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MMM SEMINAR *NCAR*

Predicting the Genesis of Typhoon Nuri (2008): Impact of GPS Radio Occultation Data

Ying-Hwa Kuo

University Corporation for Atmospheric Research
Boulder, Colorado, USA

Accurate prediction of tropical cyclogenesis by global models is a significant forecast challenge, largely because of the lack of observations in the lower-troposphere over the tropical oceans and deficiencies in model physics. The atmospheric limb sounding technique, which makes use of radio signals transmitted by global navigation satellite systems, has evolved as a robust global observing system, providing very accurate measurements at a high vertical resolution. The water vapor information contained in such measurements within the tropical lower troposphere can be very valuable for the analysis and prediction of tropical cyclones.

In this talk we present a detailed analysis of the impact of GPS radio occultation (RO) data on the prediction of the genesis of Typhoon Nuri (2008), which was observed during the field phase of T-PARC (THORPEX Pacific Asia Regional Campaign) over the western North Pacific. Typhoon Nuri was declared a tropical storm at 1800 UTC 16 August 2008, and its incipient disturbance can be tracked more than ten days prior to tropical storm formation. Nuri was a challenging case for numerical model predictions. The NCEP GFS model failed to predict the tropical storm in operation. The WRF-ARW model, initialized with either the NCEP or ECMWF global analysis, also failed to predict Nuri's genesis. However, with the assimilation of GPS RO soundings obtained from COSMIC and other missions, using a two-dimensional observation operator, the moisture analysis was substantially improved. The improved moisture analysis contributed to a more accurate prediction of the convection associated with the pre-Nuri disturbance, which developed into a robust mid-level vortex as it interacted with an upper-level potential vorticity streamer. This mid-level vortex was responsible for the subsequent formation of Nuri through its interaction with convective and boundary layer processes. Without the assimilation of GPS RO data, the convection was suppressed, the mid-level vortex did not develop, and the model failed to predict the genesis of Nuri. Further experiments on nine additional typhoons over the western North Pacific between 2008-2010 showed that the assimilation of GPS RO data substantially improved the model's ability to forecast tropical cyclogenesis.

The joint Taiwan-U.S. FORMOSAT-7/COSMIC-2 mission will be launched in September 2016, and is expected to provide ~5000 RO soundings per day over the tropics, an order of magnitude more soundings than COSMIC. With an improved design in the RO receiver and antenna, the RO data from COSMIC-2 will also be of much higher quality than COSMIC, particularly in the tropical lower troposphere. The results from this study suggest that COSMIC-2 will have a significant impact on the prediction of tropical cyclonegenesis.

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MMM SEMINAR COORDINATOR
Morris Weisman, 303.497.8901, weisman@ucar.edu
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