Analyses and Numerical Tests of an Explosive Cyclone over the Northwestern Pacific

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In this paper, the Final Analysis (FNL) data from National Centers for Environmental Prediction is utilized to analyze an explosive cyclone occurred over the Northwestern Pacific from 11 to 13 January 2012. Weather Research and Forecasting model (WRFV3.5) is employed to simulate the explosive cyclone. This cyclone generated in the east of Japan Islands around 18 UTC 10 January 2012. It deepened explosively from 00 UTC 11 to 18 UTC 12 January, and weakened near the Kamchatka Peninsula around 00 UTC 13 January. The FNL analyses showed that there was a distinct frontal structure. The high potential vorticity of the upper troposphere extended downward to the surface. This condition would be beneficial to the cyclone development.

In order to examine the development process of this cyclone in detail, we conducted a 54-h WRF simulation initialized at 18 UTC 10 January 2012. The model domain has a horizontal resolution of 45 km, 150×100 grids in horizontal, and 44-σ levels in vertical. The model top is 50 hPa. For model physics, a five-class microphysics scheme (Lin scheme) and Yonsei University planetary boundary layer scheme (YSU scheme) are used. The Kain-Fritsch cumulus scheme, which has both deep and shallow sub-grid convection, is employed for the cumulus parameterization. The change of sea surface temperature (SST) indicates that SST may affect the cyclone intensity significantly , but has little effect on the moving path of cyclone. The SST tests show that warmer SST (SST+2K) may increase the cyclone intensity than that of control run, whereas cooler SST (SST-2K) may weaken the cyclone intensity. It seems to suggest that SST plays an important role in the development of cyclone. However, all WRF simulations exhibit much weaker trend of central pressure than that of FNL analysis.

Keywords: Explosive cyclone, Numerical tests, WRF, diagnostic analysis