Long-term Changes in Explosive Cyclone Activity over the Midwinter North Pacific

Akira KUWANO-YOSHIDA[1,3], and Hisashi NAKAMURA[2,3]

[1] *Shirahama Oceanographic Observatory, Disaster Prevention Research Institute, Kyoto University, Shirahama, Japan*

[2] *Research Center for Advanced Science and Technology, The University of Tokyo, Tokyo, Japan*

[3] *Application Laboratory, Japan Agency for Marine-Earth Science and Technology, Yokohama, Japan*

Long-term changes in explosive cyclone activity over the North Pacific are investigated by using the Japanese 55-year Reanalysis only with conventional data assimilated (JRA-55C, Kobayashi et al. 2014). Explosive cyclone activity is estimated as Local Deepening Rate for 24 hours (LDR24, Kuwano-Yoshida 2014) based on surface pressure tendency. Our analysis reveals that the explosive cyclone activity in January underwent a sudden increase in 1987 over the central North Pacific. The mean activity after 1987 is as much as ~50 % stronger than its counterpart between 1959 and 1986, which is consistent with the sudden weakening of midwinter suppression of the stormtrack activity (Nakamura et al. 2002). Compared to the earlier period, sea surface temperature (SST) in January averaged after 1987 is significantly higher over the tropical Indian Ocean, the East China Sea, and the western portion of the North Pacific subtropical gyre. The warm SST anomalies induce low-level cyclonic anomaly over the northern Indian Ocean, while increases in low-level equivalent potential temperature (EPT) and its horizontal gradient over southern China are attributable to anomalous northward moisture flux from the tropics. The enhanced EPT gradient accompanies a local precipitation increase. Diagnosis of the deepening rate (Fink et al. 2012) shows that diabatic heating contributes the most to the increase of explosive cyclones. Composite analysis for explosive cyclones over the central North Pacific suggests that after 1987, they tend to undergo initial development over southern China with enhanced moisture availability and then propagate along the southern coast of Japan with rapid development under the weakened upper-level subtropical jet. Before 1986, by contrast, explosive cyclones over the central North Pacific tend to originate from the Sea of Japan under strong upper-tropospheric jet. The activity change mentioned above may affect precipitation over the north of Kamchatka and around the Hawaii islands. The results suggest that enhanced warming of the North Pacific western boundary current and marginal seas (Wu et al. 2012) affect explosive cyclone activity over the basin and precipitation around it.

Key words: Explosive cyclone, SST warming, North Pacific, Storm track, midwinter suppression

References

Fink, A. H., S. Pohle, J. G. Pinto, and P. Knippertz, 2012: *Geophysical Research Letters*, **39**, L07803.

Nakamura, H., T. Izumi, and T, Sampe, 2002: *Journal of Climate*, **15**, 1855-1874

Kobayashi, C., and Coauthors, 2014: *SOLA*, **10**, 78-82.

Kuwano-Yoshida, A., 2014: *SOLA*, **10**, 199-203.

Wu, L., and Coauthors, 2012: *Nature Climate Change*, **2**, 161-166.