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Novel analysis techniques for identifying systematic differences between convection-allowing model forecasts

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Forecast inter-comparison studies of convection-allowing models (CAMs) are needed to better understand the impacts of model and ensemble configurations on storm forecasts and to help optimize future operational CAM systems. We have recently developed novel, object-based analysis techniques to identify systematic inter-model differences in the representation of storms and near-storm environments. These techniques were initially applied to next-day forecast output from the Community Leveraged Unified Ensemble (CLUE) run during the 2017 NOAA Hazardous Weather Testbed (HWT) Spring Forecasting Experiment (SFE). The 2017 CLUE included 81 members that all used 3-km horizontal grid spacing over the continental U.S., enabling direct comparison of forecasts generated using different dynamical cores, physics schemes, and initialization procedures. No single model or set of models sharing the same dynamical core - ARW, FV3, or NMMB - performed categorically better than the others. However, there were many systematic inter-model and inter-core differences in specific forecast metrics and model fields. Some of these differences can be confidently attributed to particular differences in model design. This work is in review at Wea. and Forecasting.

The analysis techniques developed using the CLUE output have since been adapted and applied to 2017-18 SFE output from the NSSL Warn-on-Forecast (WoF) System (WoFS). The WoFS, formerly the NSSL Experimental WoF System for ensembles (NEWS-e), is a 3-km ensemble that assimilates radar, satellite, and conventional data every 15 min and issues 90- or 180-min forecasts every 30 min. The planetary boundary layer / surface physics and radiation schemes are varied among the WoFS ensemble members, enabling direct comparison of forecasts generated using different physics schemes. Preliminary results reveal that the basic techniques originally developed to compare next-day forecasts of storms and their environments are also valuable for identifying systematic impacts of different physics schemes on 0-3-h forecasts. The most recent work has examined physics impacts on storm-environment interactions.

Our hope is that the analysis framework being developed will provide a powerful tool for examining and comparing storm-centric CAM forecasts on a variety of lead-time scales.