P1.61 FORECASTER TRAINING ON THE NCEP NORTH AMERICAN MESOSCALE (NAM) WEATHER RESEARCH AND FORECASTING (WRF) MODEL

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1. INTRODUCTION

The Cooperative Program for Operational Meteorology, Education and Training (COMET®) Program is developing training on the Weather Research and Forecasting (WRF) model configuration which the National Centers for Environmental Prediction (NCEP) will run in place of the Eta model after March 2006 in the slot labeled North American Mesoscale (NAM). This training will have the same variety of components which other COMET training on Numerical Weather Prediction (NWP) has, e.g. see Bua and Jascourt (2005), Jascourt and Bua (2004). COMET training on NWP is free and available online. Most items will be listed on the MetEd web page at http://meted.ucar.edu under the topic "NWP".

The purpose of the training is to familiarize forecasters with the capabilities, limitations, and error characteristics of the WRF model in order to allow its most effective utilization as a forecast tool in the human forecast process. Forecasters have been using the NCEP Eta model (renamed NAM or NAM-Eta in January 2005) since 1993 (Black, et. al., 1993) and had to account for many changes (NCEP, 2004 and COMET, 2005) to the model physics, grid spacing (80 km down to 12 km), data assimilation (addition of radar data, higher-resolution SST, other remote sensing data, moving from Optimum Interpolation to 3d-var and changes in the 3d-var), output fields, and forecast duration (48 to 84 hours) and run frequency (every 12 hours to every 6 hours). In recent years, the COMET Operational Model Matrix at http://meted.ucar.edu/nwp/pcu2 and other COMET training, such as teletraining about the extension of the Eta model forecast period to 8 days (see http://rammb.cira.colostate.edu/visit/dgex.html), have helped translate model changes into the context of the field forecaster, facilitating better use of the models.

The training may also be a helpful supplement in some academic courses, though it certainly will not serve as a substitute for a rigorous curriculum. The focus will be on forecast application of the particular configuration used by NCEP in the NAM slot, not on the multitude of configurations possible nor will it contain information regarding setting up runs for research experiments.

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2. ABOUT THE NCEP NAM-WRF

The WRF model (WRF, 2005) consists of a variety of dynamic cores, physics packages, and sources for the initial state, all in a unified software and postprocessing structure. The NCEP NAM-WRF (Janjic, 2004) is based on the NCEP Nonhydrostatic Mesoscale Model (NMM) following the method of Janjic (2001). Details are still evolving, but generally speaking, the operational version to be implemented in March 2006 is anticipated to run with 10-km grid spacing using nonhydrostatic dynamics with terrain-following sigma-pressure hybrid vertical coordinate, physics similar to what is now in the operational NAM-Eta model, and initial conditions based on the new Grid-point Statistical Interpolation (GSI).

The NMM has been running for several years on a daily basis over regional domains at 8-km and 10-km grid spacings using initial conditions from the Eta model (e.g., Black and Michalakes, 2004). The dynamic core and physics packages are rather similar to those anticipated for the NAM-WRF implementation, with the primary model differences being the source of initial conditions and the domain size. Thus, a considerable data base and many case examples already exist for evaluating some aspects of the forecasts likely to be produced by the NAM-WRF. Better comparisons against the NAM-Eta will be possible when the tests begin soon with the NAM-WRF cycling on itself using the GSI over a large domain.

3. EXISTING TRAINING

The NMM has been running for a couple years over selectable (daily-varying) small domains to help with seasonal small-scale forecast problems, particularly for fire weather forecasting during summer and autumn. A VISITview lesson (Mostek, et. al., 2004) was developed for this application (Jascourt, 2004a) and can be accessed at http://meted.comet.ucar.edu/resource/soo/html/1181.htm . The lesson focuses on comparing the NMM forecast to the Eta forecast, explaining the reasons for differences and similarities and examining a case in detail. For example, slide captures in Figure 1 and Figure 2 discuss features of the model and their forecast impacts, while Figure 3 shows a comparison of the NMM and Eta temperatures with mesonet observations and Figure 4, valid at the same time, zooms in on a feature of topical relevance that is quite different in the two models.

