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A Multivariate Additive Inflation Approach to Improve Storm-Scale Ensemble-Based Data Assimilation and Forecasts: Methodology and Experiment With a Tornadic Supercell

ABSTRACT

This study introduces a multivariate additive-inflation method to address the underdispersive background ensemble issue that is commonly encountered in ensemble-based convective-scale radar data assimilation. The multivariate additive-inflation (AI) technique is based on a newly constructed convective-scale static background error covariance matrix. Its coherent random perturbations are generated for all variables, including hydrometeors and vertical velocity.

This study demonstrates the performances of univariate and multivariate additive-inflation in the tornadic supercell that occurred in Oklahoma City on May 8, 2003. During assimilation cycles, the multivariate approach increases the spread of reflectivity effectively and thus accelerates the generation of the tornadic supercell. In forecast fields, the multivariate approach exhibits better performance in low-level wind field rotation, reflectivity distributions, and storm maintenance. The experiment that adding hydrometeor and vertical velocity variables is beneficial in the multivariate approach, whereas it has negative impacts in the univariate approach.

Keyword

Covariance inflation

Reference

Wang, Y., & Wang, X. (2023). A multivariate additive inflation approach to improve storm-scale ensemble-based data assimilation and forecasts: Methodology and experiment with a tornadic supercell. J*ournal of Advances in Modeling Earth Systems*, **15**, e2022MS003307. https://doi.org/10.1029/2022MS003307