Atmospheric Model Evaluation Tool (AMET) v1.2 Installation Guide

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1. Introduction

The Atmospheric Model Evaluation Tool (AMET) (Gilliam et al., 2005) is a suite of software designed to facilitate the analysis and evaluation of meteorological and air quality models. AMET matches the model output for particular locations to the corresponding observed values from one or more networks of monitors. These pairings of values (model and observation) are then used to statistically and graphically analyze the model's performance.

More specifically, AMET is currently designed to analyze outputs from the PSU/NCAR Mesoscale Model (MM5), the Weather Research and Forecasting (WRF) model, and the Community Multiscale Air Quality (CMAQ) model, as well as Meteorology-Chemistry Interface Processor (MCIP)-postprocessed meteorological data (surface only). The basic structure of AMET consists of two *fields* and two *processes*.

- The two fields (scientific topics) are **MET** and **AQ**, corresponding to meteorology and air quality data.
- The two processes (actions) are **database population** and **analysis**. Database population refers to the underlying structure of AMET; after the observations and model data are paired in space and time, the pairs are inserted into a database (MySQL). Analysis refers to the statistical evaluation of these pairings and their subsequent plotting.

Practically, a user may be interested in using only one of the fields (either MET or AQ), or may be interested in using both fields. That decision is based on the scope of the study. The three main software components of AMET are **MySQL** (an open-source database software system), **R** (a free software environment for statistical computing and graphics), and **perl** (an open-sourcecross-platform programming language).

The Community Modeling and Analysis System (CMAS) Center obtained the MET and AQ portions of AMET separately from EPA, then integrated the two to create a consistent and integrated AMET package that uses the UNIX C-shell interface to perform both MET and AQ model evaluation and analyses. After this integration, we tested the integrated AMET package in multiple environments.

Finally, we created this installation guide, which describes the steps involved in the AMET software installation procedure. During this process you will install (1) the AMET source code and scripts, (2) three tiers of related software, and (3) test case model data. Notes are provided wherever appropriate pertaining to the installation on a clean Ubuntu 10.04 Linux server, based on CMAS Center's experience with the installation and testing of the AMET 1.1 version. The most important thing about getting AMET to work in a new installation is to maintain consistency with the version numbers of the Tier 2 software and libraries listed in this installation guide.

2. Download AMET Software and Test Case Data

You can download the AMET software and some of the test case data from the web site of the

CMAS Center, **http://www.cmascenter.org**, as follows:

1. In the "**Download Center**" panel on the left-hand side of the web site, click on "MODELS".
2. Log in using your existing CMAS account. If you do not already have an account, you will need to create one.
3. AMET download Step 1: Select a model family to download by choosing "AMET" from the pull-down list, and click on the "**Submit"** button.
4. AMET download Step 2: Choose "AMET 1.2" as the product, "Linux PC" as the operating system, and "GNU compilers" as the choice of compiler, and then click on the "**Submit"** button.
5. In the table that appears, follow the links to:

   a) the installation guide (this document);
   b) the AMET 1.2 User's Guide;
   c) a tarball that includes the AMET source and scripts, and Tier 3 software (**AMET_v1.2.tar.gz**);
   d) two tarballs that contains CMAQ model data (**aqExample.2006.tar.gz** and **aqExample.2002.tar.gz**);
   e) a tarball that contains MM5 model data (**mm5Example.tar.gz**);
   f) a tarball that contains MCIP postprocessed data (**mcipExample.tar.gz**);
   g) a tarball that contains WRF model data (**wrfExample.tar.gz**);
   h) a tarball that contains observational data for North America (**NA_obs.tar.gz**), and
   i) a tarball that contains observational data for Europe (**EU_obs.tar.gz**).

Download all of these files to a temporary directory.

The rest of the sections in this guide explain the remaining steps in the installation process, as follows:

- Section 3: Verifying the availability of Tier 1 software, or having it installed if necessary.
- Section 4: Installing Tier 2 software utilities that need to be downloaded from other web sites.
- Section 5: Installing the AMET and Tier 3 software (from the **AMET_v1.2.tar.gz** tarball). Tier 3 software is a set of custom software utilities that have been developed alongside AMET.
- Section 6: Installing test case datasets for both observational and model data.

3. Verify the Availability of Tier 1 Software

Software in Tier 1 includes utilities that are normally part of a "standard" installation of the UNIX/Linux operating system. Please check to make sure all of the utilities below are available to you. If some of them are not present, you should ask your system administrator to install them.

The versions used by CMAS staff in their integration and testing are included in parentheses:

1. **zlib (libz.a)** (1.2.3)
2. **libg2c.a** (3.4.6)
3. **gzip** (1.3.9)
4. **Perl** (5.8.8)
5. **g++** (4.1.2)
6. **gfortran** (4.1.2) or other F90 compiler
7. **ImageMagick** (6.2.4.5)
   Note: You need only the **convert** utility from this package.
8. **sed** (4.1.5)
   Note: **sed** is only needed for subs automatic renaming scripts.

4. Install Tier 2 Software

Tier 2 includes scientific software utilities that you need to download and install from other web sites. Given below are web links to the software and installation documentation provided by the software distributors, along with basic notes discussing what we have found beneficial in our testing. Many of these utilities are available through standard Linux package management systems; you and/or your system administrator are encouraged to install them through these package management systems.

4.1 netCDF (3.6.2)

Download from
http://www.unidata.ucar.edu/downloads/netcdf/index.jsp.

