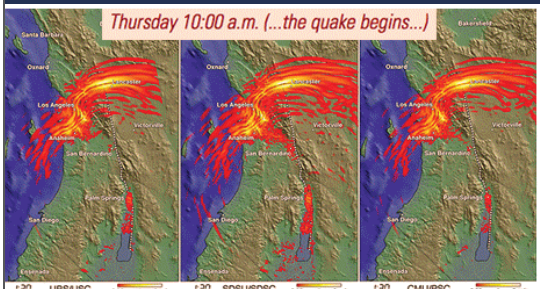
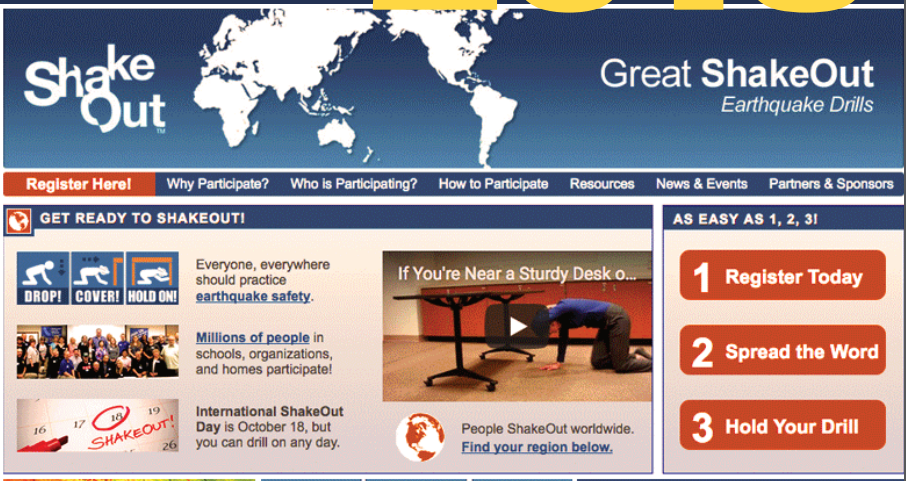
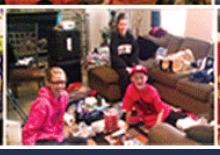
Southern California Earthquake Center

ANNUAL MEETING 2018







SCEC
AN NSF+USGS CENTER

MEETING PROGRAM

September 8-12, 2018

Core Institutions and Board of Directors (BoD)

The Board of Directors (BoD) is the primary decision-making body of SCEC; it meets three times annually to approve the annual science plan, management plan, and budget, and deal with major business items. The Center Director acts as Chair of the Board. The liaison members from the U.S. Geological Survey are non-voting members.

USC **John Vidale**, Chair	Harvard **John Shaw**, VC	Texas A&M **Patrick Fulton**	UC Santa Barbara **Toshiro Tanimoto**	USGS Menlo Park **R. Harris, S. Hickman**
Caltech **Jean-Phillippe Avouac**	MIT **Tom Herring**	UC Los Angeles **Peter Bird**	UC Santa Cruz **Emily Brodsky**	USGS Pasadena **Kate Scharer**
CGS **Tim Dawson**	SDSU **Tom Rockwell**	UC Riverside **David Oglesby**	UNR **Graham Kent**	At-Large Member **Rachel Abercrombie**
Columbia **Bruce Shaw**	Stanford **Paul Segall**	UC San Diego **Yuri Fialko**	USGS Golden **Nico Luco**	At-Large Member **Rowena Lohman**

Science Working Groups & Planning Committee (PC)

The leaders of the Disciplinary Committees and Interdisciplinary Focus Groups serve on the Planning Committee (PC) for three-year terms. The PC develops the annual Science Collaboration Plan, coordinates activities relevant to SCEC science priorities, and is responsible for generating annual reports for the Center. Leaders of SCEC Special Projects (i.e., projects with funding outside the core science program) also serve on the Planning Committee. They ensure the activities of the Special Projects are built into the annual science plans.

	Disciplinary Committee			
	Seismology	Tectonic Geodesy	EQ Geology	Computational Sci
PC Chair **Greg Beroza***	**Yehuda Ben-Zion*** **Jamie Steidl**	**Gareth Funning*** **Manoo Shirzaei**	**Mike Oskin*** **Whitney Behr**	**Eric Dunham*** **Ricardo Taborda**
	Interdisciplinary Focus Groups / Working Groups			
PC Vice-Chair **Judi Chester***	FARM **Nadia Lapusta*** **Nick Beeler**	SDOT **Kaj Johnson*** **Bridget Smith-Konter**	EFP **Max Werner*** **Ned Field**	Ground Motions **Domniki Asimaki*** **Annemarie Baltay**
* PC Members	EEII **Jack Baker*** **Jon Stewart**	SAFS **Michele Cooke*** **Ramon Arrowsmith**	CXM **Liz Hearn*** **Scott Marshall**	Special Projects **Christine Goulet*** **Phil Maechling***

CEO Planning Committee (CEO PC)

The Communication, Education, and Outreach Planning Committee (CEO PC) comprises of stakeholders representing CEO program focus areas (public education and preparedness; K-14 education initiative; experiential learning and career advancement; and the implementation interface). The CEO PC provides guidance for CEO programs, reviews reports and evaluations, and identifies synergies with other parts of SCEC and external organizations.

* Board liaison
** PC liaison

Tim Sellnow*, Chair U Central Florida	**Kate Long** CalOES	**Danielle Sumy** IRIS
Tim Dawson* CGS	**Sally McGill** CSUSB	**Ricardo Taborda**** Colombia EAFIT

Center Management

	Center Director **John Vidale***	Center Co- Director **Greg Beroza***	PC Vice-Chair **Judi Chester***	Board Vice-Chair **John Shaw***
CEO Assoc Director **Mark Benthien**	CME / IT Assoc Director **Phil Maechling***	Special Projects Exec Sci Director **Christine Goulet***	Science Ops Assoc Director **Tran Huynh***	Administration Assoc Director **John McRaney***
Communications Manager **Jason Ballmann**	Research Programmer **Scott Callaghan** **Bill Savran** **Fabio Silva** **Mei-Hui Su**	Research Programmer **Kevin Milner**	Business Ops Specialist **Deborah Gormley**	
Web Manager **John Marquis**			Research Programmer **Edric Pauk**	
ELCA Manager **Gaby Noriega**	Director of Comp Services **John Yu**			
Asst Director of Strategic Partners **Sharon Sandow**				

* Executive Committee of the Center

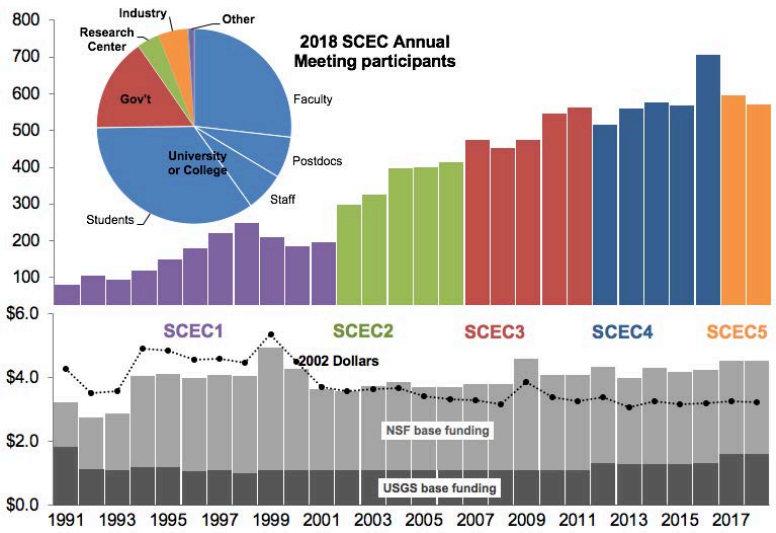
Advisory Council (AC)

The external Advisory Council (AC) provides guidance in all aspects of Center activities, including basic and applied earthquake research and related technical disciplines, formal and informal education, and public outreach. Members of the AC are elected by the Board for three-year terms and may be re-elected. The Council meets annually to review Center programs and plans, and prepares a report for the Center.

Meghan Miller, Chair UNAVCO	**Louise Kellogg** UC Davis	**Tom O'Rourke** Cornell	**Tim Sellnow** U Central Florida
Rick Aster Colorado State	**Yann Klinger** IPGP/Paris	**Susan Owen** NASA JPL	**Heidi Tremayne** EERI
Susan Beck Univ of Arizona	**Warner Marzocchi** INGV Rome	**Ellen Rathje** Univ of Texas	

Welcome to the 2018 SCEC Annual Meeting!

This year marks the second year in the fifth phase of the Center (SCEC5: 2017-2022), and the 10th anniversary of ShakeOut, the Great Earthquake Drill. We will celebrate and pay tribute to John McRaney, the very first SCEC employee, who will retire from SCEC at the end of 2018.



Upper bar chart shows registrants at SCEC Annual Meetings 1991-2018. Pie chart shows the demographic profile for 2018 pre-registrants (571 total). The lower bar chart is the history of SCEC base funding in as-spent millions of dollars; the connected dots are the base-funding totals in 2002 dollars.

The SCEC Science Planning Committee has configured a program that will keep you engaged during your stay in the desert. We will review the advances of SCEC and strategize on the goals set forth in the SCEC5 proposal. Five workshops will be held on Saturday and Sunday, and at 6pm Sunday evening, Jim Dieterich will kick off the meeting as our Distinguished Speaker with a talk on "Earthquake and Fault System Dynamics: Putting the Pieces Together."

