On The Spatial Assessment of Forest Fire Smoke Exposure and Its Health Effects:

Part 2: CALMET Initialization Methodology

Prepared by:

Benjamin J. Burkholder
School of Occupational and Environmental Hygiene
University of British Columbia
Vancouver, BC

December 2005
Acknowledgements

The author would like to thank the following parties for their help providing initialization data and tools for the CALMET modelling:

Steve Sakiyama, Michael Rensing & Paul Willis - BC Ministry of Environment
Bryan McÉwen & Bodan Hrebenyk - SENES Consultants Ltd
Eric Myers & Cindy Munns - BC Ministry of Forests
Jennifer Hay - Environment Canada

The author would also like to acknowledge the advice and support of the other primary researchers involved in this study:

Sarah Henderson & Michael Brauer - University of British Columbia
Peter Jackson - University of Northern British Columbia
# Table of Contents

Acknowledgements ........................................................................................................ ii

Table of Contents ........................................................................................................ iii

List of Figures and Tables ............................................................................................... iv

1.0 Introduction .............................................................................................................. 1

2.0 Modelling Domain ................................................................................................... 2

3.0 Data Sources and Treatment .................................................................................. 3
   3.1 Geophysical Data ............................................................................................... 3
   3.2 Meteorological Data .......................................................................................... 5

4.0 Model Parameterization ......................................................................................... 6

5.0 Discussion ................................................................................................................ 9

Appendix A: Sample CALMET Input File .................................................................. 10
List of Figures and Tables

Figure 1  Region of Interest for Health Study ................................................................. 1

Figure 2  Modelling Domain .......................................................................................... 2

Table 1  Map Projections and Horizontal Grid Parameters ......................................... 3

Table 2  Mapping from BC to CALMET Land-Use Categories .................................... 4

Table 3  Surface Station Properties ............................................................................ 5

Table 4  CALMET Vertical Levels ................................................................................. 7

Table 5  Radius of Influence Parameters ...................................................................... 8
1.0 Introduction

During the fire season of 2003, more than 266,000 hectares of forest in British Columbia were consumed by wildfires. In comparison, only 8,581 ha burned in the province in 2002 and 76,574 ha were consumed in 1998, the latter being the worst fire season of the previous decade. Of the fires occurring in 2003, approximately 75% were in the relatively dry southern interior region of the province. While the damage these widespread fires caused to the property of individuals and the commons was well-documented, less is known about the acute health effects of exposure to the extremely high levels of particulate matter witnessed during this time period.

This report concerns a small component of a larger health study which seeks to assess the health effects of exposure to the wildfire smoke during the summer of 2003 in Southern Interior British Columbia. The study region, consisting of a population of approximately 638,800 people, is shown for reference in Figure 1.

The first stage of the health study will use the CALPUFF dispersion modelling system to arrive upon a spatially-variant estimate of exposure to particulate matter originating from wildfires in the region during the time period of interest. This document outlines the initialization of the CALMET deterministic meteorological model which will be used to provide the meteorological inputs necessary to drive CALPUFF.

---

1. BC Ministry of Forests: Forest Fire Statistics, 2004
2.0 Modelling Domain

A 325,000 km$^2$ domain was chosen to cover the study area, as well as any significant wildfires which may have impacted air quality in the communities of Southern Interior British Columbia during the fire season of 2003. The area modelled, as shown below (Figure 2), covers the majority of Southern BC, including the Kootenay, Thompson-Okanagan, and Cariboo regions of the province.

![Figure 2: Modelling Domain. CALMET land-use categories and locations of input meteorological stations outline the relative location and extent of the study domain. Primary land-use categories for the region include Forest (Green), Urban (Bright Yellow), Water (Light Blue), Rangelands (Grey-Green), and Alpine (White). The coordinate system is a custom LCC projection as defined in Table 1.](image)

A modelling grid was chosen to represent the landscape at a 1-km resolution (Table 1). Although modelling at 500 m or even 250 m resolution would have been preferable to properly resolve terrain features in an area of such complex terrain, the very large size of the study area would have made this endeavour quite computationally expensive. Furthermore, during preliminary testing, no significant improvements were seen in model winds when such higher resolutions were evoked. Finally, as the input prognostic data
was only available at 12-km resolution, it is very unlikely that a finer grid structure would have been of benefit to the modelling done for this study.

Table 1: Map Projections and Horizontal Grid Parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Map Projection</td>
<td>Lambert Conformal Conic</td>
</tr>
<tr>
<td>False Easting, Northing</td>
<td>0 km, 0km</td>
</tr>
<tr>
<td>Projection Origin</td>
<td>50.5 N, 119.0 W</td>
</tr>
<tr>
<td>Matching Parallels of Latitude</td>
<td>51.5 N, 49.5 N</td>
</tr>
<tr>
<td>Datum</td>
<td>WGS-84</td>
</tr>
<tr>
<td>Number of Grid Cells (nx,ny)</td>
<td>650, 500</td>
</tr>
<tr>
<td>SW Corner (x,y)</td>
<td>-282 km, -220 km</td>
</tr>
<tr>
<td>Grid Spacing</td>
<td>1 km</td>
</tr>
</tbody>
</table>

A locally-centered Lambert Conformal Conic projection was used to represent the region of interest. This particular projection was chosen, as advised by the model’s authors,\(^2\) to minimize any potential distortion over the relatively large 650 × 500 km area.

