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The 2016 Seismic sequence in central Italy: a multi-method approach to constrain the geometry of the Mt. Vettore - Mt. Bove fault system

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Since August 24, 2016 a destructive seismic sequence has been occurring in Central Italy, between the Amatrice and Norcia towns. The seismic sequence started with the event of Mw 6.0 that was followed one hour later by the Mw 5.4 earthquake and by thousands of aftershocks along the NW-SE fault system extended for about 30 km. On October 26 the Mw=5.9 seismic event struck the area, followed by the strong Mw 6.5 earthquake on the October 30, at a depth of 9 km with epicenter located between the Norcia and Visso towns. The three months of seismicity activated the nearby 60 km long normal fault system of Mt. Vettore - Mt. Porche - Mt. Bove. The area was struck by several moderate to large earthquakes in historical times. In detail, in the Amatrice sector we mention the earthquakes of 1627 (Io=7-8 MCS, Mw 5.3), 1639 (Io=9-10 MCS, Mw=6.2), 1672 (Io=7-8 MCS, Mw=5.3) A.D. The main historical earthquakes of Valnerina, the area closest to the epicentre of the October 30 2016 earthquake, occurred in 1328 (Io=10 MCS, Mw=6.5), 1719 (Io= 8 MCS, Mw=5.6), 1730 (Io =9 MCS, Mw=6) 1859 (Io=8-9 MCS, Mw= 5.7) A.D. It is important also to remember the complex sequence of the 1703 A.D. (January 14, Valnerina, Io=11, Mw= 6.9; February 2, Aquilano, Io 10, Mw= 6.7) that had a considerably devastating impact on the area.
Nevertheless, the historical seismicity correlated with the more external fault system of the Umbria-Marche-Abruzzi Apennine ridge is characterized by absence of strong energy seismicity along the Mt. Bove - Mt. Vettore-Vettoretto sector, suggesting that the fault system was “silent” until the 2016 seismic sequence.
Our study consists in a multiparametric data analysis in GIS (Geographic Information System) environment which integrates tectonic, seismic and gravimetric datasets with the aim of investigating the neotectonic activity of the area. The gravimetric dataset contains the Multiscale Derivative Analysis (MDA) data of the gravity field, in which each maximum corresponds to a density contrast at some depth or to topographic features. We have minimized the topography effects to make sure that the MDA maxima are related only to faults. We have analyzed the seismogenic structures and investigated the geometry of the main fault planes through a combined analysis of hypocentral sections and the DEXP (Depth from Extreme Points) results on gravity data.
In this study, we have validated our method based on literature geological and geophysical data. This will allow us to employ our approach for investigating possible buried/silent active faults for contributing to the knowledge of the Apennine seismic hazard.