Typhoon prediction using GFDL hurricane model

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ABSTRACT

The Geophysical Fluid Dynamics Laboratory (GFDL) Multiply-nested Movable Mesh (MMM) high resolution hurricane model has demonstrated considerable skills for hurricane prediction over both the Atlantic and Eastern Pacific Ocean. The quasi-operational forecast of GFDL hurricane model in 1992 and 1993 showed that reduction of the forecast error compared against the official forecast by NHC and CLIPER prediction was significant through the entire 72-hour forecast period. In addition to the track forecast, the feasibility of forecasting storm intensity was also clearly indicated. The GFDL hurricane model became operational at NMC since the hurricane season of 1994, and the results up to now were consistent with those in 1993.

In this study the most updated version of the GFDL MMM hurricane model, including the new vortex initialization scheme, was used to perform the forecast of some tropical cyclones in the Northwestern Pacific region in 1994. In total, 16 cases (3 for Typhoon Tim, 4 for Doug, 2 for Fred, 3 for Gladys, and 4 for Seth) were tested. Both the track and intensity forecasts were compared to the best tracks and observed storm intensity. The errors of the forecast tracks were at least 30% lower than the average values from the past CLIPER model. The performances of both the model's track forecast and the official forecast from Join Typhoon Warning Center at Guam were equally good. The intensification of some storms were also well forecasted 36-72 hours in advance. The landfall of some of these cyclones of Taiwan was reasonably predicted. Overall, the preliminary results indicate that using the GFDL hurricane model to forecast typhoons in the Northwestern Pacific region is promising.

Besides the improvement of the model and initialization, more tests are needed to further evaluate the performance of the GFDL hurricane model on predicting typhoons over the Northwestern Pacific Ocean. The GFDL hurricane model can serve for dual purposes: First, this full-physics dynamical model is able to produce high-resolution data for researches in advancing our understanding of the hurricane dynamics. Second, the model prediction may provide valuable information for the forecasters to make accurate and timely forecasts of the cyclone track, landfall position, and the storm intensity, which is important both for minimizing the loss of life and property and for minimizing the costs associated with unnecessary evacuation of coastal regions in Taiwan and in other countries over east Asia.