**Core Institutions and Board of Directors (BoD)**

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<th>Institution</th>
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<td>USC</td>
<td>Tom Jordan*</td>
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<td>Caltech</td>
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<td>Harvard</td>
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<td>Emily Brodsky</td>
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<td>USGS Pasadena</td>
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<td>Roland Bürgmann</td>
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<td>Judi Chester*</td>
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**Science Working Groups & Planning Committee (PC)**

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<th>Group</th>
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<tr>
<td>Seismology</td>
<td>Egill Hauksson*</td>
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<td>Tectonic Geodesy</td>
<td>Jessica Murray*</td>
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<td>EQ Geology</td>
<td>Lisa Grant Ludwig*</td>
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<td>Computational Sci</td>
<td>Yifeng Cui*</td>
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**Advisory Council (AC)**

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<td>Jeff Freymueller, Chair</td>
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<td>Gail Atkinson</td>
<td>Western Ontario</td>
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<td>Roger Bilham</td>
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<td>Donna Eberhart-Phillips</td>
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<td>Bob Littie</td>
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<td>Farzad Naeim</td>
<td>John A Martin</td>
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<td>John Vidale</td>
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<td>Andrew Whittaker</td>
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**Center Management**

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<td>Greg Beroza</td>
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<td>Associate Director</td>
<td>John McRaney</td>
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<td>Special Projects/Events</td>
<td>Tran Huynh</td>
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<td>Contracts &amp; Grants</td>
<td>Karen Young</td>
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<td>Deborah Gormley</td>
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<td>Fabio Silva</td>
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Welcome to the 2013 SCEC Annual Meeting!

Hard to believe, but we’re chugging at full steam through the second year of SCEC4! At this annual meeting, we’ll have a chance to share our recent research accomplishments with the full SCEC collaboration and discuss our plans for achieving our ambitious science goals.

The SCEC Science Planning Committee has configured a program that will keep you very busy during your stay in Palm Springs. Four half-day workshops will be held on Sunday. At 6pm that evening, Professor Thomas O’Rourke of Cornell University will kick off the main meeting as our Distinguished Speaker with a talk on “Earthquake Effects on Critical Infrastructure.”

Over the next three days, the agenda will feature keynote speakers on thought-provoking subjects, discussions of major science themes, poster sessions on research results, earthquake response exercises, technical demonstrations, education and outreach activities, and some lively social gatherings. The overall goal of the meeting is to assess the collaboration’s progress towards the five-year SCEC4 objectives.

Veterans of past SCEC meetings know that much of the action happens in the poster sessions. In a very popular change, brought back last year, posters will stay up for the entire meeting to allow more face-to-face interactions on the nitty-gritty aspects of SCEC scientific research. As always, we will be looking for ways to improve the meeting, so give us your comments on any and all aspects of the meeting.

We hope you enjoy the science, the meals, the good company, and the spectacular tectonic setting of Palm Springs!

Thomas H. Jordan, Director

Gregory C. Beroza, Deputy Director

Go to meeting website: www.scec.org/meetings/2013am

Cover Image

Comparison between measured and modeled postseismic deformation following the 2010, Mw 7.2, El Mayor-Cucapah earthquake. Black vectors and colored circles respectively show horizontal and vertical displacements accumulated over one year following the earthquake measured from GPS. Green vectors and background shading respectively show horizontal and vertical displacements predicted from the model. The model simulates viscoelastic relaxation in the asthenosphere, which is uncommonly shallow in the Salton Trough due to the onset of extension and lithospheric thinning, courtesy of Chris Rollins, Sylvain Barbot and Jean-Philippe Avouac (California Institute of Technology).
**AGENDA**

**Saturday, September 7**

16:00 - 19:00  SCEC Annual Meeting Pre-Registration Check-In at Hilton Lobby

**Sunday, September 8**

07:00 - 18:30  SCEC Annual Meeting Registration & Check-In at Hilton Lobby

07:00 - 08:00  Breakfast at Hilton Poolside

08:00 - 20:00  Poster Set-Up in Plaza Ballroom

08:00 - 12:00  **Workshop: SCEC Source Inversion Validation (SIV)**

Present results on benchmarks for the M7 normal-faulting ruptures, one of which is embedded in a 3D heterogeneous Earth model that leads to seismic scattering and hence uncertain Green’s functions. Design first benchmark exercise for teleseismic source modeling.

Conveners: P. Martin Mai (KAUST), Danijel Schorlemmer (GFZ), and Morgan Page (USGS)

Location: Horizon Ballroom I, Hilton Palm Springs

**Source Inversion Validation**

- **Input=Target**
- **Model Predictions**
- **Goodness of Fit**
- **Model Comparison**

08:00  Introduction & Workshop Goals (Martin Mai)

Current SIV benchmarks and results

08:15  Seismic Source Inversion and Back Projection (Yuji Yagi)

1. Introduction of uncertainty of Green’s Function into Waveform Inversion for Seismic Source Processes

2. Theoretical Relationship Between Back-Projection Imaging and Inverse Solutions

08:45  Toward Accounting for Prediction Uncertainty When Inferring Subsurface Fault Slip (Zacharie Duputel)

09:15  Uncertainty in Kinematic Rupture Models from Variation in Source time Function and Earth Structure (Hoby Razafindrakoto & Martin Mai)

09:30  Near Realtime Teleseismic and Geodetic Finite Fault Modeling at the NEIC (William Barnhart & Gavin Hayes)

09:45  High Resolution Finite Fault Modeling of the Largest Events (M>4.8) in the 2012 Brawley Swarm (Shengji Wei)

10:00  Group Discussion on Workshop Presentations

10:15  Break

10:30  Group Discussion

- Reconciling Back-Projection & Seismic Source Inversion
- Accounting for Uncertain Earth Structure in Source Inversion
- What Do We Learn from Near Real-Time Source Inversion?
- Defining the Next SIV Benchmark: Teleseismic Source Inversion

12:00  Adjourn
Sunday, September 8

08:00 - 12:00 Workshop: SCEC BroadBand Platform and Ground Motion Simulations – Recent Progress on Validation of Methods and Planning the Next Steps
Focus on the validation of methods for ground motion simulations and on the development of forward simulations for engineering applications, using methods implemented on the SCEC BroadBand Platform (BBP).

Conveners: Norm Abrahamson (PG&E) and Christine Goulet (PEER)
Location: Horizon Ballroom II, Hilton Palm Springs

08:00 Introduction (Norm Abrahamson)
08:15 Validation Exercise: Summary and Sample Results (Christine Goulet)
08:35 First Round Validation: Evaluation of Broadband Platform and Ground Motion Simulation Results (Doug Dreger)
09:05 Group Discussion: Parametrization, Improvement to Metrics, etc.
09:45 Break
10:00 Forward Simulations: Sample Preliminary Results and Issues Encountered (Katie Wooddell)
10:30 Group Discussion
10:45 Where to Go From Here? Priorities for Research and Development for the Next Few Years (Norm Abrahamson)
11:00 Group Discussion
12:00 Adjourn

12:00 - 13:00 Lunch at Hilton Palm Springs Terrace Restaurant and Poolside
**Sunday, September 8**

**13:00 - 17:00 Workshop: SCEC Earthquake Simulators**  
Review status of comparisons on two problems considered in the SCEC Collaborative Project on Comparison, Verification, and Validation of Earthquake Simulators: (1) jumping of ruptures from one fault to another, and (2) many-fault simulated earthquake histories based on the UCERF3 deformation model(s).

