Earth Science Education and Outreach Provider Summit Project 2012-2014

Funded by the National Science Foundation (NSF)

Supplemental Materials for Final Report to the NSF, Spring 2014

Introduction

The *EarthScope National Office* (ESNO) at Arizona State University has assumed a coordinator role among a set of organizations that provide Earth science education and outreach programs related to EarthScope scientific topics. Our goal since inception of ESNO at ASU has been to develop contacts and improve communications and coordination among organizations that have a relationship to EarthScope education, public outreach, or science to promote effective development, dissemination, sharing, and usage of the resources of the EarthScope project and of the participating organizations.

To this end, ESNO received funding from *NSF* (EAR 1216301) to organize and host a two-day **Earth Science Education and Outreach** (E&O) **Provider Summit** at Tempe on 20-21 February 2012. Eleven organizations:

- *American Geosciences Institute* [AGI];
- *Consortium of Universities for the Advancement of Hydrologic Science, Inc.* [CUAHSI];
- *Critical Zone Observatories* [CZO];
- *Drilling, Observation, and Sampling of the Earth's Continental Crust* [DOSECC];
- *Geodynamic Processes at Rifting and Subducting Margins* [GeoPRISMS];
- *Incorporated Research Institutions for Seismology* [IRIS];
- *National Center for Earth-surface Dynamics* [NCED] with *Geoscience Alliance* [GA];
- *Network for Earthquake Engineering Simulation* [NEES];
- *Southern California Earthquake Center* [SCEC];
- *UNAVCO, Inc.;* and
- *United States Geological Survey* [USGS]

sent representatives to convene with EarthScope and NSF. ESNO also subcontracted wioth the *Science Education Resource Center* [SERC] at Carleton College, which served as co-facilitator, external evaluator, and archivist for the Provider Summit. SERC established a Provider Summit website (serc.carleton.edu/earthscope-eno/index.html) and also submitted a Final Report, which is included in these Supplemental Materials.

The Provider Summit included a comprehensive review and group discussion of the E&O programs and resources of the participating organizations, networking opportunities, and a day-long session in which self-organized working groups identified and prepared draft white papers on the following topics relevant to Earth science E&O: (1) Effectively measuring program impact; (2) Using an Earth-system approach to organize ideas, resources, content, and pedagogy in informal learning environments; (3) Developing inter-organizational web resources focused on specific issues such as hydrofracking; and (4) Effectively using social media for E&O. SERC also presented its own pre-Summit review of the online E&O resources of the participating organizations.

Project outcomes and deliverables include Provider Summit websites on SERC and the EarthScope website; enhanced participation by some participating organizations (AGI, GeoPRISMS, and the Geoscience Alliance) in EarthScope E&O activities, and facilitated collaboration among some of the participating organizations outside of EarthScope-specific activities. These are presented in the Final Report.

School of Earth & Space Exploration
ARIZONA STATE UNIVERSITY

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EARTH SCIENCE EDUCATION & OUTREACH PROVIDER SUMMIT

Funded by the National Science Foundation
Hosted by the EarthScope National Office

School of Earth and Space Exploration, Arizona State University, Tempe Campus

February 20–21, 2012

R. S. Dietz Museum of Geology, Bateman Physical Science F-186, ASU Tempe Campus

Goal: Develop contacts and improve coordination among organizations that have a relationship to EarthScope education, public outreach, or science to promote effective development, dissemination, sharing, and usage of the resources of the EarthScope project and of the participating organizations.

<u>Monday, February 20</u>

7:30 am — Breakfast at Sheraton Four Points

8:00 — Meet in Four Points Lobby for guided walk to R. S. Dietz Museum of Geology

8:30 — Welcome:
Ramón Arrowsmith (ESNO), Lina Patino (NSF), and Steve Semken (ESNO)

8:45 — Review of EarthScope E&O Programs: Past, Present, Planned
Bob Lillie (prior ESNO@OSU) and Steve Semken (current ESNO@ASU)

9:15 — Survey and discussion:
What does your organization expect to achieve at this Summit?

9:45 — Break

10:00 — Review of participant resources and opportunities
John McDaris (SERC)

10:30 Organization Presentations: Overview of E&O objectives, programs, and resources (15 minutes per group):

- 10:30 IRIS: John Taber and Perle Dorr
- 10:45 UNAVCO: Shelley Olds and Megan Berg
- 11:00 SCEC/Epicenter Network: Robert de Groot and Kathleen Springer
- 11:15 GeoPRISMS: Charles Bopp IV
- 11:30 DOSECC: David Zur and Shelton Alexander

12:00 pm Lunch – Catered in R.S. Dietz Museum

1:00 Organizational Presentations continue:
- 1:00 USGS: Elizabeth Colvard
- 1:15 NEES: Keith Adams and Thalia Anagnos
- 1:30 CUAHSI: Rick Hooper
- 1:45 NCED: Diana Dalbotten and Holly Pellerin
- 2:00 CZO: Tim White
- 2:15 AGI: Ann Benbow, Colin Mably and Ian Macgregor

3:15 Break

3:30 Observations and recommendations
John McDaris (SERC)

4:00 Brainstorm and organize Group Breakout Sessions for Tuesday
Groups:
- Defining and measuring impact of resources and programs
- Using an Earth system approach to organize content and pedagogy
- Creating issue-based pages and resources (e.g., fracking)
- Social media: How-tos and best practices

Other suggestions from the group will be documented for future reference.

4:45 End of Day Remarks
Steve Semken (ESNO)

5:00 Return to Hotel

6:30 pm Group Dinner; Rula Bula, 401 S. Mill Avenue, downtown Tempe

Breakout Groups are welcome to meet informally after dinner.

Tuesday, February 21

7:30 am	Breakfast at Sheraton Four Points
8:00	Meet in Four Points Lobby and Walk to R.S. Dietz Museum
8:30	Comments Lina Patino (NSF)
8:45	Breakout Groups reconvene (Breaks as desired)
11:30	Breakout Groups Report Out
12:00	Concluding Remarks and Next Steps: Steve Semken (ESNO), John McDaris (SERC), Lina Patino (NSF)
12:15 pm	**Lunch – Catered in R.S. Dietz Museum**
	Adjourn after lunch

NSF

ASU School of Earth & Space Exploration
ARIZONA STATE UNIVERSITY

Earth Science Education and Outreach Provider Summit
EarthScope National Office, School of Earth and Space Exploration
Arizona State University
February 20-21, 2012

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SERC's Involvement with the Earth Science Education and Outreach Provider Summit

The Science Education Resource Center (SERC) was contracted by the EarthScope National Office to assist with a summit for organizations that do education and outreach (E&O) in the Earth sciences. The summit took place at Arizona State University from February 20-21, 2012. SERC was asked to participate because of we have developed tools and expertise that help facilitate collaboration between groups of educators.

In preparation for the Summit, SERC staff created a private website and workspace where the participants and conveners could share information and collaborate on new materials. Then a review of the websites of the participating organizations was conducted yielding a list of the existing education and outreach resources available through each. This compilation of resources was provided to the organizations through the workspace as a centralized access point for participants.

Examining the kinds of E&O materials available allowed SERC staff and leadership to develop a set of recommendations for how summit participants could do more with the materials that they already have as well as ways they could work collaboratively to have even greater impact. These recommendations included:

- Since it can be difficult to know where to look on the various websites, the group should create pages about topics of high interest which point to the relevant areas of all the organizations' website.
- Build a collection of pages that point to the contextualized teaching resources on each organizations site. This could be done at SERC using our "-sheet" formats which would provide cross-project discovery.
- Build pages to showcase the resources each of the already has in the SERC collections (as appropriate).
- Each organization should create teaching activities from their research and data if they aren't already.
- Make "middle ground" information available to interpret your science for a layperson if they aren't already.
- Spend time looking at each other's websites and talking aloud about what you're looking for and what you make of the clues about where to find it.

Examples of how some of these recommendations might be implemented were mocked up prior to the event in order to help participants envision the results. In particular, examples of the topics of high interest pages and, showcases of existing organization materials at SERC were made. Exemplars of SERC's Activity Sheets, Data Sheets, and Tool Sheets were also provided as a way to think about how new materials could be created. The recommendations were given to the summit conveners ahead of the meeting and provided a framework for discussions at the summit.

A SERC staff member attended the summit to help participants make use of the private workspace as well as to present the results of the review and the recommendations for future work.

During the event, participants developed a list of areas where the group could direct its efforts. Using the private workspace, four working groups were formed which each spent time discussing a particular issue and brainstorming ways of moving the community forward on that issue. Each group was able to generate web pages of information, ideas, and resources related to their issue to share with the group as a whole and collect feedback on them. The workspace also provided a place to record the full list of potential topics for future reference. Summaries of the working group activities follow.

Working Group 1: Measuring Program Impact

The discussion centered on what methodologies projects can use to measure the effectiveness of the various components of their programs, and of their projects overall. The goal of such evaluation is to improve the projects overall. Participants offered various suggestions for how to do this. These included:

1. Reviewing the organization's strategic plan.
2. Identifying clear goals.
3. Deciding on activities to reach those goals.
4. Defining metrics to measure the success of the activities.
5. Implementing the evaluation plan on a regular basis.
6. Reporting evaluation results and using these to improve the program.

Working Group 2: Using an Earth System Approach to Organize Ideas, Resources, Content, and Pedagogy in Informal Learning Environments

Goals:

- Promoting earth systems thinking in informal learning environments.
- Collaborate with informal educators to incorporate their site content into a broad earth systems context.

- Promote an understanding of earth systems and their utility in telling whole stories about landscapes and their deeper meanings. When informal educators tell their stories they will be encouraged to tell them from an earth systems perspective.

Deliverables:

- Develop a tool kit for interpreters from a broad spectrum of informal learning venues to weave in an earth systems approach.

Working Group 3: Issue-based Pages

Focus: Fact sheets for land owners/general public on issues (also useful in intro) - "How to Think About X"

This group spent a lot of time brainstorming one example of a page like this: How to Think About: Fracking. There were many good ideas, but it became clear for that particular issue, available materials are not sufficient to cover the issue and substantial new materials would need to be developed. The group developed a list of the kinds of materials that would be needed for such a product and gathered links to existing resources that could fulfill aspects of this list.

Working Group 4: Social Media

Several of the represented organizations have been making concerted efforts to use Social Media platforms (Facbook, Twitter, LinkedIn…) for effective program outreach with varying levels of success. These group members shared their experiences and were able to compare notes with others who were similarly making use of these tools. The group developed a list of recommended practices for organizations that want make effective use of Social Media to increase the level of engagement of their constituencies.

AGI Education and Outreach Programs

AGI american geosciences institute

AGI Curriculum Projects

Existing Curricula

Investigating Earth Systems

EarthComm

http://www.its-about-time.com/htmls/ies.html

New Curricula

Constructing an Understanding of Earth Systems **(CUES) – to be published**

High School Environmental Science **(HSES) – published by Cengage Learning**

Physical Geology **– e-units to be published by Pearson**

http://www.agiweb.org/geoeducation.html

Ancillary Materials

Earth and You (K-5 – Lab Aids)

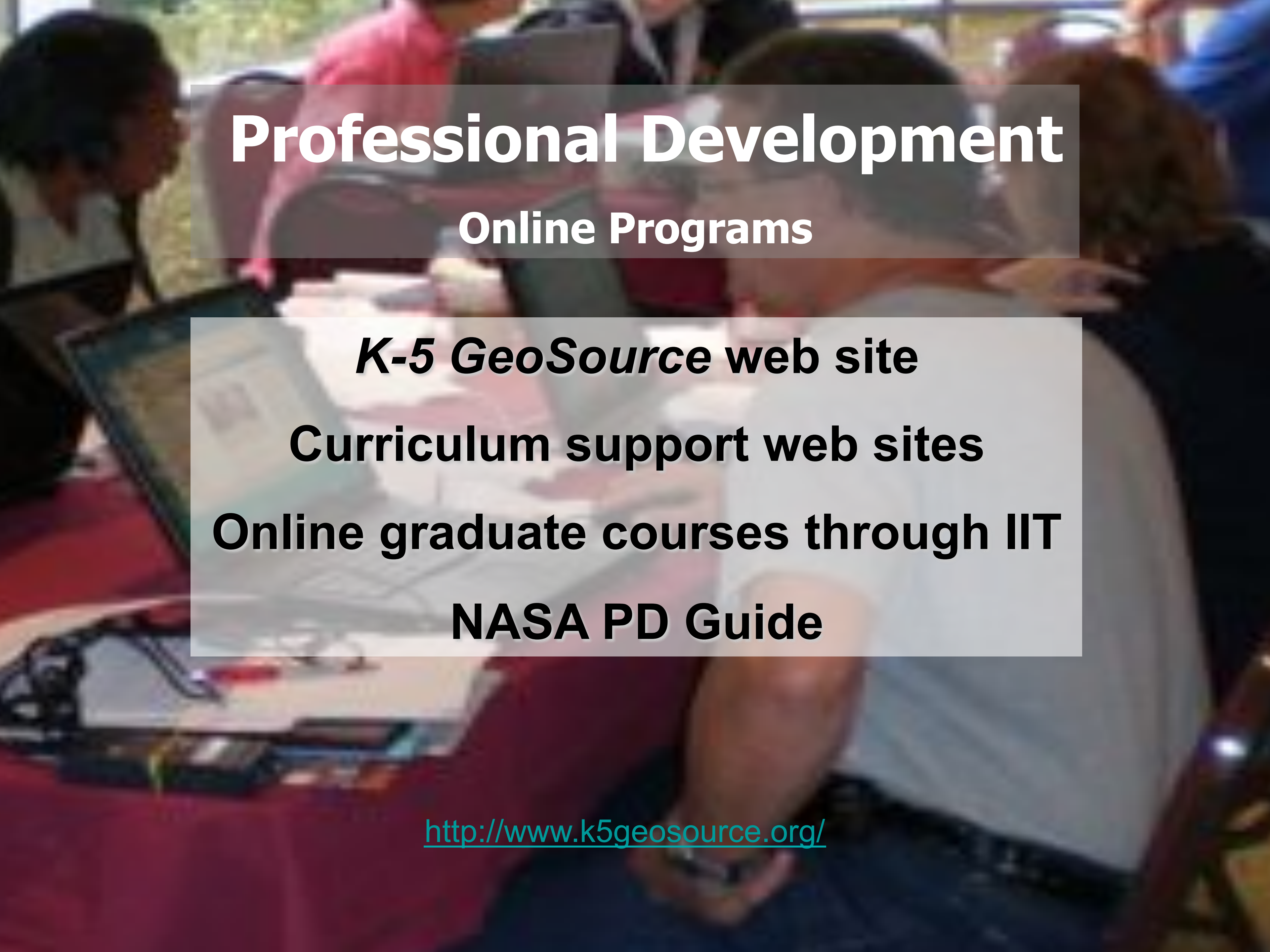
Why Earth Science?: The Video (6-12+)

Visions of Earth (9-12 - Cengage)

Big Ideas in Earth Science (6-8; 9-12)

VisionsofEarth™


Professional Development
Face-to-Face
Middle School Teacher Academy
Integrated Science Workshops
Curriculum Workshops
ExxonMobil K-5 Teacher Academy
NASA Master Teacher Academy
UK Teacher Academy
http://www.agiweb.org/education/pd/index.html



Professional Development

Online Programs

K-5 GeoSource web site

Curriculum support web sites

Online graduate courses through IIT

NASA PD Guide

http://www.k5geosource.org/

Research

Conferences and Studies

K-12 Earth Science Education Summit

Pulse of Earth Science **Web Site**

Studies on the Status and Perception of Earth Science

Outreach Programs

Earth Science Week

AAPG/AGI Visiting Geoscientists Manual

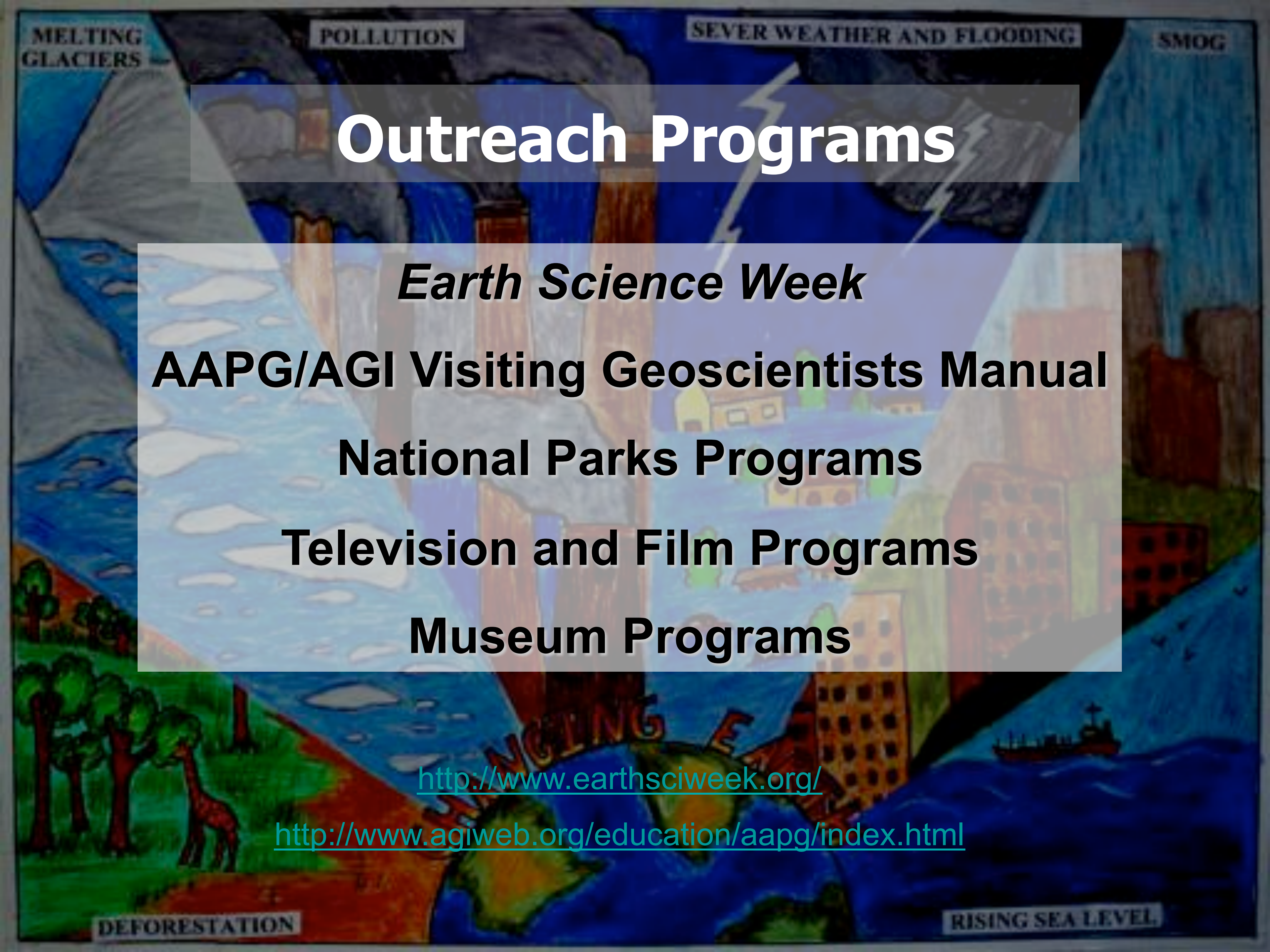
National Parks Programs

Television and Film Programs

Museum Programs

http://www.earthsciweek.org/

http://www.agiweb.org/education/aapg/index.html



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american geosciences institute

Consortium of Universities for the Advancement of Hydrologic Science, Inc.

A University Consortium for Water Science

February 20, 2012

CUAHSI

universities allied for water research

CUAHSI Mission

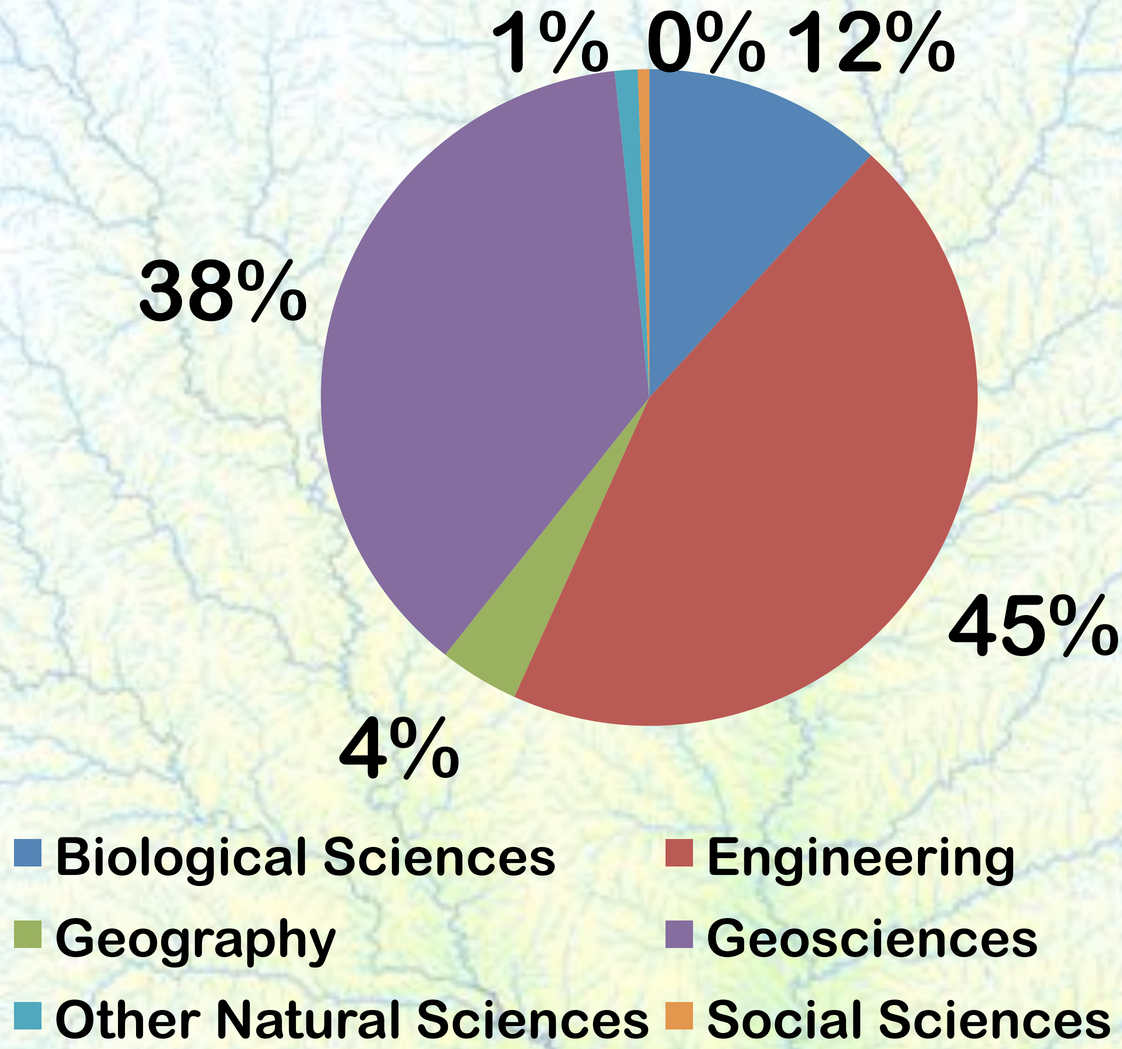
"CUAHSI enables the university water science community to advance understanding of the central role of water to life, Earth, and society.

CUAHSI focuses on water from bedrock to atmosphere, from summit to sea and from the geologic past, through the present and into the future."

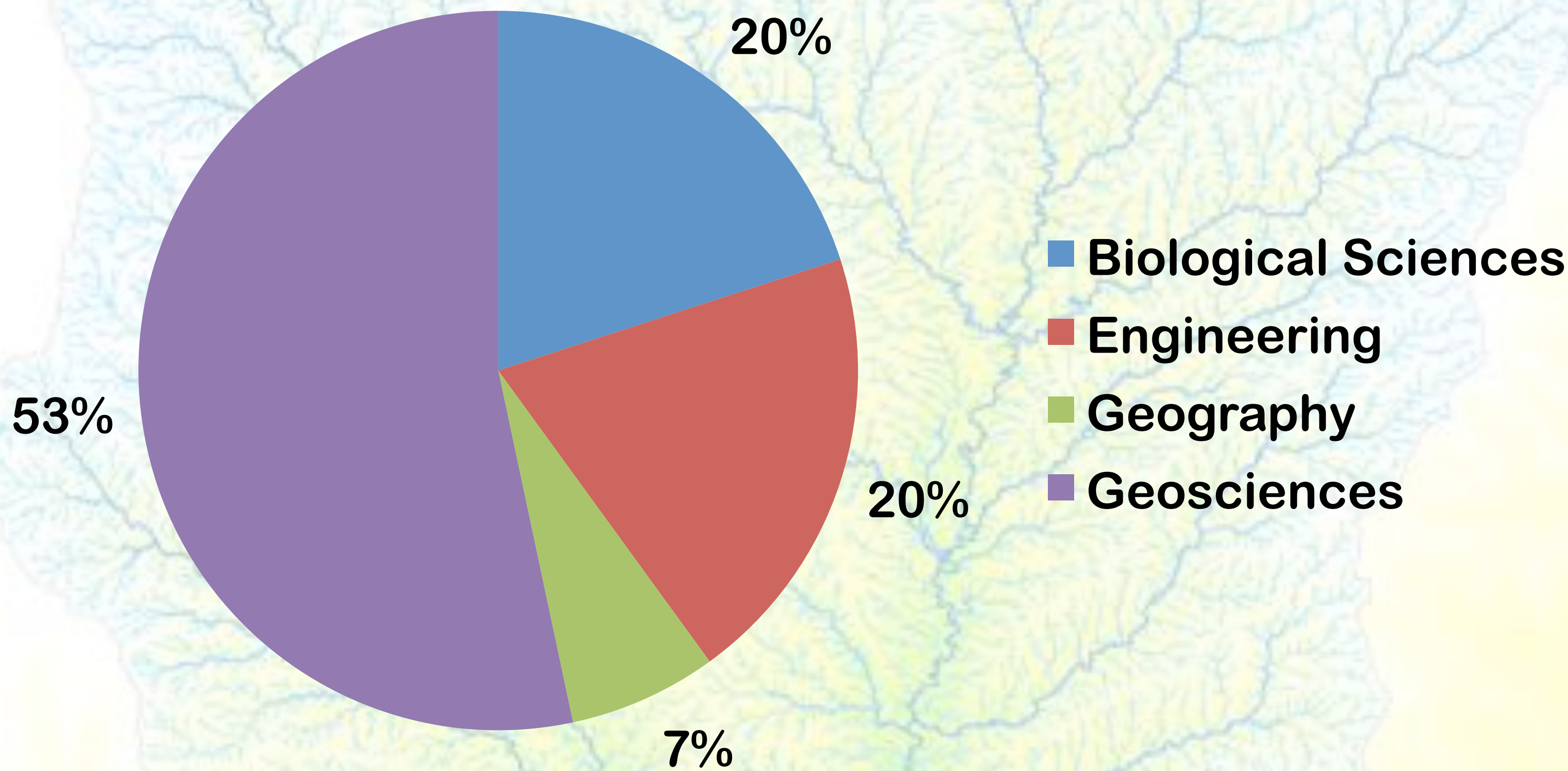
CUAHSI Mission

- Articulate community priorities for research infrastructure
- Develop and operate infrastructure
- Promote access to data
- Facilitate interdisciplinary study of water
- Assist/promote education and outreach
- Promote translating research to practice

Diversity of Member Reps:
Departmental Affiliation



Diversity of Board:
Departmental Affiliation



E&O Conceptual Basis

Water as a view into coupled Earth System

- Water transport processes link atmospheric to geologic time scales
- Water plays a key role in geomorphic and geochemical processes of surface earth
- Water links geologic, biologic, atmospheric and oceanic systems
- Humans engineer water systems for societal goals

Education Programs

- Research Community
  - Webinars by various disciplines
  - Distribution through scivee.tv and UNESCO IHE very successful (10,000+ downloads)
- Graduate Students
  - Focus on broadening educational experience (Pathfinder Travel Fellowships)
- Undergraduate
  - Exploring distributed REU (modeled on IRIS)

Outreach Programs

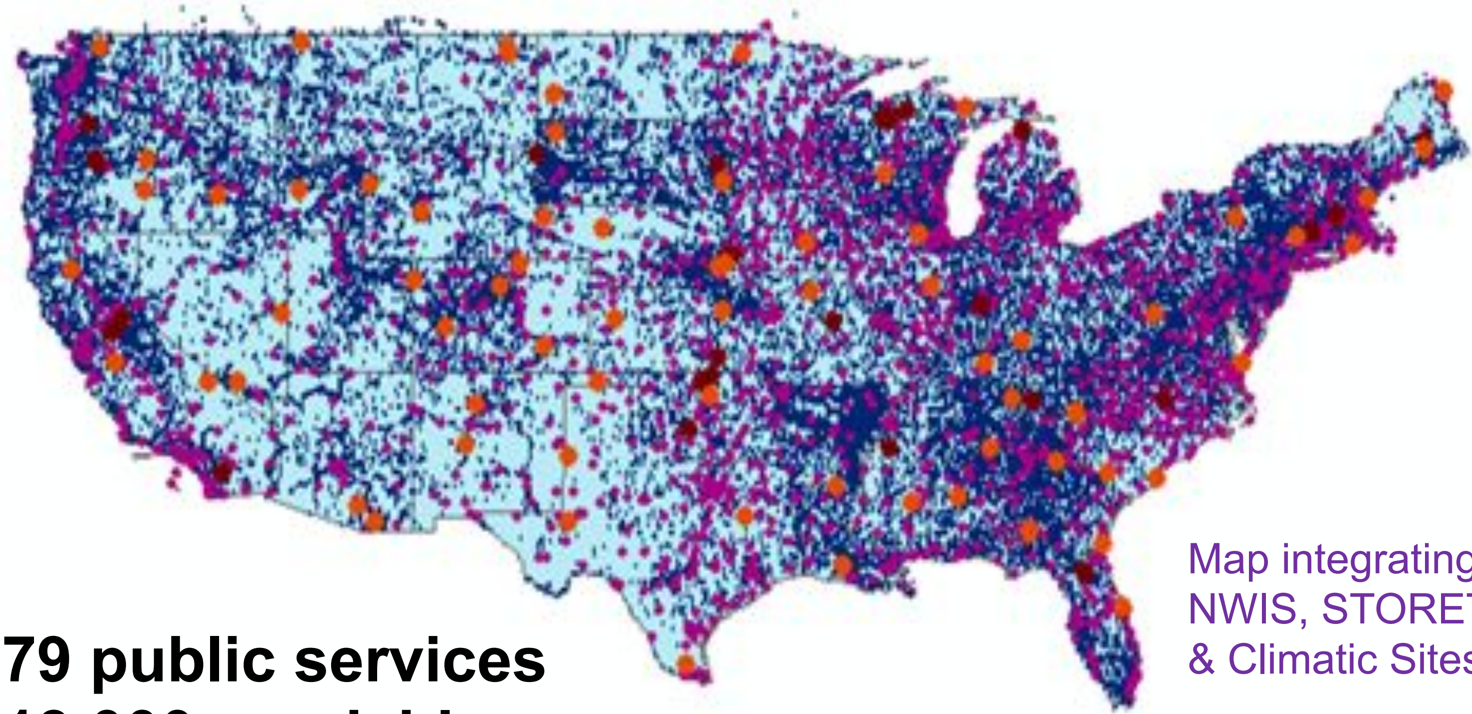
"Let's Talk about Water"

- Use of advocacy documentaries to explore scientific and social issues around water
- Carefully managed q-and-a with expert panel
- Encourage active learning, critical thinking
- Citation: Eos 92:361-362 (Oct., 2011)

Programmatic E&O

- CUAHSI Hydrologic Information System
  - Services-oriented architecture to serve time-series data
  - Complements other disciplinary data services (e.g., gridded data from atmospheric science)
  - HydroDesktop, open source client, combines map interface and analysis tools
  - Enables access to real data, local to class

Metadata Catalog, Feb 2012



Map integrating NWIS, STORET, & Climatic Sites

79 public services
13,000+ variables
2.3+ million sites
23.3 million series
Referencing 100+ billion data values

HydroDesktop: Opening Screen

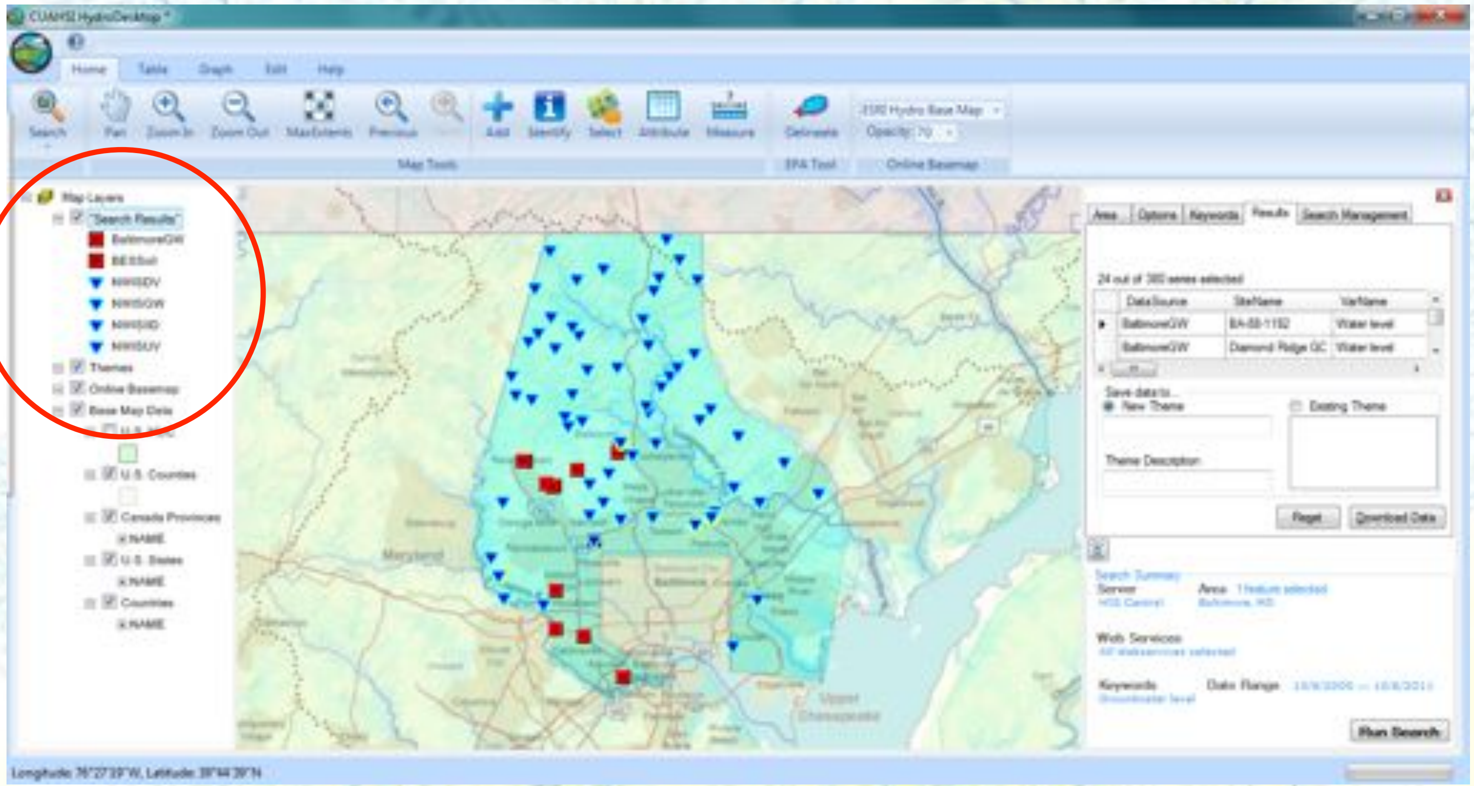
GIS Layers

Map Interface

Search Plug-in

Specify ***where***, ***when***, ***what*** to discover data

HydroDesktop: Results



Results from university and government agencies, downloaded to local database. Simple analysis tools available (e.g., R) or export to other program

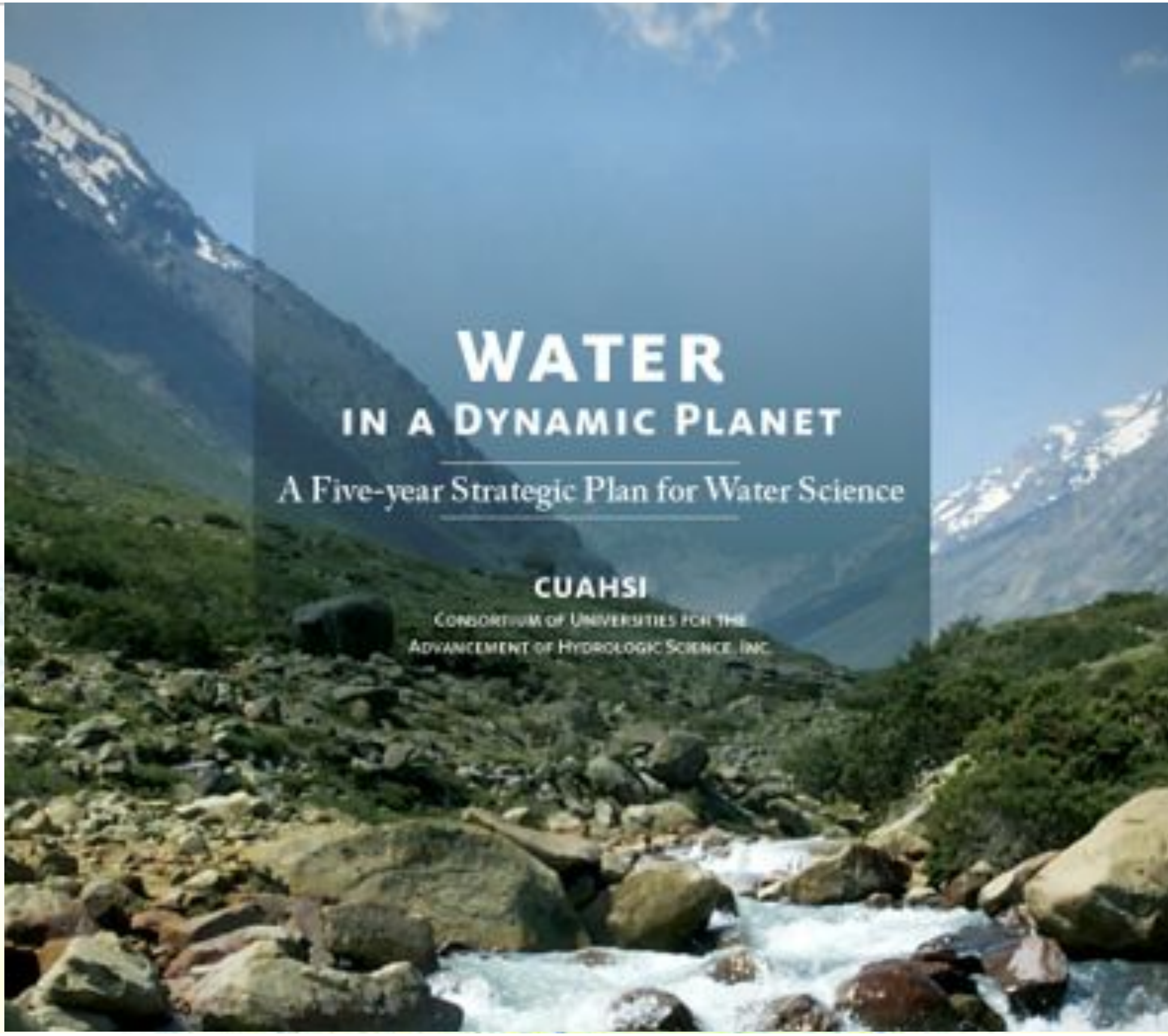
Educational Potential of HD

- Enables geographic thinking
- Introduces GIS in a free application
- Promotes place-based learning
  - Environment as integrating context
  - Encourages multidisciplinary approach
- Access to real data local to student

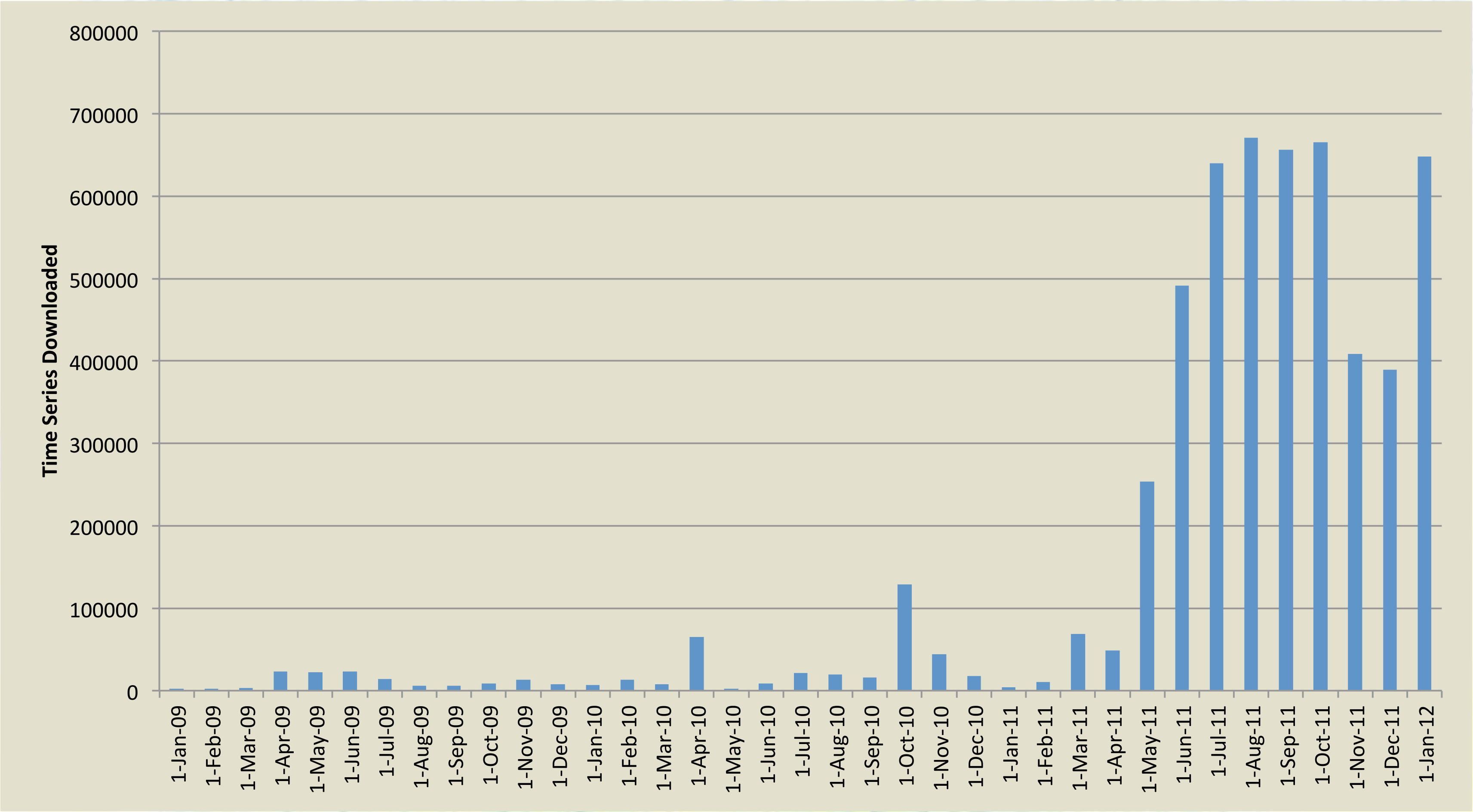
Questions?

CUAHSI

universities allied for water research


WATER
IN A DYNAMIC PLANET
A Five-year Strategic Plan for Water Science
CUAHSI
CONSORTIUM OF UNIVERSITIES FOR THE
ADVANCEMENT OF HYDROLOGIC SCIENCE, INC.

HIS Usage



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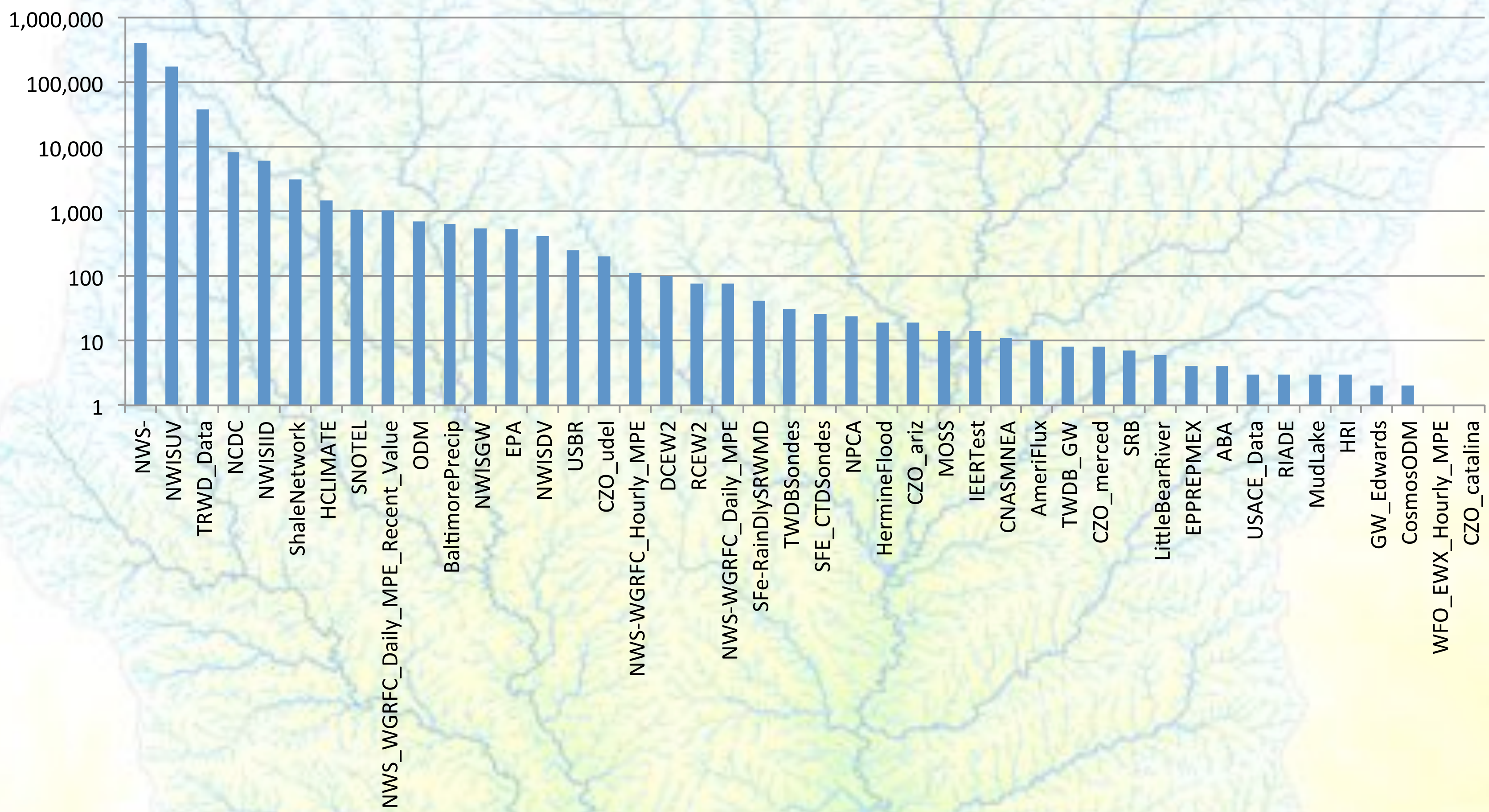
Usage by Service, Jan 2012



Critical Zone Observatory (CZO) program Education (and Outreach)

Tim White

February 20, 2012

Earth Science Provider Summit

Critical Zone:

• term published by the U.S. National Research Council in 2001 BROES report

• thin veneer at Earth's surface spanning from the top of vegetation canopy to deep in the subsurface where groundwater freely circulates.

Tropical rainforest:

- extensive forest canopy and complex understory
- thick mature soils

Polar realm:

- permafrost
- thin discontinuous soils
- stunted vegetation

Longyearbyen Valley,
Spitsbergen

State of CZ Science: Six CZOs cover an array of geologic, climatologic and ecologic settings in which a variety of critical zone processes can be studied from the vegetation canopy into bedrock.

CZOs evolved from the recognition that many similar scientific questions were being asked by diverse groups of Earth surface scientists who did not typically collaborate.

CZEN Four Driving Questions

Atmosphere

How do processes that nourish ecosystems change over human and geologic time scales?

What processes control fluxes of carbon, particulates, and reactive gases over different timescales?

Nutrients

Landform Evolution

How do biogeochemical processes govern long-term sustainability of water and soil resources?

How do variations in and perturbation to chemical and physical weathering processes impact the Critical Zone?

Chemistry of Water

CZEN Four Driving Questions

How do processes tha
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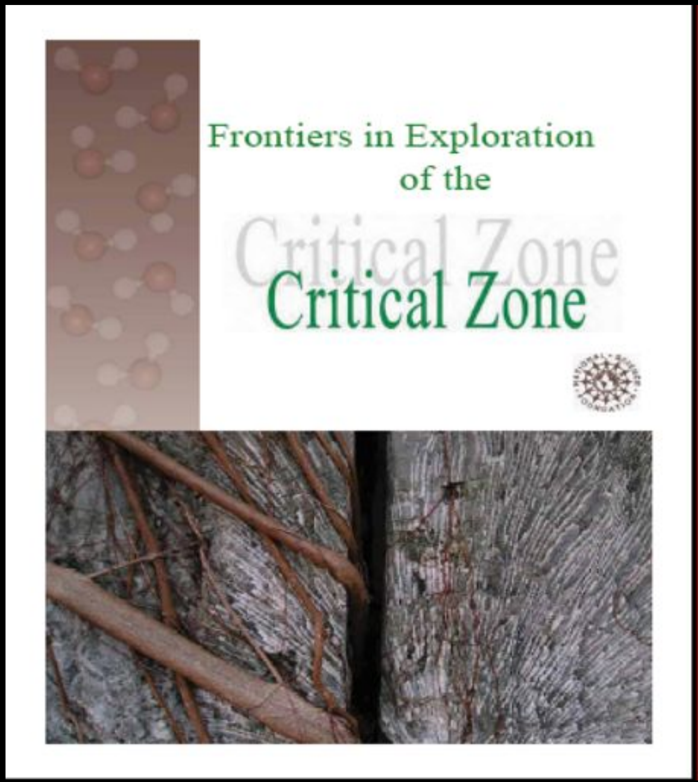
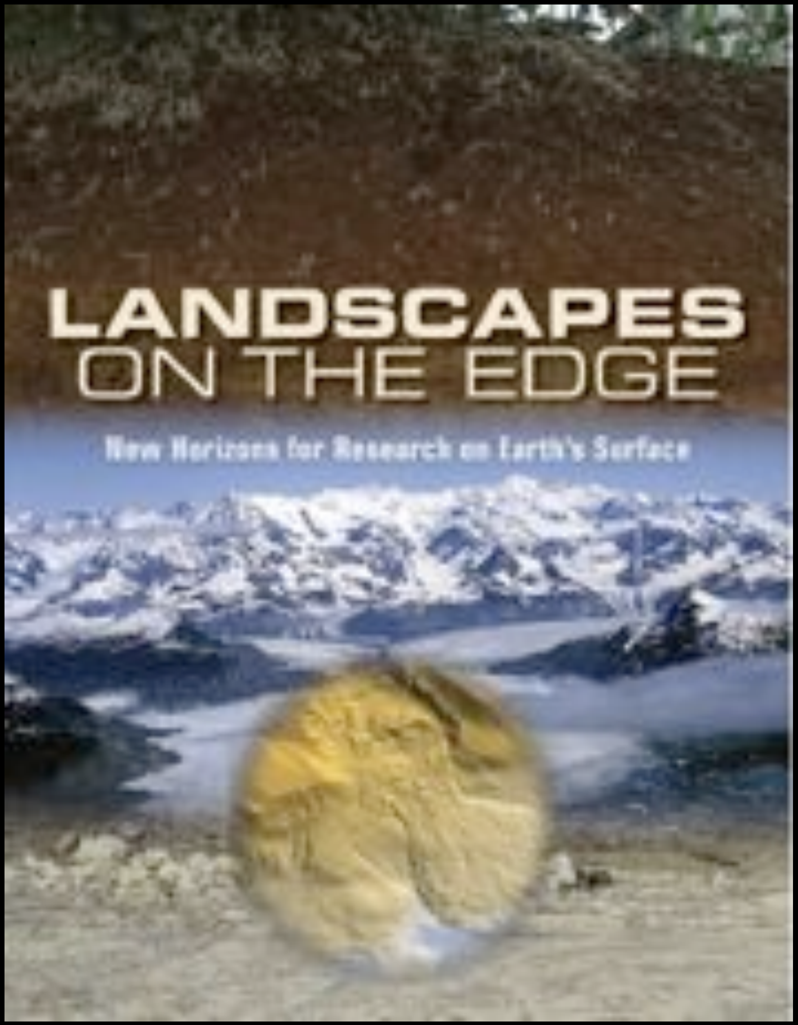


Brantley et al., 2006

Download at:
www.czen.org



National CZO Program
http://criticalzone.org

Education

• Develop a new cadre of Critical Zone scientists who early in their career have been trained in interdisciplinary (and international) collaboration.

• Supplemental funding through International Programs has since 2007 provided opportunities in Europe for 42 U.S. graduate students to pursue field or lab activities related to and supportive of their research.

CZO general information: Human resources

	Undergrads	Grads	Post-Docs	Degrees
Boulder	19 (19)	19	4	9
Shale Hills	13 (24)	18 (9)	4	4
S. Sierra	12	11	4	
Christina RB	7+	9	3	
JRB/SCM	8	11	3	
Luquillo	7	13	3(1)	1

CZO general information: Human resources

- ***51 scientists working at a CZO from entirely outside the CZO program and home institution (not counting LTER)***

- **5 intra-network multi-PI collaborations**

- **Several paired CZO-CZO projects**

- **Special CZ sessions @ AGU, GSA, SSSA, Goldschmidt**

- Two CZO-spearheaded special issues

Education

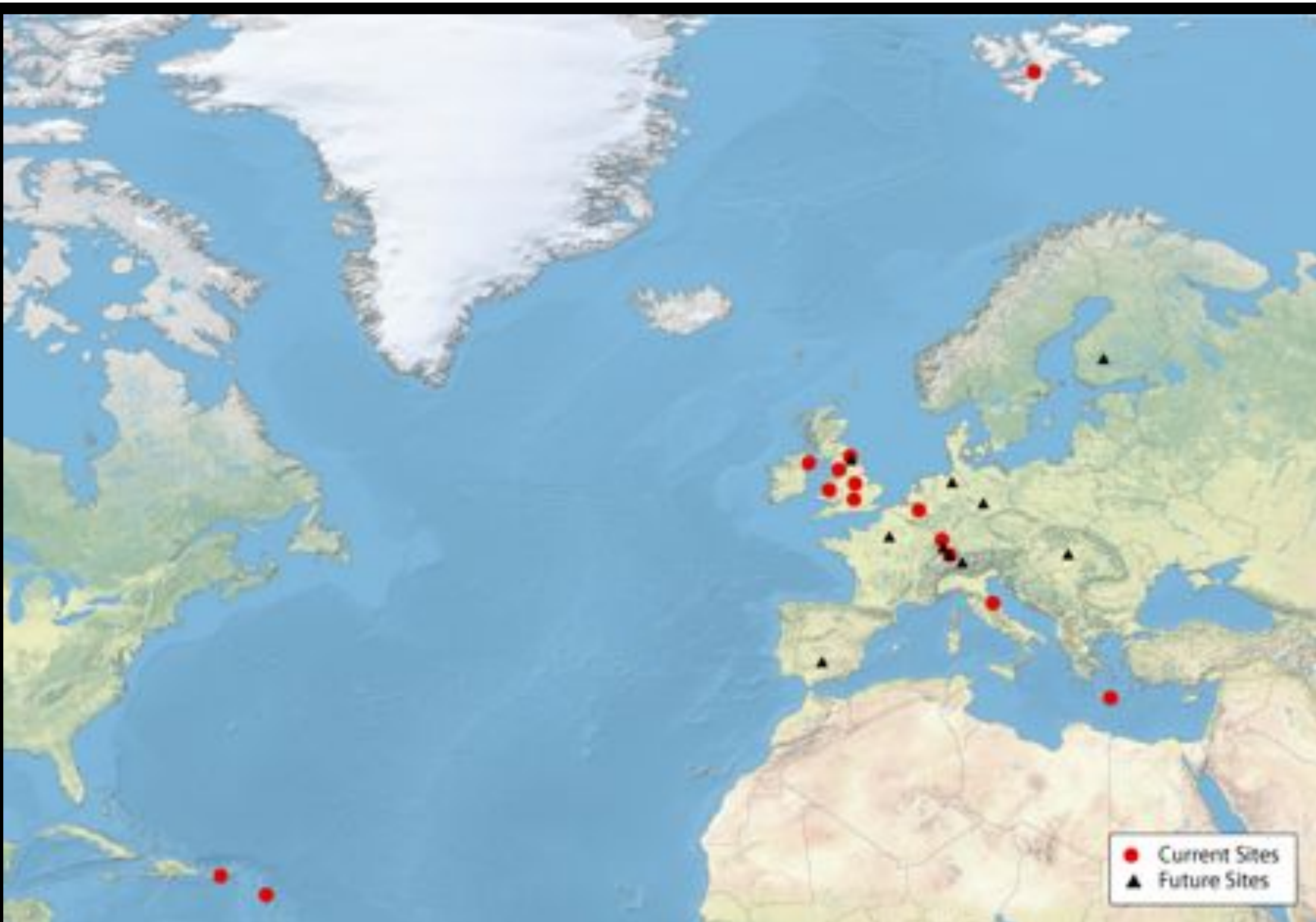
• Develop a new cadre of Critical Zone scientists who early in their career have been trained in interdisciplinary (and international) collaboration.

• Supplemental funding has since 2007 provided opportunities in Europe for 43 (12 in 2011) U.S. graduate students to pursue field or lab activities related to and supportive of their research.

