

2013 EARTHQUAKE SIMULATORS WORKSHOP REPORT

Workshop on Earthquake Simulators, Number 6

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SUMMARY

This four-hour workshop was intended both for those who are participating in the SCEC Collaborative Project on Comparison, Verification, and Validation of Earthquake Simulators and for those with general interest in the topic. The workshop was held on Sunday afternoon, September 8, prior to the 2013 SCEC Annual Meeting. We looked at the status of our comparisons on two problems that we are presently working on and considered the future of a coordinated effort on earthquake simulators.

step04_c1500_200m_single Event # 1; M = 7.3

Origin time (yrs): 0.000 Nucleated on section fault_1 max slip = 5.344 m

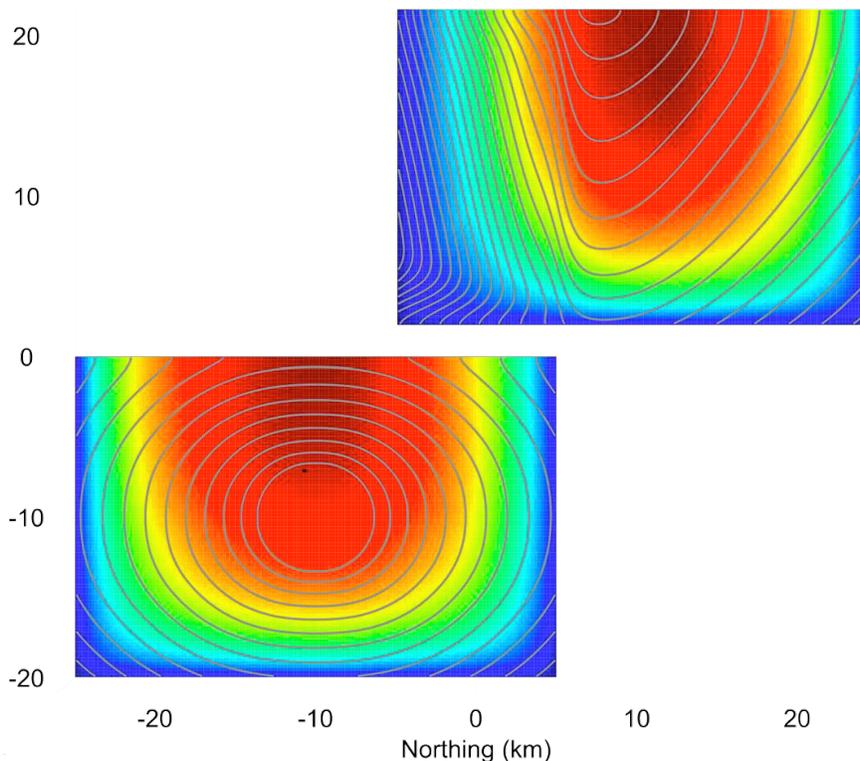


Figure 1. Illustration of rupture jumping from one fault to another, using simulator RSQSim, compressional stepover case. The initial rupture occurs on fault section 1, the one shown in the lower left. Fault section 2, shown in the upper right lies 1000 m behind section 1; to of both is at Earth's surface. The color contours show the maximum slip and the grey contours show the position of the rupture front in 1 second intervals. Rupture on section 2 occurs nearly when rupture on section 1 reaches the right end of section 1.

The two problems under investigation are 1) jumping of ruptures from one fault to another, and 2) many-fault simulated earthquake histories based on the UCERF3 deformation model(s). For the first of these problems we are both determining how far ruptures can jump from one fault to another using the simulators as they currently exist (which seems to be less than observed ruptures) and what modifications represent the best approach to make them jump more realistic distances. Comparisons are being made with results for the same fault-step problem that is being investigated by the dynamic rupture modeling TAG. The simulations will be done for a single event as is done with the dynamic rupture models,

and also for a long history of simulated events on the offset pair of faults. For the many-fault simulations using UCERF3 models, issues include settling on the best approach for assigning stress-drop values for all of the fault sections and how many of the UCERF3 deformation models should be used as input. The conclusion of the discussion is that the best approach at the outset is to start with a uniform value for the stress-drop and then tuning these values to match the paleoseismic recurrence intervals in those locations where such data exist, as was done for the UCERF2 model. Also the conclusion of the discussion is that the Zheng deformation model of UCERF3 is the best one to start with. Work on the UCERF3 model had not begun as of the time of the workshop.

Some of the presentations at the workshop can be found at <http://www.scec.org/workshops/2013/simulators/index.html>. Figure 1 shows the results of an example calculation on the fault stepover problem, with a 1000 m stepover and a 100 m grid size. Figure 2 shows the distances that ruptures will jump and the location of the initial rupture on the second fault.

