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The 2012 Emilia (Northern Italy) seismic crisis retrieved through spaceborne sar interferometry

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On May 20, 2012, a moderate earthquake of local magnitude, ML 5.9 started a seismic sequence in the central Emilia region (Northern Italy). The aftershock sequence evolved rapidly near the epicenter, with diminishing magnitudes until May 29, 2012, when at 07:00 UTC a large earthquake of ML 5.8 occurred 12 km WSW of the mainshock, starting a new seismic sequence in the western area.
We analyzed the surface displacements related to these two main shock events by exploiting the availability of X-band COSMO-SkyMed (CSK) and C-band RADARSAT-1/2 (RSAT-1/2) SAR data. Starting from differential SAR interferograms obtained from CSK and RSAT-1/2 data, we performed an analytical and numerical optimization modeling of the deformation field related to the main shock episodes of May 20, 2012 (Ml 5.9), and May 29 (Ml 5.8). The analytical model provided useful information on type, geometry and locations of the causative faults. In particular we extended the results of previous studies, based on the Okada model inversion of GPS and RADARSAT-1 InSAR data, by using the processed RADARSAT-2 data.
We benefited from the available large amount of geological and geophysical information through a Finite Element Method modeling that allows investigating the impact of known buried structures in the modulation of the observed ground deformation field. We found that the May 20 displacement pattern is consistent with the single fault plane of the Okada solution. Differently, the May 29 episode required the activation of three different fault segments and a counterclockwise block roto-translation. Finally, we propose a general methodology applicable to other seismic areas where the complexity of buried structures plays a fundamental role in modulating the associated surface deformation pattern.