### 3.0 Data Sources and Treatment

#### 3.1 Geophysical Data

Both land-use and terrain elevation data are necessary to initialize the CALMET model’s geophysical file. For this study, terrain elevations were initialized with data from the Shuttle Radar Topography Mission (SRTM). This data, a preliminary product from a joint project between the US National Aeronautics and Space Administration (NASA) and the US National Geospatial-Intelligence Agency (NGA), is available at 3 arc-second (approximately 90 m) resolution for the continent of North America.\(^3\) The SRTM data was then processed by the CALPUFF terrain pre-processor TERREL over the domain of interest.

Baseline Thematic Mapping (BTM) land-use data\(^4\) was provided for this study by the British Columbia Ministry of Environment (BC MoE). The BTM data was provided in a polygonized format at a scale of 1:250 000, with a minimum polygon size of about 10 ha for most land-use categories. This data was re-projected to the LCC projection defined in Table 1, then converted to a raster grid covering the modelling domain. This information was then exported to a text format and converted into the fractional land-use format accepted by the CALMET MAKEGEO pre-processor. This conversion was accomplished by mapping the dominant BTM land-use category for each grid cell into one of the Level

\(^2\) See Earth Tech’s FAQs at [http://www.src.com/calpuff/FAQ-answers.htm#1.1.5](http://www.src.com/calpuff/FAQ-answers.htm#1.1.5)

\(^3\) Data can be obtained at [ftp://e0mss21u.eecs.nasa.gov/srtm/North_America_3arcsec/3arcsec/](ftp://e0mss21u.eecs.nasa.gov/srtm/North_America_3arcsec/3arcsec/)

\(^4\) For more information or to order this product: [http://srmwww.gov.bc.ca/dss/initiatives/ias/btm/index.htm](http://srmwww.gov.bc.ca/dss/initiatives/ias/btm/index.htm)
I (and in a few cases, Level II) US Geological Survey (USGS) land-use categories typically used in the CALMET model (Table 2).

<table>
<thead>
<tr>
<th>BC Category</th>
<th>USGS Category</th>
<th>USGS Level</th>
<th>CALMET Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agriculture</td>
<td>Agricultural Land</td>
<td>I</td>
<td>20</td>
</tr>
<tr>
<td>Residential-Agricultural Mix</td>
<td>Agricultural Land</td>
<td>I</td>
<td>20</td>
</tr>
<tr>
<td>Alpine</td>
<td>Tundra</td>
<td>I</td>
<td>80</td>
</tr>
<tr>
<td>Sub-alpine Avalanche Shoots</td>
<td>Barren Land</td>
<td>I</td>
<td>70</td>
</tr>
<tr>
<td>Recent Burn</td>
<td>Forest Land</td>
<td>I</td>
<td>40</td>
</tr>
<tr>
<td>Old Forest</td>
<td>Forest Land</td>
<td>I</td>
<td>40</td>
</tr>
<tr>
<td>Young Forest</td>
<td>Forest Land</td>
<td>I</td>
<td>40</td>
</tr>
<tr>
<td>Recently Logged</td>
<td>Rangeland</td>
<td>I</td>
<td>30</td>
</tr>
<tr>
<td>Selectively Logged</td>
<td>Forest Land</td>
<td>I</td>
<td>40</td>
</tr>
<tr>
<td>Rangeland</td>
<td>Rangeland</td>
<td>I</td>
<td>30</td>
</tr>
<tr>
<td>Mining</td>
<td>Barren Land</td>
<td>I</td>
<td>70</td>
</tr>
<tr>
<td>Recreational Activities</td>
<td>Rangeland</td>
<td>I</td>
<td>30</td>
</tr>
<tr>
<td>Barren Land</td>
<td>Barren Land</td>
<td>I</td>
<td>70</td>
</tr>
<tr>
<td>Urban</td>
<td>Urban or Built-up Land</td>
<td>I</td>
<td>10</td>
</tr>
<tr>
<td>Shrub</td>
<td>Rangeland</td>
<td>I</td>
<td>30</td>
</tr>
<tr>
<td>Glacier</td>
<td>Perennial Snow or Ice</td>
<td>I</td>
<td>90</td>
</tr>
<tr>
<td>Wetlands</td>
<td>Non-forested Wetland</td>
<td>II</td>
<td>62</td>
</tr>
<tr>
<td>Fresh Water</td>
<td>Fresh Water</td>
<td>II</td>
<td>51</td>
</tr>
<tr>
<td>Estuaries</td>
<td>Bays and Estuaries</td>
<td>II</td>
<td>54</td>
</tr>
<tr>
<td>Salt Water</td>
<td>Salt Water</td>
<td>II</td>
<td>55</td>
</tr>
</tbody>
</table>

As the BC land-use categories are generally more descriptive than most of the default CALMET categories, the approximations made in the mapping defined by Table 1 appear legitimate. Note that CALMET Codes 51, 54, and 55 all have the same default physical properties defined in the MAKEGEO namelist file. Thus, any distinction between these categories is probably not relevant to this study.

