

Assimilation of Airborne Doppler Radar observations using the GSI-based hybrid ensemble-variational data assimilation system to improve high resolution hurricane forecast by HWRF: retrospective and real-time tests with 2012-2013 hurricanes over Atlantic Basin

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A hybrid ensemble-variational data assimilation system has been developed based on the US NCEP operational data assimilation system, GSI. The hybrid data assimilation (DA) system became operational for the US Global Forecast System (GFS) since May 22, 2012. The new hybrid DA system has significantly improved many aspects of the global forecasts (e.g., [1]). Since then, efforts have been made to further develop and test the same hybrid system with the operational Hurricane Weather Research and Forecast (HWRF) modeling system (e.g., [2]). In this system, different from the 2013 HWRF hybrid system which uses the coarse resolution GFS ensemble, the HWRF hybrid system ingests the high resolution HWRF ensemble consistently initialized by GSI based EnKF. Recent progress and results to test the hybrid DA for HWRF to improve the high-resolution tropical cyclone prediction will be presented.

The HWRF hybrid DA system was tested with retrospective hurricane cases from the 2012 season. Verification against in situ and remotely sensed observations shows that the analyses provided by the hybrid DA system captures the hurricane structure much better than the GSI 3DVar. Forecast initialized from the analysis of the hybrid system produces substantially smaller track and intensity errors than those such as the operational HWRF forecast, forecasts without assimilating the airborne Doppler radar data and forecasts initialized by the analyses generated by the GSI 3DVAR. The high-resolution GSI-based hybrid DA system for HWRF is being tested during the 2013 hurricane season in near real-time. Tests with Hurricane Ingrid (2013) showed the same results as found in the retrospective tests.

The HWRF hybrid DA system was also further developed so that the hybrid DA can be done at dual resolution with nested domains. The 3km domain was vortex following during the forecast step of the DA cycle and the free forecast. Initial results of testing the dual resolution, nested domain DA are also planned to be presented at the symposium.

References

[1] Wang, X., D. Parrish, D. Kleist and J. Whitaker, 2013: GSI 3DVar-based Ensemble-Variational Hybrid Data Assimilation for NCEP Global Forecast System: Single Resolution Experiments, *Monthly Weather Review*, in press.

[2]Yongzuo Li, X. Wang, M. Xue and M. Tong, 2013: Assimilation of Airborne Radar Radial Velocity Data with the GSI based EnKF-3DVAR Hybrid System for the Prediction of Hurricane Irene (2011). AMS annual meeting, Austin, TX