOMMENTS	integer	Number of comment records to follow
Third Line			Comment Lines depending on NCOMMENTS
	CPROJI	character	Map Coordinates, expecting longitude and latitude (LL)
	DGENERIC, DATENI	character	Map Datum and Date (WGS-84 02-21-2003)
	DEG	character	Map Units, expecting degrees (DEG)
	NLUOUTCAT	integer	Number of Land Use Categories
	LUOUTCAT	integers	List Land Use Categories
		Real arrays follow	
	LUCAT	Integer	Land Use Category
	RELON	Real	Longitude (Eastlongitude is positive, West longitude is negative)
	RELAT	Real	Latitude (North latitude is positive, South latitude is negative)
			(Continue for each record)

Table 2-13: Sample File of Generic Land Use Data set

```
GENERIC.LANDUSE 1.0             LU, Longitude, Latitude (free-format)
2
Prepared by User
Longitude is positive to east, Latitude is positive to north
LL
WGS-84  02-21-2003
DEG
16
0  1 10 11 20 21 30 31 40 43 50 60 61 70 71 72
 30 174.409729 -35.5173149
 30 174.410828 -35.5172997
 30 174.411942 -35.5172844
 20 174.413040 -35.5172691
 20 174.414139 -35.5172539
 20 174.415237 -35.5172386
 20 174.416351 -35.5172234
 20 174.417450 -35.5172081
 20 174.418549 -35.5171928
 20 174.419647 -35.5171776
 20 174.420761 -35.5171623
 20 174.421860 -35.5171471
 20 174.422958 -35.5171318
 20 174.424057 -35.5171165
```

2.3 MAKEGEO

MAKEGEO generates a GEO.DAT file that provides the geophysical data inputs required by the CALMET model[1]. These inputs include land use types, elevation, surface parameters (surface roughness length, albedo, Bowen ratio, soil heat flux parameter, vegetation leaf area index), and anthropogenic heat flux. An extensive description of GEO.DAT is provided in Section 8.

MAKEGEO requires 3 **input files**: a gridded elevation file (e.g. produced by TERREL)[2], a gridded land use file (e.g. generated by CTGPROC), and a user input control file (MAKEGEO.INP).

MAKEGEO reads gridded fractional land use, calculates dominant land use categories, as well as weighted surface parameters and remaps to new LULC categories, if desired. In MAKEGEO.INP, the user can define new Land Use categories by remapping the USGS Land Use categories. For example, the USGS land use category system has 7 types of urban or built-up land and these would all be mapped to one land use category for urban or built-up land in CALMET if using the 14 category system (see Table 8-6).

A value of each surface parameter is provided by the user for each land use category in the MAKEGEO control input file. MAKEGEO computes area weighted values for each grid cell based on the amount of area each land use category covers in the grid cell. For example, a grid cell which is half water and half forest would have surface parameters that would reflect 50% of the value assigned to water and 50% of the value assigned to forest categories. An arithmetic weighting is computed for albedo, Bowen ratio, soil heat flux, vegetation leaf area index and anthropogenic heat flux. For the surface roughness, a logarithmic weighting is used.

The format of the MAKEGEO control input file follows the same rules as those used in the CALMET.INP file (refer to the CALMET section for details). Only data within the delimiter characters (!) are processed. The input data consist of a leading delimiter followed by the variable name, equals sign, input value or values, and a terminating delimiter (e.g., !XX = 12.5!). MAKEGEO.INP may be created/edited directly using a conventional editor, or it may be created/edited indirectly by means of the PC-based, Windows-compatible Graphical User Interface (GUI) developed for the geophysical preprocessors (CALPRO). A sample MAKEGEO.INP file is provided in Table 2-14 and the input variables are described in Table 2-15.

---

[1] MAKEGEO also produces a binary “terrain” file suitable for input into UAM.

[2] MAKEGEO will run if a gridded elevation file is not supplied, but gridded terrain elevations must then be manually inserted into GEO.DAT before using as input for CALMET.

Table 2-14: Sample MAKEGEO Control File(MAKEGEO.INP)

```
Demo Application
--------------------- Run title (1 line) --------------------------------------

                 MAKEGEO PROCESSOR CONTROL FILE
                 ------------------------------

  MAKEGEO creates the geophysical data file (GEO.DAT) for CALMET.  Using
  the fractional land use data from CTGPROC (LU.DAT), it calculates the
  dominant land use for each cell and computes weighted surface parameters.
  It may also remap land use categories if desired.  Terrain data can
  be obtained from TERREL, or provided in a file of similar format
  (TERR.DAT).

-------------------------------------------------------------------------------

INPUT GROUP: 0 -- Input and Output Files
--------------

     Default Name  Type          File Name
     ------------  ----          ---------
LU.DAT        input    ! LUDAT   =lulc1km.dat !
     LU2.DAT       input    ! LU2DAT  =luglobe.dat !
TERR.DAT      input    ! TERRDAT =terr1km.dat !
     SNOW.DAT      input    * SNOWDAT =            *
     GEO.DAT       output   ! GEODAT  =geo1km.dat  !
     MAKEGEO.LST   output   ! RUNLST  =makegeo.lst !
     QALUSE.GRD    output   * LUGRD   =qaluse.grd  *
     QATERR.GRD    output   * TEGRD   =qaterr.grd  *

     All file names will be converted to lower case if LCFILES = T
     Otherwise, if LCFILES = F, file names will be converted to UPPER CASE
(LCFILES)                  Default: T      ! LCFILES = T !
T = lower case
        F = UPPER CASE

     NOTE: File/path names can be up to 70 characters in length

!END!

--------------------------------------------------------------------------------

INPUT GROUP: 1 -- Run control parameters
--------------

   Terrain Processing Control

     Read in a gridded terrain file?
(LTERR)                    Default: T      ! LTERR = T !
T = terrain elevations in GEO.DAT read from TERR.DAT
        F = terrain elevations in GEO.DAT are zero


   Land Use Processing Control

   A second file of fractional land use (LU2.DAT) may be provided for
   use when a cell in the primary land use file (LU.DAT) has no indicated
   land use.  This option allows a lower resolution dataset to supplement
   a higher resolution dataset where the higher resolution data are
   unavailable.
```

```
Read in a second fractional land use file?
(LLU2)                     Default: F      ! LLU2 = F !
   T = supplemental fractional land use read from LU2.DAT
   F = no supplemental fractional land use data are available
```

Table 2-14 (continued)
Sample MAKEGEO Control File
(MAKEGEO.INP)

```
        Daily Snow Data Processing Control

   US daily SNODAS gridded snow data can be used to modify the surface
landuse properties in the modeling grid to create one or more GEO.DAT
   files that can be used in individual CALMET runs during the winter.

     Process snow data?
     (LSNOW)                    Default: F      ! LSNOW = F  !
       T = Process SNODAS snow data
       F = Do not process SNODAS snow data

     Format for Time-Varying GEO.DAT output
     (Used only if LSNOW = T)
     (IFMTGEO)                  Default: 1      ! IFMTGEO = 1 !
       1 = One GEO.DAT file for each day. In this format the
           date stamp will be added to the GEO.DAT file name
           listed in Group 0.  For example, if the name chosen
           for the output file is geo1km.dat, the name of the
           daily file for January 10, 2008 would be
           geo1km_20080110.dat
       2 = One time-varying GEO.DAT file for all days in
           compressed format.
           (Not Available at this time)

     Beginning and Ending dates (YYYYMMDD) for daily GEO.DAT
     (Used only if LSNOW = T)
     (IDATEBEG)                 No Default      ! IDATEBEG = 20110404 !
     (IDATEBEG)                 No Default      ! IDATEEND = 20110404 !


     !END!

QA information for 1 cell in the grid can be written to the list
   file.  Identify the cell by its grid location (IX,IY).
   No QA output is generated if either index is outside your grid.  For
   example, using 0 for either turns the QA output off.

     Location of grid cell for QA output
     (IXQA)                     Default: 0      ! IXQA = 20 !
     (IYQA)                     Default: 0      ! IYQA = 15 !

!END!

--------------------------------------------------------------------------------

INPUT GROUP: 2 -- Map Projection and Grid Information for Output
--------------

     Projection
     ----------

     Map projection for all X,Y (km)
     (PMAP)                     Default: UTM    ! PMAP = UTM !

         UTM :  Universal Transverse Mercator
         TTM :  Tangential Transverse Mercator
         LCC :  Lambert Conformal Conic
         PS  :  Polar Stereographic
         EM  :  Equatorial Mercator
```

```
    LAZA:  Lambert Azimuthal Equal Area

False Easting and Northing (km) at the projection origin
(Used only if PMAP= TTM, LCC, or LAZA)
(FEAST)                    Default=0.0     ! FEAST  = 0.0 !
(FNORTH)                   Default=0.0     ! FNORTH = 0.0 !
```

Table 2-14 (continued)
Sample MAKEGEO Control File
(MAKEGEO.INP)

```
UTM zone (1 to 60)
(Used only if PMAP=UTM)
(IUTMZN)                   No Default      ! IUTMZN = 19 !

Hemisphere for UTM projection?
(Used only if PMAP=UTM)
(UTMHEM)                   Default: N      ! UTMHEM = N !
    N   :  Northern hemisphere projection
    S   :  Southern hemisphere projection

Latitude and Longitude (decimal degrees) of projection origin
(Used only if PMAP= TTM, LCC, PS, EM, or LAZA)
(RLAT0)                    No Default      ! RLAT0 = 40.0N !
(RLON0)                    No Default      ! RLON0 = 70.0W !

    TTM :  RLON0 identifies central (true N/S) meridian of projection
           RLAT0 selected for convenience
    LCC :  RLON0 identifies central (true N/S) meridian of projection
           RLAT0 selected for convenience
    PS  :  RLON0 identifies central (grid N/S) meridian of projection
           RLAT0 selected for convenience
    EM  :  RLON0 identifies central meridian of projection
           RLAT0 is REPLACED by 0.0N (Equator)
    LAZA:  RLON0 identifies longitude of tangent-point of mapping plane
           RLAT0 identifies latitude of tangent-point of mapping plane

Matching parallel(s) of latitude (decimal degrees) for projection
(Used only if PMAP= LCC or PS)
(RLAT1)                    No Default      ! RLAT1 = 30.0N !
(RLAT2)                    No Default      ! RLAT2 = 60.0N !

    LCC :  Projection cone slices through Earth's surface at RLAT1 and RLAT2
    PS  :  Projection plane slices through Earth at RLAT1
           (RLAT2 is not used)

----------
Note:  Latitudes and longitudes should be positive, and include a
       letter N,S,E, or W indicating north or south latitude, and
       east or west longitude.  For example,
35.9  N Latitude  =  35.9N
       118.7 E Longitude = 118.7E
```

```
Output Datum-Region
     -------------------

     The Datum-Region for the output coordinates is identified by a character
     string.  Many mapping products currently available use the model of the
     Earth known as the World Geodetic System 1984 (WGS-84).  Other local
     models may be in use, and their selection in TERREL will make its output
     consistent with local mapping products.  The list of Datum-Regions with
     official transformation parameters is provided by the National Imagery and
     and Mapping Agency (NIMA).

     Datum-region for output coordinates
     (DATUM)                    Default: WGS-84    ! DATUM = NAS-C  !


     Grid
     ----

     Reference coordinates X,Y (km) assigned to the southwest corner
     of grid cell (1,1)  (lower left corner of grid)
     (XREFKM)                   No Default      ! XREFKM = 310.0  !
```

Table 2-14 (continued)
Sample MAKEGEO Control File
(MAKEGEO.INP)

```
        (YREFKM)                   No Default      ! YREFKM = 4820.0 !

     Cartesian grid definition
     No. X grid cells (NX)      No default      ! NX =   99  !
     No. Y grid cells (NY)      No default      ! NY =   99  !


     Grid Spacing (DGRIDKM)     No default      ! DGRIDKM = 1. !
     in kilometers


!END!

--------------------------------------------------------------------------------

INPUT GROUP: 3 -- Output Land Use
--------------

-------------
Subgroup (3a)
-------------

     Number of output land use categories
     (NOUTCAT)                  Default: 14     ! NOUTCAT = 14 !

     Output land use categories assigned to water
     range from IWAT1 to IWAT2 (inclusive)
     (IWAT1)                    Default: 50     ! IWAT1 = 50 !
```

```
     (IWAT2)                    Default: 55     ! IWAT2 = 55 !

!END!

-------------
Subgroup (3b)
-------------
                                                       a
           OUTPUT LAND USE CATEGORIES (NOUTCAT entries)
           --------------------------------------------

! OUTCAT =   10, 20, -20, 30, 40, 51, 54, 55    !  !END!
! OUTCAT =   60, 61,  62, 70, 80, 90            !  !END!

-------------
    a
     List categories in ascending order (absolute value), with up to 10
     per line.  Each line is treated as a separate input subgroup and
     therefore must end with an input group terminator.

--------------------------------------------------------------------------------

INPUT GROUP: 4 -- Input Land Use (Defaults are set for USGS categories)
--------------

-------------
Subgroup (4a)
-------------

     Number of input land use categories
     (NINCAT)                   Default: 38     ! NINCAT = 38 !

     Number of input water categories
     (NUMWAT)                   Default: 5      ! NUMWAT = 5  !

     Number of input categories that are split
     by apportioning area among the other land
     use categories
```

Table 2-14 (continued)
Sample MAKEGEO Control File
(MAKEGEO.INP)

```
     (NSPLIT)                   Default: 0      ! NSPLIT = 0  !

     Minimum fraction of cell covered by water required
     to define the dominant land use as water

     (CFRACT)                   Default: 0.5    ! CFRACT = 0.5  !

     Land use category assigned to cell when
     no land use data are found
     (IMISS)                    Default: 55     ! IMISS = 55  !

     Minimum total fractional land use expected
```

```
     in a cell when land use data are available
     (FLUMIN)                  Default: 0.96   ! FLUMIN = 0.96 !

!END!

     Method to obtain surface roughness when
     the surface is covered by snow
     (Used only if LSNOW = T)
     (MSRL)                    Default: 1      ! MSRL = 1 !
       1 = Computed from effective obstacle height
       2 = User-defined table

     Height Scale (m) for computing effective
     obstacle height (method MSRL=1)
     (Used only if LSNOW = T)
     (HSCL)                    Default: 10.    ! HSCL = 10 !

     Method to obtain surface albedo when the
     surface is covered by snow
     (Used only if LSNOW = T)
     (MSAL)                    Default: 1      ! MSAL = 1 !
          1 = Computed using snow ages
          2 = Use user-defined table

     Minimum snow depth (meters) when surface
     roughness is affected by snow
     (Used only if LSNOW = T)
     (SDPMIN)                  Default: 0.01   ! SDPMIN = 0.01 !

     !END!


-------------
Subgroup (4b)
-------------
                                                            a
           LAND USE PROPERTIES AND OUTPUT MAP (NINCAT entries)
           ---------------------------------------------------

     Input                              Soil   Anthropogenic Leaf   Output
    Category    z0     Albedo    Bowen   Heat Flux  Heat Flux   Area  Category
       ID       (m)   (0 to 1)   Ratio   Parameter  (W/m**2)   Index     ID
     ------   ------   ------    ------  ---------  --------   ------  ------

! X =   11,     0.5,    0.18,     1.0,     0.20,      0.0,      1.0,     10  !  !END!
! X =   12,     1.0,    0.18,     1.5,     0.25,      0.0,      0.2,     10  !  !END!
! X =   13,     1.0,    0.18,     1.5,     0.25,      0.0,      0.2,     10  !  !END!
! X =   14,     1.0,    0.18,     1.5,     0.25,      0.0,      0.2,     10  !  !END!
! X =   15,     1.0,    0.18,     1.5,     0.25,      0.0,      0.2,     10  !  !END!
! X =   16,     1.0,    0.18,     1.5,     0.25,      0.0,      0.2,     10  !  !END!
! X =   17,     1.0,    0.18,     1.5,     0.25,      0.0,      0.2,     10  !  !END!
! X =   21,    0.25,    0.15,     1.0,     0.15,      0.0,      3.0,     20  !  !END!
! X =   22,    0.25,    0.15,     1.0,     0.15,      0.0,      3.0,     20  !  !END!
! X =   23,    0.25,    0.15,     1.0,     0.15,      0.0,      3.0,     20  !  !END!
```

Table 2-14 (continued)

Sample MAKEGEO Control File
(MAKEGEO.INP)

```
! X =   24,    0.25,    0.15,     1.0,     0.15,      0.0,      3.0,     20  !  !END!
! X =   31,    0.05,    0.25,     1.0,     0.15,      0.0,      0.5,     30  !  !END!
! X =   32,    0.05,    0.25,     1.0,     0.15,      0.0,      0.5,     30  !  !END!
! X =   33,    0.05,    0.25,     1.0,     0.15,      0.0,      0.5,     30  !  !END!
! X =   41,     1.0,     0.1,     1.0,     0.15,      0.0,      7.0,     40  !  !END!
! X =   42,     1.0,     0.1,     1.0,     0.15,      0.0,      7.0,     40  !  !END!
! X =   43,     1.0,     0.1,     1.0,     0.15,      0.0,      7.0,     40  !  !END!
! X =   51,   0.001,     0.1,     0.0,      1.0,      0.0,      0.0,     51  !  !END!
! X =   52,   0.001,     0.1,     0.0,      1.0,      0.0,      0.0,     51  !  !END!
! X =   53,   0.001,     0.1,     0.0,      1.0,      0.0,      0.0,     51  !  !END!
! X =   54,   0.001,     0.1,     0.0,      1.0,      0.0,      0.0,     54  !  !END!
! X =   55,   0.001,     0.1,     0.0,      1.0,      0.0,      0.0,     55  !  !END!
! X =   61,     1.0,     0.1,     0.5,     0.25,      0.0,      2.0,     61  !  !END!
! X =   62,     0.2,     0.1,     0.1,     0.25,      0.0,      1.0,     62  !  !END!
! X =   71,    0.05,     0.3,     1.0,     0.15,      0.0,     0.05,     70  !  !END!
! X =   72,    0.05,     0.3,     1.0,     0.15,      0.0,     0.05,     70  !  !END!
! X =   73,    0.05,     0.3,     1.0,     0.15,      0.0,     0.05,     70  !  !END!
! X =   74,    0.05,     0.3,     1.0,     0.15,      0.0,     0.05,     70  !  !END!
! X =   75,    0.05,     0.3,     1.0,     0.15,      0.0,     0.05,     70  !  !END!
! X =   76,    0.05,     0.3,     1.0,     0.15,      0.0,     0.05,     70  !  !END!
! X =   77,    0.05,     0.3,     1.0,     0.15,      0.0,     0.05,     70  !  !END!
! X =   81,     0.2,     0.3,     0.5,     0.15,      0.0,      0.0,     80  !  !END!
! X =   82,     0.2,     0.3,     0.5,     0.15,      0.0,      0.0,     80  !  !END!
! X =   83,     0.2,     0.3,     0.5,     0.15,      0.0,      0.0,     80  !  !END!
! X =   84,     0.2,     0.3,     0.5,     0.15,      0.0,      0.0,     80  !  !END!
! X =   85,     0.2,     0.3,     0.5,     0.15,      0.0,      0.0,     80  !  !END!
! X =   91,    0.05,     0.7,     0.5,     0.15,      0.0,      0.0,     90  !  !END!
! X =   92,    0.05,     0.7,     0.5,     0.15,      0.0,      0.0,     90  !  !END!

-------------
    a
     Data for each land use category are treated as a separate input
     subgroup and therefore must end with an input group terminator.

---------------------------------------------------------------------------
      Subgroup (4b) -- Example Values for WINTER Conditions Without Snow Cover --
      Alternate     --  (replace non-winter values above with similar values)  --
      ---------------------------------------------------------------------------

           Input                              Soil   Anthropogenic Leaf   Output
          Category    z0     Albedo    Bowen   Heat Flux  Heat Flux   Area  Category
            ID       (m)    (0 to 1)   Ratio   Parameter  (W/m**2)   Index     ID
           ------   ------   ------    ------  ---------  --------   ------  ------

      * X =   11,    0.5,     0.18,     1.0,     0.20,      0.0,      1.0,     10  *  *END*
      * X =   12,    1.0,     0.18,     1.5,     0.25,      0.0,      0.2,     10  *  *END*
      * X =   13,    1.0,     0.18,     1.5,     0.25,      0.0,      0.2,     10  *  *END*
      * X =   14,    1.0,     0.18,     1.5,     0.25,      0.0,      0.2,     10  *  *END*
      * X =   15,    1.0,     0.18,     1.5,     0.25,      0.0,      0.2,     10  *  *END*
      * X =   16,    1.0,     0.18,     1.5,     0.25,      0.0,      0.2,     10  *  *END*
      * X =   17,    1.0,     0.18,     1.5,     0.25,      0.0,      0.2,     10  *  *END*
      * X =   21,   0.02,     0.18,     0.7,     0.15,      0.0,      3.0,     20  *  *END*
      * X =   22,   0.02,     0.18,     0.7,     0.15,      0.0,      3.0,     20  *  *END*
      * X =   23,   0.02,     0.18,     0.7,     0.15,      0.0,      3.0,     20  *  *END*
      * X =   24,   0.02,     0.18,     0.7,     0.15,      0.0,      3.0,     20  *  *END*
      * X =   31,   0.01,     0.20,     1.0,     0.15,      0.0,      0.5,     30  *  *END*
      * X =   32,   0.01,     0.20,     1.0,     0.15,      0.0,      0.5,     30  *  *END*
      * X =   33,   0.01,     0.20,     1.0,     0.15,      0.0,      0.5,     30  *  *END*
      * X =   41,    0.6,     0.17,     1.0,     0.15,      0.0,      7.0,     40  *  *END*
      * X =   42,    1.3,     0.12,     0.8,     0.15,      0.0,      7.0,     40  *  *END*
      * X =   43,   0.95,     0.14,     0.9,     0.15,      0.0,      7.0,     40  *  *END*
```

```
* X =   51,  0.001,      0.1,     0.0,      1.0,      0.0,      0.0,     51  *  *END*
* X =   52,  0.001,      0.1,     0.0,      1.0,      0.0,      0.0,     51  *  *END*
* X =   53,  0.001,      0.1,     0.0,      1.0,      0.0,      0.0,     51  *  *END*
* X =   54,  0.001,      0.1,     0.0,      1.0,      0.0,      0.0,     54  *  *END*
* X =   55,  0.001,      0.1,     0.0,      1.0,      0.0,      0.0,     55  *  *END*
```

Table 2-14 (continued)
Sample MAKEGEO Control File
(MAKEGEO.INP)

```
* X =   61,    0.6,     0.14,     0.3,     0.25,      0.0,      2.0,     61  *  *END*
* X =   62,    0.2,     0.14,     0.1,     0.25,      0.0,      1.0,     62  *  *END*
* X =   71,   0.05,      0.2,     1.5,     0.15,      0.0,     0.05,     70  *  *END*
* X =   72,   0.05,      0.2,     1.5,     0.15,      0.0,     0.05,     70  *  *END*
* X =   73,   0.05,      0.2,     1.5,     0.15,      0.0,     0.05,     70  *  *END*
* X =   74,   0.05,      0.2,     1.5,     0.15,      0.0,     0.05,     70  *  *END*
* X =   75,   0.05,      0.2,     1.5,     0.15,      0.0,     0.05,     70  *  *END*
* X =   76,   0.05,      0.2,     1.5,     0.15,      0.0,     0.05,     70  *  *END*
* X =   77,   0.05,      0.2,     1.5,     0.15,      0.0,     0.05,     70  *  *END*
* X =   81,    0.1,      0.2,     1.0,     0.15,      0.0,      0.0,     80  *  *END*
* X =   82,    0.1,      0.2,     1.0,     0.15,      0.0,      0.0,     80  *  *END*
* X =   83,    0.1,      0.2,     1.0,     0.15,      0.0,      0.0,     80  *  *END*
* X =   84,    0.1,      0.2,     1.0,     0.15,      0.0,      0.0,     80  *  *END*
* X =   85,    0.1,      0.2,     1.0,     0.15,      0.0,      0.0,     80  *  *END*
* X =   91,  0.002,      0.7,     0.5,     0.15,      0.0,      0.0,     90  *  *END*
* X =   92,  0.002,      0.7,     0.5,     0.15,      0.0,      0.0,     90  *  *END*
```

```
-------------
Subgroup (4c)    (Read only when LSNOW=T)
-------------

                                                                  a, b
       SNOW-COVERED LAND USE PROPERTIES AND OUTPUT MAP (NINCAT entries)
       ----------------------------------------------------------------

     Input                               Soil   Anthropogenic Leaf   Output
    Category    z0     Albedo    Bowen   Heat Flux  Heat Flux   Area  Category
       ID       (m)   (0 to 1)   Ratio   Parameter  (W/m**2)   Index     ID
     ------   ------   ------    ------  ---------  --------   ------  ------
* XS =   ,    ,    ,    ,    ,    ,    ,      *  *END*
* XS =   ,    ,    ,    ,    ,    ,    ,      *  *END*
* XS =   ,    ,    ,    ,    ,    ,    ,      *  *END*
* XS =   ,    ,    ,    ,    ,    ,    ,      *  *END*
* XS =   ,    ,    ,    ,    ,    ,    ,      *  *END*
* XS =   ,    ,    ,    ,    ,    ,    ,      *  *END*
* XS =   ,    ,    ,    ,    ,    ,    ,      *  *END*
* XS =   ,    ,    ,    ,    ,    ,    ,      *  *END*
* XS =   ,    ,    ,    ,    ,    ,    ,      *  *END*
* XS =   ,    ,    ,    ,    ,    ,    ,      *  *END*
* XS =   ,    ,    ,    ,    ,    ,    ,      *  *END*
* XS =   ,    ,    ,    ,    ,    ,    ,      *  *END*
* XS =   ,    ,    ,    ,    ,    ,    ,      *  *END*
* XS =   ,    ,    ,    ,    ,    ,    ,      *  *END*
* XS =   ,    ,    ,    ,    ,    ,    ,      *  *END*
```

```
* XS =   ,    ,    ,    ,    ,    ,    ,      *  *END*
* XS =   ,    ,    ,    ,    ,    ,    ,      *  *END*
* XS =   ,    ,    ,    ,    ,    ,    ,      *  *END*
* XS =   ,    ,    ,    ,    ,    ,    ,      *  *END*
* XS =   ,    ,    ,    ,    ,    ,    ,      *  *END*
* XS =   ,    ,    ,    ,    ,    ,    ,      *  *END*
* XS =   ,    ,    ,    ,    ,    ,    ,      *  *END*
* XS =   ,    ,    ,    ,    ,    ,    ,      *  *END*
* XS =   ,    ,    ,    ,    ,    ,    ,      *  *END*
* XS =   ,    ,    ,    ,    ,    ,    ,      *  *END*
* XS =   ,    ,    ,    ,    ,    ,    ,      *  *END*
* XS =   ,    ,    ,    ,    ,    ,    ,      *  *END*
* XS =   ,    ,    ,    ,    ,    ,    ,      *  *END*
* XS =   ,    ,    ,    ,    ,    ,    ,      *  *END*
* XS =   ,    ,    ,    ,    ,    ,    ,      *  *END*
* XS =   ,    ,    ,    ,    ,    ,    ,      *  *END*
* XS =   ,    ,    ,    ,    ,    ,    ,      *  *END*
* XS =   ,    ,    ,    ,    ,    ,    ,      *  *END*
* XS =   ,    ,    ,    ,    ,    ,    ,      *  *END*
* XS =   ,    ,    ,    ,    ,    ,    ,      *  *END*
* XS =   ,    ,    ,    ,    ,    ,    ,      *  *END*
```

Table 2-14 (continued)
Sample MAKEGEO Control File
(MAKEGEO.INP)

```
* XS =   ,    ,    ,    ,    ,    ,    ,      *  *END*
* XS =   ,    ,    ,    ,    ,    ,    ,      *  *END*
-------------
   a
     Data for each land use category are treated as a separate input
     subgroup and therefore must end with an input group terminator.
   b
     Subgroup 4c is read only when LSNOW=T.  When LSNOW=F, this section
     must not be active.  To de-activate, change the delimiters to a
     comment marker such as '*'.  To activate, change the delimiters to
     an exclamation point.


     -------------
     Subgroup (4d)    (Read only when LSNOW=T)
     -------------

         Parameters for Snow-Age adjustment to surface albedo
         Snow Time-Scale (days) : Number of days from last snow when snow becomes dirty.
         Albedo Reduction Factor: Reduces albedo when snow becomes dirty.
                                  The amount the albedo is reduced is product of this
                                  factor and the albedo difference between the surface
                                  with and without snow.

                                                         a, b
         SNOW-AGE TIME SCALE AND ALBEDO REDUCTION FACTOR
         -----------------------------------------------
                       (With snow cover)
```

```
          Input         Snow            Albedo
         Category    Time Scale        Reduction
            ID         (days)           Factor
          ------       ------           ------
  * XF = ,         ,                *  *END*
  * XF = ,         ,                *  *END*
  * XF = ,         ,                *  *END*
  * XF = ,         ,                *  *END*
  * XF = ,         ,                *  *END*
  * XF = ,         ,                *  *END*
  * XF = ,         ,                *  *END*
  * XF = ,         ,                *  *END*
  * XF = ,         ,                *  *END*
  * XF = ,         ,                *  *END*
  * XF = ,         ,                *  *END*
  * XF = ,         ,                *  *END*
  * XF = ,         ,                *  *END*
  * XF = ,         ,                *  *END*
  * XF = ,         ,                *  *END*
  * XF = ,         ,                *  *END*
  * XF = ,         ,                *  *END*
  * XF = ,         ,                *  *END*
  * XF = ,         ,                *  *END*
  * XF = ,         ,                *  *END*
  * XF = ,         ,                *  *END*
  * XF = ,         ,                *  *END*
  * XF = ,         ,                *  *END*
  * XF = ,         ,                *  *END*
  * XF = ,         ,                *  *END*
  * XF = ,         ,                *  *END*
  * XF = ,         ,                *  *END*
  * XF = ,         ,                *  *END*
  * XF = ,         ,                *  *END*
  * XF = ,         ,                *  *END*
  * XF = ,         ,                *  *END*
  * XF = ,         ,                *  *END*
  * XF = ,         ,                *  *END*
```

Table 2-14 (continued)
Sample MAKEGEO Control File
(MAKEGEO.INP)

```
  * XF = ,         ,                *  *END*
  * XF = ,         ,                *  *END*
  * XF = ,         ,                *  *END*
  * XF = ,         ,                *  *END*
  * XF = ,         ,                *  *END*

-------------
      a
       Data for each land use category are treated as a separate input
   subgroup and therefore must end with an input group terminator.
      b
       Subgroup 4d is read only when LSNOW=T.  When LSNOW=F, this section
       must not be active.  To de-activate, change the delimiters to a
```

```
       comment marker such as '*'.  To activate, change the delimiters to
       an exclamation point.


-------------
Subgroup (4e)
-------------
                                                            a
           INPUT CATEGORIES DEFINED AS WATER (NUMWAT entries)
           --------------------------------------------------

           ! IWAT =   51  !  !END!
           ! IWAT =   52  !  !END!
           ! IWAT =   53  !  !END!
           ! IWAT =   54  !  !END!
           ! IWAT =   55  !  !END!

-------------
    a
     Each water category ID is read as a separate input
     subgroup and therefore must end with an input group terminator.

-------------
Subgroup (4f)
-------------
                                                        a
           CATEGORY SPLIT INFORMATION (NSPLIT Categories)
           ----------------------------------------------

            Split        To       Amount
           Category   Category   of Split
              ID         ID        (%)
           --------   --------   --------
* XSPLIT =    14,        76,       15.8  *  *END*
* XSPLIT =    14,        77,       84.2  *  *END*

-------------

    a
     Each assignment is read as a separate input subgroup and therefore
     must end with an input group terminator.  A total of NSPLIT input
     land use categories must be listed, and the % split from each one
     of these to all receiving land use categories must sum to 100.0%


--------------------------------------------------------------------------------
NIMA Datum-Regions  (Documentation Section)
--------------------------------------------------------------------------------
     WGS-84    WGS-84 Reference Ellipsoid and Geoid, Global coverage (WGS84)
     NAS-C     NORTH AMERICAN 1927 Clarke 1866 Spheroid, MEAN FOR CONUS (NAD27)
     NAR-C     NORTH AMERICAN 1983 GRS 80 Spheroid, MEAN FOR CONUS (NAD83)
     NWS-84    NWS 6370KM Radius, Sphere
     ESR-S     ESRI REFERENCE 6371KM Radius, Sphere
```

Table 2-15: MAKEGEO Control File Inputs

Input Group	Variable	Type	Description
(0)	CTITLE	character*80	Title for GEO.DAT file (first line)
	LUDAT	character*70	Input gridded fractional land use file
	LU2DAT	character*70	Second input gridded land use
	TERRDAT	character*70	Input gridded terrain data file (used only if CTER=y)
	SNOWDAT	character*70	Input gridded snow data
	GEODAT	character*70	Output GEO.DAT file
	RUNLST	character*70	Output list file
	LUGRD	character*70	Output land use plot (GRD) file
	TEGRD	character*70	Output terrain plot (GRD) file
	LCFILES	logical	Convert filename to lower case (T) or upper case (F)
(1)	LTERR	logical	Flag to read input gridded terrain file (T=yes, F=no)
	LLU2	Logical	Read in a second fractional land use file
	LSNOW	Logical	Process SNODAS snow data (T=yes, F=no)
	IFMTGEO	interger	Format for time-varying GEO.DAT output (used only if LSNOW = T)
	IDATEBEG	integers	Beginning dates (YYYYMMDD) for daily GEO.DAT (used only if LSNOW = T)
	IDATEEND	integers	Ending dates (YYYYMMDD) for daily GEO.DAT (used only if LSNOW = T)
	IXQA.IYQA	integers	I,J, indices of cell to write out for QA check (used only if >0)

Input Group	**Variable**	**Type**	**Description**
(2)	PMAP *	character*8	Map projection for grid: UTM : Universal Transverse Mercator TTM : Tangential Transverse Mercator LCC : Lambert Conformal Conic PS : Polar Stereographic EM : Equatorial Mercator LAZA: Lambert Azimuthal Equal Area
	FEAST	real	False Easting (km) for PMAP = TTM, LCC, or LAZA
	FNORTH	real	False Northing (km) for PMAP = TTM, LCC, or LAZA
	IUTMZN	integer	UTM zone for PMAP = UTM

Table 2-15 (continued)
MAKEGEO Control File Inputs

Input Group	Variable	Type	Description
(2)	UTMHEM	character*1	Use (N) northern or (S) southern hemisphere for UTM projection
	RLAT0, RLON0	character*16	Reference latitude and longitude (degrees) for PMAP = TTM, LCC, PS, EM, or LAZA. Enter numeric degrees and either N or S for latitude, or E or W for longitude.
	RLAT1, RLAT2	character*16	Two standard parallels of latitude for PMAP= LCC or PS. Enter numeric degrees and either N or S.
	DATUM	character*8	Datum Code for output grid
	XREFKM, YREFKM	real	Reference X and Y coordinates origin (km) of the output grid.
	NX, NY	integer	Number of grid cells in X and Y directions (if IGRID=1 or 2)
	DGRIDKM	real	Horizontal grid spacing (km)
(3a)	NOUTCAT	integer	Number of output categories (14 for default CALMET run)
	IWAT1, IWAT2	integer	Range of output categories assigned to water
(3b)	OUTCAT	integer array	List of output LU categories (14 default CALMET; see sample MAKEGEO.INP) (up to 10 categories per line)
(4a)	NINCAT	integer	Number of input land use categories (if USGS LULC categories: NINCAT=38)
	NUMWAT	integer	Number of water categories (4 for USGS LU categories)
	NSPLIT	integer	Number of input categories that are split among other LU categories

Input Group	Variable	Type	Description
	CFRACT	real	Fraction of the cell area covered by water required to define the dominant land use category as water
	IMISS	integer	Land use category assigned for missing land use data (whenever LU data is missing for a grid cell in the domain, IMISS will be attributed to that cell)
	FLUMIN	real	Minimum total fractional Land Use expected

Table 2-15 (concluded)

MAKEGEO Control File Inputs

Input Group	Variable	Type	Description
(4a)	HSCL	integer	Height scale (m) for computing effective obstacle height (used only if LSNOW=T)
	MSRL	integer	Method to obtain surface roughness when the surface is covered in snow (used only if LSNOW=T)
	MSAL	integer	Method to obtain surface albedo when the surface is covered in snow (used only if LSNOW = T)
	SDPMIN	real	Minimum snow depth (m) when surface roughness is affected by snow
(4b)	X (nincat entries)	Real arrays (8 components)	Arrays containing, the input land use properties (roughness length, albedo, Bowen ratio, soil heat flux parameter, anthropogenic heat flux, leaf area index) and the output category ID. Non-winter values and model defaults. (NINCAT) Example values for winter conditions without snow cover follow. These can replace the non-winter values above.
(4c)	XS (nincat entries)	Real arrays (8 components)	Snow-covered Land Use properties, only used when LSNOW = T. Arrays containing the input land use properties (roughness length, albedo, Bowen ratio, soil heat flux parameter, anthropogenic heat flux, leaf area index) and the output category ID.
(4d)	XF entries	Real array	Parameters for Snow-age time scale and albedo reduction factor. Only read when LSNOW = T.
(4e)	IWAT (numwat entries)	integer	Input LU categories defined as water (e.g., 51, 52, 53, 54 for USGS LU categories)

(4f)	NSPLIT entries	Array (int,int,real)	Category split information: category ID to be split, output category, amount of split (%). A total of NSPLIT land use categories must be listed, and the % split from each one must sum to 100%

* PMAP = EM, PS, and LAZA is NOT AVAILABLE in CALMET

3. READ62 UPPER AIR PREPROCESSOR

READ62 is a preprocessing program that extract and process upper air wind and temperature data from standard NCDC data formats into a form required by the CALMET meteorological model. READ62 processes data in TD-6201 format or the NCDC FSL rawinsonde data format. Note that the user must specifically request the TD-6201 format when ordering upper air data from NCDC, if this format is desired.

User options are specified in a control file. In the control file, the user selects the starting and ending dates of the data to be extracted, the top pressure level, the type of input data, and the format of the output file. Also selected are processing options determining how missing data are treated. The programs will either flag or eliminate sounding levels with missing data.

If the user selects the option to flag (rather than eliminate) levels with missing data, the data field of the missing variables are flagged with a series of nines. If the option to eliminate levels with missing data is chosen, only sounding levels with all values valid will be included in the output data file. It is generally recommended that the levels with missing data be retained in order to avoid eliminating levels that might have some valid data.

Although CALMET allows missing values of wind speed, wind direction, and temperature at intermediate levels (i.e., levels other than the surface and model top), the user is cautioned against using soundings with significant gaps due to missing data. For example, adequate vertical resolution of the morning temperature structure near the surface is especially important to the model for predicting daytime mixing heights. It should be kept in mind that the model will fill in missing data by assuming that a straight-line interpolation between valid levels is appropriate. If this assumption is questionable, the sounding should not be used with the model.

Two input files are required by the preprocessor: a user input control file and the NCDC upper air data file. Two output files are produced. A list file summarizes the options selected, provides a summary of the soundings processed, and contains informational messages indicating problems in the data set. The second output file contains the processed upper air data in a CALMET-ready format. Table 3-1 contains a listing of the input and output files for READ62.

The format of the READ62 control input file follows the same rules as those used in the CALMET.INP file (refer to the CALMET section for details). Only data within the delimiter characters (!) are processed. The input data consist of a leading delimiter followed by the variable name, equals sign, input value or values, and a terminating delimiter (e.g., !XX = 12.5!). READ62.INP may be created/edited directly using a conventional editor, or it may be created/edited indirectly by means of the PC-based, Windows-compatible Graphical User Interface (GUI) developed for the geophysical preprocessors (CALPRO). A description of each input variable is shown in Table 3-2. A sample input file is shown in Table 3-3. The output list file is shown in Table 3-4.

Table 3-1: READ62 Input and Output Files

Unit	File Name	Type	Format	Description
IO5	READ62.INP	input	formatted	Control file containing user inputs
IO6	READ62.LST*	output	formatted	List file (line printer output file)
IO8	TD6201.DAT* or	input	formatted	Upper air data in NCDC TD-6201 format
	NCDC_U.DAT*	input	formatted	Upper air data in NCDC FSL format
IO9	UP.DAT*	output	formatted	Output file containing processed upper air data in format required by CALMET
IO18	SUBSOUND.DAT	Input	formatted	Input sounding (substitutions)

Table 3-2: READ62 Control File Inputs

Input Group	Variable	Type	Description
First Line	DATASET	character*16	Dataset name (UP.DAT)
	DATAVER	character*16	Dataset version
	DATAMOD	character*64	Dataset message field
(0)	INDAT	character*70	Input sounding data file name
	SUBDAT	character*70	Name of the substitute input data file (optional)
	UPDAT	character*70	Name of the output upper air file (UP.DAT)
	RUNLST	character*70	Name of the output list file
	LCFILES	logical	Convert to lower case (T) or upper case (F)
(1)	IBYR	integer	Starting year of data to print (four digit)
	IBMO	integer	Starting month
	IBDAY	integer	Starting day
	IBHR	integer	Starting time (hour 00-23 UTC)
	IBSEC	integer	Starting time (second 0000-3599)
	IEYR	integer	Ending year of data to print (four digit)
	IEMO	Integer	Ending month
	IEDAY	Integer	Ending day
	IEHR	Integer	Ending time (hour 00-23 UTC)
	IESEC	Integer	Ending time (second 0000-3599)
	JDAT	Integer	Type of sounding data file - 1: TD-6204 format -2: NCDC FSL format
	ISUB	Integer	Type of substitute up.dat input sounding data file – 0: no substitute sounding file is used; 1: slash delimited format (wind speed and direction are integers)- 2: comma delimited (all data are real)
	IFMT	Integer	Format used in UP.DAT output data record; 1: slash delimited format (wind speed and direction are integers)- 2: comma delimited (all data are real)

PSTOP	Real	Top pressure level (mb) for which data are extracted (e.g., 850, 700, 500). The output file will contain data from the surface to the PSTOP pressure level.

Table 3-2 (continued)
READ62 Control File Inputs

Input group	Variable	Type	Description
(1)	LHT	Logical	Height field control variable. If LHT = T, a sounding level is eliminated if the height field is missing. IF LHT = F, the sounding level is included in the output file but the height field is flagged with a "9999", if missing.
	LTEMP	Logical	Temperature field control variable. If LTEMP = T, a sounding level is eliminated if the temperature field is missing. If LTEMP = F, the sounding level is included in the output file but the temperature field is flagged with a "999.9", if missing.
	LWD	Logical	Wind direction field control variable. If LWD = T, a sounding level is eliminated if the wind direction field is missing. If LWD = F, the sounding level is included in the output file but the wind direction field is flagged with a "999", if missing.
	LWS	Logical	Wind speed field control variable. If LWS = T, a sounding level is eliminated if the wind speed is missing. If LWS = F, the sounding level is included in the output file but the wind speed field is flagged with a "999", if missing.
	LXTOP	Logical	Extrapolate missing data to from PVTOP to PSTOP (constant wind and temperature). T: Yes- F: No
	PVTOP	Real	Minimum pressure above which sounding is extrapolated (if missing)
	LXSFC	Logical	Extrapolate missing data down to surface (lowest wind speed extrapolate down with neutral power law. - Temperature is not extrapolated). T: Yes- F: No
	ZVSFC	Real	Maximum elevation (m) of the first valid data for extrapolation to the surface

Table 3-3: Sample READ62 Control File (READ62.INP)

```
READ62.INP      2.1             Hour Start and End Times with Seconds
-------------------------------------------------------------------------------

                 READ62 PROCESSOR CONTROL FILE
                 -----------------------------

  CALMET accepts upper air data (wind and temperature soundings) from
  UP.DAT files, where each UP.DAT file contains data for one station.
  READ62 processes soundings from standard NCDC data formats, reports
  problems with data entries, and produces an output file in the UP.DAT
  format.  NCDC formats supported include TD-6201 and FSL.

-------------------------------------------------------------------------------

INPUT GROUP: 0 -- Input and Output Files
--------------


     Input and Output files:
     -----------------------

     Default Name  Type          File Name
     ------------  ----          ---------
    SOUNDING.DAT      input    ! INDAT = td6201.dat      !
    SUBSOUND.DAT      input    * SUBDAT =            *
    UP.DAT           output    ! UPDAT = up2n.dat      !
    READ62.LST       output    ! RUNLST = read622n.lst    !

    All file names will be converted to lower case if LCFILES = T
    Otherwise, if LCFILES = F, file names will be converted to UPPER CASE
    (LCFILES)       Default: T       ! LCFILES = T     !
        T = lower case
        F = UPPER CASE

     NOTE: file/path names can be up to 70 characters in length

!END!

--------------------------------------------------------------------------------

INPUT GROUP: 1 -- Run control parameters
--------------

 --- Processing Period ---

       Starting date:  Year (IBYR) -- No default   ! IBYR = 1993  !
                      Month (IBMO) -- No default   ! IBMO = 1  !
                        Day (IBDY) -- No default   ! IBDY = 6  !
          [00-23 UTC]  Hour (IBHR) -- No default   ! IBHR = 23  !
                  Second (IBSECN) -- No default   ! IBSEC = 0  !
```

Table 3-3 (continued)
Sample READ62 Control File (READ62.INP)

```
  Ending date:    Year (IEYR) -- No default   ! IEYR = 1993  !
                 Month (IEMO) -- No default   ! IEMO = 1  !
                   Day (IEDY) -- No default   ! IEDY = 8  !
     [00-23 UTC]  Hour (IBHR) -- No default   ! IEHR = 12  !
               Second(IBSECN) -- No default   ! IESEC = 0  !


---------------
NOTE:  Explicit times with seconds (not hour-ending times)
       in Universal Time (UTC), also known as Greenwich Mean
       Time (GMT).


--- File Options ---

    Type of NCDC input sounding data file
    (JDAT)                    No Default        ! JDAT = 1       !
       1 = TD-6201 format
       2 = NCDC FSL format

    Type of SUBSTITUTE UP.DAT input sounding data file
    (ISUB)                    Default: 0      ! ISUB =0     !
    0 = NO substitute sounding file is used
    1 = Delimiter between data in a sounding level is a slash (/)
        and wind speed and direction are written as integers
    2 = Delimiter between data in a sounding level is a comma (,)
        and all data are written as reals (more significant digits)

    Format used in UP.DAT output data records
    (IFMT)                    Default: 2      ! IFMT = 2     !
       1 = Delimiter between data in a sounding level is a slash (/)
           and wind speed and direction are written as integers
       2 = Delimiter between data in a sounding level is a comma (,)
           and all data are written as reals (more significant digits)
```

Table 3-3 (continued)

Sample READ62 Control File (READ62.INP)

```
 --- Processing Options ---

     Top pressure (mb) level for which data are extracted (e.g., 850 mb,
     700 mb, 500 mb, etc.).  Pressure level must correspond to a height
     that equals or exceeds the top of the CALMET modeling domain, or
     else CALMET will stop with an error message.
     (PSTOP)                    Default: 700.   ! PSTOP = 500     !

     Missing data control options to determine when a sounding level
     is rejected, and when an incomplete sounding level is written to
     the UP.DAT file with missing value indicators.  The missing value
     indicators are:
             Height         = 9999.
             Temperature    = 999.9
             Wind Direction = 999
             Wind Speed     = 999   (999.0)
     Eliminate level if at least one of the following is missing?
     (LHT)   Height             Default: F      ! LHT   = F     !
     (LTEMP) Temperature        Default: F      ! LTEMP = F   !
     (LWD)   Wind Direction     Default: F      ! LWD   = F     !
     (LWS)   Wind Speed         Default: F      ! LWS   = F     !


     Sounding repair options to automatically fix-up certain deficiencies
     identified in the sounding data.  Any deficiencies not addressed will
     be identified in the UP.DAT output file and must be addressed by the
     user before that file can be used in CALMET.  Note that the repair
     options selected will be applied before any sounding replacement is
     done (soundings are replaced using the SUBSOUND.DAT file only if the
     ISUB variable is not zero).

     (1) Extrapolation to extend missing profile data to PSTOP pressure level?
     - Wind speed and direction are constant with height
     - Temperature gradient is constant with height
     - Valid data must exist at heights as great as PVTOP (mb) pressure level
     (LXTOP)                Default: F      ! LXTOP   = F     !
     (PVTOP)                Default: 850.   ! PVTOP   = 850    !

     (2) Extrapolation to extend missing profile data to surface?
     - Wind  direction is constant with height
     - Wind  speed is set with first valid speed, extrapolated to 10m
       using the neutral power law
     - Valid data must exist within first ZVSFC (m) of the surface
     - Temperature is NOT extrapolated
     (LXSFC)                Default: F      ! LXSFC   = F     !
     (ZVSFC)                Default: 200.   ! ZVSFC   = 200    !

!END!
```

Table 3-4: Sample READ62 Output List file

```
                        READ62 OUTPUT SUMMARY
                 VERSION:  5.6          LEVEL:  041123

-------------------------------------------------
NOTICE: Starting year in control file sets the
        expected century for the simulation.  All
        YY years are converted to YYYY years in
        the range:  1939 2038
-------------------------------------------------


STARTING DATE:                ENDING DATE:

              YEAR = 1990                  YEAR = 1990
        JULIAN DAY =    1            JULIAN DAY =   15
              HOUR =    0  (GMT)           HOUR =   12  (GMT)


PRESSURE LEVELS EXTRACTED:

                    SURFACE TO   500. MB


INPUT FILE FORMAT (1=TD6201,2=NCDC CD-ROM):   2
OUTPUT FILE FORMAT (1=/ DELIMITED,2=COMMA DELIMITED):   1


ALT. SOUNDING FILE FOR SUBSTITUTIONS IS NOT USED


DATA LEVEL ELIMINATED IF HEIGHT MISSING ?          F

DATA LEVEL ELIMINATED IF TEMPERATURE MISSING ?     F

DATA LEVEL ELIMINATED IF WIND DIRECTION MISSING ? F

DATA LEVEL ELIMINATED IF WIND SPEED MISSING ?      F


MISSING PROFILE DATA EXTRAPOLATED TO TOP ?          F

Last valid data must be above pressure (mb):      700.0

MISSING PROFILE DATA EXTRAPOLATED TO SURFACE ?      F

First valid data must be below height (m AGL):      200.0
```

Table 3-4 (continued)
Sample READ62 Output List file

```
FILENAMES:
     Control file:          r62pwm.inp
     Input upper air file:  90010100.pwm
     Output upper air file: uppwm.dat
     Output list file:      r62pwm.lst

 -------------------------------------------------
 NOTICE: Starting year in control file sets the
         expected century for the simulation.  All
         YY years are converted to YYYY years in
         the range:  1940 2039
 -------------------------------------------------


 FSL Station ID used:         14764
             WBAN ID:       14764
              WMO ID:       72606


 Temperature values used in range checks:
     TMIN = 175.0
     TMAX = 322.0

 Pressure values used in range checks:
     PMIN =    0.0
     PMAX = 1040.0
```

Table 3-4 (concluded)
Sample READ62 Output List file

```
 THE FOLLOWING SOUNDINGS HAVE BEEN PROCESSED:

       YEAR   MONTH   DAY     JUL.DAY  HOUR-ENDING(GMT)  NO. LEVELS EXTRACTED

       1990     1       1         1          0                 30
       1990     1       1         1         12                 31
       1990     1       2         2          0                 28
       1990     1       2         2         12                 32
       1990     1       3         3          0                 33
       1990     1       3         3         12                 35
       1990     1       4         4          0                 41
       1990     1       4         4         12                 38
       1990     1       5         5          0                 37
       1990     1       5         5         12                 28
       1990     1       6         6          0                 19
       1990     1       6         6         12                 37
       1990     1       7         7          0                 20
       1990     1       7         7         12                 32
       1990     1       8         8          0                 35
       1990     1       8         8         12                 19
       1990     1       9         9          0                 35
       1990     1       9         9         12                 39
       1990     1      10        10          0                 37
       1990     1      10        10         12                 30
       1990     1      11        11          0                 26
       1990     1      11        11         12                 35
       1990     1      12        12          0                 37
       1990     1      12        12         12                 31
       1990     1      13        13          0                 27
       1990     1      13        13         12                 31
       1990     1      14        14          0                 29
       1990     1      14        14         12                 18
       1990     1      15        15          0                 33
       1990     1      15        15         12                 38


  End of run -- Clock time: 17:34:13
                      Date: 12-15-2005

        Elapsed Clock Time:        0.0 (seconds)

                 CPU      Time:                                               0.0      (seconds)
```

The output data file (UP.DAT) produced by READ62 is a formatted file containing the pressure, elevation, temperature, wind speed, and wind direction at each sounding level. The first level of each sounding is assumed to represent surface-level observations. If the surface level is missing from the sounding, it must be filled in before running CALMET.

READ62 allows the user to select either a slash (/) delimiter format (the original format), or a comma delimiter format for the UP.DAT file. The comma-delimited form of the UP.DAT file facilitates the use by CALMET of non-NCDC data sources, such as SODAR data. In CALMET, a slash-delimited file is read using FORTRAN format statements, while the comma-delimited file is read using Fortran free read statements. READ62 can be by-passed, and a comma-delimited UP.DAT file can be easily prepared from non-NCDC data by following the format discussed in Section 8.3. Sample UP.DAT files in both formats are shown in Table 3-5.

Table 3-5: Sample UP.DAT files

(a) UP.DAT - Slash-delimited format

```
UP.DAT          2.1             Hour Start and End Times with Seconds
   1
Produced by READ62 Version: 5.6  Level: 041123
NONE
UTC+0000
  2002    2   12    0 2002    9    7    0 500.    1    1
     F    F    F    F
   6201     14764    2002   1  2 12    0    2002   1  2 12    0   49      28
   1007.0/  16./279.3/160/ 10   1000.0/  77./281.0/174/ 13    983.0/ 221./284.6/186/ 19    973.0/ 304./999.9/190/ 21
    959.0/ 427./285.2/199/ 23    950.0/ 507./284.9/203/ 24    938.0/ 609./999.9/210/ 26    905.0/ 914./999.9/220/ 29
    900.0/ 959./283.1/222/ 30    872.0/1219./999.9/225/ 31    850.0/1433./281.2/222/ 31    822.0/1710./278.5/223/ 30
    810.0/1827./999.9/225/ 30    800.0/1931./277.6/226/ 29    780.0/2132./999.9/225/ 29    752.0/2437./999.9/225/ 28
    750.0/2456./275.3/226/ 28    724.0/2742./999.9/230/ 27    708.0/2920./273.2/230/ 26    700.0/3011./272.9/231/ 26
    697.0/3047./999.9/230/ 26    650.0/3601./269.6/236/ 27    645.0/3657./999.9/235/ 27    600.0/4230./266.1/240/ 31
    597.0/4267./999.9/240/ 32    552.0/4875./999.9/240/ 36    550.0/4905./262.2/241/ 36    500.0/5630./257.9/240/ 38
   6201     14764    2002   1  2 13    0    2002   1  2 13    0   49      19
    994.0/  16./276.5/240/  7    979.0/ 140./279.7/250/ 11    968.0/ 233./280.3/254/ 14    950.0/ 388./280.0/254/ 18
    933.0/ 536./279.6/250/ 19    900.0/ 832./280.4/243/ 22    898.0/ 852./280.5/242/ 22    850.0/1303./277.8/244/ 24
    800.0/1795./275.8/251/ 29    750.0/2316./273.5/256/ 35    742.0/2402./273.1/256/ 36    728.0/2554./272.3/254/ 38
    707.0/2787./273.0/249/ 39    700.0/2868./272.5/248/ 39    650.0/3457./268.6/241/ 35    603.0/4042./264.5/230/ 30
    600.0/4081./264.4/230/ 30    550.0/4754./262.3/222/ 38    500.0/5482./259.9/219/ 53

          (... records removed for clarity)
```

(b) UP.DAT - Comma-delimited format

```
UP.DAT          2.1             Hour Start and End Times with Seconds
   1
Produced by READ62 Version: 5.6  Level: 041123
NONE
UTC+0000
  2002    2   12    0 2002    9    7    0 500.    1    2
     F    F    F    F
   6201     14764    2002   1  2 12    0    2002   1  2 12    0   49      28
   1007.0,  16.,279.3,160, 10.0,   1000.0,  77.,281.0,174, 13.0,    983.0, 221.,284.6,186, 19.0,    973.0, 304.,999.9,190, 21.1,
    959.0, 427.,285.2,199, 23.0,    950.0, 507.,284.9,203, 24.0,    938.0, 609.,999.9,210, 26.2,    905.0, 914.,999.9,220, 29.8,
    900.0, 959.,283.1,222, 30.0,    872.0,1219.,999.9,225, 31.3,    850.0,1433.,281.2,222, 31.0,    822.0,1710.,278.5,223, 30.0,
    810.0,1827.,999.9,225, 30.3,    800.0,1931.,277.6,226, 29.0,    780.0,2132.,999.9,225, 29.8,    752.0,2437.,999.9,225, 28.8,
    750.0,2456.,275.3,226, 28.0,    724.0,2742.,999.9,230, 27.2,    708.0,2920.,273.2,230, 26.0,    700.0,3011.,272.9,231, 26.0,
    697.0,3047.,999.9,230, 26.7,    650.0,3601.,269.6,236, 27.0,    645.0,3657.,999.9,235, 27.7,    600.0,4230.,266.1,240, 31.0,
    597.0,4267.,999.9,240, 32.4,    552.0,4875.,999.9,240, 36.0,    550.0,4905.,262.2,241, 36.0,    500.0,5630.,257.9,240, 38.0
   6201     14764    2002   1  2 13    0    2002   1  2 13    0   49      19
    994.0,  16.,276.5,240,  7.0,    979.0, 140.,279.7,250, 11.0,    968.0, 233.,280.3,254, 14.0,    950.0, 388.,280.0,254, 18.0,
    933.0, 536.,279.6,250, 19.0,    900.0, 832.,280.4,243, 22.0,    898.0, 852.,280.5,242, 22.0,    850.0,1303.,277.8,244, 24.0,
    800.0,1795.,275.8,251, 29.0,    750.0,2316.,273.5,256, 35.0,    742.0,2402.,273.1,256, 36.0,    728.0,2554.,272.3,254, 38.0,
    707.0,2787.,273.0,249, 39.0,    700.0,2868.,272.5,248, 39.0,    650.0,3457.,268.6,241, 35.0,    603.0,4042.,264.5,230, 30.0,
    600.0,4081.,264.4,230, 30.0,    550.0,4754.,262.3,222, 38.0,    500.0,5482.,259.9,219, 53.0

          (... records removed for clarity)
```

4. PXTRACT PRECIPITATION DATA EXTRACT PROGRAM

PXTRACT is a preprocessor program which extracts precipitation data for stations and time periods of interest from a formatted precipitation data file in NCDC TD-3240 format. The TD-3240 data used by PXTRACT can be in either the fixed record length format or the variable record length format. The fixed record length format reports each hourly precipitation event in a separate record, whereas the variable record length format reports all hourly precipitation events that occur on a single day in a single record, and also includes the daily total. The hourly precipitation data usually come in large blocks of data sorted by station. For example, a typical TD-3240 file for California may contain data from over 100 stations statewide in blocks of time of 30 years or more. Modeling applications require the data sorted by time rather than station, and involve specific spatial domains and time periods from less than one year up to five years. PXTRACT allows data for a particular model run to be extracted from the larger data file and creates a set of station files that are used as input files by the second-stage precipitation preprocessor, PMERGE (see Section 5.0).

NOTE: If wet removal is not to be considered by the CALPUFF or MESOPUFF II dispersion models, no precipitation processing needs to be done. PXTRACT (and PMERGE) are required only if wet removal is an important removal mechanism for the modeling application of interest. In addition, if wet removal is a factor, the user has the option of creating a free-formatted precipitation data file that can be read by CALMET. This option eliminates the need to run the precipitation preprocessing programs for short CALMET runs (e.g., screening runs) for which the data can easily be input manually.

The input files used by PXTRACT include a control file (PXTRACT.INP) containing user inputs, and a data file (TD3240.DAT) containing the NCDC data in TD-3240 format. The precipitation data for stations selected by the user are extracted from the TD3240.DAT file and stored in separate output files (one file per station) called xxxxxx.DAT, where xxxxxx is the station identification code. PXTRACT also creates an output list file (PXTRACT.LST) which contains the user options and summarizes the station data extracted. Table 4-1 contains a summary of PXTRACT's input and output files.

The PXTRACT control file contains the user-specified variables which determine the method used to extract precipitation data from the input data file (i.e., by state, by station, or all stations), the appropriate state or station codes, and the time period to be extracted. A sample PXTRACT control file is shown in Table 4-2. The format and contents of the file are described in Table 4-3.

The PXTRACT output list file (PXTRACT.LST) contains a listing of the control file inputs and options. It also summarizes the station data extracted from the input TD-3240 data file, including the starting and ending date of the data for each station and the number of data records found. Since the TD-3240 data are not hourly, PXTRACT will extract the records that cover the period requested by the user. Therefore, the dates of the data extracted from different stations may be different although the same time period was requested by the user. If the starting (or ending) record has a data flag, the previous (or next) record will also be extracted to complete the information necessary for PMERGE to interpret the data correctly. A sample output list file is shown in Table 4-4. The PXTRACT output data files consist of precipitation data in TD-3240 format for the time period selected by the user. Each output data file contains the data for one station. A sample output file is shown in Table 4-5.

Table 4-1: PXTRACT Input and Output Files

Unit	File Name	Type	Format	Description
IO5	PXTRACT.INP	input	formatted	Control file containing user inputs
IO2	TD3240.DAT	input	formatted	Precipitation data in NCDC TD-3240 format
IO6	PXTRACT.LST	output	formatted	List file (line printer output file)
Unit 7	id1.DAT (id1 is the 6-digit station code for station #1, e.g., 040001)	output	formatted	Precipitation data (in TD-3240) format for station #1 for the time period selected by the user
Unit 7 Plus 1	id2.DAT (id2 is the 6-digit station code for station #2, e.g., 040002)	output	formatted	Precipitation data (in TD-3240) format for station #2 for the time period selected by the user

.
.
.
(Up to 200 new precipitation data files are allowed by PXTRACT).

Table 4-2: Sample PXTRACT Control File (PXTRACT.INP)

```
-------------------------------------------------------------------------------

                 PXTRACT PROCESSOR CONTROL FILE
                 ------------------------------

  CALMET accepts data for a number of precipitation stations in a
  single PRECIP.DAT file.  These data are obtained in the NCDC TD-3240
  format, with either fixed (hourly event records) or variable record
  length (daily records of hourly precipitation events).  This NCDC format
  typically places data for many stations and long periods in a single
  file.  PXTRACT extracts a subset of stations, for a specific period,
  into files for subsequent processing by PMERGE.  Each output file
  contains the data for a single station.

-------------------------------------------------------------------------------

INPUT GROUP: 0 -- Input and Output Files
--------------

     Input and Output files:
     -----------------------

     Default Name  Type          File Name
     ------------  ----          ---------
     TD3240.DAT    input    ! PRECDAT =file0001.dat !
     PXTRACT.LST   output   ! RUNLST  =pxtract1.lst  !

     All file names will be converted to lower case if LCFILES = T
     Otherwise, if LCFILES = F, file names will be converted to UPPER CASE
     (LCFILES)                  Default: T      ! LCFILES = F !
        T = lower case
        F = UPPER CASE

     NOTES: 1)  File/path names can be up to 70 characters in length;
            2)  Output files are named automatically using the state/station
                ID (e.g., 412797.DAT for station 412707)

!END!

--------------------------------------------------------------------------------

INPUT GROUP: 1 -- Run control parameters
--------------

 --- Processing Period ---

     Starting date:   Year (IBYR) -- No default       ! IBYR = 1990  !
                     Month (IBMO) -- No default       ! IBMO =  1  !
                       Day (IBDY) -- No default       ! IBDY =  8  !

     Ending date:     Year (IEYR) -- No default       ! IEYR = 1990  !
                     Month (IEMO) -- No default       ! IEMO =  1  !
                       Day (IEDY) -- No default       ! IEDY = 15  !

-------------
```

```
    Specify a processing period that includes a couple of days
    before and after your modeling period.


--- Station Extraction Method ---

    Method for selecting stations to extract
    (ICODE)                    No Default      ! ICODE = 1 !
       1 = Extract all stations within specified states
           (2-digit state codes are entered in Input Group 2)
       2 = Extract specified stations
```

Table 4-2 (continued)
Sample PXTRACT Control File (PXTRACT.INP)

```
           (6-digit station codes are entered in Input Group 3)
         3 = Extract all stations in the TD3240 file

     Number of states OR stations to extract
     (Used only if ICODE= 1 OR 2)
     (NSTA)                     Default: 0      ! NSTA = 2 !


!END!

--------------------------------------------------------------------------------

INPUT GROUP: 2 -- State codes (used only if ICODE=1)
--------------

     Data for all precipitation stations in one or more states can be
     extracted.  Specify the 2-digit code for each state selected by
     entering NSTA lines.
     (IDSTATE)                   No Default

    ! IDSTATE = 34 !  !END!
    ! IDSTATE = 41 !  !END!

-------------
     Each line is treated as a separate input subgroup and therefore
     must end with an input group terminator.

State/Territory Code Table:
---------------------------
  01 Alabama       16 Louisiana      31 North Carolina   46 West Virginia
  02 Arizona       17 Maine          32 North Dakota     47 Wisconsin
  03 Arkansas      18 Maryland       33 Ohio             48 Wyoming
  04 California    19 Massachusetts  34 Oklahoma         49 (not used)
  05 Colorado      20 Michigan       35 Oregon           50 Alaska
  06 Connecticut   21 Minnesota      36 Pennsylvania     51 Hawaii
  07 Delaware      22 Mississippi    37 Rhode Island
  08 Florida       23 Missouri       38 South Carolina   66 Puerto Rico
  09 Georgia       24 Montana        39 South Dakota     67 Virgin Islands
  10 Idaho         25 Nebraska       40 Tennessee
  11 Illinois      26 Nevada         41 Texas            91 Pacific Islands
  12 Indiana       27 New Hampshire  42 Utah
  13 Iowa          28 New Jersey     43 Vermont
  14 Kansas        29 New Mexico     44 Virginia
  15 Kentucky      30 New York       45 Washington

--------------------------------------------------------------------------------

INPUT GROUP: 3 -- Station codes (used only if ICODE=2)
--------------

     Data for specific precipitation stations can be extracted.
     Specify the 6-digit code for each station selected by
     entering NSTA lines.
```

```
 (IDSTN)                     No Default

* IDSTN = 341003 *  *END*
* IDSTN = 342615 *  *END*
```

Each line is treated as a separate input subgroup and therefore must end with an input group terminator.

Table 4-3: PXTRACT Control File Inputs (PXTRACT.INP)

Input Group	Variable	Type	Description
(0)	PRECDAT	Character*70	Input data file (TD3240.DAT)
	RUNLST	Character*70	List output file
	LCFILES	logical	Convert to upper case (F) or lower case(T)
(1)	IBYR	integer	Beginning year of data to process (YYYY)
	IBMO	integer	Beginning month
	IBDY	integer	Beginning day
	IEYR	integer	Ending year of data to process (YYYY)
	IEMO	integer	Ending month
	IEDY	integer	Ending day
	ICODE	integer	Method for selecting stations to extract. 1: extract all stations within specified states 2: extract specified stations 3: extract all station in the TD3240 file
	NSTA	integer	Number of stations to extract if ICODE =1 or 2
(2)	IDSTATE	2-digit integer	2-digit code for each state selected (NSTA lines; used only if ICODE=1)
(3)	IDSTN	6-digit integer	6-digit ID for each station selected (NSTA lines ; used only if ICODE=2)

Table 4-4: Sample PXTRACT Output List File (PXTRACT.LST)

```
                  PXTRACT OUTPUT SUMMARY
                  VERSION:  4.22         LEVEL:  030709




-------------------------------------------------
NOTICE: Starting year in control file sets the
        expected century for the simulation.  All
        YY years are converted to YYYY years in
        the range:  1940 2039
-------------------------------------------------



FILENAMES:
    Control file:          pxtract.inp
    Input TD3240 file:     TD3240.DAT
    Output list file:      PXTRACT.LST


 Data Requested by Station ID

 Period to Extract:    1/ 1/1990  to   1/15/1990


 Requested Precipitation Station ID Numbers -- :

   No.    ID           No.    ID           No.    ID           No.    ID

    1   170273          5   270741          9   274732          13   276234
    2   176905          6   270998         10   274808          14   276818
    3   177325          7   272842         11   275639          15   278885
    4   178641          8   273182         12   275780          16   437054



 Station      Starting     Ending       No. of
   Code         Date        Date        Records

 170273        1/ 1/1990   1/17/1990      6
 176905        1/ 1/1990   1/16/1990     13
 177325        1/ 1/1990   1/16/1990      6
 178641        1/ 1/1990   1/21/1990      6
 270741        1/ 1/1990   1/16/1990      5
 270998        1/ 1/1990   1/18/1990      6
 272842        1/ 1/1990   1/17/1990      8
 273182        1/ 1/1990   1/21/1990      6
 274732        1/ 1/1990   1/16/1990      9
 274808        1/ 1/1990   1/17/1990      6
 275639        1/ 1/1990   1/16/1990     83
 275780        1/ 1/1990   1/18/1990      5
 276234        1/ 1/1990   1/17/1990      9
 276818        1/ 1/1990   1/17/1990     13
```

```
  278885        1/ 1/1990   1/18/1990      7
  437054        1/ 1/1990   1/16/1990      5


  End of run -- Clock time: 18:10:35
                      Date: 07-11-2003

        Elapsed Clock Time:        0.0 (seconds)

CPU Time:        0.0 (seconds)
```

5. PMERGE PRECIPITATION DATA PREPROCESSOR

PMERGE reads, processes and reformats the precipitation data files created by the PXTRACT program, and creates either a formatted or an unformatted data file for input into the CALMET meteorological model. The output file (e.g., PRECIP.DAT) contains the precipitation data sorted by hour, as required by CALMET, rather than by station. The program can also read an existing unformatted output file and add stations to it, creating a new output file. PMERGE also resolves "accumulation periods" and flags missing or suspicious data.

Accumulation periods are intervals during which only the total amount of precipitation is known. The time history of precipitation within the accumulation period is not available. For example, it may be known that within a six-hour accumulation period, a total of a half inch of precipitation fell, but information on the hourly precipitation rates within the period is unavailable. PMERGE resolves accumulation periods such as this by assuming a constant precipitation rate during the accumulation period. For modeling purposes, this assumption is suitable as long as the accumulation time period is short (e.g., a few hours). However, for longer accumulation periods, the use of precipitation data with poor temporal resolution is not recommended. PMERGE will eliminate and flag as missing any accumulation periods longer than a user-defined maximum length.

PMERGE provides an option to "pack" the precipitation data in the unformatted output in order to reduce the size of the file. A "zero packing" method is used to pack the precipitation data. Because many of the precipitation values are zero, strings of zeros are replaced with a coded integer identifying the number of consecutive zeros that are being represented. For example, the following record with data from 20 stations requires 20 unpacked “words”:

0.0, 0.0, 0.0, 0.0, 0.0, 1.2, 3.5, 0.0, 0.0, 0.0,
0.0, 0.0, 0.0, 0.7, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0,

These data in packed form would be represented in six words:

-5., 1.2, 3.5, -6., 0.7, -6.

where five zero values are replaced by -5., six zero values are replaced by -6., etc. With many stations and a high frequency of zeros, very high packing ratios can be obtained with this simple method. All of the packing and unpacking operations are performed internally by PMERGE and CALMET, and are transparent to the user. The header records of the data file contain information flagging the file to CALMET as a packed or unpacked file. If the user selects the unpacked format, each precipitation value is assigned one full word.

The input files used by PMERGE include a control file (PMERGE.INP), an optional unformatted data file created in a previous run of PMERGE, and up to 150 TD-3240 precipitation station files (e.g., as created by PXTRACT). The output file consists of a list file and a new unformatted or formatted data file in

CALMET format with the data for all stations sorted by hour. Table 5-1 lists the name, type, format, and contents of PMERGE's input and output data files.

The PMERGE control file (PMERGE.INP) contains the user-specified input variables indicating the number of stations to be processed, a flag indicating if data are to be added to an existing, unformatted data file, the maximum length of an accumulation period, packing options, station data, and time zone data. PMERGE allows data from different time zones to be merged by time-shifting the data to a user-specified base time zone.

The format of the PMERGE control input file follows the same rules as those used in the CALMET.INP file (refer to the CALMET section for details). Only data within the delimiter characters (!) are processed. The input data consist of a leading delimiter followed by the variable name, equals sign, input value or values, and a terminating delimiter (e.g., !XX = 12.5!). PMERGE.INP may be created/edited directly using a conventional editor, or it may be created/edited indirectly by means of the PC-based, Windows-compatible Graphical User Interface (GUI) developed for the geophysical preprocessors (CALPRO). A sample PMERGE control file is shown in Table 5-2, and the input variables are described in Table 5-3.

The PMERGE output list file (PMERGE.LST) contains a listing of the control file inputs and options. It also summarizes the number of valid and invalid hours for each station including information on the number of hours with zero or non-zero precipitation rates and the number of accumulation period hours. Additional statistics provide information by station on the frequency and type of missing data in the file (i.e., data flagged as missing in the original data file, data which are part of an excessively long accumulation period, or data missing from the input files before (after) the first (last) valid record. A sample output file is shown in Table 5-4.

Table 5-1: PMERGE Input and Output Files

Unit	File Name	Type	Format	Description
I05	PMERGE.INP	input	formatted	Control file containing user inputs
I06	PMERGE.LST	output	formatted	List file (line printer output file)
Ioprev	user input file name	input	unformatted	Previous PMERGE data file to which stations are to be added (Used only if CFLAG=Y)
ioprec	user input file name	output	unformatted or formatted	Output data file created by PMERGE (this file is an input file to CALMET)
Unit 7	user input file name	input	formatted	Precipitation data (in TD-3240) format for station #1. (Output file of PXTRACT)
Unit 7 Plus 1	user input file name	input	formatted	Precipitation data (in TD-3240) format for station #2. (Output file of PXTRACT)

.
.
.

(Up to 150 new precipitation data files are allowed by PMERGE although this may be limited by the number of files an operating system will allow open at one time. Multiple runs of PMERGE may be necessary.)

Table 5-2: Sample PMERGE Control File (PMERGE.INP)

```
PMERGE.INP      2.1             Hour Start and End Times with Seconds
-------------------------------------------------------------------------------

                 PMERGE PROCESSOR CONTROL FILE
                 -----------------------------

 CALMET accepts data for a number of precipitation stations in a
 single PRECIP.DAT file.  PMERGE creates this file from several
 single-station files with precipitation event data.  Use PMERGE
 one or more times to build the PRECIP.DAT file.

-------------------------------------------------------------------------------

INPUT GROUP: 0 -- Input and Output Files
--------------

-------------
Subgroup (0a)
-------------

     Number of precipitation station files provided in Subgroup 0b.
     Up to MXPF are allowed in 1 application, although this may be
     limited by your operating system.  MXPF is set in the code,
     which needs to be  recompiled if another value is needed.
    (NPF)          No Default         ! NPF = 16    !


     Other Input and Output files:
     -----------------------------

     Default Name  Type          File Name
     ------------  ----          ---------
    PREV.DAT         input     * PREVDAT =            *
    PRECIP.DAT       output    ! PRECDAT = Precip.dat      !
    PMERGE.LST       output    ! RUNLST = Pmerge.lst      !

     All file names will be converted to lower case if LCFILES = T
     Otherwise, if LCFILES = F, file names will be converted to UPPER CASE
     (LCFILES)                 Default: T      ! LCFILES = T     !
        T = lower case
        F = UPPER CASE

    NOTE: File/path names can be up to 70 characters in length

!END!


-------------
Subgroup (0b)
-------------

     The following NPF formatted Precipitation Station files are processed.
     Enter NPF 3-line groups identifying the file name (STNFIL), the
     station number (IFSTN), and the station time zone (ASTZ) for each,
     followed by a group terminator.

    ! STNFIL = 170273.DAT!
```

```
! IFSTN  = 170273  !
! ASTZ   = UTC-0500    !   !END!

! STNFIL = 176905.DAT!
! IFSTN  = 176905  !
! ASTZ   = UTC-0500    !   !END!
```

Table 5-2 (continued)
Sample PMERGE Control File (PMERGE.INP)

```
! STNFIL = 177325.DAT!
! IFSTN  = 177325  !
! ASTZ   = UTC-0500    !   !END!

! STNFIL = 178641.DAT!
! IFSTN  = 178641  !
! ASTZ   = UTC-0500    !   !END!

! STNFIL = 270741.DAT!
! IFSTN  = 270741  !
! ASTZ   = UTC-0500    !   !END!

! STNFIL = 270998.DAT!
! IFSTN  = 270998  !
! ASTZ   = UTC-0500    !   !END!

! STNFIL = 272842.DAT!
! IFSTN  = 272842  !
! ASTZ   = UTC-0500    !   !END!

! STNFIL = 273182.DAT!
! IFSTN  = 273182  !
! ASTZ   = UTC-0500    !   !END!

! STNFIL = 274732.DAT!
! IFSTN  = 274732  !
! ASTZ   = UTC-0500    !   !END!

! STNFIL = 274808.DAT!
! IFSTN  = 274808  !
! ASTZ   = UTC-0500    !   !END!

! STNFIL = 275639.DAT!
! IFSTN  = 275639  !
! ASTZ   = UTC-0500    !   !END!

! STNFIL = 275780.DAT!
! IFSTN  = 275780  !
! ASTZ   = UTC-0500    !   !END!

! STNFIL = 276234.DAT!
! IFSTN  = 276234  !
! ASTZ   = UTC-0500    !   !END!

! STNFIL = 276818.DAT!
! IFSTN  = 276818  !
! ASTZ   = UTC-0500    !   !END!

! STNFIL = 278885.DAT!
! IFSTN  = 278885  !
! ASTZ   = UTC-0500    !   !END!

! STNFIL = 437054.DAT!
! IFSTN  = 437054  !
! ASTZ   = UTC-0500    !   !END!
```

Table 5-2 (continued)
Sample PMERGE Control File (PMERGE.INP)

```
--------------------------------------------------------------------------------

INPUT GROUP: 1 -- Run control parameters
--------------

 --- Processing Period ---

       Starting date:  Year (IBYR) -- No default   ! IBYR  = 1990  !
                      Month (IBMO) -- No default   ! IBMO  = 1  !
                        Day (IBDY) -- No default   ! IBDY  = 1  !
                       Hour (IBHR) -- No default   ! IBHR  = 0  !
                    Second (IBSEC) -- No default   ! IBSEC = 0 !

       Ending date:    Year (IEYR) -- No default   ! IEYR  = 1990  !
                      Month (IEMO) -- No default   ! IEMO  = 1  !
                        Day (IEDY) -- No default   ! IEDY  = 14  !
                       Hour (IEHR) -- No default   ! IEHR  = 24  !
                    Second (IESEC) -- No default   ! IESEC = 0 !

      UTC time zone (char*8)(ABTZ) -- No default   ! ABTZ  = UTC-0500  !
         PST = UTC-0800, MST = UTC-0700
         CST = UTC-0600, EST = UTC-0500
         GMT = UTC+0000

   -----------------------
   NOTE:  Use explicit times in hours and seconds in time zone ABTZ.

 --- Processing Options ---

     Maximum accumulation period accepted (hrs)
     (MAXAP)                    Default: 6      ! MAXAP = 12  !


 --- File Options ---

     Previous PRECIP.DAT file is used in this run?
     (LPREV)                    No Default      ! LPREV = F  !
        T = Unformatted PREV.DAT file is used
        F = PREV.DAT file is NOT used

     Number of stations to use from previous PRECIP.DAT file
     (NBSTN)                    Default: 0      ! NBSTN = 0  !
        0 = Use ALL stations
       >0 = Use only those NBSTN stations listed in Input Group 2


 --- File Formats ---

    Format of output PRECIP.DAT file
     (IOFORM)                   Default: 2      ! IOFORM = 2       !
        1 = Unformatted
        2 = Formatted
     (IOPACK)                   Default: 0      ! IOPACK = 0       !
        0 = NOT packed
        1 = Packed (used only if IOFORM=1)
```

```
    Format of previous PRECIP.DAT file
     (IPFORM)                   Default: 2      ! IPFORM = 2       !
        1 = Unformatted
        2 = Formatted

!END!
```

Table 5-2 (concluded)
Sample PMERGE Control File (PMERGE.INP)

```
--------------------------------------------------------------------------------

INPUT GROUP: 2 -- Stations used from previous PRECIP.DAT file
--------------

     Data for the following NBSTN stations in the previous PRECIP.DAT
     file identified as PREV.DAT are transferred to the new PRECIP.DAT
     file created in this run.  Enter NBSTN lines identifying the
     station number (IBSTN) for each, followed by a group terminator.
     This Input Group is used only if LPREV=T and NBSTN>0.  All stations
     from a previous PRECIP.DAT file are transferred to the new
     PRECIP.DAT file if NBSTN=0.

    * IBSTN = 14764      *   *END*
```

Table 5-3: PMERGE Control File Inputs (PMERGE.INP)

Line	Variable	Type	Description
First Line	DATASET	character*16	Dataset name (PMERGE.DAT)
	DATAVER	character*16	Dataset version
	DATAMOD	character*64	Dataset message field
0a	NPF	integer	Number of formatted TD3240 data files to process
	PREVDAT	character*70	Previous PMERGE output data file (used only if it is a continuation run)
	PRECDAT	character*70	Output data filename
	RUNLST	character*70	List-file name
	LCFILES	logical	Convert names to lower case? (T=yes; F=no)
0b	STNFIL	character*70	Input file pathname for formatted data files
	IFSTN	integer	Six digit station id number (SSIIII), where SS=two digit state code, IIII is the station id
	ASTZ	character*8	Time zone used in the input data set (UTC-0500=EST, UTC-0600=CST, UTC-0700=MST, UTC-0800=PST)
1	IBYR	integer	Beginning year of data to process (YYYY)
	IBMO	integer	Beginning month
	IBDAY	integer	Beginning day
	IBHR	integer	Beginning time (hour 00-23)
	IBSEC	integer	Beginning time (second 0000-3599)

IEYR	integer	Ending year of data to process (YYYY)
IEMO	integer	Ending month
IEDAY	integer	Ending day
IEHR	integer	Ending time (hour 00-23)
IESEC	integer	Ending time (second 0000-3599)

Table 5-3 (continued)
PMERGE Control File Inputs (PMERGE.INP)

Line	Variable	Type	Description
	ABTZ	character*8	Time zone of output data (UTC-0500=EST, UTC-0600=CST, UTC-0700=MST, UTC-0800=PST)
	MAXAP	integer	Maximum allowed length of an accumulation period (hours). It is recommended that MAXAP be set to 24 hours or less.
	LPREV	logical	Use previous PMERGE output data file? (Y=yes, N=no)
	NBSTN	integer	Number of stations requested from previous PMERGE binary output file (0 = use all stations in binary file).
	IOFORM	integer	Format of output data file (1=unformatted, 2=formatted)
	IOPACK	integer	Flag indicating if output data are to be packed (0=no, 1=yes)
	IPFORM	integer	Format of previous PRECIP.DAT file (1=unformatted, 2=formatted)
2	IBSTN	integer	6-digit station ids requested from binary input file (1 station id per record), NBSTN records in all.

Table 5-4: Sample PMERGE Output List File (PMERGE.LST)

```
                         PMERGE OUTPUT SUMMARY
                  VERSION:  5.60     LEVEL:  050921


 -------------------------------------------------
 NOTICE: Starting year in control file sets the
         expected century for the simulation.  All
         YY years are converted to YYYY years in
         the range:  1940 2039
 -------------------------------------------------


Control file name     : c:\test\new\pmerge\pmerge.inp
Output list file name : pmerge.lst
Output file name      : precip.dat
 Continuation Run?     :  F



      Time Zone      Station ID     Formatted TD3240 Precipitation
                                       Input Files

 UTC+0  0        170273       170273.dat
 UTC+0  0        176905       176905.dat
 UTC+0  0        177325       177325.dat
 UTC+0  0        178641       178641.dat
 UTC+0  0        270741       270741.dat
 UTC+0  0        270998       270998.dat
 UTC+0  0        272842       272842.dat
 UTC+0  0        273182       273182.dat
 UTC+0  0        274732       274732.dat
 UTC+0  0        274808       274808.dat
 UTC+0  0        275639       275639.dat
 UTC+0  0        275780       275780.dat
 UTC+0  0        276234       276234.dat
 UTC+0  0        276818       276818.dat
 UTC+0  0        278885       278885.dat
 UTC+0  0        437054       437054.dat

Period to Extract (in time zone:UTC-0500):    1/ 1/1990   0:   0  to   1/15/1990   0:   0


 Maximum Accumulation Period (hours):     12


 PMERGE Stations in Output File:
    No.    ID           No.    ID           No.    ID           No.    ID

     1   170273          5   270741          9   274732          13   276234
     2   176905          6   270998         10   274808          14   276818
     3   177325          7   272842         11   275639          15   278885
     4   178641          8   273182         12   275780          16   437054
```

Table 5-4

Sample PMERGE Output List File (PMERGE.LST)

```
 Summary of Data from Formatted TD3240 Precipitation Files:


                 Valid Hours:

 Station   Zero  Nonzero  Accum    Total    %
   IDs                    Period   Valid  Valid
                                   Hours  Hours
  170273    333       3       0      336  100.0
  176905    327       9       0      336  100.0
  177325    333       3       0      336  100.0
  178641    333       3       0      336  100.0
  270741    334       2       0      336  100.0
  270998    334       2       0      336  100.0
  272842    326       3       0      329   97.9
  273182    334       2       0      336  100.0
  274732    331       5       0      336  100.0
  274808    334       2       0      336  100.0
  275639    267      69       0      336  100.0
  275780    334       2       0      336  100.0
  276234    331       5       0      336  100.0
  276818    326      10       0      336  100.0
  278885    333       3       0      336  100.0
  437054    334       2       0      336  100.0


                 Invalid Hours:

 Station   Flagged   Excessive   Missing Data   Missing Data    Total       %
   IDs     Missing    Accum     Before First    After Last    Invalid   Invalid
                      Period    Valid Record   Valid Record    Hours     Hours
  170273        0         0          0              0             0        0.0
  176905        0         0          0              0             0        0.0
  177325        0         0          0              0             0        0.0
  178641        0         0          0              0             0        0.0
  270741        0         0          0              0             0        0.0
  270998        0         0          0              0             0        0.0
  272842        7         0          0              0             7        2.1
  273182        0         0          0              0             0        0.0
  274732        0         0          0              0             0        0.0
  274808        0         0          0              0             0        0.0
  275639        0         0          0              0             0        0.0
  275780        0         0          0              0             0        0.0
  276234        0         0          0              0             0        0.0
  276818        0         0          0              0             0        0.0
  278885        0         0          0              0             0        0.0
  437054        0         0          0              0             0        0.0


  LAST DAY/HOUR PROCESSED:
     Year: 1990  Month:  1   Day: 15   Julian day:  15   Hour:  0


  End of run -- Clock time: 11:16:59
                      Date: 10-06-2005

        Elapsed clock time:        0.0 (seconds)

                  CPU time:        0.0 (seconds)
```

6. SMERGE SURFACE DATA METEOROLOGICAL PREPROCESSOR

SMERGE processes and reformats hourly surface observations, and creates either a formatted or an unformatted file which is used as input by the CALMET model. It is assumed that the observations have been validated by METSCAN (for CD144 formatted data) or similar utility. SMERGE reads "N" data files containing surface data from the following formats: (1) NCDC 80-column format (CD144 format), (2) NCDC Solar and Meteorological Surface Observational Network (SAMSON) CD-ROM format, (3) NCDC Hourly U.S. Weather Observations (HUSWO) CD-ROM format, (4) NCDC's ISHWO, Integrated Surface Hourly Weather Observations, (5) NCDC's TD-3505 data – Integrated Surface Hourly Data (ISHD) format, (6) NCDC's Air Force Datasav3 surface hourly data (TD-9956), (7) Generic data format of the type comma delimited file which will process hourly observational data which is not of the form of any of 1-6 above. Note that for (3) all parameters need to be extracted from the CD-ROM datasets, and if the HUSWO CD-ROM data are used, they must be extracted using the "English" units options. Finally, there is a further 'stand-alone' program, SURFCSV which will process any incremental time interval from sub-hourly data to multi-hour data. This utility is not currently part of SMERGE and is discussed in Section 6.1.2.

The output file (e.g., SURF.DAT) contains the processed hourly data for all the stations. SMERGE can also add stations to an existing formatted or unformatted output file. A free-formatted SURF.DAT file can be created by the user and read by CALMET. This option relieves the user of the need to run the preprocessor for short CALMET runs for which the surface data can easily be input manually, or when non-standard data sources (e.g., site-specific meteorological observations) are used.

SMERGE extracts the following variables from the NCDC surface data files: wind speed, wind direction, air temperature, ceiling height, cloud cover, surface pressure, relative humidity, and precipitation type code.

An option is provided to allow the surface data stored in the unformatted output file to be "packed." Packing reduces the size of the data file by storing more than one variable in each word. If the packing option is used, the eight hourly meteorological variables for each station are stored in three words:

Word 1:	TTTTPCRRR --	TTTT	= temp. (XXX.X deg. K)
		PC	= precipitation code (XX)
		RRR	= relative humidity (XXX. %)
Word 2:	pPPPPCCWWW --	pPPPP	= station pressure (pXXX.X mb, with p = 0 or 1 only)
		CC	= opaque sky cover (XX tenths)
		WWW	= wind direction (XXX. deg.)
Word 3:	HHHHSSSS --	HHHH	= ceiling height (XXXX. hundreds

	of feet)
SSSS	= wind speed (XX.XX m/s)

For example, the following variables,

Temperature	= 273.5 deg. K	Precipitation code	= 12
Relative humidity	= 88 percent		
Station pressure	= 1012.4 mb		
Opaque sky cover	= 8 tenths		
	Wind direction	= 160 degrees	
Ceiling height	= 120 hundreds of ft		
Wind speed	= 5.65 m/s		

are stored as the following three integer words:

273512088, 1012408160, 01200565

All of the packing and unpacking operations are performed internally by SMERGE and CALMET, and are transparent to the user. The header records of the data file contain information flagging the file to CALMET as a packed or unpacked file. If the user selects the unpacked format, eight full 4-byte words are used to store the data for each station.

The input files used by SMERGE consist of a control file (SMERGE.INP) containing user inputs, up to 150 surface data files (one per surface station), and an optional SMERGE data file (formatted or unformatted) created in a previous run of SMERGE. The data from the formatted surface station files are combined with the data in the existing SMERGE data file. A new SMERGE output file (formatted or unformatted) containing all the data is created by the program. In addition, SMERGE creates an output list file (SMERGE.LST) which summarizes the user options and run time statistics. Table 6-3 contains a listing of the input and output files used by SMERGE.

The SMERGE control file specifies the number and type of input data files, time zone of output data, packing flag, station data (two lines per station), and the starting and ending dates of the period to extract. The format of the SMERGE control input file follows the same rules as those used in the CALMET.INP file (refer to the CALMET section for details). Only data within the delimiter characters (!) are processed. The input data consist of a leading delimiter followed by the variable name, equals sign, input value or values, and a terminating delimiter (e.g., !XX = 12.5!). SMERGE.INP may be created/edited directly using a conventional editor, or it may be created/edited indirectly by means of the PC-based, Windows-compatible Graphical User Interface (GUI) developed for the geophysical preprocessors (CALPRO). A sample SMERGE control file is shown in Table 6-4. The format and contents of the SMERGE control file are explained in Table 6-5.

The SMERGE output list file (SMERGE.LST) contains a summary of the control file inputs, characteristics of the output data file, and routine statistics. A sample output list file is shown in Table 6-6, and a sample SURF.DAT output data file is shown in Table 6-7.

6.1 Generic Hourly Surface Data File

For hourly surface observational data that do not conform to any of the data sets above, a user can develop a comma delimited generic data file that SMERGE is able to reformat into a surface data file for direct use in CALMET. The data must be hourly and it must also be in the exact comma delimited format in order for it to be processed by SMERGE. The comma delimited data is most easily created from a spreadsheet such as Excel which can be used to process the raw data and align the data into the specific columns required for this data processing option. Note that no blank data are allowed. All hours are multiplied by 100 and missing data must be represented by 9999.00. In the event of no cloud information, the value 999 means ‘clear skies’. The first three lines of text must not be altered other than the ID number of the meteorological site, all other column headers and text should remain unchanged. Only one generic observation file can be processed at a time. Once the file has been created in an Excel spreadsheet or similar it must be saved as a comma delimited file. Note that no blank spaces are allowed in-between the commas. A sample of this file as the final saved comma delimited version is detailed in Table 6-1 below, Table 6-2 shows the same table in spreadsheet format. The data requirements per column and units are clear from Table 6-2.

Table 6-1: Sample of Generic Input Meteorological Data File Comma Delimited Input File Ready for SMERGE

```
GENERIC,Version,'2.0',Manually generated,Time as ending hour,
Station,ID,=',1400,Temp,Precip,Pressure,RH,Wdir10m,Wspeed10m,Ccover,Cheight
Month,Day,Year,Hour,DegC,mm,mb,%,deg,ms-1,tenths,hundreds_of_feet
7,1,2005,0,33.2,0,997.1,16.6,262,2.7,0,999
7,1,2005,100,32.6,0,996.8,16.6,265,3.3,0,999
7,1,2005,200,31.8,0,996.6,16.5,267,3.4,0,999
7,1,2005,300,30.9,0,997,16.9,276,3.8,0,999
7,1,2005,400,30.5,0,997.6,16.8,279,4.1,0,999
7,1,2005,500,30.9,0,998.3,16.8,280,4,0,999
7,1,2005,600,33,0,998.7,15,294,3.9,0,999
7,1,2005,700,34.8,0,998.9,15.6,303,4.6,0,999
7,1,2005,800,36.6,0,999.3,26.4,328,5.5,0,999
7,1,2005,900,38.2,0,999.3,29.6,332,6.2,0,999
7,1,2005,1000,39.6,0,999.3,23.3,336,8.3,0,999
7,1,2005,1100,39.5,0,999.1,23.5,337,8.2,0,999
7,1,2005,1200,40.9,0,998.5,18.4,341,8.2,0,999
7,1,2005,1300,42.2,0,998,12.3,350,8.5,0,999
7,1,2005,1400,42.1,0,997.4,9,356,9,0,999
7,1,2005,1500,41.7,0,996.9,9.4,353,8.2,0,999
7,1,2005,1600,41.4,0,996.9,10.1,352,7.4,0,999
7,1,2005,1700,40.3,0,997,12.6,350,5.8,0,999
7,1,2005,1800,38,0,997.4,19.9,338,3.4,0,999
7,1,2005,1900,35.1,0,997.6,36.8,304,2,0,999
7,1,2005,2000,34.2,0,998.1,36.3,269,2.3,0,999
7,1,2005,2100,33.7,0,998.3,24.5,260,2.6,0,999
7,1,2005,2200,33.5,0,998.2,19.4,261,3.4,0,999
7,1,2005,2300,33.2,0,998.1,15.9,272,3.8,0,999
```

Table 6-2: Sample of Generic Input Meteorological File in Spreadsheet Format

GENERIC Version '2.0 Manually generated Time as ending hour

Station	ID	='	1400	Temp	Precip	Pressure	RH	Wdir10m	Wspeed10m	Ccover	Cheight
Month	Day	Year	Hour	DegC	mm	mb	%	Deg	ms-1	tenths	h_of_feet
7	1	2005	0	33.2	0	997.1	16.6	262	2.7	0	999
7	1	2005	100	32.6	0	996.8	16.6	265	3.3	0	999
7	1	2005	200	31.8	0	996.6	16.5	267	3.4	0	999
7	1	2005	300	30.9	0	997	16.9	276	3.8	0	999
7	1	2005	400	30.5	0	997.6	16.8	279	4.1	0	999
7	1	2005	500	30.9	0	998.3	16.8	280	4	0	999
7	1	2005	600	33	0	998.7	15	294	3.9	0	999
7	1	2005	700	34.8	0	998.9	15.6	303	4.6	0	999
7	1	2005	800	36.6	0	999.3	26.4	328	5.5	0	999
7	1	2005	900	38.2	0	999.3	29.6	332	6.2	0	999
7	1	2005	1000	39.6	0	999.3	23.3	336	8.3	0	999

Table 6-3: SMERGE Input and Output Files

Unit	File Name	Type	Format	Description
ioprev	user input file name	Input	unformatted or formatted	Previous SMERGE data file to which stations are to be added (Used only if CFLAG=y)
iosurf	user input file name	output	unformatted or formatted	Output data file created by SMERGE containing the processed hourly surface data (this file is the SURF.DAT input file to CALMET)
io5	SMERGE. INP	input	formatted	Control file containing user inputs
io6	SMERGE.LST	output	formatted	List file (line printer output file)
Unit 7	user input file name	input	formatted	Surface data in one of three NCDC formats for station #1
Unit 7 plus 1	user input file name	input	formatted	Surface data in one of three NCDC formats for station #2

(Up to 150 new surface data files are allowed by SMERGE, although this may be limited by the number of files an operating system will allow open at one time. Multiple runs of SMERGE may be necessary.)

Table 6-4: Sample SMERGE Control File Inputs (SMERGE.INP)

```
SMERGE.INP      2.1             Hour Start and End Times with Seconds
-------------------------------------------------------------------------------

                     SMERGE PROCESSOR CONTROL FILE
                 --------------------------------------

    CALMET accepts data for a number of 'surface meteorology stations'
    in a single SURF.DAT file.  SMERGE creates this file from several
    single-station files of hourly data.  Use SMERGE one or more times
    to build the SURF.DAT file.

-------------------------------------------------------------------------------

INPUT GROUP: 0 -- Input and Output File Names
-----------------------------------------------------

--------------
Subgroup (0a)
--------------

    Number of formatted Surface Station files provided
    in Subgroup 0b.  Up to MXFF are allowed in 1 application,
    although this may be limited by your operating system.
    MXFF is set in PARAMS.SMG, which is compiled into SMERGE.EXE.
    (NFF)          No Default         ! NFF = 1    !

Other Input and Output Files:
-----------------------------

Default Name  Type          File Name
------------  ----          ---------
    PREV.DAT       input    ! PREVDAT = Firstrun.dat      !
    SURF.DAT       output   ! SURFDAT = Surf.dat      !
    SMERGE.LST     output   ! RUNLST  = Smerge2.lst      !


    All file names will be converted to lower case if LCFILES = T
    Otherwise, if LCFILES = F, file names will be converted to UPPER CASE
    (LCFILES)       Default: T       ! LCFILES = T     !
             T = lower case
             F = UPPER CASE
    NOTE: File/path names can be up to 70 characters in length

!END!

-------------
Subgroup (0b)
-------------

    The following NFF formatted Surface Station files are processed.
    Enter NFF 4-line groups identifying the file name (SFCMET), the
    station number (IFSTN), the station elevation (optional) in meters
    (XELEV), and the time zone of the data (ASTZ) for each file,
    followed by a group terminator.
```

```
NOTE:  ASTZ identifies the time zone used in the dataset.  The
       TD3505 and TD9956 data are prepared in UTC time rather than
       local time, so ASTZ = UTC+0000. is expected for these.
```

Table 6-4 (continued)
Sample SMERGE Control File Inputs
(SMERGE.INP)

```
    The optional station elevation is a default value used to calculate
    a station pressure from altimeter or sea-level pressure if the
    station presure is missing and the station elevation is missing in
    the file.  If XELEV is not assigned a value (i.e. XELEV does not
    appear in this control file), then no default elevation is available
    and station pressure remains missing.

    ! SFCMET = PORTLND.CDR!
    ! IFSTN  = 14764  !
    ! ASTZ   = UTC-0500    !   !END!


-----------------------------------------------------------------------------
INPUT GROUP: 1 -- Run control parameters
---------------

   --- Processing Period ---

       Starting date:  Year (IBYR) -- No default   ! IBYR  = 1990  !
                      Month (IBMO) -- No default   ! IBMO  = 1  !
                        Day (IBDY) -- No default   ! IBDY  = 08  !
                       Hour (IBHR) -- No default   ! IBHR  = 0  !
                    Second (IBSEC) -- No default   ! IBSEC = 0  !

       Ending date:    Year (IEYR) -- No default   ! IEYR  = 1990  !
                      Month (IEMO) -- No default   ! IEMO  = 1  !
                        Day (IEDY) -- No default   ! IEDY  = 15  !
                       Hour (IEHR) -- No default   ! IEHR  = 0  !
                    Second (IESEC) -- No default   ! IESEC = 0  !

      UTC time zone (char*8)(ABTZ) -- No default   ! ABTZ  = UTC-0500  !
         PST = UTC-0800, MST = UTC-0700
         CST = UTC-0600, EST = UTC-0500
         GMT = UTC+0000

   -----------------------
   NOTE:  Use explicit times in hours and seconds in time zone ABTZ.

   --- File Options ---

       Previous SURF.DAT file is used in this run?
       (LPREV)          No Default        ! LPREV = T    !
             T = Station from a previous SURF.DAT file are used
             F = Previous SURF.DAT is not used

       Number of stations to use from previous SURF.DAT file
       (NBSTN)          Default: 0        ! NBSTN = 0       !
             0 = Use ALL stations
            >0 = Use only those NBSTN stations listed in Input Group 2
```

Table 6-4 (concluded)
Sample SMERGE Control File Inputs
(SMERGE.INP)

```
   --- File Formats ---

       Format of previous SURF.DAT file
       (Used only if LPREV = T
       (INFORM)          Default: 2        ! INFORM = 2       !
             1 = Unformatted
             2 = Formatted

       Format of output SURF.DAT FILE
       (IOFORM)          Default: 2        ! IOFORM = 2       !
             1 = Unformatted
             2 = Formatted
       (IOPACK)          Default: 0        ! IOPACK = 0       !
             0 = NOT packed
             1 = Packed (used only if IOFORM = 1)

       Type of ALL Surface Station files in this run
       (JDAT)            No Default        ! JDAT = 2       !
             1 = CD144
             2 = NCDC SAMSON
             3 = NCDC HUSWO
             5 = ISHWO
             6 = TD3505
             7 = TD9956 (full DATSAV3)
             8 = GENERIC (.CSV format - see "sample_generic.csv")

     Format of input HUSWO file
     (Used only if JDAT = 3)
     (IHUSWO)                   Default: 1     ! IHUSWO = 1 !
        1 = All data are in English units
        2 = All data are in Metric units

     Calculate missing station pressure from altimeter or sea level
     pressure?
     (applies to JDAT = 1-3,8; always T for JDAT = 5-7)
     (LPCALC)                   Default: F     ! LPCALC = F !

!END!

------------------------------------------------------------------------------
INPUT GROUP: 2 -- Stations used from previous SURF.DAT file
---------------

   Data for the following NBSTN stations in the previous SURF.DAT
   file identified as PREV.DAT are transferred to the new SURF.DAT
   file created in this run.  Enter NBSTN lines identifying the
   station number (IBSTN) for each, followed by a group terminator.
   This Input Group is used only if LPREV=T and NBSTN>0.  All stations
   from a previous SURF.DAT file are transferred to the new SURF.DAT
   file if NBSTA=0.
```

```
-----------------------
Each line is treated as a separate input subgroup and therefore
must end with an input group terminator.
```

Table 6-5: SMERGE Control File Inputs (SMERGE.INP)

Input Group	Variable	Type	Description
First Line	DATASET	character*16	Dataset name (SMERGE.DAT)
	DATAVER	character*16	Dataset version
	DATAMOD	character*64	Dataset message field
(0a)	NFF	integer	Number of formatted input data files to be processed
	PREVDAT	character*70	Previous SMERGE output data file (used only if it is a continuation run)
	SURFDAT	character*70	SMERGE output data file
	RUNLST	character*70	Output list file
	LCFILES	logical	Convert filename to upper case (T) or lower case (F)
(0b)	SFCMET	character*70	Input meteorological data file name
	IFSTN	integer	Station number
	XELEV	real	Default station elevation in MSL (Optional). Used only if station pressure is calculated and station elevation is not available in the data file
	ASTZ	character*8	Time zone used in the input data set (UTC-0500=EST, UTC-0600=CST, UTC-0700=MST, UTC-0800=PST)
(1)	IBYR	Integer	Starting year of data to print (four digit)
	IBMO	Integer	Starting month
	IBDAY	integer	Starting day
	IBHR	integer	Starting time (hour 00-23)
	IBSEC	integer	Starting time (second 0000-3599)
	IEYR	integer	Ending year of data to print (four digit)
	IEMO	integer	Ending month
	IEDAY	integer	Ending day
	IEHR	integer	Ending time (hour 00-23)
	IESEC	integer	Ending time (second 0000-3599)

Table 6-5 (concluded)
SMERGE Control File Inputs (SMERGE.INP)

Input Group	Variable	Type	Description
(1)	ABTZ	character*8	Time zone of output data (UTC-0500=EST, UTC-0600=CST, UTC-0700=MST, UTC-0800=PST)
	LPREV	logical	Previous SURF.DAT file is used in this run (T: yes – F: No)
	NBSTN	integer	Number of station requested from previous SMERGE output data file (0=use all stations in file)
	INFORM	integer	Format of previous data file (PREVDAT) (1=unformatted, 2=formatte)
	IOFORM	integer	Output file format flag (1=unformatted, 2=formatted)
	IOPACK	integer	Flag indicating if output data are to be packed (0=no, 1=yes). Used only if IOFORM=1
	JDAT	integer	Formatted input data file format 1 = CD144 2 = NCDC SAMSON 3 = NCDC HUSWO 4 = CD144 (extended record format with precipitation rate) 5 = TD3505(CD) NCDC Integrated Surface Hourly CD-ROM Set 6 = TD3505 NCDC Integrated Surface Hourly Database 7 = TD9956 (full DATSAV3) 8 = Generic (Comma delimited format)
	IHUSWO	integer	1 = All data are in English units 2 = All data are in Metric units
	LPCALC	logical	Calculation of missing station pressure from altimeter or sea level pressure?
(2)	IBSTN	Integer	IDs of stations used from the previous SURF.DAT file (if any). NBSTN records must be provided.

Table 6-6: Sample SMERGE Output List File (SMERGE.LST)

```
                         SMERGE OUTPUT SUMMARY
                  VERSION:  5.60     LEVEL:  050921

 -------------------------------------------------
 NOTICE: Starting year in control file sets the
         expected century for the simulation.  All
         YY years are converted to YYYY years in
         the range:  1940 2039
 -------------------------------------------------


 Control file name: c:\test\new\smerge\smerge2.inp
 Output list file name: smerge2.lst
 Output file name: surf.dat
 Continuation Run?  T
 Previous SMERGE output data file: firstrun.dat



 Station ID    Time Zone   SAMSON Surface Data
                                Input Files

      14764  UTC+0  0    portlnd.cdr


 Period to Extract (in time zone:UTC-0500):    1/ 8/1990   0:   0  to   1/15/1990   0:   0

                         ********************

 Data Read from Existing Surface Data Input File:


SURF.DAT        2.1             Hour Start and End Times with Seconds
   1
Produced by SMERGE Version: 5.60  Level: 050921
NONE
UTC-0500
   Time Zone:UTC-0500
   File Format (1=unformatted,2=formatted):  2
   Packing Code:  0

   Period (in time zoneUTC-0500):    1/ 8/1990   0:   0  to   1/15/1990   0:   0


   Stations Available in Existing Surface Data Input File:
    No.       ID         No.       ID         No.       ID         No.       ID

     1       14606        2       14611        3       14745        4       14742


                         ********************


 Error in Subr. RDWRITS: Next date and hour from the existing surface data input file,  199000823
 does not match the expected date and hour,  199000900
```

```
 No. Missing Values for    WS     WD ICEIL   ICC TEMPK   IRH  PRES
                            0      0     0     0     0     0     0


                          ********************
```

Table 6-6 (concluded)
Sample SMERGE Output List File
(SMERGE.LST)

```
Characteristics of SMERGE Output (SURF.DAT) File:

  Time Zone:     5
  File Format (1=unformatted, 2=formatted):  2

Surface Stations in Output File:
   No.       ID         No.       ID         No.       ID         No.       ID

    1       14606        3       14745        4       14742        5       14764
    2       14611




 LAST DAY/HOUR PROCESSED:
    Year: 1990  Month:  1   Day:  9   Julian day:   9   Hour:  0


 End of run -- Clock time: 11:15:15
                     Date: 10-06-2005

       Elapsed clock time:        0.0 (seconds)

                 CPU time:        0.0 (seconds)
```

Table 6-7: Sample SURF.DAT Output Data File (SURF.DAT)

```
SURF.DAT        2.1             Hour Start and End Times with Seconds
   1
Produced by SMERGE Version: 5.601  Level: 051005
NONE
UTC-0700
  1993   7   0     0  1993   7   5  3600    4
   14606
   14611
   14745
   14742
1993   7   0    0   1993   7   0 3600
    3.087  220.000  999    0  263.706   98  956.997    0
    3.087  140.000  999    0  263.706   98  956.997    0
    3.087  180.000  999    0  263.706   98  956.997    0
    3.087   90.000  999    0  263.706   98  956.997    0
1993   7   1    0   1993   7   1 3600
    3.601  220.000  999    0  263.706   98  956.319    0
    3.601  140.000  999    0  263.706   98  956.319    0
    3.601  180.000  999    0  263.706   98  956.319    0
    3.601   90.000  999    0  263.706   98  956.319    0
1993   7   2    0   1993   7   2 3600
    3.087  220.000  999    0  263.150   99  955.642    0
    3.087  140.000  999    0  263.150   99  955.642    0
    3.087  180.000  999    0  263.150   99  955.642    0
    3.087   90.000  999    0  263.150   99  955.642    0
1993   7   3    0   1993   7   3 3600
    4.116  220.000  999    0  263.150   98  955.303    0
    4.116  140.000  999    0  263.150   98  955.303    0
    4.116  180.000  999    0  263.150   98  955.303    0
    4.116   90.000  999    0  263.150   98  955.303    0
1993   7   4    0   1993   7   4 3600
    3.087  220.000  999    0  262.594   98  955.303    0
    3.087  140.000  999    0  262.594   98  955.303    0
    3.087  180.000  999    0  262.594   98  955.303    0
    3.087   90.000  999    0  262.594   98  955.303    0
1993   7   5    0   1993   7   5 3600
    1.543  220.000  999    0  262.594   98  956.319    0
    1.543  140.000  999    0  262.594   98  956.319    0
    1.543  180.000  999    0  262.594   98  956.319    0
    1.543   90.000  999    0  262.594   98  956.319    0
```

6.1.1 Generic Multi Time Interval Surface Data File

For sub-hourly or any time interval surface observation data that do not conform to any of the data sets above, a user can develop a generic comma delimited data file and process it through a stand alone program, SURFCSV to create a SURF.DAT file with one single station. The purpose of SURFCSV is to read a comma delimited format meteorological data file, extract the surface data at fixed intervals and output as SURF.DAT v2.1 with beginning and ending times that span the interval requested. This program is different to the Generic option (Section 6.1.1) offered in SMERGE which only processes hourly surface observation data which must be in the exact comma-delimited format as shown in Table 6-1. SURFCSV on the other hand is not part of SMERGE and must be executed separate of the GUI. Unlike the Generic format, SURFCSV does not require the user to have the data in specific columns but allows much more flexibility through the use of a user control input file where the user specifically states what data is available, what column the said data is in and accounts for any time period interval to the nearest minute. SURFCSV will then process the comma delimited file and create a surface data file which can be read directly into CALMET. No QA steps are employed so the user must take responsibility for the adequacy of the data. Furthermore, the single observation nearest the end of the output interval selected may be used if the exact time at the end of an interval is not in the file (missing data). No averaging is done.

The data record can be of any user defined time increment, i.e., from one minute to multi-hours. The user is required to give an output starting time and output ending time specifying the data record to the nearest minute interval. The data interval to the nearest minute is also specified. The user has the choice to use two different date/time stamp formats, either YYYY-MM-DD hh:mm or, MM/DD/YYYY hh:mm. It is up to the user to make sure the time and date stamp conform to either of these formats. This can be done using Excel. The SURFCSV control file requests specific information as to which column the wind speed, wind direction, temperature, relative humidity, pressure, cloud cover and cloud ceiling height can be found. A choice of units is available for each variable which saves the user time in having to first convert the data into the correct format, prior to processing.

The comma delimited format required for SURFCSV is specifically designed to allow users to make use of spreadsheets where the raw data can most easily be observed and sorted. Unlike the hourly Generic format where missing data in the file must be replaced with the missing value indicator of 9999.00 for real numbers and 9999 for integers, missing values are automatically replaced in SURFCSV.

Table 6.8 provides a sample control input file required for SURFCSV, while Table 6.9 provides detailed information of the control input file. A sample CSV.DAT file is shown in Table 6.10. Note that the first line of the sample control input file (Table 6.8) must remain unchanged as it provides the default file name and version number. The second line refers to the number of lines of comment records which follows immediately afterward. The rest of the parameters are detailed in Table 6.9. Note that both the input control file must be called SURFCSV.INP and the comma delimited data file (6.10), CSV.DAT, so this processor is best run using a "batch" file that renames files specific to an application. Data records within the file are identified by portions of the text field that follow the delimiter character '#', so these should not be altered. The order of the data records is not important, but should be similar to the standard example for clarity.

Table 6-8: Sample Generic SURFCSV Control Input File (SURFCSV.INP)

```
SURFCSV.INP     1.0
1
Sample input control file (Any order but keep exact RHS text and # delimiter)
106645                         #Station_ID integer
UTC-0500                       #Time_Zone (EST=UTC-0500)
2010 01 01 00 15               #Output Starting_Time (YYYY MM DD hh mm)
2010 02 01 00 00               #Output Ending_Time   (YYYY MM DD hh mm)
00 15                          #Output Time_Increment (hh mm)
1                              #Output Time_Method (1=exact, 2=nearest)
1                              #SKIP_headers (number of rows before data)
1                              #DATE_column
1                              #TIME_column (may be same as date column)
YYYY-MM-DD hh:mm               #DATETIME_format (YYYY-MM-DD hh:mm), or
                                                (MM/DD/YYYY hh:mm)
11                             #WINDSPEED_column     (0 = NA)
14                             #WINDDIRECTION_column (0 = NA)
4                              #TEMPERATURE_column   (0 = NA)
8                              #RELHUMIDITY_column   (0 = NA)
0                              #PRESSURE_column      (0 = NA)
0                              #CLOUD_column         (0 = NA) typically cloud+height
0                              #CEILING_column       (0 = NA)
0                              #CLOUDCOVER_column    (0 = NA)
MPH                            #WINDSPEED_units      (MPH, MPS, KTS)
DEG                            #WINDDIRECTION_units  (DEG, NSEW)
F                              #TEMPERATURE_units    (F, C, K)
%                              #RELHUMIDITY_units    (%,FRAC)
MB                             #PRESSURE_units       (MB, IN, ATM)
FT                             #CEILING_units        (FT, 100FT, M, KM)
TENTHS                         #CLOUDCOVER_units     (TENTHS)
```

Table 6-9: SURFCSV Control File Inputs (SURFCSV.INP)

Line	Variable	Type	Description
1	Dataset	character*16	Control input file dataset name
1	Dataver	Character*16	Dataset Version
2	Ncom	Integer	Number of Comment records to follow
3	Title	character*180	Comments (Ncom Lines)
4	ID	Integer	Station ID Number
5	ATZONE		UTC—0800=PST; UTC-0700=MST; UTC-0600=CST; UTC-0500=EST Western hemisphere-negative Eastern hemisphere-positive
6	IBEG	Integers	Output Starting time; YYYY MM DD hh mm
7	IEND	Integers	Output Ending time; YYYY MM DD hh mm
8	NHRINC	Integers	Output time increment; hh mm
9	MTIME	Integer	Output time method; (1) exact or (2) nearest
10	NSKIP	Integer	Skip the header records, provide number of rows of header records before data starts
11	ICDATE	Integer	Column of data representing the date
12	ICTIME	Integer	Column of data representing the time, can be the same column as the date
13	DATETIME	Integer	Format of the date and time YYYY-MM-DD hh:mm or, MM/DD/YYYY hh:mm
14		Integer	Column of data representing wind speed; 0 = not applicable
15		Integer	Column of data representing wind direction; 0 = not applicable
16		Integer	Column of data representing temperature; 0 = not applicable
17		Integer	Column of data representing relative humidity; 0 = not applicable
18		Integer	Column of data representing pressure; 0 = not applicable
19		Integer	Column of data representing cloud column; typically cloud+height; 0 = not applicable
20		Integer	Column of data representing the cloud ceiling height; 0 = not applicable
21		Integer	Column of data representing cloud cover; 0 = not applicable
22		Character	Units of wind speed (mph, mps, knots)

Table 6-9 (continued)
SURFCSV Control File Inputs (SURFCSV.INP)

Line	Variable	Type	Description
23		Character	Units of wind direction (deg, nsew)
24		Character	Units of temperature (F=Farenheit, C=degrees Celcius, K=degrees Kelvin)
25		Character	Units of relative humidity (%=percentage, FRAC=fraction)
26		character	Units of pressure (MB=millibar, IN, ATM=atmospheres as 101325 Pa)
27		character	Units of ceiling height units (FT=feet, 100FT=hundreds of feet, M=meters, KM=kilometers)
28		character	Units of cloud cover (tenths)

Table 6-10: SURFCSV Sample input file (CSV.DAT)

```
Time,TemperatureF,DewpointF,PressureIn,WindDirection,WindDirectionDegrees,WindSpeedMPH
,WindSpeedGustMPH,Humidity,HourlyPrecipIn,Conditions,Clouds,dailyrainin,SoftwareType
1/1/2011 0:00,61.1,52.1,30.11,ESE,108,0,0,72,0,,,0,WxSolution 1.8.5.6
1/1/2011 0:05,61.1,52.1,30.12,SE,142,0,0,72,0,,,0,WxSolution 1.8.5.6
1/1/2011 0:10,61.1,52.1,30.12,SE,143,0,0,72,0,,,0,WxSolution 1.8.5.6
1/1/2011 0:11,61,52,30.12,SE,143,0,0,72,0,,,0,WxSolution 1.8.5.6
1/1/2011 0:15,60.9,51.9,30.12,SE,143,0,0,72,0,,,0,WxSolution 1.8.5.6
1/1/2011 0:16,60.9,51.9,30.12,SE,143,0,0,72,0,,,0,WxSolution 1.8.5.6
1/1/2011 0:21,60.8,51.9,30.11,East,90,0,0,73,0,,,0,WxSolution 1.8.5.6
1/1/2011 0:26,60.6,51.8,30.11,ESE,123,0,0,73,0,,,0,WxSolution 1.8.5.6
1/1/2011 0:27,60.6,51.8,30.11,ESE,123,0,0,73,0,,,0,WxSolution 1.8.5.6
1/1/2011 0:32,60.5,51.7,30.11,ESE,123,0,0,73,0,,,0,WxSolution 1.8.5.6
1/1/2011 0:33,60.5,51.7,30.11,ESE,123,0,0,73,0,,,0,WxSolution 1.8.5.6
1/1/2011 0:37,60.4,51.7,30.11,ESE,123,0,0,73,0,,,0,WxSolution 1.8.5.6
1/1/2011 0:38,60.3,51.5,30.11,ESE,123,0,0,73,0,,,0,WxSolution 1.8.5.6
1/1/2011 0:43,60.2,51.5,30.1,ESE,109,0,0,73,0,,,0,WxSolution 1.8.5.6
1/1/2011 0:44,60.3,51.7,30.1,ESE,109,0,0,73,0,,,0,WxSolution 1.8.5.6
1/1/2011 0:48,60.1,51.7,30.1,ENE,77,0,0,74,0,,,0,WxSolution 1.8.5.6
1/1/2011 0:49,60.2,51.8,30.1,ENE,77,0,0,74,0,,,0,WxSolution 1.8.5.6
1/1/2011 0:54,60.1,51.9,30.1,ESE,102,0,0,74,0,,,0,WxSolution 1.8.5.6
1/1/2011 0:59,60,51.9,30.1,SE,135,0,0,75,0,,,0,WxSolution 1.8.5.6
1/1/2011 1:04,60.1,52.1,30.1,ENE,71,0,0,75,0,,,0,WxSolution 1.8.5.6
1/1/2011 1:09,59.9,51.8,30.1,ENE,71,0,0,75,0,,,0,WxSolution 1.8.5.6
1/1/2011 1:14,59.8,51.9,30.09,ENE,68,0,0,75,0,,,0,WxSolution 1.8.5.6
1/1/2011 1:19,59.7,51.9,30.09,East,99,0,0,75,0,,,0,WxSolution 1.8.5.6
1/1/2011 1:24,59.5,51.9,30.09,ESE,112,0,0,76,0,,,0,WxSolution 1.8.5.6
1/1/2011 1:30,59.5,52,30.09,SE,132,0,0,76,0,,,0,WxSolution 1.8.5.6
1/1/2011 1:35,59.4,52.4,30.09,East,91,3,3,78,0,,,0,WxSolution 1.8.5.6
1/1/2011 1:40,59.3,52.2,30.09,East,92,0,0,77,0,,,0,WxSolution 1.8.5.6
1/1/2011 1:45,59.4,52.2,30.09,SE,132,3,3,77,0,,,0,WxSolution 1.8.5.6
1/1/2011 1:46,59.5,52.4,30.09,SSE,149,0,0,77,0,,,0,WxSolution 1.8.5.6
1/1/2011 1:50,59.2,52.2,30.09,NE,45,1,1,78,0,,,0,WxSolution 1.8.5.6
1/1/2011 1:51,59.3,52.3,30.09,NE,45,0,0,78,0,,,0,WxSolution 1.8.5.6
1/1/2011 1:55,59.3,52.2,30.09,SE,127,3,3,77,0,,,0,WxSolution 1.8.5.6
1/1/2011 1:56,59.3,52.2,30.09,SE,126,3,3,77,0,,,0,WxSolution 1.8.5.6
1/1/2011 1:57,59.3,52.4,30.09,SSE,151,0,0,78,0,,,0,WxSolution 1.8.5.6
1/1/2011 2:00,59.2,52.3,30.09,ESE,118,1,1,78,0,,,0,WxSolution 1.8.5.6
1/1/2011 2:01,59.1,52.3,30.09,ESE,118,0,0,78,0,,,0,WxSolution 1.8.5.6
1/1/2011 2:02,59.2,52.3,30.09,ESE,120,3,3,78,0,,,0,WxSolution 1.8.5.6
1/1/2011 2:05,59.3,52.4,30.09,SE,127,0,0,78,0,,,0,WxSolution 1.8.5.6
1/1/2011 2:06,59.3,52.4,30.09,ESE,119,2,2,78,0,,,0,WxSolution 1.8.5.6
1/1/2011 2:10,59.3,52.3,30.1,ESE,116,0,0,78,0,,,0,WxSolution 1.8.5.6
1/1/2011 2:11,59.3,52.3,30.1,ESE,116,0,0,78,0,,,0,WxSolution 1.8.5.6
1/1/2011 2:16,59.2,52.2,30.1,ESE,123,0,0,78,0,,,0,WxSolution 1.8.5.6
1/1/2011 2:21,59.3,52.2,30.1,ENE,63,2,2,77,0,,,0,WxSolution 1.8.5.6
1/1/2011 2:26,59.4,52.3,30.1,SE,133,0,0,77,0,,,0,WxSolution 1.8.5.6
1/1/2011 2:27,59.4,52.3,30.1,SE,133,0,0,77,0,,,0,WxSolution 1.8.5.6
```

```
1/1/2011 2:32,59.1,52.1,30.1,SE,136,0,0,78,0,,,0,WxSolution 1.8.5.6
1/1/2011 2:34,59.2,52.3,30.1,ESE,123,3,3,78,0,,,0,WxSolution 1.8.5.6
1/1/2011 2:37,59.1,52.3,30.09,ESE,119,0,0,78,0,,,0,WxSolution 1.8.5.6
1/1/2011 2:39,59.2,52.3,30.09,ESE,119,0,0,78,0,,,0,WxSolution 1.8.5.6
1/1/2011 2:42,59.1,52.4,30.09,ESE,119,0,0,78,0,,,0,WxSolution 1.8.5.6
1/1/2011 2:44,59,52.3,30.09,East,85,0,0,78,0,,,0,WxSolution 1.8.5.6
1/1/2011 2:49,58.9,52.2,30.09,SE,137,0,0,79,0,,,0,WxSolution 1.8.5.6
1/1/2011 2:50,58.8,52.1,30.09,ESE,119,1,1,79,0,,,0,WxSolution 1.8.5.6
1/1/2011 2:54,58.7,52.1,30.09,ESE,104,3,3,79,0,,,0,WxSolution 1.8.5.6
1/1/2011 2:55,58.8,52.2,30.09,East,90,0,0,79,0,,,0,WxSolution 1.8.5.6
1/1/2011 3:00,58.7,52.3,30.09,ESE,111,0,0,79,0,,,0,WxSolution 1.8.5.
```

7. PROGNOSTIC METEOROLOGICAL DATA PROCESSORS

Optionally, CALMET can accept prognostic data extracted from models such as MM5, Eta, RUC, RAMS, WRF and TAPM and incorporate them in the computation of its own gridded meteorological fields. Prognostic data for CALMET are typically prepared as a 3D.DAT file. Earlier formats for these data are also supported: MM4.DAT and MM5.DAT, referring to the most likely origin of these earlier data sets, i.e. the PSU/NCAR Mesoscale Modeling System 4 (MM4) or the PSU/NCAR Mesoscale Modeling System 5 (MM5). However, not all modeling options in CALMET may be available if an earlier file format is used. Interface programs that create the 3D.DAT files for CALMET from MM5, Eta, RUC, RAMS and TAPM output products (CALMM5, CALETA, CALRUC, CALRAMS, CALWRF and CALTAPM) are described in the following sections, followed by a description of the 3D.DAT file format in Section 7.7.

7.1 CALMM5 Preprocessor

CALMM5 operates on the output from the PSU/NCAR Mesoscale Modeling System 5 (MM5), Version 3. It contains options to output the following MM5 variables: horizontal and vertical velocity components, pressure, temperature, relative humidity, and water vapor, cloud, rain, snow, ice and graupel mixing ratios (if available in MM5). Table 7-1 lists user-controlled options in CALMM5.INP.

The recommended format of the output file from CALMM5 for CALMET applications is the 3D.DAT file format. Other output formats are available, including the old MM4.DAT format, but these are intended for specialty uses. A 2D.DAT file may also be requested for surface variables (those without a vertical profile). Table 7-2 lists the variables in 3D.DAT and MM4.DAT. Table 7-3 lists the variables in 2D.DAT files. Note that in 3D.DAT files, the five mixing ratios of cloud, rain, ice, snow, and graupel in Table 7-2 can be zeros in most of profiles. To reduce file size in these cases, the zeros are compressed using a negative value. For example, -5 means all five mixing ratios are zero.

CALMM5 reads and interprets all information contained in the MM5 header (physical options, dates, grid size and location, etc.). Note that the MM5 header is read only once, for the first MM5 record in the MM5 file. MM5 grid specifications (latitude, longitude) are therefore saved at that time and assumed valid for all subsequent times. This assumption fails if MM5 grid has moved during the MM5 simulation. The output files from CALMM5 preserves some of the information of original MM5 configuration. In the latest 3D.DAT/2D.DAT files (Data set Version 2.0), the header records have been modified to include comment lines. These lines can be used to preserve detailed MM5 configurations in the further development of CALMM5.

Data processing in CALMM5 is mainly due to the differences of coordinate systems between MM5 and CALMET. In MM5, an Arakawa B-grid is used (Figure 7-1). There are two sets of horizontal grid locations: dot points and cross points. The dimension of cross points is one less than that of dot points, that is, if NX in the dimension of dot points, then dimension of cross points is NX-1.

Table 7-1: User-Controlled Options in CALMM5.INP

Output Option	3D.DAT	2D.DAT	MM4.DAT
Domain selection using I/J or Lat/Lon	Y	Y	Y
Beg/End X/Y (I/J or Lat/Lon)	Y	Y	Y
Beg/End Z (K)	Y	N	Y
Beg/End Date	Y	Y	Y
Output File format	Y	N	Y
Vertical velocity (w) profile	Y	N	N
Specific and relative humidity profile	Y	N	N
Cloud and rain content profile	Y	N	N
Ice and snow content profile	Y	N	N
Graupel content profile	Y	N	N
Output surface 2D variables	Y	Y	N

Table 7-2: Variables Available in CALMM5 Three-dimensional Output Files

Variables	3D.DAT	MM4.DAT
Vertical profile		
Pressure	Y	Y
Height above M.S.L	Y	Y
Temperature	Y	Y
Wind direction	Y	Y
Wind speed	Y	Y
Vertical velocity	Y	Y
Relative humidity	Y	Y (dew point depression)
Vapor mixing ratio	Y	N
Cloud mixing ratio	Y*	N
Rain mixing ratio	Y*	N
Ice mixing ratio	Y*	N
Snow mixing ratio	Y*	N
Graupel mixing ratio	Y*	N
Surface variables in header		
Sea level pressure	Y	Y
Rain fall	Y	Y
Snow cover	Y	Y
Short wave radiation at surface	Y	N
Long wave radiation at surface	Y	N
Air temperature at 2 meters above ground	Y**	N
Specific humidity at 2 meters above ground	Y**	N
U-wind at 10 meters above ground	Y**	N
V-wind at 10 meters above ground	Y**	N
Sea surface temperature	Y	N

* Exists only when available in MM5 output.

** Set to zero or blank if not available.

Table 7-3: Possible Variables in 2D.DAT files

Variables	2D.DAT
Ground temperature	Y
PBL height	Y
Sensible heat flux	Y
Latent heat flux	Y
Frictional velocity	Y
Short wave radiation at surface	Y
Long wave radiation at surface	Y
Air temperature at 2 m above ground	Y*
Specific humidity at 2 m above the ground	Y*
U-wind at 10 m above the ground	Y*
V-wind at 10 m above the ground	Y*
Sea surface temperature	Y

* Exists only when available in MM5 output

MM5 defines U and V wind components on dot points, and all other variables on cross points. In the vertical direction, MM5 uses sigma coordinate (Figure 7-2), where sigma is calculated using Equation 7-1 where P is pressure, and P_{top} is the pressure at model top. $P*$ is the pressure difference between the

$$\sigma = (P - P_{Top})/P* \tag{7-1}$$

surface and the model top. All variables are defined at half sigma levels, except vertical velocity (W), which is defined on full sigma levels. Table 7-4 lists defined horizontal and vertical locations for MM5 variables used by CALMM5.

CALMET uses a non-staggered horizontal coordinate system (see Figure 7-3) and a terrain-following vertical coordinate system. In horizontal, all variables are defined at the center of each grid cell. Therefore the staggered MM5 variables have to be interpolated to one of its two set grid locations, either dot points or cross points. Horizontal wind is the most important in air pollution modeling, which is defined at MM5 dot points. To keep it unaffected, all MM5 variables defined at MM5 cross points are interpolated to dot points using Equation 7-2 for internal grids

$$x_d(i,j) = [x_c(i-1,j-1) + x_c(i,j-1) + x_c(i-1,j) + x_c(i,j)]/4.0 \tag{7-2}$$

where x_d is the value at a dot points, and x_c is the value at four surrounding cross points. For a dot point along the model boundary, only the two cross points next to it are used. The interpolation in Equation 7-2 is based on actual horizontal spatial distance in meters, not on latitude and longitude degrees. The X and Y, or I and J, in MM5 horizontal coordinate system are confusing. MM5 uses X (or I) as its south-north coordinate, and Y (or J) as its west-east coordinate, which is opposite to the conventional use of X and Y. To eliminate this confusion, the output from CALMM5 uses conventional X and Y definition, that is, X (or I) represents the west-east direction, and Y (or J) the south-north direction.

In the vertical direction, MM5 vertical velocities (present in MM5 Version 3 and only in non-hydrostatic runs in MM5 Version 2) are computed at full sigma levels while all other variables are defined at half sigma levels (see Figure 7-2). CAMM5 interpolates the vertical velocities at full sigma levels to half sigma levels first using Equation 7-3

$$w(k) = [w(k) + w(k+1)]/2.0 \tag{7-3}$$

where k is vertical level index starting from the model top. Since the vertical velocity in MM5 is defined at cross point, the vertical velocities from Equation 7-3 are further interpolated to dot points using Equation 7-2.

Table 7-4: Defined Horizontal and Vertical Locations for MM5 Variables Used in CALMM5

Variables	Native MM5 Horizontal	Native MM5 Vertical	Output from CALMM5 Horizontal	Output from CALMM5 Vertical
Pressure	Cross point	Half sigma	Dot point	Half sigma
Temperature	Cross point	Half sigma	Dot point	Half sigma
Wind direction	Dot point	Half sigma	Dot point	Half sigma
Wind speed	Dot point	Half sigma	Dot point	Half sigma
Vertical velocity	Cross point	Full sigma	Dot point	Half sigma
Relative humidity	Cross point	Half sigma	Dot point	Half sigma
Vapor mixing ratio	Cross point	Half sigma	Dot point	Half sigma
Cloud mixing ratio	Cross point	Half sigma	Dot point	Half sigma
Rain mixing ratio	Cross point	Half sigma	Dot point	Half sigma
Ice mixing ratio	Cross point	Half sigma	Dot point	Half sigma
Snow mixing ratio	Cross point	Half sigma	Dot point	Half sigma
Graupel mixing ratio	Cross point	Half sigma	Dot point	Half sigma
Sea level pressure	Cross point		Dot point	
Rain fall	Cross point		Dot point	
Snow cover	Cross point		Dot point	
Short wave radiation at surface	Cross point		Dot point	
Long wave radiation at surface	Cross point		Dot point	
Air temperature at 2 meters above ground	Cross point		Dot point	
Specific humidity at 2 meters above ground	Cross point		Dot point	
U-wind at 10 meters above ground	Cross point		Dot point	
V-wind at 10 meters above ground	Cross point		Dot point	
Sea surface temperature	Cross point		Dot point	
Ground temperature	Cross point		Dot point	
PBL height	Cross point		Dot point	
Sensible heat flux	Cross point		Dot point	
Latent heat flux	Cross point		Dot point	
Frictional velocity	Cross point		Dot point	

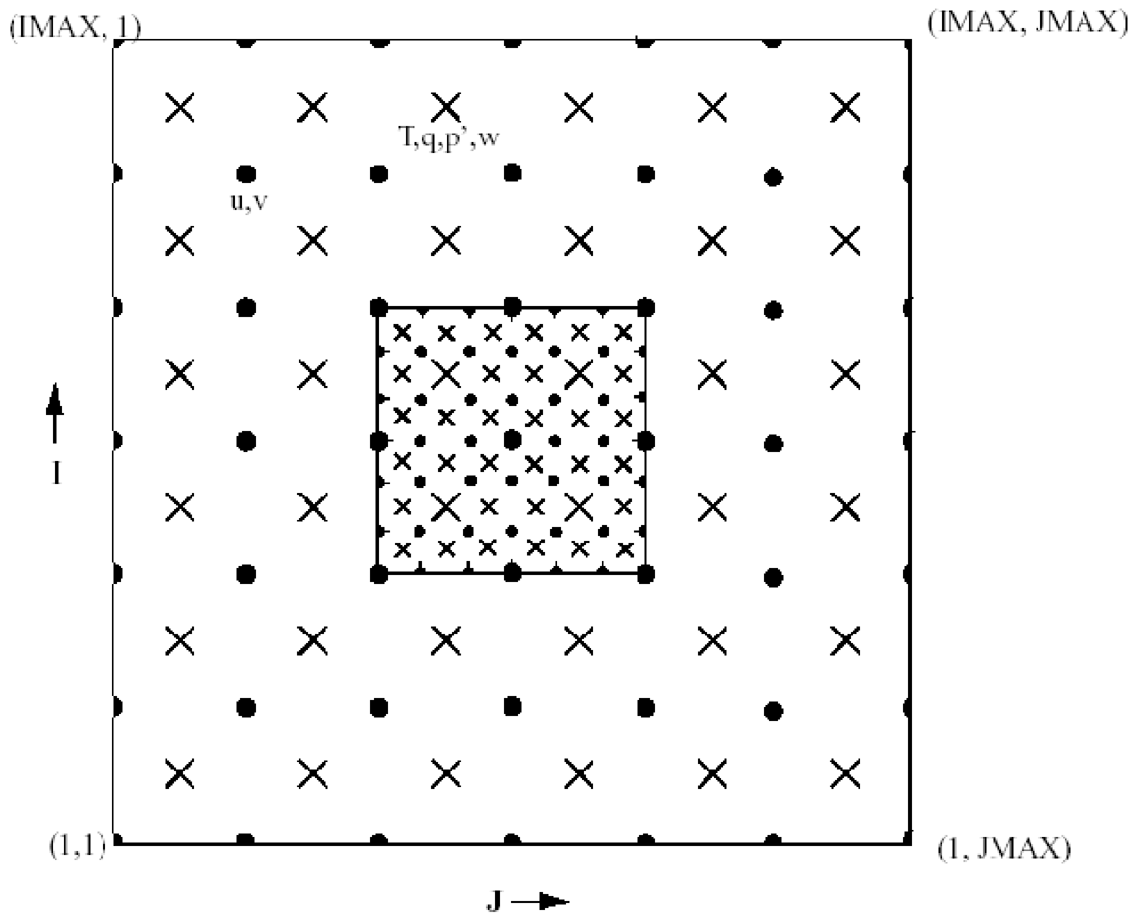

Figure 7-1: MM5 horizontal grid (Arakawa B-grid) showing the staggering of the dot (.) and cross (x) grid points. The smaller inner box is a representative mesh staggering for a 3:1 coarse-grid distance to fine-grid distance ratio (from NCAR, 1998).

