

Multi-Scale Ensemble Kalman Filter Data Assimilation and Forecasts of the 10 May 2010 Tornado Outbreak in Central United States

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The parallel ensemble square-root Kalman filter (EnSRF) algorithm [1] developed recently at the Center for Analysis and Prediction of Storms (CAPS) for assimilating multi-scale observations is applied to the May 10, 2010, Oklahoma-Kansas tornado outbreak that spawned more than 60 tornadoes with up to EF4 intensities [2]. To properly initialize both synoptic and meso-scale environment and the convective scale features, a nesting strategy is used, with the storm-scale analyses at 4-km horizontal grid spacing nested inside the continuously cycled regional analyses at a 40-km grid spacing. The former includes all observations used by the operational Rapid Refresh system.

The 4-km storm-scale domain covers a $1760 \times 1920 \text{ km}^2$ region, uses the Advanced Regional Prediction System (ARPS) as the prediction model. Conventional (sounding, profiler, surface station and mesonet) observations and data from more than 40 WSR-88D radars are assimilated every hour, while during the last hour before the free forecasts the data are assimilated every 10 minutes. Ensemble and deterministic forecasts are launched several times during the assimilation cycles.

The results showed that the parallel EnSRF algorithm exhibits good scalability for very dense radar observations. The analyzed reflectivity fields at the end of each assimilation window exhibits a good fit with the observations in shape, structure, and intensity. The ensuing deterministic and ensemble forecasts captured well the line of strong, isolated storms with supercell characteristics in the central Kansas and Oklahoma.

Based on the testing results, CAPS will run the above EnKF system interfaced with the Weather Research and Forecasting (WRF) model at 4 km grid spacing, in real-time during the spring of 2013 as part of the NOAA Hazardous Weather Testbed Spring Experiment (<http://forecast.caps.ou.edu/>) over a $\frac{1}{4}$ continental U.S. domain. Some of the results will also be reported at the symposium.

References

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