

Presentation for March 23, 2015
Kellogg West, Cal Poly Pomona, CA

March 2015

SCEC Rupture Dynamics

Code Comparison Workshop

Ruth A. Harris (U.S. Geological Survey)
Ralph Archuleta (UC Santa Barbara)



INTRODUCTION

Welcome!

Thank you very much Tran for making our workshops happen!

Thank you very much to Michael for all of his hard work on the benchmarks!



2015 Gold Star Modelers



MICHAEL BARALL, JEREMY KOZDON, SHUO MA,
Team SAM BYDLON/ KENNETH DURU, Team DUNYU LIU/ BIN LUO,
KANGCHEN BAI, YOSHI KANEKO, DANIEL ROTEN, ZHEQIANG SHI
Team ALICE GABRIEL/THOMAS ULRICH, YUKO KASE



Plans for this workshop

***See a quick overview of our group's activities to date**

***Introduce ourselves**

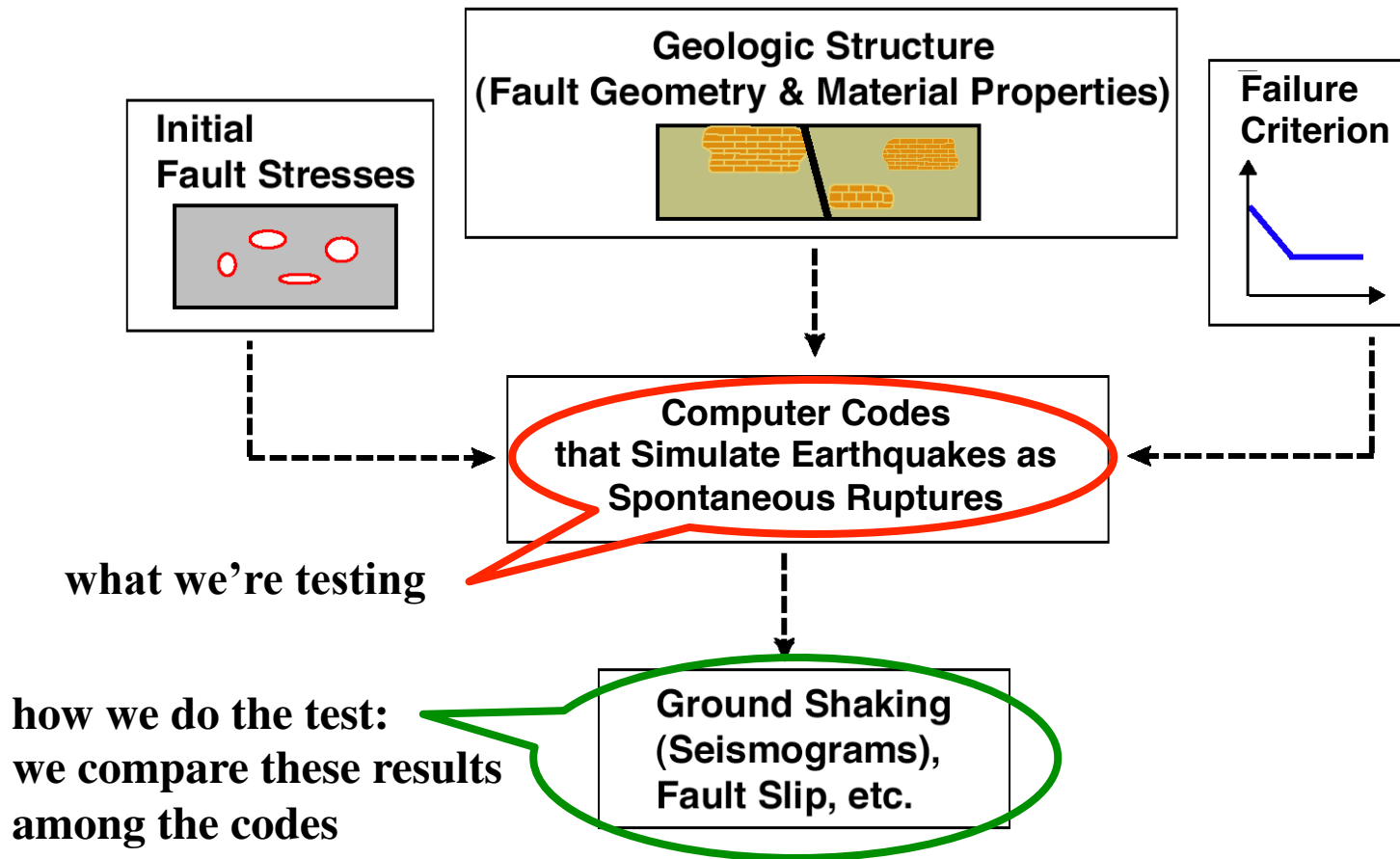
