Integrating tri-stereo Pleiades images with infrared satellite data to monitor volcanoes: the 2019 Stromboli eruption



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HOTSAT: Satellite data processing system



The HOTSAT system is designed to ingest different kind of satellite data and produce several products useful to volcano hazard monitoring. In particular, time-averaged discharge rates (TADRs) obtained from low spatial/high resolution temporal satellite data (e.g. MODIS, STLSTR) are complemented,



compared and fine-tuned with detailed maps of volcanic deposits with the aim of constraining the conversion from satellite-derived radiant heat flux to TADR. Maps of volcanic deposits include the time-varying evolution of lava flow emplacement derived from multispectral satellite data (e.g. Landsat, Sentinel-2, ASTER), as well as the flow thickness variations, retrieved from the topographic monitoring by using stereo or tri-stereo optical data (e.g. Pléiades).

Stromboli – 2019 Eruption

The 3 July 2019 explosive paroxysm at Stromboli volcano (Italy) caused severe concern in the local population and media, and killed one tourist hiking the volcano. The great explosion formed a 4-km-high eruptive cloud, and its partial collapse ignited the dry vegetation and caused hot rock avalanches spreading along the northern slope to the sea and triggering a small tsunami wave. This paroxysm was followed by 56 days of lava flow effusion, and another explosive paroxysm occurred on 28 August 2019. Also this explosive event caused an eruptive column of about 4 km and hot avalanches spreading on the north flank of the volcano and on the sea surface.

Here we use effusion rate time-series derived from MODIS and SLSTR data to follow the different thermal phases of this eruption and compute the dense rock equivalent volume emitted. Sentinel-2 MSI, Landsat-8 OLI and ASTER images were used to follow the time-varying evolution of lava flow emplacement.



Digital elevation model from tri-stereo Pléiades satellite imagery



STEREO

We computed two digital elevation models from Pléiades triplets acquired on June and October 2019 in order to map the morphological changes occurred during the eruption.



8 October 2019

The 3D processing of the tri-stereo Pléiades imagery is performed using the free and open source MicMac (Multi-images Correspondances, Méthodes Automatiques de Corrélation) photogrammetric library developed by the French IGN (Institut Géographique National).



2019 Stromboli Eruption: TADR & Volumes



Volume from MODIS & SLSTR: 3.5±1.1 Mm³

Volume from Pléiades: $2.6 \pm 0.6 \text{ Mm}^3$

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By differencing pre and post eruptive topographies we computed the bulk lava volume. Combining tristereo Pléiades results with MODIS and SLSTR ones, beside giving insights in the characterization of volcanic deposits, provides important constraints in the conversion between radiant heat flux and TADR, and demonstrates the powerful merging capability of multi-platform remote sensing data.

Preliminary Results

