The statistical analysis of the explosively developing extratropical cyclone in northern Japan and Atmospheric blocking

*Yoshikazu Kitano[1], Tomohito J. Yamada[1]

1.Hokkaido University

The explosively developing extratropical cyclone (bombs) is one of the most important meteorological phenomena in natural disaster protection, especially over the northwest Pacific and Atlantic (Sanders and Gyakum, 1980, Roebber 1984). Over east Asia, explosive cyclogenesis occurred most frequently in cold season peaked in December to February (Chen and Kuo, 1992). In mid-December 2014, a storm surge induced by explosive cyclone attacked Nemuro, a city located in Hokkaido, Northern Japan, causing great economic loss due to abnormal tides (Saruwatari and Lima, 2015). On 16 December, extratropical cyclones located off Kyusyu island and the Sea of Japan were rapidly intensified when it moved toward northeast and merged with each other. The minimum central pressure reached 946 hPa (Kitano and Yamada, 2016). On 17 December, a blocking high over western Russia and a cut-off low over the Sea of Okhotsk were observed and explosive cyclone stagnated off the coast of Nemuro city about 28 hours. The aim of this study is to estimate the deepening rate after the merger statistically and to reveal the relationship between the stagnant of explosive cyclones and atmospheric blocking.

We used the 40-yr ECMWF Re-Analysis (ERA-40; Uppala et al. 2005), with the full horizontal resolution of 1.125°, available every 6 hours for the period 1960-1999. The subject region in this study extends over the northwestern Pacific region from 20° to 65°N and from 100°E to 180°. Definition of explosively developing extratropical cyclone follows the tracking algorithm proposed by Yoshida and Asuma (2003). Here, merger is defined as the situation in which more than two cyclone trajectories overlap each other. Blocking is diagnosed by a two-dimensional (2D) blocking index derived from daily 500-hPa geopotential gradient according the method of Masato et al. (2012, 2013).

The results show that 1775 explosive cyclones were detected. After the merger, deepening rate becomes the maximum and it is 5.37 [hPa / 6 hour] statistically. The higher latitude explosive cyclones merge in, the higher the deepening rate is. The results indicate that merger often occurs over the Sea of Japan and off the Pacific coast of Kanto region. Furthermore, about 40 % of explosive cyclones are located on southern part of blocking when the velocity of explosive cyclone becomes slowest.

Keywords: explosively developing extratropical cyclone, atmospheric blocking, disaster protection

