Seismological Society of America 2021 Annual Meeting

Technical Sessions

- Advances in Real-time Geophysical Network Operations and Data Analytics
- Advances in Seismic Interferometry: Theory, Computation and Applications
- Advances in the Science and Observation of Tsunamis
- Advances in Understanding Near-Field Ground Motions: Observation, Prediction and Application
- Advances in Upper Crustal Geophysical Characterization
- Amphibious Seismic Studies of Plate Boundary Structure and Processes
- Analyses and Implications of the 4 August 2020 Beirut Explosion Series
- Applications and Technologies in Large-scale Seismic Analysis
- Application of Remote Sensing and Space-based Earth Observations Data in Earthquake Research
- Back to the Future: Innovative New Research with Legacy Seismic Data
- Beyond Poisson: Seismic Hazards and Risk Assessment for the Real Earth
- Constructing and Testing Regional and Global Earthquake Forecasts
- Critical Zone Seismology From Urban to Rural
- Crustal Stress and Strain and Implications for Fault Interaction and Slip
- Cryptic Faults: Assessing Seismic Hazard on Slow Slipping, Blind or Distributed Fault Systems
- Data Fusion and Uncertainty Quantification in Shallow Crust Characterization and Modeling
- Earthquake Early Warning Live in California! Current Status and Challenges
- Earthquake Early Warning System in the Americas: The On-going Effort and the State of the Art
- Earthquake Science, Hazards and Policy in Cascadia
- Effects and Uses of Aseismic Deformation and Fault Creep in Seismic Hazard and Warning
- Environmental and Cryospheric Seismology: Deriving Insights from Ice, Avalanches and Beyond
- Exploring Rupture Dynamics and Seismic Wave Propagation Along Complex Fault Systems
- Explosion Seismology Applications and Advances
- Fault Displacement Hazard: New Data and Modeling Advances

- Fiber-optic Seismology
- How Well Can We Assess Site Effects So Far?
- How Should Low-Probability Earthquakes be Considered in Hazard Assessments?
- Imaging Incipient and Fossil Subduction Zones
- Infrasound and the Seismo-acoustic Wavefield
- Insight Seismology on Mars: Results From the First Martian Year of Data and Prospects for the Future
- Inspiring a New Generation of Seismology Leaders
- Intermountain West Earthquakes in the Spring of 2020
- Mechanisms of Induced Seismicity: Pressure Diffusion, Elastic Stressing and Aseismic Slip
- Modern Geodesy for Observation and and Its Modeling of Earthquake Deformation
- Network Seismology: Keeping the Network Running While Integrating New Technologies
- New Insights Into the Preparatory Phase of Earthquakes From Tectonic, Field and Lab Experiments
- Numerical Modeling of Earthquake Motion, Rupture Dynamics, Seismic Noise and Wave Propagation
- Overdue?
- Physics-based Earthquake Rupture Modeling and Strong Motion Simulations
- Probabilistic Seismic Hazard Assessment: Where Do We Go from Here?
- Recent Advances in Soil-structure Interaction Inverse Problems
- Recent Development in Ultra-dense Seismic Arrays with Nodes and Distributed Acoustic Sensing
- Recent Engineering Uses of National Seismic Hazard Models
- Seismic Hazard Analysis for Critical Infrastructure
- Strategies and Actions for Fostering a Diverse Seismology Community
- Strong-Motion Data Processing and Dissemination: State-of-the-Art and Outlook
- Subduction Processes Along Latin America Subduction Zones
- Tectonics and Seismicity of Stable Continental Interiors
- Tectonics, Seismicity and Recent Significant Events in the Caribbean
- The 7 January 2020 South of Indios (m6.4) Earthquake in Puerto Rico, Response and Lessons
- The 2020 Simeonof Island, Alaska, Earthquake: Observations, Modeling and Tectonic Insights
- The UN Decade of Ocean Science for Sustainable Development and Seismology
- Towards an Integrated View of Earthquake Gates From Geologic Observations and Numerical Models

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Advances in Real-Time Geophysical Network Operations and Data Analytics

The ongoing upgrade of existing GNSS network infrastructure to real-time capability combined with advances in data management has made the possibility of hemispherical-scale low-latency, high-rate GNSS monitoring systems an actuality. Real-time GNSS streams are already being incorporated into earthquake and tsunami early warning systems, space weather monitoring and meteorological forecasting.

To become an integral part of monitoring systems the networks must have redundant data flow paths and low latencies both in data retrieval and analysis. This, and the interest in integrating GNSS, seismic and meteorological networks combined with the push of data processing to the network edge has created an opportunity to rethink traditional data flow paths and the implementation of real-time data analysis for geophysical monitoring.

This session provides an opportunity for network operators, researchers and infrastructure groups to discuss these ideas. We encourage presentations on the upgrade of existing geophysical networks to real-time capability, the integration of GNSS and seismic networks, the use of cloud technology and containerized systems to manage data flow and the development of real-time analytics to monitor the state of health of the networks, the data quality of the incoming streams and real-time data processing.

Conveners

Kathleen Hodgkinson, UNAVCO (hodgkinson@unavco.org)
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Advances in Seismic Interferometry: Theory, Computation and Applications

Seismic interferometry extracts information from the ambient seismic field and enables imaging in the absence of earthquakes or artificial sources. Recent developments in seismic interferometry have benefited from continuous records of ambient seismic noise from traditional broadband instruments and emerging new acquisition technologies, such as large-N nodal arrays and distributed acoustic sensing systems. These have opened up the possibility of performing high-resolution tomographic imaging anywhere dense networks are available. In addition, the temporal variation in continuous seismic records provides the possibility of monitoring the transient changes of subsurface properties for various geological targets, such as glaciers, volcanoes, groundwater, reservoirs, active faults, infrastructure and even other planetary bodies. We welcome contributions of recent advances in and applications of seismic interferometry on a broad range of topics, including (but not limited to) theoretical developments in amplitude measurements and structural inversion, utilization of higher-order cross-correlations, new analyzing techniques and computer programs and novel applications across disciplines.

Conveners

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Advances in the Science and Observation of Tsunamis

The catastrophic tsunami events originated after the 26 December 2004 Sumatra and 11 2011 Tohoku earthquakes reshaped the technology of the tsunami warning and the global strategy for the tsunami hazard mitigation. Tsunami warning services now cover most of the vulnerable coastlines around the World. New tsunami-specific real-time observation systems have been deployed for operations and the network of real-time data sources is continuously expanding. New data and methods are available for real-time seismic sources assessments of tsunamis. The accuracy, reliability and coverage of the warning services have increased.

However, significant challenges still exist as large tsunamis of the last decade have shown. Over 30 significant events that occurred since the 2011 Tohoku revealed many new gaps in the tsunami warning and hazard mitigation strategies. The death toll of over 5000 from just two tsunamis in Indonesia in 2018 demonstrated that much more needs to be done to make the tsunami warning systems robust and effective. The science of tsunamigenity of the seismic sources in particular requires more research, as was demonstrated by the two recent strike-slip earthquakes of the 28 September 2018 in Sulawesi and the 19 October 2020 in Alaska that generated unexpectedly strong tsunamis.

The original research on all areas of tsunami science are invited for the session, including seismic tsunami sources studies; tsunami generation, propagation and coastal impacts; research on tsunami hazard mitigation and tsunami warning strategies and other relevant topics.

Conveners

Vasily V. Titov, National Oceanic and Atmospheric Administration (vasily.titov@noaa.gov)
Bruce Jaffe, U.S. Geological Survey (bjaffe@usgs.gov)

Advances in Understanding Near-Field Ground Motions: Observation, Prediction and Application

The characterization of near-field ground motions is critical for expanding our understanding of earthquake hazard as well as improving rapid response and earthquake early warning efforts. Recent earthquakes like the 2019 Ridgecrest Sequence have provided observations of near-field ground motions in unprecedented detail, while increased computational capabilities have enabled significant advances in ground-motion simulations. With these developments come new opportunities to improve our understanding of near-field seismic ground motions, including, for example, how ground-motion characteristics translate into perceived shaking intensities as well as characterization of path and site effects. In turn, these improvements in near-field ground-motion models can lead to increased accuracy in applications such as early warning alerts, rapid response loss estimates and structural response to shaking. We invite submissions related to this broad area of near-field ground motion. Possible topics include: near-field observations; advances in near-field ground-motion modeling; and applications such as seismic hazard modeling, structural response modeling, rapid response products and earthquake early warning.

Conveners

Jessie K. Saunders, U.S. Geological Survey (jksaunders@usgs.gov)
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Advances in Upper Crustal Geophysical Characterization

The upper crust plays a critical societal role, from access to clean water to the production of energy to the impact of geologic hazards. It is also our window into the layers below; geophysical variability in the near surface can map into deeper structure if not properly considered. With respect to seismic hazards and earthquake ground motions, variability in near surface geophysical properties can lead to an overall amplification or deamplification of strong ground motions, large lateral variability in site response, as well as resonance at specific ground shaking frequencies. With respect to groundwater, characterizing soil porosity, regolith development and fracture permeability all lead to better estimates of storage potential and groundwater flow rates. Geophysical characterization of the near surface is therefore critical to being able to address these issues. A vast number of methods exists with which to characterize the subsurface from direct methods that measure rock density and seismic velocity in-situ to indirect methods where seismic wave travel times, gravity, resistivity and other parameters are measured at the Earth’s surface, and subsurface properties are inferred. We seek contributions that include direct and indirect field observations, laboratory experiments and geophysical theory that links observation and expectation to studies that explore the impact of competing assumptions.

Conveners

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Lee M. Liberty, Boise State University (lliberty@boisestate.edu)

Amphibious Seismic Studies of Plate Boundary Structure and Processes

Recent years have seen a rapid increase in the number of shorecrossing seismic experiments aimed at characterizing seismicity, deformation and structure at continental margins. Many studies use controlled source imaging in conjunction with continuous recordings of natural seismic sources. Examples of data integration include using ocean-bottom seismometer data in both disciplines and combining results from shallower, high-resolution imaging with deeper, lithospheric-scale studies to understand structures that influence seismicity and plate boundary processes. We invite contributions from the community of seismologists studying plate boundary processes at the transition from onshore to offshore (ocean or lake) environments, including subduction zones, active or relict rifted margins and transform faults.

Conveners

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Analyses and Implications of the 4 August 2020 Beirut Explosion Series

On 4 August 2020 at 15:07 UTC, a fire at the port of Beirut in Lebanon (33.54°, 33.51°) detonated a purported ~2.8kT mixture of ammonium nitrate and fuel that resulted in a sequence of explosion phenomena. These video-captured events triggered a shock wave and visible Wilson cloud, destroyed buildings and shattered glass several kilometers from the explosion(s) hypocenter. Mechanical waveform sensors that include seismic, infrasonic and hydroacoustic receivers recorded waveforms from the event out to regional distances and provide data on explosion size and timing. Assessment of this event therefore has multiple implications beyond seismology that include the interface between science and society, forensics, emergency response and hazard mitigation. This session welcomes submissions on the analysis of this event that include, but are not limited to (1) hydroacoustic and seismo-acoustic detection and association of the blast waveforms; (2) study of energy coupling mechanisms at the ground-water-air interface; (3) analyses of aseismic geophysical signatures, such as cratering; (4) multi-signature data fusion of both traditional and non-traditional data sources; (5) methods to quantify uncertainties of parameter estimates of the source or propagation path (exploitation of ground truth) and (6) broader implications of rapid response and societal consequences. We encourage both poster and talk submissions.

Conveners

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Application of Remote Sensing and Space-based Earth Observations Data in Earthquake Research

Earthquakes are one of the most unexpected and most destructive natural disasters. Spatial and temporal patterns and features of the multi-physical parameters, such as subsurface stress field, fluid flows, crustal deformation and other surface processes before and after large earthquakes are essential clues about the evolution of the earthquake cycle. Detection and identification of these processes in multiple Spatio-temporal scales much depend on observational techniques.

Recently, Remote Sensing and Space-Based Earth Observations are used in earthquake monitoring and forecast research. These include the observations of ionosphere disturbances before and during large earthquakes, as well as gravity changes due to large earthquakes detected in GRACE satellite missions. Several satellite missions such as the CSES-01 and FORMOSAT-7/COSMIC-2 are launched to detect possible atmospheric/ionospheric anomalies associated with earthquakes and other natural hazards. The development of these powerful remote sensing tools and finely tuned detection algorithms provide an exciting opportunity to image, assess and quantify physical processes that occur before, during and after large earthquakes.

This session focuses on the latest advances in remote sensing technology in earthquake research. This session expands the discussions of geohazards' predictability by presenting the latest results from cross-disciplinary observations from both space and ground measurements associated with earthquakes. These presentations will include but are not limited to: observations, modeling and analyses, geochemical, seismic, electromagnetic, thermodynamic processes, crustal deformation and case studies related to stress changes in the lithosphere along with their statistical and physical validation. Using such an interdisciplinary approach, we hope to advance current earthquake research studies and gain a better understanding of the lithosphere-atmosphere-ionosphere coupling processes.

Joint SSC-SSA Session

Conveners

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Applications and Technologies in Large-scale Seismic Analysis

The growth and maturation of technologies that make it easier to analyze large volumes of data has enabled new areas of research in seismology. Computational frameworks like Apache Spark and Dask augment existing tools like MPI. New programming languages like Julia and the emergence of new scalable analysis capabilities in languages like Java and Python supplement traditional languages like C and Fortran. Finally, new platforms like the commercial cloud offer alternatives to existing high performance computing platforms. Technologies like these increase accessibility to a new scale of inquiry, making large-scale research in seismology more tractable than ever before. In this session, we invite researchers and data providers to share work in data-hungry applications, approaches to large data collection, storage and access and experiences with processing platforms and architectures.

Conveners

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Back to the Future: Innovative New Research with Legacy Seismic Data

There has been much discussion in recent years about Big Data and, within the seismological community, how to cope with its ever-expanding volume of digital data. But there exists a source of yet Bigger Data: historical seismic records. With more than a century of seismic waveform data, there is opportunity to resolve intimate details of, and potentially revolutionize, our understanding of Earth dynamics, including phenomena associated with tectonic and geologic processes, seismic sources, climate change and seismic hazard. The challenge: much of the waveform data is tucked away on analog media such as paper, tape or film, or archaic and arcane digital media in holdings that are at risk of being lost forever. These data sets are not only more difficult to physically access and read than their digital counterparts, but often demand innovative approaches to perform any type of modern seismic analysis.

We invite presentations that highlight the discovery, preservation and/or use of seismic datasets spanning multiple decades. Such presentations would include those that address the problems of restoration, digitization and storage of the vast archives of legacy data. We encourage contributions that illustrate the on-going value of legacy data in the general fields of study for which seismographic data have been used and the value of legacy seismographic data in other geophysical disciplines. A few examples include studies of regional or local seismicity, earthquake recurrence and prediction, seismic hazard, climate signatures, inner core rotation and growth and 4D seismic tomography. We also seek contributions that feature efforts in standardizing metadata and image data formats, improving accessibility through rapid scanning, advances in vectorization software and tuned data compression algorithms, efforts in compiling calibrations of seismometers and application of machine learning techniques to directly extract geophysical information from the legacy data.

Conveners

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Beyond Poisson: Seismic Hazards and Risk Assessment for the Real Earth

Traditional probabilistic seismic hazard assessments (PSHA) assume that it is adequate to model earthquakes as temporally random, independent events modeled as a Poisson process. This approach removes the obvious clustering due to aftershocks and swarms; averages or carves out rate variations on short time scales due to natural processes such as volcanoes, as well as short-lived induced seismicity in order to focus on long-term so-called tectonic rates; and may not even use time-dependent mainshock probability variations due to elastic rebound. This may be adequate for long-term (e.g. 50-year) models aimed at low probabilities of exceedance for engineering purposes. The risk industry, typically managing risk transfer contracts from 1 to 5 years, is interested in assessing risk due to processes that act at or affect shorter time scales, from induced seismicity to aftershocks to fault interaction and elastic rebound. Over shorter timescales, when considering the impacts of multiple events and/or at higher probabilities of exceedance, non-Poissonian behavior becomes more important. Recently our ability to describe non-Poissonian behavior has been improved through short-term aftershock and swarm models, models of fluid injection and long-term physics-based simulators. As a result, some national hazard models have incorporated these processes. Many challenges remain. For instance, understanding the impact of incomplete data and non-stationarity on long-term empirical rate estimates is a particularly difficult issue in regions with low seismicity rates and is critical even for traditional PSHA. We encourage contributions that explore how we can better model the broad range of real Earth behavior in different time scales that goes beyond the Poisson process; how we can test those models and include them in hazard and risk assessments; and the societal utility of doing so for a range of users including engineers, the insurance industry, emergency planning and mitigation.

Conveners

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Constructing and Testing Regional and Global Earthquake Forecasts

Regional and global earthquake rate and rupture forecasts underpin seismic hazard and risk assessments. They can also serve to test critical hypotheses about seismogenesis, including earthquake nucleation, rupture, interaction and variations of their characteristics with tectonic setting. Global models offer greater testability than regional models because of the larger and more frequent earthquakes. Initiatives to construct and test global models have been led by the Global Earthquake Model (GEM) Foundation, the Southern California Earthquake Center (SCEC), the European H2020 project RISE, re/insurance interests and others. Regional models, on the other hand, benefit from more available and higher resolution datasets, from dense geological records to waveform-similarity enhanced catalogs and long historical catalogs that can be exploited to express bespoke hypotheses, such as spatio-temporal b-value variations, foreshock patterns, Coulomb stress transfer, geodetically detected aseismic slip or fault-based rupture forecasts. Regional and national models are more commonly constructed and can underpin national seismic hazard models and require testing at lower magnitudes to increase test data. We welcome contributions that construct and test probabilistic earthquake forecast models and algorithms from regional via national to global scales. Submissions may include hypothesis-generating research about what controls earthquake potential but should also develop plans for testing prospectively. We also seek submissions that build on vetted earthquake forecasts to construct seismic hazard and risk models, particularly at global scales.

Conveners

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Critical Zone Seismology From Urban to Rural

The upper 100 meters of the subsurface, also called the critical zone or near-surface, is a major driving factor behind geological and hydrological systems' behaviors and is the layer that most affects stability of infrastructure and buildings. The multiscale physical, chemical and biological processes that drive Critical Zone evolution can vary spatially at the scale of meters or even smaller and temporally from milliseconds (or less) to millions of years. Thus, near-surface Earth materials can be extremely heterogeneous. Due to the difficulties accessing the subsurface directly, Critical Zone structure and the processes that shape it are still largely unknown.

The Critical Zone offers many challenges and opportunities for seismic imaging and characterization in both urban and rural settings. Strong seismic gradients, high impedance boundaries, spatial and temporal variations in fluid saturation and possibly frozen conditions provide challenging imaging targets. There are many opportunities for improving near surface and Critical Zone characterization. For example, dense and (semi)permanent deployable seismic arrays can provide continuous measurements and yield spatiotemporal information that is particularly valuable for understanding the Earth's near surface in an unprecedented spatial resolution as well as temporal resolution.

We welcome contributions of recent advances in Critical Zone (near-surface) seismology on a broad range of topics, including (but not limited to) case studies, field instrumentation, advanced seismic data processing, developments in seismic models of near surface processes or systems, new analyzing techniques and computer programs and integration with other branches of the Earth or social sciences.

Conveners

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Crustal Stress and Strain and Implications for Fault Interaction and Slip

During earthquake cycles, crustal deformation includes multiple components such as inelastic strain increments associated with earthquakes, elastic strain accumulated in the interseismic period, aseismic slip on some fault sections and viscoelastic strain near and below the brittle-ductile transition depth. Resolving stress and strain distributions in the crust, specifically near fault zones, is essential for a better understanding of deformation processes, fault interactions and providing constraints on fault zone geometry and rheology.

This session focuses on (1) the estimation of the state of stress/strain in different phases of earthquake cycle and (2) the analysis of stress/strain distributions at different spatial and temporal scales by soliciting works based on theory, observations, modeling and laboratory experiments. Contributions are encouraged but not limited to address the following questions: 1) What can we extract from geodetic, geologic, borehole and seismic data regarding the state of stress and strain at regional and local scales?; 2) How are stress and strain distributed in laboratory experiments and nature and how can we bridge the two?; 3) What are the insights from numerical simulations on the state of stress and to what extent can models help in interpreting observations such as earthquakes or slow slip events?; 4) How will spatial stress/strain variations from long-term data compilations improve our knowledge of the motion partitioning across complex fault zone areas, aseismic slip, fault zone structure and earthquake cycles?; 5) How can information on the state of stress/strain be used to improve long-term earthquake forecasting and seismic hazard assessments?

Conveners

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Cryptic Faults: Assessing Seismic Hazard on Slow Slipping, Blind or Distributed Fault Systems

Characterization of active faults for seismic hazard often relies on the analysis of geomorphic records preserved within the landscape that indicate fault movement. In certain environments, particularly those that are slow (<5 mm/yr) slip rate, blind and distributed fault systems, tectonic activity leaves subtle tectonic signals within the landscape, challenging the conventional methods of identification and characterization of these fault systems. In recent years, advances in remote sensing, including high-resolution topographic data from lidar and unmanned aerial vehicles, have revolutionized the identification of fault-related features at the earth's surface and led to increasing confidence in the characterization (fault length, slip rate, recurrence interval) of faults. Recent numerical and experimental models further provide analogues for surficial fault rupture patterns and fault-related features to locate potential faults. In addition, advances in Quaternary geochronology and Bayesian modeling have refined ages of geomorphic and stratigraphic surfaces, resulting in better constraints on the activity of faults. Thus, the recognition of active and potentially active fault traces is expanding, ultimately leading to improved seismic hazard models.

This session will include studies that focus on new data and how methods have been applied to the characterization of cryptic faults. In particular, we welcome presentations on the application of remote sensing, geophysical, modeling and field work techniques, as well as geomorphic or paleoseismic case studies on cryptic slow slip rate, blind or distributed fault systems in any tectonic setting.

Conveners

Jessica A. T. Jobe, U.S. Bureau of Reclamation (jessietjobe@gmail.com)
Stephen J. Angster, U.S. Geological Survey (sangster@usgs.gov)

Data Fusion and Uncertainty Quantification in Shallow Crust Characterization and Modeling

Non-invasive methods for sub-surface seismic site characterizations have clear advantages relating to cost and effort over their invasive counterparts. However, these methods rely on several constituents that can lead to poor estimations of sub-surface properties, which significantly affect earthquake hazard assessment at the regional scale. The limiting factors include the ill-posedness of inverse problems, the shallow crust's inherent complexity and measurement and modeling uncertainties. Recent studies have shown that joint inversion of complementary datasets and statistical inference techniques can improve the estimated properties and quantify uncertainties. We here invite contributions describing the development and implementation of state-of-the-art methods in inverse problems, data assimilation and uncertainty quantification to improve constraints on shallow crust properties. We also invite contributions to the development of three-dimensional shallow crust velocity models using the methodologies mentioned above, as well as other novel approaches.

Conveners

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Earthquake Early Warning Live in California! Current Status and Challenges

In October 2019, Earthquake Early Warning (EEW) alerts were made publicly available throughout California for the first time ever. This milestone followed closely on the heels of the 2019 Ridgecrest sequence, which included both the largest main shock and the most energetic aftershock sequence encountered by the US ShakeAlert EEW system (with public alerts only available in Los Angeles at that time). These events contributed to the already rapidly advancing realm of EEW research, which spans a wide range of fields including computer science, earthquake physics, seismic network design, social science and more. EEW systems are also being developed and coming online elsewhere in the world, with each system facing its own unique set of obstacles.

Many challenges remain to maximize the potential of these systems and prevent harm from system errors and malfunctions (e.g. false alerts). Unanswered questions range from the scientific (e.g., real-time magnitude estimates of large earthquakes and rupture predictability) to the practical (e.g., how to distribute alerts to the public most efficiently, minimizing data transmission delays).

In this session we welcome abstracts related to all aspects of EEW including, but not limited to, algorithm development, system performance, improved trigger detection/discrimination techniques, network build-out, alerting methods and technology and EEW education and outreach.

Conveners

Angela I. Chung, University of California, Berkeley (aichung@berkeley.edu)
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Earthquake Early Warning System in the Americas: The On-going Effort and the State of the Art

Latin America and the Caribbean constitute one of the most earthquake-prone regions of our planet, where an exponentially growing population undergoing rapid urbanization and living in mostly vulnerable structures is frequently exposed to extremely high ground accelerations from shallow large-continental and offshore-megathrust and tsunami earthquakes. In the last 20 years, a total of 143 earthquakes with magnitudes larger than 6.5 have struck the region. From these, 29% have occurred with moment magnitudes between 7 and 8, whereas ~4% are great earthquakes, with magnitudes larger than 8, generating in most cases, a negative socio-economic impact in the developing economies.

The urgent necessity for better assessment of earthquake hazards and mitigation of some of the consequences of these damaging events has led to the development of Earthquake Early Warning Systems (EEWs) across the Americas and the Caribbean. International collaborations for building capacities and sharing experiences are on-going, these efforts are accompanied by a continuous increase in data quality and accessibility, modern technology (low latency broadband and strong motion instruments, GNSS, cheap sensors including smartphones and social network data) and improved EEW methodologies.

The aim of this session is to provide the state-of-the-art overview of earthquake early warning and rapid response systems in the Americas. We expect to generate a space to share experiences, new techniques and opportunities, but also to identify challenges, pinpoint components requiring improvement and to establish new international collaborations. We welcome contributions on Earthquake Early Warning and rapid response development, that span an end-to-end EEW system, from development of EEW-ready networks and the application of EEW algorithms to tools for public alert dissemination and social science considerations.

Conveners

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Earthquake Science, Hazards and Policy in Cascadia

The Cascadia Subduction Zone (CSZ) is the most densely populated subduction zone in the United States that is capable of producing megathrust earthquakes of approximately magnitude 9 (M9), yet its historical seismic quiescence contributes to its status as an “end-member” global subduction zone with respect to seismic activity. Recent years have brought a rapid increase in fundamental earthquake scientific knowledge about the region, through both observational studies such as the Cascadia Initiative, shoreline-crossing work, seafloor geodetic advancements and geophysical network buildout, as well as extensive geophysical modeling work. Recent projects such as the National Science Foundation-funded “M9 Project” have inspired integration of earthquake ground motion simulations with tsunami, ground failure and structural engineering studies, as well as social and behavioral sciences, planning and policy. Beyond these recent advances, Cascadia is home to large stakeholder companies involved in technological development and cloud computing infrastructure.

This session will highlight advances across earthquake hazards studies related to Cascadia earthquakes and their cascading hazards. We welcome submissions that fall within or across any of these categories, including both onshore and offshore observational and modeling work; geologic and geophysical earthquake studies in the CSZ; hazards-focused work including developments in earthquake recurrence, source physics, ground motion estimation, seismic hazard analyses, ground failure and tsunami studies; as well as social and behavioral sciences and planning studies related to the interpretation and application of recent scientific developments to quantify and reduce risk in the region.

Conveners

Valerie J. Sahakian, University of Oregon (vjs@uoregon.edu)
Erin Wirth, U.S. Geological Survey, Earthquake Science Center (emoriarty@usgs.gov)
Janet Watt, U.S. Geological Survey, Pacific Coastal and Marine Science Center (jwatt@usgs.gov)
Carlos Molina-Hutt, University of British Columbia (carlos.molinahutt@civil.ubc.ca)
Grace Parker, U.S. Geological Survey, Earthquake Science Center (gparker@usgs.gov)
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Effects and Uses of Aseismic Deformation and Fault Creep in Seismic Hazard and Warning

While earthquake hazard increases with fault area and slip, the hazard can relate to the extent of aseismic deformation. For instance the down-dip extent of intermediate and large earthquakes is limited by ductile deformation. The rate strengthening rheology provides a dynamic barrier to propagation during the earthquake, and a static barrier by relaxing down-dip stress during the interseismic period. The along strike extent of rupture can also be limited by fault rheology and by long-term aseismic deformation producing a relaxed region, e.g., the creeping section of the San Andreas.

Aseismic deformation and fault creep can also correlate in time and space with seismic slip, such as in regions of low seismic coupling. Volcanoes, regions of induced seismicity and subduction zones often have low coupling coefficients yet host significant seismicity. For example, small scale seismicity can be generated by larger scale aseismic fault creep, allowing the seismicity to be used as a proxy for slip. In instances of accelerating aseismic deformation, such seismicity may have value for warning. At larger scale, the subduction zone foreshocks and transient creep events that preceded the great Tohoku earthquake, were perhaps related to megathrust earthquake initiation, and may also be useful for warning. Underlying all of these observations are poorly known physics dictated by the rheology. The strongest rheological constraints may come from the observations themselves, but the physics are most easily determined in experiments or in models.

We invite a broad range of contributions that illustrate the value of including aseismic deformation and fault creep in earthquake hazard and warning. While context is provided by the above examples, these are not comprehensive. Contributions are expected from earthquake science disciplines that provide observations, constraints or implications, e.g., seismology, geodesy, fault mechanics, numerical modeling, experimental rock mechanics.

Conveners

Nicholas Beeler, U.S. Geological Survey (nbeeler@usgs.gov)
Amanda Thomas, University of Oregon (amt.seismo@gmail.com)
Manoochehr Shirzaei, Virginia Tech (shirzaei@vt.edu)

Environmental and Cryospheric Seismology: Deriving Insights from Ice, Avalanches and Beyond

Environmental seismology is the study of seismic signals generated at and near the surface created by environmental forces in the atmosphere, hydrosphere or solid Earth, and as such covers a broad range of subjects. Contributions to this session are welcome on a wide variety of topics including --but not limited to-- seismically focused scenarios associated with the microseism, landslides, rock falls, debris flows, lahars, snow avalanches, cliff or pinnacle resonance, river bedload transport, flood events, fluid flow in open and confined channels, water gravity waves or infragravity waves, tides, sea ice variability, subglacial hydrology, hurricanes, tornadoes or anthropogenic sources. Explorations of the seismic behavior of cryospheric media, including permafrost, ice sheet/shelves modeling, snow and firn dynamics, glacier stick-slip, icequakes, iceberg calving and crevassing and temporal monitoring are also encouraged. Studies focusing on engineering applications are additionally welcome and may include studies of groundwater and remediation, site characterization for geologic and seismic hazard applications, monitoring of critical infrastructure and geotechnical applications. Contributions that seek to conduct monitoring, create physical or statistical models of source processes or systems, detect events, characterize a wave propagation environment or interact with other branches of the Earth or social sciences are additionally encouraged. Submissions running the gamut from site-specific case studies to ongoing methodological advances are warmly welcomed.

Conveners

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Exploring Rupture Dynamics and Seismic Wave Propagation Along Complex Fault Systems

Investigations related to how complexities in fault parameters and geometry could potentially impact the behavior of earthquake rupture and affect seismic hazard are areas of active and challenging research. This session will highlight recent advances in rupture dynamics on complex fault systems. We are open to a wide range of studies related to numerical, experimental and observational fault rupture dynamic studies with heterogeneities such as fault geometry, fault roughness, frictional parameters, topography, creeping mechanisms, stress asperities, off-fault material properties, bi-material interfaces and wedge structures along subduction zones. We also encourage contributions on research that explores links between earthquake source physics, tsunami generation/propagation and ground motion variability.

Conveners

Kenny Ryan, Air Force Research Laboratory (0k.ryan0@gmail.com)
Roby Douilly, University of California, Riverside (roby.douilly@ucr.edu)
Christos Kyriakopoulos, University of Memphis (Christos.K@memphis.edu)
Eric Geist, U.S. Geological Survey (egeist@usgs.gov)
Ruth Harris, U.S. Geological Survey (harris@usgs.gov)
David D. Oglesby, University of California, Riverside (david.oglesby@ucr.edu)

Explosion Seismology Applications and Advances

Explosion sources are an important component of seismology. They can be tools to characterize the sub-surface for a variety of applications using established networks as well as inexpensive and easy to deploy arrays/networks of sensors. As a result, the wavefield produced by explosions is being studied with unprecedented detail. In regions of low natural background seismicity, mine blasting can dominate monitoring catalogs and identifying and separating these sources from tectonic earthquakes is important for hazard assessment. The seismo-acoustic signals from accidental explosions can be used in their forensic analysis and to study propagation issues. Recordings of surface explosions can illuminate geologic structures in regions where there is a lack of seismicity to better characterize the velocity structure. Recent work using template matching, waveform modeling for moment tensors and combining seismo-acoustic data has shown great success in characterizing explosions and discriminating them from earthquakes and other sources. We welcome abstracts in explosion source physics, wave propagation, Large-N network design, distributed acoustic sensing (DAS), new sensor technologies, multi-physics data fusion and advanced processing techniques applied to explosion sources.

Conveners

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William R. Walter, Lawrence Livermore National Laboratory (walter5@llnl.gov)
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Cleat P. Zeiler, Nevada National Security Site (zeilercp@nv.doe.gov)

Fault Displacement Hazard: New Data and Modeling Advances

Coseismic fault displacements resulting from earthquakes can cause significant damage to the built world. Fault displacement hazard quantification presents an especially important challenge for distributed infrastructures that span long distances, such as railways, or that densely cover wide areas, such as gas distribution systems. For these types of infrastructure, fault crossings can not always be avoided and present a threat that is often difficult to mitigate. In spite of the risks it poses, fault displacement hazard is poorly constrained, partly due to the scarcity of detailed fault-displacement observations. In this session, we welcome presentations on topics that support the development of the next generation probabilistic fault displacement hazard analysis (PFDHA) models. PFDHA requires the integration of the best available information and science from fault rupture physics and rheology while accounting for region-specific geology, seismicity and tectonic setting of the study area. Topics of interest for this session include: (i) new fault displacement datasets; (ii) recent advances in surface deformation imaging that facilitate the gathering and interpretation of detailed fault displacement data; (iii) emergent techniques for dynamic rupture modeling that support a better physical understanding of this complex natural phenomenon; and (iv) new engineering modeling approaches that integrate information from several disciplines and take into account variability and uncertainty quantification.

Conveners

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Yongfei Wang, Southern California Earthquake Center (yongfeiw@usc.edu)

Fiber-optic Seismology

Recent advancement in the field of photonics has led to novel sensing methods based on optical interferometry. For example, Distributed Acoustic Sensing (DAS) is rapidly becoming a popular tool among seismological research groups worldwide. DAS enables Large-N array seismology in novel and unique spaces such as in boreholes, mines, underneath streets in urban areas and offshore. The main advantages of DAS for seismology include, but are not limited to, dense recording, long spatial and temporal deployment of sensors, time-lapse repeatability and the unique opportunity to leverage existing fiber infrastructure such as telecommunication cables.

Because data acquired with DAS instruments contain information on the displacement gradient of a seismic wavefield along the direction of the fiber (i.e., strain), there is a need to develop a fundamental theoretical framework to cope with this new data type. The high spatial resolution and broadband nature of DAS furthermore allows for new data analysis methods or the adaptation of existing Large-N methods to this new data type.

This session will span a wide range of topics related to fiber-optic sensing methods in seismology and geophysics, including but not limited to: advancements in optical engineering; developments in theoretical and methodological aspects of fiber-optic sensing; case studies from ongoing fiber-optic sensing experiments worldwide; comparisons between non-inertial and inertial instruments; and insights gained from fiber-optic sensing measurements in the context of other types of seismological/geophysical datasets.

We invite contributions from research related to all aspects of fiber-based sensing.

Conveners

Patrick Paitz, ETH Zurich (patrick.paitz@erdw.ethz.ch)
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Ariel Lellouch, Stanford University (ariellel@stanford.edu)

How Well Can We Assess Site Effects So Far?

In seismic hazard and risk analyses, the effects of near-surface geology on ground shaking need to be quantified as precisely as possible. Ergodic amplification equations in ground motion models (GMM) can only give an average estimate of amplification, and bias is expected in a posterior application at a specific site. Various approaches are currently available to quantify site-specific amplification. If ground-motion records are available at or near a target site, ergodic models can be calibrated to derive site-specific amplification function. Otherwise, ground response analyses (GRA) are carried out to characterize site response. In addition, the horizontal-to-vertical spectral ratio (HVSR) of either earthquake or ambient noise recordings has been proven to be a cost-effective approach in site-effects studies.

In this session, we invite studies dealing with different approaches to quantify site effects. Studies on how to improve our current practice in ground response estimation are particularly welcome, e.g., the search of optimal site characterization proxy (alternative or complementary to the time-averaged 30 m shear-wave velocity and/or the fundamental resonant frequency) to improve ergodic site response models; novel approaches to evaluate the attenuation of wave propagation; ground response analysis and its associated uncertainty; soil nonlinearity, numerical or empirical studies on 2D/3D site effects; and innovative application of the horizontal-to-vertical spectral ratio (HVSR) technique; and integration of site effects into seismic hazard analysis.

Conveners

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Marco Pilz, GFZ German Research Centre for Geosciences (pilz@gfz-potsdam.de)
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How Should Low-Probability Earthquakes be Considered in Hazard Assessments?

Large, shallow, crustal earthquakes can have very long recurrence intervals, on the order of tens of thousands of years. However, their occurrence near urban centers represents one of the most significant and enigmatic seismic risks facing our society today. For example, the 2011 Christchurch earthquake resulted in losses of 3-4% of New Zealand’s Gross Domestic Product [Parker & Steenkamp, 2012], despite occurring on a previously unknown, shallow fault within the city limits. This highlights the need for seismic hazard assessment that in some way considers the impact of low probability earthquakes.

There have been great strides in characterizing some of the faults capable of this type of rupture, largely from the disciplines of satellite geodesy and paleoseismology. These studies are often expensive and spatially limited, however, leading to fault catalogs which are heterogeneous in content and demonstrably incomplete. For this reason, fault databases are inconsistently incorporated in seismic hazard maps even when there is some information available about a potentially damaging earthquake source. To bridge this gap will require participation from scientists, engineers and government agencies to (1) establish how much can be known about faults, (2) evaluate impacts to society and consider their sensitivity to unknowns and (3) consider the implications for policy. This session invites presentations which highlight recent advances in characterizing low probability faults, including their geometry, mechanism, magnitude-recurrence interval, maximum magnitude or other properties. We then welcome studies which quantitatively assess the resulting seismic hazards or consider the effect of such faults on seismic hazard mapping programs. The goal of this session is to facilitate a vibrant discussion concerning the future of seismic assessment which can fully incorporate the latest research in earthquake physics, geodesy, geomorphology and tectonics.

Conveners

Tiegan E. Hobbs, Natural Resources Canada (tiegan.hobbs@canada.ca)
Chris Rollins, University of Leeds (j.c.rollins@leeds.ac.uk)
Kristin Morell, University of California, Santa Barbara (kmorell@geol.ucsb.edu)

Imaging Incipient and Fossil Subduction Zones

Subduction is a fundamental Earth process – it is integral for plate tectonics and the recycling of the planet's surface, plays a significant role in long term climate regulation and is the principal source of volcanic and seismic hazard around the globe. We are at a critical juncture where large-scale multidisciplinary efforts are being launched to better understand the descent of oceanic slabs. But how can new trenches be generated? And what happens when the descent of the down-going slab ceases? Causes of subduction initiation and consequences of its termination are two aspects of the subduction cycle that have received little attention. Thus, they remain enigmatic, controversial and models are typically not well supported by observations. 3D high-resolution seismic images are central to the understanding of the subduction cycle and are crucial in the investigation of the mechanisms that drive likely modes of subduction initiation and termination. The goal of this session is to motivate discussion on the current state of subduction-zone imaging with a special focus on incipient and fossil subductions, new seismic network deployments, advanced seismic imaging methods (e.g., ambient noise tomography, migration imaging and full waveform inversion) that can explore and fully utilize big seismic datasets to better image subduction past, present and future.

