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Understanding b-value of Gutenberg-Richter relation from dynamic rupture simulations

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It is requested to understand the mechanism of b-value in Gutenberg-Richter relation of seismicity to improve the probabilistic seismic hazard study. Therefore, we study a simple fault system described by multi-scale heterogeneity (Ide and Aochi, JGR, 2005) and carry out dynamic rupture simulations of earthquakes subject to different stress accumulations, namely a uniformly, constantly loading (natural seismicity) and a localized stress propagating from a point (induced seismicity). We also test different distributions of the heterogeneity (its density, scaling relation of heterogeneity, etc.). The variation of b-value has been briefly reported previously (e.g. Aochi and Ide, JGR, 2009; Rohmer and Aochi, GJI, 2015), but not systematically studied yet. From our simulations, we observe that the b-value increases when the heterogeneity is sparse or when the stress accumulation is spatially heterogeneous. This is comprehensible, as a small rupture initiation difficultly extends to large scale, and this can be a key in the difference of natural and induced seismicity. The system also provides a very wide range of b-values, larger than 2.