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## ***User's Manual: CALMET-2-netCDF Tool***

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# 1 Introduction

This manual describes how to build and/or install, and then use the CALMET2netCDF program..

CALMET2netCDF, which is written in Fortran 90 (f90) and C, allows users to convert multivariate gridded environmental datasets created by the CALMET meteorological model into netCDF format. These new files can then be visualized using the Visualization Environment for Rich Data Interpretation (VERDI). CALMET produces files of gridded meteorology and land use fields that users need to visualize and compare with observational data both spatially and temporally. CALMET2netCDF can facilitate these types of analyses.

The initial prototype of CALMET2netCDF was created by the United States Forest Service AirFire team of the Forest Service Pacific Northwest Laboratory as part of the BlueSky system. The prototype was modified by the U.S. Environmental Protection Agency (EPA) to work with more recent versions of CALPUFF modeling systems and provided to UNC. As part of Work Assignment 4-06 of EPA Contract EP-D-07-102, UNC streamlined the code, made it modular, and ported it to the Windows and Linux operating systems. The CALMET2netCDF program uses the EPA-AREAL/MCNC-EnvPgms/BAMS Models-3 I/O Applications Programming Interface (I/O API) (©1992-2002 MCNC and Carlie J. Coats, Jr., and 2003-2006 Baron Advanced Meteorological Systems, LLC), which is built on top of the netCDF I/O library (©1993,1996 University Corporation for Atmospheric Research/Unidata Program) and released under the GNU LGPL License, version 2.1. See <http://www.baronams.com/products/ioapi/LGPL.txt> for conditions of use for the I/O API.

This guide describes CALMET2netCDF version 1.0, which was released in February 2011.

## 2 The Pre-compiled Windows Binary of CALMET2netCDF

### 2.1 Linux

Given the variability in linux based operating systems and computing environments the use of a pre-compiled Linux executable is not recommended. Users should build the Linux executable of CALMET2netCDF.

### 2.2 Windows

A precompiled Windows version of the CALMET2netCDF executable is provided in the exe directory (inside the CALMET2netCDF release tar file). There are no prerequisites to installing and using the precompiled binary on x86 and x86\_64 versions of Windows.

To install, move the executable to wherever you wish to run it.

(Skip the sections on building the program, skipping to the “Starting CALMET2netCDF” section.)

## 3 Building CALMET2netCDF

### 3.1 Linux

#### 3.1.1 Requirements

CALMET2netCDF is distributed as a gzipped tar file that contains the f90 source code.

In addition to this source code, Building CALMET2netCDF on Linux will require

- netCDF C/C++/Fortran
  - Version 3.6.3 or Version 4.1.1:  
[http://www.unidata.ucar.edu/downloads/netcdf/netcdf-3\\_6\\_3/index.jsp](http://www.unidata.ucar.edu/downloads/netcdf/netcdf-3_6_3/index.jsp)
- I/O API v3.1

The Build Instructions in the next section will discuss how to obtain them.

#### 3.1.2 Linux Build Process

Words in **Courier bold** below are actual Linux commands to use.

1. **tar -xvf calmet2netCDF.tar.gz** into the location where you would like to install CALMET2netcdf.
2. Download netCDF from NCAR as a gzipped tar file.
  - a. [http://www.unidata.ucar.edu/downloads/netcdf/netcdf-3\\_6\\_3/index.jsp](http://www.unidata.ucar.edu/downloads/netcdf/netcdf-3_6_3/index.jsp)
  - b. **tar xzvf netcdf-3.6.3.tar.gz**
3. Install netCDF.
  - a. Choose which compiler to use—either the Intel or Portland group compiler. It is important to use a consistent set of compilers and flags for the netCDF, I/O API and CALMET2netCDF builds. Review the compiler options used in the CALMET2netCDF/src/make.inc.
  - b. Read the INSTALL file that is provided under the netcdf-3.6.3 directory for instructions on how to set the environment variables. Review the suggested environment variable settings available on the following website:  
[http://www.unidata.ucar.edu/software/netcdf/docs/other-builds.html#aix\\_4\\_1\\_1](http://www.unidata.ucar.edu/software/netcdf/docs/other-builds.html#aix_4_1_1)
  - c. If compiling using the ifort (Intel) compiler, create a file called comp.opt.ifort that contains the environment variables. Example: `'setenv FC ifort'`, then source this file using the command `'source comp.opt.ifort'`
  - d. If compiling using the Portland Group Compiler, create a file called comp.opt.pg90 that contains the environment variables, then source this file using `'source`

- `comp.opt.pg90`'. Check to see that the environment variables were set using the `'env'` command.
- e. Run `./configure --disable-cxx --prefix=/somepath` (to control where the netCDF library gets installed).
  - f. Run `make`
  - g. Run `make install`
4. Download and install I/O API.
- a. Download and install per directions:  
<http://www.baronams.com/products/ioapi/AVAIL.html#v30>
  - b. Two notes on installation:
    - (1) The user needs to modify `tools/Makefile.nocpl` to point to his/her base directory, as it does not automatically get modified.
    - (2) `'make'` might lose its place during the install. If it does, try running `'make'` a second time.
5. Build CALMET2netCDF.
- a. Modify `src/make.inc` to specify the locations of the f90 and C compilers and the netCDF and I/O API libraries for your system. Both compiler combinations—`ifort` and `icc` compilers, and the `pg90` and `pgcc` compilers—were used in preparing this manual. Comment out all F90, FFLAGS, and LIB settings other than the one that you are using.  
Run `'make'`.

This should produce the Linux executable.

## 3.2 Windows

### 3.2.1 Requirements

To build CALMET2netCDF under Windows, you will need a web connection, and some extra privileges on the machine.

- The extra privileges are needed because you will need the right to install software and you will need access to the root folder on the machine. *(If you do not have these rights, it is still possible to install. However, problems that come up may be beyond the scope of this manual.)*
- You need web access to successfully install the MinW / MSYS environment, with the compilers and build tools. Also you need web access to download from the SCRAM site. No provision is given for a standalone build.

### 3.2.2 Preparation (done in Windows)

3.2.2.1 Download the CALMET2netCDF tarball, and the CALMET2netCDF\_Libraries tarball, from [http://www.epa.gov/ttn/scram/dispersion\\_related.htm](http://www.epa.gov/ttn/scram/dispersion_related.htm) .

The first contains CALMET2netCDF, distributed as a gzipped tar file that contains the f90 source code for both the Linux and Windows operating systems.

The second, the “\_Libraries” tarball, has the extra software needed to do the build on Windows.

*(WARNING: If one disregards these instructions and downloads a version of MinGW / MSYS newer than the 20111130 version, please note that the next release, 20120424, contained a flaw that prevented it from being useful here. It fails to install a C compiler. If possible, obtain the 20111118 version.)*

3.2.2.2 Add C:\MinGW\bin to the end of the Windows user PATH environment variable.

Edit path using semicolon (;) to separate paths.

How, depending on the version of Windows:

- a. Windows 95: Right click My Computer > Properties > Advanced tab > Environment Variables > User
- b. Windows XP: Click on Start Button > Settings > Control Panel > System > Advanced > Environment Variables > User
- c. Windows Vista: Click on Start Button > right click on Computer > Advanced System Settings > Environment Variables > User
- d. Win7: (With User Account Control in Win7, the "Advanced System Settings" screen cannot be opened without the "Administrator" password.) Click on Start Button > Control Panel > System > Advanced System Settings > Advanced tab > Environment Variables > User

*(Note: Only a user with Administrator privilege is able to edit the "System" PATH variable; however, a Standard User can create and edit the "User" PATH variable, which is appended to the PATH when the user is running the machine.)*

### 3.2.3 Build Process

#### 3.2.3.1 MinGW (Minimalist GNU for Windows)

##### 3.2.3.1.1 Install MSYS and MinGW (Minimalist GNU for Windows)

In the "CALMET2netCDF\_Libraries" tarball from the EPA SCRAM website, one will find the MinGW installer that was used to build the code at EPA. One can run the program directly from the tarball.