16 U.S. universities represented:

- Penn State
- U. Arizona
- U. Delaware
- U. Pennsylvania
- U. Colorado-Boulder
- Oregon
- Oregon State
- Purdue
- U. New Hampshire
- Cornell
- U. Georgia
- Arizona State
- Stanford
- San Francisco State
- U. Montana
- Duke

- (USGS Mendenhall Program)


Current Sites
Future Sites

20 European hosts:

- U. Newcastle
- Inst Physq Globe Paris
- Queen's U. (Belfast)
- U. Hasselt (Belgium)
- Oxford
- British Geol Survey
- Lancaster U.
- U. Sheffield
- U. Stockholm
- ETH (Zurich)
- U. Freiburg
- Helmolz Centre
- Swiss Fed Inst Tech
- Max Planck Inst
- Durham U.
- Centre Ecol Hydro
- Tech Uni Crete
- U. Strasbourg
- IAEA (Vienna)
- U. Helsinki

Chania, Crete Fall 2008

"I could not have asked for a better experience than I had at the SoilCritZone conference in Chania, Crete. The exposure, both to the ideas of others and of others to my work, will likely be a turning point in my career." J.A.

The opportunity to meet fellow soil scientists and interact personal basis was unparalleled, not to mention truly inspirational…… Although I am only just beginning my career as a soil scientist, I undoubtedly consider this experience a defining moment, both professionally and personally." A.D.

"As a master's candidate in a small department at a primarily undergraduate non- research institute, I found myself, for the first time, surrounded by researchers who in one way or another are working on the same problem I am….the feedback exceeded my expectations; I camehome with a notebook full of ideas and suggestions." J.M.

"I can say that thanks to this meeting I am currently in the process of writing a grant in collaboration with another researcher I met in the workshop." S.M.

"I do not think that I have attended a scientific meeting thus far where the "early stage researchers" have been so welcomed by the "senior researchers"; it was so easy to talk with all attendees at different stages in their careers…My hope is that meetings like this one will continue in the future, and that they will continue to include and support early stage researchers… I returned home inspired to finish up my dissertation!" E.H.

"It was very interesting to learn more about the European perspective on the critical zone. In the US, we seem to focus on the Critical Zone from a pure science perspective. Europe seems to be more focused on soil sustainability." S.R.

Outreach within CZO program:

- monthly telecons
- czen.org working groups
- annual meetings (All Hands every other year)

Outreach to greater CZO community:

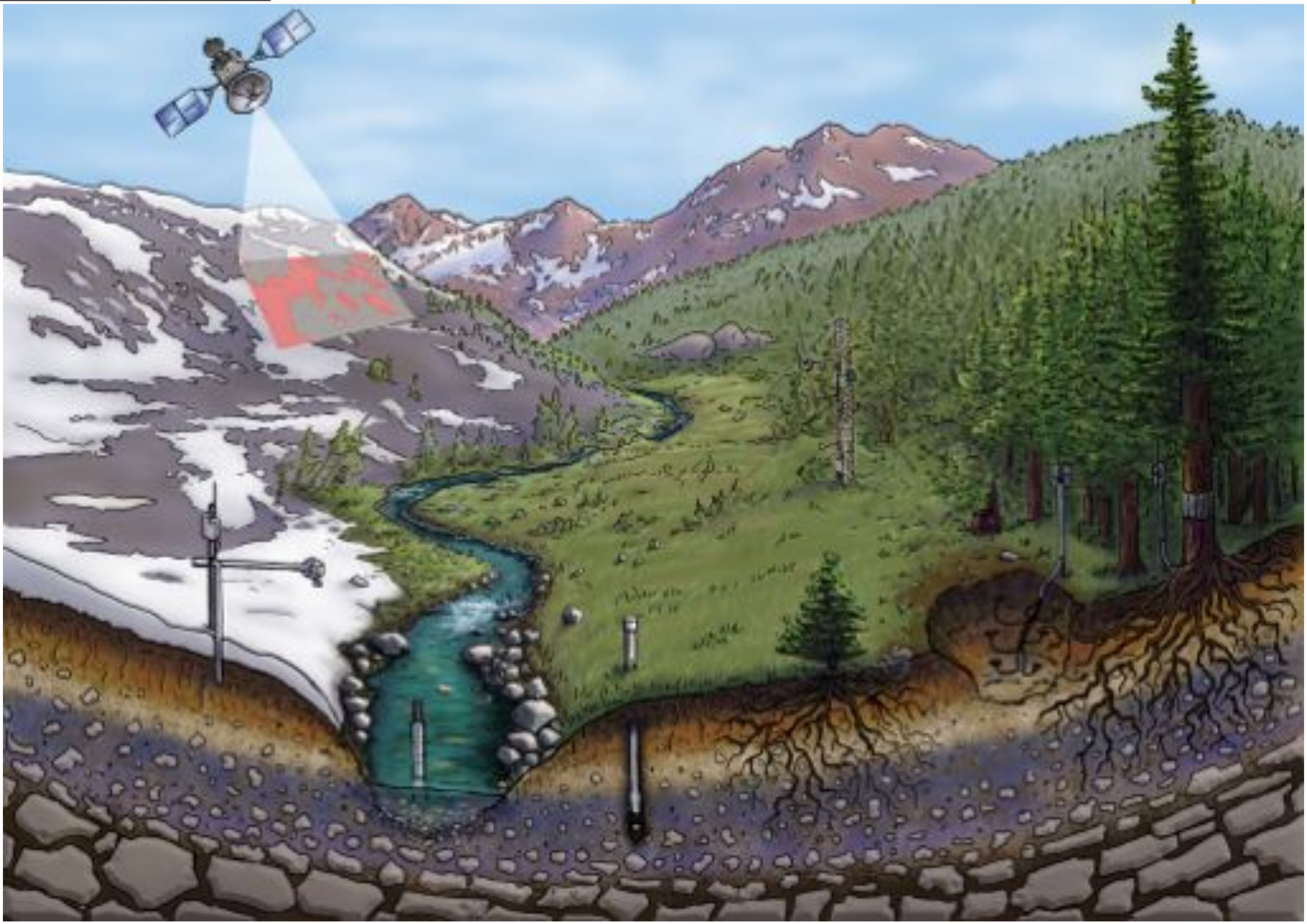
National CZO Program

funded by NSF

CRITICAL ZONE OBSERVATORIES

studying the zone where rock meets life

NSF




National STEM Best Practices Conference
September 16, 2011
Drexel U., Philadelphia

Education/outreach to greater CZ community:

Consortium of Universities for the Advancement of Hydrologic Science, Inc.

universities allied for water research

About CUAHSI | Services & Projects | Reports & News | CUAHSI Home

CUAHSI Current Cyberseminar Schedule

About Cyberseminars

A cyberseminar is a PowerPoint presentation shown over the web in conjunction with a conference call for narration by the presenter. CUAHSI pays on a connection basis so minimizing the number of connections on each campus is preferable. If time allows, a question and answer period may follow.

Spring 2012 Schedule

Cyberseminars Theme — "Earth Observatories for Interdisciplinary Science: Reports from Critical Zone Observatories and Water, Sustainability and Climate Studies"

March 30, 2012; 3:00pm ET

- **Eric Booth – Water Sustainability and Climate: The Yahara Watershed**

April 6, 2012; 3:00pm ET

- **Noah Molotch – Research at the Western Critical Zone Observatories**

April 13, 2012; 3:00pm ET

- **Jeff McDonnell: WSC: Willamette Water 2100**

April 20, 2012; 3:00pm ET

- **Fred Scantena (or delegate): Luquillo CZO**

Cyberseminar Links

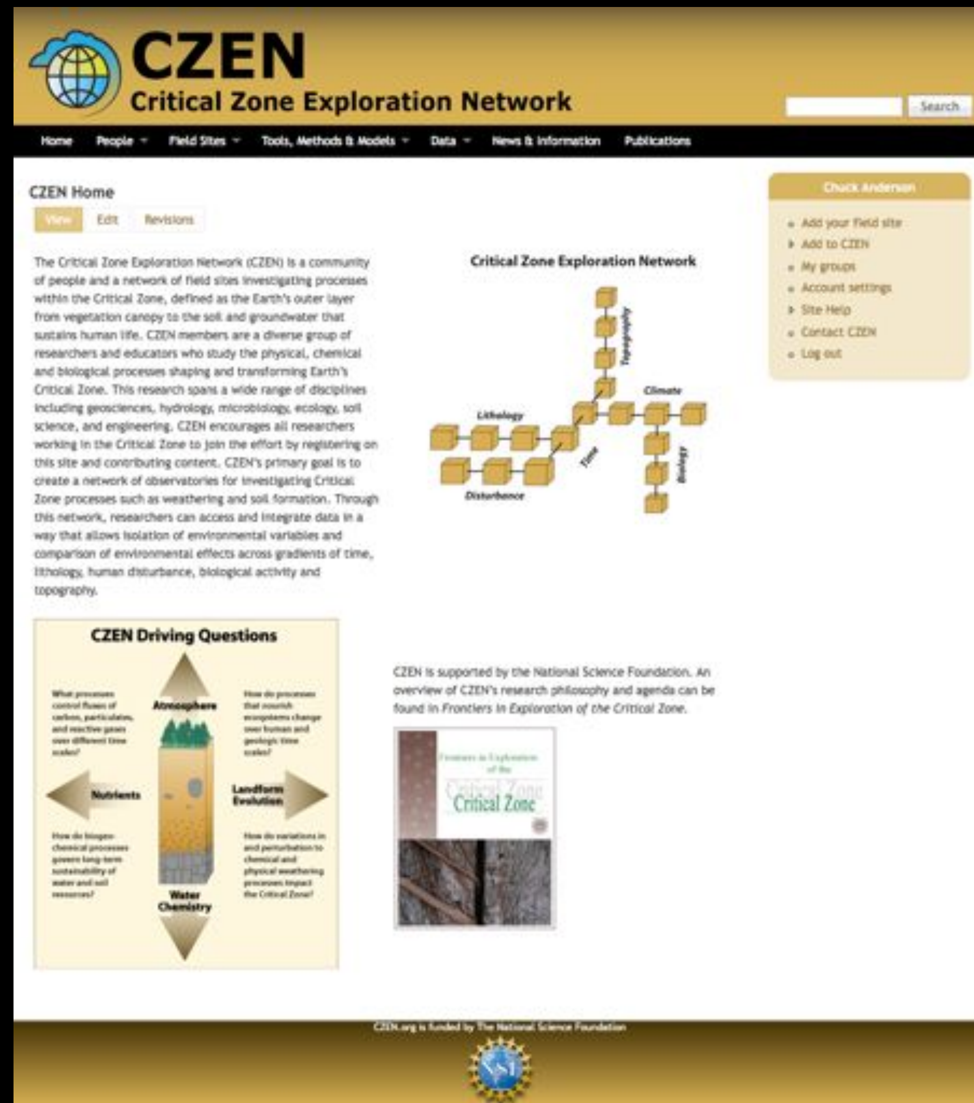
- Current Seminars
- Archive Seminars
- Index of Seminars
- SciVee Videos
- Hydrosynthesis Webinars

Adobe Connect Tutorials

- Call-Me-Back
- Audio Setup Wizard

Outreach to greater CZ community:

- www.czen.org
- C. Anderson
- >1000 members
- 31 working groups
- 1600 visits in Feb.



Science Discovery

5th grade Outdoor Classroom

~ 75 kids per year

Summer camp

~36 kids per year

Run by post-doc Eve Hinckley + 17 graduate students

Science Discovery

Middle School

Science Explorers Workshops (2011-12)

Earth System Science: Exploring change in the Critical Zone

- ~150 teachers and students for full day; 10 workshops planned
- Activities on water resources, fire ecology, and landscape evolution
- Take-home materials, module instructions, and data

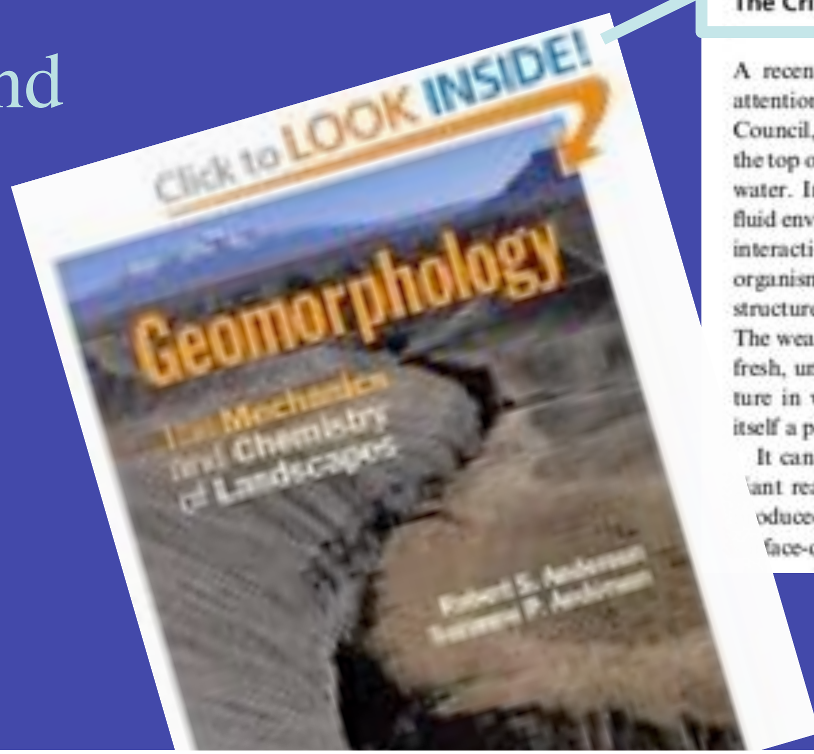
Steamboat Today headline, Jan 21, 2012

Keck Project-Colorado
Undergraduate field research

23 undergraduates since 2008
-Each completes senior thesis or project
Coordinated by David Dethier, Williams College, and Will Ouimet, Univ. of Connecticutt

University level classes

- Grad: Earth's Critical Zone
  - 14 students, 5 departments
- Undergrad: Earth's Critical Zone
  - 23 students, 3 departments
- Geomorphology
  - 30 students
- Landscapes and Water
  - 150 students



rock is pervasively oxidized but still intact. The density of fractures cutting the rock increases upward through this profile, and their orientation becomes near surface-parallel. In this example, no fractures are shown in the saprolite, which was only examined in augured holes. Auguring disrupts this type of structure.

Weathered profiles vary substantially in different environments, as illustrated in Figure 7.3. For instance, in mountain landscapes unweathered rock may be present at the surface, and fractures constitute the primary manifestation of weathering processes. In contrast, weathered profiles can be tens of meters thick in places where chemical weathering has worked for millions of years and erosion rates are low. These variations in thickness and degree of alteration of the weathered profile reflect differences in the rate at which material moves through the near-surface reactor and the rate at which weathering of the rock occur.

The Critical Zone

A recent National Research Council report called attention to the Critical Zone (National Research Council, 2001), which they defined as the region from the top of the vegetation canopy to the base of groundwater. In this heterogeneous near-surface region the fluid envelopes of the Earth overlap with the crust. The interactions between rock, water, air, and living organisms control the availability of nutrients and structure of the environment (Brantley *et al.*, 2007). The weathered profile, from the land surface down to fresh, unaltered bedrock, provides the physical structure in which Critical Zone processes occur, and is itself a product of these processes.

It can be useful to consider the Critical Zone as a ...ant reactor in which rocks are bathed in solutions ...oduced from percolating rainwater and where ...face-down perturbations such as temperature fluctu-

Southern Sierra CZO education & outreach activities

- Present seminars and science lessons to school groups and local organizations
- Work with media outlets to bring reporters to the CZO
- Organize field trips
- Presentations at science meetings
- Briefings for elected officials, resource managers & business leaders
- Use web site to promote our activities

K-12 Events

- Teacher trainings:
  - Nature Bridge at Yosemite
  - 2009 AGU GIFT session
- Hands-on science
  - Southern CA Edison Science Days
  - American Association of University Women Girls science camp
  - Center for Advanced Research and Technology (CART)
- Activity/curriculum development available on web site

Field Trips and Conferences

- UC Davis field methods class
- UC Merced surface water hydrology class
- Sierra Nevada Adaptive Management Project July 2011 field trip
- American Geophysical Union posters and talks

EDUCATION: 2010 SUMMER FIELD SCHOOL

- 2 week intensive; primarily field-based
  - 9 U.S. undergraduates – SSHO REU
  - 10 European grad + postdocs – SoilTrEC

Critical Zone summer field school, June 1-15, 2010

- Intro and overview of SSHO
- Basic field geologic measurements
- GIS approaches to building environmental gradients
- Monitoring well drilling and construction
- GW level monitoring and sampling
- Field soil description
- Soil augering and sampling
- Lysimeter installation and sampling
- Surface water surveys and sampling
- Vegetation assays
- Study implementation

EDUCATION: 2011 SSHO REU

- 8 U.S. undergrads
- 2 week field trip
- 2 week lab

2012 CZ SUMMER FIELD SCHOOL

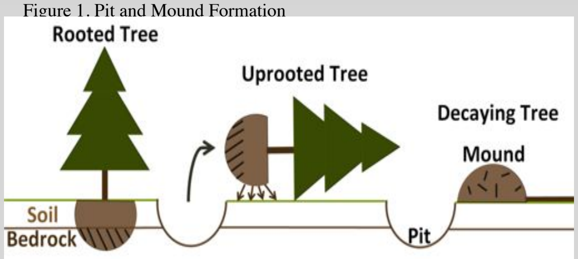
Bioturbation of Forested Shale Soils by Tree Throw in the Appalachian Mountains

Elizabeth Mann[1], Katie Downey[2], Ashlee Dere[3], Timothy White[3]

[1]Washington and Lee University, Lexington, VA, [2]Juniata College, Huntingdon, PA. [3]Department of Geosciences, Pennsylvania State University, University Park, PA

Tree Throw Processes

Figure 1. Pit and Mound Formation



Newly Uprooted Tree (PA)

Multiple Tree Throws (AL)

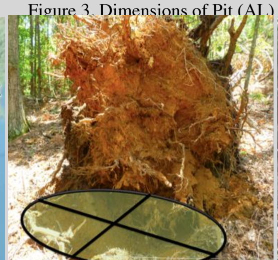
Exposed Root Mass (TN)

Soil and Bedrock Migration (TN)

Methods

Figure 2. Observed Shale Sites

Figure 3. Dimensions of Pit (AL)



Pit Measurements (PA)

Five depth measurements along the long axis and three depth measurements along the short axis were recorded.

Figure 4. Classification for Decaying Trees

1	Wood hard; all bark remaining.
2	Wood hard; >50% of bark remaining.
3	Wood hard; <50% of bark remaining.
4	Wood starts to soften, texture smooth.
5	Wood soft; small crevices and pieces lost.
6	Wood fragments lost, so the outline of the trunk is deformed.
7	The outer surface of the log is hard to define, possibly with a core of harder wood.
8	Completely soft without evidence of hard wood, outline indeterminable.

Each tree throw's relative age was determined based on decay classification for the Norway spruce.

Abstract

Tree throw, the upheaval of bedrock and soil in the root mass of a fallen tree, has been suggested as a major process in the overturn and downslope transport of soils in mountainous regions. The process typically leads to an excavated pit, often with exposed bedrock, and a large mass of rock and soil in the exposed root mass (Figure 1). Through time, the pit fills and soil and rock from the root mass move down slope as the tree and roots decay.

Reported here is an effort to quantify the effects of tree throw along a climosequence of sites on shale in the Appalachian Mountains associated with the Susquehanna-Shale Hills Critical Zone Observatory (SSHO) (Figure 2). The study includes the following field measurements for tree throws within a 120 meter diameter search area centered on soil pits on ridge tops on the Silurian Clinton Group shale: GPS location, tree girth, tree type, dimensions of pit (Figure 3), relative tree age (Figure 4), azimuth of fall, and slope and azimuth of maximum slope.

Five sites were studied: central New York, central Pennsylvania (SSHO), west central Virginia, eastern Tennessee, and northern Alabama. A general north-to-south decreasing trend in total number of tree throws was observed excluding the Virginia site (Figure 5). In Virginia, the total number of tree throws was twice the number observed in New York, which we attribute to the higher elevation setting subjected to the steadiest winds as well as the shallowest soils. The relatively high number of throws in New York is likely tied to glacial till at the site – rooting depth appears to be limited by rock fragments, abundant clay and periodic soil saturation. Trees with the largest girths tend to excavate the largest tree throw pits, a relationship best defined in Alabama where the deepest pits were excavated by large trees that had fallen most recently (Figure 6).

Most of the observed tree throws occurred on slopes ranging from 15-31 degrees except in Alabama where tree throws fall on a range of slopes with the highest number at 45 degrees (Figure 7). No strong relationship was observed between the azimuth of fallen trees and the azimuth of maximum slopes. At the New York site, all of the tree throws fell toward the east, suggestive of control by prevailing wind direction on the direction of fall. In Virginia, most of the trees fell to the west, the prevailing slope direction of the study site, though a significant number fell to the northeast, again suggestive of influence by prevailing wind direction. In Tennessee most of the trees fell to the south-southeast, the prevailing slope direction, while in Alabama most of the trees fell to the northwest, compatible with prevailing wind directions; the broader range of azimuth of falls in Alabama is most likely due to the effect of chaotic falls associated with recent tornadoes (Figure 8).

These observations of tree throw have been made as part of a broader effort to characterize rates of erosion on shale hill slopes, information that is applicable to understanding the evolution of topography and regolith thickness on shale landscapes. Specifically, our observations are used to verify formulations of volumetric regolith flux due to tree throw.

Results

Figure 5. North to South Decreasing Trend

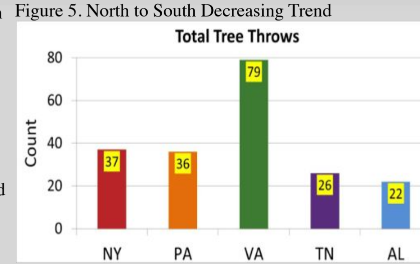


Figure 6. North to South Linear

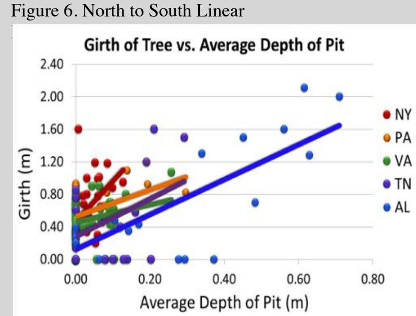


Figure 7. Tree Throws Decrease with Increasing Inclination

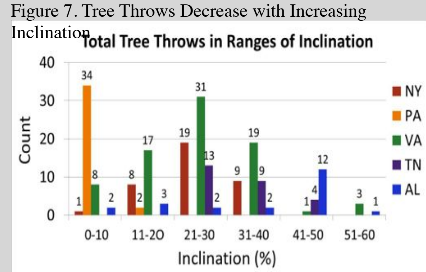
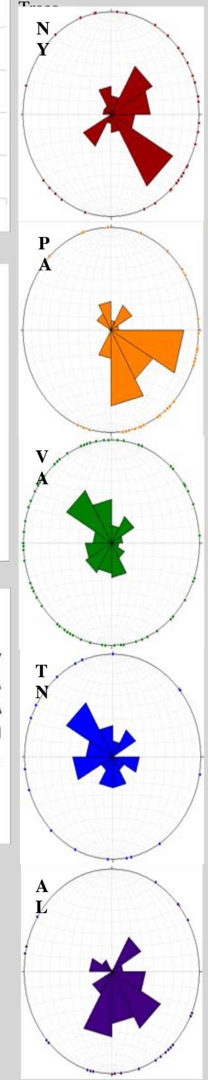


Figure 8. Rose Diagrams of Azimuth of Fallen Trees



Conclusions

We consider the greater number of tree throws in the northern sites to be a function of thinner soils. Thicker soil results in less tree throw. Moving from the north to south, we see an increase in pit size relative to girth size. We attribute this relationship to be associated with soil depth as well. The thinner soils in the northern sites are not holding tree up as well as the thicker soils in the southern sites. We see this as prevailing winds more readily knock over trees in the northern sites. The dominant range of inclinations do not show a trend from north to south.

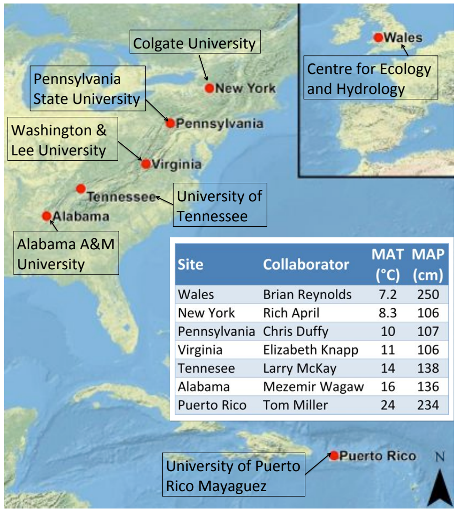
Acknowledgments

Elizabeth Knapp, Washington & Lee University; Lauren Leidel, Pennsylvania State University; Erik Heider, University of Tennessee; Feron Washington, Alabama A&M University; Deborah Vazquez-Ortiz and Ricardo Ruiz, University of Puerto Rico Mayaguez

Shale weathering on slopes across a latitudinal climosequence

Lauren Leidel[2,3], Ashlee Dere[1] and Tim White[1,3]

[1]Department of Geosciences, [2]Department of Energy and Mineral Engineering, [3]Earth and Environmental Systems Institute



Site	Collaborator	MAT (°C)	MAP (cm)
Wales	Brian Reynolds	7.2	250
New York	Rich April	8.3	106
Pennsylvania	Chris Duffy	10	107
Virginia	Elizabeth Knapp	11	106
Tennesee	Larry McKay	14	138
Alabama	Mezemir Wagaw	16	136
Puerto Rico	Tom Miller	24	234

Figure 1. Locations of transect study sites with collaborator universities labeled. Wales and Puerto Rico represent true end members of the transect, but were not considered in this effort. Table shows states, collaborators, mean annual temperature (MAT) and precipitation (MAP) for each site.

Abstract

A transect of study sites, including New York, Pennsylvania, Virginia, Tennessee, and Alabama, has been established in the Appalachian Mountains to investigate the rates of shale weathering as a function of climate (Figs. 1, 2). All sites are underlain by Silurian-age, iron-rich, organic-poor Rose Hill Shale (or local equivalent) providing a similar lithology from which soils form. Climate varies along the transect, with a lower mean annual temperature (MAT) and precipitation (MAP) in New York, both increasing to Alabama (Fig. 1). Previous studies at these sites (ongoing PSU Ph.D., A. Dere) have focused on characterizing ridgetop locations, or 1-D sites, where water enters the soil surface and proceeds vertically to bedrock. 2-D sites, where soils form on slopes, represent where water moves both vertically and laterally down the slope. A recent effort to characterize 2-D sites at each transect site was undertaken by students participating in a National Science Foundation Research Experiences for Undergraduates (REU) program. The students represented seven universities affiliated with sites along the transect.

Characterizing 2-D soils included identifying sampling sites on a convex slope located below the 1-D ridge top sampling sites, digging pits as deep as possible, and sampling by depth and horizon (Figs. 3, 4). Additionally, ground penetrating radar (GPR) surveys were conducted on transects between the ridgetop and 2-D pits (Fig. 4). In New York, the parent material is locally derived shale till and the augerable depth of the 2-D soil pit is 230 cm. A 2-D pit was not sampled in Virginia because the Rose Hill Shale Formation in this location is very thin; the narrow ridge is bounded on both sides by sandstone beds. In Tennessee, shallow soil pits (approximately 75 cm deep) were observed on the slope compared to the 398 cm depth measured at the ridgetop site. In Alabama, augerable soil depth on the slope is 60 cm deep compared to 220 cm deep at the ridgetop (Figs. 5, 6). All 2-D soil profiles have rock fragments throughout, indicating colluvial transport of material from farther upslope. Soils are brown and lack distinct horizons in New York and are increasingly redder in Virginia and Alabama. Tennessee soils are yellow-brown. Redoximorphic features are present in all 2-D soil pits and are most strongly expressed in the Tennessee soil (Fig. 3).

In general, 2-D soils are shallower and less weathered than 1-D soil profiles, and 2-D sites are more weathered from north to south along the transect, as evidenced by geochemical profiles (Fig. 5). The degree of chemical weathering is reflected in soil depth along the climosequence, where southern 1D sites have more total Na and Mg mass loss than northern 1D sites (Figs. 5, 6, 7). This study of 2-D weathering will help understand the rate at which shale weathers on slopes in various climates, information that could be used to predict the impact of climate change on soil production.

Figure 4. Photos from L to R: Digging a soil pit in NY; augering to reach deeper depth in AL; horizon sampling; describing profile in VA; ground penetrating radar (GPR) transect from 1D pit to 2D.

Methods

Figure 2. Photos of each site on the transect.

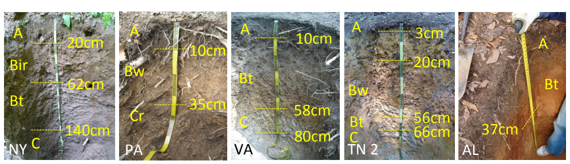


Figure 3. Soil profile photos from each site. 2D pits were dug at NY, PA, TN, and AL.

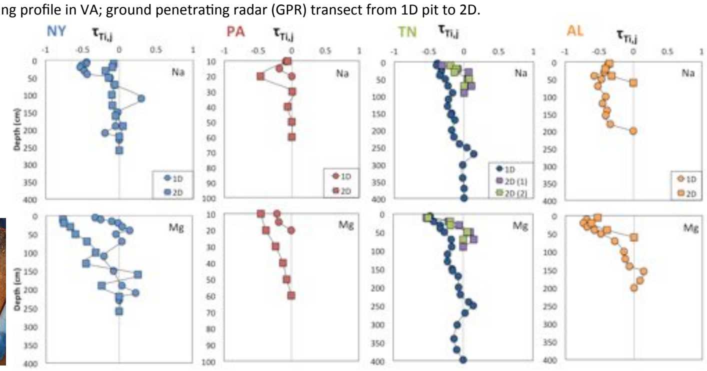


Figure 5. Tau plots of Na and Mg for New York, Pennsylvania, Tennessee, and Alabama.

Discussion

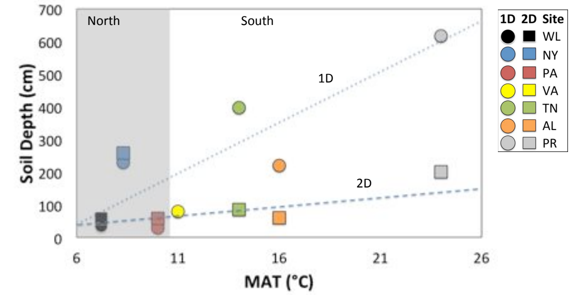


Figure 6 (above). Plot of soil depth versus MAT. Wales and Puerto Rico sites included to emphasize north versus south trend. 1D data from Dere et al., in prep. Soil depth increases with MAT and MAP, as would be expected based on long-term understanding of soil forming state factors. The gently sloping dashed line through the 2D profiles shows less variability in soil thickness on slopes than ridgetops (dotted line) or 1D profiles. Northern sites, shaded in gray, show minimal difference in soil depth between 1D and 2D profiles compared to southern sites where a large difference in soil depth occurs between ridgetop and slope profiles. Interestingly, the northern sites were either glaciated or subjected to periglacial conditions during the Last Glacial Maximum. To the south, where pedogenesis has not been interrupted by glaciation or periodic permafrost, thicker soils have developed on ridgetops. However, given the minimal difference in 2D soil depths between the north and south (dashed line), it appears that 2D weathering in southern profiles may be counterbalanced by faster erosion rates on slopes. Ridgetop soils in the south appear to be shielded from those erosion effects.

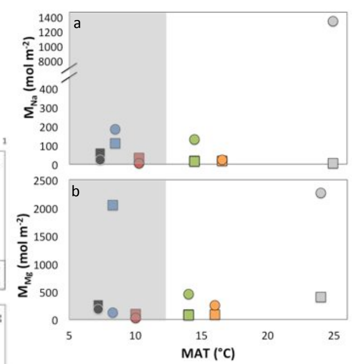


Figure 7. Total mass loss (Mj), a simplified presentation of the area under the tau plot curve (Fig. 5), of Na (a) and Mg (b) as a function of MAT across the transect. The shaded gray area denotes northern sites. Na and Mg are used as proxies of feldspar and illite weathering respectively. Southern 1D soils show more Na and Mg mass loss than 2D sites explained by faster erosion rates inferred by shallower 2D soil depths. Conversely, northern 2D sites are more depleted of Na and Mg than their 1D counterparts. At northern sites the past effects of freezing and thawing have moved previously weathered sediments downslope, increasing soil permeability and surface area, which could explain enhanced weathering observed in northern 2D soils compared to southern 2D soils.

Acknowledgments: Katie Downey, Juniata College; Erik Heider, Univ. of Tennessee; Elizabeth Mann, Washington & Lee Univ.; Feron Washington, Alabama A&M Univ.; Deborah Vazquez-Ortiz and Ricardo Ruiz Velez, Univ. of Puerto Rico Mayaguez

PENNSTATE College of Earth and Mineral Sciences

DEPARTMENT OF GEOSCIENCES

JOHN A. DUTTON e-EDUCATION INSTITUTE

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- Unit 3, Lesson 4
- Unit 3, Lesson 5
- Unit 4, Lesson 6
- Unit 4, Lesson 7

Submitted by Ann Taylor on Fri, 02/08/2008 - 15:28

Welcome!

Printer-friendly version

New to EARTH 530?

Registered students should begin with the Course Orientation, located in the "Start Here!" menu (see left).

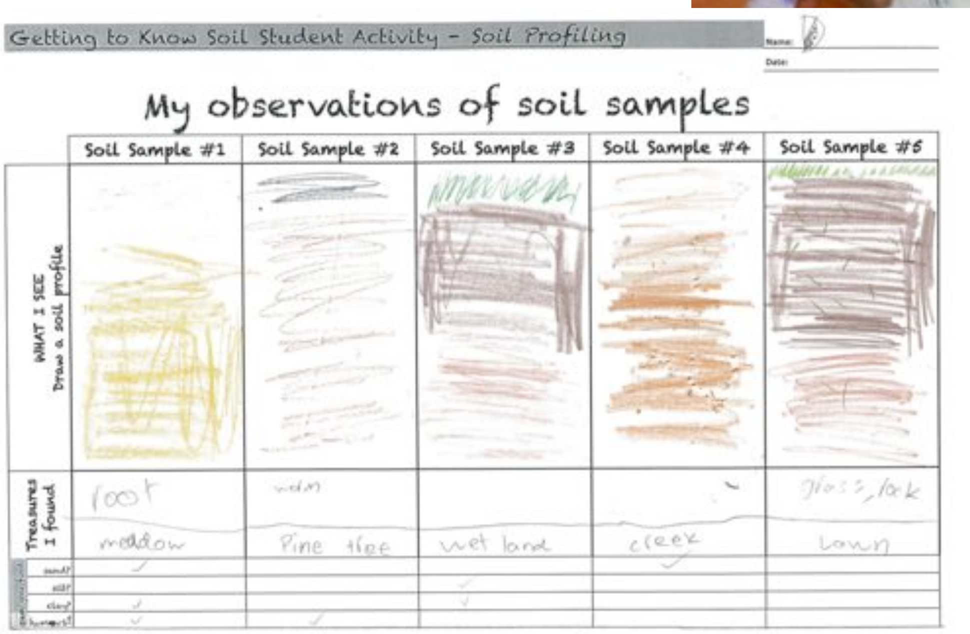
Not registered? Students who register for this Penn State course gain access to assignments and instructor feedback, and earn academic credit. Information about registering for this course and about the online Masters of Education in Earth Sciences is available at http://earth.e-education.psu.edu.

Quick Facts about EARTH 530

- Author / Instructor - Tim White, senior research associate, Penn State Earth and Environmental Systems Institute.

- Overview - EARTH 530 is an elective course in Penn State's online Masters of Education in Earth Sciences. EARTH 530 will introduce you to the basic information necessary for understanding Earth surface processes in the Critical Zone through an integration of various scientific disciplines including study of weathering and soils, geomorphology, erosion and sedimentation,hydrogeology, low-temperature geochemistry and Earth systems. Those who successfully complete EARTH 530 will be able to apply their knowledge of these fundamental concepts to understanding how all of these factors affect our daily lives within the Critical Zone. The concepts covered in the course material are based on ongoing research funded by the U.S. National Science Foundation and the European Commission.

Critical Zone Principles and Processes go to School



4th and 5th grade students at Greenwood Elementary in Kennett Square, PA examine sediments and soil samples to understand their properties and fill out data sheets on their field observations. They also record soil profiles found in the school yard.

Funded by NSF-OCE #1034961

Sensors, Data and GIS in the Classroom

Middle-school students in Chester County Pennsylvania after-school programs built sensors, collected data and learned how to use GPS to locate the exact position of the the information that they collected.

Funded by NSF-OCE #1034961

Wiki Watershed

Model My Watershed

The model is currently under development and testing with students and teachers and continues to be modified on an ongoing basis. We have three applications that are in various stages of refinement, including:

Demonstrates connections between rainfall, land use and soil texture

Show My Watershed

Allows students to find watershed or other area and calculate the land cover, soil and water budget for existing conditions

Modify My Watershed

Enables students to make changes to the underlying environmental conditions and model parameters, implement best management practices and calculate the impact of the changes from an economic, social, ecosystem and water quality perspective.

Jemez - Catalina CZO education and outreach activities

- Undergraduate, Graduate and Postdoctoral student training
- High school student participation in field campaigns for
  - Snow Surveys
  - LiDAR ground truthing
- Partnering with Biosphere 2 (B2):
  - B2 REU in Environmental and Earth System Science
  - First **CZO All Hands Meeting** May 2011
  - Educational Displays on **National CZO Program**
  - B2 Landscape Evolution Observatory (LEO) (focusing on coupled hydro-bio-geo processes in the CZ
  -

By 2013:

CZO Network Coordination Office to include:

Full-time Education and Outreach staff person

Arizona Daily Star, November 14, 2010

SCHOOL OF EARTH AND ENVIRONMENTAL SCIENCES

Living in, discovering the critical zone

The ongoing search for life on other planets reveals how fortunate we are to have the right balance of ingredients here on Earth. Our planet has 6.9 billion humans living on the Earth's land surface. This zone of the crust is critical because it provides us with fertile soil for growing food, clean water for drinking and habitat for a diversity of plants, microbes and animals. Precious landscape, indeed.

The "critical zone," which stretches from the treetops to the bottom of groundwater, can be thought of as a permeable, living filter in the larger Earth system. The thin green carpet of plants, microbes and animals directly controls how climate chisels away at the landscape, how it weathers rock to form soil and how it changes the quality of water during its transport.

Although scientists know a lot about the plant communities, soil fertility, geology and hydrology of the critical zone, we don't have a detailed understanding of how all the components interact to shape landscapes and clean and store our water. Therefore, the National Science Foundation and the European Commission recently created a network of 10 Critical Zone Observatories, six in the U.S. and four in Europe, to study this key component of our life-support system.

The University of Arizona is the headquarters of the Jemez River Basin - Santa Catalina Mountains Critical Zone Observatory.

This observatory, under the leadership of a group of faculty in the UA's School of Earth and Environmental Sciences, focuses on the Santa Catalina Mountains near Tucson and the Jemez Mountains north of Albuquerque. It is the only critical zone observatory that has research sites arrayed along elevation gradients in the semi-arid Southwest.

The mountains of Arizona and New Mexico host a range of rock types, and the amount of precipitation increases — and temperature decreases _ dramatically with elevation. Since geology and climate exert primary control over critical zone formation, variation in rock type and climate makes mountains of the Southwest natural laboratories for critical zone science. However, unraveling complex interactions among vegetation, soils, rocks and water requires close collaboration among ecologists, hydrologists, soil scientists and geologists. All of us must bring our state-of-the-art tools to the joint research effort.

Our UA-led team is setting up sensor networks in low, intermediate and high elevation watersheds in both mountain ranges to measure how climate affects the flows of water and solutes through vegetation, soils, groundwater and streams. We are collecting data on precipitation, soil moisture, plant uptake, aquifer recharge and stream flow during and between rainfall and snowmelt.

During such events, members of our team of postdoctoral scientists, graduate students and undergraduate researchers rush to the field to collect samples of water, soil and plant tissue and bring them back for laboratory analyses.

We are discovering much about the critical zone. We are finding that soil depth and development strongly influence the partitioning of water in the landscape, the speed that it is delivered to streams and the unique chemical "finger-print" it obtains during its journey.

JULIA PERDRIAL / UNIVERSITY OF ARIZONA

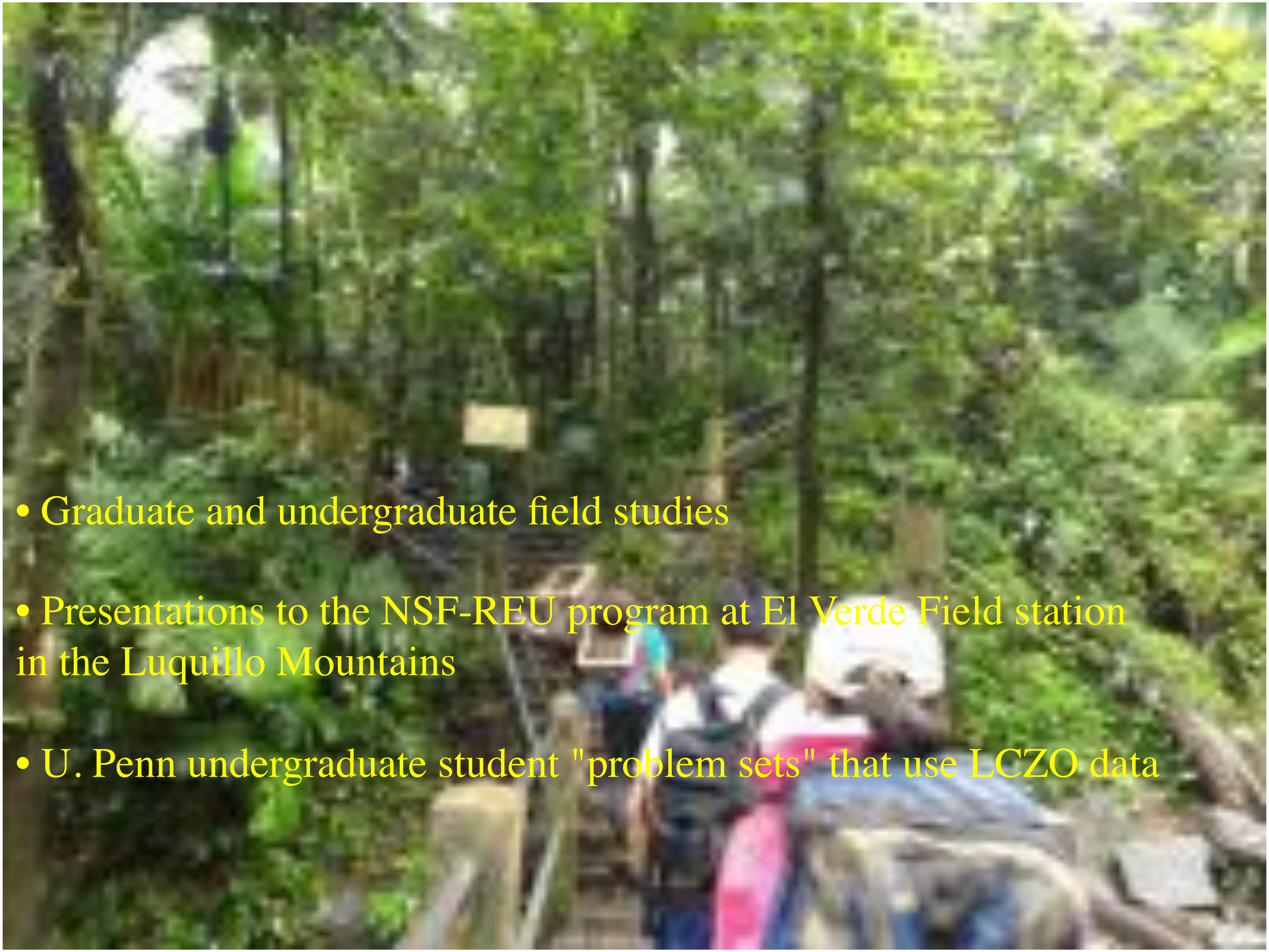
Research scientists Adrian Harpold and Sarah Hayes install soil moisture, temperature and solution probes to obtain information on the transit of water and heat through the critical zone subsurface. Wires transmit sensor results for storage on data loggers.

JON CHOROVER / UNIVERSITY OF ARIZONA

UA research scientist Julia Perdrial installs soil moisture, temperature and solution probes to obtain information on the transit of water and heat. Red flags indicate the location of sampler installations.

ONLINE

- More information on the critical zone observatory efforts can be found online at www.czo.arizona.edu


• Graduate and undergraduate field studies
• Presentations to the NSF-REU program at El Verde Field station in the Luquillo Mountains
• U. Penn undergraduate student "problem sets" that use LCZO data


Summer 2012 workshop with Puerto Rican well drillers
Joint CZO-LTER field training course the first week of every summer
06/07/2011 10:09


2

Videos and Radio

Video:

- UC Merced Office of Communications - Barbara Boxer visit
- University of California Research Video
- UC Berkeley Graduate School of Journalism CNS News - Around California

Radio:

- KQED California report: Snow Surveys of the Future
- KVPR Quality of Life: End of CA Drought

Other Media

- Central and northern CA newspapers
- On-line news outlets
- Magazine articles
- Portuguese Film Project on climate change in the US

RFID NEWS

California Researchers Expand 'Intelligent Water Infrastructures Initiative'

A University of California group is deploying hundreds of wireless sensor nodes in the Sierra Nevada, to help better predict water availability.

By Claire Swedberg

ARTICLE TOOLS
Turn Definitions Off
Email Article
Create PDF
Print Article
Digg This

Nov. 7, 2011—In the Sierra Nevada, wireless sensor nodes are transmitting data indicating the amount of snow that has fallen or melted, as well as soil-saturation levels. Ultimately, all of this information can be used to calculate the volume of water available to the tens of millions of residents and businesses located downstream.

One step in achieving that goal is SierraNet—a program being run jointly by University of California (UC) researchers at the school system's Berkeley and Merced campuses. The first SierraNet project is taking place at the Kings River Experimental Watershed area, and is part of the Southern Sierra Nevada Critical Zone Observatory (CZO)—an environmental laboratory. The SierraNet projects are being led by Steven Glaser, a UC Berkeley professor of civil and environmental engineering, and Roger Bales, a UC Merced professor of engineering and the director of the Sierra Nevada Research Institute (SNRI). Glaser's team is now launching a much larger installation of wireless sensors, spread across the basin of the American River, with a $2 million grant from the National Science Foundation (NSF). The grant, awarded in September 2011, will be dispensed over the course of four years.

Water Sense: CITRIS MOTES and Wireless Networks Deployed to Help Monitor and Manage California's Water Supply

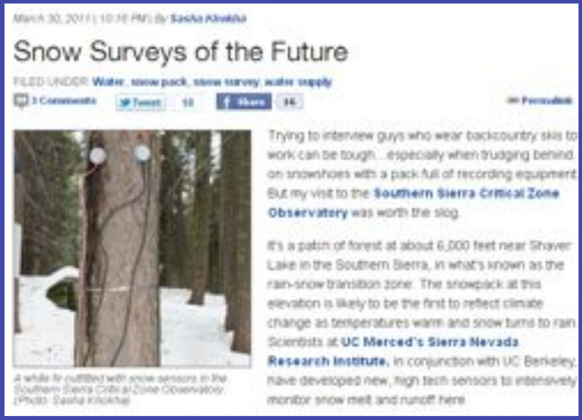
February 23, 2011

by Gordy Slack

Water is California's most precious resource. Where it flows, agriculture, natural habitats, culture, and industries all thrive; beyond water's reach, things dry up and die.

The 400-mile-long mountain range on California's eastern border is by far the state's largest water-storage facility. More than half of California's water comes from snow in the Sierra Nevada. But unlike manmade reservoirs, frozen mountain water is difficult to measure and track through the year. Harsh winter conditions make survey missions to remote parts of the range expensive and treacherous. And convoluted topography and complex snowfall, thaw, absorption, and runoff regimens make calculating the amount of water stored there an exercise in extreme approximation, according to Roger Bales, professor of engineering at UC Merced and director of the Sierra Nevada Research Institute.

Most of California's water is stored as snow in the Sierra Nevada.



March 30, 2011 | 10:16 PM | By Sasha Khokha

Snow Surveys of the Future

FILED UNDER: Water, snow pack, snow survey, water supply

3 Comments Tweet 10 Share 16 Permalink

Trying to interview guys who wear backcountry skis to work can be tough…especially when trudging behind on snowshoes with a pack full of recording equipment. But my visit to the Southern Sierra Critical Zone Observatory was worth the slog.

It's a patch of forest at about 6,000 feet near Shaver Lake in the Southern Sierra, in what's known as the rain-snow transition zone. The snowpack at this elevation is likely to be the first to reflect climate change as temperatures warm and snow turns to rain. Scientists at UC Merced's Sierra Nevada Research Institute, in conjunction with UC Berkeley, have developed new, high tech sensors to intensively monitor snow melt and runoff here.

A white fir outfitted with snow sensors in the Southern Sierra Critical Zone Observatory. (Photo: Sasha Khokha)

Introduction to DOSECC E & O

E&O Providers Workshop
February 20, 2012
David Zur

DOSECC

(Drilling, Observation and Sampling of the Earth's Continental Crust, Inc.)

- Who we are
- What we do (in general)
- What we do (for E&O)
- Future plans

DOSECC

(Drilling, Observation and Sampling of the Earth's Continental Crust, Inc.)

- Non-profit Corporation, formed in 1984
- Funded by NSF EAR-IF
- Mission:

  Provide leadership and technical support in subsurface sampling and monitoring technology for addressing topics of scientific and societal importance

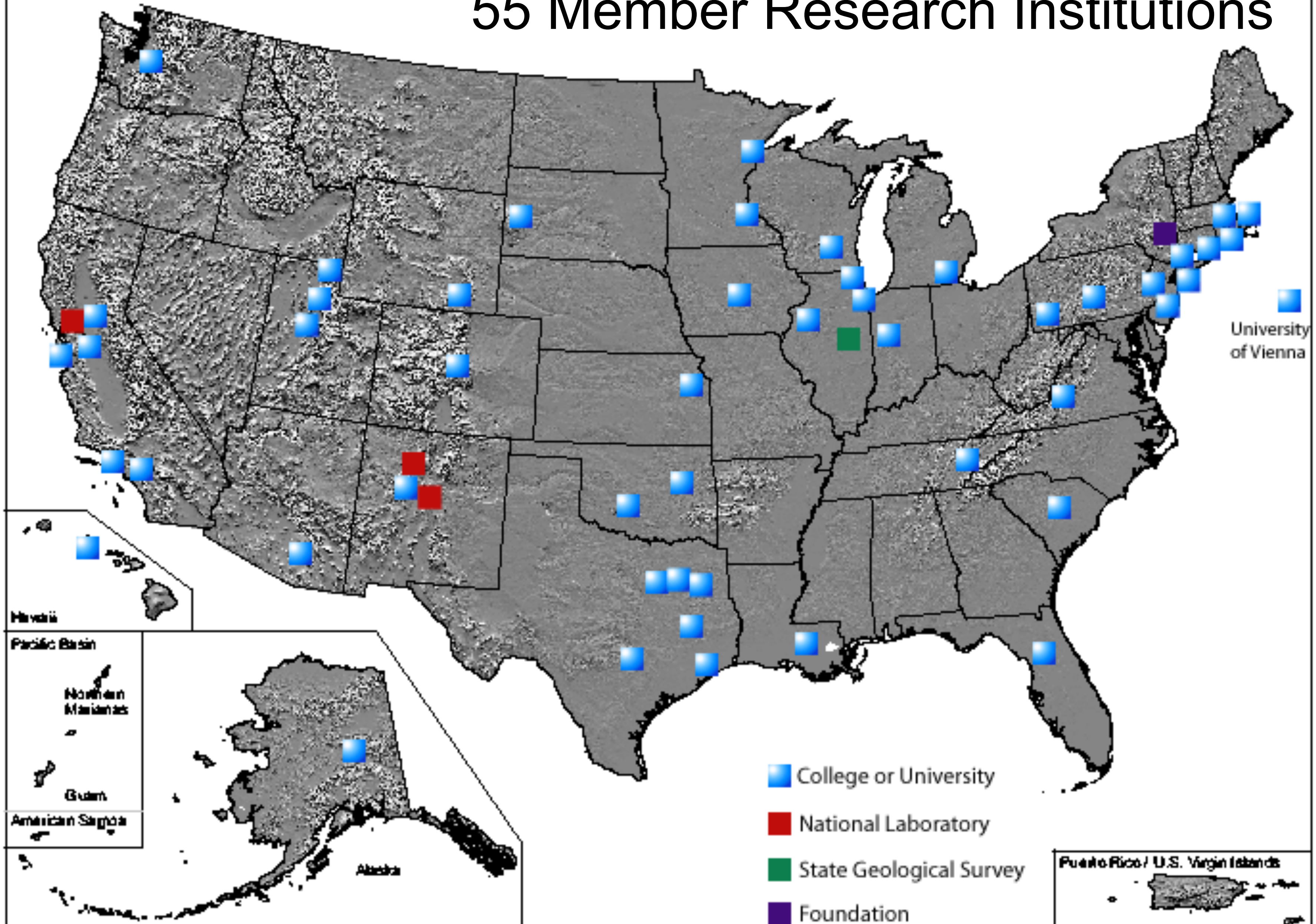
DOSECC's GOALS

- Facilitate and support cost-effective scientific drilling projects
- Link science and drilling technology
- Design, build and operate drilling systems
- Promote technology transfer and education
- Represent US interests in the international scientific drilling community

DOSECC ACTIVITIES

- Planning and Budgeting Drilling Projects
- Drilling Technology and Instrumentation
- Communications, Program Coordination and Integration
- Technical Workshops
- Education and Outreach

55 Member Research Institutions



DOSECC Consortium

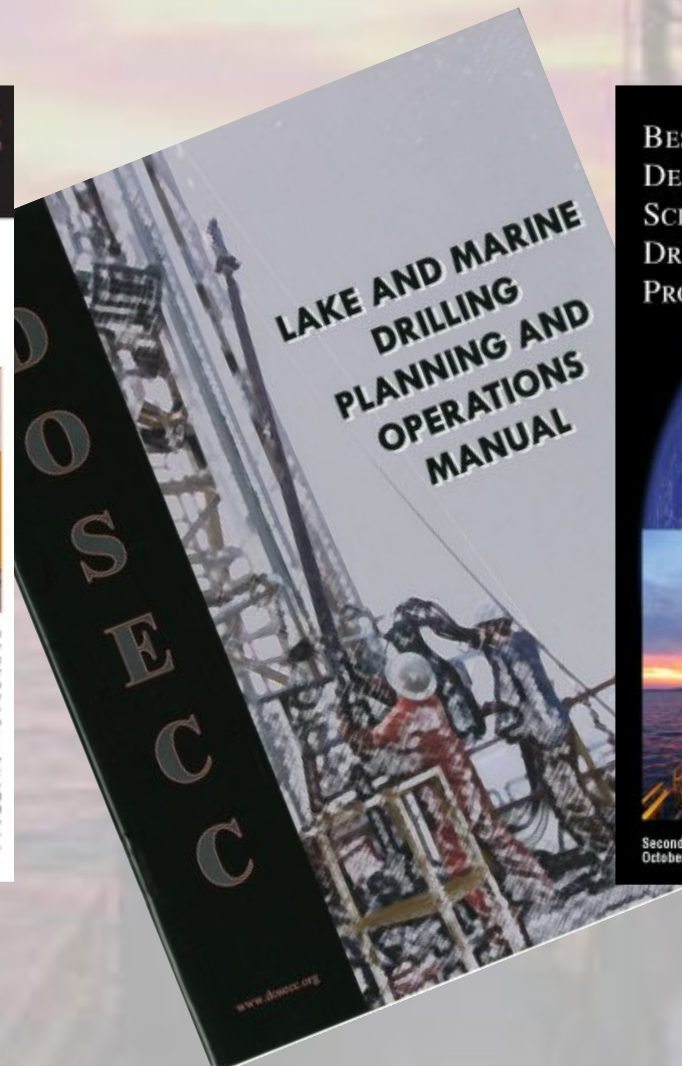

RS-5

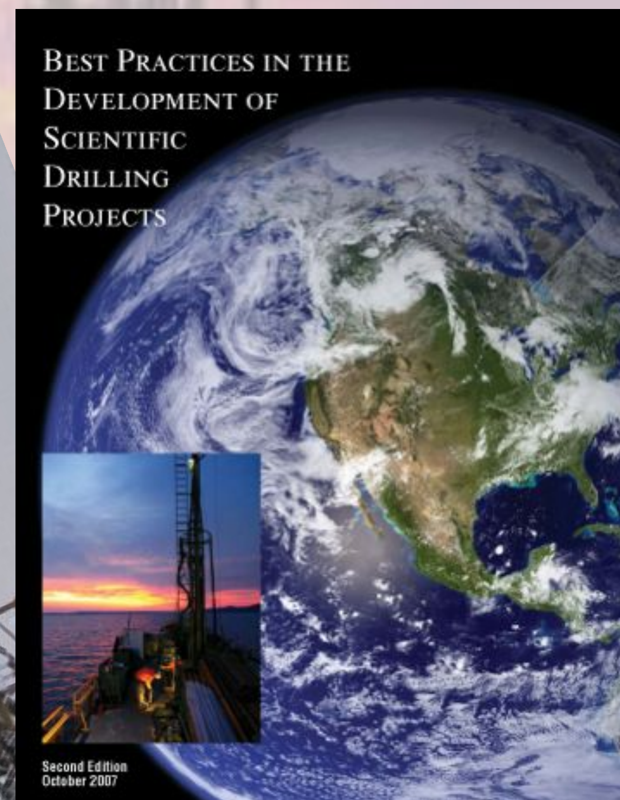
Committees

- E&O
- Science Planning
- Technology Planning
- Finance & Audit
- Nominations

WORLD-WIDE EXPERIENCE

Current E&O Efforts





DOSECC

Current E&O Efforts

- Grant Program
  - Since 2000
  - Grad/Undergrad
  - Schoolteachers
  - Awards to date:
    - 88 total applications
    - 35 awards
    - **$122,789 awarded**
      - Awards granted with 100% DOSECC Corporate funds
  - 5 Awards in 2011: $12,074

DOSECC

Current E&O Efforts

Current E&O Efforts

- Exhibitions and Conferences
  - AGU w/ Annual CSD Town Hall Meeting
  - GSA,CNSF, Others (AAAS, IGC)
- Website
- Facebook
  - DOSECC
  - Individual project sites

Current E&O Efforts

- Lightweight Portable Rig:

  The Winkie
- Field camp use
- Powerful tool for small projects

Future E&O Efforts

- Reinstate Lecture Program
- Drilling “how to” videos

- CSD-specific E&O Workshop
- CSD E&O Program Plan
- REU?
- Results of this Providers Workshop?