The agenda for the rest of the meeting features keynote speakers giving plenary talks on thought-provoking subjects that feed directly into discussions of major science themes. We also have dedicated time for poster sessions, technical demonstrations, education and outreach activities, and of course, some lively social gatherings. This year's session theme titles are borrowed from the Beatles' greatest hits.

Those of you who have attended past SCEC meetings realize that much of the action happens in the poster sessions. As in the past few years, posters will stay up for the entire meeting to allow more face-to-face interactions on the juicy details of SCEC research. SCEC leadership has a continuing interest in hearing your feedback on ways to improve the meeting, particularly now that it has grown so large.

We welcome those who are new the SCEC Collaboration, and look forward to connecting with our SCEC friends in Palm Springs!

John E. Vidale, Director

Gregory C. Beroza, Co-Director

Go to meeting website:
www.scec.org/meetings/2018/am

@SCEC **#scecmeet**

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Saturday, September 8

09:00 - 17:00 **SCEC Workshop on Predictive Skill Across Tectonic Settings and Planning CSEP 2.0,** *Maximilian Werner, Thomas Jordan, Warner Marzocchi, Andy Michael, David Rhoades, and Hiroshi Tsuruoka* (https://www.scec.org/workshops/2018/csep)

09:00 - 17:00 **SCEC Community Rheology Model Workshop: Loading of Southern California Faults: Bulk Lithospheric Deformation and/or Localized Ductile Shear Zone Strain,** *Wayne Thatcher, Whitney Behr, Elizabeth Hearn, Greg Hirth and Michael Oskin* (https://www.scec.org/workshops/2018/crm)

09:00 - 17:00 **SCEC Cajon Pass Earthquake Gate Area Initiative: Integrated Science Field Trip,** *Julian Lozos, Nate Onderdonk, and Craig Nicholson* (https://www.scec.org/workshops/2018/cajon)

09:00 - 17:00 **SCEC Open-Source Software and Data Access Workshop,** *Philip Maechling, Christine Goulet, and Tran Huynh* (https://www.scec.org/workshops/2018/software)

Sunday, September 9

07:00 - 17:00 **SCEC Annual Meeting Registration & Check-In,** *Hilton Lobby*

09:00 - 22:30 **SCECmeetUP Space Available,** *Tapestry Room*

To facilitate informal, small group discussions at the SCEC Annual Meeting, the Tapestry Room is available for anyone to use without reservations at the designated times. Meeting rooms for groups up to 24 people are also available with reservations for 2-hour blocks. See the sign-up sheet in the Hilton Lobby to reserve a room for your group.

09:00 - 12:00 **SCEC Special Projects Planning Meeting,** *Christine Goulet*

13:00 - 17:00 **Workshop: Media Interview Theory and Practice, Through War and Peace,** *Jason Ballmann, Mark Benthien, and Zachary Hall* (https://www.scec.org/workshops/2018/communications)

13:00 - 17:00 **SCEC Cajon Pass Earthquake Gate Area Initiative: Integrated Science Workshop,** *Julian Lozos, Nate Onderdonk, and Craig Nicholson* (https://www.scec.org/workshops/2018/cajon)

15:00 - 17:00 **Poster Set-Up,** *Plaza Ballroom*

17:00 - 18:00 **Welcome Social,** *Hilton Lobby and Plaza Ballroom*

18:00 - 19:00 **Distinguished Speaker Presentation,** *Horizon Ballroom*

Earthquake and fault system dynamics – Putting the pieces together, *James H. Dieterich*

In nature earthquakes do not occur as independent events on faults that are isolated in time and space. Rather they occur as emergent phenomena from the system dynamics of geometrically complex fault networks. Earthquake simulations that integrate fault system geometry, evolving stress conditions from interactions among earthquakes, and rate- and state-dependent fault constitutive properties capture well-established system-level characteristics of earthquakes including scaling statistics and Omori-type space-time clustering. In addition, long simulations with the California fault system and Cascadia models point to some relationships that would not be particularly obvious in the short historical record of earthquake observations. Among the relationships of possible significance to short- and long-term forecasts are 1) repeating slip patterns in large earthquakes whose characteristics are tied to the local fault system geometry and loading conditions; 2) the important role of structural complexities in both limiting through-going ruptures and enhancing earthquake clustering; and 3) the dependence of clustering rates on local stress conditions, which affect the probabilities of foreshock/mainshock sequences. Looking ahead, there is much room for further development of fault and earthquake system simulations. Of particular interest is the coupling of fault system simulations and background seismicity occurring off of the major modeled faults. One-way coupling of the background seismicity rates to stress changes from slip on the modeled system faults is doable in the short-term. A proof-of-concept implementation of full coupling appears to be quite promising.

James H. Dieterich's research interests have to do with the mechanics of deformation processes, particularly as they relate to earthquake and volcanic phenomena. Areas of emphasis include development of governing relations for earthquake nucleation and earthquake occurrence; estimation of earthquake probabilities; fault constitutive properties; and coupled interactions between magmatic activity, faulting, and earthquakes. Current research includes 1) numerical simulation of earthquakes processes in interacting fault systems, 2) origins of earthquake clustering including foreshocks and aftershocks, 3) application of seismicity rate changes to infer stress changes in volcanic and tectonic environments, 4) laboratory investigation of fault constitutive properties and surface contact process.

19:00 - 21:00 **Welcome Dinner,** *Hilton Poolside*

19:00 - 21:00 **Leadership Meeting: SCEC Advisory Council,** *Palm Canyon Room*

21:00 - 22:30 **Poster Session,** *Plaza Ballroom*

Monday, September 10

07:00 - 08:00 **SCEC Annual Meeting Registration & Check-In,** *Hilton Lobby*

07:00 - 08:30 Breakfast, *Hilton Poolside*

07:00 - 08:30 **SCEC Transitions Program Breakfast,** *Tapestry Room*

The Office of Experiential Learning and Career Advancement (ELCA) launched the SCEC Transitions Program to provide junior members of the SCEC community with resources and mentoring across key career transitions. At the 2018 SCEC Annual Meeting, ELCA will host its second Breakfast Club Meetup. The goal of these meetups is to provide a platform for early career attendees to connect with peers and mentors for the purpose of discussing pathways in earthquake science careers. These networking opportunities are intended for anyone starting, pursuing, building, or transitioning into a earthquake science career. (www.scec.org/workshops/2018/transitions)

08:30 - 10:10 **Plenary Session 1: "The Long Winding Road" The State of SCEC,** *Horizon Ballroom*
Moderators: John Vidale, Greg Beroza

08:30 Welcome and State of the Center (John Vidale)

08:40 Remarks from the National Science Foundation (Maggie Benoit)

08:50 Remarks from the U.S. Geological Survey (Bill Leith)

09:00 Remarks from the Pacific Gas & Electric (Katie Wooddell)

09:05 Remarks from the Federal Emergency Management Agency (David Javier)

09:10 Communication, Education, & Outreach Highlights (Mark Benthien)

09:25 SCEC Science Accomplishments (Greg Beroza / Christine Goulet)

10:00 Lightning Talks: Workshop Summaries

10:10 - 10:30 Break

10:30 - 12:00 **Plenary Session 2: "All Together Now" How Do We Construct Effective and Synergistic Community Models?** *Horizon Ballroom*
Moderators: Liz Hearn, Scott Marshall

10:30 **Heat Flow Data and Seismic Imaging Reveal Both Transient and Steady-State Thermo-Mechanical Processes at Work Beneath Southern California,** *Wayne R. Thatcher and David S. Chapman*

Analysis of heat flow and seismic data provides glimpses of the dynamical processes shaping the thermal evolution of southern California. The present day thermal field bears an imprint of long-lived subduction prior to 30 Ma and subsequent growth of a continental transform boundary. Post 30 Ma processes include (1) a continental analog of seafloor spreading beneath the Salton Trough, (2) thermal pulses due to slab window effects, (3) mantle lithosphere detachment and sinking beneath late Cretaceous batholiths, and (4) extension and formation of metamorphic core complexes (MCC) in the offshore Inner Borderland.

Over 200 high quality surface heat flow (SHF) measurements define 14 distinct southern California heat flow regions (HFRs) where SHF is relatively constant. Assuming seismic estimates of lithosphere-asthenosphere boundary depth (sLAB) coincide with thermal LAB, two remarkable features are revealed. First, for 11 HFRs with SHF 40-83 mW/m2, sLAB depth is a surprisingly constant 70 ± 5 km. These data points naturally separate into 2 clusters, the first with average SHF of 40-58 mW/m2 (Cluster 1), the second with SHF of 68-83 mW/m2 (Cluster 2).

Simple 1D steady-state thermal conduction models can match the six Cluster 2 HFRs. P/T constraints from mantle xenoliths and erupted lavas considerably narrow the range of acceptable geotherms, with Moho at 700˚- 800˚C and LAB 1200˚- 1300˚C. However, such simple models are inconsistent with the low SHF of Cluster 1. In each of these 5 HFRs there is geologic and/or seismic evidence for Late Cenozoic detachment and sinking of mantle lithosphere. A transient 1D conduction model is used that includes an initially 30 to 50 km thick lithosphere exposed to hot asthenosphere 3-10 Ma BP conductively cooled and thickened by mafic underplating. Current temperatures are warm in the lower crust, ~850˚C at the Moho, and ~1200˚C at the LAB.

