

2024-2025 Deformation of the Santorini Caldera: InSAR time-series data from the S1A satellite of the European Space Agency

Dr. Athanassios Ganas and Dr Varvara Tsironi

aganas@noa.gr vtsironi@noa.gr

The geodetic data provided by the Sentinel-1 ESA satellite are useful to determine the location and characteristics of the source of the deformation around the Santorini volcano, either a Mogi-source type of source as the 2011-2012 episode (Parks et al. 2012) or a propagating dyke along the NE-SW direction. Our InSAR analysis covers the period from October 2023 to January 2025 and leverages LiCSBAS, an open-source package (Morishita et al., 2020), for InSAR time series analysis with the N-SBAS method. We used LiCSAR generated interferograms, both wrapped and unwrapped, from Sentinel-1 SLC (Single Look Complex) data and implemented the data analysis procedures as described in Tsironi et al. (2024). The results of the InSAR analysis (**Fig. 1** ascending orbit; **Fig. 2** descending orbit) demonstrate deformation rates between -30-40 mm/yr in the line-of-sight (LOS) direction of the satellite.

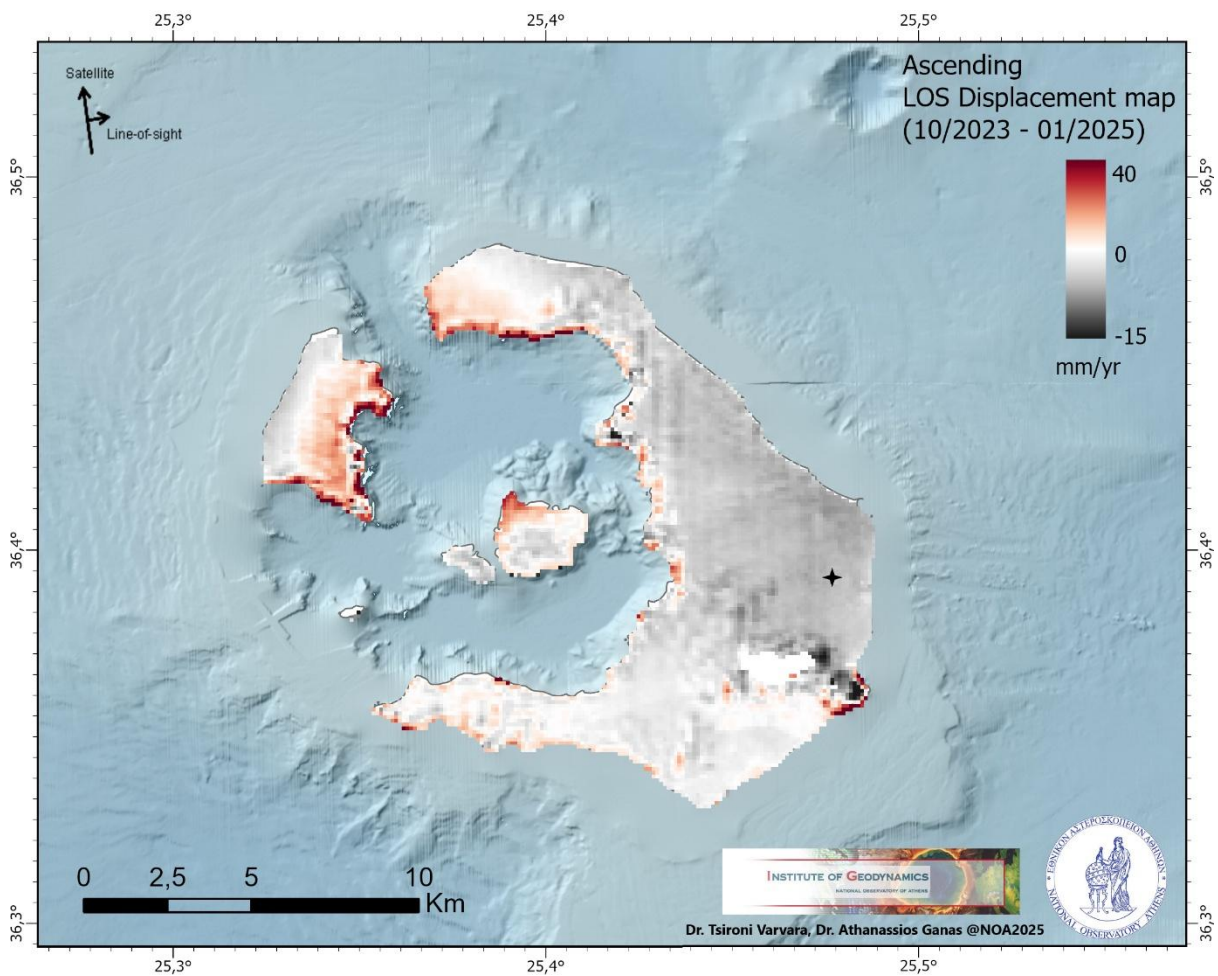


Figure 1. Map of ground velocities along the Sentinel-1 satellite line-of-sight (ascending orbit). The red colour shows motion towards the satellite, whose pattern indicates similar motions around the northern side of the Santorini Caldera. Cross indicates reference point used in the InSAR analysis. The largest values (4 cm/yr) occur around onshore Thirasia, Oia and the NW edge of Nea Kammeni islet. Satellite imagery spans the period October 2023 – January 2025.

