Monitoring Crustal Deformation at Aso Volcano since April 2016 Using InSAR Time Series Analysis System

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Geospatial Information Authority of Japan (GSI) has conducted Interferometric SAR (InSAR) analysis of Advanced Land Observing Satellite-2 (ALOS-2) images and monitored crustal deformation in Japan. GSI developed a system for InSAR time series analysis (GSITSA) to detect temporal transition of crustal deformation with higher accuracy than the conventional analysis (Kobayashi et al., 2018). Using this system, we have conducted InSAR time series analysis with ALOS-2 data accumulated since 2014 for 38 active volcanoes in Japan (as of February 2022). We have detected local crustal deformation at the summit areas of some volcanoes by the InSAR time series analysis (Mikihara et al., 2021) and have contributed to understanding of the structure and behavior of volcanic fluids in shallow areas under the volcanoes, which had never been clarified (Ichimura et al., 2021). In this presentation, we report on the crustal deformation at Mt. Aso (Aso volcano) detected by InSAR time series analysis.

For InSAR time series analysis, we use ALOS-2 images in Stripmap mode (3-m resolution) observed from the ascending and descending paths since April 18, 2014. The main flow and features of GSITSA are as follows. At first, interferograms are generated by in-house InSAR analysis software (GSISAR). Pairs within 100 m perpendicular baseline and 730 days temporal separation are generally selected. We multilooked the images in the range and azimuth direction by 8 and 8 pixels. The final pixel resolution is approximately 30 m. Then, tropospheric error in each interferogram is estimated and reduced using the numerical weather model (Kobayashi et al., 2014). After that, these interferograms are unwrapped by the MCF method (Costantini, 1998) and longwavelength noise of them are corrected. Finally, InSAR time series analysis is conducted with the SBAS method (Berardino et al., 2002). In addition to the typical SBAS method, GSITSA implements a temporal smoothing process for further reduction of errors that could not be sufficiently reduced by the previous steps.

In the results of the InSAR time series analysis, displacements away from the satellite are seen over a wide area including the central cones; ~2 cm/y (the maximum value is 2.5 cm/y around the active crater) in the descending orbit and ~ 1 cm/y in the ascending orbit. The temporal variation of the displacement in the descending orbit shows a temporary approach to the satellite from April to September 2019, before the 2019 eruption, and a stagnation of the displacement away from the satellite since June 2020. These displacements include the post-seismic deformation of the 2016 Kumamoto Earthquake, in addition to the deformation under the central cones caused by volcanic activities. Therefore, we discuss the source and its volume change of the deformation under the central cones, excluding the post-seismic deformation.

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