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Remote sensing of steep-slope volcanoes: the Stromboli case study

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Steep-slope volcanoes are geomorphological systems receptive to both exogenous and endogenous phenomena. Volcanic activity produces debris and lava accumulation, whereas magmatic/tectonic and gravitational processes can have a destructive effect, triggering mass-wasting and erosion.

Optical and radar sensors have often been used to identify areas impacted by eruptive and post-eruptive phenomena, quantify of topographic changes, and/or map ground deformation related to magmatic-tectonic-gravitational processes.

In this work, the slope processes on high-gradient volcano flanks in response to shift in volcanic activity have been identified by means of remote sensing techniques. The Sciara del Fuoco unstable flank of Stromboli volcano (Italy) was studied, having a very large set (2010-2020) of different remote sensing data available.

Data includes LiDAR and tri-stereo PLEIADES-1 DEMs, high-spatial-resolution (HSR) optical imagery (QUICKBIRD and PLEIADES-1), and space-borne and ground-based Synthetic Aperture Radar (SAR) data. Multi-temporal DEMs and HSR optical imagery permits to map areas affected by major lithological and morphological changes, and the volumes of deposited/eroded material. The results lead to the identification of topographical variations and geomorphological processes that occurred in response to the variation in eruptive intensity. The joint exploitation of space-borne and ground-based Differential and Multi Temporal SAR Interferometry (InSAR and MT-InSAR) measurements revealed deformation phenomena affecting the volcano edifice, and in particular the Sciara del Fuoco flank.

The presented results demonstrate the effectiveness of the joint exploitation of multi-temporal DEMs, HSR optical imagery, and InSAR measurements obtained through satellite and terrestrial SAR systems, highlighting their strong complementarity to map and interpret the slope phenomena in volcanic areas.

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