

Finite Element analysis of source geometry and slip distribution of the 2016 Amatrice Mw 6.2 earthquake (Central Italy) through the integration of geological and satellite data

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On 24 August 2016 (01:36 UTC) the intra-Apennine extensional fault system of Central Italy released a ML 6.0 destructive earthquake between the towns of Norcia and Amatrice. The main shock produced widespread damages and fatalities, devastating several localities and killing about 300 people. The main event was followed by a significant aftershock (ML 5.4), located 15 km to the NW. After one week, the epicentral area reached a length of about 30 km, in the NNW-SSE direction, largely developing at the hanging-wall of the WSW-dipping active extensional Vettore and Gorzano faults. The reconstructed 3D fault model consists in two major interconnected fault segments, Vettore and Gorzano, which are individual at depth shallower than about 7-8 km and converge into a unified surface at higher depths; the Vettore-Gorzano unified surface has a length of 65 km, dips WSW-ward with an angle of about 45-50° and reaches a depth of 11 km.

By inverting the generated interferograms, following a classical Okada analytical approach, the best modelling results account for two sources related to main shock and more energetic aftershock. The time interval between the ascending and descending (31 August 2016) does not discriminate the effects derived from the main 24 August event and by its aftershock, but the low magnitude of the second event can only very marginally contribute to the overall deformation pattern.

Through Finite Element modelling that jointly exploits DInSAR deformation measurements and structural-geological data, we reconstruct the 3D source of the Accumoli 2016 normal fault earthquake which fit better a moment Mw 6.2. As results of our modelling, we retrieve (i) the active seismogenic structures responsible for the observed ground deformation, (ii) the spatial distribution of the local stress field in term of volumetric stress and strain.

The inversion shows that the co-seismic displacement area was partitioned on two distinct en echelon fault planes, which at the main event hypocentral depth (8 km) merge in one single WSW-dipping surface. Slip peaks were higher along the southern half of the Vettore fault, lower along the northern half of Gorzano fault and null in the relay zone between the two faults; field evidence of co-seismic surface rupture are coherent with the reconstructed scenario.