Control of Tropospheric Stability on the Intensification of Tropical Cyclones

Tetsuya TAKEMI[1], and Shota YAMASAKI[1]

[1] *Disaster Prevention Research Institute, Kyoto University, Uji, Kyoto, Japan*

The physics for the evolution and intensity of tropical cyclones (TCs) has still unknown issues, which makes the quantitative forecast of TC intensification challenging both from research and operational perspectives. In addition, due to the lack of sufficient understandings of the TC intensification physics, the projection of future changes of the TC intensity under global warming requires further investigations. In this study, we will investigate the environmental stability control of the evolution and intensity of TCs by using an axisymmetric non-hydrostatic model, i.e., the Bryan's Cloud Model Version 1 (CM1). Based on our recent study on the future change of Typhoon Vera (1959) that was a category-5 storm and spawned devastating disasters, we specifically focus on effects of tropospheric temperature lapse rate, tropopause-height temperature, and tropopause height on the evolution and intensity of the TC by conducting a series of numerical experiments in which those temperature conditions are systematically changed.

It was found that with the increase in convective available potential energy or in temperature lapse rate the maximum intensity of the simulated TC clearly increases. In contrast, with the increase in tropopause height but with keeping the tropopause-level temperature unchanged, the maximum intensity of the TC tends to decrease; this is due to the decrease in temperature lapse rate. The decrease in the tropopause-level temperature leads to the increase in the TC intensity in a certain lapse rate condition; however, this tendency depends on the temperature lapse rate. The temperature lapse rate seems to have the most significant impacts on the evolution and intensity of the simulated TCs. Compared to the lapse rate, the increases in tropopause height and in tropopause-level temperature seem to play a secondary role, although under an unchanged lapse rate condition a higher tropopause and a colder tropopause-temperature would add a positive impact on the intensification of TCs.

Key words: tropical cyclone, tropospheric stability, numerical experiment