# Systematic errors due to terrain-following coordinates

Katarina Veljovic (1) and Fedor Mesinger (2)

(1) Institute of Meteorology, Faculty of Physics, Univ. of Belgrade, Belgrade, Serbia;
(2) Serbian Academy of Sciences and Arts, Belgrade, Serbia;

5th WGNE workshop on systematic errors in weather and climate models
Montréal, Québec, Canada, June 19-23, 2017

Starting at mid-eighties five sets of tests have been performed comparing the results of the Eta against its version switched to use sigma. In all of them the eta version did better, particularly in precipitation scores and accuracy of the placement of storms. However, a poor result of a 10-km Eta in case of a Wasatch windstorm, and an experiment of Gallus and Klemp, led many to consider the eta to be "ill suited for high-resolution models." Still, in a 5+ month parallel the Eta/EDAS system resulted in better precipitation scores than the WRF-NMM/GSI put together to replace it.

Following a refinement of the eta discretization making it a simple cut-cell scheme, and removal of an oversight, the Gallus-Klemp separation of the flow behind a bell-shaped topography was shown not to occur.

Tests of the impact of the use of the eta resumed by running ensemble experiments with the Eta driven by ECMWF 32-day ensemble members. Using a score verifying placement of chosen strongest winds at 250 hPa, as well as the customary rms wind difference, both scores generally showed advantage of the Eta in spite of about the same resolution of two models during the first 10 days of the experiment. This advantage was particularly visible during the time of a deep upper tropospheric trough crossing the Rockies the first 2-6 days of the experiment.

Rerunning the Eta ensemble switched to sigma showed this advantage to come to a considerable degree from the use of the eta. This is demonstrated to even a greater degree by the number of "wins" of one model vs. another. Thus, at 4.5 day time with the trough just about having crossed the Rockies, all 21 Eta/eta members have better strongest winds placement scores than their ECMWF driver members. Eta/sigma has 19 members improving upon ECMWF, but loses to Eta/eta by a score of as much as 20 to 1.

Examples of these results are shown, and additional reasons possibly helping or not helping the results summarized are discussed.