**Conveners:** Terry Tullis (Brown)  
**Location:** Horizon Ballroom I, Hilton Palm Springs

- **13:00** Welcome and Introduction: Purpose of Sixth Workshop
- **13:10** Discussion Topic 1: Jumping of rupture from one fault to another  
  - 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?  
  - What modifications represent the best approach to make them jump more realistic distances?  
  - What additional statistical comparison tools do we need for this problem?
- **14:00** Discussion Topic 2: Many-fault simulated earthquake histories based on the UCERF3 deformation models  
  - Settling on the best approach to assigning stress-drop values for all of the fault sections  
  - How many of the UCERF3 deformation models should be used as input?  
  - Explore the effect on the statistics of including a solution for encouraging fault-to-fault jumps in the UCERF3 simulations
- **14:45** Break
- **15:15** Discussion Topic 3: 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  
  - What is the best way to study this within SCEC?  
  - In particular, is a collaborative project and TAG as has existed for the past several years the best approach?  
  - If a TAG is the best approach, who will lead it?
- **17:00** Adjourn
Sunday, September 8

13:00 - 17:00  Workshop: SCEC Ground Motion Simulation Validation (GMSV) – Recent Progress and Future Plans
Review progress on the SCEC Software Environment for Integrated Seismic Modeling (SEISM) project and develop plans for future projects, such as those that will support the SCEC Committee for Utilization of Ground Motion Simulations (UGMS).
Convener: Nico Luco (USGS) and Sanaz Rezaeian (USGS)
Location: Horizon Ballroom II, Hilton Palm Springs

Ground Motions in Earthquake Engineering

13:00 Welcome & Overview of Various SCEC Validation Efforts (Tom Jordan)
13:05 Workshop Objectives and Agenda (Nico Luco)

GMSV TAG Efforts for SCEC SEISM Project
13:15 Focus of “GMSV-SEISM” Efforts (Nico Luco)
13:30 Validation for Engineering Analysis Using Simple and Robust Ground Motions Parameters (Lynne Burks, Jack Baker)
13:50 Validation for Building-Code Nonlinear Response History Analysis (Farzin Zareian, Peng Zhong, Iunio Iervolino)
14:10 Validation Approach for Application of Simulated Ground Motions to Duration-Sensitive Geotechnical Systems (Kioumars Afshari, Jonathan Stewart)
14:30 Discussion of “GMSV-SEISM” Efforts
14:55 Break

SCEC GMSV Technical Activity Group Projects
15:10 Overview of GMSV TAG Efforts Presented Elsewhere (Sanaz Rezaeian)
15:30 Validation of Earthquake Simulations and Their Effects on Tall Buildings Considering Spectral Shape and Duration (Ting Lin, Greg Deierlein)
15:45 Validation of Ground Motion Simulations for Seismic Slope Stability (Ellen Rathje)
16:00 Support of SCEC Committee for Utilization of Ground Motion Simulations (C.B. Crouse)
16:15 Discussion of Future GMSV TAG Efforts
17:00 Adjourn
### AGENDA

**Distinguished Speaker Presentation (Sunday 18:00)**  
Earthquake Effects on Critical Infrastructure, Tom O’Rourke (Cornell) – see p.10

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<tr>
<td>17:00 - 18:00</td>
<td>Annual Meeting Ice-Breaker in Hilton Lobby and Plaza Ballroom</td>
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<tr>
<td>18:00 - 19:00</td>
<td>Distinguished Speaker Presentation in Horizon Ballroom</td>
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<td>19:00 - 20:30</td>
<td>Welcome Dinner at Hilton Poolside</td>
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<td>19:00 - 21:00</td>
<td>SCEC Advisory Council Meeting in Tapestry Room</td>
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<td>21:00 - 22:30</td>
<td>Poster Session 1 in Plaza Ballroom</td>
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**Monday, September 9**

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<tr>
<td>07:00 - 08:00</td>
<td>SCEC Annual Meeting Registration &amp; Check-In at Hilton Lobby</td>
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<td>07:00 - 08:00</td>
<td>Breakfast at Hilton Poolside</td>
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| 08:00 - 11:00 | The State of SCEC  
*Location*: Horizon Ballroom, Hilton Palm Springs  
08:00 Welcome and State of the Center (Tom Jordan)  
08:30 Report from the National Science Foundation (Greg Anderson)  
08:45 Report from the U.S. Geological Survey (Bill Leith)  
09:00 Communication, Education, & Outreach (Mark Benthien)  
09:30 SCEC Science Accomplishments and Collaboration Plan (Greg Beroza)  
11:00 - 11:30 Break |                           |
| 11:30 - 13:00 | Stress Transfer from Plate Motion to Crustal Faults: Long-Term Fault Slip Rates  
*Moderator*: Kaj Johnson (Indiana)  
*Location*: Horizon Ballroom, Hilton Palm Springs |                           |
| 13:00 - 14:30 | Lunch at Hilton Restaurant, Tapestry Room, and Poolside                                          |                           |
| 14:30 - 16:00 | Stress-Mediated Fault Interactions and Earthquake Clustering: Evaluation of Mechanisms  
*Moderator*: Jeanne Hardebeck (USGS)  
*Location*: Horizon Ballroom, Hilton Palm Springs |                           |
| 16:00 – 17:30 | Poster Session 2 in Plaza Ballroom                                                               |                           |
| 19:00 - 21:00 | SCEC Honors Banquet                                                                             |                           |
| 21:00 - 22:30 | Poster Session 3 at Hilton Poolside                                                              |                           |

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**Tuesday, September 10**

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<td>07:00 - 08:00</td>
<td>Breakfast at Hilton Poolside</td>
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| 08:00 - 09:30 | Evolution of Fault Resistance During Seismic Slip: Scale-Appropriate Laws for Rupture Modeling  
*Moderator*: Eric Dunham (Stanford)  
*Location*: Horizon Ballroom, Hilton Palm Springs |                           |
| 09:30 - 11:00 | Structure and Evolution of Fault Zones and Systems: Relation to Earthquake Physics  
*Moderator*: Emily Brodsky (UCSC)  
*Location*: Horizon Ballroom, Hilton Palm Springs |                           |
| 11:00 - 11:30 | Break                                                                                           |                           |

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**Science Session 1 (Monday 11:30)**  
New paleoseismic data from SoSAFE: time dependency and rupture patterns on the San Andreas and San Jacinto Faults, Kate Schaar (USGS) – see p.10  
Beyond the Time-Independent Uniform California Earthquake Rupture Forecast: Where Should SCEC Go From Here? Bill Ellsworth (USGS) – see p.11

**Science Session 2 (Monday 14:30)**  
Recent Results from the Collaboratory for the Study of Earthquake Predictability (CSEP), Max Werner (Princeton) – see p.11  
Variable seismic response to fluid injection in central Oklahoma, Katie Keranen (Cornell) – see p.12

**Science Session 3 (Tuesday 08:00)**  
Insights into subduction thrust structure and mechanics from drilling the rupture zone of the 2011 Tohoku-oki earthquake, Fred Chester (Texas A&M) – p.12  
Uncovering the Mysteries of Tsunami Generation and Anomalous Seismic Radiation in the Shallow Subduction Zone, Shuo Ma (SDSU) – p.12

**Science Session 4 (Tuesday 09:30)**  
Back to the roots: Ductile shear zones below major faults, and stresses at the bottom of the seismogenic crust, Yuri Fialko (UCSD) – see p.13  
Biomarkers heat up during earthquakes: new evidence of seismic slip in the rock record, Heather Savage (LDEO) – see p.13
11:30 - 13:00  Causes and Effects of Transient Deformations: Slow Slip Events and Tectonic Tremor  
Moderator: Rowena Lohman (Cornell)  
Location: Horizon Ballroom, Hilton Palm Springs

