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Bridging earthquakes and tectonics for building a realistic 3D Quaternary fault model of Central Italy

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We use multi-source data (geological maps and sections, morphotectonic information, fault-slip data, relocated seismicity and focal mechanisms plus available seismic reflection profiles and boreholes) to construct a detailed 3D geometric-kinematic model of the Quaternary extensional system of Central Italy, to use in fault-system analysis, hazard assessment and ground-motion prediction. We follow the methodological approach of the SCEC Community in Southern California and the geographically extend of a fault model already built for the Abruzzo region.

The well exposed intra-Apennine active faults, together with the availability of a large amount of geological and seismological data, makes the Umbria-Marche-Abruzzi region of Central Italy an exceptional laboratory for moving from schematic and planar 3D seismogenic fault models to complex and detailed 3D fault representations.

The model built in this paper covers an area of approximately 20.000 $km^2$and includes more than 50 west-ward dipping upper-crust master faults (length 15-35 km), plus a regional mid-crust east-dipping basal detachment with a number of associated synthetic splays. The 3D modeling was done using the software package MOVE from the Midland Valley. The completeness of the input data, as well as the spatial uncertainties of the fault geometry, is made explicit by quality ranking factors.

The obtained representation not only offers a refined image of variation in strike and dip of each active and potentially seismogenic structure, but also of complex linkages among major faults. Such linkages might play a relevant role in controlling earthquake rupture partitioning during a seismic sequence.

An innovative result consists into the discovery of a geometric link between the well-known east-dipping Altotiberina LANF and the recently discovered Latium-Abruzzi LANF. These two LANFs, articulated along strike in minor order splays, contribute to build a regional east-dipping detachment, with a total length of about 250 km from northern Umbria to Molise. This structure, on one side, controls the along-dip extent and consequent seismogenic potential of the overlying high-angle westward-dipping master faults and, on the other, accommodates a large part of the extensional budget through creeping, aseismic deformation and, more rarely, through some isolated small-to-moderate magnitude earthquake.