- a. Run program “mingw-get0inst-20111118.exe” by clicking on it twice.

- b. When asked if you can trust it, click to allow it to run.
- c. Closing other applications, including Winzip, while running this, is a good idea, but not always necessary.
- d. When told about how it will install shortcuts, click "OK".
- e. When asked about "prepackaged repository catalogues", select "use prepackaged repository catalogues".
- f. Accept the agreement when it is presented to you.
- g. When the program asks where the installation is to be installed, accept the default of "C:\MinGW". This screen also suggests that you should check the "Free Disk Space". If you actually have less than that amount of free disk space ( 1.7 MB ) on your computer, then stop. Otherwise, click "Next".
- h. When the "Start Menu" page appears, accept it and continue.
- i. When the package selection page (named "Select Components") appears, make sure the default C compiler is selected.
- j. Then add in the following:
  - i. C++ compiler
  - ii. Fortran compiler
  - iii. MSYS basic system
  - iv. MinGW Developer ToolkitThen click "Next".
- k. At this point, the "Ready to Install" box comes up for confirmation. If anything is wrong, use the "<Back" button to correct it. There should be seven items listed under "Installing", and it should say "Using pre-packaged repository catalogues (20111118)".
- l. The installation process takes a little while, using the internet connection to fetch software over the net.
- m. When the "Finished" screen comes up, uncheck the "Show Log" checkbox and then click "Finish".

After MinGW and MSYS are installed, you will find that your start menu has the program folder "MinGW", and inside "MinGW" is the item "MinGW Shell". That item opens MSYS's bash shell.

### ***3.2.3.1.2 Notes on using the MSYS bash shell***

After MinGW and MSYS are installed, you will find that your start menu has the program folder "MinGW", and inside "MinGW" is the item "MinGW Shell".

Select "MinGW Shell" to perform rest of the steps. This will behave like a Unix "*bash*" shell. When it opens, you will see a new window, with a flashing cursor at a dollar sign.

This is like a Unix command prompt; if you give the Unix command '`exit`', the window will close.

Enter the MSYS shell again. Note that there is a command history, which can be used with the up and down arrows. Commands entered can be edited with left and right arrows and the delete key. The TAB key may provide auto-completion for commands and/or filenames.

If you give the Unix command `'pwd'`, then it will print the name of your location with a Unix-like path, with forward slashes, as in `"/home/${username}"` (where 'username' is the name you have for the user that installed MinGW and MSYS.)

Navigating through the file system is very much like doing so in Windows. For instance, if you enter `cd ..` and then enter `pwd`, then you will find that you have moved up one folder to `"/home"`. If you do that again, you will be at the folder named `"/`, the top of that tree.

To move down into a folder, use the folder's name, almost exactly as in Windows. If you are at `"/` and you enter `"cd home"` and enter `"pwd"`, you will see that you are in `"/home"`.

You also can move to any of the Windows drives if you wish. So you can enter `"cd /c/"` and then enter `"pwd"` to move to the Windows folder `"c:\"`. To get to your MinGW installation, enter `"cd /c/MinGW"` (or the name you used) and type `"pwd"` to see that you are there.

However, spaces have to have a backslash in front of them. Your "My Documents" directory would be reached with `"cd /c/Documents\ and\ Settings\tbaker02/My\ Documents/"`. (If you found that the TAB key did give auto-completion, then it will make entering such paths go much faster.)

There are two names for the top of the MSYS tree. To get there, you can enter `"cd /"`, or you can enter `"cd /c/MinGW/msys/1.0"`. You must use this information for the next few steps.

### ***3.2.3.1.3 Final Installation Step: mount folder.***

Go to the MSYS prompt, and enter the following commands:

`cd /postinstall` (and press enter)

`. pi.sh` (and press enter)

Answer `"y"` (and press enter)

Answer `"y"` (and press enter)

Answer `"c:/MinGW"` (and press enter)

Confirm with `"y"` (and press enter)



### 3.2.3.2 netCDF

#### 3.2.3.2.1 Setup (in MSYS) before installing netCDF.

( Items in **Courier bold** are actual commands to use.)

1. Since you are about to install netCDF and the CALMET2netCDF converter, make a subfolder. Go to your home folder and type “mkdir CALMET2NETCDF” and press enter.
2. Instead of editing this file, an edited version named **.profile** can be copied from the **docs** folder of the "CALMET2NETCDF\_Libraries" tarball, and this step can be skipped. But if you want to edit it yourself, follow these steps.
  - a. Define a variable for this location as **\$CALMET2NETCDFHOME**. To do that, it should be in the file ‘.profile’ in the home directory.
  - b. Prove that there is no such variable already with the command “**set | grep -i CALMET**”. You should not see ‘**CALMET2NETCDFHOME**’ in that output.
  - c. () Click “Start”, then “Run...”. Type in “wordpad” and click “OK”. The Wordpad editor will open. Create or edit the file “**C:\MinGW\msys\1.0\home\\${username}\profile.txt**” (where ‘username’ is the name you have for the user that installed MinGW and MSYS). In Wordpad, enter any letter, and then use the menu item “Save As” in the “File” menu. You should set the option “save as type” to the value “Text Document - MS-DOS Format”.
  - d. Save it with “File Name” set to “profile.txt” and in the folder “**C:\MinGW\msys\1.0\home\\${username}**”.
  - e. Once the file has been saved, edit the contents to match these lines, using whatever path you had decided upon for your “installation folder”.
    - i. **CALMET2NETCDFHOME=/c/CALMET2NETCDF**
    - ii. **export CALMET2NETCDFHOME**
  - f. Save the file one more time.
  - g. Back in the MSYS window, in your home directory, if you enter the command “cat profile.txt”, then you should see the text just entered, two lines, the first being “**CALMET2NETCDFHOME=/c/CALMET2NETCDF**” and the second being “**export CALMET2NETCDFHOME**”.
  - h. Now copy that file to a new file “**.profile**” with the command “**cat profile.txt > .profile**”. (This will overwrite any such preexisting file.) To answer a few things you may be wondering: there is a period at the beginning of the file name. There is no extension at the end of the file name, that is, no period plus three letters. This file has to be in the “home directory” discussed earlier, “/home/\${username}”.
3. Exit from the MSYS shell with the ‘**exit**’ command, and then open the MSYS shell again from the Start Menu.

Enter the command ‘**echo \$CALMET2NETCDFHOME**’. (You can type “echo \$CAL(tab)”). You should see the path of your “installation directory”, looking just like in the first line in the file you typed in.

This means we can refer to your “installation directory” as `$CALMET2NETCDFHOME` from now on.

### 3.2.3.2.2 Install netCDF.

The "CALMET2NETCDF\_Libraries" distribution from the EPA SCRAM website also has the “netcdf” tarball: `netcdf-4.1.1.tar.gz`.

**Warning:** You will be extracting files from tarballs. Please do so with the `tar` command, as shown, which will create LF line endings. If you use a Windows extractor, like WinZip, you will create CRLF line endings, breaking the scripts and programs that you will need. (However, the “`d2u`” command can fix that.)

