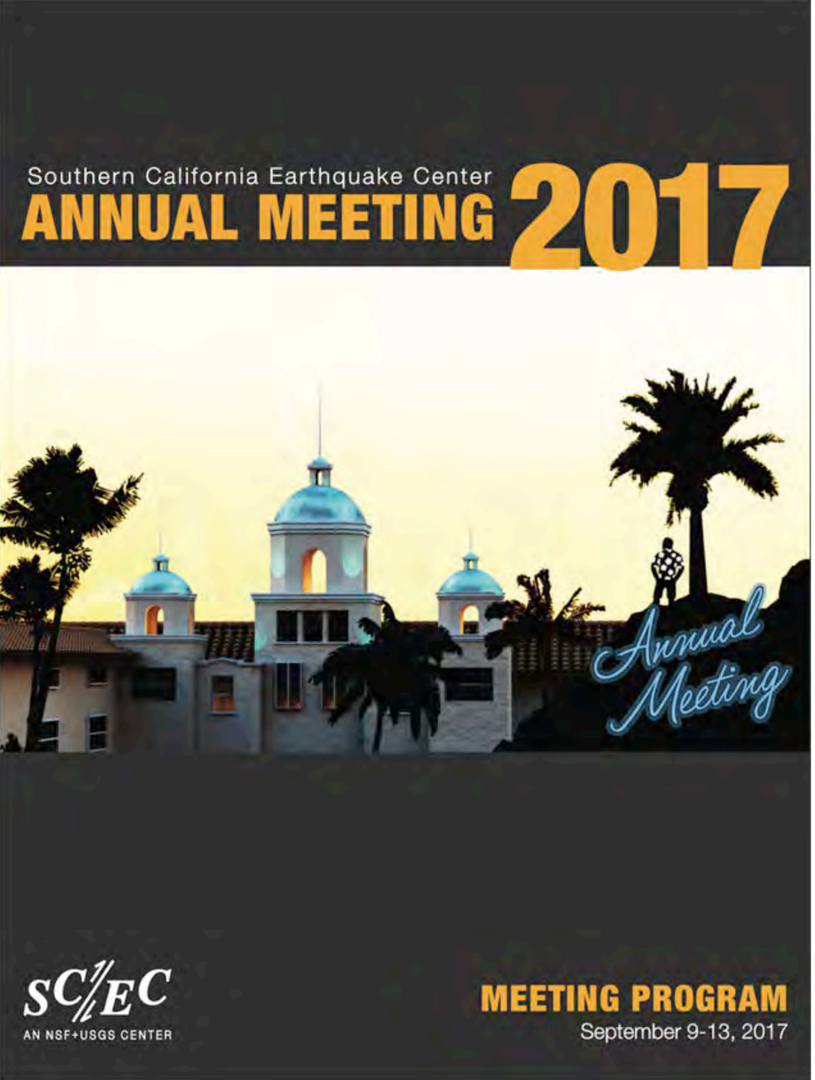
SC/EC

SCEC5 Science Planning and Accomplishments

Gregory C. Beroza
SCEC Co-Director

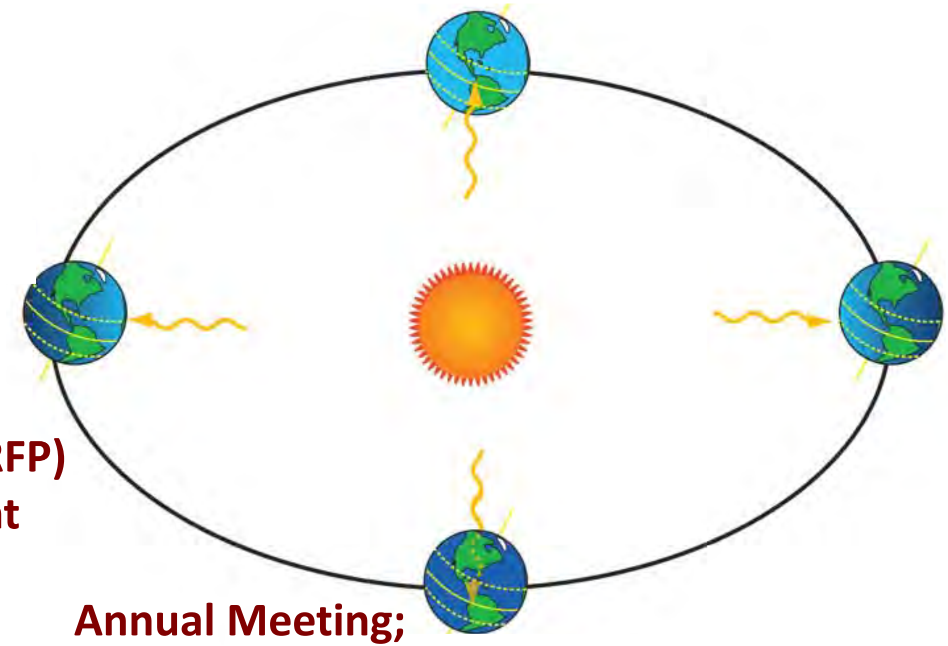


Goals of the meeting

- **Complete the leadership transition**
- **Apprise progress initiating SCEC5**
- **Refine the Science Plan (RFP) to reach SCEC5 goals**

Poster Sessions: dedicated *prime* time to kick around ideas and forge collaborations

The SCEC Planning Cycle



“Take it to the Limit”
Physics-Based Seismic Hazard Analysis
(Moderators: Christine Goulet, Ned Field)

Scott Callahan *“10 Years of Cybershake: Where are we now and where are we going with physics-based PSHA?”*

Jack Baker *“Characterization of spatial correlations in ground motions – insights from physics-based simulations”*

Open Discussion

Moderators will facilitate discussion and capture salient points for improvements to the Science Plan

Session 2: Hotel California: The Case for SCEC

Tom Jordan *SCEC Director 2002-2017*

“New Kid in Town”
The Future of SCEC

(Moderators: Nick Beeler, Nadia Lapusta)

John Vidale *“Vision for SCEC”*

Discussion

Judi Chester/Greg Beroza *“SCEC Science Collaboration”*

Christine Goulet *“SCEC Special Projects”*

Mark Benthien *“SCEC Communication, Education, and Outreach”*

SCEC5 Planning Committee Membership

Geology Disciplinary Group	Mike Oskin; Whitney Behr	FARM Focus Group	Nadia Lapusta; Nick Beeler
Geodesy Disciplinary Group	David Sandwell; Gareth Funning	SDOT Focus Group	Kaj Johnson; Bridget Smith-Konter
Seismology Disciplinary Group	Yehuda Ben-Zion; Jamie Steidl	EFP Focus Group	Max Werner; Ned Field
Comp Science Disciplinary Group	Eric Dunham; Ricardo Taborda	Ground Motions Focus Group	Domniki Asimaki; Annemarie Baltay
CXM Working Group	Liz Hearn; Scott Marshall	SAFS Working Group	Kate Scharer; Michele Cooke
Special Projects	Christine Goulet; Phil Maechling	EEII	Jack Baker, Jonathan Stewart

They put together the material I'm presenting (thank you).

They have write permission on the Collaboration Plan (talk to them).

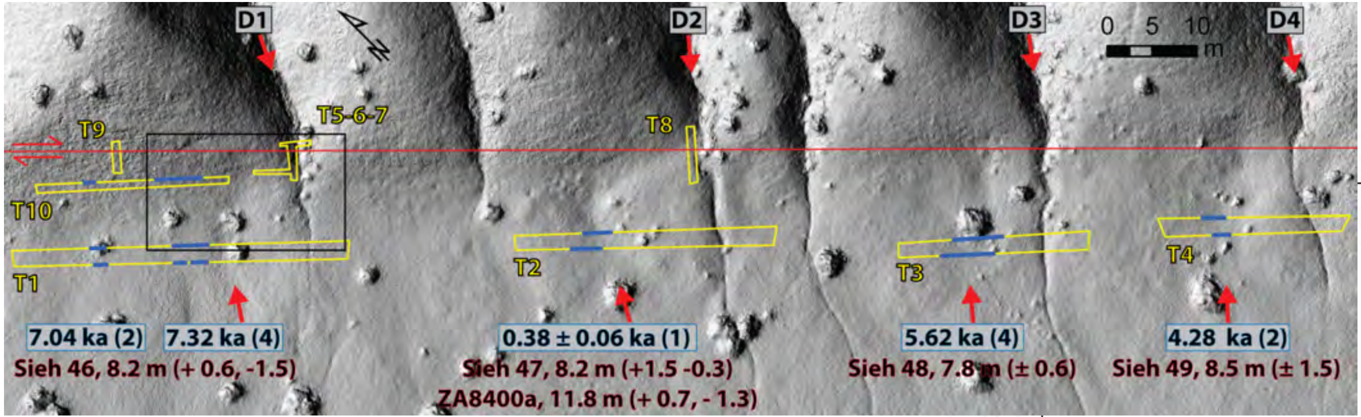
Five Basic Questions of Earthquake Science

Q1. How are faults loaded across temporal and spatial scales?

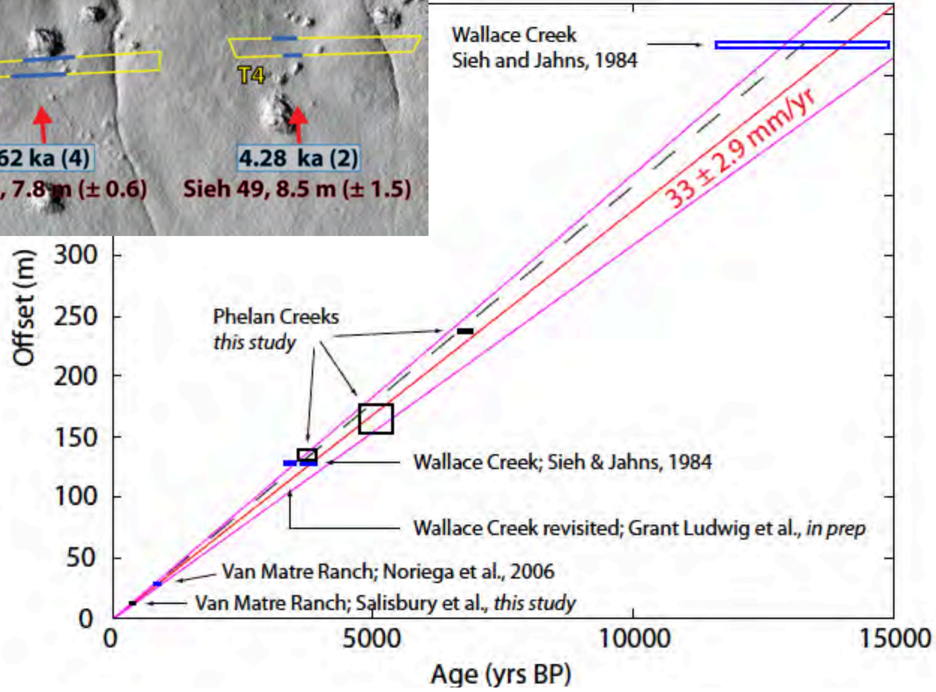
SC/EC

Southern California
Earthquake Center

Steady Slip Rate on Carrizo Segment of San Andreas Fault



Salisbury et al., 2017, *in revision*
& Salisbury, 2017

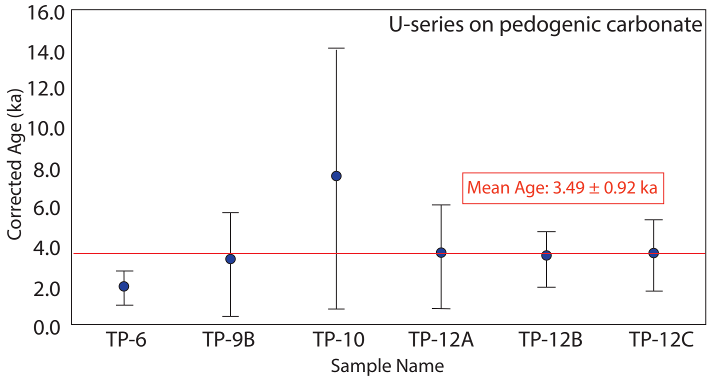


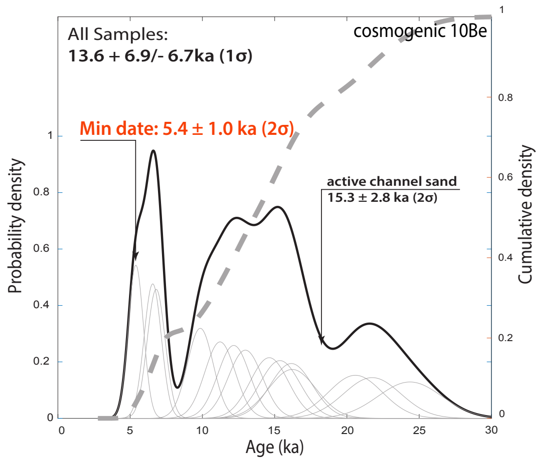
31.6 +5.9/-4.3 mm/yr

Multiple new offset rates along the San Andreas Fault in the Carrizo Plain are consistent with earlier work and fairly steady.

New Holocene geologic slip rate for the Mission Creek Fault in the Indio Hills

Juan-Jose Muñoz, Whitney Behr, Peter Gold, Warren Sharp, Rosemary Fryer





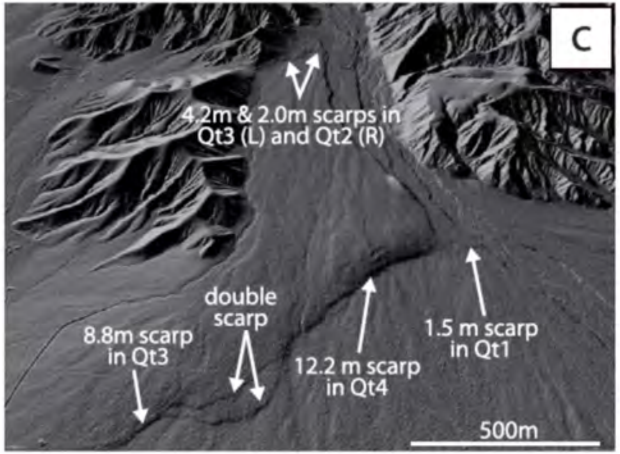
Offset: ~50 m
Age: ~3.5–5.4 ky
Preferred rate: 9-14 mm/yr

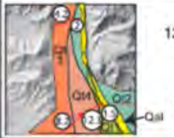
This Holocene slip rate is consistent with the Pleistocene rate averaged over the past 50 ky for the Mission Creek strand at Biskra Palms two km to the southeast

Poster #164

Holocene slip rates along the San Andreas Fault System on Obin the San Gorgonio Pass and implications for large earthquakes in southern California

Heermance and Yule, GRL 2017



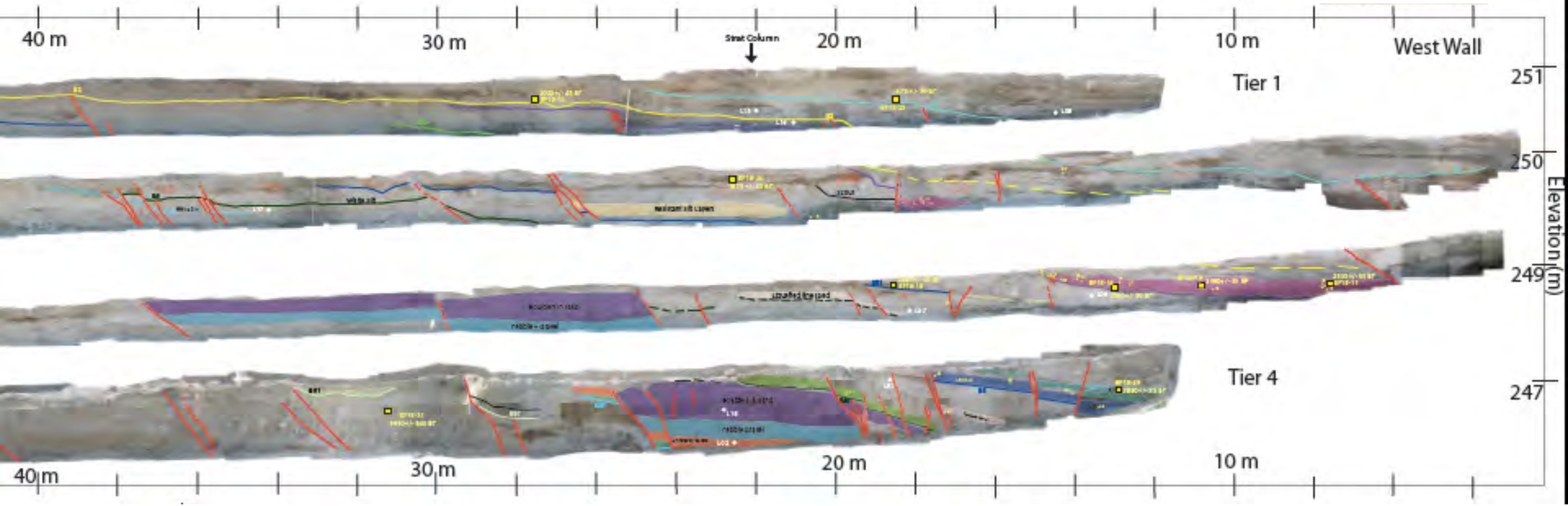
SCHEMATIC MAP	AGE (y.b.p)	SCARP HEIGHTS(m)	GEOMORPHOLOGY	EARTH QUAKES	SLIP-RATES
	8600^{+2000}_{-2200}	NF: no scarp SF: no scarp	Qt4 aggradation is completed, and has buried any faulting evidence across Millard Canyon.	NA	NA
	8600^{+2000}_{-2200} ⇩ 5700^{+1400}_{-1900}	NF: none preserved SF: 4.1m (Qt4)	Qt3 has incised ~1.5 m into Qt4. Faulting on at least the southern fault has produced a 4 m scarp in Qt4. This scarp is likely eroded by Qt3 formation on both the southern and northern faults.	NF: ? SF: ≥2	NF: NA SF: ~3.8 mm/yr
	5700^{+1400}_{-1900} ⇩ 1260±60	NF: 2.2m (Qt3) scarp SF: 10.8m (Qt4) & 6.7m (Qt3)	Qt2 has incised 6 m into Qt3. Fault scarps have developed on both the northern (2 m in Qt3) and southern (7 m in Qt3, 11 m in Qt4) strands.	NF: ≥2 SF: ≥4	NF: ~1.2 mm/yr *(~3.3 mm/yr EQ)* SF: ~4.2 mm/yr
	1260±60 ⇩ today	NF: 4.2m (Qt3) & 2.0m (Qt2) SF: 12.3m (Qt4), 8.2m (Qt3), & 1.5m (Qt1)	Qt1 incised ~1m into Qt2, and the active channel ~5 m into Qt1. Fault scarps have developed in Qt2 in north, and scarp heights have increased in both north and south.	NF: ≥1 SF: ≥1	NF: ~3.7 mm/yr *(6.9 mm/yr EQ)* SF: ~3.2 mm/yr (min)
				NF:≥3 SF:≥7	NF:1.7 mm/yr SF: 4 mm/yr
				Preferred Holocene Averages	

(4.2) scarp height (m)
fault scarp
concealed fault (no scarp)

10Be and radiocarbon dating of SGP thrust fault scarps
Slip rate of ~5.7 mm/yr
~7 earthquakes in past 8600 years

Paleoseismology of the Banning strand SAF near North Palm Springs

- Most recent event: 560-960 BP
- At least 3-4 EQs since 2.7 ka
- up to 5 older events exposed
- Recurrence Interval: 350 – 720 yrs
- EQs more frequent than SGP thrust; less frequent than Mission Creek or Coachella SAF



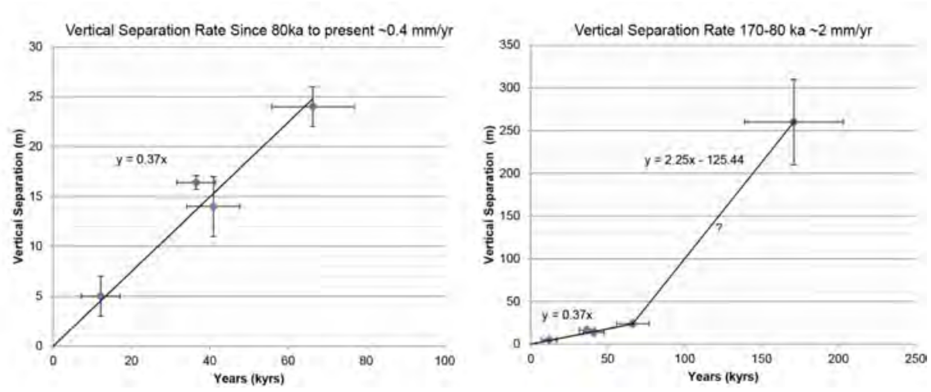
Castillo, McGill, Yule, Scharer, McPhillips, McNeil, Pace

