Crustal deformation around Azumayama volcano : InSAR analysis compared with GNSS data

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Japan is located in a subduction zone where we suffer from a lot of natural disasters, earthquakes and volcanic eruptions. The volcanic monitoring and disaster control are still very behind compared with the preparations for earthquakes. Our long-term objective is multi- dimensional or perspective monitoring of active volcanoes to prepare for potential eruptions. We hope to contribute to the regional disaster control or reduction in Fukushima Prefecture.
Azumayama volcano is one of the 5 active volcanoes in Fukushima Prefecture and located near the border with Yamagata Prefecture. Azumayama volcano had been issued the volcanic alert level 2 from winter 2014 to fall 2016, which was the highest in Fukushima Prefecture, although currently it is issued level 1 as of mid-February 2017. However, the successive monitoring of Azumayama volcano is still most necessary.
The examination of crustal deformation around Azumayama volcano was conducted recently by Muto et al. [2016]. They tried to investigate time-series of surface uplift and subsidence during fall 2014-fall 2015 based on InSAR (Interferometric Synthetic Aperture Radar) analysis combining with GNSS observation.
This study followed the method of Muto et al. [2016] introducing the latest data after fall 2015 and also all the available data which are observed by the Advanced Land observing Satellite2 (ALOS2) / Phased Allay L-band Synthetic Aperture Radar (PALSAR2). Muto et al. [2016] used only the part of the observed data by the same satellite. The objective of this study is to constrain the ground movement around Azumayama volcano more minutely and precisely.
The results of InSAR analyses showed the uplift around the Oana crater during 2014/9/9-2015/6/2 which match the results of Muto et al. [2016] and also the 134th the Coordinating Committee for Prediction of Volcanic Eruption.
We observed the possible subsidence during 2015/9/10-2015/10/8 at the west of Azumayama volcano. The GNSS observation data showed good agreement with the InSAR results for the uplift at the Oana crater. Whereas, as for the west of Azumayama volcano, we can not compare the InSAR results with GNSS data because no GNSS station exists around there.
Unwrapping bias appeared in the 2 pairs of the InSAR analyses results images. The crustal deformation estimated by InSAR analysis showed slightest agreement with GNSS observation for the 2 pairs, but the relative deformation among the different sites estimated by InSAR analysis match well with those observed by GNSS observation for both of the 2 pairs.
Weather noise existed in the InSAR results of the 2 pairs: 2015/7/30-2015/10/8 and 2015/9/10-2015/10/8. For such pairs, the results of InSAR analysis did not match GNSS observation. Water vapor is generally responsible for such noise, so we tried to constrain the source quantitatively to evaluate and eliminate the noise. First, we checked to the record of rainfall. In the Washikura observation station, which locates just ~6 km away from the Azumayama volcano, almost no rain was observed on both days of 2015/7/30 and 2015/10/8. Only a small amount of rain (about 0.5 mm per 10 minutes) was observed on 2015/9/10. However, locally heavy rain fell in the northern area of Kanto was reported on 2015/9/10, which might be related to the above noise. Second, we referred to weather and water vapor maps. A weather map showed that a typhoon approached on 2015/10/8 . A sudden break of water vapor seems to stay around Azumayama volcano based on the water vapor map on 2015/10/8. The fact might be connected to the weather noise seen on the InSAR image. It was still difficult, however, to specify the

cause of the weather noise for the 2 pairs of InSAR analysis.
In this study, we could not afford to reduce the noise indicated by some pairs of InSAR analysis, however, constrained the ground movement around Azumayama volcano after fall 2014 based on the InSAR analysis combining with GNSS observation, introducing the latest observation data.

Keywords: Azumayama volcano, Crustal deformation, InSAR, volcanic disaster prevention, GNSS

