



A new approach that utilizes the GNSS atmospheric delay gradient to monitor front-type heavy rain and typhoon-type heavy rain in 2019 in Japan.

Syachrul Arief^{1,2} and Kosuke Heki¹

¹Dept. Natural History Sciences, Hokkaido University, Japan (syachrul@eis.hokudai.ac.jp)

²Geospatial Information Agency Indonesia

We studied front-type heavy rain and typhoon-type heavy rain in 2019 in Japan, using tropospheric delay data from the dense Global Satellite Navigation System (GNSS) network GEONET. In 2019, based on data from Japan Meteorological Agency (JMA), that front type heavy rain occurred on 26-29 August 2019, and typhoon type heavy rain occurred on 10-13 October 2019.

In this study, we analyzed the behavior of water vapor during heavy rainfall, using tropospheric parameters obtained from a database at the University of Nevada, Reno (UNR). Data sets, including delays in gradient vectors in the troposphere (G), as well as delays in the zenith troposphere (ZTD), are estimated every 5 minutes. Initially, we interpolated G to get grid points. We removed the hydrostatic delay from ZTD to get zenith wet delay (ZWD). In the inversion scheme, we use G at all GEONET stations and ZWD data at low altitude GEONET stations (<100 m) as input. Then we assume that the spatial change in ZWD is proportional to G ($G_x = H \delta ZWD / \delta x$, where H is the height of the water vapor scale) and the estimated height of sea-level ZWD at grid points throughout Japan.

We try to justify our working hypothesis that heavy rains occur when the convergence of G and ZWD sea levels is high by analyzing the hourly water vapor distribution on all days in August 2019 and October 2019. We found that both values show a maximum in the period studied when two events heavy rain occurred, i.e., August 27, 2019, and October 12, 2019. Furthermore, we studied the analysis of high time resolution (every 5 minutes) on heavy rain days. The results show that the convergence of G and ZWD sea level rises before rain occurs, and ZWD shows a rapid decline once heavy rain begins.