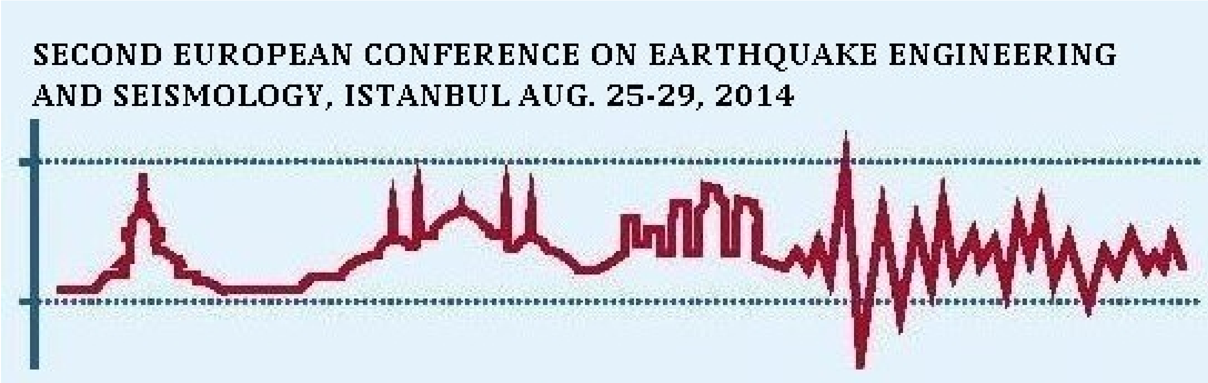

EARTHQUAKE SOURCE IMAGING BY BACKPROJECTION OF LOCAL BROADBAND AND STRONG MOTION WAVEFORMS: EXAMPLES, ADVANTAGES AND LIMITATIONS

Christos EVANGELIDIS[1]

The backprojection methods provide the alternative novel approach to image the spatiotemporal earthquake rupture. This is achieved by stacking the seismic waveforms along predicted traveltimes for the corresponding seismic phase and source–receiver paths. The method is now widely used in large and damaging earthquakes at teleseismic distances (e.g. Sumatra, Kokoxili, Denali, Wenchuan, Chile, Tohoki, Wharton basin etc). At local distances and higher frequencies, the method was applied to the 2004 Parkfield earthquake by Allmann & Shearer (2007) and to the 2011 Van earthquake by Evangelidis & Kao (2014). They both used S-wave arrivals recorded at strong motion stations to backproject into a 3-D grid by stacking waveforms shifted in time to focus on the known hypocentre.

Here, the advantages and limitation of the method are explored using earthquake local broadband and strong motion records from the 2008 Leonidio (6.1 Mw), 2010 Pollino (5 Mw), 2011 Van (7.1 Mw), 2013 Iran-Khash (7.7 Mw), 2013 Western Crete (6.4 Mw) and 2014 Cephalonia (6.0 and 5.9 Mw) events. A backprojection approach compliments conventional source inversion studies, since it explores spatio-temporally the earthquake source at higher frequency bands. This is done without any a-priori constraints on the geometry, dimension and size of the source, being especially suited on complex fault geometries. Since the waveforms are focused, through appropriate station corrections, to focus at the hypocenter, its accurate location is needed to avoid defocusing effects of the stacked images. Most stations should be asymmetrically distributed at local distances (< 200 km) around this hypocenter. Waveforms from local strong motion stations with considerable secondary site effects are not always suitable. Moreover, the most appropriate velocity model should be chosen, although time corrections are correcting for velocity heterogeneities in the 3D space. The time corrections are either based on differences between observed and calculated traveltimes, or on estimated time shifts from waveform crosscorrelation with a reference station.
Finally, any well resolved HF asperities should be also imaged by synthetic tests. In this way, the spatio-temporal resolution for each particular event would be revealed based on the available local station distribution.

REFERENCES

Allmann B.P., Shearer P.M. A high-frequency secondary event during the 2004 Parkfield earthquake. Science 2007;318(5854):1279-1283

Evangelidis C.P., Kao H. High-frequency source imaging of the 2011 October 23 Van (Eastern Turkey) earthquake by backprojection of strong motion waveforms, Geophys. J. Int., 2014 doi:10.1093/gji/ggt437

[1] Dr., National Observatory of Athens, Institute of Geodynamics, Athens, GREECE, cevan@noa.gr