13:00 - 14:30  Lunch at Hilton Restaurant, Tapestry Room, and Poolside

14:30 - 16:00  Seismic Wave Generation and Scattering: Prediction of Strong Ground Motions  
Moderator: Jean-Paul Ampuero (Caltech)  
Location: Horizon Ballroom, Hilton Palm Springs

16:00 - 17:30  Poster Session 4 in Plaza Ballroom
19:00 - 21:00  Dinner at Hilton Poolside
19:00 - 21:00  SCEC Advisory Council Meeting in Boardroom
21:00 - 22:30  Poster Session 5 in Plaza Ballroom

Wednesday, September 11

07:00 - 08:00  Poster Removal from Plaza Ballroom
07:00 - 08:00  Breakfast at Poolside

08:00 - 09:30  Earthquake Early Warning and Risk Communication  
Moderator: Lucy Jones (USGS)  
Location: Horizon Ballroom, Hilton Palm Springs

09:30 - 11:00  The Future of SCEC  
Location: Horizon Ballroom, Hilton Palm Springs  
09:30  2014 Science Collaboration Planning (Greg Beroza)  
10:30  Report from the SCEC Advisory Council (Jeff Freymueller)  
11:00  Adjourn

11:30 - 13:30  SCEC Planning Committee Lunch Meeting in Palm Canyon Room
11:30 - 13:30  SCEC Board of Directors Lunch Meeting in Tapestry Room

Science Session 5 (Tuesday 11:30)  
4D maps of fault aseismic slip obtained through multitemporal InSAR and time-dependent modeling, Manoochehr Shirzaei (ASU) – see p.14

Toward a Continuous Monitoring of the Horizontal Displacement Gradient Tensor Field using cGPS Observations from PBO, Bill Holt (SUNY Stony Brook) – see p.14

Science Session 6 (Tuesday 14:30)  
High-frequency rupture dynamics and ground motion prediction, Steve Day (SDSU) – see p.14

Using Ambient Noise Correlations for Studying Site Response, Victor Tsai (Caltech) – see p.15

Science Session 7 (Wednesday 08:00)  
Earthquake early warning: Now, or after the next big quake? Richard Allen (UC Berkeley) – see p.15

Setting the stage for early earthquake alerts and warnings, Ann Bostrom (U Washington) – see p.16
Distinguished Speaker Presentation  
Sunday

Earthquake Effects on Critical Infrastructure, Tom O’Rourke (Cornell)  
Sunday, September 8, 2013 (18:00)

The impact of the Canterbury Earthquake Sequence on the underground infrastructure in Christchurch, NZ is explored with the use of an extraordinary GIS data set covering the effects of both liquefaction-induced permanent ground deformation and transient ground motion for 3 different earthquakes. High resolution LiDAR and geospatial analyses of earthquake-affected utility systems are combined to develop relationships among lifeline damage and both lateral and vertical ground deformation. The earthquake relative performance of different types of pipelines is quantified, and lessons learned from Christchurch for Los Angeles and San Francisco, CA are discussed. To address the need for protection against rare, high consequence events with limited financial resources, a strategy for improving infrastructure resilience is proposed.

Tom O’Rourke is the Thomas R. Briggs Professor of Engineering in the School of Civil and Environmental Engineering at Cornell University. He is a member of the US National Academy of Engineering and a Fellow of American Association for the Advancement of Science. He received a number of distinctions for his research and teaching, some of which are ASTM C.A. Hogeentogler Award, ASCE Collingwood, Huber Research, C. Martin Duke, Stephen D. Bechter Pipeline Engineering, and Ralph B. Peck Awards, and the British ICE Trevithick Prize. He gave the 2009 Rankine Lecture. He served as President of the Earthquake Engineering Research Institute. He authored or co-authored over 350 technical publications. His research interests cover geotechnical engineering, earthquake engineering, underground construction technologies, engineering for large, geographically distributed systems, and geographic information technologies and database management. He served on many national advisory committees, including the NIST Advisory Committee for Earthquake Hazards Reduction, NAE Committee on New Orleans Regional Hurricane Protection Projects, and NSF Engineering Advisory Committee. He currently chairs the ATC 28 Technical Committee supported by NIST to develop national roadmap for lifelines research and implementation. He has served as chair or member of the consulting boards of many large civil construction projects, as well as the peer reviews for projects associated with highway, rapid transit, water supply, and energy distribution systems.

Plenary Talk Presentations  
Monday

New paleoseismic data from SoSAFE: time dependency and rupture patterns on the San Andreas and San Jacinto Faults, Katherine M. Scharer (USGS)  
Monday, September 9, 2013 (11:30)

The primary focus of the Southern San Andreas Fault Evaluation (SoSAFE) project is to improve the catalogue of ground-rupturing earthquakes on the San Andreas and San Jacinto faults over the last 2000 years. New geologic data from several teams provide exciting constraints on the behavior of these faults, calling into question existing models and revealing differences in the activity of the faults. On the southern San Andreas fault, there are consistent patterns in paleoearthquake records: (1) the average interval between large earthquakes is similar for proximal paleoseismic sites along the fault, although the interval length generally increases to the southeast; and (2) at most sites, ruptures are quasi-periodic and are slightly more consistent with time-dependent behavior, especially when longer records are evaluated. Correlation of records along the southern San Andreas fault reveals intriguing trends that appear to vary by section: the Carrizo and Big Bend sections have very similar records since ca. 1300 AD, but these differ significantly from the southern end of the Mojave section. Recent excavations on the San Gorgonio Pass fault zone do little to untie the San Gorgonio knot, as ruptures there are far less common than earthquakes on either side, suggesting complex and infrequent rupture patterns through the Pass are the norm. On the San Jacinto fault, new, long paleoseismic records show little time-dependent behavior, and the mismatch in rupture timing on the Clark and Claremont strands suggests that many ruptures do not extend along its entire length. Taken together, the extant data may indicate that by a factor of about three, 200-300-km long ruptures are more common than >300-km, “1857-type” ruptures on the San Andreas fault and <100 km long ruptures are more common than full fault ruptures on the San Jacinto fault. Validation of these conclusions is needed, and can be achieved by the development of high-resolution records between existing sites. Additional insight can be gained from short term slip rates and geomorphic records of slip, especially where the latter can be paired with geochronologic control.

Beyond the Time-Independent Uniform California Earthquake Rupture Forecast: Where Should SCEC Go From Here? William L. Ellsworth (USGS)  
Monday, September 9, 2013 (12:15)
The time-independent Uniform California Earthquake Rupture Forecast, Version 3 (UCERF3) represents a major accomplishment of the SCEC community. The UCERF3 forecast integrates our current understanding of the geology, geodesy and geophysics of the San Andreas Fault system into a comprehensive, system-level framework that will guide public policy and earthquake risk reduction activities for years to come. This was truly a center-wide effort, with well over 100 members of the community actively involved in the research, development, implementation, testing, and review of everything from the numerous component parts (20 appendices for starters) to the hazard implied by the model. As with any successful study of this magnitude, it exposed gaps in our understanding of how both earthquakes and fault systems work, uncovered conflicts between fundamental data sets that describe the system, revealed needs for more and better empirical measurements, and underscored the value of theoretical advances for improving our models. In short, there is much important science yet to be done. In this talk, I will highlight some of the key issues identified by the Scientific Review Panel for UCERF3 through its review meetings, project workshops and outreach activities to the broader community of earthquake professionals. Many of these questions and new directions are also shared by members of the Working Group. A sample of frequently mentioned issues includes:

- Will the UCERF3 model pass a Regional Earthquake Likelihood Model test?
- Does the Grand Inversion span the epistemic uncertainty in hazard?
- Are fault-to-fault jumps as prevalent in nature as modeled in UCERF3?
- The Grand Inversion represents a big step forward – but solutions to the equation set are highly non-unique. Can solutions be more tightly constrained?
- Initial attempts to solve the Grand Inversion with individual faults obeying Gutenberg-Richter statistics failed. Are G-R models possible?
- The discrepancies between geologic and geodetic deformation models must be telling us something important about the loading of the fault system. What is it?
- Scaling laws play a central role in UCERF3. Can we replace them with physics-based models?
- Many see physics-based fault simulators as the future. When will we be ready to move them from research tools to instruments of public policy?

