

INTRODUCING A NEW HORIZONTAL INTERPOLATION PROGRAM TO THE MM5 MODELING SYSTEM PREPROCESSORS: A FLEXIBLE REPLACEMENT FOR PROGRAM DATAGRID

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1. Introduction

DATAGRID has been an important step in the preprocessors for the Penn State/NCAR Mesoscale Modeling system for about 15 years. The function of DATAGRID is to read archived, low-resolution global or hemispheric analyses and horizontally interpolate those analyses to an MM5 grid specified by the user, thereby creating analyses on the MM5 grid suitable for use as a first-guess field for later objective analysis. Historically, DATAGRID has accessed only a few data sets (archived on NCAR's Mass Storage System), and the specific requirements for handling each data set have been hard-wired into the DATAGRID code. However, over the years new data sets have become available, each with its own peculiarities as to how data are organized and how fields are to be interpreted. Due to the hard-wiring of DATAGRID to access specific data sets, modifying the existing DATAGRID code to recognize additional data sets has become impractical. The net effect of the increased coding convolutions is that it is not easy for users to import other analyses into the modeling system. Many duplicated efforts have been spent on writing programs to import widely available data sources (such as from the NCEP file server) into the MM5 system, not all of which MM5 group at NCAR anticipates formally supporting. This situation has effectively removed software support from researchers interested in real-time applications and from researchers using analyses from other national centers.

For these reasons, the authors have created a package to replace the obsolete DATAGRID. This package, dubbed "REGRID", was designed to be more flexible than DATAGRID, giving users an

easier method to use alternative data sets. The new package has been coded largely in FORTRAN90.

2. REGRID functioning

The key elements of the "REGRID" package are:

- A set of access programs, referred to as "pregrid programs", which read various gridded data sets and write them out in a specified format. Specific pregrid programs may be written for specific data sets, or if the original format is sufficiently well-defined, specific data formats.
- A single program, called "regridder", which reads the output of the pregrid programs, interpolates surface and pressure-level fields horizontally to the MM5 grid, and writes out the data in a DATAGRID format.
- A simple, intermediate data format for introducing analyses to the regridder program. This format is the link between the pregrid programs and the regridder.

This approach of partitioning the functional pieces of REGRID into two sections was selected for several reasons:

1. Separation of input tasks from the interpolation tasks removes the complicated code handling many types of input from the relatively straightforward task of interpolation.
2. Access programs could be (and have been) written for individual data sets, keeping the code for the input tasks relatively focused.
3. Data from different sources are easy to combine. This is most applicable to surface and soil-layer analyses which are not archived in all atmospheric analysis data sets.

4. All fields output from the pregrid programs are interpolated by the regridder and passed along to the rest of the modeling system.
5. Separate programs and the simple intermediate format allow users to readily introduce into the MM5 modeling system data sets which are not included in the set of supported data sources.
6. Users need only be concerned with the parts of the package required to format their particular data sets.
7. When user intervention is necessary, the modifications are located solely in an area where the user is a presumed expert – with the new data source.

This component approach does have disadvantages, as well:

1. Instead of a single program to maintain, there are now several programs.
2. More complicated shell-scripts are needed to manage multiple programs.

There are incidental advantages to a recoding of the package to supersede DATAGRID:

1. Due to the use of standard FORTRAN 90 capabilities, the code does not require recompilation for varying MM5 grid sizes.
2. The new code is designed to be portable.
3. Generalization of the TERRAIN data (with more than 50 2-d fields) did not require modification of the DATAGRID legacy code.
4. The header definition of the intermediate format has been tailored to reflect the information available in the traditional GRIB format data sets. Many of the GRIB data sets are now examples of specific instances of a generic template that is intended to be supported.

3. Intermediate format

The key to the new interpolation package is the intermediate format. Each file in the intermediate format contains data for a single time. There may be any number of valid files for a given time. Each file may contain any number of horizontal slabs of data. The slabs in a given file need not necessarily be all from the same data source, or all on the same map projection, but they all represent analyses at the same time. Each slab of data is preceded by several header variables which describe the slab.

These files are read and written with unformatted FORTRAN read and write statements.

The header records (approximately 150 bytes) include information such as:

- Parameters describing the grid and projection of the input slab. Currently, the recognized projections are:
 - Regular latitude/longitude (cylindrical equidistant), which also serves as an approximation to gaussian grids.
 - Polar stereographic.
 - Lambert conformal.
- The pressure level of the given slab.
- The name, units and description of the analysis variable stored in the slab.

A more detailed description of the intermediate format may be found in the documentation included in the tar file available via anonymous FTP (as noted in section 5).

4. Data sets currently handled by the REGRID package

The REGRID package is currently under active development. The first priority of the new package was to match the major capabilities of the old DATAGRID program. Data sets currently handled by the pregrid programs are:

- NCEP GDAS analyses (in ON84 format, discontinued in April 1997).
- NCEP GDAS analyses (in GRIB format, beginning in April 1997).
- TOGA Basic level-III analyses. (GRIB)
- NCEP/NCAR Reanalysis Project analyses. (GRIB)
- NCEP ETA 212 forecast, available on OSO server. (GRIB)
- ECMWF Reanalysis (GRIB)
- Navy SST analyses.

In addition, we expect that many data sets in the GRIB format may be handled adequately by the GRIB decoding programs already included among the pregrid programs. Since most of the GRIB encoding programs define the domain similarly in the Grid Description Section (starting latitude and longitude, projection type, true latitude,

grid distance), the REGRID package is able to be quite robust.

The REGRID package is currently able to replicate many of the existing DATAGRID functions. These include the choice of input first-guess fields, output projections and nesting. A program has been written to allow the output from REGRID to have a format identical to that of a regular DATAGRID output file. The code is portable to several workstations and uses FORTRAN90 capabilities to remove parameterized dimensions as required input. New abilities that were not available in DATAGRID (primarily high-resolution first-guess choices), as well as the emphasis on the anticipated developments in the MM5 system, make the REGRID package attractive during this friendly-user stage.

- Ingest pressure-level data from the MM5 modeling system (i.e., output from DATAGRID, RAWINS, or back-end INTERP).
- Handle Mercator projections.

5. Where to find the REGRID package

With this workshop, we announce the release of the REGRID package for friendly users. Since the programs are still under development, we expect to have frequent and unannounced updates to the codes and driving shells. The latest version of the entire package can be accessed via anonymous ftp to ftp.ucar.edu.

```
# ftp ftp.ucar.edu
```

Log in as anonymous, with your complete e-mail address as the password.

```
# cd /mesouser/newprogs
# bin
# get regrid.tar
# quit
```

6. Future development

We expect the formal release of this package to coincide with the release of MM5 Version 3. The programs have yet to be thoroughly verified and only the initial cases have been processed with the MM5 model. The overall structure of the shells has yet to be determined. As with other recent code developments, the real-time community may be able to take early advantage of this package. The documentation for the user will be presented during the initial MM5 V3 tutorial sessions.

In the undefined near future, we hope to also include capabilities to: