SIG Session 1: Wednesday, 11:00 am

- GAGE GNSS Data Products: Past, Present and Future
- What to expect from the PASSCAL Magnetotelluric facility
- Seafloor Geodesy as a Community Resource
- Broadband Sensor Direct Burial, Appropriate Uses, Results from Recent Experiments and Best Practices in Terrestrial and Polar Environments
- Network of the Americas: The Current and Future State of the Network
- Social Media for Hazard Scientists

GAGE GNSS Data Products: Past, Present and Future

Tom Herring, Walter Szeliga, David Phillips

PAST

- Summary of methods and products from PBO MREFC to PBO O&M to GAGE
- Herring et al. (2016) *Reviews of Geophysics* paper

PRESENT

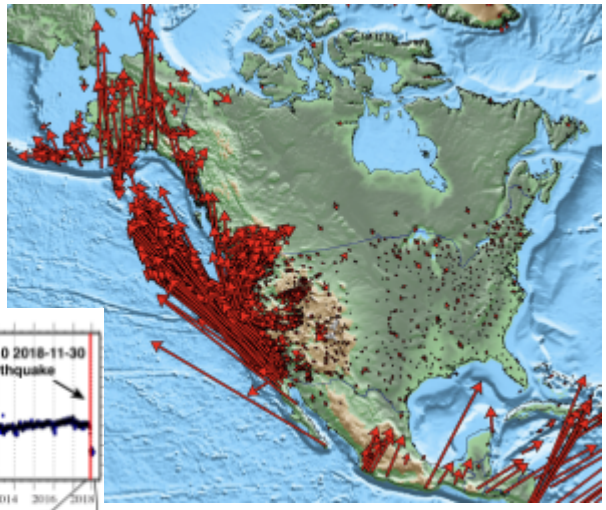
- 1 Analysis Center Coordinator (MIT) + 1 Analysis Center (CWU)
- 2,600+ stations
- Position time series, velocities, offsets, tropo, hydro loading, QA
- Products now available in ITRF 2014
- Reprocessed products going back to 1996
- DOIs for products

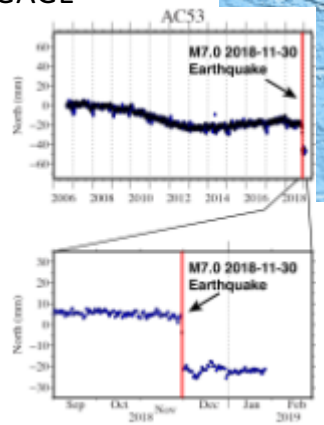
FUTURE

- CWU software migration from Gipsy6 to GipsyX
- New combination products from GAGE and non-GAGE AC's
- Many more stations added to analysis
- GPS to multi-GNSS analysis transition

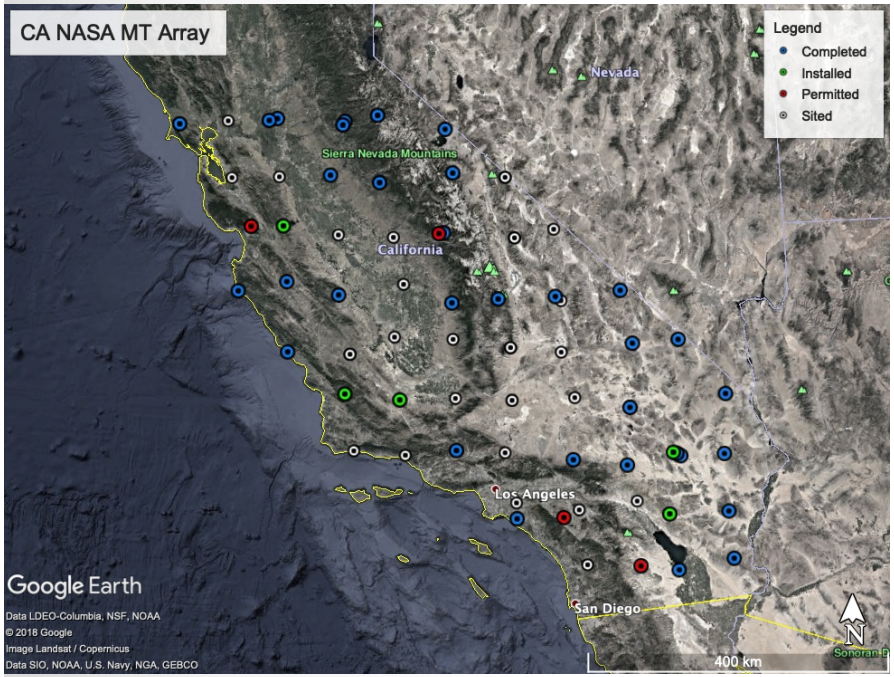
QUESTIONS/TOPICS

- Separate GPS and multi-GNSS products or only multi-GNSS?
- Flagged attributes? Extra columns? Different file format?
- How deep into the "weeds" do users really want to get?
- How to present time info. What resolution? What format?





