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DInSAR analysis of Mt. Etna volcano deformations: the December 2018 seismo-volcanic crisis

Vincenzo De Novellis (1), Simone Atzori (2), Manuela Bonano (3), Raffaele Castaldo (1), Francesco Casu (1), Claudio De Luca (1), Michele Manunta (1), Mariarosaria Manzo (1), Marco Neri (4), Giovanni Onorato (1), Susi Pepe (1), Giuseppe Solaro (1), Pietro Tizzani (1), Emanuela Valerio (5), Ivana Zinno (1), and Riccardo Lanari (1)

(1) Istituto per il Rilevamento Elettromagnetico dell'Ambiente, CNR, 80124 Napoli, Italy (denovellis.v@irea.cnr.it), (2) Istituto Nazionale di Geofisica e Vulcanologia, Via di Vigna Murata, 00143 Rome, Italy, (3) Istituto di Metodologie per l'Analisi Ambientale, CNR, C.da Santa Loja, Tito Scalo, 85050 Potenza, Italy, (4) Istituto Nazionale di Geofisica e Vulcanologia, Piazza Roma, 2, 95125 Catania, Italy, (5) Dipartimento di Scienze della Terra, Sapienza Università di Roma, 00185 Rome, Italy

Mount Etna is a large basaltic stratovolcano located on the eastern coast of Sicily (Southern Italy) and it is one of the best-known and most intensely monitored volcanoes of the planet, implying significant recent progress in the knowledge of its dynamics. Among others, the availability of space-borne SAR data provides accurate information on the volcano morphology and deformation, particularly during emergency phases, when it is difficult or even impossible to carry out in-situ surveys. Therefore, a fast availability and processing of the SAR data is crucial to help understanding the on-going volcano dynamic.
Since 24 December 2018, a new intense Etna activity has started and it has been associated with a relevant seismic sequence that culminated with a Mw 4.9 earthquake, occurred on 26 December 2018 on the lower part of the Eastern volcano flank. In this work, we investigate both the volcanic eruption process and the Mw 4.9 mainshock nucleation by using DInSAR measurements, seismological data and analytic modelling. In particular, we exploit the DInSAR measurements obtained from coseismic SAR data pairs collected by the Sentinel-1 and COSMO-SkyMed satellites from ascending and descending orbits. All of these data have been processed immediately after their availability and have been shared with the National Authorities to manage the volcano crisis. By benefiting from the availability of different orbits (ascending and descending), we retrieve the Vertical and East-West components of the displacements affecting the analyzed area. The obtained results show that the East-West component presents the most significant displacement entities, whose maximum values exceed about 30 cm towards West and about 50 cm towards East close to the volcano summit. In addition, in the area in correspondence to the 26 December main shock, maximum eastward and westward displacements of 12-14 cm and 15-17 cm are observed, respectively.
Moreover, we analyse the distribution of the relocated hypocentres in order to identify the involved and activated structures and, to better constrain the geometry and characteristics of the main sources, we extend our analysis by applying a modelling approach based on the analytical method. In particular, we invert DInSAR measurements to get the combination of seismic and vulcanic sources that better predict the displacement field; non-linear and linear modeling inversions are performed to retrieve source geometries, tensile and shear component distributions.