Imaging the rupture process of recent earthquakes using backprojection of local high frequency records

Ioannis Fountoulakis, Christos Evangelidis, and Olga-Joan Ktenidou
National Observatory of Athens, Institute of Geodynamics, Athens, Greece (ifountoul@noa.gr)

The seismic source spatio-temporal rupture processes of events in Japan, Greece and Turkey are imaged by backprojection of strong-motion waveforms. Normalized high-frequency (> 2Hz) S-waveforms from recordings on dense strong-motion networks are used to scan a predefined 3D source volume over time.

Backprojection is an alternative novel approach to image the spatio-temporal earthquake rupture. The method was first applied for large earthquakes at teleseismic distances, but is nowadays also used at local distances and over higher frequencies. The greatest advantage of the method is that processing is done without any a-priori constraints on the geometry, or size of the source. Thus, the spatio-temporal imaging of the rupture is feasible at higher frequencies (> 1Hz) than conventional source inversion studies, even when the examined fault geometry is complex. This high-frequency energy emitted during an earthquake is of great importance in seismic hazard assessment for certain critical infrastructures. The actual challenge in using high-frequency local recordings is to distinguish the local site effects from the true earthquake source content - otherwise, mapping the former incorrectly onto the latter limits the resolvability of the method. It is not straightforward to remove the site effect component or even to distinguish good reference stations from amid hard-soil and rock sites. In this study, the advantages and limitations of the method are explored using waveform data from well-recorded events in Japan (Kumamoto Mw7.1, 2016), Turkey (Marmara Mw6.4, 2019) and Greece (Antikythera Mw6.1, 2019). For each event and seismic array the resolution limits of the applied method are explored by performing various synthetic tests.