JP 1.7 COMPARISON BETWEEN THE PERFORMANCE OF ETA AND SIGMA MODES IN THE NCEP MESO ETA MODEL

Hui-Ya Chuang*[1] Geoffrey DiMego[2] Tom Black[2]
[1]General Science Corporation [2]NCEP, EMC

1. INTRODUCTION

Recent studies indicated that the step mountain representation used in the NCEP Meso Eta Model may have difficulty simulating flows in the mountainous regions at higher resolutions. McDonald et al. (1998) noted that the Eta model predicted wind speeds less than observed in all three downslope windstorm cases that occurred in January of 1997. By performing 2-dimensional idealized experiments, Gallus and Klemp (1999) concluded that flow separation may develop above the lee side of the mountain when step mountain vertical coordinate is used. Janjic et al. (2001) found that downslope windstorm case documented by Mcdonald et al. was better predicted by the sigma mode than the eta mode in the NCEP Meso Eta Model.

The use of the terrain following sigma coordinate, however, could have contributed to forecast errors in the event of lee cyclongenesis according to earlier studies. Mesinger and Black (1992) indicated that the eta mode provides better forecast than the sigma mode in the NCEP Meso Eta Model after examining three lee cyclongenesis cases.

Tests have begun which will examine the performance of the sigma vs. eta modes in the NCEP Meso Eta Model. The sigma mode may later be replaced by the newly developed hybrid mode which uses the sigma vertical coordinate in the lower atmosphere and uses pressure in the upper atmosphere. The objective of this paper is to present the preliminary results of these tests. Investigation will focus on how well the eta and hybrid modes simulate downslope windstorm and lee cyclongenesis.

2. INITIAL CONDITIONS AND MODEL SETUP

The initial conditions (e.g., ICs) for the eta mode are generated as results of Eta data assimulation system. An interpolation package is then applied to the eta ICs to transform ICs onto sigma coordinate. The terrain heights for the sigma mode are slightly different from the ones for the eta mode due to the fact that eta terrain heights are adjusted to the nearest eta steps. Therefore, when sigma ground is lower than eta ground, extrapolation is required to obtain fields on lowest few sigma levels.

The operational version of Eta model is used to perform simulations for both eta and sigma modes. The current operational 22 km domain with 50 vertical levels is used to simulate the lee cyclongenesis cases. Higher resolution will be used when examining cases of downslope windstorm.

3. RESULTS AND CONCLUDING REMARKS

The first case chosen is one in which both sigma-based NGM and AVN Models failed to capture the effect of lee cyclongenesis in their 48 h forecast and predicted cyclones that were too far north of its actual location in the eastern-central part of the Kansas. The operational Meso Eta Model, on the other hand, provided a much better forecast. The simulation results of the sigma mode in the Meso Eta Model show a lot of similarities to the operational Meso Eta run in both mass and momentum fields. As shown in Fig. 1, the surface low in the sigma run of the Eta model, unlike the forecast in the NGM and AVN, is almost as close to the actual location as the one in the operational Meso Eta run. This suggests that the major reason for the differences between the operational Meso Eta Model forecast and the NGM and AVN forecasts may not be the representation of mountains.

The work is in progress to evaluate the capability of eta and hybrid modes to reproduce downslope windstorm. The results will be presented.

4. REFERENCES

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* Corresponding author address: Hui-Ya Chuang, EMC/NCEP, room 207, 5200 Auth RD., Camp Springs, MD 20746; e-mail: hchuang@ncep.noaa.gov.

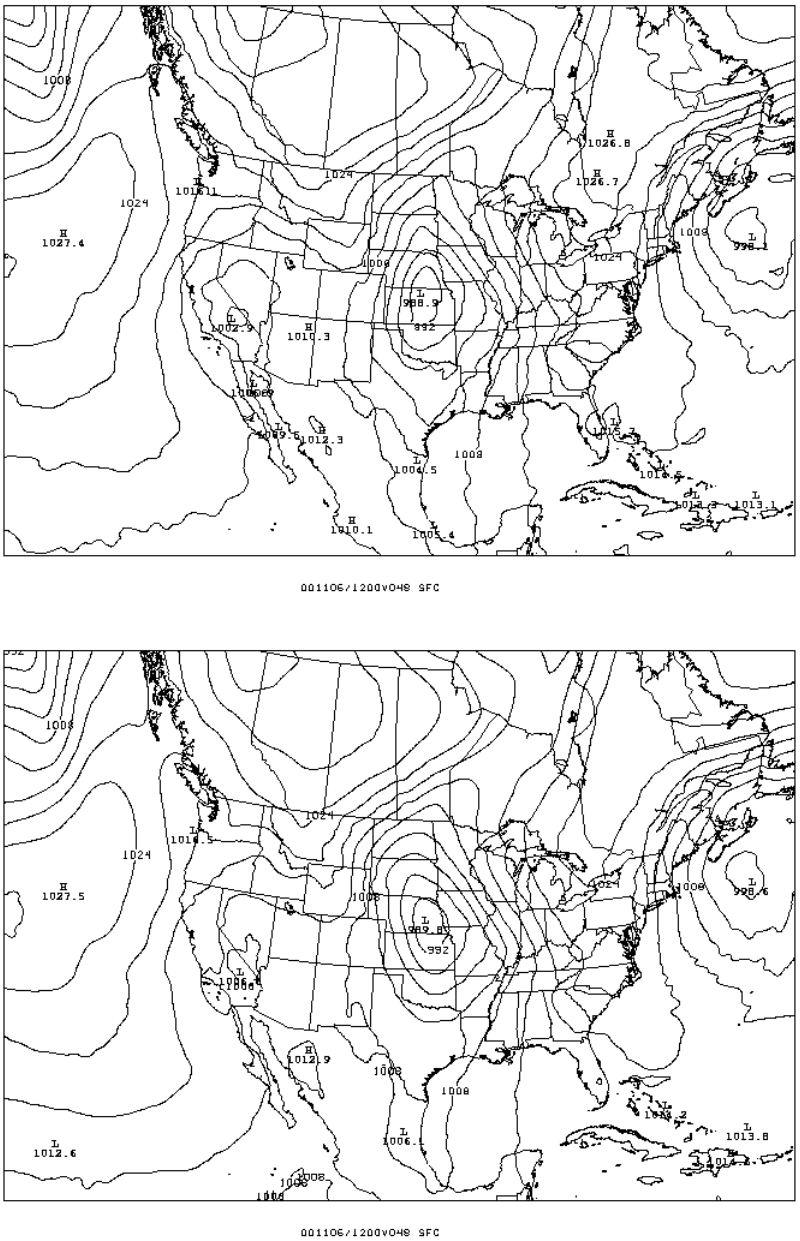

Fig. 1 Simulated 48 h sea level pressure for the eta mode (top) and sigma mode (bottom). Contour interval is 4 hPa.

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