Limited Area Predictability: Can "Upscaling" also Take Place?

Fedor Mesinger*, Keith Brill^, Hui-ya Chuang+, Geoff DiMego#, and Eric Rogers#

* NCEP/EMC and UCAR; ^ NCEP/CPC; + NCEP/EMC and SAIC; # NCEP/EMC, Camp Springs, Maryland

Introduction. A standard situation in all major forecasting centers is the existence of a global and of at least one regional, or "limited-area" forecasting system, with the latter using the lateral boundary data forecast by the former. Yet, the strategies as to what is apparently expected of the limited-area models (LAMs) can be radically different. For example, at the U.K. Met Office (Fig. 1, Staniforth 2001) and at various ALADIN partners (Fig. 1, Members of the ALADIN international team 1997) LAM domains of the order of 2000 x 2000 km and even smaller are used. In contrast, the operational Eta at NCEP is run on a domain greater than 11500 x 8500 km. Is this done to have "the contamination at the lateral boundaries" (Laprise et al. 2000) as far away from the region of interest as possible, or does the Eta strategy imply an attempt to achieve not only downscaling, but an improvement in the large scales as well?

An additional factor in the Eta operational setup is that its lateral boundary condition is obtained from the previous run of the global (Avn) model, which is at the "on" times (00 and 12z) estimated to represent about an 8 h loss in accuracy. It takes a day or two at the most for some of the forecast jet-stream entering the western Eta boundary to reach the region of most interest, the contiguous United States. Shouldn't then at later forecast times the skill of the Eta fall behind that of the Avn of the same initial time? Recent extensions of the Eta forecasts at NCEP to 60 h and then, in April 2001, to 84 h, have much improved the possibilities for looking into these issues. We here present and summarize the results of three efforts in that direction: examination of precipitation threat scores, of the rms fits to raobs, and of the accuracy in placing the centers of major storms at later forecast times.

Precipitation scores. It was pointed out earlier that out to 48 h, and then out to 60 h (Fig. 5, Mesinger 2001) no signs of the deterioration of the Eta precipitation threat scores compared to those of the Avn were evident. At the time of this writing nine full months are available of the Eta scores out to 84 h. In Fig. 1 these nine months, May 2001-January 2002, of the Eta and the Avn threat scores are shown, for the sample of 00-24, 12-36, and 24-48 h, left panel, and that of the 36-60, 48-72, and 60-84 h forecasts, all verifying at 12z, right panel. There are more than 700 verifications in each of the panels. The advantage of the Eta over the Avn in the forecast periods going beyond the two days is seen to have remained overall just about the same as it was in the up to two day periods.

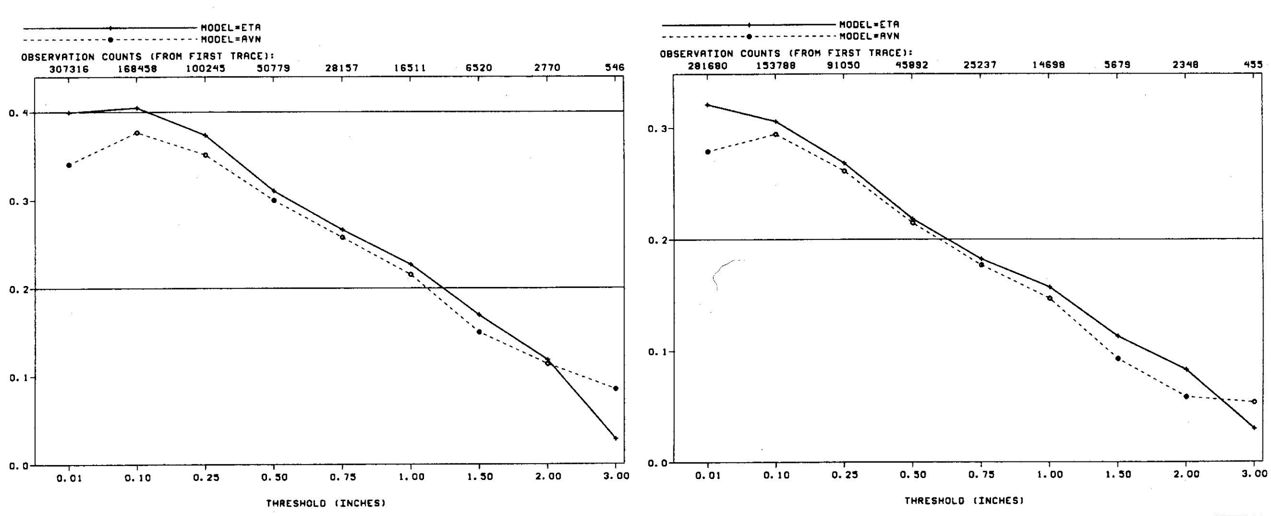

Fig. 1. Equitable precipitation threat scores of the Eta (solid) and the Avn (dashed lines), 00-24, 12-36, and 24-48 h forecasts, left panel, and 36-60, 48-72, and 60-84 h forecasts, right panel, May 2001-January 2002.

