InSAR-based investigation of the April 2009 Abruzzo (Central Italy) Earthquake

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On 6 April, 2009 a magnitude (Mw) 6.3 earthquake struck central Italy, partially destroying L'Aquila and several surrounding villages, and causing hundreds of casualties.
Just a few days later, the combination of pairs of SAR images taken by the Synthetic Aperture Radar (SAR) sensor onboard to the European Space Agency's ENVISAT satellite, acquired before and after the earthquake, allowed us to retrieve the permanent ground deformation of the area, thus providing details about the involved physical mechanisms. To this end, differential interferometric (DInSAR) techniques were applied to the selected coseismic image pairs in order to achieve a measure of the ground displacement projected along the radar Line of Sight (LOS) direction. Moreover, since the radar looks aside from the vertical (rightwards with respect to the flight direction), SAR images acquired from ascending and descending satellite orbits can be exploited to observe the phenomenon from different viewing angles, in such a way to discriminate the deformation components. In particular, the post-shock images were acquired on 12 and 15 April, from descending and ascending orbits, respectively, whereas the pre-event acquisitions were taken on 1 February and 11 March, respectively.

The analysis of the coseismic interferograms provided several evidences for the interpretation of the seismic event. First, the deformation maps detailed the extent of the interested area (~ 650 km^2), the orientation of the seismogenic structure, and unambiguously constrained the slipping nodal plane of the focal solutions. In particular, we identified the Paganica fault as the causative source for the occurred earthquake. Second, by modelling the ground deformation, we constrained the geometry, sense of motion, and the amount of slip on the fault. Indeed, by jointly considering the ascending and descending ENVISAT deformation maps, we found that the Mw 6.3 L'Aquila earthquake was characterized by a prevalent normal faulting mechanism. This interpretation fits the observation detected also by other SAR sensors, independent geodetic analyses, and aftershock focal solutions.