1. Move the gzipped, netcdf tarfile, into the `$CALMET2NETCDFHOME` directory.
2. Unpack the file: `tar zxvf netcdf-4.1.1.tar.gz`
3. Change into untarred directory: `cd netcdf-4.1.1`
4. Run Configure (do not use `netcdf4`, as that would require HDF5 libraries)  
`./configure --prefix=/mingw --disable-netcdf-4`
5. Build netCDF: `make`
6. Install netCDF: `make install`
7. Check install:
  - a. `nc-config --all > nc_config.log`
  - b. `cat nc_config.log` and look for the options that were used to build the netCDF library, `fc` → `gfortran`, etc.

At this point, netCDF is installed.

### 3.2.3.3 I/O API 3.0

#### 3.2.3.3.1 Prepare to Install

1. Set `$IOAPI` as an environment variable. Use the following method. (Not necessary if you used the `.profile` file from the `docs` folder of the "CALMET2NETCDF\_Libraries" tarball.)
  - a. Open the MSYS shell again, and go to your home directory (“`/home/${username}`”). Use the command “`cd`”, that is just the two letter command, and you will be taken to the home directory.
  - b. Copy the `.profile` file to the `profile.txt` file we opened earlier, replacing it, with the command “`cat .profile > profile.txt`”.
  - c. Open the file `profile.txt` with the Wordpad editor, and ADD TO the contents to now include as follows (if you have made any changes to `.profile`, you won’t want to lose them):
    - i. `CALMET2NETCDFHOME=/c/CALMET2NETCDF`

- ii. **export CALMET2NETCDFHOME**
- iii. **IOAPI=\$CALMET2NETCDFHOME/ioapi-30/2011-11-30**
- iv. **export IOAPI**
- d. Save the **profile.txt** file one more time.
- e. Back in the MSYS window, in your home directory, if you enter the command "**cat profile.txt**", then you should see the text you were just editing.
- f. Now copy that file and overwrite "**.profile**" with the command "**cat profile.txt > .profile**".
- g. Exit from the MSYS shell with the '**exit**' command, and then open the MSYS shell again from the Start Menu.
- h. Enter the command '**echo \$IOAPI**'. You should see the path of your "ioapi directory".

This means we can refer to your "ioapi directory" as **\$IOAPI** from now on.

### 3.2.3.3.2 Install

1. In the "CALMET2NETCDF\_Libraries" tarball from the EPA SCRAM website, one will find the I/O API tarball: **ioapi-3.0.tar.gz**
2. Save in a subfolder named **ioapi-30** under **\$CALMET2NETCDFHOME**. (That is, **\$CALMET2NETCDFHOME/ioapi-30** .)
3. While in **\$CALMET2NETCDFHOME/ioapi-30**, extract code: **tar zxvf ioapi-3.0.tar.gz** (Remember not to use Winzip.)
4. Use the following three commands to check the version (which should be the end of November 2011), then make a subdirectory with the name in the name 2011-11-30 and move all files into that subdirectory, which will be annotated as **\$IOAPI**. (Ignore the 'cannot move folder 2011-11-30 into itself' permission error.)
  - i. **cat VERSION.txt**
  - ii. **mkdir 2011-11-30**
  - iii. **mv \* 2011-11-30**
5. Save the **CALMET2netCDF.tar.gz** tarball in **\$CALMET2NETCDFHOME**.
6. Extract code: **tar zxvf CALMET2netCDF.tar.gz** (Remember not to use Winzip.)
7. Copy **Makeinclude.mingw\_x86gfortran** & **fix\_src.csh** from **CALMET2netCDF** distribution to **\$IOAPI/ioapi/**
  - i. **cd \$CALMET2NETCDFHOME/docs/**
  - ii. **cp Makeinclude.mingw\_x86gfortran \$CALMET2NETCDFHOME/ioapi-30/2011-11-30/ioapi/**
  - iii. **cp fix\_src.csh \$CALMET2NETCDFHOME/ioapi-30/2011-11-30/ioapi/**
8. Edit **Makefile** **\$IOAPI/Makefile** using Wordpad. These lines are about 100 lines into the **Makefile**. (Instead of editing this file, an edited version named **ioapi\_makefile** can be copied from the **docs** folder of the "CALMET2NETCDF\_Libraries" tarball.)
  - i. **BASEDIR = \$(\$CALMET2NETCDF\_HOME)/ioapi-30/2011-11-30**
  - ii. **INSTALL = \${\$CALMET2NETCDF\_HOME}/ioapi-30/2011-11-30/mingw\_x86gfortran**
  - iii. **CPLMODE = nocpl**
  - iv. **IOAPIDEFS =**
  - v. **PVMINCL = /dev/null**

9. Set environment variable for **BIN**. Following the procedure set before, use Wordpad and the file profile.txt to add these lines to the .profile file. (Not necessary if you used the .profile file from the docs folder of the "CALMET2NETCDF\_Libraries" tarball.)
  - i. `BIN=mingw_x86gfortran`
  - ii. `export BIN`
10. Test that **BIN** is now an environment variable by getting out of the MSYS shell, then restarting it, and typing the command `'echo $BIN'`. You should see the `'mingw_x86gfortran'` be displayed.
11. Make build directory in the `'ioapi-30/2011-11-30'` directory.
  - i. `cd $IOAPI`
  - ii. `make dirs`
  - iii. if directory isn't created then use `mkdir mingw_x86gfortran`

2. Copy netCDF library to newly created build directory: `cp /mingw/lib/libnetcdf.a mingw_x86gfortran`

3. (If you were using IOAPI version 3.1, you could skip the next two steps. You are using version 3.0.)

4. In some versions of the ioapi m3tools, the IARGC or GETARG may be declared as EXTERNAL functions in the Fortran routines. This can cause problems in the gfortran compiler.

Use the following commands to find these EXTERNAL statements. Some of these EXTERNAL statements are two lines long, though in future versions they may be three or more lines.

```
cd $IOAPI/m3tools
grep --after-context=2 EXTERNAL *.f | egrep "IARGC|GETARG"
```

In the 3.0 version, there are 8 such files: `datshift.f` `kfextract.f` `m3agmask.f` `m3agmax.f` `m3fake.f` `m3hdr.f` `m3tproc.f` `mtxcalc.f`

(You can ignore the three files `factor.f`, `gregdate.f`, and `juldate.f`, as they don't have the problem.)

5. (Instead of editing these files, edited versions can be copied from the docs folder of the "CALMET2NETCDF\_Libraries" tarball.) Where you see either IARGC or GETARGC defined as EXTERNAL in these files, open each file in Wordpad, then 'comment out' each instance of IARGC and GETARG by making them be on a 'comment line'; that is, a line with a comment character 'C' in column one. For a multiple line EXTERNAL statement with many functions, it would look as follows (from `kfextract.f`):

```
EXTERNAL GETNUM, GETYN, GETREAL, IARGC, INDEX1,
&          KFOPEN, KFREAD, KFWRITE, TRIMLEN,
&          SEC2TIME, TIME2SEC, SECSDIFF
```

becomes

```
C IARGC  EXTERNAL GETNUM, GETYN, GETREAL
EXTERNAL INDEX1,
&          KFOPEN, KFREAD, KFWRITE, TRIMLEN,
&          SEC2TIME, TIME2SEC, SECSDIFF
```

In many files, there will only be a single line to deal with.

```
EXTERNAL IARGC, GETARG
```

becomes

## C            EXTERNAL IARGC, GETARG

6. (Instead of editing this file, an edited version can be copied from the `docs` folder of the "CALMET2NETCDF\_Libraries" tarball.) Edit one C language file to add instructions for MINGW: `$IOAPI/ioapi/iobin3.c`

