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Ongoing Active Deformation Processes at Fernandina Volcano (Galapagos) Detected via Multi-Orbit COSMO-SkyMed SAR Data Analysis

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Fernandina Volcano, Galápagos (Ecuador), has experienced several uplift and eruption episodes over the last twenty-two years. The ground deformation between 2002 and 2006 was interpreted as the effect of an inflation phenomenon of two separate magma reservoirs beneath the caldera. Moreover, the uplift deformation occurred during the 2005 eruption was concentrated near the circumferential eruptive fissures, while being superimposed on a broad subsidence centred on the caldera. The geodetic studies emphasized the presence of two sub volcanic lateral intrusions from the central storage system in December 2006 and August 2007. The latest eruption in 2009 was characterized by lava flows emitted from the SW radial fissures.

We analyze the spatial and temporal ground deformation between March 2012 and July 2013, by using data acquired by COSMO-SkyMed X-band constellation along both ascending and descending orbits and by applying advanced InSAR techniques. In particular, we use the SBAS InSAR approach and combine ascending and descending time series to produce vertical and East-West components of the mean deformation velocity and deformation time series. Our analysis revealed a new uplift phenomenon due to the stress concentration inside the shallow magmatic system of the volcano. In particular, the vertical mean velocity map shows that the deformation pattern is concentrated inside caldera region and is characterized by strongly radial symmetry with a maximum displacement of about 20 cm in uplift; an axial symmetry is also observed in the EW horizontal mean velocity map, showing a maximum displacement of about +12 cm towards East for the SE flank, and -12 cm towards West for the NW flank of the volcano.

Moreover, the deformation time series show a rather linear uplift trend from March to September 2012, interrupted by a low deformation rate interval lasting until January 2013. After this stage, the deformation shows again a linear behaviour with an increased uplift rate. Starting from these observations, we set up a 3D time dependent numerical model in a fluid dynamic context; in particular, we consider the creeping flow approximation in order to simulate the stress temporal evolution inside the volcano conduit. The preliminary results show that the stress is concentred in the areas corresponding to the circumferential eruptive fissures mentioned above.

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