Geophysical Research Abstracts
Vol. 20, EGU2018-8747, 2018
EGU General Assembly 2018

Estimating rupture directivity of local earthquake data in central Italy using P-wave polarity stacking

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The 2016 central Italy earthquake sequence was recorded by numerous stations of the publicly available IV-net run by the Institutio Nazionale di Geophisica e Vulcanologia (INGV). The network is azimuthally well distributed around the region of seismicity that ranges from the northern to the central Appennines, which is a good prerequisite for rupture propagation tracking from local seismic data. We propose a simple first order rupture directivity estimation approach, which is based on P-wave polarization measurements at multiple stations. For this, the direction of the incoming wave-field is reconstructed by covariance matrix analysis of the first particle motions at each station. When stacked and combined with a sliding time window the results for different time steps provide an estimate on the rupture front propagation.
In our work we target events from the 2016 central Italy seismic sequence with magnitudes larger than M=5.0. The technique works best for unilateral ruptures. For five particular events constructive rupture tracks are obtained. All five events show normal faulting with a strike in the same direction: NNW-SSE. Our rupture tracking results show strike parallel orientations with propagation directions oriented as follows: the two northern events rupture towards SSE and the three southern events towards NNW.
In a recent study based on an Empirical Greens Function approach Calderoni et al. (JGR,2017) find unilateral rupture behavior for the same five events with direction estimates that are in good agreement with the tracking results from our work.