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A stochastic parameterization of unresolved processes in the Next Generation Global Prediction System

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In this study we address the challenge of representing uncertainties in numerical weather prediction (NWP) models at the physical process level associated with unresolved flows at various subgrid scales (convective and turbulent). The method utilizes cellular automata in order to describe sub-grid scale fluctuations and self-organization of convective cloud population (number and size) and turbulence within a NWP grid-box. In order to make the sub-grid distribution of convective clouds and turbulence physically based, we condition the rules that govern the evolution of the cellular automata on perturbed model fields, such as the deterministic mass-flux, the counter gradient term or vertical velocity. The perturbations to the model fields (in which we condition the cellular automata with) are specified according to a general class of non-Gaussian, stochastically generated skewed (SGS) distributions that are derived from large eddy simulations (LESs) and observations. We finally perturb processes associated with deep convection, shallow convection, dry plumes, turbulent eddies, cloud/radiation interaction and in-cloud microphysics using our derived distribution. We have used this method to provide a stochastic distribution of convective and turbulent variability in the physical parameterization schemes of NOAA/NCEP's newly-developed nonhydrostatic Global Forecasting System (FV3). We will show the impact of this method in ensemble medium-range weather prediction, as well as in sub-seasonal weather prediction, in terms of the precipitation distribution and organization of convection.