What to Expect from the PASSCAL Magnetotelluric Facility



EarthScope-esque MT is alive and well in California!

- 2 hosts, at least 21 attendees (11 seis, 4 MT, 5 facility)
- Feedback
  - Recognition that MT is increasingly valued
  - Instrument usage cases
    - E vs. B field sampling
    - Fluxgate vs coil magnetometers
    - Sometimes no B_z
  - New PIs will need help
    - Training for data collection
    - Processing transfer functions
    - Running inversions and other analyses
  - MT segways into continued interest in near surface geophysics

Summary for **Seafloor Geodesy as a Community Resource**

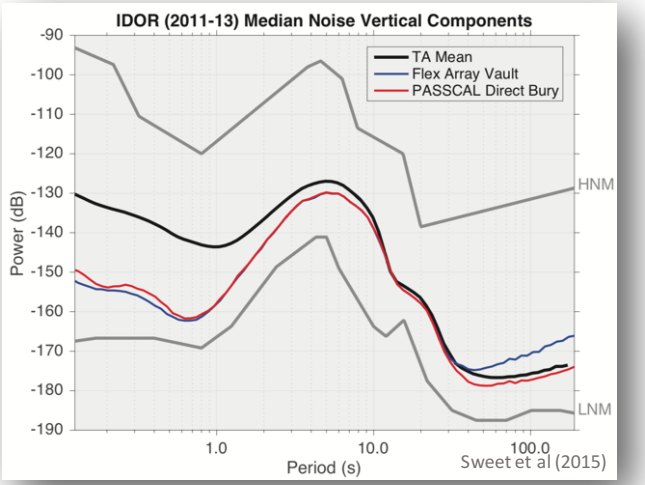
- NSF has Commissioned a seafloor geodetic instrument pool:
  - 16 GNSS-Acoustic sites w/ pressure + 3 Wave Gliders
  - Ready for deployment by winter 2021.
  - No funds for deployment, operations, maintenance, or training
- NSF is seeking feedback on how the instrument pool should be utilized.
- SIG Discussion:
  - Broad support for a dedicated workshop.
  - Community experiment(s) versus PI-driven projects
  - Need to consider optimizing with other deployments and intl. efforts.
  - Ways to maximize training and community participation.
  - Explored possible targets, both tectonic and non-tectonic.
  - Approaches for vetting targets.

Survey ➔ https://b.gatech.edu/30Vsoa6

Direct Bury SIG: 60+ participants

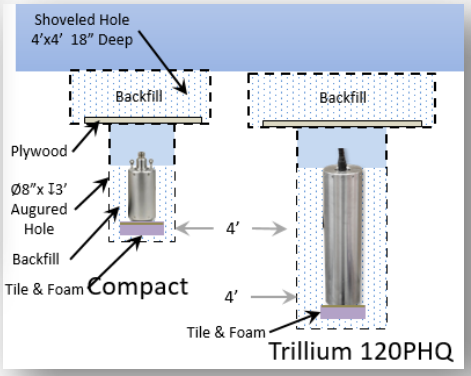
Direct-burying of non-direct bury instruments is not a great idea

Direct bury station noise can compete with TA quality data for a given setting



Direct-burying direct-bury sensors is fast and reliable

Ongoing work to facilitate deployments: shorter sensors to allow shallower holes + Quick Deploy Boxes to standardize the other end of the sensor cable



GAGE National Science Foundation's Geodetic Facility for the Advancement of Geoscience

UNAVCO

Network of the Americas: The Current and Future State of the Network
Technical Topics Session / 2019 SAGE-GAGE Workshop