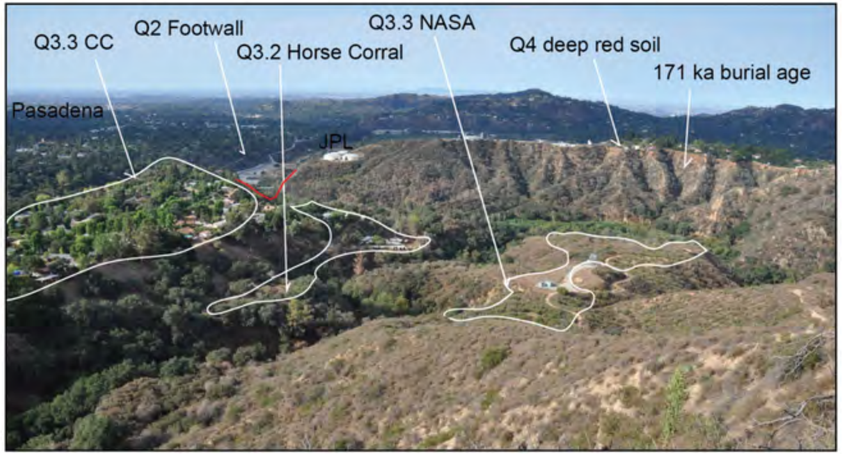
Posters #159, 160

Southern California Earthquake Center

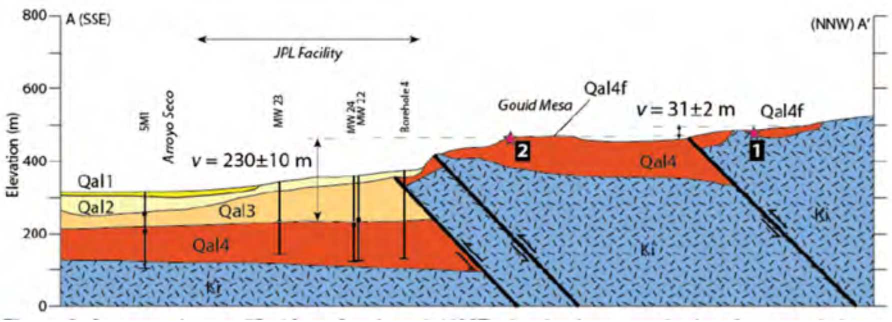
Variable Slip Rate on Central Sierra Madre Fault

Burgette, Hanson, Scharer, Lifton, Rittenour, McPhillips





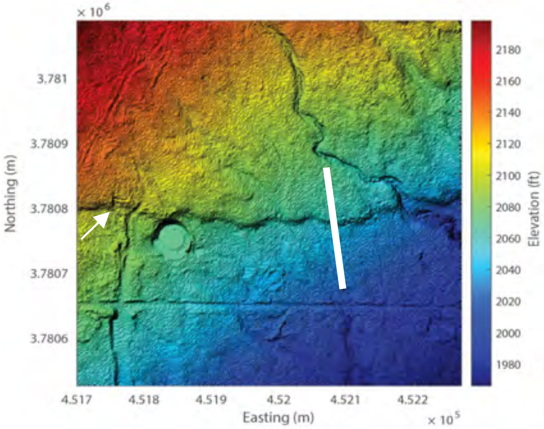
- 3 dating methods on 4 terrace/fan surface displacements (IRSL, 10Be depth profiles and 26Al-10Be burial ages)
- Vertical separation across fault decreases from ~2 mm/yr from 170-80 ka to 0.4 mm/yr from 80 ka to present.
- Slip rates since 80 ka equal to or less than geodetically modeled rates, depending on geometry

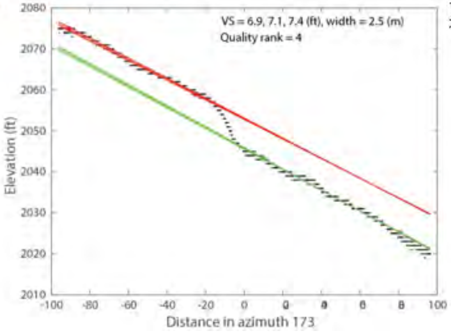


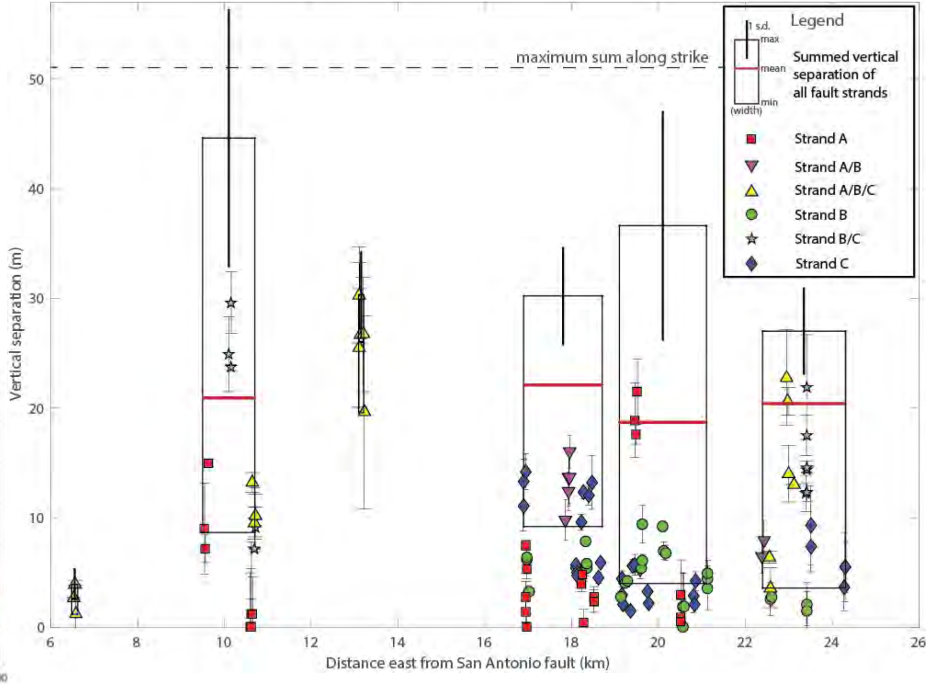
Poster #119, #121

Variability in vertical separation along the Cucamonga Fault

McPhillips and Scharer







- 33 ka surface; individual strands have 3-5x variation in slip over few km
- Emphasizes that individual slip rate locations may not reflect aggregate behavior

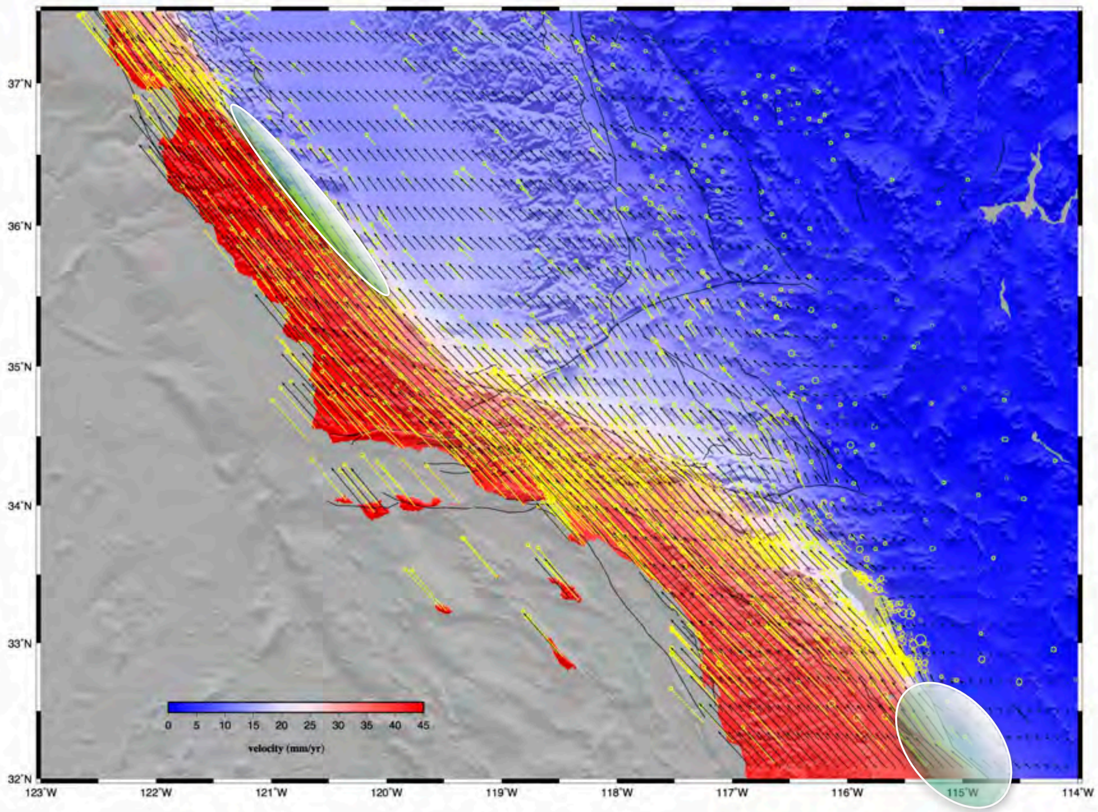
Poster #122

Community Geodetic Model V1 - GPS Secular Velocity Grid

GPS velocities from:
- PBO
- reprocessing of campaign data [Zeng and Shen, 2016]
- other dense GPS data [Crowell et al., 2013; McCaffrey et al., 2013]

Interpolation to 0.01˚ grid:
- 10 contributed models
- regridded to fit GPS data
- computed mean and standard deviation
- mean model matched GPS to 0.92 mm/yr.
- Green ellipses show region of highest uncertainity

Uses:
- constrain InSAR at long wavelengths
- expose areas of inadequate GPS coverage
- assessment of off-fault strain rate

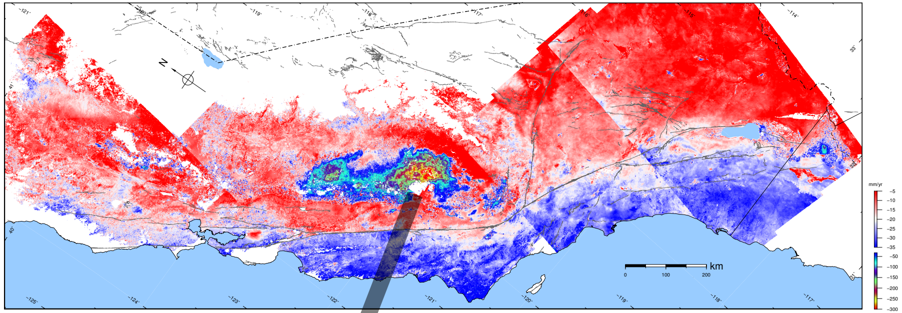


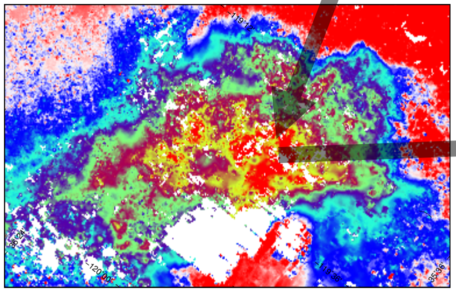
SC/EC

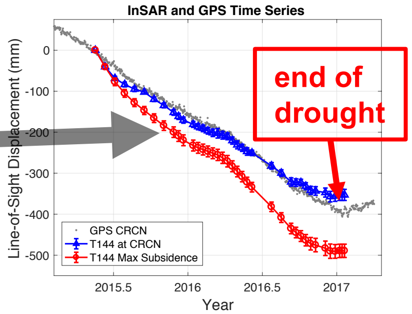
Southern California
Earthquake Center

Initial Contributions from Sentinel-1A/B InSAR

Line-of-Sight Velocity Map along the San Andreas Fault System from GPS and Sentinel-1 InSAR: Contribution to the SCEC Community Geodetic Model

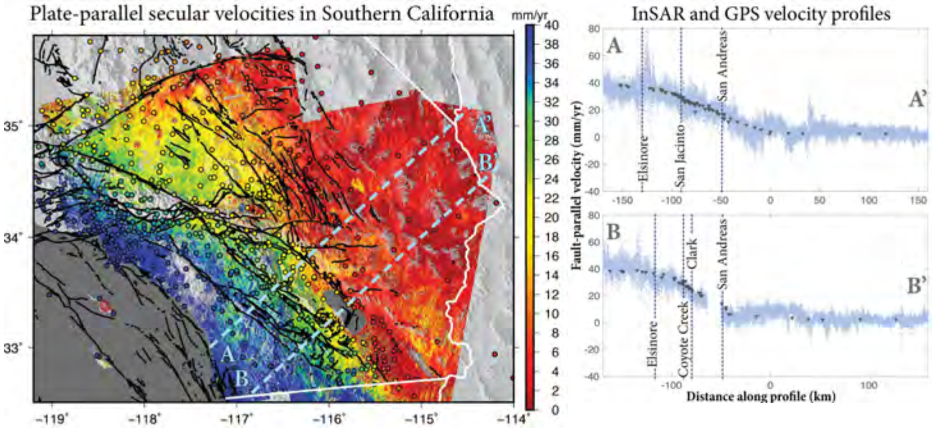






[Xu and Sandwell, Poster 103]

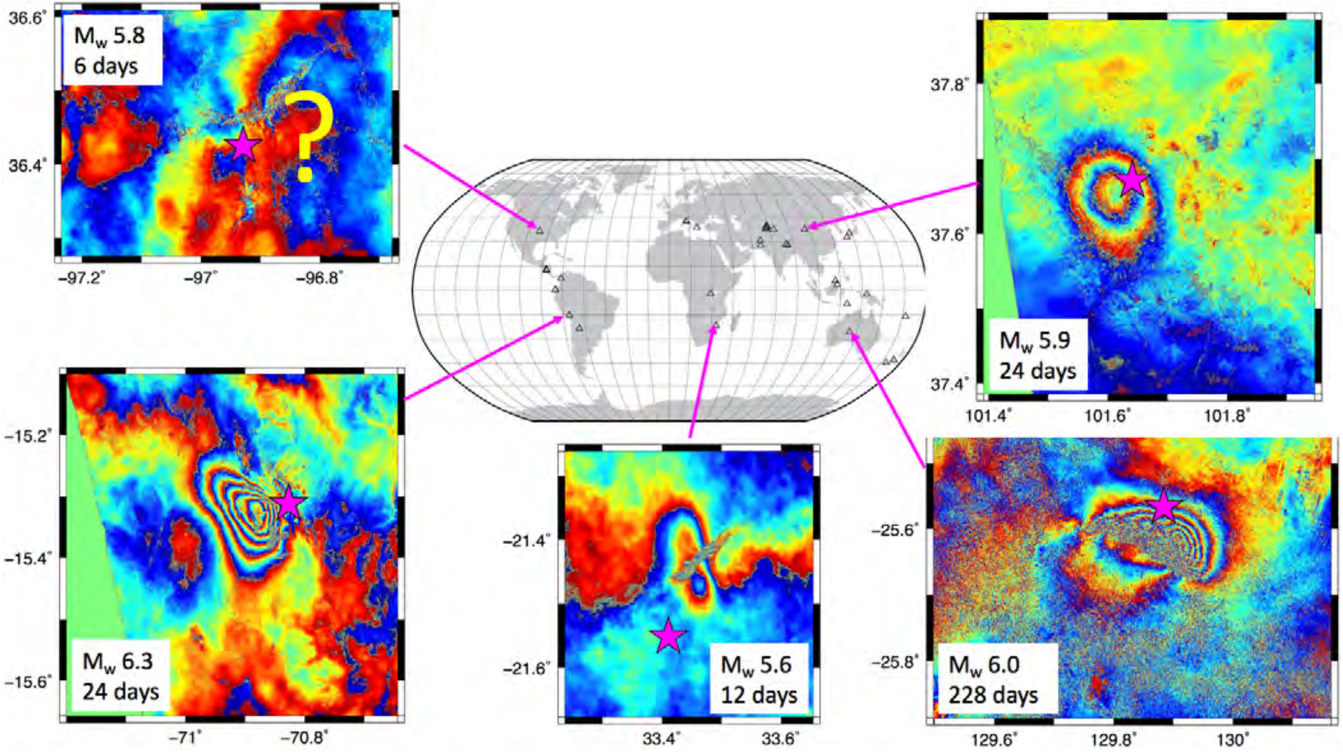
Toward the 3-component high-resolution CGM: Integration of Sentinel-1 interferometry and continuous GPS data



[Tymofyeyeva and Fialko, Poster 105]

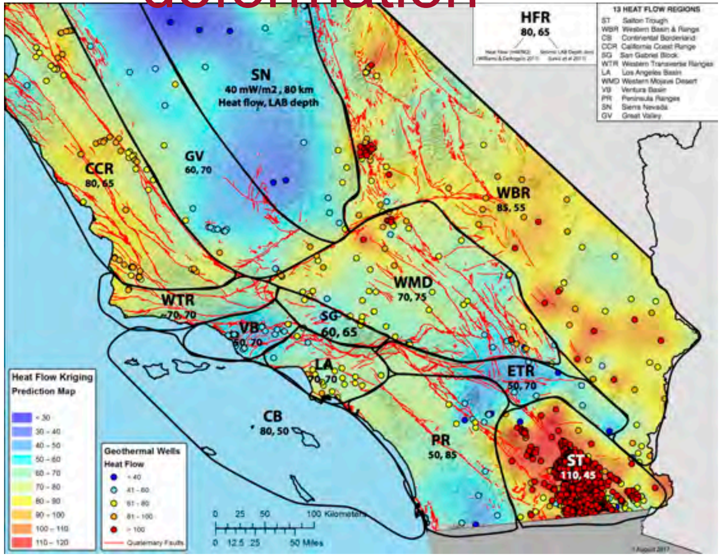
Initial Contributions from Sentinel-1A/B InSAR

A Systematic Study of Earthquake Detectability Using Sentinel-1 TOPS InSAR

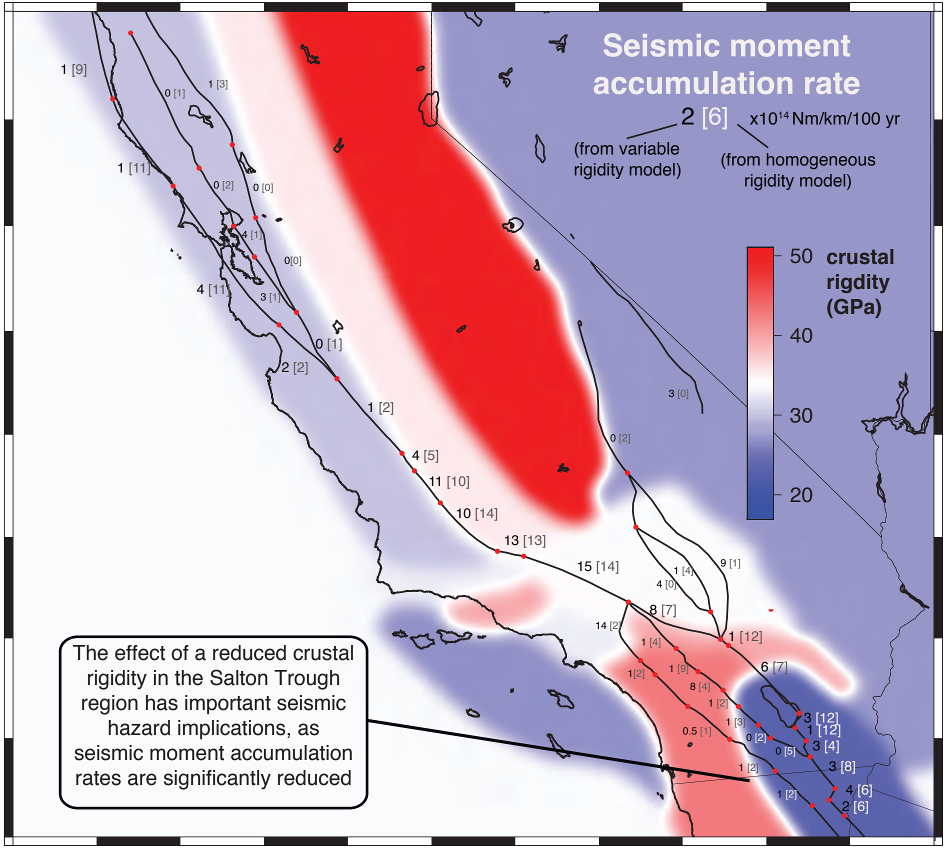


[Funning and Garcia, #098]

Effect of variations in crustal rigidity on deformation



Use heat flow as a proxy for elastic thickness for provisional southern California heat flow model (CTM) [Thatcher et al., Poster #224].