Recent Results from the Collaboratory for the Study of Earthquake Predictability (CSEP), Maximilian J. Werner (Princeton)
Monday, September 9, 2013 (14:30)

The Collaboratory for the Study of Earthquake Predictability (CSEP, www.cseptesting.org) provides a research infrastructure for the prospective, automated and independent assessment of earthquake forecasts and predictions in a variety of tectonic settings and on a global scale. The first testing center, the W.M. Keck Testing Center at SCEC, was launched in 2007 to conduct the first ever prospective and comparative earthquake forecasting experiment: the Regional Earthquake Likelihood Models (RELM) experiment, conceived by the USGS and SCEC to create and assess a suite of five-year earthquake forecasts for California. Since then, three more testing centers have been established in New Zealand, Europe, and Japan, and more are in development. Collectively, these centers are evaluating over 350 forecast models that are based on a wide variety of hypotheses about where, when and why earthquakes occur. In this presentation, I will review recent achievements of the global CSEP community and highlight recent results from California and from around the globe.

I will begin with results from the completed RELM experiment, which has led to important advances in our understanding of how intermediate-term probabilistic forecasts should be specified and assessed. RELM results are also being utilized to refine seismic hazard estimates in the most recent version 3 of the Uniform California Earthquake Rupture Forecast (UCERF). Meanwhile, CSEP’s short-term predictability program is gaining insights into tracking and forecasting earthquake cascades, such as the 2010 Canterbury and the 2011 Tohoku sequences. The greater predictability of earthquakes during such periods appears ripe for use in Operational Earthquake Forecasting (OEF), and CSEP is increasing efforts to support OEF by government agencies by independently assessing the performance of candidate OEF models. Other ongoing CSEP activities I will present include developing capabilities to import and evaluate external forecasts and predictions that are produced outside of CSEP’s cyber-infrastructure. Prototype experiments include seismicity-based algorithms such as the well-known M8 predictions, as well as predictions based on electromagnetic precursors. I will conclude with future opportunities and challenges in the study of earthquake predictability.

Variable seismic response to fluid injection in central Oklahoma, Katie M. Keranen (Cornell), Heather Savage (LDEO), Geoffrey Abers (LDEO), & Nicholas van der Elst (LDEO)
Monday, September 9, 2013 (15:15)
Seismicity within the past 5 years in Oklahoma has been concentrated in a region of historically low seismicity, in the central portion of the state near the towns of Jones, Prague, and Luther. From 2009-2013, ~75% of earthquakes from the Oklahoma Geological Survey catalog occurred in this central region (3035 earthquakes), including the largest earthquake recorded in Oklahoma and the largest anywhere potentially related to wastewater disposal, an Mw5.7 in November 2011 near Prague, OK. Precise relocations of aftershocks show that the tip of the initial rupture plane near Prague is within ~200 m of active injection wells and within ~1 km of the surface; 30% of early aftershocks occur within the sedimentary section. Importantly, the Prague region showed enhanced remote triggering following the Mw8.8 Chile earthquake in 2010 – a phenomenon also observed at other sites of induced seismicity in the Midwest in 2010 and 2011. This enhanced triggering provides additional evidence that fluid pressures were nearing critical levels as the volume of injected fluid increased after 18 years of injection. We interpret that the net fluid volume increase near Prague lowered effective stress on reservoir-bounding faults. Near Jones and Luther, OK, earthquakes began soon after the onset of injection; near Jones the earthquakes delineate multiple subparallel faults updip of high-volume wastewater disposal wells while near Luther the earthquakes define a primary fault plane. There are commonalities in the methods used for petroleum extraction from carbonate reservoirs in central Oklahoma, involving the production of high water volumes, which speculatively may explain the abundance of induced earthquakes recorded here. The differences in the timing of the Prague, Jones, and Luther sequences with respect to injection, and in the spatial distribution of seismicity, highlight the variability in seismic responses to fluid injection and deviations from historically important case studies.

**Uncovering the Mysteries of Tsunami Generation and Anomalous Seismic Radiation in the Shallow Subduction Zone, Shuo Ma (SDSU)**

**Tuesday, September 10, 2013 (08:45)**

The Japan Trench convergent margin produces frequent large interplate earthquakes greater than M7.5, and is known to display the primary characteristics of non-accretionary margins. The 2011 Mw 9.0 Tohoku-oki earthquake demonstrates the capability of this margin to rupture the full extent of the seismogenic zone and updip to the trench axis in a single great event. A variety of observations indicate that the slip magnitude of this rupture increased towards the trench, with 50+ m of slip occurring at the ~20-km-wide frontal prism of accreted sediments and lower trench slope. The Integrated Ocean Drilling Program expedition 343/343T (JFAST) was designed to address fundamental questions of earthquake physics through rapid-response drilling. The JFAST drill site is located 6 km landward from the trench axis; three boreholes were drilled through the prism and across the plate-boundary. Data from seismic surveys, logging while drilling, and lithologic and structural observations of core samples document a single dominant decollement that accommodated almost all of the interplate displacement (~3.2 km) at the drill site. The decollement is located in sheared pelagic clay near the base of the incoming sediment section of the subducting plate. The localization of interplate displacement to a single narrow layer of scaly clay and to surfaces within the clay indicate the decollement is relatively weak over geologic time. Borehole measurements of temperature across the plate boundary confirm the Tohoku earthquake ruptured the decollement and, consistent with results of high-speed friction experiments on sheared clay, that the decollement is extremely weak during seismic slip. These results, combined with borehole data indicating that the current in situ stress is approximately lithostatic, support the hypothesis that dynamic weakening of wet clay at seismic slip rates favor earthquake rupture propagation to shallow depths even though the frictional properties of wet clay at low slip rates prohibit the nucleation of slip instabilities. Ongoing analysis of JFAST borehole data combined with microstructural and experimental studies of recovered core samples will contribute to a more complete understanding of the frictional behavior and the physical mechanisms associated with dynamic weakening needed to advance models of earthquake rupture along subduction thrusts.

