Constraints on Deformation at the Summit area of Kuchinoerabujima Volcano in Japan from SAR Interferometry Time Series Analysis

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Kuchinoerabujima is an active volcanic island located on the volcanic front of the Ryukyu island arc. Recent eruptive activities of Kuchinoerabujima volcano occurred at two active craters of Shindake and Furudake. Eruption was not observed for more than 30 years; however, seismic swarms were accompanied by a radial outward pattern from the summit crater repeated almost every two years since 1999 (Iguchi, 2007). Ground displacements near the summit area of Shindake were also detected by interferometric synthetic aperture radar (InSAR) analysis using the Phased Array type L-band Synthetic Aperture Radar (PALSAR) onboard the Advanced Land Observation Satellite (ALOS) data (Yamamoto, 2009).

We applied the InSAR time-series analysis using the software package StaMPS/MTI (Stanford Method for Persistent Scatterers/Multi-Temporal InSAR) (Hooper, 2010) to the ALOS/PALSAR data acquired on both ascending and descending orbits from May 2006 to March 2011. This analysis identified enough coherent pixels to successfully resolve the spatial and temporal deformation. The line-of-sight (LOS) displacements show a rather complicated pattern compared with previous results obtained using GPS measurements and InSAR analysis. The mean velocity maps show two focused areas of LOS shortening located beneath Shindake and Furudake at a rate of 20 mm/year, confirming the inflation trend. The observed deformation near the summit area of Shindake was consistent with previous results. Also, it suggests another deformation source beneath Furudake, which was not clearly accounted for previously.

We model the Kuchinoerabujima volcano sources that produced clear and distinct fringe patterns using a Markov Chain Monte Carlo optimization. Two regions of inflation were modeled by two point sources located at depths of 0.5 and 0.3 km and with volume changes of 1.7 x 10^4 and 6.3 x 10^3 m^3 respectively. The location, depth, and volume change of a point source beneath Shindake is consistent with that of inflation and demagnetization at the summit area of Shindake, indicating expansion and heating of shallow region at about a few hundred meters beneath the Shindake summit.