Unfortunately the coverage of the high-resolution BTM data received from the BC MoE was limited to the province of British Columbia. Therefore, another source was required to initialize the land-use data over Southern Alberta and the North-Western United States. US Geological Service (USGS) Global Land Cover Characterization Database (GLCC) data, available at 30 arc-second (approximately 1 km) resolution, was used for this purpose. The relatively lower spatial resolution of this data can be seen in Figure 2. Although the USGS land-use data was neither as accurate nor as resolved as the BTM data, as the majority of the modelling for this study concerns sources and receptors inside

---

5 Data can be obtained at: [http://edcftp.cr.usgs.gov/pub/data/glcc/na/lambert/nausgs2_0l.img.gz](http://edcftp.cr.usgs.gov/pub/data/glcc/na/lambert/nausgs2_0l.img.gz)
provincial boundaries, the use of the coarser 30 arc-second data outside British Columbia was considered reasonable.

USGS North American land-use data covering the modelled domain was converted to the same fractional land-use form as the BC BTM data. This was accomplished by the CALMET CTGPOG pre-processor. Then, all missing cells in the BTM fractional land-use file were filled with the corresponding cells from the USGS fractional land-use file to produce a ‘merged’ file of the same format. This resultant land-use was then combined with the processed terrain data in the CALMET MAKEGEO pre-processor. This, in turn, provided the geophysical file which was used to initialize the CALMET meteorological model for this study.

### 3.2 Meteorological Data

Prognostic data at approximately 12 km\(^6\) resolution was provided for use in this study by SENES Consultants Ltd. in a CALMET-ready format. This data was prepared by extracting the necessary meteorological fields from archived output of the US National Weather Service (NWS) / National Centers for Environmental Prediction (NCEP) ‘Eta’ model. This product, which has analysis fields available at 6-hour time intervals, uses a vertical coordinate system which may improve modelling over complex terrain such as that found in the study domain. Table 3 outlines all data fills of missing archived ‘Eta’ records during the time period of interest.

<table>
<thead>
<tr>
<th>Date</th>
<th>Missing Hour</th>
<th>Fill</th>
</tr>
</thead>
<tbody>
<tr>
<td>June 3</td>
<td>6 UTC</td>
<td>0 UTC</td>
</tr>
<tr>
<td>June 11</td>
<td>0 &amp; 6 UTC</td>
<td>12 UTC</td>
</tr>
<tr>
<td>July 9</td>
<td>12 UTC</td>
<td>6 UTC</td>
</tr>
<tr>
<td>July 12</td>
<td>6 UTC</td>
<td>0 UTC</td>
</tr>
<tr>
<td>July 20</td>
<td>0 UTC</td>
<td>6 UTC</td>
</tr>
<tr>
<td>Aug 27</td>
<td>0 UTC</td>
<td>6 UTC</td>
</tr>
</tbody>
</table>

Observed hourly-averaged meteorological data from surface stations during the modelling period was provided by Environment Canada (EC), the British Columbia Ministry of Forests (MoF), and the British Columbia Ministry of the Environment (MoE). The relative location of these stations across the modelled domain has previously been shown in Figure 2. While certain EC weather stations contained all fields necessary to initialize CALMET for the two-week period, the majority of stations used were either missing records for certain hours or did not monitor for some of the required input variables.

---

6 GRIB Grid ID #218: [http://www.nco.ncep.noaa.gov/pmb/docs/on388/tableb.html#GRID218](http://www.nco.ncep.noaa.gov/pmb/docs/on388/tableb.html#GRID218)
Hourly cloud and station pressure information is not recorded at MoE weather stations. Because EC wind instrumentation tends to be of a lower precision than at MoE stations, five MoE stations located sufficiently near to EC stations were initialized with the cloud and station pressure from the latter source. The omission of the EC wind data was done in these cases to avoid the dampening of the more accurate MoE signal in the interpolation of CALMET surface winds. The six remaining MoE stations used provided only wind, temperature, and relative humidity fields.

All EC stations sufficiently far from the higher-quality MoE stations were used as independent station inputs for CALMET. A total of thirteen EC stations from various locations within the modelling domain were used to help initialize both surface variables as well as cloud data. Seventy-five MoF stations were also used to help initialize surface variables in areas with neither EC nor WLAP stations nearby. These MoF stations provided additional wind, temperature, and relative humidity fields for model initialization. As these stations are often located in very remote locations and sometimes utilize less accurate wind instrumentation, wind data from these stations was investigated more carefully before use in model initialization than for MoE or EC stations.

For all ninety-nine surface stations used, short sequential missing entries were filled for select meteorological variables whenever possible. For larger data gaps, fields were marked missing and, subsequently, were not included in the data assimilation during this time period. Hours with calm wind records were labelled as ‘missing’ during the pre-processing.

### 4.0 Model Parameterization

For each day from June 1\textsuperscript{st} to Sept 30\textsuperscript{th}, a twenty-four hour CALMET simulation commencing at 0:00 PST was initialized and run over the domain of interest. While the majority of parameterizations selected for the production runs were model default values, some required more specific tailoring for this application. Appendix A contains a sample CALMET input file used to initialize one of the daily simulations. Besides the simulation date, all other input files used were identical to this one.

The model was configured to run with CALMET parameter NOOBS = 1. This mode of running CALMET uses prognostic data to create the ‘Initial guess’ wind field and provide the upper-air temperatures required for input. Then, input data from local surface stations is used to initialize most surface variables as well as model cloud cover and ceiling height. The advantage of running CALMET in this mode was made clear in the

---

7 Automated interpolation of singular missing values was done for wind-speed, relative humidity, temperature, station pressure, and cloud cover; consecutive missing values, as well as wind-direction and ceiling height, were assessed manually on an individual case-by-case basis. Note that manual data fills were only done for EC and MoE stations.

