9.2 A performance comparison between multi-physics and stochastic approaches within a North American RAP ensemble.

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Most global and regional numerical weather prediction (NWP) ensemble systems are under-dispersive, producing unreliable and overconfident ensemble forecasts. With growing evidence that initial-condition uncertainties are not sufficient to entirely explain forecast uncertainty, the role of model uncertainty is receiving increasing attention. In the last decade, a number of different strategies have been proposed to represent uncertainty arising from model error. These approaches include use of multi-dynamic core, multi-physics and combination of both. While multi-physics approach yields desirable results and good performance it has practical and theoretical deficiencies. Maintenance and development of variety of physics is cost intensive. More importantly, this type of ensemble does not form a consistent distribution. Also, each member has its own climatology and error, which makes post-processing for these systems very challenging.

The focus of this study was to assess how the performance of a multi-physics approach compares to performance when the model uncertainty is addressed by using stochastic physics. For this purpose operational RAP physics suite was used. Stochastic approaches involved stochastically perturbed parameter approach, Stochastic Kinetic Energy Backscatter (SKEB), Stochastic Perturbation of Physics Tendencies and a combination of all approaches. Parameter perturbation was employed in the RAP convective scheme (Grell-Freitas), for perturbation of closures and the RAP Planetary Boundary Layer (PBL) Mellor-Yamada-Nakanishi-Niino scheme (MYNN) for perturbations of mixing length, roughness length and cloud fraction. Performance of the ensembles was evaluated in terms of bias, skill, accuracy, reliability and sharpness. Results pointed to advantages and limitations of stochastic physics approaches. However, a combination of stochastic physics showed an overall advantage when compared to multi-physics approach.