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(Article begins on next page)

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Deformations of the Stromboli volcano using GB-InSAR technique

G. Antonello (1), **N. Casagli** (2), F. Catani (2), C. Del Ventisette (2), J. Fortuny-Guasch (1), L. Guerri (2), D. Leva (3), D. Tarchi (1

(1) Joint Research Center of the European Commission, IPSC, Ispra (e-mail: dario.tarchi@jrc.it)

(2) Earth Sciences Department, University of Florence (e-mail: nicola.casagli@unifi.it)

(3) LisaLab Ltd. a JRC spin-off company, Legnano (e-mail: davide.leva@lisalab.com)

Following the collapse of the NE slope of the Stromboli volcano (Italy) and the subsequent tsunami occurred at the end of December 2002, concern over the possibility of further collapses of the Sciara del Fuoco slope (SdF) led to the set up of a permanent monitoring system of ground deformations. Problems in installing conventional topographic instrumentation, mainly related to the presence of lava flows diverting along the slope, were overcome by the use of a ground-based radar interferometer (GB-InSAR). The interferometric analysis of sequences of consecutives images, acquired every 12 minutes, has allowed to derive the entire deformation field of the observed area (900 m x 900 m, upper part of the SdF and the NE part of the flank of crater), with a millimetre precision in the displacement measurement and with a 2 x 2 m pixel resolution.

Spanning more than four years of nearly uninterrupted measurements, the data have permitted to reconstruct the temporal and spatial evolution of deformations on this part of the volcano, providing key insights on the slope instability problems.

In January 2007 the radar showed a progressive acceleration in the flank of the NE crater, forerunning the volcanic eruption occurred in February 2007. In the middle of February, the acceleration involved the upper portion of the SdF and on February 27^{th} a new effusive phase occurred on the SdF and several landslides were triggered. The

effusive phase finished on April 2^{th} 2007, after a major explosion that took place on March 15^{th}. Few minutes before this violent explosion, the system showed a clear acceleration that can be considered as a precursor.

During the whole period the GB-InSAR system provided real-time monitoring data of crucial importance for the emergency management carried out by the Italian National Civil Protection Department. The analysis of the entire dataset of GB-InSAR measurements allowed us to assess the deformation field over a large portion of the target area due to six different processes:

1. rapid lava flows, usually channellized into morphological depressions and sometimes diverting over the slope;
2. slow gravitational flows of cooling lava masses accumulated on the SdF slope;
3. gravitational sliding of volcanoclastic materials on the SdF along one or more deep-seated slip surfaces;
4. the opening of a volcanic vent in the upper sector of the SdF;
5. alternations of deflaction/inflaction phases in the upper part of the crater;
6. retrogressive landslides and falls inside the crater.

The results obtained confirm that the technique is particularly useful for an operational use, aimed at monitoring slow slope deformations and to understand complex deformation patterns during a volcanic crisis.