Tropical Cyclone Track and Intensity Prediction With a Structure Adjustable Balanced Vortex.

Hyun-Gyu Kang, Hyeong-Bin Cheong, In-Hyuk Kwon, Ja-Rin Park, and Hyun-Jun Han Department of Environmental Atmospheric Sciences, Pukyong National University

Recently, a sophisticated bogus method was developed, where the bogus vortex was produced using a spherical high-order filter and 3-D empirical functions, to replace insufficiently resolved tropical cyclones in global analysis fields [1]. In the method the disturbances of any scale can be separated with computational efficiency from the analysis (or any global domain data) accurately without affecting the large-scale environment on which TC is embedded. The bogus vortex, being of axi-symmetry, consists of variables such as geo-potential height, temperature, tangential and radial velocity. The entire 3-D vortex is constructed on input of only a few scalar parameters available at specialized TC centers such as RSMC Tokyo. Based on these, firstly the surface pressure profile is specified using the empirical function [2], which is then used to design the geo-potential field, and subsequently the velocity fields with a careful treatment of PBL and the upper-layer anti-cyclonic flow.

The forecast experiment using the new initialization scheme for 23 cases of four typhoons observed in Western North Pacific in 2007 showed a promising result, reducing both the track error and the central pressure error significantly in comparison with the forecasts of RSMC Tokyo. The overall performance of the new method, however, may be assessed with more reliability only when it is applied to much more TCs rather than a few cases, because there are fairly large case-by-case fluctuations in the performance as in other numerical forecasts [3]. Therefore, the new initialization method is applied to the track and intensities (i.e., the central pressure and the maximum wind speed) prediction of Typhoons observed in the Western North Pacific region for three years of 2005, 2006, and 2007. The numerical model used in this study is Advanced Research WRF v3.0.1. The model has a single domain with a grid size of 289×257 and a horizontal resolution of 12km in both longitude and latitude, which is set wide enough to cover the tracks of the Typhoons for a couple of days. Total of 417 cases of predictions are performed for 52 Typhoons. The mean track error and the mean pressure error of the new initialization scheme for 417 cases are 139.9 km and 12.4 hPa, while report of RSMC is 189 km and 17.0 hPa, respectively.

References

- [1] Kwon, I.-H., and H.-B. Cheong, Mon. Wea. Rev. 137, in press, (2009).
- [2] Holland, G. J., Mon. Wea. Rev. 108, 1212-1218 (1980).
- [3] Franklin, J. L., National Hurricane Center, NOAA/NWS/NCEP/Tropical Prediction Center, 71., (2008).

Acknowledgement

This work was funded by the Korea Meteorological Administration (KMA) Research and Development Program under Grant CATER 2007-2206.