Posters #089 & #223

Smith-Konter, Sandwell, Tong, Xu, Ward, Higa

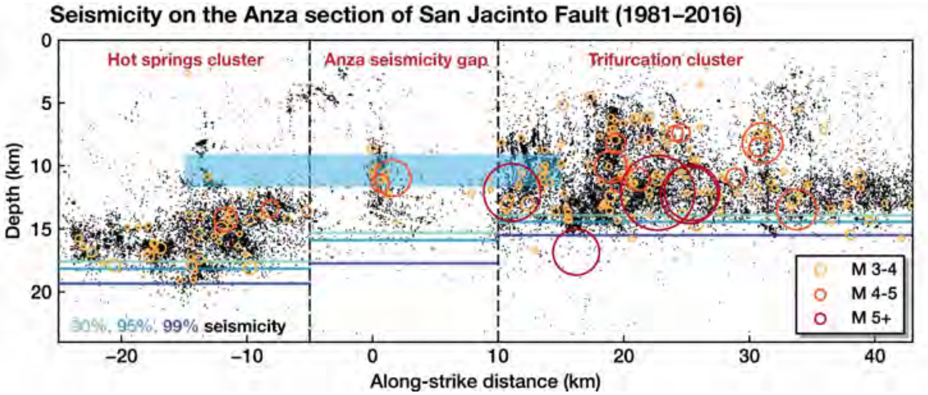
SC/EC

Southern California Earthquake Center

Earthquake variability, geodetic coupling, and microseismicity on heterogeneous faults: A case study of the Anza seismic gap

Junle Jiang & Yuri Fialko

IGPP/SIO/UCSD

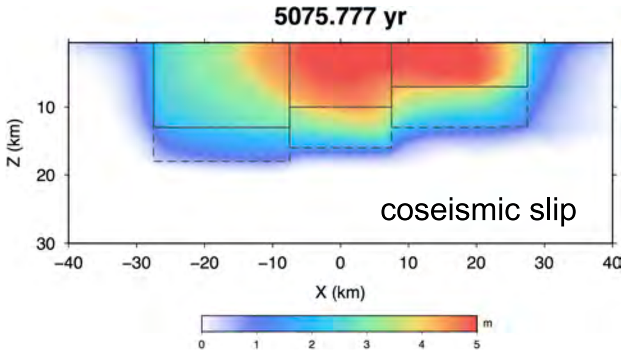


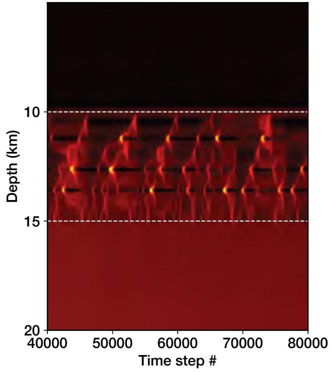
Understanding multiple observations from Anza with friction-based fault models

Smaller-scale models w/ stochastic heterogeneity

Larger-scale models w/ variable coseismic weakening

Reconcile with paleoseismic slip history, present-day microseismic quiescence/activeness, and geodetic locking





Explore characteristics of heterogeneity that control the partitioning of seismic-aseismic slip and earthquake size distribution

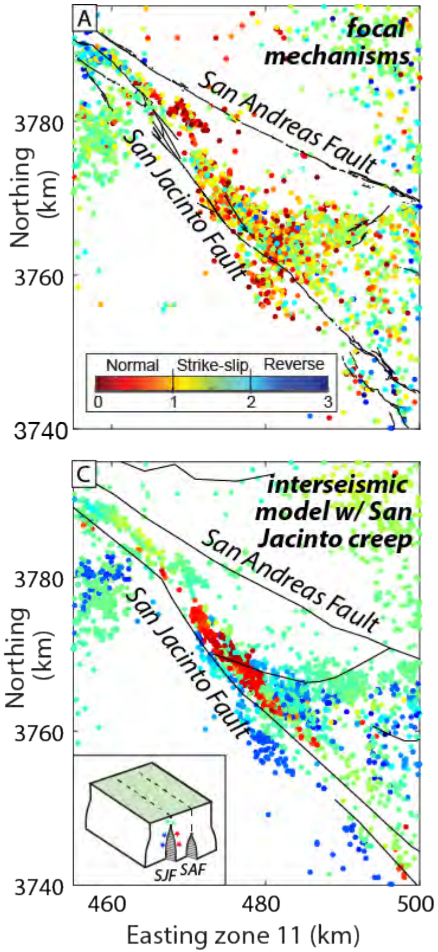
Slip rate evolution along depth

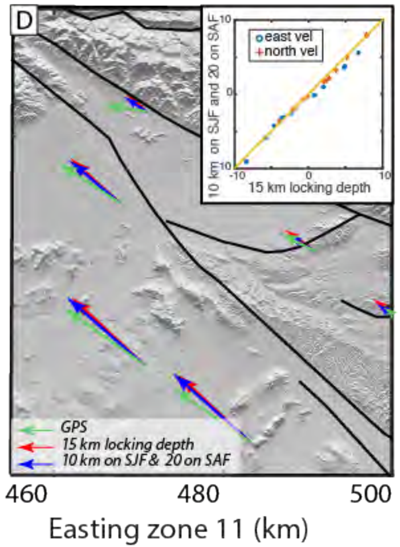
Poster #205

Off-fault seismicity suggests deep creep on the northern San Jacinto Fault

- Focal mechanisms of Yang et al. [2012] show unexpected normal slip events (mostly below 10 km) within the San Bernardino basin.

- Interseismic models with creep > 10 km depth along SJF produce normal off-fault slip events



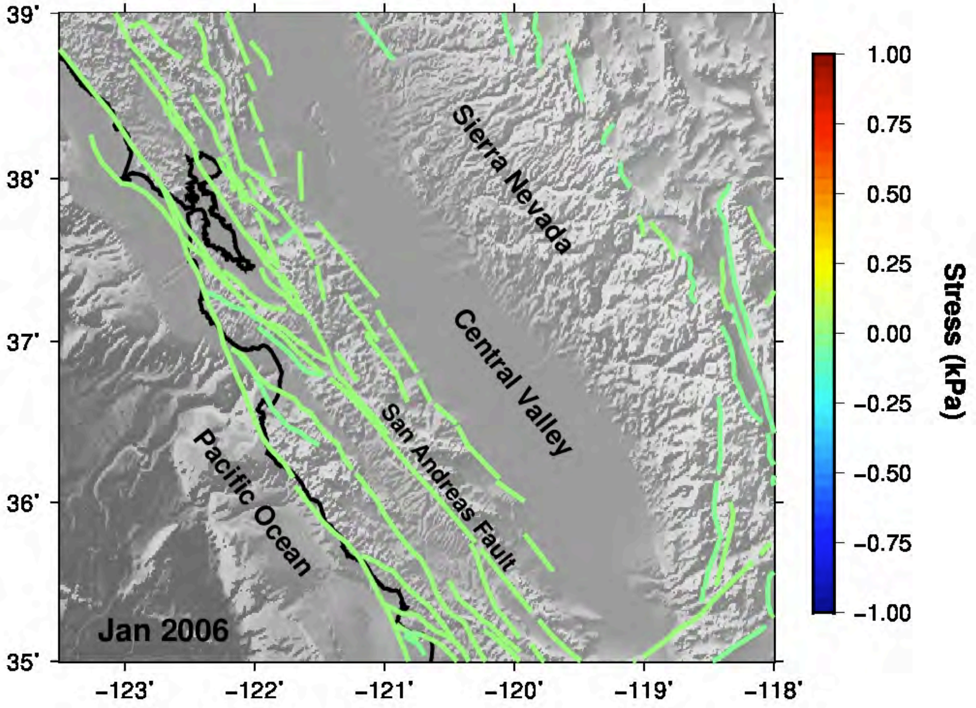


The proximity of the SAF and SJF doesn’t allow GPS to distinguish potential deep creep on SJF.

Cooke and Beyer, SCEC Award 17173

Seasonal Stresses on CA Faults

Elastic flexing of the crust is the result of water and snow accumulating during winter months.

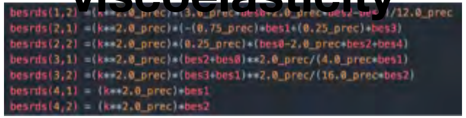


Map shows distribution of stresses – depend on the fault orientation, distance, and peak at different times of the year.

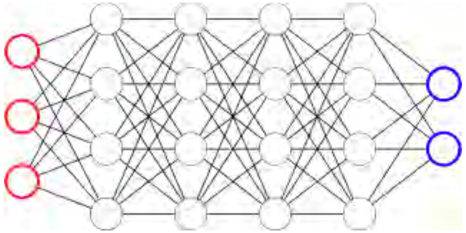
Johnson, Fu, and Burgmann, #206

Neural Network Acceleration of HPC codes

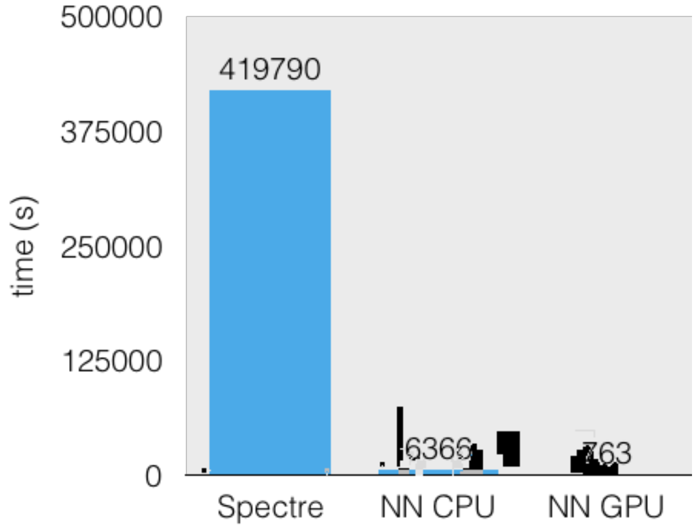
MPI parallelized HPC code for viscoelasticity



Trained neural network



550x speed up



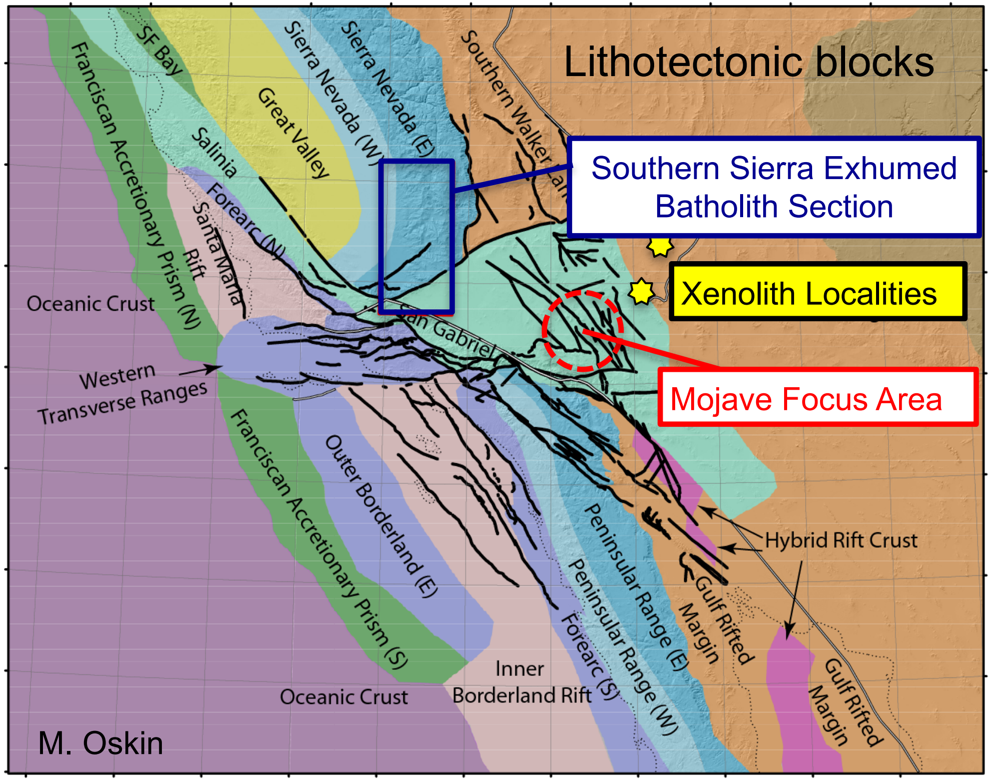
DeVries et al. 2017

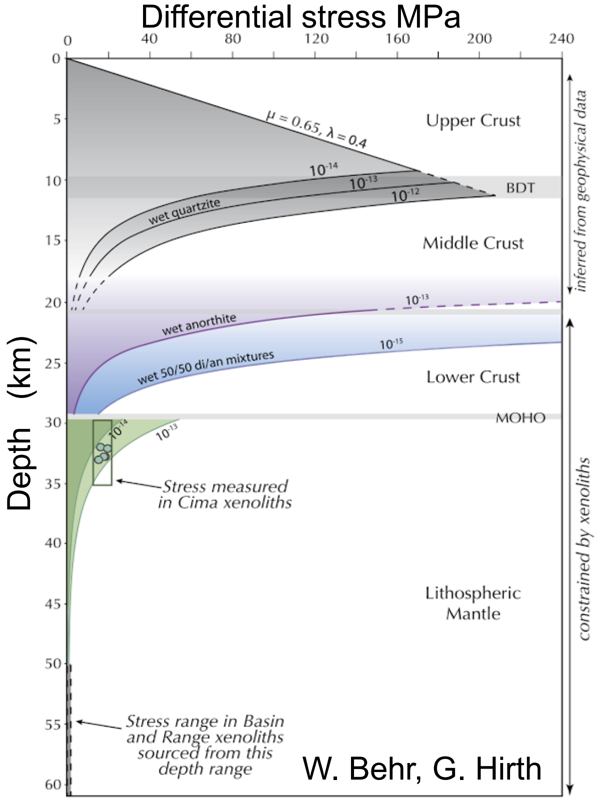
SC/EC

Southern California Earthquake Center

CXM Accomplishments: SCEC5 Year 1

Preliminary geologic framework, CTM and a Mojave CRM presented and discussed at Saturday's CRM workshop



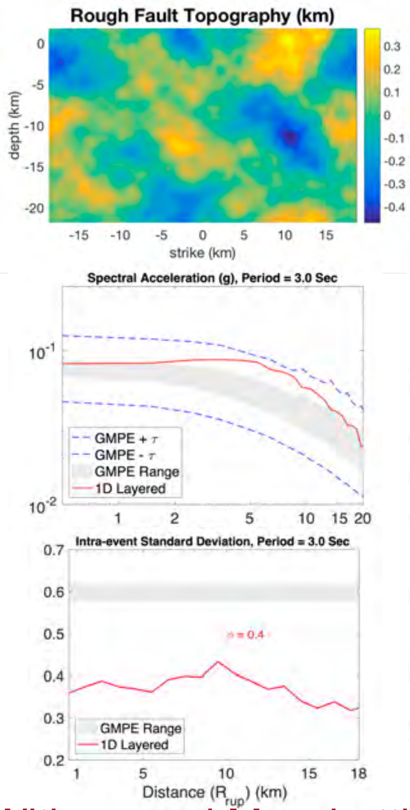


Five Basic Questions of Earthquake Science

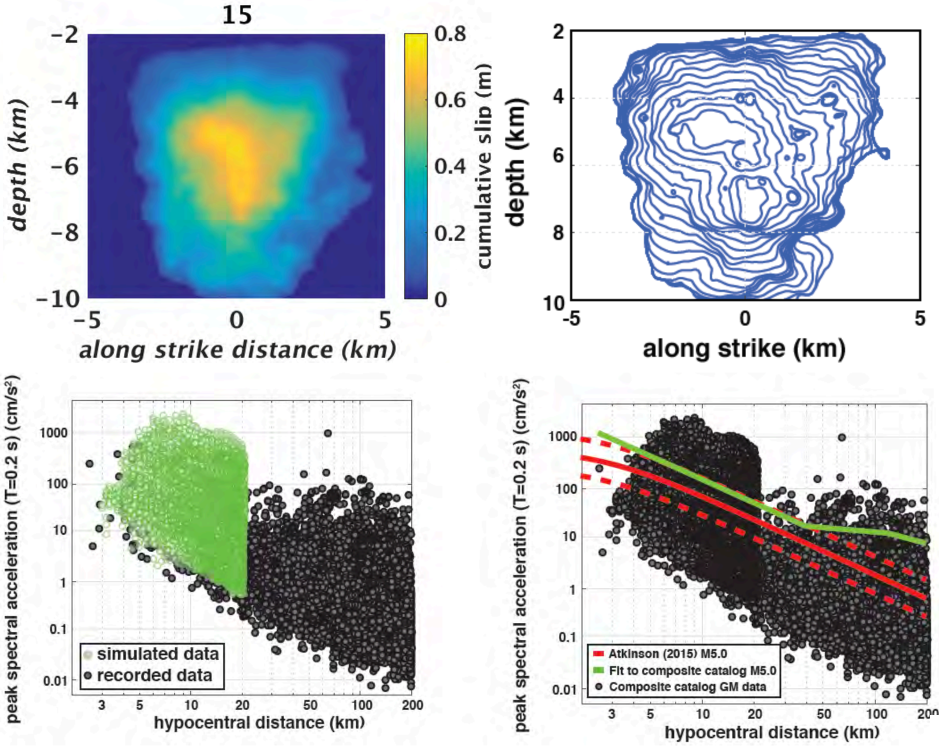
Q1. How are faults loaded across temporal and spatial scales?

Q2. What is the role of off-fault inelastic deformation on strain accumulation, dynamic rupture, and radiated seismic energy?

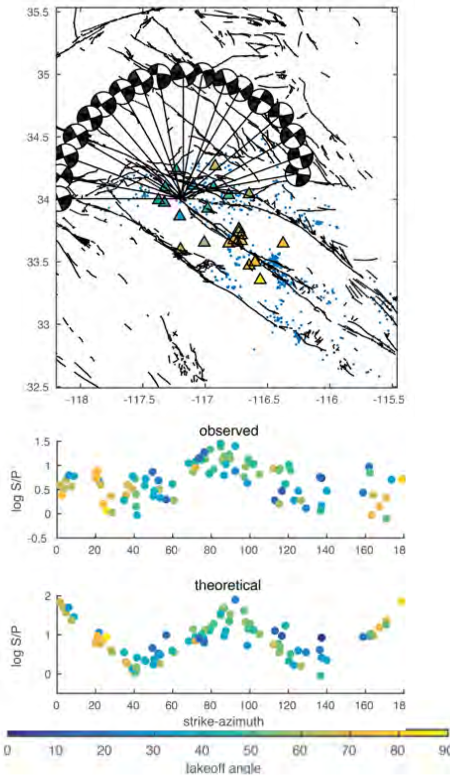
Role of off-fault inelastic deformation on strain accumulation, rupture, and radiated energy



Withers and Moschetti
Poster #246

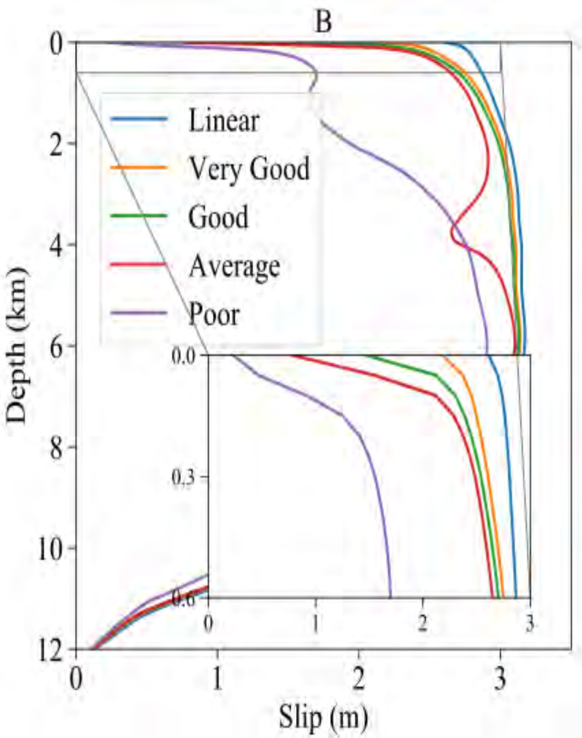


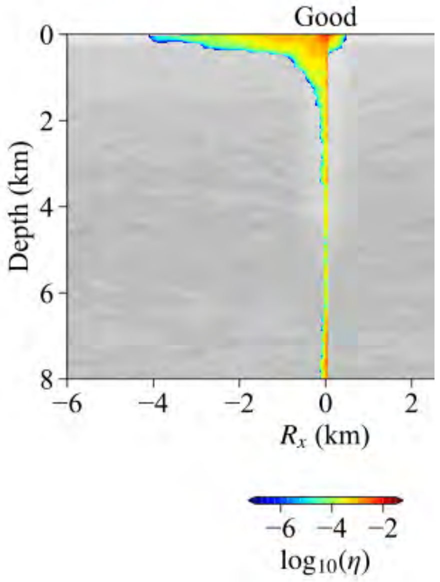
Bydlon, Withers, and Dunham
Poster #263

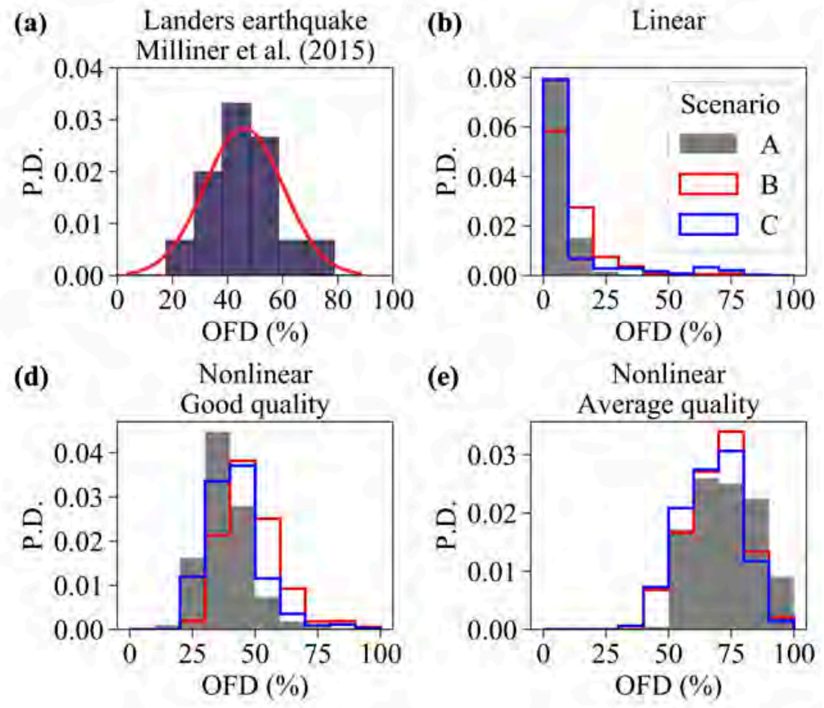


Buehler et al.
Poster #267

Off-fault Deformations and Shallow Slip Deficit from Dynamic Rupture Simulations with Fault Zone Plasticity





