Estimation of typhoon wind speed using CYGNSS observations: A case study of Typhoon Lan in 2017

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We conducted a case study of Typhoon Lan, which occurred in 2017, to investigate the impact of the Cyclone Global Navigation Satellite System (CYGNSS) on the estimation of extremely high wind speeds, such as those occurring during typhoons. We studied CYGNSS because it is expected to be capable of observing wind speeds in regions with extremely high wind speeds and heavy rains (i.e., typhoons) where it is difficult to perform measurements using the current microwave instrument. Firstly, we compared CYGNSS-derived wind speeds produced by NASA with those derived from AMSR2 produced by the Japan Aerospace Exploration Agency. CYGNSS was found to underestimate the wind speeds around Typhoon Lan compared with AMSR2. We then attempted to estimate the wind speeds using the leading edge slope (LES) and mean square slope (MSS) derived from the CYGNSS observations. Although the relationship between the MSS and wind speed differs depending on the wave age (Zhao and Tobe, 2003), it is difficult to estimate the wave age because this estimation is required the wind and wave speeds. We used the wave period as a substitute for the wave age since the wave period is expected to be similar to the wave age. We therefore first computed the fourth power of the wave period (T4) in line with Wang and Ichikawa (2016). Next, we classified the ocean into three regions based on T4 to investigate the relationship between the MSS and the wind speed observed by AMSR2 in each region. Finally, we approximated the curves relating the MSS to the wind speed using exponential functions in the three regions and estimated the wind speed using these curves. The comparison between the wind speeds produced by NASA and those estimated in this study demonstrated that our method can estimate high wind speeds more accurate than the CYGNSS wind speeds produced by NASA.

Keywords: CYGNSS, AMSR2, tyhoon

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