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Systematic Comparisons Between Earthquake Source Models Determined Using InSAR and Seismology

Jennifer Weston (1), Ana MG Ferreira (1), and Gareth J Funning (2)

(1) University of East Anglia, Norwich, United Kingdom (j.weston@uea.ac.uk), (2) University of California, Riverside, United States of America

Reliable seismic hazard assessment and mitigation requires a robust determination of earthquake source parameters (spatial and temporal location, magnitude and fault mechanism). While past progress in long-period seismology led to extensive earthquake catalogues such as the Global Centroid Moment Tensor (CMT) catalogue, recent advances in space geodesy have enabled earthquake parameter estimations from the measurement of the deformation of the Earth's surface, notably using Interferometric Synthetic Aperture Radar (InSAR) data.

In this study we present results of systematic comparisons between earthquake CMT parameters determined using InSAR and seismology, on a global scale. The absence of an earthquake catalogue with parameters obtained using InSAR prompted us to compile a large InSAR database of CMT parameters from the literature. So far, we have carried out a first analysis of 59 earthquakes published in 77 research papers on InSAR. We have used all the information provided in the papers to obtain a maximum number of earthquake parameters and multiple studies of the same earthquake are included in the database, as they are valuable to assess uncertainties. Where faults are segmented, with changes in width along-strike, a weighted average based on the seismic moment in each fault has been used to determine overall earthquake parameters. For variable slip models, we have calculated source parameters taking the spatial distribution of slip into account.

The parameters in our InSAR database are compared with those taken from the Global CMT, ISC, EHB and NEIC catalogues. In general InSAR and seismology are compatible with each other, particularly concerning the strike and rake of an earthquake. However, there are some interesting trends; InSAR depths are systematically shallower than those in the EHB catalogue with a discrepancy of 5-10km, whereas InSAR estimates have on average slightly smaller seismic moments than those from the Global CMT catalogue. The locations of the centroid epicentres also show discrepancies which are larger when comparing with Global CMT locations (10-30km) than when comparing with EHB, ISC, NEIC (5-15km). We discuss the possible reasons for these discrepancies and trends and their implications.