Installation instructions:
http://www.unidata.ucar.edu/software/netcdf/docs/netcdf-install/Building-and-Installing-NetCDF-on-Unix-Systems.html#Building-and-Installing-NetCDF-on-Unix-Systems

Notes:

- Installation needs to include a static library and include files.
- You will need the **ncdump** utility.
- If you need to build I/O API, we recommend that you rebuild netCDF with consistent compilers and flags that will be used in I/O API.
- By default, netCDF is installed in **/usr/local**. To install it in a different directory, see the installation notes.
- When using the **gcc** compilers, make sure **g++** is set up to use **gcc,** as the **c++** compiler will not work correctly.

4.2 Input/Output Applications Programming Interface (I/O API) (3.0)

Download from **http://www.baronams.com/products/ioapi**.

Installation instructions:
http://www.baronams.com/products/ioapi/AVAIL.html

Note: If I/O API and netCDF are already installed on your system, we recommend using those packages for AMET. Otherwise, we recommend compiling both with the same compilers and flags.

4.3 MySQL (5.0.38)

Download from **http://dev.mysql.com/downloads**

Installation instructions:
http://dev.mysql.com/doc/

Notes:

- Install MySQL server and client. This can be installed on the machine that will run AMET, as well as on a remote host.
- You will also need development files (include files and libraries) such as **mysql.h** and **libmysqlclient.so.15** on the system that will run AMET.
- If MySQL server is installed on a remote host, you will encounter permissions issues in accessing the database from AMET. In that event, we recommend that you run the following commands on the MySQL server via the MySQL client to provide mysql root access from outside the local host:

```
mysql> grant reload, process on *.* to
'root'@'hostname';
mysql> grant all privileges on *.* to
'root'@'hostname' identified by 'rootpass' with grant
option;
```

Notes: On Ubuntu we recommend installing MySQL from apt-get:

```
sudo apt-get install mysql-client-5.1 mysql-server-5.1
python-mysqldb
```

Once you have MySQL and the accompanying libraries installed you need to start the server and create the **ametsecure** user/password. Start the server as follows:

```
mysqld_safe &
```

Log into the MySQL server and create the user **ametsecure**; assign a password to **ametsecure** and give the user full privileges to the database as follows:

```
mysql
```

On the server prompt:

```
mysql> create user 'ametsecure'@'localhost' identified
by 'some_pass';
mysql> grant all privileges on *.* to
'ametsecure'@'localhost' with grant option;
```

```
mysql> \q
```

After you create this user, edit the **amet-config.pl** and **amet-conf.R** scripts under **$AMETBASE/configure** and add the password you created. You will need to set **$root_pass** in the *.pl script and **passwd** in the *.R script to the **ametsecure** password that you have created. See the AMET 1.2 User's Guide for additional details.

4.4 Perl packages from the Comprehensive Perl Archive Network *(CPAN)*

Download all of the software below from **http://www.cpan.org**.

Installation instructions**:** **http://search.cpan.org/~jhi/perl-5.8.0/pod/perlmodinstall.pod**

PDL

PDL::NetCDF (we suggest that you compile this package from source)

DBI

Mysql (to install this perl package, it is essential that the MySQL software mentioned above is already installed)

Mail::Sendmail

Date::Calc

Sort::Fields

Notes:

- Ignore errors in **make test** for **Sort::Fields**.
- **PDL** and **DBI** should be installed before **PDL::NetCDF** and **MySQL**, respectively.
- From our experience, we expect that fewer problems will arise if your system administrator installs the above packages in the system directory **(/usr/lib)** using the **cpan** utility, rather than in other local directories.

Notes: The latest version of perl 5.10 does not allow proper functioning of AMET scripts. The user needs to downgrade to perl 5.8.9 to ensure that AMET scripts will function as designed. Instructions on the perl 5.8.9 installation on Ubuntu 10.04 are as follows:

```
cd /home; mkdir perl; cd perl
wget http://www.cpan.org/src/5.0/perl-5.8.9.tar.gz
tar xvzf perl-5.8.9.tar.gz
cd perl-5.8.9
./Configure -des -Dprefix=/home/perl
make
make test
make install
```

Then add the perl libraries required by AMET. The key to these installation/downgrade instructions is that you must specify the downgraded version of perl as shown below so that the libraries get installed in the correct location on your system:

```
/home/perl/perl-5.8.9/bin/perl -MCPAN -e shell
cpan> install PDL
cpan> install PDL::NetCDF
cpan> install DBI
cpan> install Mysql
cpan> install Mail::Sendmail
cpan> install Date::Calc
cpan> install Sort::Fields.
```

If you experience difficulties with the PDL installation you may need to build it from the source as follows:

```
cd /home; mkdir PDL; cd PDL
wget
http://sourceforge.net/projects/pdl/files/PDL/2.4.11/PDL
-2.4.11.tar.gz
tar xvzf PDL-2.4.11.tar.gz
cd PDL-2.4.11
/home/perl/perl-5.8.9/bin/perl Makefile.PL
make
make test
make install
```

4.5 R (2.14.0)

Download and installation instructions: **http://cran.us.r-project.org/index.html**. After you have installed the basic R software, AMET also requires the following additional R packages:

Download and installation instructions:
http://cran.us.r-project.org/src/contrib/PACKAGES.html

RMySQL

DBI

date

maps

mapdata

akima

ncdf (to install this R package, it is essential that the **netCDF** software mentioned above is already installed.)