Model component	8-km NMM vs. 12-km Eta	Forecast Impact
Initial Conditions	Same (except for time filter)	Large-scale forecast same
Boundary Conditions	NMM uses Eta forecast	Large-scale forecast same
Topography	More detail in NMM, esp. valleys	Local flows very different
Vertical coordinate, vertical resolution	NMM is terrain-following. Lowlands=same vert res Highlands=NMM superior	2-m T, Td/RH and 10-m wind should be better in NMM
Numerics	NMM has less damping and less diffusion	More structure/detail in NMM at same res.
Dynamics	NMM=Nonhydrostatic	Mountain waves, less diffusion needed
Physics	Basics same, but versions not – see chart	Tuned for Eta, not NMM

Figure 1. From NMM training VISIT lesson

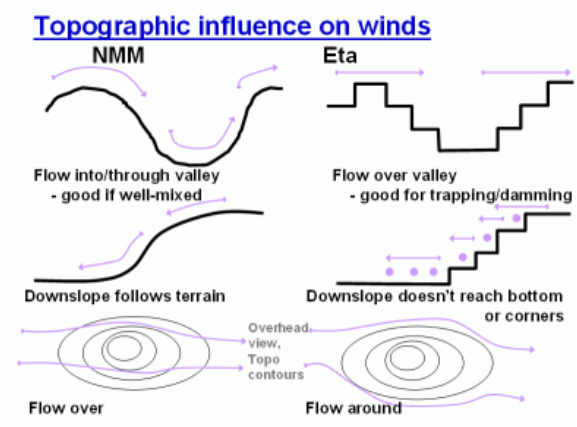


Figure 2. From NMM training VISIT lesson

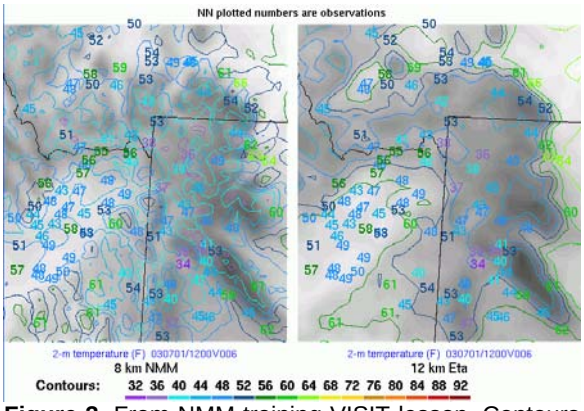


Figure 3. From NMM training VISIT lesson. Contours are forecast temperatures while observations are plotted numbers using the same color scale. Background is model topography, shaded monotonically from light to dark with increasing elevation, with the same shade representing the same height in each model. The area depicted is western WY, eastern ID, and southern MT.

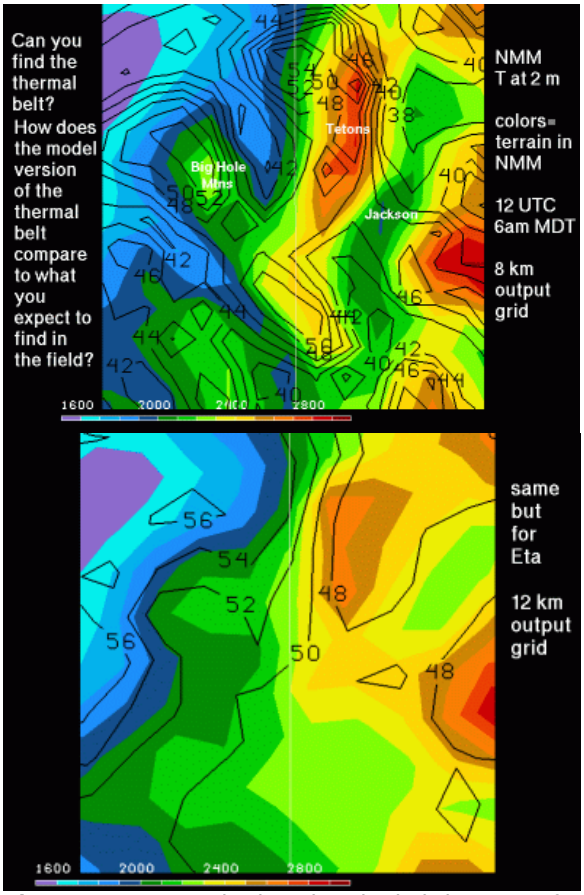
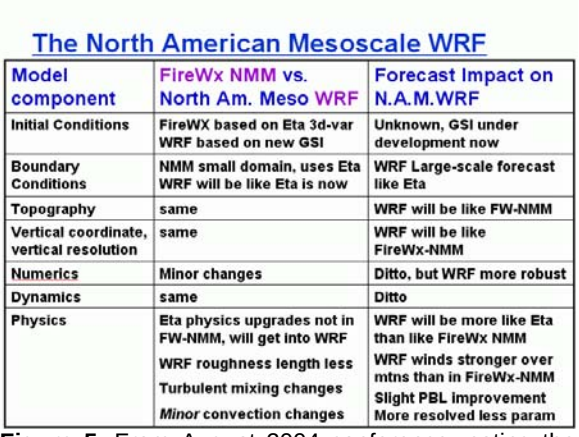