Thank You!
DOSECC

ESNO@ASU
Vision and Plan for **E&O Programs**

- At ESNO@ASU, E&O are foregrounded: given attention, expertise, and resources at the same level as EarthScope science.
  - Deputy Director for E&O (S. Semken)
  - Full time E&O Coordinator (W. Taylor)
  - Project Manager—enables rapid response (C. Dick)
  - All ESNO personnel have direct E&O experience

- E&O **vision** for the EarthScope National Office at ASU:

  Add value with new program initiatives

  Sustain activities that work

  Upgrade as needed

ESNO@ASU **E&O Plan**

Add value with new program initiatives

- EarthScope Social Media
- *EarthScope for Place-Based Earth Science Teaching*
- *Teacher Professional Development (with AGI)*
- University of EarthScope

Sustain activities that work

- *EarthScope Interpretive Workshops*
- EarthScope Newsletter
- EarthScope Speaker Series
- EarthScope presence at major conferences (AGU, GSA, etc.)
- EarthScope presence at major E&O activities (USSEF 2012)

Upgrade as needed

- *E&O Provider Summit*
- Teacher-centered E&O web presence

Upgraded EarthScope E&O presence

- Host E&O Provider Summit among E&O providers for more effective development, sharing, and usage of E&O resources.
  - Collaboration with SERC
- Teacher-centered web presence: add new categorization of E&O resources by relevance to "teachable ideas" such as the *Earth Science Literacy Principles* and National Standards, and national curricula (e.g., AGI).

EarthScope Interpretive Workshops

- Initiated by current ESNO E&O program at OSU; ASU has collaborated in three of the most recent ones.
- They mix interpretive Rangers and other informal educators (e.g., USFS, BLM, States) and EarthScope scientists to learn about current findings and design more effective Earth science interpretive programs.
- Evaluation shows that they are highly effective and provide significant national E&O return (to Parks, etc.) on ESNO investment.
- Upcoming workshop March 2012 at James Madison University, VA

spring 2012

inSights

the EarthScope newsletter

EarthScope News

Over 115 people attended the EarthScope Town Hall meeting at AGU in 2011. It provided an opportunity to update the community on significant EarthScope developments and for community members to exchange ideas and provide feedback on the EarthScope program.

- EarthScope presents a four-day **Workshop for Interpretive Professionals in the Central Appalachian Region** at James Madison University that features presentations by prominent geoscientists and interpretive professionals to help convey the story of the magnificent landscapes, geological stories, and natural hazards of the Central Appalachian Region. Details at http://www.earthscope.org/workshops/appalachians.
- In conjunction with the bicentennial of the New Madrid earthquakes of 1811-1812, the **New Madrid Seismic Zone** content set for the Active Earth Monitor is now available. Explore the geologic setting and seismic history of the region, learn about current research being conducted, and read historical accounts from eyewitnesses. For more information, visit http://www.iris.edu/hq/programs/education_and_outreach/museum_displays/

Mineral, VA Earthquake Demonstrates the **Passive Aggressive Margin** of Eastern North America

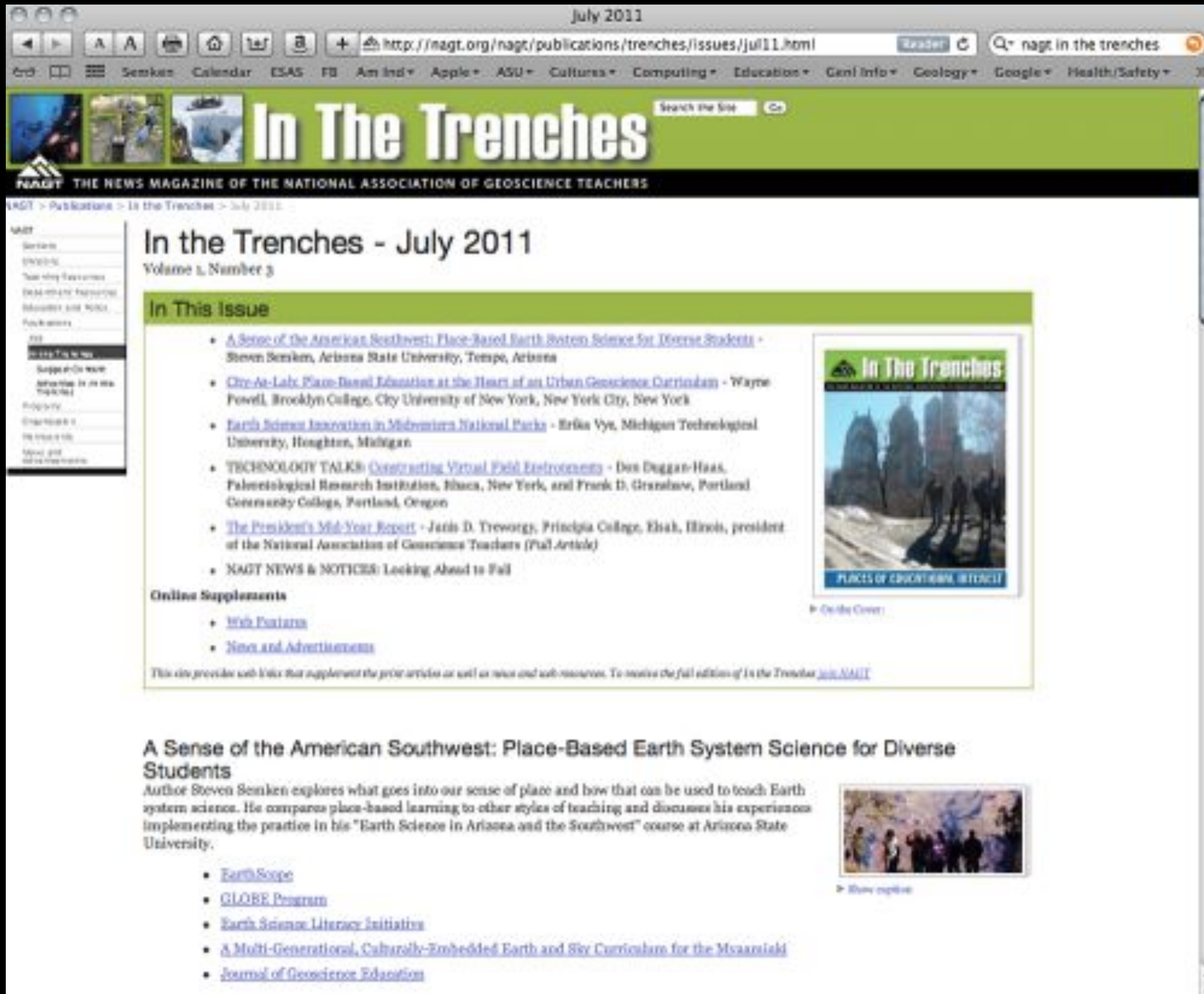
On August 23, 2011, the Mw 5.8 Mineral, Virginia, earthquake rocked the east coast of the U.S. While moderate in comparison to recent mega-thrust events in Japan, Chile, and Sumatra, and perhaps regular fare to those living on the active plate boundary in the western U.S., this earthquake serves as a reminder that seismic hazards on the east coast are real and not well documented. Ground shaking associated with the event was felt over a larger region of the U.S. than any previous instrumentally recorded earthquake due to efficient energy propagation through crystalline bedrock that underlies much of the eastern margin of the U.S. Felt reports of ground shaking in the U.S. extended from Georgia to Maine and west to Detroit and Chicago. The earthquake was also felt in southeastern Canada from Montreal to Windsor. Observations from temporary portable seismic deployments to record aftershocks in the wake of the earthquake, the installation of two new permanent GPS sites, and the arrival of EarthScope's Transportable Array on the east coast (Figure 1) present new opportunities to better quantify deformation, raise awareness of earthquake hazards, and motivate improved earthquake preparedness in eastern North America.

Community response and open data. Immediately following the earthquake, teams from the U.S. Geological Survey, IRIS PASSCAL, Virginia Tech, Lamont-Doherty Earth Observatory, the University of Memphis, and Cornell University deployed instruments to record aftershocks and deformation in the wake of the earthquake. Under the coordination of the USGS, 57 seismometers, with a combination of intermediate- and short-period sensors were installed at 47 sites. Between August 27 and September 9, 2011, an additional 117 EarthScope Flexible Array "Texans" were deployed as a series of densely spaced linear arrays (200-400 m station spacing over distances of 7 to 12 km) and 30 "Texans" were deployed as 3-component stations in a 60-km linear array. This effort, termed AIDA (Aftershock Imaging with Dense Arrays), is the first time so many densely spaced instruments have been deployed in the wake of a significant event. An important addition to the seismic deployment is two new semi-permanent PBO-quality GPS sites, one on each side of the rupture plane, installed in November 2011.

Nineteen of the seismic stations have real-time telemetry allowing for near real-time location of aftershocks and moment tensor solutions. Thirty-five sensors,

Figure 1: East coast seismicity, 1970-2011. Epicenters from NEIC, LCSN, and CERI catalogs (merged catalogs, no overlap). Historic large magnitude events shown by blue stars. Future USArray TA stations shown by gray diamonds. (Pazzagalia et al.)

EarthScope in Place-Based Earth Science Teaching


July 2011

http://nagt.org/nagt/publications/trenches/issues/jul11.html

In The Trenches

THE NEWS MAGAZINE OF THE NATIONAL ASSOCIATION OF GEOSCIENCE TEACHERS

In the Trenches - July 2011

Volume 1, Number 3

In This Issue

- A Sense of the American Southwest: Place-Based Earth System Science for Diverse Students - Steven Semken, Arizona State University, Tempe, Arizona
- City-As-Lab: Place-Based Education at the Heart of an Urban Geoscience Curriculum - Wayne Powell, Brooklyn College, City University of New York, New York City, New York
- Earth Science Innovation in Midwestern National Parks - Erika Vye, Michigan Technological University, Houghton, Michigan
- TECHNOLOGY TALKS: Constructing Virtual Field Environments - Don Duggan-Haas, Paleontological Research Institution, Ithaca, New York, and Frank D. Granshaw, Portland Community College, Portland, Oregon
- The President's Mid-Year Report - Jan D. Trewargy, Principia College, Elsah, Illinois, president of the National Association of Geoscience Teachers (Full Article)
- NAGT NEWS & NOTICES: Looking Ahead to Fall

Online Supplements

- Web Features
- News and Advertisements

In The Trenches

PLACES OF EDUCATIONAL INTEREST

A Sense of the American Southwest: Place-Based Earth System Science for Diverse Students

Author Steven Semken explores what goes into our sense of place and how that can be used to teach Earth system science. He compares place-based learning to other styles of teaching and discusses his experiences implementing the practice in his "Earth Science in Arizona and the Southwest" course at Arizona State University.

- EarthScope
- GLOBE Program
- Earth Science Literacy Initiative
- A Multi-Generational, Culturally-Embedded Earth and Sky Curriculum for the Mvaaniski
- Journal of Geoscience Education

EarthScope Speakers

Jim Evans

Bridget Smith-Konter

Lucy Flesch

Terry Plank

Bill Ellsworth

Social Media and the Geoblogosphere

- New media studio at ASU
  - Videos for social media
  - EarthScope "stories"
  - EarthScope scientists in action

Social Media and the Geoblogosphere

Enhance EarthScope's media footprint:

- Connect with Facebook, Twitter, YouTube, Wikipedia and others – interactivity wth public and scientific community
- Link to the *"geoblogosphere"* through prominent blogs
- Establish an RSS Feed for news and current events
- Infuse website with more multimedia – podcast and vodcasts (iTunes, YouTube channels, ES website)
- Capture ES scientists/students in action – GSA, AGU, field

ASU School of Earth & Space Exploration
Arizona State University

Teacher Professional Development (with AGI)

- Leveraging current ASU SESE collaborative NASA grant with American Geological Institute: *NASA Triad program*
- EarthScope content presented at two Earth science teacher PD workshops in summer 2011:
  - Teacher Leadership Academy at ASU July 2011

    Newly developed network

    20 grade 6-12 STEM teachers from across Southwest
  - Teacher Leadership Academy at NASA JSC August 2011

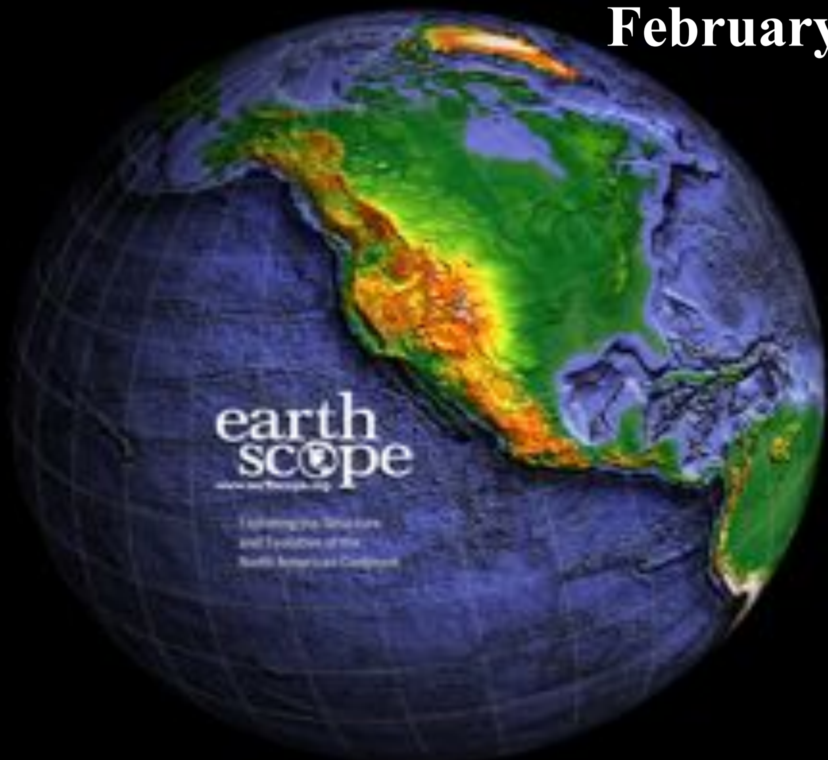
    Existing AGI cadre of teacher leaders

    30 grade 5-9 STEM teachers from all USA
  - Summer 2012 workshops are scheduled

School of Earth & Space Exploration
Arizona State University

Free-Choice Learning in EarthScope Education and Outreach

Earth Science Education and Outreach Provider Summit
EarthScope National Office
Arizona State University, Tempe, Arizona
February 20-21, 2012



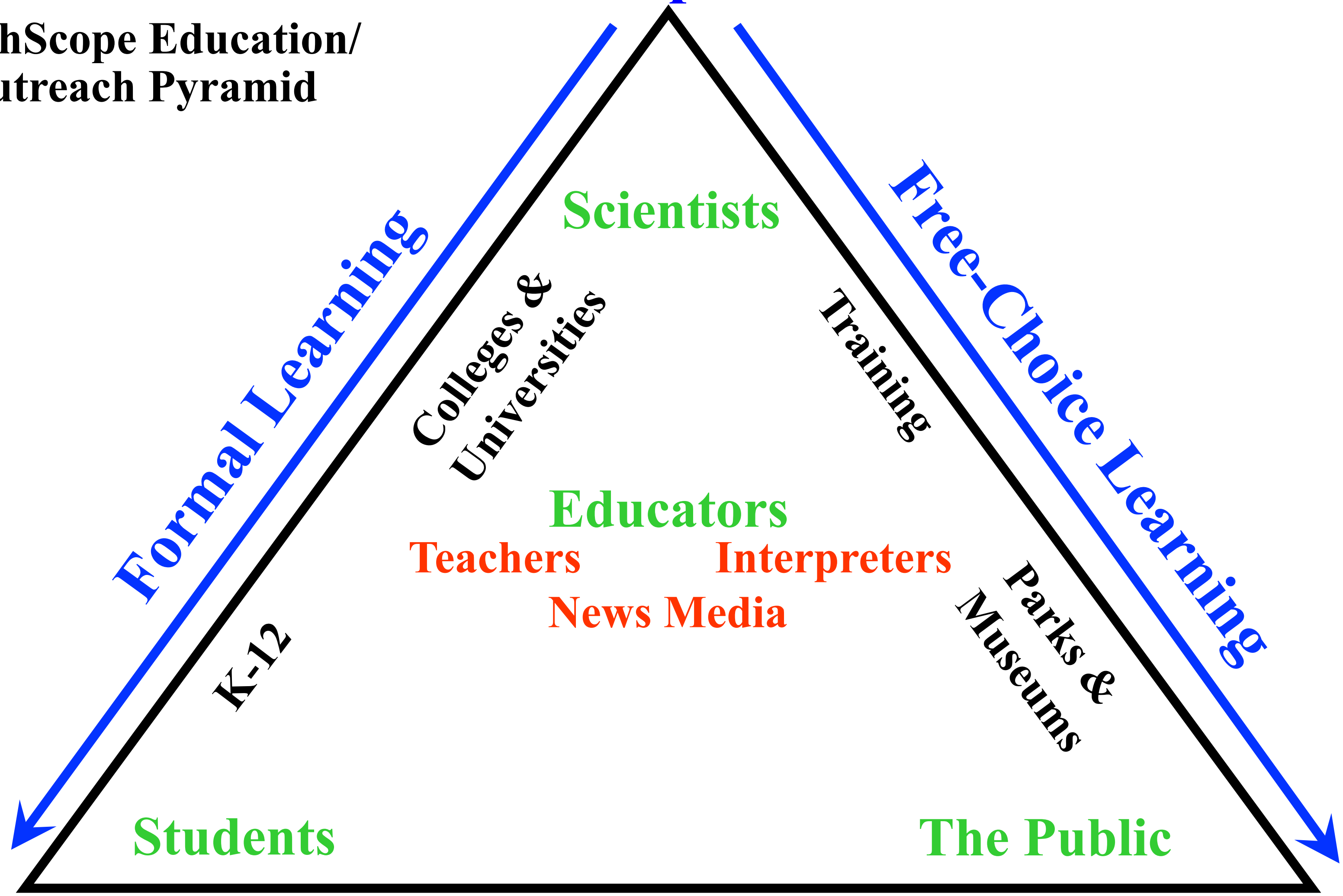
Bob Lillie
Emeritus Professor of Geosciences
Certified Interpretive Trainer
Oregon State University

www.earthscope.org

EarthScope Audiences

EarthScope Education/ Outreach Pyramid

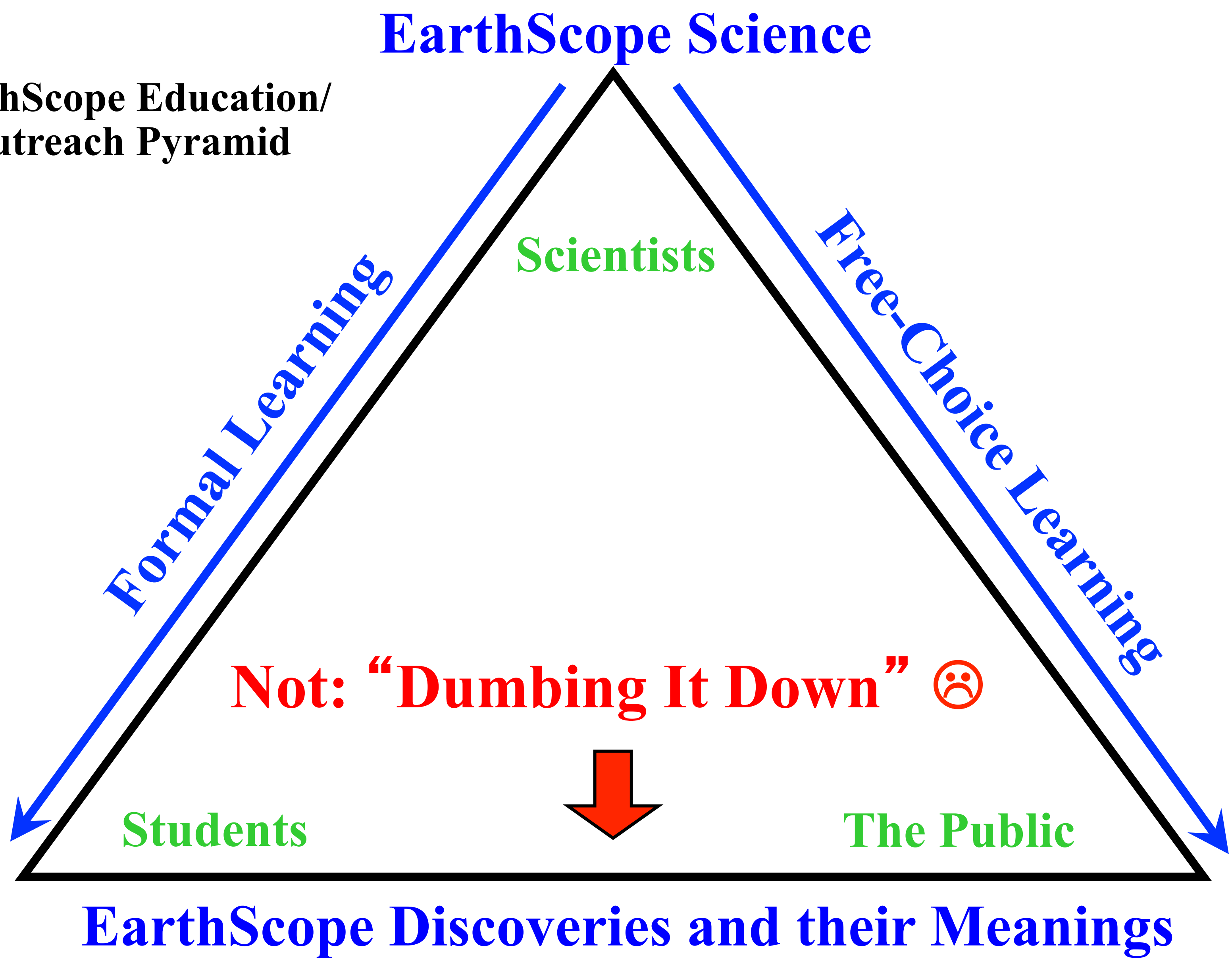
EarthScope Science



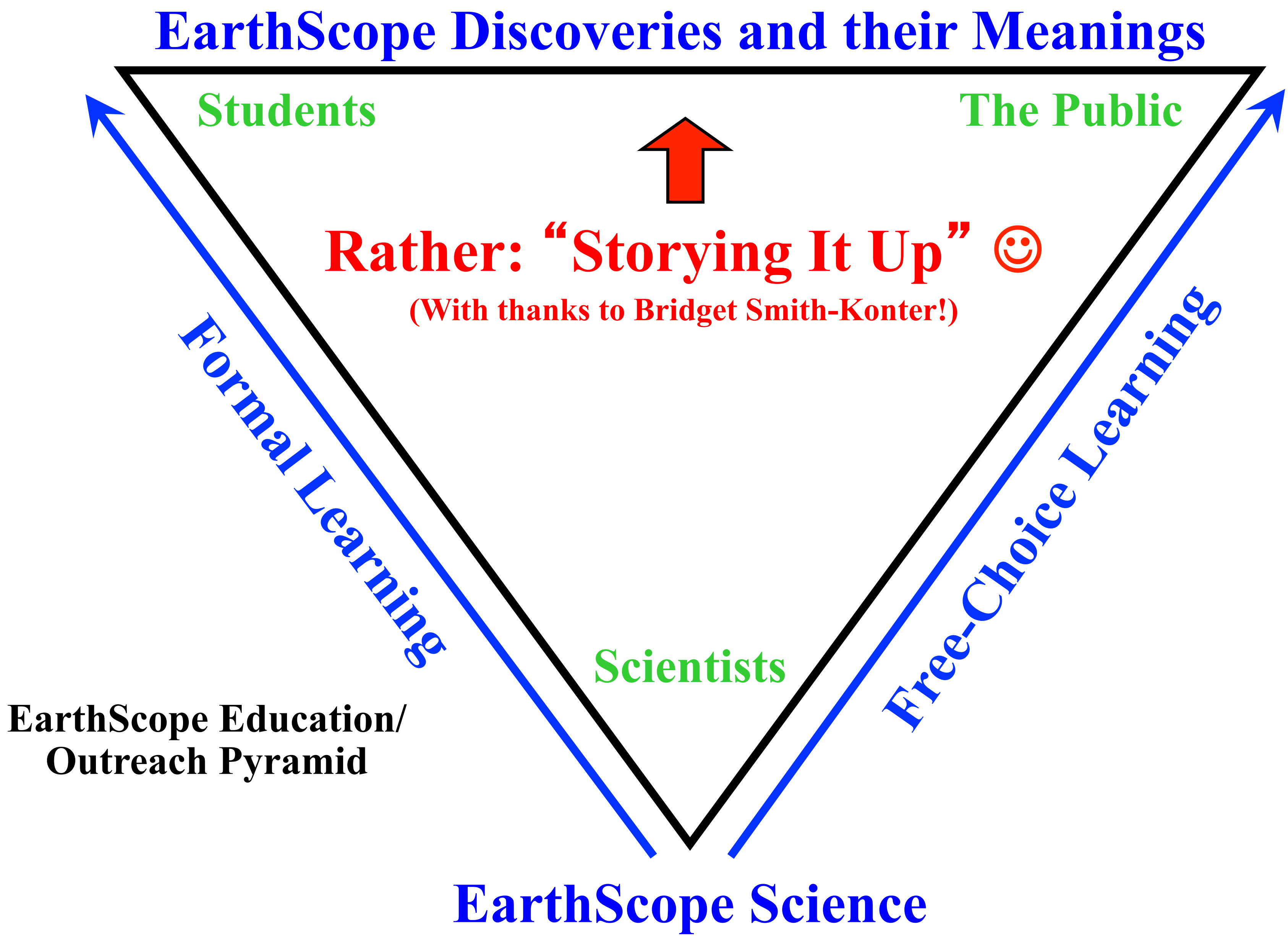
EarthScope Discoveries and their Meanings

EarthScope Audiences

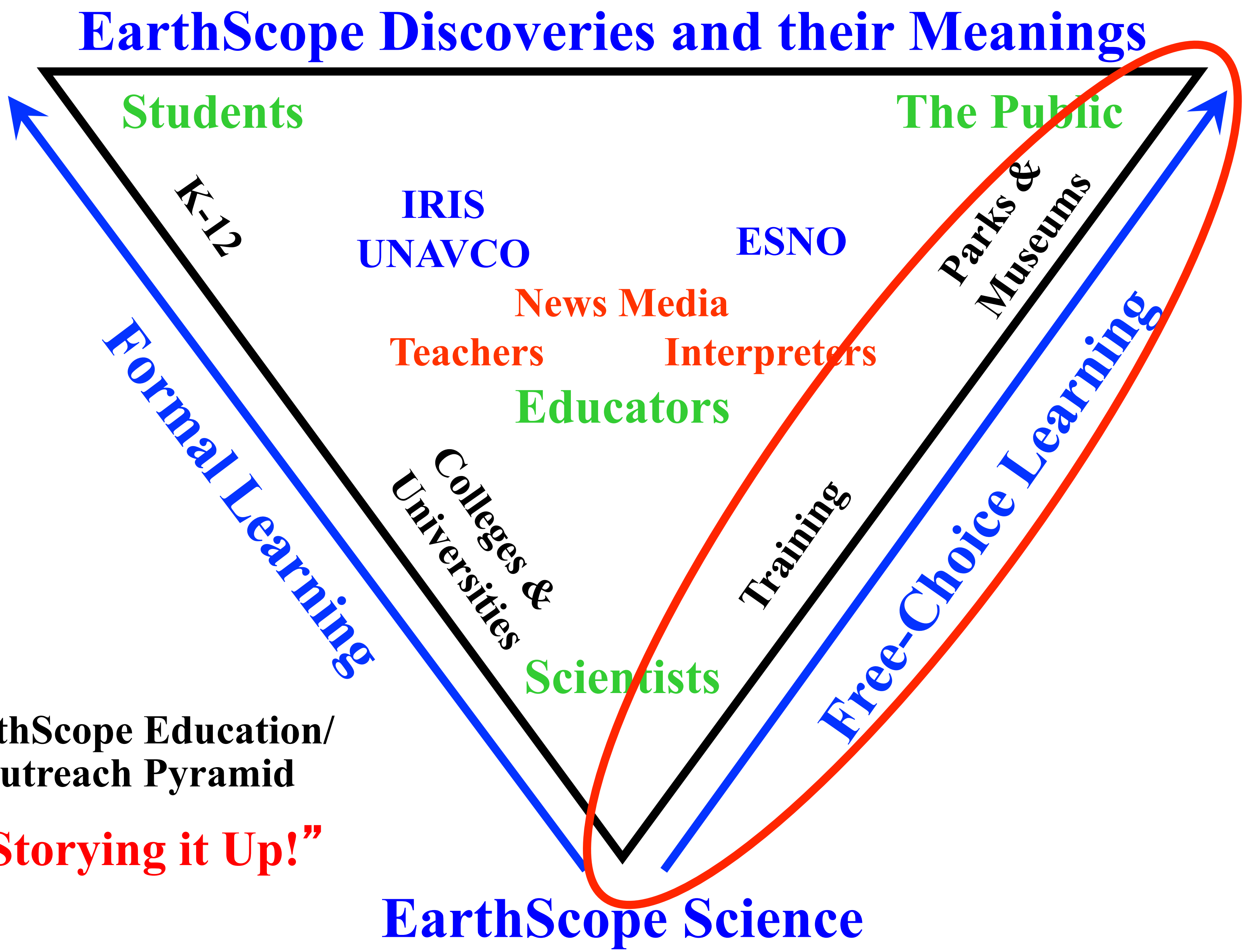
**EarthScope Education/
Outreach Pyramid**



EarthScope Audiences



EarthScope Audiences



EarthScope Education/ Outreach Pyramid

"Storying it Up!"

E&O Web Pages

www.earthscope.org/eno

EarthScope Audiences

Scientists:
- EarthScope Researchers
- Other Earth Scientists
- Scientists from other Disciplines

Educators:
- College/University Faculty
- K-12 Teachers
- Park/Museum Interpreters
- News Media

Students:
- College/Univeristy
- K-12
- Lifelong Learners

The Public:
- Planning/Policy Makers
- Science/Engineering Practicioners
- Park/Museum Visitors
- Land Owners

Red → "Informal Education" or "Free-Choice Learning" Audiences

E&O Implementation Plan Goals (2007)

1. Create high profile **EarthScope identity**.
2. Promote science literacy through **informal education**.
3. Advance **formal education** in the classroom.
4. Foster use of **data, discoveries, technology**.
5. Establish sense of **community ownership**.

Earth Science Literacy Principles

http://www.earthscienceliteracy.org

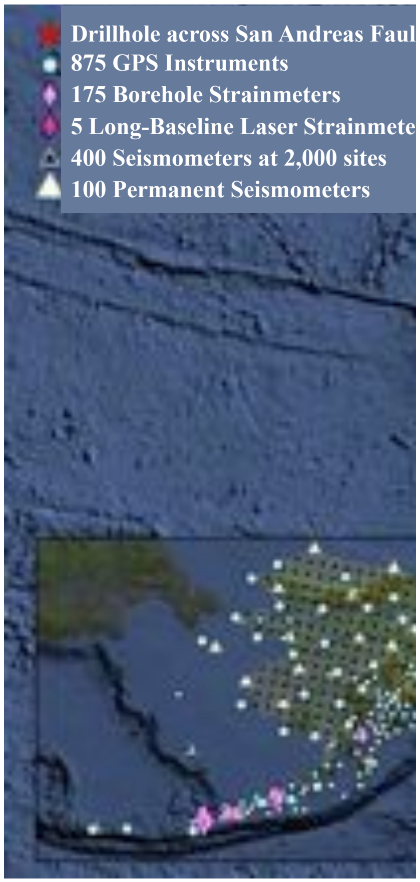
Big Ideas:

1. Earth scientists use repeatable observations and testable ideas to understand and explain our planet.
2. Earth is 4.6 billion years old.
3. Earth is a complex system of interacting rock, water, air, and life.
4. Earth is continuously changing.
5. Earth is the water planet.
6. Life evolves on a dynamic Earth and continuously modifies Earth.
7. Humans depend on Earth for resources.
8. Natural hazards pose risks to humans.
9. Humans significantly alter the Earth.

Informal Education Workshops

For Interpretive Professionals in Parks and Museums

Monitoring the Dynamic Landscape Enhances our “Sense of Place”



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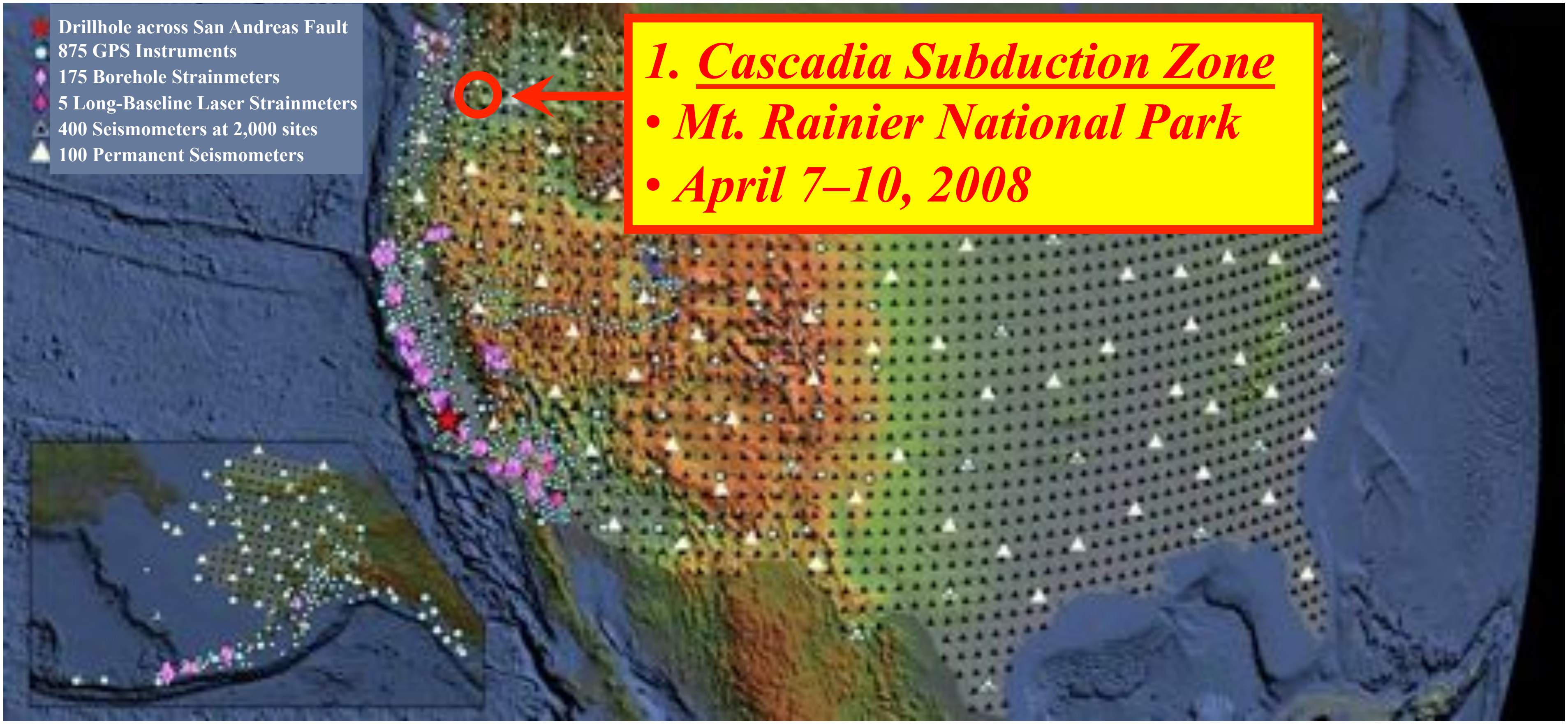
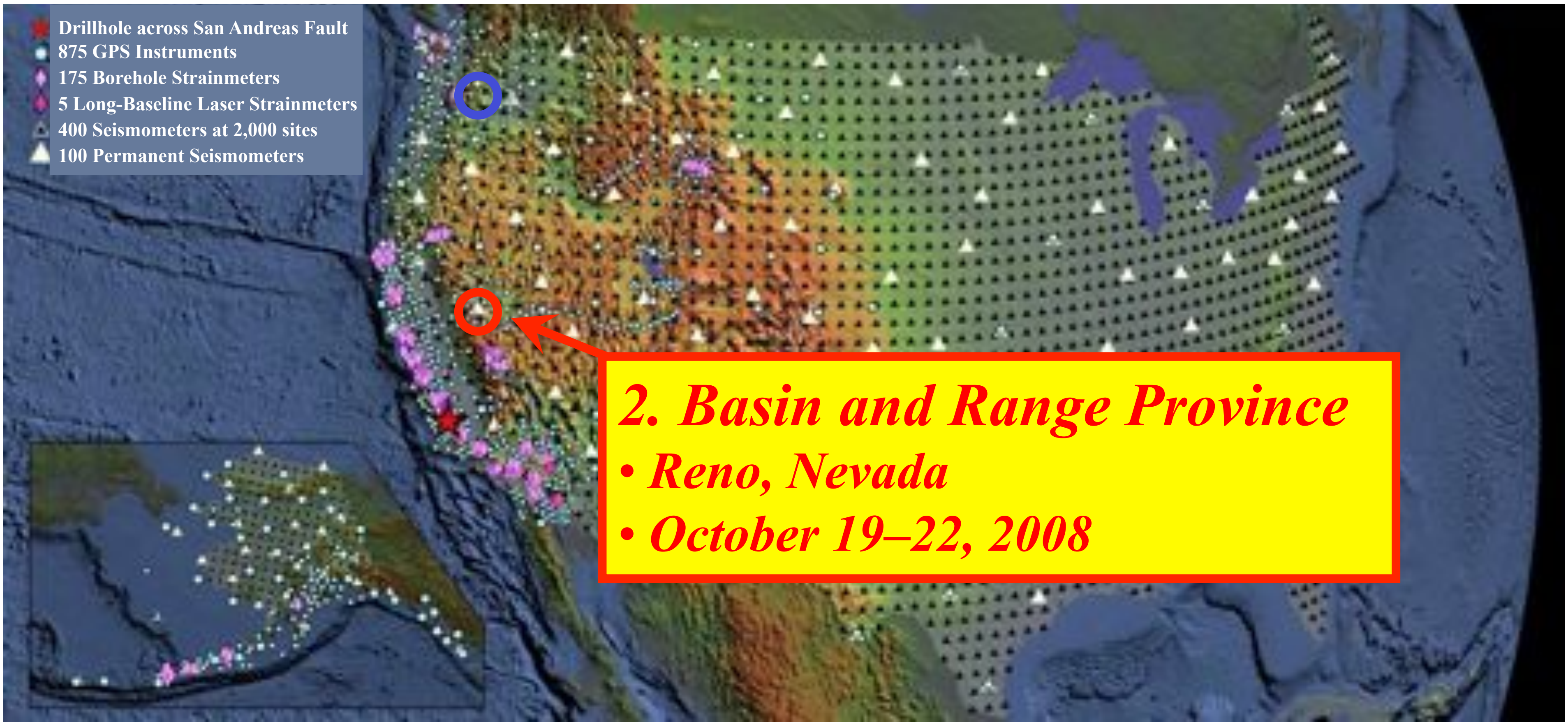


www.earthscope.org/eno/parks

For Interpretive Professionals in Parks and Museums

Monitoring the Dynamic Landscape Enhances our "Sense of Place"



www.earthscope.org/eno/parks

Basin and Range Workshop

University of Nevada – Reno
October, 2008

Plate Boundary Observatory
GPS Station

Slide Mountain, Nevada

Brian Wernicke, Cal Tech

Basin and Range Workshop

University of Nevada – Reno
October, 2008

Plate Boundary Observatory
GPS Station

Slide Mountain, Nevada

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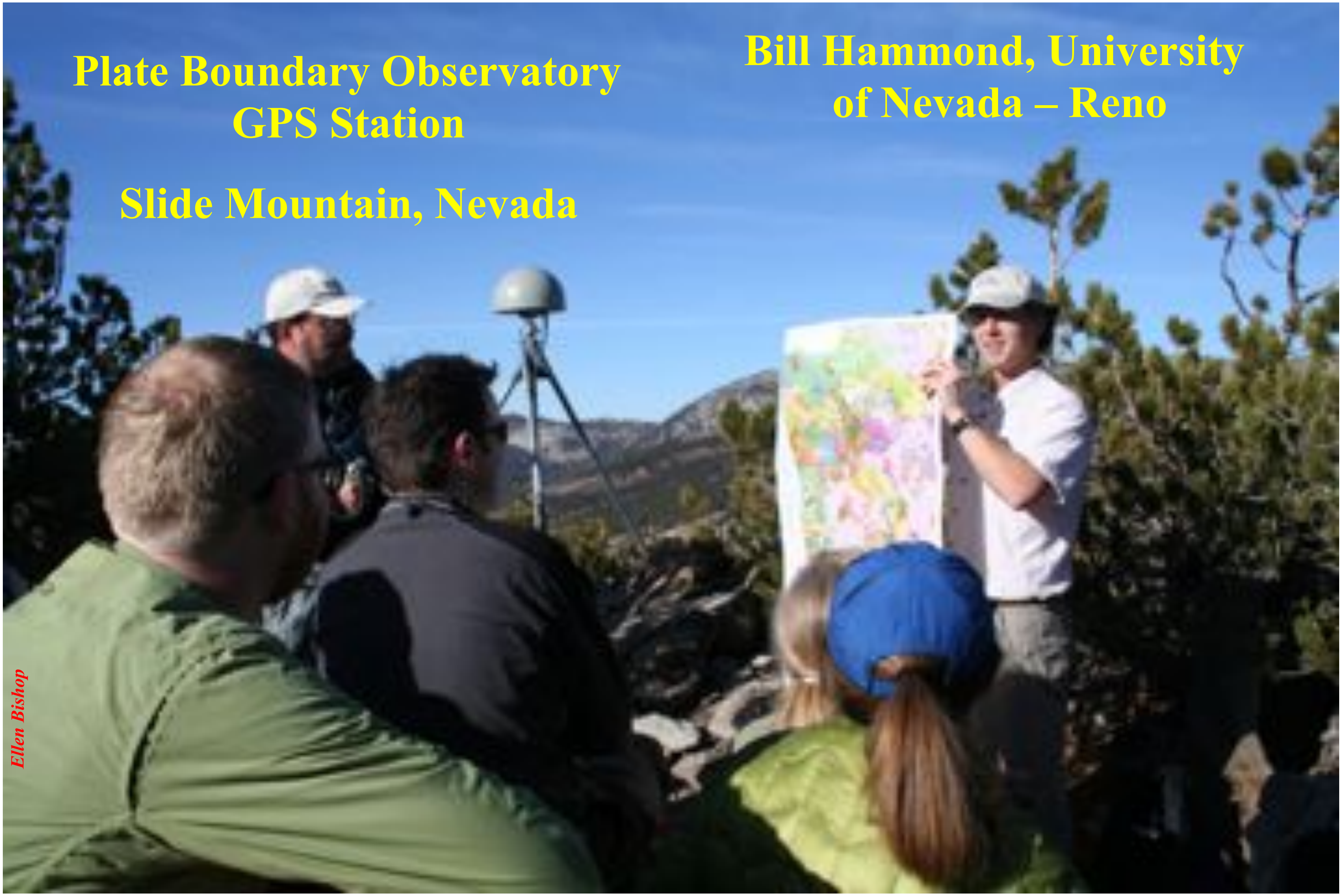


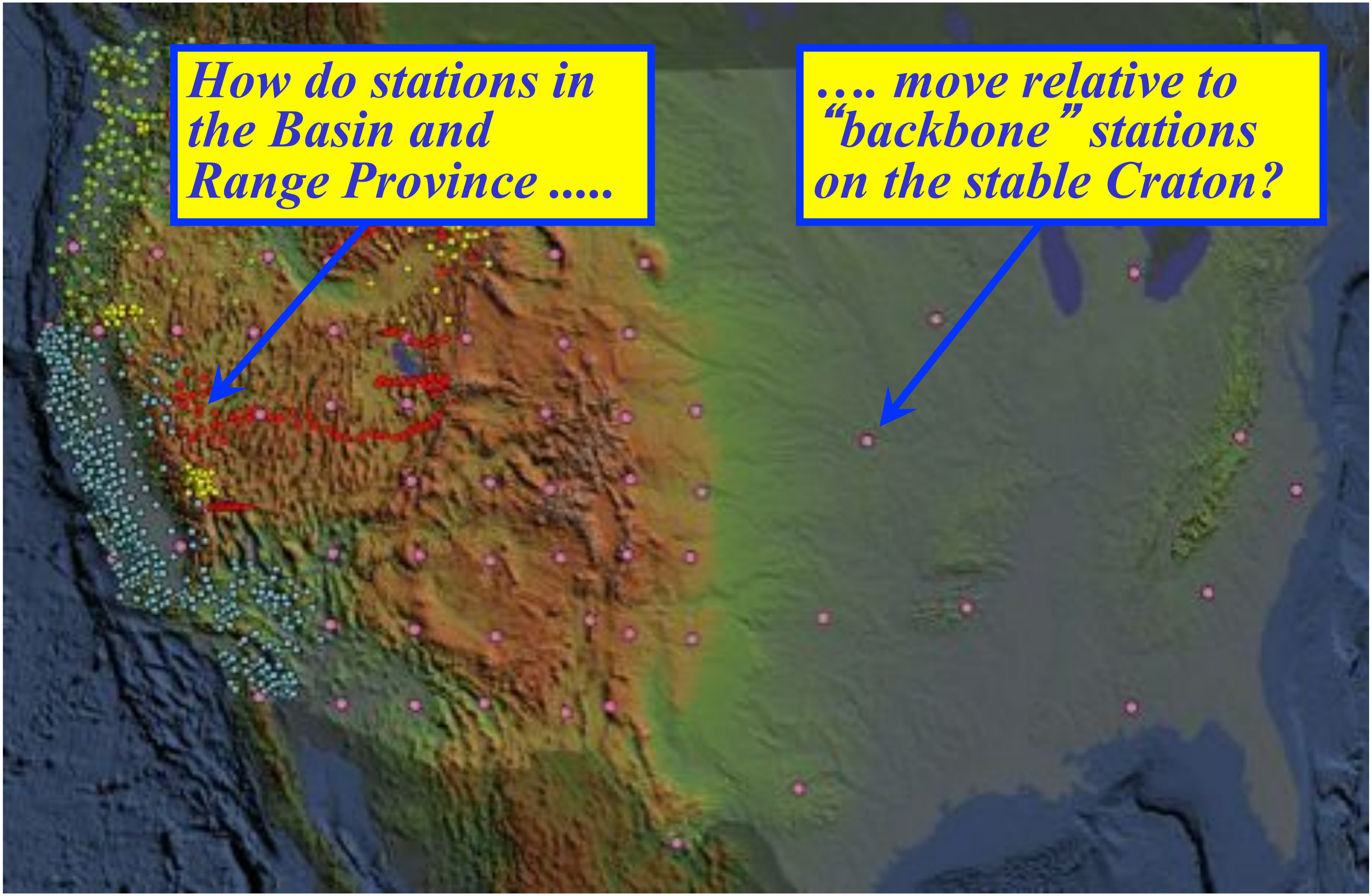
EarthScope Workshop for Interpretive Professionals
in the Basin and Range Province, 2008

EarthScope Workshop for Interpretive Professionals in the Basin and Range Province, 2008

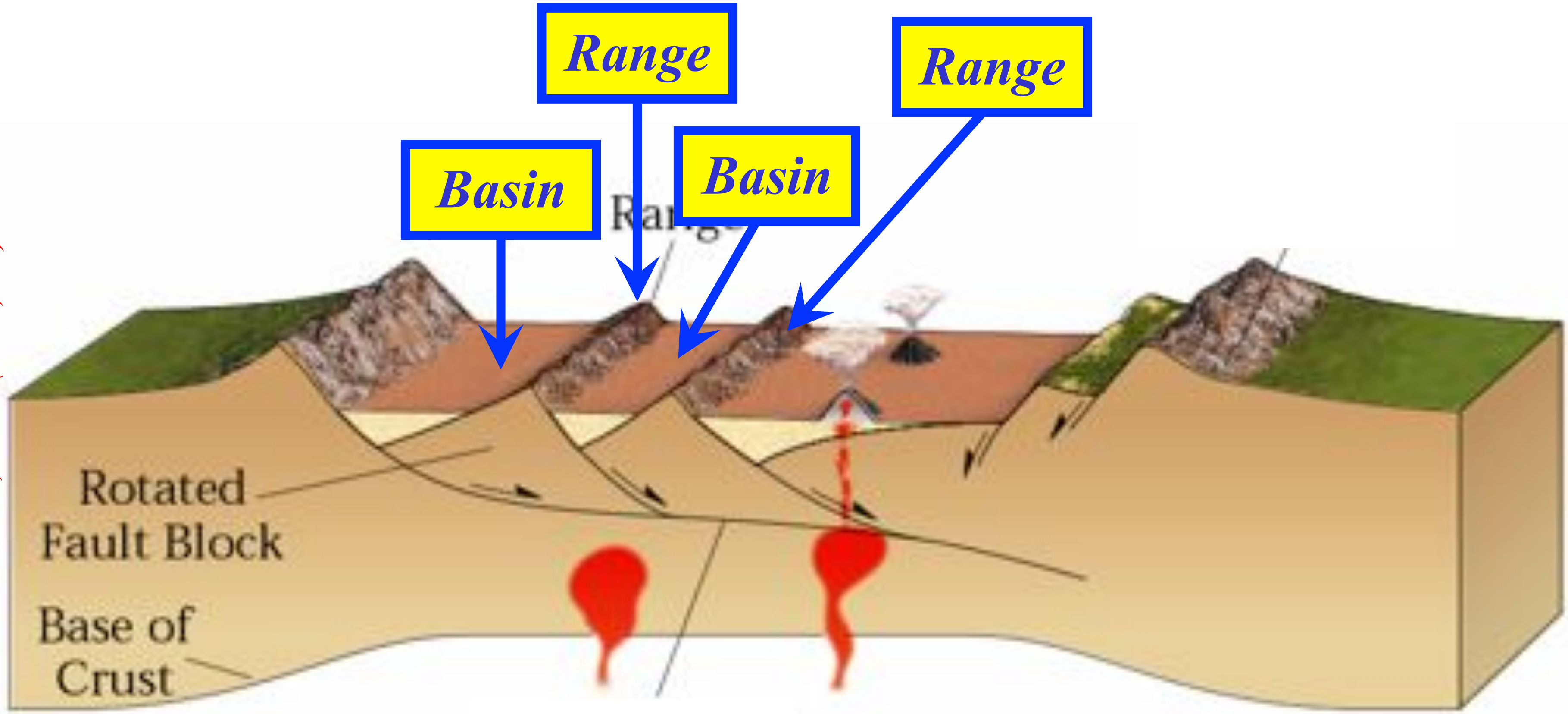
EarthScope Workshop for Interpretive Professionals
in the Basin and Range Province, 2008

EarthScope GPS Stations

Backbone Network
Subduction Cluster
Volcanic Cluster
Transform Cluster
Extension Cluster



BASIN AND RANGE PROVINCE



Marshak, EARTH (Norton, 2005)

Interpretive Presentation:
Basin – Range Tectonic Development

EarthScope Workshop for Interpretive Professionals
in the Basin and Range Province, 2008

EarthScope Workshop for Interpretive Professionals
in the Basin and Range Province, 2008

EarthScope Workshop for Interpretive Professionals in the Basin and Range Province, 2008

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in the Basin and Range Province, 2008

For Interpretive Professionals in Parks and Museums

www.earthscope.org/eno/parks

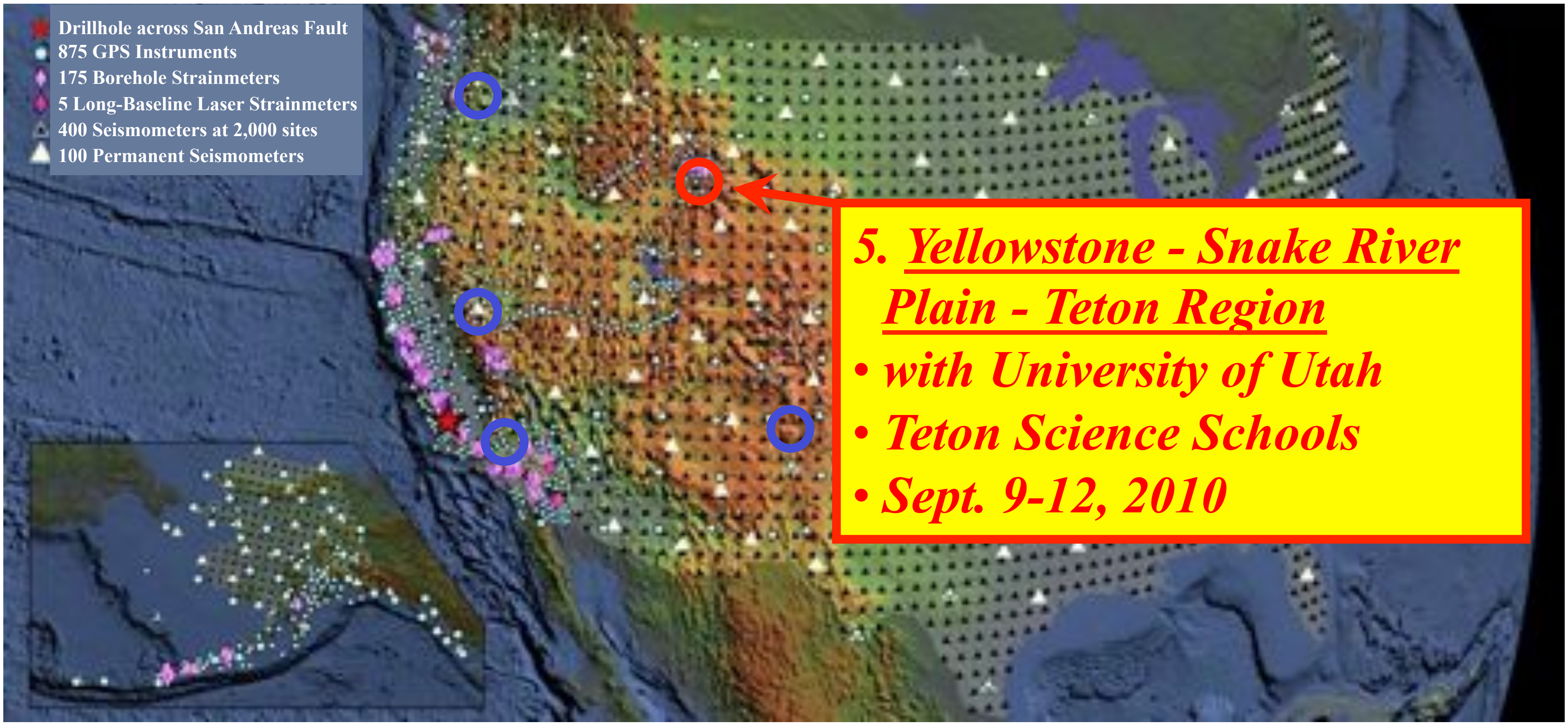
Informal Education Workshops

For Interpretive Professionals in Parks and Museums

www.earthscope.org/eno/parks

Informal Education Workshops

For Interpretive Professionals in Parks and Museums



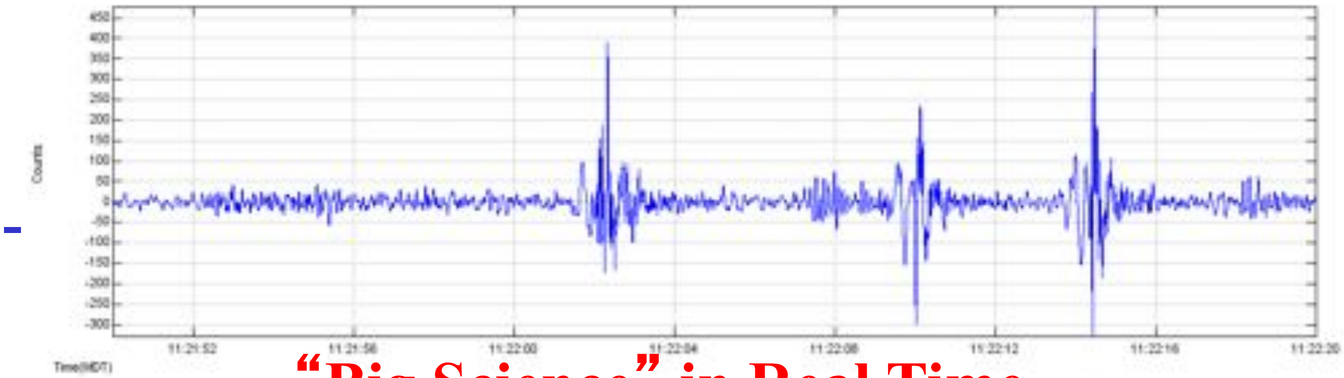
www.earthscope.org/eno/parks

EarthScope Yellowstone - Snake River Plain - Teton Interpretive Workshop

Field Trip to EarthScope Seismic, GPS, and Strainmeter Site in Yellowstone National Park

September 10, 2010

EarthScope Yellowstone - Snake River Plain - Teton Interpretive Workshop



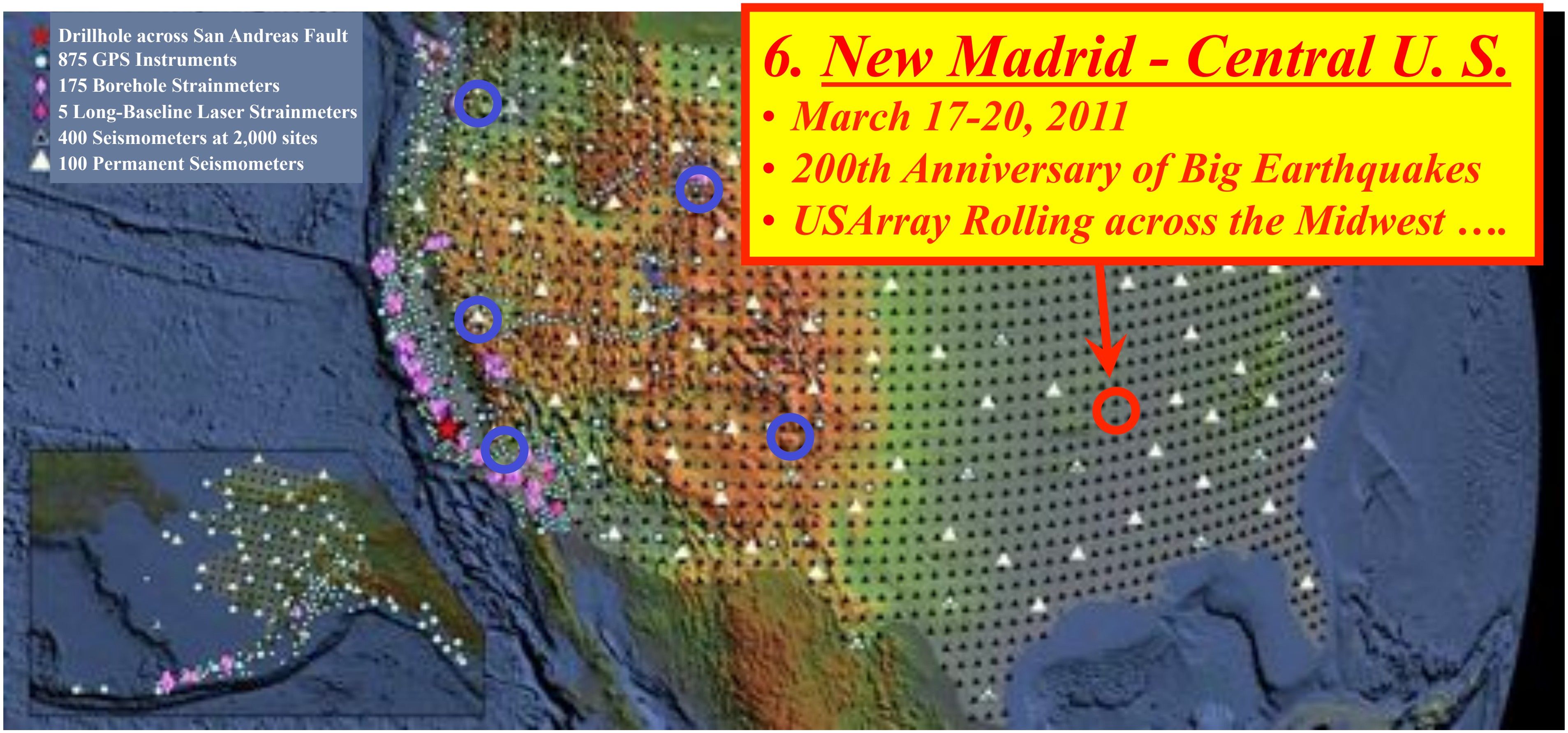
"Big Science" in Real Time ……

Field Trip to EarthScope Seismic, GPS, and Strainmeter Site in Yellowstone National Park