chron

Hmisc

Fields

Notes: On Ubuntu 10 we recommend installing R from apt-get as follows:

```
sudo apt-get install r-base-core
```

The default version of R, namely 2.15.0 does not allow some AMET R scripts to

function correctly, and so the user needs to downgrade to R 2.14.0:

```
cd /home;mkdir R; cd R
wget http://cran.r-project.org/src/base/R-2/R-2.14.0.tar.gz
tar xvzf R-2.14.0.tar.gz
cd R-2.14.0
./configure --prefix=/home/R --with-X=no
make
make test
make install
```

Install R libraries from source.

```
sudo R
> install.packages(c("RMySQL", "maps", "mapdata","date","reshape", "rgdal", "sp", "maptools", "xtable", "yaml", "ggplot"))
```

4.6 MADIS (3.4)

Download and installation instructions:
http://madis.noaa.gov/madis_api.html

Notes: On Ubuntu MADIS 3.9 does not work, and downgrading to MADIS 3.6 will be necessary.

4.7 WGRIB (1.8.x)

Download and installation instructions:
http://www.cpc.ncep.noaa.gov/products/wesley/wgrib.html

Note: The tarball from the above link does not contain its own directory, so we recommend that you create a **wgrib** directory before untarring.

5. Install AMET Source Code and Tier 3 Software

Untar **AMET_v1.0.tar.gz** (which you downloaded earlier from the CMAS web site into a temporary directory) into a new directory where you would like to have AMET installed. You do not need to make a directory called AMET prior to untarring because the tarball includes that directory. The AMET top-level directory now looks like the following:

```
drwxr-x--- 12 user cmas 4096 2008-02-08 18:25 .
drwxrwxr-x 4 user cmas 4096 2008-02-09 14:55 ..
drwxr-x--- 4 user cmas 4096 2008-02-08 18:25 bin
drwxr-x--- 2 user cmas 4096 2008-02-08 18:25 configure
drwxr-x--- 4 user cmas 4096 2008-02-08 18:25 model_data
drwxr-x--- 4 user cmas 4096 2008-02-11 23:00 obs
drwxr-x--- 5 user cmas 4096 2008-02-08 18:25 output
drwxr-x--- 2 user cmas 4096 2008-02-08 18:25 perl
drwxr-x--- 2 user cmas 4096 2008-02-08 18:25 R
```

```
drwxr-x--- 4 user cmas 4096 2008-02-08 18:25 scripts_analysis
drwxr-x--- 7 user cmas 4096 2008-02-08 18:25 scripts_db
drwxr-x--- 7 user cmas 4096 2008-02-08 18:25 src
```

During untarring, the AMET source code is installed in the **$AMETBASE/R** and **$AMETBASE/perl** directories, and the AMET scripts are located in the **$AMETBASE/script_analysis** and **$AMETBASE/script_db** directories. The Tier 3 software source code is located in the **$AMETBASE/src** directory. As noted earlier, Tier 3 software is a set of custom software utilities that have been developed alongside AMET and are included in the AMET package.

For the AMET source and scripts, there is nothing further to do during installation. Given below are some instructions to complete the installation of Tier 3 software, and directions for linking the Tier 2 and Tier 3 executables to the **$AMETBASE/bin** directory.

5.1 Meteorological model utility

mm5tonetcdf

Notes:

- If NetCDF was installed in a nonstandard directory (i.e., not under **/usr/local)**, see **$AMETBASE/src/mm5tonetcdf_1.2/README** for instructions on how to set corresponding paths to the include files and libraries.
- The default install location of **mm5tonetcdf** in **/usr/local** can be changed by the same process as for NetCDF; see the above **README** file.
- Make sure that you compile **mm5tonetcdf** with the appropriate LFS (large file support) flags. The flags for the **gcc** compiler are:

  -D_FILE_OFFSET_BITS=64
  -D_LARGEFILE64_SOURCE

5.2 Air quality model utilities

bld_overlay

combine

sitecmp

cmp_airs

Notes:

- For all of these utilities, please be sure to edit the **Makefile** to reflect where your **I/O API** and **netCDF** libraries are located, and build each of these utilities to create the executables.
- We have provided three **I/O API** includes files—**FDESC3.EXT, IODECL3.EXT** and **PARMS3.EXT**—in the directory **$AMETBASE/src/ioapi_incl**. However, if you have made any changes to these files in an existing installation of **I/O API**, make sure to use those instead. Make sure that they are from the **I/O API fixed_src** directory.

5.3 Binary linking

`bin_linker.csh`

Note: The required Tier 2 and Tier 3 executables must be linked to the **`$AMETBASE/bin`** directory. The **`bin_linker.csh`** script has been provided in the **`$AMETBASE/bin`** directory for this purpose. It includes all the executables that need to be linked. Just edit the script with paths to your executables, and then execute it.

5.4 Configure AMETBASE variable

`subs_ametbase.sh`

Note: The **`AMETBASE`** variable in all the scripts is currently set to "**`~/AMET`**". If that is not where you untarred the AMET tarball, modify the script **`$AMETBASE/bin/subs_ametbase.sh`** to reflect the top-level directory where you have AMET installed, and then execute it. The subs script has been updated to use the standard UNIX utility **`sed.`** If you do not have **`sed`**, you can modify the variable **`AMETBASE`** manually in the appropriate scripts (see the AMET user's guide for specifics).

