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Combining High Resolution InSAR and infrared photogrammetry for studying dome degassing and densification mechanisms at Volcán de Colima, Mexico

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Active volcanoes often display cyclic behaviour with alternating quiescent and eruptive periods. Continuously monitoring volcanic processes such as deformation, seismicity and degassing, irrespective of their current status, is crucial for understanding the parameters governing the fluid transport within the edifice and the transitions between different regimes. However, mapping the deformation and details of fluid escape at the summit of steep sloped volcanoes and integrating these with other types of data is challenging.
Here we present for the first time the near-3D surface deformation field derived from high resolution radar interferometry (InSAR) acquired by the satellite TerraSAR-X at a degassing volcano dome and interpret the results in combination with overflight infrared and topographic data. We find that the results strongly differ depending on the chosen InSAR time series method, which potentially overprints the true physical complexities of small scale, shallow deformation processes. We present a new method for accurate mapping of heterogeneities in the dome deformation, and comparison to the topography and precisely located surface temperature anomalies. The identified deformation is dominated by strong but highly localized subsidence of the summit dome. Our results highlight the competing effects of the topography, permeability and shallow volcanic structures controlling the degassing pathways. On small spatial scales compaction sufficiently reduced the dome permeability to redirect the fluid flow. High resolution InSAR monitoring of volcanic domes thus provides valuable data for constraining models of their internal structure, degassing pathways and densification processes.