September 10, 2010

Informal Education Workshops

For Interpretive Professionals in Parks and Museums

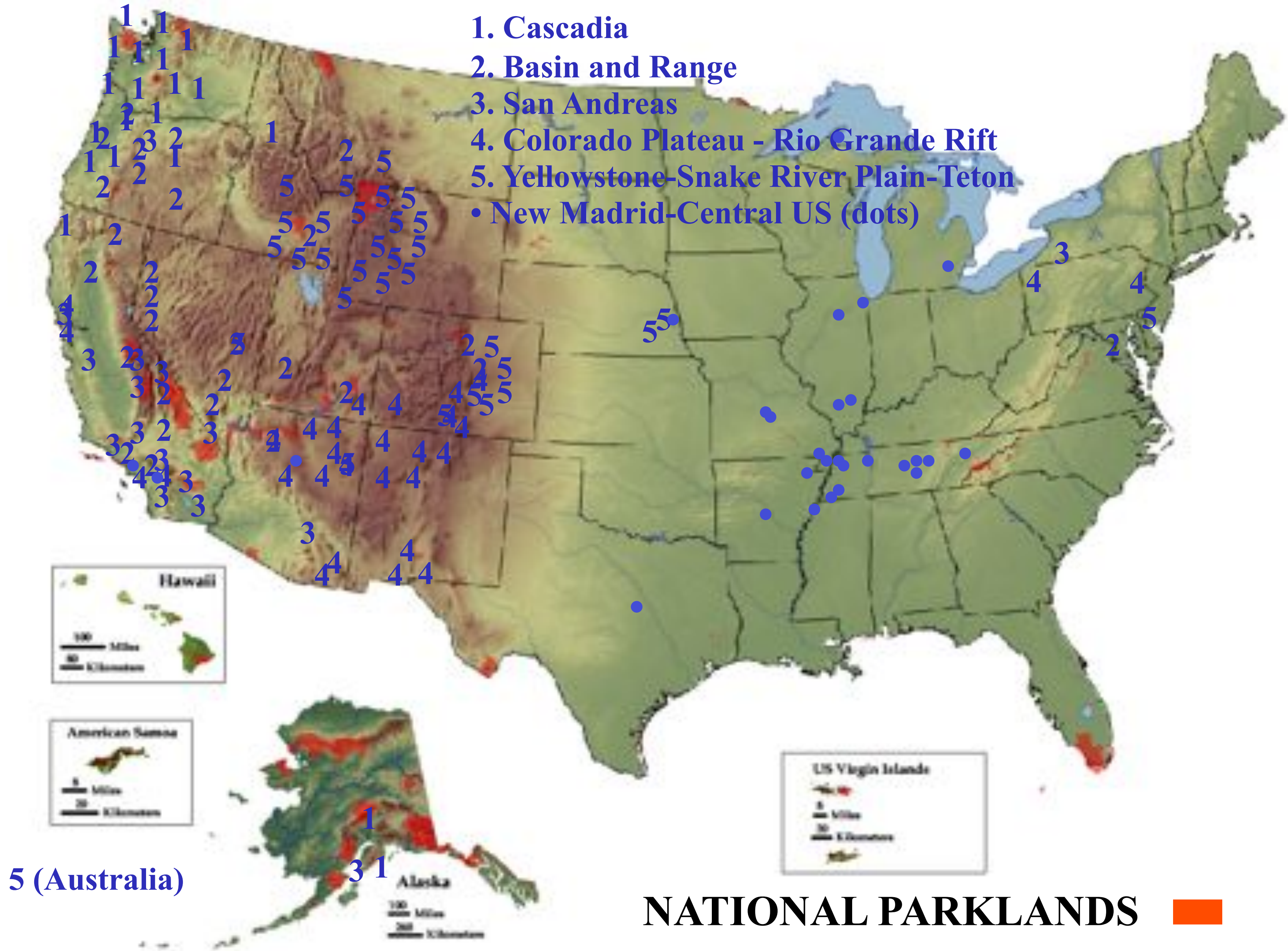


6. New Madrid - Central U. S.

- *March 17-20, 2011*
- *200th Anniversary of Big Earthquakes*
- *USArray Rolling across the Midwest ….*

www.earthscope.org/eno/parks

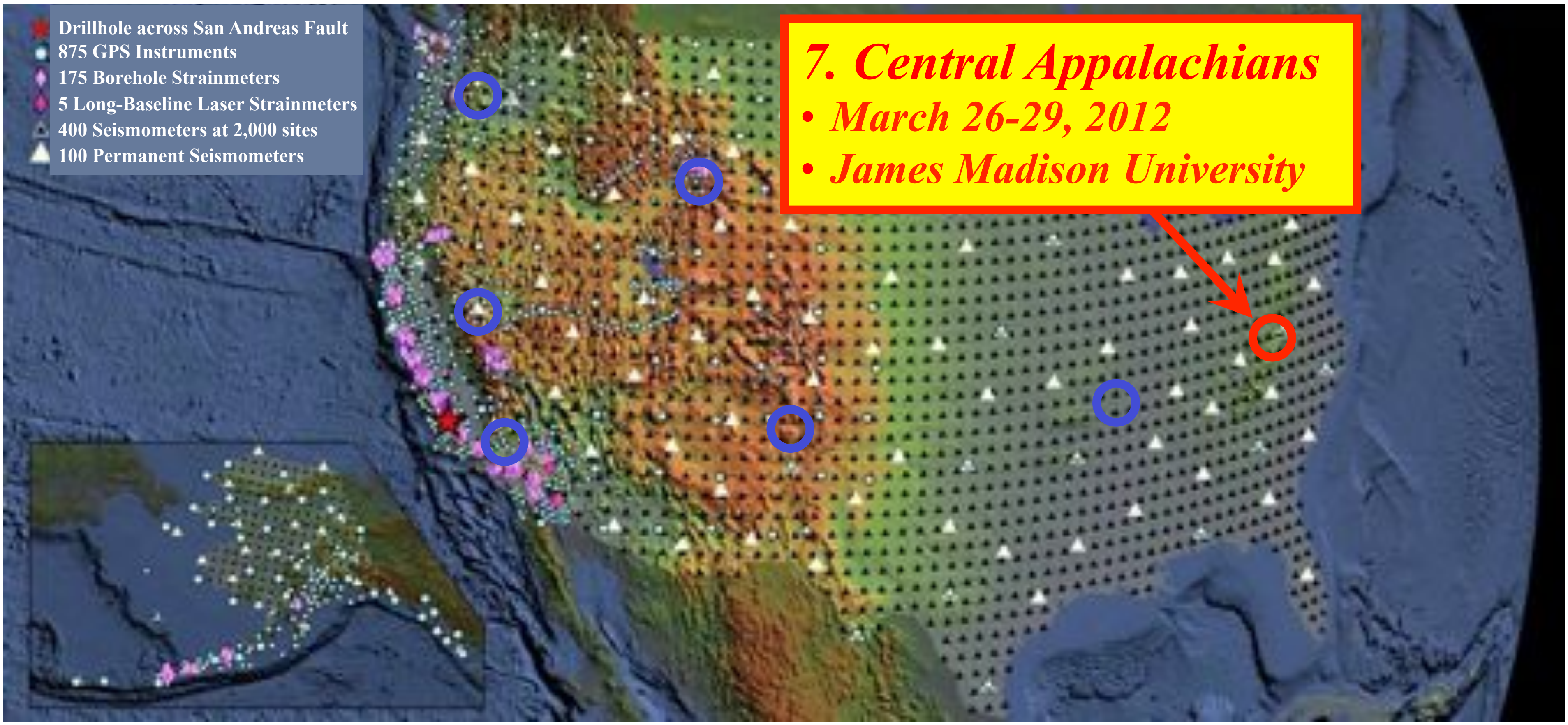
Interpretive Workshop Participants



Informal Education Workshops

For Interpretive Professionals in Parks and Museums

Future Workshops?



www.earthscope.org/eno/parks

Earthquake and Tsunami Education Program for Coastal Cascadia

Stakeholders Meeting

June 21, 2011

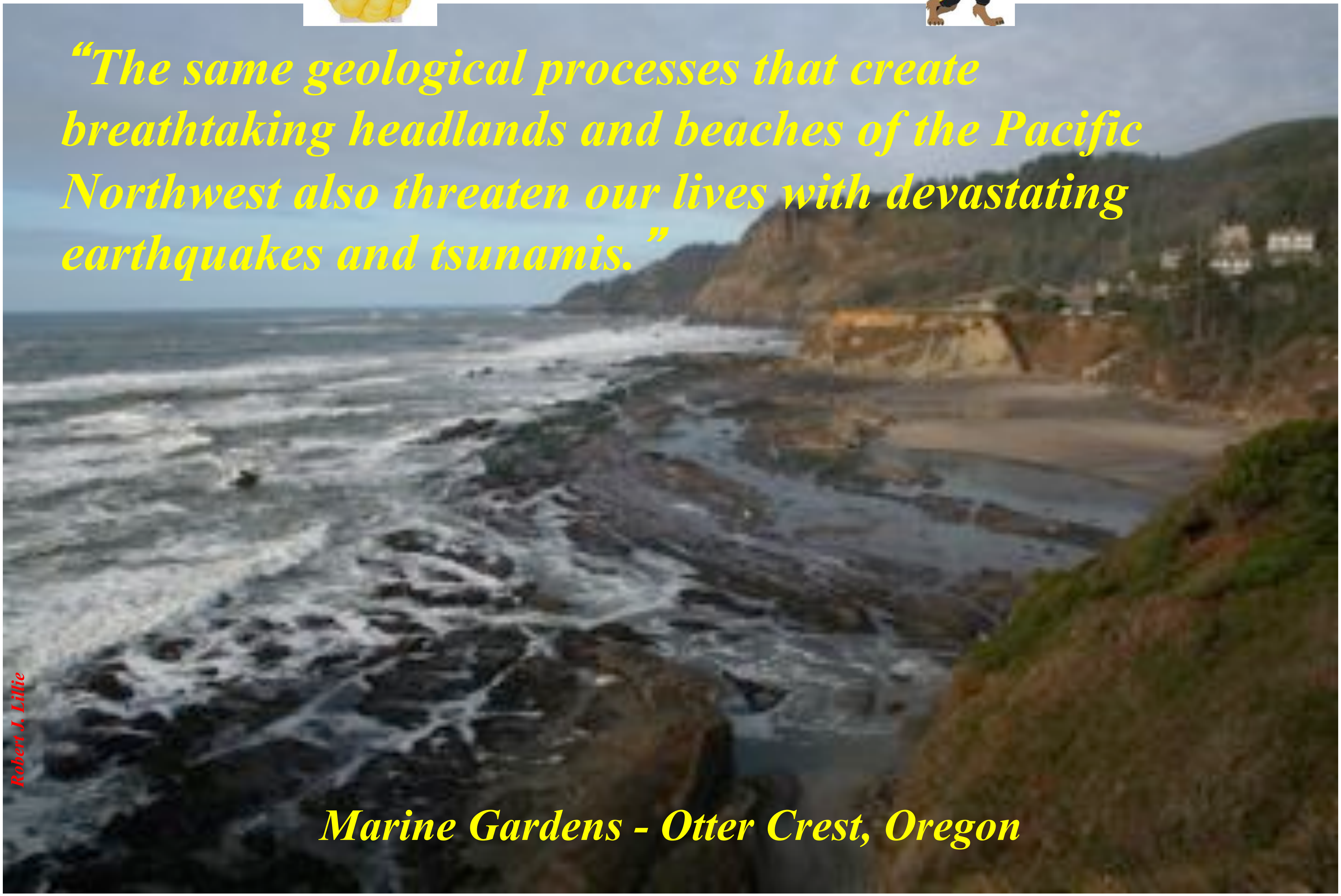
Hatfield Marine Science Center, Newport, Oregon

Teachers on the Leading Edge

www.earthscope.org

http://orgs.up.edu/totle/

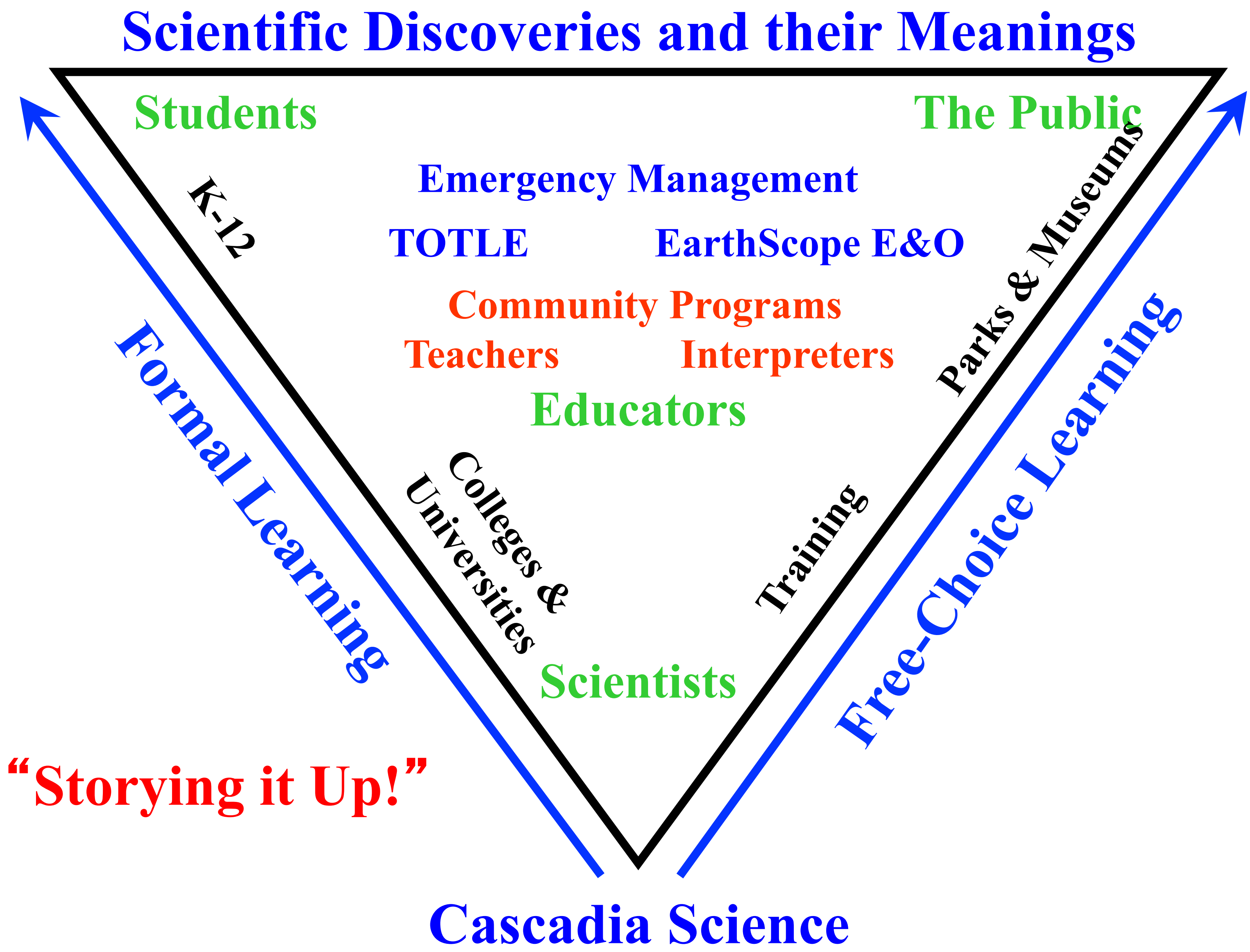
Beauty and the Beast



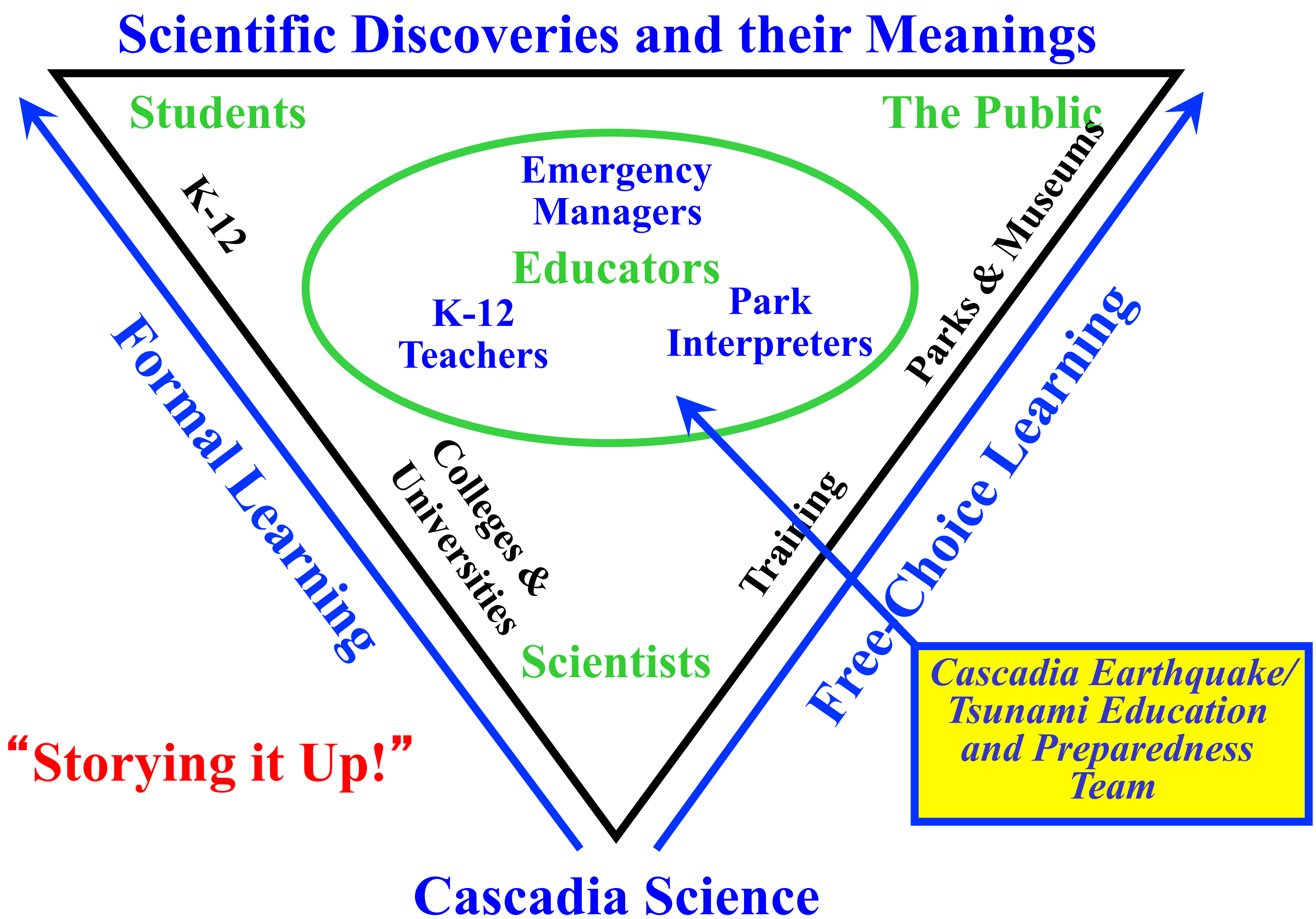
"The same geological processes that create breathtaking headlands and beaches of the Pacific Northwest also threaten our lives with devastating earthquakes and tsunamis."

Marine Gardens - Otter Crest, Oregon

Coastal Cascadia
Earthquake and Tsunami Education and Preparedness



Coastal Cascadia
Earthquake and Tsunami Education and Preparedness



Geo PRISMS

Geodynamic Processes at Rifting and Subducting Margins

GeoPRISMS Education and Outreach Programs

NSF

GeoPRISMS is the legacy of the NSF MARGINS Program. It is a decadal program, funded by NSF, committed to the amphibious study of the origin and evolution of continental margins through interdisciplinary, community-based investigations.

GEOPRISMS: MARGINS SUCCESSOR PROGRAM

Geodynamic Processes at Rifting and Subducting Margins

MARGINS E&O Review

- MEAC: **M**ARGINS **E**ducation **A**dvisory **C**ommittee
  - Successor: GEAC (**G**eoPRISMS …)
- DLP: Distinguished Lectureship Program
  - Continued without interruption into GeoPRISMS
- MARGINS Mini-Lessons
  - Retained under GeoPRISMS
- MARGINS Website
  - GeoPRISMS Successor Website
  - MARGINS website retained as archival resource
- MARGINS Postdoc Program
  - Continued without interruption into GeoPRISMS
- MARGINS AGU Townhall and Student Prize
  - Continued without interruption into GeoPRISMS
- MARGINS Newsletter
  - Continued without interruption into GeoPRISMS

Geodynamic Processes at Rifting and Subducting Margins

GeoPRISMS E&O Mandate

- MSPW and Science Plan set out E&O Goals:
- Continuation of:
  - DLP, Program Website, Mini-Lessons, Postdocs, Newsletter, AGU Student Prize and Townhall Forum
- New and Expanded Programs:
  - REU/TUES proposals
  - Student Symposia
  - Social Media

Geo PRISMS Geodynamic Processes at Rifting and Subducting Margins

GEOPRISMS EDUCATION AND OUTREACH RESOURCES

Geodynamic Processes at Rifting and Subducting Margins

Distinguished Lectureship Program

- Sends GeoPRISMS researchers to speak about their GeoPRISMS-related research at colleges and universities in the United States
- 398 institutions applied between 2005-2010

- The DLP is well subscribed and highly successful
- Points of note:
  - GPO pays travel, honorarium; host pays everything else
  - GPO provides a "media kit" of canned slides about the program
  - GPO has no control over what speakers present
- Future plans:
  - Expand DLP to include large museums and similar institutions
  - Possible international expansion of program

PRISMS Subducting Margins

GeoPRISMS Newsletter

- Wide circulation (over 1500 geoscientists)
- Mixture of articles…
  - Scientific articles
  - Workshop & project reports
  - News: AGU events, DLP speakers, funded projects
  - Interest pieces: field blogs, postdoc bios, &ct.
- Available in print or online!

Geodynamic Processes at Rifting and Subducting Margins

AGU Townhall and Prize

- GeoPRISMS holds annual townhall meeting
  - Students invited to show their posters
  - Remarks from invited guests, NSF, and GPO
- AGU Student Prize
  - Students enter their posters and presentations
  - $500 first prize for poster and presentation each
  - ≈50 students/year, ≈20 judges
  - 2 winners, ≈4 honorable mentions

Student Symposia

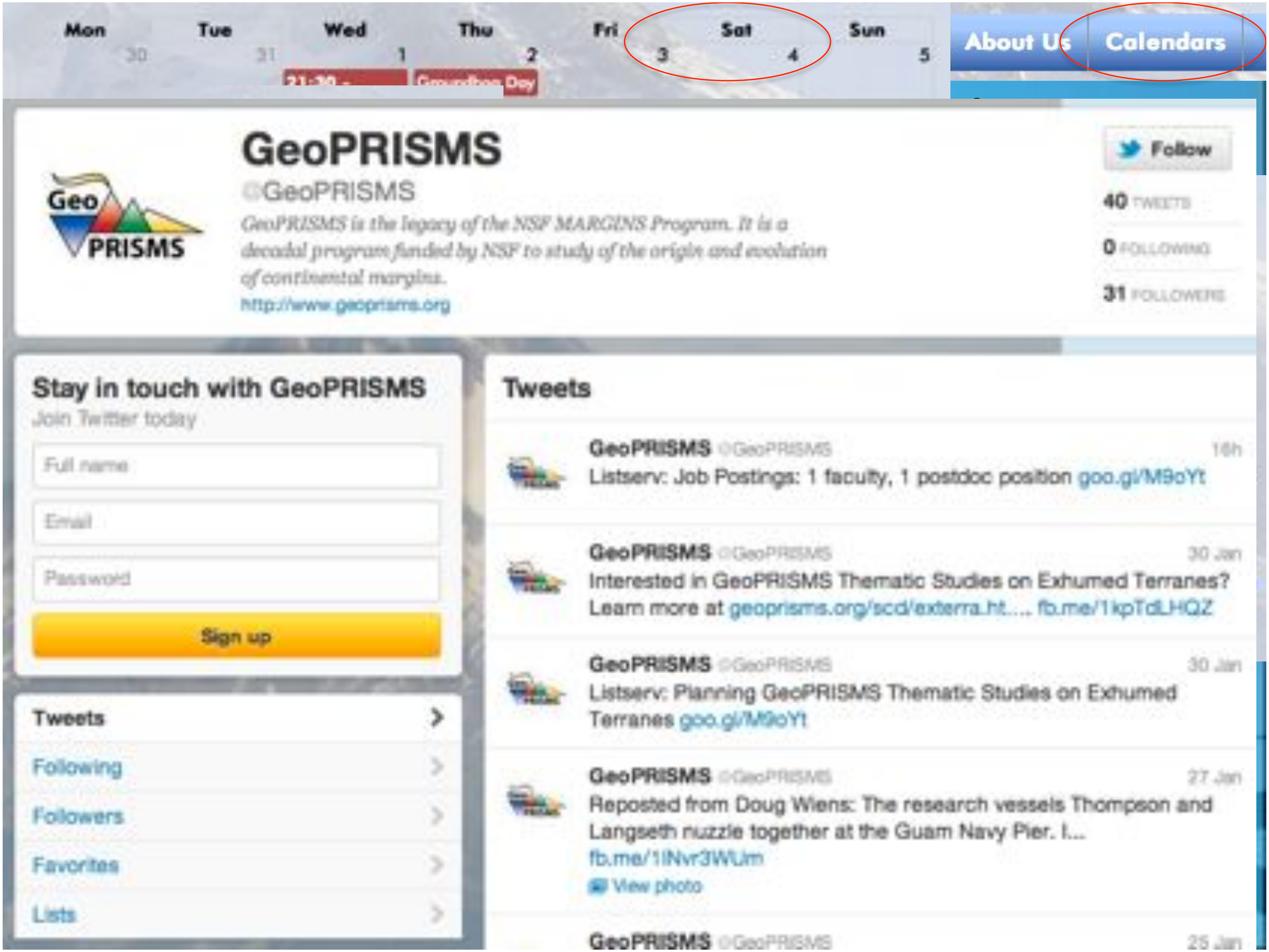
- Day-long student-only events before recent and upcoming workshops
  – Alaska, ENAM, soon Cascadia
- Typical symposium agenda:
  – Talks on GeoPRISMS and relevant background for the workshop
  – Mini poster sessions or presentations
  – Half-day field trip
- Workshop activities:
  – Students serve as recorders for breakouts
  – Students present near end of workshop

Geo PRISMS Geodynamic Processes at Rifting and Subducting Margins

Mini-Lessons

- MARGINS mini-lessons are available from SERC
  - linked from both the MARGINS and GeoPRISMS websites
  - Developed under CCLI (now TUES)
- New mini-lessons should be produced as GeoPRISMS research beings to yield results
- TUES proposal: create unified geoscience curricula from the mini-lessons
  - Proposal ranked highly but not yet funded
  - Will be resubmitted (if needed)
  - This program would be overseen by the E&O coordinator

GeoPRISMS Geodynamic Processes at Rifting and Subducting Margins


Mon 30
Tue 31
Wed 1
Thu 2
Fri 3
Sat 4
Sun 5
Groundhog Day
About Us
Calendars
GeoPRISMS
@GeoPRISMS
GeoPRISMS is the legacy of the NSF MARGINS Program. It is a decadal program funded by NSF to study of the origin and evolution of continental margins.
http://www.geoprisms.org
Follow
40 TWEETS
0 FOLLOWING
31 FOLLOWERS
Stay in touch with GeoPRISMS
Join Twitter today
Full name
Email
Password
Sign up
Tweets
Following
Followers
Favorites
Lists
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GeoPRISMS @GeoPRISMS 16h
Listserv: Job Postings: 1 faculty, 1 postdoc position goo.gl/M9oYt
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Interested in GeoPRISMS Thematic Studies on Exhumed Terranes? Learn more at geoprisms.org/scd/exterra.ht.... fb.me/1kpTdLHQZ
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Listserv: Planning GeoPRISMS Thematic Studies on Exhumed Terranes goo.gl/M9oYt
GeoPRISMS @GeoPRISMS 27 Jan
Reposted from Doug Wiens: The research vessels Thompson and Langseth nuzzle together at the Guam Navy Pier. I...
fb.me/1INvr3WUm
View photo
GeoPRISMS @GeoPRISMS 25 Jan

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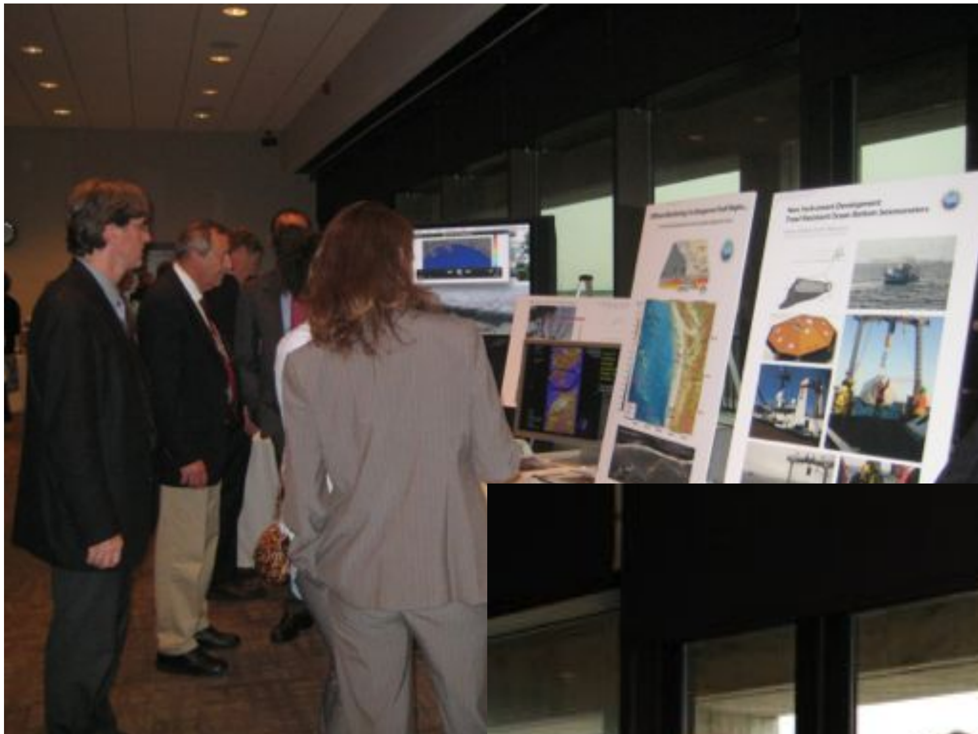


- GeoPRIS
  - Cascad
  - Present
    hazards

GEOPRISMS EDUCATION AND OUTREACH: THE PATH FORWARD

Geo PRISMS Geodynamic Processes at Rifting and Subducting Margins

REU Program

- REU proposal submitted summer of 2011
  - Proposed an distributed-model REU with a week-long orientation at a central location (likely Rice)
  - REU participants then travel to REU PI's institutions for summer-long experience
  - Emphasis on cohort-building and staying in touch via video conferencing and social media
- Proposal ranked highly but was not funded
- Intend to resubmit
- GeoPRISMS in keenly interested in coordinating with other REU programs

Geodynamic Processes at Rifting and Subducting Margins

Website Improvements

- New website CMS recently came on-line
  - Allows for new features, finer control of content
- Website offerings (current):
  - Discussion forum
  - Image gallery, media kit
- Possible website expansion plans:
  - Student/postdoc/early career area of website
  - Database of researchers and student opportunities
  - Presentation archive, “science bites”
  - Graphical interface

GeoPRISMS Geodynamic Processes at Rifting and Subducting Margins

What can GeoPRISMS …

Do for you?

- Alliances with other websites for presenting multi-program content:
  - Mini-Lessons are an example, hosted at SERC and linked by GeoPRISMS and MARGINS
  - Cascadia is another example in development: will be shared between GPO, ESNO, and CIET
- Coordinating social media efforts and student outreach
- Can GeoPRISMS contribute to other program's success, and how?

Learn from you?

- Complement other programs without duplicating content
- Best approach to social media?
- How can we expand the audience for all our E&O products?
- Ideas from this summit!

Geo PRISMS Geodynamic Processes at Rifting and Subducting Margins

IRIS Education and Public Outreach Program Overview

John Taber, Director of Education and Public Outreach
Perle Dorr, Public Outreach Manager

Facilitate – Collaborate – Educate

IRIS

Overview

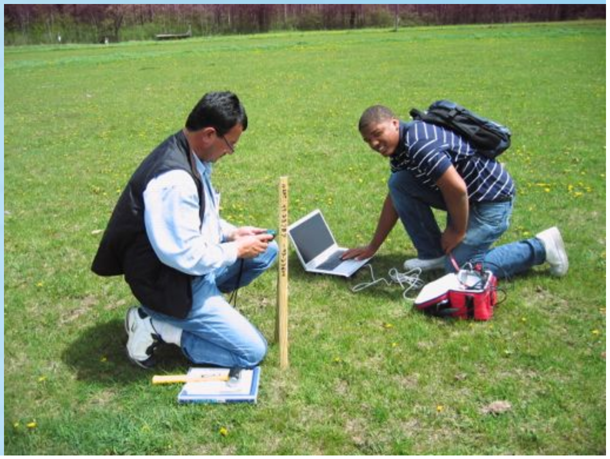
- Goals and Guiding Principles
- IRIS and EarthScope activities arranged by audience
    - Undergraduate
    - Graduate and professional
    - Middle school/high school
    - General public

IRIS EPO Strategic Plan Goals

- Improve Seismology Education
- Expand Earth Science awareness
- Support IRIS Consortium members
- Enhance IRIS Visibility
- Expand and diversify the Earth Sciences workforce
- Strengthen the EPO Program

USArray Siting Outreach Strategies

– Engaging faculty and students in USArray
  - Participating in siting process
  - Publicizing their involvement locally and nationally
– Expanding public awareness of EarthScope
  - Providing products for educational and general public use
– Providing a legacy after USArray leaves
– Closely coordinating with EarthScope partners (eg. EarthScope National Office, PBO)



IRIS EPO Guiding Principles

- Provide targeted products and services for a range of audiences
  - grades 6-12 students and teachers, college students and faculty, researchers, and the public.
- Emphasize seismology and the use of seismic data
  - Maintain scientific accuracy while employing best educational practices
- Strive for continuous improvement
  - Ongoing internal and external evaluation
- Integrate diversity into all activities

Undergraduate education

- Research Experiences for Undergraduates
  - Encourage more students to choose careers in Earth science
    - 114 undergraduates since 1998
    - 40 Consortium member institutions as hosts
    - 85% of alumni go on to grad school
  - Virtual REU
    - Student community established through 1-week orientation
    - Connection through rest of summer via online communication
  - Minority recruitment lecture series – joint with UNAVCO RESESS program
- Creating labs and exercises for intro and upper level earth science courses
  - CCLI project led by Maggie Benoit, TCNJ
  - Will link with SERC

Engaging students in USArray

Transportable Array siting through 2011

- 114 students
- 47 universities
- Nearly 1170 sites

Process

- Students receive 3.5 days of training
- 2-student teams spend 9 weeks doing site reconnaissance, supervised by local faculty member

National Earthquake Study Comes to Illinois

Student researchers scout farmland for future earthquake-measuring stations

Graduate and professional training

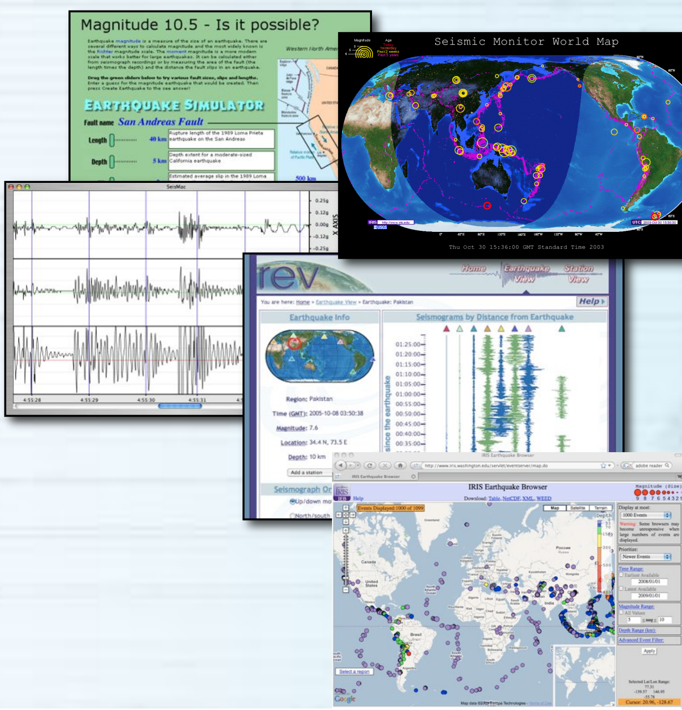
- USArray data processing short courses
  - Advanced graduate student and early career level
  - Goal is for students to develop new processing techniques
- International Development Seismology short courses
- Data Management System training courses
- PASSCAL training courses

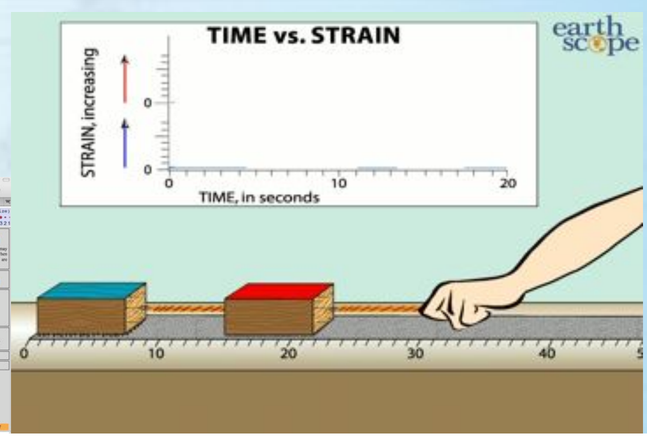
Teacher and College Faculty Professional Development

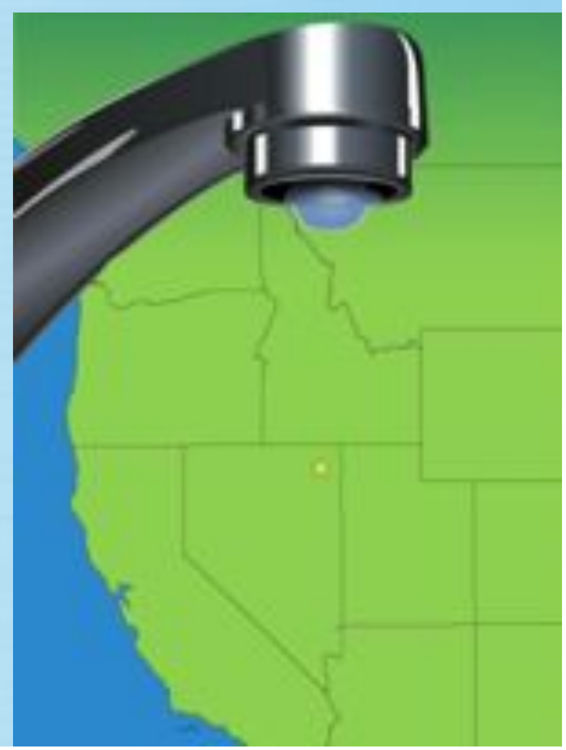
- Improve instructor knowledge and confidence
- In person workshops – 1 hour to 3 days
- Leverage via interactions with other groups
  - Joint UNAVCO/IRIS/ESNO EarthScope teacher workshops
- Can't reach enough instructors with existing methods
  - Focus on online resources
    - Creating a virtual professional environment

Web Resources

- Primary means of distribution of E&O resources
- Activities developed for school and college classroom
- Supported by over 100 animations, visualizations and videos
- Interactive software
- Materials and interactions promoted via Facebook, Youtube, Twitter

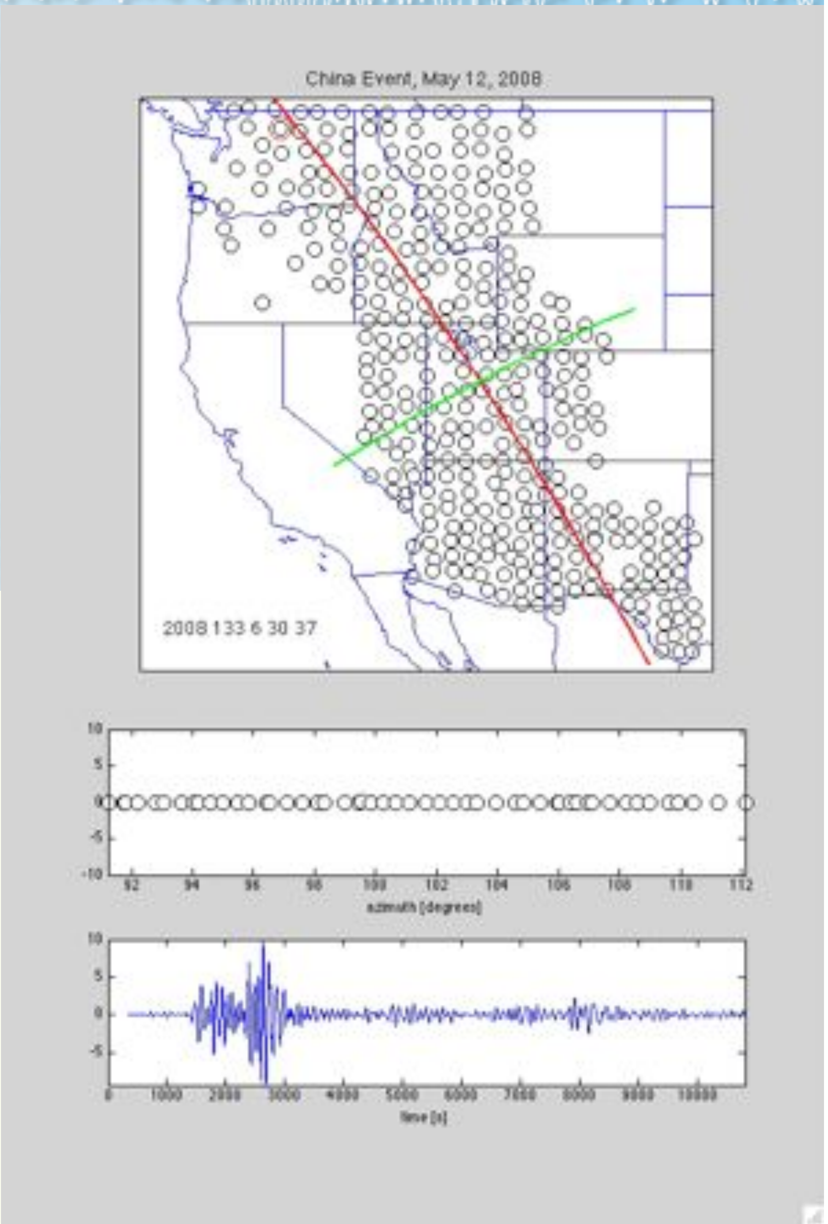


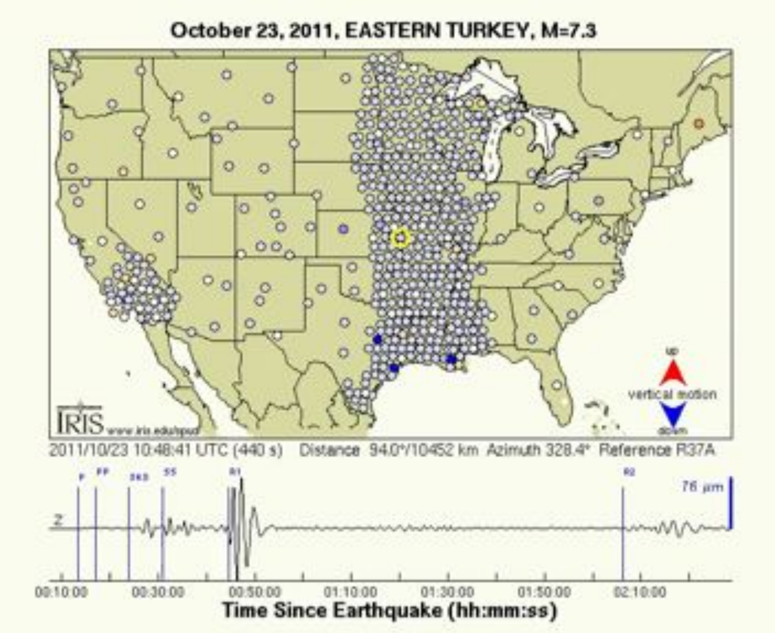




USArray Ground Motion Visualizations

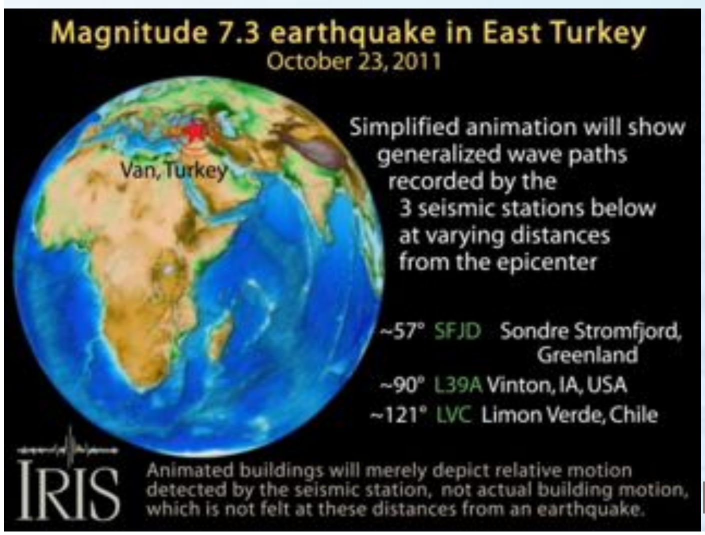
- Now automatically produced at the IRIS Data Management Center
- Specialized versions for some events
- Teaching sequence tutorial on web

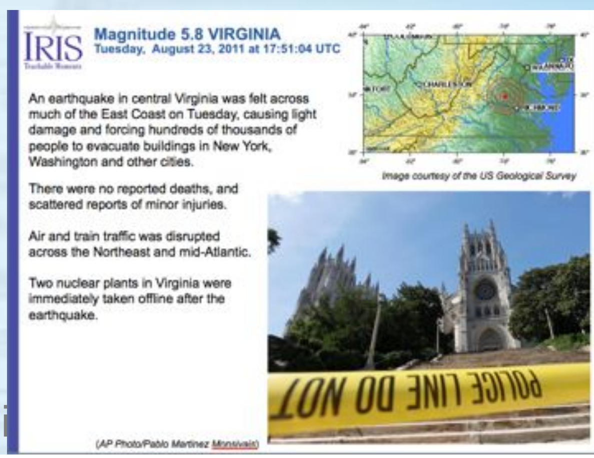


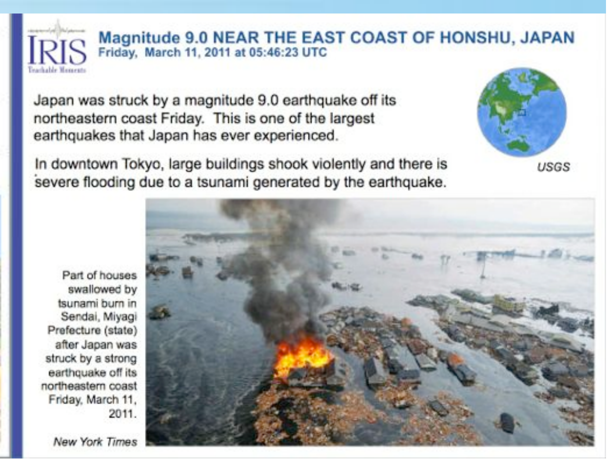


Teachable Moment slide sets

- Newsworthy earthquakes motivate students
  - College faculty and teachers have little time to prepare
- Slide sets produced within 1 day
  - Jointly produced with Univ. of Portland, collaborative content from USGS, UNAVCO, ESNO and others
  - Tell a story
  - In English and Spanish
  - ~15 sets produced per year
- Opportunity to develop follow-up slides with partners

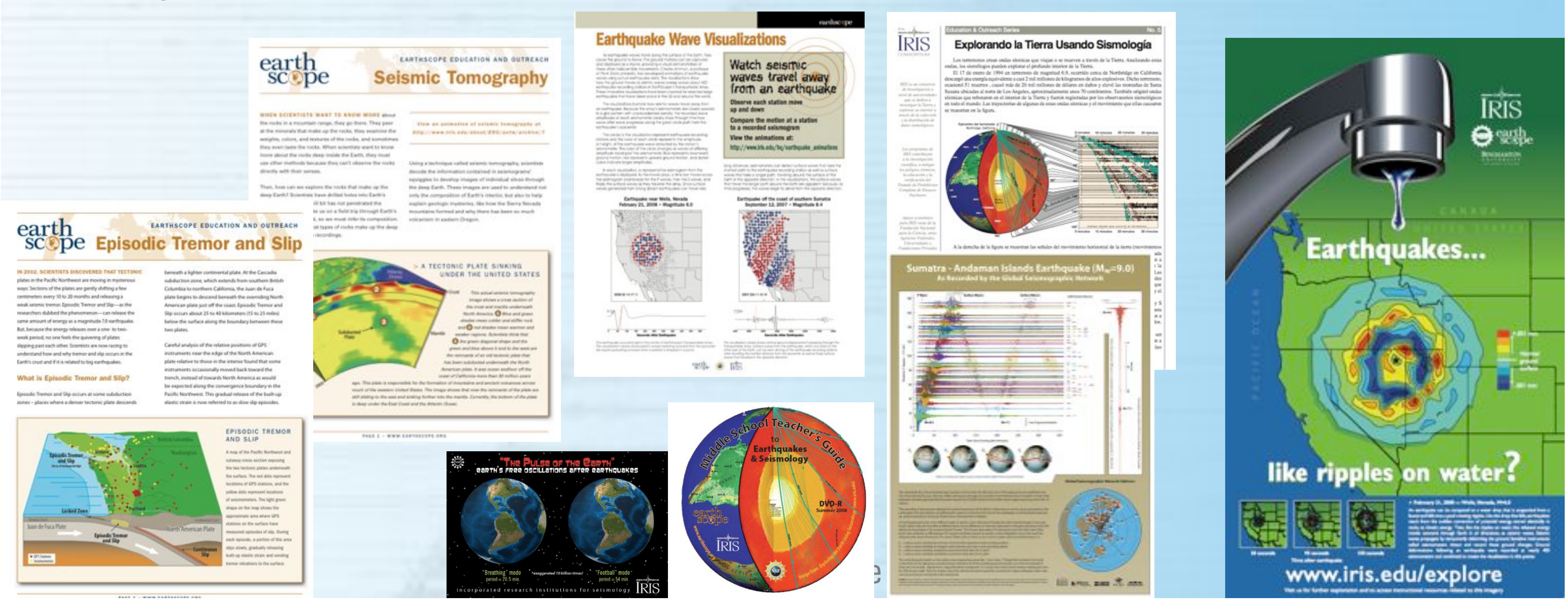






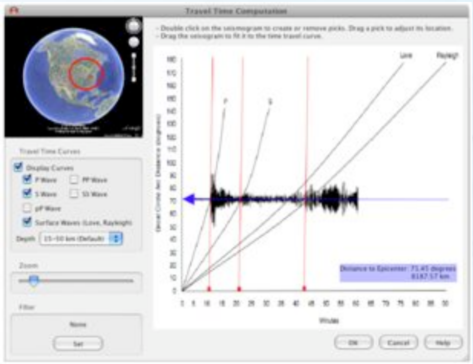
Publications

- Provide fundamentals of seismology and broaden awareness
- Many EarthScope-related publications are collaborative with UNAVCO and ESNO
- Several posters and all 1-pagers are available in Spanish



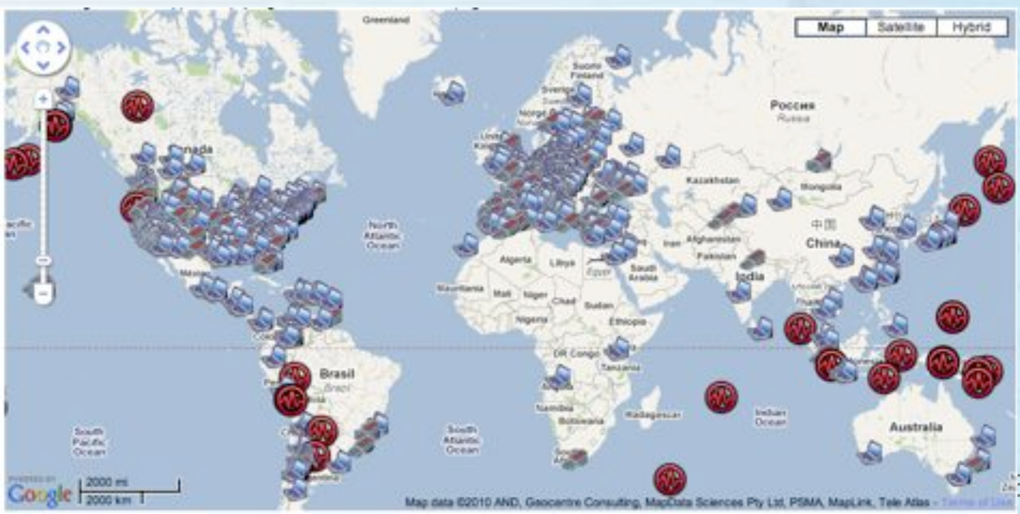
Seismographs in Schools

- Promote awareness of global seismicity
- IRIS provides training and specialized software
- Web environment to improve connections between schools
  - Gives schools visibility in the community
  - Over 150 US schools
  - 250 international schools




Mobile devices/accelerometers

- USB sensors, laptops, iPhones, etc
  - Students predict and measure shaking
- Partnering with Quake Catcher Network
  - Other QCN partners: SCEC, USGS, Epicenter Network
  - IRIS creating educational activities
- Moving content delivery to mobile devices

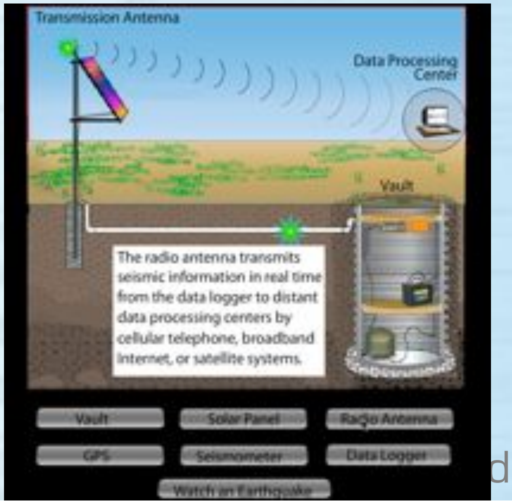


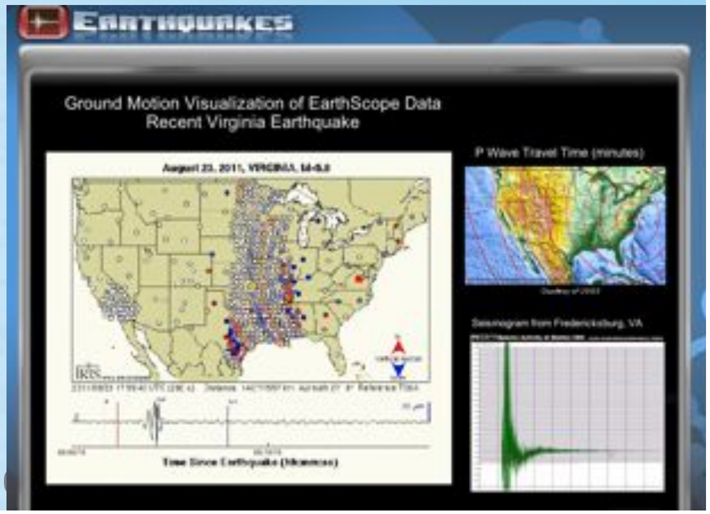
Public Displays

- Inspire interest in seismology
  - Started with IRIS/USGS displays in major museums
- Now focused on Active Earth Monitor
  - Designed for visitor centers, small museums, universities, schools
  - Customizable selection of pages to display
    - Joint content development with UNAVCO, ESNO, CERI, SCEC
  - Over 50 active accounts, will be over 1 million visitors this year
  - Expanding to wide touch screen technology

