Effect of rain and snowmelt correction of tiltmeter data - Application example for Ontakesan Volcano -

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Japan Meteorological Agency(JMA) installed a tiltmeter about 3km southeast of Mt. Ontake in 2010. A clear tilt change was observed northwest upward from several minutes before the 2014 phreatic eruption and northwest downward after the eruption. Kimura and Nakahashi (2015) applied the rain correction method using the tank model and precipitation data to the tiltmeter data of east-west component of the summer (From June to October), and they detected the small tilt change of west rising from September 10, 2014 when the earthquake activity became active. However, the similar tilt change of west rising has been confirmed several times and it has not been able to remove the influence of snowmelt in the spring (From March to May).

Miyamura et al. (2017) developed the rain and snowmelt correction method that adds the snow-tank to the tank model by Kimura et al. (2015) that uses snowmelt amount data as input values in addition to the precipitation data. They applied this method to the tiltmeter data of east-west component, and they confirmed that the influence of snowmelt in the spring was removed from the tiltmeter data. We used a method using a TR model that uses temparature and solar radiation as indices with reference to Matsumoto et al. (2010). Because there is not the continuous meteorological observation data for a long time near the tiltmeter (altitude 2195 m), they used the meteorological observation data at Kaidakogen (altitude 1130 m) closest to the tiltmeter (about 11.5km). In order to consider the difference between the two meteorological observation data, they compared with the meteorological observation data at Kaidakogen and the meteorological data near the tiltmeter observed by Kawashima et al. (2016).

There is a large seasonal changes from spring to summer every year for the tiltmeter data of north-south component. We applied the method of Miyamura et al (2017) to the tiltmeter data of north-south component, and it is able to remove this seasonal changes. Focusing on the 2014 phreatic eruption of Mt. Ontake, we detected the tilt change of north rising from the mid August 2014. In other words, the tilt change began north rising from the mid August 2014, and turned to northwest rising from around September 10. Similar tilt change could not be confirmed during the reserch period (April 2011 - September 2017).

We considered this tilt change while related to two previous studies. First, with reference to hypocenters before and after the eruption by Kato et al (2015), assuming an open crack model with NNW-SSE strike and moving its upper end from the 2 km to 1 km depth. As a result, we were able to confirm the tilt change pattern from north rising to northwest rising. Next, Miyaoka and Takagi (2016) applied the stacking method to the GNSS baseline length data, they detected that the change of the long baseline began from the middle of August and the change of the short baseline began from the beginning of September. They inferred that the pressure source migrated to a shallower region from a deeper region. The results of these previous studies are consistent with the tilt change applied the rain and snowmelt correction method to the tiltmeter data, and are considered to indicate the effectiveness of this method.

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