***Meet a new code**

***Learn about exciting research frontiers for earthquake source studies**

***Examine results from the latest benchmarks, TPV29, 30, 31, 32**

***Discuss our next steps, including ideas for SCEC5**

What our Group Does: We Test Computer Codes Used to Simulate Earthquakes



Overall Goal of our Code Verification Group

Compare the computational methods currently being used by SCEC and USGS scientists to simulate (spontaneous) earthquake rupture dynamics

Some Specific Objectives

Understand if our methods are producing the same results when using the same assumptions about friction, crustal structure, fault geometry, etc.

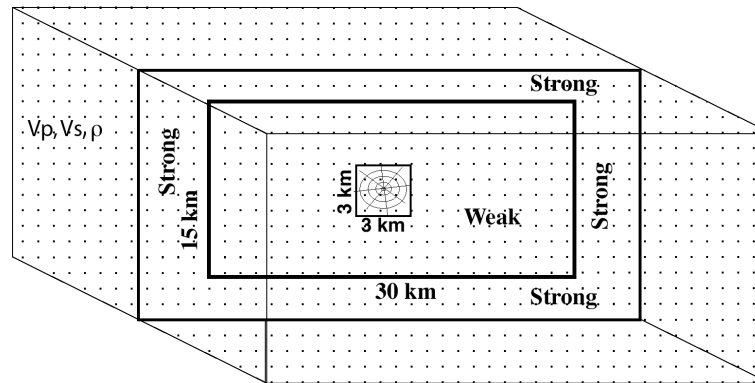
Funding

This project receives funding from SCEC, the USGS, and PG&E

Code Comparison Strategy

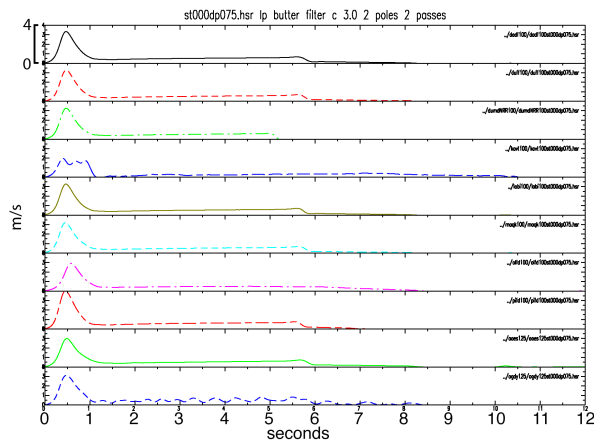
Start simply

Spontaneous
rupture on a
vertical strike-slip
fault set in a
homogeneous
(materials)
elastic Fullspace