Active Earth Monitor

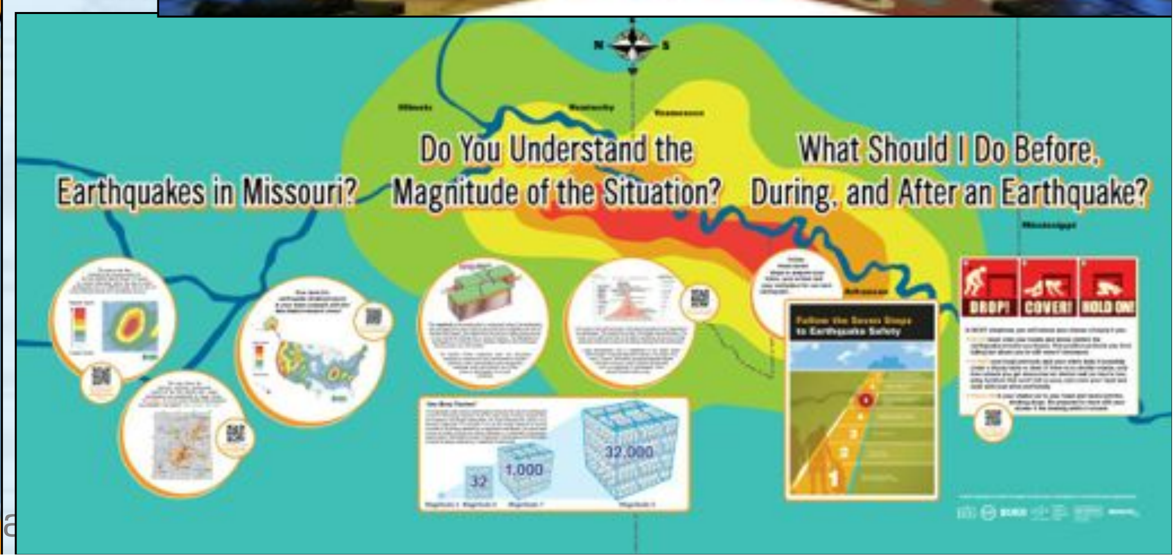
- Cascadia, Basin and Range, New Madrid, and general seismology modules available
- Additional EarthScope and regional content to be added
- 15 kiosks on permanent or loan basis
  - Sites in current TA footprint
  - parks and museums as part of ESNO interpretive workshops
  - USArray Permanent Array station hosts





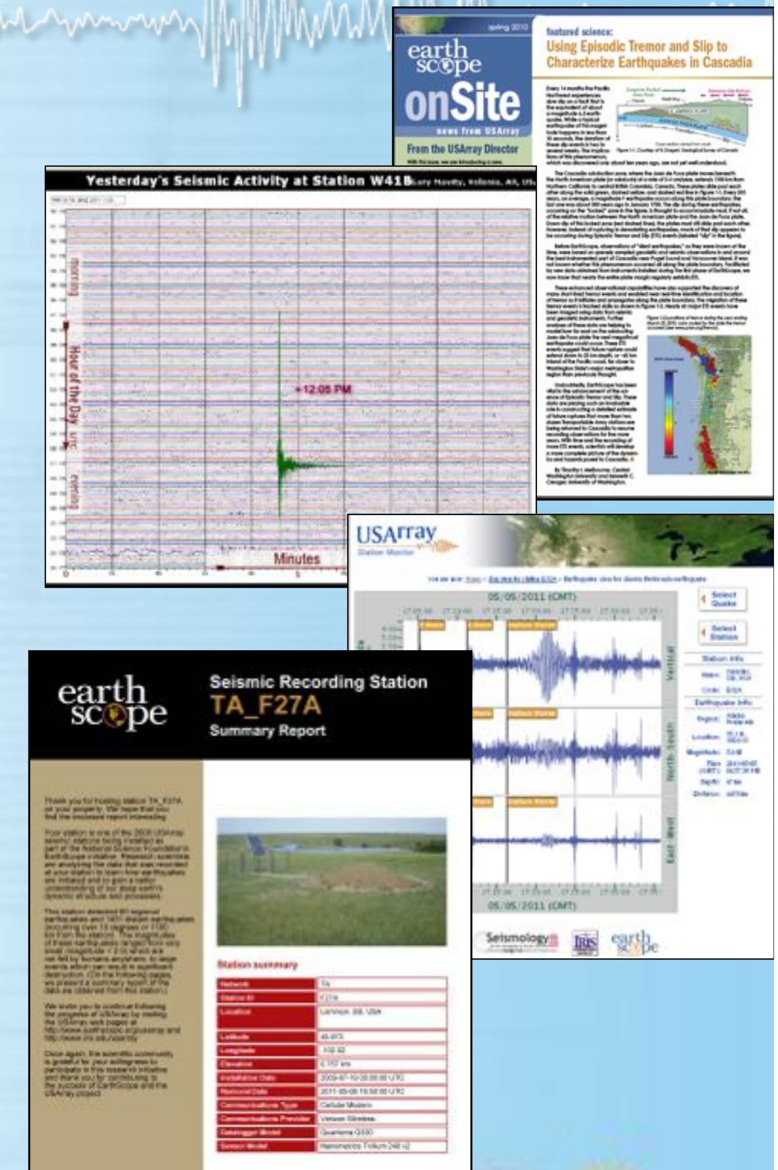
Public Displays

- Marston Welcome Center
  - EarthScope-themed exhibit
  - Active Earth Monitor connected with associated signage
  - Located near New Madrid, Missouri on I-55



Outreach to USArray Landowners

- *onSite*
  - Landowner bulletin
  - Published two times per year
- Web displays of data recorded by **<u>their</u>** station
- Final Summary Report
  - Produced by Array Network Facility



Public Outreach

- IRIS/SSA Distinguished Lecture Series
  - Convey the excitement of seismology to a general audience
  - 17 Lecturers have given over 99 presentations to up to 400 people
- Targeted materials for USArray
  - Press releases and articles as array moves across US
- Temporary exhibits for the public and/or congressional staff
  - USA Science and Engineering festival in Washington DC
- X-Ray Earth
  - National Geographic TV special with segment on EarthScope's Transportable Array and seismic tomography

Summary

- Products and services are designed for a specific audience and desired depth of involvement
- Increased emphasis on virtual delivery and interactions, but some face-to-face interactions are needed
- Impact is leveraged through collaborations

National Center for Earth-surface Dynamics gidakiimanaaniwigamig (Our Earth Lodge) manoonim (Wild Rice) project


earth

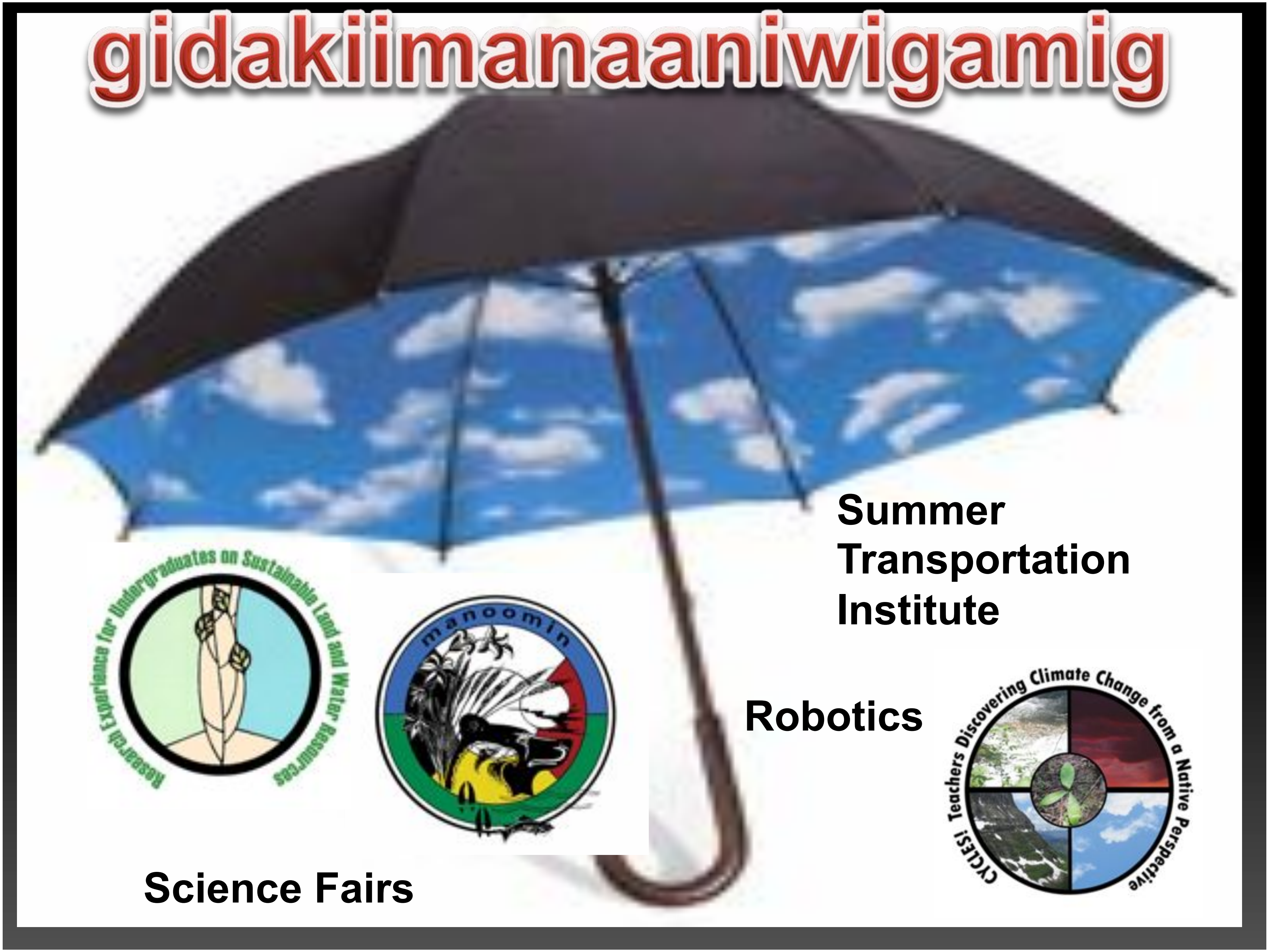

water


life

Diana. M. Dalbotten, National Center for Earth-surface Dynamics
Holly Pellerin, gidakiimanaaniwigamig Program Director

NATIONAL CENTER FOR EARTH-SURFACE DYNAMICS

gidakiimanaaniwigamig (Our Earth Lodge)


gidakiimanaaniwigamig
Summer Transportation Institute
Robotics
Science Fairs
Research Experience for Undergraduates on Sustainable Land and Water Resources
manoomin
CYCLES! Teachers Discovering Climate Change from a Native Perspective

The Circle of Learning

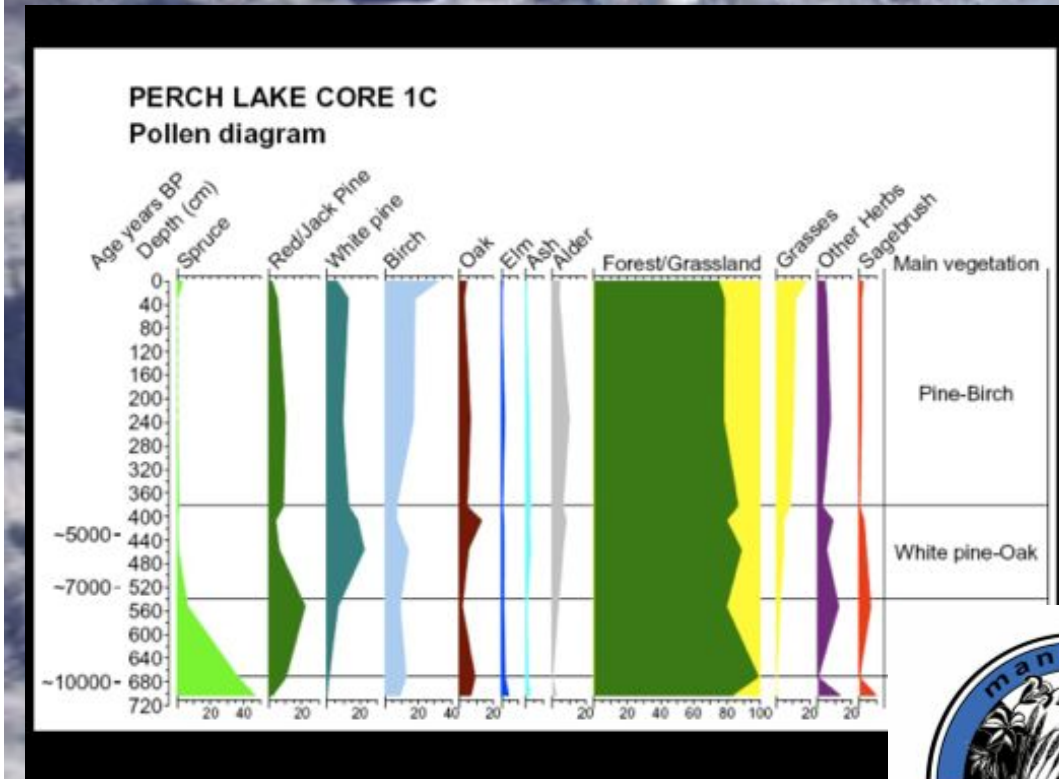
- Everyone teaches and everyone learns.
- Conflict management is handled by the elders. Everyone else teaches and learns.
- Community leaders are the best people to identify participants
- Students are recruited based on their interest rather than on merit criteria.
- •Native (or community) traditions are respected, acknowledged, valued and applied in camp.
- The primary expectation for all is that we are creating together a positive learning environment..
- All participants act as role models to younger participants.
- Teaching is primarily oral, multidisciplinary, and hands-on-project driven.
- We acknowledge that each of our student participants have the ability to be scholars and scientists in the future.
- Shared goals drive our planning.
- Evaluation is an essential task of the Circle of Learning.

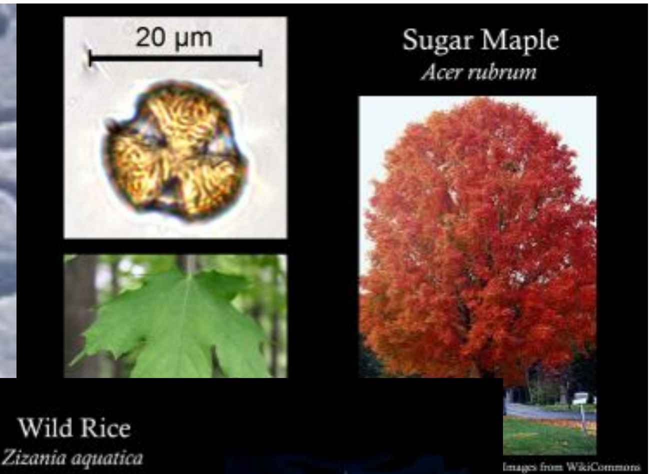
Thoughts about working in Native American communities.:

- No quick fixes—need ongoinig program to build credibility over time in Native American communities
- Building relationships matters—alliances work! (gidaa, giiwed'anong,, TRIBES, Aises northstar, geoscience alliance)
- Listen to the community first, make a long-term investment and commitment to the community
- Partnerships are key, because they provide stability when programs come and go.
- Sometimes it is good to be a partner, but not the leader.


manoomin
manoomin: wild rice


3.6
.15m
3.61
2.80
manoomin
ARIZONA


PERCH LAKE CORE 1C
Pollen diagram
Age years BP
Depth (cm)
Spruce
Red/Jack Pine
White pine
Birch
Oak
Elm
Ash
Alder
Forest/Grassland
Grasses
Other Herbs
Sagebrush
Main vegetation
Pine-Birch
White pine-Oak
~5000
~7000
~10000


20 µm
Sugar Maple
Acer rubrum
Images from WikiCommons


Wild Rice
Zizania aquatica
20 µm
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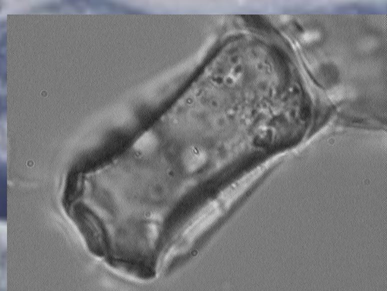


OUR FOCUS:

TEACHERS PROF DEV

K-12 (+)

Informal Science Ed

In the classroom

Undergrads and Grads

Faculty and Mentor Prof Dev

Everyone Else

Moving from a partnership model to a formal alliance model:

gidakiimanaaniwigamig

giiwed;anang Northstar undergraduate AISES alliance

geoscience Alliance (national alliance for broadening participation in the geosciences by NA

TRIBES/CYCLES teacher alliance

AISES Northstar Professional MN Chapter

GEOSCIENCE ALLIANCE: A National Alliance for Broadening Participation by Native Americans in Earth-Science Disciplines and Careers

Bringing communities together to achieve shared goals.

2nd GA Conference March 17-18, 2012
Salish Kootenai College, Pablo, Montana
Talk to me today if you want to be there!

How we do what we do:

- Rigorous programs that focus on (engagement, capacity, continuity)
- Excitement
- Content
- Infrastructure
- A useful pedagogy that shows attention to audience—7 elements (see, relate, grow, tinker, quantify, describe, understand)
- Involvement of Scientists, Elders, and Others who can help our students learn
- Incorporate traditional and local knowledge
- Being grandma's together

Undergraduate Summer Interns

REU on River and Coastal Restoration

Teams of students, with teams of advisors work
at NCED field sites to learn interdisciplinary research methods.

Our new model: the REU on Sustainable Land and Water Resources

Bringing research to the reservation.

NCED’s Faculty-to-Faculty Program

Helping to build the first 4-year hydrology degree program at a U.S. Tribal College

CYCLES! Teachers Discovering Climate Change from a Native Perspective

WE ARE EXCITED
TO BE HERE
AND DISCOVER WAYS
WE CAN BRING
WHAT YOU DO
TO OUR STUDENTS,
TEACHERS AND FRIENDS!

Miigwech!

Thank You!

NEES Education, Outreach and Training

Earth Science Provider Summit
February 20 – 21, 2012

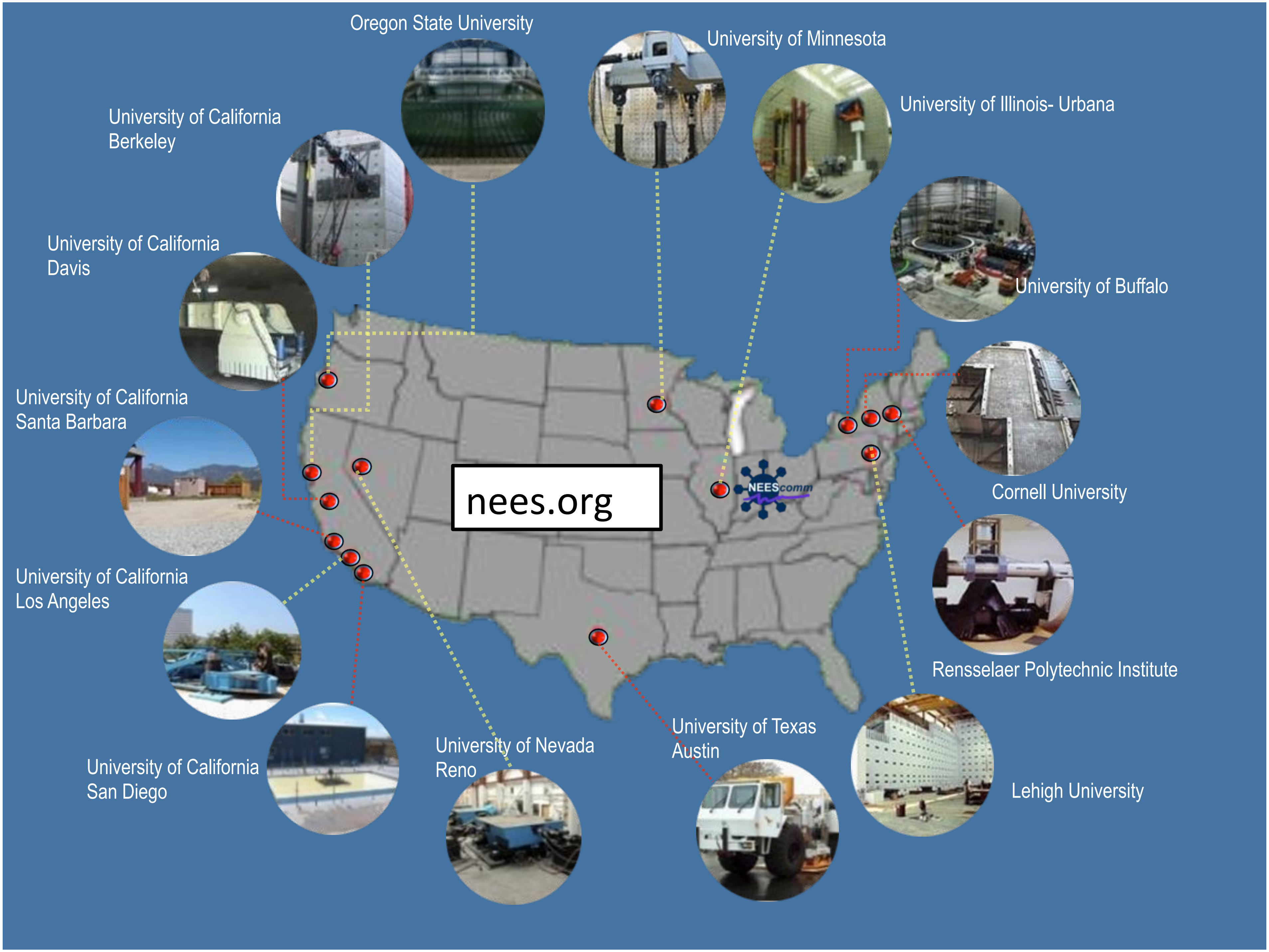
Keith Adams, NEEScomm, Director of EOT

Thalia Anagnos, San José State University
Co-PI for EOT

VIDEO INTRODUCTION

14 geographically distributed equipment sites

$82 million construction
$20 million annual operations
150+ research projects



Oregon State University
University of Minnesota
University of Illinois- Urbana
University of California Berkeley
University of California Davis
University of Buffalo
University of California Santa Barbara
Cornell University
nees.org
NEEScomm
University of California Los Angeles
Rensselaer Polytechnic Institute
University of Texas Austin
University of Nevada Reno
University of California San Diego
Lehigh University

NEES MISSION

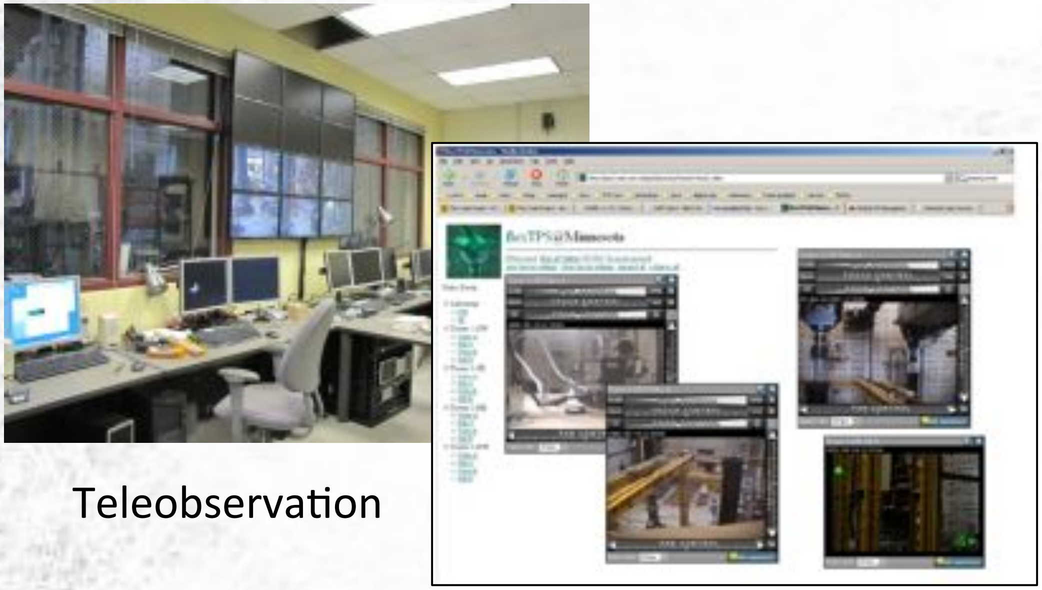
Miyako City, 2011 Iwate Prefecture

I-10 Los Angeles, 1994 Northridge CA

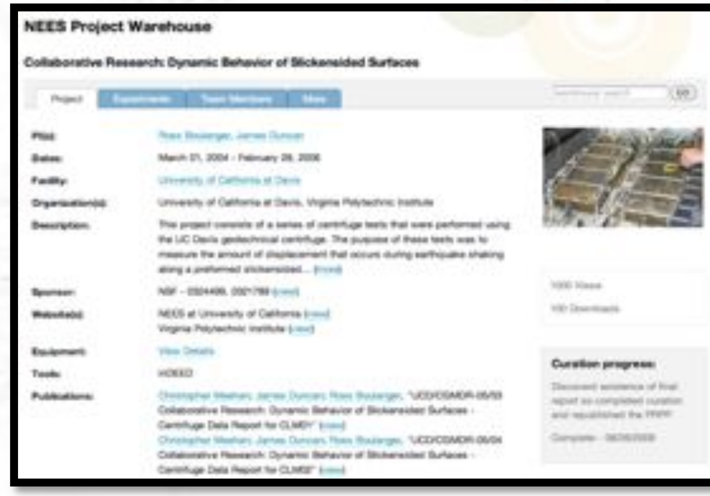
Accelerate improvements in seismic design and performance of the infrastructure **by supporting efforts of the NEES community** to:

(a) improve PBD procedures, evaluation methods, & strengthening techniques
(b) develop the next generation of researchers, educators, & engineers

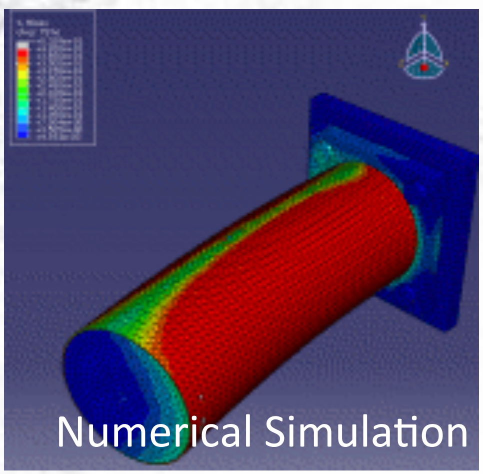
Cyberinfrastructure



Teleobservation

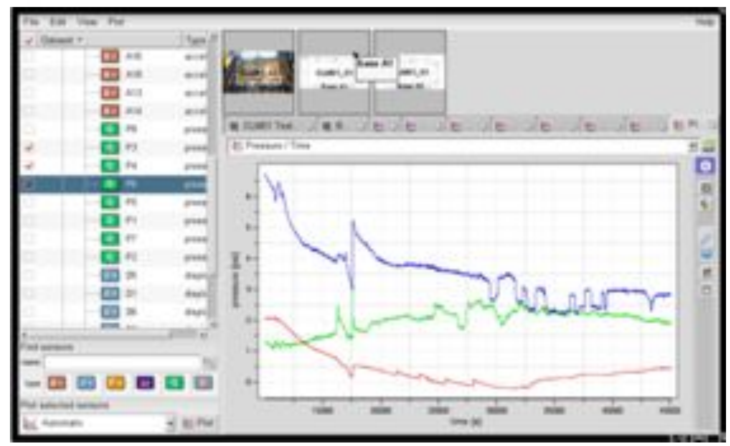


Data Repository



Numerical Simulation

Challenge: How to leverage these resources for E & O



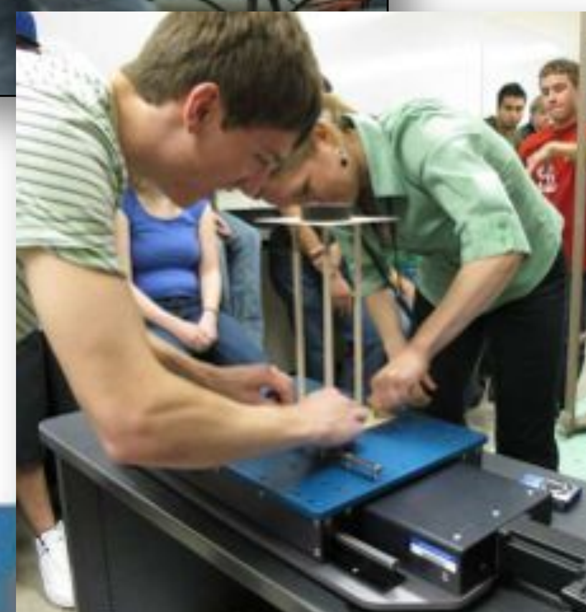
Data Viewing

Education & Outreach

People, Programs and Technology

Public Awareness

Engage K-16 Learners



Technology Transfer

Audience and EOT Programs

Aims, Audience, Actions

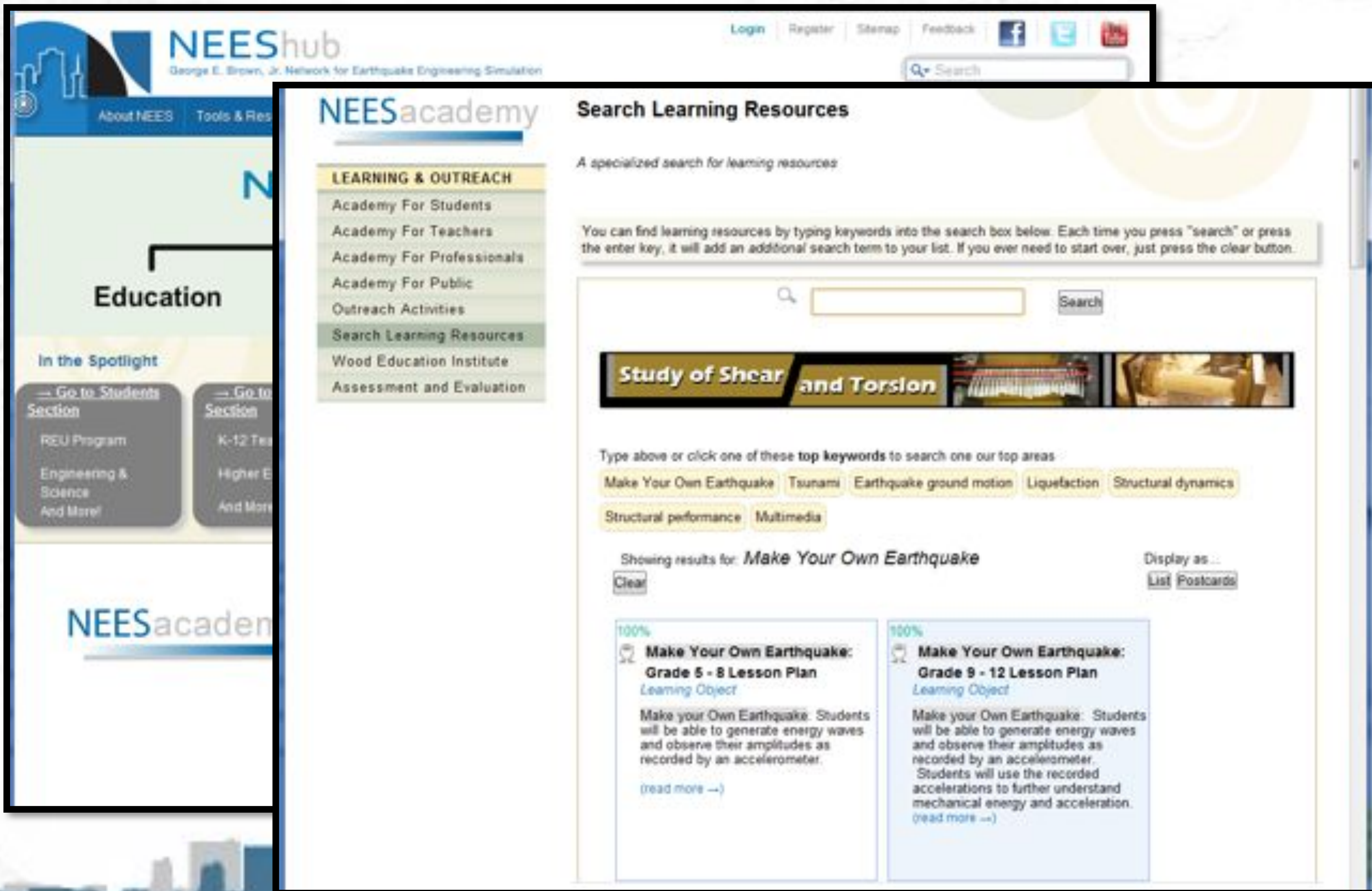
Engage K-16 Learners

A rich set of well design learning materials, based on NEES research and facilities to support teaching of…

- scientific concepts
  - Earth and physical
- scientific inquiry
- engineering problem solving
  - design
  - modeling
  - analysis

NEESacademy

...a virtual learning institution



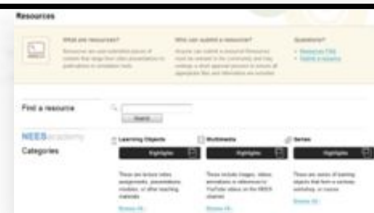
NEESacademy

"Bringing all the elements together for rich and dynamic learning spaces in classrooms, online or personal learning."

Learning Resources

Simulations, tools and multimedia contributed by the community through NEEShub

Learning Architecture



Blending Learning resources into Learning Objects, Modules and Series to be use for Education, Outreach and Training

Learning Management with Assessment

Delivering courses within the Learning Architecture for work force development, higher education and Training

Virtual World

Share, explore and synthesize ideas with learners around the nation using NEEShub *resources as a catalyst for discussion. Or perform a recon mission like the experts.*

Webcast at NEESlive

Broadcast from anywhere to your audience of hundreds from NEEShub *and archive results for future viewing or a part of a course.*

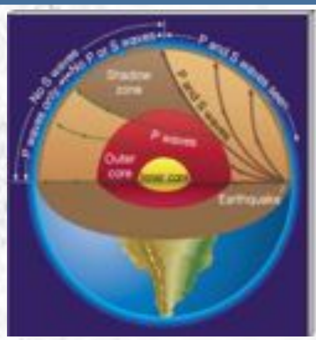
Data in the Project Warehouse

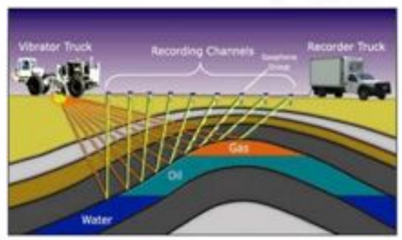
Real world data directly from the researcher as part of the Project Warehouse could provide a new learning resources to be blended into the learning architecture.

Risk Mitigation knowledge

…mapping the domain

Characterizing the causes and resulting ground motion generated by earthquakes (Geo-science) → Energy From Quake → Characterizing behavior of soil and water during earthquakes (Geo Technology) → Ground & Water motion → Designing and Testing methods to resist impact of energy transmitted by ground and water motion (Engineering) → Building & Lifeline Impact





<u>Geoscience Questions</u>

<u>Hydrodynamics & Geotechnical Questions</u>

<u>Physics and Engineering Design Questions</u>

K-12 Learning Resources

4 focus areas… contributions from the EOT community

Earthquake ground motion

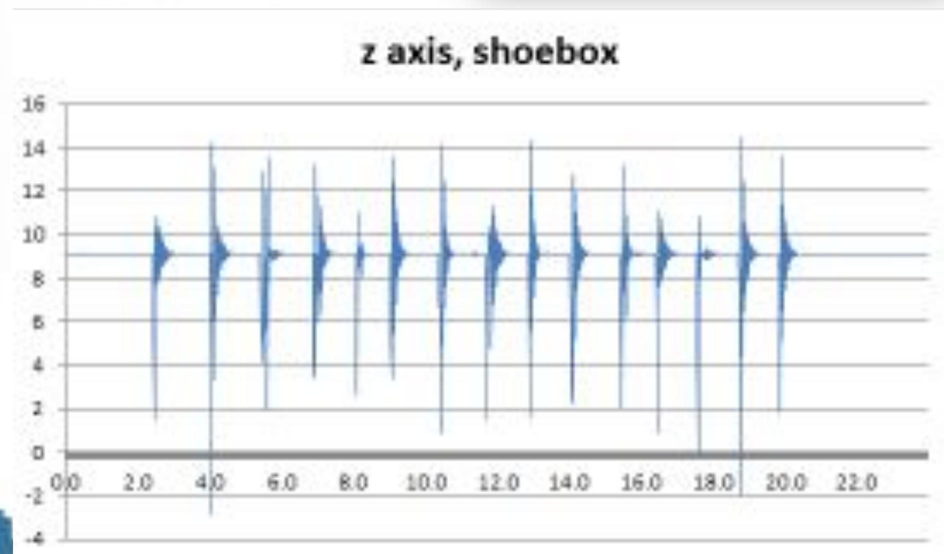
Ground failure

Tsunami

Structural dynamics & performance

K-12 Ground Motion Theme

- NEES QCN working group created
- Interaction with SCEC, IRIS, and QCN
- Sharing of materials in NEESacademy

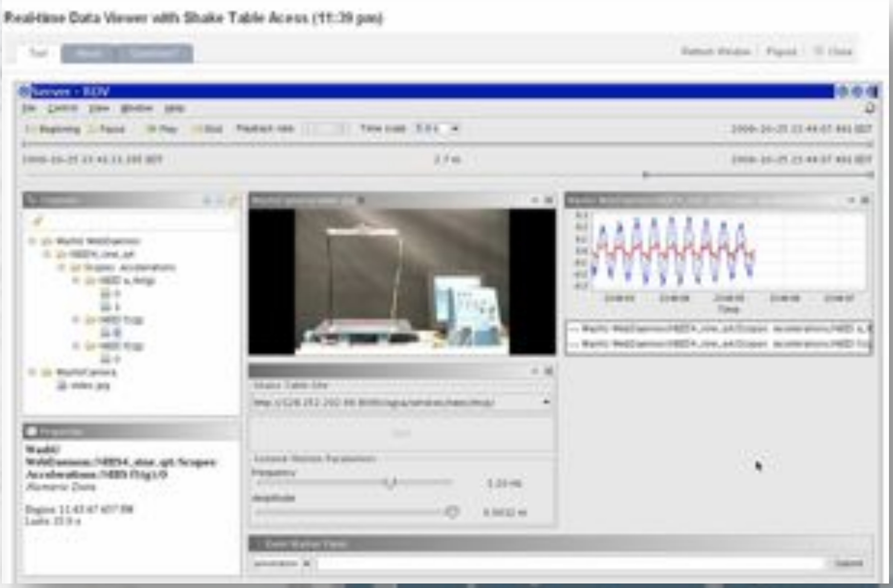


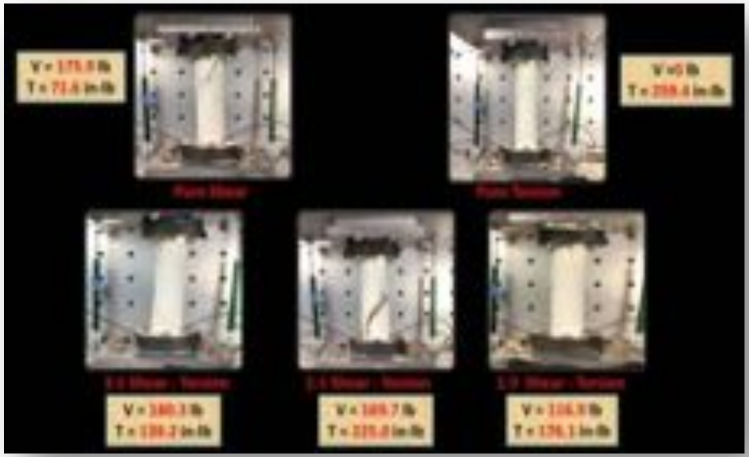
Structural Performance Theme

Shake table activities to investigate structural behavior

"… if you put braces on your building then it will not fall down." Glenview Elementary School

Remote shake table operation and data analysis

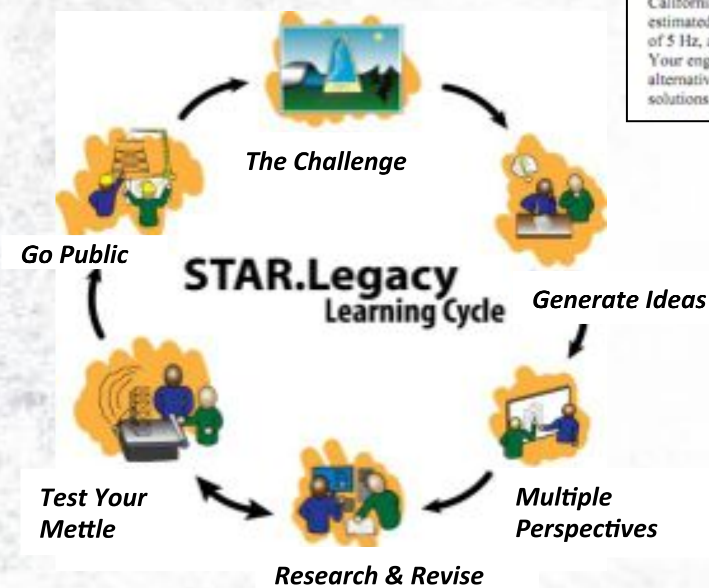


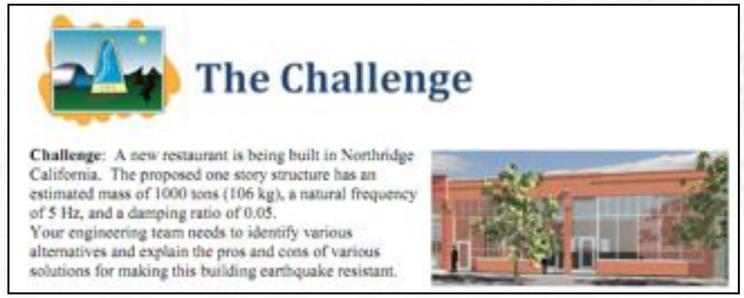


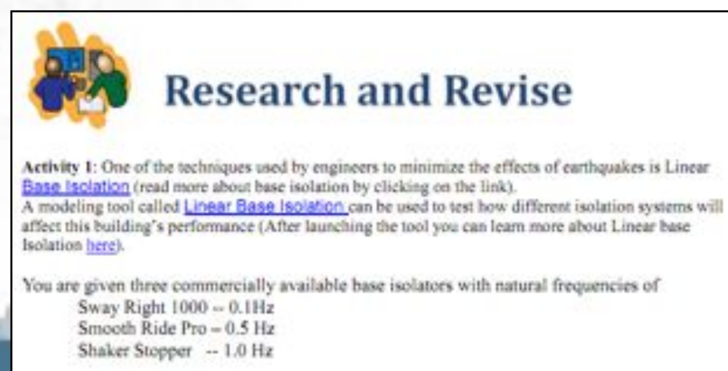
Demo to explain engineering fundamentals

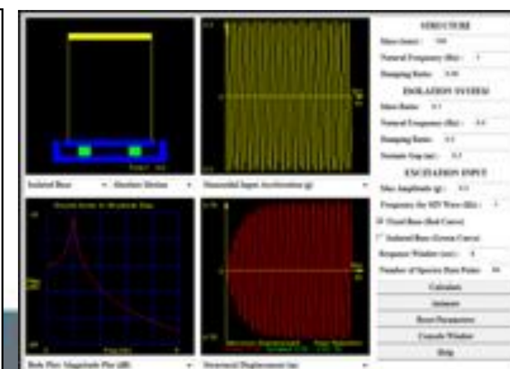
Interactive Learning Modules

Challenge-based using Tools, Data and Resources



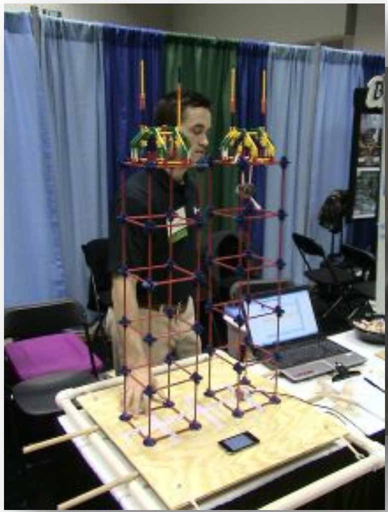
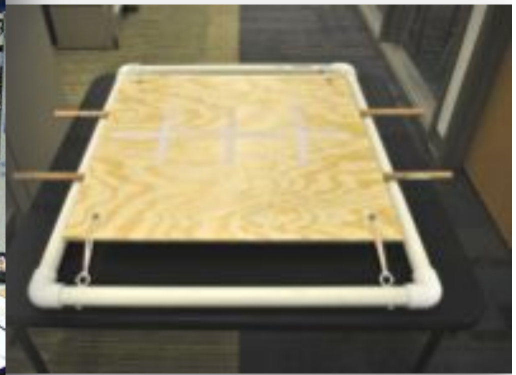






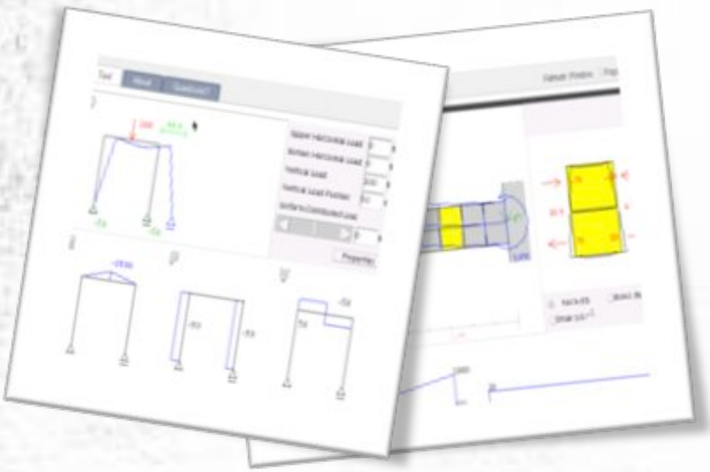
Engineering Design

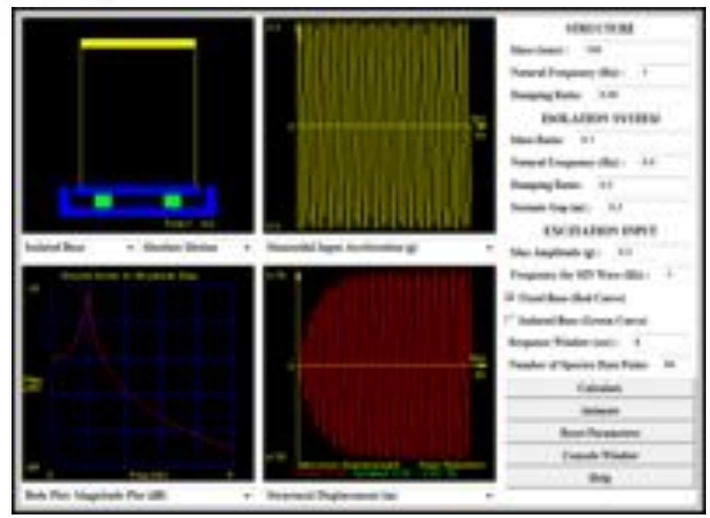
- Engage students in design challenges to create scale models of innovative ideas
- Test ideas with low cost shake tables
- Host design competitions
- Demonstrate forced vibration

Learn how to build it can be found on nees.org

Online Simulation





Technology Transfer

NEESacademy Learning Spaces

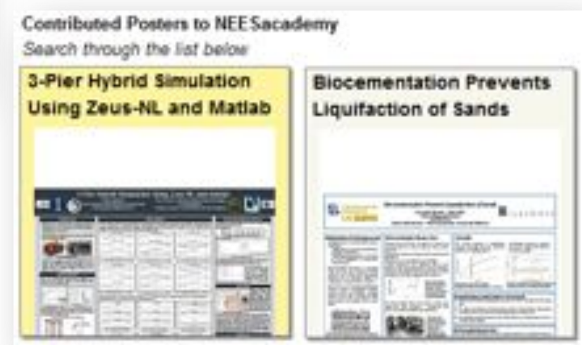
…integrating learning technologies into NEEShub architecture

Integrated Learning Management System

Wood Education Institute online course

QuakeQuest Virtual World

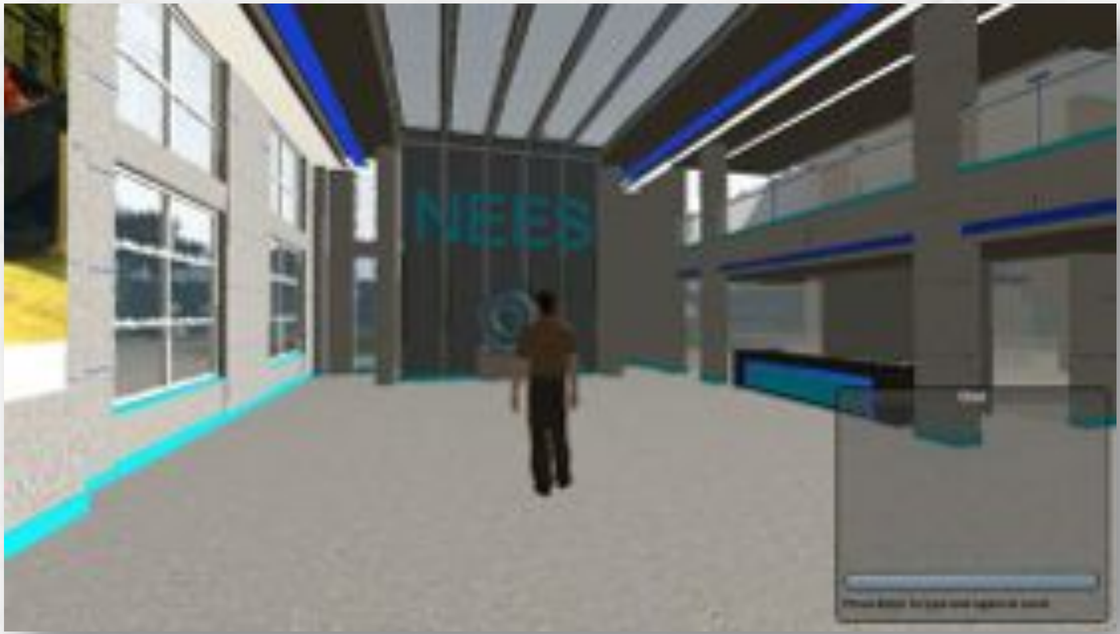
REU Virtual Research Conference



Event Manager

CMMI Conference
EERI/RAPID Workshop

Virtual Poster Sessions



Public Awareness & Education

NEES@Cornell and Sciencenter (IRIS and SCEC as partners)

– Traveling museum/library exhibits

SCEC/ECA and the EPIcenter Network

Robert de Groot – SCEC
Kathleen Springer –SBCM and ECA

EARTHQUAKE EPIcenter
EDUCATION & PUBLIC INFORMATION CENTER
Earthquake Country Alliance

Earthquake Country **Alliance**

We're all in this together.

Working Together to Promote and Improve Preparedness, Mitigation, and Resiliency

www.earthquakecountry.org

Our Organization

ECA is a statewide partnership of people, organizations, and regional alliances

Each regional alliance conducts
its own activities and collaborates with the others

Statewide committees determine long-range plans, sector-based needs, and develop resources

The Great California ShakeOut™

Our Activities

The Great California ShakeOut:
Register today at
www.ShakeOut.org

California Tsunami Awareness week

Development of consistent, statewide messaging and resources

Local presentations, fairs, media events

Much more being planned…

ECA EPIcenter Mission Statement

ECA Earthquake Education and Public Information Centers (EPIcenters) share a commitment to demonstrating and encouraging earthquake and tsunami preparedness. They help coordinate Earthquake Country Alliance activities in their county or region (including the ShakeOut), lead presentations or organize events in their communities, or in other ways demonstrate leadership in earthquake education and risk reduction. EPIcenters are found in a variety of public venues such as museums, science centers, libraries, and universities.

EARTHQUAKE EPIcenter
EDUCATION & PUBLIC INFORMATION CENTER
Earthquake Country Alliance

Why EPIcenters are Important - A Key Component of the ECA

EPIcenters have:

- a deep understanding of their audiences
- hard won ties with their local community
- an established reputation for providing reliable information
- an established brand
- a staff with many talents that come from and/or have connections to the community
- resources to offer programming within a framework that makes sense for the institution and the audiences you serve
- a place where people gather to interact, share, and learn

EARTHQUAKE EPIcenter EDUCATION & PUBLIC INFORMATION CENTER

1 Anza-Borrego Desert Natural History Association
2 Anza Borrego Desert State Park
3 Balboa Park Museums (24 Museums)
4 Birch Aquarium at Scripps
5 Buena Vista Museum
6 California Science Center
7 California Academy of Sciences
8 Cal State LA Geology Department
9 Caltech Seismological Laboratory
10 Chabot Space and Science Center
11 Children's Discovery Museum of San Jose
12 Children's Discovery Museum of the Desert
13 College of the Desert
14 Discovery Science Center
15 Fingerprints Youth Museum
16 Goodwin Interpretive Center
17 Griffith Park Observatory
18 Imagination Workshop
19 Joshua Tree National Park
20 KidSpace Children's Museum
21 Lake Perris State Recreation Area
22 Lancaster State Park
23 Lindsay Wildlife Museum
24 The Living Desert
25 Midpeninsula Open Space District
26 Mojave National Preserve
27 Mount San Jacinto State Park
28 Natural History Museum of Los Angeles County
29 Page Museum (La Brea Tar Pits)
30 Pinnacles National Monument
31 Rancho Mirage Public Library
32 Salton Sea State Recreation Area
33 San Bernardino County Library
34 San Bernardino County Museum
35 San Jose History Museum
36 Santa Barbara City College Geology Department
37 Santa Barbara Museum of Natural History
38 Santa Rosa & San Jacinto Mountains National Monument
39 Sequoia and Kings Canyon National Parks
40 Sequoia Natural History Association
41 Stanford University School of Earth Sciences
42 The Tech Museum of Innovation
43 University of California Riverside Geology Department
44 Wallace Creek Interpretive Trail
45 Western Center for Archaeology & Paleontology
46 Victor Valley Museum
47 Youth Science Institute

EARTHQUAKE
EPIcenters
EDUCATION & PUBLIC INFORMATION CENTERS
Earthquake Country Alliance

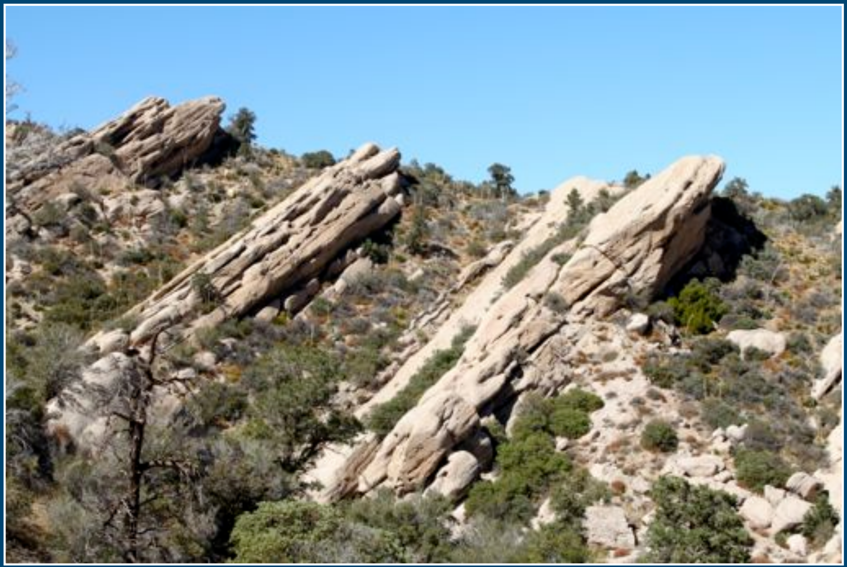
Other EPIcenters:

American Red Cross
Bay Area Earthquake Alliance
California Geographical Society
Paleontological Research Institution (Museum of the Earth), Ithaca, NY
New Mexico Museum of Natural History & Science, Albuquerque, NM
Oregon State University, Corvallis, OR
ScienCenter, Ithaca, NY

ECA EPIcenters

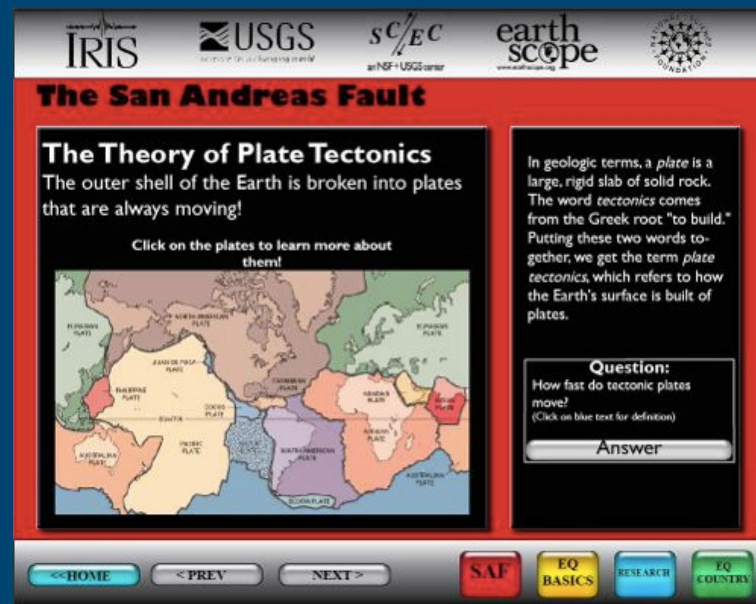
earthquakecountry.org/epicenter

Earthscope San Andreas Fault Workshop -2009



New Products and Programs

- Active Earth Monitor – San Andreas fault Content Set (with IRIS and EarthScope)
  - This online resource is one in a series of products from the EarthScope workshops for park and museum interpreters. This product is currently in the review phase and it should be live in late Spring 2012.



- Research Lesson (Lesson Study) development (McGill, EarthScope RET program)
  - Teachers and high school students collected survey-mode GPS data from 11 sites (among a total of 25 sampled by the larger group of participants) during a 5-day campaign in 2011. The information obtained will be useful for understanding and characterizing seismic hazards in that region of Southern California.

New Products and Programs

- California Science Center (Los Angeles) – Earthquake Preparedness Live Program
  - 15-minute live program performed on the Creative World Tech Review Stage
  - Debuts in Spring 2012 as a *Science Spectacular!™* Program
  - Program covers earthquake science and preparedness basics
  - This program will be shared with and performed by other members of the EPIcenter Network (and other free choice learning institutions)

- Quake Catcher Network (QCN) Collaboration
  - QCN and the EPIcenter Network are partnering to install QCN sensors in museums. Sensors are also being incorporated into educational programming such as discovery carts, school programs, and exhibits.

What is SCEC?

- A Multidisciplinary Research and Education Community
- Supported by the National Science Foundation and the U.S. Geological Survey
- Coordinates the efforts of over 60 institutions (e.g. USC, UCR, Caltech, UCLA)

<u>Mission:</u> To gather new information about earthquakes in Southern California, combine knowledge into a comprehensive understanding of earthquake phenomena, and communicate this understanding to increase earthquake awareness, reduce economic losses, and save lives.

Teachers Using Continuous Global Positioning System (GPS) Data to Learn About Earthquakes – Sharing Research Results in the Classroom Through Lesson Study

What is Lesson Study? "Jugyokenkyu"

Lesson Study is an ongoing practice used in schools throughout Japan in which teachers collaborate to plan, observe, and refine a lesson. Lesson study involves "backward design" which starts with the clarification of the lesson's learning goal and then focuses on the design of instructional experiences that lead to that goal.

