Further development of simultaneous multiscale data assimilation in EnVar to improve convective scale weather prediction

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Abstract

Accurate prediction of convective scale weather requires accurate analysis of the storm as well as its larger-scale environment. In this study, a simultaneous multiscale data assimilation (MDA) approach is further developed and implemented in the EnVar. This approach allows all resolved scales including both the storm and its embedded environment to be updated simultaneously with all available observations. This approach enables both model space scale-dependent localization and variable-dependent localization. Three experiments are designed to evaluate the impact of simultaneous MDA on radar observation assimilation. Experiments are performed on the 8 May 2003 OKC tornadic supercell storm with assimilation of both radar reflectivity and radial velocity. The simultaneous MDA outperforms the experiment with scale unaware uniform localization (UNI) in increasing the coverage of low-level reflectivity forecast, better capturing of the hook-echo structure, and enhancing the midlevel updraft. It is found that the improved forecasts in simultaneous MDA result from the enhanced storm ambient convergence. This result states that although only the radar observations are assimilated, the simultaneous MDA is capable of updating not only the storm but also the storm environment. Additionally applying the state variable-dependent localization favors to reduce the spurious reflectivity and further enhance the midlevel updraft.

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