Response of tropical cyclone activity and structure to a global warming in a high-resolution global nonhydrostatic model

*Yohei Yamada[1], Masaki Satoh[2], Masato Sugi[3], Chihiro Kodama[1], Akira T Noda[1], Masuo Nakano[1], Tomoe Nasuno[1]

1.Japan Agency for Marine-Earth Science and Technology, 2.Atmosphere and Ocean Research Institute, The University of Tokyo, 3.Meteorological Research Institute

Recently, the present-day and global warming simulations are conducted by using Nonhydrostatic ICosahedral Atmospheric Model (NICAM) without cumulus convective scheme. These simulations span 30-years. Horizontal grid interval is 14-km. The authors investigate response of tropical cyclone (TC) activities to global warming by using those outputs. The model projects reduction in the global TC formation, and a rise in rate of intense TC formation to the total TC. These findings are consistent with the previous studies.
NICAM reproduces the TC primary and secondary circulations. In particular, updrafts along eyewall cloud exhibits outward slope with height, which was documented by observational studies. Horizontal size of TC modulates the scale of natural disaster by tropical cyclone as well as its genesis number and intensity. The authors investigate a future change in the radius of maximum wind at the same life time maximum intensity. The global warming simulation projects a decrease in sea-level pressure under eyewall cloud, and an increase in TC frequency with large radius of maximum wind for TC developing to deeper than 980 hPa.
This change is related to the elevation of tropopause due to global warming. The elevation of tropopause induces upward extension of eyewall cloud, and increase in diabatic heating related to the extension. The heating decreases sea level pressure underneath the heating area mainly from hydrostatic adjustment. The change in sea level pressure distribution enhances tangential wind under and outward of eyewall cloud. The Outward slope of updrafts with height plays a key role in this mechanism.

Keywords: tropical cyclone, global warming