



## **Application and Assessment of Stochastic Representation of Model Uncertainty in GRAPES Regional Ensemble Prediction System**

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### **ABSTRACT**

A stochastically Perturbed Parameterizations (SPP) scheme consisting of temporally and spatially varying perturbations of 18 parameters in the microphysics, convection, boundary layer and surface layer parameterization schemes is developed in the Global and Regional Assimilation and Prediction Enhanced System-Regional Ensemble Prediction System (GRAPES-REPS) and its general performance is evaluated. Additionally, multi-physics, the Stochastically Perturbed Parameterization Tendency (SPPT) scheme, the stochastic kinetic energy backscatter (SKEB) scheme are also applied to investigate whether a single-physics suite combined with multiple stochastic physics schemes (SPP, SPPT and SKEB) can outperform the multi-physics scheme and further be an alternative to the GRAPES-REPS operational model perturbation configuration (multi-physics combined with SPPT). The experiments are performed for 14 summer days and multiple verification metrics are used. Results show that: 1) SPP perturbations applied to plenty of parameters in multiple physics parameterization schemes will lead to comparably sufficient spread (similar to that of the multi-physics scheme), and desirable performance for precipitation simulations. 2) Best results are achieved when combining SPP with SPPT and SKEB which overall outperforms the multi-physics scheme and the GRAPES-REPS operational configuration. 3) Introduction of SPP has a positive added value, with the local energy budget conserved and bringing no change to the energy evolution characteristics of the model for any wavelengths or levels. Overall, this study indicates the positive potentials of SPP and that a single-physics ensemble combining SPP, SPPT and SKEB can be an alternative to multi-physics and the operational configuration in GRAPES-REPS, which lays a foundation for future development and design.