Salton Trough has the highest SHF (100-140 mW/m2) and thinnest lithosphere (45-55 km) in southern California. A model with steady state crustal thickness of 24 km, constant rates of stretching and sedimentation into the Trough and basaltic under-plating at the Moho matches the data, with a hot lower crust and ~1400˚C asthenosphere at the Moho.

Finally, the Inner Borderland HFR has an unusually thin lithosphere of 49±6 km and SHF of 77±6 mW/m2, consistent with its origin as a Miocene MCC subsequently unroofed and depleted of its upper crustal heat producing elements.

11:00 **On the Role of Temperature and Rheology in Seismicity in Convergent Margins,** *Ylona van Dinther, Luca Dal Zilio, Mario D'Aquisto, Robert Herrendörfer, & Taras Gerya*

Earthquake nucleation, propagation and arrest are governed by fault stress and strength. Thus understanding how these are regulated by long-term processes involving temperature, rheology and tectonic forcing - in combination with short-term earthquake interactions - is important. To decipher and extend our too limited and indirect observational record, we developed the first quantitative model able to simulate the dynamics governing both tectonic processes over millions of years and the family of fault slip processes down to milliseconds. We utilize this seismo-thermo-mechanical modeling framework to show how stress evolution, temperature, and crustal and lithospheric rheology interact to shape convergent margins, seismic cycle observations and seismicity behavior. Through quantifying their feedback in a self-consistent manner, we establish how convergence rate across continental collision zones affects temperature and viscosity distribution. This determines stress and strength distributions, which govern earthquake maximum magnitude, recurrence patterns, and Gutenberg-Richter statistics. In a more observationally constrained approach, temperature, geometry and forcing can be predefined using geological and geophysical constraints to improve our understanding of seismicity in particular regions. Such tectonically realistic models of the Nepal Himalaya demonstrate the Main Himalayan Thrust geometry facilitates a bi-modal seismicity regime with M>=8 surface ruptures following a series of deeper, ~M7 megathrust earthquakes. In the Northern Apennines (Italy), such models show that slab delamination and retreat along with a high temperatures and a ductile lower crustal rheology are necessary to match both long- and short-term observations. These self-consistent and regionally-constrained examples illustrate the importance of thermal and rheological models for understanding seismicity.

11:30 Group Discussion

12:00 - 13:30 Lunch, *Hilton Restaurant, Tapestry Room, and Poolside*

13:00 - 17:00 **SCEC Annual Meeting Registration & Check-In,** *Hilton Lobby*

13:30 - 15:00 **Plenary Session 3: "Getting Better" What Needs to be Done to Increase the Impact of Dynamic Rupture Modeling?** *Horizon Ballroom* Moderators: Eric Dunham, David Oglesby

13:30 **Moving Earthquake Science Forward - Earthquake Simulation Codes and the SCEC-USGS Dynamic Rupture Group,** *Ruth A. Harris*

Computational simulations of earthquake rupture provide clues for deciphering earthquake behavior. In a perfect world, we would have a complete set of observations at Earth's surface and at depth that would allow us to forgo simulations, but in reality, this is never the case and additional tools are required to fill the gaps in our knowledge about how earthquakes work. Dynamic earthquake rupture simulation is one of the tools that is being used. This type of computational simulation is powerful, but it is also complex, so additional steps are required to ensure that it is working as expected. The SCEC-USGS Dynamic Rupture Group has provided a solution. We developed an extensive suite of benchmark exercises that are used to test computer codes aiming to simulate dynamic earthquake rupture and the resulting nearby ground shaking. To date, more than a dozen codes have performed the exercises, demonstrating that they reliably produce similar results for fault rupture behavior and ground motions, when they use the same assumptions about fault geometry, initial stresses, crustal properties, and friction. Our website, scecdata.usc.edu/cvws, provides the details of our benchmark exercises and other information about our group's work. As part of our investigations we have examined cutting-edge earthquake hazards problems, from a study of the effect of fault geometry on future large earthquakes near a power plant to examinations of off-fault yielding's effects on earthquake progress and near-field ground shaking. Our group has also set an example for how a long-running open and welcoming collaboration can move forward with interesting science discoveries while mentoring the next generation of scientists in our field.

14:00 **Advancing Simulations of Sequences of Earthquakes and Aseismic Slip [SEAS],** *Junle Jiang and Brittany A. Erickson*

Robust predictive models of earthquake source processes have fundamental importance in earthquake science. Numerical simulations of dynamic earthquake ruptures have excelled in reproducing detailed processes during individual events. To bridge the shorter and longer time scales, it is important to consider earthquake source processes that interact with slow tectonic deformation, through the simulation of Sequences of Earthquakes and Aseismic Slip (SEAS). In SEAS models, the interplay of aseismic periods and dynamic events gives rise to a wide range of geophysical observables such as aseismic deformation, microseismicity, and ground shaking during dynamic ruptures, providing an avenue to connect earthquake behavior to geological, paleoseismic, and geodetic observations from a fault zone. SEAS modeling can also determine which physics at what scales dominates the resulting fault behavior, aiding the interpretation of long-term seismicity patterns in large-scale models of fault systems that require various simplifications.

Understanding how earthquakes nucleate, propagate, and terminate necessitates the development of SEAS models capable of simulating pre-, inter- and postseismic slip and loading between earthquakes. Multiscale faulting processes and multiple physical factors involved lead to the complexity of SEAS models, posing significant challenges for numerical simulations. This reality requires collaborations of researchers to compare and verify simulation results. Over the past year we have initiated a community code-verification effort, with the goals to further advance our computational capabilities, promote robust and reproducible earthquake science, and develop best practices and tools for the broader community. During the first SEAS workshop this spring, we brought together ~20 modelers to participate in our first benchmark problem, a 2D quasi-dynamic crustal faulting problem that serves as the first step to ensuring that different methodologies can produce closely matching results. The initial success of this

benchmark prepares us to consider models with further complexities, including irregular earthquake patterns, nonvertical faults, 3D problems, and additional physics such as inelasticity and full dynamic effects, as we move forward. This community exercise will foster the development of a new generation of accurate SEAS models, towards a long-term goal to validate and integrate these models with geophysical observations.

14:30 Group Discussion

14:00 - 22:00 **SCECmeetUP Space Available,** *Tapestry Room*

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15:00 - 17:00 **Poster Session**

15:00 Lightning Talks (*series of presentations from SCEC Community*), *Horizon Ballroom*

15:30 Poster Viewing, *Plaza Ballroom*

15:00 - 18:00 **Leadership Meeting: SCEC CEO Planning Committee,** *Palm Canyon Room*

19:00 - 22:00 **SCEC Honors Banquet: "In My Life" Tribute to SCEC Associate Director John McRaney,** *Grand Ballroom at Hotel Zoso*

Tuesday, September 11

07:00 - 08:30 Breakfast, *Hilton Poolside*

07:00 - 08:30 **SCEC Transitions Program Breakfast,** *Tapestry Room*

The Office of Experiential Learning and Career Advancement (ELCA) launched the SCEC Transitions Program to provide junior members of the SCEC community with resources and mentoring across key career transitions. At the 2018 SCEC Annual Meeting, ELCA will host its second Breakfast Club Meetup. The goal of these meetups is to provide a platform for early career attendees to connect with peers and mentors for the purpose of discussing pathways in earthquake science careers. These networking opportunities are intended for anyone starting, pursuing, building, or transitioning into a earthquake science career. (www.scec.org/workshops/2018/transitions)

08:30 - 10:10 **Plenary Session 4: "Fixing a Hole" How Do We Assess Hazard and Risk from Distributed Deformation?** *Horizon Ballroom*
Moderators: Jack Baker, Domniki Asimaki

08:30 **On the possibility of earthquake rupture through clay-rich faults,** *Daniel Faulkner, Marieke Rempe, John Bedford, C Sanchez-Roa, C Boulton, & S den Hartog*

Many mature, large-displacement fault zones exhibit a clay-rich fault core. This low porosity, low permeability material inhibits the migration of fluid and consequently small changes in porosity produce pore pressure transients that take significant time to dissipate. Despite most clay-rich fault gouges displaying velocity strengthening frictional characteristics, variations in pore-fluid pressure can result in a wide range of behaviour including apparent velocity weakening leading to possibility of these rocks hosting instabilities. We present laboratory constraints of the frictional properties of clay-rich fault gouge both at low slip velocity, commensurate with earthquake nucleation and at higher slip velocity, equivalent to that during rupture propagation. We show that small amounts of compaction can result in large strength changes and apparent velocity weakening behaviour at slow slip velocity. At higher slip velocity, experimental results suggest thermal pressurization in clay-rich fault gouge is an efficient process that produces weakening over small slip displacements. Accounting for pore-fluid pressure effects during slip predicts a wide variety of behaviour including enhanced fault creep, slip transients, and even the possibility of rupture propagation on clay-rich fault zones.

09:00 **Assessing Surface Fault Rupture Deformation,** *Jonathan Bray*

Surface fault rupture can produce localized or distributed deformation. In addressing the surface fault rupture hazard, the potential patterns of ground deformation should be developed through the use of a comprehensive site investigation including detailed mapping. Measured patterns of surface fault-induced ground deformation from similar types of faulting from past events offer useful insights to complement site-specific studies. Mitigation can be achieved in those cases when avoidance is not possible or practical. Engineers can design structures to accommodate fault-induced ground movements. Building strong, ductile structural foundation elements that can accommodate some level of ground deformation and isolating the superstructure from much of the underlying ground movement are effective design measures. Structures should not be tied into the ground with piles or piers. Other mitigation measures include establishing non-arbitrary setbacks based on fault geometry and displacement, and the overlying soil; constructing reinforced earth fills to spread out the underlying ground movements; and using slip layers to decouple ground movements from foundation elements.

