6D.5 [1] **The Performance and Recent Improvement of the Typhoon Forecast System of the Central Weather Bureau in Taiwan**

Der-Song Chen , T. C. Yeh , K. N. Huang
Central Weather Bureau, Taipei, Taiwan

M.S Peng
Naval Research Laboratory, Monterey, CA

1. Introduction

Taiwan was affected by several typhoons each year that caused significant economic loss. Timely forecast of the typhoon movement is one of the most important tasks at the Central Weather Bureau in Taiwan. To improve the performance of the numerical typhoon track forecast model (TFS) is one of the key elements to advance the typhoon forecast of the Central Weather Bureau.

In this paper, we will report the TFS operational track forecast errors for typhoons in the last few years. More focus is on the comparison of the tracks predicted a two-level nested version of the model (15km/45km). We will present some simulation results of the rainfall distribution over Taiwan area when Typhoon Nari made landfall in Taiwan in September 2001 that caused severe damages in northern par of Taiwan. The result of a sensitivity study on the impact of including radiance observation in TFS will also be discussed.

2. Model

The typhoon-track forecast system in the Central Weather Bureau is a primitive-equation system with finite difference approximation. The operational version has a horizontal resolution of 45 km and 20 layers in the vertical. The lateral boundary conditions are provided by the T120L18 global spectral forecast model. Special vortex filtering and vortex bogussing procedures are applied (Chen et al. 1999) in the first guess fields before the optimal interpolation analysis. To study the impact of including radiance observation in TFS, three sets of simulations were conducted. Simulation identified as CWBO is the same as TFS operational forecasts. The simulations identified as NCEPO and NOR both used NCEP observations and SSI analysis, but radiance observations were excluded in NOR.

3. Discussions

For the typhoon seasons in 2000 and 2001, there were 21 and 26 tropical cyclones that occurred in the Northwest Pacific and the South China Sea. The average 24/48/72 hour forecast track distance errors of TFS in the previous two years are 148/306/520 km and 160/316/510 km, respectively. These compare with the 187/408/597 km and 160/348/553 km distance errors from a homogeneous sample of the CLIPPER. Note that the 2-day forecasts of the TFS are much better than the CLIPPER but the 3-day forecasts are less satisfactory.

Northward bias errors are observed for storms that were located at low latitudes and over the Southern China Sea, especially in their early stages. For example, Typhoon Sam (1999) was predicted as moving northeastward when the storm was located at about 20^{o}N and it actually moved eastward toward Hong Kong. The 48h/72h distance errors from the TFS were 431/1024 km for 12UTC 19 August. For simulations at initial time of 12UTC 19, the TFS forecast track is very

[1] Corresponding author address : D.-S. Chen R & D Center , Central Weather Bureau, Taipei , Taiwan
e-mail : song@rdc.cwb.gov.tw

sensitive to the initial conditions it uses. The track of Typhoon Sam for in the operational run (the CWBO) has large northward biases after 24h. The simulated storm passes by west of Taiwan along about 120^{o}E. The distance error at 48h/72h is 431/1024 km. When the model uses the NCEP initial condition (the NCEPO), although the model still is not able to correctly predict the landfall of Sam near Hong Kong, its 48h/72h error is reduced to 349/744 km. A similar right-hand-side bias is observed in the operational forecast of NOGAP, GFDN, and the regional model of JWA. To examine the effect of including the radiance in the analysis, NCEPO experiment is rerun except that the radiance observations were not used in the analysis (NOR). The track of typhoon Sam for NOR is very similar to that for CWBO. This experiment suggests the importance of radiance data in the analysis to achieve better performance of TFS in the data sparse region.

To examine the impact of model resolution to the track forecasts, 21 cases for Typhoon Xangsang, Bebinca, and Nari were studied with the nested configuration (45/15km) and vertical resolution changed from 20 to 30 levels. The average 24/48/72 hour track forecast errors of nested TFS for these 21 cases are 130/234/353km in the coarse grid and 106/219/311km in the fine grid, respectively. Meantime, the average 24/48/72 hours track forecast errors of operational TFS, with 45 km horizontal resolution and 20 levels, for these 21 cases are 149/285/475km. These results indicate that the track forecast errors are reduced with the higher resolution. Better representation of the intensity and vertical structure of the vortices in the higher resolution grids may contribute to such forecasting improvements.

Simulations for Typhoon Nari that made landfall in Taiwan and caused severe damages in northern Taiwan in September 2001 are carried out using different terrain data. The old terrain data used in the operational TFS has a resolution of 1/6 of a degree in longitude-latitude. With the two-level nested grids of 45km and 15 km, the model cannot resolve any details of the terrain profile in Taiwan even in the fine grid domain. When a new terrain data with 1km resolution is used, the fine grid mesh of 15 km shows very detailed feature in the topographic profile. There are two peaks in the topography using the new high-resolution data instead of only one using the old data. The model predicted track for Typhoon Nari on 1200UTC Sep 2001 from the fine mesh using the old terrain and the new terrain data show some difference, but the general trends are similar. However, the precipitation generated using the new terrain data shows marked difference from the one using the old coarse terrain data, especially between 24h and 48h. Comparing to the verifying rain analysis from the rain gauge for the same periods indicates that the position of the peak precipitation has improved significantly and the magnitude has also increased from 54.7 mm to 229.4 mm in the second day of the forecast. It is very encouraging that, with the new high-resolution background data, the fine grid model is capable of providing useful guidance of potential heavy rainfall region.

Reference

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