8 The ‘Initial guess’ wind field refers to the initial interpolation of winds onto the three-dimensional model grid.
initial testing: while the 12-km prognostic data allows for a higher-resolution representation of upper-level winds than do sparsely-located radiosonde stations, the addition of the surface data provides valuable localized wind information as well as actual cloud amounts for model input. See ‘Part 1: Initialization of the CALMET Meteorological Model’, for more detailed information concerning the use of the different CALMET initialization ‘modes’.

Twelve vertical levels were used to model the atmosphere up to a maximum cell face height of 5000 m (Table 4). Although emissions from forest fires may exceed this height, it was thought to be unlikely that the well-mixed particulate above the chosen maximum height would return to the ground in any significant concentration.

### Table 4: CALMET Vertical Levels

<table>
<thead>
<tr>
<th>Level</th>
<th>Height at Top (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>20</td>
</tr>
<tr>
<td>2</td>
<td>40</td>
</tr>
<tr>
<td>3</td>
<td>80</td>
</tr>
<tr>
<td>4</td>
<td>160</td>
</tr>
<tr>
<td>5</td>
<td>320</td>
</tr>
<tr>
<td>6</td>
<td>600</td>
</tr>
<tr>
<td>7</td>
<td>1000</td>
</tr>
<tr>
<td>8</td>
<td>1500</td>
</tr>
<tr>
<td>9</td>
<td>2200</td>
</tr>
<tr>
<td>10</td>
<td>3000</td>
</tr>
<tr>
<td>11</td>
<td>4000</td>
</tr>
<tr>
<td>12</td>
<td>5000</td>
</tr>
</tbody>
</table>

For all simulations, the CALMET diagnostic wind module was used. This module treats the ‘Initial guess’ wind field with processes such as divergence minimization, blocking effects of terrain, and slope-flow algorithms to form the so-called ‘Step 1’ wind field. One important model parameter which affects the action of this wind module is TERRAD, which specifies the radius of influence for terrain features. This variable was set to a value of 8 km to ensure that terrain effects would be seen up to the ridgeline for wider valleys, but would not be apparent across mountain ranges. For all other diagnostic wind module parameters, model default options were used as no clear advantage was observed during the testing of alternative configurations.

When CALMET is run with both prognostic as well as observed station data, an additional treatment of the wind field is performed following the diagnostic wind module. In brief, this involves the introduction of the observed station data into the ‘Step 1’ wind field output from the diagnostic wind module. This is accomplished by a simple inverse-distance method. Weighting factors (R1/2) as well as maximum radii of influence parameters (RMAX1/2/3) control this interpolation process (see Table 5). The result is a limited, localized effect of surface stations in the final CALMET wind field. For this study, the parameter values shown in Table 5 were chosen to allow for station influence
to dominate within the larger valley systems, and for a gradual blending of these signals into the ‘Initial Guess’ field.

Table 5: Radius of Influence Parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Definition</th>
<th>Value (km)</th>
</tr>
</thead>
<tbody>
<tr>
<td>R1</td>
<td>Distance from Surface Station at which Observation and Initial Guess Field are Equally Weighted for Surface Layer</td>
<td>8</td>
</tr>
<tr>
<td>R2</td>
<td>Same as R1, but for all Non-Surface Levels</td>
<td>8</td>
</tr>
<tr>
<td>RMAX1</td>
<td>Maximum Radius of Influence Over Land in the Surface Layer</td>
<td>25</td>
</tr>
<tr>
<td>RMAX2</td>
<td>Maximum Radius of Influence Over Land Aloft</td>
<td>25</td>
</tr>
<tr>
<td>RMAX3</td>
<td>Maximum Radius of Influence Over Water</td>
<td>25</td>
</tr>
</tbody>
</table>

The extrapolation of surface winds within CALMET allows input surface station winds to have influence in the levels aloft. When CALMET is run in the NOOBS=1 mode, this extrapolation is limited to the extent defined by model parameters R2 and RMAX2. It is important to note the model’s BIAS parameter cannot be used to control the relative weighting of the extrapolated surface and upper-air values in the final interpolation. This is an important deficiency which occurs when running CALMET in this mode; it is recommended that newer versions of CALMET allow for the use of the BIAS parameter when running the model in NOOBS=1 mode.

A ‘Power Law’ method (IEXTRP=2) was used to extrapolate surface winds into the levels aloft. Note that this is not the default parameterization for running CALMET with surface extrapolation. This alternate configuration was chosen as the default ‘Similarity Theory’ method was seen to overestimate wind speeds up to the height of the mixed layer during preliminary testing. One disadvantage seen in using the ‘Power Law’ approach is that the extrapolation effect extends all the way up to the model top. Preliminary testing showed that this behaviour, at times, could cause unrealistic upper-level wind speeds and directions aloft above surface station locations. This is another aspect of the CALMET code that could probably be improved.

Although prognostic data was used to initialize the temperature field in the levels aloft, it was decided that model level 1 temperatures should be initialized from surface station values only (ITPROG = 1). This method, while beneficial in allowing for more realistic surface temperature values, is severely limited as it does not allow the influence of this data to extend into non-surface levels. However, as the prognostic surface temperatures were often much lower than expected across the domain, this configuration was seen as the best possible option.