09:30 Group Discussion

10:00 - 10:30 Break

10:30 - 12:00 **Plenary Session 5: "Act Naturally" How Do We Use and Further Improve Earthquake Simulators?** *Horizon Ballroom*
Moderators: Ned Field, Jacqui Gilchrist

10:30 **Earthquake Simulators are Ready for Prime Time,** *Bruce E. Shaw*

A major leap has been made in the last year where earthquake simulators have been shown to replicate seismic hazard statistics across California, matching remarkably well the results from UCERF3. What this means, how to take advantage of it, why it has worked, and where we are pushing further forward will all be discussed. This application of earthquake simulators will also be deployed as an example to address the more general question of how to use, and how not to use simulators, and the importance of robustness.

11:00 **On the present and future of physics-based earthquake source modeling,** *Nadia Lapusta*

Accelerating streams of field observations, lab studies, and numerical modeling have significantly improved our understanding of earthquakes and physical factors that affect them. The main suspects have been known for a while. Tectonic loading, static and wave-mediated stress transfers, aseismic slip, rate-and-state friction, fault geometry and roughness, visco-plastic deformation at depth, shear heating during rapid slip, variations in pore fluid pressure, and off-fault damage/healing have all been shown to significantly affect, and in some cases dominate, the stress/strength evolution on faults and hence the earthquake patterns that result. Through combined field, lab, and numerical studies, our research community is well on the way to systematically quantifying the physical factors and evaluating their relative importance for different faults/phenomena/scales. A number of earthquake source models are being developed, focusing on different combinations of the physical factors and scales, to aggregate the available knowledge and identify crucial gaps. Together, the modeling efforts are advancing towards interpreting field observations in terms of tractable models with physically meaningful fault and bulk properties that can be evaluated, at least in principle, through lab, field, and smaller-scale numerical studies.

Earthquake simulators have taken on a necessary and formidable task of investigating earthquake patterns on realistic fault networks, which is presently tractable only with simplifications and omissions of the other physical factors. They have been successful in finding sets of parameters, some physical and some ad-hoc, that allow the models to match known statistical properties of regional earthquake sequences. The simulators are valuable research tools for studying fault system dynamics. However, their simplifications necessitate careful considerations about which conclusions they allow us to draw. For example, why would we expect the simulators to provide realistic probabilities of jumps over step-overs if they ignore the potentially dominating physics - dynamic stress changes brought by seismic waves? Including the simulators in hazard assessment requires clear communication of their limitations, verification through comparisons with smaller-scale models that more accurately capture relevant physics, and community consensus of what criteria and observations the models need to satisfy. We are not there yet, but we are on the right track.

11:30 Group Discussion

12:00 - 13:30 Lunch, *Hilton Restaurant, Tapestry Room, and Poolside*

13:30 - 15:00 **Plenary Session 6: "We Can Work It Out" How Should SCEC Keep Up with Rapid Developments in Computational Science?**
Horizon Ballroom Moderators: Ricardo Taborda, Philip Maechling

13:30 **Deep learning for aftershock location patterns and the earthquake cycle,** *Phoebe DeVries, Thomas B. Thompson, Martin Wattenberg, Fernanda Viegas, and Brendan J. Meade*

Over the past few years, deep learning has led to rapid advances in applied computer science, from machine vision to natural language processing. These methods are now accessible to scientists across all disciplines due to the availability of easy-to-use APIs and affordable GPU acceleration. We demonstrate two specific applications of deep learning within earthquake science. In the first, we train a deep neural network to learn computationally efficient representations of viscoelastic solutions, across large ranges of times, locations, and rheological structures. Once found, these efficient neural network representations may accelerate computationally intensive viscoelastic calculations by more than 50,000%. In the second, we focus on aftershock location patterns and find that a fully connected neural network trained on 131,000+ mainshock-aftershock pairs can explain aftershock locations in an independent testing data set of 30,000+ mainshock-aftershock pairs more accurately (AUC = 0.849) than static elastic Coulomb failure stress change (AUC = 0.583). In contrast to the common assertion that deep learning produces "black box" results, in both applications, the trained neural networks can provide unique physical insights.

14:00 **Detecting millions of earthquakes in southern California with template matching,** *Zachary E. Ross, Egill Hauksson, Daniel T. Trugman, and Peter M. Shearer*

Over the last twenty years, earthquake detection rates in southern California have improved dramatically, resulting in the minimum magnitude of completeness decreasing from M~2.5 to M~1.5 today. It is believed, however, that these events still constitute less than 10% of all activity that is being recorded by the seismic network on a regular basis. To address these shortcomings, we applied a matched filter (template matching) algorithm to the entire continuous waveform archive of the Southern California Seismic Network using the seismograms of ~300,000 past events as templates. This GPU supercomputing effort resulted in a catalog of ~2.4 million earthquakes for the period 2008-2017, which is ~13 times as many events as the standard regional catalog, and has a completeness magnitude of ~0.5. The recent double-difference GrowClust algorithm was applied to the entire dataset and its 1.3 billion differential times, resulting in state-of-the-art hypocenter precision for the whole of southern California. I will first discuss basic summary information about the catalog and new regional-scale observations. Then, I will focus on the most active sequences that occurred during the period and use the seismicity to investigate connections between properties of fault zones and the earthquake rupture process. The unprecedented level of detail in this next-generation seismicity catalog is expected to facilitate important new analyses of earthquakes and faults in southern California.

14:30 Group Discussion

14:00 - 22:00 **SCECmeetUP Space Available,** *Tapestry Room*

To facilitate informal, small group discussions at the SCEC Annual Meeting, some rooms have been made available for anyone to use without reservations (Tapestry Room and Palm Canyon Room) at designated times. Meeting rooms for groups up to 24 people are also available with reservations for 2-hour blocks. See the sign-up sheet in the Hilton Lobby to reserve a room for your group.

15:00 - 17:00 **Poster Session**

15:00 Lightning Talks (*series of presentations from SCEC Community*), *Horizon Ballroom*

15:30 Poster Viewing, *Plaza Ballroom*

19:00 - 21:00 **Group Dinner,** *Poolside*

21:00 - 22:30 **Poster Session,** *Plaza Ballroom*

Wednesday, September 12

07:00 - 08:30 Breakfast, *Hilton Poolside*

08:30 - 10:00 **Plenary Session 7: "With A Little Help From My Friends" ShakeOut - What Has Shaken Out since 2008?** *Horizon Ballroom*
Moderators: Mark Benthien, Ken Hudnut

08:30 **Earth Science Research Needs for Improving Earthquake Scenarios,** *Brad T. Aagaard*

Earthquake scenarios provide important opportunities to showcase the effectiveness of integrating science from across the spectrum of earthquake hazards research. These scenarios complement probabilistic hazard assessments by examining specific realizations of large, potential earthquakes and their consequences to improve our resilience to natural disasters. They also raise the profile of our research with national media coverage. Consequently, it is especially important to leverage knowledge from earthquake geology, tectonic geodesy, and seismology to create the most realistic earthquake scenarios possible.

The 2008 ShakeOut scenario brought together more than 300 contributors to quantify the hazards and risks associated with a magnitude 7.8 occurring on the southern San Andreas fault. This effort set new expectations for how we develop sophisticated earthquake scenarios. In 2008 the USGS also led a collaborative effort to develop a suite of earthquake ground-motion scenarios for the Hayward fault, one of which is being used as the basis for the more comprehensive HayWired earthquake scenario. Since these scenarios were developed 10 years ago, our science has continued to advance but many open questions persist.

Creating realistic earthquake ruptures remains one of the major challenges. How to select rupture end points, the depth extent of coseismic slip, and multi-fault ruptures are basic issues. Additional research is necessary to constrain rupture details, such as the spatial variability of slip, the potential hypocenter relative to geologic features and microseismicity, and the speed and direction of rupture propagation. Furthermore, we have a limited understanding of when and where we should expect significant afterslip, which impacts infrastructure response planning.

In computing scenario ground motions, research is needed to further develop techniques for incorporating sophisticated, shallow, anelastic behavior into 3D simulations and constraining the anelastic properties at regional scales. Additional work is also necessary to develop regional-scale analysis techniques for estimating the extent and severity of ground failure. Aftershock forecasts can be improved with regional parameters for clustering and fault locations.

Pursuing these research directions will lead to more accurate estimates of the anticipated consequences of large earthquakes and help support better decision-making in urban planning and disaster preparedness.

09:00 **Where We Have Been, Where We Are Going… And How We Can Work Together,** *Marissa Aho*

More than 10 years after the 2008 ShakeOut scenario, the Mayor's Office of Resilience is still working with many of the original authors and other partners to advance the region's seismic resilience. ShakeOut and other related efforts have had a major impact on seismic policy in the City of Los Angeles, including the formation of the Mayor's Seismic Safety Task Force, the advancement of DWP's water resilience program, the partnership with U.S. Geological Survey that enabled Dr. Lucy Jones to serve as Mayor Garcetti's Science Advisor, and the release of the Mayor's Resilience by Design report in December 2014. Resilience by Design focused on strengthening LA's most vulnerable buildings, fortifying LA's water system, and enhancing reliable telecommunications. Now approaching its 4-year anniversary, I will discuss the status of many of the recommendations in Resilience by Design that have been implemented.

