Mesoscale hybrid data assimilation system based on JMA nonhydrostatic model

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This presentation discusses the benefits of using a hybrid ensemble Kalman filter and four-dimensional variational (4D-Var) data assimilation (DA) system rather than a 4D-Var system employing the National Meteorological Center (NMC)-method to predict severe weather events. This hybrid system is an adjoint-based 4D-Var system that uses a background error covariance matrix **B** constructed from the NMC method and perturbations in a local ensemble transform Kalman filter (LETKF) system. To reduce the sampling noise, two types of implementation (the spatial localization and neighboring ensemble approaches) were tested. Both the 4D-Var and LETKF systems are based on the Japan Meteorological Agency's nonhydrostatic model. The assimilation of a pseudo-single-observation of sea-level pressure located at a tropical cyclone (TC) center yielded wind and potential temperature increments physically consistent with what is expected of a mature TC in both hybrid systems at the beginning of the assimilation window, whereas analogous experiments performed using the NMC-based **B** (4D-Var-Bnmc) were not. At the end of the assimilation window, the structures of the increments became similar to each other among 4D-Var-based methodologies, while the analysis increment by the 4D-Var-Bnmc system was broad in the horizontal direction. Realistic DA experiments showed that the hybrid systems provided initial conditions that yielded more accurate TC intensity and track forecasts than those achievable by the 4D-Var-Bnmc system. The hybrid systems also yielded some statistically significant improvements in forecasting a local heavy rainfall event in terms of fraction skill scores when a 160 km ×160 km window size was used.

Keywords: Data Assimilation, Tropical Cyclone, Heavy Rainfall Event

