the IRIS CONSORTIUM

The NEXT 25 Years

This material is based partly upon work supported by the National Science Foundation under award EAR-1063471. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the authors and do not necessarily reflect the views of the National Science Foundation.

IRIS
www.iris.edu

PROGRAM

Look to the Future...

The 2010 Workshop celebrated 25 years of accomplishments, based largely on facilities envisioned when IRIS was created. With the merging in 2013 of the Cooperative Agreements for core programs and USArray, the IRIS community has a special opportunity to reevaluate and possibly re-align the facilities as we look forward to the future of cooperative seismology during the next 25 years.

Science Accomplishments and Vision

The IRIS Workshop continues to serve as a forum at the cutting edge of Earth science that is unique for focusing on seismological contributions yet still covers of the full breadth of our discipline. Research enabled by IRIS facilities contributes to our understanding of:

- The effect of temperature, composition, and internal boundaries on mantle and core dynamics and the changing morphology of our living environment, and the evolution of the lithosphere and plate boundary systems over Earth history.
- The relationship between stress, strain, and deformation as exhibited through earthquakes, slow slip, volcanic eruptions and movement of fluids within the crust.
- The relationship of Earth structure and dynamics to the distribution of resources and hazards, and the system response to anthropogenic forcing.
- The interaction of atmospheric, oceanic, cryospheric, and volcanic processes with the solid Earth.

Science Program Chairs

Susan Bilek – *New Mexico Tech*
John Hole – *Virginia Tech*
Lee Liberty – *Boise State University*

Meeting Venue

Plenary sessions, poster sessions, special interest group meetings (SIGs) and pre-Workshop symposia will all be held in the Boise Centre. With a front-row view of the Boise National Forest and the pristine Boisea River, Boise Centre is located right in the heart of beautiful downtown Boise, Idaho.

Boise Centre

850 W. Front Street
Boise, Idaho 83702
P: 208-336-8900

The Grove Hotel

245 S. Capitol Blvd
Boise, Idaho 83702
P: 208-333-8000

Hampton Inn & Suites

495 S. Capitol Blvd
Boise, Idaho 83702
P: 208-331-1900

Poster Sessions

Posters will be displayed in the Eagle/Hawk room, offering over 16,000 square feet of space to comfortably view posters and enjoy refreshments during breaks from the plenary sessions. Posters on related topics are clustered and scheduled for authors to be available for discussion at the same time.

Posters will remain up throughout the meeting. You may begin to hang posters after 3:00pm on Tuesday, June 12. Posters need to be removed by 2:00pm on Friday, June 15. Poster board assignments are located in the table in the poster index of this program. Additionally, IRIS' core programs will have tables displaying publications and posters.

Internet Access

Wireless internet access is complimentary throughout the Boise Centre and the host hotels, The Grove Hotel and the Hampton Inn.

Airport Shuttle Information

Boise Airport is 4 miles from both hotels and the Boise Centre. Both hotels offer complimentary shuttle service. Look for the hotel board near the baggage claim area. Search for your hotel, push the hotel button, and a shuttle will be called for pick-up. Please check-in with your hotel concierge to secure shuttle service for your return trip to the airport.

Downtown Boise Map

Special Interest Group Meetings

(open to all)

WEDNESDAY - June 13

Next-Generation Instrumentation for Portable Seismology
– Seth Moran, James Gridley

While the IRIS 2013-2018 proposal includes a commitment to sustaining the existing PASSCAL and USArray pools of broadband, Texan, and multichannel sensor/digitizer packages, the portable pool also has limitations in terms of the types of experiments it can support. In this SIG we will discuss the science drivers for a new style of experiment involving tight spatial arrays of large numbers ("Large N") of intermediate-period (10-30s) sensors. Presentations will include summaries of discussions to date and preliminary results from an ongoing trade study, followed by community discussion of objectives and requirements.

Resources for Undergraduate Teaching in Seismology
– Maggie Benoit & Michael Hubenthal

What are the latest curricular materials available to teach seismology at a variety of undergraduate levels? What topics or resources (e.g. software, DMS tools, data sets) would you like to see developed into activities for your students? This SIG will include an overview of some of the most recently developed activities designed to be integrated into your existing courses, while also conveying the latest seismological research to your students. This will be followed by a discussion focused on eliciting feedback regarding new curricular activities that will be developed through both IRIS and the Pearson Higher Ed group. This is your chance to have an impact on the materials that will be available in the future.

GSN Data Quality
– Kent Anderson, Tim Ahern

The GSN network is two years into a major quality initiative to improve the state of the GSN dataset. This work has included the continued upgrade to the GSN field systems and infrastructure, calibration of the GSN seismometers, review and update to the station metadata, and the implementation of an updated Quality Assurance System to identify, document, rectify and report data issues to the network operators and the GSN data user community. In conjunction with the GSN effort, the DMS is revamping its data quality tools to improve and expand the metrics available to assess the quality of the overall IRIS data holdings. This SIG will provide an update to both the GSN Quality Assurance System and the DMS Quality assessment tool development.

THURSDAY - June 14

Global Array of BroadBand Arrays (GABBA)
– Chuck Ammon, Thorne Lay, Keith Koper

Important research questions related to Earth's deep interior and complex earthquake faulting processes are difficult to resolve with present day configurations of global seismic networks. However, significant progress can be made using medium-aperture (~150 km x 150 km) broadband arrays, if the number of such arrays around the world with strategic locations can be increased, with operational lifetimes of a decade or more. This SIG will explore this concept for expansion of IRIS instrumentation supporting global seismology, recognizing that strong international partnerships will be essential to achieving a system with on the order of 10 GABBA nodes around the world. We invite short contributions on research applications that have utilized current broadband arrays and dense networks of stations (from regional networks, PASSCAL deployments, etc.) of dimensions comparable to the GABBA notion, as well as contributions on complementary value of deploying additional short-period arrays around the world. We also seek to identify a GABBA working group that can advance this concept and serve as a workshop steering committee that IRIS may support in the Fall of 2012 to explore development of a proposal to augment global seismic observations with GABBA.

Seismo-Acoustics

– Brian Stump, Michael Hedlin, Stephen Arrowsmith

With the addition of both barometers and infrasound gauges to the Transportable Array a rich source of atmospheric pressure data is now available in consort with seismic data. These data are providing the ability to study sources of both seismic and acoustic energy such as shallow earthquakes, ocean storms as well as man made sources such as explosions. The data provide the opportunity to not only characterize these sources but also quantify the time varying nature of the atmosphere as well as constrain sources in the atmosphere that primarily generate pressure waves. The stations provide data for the study of coupling across a very broad frequency band between the atmosphere and the solid Earth. We will review the current opportunities that exist for combining seismic and pressure data for studying not only sources of these waves but also for characterizing the atmosphere as a function of time.

Early Career Investigators

– Danielle Sumy, Harmony Colella, Andy Frassetto

New faculty members and researchers have commitments spread across research, teaching, service, student advising, family, etc. This SIG meeting will be split into two parts. First, a panel of seasoned members of the community will profile their career paths and be available to answer questions from early career scientists. Second, we will review the current resources available to assist early career development and discuss ideas for their improvement. This SIG will serve as a formal beginning to the IRIS Early Career Investigator (ECI) Program, a community where we can foster collaboration and openly (and freely) discuss ways to overcome common challenges. We encourage all members of the IRIS community to attend and participate in this SIG. Perspectives and mentorship from more senior members of the IRIS community are particularly welcomed. For more ECI information, please visit: www.iris.iris.edu/ECI.

Special Interest Group Meetings

(open to all)

Solid Earth Science Computational Facility

– Jeroen Tromp, Alan Levander, Artie Rodgers, Louise Kellogg

With dramatic increases in the quality and quantity of geophysical data and the availability of sophisticated open-source numerical modeling tools, there is a need for a Solid Earth Science high performance computing facility. As examples, USArray and similarly dense international arrays are providing seismologists with a tsunami of new data. Data analysis is keeping up with data acquisition only for the computationally simplest analysis methods, as even computationally modest analysis is often still labor intensive. Imaging/modeling with this data requires powerful numerical modeling tools, automation of routine analysis tasks, and high-performance computing facilities, without which the power of these arrays as observational platforms for deciphering North American structure may never be realized. Such a facility was envisioned in the first IRIS proposal as long ago as 1984. Hardware structure, machine access and scheduling policies in such a facility would reflect the research, education, and training needs of the solid Earth community – thereby enabling rapid major advances in this vibrant area of research.

FRIDAY - June 15

Synergies in Seismology between GeoPRISMS and EarthScope

– Susan Schwartz, Maggie Benoit, Cliff Thurber

The GeoPRISMS Program, successor to MARGINS, offers near-term opportunities for interdisciplinary onshore-offshore investigations at three US continental margins: Alaska-Aleutians Subduction Zone, Cascadia Subduction Zone, and Eastern North American, and eventually, also in East Africa and New Zealand. Recent community planning workshops for the three US settings, jointly sponsored by GeoPRISMS and EarthScope, outlined the scientific targets and research priorities for each setting, defining research opportunities in seismology and associated interdisciplinary studies. We will review the community-developed implementation plans for these three primary sites, with emphasis on opportunities for the IRIS community, and entertain open discussions about specific projects and collaborations designed to achieve the scientific objectives of the program.

Citizen Science in Seismology

– Elizabeth Cochran and Richard Allen

The general public has been enlisted to help with seismology research and hazards mitigation in a variety of projects, ranging from the well-established such as Did You Feel It, to developing monitoring programs such as the Quake Catcher Network, to novel uses of social media. Some projects ask for volunteers to host sensors, while other go door-to-door with specific requests. This SIG will include presentations from some of the groups that count on public involvement, followed by discussion of lessons learned and strategies to engage the public in future projects.

Special Interest Group Meetings

(open to all)

International Development Seismology - What, Where, and How?

– Susan Beck, Jay Pulliam

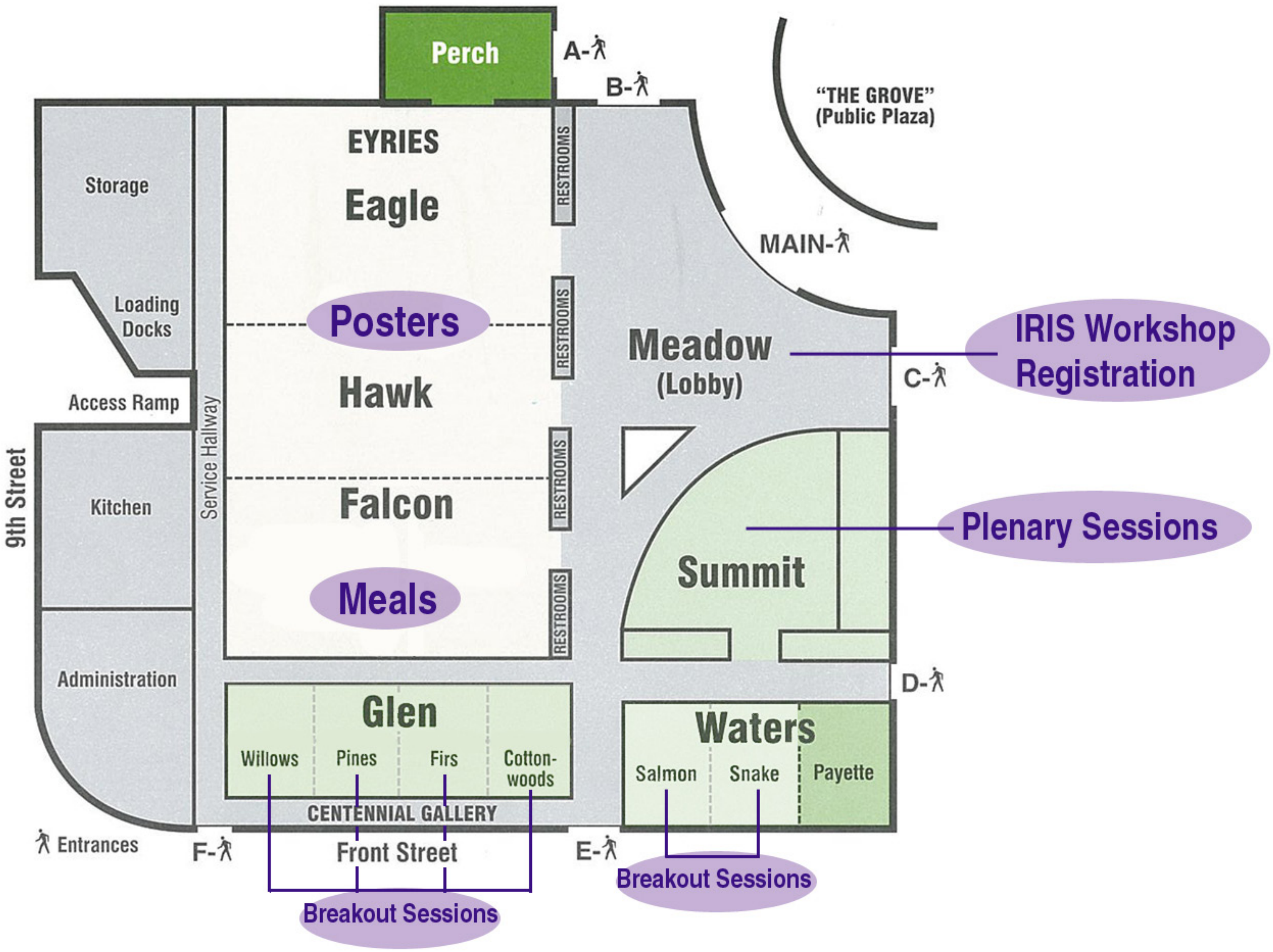
Scientific engagement in developing parts of the world presents the university community with unique challenges and exciting opportunities to directly impact society in ways that complement their fundamental research activities. In addition, scientists conducting research in developing countries have the opportunity to become true global scholars, sharing the excitement and intellectual resources of the scientific quest with local partners. While these experiences can be quite rewarding, sustaining their impetus often requires creative schemes, particularly to harness the necessary financial resources. Over the past few years, IRIS IDS has begun the exploration of these issues and the most effective ways to address them. We invite all members of the IRIS community, at any career stage to share their experiences, opinions, and recommendations for how to make global social responsibility an integral part of our exciting international seismology.