Conveners

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Min Chen, Michigan State University (chenmi22@msu.edu)
Caroline Eakin, Australian National University (caroline.eakin@anu.edu.au)

Infrasound and the Seismo-acoustic Wavefield

Infrasound monitoring is used to detect and study a variety of natural and anthropogenic sources, as well as to probe temporal and spatial variations in the atmosphere. Many infrasound sources occurring above and within the solid earth or hydrosphere also generate seismic waves. This session focuses on coupled seismo-acoustic propagation through the Earth-ocean-atmosphere system. Consideration of the seismo-acoustic wavefield has the potential to both better constrain directionality and location for a variety of geophysical sources such as volcanoes, earthquakes and chemical or nuclear explosions and elucidate a wider variety of propagation phenomena than seismology or infrasound alone. To take full advantage of a seismo-acoustic wavefield over multiple distance scales, new sensor technologies and data fusion schemes are necessary.

We invite submissions detailing recent science results and research advances in infrasound, seismo-acoustics and similar multi-phenomenological research. Presentations that explore observations and/or interpretations of seismo-acoustic phenomena, existing and emerging source and propagation models, advances in instrumentation, inversion methods and signal analysis techniques are welcome.

Conveners

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Fransiska Dannemann Dugick, Sandia National Laboratories, Southern Methodist University (fdannemann@mail.smu.edu)
Gil Averbuch, Southern Methodist University (gil.averbuch@gmail.com)
Jeffrey B. Johnson, Boise State University (jeffreybjohnson@boisestate.edu)

Insight Seismology on Mars: Results From the First Martian Year of Data and Prospects for the Future

The InSight mission landed on Mars on 26 November 2018 and was the first to place an ultra-sensitive broadband seismometer on the surface of another planet. It will provide key information on the composition and structure of an Earth-like planet that has gone through most of the evolutionary stages of the Earth up to, but not including, plate tectonics. Using seismology, geodesy and heat flow measurement, InSight aims to determine the thickness and structure of the Martian crust and mantle, the size and state of the core, the planet's thermal state and the level of tectonic activity and rate of meteorite impacts.

The two-year (one Mars year) InSight primary mission (with extension possible as the spacecraft continues to function on Mars) ushers in a new era in planetary seismology. In the coming years and decades NASA may launch missions to explore the interiors of our Moon, Venus and the "Ocean Worlds" of the Solar System (e.g., Europa, Enceladus and Titan). Other Space agencies might also launch additional missions with seismometers. While the focus of these mission concepts vary from fundamental geophysics to detection of life and conditions for life, seismological exploration of planetary bodies' interiors is likely to play a key role in understanding planetary state and evolution by helping to determine their thermal and chemical make-up.

We invite contributions that take advantage of the seismic data from the first year on Mars, as well as modeling that looks forward to upcoming data from Mars or other planetary bodies. With data being made available through the IRIS Data Management Center, results from both within and outside the mission science team are welcome.

Conveners

Mark P. Panning, Jet Propulsion Laboratory, California Institute of Technology (mark.p.panning@jpl.nasa.gov)
Sharon Kedar, Jet Propulsion Laboratory, California Institute of Technology (sharon.kedar@jpl.nasa.gov)
Bruce Banerdt, Jet Propulsion Laboratory, California Institute of Technology (william.b.banerdt@jpl.nasa.gov)

Inspiring a New Generation of Seismology Leaders

Racial and ethnic diversity in geosciences has not improved in nearly half a century. Furthermore, a changing political climate and recent events have sparked a nation-wide increased awareness of social justice issues. These events are prompting numerous diversity initiatives within the academic realm, which are being communicated widely through webinars, conferences and various social media platforms. In the geoscience community, these initiatives include newly-formed organizations (e.g. the SSA Diversity, Equity and Inclusion Task Force) that aim to dismantle systems of oppression for people with marginalized identities. Student and early-career seismologists are often advised to keep their distance from these discussions because of the common notion that diversity initiatives are undertaken at the expense of science. This either/or approach of research and diversity is unnecessary and harmful to our community. As seismologists, we work with various communities globally, which requires awareness of the diverse perspectives and identities that we interact with. Consequently, equity and diversity are necessary for scientific progress. The work of budding leaders in seismology, at the forefront of making change, should be acknowledged and heard.

This session aims to establish a community of seismologists interested in making our field more just, equitable, diverse and inclusive. We seek abstracts that highlight diversity initiatives by and/or for seismologists. We also solicit abstracts that outline strategies for integrating diversity and inclusion initiatives in academic, government and industry programs. These presentations can include personal experiences, experiences with outreach or in the field, visions for the future of seismology and/or equitable applications of our science. Note, these abstracts must be constructive for an effective conversation to take place. We encourage and will prioritize abstracts from students and early-career scientists.

Conveners

Monique M. Holt, University of Utah (mholt@seis.utah.edu)
Kevin B. Kwong, University of Washington (kbkwong@uw.edu)
Barrett N. Johnson, University of Washington (bnjo@uw.edu)

Intermountain West Earthquakes in the Spring of 2020

The Intermountain West region of the United States experienced several moderate-to-strong earthquakes in the spring of 2020. The most significant of these were the 18 March 2020 M_w 5.7 earthquake north of Magna, Utah (a suburb of Salt Lake City), the 31 March 2020 M_w 6.5 earthquake northwest of Stanley, Idaho and the

15 May 2020 M_w 6.5 Monte Cristo Range earthquake, northwest of Tonopah, Nevada. This session seeks contributions on all aspects of these earthquake sequences including geologic, geodetic and seismological studies on topics such as earthquake source properties, near-field ground motions, surface rupture, damage assessments, aftershock forecasting, seismic hazard implications and seismotectonics.

Conveners

Jayne Bormann, University of Nevada, Reno (jbormann@unr.edu)
Ryan D. Gold, U.S. Geological Survey (rgold@usgs.gov)
Keith Koper, University of Utah (koper@seis.utah.edu)

Mechanisms of Induced Seismicity: Pressure Diffusion, Elastic Stressing and Aseismic Slip

The rise of man-made earthquakes has generated interest from a broad range of scientists and stakeholders. The interest stems from both practical and scientific standpoints, whereby induced seismicity poses a hazard that can potentially be mitigated and also presents an opportunity to learn about earthquakes in an environment where driving mechanisms may be better constrained. Recent advances in seismic and geodetic monitoring has allowed for more detailed observations of anthropogenically induced and triggered seismicity. These observations have revealed more complex interactions beyond effective stress reduction, including aseismic processes and elastic stress effects. A better understanding of the contributions from these processes (as a function of distance and time, as well as flow and elastic parameters) has significant implications for the expected seismic hazard. In addition, seismic hazard assessment is tied to improved characterizations of the primary controlling factors on induced earthquakes (e.g. injection volumes and rates, change in reservoir pressure, induced stressing rates).

We solicit studies on any types of induced seismicity around the world, including geothermal, hydrocarbon production, waste-water disposal, CO_2 sequestration and gas storage. Case studies from the laboratory to large-N array deployments to field-scales are welcomed. We also seek studies from a wide variety of disciplines that aim to monitor, observe and model injection-induced seismicity. The aim of this session is to bring together numerical, observational and experimental studies on both aseismic and seismic processes associated with induced earthquakes.

Conveners

Ruijia Wang, University of New Mexico (ruijia@unm.edu)
Matthew Weingarten, San Diego State University (mweingarten@sdsu.edu)
Thomas Göbel, University of Memphis (thgoebel@memphis.edu)
Heather R. DeShon, Southern Methodist University (hdeshon@mail.smu.edu)
Kyung Won Chang, Sandia National Laboratories (kchang@sandia.gov)

Modern Geodesy for Observation and and Its Modeling of Earthquake Deformation

In this session, we would like to explore and discuss the crustal deformation features of intraplatel earthquake cycles based on all modernly available geodetic methods, including GNSS, InSAR and other techniques. The applications of these geodetic observations and techniques have significantly improved our understanding of earthquakes. This session intends to cover all of the fields of research that use geodetic applications for earthquake studies. The focus is to discuss how accurate geodetic observations help to update and challenge our current understanding of earthquakes, particularly with respect to the lithosphere's rheologic structure, hazard analysis and varying fault behaviors during seismic cycles. We would like to call for submissions involving new applications of geodetic techniques on earthquake cycle deformation studies as well as reviews on geodetic developments for earthquake application. This is a session to review and promote the revolutionary contribution of geodetic observations to seismological research.

Joint SSC-SSA Session

Conveners

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Jiankun He, Chinese Academy of Sciences (jkhe@itpcas.ac.cn)
Mingsheng Liao, Wuhan University (liao@whu.edu.cn)
Guohong Zhang, China Earthquake Administration (274990177@qq.com)

Network Seismology: Keeping the Network Running While Integrating New Technologies

This session highlights the unique observations, opportunities, challenges and future directions of seismic operation centers. Seismic operation centers play a crucial role in collecting seismic data, generating earthquake products, including catalogs, warnings and maps of ground shaking and responding to many stakeholders, including government agencies and the public. The purpose of the session is to foster collaboration between network operators, inform the wider seismological community of the interesting and challenging problems within network seismology and look to the future on how to improve monitoring capabilities. We encourage submissions related to challenges faced by networks from crises like the COVID shutdown, fires and other natural disasters. We also encourage submissions describing new techniques that would benefit network operations for detecting and locating earthquakes, particularly in a near real-time environment. We are especially interested in algorithms and machine learning (ML) applications, especially comparisons between ML and tried and true human-design algorithms and examples of where ML has been implemented into network operations.

Conveners

William L. Yeck, U.S. Geological Survey (wyeck@usgs.gov)
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Renate Hartog, Pacific Northwest Seismic Network (jrhartog@uw.edu)

New Insights Into the Preparatory Phase of Earthquakes From Tectonic, Field and Lab Experiments

Earthquake prediction and forecasting has been a great scientific challenge for many decades. When reviewing the historical developments around the world, we find that advances in our understanding of the predictability of earthquakes emerge from detailed analyses of new datasets and types of significant earthquakes as well as statistical research, model developments, lab and field experiments. Recently, new constraints have been placed on the earthquake preparation and nucleation phase from detailed observations of foreshocks, aseismic slip before subduction zone earthquakes, seismic slip nucleation in the lab and from statistical analyses of seismicity. Particularly strong constraints can emerge from experiments to catch large earthquakes in the act, such as the Parkfield, California, Earthquake Prediction Site of the U.S. Geological Survey and more recently the China Seismic Experimental Site (CSES) of the China Earthquake Administration. By using the seismically active Sichuan-Yunnan region as a natural observatory, CSES plans to foster an international and interdisciplinary cooperation on fundamental research in continental earthquakes.