Precipitation data was not formatted for entry into CALMET. This information, although not required to run CALMET, is necessary if wet deposition is to be considered in the CALPUFF dispersion model. As the majority of days of interest for this study saw little precipitation, the amount of particulate removed through wet deposition would probably not have been very significant.
5.0 Discussion

As extensive investigation of CALMET output had already been conducted during the configuration and preliminary testing stages of this study, a detailed analysis of the modelling results was not conducted. However, for select days, output meteorological fields were investigated to get a sense of the overall run quality.

Besides the erroneous prognostic temperatures, as discussed in ‘Part 1: Initialization of the CALMET Meteorological Model’, the only potential problem worth mentioning concerns the extrapolation of surface winds. While the ‘Power Law’ method was seen as favourable to the ‘Similarity Theory’ approach in preliminary testing, the extension of surface wind influence to the model top in the former method may have an important effect on the directionality of dispersion in CALPUFF. As the prognostic data probably more accurately depicts upper-level flow than do extrapolated winds (often from valley bottoms), and as wildfire smoke plumes will have a very high associated buoyancy, it may, in certain instances, actually be more desirable to not use surface wind extrapolation. Note, however, that this would mean surface station winds would effectively play no role in plume advection; this would clearly not be advantageous in many situations either.

Validation and comparison of CALPUFF output with data from PM$_{10}$ monitors within the study domain as well as satellite imagery will provide valuable information concerning the relative accuracy of the CALMET fields produced for this study. At this point, if it is seen as necessary, CALMET could easily be re-parameterized to try to deal any deficiencies in output. However, without additional input data, it is highly unlikely that any clear improvements will be seen in the modelling results.
Appendix A: Sample CALMET Input File

------------- FILE STARTS ON NEXT LINE ------------------------------------------
production

------------- 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=C:\BENJAMIN\CALMET\PROD\INPUT\GEO.DAT       !
SURF.DAT      input    ! SRFDAT=C:\BENJAMIN\CALMET\PROD\INPUT\SURF.DAT      !
CLOUD.DAT     input    * CLDDAT=            *
PRECIP.DAT    input    * PRCDAT=            *
MH4.DAT       input    ! MH4DAT=C:\BENJAMIN\CALMET\PROD\INPUT\M3D.DAT     !
WT.DAT        input    * WTDAT=             *
CALMET.LST    output   ! METLST=CALMET.LST     !
CALMET.DAT    output   ! METDAT=CALMET.DAT    !
PACOUT.DAT    output   * PACDAT=            *

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

NUMBER OF UPPER AIR & OVERWATER STATIONS:
Number of upper air stations (NUSTA)  No default     ! NUSTA =  0  !
Number of overwater met stations      (NOWSTA) No default     ! NOWSTA =  0  !

!END!

Subgroup (b)
-------------
Upper air files (one per station)
---------------------------------
Default Name  Type          File Name
-------------  ----          ---------

Subgroup (c)
-------------
Overwater station files (one per station)
-----------------------------------------
Default Name  Type          File Name
-------------  ----          ---------

Subgroup (d)
-------------
Other file names
--------------

Default Name  Type          File Name
-------------  ----          --------
CALMET Initialization Methodology

----------- ---- -----------
| 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=  2003  !
Month (IBMO) -- No default       ! IBMO=  9  !
Day (IBDY) -- No default       ! IBDY=  1  !
Hour (IBHR) -- No default       ! IBHR=  0  !
Base time zone        (IBTZ) -- No default       ! IBTZ=  8  !
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

!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 = 50.5N !
(RLON0) No Default ! RLON0 = 119W !

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 = 51.5N !
(XLAT2) No Default ! XLAT2 = 49.5N !

LCC : Projection cone slices through Earth's surface at XLAT1 and XLAT2
PS : Projection plane slices through Earth at XLAT1
(XLAT2 is not used)

Datum-region

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)
NA-C    NORTH AMERICAN 1927 Clarke 1866 Spheroid, MEAN FOR CONUS (NAD27)
NAR-C    NORTH AMERICAN 1983 GRS 80 Spheroid, MEAN FOR CONUS (NAD83)
NWS-84    NWS 6370KM Radius, Sphere
ESR-S    ESRI REFERENCE 6371KM Radius, Sphere

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

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 = 650  !
No. Y grid cells (NY)  No default   ! NY = 500  !
Grid spacing (DGRIDKM) No default   ! DGRIDKM = 1.  !
  Units: km

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

X coordinate (XORIGKM)  No default   ! XORIGKM = -282.000  !
Y coordinate (YORIGKM)  No default   ! YORIGKM = -220.000  !
  Units: km

Vertical grid definition:

No. of vertical layers (NZ)  No default   ! NZ = 12  !
Cell face heights in arbitrary
vertical grid (ZFACE(NZ+1))  No defaults
  Units: m

! ZFACE = 0.,20.,40.,80.,160.,320.,600.,1000.,1500.,2200.,3000.,4000.,5000.  !

!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 = F  !
CALMET Initialization Methodology

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 (IUVOU(NZ)) -- NOTE: NZ values must be entered
(0=Do not print, 1=Print)
(used only if LPRINT=T)     Defaults: NZ*0
! IUVOU = 0, 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 -- 12 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, 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, 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 = 1 !
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 = 99 !
Number of precipitation stations
CALMET Initialization Methodology

(NPSTA=-1: flag for use of MM5 precip data)
(NPSTA) No default ! NPSTA = 0 !

