Impact of Surface Observations on the Predictability of Landfalls of Hurricane Katrina (2005) with Ensemble-based Data Assimilation

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Significant improvements have been achieved for hurricane forecasts over the last two decades. However, only a few of studies have emphasized landfalling hurricanes. There are difficulties in predicting hurricane landfall due to the uncertainties in representing the atmospheric near-surface conditions in numerical weather prediction models, the lack of observations in oceans, and the multiple-scale dynamical and physical processes accompanying storm development.

In this study, we conducted a series of numerical experiments to examine the impact of ensemble-based data assimilation on the predictability of Hurricane Katrina (2005), one of the deadliest disasters in US history. The minimum central sea-level pressure, QuikSCAT ocean surface wind vectors, surface Mesonet observations, airborne Doppler radar-derived wind components, and conventional observations from NCEP are assimilated into an advanced research version of the Weather Research and Forecasting (WRF) model with an ensemble Kalman filter method. Impacts of data assimilation on the analyses and forecasts of Katrina's track, landfalling time and location, intensity, structure, and rainfall are evaluated. Specifically, in light of the lack of knowledge concerning the impact of surface observations, the effect of assimilating surface observations is examined in detail.

It is found that the assimilation of surface observations can improve the prediction of the hurricane track and structure through modifying low-to-mid level thermal and dynamical fields such as wind, humidity, and temperature. It also results in enhanced low-level convergence and vorticity. However, the single-level surface observations cannot constrain the model to predict reasonable intensities due to their lack of impact on the middle to upper troposphere. When surface observations are assimilated with either radar or other conventional data, obvious enhancements are found in the forecasts of track and intensity, convection and surface wind structures, and quantitative precipitation forecasts during landfalls.

References
[1] Pu, Z., H. Zhang, and J. A. Anderson. "Ensemble Kalman filter assimilation of near-surface observations over complex terrain: Comparison with 3DVAR for short-range forecasts". *Tellus A,* vol. 65, 19620, 2013. http://dx.doi.org/10.3402/tellusa.v65i0.19620
[2] Zhang, H. and Z. Pu. "Impact of surface observations on the predictability of landfalls of Hurricane Katrina (2005) with ensemble-based data assimilation". *Mon. We. Rev.* Submitted, 2013.