2 Getting Started

2.1 Purpose

This chapter discusses general aspects of MM5 modeling system programs, including

- what are required on your workstation in order to compile and run these programs;
- where and how to obtain program tar files and utility programs;
- function of a job script (or a job deck);
- parameter statement and namelist
- how to set up, compile and run the modeling system programs
- date representation in MM5 modeling system
- where to find data to use for running MM5

2.2 Program portability

MM5 modeling system programs, TERRAIN, REGRID, RAWINS/little_r, INTERP, GRAPH and MM5, can all be run on Unix workstations and Crays. Program TERRAIN and RAWINS in the latest release has become one-source program which can be run on both Cray and Unix workstations. Only MM5 model can be run on a PC running Linux and compiled with pgf77 compiler. We have plans to test and develop the rest of modeling system programs for Linux-based PCs.

MM5 modeling system programs are mostly Fortran programs that require compilation on your local computer each time you run them. A user should try to know your computer and compiler. Find out how much usable memory you have on the computer, and what version of compiler you have. This information can come handy when you encounter problems when compiling and running the modeling system programs and report problems to mesouser. If you are thinking about purchasing a computer, get at least 0.5 to 1 Gb memory and a few Gb of disk. As most of the MM5 preprocessor programs are being migrated to Fortran 90, you will need a f90 compiler too to compile and run these programs. The following table lists the source code type and compiler required to compile them:

Program Name	Source Code	Compiler required
TERRAIN	Fortran 77	f77 (and f90)
REGRID	Fortran 90	f90
RAWINS	Fortran 77	f77 (and f90)
little_r	Fortran 90	f90
INTERP	Fortran 77	f77 (and f90)
MM5	Fortran 77	f77 (and f90)
GRAPH	Fortran 77	f77 (and f90)

2.3 Prerequisite

There are a few things a user needs to prepare before starting running jobs on your workstation.

- If you have NCAR Graphics on your system, make sure you have the following line in your .cshrc file:

  setenv NCARG_ROOT /usr/local
  or
  setenv NCARG_ROOT /usr/local/ncarg

This enables a user to load NCAR Graphics libraries when compiling programs which use NCAR Graphics (Terrain, Rawins and Graph).

- If you need to remotely copy files between two workstations, make sure you have an *.rhosts* file on both workstations. A typical .rhosts file looks like this:

```
paiute.ucar.edu username
ouray.ucar.edu username
```

- Make sure that you browse through the ***~mesouser*** directories on the Crays, or ***mesouser/*** directory on anonymous ftp. All job decks, program tar files, data catalogs, and utility programs reside in the directory.

2.4 Where to obtain program tar files?

MM5 modeling system programs are archived in three locations: NCAR's anonymous ftp, NCAR Cray-accessible disk, and NCAR's Mass Storage System (MSS).

On the ftp site, the source code tar files are archived under /mesouser/MM5V2:

/mesouser/MM5V2/Terrain/terrain.tar.Z
/mesouser/MM5V2/Regrid/regrid.tar.Z
/mesouser/MM5V2/Rawins/rawins.tar.Z
(/mesouser/newprogs/little_r.tar.gz)
/mesouser/MM5V2/Interp/interp.tar.Z
/mesouser/MM5V2/MM5/mm5.tar.Z
/mesouser/MM5V2/Graph/graph.tar.Z

On Cray, the source code tar files and Cray job decks reside in ~meosuser/MM5V2:

~mesouser/MM5V2/Terrain/terrain.tar.Z, terrain.deck
~mesouser/MM5V2/Regrid/regrid.tar.Z, regrid.deck
~mesouser/MM5V2/Rawins/rawins.tar.Z, rawins.deck
~mesouser/MM5V2/Interp/interp.tar.Z, interp.deck
~mesouser/MM5V2/MM5/mm5.tar.Z, mm5.deck
~mesouser/MM5V2/Graph/graph.tar.Z, graph.deck

On MSS, the source code tar files are archived in /MESOUSER/MM5V2

/MESOUSER/MM5V2/TERRAIN/TERRAIN.TAR.Z
/MESOUSER/MM5V2/REGRID/REGRID.TAR.Z
/MESOUSER/MM5V2/RAWINS/RAWINS.TAR.Z
/MESOUSER/MM5V2/INTERP/INTERP.TAR.Z
/MESOUSER/MM5V2/MM5/MM5.TAR
/MESOUSER/MM5V2/GRAPH/GRAPH.TAR.Z