Data Products

– Chad Trabant, Tim Ahern

A discussion of data products that are or could be produced by the IRIS DMC and used by the community to aid in research. IRIS staff will give an overview of existing data products currently produced at the DMC. The DMC's product effort is community driven; this is an opportunity for direct feedback with a focus on future data products. For a list of the currently data produced products including information on future products please visit: http://www.iris.edu/dms/products/

Boise Centre Floor Plan



TUESDAY, June 12

	DMS Afternoon Tutorial on Web Services	Salmon
	OBSIP Afternoon Short Course for First-Time Users	Snake
	Educational Affiliates Dinner and Discussion Meeting	Willows
3:00-6:00 pm	Registration	Meadow Lobby
6:00-7:30 pm	Students & Post-Docs Reception *Invitation Only* • *Hors d'oeuvres and cash bar for students and post-docs participating in the workshop to meet with Senior IRIS staff and members of the Board of Directors.*	Firs-Cottonwoods

WEDNESDAY, June 13

7:30 am	Registration	Meadow Lobby
7:30 am	Breakfast	Falcons
8:30 am	Welcomes	Summit
9:00 am	Plenary Session: Recent Science Drivers and Enablers - *Rick Aster, Don Forsyth* • *Mike Ritzwoller*, "Once upon a Time on USArray" • *Brandon Schmandt*, "Community-Driven Data Collection and an Evolving View of Lithospheric Structure and Dynamics" • *Mike Brudzinski,* "New Insight into Episodic Tremor and Slip from Improved Recording Networks" • *Mark Benthien,* "Shakeouts, Scenarios, and Advances in Public Awareness and Planning"	Summit
11:00 am	Coffee Break	Eagle-Hawk
11:30 am	Special Interest Group Meetings *(concurrent)*	
	Next-Generation Instrumentation for Portable Seismology - *Seth Moran, James Gridley*	Salmon
	Resources for Undergraduate Teaching in Seismology - *Maggie Benoit, Michael Hubenthal*	Cottonwoods
	GSN Data Quality - *Kent Anderson, Tim Ahern*	Firs
1:00 pm	Lunch	Falcons
2:00 pm	Poster Sessions	Eagle-Hawk
3:30 pm	Coffee Break	Eagle-Hawk
4:00 pm	Discussion Session: The IRIS Proposal for 2013-2018 - *Brian Stump, David Simpson, Matt Fouch, John Hole*	Summit
5:30 pm	Cash Bar & Group Dinner	Falcons

THURSDAY, June 14

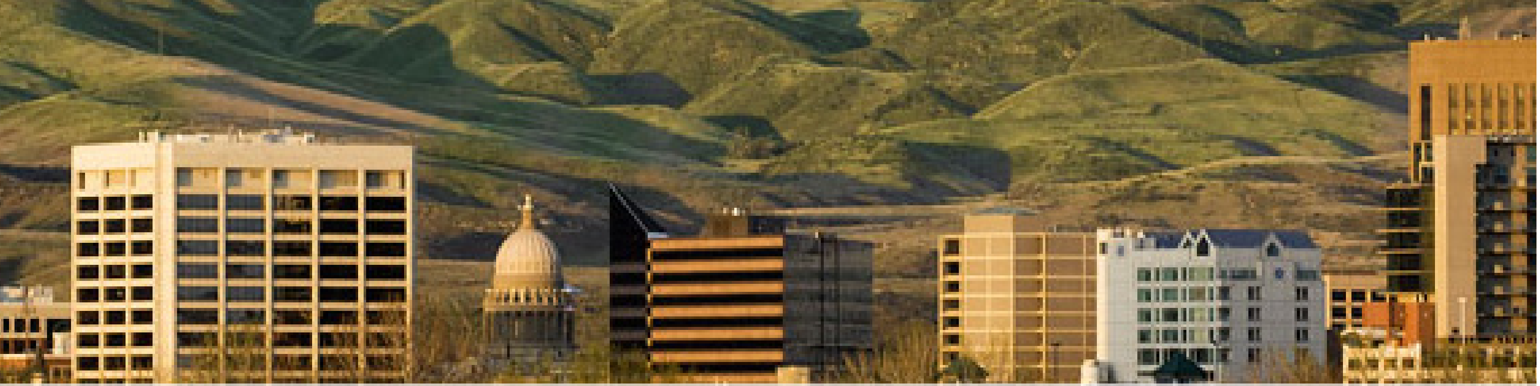
7:30 am	Breakfast	Falcons
8:30 am	Plenary Session: Imagine … Anticipated Science to Meet New Challenges - *John Vidale, Anne Sheehan* • *Kelin Wang,* “Seismology Beyond Seismic Waves: The Way Forward in the Study of Subduction Earthquakes” • *Meredith Nettles,* “Seismic Studies of the Cryosphere, Atmosphere, and Oceans” • *Matt Haney,* “The Detection of Small, Time-Varying Crustal Properties: Diving into the Seismic Dumpster for Treasure” • *Greg Beroza,* “Faulting from First Principles”	Summit
10:30 am	Coffee Break	Eagle-Hawk
11:00 am	Special Interest Group Meetings *(concurrent)*	
	Global Array of BroadBand Arrays (GABBA) - *Chuck Ammon, Thorne Lay, Keith Koper*	Salmon
	Seismo-Acoustics - *Brian Stump, Michael Hedlin, Stephen Arrowsmith*	Cottonwoods
	Early Career Investigators - *Danielle Sumy, Harmony Colella, Andy Frassetto*	Firs
	Solid Earth Science Computational Facility - *Jeroen Tromp, Alan Levander, Artie Rodgers, Louise Kellogg*	Pines
12:30 pm	Lunch	Falcons
1:30 pm	Poster Sessions	Eagle-Hawk
3:00 pm	Coffee Break	Eagle-Hawk
3:30 pm	Plenary Session: New Technology and Media -*Bob Nigbor, Elizabeth Cochran* • *James Stasiak,* “CeNSE - Hewlett-Packard’s Central Nervous System for the Earth” • *Adam Ringler,* “Where We Were, Are, and Hope to Go with Ground Motion Recording Systems” • *Frank Vernon,* “Communications Enabling the Next Generation of Seismic Systems” • *Dan Fay,* “Communicating and Advancing Environmental Understanding”	Summit
5:30 pm	Cash Bar	Falcons
6:00 pm	Group Dinner	Falcons

FRIDAY, June 15

Time	Event	Location
7:30 am	Breakfast	Falcons
8:30 am	Plenary Session: Facilities for the Next 25 Years - *Richard Allen, Jim Gaherty* • *Jesse Lawrence,* "Cyber-Social-Seismic Networks" • *Rick Aster,* "The Future of Temporary Deployments" • *Gabi Laske,* "Ocean Bottom Seismology: Past, Present and Future" • *Jeroen Tromp,* "Computational Resources for Seismology"	Summit
10:30 am	Coffee Break	Eagle-Hawk
11:00 am	Discussion Session: The Next Big Thing - *Anne Meltzer, Jeroen Tromp, Bob Woodward, Bob Busby*	
12:30 pm	Lunch	Falcons
1:30 pm	Field Trip	Meadow Lobby
1:30 pm	Special Interest Group Meetings *(concurrent)*	
	Synergies in Seismology between GeoPRISMS and EarthScope - *Susan Schwartz, Maggie Benoit, Cliff Thurber*	Pines
	Citizen Science in Seismology - *Elizabeth Cochran, Richard Allen*	Salmon
	International Development Seismology - What, Where, and How? - *Susan Beck, Jay Pulliam*	Cottonwoods
	Data Products - *Chad Trabant, Tim Ahern*	Firs
4:00 pm	Beer & BBQ	

Stonehouse Restaurant
665 Park Blvd
Boise, Idaho

- The Stonehouse Restaurant is a special events facility located 1 mile from the Boise Centre. A group will depart from the Meadow Lobby at the Boise Centre at 3:30pm to walk to Stonehouse or if you would like to meet the group at dinner, please stop by the registration table for walking directions.



Plenary Sessions

1

Rick Aster & Don Forsyth

RECENT SCIENCE DRIVERS & ENABLERS

Once upon a Time on USArray

Michael H. Ritzwoller, University of Colorado at Boulder

The story of thousands of broadband seismometers spanning a continent, professionally deployed, superbly maintained, with data ready quite literally at one's fingertips, would have been greeted fifteen years ago as a fairy tale. Now, for many young (and not so young) seismologists the building of USArray, particularly the Transportable Array, marks the crucial event of their scientific careers. An important part of the legacy of USArray will be an improved understanding of the architecture of the North American continent – one of its seminal motivations. A more dimly perceived motivation, but perhaps more important aspect of its legacy, will be its impact on the discipline of seismology.

The impacts are profound and broad, but I will speak only about one small area: the transformation of array-based surface wave seismology. Innovations stimulated by USArray include the creation of ambient noise tomography, the reformulation of the tomographic inverse problem in terms of local differential filters applied to observed travel time and amplitude fields, the extrication of subtle signals that reveal robust information about anisotropy, and the joint interpretation with other kinds of geophysical data. Interpreting the results of these innovations in a Bayesian framework helps to define another legacy of USArray, the replacement of single models with statistical distributions of model variables that can be assimilated by researchers in other fields or by future generations of seismologists.

Community-Driven Data Collection and an Evolving View of Lithospheric Structure and Dynamics

Brandon Schmandt, California Institute of Technology

Large-scale data collection programs like EarthScope are an important contributor to advances in seismology and lithospheric dynamics. Many recent successes primarily stem from access to high-quality data with an unprecedented combination of aperture and density. Prior to EarthScope, dense temporary deployments of seismometers and long-term observatories around the world provided exciting glimpses of seismology's potential to resolve the 3-D structure of the lithosphere and underlying mantle. These earlier results also identified a clear mismatch between the scale of data collection at the time and the scale of observations necessary to test fundamental hypotheses regarding the structure of the lithosphere and the nature of its coupling to the underlying mantle. This mismatch is rapidly diminishing thanks to the sustained effort of many in the community who helped to get EarthScope off the ground and guide it through several successful years. The influx of new observations and improvements in accessibility has accelerated the progress of scientists with a diverse range of motivations. Some strive to place prior "islands" of constraint in a systematic framework, and application of conventional or incrementally improved imaging methods now provides novel opportunities in this direction. Those who endeavor to push the limits of structural seismology at lithospheric and upper mantle scales are motivated by the presence of an exceptional proving ground. Others yet are motivated to explain rare events that fortuitously occurred among dense instrumentation and afford unique constraints on lithospheric properties. Results to date constitute strong progress toward addressing the fundamental science questions that inspired EarthScope, but many questions remain unanswered and others merit revision in light of recent results. Great potential also remains in the data that have been collected, and creative and integrative approaches appear increasingly important to realizing this potential.

New Insight into Episodic Tremor and Slip from Improved Recording Networks

Mike Brudzinski, Miami University of Ohio

Vast improvements in seismic and other data from plate boundary systems have illuminated highly varied and unexpected behaviors in increasing detail. One of the chief discoveries has been an intriguing class of slow earthquakes, including extended duration episodes of tectonic tremor and transient slip, which frequently rupture the transition zone of the plate interface and offer insight into the change of frictional stability along the deep roots of faults.

In this talk, I will highlight recent results in this field of research based on key improvements to recording networks that include 1) Japan's KIBAN project following the Kobe earthquake, 2) permanent and temporary arrays along the Parkfield section of the San Andreas Fault, 3) the Transportable Array, Flexible Arrays, and Plate Boundary Observatory of EarthScope, and 4) multifaceted efforts to improve seismic and geodetic recording along the Middle America subduction zone. Finally, I will discuss some of the driving factors and obstacles to pursing this new field of research.

Shakeouts, Scenarios, and Advances in Public Awareness and Planning

Mark Benthien, Sauthern California Earthquake Center

On October 20, 2011, "Great ShakeOut" earthquake drills were held in California, Nevada, Guam, Oregon, Idaho and British Columbia, involving more than 9.5 million participants who practiced how to protect themselves during earthquakes ("Drop, Cover, and Hold On"), and were encouraged to prepare to survive and recover at work, school, and home.

The ShakeOut began in southern California in 2008, as a way of involving the general public in a large-scale emergency management exercise based on a magnitude 7.8 earthquake on the San Andreas fault (the "ShakeOut Scenario," developed by a team of experts led by Dr. Lucy Jones of the U.S. Geological Survey at the request of emergency managers and other decision makers in Southern California). The goal was to promote preparedness actions by communicating the latest scientific information and recommended mitigation and preparedness behaviors in such a manner that encourages the whole community to get prepared.

The Southern California Earthquake Center (SCEC) developed advanced simulations of this earthquake that were used to estimate potential losses and casualties and also to show the public how the shaking would be throughout the region. These simulations were possible due to the application of high performance computing for simulating and visualizing dynamic fault rupture models and wave propagation throughout Southern California. In addition to scientific contributions to the ShakeOut Scenario, SCEC also hosted the ShakeOut website (www.ShakeOut.org) and created a registration system where participants could be counted in the overall total. The Earthquake Country Alliance (headquartered at SCEC with members from California science, preparedness, and community organizations) coordinated outreach and recruitment. More than 5.4 million people participated in 2008, with schools for the first time coordinating earthquake drills on the same day.

Soon after the first ShakeOut drill, participant demand convinced organizers to develop the ShakeOut into a statewide, annual event each October that grew to more than 8.5 million participants in 2011. K-12 and college students and staff comprise the largest number of participants, but the ShakeOut also has been successful at recruiting participation by businesses, non-profit organizations, government offices, neighborhoods, and individuals. Each year participants are encouraged to incorporate additional elements of their emergency plans into their ShakeOut drill.

Because of the success of the ShakeOut in California, several other states and countries have held ShakeOut drills, with websites managed by SCEC. In addition to the regions listed above, a regional drill with 9 states has now been held twice in the Central U.S. In 2012 the first Tokyo Shakeout was held in March with plans for expansion in September, Utah held its first ShakeOut in April, and New Zealand is planning a nationwide ShakeOut in September. In October 2012 the "west coast" ShakeOuts listed above will be joined by Washington State, Puerto Rico, a regional drill in the southeastern U.S., and possibly other regions. Alaska, Hawaii, and several countries (Turkey, Chile, China, and more) have also expressed interest.

Seismology Beyond Seismic Waves: The Way Forward in the Study of Subduction Earthquakes

Kelin Wang, Pacific Geoscience Centre, Geological Survey of Canada

Because of revolutionary developments in seismic and geodetic observations, we now know subduction faults display a wide range of slip modes including creep, apparent sub-convergence creep (or "partial locking"), episodic slow slip (sometimes accompanied with seismic tremor), and slower (as in tsunami earthquakes) and faster rupture. But we are still hampered by the short time span of instrumental records, difficulty in accessing the fault zone, and high cost of near-source monitoring. Our knowledge of subduction earthquakes and efforts to mitigate their impact passed most of nature's tests since 2004 but failed some major ones, and with grim consequences. Improved understanding will require advances not only in seismic wave analyses but also in areas involving material science, earthquake geology, and rock mechanics.

Lithosphere-asthenosphere coupling.

Geodetic "snapshots" of earthquake-cycle deformation from different subduction zones reveal the first-order importance of viscoelastic rheology of the asthenospheric mantle. The asymmetry between co- and inter-seismic deformation due to viscoelastic stress relaxation and its geodynamic implication have yet to be explored, and interseismic deformation models based on the assumption of elastic Earth need to be thoroughly revised. In a system as fragile as a plate boundary, it is by no means surprising that one earthquake can trigger another, but the various time delays in the stress transfer and related rheological implications demand observational and theoretical investigations.

Structural evolution of the fault zone.

