2.19 IMPLEMENTATION OF A DYNAMIC EQUATION CONSTRAINT BASED ON THE STEADY STATE MOMENTUM EQUATIONS WITHIN THE WRF HYBRID ENSEMBLE-3DVAR DATA ASSIMILATION SYSTEM AND TEST WITH RADAR T-TREC WIND ASSIMILATION FOR TROPICAL CYCLONE CHANTHU (2010)

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Proper dynamic equation constraints in data assimilation (DA) systems can help improve balance of analyzed atmospheric state. The formulation of ensemble-variational DA algorithms allows for easy incorporation of such constraints but their impacts within such DA systems have been little studied. A dynamic constraint based on the steady momentum equations is incorporated into the WRF (Weather Research and Forecasting) hybrid ensemble-3DVar (En3DVar) DA system as a weak constraint. The constraint aims at improving the coupling and balance among wind and thermodynamic state variables, especially when few state variables are directly observed. The scheme is applied to the assimilation of radar T-TREC (Typhoon-Tracking Radar Echo by Correlation) winds at a convection-allowing resolution, for landfalling typhoon, Chanthu (2010), when it was within the range of a coastal radar. Parallel experiments using the 3DVar and En3DVar with and without the dynamic constraint are run to examine the impact of the constraint. The flow-dependent ensemble covariance used in En3DVar helps to update unobserved pressure and temperature fields in a dynamically more consistent way compared to the static covariance; the added dynamic constraint produces more accurate pressure within the typhoon. The pressure field improved by the dynamic constraint also leads to better temperature and moisture analyses within the variational minimization through flow-dependent cross-covariance. En3DVar analysis with the dynamic constraint produces the best intensity forecast for the typhoon, in terms of the minimum sea level pressure and maximum surface wind speed. Additional sensitivity experiments examine the impact of the weight of the dynamic constraint.