Study on the application of Ensemble based three dimensional variation data assimilation method in a Rapid-refresh Prediction System

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Based on the Rapid-refresh Multi-scale Analysis and Prediction System(RMAPS-st) and Ensemble Prediction System（RMAPS-EN）in Beijing Meteorological Service，an Ensemble based three dimensional variation data assimilation method(Hybrid) is tested in the operational RMAPS-st environment. Both methods of Hybrid and three dimensional variation data assimilation (3DVAR) are compared in different System settings of cold start and cycle run. The conclusions are as follows: The results of single-point experiments show that the distribution of analytical increments of the hybrid data assimilation system has a good correspondence with the distribution of the ensemble spread; whether in the cold start system or in the cycle run system, the increments of 3DVAR have isotropic characteristics, while the Hybrid increments exhibit flow-dependent features, and correspond well to the ensemble spread. The analysis of precipitation cases shows that in the cold start environment, Hybrid exhibit limited improvements over 3DVAR, and in the cycle run environment, the precipitation forecast of Hybrid data assimilation is much better than that of three-dimensional variation. The verification results of batch test show that Hybrid has little advantage over 3DVAR in cold start environment. In the cycle run environment, however, the scores of Hybrid assimilation relative to three-dimensional variation are obviously better; the correlation analysis between ensemble spread and background error shows that the correlation between spread and background error is better in the cycle run system than that in the cold start system, and this is the key feature that make Hybrid perform well in the cycle run system.
Key words: Ensemble-3DVAR hybrid data assimilation; Rapid-refresh Prediction System；regional ensemble prediction; three-dimensional variation