In this session, we welcome contributions that illuminate or constrain the earthquake preparation phase from across the scales, from lab and field scales to global studies, and across the disciplines, including seismology, geodesy, geophysics and numerical modelling to experimental rock mechanics. We seek presentations that either develop new hypotheses (in exploratory research) or aim to test existing hypotheses (in confirmatory research). We also welcome contributions that leverage data science, including artificial intelligence, big data or cloud computing, to advance earthquake predictability research.

Joint SSC-SSA Session

Conveners

Zhigang Peng, Georgia Institute of Technology (zpeng@gatech.edu)
Yongxian Zhang, China Earthquake Administration (yxzhseis@sina.com)
Maximilian Werner, University of Bristol (max.werner@bristol.ac.uk)
Vladimir Kossobokov, Russian Academy of Sciences (volodya@mitp.ru)
John E. Ebel, Boston College (john.ebel.1@bc.edu)
Weijun Wang, China Earthquake Administration (wjwang@cea-ies.ac.cn)

Numerical Modeling of Earthquake Motion, Rupture Dynamics, Seismic Noise and Wave Propagation

Continuous development of numerical modeling methodology in seismology is driven by emerging requirements in the observational seismology, advances in the mathematical sciences, evolution of computer architectures and programming models, adaptation of methods originating in other scientific fields, as well as by practical applications including site-specific seismic hazard assessment.

This session is a forum for presenting advances in numerical methodology, whether the principal context is observational, mathematical/numerical, computational or application. We invite contributions focused on development, verification and validation of numerical-modeling methods and methodologically important applications especially to earthquake ground motion, seismic noise and rupture dynamics, including applications from field of induced seismicity with particular focus on multi-physics aspects, for example, combining fluid migration and stress transfer in porous media with rupture dynamics and wave propagation in poro-elastic media and full seismic cycle simulations. We encourage contributions on the analysis of methods, fast algorithms, high-performance implementations, large-scale simulations, non-linear behavior, multi-scale problems and confrontation of methods with data.

Conveners

Peter Moczo, Comenius University Bratislava (moczo@fmph.uniba.sk)
Wei Zhang, Southern University of Science and Technology (zhangwei@sustech.edu.cn)
Jozef Kristek, Comenius University Bratislava (kristek@fmph.uniba.sk)
Martin Galis, Comenius University Bratislava (martin.galis@uniba.sk)

Overdue?

Are California and other regions overdue for large earthquakes? Comparison of instrumental seismic data with longer term geological and paleoseismic data suggest that such regions have experienced fewer large earthquakes in the last century than the long term average. A commonly accepted implication is that such regions might be overdue and should expect an accelerated rate. Is the current rate actually anomalous? Just due to expected random variations? A low point between supercycles? A result of different observational techniques between the instrumental and pre-instrumental periods? We welcome presentations that will clarify the options, suggest testable hypotheses and enrich the conversation.

Conveners

David D. Jackson, University of California, Los Angeles (djackson@g.ucla.edu)
Danijel Schorlemmer, GFZ German Research Centre for Geosciences (ds@gfz-potsdam.de)

Physics-based Earthquake Rupture Modeling and Strong Motion Simulations

Advancements in high-performance computing, improved understanding of physical processes during earthquake rupture and an increased number of observations of seismic events have contributed to the development of high-resolution seismic velocity models and numerical techniques for simulating earthquake ground motion for engineering applications. The integration of this multidisciplinary knowledge into fault-to-structure simulation techniques requires interaction between earth scientists and earthquake engineers. This session will focus on state-of-the-art research on kinematic and dynamic rupture modeling, computational aspects of ground motion modeling and verification of simulation techniques in building response analysis. We welcome studies focused on all aspects of physics-based earthquake rupture modeling and 3D wave propagation modeling, including: simulations incorporating free-surface topography, small-scale heterogeneity superimposed on deterministic velocity models, linear and non-linear constitutive material models, representation of near-surface geotechnical soil properties in site response, large-scale ground motion simulation on HPC platforms as well as simulations of ground motion variability and building response. Additionally, we encourage submissions related to implementing information from ground motion simulation research into targets for engineering constraints and their application in seismic hazard assessment, as well as theoretical and numerical modeling approaches addressing recordings with emerging sensor technologies such as DAS and rotational sensors.

Conveners

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Alice Gabriel, University of California (gabriel@geophysik.uni-muenchen.de)
Kyle Withers, Geologic Hazards Science Center, U.S. Geological Survey (kwithers@usgs.gov)
František Gallovič, Charles University (gallovic@karel.troja.mff.cuni.cz)
Arthur Rodgers, Lawrence Livermore National laboratory (rodgers7@llnl.gov)

Probabilistic Seismic Hazard Assessment: Where Do We Go from Here?

A half century after its introduction (Cornell, 1968), probabilistic seismic hazard assessment (PSHA) has been adopted widely by governmental agencies and industry as the standard approach to assess hazards from future earthquakes. PSHA maps are used for myriad reasons, including building code development. Over time, extensive research has been done to develop methodology and refine key inputs -- earthquake rupture forecast (ERF) models and ground motion prediction equations (GMPEs).

Increasingly, PSHA maps are based on input ERFs and GMPEs that are constrained by best-available science, subject to certain assumptions.

However, due to the long time horizons of long-term PSHA maps relative to paleoseismic, historical and instrumental observation periods, evaluation of maps remains challenging. In this session we welcome contributions focused on the question, where does PSHA go from here?

For this session we welcome contributions focused on this question, including but not limited to: evaluation and/or testing of PSHA maps, novel approaches to improve PSHA and/or its inputs, investigations of the sensitivity of PSHA maps to inputs and/or assumptions and alternative approaches to PSHA.

Conveners

Susan E. Hough, U.S. Geological Survey (hough@usgs.gov)
Seth Stein, Northwestern University (s-stein@northwestern.edu)

Recent Advances in Soil-structure Interaction Inverse Problems

Understanding the near-surface soil's behavior and its interaction with a built environment is essential for analyzing and designing a new infrastructure and health monitoring of an existing infrastructure. Recent studies have shown that sparsely measured seismic motion data in a domain and the passive-seismic inversion methods can be used for estimating incoherent incident waveforms and material properties in the near-field. It is also shown that using active seismic source-based inversion methods can further characterize the underlying structure of such problems. The estimation of incident wave-field, the constitutive relations and the associated uncertainties, in turn, can facilitate performance-based engineering of soil-structure interaction problems. To this end, this session's primary focus is on recent advances in not only the forward analysis of soil-structure interaction problems but also its inversion using passive and active-seismic methods.

Conveners

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Recent Development in Ultra-Dense Seismic Arrays with Nodes and Distributed Acoustic Sensing

Recently, ultra-dense seismic deployments, typically consisting of hundreds to thousands of short-period nodal instruments or distributed acoustic sensing (DAS) systems with fiber optic cables, have been widely used in seismological studies. These dense arrays have very close station spacings ranging from several meters to hundreds of meters to record well-sampled and unaliased wavefields in local or regional settings. Data acquired by such dense systems promote the development of new array-based analysis methods to mine seismic wavefields and greatly improve our understanding of fine-scale subsurface properties, microseismic activities and earthquake rupture processes. In this session, we invite contributions from areas that are broadly related to ultra-dense arrays. Example topics include, but are not limited to, novel instrument development, new field experiments with nodal or DAS arrays, high-resolution imaging of subsurface structure, environmental seismology, microseismic detection/relocation, source characterization and related big data processing techniques.

Joint SSC-SSA Session

Conveners

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Recent Engineering Uses of National Seismic Hazard Models

The U.S. Geological Survey (USGS), Natural Resources Canada (NRCan) and agencies of several other countries have recently updated their National Seismic Hazard Models (NSHMs) and/or are in the process of doing so—e.g., GNS Science of New Zealand. Earthquake engineers are using these NSHMs and/or providing input on their development. For example, the 2018 USGS NSHM has been used for the "2020 NEHRP Recommended Seismic Provisions for New Buildings and Other Structures," developed by the Building Seismic Safety Council (BSSC) for adoption into building codes throughout the United States. Through prior dialogue between the BSSC and

USGS, the BSSC “Project 17” committee requested an expanded set of spectral acceleration periods and site conditions (i.e., 30-meter shear-wave velocities) for the 2018 NSHM. This BSSC request influenced the ground motion models and sedimentary basin depths incorporated by the USGS. Furthermore, BSSC review of preliminary results from the 2018 NSHM led to improvements to the modeling of basin effects. Similarly, the sixth generation of the NRCan NSHM is being used for the 2020 National Building Code of Canada (NBCC) and includes an expanded set of site conditions tailored to their use in the NBCC. GNS Science is updating its New Zealand NSHM and is including engineering users throughout their process. Concurrently, the New Zealand government is running a process to re-evaluate how NSHM results are used to meet building code goals. This session invites presentations on other recent engineering uses of and/or input on NSHMs, not only for construction codes but also seismic risk assessments and other engineering applications. In particular, we welcome contributions from international earthquake engineers and scientists who can more readily participate in the online-only format of this year’s SSA Annual Meeting.

Conveners

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Seismic Hazard Analysis for Critical Infrastructure

The term critical infrastructure refers to the facilities and systems that provide vital services to a nation. Examples of critical infrastructure include nuclear power plants and nuclear waste repositories, dams and infrastructure that supports the emergency services sector, energy sector and water systems, among others. Potential damage or destruction to any of these facilities or systems would likely have a detrimental effect on public health, safety and security. Regulatory guidance defines appropriate procedures to perform planning, siting, data collection and analysis needed to ensure the physical elements of critical infrastructure are located and constructed to sufficiently withstand seismic loads and avoid earthquake-related effects of permanent ground displacement such as surface faulting and liquefaction. These types of studies involve rigorous data collection and site-specific analysis that considers seismogenic sources over a wide area. The results of these studies can be of great benefit to neighboring and regional communities because the level of detail and areal extent is often much greater than conventional studies for non-critical infrastructure. When critical infrastructure is impacted by an earthquake, post-event assessments are performed to document the resulting deformation and to determine the extent and nature of the impact on critical structures for the purpose of improving engineering practices in the future. In this session, we welcome submissions that cover a wide-range of seismic hazard-related studies and analysis that have been performed to ensure the resiliency of critical infrastructure. We have a particular interest in submissions that discuss key insights from recent seismic events that discuss ground shaking and building damage, triggered ground failure in proximity to infrastructure and complexities related to surface fault deformation and pipelines.

