First Report on SCEC Earthquake Simulator Comparisons for an All-California Fault Set

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We are comparing the results of several earthquake simulators that are capable of simulating long sequences of earthquakes on many faults. Previously we showed comparisons between five simulators on a subset of California strike-slip faults in Northern California. In this study a much larger set of faults is included in the comparison, faults being approximated by tiled rectangles about 3 km in dimension. All of California is represented, including thrust faults, but the Cascadia subduction zone is excluded. We compare the behavior of the simulators with each other and with real seismic data.

Using common input and output formats we are able to ensure that the simulators are dealing with identical fault geometries and slip rates and that the output can be compared directly among simulators. We examine and compare space-time representations of seismicity, frequency-magnitude distributions, scaling of slip vs. length, moment vs. area, and moment vs. length, variability of moment and event rates with time, probability distribution functions of inter-event times as a function of location and magnitude, and tests of time and slip predictibility. For locations where paleoseismic data exist on inter-event times we have adjusted fault strengths to match these data, although it is not clear what earthquake sizes are represented in the paleoseismic data. Insufficient data exist to allow this for most faults in the model. We find that each simulator requires it's own separate adjustments of fault strengths to match these data, due to the differences between the simulators.

For the frequency-magnitude distributions we find general agreement among the simulators and with observations for all of California, although some differences exist based on different assumptions made about how to approximate dynamic stress transfer in these quasi-static simulations. The scaling relations are similar among the simulators and generally match observations. PDFs of inter-event times show some variability that can be compared with the variability seen in some of the paleoseismic sites, although many more events occur in the simulations.