Paste right before `#if FLDMN`

```
#ifdef __MINGW32__
# define fsync(fd) _commit (fd)
# define fseeko(fil, where, set) _lseeki64(fil, where, set)
#endif
```

7. (Instead of editing this file, an edited version can be copied from the `docs` folder of the "CALMET2NETCDF\_Libraries" tarball.) In `$IOAPI/ioapi/systemf.c`, comment out `wait.h` as follows:

```
/**include <sys/wait.h>*/
```

8. In `$IOAPI`, set up other makefiles: `make configure`
9. Edit Makefile `$IOAPI/m3tools/Makefile.nocpl`. (Do not skip this. Also, the edit is not necessary if you copy the used the `m3tools_Makefile.nocpl` file from the `docs` folder of the "CALMET2NETCDF\_Libraries" tarball.):  
`BASEDIR = ${CALMET2NETCDFHOME}/ioapi-30/2011-11-30`
10. Build IOAPI (in the `$IOAPI` folder):
  - i. `make nocpl` (NOTE that - if this fails - it does require the newly copied version of `fix_src.csh` you should have provided before. The new one, despite its name, runs from the `bash` shell, and not the `csh` shell which MSYS did not provide.)
  - ii. When it stops, run command `make nocpl` again
11. Move all `mingw_x86gfortran/*.exe` files to `c:\MinGW\bin` with the command:  
`mv mingw_x86gfortran/*.exe /mingw/bin`

### 3.2.3.4 CALMET2netCDF

#### 3.2.3.4.1 Build CALMET2netCDF

1. In `src` directory (`$CALMET2NETCDFHOME/src`), modify `make.inc` to point to your I/O API directory (edit the lines with `LIB_M3API` and `INCLUDE_M3API`), and make sure that (1) Windows MINGW compiling options are uncommented and (2) there are no uncommented `F90` or `FFLAG` lines below the MINGW lines.
2. While still in the `src` directory, copy `PARMS3.EXT`, `FDESC3.EXT`, and `IODECL3.EXT` from `$CALMET2NETCDFHOME`. The following command works well.
  - i. `cp $IOAPI/ioapi/*.EXT .`
3. In the `src` directory, make executable: `make`

#### 3.2.3.4.2 Install CALMET2netCDF

Move executable to wherever you wish to run it. To run it from a `.bat` script, ensure that the CALMET2netCDF executable is somewhere on your path.

## 4 Starting CALMET2netCDF (using samples provided)

### 4.1 Linux

To start CALMET2netCDF from Linux, find the directory where CALMET2netCDF was installed, then go to the runScripts directory and run the runCALMET2netCDF.csh script. To run the script in interactive mode, edit the runCALMET2netCDF.csh script to change 'set PROMPTFLAG=FALSE' to 'set PROMPTFLAG=TRUE'.

### 4.2 Windows

#### 4.2.1 Preparing a Windows directory structure

(If it is desired to run with the provided test data, you may wish to also use this directory structure, which matches the one used by the .BAT file.

- |   |  |
|---|--|
| 1. Open a Windows command window.                               |  |
| 2. Make a subfolder at the place of your choosing :             | <code>mkdir calmet</code>              |
| 3. Move into that folder:                                       | <code>cd calmet</code>                 |
| 4. Copy the input file(s) there, as if they were CALMET output: | <code>copy calmet.2005.met.out</code>  |
| 5. Make a subfolder for the CDF files:                          | <code>mkdir outputs</code>             |
| 6. Make a subfolder for the converter :                         | <code>mkdir calmet2netcdf</code>       |
| 7. Move into that folder:                                       | <code>cd calmet2netcdf</code>          |
| 8. Copy the exec file into that folder:                         | <code>copy calmet2netcdf.exe</code>    |
| 9. Copy the .BAT file into that folder:                         | <code>copy runcalmet2netcdf.bat</code> |

a. Use Wordpad to open the .BAT file. You will need to change the 'file type' to "All documents (\*.\*)" and select "runCALMET2netCDF.bat". Then click "Open".

b. Change "SET PROMPTFLAG=FALSE" to "SET PROMPTFLAG=TRUE"

c. Save runCALMET2netCDF.bat

Now proceed as below.)

#### 4.2.2 Preparing the Windows batch file to run interactively

The batch script that is provided in the distribution may be set to run in the background. For the purposes of learning how to use the program, it is best to change the batch script to run interactively, by making sure the variable PROMPTFLAG is set to TRUE.

The following is already done.

To edit the batch script to run interactively:

- a. Use Wordpad to open the .BAT file. You will need to change the 'file type' to "All documents (\*.\*)" and select "runCALMET2netCDF.bat". Then click "Open".
- b. Change "**SET PROMPTFLAG=FALSE**" to "**SET PROMPTFLAG=TRUE**"
- c. Save runCALMET2netCDF.bat

(Figure 5-1 shows such an edit session on a file with a few bugs in it.)

### 4.2.3 Starting CALMET2netCDF

To start CALMET2netCDF, you can either 1) use the Windows command prompt or 2) use Windows Explorer.

#### With the Command Prompt

Open the **Programs** and select the **Accessories** menu, then highlight the **Command Prompt** icon.

Change directory to the location to the Calmet2NETCDF/runscripts/ directory:

```
cd C:\MinGW\msys\1.0\home\${username}\runscripts
```

(where 'username' is the name you have for the user that installed MinGW and MSYS.)

Edit program to allow you to run it interactively.

Run program: type `runCalmet2netCDF.bat` then hit enter

#### With Windows Explorer

Use Windows Explorer to navigate to the following directory:

```
C:\MinGW\msys\1.0\home\${username}\runScripts
```

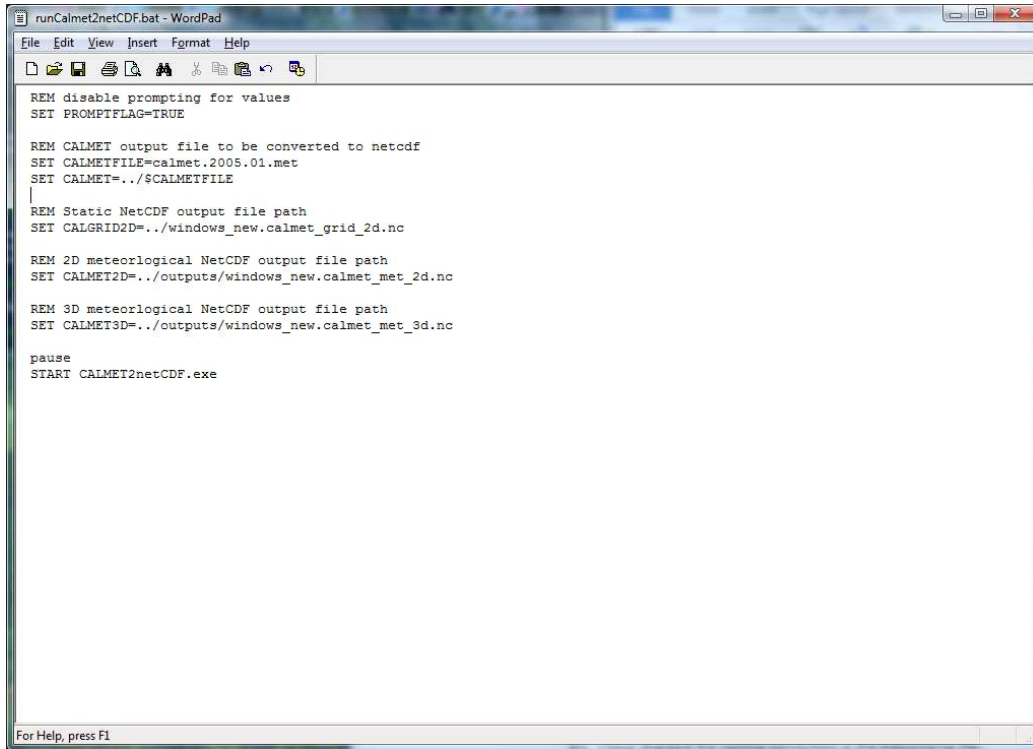
(where 'username' is the name you have for the user that installed MinGW and MSYS.)

