

# Reasons for the cut-cell Eta skill vs. ECMWF in ensemble experiments ?

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In Mesinger and Veljovic (2017, MV2017 later on) we have reported on an experiment in which the limited area cut-cell Eta model, driven by ECMWF (EC further on) 32-day ensemble members, achieved accuracy of large scales for an extended period clearly improved compared to that of its driver members. We have added to these results in our 2017 “Blue Book” contribution, and expanded on them yet some more in an extended conference preprint (Mesinger and Veljovic 2018, MV2018 later on).

With the ongoing developments of dynamical cores in numerous centers using a variety of approaches, we feel that still more attention to reasons for this cut-cell Eta skill is appropriate. One of the accuracy measures we used in MV2018 was the so called Extreme Dependency

Score (EDS). Some of its undesirable properties have been removed by the Symmetric Extreme Dependency Score (SEDS) and therefore in Fig. 1, left panel, we show number of “wins” in forecasting 250 hPa winds  $> 45 \text{ m s}^{-1}$ , according to SEDS scores, of the Eta (blue) vs. EC (red). Same, but for the Eta switched to use sigma (orange) is shown in the right panel.

For a synoptically specific information on the large scale skill of the three ensembles, in Fig. 2 contours are shown of winds of  $45 \text{ m s}^{-1}$  for each set of ensemble members, yellow-brown, along with the EC verification contours, red. It is seen that the Eta contours (middle), avoid some of the errors of the EC members (top), while with the Eta switched to sigma (bottom) some of the errors are reintroduced.

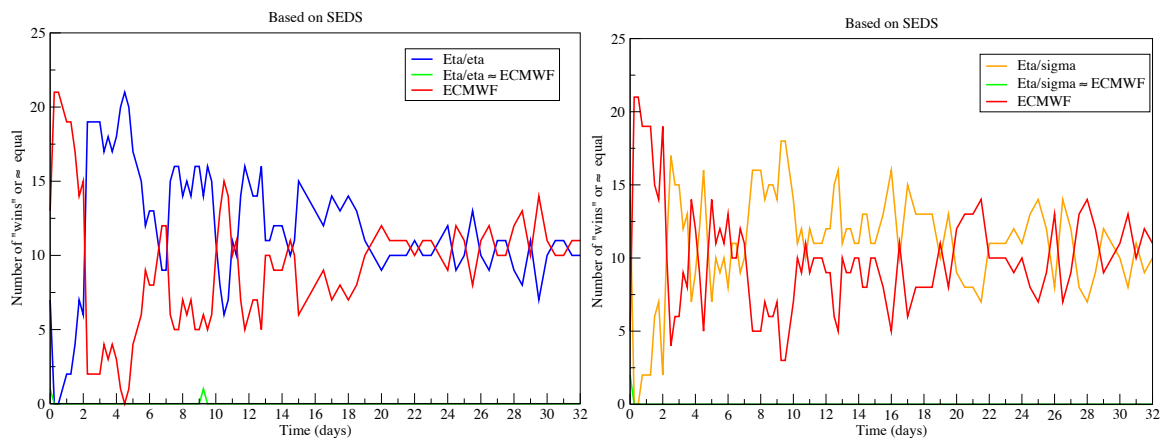


Fig. 1. Number of “wins” of one model vs. another, according to SEDS scores, in forecasting occurrence of 250 hPa winds  $> 45 \text{ m s}^{-1}$ ; blue, Eta, red, their EC driver members. left panel. Same but for the Eta switched to use sigma, orange, right panel.

Since the resolution of the two Eta ensembles was until day 10 of the experiments about the same as that of the driver EC, the results shown strongly suggest that the Eta dynamical core includes features additional to the vertical coordinate responsible for the Eta skill vs. EC. Some of the possible candidates are discussed in MV2018.

## References

Mesinger F, Veljovic K (2017) Eta vs. sigma: Review of past results, Gallus-Klemp test, and large-

scale wind skill in ensemble experiments.

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Mesinger F, Veljovic K (2018) Cut-cell Eta: Some history, and lessons from its present skill.

