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Quasi-Dynamic Simulations on Multiple Fault Systems

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We show results of an ongoing project that aims at better understanding the earthquake interactions within fault networks in order to improve seismic hazard estimates with application to the test region of the Lower Rhine Embayment (Germany).

Seismic risk and hazard estimates mostly use pure empirical, stochastic models of earthquake fault systems tuned specifically to the vulnerable areas of interest. Although such models allow for reasonable risk estimates they do not provide a link between the observed seismicity and the underlying physical processes. However, since studying a state-of-the-art description set of all physical processes related to earthquake faulting is out of sight on geological time-scales, we consider simplified physical models based on elastic dislocation and unstable slip nucleation concepts.

Specifically we present a comparison of two different earthquake simulators for simple 2-fault cases. The simulators under consideration are based on, (i) a simple quasi-static approach with Coulomb-failure criterion (e.g. Ben-Zion and Rice (1993), Zöller (2004)), and (ii) the concept of rate- and state-dependent friction as introduced by Dietrich (1995). We show basic statistical properties of the results, and investigate which of the essential properties of observed faulting and seismicity patterns are retained despite, and which are lost due to, the simplifications made. We also show preliminary statistics of synthetic earthquake sequences for a given realistic fault network geometry and slip-rates in the Lower Rhine Embayment derived from seismological and geological observations.