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Properties of seismicity and surface deformation generated by earthquakes on a heterogeneous strike slip fault in elastic half space

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We develop a physical basic for earthquake dynamics and seismic hazard on large strike-slip fault zones by joint analysis of model realizations, with parameters representing specific fault zones, and multi-disciplinary observations of deformation phenomena. The model consists of discrete slip patches (representing structural segmentation) on a vertical plane in a 3-D solid, and it accounts for brittle-slip, creep-slip, realistic boundary conditions and 3-D elastic stress transfer (Ben-Zion and Rice, 1993). Recent developments extended the framework to incorporate quasidynamic rupture propagation, gradual healing, and creeping barriers along the fault. The model produces for ranges of input parameters several realistic features of seismicity including frequency-size and temporal statistics, hypocenter distributions, realistic foreshock-mainshock-aftershock sequences, approach to and retreat from criticality, and accelerating seismic release. Our current efforts are directed in part toward extending the calculated observable quantities to include surface deformation, and to develop a better understanding of recurrence intervals of large earthquakes on faults. Previous works have shown that the model behavior can be mapped onto phase diagrams that span, as a function of input parameters, several different dynamic regimes (e.g., Dahmen et al., 1998). This may allow us to use various observables associated with a natural fault zone to classify the dynamic regime of the fault in terms of governing parameters, and then employ corresponding model realizations to produce long synthetic data sets of deformation phenomena. Analysis of such synthetic data sets can provide a better statistical characterization of the fault's response than the limited available records.