EMS Annual Meeting Abstracts
Vol. 15, EMS2018-596, 2018

Accuracy of the jet stream position forecast as a dynamical core test: Cut-cell Eta vs. ECMWF 32-day ensemble results

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If a single test were to be chosen for testing the quality of forecasts of large-scale weather patterns, accuracy of the position of tropospheric jet stream seems a good candidate. With the jet stream largely controlling the position of extratropical precipitation systems, results of looking at quantitative precipitation forecasts should not be too different, and are a good choice as well.

With this in mind, recent studies by Mesinger et al. (Meteor. Atmos. Phys. 2012), Mesinger and Veljovic (Meteor. Atmos. Phys. 2017, MV2017 further on) and Steppeler et al. (Geosci. Model Dev. 2013) focused on the impact of the choice of a cut-cell scheme vs. terrain-following (or, sigma) system to represent topography. In all of the tests performed significant benefits were demonstrated in choosing a terrain-intersecting cut-cell as opposed to traditional terrain following system.

An experiment reported 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.

A novel verification method following MV2017 is that of the number of "wins" according to the score used. Based on bias adjusted Equitable Threat Score (ETSa), during the 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. 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. Here we extend these tests by verifications based on the so-called extreme dependency score (EDS), designed for forecasts of rare events (Stephenson et al., Meteor. Appl., 2008). Even more prominent advantage of the Eta is demonstrated than that with the two preceding scores. We plan to have more verification results and analyses by the time of the presentation.