**Plenary Talk Presentations**

**Tuesday, September 10, 2013 (08:00)**

**Insights into subduction thrust structure and mechanics from drilling the rupture zone of the 2011 Tohoku-oki earthquake, Frederick M. Chester (Texas A&M)**

The Japan Trench convergent margin produces frequent large interplate earthquakes greater than M7.5, and is known to display the primary characteristics of non-accretionary margins. The 2011 Mw 9.0 Tohoku-oki earthquake demonstrates the capability of this margin to rupture the full extent of the seismogenic zone and updip to the trench axis in a single great event. A variety of observations indicate that the slip magnitude of this rupture increased towards the trench, with 50+ m of slip occurring at the ~20-km-wide frontal prism of accreted sediments and lower trench slope. The Integrated Ocean Drilling Program expedition 343/343T (JFAST) was designed to address fundamental questions of earthquake physics through rapid-response drilling. The JFAST drill site is located 6 km landward from the trench axis; three boreholes were drilled through the prism and across the plate-boundary. Data from seismic surveys, logging while drilling, and lithologic and structural observations of core samples document a single dominant decollement that accommodated almost all of the interplate displacement (~3.2 km) at the drill site. The decollement is located in sheared pelagic clay near the base of the incoming sediment section of the subducting plate. The localization of interplate displacement to a single narrow layer of scaly clay and to surfaces within the clay indicate the decollement is relatively weak over geologic time. Borehole measurements of temperature across the plate boundary confirm the Tohoku earthquake ruptured the decollement and, consistent with results of high-speed friction experiments on sheared clay, that the decollement is extremely weak during seismic slip. These results, combined with borehole data indicating that the current in situ stress is approximately lithostatic, support the hypothesis that dynamic weakening of wet clay at seismic slip rates favor earthquake rupture propagation to shallow depths even though the frictional properties of wet clay at low slip rates prohibit the nucleation of slip instabilities. Ongoing analysis of JFAST borehole data combined with microstructural and experimental studies of recovered core samples will contribute to a more complete understanding of the frictional behavior and the physical mechanisms associated with dynamic weakening needed to advance models of earthquake rupture along subduction thrusts.
Motivated by the critical taper theory for accretionary wedges (e.g., Davis et al., 1983; Dahlen, 1990), I will show that for a wedge on the verge of failure, pore pressure increase due to updip rupture causes extensive Coulomb failure within the wedge, which gives rise to slow rupture velocity and significant seafloor uplift landward from the trench (Ma, 2012; Ma and Hirakawa, 2013). During the rupture propagation the large inelastic seafloor uplift strongly dilates the shallow-dipping basal fault behind the rupture front, greatly enhanced by the presence of free surface. The dilation reduces the effective normal stress and sliding friction on the fault, and increases the dynamic stress drop and slip velocity, such that slip-velocity time histories in the shallow section of the fault tend to have a “snail-like” shape, leading to a smooth source time function and depletion of high frequencies in seismic radiation. I will also show that the failure in the wedge acts as a large energy sink (while contributing to seismic moment), giving rise to distributed heat generation (i.e., small heat flow anomaly across the fault), low moment-scaled radiated energy and small rupture directivity, which thus provides a unifying interpretation for nearly all anomalous observations documented for shallow subduction earthquakes. Finally I will discuss possible implications of a critically stressed crust for the dynamics of fault system in southern California.

**Back to the roots: Ductile shear zones below major faults, and stresses at the bottom of the seismogenic crust**, Yuri Fialko (UCSD)

**Tuesday, September 10, 2013 (09:30)**

The degree to which strain is localized in the ductile part of the lithosphere below seismogenic faults is an outstanding issue in continental tectonics. Two classes of models have been proposed: one postulating a broadly distributed viscous deformation in the lower crust and upper mantle (the “thin lithosphere” model), and another one postulating localized shear well below the brittle-ductile transition (the “thick lithosphere” model). Understanding the mechanics of lithospheric shear zones is essential for a number of problems, including the long-term strength of the Earth’s crust and upper mantle, stress transfer from the relative plate motion to seismogenic faults, and, ultimately, seismic hazards. We investigate the evolution of stress and strain in a ductile substrate driven by far-field plate motion and fault slip. Numerical models that incorporate laboratory-derived power-law rheologies with Arrhenius temperature dependence, viscous dissipation, and conductive heat transfer give rise to the long-lived fault “roots” that localize deformation below the brittle-ductile transition. Strain localization in the viscoelastic medium in this case results from thermomechanical coupling and power law dependence of strain rate on stress. For conditions corresponding to the San Jacinto and San Andreas Faults in Southern California, the predicted width of the shear zone in the lower crust is a few kilometers; this shear zone takes up more than 50% of the far-field plate motion. Deviatoric stress in the lithosphere in our models is relatively insensitive to the water content, the far-field loading rate, and the fault strength, and is of the order of 100 MPa. Furthermore, stress in the lithosphere is found to inversely correlate with the velocity of relative plate motion. We also find that the thermally-activated shear zones have little effect on postseismic transients. It follows that additional (to thermomechanical coupling) mechanisms of strain localization are required for a viscoelastic model to produce a vertical deformation pattern similar to that due to afterslip on a deep extension of a fault. Possible candidates include dynamic grain recrystallization, and fabric development (mylonitization). Realistic models of long-term deformation informed by the experimentally determined ductile properties of rocks may provide useful constraints on the magnitude of deviatoric stress at the bottom of the seismogenic layer (the nucleation zone of large earthquakes).

**Biomarkers heat up during earthquakes: new evidence of seismic slip in the rock record**, Heather M. Savage (LDEO), Pratigya J. Polissar (LDEO), Rachel E. Sheppard (LDEO), Hannah S. Rabinowitz (Columbia), Christie D. Rowe (McGill), James D. Kirkpatrick (Colorado State), and Emily E. Brodsky (UCSC)

**Tuesday, September 10, 2013 (10:15)**

Evidence of earthquake slip in fault zones has proven somewhat elusive in the rock record. Here we describe a new method that uses the thermal maturity of biomarkers to identify and measure the temperature rise on faults caused by frictional sliding at earthquake slip rates. We have applied our method to several faults, including Pasagshak Point megathrust, AK; Japan Trench at the site of IODP Exp.343 JFAST; and Punchbowl Fault, CA. The Pasagshak Point megathrust hosts large pseudotachylytes (frictional melts), making it the ideal place to test the concept that biomarkers react on earthquake timescales. We find that biomarkers within the pseudotachylyte are the most thermally mature, and that thermal maturity decays rapidly away from pseudotachylyte strands. These results show that biomarkers do record the frictional heating that occurred during earthquakes. Other faults, which do not show evidence of frictional heating and organic maturation, may be sites where coseismic temperature rise was low. In addition to our field studies, we conducted rapid heating experiments to establish the kinetic reaction rates of different biomarkers,
in order to place constraints on temperature rise. Our results have allowed us to estimate, in various cases, frictional work, maximum fault slip and friction during sliding.

**4D maps of fault aseismic slip obtained through multitemporal InSAR and time-dependent modeling. Manoochehr Shirzaei (ASU)**

**Tuesday, September 10, 2013 (11:30)**

Studies of large-scale, time-dependent fault slip have been limited, due to the sparse distribution and frequency of deformation measurements. InSAR observations have been an important addition for nearly two decades. The continually growing SAR data set allows detecting more subtle and longer-term variations from the secular deformation rates. Time-variable slip affects hazard estimates in three ways; 1) it changes the estimate of a fault’s slip budget, 2) it introduces changes in stress rate on individual fault segments that could have consequences for earthquake timing, and 3) characterizing the kinematics of time variable fault slip leads to better constraints on earth structure and fault frictional parameters. Here, I present new advances in the field of InSAR time series including, multitemporal single- and multi-track InSAR as well as multi-sensor-multitemporal InSAR. These new algorithms allows resolving the high precision time series of the surface deformation using data acquired from a single track or two overlapping tracks of same satellite or multiple ascending and descending tracks of different satellites. Wavelet transforms are the main component of these algorithms for pixel selection and filtering. Through a time-dependent inversion scheme and in combination with GPS and repeating earthquakes, the InSAR deformation time series is used to obtain the 4D map of the creep on the Hayward fault. This map includes a zone of high slip deficit that may represent the locked rupture asperity of past and future M=7 earthquakes. It also comprises the source areas of the February 1996 and July 2007 slow-slip events. Moreover, the map identifies several additional temporal variations in creep rate along the Hayward fault, the most important one being a zone of accelerating slip just to the northwest of the major locked zone. The fault creep imparts stress on the major locked zone at a rate of ~0.003 MPa/yr in addition to the background loading rates. Using this map I estimate that slip-rate deficit equivalent to Mw 6.3-6.8 has accumulated on the fault, since the last event in 1868. The probability of major earthquakes can be affected by the imparted stress from the recent earthquakes and the fault creep transients. I estimate that the 1-day probability of a large event on the Hayward increased by up to 50% due to the July 2007 south Oakland event (Mw4.2), highlighting the importance of short-term probability changes due to transient stress changes.