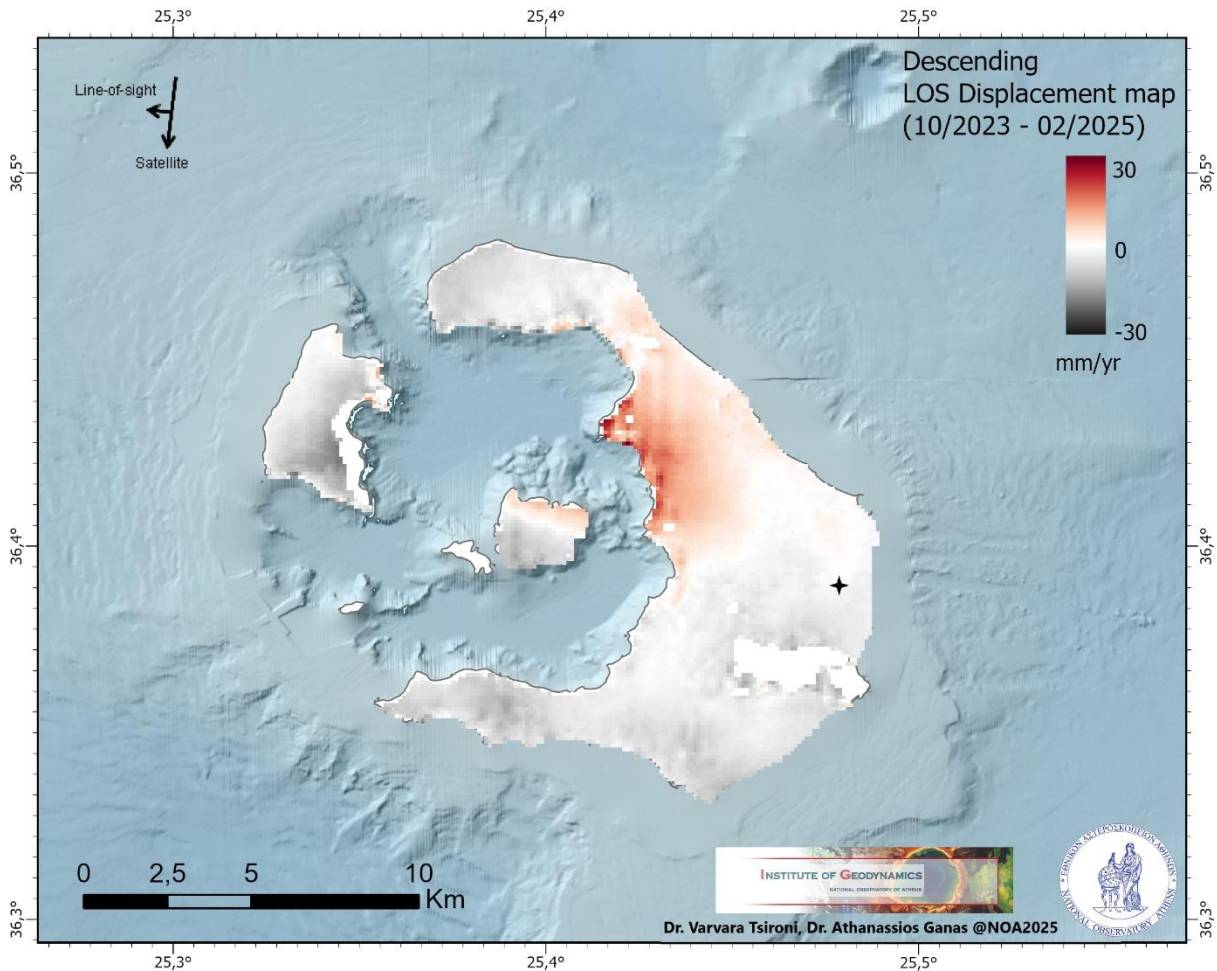


Figure 2. Map of ground velocities along the Sentinel-1 satellite line-of-sight (descending orbit). The red colour shows motion towards the satellite, whose pattern indicates similar motions around the northern side of the Santorini Caldera. Cross indicates reference point used in the InSAR analysis. The largest values (3 cm/yr) occur around Fira (east side of the caldera), Oia and the NW edge of Nea Kammeni islet. Satellite imagery spans the period October 2023 – 5 February 2025.

Acknowledgements

This work utilizes Sentinel-1 data, provided by the European Space Agency (ESA) as part of the Copernicus program.

References

Morishita, Y., Lazecky, M., Wright, T.J., Weiss, J.R., Elliott, J.R., Hooper, A. 2020. LiCSBAS: An Open-Source InSAR Time Series Analysis Package Integrated with the LiCSAR Automated Sentinel-1 InSAR Processor. *Remote Sens.*, 12, 424.

Parks, Michelle M., et al. 2012. Evolution of Santorini Volcano dominated by episodic and rapid fluxes of melt from depth. *Nature Geoscience*, 5,10, 749-754.

Tsironi, V., Ganas, A., Valkaniotis, S., Kouskouna, V., Sokos, E., Koukouvelas, I., 2024. Active shortening and aseismic slip along the Cephalonia Plate Boundary (Paliki Peninsula, Greece): Evidence from InSAR and GNSS data. *Tectonophysics*, v. 884, 230400, <https://doi.org/10.1016/j.tecto.2024.230400>