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Investigating earthquake patterns and the effects of fault interaction using a cellular automata based model

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Stress interaction between faults due to the occurrence of earthquakes has been shown to have a first order control on earthquake spatial and temporal patterns. Understanding how this interaction affects these patterns could improve our judgement of potential future events using information of past earthquakes, which could improve assessments of seismic hazard. Using computer models to investigate the problem allows direct comparison of seismicity behaviour in time and space for adequately large and complete datasets with and without fault interaction. Here, we model earthquakes in a fault network using discrete cellular automata that represent individual geometrically complex faults in 3-D space. The cells are 1km square which allows for a minimum earthquake size of approximately Mw=4. When the stress on a cell exceeds its strength, the cell breaks and stress is transferred by complex nearest-neighbour transfer rules allowing realistic stress concentrations to occur on the boundary of the rupture. If interaction is allowed, then for an event above a minimum threshold, stress is transferred to other faults using boundary element rules that allow minimum stress transfers of 0.1bar. A simulated fault network based on the active faults in the San Francisco Bay Area, California has been used to investigate the effects of interaction. Comparisons of magnitude frequency distributions for interacting and non-interacting models and the recurrence behaviour of large events in interacting and non-interacting models will be presented and discussed.