5.5 Modify header for perl scripts

`subs_perl.csh`

Note: All the **`*.pl`** scripts under **`$AMETBASE/perl`** have a default location of the base **`perl`** as **`/usr/local/perl`**. If you have **`perl`** installed in a different location on your machine, change the setting for the variable **`MYPERLDIR`** in **`$AMETBASE/bin/subs_perl.csh`** and execute it. This script makes use of the standard UNIX utility **`sed.`** If you do not have **`sed`**, you can manually edit the first line of each of the **`perl`** scripts to your **`perl`** path.

6. Install Test Case Data

The final step in the installation process is to install the test case data sets. These include sample model output data and observational data.

6.1 Sample model output data

In this step, you will untar the previously downloaded model outputs from Section 1 in the corresponding directories indicated below.

Meteorological output data

- **`MM5`** (5.2 GB uncompressed, 3.1 GB compressed):
  Untar the file **`mm5Example.tar.gz`** in the directory **`$AMETBASE/model_data/MET.`** This tarball contains a single **`MM5`** output file **`MMOUT_DOMAIN1_02Jul04`** that includes data from July 04 2002 12:00 UTC to July 10 2002 00:00 UTC, with a spatial domain covering the continental U.S. at 36-

km resolution.

- **WRF** (5.8 GB uncompressed, 3.0 GB compressed):
  Untar the file **wrfExample.tar.gz** in the directory **$AMETBASE/model_data/MET**. This tarball contains outputs from five days of **WRF** simulations in netCDF format. The temporal range is July 5 2002 0:00 UTC to July 9 2002 23:00 UTC with a spatial domain covering the continental U.S. at 36-km resolution. The spatial domain of the **WRF** output is identical to the **MM5** domain above.
- **MCIP** (566 MB uncompressed, 425 MB compressed):
  Untar the file **mcipExample.tar.gz** in the directory **$AMETBASE/model_data/MET.** This tarball contains outputs from five days of **MCIP** postprocessing in netCDF format. The temporal range is July 5 2002 0:00 UTC to July 9 2002 23:00 UTC with a spatial domain covering the continental U.S. at 36-km resolution. Additionally, there is a **GRIDCRO2D** (time-independent) file for July 6 that is also used by AMET. The **MCIP** files were created using the **MMOUT_DOMAIN1_02Jul04** file provided in the **mm5Example.tar.gz** file.

After you untar the tarfiles above, the **$AMETBASE/model_data/MET** will contain the following files.

```
total 32
drwxr-x--- 4 user cmas 4096 2008-02-14 20:35 .
drwxr-x--- 4 user cmas 4096 2008-02-14 20:34 ..
drwxr-x--- 2 user cmas 4096 2008-02-14 20:35 mm5Example
drwxr-x--- 2 user cmas 4096 2008-02-14 20:35 mcipExample
drwxr-x--- 2 user cmas 4096 2008-02-14 20:35 wrfExample

./mm5Example:
total 10807080
drwxr-x--- 2 user cmas 4096 2008-02-14 20:35 .
drwxr-x--- 4 user cmas 4096 2008-02-14 20:35 ..
-rw-r----- 1 user cmas 5527809888 2008-02-11 12:15
 MMOUT_DOMAIN1_02Jul04

./wrfExample:
total 12007696
drwxr-x--- 2 user cmas 4096 2008-02-14 20:35 .
drwxr-x--- 4 user cmas 4096 2008-02-14 20:35 ..
-rw-r----- 1 user cmas 1228378440 2007-08-20 17:26 wrfout_d01_2002-
 07-05_00:00:00
-rw-r----- 1 user cmas 1228378440 2007-08-20 18:17 wrfout_d01_2002-
 07-06_00:00:00
-rw-r----- 1 user cmas 1228378440 2007-08-20 19:03 wrfout_d01_2002-
 07-07_00:00:00
-rw-r----- 1 user cmas 1228378440 2007-08-20 19:37 wrfout_d01_2002-
 07-08_00:00:00
-rw-r----- 1 user cmas 1228378440 2007-08-20 19:37 wrfout_d01_2002-
 07-09_00:00:00
```

```
./mcipExample:
total 579634
drwxr-x--- 2 user cmas      4096 2008-02-14 20:35 .
drwxr-x--- 4 user cmas      4096 2008-02-14 20:35 ..
-rw-r----- 1 user cmas    502332 2008-05-19 12:55 GRIDCRO2D_2002187
-rw-r----- 1 user cmas 118426248 2008-05-12 11:21 METCRO2D_2002186
-rw-r----- 1 user cmas 118426248 2008-05-12 11:21 METCRO2D_2002187
-rw-r----- 1 user cmas 118426248 2008-05-12 11:25 METCRO2D_2002188
-rw-r----- 1 user cmas 118426248 2008-05-12 11:29 METCRO2D_2002189
-rw-r----- 1 user cmas 118426248 2008-05-12 11:33 METCRO2D_2002190
```

Air quality output data (7.9 GB uncompressed; 6.3 GB compressed)

- **CMAQ:**
  Untar the **aqExample.2006.tar.gz** file in the directory **$AMETBASE/model_data/AQ**. For CMAQ, we have provided an **ACONC** and a **WETDEP** output file from a CMAQ simulation to demonstrate new analysis capabilities involving the AERO6 suite of species. These two files are netCDF outputs from the **combine** postprocessing step. The temporal range is from July 1 2006 00:00 UTC to July 11 2006 00:00 UTC with a spatial domain covering the continental U.S at 12-km resolution. To demonstrate the analysis of statistical correlations of meteorological and air quality model data we have also provided a **ACONC** and **WETDEP** output file from a CMAQ simulation with the temporal range from July 1 2002 00:00 UTC to July 11 2002 00:00 UTC covering the continental U.S at 36-km resolution; these data were included in the previous AMET release and can be untarred from the **aqExample.2002.tar.gz** file.

