Updated CALPUFF Modeling Protocol and Final Report for the Subject to BART Analyses for PCA Tomahawk Mill

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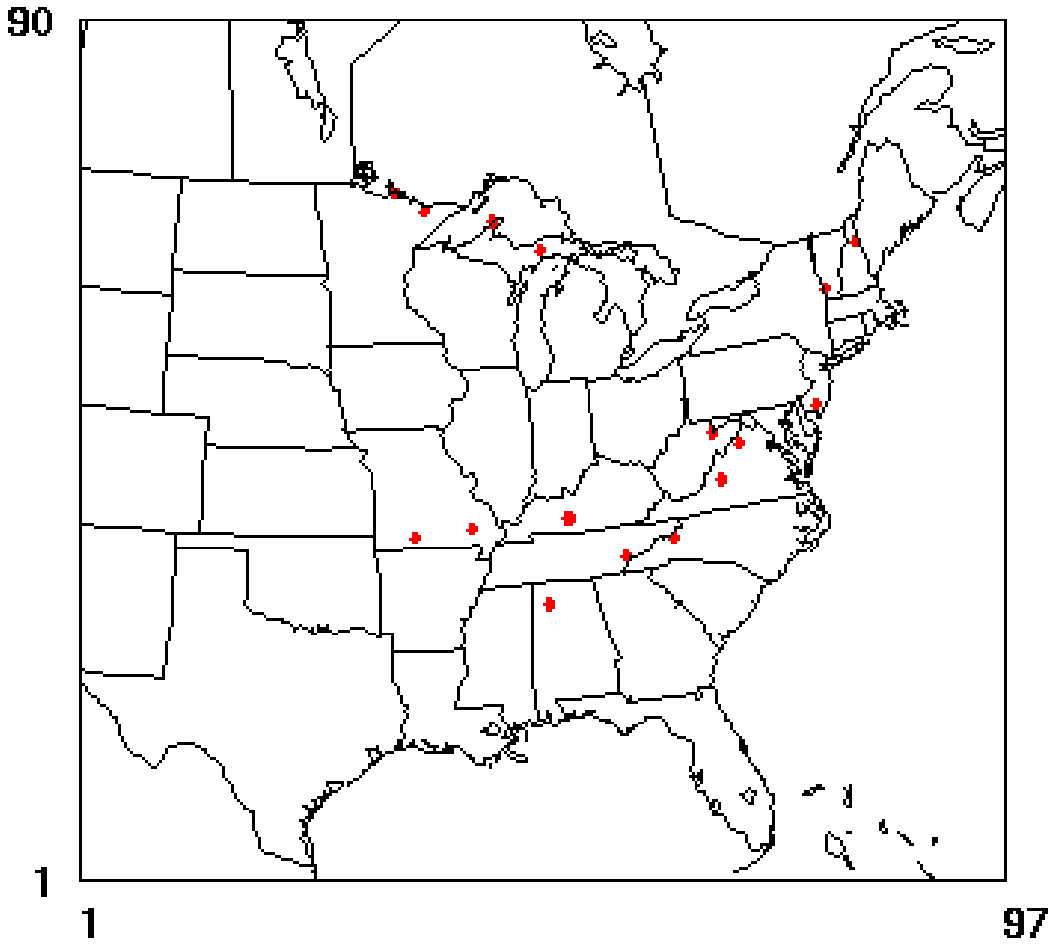
1.0 Introduction

The Wisconsin Department of Natural Resources (DNR) performed single source screening modeling in 2006 to evaluate which Best Available Retrofit Technology (BART) eligible sources in the state may "cause or contribute" to visibility impairment and could therefore be subject to BART requirements. This type of analysis is referred to as the "subject to BART" or "BART exemption" analysis. The methods used by DNR are described in the "Single Source Modeling to Support Regional Haze BART Modeling Protocol", March 21, 2006, prepared by Lake Michigan Air Directors Consortium (LADCO).

DNR applied CALPUFF to each BART eligible source for three annual periods, covering the calendar years 2002 to 2004. The CALPUFF/CALMET modeling domain consisted of ninety-seven 36-km spaced cells in the east-west direction and ninety 36-km spaced cells in the north-south direction (see Figure 1). Meteorological data generated by the MM5 prognostic weather model (provided by LADCO in CALMM5 format) was used to develop the meteorological data for CALPUFF, without additional observational data input (i.e., NOOBS mode). This represents a coarse meteorological grid, suitable for an initial screening analysis.

The results from DNR's screening analysis indicated that, with the exception of some of the largest electric power stations in the state, the only Class I areas where BART eligible sources may contribute to visibility impairment are the three areas to the north of Wisconsin, the Boundary Waters Canoe Area, Isle Royal National Park, and Seney Wildlife Area. DNR's screening analysis also indicated that the BART eligible emissions unit at the Packaging Corporation of America Tomahawk Mill (PCA) may "cause or contribute" to visibility impairment at the Seney Class I area (located approximately 280 km to the northeast of the mill), as defined by the 98th percentile visibility impacts being greater than 0.5 deciviews (dv) relative to natural background.

Figure 1 - WDNR Screening CALPUFF Domain



NOTE: Class I areas are identified by red marks.

PCA has elected to refine the DNR screening analysis by conducting refined CALPUFF modeling with a 4 km meteorological grid, based on procedures described in the "Visibility Improvement – State and Tribal Association of the Southeast (VISTAS) BART CALPUFF" modeling protocol. The VISTAS protocol was developed by a large group of stakeholders, including EPA, the VISTAS member state agencies and tribes, the Federal Land Managers (FLMs), industry representatives, and consulting experts. Given the resources expended on the VISTAS protocol, it arguably represents the most comprehensive CALPUFF BART protocol ever developed.

PCA had discussions with DNR and EPA Region 5 staff about refining the analysis, and submitted a refined CALPUFF BART modeling protocol in March 2007. EPA reviewed the protocol and provided minor comments to DNR in May 2010. Another facility undergoing Subject to BART review, Thilmany, responded to these comments in a letter "Response to EPA Comments on Thilmany BART Modeling Protocol" dated November 9, 2010. In addition, subsequent to the EPA protocol comments, the US Fish and Wildlife Service and US Forest Service reviewed the protocol and had additional discussions with DNR and EPA. The three EPA comments, and each response, are listed below.

Comment 1

Information needs to be presented which clarifies how POSTUTIL was used for ammonia.

Response 1

The VISTAS methodology was used, with a MNITRATE switch setting of one (1).

Comment 2

The modeling must include a copy of the input and list files associated with runs. The protocol only offers some of the control file information.

Response 2

All CALMET, CALPUFF, and CALPOST input and list files, as well as meteorological and geophysical data files, had been provided by PCA to DNR on a portable hard disk drive. PCA will again provide a portable hard disk drive of all modeling files to DNR for the updated BART analysis, for purposes of SIP documentation.

Comment 3

The input file … uses the background ammonia values that were produced for the LADCO protocol. These values are based on modeled estimates. Monitoring data has generally shown much higher ammonia than what was used from the model results. The refined modeling analyses … must evaluate the visibility impacts using measured background ammonia values.

Response 3

The US Fish and Wildlife Service proposed using a constant background ammonia concentration of 3.9 ppb, which was the highest concentration measured at the Mayville Wisconsin station during a mid-1990s EPA study. PCA has agreed to use this single, conservative background value in the absence of daily data.

On November 29, 2010, DNR issued a letter that approved the CALPUFF BART protocol, as well as the emission rates to be used for the BART eligible emission units. DNR requested that the 2007 version of the protocol be updated to include the responses to EPA comments, and text that addresses current CALPUFF modeling guidance. In addition, the updated modeling results could be presented in the protocol (so that all information is located in one document).

This document is the updated modeling protocol and final modeling report for the refined PCA "Subject to BART" analysis. This document does not duplicate the extensive information on visibility, CALPUFF, and EPA guidance on BART modeling procedures that are contained in the VISTAS protocol. Rather, this document describes how data specific to this setting will be used in the refined CALPUFF modeling. Section 1 of the protocol is this introduction. Section 2

briefly summarizes important concepts from the VISTAS protocol. Section 3 describes the specific CALMET data and procedures that were used to develop a refined, 4-km spaced meteorological grid for Wisconsin. Section 4 describes the CALPUFF input data and procedures, and Section 5 discusses the POSTUTIL and CALPOST processing, including the use of annual average natural background visibility. Section 6 presents the emission and stack data that were used for the BART eligible emission units, and Section 7 presents the modeling results. Appendices A and B present example CALMET and CALPUFF input file listings. A portable hard drive is also being submitted that contains all input data, control files, output files, and computer codes used in the analysis.

2.0 VISTAS BART Protocol

The VISTAS member states have prepared a CALPUFF modeling protocol for BART determinations that is fully consistent with the EPA guidelines in 40 CFR Part 51 Appendix W and Appendix Y. The VISTAS protocol describes a two-step CALPUFF analysis methodology for BART exemption analyses. The initial CALPUFF analysis uses a "screening" or coarse resolution meteorological grid to determine if a particular source may be exempted from further BART analyses. The screening results are also used to determine which Class I areas should be included in any refined analysis. Assumptions for the initial screening analysis are conservative so that a source that contributes to visibility impairment is not exempted in error. If a source is shown to contribute to visibility impairment using the initial screening assessment, the source has the option to undertake refined CALPUFF modeling using finer meteorological grids to evaluate further whether it is subject to BART.

VISTAS developed both coarse (12-km grid resolution) and refined (4-km grid resolution) CALMET files. The fine grid CALMET files utilized both MM5 prognostic data, as well as meteorological observational data for the CALMET "Step 2" calculations. Overwater (buoy) data were used in addition to the standard hourly surface meteorological observations, precipitation

observations, and twice-daily upper air sounding data. The VISTAS website provides detailed documentation and supporting information on the refined CALMET processing, including the CALMET and CALPUFF input files that contain model configuration options and settings that have been optimized after consultation with stakeholders and consulting experts. These same CALMET and CALPUFF input files were used as the basis for the refined Wisconsin analyses.

The VISTAS protocol discusses several options for defining the natural background visibility. These include use of the annual average natural background extinction or the background extinction for the 20% best natural conditions days. Based on an email survey of the state agencies from the VISTAS member states, all of the VISTAS states allowed the use of annual average natural background extinction for refined CALPUFF analyses. This is also the guidance provided by EPA Region 5 staff during discussions with DNR and the Wisconsin Paper Council, and the method approved by DNR in their November 29, 2010 letter. Therefore, the refined PCA CALPUFF modeling used the annual average natural background extinction for CALPOST processing.

The VISTAS BART guidance recommends that the threshold value used to define whether a source "contributes" to visibility impairment is a 0.5 dv change from natural background conditions. The 98th percentile 24-hr average predicted impact at the Class I area (equal to the 8th highest value) is to be compared to this contribution threshold value. According to clarification of the BART guidance received from EPA by the VISTAS workgroup, for a three-year simulation the modeling values to be compared with the threshold are the greatest of the three annual 8th highest values, or the 22nd highest value over all three years combined, whichever is greater.

3.0 CALMET Data and Procedures

EPA has updated the versions of the approved CALPUFF programs since the 2007 modeling protocol was developed, and has provided additional guidance on CALMET "switch" settings. The current approved versions are CALPUFF version 5.8 (level 070623), and CALMET version 5.8 (level 070623), and these versions were used for the updated refined BART CALPUFF analysis. On August 31, 2009, EPA published the memorandum "Clarification of EPA-FLM Recommended Settings for CALMET". EPA stated that a 4 km fine CALMET grid size was acceptable, and provided recommended CALMET settings. The CALMET settings for the updated refined BART CALPUFF analysis meet all current EPA recommendations.

The first step in development of the refined Wisconsin analysis was to define the CALMET refined modeling domain and grid. As discussed in Section 1, DNR's screening analysis indicated that there are three Class I areas to the north of Wisconsin, the Boundary Waters Canoe Area, Isle Royal National Park, and Seney Wildlife Area, where the screening analysis predicts some level of visibility impact from Wisconsin BART eligible sources. Therefore, the meteorological grid was developed to ensure coverage for these three Class I areas, as well as for the BART eligible source locations throughout Wisconsin. Standard IWAQM guidance also recommends that the CALMET grid extend a minimum of 50 km beyond any Class I or emission source location, so that puff recirculation can be properly accounted for.

The refined CALMET grid was defined as a 4-km spaced grid with 162 cells in the X-axis and 191 in the Y-axis. The grid projection was Lambert Conformal Conic, using the same projection parameters as in the DNR screening analysis (this allows the use of the same source X and Y coordinates as in the DNR analysis). The projection parameters include RLAT0 = 40N, RLON0 = 97W, XLAT1 = 33N, XLAT2 = 45N, XORIGKM = 247.0, YORIGKM = 240.0, and DATUM = NAS-C.

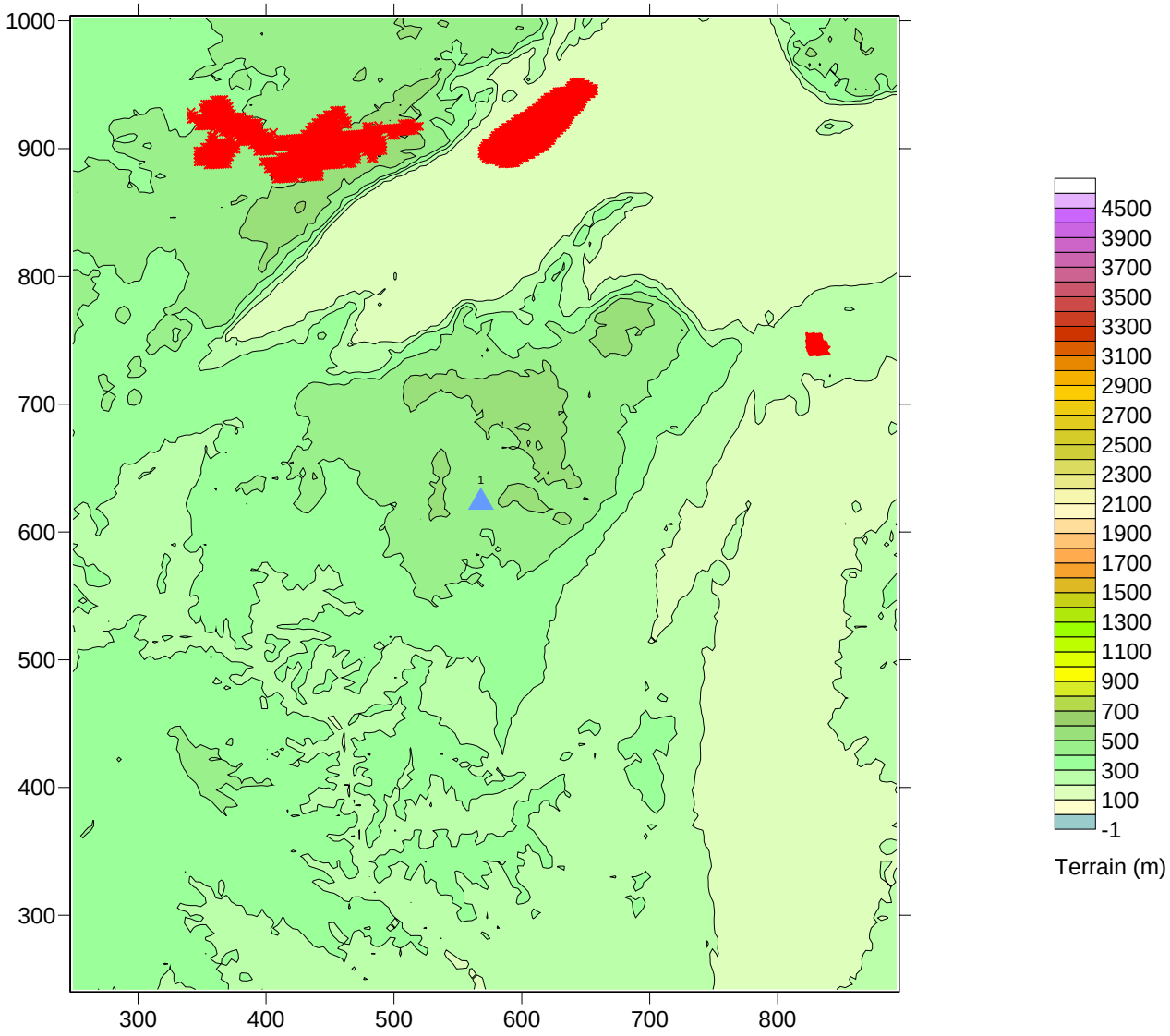
The meteorological data that was input to CALMET included the same three years (2002-2004) of CALMM5 data used by DNR, which was provided by LADCO. However, the refined CALMET runs also considered observation data from 22 surface stations, 16 precipitation stations, 5 overwater buoy stations, and 3 upper air stations. Figure 2 is a plot of the refined CALPUFF modeling domain. Figure 3 presents a plot of the locations of the observation stations in the modeling domain.

The CAMET program MAKEGEO uses USGS GTOPO30 digital terrain data (which includes coverage in Canada) and USGS Composite Theme Grid Land Use and Land Cover (LULC) data to create a gridded data file on geophysical parameters that is used by CALMET. The available USGS LULC coverage does not extend into the Canadian areas of the refined domain. These areas in Canada were assigned to the "forested land" category. Figure 4 presents a plot of the land use data for the modeling domain.

The VISTAS refined CALMET input files discussed in section 2 were used as the basis for the refined Wisconsin CALMET input files. The same CALMET configuration settings and options were utilized, as they are representative of Wisconsin terrain and land use patterns. All settings conform with current EPA and FLM guidance.

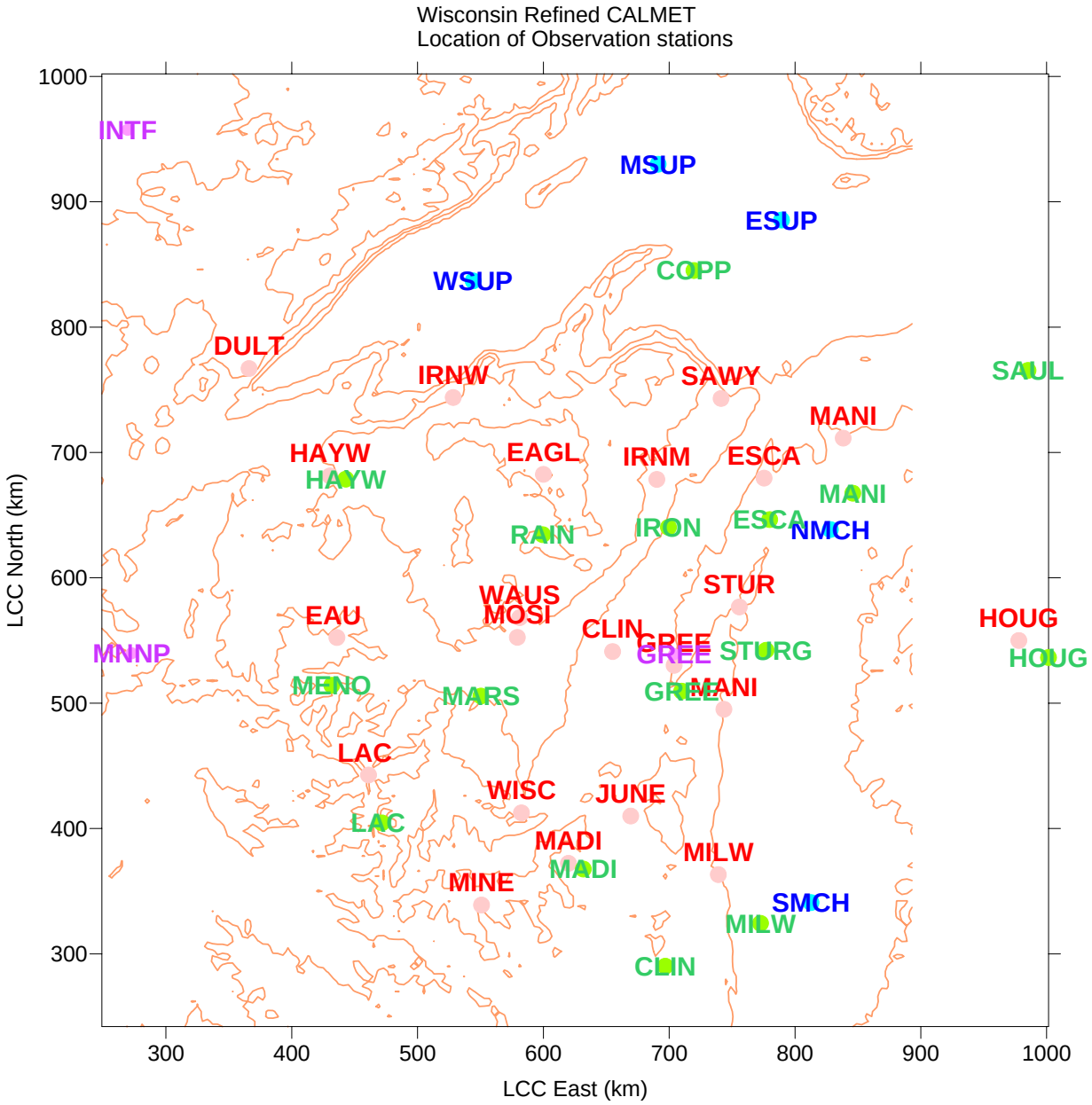
Appendix A presents a listing of a CALMET input file developed for the refined analysis.

Figure 2 – Refined CALPUFF Modeling Domain and Locations of Class I Areas



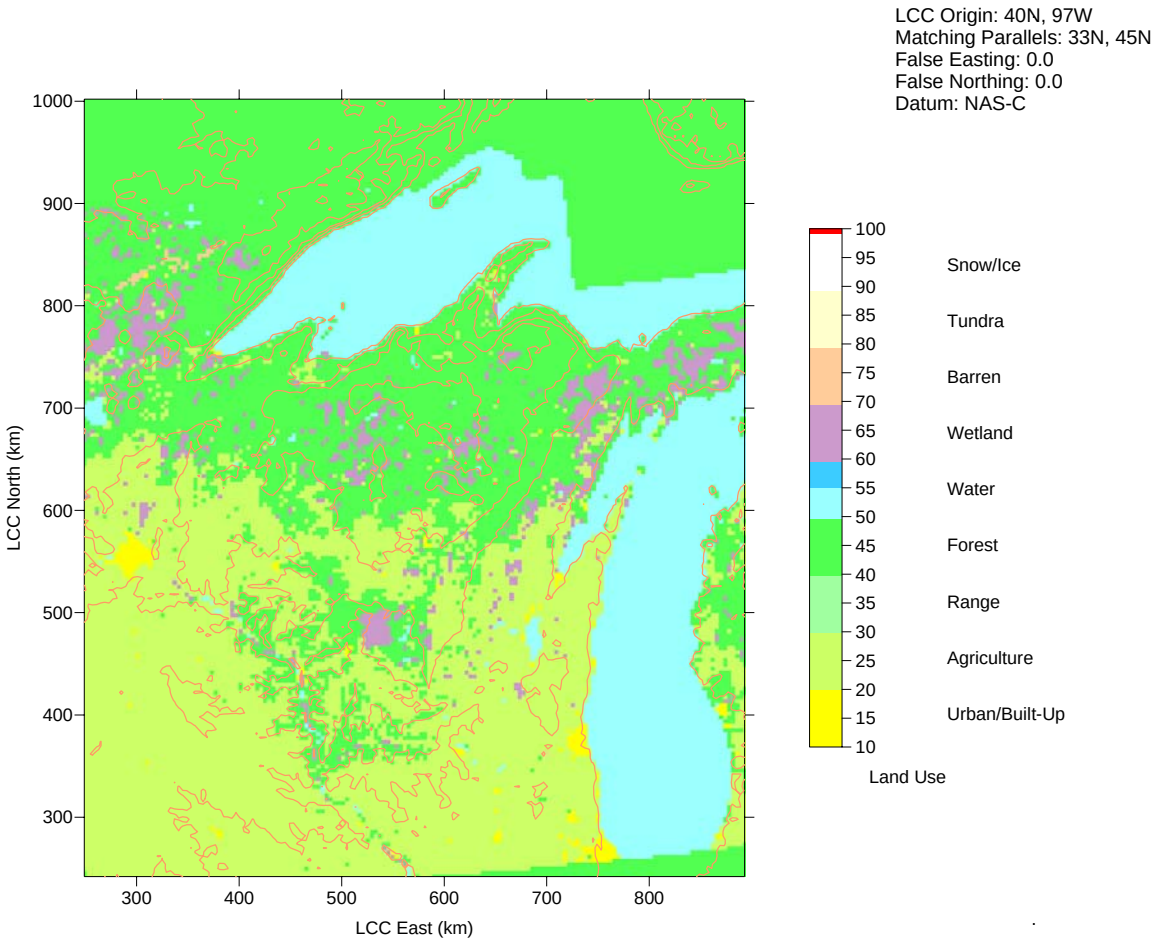
NOTE: The Class I area receptors are in red, the PCA Mill location is in blue, and the X and Y coordinates are the Lambert projection coordinates are in kms.

Figure 3 – Locations of Observational Stations in Refined CALPUFF Modeling Domain



NOTES: Surface stations are in red, overwater (buoy) in blue, precipitation in green, and upper air in purple.

Figure 4 – Land Use Data for Refined CALPUFF Modeling Domain



Some of the notable CALMET configuration settings included:

- CALMET vertical layers set to 10, with cell face heights at 20, 40, 80, 160, 320, 640, 1200, 2000, 3000, and 4000 meters,
- CALMET diagnostic options, including slope flow effects (ISLOPE = 1) with the radius of influence of terrain (TERRAD) set to 15 km,
- EPA recommended CALMET settings for the radius of influence parameters (R1=50, R2=100, RMAX1=100, RMAX2=200, and RMAX3=200).

