The Impact of COSMIC GPS RO Data on the Analysis and Prediction of Tropical Cyclogenesis

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Tropical cyclonesis remains as one of the most challenging problems in atmospheric sciences, and is still subject to lively debate. Some argue that the tropical cyclogenesis is mostly controlled by large-scale circulations, and therefore, possesses a high degree of predictability. Others argue that the large-scale circulations only provides a favorable environment, the actual cyclogenesis is significantly affected by small-scale processes (in particular, organized convection). As a result, it is essentially a stochastic process, with low predictability. The study of tropical cyclogenesis is greatly hindered by the lack of observational data over tropical oceans. In particular, the lack of reliable moisture observations presents significant challenge for the analysis and prediction of tropical cyclogenesis. Over the past decade, radio occultation (RO) technique making use of signals transmitted by Global Positioning System (GPS) has emerged as one of the most promising global observing system. In particular, GPS RO observation has been shown to be of high accuracy and high vertical resolution, and it is not affected by clouds and prediction. This makes it ideally suited for the study of tropical cyclogenesis. With the launch of the six-satellite constellation COSMIC mission, approximately 2,000 GPS RO soundings per day are routinely available, uniformly distributed around the globe. This presents an exciting new opportunity to study the impact of GPS RO data on tropical cyclogenesis.

In this paper, we examine the impact of GPS RO soundings on the genesis of Typhoon Jangmi (2008). Typhoon Jangmi is one of the most intense storms observed during T-PARC, with a minimum central pressure of 905 hPa. It formed in the wake of Typhoon Hagupit (2008), in a Rossby wave train pattern. High-resolution (4-km) mesoscale forecast experiments using the Weather Research and Forecasting (WRF) model showed that the prediction of Typhoon Jangmi is highly sensitive to initial conditions. The use of ECMWF high-resolution analysis as initial conditions produces a much better simulation than that of NCEP GFS analysis. Further analysis indicates that the key factor for better prediction with the ECMWF analysis results from its superior moisture analysis. Since both ECMWF and NCEP assimilate COSMIC GPS RO soundings in their operational analysis, this suggests that the superior moisture analysis in ECMWF result from the use of advanced 4D-Var data assimilation system (as compared with NCEP's 3D-Var GSI system). To further understand the impact of COSMIC GPS RO data on the genesis of Typhoon Jangmi, we are conducting data assimilation experiments using the WRF-DART ensemble system. In particular, we will conduct analysis and forecast experiments with and without the use of COSMIC GPS RO data. These results will be reported at the conference.