Rather than looking at what you are going to teach you start with what you want the students to learn. . .

Scientific goal of this project is to measure plate tectonic movement within the San Bernardino mountain area and the Inland Empire region of Southern California utilizing GPS.

The information obtained will be useful for understanding and characterizing seismic hazards in that region of Southern California. The 2011 Campaign: 11 sites sampled by high school teachers and their students.

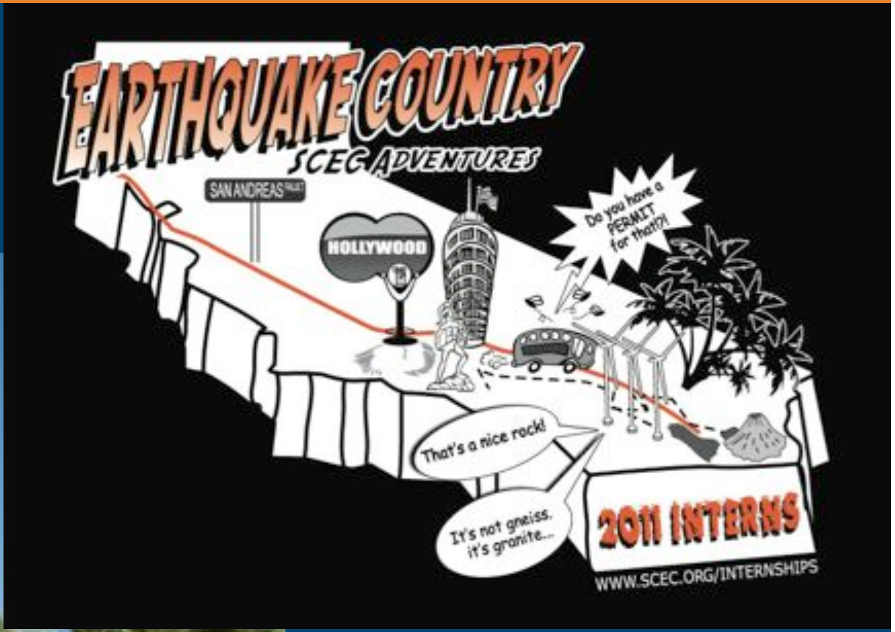
EarthScope-CSUSB GPS Research Program 2009 -11

Program Activities

1. Summer training workshop (T,S,U)
2. 5 day survey-mode GPS campaign in Inland Empire region of Southern California (T,S)
3. Post campaign data analysis workshop and poster making (T,S)
4. Lesson Study workshop (T)
5. Research Lesson development and visit to USC (T,S)
6. Plan and present at teacher workshop SCEC Annual Meeting (T, a few S, U).

T = teacher, S = high school student, U = undergraduate

Experiential Learning and Career Advancement



2011 SCEC UseIT Interns

Undergraduate Studies in Earthquake Information Technology

– 19 Interns worked at USC (NSF REU Site)
– Representing Pasadena City College, MIT, USC, Loyola Marymount University, Hampton University, The George Washington University, Howard, East Los Angeles College, UCSD, Santa Barbara City College and Columbia.

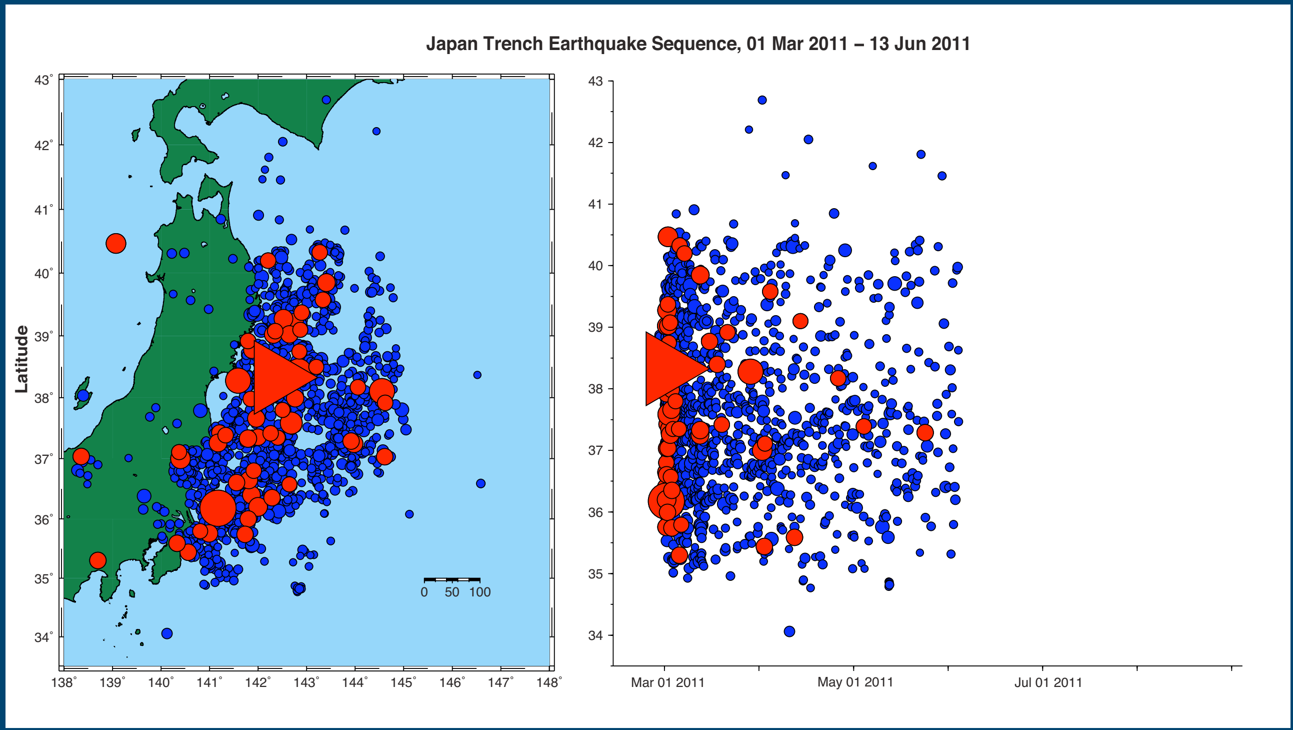
Mentors Included: T. Jordan, K. Milner, N. Rousseau, R. de Groot, D. Goldberg, K. Springer, J. Dolan, T. Huynh, M. Benthien, S. Callaghan



2011 SCEC Intern Program Partners: UNAVCO, USGS, RMS, California Science Center, San Bernardino County Museum, RiskRED, **EarthScope**, University of Rochester, NEES, USC Spatial Sciences Institute

2011 SCEC UseIT Grand Challenge

Develop a Seismic Sequence Visualization System based on SCEC-VDO and GIS that can display earthquake sequences, monitor their evolution in space and time, and assess their hazards and risks.



2011 SCEC SURE Interns

- *Summer Undergraduate Research Experience*
  - 35 Interns from 25 institutions
  - at 11 SCEC Institutions

- Mentors Included:

  G. Beroza, J. Stock, S. McGill, Y. Bock, J. Steidl, A. Barth, J. Louie, J. Evans, B. Hacker J. Dolan, J. Fairley, R. Wood, B. Ellsworth, S. Brownlee, E. Dunham, K. Mueller, E. Hauksson, S. Paterson, W. Thatcher, D. Oglesby, R. Frary, Annie Kell-Hills, M. Wood, R. de Groot, M. Benthien, N. Onderdonk, David Shelly, J. Rubinstein, R. Arrowsmith, V. Sloan, S. Seale, M. Nyst, N. Oropez, G. Bazela, M. Petal, C. Ebinger, K. Springer, B. Crowell, D. Melgar, F. Civilini, F. Ratzesberger, P. Hegarty, S. Fisher, R. Green, D. Cote, F. Amelung, M. Bagnardi

2011 SCEC SURE Interns

Summer Undergraduate Research Experience

Students representing:

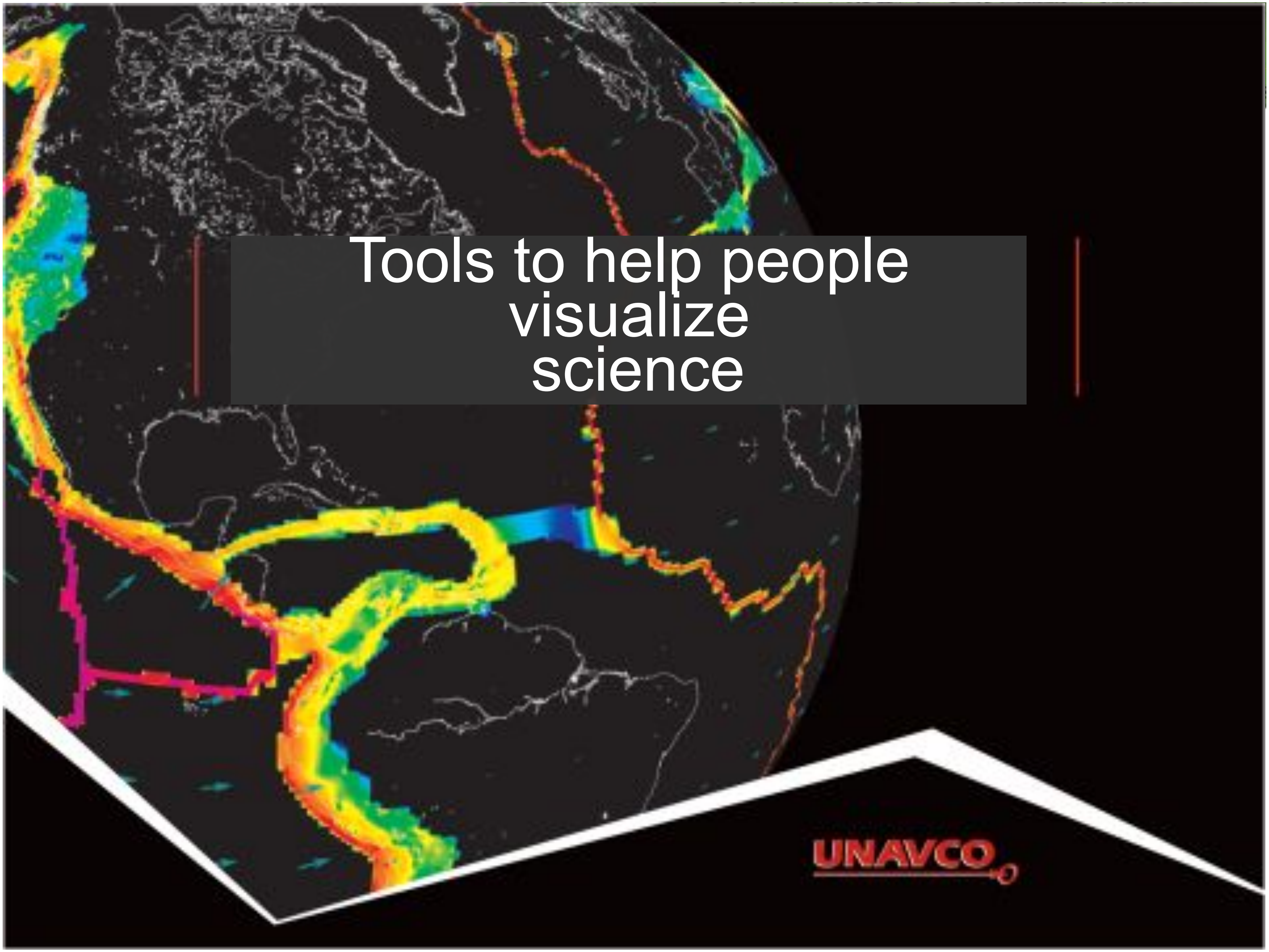
- Pasadena City College
- University of Michigan
- Haverford College
- University of Puerto Rico – Mayaguez
- University of Colorado
- University of Virginia
- Rhode Island School of Design
- University of Texas – El Paso
- Morgan State University
- University of Rochester
- East Los Angeles College
- University of British Columbia
- University of Nevada – Reno
- Northern Michigan University
- Thammasat University
- University of Wisconsin – River Falls
- Dartmouth College
- USC
- UCLA
- Occidental College
- Wesleyan University
- Colorado State
- Cerritos College
- Montana State
- UC Berkeley

Thank You

What does UNAVCO ~~Education & Outreach~~ Education & Community Engagement have to offer you?

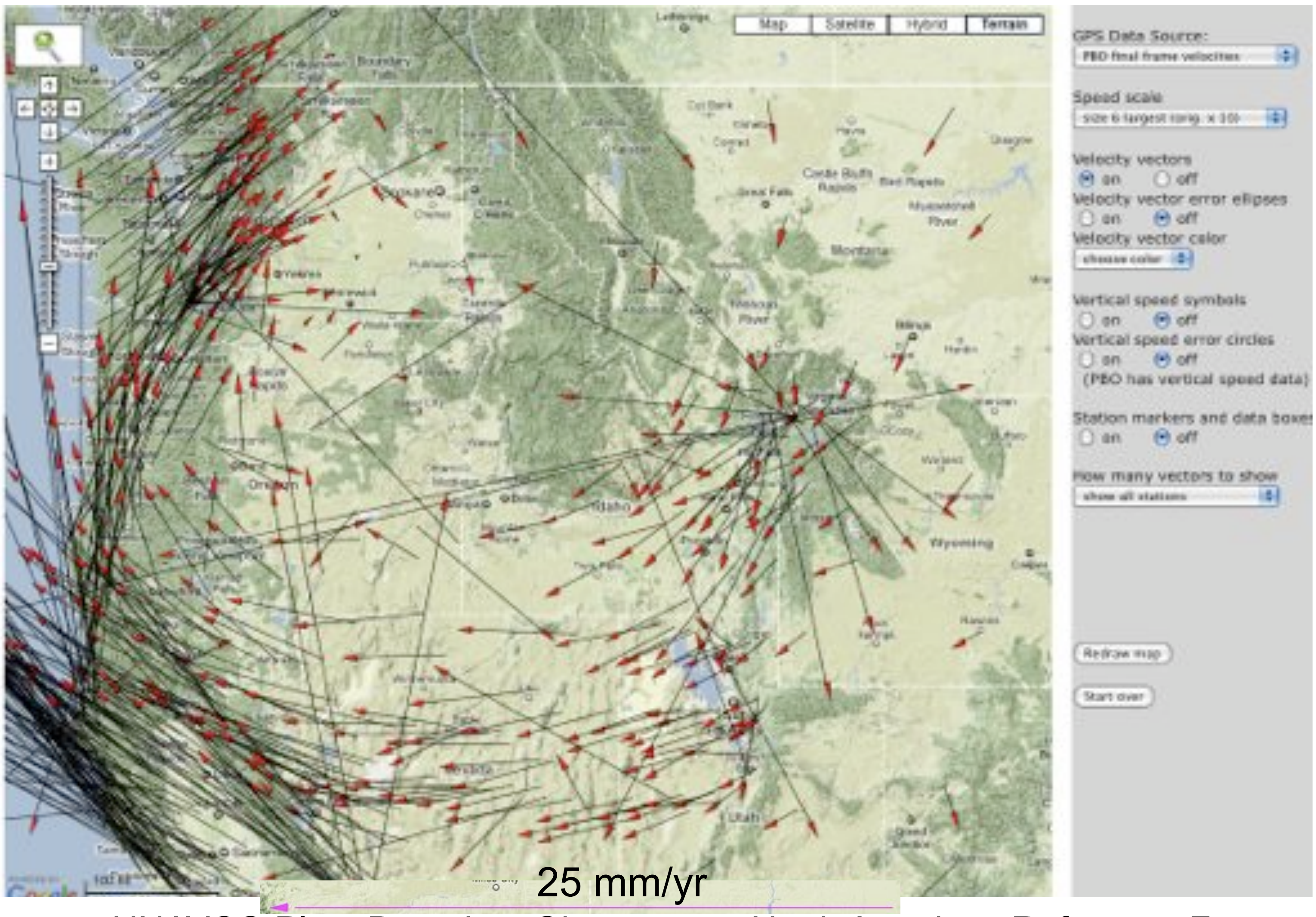
Megan Berg/Shelley Olds/Val Sloan/Melissa Weber/TBD

Tools to help people visualize science



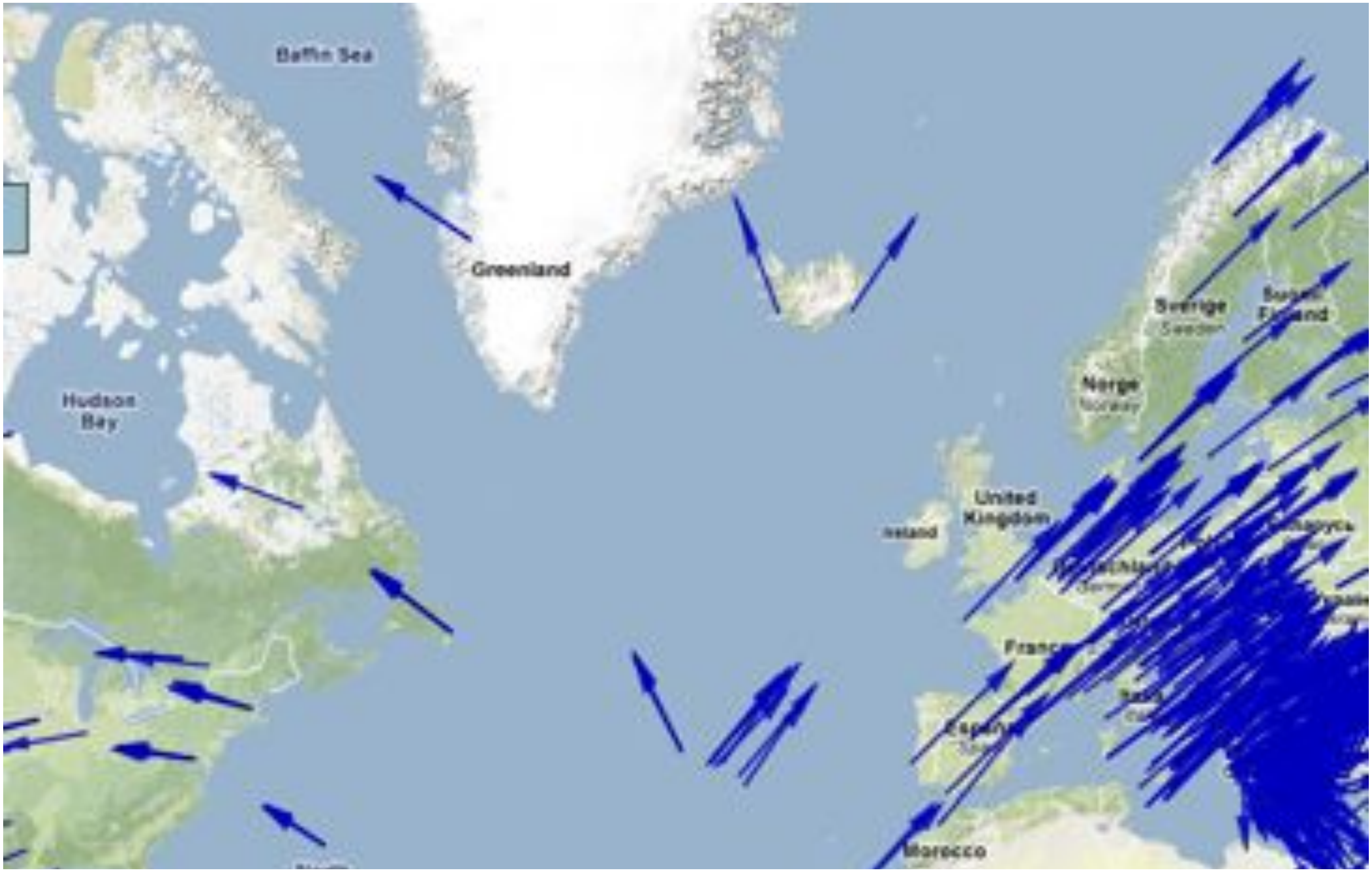
Very Large Temporal & Spatial scales can be difficult to grasp

GPS vectors bring plate tectonics to the human scale of millimeters per year



Data Source: UNAVCO Plate Boundary Observatory: North American Reference Frame
UNAVCO GPS Velocity Viewer: http://geon.unavco.org/unavco/GEV.php

Learners can ***see*** the plates moving apart



Data source: Global Strain Rate Map Project ; Reference Frame: **No Net Rotation**
UNAVCO GPS Velocity Viewer: http://geon.unavco.org/unavco/GEV.php

About UNAVCO

- NSF and NASA funded
- Non-profit
- University-governed
- Consortium
- **Facilitates geoscience research and education using geodesy.**

Education & Outreach Goal:

Broaden the use of UNAVCO data and products by a wide audience of educational and research users

- Goal 1: Increase the understanding and public appreciation of geodynamics and earth deformation processes and their relevance to society.
- Goal 2: Broaden the use of UNAVCO data and products by a wide audience of educational and research users.
- Goal 3: Increase the diversity and broader participation in geoscience education and research.
- Goal 4: Build a sustainable community of UNAVCO scientists and educators engaged in E&O.
- Goal 5: Collaborate with other organizations to provide systemic impact on geoscience education.

- Community Engagement and Outreach: *Highlights, booth*
- Publications: *Strategic Plan, Geodesy Science Plan*
- International Engagement & Partnerships: *COCONet Web Presence*
- Professional Development: *Short Courses, Higher & Secondary Education*
- Workforce development: *Geodesy Curriculum, RESESS*
- Outreach tools development: *Web*

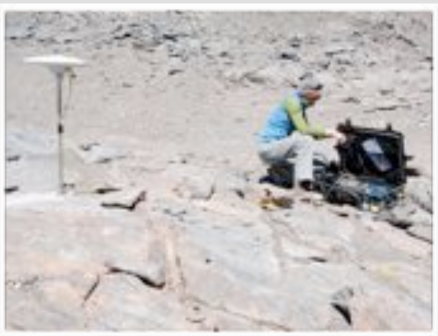
Community Engagement and Outreach: *Highlights, InSights*

Haiti GPS Network

Carbon Sequestration monitoring using GPS

Measurements of Crustal Deformation in the Rio Grande Rift Region

Santorini, Greece GPS Network Installations and Upgrades



PLUTONS GPS Installations, Part 3

Mt. Pinatubo Terrestrial Laser Scanning

Geodynamics of Ridge Collision on the Caribbean Plate and Panama Block

InSights: Alaska repairs

Community Engagement and Outreach: *AGU & GSA*

home › publications & reports › meeting & event publications

2012 AGU Fall Meeting - UNAVCO Posters

These PDF files were optimized to reduce download times and are not meant to be print quality.

Authors	Poster Title and Link
Christine Puskas; Robert B. Smith; Wu-Lung Chang; Alan Cannaday; Christopher B. DuRoss	Comparison of Moment Rates from GPS Observations and Late Quaternary Paleoearthquakes on the Wasatch Fault, Utah
Adrian A. Borsa; Jean-Bernard H. Minster	Rapid Determination of Near-Fault Earthquake Deformation Using LIDAR
Elizabeth J. Van Boskirk; Michael H. Gottlieb; Kathleen M. Hodgkinson; David Mencin; Wade Johnson; Chad Pyatt; David B. Henderson; Otina Fox; Warren W. Gallaher; Michael E. Jackson	2011 Creep Event Observations in Borehole Strainmeter Instrumentation Along the San Andreas and San Jacinto Faults
William J. Wr… Monahan; W… Karina V. Sch…	…m
Susan C. Eri…	…nt
Jeff McWhirte… Squibb; Loui…	…nt
Wade Johnso… H. Gottlieb; C… Warren W. G…	…ic
Kenneth Aus… Williams; Mic…	…a
Henry T. Ber…	

Publications::*Strategic Plan*

UNAVCO

International Engagement & Partnerships:
COCONet Web Presence

Main goals:

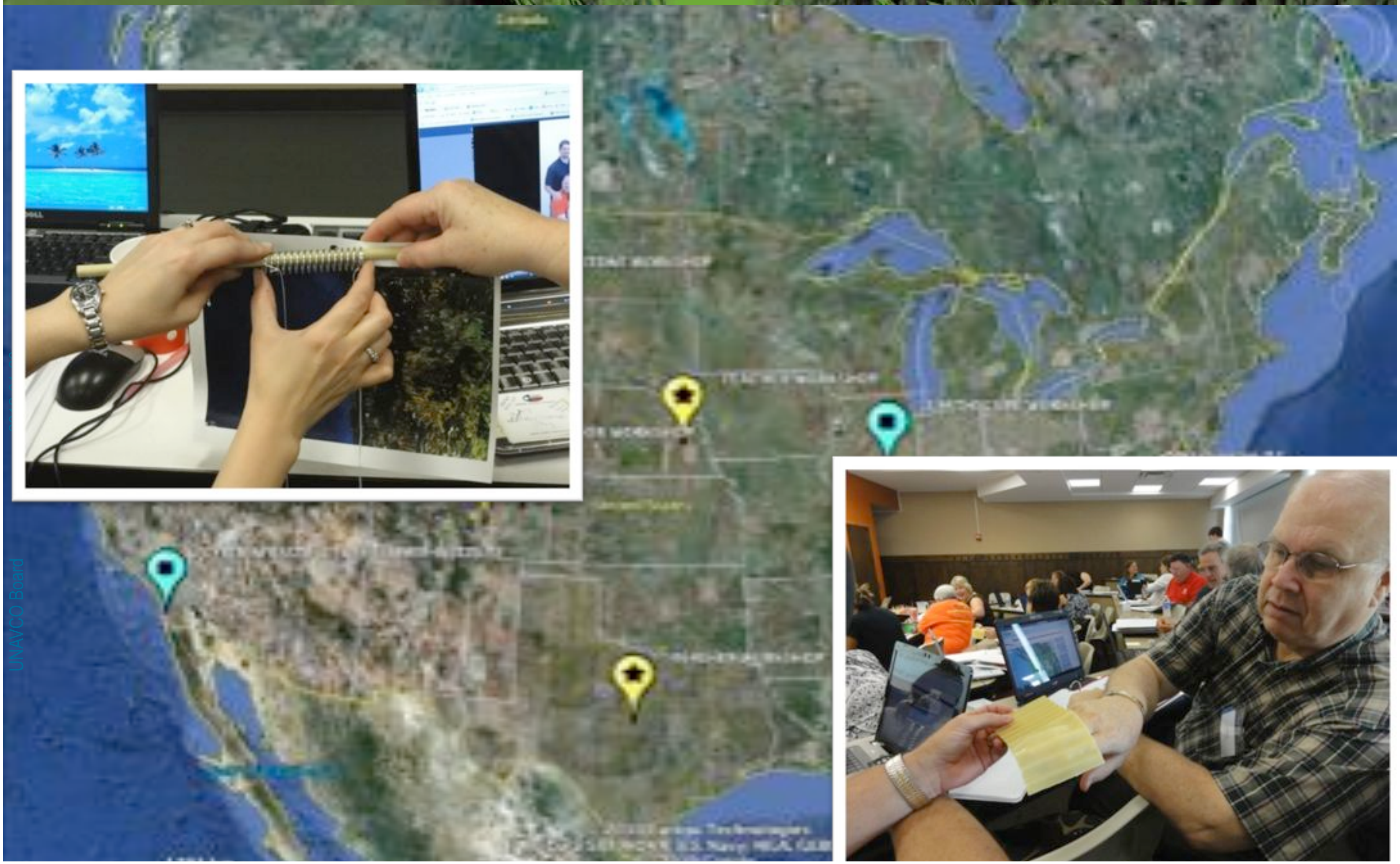
- Showcase international collaboration
- Data access
- Reports and publication archive
- Community event calendar

UNAVCO

Professional Development:
Short Courses

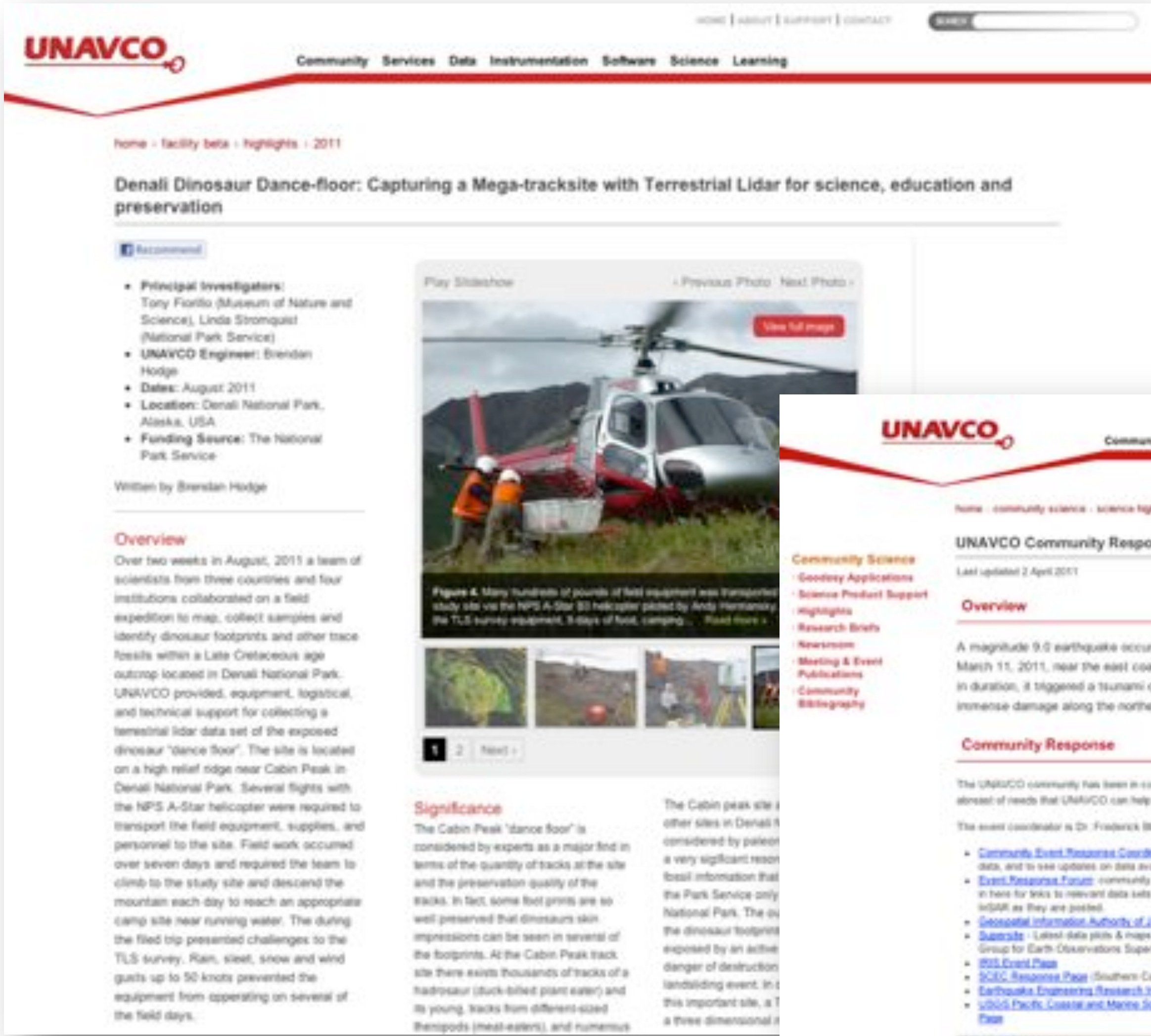
Subject	2004	2005	2006	2007	2008	2009	2010	2011
Strainmeter	✔	✔	✔		✔	✔	✔	
GPS GAMIT/ GLOBK	✔		✔	✔	✔		✔	✔
Track, TrackRT						✔		✔
Lidar Terrestrial				✔		✔✔	✔	✔
Airborne			✔	✔	✔		✔	
InSAR			✔		✔	✔	✔	✔

Professional Development:
Higher and Secondary Education



UNAVCO

Outreach tools development: *Web*



Workforce development: *Geodesy Curriculum*

UNAVCO

Transforming Undergraduate Education in Science, Technology, Engineering and Mathematics (TUES) Course, Curriculum, and Laboratory Improvement (CCLI)

PROGRAM SOLICITATION
NSF 10-544

REPLACES DOCUMENT(S):
NSF 09-529

National Scie
Directorate for
Division of

- NSF TUES Phase I proposal – May
- Team: Beth Pratt-Situala, Andy Newman, Matt Pritchard, Shimon Wdowinski, Mark Simons, Bob Butler Shelley Olds
- Inventory – *initial phase completed*
- Proposal outline – *in progress*
- Concurrent development efforts
- Learning materials – polishing and posting to SERC and UNAVCO

Workforce development: *RESESS*

RESESS: Research Experiences in the Solid Earth Sciences for Students

- Intensive summer internship program in Boulder, CO
- Authentic research projects in the geosciences
- Mentoring, writing instruction, field trips, peer group
- 2011 intern cohort:
  - 13 interns from 11 institutions, 5 Black, 5 Hispanic, 3 Native American, 8 female, 5 male.

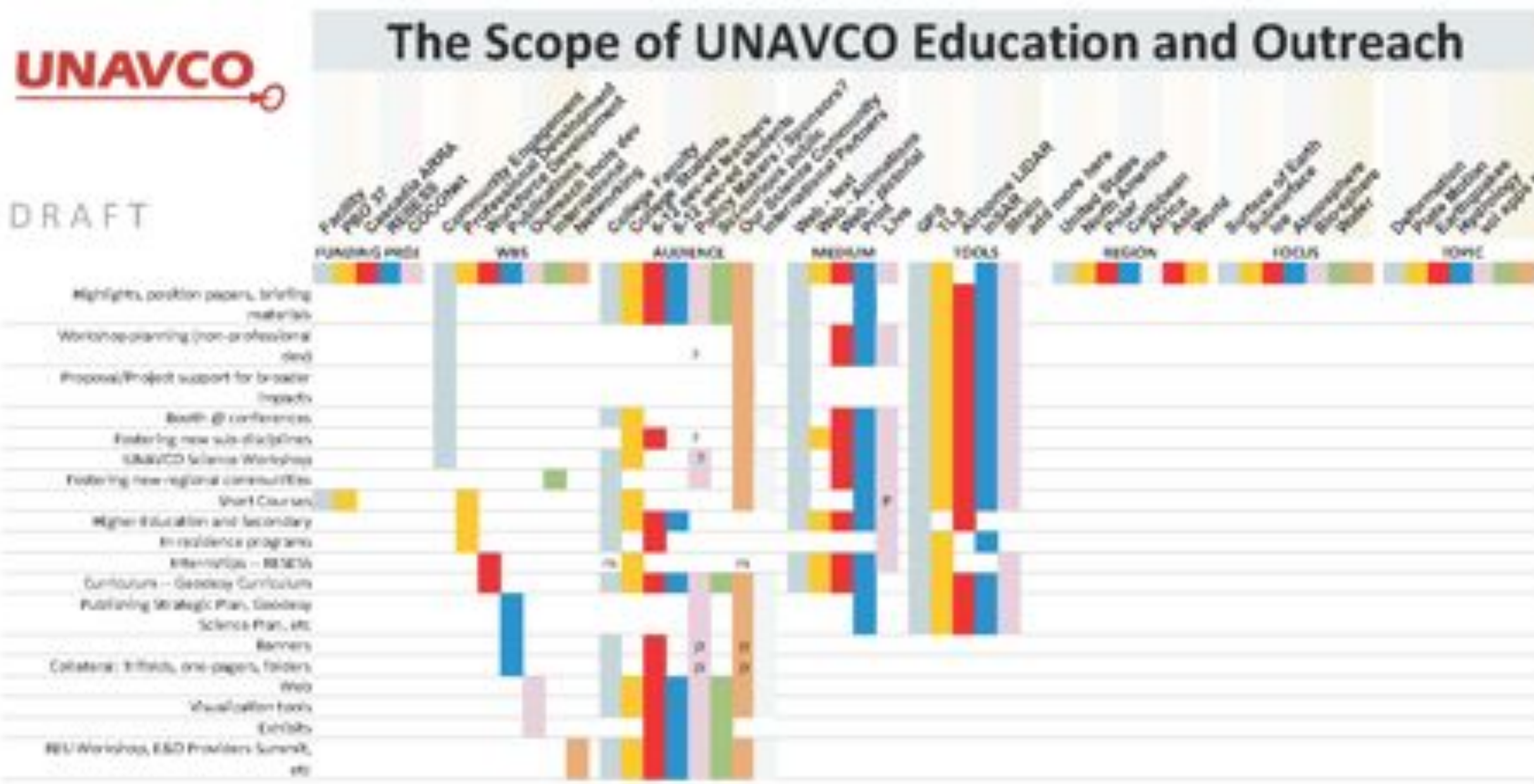


"Starting the conversation…"

Leaders from REUs (Research Experiences for Undergraduates)

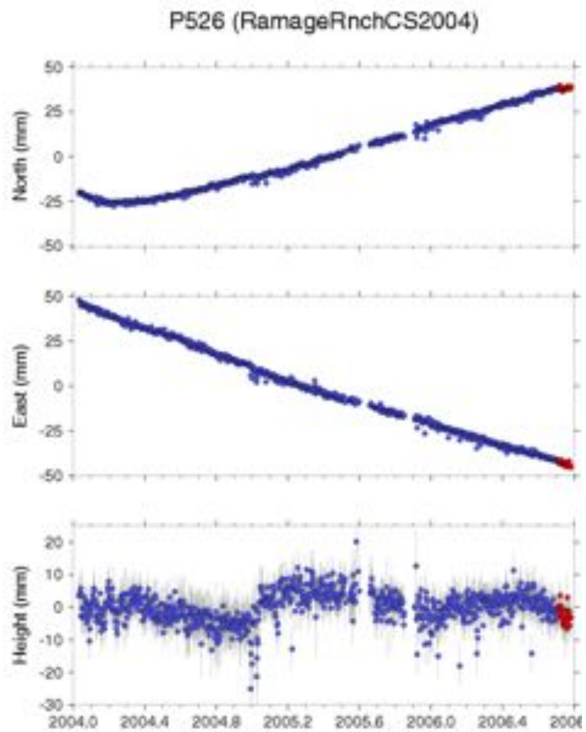
- UNAVCO organizer
- 57 out of 67 programs represented
- Goal: Begin Networking

Upcoming Initiatives:
Planning the Future: Education & Community Engaement

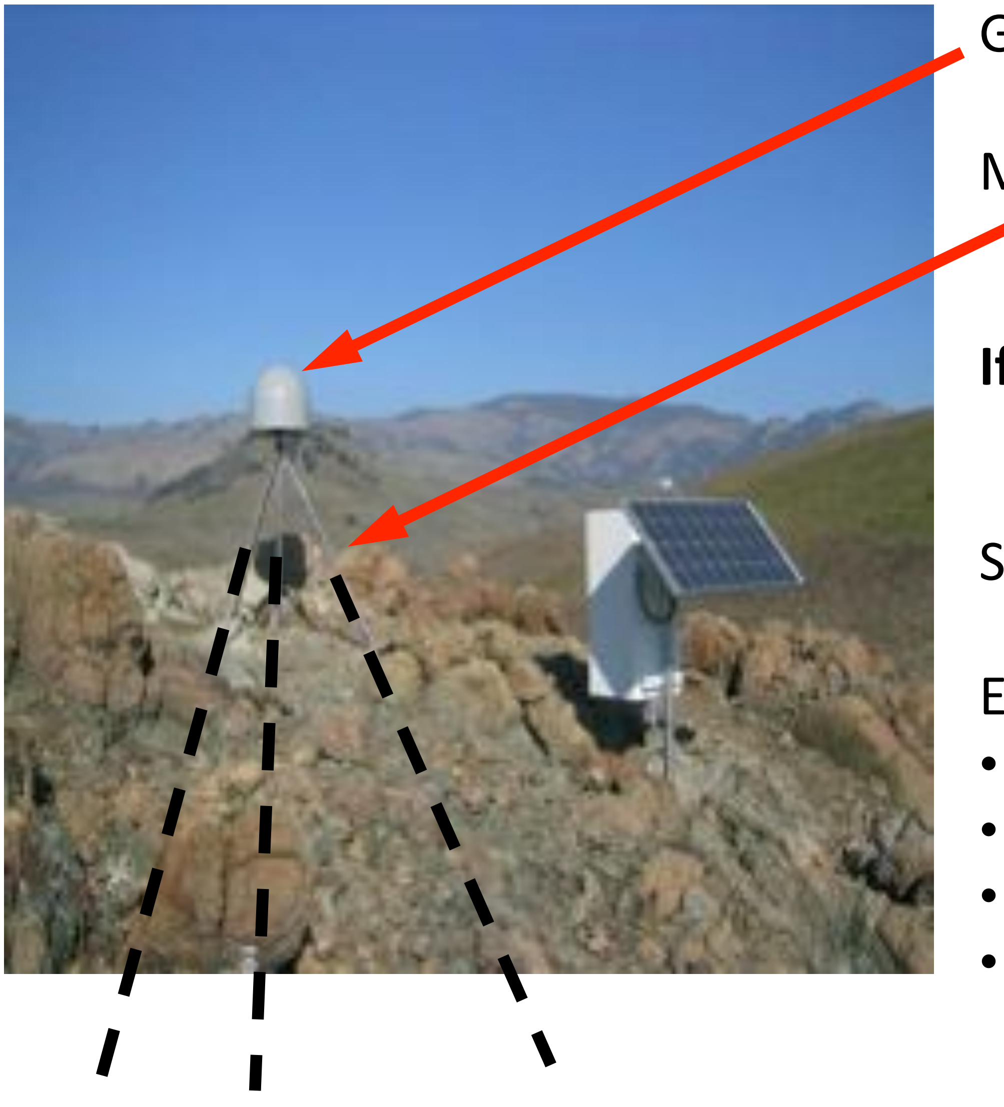


Types of Data & Products

- Multiple search interfaces
- GPS, LiDAR, InSAR, strain, tilt …
- Data/Data Products
  - ➢Time Series Plots
  - ➢Images
  - ➢Velocity Vectors
  - ➢Visualizations
  - ➢Data formats
    - ▪ Raw
    - ▪ Processed



Anatomy of a High-precision Permanent GPS Station



GPS antenna inside of dome

Monument solidly attached into the ground with braces.

If the ground moves, the station moves.

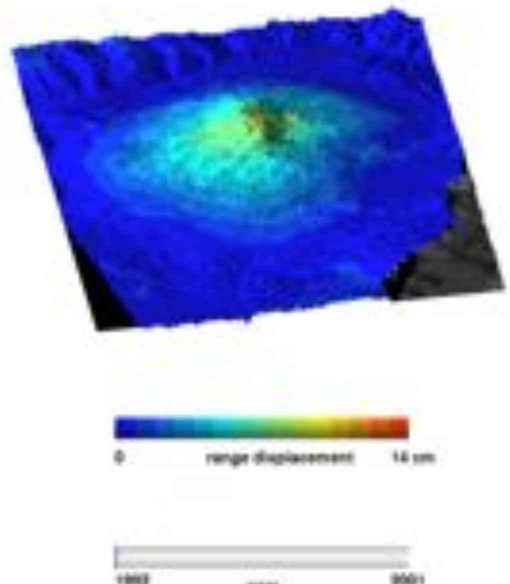
Solar panel for power

Equipment enclosure

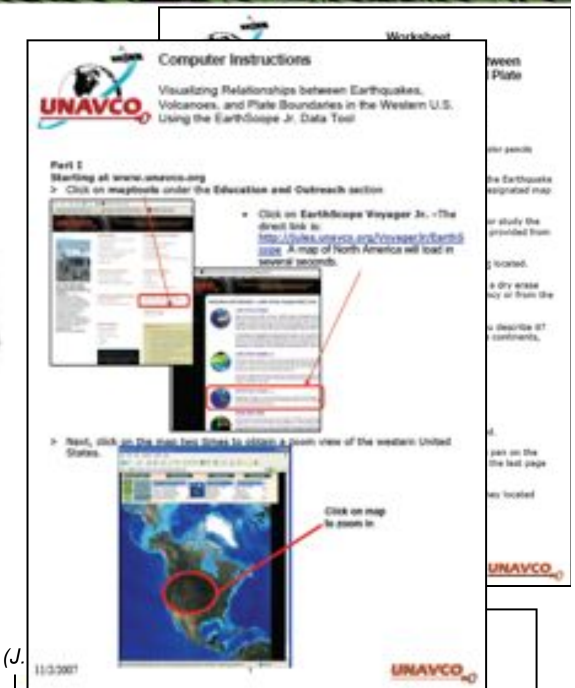
- GPS receiver
- Power/batteries
- Communications/ radio/ modem
- Data storage/ memory

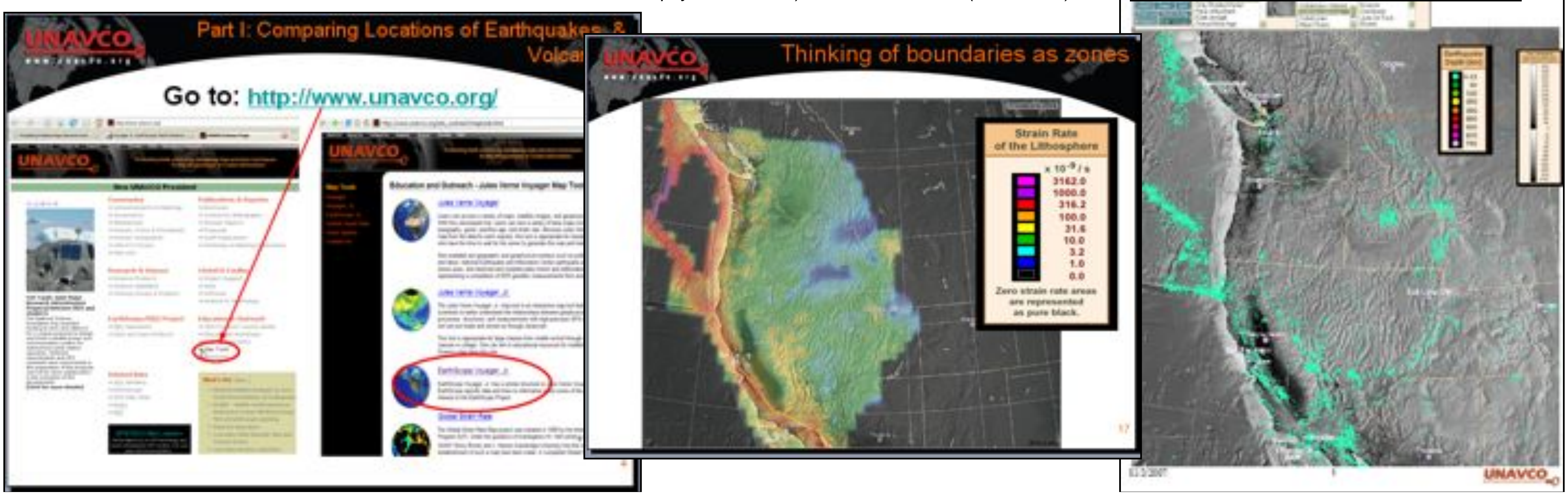
Learning Materials

- Tutorials & How to's
- Animations
- Computer instructions
- How to download data
- Student worksheets
- …

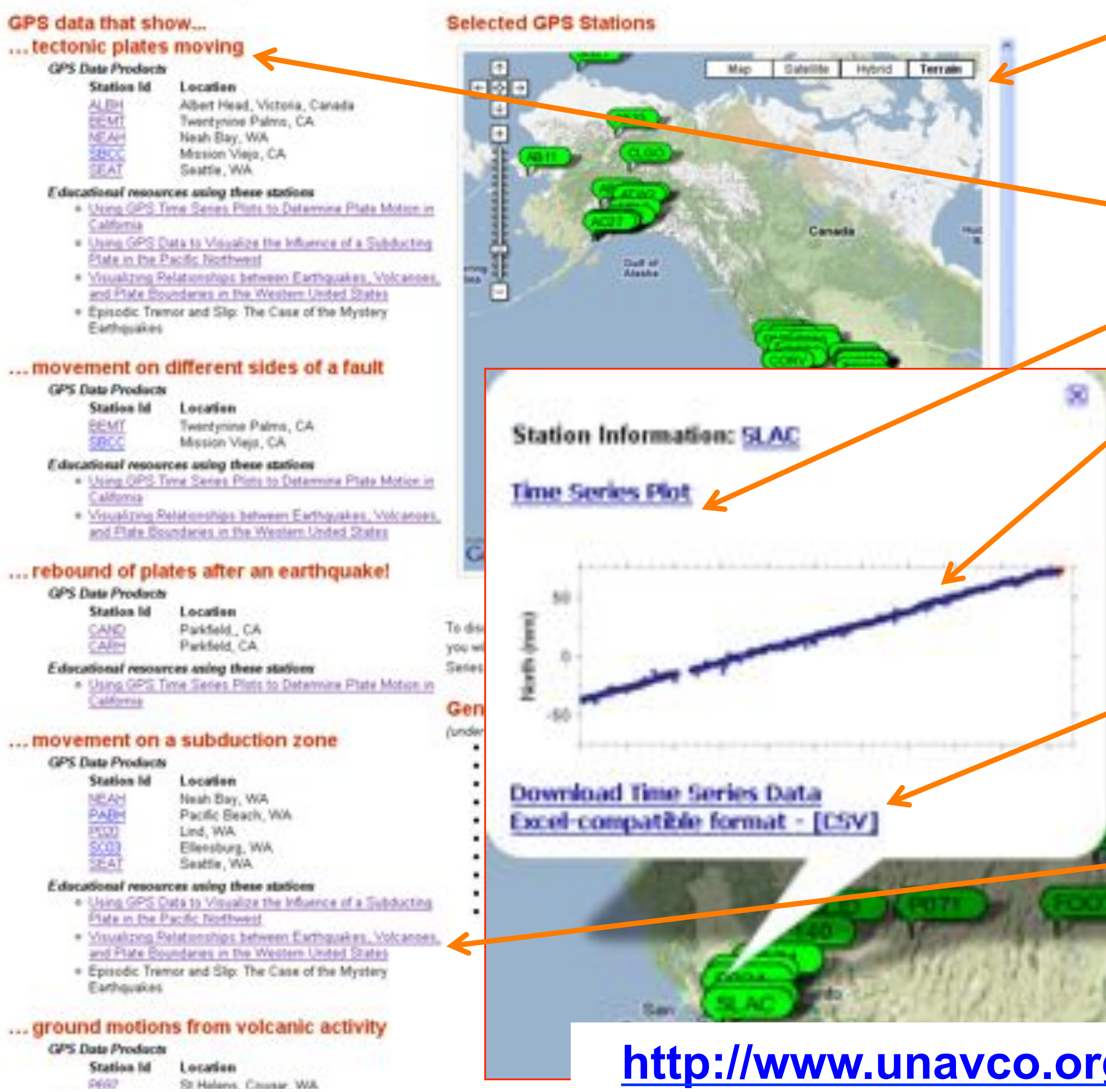


Based on time series inversion algorithms of Lundgren et al. (J. Geophys. Res., 2001) and Berardino et al. (IEEE, 2002).