Once you untar these files, the directory **$AMETBASE/model_data/AQ/aqExample** will contain the following files.

```
drwxrwxr-x 2 user cmas       4096 2013-06-24 00:36 .
drwxrwxr-x 3 user cmas       4096 2013-07-02 13:41 ..
-rw-r--r-- 1 user cmas 6851191364 2013-06-24 00:13
  test.12km.AERO6.aconc
-rw-r--r-- 1 user cmas 1264844424 2013-06-24 00:13
  test.12km.AERO6.dep
-rwxrwx--- 1 user cmas  287676752 2013-06-24 00:36 test.36km.conc
-rwxrwx--- 1 user cmas   63671444 2013-06-24 00:36 test.36km.dep
```

6.2 Observational data

Change directory to **$AMETBASE/obs**, and untar the contents of the file **AMET_obs_data.tar.gz** that you downloaded in Section 1. This will populate the air quality observations as well as provide the necessary directory structure for storing meteorological data.

Meteorological observational data

- These data are not included as part of this distribution, because AMET dynamically downloads them as needed from the Meteorological Assimilation

Data Ingest System (MADIS) web site to **$AMETBASE/obs/MET**. The contents of this directory should now look like the following:

```
drwxr-xr-x user/cmas     0 2007-11-18 21:40:59 LDAD/
drwxr-xr-x user/cmas     0 2007-11-18 21:40:59 LDAD/mesonet/
drwxr-xr-x user/cmas     0 2007-11-18 21:40:59 LDAD/mesonet/netCDF/
drwxr-xr-x user/cmas     0 2007-11-18 21:40:59 LDAD/profiler/
drwxr-xr-x user/cmas     0 2007-11-18 21:40:59 LDAD/profiler/netCDF/
drwxr-xr-x user/cmas     0 2007-11-18 21:40:59 point/
drwxr-xr-x user/cmas     0 2007-11-18 21:40:59 point/acarsProfiles/
drwxr-xr-x user/cmas     0 2007-11-18 21:40:59
 point/acarsProfiles/netCDF/
drwxr-xr-x user/cmas     0 2007-11-18 21:40:59 point/coop/
drwxr-xr-x user/cmas     0 2007-11-18 21:40:59 point/coop/netCDF/
drwxr-xr-x user/cmas     0 2007-11-18 21:40:59 point/metar/
drwxr-xr-x user/cmas     0 2007-11-18 21:40:59 point/metar/netcdf/
drwxr-xr-x user/cmas     0 2007-11-18 21:40:59 point/maritime/
drwxr-xr-x user/cmas     0 2007-11-18 21:40:59 point/maritime/netcdf/
drwxr-xr-x user/cmas     0 2007-11-18 21:40:59 point/profiler/
drwxr-xr-x user/cmas     0 2007-11-18 21:40:59 point/profiler/netcdf/
drwxr-xr-x user/cmas     0 2007-11-18 21:40:59 point/sao/
drwxr-xr-x user/cmas     0 2007-11-18 21:40:59 point/sao/netcdf/
drwxr-xr-x user/cmas     0 2007-11-18 21:40:59 point/raob/
drwxr-xr-x user/cmas     0 2007-11-18 21:40:59 point/raob/netcdf/
-rw-r----- user/cmas 324001 2007-10-08 14:12:00 stations.csv
```

If the directory where AMET is installed has limited space, we suggest that you move the entire directory structure under **$AMETBASE/obs/MET** (point and LDAD) to another directory with larger capacity, and then create soft links from the location that contains the AMET installation to the new location. For the 5-day-long model datasets we have provided, the MADIS observational data that will be dynamically downloaded is on the order of about 1.0 GB uncompressed. AMET does allow the data to be stored in compressed format, which reduces the size to 109 MB, but the data need to be decompressed before they can be used in AMET.

Air quality observational data (32 KB uncompressed; 0.2KB compressed)

- We have provided links in the User's Guide accompanying this document to several air-quality monitoring networks as part of this release. The networks from which we have provided data links are:

  North America

  - Air Quality System (AQS) network
  - Clean Air Status and Trends Network (CASTNET)
  - Interagency Monitoring of Protected Visual Environments (IMPROVE) network
  - Mercury Deposition Network (MDN)
  - National Atmospheric Deposition Program (NADP) network
  - SouthEastern Aerosol Research and Characterization Study (SEARCH) network

- Chemical Speciation Network (CSN) (previously Speciation Trends Network [STN])
- National Air Pollution Surveillance Program (NAPS) (speciated measurements from Canada).

