Geophysical Research Abstracts
Vol. 17, EGU2015-1643, 2015
EGU General Assembly 2015

Rupture directivity resolution from Popperian extended fault inversion: application to regional cases of the 2011 mainshock and foreshock Lorca (Spain).

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

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

Rupture directivity of earthquake sources is one of the most important aspects to emerge from full slip distribution as well as the rupture size, rupture velocity and identification of main slip patches. However, interpretations from a single best slip model that fits the data may be wrong, since the intrinsic non-uniqueness of the extended fault inversion persists. For a solution set, a classification of slipmaps according to any appropriate similarity may help us to interpret the inversion result and to propose different hypotheses for the source process. We apply a Popperian inversion strategy that involves the generation of a representative set of slip distributions, comparison of the corresponding forward predictions to the recorded data, and the generation of the solution to the inverse problem as an assembly of all those trial models that have not been falsified on account of unacceptable fits. Then, we propose to analyze rupture directivity resolution by calculating the centroids for each slipmap of this solution set. Thereby we obtain the “directivity rose” of an earthquake according to rake and amplitudes of each directivity vector. This result permits to define directivity slipmaps families and to evaluate possible ambiguities. For a feasibility study, we selected an earthquake with well-defined and restricted directivity as the 2011 Mw 5.2 Lorca (Spain) mainshock. Also we analyze the Mw 4.6 foreshock to compare possible similarities. First, in both cases we have obtained Apparent Source Time Functions (ASTF) from deconvolution in the frequency domain using the greatest aftershock (Mw 3.9) as empirical Green’s functions. The apparent durations fit an asymmetric bilateral rupture with rupture propagation in direction SW for mainshock and foreshock. Second, we use an inversion scheme based on a global search among precalculated slipmaps in order to fit the ASTFs. The slip velocity function is fixed and the inversion is carried out for various fixed values of rupture velocity. The best results suggest a high rupture velocity of 3.25 km/s for the mainshock and 2.75 km/s for the foreshock. The peak slips were about 31 and 7 cm for mainshock and foreshock respectively, considering an average slipmap from solution set. In both earthquakes, slipmaps show one asperity located SW of the hypocenter. These rupture similarities are probably introduced by the frictional properties of the rocks in Alhama de Murcia Fault. Finally, rupture directivity resolution reveals a setting similar as obtained from fitting only apparent durations, resulting in a single directivity family. The two events present rupture propagation towards the town of Lorca. Considering the slipmaps with amplitude greater than 0.5 km for the directivity vectors, we observe a directivity further south increasing the coincidence with the Lorca direction. The same results are obtained when analyzing the set of solutions with the largest slip above a certain fraction of the peak slip to calculate the centroids. This resolution test clearly indicates the magnitude and direction of the rupture propagation and evaluates effectively the validity of interpretations from source models.