Assessing convective hazard predictability from Days 1–5 using MPAS during Spring 2023

Ryan Sobash, Craig Schwartz, Dave Ahijevych
NSF NCAR / Mesoscale and Microscale Meteorology (MMM) Laboratory

During Spring 2023, daily 5-member, 5.5 day, 00 UTC GEFS initialized MPAS variable-resolution, convection-allowing ensemble (CAE) forecasts were generated in support of the 2023 NOAA Hazardous Weather Testbed Spring Experiment. In addition to the CAE, two MPAS 00 UTC deterministic forecasts were also generated for this period, both extending to lead-times of 5.5 days: a GFS-initialized forecast configured similarly to the variable-resolution ensemble forecasts (MPAS-VR) and a GFS-initialized MPAS regional forecast (MPAS-REG). These two deterministic forecasts allow for a comparison of the impact of running MPAS as a regional model compared to a global model with regional refinement.

To quantify the skill of the MPAS CAE at predicting convective hazards from Days 1–5, we generated daily surrogate forecasts of severe potential using the updraft helicity (UH) diagnostic and compared these forecasts to the occurrence of severe storm reports using the scale-dependent fractions skill score (FSS). The MPAS CAE Day 1–2 hazard forecasts were quite skillful, with FSS between 0.7–0.8 at spatial scales of >= 100 km and minimum useful spatial scales of 40 km. The Day 1 MPAS CAEs also had larger FSSs than the deterministic 00 UTC HRRR, primarily at spatial scales <= 120 km where the ensemble averaging improved forecast skill on convective-scales. For the MPAS CAE, the FSS gradually decreased with lead-time, with a corresponding increase in the minimum useful scale. For example, on Day 1 the minimum useful scale in the forecast was 40 km, while by Day 5 this scale increased to 120 km. This suggests that while the MPAS CAEs were useful at Day 5, this was restricted to the mesoscale and above; scales <= 120 km were not skillful.

Finally, surrogate convective hazard forecasts derived from two deterministic MPAS forecasts were compared. MPAS-REG performed similarly to MPAS-VR for Days 1–2, since they were initialized with the same initial conditions. Beyond Day 2, larger differences emerged. MPAS-REG had larger FSSs than the MPAS-VR forecasts, especially at Days 4–5, where FSSs were ~0.05 larger for MPAS-REG across spatial scales >= 60 km. This suggests that for convective hazard prediction, running a regional version of MPAS may provide equally useful forecasts compared to running MPAS as a variable-resolution global model. Discussion of why this might be the case, and additional analyses of forecast fields such as precipitation, will be reported on at the workshop.