Figure 4. Topography is color shaded the same for each model and isotherms are drawn with a contour increment of 2^{o} F. The area is near the center of Figure 3 for the same valid time. The vertical white line in the middle is the ID-WY border.

A broad-brush operationally-oriented overview on WRF including plans for NAM-WRF and COMET training on it was given at the Great Lakes Workshop (Jascourt, 2004b) and an annotated version is available on the conference CD compiled and distributed by Tom Niziol of the Buffalo NWS Office. It contains a slide shown in Figure 5, bridging the fire weather NMM to the anticipated NAM-WRF.



The North American Mesoscale WRF

Model component	FireWx NMM vs. North Am. Meso WRF	Forecast Impact on N.A.M.WRF
Initial Conditions	FireWX based on Eta 3d-var WRF based on new GSI	Unknown, GSI under development now
Boundary Conditions	NMM small domain, uses Eta WRF will be like Eta is now	WRF Large-scale forecast like Eta
Topography	same	WRF will be like FW-NMM
Vertical coordinate, vertical resolution	same	WRF will be like FireWx-NMM
Numerics	Minor changes	Ditto, but WRF more robust
Dynamics	same	Ditto
Physics	Eta physics upgrades not in FW-NMM, will get into WRF WRF roughness length less Turbulent mixing changes *Minor* convection changes	WRF will be more like Eta than like FireWx NMM WRF winds stronger over mtns than in FireWx-NMM Slight PBL improvement More resolved less param

Figure 5. From August 2004 conference, noting the similarities and differences between the fire weather NMM runs and the anticipated NAM-WRF.

Training on the experimental explicit-convection higher-resolution runs of the WRF using the NCEP core and physics and the NCAR core and physics was developed by Gary Lackmann (Lackmann, 2004) and is available online at http://www.meas.ncsu.edu/nws/www/training/ .

4. TRAINING UNDER DEVELOPMENT

To find training when it has been developed, search under the "NWP" topic on the COMET MetEd home page at http://meted.ucar.edu/ .

4.1 Background information for viewing parallel tests

NCEP will soon start generating NAM-WRF runs, cycling on itself using a GSI analysis, in parallel with NAM-Eta runs for forecasters to evaluate in side-by-side comparison. To assist forecasters in their interpretation and expectations, information will be provided on how differences in the model components manifest in forecast differences. Case examples illustrating such differences for phenomena of regional interest (varying geographically) will be included. This training will be similar to the existing training except it will be updated and will have a greater variety of example types but less in-depth examination of each.

4.2 Near real-time discussion board

Presently, COMET has two NWP newsgroups: http://meted.ucar.edu/nwp/newsgroups/index.htm but lively discussion had seldom occurred. They will be reformatted with some similarities to the RUC Forum http://ruc.fsl.noaa.gov/forum/eval/ such as email notification of new posts to anyone who signs up for such notification. The goal will be to have near real-time discussion about notable aspects of NAM-WRF forecast comparisons against the NAM-Eta, not every day, but as interesting new types of examples arise which have important forecast impact. This is expected to become available during fall or winter.

4.3 Updating the COMET Operational Models Matrix

The COMET Operational Models Matrix shown in Figure 6 contains concept modules about how different components of NWP models work and specific information about how those components are set up and their forecast impacts in a variety of current operational NWP models. These will be updated for the NAM-WRF. The expanded nonhydrostatic section in the "Model Type" module in the left column may be available in Fall 2005, while the full column of NAM-WRF details may not be ready until around the time NCEP implements the model operationally.