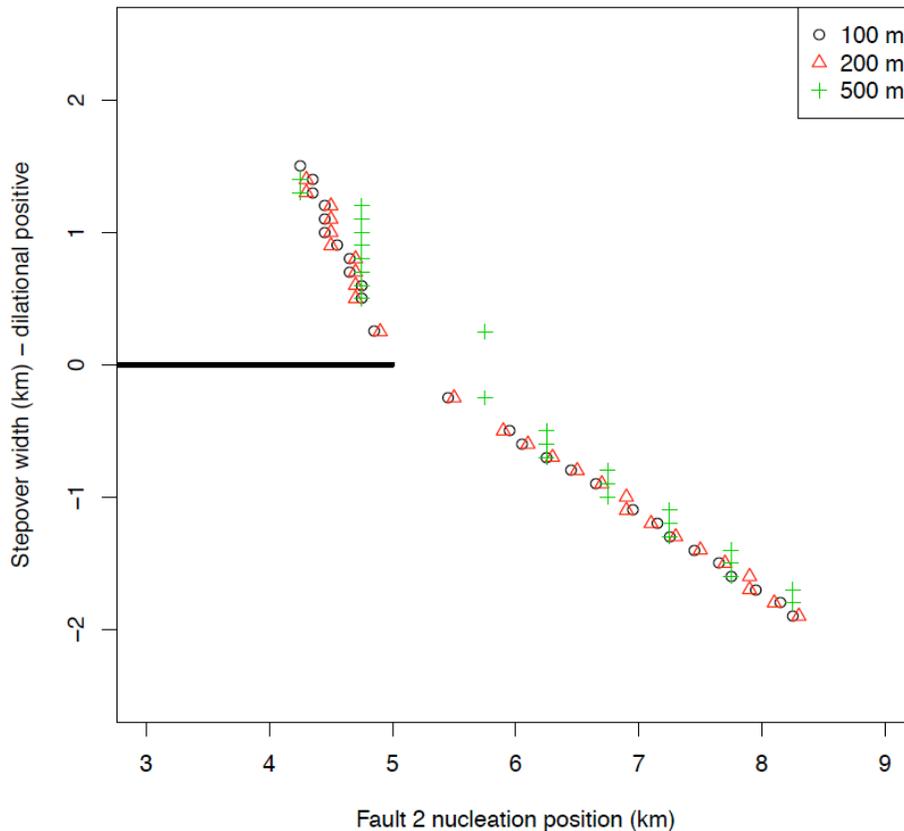


Figure 2. Dependence of second-fault nucleation position on fault stepover width and sense of stepover. Maximum extent of fault stepover for which ruptures will occur on second fault are shown by the end of the data points. Different symbols correspond to grid size used. The 100 and 200 m grids are for the RSQSim and the 500 m grid is for the ALLCAL simulator.

Looking forward, it is clear that studying the behavior of earthquake simulators can provide valuable insight into the behavior of actual earthquake interactions and sequences and the character of earthquake catalogs. What was discussed was what is the best way to study this within SCEC, and in particular, whether a collaborative project and TAG as has existed for the past several years is the best approach. The outcome of the workshop concerning this question is that a continuation of the existing TAG in which the simulated earthquake catalogs generated by several simulators are compared with one

another and with observations is likely not the best approach for SCEC at this stage of earthquake simulator development. During the workshop and via continued formal and informal discussions during the subsequent SCEC Annual Meeting, those with interest in earthquake simulators came to the following conclusion concerning how to encourage future simulator work within SCEC: The Working Group on California Earthquake Probabilities (WGCEP) is a logical organizational structure within SCEC to promote simulator research, because earthquake simulator results may play a more major role within subsequent versions of the Uniform California Earthquake Rupture Forecast (UCERF). To this end, and as a result of this workshop and subsequent discussions, a large number of simulator-related bullets have been added to the 2014 SCEC Science Collaboration Plan (RFP) under the WGCEP Special Projects heading. In addition, this RFP also lists the need to test earthquake simulators within the Collaboratory for the Study of Earthquake Predictability (CSEP).

AGENDA

SCEC Earthquake Simulators Workshop 6

September 8, 2013, Palm Springs, CA

- 1:00 Welcome and Intro: Purpose of Sixth Workshop
- 1:10 Discussion of status of status of our ongoing/future comparisons
 - 1) Jumping of ruptures from one fault to another
 - a) How far ruptures can jump from one fault to another using the simulators as they currently exist (which seems to be less than observed ruptures)? What are observed distances?
 - b) What modifications represent the best approach to make them jump more realistic distances?
 - c) What additional statistical comparison tools do we need for this problem?
 - 2) Many-fault simulated earthquake histories based on the UCERF3 deformation models
 - a) Settling on the best approach to assigning stress-drop values for all of the fault sections
 - b) How many of the UCERF3 deformation models should be used as input?
 - c) Explore the effect on the statistics of including a solution for encouraging fault-to-fault jumps in the UCERF3 simulations
- 2:45 Coffee Break
- 3:15 Looking forward, studying the behavior of earthquake simulators can provide valuable insights into the behavior of actual earthquake interactions and sequences and the character of earthquake catalogs
 - a) What is the best way to study this within SCEC?
 - b) In particular, is a collaborative project and TAG as has existed for the past several years the best approach?
 - c) If a TAG is the best approach, who will lead it?
- 5:00 Workshop End