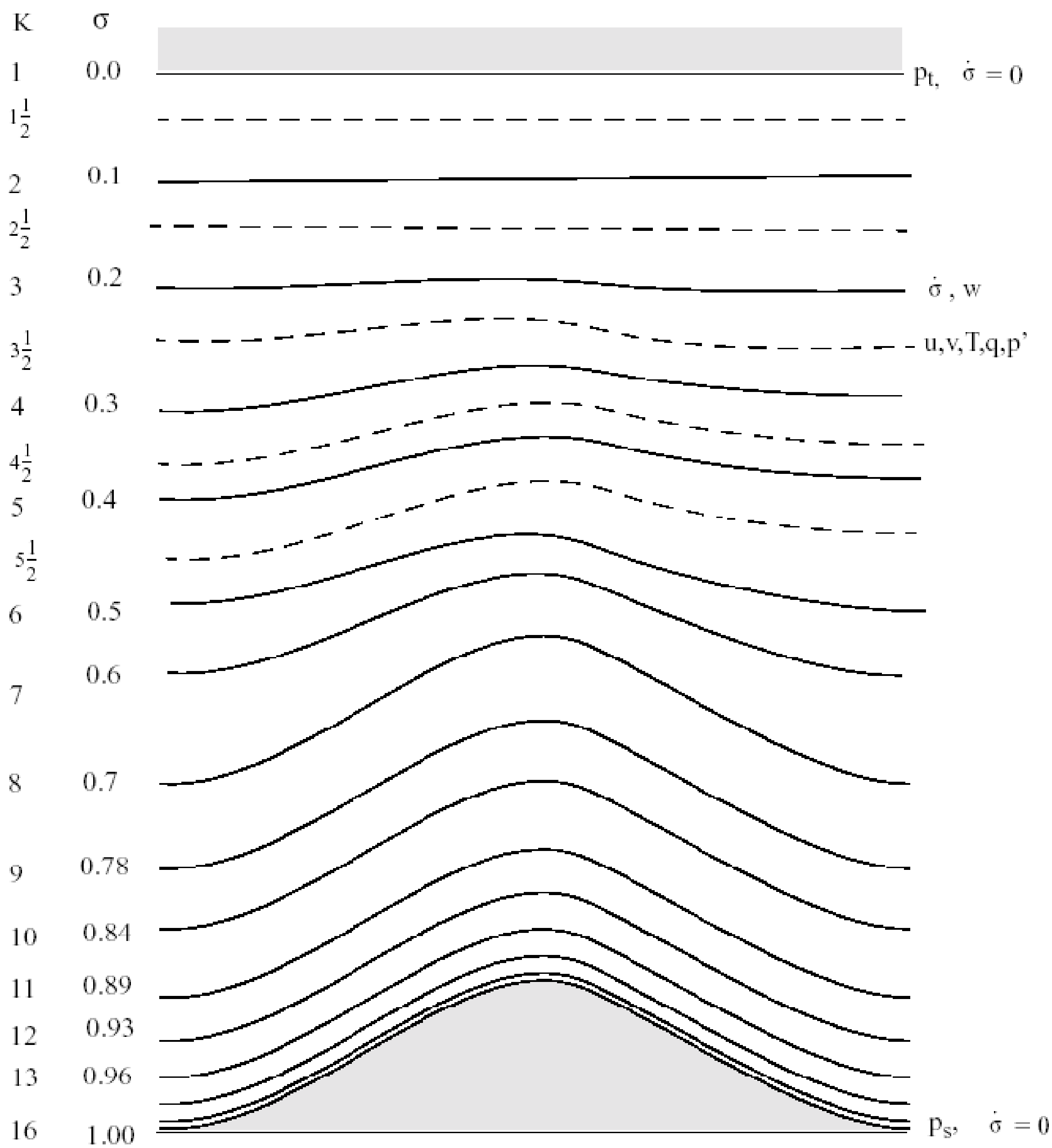

Figure 7-2: **Schematic representation of the vertical structure used in MM5. The example is for 15 vertical layers. Dashed lines denote half-sigma levels, solid lines denote full-sigma levels (from NCAR, 1998).**

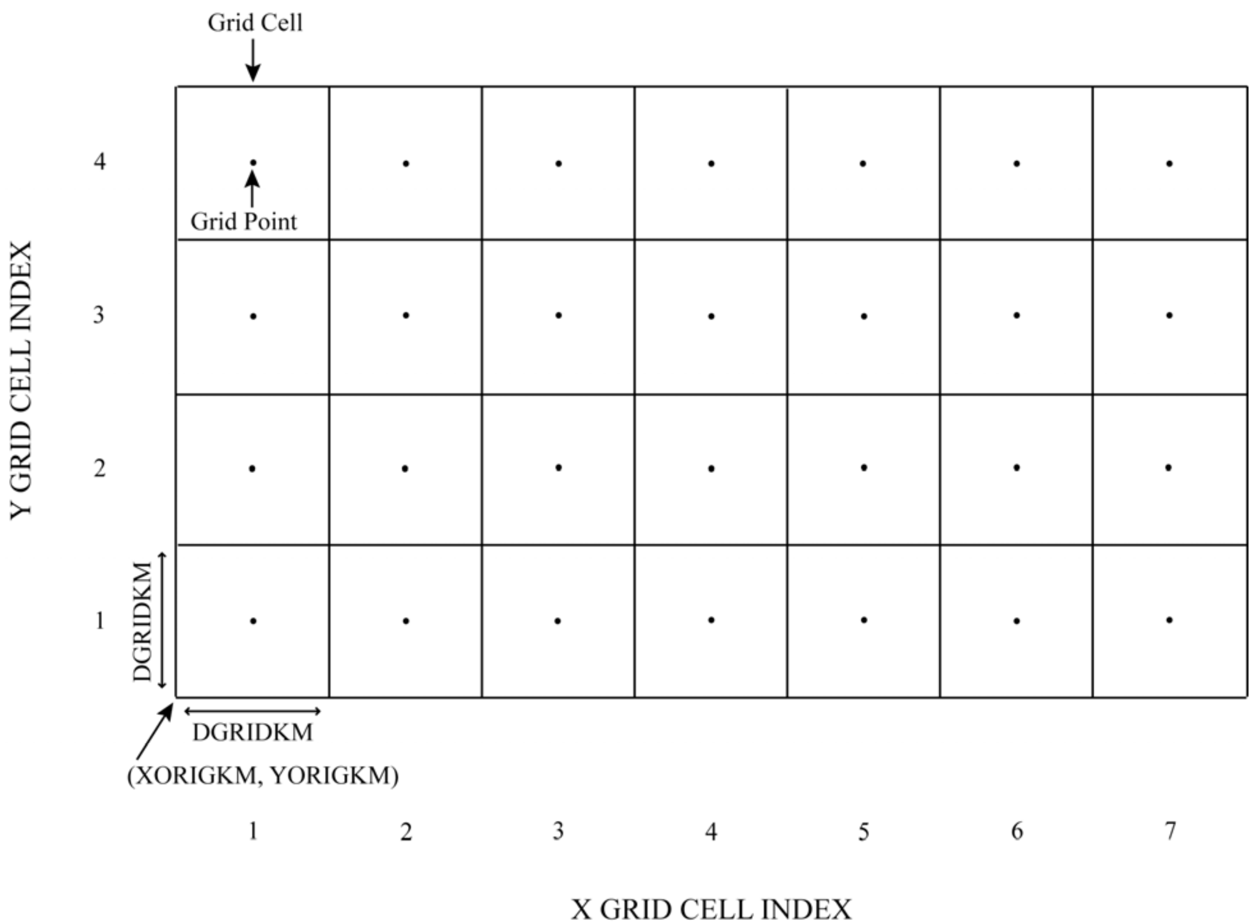

Figure 7-3: CALMET non-staggered horizontal grid system. All variables are defined at the grid points located in the center of each grid cell. The grid origin (X_o, Y_o) is also shown.

CALMM5 must be run on the platform where MM5 was initially run or a system with compatible binary format. This constraint arises from the fact that MM5 output is binary and therefore machine-dependent. Compilation options (Fortran) for CALMM5 are also machine-dependent (e.g., on a Cray: *cf77 calmm5.f* ; on a Dec Alpha: *f77 -convert big_endian calmm5.f*). But the CALMM5 output files is itself machine-independent (currently only in ASCII format).

Detailed information about MM5 settings is included in the list file (CALMM5.LST). Information needed for consistency in CALMET is included in the 3D.DAT header records as well. In particular, the type of map projection used in MM5 is listed. Note that CALMET does not handle polar stereographic projection and, in that case, CALMM5 simply converts (U, V) to wind speed and wind direction without further processing of the wind direction. For Lambert conformal projection however, CALMM5 converts the MM5 (U, V) to wind speed and wind direction with respect to true North.

CALMM5 preprocessor requires a set of common block and parameter files for compiling. It needs one user-input file to run (CALMM5.INP, hard-wired filename), and produces two or three output files (CALMM5.LST and 3D.DAT, and 2D.DAT if users select). Output filenames are determined by users.

<u>CALMM5 Input Files</u>

MM5 binary output file
Standard MM5 binary output file of the type: MMOUT_DOMAIN#.

CALMM5.INP
In CALMM5.INP, the user can specify the input and output file names, the period and the boundaries of the subdomain to extract, the output format (3D.DAT), and which of the optional variables are output.

There are six sets of variables a user can request, in addition to the default output variables (pressure, elevation, temperature, wind speed and wind direction):

1. Vertical velocity
2. Relative humidity and vapor mixing ratio
3. Cloud and rain mixing ratios (only combined with option 2)
4. Ice and snow mixing ratios (only combined with options 2+3)
5. Graupel mixing ratio (only combined with options 2+3+4)
6. Surface 2-D variables

If the user requests output variables unavailable in MM5, CALMM5 issues a warning in the list file (CALMM5.LST or user-defined filename) and stops. For example, vertical velocity is only available in non-hydrostatic MM5 runs.

A sample CALMM5.INP is shown in Table 7-5 and a description of each input variable is provided in Table 7-6.

CALMM5 Output Files

CALMM5.LST

The list file contains information about the MM5 file and reports on CALMM5 processing, including warnings and error messages. A sample list file is shown in Table 7-7.

3D.DAT, 2D.DAT

A sample 2D.DAT file is shown in Table 7-8 and each variable is described in Table 7-9. A sample 3D.DAT file is shown and described in section (7.7).

Table 7-5: CALMM5 Sample Control File (CALMM5.INP)

```
CALMM5 VER3 for MM5 Domain 1
2            ! Number of MM5 input files (filenames follow)
MMOUT_DOMAIN1A ! MM5 input file name (no space before or within filename)
MMOUT_DOMAIN1B ! MM5 input file name (no space before or within filename)
Samp3D.dat   ! CALMM5 output file name  (no space before or within filename)
calmm5.lst   ! CALMM5 list file name (no space before or within filename)
2            ! Options for selecting a region (1 = use lat/long; 2 = use J/I)
3            ! Southernmost latitude (in decimal, positive for NH), or J1/Y1
6            ! Northermost  latitude (in decimal, positive for NH), or J2/Y2
5            ! Westernmost  longitude (in decimal, negative for WH), or I1/X1
8            ! Easternmost  longitude (in decimal, negative for WH), or I2/X2
2001122912   ! Starting UTC date-hour (YYYYMMDDHH)
2001122913   ! Ending UTC date-hour (YYYYMMDDHH)
1            ! Output format (1-3D.DAT, 2-MM4, 3-GrADS, 4-void, 5- void, 6-GRIB)
Keep this line - The following lines vary depending on the output format selected
1 1 1 0 0    ! Output W, RH, cloud and rain, ice and snow, graupel (0=no;
1            ! Flag for 2-D variables output (0 = no 2-D output ; 1 = 2-D output)
samp2D.dat   ! File name for 2-D variable output (needed only if 2-D Flag=1)
1            ! Lowest extraction level in MM5
32           ! Highest extraction level in MM5
```

Table 7-6: CALMM5 Control File Inputs (CALMM5.INP)

Line	Variable	Type	Description
1	TITLE	character*80	Title line for CALMM5.INP
2	NFILE	integer	Number of MM5 files to process
3	INFILE	character*80	Name of MM5 binary input file(s) (NFILE records)
3+NFILE	OUTFILE	character*80	Name of output data file
4+NFILE	LOGFILE	character*80	Name of output list file
5+NFILE	ISELECT	integer	Sub-domain selection method: 1 = Use latitudes and longitudes to select a sub-domain 2 = Use (I,J) to select a sub-domain
6+NFILE	RLATMIN/ JMIN	real/integer	Southernmost latitude or J of the sub-domain to extract (in degrees)
7+NFILE	RLATMAX/ JMAX	real/integer	Northernmost latitude or J of the sub-domain to extract (in degrees)
8+NFILE	RLONMIN/ IMIN	real/integer	Westernmost longitude or I of the sub-domain to extract (negative in Western hemisphere; in degrees)
9+NFILE	RLONMAX/ IMAX	real/integer	Easternmost longitude or I of the sub-domain to extract (negative in Western hemisphere; in degrees)
10+NFILE	IBEG	integer	Beginning date-hour of the period to extract (UTC) - Format: YYYYMMDDHH
11+NFILE	IEND	integer	Ending date-hour of the period to extract (UTC) - Format: YYYYMMDDHH
12+NFILE	IFORMAT	integer	Output data file format: 1 = 3D.DAT (for CALMET) 2 = MM4.DAT 3 = GrADS 4 = invalid 5 = invalid 6 = GRIB

Table 7-6 (Concluded)
CALMM5 Control File Inputs (CALMM5.INP)

Line	Variable	Type	Description
13+NFILE	CNOTE	character*80	Indicator for additional information for different output formats
14+NFILE	IOUTW	integer	Flag to output vertical velocity
	IOUTQ	integer	Flag to output relative humidity and vapor mixing ratio
	IOUTC*	integer	Flag to output cloud and rain mixing ratios
	IOUTI*	integer	Flag to output ice and snow mixing ratios
	IOUTG*	integer	Flag to output graupel mixing ratio
15+NFILE	IOSRF	integer	Flag to output surface 2-D variables
16+NFILE	SRFILE	character*80	Name of surface 2-D output file (IOSRF=1 only)
17+NFILE	NZ1	integer	Lowest sigma layer extracted (1 for first layer)
18+NFILE	NZ2	integer	Highest sigma layer extracted (1 for first layer)

IOUTC=1 only if IOUTQ=1
IOUTI=1 only if IOUTC=IOUTQ=1
IOUTG=1 only if IOUTI=IOUTC=IOUTQ=1

Table 7-7: Example CALMM5 List File (CALMM5.LST)

```
CALMM5 Version: 2.1              Level: 040112


 Output Data Set Name: 3D.DAT
 Data Set Version: 2.0              Level: 040112


CALMM5 VER3 for MM5 Domain 1

Input file:   MMOUT_DOMAIN1
Output file:  samp.m3d
Log file:     calmm5.lst

Select region based on (1, lat/lon; 2, J/I):   2
Selected I/J range from Input:     5    8    3    6
 beginning date:   2001122912
 ending    date:   2001122913

output format:  1 -- MM5

 ----- Output File -----
Output File Name:samp.m3d

 2-D output flag:           1
 2-D output file: samp.m2d
   ioutw: 1
   ioutq: 1
   ioutc: 1
   iouti: 0
   ioutg: 0
   iosrf: 1

 Vertical range extracted:           1           32
  Porcessing mm5 big header

  starting date of mm5 output data:   2001122900
```

Table 7-7 (Concluded)
Example CALMM5 List File (CALMM5.LST)

```
Model initial hour:          1          12          29          0

 mm5 options:

 Fake dry run:           0
   non hydrostatic run
     reference pressure p0 :   100000.0 pa
     reference temperature :      275.0 k
     ref. temperature lapse rate : 50.0 k/500mb

 Model Top Pressure:     100.0000
 mm5 domain id:            1

 lambert conformal map projection
   center latitude  (degrees):     47.00000
   center longitude (degrees):     52.50000
   true latitude 1  (degrees):     60.00000
   true latitude 2  (degrees):     30.00000
   cone factor:    0.7155668
   SW dot point X/Y:    -1360.000       -1360.000

 nx in MM5 (east)    :           35
 ny in MM5 (north)   :           35
 nz in MM5 (vertical):           32
 dxy in MM5 (km)     :     80.00000

Selected domain I:     5    8
               J:     3    6
  Number of Grids:    4    4
Selected domain SW lat/lon:       35.170      40.796
Selected domain SW     X/Y:    -1040.013   -1200.089
  from grid point x=   5  to    8
  from grid point y=   3  to    6
  latitude  range:     35.170  to:     37.648
  longitude range:     40.390  to:     43.471

 Data Created
 ---- Successful Calmm5 Run -----
```

Table 7-8: Sample of MM5 Derived Gridded Surface 2-D Variables

```
2D.DAT          2.0            Header Structure with Comment Lines
   1
Produced by CALMM5 Version: 2.1     , Level: 040112
  1  1  1  0  0  1
LCC   47.0000   52.5000  60.00  30.00 -1360.000 -1360.000  80.000  35  35 32
  1  4  1  5  2  1  1  0  1  1  1  1  1  1  1  1  1  1  1 25
2001122912    2   4   4  32
   5   3   8   6   1  32   40.3905   43.4707  35.1695  37.6475
 0.998
 0.995
 0.992
 0.988
 0.983
 0.978
 0.972
 0.966
 0.959
 0.951
 0.942
 0.931
 0.920
 0.907
 0.892
 0.876
 0.857
 0.837
 0.813
 0.787
 0.758
 0.725
 0.688
 0.646
 0.599
 0.547
 0.487
 0.421
 0.346
```

Table 7-8 (Continued)
Sample of MM5 Derived Gridded Surface 2-D Variables

```
 0.262
 0.168
 0.059
   5   3  35.1695   40.7959  274 19   35.5861   41.1768  266
   6   3  35.2723   41.6849  236  8   35.6855   42.0720  272
   7   3  35.3671   42.5765  194  8   35.7768   42.9698  209
   8   3  35.4537   43.4707  192  8   35.8599   43.8701  293
   5   4  35.8957   40.6638  330  8   36.3136   41.0481  388
   6   4  35.9999   41.5625  333  8   36.4144   41.9532  405
   7   4  36.0959   42.4641  337  8   36.5069   42.8611  462
   8   4  36.1837   43.3681  440  6   36.5912   43.7715  796
   5   5  36.6232   40.5287  445  6   37.0424   40.9165  510
   6   5  36.7287   41.4374  470  2   37.1445   41.8318  577
   7   5  36.8260   42.3490  614  6   37.2383   42.7499 1011
   8   5  36.9150   43.2632  976 10   37.3237   43.6706 1637
   5   6  37.3518   40.3905  684  6   37.7724   40.7818  814
   6   6  37.4588   41.3094  718  6   37.8758   41.7075  970
   7   6  37.5574   42.2313 1035  7   37.9708   42.6360 1582
   8   6  37.6475   43.1559 1600  6   38.0574   43.5673 2172

2001122912  GROUND T
   283.313   283.112   281.149   277.878
   286.168   285.459   284.243   281.851
   287.755   287.333   286.963   286.019
   288.913   289.806   289.942   289.571
2001122912  PBL HGT
   705.050   631.557   673.477   864.322
   595.731   434.415   389.173   502.431
   406.427   320.297   313.579   317.165
   323.061   255.215   205.607   329.696
2001122912  SHFLUX
    -1.269    -4.073    -3.807     0.320
     4.609    -1.589    -2.952    -1.557
     4.200     1.176    -1.228    -1.915
     2.375     3.327     0.784    -2.030
```

Table 7-8 (Continued)
Sample of MM5 Derived Gridded Surface 2-D Variables

```
2001122912  LHFLUX
   11.769   14.301   10.768    2.953
   15.595   15.261   12.458    5.726
    4.389    5.470    8.807    7.591
    4.104    3.340    6.409    7.585
2001122912  UST
    0.322    0.415    0.411    0.432
    0.239    0.304    0.340    0.288
    0.129    0.180    0.242    0.208
    0.118    0.118    0.135    0.142
2001122912  SWDOWN
   60.960   58.894   47.135   25.467
  110.909   71.010   44.944   28.382
   93.124   56.395   41.772   31.818
   71.378   59.747   59.475   42.385
2001122912  LWDOWN
  347.519  346.362  341.203  334.386
  344.357  353.104  354.527  348.864
  355.508  363.698  367.030  366.451
  366.351  373.049  375.877  380.738
2001122912  T2
  283.360  283.205  281.250  277.917
  286.005  285.499  284.339  281.925
  287.394  287.186  287.038  286.141
  288.660  289.507  289.850  289.919
2001122912  Q2
    7.899    7.788    7.184    6.346
    8.475    8.350    7.938    7.394
    8.843    8.819    8.655    8.460
    8.766    8.958    8.886    8.489
2001122912  U10
   -0.795   -2.630   -2.086    0.795
   -0.621   -3.063   -3.624   -1.749
   -0.133   -2.153   -3.236   -2.766
    0.754   -0.480   -1.581   -2.042
```

Table 7-8 (Concluded)
Sample of MM5 Derived Gridded Surface 2-D Variables

```
2001122912  V10
    3.266     3.591     3.807     4.077
    2.310     2.142     1.870     2.067
    0.982     0.524     0.013     0.016
   -0.763    -1.064    -0.813    -0.093
2001122912  TSEASFC
  281.832   280.856   278.425   275.254
  282.847   282.850   282.031   279.004
  283.728   284.459   284.794   283.493
  285.112   286.237   286.885   287.299
```

Table 7-9: MM5 Derived Surface 2-D Variables File Format (2D.DAT)

HEADER RECORDS

Header Record #1

Variable No.	Variable	Type	Description
1	CNAME	char*16	Data set name
2	DATAVER	char*16	Data set version
3	DATAMODD	char*64	Data set mod
			Format(2a16,a64)

Header Record #2

Variable No.	Variable	Type	Description
1	NCOMM	integer	Number of comment lines
			Format(i4)

Header Records #3 – N (N=3+NCOMM-1)

Variable No.	Variable	Type	Description
1	COMMENT	char*132	Comment lines
			Format(a132)

Table 7-9 (Continued)
MM5 Derived Surface 2-D Variables File Format (2D.DAT)

Header Record #N+1

Variable No.	Variable	Type	Description
1	IOUTW	Integer	Flag indicating if vertical velocity is recorded.
2	IOUTQ	Integer	Flag indicating if relative humidity and vapor mixing ratio are recorded
3	IOUTC	Integer	Flag indicating if cloud and rain mixing ratios are recorded.
4	IOUTI	Integer	Flag indicating if ice and snow mixing ratios are recorded.
5	IOUTG	Integer	Flag indicating if graupel mixing ratio is recorded.
6	IOSRF	Integer	Flag indicating if surface 2-D variables is recorded
7	y1dmn	real	SW dot point Y coordinate (km, Grid 1,1) in MM5
8	dxy	real	Grid size (km)
9	nx	integer	Number of grids in X-direction (West-East) in MM5
10	ny	integer	Number of grids in Y-direction (South-North) in MM5
11	nz	integer	Number of sigma layers in MM5
			Format(a4,f9.4,f10.4,2f7.2,2f10.3,f8.3,2i4,i3)

Header Record #N+3

Variable No.	Variable	Type	Description
1	INHYD	integer	0: hydrostatic MM5 run - 1: non-hydrostatic
2	IMPHYS	integer	MM5 moisture options. 1: dry 2: removal of super saturation 3: warm rain (Hsie) 4: simple ice scheme (Dudhia) 5: mixed phase (Reisner) 6: mixed phase with graupel (Goddard) 7: mixed phase with graupel (Reisner)
3	ICUPA	integer	MM5 cumulus parameterization 1: none 2: Anthes-Kuo 3: Grell 4: Arakawa-Schubert 5: Fritsch-Chappel 6: Kain-Fritsch 7: Betts-Miller

Table 7-9 (Continued)
MM5 Derived Surface 2-D Variables File Format (2D.DAT)

HEADER RECORDS

Header Record #N+3

Variable No.	Variable	Type	Description
4	IBLTYP	integer	MM5 planetary boundary layer (PBL) scheme 0: no PBL 1: bulk PBL 2: Blackadar PBL 3: Burk-Thompson PBL 5: MRF PBL
5	IFRAD	integer	MM5 atmospheric radiation scheme 0: none 1: simple cooling 2: cloud-radiation (Dudhia) 3: CCM2
6	ISOIL	integer	MM5 soil model- 0: none - 1: multi-layer
7	IFDDAN	integer	1: FDDA grid analysis nudging - 0: no FDDA
8	IFDDAOB	integer	1: FDDA observation nudging - 0: no FDDA
9	IGRDT	integer	2D output flag for ground temperature (1/0)
10	IPBL	integer	2D output f lag for PBL height (1/0)
11	ISHF	integer	2D output f lag for sensible heat flux (1/0)
12	ILHF	integer	2D output f lag for latent heat flux (1/0)
13	IUSTR	integer	2D output f lag for frictional velocity (1/0)
14	ISWDN	integer	2D output f lag for short wave downward flux (1/0)
15	ILWDN	integer	2D output f lag for long wave flux (1/0)
16	IT2	integer	2D output f lag for air temperature at 2 m (1/0)
17	IQ2	integer	2D output f lag for specific humidity at 2 m (1/0)
18	IU10	integer	2D output f lag for U-wind at 10 m (1/0)
19	IV10	integer	2D output f lag for V-wind at 10 m (1/0)
20	ISST	integer	2D output f lag for SST (1/0)
21	NLAND	integer	Number of land use categories used in MM5
			Format(30i3)

Table 7-9 (Continued)
MM5 Derived Surface 2-D Variables File Format (2D.DAT)

HEADER RECORDS

Header Record #N+4

Variable No.	Variable	Type	Description
1	IBYRM	integer	Beginning year of the data in the file
2	IBMOM	integer	Beginning month of the data in the file
3	IBDYM	integer	Beginning day of the data in the file
4	IBHRM	integer	Beginning hour (UTC) of the data in the file
5	NHRSMM5	integer	Length of period (hours) of the data in the file
6	NXP	integer	Number of grid cells in the X direction in the extracted sub-domain
7	NYP	integer	Number of grid cells in the Y direction in the extracted sub-domain
8	NZP	integer	Number of sigma layers in the extracted sub-domain
Format (i4,3i2,i5,4i4)			

)

Header Record #N+5

Variable No.	Variable	Type	Description
1	NX1	integer	I-index (X direction) of the lower left corner of sub-domain
2	NY1	integer	J-index (Y direction) of the lower left corner of sub-domain
3	NX2	integer	I-index (X direction) of the upper right corner of sub-domain
4	NY2	integer	J-index (Y direction) of the upper right corner of sub-domain
5	NZ1	integer	k-index (Z direction) of lowest extracted layer
6	NZ2	integer	k-index (Z direction) of hightest extracted layer
7	RXMIN	real	Westernmost E. longitude (degrees) in the sub-domain
8	RXMAX	real	Easternmost E. longitude (degrees) in the sub-domain
9	RYMIN	real	Southernmost N. latitude (degrees) in the sub-domain
10	RYMAX	real	Northernmost N. latitude (degrees) in the sub-domain
Format (6i4,2f10.4,2f9.4)			

Table 7-9 (Continued)
MM5 Derived Surface 2-D Variables File Format (2D.DAT)

HEADER RECORDS

Next NZP Records

Variable No.	Variable	Type	Description
1	SIGMA	real array	Sigma values used by MM5 to define each of the NZP layers (half-sigma levels) read as: do 10 I=1,NZP 10 READ (iomm4,20) SIGMA(I) 20 FORMAT (F6.3)

Next NXP*NYP Records

Variable No.	Variable	Type	Description
1	IINDEX	integer	I-index (X direction) of the extracted grid point in original MM5 domain.
2	JINDEX	integer	J-index (Y direction) of the extracted grid point in original MM5 domain.
3	XLATDOT	real array	Latitude (degrees) of the extracted grid point, positive values for the Northern Hemisphere, negative values for the Southern Hemisphere. –999. for missing values.
4	XLONGDOT	real array	Longitude (degrees) of the extracted grid point, positive values for the Eastern Hemisphere, negative values for the Western Hemisphere. –999. for missing values.
5	IELEVDOT	integer array	Terrain elevation of the extracted grid point at dot position (m MSL)
6	ILAND	integer array	MM5 landuse categories at extracted cross points (-9 for missing values)
7	XLATCRS	real array	Same as XLATDOT but at cross point
8	XLATCRS	real array	Same as XLATDOT but at cross point
9	IELEVCRS	integer array	Same as IELEVDOT but at cross point

Format (2i4, f9.4, f10.4, i5, i3, 1x, f9.4, f10.4,i5)

Table 7-9 (Concluded)
MM5 Derived Surface 2-D Variables File Format (2D.DAT)

DATA RECORDS

Next N2D Record Pairs
(N2D: Number of output 2-D variables given in Header Record #N+3)

Data Record #1

Variable No.	Variable	Type	Description
1	MYR	integer	Year of the 2-D variable (YYYY)
2	MMO	integer	Month of the 2-D variable
3	MDAY	integer	Day of the 2-D variable
4	MHR	integer	UTC Hour of the 2-D variable
5	Vname	char*8	Name of 2-D variable

Data Record #2

Variable No.	Variable	Type	Description
1	xvar	real array (nxp by nyp)	Values of named 2-D variable Read using : do j=ny2,ny1,-1 Read(iunit,1010)(xx(i,j),I=nx1,nx2) enddo 1010 format(8f10.3) Units: K for temperature, m for PBL height, w/m**2 for heat flux, m/s for frictional velocity

7.2 CALETA Preprocessor

CALETA operates on the output from the National Centers for Environmental Prediction (NCEP) operational North American Mesoscale (NAM) model, formerly known as the Eta model, and the high-resolution simulation products from the Weather Research and Forecasting (WRF) model. Eta/NAM/WRF model output files are produced for use by the Advanced Weather Interactive Processing System (AWIPS) in various AWIPS grids. Gridded model output is stored in GRIB format, and consists of analysis and forecast fields for multiple parameters and levels. CALETA extracts and reformats a subset of these fields, and creates a 3D.DAT file for CALMET (see section 7.5).

Several datasets are available, corresponding to AWIPS grids that cover the United States at various spatial resolutions:

- AWIPS Grid 212 -- Continental U.S., 40km (NAM)
- AWIPS Grid 218 -- Continental U.S., 12km (NAM)
- AWIPS Grid 245 -- Eastern U.S., 8km (WRF)
- AWIPS Grid 246 -- Western U.S., 8km (WRF)
- AWIPS Grid 247 -- Central U.S., 8km (WRF)
- AWIPS Grid 248 -- Puerto Rico, 8km (WRF)
- AWIPS Grid 249 -- Alaska, 10km (WRF)
- AWIPS Grid 250 -- Hawaii, ~8km (WRF)

Maps of these domains are reproduced in Figures 7-4 and 7-5. Due to large size of files, the AWIPS 218 domain is processed into 54 tiles shown in Figure 7-6. Characteristics of each of these AWIPS grid products are summarized in Table 7-10. For AWIPS 212, 218, and 245, the vertical resolution is 25 hPa from 1000 hPa to 50 hPa, for a total of 39 levels. Nine vertical levels are available (1000, 925, 850, 700, 600, 500, 400, 300 and to 200 hPa.) for the other AWIPS grids.

The run frequency is four times per day for AWIPS 212 and 218, at initial hours of 00, 06, 12, and 18 UTC. It is once per day for AWIPS 245, 246, 247, and 249; and twice per day for AWIPS 248 and 250. The initial time is 00 UTC for Alaska (AWIPS 249), 06 UTC for the western US (AWIPS 246), 12 UTC for the central US (AWIPS 247), and 18 UTC for the eastern US (AWIPS 245). The initial time is 00, 12 UTC for Hawaii (AWIPS 250) and 06, 18UTC for Puerto Rico (AWIPS 248).

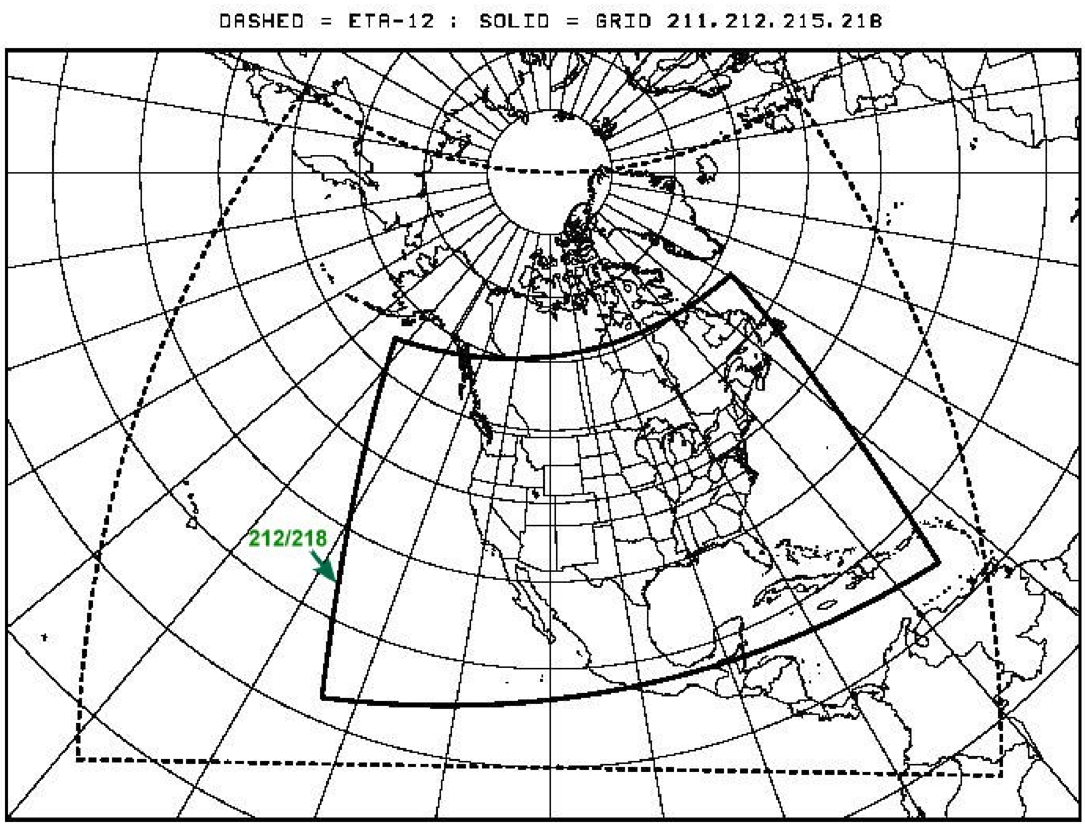

Figure 7-4: Domain coverage for AWIPS 212 and 218 grids.

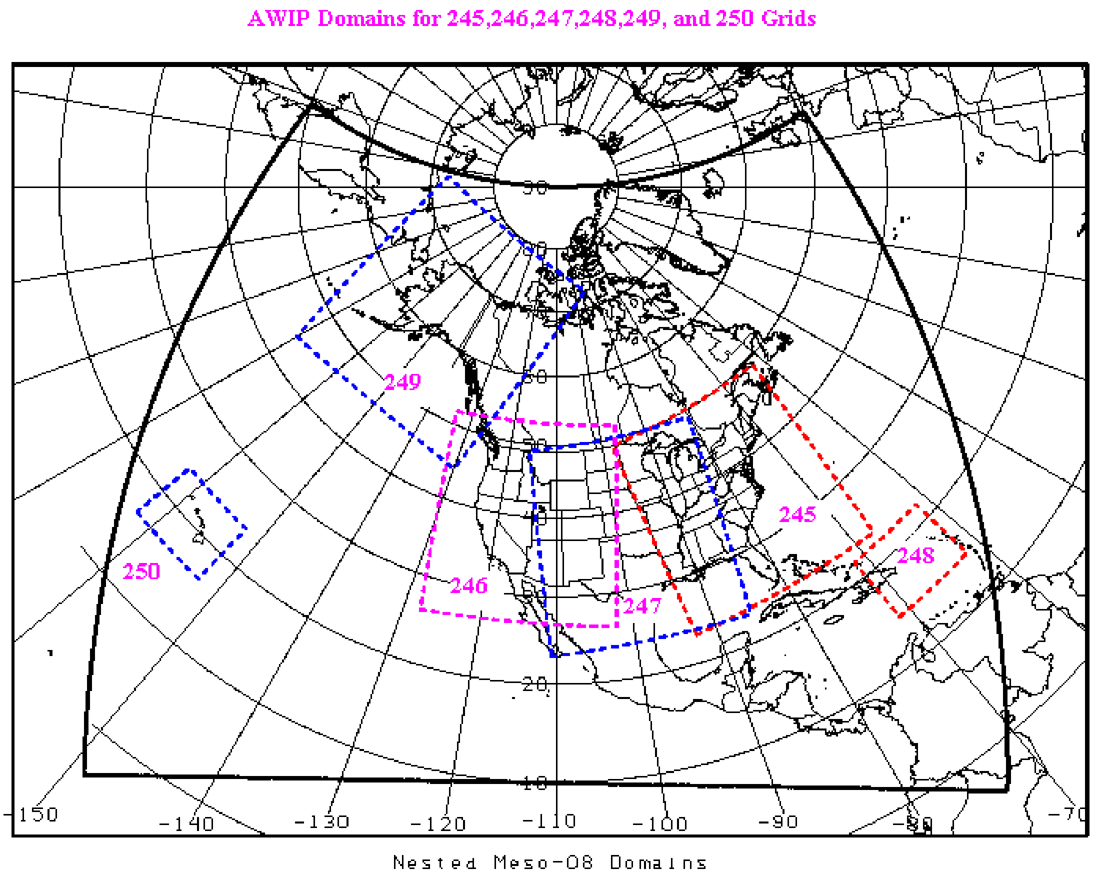

Figure 7-5: Domain coverage for AWIPS 245, 246, 247, 248, 249, and 250 grids.

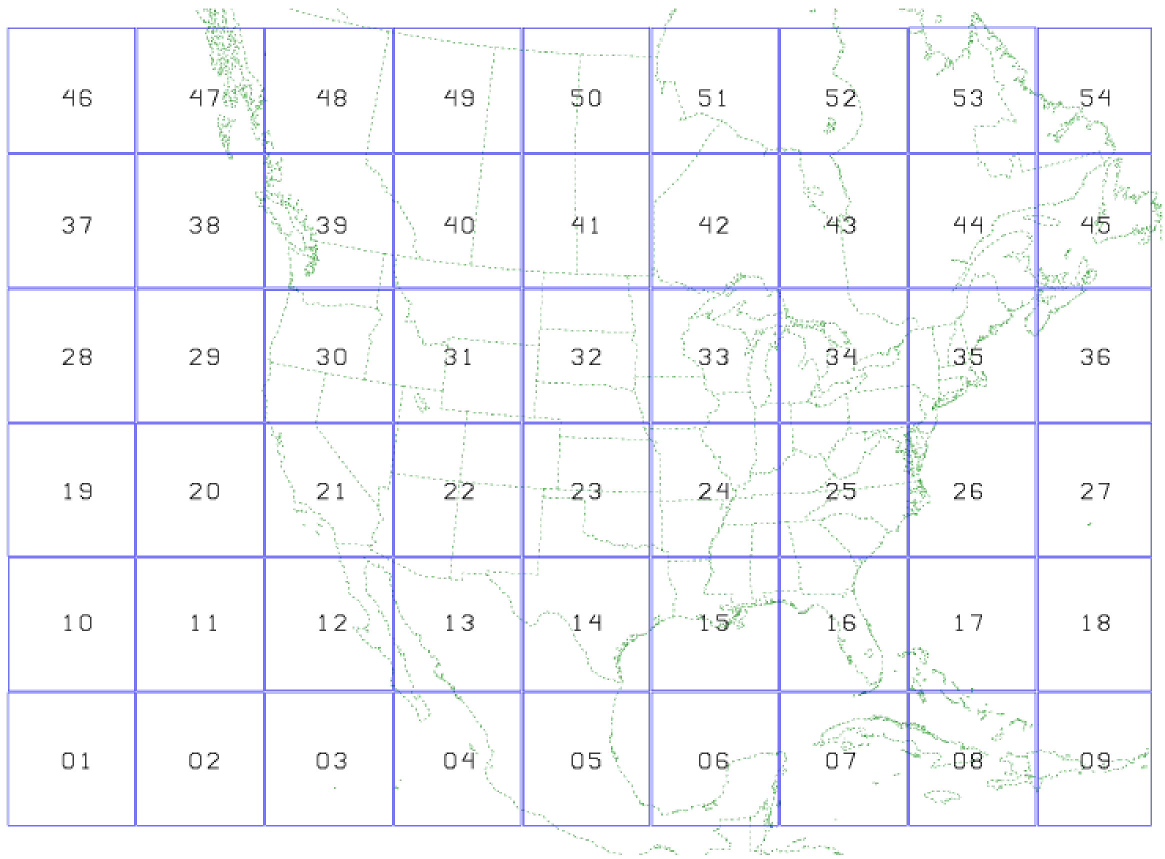

Figure 7-6: Tiles for AWIPS 218 grid.

Table 7-10: AWIPS Grid Formats Processed by CALETA.

Model	Output Grid Format (AWIPS)	Covered Area	Grid Resolution	Vertical Levels	Run Time (UTC)
ETA/NAM	212	North America	40 km Lambert Conformal	Surface, 1000-50 hPa, every 25 hPa	00, 06, 12, 18
ETA/NAM	218	North America (54 tiles)	12 km Lambert Conformal	Surface, 1000-50 hPa, every 25 hPa	00, 06, 12, 18
WRF/ETA	245	Eastern US	8 km Lambert Conformal	Surface, 1000-50 hPa, every 25 hPa	18
WRF/ETA	246	Western US	8 km Lambert Conformal	Surface, 1000-200 hPa in nine levels	06
WRF/ETA	247	Central US	8 km Lambert Conformal	Surface, 1000-200 hPa in nine levels	12
WRF/ETA	248	Puerto Rico	0.075^o X 0.075^o Latitude/Longitude	Surface, 1000-200 hPa in nine levels	06, 18
WRF/ETA	249	Alaska	10 km Polar Stereographic	Surface, 1000-200 hPa in nine levels	00
WRF/ETA	250	Hawaii	0.075^o X 0.075^o Latitude/Longitude	Surface, 1000-200 hPa in nine levels	00, 12

CALETA Input Files

AWIPS GRIB file

All AWIPS files used by CALETA can be downloaded for the NCEP web site:

ftpprd.ncep.noaa.gov:/pub/data/nccf/com/nam/prod/

AWIPS 212 files also exist at the NWS web site:

tgftp.nws.noaa.gov:/SL.us008001/ST.opnl.

The content of AWIPS212 files on these two web sites is the same, but the naming convention is different. Examples of file names on these web sites are listed in Table 7-11. These names do not contain the date associated with the start of each model application period. Therefore, the files must either be stored in separate folders or renamed. If files are not renamed, they should be placed in folders that carry the date and time of the run in the form: YYYYMMDDHH. If they are renamed, CALETA expects an extension at the end of the original name. The form of this extension is "AWIPSXXX_YYYYMMDD" for files downloaded from the NCEP web site, and "AWIPSXXX_YYYYMMDDHH" for files downloaded from the NWS web site, where "XXX" is the AWIPS grid and "YYYYMMDDHH" is the UTC year, month, day and hour of initial date and time. Examples of renamed files are also listed in Table 7-11.

CALETA.INP

In CALETA.INP, the user specifies the path of input AWIPS files, output file name, horizontal and vertical ranges for extraction, the AWIPS grid format, beginning and ending dates, time interval of initial hours of the runs, and three flags identifying the running mode and file naming convention. An example of CALETA.INP is given in Table 7-12 and described in Table 7-13. In CALETA.INP, the content after "!"is made up of comments that are not read by the program. There should be no blank space at the beginning of any records, but there should be at least on blank space before "!" if it exists.

Record 2 of CALETA.INP is the path of downloaded AWIPS files. For original AWIPS file names, files must reside in subdirectories of this path with a name of the form YYYYMMDDHH. For example, if Record 2 is "d:\task2\eta\" and users want to create a 3D.DAT file using the simulation run at initial hour 06 UTC on April 2, 2005, AWIPS GRIB files should reside in the directory "d:\task2\eta\2005040206\". The subdirectory "2005040206" should not be included in Record 2, since the code will add this subdirectory name to the path listed in Record 2. For renamed AWIPS file names, Record 2 is the actual path of renamed files. For example, all files should be in the "d:\task2\eta\" if downloaded files have been renamed. The back slash ("\") at the end of the path is needed; otherwise errors will occur. If the path is current directory, ".\" should be used.

Table 7-11: Sample Names of AWIPS GRIB Files

AWIPS Grid	Downloaded File Name	Renamed File Name
212	nam.tHHz.awip3dFH.tm00	nam.tHHz.awip3dFH.tm00.awips212_YYYYMMDD
212(NWS)	fh.00FH_tl.press_gr.awip3d	fh.00FH_tl.press_gr.awip3d.awips212_YYYYMMDDHH
218	nam.tHHz.awip218FH.TL	nam.tHHz.awip218FH.TL.awips218_YYYYMMDD
245	eastnmm.tHHz.awfullFH.tm00	eastnmm.tHHz.awfullFH.tm00.awips245_YYYYMMDD
246	westnmm.tHHz.awpregFH.tm00	westnmm.tHHz.awpregFH.tm00.awips246_YYYYMMDD
247	centnmm.tHHz.awpregFH.tm00	centnmm.tHHz.awpregFH.tm00.awips247_YYYYMMDD
248	prnmm.tHHz.awpregFH.tm00	prnmm.tHHz.awpregFH.tm00.awips248_YYYYMMDD
249	aknmm.tHHz.awpregFH.tm00	aknmm.tHHz.awpregFH.tm00.awips249_YYYYMMDD
250	hinmm.tHHz.awpregFH.tm00	hinmm.tHHz.awpregFH.tm00.awips250_YYYYMMDD

HH is the initial hour in UTC for ETA/NAM runs
FH is the forecast hours from initial hour
TL is tile number for AWIPS 218 tiled files
YYYYMMDDHH is the 4-digit year and 2-digit month, day, and hour (UTC)

Table 7-12: Example CALETA Control File (CALETA.INP)

```
ETA Model in AWIPS 212 Grid
E:\data\all\    ! Directory of Input ETA GRIB files
.\test3D.dat    ! Output 3D.DAT file name (no space before or within filename)
caleta.lst      ! List file name  (no space before or within filename)
30,31           ! Range of Lat (positive for Northern Hemisphere),grid size
-98,-96.5       ! Range of Lon (negative for Western Hemisphere),grid size
1,25            ! Range of vertical levels selected
212             ! AWIPS Flag (212,218,245,246,247,248,249,250)
2005041418      ! Beginning UTC Date-Hour (YYYYMMDDHH) for 3D.DAT file
2005041600      ! Ending UTC Date-Hour (YYYYMMDDHH) for 3D.DAT file
6               ! Time interval (hours) between ETA runs
1               ! File naming convention (1 = renamed; 0 = original)
1               ! Run mode (1 = Hybrid; 0 = Forecast)
1               ! Web site (1 = NCEP; 0 = NWS) where ETA GRIB file downloaded
```

Table 7-13: CALETA Control File Inputs (CALETA.INP)

Line	Variable	Type	Description
1	TITLE	character*80	Title for CALETA application
2	INFILE	character*80	Path name of AWIPS input files
3	OUTFILE	character*80	Output 3D.DAT file name
4	LOGFILE	character*80	Output list file name
5	RLATMIN/ RLATMAX	real	Southernmost and northernmost latitudes of the sub-domain to extract (positive in Northern hemisphere; in degrees)
6	RLONMIN/ RLONMAX	real	Westernmost and Easternmost longitude of the sub-domain to extract (negative in Western hemisphere; in degrees)
7	NZMIN/ NXMAX	integer	Lowest and highest vertical levels of the sub-domain to extract
8	IDAWP	integer	AWIPS grid format (212, 218, 245-250)
9	IDATEB	integer	Beginning UTC date-hour of 3D.DAT
10	IDATEE	integer	Ending UTC date-hour of 3D.DAT
11	IHRRUN	integer	Hours between ETA runs (6 hours for AWIPS 212, 218; 24 hours for AWIPS 245-247, 249; 12 hours for AWIPS 248,250)
12	IDFRMT	integer	Flag of file naming convention: 0 = original file name; 1 = renamed file name
13	IDRUN	integer	Flag of CALETA run mode: 0 = Forecast mode; 1= Hybrid mode.
14	IDWEB	integer	Flag of web site for AWIPS file downloading: 0 = NWS site; 1 = NCEP site

Users are responsible for choosing correct horizontal and vertical ranges and correct AWIPS grid format in Records 5-8, especially for the high-resolution WRF domains, although the code will check for consistency. Extracted horizontal and vertical ranges should be within corresponding AWIPS domains. Users should consult Figures 7-4 and 7-5 for geographical coverage. Vertical levels in current AWIPS files are listed in Table 7-10. Selected vertical range in Line 7 should be within these limits.

Line 11 is the time interval in hours of initial ETA/NAM runs. The interval is 6 hours for AWIPS 212 and 218, 24 hours for AWIPS 245-247, 249, and 12 hours for AWIPS 248 and 250.

Line 12 is the flag for file naming convention. It should be "1" if file names have been renamed following the rule in Table 7-11. It should be "0" if files keep their downloaded names; again users are reminded to put files in date-hour subdirectories in this case.

Line 13 is the flag for run mode. The flag is "0" if running CALETA in the forecast mode, and it is "1" for the hybrid mode (see below).

Line 14 is the flag for the web site, where AWIPS files are downloaded. This flag should be "1" if files are downloaded from the NCEP wet site, and it is "0" for files from the NWS web site. Since only AWIPS 212 files from the NWS web site can be used to create 3D.DAT file, this flag may be set to zero only for AWIPS 212 files. For all other AWIPS files, this flag must be set to "1".

CALETA can be applied in both forecast mode and historical mode (hybrid mode). In the forecast mode, CALETA uses AWIPS files from ***one*** run to create a 3D.DAT file. Table 7-14 gives an example for AWIPS 212 GRIB files used in a 24-hour 3D.DAT file in this mode. In the hybrid mode, CALETA uses the latest AWIPS files from multiple ETA/NAM runs to create a 3D.DAT file (Table 7-15). In this mode, if there are any missing files in the processing period, the latest existing files from previous runs will be used as substitutes within a 48-hour limit (Table 7-16).

<u>CALETA Output Files</u>

CALETA.LST

The list file of CALETA records various information from processing, including user-specified input controls, configurations of AWIPS files, processed files etc. This file should be consulted if CALETA fails to produce a complete 3D.DAT. An example of list file is given in Table 7-17.

3D.DAT

A sample 3D.DAT file is shown and described in section (7.7).

Table 7-14: AWIPS 212 Files in CALETA Forecast Mode for 24-Hour Period Starting at 00 Z
(Files in red are those used to create 3D.DAT)

Hour	ETA - 00	ETA - 06	ETA - 12	ETA - 18
00	00			
03	03			
06	06	00		
09	09	03		
12	12	06	00	
15	15	09	03	
18	18	12	06	00
21	21	15	09	03
00	24	18	12	06
03	27	21	15	09
06	30	24	18	12
09	33	27	21	15
12	36	30	24	18
15	39	33	27	21
18	42	36	30	24
21	45	39	33	27
00	48	42	36	30
03		45	39	33
06		48	42	36
09			45	39
12			48	42
15				45
18				48

Table 7-15: AWIPS 212 Files in CALETA Hybrid Mode for 24-Hour Period Starting at 00Z
(Files in red are those used to create 3D.DAT)

Hour	ETA – 00 Z	ETA – 06 Z	ETA – 12 Z	ETA – 18 Z	ETA – 00 Z
00	00				
03	03				
06	06	00			
09	09	03			
12	12	06	00		
15	15	09	03		
18	18	12	06	00	
21	21	15	09	03	
00	24	18	12	06	00
03	27	21	15	09	03
06	30	24	18	12	06
09	33	27	21	15	09
12	36	30	24	18	12
15	39	33	27	21	15
18	42	36	30	24	18
21	45	39	33	27	21
00	48	42	36	30	24
03		45	39	33	27
06		48	42	36	30
09			45	39	33
12			48	42	36
15				45	39
18				48	42

Table 7-16: AWIPS 212 Files in CALETA Hybrid Mode for 24-Hour Period Starting at 00Z with Missing Files

(Files in red are those used to create 3D.DAT)

Hour	ETA – 00 Z	ETA – 06 Z	ETA – 12 Z	ETA – 18 Z	ETA – 00 Z
00	00				
03	03				
06	06	00			
09	09	03			
12	12	06	00		
15	15	09	X		
18	18	12	06	00	
21	21	15	09	X	
00	24	18	12	06	00
03	27	21	15	09	03
06	30	24	18	12	06
09	33	27	21	15	09
12	36	30	24	18	12
15	39	33	27	21	15
18	42	36	30	24	18
21	45	39	33	27	21
00	48	42	36	30	24
03		45	39	33	27
06		48	42	36	30
09			45	39	33
12			48	42	36
15				45	39
18				48	42

The missing file at ETA-12Z 3-hour forecast is substituted using the file at ETA –06Z 9-hour forecast. X marks a missing file.

Table 7-17: Example CALETA List File (CALETA.LST)

```
CALETA - Version: 2.2       Level: 050414

ETA Model in AWIPS 212 Grid
Output 3D.DAT base or file: .\test.m3d
CALETA log file:    caleta.lst

Control file:caleta_212.inp
latitude  range:     30.00     31.00
longitude range:     -98.00    -96.50
Vertical Levels:       1      25
AWIPS Grid Format:    212

 Beginning date:         2005041418
 Ending Date:            2005041600
 Hours between ETA Runs:  6
 File name (Ren/Org):     1
 Run mode (Ana/Frst):     1
 Wet site (NCEP/NWS):     1
Required starting date:    2005    4   14   18  104
Required ending date:      2005    4   16    0  106
Required hours/grib files:   31   11
 AWIPS format: 212 1
 Vertical levels: 39
 Vertical pressure levels:
1 1000.00000
2 975.000000
3 950.000000
4 925.000000
5 900.000000
6 875.000000
7 850.000000
8 825.000000
9 800.000000
10 775.000000
11 750.000000
12 725.000000
13 700.000000
14 675.000000
15 650.000000
```

Table 7-17 (Continued)
Example CALETA List File

```
16 625.000000
17 600.000000
18 575.000000
19 550.000000
20 525.000000
21 500.000000
22 475.000000
23 450.000000
24 425.000000
25 400.000000
26 375.000000
27 350.000000
28 325.000000
29 300.000000
30 275.000000
31 250.000000
32 225.000000
33 200.000000
34 175.000000
35 150.000000
36 125.000000
37 100.000000
38 75.0000000
39 50.0000000

Processing:  1th file - d:\util_wu\caleta\Data\all\nam.t18z.awip3d00.tm00.awips212_20050414
  ioutw: 1
  ioutq: 1
  ioutc: 0
  iouti: 0
  ioutg: 0
  iosrf: 0

Output to M3D at  2005041418
Processing:  2th file - d:\util_wu\caleta\Data\all\nam.t18z.awip3d03.tm00.awips212_20050414
Output to M3D at  2005041421
Processing:  3th file - d:\util_wu\caleta\Data\all\nam.t00z.awip3d00.tm00.awips212_20050415
Output to M3D at  2005041500
```

Table 7-17 (Concluded)
Example CALETA List File

Processing: 4th file - d:\util_wu\caleta\Data\all\nam.t00z.awip3d03.tm00.awips212_20050415
Output to M3D at 2005041503
Processing: 5th file - d:\util_wu\caleta\Data\all\nam.t06z.awip3d00.tm00.awips212_20050415
Output to M3D at 2005041506
Processing: 6th file - d:\util_wu\caleta\Data\all\nam.t06z.awip3d03.tm00.awips212_20050415
Output to M3D at 2005041509
Processing: 7th file - d:\util_wu\caleta\Data\all\nam.t12z.awip3d00.tm00.awips212_20050415
Output to M3D at 2005041512
Processing: 8th file - d:\util_wu\caleta\Data\all\nam.t12z.awip3d03.tm00.awips212_20050415
Output to M3D at 2005041515
Processing: 9th file - d:\util_wu\caleta\Data\all\nam.t12z.awip3d06.tm00.awips212_20050415 Substitute
Output to M3D at 2005041518
Processing: 10th file - d:\util_wu\caleta\Data\all\nam.t12z.awip3d09.tm00.awips212_20050415 Substitute
Output to M3D at 2005041521
Processing: 11th file - d:\util_wu\caleta\Data\all\nam.t12z.awip3d12.tm00.awips212_20050415 Substitute
Output to M3D at 2005041600
Processing succeeded

7.3 CALRUC Preprocessor

CALRUC operates on the output from the National Centers for Environmental Prediction (NCEP) operational Rapid Update Cycle (RUC) model. Gridded model output is stored in GRIB format, and consists of analysis and forecast fields for multiple parameters and levels. CALRUC extracts and reformats a subset of these fields, and creates a 3D.DAT file for CALMET (see section 7.5).

RUC datasets are available at 20km and 40km resolution, covering the same domain. A map of the domain is reproduced in Figure 7-7. The NOAA/Earth System Research Laboratory RUC development group report that the key features of RUC include:

- high-frequency (every hour) short-range weather model forecasts (out to 12+ hours)
- high-frequency (every hour) 3-D objective analyses over the contiguous United States, assimilating the following types of observations:
    - commercial aircraft
    - wind profilers
    - rawinsondes and special dropwinsondes
    - surface reporting stations and buoys (including cloud, visibility, current weather)
    - GPS total precipitable water estimates
    - VAD (velocity-azimuth display) winds from NWS WSR-88D radars
    - RASS (Radio Acoustic Sounding System) - experimental
    - GOES total precipitable water estimates
    - SSM/I total precipitable water estimates
    - GOES high-density visible and IR cloud drift winds
- hybrid isentropic-sigma vertical coordinate system.

The run frequency is hourly, with hourly analysis fields. Forecast fields are produced for the subsequent 3 hours. Additional forecasts for +6, +9, and +12 hours are made every 3 hours starting at 00 UTC.

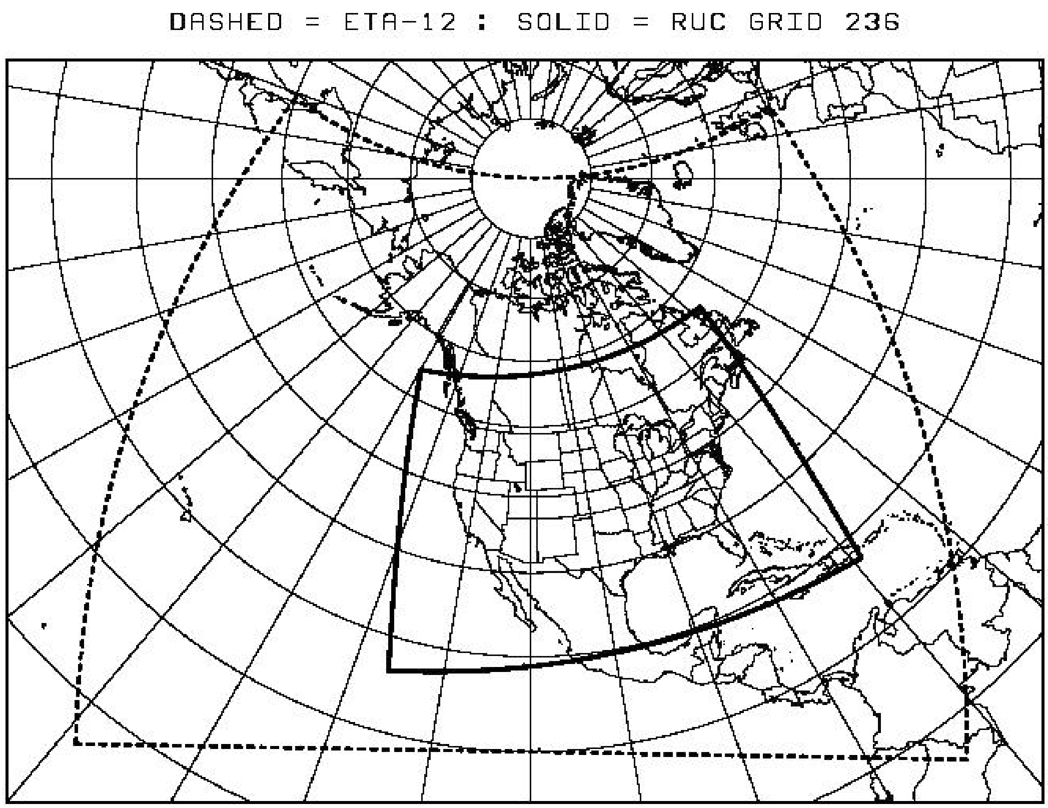

Figure 7-7: Domain coverage for RUC 20km and 40km grids. Both are denoted by the solid-line boundary. The dashed-line boundary is the NAM/ETA computational domain.

CALRUC Input Files

RUC GRIB file

RUC model output files can be downloaded directly from the NCEP or NWS web site. The NCEP web site address is

ftpprd.ncep.noaa.gov:/pub/data/nccf/com/ruc/prod/

The NWS web site address is

tgftp.nws.noaa.gov:/SL.us008001/ST.opnl.

The files at the NCEP web site reside in sub-directories named:

ruc2a.YYYYMMDD

or

ruc2b.YYYYMMDD

where YYYY is the 4-digit year, MM is the two-digit month, and DD is the two-digit day. Use the data in ruc2b.YYYYMMDD if it exists.

The files at the NWS web site reside in sub-directories named:

MT.ruc_CY.HH/RD.YYYYMMDD/PT.grid.DF.gr1

where HH is the initial hour of RUC run in UTC, and YYYY is the 4-digit year, MM is the two-digit month, and DD is the two-digit day.

File names at NCEP and NMS are different, but the contents of corresponding files are the same. Table 7-18 lists the file name formats. In the table, HH represents initial time of RUC runs, and hh or hhhh represents valid forecast hours corresponding to the initial hour of the RUC run. The current version of CALRUC uses a different naming convention, as indicated in Table 7-18. Files downloaded from NCEP or NWS web sites must be renamed as indicated prior to running CALRUC. Note that the hybrid level versions of the RUC GRIB files are preferred for preparing 3D.DAT files for CALMET.

CALRUC.INP

In CALRUC.INP, the user specifies the beginning and ending dates, output time interval, path of input CALRUC files, output file names, the RUC grid and data type, the output format, horizontal and vertical ranges for extraction, and a user-defined shift to apply to geopotential heights. An example of CALRUC.INP is given in Table 7-19 and described in Table 7-20. In CALRUC.INP, the content after "!" is made up of comments that are not read by the program. There should be no blank space at the beginning of any records, but there should be at least on blank space before "!" if it exists.

Table 7-18: RUC File-Naming Conventions

Web Site	Hybrid Level	Pressure Level
NCEP	Ruc2.tHHz.bgrb20anl (Analysis-20km)	Ruc2.tHHz.pgrb20anl (Analysis-20km)
	Ruc2.tHHz.bgrb20fhh (forecast-20km)	Ruc2.tHHz.pgrb20fhh (forecast-20km)
	Ruc2.tHHz.bgrbanl (Analysis-40km)	Ruc2.tHHz.pgrbanl (Analysis-40km)
	Ruc2.tHHz.bgrbfhh (forecast-40km)	Ruc2.tHHz.pgrbfhh (forecast-40km)
NWS	Fh.anal_tl.press_gr.bgrib20 (Analysis-20km)	fh.anal_tl.press_gr.us20 (Analysis-20km)
	fh.hhhh_tl.press_gr.bgrib20 (Forecast-20km)	fh.hhhh_tl.press_gr.us20 (Forecast-20km)
	fh.anal_tl.press_gr.bgrib (Analysis-40km)	fh.anal_tl.press_gr.us20 (Analysis-40km)
	fh.hhhh_tl.press_gr.bgrib (Forecast-40km)	fh.hhhh_tl.press_gr.us40 (Forecast-40km)

Rename for use in CALRUC:

CALRUC	sgpallruc20hybrX1.00.YYYMMDD.HH0000.raw.grb	sgpallruc20isobX1.00.YYYMMDD.HH0000.raw.grb
	sgpallruc40hybrX1.00.YYYMMDD.HH0000.raw.grb	sgpallruc40isobX1.00.YYYMMDD.HH0000.raw.grb

HH is the initial hour in UTC for RUC runs; hh or hhhh is the forecast hours corresponding to an initial hour RUC run. YYYYMMDD in file names is the 4-digit year, and 2-digit month and day.

Table 7-19: Example CALRUC Control File (CALRUC.INP)

```
3D.DAT file Created from RUC hourly data
2005070620      ! Beginning UTC Date-Hour to process (YYYYMMDDHH)
2005070621      ! Ending UTC Date-Hour to process (YYYYMMDDHH)
1               ! Process every X hours
.\              ! Directory of Input RUC GRIB files
TEST3D.dat      ! Output 3D.DAT file (no space before or within filename)
TEST.lst        ! List file name  (no space before or within filename)
1               ! Resolution of Input Data (0 = 20 km ; 1 = 40 km)
0               ! Type of Input File (0 = hybrid ; 1 = pressure)
0               ! Type of application (0 = analysis ; 1 = forecast)
1               ! Output Format (0 = MM5.DAT ; 1 = 3D.DAT)
1               ! Compress (0 = No ; 1 = Yes)
0                   ! Grid selection type (0 = i,j ; 1 = Lat/Lon)
10,15           ! Range of Lat/J (positive for Northern Hemisphere)
10,15           ! Range of Lon/I (negative for Western Hemisphere)
1,50            ! Range of vertical levels selected
5               ! User defined shift in vertical geopotential height
```

Table 7-20: CALRUC Control File Inputs (CALRUC.INP)

Line	Variable	Type	Description
1	TITLE	character*80	Title for CALRUC application
2	IDATEB	integer	Beginning UTC date-hour of 3D.DAT
3	IDATEE	integer	Ending UTC date-hour of 3D.DAT
4	NPROC	integer	Processing interval (hours)
5	INPATH	character*80	Path name of CALRUC input file directory
6	OUTFILE	character*80	Output 3D.DAT file name
7	LOGFILE	character*80	Output list file name
8	IXYGRID	integer	RUC grid resolution (0 = 20km; 1 = 40km)
9	IZGRID	integer	RUC vertical grid (0 = hybrid; 1 = pressure)
10	ITYPE	integer	Application type (0 = analysis; 1 = forecast)
11	IFORM	integer	Output format (0 = MM5.DAT; 1 = 3D.DAT) ** Select 3D.DAT for CALMET**
12	ICMPRS	integer	Compress output fields (0 = no; 1 = yes)
13	ISELECT	integer	Sub-domain selection method: 0 = Use (I,J) to select a sub-domain 1 = Use latitudes and longitudes to select a sub-domain
14	RLATMIN/ RLATMAX or JMIN/JMAX	real or integer	Southernmost and northernmost latitudes of the sub-domain to extract (positive in Northern hemisphere, in degrees) or minimum and maximum northing cell index
15	RLONMIN/ RLONMAX or IMIN/IMAX	real or integer	Westernmost and Easternmost longitude of the sub-domain to extract (negative in Western hemisphere; in degrees) or minimum and maximum easting cell index
16	NZMIN/ NXMAX	integer	Lowest and highest vertical levels of the sub-domain to extract
17	ZSHIFT	real	Shift in vertical geopotential height

CALRUC Output Files

CALRUC.LST

The list file of CALRUC records various information from processing, including user-specified input controls, configurations of RUC files, processed files etc. This file should be consulted if CALRUC fails to produce a complete 3D.DAT. An example of list file is given in Table 7-21.

3D.DAT

A sample 3D.DAT file is shown and described in section (7.7).

Table 7-21: Example CALRUC List File (CALRUC.LST)

```
CALRUC - Version: 1.92      Level: 050707

3D
Output CALRUC/3D.DAT file: TEST.dat
calruc log file:    TEST.lst

Resolution of Input Data (0 - 20 km, 1 - 40 km) :       1
Type of Input File (0 - hybrid, 1 - pressure) :        0
Application Type (0 - analysis, 1 - forecast):         0
Format of Output (0 - MM5.DAT, 1 - 3D.DAT):            1
Selection type (0 - i,j , 1 - Lat/Lon) :               0
J range:                                   10  15
I range:                                   10  15
Vertical Levels:                               1   50
Used desired shift in Geopotential Height =   5 m

Selected domain I:    10   15
             J:    10   15
  Number of Grids:     6    6
Selected domain SW lat/lon:       20.181    -123.533
Selected domain SW     X/Y:    -2681.928   -1909.858
SWIPS domain Grids (NX/NY):   151  113
SWIPS domain SW lat/lon:       16.281    -126.138
SWIPS domain SW     X/Y:    -3332.034   -2214.661
AWIPS Fake Center I/J & Latc/Lonc:    76   57     39.4600    -95.0000
AWIPS True Lat1/Lat2 & Lon_ref:      25.0000     25.0000     95.0000
AWIPS Grid size:      40.6353

 Number of Grib files: 2
Input RUC file #   1 .\sgpallruc40hybrX1.00.20050706.200000.raw.grb
3D Variable selected:      1    109     1  2005070620
2D Variable selected:      1    109     1
3D Variable selected:      1    109     2  2005070620
2D Variable selected:      1    109     2
3D Variable selected:      1    109     3  2005070620
2D Variable selected:      1    109     3
3D Variable selected:      1    109     4  2005070620
2D Variable selected:      1    109     4
( … Records omitted for clarity …)
```

Table 7-21 (Concluded)
Example CALRUC List File (CALRUC.LST)

```
2D Variable selected:    53   105     2
2D Variable selected:    33   105    10
2D Variable selected:    34   105    10
   ioutw: 1
   ioutq: 1
   ioutc: 1
   iouti: 1
   ioutg: 1
   iosrf: 0
 Output to 3D.DAT at  2005070620

Input RUC file #   2 .\sgpallruc40hybrX1.00.20050706.210000.raw.grb
3D Variable selected:     1   109     1  2005070621
2D Variable selected:     1   109     1
3D Variable selected:     1   109     2  2005070621
2D Variable selected:     1   109     2
3D Variable selected:     1   109     3  2005070621
2D Variable selected:     1   109     3
3D Variable selected:     1   109     4  2005070621
2D Variable selected:     1   109     4

( … Records omitted for clarity …)

2D Variable selected:    53   105     2
2D Variable selected:    33   105    10
2D Variable selected:    34   105    10
 Output to 3D.DAT at  2005070621
```

7.4 CALRAMS Preprocessor

CALRAMS operates on the output from the NOAA Air Resources Laboratory (ARL) Regional Atmospheric Modeling System (RAMS), Version 4.3. It extracts and reformats a subset of the gridded model output fields, and creates a 3D.DAT file for CALMET (see section 7.5).

RAMS was developed at the Colorado State University and the *ASTeR division of Mission Research Corporation in the 1980's. The main goal of the modeling system is for simulating and forecasting mesoscale meteorological fields, although it may be applied at both smaller and global scales. Specialized studies have applied RAMS at scales as small as 1m for boundary layer simulations and flows around individual buildings. RAMS can be initialized from NCEP model fields (Eta, AVN, NGM, etc.) in ARL packed form. Many different spatially varying surface variables such as soil moisture, soil and vegetation type, canopy temperature and water content, terrain height, land roughness, land percentage and sea surface temperature (SST) are ingested into RAMS on the model grid.

The horizontal coordinate used in RAMS is the Arakawa-C staggered grid of thermodynamic and momentum variables. The advantage of this staggered grid coordinating is to reduce finite differencing errors. The grid configuration is shown in Figure 7-8. The momentum variables of wind U and V components are defined at * points, while the thermodynamic variables of temperature (T), specific humidity (Q), pressure (P) are defined at + points.

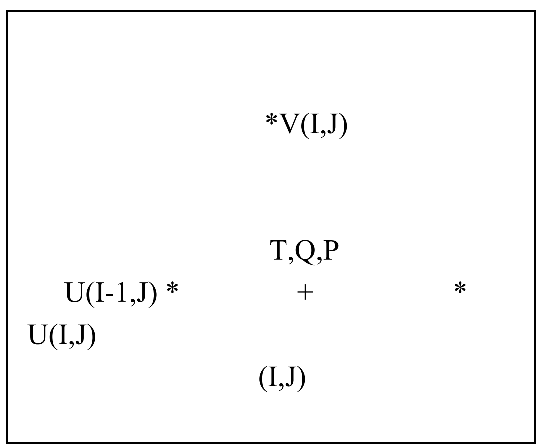

Figure 7-8: Arakawa-C grid used in RAMS.

The vertical coordinate is the terrain-following height Z* system, with Z* is defined as

$$Z^* = \frac{Z_{agl}}{1 - \frac{Z_{terr}}{Z_{top}}} \qquad 7\text{-}4$$

where Z_{agl} is the height above the ground, the Z_{terr} is the topographical height at grid, and Z_{top} is the height of model top. In this coordinate system, each level is a given fraction of the distance between the surface and the model top. The variables are staggered in vertical. The horizontal momentum of U and V components and all thermodynamic variables are defined at the full Z* levels, while the vertical velocity (W) is defined at half-Z* levels. The model top height is usually about 15-20 km above the ground.

The 3D.DAT file for CALMET needs a uniform coordinate system in both horizontal and vertical directions. Since most variables are at thermodynamic points, a two-grid averaging is used to interpolate momentum variables of U, V, and W in the staggered Arakawa-C coordinate system to its thermodynamic point. The set of thermodynamic point coordinates is used in the 3D.DAT file.

The CALRAMS processor runs on a UNIX platform and includes a host program called CALRAMS.F90 and a set of subroutines that perform various functions.

<u>CALRAMS Input Files</u>

RAMS Output file

CALRAMS was designed for a particular application of RAMS, with specific file names. Each RAMS file consists of one hour of model output for one nest. The naming convention is:

iw-A-YYYY-MM-DD-HH0000-g1.vfm
iw-A-YYYY-MM-DD-HH0000-g2.vfm
iw-A-YYYY-MM-DD-HH0000-g3.vfm
iw-A-YYYY-MM-DD-HH0000-g4.vfm
iw-A-YYYY-MM-DD-HH0000-head.txt

where YYYY is the 4-digit year, MM is the 2-digit month, DD is the 2-digit day, and HH is the 2-digit hour. The file with "head.txt" is the header file providing the RAMS configuration and output variables. The part "-g1 –g2 –g3 –g4" represents the nesting levels for the output. Because many hours are typically processed in one simulation, creating a 3D.DAT file requires many RAMS files. These file names are constructed by CALRAMS for the processing period, so all RAMS files for the period must reside in a single directory. Applications that use different file names will require changes to the CALRAMS code.

CALRAMS.INP

In CALRUC.INP, the user specifies the names of the output 3D.DAT file and list file, and the directory that contains the RAMS output files. The user may extract a subset of both the RAMS grid and the RAMS simulation period by specifying the beginning and ending indices of the RAMS grid in the easting (X), northing (Y), and surface to top (Z) directions and the beginning and ending dates for the desired processing period. There is more than one nesting in RAMS, and each nested domain usually covers a different area. The nest must be identified in the control file.

An example of CALRAMS.INP is given in Table 7-22 and is described in Table 7-23. In CALRAMS.INP, the content after "!" is made up of comments that are not read by the program. There should be no blank space at the beginning of any records, but there should be at least on blank space before "!" if it exists.

CALRAMS Output Files

CALRAMS.LST

The list file of CALRAMS records various information from processing, including user-specified input controls, configurations of RAMS files, processed files etc. This file should be consulted if CALRAMS fails to produce a complete 3D.DAT. An example list file is given in Table 7-24.

3D.DAT

A sample 3D.DAT file is shown and described in section (7.7).

Table 7-22: Example CALRAMS Control File (CALRAMS.INP)

```
Convert RAMS to CALMET 3D.DAT file
calrams.m3d      ! Output 3D.DAT file name (no space before or within filename)
/usr1/RAMS/Data  ! Directory for RAMS input data (./ for current directory)
calrams.lst      ! List file name (no space before or within filename)
15 40            ! Beg/End I in RAMS for output to 3D.DAT file
5 10             ! Beg/End J in RAMS for output to 3D.DAT file
1 17             ! Beg/End K in RAMS for output to 3D.DAT file
2001041404       ! Begining date (YYYYMMDDHH - UTC)
2001041406       ! Ending date   (YYYYMMDDHH - UTC)
1                ! RAMS nesting grid ID (1-4)
```

Line	Variable	Type	Description
1	TITLE	character*80	Header of the output 3D.DAT file
2	FIO	character*80	Name of output 3D.DAT
3	FBAS	character*80	Directory containing RAMS output files
4	FLG	character*80	List file name
5	NXB, NXE	integer	Beginning and Ending I (Easting) indices in RAMS domain extracted to 3D.DAT
6	NYB, NYE	integer	Beginning and Ending J (Northing) indices in RAMS domain extracted to 3D.DAT
7	NZB, NZE	integer	Beginning and Ending K (Surface to top) indices in RAMS domain extracted to 3D.DAT
8	NDATB	integer	Beginning UTC date-hour (YYYYYMMDDHH)
9	NDATE	integer	Ending UTC date-hour (YYYYMMDDHH)
10	INGRID	integer	Nesting level in RAMS (e.g., 1, 2, etc.)

Table 7-23: Example CALRAMS List File (CALRAMS.LST)

```
Convert RAMS to CALMET 3D.DAT file
calrams.m3d
/usr1/RAMS/Data
calrams.lst
M3D I/J/K ranges:    15   40    5   10    1   17
M3D beg/end times: 2001041404  2001041406
RAMS nesting grid ID:   1
Start/end dates         01104         4     01104         6
RAMS Header file:/usr1/RAMS/Data/iw-A-2001-04-14-040000-head.txt

 Grid parameters for the input RAMS domain
         NEST ID:         1
        NX,NY,NZ:        50        50        33
             DX:       64.
     Pole lon/lat:  -111.000    39.500
    SW x/y corner:   -1704.0   -1536.0
    NE x/y corner:    1368.0    1536.0
  SW thermo point:   -1672.0   -1504.0
  NE thermo point:    1336.0    1504.0
Date in Processing :   2001   4  14   4
     RAMS file: /usr1/RAMS/Data/iw-A-2001-04-14-040000-g1.vfm
 2-D output flag:            0
   ioutw: 1
   ioutq: 1
   ioutc: 1
   iouti: 1
   ioutg: 1
   iosrf: 0

 Vertical range extracted:           0           0
 nx in RAMS (east)    :           50
 ny in RAMS (north)   :           50
 nz in RAMS (vertical):           33
 dxy in RAMS (km)     :    64.00000

Date in Processing :   2001   4  14   5
     RAMS file: /usr1/RAMS/Data/iw-A-2001-04-14-050000-g1.vfm
Date in Processing :   2001   4  14   6
     RAMS file: /usr1/RAMS/Data/iw-A-2001-04-14-060000-g1.vfm
```

7.5 CALWRF Preprocessor

CALWRF operates on the output from NCEP and NCAR's Weather Research and Forecasting Model (WRF). WRF is a next-generation mesoscale numerical weather prediction system designed to serve both operational forecasting and atmospheric research needs. CALWRF extracts and reformats a subset of the gridded model output fields, and creates a 3D.DAT file for CALMET (see section 7.7).

WRF has been a collaborative partnership, principally among the National Center for Atmospheric Research (NCAR), the National Oceanic and Atmospheric Administration (the National Centers for Environmental Prediction (NCEP) and the Forecast Systems Laboratory (FSL), the Air Force Weather Agency (AFWA), the Naval Research Laboratory, the University of Oklahoma, and the Federal Aviation Administration (FAA). WRF features multiple dynamical cores, a 3-dimensional variational (3DVAR) data assimilation system, and a software architecture allowing for computational parallelism and system extensibility.

The CALWRF processor runs on a UNIX platform.

CALWRF Input Files

WRF Output file

CALWRF

CALWRF.INP

In CALWRF.INP, the user specifies the names of the output 3D.DAT file and list file, and the directory that contains the WRF output files. The user may extract a subset of both the WRF grid and the WRF simulation period by specifying the beginning and ending indices of the WRF grid in the easting (X), northing (Y), and surface to top (Z) directions and the beginning and ending dates for the desired processing period.

An example of CALWRF.INP is given in Table 7-29 and is described in Table 7-30. In CALWRF.INP, the content after "!" is made up of comments that are not read by the program. There should be no blank space at the beginning of any records, but there should be at least one blank space before "!" if it exists.

CALWRF Output Files

CALWRF.LST

The list file of CALWRF records various information from processing, including user-specified input controls, configurations of WRF files, processed files etc. This file should be consulted if CALWRF fails to produce a complete 3D.DAT. An example list file is given in Table 7-31.

Table 7-24: Example CALWRF Control File (CALWRF.INP)

```
Create 3D.DAT file for WRF output
calwrf.lst          ! Log file name
calwrf_em.m3d       ! Output file name
-1,-1,-1,-1,-1,-1    ! Beg/End I/J/K ("-" for all)
-1                  ! Start date (UTC yyyymmddhh, "-" for all)
-1                  ! End   date (UTC yyyymmddhh), "-" for all
1                   ! Number of WRF output files ( 1 only now)
wrfout_d01_2007-01-01_000000 ! File name of wrf output (Loop over files)

10,20,10,20,1,27    ! Beg/End I/J/K ("-" for all)
2007010100          ! Start date (UTC yyyymmddhh, "-" for all)
2007010105          ! End   date (UTC yyyymmddhh), "-" for all
*****   Below are comments ****************************************
Create 3D.DAT file for WRF output
calwrf.lst          ! Log file name
calwrf.hrd          ! Output file name
-9,-9,-9,-9,-9,-9   ! Beg/End I/J/K ("-" for all)
-9                  ! Beginning time  ("-" for all)
-9                  ! Ending time ("-" for all)
1                   ! Number of WRF output files ( 1 only now)
wrfout_070427.dat   ! File name of wrf output (Loop over files)

calwrf.lst          ! Log file name
calwrf_070427.m3d   ! Output file name
1,163,1,121,1,27    ! Beg/End I/J/K
2007042700          ! Beginning time
2007042704          ! Ending time
1                   ! Number of WRF output files ( 1 only now)
wrfout_070427.dat   ! File name of wrf output (Loop over files)

calwrf.lst          ! Log file name
calwrf_d2.m3d       ! Output file name
1,111,1,96,1,27,    ! Beg/End I/J/K
2000012412          ! Beginning time
2000012420          ! Ending time
1                   ! Number of WRF output files ( 1 only now)
wrfout_d02_000124   ! File name of wrf output (Loop over files)
```

Table 7-25: CALWRF Control File Inputs (CALWRF.INP)

Line	Variable	Type	Description
1	TITLE	character*80	Header of the output 3D.DAT file
2	FLG	character*80	List file name
3	FIO	character*80	Name of output 3D.DAT
4	NXB, NXE	integer	Beginning and Ending I (Easting) indices in WRF domain extracted to 3D.DAT
4	NYB, NYE	integer	Beginning and Ending J (Northing) indices in WRF domain extracted to 3D.DAT
4	NZB, NZE	integer	Beginning and Ending K (Surface to top) indices in WRF domain extracted to 3D.DAT
5	IDATEB	integer	Beginning UTC date-hour (YYYYYMMDDHH)
6	IDATEE	integer	Ending UTC date-hour (YYYYMMDDHH)
7	IFILE	integer	Number of WRF output file (1 only)
8	FIN	integer	Name of WRF output file

Table 7-26: Example CALWRF List File (CALWRF.LST)

```
CALWRF Code ----- Version:1.4            Level:100322
Create 3D.DAT file for WRF output
calwrf.inp
calwrf.lst
calwrf_em.m3d
 Beg/End I/J/K:    -1    -1    -1    -1    -1    -1
 Beg/End Dates:          -1
 Beg/End Dates:          -1
  WRF Output files: 1
   1 WRF File: wrfout_d01_2007-01-01_000000
 Processing WRF File:   1  wrfout_d01_2007-01-01_000000
 Warning: Attribute not exist:    3  DYN_OPT         -43
 Check whether this att. is critical
  truelat1,truelat2,stand_lon,cone,op_rot:
 0. 0. 0. 0. F
  Reset I/J/K ranges to: 1 29 1 29 1 27
 Reset require time range:  2007010100  2007010106
  x1dmn/y1dmn: -420.00027 -419.99982
 Process:    1  2007-01-01_00:00:00    2007010100
 3D-variable missing:       10  QICE
 3D-variable missing:       11  QSNOW
 3D-variable missing:       12  QGRAUP
 ioutw: 1
 ioutq: 1
 ioutc: 1
 iouti: 0
 ioutg: 0
 iosrf: 0

 Process:    2  2007-01-01_03:00:00    2007010103
 3D-variable missing:       10  QICE
 3D-variable missing:       11  QSNOW
 3D-variable missing:       12  QGRAUP
 Process:    3  2007-01-01_06:00:00    2007010106
 3D-variable missing:       10  QICE
 3D-variable missing:       11  QSNOW
 3D-variable missing:       12  QGRAUP
  End of WRF file: wrfout_d01_2007-01-01_000000
  CALWRF succeeded
```

7.6 CALTAPM Preprocessor

CALTAPM operates on the output from CSIRO's Division of Atmospheric Research, The Air Pollution Model, (TAPM). It outputs all the TAPM 3D variables: wind speed, wind direction, temperature, relative humidity, potential temperature and turbulent kinetic energy. It also outputs the 2D variables total solar radiation, net radiation, sensible heat flux, evaporative heat flux, friction velocity, potential virtual temperature scale, potential temperature scale, convective velocity scale, mixing height, surface temperature and rainfall. Table 7-32 lists the variables extracted using CALTAPM which are output to the 3D.DAT file format.

CALTAPM reads and interprets all information contained in the TAPM configuration input file headers (physical options, dates, grid size and location, etc.). TAPM requires a grid centre coordinate of latitude and longitude corresponding to the centre of the chosen grid domains. TAPM uses a Cartesian system where the x is positive from west to east and y is positive from south to north and specifies the centre of the local system with respect to the latitude and longitude of the grid centre. CALTAPM assumes the TAPM coordinate system is UTM and Datum of WGS-84 and uses this system directly in the 3D data file. Like CALMET TAPM uses a non-staggered horizontal coordinate system (see Figure 7-3) and a terrain-following vertical coordinate system. In the horizontal, all variables are defined at the center of each grid cell and the first level is 10m. The vertical levels of TAPM are used directly with no transformation to sigma levels in the 3D data file.

Table 7-27: Variables Available in CALTAPM Three-dimensional Output Files

Variables	3D.DAT
Vertical profile	
Pressure	Y
Height above M.S.L	Y
Temperature	Y
Wind direction	Y
Wind speed	Y
Vertical velocity	Y
Relative humidity	Y
Vapor mixing ratio	Y
Surface variables in header	
Sea level pressure	Y
Rain fall	Y
Snow cover	Y**
Short wave radiation at surface	Y
Long wave radiation at surface	Y
Air temperature at 2 meters above ground	Y**
Specific humidity at 2 meters above ground	Y**
Wind direction at 10m meters above ground	Y**
Wind speed at 10 meters above ground	Y**
Sea surface temperature	Y

* Exists only when available in TAPM output.

** Set to zero or blank if not available.

The output from TAPM is an ASCII file and is machine-independent. CALTAPM simply transforms the data into the correct file format compatible with CALMET. CALTAPM is easily executed on a pc.

Detailed information about TAPM settings is included in the list file (CALTAPM.LST) as shown in Table 7-33. Information needed for consistency in CALMET is included in the 3D.DAT header records as well. CALTAPM preprocessor requires a set of common block and parameter files for compiling. It needs one user-input file to run (CALTAPM.INP, hard-wired filename), and produces two output files (CALTAPM.LST and 3D.DAT). Output filenames are determined by users.

<u>CALTAPM Input Files</u>

TAPM.OUTA - TAPM ASCII output file of the type *.OUTA

TAPM The following steps below must be followed in order to generate a 3-Dimensional data file (3D.DAT) from TAPM using CALTAPM.

1. First run TAPM according to the instruction manual prepared by CSIRO (Hurley 2005). It is recommended to run TAPM using multiple nested grids, at least 3 nests with > 30 vertical levels.
2. Once TAPM has finished executing, use the Utilities command found on the File Menu Command of the TAPM GUI to convert the TAPM binary output file, *.OUT to an ASCII *.OUTA file. Usually the innermost nest is converted since it has the finest resolution and detail.

<u>CALTAPM Control File</u>

CALTAPM.INP

In CALTAPM.INP, the user can specify the input and output file names and the period to extract. The boundaries of the domain are not required as CALTAPM will transform the entire domain. It is up to the user to select the correct model domain when creating a 3D.DAT file from TAPM model output.

A sample CALTAPM.INP is shown in Table 7-26 and a description of each input variable is provided in Table 7-6.

<u>CALTAPM Output Files</u>

CALTAPM.LST

The list file contains information about the TAPM file and reports on CALTAPM processing, including warnings and error messages. A sample list file is shown in Table 7-26.

3D.DAT

A sample 3D.DAT file is shown and described in section (7.7).

Table 7-28: CALTAPM Sample Control File (CALTAPM.INP)

```
TAPM.OUTA      !  TAPM OUTA file created from TAPM GUI
TAPM.DEF       !  Default file which stores model selections
TAPM.TOP       !  TAPM topography file
CALTAPM.LST    !  CALTAPM output list file containing information about TAPM file
CALTAPM.M3D    !  3-Dimensional data output file
2001010101     : beginning date for processing (LST time - YYYYMMDDHH)
2001010105     : ending    date for processing (LST time - YYYYMMDDHH)
```

Table 7-29: CALTAPM Control File Inputs (CALTAPM.INP)

Line	Variable	Type	Description
1	TAPMASC	character*80	TAPM output ASCII meteorology file (*.OUTA)
2	TAPMDEF	character*80	TAPM default file name
3	TAPMTOP	character*80	TAPM topography file (same nest as the OUTA file)
4	TAPMOUT	character*80	Name of output list data file
5	IBEG	integer	Beginning date-hour of the period to extract (LST) - Format: YYYYMMDDHH
6	IEND	integer	Ending date-hour of the period to extract (LST) - Format: YYYYMMDDHH

Table 7-30: Example CALTAPM List File (CALTAPM.LST)

```
 CALTAPM - Version: 1.00     Level: 090907


 NX =  41  NY =  41  NZ =  20
 DX =  10000.0000  DY =  10000.0000
 ZS(1,1) =  873.080017  ZS(nx,ny) =  0.00000000E+00
 Z(1,1,1) =  9.02999973  Z(nx,ny,nz) =  8000.00000

  --- Reading TAPM.DEF file ---
 Lat,lon of grid center -34.0333290 151.158295
 Beg.date of TAPM run according to TAPM.DEF 1997 4 1
 End date of TAPM run according to TAPM.DEF 1997 4 2
 Real time zone in TAPM.DEF:  10.1000004
 Integer time zone in CALTAPM:  10
  --- Finished reading TAPM.DEF file ---

 TAPM grid center (lat,lon): -34.0333290 151.158295
 TAPM resolution dx and dy:  10000.0000 10000.0000
 TAPM number of grdpoints nx,ny:  41 41
 TAPM gridpoint (1,1) in UTM coordinates (km): 124.974121 6027.81348
 TAPM gridpoint(nx,ny)in UTM coordinates (km):  524.974121 6427.81348


Processing YYYY MM DD HH (LST):  1997  4  1  1

Processing YYYY MM DD HH (LST):  1997  4  1  2

Etc……….

Processing YYYY MM DD HH (LST):  1997  4  2 22

Processing YYYY MM DD HH (LST):  1997  4  2 23

  --- CALTAPM Successfully Completed ---
```

Table 7-31: Sample of CALTAPM derived 3D.DAT file

```
3D.DAT              2.12    Header Structure with Comment Lines
   1
Produced by CALTAPM Version: 1.00    , Level: 090907
  1  1  0  0  0  0
UTM  -34.0333  151.1583  56.00  56.00   124.974  6027.813  10.000  41  41 20
  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
1997 33115   47  41  41  20
   1   1  41  41   1  20  -35.8240  -32.2879 148.8494 153.2652
  0.000
  0.000
  0.000
  0.000
  0.000
  0.000
  0.000
  0.000
  0.000
  0.000
  0.000
  0.000
  0.000
  0.000
  0.000
  0.000
  0.000
  0.000
  0.000
  0.000
   1   1 -35.8240  148.8494  873  4
   2   1 -35.8278  148.9598  873  4
   3   1 -35.8314  149.0703  873 14
   4   1 -35.8350  149.1807  873 14
   5   1 -35.8385  149.2912  893 19
……
1997 33115  1  1  915.9 0.00 0     0.0   -97.6   278.9    4.53   163.0     3.0   278.9
 915   882 279.0 163  3.0  0.00 72 4.63
 911   918 278.7 163  6.0  0.00 74 4.63
 906   963 278.3 162  7.1  0.00 74 4.53
```

7.7 3D.DAT File Format

The 3D.DAT file is the primary output from CALMM5, CALETA, CALRUC, CALWRF, CALRAMS and CALTAPM, and provides CALMET with a common mesoscale model data input format for all of the corresponding models (MM5, Eta, RUC, RAMS, WRF and TAPM). The format of the 3D.DAT file originated with the CALMM5 processor and contains some information from MM5 that is not provided or needed to document other models. When this is the case, such fields are either set to zero, or to missing values (usually negative numbers).

A sample 3D.DAT file is provided in Table 7-32 and described in Table 7-33.

Table 7-32: Sample Mesoscale Model 3-D Data File (3D.DAT)

```
3D.DAT          2.1             Header Structure with Comment Lines
1
Produced by CALMM5 Version: 2.5     , Level: 050607
1  1  1  1  0  1
LCC   21.8530   45.0000   7.00  36.00 -1944.000 -1944.000  36.000 109 109 40
  1  4  3  5  2  2  1  0  1  1  1  1  1  1  1  1  1  1  1  1 25
2004013006    2   6   6  29
  25  10  30  15   1  29   35.1243   36.8535   6.6576   8.3718
 0.998
 0.995
 0.992
 0.988
 0.983
 0.978
 0.972
 0.966
 0.959
 0.951
 0.942
 0.931
 0.920
 0.907
 0.892
 0.876
 0.857
 0.837
 0.813
 0.787
 0.758
 0.725
 0.688
 0.646
 0.599
 0.547
 0.494
 0.449
 0.408
  25  10   6.6576   35.2281 1120 13    6.8291   35.3805 1283
```

Table 7-32 (Concluded)
Sample Mesoscale Model 3-D Data File (3D.DAT)

```
 26  10   6.6777   35.5531 1264 13    6.8489   35.7058 1426
 27  10   6.6971   35.8780 1250 13    6.8680   36.0311 1422
 28  10   6.7158   36.2031 1251 13    6.8864   36.3566 1430
 29  10   6.7338   36.5283 1365 13    6.9042   36.6821 1456
 30  10   6.7512   36.8535 1458 13    6.9212   37.0077 1433
 25  11   6.9805   35.2076 1166 13    7.1523   35.3602 1415
 26  11   7.0006   35.5331 1467 13    7.1721   35.6861 1745
 27  11   7.0201   35.8588 1605 13    7.1913   36.0122 1828
 28  11   7.0389   36.1846 1622 13    7.2098   36.3383 1807
 29  11   7.0570   36.5104 1603 13    7.2276   36.6645 1721
 30  11   7.0744   36.8363 1550 10    7.2447   36.9908 1590
 25  12   7.3038   35.1869 1274 10    7.4759   35.3398 1668
 26  12   7.3241   35.5131 1718  6    7.4958   35.6664 2045
 27  12   7.3436   35.8395 1927 13    7.5151   35.9932 2090
 28  12   7.3624   36.1659 1935 13    7.5336   36.3200 2014
 29  12   7.3806   36.4924 1867  2    7.5515   36.6469 1925
 30  12   7.3981   36.8190 1770  2    7.5687   36.9739 1843
 25  13   7.6276   35.1661 1424  2    7.8000   35.3193 1768
 26  13   7.6479   35.4930 1893 13    7.8200   35.6467 2089
 27  13   7.6675   35.8201 2107  2    7.8393   35.9741 2205
 28  13   7.6865   36.1472 2102  2    7.8579   36.3016 2099
 29  13   7.7047   36.4744 1996 13    7.8758   36.6292 1945
 30  13   7.7222   36.8017 1912 13    7.8930   36.9568 1934
 25  14   7.9519   35.1452 1441  2    8.1245   35.2987 1567
 26  14   7.9722   35.4729 1819  2    8.1445   35.6268 1851
 27  14   7.9919   35.8006 2064 13    8.1639   35.9549 2110
 28  14   8.0109   36.1284 2123 13    8.1826   36.2831 2079
 29  14   8.0292   36.4563 1995 10    8.2005   36.6114 1856
 30  14   8.0468   36.7843 1887 10    8.2179   36.9398 1811
 25  15   8.2765   35.1243 1372 10    8.4494   35.2781 1420
 26  15   8.2970   35.4526 1618 10    8.4695   35.6068 1636
 27  15   8.3167   35.7810 1871 13    8.4889   35.9356 1887
 28  15   8.3358   36.1096 2001 10    8.5077   36.2645 1930
 29  15   8.3541   36.4381 1911 10    8.5257   36.5935 1779
 30  15   8.3718   36.7668 1785 10    8.5431   36.9226 1695
2004013006 25 10 1012.3 0.03 0    26.5   406.8   293.1   14.17    62.2     2.1   291.0
 890  1130 292.9  62  2.3 -0.01 8613.89-4.000
 887  1154 292.8  62  2.8 -0.02 8513.60-4.000
```

Table 7-32 (Concluded)
Sample Mesoscale Model 3-D Data File (3D.DAT)

```
 884  1180 292.8  61  2.9 -0.02 8313.44-4.000
 881  1210 292.8  60  3.1 -0.02 8213.29-4.000
 878  1244 292.8  59  3.3 -0.02 8113.09-4.000
 874  1282 292.7  58  3.5 -0.02 7912.85-4.000
 870  1325 292.6  58  3.5 -0.02 7812.67-4.000
 865  1373 292.5  58  3.4 -0.02 7812.52 0.000 0.005 0.000 0.000
 859  1429 292.2  58  3.3 -0.02 7812.41 0.000 0.008 0.000 0.000
 853  1491 291.9  59  3.1 -0.02 7812.33 0.000 0.010 0.000 0.000
 846  1561 291.6  62  3.0 -0.02 7912.25 0.000 0.013 0.000 0.000
 838  1641 291.1  68  2.9 -0.02 8012.17 0.000 0.015 0.000 0.000
 830  1731 290.6  75  2.9 -0.02 8112.07 0.000 0.019 0.000 0.000
 820  1834 289.9  83  2.9 -0.02 8311.98 0.000 0.021 0.000 0.000
 809  1950 289.1  93  3.0 -0.02 8511.88 0.000 0.024 0.000 0.000
 796  2083 288.2 102  3.2 -0.02 8811.73 0.000 0.026 0.000 0.000
 782  2235 287.1 110  3.6 -0.01 9111.56 0.000 0.027 0.000 0.000
 766  2408 285.9 118  4.1 -0.01 9411.29 0.000 0.027 0.000 0.000
 748  2607 284.5 123  4.9  0.00 9810.90 0.000 0.029 0.000 0.000
 728  2835 283.2 124  6.4  0.01 94 9.87 0.002 0.033 0.000 0.000
 705  3099 281.4 124  7.5  0.02 92 8.92 0.028 0.036 0.000 0.000
 680  3404 279.2 122  8.0  0.03100 8.62 0.182 0.033 0.000 0.000
 651  3760 277.3 118  8.6  0.04100 7.96 0.433 0.028 0.000 0.000
 618  4178 275.3 110  8.4  0.05 98 7.01 0.342 0.027 0.000 0.000
 581  4671 272.9  96  7.7  0.04 90 5.77 0.009 0.059 0.000 0.000
 540  5260 269.1  87  7.2  0.03 99 5.15 0.024 0.123 0.000 0.000
 498  5894 265.4  78  7.3  0.01 93 3.96 0.023 0.071 0.000 0.000
 462  6474 262.3  79  8.4 -0.01 66 2.37-4.000
 430  7028 259.8  88  9.9 -0.02 57 1.82-4.000
2004013006 26 10 1012.3 0.01 0    40.2   402.0   292.5   14.16    50.4     2.0   290.7
 875  1275 292.3  52  2.4 -0.01 8813.88-4.000
 873  1298 292.1  52  2.9 -0.01 8713.58-4.000
 ……
```

Table 7-33: Mesoscale Model 3-D Data File (3D.DAT)

HEADER RECORDS

Header Record #1

Variable No.	Variable	Type	Description
1	DATASET	Char*16	Dataset name (3D.DAT)
2	DATAVER	Char*16	Dataset version
3	DATAMOD	Char*64	Dataset message field
			Format(2a16,a64)

Header Record #2 to NCOMM+2

1	NCOMM	Integer	Number of comment records
1	COMMENT	Char*132	Comments (repeated NCOMM times)
			Format(a132)

Header Record # NCOMM+3

Variable No.	Variable	Type	Description
1	IOUTW	Integer	Flag indicating if vertical velocity is recorded.
1	IOUTQ	Integer	Flag indicating if relative humidity and vapor mixing ratios are recorded
1	IOUTC	Integer	Flag indicating if cloud and rain mixing ratios are recorded.
1	IOUTI	Integer	Flag indicating if ice and snow mixing ratios are recorded.
1	IOUTG	Integer	Flag indicating if graupel mixing ratio is recorded.
1	IOSRF	Integer	Flag indicating if surface 2-D files are created.
			Format(6i3)

Table 7-33 (Continued)
Mesoscale Model 3-D Data File (3D.DAT)

HEADER RECORDS

Header Record # NCOMM+4

Variable No.	Variable	Type	Description
1	MAPTXT	char*3	Map projection LCC: Lambert Land Conformal Projection
2	RLATC	real	Center latitude (positive for northern hemisphere)
3	RLONC	real	Center longitude (positive for eastern hemisphere)
4	TRUELAT1	real	First true latitude
5	TRUELAT2	real	Second true latitude
6	X1DMN	real	SW dot point X coordinate (km, Grid 1,1) in original domain
7	Y1DMN	real	SW dot point Y coordinate (km, Grid 1,1) in original domain
8	DXY	real	Grid size (km)
9	NX	integer	Number of grids in X-direction (West-East) in original domain
10	NY	integer	Number of grids in Y-direction (South-North) in original domain
11	NZ	integer	Number of sigma layers in original domain
			Format(a4,f9.4,f10.4,2f7.2,2f10.3,f8.3,2i4,i3)

Table 7-33 (Continued)
Mesoscale Model 3-D Data File (3D.DAT)
HEADER RECORDS

Header Record #NCOMM+5

(Note: Values set to zero for models other than MM5)

Variable No.	Variable	Type	Description
1	INHYD	Integer	0: hydrostatic MM5 run - 1: non-hydrostatic
2	IMPHYS	Integer	MM5 moisture options. 1: dry 2: removal of super saturation 3: warm rain (Hsie) 4: simple ice scheme (Dudhia) 5: mixed phase (Reisner) 6: mixed phase with graupel (Goddard) 7: mixed phase with graupel (Reisner) 8: mixed phase with graupel (Schultz)
3	ICUPA	Integer	MM5 cumulus parameterization 1: none 2: Anthes-Kuo 3: Grell 4: Arakawa-Schubert 5: Fritsch-Chappel 6: Kain-Fritsch 7: Betts-Miller 8: Kain-Fritsch
4	IBLTYP	Integer	MM5 planetary boundary layer (PBL) scheme 0: no PBL 1: bulk PBL 2: Blackadar PBL 3: Burk-Thompson PBL 4: ETA PBL 5: MRF PBL 6: Gayno-Seaman PBL 7: Pleim-Chang PBL

Table 7-33 (Continued)
Mesoscale Model 3-D Data File (3D.DAT)

Variable No.	Variable	Type	Description
5	IFRAD	Integer	MM5 atmospheric radiation scheme 0: none 1: simple cooling 2: cloud-radiation (Dudhia) 3: CCM2 4: RRTM longwave
6	ISOIL	Integer	MM5 soil model 0: none 1: multi-layer 2: Noah LS model 3: Pleim-Xiu LSM
7	IFDDAN	Integer	1: FDDA grid analysis nudging - 0: no FDDA
8	IFDDAOB	Integer	1: FDDA observation nudging - 0: no FDDA
9-20	FLAGS_2D	Integer	1/0: Flags for output variables in 2D.DAT (not used in 3D.DAT)
21	NLAND	Integer	Number of land use categories
			Format(30i3)

Table 7-33 (Continued)
Mesoscale Model 3-D Data File (3D.DAT)

Header Record #NCOMM+6

Variable No.	Variable	Type	Description
1	IBYRM	integer	Beginning year of the data in the file
2	IBMOM	integer	Beginning month of the data in the file
3	IBDYM	integer	Beginning day of the data in the file
4	IBHRM	integer	Beginning hour (GMT) of the data in the file
5	NHRSMM5	integer	Length of period (hours) of the data in the file
6	NXP	integer	Number of grid cells in the X direction in the extraction subdomain
7	NYP	integer	Number of grid cells in the Y direction in the extraction subdomain
8	NZP	integer	Number of layers in the MM5 domain (half sigma levels) (same as number of vertical levels in data records)
			Format (i4, 3i2,i5,3i4)

Table 7-33 (Continued)
Mesoscale Model 3-D Data File (3D.DAT)

HEADER RECORDS

Header Record #NCOMM+7

Variable No.	Variable	Type	Description
1	NX1	integer	I-index (X direction) of the lower left corner of the extraction subdomain
2	NY1	integer	J-index (Y direction) of the lower left corner of the extraction subdomain
3	NX2	integer	I-index (X direction) of the upper right corner of the extraction subdomain
4	NY2	integer	J-index (Y direction) of the upper right corner of the extraction subdomain
5	NZ1	integer	k-index (Z direction) of lowest extracted layer
6	NZ2	integer	k-index (Z direction) of hightest extracted layer
7	RXMIN	real	Westernmost E. longitude (degrees) in the subdomain
8	RXMAX	real	Easternmost E. longitude (degrees) in the subdomain
9	RYMIN	real	Southernmost N. latitude (degrees) in the subdomain
10	RYMAX	real	Northernmost N. latitude (degrees) in the subdomain

format (6i4,2f10.4,2f9.4)

Next NZP Records

Variable No.	Variable	Type	Description
1	SIGMA	real array	Sigma-p values used by MM5 to define each of the NZP layers (half-sigma levels) Read as: do 10 I=1,NZP 10 READ (iomm4,20) SIGMA(I) 20 FORMAT (F6.3)

Table 7-33 (Continued)
Mesoscale Model 3-D Data File (3D.DAT)

HEADER RECORDS

Next NXP*NYP Records

Variable No.	Variable	Type	Description
1	IINDEX	integer	I-index (X direction) of the grid point in the extraction subdomain
2	JINDEX	integer	J-index (Y direction) of the grid point in the extraction subdomain
3	XLATDOT	real array	N. Latitude (degrees) of the grid point in the extraction subdomain (positive for the Northern Hemisphere, negative for Southern Hemisphere)
4	XLONGDOT	real array	E. Longitude (degrees) of the grid point in the extraction subdomain (positive for the Eastern Hemisphere, negative for Western Hemisphere)
5	IELEVDOT	integer array	Terrain elevation of the grid point in the extraction subdomain (m MSL)
6	ILAND	integer array	Landuse categories at cross points
7	XLATCRS	real array	Same as XLATDOT but at cross point
8	XLATCRS	real array	Same as XLATDOT but at cross point
9	IELEVCRS	integer array	Same as IELEVDOT but at cross point
			Format (2i4, f9.4, f10.4, i5, i3, 1x, f9.4, f10.4,i5)

Table 7-33 (Continued)
Mesoscale Model 3-D Data File (3D.DAT)

DATA RECORDS (repeated for each grid cell in extraction subdomain)

Data Record

Variable No.	Variable	Type	Description
1	MYR	integer	Year of MM5 wind data (YYYY)
2	MMO	integer	Month of MM5 wind data (MM)
3	MDAY	integer	Day of MM5 wind data (DD)
4	MHR	integer	Hour (GMT) of MM5 wind data (HH)
5	IX	integer	I-index (X direction) of grid cell
6	JX	integer	J-index (Y direction) of grid cell
7	PRES	real	sea level pressure (hPa)
8	RAIN	real	total rainfall accumulated on the ground for the past hour (cm)
9	SC	integer	snow cover indicator (0 or 1, where 1 = snow cover was determined to be present for the MM5 simulation)
10*	RADSW	real	Short wave radiation at the surface (W/m**2)
11*	RADLW	real	long wave radiation at the top (W/m**2)
12*	T2	real	Air temperature at 2 m (K), zero or blank if not exist
13*	Q2	real	Specific humidity at 2 m (g/kg), zero or blank if not exist
14*	WD10	real	Wind direction of 10-m wind (m/s), zero or blank if not exist
15*	WS10	Real	Wind speed of 10-m wind (m/s), zero or blank if not exist
16*	SST	real	Sea surface temperature (K), zero or blank if not exist format(i4,3i2,2i3,f7.1,f5.2,i2,3f8.1,f8.2,3f8.1)

* Set to all zero if not existing in output of MM5 or other models

MM5 Note: WD10 and WS10 are MM5 output at dot points, other meteorological variables are interpolated in CALMM5 to dot points from MM5 output at cross points.

Table 7-33 (Continued)
Mesoscale Model 3-D Data File (3D.DAT)

DATA RECORDS (repeated for each grid cell in extraction subdomain)

NZP*Data Records

Variable No.	Variable	Type	Description
1	PRES	integer	Pressure (in millibars)
2	Z	integer	Elevation (meters above m.s.l.)
3	TEMPK	integer	Temperature (^{o} K)
4	WD	integer	Wind direction (degrees)
5	WS	real	Wind speed (m/s)
6[w]	W	real	Vertical velocity (m/s)
7[q]	RH	integer	Relative humidity (%)
8[q]	VAPMR	real	Vapor mixing ratio (g/kg)
9[c] *	CLDMR	real	Cloud mixing ratio (g/kg)
10[c] *	RAINMR	real	Rain mixing ratio (g/kg)
11[i] *	ICEMR	real	Ice mixing ratio (g/kg)
12[i] *	SNOWMR	real	Snow mixing ratio (g/kg)
13[g] *	GRPMR	real	Graupel mixing ratio (g/kg)

Format(i4,i6,f6.1,i4,f5.1,f6.2,i3,f5.2,5f6.3)

MM5 Note: WD and WS are MM5 output at dot points, other variables are interpolated in CALMM5 to dot points from MM5 output at cross points.

[w] Variable present in the record only if IOUTW = 1
[q] Variable present in the record only if IOUTQ = 1
[c] Variable present in the record only if IOUTC = 1 (possible only if IOUTQ=1)
[I] Variable present in the record only if IOUTI = 1 (possible only if IOUTQ = IOUTC = 1)
[g] Variable present in the record only if IOUTG = 1 (possible only if IOUTQ = IOUTC = IOUTI=1)
* Output for variables 9 – 13 will be compressed using a negative number if ALL are zero. -5.0 represents all five variables are zero.

8. CALMET MODEL FILES

The CALMET model obtains the necessary control information and input meteorological data from a number of different input files. The control file (CALMET.INP) contains the data that define a particular model run, such as beginning and ending date and time, horizontal and vertical grid data, and model option flags. Geophysical data, including terrain elevations, land use, and surface characteristics, are read from a formatted data file called GEO.DAT.

The hourly surface meteorological observations are contained in the surface data file (SURF.DAT). If overwater temperatures are being calculated separately, this file must contain only land stations. This file can be either a formatted or an unformatted file generated by the SMERGE preprocessor program or a free-formatted, user-prepared file, depending on options specified in the control file. Upper air meteorological data are read from a series of data files called UPn.DAT, where n is the upper air station number (e.g., n=1,2,3,...). The data for each upper air station are stored in a separate data file.

Hourly precipitation observations are contained in a file called PRECIP.DAT. This file can be a formatted or an unformatted file generated by the PMERGE preprocessor program or a free-formatted, user-prepared file. Overwater meteorological data are read from a series of data files called SEAn.DAT, where n is the overwater station number (e.g., n= 1,2,3,...). The data for each overwater station are stored in a separate file. If overwater default parameters for temperature, air-sea temperature difference, etc. are being used and separate overwater temperatures are not being calculated, then overwater stations can be placed in the SURF.DAT file.

CALMET contains an option to use gridded prognostic model output from CSUMM, MM4, or MM5 as model input. If this option is selected, the CSUMM gridded prognostic model wind fields are read from an unformatted data file called PROG.DAT, the MM4/MM5 prognostic output are read from a formatted data file called MM4.DAT, or the MM5 fields may be read from a formatted file called 3D.DAT (formerly MM5.DAT).

In its default mode, CALMET computes domain-averaged winds, temperature lapse rates and surface temperatures from the hourly surface observations and twice-daily upper air data contained in the SURF.DAT, UPn.DAT, and, if present, SEAn.DAT files. However, the model contains an option for the user to specify pre-computed values for these parameters from an optional file DIAG.DAT.

The main CALMET output files are a list file (CALMET.LST) containing a listing of the model inputs and user-selected printouts of the output meteorological values and an optional, unformatted disk file (CALMET.DAT or PACOUT.DAT) containing the hourly gridded meteorological data produced by the model. In addition, several additional optional list files (TEST.PRT, TEST.OUT, TEST.KIN, TEST.FRD, and TEST.SLP) can be created. These files, provided primarily for model testing purposes, contain intermediate versions of the wind fields at various points in the diagnostic wind field analysis

(e.g., after evaluation of kinematic effects, slope flows, terrain blocking effects, divergence minimization, etc.).
The CALMET input and output files are listed in Table 8-1. The table shows the FORTRAN unit numbers associated with each file. These unit numbers are specified in a parameter file, PARAMS.MET, and can easily be modified to accommodate system-dependent restrictions on allowable unit numbers. The user should make sure that the beginning and total number of UPn.DAT and SEAn.DAT files are defined such that there is no overlap among unit numbers.

The name and full path of each of the CALMET input and output files (except one) is assigned in the control file (CALMET.INP) which is specified on the command line. For example, on a DOS system,

CALMET d:\CALMET\CALMET.INP

will execute the CALMET code (CALMET.EXE) and read the input and output filenames from d:\CALMET\CALMET.INP. If not specified on the command line, the default name of the control file is CALMET.INP in the current working directory.

In the following sections, the contents and format of each CALMET input file are described in detail.

Table 8-1: CALMET Input and Output Files

Unit	Default File Name	Type	Format	Description
IO2	DIAG.DAT	input	formatted	File containing preprocessed meteorological data for diagnostic wind field module. (Used only if IDIOPT1, IDIOPT2, IDIOPT3, IDIOPT4, or IDIOPT5 = 1.)
IO5	CALMET.INP	input	formatted	Control file containing user inputs.
IO6	CALMET.LST	output	formatted	List file (line printer output file) created by CALMET.
IO7	CALMET.DAT or PACOUT.DAT	output	unformatted	Output data file created by CALMET containing hourly gridded fields of meteorological data. (Created only if LSAVE=T.)
IO8	GEO.DAT	input	formatted	Geophysical data fields (land use, elevation, surface characteristics, anthropogenic heat fluxes).
IO10	SURF.DAT	input	unformatted (if IFORMS=1) or formatted (if IFORMS=2)	Hourly surface observations (Used only if IDIOPT4=0.) If IFORMS=1, use the unformatted output file of the SMERGE program. If IFORMS=2, use a free-formatted input file generated either by SMERGE or the user.
IO12	PRECIP.DAT	input	unformatted (if IFORMP=1) or formatted (if IFORMP=2)	Hourly precipitation data (used if NPSTA > 0). If IFORMP=1, PRECIP.DAT is the unformatted output file of the PMERGE program. If IFORMP=2, PRECIP.DAT is a free-formatted input file generated either by PMERGE or the user.
IO14	WT.DAT	input	formatted	Gridded fields of terrain weighting factors used to weight the observed winds and the MM4 winds in the interpolation process

CALMET Input and Output Files Continued)

Table 8-1 (Concluded)

CALMET Input and Output Files

Unit	Default File Name	Type	Format	Description
IO30	UP1.DAT	input	formatted	Upper air data (READ62 output) for upper air station #n. (Used only if IDIOPT5=0.)
IO30+1	UP2.DAT			
IO30+2	UP3.DAT			
	UPn.DAT			

(Up to "MAXUS" upper air stations allowed. MAXUS currently = 50).

Unit	Default File Name	Type	Format	Description
IO80	SEA1.DAT	input	formatted	Overwater meteorological data for station #n. (Used only if NOWSTA > 0).
IO80+1	SEA2.DAT			
IO80+2	SEA3.DAT			
•	•			
	SEAn.DAT			

(Up to "MXOWS" overwater stations allowed. MXOWS currently = 15).

Unit	Default File Name	Type	Format	Description
IO20	PROG.DAT (CSUMM) or	input	unformatted	Gridded fields of prognostic wind data to use as input to the diagnostic wind field module. (Used only if IPROG > 0.)
IO20	M3DDAT.DAT (MM4/MM5/3D)	input	formatted	

Wind Field Module Test and Debug Files

Unit	Default File Name	Type	Format	Description
IO21	TEST.PRT	output	unformatted	Intermediate winds and misc. input and internal variables. (Created only if at least one wind field print option activated (IPR0-IPR8).)
IO22	TEST.OUT	output	formatted	Final wind fields. (Created only if IPR8=1 and IOUTD=1.)
IO23	TEST.KIN	output	formatted	Wind fields after kinematic effects. (Created only if IPR5=1 and IOUTD=1.)
IO24	TEST.FRD	output	formatted	Wind fields after Froude No. effects. (Created only if IPR6=1 and IOUTD=1.)
IO25	TEST.SLP	output	formatted	Wind fields after slope flow effects. (Created only if IPR7=1 and IOUTD=1.)

8.1 User Control File (CALMET.INP)

The selection and control of CALMET options are determined by user-specified inputs contained in a file called the control file. This file, CALMET.INP, contains all the information necessary to define a model run (e.g., beginning and ending date and time, grid specifications, technical options, output options, etc.). CALMET.inp may be created/edited directly using a conventional editor, or it may be created/edited indirectly by means of the PC-based, Windows-compatible Graphical User Interface (GUI) developed for CALMET.

The CALMET GUI not only prepares the control file, it also executes the model and facilitates file management functions; and it contains an extensive help system that makes much of the information in this manual available to the user on-line. Although the model can be set up and run entirely within the GUI system, the interface is designed to always create the ASCII CALMET.INP file. This allows runs to be set up on PC-based systems and the control file transferred to a workstation or a mainframe computer for computationally intensive applications. The ASCII CALMET.INP file should be directly transportable to virtually any non-PC system.

When CALMET is setup and run entirely on a non-PC system, or if the GUI is not used on a PC, the control file CALMET.INP may be configured by using a conventional editor. This is facilitated by the extensive self-documenting statements contained in the standard file. As explained further below, more comments can be readily added by the user to document specific parameter choices used in the run. These comments remain in the file, and are reported to the CALMET list file when CALMET is executed from the command line. Note, however, that the GUI always writes the standard comments to CALMET.INP, and ignores any additional text. Furthermore, the control file is always updated by the GUI, even if the GUI is only used to run CALMET without altering the technical content of the control file. Thus, the user must save the control file to another filename prior to using the GUI if non-standard comments are to be saved. This feature of the GUI can be used to create a new copy of the standard control file by merely saving a "new file" to disk, so a fresh version of the control file is always available.

The control file is organized into 10 major Input Groups preceded by a three line run title (see Table 8-2). The Input Groups must appear in order, i.e., Input Group 0 followed by Input Group 1, etc. However, the variables within an Input Group may appear in any order. Each Input Group must end with an Input Group terminator consisting of the word END between two delimiters (i.e., !END!). Even a blank Input Group (i.e., one in which no variables are included) must end with an Input Group terminator in order to signal the end of that Input Group and the beginning of another. Note that Input Group 0 consists of four subgroups.

A sample control file is shown in Table 8-3. It is designed to be flexible and easy to use. The control file is read by a set of FORTRAN text processing routines contained within CALMET which allow the user considerable flexibility in designing and customizing the input file. An unlimited amount of optional descriptive text can be inserted within the control file to make it self-documenting. For example, the definition, allowed values, units, and default value of each input variable can be included within the control file.

The control file processor searches for pairs of special delimiter characters (!). All text outside the delimiters is assumed to be user comment information and is echoed back but otherwise ignored by the input module. Only data within the delimiter characters are processed. The input data consist of a leading delimiter followed by the variable name, equals sign, input value or values, and a terminating delimiter (e.g., !XX = 12.5 !). The variable name can be lower or upper case, or a mixture of both (i.e., XX, xx, Xx are all equivalent). The variable can be a real, integer or logical array or scalar. The use of repetition factors for arrays is allowed (e.g., ! XARRAY = 3 * 1.5 ! instead of ! XARRAY = 1.5, 1.5, 1.5 !). Different values must be separated by commas. Spaces within the delimiter pair are ignored. Exponential notation (E format) for real numbers is allowed. However, the optional plus sign should be omitted (e.g., enter +1.5E+10 as 1.5E10). The data may be extended over more than one line. The line being continued must end with a comma. Each leading delimiter must be paired with a terminating delimiter. All text between the delimiters is assumed to be data, so no user comment information is allowed to appear within the delimiters. The inclusion in the control file of any variable that is being assigned its default value is optional.

The control file reader expects that logical variables will be assigned using only a one character representation (i.e., 'T' or 'F'). Input Groups 7-9 are handled differently (making use of FORTRAN free reads), because they contain Character*4 input data. The data portion of each record in Input Groups 7-9 must start in Column 9 or greater of the record.

Each CALMET control file input variable is described in Table 8-4. The control file module has a list of the variable names and array dimensions for each Input Group. Checks are performed to ensure that the proper variable names are entered by the user, and that no array dimensions are exceeded. Error messages result if an unrecognized variable name is encountered or too many values are entered for a variable.

Note that if LLCONF=T, then all x,y coordinates in the CALMET.INP file must be specified on the chosen Lambert Conformal projection grid, rather than in UTM coordinates.

A standard control file is provided along with the CALMET test case run. It is recommended that a copy of the standard control file be permanently stored as a backup. Working copies of the control file may be made and then edited and customized by the user for a particular application.

Table 8-2: CALMET Control File Input Groups

Input Group	Description
*	Run Title First three lines of control file (up to 80 characters/line)
0	Input and Output File Names
1	General Run Control Parameters Beginning and ending date and time, base time zone, and run type options
2	Map Projection and Grid Control Parameters Grid spacing, number of cells, vertical layer structure, and reference coordinates
3	Output Options Printer control variables, and disk output control variables
4	Meteorological Data Options Number of surface, upper air, over water, and precipitation stations, input file formats, and precipitation options
5	Wind Field Options and Parameters Model option flags, radius of influence parameters, weighting factors, barrier data, diagnostic module input flags, and lake breeze information
6	Mixing Height, Temperature, and Precipitation Parameters Empirical constants for the mixing height scheme, spatial averaging parameters, minimum/maximum overland and overwater mixing heights, temperature options, and precipitation interpolation options
7	Surface Meteorological Station Parameters Station name, coordinates, time zone, and anemometer height
8	Upper Air Station Parameters Station name, coordinates, and time zone
9	Precipitation Station Parameters Station name, station code, and coordinates

Table 8-3: Sample CALMET Control File (CALMET.INP)

Run Title and Input Group 0

```
CALMET.INP      2.1             Hour Start and End Times with Seconds
CALMET MOD6 TEST CASE -
30x30 1km km meteorological grid -
1hr met data
---------------- Run title (3 lines) ------------------------------------------

                    CALMET MODEL CONTROL FILE
                    --------------------------

-------------------------------------------------------------------------------

INPUT GROUP: 0 -- Input and Output File Names

Subgroup (a)
------------
Default Name  Type          File Name
------------  ----          ---------
GEO.DAT       input    ! GEODAT=GEO.DAT       !
SURF.DAT      input    ! SRFDAT=SURF_10M.DAT      !
CLOUD.DAT     input    * CLDDAT=            *
PRECIP.DAT    input    * PRCDAT=            *
WT.DAT        input    * WTDAT=             *

CALMET.LST    output   ! METLST=CALMET.LST     !
CALMET.DAT    output   ! METDAT=CALMET.DAT    !
PACOUT.DAT    output   * PACDAT=            *

All file names will be converted to lower case if LCFILES = T
Otherwise, if LCFILES = F, file names will be converted to UPPER CASE
         T = lower case      ! LCFILES = T !
         F = UPPER CASE

NUMBER OF UPPER AIR & OVERWATER STATIONS:

    Number of upper air stations (NUSTA)  No default     ! NUSTA =  1  !
    Number of overwater met stations
                                 (NOWSTA) No default     ! NOWSTA =  1  !
    Number of MM4/MM5/M3D.DAT files
                                 (NM3D) No default       ! NM3D =  0  !

    Number of IGF-CALMET.DAT files
                                 (NIGF)   No default     ! NIGF =  0  !
                       !END!
```

Table 8-3 (continued)
Sample CALMET Control File (CALMET.INP)
Run Title and Input Group 0

```
-------------------------------------------------------------------------------
Subgroup (b)
---------------------------------
Upper air files (one per station)
---------------------------------
Default Name  Type       File Name
------------  ----       ---------
UP1.DAT       input     1  ! UPDAT=UP_30M.DAT!    !END!
-------------------------------------------------------------------------------
Subgroup (c)
-----------------------------------------
Overwater station files (one per station)
-----------------------------------------
Default Name  Type       File Name
------------  ----       ---------
SEA1.DAT       input     1  ! SEADAT=SEA.DAT!    !END!

Subgroup (d)
-------------------------------------------------
MM4/MM5/M3D.DAT files (consecutive or overlapping)
-------------------------------------------------
Default Name  Type       File Name
------------  ----       ---------
MM51.DAT       input     1  * M3DDAT=MM5.DAT*    *END*
Subgroup (e)
-------------------------------------------------
IGF-CALMET.DAT files (consecutive or overlapping)
-------------------------------------------------
Default Name  Type       File Name
------------  ----       ---------
IGFn.DAT       input     1  * IGFDAT=CALMET0.DAT *    *END*
-------------------------------------------------------------------------------
Subgroup (f)
----------------
Other file names
----------------

Default Name  Type       File Name
------------  ----       ---------
DIAG.DAT      input      * DIADAT=                  *
PROG.DAT      input      * PRGDAT=                  *

TEST.PRT      output     * TSTPRT=                  *
TEST.OUT      output     * TSTOUT=                  *
TEST.KIN      output     * TSTKIN=                  *
TEST.FRD      output     * TSTFRD=                  *
TEST.SLP      output     * TSTSLP=                  *
DCST.GRD      output     * DCSTGD=                  *
-------------------------------------------------------------------------------
```

Table 8-3 (Continued)
Sample CALMET Control File (CALMET.INP)
Run Title and Input Group 1

```
NOTES: (1) File/path names can be up to 70 characters in length
       (2) Subgroups (a) and (f) must have ONE 'END' (surrounded by
           delimiters) at the end of the group
       (3) Subgroups (b) through (e) are included ONLY if the corresponding
           number of files (NUSTA, NOWSTA, NM3D, NIGF) is not 0, and each must have
           an 'END' (surround by delimiters) at the end of EACH LINE

!END!
--------------------------------------------------------------------------------

INPUT GROUP: 1 -- General run control parameters
--------------

     Starting date:    Year   (IBYR)  --    No default   ! IBYR  =  2002  !
                       Month  (IBMO)  --    No default   ! IBMO  =  1  !
                       Day    (IBDY)  --    No default   ! IBDY  =  5  !
     Starting time:    Hour   (IBHR)  --    No default   ! IBHR  =  4  !
                       Second (IBSEC) --    No default   ! IBSEC =  0  !

     Ending date:      Year   (IEYR)  --    No default   ! IEYR  =  2002  !
                       Month  (IEMO)  --    No default   ! IEMO  =  1  !
                       Day    (IEDY)  --    No default   ! IEDY  =  5  !
     Ending time:      Hour   (IEHR)  --    No default   ! IEHR  =  19  !
                       Second (IESEC) --    No default   ! IESEC =  0  !

     UTC time zone         (ABTZ) -- No default       ! ABTZ= UTC-0600 !
         (character*8)
         PST = UTC-0800, MST = UTC-0700 , GMT = UTC+0000
         CST = UTC-0600, EST = UTC-0500

     Length of modeling time-step (seconds)
     Must be a fraction of 1 hour
     (NSECDT)                        Default:3600     ! NSECDT =  600  !
                                     Units: seconds

     Run type            (IRTYPE) -- Default: 1       ! IRTYPE=  1  !

        0 = Computes wind fields only
        1 = Computes wind fields and micrometeorological variables
            (u*, w*, L, zi, etc.)
        (IRTYPE must be 1 to run CALPUFF or CALGRID)

     Compute special data fields required
     by CALGRID (i.e., 3-D fields of W wind
     components and temperature)
     in additional to regular            Default: T    ! LCALGRD = T !
     fields ? (LCALGRD)
     (LCALGRD must be T to run CALGRID)
```

Table 8-3 (Continued)
Sample CALMET Control File (CALMET.INP)
Run Title and Input Group 1

```
      Flag to stop run after
      SETUP phase (ITEST)             Default: 2       ! ITEST=  2   !
      (Used to allow checking
      of the model inputs, files, etc.)
      ITEST = 1 - STOPS program after SETUP phase
      ITEST = 2 - Continues with execution of
                  COMPUTATIONAL phase after SETUP

!END!
```

Input Group 2

```
INPUT GROUP: 2 -- Map Projection and Grid control parameters
--------------

     Projection for all (X,Y):
     -------------------------

     Map projection
     (PMAP)                     Default: UTM    ! PMAP = UTM !

         UTM :  Universal Transverse Mercator
         TTM :  Tangential Transverse Mercator
         LCC :  Lambert Conformal Conic
         PS  :  Polar Stereographic
         EM  :  Equatorial Mercator
         LAZA:  Lambert Azimuthal Equal Area

     False Easting and Northing (km) at the projection origin
     (Used only if PMAP= TTM, LCC, or LAZA)
     (FEAST)                    Default=0.0     ! FEAST  = 0.0 !
     (FNORTH)                   Default=0.0     ! FNORTH = 0.0 !

     UTM zone (1 to 60)
     (Used only if PMAP=UTM)
     (IUTMZN)                   No Default      ! IUTMZN = 19 !

     Hemisphere for UTM projection?
     (Used only if PMAP=UTM)
     (UTMHEM)                   Default: N      ! UTMHEM = N !
         N   :  Northern hemisphere projection
         S   :  Southern hemisphere projection

     Latitude and Longitude (decimal degrees) of projection origin
     (Used only if PMAP= TTM, LCC, PS, EM, or LAZA)
     (RLAT0)                    No Default      ! RLAT0 = 40.0N !
     (RLON0)                    No Default      ! RLON0 = 74.0W !
```

Table 8-3 (Continued)
Sample CALMET Control File (CALMET.INP)
Input Group 2

```
    TTM :  RLON0 identifies central (true N/S) meridian of projection
           RLAT0 selected for convenience
    LCC :  RLON0 identifies central (true N/S) meridian of projection
           RLAT0 selected for convenience
    PS  :  RLON0 identifies central (grid N/S) meridian of projection
           RLAT0 selected for convenience
    EM  :  RLON0 identifies central meridian of projection
           RLAT0 is REPLACED by 0.0N (Equator)
    LAZA:  RLON0 identifies longitude of tangent-point of mapping plane
           RLAT0 identifies latitude of tangent-point of mapping plane

Matching parallel(s) of latitude (decimal degrees) for projection
(Used only if PMAP= LCC or PS)
(XLAT1)                    No Default      ! XLAT1 = 35.0N !
(XLAT2)                    No Default      ! XLAT2 = 45.0N !

    LCC :  Projection cone slices through Earth's surface at XLAT1 and XLAT2
    PS  :  Projection plane slices through Earth at XLAT1
           (XLAT2 is not used)

----------
Note:  Latitudes and longitudes should be positive, and include a
       letter N,S,E, or W indicating north or south latitude, and
       east or west longitude.  For example,
       35.9  N Latitude  =  35.9N
       118.7 E Longitude = 118.7E

Datum-Region
------------

The Datum-Region for the coordinates is identified by a character
string.  Many mapping products currently available use the model of the
Earth known as the World Geodetic System 1984 (WGS-84).  Other local
models may be in use, and their selection in CALMET will make its output
consistent with local mapping products.  The list of Datum-Regions with
official transformation parameters is provided by the National Imagery and
Mapping Agency (NIMA).

NIMA Datum - Regions(Examples)
------------------------------------------------------------------------------
WGS-84    WGS-84 Reference Ellipsoid and Geoid, Global coverage (WGS84)
NAS-C     NORTH AMERICAN 1927 Clarke 1866 Spheroid, MEAN FOR CONUS (NAD27)
NAR-C     NORTH AMERICAN 1983 GRS 80 Spheroid, MEAN FOR CONUS (NAD83)
NWS-84    NWS 6370KM Radius, Sphere
ESR-S     ESRI REFERENCE 6371KM Radius, Sphere

Datum-region for output coordinates
(DATUM)                    Default: WGS-84    ! DATUM = WGS-84  !
```

Table 8-3 (Continued)
Sample CALMET Control File (CALMET.INP)
Input Group 2 Continued

```
     Horizontal grid definition:
     ---------------------------

     Rectangular grid defined for projection PMAP,
     with X the Easting and Y the Northing coordinate

            No. X grid cells (NX)      No default     ! NX =   30  !
            No. Y grid cells (NY)      No default     ! NY =   30  !

     Grid spacing (DGRIDKM)            No default     ! DGRIDKM = 1. !
                                       Units: km

     Reference grid coordinate of
     SOUTHWEST corner of grid cell (1,1)

        X coordinate (XORIGKM)         No default     ! XORIGKM = 260.000 !
        Y coordinate (YORIGKM)         No default     ! YORIGKM = 3195.000 !
                                       Units: km


     Vertical grid definition:
     -------------------------

        No. of vertical layers (NZ)    No default     ! NZ =  10  !

        Cell face heights in arbitrary
        vertical grid (ZFACE(NZ+1))    No defaults
                                       Units: m
        ! ZFACE = 0.,20.,40.,80.,160.,320.,700.,1300.,1700.,2300.,3000. !

!END!
```

Input Group 3

```
--------------------------------------------------------------------------------

INPUT GROUP: 3 -- Output Options
--------------


    DISK OUTPUT OPTION

       Save met. fields in an unformatted
       output file ?              (LSAVE)  Default: T     ! LSAVE = T !
       (F = Do not save, T = Save)

       Type of unformatted output file:
       (IFORMO)                            Default: 1    ! IFORMO =  1  !
```

Table 8-3 (Continued)
Sample CALMET Control File (CALMET.INP)
Input Group 3

```
        1 = CALPUFF/CALGRID type file (CALMET.DAT)
        2 = MESOPUFF-II type file     (PACOUT.DAT)


 LINE PRINTER OUTPUT OPTIONS:

    Print met. fields ?  (LPRINT)       Default: F     ! LPRINT = T !
    (F = Do not print, T = Print)
    (NOTE: parameters below control which
           met. variables are printed)

    Print interval
    (IPRINF) in hours                   Default: 1     ! IPRINF =  6  !
    (Meteorological fields are printed
     every  6  hours)


    Specify which layers of U, V wind component
    to print (IUVOUT(NZ)) -- NOTE: NZ values must be entered
    (0=Do not print, 1=Print)
    (used only if LPRINT=T)        Defaults: NZ*0
    ! IUVOUT =  1 ,  0 ,  0 ,  0 ,  0 ,  0  !
    -----------------------


    Specify which levels of the W wind component to print
    (NOTE: W defined at TOP cell face --  6  values)
    (IWOUT(NZ)) -- NOTE: NZ values must be entered
    (0=Do not print, 1=Print)
    (used only if LPRINT=T & LCALGRD=T)
    -----------------------------------
                                         Defaults: NZ*0
     ! IWOUT =  0 ,  0 ,  0 ,  0 ,  0 ,  0  !


    Specify which levels of the 3-D temperature field to print
    (ITOUT(NZ)) -- NOTE: NZ values must be entered
    (0=Do not print, 1=Print)
    (used only if LPRINT=T & LCALGRD=T)
    -----------------------------------
                                         Defaults: NZ*0
     ! ITOUT =  1 ,  0 ,  0 ,  0 ,  0 ,  0  !
```

Table 8-3 (Continued)
Sample CALMET Control File (CALMET.INP)
Input Group 3

```
Specify which meteorological fields
       to print
       (used only if LPRINT=T)             Defaults: 0 (all variables)
       -----------------------


         Variable            Print ?
                         (0 = do not print,
                          1 = print)
         --------        ------------------

      !  STABILITY  =           1           ! - PGT stability class
      !  USTAR      =           1           ! - Friction velocity
      !  MONIN      =           1           ! - Monin-Obukhov length
      !  MIXHT      =           1           ! - Mixing height
      !  WSTAR      =           1           ! - Convective velocity scale
      !  PRECIP     =           1           ! - Precipitation rate
      !  SENSHEAT   =           0           ! - Sensible heat flux
      !  CONVZI     =           0           ! - Convective mixing ht.

       Testing and debug print options for micrometeorological module

          Print input meteorological data and
          internal variables (LDB)         Default: F       ! LDB = F !
          (F = Do not print, T = print)
          (NOTE: this option produces large amounts of output)

          First time step for which debug data
          are printed (NN1)                Default: 1       ! NN1 =  1  !

          Last time step for which debug data
          are printed (NN2)                Default: 1       ! NN2 =  1  !

          Print distance to land
          internal variables (LDBCST)      Default: F       ! LDBCST = F !
          (F = Do not print, T = print)
          (Output in .GRD file DCST.GRD, defined in input group 0)

       Testing and debug print options for wind field module
       (all of the following print options control output to
        wind field module's output files: TEST.PRT, TEST.OUT,
        TEST.KIN, TEST.FRD, and TEST.SLP)

          Control variable for writing the test/debug
          wind fields to disk files (IOUTD)
          (0=Do not write, 1=write)        Default: 0       ! IOUTD =  0  !

          Number of levels, starting at the surface,
          to print (NZPRN2)                Default: 1       ! NZPRN2 =  0  !

          Print the INTERPOLATED wind components ?
```

Table 8-3 (Continued)
Sample CALMET Control File (CALMET.INP)
Input Group 3

```
          (IPR0)  (0=no, 1=yes)             Default: 0       !  IPR0 =  0  !

          Print the TERRAIN ADJUSTED surface wind
          components ?
          (IPR1)  (0=no, 1=yes)             Default: 0       !  IPR1 =  0  !

          Print the SMOOTHED wind components and
          the INITIAL DIVERGENCE fields ?
          (IPR2)  (0=no, 1=yes)             Default: 0       !  IPR2 =  0  !

          Print the FINAL wind speed and direction
          fields ?
          (IPR3)  (0=no, 1=yes)             Default: 0       !  IPR3 =  0  !
          (IPR4)  (0=no, 1=yes)             Default: 0       !  IPR4 =  0  !


          Print the FINAL DIVERGENCE fields ?

          Print the winds after KINEMATIC effects are added ?
          (IPR5)  (0=no, 1=yes)             Default: 0       !  IPR5 =  0  !

          Print the winds after the FROUDE NUMBER
          adjustment is made ?
          (IPR6)  (0=no, 1=yes)             Default: 0       !  IPR6 =  0  !

          Print the winds after SLOPE FLOWS
          are added ?
          (IPR7)  (0=no, 1=yes)             Default: 0       !  IPR7 =  0  !

          Print the FINAL wind field components ?
          (IPR8)  (0=no, 1=yes)             Default: 0       !  IPR8 =  0  !

!END!
```

Table 8-3 (Continued)
Sample CALMET Control File (CALMET.INP)
Input Group 4

```
-------------------------------------------------------------------------------

INPUT GROUP: 4 -- Meteorological data options
--------------


    NO OBSERVATION MODE             (NOOBS)  Default: 0     ! NOOBS =  0   !
          0 = Use surface, overwater, and upper air stations
          1 = Use surface and overwater stations (no upper air observations)
              Use MM4/MM5/M3D for upper air data
          2 = No surface, overwater, or upper air observations
              Use MM4/MM5/M3D for surface, overwater, and upper air data

    NUMBER OF SURFACE & PRECIP. METEOROLOGICAL STATIONS

       Number of surface stations   (NSSTA)  No default     ! NSSTA =  1  !

       Number of precipitation stations
       (NPSTA=-1: flag for use of MM5/M3D precip data)
                                    (NPSTA)  No default     ! NPSTA =  0  !

    CLOUD DATA OPTIONS
       Gridded cloud fields:
                                   (ICLOUD)  Default: 0     ! ICLOUD =  0  !
       ICLOUD = 0 - Gridded clouds not used
       ICLOUD = 1 - Gridded CLOUD.DAT generated as OUTPUT
       ICLOUD = 2 - Gridded CLOUD.DAT read as INPUT
       ICLOUD = 3 - Gridded cloud cover from Prognostic Rel. Humidity

    FILE FORMATS

       Surface meteorological data file format
                                   (IFORMS)  Default: 2     ! IFORMS =  2  !
       (1 = unformatted (e.g., SMERGE output))
       (2 = formatted   (free-formatted user input))

       Precipitation data file format
                                   (IFORMP)  Default: 2     ! IFORMP =  2  !
       (1 = unformatted (e.g., PMERGE output))
       (2 = formatted   (free-formatted user input))

       Cloud data file format
                                   (IFORMC)  Default: 2     ! IFORMC =  1  !
       (1 = unformatted - CALMET unformatted output)
       (2 = formatted   - free-formatted CALMET output or user input)

!END!
```

Table 8-3 (Continued)
Sample CALMET Control File (CALMET.INP)
Input Group 5

```
--------------------------------------------------------------------------------

INPUT GROUP: 5 -- Wind Field Options and Parameters
--------------


    WIND FIELD MODEL OPTIONS
       Model selection variable (IWFCOD)     Default: 1      ! IWFCOD =  1  !
          0 = Objective analysis only
          1 = Diagnostic wind module

       Compute Froude number adjustment
       effects ? (IFRADJ)                    Default: 1      ! IFRADJ =  1  !
       (0 = NO, 1 = YES)

       Compute kinematic effects ? (IKINE)   Default: 0      ! IKINE  =  0  !
       (0 = NO, 1 = YES)

       Use O'Brien procedure for adjustment
       of the vertical velocity ? (IOBR)     Default: 0      ! IOBR =  0  !
       (0 = NO, 1 = YES)

       Compute slope flow effects ? (ISLOPE) Default: 1      ! ISLOPE  =  1  !
       (0 = NO, 1 = YES)

       Extrapolate surface wind observations
       to upper layers ? (IEXTRP)            Default: -4     ! IEXTRP = -4  !
       (1 = no extrapolation is done,
        2 = power law extrapolation used,
        3 = user input multiplicative factors
            for layers 2 - NZ used (see FEXTRP array)
        4 = similarity theory used
        -1, -2, -3, -4 = same as above except layer 1 data
            at upper air stations are ignored

       Extrapolate surface winds even
       if calm? (ICALM)                      Default: 0      ! ICALM  =  0  !
       (0 = NO, 1 = YES)

       Layer-dependent biases modifying the weights of
       surface and upper air stations (BIAS(NZ))
         -1<=BIAS<=1
       Negative BIAS reduces the weight of upper air stations
         (e.g. BIAS=-0.1 reduces the weight of upper air stations
       by 10%; BIAS= -1, reduces their weight by 100 %)
       Positive BIAS reduces the weight of surface stations
         (e.g. BIAS= 0.2 reduces the weight of surface stations
       by 20%; BIAS=1 reduces their weight by 100%)
       Zero BIAS leaves weights unchanged (1/R**2 interpolation)
       Default: NZ*0
```

Table 8-3 (Continued)
Sample CALMET Control File (CALMET.INP)
Input Group 5

```
                       ! BIAS = -1 ,  0 ,  0 ,  0 ,  0 ,  0 ,  0 ,  0 ,  0 ,  0  !

   Minimum distance from nearest upper air station
   to surface station for which extrapolation
   of surface winds at surface station will be allowed
   (RMIN2: Set to -1 for IEXTRP = 4 or other situations
    where all surface stations should be extrapolated)
                                       Default: 4.    ! RMIN2 = -1.0 !

   Use gridded prognostic wind field model
   output fields as input to the diagnostic
   wind field model (IPROG)           Default: 0      ! IPROG =  0  !
   (0 = No, [IWFCOD = 0 or 1]
    1 = Yes, use CSUMM prog. winds as Step 1 field, [IWFCOD = 0]
    2 = Yes, use CSUMM prog. winds as initial guess field [IWFCOD = 1]
    3 = Yes, use winds from MM4.DAT file as Step 1 field [IWFCOD = 0]
    4 = Yes, use winds from MM4.DAT file as initial guess field [IWFCOD = 1]
    5 = Yes, use winds from MM4.DAT file as observations [IWFCOD = 1]
    13 = Yes, use winds from MM5/M3D.DAT file as Step 1 field [IWFCOD = 0]
    14 = Yes, use winds from MM5/M3D.DAT file as initial guess field [IWFCOD = 1]
    15 = Yes, use winds from MM5/M3D.DAT file as observations [IWFCOD = 1]

   Timestep (hours) of the prognostic
   model input data   (ISTEPPG)       Default: 1      ! ISTEPPG =  1   !

   Use coarse CALMET fields as initial guess fields (IGFMET)
   (overwrites IGF based on prognostic wind fields if any)
                                      Default: 0      ! IGFMET =  0  !
RADIUS OF INFLUENCE PARAMETERS

   Use varying radius of influence    Default: F      ! LVARY =  F!
   (if no stations are found within RMAX1,RMAX2,
    or RMAX3, then the closest station will be used)

   Maximum radius of influence over land
   in the surface layer (RMAX1)       No default      ! RMAX1 = 100. !
                                      Units: km
   Maximum radius of influence over land
   aloft (RMAX2)                      No default      ! RMAX2 = 100. !
                                      Units: km
   Maximum radius of influence over water
   (RMAX3)                            No default      ! RMAX3 = 100. !
                                      Units: km

OTHER WIND FIELD INPUT PARAMETERS

   Minimum radius of influence used in
   the wind field interpolation (RMIN)   Default: 0.1    ! RMIN = 2. !
                                      Units: km
   Radius of influence of terrain
   features (TERRAD)                  No default      ! TERRAD = 50. !
```