Resilience by Design is undoubtedly the cornerstone of Los Angeles' resilience-building. As inaugural members of 100 Resilient Cities pioneered by the Rockefeller Foundation, the City of Los Angeles worked with hundreds of partners during 2016-2017 to develop Resilient Los Angeles. Resilient Los Angeles was released by Mayor Garcetti in March of 2018 as a strategy that addresses Disaster Preparedness and Recovery, Climate Adaptation, Infrastructure Modernization, Economic Security and Leadership and Engagement. A number of the 96 Actions in Resilient Los Angeles advance the City's seismic resilient efforts. I will highlight some of them and talk about how we can work together to continue to advance seismic resilience together.

09:30 Group Discussion

10:00 - 10:30 Break

10:30 - 12:00 **Plenary Session 8: "I Want to Hold Your Hand" SCEC Looking Forward,** *Horizon Ballroom*
Moderators: John Vidale, Greg Beroza

10:30 Report of the Advisory Council (Meghan Miller)

10:50 2019 Science Plan and Request for Proposals (Greg Beroza)

11:50 Director's Closing Remarks (John Vidale)

12:00 2018 SCEC Annual Meeting Adjourns

12:30 - 14:30 **Leadership Meeting: SCEC Planning Committee,** *Palm Canyon Room*

12:30 - 14:30 **Leadership Meeting: SCEC Board of Directors,** *Tapestry Room*

Sunday, September 9, 2018

15:00 – 17:00 Poster Set-Up

21:00 – 22:30 Poster Session 1

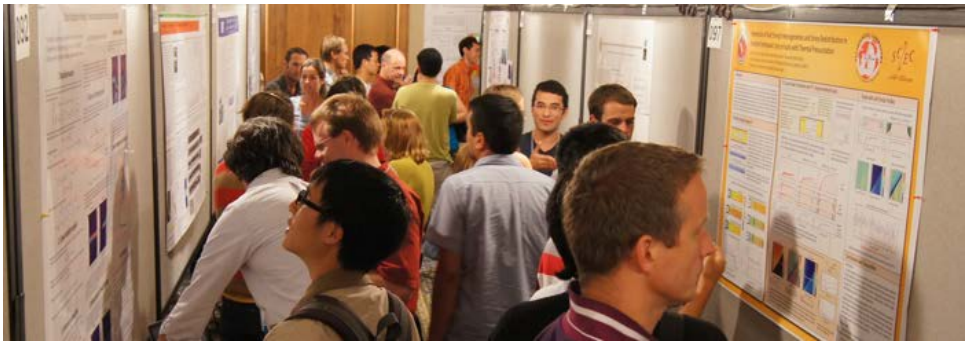
Monday, September 10, 2018

15:00 – 17:00 Poster Session 2

Tuesday, September 11, 2018

15:00 – 17:00 Poster Session 3

21:00 – 22:30 Poster Session 4



Ground Motions / Earthquake Engineering Implementation Interface (EEII) Posters 001-028, 298-305

001 **Long Shaking Durations within the Los Angeles Basin from Shallow Earthquakes,** *Voon Hui Lai, Zhongwen Zhan, Robert W Graves, and Donald V Helmberger*

002 **Effect of source rupture directivity on the ground shaking from strike-slip earthquakes and its implication for directivity models,** *Junju Xie, Paolo Zimmaro, Xiaojun Li, and Zengping Wen*

003 **Evaluating and Improving Ground Motion Predictions for Scenario Earthquakes in The San Francisco East Bay by Integrating Earthquake Ground-Motion Simulations and Noise-Derived Empirical Green's Functions,** *Taka'aki Taira, and Arthur J Rodgers*

004 **Broadband Ground Motion and Variability from 3D Dynamic Rupture Simulations along the Wasatch Fault, Utah, incorporating both Stochastic Fault Roughness and Deterministic Long-wavelength Geometry,** *Kyle B Withers, Morgan P Moschetti, and Kenneth Duru*

005 **Nonlinear Modeling of High-Rise Buildings Subject to Long-Period Ground Motion,** *Lauren M Santullo, Ahmed E Elbanna, and Setare Hajarolasvadi*

006 **Evaluation of CyberShake ground motions for engineering practice,** *Ganyu Teng, and Jack W Baker*

007 **Spatial correlations in CyberShake physics-based ground motion simulations,** *Yilin Chen, and Jack W Baker*

008 **Cybershake NZ v18.6: New Zealand simulation-based probabilistic seismic hazard analysis,** *Brendon A Bradley, Karim Tarbali, Robin L Lee, Jonney Huang, D Lagrava, V Polak, J Motha, and Sung Bae*

009 **Strong ground motions simulations for Dunedin city, New Zealand: First steps using the SCEC Broadband Simulation Platform,** *Mark W Stirling*

010 **Implementing Inter-Frequency Correlations into the SDSU Broadband Ground Motion Method,** *Nan Wang, Rumi Takedatsu, Kim B Olsen, and Steven M Day*

011 **Implementing Inter-Period Correlations into SCEC BBP Simulations,** *Jeff R Bayless, and Norman A Abrahamson*

012 **Nonlinear Fourier-based Amplification Factors for the SCEC Broadband Platform,** *Domniki Asimaki, and Jian Shi*

013 **Sampling Parametric Rupture Variability using Broadband Ground Motion Simulations,** *Robert W Graves*

014 **Simulated ground motions for induced seismicity at a 12-story structure in Oklahoma using the SCEC Broadband Platform,** *Jessie K Saunders, Frankie Martinez, Jennifer S Haase, and Mohamed Soliman*

015 **The SCEC Broadband Platform: Open-Source Software for Strong Ground Motion Simulation and Validation,** *Fabio Silva, Philip J Maechling, Christine A Goulet, and John E Vidale*

016 **Toward Hybrid Broadband Ground Motion Simulation Validation for Mw>3.5 New Zealand Earthquakes,** *Robin L Lee, Brendon A Bradley, and Xavier Bellagamba*

017 **Kinematic rupture simulations of earthquakes on multi-segment faults,** *Jorge G Crempien, and Ralph J Archuleta*

018 **Kinematic Source Models for Earthquake Simulations with Fault-zone Plasticity,** *Zhifeng Hu, Daniel Roten, Kim B Olsen, and Steven M Day*

019 **Implementation of Iwan-type Plasticity Model in AWP-ODC,** *Daniel Roten, Kim B Olsen, Steven M Day, and Yifeng Cui*

020 **Modeling shallow crustal nonlinearity in physics-based earthquake simulations: Beyond perfect plasticity,** *Elnaz Esmaeilzadeh Seylabi, Doriam Restrepo, Domniki Asimaki, and Ricardo Taborda*

021 **An Updated Compilation of VS30 in the United States,** *Alan Yong, Devin McPhillips, Julie Herrick, and Jessica Dozal*

022 **A Proposed Seismic Velocity Profile Database Model,** *Sean K Ahdi, Shamsher Sadiq, Okan Ilhan, Yousef Bozorgnia, Youssef Hashash, Dong Youp Kwak, Duhee Park, Alan Yong, and Jonathan P Stewart*

023 **Dense mapping of shallow velocity structure in the Raymond Basin using the Pasadena Distributed Acoustic Sensing Array,** *Ethan F Williams, Zhongwen Zhan, Martin Karrenbach, Steve Cole, and Lisa LaFlame*

024 **Preliminary Results on Fully Nonergodic Ground Motion Models in Central California Using NGA-West2 and SCEC CyberShake Datasets,** *Xiaofeng Meng, Christine A Goulet, Kevin R Milner, and Scott Callaghan*

025 **Probabilistic Seismic Hazard Analysis in California Using Non-Ergodic Ground-Motion Prediction Equations,** *Nicolas M Kuehn, Norman A Abrahamson, and Melanie Walling*

026 **GMPE specific average velocity profiles for developing spatially-varying path coefficients,** *Kathryn E Wooddell, Linda Al Atik, and Norman A Abrahamson*

027 **Probabilistic Seismic Hazard Analysis for Harrat Madinah, Saudi Arabia Using Regional Ground Motion Prediction Equations,** *Ryota Kiuchi, Walter D Mooney, and Hani M Zahran*

028 **Constraining epistemic uncertainties on hazard models in the Marmara region using SHERIFS (Seismic Hazard and Earthquake Rates in Fault Systems),** *Thomas Chartier, Oona Scotti, and Hélène Lyon-Caen*

298 **Characterization of high-wavenumber subsurface random heterogeneity using a very dense array at Diablo Canyon, California,** *Nori Nakata*

299 **Multi-scale study of ground motion coherence in Piñon Flats Observatory,** *Lei Qin, Christopher W Johnson, Frank L Vernon, and Yehuda Ben-Zion*

300 **Zoning Verification in Mexico City using strong motions of the M7.1 M7.1 Puebla-Morelos earthquake of September 19, 2017,** *Mehmet Celebi, Valerie J Sahakian, Diego Melgar, and Luis Quintanar*

301 **Investigating the Ground Motion Characteristics of the 2016 Mw 5.5 Gyeongju, South Korea, Earthquake Using the SCEC Broadband Platform,** *Seok Goo Song, Kwan-Hee Yun, and Sangmin Kwak*

302 **The 1933 Long Beach, California, Earthquake,** *Susan E Hough, and Robert W Graves*

303 **Sensitivities and Uncertainties in Probabilistic Fault Displacement Hazard Analysis in Southern California,** *Hong Kie Thio, and Jeff R Bayless*

304 **Towards Structural Imaging Using Scattering Artifacts Detected in Ambient Field Correlations,** *Lise Retailleau, and Gregory C Beroza*