CLOUD DATA OPTIONS
Gridded cloud fields:
(ICLOUD) Default: 0 ! ICL O U D = 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 = 2 !
(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 !
CALMET Initialization Methodology

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 = -1, -1, -1, -1, -.5,  0, .5,  1,  1,  1,  1

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 MM5.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 = 6 !

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 = 25. ! Units: km

Maximum radius of influence over land aloft (RMAX2) No default ! RMAX2 = 25. ! Units: km

Maximum radius of influence over water (RMAX3) No default ! RMAX3 = 25. ! 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 = 8. ! Units: km

Relative weighting of the first guess field and observations in the SURFACE layer (R1) No default ! R1 = 8. !
CALMET Initialization Methodology

(R1 is the distance from an 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) (R2 is applied in the upper layers in the same manner as R1 is used in the surface layer).

Relative weighting parameter of the prognostic wind field data (RPROG) (Used only if IPROG = 1)

Maximum acceptable divergence in the divergence minimization procedure (DIVLIM)

Maximum number of iterations in the divergence min. procedure (NITER)

Number of passes in the smoothing procedure (NSMTH(NZ))

NOTE: NZ values must be entered

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

Critical Froude number (CRITFN)

Empirical factor controlling the influence of kinematic effects (ALPHA)

Multiplicative scaling factor for extrapolation of surface observations to upper layers (FEXTR2(NZ))

(Used only if IEXTRP = 3 or -3)

BARRIER INFORMATION

Number of barriers to interpolation of the wind fields (NBAR)

NOTE: NBAR values must be entered for each variable

X coordinate of BEGINNING of each barrier (XBBAR(NBAR))

Y coordinate of BEGINNING of each barrier (YBBAR(NBAR))

X coordinate of ENDING of each barrier (XEBAR(NBAR))

Y coordinate of ENDING of each barrier (YEBAR(NBAR))
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 = 0 !
(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 from 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 (ZUUPWND(1), ZUUPWND(2)) Defaults: 1., 1000. ! ZUUPWND= 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  
(CONSN)  Default: 2400.  ! CONSN = 2400. !

Overwater mixing ht. equation  
(CONSTW)  Default: 0.16  ! CONSTW = 0.16 !

Absolute value of Coriolis parameter (FCORIOL)  
Default: 1.0E-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
CALMET Initialization Methodology

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)

OTHER MIXING HEIGHT VARIABLES

Minimum potential temperature lapse rate in the stable layer above the current convective mixing ht. (DPTMIN)                  Default: 0.001 ! DPTMIN = 0.001 !
                                        Units: deg. K/m
Depth of layer above current conv. mixing height through which lapse rate is computed (DZZI)                  Default: 200. ! DZZI = 200. !
                                        Units: meters
Minimum overland mixing height (ZMIN)                                Default: 50. ! ZMIN = 50. !
                                        Units: meters
Maximum overland mixing height (ZMAX)                                Default: 3000. ! ZMAX = 3000. !
                                        Units: meters
Minimum overwater mixing height (ZMINW) -- (Not used if observed overwater mixing hts. are used)     Default: 50. ! ZMINW = 50. !
                                        Units: meters
Maximum overwater mixing height (ZMAXW) -- (Not used if observed overwater mixing hts. are used)     Default: 3000. ! ZMAXW = 3000. !
                                        Units: meters

TEMPERATURE PARAMETERS

3D temperature from observations or from prognostic data? (ITPROG)       Default: 0 !ITPROG = 1 !
   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 = 10 !

Conduct spatial averaging of temperatures (IAVET) (0-no, 1=yes)           Default: 1 ! IAVET = 1 !
   (will use mixing ht MNMDAV,HAFANG so make sure they are correct)

Default temperature gradient below the mixing height over water (K/m) (TGDEFB) Default: -.0098 ! TGDEFB = -0.0098 !

Default temperature gradient above the mixing height over water (K/m) (TGDEFA) Default: -.0045 ! TGDEFA = -0.0045 !

Beginning (JWAT1) and ending (JWAT2) land use categories for temperature        ! JWAT1 = 999 !
interpolation over water -- Make                        ! JWAT2 = 999 !
bigger than largest land use to disable

**PRECIP INTERPOLATION PARAMETERS**

- **Method of interpolation (NFLAGP)**: Default = 2  
  
  - 1 = \(1/R\), 2 = \(1/R^2\), 3 = EXP/R^2

- **Radius of Influence (km) (SIGMAP)**: Default = 100.0  
  
  - 0.0 => use half dist. btwn nearest stns w & w/out precip when NFLAGP = 3

- **Minimum Precip. Rate Cutoff (mm/hr)**: Default = 0.01

\[ \text{(values < CUTP = 0.0 mm/hr)} \]

!END!

