Stochastic Physics Approach for Use in the Next Generation Ensemble Forecasting System

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Since initial-condition uncertainty is not sufficient to fully explain numerical weather prediction uncertainty, the representation of model-related uncertainty in ensemble prediction systems is receiving increasing attention. To address this issue, a number of strategies have been employed. The most commonly applied approaches are multi-dynamic core, multi-physical parameterization, or a combination of both.

Even though these approaches have been characterized by satisfactory performance, they both have theoretical and practical weaknesses. The diversity of codes introduces a maintenance and resource issue. Furthermore, the ensemble members have different climatology and mean error, and do not yield independent and identically distributed random variables, complicating statistical post-processing.

Motivated by the National Centers for Environmental Prediction's (NCEP) effort to streamline its operational NWP suite, and by the need to address the shortcomings listed above, this study conducted by the Developmental Testbed Center focuses on the development and evaluation of experimental ensembles that employ a single dynamic core with multiple physical parameterizations that are stochastically perturbed. Approaches employing stochastic parameter perturbation within selected physics schemes, Stochastic Kinetic Energy Backscatter (SKEB), and Stochastic Perturbation of Physics Tendencies (SPPT) were evaluated. Simulations were performed using the operational Rapid Refresh (RAP) forecast system and its operational physics suite, which includes the Grell-Freitas convective scheme, the Mellor-Yamada-Nakanishi-Niino (MYNN) Planetary Boundary Layer (PBL) scheme, and the Rapid Update Cycle Smirnova Land Surface Model (LSM). Results of this study, including a comparison of spread and errors obtaining using the various approaches, will be presented at the workshop.