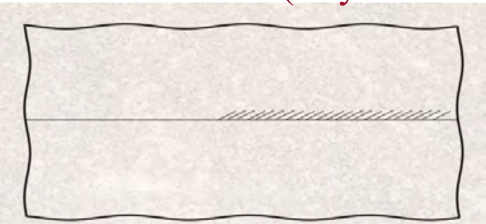


Roten, Olsen, and Day #086

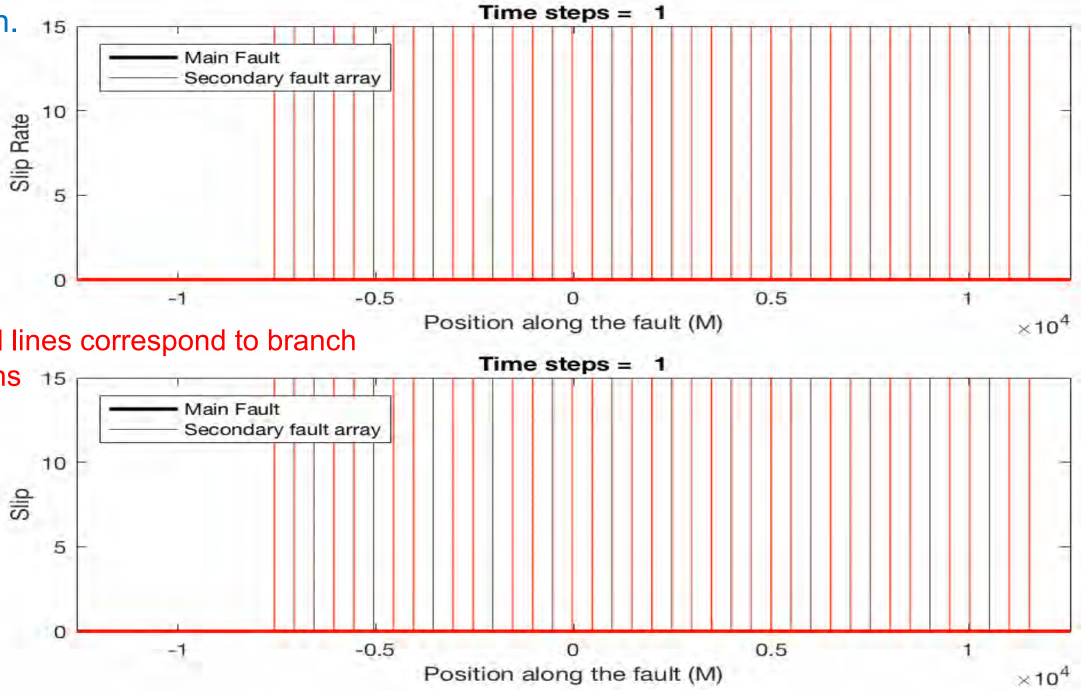
Towards Dynamic Rupture With High Resolution Fault Zone Physics (Beyond Isotropic Plasticity)

Dynamic rupture on a fault with small scale branches

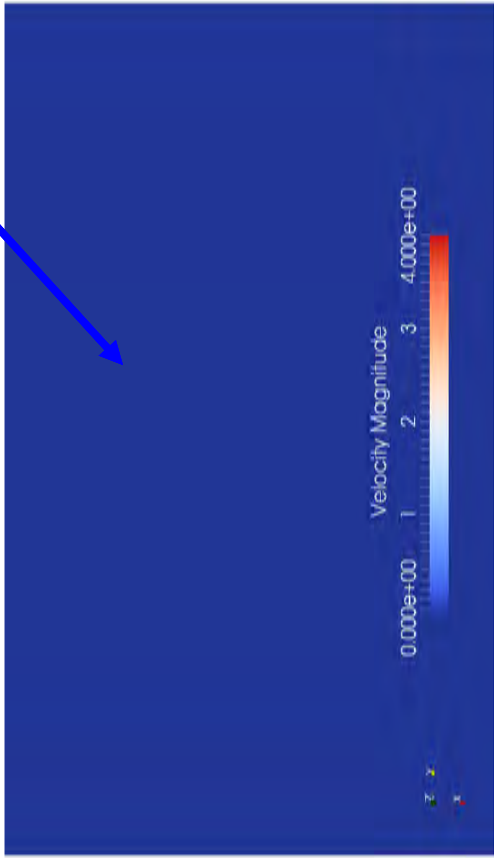
Branches slow down main rupture, reduce slip and slip rate and cause complex ground motion.



Notice the interference fringes from interaction with the branches



Vertical lines correspond to branch locations



Elbanna et al. #179

Five Basic Questions of Earthquake Science

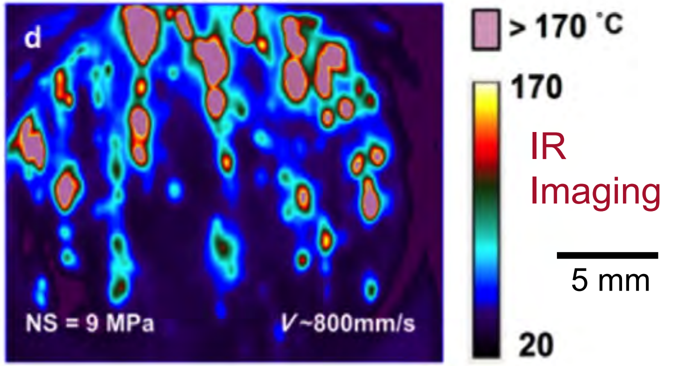
Q1. How are faults loaded across temporal and spatial scales?

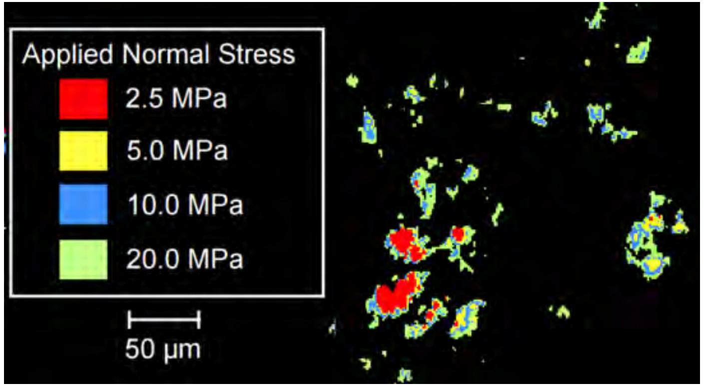
Q2. What is the role of off-fault inelastic deformation on strain accumulation, dynamic rupture, and radiated seismic energy?

Q3. How do the evolving structure, composition and physical properties of fault zones and surrounding rock affect shear resistance to seismic and aseismic slip?

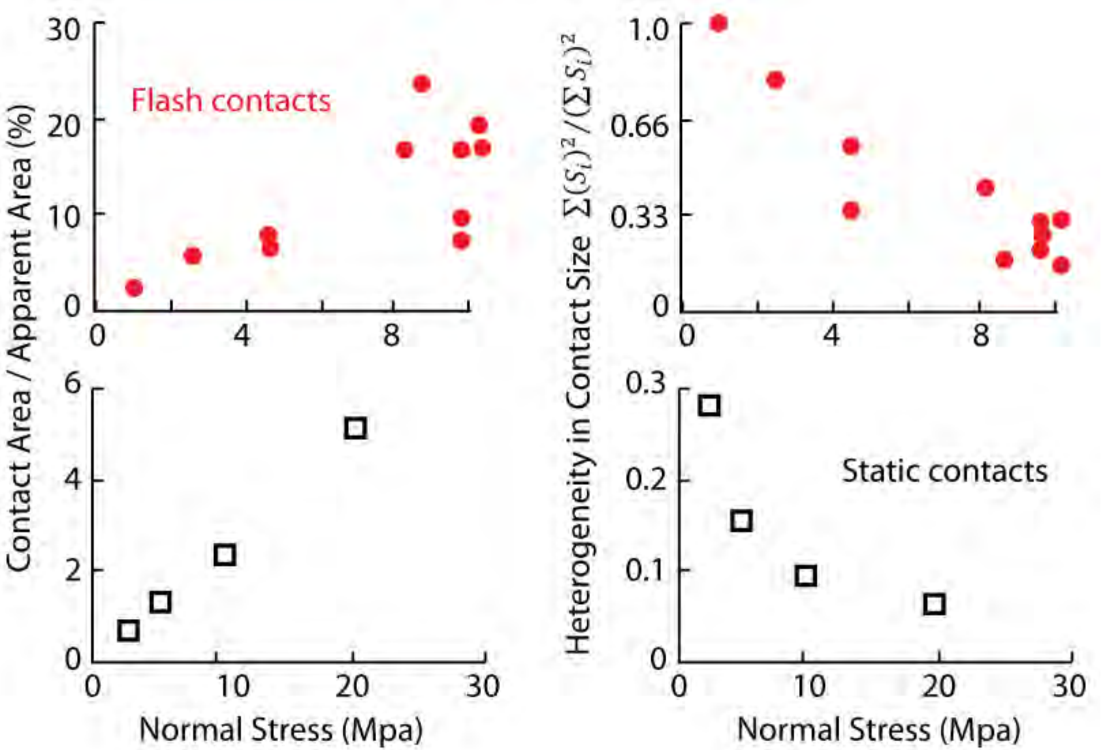
Character of Frictional Contacts Formed During Seismic Slip

Similarities and differences of friction contacts during sliding at quasi-static and seismic slip-rates





Optical Imaging, Dieterich & Kilgore, 1994

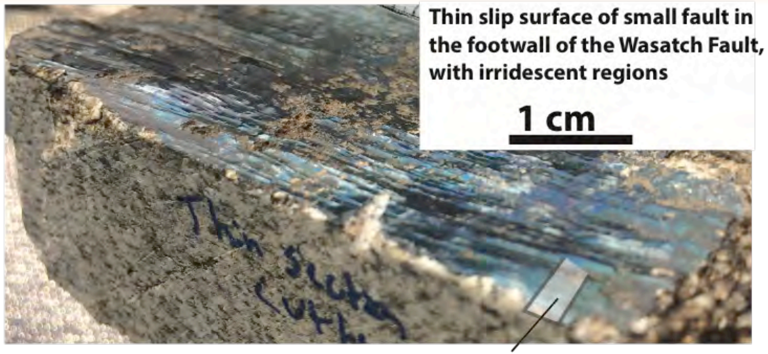


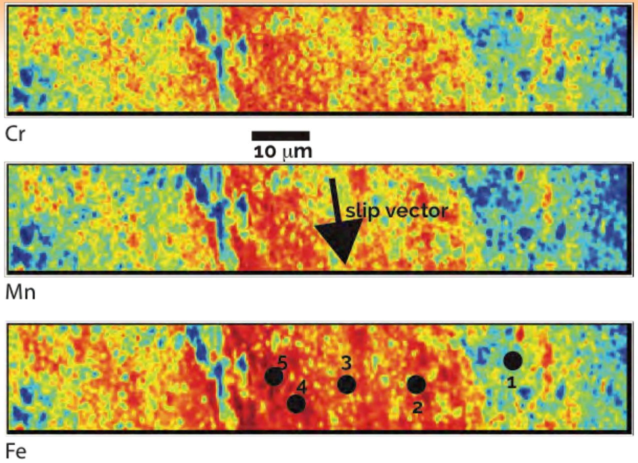
Chester and Chester #192

SC/EC

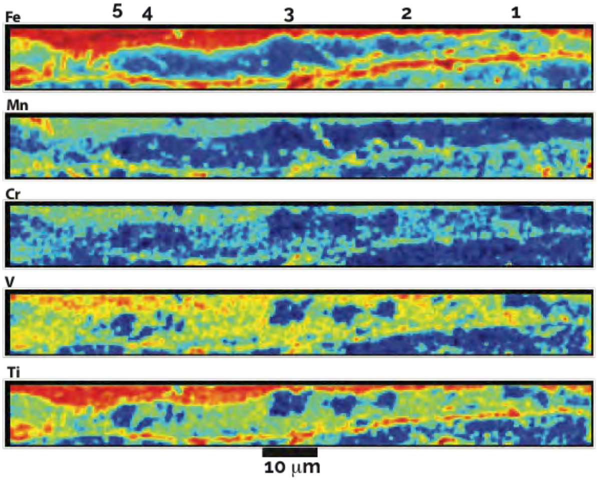
Southern California Earthquake Center

Earthquake Petrology: Insights into Fault Slip Localization and Fault Heating via Micro X-Ray Fluorescence Mapping and X-Ray Absorption Near Edge Spectroscopy

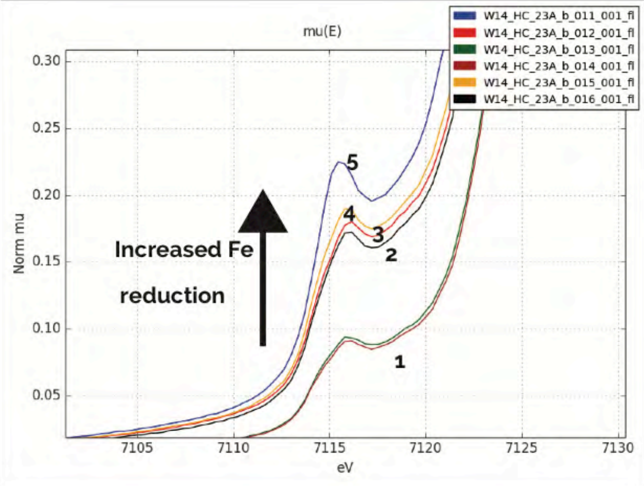




Map view of part of an Fe-coated slip surface



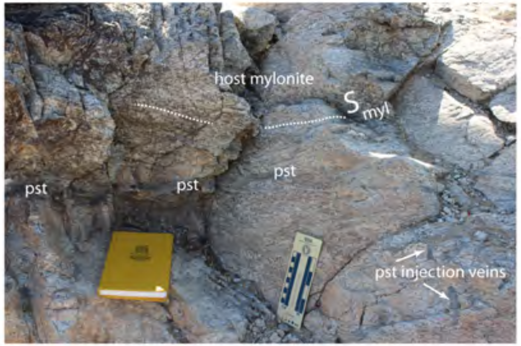
End on section pf slip surface with key element concetrations

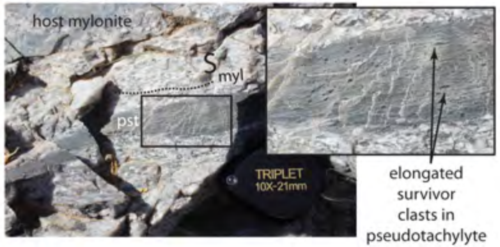


The chemistry of iron reduction suggests localized zones represent at least 400° C of heating

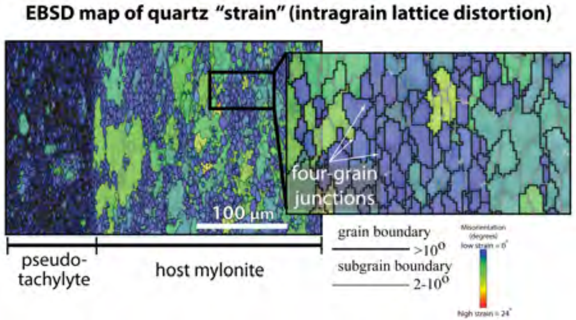
#196 Evans Borhara Webb

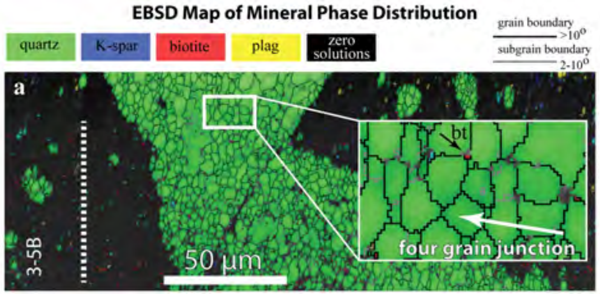
Grain boundary sliding triggers coeval pseudotachylyte development in brittle-ductile transition mylonites



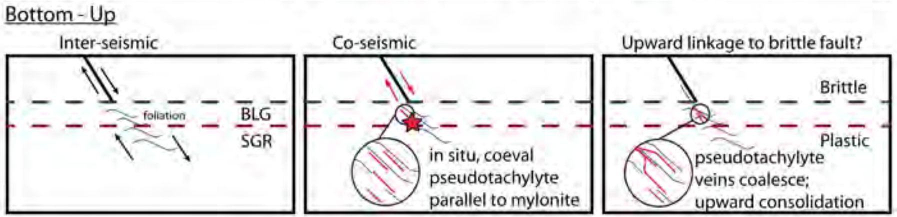


1) Coplanar pseudotachylyte (pst) veins and mylonite foliation (S_{myl}) imply coeval development





2) EBSD data: grain boundary sliding in mylonites causes runaway strain rates, triggering in situ pseudotachylyte



3) Can this process lead to bottom-up EQ ruptures from the BDT?