Like the many large faults we observe on land, subduction faults are zones of complex 3D internal structure. Geometrical irregularities hinder shear localization and hence large rupture. Smoothing by wear and sediment fill competes against roughness renewal by off-fault fracturing and newly subducted uneven seafloor. To understand the complex seismogenic behaviour of subduction faults demonstrated by the 2011 Tohoku earthquake, especially of the shallowest segment, we need to know under what conditions a fault zone can or cannot be viewed as a frictional contact and develop concepts beyond rate-state friction. Classical questions like "whether subducting bathymetric anomalies generate of stop large earthquakes" need to be addressed from fresh perspectives. New understanding depends on a combination of seismic imaging, near-source (seafloor and borehole) monitoring, and comparison with accessible active faults and exhumed ancient subduction zones.

Petrologic evolution of the fault zone.

Different from strike-slip faults, a subduction fault undergoes drastic changes in pressure and temperature in its slip direction. "Fault maturation" thus involves not only structural but also petrologic evolution. Breakdown or formation of various hydrous minerals must strongly control subduction faults' slip and seismogenic behaviour, due to changes in both mechanical properties and pore fluid pressure. Breakthrough understanding requires new laboratory experiments on relevant rock samples under conditions representative of real subduction faults. Laboratory results combined with seismic analyses of rupture/slip source, geophysical imaging, thermo-petrologic modeling, and comparison with exhumed ancient subduction zones will greatly improve our knowledge in this regard.

Seismic Studies of the Cryosphere, Atmosphere, and Oceans

Meredith Nettles, Columbia University

The surface of the solid Earth is not opaque to signals generated in the fluid envelope: the atmosphere, oceans, and cryosphere. Seismic sources in the fluid Earth recorded clearly on seismographs anchored to the solid Earth are wide ranging, including storms at sea and on land, rapid motion and calving of ice, and bolides, man-made explosions, and volcanic eruptions in the atmosphere. A first step for seismologists studying the fluid Earth has been simply to identify these exotic (external to the solid Earth) sources. Now, good data and a better understanding of several of these types of sources allows us to use them in a systematic manner to interrogate the processes and behavior of the atmosphere, oceans, and cryosphere, as well as the mechanical properties of those systems. These seismological analyses are complementary to other disciplinary studies in glaciology, atmospheric dynamics, and oceanography, and the greatest gain in knowledge will come from integrating datasets and expertise across traditionally separate disciplines.

In the cryosphere, which exhibits both fluid and solid behavior on easily observable timescales, recent, intensive studies of the source of glacial earthquakes provide an example of the need for a focused, interdisciplinary approach to maximize the utility of seismological analysis. This effort has allowed us to identify the source mechanism that generates the seismic signal associated with glacial earthquakes: discrete ice-loss events of cubic-km scale at the margins of large outlet glaciers generate surface waves comparable to those from M~5 tectonic earthquakes that are recorded globally. By combining seismological observations with geodetic, meteorological, and glaciological approaches, the study of these earthquakes has also allowed us to identify such ice-loss events as a primary control on short-term velocity variability in these very sensitive marine-terminating glaciers. An understanding of this signal also allows an assessment of melt-driven flow variability that would otherwise be obscured by the calving signal. Similarly, studies of several atmospheric and oceanic signals are now moving beyond initial identification of fluid Earth seismic signals to analyses that shed light on the structure of the atmosphere and the processes that generate microseismic noise – or signal, properly understood.

The systematic and rigorous use of seismology to study the fluid Earth is a young subfield of the discipline. To support and facilitate progress in this area requires some efforts that overlap substantially with the needs of other seismological sub-disciplines, and some new efforts. Long-term recording of high-quality seismic data, and its proper archiving and curation, are critical, particularly to assess seasonal, inter-annual, and other temporal variability in what are typically relatively small-amplitude signals. A new challenge is to facilitate access to existing time series and other data from collaborative disciplines, including but not limited to tide-gage and bottom-pressure data, meteorological time series, infrasound data, and satellite imagery; and to ease access to seismological data and products by workers in those collaborative disciplines. In addition, support is needed for the acquisition of non-seismological, geophysical data – geodetic, meteorological, infrasound, etc. – at sites co-located or loosely co-located with seismological installations.

The Detection of Small, Time-Varying Crustal Properties: Diving into the Seismic Dumpster for Treasure

Matthew Haney, Alaska Volcano Observatory, U.S. Geological Survey

Numerous geophysical processes are aseismic insofar as they do not generate seismic waves. However, such processes may still be seismically visible since they can alter the physical properties of the Earth within a specific region. Typical changes in the propagation velocity of waves due to time-varying Earth structure are often small, on the order of 1%. This level of change cannot be resolved with traditional methods like repeated tomography. As a result, the detection of subtle changes involves the analysis of signals previously discarded at one time or another in seismology, such as the scattered coda of earthquakes or ambient seismic noise. This brings to mind the sayinag that “one man’s trash is another man’s treasure.” Building on the pioneering work of Poupinet et al. (1984; J. Geophys. Res., 89, 5719–5731), small variations in propagation velocity have been detected due to stress changes in fault zones, magma movement at volcanoes, shallow earthquake damage and subsequent healing, slow slip events and even for infrasonic waves due to atmospheric temperature inversions. In the future, the implementation of state-of-the-art seismic networks, such as borehole seismometers within the KiK-net in Japan, promises to shed new light on the distribution and timing of evolving crustal properties.

We discuss applications of detecting time-varying Earth structure with earthquake coda and ambient seismic noise. We demonstrate that resolving small velocity changes with ambient noise, in contrast to imaging velocity structure, is not prone to bias arising from erroneous Green’s functions. In other words, for detecting small changes, the distribution of noise sources needs not be uniform: the only requirement is that the noise source is stable. Various types of “dirty” passive or active sources, of anthropogenic origin even (e.g., traffic, drilling), can be envisioned as tools to precisely probe the subtle signatures of changing conditions. Within volcano seismology, new approaches to monitoring volcanic structure are possible using sources besides the oceanic microseism, such as continuous volcanic tremor.

2

John Vidale & Anne Sheehan

ANTICIPATED SCIENCE TO MEET NEW CHALLENGES

Faulting from First Principles

Gregory C. Beroza, Stanford University

Faulting in nearly all earthquakes occurs as shear slip, and the elastic rebound hypothesis of strain accumulation and release – though over a century old – forms the basic framework to interpret earthquake occurrence. Earthquake scientists have developed a wealth of ideas based on observation, theoretical considerations, and laboratory experiments, about the details about how faults work, but the fact that aspects of earthquake behavior continue to surprise us testifies to the fact that we have a lot still to learn about fault mechanics, and that the field of earthquake science is not yet mature. In this talk I will illustrate this point with some recent examples, including: slow earthquakes, the depth-dependence of fault behavior, the mechanism of intermediate-depth earthquakes, the role of large-scale geometry in rupture dynamics, the importance of fault roughness, and the potential importance of plastic deformation.

Beyond faulting itself, understanding the factors that control the shaking that results from faulting is an area in need of focused, fundamental research. The systematics and variability of earthquake faulting as expressed by earthquake scaling relations and variations of earthquake source parameters, exerts a strong influence on strong ground motion. The strong spatial variations in ground motion intensity argue for observations with sufficient density to capture that variability. Even with dense observations, the need to supplement observations with accurate, validated earthquake simulations, and the need to manipulate, and infer structure, from large waveform data sets have introduced high-performance computing drivers into earthquake science for both capacity and capability computing that will only grow with time.

An emerging motivation for understanding the mechanics of faulting is that it has become increasingly clear that understanding earthquakes is central to future energy options. Most obviously, the future of nuclear power is deeply intertwined with understanding and mitigating the threat posed by earthquakes. Possible induced earthquakes related to shale gas development, enhanced geothermal development, and CO_2 sequestration are poorly understood, but managing them could prove critical to developing these alternative low/no-carbon energy options for the 21st century.

3

Bob Nigbor & Elizabeth Cochran

NEW TECHNOLOGY & MEDIA

CeNSE – Hewlett-Packard's Central Nervous System for the Earth

James Stasiak, Hewlett-Packard Company

CeNSE, the Central Nervous System for the Earth is Hewlett-Packard's vision for a new level of awareness created by the fusion of networks of millions of sensors, always-available data storage, and advanced analysis tools. Our sensor effort is focused on creating a Moore's Law for sensing using nanotechnology to push the boundaries of size, power consumption and integration to create more capable sensor nodes at lower cost. Our networking effort lays the conceptual groundwork for the communication fabric of a global-scale sensor network, including new architectures, protocols, and codes with scalability and versatility. Our analytics effort implements real-time event visibility to develop actionable information from data. Integrating sensors within a complete system that encompasses sensors, networks, storage capabilities, and computation and analysis tools will enable a new level of awareness, revolutionizing communication between objects and people.

The first part of this presentation will focus on HP's development of a new class of ultra-sensitive, low-power, seismic-grade MEMS accelerometers that can deliver high-precision data capture at ultra-low frequencies. When integrated into a large-scale wireless network, this technology will enable a wide range of seismic survey and monitoring applications including more effective oil and gas exploration. The second part of the presentation will focus on HP's development of other sensing technologies designed to bring the same level of sensitivity, scalability and versatility to other physical domains including a new approach to chemical and biological sensing using a novel, nanofabricated Surface Enhanced Raman Spectroscopy (SERS) technology. Finally I will end with a brief overview of our current efforts in the development of next-generation sensors and discuss how new discoveries in quantum photonics, nanofabrication and fundamental device physics are being used to create sensors that will offer unprecedented performance and capabilities.

Where We Were, Are, and Hope to Go with Ground Motion Recording Systems

Adam T. Ringler, Albuquerque Seismological Laboratory, U. S. Geological Survey

The wide frequency band (sub mHz to hundreds of Hz) of interest as well as the dynamic range required (over 200 dB of dynamic range) in modern seismology is truly amazing. Our current seismic systems are able to record very long period Earth tides as well as near fault high frequency ground motions. Looking back, our field has come a long way from Zhang Heng's initial seismoscope (~12 dB of dynamic range) and we are no longer satisfied at characterizing earthquakes as "somewhere in the East." The first global networks using paper records (~46 dB of dynamic range) were revolutionized when the seismic community moved to digital recording systems (~96 dB of dynamic range). Even these systems were quickly superseded by our modern recording systems (~156 dB of dynamic range) and as with any technology we can only expect this to improve. In this talk we will explore where the innovations in our data systems and recording devices might come from, some of the limitations we might encounter, and some of the things we hope to see in recording systems as we move forward in our ability to measure ground motions.

Communications Enabling the Next Generation of Seismic Systems

Frank Vernon, University of California, San Diego

In the last 20 years, the communication infrastructure has developed rapidly and has dramatically impacted seismology. Projects such as the NSF EarthScope USArray program went from a concept phase in the 1990s to the current day fully operational real time streaming data system. What allowed this to happen was that the rapid evolution of moderately low power, IP-based satellite systems and the advent and proliferation of digital mobile phone communications at affordable costs. Looking into the future, seismology will have observing systems spanning from very dense two dimensional and even three dimensional arrays, to regional scale arrays and networks, to global scale networks. We will continue to probe with the goal of resolving Earth structure with much higher resolution. Higher frequency measurements will be made to understand the physics of the earthquake source. Sensors will be deployed in some of the remotest parts of the planet including long term monitoring observations on the seafloor and in the arctic regions. Will we be able to overcome current limitations of wireless communication? In remote locations and harsh environments, such as the subsurface and the ocean bottom, what technologies will allow us to extract the information and knowledge we need and also creates data sets which can be reanalyzed as new algorithms are developed? To make effective use of our data streams, we will need to incorporate new communication methodologies that are being driven by the demands for mobile communications and networking in the terrestrial environment and to embrace advances in cables, acoustics, and optical communications in the marine environment.

Communicating and Advancing Environmental Understanding

Dan Fay, Microsoft Research

Our understanding of the world around us is evolving, and with evolution comes the need for adaptation. Environmental scientific research is increasingly having to adapt – from dealing with increasingly large and growing datasets, to trying to credibly inform the public and policy makers. There is a need to have new types of applications grounded in scientific research to move from raw discovery, to knowledge, to informing practical decisions. There are opportunities to utilize computing to visualize and analyze seismic information in new ways to gain insights.

Increasingly, scientific breakthroughs will be powered by advanced computing capabilities that help researchers manipulate and explore massive datasets. The speed at which any given scientific discipline advances will depend on how well its researchers collaborate with one another, and with technologists, in areas of eScience such as databases, workflow management, visualization, and cloud computing technologies.

Technology reinforced by computing is demonstrating the capacity to improve our environmental understanding. This talk contains examples of environmental changes and the challenges that are the focus of scientific investigation; it also identifies technologies and tools that can make an impact on these understandings.

Cyber-Social-Seismic Networks

Jesse F. Lawrence, Stanford Universitya

Modern technology, cyber-infrastructure, and citizen science are ushering in a new era for strong-motion seismic data gathering loosely described as cyber-social-seismic networking. This represents one of several technological steps that the earthquake seismology community will encounter over the coming years. In a community that always expects more and sets the standards for how scientists should interface with each other and the public, cyber-social-seismic networking is inevitable.

To fulfill the exponential growth of seismic observations our community craves, we must reduce 1) equipment costs, 2) installation time, 3) maintenance time, 4) operation costs, and 5) retro-active metadata corrections. The Quake-Catcher Network (QCN) is one of several networks designed and built to test one method for achieving these goals. We reach these objectives by connecting low-cost 3-axis micro-electro-mechanical systems (MEMS) accelerometers to the USB ports on internet-connected computers hosted by volunteers. The volunteers install QCN sensors and provide Internet, power, and shelter, thereby reducing installation, operation and maintenance costs. The sensor data automatically uploads from the volunteer's computer to the QCN server, including metadata, so no post-facto human intervention is necessary.

Since 2008, QCN's volunteer computers have recorded and detected strong-motion accelerations from 1000s of moderate-to-large events worldwide. QCN's sensors record earthquakes with PGAs comparable to traditional strong-motion sensors (e.g., the Episensor), have accurate time (error typically $<\pm 2$ ms), and best of all – archive data automatically. Every 18 months the low-cost MEMS technology improves such that the noise floor approximately halves, which means more lower-magnitude earthquake records from greater distances. While this improvement is expected to slow or stop at some point due to electronic noise and Brownian motion, silicon chips follow Moore's Law and disk storage follows Kryder's Law despite similar expected limitations. Furthermore, there is great research going into parallel sensor systems, which can greatly improve the stacked signal.

What can Cyber-Social-Seismic Networks do for us now?

Cyber-social-seismic networks are able to detect and characterize earthquakes rapidly. For example, QCN's median time between earthquake origin and earthquake detection near dense networks is ~9s. The magnitude estimates are within 1 magnitude unit for >90% of the earthquakes for this short delay. Due to the large number of sensors, such networks can yield no false detections even with ultra-fast algorithms that utilize only early parts of the waveform. AlertMaps and web content related to each event can be created and updated very rapidly (< 1s). The ease of installing sensors following large mainshock events (e.g., Maule, Chile and Darfield, New Zealand) allows cyber-social-seismic networks to rapidly deploy in populated regions to measure the aftershocks. Such rapid aftershock mobilization programs benefit scientists and citizens alike.