To obtain files from Cray and MSS, you need to have an NCAR SCD computing account. To access program tar files from NCAR's anonymous ftp site, do the following (taking MM5 tar file as an example):

```
# ftp ftp.ucar.edu
Name: anonymous
Password: your-email-address
>ftp cd mesouser/MM5V2
>ftp cd MM5
>ftp binary
>ftp get mm5.tar.Z
>quit
```

You must cd to each directory to get tar file for each program. Once you download these tar files, use Unix uncompress command to decompress the .Z files,

```
uncompress mm5.tar.Z (or gunzip)
```

and untar the file by using the command

```
tar -xfv mm5.tar
```

All utility programs are archived under Util/ directory on ftp and NCAR Cray-accessible disk. The list of the utility programs are

Program/script Name	Function
ieee.csh	convert Cray binary data to standard 32-bit IEEE data
rdmm5v1.f	read program for MM5 V1 and V2 modeling system output
vis5d/ tovis5d.tar.gz	program tar files to convert MM5 model data to Vis5D data
vis5d/ diagmm5.tar.gz	program tar file to add diagnostic variables to MM5 data to Vis5D data
mm5-memory.f	program to estimate memory requirement for a Cray job
mm5-time.f	program to estimate CPU time

2.5 What are contained in a tar file?

A program tar file contains all source code (excluding NCAR Graphics), makefile, and instructions (in README) required to compile and run that particular program. As an example, the files contained in program RAWINS tar file are listed below:

CHANGES	Description of changes to the program
Diff/	Will contain difference files between consecutive releases
Makefile	Makefile to create the program executable
README	General information about the program directory
Templates/	Job script directory
con.tbl	Table file for plots
configure.make	Rules for the Makefile
map.tbl	Table file for plots
src/	Program source code directory

2.6 Steps to run MM5 modeling system programs

Typically there are four steps to set up and run the modeling system programs.

1) Edit the configure.make or configure.user file, and select appropriate RUNTIME_SYSTEM, and uncomment the compiler options for your computer. Most programs should run on major workstation vendor machines like DEC_ALPHA, SGI, SUN, IBM and HP. This step is not needed for program REGRID and future Fortran 90 programs.

2) Type make x.deck to create a job deck for your computer.

3) Edit x.deck to select appropriate shell variables, parameter statements, and namelist.

4) Type x.deck to compile and run the program.

For Fortran 90 programs, such as Regrid and little_r, the steps are simpler.

1) Type make, which will tell you what to do next.

2) Type make *platform* to compiler the program: e.g. make dec to compiler on DEC_Alpha

3) Edit either the job script and/or namelist.input file.

4) Type the executable name to run the program, e.g. pregrid.csh

2.7 Functions of Job Decks or Scripts

Most of MM5 modeling system programs have a job deck or script to help you run the program. Some are called x.deck, and some are x.csh. They have very similar functions. When using these job decks or scripts, they assume the program tar file is local. Most also expect all input files are local too.

To obtain an appropriate job script for your computer, most require the editing of configure.make file to set the variable RUNTIME_SYSTEM. Then type 'make xxxx.deck' to create a deck for program xxxx (program name in lower case, e.g. make terrain.deck).

The general job deck construct and functions are the following:

- job switches, which may come before or after setting Fortran parameter statement and namelist;
- parameter statements used in Fortran programs to define domain and data dimensions;
- FORTRAN namelist used during program execution to select runtime options;
- a section that does not normally require user modification, which links input files to Fortran units, create executable based on parameter statement setup, and obtain data from anonymous ftp sites (such as in the case of TERRAIN program)

2.8 What to Modify in a Job Deck/Script?

2.8.1 Shell Variables

Since the MM5 modeling system is designed for multiple applications, there are many options on how a job may be run. These options include different sources for inputting terrestrial and meteorological data, ways to do objective analysis, running the model hydrostatically or nonhydrostatically, and whether an MM5 job is an initial or restart run, etc. A user is required to go through the shell variables and make appropriate selections for your application.

