Tectonic regimes and earthquake size distribution: new evidence for PSHA

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Earthquake catalogues, seismotectonic zonations and ground-motion prediction equations (GMPE) are the basic ingredients for probabilistic seismic hazard assessment (PSHA). Seismotectonic zones are commonly defined considering the style-of-faulting; contemporary GMPE's also differentiate by the style-of-faulting. Here we present a case study for Italy to show that style-of-faulting should also be incorporated into the recurrence rates estimation.

In the past 40 years many studies relating *b*-values of the Gutenberg and Richter law to physical properties have been performed, from laboratory rock specimens to observations in different tectonic regimes. Various authors analyzed the correlation between b-value and tectonic regimes and the results are generally consistent: as power laws indicate scale invariance, the inverse dependence of the b-value on the differential stress is universally valid and the parameter can therefore be interpreted as a 'stressmeter' in the Earth's crust. A consequence of the inverse dependency of the b-value on differential stress is that tectonics regimes with different dominant faulting styles should exhibit significantly different b-values, in particular the highest values for normal events (b_{NR}), followed by strike-slip (b_{SS}) and reverse (b_{TH}): $b_{TH} < b_{SS} < b_{NR}$.

In this study, we evaluate this hypothesis for the first time, using data from the Italian Peninsula, whose complex geology is reflected in a strongly variable stress field and distinctly different faulting regimes. Extensional, compressional and strike-slip regimes are simultaneously present. The study region fulfils two other critical requirements: 1) the regional seismic monitoring of the microseismicity of the past two decades was good enough to allow detailed mapping of the b-value and 2) a rich catalogue of focal mechanism exists that allows a detailed seismotectonic zonation. Because the b–value is a critical parameter in PSHA, linking it firmly to regional faulting style has significant implications for future regional PSHA studies. At present the b-values are not used for zonation purposes, but they are either assigned regionally or computed for each zone, where zones are in general defined based on expert judgment. We suggest that future seismotectonic zonation models should take into account the knowledge on faulting style dependence of b-values. There are a variety of way how this can be achieved, for example using high resolution mapping of b as an input for zonation, or by using the b-values of the large scale tectonic zones as a prior, deviating only if local b-values are found to be significantly different from the regional ones.