Dynamics and Predictability of Heavy Precipitation Induced by Landfalling Hurricanes --- Ike (2008), Irene (2011) and Sandy (2012)

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An experimental next-generation hurricane prediction system based on the cloud-permitting Weather Research and Forecast model has been developed that uses an ensemble Kalman filter (EnKF) to ingest high-resolution inner-core Doppler radar observations. Averaged over all 93 applicable cases of airborne Doppler missions during 2008-2012, forecasts by this experimental system reduce the intensity error by 20-40% through day 1 to day 5 in comparison to the corresponding National Hurricane Center's official forecasts, while their track forecasts are comparable. Moreover, this experimental cloud permitting ensemble analysis and prediction system also demonstrated great promise in the prediction of the rainfall structure and intensity associated with the landfalling hurricanes, as exemplified in the prediction for Ike (2008), Irene (2011) and Sandy (2012), three of the top 10 costliest Atlantic hurricanes. The deterministic forecasts initialized with the EnKF assimilation of the P3 airborne Doppler data produced excellent rainfall forecasts for all three storms 4 to 5 days before landfall, while the 60-member ensemble initialized from the EnKF perturbations provided informative and realistic probability of the rainfall location and intensity. An ongoing study uses the ensemble sensitivity analysis to examine the dynamics that governs the predictability of the heavy precipitation associated with these three landfalling hurricanes, and their interactions with the midlatitude baroclinic systems.