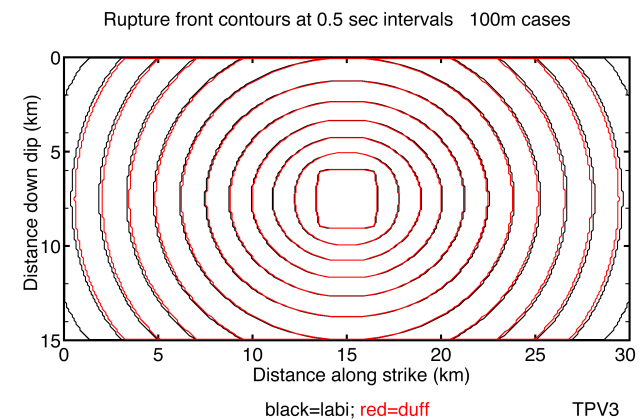


homogeneous
initial stresses

slip-weakening
friction

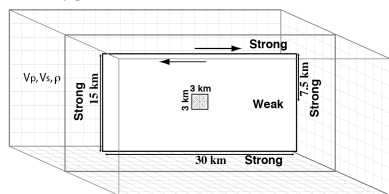


Some
Results

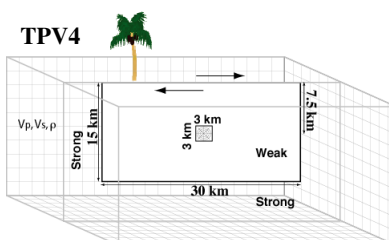


Code Comparison Benchmarks – Incrementally add complexity

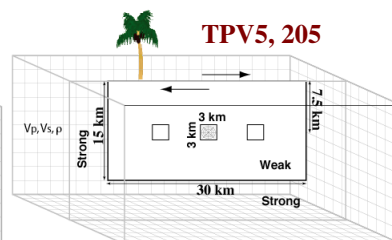
TPV3



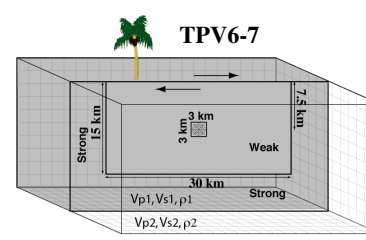
TPV4



TPV5, 205

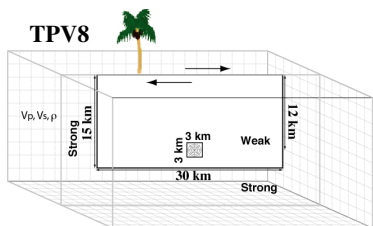


TPV6-7

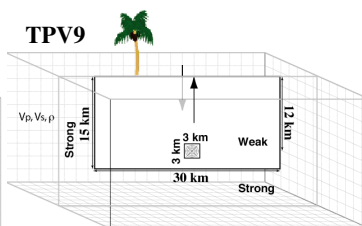


Slip-weakening friction

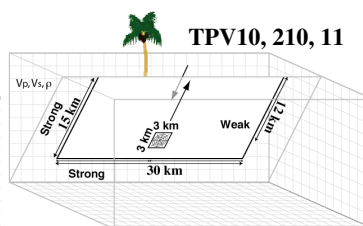
TPV8



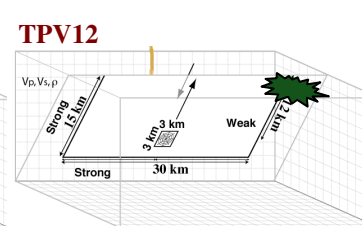
TPV9



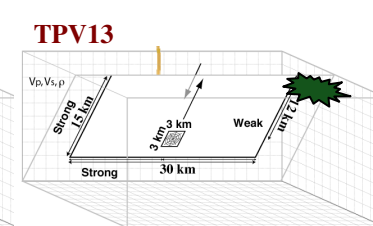
TPV10, 210, 11



TPV12

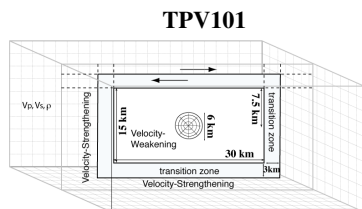


TPV13

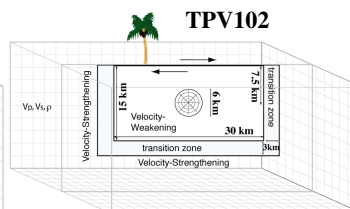


Slip-weakening friction

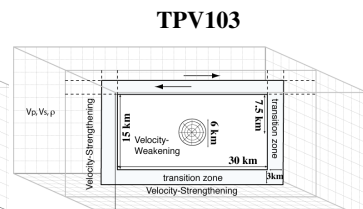
TPV101



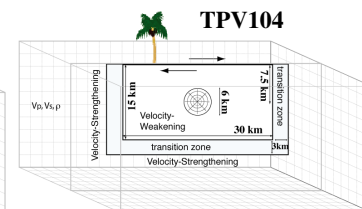
TPV102



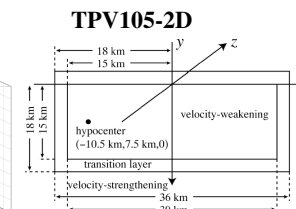
TPV103



TPV104



TPV105-2D

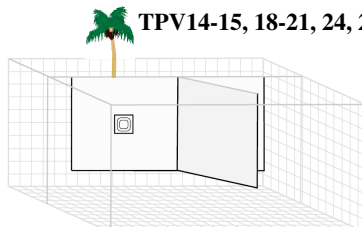


Rate-state friction using an ageing law

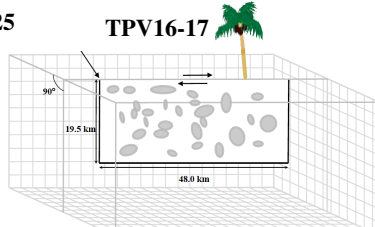
Rate-state friction using a slip law with strong rate-weakening

