Towards Understanding the Contributions of Satellite-Derived Atmospheric Motion Vectors to the Mesoscale Tropical Cyclone Analyses and Forecasts

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Atmospheric Motion Vectors (AMVs) are derived using a sequence of three satellite images to track targets (including cirrus cloud edges, gradients in water vapor, and small cumulus clouds) every 30 minutes in operation, and are assimilated 3-6 hourly in global forecast models. The enhanced AMVs are specially processed at high resolution by CIMSS in 1-h interval for the duration of Typhoon Sinlaku (2008) and Hurricane Ike (2008). Given that the assimilation of these enhanced AMVs has shown promising mesoscale analyses of track, intensity and structure of the tropical cyclone (Wu et al. 2013), further investigation on understanding where the TC analyses benefit the most from the enhanced AMVs information is motivated.

Several data-denial cycles are prepared, in which AMVs at specified height levels and cut-off distances from the TC center are withheld. These subsets of AMVs are assimilated into the Weather Research and Forecasting (WRF) model with a resolution of 27 km on the analysis grid (and 9 km in the forward forecast model) using the Ensemble Kalman Filter (EnKF) with 84 members. To identify the relative contributions of the different layers of AMVs to the analyses and forecasts of the TC and its environment, three data-denial cycles are designed: eliminate AMVs between 150-350 mb; eliminate AMVs between 350-700 mb; and eliminate AMVs between 700-999 mb respectively. Two further data-denial cycles are prepared, with AMVs withheld within (outside) 10 degrees from the TC center, in order to investigate the contribution of AMVs on the TC structure. Initial results suggest that the interior AMVs and low-level (700-999 mb) AMVs are crucial at maintaining TC intensity and size, and upper-level AMVs are necessary in reducing track errors.

References

Wu, T.-C., H. Liu, S. J. Majumdar, C. S. Velden, and J. Anderson, 2013: Influence of Assimilating Satellite-Derived Atmospheric Motion Vector Observations on Numerical Analyses and Forecasts of Tropical Cyclone Track and Intensity (In Revision). Monthly Weather Review.