What will Cyber-Social-Seismic Networks do for us in the Future?

Increasingly dense networks of increasingly sensitive accelerometers, will take advantage of array processing techniques that benefit from N(N-1)/2 relative observations between N records, rather than just N observations. Several examples include cross-correlation back-projection techniques, travel-time tomography, small-scale ambient noise tomography from virtual source up through to a building rafters, evaluation of un-aliased high-frequency (0.2-1Hz) amplification effects.

The Future of Temporary Deployments

Rick Aster, New Mexico Tech

The general technology and methodology associated with IRIS PASSCAL and similar portable research instrumentation pools for imaging and other seismological studies during the past 25 years has been remarkably stable; one could argue that the last major development of the present system was the wholesale incorporation of GPS timing (and the retiring of other timing systems) circa 20 years ago! The general reasons for this remarkable level of stasis are that the current technology is highly effective and has only recently begun to reach its limits of scalability. The phenomenal success of portable force feedback broadband seismic sensors in capturing an extraordinarily valuable sector of the seismological spectrum at an (sometimes semi-) affordable cost, the increasing need for ever larger pools of associated standardized dataloggers with uniform operational protocols, the sporadic nature of sufficiently large funding opportunities to upgrade large subsets of the instrumentation, and the extraordinarily broad range of evolving scientific opportunities (which has kept the PASSCAL instrumentation pool very well exercised) have all contributed to this stable situation. However, as was the case during the inception of PASSCAL, scientific ambitions and technological capabilities are approaching an interesting and likely historical juncture where new efforts that would employ much larger pools of portable (short period through broadband) instrumentation are realizable. This talk will overview some key science targets and methodologies that can be facilitated by a new "superpool" that would be capable of fielding many hundreds to thousands of seismographs at a time, and will explore what logistical and technical capabilities will be required to effect their deployment in the next generation of seismological experiments at a range of spatial and temporal scales.

Ocean Bottom Seismology: Past, Present and Future

Gabi Laske, University of California, San Diego

Until about 15 years ago, ocean bottom seismology was largely confined to active source seismology.

The latter has facilitated detailed studies of the structure and evolution of marine sediments, the crystalline crust and the uppermost mantle immediately below the Moho. A few long-range refraction seismic surveys have hinted a stratification in the oceanic lithosphere but detailed three-dimensional surveys remained elusive not lastly due to the lack of longterm passive broadband seismology on the ocean floor. On land, passive broadband seismology has been the key tool since the 1980s to obtain deeper, detailed views of the mantle. We know from these studies that the mantle can be quite complex, even beneath regions of large-scale tectonic stability such as continental cratons. Apart from the existence and extent of mantle plumes, one of the currently most hotly debated topics is the nature and evolution of the lower lithosphere, the upper asthenosphere and the boundary in between. It is only the combination of broadband seismic studies that allows such debates.

Following advances in battery and low-power data acquisition technology, broadband seismology on the ocean floor finally became a reality about 10 years ago. The advent of the NSF-funded Ocean Bottom Seismometer Instrument Pool (OBSIP) in 2000 allowed PIs to use shared resources to address key scientific objectives presented in the Oceanic Mantle Dynamics (OMD) Science and Implementation Plans. These objectives include but are not limited to: the seismic signature and origin of mantle plumes, the stratification and evolution of the oceanic lithosphere, the depth distribution of seismic anisotropy, the structure and nature of the continent-ocean boundary. The realization of the OMD Science Plan heavily depends on the development and establishment of instrumentation in three deployment modi: 1) broadband OBSIP instruments to conduct one to two major field projects per year (assuming 3- to 4-year grants for ~ \$1.5 M for science costs + \$0.8 M for OBS deployment costs + ship costs); 2) extension of the global seismic network (GSN) into the oceans to fill crucial gaps in data coverage; this involves borehole installations of very broadband, observatory equipment; known initially as the Ocean Seismic Network (OSN) 3) leapfrogging arrays of buried intermediate-band sensors (at \$20K/instrument) to augment the OSN; assumed are 2-year grants (\$150K/year + \$200K OBS deployment costs + ship costs). Of these, only the first deployment modus is currently successfully implemented.

While some investigators may report and lament pitfalls in ocean bottom seismology compared to experiments on land, recent OBSIP deployments have been largely successful regarding instrument recovery, data return and data quality. This essentially allowed the utilization of the full range of seismic tools including body wave and surface wave tomography, receiver functions, as well as shear-wave splitting and surface wave azimuthal anisotropy. Truth be told, one has to work around the ocean noise, especially when working with horizontal-component seismograms, but this is not a show stopper. Still, there is room for improvement: 1) OBSs have no GPS clocks and recent work indicates that assumed linear clock drift corrections may not be adequate. The use of atomic clocks helps in this respect; 2) the tilt noise on the horizontal components is considerable. Burial would likely help but this drives deployment costs beyond current "reasonable" funding limits. Perhaps, this calls for innovations in data post-processing; 3) equipment deployed in shallow seas needs to be made trawl resistant; 4) equipment needs to be re-engineered to allow deployment in very deep oceans; the depth limit for most current equipment is 6000 m; 5) the current drop-and-retrieve OBS deployment modus does not allow realtime data access.

It is perhaps this last point that makes current OBS deployments relatively unattractive for studies with immediate social impact such as earthquake and tsunami monitoring. Solutions include moored installations and cabled observatories such as H2O, MARS or NEPTUNE. Recent advances in wave glider technology also promise that real time data access in the ocean may be within our reach. There is also room for thinking broader in terms of sensors used at a particular station. On land, the co-deployment of accelerometers and (very)broadband seismometers as well as pressure sensors and/or infrasound equipment greatly expands the range of scientific studies. In the oceans, current instrument packages routinely include a pressure sensor. A differential pressure gauge (DPG) is extremely successful at recording the passage of a tsunami but it does not appear to be adequate to record wave climate at frequencies much above 1 Hz. Given the high deployment costs on the ocean floor, it seems logical to co-deploy equipment of even a greater variety of scientific flavors, including non-seismic sensors. This is in fact the intention of the Ocean Observatory Initiative (OOI) that evolved from the original OSN idea. Sadly, the

Ocean Bottom Seismology: Past, Present and Future cont...

initial inclusion of the OSN has been dropped along the way and it seems that a top priority of the seismic community should be to rectify this dilemma.

References:

Forsyth, D. and Detrick, B., Oceanic Mantle Dynamics Science Plan - An Interdisciplinary Initiative to Study the Dynamics of the Oceanic Upper Mantle, July 2000.

Oceanic Mantle Dynamics Implementation Plan: Report of a Community Workshop, September 2002.

both available at ***http://www.whoi.edu/science/GG/omd/***

Computational Resources for Seismology

Jeroen Tromp, Princeton University

In recent years, modeling, simulation and computation have come to play a central role in modern solid Earth science in general, and seismology in particular. Currently, our community is poorly organized in terms of high-performance computational (HPC) research facilities. Solid Earth science would benefit from a dedicated HPC center tailored to the unique needs of our community, taking advantage of existing open source software. Hardware structure, and machine access and scheduling policies in such a facility would reflect the research, education & training needs of the solid Earth community, thereby enabling rapid major advances in this vibrant area of research. We believe that such a facility can be set up at one of the many existing HPC centers in the U.S., allowing us to leverage an existing environment of HPC knowledge, and avoid the costs of acquiring the physical infrastructure for the hardware.

With dramatic increases in the quality and quantity of geophysical data and the availability of sophisticated open-source numerical modeling tools, we believe that there is a need for a dedicated HPC center for computational Solid Earth Science. As an example, the EarthScope USArray Transportable Array, the permanent Backbone Array, and the Flexible Array are providing seismologists with a tsunami of new data. Data analysis is keeping up with data acquisition only for the computationally simplest analysis methods, as even computationally modest analysis is often still labor intensive. Modeling of and imaging with this data requires powerful numerical modeling tools, automation of routine analysis tasks, and dedicated high-performance computing facilities, without which the power of the USArray as an observational platform for deciphering North American structure may never be realized. Such a facility was envisioned in the first IRIS proposal as long ago as 1984. Similarly, modern geodynamic modeling requires large HPC resources to make 3D predictions at the resolution needed to match observations of deformation, uplift, subsidence, flow patterns etc., made by different geoscience disciplines across a range of scales from 1 to 1000 kilometers. It is well known that near surface properties, such as basin structure and shear wavespeed and attenuation, control much of the damaging strong motions during moderate to great earthquakes. As both fine-scale local structure as well as regional-scale wave propagation from complex fault rupture scenarios must be modeled to accurately predict strong motions, earthquake hazard assessment necessarily requires dedicated HPC resources.

Computing and numerical methods have now progressed to the point that simulation has become an integral part of modern Earth sciences, and particularly so for seismology and geodynamics. The goal of a computational Earth science center is to provide our community a system structured specifically for our simulation/imaging needs, which include large fast storage capacity, large memory, and a large number of cores, configured in a system designed for long run-times, which also allows for user interaction between iterations in compute intensive inversions.

Most simulations are currently performed on modest in-house facilities, or through grants at various national supercomputing centers. A dedicated simulation center would accommodate the substantial computational demands of modern solid Earth science, including, for example, kinematic and dynamic rupture simulations to assess seismic hazard, data assimilation simulations in geodynamics, seismology, and geomagnetism, full waveform inversions in global and regional seismology, and high-pressure and temperature mineral physics simulations. Such a facility would not obviate the need for local resources, instead the local facilities would be used for development, scenario testing, and education, acting as the on-ramp to the Earth science HPC facility. The facility would benefit investigators at universities that have limited HPC resources by providing facilities, software engineering, training and a community specific environment to draw on.

Crustal Structure

Poster Presentations

1 ★	Ezer Patlan, Antony Walmawa, Lennox E Thompson, Ashley Grijalva, Galen Kaip, Aaron A Velasco	Ambient Noise Tomography Studey of the Insight Structure of Menengai Caldera: Geothermal Prospect in the Central Keyna Domes
2 ★	Celso R. Alvizuri (University of Alaska Fairbanks), Alexandra Farrell (UAF), Qingping Yu (UAF), Christopher Bruton (UAF), Michael West (UAF), Stephen McNutt (UAF), Doug Christensen (UAF), Carl Tape (UAF)	Source and Structural Investigations at Uturuncu Volcano, Bolivian Andes (PLUTONS Project)
3	G. S. Fuis (U.S. Geological Survey (USGS)), J. A. Hole (Virginia Polytechnic Institute and State University (Virginia Tech)), J. M. Stock (California Institute of Technology), N. W. Driscoll (Scripps Ins)	The Salton Seismic Imaging Project: Investigating Earthquake Hazards and Rifting Processes in the Salton Trough, Southern California
4	Fan-Chi Lin (Seismolab Caltech), Brandon Schmandt (Seismolab Caltech), Victor C. Tsai (Seismolab Caltech), Michael H. Ritzwoller (University of Colorado Boulder)	Rayleigh Wave Phase Velocity, Local Amplification, and Ellipticity Observed Across USArray: Is 3D Density Tomography in the Crust and Upper Mantle Possible?
5	Nori Nakata (Colorado School of Mines), Roel Snieder (Colorado School of Mines)	Near-surface Weakening in Japan after the Tohoku-Oki Earthquake on March 11, 2011
6 ★	Kui Liu (Virginia Tech), Ying Zhou (Virginia Tech)	On Iterative Inversions of Global Crustal Structure Using Finite-frequency Sensitivity Kernels
7 ★	Lindsay L. Worthington (Texas A&M University), William L. Yeck (University of Colorado at Boulder), Kate C. Miller (Texas A&M University), Anne F. Sheehan (University of Colorado at Boulder), Eric A. Ersl	Crustal Thickness and Velocity Structure Across the Bighorn Mountains, Northern Wyoming: Insights into Laramide-style Orogenesis from the Bighorn Arch Seismic Experiment (BASE)
8	D. McNamara (USGS), R. Williams (USGS), M. Chapman (Virginia Tech, Blacksburg), M. Withers (CERI, Memphis, TN), S. Horton (CERI, Memphis, TN), A. Meltzer (Lehigh University Bethlehem, PA), N. Barstow (IRIS)	Eastern US Attenuation and Site Amplification Characteristics from the Mw 5.8 Central Virginia Seismic Zone Earthquake of August 23, 2011 and Aftershocks
9 ★	Lianqing Zhou (University of Illinois at Urbana-Champaign, USA; Institute of Geophysics, China Earthquake Administration, Beijing, China), Xiaodong Song (University of Illinois at Urbana-Champaign, US)	Rayleigh Wave Attenuation Tomography for China Mainland
10 ★	Y. Chang, R. B. Herrmann (Saint Louis University)	Crustal Structure Between Missesota and the Gulf Coast from Joint Inversion of Surface-Wave Dispersion and Receiver Functions
11 ★	Mallory Morell (Univ. of Arizona), Kevin M. Ward (Univ. of Arizona), Susan L. Beck (Univ. of Arizona), Steve Roecker (Rensselaer Politechnic Inst), Anne Meltzer (Lehigh Univ), Lucy Brown (Lehigh Univ)	Imaging the Forearc in South-Central Chile Using Receiver Function Migration and Ambient Noise Tomography
12	Shuo Ma (San Diego State University), Gregory C. Beroza (Stanford University)	Extraction of Ambient-Field Green's Functions From Asynchronous US Array Data
13	Vera Schulte-Pelkum (University of Colorado), Hao Kuo-Chen (SUNY Binghamton), Francis Wu (SUNY Binghamton)	A View of the Taiwan Orogeny from Joint Receiver Functions, Local Seismicity, and Tomography
14 ★	E. Horry Parker (University of Georgia), Robert B. Hawman (University of Georgia), Karen M. Fischer (Brown University), Lara S. Wagner (University of North Carolina - Chapel Hill)	Preliminary Receiver Function Analysis from the Southeastern Suture of the Appalachian Margin Experiment (SESAME)
15 ★	Kevin M. Ward (The University of Arizona), Ryan Porter (Carnegie Institution of Washington), George Zandt (The University of Arizona), Susan L. Beck (The University of Arizona), Estela Minaya (El Observat)	Ambient Noise Tomography of the Central Andes

16 ★	Gabrielle Tepp, Manahloh Belachew, Cynthia Ebinger (EES Department, University of Rochester), Mario Ruiz (IGEPN, Ecuador), L Davidge (EES Department, University of Rochester)	Imaging Crustal Magma Reservoirs Beneath Sierra Negra and Cerro Azul Volcanoes, Galapagos
17	Jiayi Xie (U. Colorado), Michael H. Ritzwoller (U. Colorado)	Imaging Crustal Radial Anisotropy Structure in the Eastern Tibetan Plateau Using Ambient Noise
18	Justin S. Ball (CIRES and the Department of Geological Sciences, University of Colorado, Boulder), Anne F. Sheehan (CIRES and the Department of Geological Sciences, University of Colorado, Boulder)	Mode-Converted Shear Waves and Seafloor Compliance Measurements off the South Island of New Zealand
19	Hersh Gilbert (Purdue University)	Crustal Structure of the Western United States
20	J. Chaput, R. Aster (New Mexico Tech), A. Nyblade, S. Anandrakrishnan (Penn State University), S. Hansen (University of Alabama), D. Wiens (Washington University), A. Huerta (Central Washington University)	Receiver functions on ice: Crust, ice and sediment properties for POLENET
21 ★	Siham Mourad (Mohammad V Univ., Morocco), Gene Humphreys (Univ. of Oregon), Alan Levander (Rice Univ)	Receiver Function Analysis of PICASSO Data in Morocco

