1. Introduction

The PSU/NCAR mesoscale modeling system consists of a mesoscale model and several auxiliary programs that perform the pre-processing and post-processing of the input to and output from the forecast model (Fig. 1.1). The original TERRAIN program was written in 1977 by A. McNab. It has been revised several times. In 1985, Larkin et al. added a number of features and wrote the document "PROGRAM TERRAIN." At that time, TERRAIN was the second link in the chain of auxiliary programs. Since 1990, program MAPBKG, used to create plotting instructions for TERRAIN, was incorporated into TERRAIN. The TERRAIN program became the first component of the modeling system. That version of TERRAIN used the PSU/NCAR combined terrain height and land-use tape as input, and was able to create a maximum of two domains (coarse and fine) of terrain height and land-use data in certain areas of the globe.

From 1990-1993, the mesoscale model has been significantly improved, extended, and tested by scientists at both PSU and NCAR. The fifth-generation PSU/NCAR mesoscale model (Grell et al. 1993), referred to as the MM5 model, can be run on multiple-nest levels and multiple-nest domains. The MM5 model can generate the nested domain's initial conditions (including the terrain height and land use) by interpolating the coarse domain fields. However, such an interpolation does not take advantage of the nested domain's smaller grid length in resolving finer-scale terrain and land-use features. The importance of the details of topography and surface features in the generation of mesocale features has been justified by many studies. Therefore, a program that is able to provide a set of consistent high-resolution terrain height and land use for multiple-nest domains to the MM5 modeling system is essential.

Due to the multiple-nest requirement of the MM5 model and the availability of several new terrain height datasets, the TERRAIN program was rewritten in 1993. Below are the main features of new TERRAIN program:

1. Memory is dynamically allocated in the program, and a TERRAIN executable

file is used. No compilation is required for different model domain setups if users do not have their own modifications to TERRAIN.

2. In addition to the 1-degree, 30- and 10-minute datasets, two more types of terrain height datasets are available: global 5-minute data and USA 30-second data. Terrain height and land-use data are no longer combined together, but are in two separate data files.

3. Users have the option to let the program automatically choose the terrain and land-use data type.

4. Multiple-nest domains.**

5. If the nest type is one-way, users can select any nest ratio. If the nest type is two-way, then the nest ratio is always 3.

6. New procedure to adjust the terrain height and land-use categories along the nest boundaries. If the nest type is two-way, then the overlapping grid points have the same terrain height and land-use.

This document discusses in detail the program TERRAIN and is intended to provide users of the PSU/NCAR MM5 with an overview of the data sources and methods used in TERRAIN. Some instructions for running TERRAIN and the description of the TERRAIN source code are also provided. Chapters 1 and 4 are for users who are interested in knowing how to run the TERRAIN program. For users who need to add their own terrain height or land-use files as input to TERRAIN, Chapter 2 has detailed instructions on how to reconstruct the users' own data files. Chapter 3 describes the methods used in TERRAIN to obtain the final terrain height and land-use fields. Chapter 5 provides users specific information regarding the TERRAIN source code.

Comments and/or errors found in TERRAIN should be sent as soon as possible to the program manager at mesouser@ncar.ucar.edu.

** At this point, TERRAIN cannot generate high resolution terrain height and land-use if the domains are overlapping one another at the same nest level. For this situation, more code needs to be developed.

MM5 MODELING SYSTEM FLOW CHART

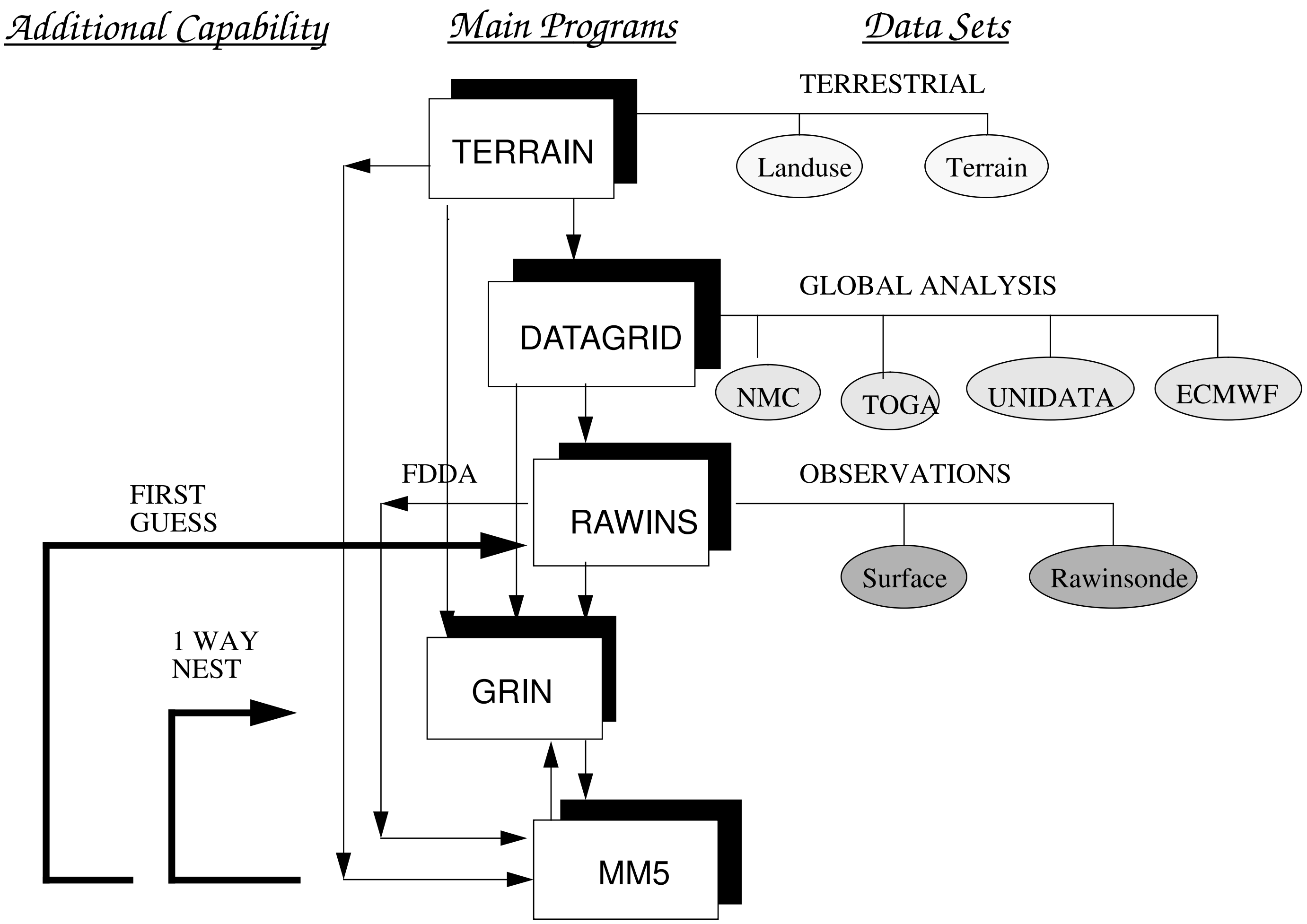

Figure 1.1 MM5 Modeling System Flow Chart