4.0 CALPUFF Procedures

Both the DNR screening and VISTAS refined CALPUFF input files were used as the basis for the refined Wisconsin CALPUFF input files. All CALPUFF settings and options are consistent with EPA and FLM guidance, and the refined VISTAS protocol recommendations. The background ozone (O3) concentrations were used directly from the DNR CALPUFF input files. Instead of using monthly background ammonia concentrations from the DNR screening analyses, a single conservative background ammonia concentration of 3.9 ppb was used. Appendix B presents a listing of a CALPUFF input file developed for the analysis.

The DNR screening analysis considered three emitted pollutants, SO_2, NOx, and $PM_{2.5}$. The refined CALPUFF modeling will consider speciated particulate emissions, including coarse PM (PMC), fine PM equivalent to $PM_{2.5}$ (PMF), sulfate (SO4), nitrate (NO3), elemental carbon (EC), and secondary organic aerosols (SOA or OC). Section 6 of this protocol describes how the speciated particulate emissions were calculated.

5.0 POSTUTIL and CALPOST Procedures

In CALPUFF, the scavenging of the available ammonia for nitrate formation is computed on a puff-by-puff basis. Because of the possibility of multiple puff overlap, this approach may tend to overestimate the amount of ammonia available to form nitrate. In order to address the cumulative consumption of ammonia, the POSTUTIL program can be used to repartition nitric acid and nitrate. POSTUTIL calculates new NO3/HNO3 equilibrium concentrations for the sample source in the Class I area using the background ammonia. As recommended in the VISTAS procedures for refined CALPUFF modeling, the POSTUTIL "MNITRATE=1" method was used for the refined Wisconsin CALPUFF modeling. Instead of using the monthly values for background ammonia concentrations from the DNR screening analyses, a single conservative background ammonia concentration of 3.9 ppb was used.

The modeling protocol submitted in 2007 proposed to use CALPOST Visibility Method 6 to calculate visibility impacts. However, since that time there have been revisions to CALPOST that allow the use of the updated IMPROVE extinction equation. CALPOST version 6.221 can implement the "Method 8 Mode 5" methodology to calculate visibility impacts, and the FLMs recommend its use in "Federal Land Managers' Air Quality Related Values Work Group (FLAG) Phase I Report—Revised (2010)" (herein referred to as FLAG 2010). Therefore, this updated methodology will be used for the PCA BART analysis. The new CALPUFF Graphical Users Interface automatically enters the appropriate values, based on the Class I area being selected, for natural background species and relative humidity adjustment factors using the data in Tables 6 through 9 of Section 3.3.5 of FLAG 2010 (which are based on "Guidance for Estimating Natural Visibility Conditions Under the Regional Haze Rule", EPA-454/B-03-005, September 2003).

6.0 Emissions Modeled

EPA's BART modeling guidance state that the 24-hr maximum actual emissions rates for the period of the modeling simulation (2002-2004) should be used for the analysis. If this data is not available, then the short term "allowable" or "potential" emission rates should be used. PCA provided DNR with source information that has been reviewed to determine the 24-hr maximum actual emissions rates. On November 29, 2010, DNR issued a letter that approved the following emission rates to be used for the PCA BART eligible boiler: 166.3 g/sec (1320 lb/hr) SO_2, 13.4 g/sec (106 lb/hr) NO_X, and 4.2 g/sec (33 lb/hr) for PM. The PM emissions have been speciated using the information for coal fired boilers developed by the National Park Service[1]. The speciated PM emissions listed in Table 1 were used in the refined BART modeling. The stack parameters used in the modeling analysis were the same as those used by DNR in their screening analysis.

Table 1 – PCA Speciated PM Emissions

PM Species	Emission Rate (lb/hr)
Coarse PM	3.8
Fine PM	7.8
Elemental Carbon	0.3
Condensable Inorganics (Sulfate)	17.2
Condensable Organics (OC)	4.3

[1] http://www2.nature.nps.gov/air/permits/ect/index.cfm)

7.0 Modeling Results

CALPOST computes the daily maximum change in deciviews relative to the annual average natural background visibility, separately for each Class I area. For evaluating the source impact relative to the "Subject to BART" visibility impact threshold of 0.5 dv, the daily maximum changes in visibility are sorted to determine the 98th percentile (8^{th} highest) value for each of three years, and the 98th percentile (22^{nd} highest) value for the completed three year period. If all 98th percentile values are below the threshold of 0.5 dv based on the refined CALPUFF analysis, the source is exempt from the BART requirements.

Another equivalent metric commonly used for BART exemption modeling is to sum the number of days per year that are above the 0.5 dv threshold for each Class I area separately; if there are 7 or fewer days above the threshold for each year, then the 98^{th} percentile value is also below the threshold. This is the metric approved by DNR for use in the BART modeling analysis. Specifically, for each Class I area separately, if there are less than 8 days per year that the predicted visibility impacts are greater than 0.5 deciviews relative to the annual average natural background visibility, then the BART eligible emission units at the modeled facility will be determined not to be Subject to BART.

Table 2 presents the results from the refined CALPUFF BART exemption modeling. These results demonstrate that there are less than 8 days per year, at each individual Class I area, when the visibility impacts from the PCA BART eligible emission unit are above 0.5 dv. Therefore, the **PCA BART eligible source is not Subject to BART** requirements.

Table 2 – PCA CALPUFF BART Exemption Results Summary

Class I area	**Distance (km) from source to Class I area boundary**	**# of days with impact > 0.5 dv in Class I area: 2002**	**# of days with impact > 0.5 dv in Class I area: 2003**	**# of days with impact > 0.5 dv in Class I area: 2004**	**# of days with impact > 0.5 dv in Class I area for 3 year period**	**Maximum 98th Percentile impact over either annual or 3-yr periods**
Seney , MI	~ 280	0	0	1	1	0.18
Isle Royal, MN	~ 320	0	0	0	0	0.14
Boundary Waters, MN	~ 350	0	0	0	0	0.13

Appendix A – Example CALMET Input File

```
WI Refined CALMET - 4km Grid - Dec 2010 - with Updated EPA Settings


---------------- 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=SURF02Z.DAT  !
CLOUD.DAT     input    * CLDDAT=            *
PRECIP.DAT    input    ! PRCDAT=PRECIP02.DAT !

MM4.DAT       input    * MM4DAT=E:\MRPO-calmm5\2002\MM5.020102.3D.DAT  *
MM4.DAT       input    ! MM4DAT=E:\MRPO-calmm5\2002\020102.MM5  !


WT.DAT        input    * WTDAT=             *
CALMET.LST    output   ! METLST=cal020102.lST  !
CALMET.DAT    output   ! METDAT=E:\WI-Calmet\2002Output\cal020102.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 =  3  !
    Number of overwater met stations
                                (NOWSTA) No default     ! NOWSTA =  5  !


                      !END!
--------------------------------------------------------------------------------
Subgroup (b)
```

```
---------------------------------
Upper air files (one per station)
---------------------------------
Default Name  Type       File Name
------------  ----       ---------
UP1.DAT       input     1  ! UPDAT=UPGB0204.DAT!    !END!
UP2.DAT       input     2  ! UPDAT=UPMN0204.DAT!    !END!
UP3.DAT       input     3  ! UPDAT=UPIN0204.DAT!    !END!

------------------------------------------------------------------------------
Subgroup (c)
---------------------------------------
Overwater station files (one per station)
SEA1.DAT input  1  ! SEADAT=4500102.DAT!    !END!
SEA2.DAT input  2  ! SEADAT=4500202.DAT!    !END!
SEA3.DAT input  3  ! SEADAT=4500402.DAT!    !END!
SEA4.DAT input  4  ! SEADAT=4500602.DAT!    !END!
SEA5.DAT input  5  ! SEADAT=4500702.DAT!    !END!

---------------------------------------
Default Name  Type       File Name
------------  ----       ---------
------------------------------------------------------------------------------
Subgroup (d)
----------------
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=                 *

------------------------------------------------------------------------------
NOTES: (1) File/path names can be up to 70 characters in length
       (2) Subgroups (a) and (d) must have ONE 'END' (surround by
           delimiters) at the end of the group
       (3) Subgroups (b) and (c) 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=  2 !
                      Hour (IBHR) -- No default       ! IBHR=  0  !

     Base time zone        (IBTZ) -- No default       ! IBTZ=  6  !
        PST = 08, MST = 07
        CST = 06, EST = 05

     Length of run (hours) (IRLG) -- No default       ! IRLG=  24  !

     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)

      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
     Test options specified to see if
     they conform to regulatory
```

```
     values? (MREG)                  No Default       ! MREG =  1   !

        0 = NO checks are made
        1 = Technical options must conform to USEPA guidance
                  IMIXH    -1       Maul-Carson convective mixing height
                                    over land; OCD mixing height overwater
                  ICOARE   0        OCD deltaT method for overwater fluxes
                  THRESHL  0.0      Threshold buoyancy flux over land needed
                                    to sustain convective mixing height grow
!END!

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

INPUT GROUP: 2 -- Map Projection and Grid control parameters
--------------

     Projection for all (X,Y):
     -------------------------

     Map projection
     (PMAP)                     Default: UTM    ! PMAP = LCC  !

         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 = -999   !

     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 = 40N  !
(RLON0)                   No Default      ! RLON0 = 97W  !

    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 = 33N  !
(XLAT2)                   No Default      ! XLAT2 = 45N  !

    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  !


     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 =  162  !
            No. Y grid cells (NY)      No default     ! NY =  191  !

     Grid spacing (DGRIDKM)            No default     ! DGRIDKM = 4. !
                                       Units: km

     Reference grid coordinate of
     SOUTHWEST corner of grid cell (1,1)

        X coordinate (XORIGKM)         No default     ! XORIGKM = 247.000 !
        Y coordinate (YORIGKM)         No default     ! YORIGKM = 240.000 !
                                       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.,640.,1200.,2000.,3000.,4000. !

!END!
```

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

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  !

            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 =  1  !
       (Meteorological fields are printed
        every  1  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 =  0 ,  0 ,  0 ,  0 ,  0 ,  0 ,  0 ,  0 ,  0 ,  0  !
       -----------------------


       Specify which levels of the W wind component to print
       (NOTE: W defined at TOP cell face --  16  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 ,  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 =  0 ,  0 ,  0 ,  0 ,  0 ,  0 ,  0 ,  0 ,  0 ,  0  !

Specify which meteorological fields
to print
(used only if LPRINT=T)             Defaults: 0 (all variables)
-----------------------


  Variable            Print ?
                  (0 = do not print,
                   1 = print)
  --------        ------------------

!  STABILITY  =           0           ! - PGT stability class
!  USTAR      =           0           ! - Friction velocity
!  MONIN      =           0           ! - Monin-Obukhov length
!  MIXHT      =           0           ! - Mixing height
!  WSTAR      =           0           ! - Convective velocity scale
!  PRECIP     =           0           ! - 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 =  2  !


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 =  1  !

   Print the INTERPOLATED wind components ?
   (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  !

   Print the FINAL DIVERGENCE fields ?
   (IPR4) (0=no, 1=yes)            Default: 0       !  IPR4 =  0  !

   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!


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

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 MM5 for upper air data
          2 = No surface, overwater, or upper air observations
              Use MM5 for surface, overwater, and upper air data

    NUMBER OF SURFACE & PRECIP. METEOROLOGICAL STATIONS

       Number of surface stations   (NSSTA)  No default     ! NSSTA =  22  !

       Number of precipitation stations
       (NPSTA=-1: flag for use of MM5 precip data)
                                    (NPSTA)  No default     ! NPSTA =  16  !

    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 =  2  !
      (1 = unformatted - CALMET unformatted output)
      (2 = formatted   - free-formatted CALMET output or user input)

!END!


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

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
                       ! BIAS =  0 ,  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 =  14  !
(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.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 = 1]

Timestep (hours) of the prognostic
model input data   (ISTEPPG)         Default: 1      ! ISTEPPG =  1   !
```

```
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 = 200. !
                                         Units: km
   Maximum radius of influence over water
   (RMAX3)                               No default      ! RMAX3 = 200. !
                                         Units: km


OTHER WIND FIELD INPUT PARAMETERS

   Minimum radius of influence used in
   the wind field interpolation (RMIN)   Default: 0.1    ! RMIN = 0.1 !
                                         Units: km
   Radius of influence of terrain
   features (TERRAD)                     No default      ! TERRAD = 15. !

                                         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 =100. !
   (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 = 0. !
```

```
      (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 ,  4 ,  4 ,  4 ,  4 ,  4 ,  4 ,  4 ,  4 ,  4   !

      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 ,  99 ,  99 ,  99 ,  99   !

      Critical Froude number (CRITFN)      Default: 1.0    ! CRITFN = 1. !

      Empirical factor controlling the
      influence of kinematic effects
      (ALPHA)                              Default: 0.1    ! ALPHA = 0.1 !

      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  !

      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)
      --------------------------

   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., 1000. !
   (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)

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 -- 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)

  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 =  1  !
                                          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
        -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 = 0.00 !
     (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 = 50. !
   (ZIMIN)                            Units: meters
   Maximum overland mixing height     Default: 3000.  ! ZIMAX = 3000. !
   (ZIMAX)                            Units: meters
   Minimum overwater mixing height    Default:   50.  ! ZIMINW = 50. !
   (ZIMINW) -- (Not used if observed  Units: meters
   overwater mixing hts. are used)
   Maximum overwater mixing height    Default: 3000.  ! ZIMAXW = 3000. !
   (ZIMAXW) -- (Not used if observed  Units: meters
   overwater mixing hts. are used)

OVERWATER SURFACE FLUXES METHOD and PARAMETERS
      (ICOARE)                        Default: 10      ! ICOARE =  0   !
       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


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 for upper air data
          (only if NOOBS = 0,1)
      2 = No surface or upper air observations
          Use MM5 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 = -0.0045 !
       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!


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

INPUT GROUP: 7 -- Surface meteorological station parameters
--------------

     SURFACE STATION VARIABLES
     (One record per station --  0  records in all)


             1     2
         Name   ID            X coord.   Y coord.   Time   Anem.
                               (km)       (km)      zone   Ht.(m)
       ------------------------------------------------------------
! SS1  ='MILW'    26400       739.061      363.200    6    10  !
! SS2  ='MADI'    26410       619.927      372.210    6    10  !
```

```
! SS3  ='LA C'    26430       461.012      442.705    6    10  !
! SS4  ='EAU '    26435       435.857      552.352    6    10  !
! SS5  ='GREE'    26450       703.911      530.179    6    10  !
! SS6  ='MANI'    26455       743.477      495.113    6    10  !
! SS7  ='STUR'    26458       755.730      576.760    6    10  !
! SS8  ='WAUS'    26463       581.202      568.247    6    10  !
! SS9  ='MOSI'    26465       579.307      552.489    6    10  !
! SS10 ='CLIN'    26502       655.019      541.168    6    10  !
! SS11 ='WISC'    26503       582.532      412.498    6    10  !
! SS12 ='EAGL'    26504       599.980      682.545    6    10  !
! SS13 ='MINE'    26507       550.817      338.941    6    10  !
! SS14 ='HAYW'    26508       430.347      681.295    6    10  !
! SS15 ='JUNE'    26509       669.429      409.931    6    10  !
! SS16 ='dulu'    27450       366.011      766.977    6    10  !
! SS17 ='MANI'    25408       838.315      711.433    5    10  !
! SS18 ='SAWY'    26284       741.237      743.078    5    10  !
! SS19 ='HOUG'    26380       977.905      549.977    5    10  !
! SS20 ='ESCA'    26480       775.417      679.550    5    10  !
! SS21 ='IRNM'    27437       690.168      678.511    5    10  !
! SS22 ='IRNW'    27445       528.314      743.857    5    10  !
------------------
      1
        Four character string for station name
        (MUST START IN COLUMN 9)

      2
        Five digit integer for station ID

!END!


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

INPUT GROUP: 8 -- Upper air meteorological station parameters
--------------

     UPPER AIR STATION VARIABLES
     (One record per station --  0  records in all)

             1     2
         Name    ID      X coord.   Y coord.  Time zone
                           (km)       (km)
        ------------------------------------------------
! US1  ='GREE'   14898    703.911    539.179    6  !
```

```
! US2  ='MNNP'   94983    272.681    539.843    6  !
! US3  ='INTF'   14918    269.489    957.416    6  !

-------------------
      1
        Four character string for station name
        (MUST START IN COLUMN 9)

      2
        Five digit integer for station ID

!END!


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

INPUT GROUP: 9 -- Precipitation station parameters
--------------

     PRECIPITATION STATION VARIABLES
     (One record per station --  0  records in all)
     (NOT INCLUDED IF NPSTA = 0)

            1          2
         Name   Station    X coord.  Y coord.
                  Code       (km)      (km)
         -----------------------------------
! PS1  ='COPP'   201780   719.681    845.179 !
! PS2  ='ESCA'   202626   779.850    646.454 !
! PS3  ='HOUG'   203936  1001.500    536.427 !
! PS4  ='IRON'   204090   699.421    640.283 !
! PS5  ='MANI'   205073   845.933    667.499 !
! PS6  ='SAUL'   207366   985.172    765.448 !
! PS7  ='CLIN'   471667   696.889    290.151 !
! PS8  ='GREE'   473269   709.933    509.579 !
! PS9  ='HAYW'   473511   442.947    678.728 !
! PS10 ='LAC '   474370   471.515    404.495 !
! PS11 ='MADI'   474961   631.719    367.656 !
! PS12 ='MARS'   475120   550.348    505.662 !
! PS13 ='MENO'   475335   431.807    514.277 !
! PS14 ='MILW'   475479   772.567    324.344 !
! PS15 ='RAIN'   476939   599.369    634.460 !
! PS16 ='STURG'  478267   776.964    542.174 !
```

```
------------------
      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!
```

Appendix B – Example CALPUFF Input File

```
Example BART Modeling
2010 Updated BART Modeling -  for PCA, WI.
Using Refined 4km CALMET Data File and SENE, ISLE, BOWA Class I Receptors

---------------- 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 =             *
    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 =PCARef02.lst  !
CONC.DAT      output   ! CONDAT =PCARef02.dat  !
DFLX.DAT      output   * DFDAT  =             *
WFLX.DAT      output   * WFDAT  =             *
VISB.DAT      output   * VISDAT =PCA02DNR.VIB  *
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=             *
H2O2.DAT      input    * H2O2DAT=             *
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=             *
------------------------------------------------------------------------------
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
NOTE: (1) file/path names can be up to 70 characters in length


Provision for multiple input files
----------------------------------
```

```
     Number of CALMET.DAT files for run (NMETDAT)
                                    Default: 1       ! NMETDAT =  364   !

     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)
-------------

  The following CALMET.DAT filenames are processed in sequence if NMETDAT>1

Default Name  Type          File Name
------------  ----          ---------
 none         input    ! METDAT=e:\WI-Calmet\2002output\cal020102.DAT     !  !END!
 none         input    ! METDAT=e:\WI-Calmet\2002output\cal020103.DAT     !  !END!
 none         input    ! METDAT=e:\WI-Calmet\2002output\cal020104.DAT     !  !END!
 none         input    ! METDAT=e:\WI-Calmet\2002output\cal020105.DAT     !  !END!
 none         input    ! METDAT=e:\WI-Calmet\2002output\cal020106.DAT     !  !END!
 none         input    ! METDAT=e:\WI-Calmet\2002output\cal020107.DAT     !  !END!
 none         input    ! METDAT=e:\WI-Calmet\2002output\cal020108.DAT     !  !END!
 none         input    ! METDAT=e:\WI-Calmet\2002output\cal020109.DAT     !  !END!
 none         input    ! METDAT=e:\WI-Calmet\2002output\cal020110.DAT     !  !END!
 none         input    ! METDAT=e:\WI-Calmet\2002output\cal020111.DAT     !  !END!
 none         input    ! METDAT=e:\WI-Calmet\2002output\cal020112.DAT     !  !END!
 none         input    ! METDAT=e:\WI-Calmet\2002output\cal020113.DAT     !  !END!
 none         input    ! METDAT=e:\WI-Calmet\2002output\cal020114.DAT     !  !END!
 none         input    ! METDAT=e:\WI-Calmet\2002output\cal020115.DAT     !  !END!
 none         input    ! METDAT=e:\WI-Calmet\2002output\cal020116.DAT     !  !END!
 none         input    ! METDAT=e:\WI-Calmet\2002output\cal020117.DAT     !  !END!
 none         input    ! METDAT=e:\WI-Calmet\2002output\cal020118.DAT     !  !END!
 none         input    ! METDAT=e:\WI-Calmet\2002output\cal020119.DAT     !  !END!
 none         input    ! METDAT=e:\WI-Calmet\2002output\cal020120.DAT     !  !END!
 none         input    ! METDAT=e:\WI-Calmet\2002output\cal020121.DAT     !  !END!
 none         input    ! METDAT=e:\WI-Calmet\2002output\cal020122.DAT     !  !END!
 none         input    ! METDAT=e:\WI-Calmet\2002output\cal020123.DAT     !  !END!
 none         input    ! METDAT=e:\WI-Calmet\2002output\cal020124.DAT     !  !END!
 none         input    ! METDAT=e:\WI-Calmet\2002output\cal020125.DAT     !  !END!
 none         input    ! METDAT=e:\WI-Calmet\2002output\cal020126.DAT     !  !END!
 none         input    ! METDAT=e:\WI-Calmet\2002output\cal020127.DAT     !  !END!
 none         input    ! METDAT=e:\WI-Calmet\2002output\cal020128.DAT     !  !END!
 none         input    ! METDAT=e:\WI-Calmet\2002output\cal020129.DAT     !  !END!
 none         input    ! METDAT=e:\WI-Calmet\2002output\cal020130.DAT     !  !END!
 none         input    ! METDAT=e:\WI-Calmet\2002output\cal020131.DAT     !  !END!
 none         input    ! METDAT=e:\WI-Calmet\2002output\cal020201.DAT     !  !END!
 none         input    ! METDAT=e:\WI-Calmet\2002output\cal020202.DAT     !  !END!
 none         input    ! METDAT=e:\WI-Calmet\2002output\cal020203.DAT     !  !END!
 none         input    ! METDAT=e:\WI-Calmet\2002output\cal020204.DAT     !  !END!
 none         input    ! METDAT=e:\WI-Calmet\2002output\cal020205.DAT     !  !END!
 none         input    ! METDAT=e:\WI-Calmet\2002output\cal020206.DAT     !  !END!
 none         input    ! METDAT=e:\WI-Calmet\2002output\cal020207.DAT     !  !END!
 none         input    ! METDAT=e:\WI-Calmet\2002output\cal020208.DAT     !  !END!
 none         input    ! METDAT=e:\WI-Calmet\2002output\cal020209.DAT     !  !END!
 none         input    ! METDAT=e:\WI-Calmet\2002output\cal020210.DAT     !  !END!
 none         input    ! METDAT=e:\WI-Calmet\2002output\cal020211.DAT     !  !END!
 none         input    ! METDAT=e:\WI-Calmet\2002output\cal020212.DAT     !  !END!
```

```
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020213.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020214.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020215.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020216.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020217.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020218.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020219.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020220.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020221.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020222.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020223.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020224.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020225.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020226.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020227.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020228.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020301.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020302.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020303.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020304.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020305.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020306.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020307.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020308.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020309.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020310.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020311.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020312.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020313.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020314.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020315.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020316.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020317.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020318.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020319.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020320.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020321.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020322.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020323.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020324.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020325.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020326.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020327.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020328.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020329.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020330.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020331.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020401.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020402.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020403.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020404.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020405.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020406.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020407.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020408.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020409.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020410.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020411.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020412.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020413.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020414.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020415.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020416.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020417.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020418.DAT     !  !END!
```

```
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020419.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020420.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020421.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020422.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020423.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020424.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020425.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020426.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020427.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020428.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020429.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020430.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020501.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020502.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020503.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020504.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020505.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020506.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020507.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020508.DAT     !  !END!
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none         input    ! METDAT=e:\WI-Calmet\2002output\cal020510.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020511.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020512.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020513.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020514.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020515.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020516.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020517.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020518.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020519.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020520.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020521.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020522.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020523.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020524.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020525.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020526.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020527.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020528.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020529.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020530.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020531.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020601.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020602.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020603.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020604.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020605.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020606.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020607.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020608.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020609.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020610.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020611.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020612.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020613.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020614.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020615.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020616.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020617.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020618.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020619.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020620.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020621.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020622.DAT     !  !END!
```

