

Rupture directivity of the 2016, Amatrice and Norcia (central Italy) destructive earthquakes and their largest aftershocks

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In this study, we investigate the along-strike rupture directivity of the five moderate-magnitude ($M_w > 5.0$) earthquakes of the 2016 central Italy seismic sequence and height aftershocks in the moment magnitude range from 4.4 to 4.8. Rupture directivity is estimated by deconvolving the observed spectra with spectra of EGF-type events.

We have found that the August 24, M_w 6.0 Amatrice earthquake results in a bilateral along-strike rupture. However, directivity of this event is asymmetrical, the predominant rupture propagation being toward NNW. In contrast, the rupture of the October 30, M_w 6.5 Norcia earthquake propagated toward SSE. We have also found that the predominant rupture directivity toward SSE is a common feature of the majority of the investigated events, including the M_w 5.4 aftershock occurred less than one hour after the Amatrice earthquake.

Along-strike rupture directivity in normal-faulting earthquakes in the Apennines has been already documented for the three largest events of the 1997 Umbria-Marche seismic sequence and for 70 earthquakes with moment magnitudes from 3.0 to 6.1 of the 2009 L'Aquila-Campotosto seismic sequence (the 2016 seismic activity filled the seismic gap between them). If we put together the results of the 1997 Umbria-Marche and the 2009 earthquakes, we find a significant spatial consistency of preferred directions of ruptures. Earthquakes to the south of Colfiorito up to Norcia show directivity toward SE-SSE, similarly to earthquakes in the southern part of the Campotosto fault and in the Paganica fault. In distinct contrast, from the northern tip of the Campotosto fault up to Amatrice the predominant rupture directivity is toward NNW-NW.