Numerical simulation of earthquakes based on the two-dimensional Burridge-Knopoff model with the long-range interaction

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Spatiotemporal correlations of the two-dimensional spring-block (Burridge-Knopoff) models of earthquakes with the long-range inter-block interactions are extensively studied by means of numerical computer simulations. The long-range interaction derived from an elasticd theory, which takes account of the effect of the elastic body adjacent to the fault plane, falls off with distance r as $1/r^3$. Comparison is made with the properties of the corresponding short-range models studied earlier. Seismic spatiotemporal correlations of the long-range models generally tend to be weaker than those of the short-range models. The magnitude distribution exhibits a 'near-critical' behavior, i.e., a power-law-like behavior close to the Gutenberg-Richter law, for a wide parameter range with its b-value insensitive to the model parameters, in sharp contrast to that of the 2D short-range model and those of the 1D short-range and long-range models where such a 'near-critical' behavior is realized only by fine-tuning the model parameters. In contrast to the short-range case, the mean stress-drop at a seismic event of the long-range model is nearly independent of its magnitude, consistently with the observation. Large events often accompany foreshocks together with a doughnut-like quiescence as their precursors, while they hardly accompany aftershocks with almost negligible seismic correlations observed after the mainshock.

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