```
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020623.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020624.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020625.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020626.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020627.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020628.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020629.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020630.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020701.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020702.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020703.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020704.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020705.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020706.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020707.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020708.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020709.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020710.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020711.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020712.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020713.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020714.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020715.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020716.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020717.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020718.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020719.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020720.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020721.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020722.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020723.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020724.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020725.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020726.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020727.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020728.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020729.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020730.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020731.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020801.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020802.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020803.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020804.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020805.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020806.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020807.DAT     !  !END!
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none         input    ! METDAT=e:\WI-Calmet\2002output\cal020809.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020810.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020811.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020812.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020813.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020814.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020815.DAT     !  !END!
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none         input    ! METDAT=e:\WI-Calmet\2002output\cal020817.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020818.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020819.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020820.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020821.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020822.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020823.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020824.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020825.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020826.DAT     !  !END!
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none         input    ! METDAT=e:\WI-Calmet\2002output\cal020827.DAT     !  !END!
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none         input    ! METDAT=e:\WI-Calmet\2002output\cal020829.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020830.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020831.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020901.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020902.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020903.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020904.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020905.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020906.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020907.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020908.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020909.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020910.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020911.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020912.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020913.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020914.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020915.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020916.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020917.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020918.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020919.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020920.DAT     !  !END!
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none         input    ! METDAT=e:\WI-Calmet\2002output\cal020922.DAT     !  !END!
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none         input    ! METDAT=e:\WI-Calmet\2002output\cal020924.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020925.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020926.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020927.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020928.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020929.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020930.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal021001.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal021002.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal021003.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal021004.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal021005.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal021006.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal021007.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal021008.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal021009.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal021010.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal021011.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal021012.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal021013.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal021014.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal021015.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal021016.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal021017.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal021018.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal021019.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal021020.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal021021.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal021022.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal021023.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal021024.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal021025.DAT     !  !END!
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none         input    ! METDAT=e:\WI-Calmet\2002output\cal021027.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal021028.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal021029.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal021030.DAT     !  !END!
```

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 none         input    ! METDAT=e:\WI-Calmet\2002output\cal021031.DAT     !  !END!
 none         input    ! METDAT=e:\WI-Calmet\2002output\cal021101.DAT     !  !END!
 none         input    ! METDAT=e:\WI-Calmet\2002output\cal021102.DAT     !  !END!
 none         input    ! METDAT=e:\WI-Calmet\2002output\cal021103.DAT     !  !END!
 none         input    ! METDAT=e:\WI-Calmet\2002output\cal021104.DAT     !  !END!
 none         input    ! METDAT=e:\WI-Calmet\2002output\cal021105.DAT     !  !END!
 none         input    ! METDAT=e:\WI-Calmet\2002output\cal021106.DAT     !  !END!
 none         input    ! METDAT=e:\WI-Calmet\2002output\cal021107.DAT     !  !END!
 none         input    ! METDAT=e:\WI-Calmet\2002output\cal021108.DAT     !  !END!
 none         input    ! METDAT=e:\WI-Calmet\2002output\cal021109.DAT     !  !END!
 none         input    ! METDAT=e:\WI-Calmet\2002output\cal021110.DAT     !  !END!
 none         input    ! METDAT=e:\WI-Calmet\2002output\cal021111.DAT     !  !END!
 none         input    ! METDAT=e:\WI-Calmet\2002output\cal021112.DAT     !  !END!
 none         input    ! METDAT=e:\WI-Calmet\2002output\cal021113.DAT     !  !END!
 none         input    ! METDAT=e:\WI-Calmet\2002output\cal021114.DAT     !  !END!
 none         input    ! METDAT=e:\WI-Calmet\2002output\cal021115.DAT     !  !END!
 none         input    ! METDAT=e:\WI-Calmet\2002output\cal021116.DAT     !  !END!
 none         input    ! METDAT=e:\WI-Calmet\2002output\cal021117.DAT     !  !END!
 none         input    ! METDAT=e:\WI-Calmet\2002output\cal021118.DAT     !  !END!
 none         input    ! METDAT=e:\WI-Calmet\2002output\cal021119.DAT     !  !END!
 none         input    ! METDAT=e:\WI-Calmet\2002output\cal021120.DAT     !  !END!
 none         input    ! METDAT=e:\WI-Calmet\2002output\cal021121.DAT     !  !END!
 none         input    ! METDAT=e:\WI-Calmet\2002output\cal021122.DAT     !  !END!
 none         input    ! METDAT=e:\WI-Calmet\2002output\cal021123.DAT     !  !END!
 none         input    ! METDAT=e:\WI-Calmet\2002output\cal021124.DAT     !  !END!
 none         input    ! METDAT=e:\WI-Calmet\2002output\cal021125.DAT     !  !END!
 none         input    ! METDAT=e:\WI-Calmet\2002output\cal021126.DAT     !  !END!
 none         input    ! METDAT=e:\WI-Calmet\2002output\cal021127.DAT     !  !END!
 none         input    ! METDAT=e:\WI-Calmet\2002output\cal021128.DAT     !  !END!
 none         input    ! METDAT=e:\WI-Calmet\2002output\cal021129.DAT     !  !END!
 none         input    ! METDAT=e:\WI-Calmet\2002output\cal021130.DAT     !  !END!
 none         input    ! METDAT=e:\WI-Calmet\2002output\cal021201.DAT     !  !END!
 none         input    ! METDAT=e:\WI-Calmet\2002output\cal021202.DAT     !  !END!
 none         input    ! METDAT=e:\WI-Calmet\2002output\cal021203.DAT     !  !END!
 none         input    ! METDAT=e:\WI-Calmet\2002output\cal021204.DAT     !  !END!
 none         input    ! METDAT=e:\WI-Calmet\2002output\cal021205.DAT     !  !END!
 none         input    ! METDAT=e:\WI-Calmet\2002output\cal021206.DAT     !  !END!
 none         input    ! METDAT=e:\WI-Calmet\2002output\cal021207.DAT     !  !END!
 none         input    ! METDAT=e:\WI-Calmet\2002output\cal021208.DAT     !  !END!
 none         input    ! METDAT=e:\WI-Calmet\2002output\cal021209.DAT     !  !END!
 none         input    ! METDAT=e:\WI-Calmet\2002output\cal021210.DAT     !  !END!
 none         input    ! METDAT=e:\WI-Calmet\2002output\cal021211.DAT     !  !END!
 none         input    ! METDAT=e:\WI-Calmet\2002output\cal021212.DAT     !  !END!
 none         input    ! METDAT=e:\WI-Calmet\2002output\cal021213.DAT     !  !END!
 none         input    ! METDAT=e:\WI-Calmet\2002output\cal021214.DAT     !  !END!
 none         input    ! METDAT=e:\WI-Calmet\2002output\cal021215.DAT     !  !END!
 none         input    ! METDAT=e:\WI-Calmet\2002output\cal021216.DAT     !  !END!
 none         input    ! METDAT=e:\WI-Calmet\2002output\cal021217.DAT     !  !END!
 none         input    ! METDAT=e:\WI-Calmet\2002output\cal021218.DAT     !  !END!
 none         input    ! METDAT=e:\WI-Calmet\2002output\cal021219.DAT     !  !END!
 none         input    ! METDAT=e:\WI-Calmet\2002output\cal021220.DAT     !  !END!
 none         input    ! METDAT=e:\WI-Calmet\2002output\cal021221.DAT     !  !END!
 none         input    ! METDAT=e:\WI-Calmet\2002output\cal021222.DAT     !  !END!
 none         input    ! METDAT=e:\WI-Calmet\2002output\cal021223.DAT     !  !END!
 none         input    ! METDAT=e:\WI-Calmet\2002output\cal021224.DAT     !  !END!
 none         input    ! METDAT=e:\WI-Calmet\2002output\cal021225.DAT     !  !END!
 none         input    ! METDAT=e:\WI-Calmet\2002output\cal021226.DAT     !  !END!
 none         input    ! METDAT=e:\WI-Calmet\2002output\cal021227.DAT     !  !END!
 none         input    ! METDAT=e:\WI-Calmet\2002output\cal021228.DAT     !  !END!
 none         input    ! METDAT=e:\WI-Calmet\2002output\cal021229.DAT     !  !END!
 none         input    ! METDAT=e:\WI-Calmet\2002output\cal021230.DAT     !  !END!
 none         input    ! METDAT=e:\WI-Calmet\2002output\cal021231.DAT     !  !END!

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INPUT GROUP: 1 -- General run control parameters
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    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 =  2002  !
     (used only if   Month (IBMO) -- No default       ! IBMO =  1  !
      METRUN = 0)      Day (IBDY) -- No default       ! IBDY =  02 !
                      Hour (IBHR) -- No default       ! IBHR =  1  !

     Base time zone        (XBTZ) -- No default       ! XBTZ = 6.0  !
        PST = 8., MST = 7.
        CST = 6., EST = 5.

     Length of run (hours) (IRLG) -- No default       ! IRLG = 8784  !

     Number of chemical species (NSPEC)
                                  Default: 5       ! NSPEC =  9   !

     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)

     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. !
```

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!END!

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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 =  3   !
        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 =  0   !
        0 = not modeled
        1 = modeled

     Near-field puffs modeled as
     elongated 0 (MSLUG)                  Default: 0     ! MSLUG =  0   !
        0 = no
        1 = yes (slug model used)

     Transitional plume rise modeled ?
     (MTRANS)                             Default: 1     ! MTRANS =  1   !
        0 = no  (i.e., final rise only)
        1 = yes (i.e., transitional rise computed)

     Stack tip downwash? (MTIP)           Default: 1     ! MTIP =  1  !
        0 = no  (i.e., no stack tip downwash)
        1 = yes (i.e., use stack tip downwash)

     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 =  1   !
        0 = chemical transformation not
            modeled
        1 = transformation rates computed
            internally (MESOPUFF II scheme)
        2 = user-specified transformation
            rates used
        3 = transformation rates computed
```

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        internally (RIVAD/ARM3 scheme)
   4 = secondary organic aerosol formation
        computed (MESOPUFF II scheme for OH)

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 adjusted
        for aqueous phase reactions

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)

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
        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 =  3  !
(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.

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)
   0 = no
   1 = yes, using formatted BCON.DAT file
   2 = yes, using unformatted CONC.DAT file


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
                        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

!END!


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

INPUT GROUP: 3a, 3b -- Species list
-------------------

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

  The following species are modeled:

  The following species are modeled:

! CSPEC =          SO2 !         !END!
! CSPEC =          SO4 !         !END!
! CSPEC =          NOX !         !END!
! CSPEC =         HNO3 !         !END!
! CSPEC =          NO3 !         !END!
! CSPEC =          PMC !         !END!
! CSPEC =          PMF !         !END!
! CSPEC =           EC !         !END!
! CSPEC =          SOA !         !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   !
!          SO4  =         1,               1,           2,                  0   !
!          NOX  =         1,               1,           1,                  0   !
!         HNO3  =         1,               0,           1,                  0   !
!          NO3  =         1,               0,           2,                  0   !
!          PMC  =         1,               1,           2,                  0   !
!          PMF  =         1,               1,           2,                  0   !
!           EC  =         1,               1,           2,                  0   !
!          SOA  =         1,               1,           2,                  0   !


!END!
```

```
-------------
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.



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


INPUT GROUP: 4 -- Map Projection and Grid control parameters
--------------

     Projection for all (X,Y):
     -------------------------

     Map projection
     (PMAP)                    Default: UTM    ! PMAP = LCC  !

         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 =  0   !

     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 =  40N  !
     (RLON0)                   No Default      ! RLON0 =  97W  !

         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 =  33N  !
```

```
     (XLAT2)                   No Default      ! XLAT2 =  45N  !

         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:

     Rectangular grid defined for projection PMAP,
     with X the Easting and Y the Northing coordinate

            No. X grid cells (NX)      No default     ! NX =  162   !
            No. Y grid cells (NY)      No default     ! NY =  191   !
         No. vertical layers (NZ)      No default     ! NZ =  10   !

           Grid spacing (DGRIDKM)      No default     ! DGRIDKM = 4. !
                                       Units: km


        Cell face heights in arbitrary
        vertical grid (ZFACE(NZ+1))    No defaults
                                       Units: m
        ! ZFACE = 0.,20.,40.,80.,160.,320.,640.,1200.,2000.,3000.,4000. !

            Reference Coordinates
           of SOUTHWEST corner of
                 grid cell(1, 1):

            X coordinate (XORIGKM)     No default     ! XORIGKM = 247. !
            Y coordinate (YORIGKM)     No default     ! YORIGKM = 240. !
                                      Units: km


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 =  162   !
                  (1 <= IECOMP <= NX)

        Y index of UR corner (JECOMP)      No default     ! JECOMP =  191   !
                  (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 = F !
        (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 =  162   !
         (IBCOMP <= IESAMP <= IECOMP)

        Y index of UR corner (JESAMP)      No default     ! JESAMP =  191   !
         (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 =  0   !
Wet Fluxes (IWET)                 1                   !  IWET =  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


 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 =  0   !
    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 =  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

    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, # 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 =     0,           1,           0,           0,           0,           0,
0   !
!          SO4 =     0,           1,           0,           0,           0,           0,
0   !
!          NOX =     0,           1,           0,           0,           0,           0,
0   !
!         HNO3 =     0,           1,           0,           0,           0,           0,
0   !
!          NO3 =     0,           1,           0,           0,           0,           0,
0   !
!          PMC =     0,           1,           0,           0,           0,           0,
0   !
!          PMF =     0,           1,           0,           0,           0,           0,
0   !
!           EC =     0,           1,           0,           0,           0,           0,
0   !
!          SOA =     0,           1,           0,           0,           0,           0,
0   !


     OPTIONS FOR PRINTING "DEBUG" QUANTITIES (much output)

       Logical for debug output
       (LDEBUG)                                 Default: F     ! LDEBUG = F !

       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 =  0   !

       Number of special complex terrain
       receptors  (NCTREC)                      Default: 0     ! NCTREC =  0   !

       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)
----          ----      ----      ------  -----  ------    ------    ------   -------    -------
-----     -----

---------------
Subgroup (6c)
---------------

    COMPLEX TERRAIN RECEPTOR INFORMATION

                      XRCT         YRCT        ZRCT          XHH
                      (km)         (km)         (m)
                     ------        -----      ------         ----


-------------------
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 !
!         HNO3 =     0.1628,            1.,           18.,               0.,
0.00000008 !

!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)
      -------      -------------------        ------------------

!          SO4 =          0.48,                     2.   !
!          NO3 =          0.48,                     2.   !
!          PMC =           2.0,                    2.0   !
!          PMF =          0.48,                     2.   !
!           EC =          0.48,                     2.   !
!          SOA =          0.48,                     2.   !


!END!


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


INPUT GROUP: 9 -- Miscellaneous dry deposition parameters
--------------
```

```
     Reference cuticle resistance (s/cm)
     (RCUTR)                          Default: 30    !  RCUTR = 30.0 !
     Reference ground resistance  (s/cm)
     (RGR)                            Default: 10    !    RGR = 10.0 !
     Reference pollutant reactivity
     (REACTR)                         Default: 8     ! REACTR = 8.0 !

     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 !
!          SO4 =         1.0E-04,            3.0E-05 !
!          NOX =          0.0E00,             0.0E00 !
!         HNO3 =         6.0E-05,             0.0E00 !
!          NO3 =         1.0E-04,            3.0E-05 !

!END!


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


INPUT GROUP: 11 -- Chemistry Parameters
---------------

     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
     (Used only if MCHEM = 1, 3, or 4 and
      MOZ = 0 or MOZ = 1 and all hourly O3 data missing)
     (BCKO3) in ppb                   Default: 12*80.

     !  BCKO3 = 31.00, 31.00, 31.00, 37.00, 37.00, 37.00, 33.00, 33.00, 33.00, 27.00, 27.00, 27.00
!

     Monthly ammonia concentrations
     (Used only if MCHEM = 1, or 3)
     (BCKNH3) in ppb                  Default: 12*10.
      ! BCKNH3 = 12*3.9 !
```

```
     *  BCKNH3 = 00.30, 00.30, 00.30, 00.50, 00.50, 00.50, 00.50, 00.50, 00.50, 00.50, 00.50,
00.50 *

     Nighttime SO2 loss rate (RNITE1)
     in percent/hour                  Default: 0.2          ! RNITE1 = .2 !

     Nighttime NOx loss rate (RNITE2)
     in percent/hour                  Default: 2.0          ! RNITE2 = 2.0 !

     Nighttime HNO3 formation rate (RNITE3)
     in percent/hour                  Default: 2.0          ! RNITE3 = 2.0 !

     H2O2 data input option (MH2O2)    Default: 1            ! MH2O2 =  1   !
     (Used only if MAQCHEM = 1)
        0 = use a monthly background H2O2 value
        1 = read hourly H2O2 concentrations from
            the H2O2.DAT data file

     Monthly H2O2 concentrations
     (Used only if MQACHEM = 1 and
      MH2O2 = 0 or MH2O2 = 1 and all hourly H2O2 data missing)
     (BCKH2O2) in ppb                 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 *
     !  BCKH2O2 = 0.50, 0.50, 0.50, 2.30, 2.30, 2.30, 3.50, 3.50, 3.50, 0.80, 0.80, 0.80 !

 --- Data for SECONDARY ORGANIC AEROSOL (SOA) Option
     (used only if MCHEM = 4)

     The 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)
     to 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.
        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!


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


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 = 5.5E02 !

     Switch for using Heffter equation for sigma z
     as above (0 = Not use Heffter; 1 = use Heffter
     (MHFTSZ)                                  Default: 0      ! MHFTSZ =  0   !

     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 = .01 !

     Vertical dispersion constant for neutral/
     unstable conditions (k2 in Eqn. 2.7-4)
     (CONK2)                                   Default: 0.1    ! CONK2 = .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 = .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
     (IURB1, IURB2)                            Default: 10     ! IURB1 =  10  !
                                                        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 = .25 !

        Leaf area index for modeling domain
        (XLAIIN)                               Default: 3.0    ! XLAIIN = 3.0 !
```

```
   Elevation above sea level (m)
   (ELEVIN)                              Default: 0.0    ! ELEVIN = .0 !

   Latitude (degrees) for met location
   (XLATIN)                              Default: -999.  ! XLATIN = -999.0 !

   Longitude (degrees) for met location
   (XLONIN)                              Default: -999.  ! XLONIN = -999.0 !

Specialized information for interpreting single-point Met data files -----

   Anemometer height (m) (Used only if METFM = 2,3)
   (ANEMHT)                              Default: 10.    ! ANEMHT = 10.0 !

   Form of lateral turbulance 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 = 1.0 !

Maximum travel distance of a puff/slug (in
grid units) during one sampling step
(XSAMLEN)                                Default: 1.0    ! XSAMLEN = 1.0 !

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 = 1.0  !

Minimum sigma z for a new puff/slug (m)
(SZMIN)                                  Default: 1.0    ! SZMIN = 1.0  !

Default minimum turbulence velocities
sigma-v and sigma-w for each
stability class (m/s)
(SVMIN(6) and SWMIN(6))     Default SVMIN : .50,  .50,  .50,  .50,  .50,  .50
                            Default SWMIN : .20,  .12,  .08,  .06,  .03,  .016

                          Stability Class :  A     B     C     D     E     F
                                             ---   ---   ---   ---   ---   ---
                                  ! SVMIN = 0.500, 0.500, 0.500, 0.500, 0.500, 0.500!
                                  ! SWMIN = 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 !

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 = .5 !

Maximum mixing height (m)
(XMAXZI)                                   Default: 3000.  ! XMAXZI = 3000.0 !

Minimum mixing height (m)
(XMINZI)                                   Default: 50.    ! XMINZI = 50.0 !

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
                                            ---   ---   ---   ---   ---
                                  ! 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
                                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 = 10.0 !

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 = 0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,1,0,0,0,0,0,0,0 !

  Split is allowed only if last hour's mixing
  height (m) exceeds a minimum value
  (ZISPLIT)                         Default: 100.       ! ZISPLIT = 100.0 !

  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 = 2.0 !

  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 !

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 = 1.0 !

  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 = 500.0 !

  Search radius (in BC segment lengths) about a receptor for sampling
  nearest BC puff.  BC puffs are emitted with a spacing of one segment
  length, so the search radius should be greater than 1.
```

```
       (RSAMPBC)                          Default:   4.      ! RSAMPBC = 10.0 !

       Near-Surface depletion adjustment to concentration profile used when
       sampling BC puffs?
       (MDEPBC)                           Default:   1        ! MDEPBC =  1  !
          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 =     Odour Unit * m**3/s  (vol. flux of odour compound)
           6 =     Odour Unit * m**3/min
           7 =     metric tons/yr

     Number of source-species
     combinations with variable
     emissions scaling factors
     provided below in (13d)        (NSPT1) Default: 0  !  NSPT1 =  0  !

     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)
---------------

  The following species are modeled:

CSPEC =          SO2
CSPEC =          SO4
CSPEC =          NOX
CSPEC =         HNO3
CSPEC =          NO3
CSPEC =          PMC
CSPEC =          PMF
CSPEC =           EC
CSPEC =          SOA
```

```
          POINT SOURCE: CONSTANT DATA
          ---------------------------
                                                                                b          c
  Source       X         Y       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 = P1 !
   1 ! X =   568.01, 625.9200,  60.700,360.00,     3.230,  17.0,  468.0,   .0,
       166.3E00, 2.17E00, 13.4E00, 0.0E00, 0.0E00, 0.47, 0.98, 0.04, 0.54 !
   1 ! FMFAC  =      1.0 !   !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)

    b
     0. = No building downwash modeled, 1. = downwash modeled
     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)
------     ---------------------------------------------------------------------


--------

    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+)



--------
    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 =  0   !

     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 =     Odour Unit * m/s  (vol. flux/m**2 of odour compound)
           6 =     Odour Unit * m/min
           7 =     metric tons/m**2/yr

     Number of source-species
     combinations with variable
     emissions scaling factors
     provided below in (14d)        (NSAR1) Default: 0  !  NSAR1 =  0  !

     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)
-------          ------    ------     --------   ---------


--------
    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 (km) FOR EACH VERTEX(4) OF EACH POLYGON
           ---------------------------------------------------------
Source                                                              a
 No.       Ordered list of X followed by list of Y, grouped by source
------     -------------------------------------------------------------


--------
    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+)


--------
    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 =  0  !

     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 =     Odour Unit * m**3/s  (vol. flux of odour compound)
           6 =     Odour Unit * m**3/min
           7 =     metric tons/yr

     Number of source-species
     combinations with variable
     emissions scaling factors
     provided below in (15c)        (NSLN1) Default: 0  !  NSLN1 =  0  !

     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 = .0 !
                                                    (in meters)

        Average building height (HBL)               No default   ! HBL = .0 !
                                                    (in meters)
```

```
        Average building width (WBL)               No default   ! WBL = .0 !
                                                   (in meters)

        Average line source width (WML)            No default   ! WML = .0 !
                                                   (in meters)

        Average separation between buildings (DXL) No default   ! DXL = .0 !
                                                   (in meters)

        Average buoyancy parameter (FPRIMEL)       No default   ! FPRIMEL = .0 !
                                                   (in m**4/s**3)

!END!

---------------
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)
------   ----------  ----------  ---------  ----------  -------   ---------    ---------

--------

    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+)
```

```
--------
    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)
---------------

     Number of volume sources with
     parameters provided in 16b,c (NVL1)     No default  !  NVL1 =  0   !

     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 =     Odour Unit * m**3/s  (vol. flux of odour compound)
           6 =     Odour Unit * m**3/min
           7 =     metric tons/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           Y        Effect.    Base     Initial    Initial    Emission
     Coordinate  Coordinate   Height   Elevation  Sigma y    Sigma z     Rates
        (km)        (km)        (m)       (m)        (m)       (m)
     ----------  ----------   ------    ------    --------   --------   --------


--------
    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 VOLEMARB.DAT and NVL2 > 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+)



--------
    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 =  1995   !
!END!

Note - three Class I areas
Seney SENE = 173 receptors
Isle Royal ISLE = 966 receptors
Boundary Waters BOWA = 856 receptors
total number of receptors is 1995
```

ALL RECEPTOR COORDINATES FOLLOW IN INPUT FILE

Updated CALPUFF Modeling Protocol and Final Report for the Subject to BART Analyses for Thilmany Kaukauna Mill

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Updated CALPUFF Modeling Protocol and Final Report for Thilmany "Subject to BART" Analysis

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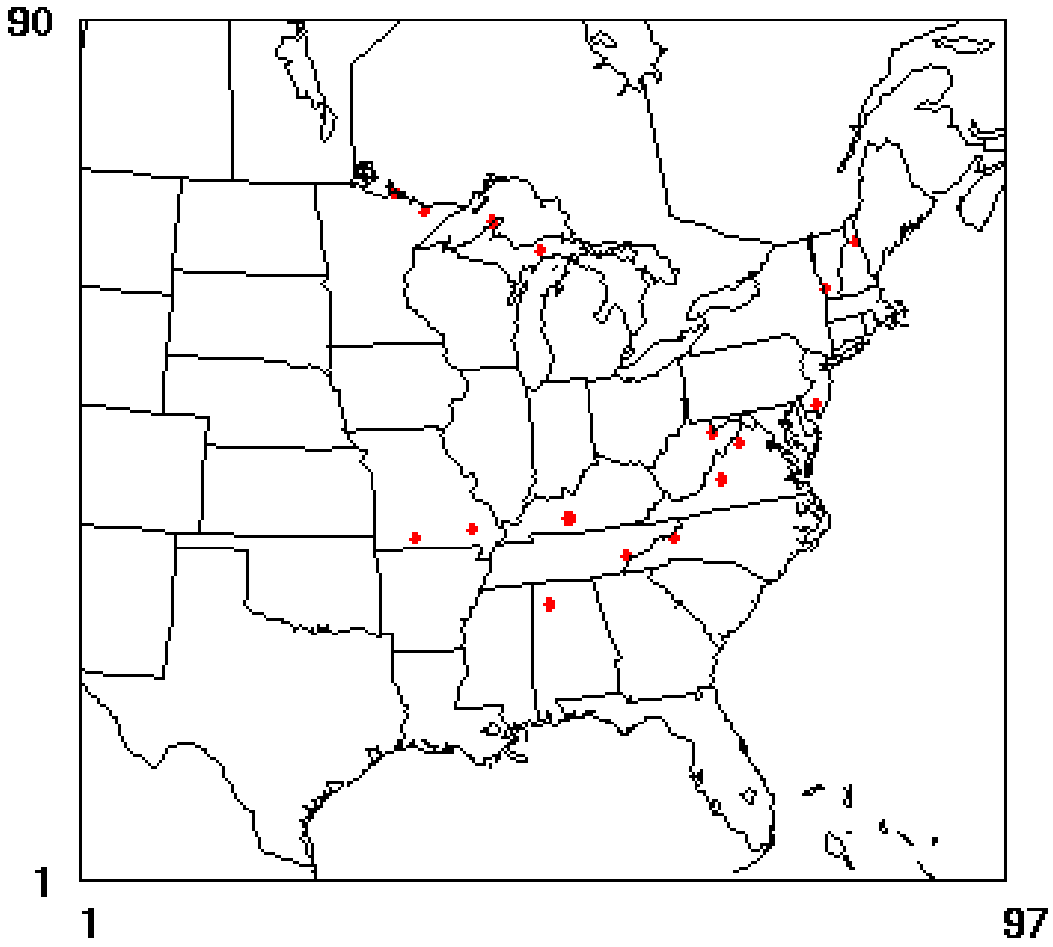
1.0 Introduction

The Wisconsin Department of Natural Resources (DNR) performed single source screening modeling in 2006 to evaluate which Best Available Retrofit Technology (BART) eligible sources in the state may "cause or contribute" to visibility impairment and could therefore be subject to BART requirements. This type of analysis is referred to as the "subject to BART" or "BART exemption" analysis. The methods used by DNR are described in the "Single Source Modeling to Support Regional Haze BART Modeling Protocol", March 21, 2006, prepared by Lake Michigan Air Directors Consortium (LADCO).