Europe

- AirBase (Europe)
- Acid Gas and Aerosol Network (AGANET [UK])
- Acid Deposition Monitoring Network (ADMN [UK])
- Automatic Urban and Rural Network (AURN [UK])
- European Monitoring and Evaluation Programme (EMEP) network
- National Ammonia Monitoring Network (NAMN [UK])

- A brief description of data from each of these networks is provided in the AMET User's Guide included in this release. We suggest that you refer to the respective web sites for additional information on these datasets, monitoring protocols, updates, etc. The temporal range of the data is network-dependent, and ranges from 2001 to 2006. The observational datasets have been preprocessed and reformatted (in some instances from their original sources) for access by AMET. We have also provided the monitoring station locations in a set of .csv files in the subdirectory **`$AMETBASE/obs/AQ/site_lists`**. This is a very important set of metadata files that allows AMET to match modeled and observed data at the available locations from each network, and is critical to the database loading.
- The air quality observational data for several years have also been provided in two tarballs, namely, **`NA_obs.tar.gz`** for North American networks and **`EU_obs.tar.gz`** for European networks; below are listings of their contents. These should be copied and untarred under the directory **`$AMETBASE/obs/AQ`**. If you choose to keep North American and European network data in separate directories under this directory you should make sure to point to the appropriate observational data location (set by the environment variable **`AMET_OBS`**) in your AMET scripts.

