Influence of Ocean Thermal Structure on Typhoon Intensity over the East China Sea using the Satellite Observations

Thi-Kieu-Diem Nguyen[1], Po-Chun Hsu[1]*

[1] *Center for Space and Remote Sensing Research, National Central University, Taiwan*

The interaction between typhoons and shallow water conditions, along with the resulting feedback mechanisms, has a significant impact on typhoon intensity upon landfall. This study investigates the ocean thermal responses during the intensification of seven typhoon cases over the shallow East China Sea (ECS). The analyzed typhoon cases include Typhoon Olga (1999), Kompasu (2010), Damrey (2012), Malakas (2016), Nanmadol (2017), Kong-Rey (2018), and Bavi (2020). Satellite observation, high-resolution reanalysis data of ocean thermal structures, and an ocean mixing model are utilized to examine the thermal responses within the inner-core and outer-core regions of the typhoons. Among the analyzed typhoons, four intensified to category 1 (Olga (1999), Damrey (2012), Nanmadol (2016), and Kong-Rey (2018)) upon entering the ECS. Typhoon Kompasu (2010) and Bavi (2020) were the two strongest typhoons (category 3) following similar paths into the Yellow Sea. Typhoon Malakas (2016) also intensified to category 3 but moved toward Japan. The findings indicate that all seven typhoons experienced intensification as a result of increased sea surface temperature (SST) (approximately 28-31?), warm subsurface conditions, and strong stratification. However, significant variations were observed among these typhoons. The magnitude of temperature responses is associated with strong wind, slow translation speeds, shallow mixed-layer depth, and the predominance of the Yellow Sea cold bottom water. Thus, category 1 typhoons generate less cooling of the SST compared to category 3 typhoons. The ocean mixing model demonstrates that shallow water depth inhibits SST cooling as the entire shallow water column is well mixed, and the warm temperatures are sustained due to the absence of deep cold water. Moreover, the ocean conditions act as an energy source, contributing to typhoon intensification. The study provides a comprehensive quantification of the ocean thermal responses to typhoon intensification, which helps explain the intensification patterns observed in the seven analyzed typhoons compared to others that did not intensify over this region. Furthermore, it sheds light on the influence of shallow water on changes in typhoon intensity and supports future typhoon forecasts and understanding of ocean behavior during extreme events.

Keywords: Satellite observation, Typhoon intensification, Shallow water, Ocean thermal responses