DNR applied CALPUFF to each BART eligible source for three annual periods, covering the calendar years 2002 to 2004. The CALPUFF/CALMET modeling domain consisted of ninety-seven 36-km spaced cells in the east-west direction and ninety 36-km spaced cells in the north-south direction (see Figure 1). Meteorological data generated by the MM5 prognostic weather model (provided by LADCO in CALMM5 format) was used to develop the meteorological data for CALPUFF, without additional observational data input (i.e., NOOBS mode). This represents a coarse meteorological grid, suitable for an initial screening analysis.

The results from DNR's screening analysis indicated that, with the exception of some of the largest electric power stations in the state, the only Class I areas where BART eligible sources may contribute to visibility impairment are the three areas to the north of Wisconsin, the Boundary Waters Canoe Area, Isle Royal National Park, and Seney Wildlife Area. DNR's screening analysis also indicated that the BART eligible emissions unit at the Thilmany Kaukauna Mill (Thilmany) may "cause or contribute" to visibility impairment at the Seney Class I area (located approximately 280 km to the northeast of the mill), as defined by the 98th percentile visibility impacts being greater than 0.5 deciviews (dv) relative to natural background.

Figure 1 - WDNR Screening CALPUFF Domain



NOTE: Class I areas are identified by red marks.

Thilmany has elected to refine the DNR screening analysis by conducting refined CALPUFF modeling with a 4 km meteorological grid, based on procedures described in the "Visibility Improvement – State and Tribal Association of the Southeast (VISTAS) BART CALPUFF" modeling protocol. The VISTAS protocol was developed by a large group of stakeholders, including EPA, the VISTAS member state agencies and tribes, the Federal Land Managers (FLMs), industry representatives, and consulting experts. Given the resources expended on the VISTAS protocol, it arguably represents the most comprehensive CALPUFF BART protocol ever developed.

Thilmany had discussions with DNR and EPA Region 5 staff about refining the analysis, and submitted a refined CALPUFF BART modeling protocol in March 2007. EPA reviewed the protocol and provided minor comments to DNR in May 2010. Thilmany responded to these comments in a letter "Response to EPA Comments on Thilmany BART Modeling Protocol" dated November 9, 2010. In addition, subsequent to the EPA protocol comments, the US Fish and Wildlife Service and US Forest Service reviewed the protocol and had additional discussions with DNR and EPA. The three EPA comments, and each response, are listed below.

Comment 1

Information needs to be presented which clarifies how POSTUTIL was used for ammonia.

Response 1

The VISTAS methodology was used, with a MNITRATE switch setting of one (1).

Comment 2

The modeling must include a copy of the input and list files associated with runs. The protocol only offers some of the control file information.

Response 2

All CALMET, CALPUFF, and CALPOST input and list files, as well as meteorological and geophysical data files, had been provided by Thilmany to DNR on a portable hard disk drive.

Thilmany will again provide a portable hard disk drive of all modeling files to DNR for the updated BART analysis, for purposes of SIP documentation.

Comment 3

The Thilmany input file … uses the background ammonia values that were produced for the LADCO protocol. These values are based on modeled estimates. Monitoring data has generally shown much higher ammonia than what was used from the model results. The refined modeling analyses for Thilmany … must evaluate the visibility impacts using measured background ammonia values.

Response 3

The US Fish and Wildlife Service proposed using a constant background ammonia concentration of 3.9 ppb, which was the highest concentration measured at the Mayville Wisconsin station during a mid-1990s EPA study. Thilmany has agreed to use this single, conservative background value in the absence of daily data.

On November 29, 2010, DNR issued a letter that approved the Thilmany CALPUFF BART protocol, as well as the emission rates to be used for the BART eligible emission units. DNR requested that the 2007 version of the protocol be updated to include the responses to EPA comments, and text that addresses current CALPUFF modeling guidance. In addition, the updated modeling results could be presented in the protocol (so that all information is located in one document).

This document is the updated modeling protocol and final modeling report for the refined Thilmany "Subject to BART" analysis. This document does not duplicate the extensive information on visibility, CALPUFF, and EPA guidance on BART modeling procedures that are contained in the VISTAS protocol. Rather, this document describes how data specific to this setting will be used in the refined CALPUFF modeling. Section 1 of the protocol is this introduction. Section 2 briefly summarizes important concepts from the VISTAS protocol.

Section 3 describes the specific CALMET data and procedures that were used to develop a refined, 4-km spaced meteorological grid for Wisconsin. Section 4 describes the CALPUFF input data and procedures, and Section 5 discusses the POSTUTIL and CALPOST processing, including the use of annual average natural background visibility. Section 6 presents the emission and stack data that were used for the BART eligible emission units, and Section 7 presents the modeling results. Appendices A and B present example CALMET and CALPUFF input file listings. A portable hard drive is also being submitted that contains all input data, control files, output files, and computer codes used in the analysis.

2.0 VISTAS BART Protocol

The VISTAS member states have prepared a CALPUFF modeling protocol for BART determinations that is fully consistent with the EPA guidelines in 40 CFR Part 51 Appendix W and Appendix Y. The VISTAS protocol describes a two-step CALPUFF analysis methodology for BART exemption analyses. The initial CALPUFF analysis uses a "screening" or coarse resolution meteorological grid to determine if a particular source may be exempted from further BART analyses. The screening results are also used to determine which Class I areas should be included in any refined analysis. Assumptions for the initial screening analysis are conservative so that a source that contributes to visibility impairment is not exempted in error. If a source is shown to contribute to visibility impairment using the initial screening assessment, the source has the option to undertake refined CALPUFF modeling using finer meteorological grids to evaluate further whether it is subject to BART.

VISTAS developed both coarse (12-km grid resolution) and refined (4-km grid resolution) CALMET files. The fine grid CALMET files utilized both MM5 prognostic data, as well as meteorological observational data for the CALMET "Step 2" calculations. Overwater (buoy) data were used in addition to the standard hourly surface meteorological observations, precipitation observations, and twice-daily upper air sounding data. The VISTAS website provides detailed

documentation and supporting information on the refined CALMET processing, including the CALMET and CALPUFF input files that contain model configuration options and settings that have been optimized after consultation with stakeholders and consulting experts. These same CALMET and CALPUFF input files were used as the basis for the refined Wisconsin analyses.

The VISTAS protocol discusses several options for defining the natural background visibility. These include use of the annual average natural background extinction or the background extinction for the 20% best natural conditions days. Based on an email survey of the state agencies from the VISTAS member states, all of the VISTAS states allowed the use of annual average natural background extinction for refined CALPUFF analyses. This is also the guidance provided by EPA Region 5 staff during discussions with DNR and the Wisconsin Paper Council, and the method approved by DNR in their November 29, 2010 letter. Therefore, the refined Thilmany CALPUFF modeling used the annual average natural background extinction for CALPOST processing.

The VISTAS BART guidance recommends that the threshold value used to define whether a source "contributes" to visibility impairment is a 0.5 dv change from natural background conditions. The 98th percentile 24-hr average predicted impact at the Class I area (equal to the 8th highest value) is to be compared to this contribution threshold value. According to clarification of the BART guidance received from EPA by the VISTAS workgroup, for a three-year simulation the modeling values to be compared with the threshold are the greatest of the three annual 8th highest values, or the 22nd highest value over all three years combined, whichever is greater.

3.0 CALMET Data and Procedures

Since the 2007 version of the modeling protocol was developed, EPA has updated the versions of the approved CALPUFF programs, and has provided additional guidance on CALMET "switch" settings. The current approved versions are CALPUFF version 5.8 (level 070623), and CALMET version 5.8 (level 070623), and these versions were used for the updated refined BART CALPUFF analysis. On August 31, 2009, EPA published the memorandum "Clarification of EPA-FLM Recommended Settings for CALMET". EPA stated that a 4 km fine CALMET grid size was acceptable, and provided recommended CALMET settings. The CALMET settings for the updated refined BART CALPUFF analysis meet all current EPA recommendations.

The first step in development of the refined Wisconsin analysis was to define the CALMET refined modeling domain and grid. As discussed in Section 1, DNR's screening analysis indicated that there are three Class I areas to the north of Wisconsin, the Boundary Waters Canoe Area, Isle Royal National Park, and Seney Wildlife Area, where the screening analysis predicts some level of visibility impact from Wisconsin BART eligible sources. Therefore, the meteorological grid was developed to ensure coverage for these three Class I areas, as well as for the BART eligible source locations throughout Wisconsin. Standard IWAQM guidance also recommends that the CALMET grid extend a minimum of 50 km beyond any Class I or emission source location, so that puff recirculation can be properly accounted for.

The refined CALMET grid was defined as a 4-km spaced grid with 162 cells in the X-axis and 191 in the Y-axis. The grid projection was Lambert Conformal Conic, using the same projection parameters as in the DNR screening analysis (this allows the use of the same source X and Y coordinates as in the DNR analysis). The projection parameters include RLAT0 = 40N, RLON0 = 97W, XLAT1 = 33N, XLAT2 = 45N, XORIGKM = 247.0, YORIGKM = 240.0, and DATUM = NAS-C.

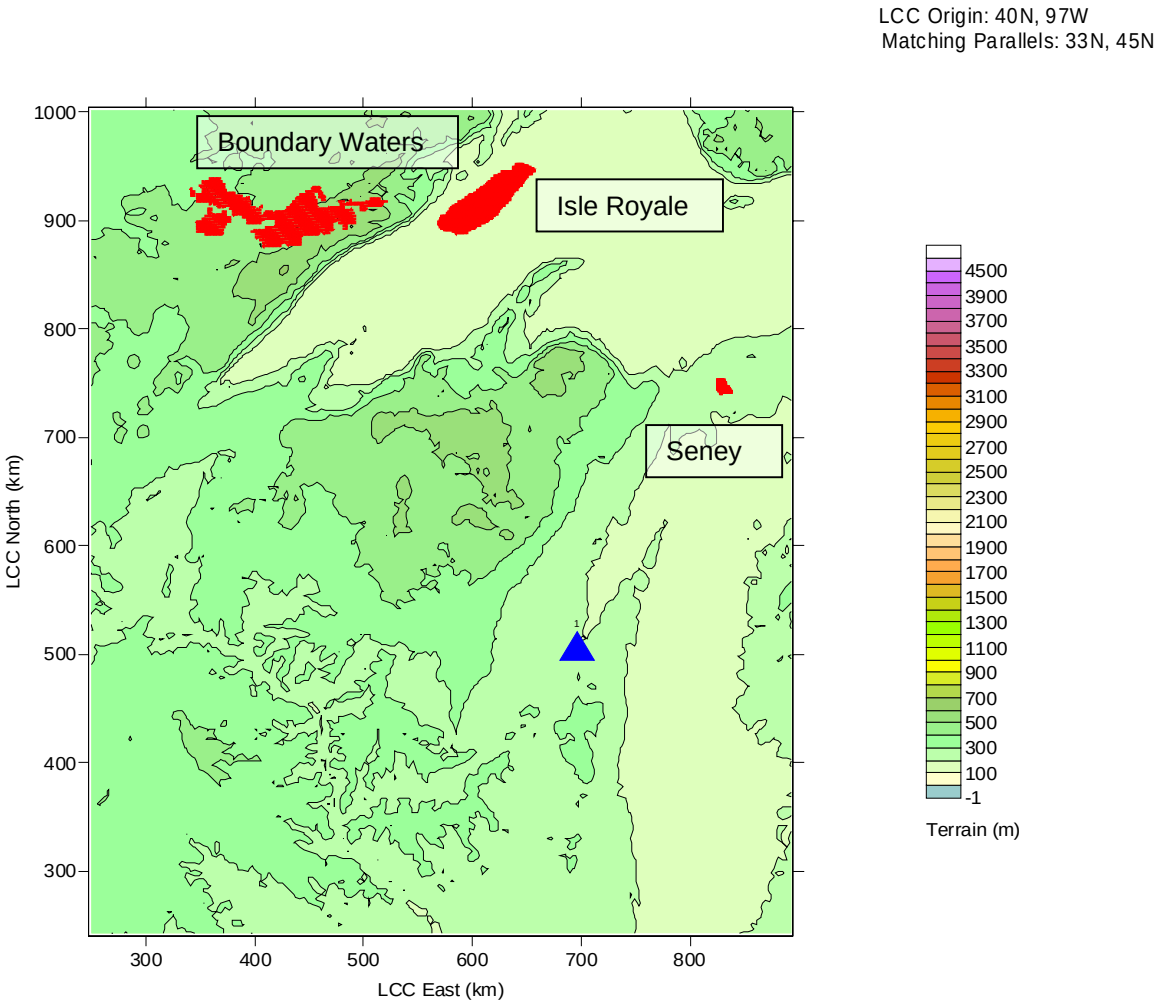
The meteorological data that was input to CALMET included the same three years (2002-2004) of CALMM5 data used by DNR, which was provided by LADCO. However, the refined CALMET runs also considered observation data from 22 surface stations, 16 precipitation stations, 5 overwater buoy stations, and 3 upper air stations. Figure 2 is a plot of the refined CALPUFF modeling domain. Figure 3 presents a plot of the locations of the observation stations in the modeling domain.

The CAMET program MAKEGEO uses USGS GTOPO30 digital terrain data (which includes coverage in Canada) and USGS Composite Theme Grid Land Use and Land Cover (LULC) data to create a gridded data file on geophysical parameters that is used by CALMET. The available USGS LULC coverage does not extend into the Canadian areas of the refined domain. These areas in Canada were assigned to the "forested land" category. Figure 4 presents a plot of the land use data for the modeling domain.

The VISTAS refined CALMET input files discussed in section 2 were used as the basis for the refined Wisconsin CALMET input files. The same CALMET configuration settings and options were utilized, as they are representative of Wisconsin terrain and land use patterns. All settings conform with current EPA and FLM guidance.

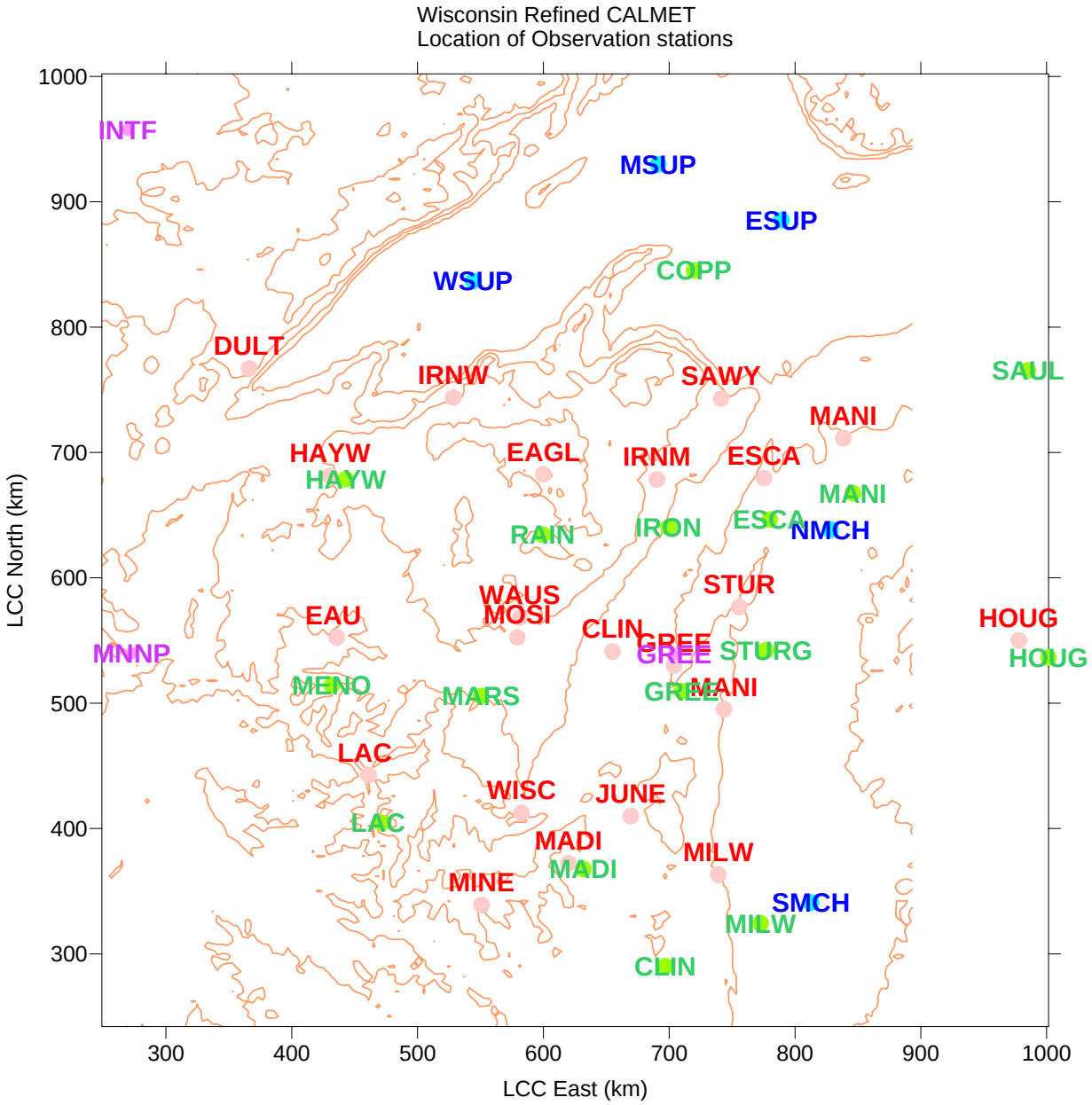
Appendix A presents a listing of a CALMET input file developed for the refined analysis.

Figure 2 – Refined CALPUFF Modeling Domain and Locations of Class I Areas



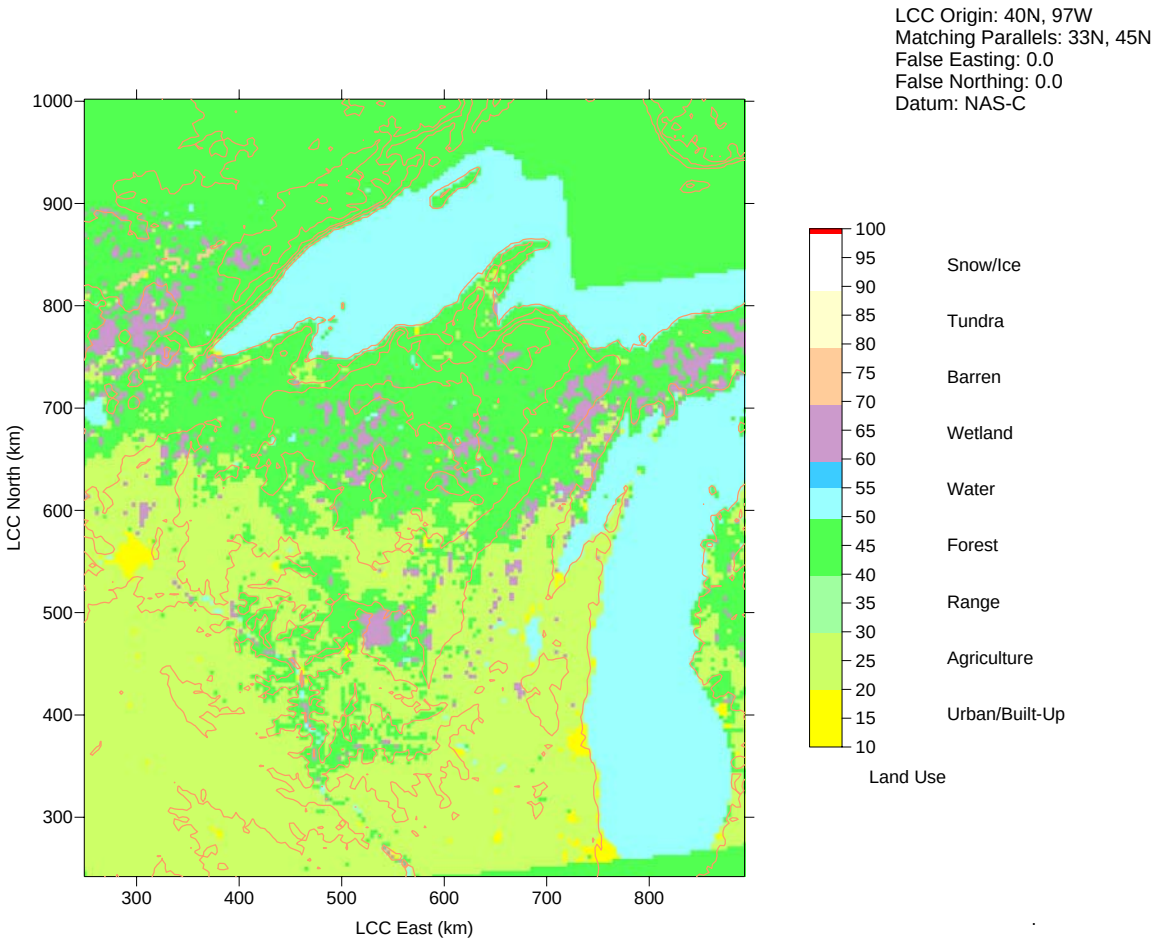
NOTE: The Class I area receptors are in red, the Thilmany mill location is in blue, and the X and Y coordinates are the Lambert projection coordinates are in kms.

Figure 3 – Locations of Observational Stations in Refined CALPUFF Modeling Domain



NOTES: Surface stations are in red, overwater (bouy) in blue, precipitation in green, and upper air in purple.

Figure 4 – Land Use Data for Refined CALPUFF Modeling Domain



Some of the notable CALMET configuration settings included:

- CALMET vertical layers set to 10, with cell face heights at 20, 40, 80, 160, 320, 640, 1200, 2000, 3000, and 4000 meters,
- CALMET diagnostic options, including slope flow effects (ISLOPE = 1) with the radius of influence of terrain (TERRAD) set to 15 km,
- EPA recommended CALMET settings for the radius of influence parameters (R1=50, R2=100, RMAX1=100, RMAX2=200, and RMAX3=200).

4.0 CALPUFF Procedures

Both the DNR screening and VISTAS refined CALPUFF input files were used as the basis for the refined Wisconsin CALPUFF input files. All CALPUFF settings and options are consistent with EPA and FLM guidance, and the refined VISTAS protocol recommendations. The background ozone (O3) concentrations were used directly from the DNR CALPUFF input files. Instead of using monthly background ammonia concentrations from the DNR screening analyses, a single conservative background ammonia concentration of 3.9 ppb was used. Appendix B presents a listing of a CALPUFF input file developed for the Thilmany analysis.

The DNR screening analysis considered three emitted pollutants, SO_2, NOx, and $PM_{2.5}$. The refined CALPUFF modeling will consider speciated particulate emissions, including coarse PM (PMC), fine PM equivalent to $PM_{2.5}$ (PMF), sulfate (SO4), nitrate (NO3), elemental carbon (EC), and secondary organic aerosols (SOA or OC). Section 6 of this protocol describes how the speciated particulate emissions were calculated.

5.0 POSTUTIL and CALPOST Procedures

In CALPUFF, the scavenging of the available ammonia for nitrate formation is computed on a puff-by-puff basis. Because of the possibility of multiple puff overlap, this approach may tend to overestimate the amount of ammonia available to form nitrate. In order to address the cumulative consumption of ammonia, the POSTUTIL program can be used to repartition nitric acid and nitrate. POSTUTIL calculates new NO3/HNO3 equilibrium concentrations for the sample source in the Class I area using the background ammonia. As recommended in the VISTAS procedures for refined CALPUFF modeling, the POSTUTIL "MNITRATE=1" method was used for the refined Wisconsin CALPUFF modeling. Instead of using the monthly values for background ammonia concentrations from the DNR screening analyses, a single conservative background ammonia concentration of 3.9 ppb was used.

The modeling protocol submitted in 2007 proposed to use CALPOST Visibility Method 6 to calculate visibility impacts. However, since that time there have been revisions to CALPOST that allow the use of the updated IMPROVE extinction equation. CALPOST version 6.221 can implement the "Method 8 Mode 5" methodology to calculate visibility impacts, and the FLMs recommend its use in "Federal Land Managers' Air Quality Related Values Work Group (FLAG) Phase I Report—Revised (2010)" (herein referred to as FLAG 2010). Therefore, this updated methodology will be used for the Thilmany BART analysis. The new CALPUFF Graphical Users Interface automatically enters the appropriate values, based on the Class I area being selected, for natural background species and relative humidity adjustment factors using the data in Tables 6 through 9 of Section 3.3.5 of FLAG 2010 (which are based on "Guidance for Estimating Natural Visibility Conditions Under the Regional Haze Rule", EPA-454/B-03-005, September 2003).