1. Click on runCALMET2netCDF.bat
2. Submit answers to prompts within the Interactive Window (Figure 5-2 and Figure 5-3)
 

Mostly the user should just take the defaults (which are the tokens in square brackets).

  - a. **Click Enter, to have it use the default Logical Name CALMET** to specify the input filename
  - b. Click Enter, to have it use the default Logical Name CALGRID2D for the 1<sup>st</sup> gridded output file
  - c. Click Enter to use the default Logical Name CALMET2D for the 2<sup>nd</sup> gridded output file
  - d. Click Enter to use the default Logical Name CALMET3D for the 3<sup>rd</sup> gridded output file
  - e. The program will run, and the output files will be saved to the outputs directory.

**Figure 4-1 Edit runCalMETnetCDF.bat**



```
runCalmet2netCDF.bat - WordPad
File Edit View Insert Format Help
REM disable prompting for values
SET PROMPTIFLAG=TRUE

REM CALMET output file to be converted to netcdf
SET CALMETFILE=calmet.2005.01.met
SET CALMET=../$CALMETFILE

REM Static NetCDF output file path
SET CALGRID2D=../windows_new.calmet_grid_2d.nc

REM 2D meteorological NetCDF output file path
SET CALMET2D=../outputs/windows_new.calmet_met_2d.nc

REM 3D meteorological NetCDF output file path
SET CALMET3D=../outputs/windows_new.calmet_met_3d.nc

pause
START CALMET2netCDF.exe

For Help, press F1
```

(This figure shows an old “\$” bug.)



**Figure 4-2 Interactive Mode on Windows**

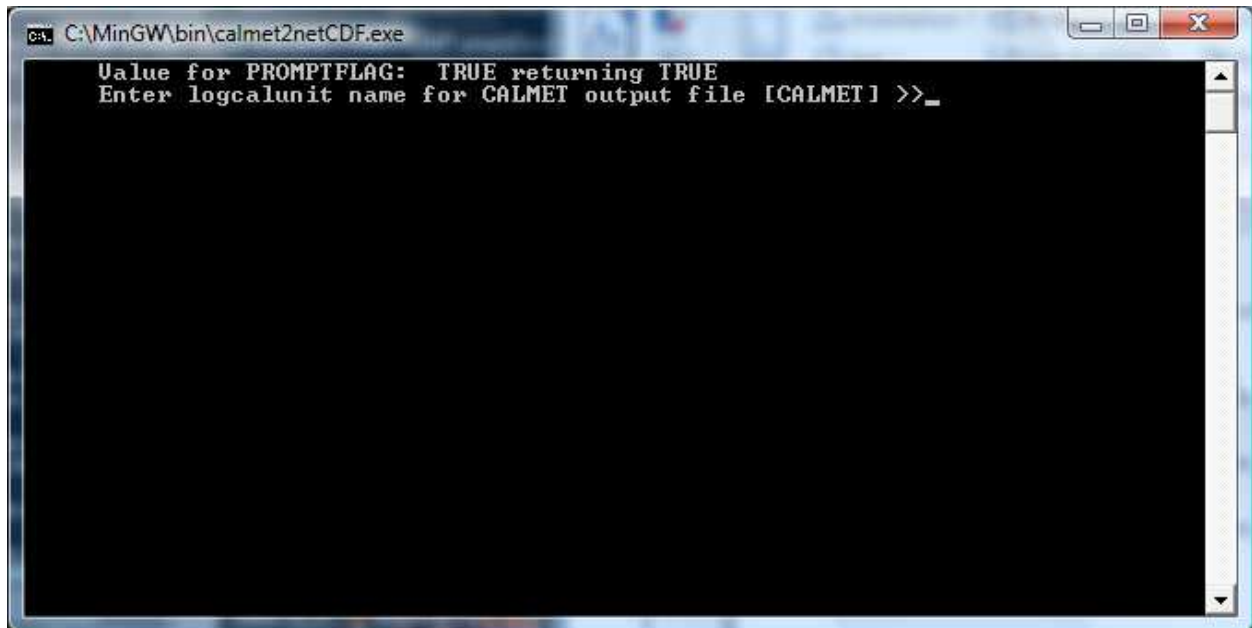


Figure 4-3 Interactive Mode on Windows (continued)

```

C:\MinGW\bin\calmet2netCDF.exe
Value for PROMPTFLAG: TRUE returning TRUE
Enter logcalunit name for CALMET output file [CALMET] >>

This program uses the EPA-AREAL/MCNC-EnvPgms/BAMS Models-3
I/O Applications Programming Interface, I/O API1 which is
built on top of the netCDF I/O library (Copyright 1993, 1996
University Corporation for Atmospheric Research/Unidata
Program) and the PUM parallel-programming library (from
Oak Ridge National Laboratory). Copyright (C) 1992-2002 MCNC
and Carlie J. Coats, Jr., and 2003-2006 Baron Advanced
Meteorological Systems, LLC and released under the GNU LGPL
License, version 2.1. See URL

    http://www.baronams.com/products/ioapi/LGPL.txt

for conditions of use.

Library release tag: $JDate: 2005333 $

$Id: @(#) ioapi library version 3.0 $
Version with PARM3.EXE/PARAMETER::MXUARS3= 120
netCDF version 4.1.1 of Aug 31 2010 12:33:08 $

This program uses the EPA-AREAL/MCNC-EnvPgms/BAMS Models-3
I/O Applications Programming Interface, I/O API1 which is
built on top of the netCDF I/O library (Copyright 1993, 1996
University Corporation for Atmospheric Research/Unidata
Program) and the PUM parallel-programming library (from
Oak Ridge National Laboratory). Copyright (C) 1992-2002 MCNC
and Carlie J. Coats, Jr., and 2003-2006 Baron Advanced
Meteorological Systems, LLC and released under the GNU LGPL
License, version 2.1. See URL

    http://www.baronams.com/products/ioapi/LGPL.txt

for conditions of use.

Library release tag: $JDate: 2005333 $

$Id: @(#) ioapi library version 3.0 $
netCDF version 4.1.1 of Aug 31 2010 12:33:08 $

Missing environment variable EXECUTION_ID

File "CALMET" opened for input on unit: 99
../inputs/calmet.2005.01.met

dataset = CALMET.DAT          dataver = 2.0          datamod = No-Obs file str
ucture with embedded control file

Value for PROMPTFLAG: TRUE returning TRUE
Enter file name for 2d gridded output [CALGRID2D1] >>

```

## 5 Sample Inputs Provided with CALMET2netCDF

The CALMET2netCDF tar.gz file contains six files in the inputs directory: calmip\_mm5.inp, calmip\_mm5.grid.txt, calmet.2005.01.out, calmet.2005.01.met, calmet.2005.01.inp, and calmip\_mm5.met. The CALMET output file (calmet.2005.01.met) is converted by CALMET2netCDF to netCDF format.

## 6 Output Files Generated by CALMET2netCDF when Using Sample Input File

CALMET2netCDF writes three output files with the following logical names: CALGRID2D, CALMET2D, and CALMET3D.