- NOTA federates three NSF-funded networks: EarthScope PBO, TLALOCNet (Mx), and COCONet (Caribbean, Central America) into a single, hemispherical-scale GNSS-Met network with ~$225M investment by NSF to date
- NOTA GNSS station decommissioning plan; NSF DCL for 10% reduction of stations - Sep. 30th -> Oct. 31th; various institutions have expressed interest in ~90/128 stations
- ShakeAlert: UNAVCO/USGS partnership helps to upgrade the network with ~$2.7M additional investment
- NOTA performance during the 2019 Ridgecrest earthquake sequence: 100% of 15s, 1Hz, and 5Hz data retrieved from stations within 200 km
- Realtime GNSS position estimates (1 Hz) used to estimate a magnitude of M6.9 +/- 0.2 in 13 seconds from OT of main shock

Social Media for Hazards Scientists

- Communications landscape has changed: fast, frequent, no gatekeepers
  - Beware the information void!
- Social media allows broad dissemination of information / ideas by individuals, institutions, and the scientific community as a whole
- Source credibility is a combination of expertise and trust
  - Trust is assessed in the first 9-30 seconds in high-stress situations, based mainly on empathy/compassion
- Work with social scientists!

SIG Session 2: Thursday, 10:30 am

- Geodetic data and products sharing: enable the future with web services?
- Preparing for future controlled-source seismic experiments that will use thousands of nodal seismometers
- Designing a Subduction Zone Observatory Initiative: Community Input to the SZ4D Research Coordination Networks
- Updating Design Goals for the Global Seismographic Network (GSN) to Enable New Discoveries
- Emerging applications for UAS (uncrewed aerial systems)
- Integrating geophysics methods into undergraduate courses

Geodetic data and products sharing: Enable the future with web services?

Elisabetta D'Anastasio (GNS Science), David Phillips (UNAVCO), Chad Trabant (IRIS), Mike Floyd (MIT)

What: Geodetic data explosion require a modernization of how we share metadata, data, products

How: learn from seismological community (IRIS): web services (FDSN)
standardize interfaces, use existing standards (RINEX3, GeodesyML, OGC)
simple is powerful
Allow, share, document!

Why: Let scientists do the science
metadata maintenance is painful but crucial
validation and interoperability
Human readable formats
provenance (DOI)
open source community approach (champions, enablers, contributors)

Help us, tell us what you need! Survey, use cases

Watch the space: Unavco, Geoscience Australia, European Plate Boundary Observatory, NASA-JPL

Preparing for future controlled-source seismic experiments that will use thousands of nodal seismometers

Purpose: With the PASSCAL Texan pool reaching end-of-life, and a node pool building, this SIG was designed to examine how active-source experiments would utilize 1000s of nodes. The goal was to provide community comments and feedback to the PASC and PASSCAL management.

Organized by: D. Okaya (USC), B. Magnani (SMU), M. Karplus (UTEP), L. Worthington (UNM), D. Shillington (LDEO), S. Veitch (UTEP), T. Luckie (USC).

SIG demographics: 40 persons. 2/3 early-to-mid career. 1/3 have used nodes.

Presentations: A. Nyblade, CZO hydrology, Texans and Fairfield nodes. R. Catchings: RAMP, mixed Fairfield and SmartSolo nodes. J. Nakai: Alaska community experiment seismic onshore-offshore, Fairfield nodes. G. Kaip: Fairfield nodes in Antarctica (extreme environment). Status of PASSCAL pool (K. Anderson, B. Beaudoin) and Seismic Source Facility (G. Kaip).

Questions explored (among others):

- Which node characteristics are most important to allow you to do your science?
- Are there operational features of node systems that influence planning or field design (shipping, programming, charging, pool homogeneity, installations, downloads, budgeting)?
- How do we access thousands of nodes: grow the pool, own vs. contract, sole or mixed vendor types, how to keep up with (industry) technology?

Recommendations:

- PASSCAL should test one or a few newest comparable node models.
- Capability: recharge batteries and harvest data on-site for QC.
- Need for more controlled-source community feedback on pool growth strategies.

SZ4D: Planning for a Decadal scale Subduction Zone Science Program

SZ4D is a community-driven planning effort via 3 NSF-funded *RCNs* that aspires to become a decadal-scale research program

- *A focus on targeted experiments to make the next big leaps in understanding of the processes underlying subduction geohazards* – megathrusts and other faults as systems, magmatic drivers of eruption, surface processes

- Elements: An amphibious *science program*, investment in *infrastructure* and *observation*, and modeling and experimental *collaboratories* are all envisioned.