Lithosphere, Lithosphere/Asthenosphere Boundary

Poster Presentations

22	Nicholas Schmerr (NASA Goddard)	Imaging the Base of a Tectonic Plate: Evidence for Melt and Volatiles at the Lithosphere-Asthenosphere Boundary
23 ★	Will Levandowski, Craig Jones, Weisen Shen, and Mike Ritzwoller (University of Colorado at Boulder)	Buoyancy Sources in the Western U.S.
24	Sergei Lebedev (Dublin Institute for Advanced Studies/IRIS Consortium), Stefan Bartzsch (Friedrich Schiller University of Jena), Thomas Meier (Christian Albrechts University of Kiel)	Lithosphere-asthenosphere Boundary Resolved with Seismic Surface Waves
25	Brigitte Endrun (University of Potsdam), Sergei Lebedev (Dublin Institute for Advanced Studies), Thomas Meier (Christian Albrechts University of Kiel), Celine Tirel (Dublin Institute for Advanced Studies)	Complex, Layered Deformation Within the Aegean Crust and Mantle Revealed by Seismic Anisotropy
26	Ryan C. Porter (Department of Terrestrial Magnetism, Carnegie Institution of Washington), Matthew J. Fouch (Department of Terrestrial Magnetism, Carnegie Institution of Washington)	Seismic Structure of the Lithosphere Within the Great Basin
27	YoungHee Kim (Lamont-Doherty Earth Observatory), Geoffrey A. Abers (Lamont-Doherty Earth Observatory), Jiyao Li (Lamont-Doherty Earth Observatory), Doug Christensen (University of Alaska, Fairbanks), Josh Stachnik (University of Alaska, Fairbanks)	Imaging Mega Thrust Zone in Alaska Subduction Zone
28	Elmer Ruigrok (Delft University of Technology), Dylan Mikesell (Boise State University), Kasper van Wijk (Boise State University)	Scanning for Velocity Anomalies in the Crust and Mantle with Diffractions from the Core-mantle Boundary
29 ★	Ryan Porter (Department of Geosciences, The University of Arizona), Hersh Gilbert (Department of Earth & Atmospheric Sciences, Purdue University), George Zandt (Department of Geosciences, The University of Arizona)	Shear-Wave Velocities in the Pampean Flat-Slab Region from Rayleigh Wave Tomography: Implications for Slab and Upper Mantle Hydration
30 ★	Heather Ford (Brown University), Karen Fischer (Brown University), Vedran Lekic (University of Maryland)	The Lithosphere-Asthenosphere Boundary Beneath California

31 ★	Joe McClenahan (University of Wyoming), Ken Dueker (University of Wyoming), Katie Foster (University of Wyoming), Steve Hansen (University of Wyoming), Brandon Schmandt (California Institute of Technology)	West of Mississippi River Ps/Sp Images from EarthScope-PASSCAL Data: Taxonomy of LAB and MLD Negative Velocity Gradients and Interpretation of the MLD as a Metasomatic Freezing Front
32	Vera Schulte-Pelkum (U Colorado Boulder), Glenn Biasi (U Nevada Reno), Anne Sheehan (U Colorado Boulder), Craig Jones (U Colorado Boulder)	Differential Motion Between Upper Crust and Lithospheric Mantle in the Central Basin and Range
33	L.S. Wagner (UNC-Chapel Hill), M.D. Long (Yale University), S.L. Beck, G. Zandt (University of Arizona), H. Tavera (Instituto Geofisico De Peru)	PULSE: The Peru Lithosphere and Slab Experiment
34	Weisen Shen (Center for Imaging the Earth's Interior, Department of Physics, University of Colorado at Boulder), Michael H. Ritzwoller (Center for Imaging the Earth’s Interior, Department of Physic)	A 3-D Shear Velocity Model of the Crust and Uppermost Mantle Beneath the Western US from Bayesian Monte Carlo Inversion of Surface Wave Dispersion and Receiver Functions
35	Derek Schutt (Colorado State University), Janine S. Buehler (University of California at San Diego), Anthony R. Lowry (Utah State University), Ken	Constraining Lithospheric Geotherms through Joint Inversion of Surface Heatflow and Pn Temperatures
36 ★	Steven M. Hansen (University of Wyoming), Ken Dueker (University of Wyoming)	Structure and Support of the Southern Rocky Mountains from CREST and TA Seismic Data
37	Amberlee Darold (University of Oregon), Gene Humphreys (University of Oregon)	Explaining the Columbia River Flood Basalts
38	Huaiyu Yuan (Berkeley Seismological Laboratory), Barbara Romanowicz (Berkeley Seismological Laboratory)	Azimuthal anisotropy in the global upper mantle

Mantle and Core Structure and Dynamics — Poster Presentations

39	Songqiao Shawn Wei (Washington University in St. Louis), Douglas A. Wiens (Washington University in St. Louis)	The Seismic Structure of the Lau Backarc Spreading Center from Rayleigh Wave Tomography
40 ★	Jing Jin (University of Illinois at Urbana-Champaign), Xiaodong Song (University of Illinois at Urbana-Champaign)	Velocity and Attenuation Structure of the Earth's Inner Core Boundary Based on an Automatic Waveform Modeling Method
41 ★	I. Palomeras (Rice University), S. Thurner (Rice Unversity), K. Liu (Rice University), A. Levander (Rice University), J. Gallard (ICTJA-CSIC)	PICASSO: Lithosphere Structure in the Western Mediterranean from Ps Receiver Functions and Rayleigh Wave Tomography
42 ★	Yanhua Yuan, Frederik Simons, et alia (Princeton University)	Solving Global Tomographic Models with 3D Spherical Wavelets
43 ★	Lun Li (University of Houston), Aibing Li (University of Houston), Yang Shen (University of Rhode Island), Eric A Sandvol (University of Missouri), Danian Shi (China Academy of Geological Sciences, Hongyi)	Rayleigh Wave Tomography in the Northeastern Tibetan Plateau
44 ★	Haiying Gao (University of Rhode Island), Yang Shen (University of Rhode Island)	Seismic Evidence for 3D Decompression Melting at the Cascadia Subduction Zone
45	Brandon Schmandt (Caltech), Ken Dueker (U. Wyoming), Steve Hansen (U. Wyoming)	Mapping Transition Zone Topography Beneath USArray
46 ★	Z. Eilon (Lamont-Doherty Earth Observatory of Columbia University, Palisades, NY USA), YH. Kim (Lamont-Doherty Earth Observatory of Columbia University, Palisades, NY USA), G.A. Abers (Lamont-Doherty)	The CDPapua Experiment: A Seismological Investigation of the Woodlark Rift, Papua New Guinea

47	Kenneth Smith (NSL-University of Nevada Reno), David von Seggern (NSL-University of Nevada Reno), Graham Kent, NSL-University of Nevada Reno (Amy Eisses, NSL-University of Nevada Reno), Neal Driscoll (NSL-University of Nevada Reno)	Moho-Depth Diking and Rifting of the Sierra Nevada Microplate
48 ★	Melissa M. Moore-Driskell (University of Memphis), Heather R. DeShon (University of Memphis), Wolfgang Rabbel (Christian-Albrechts-University), Martin Thorwart (Christian-Albrechts-University), Yvonne Dzier	3D Double Difference Velocity Tomography of Costa Rica and Nicaragua
49	Matthew J. Fouch (Department of Terrestrial Magnetism, Carnegie Institution of Washington), John D. West (School of Earth and Space Exploration, Arizona State University)	The Mantle Flow Field Beneath Western North America
50 ★	Chunquan Yu (EAPS-MIT), Xuefeng Shang (EAPS-MIT), Robert van der Hilst (EAPS-MIT), Maarten de Hoop (CCAM-Purdue)	Seismic Imaging of the Upper Mantle Discontinuities Across the Western United States: CCP and ARF-RTM Approach
51	Yang Shen (U Rhode Island), Wei Zhang (U Rhode Island)	Full-Wave Ambient Noise Tomography of the Eastern Hemisphere
52 ★	Katie Foster (University of Wyoming), Ken Dueker (University of Wyoming), Steve Hansen (University of Wyoming), Brandon Schmandt (CalTech)	Sp Imaging of the Sierra Nevada Range, Isabella Anomaly, and Gorda Plate
53 ★	Katie Foster (University of Wyoming), Ken Dueker (University of Wyoming), Steve Hansen (University of Wyoming), Brandon Schmandt (CalTech)	Sp imaging of the Escalante Anomaly in Southern Utah
54 ★	Risheng Chu (Caltech), Wei Leng (Caltech), Don V Helmberger (Caltech), Michael Gurnis (Caltech)	Hidden Hotspot Track beneath Eastern United States
55	Gabi Laske (Scripps Institution of Oceanography), John A. Collins (Woods Hole Oceanographic Institution), Cecily J. Wolfe (University of Hawaii at Manoa)	Rayleigh Waves from the PLUME Network Document Asymmetric Lithosphere and Asthenosphere Structure beneath the Hawaiian Swell
56 ★	S W French (UC Berkeley; Berkeley Seismological Laboratory), Vedran Lekic (University of Maryland), Barbara Romanowicz (UC Berkeley; Berkeley Seismological Laboratory)	Global Waveform Tomography of the Upper Mantle Using the Spectral Element Method: A Second-Generation Model
57 ★	Sanne Cottaar (UC Berkeley), Barbara Romanowicz (UC Berkeley)	A large ultra-low-velocity zone at the base of the mantle near Hawaii
58	Zhao Zheng (University of California, Berkeley), Barbara Romanowicz (University of California, Berkeley; College de France)	Apparent “double SS precursors”: artifacts from scattering at the Rocky Mountain Front

Episodic Tremor and Slip, Triggered Earthquakes

Poster Presentations

60 ★	Blaine Bockholt (University of Memphis), Charles Langston (University of Memphis), Heather DeShon (University of Memphis)	Possible Nonvolcanic Tremor on the Reelfoot Fault?
61 ★	John D. West (Arizona State University School of Earth and Space Exploration), Matthew J. Fouch (Carnegie Institution of Washington Department of Terrestrial Magnetism)	Investigating Long-term Seismic Activity Using Integrated Ground Motion
62 ★	Aurelie Guilhem (Berkeley Seismological Laboratory now at Lawrence Berkeley National Laboratory), Robert M. Nadeau (Berkeley Seismological Laboratory)	Nonvolcanic Tremors and Deep Slow Slip Events in Central California

63	Aaron A. Velasco (University of Texas at El Paso), Deborah L. Kilb (Scripps Institution of Oceanography), Kristine L. Pankow (University of Utah)	Bulk Processing of USArray Data in Search of Dynamic Earthquake Triggering
64	Pascal Audet (University of Ottawa), Susan Y Schwartz (University of California Santa Cruz)	Structural and Hydrologic Controls on Subduction Zone Seismogenic Behaviour at the Nicoya Peninsula, Costa Rica
65 ★	Danielle F. Sumy (National Science Foundation Postdoctoral Fellow visiting at the United States Geological Survey, Pasadena, CA, USA), Elizabeth S. Cochran (United States Geological Survey, Pasadena, C)	Investigating the Spatial and Temporal Distribution of Earthquakes and Tremor Along the Cholame Segment of the San Andreas Fault
66 ★	Justin R Sweet (University of Washington), Kenneth C Creager (University of Washington)	Systematic Variability in LFE Recurrence Time Up and Downdip
67	Kevin Chao (Georgia Tech), Zhigang Peng (Georgia Tech), Hector Gonzalez-Huizar (U.T. El Paso), Chastity Aiken (Georgia Tech), Aaron Velasco (U.T. El Paso)	Global Observations of Triggered Tectonic Tremor
68 ★	Stefany M. Sit (Miami University), Michael R. Brudzinski (Miami University)	Quantifying Tectonic Tremor in Southern Mexico and its Curious Relationship to Slow Slip, Earthquakes, and other Tremor Triggers
69	T. Thomas (University of Washington), J.E. Vidale (University of Washington), A. Ghosh (University of California Santa Cruz), K.C. Creager (University of Washington), H. Houston (University of Washington,)	Zooming-In on Cascadia Episodic Tremor and Slip with an Array of Arrays
70 ★	Susan Y. Schwartz, Jake Walter (UC Santa Cruz), Marino Protti, Victor Gonzalez (OVSICORI-UNA, Costa Rica), Andrew Newman (Georgia Institute of Technology)	Slow Slip and Tremor at the Northern Costa Rica Subduction Zone
71 ★	Manahloh Belachew (University of Rochester), Cindy Ebinger (University of Rochester), Dustin Cote (University of Rochester)	Dynamics of Dike Intrusions and 3D Velocity Structure beneath an Incipient Seafloor Spreading Center in Afar, Ethiopia
72 ★	Jacob Walter (University of California Santa Cruz), Susan Y. Schwartz (University of California, Santa Cruz)	Shallow Offshore Tremor and Slow Slip at the Nicoya Peninsula, Costa Rica
73	Amanda Klaus (University of Washington), Ken Creager (University of Washington), Aaron Wech (Victoria University of Wellington), Justin Sweet (University of Washington)	Influence of Tides on Cascadia Tremor Amplitudes
74	Carl Ulberg, Ken Creager, Justin Sweet, Aaron Wech	Search for Tectonic Tremor in Central Chile Following the February 2010 Maule Earthquake
75	Ken Creager (U. Washington), Justin Sweet (U. Washington)	Slow Rupture Speed of Low Frequency Earthquakes
76	Jing Wu (CAS), Zhigang Peng (GT), Weijun Wang (CEA), Xuan Gong (CEA), Qi-Fu Chen (CAS), Chunquan Wu (LANL)	Comparisons of dynamic triggering near Beijing, China following the recent Sumatra earthquakes

THURSDAY - June 14

★ Student Presentations

Faults, Earthquakes, and Other Sources

Poster Presentations

77 ★	Kate Allstadt (University of Washington), Steve Malone (University of Washington), John Vidale (University of Washington)	Correlation Between Repeating Earthquake Activity and Weather at Mount Rainier Volcano
78 ★	Kayla A. Kroll (UC Riverside), Elizabeth S. Cochran (US Geological Survey), Keith B. Richards-Dinger (UC Riverside)	Complex Faulting in the Yuha Desert Shown By Newly Detected Aftershocks

