Detection of the volcanic plume by 19 February 2018 eruption of Mount Sinabung deduced from GNSS post-fit phase residual analysis

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On 19 February 2018, 08:53 local time, the Indonesian volcano Mt. Sinabung on Sumatra, Indonesia erupted with a high volume of ash that quickly rose to an estimated 15-17 km above sea level. The eruption also generated a pyroclastic flow which mainly ran the southeastern flank of the mountain. Around the Mt. Sinabung, four GNSS sites are located to monitor the crustal deformation. Ohta and Iguchi (2015) investigated the temporal and spatial development of a volcanic plume during the eruptive event at Sakurajima volcano in Japan on July 24, 2012. In this study, we applied the similar approach to detect the volcanic plume caused by the eruption of Mt. Sinabung.

We extracted the post-fit phase residuals (PPR) of ionosphere-free linear combinations for each satellite based on the precise point positioning (PPP) approach. We used GIPSY-OASIS software ver. 6.4 for the analysis. To reduce the multi-path effect which caused by the surrounding environment at each site, we subtracted the PPR time series of previous day with sidereal time sifting. The obtained residual time series clearly shows the PPR anomalies at all GNSS sites. For example, LKWR station, which located the northern flank of the mountain, showed the clear impulsive PPR positive anomaly just three minutes after the eruption relative to SVN62 satellite which was southeastern direction with 34-degree elevation angle. In contrast, SNBG station, which locate the southeastern direction of the mountain, showed very long duration PPR anomaly relative to SVN41 satellite which was northwestern direction with 25-degree elevation angle. This ray-path corresponded to the just above the mountain. Furthermore, MRDG station, which located the southwestern flank of the mountain, also showed long duration PPR anomaly longer than one-hour, relative to SVN62. This ray-path roughly corresponded to the south of the mountain flank. Based on the results from MRDG and SNBG may suggest that the obtained PPR anomaly may reflect the pyroclastic flow after the eruption because the PPR anomaly direction concentrated in the southern direction of the mountain.

In the presentation, we will discuss the more detailed results including the not only PPR analysis but also the signal-to-noise ratio analysis of the GNSS signals.

Keywords: GNSS, plume, Sinabung