6.0 Emissions Modeled

EPA's BART modeling guidance state that the 24-hr maximum actual emissions rates for the period of the modeling simulation (2002-2004) should be used for the analysis. If this data is not available, then the short term "allowable" or "potential" emission rates should be used. Thilmany provided DNR with source information that has been reviewed to determine the 24-hr maximum actual emissions rates. The SO2 emissions are based on the maximum actual emission rate from the CEMS during the 2002-04 time frame, and the PM and NOx emissions represent maximum potential emission rates (which is conservative). On November 29, 2010, DNR issued a letter that approved the following emission rates to be used for the Thilmany BART eligible boiler: 207.9 g/sec (1650 lb/hr) SO_2, 68.2 g/sec (541 lb/hr) NO_X, and 11.1 g/sec (88 lb/hr) for PM. The PM emissions have been speciated using the information for coal fired boilers developed by the National Park Service[1]. The speciated PM emissions listed in Table 1 were used in the refined BART modeling. The stack parameters used in the modeling analysis were the same as those used by DNR in their screening analysis.

Table 1 – Thilmany Speciated PM Emissions

PM Species	Emission Rate (lb/hr)
Coarse PM	2.9
Fine PM	3.4
Elemental Carbon	0.1
Condensable Inorganics (Sulfate)	65.3
Condensable Organics (OC)	16.3

[1] http://www2.nature.nps.gov/air/permits/ect/index.cfm)

7.0 Modeling Results

CALPOST computes the daily maximum change in deciviews relative to the annual average natural background visibility, separately for each Class I area. For evaluating the source impact relative to the "Subject to BART" visibility impact threshold of 0.5 dv, the daily maximum changes in visibility are sorted to determine the 98th percentile (8^{th} highest) value for each of three years, and the 98th percentile (22^{nd} highest) value for the completed three year period. If all 98th percentile values are below the threshold of 0.5 dv based on the refined CALPUFF analysis, the source is exempt from the BART requirements.

Another equivalent metric commonly used for BART exemption modeling is to sum the number of days per year that are above the 0.5 dv threshold for each Class I area separately; if there are 7 or fewer days above the threshold for each year, then the 98^{th} percentile value is also below the threshold. This is the metric approved by DNR for use in the BART modeling analysis. Specifically, for each Class I area separately, if there are less than 8 days per year that the predicted visibility impacts are greater than 0.5 deciviews relative to the annual average natural background visibility, then the BART eligible emission units at the modeled facility will be determined not to be Subject to BART.

Table 2 presents the results from the refined CALPUFF BART exemption modeling. These results demonstrate that there are less than 8 days per year, at each individual Class I area, when the visibility impacts from the Thilmany BART eligible source are above 0.5 dv. Therefore, the **Thilmany BART eligible source is not Subject to BART** requirements.

Table 2 – Thilmany CALPUFF BART Exemption Results Summary

Class I area	**Distance (km) from source to Class I area boundary**	**# of days with impact > 0.5 dv in Class I area: 2002**	**# of days with impact > 0.5 dv in Class I area: 2003**	**# of days with impact > 0.5 dv in Class I area: 2004**	**# of days with impact > 0.5 dv in Class I area for 3 year period**	**Maximum 98th Percentile impact over either annual or 3-yr periods**
Seney , MI	~ 280	2	0	1	3	0.34
Isle Royal, MN	~ 400	0	0	0	0	0.14
Boundary Waters, MN	~ 450	1	0	0	1	0.11

Appendix A – Example CALMET Input File

```
WI Refined CALMET - 4km Grid - Dec 2010 - with Updated EPA Settings


---------------- 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=SURF02Z.DAT  !
CLOUD.DAT     input    * CLDDAT=            *
PRECIP.DAT    input    ! PRCDAT=PRECIP02.DAT !

MM4.DAT       input    * MM4DAT=E:\MRPO-calmm5\2002\MM5.020102.3D.DAT  *
MM4.DAT       input    ! MM4DAT=E:\MRPO-calmm5\2002\020102.MM5  !


WT.DAT        input    * WTDAT=             *
CALMET.LST    output   ! METLST=cal020102.lST  !
CALMET.DAT    output   ! METDAT=E:\WI-Calmet\2002Output\cal020102.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 =  3  !
    Number of overwater met stations
                                (NOWSTA) No default     ! NOWSTA =  5  !


                      !END!
--------------------------------------------------------------------------------
Subgroup (b)
```

```
--------------------------------
Upper air files (one per station)
--------------------------------
Default Name  Type       File Name
------------  ----       ---------
UP1.DAT       input     1  ! UPDAT=UPGB0204.DAT!    !END!
UP2.DAT       input     2  ! UPDAT=UPMN0204.DAT!    !END!
UP3.DAT       input     3  ! UPDAT=UPIN0204.DAT!    !END!

---------------------------------------------------------------------------------
Subgroup (c)
---------------------------------------
Overwater station files (one per station)
SEA1.DAT input  1  ! SEADAT=4500102.DAT!    !END!
SEA2.DAT input  2  ! SEADAT=4500202.DAT!    !END!
SEA3.DAT input  3  ! SEADAT=4500402.DAT!    !END!
SEA4.DAT input  4  ! SEADAT=4500602.DAT!    !END!
SEA5.DAT input  5  ! SEADAT=4500702.DAT!    !END!

---------------------------------------
Default Name  Type       File Name
------------  ----       ---------
---------------------------------------------------------------------------------
Subgroup (d)
----------------
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=                  *

---------------------------------------------------------------------------------
NOTES: (1) File/path names can be up to 70 characters in length
       (2) Subgroups (a) and (d) must have ONE 'END' (surround by
           delimiters) at the end of the group
       (3) Subgroups (b) and (c) 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=  2 !
                      Hour (IBHR) -- No default       ! IBHR=  0  !

     Base time zone        (IBTZ) -- No default       ! IBTZ=  6  !
        PST = 08, MST = 07
        CST = 06, EST = 05

     Length of run (hours) (IRLG) -- No default       ! IRLG=  24  !

     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)

      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
     Test options specified to see if
     they conform to regulatory
```

```
     values? (MREG)                  No Default       ! MREG =  1   !

        0 = NO checks are made
        1 = Technical options must conform to USEPA guidance
                  IMIXH    -1       Maul-Carson convective mixing height
                                    over land; OCD mixing height overwater
                  ICOARE   0        OCD deltaT method for overwater fluxes
                  THRESHL  0.0      Threshold buoyancy flux over land needed
                                    to sustain convective mixing height grow
!END!

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

INPUT GROUP: 2 -- Map Projection and Grid control parameters
--------------

     Projection for all (X,Y):
     -------------------------

     Map projection
     (PMAP)                     Default: UTM    ! PMAP = LCC  !

         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 = -999   !

     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 = 40N  !
(RLON0)                   No Default      ! RLON0 = 97W  !

    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 = 33N  !
(XLAT2)                   No Default      ! XLAT2 = 45N  !

    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  !


     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 =  162  !
            No. Y grid cells (NY)      No default     ! NY =  191  !

     Grid spacing (DGRIDKM)            No default     ! DGRIDKM = 4. !
                                       Units: km

     Reference grid coordinate of
     SOUTHWEST corner of grid cell (1,1)

        X coordinate (XORIGKM)         No default     ! XORIGKM = 247.000 !
        Y coordinate (YORIGKM)         No default     ! YORIGKM = 240.000 !
                                       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.,640.,1200.,2000.,3000.,4000. !

!END!
```

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

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  !

            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 =  1  !
       (Meteorological fields are printed
        every  1  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 =  0 ,  0 ,  0 ,  0 ,  0 ,  0 ,  0 ,  0 ,  0 ,  0  !
       -----------------------


       Specify which levels of the W wind component to print
       (NOTE: W defined at TOP cell face --  16  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 ,  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 =  0 ,  0 ,  0 ,  0 ,  0 ,  0 ,  0 ,  0 ,  0 ,  0  !

Specify which meteorological fields
to print
(used only if LPRINT=T)             Defaults: 0 (all variables)
-----------------------


  Variable            Print ?
                  (0 = do not print,
                   1 = print)
  --------        ------------------

!  STABILITY  =           0           ! - PGT stability class
!  USTAR      =           0           ! - Friction velocity
!  MONIN      =           0           ! - Monin-Obukhov length
!  MIXHT      =           0           ! - Mixing height
!  WSTAR      =           0           ! - Convective velocity scale
!  PRECIP     =           0           ! - 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 =  2  !


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 =  1  !

   Print the INTERPOLATED wind components ?
   (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  !

   Print the FINAL DIVERGENCE fields ?
   (IPR4) (0=no, 1=yes)            Default: 0       !  IPR4 =  0  !

   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!


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

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 MM5 for upper air data
          2 = No surface, overwater, or upper air observations
              Use MM5 for surface, overwater, and upper air data

    NUMBER OF SURFACE & PRECIP. METEOROLOGICAL STATIONS

       Number of surface stations   (NSSTA)  No default     ! NSSTA =  22  !

       Number of precipitation stations
       (NPSTA=-1: flag for use of MM5 precip data)
                                    (NPSTA)  No default     ! NPSTA =  16  !

    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 =  2  !
      (1 = unformatted - CALMET unformatted output)
      (2 = formatted   - free-formatted CALMET output or user input)

!END!


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

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
                       ! BIAS =  0 ,  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 =  14  !
(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.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 = 1]

Timestep (hours) of the prognostic
model input data   (ISTEPPG)         Default: 1      ! ISTEPPG =  1   !
```

```
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 = 200. !
                                         Units: km
   Maximum radius of influence over water
   (RMAX3)                               No default      ! RMAX3 = 200. !
                                         Units: km


OTHER WIND FIELD INPUT PARAMETERS

   Minimum radius of influence used in
   the wind field interpolation (RMIN)   Default: 0.1    ! RMIN = 0.1 !
                                         Units: km
   Radius of influence of terrain
   features (TERRAD)                     No default      ! TERRAD = 15. !

                                         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 =100. !
   (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 = 0. !
```

```
      (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 ,  4 ,  4 ,  4 ,  4 ,  4 ,  4 ,  4 ,  4 ,  4   !

      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 ,  99 ,  99 ,  99 ,  99   !

      Critical Froude number (CRITFN)      Default: 1.0    ! CRITFN = 1. !

      Empirical factor controlling the
      influence of kinematic effects
      (ALPHA)                              Default: 0.1    ! ALPHA = 0.1 !

      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  !

      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)
      --------------------------

   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., 1000. !
   (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)

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 -- 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)

  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 =  1  !
                                          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
        -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 = 0.00 !
     (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 = 50. !
   (ZIMIN)                            Units: meters
   Maximum overland mixing height     Default: 3000.  ! ZIMAX = 3000. !
   (ZIMAX)                            Units: meters
   Minimum overwater mixing height    Default:   50.  ! ZIMINW = 50. !
   (ZIMINW) -- (Not used if observed  Units: meters
   overwater mixing hts. are used)
   Maximum overwater mixing height    Default: 3000.  ! ZIMAXW = 3000. !
   (ZIMAXW) -- (Not used if observed  Units: meters
   overwater mixing hts. are used)

OVERWATER SURFACE FLUXES METHOD and PARAMETERS
      (ICOARE)                        Default: 10      ! ICOARE =  0   !
       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


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 for upper air data
          (only if NOOBS = 0,1)
      2 = No surface or upper air observations
          Use MM5 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 = -0.0045 !
       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!


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

INPUT GROUP: 7 -- Surface meteorological station parameters
--------------

     SURFACE STATION VARIABLES
     (One record per station --  0  records in all)


             1     2
         Name   ID            X coord.   Y coord.   Time   Anem.
                               (km)       (km)      zone   Ht.(m)
       ------------------------------------------------------------
! SS1  ='MILW'    26400       739.061      363.200    6    10  !
! SS2  ='MADI'    26410       619.927      372.210    6    10  !
```

```
! SS3  ='LA C'    26430       461.012      442.705    6    10  !
! SS4  ='EAU '    26435       435.857      552.352    6    10  !
! SS5  ='GREE'    26450       703.911      530.179    6    10  !
! SS6  ='MANI'    26455       743.477      495.113    6    10  !
! SS7  ='STUR'    26458       755.730      576.760    6    10  !
! SS8  ='WAUS'    26463       581.202      568.247    6    10  !
! SS9  ='MOSI'    26465       579.307      552.489    6    10  !
! SS10 ='CLIN'    26502       655.019      541.168    6    10  !
! SS11 ='WISC'    26503       582.532      412.498    6    10  !
! SS12 ='EAGL'    26504       599.980      682.545    6    10  !
! SS13 ='MINE'    26507       550.817      338.941    6    10  !
! SS14 ='HAYW'    26508       430.347      681.295    6    10  !
! SS15 ='JUNE'    26509       669.429      409.931    6    10  !
! SS16 ='dulu'    27450       366.011      766.977    6    10  !
! SS17 ='MANI'    25408       838.315      711.433    5    10  !
! SS18 ='SAWY'    26284       741.237      743.078    5    10  !
! SS19 ='HOUG'    26380       977.905      549.977    5    10  !
! SS20 ='ESCA'    26480       775.417      679.550    5    10  !
! SS21 ='IRNM'    27437       690.168      678.511    5    10  !
! SS22 ='IRNW'    27445       528.314      743.857    5    10  !
------------------
      1
        Four character string for station name
        (MUST START IN COLUMN 9)

      2
        Five digit integer for station ID

!END!


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

INPUT GROUP: 8 -- Upper air meteorological station parameters
--------------

     UPPER AIR STATION VARIABLES
     (One record per station --  0  records in all)

             1     2
         Name    ID      X coord.   Y coord.  Time zone
                           (km)       (km)
        ------------------------------------------------
! US1  ='GREE'   14898    703.911    539.179    6  !
```

```
! US2  ='MNNP'   94983    272.681    539.843    6  !
! US3  ='INTF'   14918    269.489    957.416    6  !

-------------------
      1
        Four character string for station name
        (MUST START IN COLUMN 9)

      2
        Five digit integer for station ID

!END!
```

INPUT GROUP: 9 -- Precipitation station parameters

PRECIPITATION STATION VARIABLES
(One record per station -- 0 records in all)
(NOT INCLUDED IF NPSTA = 0)

```
            1          2
         Name   Station    X coord.  Y coord.
                  Code       (km)      (km)
         -----------------------------------
! PS1  ='COPP'   201780   719.681    845.179 !
! PS2  ='ESCA'   202626   779.850    646.454 !
! PS3  ='HOUG'   203936  1001.500    536.427 !
! PS4  ='IRON'   204090   699.421    640.283 !
! PS5  ='MANI'   205073   845.933    667.499 !
! PS6  ='SAUL'   207366   985.172    765.448 !
! PS7  ='CLIN'   471667   696.889    290.151 !
! PS8  ='GREE'   473269   709.933    509.579 !
! PS9  ='HAYW'   473511   442.947    678.728 !
! PS10 ='LAC '   474370   471.515    404.495 !
! PS11 ='MADI'   474961   631.719    367.656 !
! PS12 ='MARS'   475120   550.348    505.662 !
! PS13 ='MENO'   475335   431.807    514.277 !
! PS14 ='MILW'   475479   772.567    324.344 !
! PS15 ='RAIN'   476939   599.369    634.460 !
! PS16 ='STURG'  478267   776.964    542.174 !
```

```
------------------
      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!
```

Appendix B – Example CALPUFF Input File

```
Thilmany BART Modeling -  SO2, PM speciation
Using Refined 4km CALMET Data File and SENE, ISLE, BOWA Class I Receptors

---------------- 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 =             *
    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 =ThilRef02.lst  !
CONC.DAT      output   ! CONDAT =ThilRef02.dat  !
DFLX.DAT      output   * DFDAT  =             *
WFLX.DAT      output   * WFDAT  =             *
VISB.DAT      output   * VISDAT =Thil02DNR.VIB  *
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=             *
H2O2.DAT      input    * H2O2DAT=             *
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=             *
------------------------------------------------------------------------------
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
NOTE: (1) file/path names can be up to 70 characters in length


Provision for multiple input files
----------------------------------
```

```
     Number of CALMET.DAT files for run (NMETDAT)
                                   Default: 1       ! NMETDAT =  364   !

     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)
-------------

  The following CALMET.DAT filenames are processed in sequence if NMETDAT>1

Default Name  Type          File Name
------------  ----          ---------
none         input    ! METDAT=e:\WI-Calmet\2002output\cal020102.DAT     !  !END!
NOTE: the remaining CALMET data files names are listed here …..
none         input    ! METDAT=e:\WI-Calmet\2002output\cal021231.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 =  2002  !
     (used only if   Month (IBMO) -- No default       ! IBMO =  1  !
      METRUN = 0)      Day (IBDY) -- No default       ! IBDY =  02 !
                      Hour (IBHR) -- No default       ! IBHR =  1  !

     Base time zone        (XBTZ) -- No default       ! XBTZ = 6.0  !
        PST = 8., MST = 7.
        CST = 6., EST = 5.

     Length of run (hours) (IRLG) -- No default       ! IRLG = 8736  !

     Number of chemical species (NSPEC)
                                   Default: 5       ! NSPEC =  9   !

     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)

    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. !


!END!


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

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 =  3   !
       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 =  0   !
       0 = not modeled
       1 = modeled

    Near-field puffs modeled as
    elongated 0 (MSLUG)                 Default: 0     ! MSLUG =  0   !
       0 = no
       1 = yes (slug model used)

    Transitional plume rise modeled ?
    (MTRANS)                            Default: 1     ! MTRANS =  1   !
       0 = no  (i.e., final rise only)
```

```
   1 = yes (i.e., transitional rise computed)

Stack tip downwash? (MTIP)           Default: 1     ! MTIP =  1  !
   0 = no  (i.e., no stack tip downwash)
   1 = yes (i.e., use stack tip downwash)

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 =  1   !
   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)

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 adjusted
       for aqueous phase reactions

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)

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
       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 =  3  !
(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.

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)
   0 = no
   1 = yes, using formatted BCON.DAT file
   2 = yes, using unformatted CONC.DAT file
```

```
     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
                       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


!END!


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

INPUT GROUP: 3a, 3b -- Species list
-------------------

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

  The following species are modeled:

  The following species are modeled:

! CSPEC =          SO2 !         !END!
! CSPEC =          SO4 !         !END!
```

```
! CSPEC =          NOX !         !END!
! CSPEC =         HNO3 !         !END!
! CSPEC =          NO3 !         !END!
! CSPEC =          PMC !         !END!
! CSPEC =          PMF !         !END!
! CSPEC =           EC !         !END!
! CSPEC =          SOA !         !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   !
!          SO4  =         1,               1,           2,                  0   !
!          NOX  =         1,               1,           1,                  0   !
!         HNO3  =         1,               0,           1,                  0   !
!          NO3  =         1,               0,           2,                  0   !
!          PMC  =         1,               1,           2,                  0   !
!          PMF  =         1,               1,           2,                  0   !
!           EC  =         1,               1,           2,                  0   !
!          SOA  =         1,               1,           2,                  0   !


!END!

-------------
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.



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


INPUT GROUP: 4 -- Map Projection and Grid control parameters
--------------

     Projection for all (X,Y):
     -------------------------

     Map projection
     (PMAP)                    Default: UTM    ! PMAP = LCC  !

         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 =  0   !

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 =  40N  !
(RLON0)                   No Default      ! RLON0 =  97W  !

    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 =  33N  !
(XLAT2)                   No Default      ! XLAT2 =  45N  !

    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:

     Rectangular grid defined for projection PMAP,
     with X the Easting and Y the Northing coordinate

           No. X grid cells (NX)      No default     ! NX =  162   !
           No. Y grid cells (NY)      No default     ! NY =  191   !
        No. vertical layers (NZ)      No default     ! NZ =  10    !

          Grid spacing (DGRIDKM)      No default     ! DGRIDKM = 4. !
                                      Units: km


        Cell face heights in arbitrary
        vertical grid (ZFACE(NZ+1))   No defaults
                                      Units: m
        ! ZFACE = 0.,20.,40.,80.,160.,320.,640.,1200.,2000.,3000.,4000. !

            Reference Coordinates
           of SOUTHWEST corner of
                 grid cell(1, 1):

            X coordinate (XORIGKM)    No default     ! XORIGKM = 247. !
            Y coordinate (YORIGKM)    No default     ! YORIGKM = 240. !
                                     Units: km


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 =  162   !
                  (1 <= IECOMP <= NX)

        Y index of UR corner (JECOMP)      No default     ! JECOMP =  191   !
                  (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 = F !
        (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 =  162   !
         (IBCOMP <= IESAMP <= IECOMP)

        Y index of UR corner (JESAMP)      No default     ! JESAMP =  191   !
         (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 =  0   !
   Wet Fluxes (IWET)                  1                   !  IWET =  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


    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 =  0   !
       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 =  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

      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, # 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 =     0,           1,           0,           0,           0,           0,
0   !
!          SO4 =     0,           1,           0,           0,           0,           0,
0   !
!          NOX =     0,           1,           0,           0,           0,           0,
0   !
!         HNO3 =     0,           1,           0,           0,           0,           0,
0   !
!          NO3 =     0,           1,           0,           0,           0,           0,
0   !
!          PMC =     0,           1,           0,           0,           0,           0,
0   !
!          PMF =     0,           1,           0,           0,           0,           0,
0   !
!           EC =     0,           1,           0,           0,           0,           0,
0   !
!          SOA =     0,           1,           0,           0,           0,           0,
0   !


    OPTIONS FOR PRINTING "DEBUG" QUANTITIES (much output)

      Logical for debug output
      (LDEBUG)                              Default: F     ! LDEBUG = F !

      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 =  0   !

       Number of special complex terrain
       receptors  (NCTREC)                     Default: 0     ! NCTREC =  0   !