Table 8-3 (Continued)
Sample CALMET Control File (CALMET.INP)
Input Group 5

```
                                      Units: km
      Relative weighting of the first
      guess field and observations in the
      SURFACE layer (R1)              No default      ! R1 = 50. !
      (R1 is the distance from an     Units: km
      observational station at which the
      observation and first guess field are
      equally weighted)

      Relative weighting of the first
      guess field and observations in the
      layers ALOFT (R2)               No default      ! R2 = 50. !
      (R2 is applied in the upper layers  Units: km
      in the same manner as R1 is used in
      the surface layer).

      Relative weighting parameter of the
      prognostic wind field data (RPROG)  No default  ! RPROG = 54. !
      (Used only if IPROG = 1)        Units: km
      ------------------------

      Maximum acceptable divergence in the
      divergence minimization procedure
      (DIVLIM)                        Default: 5.E-6  ! DIVLIM= 5.0E-06 !

      Maximum number of iterations in the
      divergence min. procedure (NITER)   Default: 50     ! NITER =  50  !

      Number of passes in the smoothing
      procedure (NSMTH(NZ))
      NOTE: NZ values must be entered
           Default: 2,(mxnz-1)*4 ! NSMTH =
2 ,  8 ,  8 ,  12 ,  12 ,  12 ,  0 ,  0 ,  0 ,  0  !

      Maximum number of stations used in
      each layer for the interpolation of
      data to a grid point (NINTR2(NZ))
      NOTE: NZ values must be entered   Default: 99.    ! NINTR2 =
99 ,  99 ,  99 ,  99 ,  99 ,  99 ,  0 ,  0 ,  0 ,  0  !

      Critical Froude number (CRITFN)   Default: 1.0    ! CRITFN = 1. !

      Empirical factor controlling the
      influence of kinematic effects
      (ALPHA)                         Default: 0.1    ! ALPHA = 0.1 !
```

Table 8-3 (Continued)
Sample CALMET Control File (CALMET.INP)
Input Group 5

```
   Multiplicative scaling factor for
   extrapolation of surface observations
   to upper layers (FEXTR2(NZ))          Default: NZ*0.0
   ! FEXTR2 = 0., 0., 0., 0., 0., 0., 0., 0., 0., 0. !
   (Used only if IEXTRP = 3 or -3)


BARRIER INFORMATION

   Number of barriers to interpolation
   of the wind fields (NBAR)             Default: 0      ! NBAR =  0  !

   Level (1 to NZ) up to which barriers
   apply (KBAR)                          Default: NZ     * KBAR = *

   THE FOLLOWING 4 VARIABLES ARE INCLUDED
   ONLY IF NBAR > 0
   NOTE: NBAR values must be entered     No defaults
         for each variable               Units: km

      X coordinate of BEGINNING
      of each barrier (XBBAR(NBAR))      ! XBBAR = 0. !
      Y coordinate of BEGINNING
      of each barrier (YBBAR(NBAR))      ! YBBAR = 0. !

      X coordinate of ENDING
      of each barrier (XEBAR(NBAR))      ! XEBAR = 0. !
      Y coordinate of ENDING
      of each barrier (YEBAR(NBAR))      ! YEBAR = 0. !


DIAGNOSTIC MODULE DATA INPUT OPTIONS

   Surface temperature (IDIOPT1)         Default: 0      ! IDIOPT1 =  0  !
      0 = Compute internally from
          hourly surface observations
      1 = Read preprocessed values from
          a data file (DIAG.DAT)

      Surface met. station to use for
      the surface temperature (ISURFT)   No default     ! ISURFT =  1  !
      (Must be a value from 1 to NSSTA)
      (Used only if IDIOPT1 = 0)
      --------------------------
```

Table 8-3 (Continued)

Sample CALMET Control File (CALMET.INP)

Input Group 5

```
Domain-averaged temperature lapse
rate (IDIOPT2)                      Default: 0     ! IDIOPT2 =  0  !
   0 = Compute internally from
       twice-daily upper air observations
   1 = Read hourly preprocessed values
       from a data file (DIAG.DAT)

   Upper air station to use for
   the domain-scale lapse rate (IUPT) No default     ! IUPT   =  1  !
   (Must be a value from 1 to NUSTA)
   (Used only if IDIOPT2 = 0)
   --------------------------

   Depth through which the domain-scale
   lapse rate is computed (ZUPT)      Default: 200.  ! ZUPT = 200. !
   (Used only if IDIOPT2 = 0)         Units: meters
   --------------------------

Domain-averaged wind components
(IDIOPT3)                           Default: 0     ! IDIOPT3 =  0  !
   0 = Compute internally from
       twice-daily upper air observations
   1 = Read hourly preprocessed values
       a data file (DIAG.DAT)

   Upper air station to use for
   the domain-scale winds (IUPWND)    Default: -1    ! IUPWND = -1  !
   (Must be a value from -1 to NUSTA)
   (Used only if IDIOPT3 = 0)
   --------------------------

   Bottom and top of layer through
   which the domain-scale winds
   are computed
   (ZUPWND(1), ZUPWND(2))        Defaults: 1., 1000. ! ZUPWND= 1., 2000. !
   (Used only if IDIOPT3 = 0)    Units: meters
   --------------------------

Observed surface wind components
for wind field module (IDIOPT4)  Default: 0     ! IDIOPT4 =  0  !
   0 = Read WS, WD from a surface
       data file (SURF.DAT)
   1 = Read hourly preprocessed U, V from
       a data file (DIAG.DAT)

Observed upper air wind components
for wind field module (IDIOPT5)  Default: 0     ! IDIOPT5 =  0  !
   0 = Read WS, WD from an upper
       air data file (UP1.DAT, UP2.DAT, etc.)
   1 = Read hourly preprocessed U, V from
       a data file (DIAG.DAT)
```

Table 8-3 (Continued)

Sample CALMET Control File (CALMET.INP)

Input Group 5

```
       LAKE BREEZE INFORMATION

          Use Lake Breeze Module  (LLBREZE)
                                         Default: F      ! LLBREZE = F !

           Number of lake breeze regions (NBOX)            ! NBOX =  0  !

        X Grid line 1 defining the region of interest
                                                        ! XG1 = 0. !
        X Grid line 2 defining the region of interest
                                                        ! XG2 = 0. !
        Y Grid line 1 defining the region of interest
                                                        ! YG1 = 0. !
        Y Grid line 2 defining the region of interest
                                                        ! YG2 = 0. !

         X Point defining the coastline (Straight line)
                   (XBCST)  (KM)   Default: none    ! XBCST = 0. !

         Y Point defining the coastline (Straight line)
                   (YBCST)  (KM)   Default: none    ! YBCST = 0. !

         X Point defining the coastline (Straight line)
                   (XECST)  (KM)   Default: none    ! XECST = 0. !

         Y Point defining the coastline (Straight line)
                   (YECST)  (KM)   Default: none    ! YECST = 0. !


       Number of stations in the region     Default: none ! NLB =  0 !
       (Surface stations + upper air stations)

       Station ID's  in the region   (METBXID(NLB))
       (Surface stations first, then upper air stations)
         ! METBXID =  0 !

!END!
```

Input Group 6

```
INPUT GROUP: 6 -- Mixing Height, Temperature and Precipitation Parameters
--------------

    EMPIRICAL MIXING HEIGHT CONSTANTS

       Neutral, mechanical equation
       (CONSTB)                            Default: 1.41   ! CONSTB = 1.41 !
       Convective mixing ht. equation
       (CONSTE)                            Default: 0.15   ! CONSTE = 0.15 !
       Stable mixing ht. equation
       (CONSTN)                            Default: 2400.  ! CONSTN = 2400.!
```

Table 8-3 (Continued)
Sample CALMET Control File (CALMET.INP)

Input Group 6

```
INPUT GROUP: 6 -- Mixing Height, Temperature and Precipitation Parameters
--------------

    EMPIRICAL MIXING HEIGHT CONSTANTS

       Neutral, mechanical equation
       (CONSTB)                            Default: 1.41   ! CONSTB = 1.41 !
       Convective mixing ht. equation
       (CONSTE)                            Default: 0.15   ! CONSTE = 0.15 !
       Stable mixing ht. equation
       (CONSTN)                            Default: 2400.  ! CONSTN = 2400.!
       Overwater mixing ht. equation
       (CONSTW)                            Default: 0.16   ! CONSTW = 0.16 !
       Absolute value of Coriolis
       parameter (FCORIOL)                 Default: 1.E-4  ! FCORIOL = 1.0E-04!
                                           Units: (1/s)

       Overwater mixing ht. equation
       (CONSTW)                            Default: 0.16   ! CONSTW = 0.16 !
       Absolute value of Coriolis
       parameter (FCORIOL)                 Default: 1.E-4  ! FCORIOL = 1.0E-04!
                                           Units: (1/s)



    SPATIAL AVERAGING OF MIXING HEIGHTS

       Conduct spatial averaging
       (IAVEZI)  (0=no, 1=yes)             Default: 1      ! IAVEZI =  1  !

       Max. search radius in averaging
       process (MNMDAV)                    Default: 1      ! MNMDAV =  3  !
                                           Units: Grid
                                                  cells
       Half-angle of upwind looking cone
       for averaging (HAFANG)              Default: 30.    ! HAFANG = 30. !
                                           Units: deg.
       Layer of winds used in upwind
       averaging (ILEVZI)                  Default: 1      ! ILEVZI =  1  !
       (must be between 1 and NZ)


    CONVECTIVE MIXING HEIGHT OPTIONS:
       Method to compute the convective
       mixing height(IMIHXH)               Default: 1      ! IMIXH =  1  !
           1: Maul-Carson for land and water cells
          -1: Maul-Carson for land cells only -
              OCD mixing height overwater
           2: Batchvarova and Gryning for land and water cells
```

Table 8-3 (Continued)
Sample CALMET Control File (CALMET.INP)

Input Group 6

```
      -2: Batchvarova and Gryning for land cells only
          OCD mixing height overwater

   Threshold buoyancy flux required to
   sustain convective mixing height growth
   overland (THRESHL)                    Default: 0.05   ! THRESHL = 0.05 !
   (expressed as a heat flux             units: W/m3
    per meter of boundary layer)


   Threshold buoyancy flux required to
   sustain convective mixing height growth
   overwater (THRESHW)                   Default: 0.05   ! THRESHW = 0.05 !
   (expressed as a heat flux             units: W/m3
    per meter of boundary layer)


  Option for overwater lapse rates used
   in convective mixing height growth
   (ITWPROG)                             Default: 0      ! ITWPROG =  0  !
   0 : use SEA.DAT lapse rates and deltaT (or assume neutral
       conditions if missing)
   1 : use prognostic lapse rates (only if IPROG>2)
       and SEA.DAT deltaT (or neutral if missing)
   2 : use prognostic lapse rates and prognostic delta T
       (only if iprog>12 and 3D.DAT version# 2.0 or higher)

   Land Use category ocean in 3D.DAT datasets
   (ILUOC3D)                             Default: 16     ! ILUOC3D =  16  !
   Note: if 3D.DAT from MM5 version 3.0, iluoc3d = 16
         if MM4.DAT,           typically iluoc3d = 7

OTHER MIXING HEIGHT VARIABLES

   Minimum potential temperature lapse
   rate in the stable layer above the
   current convective mixing ht.         Default: 0.001  ! DPTMIN = 0.001 !
   (DPTMIN)                              Units: deg. K/m
   Depth of layer above current conv.
   mixing height through which lapse     Default: 200.   ! DZZI = 200. !
   rate is computed (DZZI)               Units: meters

   Minimum overland mixing height        Default:  50.   ! ZIMIN = 100. !
   (ZIMIN)                               Units: meters
   Maximum overland mixing height        Default: 3000.  ! ZIMAX = 3200. !
   (ZIMAX)                               Units: meters
   Minimum overwater mixing height       Default:   50.  ! ZIMINW = 100. !
   (ZIMINW) -- (Not used if observed     Units: meters
   overwater mixing hts. are used)
   Maximum overwater mixing height       Default: 3000.  ! ZIMAXW = 3200. !
```

Table 8-3 (Continued)
Sample CALMET Control File (CALMET.INP)
Input Group 6

```
   (ZIMAXW) -- (Not used if observed     Units: meters
   overwater mixing hts. are used)


OVERWATER SURFACE FLUXES METHOD and PARAMETERS
      (ICOARE)                           Default: 10      ! ICOARE =  10   !
       0: original deltaT method (OCD)
      10: COARE with no wave parameterization (jwave=0, Charnock)
      11: COARE with wave option jwave=1 (Oost et al.)
          and default wave properties
     -11: COARE with wave option jwave=1 (Oost et al.)
          and observed wave properties (must be in SEA.DAT files)
      12: COARE with wave option 2 (Taylor and Yelland)
           and default wave properties
     -12: COARE with wave option 2 (Taylor and Yelland)
          and observed wave properties (must be in SEA.DAT files)

      Coastal/Shallow water length scale (DSHELF)
      (for modified z0 in shallow water)
      ( COARE fluxes only)
                                      Default : 0.        ! DSHELF = 0. !
                                      units: km

       COARE warm layer computation (IWARM)               ! IWARM =  0   !
       1: on - 0: off (must be off if SST measured with
       IR radiometer)                 Default: 0

       COARE cool skin layer computation (ICOOL)          ! ICOOL =  0   !
       1: on - 0: off (must be off if SST measured with
       IR radiometer)                 Default: 0

RELATIVE HUMIDITY PARAMETERS

   3D relative humidity from observations or
   from prognostic data? (IRHPROG)       Default:0        ! IRHPROG =  0   !

      0 = Use RH from SURF.DAT file
          (only if NOOBS = 0,1)
      1 = Use prognostic RH
          (only if NOOBS = 0,1,2)

TEMPERATURE PARAMETERS

   3D temperature from observations or
   from prognostic data? (ITPROG)        Default:0         !ITPROG =  0   !

      0 = Use Surface and upper air stations
          (only if NOOBS = 0)
      1 = Use Surface stations (no upper air observations)
          Use MM5/M3D for upper air data
          (only if NOOBS = 0,1)
```

Table 8-3 (Continued)
Sample CALMET Control File (CALMET.INP)
Input Group 6

```
        2 = No surface or upper air observations
            Use MM5/M3D for surface and upper air data
            (only if NOOBS = 0,1,2)

     Interpolation type
     (1 = 1/R ; 2 = 1/R**2)                Default:1         ! IRAD =  1  !

     Radius of influence for temperature
     interpolation (TRADKM)                Default: 500.     ! TRADKM = 500. !
                                           Units: km

     Maximum Number of stations to include
     in temperature interpolation (NUMTS)  Default: 5        ! NUMTS = 5  !

     Conduct spatial averaging of temp-
     eratures (IAVET)  (0=no, 1=yes)         Default: 1     ! IAVET =  1  !
     (will use mixing ht MNMDAV,HAFANG
      so make sure they are correct)

     Default temperature gradient        Default: -.0098 ! TGDEFB = -0.0098 !
     below the mixing height over
     water (K/m) (TGDEFB)

     Default temperature gradient        Default: -.0045 ! TGDEFA = -0.0035 !
     above the mixing height over
     water (K/m) (TGDEFA)

     Beginning (JWAT1) and ending (JWAT2)
     land use categories for temperature                    ! JWAT1 =  55  !
     interpolation over water -- Make                       ! JWAT2 =  55  !
     bigger than largest land use to disable

 PRECIP INTERPOLATION PARAMETERS

     Method of interpolation (NFLAGP)      Default = 2    ! NFLAGP =  2  !
      (1=1/R,2=1/R**2,3=EXP/R**2)
     Radius of Influence (km) (SIGMAP)     Default = 100.0  ! SIGMAP = 100. !
      (0.0 => use half dist. btwn
       nearest stns w & w/out
       precip when NFLAGP = 3)
     Minimum Precip. Rate Cutoff (mm/hr)   Default = 0.01  ! CUTP = 0.01 !
      (values < CUTP = 0.0 mm/hr)
!END!
```

Table 8-3 (Continued)
Sample CALMET Control File (CALMET.INP)

Input Group 7

```
--------------------------------------------------------------------------------

INPUT GROUP: 7 -- Surface meteorological station parameters
--------------

     SURFACE STATION VARIABLES
     (One record per station --  NSSTA  records in all)


             1     2
         Name   ID            X coord.   Y coord.   Time   Anem.
                               (km)       (km)      zone   Ht.(m)
       ----------------------------------------------------------
! SS1  ='SS1 '        1       277.000     3206.500    6    10  !


-------------------
      1
        Four character string for station name
        (MUST START IN COLUMN 9)

      2
        Five digit integer for station ID

!END!
```

Input Group 8

```
--------------------------------------------------------------------------------

INPUT GROUP: 8 -- Upper air meteorological station parameters
--------------

     UPPER AIR STATION VARIABLES
     (One record per station --  NUSTA  records in all)

             1     2
         Name    ID      X coord.   Y coord.  Time zone
                          (km)       (km)
        -----------------------------------------------
! US1  ='UP1 '       0    276.800   3206.400    6  !

-------------------
      1
        Four character string for station name
        (MUST START IN COLUMN 9)

      2
        Five digit integer for station ID
!END!
```

Table 8-3 (Continued)
Sample CALMET Control File (CALMET.INP)

Input Group 9

```
--------------------------------------------------------------------------------

INPUT GROUP: 9 -- Precipitation station parameters
--------------

     PRECIPITATION STATION VARIABLES
     (One record per station --  NPSTA  records in all)

            1          2
         Name   Station    X coord.  Y coord.
                  Code       (km)      (km)
         ------------------------------------


-------------------
      1
        Four character string for station name
        (MUST START IN COLUMN 9)

      2
        Six digit station code composed of state
        code (first 2 digits) and station ID (last
        4 digits)

!END!
```

Table 8-4: CALMET Control File Inputs

File Type and Run Title

Variable	Type	Description	Default Value
DATASET	C*16	File type definition record (first record of file) read with FORTRAN format (2a16,a64)	CALMET.INP
DATAVER	C*16		2.1
DATAMOD	C*64		-
TITLE(3)	char*80 array	Run title (lines 2-4 of CALMET control file). Read with FORTRAN A80 format.	-
Subgroup (a)			
GEODAT	C*70	Geophysical data input file	GEO.DAT
SRFDAT	C*70	Hourly surface meteorological file	SURF.DAT
CLDDAT	C*70	Gridded cloud file	CLOUD.DAT
PRCDAT	C*70	Precipitation data file	PRECIP.DAT
M3DDAT	C*70	MM4/MM5/3D data file	3D.DAT
WTDAT	C*70	Gridded weighting obs. vs. MM4 data file	WT.DAT
METLST	C*70	CALMET output list file	CALMET.LST
METDAT	C*70	Output meteorological data file (CALMET format)	CALMET.DAT
		Output meteorological data file (MESOPAC/MESOPUFF format)	PACOUT.DAT
NUSTA	Integer	Number of upper air stations	-
NOWSTA	Integer	Number of overwater stations	-
NM3D	Integer	Number of 3D.Dat files used in run	-
NIGF	Integer	Number of CALMET.Dat files used as initial guess	-
LCFILES	Logical	Convert files names to lower case (T = yes, F = no)	T
Subgroup (b)			
UPDAT	C*70	Upper air data files (repeated NUSTA times)	UPn.DAT
Subgroup (c)			
SEADAT	C*70	Overwater station files (repeated NOWSTA times)	SEAn.DAT
Subgroup (d)			
M3DDAT	C*70	M3D.DAT files (repeated NM3D times)	MM5n.DAT
Subgroup (e)			
IGFDAT	C*70	Initial Guess CALMET.DAT files (repeated NIGF times)	IGFn.DAT

Table 8-4 (Continued)

Input Group 0

Variable	Type	Description	Default Value
Subgroup (f)			
DIADAT	C*70	Preprocessed input met data	DIAG.DAT
PRGDAT	C*70	Gridded prognostic wind data file (CSUMM)	PROG.DAT
TSTPRT	C*70	Test file containing debug variables	TEST.PRT
TSTOUT	C*70	Test file containing final winds fields	TEST.OUT
TSTKIN	C*70	Test file containing winds after kinematic effects	TEST.KIN
TSTFRD	C*70	Test file containing winds after Froude number effects	TEST.FRD
TSTSLP	C*70	Test file containing winds after slope flow effects	TEST.SLP

Input Group 1

Variable	Type	Description	Default Value
IBYR	Integer	Beginning year of the run (four digits)	-
IBMO	Integer	Beginning month of the run	-
IBDY	Integer	Beginning day of the run	-
IBHR	Integer	Beginning Time (hour 00-23) of the run	-
IBSEC	Integer	Beginning Time (second 0000-3599) of the run	-
IEYR	Integer	Ending year of the run (four digits)	-
IEMO	Integer	Ending month of the run	-
IEDY	Integer	Ending day of the run	-
IEHR	Integer	Ending Time (hour 00-23) of the run	-
IESEC	Integer	Ending Time (second 0000-3599) of the run	-
ABTZ	C*8	Base time zone (UTC-0500=EST, UTC-0600=CST, UTC-0700=MST,UTC-0800=PST)	-
NSECDT	Integer	Length of modeling time-step (seconds)	3600
IRTYPE	Integer	Run type 0=compute wind fields only 1=compute wind fields and micrometeorological variables (IRTYPE must be 1 to run CALPUFF or CALGRID)	1

Table 8-4 (Continued)

Input Group 1

Variable	Type	Description	Default Value
LCALGRD	Logical	Store extra data fields required by special modules in CALPUFF and in CALGRID (enter T or F) T=3-D fields of vertical velocity and temperature stored in output file F=these data fields are not stored in the output file (LCALGRD must be T to run CALGRID or to use the subgrid scale complex terrain option in CALPUFF)	T
ITEST	Integer	Flag to stop run after setup phase (1 = stops run after SETUP, 2 = run continues)	2

Input Group 2 - Grid Control Parameters

Variable	Type	Description	Default Value
PMAP*	character*8	Map projection UTM : Universal Transverse Mercator TTM : Tangential Transverse Mercator LCC : Lambert Conformal Conic PS : Polar Stereographic EM : Equatorial Mercator LAZA : Lambert Azimuthal Equal Area	UTM
FEAST	real	False Easting (km) for PMAP = TTM, LCC, or LAZA	0.0
FNORTH	real	False Northing (km) for PMAP = TTM, LCC, or LAZA	0.0
IUTMZN	integer	UTM zone for PMAP = UTM	-
UTMHEM	character*1	Hemisphere for UTM projection (N or S)	N
RLAT0	character*16	Reference latitude (degrees) of origin of map projection. Enter numerical value followed by N for North Latitude or S for South Latitude. Used only if PMAP= TTM, LCC, PS, EM, or LAZA	-

Table 8-4 (Continued)

Input Group 1

Variable	Type	Description	Default Value
RLON0	character*16	Reference longitude (degrees) of origin of map projection. Enter numerical value followed by E for East Longitude or W for West Longitude. Used only if PMAP= TTM, LCC, PS, EM, or LAZA	-
XLAT1 XLAT2	character*16	Latitudes (degrees) of the two matching parallels for map projection (Used only if PMAP= LCC or PS). Enter numerical value followed by N for North Latitude or S for South Latitude.	-
DATUM	character*8	DATUM Code for grid coordinates.	WGS-G
NX	integer	Number of grid cells in the X direction	-
NY	integer	Number of grid cells in the Y direction	-

Input Group 2 - Grid Control Parameters

Variable	Type	Description	Default Value
DGRIDKM	real	Horizontal grid spacing (km)	-
XORIGKM	real	Reference X coordinate* (km) of the southwest corner of grid cell (1,1)	-
YORIGKM	real	Reference Y coordinate* (km) of the southwest corner of grid cell (1,1)	-
NZ	integer	Number of vertical layers	-
ZFACE	real array	Cell face heights (m). Note: Cell center height of layer "i" is (ZFACE(i+1) + ZFACE(i))/2. NZ+1 values must be entered.	-

* PMAP projections PS, EM, and LAZA are NOT AVAILABLE in CALMET

Table 8-4 (Continued)

Input Group 3 - Output Options

Variable	Type	Description	Default Value
LSAVE	logical	Disk output control variable. If LSAVE=T, the gridded wind fields are stored in an output disk file (CALMET.DAT).	T

IFORMO	integer	Unformatted output file type variable. If IFORMO=1, a file suitable for input to CALPUFF or CALGRID is generated. If IFORMO=2, a file suitable for input to MESOPUFF II is generated. (Used only if LSAVE=T.)	1
LPRINT	logical	Printer output control variable. If LPRINT=T, the gridded wind fields are printed every "IPRINF" hours to the output list file (CALMET.LST).	F
IPRINF	integer	Printing interval for the output wind fields. Winds are printed every "IPRINF" hours. (Used only if LPRINT=T.)	1
IUVOUT	integer array	Control variable determining which layers of U and V horizontal wind components are printed. NZ values must be entered, corresponding to layers 1-NZ. (0=do not print layer, 1=print layer.) Used only if LPRINT=T.)	NZ*0
IWOUT	integer array	Control variable determining which layers of W vertical wind components are printed. NZ values must be entered, corresponding to cell face heights 2 to NZ+1. Note that W at the ground (cell face height 1) is zero. (0=do not print layer, 1=print layer.) (Used only if LPRINT=T and LCALGRD=T.)	NZ*0

Table 8-4 (Continued)

Input Group 3 – Output Options

Variable	Type	Description	Default Value
ITOUT	integer array	Control variable determining which layers of temperature fields are printed. NZ values must be entered, corresponding to cell face heights 2 to NZ+1. (0=do not print layer, 1=print layer.) (Used only if LPRINT=T and LCALGRD=T.)	NZ*0
STABILITY	integer	Control variable determining if gridded fields of PGT stability classes are printed. (0=do not print, 1=print.) (Used only if LPRINT=T.)	0
USTAR	integer	Control variable determining if gridded fields of surface friction velocities are printed. (0=do not print, 1=print.) (Used only if LPRINT=T.)	0
MONIN	integer	Control variable determining if gridded fields of Monin-Obukhov lengths are printed. (0=do not print, 1=print.) (Used only if LPRINT=T.)	0
MIXHT	integer	Control variable determining if gridded fields of mixing heights are printed. (0=do not print, 1=print.) (Used only if LPRINT=T.)	0
WSTAR	integer	Control variable determining if gridded fields of convective velocity scales are printed. (0=do not print, 1=print.) (Used only if LPRINT=T.)	0
PRECIP	integer	Control variable determining if gridded fields of hourly precipitation rates are printed. (0=do not print, 1=print.) (Used only if LPRINT=T.)	0

Table 8-4 (Continued)

Input Group 3 – Output Options

Variable	Type	Description	Default Value
SENSHEAT	integer	Control variable determining if gridded fields of sensible heat fluxes are printed. (0=do not print, 1=print.) (Used only if LPRINT=T.)	0
CONVZI	integer	Control variable determining if gridded fields of convective mixing heights are printed. (0=do not print, 1=print.) (Used only if LPRINT=T.)	0
LDB*	logical	Control variable for printing of input meteorological data and internal control parameters. Useful for program testing and debugging. If LDB=T, data will be printed for time steps "NN1" through "NN2" to the output list file (CALMET.LST).	F
NN1*	integer	First time step for which data controlled by LDB switch are printed. (Used only if LDB=T.) Note: IF NN1=NN2=0 and LDB=T, only time-independent data will be printed.	0
NN2*	integer	Last time step for which data controlled by LDB switch are printed. (Used only if LDB=T.)	0
LDBCST*	logical	Print distance to land internal variables switch	F
IOUTD*	integer	Control variable for writing the computed wind fields to the wind field test disk files. (0=do not write, 1=write.)	

(Input Group 3 Continued)

Table 8-4 (Continued)

Input Group 3 - Output Options

Variable	Type	Description	Default Value
NZPRN2*	integer	Number of levels, starting at the surface, printed to the wind field testing and debug files (Units 41-45).	1
IPR0*	integer	Control variable for printing to the wind field test files the interpolated wind components. (0=do not print, 1=print.)	0
IPR1*	integer	Control variable for printing to the wind field test files the terrain adjusted surface wind components. (0=do not print, 1=print.) Used only with objective analysis.	0
IPR2*	integer	Control variable for printing to the wind field test files the smoothed wind components and initial divergence fields. (0=do not print, 1=print).	0
IPR3*	integer	Control variable for printing to the wind field test files the final wind speed and direction fields. (0=do not print, 1=print.)	0
IPR4*	integer	Control variable for printing to the wind field test files the final divergence fields. (0=do not print, 1=print.)	0
IPR5*	integer	Control variable for printing to the wind field test files the wind fields after kinematic effects are added. (0=do not print, 1=print.)	0
IPR6*	integer	Control variable for printing to the wind field test files the wind fields after the Froude number adjustment is made. (0=do not print, 1=print.)	0
IPR7*	integer	Control variable for printing to the wind field test files the wind fields after the slope flows are added. (0=do not print, 1=print.)	0

(Input Group 3 Continued)

Table 8-4 (Continued)

Input Group 3 - Output Options

Variable	Type	Description	Default Value
IPR8*	integer	Control variable for printing to the wind field test files the final wind component fields. (0=do not print, 1=print.)	0

* Testing and debugging print options.

Input Group 4 - Meteorological Data Options

Variable	Type	Description	Default Value
NOOBS	integer	No-Observation mode flag: 0 = Use surface, overwater, and upper air stations 1 = Use surface and overwater stations (no upper air observations); Use MM5 for upper air data 2 = No surface, overwater, or upper air observations; Use MM5 for surface, overwater, and upper air data	0
NSSTA	integer	Number of surface meteorological stations	-
NPSTA	integer	Number of precipitation stations; (NPSTA=-1: flag for use of MM5 precipitation data in place of observations)	-

(Input Group 4 Continued)

Table 8-4 (Continued)

Input Group 4 - Meteorological Data Options

Variable	Type	Description	Default Value
ICLOUD	integer	Cloud data file options (0 = Gridded clouds not used 1 = Gridded CLOUD.DAT generated as output 2 = Gridded CLOUD.DAT read as input 3 = Gridded cloud cover from prognostic relative humidity)	0
IFORMS	integer	Control variable determining the format of the input surface meteorological data (1=unformatted, i.e., SMERGE output) (2=formatted, i.e., free-formatted user input or formatted SMERGE output)	2
IFORMP	integer	Control variable determining the format of the input precipitation data (1=unformatted, i.e., PMERGE output) (2=formatted, i.e., free-formatted user input or formatted PMERGE output)	2
IFORMC	integer	Control variable determining the format of the CLOUD.DAT file (1 = unformatted - CALMET unformatted output) 2 = free formatted CALMET output or user input)	2

Table 8-4 (Continued)

Input Group 5 - Wind Field Options and Parameters

Variable	Type	Description	Default Value
IWFCOD	integer	Control variable determining which wind field module is used. (0=objective analysis only, 1=diagnostic wind module.)	1
IFRADJ	integer	Control variable for computing Froude number adjustment effects. (0=do not compute, 1=compute.) (used only if IWFCOD=1).	1
IKINE	integer	Control variable for computing kinematic effects. (0=do not compute, 1=compute.) (used only if IWFCOD=1).	0
IOBR	integer	Control variable for using the O'Brien vertical velocity adjustment procedure. (0=do not use, 1=use.)	0
ISLOPE	integer	Control variable for computing slope flow effects. (0 = do not compute, 1 = compute).	1
IEXTRP	integer	Control variable for vertical extrapolation. If ABS(IEXTRP)=1, no vertical extrapolation from the surface wind data takes place. If ABS(IEXTRP)=2, extrapolation is done using a power law profile. If ABS(IEXTRP) = 3, extrapolation is done using the values provided in the FEXTRP array for each layer. If ABS(IEXTRP) = 4 similarity theory is used. If IEXTRP < 0, Layer 1 data at the upper air stations are ignored. Layer 1 at an upper air station is also ignored if the four-character station name of the upper air station matches that of a surface station.	-4

(Input Group 5 Continued)

Table 8-4 (Continued)

Input Group 5 - Wind Field Options and Parameters

Variable	Type	Description	Default Value
ICALM	integer	Control variable for extrapolation of calm surface winds to layers aloft. (0 = do not extrapolate calms, 1 = extrapolate calms)	0
BIAS	real array	Layer-dependent biases modifying the weights of surface and upper air stations. NZ values must be entered. (-1 # BIAS # +1) Negative BIAS reduces the weight of upper air stations (e.g., BIAS = -0.1 reduces their weight by 10%). Positive BIAS reduces the weight of surface stations (e.g., BIAS = 0.2 reduces their weight by 20%). Zero BIAS leaves weights unchanged.	NZ*0
IPROG	integer	Control variable determining if gridded prognostic model field winds are used as input. 0 = No, (IWFCOD = 0 or 1) 1 = Yes, use CSUMM winds as Step 1 field, (IWFCOD=0) 2 = Yes, use CSUMM winds as initial guess field (IWFCOD=1) 3 = Yes, use winds from MM4.DAT file as Step 1 field (IWFCOD=0) 4 = Yes, use winds from MM4.DAT file as initial guess field (IWFCOD=1) 5 = Yes, use winds from MM4.DAT file as observations (IWFCOD=0 or 1) 13 = Yes, use winds from MM5.DAT file as Step 1 field (IWFCOD=0) 14 = Yes, use winds from MM5.DAT file as initial guess field (IWFCOD=1) 15 = Yes, use winds from MM5.DAT file as observations (IWFCOD=0 or 1)	0

(Input Group 5 Continued)

Table 8-4 (Continued)

Input Group 5 - Wind Field Options and Parameters

Variable	Type	Description	Default Value
ISTEPPG	integer	Timestep (hours) of the prognostic model input data	1
IGFMET	integer	Use coarse CALMET fields as initial guess fields	0
LVARY	logical	Control variable for use of varying radius of influence. If no stations with valid data are found within the specified radius of influence, then the closest station with valid data will be used. (T=use, F=do not use.)	F
RMAX1	real	Maximum radius of influence over land in the surface layer (km). This parameter should reflect the limiting influence of terrain features on the interpolation at this level.	-
RMAX2	real	Maximum radius of influence over land in layers aloft (km). RMAX2 is generally larger than RMAX1 because the effects of terrain decrease with height.	-
RMAX3	real	Maximum radius of influence overwater (km). RMAX3 is used for all layers overwater. It must be large enough to ensure that all grid points over water are large enough to be within the radius of influence of at least one observation.	-
RMIN	real	Minimum radius of influence used in the wind field interpolation (km). This parameter should be assigned a small value (e.g., <1 km) to avoid possible divide by zero errors in the inverse-distance-squared weighting scheme.	0.1
RMIN2	real	Distance (km) from an upper air station within which vertical extrapolation of surface station data will be excluded. Used only if IEXTRP > 1.	4.0

(Input Group 5 Continued)

Table 8-4 (Continued)

Input Group 5 - Wind Field Options and Parameters

Variable	Type	Description	Default Value
TERRAD	real	Radius of influence of terrain features (km)	-
R1	real	Weighting parameter for the diagnostic wind field in the surface layer (km). This parameter controls the relative weighting of the first-guess wind field produced by the diagnostic wind field model and the observations. R1 is the distance from an observational station at which the observation and the first-guess field are equally weighted.	-
R2	real	Weighting parameter for the diagnostic wind field in the layers aloft (km). R2 is applied in the upper layers in the same manner as R1 is used in the surface layer.	-
RPROG	real	Weighting parameter (km) for the prognostic wind field data	-
DIVLIM	real	Convergence criterion for the divergence minimization procedure	5.0E-6
NITER	integer	Maximum number of iterations for the divergence minimization procedure	50
NSMTH	integer array	Number of smoothing passes in each layer NZ values must be entered.	2,(MXNZ-1)*4
NINTR2	integer array	Maximum number of stations used in the interpolation of data to a grid point for each layer 1-NZ. This allows only the "NINTR2" closest stations to be included in the interpolation. The effect of increasing NINTR2 is similar to smoothing. NZ values must be entered.	99
CRITFN	real	Critical Froude number used in the evaluation of terrain blocking effects	1.0

(Input Group 5 Continued)

Table 8-4 (Continued)

Input Group 5 - Wind Field Options and Parameters

Variable	Type	Description	Default Value
ALPHA	real	Empirical parameter controlling the influence of kinematic effects	0.1
FEXTR2	integer array	Extrapolation values for layers 2 through NZ (FEXTR2(1) must be entered but is not used). Used only if ABS(IEXTRP) ∃ 3.	NZ*0.0
NBAR	integer	Number of wind field interpolation barriers	0
KBAR	integer	Level (1 to NZ) up to which barriers apply	NZ
XBBAR	real array	X coordinate (km) of the beginning of each barrier. "NBAR" values must be entered. (Used only if NBAR > 0.)	-
YBBAR	real array	Y coordinate (km) of the beginning of each barrier. "NBAR" values must be entered. (Used only if NBAR > 0.)	-
XEBAR	real array	X coordinate (km) of the end of each barrier. "NBAR" values must be entered. (Used only if NBAR > 0.)	-
YEBAR	real array	Y coordinate (km) of the end of each barrier. "NBAR" values must be entered. (Used only if NBAR > 0.)	-
IDIOPT1	integer	Control variable for surface temperature input to diagnostic wind field module. (0=compute internally from surface data, 1=read preprocessed values from the file DIAG.DAT.)	0
ISURFT	integer	Surface station number (between 1 and NSSTA) used for the surface temperature for the diagnostic wind field module	-

(Input Group 5 Continued)

Table 8-4 (Continued)

Input Group 5 - Wind Field Options and Parameters

Variable	Type	Description	Default Value
IDIOPT2	integer	Control variable for domain-averaged temperature lapse rate. (0=compute internally from upper air data, 1=read preprocessed values from the file DIAG.DAT.)	0
IUPT	integer	Upper air station number (between 1 and NUSTA) used to compute the domain-scale temperature lapse rate for the diagnostic wind field module	-
ZUPT	real	Depth (m) through which the domain-scale temperature lapse rate is computed	200.
IDIOPT3	integer	Control variable for initial-guess wind components. (0=compute internally from upper air, 1=read preprocessed values from the file DIAG.DAT.)	0
IUPWND	integer	Upper air station number used to compute the initial-guess wind components for the diagnostic wind field module. Either specify one station from 1 to nusta or specify -1 indicating the use of $1/r^2$ interpolation to generate a spatially-variable initial guess field.	-1

(Input Group 5 Continued)

Table 8-4 (Continued)

Input Group 5 - Wind Field Options and Parameters

Variable	Type	Description	Default Value
ZUPWND	real array	Bottom and top of layer through which the initial-guess winds are computed. Units: meters. (Used only if IDIOPT3=0.) Note: Two values must be entered (e.g., ! ZUPWND=1.0, 2000. !).	1.0 1000.
IDIOPT4	integer	Control variable for surface wind components. (0=compute internally from surface data, 1=read preprocessed values from the file DIAG.DAT.)	0
IDIOPT5	integer	Control variable for upper air wind components. (0=compute internally from upper air data, 1=read preprocessed values from the file DIAG.DAT.)	0
LLBREZE	logical	Control variable for lake breeze region option. LLBREZE=T, region interpolation is performed. LLBREZE=F, no region interpolation is performed.	F
NBOX	integer	Number of boxes defining region (used only if LLBREZE=T)	-
XG1	real array	1st x-grid line to define box. (Used only if LLBREZE=T.) (One for each box.)	-
XG2	real array	2nd x-grid line to define box. (Used only if LLBREZE=T.) (One for each box.)	-
YG1	real array	1st y-grid line to define box. (Used only if LLBREZE=T.) (One for each box.)	-
YG2	real array	2nd y-grid line to define box. (Used only if LLBREZE=T.) (One for each box.)	-
XBCST	real array	Beginning x coordinate (km) of user defined coastline (straight line). (Used only if LLBREZE=T.) (One for each box.)	-
YBCST	real array	Beiginning y coordinate (km) of user defined coastline (straight line). (Used only if LLBREZE=T.) (One for each box.)	-

(Input Group 5 Continued)

Table 8-4 (Continued)

Input Group 5 - Wind Field Options and Parameters

Variable	Type	Description	Default Value
XECST	real array	Beginning x coordinate (km) of user defined coastline (straight line). (Used only if LLBREZE=T.) (One for each box.)	-
YECST	real array	Beginning y coordinate (km) of user defined coastline (straight line). (Used only if LLBREZE=T.) (One for each box.)	-
NLB	integer	Number of meteorological stations (surface and upper air stations) in a box. (Used only if LLBREZE=T.) (One for each box.)	-
METBXID	integer	Station ids of the meteorological stations within each box (surface stations first, then upper air stations). (Used only if LLBREZE=T.) (One set per box.)	-

Input Group 6 - Mixing Height, Temperature, and Precipitation Parameters

Variable	Type	Description	Default Value
CONSTB	real	Neutral mechanical mixing height constant	1.41
CONSTE	real	Convective mixing height constant	0.15
CONSTN	real	Stable mixing height constant	2400.
CONSTW	real	Overwater mixing height constant	0.16
FCORIOL	real	Absolute value of Coriolis parameter (1/s)	1.E-4
DPTMIN	real	Minimum potential temperature lapse rate in the stable layer above the current convective mixing height (deg. K/m)	0.001
DZZI	real	Depth of layer (m) above current convective mixing height in which lapse rate is computed.	200.
ZIMAX	real	Maximum overland mixing height (m)	3000.
ZIMIN	real	Minimum overland mixing height (m)	50.

(Input Group 6 Continued)

Table 8-4 (Continued)

Input Group 6 - Mixing Height, Temperature, and Precipitation Parameters

Variable	Type	Description	Default Value
ZIMAXW	real	Maximum overwater mixing height (m) (Not used if observed overwater mixing heights are used)	3000.
ZIMINW	real	Minimum overwater mixing height (m) (Not used if observed overwater mixing heights are used)	50.
IAVEZI	integer	Conduct spatial averaging of mixing heights (0=no, 1=yes)	1
MNMDAV	integer	Maximum search distance (in grid cells) in the spatial averaging process. The square box of cells averaged is 2 x MNMDAV in length.	1
HAFANG	real	Half-angle of upwind-looking cone for spatial averaging (deg.)	30.
ILEVZI	integer	Layer of winds used in upwind averaging of mixing heights. (Must be between 1 and NZ.)	1
IMIXH	integer	Method to compute the convective mixing height 1: Maul-Carson for land and water cells -1: Maul-Carson for land cells only - OCD mixing height overwater 2: Batchvarova and Gryning for land and water cells -2: Batchvarova and Gryning for land cells only OCD mixing height overwater	1
THRESHL	real	Threshold buoyancy flux required to sustain convective mixing height growth overland (expressed as a heat flux per meter of boundary layer i.e. W/m3)	0.05
THRESHW	real	Threshold buoyancy flux required to sustain convective mixing height growth overwater (expressed as a heat flux per meter of boundary layer i.e. W/m3)	0.05
ITWPROG	integer	Option for overwater lapse rates used in convective mixing height growth 0 : use SEA.DAT (or default constant) lapse rates 1 : use prognostic lapse rates (only if IPROG>2)	1

(Input Group 6 Continued)

Table 8-4 (Continued)

Input Group 6 - Mixing Height, Temperature, and Precipitation Parameters

Variable	Type	Description	Default Value
ILUOC3D	integer	Land Use category ocean in 3D.DAT datasets: if 3D.DAT from MM5 version 3.0, iluoc3d = 16; if MM4.DAT, typically iluoc3d = 7	16
ICOARE	integer	Overwater surface fluxes method and parameters 0: original deltaT method (OCD) 10: COARE with no wave parameterization (jwave=0, Charnock) 11: COARE with wave option jwave=1 (Oost et al) and default wave properties -11: COARE with wave option jwave=1 (Oost et al) and observed wave properties (must be in SEA.DAT files) 12: COARE with wave option 2 (Taylor and Yelland) and default wave properties -12: COARE with wave option 2 (Taylor and Yelland) and observed wave properties (must be in SEA.DAT files)	10
DSHELF	real	Coastal/Shallow water length scale (km) for modified z0 in shallow water (0 for deep-water form)	0.
IWARM	integer	COARE warm layer computation (1: on - 0: off) must be off if SST measured with IR radiometer	1
ICOOL	integer	COARE cool skin layer computation (1: on - 0: off) must be off if SST measured with IR radiometer	1
IRHPROG	integer	3D relative humidity from observations or from prognostic data? 0 = Use RH from SURF.DAT file (if NOOBS = 0,1) 1 = Use prognostic RH (if NOOBS = 0,1,2)	0

(Input Group 6 Continued)

Table 8-4 (Continued)

Input Group 6 - Mixing Height, Temperature, and Precipitation Parameters

Variable	Type	Description	Default Value
ITPROG	integer	3D temperature from observations or from prognostic data? 0 = Use surface and upper air stations (if NOOBS = 0) 1 = Use Surface stations (no upper air observations); Use MM5 for upper air data (if NOOBS = 0,1) 2 = No surface or upper air observations; use MM5 for surface and upper air data (if NOOBS = 0,1,2)	0
IRAD	integer	Type of temperature interpolation (1 = 1/radius) (2 = 1/radius^2)	1
IAVET	integer	Conduct spatial averaging of temperatures (0 = no; 1 = yes) (Will use MNMDAV and HAFANG)	1
TRADKM	real	Radius of influence for temperature interpolation (km)	500.
NUMTS	integer	Maximum number of stations to include in temperature interpolation	5
TGDEFB	real	Default temperature lapse rate (K/m) below mixing height over water	-0.0098
TGDEFA	real	Default temperature lapse rate (K/m) above mixing height over water	-0.0045
JWAT1, JWAT2	integers	Beginning land use category for temperature interpolation overwater. Range of land use categories associated with major water bodies. Used for overwater temperature interpolation	999, 999

(Input Group 6 Continued)

Table 8-4 (Continued)

Input Group 6 - Mixing Height, Temperature, and Precipitation Parameters

Variable	Type	Description	Default Value
SIGMAP	real	If NFLAGP=1 or 2, SIGMAP is the radius of influence for precipitation (km); if NFLAGP=3, SIGMAP is the sigma weighting factor (km); if NFLAGP=3 and SIGMAP=0.0, SIGMAP will be computed internally as half of the minimum distance between any non-zero precipitation station and any zero precipitation station.	100.0
CUTP	real	Cutoff precipitation rate (mm/hr); values < CUTP are set to 0.0 mm/hr	0.01

Input Group 7 - Surface Meteorological Station Parameters

One line of data is entered for each surface station. If separate land/water interpolation is desired, this group must include only land stations. Overwater data will be in SEAn.DAT files. Each line contains the following parameters read in free format: CSNAM, IDSSTA, XSSTA, YSSTA, XSTZ, ZANEM. The data for each station are preceded by ! SSn=..., where n is the station number (e.g., ! SS1=... for station #1, ! SS2=... for station #2, etc.). The station variables (SS1, SS2, etc.) must start in Column 3. The data must start in Column 9 or greater of each record. See the sample control file for an example.

(Repeated for each of "NSSTA" Stations)

Variable	Type	Description
CSNAM	char*4	Four-character station name. Must be enclosed within single quotation marks (e.g., 'STA1', 'STA2', etc.). The opening quotation mark must be in Column 9 or greater of each record.
IDSSTA	integer	Station identification number
XSSTA	real	X coordinate* (km) of surface station
YSSTA	real	Y coordinate* (km) of surface station
XSTZ	real	Time zone of the station (e.g., 05=EST, 06=CST, 07=MST, 08=PST.)
ZANEM	real	Anemometer height (m)

* Coordinates are PMAP projection coordinates (see Input Group 2).

Table 8-4 (Continued)
CALMET Control File Inputs

Input Group 8 - Upper Air Station Parameters

One line of data is entered for each upper air station. Each line contains the following parameters read in free format: CUNAM, IDUSTA, XUSTA, YUSTA, XUTZ. The data for each station are preceded by ! USn=..., where n is the upper air station number (e.g., ! US1=... for station #1, ! US2=... for station #2, etc.). The station variables (US1, US2, etc.) must start in Column 3. The data must start in Column 9 or greater of each record. See the sample control file for an example.

(Repeated for each of "NUSTA" Stations)

Variable	Type	Description
CUNAM	char*4	Four-character upper air station name. Must be enclosed within single quotation marks (e.g., ' STA1', ' STA2', etc.). The opening quotation mark must be in Column 9 or greater of each record.
IDUSTA	integer	Station identification number
XUSTA	real	X coordinate* (km) of upper air station
YUSTA	real	Y coordinate* (km) of upper air station
XUTZ	real	Time zone of the station (e.g., 05=EST, 06=CST, 07=MST, 08=PST.)

* Coordinates are PMAP projection coordinates (see Input Group 2).

Table 8-4 (Concluded)
CALMET Control File Inputs

Input Group 9 - Precipitation Station Parameters

One line of data is entered for each precipitation station. Each line contains the following parameters read in free format: CPNAM, IDPSTA, XPSTA, and YPSTA. The data for each station are preceded by ! PSn=..., where n is the station number (e.g., ! PS1=... for station #1, ! PS2=... for station #2, etc.). The station variables (PS1, PS2, etc.) must start in Column 3. The data must start in Column 9 or greater of each record. See the sample control file for an example.

(Repeated for each of "NPSTA" Stations)

Variable	Type	Description
CPNAM	char*4	Four-character station name. Must be enclosed within single quotation marks (e.g., ' PS1', 'PS2', etc.). The opening quotation mark must be in Column 9 or greater of each record.
IDPSTA	integer	Station identification number
XPSTA	real	X coordinate* (km) of surface station
YPSTA	real	Y coordinate* (km) of surface station

* Coordinates are PMAP projection coordinates (see Input Group 2).

8.2 Geophysical Data File (GEO.DAT)

The GEO.DAT data file contains the geophysical data inputs required by the CALMET model. These inputs include land use type, elevation, surface parameters (surface roughness, length, albedo, Bowen ratio, soil heat flux parameter, and vegetation leaf area index) and anthropogenic heat flux. The land use and elevation data are entered as gridded fields. The surface parameters and anthropogenic heat flux can be entered either as gridded fields or computed from the land use data at each grid point. Default values relating each of these parameters to land use are provided in the model.

A sample GEO.DAT file is shown in Table 8-5. The first line of the file identifies the file and its format to CALMET. The second line provides the number of comment lines (character strings of up to 80 characters in length) to follow that are read but are not interpreted by the model. One of these may typically contain a title to identify the data set. The next block of 5 to 6 lines contains map projection, datum, and grid information such as the number of grid cells, grid spacing, and reference coordinates. These variables define the mapping coordinates used for the modeling and are checked by CALMET for consistency and compatibility with the CALMET control file inputs. Eight sets of flags and data records follow for the land use, elevation, surface parameters, and anthropogenic heat flux data.

The default CALMET land use scheme is based on the U.S. Geological Survey (USGS) land use classification system. The USGS primary land use categories are shown in Table 8-6. Two Level I USGS categories (water and wetlands) are subdivided into subcategories. Along with the default CALMET land use, the default values of the other geophysical parameters for each land use type are also shown. The default land use classification scheme contains 14 land use types. Note that a negative value of land use by CALMET is used as a flag to indicate irrigated land. Irrigated land may be assigned a different Bowen ratio than unirrigated land, and the CALPUFF dry deposition module uses the irrigated land use flag in computing the effect of moisture stress on stomatal resistance. (If the land is irrigated, it is assumed that the vegetation is not moisture stressed.)

CALMET allows a more detailed breakdown of land use or a totally different classification scheme to be used by providing the option for user-defined land use categories. Currently, up to 52 user-specified land use categories are allowed. An extended 52-class land use scheme based on the USGS Level I and Level II land use categories is shown in Table 8-7. The user can specify up to "MXLU" land use categories along with new values of the other geophysical parameters for each land use type. The parameter MXLU is specified in the CALMET parameter file (PARAMS.MET).

CALMET contains an option, in which temperatures over water bodies such as the ocean or large lakes are calculated by using data from only those observation stations (SEA.DAT files, usually buoys) located in it, while only land stations (SURF.DAT file) will be used to calculate temperatures over the rest of the grid. The variables JWAT1 and JWAT2 in CALMET.INP Input Group #6 specify the range of land use categories defining the water body for which this land/water temperature scheme will be implemented. A range is specified to allow inclusion of multiple categories, for example "bay" and "ocean," in the definition of the water body. To disable the overwater option, JWAT1 and JWAT2 are set to values greater than the highest land use category listed in the GEO.DAT file. The default values of JWAT1 and JWAT2 are both 999, indicating the overwater interpolation scheme is not applied in default mode.

Because the temperature of <u>any</u> grid cell whose land use is included in the range defined by JWAT1 and JWAT2 will be determined by a weighting of <u>all</u> overwater data (SEA#.DAT files), it is recommended that smaller or distant water bodies be assigned land use categories that are distinct from those used in JWAT1 and JWAT2, to avoid use of inappropriate data in determining their surface temperatures. Thus a small reservoir will have its temperature determined by surrounding land stations, rather than by ocean buoy data. After viewing the initial temperature field that results from the CALMET run, the user may wish to "fine tune" the fields using the extended, 52-class land use system in Table 8-7 and by altering the land use assignments of particular grid cells or changing the land uses included in the JWAT1-JWAT2 range. For instance, by limiting the range to "ocean" only and then changing which near-shore cells are considered to be "bay" and which are "ocean" the user can control the appearance of the temperature field in the vicinity of the coastline.

The values of IWAT1 and IWAT2 (GEO.DAT Input File) are used to determine whether the overland or overwater method will be used to produce a mixing height value for a particular grid cell. The default values of IWAT1 and IWAT2 are both 55, restricting the overwater mixing height scheme to "large" bodies of water. The user may change the values of IWAT1 and IWAT2 on a case-by-case basis to include or exclude other water bodies from being considered as overwater. For instance, the user's domain may have a bay where the mixing height should be determined using the overwater method but a series of small lakes where the overland method would be more appropriate, so the "lake" category would be excluded from the IWAT range. Alternatively, if one has a large lake that should be considered to be "overwater" and a smaller lake that should be considered to be "overland", then the land use category for the smaller lake could be changed to reflect some other category not in the IWAT range, such as forest or wetland. It is recommended that if the user creates his or her own GEO.DAT fields for roughness length, albedo, etc., they be weighted by the actual percentage of each land use in a given cell. That method is more accurate and, if one subsequently changes the dominant land use category, the variables used to calculate mixing height will still reflect the fact that there is water present in the grid cell.

The surface elevation data field is entered in "user units" along with a scaling factor to convert user units to meters. The sample GEO.DAT file shown in Table 8-5 contains elevations in meters.

The gridded fields are entered with the 'NXM' values on a line. NXM is the number of grid cells in the X direction. The data from left to right correspond to X=1 through NXM. The top line of a gridded field correspond to Y=NYM, the next line to Y=NYM-1, etc. All of the GEO.DAT inputs are read in FORTRAN free format. A detailed description of the GEO.DAT variables is contained in Table 8-8.

Table 8-5: Sample GEO.DAT Geophysical Data File

```
GEO.DAT         2.0             Header structure with coordinate parameters
   2
Produced by MAKEGEO Version: 2.26  Level: 041230
Demo Application
UTM
  16N
NAS-C   02-21-2003
      10      10     -54.000   -621.000       54.000       54.000
KM  M
   0              - LAND USE DATA -- 0=default lu categories, 1=new categories
  40  40  40  40  40  40  40  40  40  40
  40  40  40  40  40  40  40  40  40  40
  40  40  40  40  40  40  40  40  40  40
  40  40  40  40  40  40  40  40  40  40
  40  40  40  40  40  40  40  40  40  40
  40  40  40  40  40  40  40  40  40  40
  40  40  40  40  40  40  40  40  40  40
  40  40  40  40  40  40  40  40  40  40
  40  40  40  40  40  40  40  40  40  40
  40  40  40  40  40  40  40  40  40  40
1.0            - TERRAIN HEIGHTS - HTFAC - conversion to meters
    185.078       147.205       146.924       156.446       139.487
    138.010       173.812       203.405       232.758       222.710
    221.813       144.507       142.191       136.302       123.083
    133.693       158.348       192.281       224.074       247.634
    316.083       189.884       139.814       144.073       122.189
    123.002       146.333       195.571       215.208       263.082
    253.774       157.182       121.245       121.407       137.051
    144.876       152.340       200.471       246.724       318.109
    182.808       98.6778       91.7038       129.091       138.407
    165.023       190.390       225.489       253.910       314.988
    114.193       77.9254       93.2705       115.583       141.910
    190.386       187.382       204.256       306.503       448.922
    78.3998       71.2785       95.3602       129.989       148.870
    208.477       227.053       260.169       393.913       421.927
    64.1938       79.1642       117.264       139.864       158.785
    253.950       254.195       324.301       434.496       277.916
    53.5650       84.5807       134.072       148.030       162.781
    185.386       203.171       281.656       288.990       312.717
    42.8075       71.3265       111.239       96.0823       122.349
    189.143       181.916       249.689       271.627       278.849
0   - z0 --(0=default z0-lu table, 1=new z0-lu table, 2=gridded z0 field
0   - albedo --(0=default albedo-lu table,1=new albedo-lu table,2=gridded albedo field
0   - Bowen ratio --(0=default Bowen-lu table,1=new Bowen-lu table,2=gridded Bowen field
0   - soil heat flux param (HCG) --(0=default HCG-lu table,1=new HCG-lu table,2=gridded field
0   - anthropogenic heat flux (QF) --(0=default QF-lu table,1=new QF-lu table,2=gridded field
0   - leaf area index (XLAI) --(0=default XLAI-lu table,1=new XLAI-lu table,2=gridded field
```

Table 8-6: Default CALMET Land Use Categories and Associated Geophysical Parameters Based on the U.S. Geological Survey Land Use Classification System (14-Category System)

Land Use Type	Description	Surface Roughness (m)	Albedo	Bowen Ratio	Soil Heat Flux Parameter	Anthropogenic Heat Flux (W/m^2)	Leaf Area Index
10	Urban or Built-up Land	1.0	0.18	1.5	.25	0.0	0.2
20	Agricultural Land - Unirrigated	0.25	0.15	1.0	.15	0.0	3.0
-20*	Agricultural Land - Irrigated	0.25	0.15	0.5	.15	0.0	3.0
30	Rangeland	0.05	0.25	1.0	.15	0.0	0.5
40	Forest Land	1.0	0.10	1.0	.15	0.0	7.0
51	Small Water Body	0.001	0.10	0.0	1.0	0.0	0.0
54	Bays and Estuaries	0.001	0.01	0.0	1.0	0.0	0.0
55	Large Water Body	0.001	0.10	0.0	1.0	0.0	0.0
60	Wetland	1.0	0.10	0.5	.25	0.0	2.0
61	Forested Wetland	1.0	0.1	0.5	0.25	0.0	2.0
62	Nonforested Wetland	0.2	0.1	0.1	0.25	0.0	1.0
70	Barren Land	0.05	0.30	1.0	.15	0.0	0.05
80	Tundra	.20	0.30	0.5	.15	0.0	0.0
90	Perennial Snow or Ice	.05	0.70	0.5	.15	0.0	0.0

* Negative values indicate "irrigated" land use

Table 8-7: Extended CALMET Land Use Categories Based on the U.S. Geological Survey Land Use and Land Cover Classification System (52-Category System)

	Level I		Level II
10	Urban or Built-up Land	11	Residential
		12	Commercial and Services
		13	Industrial
		14	Transportation, Communications and Utilities
		15	Industrial and Commercial Complexes
		16	Mixed Urban or Built-up Land
		17	Other Urban or Built-up Land
20	Agricultural Land — Unirrigated	21	Cropland and Pasture
		22	Orchards, Groves, Vineyards, Nurseries, and Ornamental Horticultural Areas
		23	Confined Feeding Operations
		24	Other Agricultural Land
!20	Agricultural Land — Irrigated	!21	Cropland and Pasture
		!22	Orchards, Groves, Vineyards, Nurseries, and Ornamental Horticultural Areas
		!23	Confined Feeding Operations
		!24	Other Agricultural Land
30	Rangeland	31	Herbaceous Rangeland
		32	Shrub and Brush Rangeland
		33	Mixed Rangeland
40	Forest Land	41	Deciduous Forest Land
		42	Evergreen Forest Land
		43	Mixed Forest Land
50	Water	51	Streams and Canals
		52	Lakes
		53	Reservoirs
		54	Bays and Estuaries
		55	Oceans and Seas
60	Wetland	61	Forested Wetland
		62	Nonforested Wetland
70	Barren Land	71	Dry Salt Flats
		72	Beaches
		73	Sandy Areas Other than Beaches
		74	Bare Exposed Rock
		75	Strip Mines, Quarries, and Gravel Pits
		76	Transitional Areas
		77	Mixed Barren Land
80	Tundra	81	Shrub and Brush Tundra
		82	Herbaceous Tundra
		83	Bare Ground
		84	Wet Tundra
		85	Mixed Tundra
90	Perennial Snow or Ice	91	Perennial Snowfields
		92	Glaciers

Note: Negative values indicate irrigated land use.

*Values used for JWAT (Input Group 6) or IWAT (GEO.DAT Input File)

Table 8-8: GEO.DAT File Format

Record	Variable	Type	Description
1	DATASET	character*16	Dataset name (GEO.DAT)
1	DATAVER	character*16	Dataset version
1	DATAMOD	character*64	Dataset message field
2	NCOMM	integer	Number of comment records to follow
NEXT NCOMM Lines	TITLEGE	character *80	Title of file (up to 80 characters) and any other documentation for QA
NCOMM+3	PMAP *	character*8	Map projection UTM : Universal Transverse Mercator TTM : Tangential Transverse Mercator LCC : Lambert Conformal Conic PS : Polar Stereographic EM : Equatorial Mercator LAZA : Lambert Azimuthal Equal Area
NCOMM+4	IUTMZN, UTMHEM	integer, character*1	UTM zone, Hemisphere (N or S) read as format (i4,a1) ONLY for PMAP = UTM
NCOMM+4	RLAT0, RLON0, XLAT1, XLAT2	character*16	Latitude, Longitude of map projection origin, and one or two Matching Latitude Parallels. (Degrees with either N, S, E, or W, e.g., 45.6N). ONLY for PMAP = LCC, LAZA, TTM, PS, or EM
NCOMM+5	FEAST, FNORTH	real	False Easting and Northing (km). Included only if PMAP = TTM, LCC, or LAZA
NCOMM+5 or 6	DATUM	character*8	DATUM Code
NCOMM+5 or 6	DATEN	character*12	NIMA date (MM-DD-YYYY) for datum definitions
NCOMM+6 or 7	NXG	integer	Number of grid cells in the X direction
NCOMM+6 or 7	NYG	integer	Number of grid cells in the Y direction
NCOMM+6 or 7	XORG	real	Reference X coordinate of southwest corner of grid cell (1,1)
NCOMM+6 or 7	YORG	real	Reference Y coordinate of southwest corner of grid cell (1,1)
NCOMM+6 or 7	DGRIDX	real	Horizontal grid spacing: Easting

* PMAP projections PS, EM, and LAZA are NOT AVAILABLE in CALMET

Table 8-8 (Continued)
GEO.DAT File Format

Record	Variable	Type	Description
NCOMM +6 or 7	DGRIDY	real	Horizontal grid spacing: Northing (= DGRIDX)
NCOMM +7 or 8	XYUNIT	character*4	Units for horizontal coordinates (KM)
NCOMM+8 or 9	IOPT1	integer	Option flag for land use categories (0=to use default land use categories) (1=to specify new land use categories)
NCOMM +9 or 10**	NLU	integer	Number of land use categories
NCOMM +9 or 10**	IWAT1, IWAT2	integer	Range of land use categories associated with water (i.e., land use categories IWAT1 to IWAT2, inclusive, are assumed to represent water surfaces)
NCOMM +10 or 11**	ILUCAT	integer array	Array of "NLU" new user specified land use categories
NEXT NY lines	ILANDU	integer array	Land use types for cell grid point (NX values per line). The following statements are used to read the data: do 20 J=NY,1,-1 20 READ (iogeo,*)(ILANDU(n,j), n=1, nx)
NEXT line	HTFAC	real	Multiplicative scaling factor to convert terrain heights from user units to meters (e.g., HTFAC = 0.3048 for user units of ft, 1.0 for user units of meters)
NEXT NY lines	ELEV	real array	Terrain elevations (user units) for each grid point (NX values for line). The following statements are used to read the data: do 30 J=NY,1,-1 30 READ(iogeo,*)(ELEV(n,j),n=1,NX)
NEXT line	IOPT2	integer	Option flag for input of surface roughness lengths (z0) 0=compute gridded z0 values from land use types using default z0 land use table 1=compute gridded z0 values from land use types using new, user-specified z0 land use table 2=input a gridded z0 field
NEXT** NLU lines	ILU ZOLU	integer real array	Land use type and associated surface roughness lengths (m). Two variables per line read as: do 120 I=1,NLU 120 READ(iogeo,*)ILU,ZOLU(I)

Table 8-8 (Continued)
GEO.DAT File Format

Record	Variable	Type	Description
NEXT*** NY lines	ZO	real array	Surface roughness length (m) at each grid point (NX values per line). The following statements are used to read the data: do 150 J=NY,1,-1 150 READ(iogeo,*)(ZO(n,j),n=1,NX)

** Included only if IOPT2 = 1

*** Included only if IOPT2 = 2

Record	Variable	Type	Description
NEXT line	IOPT3	integer	Option flat for input of albedo 0=compute gridded albedo values from land use types using the default albedo-land use table 1=compute gridded albedo values from land use types using a new, user-specified albedo-land use table 2=input a gridded albedo field
NEXT** NLU lines	{ ILU ALBLU	integer real array	Land use type and associated albedo. Two variables per line read as: do 120 I=1,NLU 120 READ(iogeo,*)ILU,ALBLU(I)
NEXT*** NY lines	ALBEDO	real array	Albedo at each grid point (NX values per line). The following statements are used to read the data: do 150 J=NY,1,-1 150 READ(iogeo,*)(ALBEDO(n,j),n=1,NX)

** Included only if IOPT3 = 1
*** Included only if IOPT3 = 2

Table 8-8 (Continued)
GEO.DAT File Format

Record	Variable	Type	Description
NEXT line	IOPT4	integer	Option flag for input of Bowen ratio 0=compute gridded Bowen ratio values from land use types using default Bowen ratio-land use table 1=compute gridded Bowen ratio values from land use types using new, user-specified Bowen ratio-land use table 2=input a gridded Bowen ratio field
NEXT** NLU lines	{ ILU BOWLU	integer real array	Land use type and associated Bowen ratio. Two variables per line read as: do 120 I=1,NLU 120 READ(iogeo,*)ILU,BOWLU(I)
NEXT*** NY lines	BOWEN	real array	Bowen ratio at each grid point (NX values per line). The following statements are used to read the data: do 150 J=NY,1,-1 150 READ(iogeo,*)(BOWEN(n,j),n=1,NX)

** Included only if IOPT4 = 1
*** Included only if IOPT4 = 2

Table 8-8 (Continued)
GEO.DAT File Format

Record	Variable	Type	Description
NEXT line	IOPT5	integer	Option flag for input of soil heat flux constant 0=compute gridded soil heat flux constant values from land use types using the default soil heat flux constant-land use table 1=compute gridded soil heat flux constant values from land use types using new, user-specified soil heat flux constant-land use table 2=input a gridded soil heat flux constant field
NEXT** NLU lines	ILU HCGLU	integer real array	Land use type and associated soil heat flux constant. Two variables per line read as: do 120 I=1,NLU 120 READ(iogeo,*)ILU,HCGLU(I)
NEXT*** NY lines	HCG	real array	Soil heat flux constant at each grid point (NX values per line). The following statements are used to read the data: do 150 J=NY,1,-1 150 READ(iogeo,*)(HCG(n,j),n=1,NX)

** Included only if IOPT5 = 1
*** Included only if IOPT5 = 2

Table 8-8 (Continued)
GEO.DAT File Format

Record	Variable	Type	Description
NEXT line	IOPT6	integer	Option flag for input of anthropogenic heat flux (W/m^2) 0=compute gridded anthropogenic heat flux values from land use types using default anthropogenic heat flux-land use table 1=compute gridded anthropogenic heat flux values from land use types using new, user-specified anthropogenic heat flux-land use table 2=input a gridded anthropogenic heat flux field
NEXT** NLU lines	{ ILU QFLU	integer real array	Land use type and associated anthropogenic heat flux (W/m^2). Two variables per line read as: do 120 I=1,NLU 120 READ(iogeo,*)ILU,QFLU(I)
NEXT*** NY lines	QF	real array	Anthropogenic heat flux (W/m^2) at each grid point (NX values per line). The following statements are used to read the data: do 150 J=NY,1,-1 150 READ(iogeo,*)(QF(n,j),n=1,NX)

** Included only if IOPT6 = 1
*** Included only if IOPT6 = 2

Table 8-8 (Concluded)

GEO.DAT File Format

Record	Variable	Type	Description
NEXT line	IOPT7	integer	Option flag for input of leaf area index 0=compute gridded leaf area index values from land use types using default leaf area index-land use table 1=compute gridded leaf area index values from land use types using new, user-specified leaf area index-land use table 2=input a gridded leaf area index field
NEXT** NLU lines	{ ILU XLAILU	integer real array	Land use type and associated leaf area index values. Two variables per line read as: do 120 I=1,NLU 120 READ(iogeo,*)ILU,XLAILU(I)
NEXT*** NY lines	XLAI	real array	Leaf area index value at each grid point (NX values per line). The following statements are used to read the data: do 150 J=NY,1,-1 150 READ(iogeo,*)(XLAI(n,j),n=1,NX)

** Included only if IOPT7 = 1
*** Included only if IOPT7 = 2

8.3 Upper Air Data Files (UP1.DAT, UP2.DAT,...)

The upper air data used by CALMET are read from upper air data files called UPn.dat, where n is the upper air station number (n=1,2,3, etc.). The upper air data files can be created by the READ62 preprocessor program from standard NCDC upper air data formats or by application-specific reformatting programs. Observations made at non-standard sounding times can be used by CALMET.

The UPn.DAT files are formatted, user-editable files containing at least five header records followed by groups of data records. A sample upper air data file generated by READ62 and hand-edited to remove informational messages and to fill in missing soundings is shown in Table 8-9. The first line of the file identifies the file and its format to CALMET. The second line provides the number of comment lines (character strings of up to 80 characters in length) to follow that are read but are not interpreted by the model. One of these may typically contain a title to identify the data set. The next line after all comment records identifies the map projection for any locations provided in the file. Presently, the projection is NONE as no locations are provided. The next record identifies the time zone of the data in the file, which is typically UTC (e.g., the zone is UTC+0000). The next record contains the beginning and ending dates of data contained in the file and the top pressure level of the sounding data. The last header record contains the READ62 data processing options used in the creation of the file.

The data records consist of a one-record header listing the origin of the data (6201 for NCDC data or 9999 for non-NCDC data), station ID number, date and time, and information on the number of sounding levels. Following this are the pressure, elevation, temperature, wind direction, and wind speed for each sounding level. The format of the UPn.dat file is shown in Table 8-10.

As discussed in Section 3.0, the model allows missing values of wind speed, wind direction, and temperature in the UP.DAT files at intermediate levels. The model will linearly interpolate between valid levels to fill in the missing data. <u>The user is cautioned against using soundings for which this interpolation would be inappropriate</u>. Missing soundings should be replaced with soundings for the same time period from a representative substitute station. Each data set must be processed on a case-by-case basis with careful consideration given to how to deal with missing data.

Table 8-9: Sample READ62 Output Data File (UPn.DAT)

(a) UP.DAT - Slash-delimited format

```
UP.DAT          2.1             Hour Start and End Times with Seconds
   1
Produced by READ62 Version: 5.63  Level: 061020
NONE
UTC+0000
  2002    2   12    0 2002    9    7    0 500.    1    1
     F    F    F    F
   6201     14764    2002   1  2 12    0    2002   1  2 12    0   49      28
   1007.0/  16./279.3/160/ 10   1000.0/  77./281.0/174/ 13    983.0/ 221./284.6/186/ 19    973.0/ 304./999.9/190/ 21
    959.0/ 427./285.2/199/ 23    950.0/ 507./284.9/203/ 24    938.0/ 609./999.9/210/ 26    905.0/ 914./999.9/220/ 29
    900.0/ 959./283.1/222/ 30    872.0/1219./999.9/225/ 31    850.0/1433./281.2/222/ 31    822.0/1710./278.5/223/ 30
    810.0/1827./999.9/225/ 30    800.0/1931./277.6/226/ 29    780.0/2132./999.9/225/ 29    752.0/2437./999.9/225/ 28
    750.0/2456./275.3/226/ 28    724.0/2742./999.9/230/ 27    708.0/2920./273.2/230/ 26    700.0/3011./272.9/231/ 26
    697.0/3047./999.9/230/ 26    650.0/3601./269.6/236/ 27    645.0/3657./999.9/235/ 27    600.0/4230./266.1/240/ 31
    597.0/4267./999.9/240/ 32    552.0/4875./999.9/240/ 36    550.0/4905./262.2/241/ 36    500.0/5630./257.9/240/ 38
   6201     14764    2002   1  3  0    0    2002   1  3  0    0   49      19
    994.0/  16./276.5/240/  7    979.0/ 140./279.7/250/ 11    968.0/ 233./280.3/254/ 14    950.0/ 388./280.0/254/ 18
    933.0/ 536./279.6/250/ 19    900.0/ 832./280.4/243/ 22    898.0/ 852./280.5/242/ 22    850.0/1303./277.8/244/ 24
    800.0/1795./275.8/251/ 29    750.0/2316./273.5/256/ 35    742.0/2402./273.1/256/ 36    728.0/2554./272.3/254/ 38
    707.0/2787./273.0/249/ 39    700.0/2868./272.5/248/ 39    650.0/3457./268.6/241/ 35    603.0/4042./264.5/230/ 30
    600.0/4081./264.4/230/ 30    550.0/4754./262.3/222/ 38    500.0/5482./259.9/219/ 53

          (... records removed for clarity)
```

(b) UP.DAT - Comma-delimited format

```
UP.DAT          2.1             Hour Start and End Times with Seconds
   1
Produced by READ62 Version: 5.63  Level: 061020
NONE
UTC+0000
  2002    2   12    0 2002    9    7    0 500.    1    1
     F    F    F    F
   6201     14764    2002   1  2 12    0    2002   1  2 12    0   49      28
   1007.0,  16.,279.3,160, 10.0,   1000.0,  77.,281.0,174, 13.0,    983.0, 221.,284.6,186, 19.0,    973.0, 304.,999.9,190, 21.1,
    959.0, 427.,285.2,199, 23.0,    950.0, 507.,284.9,203, 24.0,    938.0, 609.,999.9,210, 26.2,    905.0, 914.,999.9,220, 29.8,
    900.0, 959.,283.1,222, 30.0,    872.0,1219.,999.9,225, 31.3,    850.0,1433.,281.2,222, 31.0,    822.0,1710.,278.5,223, 30.0,
    810.0,1827.,999.9,225, 30.3,    800.0,1931.,277.6,226, 29.0,    780.0,2132.,999.9,225, 29.8,    752.0,2437.,999.9,225, 28.8,
    750.0,2456.,275.3,226, 28.0,    724.0,2742.,999.9,230, 27.2,    708.0,2920.,273.2,230, 26.0,    700.0,3011.,272.9,231, 26.0,
    697.0,3047.,999.9,230, 26.7,    650.0,3601.,269.6,236, 27.0,    645.0,3657.,999.9,235, 27.7,    600.0,4230.,266.1,240, 31.0,
    597.0,4267.,999.9,240, 32.4,    552.0,4875.,999.9,240, 36.0,    550.0,4905.,262.2,241, 36.0,    500.0,5630.,257.9,240, 38.0
   6201     14764    2002   1  3  0    0    2002   1  3  0    0   49      19
    994.0,  16.,276.5,240,  7.0,    979.0, 140.,279.7,250, 11.0,    968.0, 233.,280.3,254, 14.0,    950.0, 388.,280.0,254, 18.0,
    933.0, 536.,279.6,250, 19.0,    900.0, 832.,280.4,243, 22.0,    898.0, 852.,280.5,242, 22.0,    850.0,1303.,277.8,244, 24.0,
    800.0,1795.,275.8,251, 29.0,    750.0,2316.,273.5,256, 35.0,    742.0,2402.,273.1,256, 36.0,    728.0,2554.,272.3,254, 38.0,
    707.0,2787.,273.0,249, 39.0,    700.0,2868.,272.5,248, 39.0,    650.0,3457.,268.6,241, 35.0,    603.0,4042.,264.5,230, 30.0,
    600.0,4081.,264.4,230, 30.0,    550.0,4754.,262.3,222, 38.0,    500.0,5482.,259.9,219, 53.0

          (... records removed for clarity)
```

Table 8-10: READ62 Output File Format (Upn.DAT)

FILE HEADER RECORD #1

Columns	Format	Variable	Description
1-16	A16	DATASET	Dataset name (UP.DAT)
17-32	A16	DATAVER	Dataset version
33-96	A64	DATAMOD	Dataset message field

FILE HEADER RECORD #2 to NCOMM+2

Columns	Format	Variable	Description
1-4	I4	NCOMM	Number of comment records
1-80	A80	TITLE	Comment (repeated NCOMM times)

FILE HEADER RECORD # NCOMM+3

Columns	Format	Variable	Description
1-8	A8	PMAP	Map projection (NONE)

FILE HEADER RECORD # NCOMM+4

Columns	Format	Variable	Description
1-8	A8	ATZ	Time Zone (UTC+hhmm) for data records

FILE HEADER RECORD # NCOMM+5

Columns	Format	Variable	Description
2-6	I5	IBYR	Beginning year of data in the file (YYYY)
7-11	I5	IBDAY	Beginning Julian day of data in the file
12-16	I5	IBHR	Beginning time (hour 00-23) of data in the file
17-21	I5	IBSEC	Beginning time (second 0000-3599) of data in the file
22-26	I5	IEYR	Ending year of data in the file (YYYY)
27-31	I5	IEDAY	Ending Julian day of data in the file
32-36	I5	IEHR	Ending time (hour 00-23) of data in the file

Table 8-10 (Continued)
READ62 Output File Format
(Upn.DAT)

Columns	Format	Variable	Description
37-41	I5	IESEC	Ending time (second 0000-3600) of data in the file
42-46	F5.0	PSTOP	Top pressure level (mb) of data in the file (possible values: 850mb, 700mb, or 500mb)
47-51	I5	JDAT	Original data file type (1 = TD-6201 format 2=NCDC CD-ROM format)
52-56	I5	IFMT	Delimiter used in the UP.DAT file (1 = slash (/) delimiter, 2= comma (,) delimiter)

FILE HEADER RECORD # NCOMM+6

Columns	Format	Variable	Description
6	L1	LHT	Sounding level eliminated if height missing ? (T=yes, F=no)
11	L1	LTEMP	Sounding level eliminated if temperature missing ? (T=yes, F=no)
16	L1	LWD	Sounding level eliminated if wind direction missing ? (T=yes, F=no)
21	L1	LWS	Sounding level eliminated if wind speed missing ? (T=yes, F=no)

Table 8-10 (Continued)
READ62 Output File Format
(Upn.DAT)

DATA RECORDS

For each sounding, a one-record data header is used followed by "N" records of data. Each record contains up to four sounding levels.

DATA HEADER RECORD

Columns	Format*	Variable	Description
4-7	I4	ITPDK	Label identifying data format of original data (e.g., 5600 or 6201 for NCDC data or 9999 for non-NCDC data)
10-17	I8	IDSTN	Station ID number
22-25	I4	IYRB	Beginning Year of data
26-29	I4	IMOB	Beginning Month of data
30-32	I3	IDYB	Beginning Day of data
33-35	I3	IHRB	Beginning Time (hour 00-23) of data
36-40	I5	ISECB	Beginning Time (second 0000-3599) of data
45-48	I4	IYRE	Ending Year of data
49-52	I4	IMOE	Ending Month of data
53-55	I3	IDYE	Ending Day of data
56-58	I3	IHRE	Ending Time (hour 00-23) of data
59-63	I5	ISECE	Ending Time (second 0000-3600) of data
66-70	I5	MLEV	Number of levels in the original sounding
72-76	I5	ISTOP	Number of levels extracted from the original sounding and stored below

* Record format is (3x,i4,2x,i8,2(4x,i4,i4,i3,i3,i5),8x,i5)

(READ62 Output File Format Continued)

Table 8-10 (Concluded)
READ62 Output File Format
(UPn.DAT)

DATA RECORDS (Slash-delimited format)
(Up to four levels per record)

Columns	Format*	Variable	Description
4-9	F6.1	PRES	Pressure (mb)
11-15	F5.0	HEIGHT	Height above sea level (m)
17-21	F5.1	TEMP	Temperature (deg. K)
23-25	I3	WD	Wind direction (degrees)
27-29	I3	WS	Wind speed (m/s)
33-38	F6.1	PRES	Pressure (mb)
40-44	F5.0	HEIGHT	Height above sea level (m)
46-50	F5.1	TEMP	Temperature (deg. K)
52-54	I3	WD	Wind direction (degrees)
56-58	I3	WS	Wind speed (m/s)
62-67	F6.1	PRES	Pressure (mb)
69-73	F5.0	HEIGHT	Height above sea level (m)
75-79	F5.1	TEMP	Temperature (deg. K)
81-83	I3	WD	Wind direction (degrees)
85-87	I3	WS	Wind speed (m/s)
91-96	F6.1	PRES	Pressure (mb)
98-102	F5.0	HEIGHT	Height above sea level (m)
104-108	F5.1	TEMP	Temperature (deg. K)
110-112	I3	WD	Wind direction (degrees)
114-116	I3	WS	Wind speed (m/s)

* Record format is (4(3x,f6.1,'/',f5.0,'/',f5.1,'/',i3,'/',i3))
Missing value indicators are !99.9 for pressure, 9999. for height, 999.9 for temperature, and 999 for wind speed and direction.

8.4 Surface Meteorological Data File (SURF.DAT)

CALMET provides two options for the format of the surface meteorological data input file, SURF.DAT. The first is to use the unformatted file created by the SMERGE meteorological preprocessor program. SMERGE processes and reformats hourly surface observations in standard NCDC formats into a form compatible with CALMET. It is best used for large data sets with many surface stations.

The second format allowed by CALMET for the SURF.DAT file is a free-formatted option. This option allows the user the flexibility of either running the SMERGE preprocessor to create a formatted data file or for short CALMET runs, manually entering the data.

The selection of which surface data input format is used by CALMET is made by the user with the control file variable, IFORMS (see Input Group 4 of the control file in Section 8.1).

A sample formatted SURF.DAT file is shown in Table 8-11. A description of each variable in the formatted surface data file is contained in Table 8-12. The first line of the file identifies the file and its format to CALMET. The second line provides the number of comment lines (character strings of up to 80 characters in length) to follow that are read but are not interpreted by the model. One of these may typically contain a title to identify the data set. The next line after all comment records identifies the map projection for any locations provided in the file. Presently, the projection is NONE as no locations are provided. The next record identifies the time zone of the data in the file, which is denoted as the time to add to UTC (e.g., the Eastern Standard Time zone in the USA is UTC-0500). The next line identifies the beginning and ending dates and times of data in the file and the number of stations. Finally, one record per station follows with the station ID for each. One data record per hour follows the header records. Each data record contains the date and time and for each station, the wind speed, wind direction, ceiling height, cloud cover, temperature, relative humidity, station pressure, and a precipitation code.

Buoy and other overwater data are normally input through the SEAn.DAT files. If the overwater method is not used, the buoy data can be either the SURF.DAT file or SEAn.DAT files. In any case, buoy data for a given station should not be in both files.

Table 8-11: Sample SURF.DAT Output Data File (SURF.DAT)

```
SURF.DAT        2.1             Hour Start and End Times with Seconds
   1
Produced by SMERGE Version: 5.601  Level: 051005
NONE
UTC-0700
  1993   7   0     0  1993   7   5  3600    4
   14606
   14611
   14745
   14742
1993   7   0    0   1993   7   0 3600
    3.087  220.000  999    0  263.706   98  956.997    0
    3.087  140.000  999    0  263.706   98  956.997    0
    3.087  180.000  999    0  263.706   98  956.997    0
    3.087   90.000  999    0  263.706   98  956.997    0
1993   7   1    0   1993   7   1 3600
    3.601  220.000  999    0  263.706   98  956.319    0
    3.601  140.000  999    0  263.706   98  956.319    0
    3.601  180.000  999    0  263.706   98  956.319    0
    3.601   90.000  999    0  263.706   98  956.319    0
1993   7   2    0   1993   7   2 3600
    3.087  220.000  999    0  263.150   99  955.642    0
    3.087  140.000  999    0  263.150   99  955.642    0
    3.087  180.000  999    0  263.150   99  955.642    0
    3.087   90.000  999    0  263.150   99  955.642    0
1993   7   3    0   1993   7   3 3600
    4.116  220.000  999    0  263.150   98  955.303    0
    4.116  140.000  999    0  263.150   98  955.303    0
    4.116  180.000  999    0  263.150   98  955.303    0
    4.116   90.000  999    0  263.150   98  955.303    0
1993   7   4    0   1993   7   4 3600
    3.087  220.000  999    0  262.594   98  955.303    0
    3.087  140.000  999    0  262.594   98  955.303    0
    3.087  180.000  999    0  262.594   98  955.303    0
    3.087   90.000  999    0  262.594   98  955.303    0
1993   7   5    0   1993   7   5 3600
    1.543  220.000  999    0  262.594   98  956.319    0
    1.543  140.000  999    0  262.594   98  956.319    0
    1.543  180.000  999    0  262.594   98  956.319    0
    1.543   90.000  999    0  262.594   98  956.319    0
```

Table 8-12: Formatted SURF.DAT File - Header Records

FILE HEADER RECORD #1

Columns	Format	Variable	Description
1-16	A16	DATASET	Dataset name (SURF.DAT)
17-32	A16	DATAVER	Dataset version
33-96	A64	DATAMOD	Dataset message field

FILE HEADER RECORD #2 to NCOMM+2

Columns	Format	Variable	Description
1-4	I4	NCOMM	Number of comment records
1-80	A80	TITLE	Comment (repeated NCOMM times)

FILE HEADER RECORD # NCOMM+3

Columns	Format	Variable	Description
1-8	A8	PMAP	Map projection (NONE)

FILE HEADER RECORD # NCOMM+4

Columns	Format	Variable	Description
1-8	A8	ATZ	Time Zone (UTC+hhmm) for data records

FILE HEADER RECORD # NCOMM+5

Variable No. *	Variable	Type	Description
1	IBYR	integer	Beginning year of the data in the file
2	IBJUL	integer	Beginning Julian day
3	IBHR	integer	Beginning time (hour 00-23)
4	IBSEC	integer	Beginning time (second 0000-3599)
5	IEYR	integer	Ending year
6	IEJUL	integer	Ending Julian day
7	IEHR	integer	Ending time (hour 00-23)
8	IESEC	integer	Ending time (second 0000-3600)
9	NSTA	integer	Number of stations

* Variables are read in FORTRAN free-format

Table 8-12 (Continued)
Formatted SURF.DAT File - Data Records*

FILE HEADER RECORD # NCOMM+5

Columns	Fornat	Variable	Description
1-8	I8	IDSTA	Surface station ID number

Next NSTA HEADER RECORDS

Variable No.	Variable	Type	Description
1	IYRB	integer	Beginning year of data
2	IJULB	integer	Beginning Julian day
3	IHRB	integer	Beginning time (hour 00-23)
4	ISECB	integer	Beginning time (second 0000-3599)
5	IYRE	integer	Ending year of data
6	IJULE	integer	Ending Julian day
7	IHRE	integer	Ending time (hour 00-23)
8	ISECE	integer	Ending time (second 0000-3600)
9	WS	real array	Wind speed (m/s)
10	WD	real array	Wind direction (degrees)
11	ICEIL	integer array	Ceiling height (hundreds of feet)
12	ICC	integer array	Opaque sky cover (tenths)
13	TEMPK	real array	Air temperature (degrees K)
14	IRH	integer array	Relative humidity (percent)
15	PRES	real array	Station pressure (mb)
16	IPCODE	integer array	Precipitation code (0=no precipitation, 1-18=liquid precipitation, 19-45=frozen precipitation)

* The data records are read in free format with the following statement:

```
      READ(io,*)IYRB,IJULB,IHRB,ISECB, IYRE,IJULE,IHRE,ISECE, (WS(n),WD(n),ICEIL(n),
     1         ICC(n),TEMPK(n),IRH(n),PRES(n),IPCODE(n),
     1         n=1,NSTA)
```

Missing value indicators are 9999. (real variables) and 9999 (integer variables)

8.5 Overwater Data Files (SEA1.DAT, SEA2.DAT, ...)

If the modeling application involves overwater transport and dispersion, the CALMET boundary layer model requires observations of the air-sea temperature difference, air temperature, relative humidity and overwater mixing height. If the overwater temperature method is used, vertical temperature gradient information is also necessary, however defaults are specified in the CALMET.INP file. The special overwater observations, along with wind speed and direction, are contained in a set of files named SEAn.DAT, where n is a station number (1,2,3,...). If SEAn.DAT files are not used, the overwater station and its standard surface parameters (e.g., wind speed and direction, etc.) can be treated as a regular surface station. Additionally, any overwater site that should not be used in the overwater temperature interpolation scheme should be placed in the SURF.DAT file instead of a SEA.DAT file. For instance, a user may want to include wind information from a lake buoy but not have the buoy influence temperatures over the ocean.

The overwater data files are structured to allow the use of data with arbitrary time resolution. For example, hourly or daily air-sea temperature difference data, if available, can be entered into the files. Otherwise, monthly or seasonal data can be used. However, any station that is reporting non-missing wind speed and direction should use hourly data resolution or inaccuracies will be introduced into the wind field. The inaccuracy results from the fact that the variables retain their current values each hour until a new observation is encountered, at which time they are updated. Thus, long periods of missing wind data between valid observations should receive hourly records with the wind data set to missing. A similar argument applies to temperature and vertical temperature gradient information if the overwater temperature method is used. All times must match the base time zone of the CALMET run (variable IBTZ).

The location of the overwater site is specified for each observation. This allows the use of data collected from ships with time-varying locations. The data for each observation station (fixed or moving) must be stored in a separate overwater data file.

Table 8-13 contains a sample overwater input file, which contains hourly overwater data. A description of each input variable and format is provided in Table 8-14.

Table 8-13: Sample Overwater Data File (SEA1.DAT)

```
SEA.DAT         2.0             Header structure with coordinate parameters
   2
Produced by BUOY Version:   1.21  Level: 051220
 Data values taken from NODC  Data Format 291
UTM
  15N
NAS-C   02-21-2003
KM
 42002  '2002'
  357.21 2783.99 -94.417 10.0 2004   1  0 2004   1  0 -214.3  296.9   82.3 9999.0 9999.0 9999.0    6.6  115.0
  357.21 2783.99 -94.417 10.0 2004   1  1 2004   1  1 -214.3  296.9   81.8 9999.0 9999.0 9999.0    6.1  109.0
  357.21 2783.99 -94.417 10.0 2004   1  2 2004   1  2 -214.4  296.8   83.8 9999.0 9999.0 9999.0    6.0  101.0
  357.21 2783.99 -94.417 10.0 2004   1  3 2004   1  3 -214.4  296.8   81.8 9999.0 9999.0 9999.0    7.3  101.0
  357.21 2783.99 -94.417 10.0 2004   1  4 2004   1  4 -214.4  296.8   80.3 9999.0 9999.0 9999.0    6.9  104.0
  357.21 2783.99 -94.417 10.0 2004   1  5 2004   1  5 -214.4  296.8   76.8 9999.0 9999.0 9999.0    5.8  111.0
  357.21 2783.99 -94.417 10.0 2004   1  6 2004   1  6 -214.3  296.9   76.4 9999.0 9999.0 9999.0    7.5  107.0
  357.21 2783.99 -94.417 10.0 2004   1  7 2004   1  7 -213.3  296.9   73.6 9999.0 9999.0 9999.0    7.6  115.0
  357.21 2783.99 -94.417 10.0 2004   1  8 2004   1  8 -213.0  297.1   75.0 9999.0 9999.0 9999.0    6.9  121.0
  357.21 2783.99 -94.417 10.0 2004   1  9 2004   1  9 -213.8  297.4   75.5 9999.0 9999.0 9999.0    8.1  124.0
  357.21 2783.99 -94.417 10.0 2004   1 10 2004   1 10 -213.9  297.2   79.3 9999.0 9999.0 9999.0    7.7  123.0
  357.21 2783.99 -94.417 10.0 2004   1 11 2004   1 11 -213.8  297.4   80.3 9999.0 9999.0 9999.0    7.7  127.0
  357.21 2783.99 -94.417 10.0 2004   1 12 2004   1 12 -215.1  297.0   84.9 9999.0 9999.0 9999.0    7.0  120.0
  357.21 2783.99 -94.417 10.0 2004   1 13 2004   1 13 -215.0  297.1   84.9 9999.0 9999.0 9999.0    7.0  123.0
  357.21 2783.99 -94.417 10.0 2004   1 14 2004   1 14 -216.1  297.0   86.5 9999.0 9999.0 9999.0    8.0  127.0
  357.21 2783.99 -94.417 10.0 2004   1 15 2004   1 15 -216.4  296.8   85.9 9999.0 9999.0 9999.0    9.4  126.0
  357.21 2783.99 -94.417 10.0 2004   1 16 2004   1 16 -215.1  297.0   87.5 9999.0 9999.0 9999.0    8.1  120.0
  357.21 2783.99 -94.417 10.0 2004   1 17 2004   1 17 -215.2  296.9   89.1 9999.0 9999.0 9999.0    7.8  120.0
  357.21 2783.99 -94.417 10.0 2004   1 18 2004   1 18 -215.3  296.9   88.0 9999.0 9999.0 9999.0    7.8  122.0
  357.21 2783.99 -94.417 10.0 2004   1 19 2004   1 19 -215.3  296.9   88.0 9999.0 9999.0 9999.0    7.0  122.0
  357.21 2783.99 -94.417 10.0 2004   1 20 2004   1 20 -214.3  296.9   88.6 9999.0 9999.0 9999.0    7.1  116.0
  357.21 2783.99 -94.417 10.0 2004   1 21 2004   1 21 -214.3  296.9   88.0 9999.0 9999.0 9999.0    6.7  118.0
  357.21 2783.99 -94.417 10.0 2004   1 22 2004   1 22 -214.3  296.9   88.6 9999.0 9999.0 9999.0    7.1  119.0
  357.21 2783.99 -94.417 10.0 2004   1 23 2004   1 23 -214.3  296.9   87.0 9999.0 9999.0 9999.0    7.0  122.0
```

Table 8-14: Overwater Data File Format (SEA1.DAT)

HEADER RECORDS

Record	Variable	Type	Description
1	DATASET	character*16	Dataset name (SEA.DAT)
1	DATAVER	character*16	Dataset version 2.0
1	DATAMOD	character*64	Dataset message field
2	NCOMM	integer	Number of comment records to follow
NEXT NCOMM Lines	TITLE	character *80	Title of file (up to 80 characters) and any other documentation for QA
NCOMM+3	PMAP *	character*8	Map projection UTM : Universal Transverse Mercator TTM : Tangential Transverse Mercator LCC : Lambert Conformal Conic PS : Polar Stereographic EM : Equatorial Mercator LAZA : Lambert Azimuthal Equal Area
NCOMM+4	IUTMZN, UTMHEM	integer, character*1	UTM zone, Hemisphere (N or S) read as format (i4,a1) ONLY for PMAP = UTM
NCOMM+4	RLAT0, RLON0, XLAT1, XLAT2	character*16	Latitude, Longitude of map projection origin, and one or two Matching Latitude Parallels. (Degrees with either N, S, E, or W, e.g., 45.6N). ONLY for PMAP = LCC, LAZA, TTM, PS, or EM
NCOMM+5	FEAST, FNORTH	real	False Easting and Northing (km). Included only if PMAP = TTM, LCC, or LAZA
NCOMM+5 or 6	DATUM	character*8	DATUM Code
NCOMM+5 or 6	DATEN	character*12	NIMA date (MM-DD-YYYY) for datum definitions
NCOMM +6 or 7	XYUNIT	character*4	Units for horizontal coordinates (KM)
NCOMM +7 or 8	IDOWSTA	integer	5-digit station ID number
NCOMM +7 or 8	CHOWSTA	character*4	station name

* PMAP projections PS, EM, and LAZA are NOT AVAILABLE in CALMET

Table 8-14 (Concluded)
Overwater Data File Format (SEA1.DAT)

DATA RECORDS

Variable No. *	Variable	Type	Description	Default Value
1	XUTM	real	X coordinate (km) of the observational site	-
2	YUTM	real	Y coordinate (km) of the observational site	-
3	XOWLON	real	Longitude (degrees) of the observational site. Positive for Western Hemisphere, negative for Eastern Hemisphere	-
4	ZOWSTA	real	Measurement height (m) above the surface of the water of the air temperature and air-sea temperature difference	-
5	I1YR	integer	Beginning year of the data in this record	-
6	I1JUL	integer	Beginning Julian day of the data in this record	-
7	I1HR	integer	Beginning hour (00-23 LST) of the data in this record	-
8	I2YR	integer	Ending year of the data in this record	-
9	I2JUL	integer	Ending Julian day of the data in this record	-
10	I2HR	integer	Ending hour (00-23 LST) of the data in this record	-
11	DTOW	real	Air-sea surface temperature difference (K)	-
12	TAIROW	real	Air temperature (K)	288.7
13	RHOW	real	Relative humidity (%)	100
14	ZIOW	real	Overwater mixing height (m)	-
15	TGRADB	real	Temperature lapse rate below the mixing height overwater (K/m)	-0.0098
16	TGRADA	real	Temperature lapse rate above the mixing height overwater (K/m)	-0.0045
17	WSOW	real	Wind speed (m/s)	-
18	WDOW	real	Wind direction (degrees)	-

* Variables are read in FORTRAN free-format
Missing value indicators are 9999. (real variables)

8.6 Precipitation Data File (PRECIP.DAT)

If the wet removal algorithm of the CALPUFF or MESOPUFF II models is to be applied, CALMET must produce gridded fields of hourly precipitation rates from observations. The PXTRACT and PMERGE preprocessing programs process and reformat the NWS precipitation data in TD-3240 format into a formatted or unformatted file called PRECIP.DAT. The output file of PMERGE is directly compatible with the input requirements of CALMET. The user needs to set the precipitation file format variable, IFORMP, in the CALMET control file to one when using PMERGE unformatted output. Otherwise, set IFORMP to two for a formatted file either prepared by the user or generated by PMERGE. This option is provided to allow the user an easy way to manually enter precipitation data for short CALMET runs.

A sample free-formatted PRECIP.DAT file is shown in Table 8-15. A description of each variable in the formatted surface data file is contained in Table 8-16. The first line of the file identifies the file and its format to CALMET. The second line provides the number of comment lines (character strings of up to 80 characters in length) to follow that are read but are not interpreted by the model. One of these may typically contain a title to identify the data set. The next line after all comment records identifies the map projection for any locations provided in the file. Presently, the projection is NONE as no locations are provided. The next record identifies the time zone of the data in the file, which is denoted as the time to add to UTC (e.g., the Eastern Standard Time zone in the USA is UTC-0500). The next line identifies the beginning and ending dates and times of data in the file, the reference time zone for these, and the number of stations. Finally, one record per station follows with the station ID for each. One data record must follow for each hour. Each data record contains the date and time and the precipitation rate (mm/hr) for each station.

Table 8-15: Sample Precipitation Data File (PRECIP.DAT)

```
PRECIP.DAT      2.1             Hour Start and End Times with Seconds
   1
Produced by PMERGE Version: 5.60  Level: 050921
NONE
UTC-0700
  1990   1   0     0  1990   1  11  3600   16
  170273
  176905
  177325
  178641
  270741
  270998
  272842
  273182
  274732
  274808
  275639
  275780
  276234
  276818
  278885
  437054
1990   1   0    0   1990   1   0 3600
                0.000    0.000    0.000    0.000    0.000    0.000 9999.000    0.000    0.000
0.000
                0.254    0.000    0.000    0.000    0.000    0.000
1990   1   1    0   1990   1   1 3600
                0.000    0.000    0.000    0.000    0.000    0.000 9999.000    0.000    0.000
0.000
                0.762    0.000    0.000    2.540    0.000    0.000
1990   1   2    0   1990   1   2 3600
                0.000    0.000    0.000    0.000    0.000    0.000 9999.000    0.000    0.000
0.000
                0.762    0.000    0.000    0.000    0.000    0.000
1990   1   3    0   1990   1   3 3600
                0.000    0.000    0.000    0.000    0.000    0.000 9999.000    0.000    0.000
2.540
                1.016    0.000    0.000    0.000    0.000    0.000
1990   1   4    0   1990   1   4 3600
                0.000    0.000    0.000    0.000    0.000    0.000 9999.000    0.000    0.000
0.000
                0.762    2.540    2.540    2.540    0.000    0.000
1990   1   5    0   1990   1   5 3600
                0.000    0.254    0.000    0.000    0.000    2.540 9999.000    0.000    2.540
0.000
                1.016    0.000    0.000    0.000    0.000    0.000
1990   1   6    0   1990   1   6 3600
                0.000    1.016    0.000    0.000    0.000    0.000 9999.000    0.000    0.000
0.000
                1.524    0.000    0.000    0.000    0.000    0.000
1990   1   7    0   1990   1   7 3600
                2.540    0.000    0.000    0.000    2.540    0.000    0.000    2.540    0.000
0.000
                2.032    0.000    0.000    0.000    0.000    0.000
1990   1   8    0   1990   1   8 3600
                0.000    0.000    2.540    0.000    0.000    0.000    0.000    0.000    0.000
0.000
                2.540    0.000    0.000    0.000    0.000    0.000
1990   1   9    0   1990   1   9 3600
                0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000
0.000
                2.794    0.000    0.000    0.000    0.000    0.000
1990   1  10    0   1990   1  10 3600
                0.000    0.000    0.000    2.540    0.000    0.000    0.000    0.000    0.000
0.000
                2.540    0.000    0.000    0.000    0.000    0.000
1990   1  11    0   1990   1  11 3600
                0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000
0.000
                2.286    0.000    0.000    0.000    0.000    0.000
```

Table 8-16: Formatted Precipitation Data File Format (PRECIP.DAT)

HEADER RECORDS

FILE HEADER RECORD #1

Columns	Format	Variable	Description
1-16	A16	DATASET	Dataset name (PRECIP.DAT)
17-32	A16	DATAVER	Dataset version
33-96	A64	DATAMOD	Dataset message field

FILE HEADER RECORD #2 to NCOMM+2

Columns	Format	Variable	Description
1-4	I4	NCOMM	Number of comment records
1-80	A80	TITLE	Comment (repeated NCOMM times)

FILE HEADER RECORD # NCOMM+3

Columns	Format	Variable	Description
1-8	A8	PMAP	Map projection (NONE)

FILE HEADER RECORD # NCOMM+4

Columns	Format	Variable	Description
1-8	A8	ATZ	Time Zone (UTC+hhmm) for data records

FILE HEADER RECORD # NCOMM+5

Variable No. *	Variable	Type	Description
1	IBYR	integer	Beginning year of the data in the file
2	IBJUL	integer	Beginning Julian day
3	IBHR	integer	Beginning time (hour 00-23)
4	IBSEC	integer	Beginning time (second 00-3599)
5	IEYR	integer	Ending year
6	IEJUL	integer	Ending Julian day
7	IEHR	integer	Ending time (hour 00-23)
8	IESEC	integer	Ending time (second 00-3600)
9	NSTA	integer	Number of stations

* Variables are read in FORTRAN free-format

Table 8-16 (Concluded)
Formatted Precipitation Data File Format (PRECIP.DAT)

Next NSTA HEADER RECORDS

Columns	Fornat	Variable	Description
1-8	I8	IDSTA	Surface station ID number

DATA RECORDS
(Repeated for each hour of data)

Variable *	Type	Description
IYRB	integer	Beginning year of data
IJULB	integer	Beginning Julian day of data
IHRB	integer	Beginning time (hour 00-23) of data
ISECB	integer	Beginning time (second 0000-3599) of data
IYRE	integer	Ending year of data
IJULE	integer	Ending Julian day of data
IHRE	integer	Ending time (hour 00-23) of data
ISECE	integer	Ending time (second 0000-3600) of data
XPREC	real array	Precipitation rates (mm/hr) for each precipitation station in the station order specified in the header records. Each data record is read as: READ(io12,*) iyrb,ijulb,ihrb,isecb, iyre,ijule,ihre,isece, (XPREC(n),n=1,NSTA)

[*] Variables are read in FORTRAN free-format
Missing value indicator is 9999.

8.7 Preprocessed Diagnostic Model Data File (DIAG.DAT)

The CALMET control file contains variables which determine how the meteorological data required by the diagnostic wind field module are entered into the program. The variables IDIOPT1 through IDIOPT5 of Input Group 5 in the control file determine whether the hourly station observation and domain-scale average surface temperature, lapse rate, and wind components are internally computed from the data in the surface and upper air data files or read directly from a separate file, DIAG.DAT.

The DIAG.DAT file allows the user to bypass the internal CALMET computation involving the interpolation and spatial averaging of the meteorological inputs to the model by specifying these inputs directly. This option has been retained in the operational version of the model although it was intended primarily as a testing tool. The use of the DIAG.DAT file requires that the time interpolation of the sounding data and routine averaging of upper layer winds through the depth of each vertical layer, as well as conversion of the wind components from wind speed and direction to U and V components, all be performed externally.

A sample DIAG.DAT file containing two hours of data is shown in Table 8-17. A description of each variable in the file and its input format is contained in Table 8-18. The variables included in the DIAG.DAT file depend on the option selected in the CALMET control file. A value of one for the following control file parameters is used to flag input of the corresponding meteorological variable via the DIAG.DAT file. A value of zero indicates the meteorological variable is internally computed by the model from the data in the SURF.DAT and UPn.DAT files. The default value for each control file parameter is set to compute the meteorological variables internally.

Control File Parameter	Meteorological Variable
IDIOPT1	Domain-average surface temperature
IDIOPT2	Domain-average vertical temperature lapse rate
IDIOPT3	Domain-average winds (U and V components)
IDIOPT4	Hourly surface station winds (U and V components)
IDIOPT5	Hourly upper air station winds (U and V components)

The wind observations in DIAG.DAT are entered with data for one station per line. The end of the surface data and upper air data are both flagged by a record with a station name of 'LAST'.

Table 8-17: Sample DIAG.DAT Input Data File

```
TINF:     300.15
GAMMA hr 1  2.5
UM    hr 1 -1.8
VM    hr 1 -0.9
SURFACE WIND 0 PTM1    1.0 -0.6 -0.8
SURFACE WIND 0 PLGN    1.0  3.0 -2.6
SURFACE WIND 0 LAST
UPPER WIND 0 LCMB    1.0999.0999.0 -0.9  0.0 -1.1  0.2 -0.3  0.1 -0.2 -0.3
UPPER WIND 0 OFLT    1.0 -0.2 -0.1 -0.1 -0.5 -0.3 -0.8 -0.4 -0.5 -2.2 -1.5
UPPER WIND 0 LAST
TINF:     300.15
GAMMA hr 2  3.5
UM    hr 2 -1.8
VM    hr 2 -0.9
SURFACE WIND 1 PTM1    1.0  0.0  0.0
SURFACE WIND 1 PLGN    1.0  4.9 -3.3
SURFACE WIND 1 LAST
UPPER WIND 1 LCMB   1.0999.0999.0 -1.3 -0.2 -0.6  0.3 -0.9  0.8 -0.9  1.1
UPPER WIND 1 OFLT   1.0 -0.1  0.0  0.2  0.1 -0.3 -1.3 -0.2 -0.9  0.3 -0.4
UPPER WIND 1 LAST
```

Table 8-18: DIAG.DAT Input File

(Records 1-6 reported for each hour)

Record	Variable No.	Variable	Type	Description
1[a]	1	TINF	real	Domain-average surface temperature (deg. K). Input format: (10X,F6.2).
2[b]	1	GAMMA	real	Domain-average temperature lapse rate (deg. K/km). Input format: (10X,F5.1).
3[c]	1	UM	real	Domain average U wind component (m/s). Input format: (10X,F5.1).
4[c]	1	VM	real	Domain average V wind component (m/s). Input format: (10X,F5.1).
5[d]	1	CNAM	char*4	Four-character surface station name ('LAST' indicates end of surface data)
5[d]	1	WT	real	Data weighting factor (usually set to 1.0)
5[d]	1	US	real	U component of surface wind (m/s)
5[d]	1	VS	real	V component of surface wind (m/s)
(Repeated one station per record)				Input format: (15X,A4,1X,3F5.1)

(DIAG.DAT Input File Continued)

[a] Record included only if control file variable IDIOPT1=1
[b] Record included only if control file variable IDIOPT2=1
[c] Record included only if control file variable IDIOPT3=1
[d] Record included only if control file variable IDIOPT4=1

Table 8-18 (Concluded)
DIAG.DAT Input File

Record	Variable No.	Variable	Type	Description
6[e]	1	CUNAM	char*4	Four-character upper air station name. ('LAST' indicates end of upper air data.)
6[e]	2	WTU	real	Data weighting factor (usually set to 1.0)
6[e]	3	ULEV1	real	U component of wind (m/s) at upper air station for CALMET layer 1
6[e]	4	VELV1	real	V component of wind (m/s) at upper air station for CALMET layer 1
6[e]	5	ULEV2	real	U component of wind (m/s) at upper air station for CALMET layer 2
6[e]	6	VELV2	real	V component of wind (m/s) at upper air station for CALMET layer 2
.	.	.		
.	.	.		
.	.	.		

[e] Record included only if control file variable IDIOPT5=1

8.8 Prognostic Model Data File (PROG.DAT)

The CALMET model allows the use of gridded prognostic model (CSUMM) winds to be used as the initial guess field or Step 1 wind field in the diagnostic model analysis procedure as a substitute for the normal Step 1 analysis. The use of the prognostic wind field option is controlled by the variable IPROG in Input Group 5 of the CALMET control file. If IPROG is set equal to one or two, the gridded prognostic model wind fields are read from a file called PROG.DAT. These winds are interpolated from the prognostic model grid system to the CALMET grid to produce either the initial guess field or the Step 1 wind field.

The PROG.DAT file is an unformatted data file containing the time, grid specifications, vertical layer structure, and three-dimensional fields of U and V wind fields. Table 8-19 contains a description of the variables included in each hourly set of winds.

Note that CSUMM does not allow the use of a Lambert conformal projection, so the coordinate system must be a UTM system when CSUMM data are used (i.e., IPROG = 1 or 2).

Table 8-19: Gridded Prognostic Model Wind Field Input File (PROG.DAT)

Record	Variable No.	Variable	Type	Description
1	1	TIMEH	real	Prognostic model simulation time (hours)
2	1	NXP	real	Number of prognostic model grid cells in the X direction
2	2	NYP	real	Number of prognostic model grid cells in the Y direction
2	3	NZP	real	Number of prognostic model vertical layers
3	1	UTMXOP	real	Reference UTM X coordinate of prognostic model grid origin
3	2	UTMYOP	real	Reference UTM Y coordinate of prognostic model grid origin
3	3	DXKP	real	Grid spacing (km)
4	1	Z	real array	Grid point heights (m) in prognostic model grid (NZP values)
Next NZP*NYP Records	1	UP	real array	Prognostic model U components (cm/s) of wind. The following statements are used to read the UP array: do 10 k=1,NZP do 10 j=1,NYP 10 READ(irdp)(UP(i,j,k),i=1,NXP)
Next NZP*NYP Records	1	VP	real array	Prognostic model V components (cm/s) of wind. The following statements are used to read the VP array: do 20 k=1,NZP do 20 j=1,NYP 20 READ(irdp)(VP(i,j,k)i=1,NXP)

(All records repeated each hour)

8.9 MM4/MM5/3D Model Data Files (MM4.DAT, MM5.DAT, 3D.DAT)

The CALMET model allows as input the use of gridded prognostic winds from MM4, MM5 or any operational weather forecasting model such as Eta or RUC. The use of the prognostic wind field option is controlled by the variable IPROG in Input Group 5 of the CALMET control file. A choice of six methods of incorporating the MM4/MM5/3D wind data into the model is available.

If	IPROG = 3	use MM4/MM5 (MM4.DAT) winds as the Step 1 field when using the objective analysis
	IPROG = 4	use MM4/MM5 (MM4.DAT) winds as the initial guess field when using the diagnostic module
	IPROG = 5	treat MM4/MM5 (MM4.DAT) winds as observations.
	IPROG = 13	use MM5/3D (MM5.DAT/3D.DAT) winds as the Step 1 field when using the objective analysis
	IPROG = 14	use MM5/3D (MM5.DAT/3D.DAT) winds as the initial guess field when using the diagnostic module
	IPROG = 15	treat MM5/3D (MM5.DAT/3D.DAT) winds as observations.

If one of the first three methods is chosen, the gridded MM4/MM5 fields are read from a file called MM4.DAT. If one of the second three methods is chosen, the gridded MM5/3D fields are read from a file called MM5.DAT/3D.DAT. Note that the MM5.DAT/3D.DAT file contains fields provided by MM5 that are not provided by MM4. Within CALMET these fields are interpolated from the prognostic model grid system to the CALMET grid.

The MM4.DAT file is a formatted data file containing header records describing the date, time, and domain of the prognostic model run. The extraction subdomain is defined in terms of (I,J) and latitude and longitude. Terrain elevation and land use description code are also provided for each grid cell in the subdomain. The sigma-p values used by MM4/MM5/3D to define each of the vertical layers are also contained in the header records of MM4.DAT.

The data records consist of a date and time record, then a data record consisting of elevation (m MSL) and winds at each grid cell for each vertical level. The surface level is followed by the mandatory levels of 1000, 925, 850, 700, 500, 400, and 300 mb. All subterranean mandatory levels will have wind direction and wind speed of 0.

A sample MM4.DAT file is presented in Table 8-20, and a description of each record is presented in Table 8-21.

The MM5.DAT file is also a formatted data file similar to the MM4.DAT file. Header records describe the prognostic model run and the subdomain and time period extracted to the MM5.DAT file. Data records for each time period are provided for each grid cell in the extracted subdomain. Sea level pressure, rainfall, and snow cover are provided for the surface, and pressure, elevation, temperature, wind speed, and wind direction are always provided at each vertical level. Other variables that may be provided at each vertical level include the vertical velocity, relative humidity, vapor mixing ratio, cloud mixing ratio, rain mixing ratio, ice mixing ratio, and grouped mixing ratio.

The 3D.DAT file is exactly similar to the MM5.DAT file with a minor exception. In the 3D.DAT file, the user can add comments to the file header. These comments are particularly useful in tracing the history of the file.

A sample 3D.DAT file is presented in Table 8-22, and a description of each record is presented in Table 8-23. Please note that the MM5.DAT file is similar to the file described in Tables 8-22 and 8-23.

Table 8-20: Sample MM4/MM5 Derived Gridded Wind Data File (MM4.DAT)

```
THIS FILE CREATED 17:17:33 04-21-92
88071500 744  60  45  15 100.0
  35  16   5   5
0.0500
0.1500
0.2500
0.3500
0.4500
0.5500
0.6500
0.7400
0.8100
0.8650
0.9100
0.9450
0.9700
0.9850
0.9950
 35 16 34.756 -85.988 0272 02
 36 16 34.715 -85.098 0321 06
 37 16 34.666 -84.210 0386 04
 38 16 34.609 -83.323 0406 04
 39 16 34.544 -82.438 0319 04
 35 17 35.488 -85.943 0277 04
 36 17 35.447 -85.043 0343 04
 37 17 35.397 -84.145 0464 04
 38 17 35.340 -83.248 0581 04
 39 17 35.274 -82.353 0539 04
 35 18 36.222 -85.897 0252 04
 36 18 36.180 -84.987 0323 04
 37 18 36.130 -84.078 0443 04
 38 18 36.071 -83.172 0609 04
 39 18 36.004 -82.266 0670 04
 35 19 36.957 -85.849 0217 02
 36 19 36.914 -84.929 0282 04
 37 19 36.863 -84.010 0365 04
 38 19 36.804 -83.093 0504 04
 39 19 36.737 -82.178 0639 04
 35 20 37.693 -85.801 0192 04
 36 20 37.650 -84.870 0244 02
 37 20 37.599 -83.941 0293 04
 38 20 37.539 -83.013 0373 04
 39 20 37.470 -82.087 0509 04
```

(Continued)

Table 8-20 (Concluded)
Sample MM4/MM5 Derived Gridded Wind Data File (MM4.DAT)

```
88071500 35 16 1015.2 0.00 0
 9849 00272 30056 24507
10000 00136 30657 00000
 9250 00831 25232 26510
 8500 01571 19814 29009
 7000 03218 10661 03011
 5000 05943 04971 07013
 4000 07655 17170 05011
 3000 09747 32566 05012
 9805 00313 29656 24507
 9716 00394 28852 24508
 9584 00517 27846 25509
 9362 00724 26038 26510
 9053 01021 23823 27010
 8654 01414 21015 28509
 8168 01914 17612 30008
 7548 02586 14058 00007
 6752 03518 09064 03512
 5867 04668 02866 05012
 4982 05971 05171 07013
 4097 07475 15971 05011
 3212 09262 28767 05011
 2327 11485 46364 05517
 1442 14523 66159 02514
88071500 36 16 1015.2 0.00 0
 9796 00321 29456 25007
10000 00136 30656 00000
 9250 00831 25231 26511
 8500 01571 20015 30009
 7000 03217 10261 01510
 5000 05940 04775 06512
 4000 07654 17173 05513
 3000 09746 32567 05014
 9752 00361 29052 25007
 9664 00442 28246 25007
 9532 00565 27239 25509
 9312 00772 25634 26511
 9004 01068 23620 27010
 8608 01461 20816 29509
 8124 01960 17214 32009
 7509 02630 13458 35509
 6717 03559 08463 02011
 5838 04706 02667 04011
 4958 06006 05176 06513
 4078 07508 16173 05513
 3199 09290 28968 05012
 2319 11505 46565 05018
 1440 14530 66360 01515
```

Table 8-21: MM4/MM5 Derived Gridded Wind Data File Format (MM4.DAT)

HEADER RECORDS

Header Record #1

Variable No.	Variable	Type	Description
1	CTEXT	char*36	Text date/time stamp for file creation

Header Record #2

Variable No.	Variable	Type	Description
1	IBYRM	integer	Beginning year of the data in the file
2	IBMOM	integer	Beginning month of the data in the file
3	IBDYM	integer	Beginning day of the data in the file
4	IBHRM	integer	Beginning hour (GMT) of the data in the file
5	NHRSMM4	integer	Length of period (hours) of the data in the file
6	NXMM4	integer	Number of columns in the MM4/MM5 domain
7	NYMM4	integer	Number of rows in the MM4/MM5 domain
8	NZP	integer	Number of layers in the MM4/MM5 domain
9	PTOPMM4	real	Top pressure level (mb) of the data in the file

format (4i2,4i4,f6.1)

Header Record #3

1	I1	integer	I-index (X direction) of the lower left corner of the extraction subdomain
2	J1	integer	J-index (Y direction) of the lower left corner of the extraction subdomain
3	NXP	integer	Number of grid cells in the X direction in the extraction subdomain
4	NYP	integer	Number of grid cells in the Y direction in the extraction subdomain

format (4i4)

Table 8-21 (Continued)
MM4/MM5 Derived Gridded Wind Data File Format (MM4.DAT)

HEADER RECORDS

Next NZP Records

Variable No.	Variable	Type	Description
1	SIGMA	real array	Sigma-p values used by MM4/MM5 to define each of the NZP layers Read as: do 10 I=1,NZP 10 READ(iomm4,20)SIGMA(I) 20 FORMAT(F6.4)

Next NXP*NYP Records

Variable No.	Variable	Type	Description
1	IINDEX	integer	I-index (X direction) of the grid point in the extraction subdomain
2	JINDEX	integer	J-index (Y direction) of the grid point in the extraction subdomain
3	XLATDOT	real array	N. Latitude (degrees) of the grid point in the extraction subdomain (positive for the Northern Hemisphere, negative for Southern Hemisphere)
4	XLONGDOT	real array	E. Longitude (degrees) of the grid point in the extraction subdomain (N.B., the MM4/MM5 convention is different than the CALMET convention: MM4/MM5 uses <u>negative</u> values for Western Hemisphere and positive values for Eastern Hemisphere. CALMET internally converts the longitudes in the MM4.DAT file, so the MM4/MM5 convention must be used in the MM4.DAT file)
5	IELEVDOT	integer array	Terrain elevation of the grid point in the extraction subdomain (m MSL)
6	ILUDOT	integer array	Land use description code of the grid point in the extraction subdomain

format (2i3,f7.3,f8.3,i5,i3)

Table 8-21 (Continued)
MM4/MM5 Derived Gridded Wind Data File Format (MM4.DAT)

DATA RECORDS (repeated for each grid cell in extraction subdomain)

Data Record

Variable No.	Variable	Type	Description
1	MYR	integer	Year of MM4/MM5 wind data
2	MMO	integer	Month of MM4/MM5 wind data
3	MDAY	integer	Day of MM4/MM5 wind data
4	MHR	integer	Hour (GMT) of MM4/MM5 wind data
5	IX	integer	I-index (X direction) of grid cell
6	JX	integer	J-index (Y direction) of grid cell
7	PRES	real	surface pressure (mb)
8	RAIN	real	total rainfall for the past hour (cm)
9	SC	integer	snow cover indicator (0 or 1, where 1 = snow cover was determined to be present for the MM4 simulation

format (4i2,2i3,f7.1,f5.2,i2)

Data Records (one record for each mandatory Level(8)* plus `NZP' significant levels)

Variable No.	Variable	Type	Description
1	-	integer	Pressure (tenths of millibars)
2	Z	integer	Elevation (meters above m.s.l.)
3**	-	integer	Temperature/dew point depression in NWS format (TTTDD)
4	WD	integer	Wind direction (degrees)
5	WS	integer	Wind speed (knots)

format of data (i5,3i6,5x)

format used by CALMET to read the data (5x,f6.0,6x,f4.0,f2.0)

* The surface level is followed by the mandatory levels of 1000, 925, 850, 700, 500, 400, and 300 mb. All subterranean mandatory levels will have wind direction and wind speed of 0.

Table 8-21 (Concluded)
MM4/MM5 Derived Gridded Wind Data File Format (MM4.DAT)

** TTT = °C*10, odd number = negative temperature
even number = positive temperature

Examples: TTT = 202 → 20.2°C
TTT = 203 → -20.3°C

DD < 56 → °C*10
DD ≥ 56 → °C+50

Examples: DD = 55 → 5.5°C
DD = 56 → 6.0°C

Table 8-22: Sample MM5/RUC Derived Gridded Wind Data File (3D.DAT)

```
3D.DAT          2.1            Header Structure with Comment Lines
   1
Produced by CALMM5 Version: 2.5     , Level: 050607
  1  1  1  1  0  1
LCC   21.8530   45.0000   7.00  36.00 -1944.000 -1944.000  36.000 109 109 40
  1  4  3  5  2  2  1  0  1  1  1  1  1  1  1  1  1  1  1  1 25
2004013006    2   6   6  29
  25  10  30  15   1  29   35.1243   36.8535   6.6576   8.3718
 0.998
 0.995
 0.992
 0.988
 0.983
 0.978
 0.972
 0.966
 0.959
 0.951
 0.942
 0.931
 0.920
 0.907
 0.892
 0.876
 0.857
 0.837
 0.813
 0.787
 0.758
 0.725
 0.688
 0.646
 0.599
 0.547
 0.494
 0.449
 0.408
  25  10   6.6576   35.2281 1120 13    6.8291   35.3805 1283
  26  10   6.6777   35.5531 1264 13    6.8489   35.7058 1426
  27  10   6.6971   35.8780 1250 13    6.8680   36.0311 1422
  28  10   6.7158   36.2031 1251 13    6.8864   36.3566 1430
  29  10   6.7338   36.5283 1365 13    6.9042   36.6821 1456
  30  10   6.7512   36.8535 1458 13    6.9212   37.0077 1433
  25  11   6.9805   35.2076 1166 13    7.1523   35.3602 1415
  26  11   7.0006   35.5331 1467 13    7.1721   35.6861 1745
  27  11   7.0201   35.8588 1605 13    7.1913   36.0122 1828
  28  11   7.0389   36.1846 1622 13    7.2098   36.3383 1807
  29  11   7.0570   36.5104 1603 13    7.2276   36.6645 1721
```

```
  30  11   7.0744   36.8363 1550 10    7.2447   36.9908 1590
  25  12   7.3038   35.1869 1274 10    7.4759   35.3398 1668
  26  12   7.3241   35.5131 1718  6    7.4958   35.6664 2045
  27  12   7.3436   35.8395 1927 13    7.5151   35.9932 2090
  28  12   7.3624   36.1659 1935 13    7.5336   36.3200 2014
  29  12   7.3806   36.4924 1867  2    7.5515   36.6469 1925
  30  12   7.3981   36.8190 1770  2    7.5687   36.9739 1843
  25  13   7.6276   35.1661 1424  2    7.8000   35.3193 1768
  26  13   7.6479   35.4930 1893 13    7.8200   35.6467 2089
  27  13   7.6675   35.8201 2107  2    7.8393   35.9741 2205
  28  13   7.6865   36.1472 2102  2    7.8579   36.3016 2099
  29  13   7.7047   36.4744 1996 13    7.8758   36.6292 1945
  30  13   7.7222   36.8017 1912 13    7.8930   36.9568 1934
  25  14   7.9519   35.1452 1441  2    8.1245   35.2987 1567
  26  14   7.9722   35.4729 1819  2    8.1445   35.6268 1851
  27  14   7.9919   35.8006 2064 13    8.1639   35.9549 2110
  28  14   8.0109   36.1284 2123 13    8.1826   36.2831 2079
  29  14   8.0292   36.4563 1995 10    8.2005   36.6114 1856
  30  14   8.0468   36.7843 1887 10    8.2179   36.9398 1811
  25  15   8.2765   35.1243 1372 10    8.4494   35.2781 1420
  26  15   8.2970   35.4526 1618 10    8.4695   35.6068 1636
  27  15   8.3167   35.7810 1871 13    8.4889   35.9356 1887
  28  15   8.3358   36.1096 2001 10    8.5077   36.2645 1930
  29  15   8.3541   36.4381 1911 10    8.5257   36.5935 1779
  30  15   8.3718   36.7668 1785 10    8.5431   36.9226 1695
2004013006 25 10 1012.3 0.03 0    26.5   406.8   293.1   14.17    62.2     2.1
291.0
 890   1130 292.9  62  2.3 -0.01 8613.89-4.000
 887   1154 292.8  62  2.8 -0.02 8513.60-4.000
 884   1180 292.8  61  2.9 -0.02 8313.44-4.000
 881   1210 292.8  60  3.1 -0.02 8213.29-4.000
 878   1244 292.8  59  3.3 -0.02 8113.09-4.000
 874   1282 292.7  58  3.5 -0.02 7912.85-4.000
 870   1325 292.6  58  3.5 -0.02 7812.67-4.000
 865   1373 292.5  58  3.4 -0.02 7812.52 0.000 0.005 0.000 0.000
 859   1429 292.2  58  3.3 -0.02 7812.41 0.000 0.008 0.000 0.000
 853   1491 291.9  59  3.1 -0.02 7812.33 0.000 0.010 0.000 0.000
 846   1561 291.6  62  3.0 -0.02 7912.25 0.000 0.013 0.000 0.000
 838   1641 291.1  68  2.9 -0.02 8012.17 0.000 0.015 0.000 0.000
 830   1731 290.6  75  2.9 -0.02 8112.07 0.000 0.019 0.000 0.000
 820   1834 289.9  83  2.9 -0.02 8311.98 0.000 0.021 0.000 0.000
 809   1950 289.1  93  3.0 -0.02 8511.88 0.000 0.024 0.000 0.000
 796   2083 288.2 102  3.2 -0.02 8811.73 0.000 0.026 0.000 0.000
 782   2235 287.1 110  3.6 -0.01 9111.56 0.000 0.027 0.000 0.000
 766   2408 285.9 118  4.1 -0.01 9411.29 0.000 0.027 0.000 0.000
 748   2607 284.5 123  4.9  0.00 9810.90 0.000 0.029 0.000 0.000
 728   2835 283.2 124  6.4  0.01 94 9.87 0.002 0.033 0.000 0.000
 705   3099 281.4 124  7.5  0.02 92 8.92 0.028 0.036 0.000 0.000
 680   3404 279.2 122  8.0  0.03100 8.62 0.182 0.033 0.000 0.000
 651   3760 277.3 118  8.6  0.04100 7.96 0.433 0.028 0.000 0.000
 618   4178 275.3 110  8.4  0.05 98 7.01 0.342 0.027 0.000 0.000
 581   4671 272.9  96  7.7  0.04 90 5.77 0.009 0.059 0.000 0.000
```

```
 540  5260 269.1  87  7.2  0.03 99 5.15 0.024 0.123 0.000 0.000
 498  5894 265.4  78  7.3  0.01 93 3.96 0.023 0.071 0.000 0.000
 462  6474 262.3  79  8.4 -0.01 66 2.37-4.000
 430  7028 259.8  88  9.9 -0.02 57 1.82-4.000
2004013006 26 10 1012.3 0.01 0    40.2   402.0   292.5   14.16    50.4     2.0
290.7
 875  1275 292.3  52  2.4 -0.01 8813.88-4.000
 873  1298 292.1  52  2.9 -0.01 8713.58-4.000
 ......
```

Table 8-23: MM5/RUC Derived Gridded Wind Data File Format (3D.DAT)

HEADER RECORDS

Header Record #1

Variable No.	Variable	Type	Description
1	DATASET	Char*16	Dataset name (3D.DAT)
2	DATAVER	Char*16	Dataset version
3	DATAMOD	Char*64	Dataset message field
			Format(2a16,a64)

Header Record #2 to NCOMM+2

1	NCOMM	Integer	Number of comment records
1	COMMENT	Char*132	Comments (repeated NCOMM times)
			Format(a132)

Header Record # NCOMM+3

Variable No.	Variable	Type	Description
1	IOUTW	Integer	Flag indicating if vertical velocity is recorded.
1	IOUTQ	Integer	Flag indicating if relative humidity and vapor mixing ratios are recorded
1	IOUTC	Integer	Flag indicating if cloud and rain mixing ratios are recorded.
1	IOUTI	Integer	Flag indicating if ice and snow mixing ratios are recorded.
1	IOUTG	Integer	Flag indicating if graupel mixing ratio is recorded.
1	IOSRF	Integer	Flag indicating if surface 2-D files are created.
		Format(6i3)	

Table 8-23 (Continued)
MM5/RUC Derived Gridded Wind Data File Format (3D.DAT)

HEADER RECORDS

Header Record # NCOMM+4

Variable No.	Variable	Type	Description
1	MAPTXT	char*3	Map projection LCC: Lambert Land Conformal Projection
2	RLATC	real	Center latitude (positive for northern hemisphere)
3	RLONC	real	Center longitude (positive for eastern hemisphere)
4	TRUELAT1	real	First true latitude
5	TRUELAT2	real	Second true latitude
6	X1DMN	real	SW dot point X coordinate (km, Grid 1,1) in original domain
7	Y1DMN	real	SW dot point Y coordinate (km, Grid 1,1) in original domain
8	DXY	real	Grid size (km)
9	NX	integer	Number of grids in X-direction (West-East) in original domain
10	NY	integer	Number of grids in Y-direction (South-North) in original domain
11	NZ	integer	Number of sigma layers in original domain
			Format(a4,f9.4,f10.4,2f7.2,2f10.3,f8.3,2i4,i3)

Table 8-23 (Continued)
MM5/RUC Derived Gridded Wind Data File Format (3D.DAT)

HEADER RECORDS

Header Record #NCOMM+5 (not used by RUC)

Variable No.	Variable	Type	Description
1	INHYD	Integer	0: hydrostatic MM5 run - 1: non-hydrostatic
2	IMPHYS	Integer	MM5 moisture options. 1: dry 2: removal of super saturation 3: warm rain (Hsie) 4: simple ice scheme (Dudhia) 5: mixed phase (Reisner) 6: mixed phase with graupel (Goddard) 7: mixed phase with graupel (Reisner) 8: mixed phase with graupel (Schultz)
3	ICUPA	Integer	MM5 cumulus parameterization 1: none 2: Anthes-Kuo 3: Grell 4: Arakawa-Schubert 5: Fritsch-Chappel 6: Kain-Fritsch 7: Betts-Miller 8: Kain-Fritsch
4	IBLTYP	Integer	MM5 planetary boundary layer (PBL) scheme 0: no PBL 1: bulk PBL 2: Blackadar PBL 3: Burk-Thompson PBL 4: ETA PBL 5: MRF PBL 6: Gayno-Seaman PBL 7: Pleim-Chang PBL

Table 8-23 (Continued)
MM5/RUC Derived Gridded Wind Data File Format (3D.DAT)

HEADER RECORDS

Header Record #NCOMM+5 (not used by RUC)

Variable No.	Variable	Type	Description
5	IFRAD	Integer	MM5 atmospheric radiation scheme 0: none 1: simple cooling 2: cloud-radiation (Dudhia) 3: CCM2 4: RRTM longwave
6	ISOIL	Integer	MM5 soil model 0: none 1: multi-layer 2: Noah LS model 3: Pleim-Xiu LSM
7	IFDDAN	Integer	1: FDDA grid analysis nudging - 0: no FDDA
8	IFDDAOB	Integer	1: FDDA observation nudging - 0: no FDDA
9-	FLAGS_2D	Integer	1/0: Flags for output variables in 2D.DAT (not used in 3D.DAT) Format(30i3) Note: Set to zero for model output other than MM5

Table 8-23 (Continued)

MM5/RUC Derived Gridded Wind Data File Format (3D.DAT)

HEADER RECORDS

Header Record #NCOMM+6

Variable No.	Variable	Type	Description
1	IBYRM	integer	Beginning year of the data in the file
2	IBMOM	integer	Beginning month of the data in the file
3	IBDYM	integer	Beginning day of the data in the file
4	IBHRM	integer	Beginning hour (GMT) of the data in the file
5	NHRSMM5	integer	Length of period (hours) of the data in the file
6	NXP	integer	Number of grid cells in the X direction in the extraction subdomain
7	NYP	integer	Number of grid cells in the Y direction in the extraction subdomain
8	NZP	integer	Number of layers in the MM5 domain (half sigma levels) (same as number of vertical levels in data records)

format (i4, 3i2,i5,3i4)

Header Record #NCOMM+7

Variable No.	Variable	Type	Description
1	NX1	integer	I-index (X direction) of the lower left corner of the extraction subdomain
2	NY1	integer	J-index (Y direction) of the lower left corner of the extraction subdomain
3	NX2	integer	I-index (X direction) of the upper right corner of the extraction subdomain
4	NY2	integer	J-index (Y direction) of the upper right corner of the extraction subdomain

Table 8-23 (Continued)

MM5/RUC Derived Gridded Wind Data File Format (3D.DAT)

HEADER RECORDS

Header Record #NCOMM+7

5	NZ1	integer	k-index (Z direction) of lowest extracted layer
6	NZ2	integer	k-index (Z direction) of hightest extracted layer
7	RXMIN	real	Westernmost E. longitude (degrees) in the subdomain
8	RXMAX	real	Easternmost E. longitude (degrees) in the subdomain
9	RYMIN	real	Southernmost N. latitude (degrees) in the subdomain
10	RYMAX	real	Northernmost N. latitude (degrees) in the subdomain

format (6i4,2f10.4,2f9.4)

Next NZP Records

Variable No.	Variable	Type	Description
1	SIGMA	real array	Sigma-p values used by MM5 to define each of the NZP layers (half-sigma levels) Read as: do 10 I=1,NZP 10 READ (iomm4,20) SIGMA(I) 20 FORMAT (F6.3)

Table 8-23 (Continued)
MM5/RUC Derived Gridded Wind Data File Format (3D.DAT)

HEADER RECORDS

Next NXP*NYP Records

Variable No.	Variable	Type	Description
1	IINDEX	integer	I-index (X direction) of the grid point in the extraction subdomain
2	JINDEX	integer	J-index (Y direction) of the grid point in the extraction subdomain
3	XLATDOT	real array	N. Latitude (degrees) of the grid point in the extraction subdomain (positive for the Northern Hemisphere, negative for Southern Hemisphere)
4	XLONGDOT	real array	E. Longitude (degrees) of the grid point in the extraction subdomain (N.B., the MM4/MM5 convention is different than the CALMET convention: MM4/MM5 uses negative values for Western Hemisphere and positive values for Eastern Hemisphere. CALMET internally converts the longitudes in the MM5.DAT file, so the MM4/MM5 convention must be used in the MM5.DAT file)
5	IELEVDOT	integer array	Terrain elevation of the grid point in the extraction subdomain (m MSL)
6	ILAND	integer array	MM5 landuse categories at cross points
7	XLATCRS	real array	Same as XLATDOT but at cross point
8	XLATCRS	real array	Same as XLATDOT but at cross point
9	IELEVCRS	integer array	Same as IELEVDOT but at cross point

Format (2i4, f9.4, f10.4, i5, i3, 1x, f9.4, f10.4,i5)

Table 8-23 (Continued)
MM5/RUC Derived Gridded Wind Data File Format (3D.DAT)

DATA RECORDS (repeated for each grid cell in extraction subdomain)

Data Record

Variable No.	Variable	Type	Description
1	MYR	integer	Year of MM5 wind data (YYYY)
2	MMO	integer	Month of MM5 wind data (MM)
3	MDAY	integer	Day of MM5 wind data (DD)
4	MHR	integer	Hour (GMT) of MM5 wind data (HH)
5	IX	integer	I-index (X direction) of grid cell
6	JX	integer	J-index (Y direction) of grid cell
7	PRES	real	sea level pressure (hPa)
8	RAIN	real	total rainfall accumulated on the ground for the past hour (cm)
9	SC	integer	snow cover indicator (0 or 1, where 1 = snow cover was determined to be present for the MM5 simulation)
10*	RADSW	real	Short wave radiation at the surface (W/m**2)
11*	RADLW	real	long wave radiation at the top (W/m**2)
12*	T2	real	Air temperature at 2 m (K), zero or blank if not exist
13*	Q2	real	Specific humidity at 2 m (g/kg), zero or blank if not exist
14*	WD10	real	Wind direction of 10-m wind (m/s), zero or blank if not exist

Table 8-23 (Continued)
MM5/RUC Derived Gridded Wind Data File Format (3D.DAT)

DATA RECORDS (repeated for each grid cell in extraction subdomain)

Data Record

Variable No.	Variable	Type	Description
15*	WS10	Real	Wind speed of 10-m wind (m/s), zero or blank if not exist
16*	SST	real	Sea surface temperature (K), zero or blank if not exist

format(i4,3i2,2i3,f7.1,f5.2,i2,3f8.1,f8.2,3f8.1)

* Set to all zero if not existing in output of MM5 or other models

Note: WD10 and WS10 are MM5 output at dot points, other meteorological variables are interpolated in CALMM5 to dot points from MM5 output at cross points.

NZP*Data Records

Variable No.	Variable	Type	Description
1	PRES	integer	Pressure (in millibars)
2	Z	integer	Elevation (meters above m.s.l.)
3	TEMPK	integer	Temperature (^{o} K)
4	WD	integer	Wind direction (degrees)
5	WS	real	Wind speed (m/s)
6^{w}	W	real	Vertical velocity (m/s)
7^{q}	RH	integer	Relative humidity (%)
8^{q}	VAPMR	real	Vapor mixing ratio (g/kg)
9^{c} *	CLDMR	real	Cloud mixing ratio (g/kg)

Table 8-23 (Concluded)
MM5/RUC Derived Gridded Wind Data File Format (3D.DAT)

DATA RECORDS (repeated for each grid cell in extraction subdomain)

NZP*Data Records

Variable No.	Variable	Type	Description
10[c] *	RAINMR	real	Rain mixing ratio (g/kg)
11[i] *	ICEMR	real	Ice mixing ratio (g/kg)
12[i] *	SNOWMR	real	Snow mixing ratio (g/kg)
13[g] *	GRPMR	real	Graupel mixing ratio (g/kg)

format(i4,i6,f6.1,i4,f5.1,f6.2,i3,f5.2,5f6.3)

Note: WD and WS are MM5 output at dot points, other variables are interpolated in CALMM5 to dot points from MM5 output at cross points.

