Geophysical Research Abstracts
Vol. 20, EGU2018-6225-2, 2018
EGU General Assembly 2018

A Stochastic Kinetic Energy Backscatter Scheme for Model Uncertainties in the GRAPES Global Ensemble Prediction System

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For describing uncertainties in the subgrid-scale energy upscaling transfer, a Stochastic Kinetic Energy Backscatter (SKEB) scheme was introduced into the Global/Regional Assimilation and Prediction System (GRAPES) global ensemble prediction system (GEPS), in order to represent model errors more reasonably. In this research, the SKEB scheme employed the stochastic patterns with temporally and spatially correlated characteristics along with the diagnosed local kinetic energy dissipation rates caused by numerical diffusion to construct the stochastic streamfunction forcing. Then, based on the relationship between the streamfunction and the rotational component of horizontal winds, the streamfunction forcing in the SKEB scheme was transformed into the horizontal wind perturbations, which were suitable for the GRAPES global model. The results indicated that on the one hand the application of the SKEB scheme improved the simulations of the atmospheric kinetic-energy spectra in the GRAPES model; and on the other hand it led to a better spread-error relationship, increased the spread of the ensemble and reduced the root-mean-square error of the ensemble mean to some extent, especially in the tropics. Besides, the SKEB scheme improved probabilistic forecast skills of rainfall in China for different thresholds, especially for moderate rain and heavy rain. On the whole, the introduction of the SKEB scheme ameliorated the probabilistic prediction skills of the GRAPES-GEPS.