Thermal pressurization, rate-state friction, slip-law, strong rate-weakening

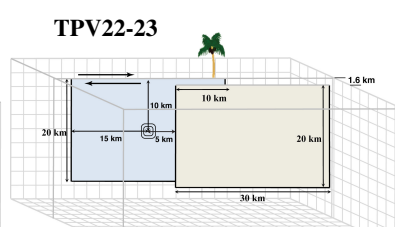
TPV14-15, 18-21, 24, 25



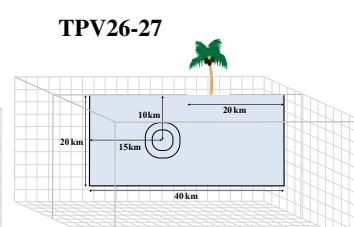
TPV16-17



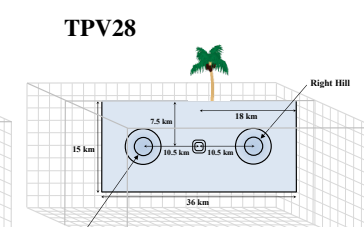
TPV22-23



TPV26-27



TPV28



Slip-weakening friction

Elastic, Viscoplastic

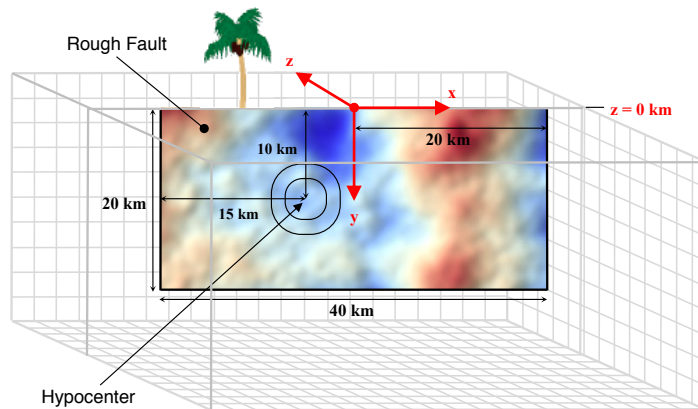
Slightly Rough Fault

Harris March 2015

Code Comparison Strategy

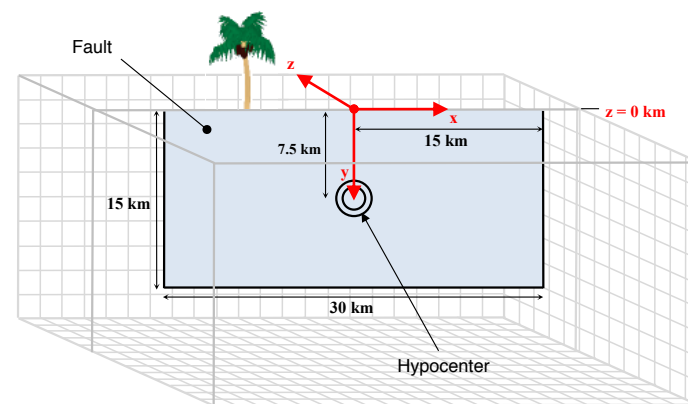
Incrementally adding complexity: fault roughness, layered velocity structure

Rupture on a **rough** vertical strike-slip fault set in a homogeneous material **elastic/viscoplastic** halfspace, Slip-weakening friction



TPV29, 30
Elastic, viscoplastic

Rupture on a vertical planar strike-slip fault set in an elastic, **1D discontinuous** and **1D continuous velocity structure**, Slip-weakening friction



TPV31, 32
Discontinuous, Continuous

2015 BENCHMARKS

2015 Barall Metrics SRL article

Barall, M., and R.A. Harris, **Metrics for comparing dynamic earthquake rupture simulations**,
Seismological Research Letters, vol. 86, 223-235, 2015.

Our group 2011 SRL article

Harris, R.A., M. Barall, D.J. Andrews, B. Duan, S. Ma, E.M. Dunham,
A.-A. Gabriel, Y. Kaneko, Y. Kase, B.T. Aagaard, D.D. Oglesby,
J.-P. Ampuero, T.C. Hanks, and N. Abrahamson,
Verifying a Computational Method for Predicting Extreme Ground Motion,
Seismological Research Letters, vol. 82, 638-644, 2011.

Our group 2009 SRL article

Harris, R.A., M. Barall, R. Archuleta, B. Aagaard, J.-P. Ampuero,