305 **Characteristics of ground motion generated by interaction of wind gusts with trees, structures and other obstacles above the surface,** *Christopher W Johnson, Haoran Meng, Frank L Vernon, Nori Nakata, and Yehuda Ben-Zion*

Earthquake Forecasting and Predictability — Posters 030-053

030 **Development of monitoring and forecasting methods for crustal activity utilizing large-scale high-fidelity finite element simulations with 3D heterogeneous medium,** *Takane Hori, Tsuyoshi Ichimura, Kohei Fujita, Takuma Yamaguchi, Takeshi Iinuma, and Ryoichiro Agata*

031 **Probabilities of Earthquakes in the San Andreas Fault System: Estimations from RSQSim Simulations,** *Jacquelyn J Gilchrist, Thomas H Jordan, and Kevin R Milner*

032 **Fully physics-based PSHA: coupling RSQSim with deterministic ground motion simulations,** *Kevin R Milner, Bruce E Shaw, Thomas H Jordan, Scott Callaghan, and Christine A Goulet*

033 **The Collaboratory for the Study of Earthquake Predictability version 2.0 (CSEP2.0): New Capabilities in Earthquake Forecasting and Testing,** *William H Savran, Philip J Maechling, Maximilian J Werner, Thomas H Jordan, Danijel Schorlemmer, David A Rhoades, Warner Marzocchi, John Yu, and John E Vidale*

034 **Nowcasting Induced Seismicity at the Groningen gas field in the Netherlands,** *Molly Luginbuhl, John B Rundle, and Donald L Turcotte*

035 **Induced Earthquake Forecasting in Oklahoma Using Models of Fluid Diffusion and Earthquake Nucleation,** *Guang Zhai, and Manoochehr Shirzaei*

036 **3D models of seismicity beneath the Greater Tokyo Area,** *Yosihiko Ogata, Koichi Katsura, Hiroshi Tsuruoka, and Naoshi Hirata*

037 **Statistics of seismicity associated with a sequence of explosive eruptions at Kilauea, Hawaii,** *Rebecca A Fildes, Louise H Kellogg, Donald L Turcotte, and John B Rundle*

038 **Forecasting earthquake behavior on the Alpine Fault, New Zealand,** *Nicolas C Barth, Jamie Howarth, Keith B Richards-Dinger, Sean Fitzsimons, and Glenn P Biasi*

039 **Emergent failure process of a M4.2 earthquake offshore Istanbul observed from GONAF downhole recordings,** *Marco Bohnhoff, Peter E Malin, Murat Nurlu, and Felix Bluemle*

041 **How Much Farther? Estimating Rupture Length Probabilities After a Rupture Has Started,** *Steven G Wesnousky, and Glenn P Biasi*

042 **Sequential Data Assimilation for Seismicity: Probabilistic Estimation and Forecasting of Fault Stresses,** *Ylona van Dinther, Hans Rudolf Künsch, and Andreas Fichtner*

043 **Are we still seeing aftershocks from the M6.8 1872 Central Washington Earthquake?** *Thomas M Brocher*

044 **Faulty Intuition about b-values and Aftershock Productivity within a Fault Network,** *Morgan T Page, and Nicholas J van der Elst*

045 **New software for computing time dependent seismic hazard during aftershock sequences using the OpenSHA platform,** *Nicholas J van der Elst, Kevin R Milner, Edward H Field, Sara K McBride, and Morgan T Page*

046 **Why do strike-slip earthquakes produce fewer aftershocks?** *Kelian Dascher-Cousineau, Emily E Brodsky, and Thorne Lay*

047 **Updated California Aftershock Parameters,** *Jeanne L Hardebeck, Andrea L Llenos, Andrew J Michael, Morgan T Page, and Nicholas J van der Elst*

048 **Aftershock Matters,** *Nicole S Gage, David J Wald, and Kristin D Marano*

049 **Uncertainties in Probabilistic Seismic Hazard Analysis for a Poisson Earthquake Occurrence Model,** *Yuehua Zeng, and Mark D Petersen*

050 **Improved medium-term earthquake forecasting: Compensating for incomplete contributions of precursory earthquakes,** *David A Rhoades, and Annemarie Christophersen*

051 **The earthquake rates they are a-changin': Improving forecasts during earthquake swarms,** *Andrea L Llenos, Andrew J Michael, Morgan T Page, Nicholas J van der Elst, and Sara K McBride*

052 **Building Earthquake Early Warning Networks With Low Cost, Off-the-Shelf Components,** *Ryan Logsdon, Robert L Walker, and Sean Gibbons*

053 **ShakeAlert v. 2.0 Testing and Certification,** *Deborah E Smith, Monica D Kohler, Jennifer R Andrews, Angela I Chung, Renate Hartog, Ivan Henson, Douglas D Given, and Stephen Guiwits*

Seismology — Posters 054-112, 283-286

054 **Detailed seismic catalog for the San Jacinto fault zone region (2008-2016) from automated processing of raw waveform data,** *Malcolm C White, Yehuda Ben-Zion, and Frank L Vernon*

055 **Checking Data Quality of Co-located Broadband and Strong-motion Sensors in Southern California Seismic Network,** *Zefeng Li, Egill Hauksson, Thomas H Heaton, Luis Rivera, and Jennifer R Andrews*

056 **Absolute and relative focal depth determination of moderate-sized earthquakes: An example from the 2010 El Mayor-Cucapah earthquake sequence,** *Chunquan Yu, Egill Hauksson, Zhongwen Zhan, Elizabeth S Cochran, and Donald V Helmberger*

057 **Cloud Computing and Big Data – Using the Southern California Earthquake Data Center (SCEDC) and the Southern California Seismic Network (SCSN) Products and Services for Earthquake Research,** *Ellen Yu, Prabha Acharya, Aparna Bhaskaran, Shang-Lin Chen, Jennifer R Andrews, Valerie Thomas, Egill Hauksson, and Robert W Clayton*

058 **Earthquake catalog reconstruction from analog seismograms: Application to the Rangely Experiment microfilms,** *Kaiwen Wang, William L Ellsworth, Gregory C Beroza, Gordon Williams, Miao Zhang, Dustin Schroeder, and Justin L Rubinstein*

059 **Tracking thousands of microearthquakes for a month in northern Oklahoma: What a large-N array can reveal about induced seismicity,** *Sara L Dougherty, Elizabeth S Cochran, Rebecca M Harrington, and Zachary E Ross*

060 **Matched-filter Detection of Microseismicity Around the Eruption of the 2018 Kilauea Volcano, Hawaii,** *Hui Huang, and Lingsen Meng*

061 **Machine Learning in detecting Low-frequency Earthquakes in Shikoku, Japan,** *Huiyun Guo, Hui Huang, Tian Feng, and Lingsen Meng*

062 **Illuminating faulting complexity of the 2017 Yellowstone (Maple Creek) earthquake swarm,** *David R Shelly, and Jeanne L Hardebeck*

063 **The Similarity Matrix Profile, an efficient method for detecting both low and high signal to noise ratio seismic events in very long time series,** *Nader Shakibay Senobari, Gareth Funning, Zachary Zimmerman, Yan Zhu, and Eamonn Keogh*

064 **Reliable Real-Time Signal/Noise Discrimination with Deep and Shallow Machine Learning Classifiers,** *Men-Andrin Meier, Zachary E Ross, Anshul Ramachandran, Ashwin Balakrishna, Peter Kundzicz, Suraj Nair, Zefeng Li, Egill Hauksson, and Thomas H Heaton*

065 **Envelope-Based Early Warning Algorithm Using Nested Grid Search,** *Becky Roh, Thomas H Heaton, and Zachary E Ross*

066 **Spatial variations of rock damage production by earthquakes in southern California,** *Yehuda Ben-Zion, and Ilya Zaliapin*

067 **Crustal seismogenic layer at active faults inferred by background seismicity and temperature data in Japan,** *Makoto Matsubara, and Tomoko E Yano*

068 **Two Moho-Depth Earthquake Swarms along the Sierra Microplate Basin and Range Boundary Region,** *Emily L Maher, Ken D Smith, Rachel L Hatch, Kent M Graham, Neal W Driscoll, and Noah Conway*

069 **Sudden Surges of Seismicity within Natural Slow Growing and Long Duration Seismicity Swarms near Cahuilla Valley in the Central Peninsular Ranges, Southern California,** *Egill Hauksson, Zachary E Ross, and Elizabeth S Cochran*

070 **Delayed Triggering of small Local Earthquakes near the San Jacinto Fault after the 2014 Mw 7.2 Papanoa Earthquake,** *Bo Li, and Abhijit Ghosh*

071 **Comprehensive Study on Reservoir-induced Seismicity in the Xiaowan Reservoir, Yunnan Province, China,** *Wei Hua, Naichen Ke, and YAQIONG DAI*

072 **Towards Quasi-Automated Estimates of Source Properties of Small to Moderate Southern California Earthquakes with Second Seismic Moments,** *Haoran Meng, Jeff J McGuire, and Yehuda Ben-Zion*

073 **Investigating microearthquake finite source attributes with IRIS Community Wavefield Demonstration Experiment in Oklahoma,** *Wenyuan Fan, and Jeff J McGuire*

074 **Fast moment acceleration in the development phase of an earthquake derived from a large catalog of Source Time Functions,** *Julien Renou, and Martin Vallée*

075 **Testing and Reconciling EGF Methods for Estimating Corner Frequency and Stress Drop from P-wave Spectra,** *Peter M Shearer, Rachel E Abercrombie, Daniel T Trugman, and Wei Wang*

