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Numerical earthquake simulations for seismic hazard assessment

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A comprehensive seismic hazard assessment can contribute to earthquake preparedness and preventive measures aimed to reduce impacts of earthquakes, especially in the view of growing population and increasing vulnerability and exposure. Realistic earthquake simulations coupled with a seismic hazard analysis can provide better assessments of potential ground shaking due to large earthquakes. We present a model of block-and-fault dynamics, which simulates earthquakes in response to lithosphere movements and allows for studying the influence of fault network properties on seismic patterns. Using case studies (e.g., the Tibet-Himalayan region and the Caucasian region), we analyse the model's performance in terms of reproduction of basic features of the observed seismicity, such as the frequency-magnitude relationship, clustering of earthquakes, occurrences of large events, fault slip rates, and earthquake mechanisms. We examine a new approach to probabilistic seismic hazard assessment, which is based on instrumentally recorded, historical and simulated earthquakes. Based on predicted and observed peak ground acceleration values, we show that the hazard level associated with large events significantly increases if the long record of simulated seismicity is considered in the hazard assessment.