[w] Variable present in the record only if IOUTW = 1
[q] Variable present in the record only if IOUTQ = 1
[c] Variable present in the record only if IOUTC = 1 (possible only if IOUTQ=1)
[I] Variable present in the record only if IOUTI = 1 (possible only if IOUTQ = IOUTC = 1)
[g] Variable present in the record only if IOUTG = 1 (possible only if IOUTQ = IOUTC = IOUTI=1)
* Output for variables 9 – 13 will be compressed using a negative number if ALL are zero. -5.0 represents all five variables are zero.

8.10 Terrain Weighting Factor Data File (WT.DAT)

CALMET contains several options for introducing MM4/MM5 winds into the calculation of the wind fields. These include the use of the MM4/MM5 winds as:

- Step 1 field (IPROG = 3 or 13)
- initial guess field (IPROG = 4 or 14)
- "observation" (IPROG = 5 or 15)

If the MM4/MM5 fields are used as an initial guess field for CALMET, the MM4/MM5 winds are subject to a full diagnostic adjustment for terrain effects on the fine-scale (CALMET) grid. But if the MM4/MM5 winds are used as either a Step 1 field or as "observations," CALMET does not perform additional terrain adjustment to the MM4/MM5 winds. When combining these MM4/MM5 winds with observed winds, local near-surface effects captured in the observations may be lost due to the scale of the terrain used in the MM4/MM5 simulations (e.g., 80 km resolution). To avoid this, CALMET accepts a three-dimensional grid of terrain weighting factors. The weight W_o is applied to the observation, and its complement ($1-W_o$) is applied to the MM4/MM5 wind. The factors used to determine this weighting are assumed to be a function of the fine-scale terrain unresolved by the MM4/MM5 grid, and height above the surface.

The WT.DAT file contains the terrain-weighting factor. This file is required only if IPROG = 3, 13 or IPROG = 5, 15 (i.e., MM4/MM5 data are used as the Step 1 field or as "observations").

Table 8-24 contains a sample WT.DAT file for a 25 H 23 18-km CALMET grid. A detailed description of the contents of the WT.DAT file are contained in Table 8-25. The first three lines consist of descriptive information on the development of the weighting factor. Records 4 and 5 describe the fine-scale (CALMET) grid system and the coarse-scale (MM4/MM5) grid. These are followed by a set of NZ groups of records, one for each CALMET layer, which contain the actual weighting factors.

Table 8-24: Sample Terrain Weighting Factor Data File (WT.DAT)

```
Sensitivity Power for Wz     =     2.00000
Sensitivity Power for Ws     =     2.00000
Significant Length-Scale (m) =     10.0000
 Fine-Grid   :    342.0  -135.0   25   23  18.000
 Coarse-Grid :    -80.0  -680.0   24   21  80.000

 Height(m) =      10.0000
  i=     1   2   3   4   5   6   7   8   9  10  11  12  13  14  15  16  17  18  19  20  21  22
23  24  25
j= 23  .51 .56 .53 .51 .48 .45 .44 .43 .42 .41 .42 .45 .48 .52 .52 .40 .28 .16 .03 .00 .00 .00
.00 .00 .00
j= 22  .51 .56 .53 .51 .48 .45 .44 .43 .42 .41 .42 .45 .48 .52 .52 .40 .28 .16 .03 .00 .00 .00
.00 .00 .00
j= 21  .49 .54 .51 .49 .46 .44 .43 .41 .40 .38 .40 .43 .47 .50 .51 .40 .28 .17 .05 .02 .02 .02
.02 .02 .01
j= 20  .43 .48 .46 .44 .42 .40 .38 .36 .34 .32 .34 .38 .41 .45 .47 .38 .29 .21 .12 .09 .09 .08
.08 .07 .05
j= 19  .37 .41 .40 .39 .38 .37 .34 .31 .29 .26 .28 .32 .36 .41 .43 .37 .31 .24 .18 .16 .15 .14
.13 .12 .09
j= 18  .31 .35 .35 .34 .34 .33 .30 .27 .23 .20 .21 .26 .31 .36 .39 .35 .32 .28 .24 .22 .21 .20
.19 .17 .13
j= 17  .26 .29 .29 .29 .30 .30 .26 .22 .18 .14 .15 .21 .26 .31 .35 .34 .33 .32 .30 .29 .28 .26
.25 .22 .17
j= 16  .25 .29 .30 .31 .31 .32 .28 .25 .21 .18 .19 .24 .29 .33 .37 .35 .34 .32 .31 .30 .29 .29
.28 .26 .20
j= 15  .26 .30 .31 .33 .34 .35 .32 .29 .27 .24 .25 .29 .32 .36 .39 .37 .34 .32 .30 .30 .30 .30
.31 .29 .22
j= 14  .27 .31 .33 .35 .36 .38 .36 .34 .32 .29 .30 .33 .36 .39 .41 .38 .35 .32 .29 .30 .31 .32
.34 .32 .25
j= 13  .27 .32 .34 .37 .39 .41 .40 .38 .37 .35 .36 .38 .40 .42 .43 .40 .36 .32 .29 .29 .32 .34
.36 .36 .27
j= 12  .28 .33 .35 .38 .40 .42 .41 .41 .40 .39 .40 .41 .43 .44 .45 .41 .36 .32 .28 .29 .33 .36
.39 .39 .31
j= 11  .31 .35 .36 .38 .39 .40 .40 .40 .41 .41 .42 .43 .44 .45 .45 .41 .36 .32 .27 .29 .34 .38
.42 .44 .37
j= 10  .33 .37 .37 .37 .38 .38 .39 .40 .41 .43 .43 .44 .45 .46 .45 .41 .36 .31 .27 .29 .35 .40
.45 .48 .43
j=  9  .35 .39 .38 .37 .37 .36 .38 .40 .42 .44 .45 .46 .46 .46 .46 .41 .36 .31 .26 .29 .35 .42
.48 .52 .49
j=  8  .37 .41 .39 .37 .36 .34 .37 .40 .43 .46 .47 .47 .47 .47 .46 .41 .35 .30 .25 .29 .36 .44
.51 .56 .55
j=  7  .31 .35 .35 .34 .34 .34 .36 .39 .41 .44 .44 .44 .44 .44 .43 .41 .38 .36 .33 .37 .43 .49
.55 .59 .57
j=  6  .26 .30 .31 .32 .33 .34 .36 .37 .39 .41 .42 .42 .41 .41 .41 .41 .41 .41 .41 .45 .50 .55
.59 .62 .58
j=  5  .20 .24 .26 .29 .31 .33 .35 .36 .38 .39 .39 .39 .38 .38 .38 .41 .44 .47 .50 .53 .56 .60
.63 .65 .60
j=  4  .15 .18 .22 .26 .30 .33 .34 .35 .36 .37 .37 .36 .35 .35 .35 .41 .46 .52 .58 .61 .63 .65
.67 .68 .62
j=  3  .15 .19 .23 .27 .31 .35 .36 .36 .37 .37 .37 .37 .37 .36 .37 .43 .49 .55 .60 .63 .65 .66
.68 .68 .62
j=  2  .20 .25 .28 .32 .35 .39 .39 .39 .39 .40 .40 .41 .41 .42 .43 .47 .51 .55 .58 .61 .62 .64
.65 .65 .61
```

Table 8-24 (Continued)
Sample Terrain Weighting Factor Data File (WT.DAT)

```
j=  1  .26 .31 .34 .37 .40 .42 .42 .42 .42 .42 .43 .45 .46 .48 .49 .51 .53 .55 .56 .58 .60 .61
.63 .63 .60
  i=     1   2   3   4   5   6   7   8   9  10  11  12  13  14  15  16  17  18  19  20  21  22
23  24  25
 Height(m) =      50.0000
  i=     1   2   3   4   5   6   7   8   9  10  11  12  13  14  15  16  17  18  19  20  21  22
23  24  25
j= 23  .11 .11 .10 .08 .07 .05 .05 .04 .04 .03 .03 .04 .05 .05 .06 .04 .03 .02 .00 .00 .00 .00
.00 .00 .00
j= 22  .11 .11 .10 .08 .07 .05 .05 .04 .04 .03 .03 .04 .05 .05 .06 .04 .03 .02 .00 .00 .00 .00
.00 .00 .00
j= 21  .10 .11 .09 .08 .07 .05 .05 .04 .03 .03 .03 .04 .04 .05 .05 .04 .03 .02 .01 .00 .00 .00
.00 .00 .00
j= 20  .09 .09 .08 .07 .06 .05 .04 .03 .03 .02 .02 .03 .03 .04 .04 .04 .03 .02 .01 .01 .01 .01
.00 .00 .00
j= 19  .07 .08 .07 .06 .05 .04 .03 .03 .02 .02 .02 .02 .03 .03 .03 .03 .03 .02 .02 .01 .01 .01
.01 .01 .00
j= 18  .06 .06 .05 .05 .04 .03 .03 .02 .02 .01 .01 .01 .02 .02 .02 .02 .02 .02 .02 .02 .02 .01
.01 .01 .01
j= 17  .04 .05 .04 .04 .03 .03 .02 .02 .01 .00 .00 .01 .01 .01 .01 .02 .02 .02 .03 .03 .02 .02
.01 .01 .01
j= 16  .06 .06 .06 .06 .05 .05 .04 .03 .02 .01 .01 .01 .02 .02 .02 .02 .02 .03 .03 .03 .02 .02
.02 .01 .01
j= 15  .08 .09 .08 .08 .08 .07 .06 .05 .04 .02 .02 .02 .02 .03 .03 .03 .03 .03 .03 .03 .02 .02
.02 .02 .01
j= 14  .09 .11 .11 .10 .10 .10 .08 .07 .05 .03 .03 .03 .03 .04 .04 .04 .03 .03 .03 .03 .03 .02
.02 .02 .01
j= 13  .11 .13 .13 .13 .13 .13 .11 .08 .06 .04 .04 .04 .04 .05 .05 .04 .04 .04 .03 .03 .03 .03
.02 .02 .02
j= 12  .12 .13 .13 .13 .14 .14 .12 .10 .08 .06 .05 .05 .05 .06 .06 .05 .04 .04 .03 .03 .03 .03
.03 .03 .03
j= 11  .10 .11 .11 .12 .12 .12 .11 .10 .09 .08 .07 .07 .07 .07 .07 .06 .05 .04 .03 .03 .03 .04
.04 .05 .04
j= 10  .08 .09 .10 .10 .10 .11 .11 .10 .10 .10 .10 .09 .09 .09 .08 .07 .05 .04 .02 .03 .03 .04
.05 .06 .06
j=  9  .06 .07 .08 .08 .09 .09 .10 .11 .11 .12 .12 .11 .11 .10 .09 .07 .05 .04 .02 .02 .04 .05
.07 .08 .08
j=  8  .05 .06 .06 .07 .07 .08 .10 .11 .13 .14 .14 .13 .12 .11 .10 .08 .06 .04 .01 .02 .04 .06
.08 .09 .10
j=  7  .04 .04 .05 .05 .06 .07 .08 .09 .11 .12 .12 .11 .11 .10 .09 .11 .12 .13 .15 .14 .14 .13
.13 .12 .12
j=  6  .03 .03 .04 .04 .05 .05 .06 .07 .09 .10 .10 .09 .09 .08 .09 .13 .18 .23 .28 .27 .24 .20
.17 .15 .14
j=  5  .02 .02 .03 .03 .03 .04 .05 .06 .07 .07 .08 .07 .07 .07 .08 .16 .24 .33 .41 .39 .33 .28
.22 .17 .16
j=  4  .01 .01 .01 .02 .02 .02 .03 .04 .04 .05 .06 .05 .05 .05 .07 .19 .31 .42 .54 .51 .43 .35
.27 .20 .18
j=  3  .02 .02 .02 .02 .02 .03 .03 .04 .05 .06 .07 .08 .09 .11 .14 .25 .36 .48 .59 .56 .48 .40
.33 .26 .22
j=  2  .04 .04 .04 .04 .05 .05 .06 .07 .07 .08 .11 .14 .18 .21 .26 .34 .42 .49 .57 .56 .50 .45
.39 .34 .28
j=  1  .06 .07 .07 .07 .07 .07 .08 .09 .10 .11 .15 .21 .27 .32 .38 .42 .47 .51 .56 .55 .52 .49
.46 .41 .35
```

Table 8-24 (Continued)
Sample Terrain Weighting Factor Data File (WT.DAT)

```
  i=     1   2   3   4   5   6   7   8   9  10  11  12  13  14  15  16  17  18  19  20  21  22
23  24  25
 Height(m) =     100.000
  i=     1   2   3   4   5   6   7   8   9  10  11  12  13  14  15  16  17  18  19  20  21  22
23  24  25
j= 23  .03 .03 .02 .02 .02 .01 .01 .01 .01 .01 .01 .01 .01 .01 .01 .01 .01 .00 .00 .00 .00 .00
.00 .00 .00
j= 22  .03 .03 .02 .02 .02 .01 .01 .01 .01 .01 .01 .01 .01 .01 .01 .01 .01 .00 .00 .00 .00 .00
.00 .00 .00
j= 21  .03 .03 .02 .02 .02 .01 .01 .01 .01 .01 .01 .01 .01 .01 .01 .01 .01 .00 .00 .00 .00 .00
.00 .00 .00
j= 20  .02 .02 .02 .02 .01 .01 .01 .01 .01 .01 .01 .01 .01 .01 .01 .01 .01 .00 .00 .00 .00 .00
.00 .00 .00
j= 19  .02 .02 .02 .01 .01 .01 .01 .01 .01 .00 .00 .01 .01 .01 .01 .01 .01 .01 .00 .00 .00 .00
.00 .00 .00
j= 18  .01 .02 .01 .01 .01 .01 .01 .01 .00 .00 .00 .00 .00 .01 .01 .01 .01 .01 .01 .00 .00 .00
.00 .00 .00
j= 17  .01 .01 .01 .01 .01 .01 .01 .00 .00 .00 .00 .00 .00 .00 .00 .00 .01 .01 .01 .01 .01 .00
.00 .00 .00
j= 16  .01 .02 .02 .01 .01 .01 .01 .01 .01 .00 .00 .00 .00 .00 .01 .01 .01 .01 .01 .01 .01 .01
.00 .00 .00
j= 15  .02 .02 .02 .02 .02 .02 .02 .01 .01 .01 .00 .01 .01 .01 .01 .01 .01 .01 .01 .01 .01 .01
.00 .00 .00
j= 14  .02 .03 .03 .03 .03 .03 .02 .02 .01 .01 .01 .01 .01 .01 .01 .01 .01 .01 .01 .01 .01 .01
.01 .00 .00
j= 13  .03 .03 .03 .03 .03 .03 .03 .02 .02 .01 .01 .01 .01 .01 .01 .01 .01 .01 .01 .01 .01 .01
.01 .01 .00
j= 12  .03 .03 .03 .03 .03 .03 .03 .02 .02 .01 .01 .01 .01 .01 .01 .01 .01 .01 .01 .01 .01 .01
.01 .01 .01
j= 11  .02 .03 .03 .03 .03 .03 .03 .02 .02 .02 .02 .02 .02 .02 .02 .01 .01 .01 .01 .01 .01 .01
.01 .01 .01
j= 10  .02 .02 .02 .03 .03 .03 .03 .03 .03 .02 .02 .02 .02 .02 .02 .02 .01 .01 .01 .01 .01 .01
.01 .02 .02
j=  9  .02 .02 .02 .02 .02 .02 .03 .03 .03 .03 .03 .03 .03 .02 .02 .02 .01 .01 .00 .01 .01 .01
.02 .02 .02
j=  8  .01 .01 .02 .02 .02 .02 .02 .03 .03 .04 .04 .03 .03 .03 .03 .02 .01 .01 .00 .01 .01 .01
.02 .02 .02
j=  7  .01 .01 .01 .01 .01 .02 .02 .02 .03 .03 .03 .03 .03 .02 .02 .03 .03 .03 .04 .04 .03 .03
.03 .03 .03
j=  6  .01 .01 .01 .01 .01 .01 .02 .02 .02 .02 .02 .02 .02 .02 .02 .03 .05 .06 .07 .07 .06 .05
.04 .04 .03
j=  5  .00 .01 .01 .01 .01 .01 .01 .01 .02 .02 .02 .02 .02 .02 .02 .04 .06 .08 .10 .10 .08 .07
.06 .04 .04
j=  4  .00 .00 .00 .00 .00 .01 .01 .01 .01 .01 .01 .01 .01 .01 .02 .05 .08 .11 .14 .13 .11 .09
.07 .05 .04
j=  3  .00 .00 .01 .01 .01 .01 .01 .01 .01 .01 .02 .02 .02 .03 .04 .08 .12 .15 .19 .19 .17 .14
.12 .10 .08
j=  2  .01 .01 .01 .01 .01 .01 .01 .02 .02 .02 .03 .04 .05 .06 .08 .12 .17 .22 .27 .27 .25 .23
.21 .19 .15
j=  1  .01 .02 .02 .02 .02 .02 .02 .02 .02 .03 .04 .06 .07 .09 .11 .17 .23 .29 .35 .35 .34 .32
.30 .27 .22
  i=     1   2   3   4   5   6   7   8   9  10  11  12  13  14  15  16  17  18  19  20  21  22
23  24  25
```

Table 8-24 (Continued)
Sample Terrain Weighting Factor Data File (WT.DAT)

```
 Height(m) =     400.000
  i=     1   2   3   4   5   6   7   8   9  10  11  12  13  14  15  16  17  18  19  20  21  22
23  24  25
j= 23  .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00
.00 .00 .00
j= 22  .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00
.00 .00 .00
j= 21  .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00
.00 .00 .00
j= 20  .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00
.00 .00 .00
j= 19  .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00
.00 .00 .00
j= 18  .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00
.00 .00 .00
j= 17  .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00
.00 .00 .00
j= 16  .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00
.00 .00 .00
j= 15  .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00
.00 .00 .00
j= 14  .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00
.00 .00 .00
j= 13  .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00
.00 .00 .00
j= 12  .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00
.00 .00 .00
j= 11  .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00
.00 .00 .00
j= 10  .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00
.00 .00 .00
j=  9  .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00
.00 .00 .00
j=  8  .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00
.00 .00 .00
j=  7  .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00
.00 .00 .00
j=  6  .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00
.00 .00 .00
j=  5  .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .01 .01 .01 .01 .00
.00 .00 .00
j=  4  .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .01 .01 .01 .01 .01
.00 .00 .00
j=  2  .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .01 .01 .01 .02 .02 .02 .01
.01 .01 .01
j=  1  .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .01 .01 .01 .01 .02 .02 .02 .02 .02
.02 .02 .01
  i=     1   2   3   4   5   6   7   8   9  10  11  12  13  14  15  16  17  18  19  20  21  22
23  24  25
```

Table 8-24 (Continued)
Sample Terrain Weighting Factor Data File (WT.DAT)

```
 Height(m) =     800.000
  i=     1   2   3   4   5   6   7   8   9  10  11  12  13  14  15  16  17  18  19  20  21  22
23  24  25
j= 23  .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00
.00 .00 .00
j= 22  .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00
.00 .00 .00
j= 21  .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00
.00 .00 .00
j= 20  .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00
.00 .00 .00
j= 19  .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00
.00 .00 .00
j= 18  .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00
.00 .00 .00
j= 17  .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00
.00 .00 .00
j= 16  .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00
.00 .00 .00
j= 15  .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00
.00 .00 .00
j= 14  .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00
.00 .00 .00
j= 13  .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00
.00 .00 .00
j= 12  .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00
.00 .00 .00
j= 11  .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00
.00 .00 .00
j= 10  .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00
.00 .00 .00
j=  9  .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00
.00 .00 .00
j=  8  .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00
.00 .00 .00
j=  7  .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00
.00 .00 .00
j=  6  .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00
.00 .00 .00
j=  5  .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00
.00 .00 .00
j=  4  .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00
.00 .00 .00
j=  3  .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00
.00 .00 .00
j=  2  .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00
.00 .00 .00
j=  1  .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .01 .01 .01 .00
.00 .00 .00
  i=     1   2   3   4   5   6   7   8   9  10  11  12  13  14  15  16  17  18  19  20  21  22
23  24  25
```

Table 8-24 (Concluded)
Sample Terrain Weighting Factor Data File (WT.DAT)

```
 Height(m) =      3500.00
  i=     1   2   3   4   5   6   7   8   9  10  11  12  13  14  15  16  17  18  19  20  21  22
23  24  25
j= 23  .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00
.00 .00 .00
j= 22  .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00
.00 .00 .00
j= 21  .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00
.00 .00 .00
j= 20  .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00
.00 .00 .00
j= 19  .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00
.00 .00 .00
j= 18  .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00
.00 .00 .00
j= 17  .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00
.00 .00 .00
j= 16  .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00
.00 .00 .00
j= 15  .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00
.00 .00 .00
j= 14  .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00
.00 .00 .00
j= 13  .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00
.00 .00 .00
j= 12  .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00
.00 .00 .00
j= 11  .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00
.00 .00 .00
j= 10  .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00
.00 .00 .00
j=  9  .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00
.00 .00 .00
j=  8  .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00
.00 .00 .00
j=  7  .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00
.00 .00 .00
j=  6  .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00
.00 .00 .00
j=  5  .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00
.00 .00 .00
j=  4  .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00
.00 .00 .00
j=  3  .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00
.00 .00 .00
j=  2  .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00
.00 .00 .00
j=  1  .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00 .00
.00 .00 .00
  i=     1   2   3   4   5   6   7   8   9  10  11  12  13  14  15  16  17  18  19  20  21  22
23  24  25
```

Table 8-25: Terrain Weighting Factor Data File Format (WT.DAT)

HEADER RECORDS

Header Record #1

Variable No.	Variable	Type	Description
1	C1	char*42	Documentation for W_{zi}

Header Record #2

Variable No.	Variable	Type	Description
1	C2	char*42	Documentation for W_s

Header Record #3

Variable No.	Variable	Type	Description
1	C3	char*42	Documentation for RMS_o

Header Record #4

Variable No.	Variable	Type	Description
1	X0FIN	real	X coordinate (km) of fine grid origin (i.e., origin of CALMET grid)
2	Y0FIN	real	Y coordinate (km) of fine grid origin
3	NXFIN	integer	Number of columns in the fine grid domain
4	NYFIN	integer	Number of rows in the fine grid domain
5	DFIN	real	Horizontal grid spacing (km) of fine grid

format (15x,2f8.1,2i5,f8.3)

Table 8-25 (Continued)
Terrain Weighting Factor Data File Format (WT.DAT)

HEADER RECORDS

Header Record #5

Variable No.	Variable	Type	Description
1	X0CRS	real	X (km) coordinate of coarse grid origin (i.e., origin of MM4 grid)
2	Y0CRS	real	Y coordinate (km) of coarse grid origin
3	NXCRS	integer	Number of columns in the coarse grid domain
4	NYCRS	integer	Number of rows in the coarse grid domain
5	DCRS	real	Horizontal grid spacing (km) of coarse grid
			format (15x,2f8.1,2i5,f8.3,//)

DATA RECORDS (repeated for NZ layers)

Record	Variable No.	Variable	Type	Description
1	1	HT	real	Grid point height (m) of CALMET layers format (12x,f12.4/)
2*	-	-	-	Line of text containing i indices
Next NY records	1	WO	real array	Terrain weighting factors. The following statements are used to read the WO array: do 15 JJ=NYFIN,1,-1 15 READ (io99,113) (WO(i,jj,k),i=1,nxfin) 113 FORMAT (6x,150(1x,f3.2)/)
NY+3*	-	-	-	Line of text containing i indices

* Line skipped by CALMET

8.11 CALMET Output Files

8.11.1 CALMET.DAT

The CALMET.DAT file contains gridded meteorological data fields required to drive the CALPUFF model. It also contains certain geophysical fields, such as terrain elevations, surface roughness lengths, and land use types, used by both the CALMET meteorological model and CALPUFF. Although the input requirements of CALPUFF are designed to be directly compatible with CALMET, meteorological fields produced by other meteorological models can be substituted for the CALMET output as long as the required variables are produced and the output is reformatted to be consistent with the CALMET.DAT file specifications described in this section.

CALMET.DAT File - Header Records

The CALMET.DAT file consists of a set of up to fifteen header records, plus a variable number of comment records, followed by a set of hourly data records. The header records contain file identification labels, descriptive titles of the CALMET run (including a complete image of the CALMET control file) as comment records, information including the horizontal and vertical grid systems of the meteorological grid, the number, type, and coordinates of the meteorological stations included in the CALMET run, gridded fields of surface roughness lengths, land use, terrain elevations, leaf area indexes, and a pre-computed field of the closest surface meteorological station number to each grid point.

In addition to the variable number of comment records, the number of header records may also vary because records containing surface, upper air, and precipitation station coordinates are not included if these stations were not included in the run. A description of each variable in the header records is provided in Table 8-26.

Sample FORTRAN write statements for the CALMET.DAT header records are:

```
c ---  Header record #1 - File Declaration -- 24 words
       write(iomet) DATASET,DATAVER,DATAMOD

c ---  Header record #2 - Number of comment lines -- 1 word
       write(iomet) NCOM

c ---  Header record #3 to NCOM+2 (Comment record section) -- 33 words each
       write(iomet) COMMENT

c ---  Header record #NCOM+3 - run control parameters -- 39 words
       write(iomet) IBYR,IBMO,IBDY,IBHR,IBSEC,
       2      IEYR,IEMO,IEDY,IEHR,IESEC,AXTZ,IRLG,IRTYPE,
       3      NX,NY,NZ,DGRID,XORIGR,YORIGR, IWFCOD,NSSTA,
```

```
      4      NUSTA,NPSTA,NOWSTA,NLU,IWAT1,IWAT2,LCALGRD
      5      PMAP,DATUM,DATEN,FEAST,FNORTH,UTMHEM,IUTMZN,
      6      RNLAT0,RELON0,XLAT1,XLAT2
c
c ---  Header record #NCOM+4 - cell face heights (NZ + 1 words)
       write(iomet)CLAB1,IDUM,IDUM,IDUM,IDUM,ZFACEM

c ---  Header records #NCOM+5 & 6 - x, y coordinates of surface stations
c ---  (NSSTA words each record)
       if(nssta.ge.1)then
          write(iomet)CLAB2,IDUM,IDUM,IDUM,IDUM,XSSTA
          write(iomet)CLAB3,IDUM,IDUM,IDUM,IDUM,YSSTA
       endif

c ---  Header records #NCOM+7 & 8 - x, y coordinates of upper air stations
c ---  (NUSTA words each record)
       if(nusta.ge.1)then
          write(iomet)CLAB4,IDUM,IDUM,IDUM,IDUM,XUSTA
          write(iomet)CLAB5,IDUM,IDUM,IDUM,IDUM,YUSTA
       endif

c ---  Header records #NCOM+9 & 10 - x, y coordinates of precipitation stations
c ---  (NPSTA words each record)
       if(npsta.ge.1)then
          write(iomet)CLAB6,IDUM,IDUM,IDUM,IDUM,XPSTA
          write(iomet)CLAB7,IDUM,IDUM,IDUM,IDUM,YPSTA
       endif

c ---  Header record #NCOM+11 - surface roughness lengths (NX * NY words)
       write(iomet)CLAB8,IDUM,IDUM,IDUM,IDUM,Z0

c ---  Header record #NCOM+12 - land use categories (NX * NY words)
       write(iomet)CLAB9,IDUM,IDUM,IDUM,IDUM,ILANDU

c ---  Header record #NCOM+13 - elevations (NX * NY words)
       write(iomet)CLAB10,IDUM,IDUM,IDUM,IDUM,ELEV

c ---  Header record #NCOM+14 - leaf area index (NX * NY words)
       write(iomet)CLAB11,IDUM,IDUM,IDUM,IDUM,XLAI

c ---  Header record #NCOM+15 - nearest surface station no. to each
c ---            grid point (NX * NY words)
       if(nssta.ge.1)then
          write(iomet)CLAB12,IDUM,IDUM,IDUM,IDUM,NEARS
       endif
```

where the following declarations apply:

```
real ZFACEM(nz+1),XSSTA(nssta),YSSTA(nssta),XUSTA(nusta),YUSTA(nusta)
real XPSTA(npsta),YPSTA(npsta)
real Z0(nx,ny),ELEV(nx,ny),XLAI(nx,ny)
integer ILANDU(nx,ny),NEARS(nx,ny)
character*132 COMMENT(ncom)
character*64 DATAMOD
character*16 DATASET,DATAVER
character*12 DATEN
character*8 PMAP,DATUM
character*8 CLAB1,CLAB2,CLAB3,CLAB4,CLAB5,CLAB6
character*8 CLAB7,CLAB8,CLAB9,CLAB10,CLAB11,CLAB12
character*4 UTMHEM
logical LCALGRD
```

Table 8-26: CALMET.DAT file - Header Records

Header Record No.	Variable No.	Variable	Type [a]	Description
1	1	DATASET	char*16	Dataset name (CALMET.DAT)
1	2	DATAVER	char*16	Dataset version
1	3	DATAMOD	char*64	Dataset message field
2	1	NCOM	integer	Number of comment records to follow
3 to NCOM+2	1	COMMENT	char*132	Comment record (repeated NCOM times), each containing an image of one line of the CALMET control file, or other information
NCOM+3	1	IBYR	integer	Beginning year of CALMET run
NCOM+3	2	IBMO	integer	Beginning month
NCOM+3	3	IBDY	integer	Beginning day
NCOM+3	4	IBHR	integer	Beginning time (hour 00-23)
NCOM+3	5	IBSEC	integer	Beginning time (second 0000-3599)
NCOM+3	6	IEYR	integer	Ending year of CALMET run
NCOM+3	7	IEMO	integer	Ending month
NCOM+3	8	IEDY	integer	Ending day
NCOM+3	9	IEHR	integer	Ending time (hour 00-23)
NCOM+3	10	IESEC	integer	Ending time (second 0000-3599)
NCOM+3	11	AXTZ	C*8	Base time zone (e.g., UTC-0500=EST, UTC-0600=CST, UTC-0700=MST, UTC-0800=PST)
NCOM+3	12	IRLG	integer	Run length (hours)
NCOM+3	13	IRTYPE	integer	Run type (0=wind fields only, 1=wind and micrometeorological fields). IRTYPE must be run type 1 to drive CALGRID or options in CALPUFF that use boundary layer parameters
NCOM+3	14	NX	integer	Number of grid cells in the X direction
NCOM+3	15	NY	integer	Number of grid cells in the Y direction
NCOM+3	16	NZ	integer	Number of vertical layers
NCOM+3	17	DGRID	real	Grid spacing (m)

Table 8-26 (Continued)
CALMET.DAT file - Header Records

Header Record No.	Variable No.	Variable	Type [a]	Description
NCOM+3	18	XORIGR	real	X coordinate (m) of southwest corner of grid cell (1,1)
NCOM+3	19	YORIGR	real	Y coordinate (m) of southwest corner of grid cell (1,1)
NCOM+3	21	NSSTA	integer	Number of surface meteorological stations
NCOM+3	22	NUSTA	integer	Number of upper air stations
NCOM+3	23	NPSTA	integer	Number of precipitation stations
NCOM+3	24	NOWSTA	integer	Number of over water stations
NCOM+3	25	NLU	integer	Number of land use categories
NCOM+3	26	IWAT1	integer	Range of land use categories
NCOM+3	27	IWAT2	integer	Corresponding to water surfaces (IWAT1 or IWAT2, inclusive)
NCOM+3	28	LCALGRD	logical	Flag indicating if the full set of meteorological parameters required by CALGRID are contained in the file (LCALGRD is normally set to TRUE for CALPUFF applications)
NCOM+3	29	PMAP[b]	char*8	Map projection[b] UTM : Universal Transverse Mercator TTM : Tangential Transverse Mercator LCC : Lambert Conformal Conic PS : Polar Stereographic EM : Equatorial Mercator LAZA : Lambert Azimuthal Equal Area
NCOM+3	30	DATUM	char*8	DATUM Code for grid coordinates
NCOM+3	31	DATEN	char*12	NIMA date (MM-DD-YYYY) for datum definitions
NCOM+3	32	FEAST	real	False Easting (km) for PMAP = TTM, LCC, or LAZA
NCOM+3	33	FNORTH	real	False Northing (km) for PMAP = TTM, LCC, or LAZA
NCOM+3	34	UTMHEM	char*4	Hemisphere for UTM projection (N or S)
NCOM+3	35	IUTMZN	integer	UTM zone for PMAP = UTM

[a]char*N = Character*N

Table 8-26 (Continued)
CALMET.DAT file - Header Records

Header Record No.	Variable No.	Variable	Type [a]	Description
NCOM+3	36	RNLAT0	real	North latitude (degrees) for projection origin (for PMAP= TTM, LCC, PS, EM, or LAZA)
NCOM+3	37	RELON0	real	East longitude (degrees) for projection origin (for PMAP= TTM, LCC, PS, EM, or LAZA)
NCOM+3	38	XLAT1	real	North latitude (degrees) of matching parallel #1 for map projection PMAP= LCC or PS
NCOM+3	39	XLAT2	real	North latitude (degrees) of matching parallel #2 for map projection PMAP= LCC
NCOM+4	1	CLAB1	char*8	Variable label ('ZFACE')
NCOM+4	2-5	IDUM	integer	Variable not used
NCOM+4	6	ZFACEM	real array	Heights (m) of cell faces (NZ + 1 values)
NCOM+5[b]	1	CLAB2	char*8	Variable label ('XSSTA')
NCOM+5[b]	2-5	IDUM	integer	Variable not used
NCOM+5[b]	6	XSSTA	real array	X coordinate (m) of each surface met. station
NCOM+6[b]	1	CLAB3	char*8	Variable label ('YSSTA')
NCOM+6[b]	2-5	IDUM	integer	Variable not used
NCOM+6[b]	6	YSSTA	real array	Y coordinate (m) of each surface met. station
NCOM+7[c]	1	CLAB4	char*8	Variable label ('XUSTA')
NCOM+7[c]	2-5	IDUM	integer	Variable not used
NCOM+7[c]	6	XUSTA	real array	X coordinate (m) of each upper air met. station
NCOM+8[c]	1	CLAB5	char*8	Variable label ('YUSTA')
NCOM+8[c]	2-5	IDUM	integer	Variable not used
NCOM+8[c]	6	YUSTA	real array	Y coordinate (m) of each upper air met. station
NCOM+9[d]	1	CLAB6	char*8	Variable label ('XPSTA')

[a] char*N = Character*N [b] PMAP = EM, PS, and LAZA is NOT AVAILABLE in CALMET

Table 8-26 (Concluded)
CALMET.DAT file - Header Records

Header Record No.	Variable No.	Variable	Type [a]	Description
NCOM+9[d]	2-5	IDUM	integer	Variable not used
NCOM+9[d]	6	XPSTA	real array	X coordinate (m) of each precipitation station
NCOM+10[d]	1	CLAB7	char*8	Variable label ('YPSTA')
NCOM+10[d]	2-5	IDUM	integer	Variable not used
NCOM+10[d]	6	YPSTA	real array	Y coordinate (m) of each precipitation station
NCOM+11	1	CLAB8	char*8	Variable label ('Z0')
NCOM+11	2-5	IDUM	integer	Variable not used
NCOM+11	6	Z0	real array	Gridded field of surface roughness lengths (m) for each grid cell
NCOM+12	1	CLAB9	char*8	Variable label ('ILANDU')
NCOM+12	2-5	IDUM	integer	Variable not used
NCOM+12	6	ILANDU	integer array	Gridded field of land use category for each grid cell
NCOM+13	1	CLAB10	char*8	Variable label ('ELEV')
NCOM+13	2-5	IDUM	integer	Variable not used
NCOM+13	6	ELEV	real array	Gridded field of terrain elevations for each grid cell
NCOM+14	1	CLAB11	char*8	Variable label ('XLAI')
NCOM+14	2-5	IDUM	integer	Variable not used
NCOM+14	6	XLAI	real array	Gridded field of leaf area index for each grid cell
NCOM+15	1	CLAB12	char*8	Variable label ('NEARS')
NCOM+15	2-5	IDUM	integer	Variable not used
NCOM+15	6	NEARS	integer array	Nearest surface meteorological station to each grid point

[a] char*N = Character*N
[b] Included only if NSSTA > 0
[c] Included only if NUSTA > 0
[d] Included only if NPSTA > 0

CALMET.DAT File - Data Records

The CALMET.DAT data records include hourly fields of winds and meteorological variables. In addition to the regular CALMET output variables, both CALGRID and CALPUFF require additional three-dimensional fields of air temperature and vertical velocity. The presence of these fields in the CALMET output file is flagged by the header record logical variable, LCALGRD, having a value of TRUE.

The data records contain three-dimensional gridded fields of U, V, and W wind components and air temperature, and two-dimensional fields of PGT stability class, surface friction velocity, mixing height, Monin-Obukhov length, convective velocity scale, precipitation rate (not used by CALGRID), near-surface temperature, air density, short-wave solar radiation, relative humidity, and precipitation type codes (not used by CALGRID). A description of each variable in the data records is provided in Table 8-27.

Sample FORTRAN write statements for the CALMET.DAT data records are:

```
c ---  Write U, V, W wind components
       ┌─            Loop over vertical layers, k
       |
       |                write(iunit)CLABU,NDATHRB,IBSEC,NDATHRE,IESEC,
       |                                 ((U(i,j,k),i=1,nx),j=1,ny)
       |                write(iunit)CLABV, NDATHRB,IBSEC,NDATHRE,IESEC,
       |                                 ((V(i,j,k),i=1,nx),j=1,ny)
       |                if(LCALGRD)write(iunit)CLABW,NDATHRB,IBSEC,NDATHRE,IESEC,
       |                                 ((W(i,j,k+1),i=1,nx),j=1,ny)
       |
       └─            End loop over vertical layers

c ---  Write 3-D temperature field
       if(LCALGRD.and.irtype.eq.1) then
       ┌─            Loop over vertical layers, k
       |
       |                write(iunit)CLABT, NDATHRB,IBSEC,NDATHRE,IESEC,
       |                          ((ZTEMP(i,j,k),i=1,nxm),j=1,nym)
       |
       └─            End loop over vertical layers
       endif

c ---  Write 2-D meteorological fields
       if(irtype.eq.1) then

              write(iunit)CLABSC, NDATHRB,IBSEC,NDATHRE,IESEC,IPGT
              write(iunit)CLABUS, NDATHRB,IBSEC,NDATHRE,IESEC,USTAR
              write(iunit)CLABZI, NDATHRB,IBSEC,NDATHRE,IESEC,ZI
              write(iunit)CLABL, NDATHRB,IBSEC,NDATHRE,IESEC,EL
              write(iunit)CLABWS, NDATHRB,IBSEC,NDATHRE,IESEC,WSTAR
              write(iunit)CLABRMM, NDATHRB,IBSEC,NDATHRE,IESEC,RMM
```

```
        write(iunit)CLABTK, NDATHRB,IBSEC,NDATHRE,IESEC,TEMPK
        write(iunit)CLABD, NDATHRB,IBSEC,NDATHRE,IESEC,RHO
        write(iunit)CLABQ, NDATHRB,IBSEC,NDATHRE,IESEC,QSW
        write(iunit)CLABRH, NDATHRB,IBSEC,NDATHRE,IESEC,IRH
        write(iunit)CLABPC, NDATHRB,IBSEC,NDATHRE,IESEC,IPCODE

    endif
```

where the following declarations apply:

```
    real U(nx,ny,nz),V(nx,ny,nz),W(nx,ny,nz)
    real ZTEMP(nx,ny,nz)
    real USTAR(nx,ny),ZI(nx,ny),EL(nx,ny)
    real WSTAR(nx,ny),RMM(nx,ny)
    real TEMPK(nx,ny),RHO(nx,ny),QSW(nx,ny)
    integer IPGT(nx,ny)
    integer IRH(nx,ny),IPCODE(nx,ny)
    character*8 CLABU, CLABV, CLABW, CLABT, CLABSC, CLABUS, CLABZI
    character*8 CLABL, CLABWS, CLABRMM, CLABTK, CLABD, CLABQ, CLABRH
    character*8 CLABPC
```

Table 8-27: CALMET.DAT file - Data Records

Record Type	Variable No.	Variable Name	Type[a]	Description
1	1	CLABU	char*8	Variable label ('U-LEVxxx', where xxx indicates the layer number)
1	2	NDATHR B	integer	Beginning year, Julian day and hour in the form YYYYJJJHH (or YYJJJHH)
1	3	IBSEC	integer	Beginning second (0000-3599)
1	4	NDATHRE	integer	Ending year, Julian day and hour in the form YYYYJJJHH (or YYJJJHH)
1	5	IESEC	integer	Ending second (0000-3599)
1	6	U	real array	U-component (m/s) of the winds at each grid point
2	1	CLABV	char*8	Variable label ('V-LEVxxx', where xxx indicates the layer number)
2	2	NDATHR B	integer	Beginning year, Julian day and hour in the form YYYYJJJHH (or YYJJJHH)
2	3	IBSEC	integer	Beginning second (0000-3599)
2	4	NDATHRE	integer	Ending year, Julian day and hour in the form YYYYJJJHH (or YYJJJHH)
2	5	IESEC	integer	Ending second (0000-3599)
2	6	V	real array	V-component (m/s) of the winds at each grid point
3[b]	1	CLABW	char*8	Variable label ('WFACExxx"), where xxx indicates the layer number)
3[b]	2	NDATHR B	integer	Beginning year, Julian day and hour in the form YYYYJJJHH (or YYJJJHH)
3[b]	3	IBSEC	integer	Beginning second (0000-3599)
3[b]	4	NDATHRE	integer	Ending year, Julian day and hour in the form YYYYJJJHH (or YYJJJHH)
3[b]	5	IESEC	integer	Ending second (0000-3599)
3[b]	6	W	real array	W-component (m/s) of the winds at each grid point

(Record types 1,2,3 repeated NZ times (once per layer) as a set)

[a] char*8 = Character*8

[b] Record type 3 is included only if LCALGRD is TRUE

Table 8-27 (Continued)
CALMET.DAT file - Data Records

Record Type	Variable No.	Variable Name	Type[a]	Description
4[b]	1	CLABT	char*8	Variable label ('T-LEVxxx', where xxx indicates the layer number)
4[b]	2	NDATHRB	integer	Beginning year, Julian day and hour in the form YYYYJJJHH (or YYJJJHH)
4[b]	3	IBSEC	integer	Beginning second (0000-3599)
4[b]	4	NDATHRE	integer	Ending year, Julian day and hour in the form YYYYJJJHH (or YYJJJHH)
4[b]	5	IESEC	integer	Ending second (0000-3599)
4[b]	6	ZTEMP	real array	Air temperature (deg. K) at each grid point
(Record type 4 repeated NZM times (once per layer))				
5	1	CLABSC	char*8	Variable label ('IPGT')
5	2	NDATHRB	integer	Beginning year, Julian day and hour in the form YYYYJJJHH (or YYJJJHH)
5	3	IBSEC	integer	Beginning second (0000-3599)
5	4	NDATHRE	integer	Ending year, Julian day and hour in the form YYYYJJJHH (or YYJJJHH)
5	5	IESEC	integer	Ending second (0000-3599)
5	6	IPGT	integer array	PGT stability class at each grid point
6	1	CLABUS	char*8	Variable label ('USTAR')
6	2	NDATHRB	integer	Beginning year, Julian day and hour in the form YYYYJJJHH (or YYJJJHH)
6	3	IBSEC	integer	Beginning second (0000-3599)
6	4	NDATHRE	integer	Ending year, Julian day and hour in the form YYYYJJJHH (or YYJJJHH)
6	5	IESEC	integer	Ending second (0000-3599)
6	6	USTAR	real array	Surface friction velocity (m/s)

[a] char*8 = Character*8

[b] Record type 4 is included only if LCALGRD is TRUE

Table 8-27 (Continued)
CALMET.DAT file - Data Records

Record Type	Variable No.	Variable Name	Type[a]	Description
7	1	CLABZI	char*8	Variable label ('ZI')
7	2	NDATHRB	integer	Beginning year, Julian day and hour in the form YYYYJJJHH (or YYJJJHH)
7	3	IBSEC	integer	Beginning second (0000-3599)
7	4	NDATHRE	integer	Ending year, Julian day and hour in the form YYYYJJJHH (or YYJJJHH)
7	5	IESEC	integer	Ending second (0000-3599)
7	6	ZI	real array	Mixing height (m)
8	1	CLABL	char*8	Variable label ('EL')
8	2	NDATHRB	integer	Beginning year, Julian day and hour in the form YYYYJJJHH (or YYJJJHH)
8	3	IBSEC	integer	Beginning second (0000-3599)
8	4	NDATHRE	integer	Ending year, Julian day and hour in the form YYYYJJJHH (or YYJJJHH)
8	5	IESEC	integer	Ending second (0000-3599)
8	6	EL	real array	Monin-Obukhov length (m)
9	1	CLABWS	char*8	Variable label ('WSTAR')
9	2	NDATHRB	integer	Beginning year, Julian day and hour in the form YYYYJJJHH (or YYJJJHH)
9	3	IBSEC	integer	Beginning second (0000-3599)
9	4	NDATHRE	integer	Ending year, Julian day and hour in the form YYYYJJJHH (or YYJJJHH)
9	5	IESEC	integer	Ending second (0000-3599)
9	6	WSTAR	real array	Convective velocity scale (m/s)

[a] char*8 = Character*8

Table 8-27 (Continued)
CALMET.DAT file - Data Records

Record Type	Variable No.	Variable Name	Type[a]	Description
10	1	CLABRMM	char*8	Variable label ('RMM')
10	2	NDATHRB	integer	Beginning year, Julian day and hour in the form YYYYJJJHH (or YYJJJHH)
10	3	IBSEC	integer	Beginning second (0000-3599)
10	4	NDATHRE	integer	Ending year, Julian day and hour in the form YYYYJJJHH (or YYJJJHH)
10	5	IESEC	integer	Ending second (0000-3599)
10	6	RMM	real array	Precipitation rate (mm/hr). Not used by CALGRID.
11	1	CLABTK	char*8	Variable label ('TEMPK')
11	2	NDATHRB	integer	Beginning year, Julian day and hour in the form YYYYJJJHH (or YYJJJHH)
11	3	IBSEC	integer	Beginning second (0000-3599)
11	4	NDATHRE	integer	Ending year, Julian day and hour in the form YYYYJJJHH (or YYJJJHH)
11	5	IESEC	integer	Ending second (0000-3599)
11	6	TEMPK	real array	Near-surface temperature (deg. K)
12	1	CLABD	char*8	Variable label ('RHO')
12	2	NDATHRB	integer	Beginning year, Julian day and hour in the form YYYYJJJHH (or YYJJJHH)
12	3	IBSEC	integer	Beginning second (0000-3599)
12	4	NDATHRE	integer	Ending year, Julian day and hour in the form YYYYJJJHH (or YYJJJHH)
12	5	IESEC	integer	Ending second (0000-3599)
12	6	RHO	real array	Near-surface air density (kg/m^3)

[a] char*8 = Character*8

Table 8-27 (Concluded)
CALMET.DAT file - Data Records

Record Type	Variable No.	Variable Name	Type[a]	Description
13	1	CLABQ	char*8	Variable label ('QSW')
13	2	NDATHRB	integer	Beginning year, Julian day and hour in the form YYYYJJJHH (or YYJJJHH)
13	3	IBSEC	integer	Beginning second (0000-3599)
13	4	NDATHRE	integer	Ending year, Julian day and hour in the form YYYYJJJHH (or YYJJJHH)
13	5	IESEC	integer	Ending second (0000-3599)
13	6	QSW	real array	Short-wave solar radiation (W/m^2)
14	1	CLABRH	char*8	Variable label ('IRH')
14	2	NDATHRB	integer	Beginning year, Julian day and hour in the form YYYYJJJHH (or YYJJJHH)
14	3	IBSEC	integer	Beginning second (0000-3599)
14	4	NDATHRE	integer	Ending year, Julian day and hour in the form YYYYJJJHH (or YYJJJHH)
14	5	IESEC	integer	Ending second (0000-3599)
14	6	IRH	integer array	Near-surface relative humidity (percent)
15	1	CLABPC	char*8	Variable label ('IPCODE')
15	2	NDATHRB	integer	Beginning year, Julian day and hour in the form YYYYJJJHH (or YYJJJHH)
15	3	IBSEC	integer	Beginning second (0000-3599)
15	4	NDATHRE	integer	Ending year, Julian day and hour in the form YYYYJJJHH (or YYJJJHH)
15	5	IESEC	integer	Ending second (0000-3599)
15	6	IPCODE	integer array	Precipitation type code (not used by CALGRID) 0 - no precipitation 1 to 18 - liquid precipitation 19 to 45 - frozen precipitation

[a] char*8 = Character*8

8.1.1 PACOUT.DAT

When run with an hourly timestep, CALMET has the option to output the unformatted meteorological data file in a form compatible with MESOPUFF II. If IFORMO is set to two in Input Group 3 of the CALMET control file, the output data file is called PACOUT.DAT.

The PACOUT.DAT output meteorological file consists of six header records followed by a set of twelve data records for each hour. The header records contain the date and length of the run, grid size and spacing, land use categories and surface roughness lengths at each grid point, as well as other information required by MESOPUFF II. A description of each variable in the header records is provided in Table 8-28. Sample FORTRAN write statements for the PACOUT.DAT header records are:

```
c ---  Header record 1 -- General run and grid information
             write(io7)NYR,IDYSTR,IHRMAX,NSSTA,NUSTA,IMAX,JMAX,IBTZ,
             1 ILWF,IUWF,DGRID,VK

c ---  Header record 2 -- Surface station coordinates
       write(io7)XSCOOR,YSCOOR

c ---  Header record 3 -- Upper air station coordinates
       write(io7)XUCOOR,YUCOOR

c ---  Header record 4  -- Surface roughness lengths
       write(io7)Z0

c ---  Header record 5 -- Nearest surface station to each grid point
             write(io7)NEARS

c ---  Header record 6 -- Land use categories
       write(io7)ILANDU
```

where the following declarations apply:

```
       real XSCOOR(nssta),YSCOOR(nssta),XUCOOR(nusta),YUCOOR(nusta)
       real Z0(nx,ny)
       integer ILANDU(nx,ny)NEARS(nx,ny)
```

The data records of the PACOUT.DAT are repeated once each hour. A description of each variable in the data records is provided in Table 8-28. Sample FORTRAN write statements for the data records are:

```
c ---  Write date and time
          write(io7)KYR,KJUL,KHR

c ---  Write lower level wind components
             Loop over grid cells
                write(io7)((UL(i,j),i=1,nx,)j=1,ny)
             End loop over grid cells
             Loop over grid cells
                write(io7)((VL(i,j),i=1,nx,)j=1,ny)
             End loop over grid cells
c ---  Write upper level wind components
             Loop over grid cells
                write(io7)((UUP(i,j),i=1,nx,)j=1,ny)
             End loop over grid cells
             Loop over grid cells
                write(io7)((VUP(i,j),i=1,nx,)j=1,ny)
             End loop over grid cells
c ---  Write mixing height
             Loop over grid cells
                write(io7)((HTMIX(i,j),i=1,nx,)j=1,ny)
             End loop over grid cells
c ---  Write friction velocity
             Loop over grid cells
                write(io7)((USTAR(i,j),i=1,nx,)j=1,ny)
             End loop over grid cells
c ---  Write convective velocity scale
             Loop over grid cells
                write(io7)((WSTAR(i,j),i=1,nx,)j=1,ny)
             End loop over grid cells
c ---  Write Monin-Obukhov length
```

```
          Loop over grid cells
             write(io7)((XMONIN(i,j),i=1,nx,)j=1,ny)
          End loop over grid cells
c ---  Write PGT stability class
          Loop over grid cells
             write(io7)((IPGT(i,j),i=1,nx,)j=1,ny)
          End loop over grid cells
c ---  Write precipitation code
          Loop over grid cells
             write(io7)((RMM(i,j),i=1,nx,)j=1,ny)
          End loop over grid cells

c ---  Write average surface air density, air temperature, total solar radiation,
       relative humidity, and precipitation code
       write(io7)AVRHO,TEMPK,SRAD,IRH,IPCODE
```

where the following declarations apply:

```
       real UL(nx,ny),VL(nx,ny),UUP(nx,ny),VUP(nx,ny)
       real HTMIX(nx,ny),USTAR(nx,ny),WSTAR(nx,ny)
       real XMONIN(nx,ny),RMM(nx,ny)
       real TEMPK(nssta),SRAD(nssta)
       integer IPGT(nx,ny)
       integer IRH(nssta),IPCODE(nssta)
```

Table 8-28: PACOUT.DAT File - Format

HEADER RECORDS - First six records of output file

Header Record No.	Variable No.	Variable	Type	Description
1	1	NYR	integer	Starting year
1	2	IDYSTR	integer	Starting Julian day
1	3	IHRMAX	integer	Number of hours in run
1	4	NSSTA	integer	Number of surface stations
1	5	NUSTA	integer	Number of rawinsonde stations
1	6	IMAX	integer	Number of grid points in X direction
1	7	JMAX	integer	Number of grid points in Y direction
1	8	IBTZ	integer	Reference time zone
1	9	ILWF	integer	Lower-level wind field code
1	10	IUWF	integer	Upper-level wind field code
1	11	DGRID	real	Grid spacing (m)
1	12	VK	real	von Karman constant
2	1	XSCOOR	real array	Surface station X coordinates (grid units)
2	2	YSCOOR	real array	Surface station Y coordinates (grid units)
3	1	XUCOOR	real array	Upper air station X coordinates (grid units)
3	2	YUCOOR	real array	Upper air station Y coordinates (grid units)
4	1	Z0	real array	Surface roughness lengths (m)
5	1	NEARS	integer array	Station number of closest surface station to each grid point
6	1	ILANDU	integer array	Land use categories

Table 8-28 (Concluded)
PACOUT.DAT File - Format

DATA RECORDS - Repeated for each hour of run

Header Record No.	Variable No.	Variable	Type	Description
7	1	KYR	integer	Year
7	2	KJUL	integer	Julian day
7	3	KHR	integer	Hour (00-23)
8	1	UL	real array	Lower-level u wind component (m/s)
9	1	VL	real array	Lower-level v wind component (m/s)
10	1	UUP	real array	Upper-level u wind component (m/s)
11	1	VUP	real array	Upper-level v wind component (m/s)
12	1	HTMIX	real array	Mixing height (m)
13	1	USTAR	real array	Friction velocity (m/s)
14	1	WSTAR	real array	Convective velocity scale (m/s)
15	1	XMONIN	real array	Monin-Obukhov length (m)
16	1	IPGT	integer array	PGT stability class
17	1	RMM	real array	Hourly precipitation rate (mm/hr)
18	1	AVRHO	real	Average surface air density (kg/m^3)
18	2	TEMPK	real array	Air temperature*(K)
18	3	SRAD	real array	Total solar radiation*(W/m^2)
18	4	IRH	integer array	Relative humidity*(%)
18	5	IPCODE	integer array	Precipitation code*

* At surface meteorological stations

8.2 PRTMET Meteorological Display Program

The CALMET meteorological model generates a large, binary meteorological file of hourly or subhourly data which includes gridded wind fields at multiple levels and gridded surface meteorological fields such as PGT (Pasquill-Gifford-Turner) stability class, friction velocity, Monin-Obukhov length, mixing height, convective velocity scale, and precipitation rate. For many typical applications, this output file will be many megabytes or more in volume. The PRTMET program is a postprocessor intended to aid in the analysis of the CALMET output data base by allowing the user to display selected portions of the meteorological data.

- PRTMET has the following capabilities and options.
- Option to print or suppress printing of the gridded meteorological fields (wind fields and surface meteorological variables).
- User-selected levels of the wind fields printed.
- Option to display wind fields as U, V components or as wind speed and wind direction.
- User-selected wind speed conversion factor for changing units (default units: m/s).
- Option to print plot files of all the meteorological variables (horizontal slices), in a format compatible with SURFER® (contour plots and/or vector plots).
- Option to print time-series of any number of variables at a single gridpoint, in a separate file compatible with Excel (column format)
- Option to produce plot files of snapshots and/or average fields.
- Option to print or suppress printing of the gridded geophysical variables (surface roughness lengths, land use categories, terrain elevations).
- Option to print plot files of the gridded geophysical variables.
- Option to print or suppress printing of X, Y coordinates of surface stations, upper air stations, and precipitation stations used in the modeling.
- Option to print or suppress printing of the CALMET run control variables stored in the header records of the CALMET output file.

- User-selected portion of horizontal grid printed for all gridded meteorological fields. Options include printing entire grid, subset of grid, or a single data point.

- User-selected time period(s) printed.

- User-selected printing time interval.

- User-selected format for display of gridded meteorological fields (self-scaling exponential format or fixed format).

Two input files are read by PRTMET: a user-input control file and the unformatted meteorological data file containing the gridded wind and micrometeorological fields generated by CALMET. The output file PRTMET.LST contains the printed data selected by the user. PRTMET also produces a user defined number of plot files. A time-series output file is created whenever a single grid point is selected for processing. Table 8-29 contains a summary of the input files and output files for PRTMET.

The format of the PRTMET control input file follows the same rules as those used in the CALMET.INP file (refer to the CALMET section for details). Only data within the delimiter characters (!) are processed. The input data consist of a leading delimiter followed by the variable name, equals sign, input value or values, and a terminating delimiter (e.g., !XX = 12.5!). PRTMET.INP may be created/edited directly using a conventional editor, or it may be created/edited indirectly by means of the PC-based, Windows-compatible Graphical User Interface (GUI) developed for the geophysical preprocessors (CALPRO). A sample input file is presented in Table 8-30. A description of each of the inputs is provided in Table 8-31.

PRTMET extracts and prints the data selected by the user from the CALMET data file. A sample output file is shown in Table 8-32. A sample contour plot file and a sample vector plot file are shown in Table 8-33 and Table 8-34, respectively. A sample time-series output file is shown in Table 8-35.

Table 8-29: PRTMET Input and Output Files

Unit	File Name	Type	Format	Description
5	PRTMET.INP	input	formatted	Control file containing user inputs
6	PRTMET.LST	output	formatted	List file (line printer output file)
7	CALMET.DAT	input	unformatted	Unformatted CALMET output file containing meteorological and geophysical data to be printed.
8	-	output	formatted	Plot file. As many files as specified in PRTMET.INP.
1	PRTTIME.TXT	output	formatted	Time-series file. Created if a single gridpoint is processed.

Table 8-30: PRTMET Control File Inputs (PRTMET.INP)

Input group	**Variable**	**Type**	**Description**
(0)	METDAT	character*132	Unformatted CALMET output file containing the meteorological and geophysical data to be printed
	RUNLST	character*132	List file name.
	PRTTIME	character*132	Time-series file name
	LCFILES	logical	Convert filename to upper (F) or lower (T) case
(1)	IBYR	integer	Beginning year of data to print (four digit)
	IBMO	integer	Beginning month
	IBDAY	integer	Beginning day
	IBHR	integer	Beginning time (hour 00-23)
	IBSEC	integer	Beginning time (second 0000-3599)
	IEYR	integer	Ending year of data to print (four digit)
	IEMO	integer	Ending month
	IEDAY	integer	Ending day
	IEHR	integer	Ending hour (00-23)
	IESEC	integer	Ending time (second 0000-3599)
	ICHR	integer	Printing interval (time periods in CALMET file) for printing/plotting field

Input group	**Variable**	**Type**	**Description**
(0)	METDAT	character*132	Unformatted CALMET output file containing the meteorological and geophysical data to be printed
	NBX	integer	X grid cell of lower left corner of grid to print
	NBY	integer	Y grid cell of lower left corner of grid to print
	NEX	integer	X grid cell of upper right corner of grid to print
	NEY	integer	Y grid cell of upper right corner of grid to print

Table 8-30 (Continued)
PRTMET Control File Inputs (PRTMET.INP)

(2)	LHDV	logical	Control variable for printing of CALMET run variables stored in header records of output file. (F=do not print, T=print)
	LMETCF	logical	Control variable for printing full CALMET control file image. (F=do not print, T=print)
	LSFC	logical	Control variable for printing of X,Y surface station coordinates. (F=do not print, T=print)
	LUPC	logical	Control variable for printing of X,Y upper air station coordinates. (F=do not print, T=print)
	LPRC	logical	Control variable for printing of X,Y precipitation station coordinates. (F=do not print, T=print)
	LNEARS	logical	Control variable for printing of nearest surface station number to each grid point. (F=do not print, T=print)
(2a)	LSURF	logical	Control variable for printing of surface station number to each grid point. (F=do not print, T=print)
	LLI	logical	Control variable for printing of leaf area index field. (F=do not print, T=print)
	LLU	logical	Control variable for printing of gridded land use categories. (F=do not print, T=print)
	LTE	logical	Control variable for printing of terrain elevations. (F=do not print, T=print)
	LZ0	logical	Control variable for printing of gridded surface roughness lengths. (F=do not print, T=print)
	FLI	integer	Output format for leaf area index. (0=self-scaling exponential format, 1=fixed format).
	FLU	integer	Output format for land use categories. (0=self-scaling exponential format, 1=fixed format).

FTE	integer	Output format for terrain elevations. (0=self-scaling exponential format, 1=fixed format).
FZ0	integer	Output format for surface roughness lengths. (0=self-scaling exponential format, 1=fixed format).
LSTAB	logical	Control variable for printing of PGT stability class. (F=do not print, T=print)
LUSTR	logical	Control variable for printing of friction velocity. (F=do not print, T=print)

Table 8-30 (Continued)
PRTMET Control File Inputs (PRTMET.INP)

Input group	Variable	Type	Description
(2a)	LMONL	logical	Control variable for printing of Monin-Obukhov length. (F=do not print, T=print)
	LWSTR	logical	Control variable for printing of convective velocity scale. (F=do not print, T=print)
	LMXHT	logical	Control variable for printing of mixing height. (F=do not print, T=print)
	LPRAT	logical	Control variable for printing of precipitation rates. (F=do not print, T=print)
	FSTAB	integer	Output format for PGT stability class. USED ONLY IF IPSC=1. (0=self-scaling exponential format, 1=fixed format)
	FUSTR	integer	Output format for friction velocity. USED ONLY IF IFV=1. (0=self-scaling exponential format, 1=fixed format)
	FMONL	integer	Output format for Monin-Obukhov length. USED ONLY IF IMOL=1. (0=self-scaling exponential format, 1=fixed format)
	FWSTR	integer	Output format for the convective velocity scale. USED ONLY IF ICVS=1. (0=self-scaling exponential format, 1=fixed format)
	FMXHT	integer	Output format for mixing height. USED ONLY IF IMH=1. (0=self-scaling exponential format, 1=fixed format)
	FPRAT	integer	Output format for precipitation rates. USED ONLY IF IPR=1. (0=self-scaling exponential format, 1=fixed format)
	IPWS	integer	Control variable for display of wind field. (0=U,V components, 1=wind speed, wind direction)

WSFAC	real	Wind speed units conversion factor. (1.0 for m/s, 1.944 for knots, 2.237 for miles/hour)
FWS	integer array element	Output format for wind speeds. (0=self-scaling exponential format, 1=fixed format)
N3D	integer	Number of layers of 3-D met data printed

Table 8-30 (Concluded)
PRTMET Control File Inputs (PRTMET.INP)

Input group	Variable	Type	Description
(2b)	X (N3D entries)	integer arrays	Data for each layer printed: layer # , horizontal wind, vertical velocity, temperature (1: print, 0: do not pring)
(3a)	LVECT	logical	Create plot files of wind vectors for each CALMET layer each hour (T: Yes ; F: No)
	LTEMP	logical	Create plot files of temperature for each CALMET layer each hour (T: Yes ; F: No)
	LWSPE	logical	Create plot files of wind speed for each CALMET layer each hour (T: Yes ; F: No)
	LPREC	logical	Create plot files of precipitation for each CALMET layer each hour (T: Yes ; F: No)
	LMIXH	logical	Create plot files of mixing height for each CALMET layer each hour (T: Yes ; F: No)
	LIPGT	logical	Create plot files of PGT class for each CALMET layer each hour (T: Yes ; F: No)
	NSNAP	integer	Number of snapshot plot files to be created.
NSNAP x 2-line entries	FILESNAP	character*132	Output file name
	XXXX	char*4 = integer, integer	Layer number, time (hour) for variable XXXX to plot. Variable XXXX options: VECT (wind field, vector plot), UVEL (u-component of wind velocity, VVEL (v-component of wind velocity),WVEL(w-component of wind velocity),, TEMP (temperature),WDIR (Wind direction), WSPE(wind speed), IPGT (PGT class), USTA(Friction velocity), MONL(Moni-Obukhov length, WSTA(convective velocity), MIXH (mixing height), PREC(precipitation rate)
(4a)	NMEAN	integer	Number of averaged field plot files to be created.
	IBEGAV	integer	Beginning hour of the averaging period (IBEGIN=1 corresponds to IYR, IMO, IDAY, IHR)
	IENDAV	integer	Ending hour of the averaging period.

(4b)	FILEMEAN	character*132	Output file name (average fields)
NMEAN x 2-line entries	XXXX	char*4 = integer	Variable to plot (same variable options as for snapshots), layer number

Table 8-31: Sample PRTMET Control File (PRTMET.INP)

```
PRTMET.INP      2.1             Hour Start and End Times with Seconds
-------------------------------------------------------------------------------

                 PRTMET PROCESSOR CONTROL FILE
                 -----------------------------

  PRTMET reads the binary meteorological data file produced by CALMET
  (CALMET.DAT), and reports selected information in formats amenable to
  quantitative analysis, QA review, or visualization.

-------------------------------------------------------------------------------
                                        a
INPUT GROUP: 0 -- Input and Output Files
--------------

     Default Name  Type          File Name
     ------------  ----          ---------
     CALMET.DAT    input     ! METDAT  = ..\Calmet.dat  !
     PRTMET.LST    output    ! RUNLST  = Prtmet.lst      !
     PRTTIME.DAT   output    ! PRTTIME  = Prttime.dat      !

     Note: PRTTIME is a time-series file created only if a single point is
     selected for processing/printing in Input Group 1.  2D and 3D variables
     specified in Input Group 2 are written each timestep for this point.

     All file names will be converted to lower case if LCFILES = T
     Otherwise, if LCFILES = F, file names will be converted to UPPER CASE
     (LCFILES)                  Default: T      ! LCFILES = T     !
        T = lower case
        F = UPPER CASE

     NOTE: File/path names can be up to 132 characters in length

-------------
   a
     Additional output files may be defined in Input Groups 3 and 4 when
     specific snapshot plots or average field plots are requested.

!END!

--------------------------------------------------------------------------------

INPUT GROUP: 1 -- Run control parameters
--------------

--- Processing Period ---

     Starting date:   Year (IBYR) -- No default       ! IBYR  = 2002  !
                     Month (IBMO) -- No default       ! IBMO  = 1  !
                       Day (IBDY) -- No default       ! IBDY  = 5  !
                      Hour (IBHR) -- No default       ! IBHR  = 6  !
                   Second (IBSEC) -- No default       ! IBSEC = 600 !

     Ending date:     Year (IEYR) -- No default       ! IEYR  = 2002  !
                     Month (IEMO) -- No default       ! IEMO  = 1  !
                       Day (IEDY) -- No default       ! IEDY  = 5  !
                      Hour (IEHR) -- No default       ! IEHR  = 7  !
                   Second (IESEC) -- No default       ! IESEC = 1800  !

 ---------------
     NOTE:  The date/time is in the base time zone of the CALMET run.


--- Processing Options ---

     Time interval between printed/plotted fields:
     (number of CALMET output timesteps)
     Enter 1 to print every timestep, enter 2 to
     print every second timestep, etc.
     (ICHR)                     Default: 1      ! ICHR = 1  !

     Portion of meteorological grid to print/plot
     Enter beginning (NBX, NBY) and ending (NEX, NEY)
     cell indices (enter 0 to indicate entire grid).
     (NBX)                      Default: 0      ! NBX = 12  !
     (NBY)                      Default: 0      ! NBY = 12  !
     (NEX)                      Default: 0      ! NEX = 16  !
     (NEY)                      Default: 0      ! NEY = 16  !

     Note: If only one gridpoint is specified, variables selected in
     Input Group 2 are written to a separate time-series output file
     defined in Input Group 0.
```

```
!END!
```

Table 8-31 (Continued)

Sample PRTMET Control File (PRTMET.INP)

```
-------------------------------------------------------------------------------

INPUT GROUP: 2 -- Listfile Output Options
--------------

-------------
Subgroup (2a)
-------------

     Print CALMET header run variables
     (e.g., grid definition, ...)?
     (LHDV)                    Default: T      ! LHDV = T  !

     Print full CALMET control file image?
     (LMETCF)                  Default: F      ! LMETCF = F  !

     Print meteorological station (X, Y)
     coordinates?
     (LSFC)  surface           Default: F      ! LSFC = F  !
     (LUPC)  upper air         Default: F      ! LUPC = F  !
     (LPRC)  precipitation     Default: F      ! LPRC = F  !

     Print nearest surface station ID for
     each grid point?
     (LNEARS)                  Default: F      ! LNEARS = F  !

     Print surface meteorological data?
     (temp, rho, SW rad, rh, precip code)
     (LSURF)                   Default: F      ! LSURF = F  !

     Print 2-D gridded domain characteristics?
     (LLI)  Leaf Area Index    Default: F      ! LLI = F  !
     (LLU)  Landuse            Default: F      ! LLU = F  !
     (LTE)  Terrain            Default: F      ! LTE = F  !
     (LZ0)  Roughness          Default: F      ! LZ0 = F  !

     Format used when printing gridded domain characteristics
     (used only if corresponding LLI,LLU,LTE,LZ0 is true)
        0 = use self-scaling exponential format
        1 = use fixed decimal format
     (FLI)  Leaf Area Index    Default: 0      ! FLI = 0  !
     (FLU)  Landuse            Default: 0      ! FLU = 0  !
     (FTE)  Terrain            Default: 0      ! FTE = 0  !
     (FZ0)  Roughness          Default: 0      ! FZ0 = 0  !

     Print 2-D gridded meteorological data?
     (LSTAB)  PG stability     Default: F      ! LSTAB = F  !
     (LUSTR)  u-star           Default: F      ! LUSTR = F  !
     (LMOLN)  Monin-Obukhov L  Default: F      ! LMOLN = F  !
     (LWSTR)  w-star           Default: F      ! LWSTR = F  !
     (LMXHT)  mixing ht        Default: F      ! LMXHT = T  !
     (LPRAT)  precip. rate     Default: F      ! LPRAT = F  !

     Format used when printing 2-D gridded meteorological data
     (used only if corresponding LSTAB,LUSTR,LMOLN,LWSTR,LMXHT,LPRAT
      is true)
        0 = use self-scaling exponential format
        1 = use fixed decimal format
     (FSTAB)  PG stability     Default: 0      ! FSTAB = 0  !
     (FUSTR)  u-star           Default: 0      ! FUSTR = 0  !
     (FMOLN)  Monin-Obukhov L  Default: 0      ! FMOLN = 0  !
     (FWSTR)  w-star           Default: 0      ! FWSTR = 0  !
     (FMXHT)  mixing ht        Default: 0      ! FMXHT = 0  !
     (FPRAT)  precip. rate     Default: 0      ! FPRAT = 0  !

     Present wind data as speed and direction?
     (IPWS)                    Default: 1      ! IPWS = 1  !
        0 = present as U,V components
        1 = present as wind speed, direction

     Scale factor to convert wind speed from m/s to other units
     (WSFAC)                   Default: 1.0    ! WSFAC = 1.0  !
        1.0   = m/s
        1.944 = to knots
        2.237 = to mph

     Format used when printing wind speeds
        0 = use self-scaling exponential format
        1 = use fixed decimal format
     (FWS)                     Default: 0      ! FWS = 0  !
```

```
     Number of layers of 3-D meteorological data printed
     (Identify data for each layer in Subgroup 2b)
     (N3D)                      Default: 0      ! N3D = 1  !

!END!
```

Table 8-31 (Continued)
Sample PRTMET Control File (PRTMET.INP)

```
-------------
Subgroup (2b)
-------------
                                                    a,b
           DATA FOR EACH LAYER PRINTED (N3D entries)
           -----------------------------------------
                     c
                  U,V
                   or
       LAYER     WS,WD       W    TEMPERATURE
       -----     -----     -----     -----
! X =    1,        1,        0,        0      !  !END!

-------------
    a
     0 = do not print this variable for this layer
     1 = print this variable for this level
    b
     Each line is treated as a separate input subgroup and therefore
     must end with an input group terminator.
    c
     U,V or WS,WD format is selected by variable IPWS

--------------------------------------------------------------------------------
INPUT GROUP: 3 -- Snapshot Output Plotfiles
--------------

-------------
Subgroup (3a)
-------------

     Automatically generated snapshot plotfiles
     ------------------------------------------

     Snapshot plotfiles can be created automatically for each CALMET layer, and
     each timestep in the processing period identified in Group 1.  The plotfiles
     are compatible with the SURFER graphics system and are given names that
     include the date-time and model layer.  Filenames are of the form

     yyyy_Mmm_Ddd_hhmm(UTC+hhmm)_Lzz_tMIN.* or
     yyyy_Mmm_Ddd_hhmm(UTC+hhmm)_Lzz_tHR.*  where

     yyyy       = Year (Base Time Zone)
     mm         = Month (Base Time Zone)
     dd         = Day (Base Time Zone)
     hhmm       = Start of Timestep: Hour & Minute (Base Time Zone)
     (UTC+hhmm) = Base Time Zone definition (e.g. EST = UTC-0500)
     zz         = CALMET layer (00 for 2D variables)
     t          = Length of timestep (e.g., 1HR or 5MIN or 30MIN etc.)


     Create automatic plotfiles for each timestep?
        (LVECT)  Wind Vectors  (*.wsp,*.wdr)    Default: F      ! LVECT = T  !
                     -- or --  (*.usp,*.vsp)
                     -- or --  (*.vec)
        (LTEMP)  Temperature   (*.deg)          Default: F      ! LTEMP = F  !
        (LPREC)  Precipitation (*.prc)          Default: F      ! LPREC = F  !
        (LMIXH)  Mixing Height (*.mix)          Default: F      ! LMIXH = F  !
        (LIPGT)  PGT Stability (*.pgt)          Default: F      ! LIPGT = F  !

     Force snapshot files to be ASCII (text), otherwise files
     containing non-integer data will be written as BINARY
     to reduce file size.
     (LSNAPTXT)                                 Default: T      ! LSNAPTXT = T  !

     Type of file created for the Wind Vector option
     (MVECT)                                    Default: 0      ! MVECT = 0  !
        0   = *.vec        (SURFER POST file)
        1   = *.wsp, *.wdr (speed and direction SURFER GRD files)
        2   = *.usp, *.vsp (U and V speed SURFER GRD files)

     Number of layers of 3-D meteorological data written to plot files.
     (Identify layers in Subgroup 3b)
     If set to 0, only layer 1 is provided.
     (NZPLOT)                                   Default: 0      ! NZPLOT = 3  !

     Explicitly defined snapshot plotfiles
     -------------------------------------
```

```
     Specific snapshot plotfiles can also be created for selected CALMET layers
     and timesteps in the processing period identified in Group 1.  Plotfiles
     are compatible with the SURFER graphics system and are given names by the
     user.

     Number of snapshot plotfiles explicitly defined in Subgroup 3c
     (NSNAP)                                    Default: 0      ! NSNAP = 0  !
!END!
```

Table 8-31 (Continued)
Sample PRTMET Control File (PRTMET.INP)

```
-------------
Subgroup (3b)
-------------
                                                        a,b
           LAYERS AUTOMATICALLY PLOTTED (NZPLOT entries)
           ---------------------------------------------

       LAYER     WIND     TEMPERATURE
       -----     ----     -----------
! X =    1 ,        1 ,          1       !  !END!
! X =    3 ,        1 ,          1       !  !END!
! X =    5 ,        1 ,          1       !  !END!

-------------
    a
     0 = do not print this variable for this layer
     1 = print this variable for this level
    b
     Each line is treated as a separate input subgroup and therefore
     must end with an input group terminator.


-------------
Subgroup (3c)
-------------
                                                              a,b
           EXPLICIT SNAPSHOT DEFINITION (NSNAP 2-line entries)
           ---------------------------------------------------

             Layer  Timestep (position in processing period)
             -----  --------

* FILESNAP =   mixht1.grd  *
* MIXH     =   1,     3    *  *END*


-------------
    a
     Enter information for each of the NSNAP plotfiles in 2-line groups.
     One line identifies the filename (FILESNAP = outfile), and the
     other line defines the type of snapshot and the layer & timestep.
     The type (e.g., MIXH =) must be one of the following:
         VECT = wind field (vector plot)
         UVEL = u-component of the wind (contour plot)
         VVEL = v-component of the wind (contour plot)
         WVEL = w-component of the wind (contour plot)
         TEMP = temperature (contour plot)
         WDIR = wind direction (contour plot)
         WSPE = wind speed (contour plot)
         IPGT = PG stability class (contour plot)
         USTA = friction velocity u-star (contour plot)
         MONL = Monin-Obukhov length (contour plot)
         WSTA = convective velocity w-star (contour plot)
         MIXH = mixing height (contour plot)
         PREC = precipitation rate (contour plot)
    b
     Each pair of lines is treated as a separate input subgroup and
     therefore must end with an input group terminator.

--------------------------------------------------------------------------------


INPUT GROUP: 4 -- Average Field Output Plotfiles
--------------

-------------
Subgroup (4a)
-------------

     Number of average field plotfiles
     (NMEAN)                   Default: 0      ! NMEAN = 0 !

     Time period to begin averaging
     (timestep within processing period)
     (IBEGAV)                  Default: 1      ! IBEGAV = 1 !

    Time period to end averaging
     (timestep within processing period)
     (IENDAV)                  Default: 1      ! IENDAV = 1 !
```

```
!END!
```

Table 8-31 (Concluded)

Sample PRTMET Control File (PRTMET.INP)

```
-------------
Subgroup (4b)
-------------
                                                        a,b
          AVERAGE PLOT DEFINITION (NMEAN 2-line entries)
          ----------------------------------------------

             Layer
             -----

* FILEMEAN =   t1_20.grd    *
* TEMP     =   1            *  *END*

-------------
    a
     Enter information for each of the NMEAN plotfiles in 2-line groups.
     One line identifies the filename (FILEMEAN = outfile), and the
     other line defines the type of average and the layer.
     The type (e.g., MIXH =) must be one of the following:
         VECT = wind field (vector plot)
         UVEL = u-component of the wind (contour plot)
         VVEL = v-component of the wind (contour plot)
         WVEL = w-component of the wind (contour plot)
         TEMP = temperature (contour plot)
         WDIR = wind direction (contour plot)
         WSPE = wind speed (contour plot)
         IPGT = PG stability class (contour plot)
         USTA = friction velocity u-star (contour plot)
         MONL = Monin-Obukhov length (contour plot)
         WSTA = convective velocity w-star (contour plot)
         MIXH = mixing height (contour plot)
         PREC = precipitation rate (contour plot)
    b
     Each pair of lines is treated as a separate input subgroup and
     therefore must end with an input group terminator.
```

Table 8-32: Sample PRTMET List File (PRTMET.LST)

```
                         PRTMET OUTPUT SUMMARY
                  VERSION:  4.42         LEVEL:  051118


 ------------------------------------------------
 NOTICE: Starting year in control file sets the
         expected century for the simulation.  All
         YY years are converted to YYYY years in
         the range:  1952 2051
 ------------------------------------------------

 -------------------------
     SETUP Information
 -------------------------

 Control File Used -----
 forlist.inp

 Input MET File    -----
metdat  : ..\calmet.dat
 Output List File  -----
runlst  : prtmet.lst
 Domain Plot Files -----
terrain elevations : qaterr.grd
land use           : qaluse.grd
surface roughness  : qaz0.grd
leaf area index    : qalai.grd
surface stations   : qassta.dat
precip. stations   : qapsta.dat
upper-air stations : qausta.dat
met grid           : qametg.bna
land use color     : luse.clr
PGT Class color    : pgt.clr

 Processing Options -----

                                  Beginning year            2002
                                  Beginning month              1
                                  Beginning day                5
                                  Beginning Julian day         5
                                  Beginning time (hour)        6
                                  Beginning time (second)    600
                                  Ending year               2002
                                  Ending month                 1
                                  Ending day                   5
                                  Ending Julian day            5
                                  Ending time (hour)           7
                                  Ending time (second)      1800
                                  Print interval (timesteps)   1

                                           Beginning X point   12
                                           Beginning Y point   12
                                           Ending X point      16
                                           Ending Y point      16

                 Display X-Y coordinates of surface sta. ?   F
                 Display X-Y coordinates of upper air sta. ? F
                 Display X-Y coordinates of precip. sta. ?   F
                 Display nearest surface station array ?     F
                 Display surface roughness length ?          F     Fixed format ?   0
                 Display land use categories ?               F     Fixed format ?   0
                 Display terrain elevations ?                F     Fixed format ?   0
                 Display leaf area index ?                   F     Fixed format ?   0

                Control variables for printing of 3-D fields.
                        LEVEL         U,V        W     TEMP ?
                          1            1         0       0
                          2            0         0       0
                          3            0         0       0
                          4            0         0       0
                          5            0         0       0
```

6	0	0	0
7	0	0	0
8	0	0	0
9	0	0	0
10	0	0	0
11	0	0	0
12	0	0	0
13	0	0	0
14	0	0	0
15	0	0	0
16	0	0	0
17	0	0	0
18	0	0	0
19	0	0	0
20	0	0	0

Table 8-32 (Continued)

Sample PRTMET List File (PRTMET.LST)

```
                   21            0         0       0
                   22            0         0       0
                   23            0         0       0
                   24            0         0       0
                   25            0         0       0
                   26            0         0       0
                   27            0         0       0
                   28            0         0       0
                   29            0         0       0
                   30            0         0       0
                   31            0         0       0
                   32            0         0       0
                   33            0         0       0
                   34            0         0       0
                   35            0         0       0
                   36            0         0       0
                   37            0         0       0
                   38            0         0       0
                   39            0         0       0
                   40            0         0       0
                   41            0         0       0
                   42            0         0       0
                   43            0         0       0
                   44            0         0       0
                   45            0         0       0
                   46            0         0       0
                   47            0         0       0
                   48            0         0       0
                   49            0         0       0
                   50            0         0       0
                   51            0         0       0
                   52            0         0       0
                   53            0         0       0
                   54            0         0       0
                   55            0         0       0
                   56            0         0       0
                   57            0         0       0
                   58            0         0       0
                   59            0         0       0
                   60            0         0       0

           Wind components (U, V) converted to WS, WD ?   1
           Display wind field in fixed format ?           0

      Multiplicative factor for wind units:         1.0000
   (If the factor is 1.0 then units will remain in m/s)

           Display PGT stability class ?              F     Fixed format ?   0
           Display friction velocity ?                F     Fixed format ?   0
           Display Monin-Obukhov length ?             F     Fixed format ?   0
           Display mixing height ?                    T     Fixed format ?   0
           Display convective velocity scale ?        F     Fixed format ?   0
           Display precipitation rate ?               F     Fixed format ?   0

           Display surface met. station variables ?    F


 Snapshot Options -----

 Automatic snapshot files selected:
    Wind Vectors  (*.VEC)         T    (MVECT = 0)
    Temperature   (*.DEG)         F
    Precipitation (*.PRC)         F
    Mixing Height (*.MIX)         F
    PGT Stability (*.PGT)         F

    All snapshot files are ASCII? T

                  Control variables for ploting 3-D fields.
                      LEVEL        WIND      TEMP ?
                        1            1         1
                        2            0         0
```

```
 3          1        1
 4          0        0
 5          1        1
 6          0        0
 7          0        0
 8          0        0
 9          0        0
10          0        0
11          0        0
12          0        0
13          0        0
14          0        0
15          0        0
16          0        0
17          0        0
18          0        0
19          0        0
20          0        0
```

Table 8-32 (Continued)
Sample PRTMET List File (PRTMET.LST)

```
                        21            0         0
                        22            0         0
                        23            0         0
                        24            0         0
                        25            0         0
                        26            0         0
                        27            0         0
                        28            0         0
                        29            0         0
                        30            0         0
                        31            0         0
                        32            0         0
                        33            0         0
                        34            0         0
                        35            0         0
                        36            0         0
                        37            0         0
                        38            0         0
                        39            0         0
                        40            0         0
                        41            0         0
                        42            0         0
                        43            0         0
                        44            0         0
                        45            0         0
                        46            0         0
                        47            0         0
                        48            0         0
                        49            0         0
                        50            0         0
                        51            0         0
                        52            0         0
                        53            0         0
                        54            0         0
                        55            0         0
                        56            0         0
                        57            0         0
                        58            0         0
                        59            0         0
                        60            0         0

 Number of specific snapshot files: 0

 Average Field Options -----

 Number of average field files: 0


 -----------------------------------------------------------------------------------------------------------------------------
 -----------------------------------------------------------------------------------------------------------------------------


  Data read from header records of CALMET file:
 ..\calmet.dat

CALMET.DAT      2.1             No-Obs file structure with embedded control file

 CALMET.INP      2.1             Hour Start and End Times with Seconds
 CALMET MOD6 TEST CASE -
 30x30 1km km meteorological grid -

Produced by CALMET Version: 6.01  Level: 051206

  Input Group #0 parameters ---
  NUSTA   =  1
  NOWSTA  =  1

  Input Group #1 parameters ---
  IBYR    =  2002
  IBMO    =  1
  IBDY    =  5
```

```
IBHR    =  4
IBSEC   =  0
IEYR    =  2002
IEMO    =  1
IEDY    =  5
IEHR    =  19
IESEC   =  0
AXTZ    = UTC-0600
IBTZ    =  6
IRLG    =  15
IRTYPE  =  1
LCALGRD =  T
```

Table 8-32 (Continued)
Sample PRTMET List File (PRTMET.LST)

```
 Input Group #2 parameters ---
 PMAP    = UTM
 DATUM   = WGS-84
 NIMADATE= 02-21-2003
 FEAST   =  0.00000000E+00
 FNORTH  =  0.00000000E+00
 IUTMZN  =  15
 UTMHEM  = N
 NX      =  30
 NY      =  30
 DGRID   =  1000.00000
 XORIGR  =  260000.000
 YORIGR  =  3195000.00
 NZ      =  10
ZFACE  =     0.000,    20.000,    40.000,    80.000,   160.000,   320.000,   700.000,  1300.000,  1700.000,  2300.000,
3000.000,

 Land Use parameters from GEO.DAT ---
 NLU     =  16
 IWAT1   =  50
 IWAT2   =  55

 Input Group #4 parameters ---
 NSSTA   =  1
 NPSTA   =  0

 Input Group #5 parameters ---
 IWFCOD  =  1

----------------------------------------------------------------------------------------------------------------------------
----------------------------------------------------------------------------------------------------------------------------

 No W levels were selected, therefore no W data will be displayed.
 No temperature levels were selected, therefore no temperature data will be displayed.

Wind Speed (m/s) -- Level:   1          Beginning year: 2002  month:  1  day:  5  Julian day:   5  hour:  6  second: 600
                                           Ending year: 2002  month:  1  day:  5  Julian day:   5  hour:  6  second:1200
Multiply all values by 10 **  -3

 16 I 2717  2717  2717  2717  2717
    I    +     +     +     +     +
 15 I 2717  2717  2717  2717  2717
    I    +     +     +     +     +
 14 I 2717  2717  2717  2717  2717
    I    +     +     +     +     +
 13 I 2717  2717  2717  2717  2717
    I    +     +     +     +     +
 12 I 2717  2717  2717  2717  2717
    I    +     +     +     +     +
    -----------------------------
        12    13    14    15    16

Wind Direction (deg.) -- Level:   1     Beginning year: 2002  month:  1  day:  5  Julian day:   5  hour:  6  second: 600
                                           Ending year: 2002  month:  1  day:  5  Julian day:   5  hour:  6  second:1200
Multiply all values by 10 **  -1

 16 I 3292  3292  3292  3292  3292
    I    +     +     +     +     +
 15 I 3292  3292  3292  3292  3292
    I    +     +     +     +     +
 14 I 3292  3292  3292  3292  3292
    I    +     +     +     +     +
 13 I 3292  3292  3292  3292  3292
    I    +     +     +     +     +
 12 I 3292  3292  3292  3292  3292
    I    +     +     +     +     +
    -----------------------------
        12    13    14    15    16

Mixing height (m)                       Beginning year: 2002  month:  1  day:  5  Julian day:   5  hour:  6  second: 600
```

```
                                            Ending year: 2002  month:  1  day:  5  Julian day:   5  hour:  6  second:1200
Multiply all values by 10 **  -1

 16 I 1605  1583  1568  1558  1543
    I    +     +     +     +     +
 15 I 1590  1564  1555  1549  1539
    I    +     +     +     +     +
 14 I 1552  1543  1543  1541  1533
    I    +     +     +     +     +
 13 I 1461  1520  1534  1548  1534
    I    +     +     +     +     +
 12 I 1450  1540  1539  1540  1505
    I    +     +     +     +     +
    -----------------------------
        12    13    14    15    16
```

Table 8-32 (Concluded)
Sample PRTMET List File (PRTMET.LST)

```
 Wind Speed (m/s) -- Level:   1          Beginning year: 2002  month:  1  day:  5  Julian day:   5  hour:  6  second:1200
                                            Ending year: 2002  month:  1  day:  5  Julian day:   5  hour:  6  second:1800
 Multiply all values by 10 **  -3

  16 I 2733  2733  2733  2733  2733
     I    +     +     +     +     +
  15 I 2733  2733  2733  2733  2733
     I    +     +     +     +     +
  14 I 2733  2733  2733  2733  2733
     I    +     +     +     +     +
  13 I 2733  2733  2733  2733  2733
     I    +     +     +     +     +
  12 I 2733  2733  2733  2733  2733
     I    +     +     +     +     +
     -----------------------------
         12    13    14    15    16

 Wind Direction (deg.) -- Level:   1     Beginning year: 2002  month:  1  day:  5  Julian day:   5  hour:  6  second:1200
                                            Ending year: 2002  month:  1  day:  5  Julian day:   5  hour:  6  second:1800
 Multiply all values by 10 **  -1

  16 I 3293  3293  3293  3293  3293
     I    +     +     +     +     +
  15 I 3293  3293  3293  3293  3293
     I    +     +     +     +     +
  14 I 3293  3293  3293  3293  3293
     I    +     +     +     +     +
  13 I 3293  3293  3293  3293  3293
     I    +     +     +     +     +
  12 I 3293  3293  3293  3293  3293
     I    +     +     +     +     +
     -----------------------------
         12    13    14    15    16

 Mixing height (m)                       Beginning year: 2002  month:  1  day:  5  Julian day:   5  hour:  6  second:1200
                                            Ending year: 2002  month:  1  day:  5  Julian day:   5  hour:  6  second:1800
 Multiply all values by 10 **  -1

  16 I 1626  1605  1589  1579  1564
     I    +     +     +     +     +
  15 I 1611  1585  1576  1570  1560
     I    +     +     +     +     +
  14 I 1572  1563  1563  1561  1554
     I    +     +     +     +     +
  13 I 1476  1539  1554  1568  1554
     I    +     +     +     +     +
  12 I 1464  1558  1558  1559  1524
     I    +     +     +     +     +
     -----------------------------
         12    13    14    15    16

(… Records removed …)

  End of run -- Clock time: 14:46:53
                      Date: 12-15-2005

        Elapsed Clock Time:        0.0 (seconds)

                  CPU Time:        0.0 (seconds)
```

Table 8-33: Sample contour plot file

```
DSAA
          5           5
    271.5000    275.5000
   3206.5002   3210.5002
  0.1527E+03  0.1698E+03
 1.5267E+02  1.6283E+02  1.6208E+02  1.6193E+02  1.5840E+02
 1.5410E+02  1.6098E+02  1.6193E+02  1.6305E+02  1.6191E+02
 1.6455E+02  1.6385E+02  1.6324E+02  1.6258E+02  1.6221E+02
 1.6852E+02  1.6595E+02  1.6489E+02  1.6360E+02  1.6294E+02
 1.6980E+02  1.6826E+02  1.6636E+02  1.6457E+02  1.6351E+02
```

Table 8-34: Sample vector plot file

```
    x        y         arrow       angle(-wd)  length(ws)
 271.500  3210.500   symbol:175    -10.79      12.50
 272.500  3210.500   symbol:175    -10.81      12.51
 273.500  3210.500   symbol:175    -10.83      12.52
 274.500  3210.500   symbol:175    -10.84      12.53
 275.500  3210.500   symbol:175    -10.85      12.54
 271.500  3209.500   symbol:175    -10.81      12.51
 272.500  3209.500   symbol:175    -10.83      12.52
 273.500  3209.500   symbol:175    -10.84      12.54
 274.500  3209.500   symbol:175    -10.85      12.55
 275.500  3209.500   symbol:175    -10.86      12.55
 271.500  3208.500   symbol:175    -10.82      12.52
 272.500  3208.500   symbol:175    -10.84      12.53
 273.500  3208.500   symbol:175    -10.85      12.55
 274.500  3208.500   symbol:175    -10.86      12.55
 275.500  3208.500   symbol:175    -10.87      12.56
 271.500  3207.500   symbol:175    -10.83      12.52
 272.500  3207.500   symbol:175    -10.85      12.54
 273.500  3207.500   symbol:175    -10.86      12.55
 274.500  3207.500   symbol:175    -10.87      12.56
 275.500  3207.500   symbol:175    -10.88      12.56
 271.500  3206.500   symbol:175    -10.83      12.53
 272.500  3206.500   symbol:175    -10.85      12.54
 273.500  3206.500   symbol:175    -10.86      12.55
 274.500  3206.500   symbol:175    -10.87      12.56
 275.500  3206.500   symbol:175    -10.88      12.57
```

Table 8-35: Sample time-series file

```
Timeseries at gridpoint ( 15 , 15 )
 YEAR MONTH DAY HOUR  SEC YEAR MONTH DAY HOUR  SEC      WS        WD         T     Mix.Hgt
                                                      (m/s)     (deg)      (K)      (m)
                                                     Layer 1   Layer 1   Layer 1   Layer
 2002    1   5    5   600 2002    1   5    5  1200      2.20    331.39    295.52    100.62
 2002    1   5    5  1200 2002    1   5    5  1800      2.30    330.83    295.53    101.62
 2002    1   5    5  1800 2002    1   5    5  2400      2.40    330.31    295.55    112.80
 2002    1   5    5  2400 2002    1   5    5  3000      2.50    329.84    295.57    125.90
 2002    1   5    5  3000 2002    1   5    5  3600      2.60    329.40    295.58    139.34
 2002    1   5    6     0 2002    1   5    6   600      2.70    329.00    295.60    153.13
 2002    1   5    6   600 2002    1   5    6  1200      2.72    329.17    295.72    154.89
 2002    1   5    6  1200 2002    1   5    6  1800      2.73    329.34    295.83    156.99
 2002    1   5    6  1800 2002    1   5    6  2400      2.75    329.51    295.95    159.21
 2002    1   5    6  2400 2002    1   5    6  3000      2.77    329.68    296.07    161.43
 2002    1   5    6  3000 2002    1   5    6  3600      2.78    329.84    296.18    163.60
 2002    1   5    7     0 2002    1   5    7   600      2.80    330.00    296.30    165.82
 2002    1   5    7   600 2002    1   5    7  1200      2.83    329.65    296.58    170.17
 2002    1   5    7  1200 2002    1   5    7  1800      2.87    329.30    296.87    174.70
 2002    1   5    7  1800 2002    1   5    7  2400      2.90    328.97    297.15    179.73
 2002    1   5    7  2400 2002    1   5    7  3000      2.93    328.64    297.43    184.10
 2002    1   5    7  3000 2002    1   5    7  3600      2.97    328.32    297.72    188.50
 2002    1   5    8     0 2002    1   5    8   600      3.00    328.00    298.00    396.68
 2002    1   5    8   600 2002    1   5    8  1200      3.01    329.03    298.37    345.56
 2002    1   5    8  1200 2002    1   5    8  1800      3.03    330.04    298.73    346.12
 2002    1   5    8  1800 2002    1   5    8  2400      3.05    331.05    299.10    348.83
 2002    1   5    8  2400 2002    1   5    8  3000      3.06    332.04    299.47    351.56
 2002    1   5    8  3000 2002    1   5    8  3600      3.08    333.03    299.83    354.38
 2002    1   5    9     0 2002    1   5    9   600      3.10    334.00    300.20    412.01
 2002    1   5    9   600 2002    1   5    9  1200      3.14    335.79    300.47    387.42
 2002    1   5    9  1200 2002    1   5    9  1800      3.19    337.54    300.73    380.07
```

9. CALPUFF

The CALPUFF model obtains information about sources, receptors, meteorological data, geophysical data, and model control parameters from a series of input files. These files are listed in Table 1-4. A sample of the main control file (CALPUFF.INP) containing the user-specified model options and switch settings is shown in Table 9-2. The model creates several output files, which are listed in Table 1-6. Detailed information on the structure and content of each of the input and output files is provided in this section.

Tables 1-4 and 1-6 show the Fortran unit numbers associated with each file. These unit numbers are specified in the parameter file (PARAMS.PUF). They can be easily modified to accommodate system-dependent restrictions on allowable unit numbers. Any changes to variables in the parameter file are automatically modified throughout the CALPUFF Fortran code. The code must be re-compiled for changes in the parameter file to take effect, since the parameter values are set at the program compilation stage rather than at program execution.

The name and full path of each CALPUFF file (except one) is assigned in the control file (CALPUFF.INP). The exception, the control filename itself, is assigned on the command line. For example, on a DOS system,

CALPUFF   d:\CALPUFF\CALPUFF.INP

will execute the CALPUFF code (CALPUFF.EXE), and read the input and output filenames for the current run from the file CALPUFF.INP in the directory d:\CALPUFF. If the control filename is not specified on the command line, the default control filename (i.e., CALPUFF.INP in the current working directory) will be used. The path and filename can be up to 70 characters long.

The utility routine that delivers a command line argument is system dependent. The function that provides the system clock time and system CPU time are also system or compiler-specific. All system-dependent or compiler-specific routines in CALPUFF are isolated into a file called DATETM.xxx, where the file extension (.xxx) indicates the system for which the code is designed. For example, DATETM.HP contains code for Hewlett-Packard Unix systems, DATETM.SUN is for Sun Unix systems, DATETM.LAH is for Lahey-compiled PC-applications, and DATETM.MS is for Microsoft-compiled PC applications. By appending the correct system-dependent DATETM file onto the main CALPUFF code, the code should run without any modifications.

9.1 User Control File

The selection and control of CALPUFF options are determined by user-specified inputs contained in a file called the control file. This file, which has the default name CALPUFF.INP, contains all of the information necessary to define a model run (e.g., starting date, run length, grid specifications, technical options, output options, etc.). CALPUFF.INP may be created/edited directly using a conventional editor, or it may be created/edited indirectly by means of the PC-based, Windows-compatible Graphical User Interface (GUI) developed for CALPUFF.

The CALPUFF GUI not only prepares the control file, it also executes the model and facilitates file management functions; and it contains an extensive help system that makes much of the information in this manual available to the user on-line. When using the GUI, the source data and receptor information required for a CALPUFF run can be entered through the edit screens or read from external ASCII files (spreadsheet-compatible). Each source type (points, areas, volumes, and lines) contains an external ASCII file format description and sample file in the help system.

Although the model can be set up and run entirely within the GUI system, the interface is designed to always create the ASCII CALPUFF.INP file. This allows runs to be set up on PC-based systems and the control file transferred to a workstation or a mainframe computer for computationally intensive applications. The ASCII CALPUFF.INP file should be directly transportable to virtually any non-PC system.

When CALPUFF is setup and run entirely on a non-PC system, or if the GUI is not used on a PC, the control file CALPUFF.INP may be configured by using a conventional editor. This is facilitated by the extensive self-documenting statements contained in the standard file. As explained further below, more comments can be readily added by the user to document specific parameter choices used in the run. These comments remain in the file, and are reported to the CALPUFF list file when CALPUFF is executed from the command line. Note, however, that the GUI always writes the standard comments to CALPUFF.INP, and ignores any additional text. Furthermore, the control file is always updated by the GUI, even if the GUI is only used to run CALPUFF without altering the technical content of the control file. Thus, the user must save the control file to another filename prior to using the GUI if non-standard comments are to be saved. This feature of the GUI can be used to create a new copy of the standard control file by merely saving a "new file" to disk, so a fresh version of the control file is always available.

The control file is organized into 18 major Input Groups and a variable number of subgroups within several of the major Input Groups. The first three lines of the input file consist of a run title. As shown in Table 9-1, the major Input Groups are defined along functional lines (e.g., technical options, output options, subgrid scale, complex terrain inputs, etc.). Each subgroup contains a set of data such as source variables, subgrid scale hill descriptions, or discrete receptor information. The number of subgroups varies with the number of sources, hills, etc., in the model run.

A sample control file is shown in Table 9-2. The control file is read by a set of Fortran text processing routines contained within CALPUFF which allow the user considerable flexibility in designing and customizing the input file. An unlimited amount of optional descriptive text can be inserted within the control file to make it self-documenting. For example, the definition, allowed values, units, and default value of each input variable can be included within the control file.

The control file processor searches for pairs of special delimiter characters (!). All text outside the delimiters is assumed to be optional documentation and is echoed back but otherwise ignored by the input module. Only data within the delimiter characters is processed. The input data consists of a leading delimiter followed by the variable name, equals sign, input value or values, and a terminating delimiter (e.g., !XX = 12.5 !). The variable name can be lower or upper case, or a mixture of both (i.e., XX, xx, Xx are all equivalent). The variable type can be real, integer, logical, or character and it can be an array or a scalar. The use of repetition factors for arrays is allowed (e.g., ! XARRAY = 3 * 1.5 ! instead of ! XARRAY = 1.5, 1.5, 1.5 !). Different values must be separated by commas. Spaces within the delimiter pair are ignored. Exponential notation (E format) for real numbers is allowed. However, the optional plus sign should be omitted (e.g., enter +1.5E+10 as 1.5E10). The data may be extended over more than one line (except for character variables, which must be entirely on one line). The line being continued must end with a comma. Each leading delimiter must be paired with a terminating delimiter. All text between the delimiters is assumed to be data, so no optional documentation is allowed to appear within the delimiters. The inclusion in the control file of any variable that is being assigned its default value is optional. The control file reader expects that logical variables will be assigned using only a one character representation (i.e., 'T' or 'F').

The major Input Groups must appear in order, i.e., Input Group 0 followed by Input Group 1 followed by Input Group 2, etc. However, the variables within an Input Group may appear in any order. The variable names in each Input Group are independent, so that the same name can be repeated in different Input Groups (e.g., as shown in the sample control file, species names (SO_2, SO_4) are used in several Input Groups). Each Input Group and subgroup must end with an Input Group terminator consisting of the word END between two delimiters (i.e., !END!). Every major Input Group, even blank Input Groups (i.e., one in which no variables are included) must end with an Input Group terminator in order to signal the end of that Input Group and the beginning of another.

The control file module has a list of variable names and array dimensions for each Input Group. Checks are performed to ensure that the proper variable names are used in each Input Group, and that no array dimensions are exceeded. Error messages result if an unrecognized variable name is encountered or too many values are entered for a variable.

As an example, the first group (Group 0) identifies all of the I/O files to be used in the run, except for the control file which is specified on the command line. Each CALPUFF input and output file has a default name and path (i.e., the current working directory). If the filename is not specified, the default name will be assumed. Each filename must be less than or equal to 70 characters long.

All text except that between the delimiters (i.e., ! characters) is treated as optional documentation, and is ignored by the input module. Between the delimiters, the character filename variables (e.g., METDAT, PUFLST, CONDAT, etc.) must be entered as shown in the sample file. The control file reader is case insensitive. The filename is placed between the equals sign and the right delimiter character (!). Files that are not used or are not to be changed from their default names can be omitted from the I/O file.

For example, by replacing the delimiter characters ("!") with "*", the line becomes a comment, and will not be interpreted by the program as data:

! CONDAT = CONC.DAT	!	- this line sets the file name of the output concentration file
* CONDAT = CONC.OLD	*	- this line is a comment that does nothing
* PUFLST =	*	- this line is OK (interpreted as a comment)
! PUFLST =	!	- this is not OK (delimiters present, so file must be specified)

Blanks within the delimiters are ignored, and all delimiters must appear in pairs. If the optional CALPUFF GUI is being used, the control file will automatically be correctly formatted and written to disk for use by CALPUFF.

Table 9-1: Input Groups in the CALPUFF Control File

Input Group	Description
*	Run title First three lines of control file (up to 80 characters/line)
0	Input and Output filenames
1	General run control parameters Starting/Ending date and time, time step. Number of species. Model restart configuration for making a series of continuation runs. Meteorological data format and averaging time adjustment.
2	Technical options Control variables determining methods for treating chemistry, wet deposition, dry deposition, dispersion, plume rise, complex terrain, and near-field puff sampling methods
3a,b	Species list Species names, flags for determining which species are modeled, advected, emitted, and dry deposited
4	Grid control parameters Specification of meteorological, computational, and sampling grids, number of cells, vertical layers, and reference coordinates.
5	Output options Printer control variables, disk output control variables
6a,b,c	Subgrid scale complex terrain (CTSG) inputs Information describing subgrid scale hill location, shape and height. Complex terrain receptor locations and elevations.
7	Dry deposition parameters - Gases Pollutant diffusivity, dissociation constant, reactivity, mesophyll resistance, Henry's law coefficient

Table 9-1 (Concluded)
Input Groups in the CALPUFF Control File

Input Group	Description
8	Dry deposition parameters - Particles Geometric mass mean diameter, geometric standard deviation
9	Miscellaneous dry deposition parameters Reference cuticle and ground resistances, reference pollutant reactivity, vegetation state
10	Wet deposition parameters Scavenging coefficients for each pollutant and precipitation type (liquid and frozen precipitation)
11	Chemistry parameters Control variables for input of ozone data, background ozone and ammonia concentrations, nighttime transformation rates
12	Miscellaneous dispersion parameters and computational parameters Vertical dispersion constants, dispersion rate above the boundary layer, crossover distance to time-dependent dispersion coefficients, land use associated with urban dispersion, site characterization parameters for single-point meteorological data files, sampling constraints, puff-splitting controls, plume path coefficients, wind speed power-law exponents, default temperature gradients and wind speed classes
13a,b,c,d	Point source parameters Point source data including source location, elevation, stack parameters, emissions, units, building dimensions, variable emissions cycle
14a,b,c,d	Area source parameters Area source data including source location, effective height, elevation, initial sigmas, emissions, units, variable emissions cycle
15a,b,c	Line source parameters Buoyant line source data including source location, elevation, line length, buoyancy parameters, release height, emissions, units, variable emissions cycle
16a,b,c	Volume source parameters Volume source data including source location, elevation, effective height, initial size data, emissions, units, variable emissions cycle

17a,b Non-gridded (discrete) receptor information
Receptor coordinates and ground elevation

Table 9-2: Sample CALPUFF Control File (CALPUFF.INP)

Input Group 0

```
CALPUFF Example
40 x 40 meteorological grid
All source types represented;  CTSG hill
---------------- Run title (3 lines) ------------------------------------------

                    CALPUFF MODEL CONTROL FILE
                    --------------------------

-------------------------------------------------------------------------------

INPUT GROUP: 0 -- Input and Output File Names

--------------
Default Name  Type          File Name
------------  ----          ---------
CALMET.DAT    input    ! METDAT =CALMET.DAT   !
    or
ISCMET.DAT    input    * ISCDAT =             *
    or
PLMMET.DAT    input    * PLMDAT =             *
    or
PROFILE.DAT   input    * PRFDAT =             *
SURFACE.DAT   input    * SFCDAT =             *
RESTARTB.DAT  input    * RSTARTB=             *
--------------------------------------------------------------------------------
CALPUFF.LST   output   ! PUFLST =CALPUFF2.LST  !
CONC.DAT      output   ! CONDAT =CONC2.DAT     !
DFLX.DAT      output   ! DFDAT  =DFLX2.DAT     !
WFLX.DAT      output   * WFDAT  =             *

VISB.DAT      output   * VISDAT =             *
TK2D.DAT      output   * T2DDAT =             *
RHO2D.DAT     output   * RHODAT =             *
RESTARTE.DAT  output   * RSTARTE=             *
--------------------------------------------------------------------------------
Emission Files
--------------
PTEMARB.DAT   input    * PTDAT  =             *
VOLEMARB.DAT  input    * VOLDAT =             *
BAEMARB.DAT   input    * ARDAT  =             *
LNEMARB.DAT   input    * LNDAT  =             *
--------------------------------------------------------------------------------
Other Files
-----------
OZONE.DAT     input    * OZDAT  =             *
VD.DAT        input    * VDDAT  =             *
CHEM.DAT      input    * CHEMDAT=             *
AUX           input    * AUXEXT = AUX         *
(Extension added to METDAT filename(s) for files
 with auxiliary 2D and 3D data)
H2O2.DAT      input    * H2O2DAT=             *
NH3Z.DAT      input    * NH3ZDAT=             *
HILL.DAT      input    * HILDAT=              *
HILLRCT.DAT   input    * RCTDAT=              *
COASTLN.DAT   input    * CSTDAT=              *
FLUXBDY.DAT   input    * BDYDAT=              *
BCON.DAT      input    * BCNDAT=              *
DEBUG.DAT     output   * DEBUG =              *
MASSFLX.DAT   output   * FLXDAT=              *
```

```
MASSBAL.DAT   output   * BALDAT=              *
FOG.DAT       output   * FOGDAT=              *
RISE.DAT      output   * RISDAT=              *
--------------------------------------------------------------------------------
All file names will be converted to lower case if LCFILES = T
Otherwise, if LCFILES = F, file names will be converted to UPPER CASE
         T = lower case      ! LCFILES = F !
         F = UPPER CASE
NOTE: (1) file/path names can be up to 132 characters in length
```

Table 9-2 (Continued)
Sample CALPUFF Control File (CALPUFF.INP)
Input Group 0

```
Provision for multiple input files
----------------------------------

     Number of Modeling Domains (NMETDOM)
                                Default: 1       ! NMETDOM =   1   !

     Number of CALMET.DAT files for run (NMETDAT)
                                Default: 1       ! NMETDAT =   1   !

     Number of PTEMARB.DAT files for run (NPTDAT)
                                Default: 0       ! NPTDAT =  0  !

     Number of BAEMARB.DAT files for run (NARDAT)
                                Default: 0       ! NARDAT =  0  !

     Number of VOLEMARB.DAT files for run (NVOLDAT)
                                Default: 0       ! NVOLDAT =  0  !
!END!

-------------
Subgroup (0a)
-------------

  Provide a name for each CALMET domain if NMETDOM > 1
  Enter NMETDOM lines.
                                    a,b
Default Name             Domain Name
------------             ------------
 none                  * DOMAIN1=     *   *END*
 none                  * DOMAIN2=     *   *END*
 none                  * DOMAIN3=     *   *END*

  The following CALMET.DAT filenames are processed in sequence if NMETDAT>1

Enter NMETDAT lines, 1 line for each file name.

Default Name  Type          File Name
------------  ----          ---------
 none         input     * METDAT =..\testing\CALMET1.DAT *   *END*
 none         input     * METDAT =CALMET2.DAT            *   *END*

    a
     The name for each CALMET domain and each CALMET.DAT file is treated
     as a separate input subgroup and therefore must end with an input
     group terminator.
    b
     Use DOMAIN1= to assign the name for the outermost CALMET domain.
     Use DOMAIN2= to assign the name for the next inner CALMET domain.
     Use DOMAIN3= to assign the name for the next inner CALMET domain, etc.
      --------------------------------------------------------------------
      |   When inner domains with equal resolution (grid-cell size)      |
      |   overlap, the data from the FIRST such domain in the list will  |
      |   be used if all other criteria for choosing the controlling     |
      |   grid domain are inconclusive.                                  |
      --------------------------------------------------------------------
    c
     Use METDAT1= to assign the file names for the outermost CALMET domain.
     Use METDAT2= to assign the file names for the next inner CALMET domain.
     Use METDAT3= to assign the file names for the next inner CALMET domain, etc.
```

```
    d
     The filenames for each domain must be provided in sequential order

-------------
Subgroup (0b)
-------------

 The following PTEMARB.DAT filenames are processed if NPTDAT>0
  (Each file contains a subset of the sources, for the entire simulation)

Default Name  Type          File Name
------------  ----          ---------
 none         input     * PTDAT =..\testing\PT1.DAT *   *END*
 none         input     * PTDAT = PT2.DAT           *   *END*
```

Table 9-2 (Continued)

Sample CALPUFF Control File (CALPUFF.INP)

Input Group 1

```
-------------
Subgroup (0c)
-------------

  The following BAEMARB.DAT filenames are processed if NARDAT>0
  (Each file contains a subset of the sources, for the entire simulation)


Default Name  Type          File Name
------------  ----          ---------
 none         input     * ARDAT =..\testing\BA1.DAT *   *END*
 none         input     * ARDAT = BA2.DAT           *   *END*

-------------
Subgroup (0d)
-------------

  The following VOLEMARB.DAT filenames are processed if NVOLDAT>0
  (Each file contains a subset of the sources, for the entire simulation)

Default Name  Type          File Name
------------  ----          ---------
 none         input     * VOLDAT =..\testing\VOL1.DAT *   *END*
 none         input     * VOLDAT = VOL2.DAT           *   *END*

--------------------------------------------------------------------------------

INPUT GROUP: 1 -- General run control parameters
--------------

    Option to run all periods found
    in the met. file     (METRUN)     Default: 0      ! METRUN =   0  !

         METRUN = 0 - Run period explicitly defined below
         METRUN = 1 - Run all periods in met. file

     Starting date:   Year  (IBYR) -- No default      ! IBYR  =  1988!
                     Month  (IBMO) -- No default      ! IBMO  =  7   !
                       Day  (IBDY) -- No default      ! IBDY  =  7   !
     Starting time:   Hour  (IBHR) -- No default      ! IBHR  =  0   !
                    Minute (IBMIN) -- No Default      ! IBMIN =  0   !
                    Second (IBSEC) -- No Default      ! IBSEC =  0   !

     Ending date:     Year  (IEYR) -- No default      ! IEYR  =  1988!
```

```
               Month  (ISMO) -- No default      ! IEMO  =  7   !
                 Day  (IEDY) -- No default      ! IEDY  =  8   !
Ending time:    Hour  (IEHR) -- No default      ! IEHR  =  0   !
              Minute (IEMIN) -- No Default      ! IEMIN =  0   !
              Second (IESEC) -- No Default      ! IESEC =  0   !

(These are used only if METRUN = 0)

     Base time zone:          (ABTZ)  --    No default   ! ABTZ= UTC+1000 !
 (character*8)
The modeling domain may span multiple time zones.  ABTZ defines the
base time zone used for the entire simulation.  This must match the
base time zone of the meteorological data.
Examples:
    Los Angeles, USA          = UTC-0800
    New York, USA             = UTC-0500
    Santiago, Chile           = UTC-0400
    Greenwich Mean Time (GMT) = UTC+0000
    Rome, Italy               = UTC+0100
    Cape Town, S.Africa       = UTC+0200
    Sydney, Australia         = UTC+1000

Length of modeling time-step (seconds)
Equal to update period in the primary
meteorological data files, or an
integer fraction of it (1/2, 1/3 ...)
(NSECDT)                        Default:3600     ! NSECDT = 900 !
                                Units: seconds

Number of chemical species (NSPEC)
                                Default: 5       ! NSPEC =  8   !
```

Table 9-2 (Continued)

Sample CALPUFF Control File (CALPUFF.INP)

Input Group 1

```
Number of chemical species
to be emitted  (NSE)            Default: 3       ! NSE =  7   !

Flag to stop run after


SETUP phase (ITEST)             Default: 2       ! ITEST =  2   !
(Used to allow checking
of the model inputs, files, etc.)
      ITEST = 1 - STOPS program after SETUP phase
      ITEST = 2 - Continues with execution of program
                  after SETUP

Restart Configuration:

   Control flag (MRESTART)      Default: 0       ! MRESTART =  0   !

      0 = Do not read or write a restart file
      1 = Read a restart file at the beginning of
          the run
      2 = Write a restart file during run
      3 = Read a restart file at beginning of run
          and write a restart file during run

   Number of periods in Restart
   output cycle (NRESPD)        Default: 0       ! NRESPD =  0   !

      0 = File written only at last period
```

```
     >0 = File updated every NRESPD periods


Meteorological Data Format (METFM)
                                Default: 1       ! METFM =  1   !

      METFM = 1 - CALMET binary file (CALMET.MET)
      METFM = 2 - ISC ASCII file (ISCMET.MET)
      METFM = 3 - AUSPLUME ASCII file (PLMMET.MET)
      METFM = 4 - CTDM plus tower file (PROFILE.DAT) and
                  surface parameters file (SURFACE.DAT)
      METFM = 5 - AERMET tower file (PROFILE.DAT) and
                  surface parameters file (SURFACE.DAT)


Meteorological Profile Data Format (MPRFFM)
       (used only for METFM = 1, 2, 3)
                                Default: 1       ! MPRFFM =  1   !

      MPRFFM = 1 - CTDM plus tower file (PROFILE.DAT)
      MPRFFM = 2 - AERMET tower file (PROFILE.DAT)


PG sigma-y is adjusted by the factor (AVET/PGTIME)**0.2
Averaging Time (minutes) (AVET)
                                Default: 60.0    ! AVET = 60. !
PG Averaging Time (minutes) (PGTIME)
                                Default: 60.0    ! PGTIME = 60. !


Output units for binary concentration and flux files
written in Dataset v2.2 or later formats
(IOUTU)                         Default: 1       ! IOUTU =  1   !
    1 = mass      -  g/m3 (conc) or g/m2/s (dep)
    2 = odour     -  odour_units (conc)
    3 = radiation -  Bq/m3 (conc) or Bq/m2/s (dep)


Output Dataset format for binary concentration
and flux files (e.g., CONC.DAT)
(IOVERS)                        Default: 2       ! IOVERS =  2   !
    1 = Dataset Version 2.1
    2 = Dataset Version 2.2

                                                !END!
```

Table 9-2 (Continued)
Sample CALPUFF Control File (CALPUFF.INP)
Input Group 2

```
--------------------------------------------------------------------------------

INPUT GROUP: 2 -- Technical options
--------------

     Vertical distribution used in the
     near field (MGAUSS)                 Default: 1     ! MGAUSS =  1   !
        0 = uniform
        1 = Gaussian

     Terrain adjustment method
     (MCTADJ)                            Default: 3     ! MCTADJ =  0   !
        0 = no adjustment
        1 = ISC-type of terrain adjustment
        2 = simple, CALPUFF-type of terrain
            adjustment
        3 = partial plume path adjustment

     Subgrid-scale complex terrain
     flag (MCTSG)                        Default: 0     ! MCTSG =  1   !
        0 = not modeled
        1 = modeled

     Near-field puffs modeled as
     elongated 0 (MSLUG)                 Default: 0     ! MSLUG =  1   !
        0 = no
        1 = yes (slug model used)

     Transitional plume rise modeled ?
     (MTRANS)                            Default: 1     ! MTRANS =  0   !
        0 = no  (i.e., final rise only)
        1 = yes (i.e., transitional rise computed)

     Stack tip downwash? (MTIP)          Default: 1     ! MTIP =  0  !
        0 = no  (i.e., no stack tip downwash)
        1 = yes (i.e., use stack tip downwash)

     Method used to compute plume rise for
     point sources not subject to building
     downwash? (MRISE)                   Default: 1     ! MRISE =  1  !
        1 = Briggs plume rise
        2 = Numerical plume rise

     Method used to simulate building
     downwash? (MBDW)                    Default: 1     ! MBDW =  1   !
        1 = ISC method
        2 = PRIME method

     Vertical wind shear modeled above
     stack top? (MSHEAR)                 Default: 0     ! MSHEAR =  0  !
        0 = no  (i.e., vertical wind shear not modeled)
        1 = yes (i.e., vertical wind shear modeled)

     Puff splitting allowed? (MSPLIT)    Default: 0     ! MSPLIT =  0  !
        0 = no (i.e., puffs not split)
        1 = yes (i.e., puffs are split)

     Chemical mechanism flag (MCHEM)     Default: 1     ! MCHEM =  0   !
```

```
   0 = chemical transformation not
       modeled
   1 = transformation rates computed
       internally (MESOPUFF II scheme)
   2 = user-specified transformation
       rates used
   3 = transformation rates computed
       internally (RIVAD/ARM3 scheme)
   4 = secondary organic aerosol formation
       computed (MESOPUFF II scheme for OH)
   5 = user-specified half-life with or
       without transfer to child species
   6 = transformation rates computed
       internally (Updated RIVAD scheme with
       ISORROPIA equilibrium)
   7 = transformation rates computed
```

Table 9-2 (Continued)

Sample CALPUFF Control File (CALPUFF.INP)

Input Group 2

```
       internally (Updated RIVAD scheme with
       ISORROPIA equilibrium and CalTech SOA)

Aqueous phase transformation flag (MAQCHEM)
(Used only if MCHEM = 1, or 3)        Default: 0     ! MAQCHEM =  0   !



   0 = aqueous phase transformation
       not modeled
   1 = transformation rates and wet
       scavenging coefficients adjusted
       for in-cloud aqueous phase reactions
       (adapted from RADM cloud model
        implementation in CMAQ/SCICHEM)

Liquid Water Content flag (MLWC)
(Used only if MAQCHEM = 1)            Default: 1     ! MLWC =  1   !
   0 = water content estimated from cloud cover
       and presence of precipitation
   1 = gridded cloud water data read from CALMET
       water content output files (filenames are
       the CALMET.DAT names PLUS the extension
       AUXEXT provided in Input Group 0)

Wet removal modeled ? (MWET)          Default: 1     ! MWET =  1   !
   0 = no
   1 = yes

Dry deposition modeled ? (MDRY)       Default: 1     ! MDRY =  1   !
   0 = no
   1 = yes
   (dry deposition method specified
    for each species in Input Group 3)

Gravitational settling (plume tilt)
modeled ? (MTILT)                     Default: 0     ! MTILT =  0   !
   0 = no
   1 = yes
   (puff center falls at the gravitational
    settling velocity for 1 particle species)

    Restrictions:
```

```
    - MDRY  = 1
    - NSPEC = 1  (must be particle species as well)
    - sg    = 0  GEOMETRIC STANDARD DEVIATION in Group 8 is
                 set to zero for a single particle diameter

Method used to compute dispersion
coefficients (MDISP)                 Default: 3     ! MDISP =  3   !

   1 = dispersion coefficients computed from measured values
       of turbulence, sigma v, sigma w
   2 = dispersion coefficients from internally calculated
       sigma v, sigma w using micrometeorological variables
       (u*, w*, L, etc.)
   3 = PG dispersion coefficients for RURAL areas (computed using
       the ISCST multi-segment approximation) and MP coefficients in
       urban areas
   4 = same as 3 except PG coefficients computed using
       the MESOPUFF II eqns.
   5 = CTDM sigmas used for stable and neutral conditions.
       For unstable conditions, sigmas are computed as in
       MDISP = 3, described above.  MDISP = 5 assumes that
       measured values are read

Sigma-v/sigma-theta, sigma-w measurements used? (MTURBVW)
(Used only if MDISP = 1 or 5)         Default: 3     ! MTURBVW =  3  !
   1 = use sigma-v or sigma-theta measurements
       from PROFILE.DAT to compute sigma-y
       (valid for METFM = 1, 2, 3, 4)
   2 = use sigma-w measurements
       from PROFILE.DAT to compute sigma-z
       (valid for METFM = 1, 2, 3, 4)
   3 = use both sigma-(v/theta) and sigma-w
```

Table 9-2 (Continued)

Sample CALPUFF Control File (CALPUFF.INP)

Input Group 2

```
       from PROFILE.DAT to compute sigma-y and sigma-z
       (valid for METFM = 1, 2, 3, 4)
   4 = use sigma-theta measurements
       from PLMMET.DAT to compute sigma-y
       (valid only if METFM = 3)

Back-up method used to compute dispersion
when measured turbulence data are
missing (MDISP2)                     Default: 3     ! MDISP2 =  4  !
(used only if MDISP = 1 or 5)
   2 = dispersion coefficients from internally calculated
       sigma v, sigma w using micrometeorological variables

       (u*, w*, L, etc.)
   3 = PG dispersion coefficients for RURAL areas (computed using
       the ISCST multi-segment approximation) and MP coefficients in
       urban areas
   4 = same as 3 except PG coefficients computed using
       the MESOPUFF II eqns.

[DIAGNOSTIC FEATURE]
Method used for Lagrangian timescale for Sigma-y
(used only if MDISP=1,2 or MDISP2=1,2)
(MTAULY)                             Default: 0     ! MTAULY =  0  !
   0 = Draxler default 617.284 (s)
   1 = Computed as Lag. Length / (.75 q) -- after SCIPUFF
  10 < Direct user input (s)             -- e.g., 306.9
```

```
[DIAGNOSTIC FEATURE]
Method used for Advective-Decay timescale for Turbulence
(used only if MDISP=2 or MDISP2=2)
(MTAUADV)                              Default: 0     ! MTAUADV =  0   !
   0 = No turbulence advection
   1 = Computed (OPTION NOT IMPLEMENTED)
  10 < Direct user input (s)   -- e.g., 800


Method used to compute turbulence sigma-v &
sigma-w using micrometeorological variables
(Used only if MDISP = 2 or MDISP2 = 2)
(MCTURB)                               Default: 1     ! MCTURB =  1   !
   1 = Standard CALPUFF subroutines
   2 = AERMOD subroutines

PG sigma-y,z adj. for roughness?       Default: 0     ! MROUGH =  0  !
(MROUGH)
   0 = no
   1 = yes
Partial plume penetration of           Default: 1     ! MPARTL =  1  !
elevated inversion?
(MPARTL)
   0 = no
   1 = yes

Strength of temperature inversion      Default: 0     ! MTINV =  0  !
provided in PROFILE.DAT extended records?
(MTINV)
   0 = no (computed from measured/default gradients)
   1 = yes

PDF used for dispersion under convective conditions?
                                       Default: 0     ! MPDF =  0  !
(MPDF)
   0 = no
   1 = yes

Sub-Grid TIBL module used for shore line?
                                       Default: 0     ! MSGTIBL = 0  !
(MSGTIBL)
   0 = no
   1 = yes

Boundary conditions (concentration) modeled?
                                       Default: 0     ! MBCON =  0  !
(MBCON)
```

Table 9-2 (Continued)
Sample CALPUFF Control File (CALPUFF.INP)
Input Group 2

```
   0 = no
   1 = yes, using formatted BCON.DAT file
   2 = yes, using unformatted CONC.DAT file

Note:  MBCON > 0 requires that the last species modeled
       be 'BCON'.  Mass is placed in species BCON when
       generating boundary condition puffs so that clean
       air entering the modeling domain can be simulated
       in the same way as polluted air.  Specify zero
       emission of species BCON for all regular sources.
```

```
     Individual source contributions saved?
                                          Default: 0     ! MSOURCE = 0  !
     (MSOURCE)
        0 = no
        1 = yes

     Analyses of fogging and icing impacts due to emissions from

     arrays of mechanically-forced cooling towers can be performed
     using CALPUFF in conjunction with a cooling tower emissions
     processor (CTEMISS) and its associated postprocessors.  Hourly
     emissions of water vapor and temperature from each cooling tower
     cell are computed for the current cell configuration and ambient
     conditions by CTEMISS. CALPUFF models the dispersion of these
     emissions and provides cloud information in a specialized format
     for further analysis. Output to FOG.DAT is provided in either
     'plume mode' or 'receptor mode' format.

     Configure for FOG Model output?
                                          Default: 0     ! MFOG =  0  !
     (MFOG)
        0 = no
        1 = yes  - report results in PLUME Mode format
        2 = yes  - report results in RECEPTOR Mode format


     Test options specified to see if
     they conform to regulatory
     values? (MREG)                       Default: 1     ! MREG =  0   !

        0 = NO checks are made
        1 = Technical options must conform to USEPA
            Long Range Transport (LRT) guidance
                       METFM    1 or 2
                       AVET     60. (min)
                       PGTIME   60. (min)
                       MGAUSS   1
                       MCTADJ   3
                       MTRANS   1
                       MTIP     1
                       MRISE    1
                       MCHEM    1 or 3 (if modeling SOx, NOx)
                       MWET     1
                       MDRY     1
                       MDISP    2 or 3
                       MPDF     0 if MDISP=3
                                1 if MDISP=2
                       MROUGH   0
                       MPARTL   1
                       MPARTLBA 0
                       SYTDEP   550. (m)
                       MHFTSZ   0
                       SVMIN    0.5 (m/s)
!END!
-------------------------------------------------------------------------------

INPUT GROUP: 3a, 3b -- Species list
-------------------

------------
Subgroup (3a)
------------

  The following species are modeled:
```

Table 9-2 (Continued)

Sample CALPUFF Control File (CALPUFF.INP)
Input Group 3

```
! CSPEC =          SO2 !         !END!
! CSPEC =          NOX !         !END!
! CSPEC =      PMSIZE1 !         !END!
! CSPEC =      PMSIZE2 !         !END!
! CSPEC =      PMSIZE3 !         !END!
! CSPEC =      PMSIZE4 !         !END!
! CSPEC =      PMSIZE5 !         !END!
! CSPEC =      PMSIZE6 !         !END!

                                                       Dry                 OUTPUT GROUP
    SPECIES          MODELED          EMITTED       DEPOSITED                 NUMBER
     NAME         (0=NO, 1=YES)    (0=NO, 1=YES)    (0=NO,                  (0=NONE,
   (Limit: 12                                        1=COMPUTED-GAS         1=1st CGRUP,
    Characters                                       2=COMPUTED-PARTICLE    2=2nd CGRUP,
    in length)                                       3=USER-SPECIFIED)      3= etc.)

!          SO2  =         1,               1,           1,                  0   !
!          NOX  =         1,               1,           1,                  0   !
!      PMSIZE1  =         1,               1,           2,                  1   !
!      PMSIZE2  =         1,               1,           2,                  1   !
!      PMSIZE3  =         1,               1,           2,                  1   !
!      PMSIZE4  =         1,               1,           2,                  1   !
!      PMSIZE5  =         1,               1,           2,                  1   !
!      PMSIZE6  =         1,               1,           2,                  1   !

!END!

  Note:  The last species in (3a) must be 'BCON' when using the
         boundary condition option (MBCON > 0).  Species BCON should
         typically be modeled as inert (no chem transformation or
         removal).

-------------
Subgroup (3b)
-------------
  The following names are used for Species-Groups in which results
  for certain species are combined (added) prior to output.  The
  CGRUP name will be used as the species name in output files.
  Use this feature to model specific particle-size distributions
  by treating each size-range as a separate species.
  Order must be consistent with 3(a) above.

! CGRUP =         PM10 !     !END!

-------------------------------------------------------------------------------

INPUT GROUP: 4 -- Map Projection and Grid control parameters
--------------

     Projection for all (X,Y):
     -------------------------

     Map projection
     (PMAP)                     Default: UTM    ! PMAP = UTM  !

         UTM :  Universal Transverse Mercator
         TTM :  Tangential Transverse Mercator
         LCC :  Lambert Conformal Conic
          PS :  Polar Stereographic
          EM :  Equatorial Mercator
        LAZA :  Lambert Azimuthal Equal Area
```

```
False Easting and Northing (km) at the projection origin
(Used only if PMAP= TTM, LCC, or LAZA)
(FEAST)                   Default=0.0     ! FEAST  = 0.000  !
(FNORTH)                  Default=0.0     ! FNORTH = 0.000  !

UTM zone (1 to 60)
(Used only if PMAP=UTM)
(IUTMZN)                  No Default      ! IUTMZN =  19   !

Hemisphere for UTM projection?
(Used only if PMAP=UTM)
(UTMHEM)                  Default: N      ! UTMHEM = N  !
    N   :  Northern hemisphere projection
    S   :  Southern hemisphere projection
```

Table 9-2 (Continued)

Sample CALPUFF Control File (CALPUFF.INP)

Input Group 4

```
Latitude and Longitude (decimal degrees) of projection origin
(Used only if PMAP= TTM, LCC, PS, EM, or LAZA)
(RLAT0)                   No Default      ! RLAT0 =  0N  !
(RLON0)                   No Default      ! RLON0 =  0E  !

    TTM :  RLON0 identifies central (true N/S) meridian of projection
           RLAT0 selected for convenience
    LCC :  RLON0 identifies central (true N/S) meridian of projection
           RLAT0 selected for convenience
    PS  :  RLON0 identifies central (grid N/S) meridian of projection
           RLAT0 selected for convenience
    EM  :  RLON0 identifies central meridian of projection
           RLAT0 is REPLACED by 0.0N (Equator)
    LAZA:  RLON0 identifies longitude of tangent-point of mapping plane
           RLAT0 identifies latitude of tangent-point of mapping plane

Matching parallel(s) of latitude (decimal degrees) for projection
(Used only if PMAP= LCC or PS)
(XLAT1)                   No Default      ! XLAT1 =  0N  !
(XLAT2)                   No Default      ! XLAT2 =  0N  !

    LCC :  Projection cone slices through Earth's surface at XLAT1 and XLAT2
    PS  :  Projection plane slices through Earth at XLAT1
           (XLAT2 is not used)

----------
Note:  Latitudes and longitudes should be positive, and include a
       letter N,S,E, or W indicating north or south latitude, and
       east or west longitude.  For example,
       35.9  N Latitude  =  35.9N
       118.7 E Longitude = 118.7E

Datum-region
------------

The Datum-Region for the coordinates is identified by a character
string.  Many mapping products currently available use the model of the
Earth known as the World Geodetic System 1984 (WGS-84).  Other local
models may be in use, and their selection in CALMET will make its output
consistent with local mapping products.  The list of Datum-Regions with
official transformation parameters is provided by the National Imagery and
Mapping Agency (NIMA).

NIMA Datum - Regions(Examples)
------------------------------------------------------------------------------
```

```
     WGS-84    WGS-84 Reference Ellipsoid and Geoid, Global coverage (WGS84)
     NAS-C     NORTH AMERICAN 1927 Clarke 1866 Spheroid, MEAN FOR CONUS (NAD27)
     NAR-C     NORTH AMERICAN 1983 GRS 80 Spheroid, MEAN FOR CONUS (NAD83)
     NWS-84    NWS 6370KM Radius, Sphere
     ESR-S     ESRI REFERENCE 6371KM Radius, Sphere

     Datum-region for output coordinates
     (DATUM)                    Default: WGS-84     ! DATUM = NAS-C  !

METEOROLOGICAL grid:

            No. X grid cells (NX)      No default     ! NX =  40   !
            No. Y grid cells (NY)      No default     ! NY =  40   !
         No. vertical layers (NZ)      No default     ! NZ =  10   !

           Grid spacing (DGRIDKM)      No default     ! DGRIDKM = 0.5 !
                                       Units: km

                Cell face heights
                    (ZFACE(nz+1))      No defaults
                                       Units: m
   ! ZFACE = 0., 20., 50., 100., 200., 400., 600., 1000., 1500., 2000.,
             3000. !

            Reference Coordinates
           of SOUTHWEST corner of
                 grid cell(1, 1):
            X coordinate (XORIGKM)     No default     ! XORIGKM = -10. !
            Y coordinate (YORIGKM)     No default     ! YORIGKM = -10. !
                                      Units: km
```

Table 9-2 (Continued)

Sample CALPUFF Control File (CALPUFF.INP)

Input Group 4, 5

```
COMPUTATIONAL Grid:

     The computational grid is identical to or a subset of the MET. grid.
     The lower left (LL) corner of the computational grid is at grid point
     (IBCOMP, JBCOMP) of the MET. grid.  The upper right (UR) corner of the
     computational grid is at grid point (IECOMP, JECOMP) of the MET. grid.
     The grid spacing of the computational grid is the same as the MET. grid.

        X index of LL corner (IBCOMP)      No default     ! IBCOMP =  1   !
                  (1 <= IBCOMP <= NX)

        Y index of LL corner (JBCOMP)      No default     ! JBCOMP =  1   !
                  (1 <= JBCOMP <= NY)


        X index of UR corner (IECOMP)      No default     ! IECOMP =  40   !
                  (1 <= IECOMP <= NX)

        Y index of UR corner (JECOMP)      No default     ! JECOMP =  40   !
                  (1 <= JECOMP <= NY)

SAMPLING Grid (GRIDDED RECEPTORS):

     The lower left (LL) corner of the sampling grid is at grid point
     (IBSAMP, JBSAMP) of the MET. grid.  The upper right (UR) corner of the
     sampling grid is at grid point (IESAMP, JESAMP) of the MET. grid.
     The sampling grid must be identical to or a subset of the computational
     grid.  It may be a nested grid inside the computational grid.
     The grid spacing of the sampling grid is DGRIDKM/MESHDN.
```

```
        Logical flag indicating if gridded
        receptors are used (LSAMP)         Default: T     ! LSAMP = T !
        (T=yes, F=no)

        X index of LL corner (IBSAMP)      No default     ! IBSAMP =  1   !
         (IBCOMP <= IBSAMP <= IECOMP)

        Y index of LL corner (JBSAMP)      No default     ! JBSAMP =  1   !
         (JBCOMP <= JBSAMP <= JECOMP)


        X index of UR corner (IESAMP)      No default     ! IESAMP =  40   !
         (IBCOMP <= IESAMP <= IECOMP)

        Y index of UR corner (JESAMP)      No default     ! JESAMP =  40   !
         (JBCOMP <= JESAMP <= JECOMP)


       Nesting factor of the sampling
        grid (MESHDN)                      Default: 1     ! MESHDN =  1  !
        (MESHDN is an integer >= 1)

!END!

-------------------------------------------------------------------------------
INPUT GROUP: 5 -- Output Options
--------------
                                             *                          *
     FILE                       DEFAULT VALUE             VALUE THIS RUN
     ----                       -------------             --------------

   Concentrations (ICON)              1                   !  ICON =  1   !
   Dry Fluxes (IDRY)                  1                   !  IDRY =  1   !
   Wet Fluxes (IWET)                  1                   !  IWET =  0   !
   2D Temperature (IT2D)              0                   !  IT2D =  0   !
   2D Density (IRHO)                  0                   !  IRHO =  0   !
   Relative Humidity (IVIS)           1                   !  IVIS =  0   !
    (relative humidity file is
     required for visibility
     analysis)
   Use data compression option in output file?
   (LCOMPRS)                           Default: T         ! LCOMPRS = T !

   *
    0 = Do not create file, 1 = create file
```

Table 9-2 (Continued)

Sample CALPUFF Control File (CALPUFF.INP)

Input Group 5

```
    QA PLOT FILE OUTPUT OPTION:

       Create a standard series of output files (e.g.
       locations of sources, receptors, grids ...)
       suitable for plotting?
       (IQAPLOT)                       Default: 1         ! IQAPLOT =  1  !
         0 = no
         1 = yes

    DIAGNOSTIC MASS FLUX OUTPUT OPTIONS:

       Mass flux across specified boundaries
```

```
      for selected species reported hourly?
      (IMFLX)                         Default: 0         ! IMFLX =  0  !
        0 = no
        1 = yes (FLUXBDY.DAT and MASSFLX.DAT filenames
                 are specified in Input Group 0)

      Mass balance for each species
      reported hourly?
      (IMBAL)                         Default: 0         ! IMBAL =  0  !
        0 = no
        1 = yes (MASSBAL.DAT filename is
             specified in Input Group 0)


   LINE PRINTER OUTPUT OPTIONS:

      Print concentrations (ICPRT)    Default: 0         ! ICPRT =  1   !
      Print dry fluxes (IDPRT)        Default: 0         ! IDPRT =  0   !
      Print wet fluxes (IWPRT)        Default: 0         ! IWPRT =  0   !
      (0 = Do not print, 1 = Print)

      Concentration print interval
      (ICFRQ) in hours                Default: 1         ! ICFRQ =  1   !
      Dry flux print interval
      (IDFRQ) in hours                Default: 1         ! IDFRQ =  1   !
      Wet flux print interval
      (IWFRQ) in hours                Default: 1         ! IWFRQ =  1   !

      Units for Line Printer Output
      (IPRTU)                         Default: 1         ! IPRTU =  1   !
                      for            for
                 Concentration    Deposition
          1 =       g/m**3         g/m**2/s
          2 =      mg/m**3        mg/m**2/s
          3 =      ug/m**3        ug/m**2/s
          4 =      ng/m**3        ng/m**2/s
          5 =     Odor Units

      Messages tracking progress of run
      written to the screen ?
      (IMESG)                         Default: 2         ! IMESG = 2 !
        0 = no
        1 = yes (advection step, puff ID)
        2 = yes (YYYYJJJHH, SSSS, # old puffs, # emitted puffs)


    SPECIES (or GROUP for combined species) LIST FOR OUTPUT OPTIONS

             ---- CONCENTRATIONS ----   ------ DRY FLUXES ------   ------ WET FLUXES ------   -- MASS FLUX --
  SPECIES
  /GROUP     PRINTED?  SAVED ON DISK?   PRINTED?  SAVED ON DISK?   PRINTED?  SAVED ON DISK?   SAVED ON DISK?
  -------    ------------------------   ------------------------   ------------------------   ---------------
!      SO2 =     1,           1,           0,           1,           0,           0,           0   !
!      NOX =     1,           1,           0,           1,           0,           0,           0   !
!     PM10 =     1,           1,           0,           1,           0,           0,           0   !

  Note:  Species BCON (for MBCON > 0) does not need to be saved on disk.

    OPTIONS FOR PRINTING "DEBUG" QUANTITIES (much output)

      Logical for debug output
      (LDEBUG)                                 Default: F     ! LDEBUG = F !
```