79	Steven R. Taylor (Rocky Mountain Geophysics), Phillip E. Harben (Rocky Mountain Geophysics), Steve Jarpe (Jarpe Data Solutions), David B. Harris (Deschutes Signal Processing)	Ground Truth Monitoring System
80 ★	Jeffrey S. Lockridge (School of Earth and Space Exploration, Arizona State University), Matthew J. Fouch (Department of Terrestrial Magnetism, Carnegie Institution of Washington), J Ramon Arrowsmith (Arizona State University)	Capturing Small-Scale Seismicity with EarthScope's USArray Transportable Array
81	Ellen M. Syracuse (University of Wisconsin-Madison), Rob A. Holt (Victoria University of Wellington), Martha K. Savage (Victoria University of Wellington), Jessica H. Johnson (Victoria University of Wellington)	Temporal and Spatial Evolution of Hypocentres and Anisotropy from the Darfield Aftershock Sequence: Implications for Fault Geometry and Age
82	Kasper van Wijk (Boise State University), Dylan Mikesell (Boise State University), Vera Schulte-Pelkum (CU Boulder), Josh Stachnik (UofA Fairbanks)	Estimating the Rayleigh-wave Impulse Response Between Seismic Stations with the Cross Terms of the Green Tensor
83	Deb Fagan (Boise State University), Kasper van Wijk (Boise State University), Jim Rutledge (MEQ Geo)	Spectral Analysis for Earthquake Cluster Detection
84	Oner Sufri (University of Utah), Keith D. Koper (University of Utah)	Microseisms from 2009 Hurricane Ida Recorded Across the Transportable Array
85 ★	K.K. Davenport (Virginia Tech), J.A. Hole (Virginia Tech), L.D. Brown (Cornell University), D.A. Quiros (Cornell University), L. Han (Virginia Tech), W. Mooney (U.S. Geological Survey Menlo Park), M. Chapman (Virginia Tech)	Aftershock Imaging with Dense Arrays (AIDA) Following the August 23, 2011 Virginia Earthquake
86	Jonathan Tytell (UC San Diego), Frank Vernon (UC San Diego), Jennifer Eakins (UC San Diego)	Real-Time Observation of EF3 Tornado Passage Near USArray TA Station Y46A on 4/27/2011
87	Rachel E. Abercrombie (Boston University)	Comparison of Direct and Coda Wave Stress Drop Measurements for the Wells, Nevada, Earthquake Sequence
88	Lingsen Meng (Caltech), Jean-Paul Ampuero (Caltech), Joann Stock (Caltech), Zacharie Duputel (Caltech), Yingdi Luo (Caltech), Victor Tsai (Caltech)	Rupture Branching of the 2012 M8.6 Sumatra Earthquake
89 ★	Joshua P. Richardson, Gregory P. Waite (Michigan Technological University)	Source Inversion of Repetitive Long-Period Seismicity beneath Villarrica Volcano, Chile
90 ★	Jaime A. Convers (Georgia Institute of Technology), Andrew V. Newman (Georgia Institute of Technology)	The Use of Seismic Energy Release for Real-time Characterization of Tsunami Potential from Slow-source and Giant Earthquakes
91	Shaun Finn (Boise State University), Lee Liberty (Boise State University)	Near Surface Exposures of Megathrust Splay Faults in Prince William Sound, Alaska
92 ★	Chen Ji (UCSB), Guangfu Shao (UCSB), Gavin Hayes (NEIC, USGS), Xiangyu Li (UCSB)	A Multiple Double Couple Analysis of the April 11, 2012 Mw 8.6 Off the West Coast of Sumatra Earthquake and its Largest Aftershock
93	Guangfu Shao, Chen Ji, and Ralph Archuleta (Department of Earth Science, University of California Santa Barbara)	Quality of Earthquake Source Models Constrained by Teleseismic Waves: Using the 2011 M9 Tohoku-Oki Earthquake as an Example
94 ★	Kasey Aderhold (Boston University), Rachel E. Abercrombie (Boston University)	Oceanic Strike-Slip Earthquakes Along the Sumatra Subduction Zone
95	K. M. Cleveland (Penn State), T. F. VanDeMark (AFTAC), C. J. Ammon (Penn State)	Precise Relative Relocation of Oceanic Transform Fault Earthquakes Using Rayleigh-Waveforms
96	Eric Matzel (Lawrence-Livermore National Laboratory)	Imaging faults using virtual seismometers
97	Max Bezada (University of Oregon), Gene Humphreys (University of Oregon)	Contrasting rupture processes for sub-events within a well-recorded deep earthquake

98	A. T. Ringler (U.S. Geological Survey), D. Wilson (U.S. Geological Survey), C. R. Hutt (U.S. Geological Survey), L. S. Gee (U.S. Geological Survey), Y. Prior (Honeywell Technology Solutions Incorporated)	Calibration Coil Forcing Constants from Sine Waves
99	David Wilson (USGS Albuquerque Seismic Lab), Adam Ringler (USGS Albuquerque Seismic Lab), Tyler Storm (HTSI Albuquerque Seismic Lab), Bob Hutt (USGS Albuquerque Seismic Lab), Lind Gee (USGS Albuquerque Seismic Lab)	The Importance of Removing Seismic Sensor Instrument Response
100 ★	Katherine E. Anderson (New Mexico Tech), Jacob F. Anderson (New Mexico Tech), Robert E. Anthony (New Mexico Tech), Julien Chaput (New Mexico Tech), Nicole D. McMahon (New Mexico Tech), Emily A. Morton (New Mexico Tech)	A Site Comparison Between Shallow Vault-Deploted and Direct Burial Broadband Seismometers
101	Alberto Lopez-Venegas (University of Puerto Rico, Mayaguez), Dwight Williams (Morehouse College/ University of Michigan)	Focal Mechanisms & Thermal Fluctuations of Seismometers
102	Elizabeth S. Cochran (U.S. Geological Survey), Jesse F. Lawrence (Stanford University), Angela Chung (Stanford University), Anna Kaiser (GNS Science), Bill Fry (GNS Science), John Evans (U.S. Geological Survey)	Ground Motion Estimates and Rapid Earthquake Detection Using the Quake-Catcher Network
103	Jonathan Berger (Scripps Instution of Oceanography), John Orcutt (SIO), Gabi Laske (SIO), Jeff Babcock (SIO), John Brennan (Liquid Robotics, Inc.,)	Autonomously Deployed Deep-Ocean Seismic System
104	T. Dylan Mikesell, Kasper van Wijk (Department of Geosciences, Boise State University)	Monitoring Glacier Surface Seismicity in Time and Space Using Rayleigh Waves
105 ★	Emily Wolin (Northwestern University), Suzan van der Lee (Northwestern University)	Evaluation and Animation of Noise at SPREE Flexible Array and Transportable Array Stations
106 ★	Zagid Abatchev (UCLA), Paul Davis (UCLA)	Seismicity Distribution in the Peruvian Andes
107	Monica Maceira (Los Alamos National Laboratory), Carene Larmat (Los Alamos National Laboratory), Rob Porritt (UC Berkeley), Richard Allen (UC Berkeley), Charlotte Rowe (Los Alamos National Laboratory)	3D Seismic Models and Finite-Frequency vs Ray Theoretical Approaches
108	Michael Hedlin (UCSD), Kris Walker (UCSD), Doug Drob (NRL)	A Study of Infrasonic Anisotropy and Multipathing in the Atmosphere Using Seismic Networks
109	Hui Long (Stony Brook University)	Using Repeating Earthquakes to Quantitatively Determine Temporal Changes of Medium Proper
110 ★	Jennifer M. Tarnowski (University of California, Riverside), David D. Oglesby (University of California, Riverside)	Preliminary dynamic models of potential earthquakes in the San Gorgonio Pass, CA
111	Steven C. Jaume (College of Charleston)	Teaching Undergraduate Seismology with Spreadsheets and Global Earthquake Explorer (GEE)
112	Kasper van Wijk (Boise State University), Ted Channel (Boise State University), Martin Smith (Blindgoat Geophysical), Chris Knudsen (New England Research Inc)	Recording Earthquakes with the Slinky Seismometer
113	Glenn C. Kroeger (Trinity University, San Antonio, TX)	SeismicCanvas: Interactive Software for Accessing and Analyzing Seismic Waveform Data

BOTH DAYS - June 13-14

Facility

Poster Presentations

IRIS staff members will be available to share literature and discuss IRIS facilities during the poster session on both days at these and other posters, as well as an Active Earth Monitor.

Bob Butler (University of Portland), Tammy Bravo (IRIS), Michael Hubenthal (IRIS), Jenda Johnson (Volcano Video Productions), Aubrey Patsika (IRIS)	IRIS: InClass - Infrastructure to Support the Dissemination and Implementation Seismology Education Resources at the Undergraduate Level
Patrick McQuillan (IRIS Consortium), Russ Welti (IRIS Consortium), Shelley Olds (UNAVCO)	Create a Real-Time Geoscience Display for Your Department's Lobby
Michael Hubenthal (IRIS), John Taber (IRIS), Rick Aster (New Mexico Tech)	IRIS' Undergraduate Internship Program Celebrates its 15th Year and Offers New Opportunities for Community Involvement!
The Staff of the Albuquerque Seismological Lab	Data Quality Control procedures at the USGS Albuquerque Seismological Lab (ASL)
L. Astiz, J. A. Eakins, V. M. Martynov, T. A. Cox, J. Tytell, G.H. Karasu, R.L. Newman, J. C. Reyes, G. A. Davis, F.L. Vernon (All at U.C. San Diego, Scripps Institution of Oceanography)	The ANF Seismic Bulletin
Celso G Reyes (IRIS DMC), Chad Trabant (IRIS DMC), Yazan Suleiman (IRIS DMC), Rich Karstens (IRIS DMC)	MATLAB Joins the Growing Number of Methods for Direct IRIS-DMC Data Access
M. Bahavar (IRIS DMC), A. Hutko (IRIS DMC), R. Karstens (IRIS DMC), C. Trabant (IRIS DMC)	Data products at the IRIS DMC
Ray Willemann (IRIS Consortium), Greg Beroza (Stanford University), Shuo Ma (San Diego State University)	Leveraging Asynchronous Dense Deployments – An Important Benefit from Extending the Operation of "One-in-Four" TA Stations

Participant List

Zagid Abatchev
University of California, Los Angeles
595 Charles Young Drive, East
Box 951567
Los Angeles, California 90095
208-389-8256
abatchev@ucla.edu

Geoff Abers
Lamont-Doherty Earth Observatory of Columbia University
61 Rte 9W, Palisades, New York 10964
845-365-8539
abers@ldeo.columbia.edu

Kasey Aderhold
Boston University
675 Commonwealth Ave
Stone Science Room 141
Boston, Massachusetts 2215
509-481-7423
kasey@bu.edu

Tim Ahern
IRIS Consortium
1408 NE 45th Street
Suite 201, Seattle
Washington 98105
206-547-0393
tim@iris.washington.edu

Richard Allen
University of California, Berkeley
307 McCone Hall
Berkeley, California 94720
510-642-1275
rallen@berkeley.edu

Kate Allstadt
University of Washington
Box 351310, Dept of Earth and Space Science
4000 15th Avenue NE
Seattle, Washington 98195
206-543-0570
allstadt@uw.edu

Chuck Ammon
Pennsylvania State University
Department of Geosciences
440 Deike Building
University Park, Pennsylvania 16802
814-865-2310
charlesammon@psu.edu

Pablo Ampuero
California Institute of Technology
1200 E. California Blvd. MC 252-21
Pasadena, California 91125
626-395-6958
ampuero@gps.caltech.edu

Greg Anderson
National Science Foundation
4201 Wilson Blvd
Room 785.27
Arlington, Virginia 22230
703-292-4693
greander@nsf.gov

Katherine E Anderson
New Mexico Tech
2132 Coal Avenue Se
Albuquerque, New Mexico 87106
505-506-2726
katiandss@gmail.com

Kent Anderson
IRIS Consortium
30 McLaughlin Lane
Sandia Park, New Mexico 87047
505-228-3082
kent@iris.edu

Ramon Arrowsmith
Arizona State University
550 East Tyler Mall
PSF Rm #683, Tempe, Arizona 85287
480-236-9226
ramon.arrowsmith@asu.edu

Sarah Ashmore
IRIS Consortium/Data Management Center
1408 NE 45 St, Suite 201
Seattle, Washington 98105
206- 547-0393 ext. 120
sarah@iris.washington.edu

Rick Aster
New Mexico Tech
Earth and Environmental Science Dept.
Socorro, New Mexico 87801
575-835-5924
aster@ees.nmt.edu

Luciana Astiz
University of California, San Diego
3455 Wellesly Ave
San Diego, California 92122
858-534-2976
lastiz@ucsd.edu

Pascal Audet
University of Ottawa
Department of Earth Sciences
223 Marion Hall
Ottawa, Ontario K1N 6N5 Canada
613-562-5800 #2344
pascal.audet@uottawa.ca

Ken Austin
UNAVCO, Inc.
400 E University Way
Dept of Geological Sciences, CWU
Ellensburg, Washington 98926
303-775-2415
austin@unavco.org

Sandra Azevedo
IRIS Consortium/PASSCAL
801 Leroy Place, IRIS/PASSCAL
Socorro, New Mexico 87801
575-835-5090
sazevedo@passcal.nmt.edu

Steve Azevedo
IRIS Consortium/PASSCAL
801 Leroy Place, IRIS/PASSCAL
Socorro, New Mexico 87801
575-835-5090
azevedo@passcal.nmt.edu

Justin Ball
University of Colorado, Boulder
CIRES Building, Rm #318
Boulder, Colorado 80309
justin.ball@colorado.edu

Stephen Bannister
GNS Science, New Zealand
PO Box 30368
Lower Hutt, New Zealand
s.bannister@gns.cri.nz

Mary Baranowski
IRIS Consortium
1200 New York Ave NW, Suite 400
Washington, District of Columbia 20005
202-682-2220
maryb@iris.edu

Rodey Batiza
National Science Foundation
4201 Wilson Blvd.
Fairfax, Virginia 22230
703-292-7710
rbatiza@nsf.gov

Bruce Beaudoin
IRIS Consortium/PASSCAL
100 East Rd
New Mexico Tech, Socorro
New Mexico 87801
575-835-5070
bruce@passcal.nmt.edu

Susan Beck
University of Arizona
Dept. of Geosciences, Gould Simpson Building
Tucson, Arizona 85721
520-621-8628
slbeck@email.arizona.edu

Maggie Benoit
The College of New Jersey
53 Montague Ave
Ewing, New Jersey 8628
609-771-2237
benoit@tcnj.edu

Rick Benson
IRIS Consortium/Data Management Center
1408 NE 45th St
Seattle, Washington 98105
206-547-0393
rick@iris.edu

Susan Bilek
New Mexico Tech
Earth and Environmental Sci Dept
801 Leroy Place
Socorro, New Mexico 87801
575-835-6510
sbilek@nmt.edu

Blaine Bockholt
University of Memphis
1275 Applebrook Ln #6
Memphis, Tennessee 38134
208-577-0526
bbckholt@memphis.edu

Steve Bohlen
Lawrence Livermore National Lab
7000 East Avenue L-184
Livermore, California 94550
925-699-2972
bohlen1@llnl.gov