Conveners

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Laurel M. Bauer, U.S. Nuclear Regulatory Commission (laurel.bauer@nrc.gov)

Strategies and Actions for Fostering a Diverse Seismology Community

The goal of this session is to share ideas, efforts and programs that the community is currently using to increase diversity in seismology and related fields. In spite of efforts to increase diversity for several decades, the demographic makeup of the geosciences remains imbalanced in proportion to that of the U.S. population (Bernard and Cooperdock, 2018, Dutt, 2019), even though the work of demographically underrepresented groups is scientifically novel and highly innovative (Hofstra et al. 2020).

New strategies to address these disparities will be highlighted in this session. We encourage submissions on topics such as: providing education on implicit biases; developing equitable selection processes; ensuring an inclusive and welcoming work environment; creating safe fieldwork spaces (Demery and Pipkin, 2020); acknowledging mental health issues related to experiences of identity; and fostering retention. We welcome examples in seismology such as successful broader impacts activities, policy changes, efforts in Diversity, Equity and Inclusion (DEI) education and recruitment and retention of underrepresented students/employees, postdoctoral researchers, staff and faculty.

We welcome submissions from principal investigators, educators, scientists in national laboratories, the USGS and BOR, non-profits and industry seismologists who have incorporated elements of outreach and diversity into their research and leadership efforts, as well as specialists in DEI and education efforts. The emphasis is on finding out how leaders are currently promoting and addressing diversity, education and inclusion efforts and actions we can take to make progress on those efforts.

Conveners

Valerie Sloan, National Center for Atmospheric Research (vsloan@ucar.edu)
Aradhna Tripati, University of California, Los Angeles (atripati@g.ucla.edu)
Aubreya Adams, Colgate University (aadams@colgate.edu)
Wendy Bohon, Incorporated Research Institutions for Seismology (wendy.bohon@iris.edu)

Strong-Motion Data Processing and Dissemination: State-of-the-Art and Outlook

Strong-motion waveforms and associated metadata are key input to a broad range of studies spanning the domains of engineering seismology, soil dynamics, earthquake engineering, seismic hazard and risk and computational near-source seismology. The deployment of dense accelerometer networks with modern broadband high-dynamic-range instruments has progressively blurred the traditional boundary between weak-motion and strong-motion seismology. Some strong-motion data banks started to also include on-scale data recorded by velocity sensors especially for low-magnitude events, and the discussion is open on whether this should become standard practice. Geophysical characterization of the recording sites has become a standard, and open databases have been created to host both basic and advanced station metadata crucial to the scientific interpretation of earthquake recordings. The dramatic increase in the amount of available data prompts for new dissemination strategies centered on web services, standardized and optimized data formats and the development of automatic processing techniques, which in turn require strict quality checks prior to data dissemination. Machine learning methods promise to provide an automated solution to quality checks that have traditionally been performed by visual inspection. In this session we welcome contributions on strong-motion data processing (manual and automatic) and dissemination strategies (data formats, databases, web services) as implemented by seismological agencies worldwide. We aim at collecting input from the global community to optimize and harmonize best practices in strong-motion data management.

Conveners

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Subduction Processes Along Latin America Subduction Zones

Subduction zones along Latin America, including those in Mexico, Central America, Caribe and South America, present a dynamic and complex diversity of Earth processes that have important effects on permanent and elastic deformation. Both in the strike and dip directions there is a marked segmentation with a wide variety of seismic and aseismic slip behavior at the plate interface and different deformation styles in the down-going and overriding plates. In addition to megathrust earthquakes, intermediate depth earthquakes and shallow backarc earthquakes are often very damaging and less well studied. Furthermore, recent years have seen an increase in onshore/offshore experiments tackling issues such as fluid content and interaction between seismic and aseismic slip. Likewise, improvements in seismic imaging and earthquake sources studies have led to a wealth of new knowledge related to convergent margin processes including both flat and normal slab subduction.

In this session, we invite contributions studying the variety of subduction processes that take place in these subduction zones and their effects on permanent and elastic deformation along the margin. We welcome both theoretical, observational and modeling studies, including studies using passive and active seismology and geodesy.

Joint LACSC-SSA Session

Conveners

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Tectonics and Seismicity of Stable Continental Interiors

Perhaps the least understood seismicity and tectonic deformation is that in stable continental interiors far removed from active plate boundaries. Areas of interest include central and eastern North America, northern Europe, Australia and parts of Asia. New understandings of intraplate tectonic activity and corresponding seismicity are being achieved through a variety of approaches, including increased completeness of earthquake catalogs from local or national-scale monitoring efforts like USARRAY, new methods of identifying smaller earthquakes from existing data, through analyses of data sets that image subsurface faults, through studies that constrain historical slip on such faults, from examinations of geodetic, geomorphologic and elevation changes and through improved measurements of local stresses. Complementing these approaches are studies that show that the lower attenuation of ground motions and strong site responses in continental interior regions result in earthquakes having greater impacts than those at plate boundaries.

This session seeks diverse contributions related to intraplate earthquake hazards with goals of describing seismicity, characterizing active faults and/or deformation in stable continental interiors, learning the long-term earthquake histories, assessing potential ground motion impacts, applying lessons learned from induced earthquakes and understanding the mechanisms that cause enigmatic intraplate earthquakes. Contributions regarding 2020 earthquakes such as those in Sparta, North Carolina are especially welcome.

Conveners

Anjana K. Shah, U.S. Geological Survey (ashah@usgs.gov)
Christine A. Powell, CERI, University of Memphis (capowell@memphis.edu)
Will Levandowski, Tetra Tech (will.levandowski@tetratech.com)

Tectonics, Seismicity and Recent Significant Events in the Caribbean

Greater and Lesser Antilles are located at the active plate boundary between the North American and the Caribbean plates. Large magnitude earthquakes and destructive tsunamis are mostly caused by the convergence and interactions of these plates. In the 20th century, there have been several large magnitude and destructive earthquakes such as the 1918 M7.4 earthquake, the 1943 M7.6 earthquake, the 1946 M8.0 earthquake and the 2010 M7.0 Haiti earthquake (Puerto Rico and Hispaniola). The most recent 2020 M6.4 earthquake caused significant damages and destruction in Puerto Rico.

In addition to earthquakes, other tsunamigenic events, including submarine/subaerial landslides, submarine volcanoes and subaerial pyroclastic flows have occurred in the Caribbean. Large tsunamis have hit the islands killing many people. The exposure and associated risk have increased because of the high population density and extensive development near the coast, including tourism and recreation infrastructure. All the northeastern Caribbean has a significant exposure to earthquakes and tsunamis and that is the goal of this session to have a forum to present the actuality of research, activity, forecasting, etc. in this very sensitive part of the world.

Joint LACSC-SSA Session

Conveners

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The 7 January 2020 South of Indios (M6.4) Earthquake in Puerto Rico, Response and Lessons

The Puerto Rico archipelago is located in the active plate boundary between the North American and the Caribbean plates. Large magnitude earthquakes and destructive tsunamis are part of its geologic history, including events in the last 500 years, i.e. 1670, 1787, 1867 and 1918. The most recent event occurred on 7 January 2020 (M6.4), causing significant damages and destruction to the main island.

Although the southwestern region of Puerto Rico is identified as one of the most active regions in the area, it was not until 28 December 2019 that the southwestern region of the island experienced a major significant event since 1918. The activity consisted of an ongoing seismic sequence with the largest earthquake, magnitude 6.4, occurring on 7 January 2020 located South of Indios neighborhood of Guayanilla, Puerto Rico. In the aftermath of the event, the Island was declared in an official state of emergency at local and federal levels.

One person was killed and four were injured during the event. The main shock caused a power outage across the island, as well as structural damage to roads and bridges, especially in the southwestern region. Public offices, churches and schools were closed. Hospitals mostly in the southwestern region were evacuated for safety reasons. Residents were terrified to go into their homes for fear that another quake will bring the structures down.

In this session we will discuss the response carried out at all levels from the event detection, alert notifications, research and field work to the emergency response and public preparedness. Lessons learned will be a topic of discussion as well.

Conveners

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The 2020 Simeonof Island, Alaska, Earthquake: Observations, Modeling and Tectonic Insights

In July 2020, a Mw 7.8 earthquake struck along the Alaskan subduction zone at the edge of the Shumagin Gap, a region with poorly coupled megathrust that has been devoid of large earthquakes for the last century. The relation of the Simeonof Island earthquake and its associated afterslip to plate coupling in the region is important to determine the future tsunamigenic potential of the subduction interface, of interest to both local and Pacific basin wide communities. Moreover, understanding why seismic and aseismic slip occurs in poorly coupled subduction zones is relevant to characterizing hazards globally. Past events along the edges of the Shumagin gap, most notably in 1936 and 1948, showed that shallow megathrust slip is possible. Here we invite submissions that describe the entire earthquake cycle within the Shumagin Gap, including but not limited to: historical seismicity, preseismic deformation and coupling, earthquake rupture modeling, aftershock monitoring and forecasts, field observations, postseismic deformation, tsunami observations and hazards implications.

Conveners

Brendan W. Crowell, University of Washington (crowellb@uw.edu)
Natalia Ruppert, University of Alaska Fairbanks (naruppert@alaska.edu)

The UN Decade of Ocean Science for Sustainable Development and Seismology

The UN Decade of Ocean Science for Sustainable Development will take place 2021-2030. It seeks to transform the ocean, the understanding of the ocean and address future challenges that face the ocean and thus humankind. The Implementation Plan proposes seven outcomes, two of which are related and would benefit from an advancement of seismology in the ocean: A safe ocean where life and livelihoods are protected from ocean-related hazards, including submarine earthquakes and tsunamis and an accessible ocean with open and equitable access to data, information and technology and innovation. Likewise, two of the Decade challenges are relevant to the seismological community: enhanced multi-hazard early warning services and a sustainable ocean observing system across all ocean basins that delivers accessible, timely and actionable data and information to all users. Additionally, there are seismological observations and methods that could contribute to other areas of Ocean Science.

