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A WRF-VAR Ensemble Transform Kalman Filter (ETKF) Hybrid Data Assimilation System Based Extensive Tests with Real Observations

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Ensemble-based analysis data assimilation systems provide a good avenue for addressing uncertainties of initial conditions in numerical weather prediction. There are various ensemble-based data assimilation techniques used in research and operations. In this study, we have made real data based extensive tests with Weather Research and Forecasting Variational Data Assimilation System-Ensemble Transform Kalman Filter hybrid DA system (hereafter WRFVAR-ETKF hybrid DA system) that provides flow-dependent estimate of background forecast.

We have implemented WRFVAR-ETKF hybrid DA system at National Center for Atmospheric Research, Data Assimilation Testbed Center -where various data assimilation techniques are tested and evaluated for research and operational usage. In our WRFVAR-ETKF hybrid DA system, the ETKF technique has been used to update ensemble perturbations and hybrid technique is for updating ensemble mean. In cycling mode, both initial and boundary conditions are updated and used as input to run WRF for generating next cycle's ensemble forecasts.

We have tested WRFVAR-ETKF hybrid DA system for a specified Caribbean domain – which covers 5-35N, 100-50W – has 45km horizontal resolution and 57 vertical levels. Some extensive runs with 3-hourly cycling have been conducted for 30-day test period (20070815-20070915). Conventional observations (Global Telecommunication System-GTS data) and Global Forecasting System data sets used as initial input.

The presence of a hurricane system in our run period also presented an opportunity to examine how non-localized ETKF technique would handle it. We have tested two versions of ETKF system; the first version produced modest inflation factors and provided stable runs, while the second version gave higher inflation factors and a few CFL issues in some WRF runs. Both runs have shown impact of flow-dependent capacity of WRFVAR-ETKF hybrid DA system, and provided encouraging results.

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