Mike Brudzinski
Miami University of Ohio
114 Shideler Hall
Oxford, Ohio 45056
513-280-0660
brudzimr@muohio.edu

Bob Busby
IRIS Consortium
37 Haynes Avenue
Falmouth, Massachusetts 2540
508-801-7628
busby@iris.edu

Bob Butler
University of Portland
Environmental Studies MSC 182
5000 N Willamette Blvd
Portland, Oregon 97203
503-943-7780
butler@up.edu

Olga Cabello
IRIS Consortium
1200 New York Ave, Suite 400
Washington, District of Columbia 20005
202-682-2220
olga.cabello@iris.edu

Rick Carlson
National Science Foundation
4201 Wilson Blvd
Arlington, Virginia 22203
979-229-1283
rcarlson@nsf.gov

Rob Casey
IRIS Consortium/Data Management Center
1408 NE 45th St
Seattle, Washington 98105
206-547-0393
rob@iris.washington.edu

Ying Chang
Saint Louis University
205 O'Neil Hall
3642 Lindell Blvd
Saint Louis, Missouri 63108
314--977-3131
ychang14@slu.edu

Ted Channel
Boise State University
1875 N. Tuscolano Pl.
Eagle, Idaho 83616
208-286-4787
tchannel@cableone.net

Julien Chaput
New Mexico Tech
801 Fitch St
Socorro, New Mexico 87801
575-418-9617
jchaput@ees.nmt.edu

Wang-Ping Chen
Zhejiang University
Ocean Hall, Zijingang Campus
366 Yuhangtang Rd., Zhejiang Univ.
Hangzhou, 310058 China
wpchen@uiuc.edu

Yu Chen
Stony Brook University
255 ESS Building
Stony Brook, New York 11794
631-632-1790
yucchen@ic.sunysb.edu

Jiajun Chong
University of California, Berkeley
201 McCone Hall, Berkeley
Seismological Lab
UC Berkeley,
Berkeley, California 94720
jiajunchong@gmail.com

Doug Christensen
University of Alaska Fairbanks
P.O. Box 82821
Fairbanks, Alaska 99708
907-474-7426
doug@giseis.alaska.edu

Risheng Chu
California Institute of Technology
1200 E California Blvd
MC 252-21
Pasadena, California 91125
626-395-2439
chur@gps.caltech.edu

Adam Clark
IRIS Consortium/Data
Management Center
7541 37th Ave NE
Seattle, Washington 98115
206-547-0393
adam@iris.washington.edu

Mike Cleveland
Pennsylvania State University
438 Deike Bldg
University Park, Pennsylvania 16802
937-462-0521
kmc388@psu.edu

Elizabeth S. Cochran
U.S. Geological Survey
525 S. Wilson Ave
Pasadena, California 91106
626-583-7238
escochran@gmail.com

Harmony Colella
Miami University of Ohio
114 Shideler Hall
Oxford, Ohio 45056
colellhv@muohio.edu

Jaime Convers
Georgia Institute of Technology
311 Ferst Drive, School of EAS
Atlanta, Georgia 30332-0340
404-384-2229
jconvers@gatech.edu

Tim Cote
NRCan/GSC
7 Observatory Crescent
Ottawa, Ontario K1A 0Y3, Canada
613-943-1581
tcote@nrcan.gc.ca

Gale J. Cox
IRIS Consortium/Data
Management Center
1408 NE 45th St
Seattle, Washington 98105
206-547-0393
gale@iris.washington.edu

Trilby Cox
UCSD-USArray-ANF
1112 Waukesha Street
Butte, Montana 59701
406-498-9995
tacox@ucsd.edu

Kathy Davenport
Virginia Tech
Department of Geosciences
4044 Derring Hall (0420)
Blacksburg, Virginia 24061
423-612-3212
kdavenport@vt.edu

Pete Davis
University of California, San Diego
UCSD/IGPP 0225
9500 Gilman Drive
La Jolla, California 92093-0225
858-277-8554
pdavis@ucsd.edu

Perle Dorr
IRIS Consortium
1200 New York Ave, NW, Suite 400
Washington, District of Columbia 20005
202-682-2220
dorr@iris.edu

Melissa Moore-Driskell
University of Memphis
3890 Central Ave
Memphis, Tennessee 38152
256-765-4174
mmdrskll@Memphis.edu

Ken Dueker
University of Wyoming
916 south 13
Laramie, Wyoming 82070
307-742-1765
dueker@uwyo.edu

Jennifer Eakins
University of California, San Diego
MC-0255, 9500 Gilman Drive
La Jolla, California 92093-0255
303-530-3985
jeakins@ucsd.edu

Cindy Ebinger
University of Rochester
227 Hutchison Hall
Rochester, New York 14627
585-276-3364
cebinger@ur.rochester.edu

Goran Ekstrom
Columbia University
LDEO, 61 Route 9W
Palisades, New York 10025
845-365-8427
ekstrom@ldeo.columbia.edu

Brent Evers
IRIS Consortium
1200 New York Ave, NW, Suite 400
Washington, District of Columbia 20005
202-682-2220 ext. 156
brent.evers@iris.edu

Dan Fay
Microsoft Research
1 Microsoft Way
Redmond, Washington 98052
425-706-4947
danf@microsoft.com

Megan Flanagan
Lawrence Livermore National Laboratory
LLNL, L-046 PO Box 808
Livermore, California 94550
925-422-3945
flanagan5@llnl.gov

Heather Ford
Brown University
324 Brook Street
Box 1846
Providence, Rhode Island 2912
401-863-1965
heather_ford@brown.edu

Don Forsyth
Brown University
Box 1846, Brown University
Providence, Rhode Island 2912
401-863-1699
donald_forsyth@brown.edu

Katie Foster
University of Wyoming
1000 University Ave.
University of Wyoming
Laramie, Wyoming 82071
805-570-2353
kfoste14@uwyo.edu

Matt Fouch
Carnegie Institution of Washington
Department of Terrestrial Magnetism
5241 Broad Branch Rd., NW
Washington, District of Columbia 20015
202-478-8827
fouch@dtm.ciw.edu

Mathias Franke
Kinemetrics
222 Vista Ave.
Pasadena, California 91107
626-795-2220 X699
mf@kmi.com

Andy Frassetto
IRIS Consortium
1200 New York Ave, Suite 400
Washington, District of Columbia 20005
andyf@iris.edu

Gary Fuis
U.S. Geological Survey
345 Middlefield Rd.
Menlo Park, California 94025
650-329-4758
fuis@usgs.gov

Jim Gaherty
Columbia University
LDEO 61 Rt 9W
Palisades, New York 10964
845-365-8450
gaherty@ldeo.columbia.edu

Haiying Gao
University of Rhode Island
215 South Ferry Road
Narragansett, Rhode Island 2882
401-874-6222
hgao@gso.uri.edu

Paul Golden
Southern Methodist University
818 Torrey Pines Ln.
Garland, Texas 75044
972-742-1538
pgolden@smu.edu

Steve Golonka
Refraction Technology
1600 Tenth Street
Plano, Texas 75074
214-440-1265
s.golonka@reftek.com

James Gridley
IRIS Consortium
100 East Rd
Socorro, New Mexico 87801
575-835-6933
james.gridley@iris.edu

Aurelie Guilhem
Lawrence Berkeley National Laboratory
1 road Cyclotron
Berkeley, California 94720
510-542-7276
aurelieguilhem@gmail.com

Katrin Hafner
IRIS Consortium
4314 Bella Vista Dr.
Longmont, Colorado 80503
509-899-5449
hafner@iris.edu

Matt Haney
U.S. Geological Survey
4230 University Dr.
Anchorage, Alaska 99508
907-786-7111
mhaney@usgs.gov

Roger Hansen
University of Alaska, Fairbanks
1370 Viewpoint Dr.
Fairbanks, Alaska 99709
907-474-5533
roger@giseis.alaska.edu

Steve Hansen
University of Wyoming
608 E Sheridan
Laramie, Wyoming 82070
shansen1@uwyo.edu

Phil Harben
Rocky Mountain Geophysics
32025 Nichols Lane
Cottage Grove, Oregon 97424
925-667-1120
philip.harben@gmail.com

Steve Harder
University of Texas at El Paso
Dept. of Geological Sciences
Univ. of Texas at El Paso
El Paso, Texas 79968
915-747-5746
harder@utep.edu

Khalil Hayek
Canadian Hazards Information Service
7 Observatory Crescent
Ottawa, Ontario K1A 0Y3 Canada
613-992-5699
khalil.hayek@nrcan.gc.ca

Gavin Hayes
U.S. Geological Survey
P.O. Box 25046, MS 966
Denver, Colorado 80225
303-273-8421
ghayes@usgs.gov

Tom Hearn
New Mexico State University
Physics Dept.
New Mexico State University
Las Cruces, New Mexico 88003
575-646-5076
thearn@nmsu.edu

Michael Hedlin
University of California, San Diego
5675 Lord Cecil Street
San Diego, California 92122
858-534-8773
hedlin@ucsd.edu

Sid Hellman
Instrumental Software Technologies, Inc.
77 Van Dam Street, Suite 9
Sara, New York 12866
518-602-0001
s.hellman@isti.com

Don Hellstern
Southern Methodist University
Huffington Department of Earth Sciences
PO Box 750395
Dallas, Texas 75275-0395
214-768-2750
dmhellst@flash.net

Kathleen Hodgkinson
UNAVCO
6350 Nautilus Drive
Boulder, Colorado 80301-5554
575-520-0912
hodgkinson@unavco.org

Kelly Holcomb
IRIS Consortium
1200 New York Ave, NW, Suite 400
Washington, District of Columbia 20005
202-682-2220 ext. 128
kelly.holcomb@iris.edu

John Hole
Virginia Tech
Dept. of Geosciences, Virginia Tech
4044 Derring Hall
Blacksburg, Virginia 24061
540-231-3858
hole@vt.edu

Michael Hubenthal
IRIS Consortium
1200 New York Ave, NW, Suite 400
Washington, District of Columbia 20005
202-682-2220
hubenth@iris.edu

Gene Humphreys
University of Oregon
Dept of Geological Sciences
University of Oregon
Eugene, Oregon 97403
541-346-5575
genehumphreys@gmail.com

Takehi Isse
University of Tokyo
Yayoi, Bunkyo-ku, Tokyo 113-0032 Japan
tisse@eri.u-tokyo.ac.jp

Steven Jaume
College of Charleston
66 George Street
Charleston, South Carolina 29424
843-953-1802
jaumes@cofc.edu

Chen Ji
University of California, Santa Barbara
Department of Earth Science
University of California
Santa Barbara, California 93106
805-893-2923
ji@geol.ucsb.edu

Jing Jin
University of Illinois at
Urbana-Champaign
439 NHB, 1301 W Green St
Urbana, Illinois 61801
217-550-2505
jingjin4@illinois.edu

Louise Kellogg
University of California, Davis
1 Shields Avenue
Geology Dept.
Davis, California 95616
530-752-3690
kellogg@ucdavis.edu

Katie Keranen
University of Oklahoma
100 E Boyd St, Suite 710
Norman, Oklahoma 73019
405-325-6528
keranen@ou.edu

YoungHee Kim
Columbia University
61 Route 9W
Palisades, New York 10960
213-608-6414
yh1230@gmail.com

Amanda Klaus
University of Washington
3825 Whitman Ave N Apt 203
Seattle, Washington 98103
626-277-5655
aklaus@u.washington.edu

Hunter Knox
Sandia National Labs
P.O. Box 5800
Albuquerque, New Mexico 87123
575-418-7581
haknox@sandia.gov

Keith Koper
University of Utah
115 S. 1460 East, Room 383
Salt Lake City, Utah 84112
801-585-3669
koper@seis.utah.edu

Glenn Kroeger
Trinity University
Department of Geosciences
One Trinity Place
San Antonio, Texas 78212
210-999-7607
gkroeger@trinity.edu

Kayla Kroll
University of California, Riverside
2442 Iowa Ave, Apt I15
Riverside, California 92507
kkrol001@ucr.edu

Hao Kuo-Chen
State University of New York at Binghamton
4400 Vestal Parkway East
Binghamton, New York 13902
267-243-4651
kuochen.hao@gmail.com

Ogie Kuraica
Kinemetrics
222 Vista Ave
Pasadena, California 91107
310-562-5533
ogie@kmi.com

Carene Larmat
Los Alamos National Laboratory
PO Box 1663
EES-17 MS D443
Los Alamos, New Mexico 87545
505-667-2074
carene@lanl.gov

Gabi Laske
Scripps Institution of Oceanography
UC San Diego
9500 Gilman Dr
La Jolla, California 92093-0225
858-534-8774
glaske@ucsd.edu

Thorne Lay
University of California, Santa Cruz
Earth and Planetary Sciences Dept.
Earth and Marine Sciences Bldg.
Santa Cruz, California 95062
831-459-3164
tlay@ucsc.edu

Vadim Levin
Rutgers University
610 Taylor Rd
Piscataway, New Jersey 8854
vlevin@eps.rutgers.edu

Lee Liberty
Boise State University
1910 University Drive
Boise, Idaho 83725
208-426-1166
lliberty@boisestate.edu

Leslie Linn
IRIS Consortium
1200 New York Ave NW Suite 400
Washington, District of Columbia 20005
202-682-2220
leslie@iris.edu

Kui Liu
Virginia Tech
4044 Derring Hall
Blacksburg, Virginia 24061
lkui@vt.edu

Jeff Lockridge
Arizona State University
9750 N. 96th Street #206
Scottsdale, Arizona 85258
480-239-2169
lockridge@asu.edu

Hui Long
Stony Brook University
255 Earth and Space Science Building
Stony Brook, New York 11794
631-632-8200
hulong@ic.sunysb.edu

Maureen Long
Yale University
210 Whitney Ave.
New Haven, Connecticut 6520
617-272-0017
maureen.long@yale.edu

Alberto Lopez
University of Puerto Rico, Mayaguez
723 Qtas de Santa Maria
Mayaguez, Puerto Rico 680
787-265-3845
alberto@prsn.uprm.edu

Dr. Lindsay Worthington
Texas A&M University MS 3148
Texas A&M University
College Station, Texas 77843-3148
979-845-3651
lindsaylowe@gmail.com

Monica Maceira
Los Alamos National Laboratory
P.O. Box 1663
Los Alamos, New Mexico 87545
505-667-2404
mmaceira@lanl.gov

Ben Marshall
Albuquerque Seismological Laboratory
P.O. Box 82010
Albuquerque, New Mexico 87110
505-853-6299
bmarshall@usgs.gov

Glen Mattioli
UNAVCO
6350 Nautilus Drive
Boulder, Colorado 80301
303.381.7554
mattioli@unavco.org

Eric Matzel
Lawrence Livermore National Laboratory
7000 East Ave
Livermore, California 94551
925-422-0772
matzel1@llnl.gov

Joseph McClenahan
University of Wyoming
669 N 10th St., Apt B
Laramie, Wyoming 82072
360-201-9279
jmcclena@uwyo.edu