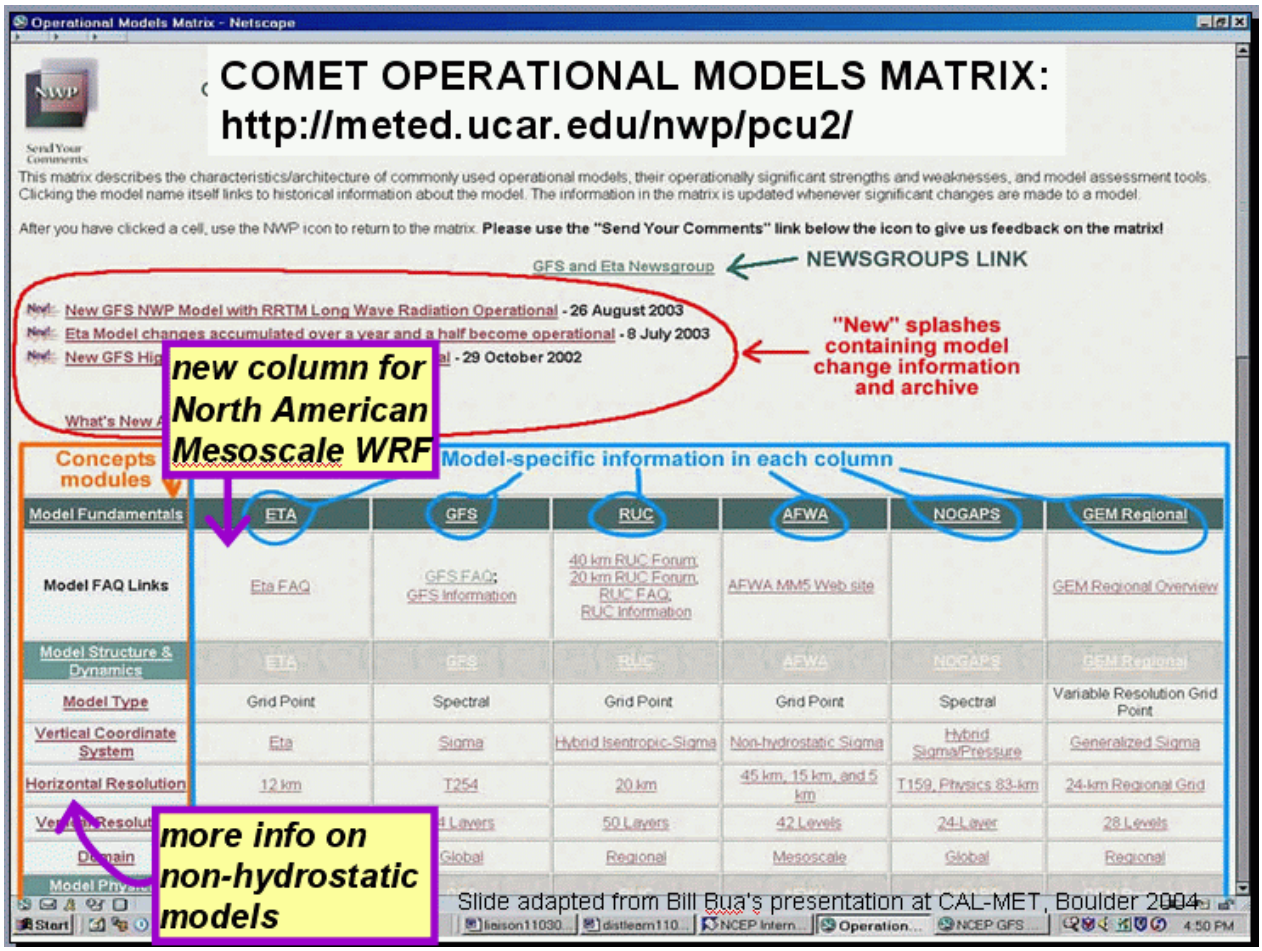


Figure 6. WRF updates planned to the COMET Operational Models Matrix

4.4 VISITview lessons on operationally significant practical results

One or more live teletraining lessons will be developed and delivered on a repeated basis during the time leading up to operational implementation of the NAM-WRF in order to finalize field office preparations for understanding how the model performs. The focus will be on changes in error characteristics and phenomenological predictability compared to the NAM-Eta model, with which forecasters already are highly familiar. Heavy use will be made of case examples with observations to verify the model analyses and forecasts. A version with audio and annotations will be developed and publicly available after the usual revision period as improvements are made based on feedback from early sessions and time is needed to prepare the recorded version. The lesson files linked from http://rammb.cira.colostate.edu/visit/ts.html are self-contained and can be downloaded and unzipped into their own folder and viewed without any special software required (they do use java).

5. ACKNOWLEDGEMENTS

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