- First pieces are coming into focus via elements like Seafloor Geodesy facility, Rapid Response initiatives

SZ4D

www.sz4d.org

Web site: Sign up for our mailing list, sign up for Interest Groups, and watch for a call for nominations to Working Group teams
See SZ4D at AGU via Session and Town Hall

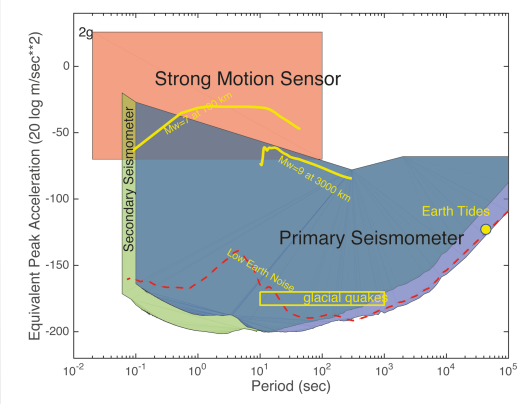
SAGE NSF's Seismological Facility for the Advancement of Geosciences

Updating Design Goals for the GSN to Enable New Discoveries

K. Hafner, P. Davis, D. Wilson

(1985, 2002) GSN DESIGN GOALS

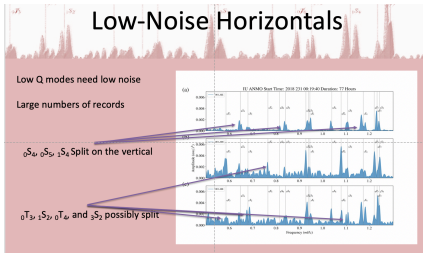
150+ seismic stations with a Global distribution, at ~ 2000 km spacing recording with High dynamic range, & Very Broadband (hrs to ~10 Hz)

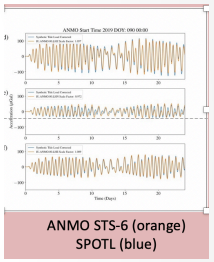


How do we update GSN design goals to reflect evolving basic geophysical research and earthquake monitoring needs?

Proposals – Just the Beginning!

1) Extend the bandwidth to longer periods (even DC) via either GPS or strain meters to help better resolve modes and tides





A. Ringler, 2019

2) Use existing GSN stations as "platforms" to measure additional data that allow perturbations in seismic data to be corrected

3) Long term sea-floor seismic station(s); look for opportunities to collaborate with geodesy efforts

2019 IRIS Design Goals Working Group

e-mail katrin.hafner@iris.edu

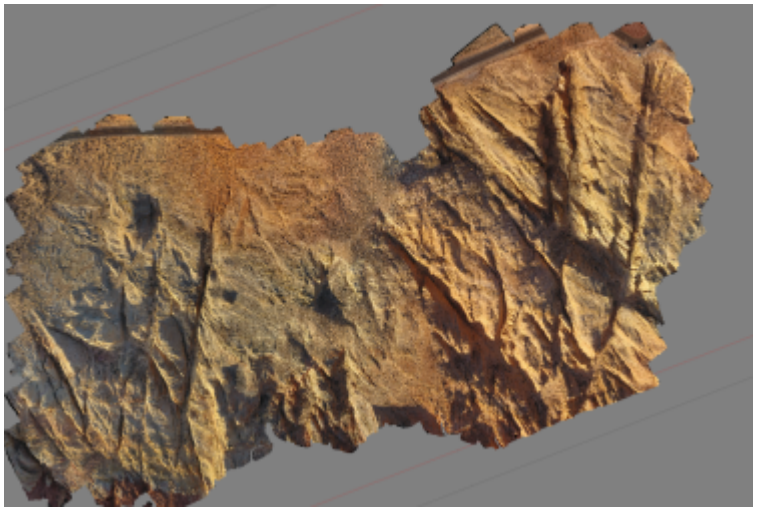
Emerging applications for Uncrewed Aerial Systems (drones)

Opportunity and enthusiasm for UAS for optical, 3D, thermal, hyperspectral, sampling.

Easy access to low-cost UAS for photogrammetry enables PI's to use technology without facility support.

Demand for more sophisticated sensors (e.g., lidar, hyperspectral), but complexity and cost makes them prohibitive without facility support

Facility can provide data processing expertise and archiving.



