Geophysical Research Abstracts
Vol. 20, EGU2018-7935, 2018
EGU General Assembly 2018

Earthquake rupture hypotheses at the Eastern Betic Shear Zone (SE Spain): what does the SHERIFS approach tell about their magnitude-frequency distributions?

Octavi Gómez-Novell (1), Julián García-Mayordomo (2), María Ortuño (1), Eulàlia Masana (1), Robert López (1), Thomas Chartier (3,4), and Oona Scotti (3)

(1) RISKNAT Group, GEOMODELS Research Institute, Departament de Dinàmica de la Terra i de l'Oceà, Facultat de Ciències de la Terra, Universitat de Barcelona, 08028 Barcelona, Spain (octgomez@ub.edu), (2) Instituto Geológico y Minero de España, 28003 Madrid, Spain, (3) Bureau d'Evaluation des Risques Sismiques pour la Sûreté des Installations, Institut de Radioprotection et de Sûreté Nucléaire, 92262 Fontenay-aux-Roses, France, (4) Laboratoire de géologie, Ecole Normale Supérieure, CNRS UMR 8538, PSL Research University, 75005 Paris, France

It has been observed that earthquake ruptures can be accommodated through the implication of multiple different fault sections within a specific fault system (multi-fault ruptures) (e.g. 2016 Kaikoura earthquake). Accordingly, seismic hazard assessments must consider fault sources as an interacting system and should leave behind the idea of faults only rupturing individually. The Eastern Betic Shear Zone (EBSZ, SE Spain) is a tectonically active area with mainly strike-slip faults, where recent studies (paleoseismological, geomorphological and geodetic) have yielded high values of slip rate (e.g. 1.6-1.7 mm/yr for the Alhama de Murcia fault and 1.1-1.3 mm/yr for the Carboneras fault). In this preliminary study we explored the magnitude-frequency distributions (MFDs) of different hypothesis of multi-fault ruptures for the EBSZ, each one determined by rules that allow or prevent particular fault sections from rupturing together. We used SHERIFS, a new code and methodology developed by Chartier et al. (2017), in order to obtain the MFDs of each hypothesis. Then, we performed a consistency check to analyse the fit between every modelled MFD and the short-term seismicity rates deduced from the regional seismic catalog.

The hypotheses that allow ruptures to propagate through a part or the whole fault system (multi-fault ruptures) produce maximum magnitudes (Mw max.) over 7-7.5 with annual rates in the range of 10^{-5}earthquakes/year (eq/yr). These values of annual rate are at least one order of magnitude lower than those obtained from the hypotheses that prevent multi-fault ruptures, but maximum magnitudes are about one order higher ($\sim 10^{-4}$eq/yr for Mw max. of at least 6.5). For the consistency check we tested different available seismic catalogs and different sizes of the buffer area around the fault sources to extract the seismicity data. We observed that depending on the catalog used and the buffer area defined, the fit with the modelled MFDs is different and hence the solutions for the most reliable fault rupture hypothesis at the EBSZ are also different. This means that there are uncertainties concerning the catalogs and the size of the buffer area that need to be explored in order to determine which has better quality information for the fault system. Using the most complete catalog available for the consistency check we observed that the hypotheses implying longer multi-fault ruptures seem to fit better with the catalog's seismicity rates. Consequently these hypotheses are preferred over the ones that don't allow multi-fault ruptures. This is relevant for the understanding of the fault system's activity and dynamics, and for the seismic hazard of SE Spain.

The methodology used in this preliminary study emerges as especially useful for areas as the EBSZ, i.e., with strong geological evidence of activity and seismic potential but with low seismicity and scarce data on the interaction between neighboring fault sources. The consistency between the modelled MFDs and the long-term seismicity rates deduced from geological data will be checked in further research.