Data for Educators for resources you can use

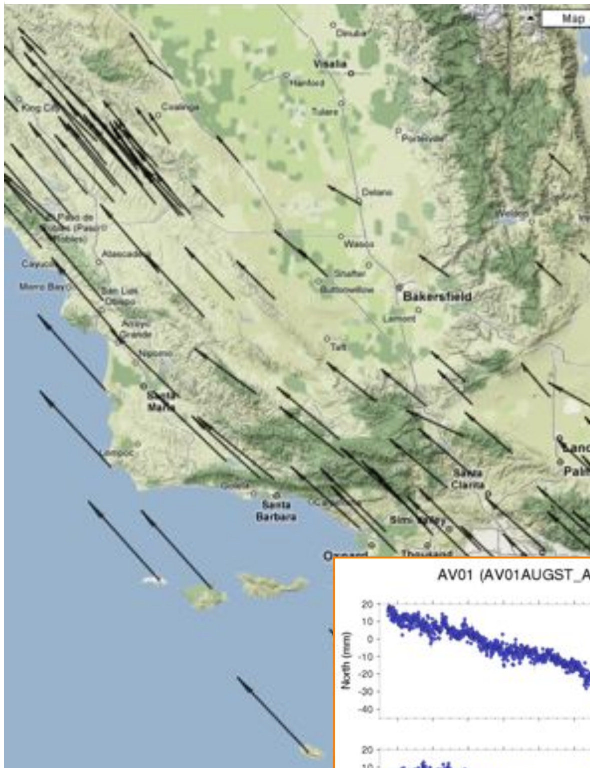


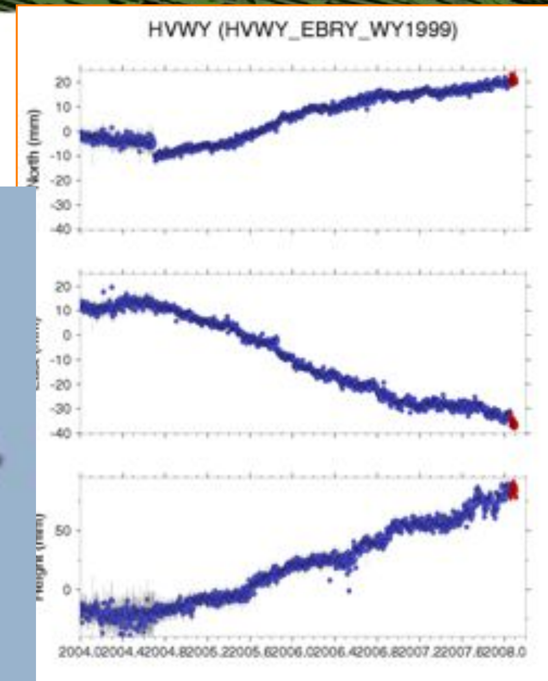
- Visual display of station locations
- Interesting data
- Full data plot
- Quick data preview
- Excel readable formats
- Associated Activities

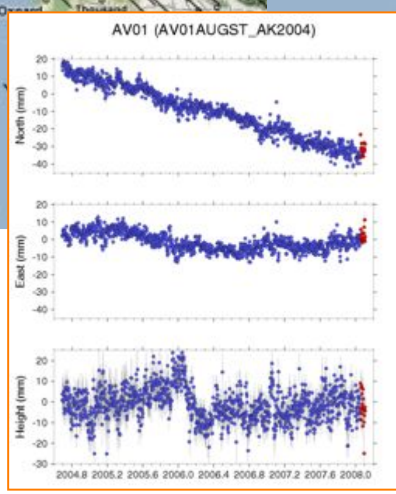
http://www.unavco.org/edu_outreach/data.html

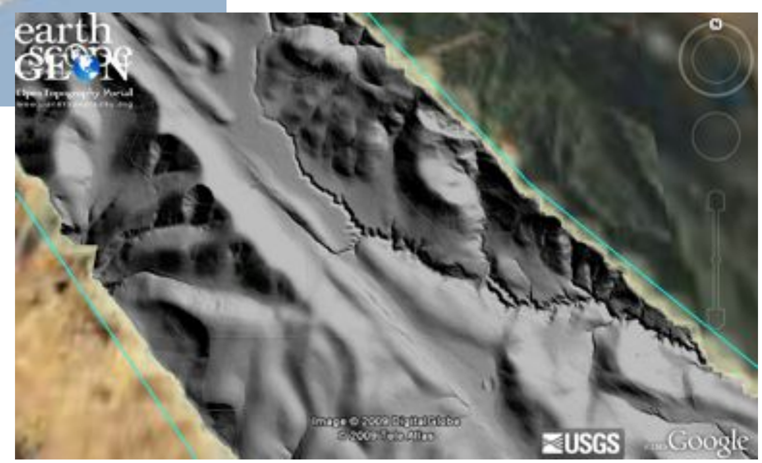
Explore & Compare Data

GPS Velocities in UNAVCO Velocity Viewer using Google Maps
http://geon.unavco.org/unavco/GPSVelocityViewer.php



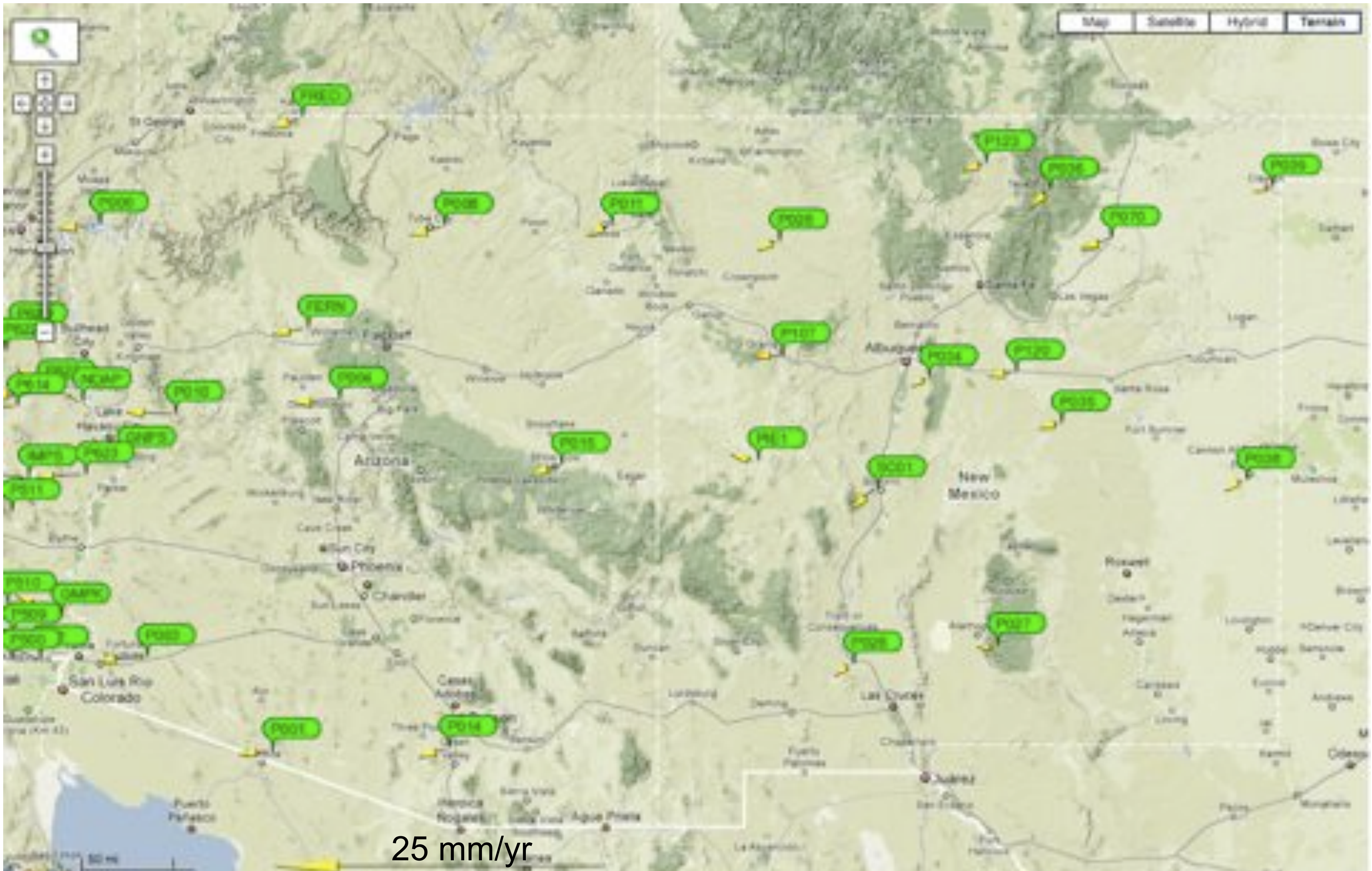






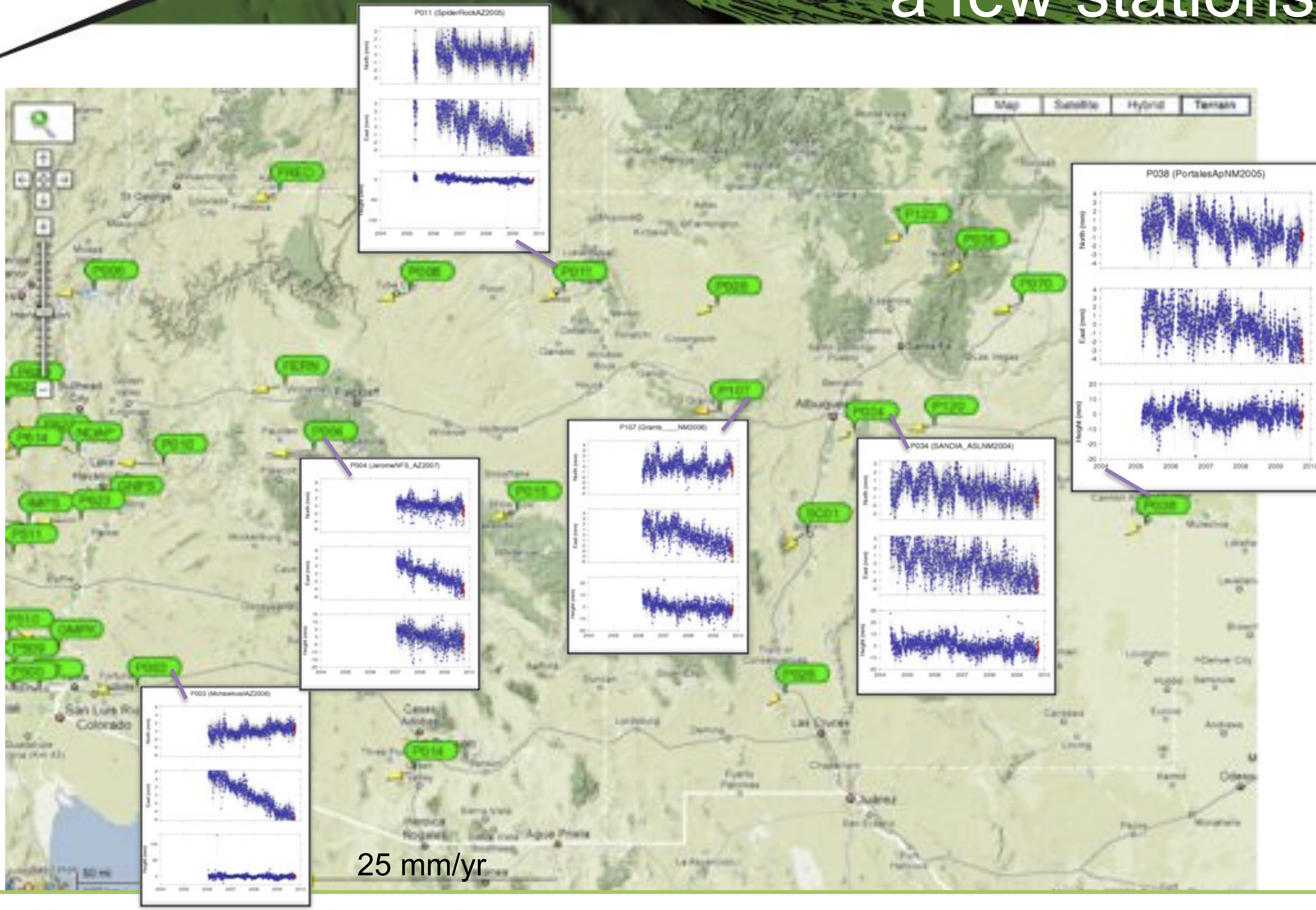
GEON LiDAR image in Google Maps
http://www.opentopography.org/index.php

GPS Stations in Arizona and New Mexico



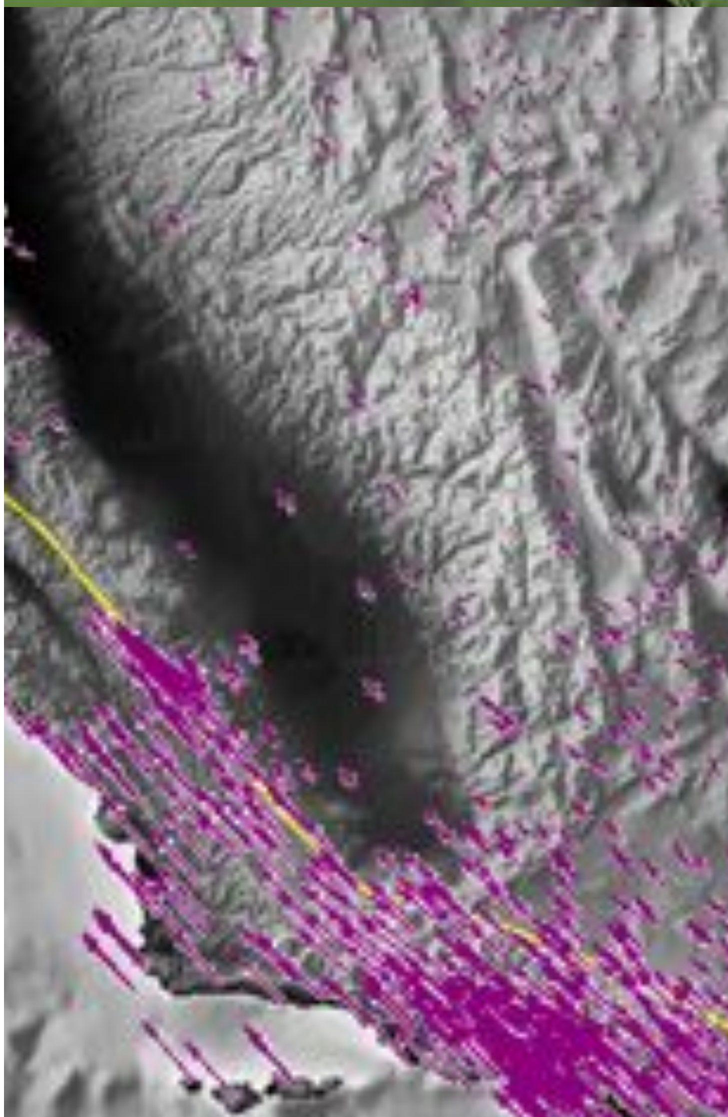
http://geon.unavco.org/unavco/GPSVelocityViewer.php

GPS Time Series Plots for a few stations

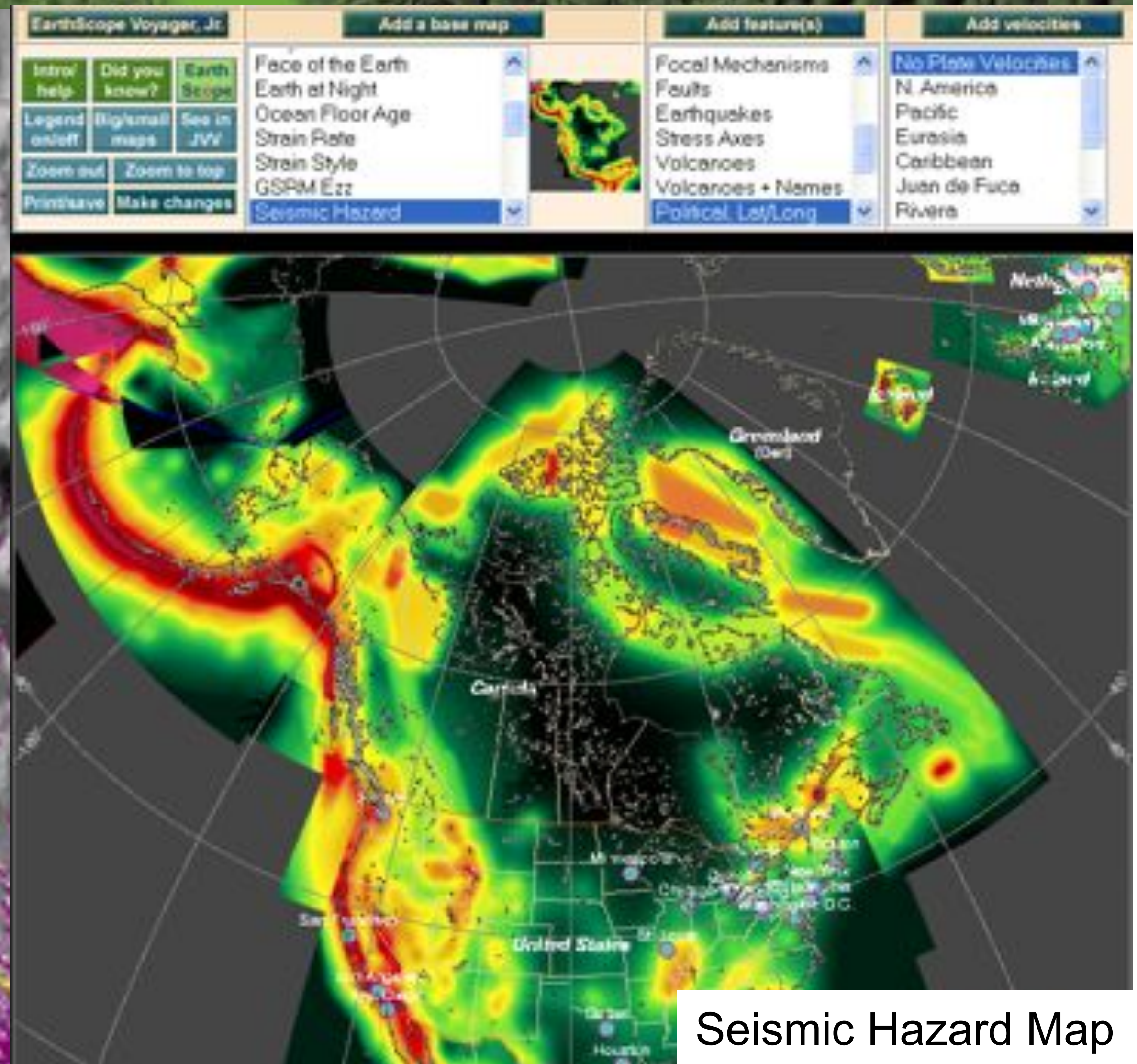


http://geon.unavco.org/unavco/GPSVelocityViewer.php

Jules Verne & EarthScope Voyager Jr.



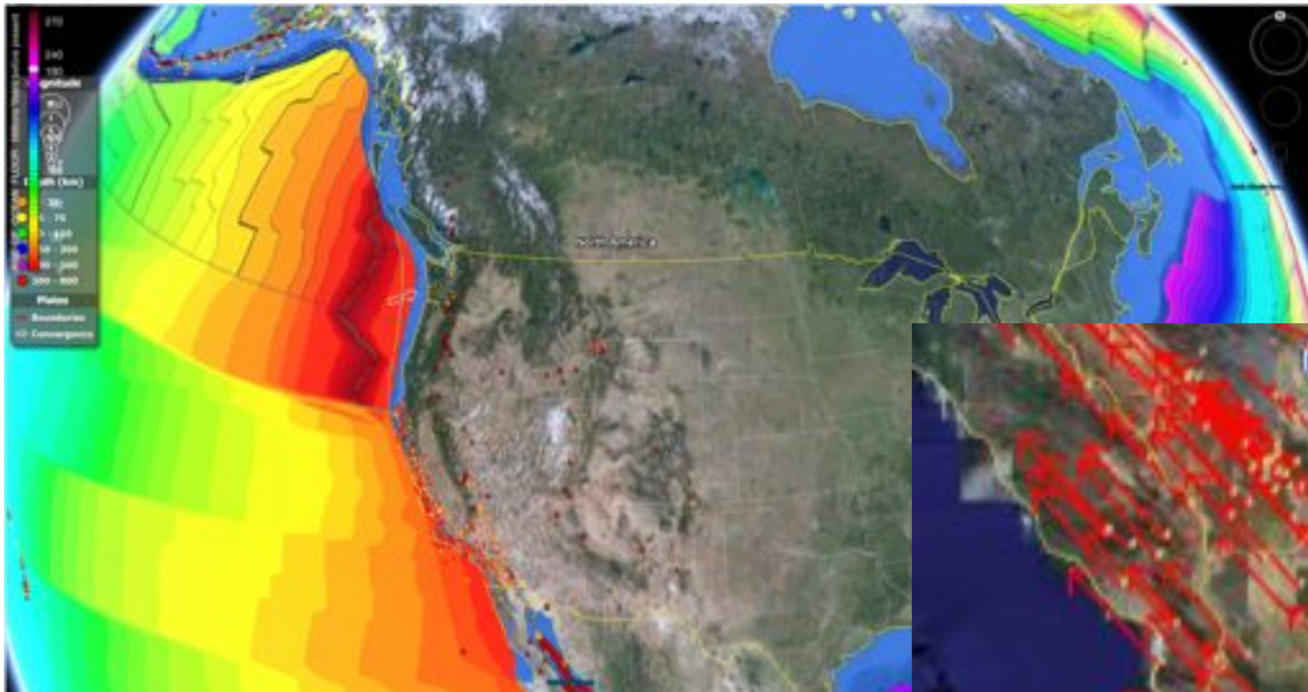
Velocity Vectors



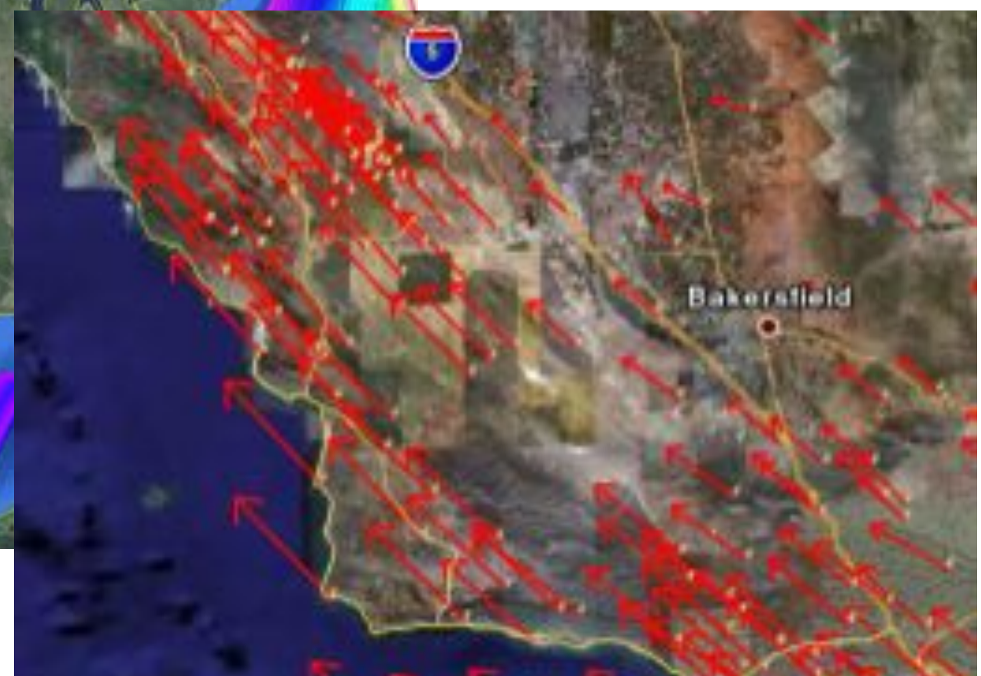
Seismic Hazard Map

http://www.unavco.org/edu_outreach/maptools.html

UNAVCO Geophysics / Learn about Plate Tectonics, Google Earth KMZ

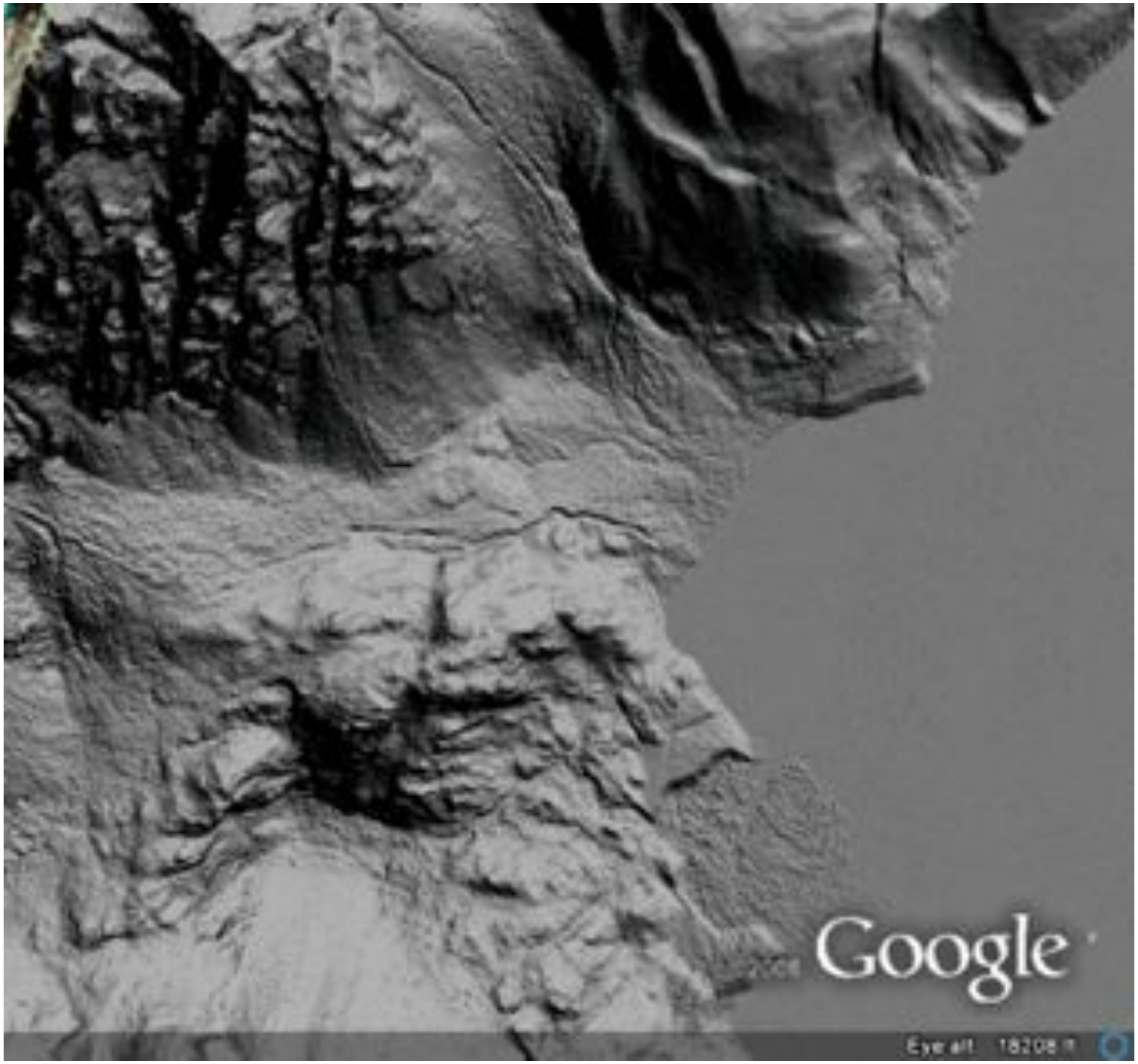


Google Earth KMZ
http://geon.unavco.org/unavco/GE/Learn_about_Plate_Tectonics.kmz

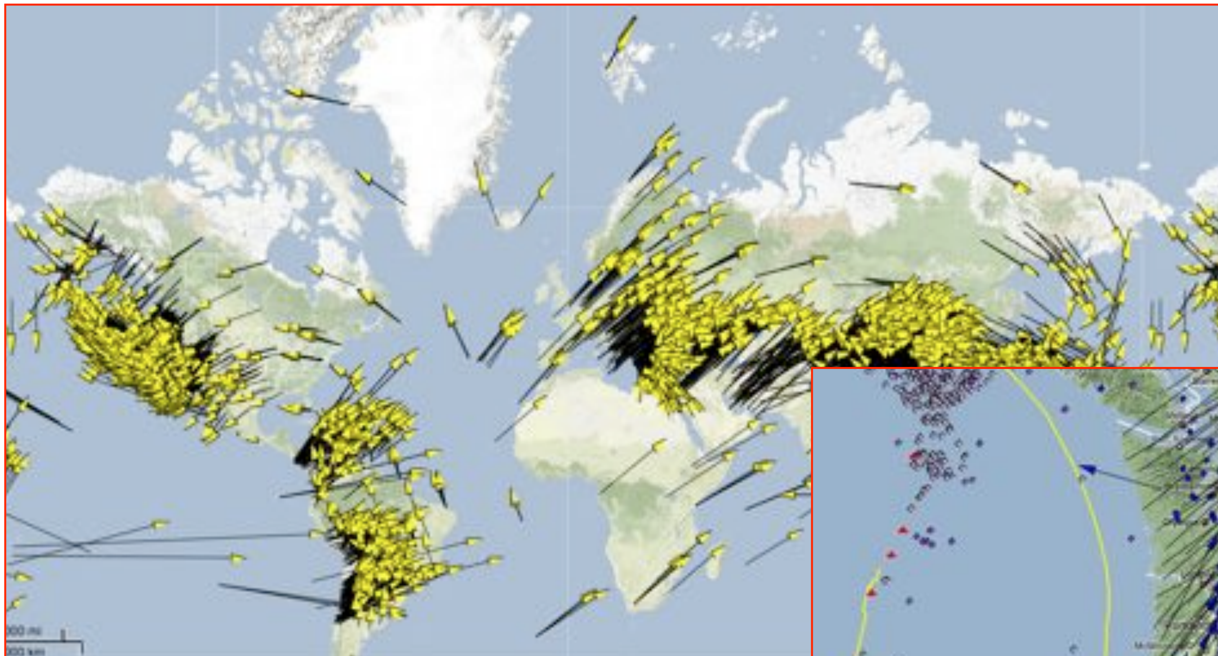


GPS Velocities Google Earth KMZ
http://pboweb.unavco.org/products/velocity/pbo_final_frame.km
http://facility.unavco.org/data/maps/maps.html

LiDar in Google Earth

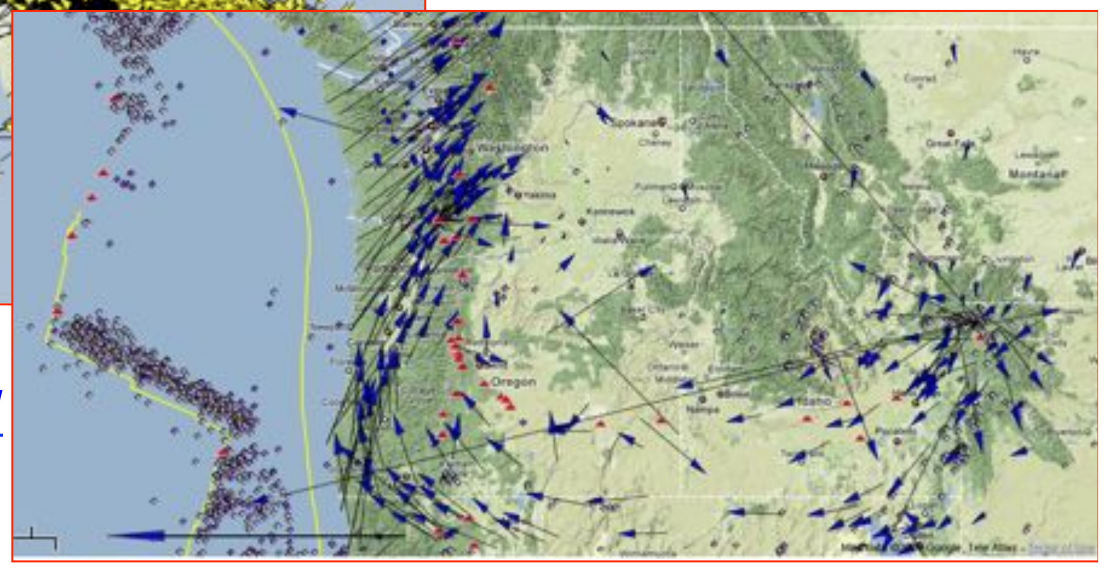


GPS Velocity Viewer beta
V1 & V2 in Google Maps



V1: vectors only

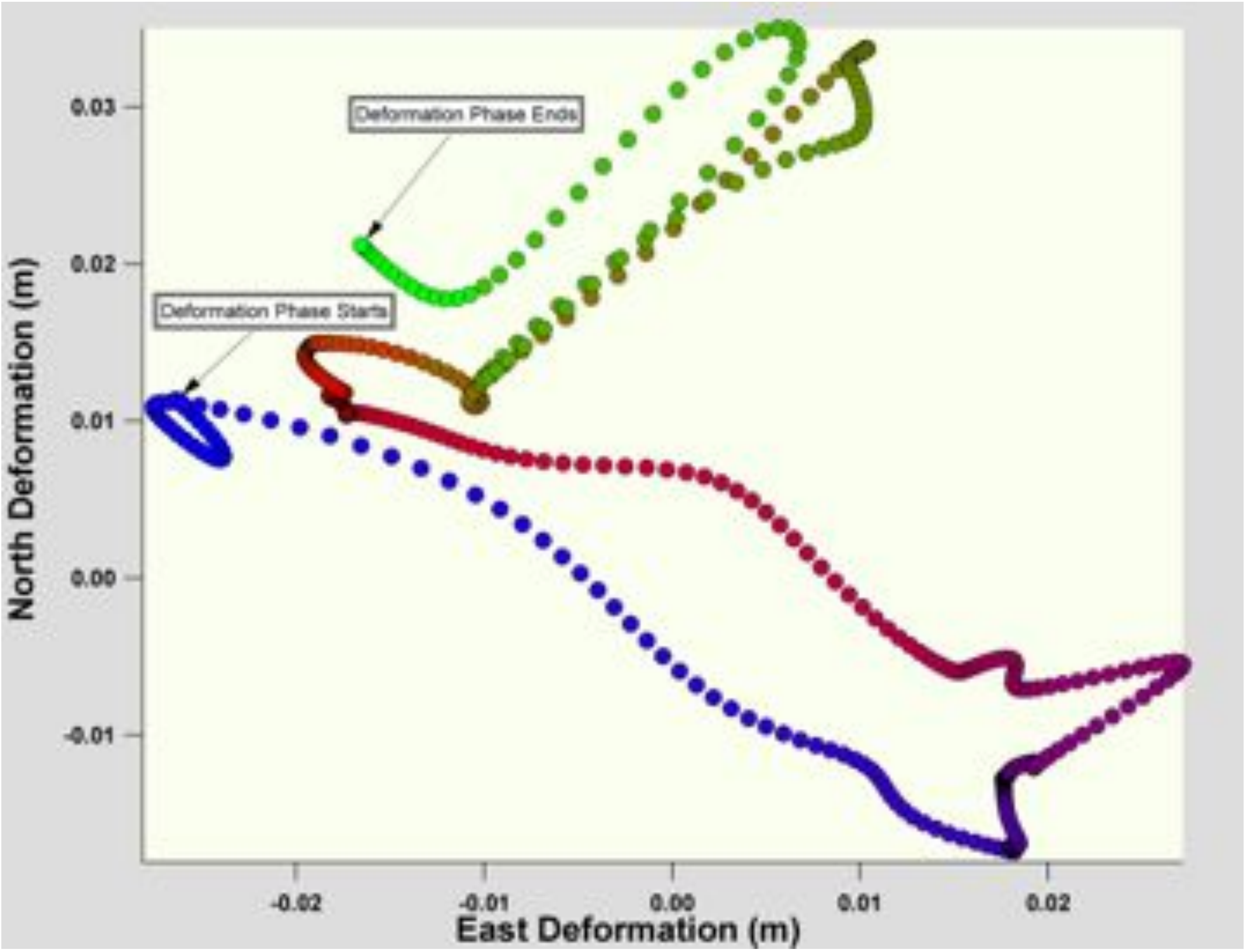
http://geon.unavco.org/unavco/GPSVelocityViewer.php



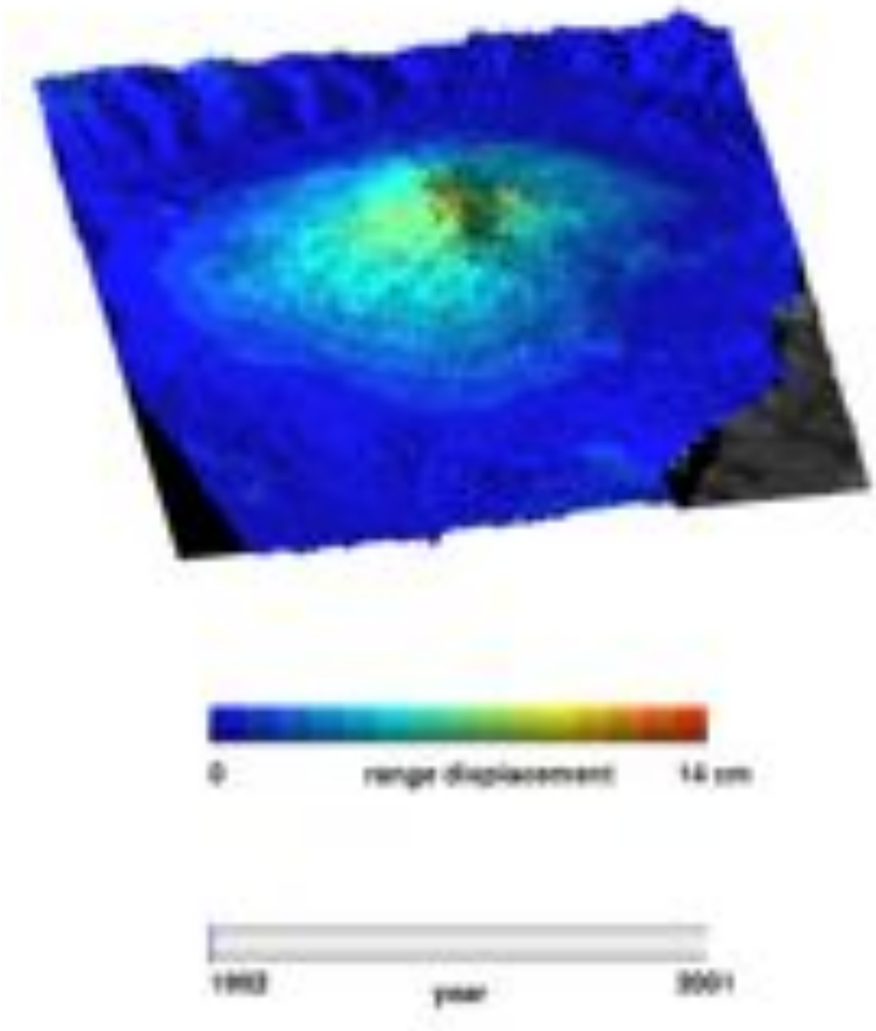
V2: vectors, volcanoes, earthquakes, plate boundaries

http://geon.unavco.org/unavco/GEV.php

The Path of Station P697 on Mt. St. Helens



Volcanoes… inflate and deflate Mt. Etna, Sicily



- > 100 Synthetic Aperture Radar (SAR) interferograms from 47 dates during 1992-2000
- 14 cm range

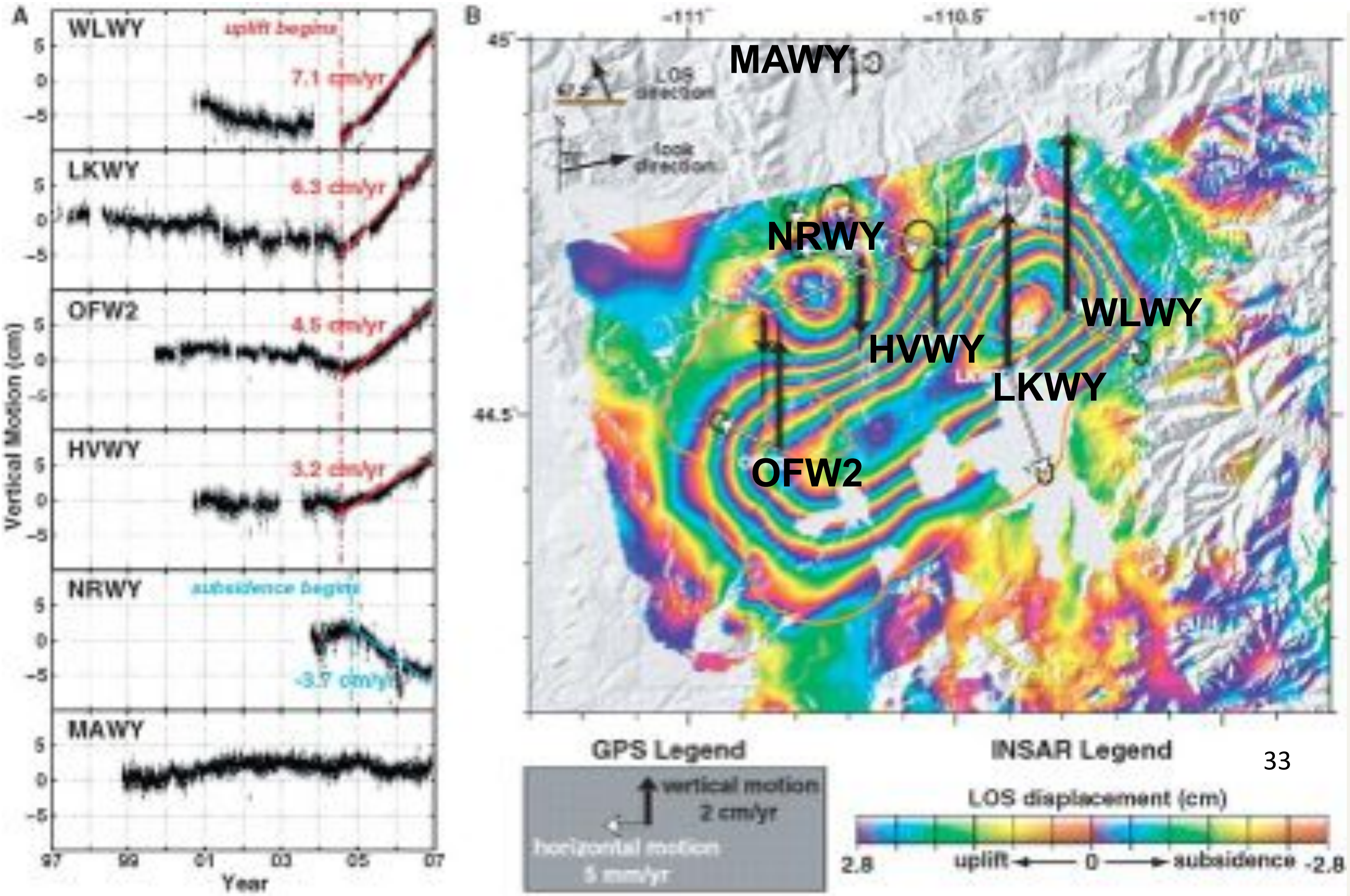
Timeline and activity:

- 1991-1993 Flank eruption
- 1992-1993 Etna deflates as eruption subsides
- 1993-1995 Etna inflates, undergoes summit magmatic activity
- 1995-2000 Multiple inflation and deflation “breathing” episodes, accompanying repeated summit activity.

Based on time series inversion algorithms of Lundgren et al. (J. Geophys. Res., 2001) and Berardino et al. (IEEE, 2002).

Inflation @ Yellowstone Caldera

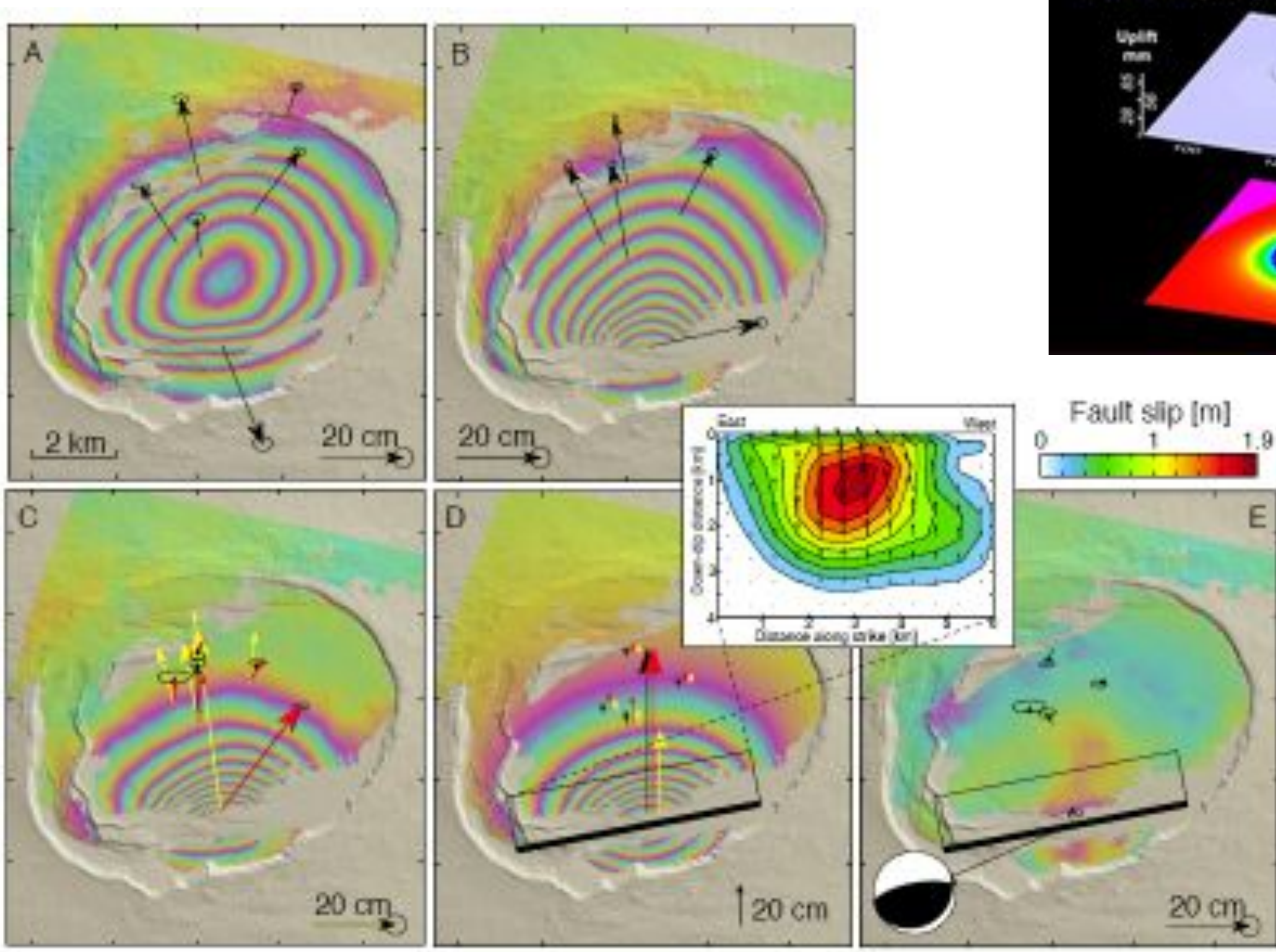
Fig. 2. (A) Temporal variation of vertical ground motions of labeled Yellowstone GPS stations

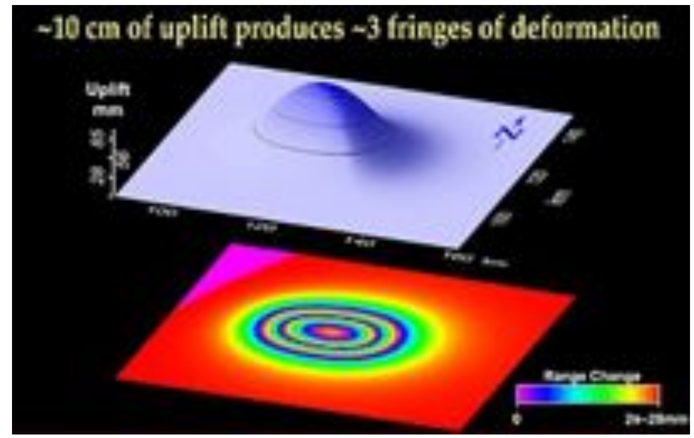


W.-L. Chang et al., Science 318, 952 -956 (2007)

Using InSAR and GPS: Galapagos

InSAR and GPS Vectors
Showing trapdoor faulting event





Summary of Resources

- UNAVCO: http://www.unavco.org
- Stay in Touch withUNAVCO on
  - Facebook: http://www.facebook.com/pages/UNAVCO/58415136190
  - Twitter: http://twitter.com/UNAVCO
- Data for Educators: http://www.unavco.org/edu_outreach/data.html
- UNAVCO GPS Velocity Viewer: **http://geon.unavco.org/unavco/GPSVelocityViewer.php**
- Jules Verne Voyager tools: http://www.unavco.org/edu_outreach/maptools.html
- Geology and Geophysic in Google Earth (Learn about Plate Tectonics KMZ): http://geon.unavco.org/unavco/GE/Learn_about_Plate_Tectonics.kmz
- GPS Velocities Google Earth KMZ: http://pboweb.unavco.org/products/velocity/pbo_final_frame.kmz
- Locations of GPS stations: http://facility.unavco.org/data/maps/maps.html
- LiDAR images in Google Maps from Open Topography: http://www.opentopography.org/index.php

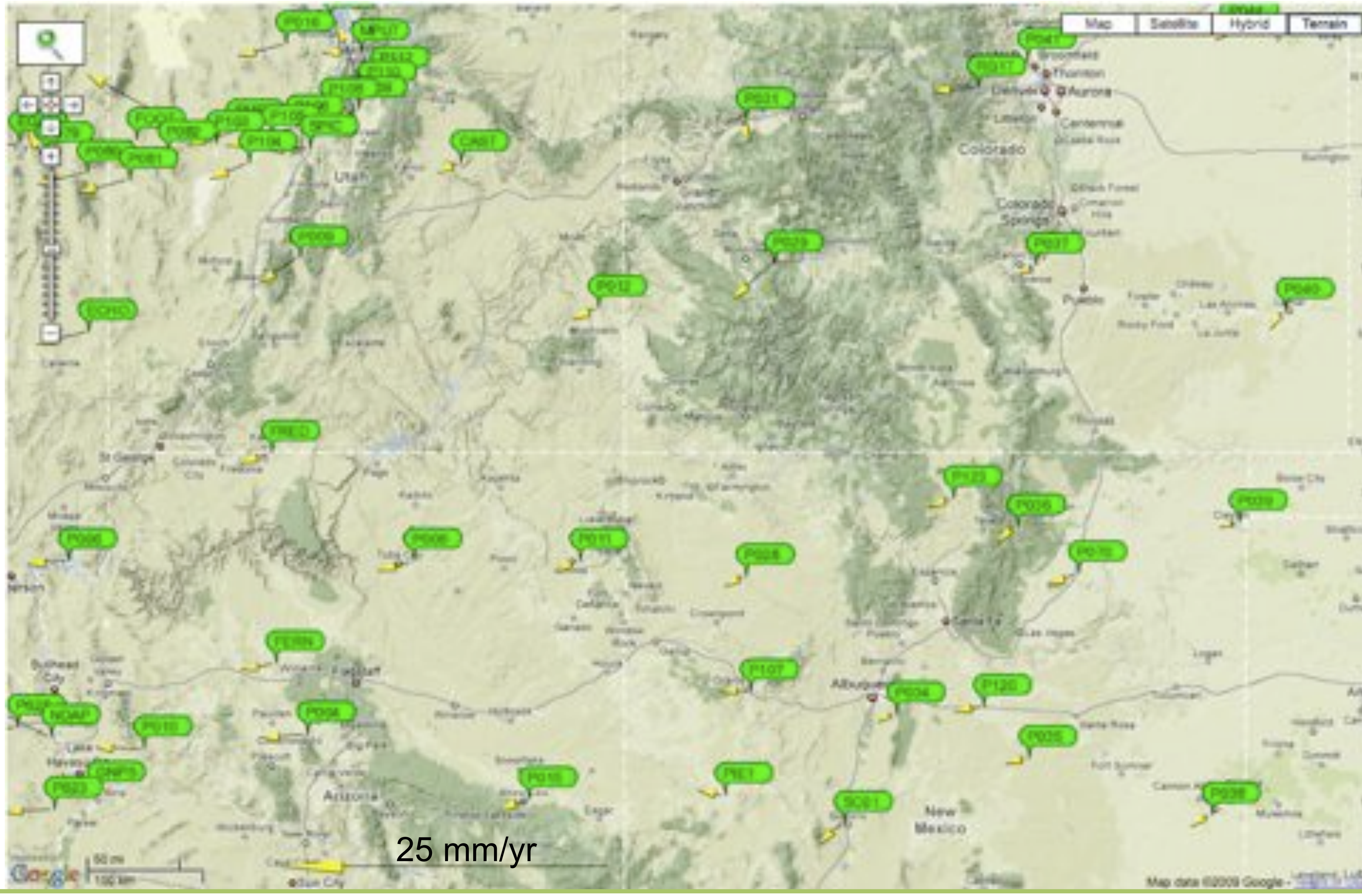
Thank You!

Contact: Shelley Olds
olds@unavco.org
http://www.unavco.org/

Stay in touch with UNAVCO on

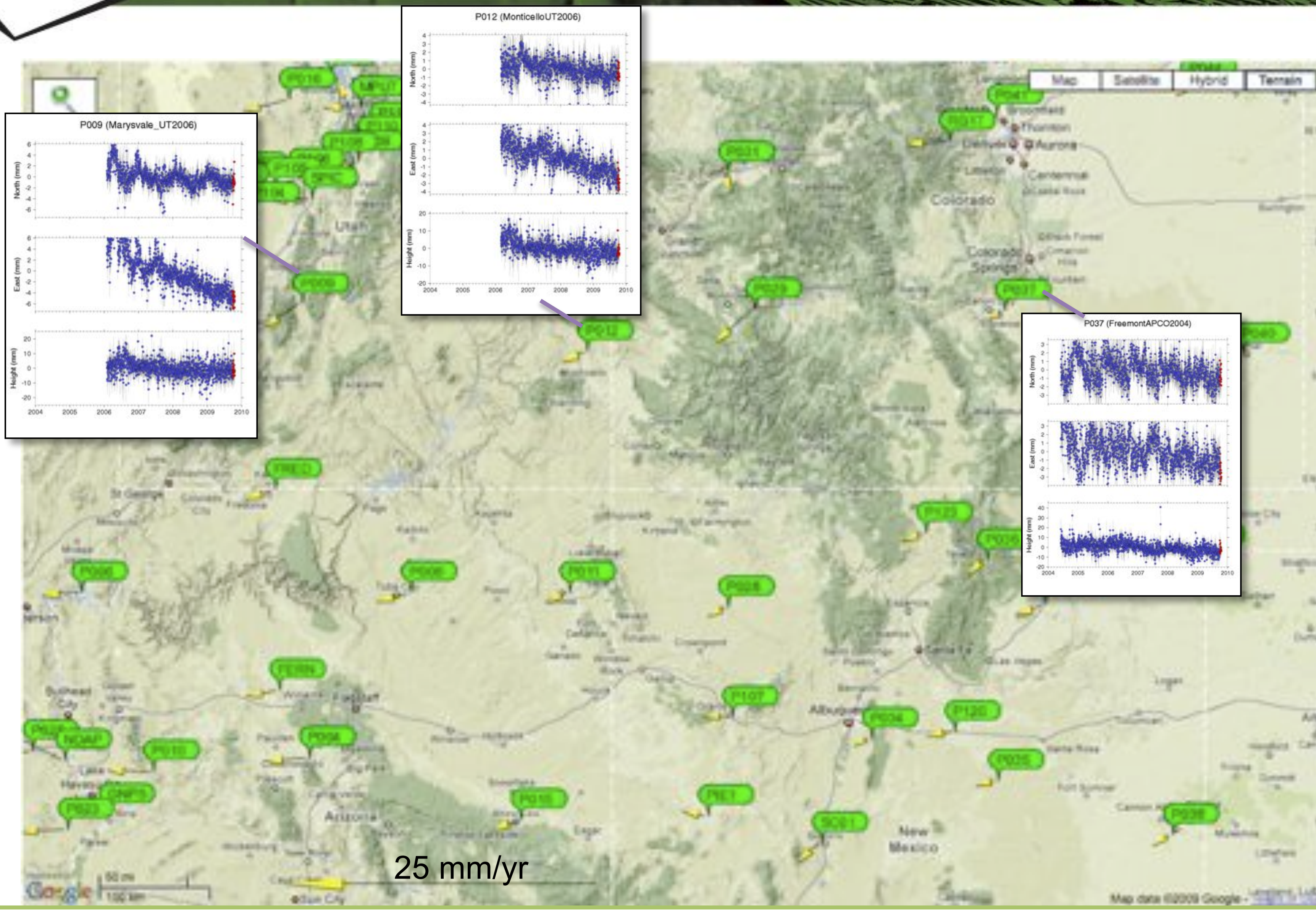
Facebook Twitter

GPS Stations in Utah and Colorado



http://geon.unavco.org/unavco/GPSVelocityViewer.php

GPS Time Series Plots for a few stations in UT and CO



http://geon.unavco.org/unavco/GPSVelocityViewer.php

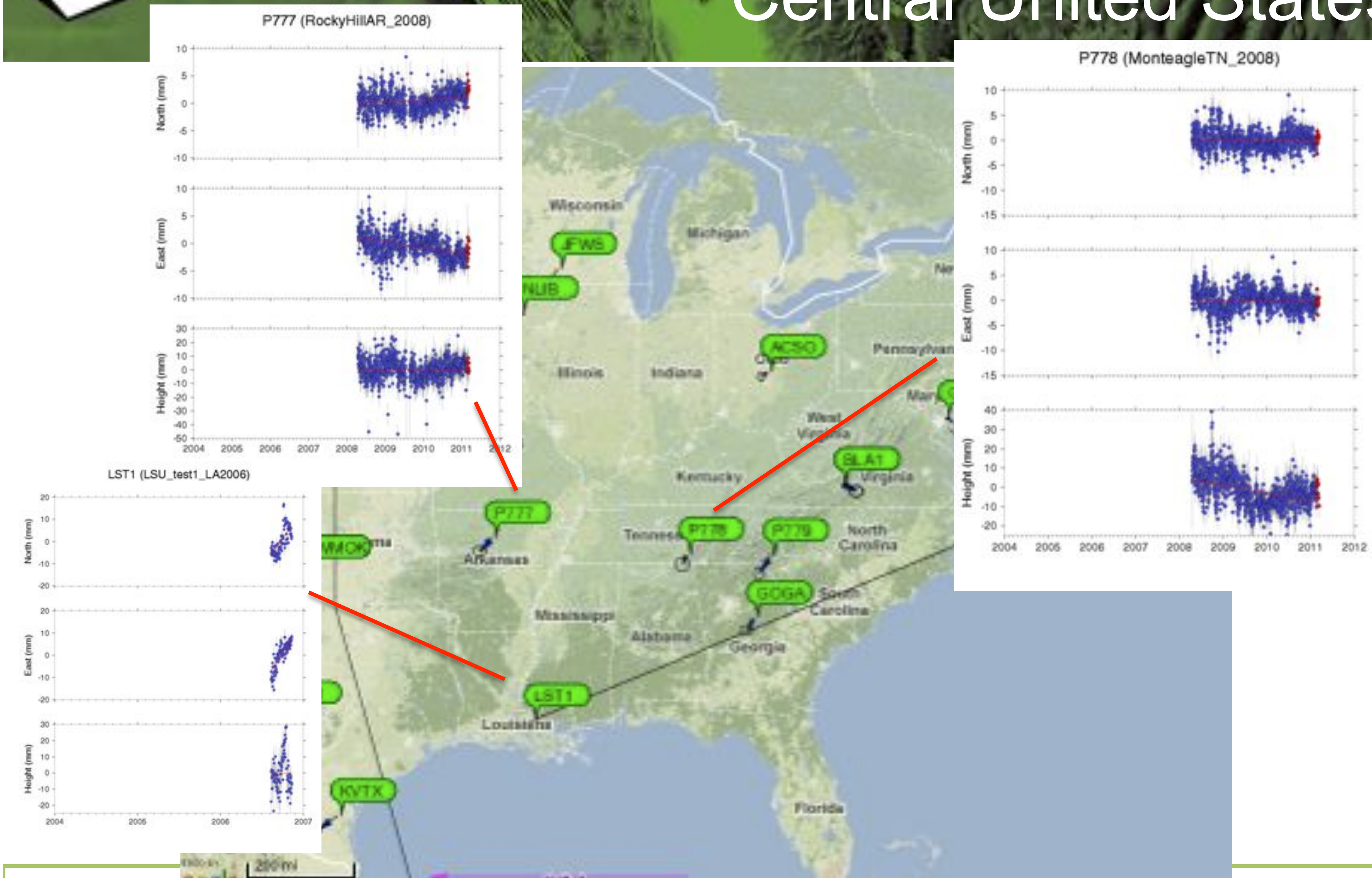
PBO GPS Stations in the Central United States

http://geon.unavco.org/unavco/GPSVelocityViewer.php

GPS Time Series Plots
Central United States

http://geon.unavco.org/unavco/GPSVelocityViewer.php

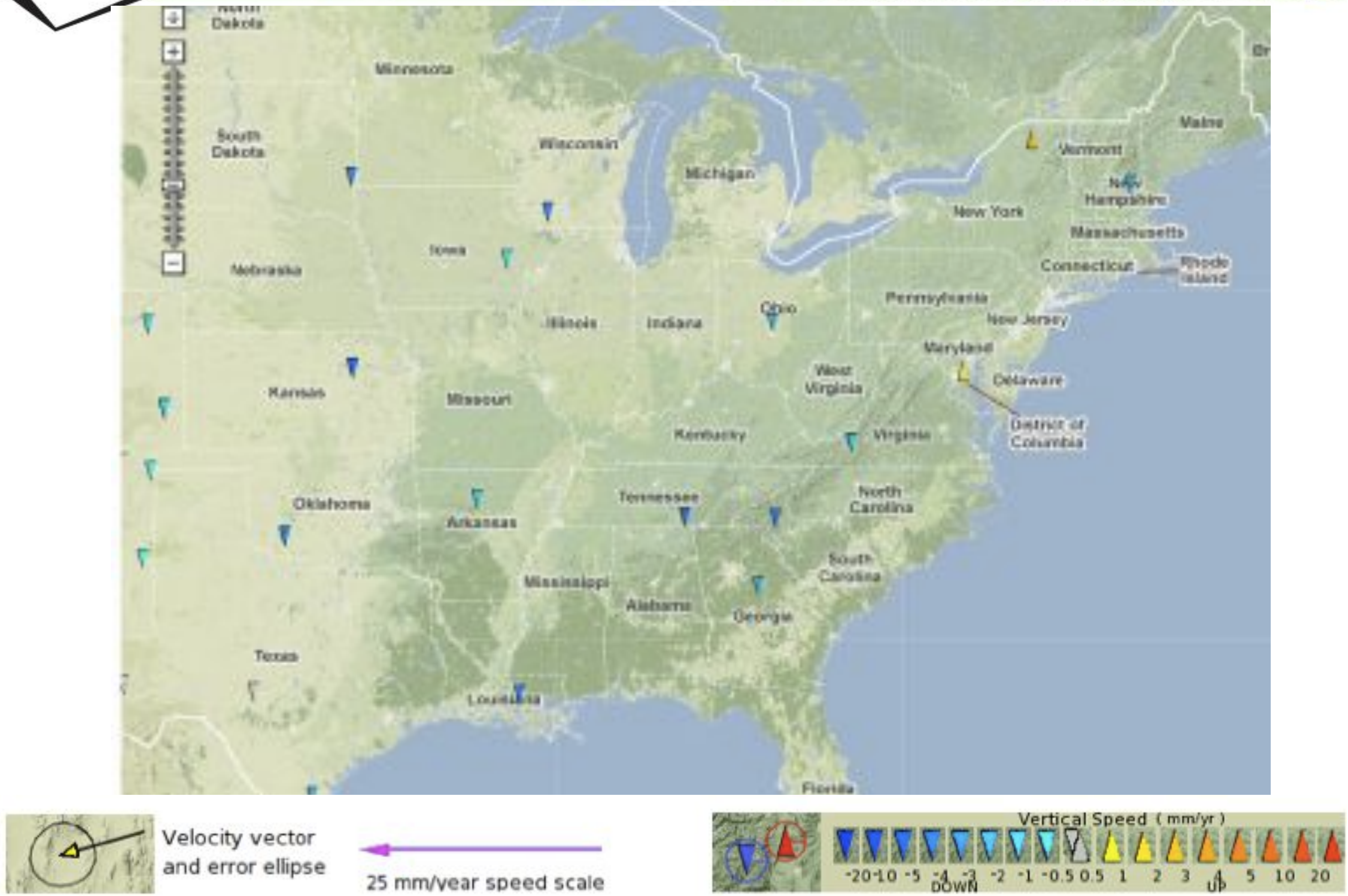
PBO GPS Stations in the Central United States



http://geon.unavco.org/unavco/GPSVelocityViewer.php

UNAVCO

GPS Vertical Movement



GPS Horizontal Vectors: Central United States

Reference Frame: Eurasia

Federal Agencies Within the Executive Branch

Department of Agriculture
Department of Commerce
Department of Defense
Department of Energy
Department of Health
and Human Services

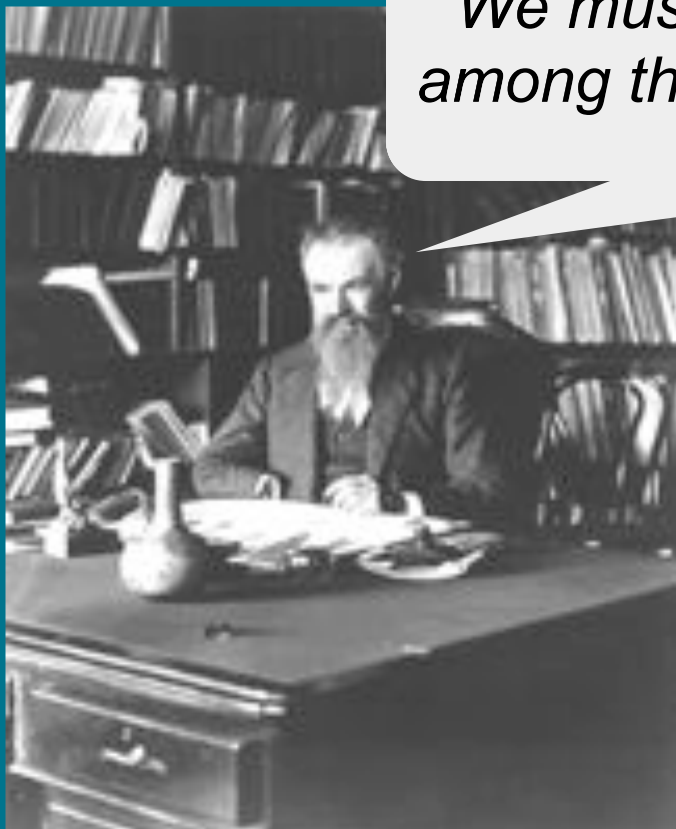
Department of Homeland Security
Department of Housing
and Urban Development
Department of the Interior
Department of Labor
Department of State

USGS U.S. Geological Survey
Bureau of Indian Affairs
National Park Service
U.S. Fish and Wildlife Service
U.S. Fish and Wildlife Service
Bureau of Land Management
Bureau of Reclamation
Office of Surface Mining
Minerals Management Service

USGS

" We must distribute our understandings among the people. How shall it be done? "

(May 1890)



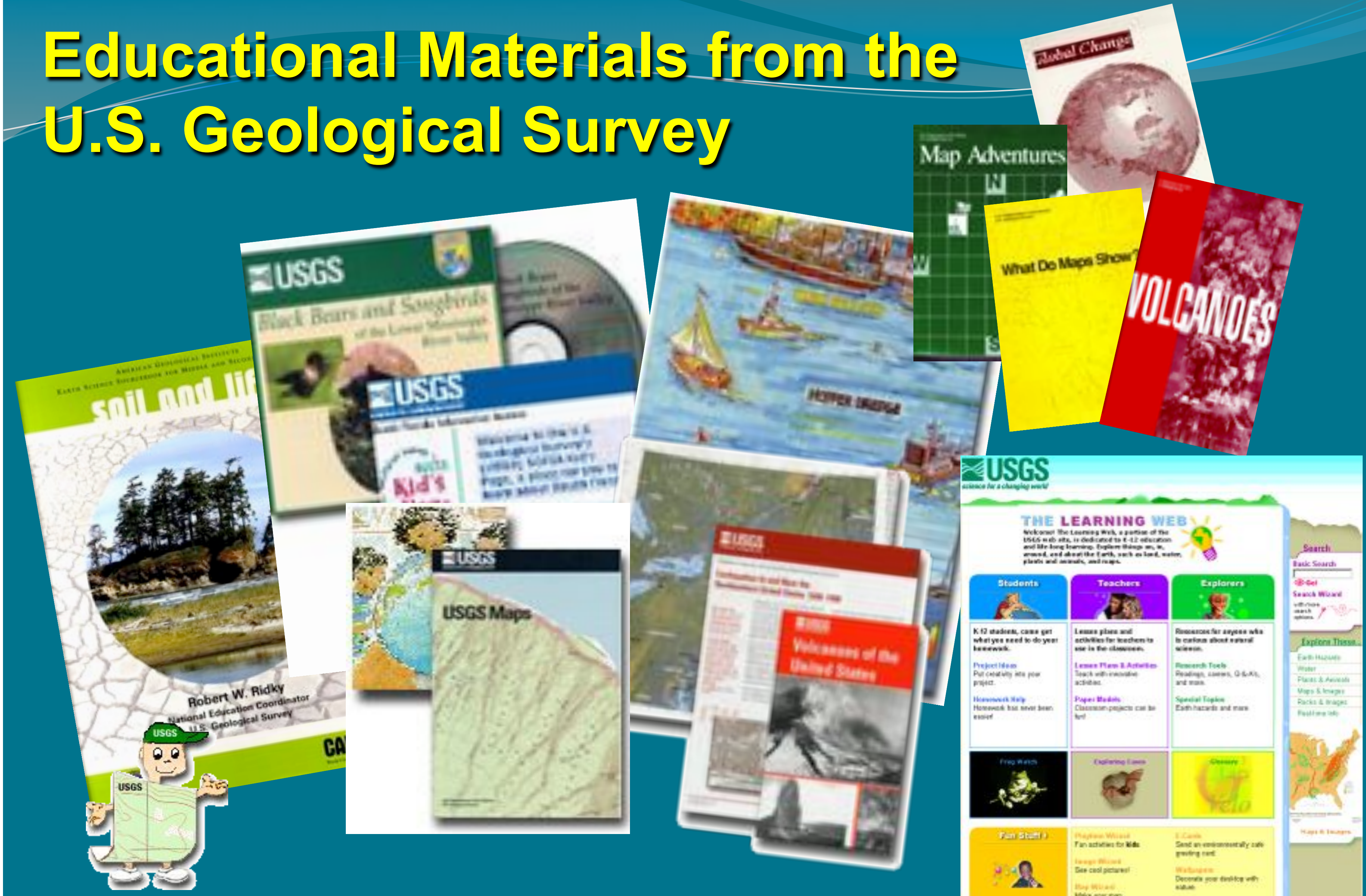
John Wesley Powell began his career in one room schoolhouse teaching for seven years.