### 6.1 CALGRID2D

CALGRID2D is a static netCDF output file. The output file that is generated by CALMET2netCDF when using the provided sample input file contains one time step and one layer (TSTEP=1, LAY=1) for the following variables: Surface Roughness length (ZO), Land Use Category (ILANDU), Terrain Elevation (ELEV), and Leaf Area Index (XLAI).

### 6.2 CALMET2D

CALMET2D is a two-dimensional meteorological netCDF output file. The output file that is generated by CALMET2netCDF when using the provided sample input file contains 24 time steps and one layer (TSTEP=24, LAY=1) for the following variables; PGT stability class (IPGT), Surface friction velocity (USTAR), Mixing height (ZI), Monin-Obukhov length (EL), Convective velocity scale (WSTAR), Precipitation rate (RRM), Near-surface temperature (TEMPK), Near-surface air density (RHO), Short-wave solar radiation (QSW), Near-surface relative humidity (IRH), and Precipitation type code (IPCODE).

### 6.3 CALMET3D

CALMET3D is a three-dimensional meteorological netCDF output file. The output file that is produced by CALMET2netCDF when using the provided sample input file contains 24 time steps and 10 layers (TSTEP=24, LAY=10) for these variables: U-component of the wind (U), V-component of the wind (V), W-component of the wind (W), and Air temperature (T).

## 7 Convert additional CALMET output files

Load additional CALMET output files that need to be converted to netCDF into the inputs directory, and then edit the runCALMET2netCDF.csh or runCALMET2netCDF.bat file (depending on whether you are running on Linux or Windows) to specify the name of the CALMET output file that needs to be converted. The CALMET2netCDF output files retain the name of the input file as the first part of the three netCDF output file names, to facilitate record keeping, and to help the user identify the origin of the netCDF files that were generated by CALMET2netCDF.

## 8 NetCDF Utilities

The ncdump utility comes with the netCDF library. The command `ncdump -h` is useful for examining the file metadata and coordinate values of netCDF-formatted files.

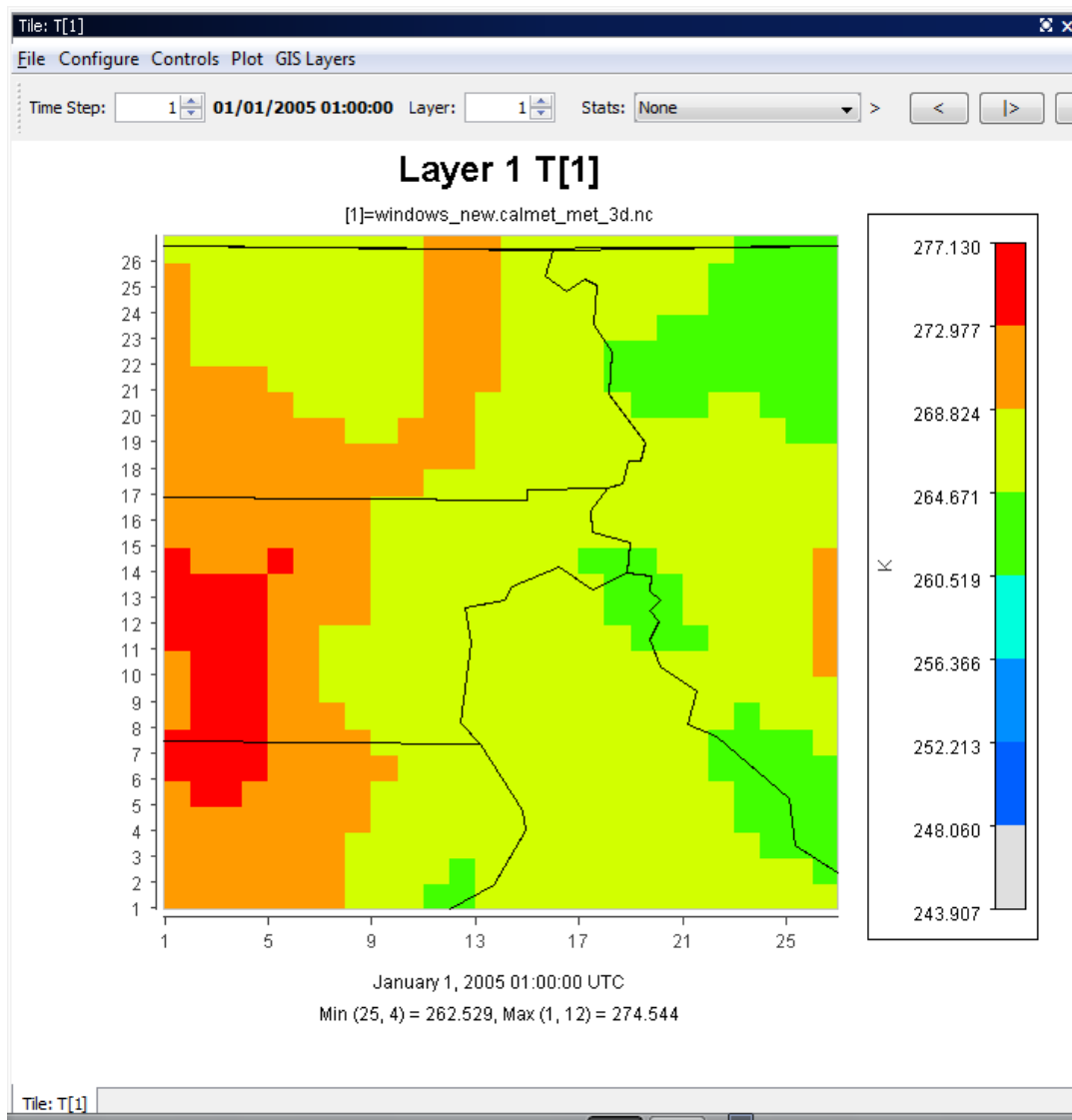
## 9 Plots of Output Files using VERDI

We present below sample graphics produced by VERDI using the outputs from the CALMET2netCDF tool.

### 9.1 Fast Tile Plot

The **fast tile plot** with the U.S. county grid lines shows the air temperature at each grid cell (Figure 9-1).