This session will seek to discuss the transformational and innovative technologies that may be developed and deployed to address the gap in telemetered, near real time, permanent, continuous and high quality seismic and geophysical data that permit the quick characterization of hazards and complement the higher density land stations. Despite notable advances in the global tsunami warning system, including land based instrumentation, significant detection, measurement and forecast uncertainties remain to meet emergency response and community needs. A new generation of ocean sensing capabilities presents an opportunity to address several of these uncertainties. The conveners invite talks on technologies, methods and applications, including but not limited to long term sea floor seismographs, ocean observatories, submarine communication cables, (SMART) and ocean geodesy. Proposals on strategic partnerships between the academic, research, government and industry are also welcome.

Conveners

Christa Von Hillebrandt-Andrade, National Oceanic and Atmospheric Administration (christa.vonh@noaa.gov)
Monica Kohler, California Institute of Technology (kohler@caltech.edu)

Towards an Integrated View of Earthquake Gates From Geologic Observations and Numerical Models

Fault complexities, such as bends, stepovers and branches, may inhibit earthquake rupture propagation. Numerical modeling, Quaternary slip rate analyses and paleoseismic studies have demonstrated that these structural complexities can act as earthquake gates that exhibit a time-dependent probability of throughgoing rupture. Earthquake gate breaching is sensitive to a variety of parameters, including stress heterogeneities due to prior rupture history, rupture directivity and velocity, rheological properties and fault geometry. Observational records of global earthquake gates remain sparse, and numerical models remain relatively simple compared to real-world fault systems. However, in concert both approaches have advanced our understanding of earthquake gate timing and mechanical behavior considerably.

In this session, we seek to bring together geoscientists from a diverse disciplinary range interested in rupture behavior and timing through fault complexities. We welcome studies using geologic observations, observational seismology and numerical modeling to advance our understanding of earthquake gate behavior. We are particularly interested in studies that synthesize observations from multiple disciplines.

Conveners

Veronica B. Prush, University of California, Davis (vbprush@ucdavis.edu)
Alba M. Rodríguez Padilla, University of California, Davis (arodriguezpadilla@ucdavis.edu)
Julian C. Lozos, California State University, Northridge (julian.lozos@csun.edu)
Michele L. Cooke, University of Massachusetts, Amherst (cooke@umass.edu)

Tsunami Warning System in Latin America and the Caribbean: COVID-19 Challenges

The SARS-Cov-2, was first identified in December 2019 in Wuhan, China and rapidly became a Public Health Emergency worldwide in early 2020. As of 1 October 2020, over 39.0 million cases and more than 1.0 million deaths have been reported.

In the Latin American and Caribbean region, the COVID-19 pandemic represents a major challenge in all fronts, but particularly in the ongoing Tsunami Warning System, that involves the TSP (Tsunami Service Provider), the communication protocol of national agencies and the public in the hazard zones. Associated research, academic initiatives and preparedness activities in the region have been affected as well.

This session provides a broad opportunity to present how our Tsunami Warning System is impacted, responding and planning in the face of this and future health emergencies. It will provide a forum to identify inter- and transdisciplinary strategies to sustain the system and adjustments needed under this new reality. Topics will include from the monitoring and detection; hazard and risk assessments, forecast and warnings, mitigation, education, preparedness, response and recovery strategies. As is broadly known, over the past centuries several tsunamigenic earthquakes devastated our region and the associated sea waves destroyed our coastlines causing tragedies i.e. Peru (1687), Ecuador (1906), Dominican Republic (1946), Chile (1960, 2010), etc. Recent tsunami events have demonstrated that the risk and vulnerability from tsunami hazards continues to grow with expanding coastal populations and infrastructure. While the understanding and warning capabilities have significantly increased over the last decades, it is mandatory to adapt our programs to include the public health recommendations.

Joint LACSC-SSA Session

Conveners

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Christa von Hillebrandt-Andrade, NOAA (christa.vonh@noaa.gov)
Silvia Chacon-Barrantes, UNA (silviach@una.ac.cr)

Updating the US National Seismic Hazard Models

The U.S. Geological Survey (USGS) National Seismic Hazard Models (NSHMs) are a bridge between best-available earthquake science and public policy. Over the next few years, the National Seismic Hazard Model Project (NSHMP) will publish updates to three model regions: Hawaii, the conterminous U.S. (CONUS) and Alaska. This effort will bring NSHMs for all 50 states in line with current data and modeling approaches. Although the CONUS NSHM was updated in 2018, the Alaska seismic hazard model was last updated in 2007 and Hawaii in 1998. Over the next few years, the NSHMP will evaluate the new NGA-Subduction GMMs for use in the Cascadia and Aleutian arc subduction zones. It will also consider deep basin effects in other locations with high population density as it did for Los Angeles, San Francisco, Seattle and Salt Lake City in the 2018 CONUS update. New ground motion modeling approaches (e.g. simulation-based, non-ergodic) also require attention.

For this session, we invite contributions on current and future NSHM components. Example topics include: Atlantic and Gulf Coast and other alternative site amplification models, new fault data and models, fault-system modeling (e.g. UCERF3), NGA-Subduction GMMs, physics-based (3D simulation) ground motion model validation and implementation, non-ergodic aleatory uncertainty, basin models, new geodetic data and inversions, M-area scaling relations, the Alaska megathrust geometry and recurrence and novel approaches to modeling and computing hazard and associated uncertainties. Although the session is largely focused on updates to U.S. models, much of what goes into modeling earthquake hazard has global applicability. We therefore also welcome submissions on the development and details of other NSHMs worldwide.

Conveners

Peter M. Powers, U.S. Geological Survey (pmpowers@usgs.gov)
Allison M. Shumway, U.S. Geological Survey (ashumway@usgs.gov)
Mark D. Petersen, U.S. Geological Survey (mpetersen@usgs.gov)
Sanaz Rezaeian, U.S. Geological Survey (srezaeian@usgs.gov)

Utilizing Earthscope and Aacse Datasets in Alaska and Canada to Unravel Earth Science Mysteries

As part of the National Science Foundation (NSF) funded EarthScope project, the USArray Transportable Array (TA) in Alaska and western Canada deployed and operated near 200 telemetered broadband seismic and infrasound stations. This systematic coverage of continental Alaska and northwest Canada has provided an unprecedented dataset for the seismological community. This large-scale scientific experiment also inspired another simultaneous effort, the Alaska Amphibious Community Seismic Experiment (AACSE), and is complemented by numerous seismic and nonseismic field efforts in the Aleutians through the NSF GeoPRISMS program. This session invites results from studies utilizing all or part of this community datasets to investigate crustal and mantle structures, active tectonics, volcanism, local and regional earthquakes or other elastic wave sources and seismic wave propagation.

Conveners

Natalia A. Ruppert, University of Alaska Fairbanks (naruppert@alaska.edu)
Meghan S. Miller, Australian National University (meghan.miller@anu.edu.au)

Waveform Cross-correlation-based Methods in Observational Seismology

Recent development in observational seismology relies heavily on the mining of increasingly large datasets through waveform cross-correlation-based techniques to improve signal to noise ratios and extract useful information from continuous seismograms. These include obtaining accurate differential arrival times with waveform correlation analysis for accurate earthquake relocation and 3D seismic tomography, detecting low-magnitude events using array-based waveform matching, extracting empirical Green's functions (e.g., surface and body waves) from cross-correlation of continuous ambient noise waveforms and creating virtual sources or receivers from cross-correlating earthquake coda waveforms. In this session, we welcome both methodologically- and observationally-focused contributions that utilize correlation-based methods to detect repeating earthquakes near creeping faults and volcanoes, relocate microearthquakes and low-frequency earthquakes around seismically active regions and image subsurface structures and monitor their temporal changes with ambient noise and earthquake coda correlation techniques. We hope to provide a platform for discussing how to efficiently apply correlation-based methods to ultra-dense arrays and long-duration continuous waveforms to better extract useful seismic events and image subsurface structures.

Conveners

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Taka'aki Taira, University of California, Berkeley (taira@berkeley.edu)
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What Can We Infer About the Earthquake Source Through Analyses of Strong Ground Motion?

Because the earthquake source cannot be directly observed, we rely on multiple analyses to infer knowledge of the parameters used to describe an earthquake. In this session we would invite presentations that describe methods and results for inferring the properties of the earthquake source, such as, rupture velocity, fracture energy, stress drop (stress parameter), slip-rate functions, critical slip weakening distance, friction, scaling laws, duration, moment rate, spatial heterogeneity, directivity, etc. We encourage presentations that discuss uncertainties in the inferred parameters. We look forward to presentations that link earthquake simulations, both kinematic and dynamic, to generation of near-source ground motions. In particular, analysis of near-source data sets using inversion, arrays or other novel methods are most welcome.

Conveners

Ralph J. Archuleta, University of California, Santa Barbara (ralph.archuleta@ucsb.edu)
Joe Fletcher, U.S. Geological Survey (jfletcher@usgs.gov)
Greg Beroza, Stanford University (beroza@stanford.edu)

When Seismology Meets Machine Learning, Data Science, HPC, Cloud Computing and Beyond

Seismology is a data rich and data-driven science. As seismologists, we are lucky to be in an age where new tools and techniques are emerging to facilitate extracting insights from huge amounts of data. Over the past few years, there has been a new surge of interests in the applications of machine learning and data science techniques to seismological problems, as well as exploring the use of HPC and cloud computing to address computation-intensive tasks, and this new sub-field is rapidly evolving. Recent examples of seismological tasks in which machine learning applications have been shown to be promising include earthquake signal detection, seismic phase picking, phase association, first polarity determination, magnitude estimation, source location determination, event discrimination, seismic image pre-processing and interpretation, signal denoising, subsurface characterization, ground motion prediction and simulation, lab earthquake and aftershock prediction and exploratory data analyses. Though the progress on these tasks is not even, there is huge potential and more room for improvement in the near future. In this session, we invite contributions discussing the application of machine learning, data science, high performance computing, cloud computing and other recent data driven related efforts in all seismological problems. We welcome contributors to discuss successes, challenges and lessons learned in the application of these developing technologies.

Conveners

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