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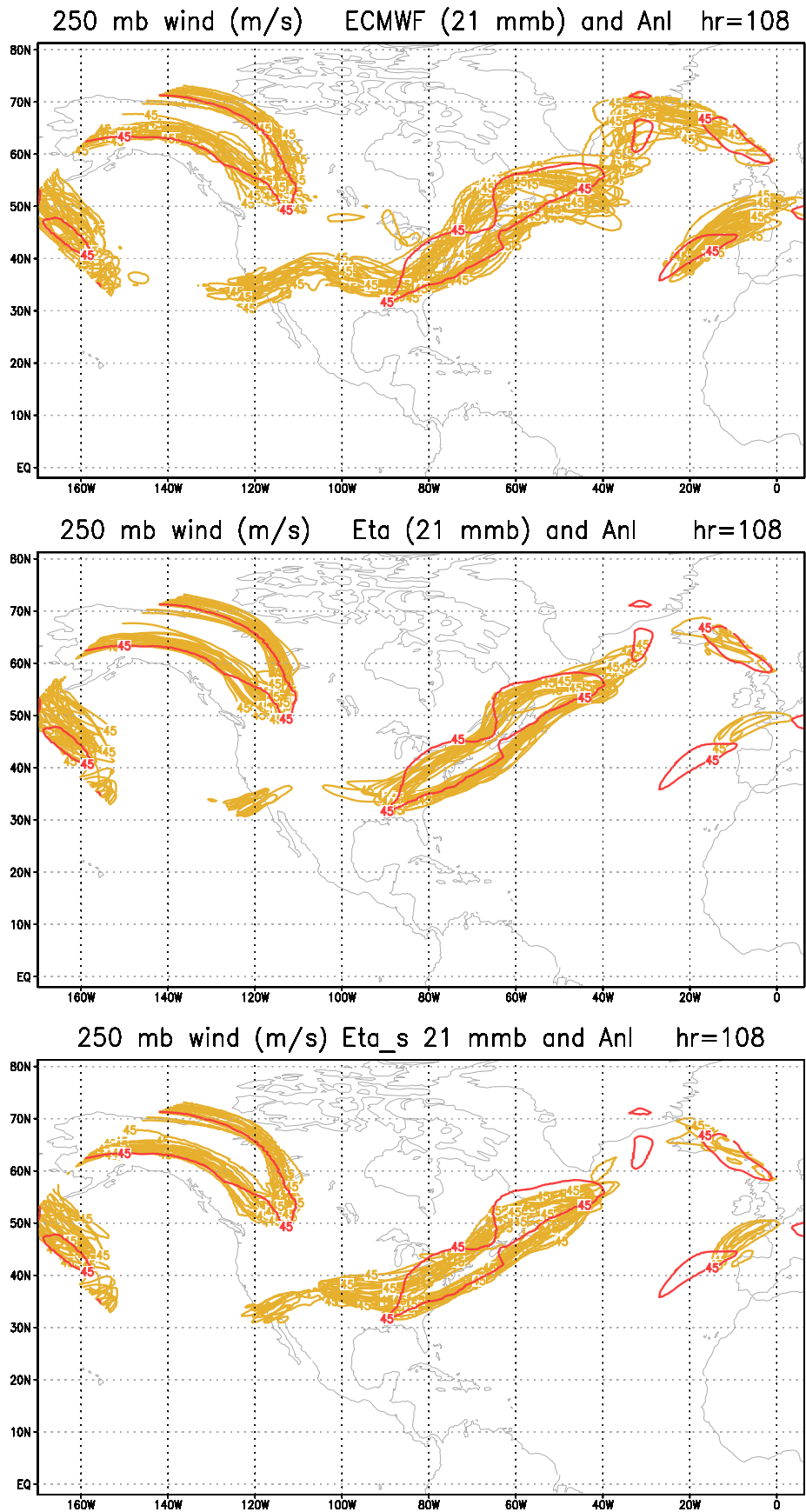


Fig. 2. Contours of the 250 hPa wind speeds of 45 m s<sup>-1</sup> of 21 members of the EC driver ensemble, upper panel, the Eta ensemble, middle panel, and the Eta/sigma ensemble, lower panel, all yellow-brown, and of the EC verification analysis, red; at 4.5 day lead time. (From MV2018).