Geophysical Research Abstracts
Vol. 17, EGU2015-1639, 2015
EGU General Assembly 2015

Extended fault inversion with random slipmaps: A resolution test for the 2012 Mw 7.6 Nicoya, Costa Rica earthquake from a Popperian inversion strategy.

José Ángel López Comino (1), Daniel Stich (1), Ana M. G. Ferreira (2), and José Morales Soto (1)

(1) Insitituto Andaluz de Geofísica, Universidad de Granada, Spain (jalopezcomino@ugr.es), (2) Department of Earth Sciences, Faculty of Maths & Physical Sciences, University College London, UK

The inversion of seismic data for extended fault slip distributions provides us detailed models of earthquake sources. The validity of the solutions depends on the fit between observed and synthetic seismograms generated with the source model. However, there may exist more than one model that fit the data in a similar way, leading to a multiplicity of solutions. This underdetermined problem has been analyzed and studied by several authors, who agree that inverting for a single best model may become overly dependent on the details of the procedure. We have addressed this resolution problem by using a global search that scans the solutions domain using random slipmaps, applying a Popperian inversion strategy that involves the generation of a representative set of slip distributions. The proposed technique solves the forward problem for a large set of models calculating their corresponding synthetic seismograms. Then, we propose to perform extended fault inversion through falsification, that is, falsify inappropriate trial models that do not reproduce the data within a reasonable level of mismodelling. The remainder of surviving trial models forms our set of coequal solutions. Thereby the ambiguities that might exist can be detected by taking a look at the solutions, allowing for an efficient assessment of the resolution. The solution set may contain only members with similar slip distributions, or else uncover some fundamental ambiguity like, for example, different patterns of main slip patches or different patterns of rupture propagation. For a feasibility study, the proposed resolution test has been evaluated using teleseismic body wave recordings from the September 5th 2012 Nicoya, Costa Rica earthquake. Note that the inversion strategy can be applied to any type of seismic, geodetic or tsunami data for which we can handle the forward problem. A 2D von Karman distribution is used to describe the spectrum of heterogeneity in slipmaps, and we generate possible models by spectral synthesis for random phase, keeping the rake angle, rupture velocity and slip velocity function fixed. The 2012 Nicoya earthquake turns out to be relatively well constrained from 50 teleseismic waveforms. The solution set contains 252 out of 10.000 trial models with normalized L1-fit within 5 percent from the global minimum. The set includes only similar solutions –a single centred slip patch- with minor differences. Uncertainties are related to the details of the slip maximum, including the amount of peak slip (2m to 3.5m), as well as the characteristics of peripheral slip below 1 m. Synthetic tests suggest that slip patterns like Nicoya may be a fortunate case, while it may be more difficult to unambiguously reconstruct more distributed slip from teleseismic data.