Integrating geophysics methods into undergraduate courses

Beth Pratt-Sitaula, UNAVCO. John Taber, IRIS

- Presentations: existing and planned geophysics teaching resources
  - Geodetic education modules (GETSI)(UNAVCO)
  - Urban and environmental intro geophysics module development (IRIS)
  - Focused on addressing critical and societally relevant issues, engaging students early in academic career
- Discussion: Current practices and future needs for geophysics teaching
  - Barriers to increased minority student participation
    - Need to capture attention sooner, provide clear career options
    - 3D visualization skills
  - Module component recommendations to attract URM students
    - Bite sized, easily inserted in existing courses, include virtual field work option
    - Topics: environmental and forensic applications, climate change, ground water issues, natural hazards

SIG Session 3: Thursday, 5:30 pm

- SAGE/GAGE Common Data Access Point (CDAP)
- The Big Data Exchange: How?
- Low-Cost Sensors
- Don’t Let Sediments Cover All the Good Geophysics Below
- Synthesis of Syntheses: A Retrospective and Results of EarthScope Workshops
- Communication, Education, and Outreach with the ShakeAlert Earthquake Early Warning System

GAGE National Science Foundation's Geodetic Facility for the Advancement of Geoscience | UNAVCO | SAGE NSF's Seismological Facility for the Advancement of Geosciences | IRIS

SAGE/GAGE Common Data Access Point (CDAP)

Rob Casey, David Phillips

OVERVIEW

- "Allow users to obtain both seismic and geodetic data … with a single web services call."
- Examples of GAGE and SAGE efforts benefitting discovery and access.
- Technology Overview.

QUESTIONS / COMMENTS / TOPICS

- Data products. Which levels? Level 2 and higher most appropriate for direct time series comparisons.
- Seismic data may need to be decimated to align with geodetic data.
- Catalogs of events. Case studies and tutorials that highlight geophysical signals recorded by complementary datasets, with explanations of interpretations by domain experts to inform cross-examination.
- DOIs. Importance of attribution at all levels especially when data are accessed via a more integrated -- and more potentially anonymous -- common portal.
- Feedback mechanisms to alert users about downloading unwieldy data volumes.
- Flags regarding data QA.
- Mechanisms to allow "what's changed?" types of queries. What's new? What's different?
- Federated access. Could non-GAGE/SAGE providers contribute directly via federated search?
- Unique identifiers. URN now available for seismic. Time for networks codes for geodetic networks?
- Common vocabulary (at some level).
- Temporary data pool for "high interest" datasets?
- Open standard for web service layer that allows graphical discovery tool on top. Use an interactive GUI for search and discovery...then once discovered, facilitate subsequent automated access.

Big Data Exchange: How? SIG

- Multiple large scale data generation/production scenarios identified − the problem has arrived.
- Move the data as little as possible.
- Generate derivative products to mitigate big data problem.
- Need affordable mechanism for very deep cold storage of raw data − clear path to infrastructure is unclear for facilities.
- Lack of common framework/approaches for workflow execution in HPC/cloud environments.

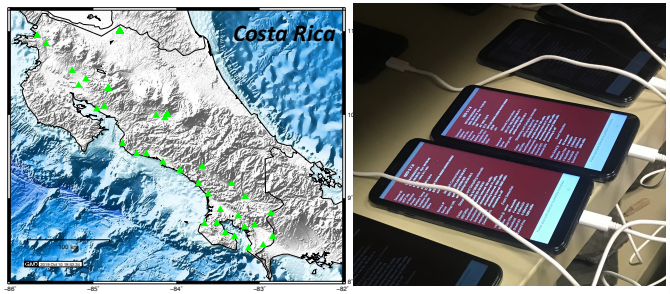
Low-cost Sensors

James Foster *(University of Hawaii)*; John LaBrecque *(UT-Austin)*

Presentations

Smart-Phone Based Earthquake Early Warning

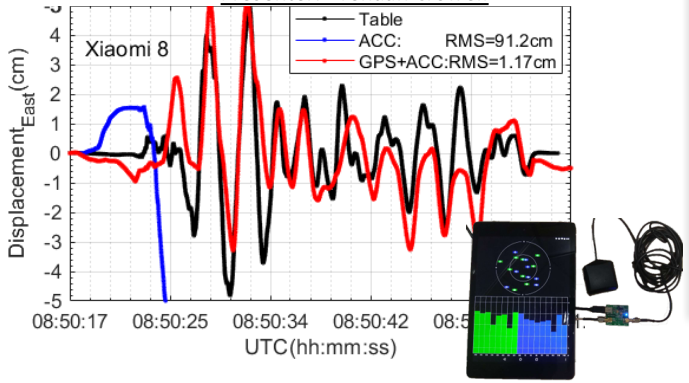
Ben Brooks (*USGS*) and co-authors



Six-degree-of-freedom Seismogeodesy using Android GNSS, accelerometer and gyroscope data for Rapid Earthquake Response

Jianghui GENG, Guangcai LI, Kai LIU, Qiang WEN *Wuhan University*

Presenter: Brendan Crowell



Discussion

Identify science & applications that could be enabled/augmented by low-cost sensors

1. *Short baseline observations*
2. *Rapid response*
3. *Volcano response in hazardous zones*
4. *Structural health monitoring*

What barriers exist to adopting/implementing low-cost sensor solutions?

