



## **Cut-cell Eta: Design and skill in jet stream position accuracy compared to its driver ECMWF ensemble, and illustrations**

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Although in various tests the operational Eta at NCEP did well compared to its version switched to sigma, and vs. NCEP sigma system models, the problem of flow separation in the lee of bell-shaped topography discovered by Gallus and Klemp resulted in considerable concern. In response, the Eta was refined to use a simple cut-cell scheme (Mesinger and Veljovic, Meteor. Atmos. Phys. 2017, MV2017 further on).

Another cut-cell approach, using strictly as opposed to Eta's approximately horizontal coordinate surfaces, is that of Steppeler et al. (Geosci. Model Dev., 2013, among others).

Removal of "major numerical errors near mountains" and "better localisation of precipitation" were pointed out as notable improvements by Steppeler et al (2013), very much like those of the typical advantages of the Eta (MV2017, e.g., Fig. 4).

A more recent experiment reported on in MV2017 is that of the Eta driven by ECMWF (EC further on) 32-day ensemble members. Two verification scores were used on 250 hPa winds and both showed advantage of the Eta, in particular during the first 10 days of the experiment when the ensembles had about the same resolution. The Eta advantage was very prominent during days 2-6 when a major upper-tropospheric trough was crossing the Rockies. Rerunning the ensemble with the Eta switched to sigma advantage over EC was shown as well, although not to such a degree.

250 hPa wind maps are shown to illustrate this Eta advantage. At day 4.5 there were two jet streaks over the domain used; one across northern Alaska, and the other stretching along eastern U.S. and into Atlantic. On average maps for the 21 members, Eta and also Eta/sigma positions of both were more accurate than those of their driver members. Eta however was more accurate than the Eta/sigma in positioning the streak across the U.S. and towards the tip of Greenland.

A novel verification method following MV2017 is that of the number of "wins" according to the scores used. Based on bias adjusted Equitable Threat Scores (ETSa), during this 2-6 day time 4 times the Eta had all 21 members placing the strongest winds, with speeds > 45 m/s, more accurately than their EC driver members. In placement of winds with speeds > 30 m/s the Eta advantage was similar, although a bit smaller. Based on the RMS difference against the EC analysis, the dominance of the Eta over the EC during this 2-6 day time was similar. Eta/sigma was mostly "winning" these placement scores against the EC also, but not to that extent. Eta, on the other hand, showed a prominent advantage over the Eta/sigma. Still, we find the degree of the advantage of the Eta/sigma over the EC puzzling, and suggest a number of candidate reasons. We plan to have more verification results by the time of the presentation