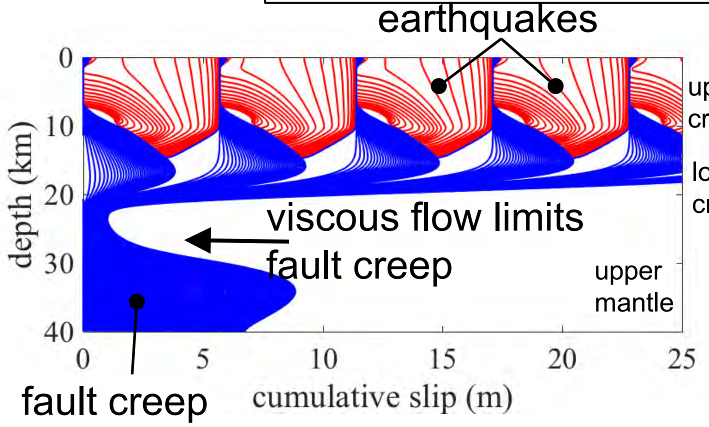
Miranda et al.
Poster #197

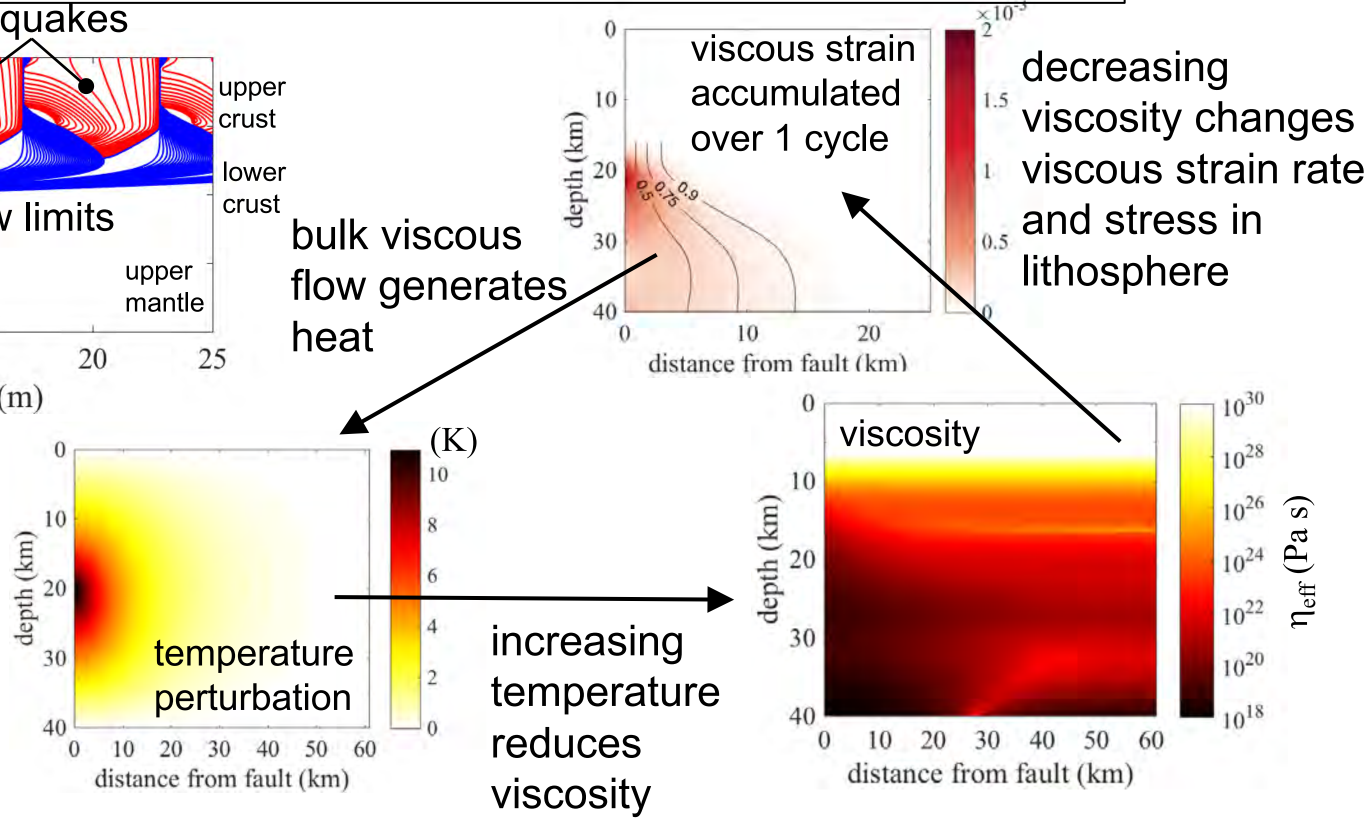
SC/EC

Southern California
Earthquake Center

Thermomechanical Earthquake Cycle Simulations

Strike-slip fault in a layered viscoelastic half-space with rate-and-state friction, temperature-dependent power-law flow laws, and thermomechanical coupling





Kali Allison and
Eric Dunham

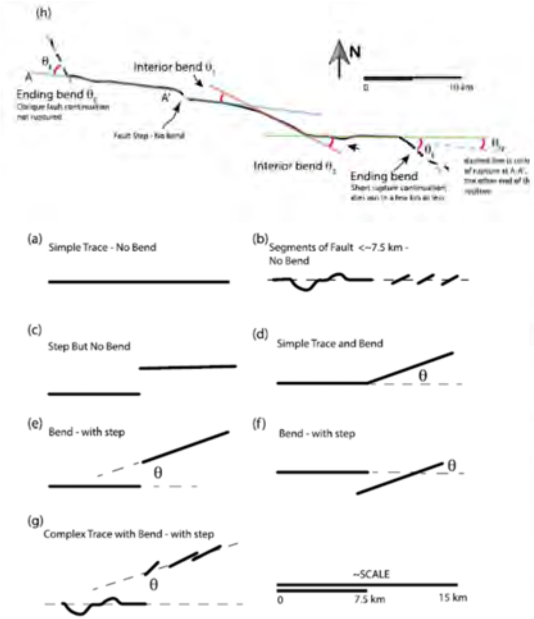
Poster #059

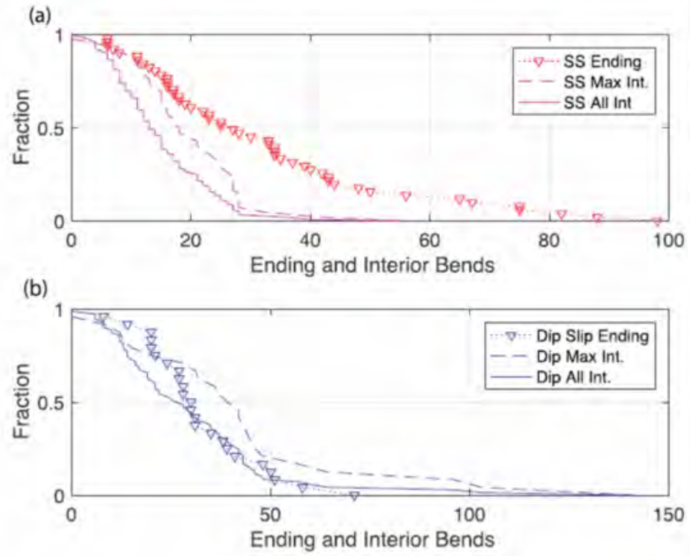
SC/EC

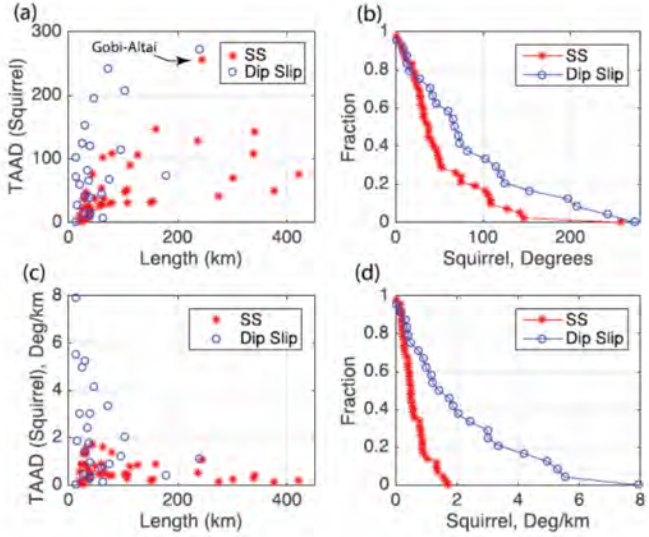
Southern California Earthquake Center

Bends and Ends of Surface Ruptures

Biasi and Wesnousky, in press @ BSSA







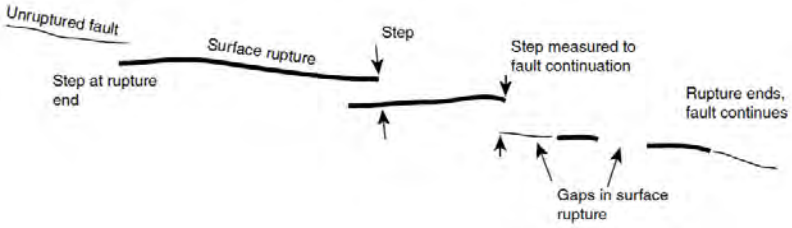
Empirical dataset 67 historical ruptures
Measure bend angles

50% of strike slip ruptures make it through 25° bend

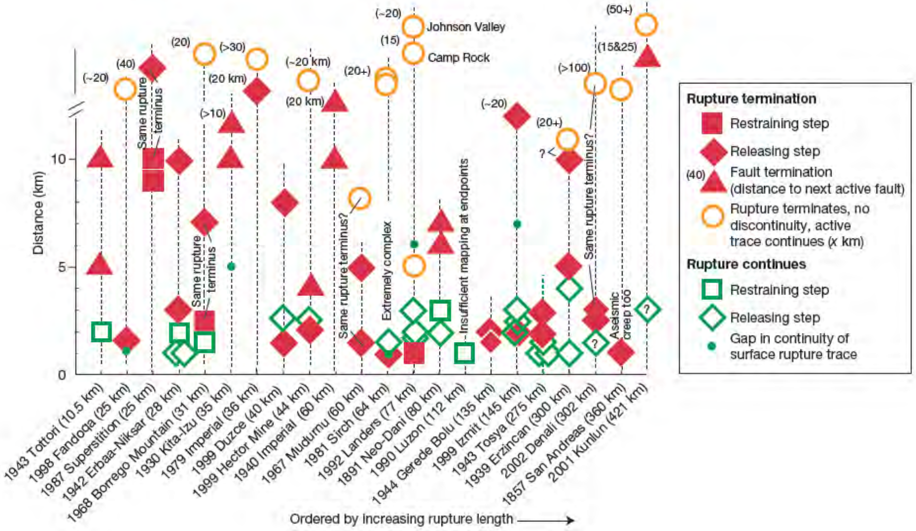
Amount of internal deflection, aka “squirrel”

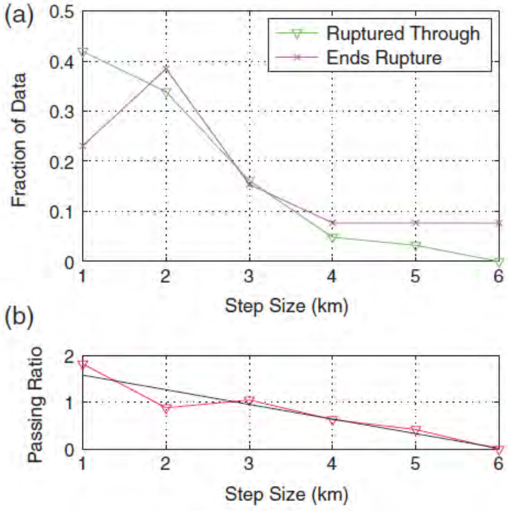
Poster #130

Earthquakes can grow by jumping across fault stepovers unless the stepover size is larger than 5 km



Wesnousky (2006), Biasi and Wesnousky (2016)



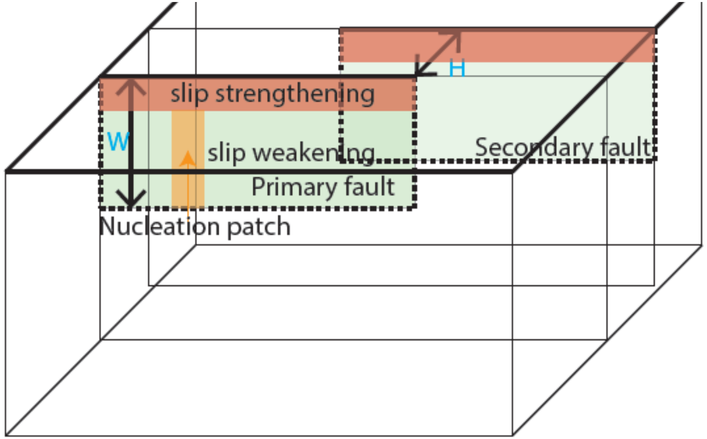


But why 5 km?
What controls the maximum size of fault stepovers an earthquake can jump?

Role of seismogenic depth and background stress on physical limits of earthquake rupture across fault stepovers

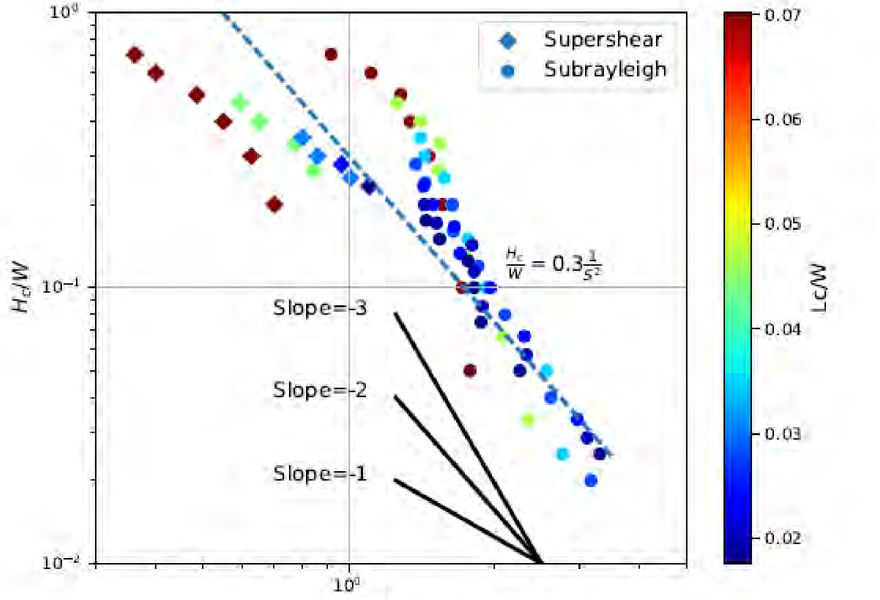
K. Bai and J. P. Ampuero

What controls the maximum stepover size an earthquake can jump?



Theory and dynamic rupture simulations

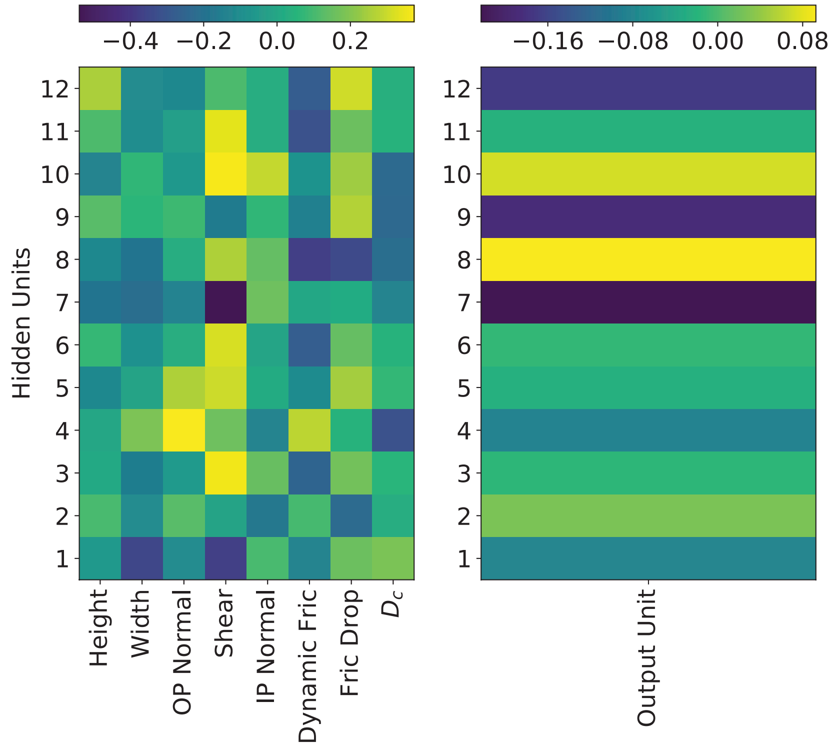
Critical stepover size / seismogenic depth



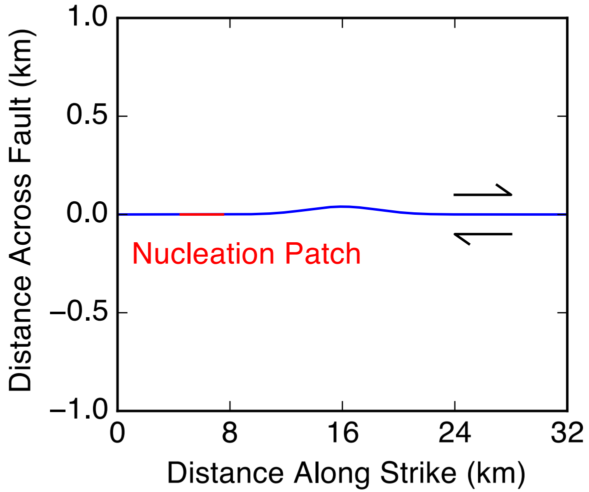
Strength excess / stress drop

Machine Learning Applied to Complex Rupture Dynamics Simulations

Sabber Ahamed and Eric Daub



Given a large set of earthquake rupture simulations, use a neural network to determine the parameter combinations (stress, friction, fault geometry) that are most predictive of rupture



Poster #173

Five Basic Questions of Earthquake Science

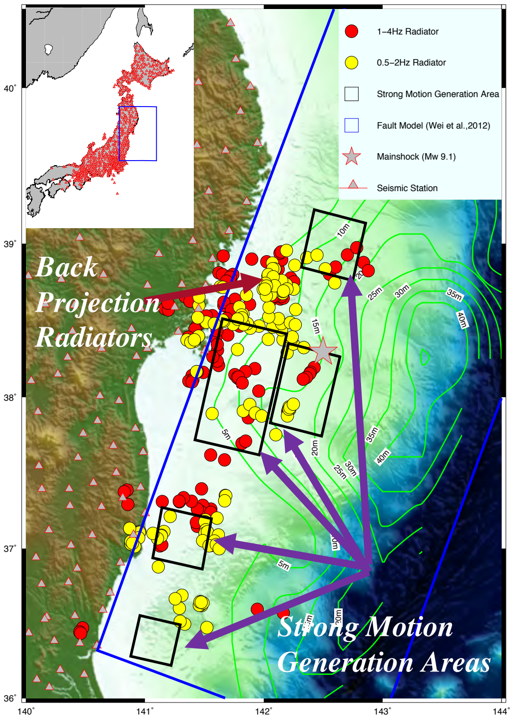
Q1. How are faults loaded across temporal and spatial scales?

Q2. What is the role of off-fault inelastic deformation on strain accumulation, dynamic rupture, and radiated seismic energy?

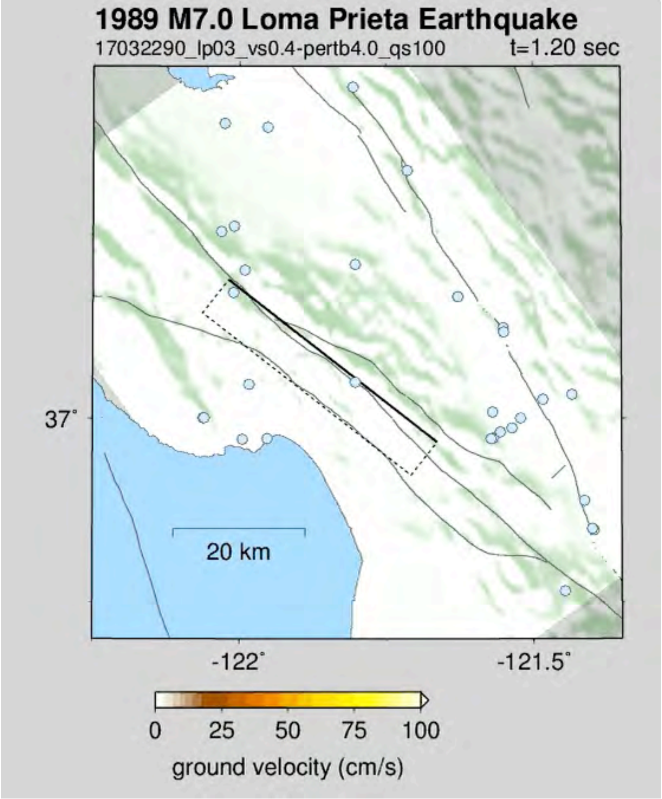
Q3. How do the evolving structure, composition and physical properties of fault zones and surrounding rock affect shear resistance to seismic and aseismic slip?

Q4. How do strong ground motions depend on the complexities and nonlinearities of dynamic earthquake systems?

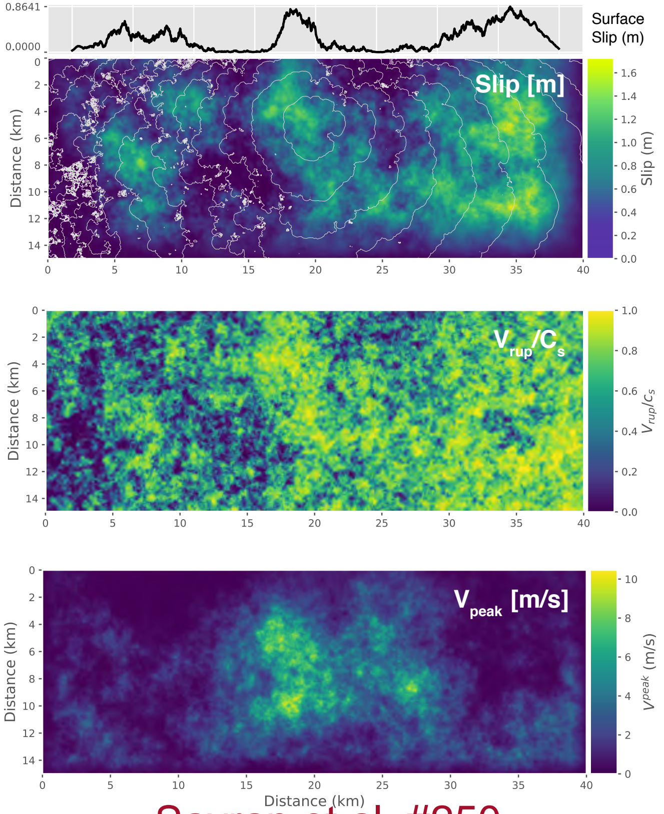
How do strong ground motions depend on the complexities and nonlinearities of dynamic earthquake systems?



