Estimation of crustal deformation around Azumayama volcano by using InSAR analysis: Evaluation of errors from atmospheric delay

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Japan is located in a subduction zone where we suffer from a lot of natural disasters, earthquakes and volcanic eruptions. Recently, eruption disasters occurred at Mt. Ontake and Kusatsu Shirane volcano. Continuous and multifaceted monitoring of volcanoes is necessary from the viewpoint of volcanic disaster prevention.

We are aiming to establish the method of continuous monitoring of volcanoes for Azumayama volcano in Fukushima Prefecture. Azumayama volcano is a chain of mountains in Fukushima Prefecture. The volcano had been issued the volcanic alert level 2 from Dec. 2014 to Oct. 2016. As one of the monitoring methods, we estimated the amount of crustal deformation by using InSAR (Interferometric Synthetic Aperture Radar) analysis. The satellite data of “Daichi-2” during Sep. 2014 –May 2016 were used. The results showed the uplift around the Oana crater, locating at the east of Azumayama volcano, from Sep. 2014 to Jun. 2015. The possible subsidence at the west of Azumayama volcano from Sep. 2015 to Oct. 2015, and subsidence at the Oana crater from Nov. 2015 to Nov. 2016 are also indicated by the analyses results.

However, the significant correlation between the InSAR analysis image and the topography map was observed in some cases. We often interpret that such the results are biased by the effect of atmospheric delay. We compared the results of InSAR analysis and GNSS (Global Navigation Satellite System) observation. A large discrepancy was found in the analytical pairs where the topographical correlation was remarkable. Therefore, we introduced atmospheric delay correction using MSM (MesoScale Model) for those pairs. As a result, the subsidence at the west of Azumayama during Sep. 2014 –Nov. 2015 seems decreased or disappeared after the correction. On the other hand, the uplift at the Oana crater was emphasized after the correction.

In this study, the results of atmospheric delay correction based on the three meteorological models of MSM, MANAL (Meso Analysis), LFM (Local Forecast Model) are compared and discussed. The three models correspond to mesh data with different spatial resolutions: 5km, 10km and 2km per pix, respectively. We examine the effect of each meteorological model for the atmospheric correction, and try to select the model that is most suitable for atmospheric delay correction in InSAR. Then, we compare the GNSS observation with the InSAR analysis result again where the atmospheric delay correction is properly applied. We also try to model the spherical pressure source of magma using Mogi model based in the estimated crustal deformation. We plan to integrate the above all observational and analytical elements for continuous monitoring of active volcanoes.

