# Crustal deformation by the 2019 Typhoon Hagibis: High time-resolution study

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Powerful typhoon Hagibis (2019 #19) which made landfall in Japan on 12 October 2019 was the one of the strongest typhoons to hit the country. In the Gulf Coast of southern USA, Milliner et al. (2018) analyzed crustal deformation using a dense network of continuous GNSS (Global Navigation Satellite System) receivers due to the stormwater load of the 2017 Hurricane Hurvey. They found ~1/3 of the total precipitation stayed on land for days and caused significant crustal subsidence. Here we study crustal deformation caused by the water load left by the 2019 Typhoon #19 Hagibis, based on the coordinate time series of the dense continuous GNSS network of Japan GEONET (GNSS Earth Observation Network) downloaded from the Univ. Nevada Reno (UNR) data base (Blewitt et al., 2018). Discussions using daily GSI F3 solution are given in another paper, Heki et al. (this session).

In this paper, we concentrate on high time resolution crustal deformation, and use the 5 min solution from the UNR data base to study sub-daily vertical coordinate changes in four regions, Izu (R1), Boso (R2), Fukushima (R3), and Jo’ etsu (R4) (Fig.1a). To reduce the noise, we calculated 1h-average and 6h-average coordinates and show their time series in Fig.lb. The station J620 (0620) in region R1 showed that the station started to subside by up to ~2 cm on 11 October, corresponding to the day of the year (DOY) 284, one day before the Typhoon Hagibis made landfall. It recovered to the original position on 12 October (DOY 285) (days and times are all in UT). Conversely, station I025 (3025) in region R2 did not show significant subsidence on 12 October. Station G176 (1176) in region R3 showed a large subsidence of 2-3 cm during 12 October. Station J820 (0820) showed a subsidence of ~2 cm over a longer duration, starting on 12 October and lasting until 13 October (DOY 286).

From these results, we can study distribution of stormwater load and its decay by draining to ocean as was done by Milliner et al. (2018) in USA. These results demonstrate that the dense GPS network is a useful sensor to understand water dynamics associated with extreme weather events with high spatial and temporal resolution.

Keywords: Crustal deformation, Typhoon Hagibis, GNSS

 

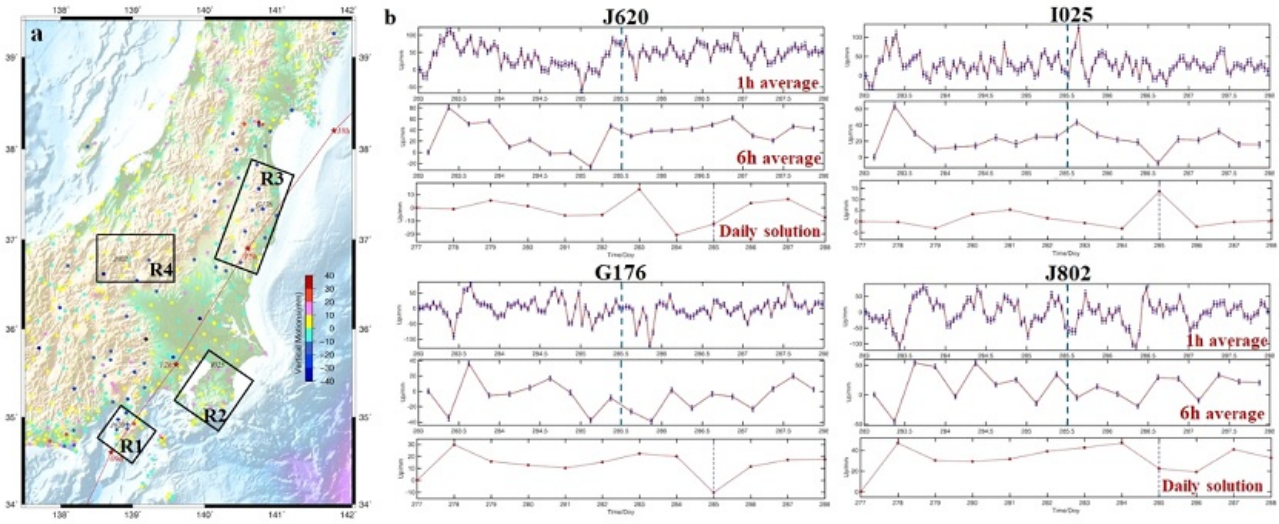


Figure 1. (a) Track of the 2019 Typhoon Hagibis on 12 October 2019 (red curve) and four studied regions R1-R4 shown in black rectangles. (b) Time series of the vertical coordinates of the GNSS stations J620, I025, G176 and J802 in the regions R1-R4 from DOY 277-289 (from 04 to 16 October 2019) in three different time resolution, hourly (top), every 6 hours (middle) and daily (bottom). Times and days are in UT. The dashed vertical lines indicate the beginning of 12 October (DOY 285).

 