The following is an example taken from the *pregrid.csh*, and the selection is with regarding to the type of global analysis to be used to create the first guess fields:

```
#
# Select the source of 3-d analyses
#
```

```
#   set SRC3D = ON84
#   set SRC3D = NCEP
    set SRC3D = GRIB   # Many GRIB-format datasets
```

Other examples of shell variables are listed below and they need to be defined by users for each program of the MM5 modeling system:

Program Name	*Shell Variables*
TERRAIN	TerPlt, GLOBAL30S, NewLandUse, VegType, FillCo
REGRID	SRC3D,SRCSST,SRCSNOW,SRCSOIL
RAWINS	INOBS, SFCsw, BOGUSsw,InRaobs,InSfc3h,InSfc6h
INTERP	HYDROsw, ForBsw, NESTsw
MM5	STARTsw, FDDAsw, HYDROsw

These shell variables will be discussed in detail in the other chapters of this document.

2.8.2 Parameter Statements

Most MM5 modeling system programs require user to set parameter statements in a deck or script, which are typically used to define the parameterized dimensions for a FORTRAN 77 program. The unix ***cat*** command is used in a deck to create FORTRAN include files containing these parameter statements. These are direct modifications to the source code, implying that strict FORTRAN syntax must be observed. Most programs require users to set up the parameter statements (except for program REGRID which is written in Fortran 90). The usage of *cat* is shown below:

```
cat > src/param.incl << EOF
     PARAMETER (.....)
     .....................
EOF
```

This creates a Fortran include file param.incl in the src/ directory and this include file will be used by a number of subroutines during compilation. As an example, the following is taken from *terrain.deck*:

```
cat > src/parame.incl.tmp << EOF
C IIMX,JJMX are the maximum size of the domains, NSIZE = IIMX*JJMX
        PARAMETER (IIMX = 136, JJMX = 181, NSIZE = IIMX*JJMX)
EOF
```

2.8.3 Fortran Namelist

The MM5 modeling system uses FORTRAN namelist to provide a way of selecting different options without re-compiling the program. The unix ***cat*** command is used to create namelist files from the shell script during the execution of the shell script. The variables in the namelist are described in detail in other chapters of this document specific to those individual programs. The format is the following

```
cat >! xxxx << EOF
&......
```

```
.........
& ;------------------------------------
EOF
```

Where xxxx is the name of the namelist. Since the namelist is not a ANSI 77 standard, the FORTRAN 77 compiler used by different machines may have different syntax for the namelist. The following is an example of namelist MAPBG from program TERRAIN:

```
&MAPBG
 PHIC  =   36.0,       ; CENTRAL LATITUDE (minus for southern hemesphere)
 XLONC =  -85.0,       ; CENTRAL LONGITUDE (minus for western hemesphere)
 IEXP  =    .T.,       ; .T. EXTENDED COARSE DOMAIN, .F. NOT EXTENDED.
 AEXP  =   360.,       ; APPROX EXPANSION(KM)
 IPROJ = 'LAMCON',     ; MAP PROJECTION
&END
```

After the user has 1) correctly set the shell variables, 2) modified the parameter statements, and 3) set up the FORTRAN namelist, there is typically no more user modification required in the deck. The rest of the script can be treated as a black box.

2.9 How to build the executable and run the program?

After you edit the deck or script, type

x.deck

or

x.csh

to run the program. Depending on how the deck or script is constructed, it will typically compile the code, create an executable, link files, and run the program.

2.9.1 Creating FORTRAN Executable

Typically if you need to set up parameter statement in a job deck/script, the command to create the executable is built in the deck/script. Again REGRID is the only exception that you can compile the code by typing make in the appropriate directory.

Unix make utility is used to generate FORTRAN executable in the MM5 modeling system. The rules and compile options a *make* command uses are contained in the file: *configure.make* for programs TERRAIN, RAWINS, INTERP and GRAPH, *Makefile* and *configure.rules* for REGRID and little_r, and *configure.user* for program MM5. For more information on make, please see Chapters 3 and 10 of this document.

2.9.2 Linking files to Fortran units

Files with file names are typically linked to Fortran units prior to execution of the program. For example,

```
ln -s ter.30 fort.23
```

This command makes a soft ‘link’ between filename ter.30 and Fortran-unit number 23.

