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Caldera deformation in Kyushu island (SW Japan) through InSAR data

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Calderas are the surface expression of a long-lived and complex magmatic system, often hosting a shallower hydrothermal system. Most monitored calderas have experienced some forms of unrest, even though only a part of these unrest episodes has culminated in an eruption. This study focuses on surface deformation analysis using InSAR from 1993 to 2013 at two large active calderas, Aso and Aira, located on Kyushu Island (Japan). Despite being closely monitored, our knowledge on the deformation history of both calderas with regard to their activity is poor. ERS, ENVISAT, ALOS and COSMO-SkyMed SAR images have been processed to obtain mean velocity deformation maps and time series through the SBAS technique. Results are then inverted using the simulated annealing technique to evaluate the deformation source parameters.
Aso caldera hosts several vents in its central portion. One of these, the Naka Dake crater is the only currently active and erupted 7 times since 1993. From January 1996 to November 1998, after the important 1994 - 1995 eruption, we observed a subsidence of $\sim$1.2 cm/yr at the center of the caldera. Analytical models suggest a deflating source (with various possible shapes) at 5-7 km of depth, implying a magmatic nature for the deformation. Inversion results are consistent with available seismic and GPS data.
Aira Caldera hosts the Sakurajima volcano along its southern rim, with a persistent eruptive activity since 1950s. From June 2006 to March 2011, we observed a broad uplift of $\sim$1.5 cm along most of the caldera rim. Analytical inversion of both the entire dataset and a cross-correlated dataset suggests a deformation source at the caldera center, at a depth of 5-9 km (depending on the source shape), implying a magmatic nature of the deformation. Inversion results are in agreement with GPS and InSAR data inversions for other periods of activity.
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