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Detailed fault slip-rates and geometry for recurrence intervals in PSHA

Joanna Faure Walker (1), Francesco Visini (2), Gerald Roberts (3), and Ken McCaffrey (4)

(1) Institute for Risk and Disaster Reduction, UCL: University College London (j.faure-walker@ucl.ac.uk), (2) INGV: Instituto Nazionale di Geofisica e Vulcanologia (francesco.visini@ingv.it), (3) Department of Earth and Planetary Sciences, Birkbeck College, University of London (gerald.roberts@ucl.ac.uk), (4) Department of Earth Sciences, Durham University (k.j.w.mccaffrey@durham.ac.uk)

Previous studies have shown that profiles of fault throw-rates along a fault are complicated by local changes in fault geometry and slip vectors. We show that this affects the strain-rate calculated across a whole fault and calculations of average recurrence intervals and estimated frequency-magnitude distributions that can be used in probabilistic seismic hazard assessment (PSHA).

Detailed fault geometry and slip-rate data are generally ignored in PSHA. When faults are included, it is common practice to use a simplified description of the fault: The faults are modelled as planar structures and the shape of the slip-rate profile along the fault is simplified and often extrapolated from only one or two measurements of slip-rate along the fault.

Using an example fault from the central Apennines, Italy, we show that including detailed local changes in fault parameters - such as strike, dip and slip-rate - can have dramatic changes on the strain-rate across a fault. We calculate average fault recurrence intervals across the fault using detailed long-term slip-rate data and compare these to recurrence intervals calculated using simplified, idealised profiles of slip. Our results demonstrate that, for a single fault, significant changes in average recurrence intervals can be calculated depending on the slip-rate profile assumed across the fault. This has important consequences for fault-based seismic hazard assessment, especially where there are limited constraints on the slip-rate across a fault. We argue that these results show the importance of including detailed fault data within seismic hazard assessments. We further suggest that, where such data is lacking, PSHA calculations need to account for the uncertainties in not knowing how slip-rate varies along a fault.