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An Ising model for Probabilistic Seismic Hazard Assessment

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We consider whether a cellular automaton which reproduces the seismic activity in a region following an Ising interaction scheme can be constructed. After a coarse-graining of the events, both spatially and temporally, a state (active or quiescent for seismic activity) is assigned to each cell at each time step. Then, a serial of lattice configurations (patterns) is obtained. Considering that each cell interacts only with its nearest neighbors, we can calculate the transition rules directly from these patterns. However, the predictive capacity of the model depends on the number of cells and time intervals chosen. By maximizing the mutual information between the past and future states we can find the model which contains a higher correlation between them. To accomplish this, a grid search in time steps and number of cells is made and, finally, we derive our cellular automaton. If the cellular automaton rules are applied to the latest pattern, we obtain a Probabilistic Seismic Hazard Map, where the probability of surpassing certain energy (equivalent to certain magnitude) in the next interval of time is shown.