Kirk McIntosh
University of Texas at Austin
10100 Burnet Rd. (R2200) Bldg. 196
Austin, Texas 78758-4445
512-471-0480
kirk@ig.utexas.edu

Daniel McNamara
U.S. Geological Survey
USGS NEIC
1711 Illinois St.
Golden, Colorado 80401
303-273-8550
mcnamara@usgs.gov

Patrick McQuillan
IRIS Consortium
1200 New York Ave, NW
Washington, District of Columbia 20005
202-682-2220
mcquillan@iris.edu

Lingsen Meng
California Institute of Technology
1200 E California blvd
Pasadena, California 91106
626-395-6931
lsmeng@caltech.edu

Dr. Kate Miller
Texas A&M University
MS 3148 TAMU
Texas A&M University
College Station, Texas 77843-3148
979-845-3651
kcmiller@tamu.edu

Pnina Miller
PASSCAL Instrument Center
NMT, 801 Leroy Place
PASSCAL, 100 East Road.
Socorro, New Mexico 87801
575-835-5331
pmiller@passcal.nmt.edu

Seth Moran
U.S. Geological Survey
Cascades Volcano Observatory
1300 SE Cardinal Ct
Vancouver, Washington 98683
360-993-8934
smoran@usgs.gov

Juli Morgan
Rice University
Dept Earth Science
6100 Main St
Houston, Texas 77005
713-348-6330
morganj@rice.edu

Siham Mourad
University of Oregon
Department of Geological Sciences
University of Oregon
Eugene, Oregon 97403
541-346-5575
mourad.siham@gmail.com

Dr. Betim Muco
General Dynamics Information Technology
4 Maryland Ave.
Rockville, Maryland 20850
301-315-9017
betmuco@gmail.com

Meredith Nettles
Columbia University
61 Route 9W
Palisades, New York 10964
845-365-8613
nettles@ldeo.columbia.edu

Doug Neuhauser
University of California, Berkeley
215 McCone Hall #4760
Seismological Laboratory
Berkeley, California, 94720
510-642-0931
doug@seismo.berkeley.edu

Andrew Newman
Georgia Institute of Technology
311 Ferst Drive
Atlanta, Georgia 30332
404-894-3976
anewman@gatech.edu

Susan Newman
Seismological Society of America
201 Plaza Prof Bldg
El Cerrito, California 94530
510-559-1782
snewman@seismosoc.org

Bob Nigbor
University of California, Los Angeles
Dept. of Civil Engineering
5731 Boelter Hall
Los Angeles, California 90095
626-482-1459
nigbor@ucla.edu

David Okaya
University of Southern California
Dept. Earth Sciences, USC
Los Angeles, California 90089-0740
213-740-7452
okaya@usc.edu

Lani Oncescu
Geotech Instruments, LLC
10755 Sanden Drive
Dallas, Texas 75238
214-221-0000
lani.oncescu@geoinstr.com

Imma Palomeras
Rice University
6100 Main St.
Earth Science, MS126
Houston, Texas 77005
713-348-3048
ip7@rice.edu

Horry Parker
University of Georgia
121 Woodrow Street
Athens, Georgia 30605
843-810-6648
horryparker@gmail.com

Paul Passmore
Refraction Technology, Inc.
1600 Tenth St., Ste A
Plano, Texas 75074
214-440-1265
p.passmore@reftek.com

Wayne Pennington
Michigan Technological University
Dept Geological & Mining Eng'g & Sci
1400 Townsend Dr.
Houghton, Michigan 49931
906-370-9937
wayne@mtu.edu

Bob Phinney
Princeton University
1052 Cherry Hill Road
Princeton, New Jersey 8540
609-203-4425
rphinney@princeton.edu

Christian Poppeliers
Augusta State University
Dept. of Chem. and Physics
2500 Walton Way
Augusta, Georgia 30904
706-664-4253
cpoppeli@aug.edu

Ryan Porter
Carnegie Institute DTM
5241 Broad Branch Road, NW
Washington, District of Columbia 20015
202-478-8820
rporter@dtm.ciw.edu

Christine Puskas
UNAVCO
6350 Nautilus Dr
Boulder, Colorado 80301
puskas@unavco.org

Nishath Rajiv Ranasinghe
New Mexico State University
1132 E Mesa Ave, Apt 6
Las cruces, New Mexico 88001
240-460-9039
nrana001@nmsu.edu

Adam Ringler
U.S. Geological Survey
Albuquerque Seismological Lab.
P.O. Box 82010
Albuquerque, New Mexico 87198
505-846-6116
aringler@usgs.gov

Jeroen Ritsema
University of Michigan
2534 CC Little
Dept. Earth & Environmental Sciences
Ann Arbor, Michigan 48109
734-615-6405
jritsema@umich.edu

Michael Ritzwoller
University of Colorado
390 UCB
Boulder, Colorado 80309
303-492-7075
michael.ritzwoller@Colorado.edu

Artie Rodgers
Lawrence Livermore National Laboratory
7000 East Avenue L-046
Livermore, California 94551
925-423-5018
rodgers7@llnl.gov

Teresa Saavedra
IRIS Consortium
1200 New York Ave. NW, Suite 400
Washington, District of Columbia 20005
202-682-2220
teresa@iris.edu

Allan Sauter
IRIS Consortium/PASSCAL
100 East Road
Socorro, New Mexico 87801
575-835-6651
allan.sauter@gmail.com

Brandon Schmandt
California Institute of Technology
1200 E. California Blvd., MS 252-21
So. Mud Bldg, Rm 262
Pasadena, California 91125
626-395-3825
schmandt@caltech.edu

Nick Schmerr
NASA Goddard
Space Flight Center, Code 698
Greenbelt, Maryland 20771
301- 614-5223
nicholas.c.schmerr@nasa.gov

Vera Schulte-Pelkum
University of Colorado Boulder
2200 Colorado Ave, UCB 399
Boulder, Colorado 80309
303-919-0746
vera.schulte@gmail.com

Derek Schutt
Colorado State University
1482 Campus Delivery
Colorado State University
Fort Collins, Colorado 80523-1482
970-491-5786
derek.schutt@colostate.edu

Guangfu Shao
University of California, Santa Barbara
711 Bolton Walk, Apt. 101
Goleta, California 93117
805-284-8271
shao@umail.ucsb.edu

Anne Sheehan
University of Colorado at Boulder, UCB 399
Dept. Geological Sciences
Boulder, Colorado 80301
303-492-4597
anne.sheehan@colorado.edu

Weisen Shen
University of Colorado at Boulder
2000 Colorado Ave.
Dep. of Physics, Univ. of Colorado
Boulder, Colorado 80309
303-735-1850
weisen.shen@colorado.edu

David Simpson
IRIS Consortium
1200 New York Ave NW, Suite 400
Washington, District of Columbia 20005
202-682-2220
simpson@iris.edu

Stefany Sit
Miami University
114 Shideler Hall
Oxford, Ohio 45056
stefany.m.sit@gmail.com

George Slad
IRIS Consortium/PASSCAL
801 Leroy Pl.
New Mexico Tech
Socorro, New Mexico 87801
505-835-6768
george@passcal.nmt.edu

Ken Smith
University of Nevada, Reno
1664 N Virginia St. MS0174
Reno, Nevada 89557-0174
775-784-4218
ken@seismo.unr.edu

Martin L. Smith
Blindgoat Geophysics
2022 Quimby Mtn. Rd.
Sharon, Vermont 5065
802-763-0660
iris@blindgoat.org

Lee Snett
UNAVCO
6350 Nautilus Dr
Boulder, Colorado 80301
303-601-6197
snett@unavco.org

Neil Spriggs
Nanometrics
250 Herzberg Road
Kanata, Ontario K2K 2A1 Canada
613-286-4800
neil@nanometrics.ca

Jim Stasiak
Hewlett Packard
1070 NE Circle Blvd
Corvallis, Oregon 97330
541-715-0917
james_stasiak@hp.com

Brian Stump
Southern Methodist University
1605 Pembroke Lane
McKinney, Texas 75070
214-768-1223
bstump@smu.edu

Oner Sufri
University of Utah
1155 East 300 South, Apt #3
Salt Lake City, Utah 84102
314-691-9716
oner.sufri@gmail.com

Danielle Sumy
United States Geological Survey
525 S Wilson Ave.
Pasadena, California 91101
845-667-6742
danielle.sumy@gmail.com

Justin Sweet
University of Washington
4000 15th Ave NE
Box 351310
Seattle, Washington 98195
206-543-0570
jrsweet@uw.edu

John Taber
IRIS Consortium
1200 New York Ave NW, Suite 400
Washington, District of Columbia 20005
202-682-2220
taber@iris.edu

Jennifer Tarnowski
University of California, Riverside
Department of Earth Sciences:
University of California, Riverside
900 University Ave.
Riverside, California 92521-0423
951-385-1058
jmtarnowski@gmail.com

Steven Taylor
Rocky Mountain Geophysics
167 Piedra Loop
Los Alamos, New Mexico 87544
505-412-2841
srt-rmg@comcast.net

Gabrielle Tepp
University of Rochester
Bausch & Lomb Hall,P.O. Box 270171
500 Wilson Blvd
Rochester, New York 14627
585-275-4001
gtepp@pas.rochester.edu

Trevor Thomas
University of Washington
4000 15th Ave NE
Box 351310
Seattle, Washington 98195
206-543-0570
twthomas@uw.edu

Lennox E. Thompson
University of Texas at El Paso
200 N Mesa Hills Drive Apt 111
El Paso, Texas 79912
443-540-3881
lethompson@miners.utep.edu

Cliff Thurber
University of Wisconsin, Madison
Dept. of Geoscience
1215 W. Dayton St.
Madison, Wisconsin 53706
608-262-6027
thurber@geology.wisc.edu

Sally Thurner
Rice University
6100 Main St.
Rice University MS-126
Houston, Texas 77005
713-348-5169
smt4@rice.edu

Chad Trabant
IRIS Consortium/Data Management Center
1408 NE 45th St.
Seattle, Washington 98105
206-547-0393
chad@iris.washington.edu

Jeroen Tromp
Princeton University
320 Guyot Hall
Princeton, New Jersey 8544
609-258-4128
jtromp@princeton.edu

Jon Tytell
University of California, San Diego
9500 Gilman Dr MC 0225
La Jolla, California 92093
858-534-9574
jtytell@ucsd.edu

Carl Ulberg
University of Washington
8513 Burke Ave N
Seattle, Washington 98103
ulbergc@uw.edu

Kasper van Wijk
Boise State University
1910 University Dr
Boise, Idaho 83725
208-426-4604
kaspervanwijk@boisestate.edu

Aaron Velasco
University of Texas at El Paso
Geological Sciences
El Paso, Texas
915-747-5101
aavelasco@utep.edu

Frank Vernon
University of California, San Diego
IGPP SIO
La Jolla, California, 92093
858-534-5537
flvernon@ucsd.edu

Lara Wagner
University of North Carolina at Chapel Hill
Mitchell Hall, CB#3315
UNC-Chapel Hill
Chapel Hill, North Carolina 27599
919-966-4714
wagner@unc.edu

Greg Waite
Michigan Technological University
1400 Townsend Drive
Houghton, Michigan 49931
906-487-3554
gpwaite@mtu.edu

Jake Walter
University of California, Santa Cruz
Earth & Marine Science C317
Santa Cruz, California 95060
831-295-0414
jwalter@ucsc.edu

Bill Walter
Lawrence Livermore National Laboratory
L-046, LLNL, P.O. Box 808
Livermore, California 94550
925-423-8777
walter5@llnl.gov

Kelin Wang
Geological Survey of Canada
Pacific Geoscience Centre
9860 W Saanich Rd
Sidney, British Columbia V8L 4B2 Canada
250-363-6429
kwang@nrcan.gc.ca

Kevin M. Ward
University of Arizona
1040 E. 4th Street
Tucson, Arizona 85721
520-621-6000
wardk@email.arizona.edu

Linda Warren
Saint Louis University
3642 Lindell Blvd
205 O'Neil Hall
St Louis, Missouri 63108
314-977-3197
lwarren8@slu.edu

Bruce Weertman
IRIS Consortium/Data
Management Center
1408 NE 45th St, Suite 201
Seattle, Washington 98105
206-547-0393
bruce@iris.washington.edu

S. Shawn Wei
Washington University in St. Louis
Campus Box 1169
1 Brookings Drive
St. Louis, Missouri 63130
314-935-6619
songqiaowei@wustl.edu

John D. West
Arizona State University
3370 N. Hayden Rd #123-179
Scottsdale, Arizona 85251
928-978-1825
john.d.west@asu.edu

Doug Wiens
Washington University
Dept Earth & Planetary Sci
1 Brookings Drive
Saint Louis, Missouri 63130
314-935-6517
doug@wustl.edu

Ray Willemann
IRIS Consortium
1200 New York Ave. NW, Suite 400
Washington, District of Columbia 20005
202-682-2220
ray@iris.edu

Dave Wilson
U.S. Geological Survey
P.O. Box 82010
Albuquerque, New Mexico 87109
505-846-2856
dwilson@usgs.gov

Emily Wolin
Northwestern University
1850 Campus Dr.
Evanston, Illinois 60083
847-467-2467
emilyw@earth.northwestern.edu

Bob Woodward
IRIS Consortium
1200 New York Ave., NW, Suite 400
Washington, District of Columbia 20005
202-682-2220
woodward@iris.edu

Rob Woolley
IRIS Consortium
1200 New York Ave, Suite 400
Washington, District of Columbia 20005
202-682-2220
woolley@iris.edu

Francis Wu
State University of New York at Binghamton
242 Fox Ridge Drive
Thousand Oaks, California 91361
607-727-1933
wu@binghamton.edu

Jing Wu
Chinese Academy of Sciences
19# West Beitucheng Road, Chaoyang District
Beijing 100029 China 86-1082998229
xianhua123@yahoo.com

Jiayi Xie
University of Colorado at Boulder
1300 30th St, Apt E2-23
Boulder, Colorado 80303
303-492-0985
jiayi.xie@colorado.edu

Chunquan Yu
Massachusetts Institute of Technology
77 Mass Ave. 54-523
Cambridge, Massachusetts 2139
617-324-5261
yucq@mit.edu

Huaiyu Yuan
Berkeley Seismological Lab
215 McCone Hall UC Berkeley
Berkeley, California 94720
510-642-9374
huaiyu.yuan@berkeley.edu

Yanhua Yuan
Princeton University
Department of Geosciences
Guyot Hall
Princeton, New Jersey 8544
609-258-0498
yanhuay@princeton.edu

Eva Zanzerkia
National Science Foundation
4201 Wilson Blvd, Room 785.27
Arlington, Virginia 22230
703-292-5111
ezanzerk@nsf.gov

Lianqing Zhou
University of Illinois at Urbana-Champaign
4408 Curtis Meadow, Champaign
Champaign, Illinois 61822
217-714-5124
lianqingzhou@gmail.com

Leonid Zimakov
Refraction Technology, Inc.
1600 Tenth St., Ste A
Plano, Texas 75074
214-440-1265
l.zimakov@reftek.com

NOTES

IRIS
www.iris.edu