076 **Characteristics of Three Small (Mw < 4.5) Urban Area Sequences in the Walker Lane: Earthquake Interaction, Fault Structure, and Source Properties,** *Rachel L Hatch, Rachel E Abercrombie, Christine J Ruhl, and Ken D Smith*

077 **Characteristics of earthquake source complexity in the San Jacinto Fault Zone,** *Qimin Wu, and Xiaowei Chen*

078 **Source parameter variability of intraslab earthquakes as determined from the empirical Green's function method,** *Shanna Chu, Gregory C Beroza, and William L Ellsworth*

079 **Effective stress drop and aseismic deformation,** *Tomas Fischer, and Sebastian Hainzl*

080 **Revisiting historical earthquakes in our backyard: 1925 Santa Barbara and 1952 Kern County,** *Scott J Condon*

081 **Applying improved spectral analysis to an induced earthquake sequence in Oklahoma and implications on earthquake triggering,** *Xiaowei Chen, and Rachel E Abercrombie*

082 **Comparison of Brune-type Stress Drops Estimated from Direct P, S, and Coda Waves,** *Wei Wang, and Peter M Shearer*

083 **Relating teleseismic backprojection images to earthquake kinematics,** *Jiuxun Yin, and Marine A Denolle*

084 **Mitigating Spatial Bias of Back-projections with the Slowness Enhanced Back Projection,** *Han Bao, and Lingsen Meng*

085 **Using Kinematic models to Evaluate the Back Projection Results,** *Baoning Wu, Bo Li, David D Oglesby, and Abhijit Ghosh*

086 **Combining back-projection and matched filter in detecting offshore seismicity: Application to NE Japan subduction zone,** *Tian Feng, and Lingsen Meng*

087 **Exploration of Prompt Elastogravity Signal for the 2004 M9.0 Sumatra and 2010 M8.8 Maule Earthquakes,** *Xinyu Jiang, and Lingsen Meng*

088 **Rupture Model of the 2016 M5.8 Pawnee Induced Earthquake,** *Morgan P Moschetti, Stephen Hartzell, and Robert B Herrmann*

089 **Rapid induced seismicity mitigation and its impact on aftershock productivity in Oklahoma,** *Thomas H Goebel, Zach Rosson, Emily E Brodsky, and Jake I Walter*

090 **Characterizing seismogenic fault structures in Oklahoma,** *Rob Skoumal, and J. Ole Kaven*

091 **2017 Mw 5.4 Pohang earthquake, South Korea and poroelastic stress change associated with fluid injection,** *YoungHee Kim, Hobin Lim, Kai Deng, Jin-Han Ree, and Teh-Ru Song*

092 **Capturing Frictional Asperities along the Complex Structure of the Main Himalayan Thrust in Nepal after the 2015 Mw 7.8 Gorkha Earthquake,** *Manuel M Mendoza, Bo Li, Abhijit Ghosh, Marianne S Karplus, John Nabelek, Soma N Sapkota, Lok B Adhikari, Simon L Klemperer, and Aaron A Velasco*

093 **Towards Seismic Inverse Problems Using Deep Learning,** *Jared T Bryan, Alexander N Breuer, and Yifeng Cui*

094 **Machine learning-based surface wave tomography of Long Beach, CA, USA,** *Michael J Bianco, Kim B Olsen, Peter Gerstoft, and Fan-Chi Lin*

095 **First-arrival traveltime tomography at Long Beach California using ambient seismic noise and the adjoint-state method,** *Jorge A Castillo Castellanos, and Robert W Clayton*

096 **New techniques in point cloud analysis of high-density seismic array data to determine three dimensional fault and crustal structures in the Long Beach Basin,** *Andrew Allevato, Robert W Clayton, and Dayanthie S Weeraratne*

097 **A Proposal for an Industry-Scale Seismic Survey in the Los Angeles Basin,** *Daniel D Hollis, and Robert W Clayton*

098 **Shallow Velocity Structure of Los Angeles Basin from ambient noise correlations with dense seismic arrays,** *Zhe Jia, Robert W Clayton, and Jorge A Castillo Castellanos*

099 **Basin Amplification Seismic INvestigation: tracking the propagation of waves from the San Andreas Fault to Los Angeles,** *Robert W Clayton, Marine A Denolle, Kim B Olsen, Patricia Persaud, and Jascha Polet*

100 **Eikonal Tomography of the Southern California Plate Boundary Region ,** *Hongrui Qiu, Yehuda Ben-Zion, and Fan-Chi Lin*

101 **Seismic imaging of the Southern California plate boundary around the South-Central Transverse Ranges using double-difference tomography and fault zone head waves,** *Pieter-Ewald Share, Hao Guo, Clifford H Thurber, Haijiang Zhang, and Yehuda Ben-Zion*

102 **Mapping Near-Surface Rigidity Structure using Co-located Pressure and Seismic Sensors from the EarthScope Transportable Array,** *Jiong Wang, and Toshiro Tanimoto*

103 **3-D upper crustal velocity structure of the Coachella Valley, Southern California: results from the salton seismic imaging project,** *Rasheed Ajala, Patricia Persaud, Joann M Stock, Gary S Fuis, John A Hole, Mark R Goldman, and Daniel S Scheirer*

104 **Modeling Crust of Columbia River Basalts Using Ambient Noise Recordings,** *Mackenzie R Wooten, Jorge A Castillo Castellanos, and Robert W Clayton*

105 **Geometric and Level Set Tomography for Interface Detection in the Near Surface,** *Jack B Muir, and Victor C Tsai*

106 **Full waveform ambient noise inversion,** *Korbinian Sager, Christian Boehm, Laura Ermert, Lion Krischer, and Andreas Fichtner*

107 **Testing the Amplitude of Ambient-field Green's Function by Simulated Scattered Waves in a 3D Sedimentary Basin,** *Shiying Nie, and Shuo Ma*

108 **Finite Frequency Sensitivity Kernel for the Correlation of Ambient Noise Correlations: Theory and Numerical Tests,** *Xin Liu, and Gregory C Beroza*

109 **Detecting the Earth's Interior Structure Using Reverse-Time Migration Based on Wavefield Normalized Cross-Correlation Imaging Condition,** *Lei Yang, Gregory C Beroza, and Liang Zhao*

110 **Shear wave velocity structure of a remnant slab beneath the western Transverse Ranges offshore southern California,** *Dayanthie S Weeraratne, Kaitlyn Amodeo, Sampath Rathnayaka, Escobar Lennin, Carlos D Gomez, and Monica D Kohler*

111 **Preliminary Site Response Results across the San Gabriel and San Bernardino Basins Utilizing the Ambient Noise Spectral Ratio Method,** *Anisha D Tyagi, Margaret Grenier, Rachel Kreuziger, Jacob S Kays, and Jascha Polet*

112 **Enhancing 0.4-1.0 Hz seismic signals in Green's functions through judicious selection of time intervals,** *Ian Vandevert, Aaron K Anderson, Taro Okamoto, and Toshiro Tanimoto*

283 **Preliminary evidence for localized lithospheric deformation in the western Basin and Range and Walker Lane from Ps receiver function analysis,** *Heather A Ford*

284 **Fault Continuity and Rupture Branching of the 2014 Mw 6.0 South Napa Earthquake Viewed by Fault-Zone Trapped Waves,** *Yong-Gang Li*

285 **The rupture process of 2018 Mw 7.0 Kalapana, Hawaii earthquake and relation with the 1975 event,** *Jinlai Hao, Wenze Deng, and Chen Ji*

286 **Magma movement from Nāpau down to Leilani Triggered the 4th May 2018 Mw 7.0 Hawaii earthquake,** *Kejie Chen, Jonathan D. Smith, Jean-Philippe Avouac, Zhen Liu, and Song Y. Tony*

Tectonic Geodesy

Posters 113-142

113 **Surface Creep Rate of the Southern San Andreas Fault Modulated by Stress Perturbations from Nearby Large Events,** *Xiaohua Xu, Lauren Ward, Junle Jiang, Bridget R Smith-Konter, Ekaterina Tymofyeyeva, Eric O Lindsey, Arthur G Sylvester, and David T Sandwell*

114 **Geodetic and geologic observations of creep on the Southern San Andreas Fault triggered by the 2017 Chiapas (Mexico) earthquake,** *Ekaterina Tymofyeyeva, Yuri Fialko, Junle Jiang, Roger Bilham, David T Sandwell, Thomas K Rockwell, Chelsea M Blanton, and Allen M Gontz*

115 **Using a dense GPS array as a strain meter on the Anza section of the San Jacinto fault,** *Margaret Grenier, and Yuri Fialko*

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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

USC, Lead John Vidale	**Harvard** John Shaw	**Texas A&M** Patrick Fulton	**UC Santa Barbara** Toshiro Tanimoto	**USGS Menlo Park** R. Harris, S. Hickman
Caltech Jean-Phillippe Avouac	**MIT** Tom Herring	**UC Los Angeles** Peter Bird	**UC Santa Cruz** Emily Brodsky	**USGS Pasadena** Kate Scharer
CGS Tim Dawson	**SDSU** Tom Rockwell	**UC Riverside** David Oglesby	**UNR** Graham Kent	**At-Large Member** Rachel Abercrombie
Columbia Bruce Shaw	**Stanford** Paul Segall	**UC San Diego** Yuri Fialko	**USGS Golden** Nico Luco	**At-Large Member** Rowena Lohman

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.

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 wells 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.