       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)
----          ----      ----      ------  -----  ------    ------    ------   -------    -------
-----     -----

---------------
Subgroup (6c)
```

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

    COMPLEX TERRAIN RECEPTOR INFORMATION

                      XRCT         YRCT        ZRCT          XHH
                      (km)         (km)         (m)
                     ------       -----      ------         ----


-------------------
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 !
!         HNO3 =     0.1628,            1.,           18.,               0.,
0.00000008 !

!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)
      -------      ------------------        ------------------

!          SO4 =          0.48,                      2.   !
!          NO3 =          0.48,                      2.   !
!          PMC =           2.0,                     2.0   !
!          PMF =          0.48,                      2.   !
!           EC =          0.48,                      2.   !
!          SOA =          0.48,                      2.   !


!END!


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


INPUT GROUP: 9 -- Miscellaneous dry deposition parameters
--------------

     Reference cuticle resistance (s/cm)
     (RCUTR)                          Default: 30    !  RCUTR = 30.0 !
     Reference ground resistance  (s/cm)
     (RGR)                            Default: 10    !    RGR = 10.0 !
     Reference pollutant reactivity
     (REACTR)                         Default: 8     ! REACTR = 8.0 !

     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 !
!          SO4 =         1.0E-04,            3.0E-05 !
!          NOX =          0.0E00,             0.0E00 !
!         HNO3 =         6.0E-05,             0.0E00 !
!          NO3 =         1.0E-04,            3.0E-05 !
```

```
!END!


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


INPUT GROUP: 11 -- Chemistry Parameters
---------------

     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
     (Used only if MCHEM = 1, 3, or 4 and
      MOZ = 0 or MOZ = 1 and all hourly O3 data missing)
     (BCKO3) in ppb                    Default: 12*80.

     !  BCKO3 = 31.00, 31.00, 31.00, 37.00, 37.00, 37.00, 33.00, 33.00, 33.00, 27.00, 27.00, 27.00
!

     Monthly ammonia concentrations
     (Used only if MCHEM = 1, or 3)
     (BCKNH3) in ppb                   Default: 12*10.

     !  BCKNH3 = 12*3.9 !

     Nighttime SO2 loss rate (RNITE1)
     in percent/hour                   Default: 0.2          ! RNITE1 = .2 !

     Nighttime NOx loss rate (RNITE2)
     in percent/hour                   Default: 2.0          ! RNITE2 = 2.0 !

     Nighttime HNO3 formation rate (RNITE3)
     in percent/hour                   Default: 2.0          ! RNITE3 = 2.0 !

     H2O2 data input option (MH2O2)    Default: 1            ! MH2O2 =  1   !
     (Used only if MAQCHEM = 1)
        0 = use a monthly background H2O2 value
        1 = read hourly H2O2 concentrations from
            the H2O2.DAT data file

     Monthly H2O2 concentrations
     (Used only if MQACHEM = 1 and
      MH2O2 = 0 or MH2O2 = 1 and all hourly H2O2 data missing)
     (BCKH2O2) in ppb                  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 *
     !  BCKH2O2 = 0.50, 0.50, 0.50, 2.30, 2.30, 2.30, 3.50, 3.50, 3.50, 0.80, 0.80, 0.80 !

 --- Data for SECONDARY ORGANIC AEROSOL (SOA) Option
     (used only if MCHEM = 4)

     The 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)
     to 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.
        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 !


!END!


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


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 = 5.5E02 !

     Switch for using Heffter equation for sigma z
     as above (0 = Not use Heffter; 1 = use Heffter
     (MHFTSZ)                                  Default: 0      ! MHFTSZ =  0   !

     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 = .01 !

     Vertical dispersion constant for neutral/
     unstable conditions (k2 in Eqn. 2.7-4)
```

```
(CONK2)                                 Default: 0.1    ! CONK2 = .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 = .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
(IURB1, IURB2)                          Default: 10     ! IURB1 =  10  !
                                                 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 = .25 !

   Leaf area index for modeling domain
   (XLAIIN)                             Default: 3.0    ! XLAIIN = 3.0 !

   Elevation above sea level (m)
   (ELEVIN)                             Default: 0.0    ! ELEVIN = .0 !

   Latitude (degrees) for met location
   (XLATIN)                             Default: -999.  ! XLATIN = -999.0 !

   Longitude (degrees) for met location
   (XLONIN)                             Default: -999.  ! XLONIN = -999.0 !

Specialized information for interpreting single-point Met data files -----

   Anemometer height (m) (Used only if METFM = 2,3)
   (ANEMHT)                             Default: 10.    ! ANEMHT = 10.0 !

   Form of lateral turbulance 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 = 1.0 !

Maximum travel distance of a puff/slug (in
grid units) during one sampling step
(XSAMLEN)                               Default: 1.0    ! XSAMLEN = 1.0 !

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 = 1.0  !

Minimum sigma z for a new puff/slug (m)
(SZMIN)                                  Default: 1.0    ! SZMIN = 1.0  !

Default minimum turbulence velocities
sigma-v and sigma-w for each
stability class (m/s)
(SVMIN(6) and SWMIN(6))     Default SVMIN : .50,  .50,  .50,  .50,  .50,  .50
                            Default SWMIN : .20,  .12,  .08,  .06,  .03,  .016

                         Stability Class :  A     B     C     D     E     F
                                           ---   ---   ---   ---   ---   ---
                                  ! SVMIN = 0.500, 0.500, 0.500, 0.500, 0.500, 0.500!
                                  ! SWMIN = 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 !

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 = .5 !

Maximum mixing height (m)
(XMAXZI)                                 Default: 3000.  ! XMAXZI = 3000.0 !

Minimum mixing height (m)
(XMINZI)                                 Default: 50.    ! XMINZI = 50.0 !

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
                                             ---   ---   ---   ---   ---
                                    ! 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
                                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 = 10.0 !

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 = 100.0 !

  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 = 2.0 !

  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 !

     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 = 1.0 !

       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 = 500.0 !

       Search radius (in BC segment lengths) about a receptor for sampling
       nearest BC puff.  BC puffs are emitted with a spacing of one segment
       length, so the search radius should be greater than 1.
       (RSAMPBC)                         Default:   4.       ! RSAMPBC = 10.0 !

       Near-Surface depletion adjustment to concentration profile used when
       sampling BC puffs?
       (MDEPBC)                          Default:   1        ! MDEPBC =  1  !
          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 =     Odour Unit * m**3/s  (vol. flux of odour compound)
           6 =     Odour Unit * m**3/min
           7 =     metric tons/yr

     Number of source-species
     combinations with variable
     emissions scaling factors
     provided below in (13d)        (NSPT1) Default: 0  !  NSPT1 =  0  !
```

```
     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)
---------------

  The following species are modeled:

CSPEC =          SO2
CSPEC =          SO4
CSPEC =          NOX
CSPEC =         HNO3
CSPEC =          NO3
CSPEC =          PMC
CSPEC =          PMF
CSPEC =           EC
CSPEC =          SOA
                                    a
          POINT SOURCE: CONSTANT DATA
          ---------------------------
                                                                        b          c
  Source       X         Y       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 = P1 !
   1 ! X =   695.75, 507.2100,  88.390,216.46,     2.600,  20.0,  445.0,   .0,
       208.0E00, 8.23, 68.1E00, 0.0E00, 0.0E00, 0.37, 0.43, 0.02,  2.06 !
   1 ! FMFAC  =      1.0 !   !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)

    b
     0. = No building downwash modeled, 1. = downwash modeled
     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)
------     ------------------------------------------------------------------


--------

    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+)



--------
    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 =  0   !

     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 =     Odour Unit * m/s  (vol. flux/m**2 of odour compound)
           6 =     Odour Unit * m/min
           7 =     metric tons/m**2/yr

     Number of source-species
     combinations with variable
     emissions scaling factors
     provided below in (14d)        (NSAR1) Default: 0  !  NSAR1 =  0  !

     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)
-------          ------    ------     --------   ---------


--------
    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 (km) FOR EACH VERTEX(4) OF EACH POLYGON
           ---------------------------------------------------------
Source                                                              a
 No.       Ordered list of X followed by list of Y, grouped by source
------     -------------------------------------------------------------
```

```
--------
    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+)



--------
    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 =  0  !

     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 =     Odour Unit * m**3/s  (vol. flux of odour compound)
          6 =     Odour Unit * m**3/min
          7 =     metric tons/yr

     Number of source-species
     combinations with variable
     emissions scaling factors
     provided below in (15c)        (NSLN1) Default: 0  !  NSLN1 =  0  !

     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 = .0 !
                                                    (in meters)

        Average building height (HBL)               No default   ! HBL = .0 !
                                                    (in meters)

        Average building width (WBL)                No default   ! WBL = .0 !
                                                    (in meters)

        Average line source width (WML)             No default   ! WML = .0 !
                                                    (in meters)

        Average separation between buildings (DXL)  No default   ! DXL = .0 !
                                                    (in meters)

        Average buoyancy parameter (FPRIMEL)        No default   ! FPRIMEL = .0 !
                                                    (in m**4/s**3)

!END!

---------------
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)
------   ----------  ----------  ---------  ----------  -------   ---------    ---------

--------

    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+)



--------
    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)
---------------

     Number of volume sources with
     parameters provided in 16b,c (NVL1)     No default  !  NVL1 =  0   !

     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 =     Odour Unit * m**3/s  (vol. flux of odour compound)
           6 =     Odour Unit * m**3/min
           7 =     metric tons/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           Y        Effect.    Base     Initial    Initial    Emission
     Coordinate  Coordinate   Height   Elevation  Sigma y    Sigma z     Rates
        (km)        (km)        (m)       (m)        (m)       (m)
     ----------  ----------   ------    ------    --------   --------   --------


--------
    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 VOLEMARB.DAT and NVL2 > 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+)



--------
    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 =  1995   !

!END!

---------------
Subgroup (17b)
---------------
                                              a
           NON-GRIDDED (DISCRETE) RECEPTOR DATA
           -----------------------------------

                   X            Y          Ground        Height   b
Receptor       Coordinate   Coordinate    Elevation   Above Ground
  No.             (km)         (km)          (m)           (m)
--------       ----------   ----------    ---------   ------------


Note - three Class I areas
Seney SENE = 173 receptors
Isle Royal ISLE = 966 receptors
Boundary Waters BOWA = 856 receptors
total number of receptors is 1995
```

ALL RECEPTOR COORDINATES FOLLOW IN INPUT FILE

Updated CALPUFF Modeling Protocol and Final Report for the Subject to BART Analyses for Wausau Paper Mills, LLC Mosinee Mill

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December 2010

Updated CALPUFF Modeling Protocol and Final Report for Wausau "Subject to BART" Analysis

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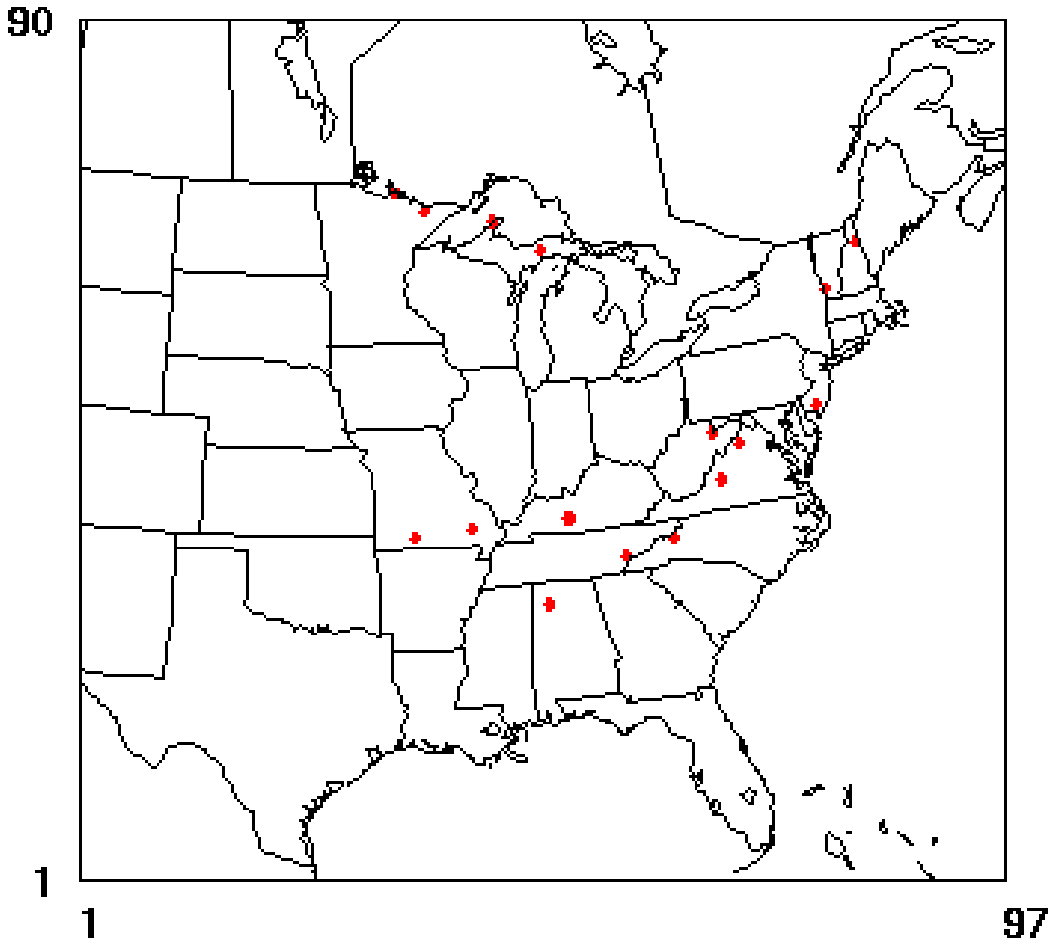
1.0 Introduction

The Wisconsin Department of Natural Resources (DNR) performed single source screening modeling in 2006 to evaluate which Best Available Retrofit Technology (BART) eligible sources in the state may "cause or contribute" to visibility impairment and could therefore be subject to BART requirements. This type of analysis is referred to as the "subject to BART" or "BART exemption" analysis. The methods used by DNR are described in the "Single Source Modeling to Support Regional Haze BART Modeling Protocol", March 21, 2006, prepared by Lake Michigan Air Directors Consortium (LADCO).

DNR applied CALPUFF to each BART eligible source for three annual periods, covering the calendar years 2002 to 2004. The CALPUFF/CALMET modeling domain consisted of ninety-seven 36-km spaced cells in the east-west direction and ninety 36-km spaced cells in the north-south direction (see Figure 1). Meteorological data generated by the MM5 prognostic weather model (provided by LADCO in CALMM5 format) was used to develop the meteorological data for CALPUFF, without additional observational data input (i.e., NOOBS mode). This represents a coarse meteorological grid, suitable for an initial screening analysis.

The results from DNR's screening analysis indicated that, with the exception of some of the largest electric power stations in the state, the only Class I areas where BART eligible sources may contribute to visibility impairment are the three areas to the north of Wisconsin, the Boundary Waters Canoe Area, Isle Royal National Park, and Seney Wildlife Area. DNR's screening analysis also indicated that the BART eligible emissions unit at the Wausau Paper Mills LLC Mosinee Mill (Wausau) may "cause or contribute" to visibility impairment at the Seney Class I area (located approximately 320 km to the northeast of the mill), as defined by the 98th percentile visibility impacts being greater than 0.5 deciviews (dv) relative to natural background.

Figure 1 - WDNR Screening CALPUFF Domain



NOTE: Class I areas are identified by red marks.

Wausau has elected to refine the DNR screening analysis by conducting refined CALPUFF modeling with a 4 km meteorological grid, based on procedures described in the "Visibility Improvement – State and Tribal Association of the Southeast (VISTAS) BART CALPUFF" modeling protocol. The VISTAS protocol was developed by a large group of stakeholders, including EPA, the VISTAS member state agencies and tribes, the Federal Land Managers (FLMs), industry representatives, and consulting experts. Given the resources expended on the VISTAS protocol, it arguably represents the most comprehensive CALPUFF BART protocol ever developed.

Wausau had discussions with DNR and EPA Region 5 staff about refining the analysis, and submitted a refined CALPUFF BART modeling protocol in March 2007. EPA reviewed the protocol and provided minor comments to DNR in May 2010. Another facility undergoing Subject to BART review, Thilmany, responded to these comments in a letter "Response to EPA Comments on Thilmany BART Modeling Protocol" dated November 9, 2010. In addition, subsequent to the EPA protocol comments, the US Fish and Wildlife Service and US Forest Service reviewed the protocol and had additional discussions with DNR and EPA. The three EPA comments, and each response, are listed below.

Comment 1

Information needs to be presented which clarifies how POSTUTIL was used for ammonia.

Response 1

The VISTAS methodology was used, with a MNITRATE switch setting of one (1).

Comment 2

The modeling must include a copy of the input and list files associated with runs. The protocol only offers some of the control file information.

Response 2

All CALMET, CALPUFF, and CALPOST input and list files, as well as meteorological and geophysical data files, had been provided by Wausau to DNR on a portable hard disk drive. Wausau will again provide a portable hard disk drive of all modeling files to DNR for the updated BART analysis, for purposes of SIP documentation.

Comment 3

The input file … uses the background ammonia values that were produced for the LADCO protocol. These values are based on modeled estimates. Monitoring data has generally shown much higher ammonia than what was used from the model results. The refined modeling analyses … must evaluate the visibility impacts using measured background ammonia values.

Response 3

The US Fish and Wildlife Service proposed using a constant background ammonia concentration of 3.9 ppb, which was the highest concentration measured at the Mayville Wisconsin station during a mid-1990s EPA study. Wausau has agreed to use this single, conservative background value in the absence of daily data.

On November 29, 2010, DNR issued a letter that approved the CALPUFF BART protocol, as well as the emission rates to be used for the BART eligible emission units. DNR requested that the 2007 version of the protocol be updated to include the responses to EPA comments, and text that addresses current CALPUFF modeling guidance. In addition, the updated modeling results could be presented in the protocol (so that all information is located in one document).

This document is the updated modeling protocol and final modeling report for the refined Wausau "Subject to BART" analysis. This document does not duplicate the extensive information on visibility, CALPUFF, and EPA guidance on BART modeling procedures that are contained in the VISTAS protocol. Rather, this document describes how data specific to this setting will be used in the refined CALPUFF modeling. Section 1 of the protocol is this introduction. Section 2

briefly summarizes important concepts from the VISTAS protocol. Section 3 describes the specific CALMET data and procedures that were used to develop a refined, 4-km spaced meteorological grid for Wisconsin. Section 4 describes the CALPUFF input data and procedures, and Section 5 discusses the POSTUTIL and CALPOST processing, including the use of annual average natural background visibility. Section 6 presents the emission and stack data that were used for the BART eligible emission units, and Section 7 presents the modeling results. Appendices A and B present example CALMET and CALPUFF input file listings. A portable hard drive is also being submitted that contains all input data, control files, output files, and computer codes used in the analysis.

2.0 VISTAS BART Protocol

The VISTAS member states have prepared a CALPUFF modeling protocol for BART determinations that is fully consistent with the EPA guidelines in 40 CFR Part 51 Appendix W and Appendix Y. The VISTAS protocol describes a two-step CALPUFF analysis methodology for BART exemption analyses. The initial CALPUFF analysis uses a "screening" or coarse resolution meteorological grid to determine if a particular source may be exempted from further BART analyses. The screening results are also used to determine which Class I areas should be included in any refined analysis. Assumptions for the initial screening analysis are conservative so that a source that contributes to visibility impairment is not exempted in error. If a source is shown to contribute to visibility impairment using the initial screening assessment, the source has the option to undertake refined CALPUFF modeling using finer meteorological grids to evaluate further whether it is subject to BART.

VISTAS developed both coarse (12-km grid resolution) and refined (4-km grid resolution) CALMET files. The fine grid CALMET files utilized both MM5 prognostic data, as well as meteorological observational data for the CALMET "Step 2" calculations. Overwater (buoy) data were used in addition to the standard hourly surface meteorological observations, precipitation

observations, and twice-daily upper air sounding data. The VISTAS website provides detailed documentation and supporting information on the refined CALMET processing, including the CALMET and CALPUFF input files that contain model configuration options and settings that have been optimized after consultation with stakeholders and consulting experts. These same CALMET and CALPUFF input files were used as the basis for the refined Wisconsin analyses.

The VISTAS protocol discusses several options for defining the natural background visibility. These include use of the annual average natural background extinction or the background extinction for the 20% best natural conditions days. Based on an email survey of the state agencies from the VISTAS member states, all of the VISTAS states allowed the use of annual average natural background extinction for refined CALPUFF analyses. This is also the guidance provided by EPA Region 5 staff during discussions with DNR and the Wisconsin Paper Council, and the method approved by DNR in their November 29, 2010 letter. Therefore, the refined Wausau CALPUFF modeling used the annual average natural background extinction for CALPOST processing.

The VISTAS BART guidance recommends that the threshold value used to define whether a source "contributes" to visibility impairment is a 0.5 dv change from natural background conditions. The 98th percentile 24-hr average predicted impact at the Class I area (equal to the 8th highest value) is to be compared to this contribution threshold value. According to clarification of the BART guidance received from EPA by the VISTAS workgroup, for a three-year simulation the modeling values to be compared with the threshold are the greatest of the three annual 8th highest values, or the 22nd highest value over all three years combined, whichever is greater.

3.0 CALMET Data and Procedures

EPA has updated the versions of the approved CALPUFF programs since the 2007 modeling protocol was developed, and has provided additional guidance on CALMET "switch" settings. The current approved versions are CALPUFF version 5.8 (level 070623), and CALMET version 5.8 (level 070623), and these versions were used for the updated refined BART CALPUFF analysis. On August 31, 2009, EPA published the memorandum "Clarification of EPA-FLM Recommended Settings for CALMET". EPA stated that a 4 km fine CALMET grid size was acceptable, and provided recommended CALMET settings. The CALMET settings for the updated refined BART CALPUFF analysis meet all current EPA recommendations.

The first step in development of the refined Wisconsin analysis was to define the CALMET refined modeling domain and grid. As discussed in Section 1, DNR's screening analysis indicated that there are three Class I areas to the north of Wisconsin, the Boundary Waters Canoe Area, Isle Royal National Park, and Seney Wildlife Area, where the screening analysis predicts some level of visibility impact from Wisconsin BART eligible sources. Therefore, the meteorological grid was developed to ensure coverage for these three Class I areas, as well as for the BART eligible source locations throughout Wisconsin. Standard IWAQM guidance also recommends that the CALMET grid extend a minimum of 50 km beyond any Class I or emission source location, so that puff recirculation can be properly accounted for.

The refined CALMET grid was defined as a 4-km spaced grid with 162 cells in the X-axis and 191 in the Y-axis. The grid projection was Lambert Conformal Conic, using the same projection parameters as in the DNR screening analysis (this allows the use of the same source X and Y coordinates as in the DNR analysis). The projection parameters include RLAT0 = 40N, RLON0 = 97W, XLAT1 = 33N, XLAT2 = 45N, XORIGKM = 247.0, YORIGKM = 240.0, and DATUM = NAS-C.

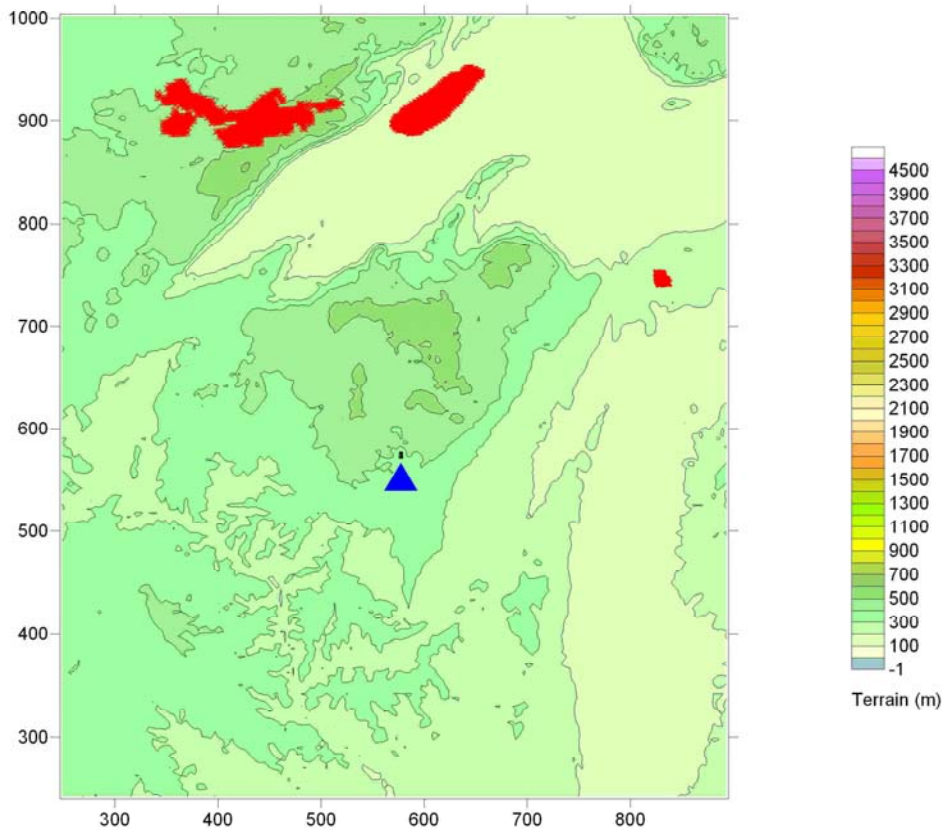
The meteorological data that was input to CALMET included the same three years (2002-2004) of CALMM5 data used by DNR, which was provided by LADCO. However, the refined CALMET runs also considered observation data from 22 surface stations, 16 precipitation stations, 5 overwater buoy stations, and 3 upper air stations. Figure 2 is a plot of the refined CALPUFF modeling domain. Figure 3 presents a plot of the locations of the observation stations in the modeling domain.

The CAMET program MAKEGEO uses USGS GTOPO30 digital terrain data (which includes coverage in Canada) and USGS Composite Theme Grid Land Use and Land Cover (LULC) data to create a gridded data file on geophysical parameters that is used by CALMET. The available USGS LULC coverage does not extend into the Canadian areas of the refined domain. These areas in Canada were assigned to the "forested land" category. Figure 4 presents a plot of the land use data for the modeling domain.

The VISTAS refined CALMET input files discussed in section 2 were used as the basis for the refined Wisconsin CALMET input files. The same CALMET configuration settings and options were utilized, as they are representative of Wisconsin terrain and land use patterns. All settings conform with current EPA and FLM guidance.

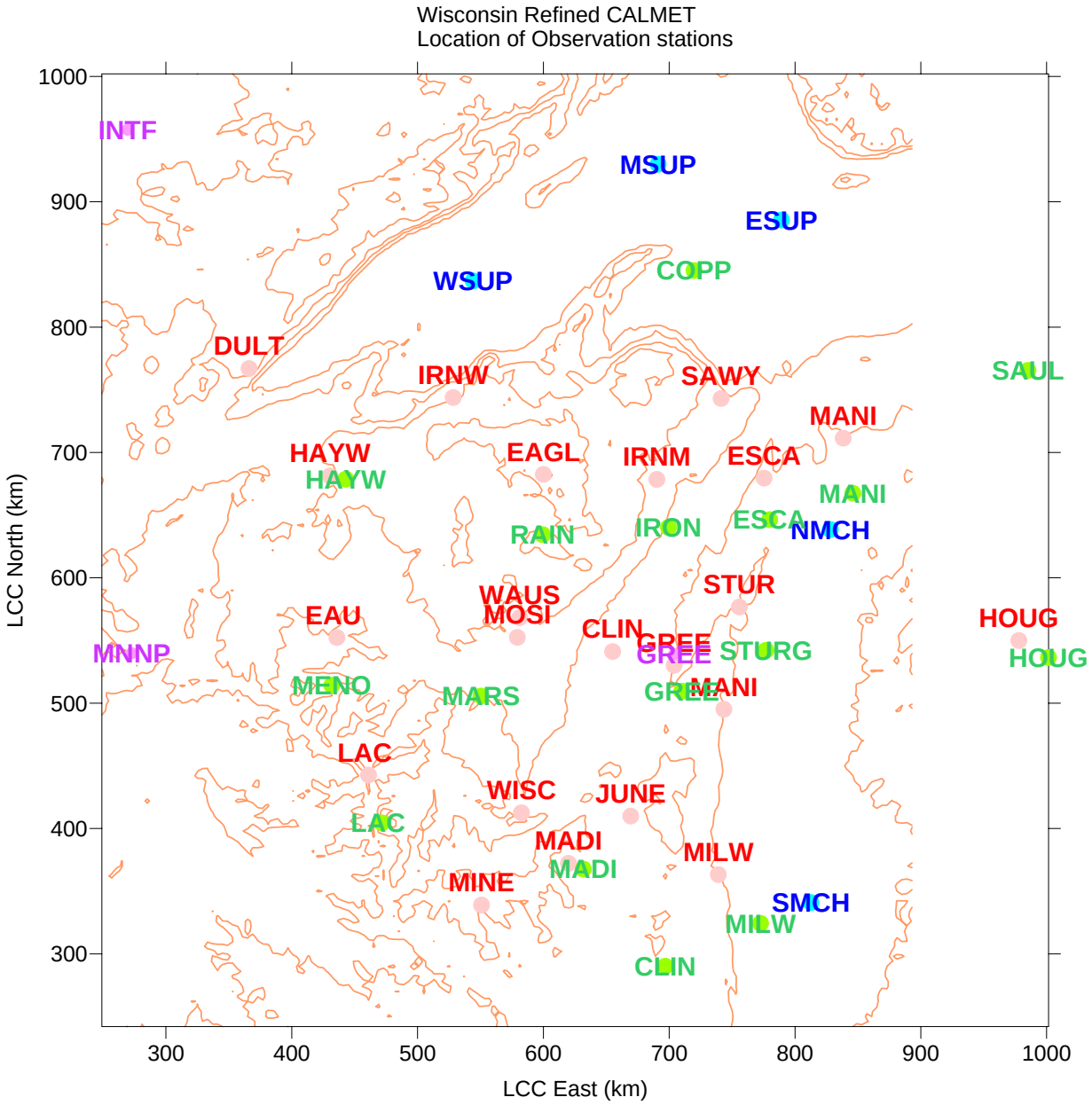
Appendix A presents a listing of a CALMET input file developed for the refined analysis.

