Uncertainty in strain-rate from field measurements of the geometry, rates and kinematics of active normal faults: Implications for seismic hazard assessment

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Multiple measurements of the geometry, kinematics and rates of slip across the well-exposed Auletta fault scarp (Campania, Italy) are presented, and we use these in order to investigate: (1) the spatial resolution of field measurements needed to accurately calculate a representative strain-rate for seismic hazard calculations; (2) what aspects of the geometry and kinematics would introduce uncertainty in calculated strain-rate, if those are not measured in the field. Our results show that the magnitude of the post-glacial maximum (15\(\pm\)3 ka) throw gradually decreases towards the tip of the fault, but variations are observed along strike, across areas of structural complexity such as along-strike bends in the fault plane where the fault dip is greater. We find that if such variations are unnoticed, different values of strain-rate would be produced, and hence different values would result in seismic hazard calculations. To demonstrate this, we calculate the strain-rate across the Auletta fault using all our measurements, and subsequently degrade the dataset removing one measurement at a time and recalculating the implied strain-rate at each step. The results show that excluding measurements can alter strain-rate results beyond 1 \(\sigma\) uncertainty, thus we suggest caution when using only one measurement of slip-rate along a fault for calculating hazard, as a full understanding of the potential implied errors needs consideration. Furthermore, we investigate the effect of approximating the throw profile along the fault using boxcar and triangular slip distributions; we show that this can underestimate or overestimate the strain-rate, with results in the range of 72–237\% of our most detailed strain-rate calculation. We suggest that improved understanding of the potential implied errors in strain-rate calculations from field structural data should be implemented in seismic hazard calculations.