Meng and Feng #256



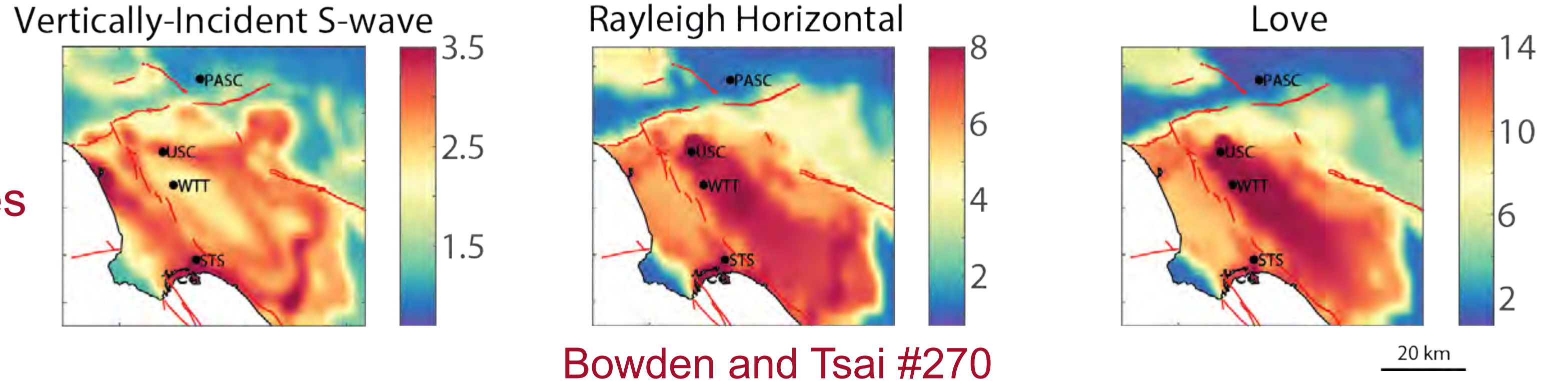
Graves #247



Savran et al. #250

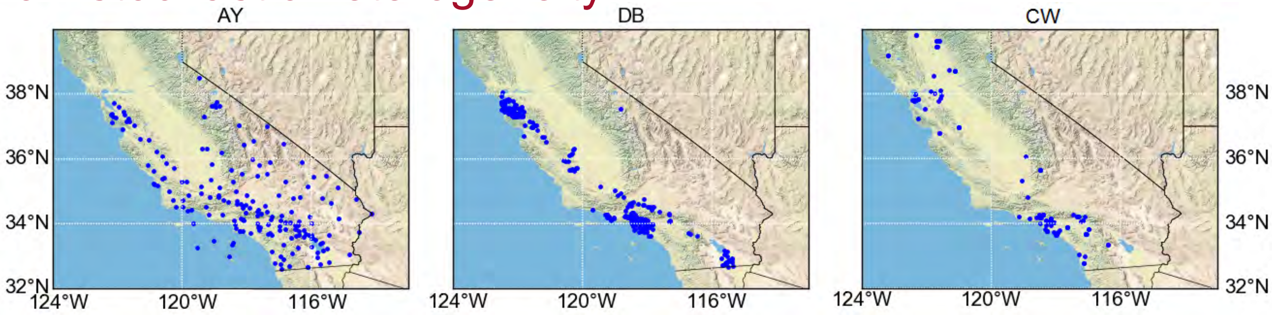
Characterization and modeling of shallow sedimentary basins

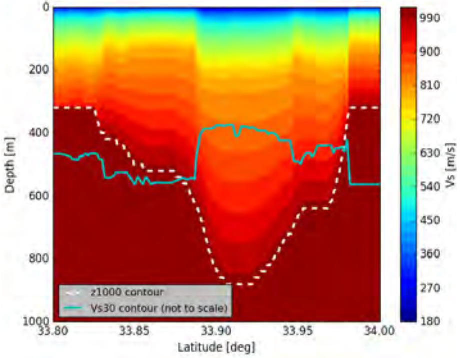
Site Responses



Bowden and Tsai #270

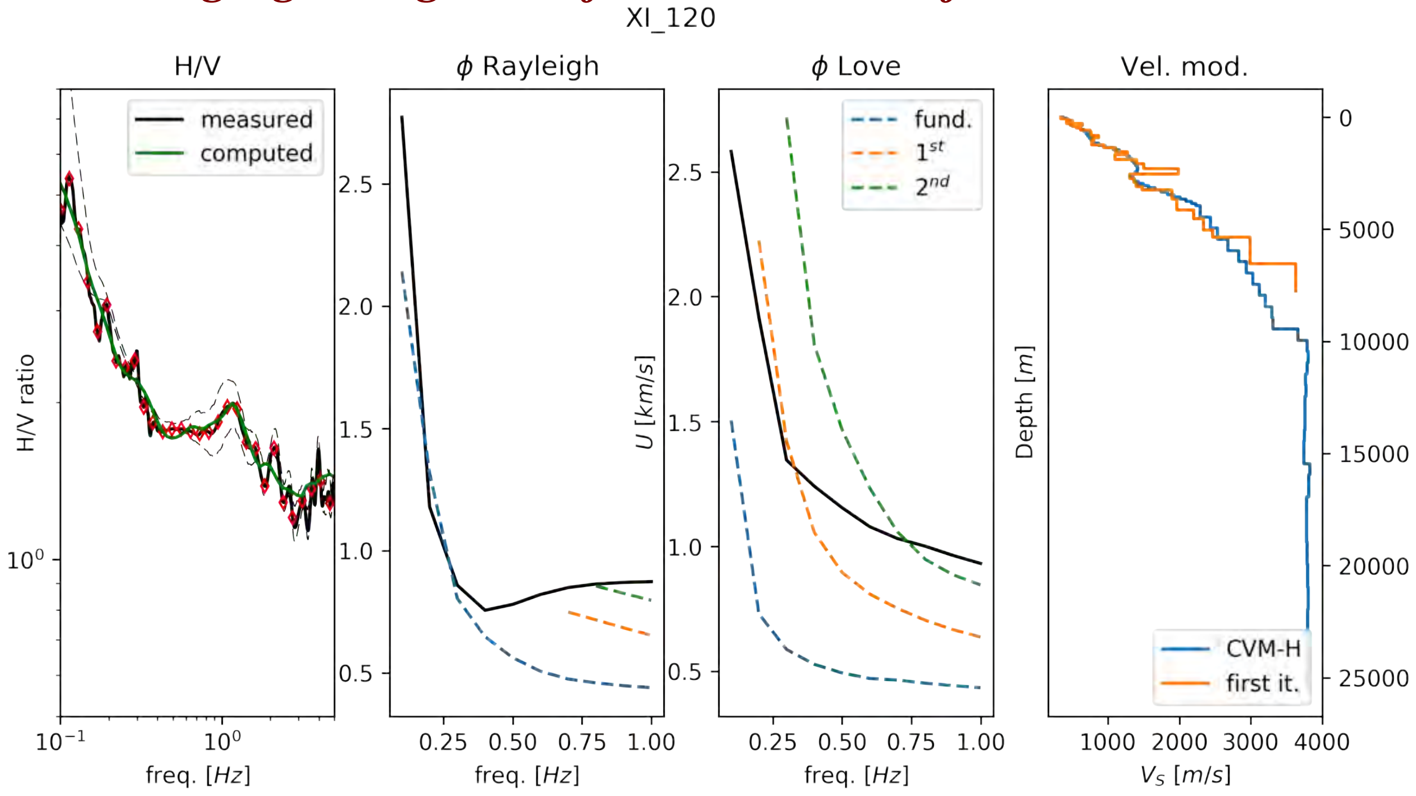
Shallow stochastic heterogeneity





Asimaki, Shi, and Taborda #271

Imaging Using H/V of Ambient Field for LASSIE Data



Spica et al. #026

Topography Effects in 3D Earthquake Simulation

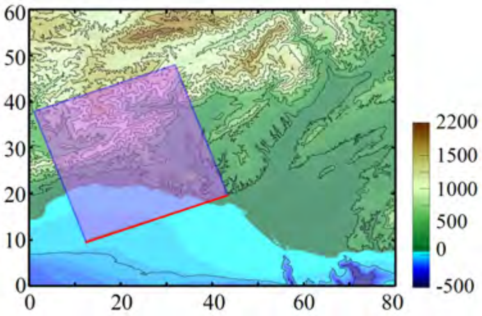
SC/EC — Southern California Earthquake Center

Andrea Riaño, Doriam Restrepo, Ricardo Taborda, and Jacobo Bielak

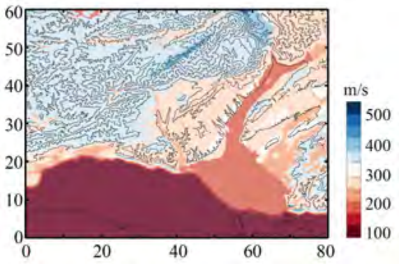
Region of Study

$80 \times 60 \times 40$ km^3 of the SC Region

Ventura Fault Location



CVM-H V15.1.0



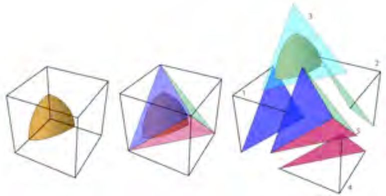
Simulation Parameters

Analytics	Topography		Flat	
	$V_{s_{min}}$ = 200 m/s	$V_{s_{min}}$ = 400 m/s	$V_{s_{min}}$ = 200 m/s	$V_{s_{min}}$ = 400 m/s
f_{max}, Hz	4	4	4	4
Max elevation, m	2284	2284	—	—
M_w	7.05	7.05	7.05	7.05
No. elements, billions	8.2	4.9	7.2	4.7
PPWL	10	10	10	10
Min. elem. size, m	5	5	10	10
Time Step, s	0.00016	0.0002	0.0004	0.0008
Sim. Time, s	40	40	40	40
Num. of cores	32000	25600	21440	25600
Cores usage time, hours	25 hr, 32 min	8 hr, 46 min	15 hr, 26 min	2 hr, 30 min

Simulations run in Blue Waters

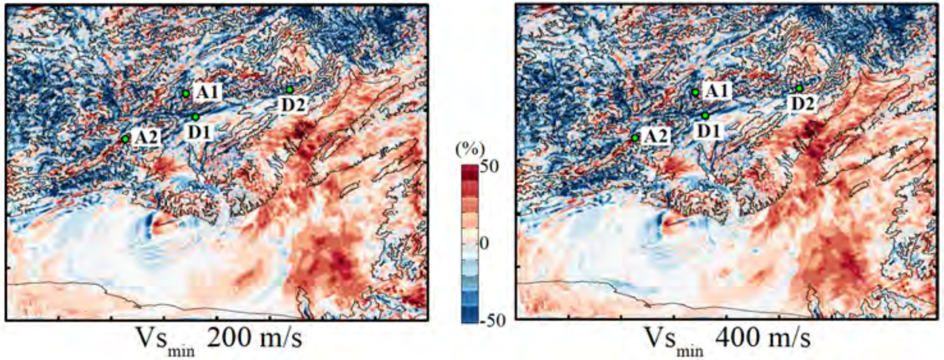
How we do it

We apply the Virtual Topography (VT) scheme (Restrepo and Bielak (2014)), which accounts for the non-conforming nature of octree meshes.

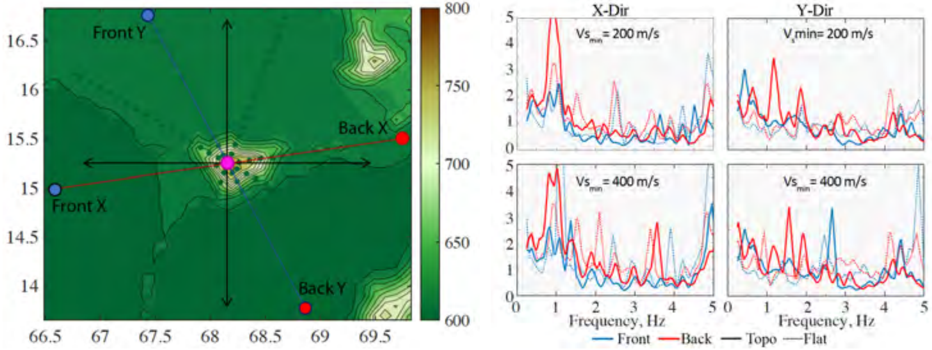


Topographic Amplification

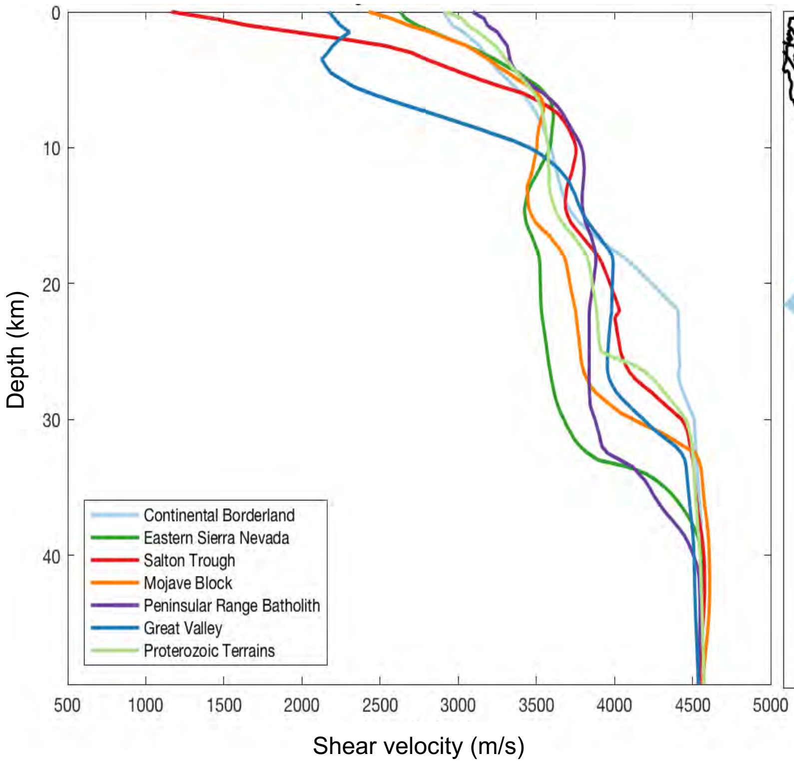
$$TAF = (PGV_{Topo} - PGV_{Flat})/PGV_{Topo}$$

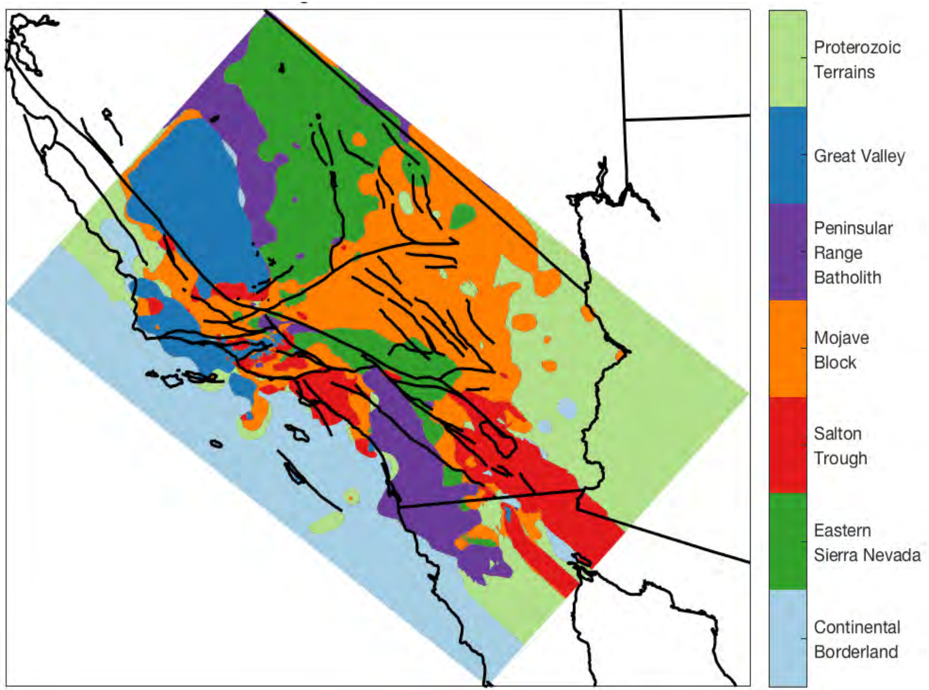


SSR of Hill M1



k-Means Regionalization of CVM-S4.26



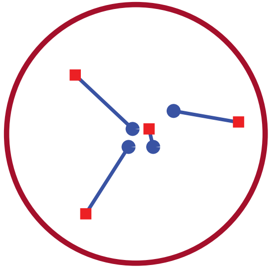


Shear-velocity regionalization, *k* = 7
(Eymold & Jordan, Poster #229, this meeting)

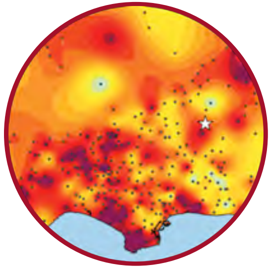
Data-Informed Validation Metrics Selection

Naeem Khoshnevis and Ricardo Taborda
University of Memphis

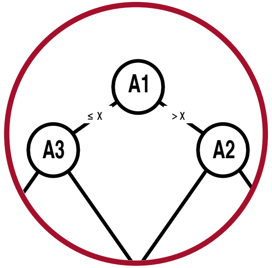
GOF Database



Constrained k-means Clustering through Subspace Analysis (Semi-supervised Learning)



Generate Labeled Data



Develop Prediction Models using Supervised-Learning

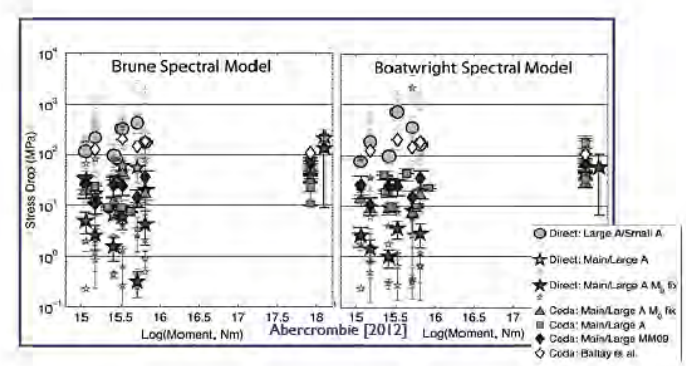
Applying machine learning techniques to interpret ground motion validation results, and thus develop simple, yet effective hierarchical models for goodness-of-fit metrics to accurately classify a simulation as poor, fair, good or excellent.

Poster #237

SCEC Southern California Earthquake Center

Community Stress Drop Validation Experiment

Stress drops of the same earthquake estimated by different methods, researchers or using different data can show vastly different results.

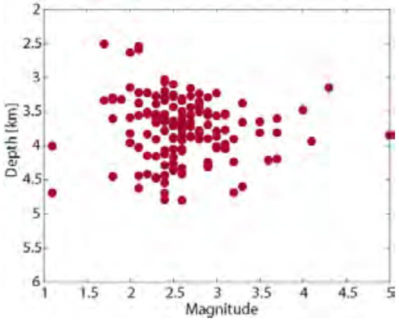


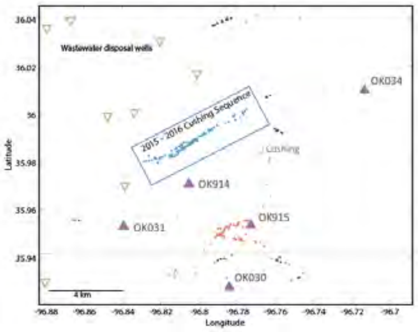
Goal: We invite all interested participants to join the experiment, using the same data set to work towards estimating stress drops by whatever method(s) are deemed appropriate.

Data: 2016 Cushing, OK sequence, ~50 events from M1.1 to M5.0 mainshock, recorded on up to 50 stations from ~2km to 100 km. Dataset is already assembled.

Interested? Add your name to the list on the website, let Annemarie know (abaltay@usgs.gov) **or visit Poster #055**

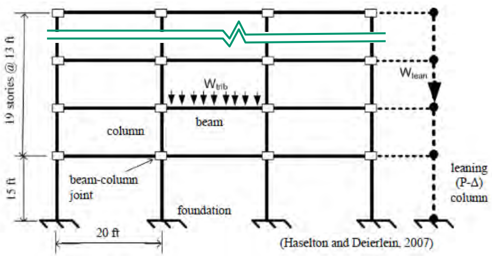
https://stressdrop.wixsite.com/stressdrop



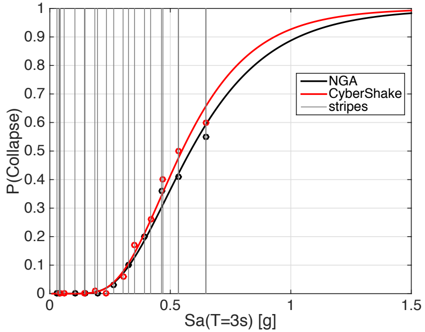


Structural Simulations: Disaggregation of Risk

Nenad Bijelic, Ting Lin, Greg Deierlein

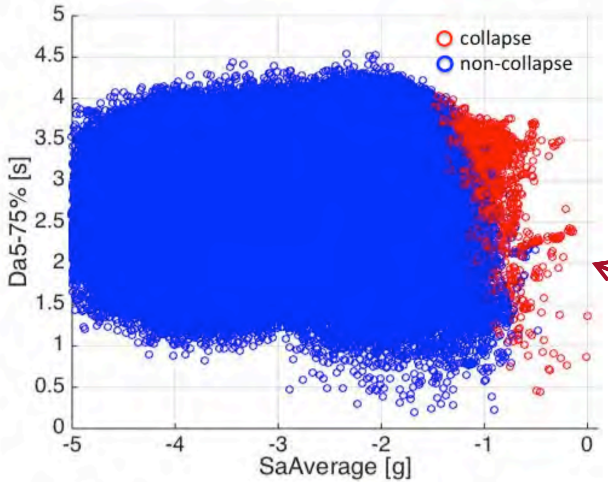


20-story building, T_1 = 2.60s

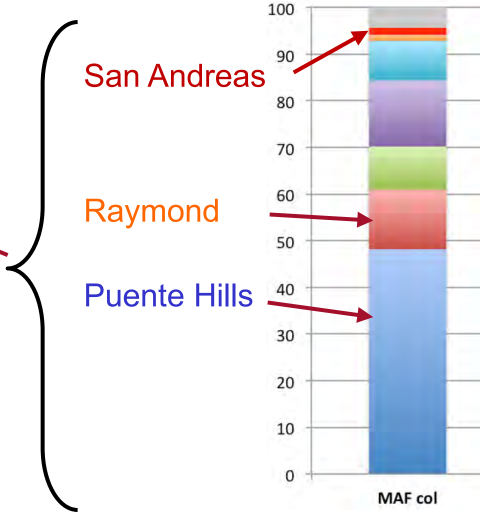


Collapse Fragility

Which faults and earthquakes contribute most to the collapse risk?