Figure 2 – Refined CALPUFF Modeling Domain and Locations of Class I Areas



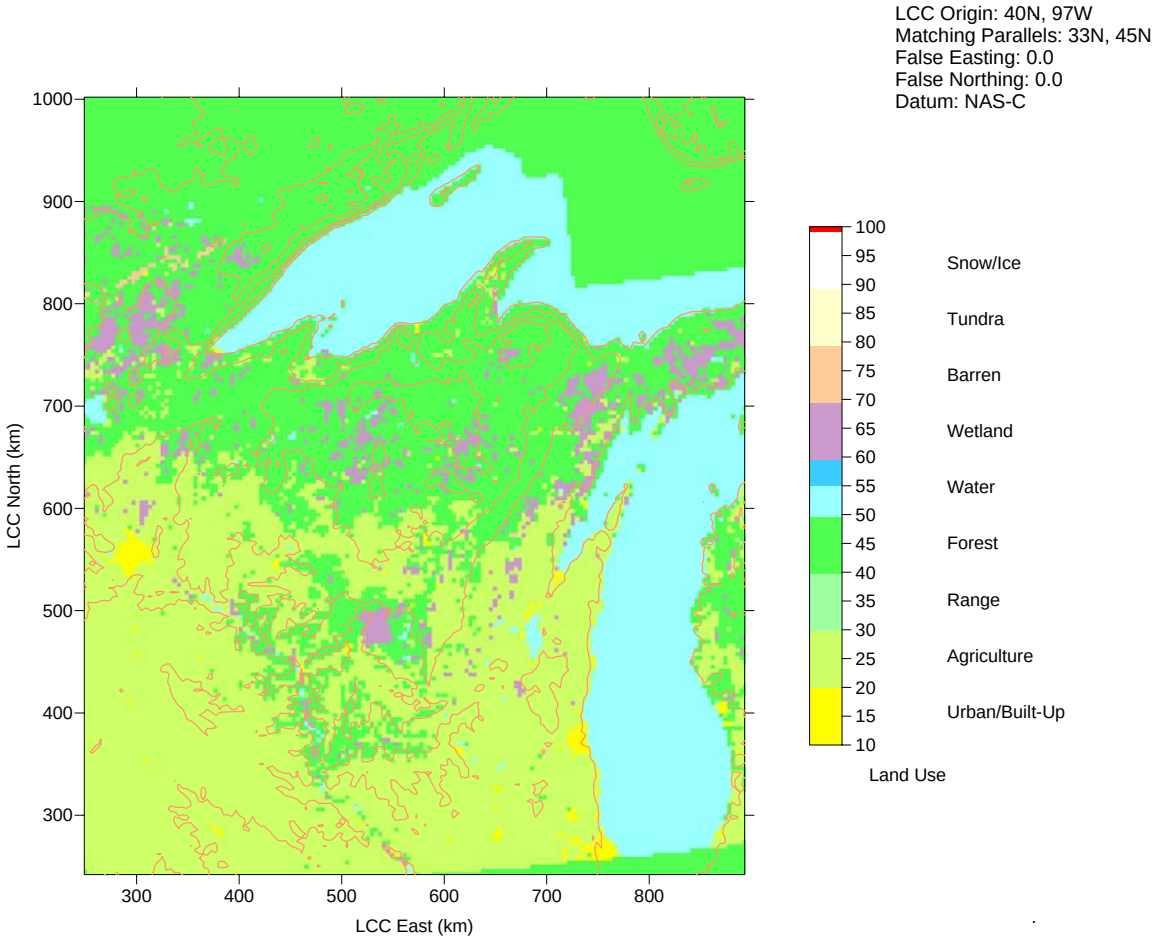
NOTE: The Class I area receptors are in red, the Wausau Mill location is in blue, and the X and Y coordinates are the Lambert projection coordinates are in kms.

Figure 3 – Locations of Observational Stations in Refined CALPUFF Modeling Domain



NOTES: Surface stations are in red, overwater (buoy) in blue, precipitation in green, and upper air in purple.

Figure 4 – Land Use Data for Refined CALPUFF Modeling Domain



Some of the notable CALMET configuration settings included:

- CALMET vertical layers set to 10, with cell face heights at 20, 40, 80, 160, 320, 640, 1200, 2000, 3000, and 4000 meters,
- CALMET diagnostic options, including slope flow effects (ISLOPE = 1) with the radius of influence of terrain (TERRAD) set to 15 km,
- EPA recommended CALMET settings for the radius of influence parameters (R1=50, R2=100, RMAX1=100, RMAX2=200, and RMAX3=200).

4.0 CALPUFF Procedures

Both the DNR screening and VISTAS refined CALPUFF input files were used as the basis for the refined Wisconsin CALPUFF input files. All CALPUFF settings and options are consistent with EPA and FLM guidance, and the refined VISTAS protocol recommendations. The background ozone (O3) concentrations were used directly from the DNR CALPUFF input files. Instead of using monthly background ammonia concentrations from the DNR screening analyses, a single conservative background ammonia concentration of 3.9 ppb was used. Appendix B presents a listing of a CALPUFF input file developed for the analysis.

The DNR screening analysis considered three emitted pollutants, SO_2, NOx, and $PM_{2.5}$. The refined CALPUFF modeling will consider speciated particulate emissions, including coarse PM (PMC), fine PM equivalent to $PM_{2.5}$ (PMF), sulfate (SO4), nitrate (NO3), elemental carbon (EC), and secondary organic aerosols (SOA or OC). Section 6 of this protocol describes how the speciated particulate emissions were calculated.

5.0 POSTUTIL and CALPOST Procedures

In CALPUFF, the scavenging of the available ammonia for nitrate formation is computed on a puff-by-puff basis. Because of the possibility of multiple puff overlap, this approach may tend to overestimate the amount of ammonia available to form nitrate. In order to address the cumulative consumption of ammonia, the POSTUTIL program can be used to repartition nitric acid and nitrate. POSTUTIL calculates new NO3/HNO3 equilibrium concentrations for the sample source in the Class I area using the background ammonia. As recommended in the VISTAS procedures for refined CALPUFF modeling, the POSTUTIL "MNITRATE=1" method was used for the refined Wisconsin CALPUFF modeling. Instead of using the monthly values for background ammonia concentrations from the DNR screening analyses, a single conservative background ammonia concentration of 3.9 ppb was used.

The modeling protocol submitted in 2007 proposed to use CALPOST Visibility Method 6 to calculate visibility impacts. However, since that time there have been revisions to CALPOST that allow the use of the updated IMPROVE extinction equation. CALPOST version 6.221 can implement the "Method 8 Mode 5" methodology to calculate visibility impacts, and the FLMs recommend its use in "Federal Land Managers' Air Quality Related Values Work Group (FLAG) Phase I Report—Revised (2010)" (herein referred to as FLAG 2010). Therefore, this updated methodology will be used for the Wausau BART analysis. The new CALPUFF Graphical Users Interface automatically enters the appropriate values, based on the Class I area being selected, for natural background species and relative humidity adjustment factors using the data in Tables 6 through 9 of Section 3.3.5 of FLAG 2010 (which are based on "Guidance for Estimating Natural Visibility Conditions Under the Regional Haze Rule", EPA-454/B-03-005, September 2003).

6.0 Emissions Modeled

EPA's BART modeling guidance state that the 24-hr maximum actual emissions rates for the period of the modeling simulation (2002-2004) should be used for the analysis. If this data is not available, then the short term "allowable" or "potential" emission rates should be used. Wausau provided DNR with source information that has been reviewed to determine the 24-hr maximum actual emissions rates.

There are a number of BART eligible emission units at the Wausau Mosinee mill. Stack S10 is a combined stack for the 3 boilers that are the primary source of the BART pollutants, and the recovery boiler (B21) vents to stack S11. In addition, although the BART eligibility is in question for some smaller emissions sources (the lime kiln, smelt tank, and slaker), these units were also included in the modeling to be conservative. Based on discussions between RMT (Wausau Paper's consultant) and DNR on December 7 and 9, 2010, it was agreed to use PTE emissions for all emission units, as listed in Table 1. Note that the PTE for S10 was adjusted to reflect fuel oil usage limitations as specified in the air permit. The PM emissions have been speciated using the information for coal and oil fired boilers developed by the National Park Service[1].

[1] http://www2.nature.nps.gov/air/permits/ect/index.cfm)

Table 1 – Wausau Emissions (in units of g/sec)

Unit	SO2	NOx	PM	PMC	PMF	EC	SO4	SOA
S10	143.1	28.1	11.68	1.16	2.39	0.09	6.43	1.61
S11	13.1	5.4	2.32	0.73	1.26	0.10	0.19	0.04
S12	0.4	0.0	0.43	0.00	0.43	0.00	0.00	0.00
S52	0.0	0.0	0.43	0.00	0.43	0.00	0.00	0.00
S53	1.4	0.9	0.62	0.32	0.19	0.01	0.10	0.00
Total	158.0	34.4	15.5	2.2	4.7	0.2	6.7	1.7

7.0 Modeling Results

CALPOST computes the daily maximum change in deciviews relative to the annual average natural background visibility, separately for each Class I area. For evaluating the source impact relative to the "Subject to BART" visibility impact threshold of 0.5 dv, the daily maximum changes in visibility are sorted to determine the 98th percentile (8^{th} highest) value for each of three years, and the 98th percentile (22^{nd} highest) value for the completed three year period. If all 98th percentile values are below the threshold of 0.5 dv based on the refined CALPUFF analysis, the source is exempt from the BART requirements.

Another equivalent metric commonly used for BART exemption modeling is to sum the number of days per year that are above the 0.5 dv threshold for each Class I area separately; if there are 7 or fewer days above the threshold for each year, then the 98^{th} percentile value is also below the threshold. This is the metric approved by DNR for use in the BART modeling analysis. Specifically, for each Class I area separately, if there are less than 8 days per year that the predicted visibility impacts are greater than 0.5 deciviews relative to the annual average natural background visibility, then the BART eligible emission units at the modeled facility will be determined not to be Subject to BART.

Table 2 presents the results from the refined CALPUFF BART exemption modeling. These results demonstrate that there are less than 8 days per year, at each individual Class I area, when the visibility impacts from the Wausau mill BART eligible emission unit are above 0.5 dv. Therefore, the **Wausau mill BART eligible sources are not Subject to BART** requirements.

Table 2 – Wausau CALPUFF BART Exemption Results Summary

Class I area	**Distance (km) from source to Class I area boundary**	**# of days with impact > 0.5 dv in Class I area: 2002**	**# of days with impact > 0.5 dv in Class I area: 2003**	**# of days with impact > 0.5 dv in Class I area: 2004**	**# of days with impact > 0.5 dv in Class I area for 3 year period**	**Maximum 98th Percentile impact over either annual or 3-yr periods**
Seney , MI	~ 320	0	0	1	1	0.20
Isle Royal, MN	~ 340	0	0	0	0	0.15
Boundary Waters, MN	~ 360	2	0	0	2	0.13

Appendix A – Example CALMET Input File

```
WI Refined CALMET - 4km Grid - Dec 2010 - with Updated EPA Settings


---------------- 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=SURF02Z.DAT  !
CLOUD.DAT     input    * CLDDAT=            *
PRECIP.DAT    input    ! PRCDAT=PRECIP02.DAT !

MM4.DAT       input    * MM4DAT=E:\MRPO-calmm5\2002\MM5.020102.3D.DAT  *
MM4.DAT       input    ! MM4DAT=E:\MRPO-calmm5\2002\020102.MM5  !


WT.DAT        input    * WTDAT=             *
CALMET.LST    output   ! METLST=cal020102.lST  !
CALMET.DAT    output   ! METDAT=E:\WI-Calmet\2002Output\cal020102.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 =  3  !
    Number of overwater met stations
                                (NOWSTA) No default     ! NOWSTA =  5  !


                      !END!
--------------------------------------------------------------------------------
Subgroup (b)
```

```
---------------------------------
Upper air files (one per station)
---------------------------------
Default Name  Type       File Name
------------  ----       ---------
UP1.DAT       input     1  ! UPDAT=UPGB0204.DAT!    !END!
UP2.DAT       input     2  ! UPDAT=UPMN0204.DAT!    !END!
UP3.DAT       input     3  ! UPDAT=UPIN0204.DAT!    !END!

--------------------------------------------------------------------------------
Subgroup (c)
---------------------------------------
Overwater station files (one per station)
SEA1.DAT input  1  ! SEADAT=4500102.DAT!    !END!
SEA2.DAT input  2  ! SEADAT=4500202.DAT!    !END!
SEA3.DAT input  3  ! SEADAT=4500402.DAT!    !END!
SEA4.DAT input  4  ! SEADAT=4500602.DAT!    !END!
SEA5.DAT input  5  ! SEADAT=4500702.DAT!    !END!

---------------------------------------
Default Name  Type       File Name
------------  ----       ---------
--------------------------------------------------------------------------------
Subgroup (d)
----------------
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=                  *

--------------------------------------------------------------------------------
NOTES: (1) File/path names can be up to 70 characters in length
       (2) Subgroups (a) and (d) must have ONE 'END' (surround by
           delimiters) at the end of the group
       (3) Subgroups (b) and (c) 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=  2 !
                      Hour (IBHR) -- No default       ! IBHR=  0  !

     Base time zone        (IBTZ) -- No default       ! IBTZ=  6  !
        PST = 08, MST = 07
        CST = 06, EST = 05

     Length of run (hours) (IRLG) -- No default       ! IRLG=  24  !

     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)

      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
     Test options specified to see if
     they conform to regulatory
```

```
     values? (MREG)                  No Default       ! MREG =  1   !

        0 = NO checks are made
        1 = Technical options must conform to USEPA guidance
                  IMIXH    -1       Maul-Carson convective mixing height
                                    over land; OCD mixing height overwater
                  ICOARE   0        OCD deltaT method for overwater fluxes
                  THRESHL  0.0      Threshold buoyancy flux over land needed
                                    to sustain convective mixing height grow
!END!

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

INPUT GROUP: 2 -- Map Projection and Grid control parameters
--------------

     Projection for all (X,Y):
     -------------------------

     Map projection
     (PMAP)                     Default: UTM    ! PMAP = LCC  !

         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 = -999   !

     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 = 40N  !
(RLON0)                   No Default      ! RLON0 = 97W  !

    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 = 33N  !
(XLAT2)                   No Default      ! XLAT2 = 45N  !

    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  !


     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 =  162  !
            No. Y grid cells (NY)      No default     ! NY =  191  !

     Grid spacing (DGRIDKM)            No default     ! DGRIDKM = 4. !
                                       Units: km

     Reference grid coordinate of
     SOUTHWEST corner of grid cell (1,1)

        X coordinate (XORIGKM)         No default     ! XORIGKM = 247.000 !
        Y coordinate (YORIGKM)         No default     ! YORIGKM = 240.000 !
                                       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.,640.,1200.,2000.,3000.,4000. !

!END!
```

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

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  !

            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 =  1  !
       (Meteorological fields are printed
        every  1  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 =  0 ,  0 ,  0 ,  0 ,  0 ,  0 ,  0 ,  0 ,  0 ,  0  !
       -----------------------


       Specify which levels of the W wind component to print
       (NOTE: W defined at TOP cell face --  16  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 ,  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 =  0 ,  0 ,  0 ,  0 ,  0 ,  0 ,  0 ,  0 ,  0 ,  0  !

Specify which meteorological fields
to print
(used only if LPRINT=T)             Defaults: 0 (all variables)
-----------------------


  Variable            Print ?
                  (0 = do not print,
                   1 = print)
  --------        ------------------

!  STABILITY  =           0           ! - PGT stability class
!  USTAR      =           0           ! - Friction velocity
!  MONIN      =           0           ! - Monin-Obukhov length
!  MIXHT      =           0           ! - Mixing height
!  WSTAR      =           0           ! - Convective velocity scale
!  PRECIP     =           0           ! - 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 =  2  !


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 =  1  !

   Print the INTERPOLATED wind components ?
   (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  !

   Print the FINAL DIVERGENCE fields ?
   (IPR4) (0=no, 1=yes)            Default: 0       !  IPR4 =  0  !

   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!


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

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 MM5 for upper air data
          2 = No surface, overwater, or upper air observations
              Use MM5 for surface, overwater, and upper air data

    NUMBER OF SURFACE & PRECIP. METEOROLOGICAL STATIONS

       Number of surface stations   (NSSTA)  No default     ! NSSTA =  22  !

       Number of precipitation stations
       (NPSTA=-1: flag for use of MM5 precip data)
                                    (NPSTA)  No default     ! NPSTA =  16  !

    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 =  2  !
      (1 = unformatted - CALMET unformatted output)
      (2 = formatted   - free-formatted CALMET output or user input)

!END!


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

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
                       ! BIAS =  0 ,  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 =  14  !
(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.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 = 1]

Timestep (hours) of the prognostic
model input data   (ISTEPPG)         Default: 1      ! ISTEPPG =  1   !
```

```
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 = 200. !
                                         Units: km
   Maximum radius of influence over water
   (RMAX3)                               No default      ! RMAX3 = 200. !
                                         Units: km


OTHER WIND FIELD INPUT PARAMETERS

   Minimum radius of influence used in
   the wind field interpolation (RMIN)   Default: 0.1    ! RMIN = 0.1 !
                                         Units: km
   Radius of influence of terrain
   features (TERRAD)                     No default      ! TERRAD = 15. !

                                         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 =100. !
   (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 = 0. !
```

```
      (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 ,  4 ,  4 ,  4 ,  4 ,  4 ,  4 ,  4 ,  4 ,  4   !

      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 ,  99 ,  99 ,  99 ,  99   !

      Critical Froude number (CRITFN)      Default: 1.0    ! CRITFN = 1. !

      Empirical factor controlling the
      influence of kinematic effects
      (ALPHA)                              Default: 0.1    ! ALPHA = 0.1 !

      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  !

      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)
      --------------------------

   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., 1000. !
   (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)

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 -- 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)

  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 =  1  !
                                          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
        -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 = 0.00 !
     (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 = 50. !
   (ZIMIN)                            Units: meters
   Maximum overland mixing height     Default: 3000.  ! ZIMAX = 3000. !
   (ZIMAX)                            Units: meters
   Minimum overwater mixing height    Default:   50.  ! ZIMINW = 50. !
   (ZIMINW) -- (Not used if observed  Units: meters
   overwater mixing hts. are used)
   Maximum overwater mixing height    Default: 3000.  ! ZIMAXW = 3000. !
   (ZIMAXW) -- (Not used if observed  Units: meters
   overwater mixing hts. are used)

OVERWATER SURFACE FLUXES METHOD and PARAMETERS
      (ICOARE)                        Default: 10      ! ICOARE =  0   !
       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


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 for upper air data
          (only if NOOBS = 0,1)
      2 = No surface or upper air observations
          Use MM5 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 = -0.0045 !
       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!


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

INPUT GROUP: 7 -- Surface meteorological station parameters
--------------

     SURFACE STATION VARIABLES
     (One record per station --  0  records in all)


             1     2
         Name   ID            X coord.   Y coord.   Time   Anem.
                               (km)       (km)      zone   Ht.(m)
       -----------------------------------------------------------
! SS1  ='MILW'    26400       739.061      363.200    6    10  !
! SS2  ='MADI'    26410       619.927      372.210    6    10  !
```

```
! SS3  ='LA C'    26430       461.012      442.705    6    10  !
! SS4  ='EAU '    26435       435.857      552.352    6    10  !
! SS5  ='GREE'    26450       703.911      530.179    6    10  !
! SS6  ='MANI'    26455       743.477      495.113    6    10  !
! SS7  ='STUR'    26458       755.730      576.760    6    10  !
! SS8  ='WAUS'    26463       581.202      568.247    6    10  !
! SS9  ='MOSI'    26465       579.307      552.489    6    10  !
! SS10 ='CLIN'    26502       655.019      541.168    6    10  !
! SS11 ='WISC'    26503       582.532      412.498    6    10  !
! SS12 ='EAGL'    26504       599.980      682.545    6    10  !
! SS13 ='MINE'    26507       550.817      338.941    6    10  !
! SS14 ='HAYW'    26508       430.347      681.295    6    10  !
! SS15 ='JUNE'    26509       669.429      409.931    6    10  !
! SS16 ='dulu'    27450       366.011      766.977    6    10  !
! SS17 ='MANI'    25408       838.315      711.433    5    10  !
! SS18 ='SAWY'    26284       741.237      743.078    5    10  !
! SS19 ='HOUG'    26380       977.905      549.977    5    10  !
! SS20 ='ESCA'    26480       775.417      679.550    5    10  !
! SS21 ='IRNM'    27437       690.168      678.511    5    10  !
! SS22 ='IRNW'    27445       528.314      743.857    5    10  !
------------------
      1
        Four character string for station name
        (MUST START IN COLUMN 9)

      2
        Five digit integer for station ID

!END!


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

INPUT GROUP: 8 -- Upper air meteorological station parameters
--------------

     UPPER AIR STATION VARIABLES
     (One record per station --  0  records in all)

             1     2
         Name    ID      X coord.   Y coord.  Time zone
                           (km)       (km)
        ------------------------------------------------
! US1  ='GREE'   14898    703.911    539.179    6  !
```

```
! US2  ='MNNP'   94983    272.681    539.843    6  !
! US3  ='INTF'   14918    269.489    957.416    6  !

-------------------
      1
        Four character string for station name
        (MUST START IN COLUMN 9)

      2
        Five digit integer for station ID

!END!


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

INPUT GROUP: 9 -- Precipitation station parameters
--------------

     PRECIPITATION STATION VARIABLES
     (One record per station --  0  records in all)
     (NOT INCLUDED IF NPSTA = 0)

            1          2
         Name   Station    X coord.  Y coord.
                  Code       (km)      (km)
         -----------------------------------
! PS1  ='COPP'   201780   719.681    845.179 !
! PS2  ='ESCA'   202626   779.850    646.454 !
! PS3  ='HOUG'   203936  1001.500    536.427 !
! PS4  ='IRON'   204090   699.421    640.283 !
! PS5  ='MANI'   205073   845.933    667.499 !
! PS6  ='SAUL'   207366   985.172    765.448 !
! PS7  ='CLIN'   471667   696.889    290.151 !
! PS8  ='GREE'   473269   709.933    509.579 !
! PS9  ='HAYW'   473511   442.947    678.728 !
! PS10 ='LAC '   474370   471.515    404.495 !
! PS11 ='MADI'   474961   631.719    367.656 !
! PS12 ='MARS'   475120   550.348    505.662 !
! PS13 ='MENO'   475335   431.807    514.277 !
! PS14 ='MILW'   475479   772.567    324.344 !
! PS15 ='RAIN'   476939   599.369    634.460 !
! PS16 ='STURG'  478267   776.964    542.174 !
```

```
------------------
      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!
```

Appendix B – Example CALPUFF Input File

```
Example BART Modeling
2010 Updated BART Modeling for Wausau, WI -
Using Refined 4km CALMET Data File and SENE, ISLE, BOWA Class I Receptors

---------------- 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 =             *
    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 =WausuaRef02.lst  !
CONC.DAT      output   ! CONDAT =wausuaRef02.dat  !
DFLX.DAT      output   * DFDAT  =             *
WFLX.DAT      output   * WFDAT  =             *
VISB.DAT      output   * VISDAT =wausua02DNR.VIB  *
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=             *
H2O2.DAT      input    * H2O2DAT=             *
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=             *
------------------------------------------------------------------------------
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
NOTE: (1) file/path names can be up to 70 characters in length


Provision for multiple input files
----------------------------------
```

```
     Number of CALMET.DAT files for run (NMETDAT)
                                    Default: 1       ! NMETDAT =  364   !