North America

```
total 41324008
drwxrwxr-x 4 user cmas        4096 2013-07-01 18:21 .
drwxrwxr-x 4 user cmas        4096 2013-06-24 13:19 ..
-rw-r--r-- 1 user cmas 18830182400 2012-12-03 11:37 aqs_2001_data.csv
-rw-r--r-- 1 user cmas    60860821 2012-11-13 09:15 aqs_2001_O3_data.txt
-rw-r--r-- 1 user cmas  1282322644 2012-11-07 09:13 aqs_2002_data.csv
-rw-r--r-- 1 user cmas    63191870 2012-11-13 09:15 aqs_2002_O3_data.txt
-rw-r--r-- 1 user cmas  1296704146 2012-11-07 09:16 aqs_2003_data.csv
-rw-r--r-- 1 user cmas    64528385 2012-11-13 09:15 aqs_2003_O3_data.txt
-rw-r--r-- 1 user cmas  1319139096 2012-11-07 09:18 aqs_2004_data.csv
-rw-r--r-- 1 user cmas    64868353 2012-11-13 09:15 aqs_2004_O3_data.txt
```

```
-rw-r--r-- 1 user cmas  1317521803 2012-11-07 09:19 aqs_2005_data.csv
-rw-r--r-- 1 user cmas    63021553 2012-11-13 09:15 aqs_2005_O3_data.txt
-rw-r--r-- 1 user cmas  1318149874 2012-11-07 09:21 aqs_2006_data.csv
-rw-r--r-- 1 user cmas    66682252 2012-11-13 09:15 aqs_2006_O3_data.txt
-rw-r--r-- 1 user cmas  1326122946 2012-11-07 09:23 aqs_2007_data.csv
-rw-r--r-- 1 user cmas    68686471 2012-11-13 09:15 aqs_2007_O3_data.txt
-rw-r--r-- 1 user cmas  1314689481 2012-11-07 09:25 aqs_2008_data.csv
-rw-r--r-- 1 user cmas    70125944 2012-11-13 09:15 aqs_2008_O3_data.txt
-rw-r--r-- 1 user cmas  1308021319 2012-11-07 09:27 aqs_2009_data.csv
-rw-r--r-- 1 user cmas    70729666 2012-11-13 09:15 aqs_2009_O3_data.txt
-rw-r--r-- 1 user cmas  1274125463 2012-11-07 09:29 aqs_2010_data.csv
-rw-r--r-- 1 user cmas    67778858 2012-11-13 09:16 aqs_2010_O3_data.txt
-rw-r--r-- 1 user cmas   748927759 2012-11-07 09:30 aqs_2011_data.csv
-rw-r--r-- 1 user cmas    27420022 2012-11-13 09:16 aqs_2011_O3_data.txt
-rw-r--r-- 1 user cmas    77101806 2012-11-13 08:47
 aqs_daily_pm_2000_data.csv
-rw-r--r-- 1 user cmas    95116385 2012-11-13 08:48
 aqs_daily_pm_2001_data.csv
-rw-r--r-- 1 user cmas    98575411 2012-11-13 08:48
 aqs_daily_pm_2002_data.csv
-rw-r--r-- 1 user cmas   107096763 2012-11-13 08:48
 aqs_daily_pm_2003_data.csv
-rw-r--r-- 1 user cmas   110661441 2012-11-13 08:48
 aqs_daily_pm_2004_data.csv
-rw-r--r-- 1 user cmas   118797658 2012-11-13 08:48
 aqs_daily_pm_2005_data.csv
-rw-r--r-- 1 user cmas   120657207 2012-11-13 08:48
 aqs_daily_pm_2006_data.csv
-rw-r--r-- 1 user cmas   116733148 2012-11-13 08:52
 aqs_daily_pm_2007_data.csv
-rw-r--r-- 1 user cmas   134278393 2012-11-13 08:49
 aqs_daily_pm_2008_data.csv
-rw-r--r-- 1 user cmas   163337211 2012-11-13 08:49
 aqs_daily_pm_2009_data.csv
-rw-r--r-- 1 user cmas   182014631 2012-11-13 08:49
 aqs_daily_pm_2010_data.csv
-rw-r--r-- 1 user cmas      886189 2012-11-07 15:11 aqs_sites.txt
-rwxr--r-- 1 user cmas    85259567 2012-11-07 09:40
 castnet_hourly_2000_data.csv
-rw-r--r-- 1 user cmas   113560955 2012-11-07 09:40
 castnet_hourly_2001_data.csv
-rw-r--r-- 1 user cmas   118500763 2012-11-07 09:41
 castnet_hourly_2002_data.csv
-rw-r--r-- 1 user cmas   121439825 2012-11-07 09:41
 castnet_hourly_2003_data.csv
```

```
-rw-r--r-- 1 user cmas   100910151 2012-11-07 09:41
 castnet_hourly_2004_data.csv
-rw-r--r-- 1 user cmas   113308582 2012-11-07 09:41
 castnet_hourly_2005_data.csv
-rw-r--r-- 1 user cmas    79911152 2012-11-07 09:41
 castnet_hourly_2006_data.csv
-rwxr--r-- 1 user cmas    79543538 2012-11-07 09:42
 castnet_hourly_2007_data.csv
-rwxr--r-- 1 user cmas    84345443 2012-11-07 09:42
 castnet_hourly_2008_data.csv
-rwxr--r-- 1 user cmas    91042186 2012-11-07 09:42
 castnet_hourly_2009_data.csv
-rwxr--r-- 1 user cmas    89569974 2012-11-07 09:42
 castnet_hourly_2010_data.csv
-rwxr--r-- 1 user cmas    87594123 2012-11-07 09:42
 castnet_hourly_2011_data.csv
-rw-r--r-- 1 user cmas        3446 2012-11-07 15:10 castnet_sites.txt
-rwxr--r-- 1 user cmas    18439649 2012-11-07 09:39 castnet_weekly_data.csv
drwxr-xr-x 2 user cmas        4096 2012-11-08 09:19 CSN
-rwxr--r-- 1 user cmas     1713893 2012-11-07 09:05 csn_data_2000.csv
-rwxr--r-- 1 user cmas     5305677 2012-11-07 09:05 csn_data_2001.csv
-rwxr--r-- 1 user cmas    11360755 2012-11-07 09:05 csn_data_2002.csv
-rwxr--r-- 1 user cmas    12484348 2012-11-07 09:05 csn_data_2003.csv
-rwxr--r-- 1 user cmas    12753718 2012-11-07 09:05 csn_data_2004.csv
-rwxr--r-- 1 user cmas    12385283 2012-11-07 09:05 csn_data_2005.csv
-rwxr--r-- 1 user cmas    10880145 2012-11-07 09:05 csn_data_2006.csv
-rw-r--r-- 1 user cmas    10859863 2012-11-07 09:05 csn_data_2007.csv
-rwxr--r-- 1 user cmas     8977500 2012-11-08 11:12 csn_data_2008.csv
-rwxr--r-- 1 user cmas     9806477 2012-11-08 11:12 csn_data_2009.csv
-rwxr--r-- 1 user cmas     7718340 2012-11-08 12:30 csn_data_2010.csv
-rwxr--r-- 1 user cmas     2884369 2012-11-08 12:31 csn_data_2011.csv
-rwxr--r-- 1 user cmas      614164 2012-11-07 15:10 csn_sites.txt
drwxr-xr-x 2 user cmas        4096 2012-11-08 09:19 CSN_VEIWS
-rwxr--r-- 1 user cmas     4055648 2012-11-07 09:05 improve_data_2000.csv
-rwxr--r-- 1 user cmas     6163256 2012-11-07 09:05 improve_data_2001.csv
-rwxr--r-- 1 user cmas     7512820 2012-11-07 09:05 improve_data_2002.csv
-rwxr--r-- 1 user cmas     8140897 2012-11-07 09:05 improve_data_2003.csv
-rwxr--r-- 1 user cmas     8650149 2012-11-07 09:05 improve_data_2004.csv
-rwxr--r-- 1 user cmas     9279133 2012-11-07 09:05 improve_data_2005.csv
-rwxr--r-- 1 user cmas     9275806 2012-11-07 09:05 improve_data_2006.csv
-rwxr--r-- 1 user cmas     9735967 2012-11-07 09:05 improve_data_2007.csv
-rwxr--r-- 1 user cmas     9766358 2012-11-07 09:05 improve_data_2008.csv
-rwxr--r-- 1 user cmas     9839211 2012-11-07 09:05 improve_data_2009.csv
-rwxr--r-- 1 user cmas     6495047 2012-11-07 09:05 improve_data_2010.csv
```

```
-rwxr--r-- 1 user cmas     8407203 2012-11-08 14:10 improve_data_2011.csv
-rw-r--r-- 1 user cmas        5827 2012-11-07 15:10 improve_sites.txt
-rwxr--r-- 1 user cmas     1932017 2012-11-07 10:17 nadp_data_2001.csv
-rwxr--r-- 1 user cmas     2072988 2012-11-07 10:17 nadp_data_2002.csv
-rwxr--r-- 1 user cmas     2121180 2012-11-07 10:17 nadp_data_2003.csv
-rwxr--r-- 1 user cmas     2160429 2012-11-07 10:17 nadp_data_2004.csv
-rwxr--r-- 1 user cmas     2159855 2012-11-07 10:17 nadp_data_2005.csv
-rwxr--r-- 1 user cmas     2159892 2012-11-07 10:17 nadp_data_2006.csv
-rwxr--r-- 1 user cmas     2145445 2012-11-07 10:17 nadp_data_2007.csv
-rwxr--r-- 1 user cmas     2150185 2012-11-07 10:17 nadp_data_2008.csv
-rwxr--r-- 1 user cmas     2071239 2012-11-07 10:17 nadp_data_2009.csv
-rwxr--r-- 1 user cmas     1943952 2012-11-07 10:17 nadp_data_2010.csv
-rwxr--r-- 1 user cmas     1915400 2012-11-07 10:17 nadp_data_2011.csv
-rw-r--r-- 1 user cmas        7845 2012-11-07 15:10 nadp_sites.txt
-rw-r--r-- 1 user cmas   257386641 2012-11-07 10:19 NAPS_hourly_2000.csv
-rw-r--r-- 1 user cmas   264372500 2012-11-07 10:19 NAPS_hourly_2001.csv
-rw-r--r-- 1 user cmas   268643972 2012-11-07 10:19 NAPS_hourly_2002.csv
-rw-r--r-- 1 user cmas   284096155 2012-11-07 10:20 NAPS_hourly_2003.csv
-rw-r--r-- 1 user cmas   199665828 2012-11-07 10:20 NAPS_hourly_2004.csv
-rw-r--r-- 1 user cmas   218295303 2012-11-07 10:20 NAPS_hourly_2005.csv
-rw-r--r-- 1 user cmas   212831798 2012-11-07 10:20 NAPS_hourly_2006.csv
-rw-r--r-- 1 user cmas   214808390 2012-11-07 10:21 NAPS_hourly_2007.csv
-rw-r--r-- 1 user cmas   218859625 2012-11-07 10:21 NAPS_hourly_2008.csv
-rw-r--r-- 1 user cmas   209968228 2012-11-07 10:21 NAPS_hourly_2009.csv
-rw-r--r-- 1 user cmas   194826993 2012-11-07 10:22 NAPS_hourly_2010.csv
-rw-r--r-- 1 user cmas       26295 2012-11-07 15:11 naps_sites.txt
-rw-r--r-- 1 user cmas     1705348 2012-11-07 13:59 search_daily_2005.csv
-rw-r--r-- 1 user cmas     1201080 2012-11-07 13:59 search_daily_2006.csv
-rw-r--r-- 1 user cmas     1677337 2012-11-07 13:59 search_daily_2007.csv
-rw-r--r-- 1 user cmas     4176369 2012-11-07 13:59
 search_daily_pre_2005.csv
-rw-r--r-- 1 user cmas    11865666 2012-11-07 10:29 search_hourly_2000.csv
-rw-r--r-- 1 user cmas    12085047 2012-11-07 10:29 search_hourly_2001.csv
-rw-r--r-- 1 user cmas    13314956 2012-11-07 10:29 search_hourly_2002.csv
-rw-r--r-- 1 user cmas     8771053 2012-11-07 10:30 search_hourly_2003.csv
-rw-r--r-- 1 user cmas    10121996 2012-11-07 10:30 search_hourly_2004.csv
-rw-r--r-- 1 user cmas    51361363 2012-11-07 10:30 search_hourly_2005.csv
-rw-r--r-- 1 user cmas    54229735 2012-11-07 10:30 search_hourly_2006.csv
-rw-r--r-- 1 user cmas    52590428 2012-11-07 10:30 search_hourly_2007.csv
-rw-r--r-- 1 user cmas    53190895 2012-11-07 10:30 search_hourly_2008.csv
-rw-r--r-- 1 user cmas         234 2012-11-07 15:11 search_sites.txt
```