Improved "intensity measure(s)" to characterize ground motions



Poster #241

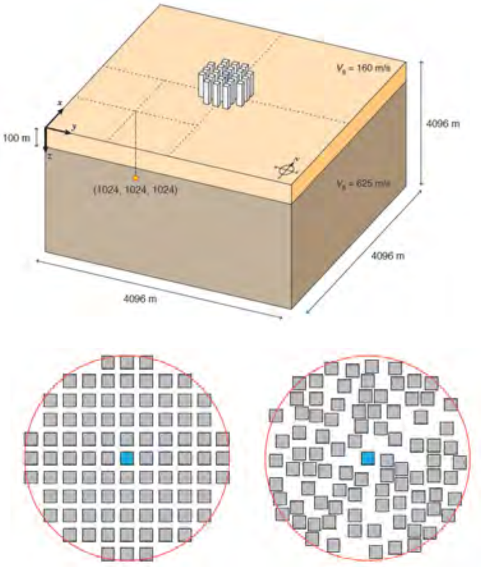
Characterizing Building-Cluster Site-City Interaction Effects

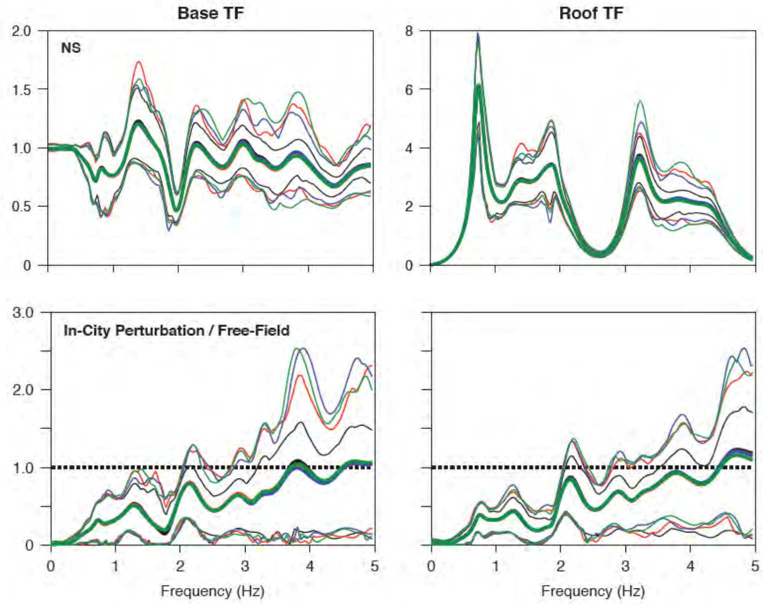
Ricardo Taborda and Yigit Isbiliroglu
University of Memphis and RIZZO Associates

Developed algorithms to create and instrument synthetic city models.

Ran simulation experiments aimed at characterizing the influence of building clusters on…

- *The dynamics of soil-structure interaction systems*
- *The ground motion (variability) inside and outside the city.*





Poster #240

Five Basic Questions of Earthquake Science

Q1. How are faults loaded across temporal and spatial scales?

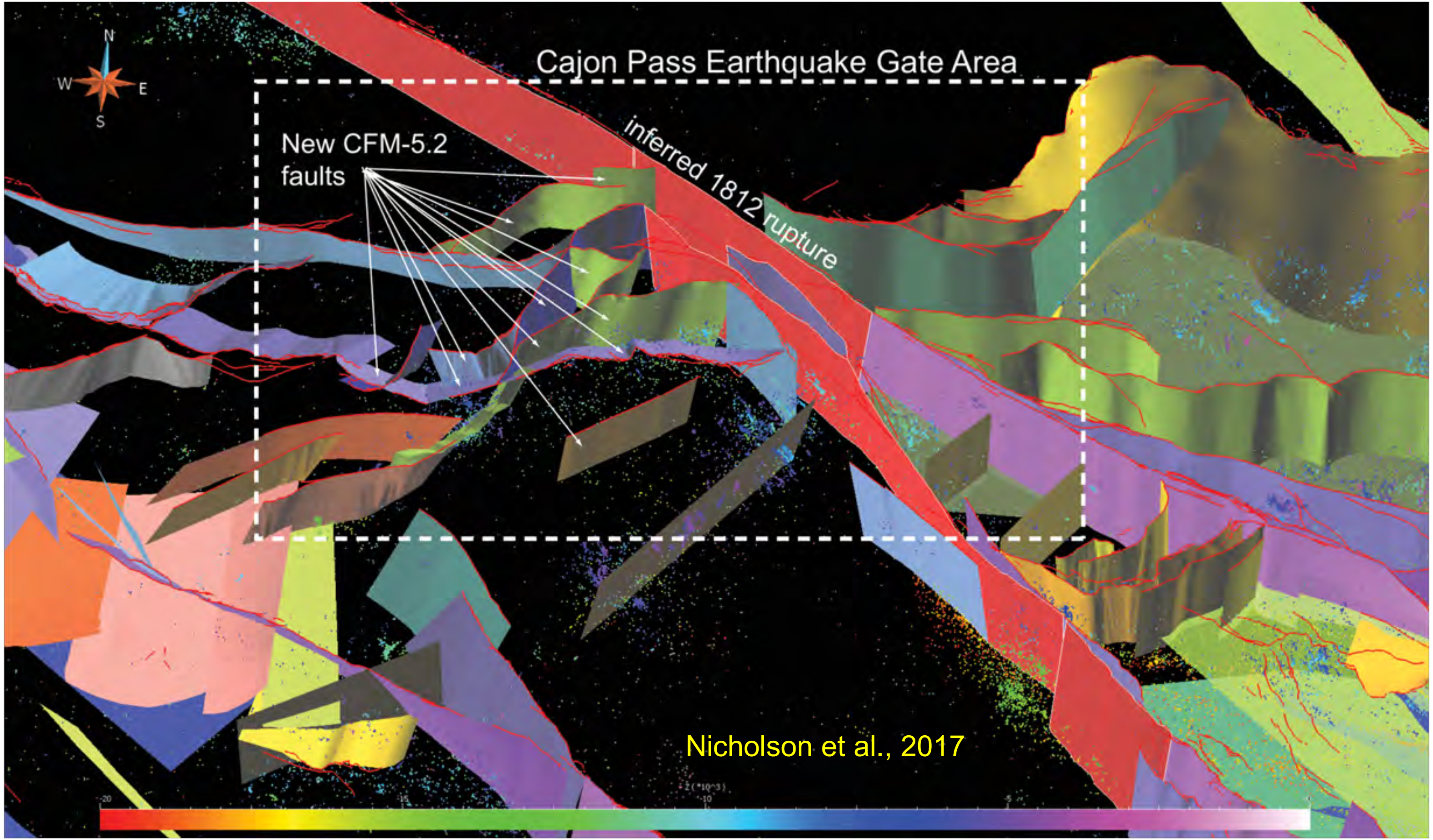
Q2. What is the role of off-fault inelastic deformation on strain accumulation, dynamic rupture, and radiated seismic energy?

Q3. How do the evolving structure, composition and physical properties of fault zones and surrounding rock affect shear resistance to seismic and aseismic slip?

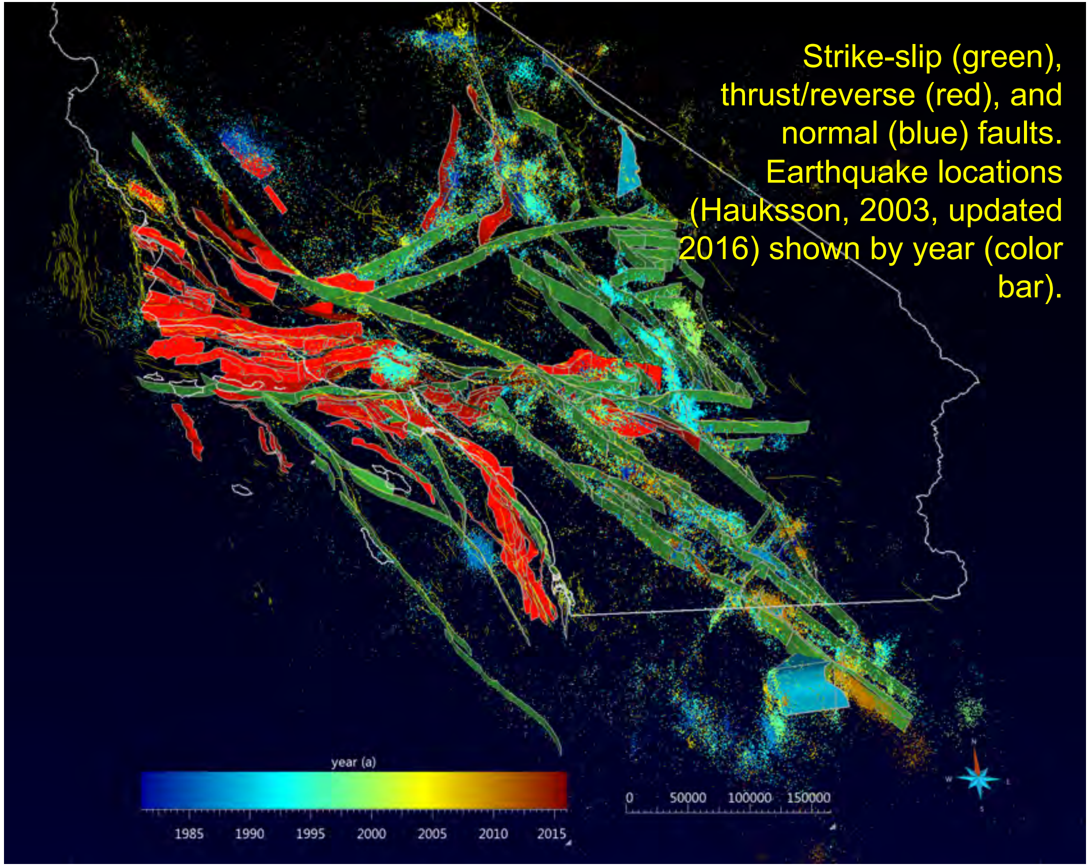
Q4. How do strong ground motions depend on the complexities and nonlinearities of dynamic earthquake systems?

Q5. In what ways can system-specific studies enhance the general understanding of earthquake predictability?

New, updated and improved CFM-v.5.2 fault representations within the Cajon Pass Earthquake Gate Area



CFM Version 5.2

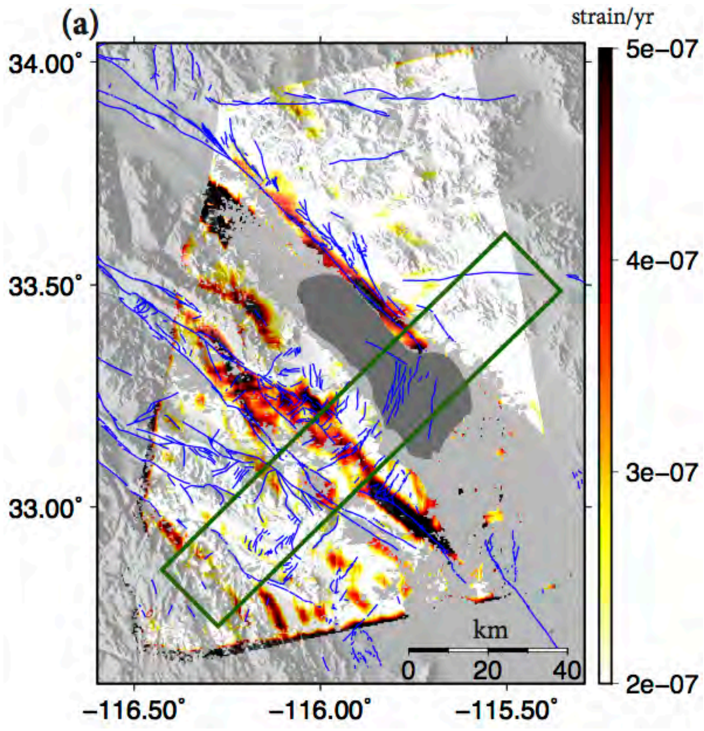


- added faults
- improved, expanded database
- alternative representations
- to be served at https://www.scec.org/research/cfm and linked to CXM website

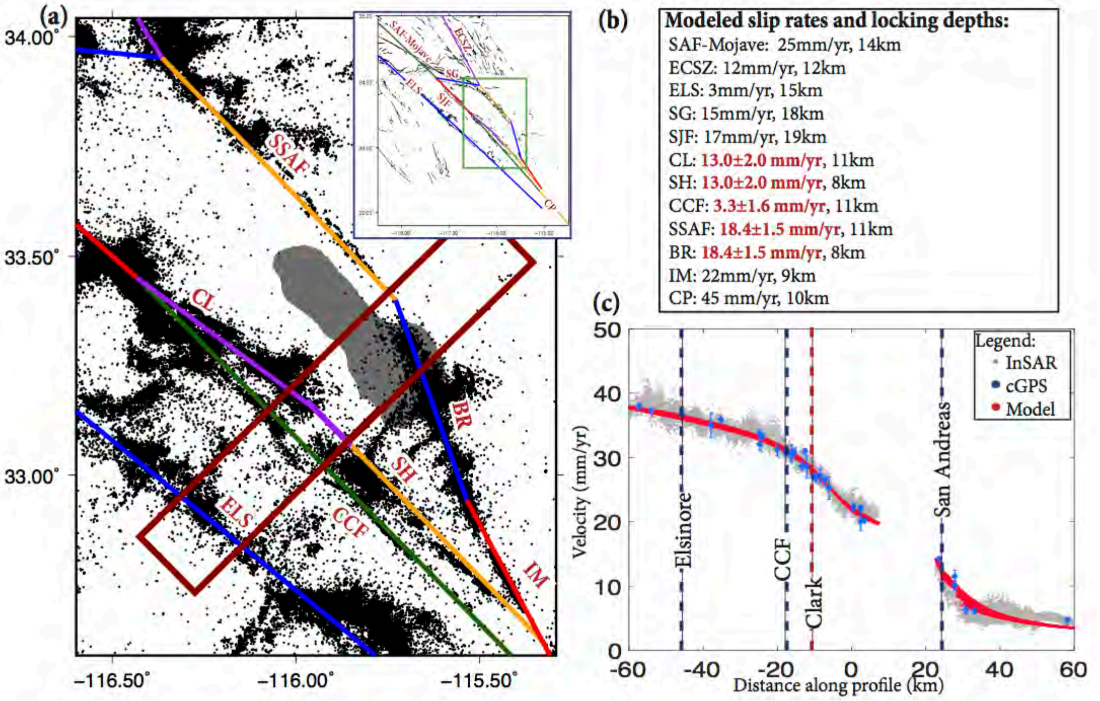
DETAILS: See poster! Nicholson, C., Plesch, A., & Shaw, J. H. (2017), "Community Fault Model Version 5.2: Updating & expanding the CFM 3D fault set and its associated fault database."

Blind southern extension of the San Jacinto Fault

Strain rate from InSAR and GPS data



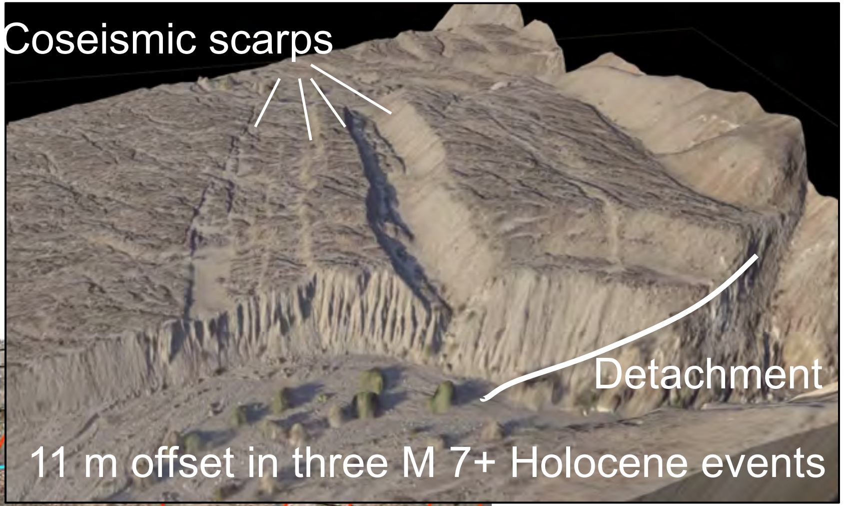
3-D fault model: San Jacinto connects to Superstition Hills fault