Table 9-2 (Continued)

Sample CALPUFF Control File (CALPUFF.INP)
Input Group 5, 6

```
       First puff to track
       (IPFDEB)                          Default: 1     ! IPFDEB =  1  !

       Number of puffs to track
       (NPFDEB)                          Default: 1     ! NPFDEB =  1  !

       Met. period to start output
       (NN1)                             Default: 1     ! NN1 =  1   !

       Met. period to end output
       (NN2)                             Default: 10    ! NN2 =  10  !

!END!
-------------------------------------------------------------------------------

INPUT GROUP: 6a, 6b, & 6c -- Subgrid scale complex terrain inputs
-------------------------
---------------
Subgroup (6a)
---------------
       Number of terrain features (NHILL)       Default: 0     ! NHILL =  1   !

       Number of special complex terrain
       receptors  (NCTREC)                      Default: 0     ! NCTREC =  9   !

       Terrain and CTSG Receptor data for
       CTSG hills input in CTDM format ?
       (MHILL)                                  No Default     ! MHILL =  2   !
       1 = Hill and Receptor data created
           by CTDM processors & read from
           HILL.DAT and HILLRCT.DAT files
       2 = Hill data created by OPTHILL &
           input below in Subgroup (6b);
           Receptor data in Subgroup (6c)

       Factor to convert horizontal dimensions  Default: 1.0   ! XHILL2M = 1. !
       to meters (MHILL=1)

       Factor to convert vertical dimensions    Default: 1.0   ! ZHILL2M = 1. !
       to meters (MHILL=1)

       X-origin of CTDM system relative to      No Default     ! XCTDMKM = 0.0E00 !
       CALPUFF coordinate system, in Kilometers (MHILL=1)

       Y-origin of CTDM system relative to      No Default     ! YCTDMKM = 0.0E00 !
       CALPUFF coordinate system, in Kilometers (MHILL=1)

! END !

---------------
Subgroup (6b)
---------------
                      1 **
     HILL information


HILL      XC      YC    THETAH  ZGRID  RELIEF   EXPO 1   EXPO 2   SCALE 1   SCALE 2    AMAX1   AMAX2
 NO.     (km)    (km)   (deg.)   (m)     (m)     (m)      (m)       (m)       (m)       (m)     (m)
----     ----    ----   ------  -----  ------   ------   ------   -------   -------    -----   -----
1!HILL =  0.,     0.,     0.,    25.,   100.,     2.,      2.,     800.,     400.,    1132.,   566. ! !END!
```

```
---------------
Subgroup (6c)
---------------

    COMPLEX TERRAIN RECEPTOR INFORMATION

                      XRCT         YRCT        ZRCT          XHH
                      (km)         (km)         (m)

                     ------        -----      ------         ----

     1 !CTREC =          -0.2,          0.,      95.0,       1.0 !     !END!
     2 !CTREC =          -0.2,        -0.1,      93.5,       1.0 !     !END!
```

Table 9-2 (Continued)

Sample CALPUFF Control File (CALPUFF.INP)

Input Group 6, 7, 8, 9

```
     3 !CTREC =          -0.2,        -0.2,      89.3,       1.0 !     !END!
     4 !CTREC =          -0.2,        -0.3,      82.9,       1.0 !     !END!
     5 !CTREC =          -0.2,        -0.4,      75.0,       1.0 !     !END!
     6 !CTREC =          -0.2,        -0.5,      66.4,       1.0 !     !END!
     7 !CTREC =          -0.2,        -0.6,      57.8,       1.0 !     !END!
     8 !CTREC =          -0.2,        -0.7,      49.4,       1.0 !     !END!
     9 !CTREC =          -0.2,        -0.8,      41.7,       1.0 !     !END!


-------------------
1
     Description of Complex Terrain Variables:
          XC, YC  = Coordinates of center of hill
          THETAH  = Orientation of major axis of hill (clockwise from
                    North)
          ZGRID   = Height of the  0  of the grid above mean sea
                    level
          RELIEF  = Height of the crest of the hill above the grid elevation
          EXPO 1  = Hill-shape exponent for the major axis
          EXPO 2  = Hill-shape exponent for the major axis
          SCALE 1 = Horizontal length scale along the major axis
          SCALE 2 = Horizontal length scale along the minor axis
          AMAX    = Maximum allowed axis length for the major axis
          BMAX    = Maximum allowed axis length for the major axis

          XRCT, YRCT = Coordinates of the complex terrain receptors
          ZRCT    = Height of the ground (MSL) at the complex terrain
                    Receptor
          XHH     = Hill number associated with each complex terrain receptor
                    (NOTE: MUST BE ENTERED AS A REAL NUMBER)

   **
     NOTE: DATA for each hill and CTSG receptor are treated as a separate
           input subgroup and therefore must end with an input group terminator.

-------------------------------------------------------------------------------

INPUT GROUP: 7 -- Chemical parameters for dry deposition of gases
--------------

  SPECIES     DIFFUSIVITY      ALPHA STAR      REACTIVITY    MESOPHYLL RESISTANCE     HENRY'S LAW COEFFICIENT
   NAME        (cm**2/s)                                             (s/cm)                 (dimensionless)
  -------     -----------      ----------      ----------    --------------------     -----------------------

!      SO2 =     0.1509,         1000.,           8.,              0.,                    0.04 !
!      NOX =     0.1656,         1.,              8.,              5.,                    3.5  !
```

```
!END!
-------------------------------------------------------------------------------
INPUT GROUP: 8 -- Size parameters for dry deposition of particles
--------------

     For SINGLE SPECIES, the mean and standard deviation are used to
     compute a deposition velocity for NINT (see group 9) size-ranges,
     and these are then averaged to obtain a mean deposition velocity.

     For GROUPED SPECIES, the size distribution should be explicitly
     specified (by the 'species' in the group), and the standard deviation
     for each should be entered as 0.  The model will then use the
     deposition velocity for the stated mean diameter.

      SPECIES      GEOMETRIC MASS MEAN        GEOMETRIC STANDARD
       NAME             DIAMETER                   DEVIATION
                        (microns)                  (microns)
      -------      -------------------        ------------------
!      PMSIZE1 =          0.05,                      0.   !
!      PMSIZE2 =           0.1,                      0.   !
!      PMSIZE3 =           0.2,                      0.   !
!      PMSIZE4 =           0.4,                      0.   !
!      PMSIZE5 =           0.8,                      0.   !
!      PMSIZE6 =           1.6,                      0.   !

!END!
-------------------------------------------------------------------------------
INPUT GROUP: 9 -- Miscellaneous dry deposition parameters
```

Table 9-2 (Continued)

Sample CALPUFF Control File (CALPUFF.INP)

Input Group 9, 10, 11

```
--------------

     Reference cuticle resistance (s/cm)
     (RCUTR)                          Default: 30    !  RCUTR = 30. !
     Reference ground resistance  (s/cm)
     (RGR)                            Default: 10    !    RGR = 10. !
     Reference pollutant reactivity
     (REACTR)                         Default: 8     ! REACTR = 8.  !


     Number of particle-size intervals used to
     evaluate effective particle deposition velocity
     (NINT)                           Default: 9     !   NINT =  9  !

     Vegetation state in unirrigated areas
     (IVEG)                           Default: 1     !   IVEG =  1   !
        IVEG=1 for active and unstressed vegetation
        IVEG=2 for active and stressed vegetation
        IVEG=3 for inactive vegetation

!END!

-------------------------------------------------------------------------------

INPUT GROUP: 10 -- Wet Deposition Parameters
---------------

                      Scavenging Coefficient -- Units: (sec)**(-1)

       Pollutant      Liquid Precip.       Frozen Precip.
```

```
      ---------      --------------       --------------
!          SO2 =         3.0E-05,            0.0E00  !
!          NOX =         0.0,                0.0     !
!      PMSIZE1 =         1.0E-04,            3.0E-05 !
!      PMSIZE2 =         1.0E-04,            3.0E-05 !
!      PMSIZE3 =         1.0E-04,            3.0E-05 !
!      PMSIZE4 =         1.0E-04,            3.0E-05 !
!      PMSIZE5 =         1.0E-04,            3.0E-05 !
!      PMSIZE6 =         1.0E-04,            3.0E-05 !

!END!

-------------------------------------------------------------------------------
INPUT GROUP: 11a, 11b -- Chemistry Parameters
---------------------
---------------
Subgroup (11a)
---------------

     Several parameters are needed for one or more of the chemical transformation
     mechanisms.  Those used for each mechanism are:
                                  M                 B
                                  A  B  R  R  R     C  B        N
                            B     V  C  N  N  N  M  K  C  O     D
                            C  M  G  K  I  I  I  H  H  K  F  V  E
                         M  K  N  N  N  T  T  T  2  2  P  R  C  C
                         O  O  H  H  H  E  E  E  O  O  M  A  N  A
     Mechanism (MCHEM)   Z  3  3  3  3  1  2  3  2  2  F  C  X  Y
     --------------------   --------------------------------------------
     0 None              .  .  .  .  .  .  .  .  .  .  .  .  .  .
     1 MESOPUFF II       X  X  .  .  X  X  X  X  .  .  .  .  .  .
     2 User Rates        .  .  .  .  .  .  .  .  .  .  .  .  .  .
     3 RIVAD             X  X  .  .  X  .  .  .  .  .  .  .  .  .
     4 SOA               X  X  .  .  .  .  .  .  .  .  X  X  X  .
     5 Radioactive Decay .  .  .  .  .  .  .  .  .  .  .  .  .  X
     6 RIVAD/ISORRPIA    X  X  X  X  X  X  .  .  X  X  .  .  .  .
     7 RIVAD/ISORRPIA/SOA X X  X  X  X  X  .  .  X  X  X  X  .  .

     Ozone data input option (MOZ)     Default: 1            ! MOZ =  0   !
     (Used only if MCHEM = 1, 3, or 4)
        0 = use a monthly background ozone value
        1 = read hourly ozone concentrations from
            the OZONE.DAT data file

     Monthly ozone concentrations in ppb (BCKO3)
```

Table 9-2 (Continued)

Sample CALPUFF Control File (CALPUFF.INP)

Input Group 11

```
     (Used only if MCHEM = 1,3,4,6, or 7 and either
        MOZ = 0, or
        MOZ = 1 and all hourly O3 data missing)
                                  Default: 12*80.
     !  BCKO3 = 80.00, 80.00, 80.00, 80.00, 80.00, 80.00, 80.00, 80.00, 80.00, 80.00, 80.00, 80.00 !

     Ammonia data option (MNH3)        Default: 0            ! MNH3 =  0   !
     (Used only if MCHEM = 6 or 7)
        0 = use monthly background ammonia values (BCKNH3) - no vertical variation
        1 = read monthly background ammonia values for each layer from
            the NH3Z.DAT data file

     Ammonia vertical averaging option (MAVGNH3)
     (Used only if MCHEM = 6 or 7, and MNH3 = 1)
```

```
       0 = use NH3 at puff center height (no averaging is done)
       1 = average NH3 values over vertical extent of puff
                                  Default: 1            ! MAVGNH3 =  1   !

    Monthly ammonia concentrations in ppb (BCKNH3)
    (Used only if MCHEM = 1 or 3, or
               if MCHEM = 6 or 7, and MNH3 = 0)

                                  Default: 12*10.
    !  BCKNH3 = 10.00, 10.00, 10.00, 10.00, 10.00, 10.00, 10.00, 10.00, 10.00, 10.00, 10.00, 10.00 !

    Nighttime SO2 loss rate in %/hour (RNITE1)
    (Used only if MCHEM = 1, 6 or 7)
    This rate is used only at night for MCHEM=1
    and is added to the computed rate both day
    and night for MCHEM=6,7 (heterogeneous reactions)
                                  Default: 0.2          ! RNITE1 = .2 !

   Nighttime NOx loss rate in %/hour (RNITE2)
    (Used only if MCHEM = 1)
                                  Default: 2.0          ! RNITE2 = 2.0 !

    Nighttime HNO3 formation rate in %/hour (RNITE3)
    (Used only if MCHEM = 1)
                                  Default: 2.0          ! RNITE3 = 2.0 !

    H2O2 data input option (MH2O2)    Default: 1            ! MH2O2 =  1   !
    (Used only if MCHEM = 6 or 7, and MAQCHEM = 1)
       0 = use a monthly background H2O2 value
       1 = read hourly H2O2 concentrations from
           the H2O2.DAT data file

    Monthly H2O2 concentrations in ppb (BCKH2O2)
    (Used only if MQACHEM = 1 and either
       MH2O2 = 0 or
       MH2O2 = 1 and all hourly H2O2 data missing)
                                  Default: 12*1.
    !  BCKH2O2 = 1.00, 1.00, 1.00, 1.00, 1.00, 1.00, 1.00, 1.00, 1.00, 1.00, 1.00, 1.00 !


--- Data for SECONDARY ORGANIC AEROSOL (SOA) Options
    (used only if MCHEM = 4 or 7)

    The MCHEM = 4 SOA module uses monthly values of:
         Fine particulate concentration in ug/m^3 (BCKPMF)
         Organic fraction of fine particulate     (OFRAC)
         VOC / NOX ratio (after reaction)         (VCNX)

    The MCHEM = 7 SOA module uses monthly values of:
         Fine particulate concentration in ug/m^3 (BCKPMF)
         Organic fraction of fine particulate     (OFRAC)

    These characterize the air mass when computing
    the formation of SOA from VOC emissions.
    Typical values for several distinct air mass types are:

       Month    1    2    3    4    5    6    7    8    9   10   11   12
               Jan  Feb  Mar  Apr  May  Jun  Jul  Aug  Sep  Oct  Nov  Dec

    Clean Continental
       BCKPMF   1.   1.   1.   1.   1.   1.   1.   1.   1.   1.   1.   1.
```

Table 9-2 (Continued)

Sample CALPUFF Control File (CALPUFF.INP)

Input Group 11

```
        OFRAC  .15  .15  .20  .20  .20  .20  .20  .20  .20  .20  .20  .15
        VCNX    50.  50.  50.  50.  50.  50.  50.  50.  50.  50.  50.  50.

     Clean Marine (surface)
        BCKPMF  .5   .5   .5   .5   .5   .5   .5   .5   .5   .5   .5   .5
        OFRAC  .25  .25  .30  .30  .30  .30  .30  .30  .30  .30  .30  .25
        VCNX    50.  50.  50.  50.  50.  50.  50.  50.  50.  50.  50.  50.

     Urban - low biogenic (controls present)
        BCKPMF  30.  30.  30.  30.  30.  30.  30.  30.  30.  30.  30.  30.
        OFRAC  .20  .20  .25  .25  .25  .25  .25  .25  .20  .20  .20  .20
        VCNX     4.   4.   4.   4.   4.   4.   4.   4.   4.   4.   4.   4.

     Urban - high biogenic (controls present)
        BCKPMF  60.  60.  60.  60.  60.  60.  60.  60.  60.  60.  60.  60.
        OFRAC  .25  .25  .30  .30  .30  .55  .55  .55  .35  .35  .35  .25
        VCNX    15.  15.  15.  15.  15.  15.  15.  15.  15.  15.  15.  15.

     Regional Plume
        BCKPMF  20.  20.  20.  20.  20.  20.  20.  20.  20.  20.  20.  20.
        OFRAC  .20  .20  .25  .35  .25  .40  .40  .40  .30  .30  .30  .20
        VCNX    15.  15.  15.  15.  15.  15.  15.  15.  15.  15.  15.  15.

     Urban - no controls present
        BCKPMF 100. 100. 100. 100. 100. 100. 100. 100. 100. 100. 100. 100.
        OFRAC  .30  .30  .35  .35  .35  .55  .55  .55  .35  .35  .35  .30
        VCNX     2.   2.   2.   2.   2.   2.   2.   2.   2.   2.   2.   2.

     Default: Clean Continental
     !  BCKPMF = 1.00, 1.00, 1.00, 1.00, 1.00, 1.00, 1.00, 1.00, 1.00, 1.00, 1.00, 1.00 !
     !  OFRAC  = 0.15, 0.15, 0.20, 0.20, 0.20, 0.20, 0.20, 0.20, 0.20, 0.20, 0.20, 0.15 !
     !  VCNX   = 50.00, 50.00, 50.00, 50.00, 50.00, 50.00, 50.00, 50.00, 50.00, 50.00, 50.00, 50.00 !

 --- End Data for SECONDARY ORGANIC AEROSOL (SOA) Option


     Number of half-life decay specification blocks provided in Subgroup 11b
     (Used only if MCHEM = 5)
     (NDECAY)                                   Default: 0      ! NDECAY =  0   !

!END!

--------------
Subgroup (11b)
--------------

     Each species modeled may be assigned a decay half-life (sec), and the associated
     mass lost may be assigned to one or more other modeled species using a mass yield
     factor. This information is used only for MCHEM=5.

     Provide NDECAY blocks assigning the half-life for a parent species and mass yield
     factors for each child species (if any) produced by the decay.
     Set HALF_LIFE=0.0 for NO decay (infinite half-life).
                            a            b
        SPECIES      Half-Life   Mass Yield
         NAME          (sec)       Factor
        -------      ---------   ----------

     *   SPEC1   =    3600.,        -1.0   *    (Parent)
     *   SPEC2   =     -1.0,         0.0   *    (Child)
   *END*
```

```
--------
    a
     Specify a half life that is greater than or equal to zero for 1 parent species
     in each block, and set the yield factor for this species to -1
    b
     Specify a yield factor that is greater than or equal to zero for 1 or more child
     species in each block, and set the half-life for each of these species to -1

     NOTE: Assignments in each block are treated as a separate input
           subgroup and therefore must end with an input group terminator.
           If NDECAY=0, no assignments and input group terminators should appear.

-------------------------------------------------------------------------------
```

Table 9-2 (Continued)

Sample CALPUFF Control File (CALPUFF.INP)

Input Group 12

```
-------------------------------------------------------------------------------
INPUT GROUP: 12 -- Misc. Dispersion and Computational Parameters
---------------

     Horizontal size of puff (m) beyond which
     time-dependent dispersion equations (Heffter)
     are used to determine sigma-y and
     sigma-z (SYTDEP)                           Default: 550.   ! SYTDEP = 1.0E04 !

     Switch for using Heffter equation for sigma z
     as above (0 = Not use Heffter; 1 = use Heffter
     (MHFTSZ)                                   Default: 0      ! MHFTSZ =  1   !

     Stability class used to determine plume
     growth rates for puffs above the boundary
     layer (JSUP)                               Default: 5      ! JSUP =  5   !

     Vertical dispersion constant for stable
     conditions (k1 in Eqn. 2.7-3)  (CONK1)     Default: 0.01   ! CONK1 = 0.01 !

     Vertical dispersion constant for neutral/
     unstable conditions (k2 in Eqn. 2.7-4)
     (CONK2)                                    Default: 0.1    ! CONK2 = 0.1 !

     Factor for determining Transition-point from
     Schulman-Scire to Huber-Snyder Building Downwash
     scheme (SS used for Hs < Hb + TBD * HL)
     (TBD)                                      Default: 0.5    ! TBD = 0.5 !
        TBD < 0   ==> always use Huber-Snyder
        TBD = 1.5 ==> always use Schulman-Scire
        TBD = 0.5 ==> ISC Transition-point

     Range of land use categories for which
     urban dispersion is assumed                Default: 10     ! IURB1 =  10  !
     (IURB1, IURB2)                                      19     ! IURB2 =  19  !

     Site characterization parameters for single-point Met data files ---------
     (needed for METFM = 2,3,4)

        Land use category for modeling domain
        (ILANDUIN)                              Default: 20     ! ILANDUIN =  20  !

        Roughness length (m) for modeling domain
        (Z0IN)                                  Default: 0.25   ! Z0IN = 0.25 !

        Leaf area index for modeling domain
```

```
   (XLAIIN)                                Default: 3.0    ! XLAIIN = 3. !

   Elevation above sea level (m)
   (ELEVIN)                                Default: 0.0    ! ELEVIN = 0. !

   Latitude (degrees) for met location
   (XLATIN)                                Default: -999.  ! XLATIN = 0. !

   Longitude (degrees) for met location
   (XLONIN)                                Default: -999.  ! XLONIN = 0. !

Specialized information for interpreting single-point Met data files -----

   Anemometer height (m) (Used only if METFM = 2,3)
   (ANEMHT)                                Default: 10.    ! ANEMHT = 10. !

   Form of lateral turbulence data in PROFILE.DAT file
   (Used only if METFM = 4 or MTURBVW = 1 or 3)
   (ISIGMAV)                               Default: 1      ! ISIGMAV =  1  !
       0 = read sigma-theta
       1 = read sigma-v

   Choice of mixing heights (Used only if METFM = 4)
   (IMIXCTDM)                              Default: 0      ! IMIXCTDM =  0  !
       0 = read PREDICTED mixing heights
       1 = read OBSERVED mixing heights

Maximum length of a slug (met. grid units)
(XMXLEN)                                   Default: 1.0    ! XMXLEN = 1. !
```

Table 9-2 (Continued)
Sample CALPUFF Control File (CALPUFF.INP)
Input Group 12

```
Maximum travel distance of a puff/slug (in
grid units) during one sampling step
(XSAMLEN)                                  Default: 1.0    ! XSAMLEN = 1. !

Maximum Number of slugs/puffs release from
one source during one time step
(MXNEW)                                    Default: 99     ! MXNEW =  99   !

Maximum Number of sampling steps for
one puff/slug during one time step
(MXSAM)                                    Default: 99     ! MXSAM =  99   !

Number of iterations used when computing
the transport wind for a sampling step
that includes gradual rise (for CALMET
and PROFILE winds)
(NCOUNT)                                   Default: 2      ! NCOUNT =  2   !

Minimum sigma y for a new puff/slug (m)
(SYMIN)                                    Default: 1.0    ! SYMIN = 1.  !

Minimum sigma z for a new puff/slug (m)
(SZMIN)                                    Default: 1.0    ! SZMIN = 1.  !

Default minimum turbulence velocities sigma-v and sigma-w
for each stability class over land and over water (m/s)
(SVMIN(12) and SWMIN(12))

                ----------  LAND  ----------       ---------  WATER  ----------
   Stab Class :  A    B    C    D    E    F         A    B    C    D    E    F
                ---  ---  ---  ---  ---  ---       ---  ---  ---  ---  ---  ---
Default SVMIN : .50, .50, .50, .50, .50, .50,      .37, .37, .37, .37, .37, .37
Default SWMIN : .20, .12, .08, .06, .03, .016,     .20, .12, .08, .06, .03, .016

      ! SVMIN = 0.500, 0.500, 0.500, 0.500, 0.500, 0.500, 0.370, 0.370, 0.370, 0.370, 0.370, 0.370!
      ! SWMIN = 0.200, 0.120, 0.080, 0.060, 0.030, 0.016, 0.200, 0.120, 0.080, 0.060, 0.030, 0.016!

Divergence criterion for dw/dz across puff
used to initiate adjustment for horizontal
convergence (1/s)
Partial adjustment starts at CDIV(1), and
full adjustment is reached at CDIV(2)
(CDIV(2))                                  Default: 0.0,0.0  ! CDIV = 0., 0. !

Search radius (number of cells) for nearest
land and water cells used in the subgrid
TIBL module
(NLUTIBL)                                  Default: 4      ! NLUTIBL =  4  !

Minimum wind speed (m/s) allowed for
non-calm conditions. Also used as minimum
speed returned when using power-law
extrapolation toward surface
(WSCALM)                                   Default: 0.5    ! WSCALM = 0.5 !

Maximum mixing height (m)
(XMAXZI)                                   Default: 3000.  ! XMAXZI = 3000. !
```

```
Minimum mixing height (m)
(XMINZI)                             Default: 50.    ! XMINZI = 50. !

Default wind speed classes --
5 upper bounds (m/s) are entered;
the 6th class has no upper limit
(WSCAT(5))                      Default   :
                                ISC RURAL : 1.54, 3.09, 5.14, 8.23, 10,8 (10.8+)

                         Wind Speed Class :  1     2     3     4     5     6
                                            ---   ---   ---   ---   ---   ---
                                  ! WSCAT = 1.54, 3.09, 5.14, 8.23, 10.80 !

Default wind speed profile power-law
exponents for stabilities 1-6
(PLX0(6))                       Default   : ISC RURAL values
```

Table 9-2 (Continued)

Sample CALPUFF Control File (CALPUFF.INP)

Input Group 12

```
                                ISC RURAL : .07, .07, .10, .15, .35, .55
                                ISC URBAN : .15, .15, .20, .25, .30, .30

                          Stability Class :  A     B     C     D     E     F
                                            ---   ---   ---   ---   ---   ---
                                   ! PLX0 = 0.07, 0.07, 0.10, 0.15, 0.35, 0.55 !


Default potential temperature gradient
for stable classes E, F (degK/m)
(PTG0(2))                       Default: 0.020, 0.035
                                   ! PTG0 = 0.020,   0.035 !

Default plume path coefficients for
each stability class (used when option
for partial plume height terrain adjustment
is selected -- MCTADJ=3)
(PPC(6))                  Stability Class :  A     B     C     D     E     F
                             Default  PPC : .50,  .50,  .50,  .50,  .35,  .35
                                            ---   ---   ---   ---   ---   ---
                                   !  PPC = 0.50, 0.50, 0.50, 0.50, 0.35, 0.35 !

Slug-to-puff transition criterion factor
equal to sigma-y/length of slug
(SL2PF)                               Default: 10.       ! SL2PF = 10. !

Puff-splitting control variables ------------------------

  VERTICAL SPLIT
  --------------

  Number of puffs that result every time a puff
  is split - nsplit=2 means that 1 puff splits
  into 2
  (NSPLIT)                            Default:   3       ! NSPLIT =  3  !

  Time(s) of a day when split puffs are eligible to
  be split once again; this is typically set once
  per day, around sunset before nocturnal shear develops.
  24 values: 0 is midnight (00:00) and 23 is 11 PM (23:00)
  0=do not re-split    1=eligible for re-split
  (IRESPLIT(24))                      Default:  Hour 17 = 1
  !  IRESPLIT = 0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,1,0,0,0,0,0,0 !
```

```
  Split is allowed only if last hour's mixing
  height (m) exceeds a minimum value
  (ZISPLIT)                          Default: 100.       ! ZISPLIT = 100. !

  Split is allowed only if ratio of last hour's
  mixing ht to the maximum mixing ht experienced
  by the puff is less than a maximum value (this
  postpones a split until a nocturnal layer develops)
  (ROLDMAX)                          Default: 0.25       ! ROLDMAX = 0.25 !

  HORIZONTAL SPLIT
  ----------------

  Number of puffs that result every time a puff
  is split - nsplith=5 means that 1 puff splits
  into 5
  (NSPLITH)                          Default:   5        ! NSPLITH =  5  !

  Minimum sigma-y (Grid Cells Units) of puff
  before it may be split
  (SYSPLITH)                         Default:  1.0       ! SYSPLITH = 1.0 !

  Minimum puff elongation rate (SYSPLITH/hr) due to
  wind shear, before it may be split
  (SHSPLITH)                         Default:  2.        ! SHSPLITH = 2. !

  Minimum concentration (g/m^3) of each
  species in puff before it may be split
  Enter array of NSPEC values; if a single value is
  entered, it will be used for ALL species
  (CNSPLITH)                         Default:  1.0E-07   ! CNSPLITH = 1.0E-07 !
```

Table 9-2 (Continued)

Sample CALPUFF Control File (CALPUFF.INP)

Input Group 12, 13

```
Integration control variables ------------------------

  Fractional convergence criterion for numerical SLUG
  sampling integration
  (EPSSLUG)                          Default:   1.0e-04  ! EPSSLUG = 1.0E-04 !


  Fractional convergence criterion for numerical AREA
  source integration
  (EPSAREA)                          Default:   1.0e-06  ! EPSAREA = 1.0E-06 !

  Trajectory step-length (m) used for numerical rise
  integration
  (DSRISE)                           Default:   1.0      ! DSRISE = 1. !


Boundary Condition (BC) Puff control variables ------------------------

  Minimum height (m) to which BC puffs are mixed as they are emitted
  (MBCON=2 ONLY).  Actual height is reset to the current mixing height
  at the release point if greater than this minimum.
  (HTMINBC)                          Default:   500.     ! HTMINBC = 500. !

  Search radius (km) about a receptor for sampling nearest BC puff.
  BC puffs are typically emitted with a spacing of one grid cell
  length, so the search radius should be greater than DGRIDKM.
  (RSAMPBC)                          Default:   10.      ! RSAMPBC = 15. !
```

```
       Near-Surface depletion adjustment to concentration profile used when
       sampling BC puffs?
       (MDEPBC)                            Default:   1        ! MDEPBC = 0. !
          0 = Concentration is NOT adjusted for depletion
          1 = Adjust Concentration for depletion

!END!

-------------------------------------------------------------------------------
INPUT GROUPS: 13a, 13b, 13c, 13d -- Point source parameters
--------------------------------

---------------
Subgroup (13a)
---------------

     Number of point sources with
     parameters provided below      (NPT1)  No default  !  NPT1 =  1  !

     Units used for point source
     emissions below                (IPTU)  Default: 1  !  IPTU =   1  !
           1 =        g/s
           2 =       kg/hr
           3 =       lb/hr
           4 =     tons/yr
           5 =     Odor Unit * m**3/s  (vol. flux of odor compound)
           6 =     Odor Unit * m**3/min
           7 =     metric tons/yr
           8 =     Bq/s  (Bq = becquerel = disintegrations/s)
           9 =     GBq/yr

     Number of source-species
     combinations with variable
     emissions scaling factors
     provided below in (13d)        (NSPT1) Default: 0  !  NSPT1 =  1  !

     Number of point sources with
     variable emission parameters
     provided in external file      (NPT2)  No default  !  NPT2 =  0  !

     (If NPT2 > 0, these point source emissions are read from the file: PTEMARB.DAT)

!END!

---------------
Subgroup (13b)
---------------
```

Table 9-2 (Continued)

Sample CALPUFF Control File (CALPUFF.INP)

Input Group 13

```
                                       a
          POINT SOURCE: CONSTANT DATA
          -----------------------------
                                                                                b          c
  Source       X UTM      Y UTM     Stack    Base     Stack    Exit  Exit    Bldg.  Emission
   No.     Coordinate Coordinate Height Elevation Diameter  Vel.  Temp.   Dwash   Rates
              (km)       (km)       (m)       (m)       (m)  (m/s)  (deg. K)
  ------   ---------- ---------- ------  ------   -------- ----- -------- ----- --------
   1 ! SRCNAM = BLR1 !
   1 ! X =      0.1,      -3.,     40.,   25.,       2.2,   10.,   450.,   1.,   1.7E00,  1.0E00,
                1.0E-02, 1.0E-01, 2.0E-01, 2.4E-01, 2.5E-01, 2.0E-01 !
   1 ! SIGYZI =       3.,      1.5   !
```

```
   1 ! ZPLTFM =       0.   !
   1 ! FMFAC  = 1. !   !END!
--------
    a
     Data for each source are treated as a separate input subgroup
     and therefore must end with an input group terminator.

     SRCNAM  is a 12-character name for a source
             (No default)
     X       is an array holding the source data listed by the column headings
             (No default)
     SIGYZI  is an array holding the initial sigma-y and sigma-z (m)
             (Default: 0.,0.)
     FMFAC   is a vertical momentum flux factor (0. or 1.0) used to represent
             the effect of rain-caps or other physical configurations that
             reduce momentum rise associated with the actual exit velocity.
             (Default: 1.0  -- full momentum used)
     ZPLTFM  is the platform height (m) for sources influenced by an isolated
             structure that has a significant open area between the surface
             and the bulk of the structure, such as an offshore oil platform.
             The Base Elevation is that of the surface (ground or ocean),
             and the Stack Height is the release height above the Base (not
             above the platform).  Building heights entered in Subgroup 13c
             must be those of the buildings on the platform, measured from
             the platform deck.  ZPLTFM is used only with MBDW=1 (ISC
             downwash method) for sources with building downwash. (Default: 0.0)

    b
     0. = No building downwash modeled
     1. = Downwash modeled for buildings resting on the surface
     2. = Downwash modeled for buildings raised above the surface (ZPLTFM > 0.)
     NOTE: must be entered as a REAL number (i.e., with decimal point)

    c
     An emission rate must be entered for every pollutant modeled.
     Enter emission rate of zero for secondary pollutants that are
     modeled, but not emitted.  Units are specified by IPTU
     (e.g. 1 for g/s).

---------------
Subgroup (13c)
---------------

           BUILDING DIMENSION DATA FOR SOURCES SUBJECT TO DOWNWASH
           -------------------------------------------------------
Source                                                                 a
No.       Effective building height, width, length and X/Y offset (in meters)
          every 10 degrees.  LENGTH, XBADJ, and YBADJ are only needed for
          MBDW=2 (PRIME downwash option)
------    --------------------------------------------------------------

 1    ! SRCNAM  =   BLR1 !
 1    ! HEIGHT  =  45.,   45.,   45.,   45.,   45.,   45.,
                   45.,   45.,   45.,   0.,   0.,   0.,
                   0.,   0.,   0.,   0.,   0.,   0.,
                   45.,   45.,   45.,   45.,   45.,   45.,
                   45.,   45.,   45.,   0.,   0.,   0.,
                   0.,   0.,   0.,   0.,   0.,   0.!
 1    ! WIDTH  =   12.5,   12.5,   12.5,   12.5,   12.5,   12.5,
                   12.5,   12.5,   12.5,   0.,   0.,   0.,
                   0.,   0.,   0.,   0.,   0.,   0.,
                   12.5,   12.5,   12.5,   12.5,   12.5,   12.5,
                   12.5,   12.5,   12.5,   0.,   0.,   0.,
                   0.,   0.,   0.,   0.,   0.,   0.!
```

Table 9-2 (Continued)

Sample CALPUFF Control File (CALPUFF.INP)
Input Group 13

```
 1   *  LENGTH = 82.54,  87.58,  89.95,  89.59,  86.51,  80.80,
                 72.64,  62.26,  50.00,  62.26,  72.64,  80.80,
                 86.51,  89.59,  89.95,  87.58,  82.54,  75.00,
                 82.54,  87.58,  89.95,  89.59,  86.51,  80.80,
                 72.64,  62.26,  50.00,  62.26,  72.64,  80.80,
                 86.51,  89.59,  89.95,  87.58,  82.54,  75.00 *
 1   *  XBADJ =  -47.35, -55.76, -62.48, -67.29, -70.07, -70.71,
                 -69.21, -65.60, -60.00, -65.60, -69.21, -70.71,
                 -70.07, -67.29, -62.48, -55.76, -47.35, -37.50,
                 -35.19, -31.82, -27.48, -22.30, -16.44, -10.09,
                 -3.43,   3.34,  10.00,   3.34,  -3.43, -10.09,
                 -16.44, -22.30, -27.48, -31.82, -35.19, -37.50 *
 1   *  YBADJ =  34.47,  32.89,  30.31,  26.81,  22.50,  17.50,
                 11.97,   6.08,   0.00,  -6.08, -11.97, -17.50,
                 -22.50, -26.81, -30.31, -32.89, -34.47, -35.00,
                 -34.47, -32.89, -30.31, -26.81, -22.50, -17.50,
                 -11.97,  -6.08,   0.00,   6.08,  11.97,  17.50,
                 22.50,  26.81,  30.31,  32.89,  34.47,  35.00 *
!END!
--------
    a
     Building height, width, length, and X/Y offset from the source are treated
     as a separate input subgroup for each source and therefore must end with
     an input group terminator.  The X/Y offset is the position, relative to the
     stack, of the center of the upwind face of the projected building, with the
     x-axis pointing along the flow direction.

---------------
Subgroup (13d)
---------------
                                                 a
          POINT SOURCE: VARIABLE EMISSIONS DATA
          ---------------------------------------

     Use this subgroup to describe temporal variations in the emission
     rates given in 13b.  Factors entered multiply the rates in 13b.
     Skip sources here that have constant emissions.  For more elaborate
     variation in source parameters, use PTEMARB.DAT and NPT2 > 0.

     IVARY determines the type of variation, and is source-specific:
     (IVARY)                                Default: 0
           0 =       Constant
           1 =       Diurnal cycle (24 scaling factors: hours 1-24)
           2 =       Monthly cycle (12 scaling factors: months 1-12)
           3 =       Hour & Season (4 groups of 24 hourly scaling factors,
                                    where first group is DEC-JAN-FEB)
           4 =       Speed & Stab. (6 groups of 6 scaling factors, where
                                    first group is Stability Class A,
                                    and the speed classes have upper
                                    bounds (m/s) defined in Group 12
           5 =       Temperature   (12 scaling factors, where temperature
                                    classes have upper bounds (C) of:
                                    0, 5, 10, 15, 20, 25, 30, 35, 40,
                                    45, 50, 50+)

 1  ! SRCNAM = BLR1 !
 1  ! IVARY  =  2  !    (12 Months)
 1  ! SO2          = 0.1,0.1,0.5,0.9,2,2.2,
                   2.5,1.5,1.1,0.9,0.5,0.1      !
!END!
--------
```

```
    a
     Data for each species are treated as a separate input subgroup
     and therefore must end with an input group terminator.
-------------------------------------------------------------------------------

INPUT GROUPS: 14a, 14b, 14c, 14d -- Area source parameters
--------------------------------
---------------
Subgroup (14a)
---------------

     Number of polygon area sources with
    parameters specified below (NAR1)       No default  !  NAR1 =  2   !
```

Table 9-2 (Continued)
Sample CALPUFF Control File (CALPUFF.INP)
Input Group 14

```
     Units used for area source
     emissions below            (IARU)       Default: 1  !  IARU =   1  !
           1 =        g/m**2/s
           2 =       kg/m**2/hr
           3 =       lb/m**2/hr
           4 =     tons/m**2/yr
           5 =     Odor Unit * m/s  (vol. flux/m**2 of odor compound)
           6 =     Odor Unit * m/min
           7 =     metric tons/m**2/yr
           8 =     Bq/m**2/s  (Bq = becquerel = disintegrations/s)
           9 =     GBq/m**2/yr

     Number of source-species
     combinations with variable
     emissions scaling factors
     provided below in (14d)        (NSAR1) Default: 0  !  NSAR1 =  4  !

     Number of buoyant polygon area sources
     with variable location and emission
     parameters (NAR2)                      No default  !  NAR2 =  0   !
     (If NAR2 > 0, ALL parameter data for
     these sources are read from the file: BAEMARB.DAT)

!END!

---------------
Subgroup (14b)
---------------
                                     a
          AREA SOURCE: CONSTANT DATA
          ----------------------------
                                                         b
Source           Effect.    Base      Initial    Emission
 No.             Height   Elevation   Sigma z     Rates
                   (m)       (m)        (m)
-------          ------    ------     --------   ---------

   1! SRCNAM = AREA1 !
   1! X =           1.,      0.,         2.5,   8.5E-01,  0.5E00,  0.0E00,
 0.0E00,  0.0E00,  0.0E00,  0.0E00,  0.0E00 !
!END!
   2! SRCNAM = AREA2 !
   2! X =          1.5,      0.,          3.,    0.0E00,  0.0E00, 1.0E-01,
 0.0E00,  0.0E00, 5.0E-01,  1.0E00,  1.3E00 !
!END!
```

```
--------
    a
     Data for each source are treated as a separate input subgroup
     and therefore must end with an input group terminator.
    b
     An emission rate must be entered for every pollutant modeled.
     Enter emission rate of zero for secondary pollutants that are
     modeled, but not emitted.  Units are specified by IARU
     (e.g. 1 for g/m**2/s).


---------------
Subgroup (14c)
---------------

           COORDINATES (UTM-km) FOR EACH VERTEX(4) OF EACH POLYGON
           --------------------------------------------------------
Source                                                               a
 No.       Ordered list of X followed by list of Y, grouped by source
------     ------------------------------------------------------------

 1    ! SRCNAM  =   AREA1 !
 1      !  XVERT = 0.5,    0.51,    0.51,    0.5!
 1      !  YVERT = 1.61,    1.61,    1.6,    1.6!
!END!
 2    ! SRCNAM  =   AREA2 !
 2      !  XVERT = 0.75,    0.76,    0.76,    0.75!
 2      !  YVERT = 1.81,    1.81,    1.8,    1.8!
!END!
```

Table 9-2 (Continued)

Sample CALPUFF Control File (CALPUFF.INP)

Input Group 14

```
--------
    a
     Data for each source are treated as a separate input subgroup
     and therefore must end with an input group terminator.


---------------
Subgroup (14d)
---------------
                                               a
          AREA SOURCE: VARIABLE EMISSIONS DATA
          ---------------------------------------

     Use this subgroup to describe temporal variations in the emission
     rates given in 14b.  Factors entered multiply the rates in 14b.
     Skip sources here that have constant emissions.  For more elaborate
     variation in source parameters, use BAEMARB.DAT and NAR2 > 0.

     IVARY determines the type of variation, and is source-specific:
     (IVARY)                              Default: 0
           0 =       Constant
           1 =       Diurnal cycle (24 scaling factors: hours 1-24)
           2 =       Monthly cycle (12 scaling factors: months 1-12)
           3 =       Hour & Season (4 groups of 24 hourly scaling factors,
                                    where first group is DEC-JAN-FEB)
           4 =       Speed & Stab. (6 groups of 6 scaling factors, where
                                    first group is Stability Class A,
                                    and the speed classes have upper
                                    bounds (m/s) defined in Group 12
```

```
          5 =       Temperature   (12 scaling factors, where temperature
                                   classes have upper bounds (C) of:
                                   0, 5, 10, 15, 20, 25, 30, 35, 40,
                                   45, 50, 50+)


 2  ! SRCNAM = AREA2 !
 2  ! IVARY  =  4  !    (6 speed classes for each stability)
 2  ! PMSIZE1      = 0.1,0.1,0.5,0.9,1,1.5,
                  0.1,0.1,0.5,0.9,1,1.5,
                  0.1,0.1,0.5,0.9,1,1.5,
                  0.1,0.1,0.5,0.9,1,1.5,
                  0.1,0.1,0.5,0.9,1,1.5,
                  0.1,0.1,0.5,0.9,1,1.5      !
!END!
 2  ! SRCNAM = AREA2 !
 2  ! IVARY  =  4  !    (6 speed classes for each stability)
 2  ! PMSIZE4      = 0.1,0.1,0.5,0.9,1.5,2.2,
                  0.1,0.1,0.5,0.9,1.5,2.2,
                  0.1,0.1,0.5,0.9,1.5,2.2,
                  0.1,0.1,0.5,0.9,1.5,2.2,
                  0.1,0.1,0.5,0.9,1.5,2.2,
                  0.1,0.1,0.5,0.9,1.5,2.2      !
!END!


 2  ! SRCNAM = AREA2 !
 2  ! IVARY  =  4  !    (6 speed classes for each stability)
 2  ! PMSIZE5      = 0.1,0.1,0.5,0.9,2,2.5,
                  0.1,0.1,0.5,0.9,2,2.5,
                  0.1,0.1,0.5,0.9,2,2.5,
                  0.1,0.1,0.5,0.9,2,2.5,
                  0.1,0.1,0.5,0.9,2,2.5,
                  0.1,0.1,0.5,0.9,2,2.5      !
!END!
 2  ! SRCNAM = AREA2 !
 2  ! IVARY  =  4  !    (6 speed classes for each stability)
 2  ! PMSIZE6      = 0.1,0.1,0.5,0.9,2,2.5,
                  0.1,0.1,0.5,0.9,2,2.5,
                  0.1,0.1,0.5,0.9,2,2.5,
                  0.1,0.1,0.5,0.9,2,2.5,
                  0.1,0.1,0.5,0.9,2,2.5,
                  0.1,0.1,0.5,0.9,2,2.5      !
!END!

--------
```

Table 9-2 (Continued)

Sample CALPUFF Control File (CALPUFF.INP)

Input Group 15

```
    a
     Data for each species are treated as a separate input subgroup
     and therefore must end with an input group terminator.

-------------------------------------------------------------------------------

INPUT GROUPS: 15a, 15b, 15c -- Line source parameters
---------------------------

---------------
Subgroup (15a)
---------------
```

```
     Number of buoyant line sources
     with variable location and emission
     parameters (NLN2)                              No default  !  NLN2 =  0   !

     (If NLN2 > 0, ALL parameter data for
      these sources are read from the file: LNEMARB.DAT)

     Number of buoyant line sources (NLINES)        No default   ! NLINES =  2  !

     Units used for line source
     emissions below                (ILNU)          Default: 1  !  ILNU =   1  !
           1 =        g/s
           2 =       kg/hr
           3 =       lb/hr
           4 =     tons/yr
           5 =     Odor Unit * m**3/s  (vol. flux of odor compound)
           6 =     Odor Unit * m**3/min
           7 =     metric tons/yr
           8 =     Bq/s  (Bq = becquerel = disintegrations/s)
           9 =     GBq/yr

     Number of source-species
     combinations with variable
     emissions scaling factors
     provided below in (15c)        (NSLN1) Default: 0  !  NSLN1 =  1  !

     Maximum number of segments used to model
     each line (MXNSEG)                             Default: 7   ! MXNSEG =  7  !

     The following variables are required only if NLINES > 0.  They are
     used in the buoyant line source plume rise calculations.

        Number of distances at which                Default: 6   ! NLRISE =  6  !
        transitional rise is computed

        Average building length (XL)                No default   ! XL = 500. !
                                                    (in meters)

        Average building height(HBL)                No default   ! HBL = 22. !
                                                    (in meters)

        Average building width (WBL)                No default   ! WBL = 18. !
                                                    (in meters)

        Average line source width (WML)             No default   ! WML = 3.2 !
                                                    (in meters)

        Average separation between buildings (DXL)  No default   ! DXL = 22. !
                                                    (in meters)

        Average buoyancy parameter (FPRIMEL)        No default   ! FPRIMEL = 300. !
                                                    (in m**4/s**3)

!END!

---------------
Subgroup (15b)
---------------

          BUOYANT LINE SOURCE: CONSTANT DATA
          ----------------------------------
                                                                                a
```

Table 9-2 (Continued)
Sample CALPUFF Control File (CALPUFF.INP)

Input Group 15

```
Source     Beg. X      Beg. Y      End. X    End. Y     Release    Base        Emission
 No.     Coordinate  Coordinate  Coordinate Coordinate  Height    Elevation      Rates
            (km)        (km)        (km)       (km)       (m)       (m)
------   ----------  ----------  ---------  ----------  -------   ---------    ---------
   1! SRCNAM = LINE1 !
   1! X =       12.,       35.,      12.5,       35.,    22.000,     0.000, 2.3E00, 1.1E00, 0.0E00,
 0.0E00, 0.0E00, 0.0E00, 0.0E00, 0.0E00 !
!END!
   2! SRCNAM = LINE2 !
   2! X =       12.,    35.022,      12.5,    35.022,    22.000,     0.000, 2.3E00, 1.1E00, 0.0E00,
 0.0E00, 0.0E00, 0.0E00, 0.0E00, 0.0E00 !
!END!

--------

    a
     Data for each source are treated as a separate input subgroup
     and therefore must end with an input group terminator.

    b
     An emission rate must be entered for every pollutant modeled.
     Enter emission rate of zero for secondary pollutants that are
     modeled, but not emitted.  Units are specified by ILNTU
     (e.g. 1 for g/s).

---------------
Subgroup (15c)
---------------
                                                        a
          BUOYANT LINE SOURCE: VARIABLE EMISSIONS DATA
          ----------------------------------------------

     Use this subgroup to describe temporal variations in the emission
     rates given in 15b.  Factors entered multiply the rates in 15b.
     Skip sources here that have constant emissions.

     IVARY determines the type of variation, and is source-specific:
     (IVARY)                                Default: 0
           0 =       Constant
           1 =       Diurnal cycle (24 scaling factors: hours 1-24)
           2 =       Monthly cycle (12 scaling factors: months 1-12)
           3 =       Hour & Season (4 groups of 24 hourly scaling factors,
                                    where first group is DEC-JAN-FEB)
           4 =       Speed & Stab. (6 groups of 6 scaling factors, where
                                    first group is Stability Class A,
                                    and the speed classes have upper
                                    bounds (m/s) defined in Group 12
           5 =       Temperature   (12 scaling factors, where temperature
                                    classes have upper bounds (C) of:
                                    0, 5, 10, 15, 20, 25, 30, 35, 40,
                                    45, 50, 50+)


 1  ! SRCNAM = LINE1 !
 1  ! IVARY  =  1  !    (24 Hours)
 1  ! SO2         = 0.1,0.1,0.1,0.2,0.2,0.3,
                  0.3,0.4,0.4,0.5,0.6,1,
                  1,1,1,1,1,1,
                  0.6,0.4,0.3,0.2,0.1,0.1      !
!END!
```

```
--------
    a
     Data for each species are treated as a separate input subgroup
     and therefore must end with an input group terminator.


-------------------------------------------------------------------------------

INPUT GROUPS: 16a, 16b, 16c -- Volume source parameters
---------------------------

---------------
Subgroup (16a)
```

Table 9-2 (Continued)
Sample CALPUFF Control File (CALPUFF.INP)
Input Group 16

```
---------------

     Number of volume sources with
     parameters provided in 16b,c (NVL1)     No default  !  NVL1 =  1   !

     Units used for volume source
     emissions below in 16b       (IVLU)     Default: 1  !  IVLU =   1  !
           1 =        g/s
           2 =       kg/hr
           3 =       lb/hr
           4 =     tons/yr
           5 =     Odor Unit * m**3/s  (vol. flux of odor compound)
           6 =     Odor Unit * m**3/min
           7 =     metric tons/yr
           8 =     Bq/s  (Bq = becquerel = disintegrations/s)
           9 =     GBq/yr

     Number of source-species
     combinations with variable
     emissions scaling factors
     provided below in (16c)      (NSVL1)    Default: 0  !  NSVL1 =  0  !

     Number of volume sources with
     variable location and emission
     parameters                   (NVL2)     No default  !  NVL2 =  0   !

     (If NVL2 > 0, ALL parameter data for
      these sources are read from the VOLEMARB.DAT file(s) )

!END!

---------------
Subgroup (16b)
---------------
                                        a
           VOLUME SOURCE: CONSTANT DATA
           ------------------------------
                                                                      b
        X UTM      Y UTM      Effect.    Base     Initial    Initial    Emission
     Coordinate  Coordinate   Height   Elevation  Sigma y    Sigma z     Rates
        (km)       (km)        (m)       (m)        (m)       (m)
     ----------  ----------   ------    ------    --------   --------   --------

   1! SRCNAM = VOLS1 !
! X =      -5.6,      -1.2,     10.,       0.,       6.2,       6.2, 2.2E00, 4.0E00, 0.0E00,
```

```
 0.0E00, 0.0E00, 0.0E00, 0.0E00, 0.0E00 !
!END!

--------
    a
     Data for each source are treated as a separate input subgroup
     and therefore must end with an input group terminator.

    b
     An emission rate must be entered for every pollutant modeled.
     Enter emission rate of zero for secondary pollutants that are
     modeled, but not emitted.  Units are specified by IVLU
     (e.g. 1 for g/s).



---------------
Subgroup (16c)
---------------
                                                 a
          VOLUME SOURCE: VARIABLE EMISSIONS DATA
          ----------------------------------------

     Use this subgroup to describe temporal variations in the emission
     rates given in 16b.  Factors entered multiply the rates in 16b.
     Skip sources here that have constant emissions.  For more elaborate
     variation in source parameters, use VOLEM.DAT and IGRDVL = 1.

     IVARY determines the type of variation, and is source-specific:
```

Table 9-2 (Continued)

Sample CALPUFF Control File (CALPUFF.INP)

Input Group 17

```
     (IVARY)                               Default: 0
           0 =       Constant
           1 =       Diurnal cycle (24 scaling factors: hours 1-24)
           2 =       Monthly cycle (12 scaling factors: months 1-12)
           3 =       Hour & Season (4 groups of 24 hourly scaling factors,
                                    where first group is DEC-JAN-FEB)
           4 =       Speed & Stab. (6 groups of 6 scaling factors, where
                                    first group is Stability Class A,
                                    and the speed classes have upper
                                    bounds (m/s) defined in Group 12
           5 =       Temperature   (12 scaling factors, where temperature
                                    classes have upper bounds (C) of:
                                    0, 5, 10, 15, 20, 25, 30, 35, 40,
                                    45, 50, 50+)



--------
    a
     Data for each species are treated as a separate input subgroup
     and therefore must end with an input group terminator.

-------------------------------------------------------------------------------

INPUT GROUPS: 17a & 17b -- Non-gridded (discrete) receptor information
-----------------------

---------------
Subgroup (17a)
---------------
```

```
     Number of non-gridded receptors (NREC)  No default  !  NREC =  3   !

!END!

---------------
Subgroup (17b)
---------------
                                               a
           NON-GRIDDED (DISCRETE) RECEPTOR DATA
           ------------------------------------

                  X UTM       Y UTM        Ground        Height   b
Receptor       Coordinate   Coordinate    Elevation   Above Ground
  No.             (km)        (km)           (m)           (m)
--------       ----------   ----------    ---------   ------------
     1 ! X =          1.,         1.,      12.500,       0.000!   !END!
     2 ! X =         2.5,        4.2,      28.100,       0.000!   !END!
     3 ! X =        2.89,        3.2,      39.600,       0.000!   !END!
-------------
    a
     Data for each receptor are treated as a separate input subgroup
     and therefore must end with an input group terminator.

    b
     Receptor height above ground is optional.  If no value is entered,
     the receptor is placed on the ground.
```

Table 9-3: CALPUFF Control File Inputs - Input Group 0

Input File Names

Variable	Type	Description	Default Value
		Input Files	
METDAT	character*70	Meteorological data file created by CALMET	CALMET.DAT
ISCDAT	character*70	Meteorological data file in ISC3 format or extended ISC3 format	ISCMET.DAT
PLMDAT	character*70	Meteorological data file in AUSPLUME format or extended AUSPLUME format	PLMMET.DAT
PRFDAT	character*70	Meteorological data file in CTDM/AERMET profile format	PROFILE.DAT
SFCDAT	character*70	Meteorological data file in CTDM/AERMET surface format	SURFACE.DAT
RSTARTB	character*70	Model restart file read at beginning of run	RESTARTB.DAT
NMETDAT	integer	Number of CALMET files; if more than 1 CALMET file is used, all names must be placed in Subgroup 0a	1
NPTDAT	integer	Number of PTEMARB files placed in Subgroup 0b	0
NARDAT	integer	Number of AREMARB files placed in Subgroup 0c	0
NVOLDAT	integer	Number of VOLEMARB files placed in Subgroup 0d	0
LNDAT	character*70	Arbitrarily-varying buoyant line source emissions file	LNEMARB.DAT
OZDAT	character*70	Ambient ozone measurement file	OZONE.DAT
VDDAT	character*70	User-specified deposition velocity file	VD.DAT
CHEMDAT	character*70	User-specified chemical transformation rate file	CHEM.DAT
AUXEXT	character*70	Extension added to METDAT filename/s for files with auxiliary 2D and 3D data	AUX
H2O2DAT	character*70	User-specified H2O2 measurement file	H2O2.DAT
NH3ZDAT	character*70	User-specified NH3 values for each layer	NH3Z.DAT
HILLDAT	character*70	Subgrid-scale terrain (hill) file in CTDM format	HILL.DAT
RCTDAT	character*70	Subgrid-scale terrain receptor file in CTDM format	HILLRCT.DAT
CSTDAT	character*70	Subgrid-scale coastal boundary file	COASTLN.DAT
BDYDAT	character*70	Mass flux boundary file	FLUXBDY.DAT
BCNDAT	character*70	Boundary concentration file	BCON.DAT

Table 9-3 (Continued)
CALPUFF Control File Inputs - Input Group 0
Output File Names

Variable	Type	Description	Default Value
		Output Files	
PUFLST	character*70	CALPUFF list file	CALPUFF.LST
CONDAT	character*70	CALPUFF output concentration file	CONC.DAT
DFDAT	character*70	CALPUFF output dry deposition flux file	DFLX.DAT
WFDAT	character*70	CALPUFF output wet deposition flux file	WFLX.DAT
VISDAT	character*70	Output relative humidity file (needed for visibility calculations in CALPOST)	VISB.DAT
T2DDAT	character*70	Output 2D temperature file	TK2D.DAT
RHODAT	character*70	Output 2D density file	RHO2D.DAT
RSTARTE	character*70	Model restart file written during run	RESTARTE.DAT
DEBUG	character*70	Puff-tracking data file (created only if LDEBUG = .TRUE. - see Input Group 5)	DEBUG.DAT
FLXDAT	character*70	Mass flux output (time-step)	MASSFLX.DAT
BALDAT	character*70	Mass balance output (time-step)	MASSBAL.DAT
FOGDAT	character*70	Fogging data output (hourly)	FOG.DAT
RISDAT	character*70	Plume rise properties for each rise increment for each model timestep	RISE.DAT

Table 9-3 (Continued)
CALPUFF Control File Inputs - Input Group 0
Input and Output File Names

Input Group 0 consists of several parts. The first part contains the control variables NMETDAT, NMETDOM, NPTDAT, NARDAT, NVOLDAT, and all of the filenames listed above. The remaining parts, Input Groups 0a through 0d, are only needed when more than one CALMET or variable emissions files are used in the simulation. If a number of separate CALMET simulations are made to span the full modeling period, this feature allows a single application of CALPUFF to use all of the CALMET simulations in sequence. This feature is signaled by an NMETDAT value greater than one. Further provision is made to provide multiple CALMET domains through NMETDOM > 1. Similarly, having the ability to use multiple emissions files allows you to place source groups with markedly different time-variations into separate files.

If you have no CALMET file (i.e., you are using one of the other options for providing meteorological data to CALPUFF such as ISC meteorological data), set NMETDAT=0:

```
INPUT GROUP: 0 -- Input and Output File Names

--------------
Default Name  Type          File Name
------------  ----          ---------
CALMET.DAT    input    * METDAT =             *
    or
ISCMET.DAT    input    ! ISCDAT = ISCMET.DAT  !
    or

Provision for multiple input files
----------------------------------

     Number of CALMET.DAT files for run (NMETDAT)
                                Default: 1       ! NMETDAT =   0   !
```

If you have a single CALMET file, set NMETDAT=1:

```
INPUT GROUP: 0 -- Input and Output File Names

--------------
Default Name  Type          File Name
------------  ----          ---------
CALMET.DAT    input    ! METDAT = CALMET.DAT  !
    or
ISCMET.DAT    input    * ISCDAT =             *

Provision for multiple input files
----------------------------------

     Number of CALMET.DAT files for run (NMETDAT)
                                Default: 1       ! NMETDAT =   1   !
```

If you have 3 CALMET files, set NMETDAT=3:

```
INPUT GROUP: 0 -- Input and Output File Names

--------------
Default Name  Type          File Name
------------  ----          ---------
CALMET.DAT    input    * METDAT =             *
    or
ISCMET.DAT    input    * ISCDAT =             *

Provision for multiple input files
----------------------------------

     Number of CALMET.DAT files for run (NMETDAT)
                                     Default: 1       ! NMETDAT =   3   !
```

Table 9-3 (Continued)
CALPUFF Control File Inputs - Input Group 0
Input and Output File Names

and provide all of the CALMET file names in Input Group 0a:

```
-------------
Subgroup (0a)
-------------

  The following CALMET.DAT filenames are processed in sequence if NMETDAT>1

Default Name  Type          File Name
------------  ----          ---------
 none         input    ! METDAT= CALMET1.DAT    !        !END!
 none         input    ! METDAT= CALMET2.DAT    !        !END!
 none         input    ! METDAT= CALMET3.DAT    !        !END!
```

Note that each filename entered in Input Group 0a is treated as a separate input subgroup and therefore must end with the input group terminator (!END!). A total of NMETDAT lines assigning the CALMET file names must be present, and the names must be ordered in the proper sequence (e.g., CALMET results for June must not precede CALMET results for February).

For the emissions files, you may either place a single file name in the main section of Group 0, and place no names in the corresponding subsection, or you may place all names in the subsection (any names placed in the subsection replace any name specified in the main Group). Using the point source variable emissions file as an example, if you have 1 file you may either set the name in the main group:

```
INPUT GROUP: 0 -- Input and Output File Names

--------------
Default Name  Type          File Name
------------  ----          ---------
PTEMARB.DAT   input    ! PTDAT  =  pts1.dat        !

Provision for multiple input files
----------------------------------

     Number of PTEMARB.DAT files for run (NPTDAT)
                                     Default: 0       ! NPTDAT =   0   !
-------------
Subgroup (0b)
-------------

  The following PTEMARB.DAT filenames are processed if NPTDAT>0
  (Any PTEMARB.DAT name provided above is replaced)

Default Name  Type          File Name
------------  ----          ---------
 none         input     * PTDAT =             *   *END*
```

Table 9-3 (Continued)
CALPUFF Control File Inputs - Input Group 0
Input and Output File Names

or set the name in the subgroup:

```
INPUT GROUP: 0 -- Input and Output File Names

--------------
Default Name  Type          File Name
------------  ----          ---------
PTEMARB.DAT   input    * PTDAT  =            *

Provision for multiple input files
----------------------------------

     Number of PTEMARB.DAT files for run (NPTDAT)
                                     Default: 0       ! NPTDAT =   1   !
-------------
Subgroup (0b)
-------------

  The following PTEMARB.DAT filenames are processed if NPTDAT>0
  (Any PTEMARB.DAT name provided above is replaced)

Default Name  Type          File Name
------------  ----          ---------
 none         input     ! PTDAT = pts1.dat   !   !END!
```

Table 9-3 (Continued)
CALPUFF Control File Inputs - Input Group 1
General Run Control Parameters

Variable	Type	Description	Default Value
METRUN	integer	Control parameter for running all periods in met. file (0=no; 1=yes)	0
IBYR	integer	Starting year of the CALPUFF run (four digits)	-
IBMO	integer	Starting month	-
IBDY	integer	Starting day	-
IBHR, IBMIN, IBSEC	integer	Starting time (time at the start of the first period in hours, minutes, seconds)	-
IEYR	integer	Ending year of the CALPUFF run (four digits)	-
IEMO	integer	Ending month	-
IEDY	integer	Ending day	-
IEHR, IEMIN, IESEC	integer	Ending time (time at the end of the last period in hours, minutes, seconds)	-
ABTZ	integer	Time zone example ; (Los Angeles, USA = UTC-0800)	-
NSECDT	integer	Length of modeling time-step (seconds) equal to update period in the primary meteorological data files, or an integer fraction of it (1/2, 1/3 ...)	3600
NSPEC	integer	Total number of species modeled	5
NSE	integer	Number of species emitted	3
ITEST	integer	Flag to stop run after the setup phase (1 = stops the program, 2 = continues with execution after setup)	2

MRESTART	integer	Restart control may direct model to read and/or write a file of puff data which allows a run to be segmented 0 = Do not read or write a restart file 1 = Read a restart file at the beginning of the run 2 = Write a restart file during run 3 = Read a restart file at beginning of run and write a restart file during run	0
NRESPD	integer	Number of periods in restart output cycle; a restart file that is written during the run is refreshed at the end of every cycle 0 = File written only at last period >0 = File updated every NRESPD periods	0

Table 9-3 (Continued)
CALPUFF Control File Inputs - Input Group 1
General Run Control Parameters

Variable	Type	Description	Default Value
METFM	integer	Meteorological data format 1 = CALMET unformatted file (CALMET.DAT) 2 = ISC3 ASCII file (ISCMET.DAT) 3 = AUSPLUME ASCII file (PLMMET.DAT) 4 = CTDMPLUS tower file (PROFILE.DAT) and surface parameters file (SURFACE.DAT) 5 = AERMET tower file (PROFILE.DAT) and surface parameters file (SURFACE.DAT)	1
MPRFFM	integer	1 = CTDM plus tower file (PROFILE.DAT) 2 = AERMET tower file (PROFILE.DAT)	1
AVET	Real	Averaging time (minutes) PG - σ_y is adjusted by the equation $(AVET/PGTIME)^{0.2}$	60.0
PGTIME	Real	Averaging time (minutes) for PG - σ_y	60.0

IOUTU	integer	Output units for conc. and flux files for Dataset v2.2 or later formats 1 = mass - g/m3 (conc) or g/m2/s (dep) 2 = odour – OU odour units (conc) 3 = radiation – Bq/m3 (conc) or Bq/m2/s (dep)	1
IOVERS	integer	Output Dataset format for binary conc. and flux files 1 = Dataset Version 2.1 2 = Dataset Version 2.2	

Table 9-3 (Continued)
CALPUFF Control File Inputs - Input Group 2

Technical Options

Variable	Type	Description	Default Value
MGAUSS	integer	Control variable determining the vertical distribution used in the near field (0 = uniform, 1 = Gaussian)	1
MCTADJ	integer	Terrain adjustment method 0 = no adjustment 1 = ISC-type of terrain adjustment 2 = simple, CALPUFF-type of terrain adjustment 3 = partial plume path adjustment	3
MCTSG	integer	CALPUFF subgrid scale complex terrain module (CTSG) flag (0 = CTSG not modeled, 1 = CTSG modeled)	0
MSLUG	integer	Near-field puffs modeled as elongated "slugs" ? (0 = no, 1 = yes)	0
MTRANS	integer	Transitional plume rise modeled ? (0 = only final rise computed, 1 = transitional rise computed) Note: Transitional plume rise is always computed for sources subject to building downwash effects.	1
MTIP	integer	Stack tip downwash modeled ? 0 = no (i.e., no stack tip downwash) 1 = yes (i.e., use stack tip downwash)	1
MRISE	interger	Method used to compute plume rise for point sources not subject to downwash 1 = Briggs plume rise 2 = Numerical plume rise	1
MBDW	integer	Method used to simulate building downwash? 1 = ISC method 2 = PRIME method	1

MSHEAR	integer	Vertical wind shear above stack top modeled in plume rise? (0 = no, 1 = yes)	0
MSPLIT	integer	Puff splitting allowed ? (0 = no, 1 = yes)	0

Table 9-3 (Continued)
CALPUFF Control File Inputs - Input Group 2

Technical Options

Variable	Type	Description	Default Value
MCHEM	integer	Chemical mechanism flag. 0 = chemical transformation not modeled 1 = transformation rates computed internally (MESOPUFF II scheme) 2 = user specified transformation rates used (If MCHEM = 2, the user must prepare a file (CHEM.DAT) with a diurnal cycle of transformation rates) 3 = transformation rates computed internally (RIVAD/ARM3 scheme) 4 = secondary organic aerosol formation computed (MESOPUFF II scheme for OH) 5 = user-specified half-life with or without transfer to child species 6 = transformation rates computed internally (Updated RIVAD scheme with ISORROPIA equilibrium) 7 = transformation rates computed internally (Updated RIVAD scheme with ISORROPIA equilibrium and CalTech SOA	1
MAQCHEM	integer	Aqueous phase transformation modeled ? (Used only if MCHEM = 6, or 7) (0 = no, 1 = yes, transformation rates and wet scavenging coefficients adjusted for in-cloud aqueous phase reactions)	0

MLWC	integer	Liquid water content flag (0 = water content est. from cloud cover and precipitation; 1 = gridded cloud water data read from CALMET)	1
MWET	integer	Wet removal modeled ? (0 = no, 1 = yes)	1
MDRY	integer	Dry deposition modeled ? (0 = no, 1 = yes) Note: The method used to determine dry deposition velocities is specified by the user on a species-by-species basis in Input Group 3.	1
MTILT	integer	Gravitational settling (plume tilt) modeled? (0= no, 1=yes)	0

Table 9-3 (Continued)
CALPUFF Control File Inputs - Input Group 2

Technical Options

Variable	Type	Description	Default Value
MTURBVW	integer	σv /σθ, σw measurements used? (Used only if MDISP = 1 or 5) 1 = use σv or σθ measurements from PROFILE.DAT to compute σy (valid for METFM = 1, 2, 3, 4) 2 = use σw measurements from PROFILE.DAT to compute σz (valid for METFM = 1, 2, 3, 4) 3 = use both σv /σθ and σw from PROFILE.DAT to compute σy and σz (valid for METFM = 1, 2, 3, 4) 4 = use σθ measurements from PLMMET.DAT to compute σy (valid only if METFM = 3)	3

MDISP	integer	Method used to compute the horizontal and vertical dispersion coefficients 1 = computed from values of σ_v and σ_w from the PROFILE.DAT file 2 = computed from σ_v and σ_w which are calculated internally from the micrometeorological variables (u_*, w_*, L, etc.) 3 = PG dispersion coefficients used in RURAL areas (computed using the ISCST multi-segment approximation) and MP coefficients used in URBAN areas 4 = same as 3 except PG coefficients computed using the MESOPUFF II equations 5 = CTDM sigmas used for stable and neutral conditions, for unstable conditions, sigmas are computed as in MDISP = 3. MDISP = 5 assumes that σ_v and σ_w are read from PROFILE.DAT file.	

Table 9-3 (Continued)
CALPUFF Control File Inputs - Input Group 2
Technical Options

Variable	Type	Description	Default Value

MDISP2	integer	Back-up method used to compute dispersion when measured turbulence data are missing (used only if MDISP = 1 or 5) 2 = computed from σ_v and σ_w which are calculated internally from the micrometeorological variables (u_*, w_*, L, etc.) 3 = PG dispersion coefficients used in RURAL areas (computed using the ISCST multi-segment approximation) and MP coefficients used in URBAN areas 4 = same as 3 except PG coefficients computed using the MESOPUFF II equations	3
MTAULY	integer	[DIAGNOSTIC FEATURE] Method used for Lagrangian timescale for Sigma-y 0=Draxler default 617.284 (s) 1=Computed (OPTION NOT IMPLEMENTED) 10<Direct user input (s) -- e.g., 307	0
MTAUADV	integer	Advective-Decay timescale (s) for Turbulence 0=No turbulence advection 1=Computed (OPTION NOT IMPLEMENTED) 10<Direct user input (s) -- e.g., 800	0
MCTURB	integer	Method used to compute turbulence σ_v & σ_w using micrometeorological variables 1=Standard CALPUFF subroutines 2=AERMOD subroutines	1
MROUGH	integer	PG σ_y and σ_z adjusted for surface roughness ? (0 = no, 1 = yes)	0
MPARTL	integer	Partial plume penetration of elevated inversion for point sources ? (0 = no, 1 = yes)	1
MPARTLBA	integer	Partial plume penetration of elevated inversion for buoyant area sources ? (0 = no, 1 = yes)	
MTINV	integer	Strength of temperature inversion provided in PROFILE.DAT extended records? (0=no, computed from gradients; 1= yes)	0

MPDF	integer	Probability Distribution Function method used for dispersion in the convective boundary layer? (0=no, 1 = yes)	0

Table 9-3 (Continued)
CALPUFF Control File Inputs - Input Group 2

Technical Options

Variable	Type	Description	Default Value
MSGTIBL	integer	Subgrid scale TIBL module used for shoreline? (0 = no, 1 = yes)	0
MBCON	integer	Boundary conditions (concentration) modeled? (0 = no, 1 = yes)	0
MSOURCE	integer	Individual source contributions saved? (0=no, 1 = yes)	0
MFOG	integer	Configure for FOG Model output? (0 = no 1 = yes - report results in PLUME Mode format 2 = yes - report results in RECEPTOR Mode format)	
MREG	integer	Check options for Regulatory values? 0 = NO checks are made 1 = Technical options must conform to USEPA Long Range Transport (LRT) guidance METFM 1 or 2 AVET 60. (min) PGTIME 60. (min) MGAUSS 1 MCTADJ 3 MTRANS 1 MTIP 1 MCHEM 1 or 3 (if modeling SOx, NOx) MWET 1 MDRY 1 MDISP 2 or 3 MPDF 0 if MDISP=3 1 if MDISP=2 MROUGH 0 MPARTL 1 SYTDEP 550. (m) MHFTSZ 0	

Table 9-3 (Continued)
Control File Inputs - Input Group 3
Species List

Input Group 3 consists of two parts. The first part contains a list of species names and a table with four integer flags for each species. These flags indicate if a pollutant is modeled (0=no, 1=yes), emitted (0=no, 1=yes), dry deposited (0=no, 1=yes, treated as a gas with the resistance model, 2=yes, treated as a particle with the resistance model, or 3=yes, user-specified deposition velocities used), and if the species is to be added to group for output by specifying a group number greater than zero. The second part allows one to name the output species groups, if any are identified in the table.

However, the user must first specify the species names to be modeled. Each species is entered on a separate line with ! CSPEC = XXX ! !END!, where XXX is a species name (up to 12 characters in length), and the variable delimiter and group delimiter (!END!) appears on the line. For example, a five-species SO_x, NO_x run with MCHEM=1 would be:

```
INPUT GROUP: 3a, 3b  --  Species list
-------------------
-------------
Subgroup (3a)
-------------
        ! CSPEC = SO2  !       !END!
        ! CSPEC = SO4  !       !END!
        ! CSPEC = NOX  !       !END!
        ! CSPEC = HNO3 !       !END!
        ! CSPEC = NO3  !       !END!
```

The MESOPUFF II chemical transformation option (MCHEM=1) in CALPUFF is designed to simulate the conversion of $SO_2 \rightarrow SO_4^{=}$ and $NO_x \rightarrow HNO_3 : NO_3^{-}$. For this option, five pollutants in CALPUFF are labeled as SO_2, $SO_4^{=}$, NO_x, HNO_3, and NO_3^{-}. If the RIVAD/ARM3 transformation option (MCHEM=3) is selected, NO and NO_2 are explicitly treated, and six pollutants are labeled as SO_2, $SO_4^{=}$, NO, NO_2, HNO_3, and NO_3^{-}. However, by setting the appropriate flags controlling the various technical options (chemical transformation, deposition, etc.), other reactive or non-reactive pollutants can be simulated.

The user has control over which species are to be emitted and dry deposited in a particular run. If the dry deposition flag is set equal to 3 for any pollutant, a file called VD.DAT must be made available to the model. This file contains a diurnal cycle of 24 user-specified deposition velocities for each pollutant flagged.

The last species in (3a) must be 'BCON' when using the boundary condition option (MBCON > 0). Species BCON does not participate in any chemical transformation mechanism and it should typically be modeled without removal. Mass is placed in species BCON when generating boundary condition puffs so that ‘clean’ air entering the modeling domain can be simulated in the same way as ‘polluted’ air.

Table 9-3 (Continued)
Control File Inputs - Input Group 3
Species List

Species-groups can be used to allow mass distributions of particles to be source-specific. In the example provided in Table 9-2, we have defined six particle-sizes as individual species:

```
! CSPEC =          SO2 !         !END!
! CSPEC =          NOX !         !END!
! CSPEC =      PMSIZE1 !         !END!
! CSPEC =      PMSIZE2 !         !END!
! CSPEC =      PMSIZE3 !         !END!
! CSPEC =      PMSIZE4 !         !END!
! CSPEC =      PMSIZE5 !         !END!
! CSPEC =      PMSIZE6 !         !END!

                                                       Dry                OUTPUT GROUP
    SPECIES          MODELED          EMITTED       DEPOSITED                NUMBER
     NAME         (0=NO, 1=YES)    (0=NO, 1=YES)    (0=NO,                 (0=NONE,
   (Limit: 12                                        1=COMPUTED-GAS        1=1st CGRUP,
    Characters                                       2=COMPUTED-PARTICLE   2=2nd CGRUP,
    in length)                                       3=USER-SPECIFIED)     3= etc.)

!         SO2  =         1,               1,           1,                  0   !
!         NOX  =         1,               0,           2,                  0   !
!     PMSIZE1  =         1,               1,           2,                  1   !
!     PMSIZE2  =         1,               1,           2,                  1   !
!     PMSIZE3  =         1,               1,           2,                  1   !
!     PMSIZE4  =         1,               1,           2,                  1   !
!     PMSIZE5  =         1,               1,           2,                  1   !
!     PMSIZE6  =         1,               1,           2,                  1   !

!END!
```

This allows each size to be modeled separately, each with its own mass emission rate and deposition velocity. Several sources in the run could have been given different emission rates for these "species", thereby producing unique mass distributions for their particulate emissions. Prior to reporting any concentrations or deposition fluxes for these individual "species", however, they must be summed to provide the total particulate concentration or deposition flux. This is done through "grouping":

```
-------------
Subgroup (3b)
-------------

! CGRUP =         PM10 !     !END!
```

Table 9-3 (Continued)
Control File Inputs - Input Group 3
Species List

In this case, the species-group name provided to characterize the total concentration is "PM10". Only one group name is required because only one non-zero group number was given in Input Group 3a. This group name must be used later in Input Group 5 when selecting output options for the particulates, and this is the name that will be written to the output files (the list file as well as the concentration/flux files used by the postprocessor). Note that any species not assigned to a non-zero species-group retain the initial species name in the output. Also, the order of names provided in Input Group 3b must be consistent with the group numbers provided in Input Group 3a.

Table 9-3 (Continued)
CALPUFF Control File Inputs - Input Group 4
Map Projection and Grid Control Parameters

Variable	Type	Description	Default Value
PMAP *	char*8	Map projection UTM : Universal Transverse Mercator TTM : Tangential Transverse Mercator LCC : Lambert Conformal Conic PS : Polar Stereographic EM : Equatorial Mercator LAZA : Lambert Azimuthal Equal Area	UTM
FEAST	real	False Easting (km) for PMAP= TTM, LCC, or LAZA	0.0
FNORTH	real	False Easting (km) for PMAP= TTM, LCC, or LAZA	0.0
IUTMZN	integer	UTM zone of coordinates for PMAP=UTM	-
UTMHEM	char*4	Hemisphere (N or S) for PMAP = UTM	N
RLAT0	char*16	Latitude (decimal degrees N or S; e.g., 45.7N) of projection origin for PMAP= TTM, LCC, PS, EM, or LAZA	-
RLON0	char*16	Longitude (decimal degrees E or W; e.g., 75.2E) of projection origin for PMAP= TTM, LCC, PS, EM, or LAZA	-
XLAT1	char*16	Matching parallel #1 of latitude (decimal degrees N or S) for projection (Used only if PMAP= LCC or PS)	-
XLAT2	char*16	Matching parallel #2 of latitude (decimal degrees N or S) for projection (Used only if PMAP= LCC)	-
DATUM	char*8	Datum code for output coordinates	WGS-84
NX	integer	Number of grid cells in the X direction of the meteorological grid	-
NY	integer	Number of grid cells in the Y direction of the meteorological grid	-
NZ	integer	Number of vertical layers	-
DGRIDKM	real	Grid spacing (km) of the meteorological grid	-
ZFACE	real array	Cell face heights (m) for the meteorological grid (NX + 1 values must be entered). Note: Cell center (grid point) height of layer "i" is ((ZFACE(i+1) + (ZFACE(i))/2).	-

XORIGKM	real	Reference X coordinate (km) of the southwest corner of grid cell (1,1) of the meteorological grid	-
YORIGKM	real	Reference Y coordinate (km) of the southwest corner of grid cell (1,1) of the meteorological grid	-

* PMAP = PS, EM, and LAZA is NOT AVAILABLE in CALMET

Table 9-3 (Continued)

CALPUFF Control File Inputs - Input Group 4

Grid Control Parameters

Variable	Type	Description	Default Value
IBCOMP	integer	X index of lower left corner of the computational grid ($1 \le$ IBCOMP $\le$ NX)	-
JBCOMP	integer	Y index of lower left corner of the computational grid ($1 \le$ JBCOMP $\le$ NY)	-
IECOMP	integer	X index of upper right corner of the computational grid (IBCOMP < IECOMP $\le$ NX)	-
JECOMP	integer	Y index of upper right corner of computational grid (JBCOMP < JECOMP $\le$ NY)	-
LSAMP	integer	Flag indicating if an array of gridded receptors (i.e., sampling grid) is used (T = yes, F = no)	T
IBSAMP	integer	X index of lower left corner of the sampling grid (IBCOMP $\le$ IBSAMP $\le$ IECOMP)	-
JBSAMP	integer	Y index of lower left corner of the sampling grid (JBCOMP $\le$ JBSAMP $\le$ JECOMP)	-
IESAMP	integer	X index of upper right corner of the sampling grid (IBCOMP $\le$ IESAMP $\le$ IECOMP)	-
JESAMP	integer	Y index of upper right corner of the sampling gird (JBCOMP $\le$ JESAMP $\le$ JECOMP)	-
MESHDN	integer	Nesting factor of the sampling grid (MESHDN $\ge$ 1). The grid spacing of the sampling grid is DGRIDKM/MESHDN. The number of sampling grid points is NXSAM * NYSAM, where NXSAM = MESHDN * (IESAMP - IBSAMP) + 1 NYSAM = MESHDN * (JESAMP - JBSAMP) + 1	1

Table 9-3 (Continued)
CALPUFF Control File Inputs - Input Group 5

Output Options

Variable	Type	Description	Default Value
ICON	integer	Control variable for creation of an output disk file (CONC.DAT) containing concentration fields (species stored in this file are controlled by the output species table described below). (0 = do not create CONC.DAT, 1 = create CONC.DAT)	1
IDRY	integer	Control variable for creation of an output disk file (DFLX.DAT) containing dry flux fields. (The species stored in this file are controlled by the output species table in Input Group 5 described below.) (0 = do not create DFLX.DAT, 1 = create DFLX.DAT)	1
IWET	integer	Control variable for creation of an output disk file (WFLX.DAT) containing wet flux fields. (The species stored in this file are controlled by the output species table in Input Group 5 described below.) (0 = do not create WFLX.DAT, 1 = create WFLX.DAT)	1
IT2D	integer	Control variable for creation of an output disk file containing 2D temperature fields. (0 = do not create, 1 = create)	0
IRHO	integer	Control variable for creation of an output disk file containing 2D density fields. (0 = do not create, 1 = create)	0
IVIS	integer	Control variable for creation of an output disk file containing relative humidity data required for visibility applications	1
LCOMPRS	logical	Use data compression on output file (T = true or, F = false)	T
IQAPLOT	integer	Create a standard series of output files (e.g. locations of sources, receptors, grids ...) suitable for plotting? (0 = do not create, 1 = create)	0

IMFLX	integer	Control variable for creating output disc file (MASSFLX.DAT) for mass flux across user-specified boundaries (0 = do not create MASSFLX.DAT, 1 = create MASSFLX. DAT)	0

Table 9-3 (Continued)
CALPUFF Control File Inputs - Input Group 5

Output Options

Variable	Type	Description	Default Value
IMBAL	integer	Control variable for creating output disk file (MASSBAL.DAT) for mass balance results (0 = do not create MASSBAL.DAT, 1 = create MASSBAL. DAT)	0
INRISE	integer	Create a file with plume properties for each rise increment for each model time step (0 = no, 1 = yes)	0
ICPRT	integer	Control variable for printing of concentration fields to the output list file (CALPUFF.LST). (0 = do not print any dry fluxes, 1 = print dry fluxes indicated in output table)	0
IDPRT	integer	Control variable for printing of dry flux fields to the output list file (CALPUFF.LST). (0 = do not print any dry fluxes, 1 = print dry fluxes indicated in output table)	0
IWPRT	integer	Control variable for printing of wet flux fields to the output list file (CALPUFF.LST). (0 = do not print any wet fluxes, 1 = print wet fluxes indicated in output table) 0	0
ICFRQ	integer	Printing interval for the concentration fields. Concentrations are printed every "ICFRQ" time steps. (Used only if ICPRT = 1.)	1
IDFRQ	integer	Printing interval for the dry flux fields. Dry fluxes are printed every "IDFRQ" time steps. (Used only if IDPRT = 1.)	1
IWFRQ	integer	Printing interval for the wet flux fields. Wet fluxes are printed every "IWFRQ" time steps. (Used only if IWPRT = 1.)	1

IPRTU	integer	Control variable for selecting units used for concentrations and deposition fluxes reported in the list file Concentration Deposition 1 = g/m**3 g/m**2/s 2 = mg/m**3 mg/m**2/s 3 = ug/m**3 ug/m**2/s 4 = ng/m**3 ng/m**2/s 5 = odor units (OU)	1
IMESG	integer	Control variable determining if messages tracking the progress of the run are written to the screen 0 = no 1 = yes (advection step, puff ID) 2 = yes (YYYYJJJHH, SSSS, # old puffs, # emitted puffs)	2

Table 9-3 (Continued)
CALPUFF Control File Inputs - Input Group 5

Output Options

Variable	Type	Description	Default Value
LDEBUG	logical	Control variable for activation of "debug" write statements	F
IPFDEB	integer	Puff ID number to start tracking in debug option (used only if LDEBUG = T)	1
NPFDEB	integer	Number of puffs to track in debug option (used only if LDEBUG = T)	1
NN1	integer	Time period to begin debug output (used only if LDEBUG = T)	1
NN2	integer	Time period to stop debug output (used only if LDEBUG = T)	10

In addition to the variables described above, Input Group 5 also contains a table of species with a series of flags indicating if the pollutant's concentration and wet/dry flux fields are to be printed to the output list file (CALPUFF.LST) and/or stored in the output disk files (CONC.DAT, DFLX.DAT, WFLX.DAT, and MASSFLX.DAT).

The format of the species output table is shown below. A value of 0 indicates "no", and a value of 1 indicates "yes". Note that the names provided here must be the output species names, which would be the species-group names if any species were grouped in Input Group 4.

```
     SPECIES (or GROUP for combined species) LIST FOR OUTPUT OPTIONS

             ---- CONCENTRATIONS ----   ------ DRY FLUXES ------   ------ WET FLUXES ------   -- MASS FLUX --
   SPECIES
   /GROUP    PRINTED?  SAVED ON DISK?   PRINTED?  SAVED ON DISK?   PRINTED?  SAVED ON DISK?   SAVED ON DISK?
   -------   ------------------------   ------------------------   ------------------------   ---------------
!    SO2 =       1,           1,           0,           1,           0,           0,                 0   !
!    NOX =       1,           1,           0,           1,           0,           0,                 0   !
!   PM10 =       1,           1,           0,           1,           0,           0,                 0   !
```

Species BCON, which is required when using the boundary condition option (MBCON > 0), does not need to be saved on disk or written to the list file. Select all zeroes for species BCON to avoid creating output files that are larger than needed:

```
!   BCON =       0,           0,           0,           0,           0,           0,                 0   !
```

Table 9-3 (Continued)
CALPUFF Control File Inputs - Input Group 6
Subgrid Scale Complex Terrain (CTSG) Inputs

Variable	Type	Description	Default Value
		(Input Group 6a - General CTSG Parameters)	
NHILL	integer	Number of subgrid scale terrain features	0
NCTREC	integer	Number of special subgrid scale complex terrain receptors	0
MHILL	integer	Terrain and receptor data for CTSG hills input in CTDM format ? (1 = data created by CTDM processors and read from HILL.DAT and HILLRCT.DAT files; 2 = hill data created by OPTHILL & input below in Subgroup (6b)).	-
XHILL2M	real	Factor to convert horizontal dimensions to meters (used only if MHILL = 1)	1.0
ZHILL2M	real	Factor to convert vertical dimensions to meters (used only if MHILL = 1)	1.0
XCTDMKM	real	X-origin of CTDM system relative to CALPUFF coordinate system, in Kilometers (MHILL = 1)	-
YCTDMKM	real	Y-origin of CTDM system relative to CALPUFF coordinate system, in Kilometers (MHILL = 1)	-
		(Input Group 6b - Hill Information)	
XC	real	UTM X coordinate (km) of the center of the hill on the meteorological grid	-
YC	real	UTM Y coordinate (km) of the center of the hill on the meteorological grid	-
THETAH	real	Orientation of the major axis of the hill (in degrees) clockwise from north	-
ZGRID	real	Height (m) of the "zero-plane" of the grid above mean sea level	-
RELIEF	real	Height (m) of the crest of the hill above the grid elevation	-
EXPO1	real	Hill shape exponent for the major axis of the hill	-
EXPO2	real	Hill shape exponent for the minor axis of the hill	-
SCALE1	real	Horizontal length scale of the hill along the major axis	-
SCALE2	real	Horizontal length scale of the hill along the minor axis	-

Variable	Type	Description	Default Value
AMAX1	real	Maximum allowed axis length of the major axis of the hill	-
AMAX2	real	Maximum allowed axis length of the minor axis of the hill	-

Table 9-3 (Continued)
CALPUFF Control File Inputs - Input Group 6
Subgrid Scale Complex Terrain (CTSG) Inputs

The variables in Input Group 6b are entered for each of the "NHILL" subgrid scale hills treated in the model run. The data for each hill is treated as a separate input subgroup, and therefore must end with an input group terminator (i.e., !END!). The format of Input Group 6b is shown below.

```
-------------
Subgroup (6b)
-------------

                     1 **
   HILL INFORMATION


HILL          XC        YC      THETAH  ZGRID   RELIEF  EXPO 1  EXPO 2   SCALE 1  SCALE 2  AMAX1   AMAX2
 NO.         (km)      (km)     (deg.)   (m)      (m)     (m)     (m)       (m)      (m)     (m)     (m)
----         ----      ----     ------  -----   ------  ------  ------   -------  -------  -----    -----
 1 ! HILL = 170.5,    3841.0 ,  69.  , 1310. ,  300.  , 1.91 , 1.24  ,   1523. ,  2896.  , 2000., 1500. !   !END!
 2 ! HILL = 173.0,    3839.0 ,  49.  , 1310. ,  230.  , 1.50 , 1.50  ,   3000. ,  1000.  , 4000., 2000. !   !END!
```

Note that the hill number is an optional user comment which is outside of the delimiters containing the required data. The data for each hill must follow the opening delimiter and "HILL=". The data for each hill is followed by a closing delimiter and an input group terminator (i.e., !END!).

Table 9-3 (Continued)
CALPUFF Control File Inputs - Input Group 6
Subgrid Scale Complex Terrain (CTSG) Inputs

Variable	Type	Description	Default Value
		(Input Group 6c - CTSG Receptor Data)	
XRCT	real	X coordinate (km) on the meteorological grid system of a CTSG receptor	-
YRCT	real	Y coordinate (km) on the meteorological grid system of a CTSG receptor	-
ZRCT	real	Height (m) of the ground above mean sea level at the CTSG receptor	-
XHH	real	Hill number associated with this CTSG receptor	-

The variables in Input Group 6c are entered for each of the "NCTREC" complex terrain receptors in the model run. <u>The data for each receptor is treated as a separate input subgroup, and therefore must end with an input group terminator (i.e., !END!)</u>. The format of Input Group 6c is shown below.

```
-------------
Subgroup (6c)
-------------

                                      1  **
   COMPLEX TERRAIN RECEPTOR INFORMATION

            XRCT    YRCT         ZRCT      XHH
            (km)    (km)          (m)
           --------------      -----     ----
! CTREC =  170.5, 3840.0   ,  1430.  ,    1.  !   !END!
! CTREC =  169.0, 3840.5   ,  1430.  ,    1.  !   !END!
! CTREC =  170.5, 3841.0   ,  1580.  ,    1.  !   !END!
! CTREC =  173.5, 3840.0   ,  1525.  ,    2.  !   !END!
! CTREC =  172.5, 3840.0   ,  1430.  ,    2.  !   !END!

-------------------
```

** The data for each CTSG receptor must follow an opening delimiter and "CTREC=". The data for each receptor is followed by a closing delimiter and an input group terminator (i.e., !END!).

Table 9-3 (Continued)
CALPUFF Control File Inputs - Input Group 7
Dry Deposition Parameters - Gases

Input Group 7 consists of a table containing the following five parameters which are required by the resistance deposition model for computing deposition velocities for gases:

- Pollutant diffusivity (cm^2/s)
- Aqueous phase dissociation constant, α_*
- Pollutant reactivity
- Mesophyll resistance, r_m (s/cm)
- Henry's Law coefficient, H (dimensionless)

These parameters must be specified for each pollutant with a dry deposition flag of "1" in the species list (Input Group 3) indicating the use of the resistance model for a gas.

The format of the input table is shown below:

```
-------------------------------------------------------------------------------------------------------------------

INPUT GROUP: 7 -- Chemical parameters for dry deposition of gases
--------------------------

SPECIES  DIFFUSIVITY  ALPHA STAR   REACTIVITY     MESOPHYLL RESISTANCE     HENRY'S LAW COEFFICIENT
 NAME     (cm**2/s)                                       (s/cm)                   (dimensionless)
-------  -----------  ----------   ----------     --------------------     -----------------------

! SO2  =   0.1509   ,   1.00E3   ,     8.0      ,           0.0         ,            4.e-2         !
! NOX  =   0.1656   ,   1.00     ,     8.0      ,           5.0         ,            3.5           !
! HNO3 =   0.1628   ,   1.00     ,    18.0      ,           0.0         ,            8.e-8         !

!END!
```

Table 9-3 (Continued)
CALPUFF Control File Inputs - Input Group 8
Dry Deposition Parameters - Particles

Input Group 8 consists of a table containing the geometric mass mean diameter (microns) and the geometric standard deviation (microns) required by the resistance deposition model for computing deposition velocities for particulate matter.

These parameters must be specified for each pollutant with a dry deposition flag of "2" in the species list (Input Group 3) indicating the use of the resistance model for a pollutant deposited as particulate matter.

The format of the input table is shown below:

```
--------------------------------------------------------------------------------------------------------------

INPUT GROUP: 8 -- Size parameters for dry deposition of particles
------------------

SPECIES     GEOMETRIC MASS MEAN       GEOMETRIC STANDARD
 NAME           DIAMETER                  DEVIATION
                (microns)                 (microns)
------------   ---------------------------------------
! SO4    =        0.48            ,          2.00     !
! NO3    =        0.48            ,          2.00     !
! PM10 =          0.48            ,          2.00     !


!END!
```

Table 9-3 (Continued)
CALPUFF Control File Inputs - Input Group 9
Miscellaneous Dry Deposition Parameters

Variable	Type	Description	Default Value
RCUTR	real	Reference cuticle resistance (s/cm)	30.
RGR	real	Reference ground resistance (s/cm)	10.
REACTR	real	Reference pollutant reactivity	8.
NINT	integer	Number of particle-size intervals used to evaluate effective particle deposition velocity	9
IVEG	integer	Flag specifying the state of vegetation in unirrigated areas 1 = vegetation is active and unstressed 2 = vegetation is active and stressed 3 = vegetation is inactive	1

CALPUFF Control File Inputs - Input Group 10
Wet Deposition Parameters

Input Group 10 consists of a table containing pollutant-dependent values of the scavenging coefficient, 8, for both liquid and frozen precipitation types. The format of the input table is shown below.

```
-----------------------------------------------------------------------------------------------

INPUT GROUP: 10 -- Wet Deposition Parameters
--------------------------------------------


                    Scavenging Coefficient -- Units: (sec)^-1

     Pollutant   Liquid Precip.          Frozen Precip.
     ---------   --------------          --------------
     !   SO2  =      3.0e-5     ,             0.0       !
     !   SO4  =     10.0e-5     ,             3.0e-5    !
     !   NOX  =      0.0        ,             0.0       !
     !  HNO3  =      6.0e-5     ,             0.0       !
     !   NO3  =     10.0e-5     ,             3.0e-5    !

!END!
```

Table 9-3 (Continued)
CALPUFF Control File Inputs - Input Group 11
Chemistry Parameters

CALPUFF contains several chemical transformation mechanisms. The parameters required for each chemical mechanism are included in this table below. The various chemical names are; MOZ, BCKO3, MNH3, MAVGNH3, BCKNH3, RNITE1, RNITE2, RNITE3, MH2O2, BCKH2O2, BCKPMF, OFRAC, VCNX, NDECAY.

Mechanism (MCHEM)	MOZ	BCKO3	MNH3	MAVGNH3	BCKNH3	RNITE1	RNITE2	RNITE3	MH2O2	BCKH2O2	BCKPMF	OFRAC	VCNX	NDECAY
0 none	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1 MESOPUFF II	X	X	-	-	X	X	X	X	-	-	-	-	-	-
2 User Rates	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3 RIVAD	X	X	-	-	X	-	-	-	-	-	-	-	-	-
4 SOA	X	X	-	-	-	-	-	-	-	-	X	X	X	-
5 Radioactive Decay	-	-	-	-	-	-	-	-	-	-	-	-	-	X
6 RIVAD/ISORRPIA	X	X	X	X	X	X	-	-	X	X	-	-	-	-
7 RIVAD/ISORRPIA/SOA	X	X	X	X	X	X	-	-	X	X	X	X	-	-

Variable	Type	Description	Default Value
MOZ	integer	Control variable for the input of ozone data used in the chemical transformation module (Used only if MCHEM = 1,3,4) 0 = use a monthly background ozone value in chemistry calculation 1 = use ozone concentrations from the OZONE.DAT data file	1
BCKO3(12)	real array	Monthly background ozone concentration in ppb (Used only if MCHEM=1,3,4,6 or 7 and MOZ = 0 or if (MOZ=1 and all hourly ozone data are missing))	12*80.
MNH3	integer	Ammonia data option (used only if MCHEM=6 or 7)	0
MAVGNH3	integer	Ammonia vertical averaging option (used only if MCHEM = 6 or 7, and MNH3 = 1)	1

BCKNH3(12)	real	Monthly background ammonia concentration in ppb (Used only if MCHEM = 1 or 3, or if MCHEM = 6 or 7 and MNH3 =0)	12*10.
RNITE1	real	Nighttime SO_2 loss rate in percent/hour (Used only if MCHEM = 1, 6, or 7)	0.2
RNITE2	real	Nighttime NO_x loss rate in percent/hour (Used only if MCHEM = 1)	2.0

Table 9-3 (Continued)
CALPUFF Control File Inputs - Input Group 11
Chemistry Parameters

Variable	Type	Description	Default Value
RNITE3	real	Nighttime HNO_3 formation rate in percent/hour (Used only if MCHEM =1)	2.0
MH2O2	integer	Control variable for the input of hourly ozone data used in the chemical transformation module (Used only if MCHEM = 6 or 7 and MAQCHEM =1) 0 = use a monthly background H_2O_2 value 1 = use H_2O_2 concentrations from the H2O2.DAT data file	1
BCKH2O2(12)	Real array	Monthly background H_2O_2 concentration in ppb (Used only if MAQCHEM=1 and MH2O2 or if (MH2O2=1 and all hourly H_2O_2 data are missing))	12*1.
BCKPMF(12)	real array	Data for Secondary Organic Aerosol (SOA) (Used only if MCHEM=4 or 7). For MCHEM = 4 SOA uses monthly values of fine particulate concentration in ug/m^3	
		for Clean Continental (default)	12*1
		for Clean Marine (surface) (12*0.5)	
		for Urban – low biogenic (controls present) (12*30)	
		for Urban – high biogenic (controls present) (12*60)	
		Regional Plume (12*20)	
		Urban – (no controls present) (12*100)	

OFRAC(12)	real array	Data for Secondary Organic Aerosol (SOA) (Used only if MCHEM = 4 or 7). For MCHEM = 4 SOA uses monthly organic fraction of fine particulate for Clean Continental (default) for Clean Marine (surface) (2*0.25, 9*30, 0.25) for Urban – low biogenic (2*0.2,6*0.25,4*0.20) for Urban – high biogenic (2*0.25,3*0.3,3*0.55,3*0.35, 1*0.25) Regional Plume – (2*0.2,1*0.25,1*0.35,1*0.25, 3*0.4,3*0.3, 1*0.2) Urban – (no controls) - (2*0.3,3*0.35,3*0.55,3*0.35, 1*0.3	2*0.15, 9*0.20, 0.15
VCNX(12)	real array	Data for Secondary Organic Aerosol (SOA) (Used only if MCEHM = 4). Monthly VOC / NOX ratio (after reaction) for Clean Continental (default) for Clean Marine (surface) (12*50.0) for Urban – low biogenic (controls present) (12*4.0) for Urban – high biogenic (controls present) (12*15.0) Regional plume –(12*15.0) Urban – no controls present (12*2.0)	12*50.0
NDECAY	integer	Number of half-life decay specification blocks (Used only if MCHEM = 5)	0

Table 9-3 (Continued)
CALPUFF Control File Inputs - Input Group 11b
Chemistry Parameters

Input Group 11b consists of a table containing the number of half-life decay specifications for each radioactive species specified in Input Group 3. The 24 radioactive species of Input Group 3 are;

```
! CSPEC =          H-3 !          !END!
! CSPEC =         HE-3 !          !END!
! CSPEC =         C-14 !          !END!
! CSPEC =         N-14 !          !END!
! CSPEC =        CO-58 !          !END!
! CSPEC =        FE-58 !          !END!
! CSPEC =        CO-60 !          !END!
! CSPEC =        NI-60 !          !END!
! CSPEC =        KR-85 !          !END!
! CSPEC =        RB-85 !          !END!
! CSPEC =        I-131 !          !END!
! CSPEC =      XE-131M !          !END!
! CSPEC =       XE-131 !          !END!
! CSPEC =        I-133 !          !END!
! CSPEC =      XE-133M !          !END!
! CSPEC =       XE-133 !          !END!
! CSPEC =       CS-133 !          !END!
! CSPEC =       CS-134 !          !END!
! CSPEC =       BA-134 !          !END!
! CSPEC =       XE-134 !          !END!
! CSPEC =       CS-137 !          !END!
! CSPEC =      BA-137M !          !END!
! CSPEC =       BA-137 !          !END!
```

Each species modeled is assigned a decay half-life (sec), and the associated mass lost may be assigned to one or more other modeled species using a mass yield factor. CALPUFF includes NDECAY blocks which assign the half-life for a parent species and mass yield factors for each child species (if any) produced by the decay. An example of the CALPUFF default values for the 23 radioactive species is as follows;

```
Set HALF_LIFE=0.0 for NO decay (infinite half-life).
                              a            b
        SPECIES      Half-Life   Mass Yield
         NAME          (sec)       Factor
        -------      ---------   ----------
   !         H-3 = 388523520.0,   -1.0    !    (Parent)
   !        HE-3 =   -1.0, 1.0 !    (Child)   !END!

   !        C-14 = 179755200000.0,   -1.0    !    (Parent)
   !        N-14 =   -1.0, 1.0 !    (Child)   !END!

   !       CO-58 = 6122304.0,   -1.0    !    (Parent)
   !       FE-58 =   -1.0, 1.0 !    (Child)   !END!

   !       CO-60 = 166235716.8,   -1.0    !    (Parent)
   !       NI-60 =   -1.0, 1.0 !    (Child)   !END!

   !       KR-85 = 339201216.0,   -1.0    !    (Parent)
   !       RB-85 =   -1.0, 1.0 !    (Child)   !END!

   !       I-131 = 692988.48,   -1.0    !    (Parent)
   !      XE-131 =   -1.0, .98824 !    (Child)
   !     XE-131M =   -1.0, .011759 !    (Child)   !END!
```

Table 9-3 (Continued)
CALPUFF Control File Inputs - Input Group 11b
Chemistry Parameters

```
!        I-133 = 74880.0,   -1.0    !    (Parent)
!       XE-133 =   -1.0, .97115 !    (Child)
!      XE-133M =   -1.0, .028846 !    (Child)   !END!

!      XE-133M = 189216.0,   -1.0    !    (Parent)
!       XE-133 =   -1.0, 1.0 !    (Child)   !END!

!       XE-133 = 452995.2,   -1.0    !    (Parent)
!       CS-133 =   -1.0, 1.0 !    (Child)   !END!

!       CS-134 = 65115540.0,   -1.0    !    (Parent)
!       BA-134 =   -1.0, 1.0 !    (Child)
!       XE-134 =   -1.0, .000003 !    (Child)   !END!

!       CS-137 = 951336000.0,   -1.0    !    (Parent)
!       BA-137 =   -1.0, .056005 !    (Child)
!      BA-137M =   -1.0, .94399 !    (Child)   !END!

!      BA-137M = 153.1188,   -1.0    !    (Parent)
!       BA-137 =   -1.0, 1.0 !    (Child)   !END!
```

----

a
Specify a half life that is greater than or equal to zero for 1 parent species in each block, and set the yield factor for this species to -1

b
Specify a yield factor that is greater than or equal to zero for 1 or more child species in each block, and set the half-life for each of these species to -1

NOTE: Assignments in each block are treated as a separate input subgroup and therefore must end with an input group terminator. If NDECAY=0, no assignments and input group terminators should appear.

Table 9-3 (Continued)
CALPUFF Control File Inputs - Input Group 12
Dispersion and Computational Parameters

Variable	Type	Description	Default Value
SYTDEP	real	Horizontal size of a puff (m) beyond which the time-dependent dispersion equation of Heffter (1965)	550.
MHFTRZ	integer	Use Heffter formulas for σ_z ? (0 = no; 1 = yes). If yes, the distance at which the Heffter formula will be applied for σ_z is determined by when σ_y switches to Heffter's eqn. (see SYTDEP).	0
JSUP	integer	Stability class used to determine dispersion rates for puffs above the boundary layer (e.g., 6 = F stability)	5
CONK1	real	Vertical dispersion constant for stable conditions	0.01
CONK2	real	Vertical dispersion constant for neutral/unstable conditions	0.10
TBD	real	Factor for determining transition-point from Schulman-Scire to Huber-Snyder Building Downwash scheme (SS used for Hs < Hb + TBD * HL) TBD < 0 always use Huber-Snyder TBD = 1.5 always use Schulman-Scire TBD = 0.5 ISC transition-point	0.5
IURB1, IURB2	integer	Land use categories associated with urban areas. If MDISP = 3 or 4, MP dispersion coefficients are used when puff is over land use type IURB1 through IURB2	10,19
		(Site characterization parameters for single-point met. data files*)	
*ILANDUIN	integer	Land use category for modeling domain	20
*Z0IN	real	Roughness length (m) for modeling domain	0.25
*XLAIIN	real	Leaf area index for modeling domain	3.0
*ELEVIN	real	Elevation (m) above sea level	0.0
*XLATIN	real	North Latitude (deg) of station; positive for the northern hemisphere, negative for the southern hemisphere (used for solar angle in RIVAD/ARM3 chem. transformation)	-999.
*XLONIN	real	West Longitude (deg) of station; positive west of 0.0, negative east of 0.0 (used for solar angle in RIVAD/ARM3 chem. transformation)	-999.

*ANEMHT	real	Anemometer height (m) (used only if METFM = 2,3)	10.0

Table 9-3 (Continued)
CALPUFF Control File Inputs - Input Group 12
Dispersion and Computational Parameters

Variable	Type	Description	Default Value
*ISIGMAV	integer	Form of lateral turbulence data in PROFILE.DAT file (used only if METFM = 4 or MTURBVW = 1 or 3) 0 = read sigma-theta 1 = read sigma-v	1
*IMIXCTDM	integer	Choice of mixing heights (used only if METFM = 4) 0 = read PREDICTED mixing heights 1 = read OBSERVED mixing heights	0
XMXLEN	real	Maximum length of an emitted slug (in met. grid units)	1.0
XSAMLEN	real	Maximum travel distance of a slug or puff (in met. grid units) during one sampling step	1.0
MXNEW	integer	Maximum number of puffs or slugs released from one source during one time step (serves as a cap if XMXLEN is specified too small)	99
MXSAM	integer	Maximum number of sampling steps during one time step for a puff or slug (serves as a cap if XSAMLEN is specified too small)	99
NCOUNT	integer	Number of iterations used when computing the transport wind for a sampling step that includes transitional plume rise (used when METFM=1 or 4)	2
SYMIN	real	Minimum σ_y (m) a new puff or slug	1.0
SZMIN	real	Minimum σ_z (m) a new puff or slug	1.0
SZCAP_M	real	Maximum σ_z (m) allowed to avoid numerical problem in calculating virtual time/distance	5.0E06
SVMIN	real	Minimum turbulence σ_v (m/s) -- 6 LAND, 6 WATER	6*.50, 6*.37
SWMIN	real	Minimum turbulence σ_w (m/s) -- 6 LAND, 6 WATER	.20, .12, .08, .06, .03,0.016, .20, .12, .08, .06, .03,0.016

CDIV(2)	real	Divergence criterion for dw/dz in met cell used to initiate adjustment for horizontal convergence (l/s). Partial adjustment starts at CDIV(1), and full adjustment is reached at CDIV(2)	0.0, 0.0
NLUTIBL	integer	Search radius (no. of cells) for nearest land and water cells used in subgrid TIBL module	4
WSCALM	real	Minimum wind speed allowed for non-calm conditions. Wind speeds less than WSCALM will be considered as "calm" by the model. WSCALM is also used as the minimum speed returned from the power law extrapolation of the wind speed toward the surface.	0.5

Table 9-3 (Continued)

CALPUFF Control File Inputs - Input Group 12

Dispersion and Computational Parameters

Variable	Type	Description	Default Value
XMAXZI	real	Maximum mixing height (m)	3000.
XMINZI	real	Minimum mixing height (m)	50.
WSCAT(5)	real array	Upper bounds on the first 5 wind speed classes (m/s); The last class has no upper limit	1.54, 3.09, 5.14, 8.23, 10.8
PLX0(6)	real array	Wind speed profile power-law exponents for stabilities A-F	0.07, 0.07, 0.10, 0.15, 0.35, 0.55
PTG0(2)	real array	Potential temperature gradient (deg. k/m) for stability classes E and F	.020, .035
PPC(6)	real array	Default plume path coefficients for each stability class (used when option for partial plume height terrain adjustment is selected, MCTADJ = 3)	0.50, 0.50, 0.50, 0.50, 0.35, 0.35
SL2PF	real	Slug-to-puff transition criterion factor (max. σ_y/slug length before transition to puff)	10.
		(Vertical Puff-Spliting Control Variables *)	
*NSPLIT	integer	Number of puffs that result every time a puff is split; nsplit=2 means that 1 puff splits into 2	3
*IRESPLIT (24)	integer array	Time(s) of a day when split puffs are eligible to be split once again; this is typically set once per day, around sunset before nocturnal shear develops. 24 values: 0 is midnight (00:00) and 23 is 11 PM (23:00) 0=do not re-split; 1=eligible for re-split	17*0, 1, 6*0

*ZISPLIT	real	Split is allowed only if last hour's mixing height (m) exceeds this minimum value	100.0
*ROLDMAX	real	Split is allowed only if ratio of last hour's mixing ht to the maximum mixing ht experienced by the puff is less than this maximum value (this postpones a split until a nocturnal layer develops)	0.25
		(Horizontal Puff-Spliting Control Variables *)	
*NSPLITH	integer	Number of puffs that result every time a puff is split - nsplith=5 means that 1 puff splits into 5	5
*SYSPLITH	integer	Minimum sigma-y (Grid Cells Units) of puff before it may be split	1.0
*SHSPLITH	integer	Minimum puff elongation rate (SYSPLITH/hr) due to wind shear, before it may be split	2.0

Table 9-3 (Continued)

CALPUFF Control File Inputs - Input Group 12

Dispersion and Computational Parameters

Variable	Type	Description	Default Value
*CNSPLITH (mxspec)	integer array	Minimum concentration (g/m^3) of each species in puff before it may be split. Enter array of NSPEC values; if a single value is entered, it will be used for ALL species	1.0E-07
		(Integration Control Variables *)	
*EPSSLUG	real	Fractional convergence criterion for numerical slug sampling integration	1.0E-04
*EPSAREA	real	Fractional convergence criterion for numerical area source integration	1.0E-06
*DSRISE	real	Trajectory step length (m) for numerical rise integration.	1.0
		(Boundary Condition Puff Control Variables *)	
*HTMINBC	real	Minimum height (m) to which BC puffs are mixed as they are emitted (MBCON=2 ONLY). Actual height is reset to the current mixing height at the release point if greater than this minimum.	500.
*RSAMPBC	real	Search radius (km) about a receptor for sampling nearest BC puff. BC puffs are typically emitted with a spacing of one grid cell length, so the search radius should be greater than DGRIDKM.	10.

*MDEPBC	integer	Near-Surface depletion adjustment to concentration profile used when sampling BC puffs? 0 = Concentration is NOT adjusted for depletion 1 = Adjust Concentration for depletion	1

Table 9-3 (Continued)
CALPUFF Control File Inputs - Input Group 13
Point Source Parameters

Variable	Type	Description	Default Value
(Input Group 13a - General Data)			
NPT1	integer	Number of point sources with constant stack parameters or variable emission rate scale factors	-
IPTU	integer	Units choice for emission rates from point sources 1 = g/s 2 = kg/hr 3 = lb/hr 4 = tons/yr 5 = Odor Units * m^3/s (vol. flux of compound) 6 = Odor Units * m^3/min 7 = metric tons/yr 8 = Bq/s (Bq = becquerel = disintegration/s) 9 = GBq/yr	1
NSPT1	integer	Number of source-species with variable emission rate scaling factors provided in 13d	0
NPT2	integer	Number of point sources with arbitrarily-varying emission parameters (If NPT2 > 0, the point source emissions file PTEMARB.DAT must be provided)	-
(Input Group 13b - Point Source Data for Sources with Constant Stack Parameters or Variable Emission Rate Scale Factors)			-
SRCNAM	character*12	Source name, used to coordinate inputs in Subgroups b,c,d	-
XKM	real	X coordinate (km) of the stack on the meteorological grid	-
YKM	real	Y coordinate (km) of the stack on the meteorological grid	-
HSTAK	real	Stack height (m)	-
SELEV	real	Stack base elevation (m) above mean sea level	-
DIAM	real	Stack diameter (m)	-
EXITW	real	Stack gas exit velocity (m/s)	-
EXITT	real	Stack gas exit temperature (deg. K)	-

BDOWN	real	Building downwash flag 0. = building downwash not modeled, 1. = building downwash modeled	-
EMS	real array	Emission rate of each modeled species Note: "NSPEC" values must be entered	-

Table 9-3 (Continued)
CALPUFF Control File Inputs - Input Group 13

Point Source Parameters

Variable	Type	Description	Default Value
(Optional Variables for Input Group 13b)			
SIGMAYI	real	Initial sigma-y (m) associated with the release from this source	0.0 -
SIGMAZI	real	Initial sigma-z (m) associated with the release from this source	0.0
FMFAC	real	is a vertical momentum flux factor (0. or 1.0) used to represent the effect of rain-caps or other physical configurations that reduce momentum rise associated with the actual exit velocity. FMFAC=1 is full momentum (no obstruction).	1.0
ZPLTFM	real	is the platform height (m) for sources influenced by an isolated structure that has a significant open area between the surface and the bulk of the structure	0.0

The variables in Input Group 13b are entered for each of the "NPT1" point sources. <u>The data for each source is treated as a separate input subgroup, and therefore, must end with an input group terminator (i.e., !END!)</u>. Note that the source number is an optional user comment which is outside of the delimiter containing the required source data. The data for each source must follow an opening delimiter and "X=". The data for each source is followed by a closing delimiter and an input group terminator.

The first two optional variables may be provided for point sources that have a characteristic distribution much like volume sources. The values are entered in order between delimiters, following “SIGYZI=”. The third optional variable is typically used for sources with rain-hats that eliminate the initial vertical momentum of the release. These records must be placed before the input group terminates (i.e., !END!) for the point source.

The format of Input Group 13b for a simulation with eight species is shown below.

```
---------------
Subgroup (13b)
---------------
                                     a
          POINT SOURCE: CONSTANT DATA
          -----------------------------
                                                                               b           c
  Source      X UTM      Y UTM     Stack   Base     Stack    Exit  Exit    Bldg.  Emission
   No.     Coordinate Coordinate Height Elevation Diameter  Vel.  Temp.   Dwash   Rates
              (km)      (km)       (m)      (m)       (m)   (m/s) (deg. K)
  ------   ---------- ---------- ------  ------   -------- ----- -------- -----  --------
   1 ! SRCNAM = BLR1 !
   1 ! X =     0.1,     -3.,       40.,   25.,       2.2,   10.,   450.,   1.,   1.7, 1.0,  0.01, 0.1, 0.2,
                                                                                  0.24,0.25, 0.20    !
   1 ! SIGYZI =       3.,      1.5   !
   1 ! FMFAC  = 1. !
   1 ! ZPLTFM = 0. !     !END!
```

Table 9-3 (Continued)
CALPUFF Control File Inputs - Input Group 13
Point Source Parameters

Variable	Type	Description	Default Value
(Input Group 13c - Building Dimension Data)			
SRCNAM	character*12	Source name, used to coordinate inputs in Subgroups b,c,d	-
HEIGHT	real array	Array of 36-direction-specific building heights (m) for flow vectors from 10°-360° in 10° increments	-
WIDTH	real array	Array of 36 direction-specific building widths (m) for flow vectors from 10°-360° in 10° increments	-
LENGTH*	real array	Array of 36 direction-specific building lengths (m) for flow vectors from 10°-360° in 10° increments	-
XBADJ*	real array	Array of 36 direction-specific along-flow offset lengths (m) from the source to the center of the upwind face of the building for flow vectors from 10°-360° in 10° increments	-
YBADJ*	real array	Array of 36 direction-specific cross-flow offset lengths (m) from the source to the center of the upwind face of the building for flow vectors from 10°-360° in 10° increments	-

* LENGTH, XBADJ, and YBADJ are required only for the PRIME downwash option (MBDW=2)

The variables in Input Group 13c are entered for each point source for which IDOWN=1 in Input Group 13b. <u>The data for each point source (i.e., source name, 36 widths and 36 heights, 36 lengths, 36 xb-adjusts, and 36 yb-adjusts) is treated as a separate input subgroup and therefore must end with an input group terminator (i.e., !END!)</u>. Once again, the source number is an optional user comment which is outside of the delimiters. The source name is used to place the building information with the correct source. The data for each source must follow an opening delimiter and either "WIDTH=" or "HEIGHT=". The data for each source is followed by a closing delimiter and an input group terminator (i.e., !END!).

Table 9-3 (Continued)
CALPUFF Control File Inputs - Input Group 13
Point Source Parameters

The format of Input Group 13c is shown below.

```
---------------
Subgroup (13c)
---------------

           BUILDING DIMENSION DATA FOR SOURCES SUBJECT TO DOWNWASH
           -------------------------------------------------------
Source                                                                a
No.       Effective building height, width, length and X/Y offset (in meters)
           every 10 degrees.  LENGTH, XBADJ, and YBADJ are only needed for
           MBDW=2 (PRIME downwash option)
------     ----------------------------------------------------------------

 1    ! SRCNAM  =   BLR1 !
 1    ! HEIGHT  =  45., 45., 45., 45., 45., 45., 45., 45., 45.,  0.,  0.,  0.,
                   0.,  0.,  0.,  0.,  0.,  0., 45., 45., 45., 45., 45., 45.,
                   45., 45., 45.,  0.,  0.,  0.,  0.,  0.,  0.,  0.,  0.,  0. !
 1    ! WIDTH  =   12.5, 12.5, 12.5, 12.5, 12.5, 12.5, 12.5, 12.5, 12.5,  0.,   0.,   0.,
                    0.,   0.,   0.,   0.,   0.,   0.,  12.5, 12.5, 12.5, 12.5, 12.5, 12.5,
                   12.5, 12.5, 12.5,  0.,   0.,   0.,   0.,   0.,   0.,   0.,   0.,   0.  !
 1    ! LENGTH =  82.54,  87.58,  89.95,  89.59,  86.51,  80.80,
                  72.64,  62.26,  50.00,  62.26,  72.64,  80.80,
                  86.51,  89.59,  89.95,  87.58,  82.54,  75.00,
                  82.54,  87.58,  89.95,  89.59,  86.51,  80.80,
                  72.64,  62.26,  50.00,  62.26,  72.64,  80.80,
                  86.51,  89.59,  89.95,  87.58,  82.54,  75.00 !
 1    ! XBADJ  =  -47.35, -55.76, -62.48, -67.29, -70.07, -70.71,
                  -69.21, -65.60, -60.00, -65.60, -69.21, -70.71,
                  -70.07, -67.29, -62.48, -55.76, -47.35, -37.50,
                  -35.19, -31.82, -27.48, -22.30, -16.44, -10.09,
                  -3.43,   3.34,  10.00,   3.34,  -3.43, -10.09,
                  -16.44, -22.30, -27.48, -31.82, -35.19, -37.50 !
 1    ! YBADJ =   34.47,  32.89,  30.31,  26.81,  22.50,  17.50,
                  11.97,   6.08,   0.00,  -6.08, -11.97, -17.50,
                  -22.50, -26.81, -30.31, -32.89, -34.47, -35.00,
                  -34.47, -32.89, -30.31, -26.81, -22.50, -17.50,
                  -11.97,  -6.08,   0.00,   6.08,  11.97,  17.50,
                  22.50,  26.81,  30.31,  32.89,  34.47,  35.00 !
!END!
--------
    a
     Building height, width, length, and X/Y offset from the source are treated
     as a separate input subgroup for each source and therefore must end with
     an input group terminator.
```

Table 9-3 (Continued)
CALPUFF Control File Inputs - Input Group 13
Point Source Parameters

Variable	Type	Description	Default Value
(Input Group 13d - Variable Emissions Scale Factors)			
SRCNAM	character*12	Source name, used to coordinate inputs in Subgroups b,c,d	-
IVARY	integer	Type of scale factor variation (diurnal, monthly, etc.) 0 = Constant 1 = Diurnal cycle (24 scaling factors: hours 1-24) 2 = Monthly cycle (12 scaling factors: months 1-12) 3 = Hour & Season (4 groups of 24 hourly scaling factors, where first group is DEC-JAN-FEB) 4 = Speed & Stab. (6 groups of 6 scaling factors, where first group is Stability Class A, and the 6 speed classes have upper bounds (m/s) defined in Group 12) 5 = Temperature (12 scaling factors, where temperature classes have upper bounds (C) of: 0, 5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 50+)	0
QFAC	real array	Array of emissions scaling factors for this source and the species indicated	-

The variables in Input Group 13d are entered for each point source - species combination indicated by NSPT1 in Input Group 13a (e.g., only NSPT1 combinations are entered). <u>The data for each point source-species combination (i.e., source name, type of variation, and the QFAC array) are treated as a separate input subgroup and therefore must end with an input group terminator (i.e., !END!)</u>. Once again, the source number is an optional user comment which is outside of the delimiters. The source name is used to place the scaling factors with the correct source. The data for each source-species combination must follow an opening delimiter and "(cspec)=", where (cspec) is a species name defined in Group 3. The data for each source-species combination is followed by a closing delimiter and an input group terminator (i.e., !END!). If NSPT1=0, no scaling factors should be defined here.

Table 9-3 (Continued)
CALPUFF Control File Inputs - Input Group 13
Point Source Parameters

The format for Input Group 13d is shown below.

```
---------------
Subgroup (13d)
---------------
                                                a
          POINT SOURCE: VARIABLE EMISSIONS DATA
          ---------------------------------------

 1  ! SRCNAM = BLR1 !
 1  ! IVARY  =  2  !    (12 Months)
 1  ! SO2          = 0.1,0.1,0.5,0.9,2,2.2,
                   2.5,1.5,1.1,0.9,0.5,0.1      !
!END!

--------
    a
     Data for each species are treated as a separate input subgroup
     and therefore must end with an input group terminator.
```

Table 9-3 (Continued)
CALPUFF Control File Inputs - Input Group 14
Area Source Parameters

Variable	Type	Description	Default Value
(Input Group 14a - General Area Source Data)			
NAR1	integer	Number of area sources with constant parameters or variable emission rate scale factors	-
IARU	integer	Units choice for emission rates from area sources 1 = $g/m^2/s$ 2 = $kg/m^2/hr$ 3 = $lb/m^2/hr$ 4 = $tons/m^2/yr$ 5 = Odor Units * m/s (vol. flux/m^2 of compound) 6 = Odor Units * m/min 7 = metric $tons/m^2/yr$ 8 = $Bq/m^2/s$ (Bq = becquerel = disintegration/s) 9 = $GHq/m^2/yr$	1
NSAR1	integer	Number of source-species with variable emission rate scaling factors provided in 14d	0
NAR2	integer	Number of buoyant area sources with arbitrary varying emission parameters	-
(Input Group 14b - Area Source Data for Sources with Constant Parameters or Emissions Scale Factors)			
SRCNAM	character*12	Source name, used to coordinate inputs in Subgroups b,c,d	-
HTEFF	real	Effective height (m) of the area source	-
AELEV	real	Base elevation (m) above mean sea level	-
SIGZI	real	Initial vertical dispersion coefficient (σ_z), in meters, of the area source	-
EMIS	real array	Emission rate ($g/s/m^2$) of each modeled species Note: "NSPEC" values must be entered	-

The variables in Input Group 14b are entered for each of the "NAR1" area sources. <u>The data for each</u>

source is treated as a separate input subgroup, and therefore, must end with an input group terminator (i.e., !END!). Note that the source number is an optional user comment which is outside of the delimiter containing the required source data. The data for each source must follow an opening delimiter and "X=". The data for each source is followed by a closing delimiter and an input group terminator.

Table 9-3 (Continued)
CALPUFF Control File Inputs - Input Group 14
Area Source Parameters

The format of Input Group 14b for a simulation with eight species is shown below.

```
---------------
Subgroup (14b)
---------------
                                     a
          AREA SOURCE: CONSTANT DATA
          ----------------------------
                                                         b
Source           Effect.    Base      Initial    Emission
 No.             Height   Elevation   Sigma z     Rates
                   (m)       (m)        (m)
-------          ------    ------     --------   ---------

   1! SRCNAM = AREA1 !
   1! X =          1.,      0.,         2.5,   8.5E-01,  0.5E00,  0.0E00,
                               0.0E00,  0.0E00,  0.0E00,  0.0E00,  0.0E00 !
    !END!
   2! SRCNAM = AREA2 !
   2! X =         1.5,      0.,          3.,    0.0E00,  0.0E00, 1.0E-01,
                               0.0E00,  0.0E00, 5.0E-01,  1.0E00,  1.3E00 !
    !END!

--------
    a
     Data for each source are treated as a separate input subgroup
     and therefore must end with an input group terminator.
    b
     An emission rate must be entered for every pollutant modeled.
     Enter emission rate of zero for secondary pollutants that are
     modeled, but not emitted.  Units are specified by IARU
     (e.g. 1 for g/m**2/s).
```

Table 9-3 (Continued)
CALPUFF Control File Inputs - Input Group 14
Area Source Parameters

Variable	Type	Description	Default Value
(Input Group 14c - Vertex Data for Area Sources with Constant Parameters or Emissions Scale Factors)			
SRCNAM	character*12	Source name, used to coordinate inputs in Subgroups b,c,d	-
XVERT	real	X coordinates (km) of each vertex of the area source on the meteorological grid	-
YVERT	real	Y coordinate (km) of each vertex of the area source on the meteorological grid	-

The variables in Input Group 14c are entered for each of the "NAR1" area sources. The data for each source is treated as a separate input subgroup, and therefore, must end with an input group terminator (i.e., !END!). Note that the source number is an optional user comment which is outside of the delimiter containing the required source data. The data for each source must follow an opening delimiter and "X=". The data for each source is followed by a closing delimiter and an input group terminator.

The format of Input Group 14c is shown below.

```
--------------
Subgroup (14c)
---------------

           COORDINATES (UTM-km) FOR EACH VERTEX(4) OF EACH POLYGON
           --------------------------------------------------------
Source                                                             a
 No.       Ordered list of X followed by list of Y, grouped by source
------     ------------------------------------------------------------

 1    ! SRCNAM  =   AREA1 !
 1      !  XVERT = 0.5,    0.51,    0.51,    0.5!
 1      !  YVERT = 1.61,    1.61,    1.6,    1.6!
      !END!
 2    ! SRCNAM  =   AREA2 !
 2      !  XVERT = 0.75,    0.76,    0.76,  0.75!
 2      !  YVERT = 1.81,    1.81,    1.8,    1.8!
      !END!

--------
    a
     Data for each source are treated as a separate input subgroup
     and therefore must end with an input group terminator.
```

Table 9-3 (Continued)
CALPUFF Control File Inputs - Input Group 14
Area Source Parameters

Variable	Type	Description	Default Value
(Input Group 14d - Variable Emissions Scale Factors)			
SRCNAM	character*12	Source name, used to coordinate inputs in Subgroups b,c,d	-
IVARY	integer	Type of scale factor variation (diurnal, monthly, etc.) 0 = Constant 1 = Diurnal cycle (24 scaling factors: hours 1-24) 2 = Monthly cycle (12 scaling factors: months 1-12) 3 = Hour & Season (4 groups of 24 hourly scaling factors, where first group is DEC-JAN-FEB) 4 = Speed & Stab. (6 groups of 6 scaling factors, where first group is Stability Class A, and the 6 speed classes have upper bounds (m/s) defined in Group 12) 5 = Temperature (12 scaling factors, where temperature classes have upper bounds (C) of: 0, 5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 50+)	0
QFAC	real array	Array of emissions scaling factors for this source and the species indicated	-

The variables in Input Group 14d are entered for each area source - species combination indicated by NSAR1 in Input Group 14a (e.g., only NSAR1 combinations are entered). <u>The data for each area source-species combination (i.e., source name, type of variation, and the QFAC array) are treated as a separate input subgroup and therefore must end with an input group terminator (i.e., !END!)</u>. Once again, the source number is an optional user comment which is outside of the delimiters. The source name is used to place the scaling factors with the correct source. The data for each source-species combination must follow an opening delimiter and "(cspec)=", where (cspec) is a species name defined in Group 3. The data for each source-species combination is followed by a closing delimiter and an input group terminator (i.e., !END!). If NSAR1=0, no scaling factors should be defined here.

Table 9-3 (Continued)
CALPUFF Control File Inputs - Input Group 14
Area Source Parameters

The format of Input Group 14d is shown below.

```
---------------
Subgroup (14d)
---------------
                                              a
          AREA SOURCE: VARIABLE EMISSIONS DATA
          --------------------------------------

 2  ! SRCNAM = AREA2 !
 2  ! IVARY  =  4  !    (6 speed classes for each stability)
 2  ! PMSIZE1      = 0.1,0.1,0.5,0.9,1,1.5,
                   0.1,0.1,0.5,0.9,1,1.5,
                   0.1,0.1,0.5,0.9,1,1.5,
                   0.1,0.1,0.5,0.9,1,1.5,
                   0.1,0.1,0.5,0.9,1,1.5,
                   0.1,0.1,0.5,0.9,1,1.5      !
!END!

--------
    a
     Data for each species are treated as a separate input subgroup
     and therefore must end with an input group terminator.
```

Table 9-3 (Continued)
CALPUFF Control File Inputs - Input Group 15
Line Source Parameters

Variable	Type	Description	Default Value
(Input Group 15a - General Line Source Data)			
NLN2	integer	Number of buoyant line sources with variable location and emission parameters (all data provided in file LNEMARB.DAT)	0
NLINES	integer	Number of buoyant line sources	-
ILNU	integer	Units choice for line source emissions 1 = g/s 2 = kg/hr 3 = lb/hr 4 = tons/yr 5 = Odor Units * m^3/s (vol. flux of compound) 6 = Odor Units * m^3/min 7 = metric tons/yr 8 = Bq/s (Bq = becquerel = disintegration/s) 9 = GB/yr	1
NSLN1	integer	Number of source-species with variable emission rate scaling factors provided in 15c	0
MXNSEG	integer	Maximum number of line segments into which each line may be divided (if MSLUG=1); Actual number of virtual points which will be used to represent each line (if MSLUG=0)	7
NLRISE	integer	Number of distances at which transitional rise is computed	6
XL	real	Average building length (m)	-
HBL	real	Average building height (m)	-
WBL	real	Average building width (m)	-
WML	real	Average line source width (m)	-
DXL	real	Average separation between buildings (m)	
FPRIMEL	real	Average buoyancy parameter (m^4/s^3)	-
(Input Group 15b - Buoyant Line Source Data) - repeated for each line source			
SRCNAM	character*12	Source name, used to coordinate inputs in Subgroups b,c	-

Variable	Type	Description	Default Value
XBEGL	real	Beginning X coordinate of line source (km)	-
YBEGL	real	Beginning Y coordinate of line source (km)	-
XENDL	real	Ending X coordinate of line source (km)	-
YENDL	real	Ending Y coordinate of line source (km)	-

Table 9-3 (Continued)
CALPUFF Control File Inputs - Input Group 15
Line Source Parameters

Variable	Type	Description	Default Value
HTL	real	Release height (m)	-
ELEVL	real	Base elevation (m)	-
QL	real	Emissions rate (g/s) of each pollutant	-

The variables in Input Group 15b are entered for each of the "NLINES" line sources. The data for each line is treated as a separate input subgroup, and therefore, must end with an input group terminator (i.e., !END!). Note that the line number is an optional user comment which is outside of the delimiter containing the required source data. The data for each line must follow an opening delimiter and "X=". The data for each line is followed by a closing delimiter and an input group terminator.

The format of Input Group 15b for a simulation with eight species is shown below.

```
---------------
Subgroup (15b)
---------------

          BUOYANT LINE SOURCE: CONSTANT DATA
          ----------------------------------
                                                                                             a
Source     Beg. X      Beg. Y      End. X     End. Y     Release    Base        Emission
 No.     Coordinate  Coordinate  Coordinate Coordinate  Height    Elevation      Rates
            (km)        (km)        (km)       (km)       (m)       (m)
------   ----------  ----------  ---------  ----------  -------   ---------    ---------
   1! SRCNAM = LINE1 !
   1! X =       12.,       35.,       12.5,       35.,    22.000,     0.000, 2.3E00, 1.1E00,
0.0E00, 0.0E00, 0.0E00, 0.0E00, 0.0E00, 0.0E00 !
    !END!
   2! SRCNAM = LINE2 !
   2! X =       12.,    35.022,       12.5,    35.022,    22.000,     0.000, 2.3E00, 1.1E00,
0.0E00, 0.0E00, 0.0E00, 0.0E00, 0.0E00, 0.0E00 !
    !END!

--------

    a
     Data for each source are treated as a separate input subgroup
     and therefore must end with an input group terminator.

    b
     An emission rate must be entered for every pollutant modeled.
     Enter emission rate of zero for secondary pollutants that are
     modeled, but not emitted.  Units are specified by ILNTU
     (e.g. 1 for g/s).
```

Table 9-3 (Continued)
CALPUFF Control File Inputs - Input Group 15
Line Source Parameters

Variable	Type	Description	Default Value
(Input Group 15c - Variable Emissions Scale Factors)			
SRCNAM	character*12	Source name, used to coordinate inputs in Subgroups b,c	-
IVARY	integer	Type of scale factor variation (diurnal, monthly, etc.) 0 = Constant 1 = Diurnal cycle (24 scaling factors: hours 1-24) 2 = Monthly cycle (12 scaling factors: months 1-12) 3 = Hour & Season (4 groups of 24 hourly scaling factors, where first group is DEC-JAN-FEB) 4 = Speed & Stab. (6 groups of 6 scaling factors, where first group is Stability Class A, and the 6 speed classes have upper bounds (m/s) defined in Group 12) 5 = Temperature (12 scaling factors, where temperature classes have upper bounds (C) of: 0, 5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 50+)	0
QFAC	real array	Array of emissions scaling factors for this source and the species indicated	-

The variables in Input Group 15c are entered for each line source - species combination indicated by NSLN1 in Input Group 15a (e.g., only NSLN1 combinations are entered). The data for each line source-species combination (i.e., source name, type of variation, and the QFAC array) are treated as a separate input subgroup and therefore must end with an input group terminator (i.e., !END!). Once again, the source number is an optional user comment which is outside of the delimiters. The source name is used to place the scaling factors with the correct source. The data for each source-species combination must follow an opening delimiter and "(cspec)=", where (cspec) is a species name defined in Group 3. The data for each source-species combination is followed by a closing delimiter and an input group terminator (i.e., !END!). If NSLN1=0, no scaling factors should be defined here.

Table 9-3 (Continued)
CALPUFF Control File Inputs - Input Group 15
Line Source Parameters

The format of Input Group 15c is shown below.

```
---------------
Subgroup (15c)
---------------
                                                        a
          BUOYANT LINE SOURCE: VARIABLE EMISSIONS DATA
          ----------------------------------------------

 1  ! SRCNAM = LINE1 !
 1  ! IVARY  =  1  !    (24 Hours)
 1  ! SO2          = 0.1,0.1,0.1,0.2,0.2,0.3,
                   0.3,0.4,0.4,0.5,0.6,1,
                   1,1,1,1,1,1,
                   0.6,0.4,0.3,0.2,0.1,0.1      !
!END!

--------
    a
     Data for each species are treated as a separate input subgroup
     and therefore must end with an input group terminator.
```

Table 9-3 (Continued)
CALPUFF Control File Inputs - Input Group 16
Volume Source Parameters

Variable	Type	Description	Default Value
(Input Group 16a - General Volume Source Data)			
NVL1	integer	Number of volume sources with constant parameters or variable emission scale factors	-
IVLU	integer	Units choice for volume source emissions 1 = g/s 2 = kg/hr 3 = lb/hr 4 = tons/yr 5 = Odor Units * m^3/s (vol. flux of compound) 6 = Odor Units * m^3/min 7 = metric tons/yr 8 = Bq/s (Bq = becquerel = disintegration/s) 9 = GBq/yr	1
NSVL1	integer	Number of source-species with variable emission rate scaling factors provided in 16c	0
NVL2	integer	Number of volume sources with variable location and emission parameters read from file VOLEMARB.DAT	0
(Input Group 16b - Volume Source Data for Sources with Constant Parameters or Variable Emission Scaling Factors (repeated for each volume source (NVL1))			
SRCNAM	character*12	Source name, used to coordinate inputs in Subgroups b,c	-
XVOL	real	X coordinate (km) of center of volume source	-
YVOL	real	Y coordinate (km) of center of volume source	-
HTVOL	real	Effective height (m) of volume source	-
ELEVOL	real	Base elevation (m) of volume source	-
SYVOL	real	Initial σ_y (m) of volume source	-
SZVOL	real	Initial σ_z (m) of volume source	-
QVOL	real	Emission rates (g/s) of each pollutant from volume source	-

Table 9-3 (Continued)
CALPUFF Control File Inputs - Input Group 16
Volume Source Parameters

The variables in Input Group 16b are entered for each of the "NVL1" volume sources. The data for each source is treated as a separate input subgroup, and therefore, must end with an input group terminator (i.e., !END!). Note that the source number is an optional user comment which is outside of the delimiter containing the required source data. The data for each source must follow an opening delimiter and "X=". The data for each source is followed by a closing delimiter and an input group terminator.

The format of Input Group 16b for a simulation with eight species is shown below.

```
---------------
Subgroup (16b)
---------------
                                       a
           VOLUME SOURCE: CONSTANT DATA
           ------------------------------
                                                                               b
        X UTM      Y UTM      Effect.    Base     Initial    Initial    Emission
     Coordinate  Coordinate   Height   Elevation  Sigma y    Sigma z     Rates
        (km)       (km)        (m)       (m)        (m)        (m)
     ----------  ----------   ------    ------    --------   --------   --------

   1! SRCNAM = VOLS1 !
! X =      -5.6,      -1.2,     10.,       0.,       6.2,       6.2, 2.2E00, 4.0E00, 0.0E00,
                                                     0.0E00, 0.0E00, 0.0E00, 0.0E00, 0.0E00 !
!END!

--------
    a
     Data for each source are treated as a separate input subgroup
     and therefore must end with an input group terminator.

    b
     An emission rate must be entered for every pollutant modeled.
     Enter emission rate of zero for secondary pollutants that are
     modeled, but not emitted.  Units are specified by IVLU
     (e.g. 1 for g/s).
```

Table 9-3 (Continued)
CALPUFF Control File Inputs - Input Group 16
Volume Source Parameters

Variable	Type	Description	Default Value
(Input Group 16c - Variable Emissions Scale Factors)			
SRCNAM	character*12	Source name, used to coordinate inputs in Subgroups b,c	-
IVARY	integer	Type of scale factor variation (diurnal, monthly, etc.) 0 = Constant 1 = Diurnal cycle (24 scaling factors: hours 1-24) 2 = Monthly cycle (12 scaling factors: months 1-12) 3 = Hour & Season (4 groups of 24 hourly scaling factors, where first group is Dec-Jan-Feb) 4 = Speed & Stab. (6 groups of 6 scaling factors, where first group is Stability Class A, and the 6 speed classes have upper bounds (m/s) defined in Group 12) 5 = Temperature (12 scaling factors, where temperature classes have upper bounds (C) of: 0, 5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 50+)	0
QFAC	real array	Array of emissions scaling factors for this source and the species indicated	-

The variables in Input Group 16c are entered for each volume source - species combination indicated by NSVL1 in Input Group 16a (e.g., only NSVL1 combinations are entered). <u>The data for each volume source-species combination (i.e., source name, type of variation, and the QFAC array) are treated as a separate input subgroup and therefore must end with an input group terminator (i.e., !END!)</u>. Once again, the source number is an optional user comment which is outside of the delimiters. The source name is used to place the scaling factors with the correct source. The data for each source-species combination must follow an opening delimiter and "(cspec)=", where (cspec) is a species name defined in Group 3. The data for each source-species combination is followed by a closing delimiter and an input group terminator (i.e., !END!). If NSVL1=0, no scaling factors should be defined here.