Domestic Participating Institutions and Representatives

AECOM Paul Somerville	**CSU Sacramento** Steve Skinner	**Marquette U** Ting Lin	**U Alaska Fairbanks** Carl Tape	**U New Hampshire** Margaret Boettcher
Appalachian State Scott Marshall	**CSU San Bernardino** Sally McGill	**Oregon State** Andrew Meigs	**UC Berkeley** Roland Bürgmann	**U Oregon** Ray Weldon
Arizona State J Ramon Arrowsmith	**Carnegie Mellon** Jacobo Bielak	**Penn State** Eric Kirby	**UC Davis** Michael Oskin	**U Texas El Paso** Bridget Smith-Konter
Boston University Rachel Abercrombie	**Colorado Sch. Mines** Edwin Nissen	**Portland State** Brittany Erickson	**UC Irvine** Lisa Grant Ludwig	**U Texas Austin** Whitney Behr
Brown Terry Tullis	**Cornell** Rowena Lohman	**Purdue** Andrew Freed	**U Cincinnati** Lewis Owen	**U Wisconsin Madison** Clifford Thurber
CalPoly Pomona Jascha Polet	**Georgia Tech** Zhigang Peng	**Smith** John Loveless	**U Illinois** Karin Dahmen	**Utah State** Susanne Janecke
CSU Fullerton Dave Bowman	**Indiana** Kaj Johnson	**SMU** M. Beatrice Magnani	**U Kentucky** Sean Bemis	**Utah Valley** Nathan Toke
CSU Long Beach Nate Onderdonk	**JPL** Andrea Donnellan	**SUNY at Stony Brook** William Holt	**U Massachusetts** Michele Cooke	**WHOI** Jeff McGuire
CSU Northridge Doug Yule	**LLNL** Arben Pitarka	**Tufts** Robert Viesca	**U Michigan Ann Arbor** Eric Hetland	

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.

International Participating Institutions

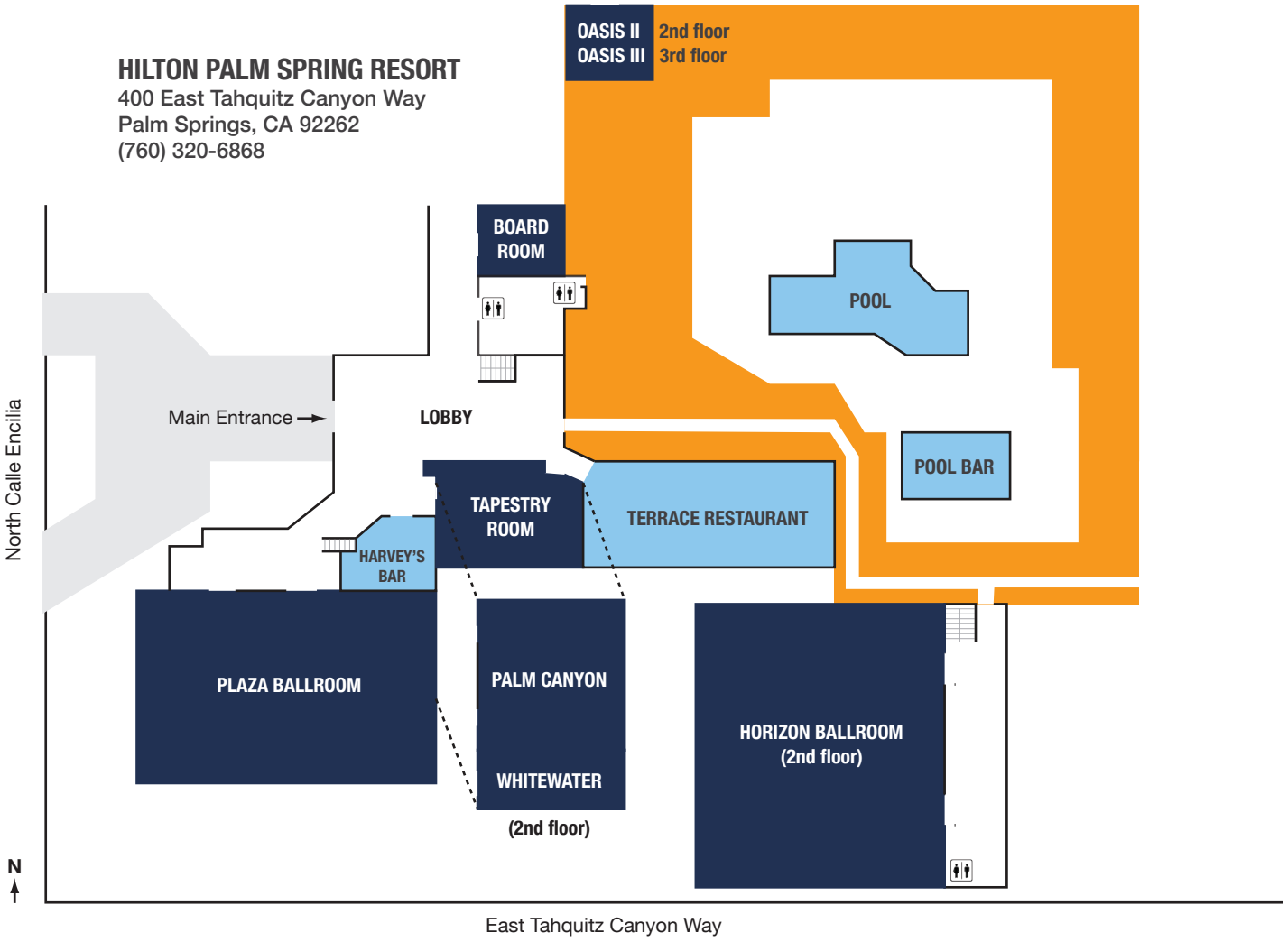
Academia Sinica (Taiwan)	**ERI Tokyo (Japan))**	**Nat'l Central U (Taiwan)**	**U Otago (New Zealand)** Mark Stirling
CEA (China)	**ETH Zürich (Switzerland)**	**Nat'l Taiwan U (Taiwan)**	**Western Univ (Canada)**
CICESE (Mexico)	**GNS (New Zealand)**	**U Bristol (United Kingdom)** Max Werner	
CRUST (Italy)	**KIGAM (Korea)** Seok Goo Song	**U Canterbury (New Zealand)** Brendon Bradley	

Apply as a Participating Institution

E-mail the application to scec@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 must be approved by a majority vote of the SCEC Board of Directors.

HILTON PALM SPRING RESORT

400 East Tahquitz Canyon Way
Palm Springs, CA 92262
(760) 320-6868



SATURDAY, September 8

09:00-17:00 Workshop: CSEP 2.0 (Plaza C)
09:00-17:00 Workshop: Community Rheology Model (Plaza D)
09:00-17:00 Workshop: Open-Source Software and Data Access (Plaza AB)
09:00-17:00 Field Trip: Cajon Pass Earthquake Gate Area

SUNDAY, September 9

07:00-17:00 Registration and Check-In (Lobby)
09:00-22:30 SCECmeetUP Space Available (Tapestry)
09:00-12:00 SCEC Special Projects Planning Meeting (Palm Canyon)
13:00-17:00 Workshop: Media Interview Theory and Practice, Through War and Peace (Palm Canyon)
13:00-17:00 Workshop: Cajon Pass Earthquake Gate Area (Horizon)
15:00-17:00 Poster Set-Up (Plaza)
17:00-18:00 Annual Meeting Welcome Social (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 (Palm Canyon)
21:00-22:30 Poster Viewing (Plaza)

MONDAY, September 10

07:00-08:00 Registration and Check-In (Lobby)
07:00-08:30 Breakfast (Poolside)
07:00-08:30 SCEC Transitions Program Student Breakfast (Tapestry)
08:00-10:10 Session 1: State of SCEC (Horizon)
10:30-12:00 Session 2: SCEC Community Models (Horizon)
12:00-13:30 Lunch (Restaurant, Tapestry, Poolside)
13:00-17:00 Registration and Check-In (Lobby)
13:30-15:00 Session 3: Dynamic Rupture Modeling (Horizon)

MONDAY, September 10 (continued)

14:00-22:00 SCECmeetUP Space Available (Tapestry)
15:00-15:30 Poster Lightning Talks (Horizon)
15:30-17:00 Poster Viewing (Plaza)
15:00-18:00 Leadership Meeting: SCEC CEO Planning Commitee (Palm Canyon)
19:00-22:00 SCEC Honors Banquet (Hotel Zoso Ballroom)

TUESDAY, September 11

07:00-08:30 Breakfast (Poolside)
07:00-08:30 SCEC Transitions Program Student Breakfast (Tapestry)
08:30-10:00 Session 4: Distributed Deformation (Horizon)
10:30-12:00 Session 5: Earthquake Simulators (Horizon)
12:00-13:30 Lunch (Restaurant, Tapestry, Poolside)
13:30-15:00 Session 6: Computational Science (Horizon)
14:00-22:00 SCECmeetUP Space Available (Tapestry)
15:00-15:30 Poster Lightning Talks (Horizon)
15:30-17:00 Poster Session (Plaza)
19:00-21:00 Group Dinner (Poolside)
21:00-22:30 Poster Viewing (Plaza)

WEDNESDAY, September 12

07:00-08:30 Breakfast (Poolside)
08:30-10:00 Session 7: ShakeOut (Horizon)
10:30-12:00 Session 8: SCEC Looking Forward (Horizon)
12:00 Adjourn 2018 SCEC Annual Meeting

12:30-14:30 SCEC PC Lunch Meeting (Palm Canyon)
12:00-14:30 SCEC Board Lunch Meeting (Tapestry)