**Toward a Continuous Monitoring of the Horizontal Displacement Gradient Tensor Field using cGPS Observations from PBO. William E. Holt (SUNY Stony Brook) and Gina Shcherbenko (SUNY Stony Brook)**

**Tuesday, September 10, 2013 (12:15)**

We have developed a cGPS network-processing tool for detection of anomalous strain transients within the Plate Boundary Observatory network in southern California. Position estimates from cGPS are interpolated (through a joint inversion of strains and position estimates) to provide a model solution for the horizontal displacement gradient tensor field as a function of time. Regularization of the solution is achieved by adjusting a single isotropic strain variance parameter until the reduced chi-squared misfit between model and observed displacement approaches 1.0. Additional constraints are provided by a priori information on fault style and orientation, along with the application of Pacific-North America displacement boundary conditions. A geodetic reference solution is subtracted from the epoch solution and the significance of residual strains is tested using a t-statistic. Tests using synthetic cGPS observations, generated in the SCEC IV Transient Detection Exercise, show that anomalous strains associated with slow-slip over 6-8 week time frames, totaling less than 1 cm, can be detected with high confidence (assuming uncertainties in daily positions estimates of ± 3 mm). Analysis of PBO cGPS time series since July 2010 shows a complex field of significant anomalous strain within southern California primarily associated with post-seismic processes. Interesting and characteristic patterns of anomalous crustal strain, generated during the ETS slow slip events, have also been quantified for the different sections of the Cascadia subduction zone.

**High-frequency rupture dynamics and ground motion prediction. Steven M. Day (SDSU)**

**Tuesday, September 10, 2013 (14:30)**

Empirical ground motion prediction is a relatively mature science and may in some respects be subject to diminishing returns. This situation has given impetus to the development and application ground motion simulation methods to address outstanding generic ground motion issues as well as site-specific issues. Simulations based on simplified wave propagation models and kinematically specified sources contain tuning parameters that can be calibrated to shape the ground motion spectrum to match observations, but these parameters frequently do not have a well-established physical interpretation. Thus, these methods have the advantage that they directly encode
observational information, but the disadvantage that they provide minimal physical basis from which to extrapolate beyond the data to which they have been calibrated. On the other hand, dynamic rupture models start from well-defined physical models, but until recently have lacked the model complexity and resolution required to test their validity through meaningful comparisons with strong motion data at frequencies beyond about 1 Hz.

However, it is now possible to simulate dynamic rupture and ground motion for large (M > 7) earthquakes, in 3D, while resolving frequencies up to greater than 10 Hz, over source-receiver distances of several tens of kilometers. This capability permits ground motion from rupture simulations to be tested quantitatively against strong motion observations over much of the frequency and distance range of engineering interest. Simulations (e.g., Dunham et al., 2011; Shi and Day, 2013) suggest that the departure of natural fault surfaces from planarity, i.e., fault roughness, is an essential element in the generation of high-frequency ground motion. Rupture models that incorporate power-law roughness, even though very oversimplified in other respects (notably the initial stress state) predict ground motion with many of the qualitative features of recorded ground motion. Synthetic spectral accelerations from such simulations in 3D, once averaged to remove random site and path variations, show a remarkable degree of quantitative agreement with the corresponding spectral averages from recorded strong motion data. These results are promising, but preliminary and still of limited scope, and I will discuss some of the more notable limitations, as well as some possible pathways for future research.

**Using Ambient Noise Correlations for Studying Site Response**, Victor C. Tsai (Caltech), Fan-Chi Lin (Caltech), and Daniel C. Bowden (Caltech)

**Tuesday, September 10, 2013 (15:15)**

Over the last decade, there has been an explosion in the number of studies using ambient noise cross correlations to perform surface-wave travel-time tomography. However, there have only been a limited number of successful applications using ambient noise correlation amplitudes, partly due to the difficulty in interpreting these amplitudes given realistic distributions of ambient noise. Here, we discuss two complementary methods we are developing to overcome some of these issues and which allow us to use noise correlation amplitudes to constrain site response.

The first method is an extension of the array-based Helmholtz wavefield estimator to analyze surface-wave amplitudes. With this new method, spatial differential operators are applied to surface-wave travel-time and amplitude maps to account for focusing effects and directly estimate the site response at each station. Theoretical considerations show that the method works for an arbitrary incoming wavefield and is not affected by noise field directionality. However, the method still assumes that noise sources within the array are weak, and can potentially also be biased by small-scale scattering. Applying the method to noise measured by southern California arrays, including the densely spaced 5000-component Long Beach array, leads to promising results.

The second method is an extension of the classical horizontal-to-vertical (H/V) ratio method to multi-station cross correlations. The classical method uses a single station’s ambient-noise H/V spectral ratio to estimate the local site structure. While it has been successfully applied in many studies, there remain questions about how to best interpret these H/V observations. In contrast, cross-correlation H/V measurements have a straightforward interpretation in terms of Rayleigh-wave ellipticity. Correlation H/V ratios have the added benefit that multiple measurements can be made by varying the second station, leading to more robust estimates and the ability to constrain azimuthal variations of site response. The approach also has the nice feature that each station’s noise data can be normalized independently without affecting the H/V measurement whereas other amplitude-based correlation methods are highly affected by station normalization. Application to low-frequency (8-30 second) USArray data suggests that the method works as expected.

**Plenary Talk Presentation**

**Wednesday**

**Earthquake early warning: Now, or after the next big quake?** Richard M. Allen (UC Berkeley)

**Wednesday, September 11, 2013 (08:00)**

The science and technology behind earthquake early warning has developed rapidly over the last 5 years. The 2011 M9 Tohoku-Oki earthquake was the first major test of Japan’s public alert system. Alerts were issued successfully in the epicentral region, but the extent of the source was not recognized, resulting in the warnings not being as widespread as they should have been. In California we now have a demonstration system delivering alerts to test users, and this system is currently being extended to the Pacific Northwest. Research is also underway to better characterize large earthquake ruptures--using seismic and geodetic observation networks--and integrate this information into existing point-source systems. Test users are receiving alerts and developing protocols for taking actions. Some responses have already been automated, including stopping the
BART trains in the Bay Area. Legislative activity in Sacramento and Washington DC is also moving us closer to funding a public warning system. In this talk I will summarize the status of this community effort, and argue that the implementation of a public early warning system is now inevitable. The only question is whether there will be the political will to do this before, or immediately following the next big earthquake.