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

---

**SURFACE STATION VARIABLES**

(One record per station -- 99 records in all)

<table>
<thead>
<tr>
<th></th>
<th>Name</th>
<th>ID</th>
<th>X coord. (km)</th>
<th>Y coord. (km)</th>
<th>Time zone</th>
<th>Anem. Ht. (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>!</td>
<td>SS1</td>
<td>KELP</td>
<td>-34.148</td>
<td>-70.625</td>
<td>8</td>
<td>10</td>
</tr>
<tr>
<td>!</td>
<td>SS2</td>
<td>KAMP</td>
<td>-98.752</td>
<td>22.952</td>
<td>8</td>
<td>10</td>
</tr>
<tr>
<td>!</td>
<td>SS3</td>
<td>CSTP</td>
<td>93.107</td>
<td>-128.989</td>
<td>8</td>
<td>10</td>
</tr>
<tr>
<td>!</td>
<td>SS4</td>
<td>GOLP</td>
<td>141.428</td>
<td>90.473</td>
<td>8</td>
<td>10</td>
</tr>
<tr>
<td>!</td>
<td>SS5</td>
<td>REV</td>
<td>1.966</td>
<td>54.168</td>
<td>8</td>
<td>10</td>
</tr>
<tr>
<td>!</td>
<td>SS6</td>
<td>SKOW</td>
<td>233.991</td>
<td>-68.609</td>
<td>8</td>
<td>10</td>
</tr>
<tr>
<td>!</td>
<td>SS7</td>
<td>TRAW</td>
<td>101.741</td>
<td>-155.198</td>
<td>8</td>
<td>10</td>
</tr>
<tr>
<td>!</td>
<td>SS8</td>
<td>TCGW</td>
<td>101.848</td>
<td>-160.869</td>
<td>8</td>
<td>10</td>
</tr>
<tr>
<td>!</td>
<td>SS9</td>
<td>OHMW</td>
<td>-163.657</td>
<td>130.867</td>
<td>8</td>
<td>10</td>
</tr>
<tr>
<td>!</td>
<td>SS10</td>
<td>WLGW</td>
<td>-219.148</td>
<td>190.187</td>
<td>8</td>
<td>10</td>
</tr>
<tr>
<td>!</td>
<td>SS11</td>
<td>WLKW</td>
<td>-214.394</td>
<td>185.974</td>
<td>8</td>
<td>10</td>
</tr>
<tr>
<td>!</td>
<td>SS12</td>
<td>OSYE</td>
<td>-31.668</td>
<td>-163.067</td>
<td>8</td>
<td>10</td>
</tr>
<tr>
<td>!</td>
<td>SS13</td>
<td>PENE</td>
<td>-43.640</td>
<td>-115.156</td>
<td>8</td>
<td>10</td>
</tr>
<tr>
<td>!</td>
<td>SS14</td>
<td>SUME</td>
<td>-47.018</td>
<td>-103.560</td>
<td>8</td>
<td>10</td>
</tr>
<tr>
<td>!</td>
<td>SS15</td>
<td>CRNE</td>
<td>232.426</td>
<td>-93.948</td>
<td>8</td>
<td>10</td>
</tr>
<tr>
<td>!</td>
<td>SS16</td>
<td>CRSE</td>
<td>182.619</td>
<td>-154.523</td>
<td>8</td>
<td>10</td>
</tr>
<tr>
<td>!</td>
<td>SS17</td>
<td>NAKE</td>
<td>84.330</td>
<td>-25.242</td>
<td>8</td>
<td>10</td>
</tr>
<tr>
<td>!</td>
<td>SS18</td>
<td>PRNE</td>
<td>-109.589</td>
<td>-133.661</td>
<td>8</td>
<td>10</td>
</tr>
<tr>
<td>!</td>
<td>SS19</td>
<td>SNAE</td>
<td>-19.991</td>
<td>22.283</td>
<td>8</td>
<td>10</td>
</tr>
<tr>
<td>!</td>
<td>SS20</td>
<td>VANE</td>
<td>-13.771</td>
<td>-30.679</td>
<td>8</td>
<td>10</td>
</tr>
<tr>
<td>!</td>
<td>SS21</td>
<td>LYTE</td>
<td>-184.194</td>
<td>-27.494</td>
<td>8</td>
<td>10</td>
</tr>
<tr>
<td>!</td>
<td>SS22</td>
<td>YOHE</td>
<td>184.621</td>
<td>108.198</td>
<td>8</td>
<td>10</td>
</tr>
<tr>
<td>!</td>
<td>SS23</td>
<td>BLRE</td>
<td>-19.864</td>
<td>181.269</td>
<td>8</td>
<td>10</td>
</tr>
<tr>
<td>!</td>
<td>SS24</td>
<td>CLNE</td>
<td>171.818</td>
<td>186.472</td>
<td>8</td>
<td>10</td>
</tr>
<tr>
<td>!</td>
<td>SS25</td>
<td>HGCF</td>
<td>-180.967</td>
<td>-122.751</td>
<td>8</td>
<td>10</td>
</tr>
<tr>
<td>!</td>
<td>SS26</td>
<td>VALF</td>
<td>-21.252</td>
<td>254.650</td>
<td>8</td>
<td>10</td>
</tr>
<tr>
<td>!</td>
<td>SS27</td>
<td>TONF</td>
<td>35.841</td>
<td>245.223</td>
<td>8</td>
<td>10</td>
</tr>
<tr>
<td>!</td>
<td>SS28</td>
<td>RCKF</td>
<td>-241.227</td>
<td>168.125</td>
<td>8</td>
<td>10</td>
</tr>
<tr>
<td>!</td>
<td>SS29</td>
<td>GSFP</td>
<td>-254.432</td>
<td>112.138</td>
<td>8</td>
<td>10</td>
</tr>
<tr>
<td>!</td>
<td>SS30</td>
<td>GVNF</td>
<td>-186.357</td>
<td>222.628</td>
<td>8</td>
<td>10</td>
</tr>
<tr>
<td>!</td>
<td>SS31</td>
<td>HHHF</td>
<td>-163.418</td>
<td>206.240</td>
<td>8</td>
<td>10</td>
</tr>
<tr>
<td>!</td>
<td>SS32</td>
<td>CSLF</td>
<td>-96.048</td>
<td>137.170</td>
<td>8</td>
<td>10</td>
</tr>
<tr>
<td>!</td>
<td>SS33</td>
<td>TIMF</td>
<td>-164.386</td>
<td>159.836</td>
<td>8</td>
<td>10</td>
</tr>
<tr>
<td>!</td>
<td>SS34</td>
<td>YGLF</td>
<td>-139.482</td>
<td>83.943</td>
<td>8</td>
<td>10</td>
</tr>
<tr>
<td>!</td>
<td>SS35</td>
<td>MDLF</td>
<td>-189.116</td>
<td>100.790</td>
<td>8</td>
<td>10</td>
</tr>
<tr>
<td>!</td>
<td>SS36</td>
<td>EBRF</td>
<td>-61.550</td>
<td>84.157</td>
<td>8</td>
<td>10</td>
</tr>
<tr>
<td>!</td>
<td>SS37</td>
<td>WMTF</td>
<td>-114.147</td>
<td>131.420</td>
<td>8</td>
<td>10</td>
</tr>
<tr>
<td>!</td>
<td>SS38</td>
<td>DCPF</td>
<td>-110.526</td>
<td>164.398</td>
<td>8</td>
<td>10</td>
</tr>
<tr>
<td>!</td>
<td>SS39</td>
<td>CTLF</td>
<td>-58.979</td>
<td>43.522</td>
<td>8</td>
<td>10</td>
</tr>
<tr>
<td>!</td>
<td>SS40</td>
<td>WGYF</td>
<td>-84.763</td>
<td>205.615</td>
<td>8</td>
<td>10</td>
</tr>
<tr>
<td>Four character string for station name</td>
<td>Five digit integer for station ID</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>----------------------------------------</td>
<td>----------------------------------</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SS41 = 'BRYF'</td>
