IMPACT OF GNSS RADIO OCCULTATION DATA ON THE PREDICTION OF CONVECTIVE SYSTEMS ASSOCIATED WITH A MEI-YU FRONT

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During the seasonal transition period between Spring and Summer, a quasi-stationary front, known as the Mei-Yu front, can be found over Southern China, extending through Taiwan to Japan. The Mei-Yu front is characterized by a strong moisture gradient, but with a relatively weak temperature contrast. Mesoscale convective systems often develop along the Mei-Yu front and produce heavy rainfall. On 21-22 May 2020, a series of convective systems developed along the Mei-yu front. These convective systems moved eastward across the Taiwan Strait. They interacted with the steep topography of Taiwan's Central Mountain Range and produced severe flooding for southwestern Taiwan. Because of the lack of observations over the ocean, accurate prediction of these convective systems and the associated precipitation is a significant challenge.

Since the launch in June 2019, the FORMOSAT-7/COSMIC-2 has been providing ~6,000 GNSS RO data from 40S to 40N, which can be very valuable for the prediction of severe weather systems. In this paper we examine the impact of COSMIC-2 GNSS RO data on the prediction of this heavy rainfall event. Using a configuration of the Weather Research and Forecasting (WRF) Model similar to that of Taiwan's Central Weather Bureau with 15/3 km nested grids, we performed continuous assimilation of conventional observations and COSMIC-2 data starting from 0000 UTC 18 May 2020. We then performed short-range (12-h) forecast experiments at 3 hr intervals. Our results showed that the assimilation of COSMIC-2 RO data using a nonlocal excess phase operator significantly improved the moisture analysis over the South China Sea, the structure and movement of the Mei-Yu front over the Taiwan Strait, and the organization of the convective systems ahead of the Mei-Yu front. As a result, short-range (6-h) rainfall prediction over Taiwan was improved significantly. Averaged over 12 forecasts, the precipitation skill scores increased by 30% for high precipitation thresholds. The structure and the distribution of the precipitation are also much more consistent with the observation. Additional sensitivity experiments showed that the use of a local refractivity observation operator had a much reduced impact. These results suggest that the COSMIC-2 GNSS RO data, when properly assimilated, have the potential to improve the prediction of mesoscale convective systems. Detailed analysis will be presented to gain physical insights on how GNSS RO improves the prediction of convective systems associated with the Mei-Yu front.