Setting the stage for early earthquake alerts and warnings, Ann Bostrom (U Washington) and John Vidale (U Washington)

Wednesday, September 11, 2013 (08:45)

Early earthquake warning (EEW) systems hold great promise. The few EEW systems deployed around the world have helped prevent and mitigate damage from earthquakes. While the technologies to detect threats, their reliability, and the length of time needed to achieve accuracy in forecasts and predictions in EEW are important factors in achieving this, equally important are how EEW rely on human mediation; channels for issuing warnings; familiarity and institutionalization of warning procedure; settings in which systems are used; and system goals and objectives. In other words, how early earthquake alerts and warnings are interpreted and what actions people take in response to them depend on cognitive, emotive, social and institutional contexts, as well as on their natural and built environment. A key lesson from prior research on hazard warnings is that people need actionable information on what to do, not just that there is a threat. With seconds to minutes of lead time, accomplishing this will require setting the stage for action by working with communities and institutions to develop goals, procedures, and expectations.
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002 A Potential Paleotsunami Shell-Hash layer from the Los Penasquitos Marsh, San Diego County, California, Jeremy Cordova, Brady Rhodes, Matt Kirby, Nicole Bonuso, and Robert Leeper

003 Does Evidence of Abrupt Coseismic Subsidence and Tsunami During the Late Holocene Exist in Seal Beach Marsh Stratigraphy? Robert J. Leeper, Brady P. Rhodes, Matthew E. Kirby, Katherine M. Scharer, D’Lisa O. Creager, and Dylan J. Garcia

004 Paleotsunami Research at the Seal Beach Wetlands, Seal Beach, California, Disco O. Creager, Brady P. Rhodes, Matthew E. Kirby, and Robert J. Leeper


006 Holocene folding deformation associated with large uplift events on the Ventura Avenue Anticline, Gulsen Ucaruskus, Neal Driscoll, Daniel Brothers, Graham Kent, and Thomas Rockwell

007 Late-Quaternary evolution of the eastern Sierra Madre Fault Zone in the San Gabriel Valley, southern California, Jerome A. Treiman

008 The Agua Tibia-Earthquake Valley Fault Zone: reorganization of tectonic slip between the northern Elsinore and southern San Jacinto fault zones, Erik M. Gordon, Thomas K. Rockwell, and Gary H. Girty

009 Pleistocene offset and constraints on the South Bristol Mountains Fault, eastern Mojave Desert, Janet C. Harvey and Joann Stock

010 New investigations of the October 1999 Hector Mine Earthquake surface rupture, Frank J. Sousa, Janet C. Harvey, Ken W. Hudnut, Sinan O. Akciz, and Joann M. Stock

011 Assessing the variability in strain accumulation and release through time along the Central Garlock fault: results from a new late Holocene slip rate, Lee M. McAuliffe, James F. Dolan, Ed Rhodes, and Sally F. McGill

012 New structures from the southern tip of the San Andreas fault zone near Durum Hill, Susanne U. Janecke and Daniel Markowski

013 Evolution of the Puente Hills Thrust Fault, Kristian J. Bergen, John H. Shaw, and James F. Dolan

014 Scarp degradation of the 2010 El Mayor-Cucapah surface rupture captured by annual t-lidar surveys, Austin J. Elliott, Michael E. Oskin, Peter O. Gold, Alejandro Hinojosa-Corona, Richard Styrön, and Michael H. Taylor

015 Rapid, decimeter-resolution fault zone topography from Structure-from-Motion (SIM), Kendra Johnson, Edwin Nissen, J. Ramon Arrowsmith, Srikanth Saripalli, Patrick McGarey, Katherine Scharer, and Patrick Williams

016 How well do surface offsets represent earthquake slip at depth? David E. Haddad, Olaf Zielke, and Ramon Arrowsmith

017 Tectonic geomorphology of the San Timoteo Badlands: New insights from OSL and LiDAR data, Cary S. Wicker

018 Origins of Variability in Fault-Rupture Slip Measurements: Comparison of Field Observations to Airborne, Differential, and Terrestrial LiDAR from the 2010 El Mayor-Cucapah Earthquake, Michael Oskin, Jaime Delano, Divya Banesh, Alejandro Hinojosa, Craig Glennie, and Austin Elliott

Cosmogenic exposure dating of paleo-rockfall deposits, Chrstchurch, New Zealand, Ben H. Mackey and Mark C. Quigley

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Organic thermal maturity as a proxy for frictional fault heating: experimental constraints on biomarker kinetics at earthquake timescales, Rachel E. Sheppard, Pratigya J. Polissar, and Heather M. Savage

Rheological controls on the seismicity and fault zone structure of oceanic transform faults, Arjun H. Kohli, Jessica M. Warren, and Mark Zimmerman

Textural recognition of shallow pulverization of sandstone in the damage zone along the San Jacinto fault, southern California, Joe Whearty, Thomas Rockwell, and Gary Girty

The Importance of Glacial-Isostatic Adjustment in Determining Rates of Crustal Deformation along the Pacific Coast of the USA and Mexico, Alexander R. Simms and Kurt Lambeck

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026 Refining the South-Central San Andreas Fault Slip Rate at the 6 ka Timescale: Phelan Creeks, James B. Salisbury, Emily Kleber, Sinan Akciz, Ramon Arrowsmith, Gayatri Marliyani, Lisa Grant Ludwig, and Daniel Halford

027 Mobile Laser Scanning for Earthquake Studies and Rapid Response, Benjamin A. Brooks, Ken Hudnut, Sinan Akciz, Katherine M. Scharer, Jaime Delano, Craig Glennie, Darren Hauser, Carol Prentice and Stephen DeLong

028 Paleoequation evidence at the Elizabeth Lake paleoseismic site, Mojave section of the San Andreas fault, California, Sean P. Bemis, Kate Scharer, James Dolan, Alexandra Hatem, Chris Milliner, Ann Hislop, Corey Burkett, Mary Barr and Ryan Witkosky

029 Implications for San Andreas fault ruptures based on new evidence from the Cabazon, CA paleoseismic site, San Gorgonio Pass Fault Zone, Katherine Scharer, Doug Yule, Lisa Wolff, and Ryan Witkosky

030 Evidence for five paleoearthquakes on the San Gorgonio Pass Fault Zone in the last 6000 years, Lisa R. Wolff, Doug Yule, Katherine Scharer, Ryan Witkosky, Ian Desjarlais, and Brittany Huerta

031 Paleoearthquakes and slip rate of the Garnet Hill Fault at Whitewater Hill, Jose E. Cardona

032 New geological slip rate estimates for the Mission Creek strand of the San Andreas fault zone, Kimberly D. Blisniuk, Katherine Scharer, Warren D. Sharp, Roland Bürgmann, Michael J. Rymer, and Patrick Williams

033 The interplay of fault geometry and uplift in the Coachella Valley and Mecca Hills, Laura A. Fattaruso, Michele L. Cooke, and Rebecca J. Dorsey

034 A High Resolution Lake Cahuilla Chronology to Constrain Earthquakes on the Southern San Andreas System, Erik Haaker, Nicholas Weldon, Ray Weldon, and Thomas Rockwell

035 Shallow velocity structure in the Imperial Valley region of Southern California, Yiran Ma, Joann M. Stock, John A. Hole, and Gary S. Fuis

036 Cascading Disaster Assessment for the ShakeOut Earthquake Scenario, Erin R. Burkett

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037 Vital Signs of the Planet: Southern California Educators Contribute to Crustal Deformation Studies Within San Bernardino and Riverside Counties, Mark Kline, Sally McGill, Mark Swift, Alfonso Barrientos, Sandy Calonge, Helen Connal-Bonner, Robert de Groot, Rhonda Fuller, Adrian Gamez, Paul Gonzales, Kristen Holland, Dan Keck, Guadalupe Rowley, Bernadette Vargas, Jerry Young, Joshua Spinler, Rick Bennett, Mike Floyd and Gareth Funning

