Stochastic Approaches Within a High Resolution Rapid Refresh Ensemble – Part II: Expanded Evaluation

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It is well known that global and regional numerical weather prediction (NWP) ensemble systems are under-dispersive, producing unreliable and overconfident ensemble forecasts. Typical approaches to alleviate this problem include the use of multiple dynamic cores, multiple physics suite configurations, or a combination of the two. While these approaches may produce desirable results, they have practical and theoretical deficiencies and are more difficult and costly to maintain. An active area of research that promotes a more unified and sustainable system is the use of stochastic physics.

Stochastic approaches include Stochastic Parameter Perturbations (SPP), Stochastic Kinetic Energy Backscatter (SKEB), and Stochastic Perturbation of Physics Tendencies (SPPT). The focus of this study is to assess model performance within a convection-permitting ensemble at 3-km grid spacing across the Contiguous United States (CONUS) using a variety of stochastic approaches. A single physics suite configuration based on the operational High-Resolution Rapid Refresh (HRRR) model was utilized and ensemble members produced by employing stochastic methods. Parameter perturbations (using SPP) for select fields were employed in the Rapid Update Cycle (RUC) land surface model (LSM) and Mellor-Yamada-Nakanishi-Niino (MYNN) Planetary Boundary Layer (PBL) schemes. Iterative testing was conducted to assess the initial performance of several configuration settings (see Jankov et al. - Part I). Upon selection of the most promising candidate configurations using SPP, a 10-day time period was run and more robust statistics were gathered. SKEB and SPPT were included in additional retrospective tests to assess the impact of using all three stochastic approaches to address model uncertainty.

Results from the stochastic perturbation testing will be compared to a baseline multi-physics control ensemble and presented. Probabilistic forecast performance of each ensemble will be evaluated using the Model Evaluation Tools (MET) verification package. Individual deterministic forecasts will also be assessed to investigate their contribution to the overall ensemble spread.