Diagnosis and Numerical Modeling of an Explosive Cyclone over the
Changbai Mountain in North of Korean Peninsula

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Abstract

The Changbai Mountain (Fig.1a) is a major mountain located in the north of Korean Peninsula. In winter, the Changbai Mountain usually blocks the cold air from Siberia, and in its leeside, forms the Japan-Sea Polar-Airmass Convergence Zone (JPCZ) which provides favorable conditions for the generation of cyclone. In this talk, an explosive cyclone over the Changbai Mountain from 12 UTC 18 to 18 UTC 21 November 2007 was introduced. The synoptic situations and structure of this cyclone were documented by using the $1^\circ\times1^\circ$ final analysis data of National Center for Environmental Prediction (NCEP). It is shown that this cyclone developed explosively around 18 UTC 19 and reached its maximum deepening rate (MDR, 1.3 Bergeron, Fig.1b) around 06 UTC 20 November 2007. At its MDR moment, the surface cyclone center was located in the downstream of the upper-level trough and northern entrance zone of the upper-level jet. The diagnostic results using Zwack-Okossi equation suggested that cyclonic-vorticity advection, warm advection, and latent heat release acted to deepen this cyclone, while adiabatic cooling suppressed its development. For investigation of this cyclone development, numerical sensitivity results using the Weather and Research Forecasting model (WRFv4.0) showed that the latent heat release in the lower level made less contribution, while the surface sensible and latent flux played important roles. Sea Surface Temperature (SST) sensitivity tests showed that warmer SST (SST+2K) increased the cyclone intensity, whereas cooler SST (SST-2K) weakened the cyclone intensity. In order to examine the mountain influences on the development of this cyclone, two orography tests were

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designed: removing mountain and doubling the height of mountain. The results showed that Changbai Mountain suppressed the development of cyclone by preventing the southern moisture air from invading the inland. Without the moisture air, there is no latent heat release.

Fig. 1a The trajectory of the cyclone center derived by the FNL data from 12 UTC 18 to 18 UTC 21 November 2007. Solid circle represents the explosive developing stage with the deepening rate larger than 1 Bergeron.

Fig. 1b Time series of central sea level pressure (red dash line, hPa) and the deepening rate (black line, in hPa/hour)