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Comparison of 3-km analyses and forecasts from WRF-LETKF and WRF-EAKF ensembles

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The primary objective of the Warn-on-Forecast (WoF) program is to deploy a real-time storm-scale ensemble system that provides probabilistic forecasts of tornadoes and other thunderstorm hazards. This guidance will complement existing operational products to enable longer warning lead times and fewer false alarms. The ensemble Kalman filter (EnKF) will be an integral component of the WoF data assimilation system, possibly as part of a hybrid variational-ensemble configuration. EnKF variants currently used for convective-scale data assimilation vary in two important ways: (1) observations are processed either serially or simultaneously, and (2) covariance localization is applied to either the forecast covariances (serial filters) or the observation error variances (simultaneous filters). The ensemble adjustment Kalman filter (EAKF) used in the Data Assimilation Research Testbed (DART) is a serial filter, while the local ensemble transform Kalman filter (LETKF) is a simultaneous filter. Each filter offers its own advantages for assimilating radar data on convective scales, but their relative accuracy has not been thoroughly explored using real data.

Toward this end, 3-km analyses and 1-h forecasts are generated from two ensemble systems: the NSSL WRF-LETKF ensemble, and the NSSL Experimental Warn-on-Forecast System ensemble (NEWS-e), which uses the DART EAKF. Initial and boundary conditions for the 3-km grid are provided by analyses and forecasts from a 15-km grid covering the CONUS. Three supercell outbreak days are examined: 19 May 2013, 20 May 2013, and 27 April 2014. In each case, observations are assimilated onto the 3-km grid every 15 min from surface stations (including mesonet sites where available) and three WSR-88D radars. Verification of the analyses and forecasts focuses on rainfall and tracks of low-level rotation and tornadoes. Preliminary results suggest analyses and short-range forecasts of convective hazards have similar accuracy whether the EAKF or LETKF is used. This would motivate exploration of potential advantages of the LETKF over serial filters, including better scaling to large numbers of cores, and increased accuracy of dual-resolution configurations.