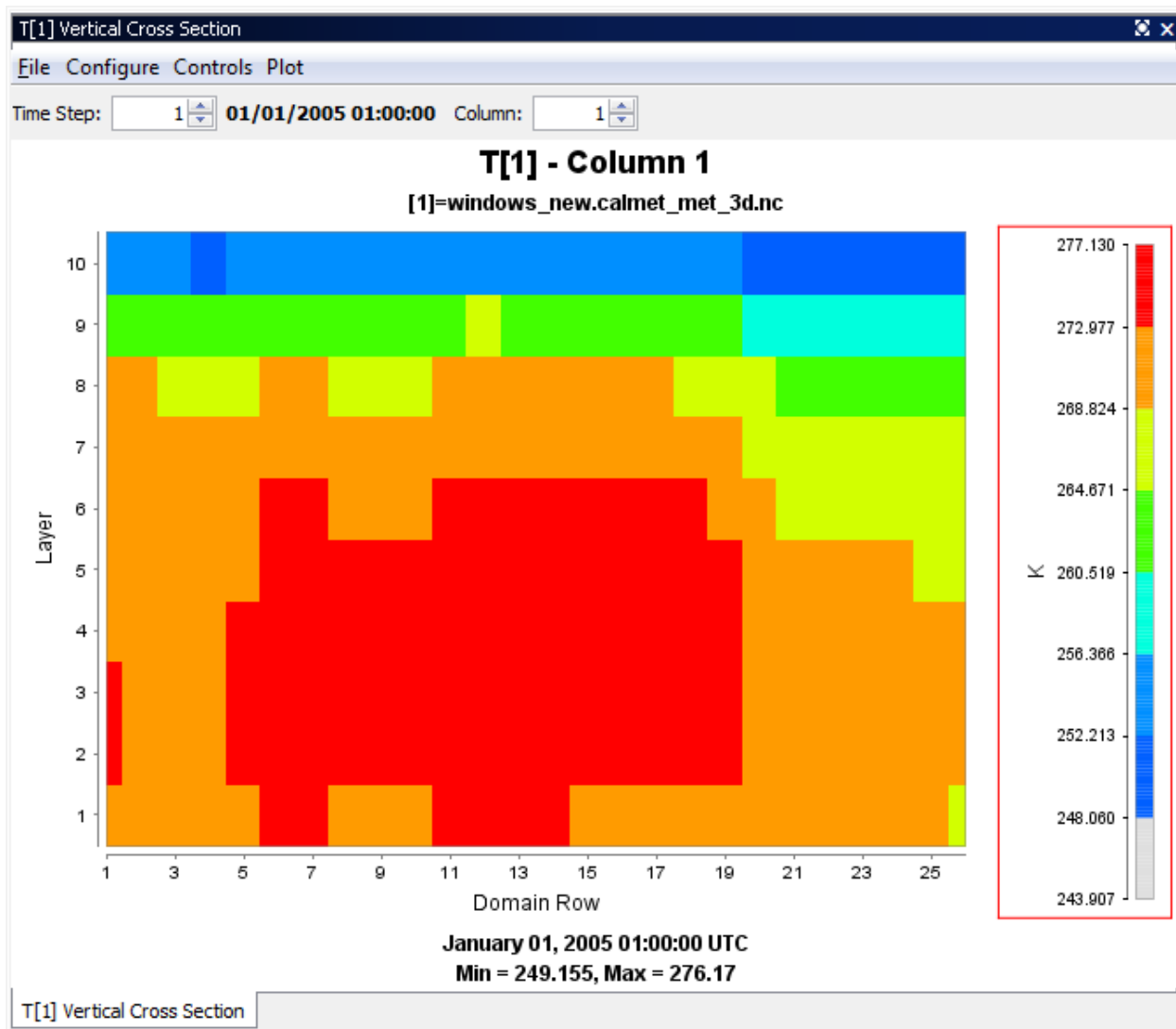
Figure 9-1 Fast Tile Plot of Air Temperature



## 9.2 Vertical Cross Section Plot

The vertical cross section plot allows you to show a slice of data in the vertical (Figure 9-2).

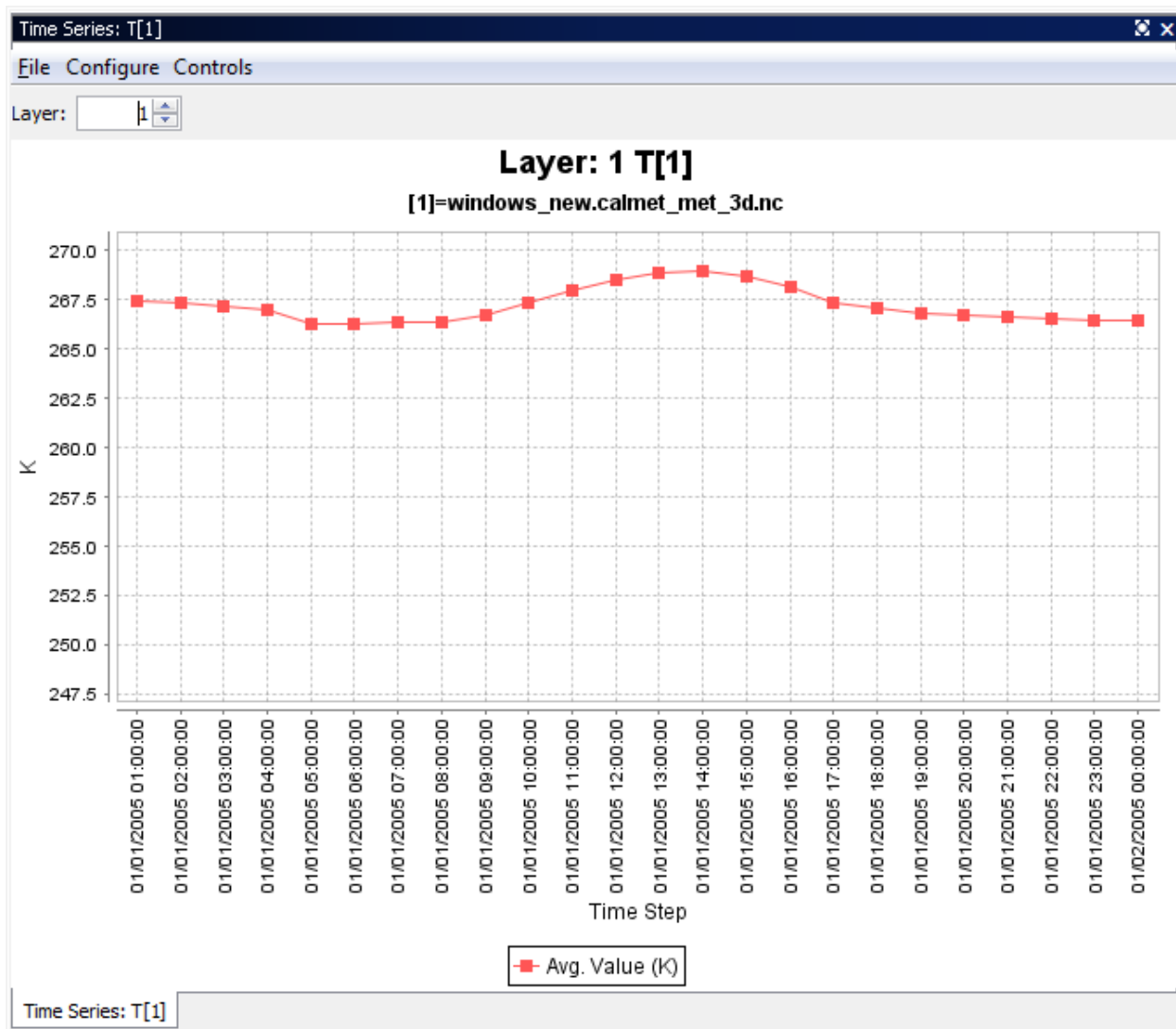
**Figure 9-2 Vertical Cross Section Plot of Air Temperature**



### 9.3 Time Series Plot

The **time series plot** shows a line graph with the average values of air temperature over time (Figure 9-3).