Table 9-3 (Continued)
CALPUFF Control File Inputs - Input Group 16
Volume Source Parameters

The format of Input Group 16c is shown below.

```
---------------
Subgroup (16c)
---------------
                                                 a
          VOLUME SOURCE: VARIABLE EMISSIONS DATA
          ---------------------------------------

 1  ! SRCNAM = VOLS1 !
 1  ! IVARY  =  1  !    (24 Hours)
 1  ! SO2          = 0.1, 0.1, 0.1, 0.2, 0.2, 0.3,
                     0.3, 0.4, 0.4, 0.5, 0.6,   1,
                       1,   1,   1,   1,   1,   1,
                     0.6, 0.4, 0.3, 0.2, 0.1, 0.1  !
!END!

--------
    a
     Data for each species are treated as a separate input subgroup
     and therefore must end with an input group terminator.
```

Table 9-3 (Concluded)
CALPUFF Control File Inputs - Input Group 17
Non-Gridded (Discrete) Receptor Data

Variable	Type	Description	Default Value
(Input Group 17a - General Discrete Receptor Data)			
NREC	integer	Number of non-gridded receptors	-
(Input Group 17b - Discrete Receptor Data)			
XKM	real	X coordinate (km) of the discrete receptor on the meteorological grid	-
YKM	real	Y coordinate (km) of the discrete receptor on the meteorological grid	-
ELEV	real	Ground elevation (m) above mean sea level of the receptor	-
ZREC	real	Height (m) of discrete receptor above the ground	0.0

The variables in Input Group 17b are entered for each of the "NREC" discrete receptors. The data for each receptor is treated as a separate input subgroup, and therefore, must end with an input group terminator (i.e., !END!). The format of Input Group 17b is shown below.

```
---------------
Subgroup (17b)
---------------
                                               a
           NON-GRIDDED (DISCRETE) RECEPTOR DATA
           ------------------------------------

                  X UTM        Y UTM         Ground        Height   b
Receptor       Coordinate   Coordinate    Elevation    Above Ground
  No.             (km)         (km)          (m)            (m)
--------       ----------   ----------    ---------    ------------
     1 ! X =          1.,          1.,      12.500,        0.000!   !END!
     2 ! X =         2.5,         4.2,      28.100,        0.000!   !END!
     3 ! X =        2.89,         3.2,      39.600,        0.000!   !END!



-------------
    a
     Data for each receptor are treated as a separate input subgroup
     and therefore must end with an input group terminator.

    b
     Receptor height above ground is optional.  If no value is entered,
     the receptor is placed on the ground.
```

Note that the receptor number is an optional user comment which is outside of the delimiter. The data for each receptor must follow an opening delimiter and "X=". The data for each receptor is followed by a closing delimiter and an input group terminator (i.e., !END!).

9.2 Meteorological Data Files

Four types of meteorological data files can be used to drive the CALPUFF model. In order to take full advantage of the capabilities of the model to simulate the effects spatially-varying meteorological fields, gridded fields of winds, temperatures, mixing heights, and other meteorological variables should be input to CALPUFF through the CALMET.DAT file. The format and contents of this file are described in Section 9.2.1.

Alternatively, CALPUFF will accept single station meteorological data in the ISC3 format, CTDMPLUS / AERMET format, or AUSPLUME format. The ISC3 meteorological data file (ISCMET.DAT) is described in Section 9.2.2, the AUSPLUME file (PLMMET.DAT) is described in Section 9.2.3, and the CTDMPLUS meteorological data files SURFACE.DAT and PROFILE.DAT are described in Section 9.2.4.

9.2.1 CALMET.DAT

The CALMET.DAT file contains gridded meteorological data fields required to drive the CALPUFF model. It also contains certain geophysical fields, such as terrain elevations, surface roughness lengths, and land use types, used by both the CALMET meteorological model and CALPUFF. Although the input requirements of CALPUFF are designed to be directly compatible with CALMET, meteorological fields produced by other meteorological models can be substituted for the CALMET output as long as the required variables are produced and the output is reformatted to be consistent with the CALMET.DAT file specifications described in this section.

CALMET.DAT File - Header Records

The CALMET.DAT file consists of a set of up to fifteen header records, plus a variable number of comment records, followed by a set of data records. The header records contain file identification labels, descriptive titles of the CALMET run (including a complete image of the CALMET control file) as comment records, information including the horizontal and vertical grid systems of the meteorological grid, the number, type, and coordinates of the meteorological stations included in the CALMET run, gridded fields of surface roughness lengths, land use, terrain elevations, leaf area indexes, and a pre-computed field of the closest surface meteorological station number to each grid point.

In addition to the variable number of comment records, the number of header records may also vary because records containing surface, upper air, and precipitation station coordinates are not included if these stations were not included in the run. A description of each variable in the header records is provided in Table 9-4.

Sample FORTRAN write statements for the CALMET.DAT header records are:

```
c ---   Header record #1 - File Declaration -- 24 words
        write(iomet) DATASET,DATAVER,DATAMOD

c ---   Header record #2 - Number of comment lines -- 1 word
        write(iomet) NCOM

c ---   Header record #3 to NCOM+2 (Comment record section) -- 33 words each
        write(iomet) COMMENT

c ---   Header record #NCOM+3 - run control parameters -- 39 words
        write(iomet) IBYR,IBMO,IBDY,IBHR,IBSEC,
        2       IEYR,IEMO,IEDY,IEHR,IESEC,AXTZ,IRLG,IRTYPE,
        3       NX,NY,NZ,DGRID,XORIGR,YORIGR, IWFCOD,NSSTA,
        4       NUSTA,NPSTA,NOWSTA,NLU,IWAT1,IWAT2,LCALGRD
        5       PMAP,DATUM,DATEN,FEAST,FNORTH,UTMHEM,IUTMZN,
        6       RNLAT0,RELON0,XLAT1,XLAT2

c ---   Header record #NCOM+4 - cell face heights (NZ + 1 words)
        write(iomet)CLAB1,IDUM,IDUM,IDUM,IDUM,ZFACEM

c ---   Header records #NCOM+5 & 6 - x, y coordinates of surface stations
c ---   (NSSTA words each record)
        if(nssta.ge.1)then
           write(iomet)CLAB2,IDUM,IDUM,IDUM,IDUM,XSSTA
           write(iomet)CLAB3,IDUM,IDUM,IDUM,IDUM,YSSTA
        endif

c ---   Header records #NCOM+7 & 8 - x, y coordinates of upper air stations
c ---   (NUSTA words each record)
        if(nusta.ge.1)then
           write(iomet)CLAB4,IDUM,IDUM,IDUM,IDUM,XUSTA
           write(iomet)CLAB5,IDUM,IDUM,IDUM,IDUM,YUSTA
        endif

c ---   Header records #NCOM+9 & 10 - x, y coordinates of precipitation stations
c ---   (NPSTA words each record)
        if(npsta.ge.1)then
           write(iomet)CLAB6,IDUM,IDUM,IDUM,IDUM,XPSTA
           write(iomet)CLAB7,IDUM,IDUM,IDUM,IDUM,YPSTA
        endif

c ---   Header record #NCOM+11 - surface roughness lengths (NX * NY words)
        write(iomet)CLAB8,IDUM,IDUM,IDUM,IDUM,Z0

c ---   Header record #NCOM+12 - land use categories (NX * NY words)
        write(iomet)CLAB9,IDUM,IDUM,IDUM,IDUM,ILANDU

c ---   Header record #NCOM+13 - elevations (NX * NY words)
        write(iomet)CLAB10,IDUM,IDUM,IDUM,IDUM,ELEV

c ---   Header record #NCOM+14 - leaf area index (NX * NY words)
        write(iomet)CLAB11,IDUM,IDUM,IDUM,IDUM,XLAI

c ---   Header record #NCOM+15 - nearest surface station no. to each
c ---              grid point (NX * NY words)
```

```
    if(nssta.ge.1)then
       write(iomet)CLAB12,IDUM,IDUM,IDUM,IDUM,NEARS
    endif
```

where the following declarations apply:

```
real ZFACEM(nz+1),XSSTA(nssta),YSSTA(nssta),XUSTA(nusta),YUSTA(nusta)
real XPSTA(npsta),YPSTA(npsta)
real Z0(nx,ny),ELEV(nx,ny),XLAI(nx,ny)
integer ILANDU(nx,ny),NEARS(nx,ny)
character*132 COMMENT(ncom)
character*64 DATAMOD
character*16 DATASET,DATAVER
character*12 DATEN
character*8 PMAP,DATUM
character*8 CLAB1,CLAB2,CLAB3,CLAB4,CLAB5,CLAB6
character*8 CLAB7,CLAB8,CLAB9,CLAB10,CLAB11,CLAB12
character*4 UTMHEM
logical LCALGRD
```

CALMET.DAT File - Data Records

The CALMET.DAT data records include time-varying fields of winds and meteorological variables. In addition to the regular CALMET output variables, both CALGRID and CALPUFF require additional three-dimensional fields of air temperature and vertical velocity. The presence of these fields in the CALMET output file is flagged by the header record logical variable, LCALGRD, having a value of TRUE.

The data records contain three-dimensional gridded fields of U, V, and W wind components and air temperature, and two-dimensional fields of PGT stability class, surface friction velocity, mixing height, Monin-Obukhov length, convective velocity scale, precipitation rate (not used by CALGRID), near-surface temperature, air density, short-wave solar radiation, relative humidity, and precipitation type codes (not used by CALGRID). A description of each variable in the data records is provided in Table 9-5.

Sample FORTRAN write statements for the CALMET.DAT data records are:

```
c ---  Write U, V, W wind components
       ┌─            Loop over vertical layers, k
       │
       │                write(iunit)CLABU,NDATHRB,IBSEC,NDATHRE,IESEC,
       │                                  ((U(i,j,k),i=1,nx),j=1,ny)
       │                write(iunit)CLABV, NDATHRB,IBSEC,NDATHRE,IESEC,
       │                                  ((V(i,j,k),i=1,nx),j=1,ny)
       │                if(LCALGRD)write(iunit)CLABW,NDATHRB,IBSEC,NDATHRE,IESEC,
       │                                  ((W(i,j,k+1),i=1,nx),j=1,ny)
       │
       └─            End loop over vertical layers
```

```
c ---   Write 3-D temperature field
        if(LCALGRD.and.irtype.eq.1) then
        ┌─             Loop over vertical layers, k
        │
        │                  write(iunit)CLABT, NDATHRB,IBSEC,NDATHRE,IESEC,
        │                              ((ZTEMP(i,j,k),i=1,nxm),j=1,nym)
        │
        └─             End loop over vertical layers
        endif

c ---   Write 2-D meteorological fields
        if(irtype.eq.1) then

                write(iunit)CLABSC, NDATHRB,IBSEC,NDATHRE,IESEC,IPGT
                write(iunit)CLABUS, NDATHRB,IBSEC,NDATHRE,IESEC,USTAR
                write(iunit)CLABZI, NDATHRB,IBSEC,NDATHRE,IESEC,ZI
                write(iunit)CLABL, NDATHRB,IBSEC,NDATHRE,IESEC,EL
                write(iunit)CLABWS, NDATHRB,IBSEC,NDATHRE,IESEC,WSTAR
                write(iunit)CLABRMM, NDATHRB,IBSEC,NDATHRE,IESEC,RMM
                write(iunit)CLABTK, NDATHRB,IBSEC,NDATHRE,IESEC,TEMPK
                write(iunit)CLABD, NDATHRB,IBSEC,NDATHRE,IESEC,RHO
                write(iunit)CLABQ, NDATHRB,IBSEC,NDATHRE,IESEC,QSW
                write(iunit)CLABRH, NDATHRB,IBSEC,NDATHRE,IESEC,IRH
                write(iunit)CLABPC, NDATHRB,IBSEC,NDATHRE,IESEC,IPCODE

        endif
```

where the following declarations apply:

```
        real U(nx,ny,nz),V(nx,ny,nz),W(nx,ny,nz)
        real ZTEMP(nx,ny,nz)
        real USTAR(nx,ny),ZI(nx,ny),EL(nx,ny)
        real WSTAR(nx,ny),RMM(nx,ny)
        real TEMPK(nx,ny),RHO(nx,ny),QSW(nx,ny)
        integer IPGT(nx,ny)
        integer IRH(nx,ny),IPCODE(nx,ny)
        character*8 CLABU, CLABV, CLABW, CLABT, CLABSC, CLABUS, CLABZI
        character*8 CLABL, CLABWS, CLABRMM, CLABTK, CLABD, CLABQ, CLABRH
        character*8 CLABPC
```

Table 9-4: CALMET.DAT file - Header Records

Header Record No.	Variable No.	Variable	Type[a]	Description
1	1	DATASET	char*16	Dataset name (CALMET.DAT)
1	2	DATAVER	char*16	Dataset version
1	3	DATAMOD	char*64	Dataset message field
2	1	NCOM	integer	Number of comment records to follow
3 to NCOM+2	1	COMMENT	char*132	Comment record (repeated NCOM times), each containing an image of one line of the CALMET control file, or other information
NCOM+3	1	IBYR	integer	Starting year of CALMET run
NCOM+3	2	IBMO	integer	Starting month
NCOM+3	3	IBDY	integer	Starting day
NCOM+3	4	IBHR	integer	Starting time (hour at start)
NCOM+3	5	IBSEC	integer	Starting time (seconds at start, 0-3600)
NCOM+3	6	IEYR	integer	Starting year of CALMET run
NCOM+3	7	IEMO	integer	Ending month
NCOM+3	8	IEDY	integer	Ending day
NCOM+3	9	IEHR	integer	Ending time (hour at end)
NCOM+3	10	IESEC	integer	Ending time (seconds at end, 0-3600)
NCOM+3	11	ABTZ	char*8	Base time zone (e.g., UTC-0500 =EST)
NCOM+3	12	IRLG	integer	Run length
NCOM+3	13	IRTYPE	integer	Run type (0=wind fields only, 1=wind and micrometeorological fields). IRTYPE must be run type 1 to drive CALGRID or options in CALPUFF that use boundary layer parameters
NCOM+3	14	NX	integer	Number of grid cells in the X direction
NCOM+3	15	NY	integer	Number of grid cells in the Y direction
NCOM+3	16	NZ	integer	Number of vertical layers
NCOM+3	17	DGRID	real	Grid spacing (m)
NCOM+3	18	XORIGR	real	X coordinate (m) of southwest corner of grid cell (1,1)

NCOM+3	19	YORIGR	real	Y coordinate (m) of southwest corner of grid cell (1,1)

[a]char*N = Character*N

Table 9-4 (Continued)
CALMET.DAT file - Header Records

Header Record No.	Variable No.	Variable	Type[a]	Description
NCOM+3	20	IWFCOD	integer	Wind field module used (0=objective analysis, 1=diagnostic model)
NCOM+3	21	NSSTA	integer	Number of surface meteorological stations
NCOM+3	22	NUSTA	integer	Number of upper air stations
NCOM+3	23	NPSTA	integer	Number of precipitation stations
NCOM+3	24	NOWSTA	integer	Number of over water stations
NCOM+3	25	NLU	integer	Number of land use categories
NCOM+3	26	IWAT1	integer	Range of land use categories
NCOM+3	27	IWAT2	integer	Corresponding to water surfaces (IWAT1 or IWAT2, inclusive)
NCOM+3	28	LCALGRD	logical	Flag indicating if the full set of meteorological parameters required by CALGRID are contained in the file (LCALGRD is normally set to TRUE for CALPUFF applications)
NCOM+3	29	PMAP[b]	char*8	Map projection[b] UTM : Universal Transverse Mercator TTM : Tangential Transverse Mercator LCC : Lambert Conformal Conic PS : Polar Stereographic EM : Equatorial Mercator LAZA : Lambert Azimuthal Equal Area
NCOM+3	30	DATUM	char*8	DATUM Code for grid coordinates
NCOM+3	31	DATEN	char*12	NIMA date (MM-DD-YYYY) for datum definitions
NCOM+3	32	FEAST	real	False Easting (km) for PMAP = TTM, LCC, or LAZA
NCOM+3	33	FNORTH	real	False Northing (km) for PMAP = TTM, LCC, or LAZA
NCOM+3	34	UTMHEM	char*4	Hemisphere for UTM projection (N or S)
NCOM+3	35	IUTMZN	integer	UTM zone for PMAP = UTM

NCOM+3	36	RNLAT0	real	North latitude (degrees) for projection origin (for PMAP= TTM, LCC, PS, EM, or LAZA)
NCOM+3	37	RELON0	real	East longitude (degrees) for projection origin (for PMAP= TTM, LCC, PS, EM, or LAZA)

[a] char*N = Character*N
[b] PMAP = EM, PS, and LAZA is NOT AVAILABLE in CALMET

Table 9-4 (Continued)
CALMET.DAT file - Header Records

Header Record No.	Variable No.	Variable	Type[a]	Description
NCOM+3	38	XLAT1	real	North latitude (degrees) of matching parallel #1 for map projection PMAP= LCC or PS
NCOM+3	39	XLAT2	real	North latitude (degrees) of matching parallel #2 for map projection PMAP= LCC
NCOM+4	1	CLAB1	char*8	Variable label ('ZFACE')
NCOM+4	2-5	IDUM	integer	Variable not used
NCOM+4	6	ZFACEM	real array	Heights (m) of cell faces (NZ + 1 values)
NCOM+5[b]	1	CLAB2	char*8	Variable label ('XSSTA')
NCOM+5[b]	2-5	IDUM	integer	Variable not used
NCOM+5[b]	6	XSSTA	real array	X coordinates (m) of each surface met. station
NCOM+6[b]	1	CLAB3	char*8	Variable label ('YSSTA')
NCOM+6[b]	2-5	IDUM	integer	Variable not used
NCOM+6[b]	6	YSSTA	real array	Y coordinates (m) of each surface met. station
NCOM+7[c]	1	CLAB4	char*8	Variable label ('XUSTA')
NCOM+7[c]	2-5	IDUM	integer	Variable not used
NCOM+7[c]	6	XUSTA	real array	X coordinates (m) of each upper air met. station
NCOM+8[c]	1	CLAB5	char*8	Variable label ('YUSTA')
NCOM+8[c]	2-5	IDUM	integer	Variable not used
NCOM+8[c]	6	YUSTA	real array	Y coordinate (m) of each upper air met. station
NCOM+9[d]	1	CLAB6	char*8	Variable label ('XPSTA')
NCOM+9[d]	2-5	IDUM	integer	Variable not used
NCOM+9[d]	6	XPSTA	real array	X coordinate (m) of each precipitation station
NCOM+10[d]	1	CLAB7	char*8	Variable label ('YPSTA')
NCOM+10[d]	2-5	IDUM	integer	Variable not used
NCOM+10[d]	6	YPSTA	real array	Y coordinate (m) of each precipitation station
NCOM+11	1	CLAB8	char*8	Variable label ('Z0')
NCOM+11	2-5	IDUM	integer	Variable not used

[a] char*N = Character*N
[b] Included only if NSSTA > 0
[c] Included only if NUSTA > 0
[d] Included only if NPSTA > 0

Table 9-4 (Concluded)
CALMET.DAT file - Header Records

Header Record No.	Variable No.	Variable	Type[a]	Description
NCOM+11	6	Z0	real array	Gridded field of surface roughness lengths (m) for each grid cell
NCOM+12	1	CLAB9	char*8	Variable label ('ILANDU')
NCOM+12	2-5	IDUM	integer	Variable not used
NCOM+12	6	ILANDU	integer array	Gridded field of land use category for each grid cell
NCOM+13	1	CLAB10	char*8	Variable label ('ELEV')
NCOM+13	2-5	IDUM	integer	Variable not used
NCOM+13	6	ELEV	real array	Gridded field of terrain elevations for each grid cell
NCOM+14	1	CLAB11	char*8	Variable label ('XLAI')
NCOM+14	2-5	IDUM	integer	Variable not used
NCOM+14	6	XLAI	real array	Gridded field of leaf area index for each grid cell
NCOM+15	1	CLAB12	char*8	Variable label ('NEARS')
NCOM+15	2-5	IDUM	integer	Variable not used
NCOM+15	6	NEARS	integer array	Nearest surface meteorological station to each grid point

[a]char*N = Character*N

Table 9-5: CALMET.DAT file - Data Records

Record Type	Variable No.	Variable Name	Type[a]	Description
1	1	CLABU	char*8	Variable label ('U-LEVxxx', where xxx indicates the layer number)
1	2,3	NDATHRB, NSECB	integer	Year, Julian day and hour (YYYYJJJHH) and seconds (SSSS)
1	4,5	NDATHRE, NSECB	integer	Year, Julian day and hour (YYYYJJJHH) and seconds (SSSS)
1	6	U	real array	U-component (m/s) of the winds at each grid point
2	1	CLABV	char*8	Variable label ('V-LEVxxx', where xxx indicates the layer number)
2	2,3	NDATHRB, NSECB	integer	Year, Julian day and hour (YYYYJJJHH) and seconds (SSSS)
2	4,5	NDATHRE, NSECB	integer	Year, Julian day and hour (YYYYJJJHH) and seconds (SSSS)
2	6	V	real array	V-component (m/s) of the winds at each grid point
3[b]	1	CLABW	char*8	Variable label ('WFACExxx"), where xxx indicates the layer number)
3[b]	2,3	NDATHRB, NSECB	integer	Year, Julian day and hour (YYYYJJJHH) and seconds (SSSS)
3[b]	4,5	NDATHRE, NSECB	integer	Year, Julian day and hour (YYYYJJJHH) and seconds (SSSS)
3[b]	6	W	real array	W-component (m/s) of the winds at each grid point
(Record types 1,2,3 repeated NZ times (once per layer) as a set)				
4[b]	1	CLABT	char*8	Variable label ('T-LEVxxx', where xxx indicates the layer number)
4[b]	2,3	NDATHRB, NSECB	integer	Year, Julian day and hour (YYYYJJJHH) and seconds (SSSS)
4[b]	4,5	NDATHRE, NSECB	integer	Year, Julian day and hour (YYYYJJJHH) and seconds (SSSS)

4[b]	6	ZTEMP	real array	Air temperature (deg. K) at each grid point

(Record type 4 repeated NZM times (once per layer))

[a] char*8 = Character*8
[b] Record types 3 and 4 are included only if LCALGRD is TRUE

Table 9-5 (Continued)
CALMET.DAT file - Data Records

Record Type	Variable No.	Variable Name	Type[a]	Description
5	1	CLABSC	char*8	Variable label ('IPGT')
5	2,3	NDATHRB, NSECB	integer	Year, Julian day and hour (YYYYJJJHH) and seconds (SSSS)
5	4,5	NDATHRE, NSECB	integer	Year, Julian day and hour (YYYYJJJHH) and seconds (SSSS)
5	6	IPGT	integer array	PGT stability class at each grid point
6	1	CLABUS	char*8	Variable label ('USTAR')
6	2,3	NDATHRB, NSECB	integer	Year, Julian day and hour (YYYYJJJHH) and seconds (SSSS)
6	4,5	NDATHRE, NSECB	integer	Year, Julian day and hour (YYYYJJJHH) and seconds (SSSS)
6	6	USTAR	real array	Surface friction velocity (m/s)
7	1	CLABZI	char*8	Variable label ('ZI')
7	2,3	NDATHRB, NSECB	integer	Year, Julian day and hour (YYYYJJJHH) and seconds (SSSS)
7	4,5	NDATHRE, NSECB	integer	Year, Julian day and hour (YYYYJJJHH) and seconds (SSSS)
7	6	ZI	real array	Mixing height (m)
8	1	CLABL	char*8	Variable label ('EL')
8	2,3	NDATHRB, NSECB	integer	Year, Julian day and hour (YYYYJJJHH) and seconds (SSSS)
8	4,5	NDATHRE, NSECB	integer	Year, Julian day and hour (YYYYJJJHH) and seconds (SSSS)
8	6	EL	real array	Monin-Obukhov length (m)
9	1	CLABWS	char*8	Variable label ('WSTAR')
9	2,3	NDATHRB, NSECB	integer	Year, Julian day and hour (YYYYJJJHH) and seconds (SSSS)
9	4,5	NDATHRE, NSECB	integer	Year, Julian day and hour (YYYYJJJHH) and seconds (SSSS)

9	6	WSTAR	real array	Convective velocity scale (m/s)

[a] char*8 = Character*8

Table 9-5 (Concluded)
CALMET.DAT file - Data Records

Record Type	Variable No.	Variable Name	Type[a]	Description
10	1	CLABRMM	char*8	Variable label ('RMM')
10	2,3	NDATHRB, NSECB	integer	Year, Julian day and hour (YYYYJJJHH) and seconds (SSSS)
10	4,5	NDATHRE, NSECB	integer	Year, Julian day and hour (YYYYJJJHH) and seconds (SSSS)
10	6	RMM	real array	Precipitation rate (mm/hr). Not used by CALGRID.
11	1	CLABTK	char*8	Variable label ('TEMPK')
11	2,3	NDATHRB, NSECB	integer	Year, Julian day and hour (YYYYJJJHH) and seconds (SSSS)
11	4,5	NDATHRE, NSECB	integer	Year, Julian day and hour (YYYYJJJHH) and seconds (SSSS)
11	6	TEMPK	real array	Near-surface temperature (deg. K)
12	1	CLABD	char*8	Variable label ('RHO')
12	2,3	NDATHRB, NSECB	integer	Year, Julian day and hour (YYYYJJJHH) and seconds (SSSS)
12	4,5	NDATHRE, NSECB	integer	Year, Julian day and hour (YYYYJJJHH) and seconds (SSSS)
12	6	RHO	real array	Near-surface air density (kg/m^3)
13	1	CLABQ	char*8	Variable label ('QSW')
13	2,3	NDATHRB, NSECB	integer	Year, Julian day and hour (YYYYJJJHH) and seconds (SSSS)
13	4,5	NDATHRE, NSECB	integer	Year, Julian day and hour (YYYYJJJHH) and seconds (SSSS)
13	6	QSW	real array	Short-wave solar radiation (W/m^2)
14	1	CLABRH	char*8	Variable label ('IRH')
14	2,3	NDATHRB, NSECB	integer	Year, Julian day and hour (YYYYJJJHH) and seconds (SSSS)
14	4,5	NDATHRE, NSECB	integer	Year, Julian day and hour (YYYYJJJHH) and seconds (SSSS)

14	6	IRH	integer array	Near-surface relative humidity (percent)

[a] char*8 = Character*8

Table 9-5 (Concluded)
CALMET.DAT file - Data Records

Record Type	Variable No.	Variable Name	Type[a]	Description
15	1	CLABPC	char*8	Variable label ('IPCODE')
15	2,3	NDATHRB, NSECB	integer	Year, Julian day and hour (YYYYJJJHH) and seconds (SSSS)
15	4,5	NDATHRE, NSECB	integer	Year, Julian day and hour (YYYYJJJHH) and seconds (SSSS)
15	6	IPCODE	integer array	Precipitation type code 0 - no precipitation 1 to 18 - liquid precipitation 19 to 45 - frozen precipitation

[a] char*8 = Character*8

9.2.2 ISCMET.DAT

CALPUFF can be driven by a single-station standard ISC3-type of meteorological file, compatible with the earlier ISC2 version of the model, or an augmented ISC3-type of meteorological file. In addition, the ISCMET.DAT file used by CALPUFF can accommodate an extended data record that includes the augmented ISC3 data plus variables not found in either a standard ISC3 data record, or the augmented ISC3 data record. This extended ISC3-type data file format has been modified further to allow sub-hourly time steps. In the description to follow, we refer to the standard ISC3 file as the "base" ISC3 format.

CALPUFF is normally run with a full three-dimensional wind field and temperature field, as well as two-dimensional fields of mixing heights and other meteorological variables (see CALMET.DAT in Section 9.2.1). However, in some near-field applications, when spatial variability of the meteorological fields may not be significant (e.g., uniform terrain and land use), the single-station data file may be used. The model uses the data in the ISCMET.DAT file to fill the 2-D or 3-D arrays with the scalar values read from the file. In single-station mode, CALPUFF assigns the single value of each variable read from the ISCMET.DAT file to all grid points, resulting in a spatially uniform gridded field. However, the model does not assume that the meteorological conditions are steady-state, which allows the important effects of causality to be simulated even with the single-station meteorological data. For example, the time required for plume material to reach a receptor is accounted for in the puff formulation, and curved trajectories and variable dispersion and stability conditions over multiple hours of transport will result even when using the single-station meteorological data. However, in general, the preferred mode for most applications of CALPUFF is to use the spatially variable fields generated by CALMET.

The minimum data required in the ISCMET.DAT file includes time-varying values of the vector flow direction, wind speed, temperature, stability class, and mixing height (urban or rural), which are found in the "base" ISC3 format. In addition, if dry or wet deposition are being modeled, or if turbulence-based dispersion coefficients are to be computed based on micrometeorological parameters, time-varying values of the surface friction velocity (u_*), Monin-Obukhov length (L), a time-varying surface roughness length (z_o), precipitation rate, and precipitation type code are entered on an extended record. These additional variables are contained in the augmented ISC3 meteorological file. If chemical transformation is being modeled, time-varying values of short-wave solar radiation and relative humidity can also be included in the extended record. In addition, time-varying values of the potential temperature lapse rate ($d\theta/dz$) and power law profile exponent (p) can be entered. Non-missing values of the basic meteorological variables (i.e., vector wind direction, wind speed, temperature, stability class, and mixing height) must be provided for all applications. The data fields for the extended record variables (u_*, L, etc.) may be left blank if the CALPUFF options are set so that they are not needed (e.g., no wet or dry deposition, no chemical transformation, no computation of turbulence-based dispersion coefficients). However, if the CALPUFF model options are set to require them, the model assumes that valid values of the extended record variables will be provided for every period. The only exceptions are $d\theta/dz$ and p, which can be entered for some periods and not others. If values of $d\theta/dz$ or p are missing (i.e., blank) for a given period, the model will use its default or user-specified stability-dependent values (see the PLX0 and PTG0 variables in Input Group 12 of the control file).

Sample ISCMET.DAT files are shown in Tables 9-6(a-c). Part (a) of the table shows the "base" ISC3 meteorological data record. The fully extended data record is shown in Part (b) of the table, and the form of the extended record data with sub-hourly time steps is shown in Part (c). Table 9-7 lists the contents of the ISCMET.DAT header records, and Table 9-8 describes the data records. Note that neither version of the fully extended data record formats is produced by any available processing program. These formats are defined here for those users who wish to transform non-standard data sources into a single-station format file for use in CALPUFF.

Other data associated with the meteorological data in ISCMET.DAT are provided in the CALPUFF.INP control file. These data include the anemometer height, surface roughness length, land use type, elevation, and leaf area index of the modeling region. The anemometer height is required in the vertical power law extrapolation of the wind speed. The roughness length is used if turbulence-based dispersion coefficients are selected, and in the calculation of dry deposition velocities, when the hourly value is missing. The land use category is used to determine if urban or rural dispersion coefficients are appropriate when the Pasquill-Gifford/McElroy-Pooler dispersion coefficients are used. Also see the variables IURB1 and IURB2 in Input Group 12 of the control file. They define the range of land use categories that are to be considered urban (i.e., if the value of the land use category in the ISCMET.DAT file is between IURB1 and IURB2, inclusive, the modeling domain will be consider urban). Otherwise, it will be considered rural. The leaf area index is only used by the model if dry deposition velocities are being computed. The elevation is used to fill the 2-D terrain elevation array in CALPUFF that is normally filled from the CALMET file. This array is used to determine, through interpolation, the elevation of the *gridded* receptors generated by the model as an option. Because a single value is available when the ISCMET.DAT file is used, all of the gridded receptors will be assigned this elevation. Receptor-specific elevations are assigned to each *discrete* receptor by the user in the CALPUFF control file (see Input Group 17).

Table 9-6: Sample ISCMET.DAT files

(a) Base Data Records (hourly)

```
 94728     90  14735     90
90 1 1 1  81.0000   3.0866 280.9 5  881.5   53.0
90 1 1 2  98.0000   1.5433 279.8 6  904.6   53.0
90 1 1 3 114.0000   2.5722 279.8 5  927.8   53.0
90 1 1 4 113.0000   4.1155 280.4 4  951.0  951.0
90 1 1 5 103.0000   3.0866 279.8 5  974.2   53.0
|  | | |    |          |    |    |    |      |
yr  dy     WD vect     WS  Temp     rural  urban
  mo  hr                       stab   zi     zi
```

(b) Extended Data Records (hourly)

```
 94728     90  14735     90
90 1 1 1  81.0000   3.0866 280.9 5  881.5   53.0     0.33      355.    0.25    0    0.0      .020  .35       0. 77
90 1 1 2  98.0000   1.5433 279.8 6  904.6   53.0     0.17      122.    0.25    0    0.0      .035  .55       0. 68
90 1 1 3 114.0000   2.5722 279.8 5  927.8   53.0     0.28      259.    0.25    0    0.0            .30       0. 72
90 1 1 4 113.0000   4.1155 280.4 4  951.0  951.0     0.45      655.    0.25    0    0.0            .15       0. 74
90 1 1 5 103.0000   3.0866 279.8 5  974.2   53.0     0.33      355.    0.25    0    0.0      .022             0. 75
|  | | |    |          |    |    |    |      |        |         |       |      |     |         |     |         |   |
yr  dy     WD vect     WS  Temp    rural  urban       u*        L       zo     p   precip.   dθ/dz   p         SW  rh
  mo  hr                       stab   zi     zi                                code    amt.                    rad.  %
```

(c) Extended Data Records (sub-hourly)

ISCMET.DAT Header comments, begin/end times with seconds, time zone

```
   1
Prepared by user
NONE
UTC-0500
1990 01 01 00 0000    1990 01 01 02 1800
94728     90  14735     90
90 1 1 0   090 1 1 01800  81.0000   3.0866 280.9 5  881.5   53.0     0.33      355.    0.25    0    0.0      .020  .35       0. 77
90 1 1 0180090 1 1 03600  98.0000   1.5433 279.8 6  904.6   53.0     0.17      122.    0.25    0    0.0      .035  .55       0. 68
90 1 1 1   090 1 1 11800 114.0000   2.5722 279.8 5  927.8   53.0     0.28      259.    0.25    0    0.0            .30       0. 72
90 1 1 1180090 1 1 13600 113.0000   4.1155 280.4 4  951.0  951.0     0.45      655.    0.25    0    0.0            .15       0. 74
90 1 1 2   090 1 1 21800 103.0000   3.0866 279.8 5  974.2   53.0     0.33      355.    0.25    0    0.0      .022             0. 75
 | | | |   | | | | |   |    |         |     |     |    |      |         |         |       |      |     |         |     |         |   |
yr  dy  sec yr  dy  sec    WD vect    WS   Temp    rural  urban      u*        L       zo      p   precip.   dθ/dz   p         SW  rh
  mo  hr      mo  hr                          stab   zi     zi                                code    amt.                    rad.  %
```

Table 9-7: ISCMET.DAT File - Header Record (Hourly Data File)

Record	Columns	Variable	Type	Description
1	1-6	*	integer	Surface station number.
1	8-13	*	integer	Surface station year.
1	15-20	*	integer	Mixing height station number.
1	22-27	*	integer	Mixing height station year.

* These variables are not interpreted in CALPUFF

ISCMET.DAT File - Header Records (Sub-Hourly Data File)

Record	Variable	Type	Description
1	DATASET	character*16	Dataset name (ISCMET.DAT)
1	DATAVER	character*16	Dataset version (2.1)
1	DATAMOD	character*64	Dataset message field
2	NCOMM	integer	Number of comment records to follow
NEXT NCOMM Lines	COMMENT	character *80	Other documentation
NCOMM+3	PMAP	character*8	Map projection (NONE)
NCOMM+4	TZONE	character*8	Time zone (UTC+hhmm)
NCOMM+5	IBYR	integer	Starting year
NCOMM+5	IBMO	integer	Starting month
NCOMM+5	IBDY	integer	Starting day
NCOMM+5	IBHR	integer	Starting time (hour 00-23)
NCOMM+5	IBSEC	integer	Starting time (second 0000-3600)
NCOMM+5	IEYR	integer	Ending year
NCOMM+5	IEMO	integer	Ending month
NCOMM+5	IEDY	integer	Ending day
NCOMM+5	IEHR	integer	Ending time (hour 00-23)
NCOMM+5	IESEC	integer	Ending time (second 0000-3600)
NCOMM+6	*	integer	Surface station number
NCOMM+6	*	integer	Surface station year.

NCOMM+6	*	integer	Mixing height station number
NCOMM+6	*	integer	Mixing height station year

* These variables are not interpreted in CALPUFF

Table 9-8: ISCMET.DAT File - Data Records (Hourly Data File)

(One record per time period)
Records 2,3,4,... Hourly Meteorological Data.

Columns	Variable	Type	Description
	Base Data		
1-2	IY	integer	Year of data in record
3-4	IM	integer	Month
5-6	ID	integer	Day
7-8	IH	integer	Hour (ISC3 convention (1-24) at end of hour)
9-17	FVEC	real	Flow vector (deg.)
18-26	WSPD	real	Wind speed (m/s)
27-32	TMPK	real	Temperature (deg. K)
33-34	KST	integer	Stability class (1-6)
35-41	RMIX	real	Rural mixing height (m)
42-48	UMIX	real	Urban mixing height (m)
	Extended data		
49-57	USTR	real	Friction velocity (m/s)
58-67	XMON	real	Monin-Obukhov length (m)
68-75	Z0M	real	Surface roughness length (m)
76-79	IPC	integer	Precipitation type code 0 - no precipitation 1 to 18 - liquid precipitation 19 to 45 - frozen precipitation
80-86	PMMHR	real	Precipitation rate (mm/hr)
87-96	DTHTD	real	Potential temperature lapse rate (deg. K/m)
97-101	PLAW	real	Wind speed power law exponent
102-110	QSWRAD	real	Short-wave solar radiation (W/m^2)
111-113	IRH	integer	Relative humidity (%)

Read using format(4i2,2f9.4,f6.1,i2,2f7.1,f9.4,f10.1,f8.4,i4,f7.2,f10.5,a5,a9,a3)

Table 9-8 (continued)
ISCMET.DAT File - Data Records (Sub-Hourly Data File)
(One record per time period)

Records NCOMM+7,8,9,... Sub-Hourly Meteorological Data.

Columns	Variable	Type	Description
1-2	IBY	integer	Beginning year of data in record
3-4	IBM	integer	Beginning month
5-6	IBD	integer	Beginning day
7-8	IBH	integer	Beginning time (hour 00-23)
9-12	IBS	integer	Beginning time (second 0000-3600)
13-14	IEY	integer	Ending year of data in record
15-16	IEM	integer	Ending month
17-18	IED	integer	Ending day
19-20	IEH	integer	Ending time (hour 00-23)
21-24	IES	integer	Ending time (second 0000-3600)
25-33	FVEC	real	Flow vector (deg.)
34-42	WSPD	real	Wind speed (m/s)
43-48	TMPK	real	Temperature (deg. K)
49-50	KST	integer	Stability class (1-6)
51-57	RMIX	real	Rural mixing height (m)
58-64	UMIX	real	Urban mixing height (m)
65-73	USTR	real	Friction velocity (m/s)
74-83	XMON	real	Monin-Obukhov length (m)
84-91	Z0M	real	Surface roughness length (m)
92-95	IPC	integer	Precipitation type code 0 - no precipitation 1 to 18 - liquid precipitation 19 to 45 - frozen precipitation
96-102	PMMHR	real	Precipitation rate (mm/hr)
103-112	DTHTD	real	Potential temperature lapse rate (deg. K/m)
113-117	PLAW	real	Wind speed power law exponent
118-126	QSWRAD	real	Short-wave solar radiation (W/m^2)
127-129	IRH	integer	Relative humidity (%)

Read using format(2(4i2,i4),2f9.4,f6.1,i2,2f7.1,f9.4,f10.1,f8.4,i4,f7.2,f10.5,a5,a9,a3)

9.2.3 PLMMET.DAT

In addition to the capability to use three-dimensional wind fields generated by CALMET, a single-station meteorological file can also be used by CALPUFF as its source of meteorological data. One form of single station data accepted by CALPUFF is the AUSPLUME (Lorimer, 1976) type of data file. The standard AUSPLUME data file can be used without modification, although some CALPUFF options require additional meteorological variables that must be added as part of an extended data record.

CALPUFF is normally run with a full three-dimensional wind field and temperature field, as well as two-dimensional fields of mixing heights and other meteorological variables (see CALMET.DAT in Section 9.2.1). However, in some near-field applications, when spatial variability of the meteorological fields may not be significant (e.g., uniform terrain and land use), the single-station data file may be used. In single station mode, CALPUFF assigns the single value of each variable read from the PLMMET.DAT file to all grid points, resulting in a spatially uniform gridded field. However, the model does not assume the meteorological conditions are steady-state, which allows the important effects of causality to be simulated even with the single-station meteorological data. For example, the time required for plume material to reach a receptor is accounted for in the puff formulation, and curved trajectories and variable dispersion and stability conditions over multiple hours of transport will result even when using the single-station meteorological data. However, in general, the preferred mode for most applications of CALPUFF is to use the spatially variable fields generated by CALMET.

The PLMMET.DAT file includes the basic hourly data required by CALPUFF, including the wind direction, wind speed, temperature, stability class, and mixing height. Note that PLMMET.DAT uses *wind direction* in the usual meteorological convention (i.e., winds from the west blowing toward the east has a value of 270°), while ISCMET.DAT uses *flow vector* (i.e., winds from the west toward the east have a vector direction of 90°). The PLMMET.DAT format also contains data for the horizontal component of turbulence (Φ_2). If both components of turbulence are available, they should be entered through the use of the PROFILE.DAT data file (see Section 9.2.4). Also, CALPUFF contains several options for modeling chemical transformation that do not involve the use of a decay constant.

The PLMMET.DAT format does not contain micrometeorological variables (the surface friction velocity and Monin-Obukhov length), precipitation data, solar radiation, or relative humidity. The Monin-Obukhov length is inferred from the stability class and the surface roughness length using the Golder (1972) relations. The friction velocity can then be estimated from the surface-layer similarity wind profile equation. The remaining variables must be added to the standard file in an exended data record. These fields may remain blank if they are not needed for the CALPUFF options selected. Precipitation is needed for wet deposition modeling, and the solar radiation and humidity data are needed for chemical transformation calculations.

Sample PLMMET.DAT files are shown in Tables 9-9(a) and 9-9(b). Part (a) of the table shows the standard AUSPLUME meteorological data record. The extended data record is shown in Part (b) of the table. A description of the contents of the header record is provided in Table 9-10, and the data records are described in Table 9-11. The header record contains an 80-character title of the data set.

Note that other data associated with the PLMMET.DAT are provided in the CALPUFF.INP control file. These data include the anemometer height, surface roughness length, land use type, elevation, and leaf area index of the modeling region. The anemometer height is required in the vertical power law extrapolation of the wind speed. The roughness length is used to estimate the micrometeorological variables, the turbulence-based dispersion coefficients (when selected), and in the calculation of dry deposition velocities. The land use category is used to determine if urban or rural dispersion coefficients are appropriate when the Pasquill-Gifford/McElroy-Pooler dispersion coefficients are used. Also see the variables IURB1 and IURB2 in Input Group 12 of the control file. They define the range of land use categories that are to be considered urban (i.e., if the value of the land use category in the PLMMET.DAT file is between IURB1 and IURB2, inclusive, the modeling domain will be consider urban). Otherwise, it will be considered rural. The leaf area index is only used by the model if dry deposition velocities are being computed. The elevation is used to fill the 2-D terrain elevation array in CALPUFF that is normally filled from the CALMET file. This array is used to determine, through interpolation, the elevation of the *gridded* receptors generated by the model as an option. Because a single value is available here, all of the gridded receptors will be assigned this elevation. Receptor-specific elevations are assigned to each *discrete* receptor by the user in the CALPUFF control file (see Input Group 17).

Table 9-9: Sample PLMMET.DAT file

(a) Base Data Records

```
Sample PLMMET.DAT data file.  Min. ws=1.0 m/s
94010101 19  1.0 270 F  100  17. 0.55 .035        0.
94010102 19  1.2 270 F  122  22.      .030        0.
94010103 20  1.5 270 F  132  18.                  0.
94010104 19  3.2 270 E  256      0.35             0.
94010105 20  1.8 270 F  103      0.45 .031        0.
94010106 20  3.3 270 E  201      0.32 .024        0.
94010107 21  5.0 270 D  284      0.25             0.
94010108 21  4.6 270 D  301  12.                  0.
94010109 22  3.5 270 D  525  11.                  0.
94010110 22  3.9 270 C  658  16. 0.19             0.
 | | | |  |    |   | |    |   |    |    |         |
yr  dy   Temp WS  WD     zi   σθ    p  dθ/dz   decay
  mo  hr           stab
```

(b) Extended Data Records

```
Sample PLMMET.DAT data file.  Min. ws=1.0 m/s
94010101 19  1.0 270 F  100  17. 0.55 .035        0.  0      0.0       0. 65
94010102 19  1.2 270 F  122  22.      .030        0.  0      0.0       0. 69
94010103 20  1.5 270 F  132  18.                  0.  0      0.0       0. 65
94010104 19  3.2 270 E  256      0.35             0.  0      0.0       0. 66
94010105 20  1.8 270 F  103      0.45 .031        0.  0      0.0       0. 69
94010106 20  3.3 270 E  201      0.32 .024        0.  0      0.0       0. 73
94010107 21  5.0 270 D  284      0.25             0.  1     1.80      11. 78
94010108 21  4.6 270 D  301  12.                  0.  1      .95      82. 76
94010109 22  3.5 270 D  525  11.                  0.  0      0.0     116. 58
94010110 22  3.9 270 C  658  16. 0.19             0.  0      0.0     250. 55
 | | | |  |    |   | |    |   |    |    |         |   |       |        |   |
yr  dy   Temp WS  WD     zi   σθ    p  dθ/dz    decay  p   precip.    SW   rh
  mo   hr          stab                               code  amount    rad.   %
```

Table 9-10: PLMMET.DAT File - Header Record

Record 1. Title.

Record	Columns	Variable	Type	Description
1	1-80	TITLE	character*80	Title of file.

Table 9-11: PLMMET.DAT File - Data Records

(One record per hour)
Records 2,3,4,... Hourly meteorological data.

Columns	Variable	Type	Description
	Base Data		
1-2	IY	integer	Year of data in record
3-4	IM	integer	Month
5-6	ID	integer	Day
7-8	IH	integer	Hour (1-24) time at end of hour
9-11	TMPC	real	Temperature (deg. C)
12-16	WSPD	real	Wind speed (m/s)
17-20	IWD	integer	Wind direction (deg.)
21-22	KST *	character	Stability class (A-F)
23-27	ZMIX	real	Mixing height (m)
28-32	SIGTHA	real	σ_θ (deg.). Or use PROFILE.DAT file for turbulence measurements.
33-37	PLEXP	real	Wind speed power law exponent
38-42	PTGDF	real	Potential temperature gradient (deg. K/m)
43-52	DECAY	real	Decay constant (s^{-1}). Not used by CALPUFF.
	Extended Data		
53-55	IPC	integer	Precipitation type code 0 - no precipitation 1 to 18 - liquid precipitation 19 to 45 - frozen precipitation
56-64	PMMHR	real	Precipitation rate (mm/hr)
65-73	QSWRAD	real	Short-wave solar radiation (W/m^2)
74-76	IRELHUM	integer	Relative humidity (%)

* KST is converted from character (A-F) to integer (1-6)

9.2.4 SURFACE.DAT and PROFILE.DAT

In addition to the capability to use three-dimensional wind fields generated by CALMET, a single-station meteorological file can also be used by CALPUFF as its source of meteorological data. One form of single station data accepted by CALPUFF is the CTDMPLUS (Perry et al., 1989) form. The standard meteorological data files SURFACE.DAT and PROFILE.DAT can be used without modification, although some CALPUFF options require additional meteorological variables that must be added as part of an extended data record to SURFACE.DAT and PROFILE.DAT. Unlike the other two types of single-station data described above, the PROFILE.DAT file contains a vertical profile of data each hour, rather than measurements made at a single height above ground. In this way, more detailed data from an on-site tower with supporting remote measurement platforms (e.g., SODAR) can be used to define the vertical structure of the flow. SURFACE.DAT contains calculated micrometeorological variables and the mixing height. This extended SURFACE.DAT and PROFILE.DAT formats have been modified further to allow sub-hourly time steps.

CALPUFF is normally run with a full three-dimensional wind field and temperature field, as well as two-dimensional fields of mixing heights and other meteorological variables (see CALMET.DAT in Section 9.2.1). However, in some near-field applications, when spatial variability of the meteorological fields may not be significant (e.g., uniform terrain and land use), the single-station data file may be used. In single station mode, CALPUFF assigns the single value of each variable read from the file to all grid points, resulting in a spatially uniform gridded field. However, the model does not assume the meteorological conditions are steady-state, which allows the important effects of causality to be simulated even with the single-station meteorological data. For example, the time required for plume material to reach a receptor is accounted for in the puff formulation, and curved trajectories and variable dispersion and stability conditions over multiple hours of transport will result even when using the single-station meteorological data. However, in general, the preferred mode for most applications of CALPUFF is to use the spatially variable fields generated by CALMET.

SURFACE.DAT is created by the CTDMPLUS meteorological preprocessor, and the user should consult the CTDMPLUS documentation to learn of its use and requirements. SURFACE.DAT includes hourly mixing height, surface friction velocity, Monin-Obukhov length, and surface roughness. PROFILE.DAT is created directly by the user. In standard form, it includes the hourly wind direction, wind speed (vector and scalar), temperature, and turbulence (σ_w, and either σ_v or σ_θ) at each measurement level. Note that PROFILE.DAT uses *wind direction* in the usual meteorological convention (i.e., winds from the west blowing toward the east has a value of 270°).

As an option, a non-standard, or extended version of PROFILE.DAT can also be used to provide the temperature jump across an inversion above a mixed layer. This jump is used as a measure of the strength of the temperature inversion when assessing the ability of a buoyant plume to penetrate the top of the mixed layer (for the partial penetration option: MPARTL = 1). When a positive temperature difference is provided at the end of the first record for the hour, CALPUFF will recognize it and use it. Otherwise, available temperature gradient data are used to estimate the inversion strength.

Precipitation data, solar radiation, and relative humidity are not required in CTDMPLUS. They may be added to SURFACE.DAT in an extended data record. These fields may remain blank if they are not needed for the CALPUFF options selected. Precipitation is needed for wet deposition modeling, and the solar radiation and humidity data are needed for chemical transformation calculations.

Other data associated with the SURFACE.DAT and PROFILE.DAT are provided in the CALPUFF.INP control file. These data include the land use type, elevation, and leaf area index of the modeling region, and two control variables (ISIGMAV and IMIXCTDM). The land use category is used to determine if urban or rural dispersion coefficients are appropriate when the Pasquill-Gifford/McElroy-Pooler dispersion coefficients are used during convective regimes. Also see the variables IURB1 and IURB2 in Input Group 12 of the control file. They define the range of land use categories that are to be considered urban (i.e., if the value of the land use category is between IURB1 and IURB2, inclusive, the modeling domain will be consider urban). Otherwise, it will be considered rural. The leaf area index is only used by the model if dry deposition velocities are being computed. The elevation is used to fill the 2-D terrain elevation array in CALPUFF that is normally filled from the CALMET file. This array is used to determine, through interpolation, the elevation of the *gridded* receptors generated by the model as an option. Because a single value is available here, all of the gridded receptors will be assigned this elevation. Receptor-specific elevations are assigned to each *discrete* receptor by the user in the CALPUFF control file (see Input Group 17). ISIGMAV indicates the form of the lateral turbulence data, and IMIXCTDM indicates which mixing height field (observed or calculated) is to be used.

Sample SURFACE.DAT files are shown in Tables 9-12(a-c). Part (a) of the table shows the standard SURFACE.DAT data record. The extended data record is shown in Part (b) of the table, and the form of the extended record data with sub-hourly time steps is shown in Part (c). Similarly, sample PROFILE.DAT files are shown in Table 9-13. Data records for SURFACE.DAT are described in Table 9-14, and data records for PROFILE.DAT are described in Table 9-15. Note that the year may be specified in either a YY (e.g., 94) or YYYY (e.g., 1994) format. The YY format is the original CTDM PLUS format.

The PROFILE.DAT file may also be used in conjunction with the other meteorological data options in CALPUFF to provide measured turbulence data, or to provide the strength of the temperature inversion. When turbulence data are supplied, wind speeds should be provided in the file as well as the turbulence, so that conversions between σ_v and σ_θ can be made.

Table 9-12: Sample SURFACE.DAT file

(a) Base Data Records (hourly)

```
94  1  1   1  1          658.       30.     0.047      15.7  0.500E+00
94  1  1   1  2          658.       37.     0.067      15.7  0.500E+00
94  1  1   1  3          658.       35.     0.060      15.7  0.500E+00
94  1  1   1  4          658.       33.     0.053      15.7  0.500E+00
94  1  1   1  5          658.       30.     0.047      15.7  0.500E+00
94  1  1   1  6          658.       35.     0.060      15.7  0.500E+00
 |  |  |   |  |            |          |         |         |          |
Yr Mo Dy Jul Hr          Ziobs     Zipre     Ustar     Monin       Zo
         Dy                                           Obukhov
```

(b) Extended Data Records (hourly)

```
94  1  1   1  1          658.       30.     0.047      15.7  0.500E+00  0      0.0       0. 65
94  1  1   1  2          658.       37.     0.067      15.7  0.500E+00  0      0.0       0. 69
94  1  1   1  3          658.       35.     0.060      15.7  0.500E+00  0      0.0       0. 65
94  1  1   1  4          658.       33.     0.053      15.7  0.500E+00  0      0.0       0. 66
94  1  1   1  5          658.       30.     0.047      15.7  0.500E+00  0      0.0       0. 69
94  1  1   1  6          658.       35.     0.060      15.7  0.500E+00  0      0.0       0. 73
|   |  |  |   |            |          |         |         |          |    |       |         |   |
Yr Mo Dy Jul Hr          Ziobs     Zipre     Ustar     Monin         Zo   p    precip.      SW rh
         Dy                                           Obukhov           code  amount     rad. %
```

(b) Extended Data Records (sub-hourly)

```
SURFACE.DAT     2.1             Header comments, begin/end times with seconds, time zone
   1
Prepared by user
NONE
UTC-0500
1995  7 20 4 0000  1995  7 20  5 1800
1995  7 20 201  4    0  1995  7 20 201  4  900   600.0  600.0   0.0332      14.1  0.1000  0      0.0      0. 65
1995  7 20 201  4  900  1995  7 20 201  4 1800   600.0  600.0   0.0360      14.1  0.1000  0      0.0      0. 65
1995  7 20 201  4 1800  1995  7 20 201  4 2700   600.0  600.0   0.0309      14.1  0.1000  0      0.0      0. 69
1995  7 20 201  4 2700  1995  7 20 201  4 3600   600.0  600.0   0.0323      14.1  0.1000  0      0.0      0. 70
1995  7 20 201  5    0  1995  7 20 201  5  900   600.0  600.0   0.0264      14.1  0.1000  0      0.0      0. 74
1995  7 20 201  5  900  1995  7 20 201  5 1800   600.0  600.0   0.0185      14.1  0.1000  0      0.0      0. 75
  |   |  |  |   |   |     |   |  |  |   |   |      |      |        |          |       |     |       |       |   |
 Yr   Mo Dy Jul  Hr Sec   Yr  Mo Dy Jul  Hr Sec   Ziobs  Zipre    Ustar     Monin     Zo     p    precip.    SW  rh
          Dy                       Dy                                       Obukhov         code  amount    rad. %
```

Table 9-13: Sample PROFILE.DAT file

(a) Base Data Records (hourly)

```
 94  1  1  1   2. 0 -999.9  -9.9  259.6  -99.9 -9.90 -999.9
 94  1  1  1  10. 0  156.4   0.7  263.2   42.5  0.01 -999.9
 94  1  1  1  40. 0 -999.9  -9.9  265.4  -99.9 -9.90 -999.9
 94  1  1  1  70. 0  177.9   2.4  266.0   18.3  0.16 -999.9
 94  1  1  1 100. 0  207.1   3.0  266.3   23.9  0.20 -999.9
 94  1  1  1 120. 0  218.0   2.8 -999.9  -99.9 -9.90 -999.9
 94  1  1  1 150. 0  233.0   4.3 -999.9  -99.9 -9.90 -999.9
 94  1  1  1 180. 0  238.0   6.0 -999.9  -99.9 -9.90 -999.9
 94  1  1  1 210. 1  242.0   7.2 -999.9  -99.9 -9.90 -999.9
 94  1  1  2   2. 0 -999.9  -9.9  258.9  -99.9 -9.90 -999.9
 94  1  1  2  10. 0  162.9   1.0  262.1   28.8  0.01 -999.9
 94  1  1  2  40. 0 -999.9  -9.9  263.9  -99.9 -9.90 -999.9
 94  1  1  2  70. 0  155.6   2.2  265.4    8.9  0.09 -999.9
 94  1  1  2 100. 0  179.1   1.8  266.0   10.5  0.10 -999.9
 94  1  1  2 120. 0  191.0   1.8 -999.9  -99.9 -9.90 -999.9
 94  1  1  2 150. 0  224.0   2.2 -999.9  -99.9 -9.90 -999.9
 94  1  1  2 180. 0  246.0   3.2 -999.9  -99.9 -9.90 -999.9
 94  1  1  2 210. 0  259.0   4.7 -999.9  -99.9 -9.90 -999.9
 94  1  1  2 240. 0  265.0   6.1 -999.9  -99.9 -9.90 -999.9
 94  1  1  2 270. 0  268.0   7.3 -999.9  -99.9 -9.90 -999.9
  |  |  |  |    |  |     |     |      |      |     |       |
 Yr Mo Dy Hr    Z Ilast WD    WS    Temp     σv    σw      WS
                            Scalar                      Vector
```

(b) Extended Data Records (hourly)

```
 94  1  1 13   2. 0 -999.9  -9.9  275.8  -99.9 -9.90 -999.9    .18
 94  1  1 13  10. 0  162.9   0.9  275.6   51.6  0.03 -999.9
 94  1  1 13  40. 0 -999.9  -9.9  274.6  -99.9 -9.90 -999.9
 94  1  1 13  70. 0  176.5   2.6  274.4    8.9  0.11 -999.9
 94  1  1 13 100. 0  185.3   2.7  274.1   14.0  0.10 -999.9
 94  1  1 13 120. 0  194.0   2.0 -999.9  -99.9 -9.90 -999.9
 94  1  1 13 150. 0  225.0   1.8 -999.9  -99.9 -9.90 -999.9
 94  1  1 13 180. 0  259.0   2.3 -999.9  -99.9 -9.90 -999.9
 94  1  1 13 210. 1  269.0   3.5 -999.9  -99.9 -9.90 -999.9
 94  1  1 14   2. 0 -999.9  -9.9  275.8  -99.9 -9.90 -999.9
 94  1  1 14  10. 0  162.9   0.9  275.6   51.6  0.03 -999.9
 94  1  1 14  40. 0 -999.9  -9.9  274.6  -99.9 -9.90 -999.9
 94  1  1 14  70. 0  176.5   2.6  274.4    8.9  0.11 -999.9
 94  1  1 14 100. 0  185.3   2.7  274.1   14.0  0.10 -999.9
 94  1  1 14 120. 0  194.0   2.0 -999.9  -99.9 -9.90 -999.9
 94  1  1 14 150. 0  225.0   1.8 -999.9  -99.9 -9.90 -999.9
 94  1  1 14 180. 0  259.0   2.3 -999.9  -99.9 -9.90 -999.9
 94  1  1 14 210. 1  269.0   3.5 -999.9  -99.9 -9.90 -999.9
 94  1  1 15   2. 0 -999.9  -9.9  275.8  -99.9 -9.90 -999.9    .5
 94  1  1 15  10. 0  162.9   0.9  275.6   51.6  0.03 -999.9
 94  1  1 15  40. 0 -999.9  -9.9  274.6  -99.9 -9.90 -999.9
 94  1  1 15  70. 0  176.5   2.6  274.4    8.9  0.11 -999.9
 94  1  1 15 100. 0  185.3   2.7  274.1   14.0  0.10 -999.9
  |  |  |  |    |  |    |      |     |       |     |      |      |
 Yr Mo Dy Hr  Z Ilast WD      WS   Temp     σv    σw     WS     ΔT at
                            Scalar                     Vector  Inversion
```

Table 9-13 (continued)
Sample PROFILE.DAT file

(c) Extended Data Records (sub-hourly)

```
PROFILE.DAT     2.1             Header comments, begin/end times with seconds, time zone
   1
Prepared by user
NONE
UTC-0500
1995  7 20  4 0000  1995  7 20  6 3600
1995  7 20  4    0  1995  7 20  4  900  10.0 0  196.20   1.33   298.330   7.080 -999.9 -999.9
1995  7 20  4    0  1995  7 20  4  900  60.0 1  226.40   3.86   299.798   3.652 -999.9 -999.9
1995  7 20  4  900  1995  7 20  4 1800  10.0 0  191.50   1.44   298.230   8.630 -999.9 -999.9  .5
1995  7 20  4  900  1995  7 20  4 1800  60.0 1  224.40   3.91   299.865   6.260 -999.9 -999.9
1995  7 20  4 1800  1995  7 20  4 2700  10.0 0  179.70   1.19   298.230  11.150 -999.9 -999.9
1995  7 20  4 1800  1995  7 20  4 2700  60.0 1  210.00   3.84   299.601   3.404 -999.9 -999.9
1995  7 20  4 2700  1995  7 20  4 3600  10.0 0  196.70   1.24   298.220   9.950 -999.9 -999.9
1995  7 20  4 2700  1995  7 20  4 3600  60.0 1  214.80   4.70   299.793   3.403 -999.9 -999.9
1995  7 20  5    0  1995  7 20  5  900  10.0 0  203.00   1.01   298.210  12.390 -999.9 -999.9
1995  7 20  5    0  1995  7 20  5  900  60.0 1  217.10   4.07   299.434   4.793 -999.9 -999.9
1995  7 20  5  900  1995  7 20  5 1800  10.0 0  200.40   0.70   298.280  16.920 -999.9 -999.9
1995  7 20  5  900  1995  7 20  5 1800  60.0 1  218.80   3.57   299.092   6.622 -999.9 -999.9
1995  7 20  5 1800  1995  7 20  5 2700  10.0 0  180.00   0.74   298.320  17.980 -999.9 -999.9
1995  7 20  5 1800  1995  7 20  5 2700  60.0 1  223.00   3.53   299.306   5.789 -999.9 -999.9
1995  7 20  5 2700  1995  7 20  5 3600  10.0 0  203.50   1.15   298.490   7.190 -999.9 -999.9
1995  7 20  5 2700  1995  7 20  5 3600  60.0 1  235.20   3.79   299.759   1.726 -999.9 -999.9
1995  7 20  6    0  1995  7 20  6  900  10.0 0  217.90   1.02   298.720  16.610 -999.9 -999.9
1995  7 20  6    0  1995  7 20  6  900  60.0 1  242.60   3.21   299.844   4.261 -999.9 -999.9
1995  7 20  6  900  1995  7 20  6 1800  10.0 0  239.80   0.78   299.280  22.060 -999.9 -999.9
1995  7 20  6  900  1995  7 20  6 1800  60.0 1  248.90   2.13   299.752   3.823 -999.9 -999.9
1995  7 20  6 1800  1995  7 20  6 2700  10.0 0  242.60   0.92   299.800  15.180 -999.9 -999.9 .18
1995  7 20  6 1800  1995  7 20  6 2700  60.0 1  251.00   2.30   299.849   5.116 -999.9 -999.9
1995  7 20  6 2700  1995  7 20  6 3600  10.0 0  257.00   1.29   300.540  16.340 -999.9 -999.9
1995  7 20  6 2700  1995  7 20  6 3600  60.0 1  257.90   2.25   300.149  10.386 -999.9 -999.9
   |    |  |  |   |      |   |  |  |   |     |   |      |       |         |       |       |      |     |
```

Yr	Mo	Dy	Hr	Sec	Yr	Mo	Dy	Hr	Sec	Z	Ilast	WD	WS Scalar	Temp	σ_v	σ_w	WS Vector	ΔT at Inversion

Table 9-14: SURFACE.DAT File - Header Records (Sub-Hourly Data File)

Record	Variable	Type	Description
1	DATASET	character*16	Dataset name (SURFACE.DAT)
1	DATAVER	character*16	Dataset version (2.1)
1	DATAMOD	character*64	Dataset message field
2	NCOMM	integer	Number of comment records to follow
NEXT NCOMM Lines	COMMENT	character *80	Other documentation
NCOMM+3	PMAP	character*8	Map projection (NONE)
NCOMM+4	TZONE	character*8	Time zone (UTC+hhmm)
NCOMM+5	IBYR	integer	Starting year
NCOMM+5	IBMO	integer	Starting month
NCOMM+5	IBDY	integer	Starting day
NCOMM+5	IBHR	integer	Starting time (hour 00-23)
NCOMM+5	IBSEC	integer	Starting time (second 0000-3600)
NCOMM+5	IEYR	integer	Ending year
NCOMM+5	IEMO	integer	Ending month
NCOMM+5	IEDY	integer	Ending day
NCOMM+5	IEHR	integer	Ending time (hour 00-23)
NCOMM+5	IESEC	integer	Ending time (second 0000-3600)

Table 9-14 (continued)
SURFACE.DAT File – Data Records (Hourly Data File)
(One record per hour)

Records 1,2,3,... Hourly meteorological data.

Columns	Variable	Type	Description
	Base Data		
*	IY	integer	Year of data in record (YY or YYYY format)
*	IM	integer	Month
*	ID	integer	Day
*	IJUL	integer	Julian day (1-366)
*	IH	integer	Hour (1-24) at end of hour
*	ZIOBS	real	Observed mixing height (m)
*	ZIPRE	real	Calculated mixing height (m)
*	USTR	real	Surface friction velocity (m/s)
*	XMON	real	Monin-Obukhov length (m)
*	Z0M	real	Hourly surface roughness length (m)
	Extended Data		
*	IPC	integer	Precipitation type code
			0 - no precipitation
			1 to 18 - liquid precipitation
			19 to 45 - frozen precipitation
*	PMMHR	real	Precipitation rate (mm/hr)
*	QSWRAD	real	Short-wave solar radiation (W/m^2)
*	IRELHUM	integer	Relative humidity (%)

* Free format

Table 9-14 (concluded)
SURFACE.DAT File – Data Records (Sub-Hourly Data File)
(One record per time period)

Records NCOMM+6,7,8,... Sub-hourly meteorological data.

Columns	Variable	Type	Description
*	IBY	integer	Starting year of data in record (YY or YYYY format)
*	IBM	integer	Starting month
*	IBD	integer	Starting day
*	IBJUL	integer	Starting Julian day (1-366)
*	IBH	integer	Starting time (hour 00-23)
*	IBSEC	integer	Starting time (second 0000-3600)
*	IBY	integer	Ending year of data in record (YY or YYYY format)
*	IBM	integer	Ending month
*	IBD	integer	Ending day
*	IBJUL	integer	Ending Julian day (1-366)
*	IBH	integer	Ending time (hour 00-23)
*	IBSEC	integer	Ending time (second 0000-3600)
*	ZIOBS	real	Observed mixing height (m)
*	ZIPRE	real	Calculated mixing height (m)
*	USTR	real	Surface friction velocity (m/s)
*	XMON	real	Monin-Obukhov length (m)
*	Z0M	real	Hourly surface roughness length (m)
*	IPC	integer	Precipitation type code 0 - no precipitation 1 to 18 - liquid precipitation 19 to 45 - frozen precipitation
*	PMMHR	real	Precipitation rate (mm/hr)
*	QSWRAD	real	Short-wave solar radiation (W/m^2)
*	IRELHUM	integer	Relative humidity (%)

* Free format

Table 9-15: PROFILE.DAT File - Header Records (Sub-Hourly Data File)

Record	Variable	Type	Description
1	DATASET	character*16	Dataset name (PROFILE.DAT)
1	DATAVER	character*16	Dataset version (2.1)
1	DATAMOD	character*64	Dataset message field
2	NCOMM	integer	Number of comment records to follow
NEXT NCOMM Lines	COMMENT	character *80	Other documentation
NCOMM+3	PMAP	character*8	Map projection (NONE)
NCOMM+4	TZONE	character*8	Time zone (UTC+hhmm)
NCOMM+5	IBYR	integer	Starting year
NCOMM+5	IBMO	integer	Starting month
NCOMM+5	IBDY	integer	Starting day
NCOMM+5	IBHR	integer	Starting time (hour 00-23)
NCOMM+5	IBSEC	integer	Starting time (second 0000-3600)
NCOMM+5	IEYR	integer	Ending year
NCOMM+5	IEMO	integer	Ending month
NCOMM+5	IEDY	integer	Ending day
NCOMM+5	IEHR	integer	Ending time (hour 00-23)
NCOMM+5	IESEC	integer	Ending time (second 0000-3600)

Table 9-15 (continued)
PROFILE.DAT File - Data Records (Hourly Data File)
(One or more records per hour)

Records 1,2,3,... Hourly meteorological data.

Columns	Variable	Type	Description
	Base Data		
*	IY	integer	Year of data in record (YY or YYYY format)
*	IM	integer	Month
*	ID	integer	Day
*	IH	integer	Hour (1-24) time at end of hour
*	ZPRF	real	Height of measurement above ground (m)
*	ILAST	integer	0 if not the highest (last) level; otherwise 1
*	WDPRF	real	Wind direction (deg.)
*	SSPRF	real	Scalar wind speed (m/s)
*	TPRF	real	Ambient dry bulb temperature (K)
*	SVPRF	real	σ_θ (deg.) or σ_v (m/s)
*	SWPRF	real	σ_w (m/s)
*	WSPRF	real	Vector wind speed (m/s)
	Extended Data		
*	DPTINV	real	Increase in potential temperature across the inversion at the top of the mixed layer (K); only on first record each hour

* Free format, one record per height in ascending order

Table 9-15 (Concluded)
PROFILE.DAT File - Data Records (Sub-Hourly Data File)
(One or more records per period)

Records NCOMM+6,7,8,... Sub-hourly meteorological data.

Columns	Variable	Type	Description
	Base Data		
*	IBY	integer	Starting year of data in record (YY or YYYY format)
*	IBM	integer	Starting month
*	IBD	integer	Starting day
*	IBJUL	integer	Starting Julian day (1-366)
*	IBH	integer	Starting time (hour 00-23)
*	IBSEC	integer	Starting time (second 0000-3600)
*	IBY	integer	Ending year of data in record (YY or YYYY format)
*	IBM	integer	Ending month
*	IBD	integer	Ending day
*	IBJUL	integer	Ending Julian day (1-366)
*	IBH	integer	Ending time (hour 00-23)
*	IBSEC	integer	Ending time (second 0000-3600)
*	ZPRF	real	Height of measurement above ground (m)
*	ILAST	integer	0 if not the highest (last) level; otherwise 1
*	WDPRF	real	Wind direction (deg.)
*	SSPRF	real	Scalar wind speed (m/s)
*	TPRF	real	Ambient dry bulb temperature (K)
*	SVPRF	real	σ_θ (deg.) or σ_v (m/s)
*	SWPRF	real	σ_w (m/s)
	WSPRF	real	Vector wind speed (m/s)
*	DPTINV	real	Increase in potential temperature across the inversion at the top of the mixed layer (K); only on first record each hour

* Free format, one record per height in ascending order

9.3 Point Source Emissions File With Arbitrarily Varying Emissions (PTEMARB.DAT)

The PTEMARB.DAT file contains point source emissions data for sources with detailed, arbitrarily varying emissions parameters. In the PTEMARB.DAT file, values for the stack parameters and emission rates can be specified for each time step in the run. Plume rise is computed within the CALPUFF model for each source.

PTEMARB.DAT is a free-formatted ASCII data file (see Table 9-16 for an example). Multiple files may be provided if groups of sources possess very different time-variability. For example, group 1 may require hourly data records for the entire simulation period, while group 2 may produce emissions for only a few weeks during the simulation. Using a second file for group 2 is more economical to prepare because a single data record can be used to prescribe a long period with no (or constant) emissions. Each such file must cover the entire modeling period, no source may appear in more than one file, and the species list must be identical among these files.

The data in the PTEMARB.DAT file are independent of the horizontal and vertical grid systems being used in the model. The horizontal coordinates are specified for a particular map projection and datum, and CALPUFF converts these coordinates to the map projection and datum used in the modeling grid.

Header records of the PTEMARB.DAT file (see Table 9-17) contain the coordinate definitions, number of sources, starting and ending time periods of data in the file, the time zone, and a list of the emitted species and the corresponding molecular weights.

The PTEMARB.DAT file contains two types of data records. A set of time-invariant records (see Table 9-18) are read after the header records. These records specify the time-invariant source parameters, including the source coordinates, stack height, diameter, momentum flux factor, and building data for sources subject to building downwash. The vertical momentum flux factor may be either 1.0 (full vertical momentum flux), or 0.0 (no vertical momentum). Use 0.0 to simulate the effect of stack structures like rain hats. A set of time-varying data follows (see Table 9-19). The time-varying records contain the stack temperature, exit velocity, initial plume size (σ_y and σ_z), and emission rate for each species.

Table 9-16: Sample PTEMARB.DAT file

```
PTEMARB.DAT     2.1             Comments, times with seconds, time zone, coord info
   1
Test Example
UTM
  19N
NAS-C   02-21-2003
  KM
UTC-0500
1988  11   0  0000  1988  11  23 3600
   3   2
'POL1'    'POL2'
      30.000      30.000
'Source 1'      0.13489    0.00360  18.600   9.754   88.70    1.00  1.00    0.00
   18.590   18.590   18.590   27.430   28.960   14.330
   18.590   18.590   18.590   18.590   28.960   18.590
   18.590   18.590   18.590   18.590   18.590   18.590
   18.590   18.590   18.590   27.430   28.960   28.960
   28.960   28.960   28.960   28.960   28.960   18.590
   18.590   18.590   18.590   18.590   18.590   18.590
   19.010   26.080   22.550   96.020   88.200   14.330
   14.200   18.480   22.160   25.660   85.390   20.820
   21.590   21.690   22.250   22.320   21.720   20.450
   19.010   26.080   22.550   53.360   88.200   87.590
   84.330   85.190   87.930   88.000   85.390   20.820
   21.590   21.690   22.250   22.320   21.720   20.450
'Source 2'      0.07380   -0.00280  50.100   4.251   88.70    0.00   1.0    0.00
'Source 3'      0.01272   -0.00919  35.850   3.100   88.70    0.00   1.0    0.00
   1988   11  00 0000    1988   11  00 3600
'Source 1'    280.55      8.66 0.0   0.0    0.468814E+01  0.202236E+02
'Source 2'    380.4       8.66 0.0   0.0    610.          120.
'Source 3'    280.55      2.66 0.0   0.0    0.468814E+01  0.202236E+02
   1988   11  01 0000    1988   11  01 3600
'Source 1'    279.27      8.50 0.0   0.0    0.449538E+01  0.204942E+02
'Source 2'    380.4       8.66 0.0   0.0    0.0           0.0
'Source 3'    279.27      2.66 0.0   0.0    0.449538E+01  0.204942E+02
   1988   11  02 0000    1988   11  02 3600
'Source 1'    279.26      8.50 0.0   0.0    0.449753E+01  0.204895E+02
'Source 2'    380.4       8.66 0.0   0.0    0.0
'Source 3'    279.26      2.66 0.0   0.0    0.449753E+01  0.204895E+02
   1988   11  03 0000    1988   11  22 3600
'Source 1'    277.97      8.41 0.0   0.0    0.430570E+01  0.207542E+02
'Source 2'    380.4       8.66 0.0   0.0    0.0           0.0
'Source 3'    277.97      2.66 0.0   0.0    0.430570E+01  0.207542E+02
   1988   11  23 0000    1988   11  23 3600
'Source 1'    285.82      8.90 0.0   0.0    0.553510E+01  0.189712E+02
'Source 2'    380.4       8.66 0.0   0.0    610.          120.
'Source 3'    285.82      2.66 0.0   0.0    0.553510E+01  0.189712E+02
.
.
.
```

Table 9-17: PTEMARB.DAT - Header Records - General Data

Record	Variable	Type	Description
1	DATASET	character*16	Dataset name (PTEMARB.DAT)
1	DATAVER	character*16	Dataset version (2.1)
1	DATAMOD	character*64	Dataset message field
2	NCOMM	integer	Number of comment records to follow
NEXT NCOMM Lines	TITLE	character *80	Title of file (up to 80 characters) and any other documentation for QA
NCOMM+3	PMAP *	character*8	Map projection UTM : Universal Transverse Mercator TTM : Tangential Transverse Mercator LCC : Lambert Conformal Conic PS : Polar Stereographic EM : Equatorial Mercator LAZA : Lambert Azimuthal Equal Area
NCOMM+4	IUTMZN, UTMHEM	integer, character*1	UTM zone, Hemisphere (N or S) read as format (i4,a1) ONLY for PMAP = UTM
NCOMM+4	RLAT0, RLON0, XLAT1, XLAT2	character*16	Latitude, Longitude of map projection origin, and one or two Matching Latitude Parallels. (Degrees with either N, S, E, or W, e.g., 45.6N). ONLY for PMAP = LCC, LAZA, TTM, PS, or EM
NCOMM+5	FEAST, FNORTH	real	False Easting and Northing (km). Included only if PMAP = TTM, LCC, or LAZA
NCOMM+5 or 6	DATUM	character*8	DATUM Code
NCOMM+5 or 6	DATEN	character*12	NIMA date (MM-DD-YYYY) for datum definitions
NCOMM+6 or 7	XYUNIT	character*4	Horizontal map units (KM or DEG)
NCOMM+7 or 8	TZONE	character*8	Time zone (UTC+hhmm)

Table 9-17 (Continued)
PTEMARB.DAT - Header Records - General Data

Record	Variable	Type	Description
NCOMM+8 or 9	IBYEAR	integer	Year of beginning of data in the file (YYYY)
NCOMM+8 or 9	IBJUL	integer	Julian day of beginning of data in the file (JJJ)
NCOMM+8 or 9	IBHOUR	integer	Time-hour at beginning of data in the file (HH)
NCOMM+8 or 9	IBSEC	integer	Time-second at beginning of data in the file (SSSS)
NCOMM+8 or 9	IEYEAR	integer	Year of end of data in the file (YYYY)
NCOMM+8 or 9	IEJUL	integer	Julian day of end of data in the file (JJJ)
NCOMM+8 or 9	IEHOUR	integer	Time-hour at end of data in the file (HH)
NCOMM+8 or 9	IESEC	integer	Time-second at end of data in the file (SSSS)
NCOMM+9 or 10	NSRC	integer	Number of sources in the file
NCOMM+9 or 10	NSE	integer	Number of species emitted

No.*	Type[a]	Description	Sample Values
1	C*12	Species identifier for species 1	SO2
2	C*12	Species identifier for species 2	SO4
.	.	.	.
.	.	.	.
.	.	.	.
NSE	C*12	Species identifier for species "NSE"	NOX

* "NSE" elements of CSLST2 array
[a] C*12 = Character*12

Table 9-17 (Concluded)
PTEMARB.DAT - Header Record NCOMM+11 or 12 - Molecular Weights

No.*	Type[a]	Description	Sample Values
1	real	Molecular weight for species 1	64. (SO2)
2	real	Molecular weight for species 2	96. (SO4)
.	.	.	.
.	.	.	.
.	.	.	.
NSE	real	Molecular weight for species "NSE"	46. (NOX as NO2)

* "NSE" elements of XMWEM2 array

Table 9-18: PTEMARB.DAT - Time-Invariant Data Record Contents

(Repeated for each source)

Data Record No.	Variable No.	Variable	Type[a]	Description
1	1	CID	C*16	Source identifier (16 characters = 4 words)
1	2	TIDATA(1)	real	Easting UTM or Lambert conformal coordinate (km) of the source
1	3	TIDATA(2)	real	Northing UTM or Lambert conformal coordinate (km) of the source
1	4	TIDATA(3)	real	Stack height (m)
1	5	TIDATA(4)	real	Stack diameter (m)
1	6	TIDATA(5)	real	Stack base elevation (m)
1	7	TIDATA(6)	real	Building downwash flag (0 = no, 1 = yes)
1	8	TIDATA(7)	real	Vertical momentum flux factor (0.0 or 1.0) to simulate structures like rain hats
1	9	TIDATA(8)	real	User defined flag (e.g., fuel code)
2[b]	1-36	BHT	real	Controlling building heights (m) for each 10° flow direction, starting 10° from North
3[b]	1-36	BWD	real	Controlling building width (m) for each 10° flow direction, starting 10° from North
4[c]	1-36	BLN	real	Controlling building length (m) for each 10° flow direction, starting 10° from North
5[c]	1-36	XBADJ	real	Along-wind distance (m) from the source to the center of the upwind face of the building for each 10° flow direction, starting 10° from North
6[c]	1-36	YBADJ	real	Cross-wind distance (m) from the source to the center of the upwind face of the building for each 10° flow direction, starting 10° from North

[a] C*16 = Character*16

[b] Time-invariant data Records 2 and 3 are provided only for those sources identified as being subject to building

downwash

[c] Time-invariant data Records 4 through 6 are provided only for those sources identified as being subject to building downwash when using the PRIME downwash option

Table 9-19: PTEMARB.DAT - Time-Varying Data Record Contents

(First record of "NSRC"+1 records required for each time period)

No.	Variable	Type	Description
1	IBYEAR	integer	Beginning year for which data in this set is valid (YYYY)
2	IBJUL	integer	Beginning Julian day for which data in this set is valid (JJJ)
3	IBHOUR	Integer	Beginning hour for which data in this set is valid (HH)
4	IBSEC	Integer	Beginning second for which data in this set is valid (SSSS)
5	IEYEAR	integer	Ending year for which data in this set is valid (YYYY)
6	IEJUL	integer	Ending Julian day for which data in this set is valid (JJJ)
7	IEHOUR	Integer	Ending hour for which data in this set is valid (HH)
8	IESEC	Integer	Ending second for which data in this set is valid (SSSS)

PTEMARB.DAT - Time-Varying Data Record Contents
(Next "NSRC" records)

No.	Variable	Type[a]	Description
1	CID	C*16	Source identifier (must match values in time-invariant records)
2	TEMPK	real	Exit temperature (deg. K)
3	VEXIT	real	Exit velocity (m/s)
4	SIGY	real	Initial sigma-y (m) for source
5	SIGZ	real	Initial sigma-z (m) for source
Next NSE2	QEMIT	real array	Emission rates (g/s) for each species in the order specified in Header Record 2

[a]C*16 = Character*16

9.4 Buoyant Area Source Emissions File With Arbitrarily Varying Emissions (BAEMARB.DAT)

The BAEMARB.DAT file contains buoyant area source emissions data for sources with detailed, arbitrarily varying emissions parameters. This file can be generated from the output of the Forest Service's Emissions Production Model (EPM) using a reformatting and preprocessing program provided with CALPUFF. In the BAEMARB.DAT file, values for the source parameters and emission rates can be specified for each time step in the run. Plume rise is computed within the CALPUFF model for each source using the numerical plume rise algorithm.

BAEMARB.DAT is a free-formatted ASCII data file (see Table 9-20 for an example). Multiple files may be provided if groups of sources possess very different time-variability. For example, group 1 may require hourly data records for the entire simulation period, while group 2 may produce emissions for only a few weeks during the simulation. Using a second file for group 2 is more economical to prepare because a single data record can be used to prescribe a long period with no (or constant) emissions. Each such file must cover the entire modeling period, no source may appear in more than one file, and the species list must be identical among these files.

The data in the BAEMARB.DAT file are independent of the horizontal and vertical grid systems being used in the model. The horizontal coordinates are specified for a particular map projection and datum, and CALPUFF converts these coordinates to the map projection and datum used in the modeling grid.

Header records of the BAEMARB.DAT file (see Table 9-21) contain the coordinate definitions, number of sources, starting and ending time periods of data in the file, the time zone, and a list of the emitted species and the corresponding molecular weights.

The BAEMARB.DAT file contains two types of data records. A set of time-invariant records (see Table 9-22) are read after the header records. These records specify the time-invariant source names and the emissions units for each source. The units must be either 'g/m2/s' or 'g/s', no other character strings will be accepted. Two additional fields are read as real variables, but are not used in the current version of the model. A set of time-varying data follows (see Table 9-23). The time-varying records contain the coordinates of four vertices that define the perimeter of the source, effective release height, ground elevation, temperature, effective vertical velocity, effective radius, initial vertical spread, and an emission rate for each species. Note that the four vertices must be centered in sequence around the perimeter; all four "x" coordinates followed by all four "y" coordinates.

Table 9-20: Sample BAEMARB.DAT file

```
BAEMARB.DAT     2.1             Comments, times with seconds, time zone, coord info
   2
Prepared by user
NOX_FIRE_RUN
LCC
40.5N           90.0W           30.0N           60.0N
 0.00000000E+00 0.00000000E+00
NWS-84  02-21-2003
  KM
UTC-0500
1994 365  23  0000  1995 142  12 0000
   3   3
'SO2'  'NO'   'NO2'
    64.0000        30.0000        46.0000
'Fire_Number_1'   'g/s'       0.0        0.0
'Fire_Number_2'   'g/s'       0.0        0.0
'Fire_Number_3'   'g/s'       0.0        0.0
       1994  365 23  0000        1995  142  09  3600
'Fire_Number_1'   -84.8600       -84.7423       -84.7423       -84.8600
   -254.620       -254.620       -254.502       -254.502        1.00000
    2259.00        1126.35        5.76000        7.98000        10.0000
   0.000000       0.000000       0.000000
'Fire_Number_2'   -167.190       -167.029       -167.029       -167.190
    29.0900        29.0900        29.2514        29.2514        1.00000
    1545.00        1126.35        2.97000        20.5500        10.0000
   0.000000       0.000000       0.000000
'Fire_Number_3'   -65.0600       -64.9668       -64.9668       -65.0600
   -88.9500       -88.9500       -88.8568       -88.8568        1.00000
    1527.00        1126.35        19.1300        3.92000        10.0000
   0.000000       0.000000       0.000000
       1995  142 10  0000        1995  142  11  3600
'Fire_Number_1'   -84.8600       -84.7423       -84.7423       -84.8600
   -254.620       -254.620       -254.502       -254.502        1.00000
    2259.00        1126.35        5.76000        7.98000        10.0000
   0.000000       3.94435       0.672000
'Fire_Number_2'   -167.190       -167.029       -167.029       -167.190
    29.0900        29.0900        29.2514        29.2514        1.00000
    1545.00        1126.35        2.97000        20.5500        10.0000
   0.000000       155.367        26.4700
'Fire_Number_3'   -65.0600       -64.9668       -64.9668       -65.0600
   -88.9500       -88.9500       -88.8568       -88.8568        1.00000
    1527.00        1126.35        19.1300        3.92000        10.0000
   0.000000       0.000000       0.000000
```

Table 9-21: BAEMARB.DAT - Header Records - General Data

Record	Variable	Type	Description
1	DATASET	character*16	Dataset name (BAEMARB.DAT)
1	DATAVER	character*16	Dataset version (2.1)
1	DATAMOD	character*64	Dataset message field
2	NCOMM	integer	Number of comment records to follow
NEXT NCOMM Lines	TITLE	character *80	Title of file (up to 80 characters) and any other documentation for QA
NCOMM+3	PMAP *	character*8	Map projection UTM : Universal Transverse Mercator TTM : Tangential Transverse Mercator LCC : Lambert Conformal Conic PS : Polar Stereographic EM : Equatorial Mercator LAZA : Lambert Azimuthal Equal Area
NCOMM+4	IUTMZN, UTMHEM	integer, character*1	UTM zone, Hemisphere (N or S) read as format (i4,a1) ONLY for PMAP = UTM
NCOMM+4	RLAT0, RLON0, XLAT1, XLAT2	character*16	Latitude, Longitude of map projection origin, and one or two Matching Latitude Parallels. (Degrees with either N, S, E, or W, e.g., 45.6N). ONLY for PMAP = LCC, LAZA, TTM, PS, or EM
NCOMM+5	FEAST, FNORTH	real	False Easting and Northing (km). Included only if PMAP = TTM, LCC, or LAZA
NCOMM+5 or 6	DATUM	character*8	DATUM Code
NCOMM+5 or 6	DATEN	character*12	NIMA date (MM-DD-YYYY) for datum definitions
NCOMM+6 or 7	XYUNIT	character*4	Horizontal map units (KM or DEG)
NCOMM+7 or 8	TZONE	character*8	Time zone (UTC+hhmm)
NCOMM+8 or 9	IBYEAR	integer	Year of beginning of data in the file (YYYY)
NCOMM+8 or 9	IBJUL	integer	Julian day of beginning of data in the file (JJJ)
NCOMM+8 or 9	IBHOUR	integer	Time-hour at beginning of data in the file (HH)
NCOMM+8 or 9	IBSEC	integer	Time-second at beginning of data in the file (SSSS)
NCOMM+8 or 9	IEYEAR	integer	Year of end of data in the file (YYYY)

NCOMM+8 or 9	IEJUL	integer	Julian day of end of data in the file (JJJ)
NCOMM+8 or 9	IEHOUR	integer	Time-hour at end of data in the file (HH)
NCOMM+8 or 9	IESEC	integer	Time-second at end of data in the file (SSSS)
NCOMM+9 or 10	NSRC	integer	Number of sources in the file
NCOMM+9 or 10	NSE	integer	Number of species emitted

Table 9-21 (Continued)

BAEMARB.DAT - Header Record NCOMM+10 or 11 - Species List

No.[*]	Type[a]	Description	Sample Values
1	C*12	Species identifier for species 1	SO2
2	C*12	Species identifier for species 2	SO4
.	.	.	.
.	.	.	.
.	.	.	.
NSE	C*12	Species identifier for species "NSE"	NOX

[*] "NSE" elements of CSLST3 array

[a] C*12 = Character*12

BAEMARB.DAT - Header Record NCOMM+11 or 12 - Molecular Weights

No.[*]	Type[a]	Description	Sample Values
1	real	Molecular weight for Species 1	64. (SO2)
2	real	Molecular weight for Species 2	96. (SO4)
.	.	.	.

.	.	.	.
.	.	.	.
NSE	real	Molecular weight for Species "NSE"	46. (NOX as NO2)

* "NSE" elements of XMWEM3 array

Table 9-22: BAEMARB.DAT - Time-Invariant Data Record Contents

(Repeated for each source)

No.	Variable No.	Variable	Type[a]	Description
1	1	CID	C*16	Source identifier (16 characters = 4 words)
1	2	BAEMUNIT	C*16	Source Emission Rate Units (‘g/m2/s’ or ‘g/s’)
1	3	TIDATA(1)	real	User defined flag (not used)
1	4	TIDATA(2)	real	User defined flag (not used)

[a] C*16 = Character*16

Table 9-23: BAEMARB.DAT - Time-Varying Data Record Contents

(First record of "NSRC"+1 records required for each time period)

No.	Variable	Type	Description
1	IBYEAR	integer	Beginning year for which data in this set is valid (YYYY)
2	IBJUL	integer	Beginning Julian day for which data in this set is valid (JJJ)
3	IBHOUR	Integer	Beginning hour for which data in this set is valid (HH)
4	IBSEC	Integer	Beginning second for which data in this set is valid (SSSS)
5	IEYEAR	integer	Ending year for which data in this set is valid (YYYY)
6	IEJUL	integer	Ending Julian day for which data in this set is valid (JJJ)
7	IEHOUR	Integer	Ending hour for which data in this set is valid (HH)
8	IESEC	Integer	Ending second for which data in this set is valid (SSSS)

Table 9-23 (Concluded)
BAEMARB.DAT - Time-Varying Data Record Contents
(Next "NSRC" records)

No.	Variable	Type[a]	Description
1	CID	C*16	Source identifier (must match values in time-invariant records)
2–5	VERTX	real array	X-coordinate (km) of each of the four vertices defining the perimeter of the area source
6–9	VERTY	real array	Y-coordinate (km) of each of the four vertices defining the perimeter of the area source
10	HT	real	Effective height (m) of the emissions above the ground
11	ELEV	real	Elevation of ground (m MSL)
12	TEMPK	real	Temperature (deg. K)
13	WEFF	real	Effective rise velocity (m/s)
14	REFF	real	Effective radius (m) for rise calculation
15	SIGZ	real	Initial vertical spread (m)
Next NSE3	QEMIT	real array	Emission rates (g/s or $g/m^2/s$) for each species in the order specified in Header Record 2

[a]C*16 = Character*16

9.5 Line Source Emissions File with Arbitrarily Varying Emissions (LNEMARB.DAT)

The LNEMARB.DAT file contains line source emissions data for sources with detailed, arbitrarily varying emissions parameters. In the LNEMARB.DAT file, values for the source parameters and emission rates can be specified for each time step in the run. Plume rise is computed within the CALPUFF model for groups of line sources using the buoyant line source algorithm.

Data in the LNEMARB.DAT file are independent of the horizontal and vertical grid systems being used in the model. The horizontal coordinates are specified for a particular map projection and datum, and CALPUFF converts these coordinates to the map projection and datum used in the modeling grid.

LNEMARB.DAT is a free-formatted ASCII data file (see Table 9-24 for an example). The header records of the LNEMARB.DAT file (see Table 9-25) contain the maximum number of lines in the group, starting and ending time periods of data in the file, time zone, map projection and datum, and a list of the emitted species. A set of time-invariant records (see Table 9-26) are read after the header records, to specify parameters used in modeling all line sources in the file, and the number of time-invariant names used to identify each line source. The time varying emissions and source parameter data follow in subsequent records (see Table 9-27). The first record in this group identifies the time period. The second identifies the number of groups of active line sources. Thereafter, a block of records must be supplied for each active group. The first of these identifies the number of active lines, and the average characteristics of this group of active lines. The remaining time-varying records in the block complete the description for each active line: the character name given to the line, the coordinates of the end-points, the release height, the elevation of the ground, and an emission rate for each species.

Table 9-24: Sample LNEMARB.DAT file

```
LNEMARB.DAT     2.1             Comments, times with seconds, time zone, coord info
   1
Test Example
UTM
  19N
NAS-C   02-21-2003
  KM
UTC-0500
1988   1   0  0000  1988 366  23 3600
   2   1
'SO2'
64.
7  6
'Line_Source_1'  'Line_Source_2'
1988  01  00  0000  1988  01  06  3600
1
2  500.  22.  18.  3.2  22.  100.
'Line_Source_1'     1.  3.     1.5  3.     22.  0.  1.3
'Line_Source_2'     1.  3.022  1.5  3.022  22.  0.  3.1
1988  01  07  0000  1988  01  12  3600
1
2  500.  22.  18.  3.2  22.  300.
'Line_Source_1'     1.  3.     1.5  3.     22.  0.  2.3
'Line_Source_2'     1.  3.022  1.5  3.022  22.  0.  2.3
1988  01  13  0000  1988  02  02  3600
1
2  500.  22.  18.  3.2  22.  150.
'Line_Source_1'     1.  3.     1.5  3.     22.  0.  1.3
'Line_Source_2'     1.  3.022  1.5  3.022  22.  0.  3.1
1988  02  03  0000  1988 366  23  3600
1
2  500.  22.  18.  3.2  22.  150.
'Line_Source_1'     1.  3.     1.5  3.     22.  0.  1.3
'Line_Source_2'     1.  3.022  1.5  3.022  22.  0.  3.1
```

Table 9-25: LNEMARB.DAT - Header Records - General Data

Record	Variable	Type	Description
1	DATASET	character*16	Dataset name (LNEMARB.DAT)
1	DATAVER	character*16	Dataset version (2.1)
1	DATAMOD	character*64	Dataset message field
2	NCOMM	integer	Number of comment records to follow
NEXT NCOMM Lines	TITLE	character *80	Title of file (up to 80 characters) and any other documentation for QA
NCOMM+3	PMAP *	character*8	Map projection UTM : Universal Transverse Mercator TTM : Tangential Transverse Mercator LCC : Lambert Conformal Conic PS : Polar Stereographic EM : Equatorial Mercator LAZA : Lambert Azimuthal Equal Area
NCOMM+4	IUTMZN, UTMHEM	integer, character*1	UTM zone, Hemisphere (N or S) read as format (i4,a1) ONLY for PMAP = UTM
NCOMM+4	RLAT0, RLON0, XLAT1, XLAT2	character*16	Latitude, Longitude of map projection origin, and one or two Matching Latitude Parallels. (Degrees with N, S, E or W, e.g., 45.6N). ONLY for PMAP = LCC, LAZA, TTM, PS, or EM
NCOMM+5	FEAST, FNORTH	real	False Easting and Northing (km). Included only if PMAP = TTM, LCC, or LAZA
NCOMM+5 or 6	DATUM	character*8	DATUM Code
NCOMM+5 or 6	DATEN	character*12	NIMA date (MM-DD-YYYY) for datum definitions
NCOMM+6 or 7	XYUNIT	character*4	Horizontal map units (KM or DEG)
NCOMM+7 or 8	TZONE	character*8	Time zone (UTC+hhmm)
NCOMM+8 or 9	IBYEAR	integer	Year of beginning of data in the file (YYYY)
NCOMM+8 or 9	IBJUL	integer	Julian day of beginning of data in the file (JJJ)
NCOMM+8 or 9	IBHOUR	integer	Time-hour at beginning of data in the file (HH)
NCOMM+8 or 9	IBSEC	integer	Time-second at beginning of data in the file (SSSS)
NCOMM+8 or 9	IEYEAR	integer	Year of end of data in the file (YYYY)

NCOMM+8 or 9	IEJUL	integer	Julian day of end of data in the file (JJJ)
NCOMM+8 or 9	IEHOUR	integer	Time-hour at end of data in the file (HH)
NCOMM+8 or 9	IESEC	integer	Time-second at end of data in the file (SSSS)
NCOMM+9 or 10	NSRC	integer	Number of sources in the file
NCOMM+9 or 10	NSE	integer	Number of species emitted

Table 9-25 (Continued)
LNEMARB.DAT - Header Record NCOMM+10 or 11 - Species List

No.*	Type[a]	Description	Sample Values
1	C*12	Species identifier for species 1	PM
2	C*12	Species identifier for species 2	PM10
.	.	.	.
.	.	.	.
.	.	.	.
NSE	C*12	Species identifier for species "NSE"	PM25

* "NSE" elements of CSLST5 array
[a] C*12 = Character*12

LNEMARB.DAT - Header Record NCOMM+11 or 12 - Molecular Weights

No.*	Type[a]	Description	Sample Values
1	real	Molecular weight for species 1	200.
2	real	Molecular weight for species 2	200.
.	.	.	.
.	.	.	.
.	.	.	.

NSE	real	Molecular weight for species "NSE"	200.

---

* "NSE" elements of XMWEM5 array

Table 9-26: LNEMARB.DAT - Time-Invariant Data Record Contents

No.	Variable	Type[a]	Description
1	MXNSEG	Integer	Maximum number of segments used to model one line
2	NLRISE	Integer	Number of distances at which transitional rise is tabulated
Next NSRC	CID	C*16	Source identifier (16 characters = 4 words)

[a] C*16 = Character*16

Table 9-27: LNEMARB.DAT - Time-Varying Data Record Contents

(First record required for each time period)

No.	Variable	Type	Description
1	IBYEAR	integer	Beginning year for which data in this set is valid (YYYY)
2	IBJUL	integer	Beginning Julian day for which data in this set is valid (JJJ)
3	IBHOUR	Integer	Beginning hour for which data in this set is valid (HH)
4	IBSEC	Integer	Beginning second for which data in this set is valid (SSSS)
5	IEYEAR	integer	Ending year for which data in this set is valid (YYYY)
6	IEJUL	integer	Ending Julian day for which data in this set is valid (JJJ)
7	IEHOUR	Integer	Ending hour for which data in this set is valid (HH)
8	IESEC	Integer	Ending second for which data in this set is valid (SSSS)

(Second record required for each time period)

No.	Variable	Type	Description
1	NGROUPS	integer	Number of groups of line sources active this time period

Table 9-27 (Continued)
LNEMARB.DAT - Time-Varying Data Record Contents
(First record required for each group, each time period)

No.	Variable	Type	Description
1	NLINES	integer	Number of active lines
2	XL	real	Average building length (m)
3	HBL	real	Average building height (m)
4	WBL	real	Average building width (m)
5	WML	real	Average line source width (m)
6	DXL	real	Average separation between buildings (m)
7	FPRIMEL	real	Average buoyancy parameter (m^4/s^3)

LNEMARB.DAT - Time-Varying Data Record Contents
(Next "NLINES" records)

No.	Variable	Type[a]	Description
1	CID	C*16	Source identifier (must match one of the values in time-invariant records)
2,3	XBEGL,YBEGL	real	X,Y-coordinates (km) of beginning of line
4,5	XENDL,YENDL	real	X,Y-coordinates (km) of end of line
6	HTL	real	Release height (m) of the emissions above the ground
7	ELEVL	real	Base elevation (m)
Next NSE	QL	real array	Emission rates for each species in the order specified in Header Record

[a]C*16 = Character*16

9.6 Volume Source Emissions File (VOLEMARB.DAT) with Arbitrarily Varying Emissions

The VOLEMARB.DAT file contains volume source data for sources with detailed, arbitrarily varying characteristics in time. Such volume sources may have time-varying emission rates, time-varying initial size, and time-varying location (they may move).

VOLEMARB.DAT is a free-formatted ASCII data file (see Table 9-28 for an example). Multiple files may be provided if groups of sources possess very different time-variability. For example, group 1 may require hourly data records for the entire simulation period, while group 2 may produce emissions for only a few weeks during the simulation. Using a second file for group 2 is more economical to prepare because a single data record can be used to prescribe a long period with no (or constant) emissions. Each such file must cover the entire modeling period, no source may appear in more than one file, and the species list must be identical among these files.

Data in the VOLEMARB.DAT file are independent of the horizontal and vertical grid systems being used in the model. The horizontal coordinates are specified for a particular map projection and datum, and CALPUFF converts these coordinates to the map projection and datum used in the modeling grid.

The header records of the VOLEMARB.DAT file (see Table 9-29) contain the number of sources, starting and ending time periods of data in the file, time zone, map projection and datum, and a list of the emitted species. When more than one file is used, the species information in each file must be the same. The number of sources NSRC must identify the number of sources in the file, and the sum of the NSRC values from all files must equal the total number of sources (NVL2) provided in Subgroup (16a) of the control file. A set of time-invariant records (see Table 9-30) are read after the header records. These records specify the source names, and a user-defined index (read but not used). A set of time-varying data follows (see Table 9-31). The time-varying records contain the source location, its effective height above ground, the elevation (MSL) at the location, the initial σ_y and σ_z, and the emission rate for each species.

Table 9-28: Sample VOLEMARB.DAT file

```
VOLEMARB.DAT    2.1             Comments, times with seconds, time zone, coord info
   1
Example using Lambert Conformal coordinates
LCC
44.0N           80.0W           30.0N           60.0N
 0.00000000E+00 0.00000000E+00
WGS-84  02-21-2003
  KM
UTC-0500
1988  11  00  0000  1988  11  23 3600
   3   2
'POL1'    'POL2'
      30.000      30.000
'Source 1'      0
'Source 2'      0
'Source 3'      0
   1988  011   00  0000   1988  011   00  3600
'Source 1'  151.034  4661.448 10.0   110.8  14.6  2.4   0.468814E+01  0.202236E+02
'Source 2'  151.652  4661.412  7.0   115.8  10.6  3.9   610.          120.
'Source 3'  151.111  4661.374  9.0   121.2  10.0  10.0  0.468814E+01  0.202236E+02
   1988  011   01  0000   1988  011   01  3600
'Source 1'  151.034  4661.448 10.0   110.8  14.6  2.4   0.449538E+01  0.204942E+02
'Source 2'  151.652  4661.412  7.0   115.8  10.6  3.9   0.0           0.0
'Source 3'  151.115  4661.374  9.0   121.2  10.0  10.0  0.468814E+01  0.202236E+02
   1988  011   02  0000   1988  011   02  3600
'Source 1'  151.034  4661.448 10.0   110.8  14.6  2.4   0.449753E+01  0.204895E+02
'Source 2'  151.652  4661.412  7.0   115.8  10.6  3.9   0.0           0.0
'Source 3'  151.120  4661.374  9.0   121.2  10.0  10.0  0.468814E+01  0.202236E+02
   1988  011   03  0000   1988  011   22  3600
'Source 1'  151.034  4661.448 10.0   110.8  14.6  2.4   0.430570E+01  0.207542E+02
'Source 2'  151.652  4661.412  7.0   115.8  10.6  3.9   0.0           0.0
'Source 3'  151.131  4661.374  9.0   121.2  10.0  10.0  0.468814E+01  0.202236E+02
   1988  011   23  0000   1988  011   23  3600
   1988012       0   1988012       0
'Source 1'  151.034  4661.448 10.0   110.8  14.6  2.4   0.553510E+01  0.189712E+02
'Source 2'  151.652  4661.412  7.0   115.8  10.6  3.9   610.          120.
'Source 3'  151.131  4661.374  9.0   121.2  10.0  10.0  0.468814E+01  0.202236E+02
```

Table 9-29: VOLEMARB.DAT - Header Records - General Data

Record	Variable	Type	Description
1	DATASET	character*16	Dataset name (VOLEMARB.DAT)
1	DATAVER	character*16	Dataset version (2.1)
1	DATAMOD	character*64	Dataset message field
2	NCOMM	integer	Number of comment records to follow
NEXT NCOMM Lines	TITLE	character *80	Title of file (up to 80 characters) and any other documentation for QA
NCOMM+3	PMAP *	character*8	Map projection UTM : Universal Transverse Mercator TTM : Tangential Transverse Mercator LCC : Lambert Conformal Conic PS : Polar Stereographic EM : Equatorial Mercator LAZA : Lambert Azimuthal Equal Area
NCOMM+4	IUTMZN, UTMHEM	integer, character*1	UTM zone, Hemisphere (N or S) read as format (i4,a1) ONLY for PMAP = UTM
NCOMM+4	RLAT0, RLON0, XLAT1, XLAT2	character*16	Latitude, Longitude of map projection origin and one or two Matching Latitude Parallels. (Degrees with N, S, E or W, e.g., 45.6N). ONLY for PMAP = LCC, LAZA, TTM, PS, or EM
NCOMM+5	FEAST, FNORTH	real	False Easting and Northing (km). Included only if PMAP = TTM, LCC, or LAZA
NCOMM+5 or 6	DATUM	character*8	Datum Code
NCOMM+5 or 6	DATEN	character*12	NIMA date (MM-DD-YYYY) for datum definitions
NCOMM+6 or 7	XYUNIT	character*4	Horizontal map units (km or deg)
NCOMM+7 or 8	TZONE	character*8	Time zone (UTC+hhmm)
NCOMM+8 or 9	IBYEAR	integer	Year of beginning of data in the file (YYYY)
NCOMM+8 or 9	IBJUL	integer	Julian day of beginning of data in the file (JJJ)
NCOMM+8 or 9	IBHOUR	integer	Time-hour at beginning of data in the file (HH)
NCOMM+8 or 9	IBSEC	integer	Time-second at beginning of data in the file (SSSS)
NCOMM+8 or 9	IEYEAR	integer	Year of end of data in the file (YYYY)

NCOMM+8 or 9	IEJUL	integer	Julian day of end of data in the file (JJJ)
NCOMM+8 or 9	IEHOUR	integer	Time-hour at end of data in the file (HH)
NCOMM+8 or 9	IESEC	integer	Time-second at end of data in the file (SSSS)
NCOMM+9 or 10	NSRC	integer	Number of sources in the file
NCOMM+9 or 10	NSE	integer	Number of species emitted

Table 9-29 (Continued)
VOLEMARB.DAT - Header Record NCOMM+10 or 11 - Species List

No.[*]	Type[a]	Description	Sample Values
1	C*12	Species identifier for species 1	SO2
2	C*12	Species identifier for species 2	SO4
.	.	.	.
.	.	.	.
.	.	.	.
NSE	C*12	Species identifier for species "NSE"	NOX

[*] "NSE" elements of CSLST4 array
[a] C*12 = Character*12

VOLEMARB.DAT - Header Record NCOMM+11 or 12 - Molecular Weights

No.[*]	Type	Description	Sample Values
1	real	Molecular weight for species 1	64. (SO2)
2	real	Molecular weight for species 2	96. (SO4)
.	.	.	.
.	.	.	.
.	.	.	.
NSE	real	Molecular weight for species "NSE"	46. (NOX as NO2)

* "NSE" elements of XMWEM4 array

Table 9-30: VOLEMARB.DAT - Time-Invariant Data Record Contents

(Repeated for each source)

Data Record No.	Variable No.	Variable	Type[a]	Description
1	1	CID	C*16	Source identifier (16 characters = 4 words)
1	2	TIDATA	real	User defined flag (e.g., fuel code)

[a] C*16 = Character*16

Table 9-31: VOLEMARB.DAT - Time-Varying Data Record Contents

(First record of "NSRC"+1 records required for each time period)

No.	Variable	Type	Description
1	IBYEAR	integer	Beginning year for which data in this set is valid (YYYY)
2	IBJUL	integer	Beginning Julian day for which data in this set is valid (JJJ)
3	IBHOUR	Integer	Beginning hour for which data in this set is valid (HH)
4	IBSEC	Integer	Beginning second for which data in this set is valid (SSSS)
5	IEYEAR	integer	Ending year for which data in this set is valid (YYYY)
6	IEJUL	integer	Ending Julian day for which data in this set is valid (JJJ)
7	IEHOUR	Integer	Ending hour for which data in this set is valid (HH)
8	IESEC	Integer	Ending second for which data in this set is valid (SSSS)

Table 9-31 (Concluded)
VOLEMARB.DAT - Time-Varying Data Record Contents
(Next "NSRC" records)

No.	Variable	Type[a]	Description
1	CID	C*16	Source identifier (must match values in time-invariant records)
2	XKM	real	X-coordinate (km) for source
3	YKM	real	Y-coordinate (km) for source
4	HTAGL	real	Effective height above ground (m)
5	ELMSL	real	Elevation of ground (m MSL) at source
6	SIGYI	real	Initial σ_y (m)
7	SIGZI	real	Initial σ_z (m)
Next NSE	QEMIT	real array	Emission rates (g/s) for each species in the order specified in Header Record 2

[a]C*16 = Character*16

9.7 Boundary Concentration Module File (BCON.DAT)

The impact of significant regional pollution transport on concentrations and deposition fluxes computed within the modeling domain can be included in a CALPUFF analysis either by adding a spatially uniform (and either constant in time or varying by hour) field at the post-processing step with CALPOST, or by selecting the boundary concentration (BCON) module within CALPUFF. The latter choice is preferable if there are known spatial gradients in regional concentrations outside the modeling domain, or if chemical transformation and removal processes associated with the regional pollution must be explicitly modeled.

Regional air-mass characteristics are defined and assigned to segments along each boundary of the computational domain when the boundary concentration module is used. A segment is equivalent to the length of one side of a grid cell. The number of air-mass types can be equal to the number of cells along the perimeter of the domain if sufficient information exists on this scale, or the number can be far fewer in typical applications where an entire side of the domain is characterized by a single air-mass. Air-mass characteristics include the concentration of each species advected into the domain and the thickness of the layer that contains these species. These concentrations are used to initialize puffs that are well-mixed in the vertical and the horizontal. The vertical depth of a puff is the thickness of the layer assigned to the air-mass, and the radius of the puff is related to the length of the segment and the component of the transport wind that is perpendicular to the segment (the mass flux into the domain and the initial concentration are conserved). The concentration of each species for each air-mass type may be scaled by factors that vary in one of the following ways: by hour of the day (24 factors); by month (12 factors); by hour and season (96 factors); by wind speed and stability class (36 factors); or by temperature (12 factors). These are the same factors provided for sources specified in the CALPUFF control file. If more detailed variation is needed for one or more air-mass types, air-mass characteristics for these can be provided hourly. When this method is used, the layer thickness may change as well as the concentrations. Otherwise, the layer thickness is constant for each air-mass type.

The configuration of the boundary properties is provided to CALPUFF in a "BCON.DAT" file. Two formats are available for this file. The first is a formatted file prepared specifically for use with the BCON option (MBCON = 1). It is constructed using the CALPUFF control file conventions. A sample file is shown in Table 9-32, and a description of the input parameters is provided in Table 9-33. The second (MBCON = 2) is a standard CALPUFF unformatted “CONC.DAT” output concentration file. Receptors in this file must lie along the boundary of the modeling region, providing near-surface concentrations for the air mass transported across the boundary into the modeling domain. This format may be chosen if CALPUFF results from a larger domain are available.

Input Group 1 in the BCON.DAT file identifies the grid information for the computational domain, the units for the concentrations that are provided, the number of air-mass types, and the type of temporal variation used in describing air-mass properties. Four air-mass types are used in this example. Three of these use the temporal variation factors provided in Input Group 3 and one uses an explicit sequence of values in time provided in Input Group 5. Note that the temporal variation factors are specific to both the species and the air mass. Input Group 2 names the six species that will be emitted along the boundary of the computational domain.

Input Group 3 defines the properties of each air-mass that is either constant, or that uses the factored time variation. In subgroup 3a, each air-mass is given a name and an index, followed by the thickness of the layer associated with the air-mass, and the concentration of each species. The name is used to identify air-mass properties in subsequent sections of the file, and the index is used to associate each air-mass type with specific cells along each boundary of the domain. Concentrations are entered in the order defined in Input Group 2. Here we have used generic names to suggest the characteristics of each air-mass, and have provided concentrations for each species. This is only intended to illustrate the structure of the BCON.DAT file, and should not be interpreted as typical values suitable for any application.

Subgroup 3b provides the temporal variation factors for the number of species/air-mass combinations indicated in Input Group 1 (NSBC). Only SO_2 for each of three air-masses (clean, urban, and model) is given a temporal variation here.

Input Group 4 assigns the air-mass types to cells along each boundary, using index values assigned in subgroups 3a and 5a. All cells along the north boundary and the south boundary are assigned to names NORTH and SOUTH, respectively. The cells along the west and east boundaries are entered in pairs, assigned to the variable name WEST-EAST. All of these assignments should be oriented to produce a "map-like" representation of the domain, with north at the top.

Input Group 5 defines any remaining air-mass types with properties that may vary hourly. Subgroup 5a assigns the air-mass name and index, and subgroup 5b identifies the time-period that is included in the data records. The input group terminator (!END!) for 5b must be followed immediately by the data records. The first record of each time period defines the range of hours for which the concentration data are valid by listing the beginning date(YYYYJJJ) and hour(HH), and the ending date and hour. The hour is denoted by the time at the end of the hour (00-23 LST).

For example, a 3-hour period would be:

    1987056 23 1987057 01

and a 1-hour period would be:

    1987056 23 1987056 23

Subsequent records of each time period provide the data for each air-mass. Each record contains the air-mass name (in single quotes), the layer-top (m), and the concentration of each species (units specified by IBCU).

Table 9-32: Boundary Condition File (BCON.DAT)

```
-----------------------------------------------------------------------
                CALPUFF Boundary Condition Data File
-----------------------------------------------------------------------

INPUT GROUP: 1 -- General Specifications
--------------
                          a
     Dataset documentation

        Dataset version            (VRSBC)  No default  !  VRSBC =  5.4 !
        Dataset label              (LBLBC)  No default  !  LBLBC =  example !


     Number of segments along boundaries of computational domain

        North and South             (NBCX)  No default  !  NBCX =  17 !
        East and West               (NBCY)  No default  !  NBCY =  17 !

     Units for boundary concentrations
     provided below                 (IBCU)  Default: 1  !  IBCU =   2  !
           1 =     g/m**3
           2 =     ug/m**3
           3 =     ppm
           4 =     ppb

     Number of air-mass types:

          Constant or factored
          variation [Group 3]    (NTYPEBC1) No Default  ! NTYPEBC1 =  3 !

          Arbitrary time
          variation [Group 5]    (NTYPEBC2) No Default  ! NTYPEBC2 =  1 !


     Number of air-mass species  (NSPECBC)  No Default  ! NSPECBC =  5 !

     Number of air-mass type / species
     combinations with variable
     concentration scaling factors
     provided below in (3b)         (NSBC)  Default: 0  !  NSBC =  3  !

--------
    a
     The form of the BCON file may change in the future.  Identify
     this file as being consistent with the version of CALPUFF for
     which it was prepared.
     (NOTE: The dataset label is processed as a 12-character name)


!END!
-------------------------------------------------------------------------------

INPUT GROUP: 2 -- Species list
--------------

  Concentrations for the following species are provided at the boundary,
  in the following order:

    ! CSPEC =         HNO3 !         !END!
    ! CSPEC =          NO3 !         !END!
    ! CSPEC =          SO4 !         !END!
    ! CSPEC =          NOX !         !END!
```

```
    ! CSPEC =          SO2 !         !END!


  Molecular weight (g/mole) for each species
  (used ONLY if IBCU=3,4 to convert to mass concentration)

    *        SO2  =         *
    *        SO4  =         *

*END*
----------------------------------------------------------------------
```

Table 9-32 (Continued)
Boundary Condition File (BCON.DAT)

```
INPUT GROUP: 3 -- Air-Mass Types (Constant or factored variation)
-------------

------------
Subgroup (3a)
------------
                             a
          AIR-MASS DEFINITION
          --------------------
            b                              c
        Type       Top of      Pollutant
         No.        Layer     Concentration(s)
                     (m)
       ------    ---------- ------------------------------------
 ! AIRMASS = clean !
 ! X =   1,         3000.,    1.1, 1.2, 1.3, 1.4, 1.5 ! !END!
 ! AIRMASS = urban !
 ! X =   3,         1500.,    5.1, 5.2, 5.3, 5.4, 5.5 ! !END!
 ! AIRMASS = model !
 ! X =   4,         3000.,    2.1, 2.2, 2.3, 2.4, 2.5 ! !END!

--------
    a
     Data for each air-mass type are treated as a separate input subgroup
     and therefore must end with an input group terminator.

    b
     An INTEGER from 1 to NTYPEBC1+NTYPEBC2, with no duplications; used
     for mapping air-mass types to boundary of computational grid.

    c
     A concentration must be entered for every species listed in Group 2,
     and in the order presented in Group 2.
     Units are specified by IBCU (e.g. 1 for g/m**3).


------------
Subgroup (3b)
------------
                                   a
          VARIABLE AIR-MASS FACTORS
          --------------------------

     Use this subgroup to describe temporal variations in the concentrations
     for one or more air-mass types given in Group 3a.  Factors entered multiply
     the concentrations in Group 3a.  Skip air-mass type / species combinations
     that have constant concentrations.  For more elaborate variations in
     air-mass properties, provide specific records in Input Group 5.

     IVARY determines the type of variation, and is air-mass specific:
     (IVARY)                                Default: 0
           0 =       Constant
           1 =       Diurnal cycle (24 scaling factors: hours 1-24)
           2 =       Monthly cycle (12 scaling factors: months 1-12)
           3 =       Hour & Season (4 groups of 24 hourly scaling factors,
                                    where first group is DEC-JAN-FEB)
           4 =       Speed & Stab. (6 groups of 6 scaling factors, where
                                    first group is Stability Class A,
                                    and the speed classes have upper
                                    bounds (m/s) defined in Group 12
           5 =       Temperature   (12 scaling factors, where temperature
```

```
classes have upper bounds (C) of:
0, 5, 10, 15, 20, 25, 30, 35, 40,
45, 50, 50+)
```

Table 9-32 (Continued)
Boundary Condition File (BCON.DAT)

```
    ! AIRMASS = clean  !
    ! IVARY   =    2   !      (12 Months)
    ! SO2     =   0.1,   0.1,   0.5,   0.9,   1.0,   1.0,
                  1.0,   1.0,   1.0,   0.9,   0.5,   0.1        !
    !END!

    ! AIRMASS = urban  !
    ! IVARY   =    2   !      (12 Months)
    ! SO2     =   0.1,   0.1,   0.5,   0.9,   2.0,   2.2,
                  2.5,   1.5,   1.1,   0.9,   0.5,   0.1        !
    !END!

    ! AIRMASS = model  !
    ! IVARY   =    1   !      (24 Hours)
    ! SO2     =   0.1,   0.1,   0.5,   0.9,   2.0,   2.2,
                  2.5,   2.6,   2.7,   2.8,   2.9,   3.0,
                  2.9,   2.8,   2.7,   2.6,   2.5,   2.4,
                  2.2,   2.0,   1.5,   0.9,   0.5,   0.1        !
    !END!


--------
    a
     Data for each species are treated as a separate input subgroup
     and therefore must end with an input group terminator.

-----------------------------------------------------------------------

INPUT GROUP: 4 -- Air-Mass Map
-------------

     Use this Input Group to assign an air-mass type to each segment
     along the perimeter of the computational grid.  The North boundary
     is listed first, then the West-East segment pairs should be listed
     from North to South, followed by the South boundary.  Within a row,
     segments are provided from West to East.


   ! NORTH     = 7*1,  10*2 !   !END!
   ! WEST_EAST = 1,                        2   ! !END!
   ! WEST_EAST = 1,                        2   ! !END!
   ! WEST_EAST = 4,                        2   ! !END!
   ! WEST_EAST = 4,                        2   ! !END!
   ! WEST_EAST = 4,                        2   ! !END!
   ! WEST_EAST = 4,                        2   ! !END!
   ! WEST_EAST = 4,                        2   ! !END!
   ! WEST_EAST = 4,                        2   ! !END!
   ! WEST_EAST = 4,                        2   ! !END!
   ! WEST_EAST = 4,                        2   ! !END!
   ! WEST_EAST = 4,                        2   ! !END!
   ! WEST_EAST = 4,                        2   ! !END!
   ! WEST_EAST = 4,                        2   ! !END!
   ! WEST_EAST = 3,                        2   ! !END!
   ! WEST_EAST = 3,                        2   ! !END!
   ! WEST_EAST = 3,                        2   ! !END!
   ! WEST_EAST = 3,                        2   ! !END!
   ! SOUTH     = 6*3,  11*2 !   !END!


-----------------------------------------------------------------------
```

Table 9-32 (Continued)
Boundary Condition File (BCON.DAT)

```
INPUT GROUP: 5 -- Air-Mass Types (Arbitrary time variation)
--------------

     Use this Input Group to describe temporal variations in all air-mass
     properties for air-mass types NOT given in Input Group 3.


-------------
Subgroup (5a)
-------------

                             a
          AIR-MASS DEFINITION
          --------------------

             Type
              No.
            ------
 ! AIRMASS = regional !
 !       X =     2 !       !END!


--------
    a
     Data for each air-mass type are treated as a separate input subgroup
     and therefore must end with an input group terminator.
     The TYPE is an INTEGER from 1 to NTYPEBC1+NTYPEBC2, with no duplications;
     used for mapping air-mass types to boundary of computational grid.

-------------
Subgroup (5b)
-------------

          EXPLICIT TIME-VARYING AIR-MASS PROPERTIES
          ------------------------------------------

     Records following the final group terminator below provide the
     layer-top and concentration(s) for each air-mass type identified
     in Subgroup (5a), for the simulation period identified below.
     The concentration for each species listed in Input Group 2 must
     be provided in order, for each air-mass.

     Simulation Period
     -----------------
     The date is a combined year and Julian day (YYYYJJJ).
     The hour is identified by the time at the END of the hour (00-23 LST).

         Starting date :   (IBDAT) -- No default    ! IBDAT = 1988189 !
         Starting hour :   (IBHH)  -- No default    ! IBHH  = 01      !
         Ending date   :   (IEDAT) -- No default    ! IEDAT = 1988190 !
         Ending hour   :   (IEHH)  -- No default    ! IEHH  = 00      !


     Data Record Structure
     ---------------------
     The first record of each time period defines the range of hours
     for which the concentration data are valid by listing the beginning
     date(YYYYJJJ) and hour(HH), and the ending date and hour.  The hour
     is denoted by the time at the end of the hour (00-23 LST).
```

```
For example, a 3-hour period would be:
1987056  23  1987057  01

and a 1-hour period would be:
1987056  23  1987056  23
```

Table 9-32 (Concluded)
Boundary Condition File (BCON.DAT)

```
     Subsequent records of each time period provide the data for each
     air-mass.  Each record contains the air-mass name (in single quotes),
     the layer-top (m), and the concentration of each species (units
     specified by IBCU).

-----------------------------------------------------------------------
!END!     (Data records must follow immediately)
     1988189  01  1988189  03
'regional'     3000.,    1.11, 1.21, 1.31, 1.41, 1.51
     1988189  04  1988189  06
'regional'     3000.,    1.12, 1.22, 1.32, 1.42, 1.52
     1988189  07  1988189  09
'regional'     3000.,    1.13, 1.23, 1.33, 1.43, 1.53
     1988189  10  1988189  12
'regional'     3000.,    1.14, 1.24, 1.34, 1.44, 1.54
     1988189  13  1988189  15
'regional'     3000.,    1.15, 1.25, 1.35, 1.45, 1.55
     1988189  16  1988189  18
'regional'     3000.,    1.16, 1.26, 1.36, 1.46, 1.56
     1988189  19  1988189  21
'regional'     3000.,    1.17, 1.27, 1.37, 1.47, 1.57
     1988189  22  1988190  00
'regional'     3000.,    1.18, 1.28, 1.38, 1.48, 1.58
```

Table 9-33: BCON.DAT File Inputs

Variable	Type	Description	Sample Values
(Input Group 1 - General Specifications)			
VRSBC	character *12	Dataset version	5.4
LBLBC	character *12	Dataset label	SAMPLE
NBCX	integer	Number of segments along north or south boundary of the computational domain	50
NBCY	integer	Number of segments along east or west boundary of the computational domain	50
IBCU	integer	Units for boundary concentrations 1 = g/m**3 2 = ug/m**3 3 = ppm 4 = ppb	2
NTYPEBC1	integer	Number of air-mass types that are treated as constant, or that are varied using temporal factors (Group 3)	3
NTYPEBC2	integer	Number of air-mass types that are varied hourly (Group 5)	2
NSPECBC	integer	Number of species in each air-mass	5
NSBC	integer	Number of air-mass type / species combinations with variable concentration scaling factors provided in (3b)	10
(Input Group 2 - Species List)			
CSPEC	character *12	Species name (NSPECBC records are required). These names are passed into the data dictionary for later use when assigning properties for particular species.	SO2
XMWTBC (mxspec)	real array	Molecular weight (g/mole) for each species (used ONLY if IBCU=3,4 to convert to mass concentration), assigned by species dictionary name	64., ...

Table 9-33 (Continued)
BCON.DAT File Inputs

Variable	Type	Description	Sample Values
(Input Group 3a - Air-Mass Definiton)			
AIRMASS	character *12	Air-mass name, used to coordinate inputs	urban
IAM	integer	Air-mass index, used to store properties	1
HTBC(IAM)	real array	Top of layer for air-mass type	1500.
CONBC (1 to NSPECBC, IAM)	real array	Concentration of each species for Air-mass type	.1, .11., .34, .52,.6
(Input Group 3b - Variable Air-Mass Concentration Factors)			
AIRMASS	character *12	Air-mass name, used to coordinate inputs	urban
IVARY	integer	Type of scale factor variation (diurnal, monthly, etc.) 0 = Constant 1 = Diurnal cycle (24 scaling factors: hours 1-24) 2 = Monthly cycle (12 scaling factors: months 1-12) 3 = Hour & Season (4 groups of 24 hourly scaling factors, where first group is DEC-JAN-FEB) 4 = Speed & Stab. (6 groups of 6 scaling factors, where first group is Stability Class A, and the 6 speed classes have upper bounds (m/s) defined in Group 12) 5 = Temperature (12 scaling factors, where temperature classes have upper bounds (C) of: 0, 5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 50+)	2
QFAC	real array	Array of concentration scaling factors for this air-mass and the species indicated	-

The variables in Input Group 3b are entered for the number of air-mass / species combination indicated by

NSBC in Input Group 1. The data for each combination (i.e., air-mass name, type of variation, and the QFAC array) are treated as a separate input subgroup and therefore must end with an input group terminator (i.e., !END!). The data for each source-species combination must follow an opening delimiter and "(cspec)=", where (cspec) is a species name defined in Group 2. The data for each combination is followed by a closing delimiter and an input group terminator (i.e., !END!). If NSBC=0, no scaling factors should be defined here.

Table 9-33 (Concluded)
BCON.DAT File Inputs

Variable	Type	Description	Sample Values
(Input Group 4 - Air-Mass Map)			
NORTH	integer array	Air-mass type index for each cell along the northern boundary of the computational grid	7*1,3, ...
WEST-EAST	integer array	Air-mass type index for the first (west) and last (east) cell of one row of the computational grid. Records should progress from north to south, starting with the second row from the 'top', and ending with the next-to-last row from the 'bottom'.	1, 2
SOUTH	integer array	Air-mass type index for each cell along the southern boundary of the computational grid	4,1,8*2, ...
(Input Group 5a - Air-Mass Definition)			
AIRMASS	character *12	Air-mass name, used to coordinate inputs	regional
IAM	integer	Air-mass index, used to store properties	2
(Input Group 5b - Explicit Time-Varying Air-Mass Properties)			
IBDAT	integer	Starting date (YYYYJJJ)	2000153
IBHH	integer	Starting hour (HH), identified by the time at the END of the hour (00-23 LST)	01
IEDAT	integer	Ending date (YYYYJJJ)	2000345
IEHH	integer	Ending hour (HH), identified by the time at the END of the hour (00-23 LST)	00

Data records follow Input Group 5b (after the !END! terminator)

The first record of each time period defines the range of hours for which the concentration data are valid by listing the beginning date (YYYYJJJ) and hour(HH), and the ending date and hour. Subsequent records of each time period provide the data for each air-mass listed in Input Group 5a. Each record contains the air-mass name (in single quotes), the layer-top (m), and the concentration of each species (units specified by IBCU).

9.8 User-Specified Deposition Velocity Data File (VD.DAT)

The CALPUFF model requires that the user specify the method for determining dry deposition velocities for each species. In Input Group 3 of the control file, one of the following flags must be specified for each pollutant.

0 =no dry deposition (deposition velocities set to zero)
1 =resistance model used - pollutant deposited as a gas
2 =resistance model used - pollutant deposited as a particle
3 =user-specified deposition velocities used

Note that different methods can be used for different pollutants in the same CALPUFF run.

If any species are flagged as using "user-specified" deposition velocities, CALPUFF reads a formatted user-prepared data file with a 24-hour diurnal cycle of deposition velocities for each species flagged. The 24 values correspond to hours 01-24 (LST) of the simulated day. Twenty-four values must be entered for each flagged pollutant, even if the model run is for less than a full diurnal cycle. The units of the deposition velocities are m/s.

An example of a user-specified VD.DAT file is shown in Table 9-34. The VD.DAT file uses a control file format (see Section 9.1). All text outside the delimiters (!) is considered as user comment information and is echoed back but otherwise ignored by the input module. Each data line consists of a delimiter followed by the species name, 24 deposition velocities, and a terminating delimiter. The data may extend over more than one line. The line being continued must end with a comma. The control file format allows the use of repetition factors (e.g., 3 * 1.0 instead of 1.0, 1.0, 1.0). The order in which the species are entered in the file is not important. However, the file must end with an input group terminator (i.e., !END!).

The model checks that values have been entered for each species flagged as using user-specified deposition velocities. An error message is printed and execution of the run is terminated if any values are missing. The run will also terminate with an error message from the input routine if too many values are entered (i.e., more than 24 values for a particular pollutant). The species names must match those used in the chemical mechanism of the model.

Table 9-34: Sample User-Specified Deposition Velocity File for Two Species

```
        DEPOSITION VELOCITY FILE (VD.DAT)
        ---------------------------------


VD.DAT contains 24-hour diurnal cycle of deposition velocities for each species flagged as using
user-specified values in the control file (CALPUFF.INP).

The first value correspond to the period from 0:00 to 1:00, and the 24th value corresponds to
23:00-0:00.

NOTE: Units are in m/s.
-----------------------


SPECIES
 NAME               Deposition Velocities (m/s)
-------             ---------------------------

!  HNO3      =      5*1.5e-2, 4*1.7e-2, 3*1.8e-2, 3*1.9e-2, 3*1.7e-2, 6*1.5e-2        !
!  SO2       =      5*0.8e-2, 13*1.0e-2, 6*0.8e-2                                     !


!END!
```

9.9 Ozone Data File (OZONE.DAT)

If the MESOPUFF II or RIVAD/ARM3 chemical mechanism is used to simulate the chemical transformation of $SO_2 \rightarrow SO_4^{=}$ and $NO_x \rightarrow HNO_3 : NO_3^{-}$, estimates of background ambient ozone concentration levels are required to compute the hourly conversion rates. CALPUFF provides two options for the user to provide these data: (1) a single, typical background value appropriate for the modeling region, or (2) ozone data from one or more ozone monitoring stations. The selection of Option 2 requires that a file called OZONE.DAT be created with the necessary data.

OZONE.DAT is a sequential, formatted data file containing three types of records: header records, time-invariant data records, and ozone data records. A sample OZONE.DAT file is shown in Table 9-35. The header record contains information on the number of stations in the data set, the time period and time zone of the data, the coordinate map projection and datum, and descriptive information regarding the file. Horizontal coordinates are specified in this particular map projection and datum, and CALPUFF converts these coordinates to the map projection and datum used in the modeling grid.

A set of time-invariant records are read after the header records. These records specify the coordinates of each ozone station (see Table 9-37). A set of time-varying data follows, which contain the hourly ozone concentration (in ppb) for each station (see Table 9-38).

Table 9-35: Sample Ozone Data File (OZONE.DAT)

```
OZONE.DAT       2.1             Comments, times with seconds, time zone, coord info
   1
Prepared by user
UTM
  11N
NWS-84  02-21-2003
  KM
UTC-0800
1979  365 23 0000  1980  001 23 3600
3
'STATION 1'      168.000      3840.000
'STATION 2'      200.000      3880.000
'STATION 3'      180.000      3860.000
1979  365 23 0000  1979  365 23 3600     9999.        62.        50.
1980  001 00 0000  1980  001 00 3600     9999.      9999.      9999.
1980  001 01 0000  1980  001 01 3600       68.        61.      9999.
1980  001 02 0000  1980  001 02 3600       66.      9999.      9999.
1980  001 03 0000  1980  001 03 3600     9999.      9999.        53.
1980  001 04 0000  1980  001 04 3600     9999.      9999.      9999.
1980  001 05 0000  1980  001 05 3600     9999.      9999.      9999.
1980  001 06 0000  1980  001 06 3600     9999.      9999.      9999.
1980  001 07 0000  1980  001 07 3600       69.        68.        60.
1980  001 08 0000  1980  001 08 3600       72.        75.        65.
1980  001 09 0000  1980  001 09 3600       74.        78.        69.
1980  001 10 0000  1980  001 10 3600       87.        85.        74.
1980  001 11 0000  1980  001 11 3600      102.        99.        84.
1980  001 12 0000  1980  001 12 3600      109.       105.        92.
1980  001 13 0000  1980  001 13 3600      120.       118.       102.
1980  001 14 0000  1980  001 14 3600      116.       116.        95.
1980  001 15 0000  1980  001 15 3600      103.       100.        97.
1980  001 16 0000  1980  001 16 3600       98.        90.        88.
1980  001 17 0000  1980  001 17 3600       89.        82.        83.
1980  001 18 0000  1980  001 18 3600     9999.      9999.        80.
1980  001 19 0000  1980  001 19 3600     9999.      9999.        78.
1980  001 20 0000  1980  001 20 3600     9999.      9999.        74.
1980  001 21 0000  1980  001 21 3600     9999.      9999.        69.
1980  001 22 0000  1980  001 22 3600     9999.      9999.        69.
1980  001 23 0000  1980  001 23 3600     9999.      9999.        68.
```

Table 9-36: OZONE.DAT - Header Records - General Data

Record	Variable	Type	Description
1	DATASET	character*16	Dataset name (OZONE.DAT)
1	DATAVER	character*16	Dataset version (2.1)
1	DATAMOD	character*64	Dataset message field
2	NCOMM	integer	Number of comment records to follow
NEXT NCOMM Lines	TITLE	character *80	Title of file (up to 80 characters) and any other documentation for QA
NCOMM+3	PMAP *	character*8	Map projection LL: Latitude/Longitude UTM : Universal Transverse Mercator TTM : Tangential Transverse Mercator LCC : Lambert Conformal Conic PS : Polar Stereographic EM : Equatorial Mercator LAZA : Lambert Azimuthal Equal Area
NCOMM+4	IUTMZN, UTMHEM	integer, character*4	UTM zone, Hemisphere (N or S) read as format (i4,a4) ONLY for PMAP = UTM
NCOMM+4	RLAT0, RLON0, XLAT1, XLAT2	character*16	Latitude, Longitude of map projection origin, and one or two Matching Latitude Parallels. (Degrees with N, S, E or W, e.g., 45.6N). ONLY for PMAP = LCC, LAZA, TTM, PS, or EM
NCOMM+5	FEAST, FNORTH	real	False Easting and Northing (km). Included only if PMAP = TTM, LCC, or LAZA
NCOMM+5 or 6	DATUM	character*8	Datum Code
NCOMM+5 or 6	DATEN	character*12	NIMA date (MM-DD-YYYY) for datum definitions
NCOMM+6 or 7	XYUNIT	character*4	Horizontal map units (km or deg)
NCOMM+7 or 8	TZONE	character*8	Time zone (UTC+hhmm)
NCOMM+8 or 9	IBYEAR	integer	Year of beginning of data in the file (YYYY)
NCOMM+8 or 9	IBJUL	integer	Julian day of beginning of data in the file (JJJ)
NCOMM+8 or 9	IBHOUR	integer	Time-hour at beginning of data in the file (HH)
NCOMM+8 or 9	IBSEC	integer	Time-second at beginning of data in the file (SSSS)
NCOMM+8 or 9	IEYEAR	integer	Year of end of data in the file (YYYY)

NCOMM+8 or 9	IEJUL	integer	Julian day of end of data in the file (JJJ)
NCOMM+8 or 9	IEHOUR	integer	Time-hour at end of data in the file (HH)
NCOMM+8 or 9	IESEC	integer	Time-second at end of data in the file (SSSS)
NCOMM+9 or 10	NSTA	integer	Number of stations in the file

Table 9-37: OZONE.DAT - Time-Invariant Data Record Contents

(Repeated for each station)

No.	Variable	Type[a]	Description
1	CID	C*16	Station identifier (16 characters = 4 words)
2	XOZ	Real	X coordinate (km) of the ozone station
		or	or
		C*16	Latitude (deg N or deg S)[b] of the ozone station
3	YOZ	Real	Y coordinate (km) of the ozone station
		or	or
		C*16	Longitude (deg E or deg W)[b] of the ozone station

[a] C*16 = Character*16, placed in quotes
[b] Latitude and longitude are provided as quoted strings: ’45.85N’ ‘90.6W’

Table 9-38: OZONE.DAT - Time-Varying Data Record Contents

(One record per time period)

No.	Variable	Type	Description

1	IBYEAR	integer	Beginning year for which data in this set is valid (YYYY)
2	IBJUL	integer	Beginning Julian day for which data in this set is valid (JJJ)
3	IBHOUR	Integer	Beginning hour for which data in this set is valid (HH)
4	IBSEC	Integer	Beginning second for which data in this set is valid (SSSS)
5	IEYEAR	integer	Ending year for which data in this set is valid (YYYY)
6	IEJUL	integer	Ending Julian day for which data in this set is valid (JJJ)
7	IEHOUR	Integer	Ending hour for which data in this set is valid (HH)
8	IESEC	Integer	Ending second for which data in this set is valid (SSSS)
Next "NSTA"	OZCONC	real array	Ozone concentration (ppb) at each ozone station (in the same order as the station coordinates in the time-invariant records; missing value indicator is 9999.)

9.10 User-Specified Chemical Transformation Rate Data File (CHEM.DAT)

If chemical conversion is to be considered by CALPUFF, the user must specify a variable in the control file, MCHEM, which determines how chemical transformation rates are computed. The options for MCHEM are:

- 0 = chemical transformation is not modeled
- 1 = the MESOPUFF II chemical scheme is used to compute transformation rates
- 2 = user-specified 24-hour cycles of transformation rates are used
- 3 = the RIVAD/ARM3 chemical scheme is used to compute transformation

If MCHEM is set equal to 2, CALPUFF reads a formatted user-prepared data file with 24-hour diurnal cycles of transformation rates k_1, k_2, k_3. The nature of the equilibrium relationship assumed between pollutants 4 and 5 (e.g., HNO_3 and NO_3^-) precludes the use of a user-specified conversion rate between these pollutants. If NO_3 is being modeled, the NH_4NO_3 dissociation constant is determined as a function of temperature and relative humidity.

A sample user-specified CHEM.DAT file is shown in Table 9-39. The CHEM.DAT file uses a control file format (see Section 9.1). All text outside the delimiters (!) is considered as user comment information and is echoed back but otherwise ignored by the input module. Each data line consists of a delimiter followed by the species name, 24 conversion rates, and a terminating delimiter. The data may extend over more than one line. The line being continued must end with a comma. The control file format allows the use of repetition factors (e.g., 3 * 1.0 instead of 1.0, 1.0, 1.0). The order in which the species are entered in the file is not important. However, the file must end with an input group terminator (i.e., !END).

The model checks that the proper number of values have been entered for each conversion rate. An error message is printed and execution of the run is terminated if any values are missing. The run will also terminate with an error message from the input routine if too many values are entered (i.e., more than 24 values).

Table 9-39: Sample User-Specified Chemical Transformation Rate Data File (CHEM.DAT)

```
                       CHEMICAL TRANSFORMATION RATE FILE (CHEM.DAT)
                       --------------------------------------------


CHEM.DAT contains a 24-hour diurnal cycle of chemical transformation
rates for the chemical transformation of SO2 to SO4, and NOx to HNO3/PAN.

          k1 = SO2 to SO4 transformation rate(percent/hour)

          k2 = NOx to HNO3 + PAN transformation rate (percent/hour)

          k3 = NOx to HNO3 (only) transformation rate (percent/hour)

The first value correspond to the period from 0:00 to 1:00, and the 24th value corresponds to
23:00-0:00.


                  TRANSFORMATION RATE (percent/hour)
                  ----------------------------------

! K1          =   7*0.2, 0.4, 0.8, 1.2, 1.6, 3*2.0,   1.6,  1.2, 0.8, 0.4, 6*0.2 !
! K2          =   7*2.0, 4.0, 8.0,12.0,15.0, 3*20.0, 15.0, 12.0, 8.0, 4.0, 6*2.0 !
! K3          =   7*2.0, 3.0, 6.0, 8.0,11.0, 3*15.0, 11.0,  8.0, 6.0, 3.0, 6*2.0 !

!END!
```

9.11 Site-Specific Turbulence Data (PROFILE.DAT)

CALPUFF provides several options for computing the dispersion coefficients, σ_y and σ_z. In Input Group 2 of the control file, the user specifies a value for the dispersion method flag, MDISP:

1 = dispersion coefficients computed from values of σ_v and σ_w read from a data file (PROFILE.DAT),

2 = dispersion coefficients determined from internally computed values of σ_v and σ_w based on similarity scaling relationships,

3 = PG coefficients (computed using the ISCST multi-segment approximation) used for rural areas and MP coefficients used in urban areas,

4 = same as 3 except that the PG coefficients are computed using the MESOPUFF II equations.