2.9.3 Execution

```
timex X.exe >&! X.print.out
```

Where X is the program name. And Unix command timex is used to get a timing of the executable run. Example:

```
#
#        run MM5
#
timex mm5.exe >&! mm5.print.out
```

At the end of your mm5.print.out file, you will see something like:

```
real    1028.8
user    1009.7
sys     2.4
```

which tells you how long the mm5 job has taken in terms of wallclock time (real).

2.10 Output Files

When a job is completed, certain output files are generated. It is up to the user to archive the output. If you want to keep the output files, move them to a disk where you can keep them. If you run the same program again, these files will be overwritten.

2.11 Representation of date in MM5 modeling system programs

Date is represented in the MM5 modeling system programs by what we call MDATE, which is a 8-digit integer denoting YYMMDDHH. For example, 1200 UTC 15 June 1999 is represented as 99061512 in the model. Note that all model times are referring to Universal Time or Greenwich Mean Time, and not local time.

2.12 Where to Find Data at NCAR?

Mesouser provides catalogs of data MM5 modeling system programs REGRID and RAWINS/ little_r use in mesouser directory ~mesouser/catalog on NCAR’s Cray, or anonymous ftp’s / mesouser/catalog. These catalogs are copies from the Data Support Section of NCAR/SCD from

ftp://ncardata.ucar.edu/datasets/dsNNN.x where NNN.x is a dataset identifier. Most datasets that MM5 uses are listed below:

Dataset Identifier	Dataset Name
DS111.2	ECMWF TOGA GLOBAL SFC & UPPER AIR ANALS, DAILY 1985-CON
DS082.0	NCEP GLOBAL TROPO ANALS, DAILY 1976JUL-1997MAR
DS083.0	NCEP GLOBAL TROPO ANALS, DAILY 1997MAY-CON (GRIB)
DS240.0	U.S. NAVY FNOC N.HEM SEA SFC TEMP ANALS, DAILY 1961NOV-1993DEC
DS353.1	NCEP ADP GLOBAL UPPER AIR OBS (MIXED), DAILY 1985-1997APR
DS353.4	NCEP ADP GLOBAL UPPER AIR OBS SUBSETS, DAILY 1973-CON
DS464.0	NCEP ADP GLOBAL SFC OBS, DAILY JUL1976-CON

Information on NCEP/NCAR Reanalysis Project can be found at URL

http://www.scd.ucar.edu/dss/pub/reanalysis/index.html

and on European Center Reanalysis at URL

http://www.scd.ucar.edu/dss/pub/ec-reanalysis.html

A sample of the catalog for NCEP dataset DS083.0 is shown below:

```
Y47606         1998OCT01-1998OCT31, 12524 BLKS,  86.0MB
Y48077         1998NOV01-1998NOV30, 12120 BLKS,  83.3MB
Y48277         1998DEC01-1998DEC31, 12524 BLKS,  85.9MB
```

The MSS filenames correspond to these files are

```
/DSS/Y47606
/DSS/Y48077
/DSS/Y48277
```

A sample of the catalog for NCEP Global upper air observation dataset DS343.4 looks like

```
Y47652    1998OCT01-1998OCT31,  9096 BLKS                LIST A98
Y48086    1998NOV01-1998NOV30,  8688 BLKS                LIST A98
Y48286    1998DEC01-1998DEC31,  8541 BLKS, SEE NOTES - LIST A98
          NOTE:ADPUPA 1998DEC15 MISSING                  LIST A98
```

Similarly, the MSS file name corresponding to the Oct 1998 dataset is

```
/DSS/Y47625
```

File specifics for all global analysis used as input to REGRID are no longer required. Shell scripts are provided to access the data MASTER file (same file as in mesouser/catalog/catalog.*), find the

MSS file names, and obtain them based user selected data source and date. If you run RAWINS at your local computer, you will still need to go to the catalog, find the file name on MSS, and access them from NCAR's computer. Note that you need to use -fBI option with msread to obtain observations to be used on your workstation. A small utility program, *fetch.csh*, may be used to obtain observational data too.

If you don't have access to NCAR's data, you need to consider where you can obtain similar data to run the modeling system.