Decade Development of the numerical tropical cyclone prediction system at the Central Weather Bureau of Taiwan: TWRF (Typhoon WRF)

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Abstract

Taiwan Island located in the western North Pacific off the southeast Asia continent frequently visited by tropical cyclones (typhoons). Due to its unique geographical location, typhoons post great threats to Taiwan's civilian lives and properties. In the past hundred years, roughly 3 to 4 typhoons hit Taiwan each year with some events have caused severe damage and loss of lives. Accurate and timely predictions of typhoons could save lives, provide enough time for preparedness are also critical for optimal resource managements. Typhoon WRF (TWRF) based on the Advanced Research Weather Research and Forecasting Model (ARW WRF) was operational at the Central Weather Bureau (CWB) for tropical cyclone (TC) predictions since 2010 (named TWRF V1). CWB has committed to improve this regional model, aiming to increase the model predictability toward typhoons over East Asia. In 2016, an upgraded version designed to replace TWRF V1 became operational (named TWRF V2). Compared with V1, which has triple-nested meshes with coarser resolution (45/15/5 km), V2 increased the model resolution to 15/3 km. Since V1 and V2 were maintained in parallel from 2016 to 2018, this study utilized the real-time forecasts to investigate the impact of model resolution on TC prediction. Statistical measures pointed out the superiority of the high-resolution model on TC prediction. The forecast performance was also found competitive with that of two leading global models. The case study further pointed out, with the higher resolution, the model not only advanced the prediction on the TC track and inner core structure but also improved the representativeness of the complex terrain. Overall, the high-resolution model can better handle the so-called terrain phase-lock effect and, therefore, improve the TC quantitative precipitation forecast over the complex Taiwanese terrain.

Keywords: tropical cyclone (TC) prediction; Typhoon WRF; high-resolution model