5 = CTDMPLUS dispersion coefficients computed from σ_v and σ_w for neutral/stable.

If Option 1 or Option 5 is selected, the user must prepare a data file with hourly values of σ_v and σ_w. This option is intended primarily for application to a single source or facility with onsite measurements of σ_v and σ_w. Therefore, only one set of observations are allowed in the data base and they are assumed to apply over the entire computational region.

The CTDMPLUS meteorological data file PROFILE provides for measurements of turbulence as well as wind speed, wind direction, and temperature at one or more heights on a tower. Because the PROFILE.DAT file is one of the meteorological formats accepted by CALPUFF, it may also be used for entering turbulence measurements for use with any of the other options. Its structure is documented in Section 9.2.4.

9.12 CTDMPLUS Terrain Feature Description and Receptors (HILL.DAT, HILLRCT.DAT)

CALPUFF allows two ways of specifying the characteristics of terrain features modeled by CTSG. The first is by means of the OPTHILL processor described in Section 9.15, which provides the parameters to be entered in the control file CALPUFF.INP. The second approach allows the use of the terrain preprocessing programs provided with CTDMPLUS (Mills et al., 1987). If a user is familiar with the terrain preprocessor, then this may be the preferred option because the standard terrain file used in CTDMPLUS, "TERRAIN", can be read by CALPUFF without modification. CTDMPLUS subroutines that read and process the terrain data have been incorporated in CALPUFF. Similarly, CTSG receptors may either be entered directly into the control file, or may be read from the corresponding CTDMPLUS "RECEPTOR" file. Note however that any CTSG receptors that are not located on one of the hill features (designated by a hill ID of 0) are ignored in CALPUFF. The default filenames in CALPUFF for TERRAIN and RECEPTOR are HILL.DAT and HILLRCT.DAT, respectively, and they are used together so that both must be used if the CTDMPLUS input option is selected.

Table 9-40 illustrates a typical HILL.DAT file for one hill. This one is defined by ellipse/polynomial shapes determined for a range of 10 "critical elevations" from 25 m to 115 m above the base of the hill. After the header record, the first group of 10 records provides the ellipse parameters at each "critical elevation", and the second group of 10 records provides the parameters for the corresponding inverse polynomial shape profile fit to the portion of the hill above it. Refer to Mills et al. (1987) for more detailed information. Table 9-41 shows a typical HILLRCT.DAT file. Data for each CTSG receptor are placed in one record, and identify the location, hill number (ID), ground elevation, and receptor height above the ground. Note that CALPUFF places all receptors on the ground. The structure of the data records is defined in Table 9-42 (HILL.DAT) and 9-43 (HILLRCT.DAT).

Other data associated with the HILL.DAT and HILLRCT.DAT are provided in the CALPUFF.INP control file, in Input Group 6. These reference the coordinate system used to prepare the CTDMPLUS simulation to the system chosen for the CALPUFF simulation. XHILL2M and ZHILL2M are the conversion factors that scale the CTDMPLUS "user units" in the horizontal and vertical, respectively, to meters. XCTDMKM and YCTDMKM define the location of the origin of the CTDMPLUS coordinate system in the CALPUFF coordinate system. The units used for this are kilometers. Hence, if UTM coordinates are used for both simulations, the origins of the two system are the same, and XCTDMKM = YCTDMKM = 0.

Table 9-40: Sample CTDMPLUS Terrain Feature File (HILL.DAT)

```
    1 20          .5000E+03         CTSG Test Hill
     .000 .5000E+04 .2067E-02   180.000  2498.000  2498.000
   24.000 .5000E+04 .1071E-02   180.000  2242.000  2242.000
   48.000 .5000E+04 .8304E-03   180.000  1986.000  1986.000
   72.000 .5000E+04 .4369E-03   180.000  1820.000  1820.000
   96.000 .5000E+04 .7918E-03   180.000  1692.000  1692.000
  120.000 .5000E+04 .3501E-03   180.000  1493.000  1493.000
  144.000 .5000E+04-.1282E-03   180.000  1410.000  1410.000
  168.000 .5000E+04 .1463E-03   180.000  1334.000  1334.000
  192.000 .5000E+04 .7370E-04   180.000  1263.000  1263.000
  216.000 .5000E+04 .3210E-03   180.000  1196.000  1196.000
  240.000 .5000E+04-.2209E-03   180.000  1071.000  1071.000
  264.000 .5000E+04 .1904E-03   180.000  1011.000  1011.000
  288.000 .5000E+04-.7684E-03   180.000   951.700   951.700
  312.000 .5000E+04 .7754E-03   180.000   893.300   893.300
  336.000 .5000E+04 .5356E-04   180.000   835.000   835.000
  360.000 .5000E+04 .5811E-03   180.000   716.400   716.400
  384.000 .5000E+04-.1251E-03   180.000   654.800   654.800
  408.000 .5000E+04-.1892E-04   180.000   590.400   590.400
  432.000 .5000E+04 .2414E-03   180.000   521.900   521.900
  456.000 .5000E+04 .7710E-04   180.000   446.900   446.900
     .000 .5000E+04 .2430E-03   180.000     2.859     2.859   959.101   959.101
   24.000 .5000E+04 .1997E-03   180.000     3.039     3.039   914.047   914.047
   48.000 .5000E+04 .1903E-03   180.000     3.232     3.232   872.399   872.399
   72.000 .5000E+04 .1296E-03   180.000     3.472     3.472   832.424   832.424
   96.000 .5000E+04 .1485E-03   180.000     3.853     3.853   792.979   792.979
  120.000 .5000E+04 .8714E-04   180.000     3.281     3.281   779.560   779.560
  144.000 .5000E+04 .1015E-03   180.000     3.439     3.439   743.594   743.594
  168.000 .5000E+04 .1086E-03   180.000     3.639     3.639   707.754   707.754
  192.000 .5000E+04 .9029E-04   180.000     3.920     3.920   671.777   671.777
  216.000 .5000E+04 .1062E-03   180.000     4.416     4.416   635.301   635.301
  240.000 .5000E+04 .1061E-03   180.000     3.541     3.541   620.841   620.841
  264.000 .5000E+04 .5922E-04   180.000     3.727     3.727   584.737   584.737
  288.000 .5000E+04 .2187E-03   180.000     3.981     3.981   547.935   547.935
  312.000 .5000E+04 .2005E-03   180.000     4.371     4.371   510.250   510.250
  336.000 .5000E+04 .9593E-04   180.000     5.127     5.127   471.649   471.649
  360.000 .5000E+04 .6310E-04   180.000     3.752     3.752   449.211   449.211
  384.000 .5000E+04 .1081E-03   180.000     4.012     4.012   406.554   406.554
  408.000 .5000E+04 .1295E-03   180.000     4.418     4.418   361.177   361.177
  432.000 .5000E+04 .1997E-03   180.000     5.163     5.163   312.371   312.371
  456.000 .5000E+04 .7139E-04   180.000     6.957     6.957   259.205   259.205
```

Table 9-41: Sample CTDMPLUS Receptor File (HILLRCT.DAT)

```
XYGauss        1       5070.00   2242.00      0.00     20.00    1
XYGauss        2       6368.67   1776.67      0.00     20.00    1
XYGauss        3       7149.66    639.60      0.00     20.00    1
XYGauss        4       7117.04   -739.29      0.00     20.00    1
XYGauss        5       6283.93  -1838.51      0.00     20.00    1
XYGauss        6       4965.10  -2242.50      0.00     20.00    1
XYGauss        7       3659.73  -1797.30      0.00     20.00    1
XYGauss        8       2860.77   -673.04      0.00     20.00    1
XYGauss        9       2871.56    706.23      0.00     20.00    1
XYGauss       10       3687.74   1818.13      0.00     20.00    1
XYGauss       11       5057.00   1819.00      0.00     60.00    1
XYGauss       12       6110.92   1441.86      0.00     60.00    1
XYGauss       13       6744.54    518.94      0.00     60.00    1
XYGauss       14       6718.43   -600.22      0.00     60.00    1
XYGauss       15       6041.93  -1492.11      0.00     60.00    1
XYGauss       16       4971.64  -1819.50      0.00     60.00    1
XYGauss       17       3911.83  -1459.18      0.00     60.00    1
XYGauss       18       3263.93   -546.19      0.00     60.00    1
XYGauss       19       3272.78    573.16      0.00     60.00    1
XYGauss       20       3934.60   1476.13      0.00     60.00    1
XYGauss       21       5050.00   1585.00      0.00    100.00    1
XYGauss       22       5968.12   1255.91      0.00    100.00    1
XYGauss       23       6520.03    451.83      0.00    100.00    1
XYGauss       24       6496.78   -523.11      0.00    100.00    1
XYGauss       25       5907.65  -1300.23      0.00    100.00    1
XYGauss       26       4975.03  -1585.50      0.00    100.00    1
XYGauss       27       4051.91  -1270.93      0.00    100.00    1
XYGauss       28       3487.48   -475.67      0.00    100.00    1
XYGauss       29       3495.20    499.44      0.00    100.00    1
XYGauss       30       4071.97   1285.80      0.00    100.00    1
XYGauss       31       5044.00   1410.00      0.00    140.00    1
XYGauss       32       5860.32   1116.84      0.00    140.00    1
XYGauss       33       6351.35    402.11      0.00    140.00    1
XYGauss       34       6331.27   -464.92      0.00    140.00    1
XYGauss       35       5807.34  -1156.04      0.00    140.00    1
XYGauss       36       4978.05  -1410.00      0.00    140.00    1
XYGauss       37       4157.13  -1130.30      0.00    140.00    1
XYGauss       38       3655.12   -423.18      0.00    140.00    1
XYGauss       39       3661.76    444.07      0.00    140.00    1
XYGauss       40       4174.62   1143.51      0.00    140.00    1
XYGauss       41       5040.00   1263.00      0.00    180.00    1
XYGauss       42       5771.26   1000.39      0.00    180.00    1
XYGauss       43       6210.87    359.85      0.00    180.00    1
XYGauss       44       6192.83   -416.93      0.00    180.00    1
XYGauss       45       5723.06  -1035.90      0.00    180.00    1
XYGauss       46       4980.14  -1263.50      0.00    180.00    1
XYGauss       47       4244.74  -1012.63      0.00    180.00    1
XYGauss       48       3794.72   -379.10      0.00    180.00    1
XYGauss       49       3800.65    398.05      0.00    180.00    1
XYGauss       50       4260.64   1024.54      0.00    180.00    1
XYGauss       51       5036.00   1132.00      0.00    220.00    1
```

Table 9-41 (Continued)
Sample CTDMPLUS Receptor File (HILLRCT.DAT)

XYGauss	52	5691.56	896.77	0.00	220.00	1
XYGauss	53	6085.89	322.53	0.00	220.00	1
XYGauss	54	6069.21	-373.86	0.00	220.00	1
XYGauss	55	5648.17	-928.84	0.00	220.00	1
XYGauss	56	4982.05	-1132.50	0.00	220.00	1
XYGauss	57	4322.81	-907.74	0.00	220.00	1
XYGauss	58	3919.67	-339.71	0.00	220.00	1
XYGauss	59	3925.21	356.75	0.00	220.00	1
XYGauss	60	4337.13	918.50	0.00	220.00	1
XYGauss	61	5032.00	1010.00	0.00	260.00	1
XYGauss	62	5617.35	800.64	0.00	260.00	1
XYGauss	63	5969.04	287.97	0.00	260.00	1
XYGauss	64	5953.99	-333.44	0.00	260.00	1
XYGauss	65	5578.50	-828.65	0.00	260.00	1
XYGauss	66	4984.12	-1010.50	0.00	260.00	1
XYGauss	67	4395.78	-809.99	0.00	260.00	1
XYGauss	68	4035.97	-303.20	0.00	260.00	1
XYGauss	69	4040.96	318.29	0.00	260.00	1
XYGauss	70	4408.48	819.54	0.00	260.00	1
XYGauss	71	5028.00	893.00	0.00	300.00	1
XYGauss	72	5856.38	254.71	0.00	300.00	1
XYGauss	73	5511.36	-732.35	0.00	300.00	1
XYGauss	74	4465.87	-716.09	0.00	300.00	1
XYGauss	75	4151.82	281.47	0.00	300.00	1
XYGauss	76	5024.00	775.90	0.00	340.00	1
XYGauss	77	5743.56	221.38	0.00	340.00	1
XYGauss	78	5444.40	-636.12	0.00	340.00	1
XYGauss	79	4536.07	-622.21	0.00	340.00	1
XYGauss	80	4263.52	244.28	0.00	340.00	1
XYGauss	81	5021.00	654.50	0.00	380.00	1
XYGauss	82	5627.88	186.37	0.00	380.00	1
XYGauss	83	5374.71	-536.94	0.00	380.00	1
XYGauss	84	4608.47	-524.74	0.00	380.00	1
XYGauss	85	4378.42	206.32	0.00	380.00	1
XYGauss	86	5016.00	521.70	0.00	420.00	1
XYGauss	87	5499.93	148.95	0.00	420.00	1
XYGauss	88	5299.01	-427.66	0.00	420.00	1
XYGauss	89	4688.11	-418.57	0.00	420.00	1
XYGauss	90	4504.92	164.14	0.00	420.00	1
XYGauss	91	5011.00	360.80	0.00	460.00	1
XYGauss	92	5346.09	103.16	0.00	460.00	1
XYGauss	93	5206.83	-295.73	0.00	460.00	1
XYGauss	94	4784.34	-289.23	0.00	460.00	1
XYGauss	95	4657.56	113.51	0.00	460.00	1
XYGauss	96	5000.00	0.00	0.00	500.00	1

Table 9-42: HILL.DAT File - Record Group Structure

Record Group *	Columns	Variable	Type	Description
1	6-7	NH	integer	Hill ID number
1	9-10	NZ	integer	Number of critical elevations
1	21-30	HTP	real	Elevation of top of feature (user units)
1	31-45	HNAME	character	Hill name
2 **	1-10	ZH	real	Critical elevation (user units)
2	11-20	XHW	real	X-coordinate of ellipse centroid (user units)
2	21-30	YHW	real	Y-coordinate of ellipse centroid (user units)
2	31-40	MAJORW	real	Orientation (deg) of major axis from North
2	41-50	MAJAXW	real	Semi-major axis length (user units)
2	51-60	MINAXW	real	Semi-minor axis length (user units)
3 **	1-10	ZH	real	Critical elevation (again)
3	11-20	L(1)	real	X-coordinate of cut-off hill (user units)
3	21-30	L(2)	real	Y-coordinate of cut-off hill (user units)
3	31-40	MAJORL	real	Orientation (deg) of major axis of cut-off hill from North
3	41-50	EXPOMA	real	Inverse polynomial exponent for major axis
3	51-60	EXPOMI	real	Inverse polynomial exponent for minor axis
3	61-70	SCALMA	real	Inverse polynomial length scale for major axis
3	71-80	SCALMI	real	Inverse polynomial length scale for minor axis

* Record groups are repeated for each hill in the file

** There are NZ records for group 2 followed by NZ records for group 3

Table 9-43: HILLRCT.DAT File - Data Records

(One record per CTSG receptor)

Columns	Variable	Type	Description
1-16	RNAME	character	Receptor name
21-30	XR	real	X-coordinate (user units)
31-40	YR	real	Y-coordinate (user units)
41-50	ZR	real	Height above ground (user units)
51-60	GE	real	Ground-level elevation (user units)
61-65	NH *	integer	ID number of hill under this receptor

* Receptors with NH=0 are ignored

9.13 Subgrid Scale Coastal Boundary Data File (COASTLN.DAT)

CALPUFF contains an option to treat subgrid scale coastal effects such as the development of a Thermal Internal Boundary Layer (TIBL) within an individual grid cell. The subgrid scale coastal module is controlled by the MSGTIBL variable in Input Group 2 of the control file. If MSGTIBL = 1, CALPUFF will introduce a subgrid scale TIBL along a coastal boundary specified in an external file (COASTLN.DAT) when appropriate meteorological conditions exist. The COASTLN.DAT file contains a set of points that serve to define the coastline. Multiple coastlines (up to "MXCOAST", see the PARAMS.PUF file) are allowed within a single file.

The COASTLN.DAT file is a sequential, formatted data file (see Table 9-44 for an example) consisting of two types of records: a single header record and a variable number of sets of data records. Each set of data records includes a record indicating the location of the water body relative to the coastline (i.e., left or right of the line as one travels in the direction of the data points in the file) and a variable number of records containing the coordinates of each point defining the coastline.

COASTLN.DAT File - Header Record

The header record of the COASTLN.DAT file contain the name, version, and label of the data set, the UTM zone of the coordinates, and the number of coastlines defined in the file (see Table 9-45). A sample Fortran read statement for the header record is:

```
READ(iunit,*)FNAMEC,NCOAST,IUTMCST,VRSCST,LABCST
```

where the following declaration applies:

```
CHARACTER*12 FNAMEC,VRSCST,LABCST.
```

Table 9-44: Sample Subgrid Scale Coastal Boundary Data File (COASTLN.DAT)

```
'COASTLN', 2, 19, '5', 'test'
'WR','Atlantic'
242., 4568.
264., 4588.
270., 4574.
286., 4584.
298., 4602.
308., 4634.
316., 4646.
340., 4610.
354., 4624.
390., 4630.
370., 4648.
340., 4700.
356., 4738.
346., 4744.
394., 4822.
410., 4860.
454., 4862.
474., 4864.
'WL','Large Lake'
200., 4500.
176., 4588.
```

Table 9-45: COASTLN.DAT - Header Record - General Data

No.	Variable	Type[a]	Description	Sample Values
1	FNAMEC	C*12	Data set name	COASTLN
2	NCOAST	integer	Number of coastlines in the file	2
3	ITUMCST	integer	UTM zone in which coastline coordinates are specified (enter 0 if using Lambert conformal coordinates)	19
4	VRSCST	C*12	Data set version	5
5	LABCST	C*12	Data set label	Test

[a]C*12 = Character*12

COASTLN.DAT File - Data Records

The COASTLN.DAT file contains "NCOAST" groups of coastal coordinates and related data. Each group of records consists of a single data header record (see Table 9-46) followed by a variable number of data records (see Table 9-47) containing the X and Y coordinates of each point used to define the coastline. The number of coastlines (NCOAST) must not exceed the maximum number specified in the parameter file (MXCOAST), and the number of points used to define a coastline must not exceed its maximum (MXPTCST). See the PARAMS.PUF file for the specification of the MXCOAST and MXPTCST variables.

Sample Fortran read statements for COASTLN.DAT data records are:

```
┌─    Loop over "NCOAST" coastlines (i)
│
│           READ(iunit,*)ADIR, ALABEL
│
│     ┌─    Loop over data points (j)
│     │
│     │           READ(iunit,*)XKM(i,j), YKM(i,j)
│     │
│     └─    End loop over data points
│
└─    End loop over coastlines
```

where the following declarations apply:

```
REAL XKM(mxcoast,mxptcst),YKM(mxcoast,mxptcst)
CHARACTER*2 ADIR
CHARACTER*12 ALABEL
```

Table 9-46: COASTLN.DAT - Data Header Record Contents

(Data header and data point set repeated for each coastline)

No.	Variable	Type[a]	Description
1	ADIR	C*2	Flag indicating which side of the coastline water is located as one moves in the direction of the data points in the file (WR indicates water is on right side, WL indicates water is on left side).
2	ALABEL	C*16	Character identifier or name of the water body

[a]C*2 = Character*2
C*16= Character*16

Table 9-47: COASTLN.DAT - Data Record Contents

(Data header and data point set repeated for each coastline)

No.	Variable	Type	Description
1	XKM	real array	X coordinate (km) of point defining coastline
2	YKM	real array	Y coordinate (km) of point defining coastline

9.14 Mass Flux Boundary Data File (FLUXBDY.DAT)

When the IMFLX variable in Input Group 5 of the control file is 1, CALPUFF will compute the hourly mass that crosses boundaries specified in the external file FLUXBDY.DAT. This file contains a set of points that serve to define one or more boundaries that separate regions. The mass is said to either pass into or out of a region depending on how the user defines "in" and "out" for each boundary. Multiple boundaries (up to "MXBNDRY", see the PARAMS.PUF file) are allowed within a single file.

The FLUXBDY.DAT file is a sequential, formatted data file (see Table 9-48 for an example) consisting of two types of records: a single header record and a variable number of sets of data records. Each set of data records includes one record that establishes which side of the boundary is considered "in" and provides a name for the boundary, and a variable number of records containing the coordinates (km) of each point defining the boundary.

The side of the boundary that is considered "in" may lie either to the left or the right of the boundary as one travels in the direction of the data points provided in the file. The choice is made by specifying either IR to indicate that the region to the right is inside, or by specifying IL to indicate that the region to the left is inside.

FLUXBDY.DAT File - Header Record

The header record of the FLUXBDY.DAT file contains the name, version, and label of the data set, the UTM zone of the coordinates, and the number of boundaries defined in the file (see Table 9-49). A sample Fortran read statement for the header record is:

```
READ(iunit,*)DATATYPE,NBNDRY,IUTMBDY,VRSBDY,LABBDY
```

where the following declaration applies:

```
CHARACTER*12 DATATYPE,VRSBDY,LABBDY.
```

Table 9-48: Sample Mass Flux Boundary Data File (FLUXBDY.DAT)

```
'FLUXBDY', 4, 19, '  5  ', 'test '
'IR','Square 1KM Box'
298., 4629.
298., 4631.
300., 4631.
300., 4629.
298., 4629.
'IL','Diamond 1KM Box'
299., 4629.
298., 4630.
299., 4631.
300., 4630.
299., 4629.
'IR','Square 5KM Box'
294., 4625.
294., 4635.
304., 4635.
304., 4625.
294., 4625.
'IL','Diamond 5KM Box'
299., 4625.
294., 4630.
299., 4635.
304., 4630.
299., 4625.
```

Table 9-49: FLUXBDY.DAT - Header Record - General Data

No.	Variable	Type[a]	Description	Sample Values
1	DATATYPE	C*12	Data set name	FLUXBDY
2	NBNDRY	integer	Number of boundaries in the file	2
3	ITUMBDY	integer	UTM zone in which boundary coordinates are specified (enter 0 if using Lambert conformal coordinates)	19
4	VRSBDY	C*12	Data set version	"5"
5	LABBDY	C*12	Data set label	"Test"

[a]C*12 = Character*12

FLUXBDY.DAT File - Data Records

The FLUXBDY.DAT file contains "NBNDRY" groups of boundary coordinates and related data. Each group of records consists of a single data header record (see Table 9-50) followed by a variable number of data records (see Table 9-51) containing the X and Y coordinates of each point used to define the boundary. The number of boundaries (NBNDRY) must not exceed the maximum number specified in the parameter file (MXBNDRY), and the number of points used to define a boundary must not exceed its maximum (MXPTBDY). See the PARAMS.PUF file for the specification of the MXBNDRY and MXPTBDY variables.

Sample Fortran read statements for FLUXBDY.DAT data records are:

```
┌  Loop over "NBNDRY" boundaries (i)
│
│    READ(iunit,*)ADIR, ALABEL
│
│    ┌  Loop over data points (j)
│    │
│    │    READ(iunit,*)XKM(i,j), YKM(i,j)
│    │
│    └  End loop over data points
│
└  End loop over boundaries
```

where the following declarations apply:

```
REAL XKM(mxbndry,mxptbdy),YKM(mxbndry,mxptbdy)
CHARACTER*2 ADIR
CHARACTER*12 ALABEL
```

Table 9-50: FLUXBDY.DAT - Data Header Record Contents

(Data header and data point set repeated for each boundary)

No.	Variable	Type[a]	Description
1	ADIR	C*2	Flag indicating which side of the boundary is considered "in" as one moves in the direction of the data points in the file (IR indicates "in" is on right side, IL indicates "in" is on left side).
2	ALABEL	C*16	Character identifier or name of the boundary

[a]C*2 = Character*2
C*16= Character*16

Table 9-51: FLUXBDY.DAT - Data Record Contents

(Data header and data point set repeated for each boundary)

No.	Variable	Type	Description
1	XKM	real array	X coordinate (km) of point defining boundary
2	YKM	real array	Y coordinate (km) of point defining boundary

9.15 CALPUFF Output Files

9.15.1 List File (CALPUFF.LST)

The general list file for your CALPUFF run, CALPUFF.LST, is an ASCII text file that may be viewed by any standard text editor, or printed to any standard printer. It provides the primary means of documenting the CALPUFF application, and it also contains all warning messages that may have been generated by the application. Note that some problems detected by CALPUFF result in fatal error messages (the requested modeling period is not simulated), while other problems are not severe enough to halt the run, and warning messages are written to the list file. Warning messages may be located throughout the file, whereas fatal error messages are at the end (because the run is halted). Therefore, the list file should always be reviewed.

The contents of the control file are echoed to the first part of the list file, and header records from each external data file for the run follow. In the case of CALMET.DAT, the header records include all of the time-invariant data fields, so that the file can become quite large when large CALMET grids are used. The remainder of the list file contains any hourly concentrations and deposition fluxes that are selected for output to the "printer". This selection is made in Input Group 5 (see Section 9.1) where ICPRT, IDPRT, and IWPRT identify the types of data selected; ICFRQ, IDFRQ, and IWFRQ identify the interval (in hours) between the data written to the list file; and IPRTU identifies the units used for this output. The species written are also explicitly selected here. Because the primary data files produced by CALPUFF are CONC.DAT, DFLX.DAT. and WFLX.DAT, which are processed by CALPOST, any data sent to the list file are generally for making spot-checks prior to the post-processing step, or for viewing the results of very short runs.

The debug option, controlled by LDEBUG, IPFDEB, NPFDEB, NN1, and NN2 in Input Group 5, also places a good deal of information in the list file. Much of this uses internal parameter names, and is most useful for those who are tracing the treatment of a few specific puffs through the many CALPUFF subroutines, or for those who are preparing a run and want to obtain more information during the setup phase (use ITEST=1 in Input Group 1 to stop the run before going into the computational phase). If many puffs are traced (NPFDEB) over many modeling periods (NN1 to NN2), the list file will become huge. A limited set of puff information is also written to DEBUG.DAT each sampling step when the debug option is selected. This file is described in Section 9.15.7.

9.15.2 Restart File (RESTARTE.DAT)

Information for all puffs that are still within the computational grid at the end of a CALPUFF run can be saved to disk in RESTARTE.DAT to initialize a continuation run. This allows CALPUFF to properly account for "old" material within the modeling domain at the start of the continuation run. This restart file may also be refreshed periodically during a run, as configured by NRESPD in Input Group 1 of the control file (see Section 9.1). RESTARTE.DAT is an unformatted data file that contains information about the modeling grid, the date and time at the end of the period simulated, and all of the internal puff array data at the end of the simulation. Note that this file becomes the RESTARTB.DAT input file for the continuation run, and that all CALPUFF output files for the continuation run are "new". For example, if a full year is simulated in four quarterly CALPUFF runs with three restart files, there will be four concentration files rather than one.

9.15.3 Concentration File (CONC.DAT)

The CONC.DAT file is an unformatted data file containing concentrations of one or more species simulated by CALPUFF at each receptor, for each period in the run. The creation and contents of the CONC.DAT file are controlled by user-specified inputs in Input Group 5 of the control file (see Section 9.1). The control file variable ICON must be set equal to one in order to create the CONC.DAT file, and the file will contain only those species that are specifically "saved on disk".

CONC.DAT File - Header Records

The CONC.DAT file consists of as many as NCOM+15 header records followed by a set of data records. The header records contain information describing the version of the model used in the run creating the file, horizontal and vertical grid data, a user-input title, a list of the species combinations stored in the output file, receptor information, and source names (see Table 9-52). NCOM, provided in record 2, defines the number of comment records that are present. Comment records are used to transfer the image of CALMET and CALPUFF control files used in the simulation for documentation and QA purposes.

Sample FORTRAN read statements for the header records are:

```
 READ(iunit) DATASET,DATAVER,DATAMOD
 READ(iunit) NCOM
          DO n=1,NCOM
   READ(iunit) COMMENT
          ENDDO
 READ(iunit)CMODEL,VER,LEVEL,IBYR,IBJUL,IBHR,IBSEC,XBTZ,
1 IRLG,IAVG,NSECDT,NXM,NYM,DXKM,DYKM,IONE,XORIGKM,YORIGKM,NSSTA,IBCOMP,IECOMP,
2 JBCOMP,JECOMP,IBSAMP,JBSAMP,IESAMP,JESAMP,MESHDN,NPT1,NPT2,NAR1,NAR2,NLN1,NLN2,
3 NVL1,NVL2,MSOURCE,NREC,NCTREC,LSAMP,NSPOUT,LCOMPR,
       4 I2DMET,IUTMZN,FEAST,FNORTH,RNLAT0,RELON0,
       5 XLAT1,XLAT2,PMAP,UTMHEM,DATUM,DATEN,
       6 CLAT0,CLON0,CLAT1,CLAT2
 READ(iunit)TITLE
 READ(iunit)CSOUT
 IF(NDREC.GT.0) READ(iunit)XREC,YREC,ZREC
 IF(NCTREC.GT.0) READ(iunit)XRCT,YRCT,ZRCT,IHILL
 IF(NPT1.GT.0) READ(iunit)ISTYPE,CNAMPT1
 IF(NPT2.GT.0) READ(iunit)ISTYPE,CNAMPT2
 IF(NAR1.GT.0) READ(iunit)ISTYPE,CNAMAR1
 IF(NAR2.GT.0) READ(iunit)ISTYPE,CNAMAR2
 IF(N LN1.GT.0) READ(iunit)ISTYPE,CNAMLN1
 IF(NLN2.GT.0) READ(iunit)ISTYPE,CNAMLN2
```

```
IF(NVL1.GT.0) READ(iunit)ISTYPE,CNAMVL1
IF(NVL2.GT.0) READ(iunit)ISTYPE,CNAMVL2
```

where the following declarations apply:

```
Character*132 COMMENT
Character*80 TITLE(3)
Character*64 DATAMOD
Character*16 DATASET, DATAVER, CLAT0, CLON0, CLAT1, CLAT2
Character*16 CNAMPT1(MXPT1),CNAMPT2(MXPT2), CNAMAR1(MXAREA),CNAMAR2(MXAREA)
Character*16 CNAMLN1(MXLINES),CNAMLN2(MXLNGRP), CNAMVL1(MXVOL),CNAMVL2(MXVOL)
Character*15 CSOUT(NSPOUT)
Character*12 CMODEL,VER,LEVEL, DATEN
Character*8 PMAP, DATUM
Character*4 UTMHEM

Real XREC(NREC),YREC(NREC),ZREC(NREC)
Real XRCT(NCTREC),YRCT(NCTREC),ZRCT(NCTREC)

Integer IHILL(NCTREC)

Logical LCOMPR
```

Table 9-52: Unformatted CONC.DAT file - Header

Header Record 1 – Dataset Definition

No.	Variable	Type	Description	Sample Values
1	DATASET	Character*16	Dataset name	CONC.DAT
2	DATAVER	Character *16	Dataset version	2.1
3	DATAMOD	Character *64	Dataset message field	-

Header Record 2 to (NCOM+2) – Comments

No.	Variable	Type	Description	Sample Values
1	NCOM	integer	Number of comment records to follow	-
1	COMMENT	Character *132	Comment (repeated NCOM times)	-

Table 9-52 (Continued)
Unformatted CONC.DAT file - Header Record NCOM+3 - General Data

No.	Variable	Type[a]	Description	Sample Values
1	CMODEL	C*12	Model name	CALPUFF
2	VER	C*12	Model version number	5.72
3	LEVEL	C*12	Model level number	031017
4	IBYR	integer	Starting year of the run	1980
5	IBJUL	integer	Starting Julian day	183
6	IBHR	integer	Time at start of first period (hour 00-23 LST)	8
7	IBSEC	integer	Time at start of first period (second 0000-3600)	0000
8	XBTZ	real	Base time zone (LST+XBTZ=UTC)	6.0
9	IRLG	integer	Length of run (timesteps)	10
10	IAVG	integer	Averaging time (timesteps) of output concentrations	2
11	NSECDT	integer	Length of a timestep (seconds)	1800
12	NXM	integer	Number of grid points in meteorological grid (X direction)	20
13	NYM	integer	Number of grid points in meteorological grid (Y direction)	20
14	DXKM	real	Grid spacing (km) in the X direction	5.
15	DYKM	real	Grid spacing (km) in the Y direction	5.
16	IONE	integer	Number of receptor layers (must be equal to one for CALPUFF runs)	1
17	XORIGKM	real	Reference X coordinate (km) of the southwest corner of grid cell (1,1) of the meteorological grid	190.
18	YORIGKM	real	Reference Y coordinate (km) of the southwest corner of grid cell (1,1) of the meteorological grid	440.
19	NSSTA	integer	Number of surface meteorological stations	5
20	IBCOMP	integer	Start of computational grid in X direction	1
21	IECOMP	integer	End of computational grid in X direction	20
22	JBCOMP	integer	Start of computation grid in the Y direction	1
23	JECOMP	integer	End of computational grid in Y direction	20

24	IBSAMP	integer	Start of sampling grid in X direction	1
25	JBSAMP	integer	Start of sampling grid in Y direction	1

[a]C*12 = Character*12

Table 9-52 (Continued)
Unformatted CONC.DAT file - Header Record NCOM+3 - General Data

No.	Variable	Type[a]	Description	Sample Values
26	IESAMP	integer	End of sampling grid in X direction	20
27	JESAMP	integer	End of sampling grid in Y direction	20
28	MESHDN	integer	Sampling grid spacing factor	1
29	NPT1	integer	Number of point sources (control file)	2
30	NPT2	integer	Number of point sources (variable emissions file)	0
31	NAR1	integer	Number of area sources (control file)	0
32	NAR2	integer	Number of area sources (variable emissions file)	0
33	NLN1	integer	Number of line sources (control file)	0
34	NLN2	integer	Number of line sources (variable emissions file)	0
35	NVL1	integer	Number of volume sources (control file)	0
36	NVL2	integer	Number of volume sources (variable emissions file)	0
37	MSOURCE	integer	Individual source contribution flag : 0 = report just the total 1 = report individual contributions and the total	0
38	NDREC	integer	number of discrete receptors	0
39	NCTREC	integer	Number of complex terrain receptors	0
40	LSAMP	logical	Sampling grid flag (T = gridded receptors used, F = no gridded receptors)	T
41	NSPOUT	integer	Number of output species	5
42	LCOMPR	logical	Flag indicating if concentration data are compressed (T=yes, F=no)	T
43	I2DMET	integer	RH data flag: 0 = relative humidity at surface stations (1D) 1 = relative humidity at grid points (2D)	1
44	IUTMZN	integer	UTM zone (1-60)	19
45	FEAST	real	False Easting of map projection (km)	0.0
46	FNORTH	real	False Northing of map projection (km)	0.0
47	RNLAT0	real	N. latitude of origin of map projection (degrees)	45.8

48	RELON0	real	E. longitude of origin of map projection (degrees)	-75.2
49	XLAT1	real	Matching N. latitude #1 of map projection (degrees)	30.0
50	XLAT2	real	Matching N. latitude #2 of map projection (degrees)	60.0

[a] C*N = Character*N

Table 9-52 (Continued)
Unformatted CONC.DAT file - Header Record NCOM+3 - General Data

No.	Variable	Type[a]	Description	Sample Values
51	PMAP	C*8	Map projection	UTM
52	UTMHEM	C*4	Hemisphere (N or S) for UTM projection	N
53	DATUM	C*8	Datum code	WGS-84
54	DATEN	C*12	NIMA date (MM-DD-YYYY) for datum definitions	10-10-2002
55	CLAT0	C*16	Latitude of origin of map projection	45.8N
56	CLON0	C*16	Longitude of origin of map projection	75.2W
57	CLAT1	C*16	Matching latitude #1 of map projection	30N
58	CLAT2	C*16	Matching latitude #2 of map projection	60N

[a] C*N = Character*N

Unformatted CONC.DAT file - Header

Header Record NCOM+4 - Run Title

No.	Variable	Type[a]	Description
1	TITLE (3)	C*80	User-specified run title (three lines of up to 80 characters/line)

[a] C*80 = Character*80

Table 9-52 (Continued)

Header Record NCOM+5 - List of Species in Output File

No.	Variable	Type[a]	Description
1-NSPEC	CSOUT array	C*15	Species name (characters 1-12) and layer (characters 13-15) of concentrations stored in the output file. For example[b], "SO2..........1" indicates SO_2 concentrations in Layer 1; "DIOXINP.......1" indicates dioxin in particulate form in Layer 1. CALPUFF concentrations are always computed at ground-level, so therefore are labeled as Layer 1, but there can be up to NZ layers in CALGRID.).

[a] C*15 = Character*15
[b] Dots (....) indicate spaces.

Table 9-52 (Continued)
Unformatted CONC.DAT file - Header

Header Record NCOM+6 - Discrete Receptors
(Included only if NDREC > 0)

No.	Variable	Type	Description
1	XREC	real array	X-coordinate (km) of each discrete receptor
2	YREC	real array	Y-coordinate (km) of each discrete receptor
3	ZREC	real array	Ground level elevation (m) of each discrete receptor

Header Record NCOM+7 - Complex Terrain Receptors
(Included only if NCTREC > 0)

No.	Variable	Type	Description

1	XRCT	real array	X-coordinate (km) of each complex terrain receptor
2	YRCT	real array	Y-coordinate (km) of each complex terrain receptor
3	ZRCT	real array	Ground level elevation (m) of each complex terrain receptor
4	IHILL	integer array	Hill number associated with this receptor

Table 9-52 (Continued)
Unformatted CONC.DAT file - Header

Header Record NCOM+8 – Point Source Names (Control File)
(Included only if NPT1 > 0)

No.	Variable	Type	Description
1	ISTYPE	integer	Source type (1)
2	CNAMPT1	C*16 array	Source names

C*16 = Character*16

Header Record NCOM+9 - Point Source Names (Variable Emissions File)
(Included only if NPT2 > 0)

No.	Variable	Type	Description
1	ISTYPE	integer	Source type (2)
2	CNAMPT2	C*16 array	Source names

C*16 = Character*16

Header Record NCOM+10 – Area Source Names (Control File)
(Included only if NAR1 > 0)

No.	Variable	Type	Description
1	ISTYPE	integer	Source type (3)
2	CNAMAR1	C*16 array	Source names

C*16 = Character*16

Table 9-52 (Continued)
Unformatted CONC.DAT file - Header

Header Record NCOM+11 - Area Source Names (Variable Emissions File)
(Included only if NAR2 > 0)

No.	Variable	Type	Description
1	ISTYPE	integer	Source type (4)
2	CNAMAR2	C*16 array	Source names

C*16 = Character*16

Header Record NCOM+12 – Line Source Names (Control File)
(Included only if NLN1 > 0)

No.	Variable	Type	Description
1	ISTYPE	integer	Source type (5)
2	CNAMLN1	C*16 array	Source names

C*16 = Character*16

Header Record NCOM+13 - Line Source Names (Variable Emissions File)
(Included only if NLN2 > 0)

No.	Variable	Type	Description
1	ISTYPE	integer	Source type (6)
2	CNAMLN2	C*16 array	Source names

C*16 = Character*16

Table 9-52 (Concluded)
Unformatted CONC.DAT file - Header

Header Record NCOM+14 – Volume Source Names (Control File)
(Included only if NVL1 > 0)

No.	Variable	Type	Description
1	ISTYPE	integer	Source type (7)
2	CNAMVL1	C*16 array	Source names

C*16 = Character*16

Header Record NCOM+15 - Volume Source Names (Variable Emissions File)
(Included only if NVL2 > 0)

No.	Variable	Type	Description
1	ISTYPE	integer	Source type (8)
2	CNAMVL2	C*16 array	Source names

C*16 = Character*16

CONC.DAT File - Data Records

The CONC.DAT data records consist of "NSPOUT+2" sets of records for each hour of the CALPUFF run and for each source for each hour of the CALPUFF run if the source contribution option is selected (NSPOUT is the number of output species in the CALPUFF run). The first record of each set contains the date and time period, and the second contains the identity of the source of the data in the records which follow it. The next "NSPOUT" record groups contain the predicted concentrations in g/m^3, for each species flagged for output in the control file. If the source contribution option is active, there will be one output record set for each source, followed by an additional record set for the total due to all sources. The source name used for the total due to all sources is "TOTAL", the type is "0", and the number is "1". Table 9-53 describes the variables.

Sample FORTRAN read statements for one data record set (in uncompressed format) are:

```
     READ(iunit)nyrb,njulb,nhrb,nsecb,nyre,njule,nhre,nsece
     READ(iunit) istype,isnum,sname,sxkm,sykm

┌─   LOOP OVER OUTPUT SPECIES
|
|    GRIDDED RECEPTOR CONCENTRATIONS
|    IF(LSGRID)READ(iunit)CSPECG,CONCG
|
|    DISCRETE RECEPTOR CONCENTRATIONS
|    IF(NDREC.GT.0)READ(iunit)CSPECD,CONCD
|
|    COMPLEX TERRAIN RECEPTOR CONCENTRATIONS
|    IF(NCTREC.GT.0)READ(iunit)CSPECCT,CONCCT
|
└─   END LOOP OVER OUTPUT SPECIES
```

where the following declarations apply:

```
     Character*15 CSPECG,CPSECD,CSPECCT
     Character*16 SNAME
     Real CONCG(nxg,nyg),CONCD(NDREC),CONCCT(NCTREC)
```

and

```
     nxg = IESAMP - IBSAMP+1
     nyg = JESAMP - JBSAMP+1
```

CALPUFF contains an option to compress the data by replacing strings of zeroes with a coded repetition factor. The factor is a negative number whose absolute value indicates the number of consecutive zeroes that have been replaced by the repetition factor. This method is especially useful in reducing the size of the output file when large segments of the receptor arrays lie upwind of the puffs during an hour, thereby producing long strings of zeroes in the output arrays. For example, the following record with data for 20 receptors requires 20 unpacked words:

```
     0.0, 0.0, 0.0, 0.0, 0.0, 1.2, 3.5, 0.0, 0.0, 0.0,
     0.0, 0.0, 0.0, 0.7, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0
```

These data in packed form would be represented in six words:

```
-5., 1.2, 3.5, -6., 0.7, -6.
```

Table 9-53: Unformatted CONC.DAT File - Data Records

(Records 1 and 2 of each set)

No.	Variable	Type	Description (Record 1)
1	NYRB	integer	Year (4 digits) at start of averaging period
2	NJULB	integer	Julian day at start of averaging period
3	NHRB	integer	Hour (00-23 LST) at start of averaging period
4	NSECB	integer	Second (0000-3600 LST) at start of averaging period
5	NYRE	integer	Year (4 digits) at end of averaging period
6	NJULE	integer	Julian day at end of averaging period
7	NHRE	integer	Hour (00-23 LST) at end of averaging period
8	NSECE	integer	Second (0000-3600 LST) at start of averaging period
No.	**Variable**	**Type[a]**	**Description (Record 2)**
1	ISTYPE	integer	Source type
2	ISNUM	integer	Source number of this type
3	SNAME	C*16	Source name
4	SXKM	real	Source X-coordinate (km) in the modeling map projection
5	SYKM	real	Source Y-coordinate (km) in the modeling map projection

[a] C*16 = Character*16

(Next Data Record)
(Included only if LSAMP = TRUE)

No.	Variable	Type[a]	Description
1	CSPECG	C*15	Species name (characters 1-12) and layer (characters 13-15) of the concentrations in this record. For example [b], "`SO2..........1`" indicates SO_2 concentrations in Layer 1; "`DIOXINP.......1`" indicates dioxin in particulate form in Layer 1. (Note: Layer is always `1` in CALPUFF output, but can be up to NZ in CALGRID.)

Next NXG*NYG	CONCG	real array	"IAVG" - hour averaged concentrations (g/m^3) for each sampling grid point.

[a] C*15 = Character*15

[b] Dots (....) indicate spaces.

Table 9-53 (Concluded)
Unformatted CONC.DAT File - Data Records

(Next Data Record)
(Included only if NDREC > 0)

No.	Variable	Type[a]	Description
1	CSPECD	C*15	Species name (characters 1-12) and layer (characters 13-15) of the concentrations in this record. For example [b], "SO2..........1" indicates SO_2 concentrations in Layer 1; "DIOXINP.......1" indicates dioxin in particulate form in Layer 1. (Note: Layer is always 1 in CALPUFF output, but can be up to NZ in CALGRID.)
Next NDREC	CONCD	real array	"IAVG" - hour averaged concentrations (g/m^3) for each discrete receptor

[a] C*15 = Character*15

(Next Data Record)
(Included only if NCTREC > 0)

No.	Variable	Type	Description
1	CSPECCT	C*15	Species name (characters 1-12) and layer (characters 13-15) of the concentrations in this record. For example [b], "SO2..........1" indicates SO_2 concentrations in Layer 1; "DIOXINP.......1" indicates dioxin in particulate form in Layer 1. (Note: Layer is always 1 in CALPUFF output, but can be up to NZ in CALGRID.)
Next NCTREC	CONCCT	real array	"IAVG" - hour averaged concentrations (g/m^3) at each complex terrain (CTSG) receptor

[a] C*15 = Character*15
[b] Dots (....) indicate spaces.

9.15.4 Dry Flux File (DFLX.DAT)

The DFLX.DAT file is an unformatted data file containing dry deposition fluxes of one or more species simulated by CALPUFF at each receptor, for each period in the run. The creation and contents of the DFLX.DAT file are controlled by user-specified inputs in Input Group 5 of the control file (see Section 9.1).

The control file variable IDRY must be set equal to one in order to create the DFLX.DAT file. The species saved in the output file are also controlled by the user by setting flags in the output species table in Input Group 5 of the control file. The model checks that only deposited species are flagged for output into the DFLX.DAT file. The effects of dry deposition on ambient concentrations can be evaluated without saving the dry fluxes in the output file if the actual values of the deposition fluxes are not of interest.

DFLX.DAT File - Header Records

The DFLX.DAT file consists of NCOM+7 header records followed by a set of data records. The header records contain information describing the version of the model used in the run creating the file, horizontal and vertical grid data, a user-input title, a list of the species combinations stored in the output file, and receptor information (see Table 9-54). NCOM, provided in record 2, defines the number of comment records that are present. Comment records are used to transfer the image of CALMET and CALPUFF control files used in the simulation for documentation and QA purposes.

Sample FORTRAN read statements for the header records are:

```
      READ(iunit) DATASET,DATAVER,DATAMOD
      READ(iunit) NCOM
               DO n=1,NCOM
         READ(iunit) COMMENT
               ENDDO
       READ(iunit)CMODEL,VER,LEVEL,IBYR,IBJUL,IBHR,IBSEC,XBTZ,
    1 IRLG,IAVG,NSECDT,NXM,NYM,DXKM,DYKM,IONE,XORIGKM,YORIGKM,NSSTA,IBCOMP,IECOMP,
    2 JBCOMP,JECOMP,IBSAMP,JBSAMP,IESAMP,JESAMP,MESHDN,NPT1,NPT2,NAR1,NAR2,NLN1,NLN2,
    3 NVL1,NVL2,MSOURCE,NREC,NCTREC,LSAMP,NDFOUT,LCOMPR,
    4 I2DMET,IUTMZN,FEAST,FNORTH,RNLAT0,RELON0,
    5 XLAT1,XLAT2,PMAP,UTMHEM,DATUM,DATEN,
    6 CLAT0,CLON0,CLAT1,CLAT2
   READ(iunit)TITLE
   READ(iunit)CDFOUT
       IF(NDREC.GT.0) READ(iunit)XREC,YREC,ZREC
       IF(NCTREC.GT.0) READ(iunit)XRCT,YRCT,ZRCT,IHILL
       IF(NPT1.GT.0) READ(iunit)ISTYPE,CNAMPT1
       IF(NPT2.GT.0) READ(iunit)ISTYPE,CNAMPT2
       IF(NAR1.GT.0) READ(iunit)ISTYPE,CNAMAR1
       IF(NAR2.GT.0) READ(iunit)ISTYPE,CNAMAR2
       IF(N LN1.GT.0) READ(iunit)ISTYPE,CNAMLN1
       IF(NLN2.GT.0) READ(iunit)ISTYPE,CNAMLN2
```

```
     IF(NVL1.GT.0) READ(iunit)ISTYPE,CNAMVL1
 IF(NVL2.GT.0) READ(iunit)ISTYPE,CNAMVL2
```

where the following declarations apply:

```
Character*132 COMMENT
Character*80 TITLE(3)
Character*64 DATAMOD
Character*16 DATASET, DATAVER, CLAT0, CLON0, CLAT1, CLAT2
Character*16 CNAMPT1(MXPT1),CNAMPT2(MXPT2), CNAMAR1(MXAREA),CNAMAR2(MXAREA)
Character*16 CNAMLN1(MXLINES),CNAMLN2(MXLNGRP), CNAMVL1(MXVOL),CNAMVL2(MXVOL)
Character*15 CSOUT(NDFOUT)
Character*12 CMODEL,VER,LEVEL, DATEN
Character*8 PMAP, DATUM
Character*4 UTMHEM

Real XREC(NREC),YREC(NREC),ZREC(NREC)
Real XRCT(NCTREC),YRCT(NCTREC),ZRCT(NCTREC)

Integer IHILL(NCTREC)

Logical LCOMPR
```

Table 9-54: Unformatted DFLX.DAT file - Header

Header Record 1 – Dataset Definition

No.	Variable	Type	Description	Sample Values
1	DATASET	Character*16	Dataset name	DFLX.DAT
2	DATAVER	Character *16	Dataset version	2.1
3	DATAMOD	Character *64	Dataset message field	-

Header Record 2 to (NCOM+2) – Comments

No.	Variable	Type	Description	Sample Values

1	NCOM	integer	Number of comment records to follow	-
1	COMMENT	Character *132	Comment (repeated NCOM times)	-

Table 9-54 (Continued)
Unformatted DFLX.DAT file - Header Record NCOM+3 - General Data

No.	Variable	Type[a]	Description	Sample Values
1	CMODEL	C*12	Model name	CALPUFF
2	VER	C*12	Model version number	5.72
3	LEVEL	C*12	Model level number	031017
4	IBYR	integer	Starting year of the run	1980
5	IBJUL	integer	Starting Julian day	183
6	IBHR	integer	Time at start of first period (hour 00-23 LST)	8
7	IBSEC	integer	Time at start of first period (second 0000-3600)	0000
8	XBTZ	real	Base time zone (LST+XBTZ=UTC)	6.0
9	IRLG	integer	Length of run (timesteps)	10
10	IAVG	integer	Averaging time (timesteps) of output concentrations	2
11	NSECDT	integer	Length of a timestep (seconds)	1800
12	NXM	integer	Number of grid points in meteorological grid (X direction)	20
13	NYM	integer	Number of grid points in meteorological grid (Y direction)	20
14	DXKM	real	Grid spacing (km) in the X direction	5.
15	DYKM	real	Grid spacing (km) in the Y direction	5.
16	IONE	integer	Number of receptor layers (must be equal to one for CALPUFF runs)	1
17	XORIGKM	real	Reference X coordinate (km) of the southwest corner of grid cell (1,1) of the meteorological grid	190.
18	YORIGKM	real	Reference Y coordinate (km) of the southwest corner of grid cell (1,1) of the meteorological grid	440.
19	NSSTA	integer	Number of surface meteorological stations	5
20	IBCOMP	integer	Start of computational grid in X direction	1
21	IECOMP	integer	End of computational grid in X direction	20
22	JBCOMP	integer	Start of computation grid in the Y direction	1
23	JECOMP	integer	End of computational grid in Y direction	20

24	IBSAMP	integer	Start of sampling grid in X direction	1
25	JBSAMP	integer	Start of sampling grid in Y direction	1

[a]C*12 = Character*12

Table 9-54 (Continued)
Unformatted DFLX.DAT file - Header Record NCOM+3 - General Data

No.	Variable	Type[a]	Description	Sample Values
26	IESAMP	integer	End of sampling grid in X direction	20
27	JESAMP	integer	End of sampling grid in Y direction	20
28	MESHDN	integer	Sampling grid spacing factor	1
29	NPT1	integer	Number of point sources (control file)	2
30	NPT2	integer	Number of point sources (variable emissions file)	0
31	NAR1	integer	Number of area sources (control file)	0
32	NAR2	integer	Number of area sources (variable emissions file)	0
33	NLN1	integer	Number of line sources (control file)	0
34	NLN2	integer	Number of line sources (variable emissions file)	0
35	NVL1	integer	Number of volume sources (control file)	0
36	NVL2	integer	Number of volume sources (variable emissions file)	0
37	MSOURCE	integer	Individual source contribution flag : 0 = report just the total 1 = report individual contributions and the total	0
38	NREC	integer	number of discrete receptors	0
39	NCTREC	integer	Number of complex terrain receptors	0
40	LSAMP	logical	Sampling grid flag (T = gridded receptors used, F = no gridded receptors)	T
41	NDFOUT	integer	Number of output species	5
42	LCOMPRS	logical	Flag indicating if concentration data are compressed (T=yes, F=no)	T
43	I2DMET	integer	RH data flag: 0 = relative humidity at surface stations (1D) 1 = relative humidity at grid points (2D)	1
44	IUTMZN	integer	UTM zone (1-60)	19
45	FEAST	real	False Easting of map projection (km)	0.0
46	FNORTH	real	False Northing of map projection (km)	0.0
47	RNLAT0	real	N. latitude of origin of map projection (degrees)	45.8

48	RELON0	real	E. longitude of origin of map projection (degrees)	-75.2
49	XLAT1	real	Matching N. latitude #1 of map projection (degrees)	30.0
50	XLAT2	real	Matching N. latitude #2 of map projection (degrees)	60.0

[a] C*N = Character*N

Table 9-54 (Continued)
Unformatted DFLX.DAT file - Header Record NCOM+3 - General Data

No.	Variable	Type[a]	Description	Sample Values
51	PMAP	C*8	Map projection	UTM
52	UTMHEM	C*4	Hemisphere (N or S) for UTM projection	N
53	DATUM	C*8	Datum code	WGS-84
54	DATEN	C*12	NIMA date (MM-DD-YYYY) for datum definitions	10-10-2002
55	CLAT0	C*16	Latitude of origin of map projection	45.8N
56	CLON0	C*16	Longitude of origin of map projection	75.2W
57	CLAT1	C*16	Matching latitude #1 of map projection	30N
58	CLAT2	C*16	Matching latitude #2 of map projection	60N

[a] C*N = Character*N

Header Record NCOM+4 - Run Title

No.	Variable	Type[a]	Description
1	TITLE (3)	C*80	User-specified run title (three lines of up to 80 characters/line)

[a] C*80 = Character*80

Header Record NCOM+5 - List of Species-Layers in Output File

No.	Variable	Type[a]	Description

1-NDFOUT	CDFOUT array	C*15	Species name (characters 1-12) and variable flag (characters 13-15) of data stored in the output file. The variable flag for dry fluxes is " DF". For example [b], "SO2..........DF" corresponds to SO_2 dry fluxes.

[a] C*15 = Character*15
[b] Dots (....) indicate spaces.

Table 9-54 (Continued)
Unformatted DFLX.DAT file - Header

Header Record NCOM+6 - Discrete Receptors
(Included only if NDREC > 0)

No.	Variable	Type	Description
1	XREC	real array	X-coordinate (km) of each discrete receptor
2	YREC	real array	Y-coordinate (km) of each discrete receptor
3	ZREC	real array	Ground level elevation (m) of each discrete receptor

Header Record NCOM+7 - Complex Terrain Receptors
(Included only if NCTREC > 0)

No.	Variable	Type	Description
1	XRCT	real array	X-coordinate (km) of each complex terrain receptor
2	YRCT	real array	Y-coordinate (km) of each complex terrain receptor
3	ZRCT	real array	Ground level elevation (m) of each complex terrain receptor
4	IHILL	integer array	Hill number associated with this receptor

Header Record NCOM+8 – Point Source Names (Control File)
(Included only if NPT1 > 0)

No.	Variable	Type	Description
1	ISTYPE	integer	Source type (1)
2	CNAMPT1	C*16 array	Source names

C*16 = Character*16

Table 9-54 (Continued)
Unformatted DFLX.DAT file - Header

Header Record NCOM+9 - Point Source Names (Variable Emissions File)
(Included only if NPT2 > 0)

No.	Variable	Type	Description
1	ISTYPE	integer	Source type (2)
2	CNAMPT2	C*16 array	Source names

C*16 = Character*16

Header Record NCOM+10 – Area Source Names (Control File)
(Included only if NAR1 > 0)

No.	Variable	Type	Description
1	ISTYPE	integer	Source type (3)
2	CNAMAR1	C*16 array	Source names

C*16 = Character*16

Header Record NCOM+11 - Area Source Names (Variable Emissions File)
(Included only if NAR2 > 0)

No.	Variable	Type	Description
1	ISTYPE	integer	Source type (4)
2	CNAMAR2	C*16 array	Source names

C*16 = Character*16

Table 9-54 (Continued)
Unformatted DFLX.DAT file - Header

Header Record NCOM+12 – Line Source Names (Control File)
(Included only if NLN1 > 0)

No.	Variable	Type	Description
1	ISTYPE	integer	Source type (5)
2	CNAMLN1	C*16 array	Source names

C*16 = Character*16

Header Record NCOM+13 - Line Source Names (Variable Emissions File)
(Included only if NLN2 > 0)

No.	Variable	Type	Description
1	ISTYPE	integer	Source type (6)
2	CNAMLN2	C*16 array	Source names

C*16 = Character*16

Header Record NCOM+14 – Volume Source Names (Control File)
(Included only if NVL1 > 0)

No.	Variable	Type	Description
1	ISTYPE	integer	Source type (7)
2	CNAMVL1	C*16 array	Source names

C*16 = Character*16

Table 9-54 (Concluded)
Unformatted DFLX.DAT file - Header

Header Record NCOM+15 - Volume Source Names (Variable Emissions File)
(Included only if NVL2 > 0)

No.	Variable	Type	Description
1	ISTYPE	integer	Source type (8)
2	CNAMVL2	C*16 array	Source names

C*16 = Character*16

DFLX.DAT File - Data Records

The DFLX.DAT data records consist of a set of "NDFOUT+1" records for each hour of the CALPUFF runs (NDFOUT is the number of species flagged as being stored in the output file). The first record of each set contains the date and hour of the data in the records which follow it. The next "NDFOUT" records contain predicted one-hour averaged dry deposition fluxes in $g/m^2/s$ for each relevant species (see Table 9-55).

Sample FORTRAN read statements for the data records (in uncompressed format) are:

```
READ(iunit)nyrb,njulb,nhrb,nsecb,nyre,njule,nhre,nsece
READ(iunit) istype,isnum,sname,sxkm,sykm

┌   LOOP OVER DRY DEPOSITED SPECIES STORED ON DISK
│
│   GRIDDED RECEPTOR DRY FLUXES
│      IF(LSGRID)READ(iunit)CDFG,DFLXG
│
│   DISCRETE RECEPTOR DRY FLUXES
│      IF(NDREC.GT.0)READ(iunit)CDFD,DFLXD
│
└   END LOOP OVER DRY DEPOSITED SPECIES STORED ON DISK
```

where the following declarations apply:

```
Character*15 CDFG,CDFD
Real DFLXG(nxg,nyg),DFLXD(NDREC)
```

and

```
nxg = IESAMP - IBSAMP+1
nyg = JESAMP - JBSAMP+1
```

CALPUFF contains an option to compress the data by replacing strings of zeroes with a coded repetition factor. The factor is a negative number whose absolute value indicates the number of consecutive zeroes that have been replaced by the repetition factor. This method is especially useful in reducing the size of the output file when large segments of the receptor arrays lie upwind of the puffs during an hour, thereby producing long strings of zeroes in the output arrays. For example, the following record with data for 20 receptors requires 20 unpacked words:

```
0.0, 0.0, 0.0, 0.0, 0.0, 1.2, 3.5, 0.0, 0.0, 0.0,
0.0, 0.0, 0.0, 0.7, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0
```

These data in packed form would be represented in six words:

```
-5., 1.2, 3.5, -6., 0.7, -6.
```

Table 9-55: Unformatted DFLX.DAT File - Data Records

(Records 1 and 2 of each set)

No.	Variable	Type	Description (Record 1)
1	NYRB	integer	Year (4 digits) at start of averaging period
2	NJULB	integer	Julian day at start of averaging period
3	NHRB	integer	Hour (00-23 LST) at start of averaging period
4	NSECB	integer	Second (0000-3600 LST) at start of averaging period
5	NYRE	integer	Year (4 digits) at end of averaging period
6	NJULE	integer	Julian day at end of averaging period
7	NHRE	integer	Hour (00-23 LST) at end of averaging period
8	NSECE	integer	Second (0000-3600 LST) at start of averaging period
No.	**Variable**	**Type[a]**	**Description (Record 2)**
1	ISTYPE	integer	Source type
2	ISNUM	integer	Source number of this type
3	SNAME	C*16	Source name
4	SXKM	real	Source X-coordinate (km) in the modeling map projection
5	SYKM	real	Source Y-coordinate (km) in the modeling map projection

[a] C*16 = Character*16

Table 9-55 (Concluded)
Unformatted DFLX.DAT File - Data Records

(Next Data Record)
(Included only if LSAMP = TRUE)

No.	Variable	Type	Description
1	CDFG	C*15	Species name (characters 1-12) and variable flag (characters 13-15) of the data in this record. For example [b], "SO2..........DF" corresponds to SO_2 dry flux.
Next NXG*NYG	DFLXG	real array	"IAVG" - hour averaged dry deposition fluxes ($g/m^2/s$) for each gridded receptor

(Next Data Record)
(Included only if NDREC > 0)

No.	Variable	Type[a]	Description
1	CDFD	C*15	Species name (characters 1-12) and dry flux flag (characters 13-15) of the data in this record. For example, "SO2..........DF" corresponds to SO_2 dry fluxes.
Next NDREC	DFLXD	real array	"IAVG" - hour averaged dry deposition fluxes ($g/m^2/s$) for each discrete receptor

[a] C*15 = Character*15
[b] Dots (....) indicate spaces.

9.15.5 Wet Flux File (WFLX.DAT)

The WFLX.DAT file is an unformatted data file containing wet deposition fluxes of one or more species simulated by CALPUFF at each receptor, for each period in the run. The creation and contents of the WFLX.DAT file are controlled by user-specified inputs in Input Group 5 of the control file (see Section 9.1).

The control file variable IWET must be set equal to one in order to create the WFLX.DAT file. The species saved in the output file are also controlled by the user by setting flags in the output species table in Input Group 5 of the control file. The model checks that only deposited species are flagged for output into the WFLX.DAT file. The effects of wet deposition on ambient concentrations can be evaluated without saving the wet fluxes in the output file if the actual values of the deposition fluxes are not of interest.

WFLX.DAT File - Header Records

The WFLX.DAT file consists of NCOM+7 header records followed by a set of data records. The header records contain information describing the version of the model used in the run creating the file, horizontal and vertical grid data, a user-input title, a list of the species combinations stored in the output file, and receptor information (see Table 9-56). NCOM, provided in record 2, defines the number of comment records that are present. Comment records are used to transfer the image of CALMET and CALPUFF control files used in the simulation for documentation and QA purposes.

Sample FORTRAN read statements for the header records are:

```
      READ(iunit) DATASET,DATAVER,DATAMOD
      READ(iunit) NCOM
               DO n=1,NCOM
         READ(iunit) COMMENT
               ENDDO
       READ(iunit)CMODEL,VER,LEVEL,IBYR,IBJUL,IBHR,IBSEC,XBTZ,
    1 IRLG,IAVG,NSECDT,NXM,NYM,DXKM,DYKM,IONE,XORIGKM,YORIGKM,NSSTA,IBCOMP,IECOMP,
    2 JBCOMP,JECOMP,IBSAMP,JBSAMP,IESAMP,JESAMP,MESHDN,NPT1,NPT2,NAR1,NAR2,NLN1,NLN2,
    3 NVL1,NVL2,MSOURCE,NREC,NCTREC,LSAMP,NWFOUT,LCOMPR,
    4 I2DMET,IUTMZN,FEAST,FNORTH,RNLAT0,RELON0,
    5 XLAT1,XLAT2,PMAP,UTMHEM,DATUM,DATEN,
    6 CLAT0,CLON0,CLAT1,CLAT2
   READ(iunit)TITLE
   READ(iunit)CWFOUT
       IF(NDREC.GT.0) READ(iunit)XREC,YREC,ZREC
       IF(NCTREC.GT.0) READ(iunit)XRCT,YRCT,ZRCT,IHILL
       IF(NPT1.GT.0) READ(iunit)ISTYPE,CNAMPT1
       IF(NPT2.GT.0) READ(iunit)ISTYPE,CNAMPT2
       IF(NAR1.GT.0) READ(iunit)ISTYPE,CNAMAR1
       IF(NAR2.GT.0) READ(iunit)ISTYPE,CNAMAR2
       IF(N LN1.GT.0) READ(iunit)ISTYPE,CNAMLN1
       IF(NLN2.GT.0) READ(iunit)ISTYPE,CNAMLN2
```

```
    IF(NVL1.GT.0) READ(iunit)ISTYPE,CNAMVL1
IF(NVL2.GT.0) READ(iunit)ISTYPE,CNAMVL2
```

where the following declarations apply:

```
Character*132 COMMENT
Character*80 TITLE(3)
Character*64 DATAMOD
Character*16 DATASET, DATAVER, CLAT0, CLON0, CLAT1, CLAT2
Character*16 CNAMPT1(MXPT1),CNAMPT2(MXPT2), CNAMAR1(MXAREA),CNAMAR2(MXAREA)
Character*16 CNAMLN1(MXLINES),CNAMLN2(MXLNGRP), CNAMVL1(MXVOL),CNAMVL2(MXVOL)
Character*15 CWFOUT(NWFOUT)
Character*12 CMODEL,VER,LEVEL, DATEN
Character*8 PMAP, DATUM
Character*4 UTMHEM

Real XREC(NREC),YREC(NREC),ZREC(NREC)
Real XRCT(NCTREC),YRCT(NCTREC),ZRCT(NCTREC)

Integer IHILL(NCTREC)

Logical LCOMPR
```

Table 9-56: Unformatted WFLX.DAT file - Header

Header Record 1 – Dataset Definition

No.	Variable	Type	Description	Sample Values
1	DATASET	Character*16	Dataset name	WFLX.DAT
2	DATAVER	Character *16	Dataset version	2.1
3	DATAMOD	Character *64	Dataset message field	-

Header Record 2 to (NCOM+2) – Comments

No.	Variable	Type	Description	Sample Values
1	NCOM	integer	Number of comment records to follow	-

1	COMMENT	Character *132	Comment (repeated NCOM times)	-

Table 9-56 (Continued)
Unformatted WFLX.DAT file - Header Record NCOM+3 - General Data

No.	Variable	Type[a]	Description	Sample Values
1	CMODEL	C*12	Model name	CALPUFF
2	VER	C*12	Model version number	5.72
3	LEVEL	C*12	Model level number	031017
4	IBYR	integer	Starting year of the run	1980
5	IBJUL	integer	Starting Julian day	183
6	IBHR	integer	Time at start of first period (hour 00-23 LST)	8
7	IBSEC	integer	Time at start of first period (second 0000-3600)	0000
8	XBTZ	real	Base time zone (LST+XBTZ=UTC)	6.0
9	IRLG	integer	Length of run (timesteps)	10
10	IAVG	integer	Averaging time (timesteps) of output concentrations	2
11	NSECDT	integer	Length of a timestep (seconds)	1800
12	NXM	integer	Number of grid points in meteorological grid (X direction)	20
13	NYM	integer	Number of grid points in meteorological grid (Y direction)	20
14	DXKM	real	Grid spacing (km) in the X direction	5.
15	DYKM	real	Grid spacing (km) in the Y direction	5.
16	IONE	integer	Number of receptor layers (must be equal to one for CALPUFF runs)	1
17	XORIGKM	real	Reference X coordinate (km) of the southwest corner of grid cell (1,1) of the meteorological grid	190.
18	YORIGKM	real	Reference Y coordinate (km) of the southwest corner of grid cell (1,1) of the meteorological grid	440.
19	NSSTA	integer	Number of surface meteorological stations	5
20	IBCOMP	integer	Start of computational grid in X direction	1
21	IECOMP	integer	End of computational grid in X direction	20
22	JBCOMP	integer	Start of computation grid in the Y direction	1
23	JECOMP	integer	End of computational grid in Y direction	20

24	IBSAMP	integer	Start of sampling grid in X direction	1
25	JBSAMP	integer	Start of sampling grid in Y direction	1

[a]C*12 = Character*12

Table 9-56 (Continued)
Unformatted WFLX.DAT file - Header Record NCOM+3 - General Data

No.	Variable	Type[a]	Description	Sample Values
26	IESAMP	integer	End of sampling grid in X direction	20
27	JESAMP	integer	End of sampling grid in Y direction	20
28	MESHDN	integer	Sampling grid spacing factor	1
29	NPT1	integer	Number of point sources (control file)	2
30	NPT2	integer	Number of point sources (variable emissions file)	0
31	NAR1	integer	Number of area sources (control file)	0
32	NAR2	integer	Number of area sources (variable emissions file)	0
33	NLN1	integer	Number of line sources (control file)	0
34	NLN2	integer	Number of line sources (variable emissions file)	0
35	NVL1	integer	Number of volume sources (control file)	0
36	NVL2	integer	Number of volume sources (variable emissions file)	0
37	MSOURCE	integer	Individual source contribution flag : 0 = report just the total 1 = report individual contributions and the total	0
38	NREC	integer	number of discrete receptors	0
39	NCTREC	integer	Number of complex terrain receptors	0
40	LSAMP	logical	Sampling grid flag (T = gridded receptors used, F = no gridded receptors)	T
41	NWFOUT	integer	Number of output species	5
42	LCOMPRS	logical	Flag indicating if concentration data are compressed (T=yes, F=no)	T
43	I2DMET	integer	RH data flag: 0 = relative humidity at surface stations (1D) 1 = relative humidity at grid points (2D)	1
44	IUTMZN	integer	UTM zone (1-60)	19
45	FEAST	real	False Easting of map projection (km)	0.0
46	FNORTH	real	False Northing of map projection (km)	0.0
47	RNLAT0	real	N. latitude of origin of map projection (degrees)	45.8

48	RELON0	real	E. longitude of origin of map projection (degrees)	-75.2
49	XLAT1	real	Matching N. latitude #1 of map projection (degrees)	30.0
50	XLAT2	real	Matching N. latitude #2 of map projection (degrees)	60.0

[a] C*N = Character*N

Table 9-56 (Continued)
Unformatted WFLX.DAT file - Header Record NCOM+3 - General Data

No.	Variable	Type[a]	Description	Sample Values
51	PMAP	C*8	Map projection	UTM
52	UTMHEM	C*4	Hemisphere (N or S) for UTM projection	N
53	DATUM	C*8	Datum code	WGS-84
54	DATEN	C*12	NIMA date (MM-DD-YYYY) for datum definitions	10-10-2002
55	CLAT0	C*16	Latitude of origin of map projection	45.8N
56	CLON0	C*16	Longitude of origin of map projection	75.2W
57	CLAT1	C*16	Matching latitude #1 of map projection	30N
58	CLAT2	C*16	Matching latitude #2 of map projection	60N

[a] C*N = Character*N

Header Record NCOM+4 - Run Title

No.	Variable	Type[a]	Description
1	TITLE (3)	C*80	User-specified run title (three lines of up to 80 characters/line)

[a] C*80 = Character*80

Header Record NCOM+5 - List of Species-Layers in Output File

No.	Variable	Type[a]	Description

1-NWFOUT	CWFOUT array	C*15	Species name (characters 1-12) and variable flag (characters 13-15) of data stored in the output file. The variable flag for wet fluxes is " WF". For example [b], `"SO2..........WF"` corresponds to SO_2 wet fluxes.

[a] C*15 = Character*15
[b] Dots (....) indicate spaces.

Table 9-56 (Continued)
Unformatted WFLX.DAT file - Header

Header Record NCOM+6 - Discrete Receptors
(Included only if NDREC > 0)

No.	Variable	Type	Description
1	XREC	real array	X-coordinate (km) of each discrete receptor
2	YREC	real array	Y-coordinate (km) of each discrete receptor
3	ZREC	real array	Ground level elevation (m) of each discrete receptor

Header Record NCOM+7 - Complex Terrain Receptors
(Included only if NCTREC > 0)

No.	Variable	Type	Description
1	XRCT	real array	X-coordinate (km) of each complex terrain receptor
2	YRCT	real array	Y-coordinate (km) of each complex terrain receptor
3	ZRCT	real array	Ground level elevation (m) of each complex terrain receptor
4	IHILL	integer array	Hill number associated with this receptor

Header Record NCOM+8 – Point Source Names (Control File)
(Included only if NPT1 > 0)

No.	Variable	Type	Description
1	ISTYPE	integer	Source type (1)
2	CNAMPT1	C*16 array	Source names

C*16 = Character*16

Table 9-56 (Continued)
Unformatted WFLX.DAT file - Header

Header Record NCOM+9 - Point Source Names (Variable Emissions File)
(Included only if NPT2 > 0)

No.	Variable	Type	Description
1	ISTYPE	integer	Source type (2)
2	CNAMPT2	C*16 array	Source names

C*16 = Character*16

Header Record NCOM+10 – Area Source Names (Control File)
(Included only if NAR1 > 0)

No.	Variable	Type	Description
1	ISTYPE	integer	Source type (3)
2	CNAMAR1	C*16 array	Source names

C*16 = Character*16

Header Record NCOM+11 - Area Source Names (Variable Emissions File)
(Included only if NAR2 > 0)

No.	Variable	Type	Description
1	ISTYPE	integer	Source type (4)
2	CNAMAR2	C*16 array	Source names

C*16 = Character*16

Table 9-56 (Continued)
Unformatted WFLX.DAT file - Header

Header Record NCOM+12 – Line Source Names (Control File)
(Included only if NLN1 > 0)

No.	Variable	Type	Description
1	ISTYPE	integer	Source type (5)
2	CNAMLN1	C*16 array	Source names

C*16 = Character*16

Header Record NCOM+13 - Line Source Names (Variable Emissions File)
(Included only if NLN2 > 0)

No.	Variable	Type	Description
1	ISTYPE	integer	Source type (6)
2	CNAMLN2	C*16 array	Source names

C*16 = Character*16

Header Record NCOM+14 – Volume Source Names (Control File)
(Included only if NVL1 > 0)

No.	Variable	Type	Description
1	ISTYPE	integer	Source type (7)
2	CNAMVL1	C*16 array	Source names

C*16 = Character*16

Table 9-56 (Concluded)
Unformatted WFLX.DAT file - Header

Header Record NCOM+15 - Volume Source Names (Variable Emissions File)
(Included only if NVL2 > 0)

No.	Variable	Type	Description
1	ISTYPE	integer	Source type (8)
2	CNAMVL2	C*16 array	Source names

C*16 = Character*16

WFLX.DAT File - Data Records

The WFLX.DAT data records consist of a set of "NWFOUT+1" records for each hour of the CALPUFF runs (NWFOUT is the number of species flagged as being stored in the output file). The first record of each set contains the date and hour of the data in the records which follow it. The next "NWFOUT" records contain predicted one-hour averaged wet deposition fluxes in g/m^2/s for each relevant species (see Table 9-57).

Sample FORTRAN read statements for the data records (in uncompressed format) are:

```
READ(iunit)nyrb,njulb,nhrb,nsecb,nyre,njule,nhre,nsece
READ(iunit) istype,isnum,sname,sxkm,sykm

┌─  LOOP OVER WET DEPOSITED SPECIES STORED ON DISK
|
|     GRIDDED RECEPTOR WET FLUXES
|         IF(LSGRID)READ(iunit)CWFG,WFLXG
|
|     DISCRETE RECEPTOR WET FLUXES
|         IF(NDREC.GT.0)READ(iunit)CWFD,WFLXD
|
└─  END LOOP OVER WET DEPOSITED SPECIES STORED ON DISK
```

where the following declarations apply:

```
Character*15 CWFG,CWFD
```

```
Real WFLXG(nxg,nyg),WFLXD(NDREC)
```

and

```
nxg = IESAMP - IBSAMP+1
nyg = JESAMP - JBSAMP+1
```

CALPUFF contains an option to compress the data by replacing strings of zeroes with a coded repetition factor. The factor is a negative number whose absolute value indicates the number of consecutive zeroes that have been replaced by the repetition factor. This method is especially useful in reducing the size of the output file when large segments of the receptor arrays lie upwind of the puffs during an hour, thereby producing long strings of zeroes in the output arrays. For example, the following record with data for 20 receptors requires 20 unpacked words:

```
0.0, 0.0, 0.0, 0.0, 0.0, 1.2, 3.5, 0.0, 0.0, 0.0,
0.0, 0.0, 0.0, 0.7, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0
```

These data in packed form would be represented in six words:

```
-5., 1.2, 3.5, -6., 0.7, -6.
```

Table 9-57: Unformatted WFLX.DAT File - Data Records
(Record 1 of each set)

No.	Variable	Type	Description (Record 1)
1	NYRB	integer	Year (4 digits) at start of averaging period
2	NJULB	integer	Julian day at start of averaging period
3	NHRB	integer	Hour (00-23 LST) at start of averaging period
4	NSECB	integer	Second (0000-3600 LST) at start of averaging period
5	NYRE	integer	Year (4 digits) at end of averaging period
6	NJULE	integer	Julian day at end of averaging period
7	NHRE	integer	Hour (00-23 LST) at end of averaging period
8	NSECE	integer	Second (0000-3600 LST) at start of averaging period
No.	**Variable**	**Type[a]**	**Description (Record 2)**
1	ISTYPE	integer	Source type
2	ISNUM	integer	Source number of this type
3	SNAME	C*16	Source name
4	SXKM	real	Source X-coordinate (km) in the modeling map projection

5	SYKM	real	Source Y-coordinate (km) in the modeling map projection

[a] C*16 = Character*16

Table 9-57 (Concluded)
Unformatted WFLX.DAT File - Data Records

(Next Data Record)
(Included only if LSAMP = TRUE)

No.	Variable	Type	Description
1	CWFG	C*15	Species name (characters 1-12) and wet flux flag (characters 13-15) of the data in this record. For example [b], "SO2..........WF" corresponds to SO_2 wet fluxes.
Next NXG*NYG	DWLXG	real array	"IAVG" - hour averaged wet deposition fluxes ($g/m^2/s$) for each gridded receptor

(Next Data Record)
(Included only if NDREC > 0)

No.	Variable	Type[a]	Description
1	CWFD	C*15	Species name (characters 1-12) and wet flux flag (characters 13-15) of the data in this record. For example [b], "SO2..........WF" corresponds to SO_2 wet fluxes.
Next NDREC	WFLXD	real array	"IAVG" - hour averaged wet deposition fluxes ($g/m^2/s$) for each discrete receptor

[a] C*15 = Character*15
[b] Dots (....) indicate spaces.

9.15.6 Relative Humidity File for Visibility Processing in CALPOST (VISB.DAT)

The VISB.DAT file is an unformatted data file containing relative humidity data at each surface meteorological station, for each period in the run. It is required if CALPOST will be used to assess visibility. The variable IVIS in Input Group 5 of the control file (see Section 9.1) must be set equal to one in order to create the VISB.DAT file.

VISB.DAT File - Header Records

The VISB.DAT file consists of at least either NCOM+7 or NCOM+10 header records followed by a set of data records. The header records contain information describing the version of the model used in the run creating the file, horizontal and vertical grid data, a user-input title, a list of the species combinations stored in the output file, and receptor information (see Table 9-58). NCOM, provided in record 2, defines the number of comment records that are present. Comment records are used to transfer the image of CALMET and CALPUFF control files used in the simulation for documentation and QA purposes.

Sample FORTRAN read statements for the header records are:

```
      READ(iunit) DATASET,DATAVER,DATAMOD
      READ(iunit) NCOM
               DO n=1,NCOM
         READ(iunit) COMMENT
               ENDDO
       READ(iunit)CMODEL,VER,LEVEL,IBYR,IBJUL,IBHR,IBSEC,XBTZ,
    1 IRLG,IAVG,NSECDT,NXM,NYM,DXKM,DYKM,IONE,XORIGKM,YORIGKM,NSSTA,IBCOMP,IECOMP,
    2 JBCOMP,JECOMP,IBSAMP,JBSAMP,IESAMP,JESAMP,MESHDN,NPT1,NPT2,NAR1,NAR2,NLN1,NLN2,
    3 NVL1,NVL2,MSOURCE,NREC,NCTREC,LSAMP,NVSOUT,LCOMPR,
    4 I2DMET,IUTMZN,FEAST,FNORTH,RNLAT0,RELON0,
    5 XLAT1,XLAT2,PMAP,UTMHEM,DATUM,DATEN,
    6 CLAT0,CLON0,CLAT1,CLAT2
   READ(iunit)TITLE
   READ(iunit)CVSOUT
       IF(NDREC.GT.0) READ(iunit)XREC,YREC,ZREC
       IF(NCTREC.GT.0) READ(iunit)XRCT,YRCT,ZRCT,IHILL
       IF(NPT1.GT.0) READ(iunit)ISTYPE,CNAMPT1
       IF(NPT2.GT.0) READ(iunit)ISTYPE,CNAMPT2
       IF(NAR1.GT.0) READ(iunit)ISTYPE,CNAMAR1
       IF(NAR2.GT.0) READ(iunit)ISTYPE,CNAMAR2
       IF(N LN1.GT.0) READ(iunit)ISTYPE,CNAMLN1
       IF(NLN2.GT.0) READ(iunit)ISTYPE,CNAMLN2
       IF(NVL1.GT.0) READ(iunit)ISTYPE,CNAMVL1
   IF(NVL2.GT.0) READ(iunit)ISTYPE,CNAMVL2
```

where the following declarations apply:

```
      Character*132 COMMENT
      Character*80 TITLE(3)
      Character*64 DATAMOD
      Character*16 DATASET, DATAVER, CLAT0, CLON0, CLAT1, CLAT2
```

```
Character*16 CNAMPT1(MXPT1),CNAMPT2(MXPT2), CNAMAR1(MXAREA),CNAMAR2(MXAREA)
Character*16 CNAMLN1(MXLINES),CNAMLN2(MXLNGRP), CNAMVL1(MXVOL),CNAMVL2(MXVOL)
Character*15 CVSOUT(NVSOUT)
Character*12 CMODEL,VER,LEVEL, DATEN
Character*8 PMAP, DATUM
Character*4 UTMHEM

Real XREC(NREC),YREC(NREC),ZREC(NREC)
Real XRCT(NCTREC),YRCT(NCTREC),ZRCT(NCTREC)

Integer IHILL(NCTREC)

Logical LCOMPR
```

Table 9-58: Unformatted VISB.DAT file - Header

Header Record 1 – Dataset Definition

No.	Variable	Type	Description	Sample Values
1	DATASET	Character*16	Dataset name	VISB.DAT
2	DATAVER	Character *16	Dataset version	2.1
3	DATAMOD	Character *64	Dataset message field	-

Header Record 2 to (NCOM+2) – Comments

No.	Variable	Type	Description	Sample Values
1	NCOM	integer	Number of comment records to follow	-
1	COMMENT	Character *132	Comment (repeated NCOM times)	-

Table 9-58 (Continued)
Unformatted VISB.DAT file - Header Record NCOM+3 - General Data

No.	Variable	Type[a]	Description	Sample Values
1	CMODEL	C*12	Model name	CALPUFF
2	VER	C*12	Model version number	5.72
3	LEVEL	C*12	Model level number	031017
4	IBYR	integer	Starting year of the run	1980
5	IBJUL	integer	Starting Julian day	183
6	IBHR	integer	Time at start of first period (hour 00-23 LST)	8
7	IBSEC	integer	Time at start of first period (second 0000-3600)	0000
8	XBTZ	real	Base time zone (LST+XBTZ=UTC)	6.0
9	IRLG	integer	Length of run (time steps)	10
10	IAVG	integer	Averaging time (time steps) of output concentrations	2
11	NSECDT	integer	Length of a time step (seconds)	1800
12	NXM	integer	Number of grid points in meteorological grid (X direction)	20
13	NYM	integer	Number of grid points in meteorological grid (Y direction)	20
14	DXKM	real	Grid spacing (km) in the X direction	5.
15	DYKM	real	Grid spacing (km) in the Y direction	5.
16	IONE	integer	Number of receptor layers (must be equal to one for CALPUFF runs)	1
17	XORIGKM	real	Reference X coordinate (km) of the southwest corner of grid cell (1,1) of the meteorological grid	190.
18	YORIGKM	real	Reference Y coordinate (km) of the southwest corner of grid cell (1,1) of the meteorological grid	440.
19	NSSTA	integer	Number of surface meteorological stations	5
20	IBCOMP	integer	Start of computational grid in X direction	1
21	IECOMP	integer	End of computational grid in X direction	20
22	JBCOMP	integer	Start of computation grid in the Y direction	1
23	JECOMP	integer	End of computational grid in Y direction	20

24	IBSAMP	integer	Start of sampling grid in X direction	1
25	JBSAMP	integer	Start of sampling grid in Y direction	1

[a]C*12 = Character*12

Table 9-58 (Continued)
Unformatted VISB.DAT file - Header Record NCOM+3 - General Data

No.	Variable	Type[a]	Description	Sample Values
26	IESAMP	integer	End of sampling grid in X direction	20
27	JESAMP	integer	End of sampling grid in Y direction	20
28	MESHDN	integer	Sampling grid spacing factor	1
29	NPT1	integer	Number of point sources (control file)	2
30	NPT2	integer	Number of point sources (variable emissions file)	0
31	NAR1	integer	Number of area sources (control file)	0
32	NAR2	integer	Number of area sources (variable emissions file)	0
33	NLN1	integer	Number of line sources (control file)	0
34	NLN2	integer	Number of line sources (variable emissions file)	0
35	NVL1	integer	Number of volume sources (control file)	0
36	NVL2	integer	Number of volume sources (variable emissions file)	0
37	MSOURCE	integer	Individual source contribution flag : 0 = report just the total 1 = report individual contributions and the total	0
38	NREC	integer	number of discrete receptors	0
39	NCTREC	integer	Number of complex terrain receptors	0
40	LSAMP	logical	Sampling grid flag (T = gridded receptors used, F = no gridded receptors)	T
41	NVSOUT	integer	Number of output species	5
42	LCOMPRS	logical	Flag indicating if concentration data are compressed (T=yes, F=no)	T
43	I2DMET	integer	RH data flag: 0 = relative humidity at surface stations (1D) 1 = relative humidity at grid points (2D)	1
44	IUTMZN	integer	UTM zone (1-60)	19
45	FEAST	real	False Easting of map projection (km)	0.0
46	FNORTH	real	False Northing of map projection (km)	0.0
47	RNLAT0	real	N. latitude of origin of map projection (degrees)	45.8

48	RELON0	real	E. longitude of origin of map projection (degrees)	-75.2
49	XLAT1	real	Matching N. latitude #1 of map projection (degrees)	30.0
50	XLAT2	real	Matching N. latitude #2 of map projection (degrees)	60.0

[a] C*N = Character*N

Table 9-58 (Continued)
Unformatted VISB.DAT file - Header Record NCOM+3 - General Data

No.	Variable	Type[a]	Description	Sample Values
51	PMAP	C*8	Map projection	UTM
52	UTMHEM	C*4	Hemisphere (N or S) for UTM projection	N
53	DATUM	C*8	Datum code	WGS-84
54	DATEN	C*12	NIMA date (MM-DD-YYYY) for datum definitions	10-10-2002
55	CLAT0	C*16	Latitude of origin of map projection	45.8N
56	CLON0	C*16	Longitude of origin of map projection	75.2W
57	CLAT1	C*16	Matching latitude #1 of map projection	30N
58	CLAT2	C*16	Matching latitude #2 of map projection	60N

[a] C*N = Character*N

Header Record NCOM+4 - Run Title

No.	Variable	Type[a]	Description
1	TITLE (3)	C*80	User-specified run title (three lines of up to 80 characters/line)

[a] C*80 = Character*80

Header Record NCOM+5 - List of Species-Layers in Output File

No.	Variable	Type[a]	Description
1-NVSOUT	CVSOUT array	C*15	Data name (characters 1-15) for data stored in the output file (always ' REL HUM (%) ').

[a] C*15 = Character*15
[b]Dots (....) indicate spaces.

Table 9-58 (Continued)
Unformatted VISB.DAT file - Header

Header Record NCOM+6 - Discrete Receptors
(Included only if NDREC > 0)

No.	Variable	Type	Description
1	XREC	real array	X-coordinate (km) of each discrete receptor
2	YREC	real array	Y-coordinate (km) of each discrete receptor
3	ZREC	real array	Ground level elevation (m) of each discrete receptor

Header Record NCOM+7 - Complex Terrain Receptors
(Included only if NCTREC > 0)

No.	Variable	Type	Description
1	XRCT	real array	X-coordinate (km) of each complex terrain receptor
2	YRCT	real array	Y-coordinate (km) of each complex terrain receptor
3	ZRCT	real array	Ground level elevation (m) of each complex terrain receptor
4	IHILL	integer array	Hill number associated with this receptor

Header Record NCOM+8 – Point Source Names (Control File)
(Included only if NPT1 > 0)

No.	Variable	Type	Description
1	ISTYPE	integer	Source type (1)
2	CNAMPT1	C*16 array	Source names

C*16 = Character*16

Table 9-58 (Continued)
Unformatted VISB.DAT file - Header

Header Record NCOM+9 - Point Source Names (Variable Emissions File)
(Included only if NPT2 > 0)

No.	Variable	Type	Description
1	ISTYPE	integer	Source type (2)
2	CNAMPT2	C*16 array	Source names

C*16 = Character*16

Header Record NCOM+10 – Area Source Names (Control File)
(Included only if NAR1 > 0)

No.	Variable	Type	Description
1	ISTYPE	integer	Source type (3)
2	CNAMAR1	C*16 array	Source names

C*16 = Character*16

Header Record NCOM+11 - Area Source Names (Variable Emissions File)
(Included only if NAR2 > 0)

No.	Variable	Type	Description
1	ISTYPE	integer	Source type (4)
2	CNAMAR2	C*16 array	Source names

C*16 = Character*16

Table 9-58 (Continued)
Unformatted VISB.DAT file - Header

Header Record NCOM+12 – Line Source Names (Control File)
(Included only if NLN1 > 0)

No.	Variable	Type	Description
1	ISTYPE	integer	Source type (5)
2	CNAMLN1	C*16 array	Source names

C*16 = Character*16

Header Record NCOM+13 - Line Source Names (Variable Emissions File)
(Included only if NLN2 > 0)

No.	Variable	Type	Description
1	ISTYPE	integer	Source type (6)
2	CNAMLN2	C*16 array	Source names

C*16 = Character*16

Header Record NCOM+14 – Volume Source Names (Control File)
(Included only if NVL1 > 0)

No.	Variable	Type	Description
1	ISTYPE	integer	Source type (7)
2	CNAMVL1	C*16 array	Source names

C*16 = Character*16

Table 9-58 (Concluded)
Unformatted VISB.DAT file - Header

Header Record NCOM+15 - Volume Source Names (Variable Emissions File)
(Included only if NVL2 > 0)

No.	Variable	Type	Description
1	ISTYPE	integer	Source type (8)
2	CNAMVL2	C*16 array	Source names

C*16 = Character*16

VISB.DAT File - Data Records

The VISB.DAT data records consist of a set of "NVSOUT+1" records for each hour of the CALPUFF runs (where NVSOUT is always one). The first record of each set contains the date and hour of the data in the records which follow it. The next "NVSOUT" records contain the relative humidity reported in % at each meteorological surface station if I2DRH=0, or at each sampling grid cell if I2DRH=1 (see Table 9-59).

Sample FORTRAN read statements for the data records are:

```
READ(iunit)nyrb,njulb,nhrb,nsecb,nyre,njule,nhre,nsece
READ(iunit) istype,isnum,sname,sxkm,sykm

IF(I2DRH.EQ.0) THEN
   READ(iunit)CNAME,IRHSS
ELSE
   READ(iunit)CNAME,IRH2D
ENDIF
```

where the following declarations apply:

```
Character*15 CNAME
Integer IRHSS(NSSTA)
Integer IRH2D(nxm,nym)
```

Table 9-59: Unformatted VISB.DAT File - Data Records

(Record 1 of each set)

No.	Variable	Type	Description (Record 1)
1	NYRB	integer	Year (4 digits) at start of averaging period
2	NJULB	integer	Julian day at start of averaging period
3	NHRB	integer	Hour (00-23 LST) at start of averaging period
4	NSECB	integer	Second (0000-3600 LST) at start of averaging period
5	NYRE	integer	Year (4 digits) at end of averaging period
6	NJULE	integer	Julian day at end of averaging period
7	NHRE	integer	Hour (00-23 LST) at end of averaging period
8	NSECE	integer	Second (0000-3600 LST) at start of averaging period

No.	Variable	Type[a]	Description (Record 2)
1	ISTYPE	integer	Source type
2	ISNUM	integer	Source number of this type
3	SNAME	C*16	Source name
4	SXKM	real	Source X-coordinate (km) in the modeling map projection
5	SYKM	real	Source Y-coordinate (km) in the modeling map projection

[a] C*16 = Character*16

(Next Record)

No.	Variable	Type[a]	Description
1	CNAME	C*15	' REL HUM (%) '
Next NSSTA (if I2DRH = 0)	IRHSS	integer array	Relative humidity (%) reported as an integer for each surface meteorological station
Next NXM*NYM (if I2DRH = 1)	IRH2D	integer array	Relative humidity (%) reported as an integer for each CALMET meteorological grid cell

[a] C*15 = Character*15

9.15.7 Debug Puff-Tracking File (DEBUG.DAT)

CALPUFF contains a debug option to report much information about each selected puff as it is transported and sampled over a number of modeling periods. Most of this extra information is written to the CALPUFF list file (see Section 9.15.1). A limited set of puff information is also written to DEBUG.DAT each sampling step when the debug option is selected. The purpose of this file is to provide puff characteristics at the end of each sampling step so that its location and size can be reviewed to visualize the combined effects of transport and diffusion at specific times.

The DEBUG.DAT file is a sequential, formatted data file (see Table 9-60 for an example) consisting of two types of records: two header records and a variable number of sets of data records. The header records name the variables that are reported in the data records (see Table 9-61). Each data record provides information about a single puff at the end of a single sampling step. While there may be many sampling steps over the course of an hour, the time reported for each is the end-time of the current hour.

A series of nested loops controls the sequence in which the data records are written to the file. The outermost loop is over the number of modeling periods (hours) for which debug output is selected. Within this is a loop over the range of puffs that has been selected. The innermost loop is over the sampling steps for each of these puffs. Because the puff ID and the date and time are included in each record, this structure is readily discerned.

Records for individual puffs are written during the selected modeling period only while that puff exists on the computational grid. It is not tracked before it is emitted, and it is not tracked once it leaves the modeling domain.

Table 9-60: Sample Debug Puff-Tracking File (DEBUG.DAT)

				---- PUFF/ Old SLUG end ---------										
YYYYJJJHH	SEC	ipnum	cd	zfnl	x(metG)	y(metG)	sigyB	sigzB	QM	QU	zimax	rflctn	dpbl	jdstab
199000904	1800	1	1	104.1	33.2228	52.3154	100.1	28.3	3.4591E+02	0.0000E+00	10000.0	10000.0	197.1	6
199000904	1800	1	1	104.1	33.3025	52.3758	102.9	28.7	3.4591E+02	0.0000E+00	10000.0	10000.0	197.1	6
199000904	1800	1	1	104.1	33.3822	52.4362	105.6	29.1	3.4590E+02	0.0000E+00	10000.0	10000.0	197.1	6
199000904	1800	1	1	104.1	33.4620	52.4965	108.3	29.5	3.4589E+02	0.0000E+00	10000.0	10000.0	197.1	6
199000904	1800	1	1	104.1	33.5417	52.5568	111.0	29.9	3.4588E+02	0.0000E+00	10000.0	10000.0	197.1	6
199000904	1800	1	1	104.1	33.6215	52.6171	113.7	30.3	3.4587E+02	0.0000E+00	10000.0	10000.0	197.1	6
199000904	1800	1	1	104.1	33.7013	52.6774	116.4	30.7	3.4586E+02	0.0000E+00	10000.0	10000.0	197.1	6
199000904	1800	1	1	104.1	33.7811	52.7376	119.1	31.0	3.4586E+02	0.0000E+00	10000.0	10000.0	197.1	6
199000904	1800	1	1	104.1	33.8610	52.7978	121.8	31.4	3.4585E+02	0.0000E+00	10000.0	10000.0	197.1	6
199000904	1800	1	1	104.1	33.9409	52.8579	124.4	31.8	3.4584E+02	0.0000E+00	10000.0	10000.0	197.1	6
199000904	1800	1	1	104.1	34.0208	52.9181	127.1	32.5	3.4583E+02	0.0000E+00	10000.0	10000.0	197.1	6
199000904	1800	1	1	104.1	34.1009	52.9779	129.8	33.3	3.4582E+02	0.0000E+00	10000.0	10000.0	197.2	6
199000904	1800	1	1	104.1	34.1810	53.0378	132.4	34.2	3.4581E+02	0.0000E+00	10000.0	10000.0	183.1	6
199000904	1800	1	1	104.1	34.2681	53.0869	135.0	35.1	3.4580E+02	0.0000E+00	10000.0	10000.0	183.1	6
199000904	1800	1	1	104.1	34.3553	53.1359	137.7	36.0	3.4578E+02	0.0000E+00	10000.0	10000.0	183.1	6
199000904	1800	1	1	104.1	34.4425	53.1849	140.3	37.0	3.4577E+02	0.0000E+00	10000.0	10000.0	183.1	6
199000904	1800	1	1	104.1	34.5297	53.2338	142.9	37.9	3.4576E+02	0.0000E+00	10000.0	10000.0	183.1	6
199000904	1800	1	1	104.1	34.6169	53.2827	145.5	38.9	3.4574E+02	0.0000E+00	10000.0	10000.0	183.1	6
199000904	1800	1	1	104.1	34.7042	53.3315	148.2	39.8	3.4573E+02	0.0000E+00	10000.0	10000.0	183.1	6
199000904	1800	1	1	104.1	34.7915	53.3803	150.8	40.8	3.4571E+02	0.0000E+00	10000.0	10000.0	183.1	6
199000904	1800	1	1	104.1	34.8788	53.4291	153.4	41.7	3.4570E+02	0.0000E+00	10000.0	10000.0	183.1	6
199000904	1800	1	1	104.1	34.9661	53.4778	156.0	42.7	3.4568E+02	0.0000E+00	10000.0	10000.0	183.1	6
199000904	1800	1	1	104.1	35.0372	53.5174	167.1	52.6	3.4565E+02	0.0000E+00	158.7	158.7	150.8	2
199000904	1800	1	1	104.1	35.1045	53.5410	176.8	61.8	3.4562E+02	0.0000E+00	158.7	158.7	150.8	2
199000905	0	1	1	104.1	35.1966	53.5729	189.9	74.8	3.4556E+02	0.0000E+00	158.7	158.7	150.8	2
199000905	0	1	1	104.1	35.2877	53.6038	202.8	88.2	3.4547E+02	0.0000E+00	158.7	158.7	150.8	2
199000905	0	1	1	104.1	35.3774	53.6335	215.3	101.8	3.4537E+02	0.0000E+00	158.7	158.7	150.8	2
199000905	0	1	1	104.1	35.4648	53.6617	227.3	115.9	3.4525E+02	0.0000E+00	158.7	158.7	150.8	2
199000905	0	1	1	104.1	35.5519	53.6897	239.3	130.4	3.4512E+02	0.0000E+00	158.7	158.7	150.8	2
199000905	0	1	1	104.1	35.6390	53.7177	251.1	145.4	3.4499E+02	0.0000E+00	158.7	158.7	150.8	2
199000905	0	1	1	104.1	35.7261	53.7457	262.9	161.0	3.4485E+02	0.0000E+00	158.7	158.7	150.8	2
199000905	0	1	1	104.1	35.8132	53.7736	274.6	177.2	3.4472E+02	0.0000E+00	158.7	158.7	150.8	2
199000905	0	1	1	104.1	35.9003	53.8016	286.2	193.9	3.4458E+02	0.0000E+00	158.7	158.7	150.8	2

Table 9-61: DEBUG.DAT - Data Record

No.	Variable	Description
1	YYYYJJJHH	Year-Julian Day-Hour for modeling period
2	SEC	Seconds (SSSS) for modeling period
3	IPNUM	Puff ID number
4	CD	Puff Code 1 = Puff within mixed layer & Gaussian 2 = Puff within mixed layer & uniform 3 = Puff above mixed layer & Gaussian 4 = Puff above mixed layer & uniform 5 = Puff currently above mixed layer (but previously below) & Gaussian 6 = Puff currently above mixed layer (but previously below) & uniform 11 = Slug within mixed layer & Gaussian 12 = Slug within mixed layer & uniform 13 = Slug above mixed layer & Gaussian 14 = Slug above mixed layer & uniform 15 = Slug currently above mixed layer (but previously below) & Gaussian 16 = Slug currently above mixed layer (but previously below) & uniform 99 = Puff/slug off computational grid
5	ZFNL	Puff height (m) at final rise
6	X	X-coordinate of puff or old slug-end (Met Grid Units)
7	Y	Y-coordinate of puff or old slug-end (Met Grid Units)
8	SIGYB	Sigma-y of puff or old slug-end (m)
9	SIGZB	Sigma-z of puff or old slug-end (m)
10	QM	Puff mass (g) of species 1 below mixing lid
11	QU	Puff mass (g) of species 1 above mixing lid
12	ZIMAX	Largest mixing height (m) for this puff (10000 m used for unlimited mixing)
13	RFLCTN	Reflecting lid height (m) for Gaussian distribution (10000 m used for unlimited mixing)
14	DPBL	Current surface boundary layer height (m)
15	JDSTAB	Stability class

16	Length	Emitted slug length (m)

9.15.8 Mass Flux List File (MASSFLX.DAT)

Mass flux results for those species selected in the control file are reported to the list file MASSFLX.DAT for each boundary that is contained in the boundary file FLUXBDY.DAT. MASSFLX.DAT is a formatted text file that identifies the CALPUFF version and level, echoes the 3-line title of the CALPUFF simulation, identifies the output as mass flux (g/s), sets out column headings to label each variable listed, and then reports the mass fluxes for each hour in the simulation. The boundaries are identified by the names provided in FLUXBDY.DAT, and for each boundary, the mass flux in and out across the boundary is reported. The date and time of each output record marks the time at the end of the hour, where midnight is hour zero of the new day (CALPUFF convention).

An example list file is provided in Table 9-62. The four boundaries are identified using the names provided in the boundary data file. Note that these boundaries do not surround a source, and enclose small regions so that the fluxes produced across each boundary are frequently both in and out as the puffs in this example pass through the enclosed regions.

Table 9-62: Sample Mass Flux List File (MASSFLX.DAT)

```
                                        CALPUFF       Version: 6.1           Level: 050915
***********************************************************************************************************************

CALPUFF test case run - 3 point sources
24-Hour Simulation using CALMET met. data
Gridded receptors on 17x17 20-km met grid

                             ---------------
                                Mass Flux
                                  (g/s)
                             ---------------

                                Square 1KM Box          Diamond 1KM Box         Square 5KM Box          Diamond 5KM Box
  Yr Day Hr  Sec Species        In         Out          In         Out          In         Out          In         Out

1988 189  1 0000 SO2          0.00000E+00 0.00000E+00 0.00000E+00 0.00000E+00 0.00000E+00 0.00000E+00 0.00000E+00 0.00000E+00
1988 189  2 0000 SO2          0.00000E+00 0.00000E+00 0.00000E+00 0.00000E+00 0.00000E+00 0.00000E+00 0.00000E+00 0.00000E+00
1988 189  3 0000 SO2          0.00000E+00 0.00000E+00 0.00000E+00 0.00000E+00 0.00000E+00 0.00000E+00 0.00000E+00 0.00000E+00
1988 189  4 0000 SO2          0.00000E+00 0.00000E+00 0.00000E+00 0.00000E+00 0.50000E+01 0.00000E+00 0.00000E+00 0.00000E+00
1988 189  5 0000 SO2          0.00000E+00 0.00000E+00 0.00000E+00 0.00000E+00 0.50000E+01 0.10000E+02 0.10000E+02 0.10000E+02
1988 189  6 0000 SO2          0.00000E+00 0.00000E+00 0.00000E+00 0.00000E+00 0.00000E+00 0.00000E+00 0.00000E+00 0.00000E+00
1988 189  7 0000 SO2          0.25000E+01 0.25000E+01 0.25000E+01 0.25000E+01 0.50000E+01 0.50000E+01 0.50000E+01 0.50000E+01
1988 189  8 0000 SO2          0.00000E+00 0.00000E+00 0.00000E+00 0.00000E+00 0.25000E+01 0.25000E+01 0.25000E+01 0.25000E+01
1988 189  9 0000 SO2          0.00000E+00 0.00000E+00 0.00000E+00 0.00000E+00 0.50000E+01 0.00000E+00 0.00000E+00 0.50000E+01
1988 189 10 0000 SO2          0.25000E+01 0.25000E+01 0.25000E+01 0.25000E+01 0.50000E+01 0.75000E+01 0.50000E+01 0.00000E+00
1988 189 11 0000 SO2          0.50000E+01 0.50000E+01 0.00000E+00 0.00000E+00 0.50000E+01 0.25000E+01 0.00000E+00 0.50000E+01
1988 189 12 0000 SO2          0.00000E+00 0.00000E+00 0.00000E+00 0.00000E+00 0.00000E+00 0.50000E+01 0.50000E+01 0.00000E+00
```

9.15.9 Mass Balance List File (MASSBAL.DAT)

Mass balance results for all species in the run are reported to the list file MASSBAL.DAT. MASSBAL.DAT is a formatted text file that identifies the CALPUFF version and level, echoes the 3-line title of the CALPUFF simulation, identifies the output as hourly mass balance (g), sets out column headings to label each variable listed, and then reports changes in the mass of each species in the entire modeling domain for each hour in the simulation. The date and time of each output record marks the time at the end of the hour, where midnight is hour zero of the new day (CALPUFF convention).

An example list file is provided in Table 9-63. The first five columns after the species name identify the hourly change in mass due to emissions, transport out of the domain, chemical transformation, and depletion (wet and dry deposition). The last three columns report the current mass totals at the end of the hour, and the portion that is in the surface mixed layer, and above the mixed layer. A single record is written for each species and each hour of the simulation.

Table 9-63: Sample Mass Balance List File (MASSBAL.DAT)

```
                                        CALPUFF        Version: 6.1            Level: 050915
**********************************************************************************************************************************
 CALPUFF Demonstration Run
 1800 sec Steps
 Emission & Sampling Limit 0.1 grid cell

                             -----------------------
                             Mass Balance (Timestep)
                                      (g)
                             -----------------------

                                        Advected                          Wet          Dry          Domain       Domain       Domain
Year Day Hr Sec   Species  Emitted        Out       Transformed  Depletion    Depletion       Total       Surface       Aloft

1990   9  4 1800  SO2      1.80000E+04  0.00000E+00 -9.17624E+00  0.00000E+00  1.97986E+00  1.79888E+04  1.79888E+04  0.00000E+00
1990   9  4 1800  SO4      0.00000E+00  0.00000E+00  1.37545E+01  0.00000E+00  6.53565E-05  1.37545E+01  1.37545E+01  0.00000E+00
1990   9  4 1800  NO       7.20000E+03  0.00000E+00 -6.78762E+03  0.00000E+00  0.00000E+00  4.12364E+02  4.12364E+02  0.00000E+00
1990   9  4 1800  NO2      1.80000E+03  0.00000E+00  1.01455E+04  0.00000E+00  1.37590E+00  1.19442E+04  1.19442E+04  0.00000E+00
1990   9  4 1800  HNO3     0.00000E+00  0.00000E+00  6.16501E-01  0.00000E+00  1.53495E-04  6.16350E-01  6.16350E-01  0.00000E+00
1990   9  4 1800  NO3      0.00000E+00  0.00000E+00  3.52697E+02  0.00000E+00  1.80578E-03  3.52695E+02  3.52695E+02  0.00000E+00
1990   9  4 1800  PM10     1.80000E+04  0.00000E+00  0.00000E+00  0.00000E+00  6.71997E-02  1.79999E+04  1.79999E+04  0.00000E+00
1990   9  5    0  SO2      1.80000E+04  0.00000E+00 -2.71013E+01  0.00000E+00  1.73306E+02  3.57884E+04  3.32807E+04  2.50777E+03
1990   9  5    0  SO4      0.00000E+00  0.00000E+00  4.06383E+01  0.00000E+00  1.04447E-02  5.43821E+01  4.74453E+01  6.93675E+00
1990   9  5    0  NO       7.20000E+03  0.00000E+00 -7.19998E+03  0.00000E+00  2.92154E-06  4.12365E+02  4.12365E+02  4.61526E-04
1990   9  5    0  NO2      1.80000E+03  0.00000E+00  1.05778E+04  0.00000E+00  8.39207E+01  2.42381E+04  2.25070E+04  1.73115E+03
1990   9  5    0  HNO3     0.00000E+00  0.00000E+00  1.07672E+00  0.00000E+00  1.33487E-02  1.67972E+00  1.52543E+00  1.54297E-01
1990   9  5    0  NO3      0.00000E+00  0.00000E+00  6.21701E+02  0.00000E+00  1.75748E-01  9.74221E+02  8.84016E+02  9.02054E+01
1990   9  5    0  PM10     1.80000E+04  0.00000E+00  0.00000E+00  0.00000E+00  5.17953E+00  3.59948E+04  3.34503E+04  2.54442E+03
1990   9  5 1800  SO2      1.80000E+04  0.00000E+00 -4.47896E+01  0.00000E+00  3.27171E+02  5.34165E+04  3.91207E+04  1.42958E+04
1990   9  5 1800  SO4      0.00000E+00  0.00000E+00  6.71752E+01  0.00000E+00  3.80584E-02  1.21518E+02  7.30463E+01  4.84721E+01
1990   9  5 1800  NO       7.20000E+03  0.00000E+00 -7.22879E+03  0.00000E+00  1.48103E-05  3.83576E+02  3.83573E+02  3.18023E-03
1990   9  5 1800  NO2      1.80000E+03  0.00000E+00  1.06269E+04  0.00000E+00  1.66231E+02  3.64988E+04  2.66292E+04  9.86964E+03
1990   9  5 1800  HNO3     0.00000E+00  0.00000E+00  1.33111E+00  0.00000E+00  2.52885E-02  2.98553E+00  2.01056E+00  9.74977E-01
1990   9  5 1800  NO3      0.00000E+00  0.00000E+00  6.14703E+02  0.00000E+00  4.94974E-01  1.58843E+03  1.06781E+03  5.20621E+02
1990   9  5 1800  PM10     1.80000E+04  0.00000E+00  0.00000E+00  0.00000E+00  1.42185E+01  5.39806E+04  3.94881E+04  1.44924E+04
```

9.16 OPTHILL

When the subgrid scale complex terrain (CTSG) option of the CALPUFF model is invoked, two groups of additional data must be prepared by the user: CTSG receptor and terrain information. These data may be provided in external files in the format used by CTDMPLUS (Section 9.12), or they may be entered into the CALPUFF control file. The purpose of the optimizer program OPTHILL is to provide the user with the means for calculating the set of terrain data that best characterizes each feature when these data are entered into the control file.

9.16.1 CTSG Terrain Information

CTSG requires information on the location, orientation, size, and shape of each terrain feature being modeled. The variables that contain this information are:

xc,yc	coordinates (km) of the center of the hill
thetah	orientation (deg) of major axis of hill (clockwise from north)
zgrid	height (m) of "grid-plane" of grid above mean sea level
relief	height (m) of crest of hill above the "grid-plane" elevation
expo (1)	hill-shape exponent for major axis
expo (2)	hill-shape exponent for minor axis
scale(1)	horizontal length scale (m) along major axis
scale(2)	horizontal length scale (m) along minor axis
axmax(1)	maximum allowed axis length (m) for major axis
axmax(2)	maximum allowed axis length (m) for minor axis

The profile of the terrain along each axis of the feature is prescribed by the following equation:

$$ht(x) = \left[\frac{1 - (x/axmax)^{expo}}{1 + (x/scale)^{expo}} \right] * \; relief \qquad (9\text{-}1)$$

where ht(x) is the height of the profile above the base of the feature, at a distance x from the peak (Figure 9-1).

The terrain profile-optimizing program (OPTHILL) computes the hill shape exponent (EXPO) and horizontal terrain length scale (SCALE) parameters from a user-entered terrain profile along each of two axes. This terrain profile defines the height of the surface of the hill at a number of distances from the center of the hill, along each axis. The OPTHILL program performs computations for one axis (i.e., major or minor axis) of the terrain feature at a time. Therefore, two runs of OPTHILL are necessary for each subgrid scale terrain feature.

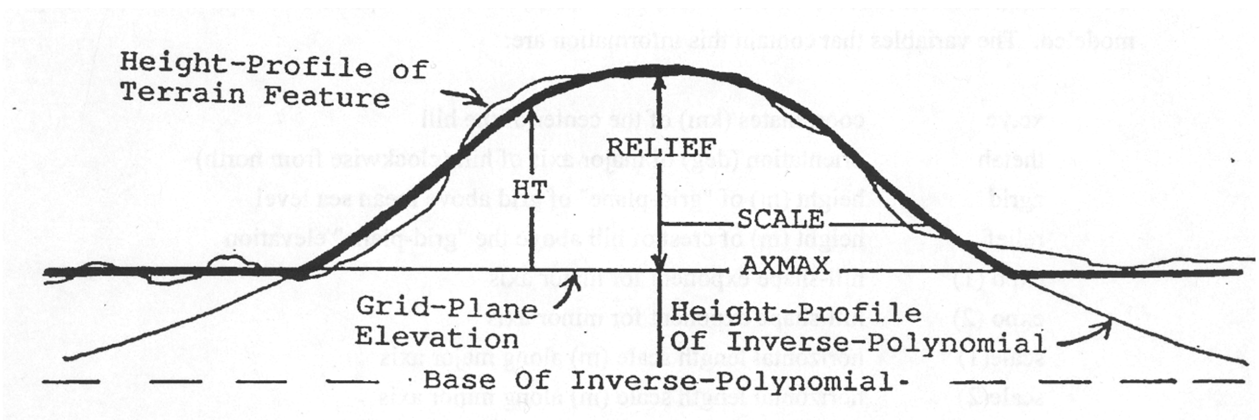

Figure 9-1: Profile of a terrain feature along one of its two axes. A best-fit inverse polynomial function describes this profile to CTSG.

The following procedure is recommended to determine the terrain inputs for the CALPUFF CTSG algorithm from a topographic map.

a. Identify the sub-grid terrain features to be modeled.

Such features will generally be small enough that they could be contained within one grid-square. This does not mean that they cannot straddle two or more squares. The features should be prominent, and possibly lie near source regions so that the additional computations required by CTSG are warranted in resolving important pollutant impact areas.

b. Decide on the orientation of the feature.

The orientation of the feature is generally evident if the feature is longer in one direction than another. If there is no dominant direction to the feature, model it as a symmetric feature, and choose an orientation of north.

c. Obtain height-profiles along each axis of the feature.

Choose an approximate center for the feature and draw axes through it (one axis should lie along the direction of orientation). Along each axis, measure the distance between approximate intersections of the axis with marked contours. The distances so measured should extend from the contour furthest to the south to the same contour furthest to the north (for a north-south axis). Divide each of these distances by two, and tabulate the results.

d. Identify the maximum elevation of the feature.

Take the peak elevation directly from the map.

e. Identify the elevation at the base of the feature.

Generally, the base of the feature will be that point at which the feature becomes indistinguishable from terrain variations around it.

f. Convert all elevations that were tabulated to heights above the base of the feature.

g. Use optimizer program (OPTHILL) to obtain shape parameters.

The "relief" parameter is just the peak elevation less the base elevation. The "axmax" value for each axis should be representative of the maximum extent of the feature along each axis at the elevation of the base of the feature. With these two variables fixed for each axis, the height-profile data from step c. can be put through OPTHILL to obtain "expo" and "scale" for each axis.

Table 9-64 summarizes the OPTHILL input and output filenames. OPTHILL requires a single input file (OPTHILL.INP) which contains the user's inputs describing the terrain profile, each height, and maximum axis length. The computed values of EXPO and SCALE for one axis of the hill are listed in the output list file (OPTHILL.LST). The format and contents of the OPTHILL control file are explained in Table 9-65.

9.16.2 Example OPTHILL Application

The OPTHILL program is an optimization that takes a value of "relief" and "axmax," and a sequence of pairs of (x,ht) values along an axis, and returns a value of "expo" and "scale" that prescribes the profile function that best matches the (x,ht) pairs. Its use is illustrated by the following example.

Figure 9-2 shows the terrain surrounding the site of EPA's "Full-Scale Plume Study" (FSPS) that was performed in the Truckee River Valley near Reno, NV (Strimaitis et al., 1985), as part of the Complex Terrain Model Development Program. Nocturnal flow in this valley is frequently channeled by the high terrain to the north and south of the Tracy power plant. Elevations typical of nocturnal plume heights (4600-4800 ft. MSL) are emphasized on the figure. Given the predominant flow to the east during stable conditions, there is potential for plume impact on the feature just northeast of the plant. This feature, marked by axes in Figure 9-2, was named "Beacon Hill" during the study.

Following the procedures outlined above, axes were drawn over the feature and distances between fixed contour elevations were tabulated. After subtracting the elevation above sea level of the base of the feature (the floor of the river valley), these data were entered into two files. Table 9-66 displays the contents of both files. The files (axis1.inp and axis2.inp) contain "relief" and the value for "axmax" for each axis of the hill, followed by five pairs of (x,ht) values. The first record of each file is reserved for comments to identify the data. Values for "relief" and "axmax" are free-format, and should be entered anywhere in the open space provided on the next two lines. Pairs of (x,ht) should be entered right after the next comment record.

OPTHILL must be invoked separately for each of the two axes of the hill. This is accomplished by renaming one input file (e.g., axis1.inp) to the OPTHILL input control file name (OPTHILL.INP), executing the program, renaming the output file (OPTHILL.LST) to a new name (e.g., axis1.lst), and then repeating these steps for the second axis of the hill. The output files produced by OPTHILL for the current example are presented in Table 9-67 and 9-68. The output file lists the final values of the profile parameters, and it also lists the profile data provided by the user along with the corresponding data computed from the profile parameters.

Table 9-64: OPTHILL Input and Output Files

Unit	File Name	Type	Format	Description
5	OPTHILL.INP	input	formatted	Control file containing user inputs
6	OPTHILL.LST	output	formatted	List file (line printer output file)

Table 9-65: OPTHILL Control File Inputs (OPTHILL.INP)

Record	Variable No.	Variable Name	Columns	Type of Format	Description
1	1	TITLE(15)	1-60	15A4	60 character title
2	1	RELIEF	*	real	Height (m) of the crest of the hill above the grid elevation
3	1	AXMAX	*	real	Maximum allowed axis length (m) for the axis (major or minor) being evaluated
4	1	-	*	-	This record is skipped by the program. May contain optional text data (see example)
5	1	DIST	*	real	Distance-height pairs describing the profile of the terrain. Units: m
5	2	HGT	*	real	Distance-height pairs describing the profile of the terrain. Units: m

* Entered in FORTRAN free format.

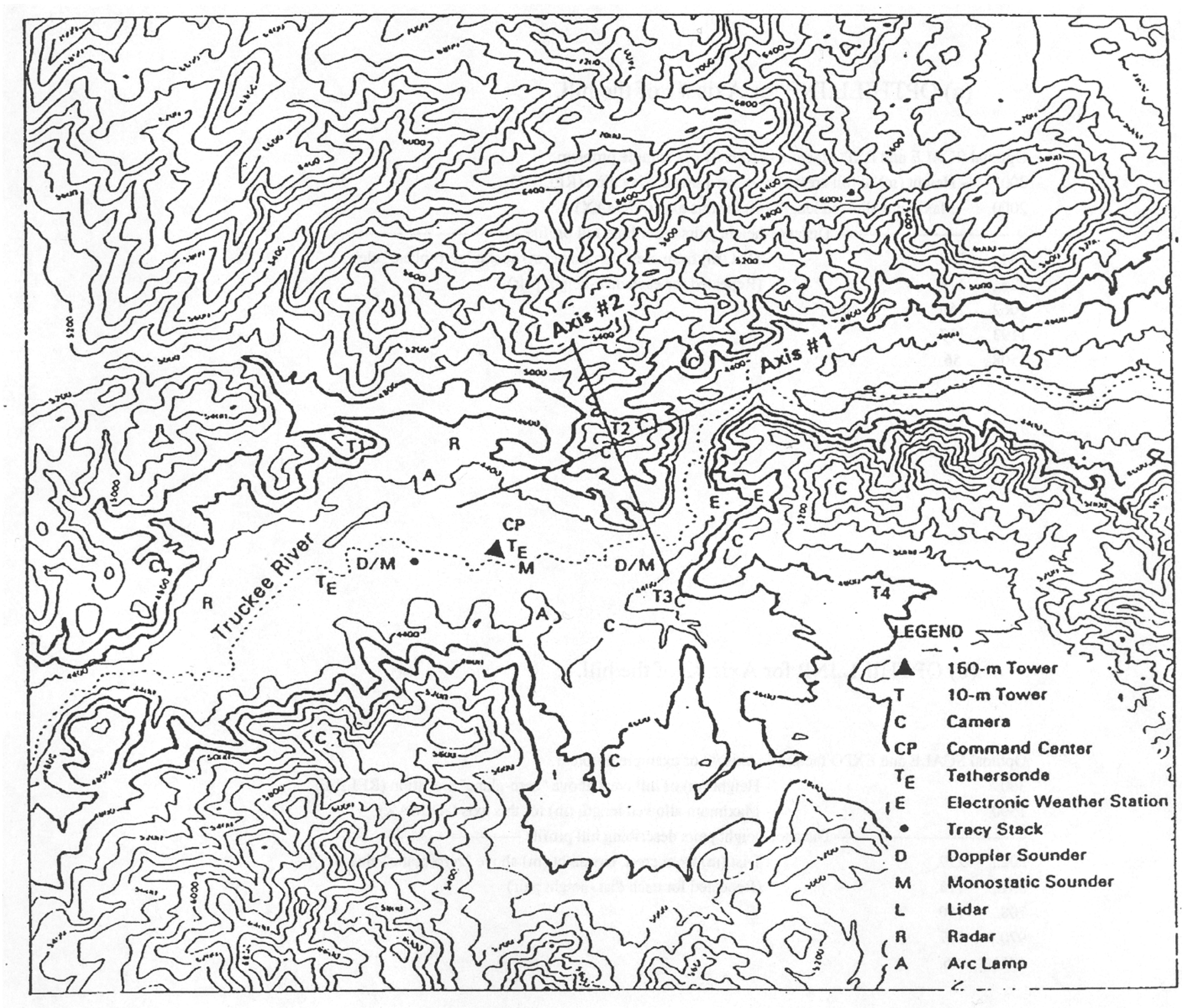

Figure 9-2: Map of terrain surrounding the site of the FSPS, illustrating the selection and characterization of a terrain feature for CTSG modeling.

Table 9-66: Sample OPTHILL Input Files

(a) OPTHILL.INP for Axis #1 of the hill.

```
Optimal SCALE and EXPO factors -- Axis #1 of example problem
300.    - Height (m) of hill crest above "zero-plane" elevation (RELIEF)
2000.   - Maximum allowed length (m) for this axis (AXMAX)
--------------------------------- Distance-height pairs describing hill profile -------------------------------
564.,   239.                    - Dist.(m) from crest, terrain ht (m) above "zero-plane" elev.
826.,   178.                      (Repeated for each dist.-height pair)
1062.,  150.
1193.,  117.
1508.,   56.
```

(b) OPTHILL.INP for Axis #2 of the hill.

```
Optimal SCALE and EXPO factors -- Axis #2 of example problem
300.                            - Height (m) of hill crest above "zero-plane" elevation (RELIEF)
1500.                           - Maximum allowed length (m) for this axis (AXMAX)
--------------------------------- Distance-height pairs describing hill profile -------------------------------
302.,   239.                    - Dist.(m) from crest, terrain ht (m) above "zero-plane" elev.
551.,   178.                      (Repeated for each dist.-height pair)
708.,   150.
970.,   117.
1311.,   56.
```

Table 9-67: OPTHILL Output File for Axis #1 of Sample Hill

```
***  Optimal SCALE and EXPO factors -- Axis #1 of example problem ***

        EVOL TIME LIMIT =       60. SECONDS        SKIP = 10

NUMBER OF PARAMETERS FOR THIS STUDY :  4

PARAMETER        START VALUE      STEP CONTROL     LOWER LIMIT      UPPER LIMIT
---------        -----------      -----------      ----------       ----------

1 RELIEF         0.3000E+03       0.0000E+00       0.3000E+03       0.3000E+03
2 AXMAX          0.2000E+04       0.0000E+00       0.2000E+04       0.2000E+04
3 EXPO           0.2000E+01       0.2000E+01       0.1000E+00       0.1000E+02
4 SCALE          0.2000E+04       0.1000E+04       0.2000E+02       0.2000E+06


CALCULATIONS STARTED



RETURN VALUE:  2 NORMAL RETURN    FUNCTION VALUE: 0.50303

PARAMETER VALUES:
             RELIEF   =    300.00000
             AXMAX    =   2000.00000
             EXPO =      1.90651
             SCALE    =   1522.94500


Distance  Height    Fitted Value

  564.0    239.0      237.4
  826.0    178.0      186.4
 1062.0    150.0      139.9
 1193.0    117.0      115.5
 1508.0     56.0       63.0
```

Table 9-68: OPTHILL Output File for Axis #2 of Sample Hill

```
.***  Optimal SCALE and EXPO factors -- Axis #2 of example problem ***

         EVOL TIME LIMIT =       60. SECONDS        SKIP = 10

NUMBER OF PARAMETERS FOR THIS STUDY :  4

PARAMETER  START VALUE   STEP CONTROL  LOWER LIMIT   UPPER LIMIT
---------- -----------   -----------   ----------    -----------

1 RELIEF   0.3000E+03    0.0000E+00    0.3000E+03    0.3000E+03
2 AXMAX    0.1500E+04    0.0000E+00    0.1500E+04    0.1500E+04
3 EXPO     0.2000E+01    0.2000E+01    0.1000E+00    0.1000E+02
4 SCALE    0.1500E+04    0.7500E+03    0.1500E+02    0.1500E+06


CALCULATIONS STARTED



RETURN VALUE:  2         NORMAL RETURN             FUNCTION VALUE: 2.17504

PARAMETER VALUES:
           RELIEF  =    300.00000
           AXMAX   =   1500.00000
           EXPO    =      1.23912
           SCALE   =   2895.90200


Distance  Height    Fitted Value

  302.0    239.0      244.0
  551.0    178.0      189.1
  708.0    150.0      154.7
  970.0    117.0       99.5
 1311.0     56.0       33.5
```

This process is simplified somewhat if a batch file is used to manage the filenames. One such batch file for DOS (RUNOPT.BAT) is included with the testcase. It requires three filenames as arguments:

RUNOPT file1 file2 file3

where

file1	OPTHILL.EXE	executable program file
file2	user.inp	input file
file3	user.out	output file

The batch file copies file2 to OPTHILL.INP, runs OPTHILL.EXE which creates OPTHILL.LST, then renames OPTHILL.LST to the name supplied as file3. For the example above, axis #1 would be processed by typing the command:

RUNOPT OPTHILL.EXE AXIS1.INP AXIS1.LST

With these results, hill information that is independent of the choice of coordinate system and the modeling grid for the wind model can be specified:

xc,yc (m)	(depends on choice of coordinates)
thetah (deg)	69°
zgrid (m)	(depends on grid for wind model)
relief (m)	300.
expo (1)	1.91
expo (2)	1.24
scale (1) (m)	1523.
scale (2) (m)	2896.
axmax (1) (m)	2000.
axmax (2) (m)	1500.

Note that scale(2) is almost twice scale(1), even though axis 1 corresponds to the longer axis of the hill. This can occur because the "scale" parameter is a property of the entire inverse-polynomial function (Equation 9-1), rather than just the portion of the function that is fit to the profile of the terrain. In Figure 9-1, the shape of the terrain might best conform to the upper 10% of the polynomial function, in which case the "scale" parameter would exceed "axmax." In this example application of the OPTHILL program, we see that axmax(2) is substantially less than axmax(1), whereas scale(2) exceeds scale(1), indicating that a comparatively <u>smaller</u> portion of the polynomial function represents the terrain profile along the minor axis.

10. POSTPROCESSORS

After making one or more CALPUFF simulations, concentrations and/or deposition fluxes for each species at each receptor exist in several unformatted data files. A single CALPUFF application can produce four such files: CONC.DAT (concentrations in g/m^3); WFLUX.DAT (wet deposition fluxes in $g/m^2/s$); DFLUX.DAT (dry deposition fluxes in $g/m^2/s$); and VISB.DAT (relative humidity for visibility analyses). When a period is simulated as a sequence of shorter-period CALPUFF applications, as when a year is simulated in chunks of about four weeks, for example, each of the shorter runs produces its own set of files. When certain groups of sources need to be characterized separately, individual CALPUFF applications are required for each group, again producing a set of data files for each application. Similarly, certain species may be modeled separately, producing more output data files. Data in all of these files must be processed to obtain results that can be used to characterize air quality impacts in terms of multiple-hour averages, increment consumption, threshold exceedences, visibility reduction, total deposition, and so forth. Postprocessors designed for this work include:

APPEND is a postprocessor which appends two or more sequential CALPUFF concentration, wet flux, dry flux or relative humidity (visibility) files in time.

CALSUM is a postprocessor which sums and scales concentrations or wet/dry fluxes from two or more source groups from different CALPUFF runs.

POSTUTIL is a postprocessor which operates on one or more CALPUFF concentration and wet/dry flux files to create new species as weighted combinations of modeled species; to sum wet and dry deposition fluxes; to merge species from different runs into a single output file; to sum and scale results from different runs; to repartition nitric acid/nitrate based on total available sulfate and ammonia; and to add time/space-varying background.

CALPOST is a postprocessor which operates on one CALPUFF concentration or wet/dry deposition flux file to perform visibility calculations; to average and summarize concentrations and deposition fluxes; to determine ranked concentration/flux/light extinction values; and to create list files and plot files.

These postprocessors are described in the following sections.

10.1 APPEND

The APPEND program is designed to combine a set of sequential CALPUFF output data files into a single file with the same format, covering the entire period of the original collection of files. The files combined must be of the same type, containing concentrations, wet deposition fluxes, dry deposition fluxes, or relative humidity data. The periods contained in the files should either overlap, or meet exactly (files start with the time period that follows the last period in the preceding file).

Table 10-1 lists the input and output files for one application of APPEND. Both the control file name (APPEND.INP) and the list file name (APPEND.LST) are set in the program, so the user cannot change these. All CALPUFF output file names must be provided by the user, and these are placed in the control file. The control file structure is listed in Table 10-2, and a sample control file is listed in Table 10-3.

To run this program, place the executable and the control file (edited to reflect your application) in the same directory or folder, and enter the following command-line:

```
APPEND
```

The program will open the control file for your application, and follow the instructions. Messages appear on the screen as the program runs, and full documentation for the run is written to the list file. A sample list file is presented in Table 10-4.

Table 10-1: APPEND Input and Output Files

Unit	File Name	Type	Format	Description
io5	APPEND.INP	input	formatted	Control file containing user inputs
io6	APPEND.LST	output	formatted	List file containing APPEND application information
io10	MODEL.DAT	output	unformatted	CALPUFF output data file containing modeled concentration or deposition flux or relative humidity data, containing all periods
io21	MODEL1.DAT	input	unformatted	First sequential CALPUFF output data file containing modeled concentration or deposition flux or relative humidity data
io21 +(n-1)	MODELn.DAT	input	unformatted	Last of "n" sequential CALPUFF output data files containing modeled concentration or deposition flux or relative humidity data

Table 10-2: APPEND Control File Structure

Record No.	Variable No.	Variable	Type	Description	Sample Values
1	1	ITYPE	integer	File type (1=concentration/flux, 2=relative humidity/visibility)	1
2	1	NFILES	integer	Number of files to append	3
3	1	CFILE (1)	character*70 array	File name for first CALPUFF data file in the sequence that will be appended	RUN1.CON
4	1	NSKIP (1)	integer array	Number of periods to skip over at the start of file 1	0
4	2	NPDS (1)	integer array	Total number of periods to read from file 1 (including NSKIP)	240
...	...	...	...	...	...
1+2*NFILES	1	CFILE (NFILES)	character*70 array	File name for last CALPUFF data file in the sequence that will be appended	RUN3.CON
2+2*NFILES	1	NSKIP (NFILES)	integer array	Number of periods to skip over at the start of the last file	0
2+2*NFILES	2	NPDS (NFILES)	integer array	Total number of periods to read from the last file (including NSKIP)	240
3+2*NFILES	1	CFILOUT	character*70 array	File name for the new CALPUFF data file (all periods)	CONC.DAT
4+2*NFILES	1	TITLEO (1)	character*80 array	Title record #1 for output data file	-
5+2*NFILES	1	TITLEO (2)	character*80 array	Title record #2 for output data file	-

6+2* NFILE S	1	TITLEO (3)	character*8 0 array	Title record #3 for output data file	-

Table 10-3: Sample APPEND Control File (APPEND.INP)

```
1                  - File type (1=conc/flux files, 2=RH/visibility files)
2                  - Number of input data files
cpuf.con
0, 2
cpuf2.con
2, 4
cpufapp.con
APPEND Demonstration
Reconstructing CALPUFF concentration file
Combine 2 hours from first and 2 hours from second file
```

Table 10-4: Sample APPEND List File (APPEND.LST)

```
APPEND -- Version: 2.34       Level: 051122

  Number of input files (NFILES) =  2

  Names of input files:

     No.   1   Filename: cpuf.con
     No.   2   Filename: cpuf2.con


 Output Filename: cpufapp.con

  Title lines on new output file:
     APPEND Demonstration
     Reconstructing CALPUFF concentration file
     Combine 2 hours from first and 2 hours from second file

  Title lines from file No.:  1
     CALPUFF Demonstration Run



  Title lines from file No.:  2
     CALPUFF Demonstration Run



  Selected header record data
    CMODEL: CALPUFF
    VER:     5.727
    LEVEL:   050309
    IBYR:     1990
    IBJUL:    9
    IBHR:     4
    IBSEC:    0
    NSECDT:   3600
    XBTZ:     5.00000000
    IRLG:     4
    IAVG:     1
    PMAP:    UTM
    DATUM:   NAS-C
    NX:       99
    NY:       99
    DXKM:     1.00000000
    DYKM:     1.00000000
    IONE:     1
    XORIGKM:  310.000000
    YORIGKM:  4820.00000
    NSSTA:    5
    IBCOMP:   1
    IECOMP:   99
    JBCOMP:   1
    JECOMP:   99
```

Table 10-4 (Concluded)
Sample APPEND List File (APPEND.LST)

```
    IBSAMP:   29
    IESAMP:   48
    JBSAMP:   40
    JESAMP:   70
    MESHDN:   1
    NREC:     0
    NCTREC:   0
    LSGRID:   T
    LCOMPR:   T
    NSPOUT:   7
    MSOURCE:  0

 File      NPTS     NAREAS     NLINES     NVOLS
    1         1          0          0         0
    2         1          0          0         0

 SPECIES: SO2           1  SO4           1  NO            1  NO2           1  HNO3          1
NO3           1  PM10          1

  File:  1  Skipping:  0  Writing:  2
  File:  2  Skipping:  2  Writing:  2
 Skipping YRE,DAYE,HRE,SECE =  1990  9 5 0  in File:  2
 Skipping YRE,DAYE,HRE,SECE =  1990  9 6 0  in File:  2

 Number of periods processed:  4
```

10.2 CALSUM

The CALSUM program is designed to combine a set of CALPUFF output data files for individual sources or source groups into a single file with the same format. The concentrations or deposition fluxes in each file may be scaled using a linear operator of the form (a*X+b), where 'X' represents either the concentration or the flux, "a" is the multiplicative constant, and "b" is the additive constant (g/m^3 or $g/m^2/s$). The files combined must be of the same type, containing either concentrations, wet deposition fluxes, or dry deposition fluxes. The periods contained in the files must be identical.

Table 10-5 lists the input and output files for one application of CALSUM. Both the control file name (CALSUM.INP) and the list file name (CALSUM.LST) are set in the program, so the user cannot change these. All CALPUFF output file names must be provided by the user, and these are placed in the control file. The control file structure is listed in Table 10-6, and a sample control file is listed in Table 10-7.

To run this program, place the executable and the control file (edited to reflect your application) in the same directory or folder, and enter the following command-line:

```
CALSUM
```

The program will open the control file for your application, and follow the instructions. Messages appear on the screen as the program runs, and full documentation for the run is written to the list file. A sample list file is presented in Table 10-8.

Table 10-5: CALSUM Input and Output Files

Unit	File Name	Type	Format	Description
io5	CALSUM.INP	input	formatted	Control file containing user inputs
io6	CALSUM.LST	output	formatted	List file containing CALSUM application information
io10	MODEL.DAT	output	unformatted	CALPUFF output data file containing modeled concentration or deposition flux data for all sources
io21	MODEL1.DAT	input	unformatted	First CALPUFF output data file containing modeled concentration or deposition flux data for first group of sources
io21 +(n-1)	MODELn.DAT	input	unformatted	Last of "n" CALPUFF output data files containing modeled concentration or deposition flux data for source group "n"

Table 10-6: CALSUM Control File Structure

Record No.	Variable No.	Variable	Type	Description	Sample Values
1	1	NFILES	integer	Number of files to combine	3
2	1	CFILE (1)	character*70 array	File name for first CALPUFF data file that will be combined	SRC1.CON
...	...	...	...	...	...
1+ NFILES	1	CFILE (NFILES)	character*70 array	File name for last CALPUFF data file that will be combined	SRC3.CON
2+ NFILES	1	CFILOUT	character*70 array	File name for the new CALPUFF data file (all sources)	CONC.DAT
3+ NFILES	1	LCOMPRO	logical	Data compression used in output file? (T/F)	T
4+ NFILES	1	NSPEC	integer	Number of species in each of the files	3
4+ NFILES +1	1 to 2*NSPEC	ASCALE, BSCALE	real array	Scaling factors a,b for each species for the first file that will be combined (B in g/m^3 or $g/m^2/s$)	2.0,0.0001, 2.0,0.0001, 2.0,0.0001
...	...	...	...	...	...
4+2* NFILES	1 to 2*NSPEC	ASCALE, BSCALE	real array	Scaling factors a,b for each species for the last file that will be combined (B in g/m^3 or $g/m^2/s$)	1.0,0.000, 1.0,0.000, 1.0,0.000
5+2* NFILES	1	TITLEO (1)	character*80 array	Title record #1 for output data file	-
6+2*	1	TITLEO	character*8	Title record #2 for output data file	-

NFILES		(2)	0 array		
7+2* NFILES	1	TITLEO (3)	character*80 array	Title record #3 for output data file	-

Table 10-7: Sample CALSUM Control File (CALSUM.INP)

```
2                                                                                - Number of files
cpuf.con                                                                         - INPUT file name
cpuf2.con                                                                        - INPUT file name
cpufsum.con                                                                      - OUTPUT file name
T                                - Compression flag for OUTPUT file (T, F)
7                                - Number of species
.5 .0 .5 .0 .5 .0 .5 .0 .5 .0 .5 .0 .5 .0   - Scaling factors (aX+b) for each species and file
.5 .0 .5 .0 .5 .0 .5 .0 .5 .0 .5 .0 .5 .0    - Scaling factors (file #2)
CALSUM output file - Example CALPUFF Application
Sum of concentrations from 2 identical CALPUFF Files
Scale values by 0.5 before summing
```

Table 10-8: Sample CALSUM List File (CALSUM.LST)

```
CALSUM -- Version: 1.33       Level: 051122
 NFILES =  2

 Names of input files:

     No.   1   Filename: cpuf.con
     No.   2   Filename: cpuf2.con

 Name of output file:

        Output Filename: cpufsum.con

 Output file compressed? (LCOMPRO) =  T


 Scaling factors (of form X(new) = X(old)*ASCALE + BSCALE) for each species

 No. species (NSPEC) =      7
 File:     1(ASCALE, BSCALE):
      5.00000E-01       0.00000E+00 5.00000E-01       0.00000E+00 5.00000E-01       0.00000E+00
5.00000E-01       0.00000E+00 5.00000E-01       0.00000E+00
      5.00000E-01       0.00000E+00 5.00000E-01       0.00000E+00
 File:     2(ASCALE, BSCALE):
      5.00000E-01       0.00000E+00 5.00000E-01       0.00000E+00 5.00000E-01       0.00000E+00
5.00000E-01       0.00000E+00 5.00000E-01       0.00000E+00
      5.00000E-01       0.00000E+00 5.00000E-01       0.00000E+00

 BSCALE is in grams/m**3

 NOTE: When using BSCALE to add a constant background concentration
       this is normally done by apply BSCALE to one CALPUFF
       output file only, with SCALE=0 for the other files

 Title lines on new output file:
     CALSUM output file - Example CALPUFF Application
     Sum of concentrations from 2 identical CALPUFF Files
     Scale values by 0.5 before summing

 Title lines from file No.:  1
     CALPUFF Demonstration Run



 Title lines from file No.:  2
     CALPUFF Demonstration Run
```

Table 10-8 (Concluded)
Sample CALSUM List File (CALSUM.LST)

```
Data from header records of File #1
    CMODEL: CALPUFF
    VER:     5.727
    LEVEL:   050309
    IBYR:     1990
    IBJUL:    9
    IBHR:     4
    IBSEC:    0
    NSECDT:   3600
    XBTZ:     5.00000000
    IRLG:     4
    IAVG:     1
    PMAP:    UTM
    DATUM:   NAS-C
    NX:       99
    NY:       99
    DXKM:     1.00000000
    DYKM:     1.00000000
    IONE:     1
    XORIGKM:  310.000000
    YORIGKM:  4820.00000
    NSSTA:    5
    IBCOMP:   1
    IECOMP:   99
    JBCOMP:   1
    JECOMP:   99
    IBSAMP:   29
    IESAMP:   48
    JBSAMP:   40
    JESAMP:   70
    MESHDN:   1
    NREC:     0
    NCTREC:   0
    LSGRID:   T
    NSPOUT:   7
    MSOURCE:  0

 File      NPTS     NAREAS     NLINES     NVOLS
    1         1          0          0         0
    2         1          0          0         0

 SPECIES: SO2           1  SO4           1  NO            1  NO2           1  HNO3          1
NO3           1  PM10          1

 Sources identified in all files processed
 Source type  1
 STK1
 STK1

 Number of periods processed:  4
```

10.3 POSTUTIL

POSTUTIL operates on one or more CALPUFF concentration or wet/dry deposition flux files to create a new file that can be analyzed by CALPOST. Species in the new file may include all species in these files, they may be a subset of these, or they may be new species constructed as weighted combinations of the modeled species. If nitrates are modeled, the partition between nitric acid and nitrate can be recalculated based on total available sulfate and ammonia. Specific capabilities and options include:

- User-selected processing period.
- User-selected chemical species to process.
- User-selected chemical species to output.
- User-defined (new) chemical species to construct and output (e.g., total S and Total N deposition).
- Option to sum wet and dry deposition fluxes to a total flux species.
- Option to repartition nitric acid/nitrate based on total available sulfate and ammonia.
- Option to scale all concentration/deposition flux data by means of a linear function of the form: a*X + b (where X is concentration or deposition, and a,b are user-supplied constants).
- Option to add an hourly, receptor-specific background concentration/deposition flux.