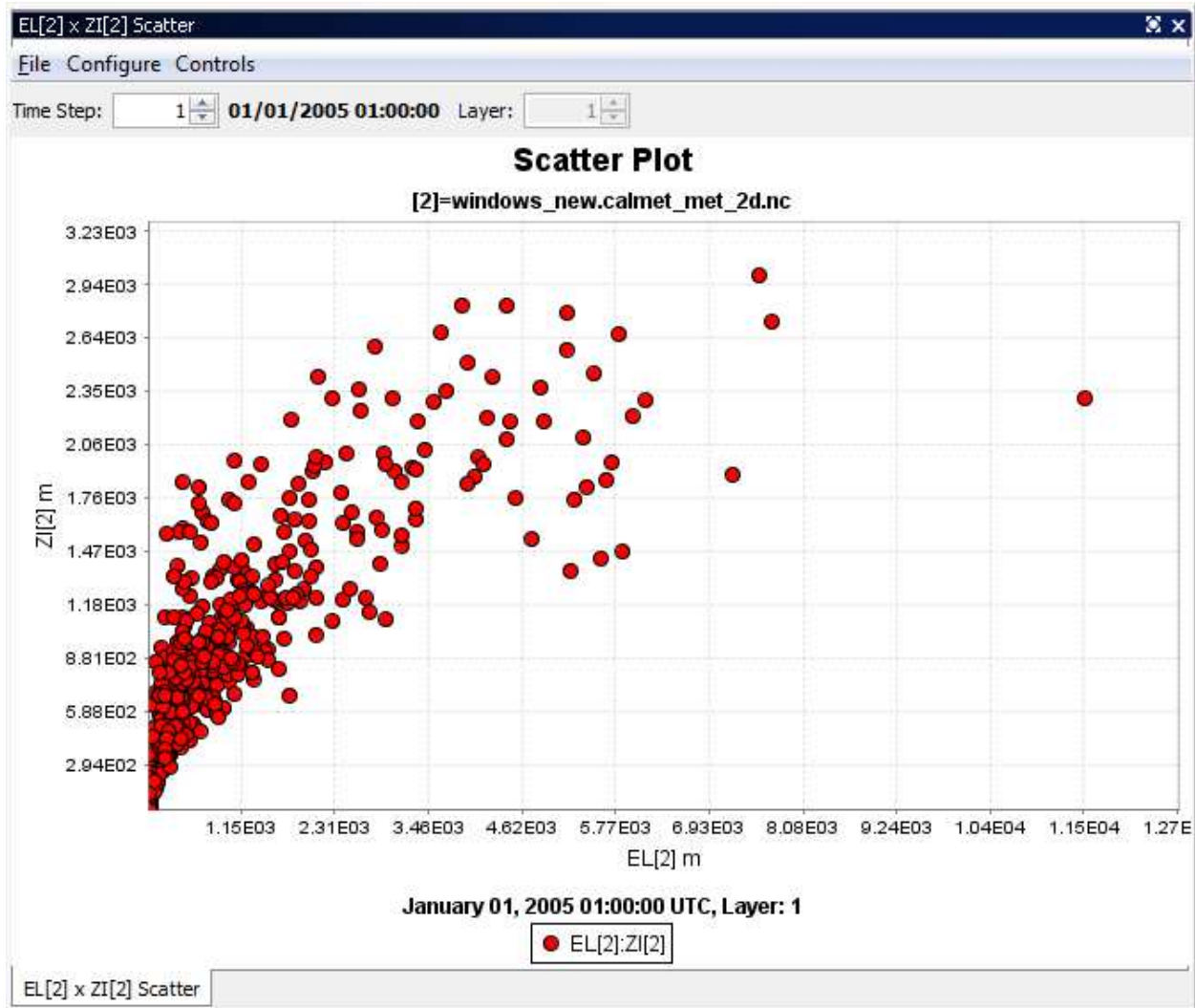
**Figure 9-3 Time Series Plot of Air Temperature Averaged over the Domain**



### 9.4 Scatter Plot

The **scatter plot** shows the relationship between the mixing height and the Monin-Obukhov length in the CALMET2D output file (Figure 9-4).

Figure 9-4 Scatter Plot of Mixing Height versus Monin-Obukhov Length

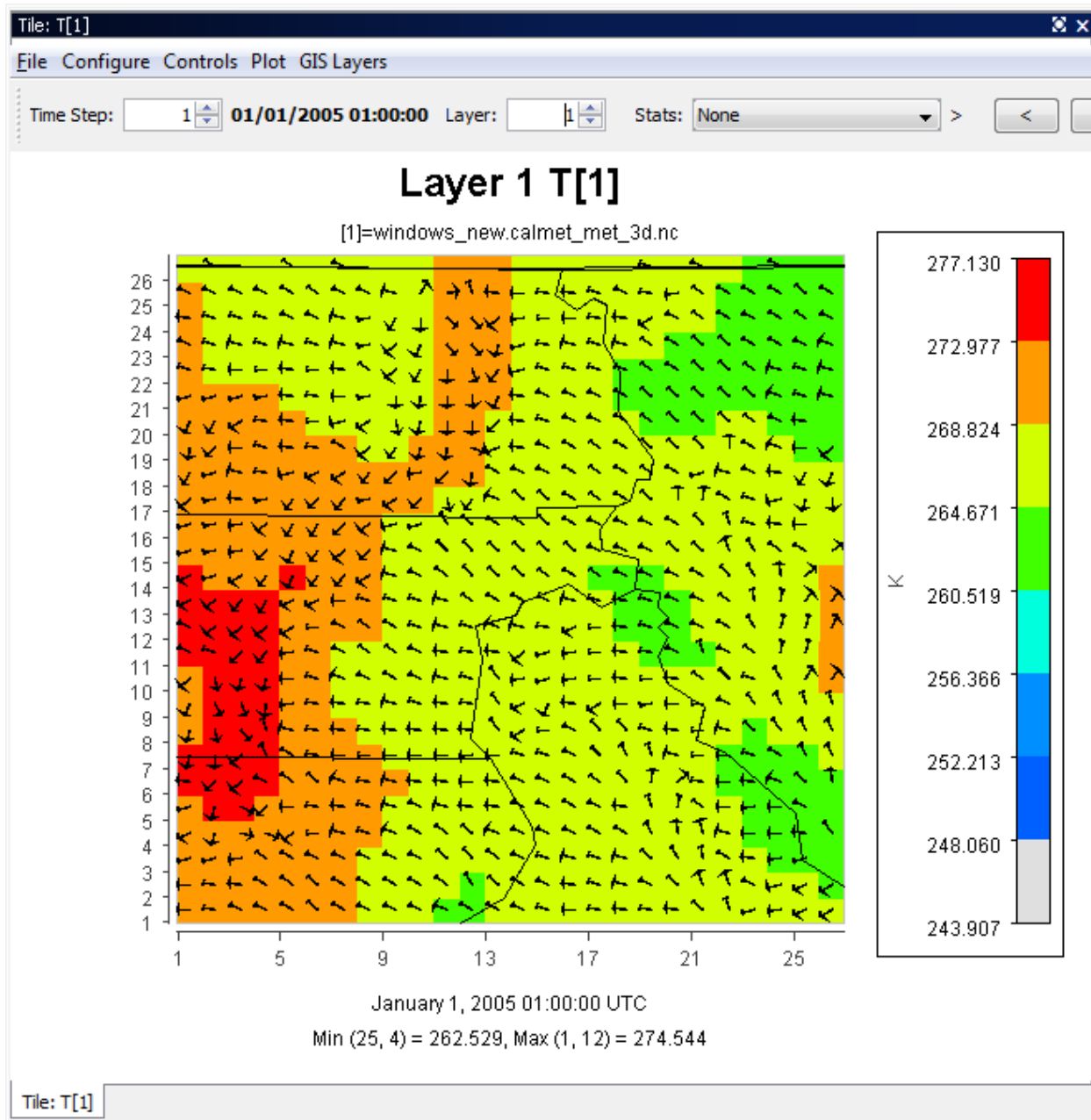


### 9.5 Vector Plot

The **vector plot** shows vector lines representing the vector formed by combining the magnitudes of the U and V components of the wind across the geographic domain (Figure 9-5).



**Figure 9-5. U and V Wind Vectors Overlaid on Temperature Plot**



## 9.6 Contour Plot

The Contour Plot shows the Terrain Elevation from the CALMET\_grid.nc output file. (Figure 9-6).

Figure 9-6. Contour Plot of Terrain Elevation