Europe

```
total 3861072
drwxrwxr-x 2 user cmas       4096 2013-07-02 12:27 .
drwxrwxr-x 4 user cmas       4096 2013-07-02 12:26 ..
-rw-r--r-- 1 user cmas     304870 2012-11-07 09:12 admn_2006_data.csv
-rw-r--r-- 1 user cmas       1159 2012-11-07 09:01 admn_sites.txt
-rw-r--r-- 1 user cmas      82608 2012-11-07 09:12 aganet_2006_data.csv
-rw-r--r-- 1 user cmas       1059 2012-11-07 09:01 aganet_sites.txt
-rw-r--r-- 1 user cmas  114031151 2012-11-07 09:12
 airbase_daily_2006_data.csv
-rw-r--r-- 1 user cmas 2691757612 2012-11-07 09:14
 airbase_hourly_2006_data.csv
-rw-r--r-- 1 user cmas      37376 2012-11-07 09:01 airbase_sites.txt
-rw-r--r-- 1 user cmas   11571886 2012-11-07 09:14 aurn_daily_2006_data.csv
-rw-r--r-- 1 user cmas  277595143 2012-11-07 09:14 aurn_hourly_2006_data.csv
-rw-r--r-- 1 user cmas       3723 2012-11-07 09:01 aurn_sites.txt
-rw-r--r-- 1 user cmas    6556257 2012-11-07 09:14 emep_daily_2006_data.csv
-rw-r--r-- 1 user cmas  139425383 2012-11-07 09:14 emep_hourly_2006_data.csv
-rw-r--r-- 1 user cmas       1866 2012-11-07 09:01 emep_sites.txt
-rw-r--r-- 1 user cmas     127431 2012-11-07 09:14 namn_2006_data.csv
-rw-r--r-- 1 user cmas       3543 2012-11-07 09:01 namn_sites.txt
```

Congratulations! You have successfully installed the AMET package on your system and are ready to begin using it. Please see the *Atmospheric Model Evaluation Tool (AMET) User's Guide,* which you downloaded earlier from the CMAS web site, for instructions on how to perform the example analyses.

Reference

Gilliam, R. C., W. Appel, and S. Phillips. The Atmospheric Model Evaluation (AMET): Meteorology Module. Presented at 4th Annual CMAS Models-3 Users Conference, Chapel Hill, NC, September 26 - 28, 2005.