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# NCEP CLASS VIII UPGRADE AND OPERATIONAL MODEL SUITE CHANGES

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## Introduction

The National Centers for Environmental Prediction (NCEP) are currently undergoing an operational upgrade to the Class VIII supercomputer (IBM SP). This hardware upgrade will motivate a move of the operational model and guidance suites to the new system as well as a series of proposed modifications to the models themselves. This Technical Attachment documents the scheduling of the supercomputer upgrade and transfer of operations in addition to the proposed modifications to the models and MOS guidance.

## Class VIII Upgrade

The upgrade to the new IBM supercomputer is to occur in two phases. The phase I installation was completed at the end of March 1999. This system is a massively parallel machine consisting of 768 processors. The phase I implementation of the Class VIII machine is approximately 4.3 times faster than the Cray C-90. Even though the installation of the phase I system is complete, a facility problem may, in fact, delay the operations move to late summer 1999. The phase II installation is scheduled to be completed by the end of September 2000. Again, the phase II implementation is a massively parallel system consisting of 2048 processors. This configuration is approximately 28.6 times faster than the C-90, and represents the largest increase in computing power over the current operational suite. The increased performance not only provides the means for improvement to the operational model suites, but more importantly allows for proper parallel testing of these improvements. This caveat may have the largest impact on operations and the field forecasters, meaning that the only changes noticed by the forecaster should be improvements in the quality of model guidance.

## Eta Changes

The Eta model has undergone significant development in recent years (Mittelstadt, 1998) and it should not be surprising to note that this evolution is likely to continue throughout its remaining lifetime. In the near term, several sets of significant changes have been proposed

to occur throughout the next year. These intended upgrades are presented and briefly described below. The first group of changes will occur in conjunction with the move of the operational Eta suite to the new computer platform by late summer 1999. The second group is proposed for late fall 1999 and a third, possible group of changes, is tentatively planned in association with the phase II upgrade in late summer or fall 2000.

Change Group 1 (Late Summer 1999)

Eta operational move

- Eta - Equilibrium profile adjustment
- Eta - Elevated convection change
- Eta - Larger domain
- Eta - 03 UTC run moved to 06 UTC
- Eta - Extended lead-time (F072 - 00z and 12z runs)

Change Group 2 (Late Fall 1999)

- Eta - Increased resolution (22km/50 levels)
- Eta/3DVAR - Assimilation of observed ppt and clouds

Change Group 3 (Summer/Fall 2000)

- Eta - Increased resolution (16-12km)
- Eta/3DVAR - Hourly updates
- Eta/3DVAR - Assimilation of WSR-88D radial velocities
- Eta/3DVAR - Assimilation of GOES radiances

The first group of changes is represented primarily by an increased domain size (nearly the areal coverage of the 48-km version of the early Eta) in addition to improvements to the convective parameterization. The Betts-Miller-Janic (BMJ) convective scheme will be modified to allow for the use of a more reasonable saturation point deficit (DSP) within the equilibrium profiles. This is intended to remove the positive bias seen in coastal areas within the parameterization. In addition, an elevated convection fix is included in the change group, allowing for a lower cloud depth threshold (200 hPa as opposed to 290 hPa). This will have the greatest impact in the Eta convective precipitation estimates over the western United States, allowing for more convection over higher terrain. The second group of changes includes an increase in horizontal and vertical resolution (22 km and 50 levels) as well as the addition of observed precipitation and clouds in the model initialization (3DVAR). This assimilation is done using a simple scheme and will improve the soil moisture package and eliminate erroneously forecasted clouds at different levels (without the ability to grow clouds). Finally, a third proposed group of changes (probably with the phase II implementation) will include an increase in horizontal resolution (12 to 16 km depending on computer resources) as well as the addition of WSR-88D radial velocities, GOES radiances, and hourly updates to 3DVAR. The addition of non-radiosonde upper-level winds will most benefit the off-hour initializations (0600 and 1800 UTC).

## MRF/AVN Changes

The operational MRF/AVN Analysis and Forecast system has undergone several upgrades and enhancements (Nelson, 1998) during its life span, and, like the Eta, will continue to evolve in the years to come. Plans for the implementation of enhancements to the MRF/AVN system, with respect to the current upgrade to the IBM SP, are presented and discussed briefly below. The first change group will occur with the operational move of the MRF/AVN system to the phase I system by late summer 1999. Other proposed enhancements represent the ongoing upgrade process and have no definite dates attached to them.

Change Group 1 (Late Summer 1999):

MRF/AVN operational move

- MRF/AVN - Increase resolution to T170/ 42 levels (F078-AVN and F168 - MRF)

Proposed Future Changes:

- MRF/AVN - Vertical resolution increase
- MRF/AVN - Horizontal resolution increase to T254 (2001?)
- MRF/AVN - Cloud water scheme
- MRF/AVN - Radiation scheme adjustment
- MRF - Satellite derived ppt - tropics
- AVN - Extended lead-time, 5 days (F120)

The change package scheduled with the operational move late this summer represents a return to the higher resolution version implemented the previous June of 1998. This upgrade was withdrawn due to poor performance, and an emergency change was issued operationally in early October 1998. The modifications from the October package, which include increased iterations within the analysis, improved ice albedo, heat/momentum roughness-length corrections, and an adjustment to observation error variances are to be retained in the latest upgrade. The MRF will run at T170 and 42 levels out to seven days (F168) and at T62 and 28 levels out to sixteen days (F384). The AVN will run at T170 and 42 levels out to F078. The increased resolution will result in a better fit of the model analysis to the observations and improved short-range forecasts. Future enhancements will include increased resolution both horizontally and vertically, improvements to the cloud water and radiation schemes, added observation assimilation (ppt), and extended lead-times (F120 in the case of the AVN).

## NGM and MOS Guidance

Unlike the Eta and MRF/AVN, the NGM has seen little development since its induction. In April 1999, the Committee on Analysis and Forecast Techniques Implementation (CAFTI) recommended that NCEP move the operational NGM to the class VIII IBM machine. Technical constraints on the new supercomputer require that the model be run in a limited fashion on a single node. Because of this restriction, the NGM will be configured such that initial conditions

are obtained from the Eta analysis and lateral boundary conditions from the previous AVN run (single, one-way nest). This new configuration will be transferred to the Class VIII machine after sufficient testing (as early as August 1999) and will continue to run for at least a year until AVN MOS is fully developed and tested. Additional information regarding MOS guidance development can be found at:

**http://www.ncep.noaa.gov/NCO/PMB/announcements/ngmwkshp.html**

MOS Guidance Development:

NGM operational move (Late Summer 1999)

- Experimental AVN MOS package (Fall 1999)
- Operational AVN MOS package (Spring 2000)
- MRF MOS package upgrades
- Eta severe weather MOS package development.

The AVN MOS guidance will include the same weather elements and forecast intervals as the current package, however, this guidance will be valid at over 1000 sites and extend out to 72-h lead-times (0000 and 1200 UTC intializations). Additional plans for the implementation of 0600 and 1800 UTC initialized products are being discussed. Future MRF MOS guidance upgrades will include an identical station package as AVN MOS, additional temperature and dewpoint products as well as possible implementations of 10-day lead-times and QPF products (12-h and 24-h accumulations out to 5 days). Although there are no intentions to develop a complete Eta package, some work is being done to implement an Eta-based guidance system that will produce severe weather and thunderstorm products.

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## References

Mittelstadt, J., 1998: The Eta-32 Model. WR-Technical Attachment 98-03.

Nelson, J. A., 1998: The AVN/MRF Model Enhancements. WR-Technical Attachment 98-22.