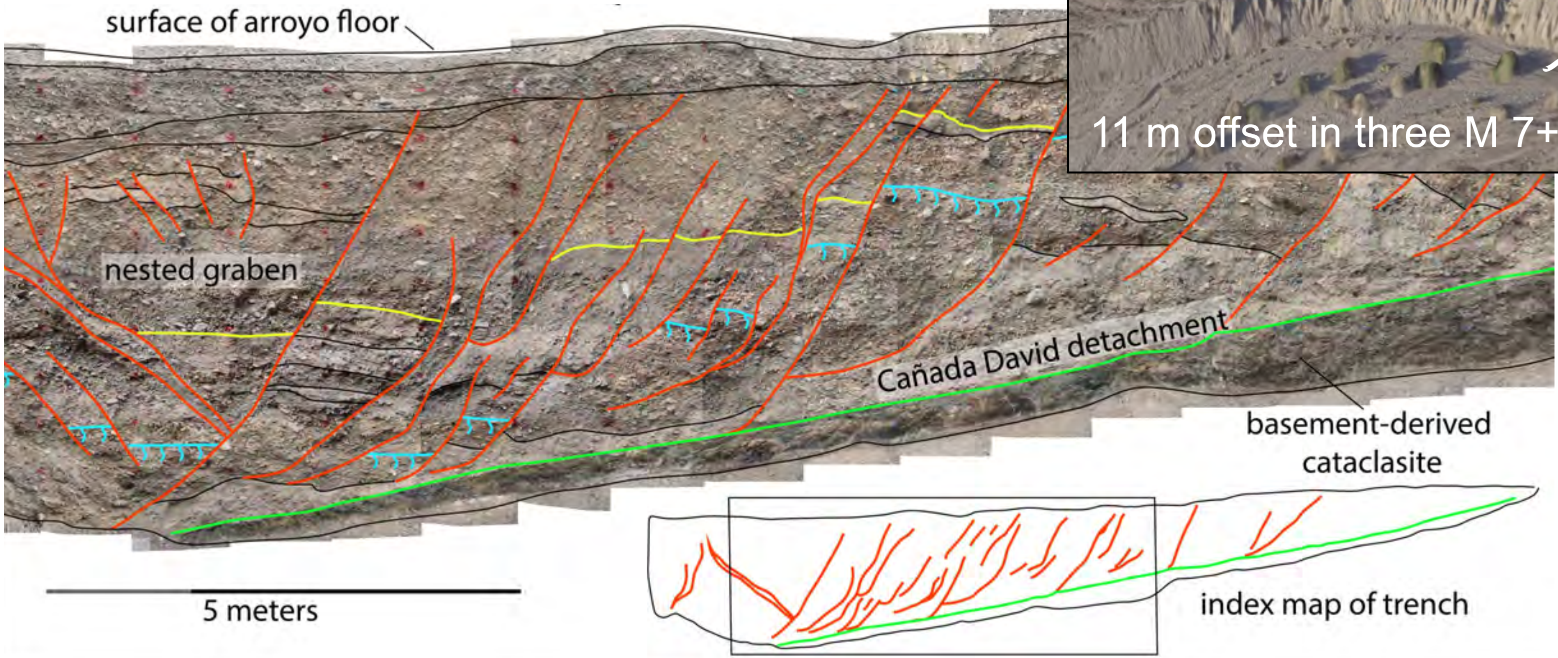


Tymofyeyeva and Fialko, JGR, in review

Seismogenic low-angle normal fault with surface rupture

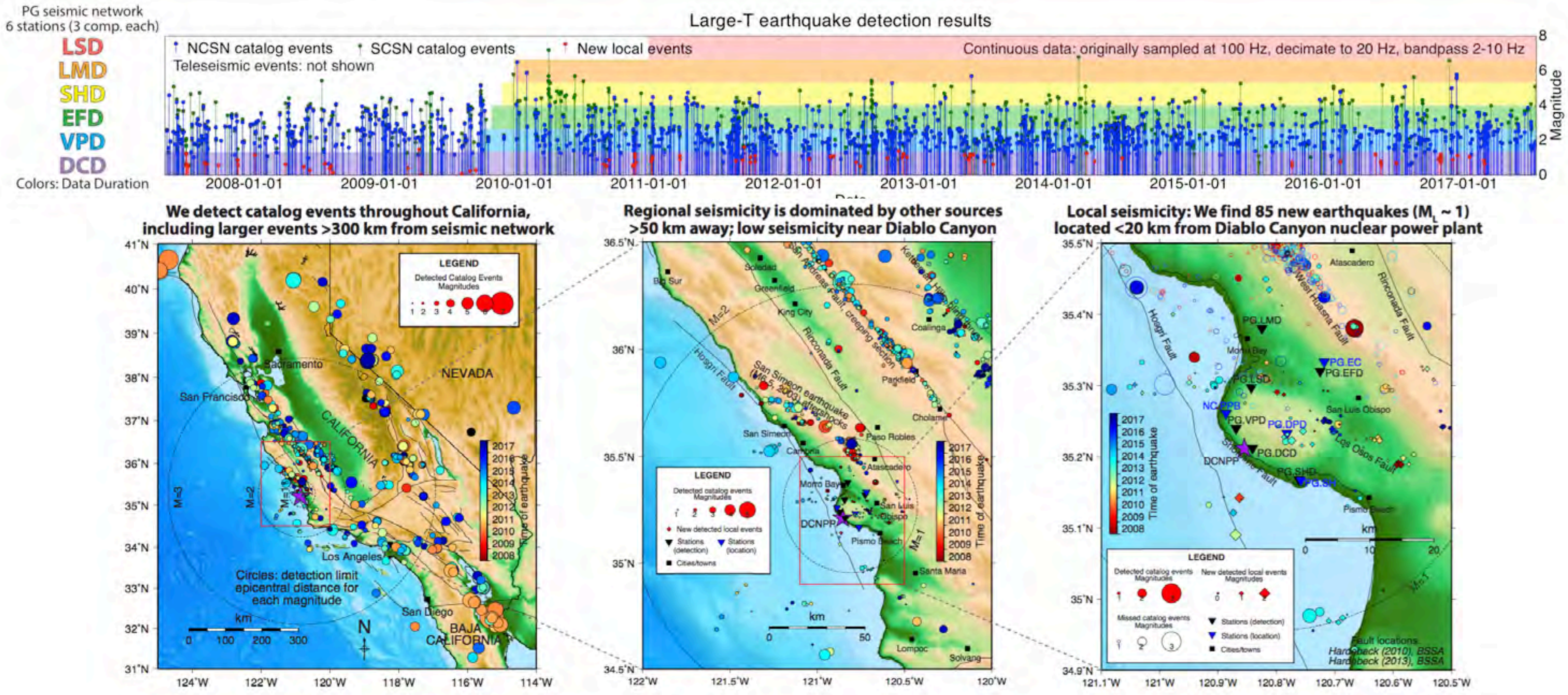
Three ~M7 events since 15 ka (latest 1892)
Cañon David Detachment Fault, Baja CA





Poster #142
Fletcher et al.

FAST for Earthquake Detection

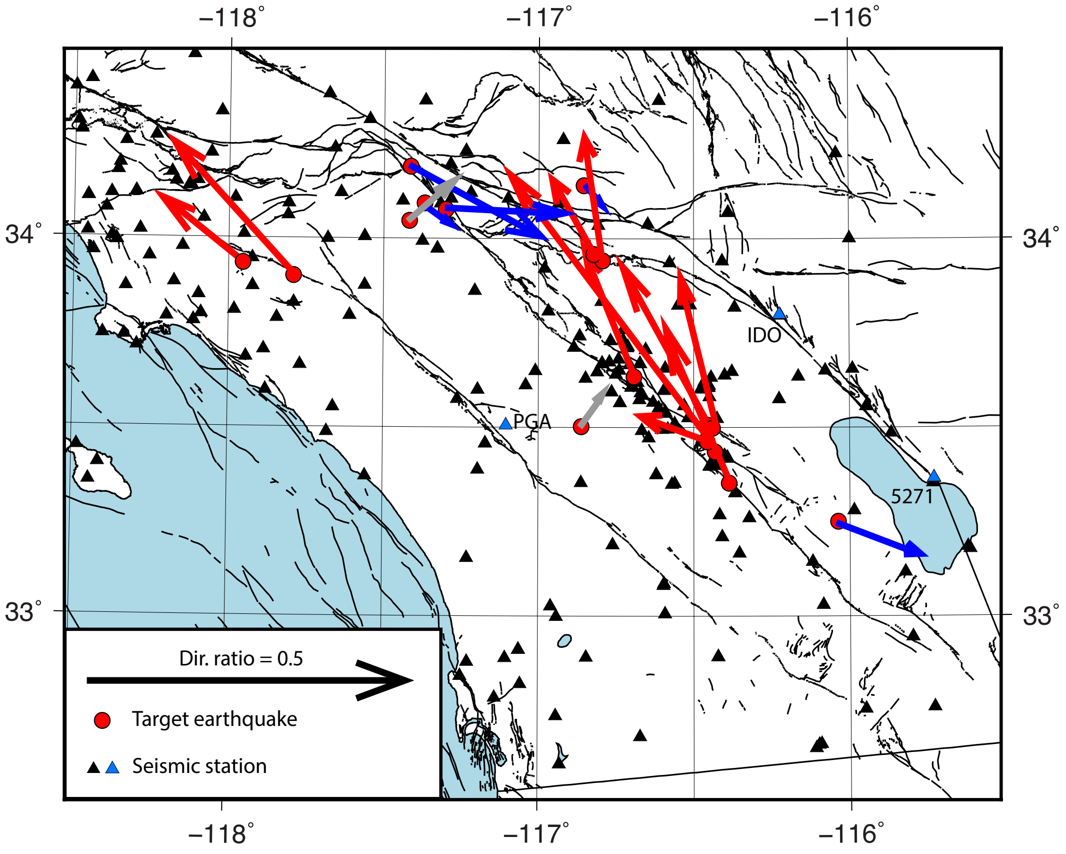


Yoon et al. #24

Directivity from Second Moments

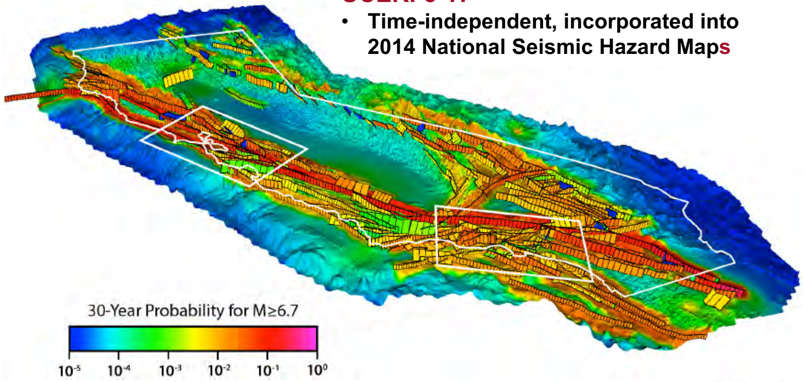
Reversed dominant directions in the central and north SJF are consistent with reversed velocity contrasts polarities at these sections

(Meng, Ben-Zion & McGuire, poster 29)

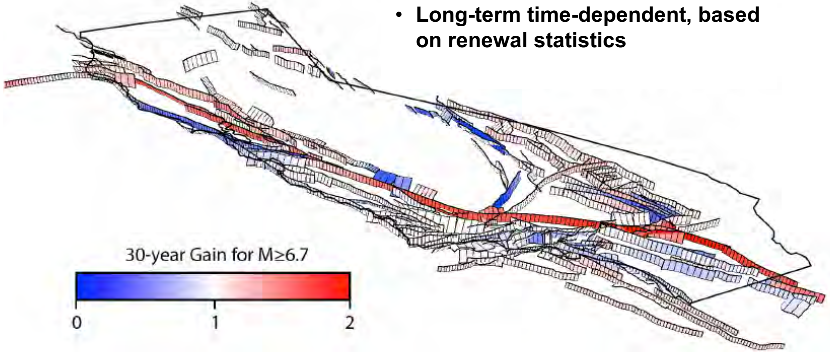


Uniform California Earthquake Rupture Forecast (UCERF3)

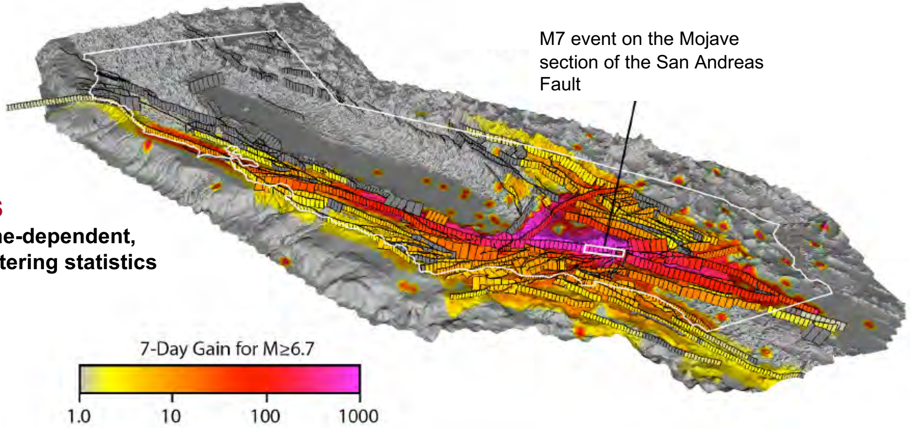
UCERF3-TI
- **Time-independent, incorporated into 2014 National Seismic Hazard Maps**



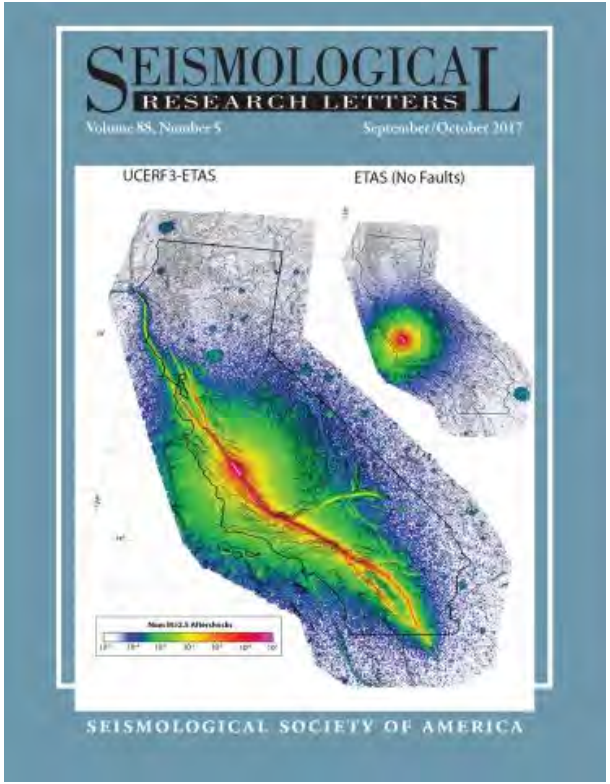
UCERF3-TD
- **Long-term time-dependent, based on renewal statistics**



UCERF3-ETAS
- **Short-term time-dependent, based on clustering statistics**



Field et al. (2014, 2015, 2017)



Average M≥2.5 aftershock nucleation rate following an M 6.1 Parkfield earthquake

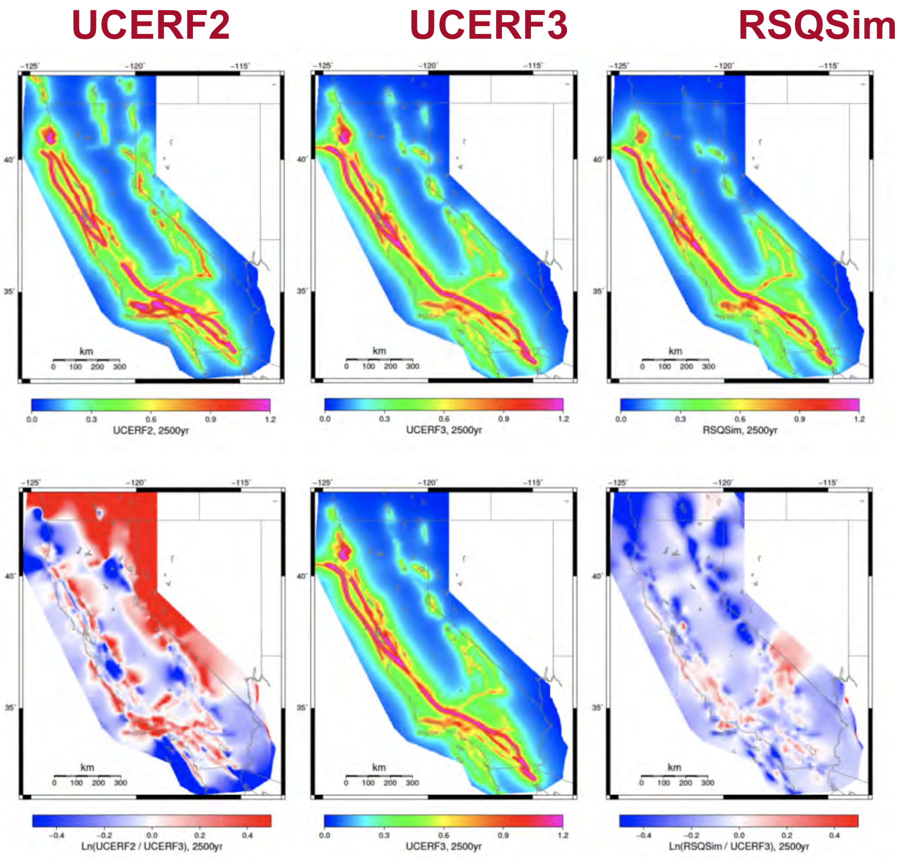
UCERF3 Implications:

- Both multi-fault ruptures and spatiotemporal clustering in a fault system are now included (e.g., as basis for OEF)
- Gutenberg Richter distribution is not applicable to all faults
- Combining finite faults with spatiotemporal clustering implies a need for elastic rebound/relaxation (otherwise large triggered events would simply re-rupture the main-shock rupture surface much more than we see in nature)

RSQSim/UCERF3 Hazard Comparisons

Shaw et al. #14

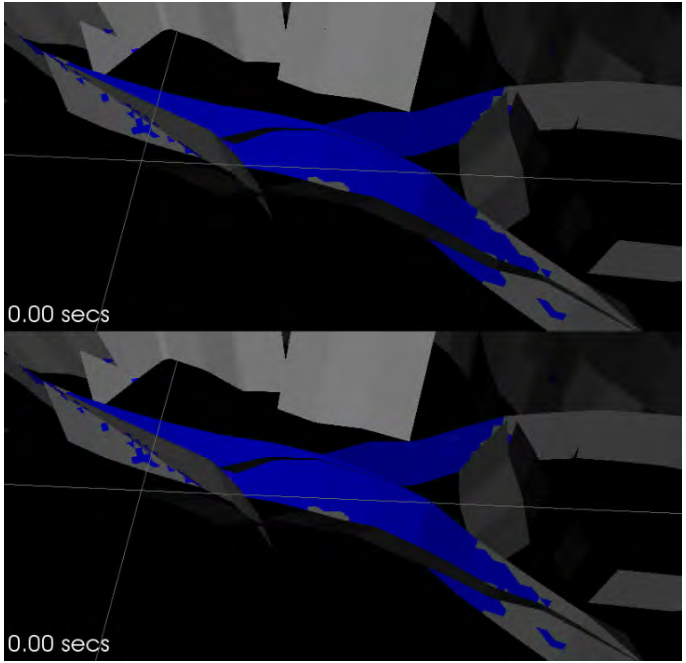
- **Hazard comparisons with UCERF3 show strong agreement, even with only global calibration**
- **RSQSim/UCERF3 differences often smaller than UCERF3/UCERF2**
- **Agreement between the empirical and physics-based models provides substantial support for the PSHA methodology**



Steps Toward RSQSim-based CyberShake

Milner et al. #12; Gilchrist et al. #13

- New SCEC-VDO based visualization tools for RSQSim ruptures
- RSQSim generates complex multi-fault rupture slip/time histories
  - Not currently possible with kinematic rupture generators used in CyberShake
- Likely some tweaking needed before use in CyberShake
- Would be first end-to-end physics-based hazard calculation



CXM Website: www.scec.org/research/cxm

- one-stop access to all community models
- links and model descriptions to be added

Time-dependent hazard and forecasting for the Kaikoura Earthquake

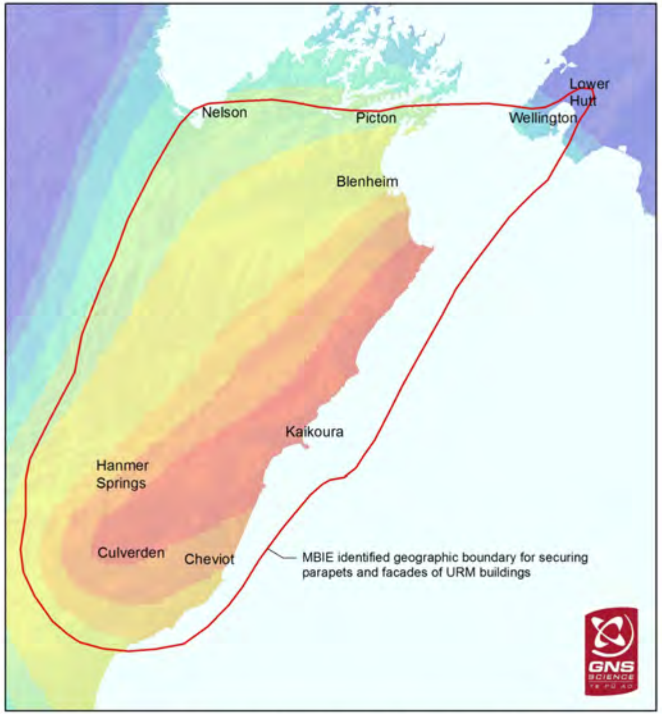
Ratio of increase in probability of exceeding ground shaking equivalent to *33% New Building Standard*:

Hazard for September 5th to Dec 5th, 2017
-compared to-
Pre-Kaikoura Hazard

Using hybrid time-dependent forecast model, combining 6 models

Short-term hazard increases of up to 10x

Retrofit time for unreinforced masonry facades and parapets reduced to 1-year (government cost share) from 10-years +



Increase in probability of exceeding ground shaking equivalent to 33% NBS in Wellington for the three month period ending December 5, 2017
(ratio betwen probabilities for post- and pre- 2016 Kaikoura M7.8 earthquake)

< 1.1	2 - 4
1.1 - 1.2	4 - 6
1.2 - 1.4	6 - 10
1.4 - 1.6	10 - 15
1.6 - 2	

Thank You

“One of These Nights”
CSEP and Operational Earthquake Forecasting

(Moderators: Max Werner, Morgan Page)

Matt Gerstenberger *“Earthquake Forecasting in recent large events in New Zealand and the role of CSEP”*

Warner Marzocchi “*Progress and challenges for Operational Earthquake Forecasting in Italy”*

Open Discussion

"Life in the Fast Lane"
Earthquake Gates Areas Initiative
(Moderators: Kate Scharer, Mike Oskin)

Kate Scharer *"Framing the EGA: Limits and Opportunities of Paleoseismic Data"*

Julia Lozos *"Introducing the* Cajon Pass Earthquake Gate Area"

Egill Hauksson *"Applying Paleo-earthquake Data to Query for Earthquake Gate Areas.*

Discussion: *How to get involved in EGA*

“Take it Easy”
SCEC Community Models
(Moderators: Liz Hearn, Scott Marshall)

Eileen Evans *“Strategies for building community-based geodetic models of fault slip rates”*

Rob Langridge *“The 2016 Mw 7.8 Kaikoura Earthquake: Perspectives from Earthquake Geology into Seismic Hazard”*

Discussion

“Desperado”
From Hazard to Risk
(Moderators: Annemarie Baltay, John Stewart)

Sarah Minson *“The Limits of Earthquake Early Warning”*

Ertugrul Taciroglu *“A Vision for Regional Performance-Based Seismic Assessment”*

Discussion

“Already Gone”
Postearthquake Response

(Moderators: Mike Oskin, Jamie Steidl)

Ken Hudnut *“The HayWired Scenario – How can the San Francisco Bay region bounce back better?”*

Silvia Mazzoni *“Post-earthquake Reconnaissance: a Structural Engineers Perspective*”

Discussion

Other Features

Tuesday (15:00-16:00) *“Cajon Pass EGA Collaboration Discussion*”

Wednesday (10:00-10:15) “*Demonstration of Temblor,” Ross Stein*

Wednesday (12:00-12:15) *Directors’ Closing Remarks*

Off-fault Deformations and Shallow Slip Deficit from Dynamic Rupture Simulations with Fault Zone Plasticity

Average of simulated displacement Displacement from aerial images