1. *Biases/Lack of calibration of sensors*
2. *Black box processing/filtering*
3. *Capabilities not clear for many traditional science targets*

What technological (hardware/software/infrastructure?) developments would further enhance capabilities for science?

1. *Temperature tolerance*

What support and/or facilities could ease adoption of low-cost solutions in the community?

1. *Clearly documenting capabilities*
2. *Github repository for software*
3. *Documentation of data/work flow & components.*
4. *Forum/workshops for information & capabilities*

Don't Let Sediments Cover All the Good Geophysics Below

0. Friend or foe?

1. Vera Schulte-Pelkum, Univ. of Colorado
   - Conventional receiver functions
   - How to device "filters" to mitigate interference from near-surface effects

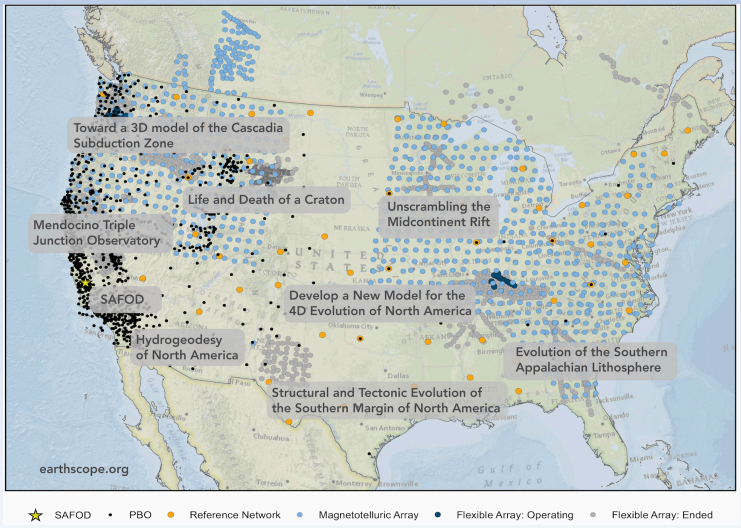
2. Weisen Shen, Stony Brook Univ.
   - Surface wave perspectives
   - Combining dispersion, H/V ratio and RF to improve resolution

3. Wang-Ping Chen (for Chunquan Yu, Southern Univ. of Science & Technology, China)
   - Alternative perspectives: Using reflection under the free surface as a virtual source
   - Strong reflections; examples of post-critical, critical and pre-critical cases

4. Open discussions
   - What are we imaging? Interface detected from seismology vs. geology
   - Magnetotellurics: audio-frequency MT (PASSCAL Instrument Center)
   - Technical aspects

Synthesis of Syntheses: A Retrospective and Results of EarthScope Workshops

- Combine familiar observations with unfamiliar – understand uncertainties and respect what other fields contribute
- Community building opportunities for bringing in early career researchers
- Synthesis workshops often end up in discussions of “what’s next”
- Instigating many synthesis activities like community model development
- Relatively inexpensive (~$12k each)
- It is not over! Synthesis is ongoing and the trajectory appears to be long, more workshops can be proposed through programs at NSF



Communication, Education, & Outreach with the ShakeAlert Earthquake Early Warning System

Co-Conveners:
Bob de Groot (USGS)
Danielle Sumy (IRIS)

- Introduction to ShakeAlert CEO: Status and Future Plans
- Introduction to IRIS Education Component
  - UNAVCO is current technical partner
- Demonstrations/Animations

<u>Things that keep us up at night:</u>

- Phase 3 of ShakeAlert (MyShake & WEA testing) coming soon
- Magnitude v. Intensity
  - e.g., 2019 Ridgecrest earthquake & ShakeAlertLA
- Intersection of Education & Social Science
- Best Practices for Dissemination
- ShakeOut 2019 – October 17, 2019
  - Practice Drop, Cover, and Hold On