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Geodetic model of the 2016 Central Italy earthquake sequence inferred from InSAR and GPS measurements

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On 24th August 2016, a Mw 6.0 earthquake struck a sector of the Apennines in Central Italy, causing extensive damage to the town of Amatrice and several surroundings villages, and killing about 300 inhabitants. The seismic sequence which followed was characterized by numerous aftershocks southeast and northwest of the main event, which decreased in frequency and magnitude until the end of October, when an event of magnitude Mw 5.9 occurred on 26th October about 25 km to the NW of the 24th August event, close to Visso village. In addition, few days later, on 30th October a third great shock of magnitude Mw 6.5, nucleated below the town of Norcia, hit an area encompassing the two previous main events.

In order to infer the ground displacement field and to determine the source parameters of the causative faults associated with the three main events of the seismic sequence we exploit the InSAR and GPS coseismic measurements. In particular, we use SAR data acquired by the ALOS-2 (Japanese Aerospace Exploration Agency), Sentinel-1 (European Space Agency) and COSMO-SkyMed (Italian Space Agency) satellites, from both ascending and descending orbits, and data from continuous and survey-mode GPS stations operating during the earthquake sequence.

We show that our preferred model is consistent with the activation of at least four main coseismic asperities during the entire sequence, belonging to a SW-dipping normal fault system, the surface expression of which could be associated with the Mt. Gorzano-Mt. Vettore-Mt. Bove alignment. To better simulate the complex deformation pattern associated with the greatest event of the sequence (the 30th October Mw 6.5 Norcia earthquake), additional slip is required by secondary anti- and synthetic faults in the hanging-wall of the main fault, and by a further SW-dipping low-angle fault plane. Finally, we compare the latter retrieved geodetic source with the known geological structures of the Central Apennines; this result may suggest a reactivation of a pre-existing compressive structure below the Castelluccio plain inherited from pre-Quaternary tectonic phases.