MM5 MODEL STATUS AND PLANS

Jimy Dudhia

NCAR/MMM/MPG

(dudhia@ucar.edu)

1. INTRODUCTION

MM5 Version 3.5 was released in December, 2001, and was described in last year's workshop. In December, 2002, we released Version 3.6, and here the changes for release 3.6 will be summarized.

2. CHANGES

Two major changes were added in Version 3.6. The new Noah LSM replaced the OSU LSM, and the Polar modifications were added.

2.1 Noah LSM

The Noah LSM represents a collective effort between NCAR, NCEP, and AFWA, to develop a unified land-surface model for the three centers and the user community. This LSM will also be made available in WRF in the near future. The Noah LSM is closely related to the previous Oregon State University version that MM5 has had since Version 3.0, but adds several changes that have been implemented in NCEP's operational version and AFWA AGRMET model.

New features of the Noah LSM include frozen-soil physics, physical snow height prediction, and the ability to read in albedo data. The snow module has been improved, and the tendency to lose snow too quickly has been mitigated. The new LSM is activated by *ISOIL=1*.

2.2 Polar Physics

Version 3.5 contained the first component of polar physics, which was the cloud-interactive version of the CCM2 radiation scheme. In Version 3.6, several more components have been added, based upon developments made for the Antarctic Mesoscale Prediction System (AMPS) at NCAR and Ohio State University.

Currently the polar physics only applies to use with the Eta PBL and the 5-layer soil model. The polar physics are designed for use in frozen or snow-covered regions, and modify the 5-layer soil model to 7 layers to help account for fluxes in deep snow, and within sea ice. Sea-ice fraction is also accounted for, and a sea-ice fraction can either be read in as part of the *LOWBDY* file, or diagnosed from the analyzed sea-surface temperature (*IEXSI* switch). In regions of fractional sea ice, part of the heat flux comes from open water, and part comes from the ice surface, which is important in obtaining reasonable fluxes in these areas. The *slab.F* routine has new parameters to better represent the snow/ice thermal conductivity. The Eta PBL scheme is also modified to account for latent heat of sublimation in the surface fluxes, and the separate sea-ice ground temperature.

Activating the *IPOLAR=1* switch in the *configure.user* file turns on the polar modifications. Another change activated by this switch is the use of the Meyers formula for ice number concentration in the simple-ice and Reisner 1 microphysics instead of the Fletcher formula. A general change to MM5's *LANDUSE.TBL* was to substantially decrease the roughness length and increase the albedo for the snow and ice categories.

2.3 Other Changes

The Reisner 2 graupel scheme has had substantial changes since 3.5. These are documented in the *exmoisg.F* file. There is also code (deactivated by default) that would allow the scheme to be less expensive by only calculating the majority of the processes every few time steps. This may save up to 10% of the run time, but much of the additional cost of this scheme over simpler microphysics is due to the advection and diffusion of a larger number of variables, and that cost remains significant.

Other smaller changes went into the Pleim-Xiu LSM, the MRF and Gayno-Seaman PBLs, the Betts-Miller and old Kain-Fritsch cumulus schemes. Also melting of snow was added properly in the new snow-cover prediction scheme that was released in 3.5. The new variable to control diffusion, *CKH*, was corrected to be a real number.

Version 3.6.1, released early in 2003, included a modification from John Nielsen-Gammon to the method by which the stable regime 2m and 10m diagnostic fields are calculated in the MRF and Blackadar PBL schemes (this does not affect other results). This change leads to cooler night-time 2m temperatures, and weaker night-time winds, that generally improves verification scores. This new method is activated by the namelist choice *ISFMTHD=1*, which is now the default.

3. FUTURE CHANGES

While WRF is being ramped up as NCAR/MPG's primary supported mesoscale model, MM5's development is ramping down, and major changes are not foreseen for MM5 this year. The polar modifications are due to be extended to the MRF PBL, and it is possible that improvements made to the diffusion for complex topography by Guenther Zaengl will make it into a future MM5 version, given sufficient resources to add these.

Work for the AMPS system includes adding an absorbing layer option at the model top as an alternative to the upper radiative condition, and this development may also be part of a future release.

Version 3.7 will consolidate recent fixes, and will likely be released with some or all of the above changes towards the end of 2003.