H. Bhat, V. Cruz-Atienza, L. Dalguer, P. Dawson, S. Day,
B. Duan, E. Dunham, G. Ely, Y. Kaneko, Y. Kase, N. Lapusta, Y. Liu,
S. Ma, D. Oglesby, K. Olsen, A. Pitarka, S. Song, and E. Templeton,
The SCEC/USGS Dynamic Earthquake-Rupture Code Verification Exercise,
Seismological Research Letters, vol. 80, 119-126, 2009.

links available on our website <http://sceccdata.usc.edu/cvws>



SCEC Rupture Dynamics Code Comparison Workshop

Monday March 23, 2015

Kellogg West Conference Center, Cal Poly Pomona, CA

10:00	Introduction to the Workshop	<i>Ruth Harris</i>
10:23	Meet a New Code	<i>Jeremy Kozdon</i>
10:30	Wasatch Front Earthquake Simulations	<i>Ralph Archuleta</i>
11:00	Lessons from Parkfield for Earthquake Interaction	<i>Nadia Lapusta</i>
11:30	High Performance Computing of Dynamic Rupture Scenarios on Natural Fault Zones with SeisSol	<i>Alice Gabriel</i>
12:00	<i>Lunch</i>	
13:00	Metrics and Benchmark Results, Part 1	<i>Michael Barall</i>
14:00	A Case for Multi-Fault Rupture in the So. CA Earthquake of 12/08/1812	<i>Julian Lozos</i>
14:30	Dynamic Models of Earthquakes and Tsunamis Offshore Ventura, CA	<i>Kenny Ryan</i>
15:00	<i>Break</i>	
15:30	Benchmark Results, Part 2	<i>Michael Barall</i>
16:15	Norm Speaks	<i>Norm Abrahamson</i>
16:45	Additional Group Discussion	<i>Ruth Harris/ All</i>

Next Benchmark Plans (SCEC2015 Proposal)

***Vertically-layered 1D Velocity Structure**

***3D Velocity Structure**

Planning for SCEC 5 (SCEC5 Proposal)

Next group paper?