Stochastic Approaches Within a High Resolution Rapid Refresh Ensemble

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In most existing regional ensemble systems, model-related uncertainty is addressed by using multiple dynamic cores, multiple physics suites, or a combination thereof. While such multi-model ensembles have demonstrated potential, their maintenance is resource-intensive, especially in operations. More importantly, probabilistic forecasts from multi-models do not have consistent distributions; since each ensemble member can have a different mean error and variance. Post-processing generally assumes independent and identically distributed random variables, a requirement that is not met by multi-model forecasts. An alternative option of creating desirable spread and reliability by perturbing the ensemble simulations stochastically. The stochastic approach results in statistically consistent ensemble distributions. Two widely used stochastic schemes are the Stochastic-Kinetic Energy Backscatter (SKEB) and the Stochastic Perturbations of Physics Tendencies (SPPT). These methods are formulated to represent the effect of unresolved subgrid-scale variability and are added a posteriori to independently tuned models. Stochastically perturbed parameterizations (SPP) approach targets parameters and variables uncertainty within a physical parameterization schemes. For the purpose of this study, SPP which spatially and temporally perturbs parameters in the Mellor-Yamada-Nakanishi-Niino planetary boundary layer (PBL) scheme, the Rapid Update Cycle land surface model and Thompson microphysics scheme was developed within the High Resolution Rapid Refresh convection-allowing ensemble (HRRRE) system. The SPP approach is mainly used to target the performance of low-level variables (e.g. 2-m temperature and dew point, and 10-m wind and precipitations). The SKEB and SPPT scheme will be combined with the SPP approach to focus on performance of upper-level variables. The stochastic experiments will be compared to the HRRRE without SPP.