     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)
-------------

  The following CALMET.DAT filenames are processed in sequence if NMETDAT>1

Default Name  Type          File Name
------------  ----          ---------
 none         input    ! METDAT=e:\WI-Calmet\2002output\cal020102.DAT     !  !END!
 none         input    ! METDAT=e:\WI-Calmet\2002output\cal020103.DAT     !  !END!
 none         input    ! METDAT=e:\WI-Calmet\2002output\cal020104.DAT     !  !END!
 none         input    ! METDAT=e:\WI-Calmet\2002output\cal020105.DAT     !  !END!
 none         input    ! METDAT=e:\WI-Calmet\2002output\cal020106.DAT     !  !END!
 none         input    ! METDAT=e:\WI-Calmet\2002output\cal020107.DAT     !  !END!
 none         input    ! METDAT=e:\WI-Calmet\2002output\cal020108.DAT     !  !END!
 none         input    ! METDAT=e:\WI-Calmet\2002output\cal020109.DAT     !  !END!
 none         input    ! METDAT=e:\WI-Calmet\2002output\cal020110.DAT     !  !END!
 none         input    ! METDAT=e:\WI-Calmet\2002output\cal020111.DAT     !  !END!
 none         input    ! METDAT=e:\WI-Calmet\2002output\cal020112.DAT     !  !END!
 none         input    ! METDAT=e:\WI-Calmet\2002output\cal020113.DAT     !  !END!
 none         input    ! METDAT=e:\WI-Calmet\2002output\cal020114.DAT     !  !END!
 none         input    ! METDAT=e:\WI-Calmet\2002output\cal020115.DAT     !  !END!
 none         input    ! METDAT=e:\WI-Calmet\2002output\cal020116.DAT     !  !END!
 none         input    ! METDAT=e:\WI-Calmet\2002output\cal020117.DAT     !  !END!
 none         input    ! METDAT=e:\WI-Calmet\2002output\cal020118.DAT     !  !END!
 none         input    ! METDAT=e:\WI-Calmet\2002output\cal020119.DAT     !  !END!
 none         input    ! METDAT=e:\WI-Calmet\2002output\cal020120.DAT     !  !END!
 none         input    ! METDAT=e:\WI-Calmet\2002output\cal020121.DAT     !  !END!
 none         input    ! METDAT=e:\WI-Calmet\2002output\cal020122.DAT     !  !END!
 none         input    ! METDAT=e:\WI-Calmet\2002output\cal020123.DAT     !  !END!
 none         input    ! METDAT=e:\WI-Calmet\2002output\cal020124.DAT     !  !END!
 none         input    ! METDAT=e:\WI-Calmet\2002output\cal020125.DAT     !  !END!
 none         input    ! METDAT=e:\WI-Calmet\2002output\cal020126.DAT     !  !END!
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none         input    ! METDAT=e:\WI-Calmet\2002output\cal021003.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal021004.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal021005.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal021006.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal021007.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal021008.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal021009.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal021010.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal021011.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal021012.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal021013.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal021014.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal021015.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal021016.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal021017.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal021018.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal021019.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal021020.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal021021.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal021022.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal021023.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal021024.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal021025.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal021026.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal021027.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal021028.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal021029.DAT     !  !END!
none         input    ! METDAT=e:\WI-Calmet\2002output\cal021030.DAT     !  !END!
```

```
 none         input    ! METDAT=e:\WI-Calmet\2002output\cal021031.DAT     !  !END!
 none         input    ! METDAT=e:\WI-Calmet\2002output\cal021101.DAT     !  !END!
 none         input    ! METDAT=e:\WI-Calmet\2002output\cal021102.DAT     !  !END!
 none         input    ! METDAT=e:\WI-Calmet\2002output\cal021103.DAT     !  !END!
 none         input    ! METDAT=e:\WI-Calmet\2002output\cal021104.DAT     !  !END!
 none         input    ! METDAT=e:\WI-Calmet\2002output\cal021105.DAT     !  !END!
 none         input    ! METDAT=e:\WI-Calmet\2002output\cal021106.DAT     !  !END!
 none         input    ! METDAT=e:\WI-Calmet\2002output\cal021107.DAT     !  !END!
 none         input    ! METDAT=e:\WI-Calmet\2002output\cal021108.DAT     !  !END!
 none         input    ! METDAT=e:\WI-Calmet\2002output\cal021109.DAT     !  !END!
 none         input    ! METDAT=e:\WI-Calmet\2002output\cal021110.DAT     !  !END!
 none         input    ! METDAT=e:\WI-Calmet\2002output\cal021111.DAT     !  !END!
 none         input    ! METDAT=e:\WI-Calmet\2002output\cal021112.DAT     !  !END!
 none         input    ! METDAT=e:\WI-Calmet\2002output\cal021113.DAT     !  !END!
 none         input    ! METDAT=e:\WI-Calmet\2002output\cal021114.DAT     !  !END!
 none         input    ! METDAT=e:\WI-Calmet\2002output\cal021115.DAT     !  !END!
 none         input    ! METDAT=e:\WI-Calmet\2002output\cal021116.DAT     !  !END!
 none         input    ! METDAT=e:\WI-Calmet\2002output\cal021117.DAT     !  !END!
 none         input    ! METDAT=e:\WI-Calmet\2002output\cal021118.DAT     !  !END!
 none         input    ! METDAT=e:\WI-Calmet\2002output\cal021119.DAT     !  !END!
 none         input    ! METDAT=e:\WI-Calmet\2002output\cal021120.DAT     !  !END!
 none         input    ! METDAT=e:\WI-Calmet\2002output\cal021121.DAT     !  !END!
 none         input    ! METDAT=e:\WI-Calmet\2002output\cal021122.DAT     !  !END!
 none         input    ! METDAT=e:\WI-Calmet\2002output\cal021123.DAT     !  !END!
 none         input    ! METDAT=e:\WI-Calmet\2002output\cal021124.DAT     !  !END!
 none         input    ! METDAT=e:\WI-Calmet\2002output\cal021125.DAT     !  !END!
 none         input    ! METDAT=e:\WI-Calmet\2002output\cal021126.DAT     !  !END!
 none         input    ! METDAT=e:\WI-Calmet\2002output\cal021127.DAT     !  !END!
 none         input    ! METDAT=e:\WI-Calmet\2002output\cal021128.DAT     !  !END!
 none         input    ! METDAT=e:\WI-Calmet\2002output\cal021129.DAT     !  !END!
 none         input    ! METDAT=e:\WI-Calmet\2002output\cal021130.DAT     !  !END!
 none         input    ! METDAT=e:\WI-Calmet\2002output\cal021201.DAT     !  !END!
 none         input    ! METDAT=e:\WI-Calmet\2002output\cal021202.DAT     !  !END!
 none         input    ! METDAT=e:\WI-Calmet\2002output\cal021203.DAT     !  !END!
 none         input    ! METDAT=e:\WI-Calmet\2002output\cal021204.DAT     !  !END!
 none         input    ! METDAT=e:\WI-Calmet\2002output\cal021205.DAT     !  !END!
 none         input    ! METDAT=e:\WI-Calmet\2002output\cal021206.DAT     !  !END!
 none         input    ! METDAT=e:\WI-Calmet\2002output\cal021207.DAT     !  !END!
 none         input    ! METDAT=e:\WI-Calmet\2002output\cal021208.DAT     !  !END!
 none         input    ! METDAT=e:\WI-Calmet\2002output\cal021209.DAT     !  !END!
 none         input    ! METDAT=e:\WI-Calmet\2002output\cal021210.DAT     !  !END!
 none         input    ! METDAT=e:\WI-Calmet\2002output\cal021211.DAT     !  !END!
 none         input    ! METDAT=e:\WI-Calmet\2002output\cal021212.DAT     !  !END!
 none         input    ! METDAT=e:\WI-Calmet\2002output\cal021213.DAT     !  !END!
 none         input    ! METDAT=e:\WI-Calmet\2002output\cal021214.DAT     !  !END!
 none         input    ! METDAT=e:\WI-Calmet\2002output\cal021215.DAT     !  !END!
 none         input    ! METDAT=e:\WI-Calmet\2002output\cal021216.DAT     !  !END!
 none         input    ! METDAT=e:\WI-Calmet\2002output\cal021217.DAT     !  !END!
 none         input    ! METDAT=e:\WI-Calmet\2002output\cal021218.DAT     !  !END!
 none         input    ! METDAT=e:\WI-Calmet\2002output\cal021219.DAT     !  !END!
 none         input    ! METDAT=e:\WI-Calmet\2002output\cal021220.DAT     !  !END!
 none         input    ! METDAT=e:\WI-Calmet\2002output\cal021221.DAT     !  !END!
 none         input    ! METDAT=e:\WI-Calmet\2002output\cal021222.DAT     !  !END!
 none         input    ! METDAT=e:\WI-Calmet\2002output\cal021223.DAT     !  !END!
 none         input    ! METDAT=e:\WI-Calmet\2002output\cal021224.DAT     !  !END!
 none         input    ! METDAT=e:\WI-Calmet\2002output\cal021225.DAT     !  !END!
 none         input    ! METDAT=e:\WI-Calmet\2002output\cal021226.DAT     !  !END!
 none         input    ! METDAT=e:\WI-Calmet\2002output\cal021227.DAT     !  !END!
 none         input    ! METDAT=e:\WI-Calmet\2002output\cal021228.DAT     !  !END!
 none         input    ! METDAT=e:\WI-Calmet\2002output\cal021229.DAT     !  !END!
 none         input    ! METDAT=e:\WI-Calmet\2002output\cal021230.DAT     !  !END!
 none         input    ! METDAT=e:\WI-Calmet\2002output\cal021231.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 =  2002  !
     (used only if   Month (IBMO) -- No default       ! IBMO =  1  !
      METRUN = 0)      Day (IBDY) -- No default       ! IBDY =  02 !
                      Hour (IBHR) -- No default       ! IBHR =  1  !

     Base time zone        (XBTZ) -- No default       ! XBTZ = 6.0  !
        PST = 8., MST = 7.
        CST = 6., EST = 5.

     Length of run (hours) (IRLG) -- No default       ! IRLG = 8736  !

     Number of chemical species (NSPEC)
                                  Default: 5       ! NSPEC =  9   !

     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)

     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. !
```

```
!END!

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

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 =  3   !
        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 =  0   !
        0 = not modeled
        1 = modeled

     Near-field puffs modeled as
     elongated 0 (MSLUG)                  Default: 0     ! MSLUG =  0   !
        0 = no
        1 = yes (slug model used)

     Transitional plume rise modeled ?
     (MTRANS)                             Default: 1     ! MTRANS =  1   !
        0 = no  (i.e., final rise only)
        1 = yes (i.e., transitional rise computed)

     Stack tip downwash? (MTIP)           Default: 1     ! MTIP =  1  !
        0 = no  (i.e., no stack tip downwash)
        1 = yes (i.e., use stack tip downwash)

     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 =  1   !
        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)

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 adjusted
        for aqueous phase reactions

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)

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
        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 =  3  !
(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.

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)
   0 = no
   1 = yes, using formatted BCON.DAT file
   2 = yes, using unformatted CONC.DAT file


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
                    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

!END!


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

INPUT GROUP: 3a, 3b -- Species list
-------------------

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

  The following species are modeled:

  The following species are modeled:

! CSPEC =          SO2 !         !END!
! CSPEC =          SO4 !         !END!
! CSPEC =          NOX !         !END!
! CSPEC =         HNO3 !         !END!
! CSPEC =          NO3 !         !END!
! CSPEC =          PMC !         !END!
! CSPEC =          PMF !         !END!
! CSPEC =           EC !         !END!
! CSPEC =          SOA !         !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   !
!          SO4  =         1,               1,           2,                 0   !
!          NOX  =         1,               1,           1,                 0   !
!         HNO3  =         1,               0,           1,                 0   !
!          NO3  =         1,               0,           2,                 0   !
!          PMC  =         1,               1,           2,                 0   !
!          PMF  =         1,               1,           2,                 0   !
!           EC  =         1,               1,           2,                 0   !
!          SOA  =         1,               1,           2,                 0   !


!END!
```

```
-------------
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.



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


INPUT GROUP: 4 -- Map Projection and Grid control parameters
--------------

     Projection for all (X,Y):
     -------------------------

     Map projection
     (PMAP)                    Default: UTM    ! PMAP = LCC  !

         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 =  0   !

     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 =  40N  !
     (RLON0)                   No Default      ! RLON0 =  97W  !

         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 =  33N  !
```

```
     (XLAT2)                   No Default      ! XLAT2 =  45N  !

         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:

     Rectangular grid defined for projection PMAP,
     with X the Easting and Y the Northing coordinate

            No. X grid cells (NX)      No default     ! NX =  162   !
            No. Y grid cells (NY)      No default     ! NY =  191   !
         No. vertical layers (NZ)      No default     ! NZ =  10   !

           Grid spacing (DGRIDKM)      No default     ! DGRIDKM = 4. !
                                       Units: km


        Cell face heights in arbitrary
        vertical grid (ZFACE(NZ+1))    No defaults
                                       Units: m
        ! ZFACE = 0.,20.,40.,80.,160.,320.,640.,1200.,2000.,3000.,4000. !

            Reference Coordinates
           of SOUTHWEST corner of
                 grid cell(1, 1):

            X coordinate (XORIGKM)     No default     ! XORIGKM = 247. !
            Y coordinate (YORIGKM)     No default     ! YORIGKM = 240. !
                                      Units: km


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 =  162   !
                  (1 <= IECOMP <= NX)

        Y index of UR corner (JECOMP)      No default     ! JECOMP =  191   !
                  (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 = F !
        (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 =  162   !
         (IBCOMP <= IESAMP <= IECOMP)

        Y index of UR corner (JESAMP)      No default     ! JESAMP =  191   !
         (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 =  0   !
Wet Fluxes (IWET)                 1                   !  IWET =  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


 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 =  0   !
    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 =  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

    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, # 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 =     0,           1,           0,           0,           0,           0,
0   !
!          SO4 =     0,           1,           0,           0,           0,           0,
0   !
!          NOX =     0,           1,           0,           0,           0,           0,
0   !
!         HNO3 =     0,           1,           0,           0,           0,           0,
0   !
!          NO3 =     0,           1,           0,           0,           0,           0,
0   !
!          PMC =     0,           1,           0,           0,           0,           0,
0   !
!          PMF =     0,           1,           0,           0,           0,           0,
0   !
!           EC =     0,           1,           0,           0,           0,           0,
0   !
!          SOA =     0,           1,           0,           0,           0,           0,
0   !


     OPTIONS FOR PRINTING "DEBUG" QUANTITIES (much output)

       Logical for debug output
       (LDEBUG)                                  Default: F     ! LDEBUG = F !

       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 =  0   !

       Number of special complex terrain
       receptors  (NCTREC)                       Default: 0     ! NCTREC =  0   !

       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)
----          ----      ----      ------  -----  ------    ------    ------   -------    -------
-----     -----

---------------
Subgroup (6c)
---------------

    COMPLEX TERRAIN RECEPTOR INFORMATION

                      XRCT         YRCT        ZRCT          XHH
                      (km)         (km)         (m)
                     ------        -----      ------         ----


-------------------
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 !
!         HNO3 =     0.1628,            1.,           18.,               0.,
0.00000008 !

!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)
      -------      -------------------        ------------------

!          SO4 =          0.48,                     2.   !
!          NO3 =          0.48,                     2.   !
!          PMC =           2.0,                    2.0   !
!          PMF =          0.48,                     2.   !
!           EC =          0.48,                     2.   !
!          SOA =          0.48,                     2.   !


!END!


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


INPUT GROUP: 9 -- Miscellaneous dry deposition parameters
--------------
```

```
     Reference cuticle resistance (s/cm)
     (RCUTR)                          Default: 30    !  RCUTR = 30.0 !
     Reference ground resistance  (s/cm)
     (RGR)                            Default: 10    !    RGR = 10.0 !
     Reference pollutant reactivity
     (REACTR)                         Default: 8     ! REACTR = 8.0 !

     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 !
!          SO4 =         1.0E-04,            3.0E-05 !
!          NOX =          0.0E00,             0.0E00 !
!         HNO3 =         6.0E-05,             0.0E00 !
!          NO3 =         1.0E-04,            3.0E-05 !

!END!


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


INPUT GROUP: 11 -- Chemistry Parameters
---------------

     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
     (Used only if MCHEM = 1, 3, or 4 and
      MOZ = 0 or MOZ = 1 and all hourly O3 data missing)
     (BCKO3) in ppb                   Default: 12*80.

     !  BCKO3 = 31.00, 31.00, 31.00, 37.00, 37.00, 37.00, 33.00, 33.00, 33.00, 27.00, 27.00, 27.00
!

     Monthly ammonia concentrations
     (Used only if MCHEM = 1, or 3)
     (BCKNH3) in ppb                  Default: 12*10.
```

```
!  BCKNH3 = 12*3.9 !

Nighttime SO2 loss rate (RNITE1)
in percent/hour                  Default: 0.2          ! RNITE1 = .2 !

Nighttime NOx loss rate (RNITE2)
in percent/hour                  Default: 2.0          ! RNITE2 = 2.0 !

Nighttime HNO3 formation rate (RNITE3)
in percent/hour                  Default: 2.0          ! RNITE3 = 2.0 !

H2O2 data input option (MH2O2)    Default: 1            ! MH2O2 =  1   !
(Used only if MAQCHEM = 1)
   0 = use a monthly background H2O2 value
   1 = read hourly H2O2 concentrations from
       the H2O2.DAT data file

Monthly H2O2 concentrations
(Used only if MQACHEM = 1 and
 MH2O2 = 0 or MH2O2 = 1 and all hourly H2O2 data missing)
(BCKH2O2) in ppb                 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 *
!  BCKH2O2 = 0.50, 0.50, 0.50, 2.30, 2.30, 2.30, 3.50, 3.50, 3.50, 0.80, 0.80, 0.80 !

--- Data for SECONDARY ORGANIC AEROSOL (SOA) Option
    (used only if MCHEM = 4)

    The 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)
    to 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.
       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!


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


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 = 5.5E02 !

     Switch for using Heffter equation for sigma z
     as above (0 = Not use Heffter; 1 = use Heffter
     (MHFTSZ)                                  Default: 0      ! MHFTSZ =  0   !

     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 = .01 !

     Vertical dispersion constant for neutral/
     unstable conditions (k2 in Eqn. 2.7-4)
     (CONK2)                                   Default: 0.1    ! CONK2 = .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 = .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
     (IURB1, IURB2)                            Default: 10     ! IURB1 =  10  !
                                                        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 = .25 !

        Leaf area index for modeling domain
        (XLAIIN)                               Default: 3.0    ! XLAIIN = 3.0 !

        Elevation above sea level (m)
```

```
   (ELEVIN)                                Default: 0.0    ! ELEVIN = .0 !

   Latitude (degrees) for met location
   (XLATIN)                                Default: -999.  ! XLATIN = -999.0 !

   Longitude (degrees) for met location
   (XLONIN)                                Default: -999.  ! XLONIN = -999.0 !

Specialized information for interpreting single-point Met data files -----

   Anemometer height (m) (Used only if METFM = 2,3)
   (ANEMHT)                                Default: 10.    ! ANEMHT = 10.0 !

   Form of lateral turbulance 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 = 1.0 !

Maximum travel distance of a puff/slug (in
grid units) during one sampling step
(XSAMLEN)                                  Default: 1.0    ! XSAMLEN = 1.0 !

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 = 1.0  !

Minimum sigma z for a new puff/slug (m)
(SZMIN)                                    Default: 1.0    ! SZMIN = 1.0  !

Default minimum turbulence velocities
sigma-v and sigma-w for each
stability class (m/s)
(SVMIN(6) and SWMIN(6))     Default SVMIN : .50,  .50,  .50,  .50,  .50,  .50
                            Default SWMIN : .20,  .12,  .08,  .06,  .03,  .016

                          Stability Class :  A     B     C     D     E     F
                                             ---   ---   ---   ---   ---   ---
                                  ! SVMIN = 0.500, 0.500, 0.500, 0.500, 0.500, 0.500!
                                  ! SWMIN = 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 !

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 = .5 !

Maximum mixing height (m)
(XMAXZI)                                   Default: 3000.  ! XMAXZI = 3000.0 !

Minimum mixing height (m)
(XMINZI)                                   Default: 50.    ! XMINZI = 50.0 !

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
                                            ---   ---   ---   ---   ---
                                  ! 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
                                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 = 10.0 !

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 = 0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,1,0,0,0,0,0,0 !

  Split is allowed only if last hour's mixing
  height (m) exceeds a minimum value
  (ZISPLIT)                         Default: 100.       ! ZISPLIT = 100.0 !

  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 = 2.0 !

  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 !

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 = 1.0 !

  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 = 500.0 !

  Search radius (in BC segment lengths) about a receptor for sampling
  nearest BC puff.  BC puffs are emitted with a spacing of one segment
  length, so the search radius should be greater than 1.
  (RSAMPBC)                         Default:   4.       ! RSAMPBC = 10.0 !
```

```
       Near-Surface depletion adjustment to concentration profile used when
       sampling BC puffs?
       (MDEPBC)                          Default:   1        ! MDEPBC =  1  !
          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 =  5  !

     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 =     Odour Unit * m**3/s  (vol. flux of odour compound)
           6 =     Odour Unit * m**3/min
           7 =     metric tons/yr

     Number of source-species
     combinations with variable
     emissions scaling factors
     provided below in (13d)        (NSPT1) Default: 0  !  NSPT1 =  0  !

     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)
---------------

  The following species are modeled:

CSPEC =          SO2
CSPEC =          SO4
CSPEC =          NOX
CSPEC =         HNO3
CSPEC =          NO3
CSPEC =          PMC
CSPEC =          PMF
CSPEC =           EC
CSPEC =          SOA
```

```
          POINT SOURCE: CONSTANT DATA
          ---------------------------
  Source       X         Y       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)         SO2 SO4 NOX HNO3
NO3 PMC PMF EC SOA
  ------   ---------- ---------- ------  ------   -------- ----- -------- ----- --------

   1 ! SRCNAM = S10 !
   1 ! X = 577.39257, 553.25636, 64.9, 352.7, 2.6 , 14.6, 449, .0, 143.1, 6.43, 28.1, 0, 0, 1.16,
2.39, 0.09, 1.61  !
   1 ! FMFAC  =      1.0 !   !END!
   2 ! SRCNAM = S11 !
   2 ! X =  577.37101, 553.15432, 36  , 352.7, 1.64, 25.7, 457, .0, 13.12, 0.19, 5.35, 0, 0, 0.73,
1.26, 0.10, 0.04 !
   2 ! FMFAC  =      1.0 !   !END!
   3 ! SRCNAM = S12 !
   3 ! X =  577.37292, 553.18169, 41.8, 352.7, 0.8 , 11.4, 347, .0, 0.40 , 0   , 0   , 0, 0, 0.00,
0.43, 0.00, 0.00 !
   3 ! FMFAC  =      1.0 !   !END!
   4 ! SRCNAM = S52 !
   4 ! X =  577.32104, 553.10738, 23.4, 352.7, 0.51, 9.4 , 313, .0, 0 0  , 0   , 0   , 0, 0, 0.43,
0.00, 0.00, 0.00 !
   4 ! FMFAC  =      1.0 !   !END!
   5 ! SRCNAM = S53 !
   5 ! X =  577.31194, 553.12545, 25.9, 352.7, 0.98, 8.8 , 347, .0, 1.35 , 0.10, 0.92, 0, 0, 0.32,
0.19, 0.01, 0.00 !
   5 ! FMFAC  =      1.0 !   !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)

    b
     0. = No building downwash modeled, 1. = downwash modeled
     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)
------     ---------------------------------------------------------------------


--------

    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+)



--------
    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 =  0   !

     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 =     Odour Unit * m/s  (vol. flux/m**2 of odour compound)
           6 =     Odour Unit * m/min
           7 =     metric tons/m**2/yr

     Number of source-species
     combinations with variable
     emissions scaling factors
     provided below in (14d)        (NSAR1) Default: 0  !  NSAR1 =  0  !

     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)
-------          ------    ------     --------   ---------


--------
    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 (km) FOR EACH VERTEX(4) OF EACH POLYGON
           ---------------------------------------------------------
Source                                                              a
 No.       Ordered list of X followed by list of Y, grouped by source
------     ------------------------------------------------------------


--------
    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+)



--------
    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 =  0  !

     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 =     Odour Unit * m**3/s  (vol. flux of odour compound)
           6 =     Odour Unit * m**3/min
           7 =     metric tons/yr

     Number of source-species
     combinations with variable
     emissions scaling factors
     provided below in (15c)    (NSLN1) Default: 0  !  NSLN1 =  0  !
```

```
     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 = .0 !
                                                 (in meters)

        Average building height (HBL)            No default   ! HBL = .0 !
                                                 (in meters)

        Average building width (WBL)             No default   ! WBL = .0 !
                                                 (in meters)

        Average line source width (WML)          No default   ! WML = .0 !
                                                 (in meters)

        Average separation between buildings (DXL)  No default   ! DXL = .0 !
                                                 (in meters)

        Average buoyancy parameter (FPRIMEL)     No default   ! FPRIMEL = .0 !
                                                 (in m**4/s**3)

!END!

---------------
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)
------   ----------  ----------  ---------  ----------  -------   ---------    ---------

--------

    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+)


--------
    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)
---------------

     Number of volume sources with
     parameters provided in 16b,c (NVL1)     No default  !  NVL1 =  0   !

     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 =     Odour Unit * m**3/s  (vol. flux of odour compound)
           6 =     Odour Unit * m**3/min
           7 =     metric tons/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           Y        Effect.    Base     Initial    Initial    Emission
    Coordinate  Coordinate   Height   Elevation  Sigma y    Sigma z     Rates
       (km)        (km)        (m)       (m)       (m)        (m)
    ----------  ----------   ------    ------    --------   --------   --------


--------
    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 VOLEMARB.DAT and NVL2 > 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+)



--------
    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 =  1995   !
```

```
!END!

Note - three Class I areas
Seney SENE = 173 receptors
Isle Royal ISLE = 966 receptors
Boundary Waters BOWA = 856 receptors
total number of receptors is 1995
```

ALL RECEPTOR COORDINATES FOLLOW IN INPUT FILE