* *Corresponding author address*: Fedor Mesinger, NCEP Environmental Modeling Center, 5200 Auth Road, Room 207, Camp Springs, MD 20746-4304; e-mail: fedor.mesinger@noaa.gov

RMS fits to raobs. EMC Forecast Verification System offers numerous possibilities for compilation of various statistics of NCEP model forecasts' fits to data. RMS fits to raobs for the last 30 days for four forecast variables, including 250 mb winds, 500 mb heights, and 850 mb temperatures, are posted at http://sgi62.wwb.noaa.gov:8080/VSDB/. In compiling those, each model results are interpolated to an output grid; the Avn is interpolated to an 80-km grid ("211") while the Eta is interpolated to a 40-km grid ("212"). This presumably favors the Avn, but should not affect much the "error growth" rate.

Plots of the rms fits to raobs of the three variables mentioned, for spring 2001 out to 60 h, and for the summer 2001 out to 84 h, have been shown in Mesinger et al. (2002). No general tendency of the Eta "errors" to increase at later forecast times faster than those of the Avn was seen. In Fig. 2 we show rms plots for 250 mb winds, left panel, and 500 mb heights, right panel, for 00 and 12z verifications during December 2001-January 2002, the two full months of winter 2001-2002 available at the time of this writing. Even though in winter the inflow of the lateral boundary information is the fastest, the Eta "error growth" after 60 h happens to be in fact on both plots somewhat slower than that of the Avn's.

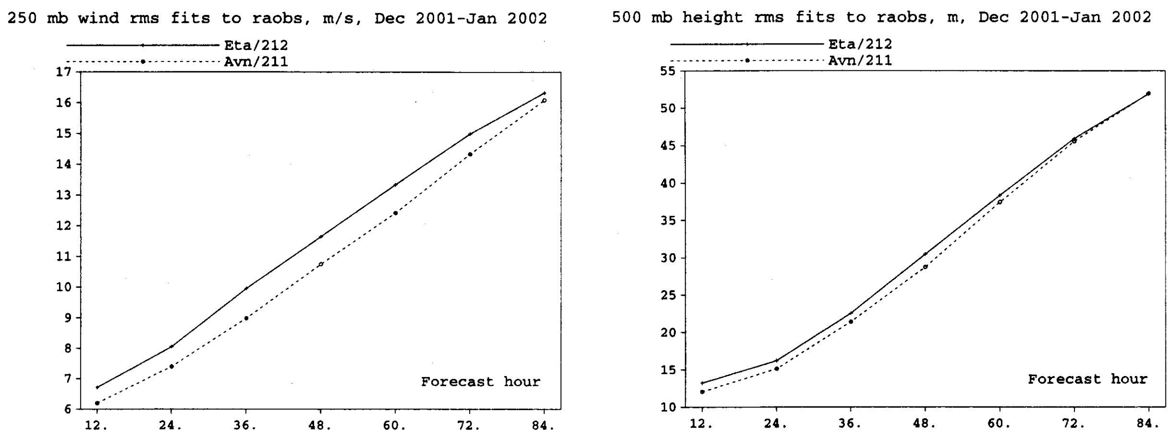

Fig 2. RMS fits to raobs, 250 mb winds (m/s, left) and 500 mb heights (m, right panel), for the Eta (solid) and the Avn (dashed lines) models, as a function of forecast hour, December 2001-January 2002.

Placing the centers of major storms. In (Mesinger et al. 2002) rules were set up for identification of major surface lows, and the accuracy of the Eta and the Avn in forecasting the positions of these centers at 60 h forecast time during December 2000-February 2001 was inspected. It was found that the Eta was considerably more accurate, winning about 2/3 of the 31 cases identified, and having a 100 km smaller median error. But when one case was rerun by the Eta switched to use the sigma coordinate (Fig. 2, Mesinger et al. 2002) the position error, at 48 h, increased from 215 to 315 km.

Concluding comments. Results shown and summarized indicate that the Eta is able to compensate for the inflow of the less accurate "old" Avn boundary condition, so that out to 3.5 day forecast time it remains competitive with the Avn of the same initial time. One experiment referred to suggests that the eta coordinate is a significant contributor to this ability.

The large-scale character of the various statistics presented and cited indicates that the Eta is indeed generally improving on the largest scales it can accommodate in its relatively large domain, of about 1/5 of the globe, over the Avn information it is receiving at its lateral boundaries.

References

Laprise, R., M. R. Varma, B. Denis, D. Caya, and I. Zawadzki, 2000, *Mon. Wea. Rev.*, **128**, 4149-4154.

Members of the ALADIN international team, 1997, *WMO Bull.*, **46**, 317-324.

Mesinger, F., 2001, *50th Anniversary of Numerical Weather Prediction Commemorative Symposium*, A. Spekat, Ed., European Meteor. Soc. (Carl-Heinrich-Becker-Weg 6-10, 12165 Berlin, Germany), 91-118.

Mesinger, F., K. Brill, H.-Y. Chuang, G. DiMego, and E. Rogers, 2002, *Symp. on Observations, Data Assimilation, and Probabilistic Prediction*, Orlando, FL, Amer. Meteor. Soc., J36-J41.

Staniforth, A., 2001, *50th Anniversary of Numerical Weather Prediction Commemorative Symposium*, A. Spekat, Ed., European Meteor. Soc. (Carl-Heinrich-Becker-Weg 6-10, 12165 Berlin, Germany), 185-200.