Achieving Superior Tropical Cyclone Intensity Forecasts by Improving the Assimilation of High-Resolution Satellite Data into Mesoscale Prediction Models

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Forecasts of tropical cyclone intensity change have shown little improvement during the past decade, due in part to the lack of conventional observations over oceans and deficiencies in mesoscale modeling and assimilation. In this study, we build on recent advancements in mesoscale data assimilation to exploit the use of high spatial and temporal resolution satellite measurements in mesoscale model forecasts of tropical cyclones. These observations include rapid-scan Atmospheric Motion Vectors (AMVs, 15-mins), hyper-spectral AIRS advanced soundings of temperature and water vapor soundings (~15km), AMSU retrieved surface winds (25km), and AMSR total Precipitable Water (TPW, ~25km). The observations are assimilated into the Weather Research and Forecasting model (WRF) with 27km/9km nested grids. Parallel cycling assimilation experiments with and without the different types of satellite observations are performed for two TC cases, Sinlaku and Ike (2008) using the Ensemble Kalman Filter in the NCAR Data Assimilation Research Testbed (DART).

The forecasts initialized from analyses that use these high-resolution satellite observations capture the intensification of the TCs during their early stages. The wind analyses of Sinlaku are found to be more consistent with independent ELDORA radar observations throughout the vertical column. In general, the impact of assimilating AMV observations dominate the impacts of other observation types assimilated in this study.