<td>267</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SS42 = 'GOSF'</td>
<td>270</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SS43 = 'GDHF'</td>
<td>272</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SS44 = 'TYNF'</td>
<td>279</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SS45 = 'BTNIF'</td>
<td>281</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SS46 = 'BMNF'</td>
<td>283</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SS47 = 'TRTF'</td>
<td>286</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SS48 = 'MRTF'</td>
<td>294</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SS49 = 'FNF'</td>
<td>298</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SS50 = 'APGF'</td>
<td>302</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SS51 = 'FRBF'</td>
<td>306</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SS52 = 'MCLF'</td>
<td>311</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SS53 = 'GSNF'</td>
<td>321</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SS54 = 'BBRF'</td>
<td>324</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SS55 = 'SNRF'</td>
<td>325</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SS56 = 'PPRF'</td>
<td>326</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SS57 = 'ASNF'</td>
<td>331</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SS58 = 'DMYF'</td>
<td>334</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SS59 = 'HDF'</td>
<td>343</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SS60 = 'SMAF'</td>
<td>344</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SS61 = 'WNTF'</td>
<td>345</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SS62 = 'TLAF'</td>
<td>350</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SS63 = 'CWCIF'</td>
<td>352</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SS64 = 'GSRF'</td>
<td>355</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SS65 = 'TRCF'</td>
<td>361</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SS66 = 'MRLF'</td>
<td>362</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SS67 = 'WSIF'</td>
<td>366</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SS68 = 'MRIF'</td>
<td>367</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SS69 = 'SCCF'</td>
<td>374</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SS70 = 'PDCF'</td>
<td>380</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SS71 = 'FLCF'</td>
<td>383</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SS72 = 'HWSF'</td>
<td>384</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SS73 = 'DUNF'</td>
<td>385</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SS74 = 'TRLF'</td>
<td>387</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SS75 = 'KETF'</td>
<td>388</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SS76 = 'BVDF'</td>
<td>390</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SS77 = 'EMLF'</td>
<td>391</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SS78 = 'GFIF'</td>
<td>392</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SS79 = 'NCLF'</td>
<td>393</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SS80 = 'OPKF'</td>
<td>396</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SS81 = 'SMWF'</td>
<td>404</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SS82 = 'SLIF'</td>
<td>406</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SS83 = 'NYGF'</td>
<td>407</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SS84 = 'NRNF'</td>
<td>408</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SS85 = 'PLSF'</td>
<td>411</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SS86 = 'ELIF'</td>
<td>412</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SS87 = 'TBIF'</td>
<td>417</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SS88 = 'PHDF'</td>
<td>418</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SS89 = 'DWCIF'</td>
<td>421</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SS90 = 'BLIF'</td>
<td>422</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SS91 = 'BKHF'</td>
<td>423</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SS92 = 'EMCF'</td>
<td>425</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SS93 = 'JFIF'</td>
<td>427</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SS94 = 'PRPF'</td>
<td>435</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SS95 = 'NGCF'</td>
<td>438</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SS96 = 'MRVF'</td>
<td>452</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SS97 = 'CRLF'</td>
<td>453</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SS98 = 'CSCF'</td>
<td>454</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SS99 = 'CRCF'</td>
<td>455</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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

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

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!

LAST LINE OF FILE PRECEDES THIS ONE