Typical uses for POSTUTIL include:

- Scaling and summing results obtained from CALPUFF applications to different source groups. This is similar to CALSUM, but the files that are combined do not need to contain the same species. Negative scale factors can be used to obtain difference fields suitable for assessing increment consumption.
- Combining species sets modeled in different CALPUFF applications, as when MESOPUFF II chemical transformation is modeled in one CALPUFF application, and secondary organic aerosol (SOA) formation is modeled in another CALPUFF application (both would be needed in one file to assess visibility).
- Summing wet and dry deposition fluxes to obtain the total deposition flux as a new species.
- Computing the total sulfur and the total nitrogen deposition flux associated with ammonium sulfate and ammonium nitrate.
- Repartitioning nitrates to be consistent with the total available sulfate and ammonia due to all sources and background, prior to assessing visibility with CALPOST.

Table 10-9 lists the default name of each input and output file associated with POSTUTIL.

Table 10-9: POSTUTIL Input and Output Files

Unit	Default File Name	Type	Format	Description
in2	POSTUTIL.INP	input	formatted	Control file containing user inputs
in1	CALPUFF.DAT	input	unformatted	First CALPUFF format data file containing modeled concentration or deposition flux data
in1 +(n-1)	(none)	input	unformatted	Last of "n" CALPUFF format data files containing modeled concentration or deposition flux data
in4	MET.DAT	input	unformatted	Optional file of meteorological data from CALMET
in5	MET_1D.DAT	input	unformatted	Optional file of meteorological data as a 1-dimensional file
in5	RHUMD.DAT	input	unformatted	Optional file of surface relative humidity as a 2-dimensional file (output of CALPUFF)
in6	TEMP.DAT	input	unformatted	Optional file of surface temperature as a 2-dimensional file (output of CALPUFF)
in7	RHOAIR.DAT	input	unformatted	Optional file of surface density as a 2-dimensional file (output of CALPUFF)
in8	BCKGALM.DAT	input	unformatted	Optional file of background concentrations such as SO_4, NO_3, HNO_3 and TNH_3
io1	POSTUTIL.LST	output	formatted	List file containing POSTUTIL application information
io2	MODEL.DAT	output	unformatted	Data file containing POSTUTIL results (CALPUFF format)

The name and full path of each file (except one) is assigned in the control file. The exception, the control filename itself, is assigned on the command line. For example, on a DOS system,

POSTUTIL d:\MYWORK\UTIL1.INP

will execute the POSTUTIL code in the current working directory, and read the input and output filenames for the current run from the control file UTIL1.INP in the directory d:\MYWORK. If the control filename is not specified on the command line, the default control filename (i.e., POSTUTIL.INP in the current working directory) will be used. The total number of characters in the path and filename can be up to 132 characters.

The POSTUTIL control file is configured using any standard text editor (e.g., NOTEPAD). It uses the general CALPUFF control file structures, containing several input groups with module inputs set within a pair of special delimiter characters (!). All documentation associated with these inputs is written outside of these delimiters. A description of each input variable is shown in Table 10-10.

A sample control file that illustrates a common POSTUTIL application for obtaining total sulfur and total nitrogen deposition fluxes is provided in Table 10-11. The top of the control file contains three lines that are reserved for identifying the application. These lines are written to the output file, and become part of the documentation in subsequent processing.

Input Group: 0

Input Group 0 identifies the input and output files for the application. The output consists of a list file that documents how this application of POSTUTIL is configured, and a data file that is identical in form to the binary data files created by CALPUFF. In this sample, the data file is given the generic name 'cpuf.flx' (!UTLDAT = CPUF.FLX!) to indicate that wet and dry fluxes are summed, and that total sulfur and total nitrogen are added to the list of species in the file. The list file is given the default name (!UTLLST = POSTUTIL.LST!). More specific names should be used in typical applications.

Input files include one or more CALMET meteorological data files and one or more CALPUFF binary files. A CALMET file is not needed for this application because no nitrate partitioning will be calculated (MNITRATE=0), but is included in the control file to illustrate the format. Two CALPUFF binary files are needed for this application: one for the dry deposition flux, and one for the wet deposition flux. Therefore !NFILES = 2! and two filenames are provided in Subgroup 0b:

```
! MODDAT =WFLX.DAT   !   !END!
! MODDAT =DFLX.DAT   !   !END!
```

Table 10-10: POSTUTIL Control File Inputs - Input Group 0

Input and Output File Names

Variable	Type	Description	Default
UTLLST	character*132	File name of list file of information output from POSTUTIL application, including path if desired	POSTUTIL.LST
UTLDAT	character*132	File name of CALPUFF format data file created by POSTUTIL application, including path if desired	MODEL.DAT
BCKGALM	character*132	File name of background data in CALPUFF output format containing the following species NO_3, SO_4, HNO_3 and TNH_3	BCKGALM.DAT
NFILES	integer	Number of CALPUFF data files input for processing	1
METFM	integer	Type of meteorological data file to use 0 (3D file in CALMET format), 1 (1D file) or 2 (three 2D files output of CALPUFF).	0
NMET	integer	Number of CALMET data files or other meteorological data files input for processing	0
LCFILES	logical	Control flag for converting file names to lower case if T, or to upper case if F	T
UTLMET	character*132	NMET file names of CALMET data files needed by POSTUTIL application if METFM = 0, including path if desired (used only if MNITRATE = 1 or 3)	MET.DAT
MET1D	character*132	File name of a 1D meteorological file needed by POSTUTIL application if METFM=1, including path if desired (used only if MNITRATE = 1 or 3)	MET_1D.DAT
M2DRHU	character_132	File name of a 2D relative humidity file created by CALPUFF needed by POSTUIL application if METFM=2, including path if desired (used only if MNITRATE=1 or 3)	M2DRHU
M2DTMP	character_132	File name of a 2D temperature file created by CALPUFF needed by POSTUIL application if METFM=2, including path if desired (used only if	M2DTMP

		MNITRATE=1 or 3)	
M2DRHO	character_132	File name of a 2D density file created by CALPUFF needed by POSTUIL application if METFM=2, including path if desired (used only if MNITRATE=1 or 3)	M2DRHO
MODDAT	character*132	NFILES file names of CALPUFF data files processed by POSTUTIL application, including path if desired	CALPUFF.DAT

Table 10-10 (Continued)
POSTUTIL Control File Inputs - Input Group 1
General Run Control Parameters

Variable	Type	Description	Default
ISYR	integer	Starting year of data to process (four digits)	-
ISMO	integer	Starting month	-
ISDY	integer	Starting day	-
ISHR	integer	Starting hour (0-23). Uses ending hour convention (e.g., Hour 1 refers to the period from 0:00 - 1:00).	-
NPER	integer	Number of periods to process	-
NSPECINP	integer	Number of modeled species to process from input CALPUFF data files	-
NSPECOUT	integer	Number of species to write to output CALPUFF format data file	-
NSPECCMP	integer	Number of new species computed from the modeled species that are processed (must be no greater than NSPECOUT)	-
MDUPLCT	integer	Stop run if any of the NSPECINP species names are found in more than one data file 0 = no (i.e., duplicate species are summed) 1 = yes (i.e., run is halted)	0
NSCALED	integer	Number of input CALPUFF data files for which scaling factors are provided in Group 2d by species (must be no greater than NFILES)	0

Table 10-10 (Continued)
POSTUTIL Control File Inputs - Input Group 1
Control Parameters (continued) for HNO3/NO3 repartition

Variable	Type	Description	Default
MNITRAT E	integer	Option to repartition HNO3/NO3 concentrations prior to performing other actions (does not alter deposition fluxes) 0 = no 1 = yes, for all sources combined (requires MET.DAT) 2 = yes, for a source group, based on ratio of species HNO3ALL/NO3ALL 3 = yes, for ALM application in one step	0
NH3TYP	integer	Option to select the input source of Ammonia (NH3 or TNH3) for either MNITRATE=1 or MNITRATE=3 0 = Ammonia from concentration file is used alone 1 = Ammonia listed in BCKNH3 or BCKTNH3 will be added to Ammonia from the concentration file 2 = Ammonia from background concentration file BCKGALM will be added to Ammonia from the concentration file 3 = Ammonia listed in BCKNH3 or NCKTNH3 will be used alone 4 = Ammonia from background concentration file BCKGALM will be used alone	No default
BCKNH3	real	Background ammonia concentration (ppb) used to repartition nitrates when ammonia is NOT a modeled species (used only when MNITRATE=1 or 3 and BCKTNH3 is not used)	-999 (not used)
BCKTNH3	real	Background total ammonia concentration (ppb) used to repartition nitrates when ammonia is NOT a modeled species (used only when MNITRATE =1 or 3 and BCKNH3 is not used)	-999 (not used)

Table 10-10 (Concluded)
POSTUTIL Control File Inputs - Input Group 2
Species Processing Information

Variable	Type	Description	Default
ASPECI	character*12	Subgroup 2a: Input species names to process (NSPECINP names)	-
ASPECO	character*12	Subgroup 2b: Output species names (NSPECOUT names)	-
CSPECCMP	character*12	Subgroup 2c: (if NSPECCMP > 0) Names for new species created (NSPECCMP names), followed by the scaling factor for each of the NSPECINP species that are processed (use species names to assign scaling factors)	-
MODDAT	character*70	Subgroup 2d: (if NSCALED > 0) File name for each input CALPUFF data file that is scaled before being processed (NSCALED names must be a subset of the MODDAT file names provided in Group 0)	-
A,B	real	Subgroup 2d: (if NSCALED > 0) Scaling constants for linear scaling of the form (A*x+B). Provide NSCALED groups of A,B values, one group per input CALPUFF data file that is scaled. Each group, consistes of the MODDAT identifying the file, and the pair of scaling parameters for each species in the file.	1.0, 0.0

Table 10-11: Sample POSTUTIL Control File (POSTUTIL.INP)

Input Group 0

```
Example application for total deposition fluxes (wet & dry)
Nitrogen deposition due to NO, NO2, HNO3, NH4NO3, and (NH4)2SO4
Sulfur deposition due to SO2, (NH4)2SO4
---------------- Run title (3 lines) ------------------------------------------

                    POSTUTIL MODEL CONTROL FILE
                    ---------------------------

-------------------------------------------------------------------------------

INPUT GROUP: 0 -- Input and Output File Names
--------------

-------------
Subgroup (0a)
-------------

Output Files
------------

 File            Default File Name
 ----            -----------------
 List File       POSTUTIL.LST       ! UTLLST =POSTUTIL.LST   !
 Data File       MODEL.DAT          ! UTLDAT =CALPUFF.FLX       !



Input Files
-----------

 A time-varying file of "background" concentrations can be included
 when the ammonia-limiting method (ALM) for setting the HNO3/NO3
 concentration partition is accomplished in 1 step.  This option
 is selected by setting MNITRATE=3 in Input Group 1.
 Species required in the "background" concentration file are:
 SO4, NO3, HNO3 and TNH3 (total NH3).

 File            Default File Name
 ----            -----------------
 BCKG File       BCKGALM.DAT         * BCKGALM =BCKGALM.DAT     *


 A number of CALPUFF data files may be processed in this application.
 The files may represent individual CALPUFF simulations that were made
 for a specific set of species and/or sources.  Specify the total number
 of CALPUFF runs you wish to combine, and provide the filename for each
 in subgroup 0b.

     Number of CALPUFF data files (NFILES)
                                     Default: 1       ! NFILES  = 2   !
```

Table 10-11 (Continued)
Sample POSTUTIL Control File (POSTUTIL.INP)
Input Group 0

```
 Meteorological data files are needed for the HNO3/NO3 partition option.
 Three types of meteorological data files can be used:
       METFM= 0 - CALMET.DAT
       METFM= 1 - 1-D file with RH, Temp and Rhoair timeseries
       METFM= 2 - 2-D files with either Rh, Temp or Rhoair in each
                  (3 2_D files are needed)
      The default is to use CALMET.DAT files.

                                     Default: 0       ! METFM   = 0   !


 Multiple meteorological data files may be used in sequence to span the
 processing period.  Specify the number of time-period files (NMET) that
 you need to use, and provide a filename for each in subgroup 0b.
 - NMET is 0 if no meteorological files are provided
 - NMET is 1 if METFM=1 (multiple file feature is not available)
 - NMET is 1 or more if METFM=0 or 2 (multiple CALMET files or 2DMET files)

     Number of meteorological data file time-periods (NMET)
                                     Default: 0       ! NMET    = 0   !



 All filenames will be converted to lower case if LCFILES = T
 Otherwise, if LCFILES = F, filenames will be converted to UPPER CASE

     Convert filenames to lower case?  Default: T     ! LCFILES = T !
         T = lower case
         F = UPPER CASE

!END!

-----------------------------------------------------------
 NOTE: file/path names can be up to 70 characters in length
-----------------------------------------------------------
```

Table 10-11 (Continued)
Sample POSTUTIL Control File (POSTUTIL.INP)
Input Group 0b

```
-------------
Subgroup (0b)
-------------

NMET CALMET Data Files (METFM=0):

Input File      Default File Name
----------      -----------------
   1            MET.DAT            * UTLMET =CALMET.DAT  * *END*


NMET 1-D Data Files (METFM=1):

Input File      Default File Name
----------      -----------------
   1            MET_1D.DAT         * MET1D   = MET_1D.DAT * *END*


NMET 2-D Data Files of Each Type (METFM=2):

Input File      Default File Name
----------      -----------------
   1            RHUMD.DAT          * M2DRHU  = RELHUM.DAT * *END*
   1            TEMP.DAT           * M2DTMP  = TEMP.DAT   * *END*
   1            RHOAIR.DAT         * M2DRHO  = RHOAIR.DAT * *END*


NFILES CALPUFF Data Files:

Input File      Default File Name
----------      -----------------
   1            CALPUFF.DAT        ! MODDAT =CALPUFF.WET    ! !END!
   2            (none)             ! MODDAT =CALPUFF.DRY    ! !END!


-------------
Note:  provide NMET lines of the form   * UTLMET = name * *END*

                                   or   * MET1D  = name * *END*

                                   or   * M2DRHU = name * *END*
                                (and)   * M2DTMP = name * *END*
                                (and)   * M2DRHO = name * *END*

       and NFILES lines of the form     * MODDAT = name * *END*

       where the * should be replaced with an exclamation point,
       the special delimiter character.
```

Table 10-11 (Continued)
Sample POSTUTIL Control File (POSTUTIL.INP)
Input Group 1

```
--------------------------------------------------------------------------------

INPUT GROUP: 1 -- General run control parameters
--------------

     Starting date:    Year  (ISYR) --    No default   ! ISYR  =  1990 !
                       Month (ISMO) --    No default   ! ISMO  = 1   !
                       Day   (ISDY) --    No default   ! ISDY  = 9   !
                       Hour  (ISHR) --    No default   ! ISHR  = 5   !

     Number of periods to process
                                (NPER) -- No default   ! NPER  = 4   !

     Number of species to process from CALPUFF runs
                            (NSPECINP) -- No default   ! NSPECINP = 7 !

     Number of species to write to output file
                            (NSPECOUT) -- No default   ! NSPECOUT = 3 !

     Number of species to compute from those modeled
     (must be no greater than NSPECOUT)
                            (NSPECCMP) -- No default   ! NSPECCMP = 2 !


 When multiple files are used, a species name may appear in more than
 one file.  Data for this species will be summed (appropriate if the
 CALPUFF runs use different source groups).  If this summing is not
 appropriate, remove duplicate species from the file(s).

     Stop run if duplicate species names
     are found? (MDUPLCT)            Default: 0       ! MDUPLCT  =  0  !
        0 = no  (i.e., duplicate species are summed)
        1 = yes (i.e., run is halted)

 Data for each species in a CALPUFF data file may also be scaled as
 they are read.  This can be done to alter the emission rate of all
 sources that were modeled in a particular CALPUFF application.
 The scaling factor for each species is entered in Subgroup (2d), for
 each file for which scaling is requested.

     Number of CALPUFF data files that will be scaled
     (must be no greater than NFILES)
     (NSCALED)                       Default: 0       ! NSCALED = 0 !
```

Table 10-11 (Continued)
Sample POSTUTIL Control File (POSTUTIL.INP)
Input Group 1

```
Ammonia-Limiting Method Option to recompute the HNO3/NO3 concentration
partition prior to performing other actions is controlled by MNITRATE.
This option will NOT alter any deposition fluxes contained in the CALPUFF
file(s).  Three partition selections are provided.  The first two are
typically used in sequence (POSTUTIL is run more than once).  The first
selection (MNITRATE=1) computes the partition for the TOTAL (all sources)
concentration fields (SO4, NO3, HNO3; NH3), and the second (MNITRATE=2)
uses this partition (from the previous application of POSTUTIL) to
compute the partition for individual source groups.  The third selection
(MNITRATE=3) can be used instead in a single POSTUTIL application if a
file of background concentrations is provided (BCKGALM in Input Group 0).

Required information for MNITRATE=1 includes:
         species NO3, HNO3, and SO4
         NH3 concentration(s)
         met. data file for RH and T

Required information for MNITRATE=2 includes:
         species NO3 and HNO3 for a source group
         species NO3ALL and HNO3ALL for all source groups, properly
         partitioned

Required information for MNITRATE=3 includes:
         species NO3, HNO3, and SO4 for a source group
         species NO3, HNO3, SO4 and TNH3 from the background BCKGALM file
         If TNH3 is not in the background BCKGALM file, monthly TNH3
         concentrations are used (BCKTNH3)

    Recompute the HNO3/NO3 partition for concentrations?
    (MNITRATE)                     Default: 0       ! MNITRATE  =  0  !
       0 = no
       1 = yes, for all sources combined
       2 = yes, for a source group
       3 = yes, ALM application in one step


SOURCE OF AMMONIA:

Ammonia may be available as a modeled species in the CALPUFF files,
and it may or may not be appropriate to use it for repartitioning NO3/HNO3
(in option MNITRATE=1 or MNITRATE=3).  Its use is contolled by NH3TYP.
When NH3 is listed as a processed species in Subgroup (2a), as one of
the NSPECINP ASPECI entries, and the right option is chosen for NH3TYP,
the NH3 modeled values from the CALPUFF concentration files will be used
in the chemical equilibrium calculation.
```

Table 10-11 (Continued)
Sample POSTUTIL Control File (POSTUTIL.INP)
Input Group 1

```
NH3TYP also controls when monthly background ammonia values are used.  Both
gaseous (NH3) and total (TNH3) ammonia can be provided monthly as
BCKNH3/BCKTNH3.

    What is the input source of Ammonia?
    (NH3TYP)                       No Default       ! NH3TYP = 0  !
       0 = No background will be used.
           ONLY NH3 from the concentration
           files listed in Subgroup (2a) as
           a processed species will be used.
           (Cannot be used with MNITRATE=3)

       1 = NH3 Monthly averaged background (BCKNH3)
           listed below will be added to NH3 from
           concentration files listed in Subgroup (2a)

       2 = NH3 from background concentration file BCKGALM
           will be added to NH3 from concentration files
           listed in Subgroup (2a)
           (ONLY possible for MNITRATE=3)

       3 = NH3 Monthly averaged background (BCKNH3)
           listed below will be used alone.

       4 = NH3 from background concentration file BCKGALM
           will be used alone
           (ONLY possible for MNITRATE=3)

   | NH3TYP | NH3 CONC | NH3 FROM BCKNH3 | NH3 FROM BCKGALM |
   |--------|----------|-----------------|------------------|
   |    0   |     X    |        0        |        0         |
   |--------|----------|-----------------|------------------|
   |    1   |     X    |        X        |        0         |
   |--------|----------|-----------------|------------------|
   |    2   |     X    |        0        |        X         |
   |--------|----------|-----------------|------------------|
   |    3   |     0    |        X        |        0         |
   |--------|----------|-----------------|------------------|
   |    4   |     0    |        0        |        X         |
   |--------|----------|-----------------|------------------|


    Default monthly (12 values) background ammonia concentration (ppb)
    used for HNO3/NO3 partition:

     Gaseous NH3 (BCKNH3)            Default: -999
     ! BCKNH3 = 1., 1., 1., 1.1, 1.4, 1.3, 1.3, 1.2, 4*1. !

     Total TNH3  (BCKTNH3)           Default: -999
     * BCKTNH3 = 1., 1., 1., 1.1, 1.4, 1.3, 1.3, 1.2, 4*1. *

    If a single value is entered, this is used for all 12 months.
    Month 1 is JANUARY, Month 12 is DECEMBER.

!END!
```

Table 10-11 (Concluded)
Sample POSTUTIL Control File (POSTUTIL.INP)
Input Group 2

```
-------------------------------------------------------------------------------

INPUT GROUP: 2 -- Species Processing Information
--------------

-------------
Subgroup (2a)
-------------

  The following NSPECINP species will be processed:

! ASPECI =          SO2 !         !END!
! ASPECI =          SO4 !         !END!
! ASPECI =          NO  !         !END!
! ASPECI =          NO2 !         !END!
! ASPECI =         HNO3 !         !END!
! ASPECI =          NO3 !         !END!
! ASPECI =         PM10 !         !END!


-------------
Subgroup (2b)
-------------

  The following NSPECOUT species will be written:

! ASPECO =            N !         !END!
! ASPECO =            S !         !END!
! ASPECO =         PM10 !         !END!

-------------
Subgroup (2c)
-------------

  The following NSPECCMP species will be computed by scaling and summing
  one or more of the processed input species.  Identify the name(s) of
  the computed species and provide the scaling factors for each of the
  NSPECINP input species (NSPECCMP groups of NSPECINP+1 lines each):

! CSPECCMP =        N !
!     SO2  =     0.0 !
!     SO4  =     0.291667 !
!     NO   =     0.466667 !
!     NO2  =     0.304348 !
!    HNO3  =     0.222222 !
!     NO3  =     0.451613 !
!    PM10  =     0.0 !
!END!

! CSPECCMP =        S !
!     SO2  =     0.500000 !
!     SO4  =     0.333333 !
!     NO   =     0.0 !
!     NO2  =     0.0 !
!    HNO3  =     0.0 !
!     NO3  =     0.0 !
!    PM10  =     0.0 !
!END!

-------------
```

```
Subgroup (2d)
-------------

  Each species in NSCALED CALPUFF data files may be scaled before being
  processed (e.g., to change the emission rate for all sources modeled
  in the run that produced a data file).  For each file, identify the
  file name and then provide the name(s) of the scaled species and the
  corresponding scaling factors (A,B where x' = Ax+B).

               A(Default=1.0)      B(Default=0.0)
               --------------      --------------

* MODDAT =NOFILES.DAT    *
*     SO2  =      1.1,                0.0   *
*     SO4  =      1.5,                0.0   *
*    HNO3  =      0.8,                0.0   *
*     NO3  =      0.1,                0.0   *
*END*
```

Note the location of the input terminator! END! This terminator signals the end of a group or a subgroup in the control file, and it also signals the end of an assignment for variables such as MODDAT that appear multiple times.

Input Group: 1

Input Group 1 identifies the period to process, and sets parameters that configure POSTUTIL. Note that there is no "run all periods" option as in CALPUFF or CALPOST, so that the period must be explicitly stated.

Three "nspec" variables are set:
NSPECINP identifies the number of species that are stored as the input data files are read.
NSPECOUT identifies the number of species that are written to the output data file.
NSPECCMP identifies the number of new species that are computed from those that are stored.

For example, you may wish to store 7 of 12 species from the input files, and you may wish to compute 3 new species from these 7, and write the 3 new species plus 5 of the stored species to the output data file for analysis with CALPOST. In this sample, the 6 chemical transformation species are stored, plus the PM10 (! NSPECINP = 7 !), because all 6 are needed to compute the 2 new species (! NSPECCMP = 2 !), the total sulfur and the total nitrogen fluxes. The original PM10 plus the 2 new species are written to the output data file (! NSPECOUT = 3 !) so that the sum of the wet and dry fluxes are available for further analysis.

Input Group: 2

The NSPECINP species that are stored for processing are named in Subgroup 2a. Species names must match those used in the CALPUFF runs, but may be entered in any order. Each is read into the data dictionary variable ASPECI.

Similarly, the NSPECOUT species are named in Subgroup 2b. These names include the original PM10 species, plus the two new species for total sulfur (S) and total nitrogen (N). Each is read into the data dictionary variable ASPECO.

Subgroup 2c provides the information required to compute the new species. New species concentrations or deposition fluxes are constructed using a weighted sum of the concentrations or deposition fluxes of all of the stored species. The weight for each species is entered here. Only SO2 and SO4 contribute sulfur mass. Nitrogen mass is contributed by SO4 (CALPUFF tracks ammonium sulfate as SO4), NO, NO2, HNO3, and NO3 (CALPUFF tracks ammonium nitrate as NO3). The atomic weights for the constituent elements are sulfur = 32, oxygen = 16, nitrogen = 14, and hydrogen = 1. The molecular formula for ammonium sulfate is $(NH_4)_2SO_4$ and ammonium nitrate is $(NH_4)NO_3$. Therefore:

1 g of SO2	contributes 0.500000 g of S
1 g of SO4	contributes 0.333333 g of S
1 g of SO4	contributes 0.291667 g of N
1 g of NO	contributes 0.466667 g of N
1 g of NO2	contributes 0.304348 g of N
1 g of HNO3	contributes 0.222222 g of N
1 g of NO3	contributes 0.452623 g of N

As illustrated in the sample control file, each new species is identified by name using the data dictionary variable CSPECCMP, and then each species weight is assigned by name. These species names must match those NSPECINP names already provided in subgroup 2a. The! END! terminates each of the NSPECCMP groups.

Subgroup 2d is not used in this sample, and could have been deleted from the file. Its structure is similar to that of subgroup 2c. There must be NSCALED groups provided, and each group is closed with the !END! terminator. Within each group, the file that is scaled is identified by name, assigned to the data dictionary variable MODDAT. This name must match one of the file names provided in subgroup 0b. After the file is identified, the scaling parameters are assigned to each species by name. Again, the species names must match those NSPECINP names assigned in subgroup 2a.

A sample list file is shown in Table 10-12. The top part of the file repeats the records from the control file. The remainder of the file restates the major selections, reports any warning messages, lists information from the header of each CALPUFF data file that is processed, and it reports the full species names that are read and written.

Table 10-12: Sample POSTUTIL List File (POSTUTIL.LST)

(Partial Listing)

```
**************************************************************************************************************
                                              POSTUTIL Version 1.52          Level 060412
**************************************************************************************************************

POSTUTIL Control File Input Summary ------------------------

                       Run starting date -- year: 1990
                                           month:    1
                                             day:    9
                                      Julian day:    9
                   time beginning  -  hour(0-23):    4
                                   -      second:    0
                            Run length (periods):    4


 Note: the length of a period is controlled by
       the averaging time selected in the model

 Partition between HNO3 and NO3 is NOT computed
 and 1-step Ammonia Limiting Method is not used

       Species needed from input file --
                              SO2
                              SO4
                              NO
                              NO2
                              HNO3
                              NO3
                              PM10

       Species written to output file --
                              N
                              S
                              PM10

  Species computed from input species --

                              N            =
                                0.0000E+00 * SO2
                                0.2917E+00 * SO4
                                0.4667E+00 * NO
                                0.3043E+00 * NO2
                                0.2222E+00 * HNO3
                                0.4516E+00 * NO3
                                0.0000E+00 * PM10

                              S            =
                                0.5000E+00 * SO2
                                0.3333E+00 * SO4
                                0.0000E+00 * NO
                                0.0000E+00 * NO2
                                0.0000E+00 * HNO3
                                0.0000E+00 * NO3
                                0.0000E+00 * PM10
```

Table 10-12 (Continued)
Sample POSTUTIL List File (POSTUTIL.LST)
(Partial Listing)

```
PROCESSED MODEL FILE ---------- Number  1

 CALPUFF     5.754       060202

 CALPUFF Demonstration Run



 Averaging time for values reported from model:
       1    HOUR

 Number of averaging periods in file from model:
       4

 Chemical species names for each layer in model:
 SO2          WF
 SO4          WF
 NO           WF
 NO2          WF
 HNO3         WF
 NO3          WF
 PM10         WF

  msyr,mjsday      = 1990 9
  mshr,mssec       = 4 0
  nsecdt (period)  = 3600
  mnper,nszout,mavgpd = 4 7 1
  xorigkm,yorigkm,nstas =  310.000000 4820.00000 5
  ielmet,jelmet = 99 99
  delx,dely,nz = 1.00000000 1.00000000 1
  iastar,iastop,jastar,jastop = 1 99 1 99
  isastr,isastp,jsastr,jsastp = 29 48 40 70
  (computed) ngx,ngy  = 20 31
  meshdn,npts,nareas  = 1 1 0
  nlines,nvols        = 0 0
  ndrec,nctrec,LSGRID = 0 0 T

 Source names stored (all files):
 type: pt1 -  STK1






 PROCESSED MODEL FILE ---------- Number  2

 CALPUFF     5.754       060202

 CALPUFF Demonstration Run



 Averaging time for values reported from model:
       1    HOUR

 Number of averaging periods in file from model:
       4
```

```
Chemical species names for each layer in model:
SO2          DF
SO4          DF
NO           DF
NO2          DF
HNO3         DF
NO3          DF
PM10         DF
```

Table 10-12 (Continued)
Sample POSTUTIL List File (POSTUTIL.LST)
(Partial Listing)

```
 msyr,mjsday      = 1990 9
 mshr,mssec       = 4 0
 nsecdt (period)  = 3600
 mnper,nszout,mavgpd = 4 7 1
 xorigkm,yorigkm,nstas =  310.000000 4820.00000 5
 ielmet,jelmet = 99 99
 delx,dely,nz = 1.00000000 1.00000000 1
 iastar,iastop,jastar,jastop = 1 99 1 99
 isastr,isastp,jsastr,jsastp = 29 48 40 70
 (computed) ngx,ngy  = 20 31
 meshdn,npts,nareas  = 1 2 0
 nlines,nvols        = 0 0
 ndrec,nctrec,LSGRID = 0 0 T

Source names stored (all files):
type: pt1 -  STK1
type: pt1 -  STK1




**************   WARNING   ***************
Requested input species name exists in more
than one data file. Species will be summed
  Species Name: SO2

**************   WARNING   ***************
Requested input species name exists in more
than one data file. Species will be summed
  Species Name: SO4

**************   WARNING   ***************
Requested input species name exists in more
than one data file. Species will be summed
  Species Name: NO

**************   WARNING   ***************
Requested input species name exists in more
than one data file. Species will be summed
  Species Name: NO2

**************   WARNING   ***************
Requested input species name exists in more
than one data file. Species will be summed
  Species Name: HNO3

**************   WARNING   ***************
Requested input species name exists in more
than one data file. Species will be summed
  Species Name: NO3

**************   WARNING   ***************
Requested input species name exists in more
than one data file. Species will be summed
  Species Name: PM10


Chemical species names written to new file:
```

```
N           TF
S           TF
PM10        TF
```

Table 10-12 (Concluded)
Sample POSTUTIL List File (POSTUTIL.LST)
(Partial Listing)

```
-----------------------------------------------------------------------------------------------------------
         INPUT FILES

Default Name     Unit No.     File Name and Path
------------     --------     ------------------
POSTUTIL.INP         5        postutil.inp
 CALPUFF.DAT        10        calpuff.wet
     (none)         11        calpuff.dry


-----------------------------------------------------------------------------------------------------------
         OUTPUT FILES

Default Name     Unit No.     File Name and Path
------------     --------     ------------------
POSTUTIL.LST         7        postutil.lst
   MODEL.DAT         8        calpuff.flx

Skipping periods in data files
 Start Time  1990 9 4 0
 Data File  ---  Skipped Periods
      1            0
      2            0


Skipping periods in background pollutant files
 Start Time  1990 9 4 0
 Data File  ---  Skipped Periods
      3            0
```

10.4 CALPOST

The CALPOST program is a postprocessor designed to average and report concentration or wet/dry deposition flux results based on the data contained in the CALPUFF output file. If the CALPUFF application had been configured to provide concentrations needed to assess visibility, CALPOST can also compute extinction coefficients for visibility-related impacts. A range of averaging times may be selected, and the results may be reported in a number of different formats (e.g. rank tables and plots; exceedance tables and plots). Capabilities and options include:

- User-selected processing period.
- User-selected averaging times, including option for one defined by the user.
- User-selected chemical species.
- User-selected units for reporting concentrations or deposition fluxes.
- Option to include gridded receptors, discrete receptors, and complex terrain receptors in any combination.
- Option to specify subsets of the gridded and discrete receptors.
- Option to report results by receptor rings.
- Option to produce tables of the "top-50" average concentration/deposition flux data (includes time and receptor information) for specified averaging times.
- Option to produce tables of up to four "top-N" (user specifies the number N) ranked average concentration/deposition flux data at the selected receptors for specified averaging times.
- Option to produce tables of the number of exceedances of user-specified threshold values at the selected receptors for specified averaging times.
- Option to produce a table of the annual (or length-of-run) average concentration/deposition flux at the selected receptors.
- Option to print concentration/deposition flux averages for selected days.
- Option to produce a file of timeseries of concentration/deposition flux averages for selected days.
- Option to produce files of timeseries of the peak concentration/deposition flux average over all selected receptors for each selected averaging period. Each output file contains one averaging period.
- Option to produce plot-files in addition to the selected tables for the top-N concentrations or deposition fluxes, the number of exceedances of the user-specified thresholds, and the concentration/deposition flux fields for a particular day.
- Option to scale all concentration/deposition flux data by means of a linear function of the form: a*X + b (where X is concentration or deposition, and a,b are user-supplied constants).
- Option to add an hourly background concentration/deposition flux from an external file.
- Option to produce visibility parameters, signaled by setting the species name to "VISB". Requires that CALPUFF is configured for visibility computations.

When CALPOST is directed to perform visibility calculations, most of the preceding options remain valid and determine how the computed extinction coefficients are averaged and reported. Additional options are provided to configure how the extinction coefficients are computed:

- Option to select which modeled species (sulfate, nitrate, fine/coarse particulate matter) are included in the extinction coefficient.
- Option to include background extinction when forming ranked tabulations, top-50 tabulations, or exceedance tabulations.
- Option to specify the extinction efficiency for each modeled species.
- User-selected method for obtaining the background extinction coefficients (non-speciated extinction coefficient, monthly speciated extinction coefficients, measured hourly extinction coefficients)

Whenever visibility processing is selected, the peak daily percent change in extinction and the corresponding change in deciview are always tabulated and reported in addition to the tables and plot-files selected to characterize the extinction coefficient results.

Table 10-13 lists the default name of each input and output file associated with CALPOST. The plot-files are named automatically, with the user able to specify a pathname and character string to make the file names unique. The name and full path of each file (except one) is assigned in the control file. The exception, the control filename itself, is assigned on the command line. For example, on a DOS system,

```
CALPOST   d:\CALPUFF\CALPOST.INP
```

will execute the CALPOST code, and read the input and output filenames for the current run from the control file CALPOST.INP in the directory d:\CALPUFF. If the control filename is not specified on the command line, the default control filename (i.e., CALPOST.INP in the current working directory) will be used. The total number of characters in the path and filename can be up to 70 characters.

The utility routine that delivers a command line argument is system dependent. The function that provides the system clock time and system CPU time is also system or compiler-specific. All system-dependent or compiler-specific routines in CALPOST are isolated into a file called DATETM.xxx, where the file extension (.xxx) indicates the system for which the code is designed. For example, DATETM.HP contains code for Hewlett-Packard7 Unix systems, DATETM.SUN is for Sun7 Unix systems, DATETM.LAH is for Lahey7 FORTRAN-compiled PC-applications, and DATETM.MS is for Microsoft7 FORTRAN-compiled PC applications. By appending the correct system-dependent DATETM file onto the main CALPOST code, the code should run without any modifications.

Table 10-13: CALPOST Input and Output Files

Unit	File Name	Type	Format	Description
in2	CALPOST.INP	input	formatted	Control file containing user inputs
in1	MODEL.DAT	input	unformatted	CALPUFF output file containing modeled concentration or deposition flux data
in3	VISB.DAT	input	unformatted	CALPUFF output file containing relative humidity data (required only for visibility applications)
in4	BACK.DAT	input	formatted	Optional file of hourly background concentrations
in5	VSRN.DAT	input	formatted	Optional file of hourly background extinction coefficients from transmissometer or nephelometer
io1	CALPOST.LST	output	formatted	List file containing CALPOST tables and other generated data
iot (1,3,24,n)	TSERIES_ASPEC_ttHR_CONC_TSUNAM.DAT	ouput	formatted	Timeseries of (1,3,24)-hour or N-period averages
iop (1,3,24,n)	PEAKVAL_ASPEC_ttHR_CONC_TSUNAM.DAT	ouput	formatted	Timeseries of PEAK (1,3,24)-hour or N-period average at selected receptors
mapu	RANK(ALL)_ASPEC_ttHR_CONC_TUNAM.DAT RANK(ii)_ASPEC_ttHR_CONC_TUNAM.GRD	output	formatted	Top Nth Rank Plot File in DATA format Top Nth Rank Plot File in GRID format

Filenames for optional files are constructed using a template that includes a pathname, optional user-supplied character(s), and automatically generated characters, where

tt = averaging period (e.g. 03) (HR or MIN)

ii = rank (e.g. 02)

DAT = DATA format (comma-delimited ASCII file in x, y, value1, value2, ... , value4 format)

GRD = GRID format (only for gridded receptors) compatible with Surfer7 plotting software

Table 10-13 (concluded)
CALPOST Input and Output Files

Unit	File Name	Type	Format	Description
mapu	EXCEED_ASPEC_ttHR_CONC_XUNAM.DAT EXCEED_ASPEC_ttHR_CONC_XUNAM.GRD	output	formatted	Exceedance Plot File in DATA format Exceedance Plot File in GRID format
mapu	yyyy_Mmm_Ddd_hh00(UTCszzzz)_L00_ASPEC_ttHR_CONC.DAT yyyy_Mmm_Ddd_hhmm(UTCszzzz)_L00_ASPEC_ttHR_CONC.GRD	output	formatted	Echo Plot File in DATA format Echo Plot File in GRID format
mapu	DAILY_VISIB_VUNAM.DAT	output	formatted	Daily Peak Summary of Visibility

Filenames for optional files are constructed using a template that includes a pathname, optional user-supplied character(s), and automatically generated characters, where

tt = averaging period (e.g. 03) (HR or MIN)

yyyy = year mm = month dd = day hh = starting hour (00-23) mm = starting minute (00-59)

szzzz = time added to UTC to obtain base time (szzzz = -0500 for time zone 5)

DAT = DATA format (comma-delimited ASCII file in x, y, value1, value2, ... , value4 format)

GRD = GRID format (only for gridded receptors) compatible with Surfer7 plotting software

CALPOST generates an output list file (default name: CALPOST.LST) and a set of optional files. The names for the optional files follow a fixed template, with one or more characters reserved for the user to specify in order to distinguish output from multiple applications. For example, a plot-file in GRID format containing the highest second-high 24-hour average concentration of species ASPEC at each receptor would be called:

RANK(02)_ASPEC_24HR_CONC_TEST1.grd

where "TEST1" is the user-specified run identifier. If the user does not enter a run identifier, the file would be called:

RANK(02)_ASPEC_24HR_CONC.grd

A plot-file in DATA format containing the number of exceedances of a 3-hour concentration threshold specified by the user for species ASPEC with a run identifier "TEST2" would be called:

EXCEED_ASPEC_03HR_CONC_TEST2.dat

Plot-files in GRID format containing 8-hour average concentrations of species ASPEC for Julian Day 112 in 1995 (April 22) in base time zone 5 (EST in the USA) would be called

1995_M04_D22_0000(UTC-0500)_L00_ASPEC_08HR_CONC.GRD
1995_M04_D22_0800(UTC-0500)_L00_ASPEC_08HR_CONC.GRD
1995_M04_D22_1600(UTC-0500)_L00_ASPEC_08HR_CONC.GRD

A visibility analysis with a run identifier "TOTAL" would generate the plot-file:

DAILY_VISIB_TOTAL.DAT

As with CALPUFF and CALMET, CALPOST is configured by means of a parameter file, called PARAMS.PST, in which all of the array dimensions related to the number of gridded, discrete, and complex terrain receptors, the number of "top N" tables allowed, and the Fortran unit numbers associated with each input and output file are specified. If for a particular application, the user needs to increase the number of discrete receptors, for example, beyond the current maximum, a change to the value of the discrete receptor parameter in PARAMS.PST will automatically re-size all arrays related to this parameter upon recompilation of the CALPOST code.

10.5 Input Files

10.5.1 User Control File (CALPOST.INP)

User-specified inputs to CALPOST are read from a control file whose default name is CALPOST.INP. A description of each input variable is shown in Table 10-14, and a sample input file is presented in Table 10-15. This control file uses the same self-documenting control file format as CALPUFF. See Section 9.1 for a description of the control file input conventions. Selections may be made by either editing an existing control file, or by using the CALPOST GUI. Note that you can generate a new control file with all of the standard options and comments by saving the NEW.INP file from the GUI to disk.

10.5.2 CALPUFF Output Files (MODEL.DAT and VISB.DAT)

The program reads the concentration/deposition flux data from an unformatted data file (default name: MODEL.DAT) that is generated by the CALPUFF model (or CALGRID). CALPUFF also generates a file containing relative humidity data (default name: VISB.DAT), which is read by CALPOST if needed for the visibility option selected. The structure of these files is described in Section 9-13.

10.5.3 Background Concentrations/Deposition Fluxes (BACK.DAT)

As an option, a spatially uniform, hourly background concentration/deposition flux can be added to modeled concentrations/deposition fluxes before averages are processed in CALPOST. These values are provided in a formatted ASCII file (default name: BACK.DAT) prepared by the user. Table 10-16 lists the record structure for this file, and a partial listing of a sample file is presented in Table 10-17.

Units for the background values may be different from those requested from CALPOST. Therefore, the scaling factor placed in the header record is an important feature. It converts the native units for the background concentrations to g/m^3 , or it converts the native units for background deposition fluxes to g/m^2 /s. These are the internal units used in the CALPUFF output file. Any units conversion specified in the control file (parameter IPRTU) can then be applied uniformly to both the CALPUFF and background values. Note that the multiplicative and additive scaling factors (A, B) are not applied to the background values.

10.5.4 Visibility Measurements (VSRN.DAT)

CALPOST allows the use of visibility measurements to establish hourly background extinction for use in assessing the change in visibility resulting from modeled emissions. Two formats are supported for these data, and both are taken from the data files available on CD-ROM from the Interagency Monitoring of Protected Visual Environments (IMPROVE) program. When background extinction method number 4 is selected in the control file (MVISBK = 4), transmissometer measurements must be provided in the

IMPROVE format. Example records for this file are listed in Table 10-18. When background extinction method number 5 is selected in the control file (MVISBK = 5), nephelometer measurements must be provided in the IMPROVE format. Example records for this file are listed in Table 10-19.

CALPOST uses the content of one field in the file header record to identify which type of file is provided (it must be consistent with the MVISBK selection). The first 26 characters are read, and the characters in position 24-26 must be "INS" for the nephelometer data file. Subsequent data records are read using the following statements, where the variable "meas" is the extinction coefficient (Mm^{-1}):

Transmissometer Data:

```
     read(in5,102) iyr,ijday,ihr,meas,ivflag,irh
102  format(7x,i2,5x,i3,1x,i2,2x,i5,22x,i2,17x,i2)
```

Nephelometer Data :

```
     read(in5,101) iyr,ijday,ihr,meas,ivflag,rh
101  format(7x,i2,5x,i3,1x,i2,8x,i6,8x,i2,40x,40x,40x,11x,f7.2)
```

If similar measurements are available from other sources, they may be used in CALPOST by adhering to this file structure. Note that the transmissometer measurements are assumed to provide the total extinction coefficient, whereas the nephelometer measurements provide just the extinction coefficient due to particle scattering.

Table 10-14: CALPOST Control File Inputs - Input group 0

Input and Output File Names

Variable	Type	Description	Default
MODDAT	character*70	File name of modeled concentration/deposition data file, including full path if desired	MODEL.DAT
VISDAT	character*70	File name of input relative humidity data file, including full path if desired (for visibility)	VISB.DAT
BACKDAT	character*70	File name of input hourly background concentration or deposition flux data file, including full path if desired	BACK.DAT
VSRDAT	character*70	File name of input hourly background light extinction data, including full path if desired	VSRN.DAT
PSTLST	character*70	File name of list file of output from CALPOST, including full path if desired	CALPOST.LST
TSPATH	character*70	Pathname for time-series files (optional: must not be blank if supplied)	(blank)
PLPATH	character*70	Pathname for plot-files (optional: must not be blank if supplied)	(blank)
TSUNAM	character*8	User-supplied characters for Timeseries file names (optional: must not be blank if supplied)	(blank)
TUNAM	character*8	User-supplied characters for Top-N plot-file names (optional: must not be blank if supplied)	(blank)
XUNAM	character*8	User-supplied characters for Exceedance plot-file names (optional: must not be blank if supplied)	(blank)
EUNAM	character*8	User-supplied characters for Echo plot-file names (optional: must not be blank if supplied)	(blank)
VUNAM	character*8		

		User-supplied characters for Visibility plot-file names (optional: must not be blank if supplied)	
LCFILES	logical	Control flag for converting file names to lower case if T, or to upper case if F	T

Table 10-14 (Continued)
CALPOST Control File Inputs - Input Group 1
General Run Control Parameters

Variable	Type	Description	Default
METRUN	integer	Option to run all periods in CALPUFF file (0,1) 0 = no, run the period defined by ISYR, ISMO, ISDY, ISHR, ISMIN, ISSEC and IEYR, IEMO, IEDY, IEHR, IEMIN, IESEC 1 = yes, run all periods found in the file	0
ISYR	integer	Starting year of data to process (four digits)	-
ISMO	integer	Starting month [a]	-
ISDY	integer	Starting day [a]	-
ISHR, ISMIN, ISSEC	integer	Starting time[a] (hour, minutes, seconds at the start of the simulation).	-
IEYR	integer	Ending year of data to process (four digits)	-
IEMO	integer	Ending month [a]	-
IEDY	integer	Ending day [a]	-
IEHR, IEMIN, IESEC	integer	Ending time[a] (hour, minutes, seconds at the end of the simulation).	-
BTZONE	real	Base Time Zone (optional if CALPUFF.DAT dataset 2.1)	-
NREP	integer	Process every "NREPth "period of data 1 = process every period 2 = process every 2nd period 5 = process every 5th period	1
ASPEC	character*12	Name of "species" to process [b]	-
ILAYER	integer	Code indicating layer of concentrations (always "1" when processing concentrations from CALPUFF, "-1" for dry deposition fluxes, "-2" for wet deposition fluxes, and "-3" for total deposition fluxes)	1
A	real	Multiplicative scaling factor applied to modeled concentrations or deposition fluxes (not applied if A = B = 0.0)	0.0
B	real	Additive factor applied to modeled concentrations or deposition fluxes (not applied if A = B = 0.0)	0.0
LBACK	logical	Add background concentrations/deposition fluxes from external file?	F

[a] Used only if METRUN = 0.

[b] Sample values of ASPEC: SO2, SO4, NOX, HNO3, NO3. For visibility calculations, the species name must be entered as VISIB, which is not a species name actually used in the CALPUFF run: the species included in the visibility calculations are selected by the LVSO4, LVNO3, etc. parameters.

Table 10-14 (Continued)
CALPOST Control File Inputs - Input Group 1
General Run Control Parameters

Variable	Type	Description	Default
MSOURCE	integer	0 = Process only total reported contributions 1 = Sum all individual source contributions and process 2 = Run in TRACEBACK mode to identify source contributions at a SINGLE receptor	0
LG	logical	Process Gridded receptors?	F
LD	logical	Process Discrete receptors?	F
LCT	logical	Process CTSG complex terrain receptors?	F
LDRING	logical	Report results by receptor ring? (Used only if LD= T)	F
NDRECP	integer aray	Select specific discrete receptors (used only if LD=T) -1 = process ALL discrete receptors[c] 0 = discrete receptor not processed 1 = discrete receptor processed (Enter NREC values using repeated-value notation)[d]	-1
IBGRID	integer	X grid index of lower left corner of subset of gridded receptors to process if LG = T (-1[e] or 1 to NX)	-1[c]
JBGRID	integer	Y grid index of lower left corner of subset of gridded receptors to process if LG = T (-1[e] or 1 to NY)	-1[c]
IEGRID	integer	X grid index of upper right corner of subset of gridded receptors to process if LG = T (-1[e] or IBGRID to NX)	-1[c]
JEGRID	integer	Y grid index of upper right corner of subset of gridded receptors to process if LG = T (-1[e] or JBGRID to NY)	-1[c]
NGONOFF	integer	Number of gridded receptor rows provided in Subgroup 1a to identify specific gridded receptors to process	0
		(Optional Input Group 1a - Specific Gridded Receptors)	
NGXRECP	integer array	Sequence of 0,1 values (one for each gridded receptor in a row of the sampling grid) used to select individual	1

gridded receptors
0 = gridded receptor not processed
1 = gridded receptor processed
(Repeated value notation may be used)[f]

---

[c] Use -1 for the first discrete receptor to signal the use of all discrete receptors in the CALPUFF file.

[d] Explicitly turn each discrete receptor on/off (1/0). NREC receptors were used in the CALPUFF run, so NREC entries are needed in this array. These may be entered in groups: 3*1,2*0 is equivalent to 1,1,1,0,0.

[e] Use -1 for all 4 grid cell indices to signal the use of all gridded receptors.

[f] Enter NGONOFF lines which represent rows of the sampling grid, starting with the northernmost row that contains receptors to be excluded and ending with row 1 to the south (none may be skipped).

Table 10-14 (Continued)
CALPOST Control File Inputs - Input Group 2
Visibility Parameters

Variable	Type	Description	Default
MFRH	integer	1 = IWAQM (1998) f(RH) curve (originally used with MVISBK=1) 2 = FLAG (2000) f(RH) tabulation 3 = EPA (2003) f(RH) tabulation	2
RHMAX	real	Maximum relative humidity (%) used in the particle growth equation for visibility processing	98
LVSO4	logical	Include modeled sulfate in extinction (T/F)	T
LVNO3	logical	Include modeled nitrate in extinction (T/F)	T
LVOC	logical	Include modeled organic carbon in extinction (T/F)	T
LVPMC	logical	Include modeled coarse particulates in extinction (T/F)	T
LVPMF	logical	Include modeled fine particulates in extinction (T/F)	T
LVEC	logical	Include modeled elemental carbon (T/F)	T
LVBK	logical	Include background in extinction when ranking for top-n, top-50, or exceedance tables (T/F)	T
SPECPMC	character*12	Species name for coarse particulates in MODEL. DAT	PMC
SPECPMF	character*12	Species name for coarse particulates in MODEL. DAT	PMF
		----- Extinction Efficiencies (m^2/g) -----	
EEPMC	real	Modeled coarse particulates	0.6
EEPMF	real	Modeled fine particulates	1.0
EEPMCBK	real	Background coarse particulates	0.6
EESO4	real	Ammonium Sulfate	3.0
EENO3	real	Ammonium Nitrate	3.0

EEOC	real	Organic Carbon	4.0
EESOIL	real	Soil Dust	1.0
EEEC	real	Elemental Carbon (soot)	10.0

Table 10-14 (Continued)

CALPOST Control File Inputs - Input Group 2

Visibility Parameters

Variable	Type	Description	Default
LAVER	logical	Method used for the 24h-average of percent change of light extinction: Hourly ratio of source light extinction / background light extinction is averaged?	F
MVISBK	integer	Method used to obtain background extinction: 1 = Supply single light extinction and hygroscopic fraction - IWAQM (1993) RH adjustment applied to hygroscopic background and modeled sulfate and nitrate 2 = Compute extinction from speciated PM measurements (A) - Hourly RH adjustment applied to observed and modeled sulfate and nitrate - RH factor is capped at RHMAX 3 = Compute extinction from speciated PM measurements (B) - Hourly RH adjustment applied to observed and modeled sulfate and nitrate - Receptor-hour excluded if RH>RHMAX - Receptor-day excluded if fewer than 6 valid receptor-hours 4 = Read hourly transmissometer background extinction data - Hourly RH adjustment applied to modeled sulfate and nitrate - Hour excluded if measurement invalid (missing, interference, or large RH) - Receptor-hour excluded if RH>RHMAX - Receptor-day excluded if fewer than 6 valid receptor-hours 5 = Read hourly nephelometer background extinction measurements - Rayleigh extinction value (BEXTRAY) added to measurement - Hourly RH adjustment applied to modeled sulfate and nitrate - Hour excluded if measurement invalid (missing, interference, or large RH) - Receptor-hour excluded if RH>RHMAX 6 = Compute extinction from speciated PM measurements - FLAG RH adjustment factor applied to observed and modeled sulfate and nitrate. 7 = Compute extinction from speciated PM measurements as in [2] for 'unobstructed' conditions; replace with extinction from observed visual range for fog/precipitation conditions - Hourly RH adjustment applied to observed and modeled sulfate and nitrate - RH factor is capped at RHMAX - When fog/precip is observed, replace computed Bext with: Bext(1/Mm) = 3912/VR(km)	2

----- Additional MVISBK = 1 Inputs -----

BEXTBK	real	Background light extinction coefficient (Mm^{-1})	-
RHFRAC	real	Percentage of particles affected by relative humidity	-

Table 10-14 (Continued)
CALPOST Control File Inputs - Input Group 2
Visibility Parameters

Variable	Type	Description	Default
		----- Additional MVISBK = 6 Inputs -----	
RHFAC (12)	integer array	Monthly relative humidity factors for adjusting extinction coefficients for hygroscopic species	-
		----- Additional MVISBK = 7 Inputs -----	
IDWSTA	integer	Station ID	-
TZONE	real	Time Zone	-
		----- Additional MVISBK = 2,3,6,7 Inputs -----	
BKSO4 (12)	real array	Monthly Background Ammonium Sulfate Concentration (μg/m^3)	-
BKNO3 (12)	real array	Monthly Background Ammonium Nitrate Concentration (μg/m^3)	-
BKPMC (12)	real array	Monthly Background Coarse Particulate Concentration (μg/m^3)	-
BKOC (12)	real array	Monthly Background Organic Carbon Concentration (μg/m^3)	-
BKSOIL (12)	real array	Monthly Background Soil Dust Concentration (μg/m^3)	-
BKEC (12)	real array	Monthly Background Elemental Carbon Concentration (μg/m^3)	-
		----- Additional MVISBK = 2,3,5,6,7 Inputs -----	

BEXTRAY	real	Extinction due to Rayleigh Scattering (Mm^{-1})	10.

Table 10-14 (Continued)
CALPOST Control File Inputs - Input Group 3
Output Options

Variable	Type	Description	Default
LDOC	logical	Documentation records contained in the header of the CALPUFF output file may be written to the list file. Print documentation image?	F
IPRTU	integer	Output units flag: (always Mm^{-1} for extinction) For concentrations — For deposition fluxes 1 = g/m^3 — $g/m^2/s$ 2 = mg/m^3 — $mg/m^2/s$ 3 = ug/m^3 — $ug/m^2/s$ 4 = ng/m^3 — $ng/m^2/s$ 5 = odor units — -	1
L1PD	logical	Report 1-period averages? (averaging period of CALPUFF output)	T
L1HR	logical	Report 1-hr averages?	T
L3HR	logical	Report 3-hr averages?	T
L24HR	logical	Report 24-hr averages?	T
LRUNL	logical	Report length-of-run averages?	T
NAVGH	integer	User-specified averaging time (hours component)	0
NAVGM	integer	User-specified averaging time (minutes component)	0
NAVGS	integer	User-specified averaging time (seconds component)	0
LT50	logical	Produce top 50 tables?	T
LTOPN	logical	Produce top N tables?	F
NTOP	integer	Number of "top" values at each receptor (must be # 4)	4
ITOP(4)	integer array	Specific ranks of "top" values reported (e.g., values of 1, 2, 5 and 48 would produce the highest, 2nd highest, 5th	1,2,3,4

		highest, and 48th highest concentrations at each receptor)	
LEXCD	logical	Produce exceedance tables?	F
THRESH1	real	Exceedance threshold (output units) for 1-hr averages	-1[g]

[g] Exceedance processing is only performed for selected averaging times with thresholds greater than or equal to zero.

Table 10-14 (Concluded)
CALPOST Control File Inputs - Input Group 3
Output Options

Variable	Type	Description	Default
THRESH3	real	Exceedance threshold (output units) for 3-hr averages	-1[g]
THRESH24	real	Exceedance threshold (output units) for 24-hr averages	-1[g]
THRESHN	real	Exceedance threshold (output units) for NAVG-hr averages	-1[g]

[g] Exceedance processing is only performed for selected averaging times with thresholds greater than or equal to zero.

----- Multiple Exceedance Processing -----

NDAY	integer	Number of days to accumulate exceedance counts when reporting violations (NDAY > 0 activates this processing option)	0
NCOUNT	integer	Number of exceedances allowed in a single NDAY period	1
LECHO	logical	Output selected averages on selected days?	F
IECHO(366)	integer array	Array of days selected to print data for all selected averaging times (0 = do not print, 1 = print)	366*0
LTIME	logical	Output timeseries for all selected receptors for all	F

		selected days for all selected averaging times?	
LPLT	logical	Generate plot-file output?	F
LGRD	logical	Write plot-files in GRID[h] format when available?	F
LDEBUG	logical	Activate special debug output statements?	F
LVEXTHR	logical	Output hourly extinction information to REPORT.HRV?	F

[h] GRID format is compatible with the Surfer7 plotting software. Only processed values obtained at gridded receptors are written in this format. If the GRID option is not selected, processed values obtained at all receptors are written in the comma-delimited DATA format (x, y, value1, value2, ... , value4).

Table 10-15: Sample CALPOST Control File (CALPOST.INP)

```
CALPUFF Demonstration


---------------- Run title (3 lines) ------------------------------------------

                    CALPOST MODEL CONTROL FILE
                    --------------------------

-------------------------------------------------------------------------------

INPUT GROUP: 0 -- Input and Output File Names
--------------

Input Files
-----------

File                      Default File Name
----                      -----------------
Conc/Dep Flux File        MODEL.DAT          ! MODDAT =CPUF.CON   !
Relative Humidity File    VISB.DAT           * VISDAT =   *
Background Data File      BACK.DAT           * BACKDAT =   *
Transmissometer or        VSRN.DAT           * VSRDAT =   *
Nephelometer Data File     or
DATSAV Weather Data File   or
Prognostic Weather  File

Output Files
------------

File                      Default File Name
----                      -----------------
List File                 CALPOST.LST        ! PSTLST =CPST.LST   !

Pathname for Timeseries Files   (blank)      * TSPATH =   *
(activate with exclamation points only if
providing NON-BLANK character string)

Pathname for Plot Files   (blank)            * PLPATH =   *
(activate with exclamation points only if
 providing NON-BLANK character string)

User Character String to augment default filenames
(activate with exclamation points only if
 providing NON-BLANK character string)

Timeseries          TSERIES_ASPEC_ttHR_CONC_TSUNAM.DAT

                                             * TSUNAM =   *

Top Nth Rank Plot   RANK(ALL)_ASPEC_ttHR_CONC_TUNAM.DAT
                or  RANK(ii)_ASPEC_ttHR_CONC_TUNAM.GRD

                                             * TUNAM =   *

Exceedance Plot      EXCEED_ASPEC_ttHR_CONC_XUNAM.DAT
                 or  EXCEED_ASPEC_ttHR_CONC_XUNAM.GRD

                                             * XUNAM =   *

Echo Plot
(Specific Days)
           yyyy_Mmm_Ddd_hhmm(UTCszzzz)_L00_ASPEC_ttHR_CONC.DAT
```

```
     or    yyyy_Mmm_Ddd_hhmm(UTCszzzz)_L00_ASPEC_ttHR_CONC.GRD


Visibility Plot      DAILY_VISIB_VUNAM.DAT   ! VUNAM =VTEST   !
(Daily Peak Summary)

--------------------------------------------------------------------------------
All file names will be converted to lower case if LCFILES = T
Otherwise, if LCFILES = F, file names will be converted to UPPER CASE
         T = lower case               ! LCFILES = T !
         F = UPPER CASE
```

Table 10-15 (Continued)
Sample CALPOST Control File (CALPOST.INP)

```
NOTE: (1) file/path names can be up to 132 characters in length
NOTE: (2) Filenames for ALL PLOT and TIMESERIES FILES are constructed
          using a template that includes a pathname, user-supplied
          character(s), and context-specific strings, where
             ASPEC = Species Name
              CONC = CONC Or WFLX Or DFLX Or TFLX
                tt = Averaging Period (e.g. 03)
                ii = Rank (e.g. 02)
              hhmm = Time(begining) in LST - hour/minute
             szzzz = LST time zone shift (EST is -0500)
              yyyy = Year(LST)
                mm = Month(LST)
                dd = day of month (LST)
          are determined internally based on selections made below.
          If a path or user-supplied character(s) are supplied, each
          must contain at least 1 non-blank character.

!END!
--------------------------------------------------------------------------------

INPUT GROUP: 1 -- General run control parameters
--------------

     Option to run all periods found
     in the met. file(s)  (METRUN)        Default: 0   ! METRUN =   0  !

         METRUN = 0 - Run period explicitly defined below
         METRUN = 1 - Run all periods in CALPUFF data file(s)

     Starting date:    Year  (ISYR) --    No default   ! ISYR  =  1988!
                       Month (ISMO) --    No default   ! ISMO  =  7   !
                       Day   (ISDY) --    No default   ! ISDY  =  7   !
     Starting time:    Hour  (ISHR) --    No default   ! ISHR  =  0   !
                     Minute (ISMIN) --    No Default   ! ISMIN =  0   !
                     Second (ISSEC) --    No Default   ! ISSEC =  0   !

     Ending date:      Year  (IEYR) --    No default   ! IEYR  =  1988!
                       Month (ISMO) --    No default   ! IEMO  =  7   !
                       Day   (IEDY) --    No default   ! IEDY  =  7   !
     Ending time:      Hour  (IEHR) --    No default   ! IEHR  =  1   !
                     Minute (IEMIN) --    No Default   ! IEMIN =  0   !
                     Second (IESEC) --    No Default   ! IESEC =  0   !

     (These are used only if METRUN = 0)

     All times are in the base time zone of the CALPUFF simulation.
     CALPUFF Dataset Version 2.1 contains the zone, but earlier versions
     do not, and the zone must be specified here.  The zone is the
     number of hours that must be ADDED to the time to obtain UTC (or GMT).
     Identify the Base Time Zone for the CALPUFF simulation
     (BTZONE)                          -- No default   ! BTZONE =     5.!

     Process every period of data?
                                (NREP) -- Default: 1   ! NREP  =  1  !
      (1 = every period processed,
       2 = every 2nd period processed,
       5 = every 5th period processed, etc.)

Species & Concentration/Deposition Information
----------------------------------------------
```

```
Species to process (ASPEC)       -- No default   ! ASPEC = SO2  !
(ASPEC = VISIB for visibility processing)

Layer/deposition code (ILAYER)   -- Default: 1   ! ILAYER =  1  !
  '1'  for CALPUFF concentrations,
  '-1' for dry deposition fluxes,
  '-2' for wet deposition fluxes,
  '-3' for wet+dry deposition fluxes.

Scaling factors of the form:     -- Defaults:    ! A =  0.0    !
      X(new) = X(old) * A + B         A = 0.0    ! B =  0.0    !
  (NOT applied if A = B = 0.0)        B = 0.0

Add Hourly Background Concentrations/Fluxes?
                        (LBACK)  -- Default: F   ! LBACK =  F !
```

Table 10-15 (Continued)
Sample CALPOST Control File (CALPOST.INP)

```
Source information
------------------

  Option to process source contributions:
         0 =  Process only total reported contributions
         1 =  Sum all individual source contributions and process
         2 =  Run in TRACEBACK mode to identify source
              contributions at a SINGLE receptor
                             (MSOURCE) -- Default: 0   ! MSOURCE =  0  !

Receptor information
--------------------

  Gridded receptors processed?    (LG) -- Default: F   ! LG  = T  !
  Discrete receptors processed?   (LD) -- Default: F   ! LD  = F  !
  CTSG Complex terrain receptors processed?
                                 (LCT) -- Default: F   ! LCT = F  !

--Report results by DISCRETE receptor RING?
  (only used when LD = T)     (LDRING) -- Default: F   ! LDRING = F  !

--Select range of DISCRETE receptors (only used when LD = T):

  Select ALL DISCRETE receptors by setting NDRECP flag to -1;
                               OR
  Select SPECIFIC DISCRETE receptors by entering a flag (0,1) for each
     0 = discrete receptor not processed
     1 = discrete receptor processed
  using repeated value notation to select blocks of receptors:
     23*1, 15*0, 12*1
  Flag for all receptors after the last one assigned is set to 0
  (NDRECP) -- Default: -1
                                               ! NDRECP =  -1  !


--Select range of GRIDDED receptors (only used when LG = T):

       X index of LL corner (IBGRID) -- Default: -1     ! IBGRID = -1  !
           (-1 OR 1 <= IBGRID <= NX)

       Y index of LL corner (JBGRID) -- Default: -1     ! JBGRID = -1  !
           (-1 OR 1 <= JBGRID <= NY)

       X index of UR corner (IEGRID) -- Default: -1     ! IEGRID = -1  !
           (-1 OR 1 <= IEGRID <= NX)

       Y index of UR corner (JEGRID) -- Default: -1     ! JEGRID = -1  !
           (-1 OR 1 <= JEGRID <= NY)

  Note: Entire grid is processed if IBGRID=JBGRID=IEGRID=JEGRID=-1


--Specific gridded receptors can also be excluded from CALPOST
  processing by filling a processing grid array with 0s and 1s.  If the
  processing flag for receptor index (i,j) is 1 (ON), that receptor
  will be processed if it lies within the range delineated by IBGRID,
  JBGRID,IEGRID,JEGRID and if LG=T. If it is 0 (OFF), it will not be
  processed in the run.  By default, all array values are set to 1 (ON).

  Number of gridded receptor rows provided in Subgroup (1a) to
```

```
  identify specific gridded receptors to process
                           (NGONOFF) -- Default: 0       ! NGONOFF =  0  !

!END!
```

Table 10-15 (Continued)
Sample CALPOST Control File (CALPOST.INP)

```
--------------
Subgroup (1a) -- Specific gridded receptors included/excluded
--------------

    Specific gridded receptors are excluded from CALPOST processing
    by filling a processing grid array with 0s and 1s.  A total of
    NGONOFF lines are read here.  Each line corresponds to one 'row'
    in the sampling grid, starting with the NORTHERNMOST row that
    contains receptors that you wish to exclude, and finishing with
    row 1 to the SOUTH (no intervening rows may be skipped).  Within
    a row, each receptor position is assigned either a 0 or 1,
    starting with the westernmost receptor.
       0 = gridded receptor not processed
       1 = gridded receptor processed

    Repeated value notation may be used to select blocks of receptors:
       23*1, 15*0, 12*1

    Because all values are initially set to 1, any receptors north of
    the first row entered, or east of the last value provided in a row,
    remain ON.

    (NGXRECP) -- Default: 1

-------------------------------------------------------------------------------

INPUT GROUP: 2 -- Visibility Parameters (ASPEC = VISIB)
--------------

    Particle growth curve f(RH) for hygroscopic species
                            (MFRH) -- Default: 2   ! MFRH   =  2  !

         1 =  IWAQM (1998) f(RH) curve (originally used with MVISBK=1)
         2 =  FLAG (2000) f(RH) tabulation
         3 =  EPA (2003) f(RH) tabulation

    Maximum relative humidity (%) used in particle growth curve
                           (RHMAX) -- Default: 98  ! RHMAX  = 95.0 !

    Modeled species to be included in computing the light extinction
     Include SULFATE?          (LVSO4) -- Default: T   ! LVSO4  = T  !
     Include NITRATE?          (LVNO3) -- Default: T   ! LVNO3  = T  !
     Include ORGANIC CARBON?   (LVOC)  -- Default: T   ! LVOC   = F  !
     Include COARSE PARTICLES? (LVPMC) -- Default: T   ! LVPMC  = F  !
     Include FINE PARTICLES?   (LVPMF) -- Default: T   ! LVPMF  = F  !
     Include ELEMENTAL CARBON? (LVEC)  -- Default: T   ! LVEC   = T  !

    And, when ranking for TOP-N, TOP-50, and Exceedance tables,
     Include BACKGROUND?       (LVBK)  -- Default: T   ! LVBK   = T  !

    Species name used for particulates in MODEL.DAT file
                 COARSE    (SPECPMC) -- Default: PMC ! SPECPMC = PMC !
                 FINE      (SPECPMF) -- Default: PMF ! SPECPMF = PMF !

Extinction Efficiency (1/Mm per ug/m**3)
----------------------------------------
    MODELED particulate species:
             PM  COARSE      (EEPMC) -- Default: 0.6 ! EEPMC  = 0.6 !
             PM  FINE        (EEPMF) -- Default: 1.0 ! EEPMF  = 1.0 !
    BACKGROUND particulate species:
```

```
               PM  COARSE    (EEPMCBK) -- Default: 0.6 ! EEPMCBK = 0.6 !
    Other species:
              AMMONIUM SULFATE (EESO4) -- Default: 3.0 ! EESO4  = 3.0 !
              AMMONIUM NITRATE (EENO3) -- Default: 3.0 ! EENO3  = 3.0 !
              ORGANIC CARBON   (EEOC)  -- Default: 4.0 ! EEOC   = 4.0 !
              SOIL             (EESOIL)-- Default: 1.0 ! EESOIL = 1.0 !
              ELEMENTAL CARBON (EEEC)  -- Default: 10. ! EEEC   = 10.0 !

Background Extinction Computation
---------------------------------

    Method used for the 24h-average of percent change of light extinction:
    Hourly ratio of source light extinction / background light extinction
    is averaged?               (LAVER) -- Default: F   ! LAVER = F  !
```

Table 10-15 (Continued)
Sample CALPOST Control File (CALPOST.INP)

```
Method used for background light extinction
                          (MVISBK) -- Default: 2   ! MVISBK =  2  !

     1 =  Supply single light extinction and hygroscopic fraction
          - IWAQM (1993) RH adjustment applied to hygroscopic background
            and modeled sulfate and nitrate
     2 =  Compute extinction from speciated PM measurements (A)
          - Hourly RH adjustment applied to observed and modeled sulfate
            and nitrate
          - RH factor is capped at RHMAX
     3 =  Compute extinction from speciated PM measurements (B)
          - Hourly RH adjustment applied to observed and modeled sulfate
            and nitrate
          - Receptor-hour excluded if RH>RHMAX
          - Receptor-day excluded if fewer than 6 valid receptor-hours
     4 =  Read hourly transmissometer background extinction measurements
          - Hourly RH adjustment applied to modeled sulfate and nitrate
          - Hour excluded if measurement invalid (missing, interference,
            or large RH)
          - Receptor-hour excluded if RH>RHMAX
          - Receptor-day excluded if fewer than 6 valid receptor-hours
     5 =  Read hourly nephelometer background extinction measurements
          - Rayleigh extinction value (BEXTRAY) added to measurement
          - Hourly RH adjustment applied to modeled sulfate and nitrate
          - Hour excluded if measurement invalid (missing, interference,
            or large RH)
          - Receptor-hour excluded if RH>RHMAX
          - Receptor-day excluded if fewer than 6 valid receptor-hours
     6 =  Compute extinction from speciated PM measurements
          - FLAG RH adjustment factor applied to observed and
            modeled sulfate and nitrate
     7 =  Compute extinction from speciated PM measurements as in [2]
          for 'unobstructed' conditions;  replace with extinction from
          observed visual range for fog/precipitation conditions
          - Hourly RH adjustment applied to observed and modeled sulfate
            and nitrate
          - RH factor is capped at RHMAX
          - When fog/precip is observed, replace computed Bext with:
              Bext(1/Mm) = 3912/VR(km)

Additional inputs used for MVISBK = 1:
--------------------------------------
 Background light extinction (1/Mm)
                          (BEXTBK) -- No default   ! BEXTBK = 12.0 !
 Percentage of particles affected by relative humidity
                          (RHFRAC) -- No default   ! RHFRAC = 10.0 !

Additional inputs used for MVISBK = 6:
--------------------------------------
 Extinction coefficients for hygroscopic species (modeled and
 background) are computed using a monthly RH adjustment factor
 in place of an hourly RH factor (VISB.DAT file is NOT needed).
 Enter the 12 monthly factors here (RHFAC).  Month 1 is January.

 (RHFAC)  -- No default     ! RHFAC = 0.0, 0.0, 0.0, 0.0,
                                      0.0, 0.0, 0.0, 0.0,
                                      0.0, 0.0, 0.0, 0.0 !
```

```
Additional inputs used for MVISBK = 7:
--------------------------------------
 The weather data file (DATSAV abbreviated space-delimited) that
 is identified as VSRN.DAT may contain data for more than one
 station.  Identify the stations that are needed in the order in
 which they will be used to obtain valid weather and visual range.
 The first station that contains valid data for an hour will be
 used.  Enter up to MXWSTA (set in PARAMS file) integer station IDs
 of up to 6 digits each as variable IDWSTA, and enter the corresponding
 time zone for each, as variable TZONE (= UTC-LST).

 A prognostic weather data file with Bext for weather events may be used
 in place of the observed weather file.  Identify this as the VSRN.DAT
 file and use a station ID of IDWSTA = 999999, and TZONE = 0.
```

Table 10-15 (Continued)
Sample CALPOST Control File (CALPOST.INP)

```
     NOTE:  TZONE identifies the time zone used in the dataset.  The
            DATSAV abbreviated space-delimited data usually are prepared
            with UTC time rather than local time, so TZONE is typically
            set to zero.

     (IDWSTA)   -- No default   * IDWSTA = 000000 *
     (TZONE)    -- No default   * TZONE =      0. *

    Additional inputs used for MVISBK = 2,3,6,7:
    --------------------------------------------
     Background extinction coefficients are computed from monthly
     CONCENTRATIONS of ammonium sulfate (BKSO4), ammonium nitrate (BKNO3),
     coarse particulates (BKPMC), organic carbon (BKOC), soil (BKSOIL), and
     elemental carbon (BKEC).  Month 1 is January.
     (ug/m**3)

     (BKSO4)  -- No default     ! BKSO4 = 0.0, 0.0, 0.0, 0.0,
                                          0.0, 0.0, 0.0, 0.0,
                                          0.0, 0.0, 0.0, 0.0 !
     (BKNO3)  -- No default     ! BKNO3 = 0.0, 0.0, 0.0, 0.0,
                                          0.0, 0.0, 0.0, 0.0,
                                          0.0, 0.0, 0.0, 0.0 !
     (BKPMC)  -- No default     ! BKPMC = 0.0, 0.0, 0.0, 0.0,
                                          0.0, 0.0, 0.0, 0.0,
                                          0.0, 0.0, 0.0, 0.0 !
     (BKOC)   -- No default     ! BKOC  = 0.0, 0.0, 0.0, 0.0,
                                          0.0, 0.0, 0.0, 0.0,
                                          0.0, 0.0, 0.0, 0.0 !
     (BKSOIL) -- No default     ! BKSOIL= 0.0, 0.0, 0.0, 0.0,
                                          0.0, 0.0, 0.0, 0.0,
                                          0.0, 0.0, 0.0, 0.0 !
     (BKEC)   -- No default     ! BKEC  = 0.0, 0.0, 0.0, 0.0,
                                          0.0, 0.0, 0.0, 0.0,

                                          0.0, 0.0, 0.0, 0.0 !

    Additional inputs used for MVISBK = 2,3,5,6,7:
    ----------------------------------------------
     Extinction due to Rayleigh scattering is added (1/Mm)
                            (BEXTRAY) -- Default: 10.0 ! BEXTRAY = 10.0 !

!END!
-------------------------------------------------------------------------------

INPUT GROUP: 3 -- Output options
--------------

Documentation
-------------

    Documentation records contained in the header of the
    CALPUFF output file may be written to the list file.
    Print documentation image?
                               (LDOC) -- Default: F   !  LDOC = F !

Output Units
------------
    Units for All Output       (IPRTU) -- Default: 1   ! IPRTU =  3   !
                     for            for
                Concentration    Deposition
```

```
      1 =         g/m**3         g/m**2/s
      2 =        mg/m**3        mg/m**2/s
      3 =        ug/m**3        ug/m**2/s
      4 =        ng/m**3        ng/m**2/s
      5 =      Odour Units

   Visibility: extinction expressed in 1/Mega-meters (IPRTU is ignored)

Averaging time(s) reported
--------------------------

   1-pd averages           (L1PD) -- Default: F   !   L1PD = T  !
   (pd = averaging period of model output)

   1-hr averages           (L1HR) -- Default: T   !   L1HR = T  !

   3-hr averages           (L3HR) -- Default: T   !   L3HR = F  !
```

Table 10-15 (Continued)
Sample CALPOST Control File (CALPOST.INP)

```
    24-hr averages         (L24HR) -- Default: T   !  L24HR = F  !

    Run-length averages    (LRUNL) -- Default: T   !  LRUNL = F  !

    User-specified averaging time in hours, minutes, seconds
    - results for this averaging time are reported if it is not zero

                           (NAVGH) -- Default: 0   !   NAVGH =  0  !
                           (NAVGM) -- Default: 0   !   NAVGM =  0  !
                           (NAVGS) -- Default: 0   !   NAVGS =  0  !

Types of tabulations reported
------------------------------

   1) Visibility: daily visibility tabulations are always reported
                  for the selected receptors when ASPEC = VISIB.
                  In addition, any of the other tabulations listed
                  below may be chosen to characterize the light
                  extinction coefficients.
                  [List file or Plot/Analysis File]


   2) Top 50 table for each averaging time selected
      [List file only]
                            (LT50) -- Default: T   !   LT50 = F  !

   3) Top 'N' table for each averaging time selected
      [List file or Plot file]
                           (LTOPN) -- Default: F   !  LTOPN = T  !

        -- Number of 'Top-N' values at each receptor
           selected (NTOP must be <= 4)
                            (NTOP) -- Default: 4   ! NTOP =  1   !

        -- Specific ranks of 'Top-N' values reported
           (NTOP values must be entered)
                   (ITOP(4) array) -- Default:     ! ITOP =  1   !
                                      1,2,3,4


   4) Threshold exceedance counts for each receptor and each averaging
      time selected
      [List file or Plot file]
                           (LEXCD) -- Default: F   !  LEXCD = T  !

        -- Identify the threshold for each averaging time by assigning a
           non-negative value (output units).
                                   -- Default: -1.0
           Threshold for  1-hr averages   (THRESH1) !  THRESH1 = 1.000E01 !
           Threshold for  3-hr averages   (THRESH3) !  THRESH3 = -1.0  !
           Threshold for 24-hr averages  (THRESH24) ! THRESH24 = -1.0  !
           Threshold for NAVG-hr averages (THRESHN) !  THRESHN = -1.0  !


        -- Counts for the shortest averaging period selected can be
           tallied daily, and receptors that experience more than NCOUNT
           counts over any NDAY period will be reported.  This type of
           exceedance violation output is triggered only if NDAY > 0.
```

```
        Accumulation period(Days)
                          (NDAY) -- Default: 0   !    NDAY =  0  !
        Number of exceedances allowed
                        (NCOUNT) -- Default: 1   !  NCOUNT =  1  !

   5) Selected day table(s)

      Echo Option -- Many records are written each averaging period
      selected and output is grouped by day
      [List file or Plot file]
                         (LECHO) -- Default: F   !  LECHO = F  !

      Timeseries Option -- Averages at all selected receptors for
      each selected averaging period are written to timeseries files.
      Each file contains one averaging period, and all receptors are
      written to a single record each averaging time.
      [TSttUUUU.DAT files]
                         (LTIME) -- Default: F   !  LTIME = F  !
```

Table 10-15 (Concluded)
Sample CALPOST Control File (CALPOST.INP)

```
        -- Days selected for output
                      (IECHO(366)) -- Default: 366*0
           ! IECHO  = 366*0  !
           (366 values must be entered)

Plot output options
-------------------

     Plot files can be created for the Top-N, Exceedance, and Echo
     tables selected above.  Two formats for these files are available,
     DATA and GRID.  In the DATA format, results at all receptors are
     listed along with the receptor location [x,y,val1,val2,...].
     In the GRID format, results at only gridded receptors are written,
     using a compact representation.  The gridded values are written in
     rows (x varies), starting with the most southern row of the grid.
     The GRID format is given the .GRD extension, and includes headers
     compatible with the SURFER(R) plotting software.

     A plotting and analysis file can also be created for the daily
     peak visibility summary output, in DATA format only.

     Generate Plot file output in addition to writing tables
     to List file?
                             (LPLT) -- Default: F   ! LPLT  = F !

     Use GRID format rather than DATA format,
     when available?
                             (LGRD) -- Default: F   ! LGRD  = F !


Additional Debug Output
-----------------------

   Output selected information to List file
    for debugging?
                           (LDEBUG) -- Default: F  ! LDEBUG  = F !

   Output hourly extinction information to REPORT.HRV?
    (Visibility Method 7)
                          (LVEXTHR) -- Default: F  ! LVEXTHR = F !

!END!
```

Table 10-16: BACK.DAT Record Structure

Header Record

Record No.	Variable	Type	Description	Sample Values
1	CONFACT	real	Multiplicative factor to convert background concentrations to g/m^3, or to convert background deposition fluxes to $g/m^2/s$. For example, CONFACT = .000001 indicates that the background values are in either $\mu g/m^3$ or $\mu g/m^2/s$.	.000001

Data Records (free format)

Variable No.	Variable	Type	Description	Sample Values
1	NYR	integer	Year for record (YYYY)	1994
2	NJDAY	integer	Julian Day for record (JJJ)	210
3	NHR	integer	Hour for record (00-23, time ending)	13
4	XMHBU	real	Background Concentration/Deposition Flux	32.8

Table 10-17: Sample Background Concentration File (BACK.DAT)

```
0.000001
1994   2   1   23.57
1994   2   2   20.95
1994   2   3   20.95
1994   2   4   15.71
1994   2   5   23.57
1994   2   6   28.81
1994   2   7   28.81
1994   2   8   26.19
1994   2   9   31.43
1994   2  10   23.57
1994   2  11   20.95
1994   2  12   18.33
1994   2  13   15.71
1994   2  14   15.71
1994   2  15   13.09
1994   2  16   13.09
1994   2  17   13.09
1994   2  18   10.48
1994   2  19   13.09
1994   2  20   15.71
1994   2  21   13.09
1994   2  22   10.48
1994   2  23   10.48
1994   3   0   13.09
```

Table 10-18: Sample Transmissometer File (VSRN.DAT)
(Partial Listing)

SITE	YYYYMMDD	JD	HHMM	BEXT	UC	#	#	UT	DT	MAX	V	A	AT	U	C	RH	U	C	DV
YOSE	19890317	76	0	19	2	1	0	-99	-99	1105	0		0	1	0	78	5	0	64
YOSE	19890317	76	100	17	2	1	0	-99	-99	1105	0		-1	1	0	84	5	0	53
YOSE	19890317	76	200	16	2	1	0	-99	-99	1105	0		0	1	0	80	5	0	47
YOSE	19890317	76	300	14	2	1	0	-99	-99	1105	0		1	1	0	65	5	0	34
YOSE	19890317	76	400	18	2	1	0	-99	-99	1105	0		-1	1	0	76	5	0	59
YOSE	19890317	76	500	16	2	1	0	-99	-99	1105	0		-1	1	0	79	5	0	47
YOSE	19890317	76	600	12	2	1	0	-99	-99	1105	0		-1	1	0	71	5	0	18
YOSE	19890317	76	700	16	2	1	0	-99	-99	1105	0		1	1	0	67	5	0	47
YOSE	19890317	76	800	16	2	1	0	-99	-99	1105	0		4	1	0	48	5	0	47
YOSE	19890317	76	900	20	2	1	0	-99	-99	1105	0		11	1	0	34	5	0	69
YOSE	19890317	76	1000	21	2	1	0	-99	-99	1105	0		9	1	0	32	5	0	74
YOSE	19890317	76	1100	25	2	1	0	-99	-99	1105	0		10	1	0	30	5	0	92
YOSE	19890317	76	1200	33	2	1	0	-99	-99	1105	0		9	1	0	45	5	0	119
YOSE	19890317	76	1300	45	2	1	0	-99	-99	1105	0		9	1	0	51	5	0	150
YOSE	19890317	76	1400	55	2	1	0	-99	-99	1105	0		10	1	0	58	5	0	170
YOSE	19890317	76	1500	67	2	1	0	-99	-99	1105	0		10	1	0	62	5	0	190
YOSE	19890317	76	1600	99	2	1	0	-99	-99	1105	0		8	1	0	70	5	0	229
YOSE	19890317	76	1700	60	2	1	0	-99	-99	1105	0		9	1	0	74	5	0	179
YOSE	19890317	76	1800	42	2	1	0	-99	-99	1105	0		6	1	0	84	5	0	144
YOSE	19890317	76	1900	37	2	0	1	-99	-99	1105	1	A	5	1	0	92	5	0	131
YOSE	19890317	76	2000	33	2	1	0	-99	-99	1105	0		6	1	0	82	5	0	119
YOSE	19890317	76	2100	29	2	1	0	-99	-99	1105	0		6	1	0	82	5	0	106
YOSE	19890317	76	2200	32	2	1	0	-99	-99	1105	0		6	1	0	83	5	0	116
YOSE	19890317	76	2300	30	2	1	0	-99	-99	1105	0		6	1	0	83	5	0	110
YOSE	19890318	77	0	35	2	1	0	-99	-99	1105	0		7	1	0	80	5	0	125

Field	Description
SITE	Site abbreviation
YYYYMMDD	Date (4-digit year/month/day)
JD	Julian Date
HHMM	Time using a 24-hour clock in hour/minute format
BEXT	bext (Mm^{-1})
UC	bext uncertainty (Mm^{-1})
#	Number of readings in average
#	Number of readings not in average due to weather
UT	Uncertainty threshold (Mm^{-1})
DT	threshold (Mm^{-1})
MAX	Maximum threshold (Mm^{-1})
V	bext validity code (0=valid, 1=interference, 2=invalid, 9=suspect)
A	bext validity interference subcode
AT	Temperature (°C)
U	Temperature uncertainty (°C)
C	Temperature validity code
RH	Relative humidity (%)
U	Relative humidity uncertainty (%)
C	Relative humidity validity code (0=valid, 2=invalid, 9=suspect)
DV	Haziness (deciview x 10)

Table 10-19: Sample Nephelometer File (VSRN.DAT)

(Partial Listing)

SITE	YYYYMMDD	JD	HHMM	INS	BSP	PREC	V	A	RAW-M	RAW-SD	#	N/A	SD/M	DEL	MAX	RH	0123456789mPMOT	YINTER	SLOPE	AT	AT-SD	#	AT-PR	CT	CT-SD	#	CT-PR	RH	RH-SD	#	RH-PR N/A
MOZ2	19941009	282	0000	048	22	0.140	0		43.33	1.60	12	-99.0	10.0	50	5000	90	0C0000000000000	-18.9	1.12	-3.58	0.19	12	1.00	-3.01	0.14	12	1.00	85.17	1.06	12	2.00XXXX
MOZ2	19941009	282	0100	048	17	0.140	0		38.87	1.36	12	-99.0	10.0	50	5000	90	0C0000000000000	-18.9	1.12	-3.67	0.23	12	1.00	-2.79	0.10	12	1.00	82.03	0.93	12	2.00XXXX
MOZ2	19941009	282	0200	048	18	0.140	0		40.24	0.71	12	-99.0	10.0	50	5000	90	0C0000000000000	-18.8	1.12	-3.94	0.10	12	1.00	-2.94	0.05	12	1.00	84.49	0.72	12	2.00XXXX
MOZ2	19941009	282	0300	048	19	0.140	0		40.54	1.47	12	-99.0	10.0	50	5000	90	0C0000000000000	-18.7	1.12	-4.07	0.07	12	1.00	-3.06	0.04	12	1.00	84.49	1.40	12	2.00XXXX
MOZ2	19941009	282	0400	048	16	0.140	0		38.57	1.72	10	-99.0	10.0	50	5000	90	0A2000000000003	-18.7	1.12	-4.30	0.11	12	1.00	-3.19	0.09	9	1.00	82.56	0.84	12	2.00XXXX
MOZ2	19941009	282	0500	048	18	0.140	0		39.50	1.40	12	-99.0	10.0	50	5000	90	0C0000000000000	-18.7	1.12	-4.40	0.21	12	1.00	-3.33	0.13	12	1.00	82.87	1.13	12	2.00XXXX
MOZ2	19941009	282	0600	048	15	0.140	0		37.24	1.04	12	-99.0	10.0	50	5000	90	0C0000000000000	-18.7	1.12	-4.16	0.16	12	1.00	-3.05	0.20	12	1.00	79.12	1.44	12	2.00XXXX
MOZ2	19941009	282	0700	048	13	0.140	0		35.60	1.34	12	-99.0	10.0	50	5000	90	0C0000000000000	-18.7	1.12	-3.62	0.43	12	1.00	-2.23	0.41	12	1.00	76.14	2.20	12	2.00XXXX
MOZ2	19941009	282	0800	048	10	0.140	0		32.62	1.26	12	-99.0	10.0	50	5000	90	0C0000000000000	-18.7	1.12	-2.02	0.48	12	1.00	-0.29	0.63	11	1.00	69.82	1.82	12	2.00XXXX
MOZ2	19941009	282	0900	048	10	0.140	0		32.75	1.42	12	-99.0	10.0	50	5000	90	0C0000000000000	-18.7	1.12	-0.69	0.31	12	1.00	1.32	0.33	12	1.00	65.75	1.18	12	2.00XXXX
MOZ2	19941009	282	1000	048	10	0.140	0		32.94	1.73	10	-99.0	10.0	50	5000	90	0A2000000000003	-18.7	1.12	0.24	0.30	12	1.00	2.03	0.40	9	1.00	63.34	1.71	12	2.00XXXX
MOZ2	19941009	282	1100	048	15	0.140	0		37.18	1.47	12	-99.0	10.0	50	5000	90	0C0000000000000	-18.8	1.12	1.23	0.29	12	1.00	3.13	0.28	12	1.00	66.90	1.48	12	2.00XXXX
MOZ2	19941009	282	1200	048	15	0.140	0		37.44	1.76	12	-99.0	10.0	50	5000	90	0C0000000000000	-19.1	1.12	2.13	0.23	12	1.00	4.27	0.27	12	1.00	64.31	1.93	12	2.00XXXX
MOZ2	19941009	282	1300	048	12	0.140	0		35.03	1.17	12	-99.0	10.0	50	5000	90	0C0000000000000	-19.3	1.12	2.74	0.32	12	1.00	4.74	0.35	12	1.00	57.82	4.01	10	2.00XXXX
MOZ2	19941009	282	1400	048	9	0.140	0		32.69	0.83	12	-99.0	10.0	50	5000	90	0C0000000000000	-19.6	1.12	3.86	0.34	12	1.00	5.73	0.34	12	1.00	51.25	2.95	12	2.00XXXX
MOZ2	19941009	282	1500	048	10	0.140	0		33.59	0.98	12	-99.0	10.0	50	5000	90	0C0000000000000	-19.8	1.12	4.35	0.17	12	1.00	5.94	0.20	12	1.00	50.14	1.11	12	2.00XXXX
MOZ2	19941009	282	1600	048	10	0.140	0		34.10	1.64	12	-99.0	10.0	50	5000	90	0C0000000000001	-20.1	1.12	3.82	0.22	12	1.00	5.25	0.23	11	1.00	51.88	1.66	12	2.00XXXX
MOZ2	19941009	282	1700	048	11	0.140	0		34.78	1.66	10	-99.0	10.0	50	5000	90	0A2000000000002	-20.3	1.12	2.18	0.75	12	1.00	3.46	0.93	10	1.00	57.44	2.77	12	2.00XXXX
MOZ2	19941009	282	1800	048	11	0.140	0		35.13	0.73	12	-99.0	10.0	50	5000	90	0C0000000000000	-20.4	1.12	1.12	0.22	12	1.00	2.01	0.23	12	1.00	58.90	1.04	12	2.00XXXX
MOZ2	19941009	282	1900	048	10	0.140	0		34.22	0.96	12	-99.0	10.0	50	5000	90	0C0000000000000	-20.4	1.12	0.71	0.13	12	1.00	1.56	0.11	12	1.00	56.36	1.23	12	2.00XXXX
MOZ2	19941009	282	2000	048	10	0.140	0		34.27	1.51	12	-99.0	10.0	50	5000	90	0C0000000000000	-20.4	1.12	0.02	0.13	12	1.00	0.89	0.16	12	1.00	56.45	0.99	12	2.00XXXX
MOZ2	19941009	282	2100	048	9	0.140	0		33.52	0.64	12	-99.0	10.0	50	5000	90	0C0000000000000	-20.4	1.12	-0.17	0.06	12	1.00	0.61	0.06	12	1.00	55.21	0.41	12	2.00XXXX
MOZ2	19941009	282	2200	048	9	0.140	0		33.48	0.89	12	-99.0	10.0	50	5000	90	0C0000000000000	-20.5	1.12	-0.33	0.04	12	1.00	0.43	0.03	12	1.00	54.33	1.55	12	2.00XXXX
MOZ2	19941009	282	2300	048	8	0.140	0		32.90	0.77	10	-99.0	10.0	50	5000	90	0A2000000000003	-20.5	1.12	-0.26	0.08	12	1.00	0.50	0.07	9	1.00	47.41	0.78	12	2.00XXXX
MOZ2	19941010	283	0000	048	8	0.140	0		32.44	0.63	12	-99.0	10.0	50	5000	90	0C0000000000000	-20.4	1.12	-0.42	0.16	12	1.00	0.41	0.11	12	1.00	48.51	1.46	12	2.00XXXX

Field	Description
SITE	Site Abbreviation
YYYYMMDD	Date (4-digit year/month/day)
JD	Julian Date
HHMM	Time using a 24-hour clock in hour/minute format
INS	Nephelometer Serial Number
BSP	bsp (Mm^{-1}) X Particle scattering coefficient = Total - Rayleigh
PREC	bsp Estimated Precision (%/100)
V	bsp Validity Code(0=valid, 1=interference, 2=invalid, 9=suspect)
A	bsp Interference Code
RAW-M	Raw Nephelometer Hourly Average (Counts)
RAW-SD	Standard Deviation of Raw Nephelometer Average (Counts)
#	Number of Data Points in Hourly Nephelometer Average
N/A	(Not Used)
SD/M	Standard Deviation/Mean Interference Threshold
DEL	bsp Rate of Change Interference Threshold
MAX	Maximum bsp Interference Threshold
RH	Relative Humidity Interference Threshold
0123456789mPMOT	Composite Nephelometer Code Summary
YINTER	Y-intercept of Calibration Line Used to Calculate bsp
SLOPE	Slope of Calibration Line Used to Calculate bsp
AT	Average Ambient Temperature (°C)
AT-SD	Standard Deviation of Hourly AT Average
#	Number of Data Points in Hourly AT Average
AT-PR	Estimated Precision of Ambient Temperature
CT	Average Nephelometer Chamber Temperature (°C)
CD-SD	Standard Deviation of Hourly CT Average
#	Number of Data Points in Hourly CT Average
CT-PR	Estimated Precision of Chamber Temperature
RH	Average Relative Humidity (%)
RH-SD	Standard Deviation of Hourly RH Average

#	Number of Data Points in Hourly RH Average
RH-PR	Estimated Precision of Relative Humidity

10.6 Output Files

10.6.1 List File (CALPOST.LST)

The list file has four logical sections. The first section contains an image of the control file inputs; the second section contains a summary of these inputs and it documents the content of the CALPUFF output file that is processed; the third section contains the tabulations of CALPOST results requested by the user; and the fourth section reports the peak value(s) obtained for each averaging time processed. An example list file is shown in Table 10-20, with the first logical section removed (the image of the input control file).

Each table contains specific reference to the averaging time, the pollutant species (CALPOST processes a single species at a time), concentration/deposition units, receptor locations, and the date and time (marked at the end of the averaging period). When visibility is assessed, the modeled extinction in inverse megameters (1/Mm) is processed and reported just like concentration or deposition. In addition, the peak daily average visibility reduction is reported for each day processed, characterized as either a percent change in extinction (from background), or as a change in deciview.

10.6.2 Visibility File (DAILY_VISIB_VUNAM.DAT)

When visibility processing is selected and plot-files are requested, the peak daily average visibility reduction tabulations written to the list file are written to disk as a visibility file as well. This facilitates the use of subsequent analysis tools, such as spreadsheets. The record format is the same as that used in the list file.

10.6.3 Plot-file(s)

CALPOST can generate a set of optional plot-files containing the "top N" highest concentrations/deposition fluxes at each receptor, the number of exceedances of user-specified threshold values at each receptor and averaging time, or the values of concentration/deposition flux for user-specified time periods. Two formats are available for these plot-files. The first, called DATA format, is of the form: receptor (X, Y), value1, ... , value4 as described in Table 10-21. This comma-delimited format is suitable for both gridded and discrete receptor data. It is compatible with many of the popular PC-based graphics and analysis packages. An example of this format is shown in Table 10-22. The second format, called the GRID format is appropriate for gridded receptor fields only. It is directly compatible with the contouring option of the Surfer7 plotting package (i.e., it bypasses the need to first interpolate the data to a regular rectangular grid by the plotting package). Its record structure is described in Table 10-23, and an example is shown in Table 10-24.

10.6.4 Timeseries File(s)

CALPOST can generate a set of optional timeseries files for the concentration, deposition flux, or extinction coefficient identified in the CALPOST control file, at each receptor selected, for each averaging time selected. Each averaging time is placed in a separate file, so there may be as many as five timeseries files generated (1-period, 1-hour, 3-hour, 24-hour and N-user averages). The period covered by the timeseries is controlled by the selected day option as well as the period processed. No timeseries output is generated if no days are selected. All averages in the period processed are written to the timeseries file(s) if all days are selected.

For a given time (e.g, the 3-hour period beginning at 0900 on Julian day 310), the current averages for all selected receptors are written as a single "record". The length of the record grows as the number of receptors increases. Therefore, the timeseries option should be used with a manageable subset of the receptors contained in the CALPUFF simulation.

The format of the timeseries file is described in Table 10-25. The file contains a number of header records that identify the parameter that is reported, its units and averaging time, and the number of receptors included. The location of each receptor is provided. Data records follow, with a single record for each time period. An example timeseries file for 30-minute averages of SO_2 at one gridded receptor for a single 4-hour period is shown in Table 10-26.

Table 10-20: Sample CALPOST Output File (CALPOST.LST)

(Partial Listing)

```
*******************************************************************************************************************************
*
                                              CALPOST  Version 6.11          Level 051012
*******************************************************************************************************************************
*

  CALPOST Control File Input Summary ------------------------

     Replace run data with data in Puff file 1=Y:    1
                       Run starting date -- year: 1988
                                           month:    7
                                             day:    7
                                      Julian day:    0
             Time at start of run  -  hour(0-23):    0
                                   -      minute:    0
                                   -      second:    0

                         Run ending date -- year: 1988
                                           month:    7
                                             day:    7
                                      Julian day:    0
               Time at end of run  -  hour(0-23):    1
                                   -      minute:    0
                                   -      second:    0


                                  Base time zone: from CALPUFF

 Every period of data processed -- NREP = 1


  Species & Concentration/Deposition Information
                                         Species: SO2
                         Layer of processed data:    1
     (>0=conc, -1=dry flux, -2=wet flux, -3=wet & dry flux)
                   Multiplicative scaling factor: 0.0000E+00
                         Additive scaling factor: 0.0000E+00
                  Hourly background values used?: F


  SAMPLER option
                               Processing method: 0
                   0= SAMPLER option not used
                   1= Report total modeled impact (list file)
                   2= TRACEBACK mode (DAT files)
                   3= TRACEBACK mode with sampling factor (DAT files)


  Source information
                  Source contribution processing: 0
                   0= No source contributions
                   1= Contributions are summed
                   2= TRACEBACK mode for 1 receptor
                   3= Reported TOTAL is processed


  Receptor information
                    Gridded receptors processed?: T
                   Discrete receptors processed?: F
       CTSG Complex terrain receptors processed?: F

  Gridded Receptors Processed

                                     Begin at ix:   10
                                       End at ix:   15
                                     Begin at iy:   15
                                       End at iy:   20


  Visibility Processing is NOT Selected
```

Table 10-20 (Continued)
Sample CALPOST Output File (CALPOST.LST)
(Partial Listing)

```
 Output options
                    Units requested for output:   (ug/m**3)

 Averaging time(s) selected
       User-specified averaging time (hr:mm:ss):     0:60: 0
                                 1-pd averages:     T
                                 1-hr averages:     F
                                 3-hr averages:     T
                                24-hr averages:     F
                         User-specified averages:     T
                          Length of run averages:     F

 Output components selected
                                        Top-50:     F
                 Top-N values at each receptor:     T
            Exceedance counts at each receptor:     T
      Output selected information for debugging:     F
                 Echo tables for selected days:     T
                 Time-series for selected days:     F
      Peak value Time-series for selected days:     F

 Top "n" table control
        Number of "top" values at each receptor:     1
        Specific ranks of "top" values reported:   1


 Plot file option
                             Plot files created:     T
                       Plot file format is DATA:  .DAT


 Threshold Exceedance control
      Exceedances of a specified value will be counted for --
                        3-hr averages exceeding: 1.0000E+01
              User-specified averages exceeding: 1.0000E+01


 Days selected for output tables
    1111111111  1111111111  1111111111  1111111111  1111111111  1111111111  1111111111  1111111111  1111111111  1111111111
    1111111111  1111111111  1111111111  1111111111  1111111111  1111111111  1111111111  1111111111  1111111111  1111111111
    1111111111  1111111111  1111111111  1111111111  1111111111  1111111111  1111111111  1111111111  1111111111  1111111111
    1111111111  1111111111  1111111111  1111111111  1111111111  1111111111  111111

IDENTIFICATION OF PROCESSED MODEL FILE ----------

CALPUFF     6.1         050915

CALPUFF Demonstration Run
1800 sec Steps
Emission & Sampling Limit 0.1 grid cell

Averaging time for values reported from model:
      30  MINUTE

Number of averaging periods in file from model:
      8

Chemical species names for each layer in model:
SO2           1
SO4           1
NO            1
NO2           1
HNO3          1
NO3           1
PM10          1

-------------------------------------------------------------------------------------------------------------------------------
-
```

Table 10-20 (Continued)
Sample CALPOST Output File (CALPOST.LST)
(Partial Listing)

```
         INPUT FILES

 Default Name     Unit No.     File Name and Path
 ------------     --------     ------------------
  CALPOST.INP         5        manual.inp
    MODEL.DAT         4        cpuf.con
 -----------------------------------------------------------------------------------------------------------------------------
-
         OUTPUT FILES

 Default Name     Unit No.     File Name and Path
 ------------     --------     ------------------
  CALPOST.LST         8        manual.lst
       (TOPN)        11        RANK()_SPECIES_ttHR_CONC.DAT
     (EXCEED)        11        EXCEED_SPECIES_ttHR_CONC.DAT
       (ECHO)        11        yyyy_Mmm_Ddd_hh00(UTC+0000)_L00_SPECIES_ttHR_CONC.DAT
   ------------------------------------------------
 ECHO OPTION -
 ------------------------------------------------
  CONCENTRATION AT EACH RECEPTOR IS PRINTED FOR THE FOLLOWING DAYS (0=NOT printed; 1=PRINTED):
1111111111   1111111111   1111111111   1111111111   1111111111   1111111111   1111111111   1111111111   1111111111   1111111111
1111111111   1111111111   1111111111   1111111111   1111111111   1111111111   1111111111   1111111111   1111111111   1111111111
1111111111   1111111111   1111111111   1111111111   1111111111   1111111111   1111111111   1111111111   1111111111   1111111111
1111111111   1111111111   1111111111   1111111111   1111111111   1111111111   111111
 AND FOR THE FOLLOWING AVERAGING PERIODS:    (NOTE THAT THE AVERAGING PERIOD IN MODEL IS  30 MINUTE )
                   3   HOUR
                  30 MINUTE
                  60 MINUTE

       30 MINUTE AVERAGE  CONCENTRATION AT EACH RECEPTOR FOR THE PERIOD STARTING   YEAR: 1990 DAY:   9 HOUR:  4 SEC:    0
 GRIDDED RECEPTORS:

 SO2           1

 GRID NOT PRINTED -- all values zero


        1   HOUR AVERAGE  CONCENTRATION AT EACH RECEPTOR FOR THE PERIOD STARTING   YEAR: 1990 DAY:   9 HOUR:  4 SEC:    0
 GRIDDED RECEPTORS:

 SO2           1

 Multiply all values by 10 **  -3

  20 I    0     0     0     0     0     0
     I    +     +     +     +     +     +
  19 I    0     0     0     0     0     0
     I    +     +     +     +     +     +
  18 I    0     0     0     0     0     0
     I    +     +     +     +     +     +
  17 I   62   300     6     0     0     0
     I    +     +     +     +     +     +
  16 I 3555   892     7     0     0     0
     I    +     +     +     +     +     +
  15 I   58     0     0     0     0     0
     I    +     +     +     +     +     +
     -----------------------------------
         10    11    12    13    14    15
```

Table 10-20 (Continued)
Sample CALPOST Output File (CALPOST.LST)
(Partial Listing)

```
      30 MINUTE AVERAGE  CONCENTRATION AT EACH RECEPTOR FOR THE PERIOD STARTING   YEAR: 1990 DAY:   9 HOUR:  4 SEC: 1800
GRIDDED RECEPTORS:

SO2          1

Multiply all values by 10 **  -3

 20 I    0     0     0     0     0     0
    I    +     +     +     +     +     +
 19 I    0     0     0     0     0     0
    I    +     +     +     +     +     +
 18 I    0     0     0     0     0     0
    I    +     +     +     +     +     +
 17 I  123   600    13     0     0     0
    I    +     +     +     +     +     +
 16 I 7110  1784    13     0     0     0
    I    +     +     +     +     +     +
 15 I  116     0     0     0     0     0
    I    +     +     +     +     +     +
    -----------------------------------
        10    11    12    13    14    15

      30 MINUTE AVERAGE  CONCENTRATION AT EACH RECEPTOR FOR THE PERIOD STARTING   YEAR: 1990 DAY:   9 HOUR:  5 SEC:    0
GRIDDED RECEPTORS:

SO2          1

Multiply all values by 10 **  -2

 20 I    0     0     0     6     6     0
    I    +     +     +     +     +     +
 19 I    0     0     4   115    39     0
    I    +     +     +     +     +     +
 18 I    0     0    86   323    16     0
    I    +     +     +     +     +     +
 17 I    5   419   816   207     0     0
    I    +     +     +     +     +     +
 16 I 1276  2323   434     2     0     0
    I    +     +     +     +     +     +
 15 I   99    18     0     0     0     0
    I    +     +     +     +     +     +
    -----------------------------------
        10    11    12    13    14    15

       1   HOUR AVERAGE  CONCENTRATION AT EACH RECEPTOR FOR THE PERIOD STARTING   YEAR: 1990 DAY:   9 HOUR:  5 SEC:    0
GRIDDED RECEPTORS:

SO2          1

Multiply all values by 10 **  -2

 20 I    0     0     0    75   310    44
    I    +     +     +     +     +     +
 19 I    0     0     7   321   223     2
    I    +     +     +     +     +     +
 18 I    0     0   108   562    46     0
    I    +     +     +     +     +     +
 17 I    2   320   917   322     0     0
    I    +     +     +     +     +     +
 16 I 1153  2558   652     8     0     0
    I    +     +     +     +     +     +
 15 I  119    32     0     0     0     0
    I    +     +     +     +     +     +
    -----------------------------------
        10    11    12    13    14    15
```

Table 10-20 (Continued)
Sample CALPOST Output File (CALPOST.LST)
(Partial Listing)

```
      30 MINUTE AVERAGE  CONCENTRATION AT EACH RECEPTOR FOR THE PERIOD STARTING   YEAR: 1990 DAY:   9 HOUR:  5 SEC: 1800
GRIDDED RECEPTORS:

SO2          1

Multiply all values by 10 **  -2

 20 I    0     0     0   144   613    89
    I    +     +     +     +     +     +
 19 I    0     0    10   527   408     4
    I    +     +     +     +     +     +
 18 I    0     0   131   802    76     0
    I    +     +     +     +     +     +
 17 I    0   220  1018   436     0     0
    I    +     +     +     +     +     +
 16 I 1029  2792   871    14     0     0
    I    +     +     +     +     +     +
 15 I  139    45     0     0     0     0
    I    +     +     +     +     +     +
    -----------------------------------
        10    11    12    13    14    15

      30 MINUTE AVERAGE  CONCENTRATION AT EACH RECEPTOR FOR THE PERIOD STARTING   YEAR: 1990 DAY:   9 HOUR:  6 SEC:    0
GRIDDED RECEPTORS:

SO2          1

Multiply all values by 10 **  -2

 20 I    0     0     0   143   702   135
    I    +     +     +     +     +     +
 19 I    0     0     9   515   440     8
    I    +     +     +     +     +     +
 18 I    0     0   126   801    83     0
    I    +     +     +     +     +     +
 17 I    0   171   982   444     0     0
    I    +     +     +     +     +     +
 16 I  810  2781   983    15     0     0
    I    +     +     +     +     +     +
 15 I  216    85     0     0     0     0
    I    +     +     +     +     +     +
    -----------------------------------
        10    11    12    13    14    15

       1   HOUR AVERAGE  CONCENTRATION AT EACH RECEPTOR FOR THE PERIOD STARTING   YEAR: 1990 DAY:   9 HOUR:  6 SEC:    0
GRIDDED RECEPTORS:

SO2          1

Multiply all values by 10 **  -2

 20 I    0     0     0   140   692   134
    I    +     +     +     +     +     +
 19 I    0     0     9   505   438     8
    I    +     +     +     +     +     +
 18 I    0     0   122   797    85     0
    I    +     +     +     +     +     +
 17 I    0   144   976   456     0     0
    I    +     +     +     +     +     +
 16 I  711  2742  1121    18     0     0
    I    +     +     +     +     +     +
 15 I  278   119     0     0     0     0
    I    +     +     +     +     +     +
    -----------------------------------
        10    11    12    13    14    15
```

Table 10-20 (Continued)
Sample CALPOST Output File (CALPOST.LST)
(Partial Listing)

```
      3   HOUR AVERAGE  CONCENTRATION AT EACH RECEPTOR FOR THE PERIOD STARTING   YEAR: 1990 DAY:   9 HOUR:  4 SEC:    0
GRIDDED RECEPTORS:

SO2          1

Multiply all values by 10 **  -2

 20 I    0     0     0    72   334    59
    I    +     +     +     +     +     +
 19 I    0     0     5   275   220     3
    I    +     +     +     +     +     +
 18 I    0     0    77   453    44     0
    I    +     +     +     +     +     +
 17 I    3   165   631   259     0     0
    I    +     +     +     +     +     +
 16 I  740  1796   591     9     0     0
    I    +     +     +     +     +     +
 15 I  134    50     0     0     0     0
    I    +     +     +     +     +     +
    -----------------------------------
        10    11    12    13    14    15

      30 MINUTE AVERAGE  CONCENTRATION AT EACH RECEPTOR FOR THE PERIOD STARTING   YEAR: 1990 DAY:   9 HOUR:  6 SEC: 1800
GRIDDED RECEPTORS:

SO2          1

Multiply all values by 10 **  -2

 20 I    0     0     0   137   682   133
    I    +     +     +     +     +     +
 19 I    0     0     8   496   435     8
    I    +     +     +     +     +     +
 18 I    0     0   119   793    87     0
    I    +     +     +     +     +     +
 17 I    0   118   969   467     0     0
    I    +     +     +     +     +     +
 16 I  612  2704  1259    21     0     0
    I    +     +     +     +     +     +
 15 I  340   154     0     0     0     0
    I    +     +     +     +     +     +
    -----------------------------------
        10    11    12    13    14    15

      30 MINUTE AVERAGE  CONCENTRATION AT EACH RECEPTOR FOR THE PERIOD STARTING   YEAR: 1990 DAY:   9 HOUR:  7 SEC:    0
GRIDDED RECEPTORS:

SO2          1

Multiply all values by 10 **  -2

 20 I    0     0     0   144   636   163
    I    +     +     +     +     +     +
 19 I    0     0    12   470   442    17
    I    +     +     +     +     +     +
 18 I    0     0   121   748   110     0
    I    +     +     +     +     +     +
 17 I    0   120   912   478     1     0
    I    +     +     +     +     +     +
 16 I  588  2408  1305    31     0     0
    I    +     +     +     +     +     +
 15 I  372   213     5     0     0     0
    I    +     +     +     +     +     +
    -----------------------------------
        10    11    12    13    14    15
```

Table 10-20 (Continued)
Sample CALPOST Output File (CALPOST.LST)
(Partial Listing)

```
       1   HOUR AVERAGE  CONCENTRATION AT EACH RECEPTOR FOR THE PERIOD STARTING   YEAR: 1990 DAY:   9 HOUR:  7 SEC:    0
GRIDDED RECEPTORS:

SO2          1

Multiply all values by 10 **  -2

 20 I    0     0     0   152   589   188
    I    +     +     +     +     +     +
 19 I    0     0    18   454   432    24
    I    +     +     +     +     +     +
 18 I    1     7   145   704   121     0
    I    +     +     +     +     +     +
 17 I   21   201   896   479     9     0
    I    +     +     +     +     +     +
 16 I  576  1987  1229    70     2     0
    I    +     +     +     +     +     +
 15 I  424   306    61     7     1     0
    I    +     +     +     +     +     +
    -----------------------------------
        10    11    12    13    14    15

      30 MINUTE AVERAGE  CONCENTRATION AT EACH RECEPTOR FOR THE PERIOD STARTING   YEAR: 1990 DAY:   9 HOUR:  7 SEC: 1800
GRIDDED RECEPTORS:

SO2          1

Multiply all values by 10 **  -2

 20 I    0     0     0   160   541   213
    I    +     +     +     +     +     +
 19 I    0     0    24   439   422    30
    I    +     +     +     +     +     +
 18 I    3    14   169   660   131     0
    I    +     +     +     +     +     +
 17 I   42   282   880   480    18     0
    I    +     +     +     +     +     +
 16 I  564  1567  1153   109     3     0
    I    +     +     +     +     +     +
 15 I  476   400   117    13     1     0
    I    +     +     +     +     +     +
    -----------------------------------
        10    11    12    13    14    15
```

Table 10-20 (Continued)
Sample CALPOST Output File (CALPOST.LST)
(Partial Listing)

```
********************************************************************************************************************************
*
                                              CALPOST  Version 6.11          Level 051012
********************************************************************************************************************************
*


                                                        SO2           1


 1 RANKED    30 MINUTE AVERAGE  CONCENTRATION VALUES AT EACH GRIDDED RECEPTOR  (YEAR,DAY,START TIME)   (ug/m**3)

RECEPTOR     COORDINATES (km)            1 RANK
  10, 15     347.500  4873.500   4.7620E+00 (1990,009,0730)
  10, 16     347.500  4874.500   1.2761E+01 (1990,009,0500)
  10, 17     347.500  4875.500   4.2162E-01 (1990,009,0730)
  10, 18     347.500  4876.500   2.5579E-02 (1990,009,0730)
  10, 19     347.500  4877.500   0.0000E+00 (1990,009,0400)
  10, 20     347.500  4878.500   0.0000E+00 (1990,009,0400)
  11, 15     348.500  4873.500   3.9999E+00 (1990,009,0730)
  11, 16     348.500  4874.500   2.7921E+01 (1990,009,0530)
  11, 17     348.500  4875.500   4.1897E+00 (1990,009,0500)
  11, 18     348.500  4876.500   1.4227E-01 (1990,009,0730)
  11, 19     348.500  4877.500   3.8896E-03 (1990,009,0730)
  11, 20     348.500  4878.500   0.0000E+00 (1990,009,0400)
  12, 15     349.500  4873.500   1.1704E+00 (1990,009,0730)
  12, 16     349.500  4874.500   1.3046E+01 (1990,009,0700)
  12, 17     349.500  4875.500   1.0177E+01 (1990,009,0530)
  12, 18     349.500  4876.500   1.6916E+00 (1990,009,0730)
  12, 19     349.500  4877.500   2.3593E-01 (1990,009,0730)
  12, 20     349.500  4878.500   4.7590E-04 (1990,009,0730)
  13, 15     350.500  4873.500   1.3057E-01 (1990,009,0730)
  13, 16     350.500  4874.500   1.0885E+00 (1990,009,0730)
  13, 17     350.500  4875.500   4.7962E+00 (1990,009,0730)
  13, 18     350.500  4876.500   8.0180E+00 (1990,009,0530)
  13, 19     350.500  4877.500   5.2743E+00 (1990,009,0530)
  13, 20     350.500  4878.500   1.5970E+00 (1990,009,0730)
  14, 15     351.500  4873.500   1.0976E-02 (1990,009,0730)
  14, 16     351.500  4874.500   3.1578E-02 (1990,009,0730)
  14, 17     351.500  4875.500   1.7673E-01 (1990,009,0730)
  14, 18     351.500  4876.500   1.3150E+00 (1990,009,0730)
  14, 19     351.500  4877.500   4.4243E+00 (1990,009,0700)
  14, 20     351.500  4878.500   7.0209E+00 (1990,009,0600)
  15, 15     352.500  4873.500   0.0000E+00 (1990,009,0400)
  15, 16     352.500  4874.500   0.0000E+00 (1990,009,0400)
  15, 17     352.500  4875.500   0.0000E+00 (1990,009,0400)
  15, 18     352.500  4876.500   5.2182E-04 (1990,009,0730)
  15, 19     352.500  4877.500   3.0323E-01 (1990,009,0730)
  15, 20     352.500  4878.500   2.1260E+00 (1990,009,0730)

   1 - RANK HIGHEST VALUES FOR PERIOD

 Multiply all values by 10 **  -2

  20 I    0     0     0   160   702   213
     I    +     +     +     +     +     +
  19 I    0     0    24   527   442    30
     I    +     +     +     +     +     +
  18 I    3    14   169   802   131     0
     I    +     +     +     +     +     +
  17 I   42   419  1018   480    18     0
     I    +     +     +     +     +     +
  16 I 1276  2792  1305   109     3     0
     I    +     +     +     +     +     +
  15 I  476   400   117    13     1     0
     I    +     +     +     +     +     +
     -----------------------------------
         10    11    12    13    14    15
```

Table 10-20 (Continued)
Sample CALPOST Output File (CALPOST.LST)
(Partial Listing)

```
********************************************************************************************************************************
*
                                              CALPOST  Version 6.11          Level 051012
********************************************************************************************************************************
*


                                                        SO2           1


 1 RANKED     3   HOUR AVERAGE  CONCENTRATION VALUES AT EACH GRIDDED RECEPTOR  (YEAR,DAY,START TIME)   (ug/m**3)

RECEPTOR     COORDINATES (km)            1 RANK
  10, 15     347.500  4873.500   1.3436E+00 (1990,009,0400)
  10, 16     347.500  4874.500   7.3973E+00 (1990,009,0400)
  10, 17     347.500  4875.500   2.8547E-02 (1990,009,0400)
  10, 18     347.500  4876.500   0.0000E+00 (1990,009,0400)
  10, 19     347.500  4877.500   0.0000E+00 (1990,009,0400)
  10, 20     347.500  4878.500   0.0000E+00 (1990,009,0400)
  11, 15     348.500  4873.500   5.0391E-01 (1990,009,0400)
  11, 16     348.500  4874.500   1.7964E+01 (1990,009,0400)
  11, 17     348.500  4875.500   1.6470E+00 (1990,009,0400)
  11, 18     348.500  4876.500   0.0000E+00 (1990,009,0400)
  11, 19     348.500  4877.500   0.0000E+00 (1990,009,0400)
  11, 20     348.500  4878.500   0.0000E+00 (1990,009,0400)
  12, 15     349.500  4873.500   0.0000E+00 (1990,009,0400)
  12, 16     349.500  4874.500   5.9126E+00 (1990,009,0400)
  12, 17     349.500  4875.500   6.3100E+00 (1990,009,0400)
  12, 18     349.500  4876.500   7.6930E-01 (1990,009,0400)
  12, 19     349.500  4877.500   5.3020E-02 (1990,009,0400)
  12, 20     349.500  4878.500   0.0000E+00 (1990,009,0400)
  13, 15     350.500  4873.500   0.0000E+00 (1990,009,0400)
  13, 16     350.500  4874.500   8.6676E-02 (1990,009,0400)
  13, 17     350.500  4875.500   2.5909E+00 (1990,009,0400)
  13, 18     350.500  4876.500   4.5302E+00 (1990,009,0400)
  13, 19     350.500  4877.500   2.7549E+00 (1990,009,0400)
  13, 20     350.500  4878.500   7.1599E-01 (1990,009,0400)
  14, 15     351.500  4873.500   0.0000E+00 (1990,009,0400)
  14, 16     351.500  4874.500   0.0000E+00 (1990,009,0400)
  14, 17     351.500  4875.500   0.0000E+00 (1990,009,0400)
  14, 18     351.500  4876.500   4.3705E-01 (1990,009,0400)
  14, 19     351.500  4877.500   2.2027E+00 (1990,009,0400)
  14, 20     351.500  4878.500   3.3393E+00 (1990,009,0400)
  15, 15     352.500  4873.500   0.0000E+00 (1990,009,0400)
  15, 16     352.500  4874.500   0.0000E+00 (1990,009,0400)
  15, 17     352.500  4875.500   0.0000E+00 (1990,009,0400)
  15, 18     352.500  4876.500   0.0000E+00 (1990,009,0400)
  15, 19     352.500  4877.500   3.4252E-02 (1990,009,0400)
  15, 20     352.500  4878.500   5.9414E-01 (1990,009,0400)

   1 - RANK HIGHEST VALUES FOR PERIOD

 Multiply all values by 10 **  -2

  20 I    0     0     0    72   334    59
     I    +     +     +     +     +     +
  19 I    0     0     5   275   220     3
     I    +     +     +     +     +     +
  18 I    0     0    77   453    44     0
     I    +     +     +     +     +     +
  17 I    3   165   631   259     0     0
     I    +     +     +     +     +     +
  16 I  740  1796   591     9     0     0
     I    +     +     +     +     +     +
  15 I  134    50     0     0     0     0
     I    +     +     +     +     +     +
     -----------------------------------
         10    11    12    13    14    15
```

Table 10-20 (Continued)
Sample CALPOST Output File (CALPOST.LST)
(Partial Listing)

```
*******************************************************************************************************************************
*
                                              CALPOST  Version 6.11          Level 051012
*******************************************************************************************************************************
*


                                                        SO2           1


 1 RANKED     1   HOUR AVERAGE  CONCENTRATION VALUES AT EACH GRIDDED RECEPTOR  (YEAR,DAY,START TIME)   (ug/m**3)

RECEPTOR     COORDINATES (km)            1 RANK
  10, 15     347.500  4873.500   4.2411E+00 (1990,009,0700)
  10, 16     347.500  4874.500   1.1527E+01 (1990,009,0500)
  10, 17     347.500  4875.500   2.1081E-01 (1990,009,0700)
  10, 18     347.500  4876.500   1.2789E-02 (1990,009,0700)
  10, 19     347.500  4877.500   0.0000E+00 (1990,009,0400)
  10, 20     347.500  4878.500   0.0000E+00 (1990,009,0400)
  11, 15     348.500  4873.500   3.0640E+00 (1990,009,0700)
  11, 16     348.500  4874.500   2.7421E+01 (1990,009,0600)
  11, 17     348.500  4875.500   3.1958E+00 (1990,009,0500)
  11, 18     348.500  4876.500   7.1133E-02 (1990,009,0700)
  11, 19     348.500  4877.500   1.9448E-03 (1990,009,0700)
  11, 20     348.500  4878.500   0.0000E+00 (1990,009,0400)
  12, 15     349.500  4873.500   6.1239E-01 (1990,009,0700)
  12, 16     349.500  4874.500   1.2289E+01 (1990,009,0700)
  12, 17     349.500  4875.500   9.7570E+00 (1990,009,0600)
  12, 18     349.500  4876.500   1.4517E+00 (1990,009,0700)
  12, 19     349.500  4877.500   1.7964E-01 (1990,009,0700)
  12, 20     349.500  4878.500   2.3795E-04 (1990,009,0700)
  13, 15     350.500  4873.500   6.5287E-02 (1990,009,0700)
  13, 16     350.500  4874.500   7.0085E-01 (1990,009,0700)
  13, 17     350.500  4875.500   4.7872E+00 (1990,009,0700)
  13, 18     350.500  4876.500   7.9679E+00 (1990,009,0600)
  13, 19     350.500  4877.500   5.0538E+00 (1990,009,0600)
  13, 20     350.500  4878.500   1.5197E+00 (1990,009,0700)
  14, 15     351.500  4873.500   5.4882E-03 (1990,009,0700)
  14, 16     351.500  4874.500   1.5789E-02 (1990,009,0700)
  14, 17     351.500  4875.500   9.3110E-02 (1990,009,0700)
  14, 18     351.500  4876.500   1.2052E+00 (1990,009,0700)
  14, 19     351.500  4877.500   4.3756E+00 (1990,009,0600)
  14, 20     351.500  4878.500   6.9195E+00 (1990,009,0600)
  15, 15     352.500  4873.500   0.0000E+00 (1990,009,0400)
  15, 16     352.500  4874.500   0.0000E+00 (1990,009,0400)
  15, 17     352.500  4875.500   0.0000E+00 (1990,009,0400)
  15, 18     352.500  4876.500   2.6091E-04 (1990,009,0700)
  15, 19     352.500  4877.500   2.3845E-01 (1990,009,0700)
  15, 20     352.500  4878.500   1.8803E+00 (1990,009,0700)

   1 - RANK HIGHEST VALUES FOR PERIOD

 Multiply all values by 10 **  -2

  20 I    0     0     0   152   692   188
     I    +     +     +     +     +     +
  19 I    0     0    18   505   438    24
     I    +     +     +     +     +     +
  18 I    1     7   145   797   121     0
     I    +     +     +     +     +     +
  17 I   21   320   976   479     9     0
     I    +     +     +     +     +     +
  16 I 1153  2742  1229    70     2     0
     I    +     +     +     +     +     +
  15 I  424   306    61     7     1     0
     I    +     +     +     +     +     +
     -----------------------------------
         10    11    12    13    14    15
```

Table 10-20 (Continued)
Sample CALPOST Output File (CALPOST.LST)
(Partial Listing)

```
********************************************************************************************************************************
*
                                              CALPOST  Version 6.11          Level 051012
********************************************************************************************************************************
*


                                                        SO2           1      (ug/m**3)


 COUNTS OF   30 MINUTE AVERAGE  CONCENTRATION EXCEEDENCES AT EACH GRIDDED RECEPTOR


 NUMBER OF AVERAGES   >  0.1000E+02

  20 I   0    0    0    0    0    0
     I   +    +    +    +    +    +
  19 I   0    0    0    0    0    0
     I   +    +    +    +    +    +
  18 I   0    0    0    0    0    0
     I   +    +    +    +    +    +
  17 I   0    0    1    0    0    0
     I   +    +    +    +    +    +
  16 I   2    6    3    0    0    0
     I   +    +    +    +    +    +
  15 I   0    0    0    0    0    0
     I   +    +    +    +    +    +
      -----------------------------
        10   11   12   13   14   15

********************************************************************************************************************************
*
                                              CALPOST  Version 6.11          Level 051012
********************************************************************************************************************************
*


                                                        SO2           1      (ug/m**3)


 COUNTS OF    3   HOUR AVERAGE  CONCENTRATION EXCEEDENCES AT EACH GRIDDED RECEPTOR


 NUMBER OF AVERAGES   >  0.1000E+02

  20 I   0    0    0    0    0    0
     I   +    +    +    +    +    +
  19 I   0    0    0    0    0    0
     I   +    +    +    +    +    +
  18 I   0    0    0    0    0    0
     I   +    +    +    +    +    +
  17 I   0    0    0    0    0    0
     I   +    +    +    +    +    +
  16 I   0    1    0    0    0    0
     I   +    +    +    +    +    +
  15 I   0    0    0    0    0    0
     I   +    +    +    +    +    +
      -----------------------------
        10   11   12   13   14   15
```

Table 10-20 (Concluded)
Sample CALPOST Output File (CALPOST.LST)
(Partial Listing)

```
********************************************************************************************************************************
*
                                             CALPOST  Version 6.11          Level 051012
********************************************************************************************************************************
*


                                                       SO2           1      (ug/m**3)


 COUNTS OF    1   HOUR AVERAGE  CONCENTRATION EXCEEDENCES AT EACH GRIDDED RECEPTOR


 NUMBER OF AVERAGES   >  0.1000E+02

  20 I   0    0    0    0    0    0
     I   +    +    +    +    +    +
  19 I   0    0    0    0    0    0
     I   +    +    +    +    +    +
  18 I   0    0    0    0    0    0
     I   +    +    +    +    +    +
  17 I   0    0    0    0    0    0
     I   +    +    +    +    +    +
  16 I   1    3    2    0    0    0
     I   +    +    +    +    +    +
  15 I   0    0    0    0    0    0
     I   +    +    +    +    +    +
      -----------------------------
        10   11   12   13   14   15

********************************************************************************************************************************
*
                                             CALPOST  Version 6.11          Level 051012
********************************************************************************************************************************
*


                                                       SUMMARY SECTION


                                                       SO2           1


                                                         (ug/m**3)


 RECEPTOR     COORDINATES (km)    TYPE      PEAK (YEAR,DAY,START TIME)      FOR RANK    FOR AVERAGE PERIOD

  11, 16     348.500  4874.500   GRIDDED    2.7921E+01 (1990,009,0530)       RANK  1         30 MINUTE

  11, 16     348.500  4874.500   GRIDDED    1.7964E+01 (1990,009,0400)       RANK  1          3   HOUR

  11, 16     348.500  4874.500   GRIDDED    2.7421E+01 (1990,009,0600)       RANK  1          1   HOUR
```

Table 10-21: Plot-File DATA Record Structure

Header Records

Record No.	Variable	Type	Description
1	Line 1	character	Title line identifying averaging time, type of output, and units
2	(blank)		
3	Line 2	character	Species Processed
4	(blank)		
5	Line 3	character	Column Headings
6	(blank)		

Data Records (free format)

Variable No.	Variable	Type	Description	Sample Values
1	X	real	X-coordinate of receptor (km)	94.02
2	Y	real	Y-coordinate of receptor (km)	210.89
3	V1	real	Value 1	213.8
4	V2	real	Value 2 (optional)	132.6
5	V3	real	Value 3 (optional)	16.88
6	V4	real	Value 4 (optional)	.009

Table 10-22: Sample DATA Plot-File

(Partial Listing)

```
 2 RANKED        1-HOUR AVERAGE  CONCENTRATION VALUES AT EACH RECEPTOR  ( g/m**3)
        SO2            1

    RECEPTOR (x,y) km        1 RANK        2 RANK

    270.000  4720.000     7.8952E-09    1.9814E-09
    290.000  4720.000     5.9128E-08    1.5432E-08
    310.000  4720.000     8.2049E-08    3.7027E-08
    330.000  4720.000     7.2441E-08    5.9440E-08
    350.000  4720.000     7.9033E-08    5.8254E-08
    370.000  4720.000     7.0579E-08    4.8233E-08
    390.000  4720.000     1.3587E-07    9.4182E-08
    410.000  4720.000     4.7199E-08    4.6522E-08
    270.000  4740.000     4.6755E-12    1.6541E-12
    290.000  4740.000     9.4266E-10    6.2788E-10
    310.000  4740.000     7.0272E-09    3.6496E-09
    330.000  4740.000     1.8139E-08    1.2038E-08
    350.000  4740.000     3.8828E-08    1.9662E-08
    370.000  4740.000     5.8562E-08    4.9597E-08
    390.000  4740.000     5.3909E-08    5.2398E-08
    410.000  4740.000     4.5306E-07    2.8328E-07
    270.000  4760.000     0.0000E+00    0.0000E+00
    290.000  4760.000     1.7201E-10    1.2712E-10
    310.000  4760.000     1.3340E-09    1.1862E-09
    330.000  4760.000     4.5722E-09    4.4274E-09
    350.000  4760.000     1.0541E-08    1.0369E-08
    370.000  4760.000     3.2621E-07    6.5301E-08
    390.000  4760.000     8.6671E-07    4.7615E-07
    410.000  4760.000     5.4748E-07    4.4530E-07
    270.000  4780.000     0.0000E+00    0.0000E+00
    290.000  4780.000     1.8996E-11    1.7348E-11
    310.000  4780.000     5.3253E-10    5.0730E-10
    330.000  4780.000     2.2485E-09    2.2173E-09
    350.000  4780.000     6.2623E-09    6.2032E-09
    370.000  4780.000     1.0701E-06    1.6573E-07
    390.000  4780.000     6.4020E-07    6.0337E-07
    410.000  4780.000     6.3429E-07    4.6677E-07
    270.000  4800.000     0.0000E+00    0.0000E+00
    290.000  4800.000     0.0000E+00    0.0000E+00
    310.000  4800.000     1.9163E-10    1.6276E-10
    330.000  4800.000     1.1810E-09    9.1738E-10
    350.000  4800.000     2.6353E-08    4.7434E-09
    370.000  4800.000     1.2015E-06    1.0502E-06
    390.000  4800.000     2.4910E-07    1.9500E-07
    410.000  4800.000     2.9590E-07    2.0784E-07
    270.000  4820.000     0.0000E+00    0.0000E+00
    290.000  4820.000     0.0000E+00    0.0000E+00
    310.000  4820.000     5.6655E-11    5.0932E-11
    330.000  4820.000     5.0676E-10    4.5829E-10
    350.000  4820.000     5.7000E-09    3.2322E-09
    370.000  4820.000     8.0446E-07    4.9414E-07
    390.000  4820.000     6.8545E-07    5.6447E-07
    410.000  4820.000     2.5748E-07    2.0238E-07
```

Table 10-23: Plot-File GRID Record Structure

Header Records (free format)

Record No.	Variable No.	Variable	Type	Description	Sample Values
1	1	ID	character	File type code (must be >DSAA= for ASCII file)	DSAA
2	1	NX	integer	Number of receptors in easting direction	34
2	2	NY	integer	Number of receptors in northing direction	51
3	1	XBEG	real	X-coordinate (km) of first gridded receptor (southwest)	213.75
3	2	YBEG	real	Y-coordinate (km) of first gridded receptor (southwest)	439.00
4	1	XEND	real	X-coordinate (km) of last gridded receptor (northeast)	222.00
4	2	YEND	real	Y-coordinate (km) of last gridded receptor (northeast)	451.50
5	1	VMIN	real	Minimum value in grid	0.001
5	2	VMAX	real	Maximum value in grid	159.0

Data Records (free format)

Record No.	Variable	Type	Description
1	V1	real array	NX values in first row of grid (southernmost row)
2	V2	real array	NX values in second row of grid
...	...	...	
NY	VNY	real array	NX values in last row of grid (northernmost row)

Table 10-23 (Concluded)
Plot-File GRID Record Structure

Footer Records

Record No.	Variable	Type	Description
1-5	(blank)		
6	Line 1	character	Title line identifying averaging time, type of output, and units
7	(blank)		
8	Line 2	character	Species Processed or other information (varies with type of data)
9	(blank)		
10	Line 3	character	Species Processed or other information (varies with type of data)

Table 10-24: Sample GRID Plot-File

```
DSAA
          8           8
     270.000     410.000
    4720.000    4860.000
  0.0000E+00  0.1202E-05
7.8952E-09  5.9128E-08  8.2049E-08  7.2441E-08  7.9033E-08  7.0579E-08  1.3587E-07  4.7199E-08
4.6755E-12  9.4266E-10  7.0272E-09  1.8139E-08  3.8828E-08  5.8562E-08  5.3909E-08  4.5306E-07
0.0000E+00  1.7201E-10  1.3340E-09  4.5722E-09  1.0541E-08  3.2621E-07  8.6671E-07  5.4748E-07
0.0000E+00  1.8996E-11  5.3253E-10  2.2485E-09  6.2623E-09  1.0701E-06  6.4020E-07  6.3429E-07
0.0000E+00  0.0000E+00  1.9163E-10  1.1810E-09  2.6353E-08  1.2015E-06  2.4910E-07  2.9590E-07
0.0000E+00  0.0000E+00  5.6655E-11  5.0676E-10  5.7000E-09  8.0446E-07  6.8545E-07  2.5748E-07
0.0000E+00  0.0000E+00  0.0000E+00  2.0870E-10  2.1584E-09  3.1430E-08  5.1841E-07  2.4384E-07
0.0000E+00  0.0000E+00  0.0000E+00  6.9000E-11  4.3005E-10  1.0159E-08  1.3561E-07  3.3995E-07




           1-HOUR AVERAGE  CONCENTRATION VALUES AT EACH RECEPTOR  ( g/m**3)

         SO2           1

         RANK          1
```

Table 10-25: Timeseries File Record Structure

Header Records

Record No.	Variable	Type	Description
1	Line 1	character	Title line identifying file type and species processed
2	(blank)		
3	Line 2	character	Averaging time, type of output, and units
4	Line 3	character	Number of receptors processed
5	(blank)		
6	Line 4	character	Receptor type for each receptor processed
7	Line 5	character	Receptor ID or Easting cell index for each receptor processed
8	Line 6	character	Northing cell index for each receptor processed
9	Line 7	character	Easting coordinate (km) for each receptor processed
10	Line 8	character	Northing coordinate (km) for each receptor processed
11	(blank)		
12	Line 9	character	Heading for year, day, time columns
13	(blank)		

Data Records (free format)

Variable No.	Variable	Type	Description	Sample Values
1	IYR	integer	Year (YYYY format)	1996
2	JDAY	integer	Julian Day (JJJ format)	216
3	ITIME	integer	Time at start of averaging period (HHMM format)	0800
4 to NREC+3	V	real array	Value for each of the NREC receptors processed	5.473498E-07

Table 10-26: Sample Timeseries File

```
TIME-SERIES Output  --------  SO2           1

       30 MINUTE Average  CONCENTRATION Values at Selected Receptors  (ug/m**3)
        1   Receptors are Included

           Type:          GRID
             ix:             8
             iy:            15
          x(km):  3.455000E+02
          y(km):  4.873500E+03

 YYYY JDY HHMM (START time)

 1990   9 0400    1.002828E-02
 1990   9 0430    2.671714E+01
 1990   9 0500    3.384249E+01
 1990   9 0530    3.526189E+01
 1990   9 0600    3.907162E+01
 1990   9 0630    3.778828E+01
 1990   9 0700    2.984025E+01
 1990   9 0730    1.953775E+01
```