038 NSF-PRISM Scholars Use GPS to Investigate Fault Slip Rates in Southern California, Lowell Andrew R. Iporac, Isabella Benitez, Karmina Diaz, Marlene Noriega, Vanessa Vega, Sally McGill, Joshua Spinler and Rick Bennett

039 Using GPS to Investigate Slip Rates on Faults along the Plate Boundary near San Bernardino, CA, Walter W. Nelson, Sally F. McGill, Joshua C. Spinler, Rick A. Bennett, Michael Floyd, and Gareth J. Funning

040 Results from the San Bernardino Mountains GPS network: velocities of sites in the vicinity of the San Andreas fault in Southern California, Barry Chew, Sally McGill, Josh Spinler, Rick Bennett, Mike Floyd, and Gareth Funning

041 Status of GPS Network Operations at USGS Pasadena, Daniel N. Determan, Aris G. Aspiotes, Ken W. Hudnut, Nancy E. King, and Keith F. Stark

042 Does the slip rate of the San Jacinto fault vary along strike? Constraints from campaign GPS data, John P. Conrad and Gareth J. Funning

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044 GPS as a high resolution technique for evaluating water resources available to California, Donald F. Argus, Yuning Fu, and Felix W. Landerer

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046 Image Southern California crustal deformation from InSAR time series analysis, Zhen Liu, Paul Lundgren, and Zheng-Kang Shen

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053 Strain-Rate Changes Triggered by Local and Regional Earthquakes? Strainmeter Observations in the Anza Section of the San Jacinto Fault, Duncan C. Agnew, Frank K. Wyatt, Billy Hatfield, and Kathleen Hodgkinson

054 Modeling strains associated with fluid extraction, Andrew J. Barbour, Duncan C. Agnew, and Frank K. Wyatt

055 Fault coupling and potential for earthquakes on the creeping section of the Central San Andreas Fault, Jeremy L. Maurer, Kai Johnson, and Paul Segall

056 Is there a discrepancy between geological and geodetic slip rates along the San Andreas Fault System? Xiaopeng Tong, Bridget Smith-Konter, and David Sandwell


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The Southern California Earthquake Center (SCEC) is an institutionally based organization that recognizes both core institutions, which make a major, sustained commitment to SCEC objectives, and a larger number of participating institutions, which are self-nominated through the involvement of individual scientists or groups in SCEC activities and confirmed by the Board of Directors. Membership continues to evolve because SCEC is an open consortium, available to any individual or institution seeking to collaborate on earthquake science in Southern California.

Core Institutions and Representatives

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<td>Tom Jordan</td>
<td>USC Los Angeles</td>
<td>Peter Bird</td>
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<td>Nadia Lapusta</td>
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<td>Chris Wills</td>
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<td>Bruce Shaw</td>
<td>UC Santa Barbara</td>
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<td>Stanford</td>
<td>Paul Segall</td>
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SCEC membership is open to participating institutions upon application. Eligible institutions may include any organization (including profit, non-profit, domestic, or foreign) involved in a Center-related research, education, or outreach activity. An invitation was sent this summer to all SCEC3 domestic participating institutions and institutions new to SCEC that were funded in 2012 to apply for participating institution status in SCEC4, as called for in the SCEC by-laws. As of August 2012, the following institutions have applied for participating institution status for SCEC4 (2012-2017).

Domestic Participating Institutions and Representatives

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<td>U Alaska Fairbanks</td>
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<td>Carl Tape</td>
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<td>Utah State</td>
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<td>Carl Tape</td>
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<td>Jeff McGuire</td>
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<td>Michael Oskin</td>
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Core institutions are designated academic and government research organizations with major research programs in earthquake science. Each core institution is expected to contribute a significant level of effort (both in personnel and activities) to SCEC programs, as well as a yearly minimum of $35K of institutional resources (spent in-house on SCEC activities) as matching funds to Center activities. Each core institution appoints an Institutional Director to the Board of Directors.

Participating institutions do not necessarily receive direct support from the Center. Each participating institution (through an appropriate official) appoints a qualified Institutional Representative to facilitate communication with the Center. The interests of the participating institutions are represented on the Board of Directors by two Directors At-Large.

Apply as a Participating Institution

E-mail application to John McRaney [mcraney@usc.edu]. The application should come from an appropriate official (e.g. department chair or division head) and include a list of interested faculty and a short statement on earthquake science research at your institution. Applications will be approved by a majority vote of the SCEC Board of Directors.
SATURDAY, September 7
10:00-19:00 Pre-Registration Check-In (Lobby)

SUNDAY, September 8
07:00-18:30 Registration and Check-In (Lobby)
07:00-08:00 Breakfast (Poolside)
08:00-20:00 Poster Set-Up (Plaza)
08:00-12:00 Workshop: Source Inversion Validation (Horizon I)
   Workshop: SCEC Broadband Platform (Horizon II)
12:00-13:00 Lunch (Restaurant and Poolside)
13:00-17:00 Workshop: Earthquake Simulators (Horizon I)
   Workshop: Ground Motion Simulation Validation (Horizon II)
17:00-18:00 Annual Meeting Ice-Breaker (Lobby, Harvey's, Plaza)
18:00-19:00 Distinguished Speaker Presentation (Horizon)
19:00-20:30 Welcome Dinner (Poolside)
19:00-21:00 SCEC Advisory Council Dinner Meeting (Tapestry)
21:00-22:30 Poster Session (Plaza)

MONDAY, September 9
07:00-08:00 Registration and Check-In (Lobby)
07:00-08:00 Breakfast (Poolside)
08:00-11:00 Session: The State of SCEC (Horizon)
11:00-13:00 Session: Stress Transfer from Plate Motion to Crustal Faults:
   Long-Term Fault Slip Rates (Horizon)
13:00-14:30 Lunch (Restaurant, Tapestry, Poolside)
14:30-16:00 Session: Stress-Mediated Fault Interactions and Earthquake
   Clustering: Evaluation of Mechanisms (Horizon)
16:00-17:30 Poster Session (Plaza)
19:00-21:00 SCEC Honors Banquet (Poolside)
21:00-22:30 Poster Session (Plaza)

TUESDAY, September 10
07:00-08:00 Breakfast (Poolside)
08:00-09:30 Session: Evolution of Fault Resistance During
   Seismic Slip: Scale-Appropriate Laws for Rupture
   Modeling (Horizon)
09:30-11:00 Session: Structure and Evolution of Fault Zones and
   Systems: Relation to Earthquake Physics (Horizon)
11:30-13:00 Session: Causes & Effects of Transient Deformations:
   Slow Slip Events and Tectonic Tremor (Horizon)
13:00-14:30 Lunch (Restaurant, Tapestry, Poolside)
14:30-16:00 Session: Seismic Wave Generation and Scattering:
   Prediction of Strong Ground Motions (Horizon)
16:00-17:30 Poster Session (Plaza)
19:00-21:00 Dinner (Poolside)
19:00-21:00 SCEC Advisory Council Dinner Meeting (Boardroom)
21:00-22:30 Poster Session (Plaza)

WEDNESDAY, September 11
07:00-08:00 Poster Removal (Plaza)
07:00-08:00 Breakfast (Poolside)
08:00-09:30 Session: Earthquake Early Warning and Risk
   Communication (Horizon)
09:30-11:00 Session: The Future of SCEC (Horizon)
11:00 Adjourn 2013 SCEC Annual Meeting
11:30-13:30 SCEC PC Lunch Meeting (Palm Canyon)
   SCEC Board Lunch Meeting (Tapestry)