Model Error Representation in Mesoscale WRF-DART Cycling Run

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Mesoscale forecasts are strongly influenced by physical processes, from turbulence and mixing in the planetary boundary layer to moist convection and microphysics, that are either poorly resolved or must be parameterized in numerical models.

Due to the model errors, mesoscale ensemble systems generally suffer from underdispersiveness that often leads to poor forecast skills. In an ensemble Kalman filter data assimilation, insufficient ensemble spread leads to poor filter performance in the analysis cycle.

To alleviate the underestimate of ensemble spread, we compare two approaches to this issue: a multi-physics ensemble, in which each member's forecast is based on a distinct suite of physical parameterizations, and stochastic backscatter, in which small noise terms are included in the model equations for momentum and potential temperature.

We perform our experiments in a domain over the continental U.S. using the WRF/DART system, which employs the Weather Research and Forecasting model for ensemble forecasts and the Data Assimilation Research Testbed for the ensemble Kalman filter.

Verification against independent observations for a one-month summer period shows that including model-error techniques improves not only an ensemble of analyses, but also short-range forecasts started from these analyses. The stochastic backscatter scheme outperforms the multi-physics ensemble near the surface throughout the whole cycling period.