USGS

Culture Counts…

USGS

Educational Materials from the U.S. Geological Survey

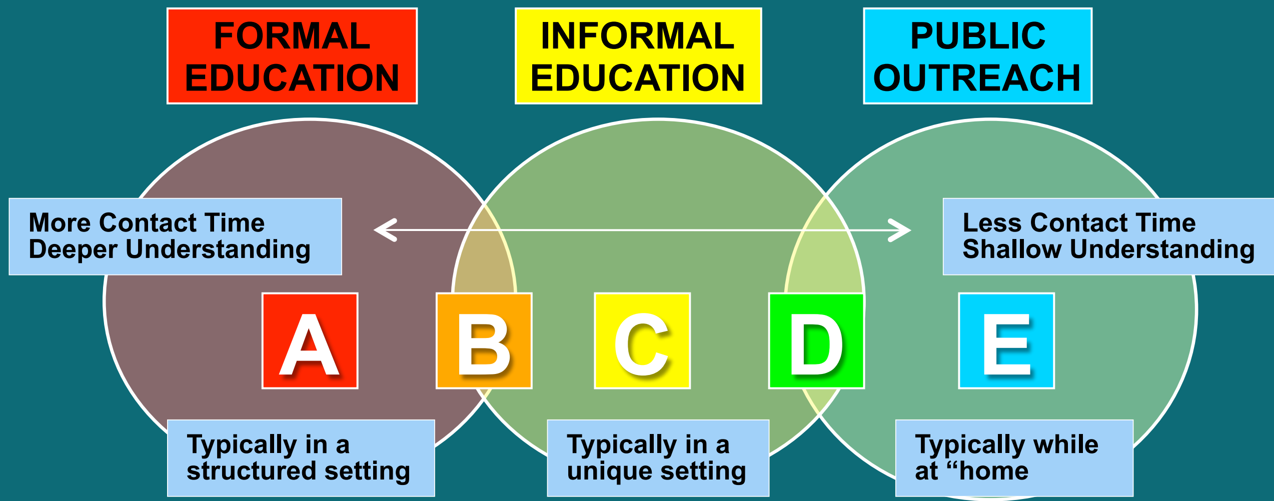


USGS

Education and research are always in the public service, both are inextricably bound at all levels

USGS

The Domains of Education and Outreach



A Curriculum, and instructional modules; field guides; laboratory investigations; workshops; u.g. course development; internships, National Earth Science Standards

B Programs at museums/libraries/parks, and science centers; science fairs; some distance learning courses; some “citizen science” initiatives e.g., Phenology Network

C Museum exhibits/kiosks; Earth Science Week; field trips; career workshops; community talks; invited lecture series at universities;

D IMAX presentation, e.g., “Earthquake Storms,” public talks, open houses, Websites

E Educational TV/ radio; e.g., “Faces of Earth,” evening news, Wikipedia; podcasts

USGS

USGS Education's Professional Linkages:

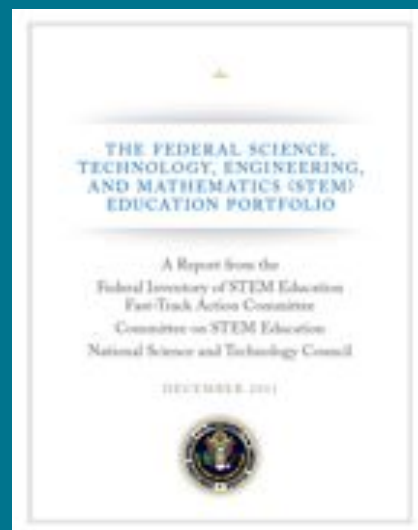
NSF

National Environmental Education Foundation

Knowledge to live by

EXECUTIVE OFFICE OF THE PRESIDENT OF THE UNITED STATES

National Science Technology Council



THE FEDERAL SCIENCE, TECHNOLOGY, ENGINEERING, AND MATHEMATICS (STEM) EDUCATION PORTFOLIO

A Report from the
Federal Inventory of STEM Education Fast-Track Action Committee
Committee on STEM Education
National Science and Technology Council

DECEMBER 2011

american geosciences institute

AGI

YOUTH IN THE GREAT OUTDOORS

U.S. DEPARTMENT OF THE INTERIOR MARCH 3, 1849

Engage-Educate -Employ

CollegeBoard

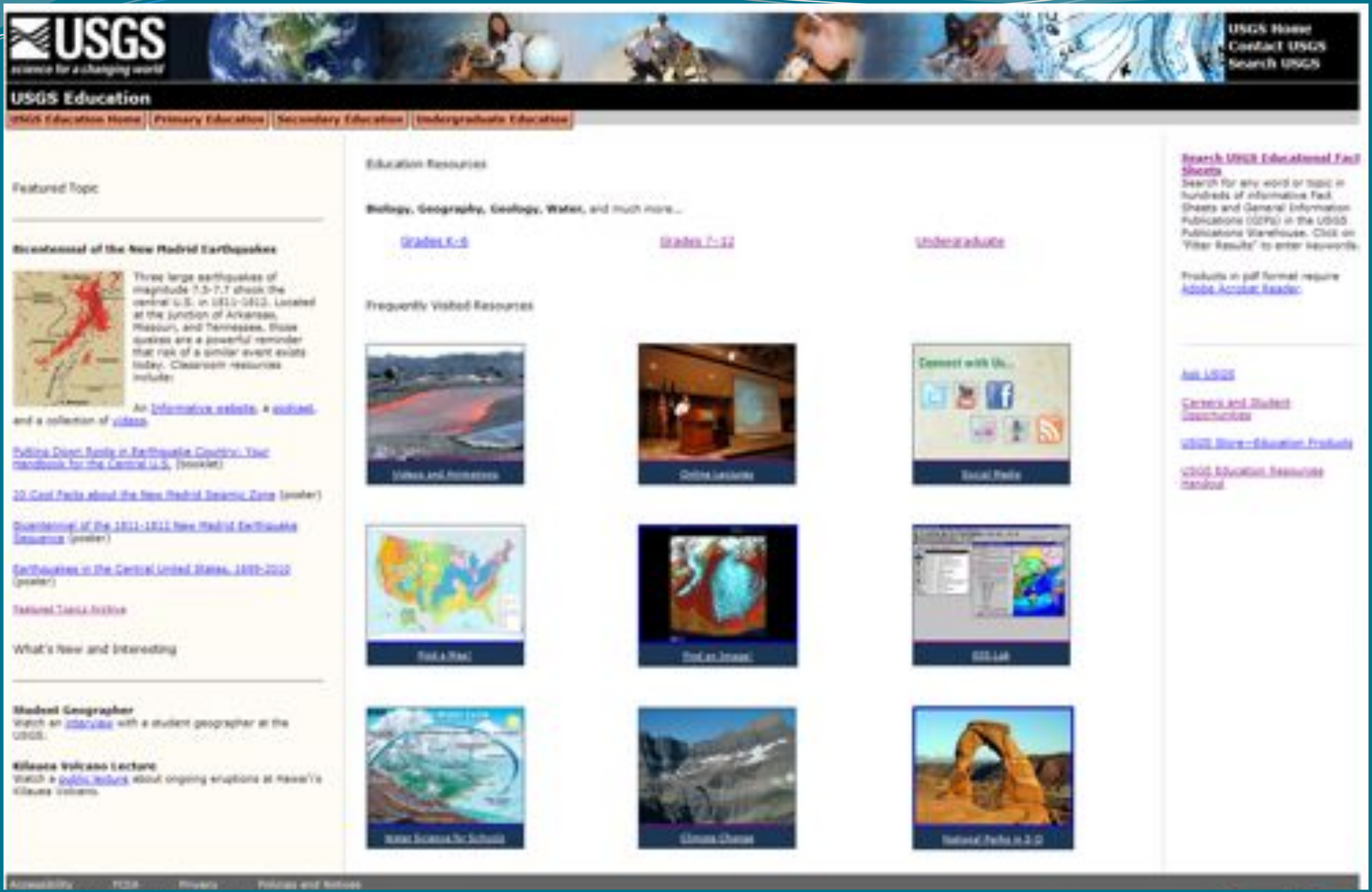
USGS

USGS National Presence is Essential

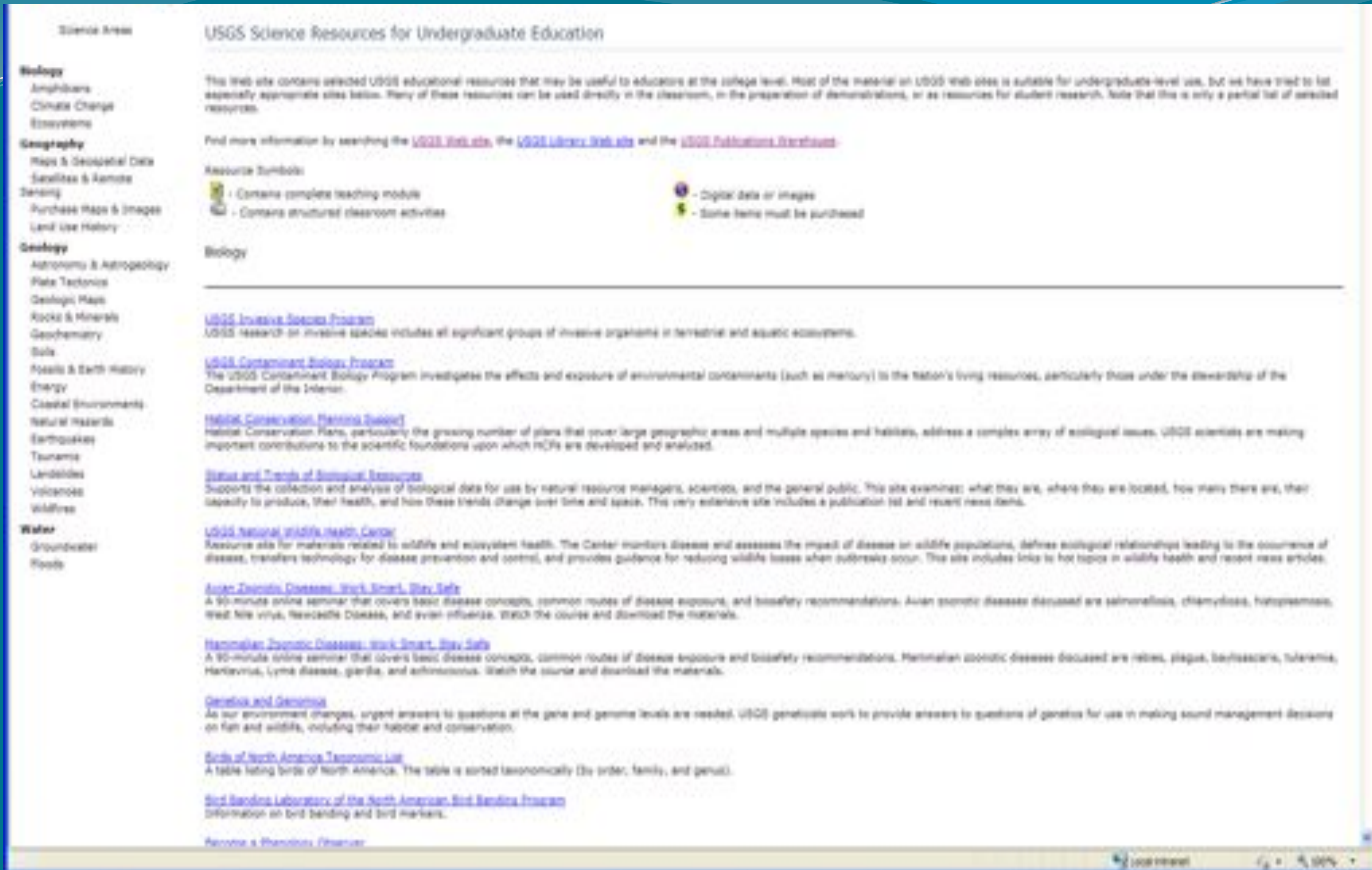
National Science Teachers Association Annual Conference, USA Science & Engineering Festival and many other science education workshops and meetings

USGS

USGS Education: A major portal for educators (at all levels)



USGS



Science Areas

Biology
Amphibians
Climate Change
Ecosystems

Geography
Maps & Geospatial Data
Satellites & Remote Sensing
Purchase Maps & Images
Land Use History

Geology
Astronomy & Astrogeology
Plate Tectonics
Geologic Maps
Rocks & Minerals
Geochemistry
Soils
Fossils & Earth History
Energy
Coastal Environments
Natural Hazards
Earthquakes
Tsunamis
Landslides
Volcanoes
Wildfires

Water
Groundwater
Floods

USGS Science Resources for Undergraduate Education

This Web site contains selected USGS educational resources that may be useful to educators at the college level. Most of the material on USGS Web sites is suitable for undergraduate-level use, but we have tried to list especially appropriate sites below. Many of these resources can be used directly in the classroom, in the preparation of demonstrations, or as resources for student research. Note that this is only a partial list of selected resources.

Find more information by searching the USGS Web site, the USGS Library Web site and the USGS Publications Warehouse.

Resource Symbols:

- Contains complete teaching module
- Contains structured classroom activities
- Digital data or images
- Some items must be purchased

Biology

USGS Invasive Species Program
USGS research on invasive species includes all significant groups of invasive organisms in terrestrial and aquatic ecosystems.

USGS Contaminant Biology Program
The USGS Contaminant Biology Program investigates the effects and exposure of environmental contaminants (such as mercury) to the Nation's living resources, particularly those under the stewardship of the Department of the Interior.

Habitat Conservation Planning Support
Habitat Conservation Plans, particularly the growing number of plans that cover large geographic areas and multiple species and habitats, address a complex array of ecological issues. USGS scientists are making important contributions to the scientific foundations upon which HCPs are developed and analyzed.

Status and Trends of Biological Resources
Supports the collection and analysis of biological data for use by natural resource managers, scientists, and the general public. This site examines: what they are, where they are located, how many there are, their capacity to produce, their health, and how these trends change over time and space. This very extensive site includes a publication list and recent news items.

USGS National Wildlife Health Center
Resource site for materials related to wildlife and ecosystem health. The Center monitors disease and assesses the impact of disease on wildlife populations, defines ecological relationships leading to the occurrence of disease, transfers technology for disease prevention and control, and provides guidance for reducing wildlife losses when outbreaks occur. This site includes links to hot topics in wildlife health and recent news articles.

Avian Zoonotic Diseases: Work Smart, Stay Safe
A 90-minute online seminar that covers basic disease concepts, common routes of disease exposure, and biosafety recommendations. Avian zoonotic diseases discussed are salmonellosis, chlamydiosis, histoplasmosis, West Nile virus, Newcastle Disease, and avian influenza. Watch the course and download the materials.

Mammalian Zoonotic Diseases: Work Smart, Stay Safe
A 90-minute online seminar that covers basic disease concepts, common routes of disease exposure and biosafety recommendations. Mammalian zoonotic diseases discussed are rabies, plague, baylisascaris, tularemia, Hantavirus, Lyme disease, giardia, and echinococcus. Watch the course and download the materials.

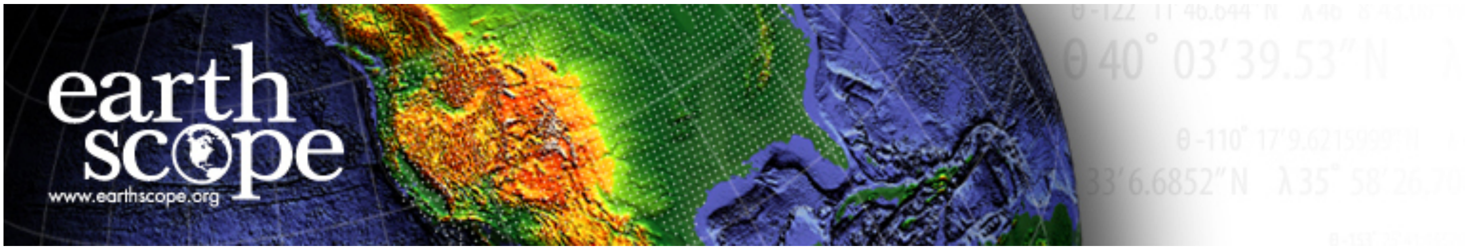
Genetics and Genomics
As our environment changes, urgent answers to questions at the gene and genome levels are needed. USGS geneticists work to provide answers to questions of genetics for use in making sound management decisions on fish and wildlife, including their habitat and conservation.

Birds of North America Taxonomic List
A table listing birds of North America. The table is sorted taxonomically (by order, family, and genus).

Bird Banding Laboratory of the North American Bird Banding Program
Information on bird banding and bird markers.

Become a Phenology Observer

Earth Science Education and Outreach Summit



Earth Science Education and Outreach Provider Summit

***Sponsored by the* National Science Foundation *and hosted by the* EarthScope National Office *in the* School of Earth and Space Exploration *at* Arizona State University**

Tempe, Arizona, 20-21 February 2012

- Program
- Summit Participants
- Participating Organizations
- Organization Pages
- Working Group Pages

SERC the Science Education Resource Center at Carleton College

Earth Science Education and Outreach Provider Summit > Program

Program

Goal: Develop contacts and improve coordination among organizations that have a relationship to EarthScope education, public outreach, or science to promote effective development, dissemination, sharing, and usage of the resources of the EarthScope project and of the participating organizations.

Monday, February 20

7:30 AM Breakfast at Sheraton Four Points

8:00 AM Meet in Four Points Lobby for guided walk to R. S. Dietz Museum of Geology

8:30 AM Welcome:

Ramón Arrowsmith (ESNO), Lina Patino (NSF), and Steve Semken (ESNO)

8:45 AM Review of EarthScope Education and Outreach (E&O) Programs: Past, Present, Planned

- Bob Lillie (prior ESNO@OSU) - Free Choice Learning in EarthScope Education and Outreach (PowerPoint 2007 (.pptx) 39.8MB Mar22 12)
- Steve Semken (current ESNO@ASU) - Vision and Plan for E&O Programs (PowerPoint 2007 (.pptx) 4.5MB Mar22 12)

9:15 AM Brainstorming followed by group discussion:

What does your organization hope to achieve at this Summit?

These responses were offered by the participants:

- Our young organization is seeking E&O partnerships and collaborations.
- Our large membership-driven organization would like to help other organizations with E&O dissemination.
- Share ideas, examples, models...budgets?
- Advertise EarthScope more broadly in the Eastern United States.
- Engineering organizations want to know what Earth science organizations do, know, and need (and vice versa).
- Assemble a fracking module for the entire country.
- Learning about different organizations in order to promote geoscience education and opportunities for Native American students, educators, and communities.
- Incorporate more of a global perspective.
- Develop more institutionalized and sustainable models of collaboration among organizations.
- Work together to prevent dilution of the message.
- Make our collaborations exothermic ($\Delta H_{collaboration} < 0$)
- Put faces with places; make connections; network.
- Link organizational framework with intellectual framework.

9:45 AM Break

10:00 AM Review of existing resources and opportunities for collaboration:

John McDaris (SERC)

10:30 AM Organizational Presentations (15 minutes each)

- 10:30 IRIS (Zip Archive 77.3MB Mar22 12): John Taber and Perle Dorr
- 10:45 UNAVCO (PowerPoint 2007 (.pptx) 33.4MB Mar22 12): Shelley Olds, Megan Berg, and Valerie Sloan
- 11:00 SCEC/ECA EPIcenter Network (PowerPoint 2007 (.pptx) 36.9MB Mar22 12): Robert de Groot and Kathleen Springer
- 11:15 GeoPRISMS (PowerPoint 2007 (.pptx) 8.6MB Mar22 12): Charles Bopp IV
- 11:30 DOSECC (PowerPoint 2007 (.pptx) 8.6MB Mar22 12): David Zurr and Shelton Alexander

12:00 PM Lunch – Catered in R.S. Dietz Museum

1:00 PM Organizational Presentations continue

- 1:00 USGS (PowerPoint 2007 (.pptx) 6.7MB Mar22 12): Elizabeth Colvard
- 1:15 NEES (Zip Archive 20.4MB Mar22 12): Keith Adams and Thalia Anagnos
- 1:30 CUAHSI (PowerPoint 2007 (.pptx) 6.5MB Mar22 12): Rick Hooper
- 1:45 NCED (PowerPoint 2007 (.pptx) 10.7MB Mar22 12): Diana Dalbotten and Holly Pellerin
- 2:00 CZO (PowerPoint 2007 (.pptx) 63.9MB Mar22 12): Tim White
- 2:15 AGI (PowerPoint 2007 (.pptx) 19.3MB Mar22 12): Ann Benbow, Colin Malby, and Ian Macgregor

3:15 PM Break

3:30 PM Observations and recommendations:

John McDaris (SERC)

4:00 PM Brainstorm and organize Group Breakout Sessions for Tuesday

Groups:

- Working Group 1: Measuring program impact
- Working Group 2: Using an Earth system approach to organize ideas, resources, content, and pedagogy in informal learning environments
- Working Group 3: Creating issue-based pages and resources
- Working Group 4: Social media: How-tos and best practices.

Other suggestions from the group are posted here for future reference.

4:45 PM End of Day Remarks:

Steven Semken (ESNO)

5:00 PM Return to Hotel

6:00 PM Group Dinner; Rula Bula, 401 S. Mill Avenue, downtown Tempe

Breakout Groups are welcome to meet informally after dinner.

Tuesday, February 21

7:30 AM Breakfast at Sheraton Four Points

8:00 AM Meet in Four Points Lobby and Walk to R.S. Dietz Museum

8:30 AM Comments:

Lina Patino (NSF)

8:45 AM Breakout Groups reconvene (Breaks as desired)

11:30 AM Breakout Groups Report Out

12:00 PM Concluding Remarks and Next Steps:

Steve Semken (ESNO), John McDaris (SERC), Lina Patino (NSF)

12:15 PM Lunch – Catered in R.S. Dietz Museum

Adjourn after lunch

Earth Science Education and Outreach Provider Summit > Program > Observations and Recommendations

Observations and Recommendations

Supporting Materials

- Activity Sheets
- Data Sheets
- Tool Sheets

"Middle Ground" Resources

- USGS - Carbon Sequestration
- IRIS - Teachable Moments (more info)
- NPS - Geologic Hazards

Ways of Finding Resources

- Understanding X: pages pulling together resources from across the group dealing with particular topics.
  - Understanding Tectonics
- Organization Pages: pages with a short description of the organization, some links into particular E&O sections of the website, and listings of E&O materials at SERC
  - EarthScope (extended version in Cutting Edge)
- Broad collections - Teach the Earth Site Guide: Plate Tectonics
  - MARGINS Data in the Classroom

Other Recommendations

- Create teaching activities from the research and data if you aren't already: MARGINS, UNAVCO (more info) , SCEC
- Make "middle ground" information available to interpret your science for a layperson.
- Spend looking at each others' websites and talking aloud about what you're looking for and what you make of the clues about where to find it.

Larger Issues

- Clearinghouse website for REU and Workshop opportunities. NAGT, NESTA, CUR...
- Some strategy for finding good geoscience Visualizations. SERC's approach - Plate Tectonic Movements
- Clearinghouse for data sets - A joint strategy for making sure that the best data is available with activities that demonstrate how to use it. Could generate Data Sheets at SERC or having the same kinds of info available on the individual sites.
- Achieving good coverage of topics across the range of appropriate levels - everyone not aimed at a particular topic or a particular grade level
- It would be helpful to share statistics on web usage and social media to start to get a sense of context and reach and get a better sense of what is meaningful in terms of impacts.

Earth Science Education and Outreach Provider Summit > Participants

Summit Participants

Keith Adams, NEES
Shelton Alexander, DOSECC
Thalia Anagnos, NEES
Ramón Arrowsmith, ESNO@ASU
Ann Benbow, AGI
Megan Berg, UNAVCO
Wendy Bohon, ESNO@ASU
Charles John Bopp IV, GeoPRISMS
Elizabeth Colvard, USGS
Diana Dalbotten, NCED
Robert de Groot, SCEC and ECA EPIcenter Network
Cindy Dick, ESNO@ASU
Perle Dorr, IRIS
Rick Hooper, CUAHSI
Bob Lillie, NPS/OSU
Colin Mably, AGI
John McDaris, SERC
Ian MacGregor, AGI
Shelley Olds, UNAVCO
Lina Patino, NSF
Holly Pellerin, NCED
Steven Semken, ESNO@ASU
Kathleen Springer, San Bernardino County Museum and ECA
John Taber, IRIS
Wendy Taylor, ESNO@ASU
Tim White, Critical Zone Observatories, Penn State
David Zur, DOSECC

SERC the Science Education Resource Center at Carleton College

Earth Science Education and Outreach Provider Summit > Participating Organizations

Participating Organizations

American Geosciences Institute (AGI) – http://www.agiweb.org/
AGI provides information services to geoscientists, serves as a voice of shared interests in our profession, plays a major role in strengthening geoscience education, and strives to increase public awareness of the vital role the geosciences play in society's use of resources, resilience to natural hazards, and the health of the environment.

- Earth Science World Image Bank
- YouTube Videos from Earth Magazine
- k12 professional development programs
- Visiting Geoscientists - An Outreach Guide for Geoscience Professionals
- Curricua - Investigating Earth Systems, EarthComm, Constructing an Understanding of earth Systems, High School Environmental Science, Physical Geology
- http://www.agiweb.org/education/pd/index.html
- http://www.k5geosource.org
- 2012 Earth Science Week topic is Careers

Critical Zone Observatories – http://criticalzone.org/
Critical Zone Observatories are environmental laboratories established to study the chemical, physical and biological processes that shape the Earth's surface. The National CZO Program serves the international scientific community through research, infrastructure, data, and models.

- Data: wide variety of data sets available from each of the 6 CZO sites. Data not centralized.
- Research: accessibly written. distributed between the various sites. Not centralized.
- Visualizations: embedded in research pages
- Critical Zone Exploration Network

Consortium of Universities for the Advancement of Hydrologic Science, Inc. (CUAHSI) – http://www.cuahsi.org/
CUAHSI is a research organization representing more than 130 U.S. universities and international water science-related organizations. CUAHSI develops infrastructure and services for the advancement of water science in the United States.

- Videos of general community interest
- Cyberseminars
- Research: technical reports, vision papers, synthesis papers - aimed at professionals
- Data: HydroDesktop computer application for accessing hydro data
- Modular Curriculum for Hydrologic Advancement (MOCHA)

Drilling, Observation and Sampling of the Earths Continental Crust (DOSECC) – http://www.dosecc.org/
DOSECC is a not-for-profit corporation whose mission is to provide leadership and technical support in subsurface sampling and monitoring technology for addressing topics of scientific and societal importance. Fifty-three research organizations are members of DOSECC.

- newsletters provide research results and discussion that is broadly accessible.
- 2 handbooks - Lake and Marine sediment drilling, best practices in drilling programs
- grant programs for grad/undergrad/teachers - apps March 1 (pub via NAGT)
- lightweight portable drilling rig for field camps

EarthScope - http://www.earthscope.org/

- EarthScope Data Portal
- EarthScope Visualizations
- EarthScope Science Products : Data Products, Complimentary Data, Active Field Programs, Funding
- LiDAR imagery
- EarthScope Resources: maps, photos, illustrations, video clips

EarthScope Education and Outreach - http://www.earthscope.org/eno

GeoPRISMS – http://www.geoprisms.org/
GeoPRISMS is a decadal program, funded by NSF, committed to the amphibious study of the origin and evolution of continental margins through interdisciplinary, community-based investigations.

- MARGINS data portal
- GeoPRISMS data portal
- MARGINS Minilessons (at SERC)
- GeoPRISMS Distinguished Lectureship Program

Incorporated Research Institutions for Seismology (IRIS) – http://www.iris.edu/
IRIS is a consortium of over 100 US universities dedicated to the operation of science facilities for the acquisition, management, and distribution of seismological data. IRIS programs contribute to scholarly research, education, earthquake hazard mitigation, and verification of the Comprehensive Nuclear-Test-Ban Treaty.

- IRIS Seismic Data Access portal
- educational data/vis software
- Teachable Moments pages (more info)
- animations and interactive animations
- public outreach videos
- USArray Wave Visualizations
- Virtual REU
- Labs and activities for undergrads
- http://www.iris.edu/hq/explore

National Center for Earth surface Dynamics (NCED) – http://www.nced.umn.edu/
The National Center for Earth-surface Dynamics, an NSF Science and Technology Center, is a partnership of research and educational institutions, government agencies, and industry that pursues its goal of predictive Earth-surface science by integrating physical, biological, and social sciences to understand how landscapes and ecosystems evolve together.

- research publications
- news posts about research results - broadly accessible, with some images/data representations
- NCED data repository
- several models and modeling tools
- gidakiimanaaniwigamig

Network for Earthquake Engineering Simulation (NEES) – http://www.nees.org/
NEES is a shared national network of 14 experimental facilities, centralized data repository, collaborative tools and resources and earthquake simulation software.

- Multimedia databases of videos, visualizations, images, and animations
- database of lecture notes, assignments, presentations, and other learning objects
- database of computational models
- database of published research papers
- database of simulation tools
- Make Your Own Earthquake module
- NEESacademy
- research to practice webinar series

National Park Service (NPS) – http://www.nps.gov/

- curriculum based education programs at parks (k12)
- materials to loan
- environmental education reading list
- Teaching with Historic Places
- "Views of the National Parks (Views)is a multimedia education program that presents the natural, historical, and cultural wonders associated with national parks and provides opportunities for all Americans to discover why national parks are special places."
- Parks with teacher Professional Development programs
- Geologic Resources: Education and Outreach

National Science Foundation (NSF) – http://www.nsf.gov/

Southern California Earthquake Center (SCEC) – http://www.scec.org
SCEC is a community of over 600 scientists, students, and others at over 60 institutions worldwide, headquartered at the University of Southern California. SCEC is funded by the National Science Foundation and the U.S. Geological Survey to develop a comprehensive understanding of earthquakes in Southern California and elsewhere, and to communicate useful knowledge for reducing earthquake risk.

SCEC's Office of Experiential Learning & Career Advancement offers two internship programs for college undergraduate students. SCEC/SURE interns are paired one-on-one with a SCEC scientist at that researcher's institution or field site. SCEC/UseIT (Undergraduate Studies in Earthquake Information Technology) is a team based program where interns develop technical tools to communicate important concepts about earthquakes in Southern California and other earthquake-prone regions.

- Technical resources (e.g. animations and movies)
- Education and preparedness
- SCEC/SURE intern program

- SCEC/UseIT intern program

The Earthquake Country Alliance (ECA) and the ECA EPIcenter Network – http://www.earthquakecountry.info
The ECA is a public-private partnership of leading earthquake professionals, emergency managers, government officials, business and community leaders, and others. The mission of the ECA is to support and coordinate efforts which improve earthquake and tsunami resilience. Among its many activities the ECA plans and implements the annual ShakeOut drill. The ECA is administered by the Southern California Earthquake Center at USC.

The Earthquake Education and Public Information Center (EPIcenter) Network is a community of free-choice learning institutions within the ECA that share a commitment to earthquake and tsunami preparedness. They coordinate ECA activities (e.g. ShakeOut) or in other ways demonstrate leadership in earthquake education and risk reduction. EPIcenters are found in a variety of free-choice learning venues such as museums, science centers, libraries, and universities. The EPIcenter Network has flourished through its many collaborative efforts with IRIS, EarthScope, NEES, USGS, the California Geological Survey (CGS), and the Quake Catcher Network.

- The ShakeOut
- ShakeOut - Museums
- The EPIcenter Network
- San Bernardino County Museum (Redlands, CA) - EPIcenter Coordinating Institution
- The Tech Museum (San Jose, CA) - EPIcenter Coordinating Institution
- CGS Tsunami Preparedness
- The Quake Catcher Network

Science Education Resource Center (SERC) – http://serc.carleton.edu
SERC works to improve education through projects that support educators. Although the work has a particular emphasis on undergraduate Science, Technology, Engineering, and Mathematics (STEM) education, SERC has worked with educators across a broad range of disciplines and at all educational levels.

- SiteGuides: Earthquakes, Energy, Teaching with Current Research and Data, ...
- DataSheets
- ActivitySheets
- InTeGrate

UNAVCO – http://www.unavco.org/
The mission of UNAVCO's Education and Community Engagement Program is to promote a broader understanding of Earth science through the scientific methods, data, and results of the unique suite of scientific research of UNAVCO's community. We will foster collaboration between the scientific and educational communities and will increase the number and diversity of students to strengthen and sustain the next generation of Earth scientists.

- Geodetic, strain, borehole, and meteorological databases
- Variety of tools for data visualization, mapping, data collection, and processing
- education materials/activities with links to all 50 state k12 science standards
- Data for Educators (more info) : GPS data/sources aimed at educators. Some teaching activities associated with particular stations/datasets. Along with some tutorial info for using UNAVCO GPS data.

United States Geologic Survey (USGS) – http://www.usgs.gov/
The USGS is a science organization that provides impartial information on the health of our ecosystems and environment, the natural hazards that threaten us, the natural resources we rely on, the impacts of climate and land-use change, and the core science systems that help us provide timely, relevant, and useable information.

- Maps and Geospatial data
- wide array of educational resources for k16 including good "connective tissue" pages that contextualize research results in such a way that they are more easily used in the classroom.
- video and image gallery
- photo gallery (more info)
- photographic library (This site may be offline.)
- publications warehouse
- online videos of lectures

SERC the Science Education Resource Center at Carleton College

Earth Science Education and Outreach Provider Summit > Organization Pages

Organization Pages

- American Geosciences Institute (AGI)
- Critical Zone Observatories
- Consortium of Universities for the Advancement of Hydrologic Science, Inc. (CUAHSI)
- Drilling, Observation and Sampling of the Earths Continental Crust (DOSECC)
- EarthScope
- GeoPRISMS
- Incorporated Research Institutions for Seismology (IRIS)
- National Center for Earth surface Dynamics (NCED)
- Network for Earthquake Engineering Simulation (NEES)
- Southern California Earthquake Center (SCEC)
- UNAVCO
- United States Geologic Survey (USGS)

Earth Science Education and Outreach Provider Summit > Organization Pages > American Geosciences Institute

American Geosciences Institute (AGI)

american geosciences institute **agiweb.org**

AGI provides information services to geoscientists, serves as a voice of shared interests in the profession, plays a major role in strengthening geoscience education, and strives to increase public awareness of the vital role the geosciences play in society's use of resources, resilience to natural hazards, and the health of the environment.

- *Big Ideas in Earth Science* videos and activities
- Curricula: *Investigating Earth Systems*, *EarthComm*, *Constructing an Understanding of Earth Systems*, *High School Environmental Science*, *Physical Geology Laboratory Manual*
- *Earth Science Education Advocacy Guide*
- Earth Science Week. The 2012 theme is *Discovering Careers in the Geosciences*.
- Image Bank
- K-5 GeoSource: Professional Development Website for Elementary Teachers
- Map of U.S. Geoscience Organizations
- NASA-AGI-ASU Triad Teacher Professional Development Guide
- *Outreach Guide for Geoscientists Visiting Classrooms*
- *Pulse of Earth Science*: State-by-State data
- Teacher Awards
- Teacher Professional Development Resources
- Video Curriculum Ancillaries

Earth Science Education and Outreach Provider Summit > Organization Pages > Critical Zone Observatories

Critical Zone Observatories

Earth Science Education and Outreach Provider Summit > Organization Pages > CUAHSI

Consortium of Universities for the Advancement of Hydrologic Science, Inc. (CUAHSI)

Earth Science Education and Outreach Provider Summit > Organization Pages > DOSECC

Drilling, Observation and Sampling of the Earth's Continental Crust (DOSECC)

DOSECC.org

is a not-for-profit corporation whose mission is to provide leadership and technical support in subsurface sampling and monitoring technology for addressing topics of scientific and societal importance. Fifty-five research organizations are members of DOSECC.

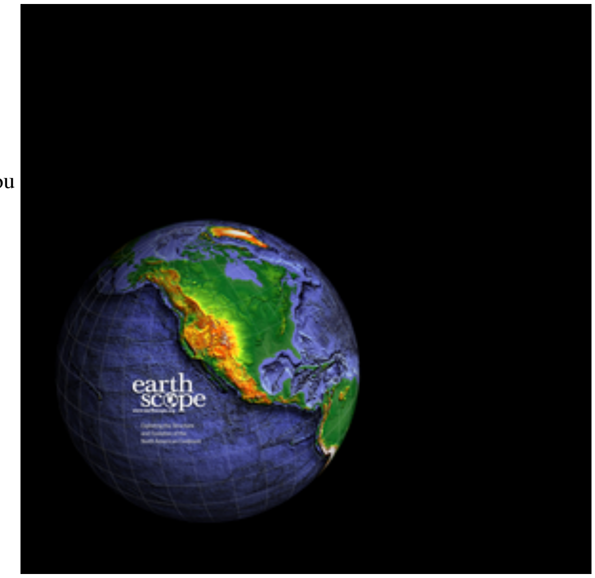
Our goals are as follows:

- Facilitate and support cost-effective scientific drilling projects
- Link science and drilling technology
- Design, build and operate drilling systems
- Promote technology transfer and education
- Represent U.S. interests in the international scientific drilling community.

SERC the Science Education Resource Center at Carleton College

[Earth Science Education and Outreach Provider Summit](#) > [Organization Pages](#) > EarthScope

EarthScope



[EarthScope](#) is a community of scientists conducting multidisciplinary research across the Earth sciences utilizing the freely accessible data collected and maintained by EarthScope facilities. EarthScope is also an in-depth collaboration between scientists and educators bringing the excitement of cutting-edge Earth science research into classrooms, museums and parks. Below, you will find links into various parts of the EarthScope site where you can find information, data, and materials that can help you create teaching activities related to the Deep Earth.

- [EarthScope Data Portal](#)
- [Publications page](#)
- [EarthScope Science Products](#)
- [LiDAR imagery](#) based on EarthScope data

EarthScope Resources on SERC

[EarthScope in the Northern Rockies](#)
Interdisciplinary workshop dedicated to the identification of links between the surface geology of North America and the forces at work in Earth's interior. Included an overview of the EarthScope facilities in Montana, identification of research and educational opportunities related to the EarthScope project, and two field trips. The workshop website features [posters](#) and [presentations](#) by participants on EarthScope science and incorporating it into geoscience education.

Teaching Activities

Refine the Results

Subject

- [Geoscience 2 matches](#)

Resource Type: Activities

[1 match](#) General/Other
- [Problem Set 1 match](#)
- [Classroom Activity 2 matches](#)
- [Lab Activity 1 match](#)

Results 1 - 2 of **2 matches**

[Analyzing Plate Motion Using EarthScope GPS Data](#) part of Earth Exploration Toolbook:Analyzing Tectonic Plate Motion with GPS Data
DATA: EarthScope GPS Data. TOOLS: Spreadsheet, Google Maps. SUMMARY: Learn how GPS monuments make precise measurements of Earth's surface. Graph motion data and map velocity vectors to explore tectonic motion and surface deformation in the Pacific Northwest.
Subject: Geoscience:Geology:Geophysics:Geodesy, Geoscience:Geology:Tectonics
Resource Type: Activities: Computer Applications, Datasets and Tools:Datasets, Activities:Classroom Activity

[Where is that chunk of crust going?](#) part of Cutting Edge:Introductory Courses:Activities
I introduce students to GPS, frames of reference, and the permanent GPS stations in the EarthScope Plate Boundary Observatory (PBO) in class, and obtain near-real-time data for two stations from UNAVCO. We use ...
Subject: Geoscience:Geology:Tectonics, Geophysics:Geodesy, Geoscience:Geology:Structural Geology:Regional Structural/Tectonic Activity
Resource Type: Activities: Activities, :Problem Set, Classroom Activity, Lab Activity

GeoPRISMS

geoprisms.org

GeoPRISMS (Geodynamic Processes at Rifting and Subducting Margins) is a decadal program, funded by NSF, committed to the amphibious study of the origin and evolution of continental margins through interdisciplinary, community-based investigations. GeoPRISMS is the successor program to MARGINS, and seeks to build and expand upon the work begun by the MARGINS program.

GeoPRISMS maintains several education and outreach programs:

- GeoPRISMS Distinguished Lectureship Program
- GeoPRISMS Newsletter
- GeoPRISMS Listserv Archive
- MARGINS data portal
- GeoPRISMS data portal
- MARGINS Minilessons (at SERC)

Earth Science Education and Outreach Provider Summit > Organization Pages > IRIS

IRIS

National Center for Earth-Surface Dynamics (NCED)

Earth Science Education and Outreach Provider Summit > Organization Pages > NEES

George E. Brown, Jr. Network for Earthquake Engineering Simulation (NEES)

NEES.org

The George E. Brown, Jr. Network for Earthquake Engineering Simulation (NEES) was created by the National Science Foundation (NSF) to aggressively promote the development of improvements and innovations in infrastructure design and construction practices to prevent or minimize damage during earthquakes and tsunamis.

Earthquake engineering researchers and students have the opportunity through the NEES collaboratory of 14 experimental equipment sites and a robust cyberinfrastructure featuring online simulation tools to conduct more advanced research of designs, materials, construction techniques and monitoring tools. Research results will enable engineers to develop better and more cost-effective ways of mitigating earthquake damage.

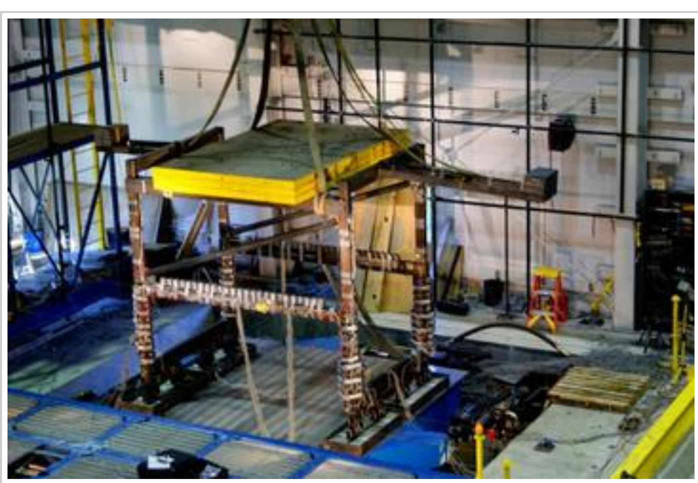
NEES also plays a major role in developing next-generation earthquake and tsunami engineers, offering education, outreach and training for K-16 students, graduate students, educators, and researchers. The highly successful Research Experience for Undergraduates (REU) Program offers upper division undergraduate students a chance to work with NEES researchers on individual projects that contribute to the goals of an existing NEES research project or the opportunity to develop cyberinfrastructure tools and/or educational modules. The NEESacademy is an excellent resource for teachers of all student ages to find engaging activities for classroom demonstrations or individual inquiry activities. Professionals may access illuminating reports on research projects and their impact or participate in quality seminars and webinars sponsored by NEES affiliated projects and professional partnerships.

NEES Logo

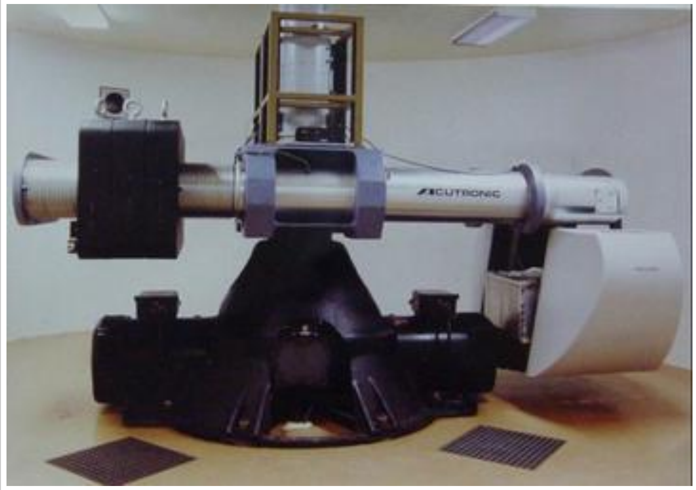
The NEES network features 14 geographically-distributed, shared-use laboratories that support several types of experimental work: geotechnical centrifuge research, shake table tests, large-scale structural testing, tsunami wave basin experiments, and field site research. Participating universities include: Cornell University; Lehigh University; Oregon State University; Rensselaer Polytechnic Institute; University at Buffalo, SUNY; University of California, Berkeley; University of California, Davis; University of California, Los Angeles; University of California, San Diego; University of California, Santa Barbara; University of Illinois, Urbana-Champaign; University of Minnesota; University of Nevada, Reno; and the University of Texas, Austin.

The equipment sites (labs) and a central data repository are connected to the global earthquake engineering community via the NEEShub, a website that is more than a website. The NEES website, NEES.org, is powered by HUBzero software developed at Purdue University specifically to help the scientific community share resources and collaborate. The cyberinfrastructure, connected via Internet2, provides interactive simulation tools, a simulation tool development area, a curated central data repository, animated presentations, user support, telepresence, mechanism for uploading and sharing resources and statistics about users, and usage patterns.

These resources jointly provide the means for collaboration and discovery to improve the seismic design and performance of civil and mechanical infrastructure systems.



Shake Table Laboratory



Geotechnical Centrifuge Laboratory

Tsunami Wave Basin

"Make Your Own Earthquake" lesson plans

Earth Science Education and Outreach Provider Summit > Organization Pages > SCEC

Southern California Earthquake Center (SCEC)

SERC the Science Education Resource Center at Carleton College

Earth Science Education and Outreach Provider Summit > Organization Pages > UNAVCO

UNAVCO

Data for Educators: GPS stations and data that illustrate various Earth science processes

U.S. Geological Survey

The U.S. Geological Survey (USGS) is a science organization that provides impartial information on the health of our ecosystems and environment, the natural hazards that threaten us, the natural resources we rely on, the impacts of climate and land-use change, and the core science systems that help us provide timely, relevant, and useable information.

Sites of interest to the Education and Outreach community include:

- **USGS Home Page**
- **USGS Education Resources**
- **USGS Social Media**
- **USGS Public Calendar**
- **USGS News Releases**

Earth Science Education and Outreach Provider Summit > Working Group Pages

Working Group Pages

- Group 1 - Measuring Program Impact
- Group 2 - Using an Earth System Approach to Organize Ideas, Resources, Content, and Pedagogy in Informal Learning Environments
- Group 3 - Issue-Based Pages
- Group 4 - Social Media

- Other Potential Tasks for Working Groups

Earth Science Education and Outreach Provider Summit > Working Group Pages > Group 1

Working Group 1: Measuring Program Impact

Members: Shelton Alexander (NEES), Ann Benbow (AGI), Elizabeth Colvard (USGS), Holly Pellerin (NCED), John Taber (IRIS), Keith Adams (DOSECC), Ramon Arrowsmith (ESNO@ASU), Shelley Olds (UNAVCO)

The discussion centered on what methodologies projects can use to measure the effectiveness of the various components of their programs, and of their projects overall. The goal of such evaluation is to improve the projects overall. Participants offered various suggestions for how to do this. These included:

1. Reviewing the organization's strategic plan.
2. Identifying clear goals.
3. Deciding on activities to reach those goals.
4. Defining metrics to measure the success of the activities.
5. Implementing the evaluation plan on a regular basis.
6. Reporting evaluation results and using these to improve the program.

The group also discussed various metrics that they have used, including Google search ratings, numbers of people reached, use of materials, measures of student learning (embedded questions), web hits, new accounts, new users, teacher self report, collection of anecdotes (stories), program activities that translate to jobs and college graduates, and program cited in the literature.

Problems cited included: Dealing with IRBs; justifying the overall effectiveness of a multi-faceted program; measuring impact on programs designed to reach the general public; cost of external evaluation

Suggestions for better evaluation: Consult with your program officer; define your goals clearly; work with more experienced projects that have well-developed evaluation programs; decide, across programs and different organizations, what are three major goals - possibly consult with an external evaluator to do this; using other people's research to justify evaluation strategies; use both quantitative and qualitative methods as appropriate; consider developing a logic model for your project.

Overall Goals for E&O

Establish sustainable programs (legacy) that:

1. Improve the quality (scientifically accurate and current; pedagogically sound) and reach (number of students and teachers) of geoscience education for K-12, undergraduates (pre-service teachers, in particular), graduates, post-graduates and free choice learners.

2. Expand Earth science awareness and importance to society.

3. Broaden the awareness and use of data and products to researchers, educators, students and the workforce in the geosciences and related fields.

4. Expand and increase the diversity of the geoscience community (workforce, researchers, educators, and students).

Earth Science Education and Outreach Provider Summit > Working Group Pages > Group 2

Working Group 2: Using an Earth System Approach to Organize Ideas, Resources, Content, and Pedagogy in Informal Learning Environments

Members: Thalia Anagnos (NEES), Megan Berg (UNAVCO), Robert de Groot (SCEC), Bob Lillie (OSU), Colin Mably (AGI), Ian MacGregor (AGI), Steve Semken (ESNO@ASU), Kathleen Springer (SBCM and ECA), Dave Zur (DOSECC)

"Earth is the interaction among rock, water, air, and life." Regardless of the background of an informal educator, how do we motivate them to incorporate more about the earth and its processes into their interpretive programs and exhibits?

Goals:

- Promoting earth systems thinking in informal learning environments.
- Collaborate with informal educators to incorporate their site content into a broad earth systems context.
- Promote an understanding of earth systems and their utility in telling whole stories about landscapes and their deeper meanings. When informal educators tell their stories they will be encouraged to tell them from an earth systems perspective.

Deliverables:

- Develop a tool kit for interpreters from a broad spectrum of informal learning venues to weave in an earth systems approach. The tool kit will include:

  - Understanding of earth systems and their utility in telling whole stories about landscapes and their deeper meanings.

  - A framework using the literacy principles from earth science, ocean, atmosphere, and climate documents. The literacy principles will be used to create a set of theme statements as a framework for interpretation.

  - Some example interpretive methods, such as analogies that would help visitors to relate better to geological features and processes.

Earth Science Education and Outreach Provider Summit > Working Group Pages > Group 3

Working Group 3: Issue-Based Pages

Members: John McDaris (SERC), Perle Dorr (IRIS), Diana Dalbotten (NCED), Rick Hooper (CUASI), Tim White (CZO)

Focus: Fact sheets for land owners/general public on issues (also useful in intro) - "How to Think About X"

resource materials for outreach to public

Perle needs info on frakking related issues to be able to hand out to land owners when students are going around to get permission to place transportable array seismometers on their land as USArray moves east. General information and curated links to enable out-of-field geoscientists to speak to the issue.

How to be/become the trusted source for unbiased info on issues. As opposed to just a front company.

Need to craft an overarching message from the earth science community. how to do it?

how to walk the line between advocating for the environment and simply presenting the science.

river erosion due to farming
frakking
....

How to Think About: Fracking

Should be aimed at general public (6-8th grade reading level). This automatically brings in the Middle, High, Intro undergrad, public, parks, policy makers...

What should be on a page about this? Where do we find it? -

http://marcellus.psu.edu/resources/index.php

http://cce.cornell.edu/EnergyClimateChange/NaturalGasDev/Pages/default.aspx

http://www.theoec.org/Fracking.htm?gclid=CLKTs6zVr64CFakbQgod2W8FRg

Pose a series of questions:

What's under my house? (cinvey concept of generalized knowledge, but not specific knowledge of what is at this point)

http://www.usgs.gov/newsroom/article.asp?ID=2893

Where does my water come from? (do you depend upon a groundwater?)

http://water.usgs.gov/ogw/

Where would the gas come from? (Distance between shale layer and aquifer)

Is Fracking a new technology?

http://frack.mixplex.com/content/hydraulic-fracturing-history-enduring-technology

What is the Fracking process? (describe drilling processes, potential for things "to go wrong")

http://www.chevron.com/deliveringenergy/naturalgas/shalegas/?gclid=CPHvgdTWr64CFQ9-hwodzDgJUQ

Is Fracking responsible for earthquakes?

What's the relationship between the gas and my water?

http://pubs.usgs.gov/fs/2009/3032/

What are the risks?

http://earthjustice.org/our_work/campaigns/fracking-gone-wrong-finding-a-better-way?gclid=CKT1pITVr64CFQOEhwodlD3WQA

What are the benefits?

How will drilling affect my community? (bonuses, cons)

Earth Science Education and Outreach Provider Summit > Working Group Pages > Group 4

Working Group 4: Social Media

Members: Wendy Bohon (ESNO@ASU), Thalia Anagnos (NEES), Charles Bopp (GeoPRISMS), Lina Patino (NSF)

Our objective is to understand how to use social media for effective program outreach.

Media Discussed:

Facebook, Twitter, LinkedIn

- Organizations need a goal and a plan before undertaking a social media project: what does your organization want to accomplish, and who is your audience? what are your priorities for posting?

EarthScope Experience (see this link for a recent talk by Wendy: http://earthscope.asu.edu/?q=content/bohon-social-media-talk-earthquake-country-alliance-12512-0):

- Frequency of posts (4-7/day) and effect of post frequency on social media following
- Facebook and twitter broadcast to different groups:
    - Facebook reaches out to scientists, students and teachers
    - Twitter reaches out to the public and professor communities
- Facebook and twitter also expect different content:
    - Facebook is more interested in the news, workshop reports, and the like
    - Twitter is more interested in hard science news and links
- Content generation is greatly helped by reposting/retweeting
- Tweeting can be used at conferences to bring attendees to your booth when you have demonstrations or giveaways.
- Types of content (examples):
    - field photos
    - question of the week
    - publications
    - meeting updates and news
    - data products
    - factoids
    - science humor
- Social media services need a voice, committee vetting or content writing would be less effective
- Alliance for Social Media (our organizations need to work together to leverage each other's content)
- Content delivery for posting etc...
    - Use google alerts to filter news

- RSS feeds from pertinent organizations
- Twitter: trending topics and the like

- Analysis of social media effectiveness is crucial:
    - Facebook has tools for analyzing your page's visitors, followers, posts, and the like.
    - Twitter does not offer such tools, but many 3rd party tools exist

Earth Science Education and Outreach Provider Summit > Working Group Pages > Other Tasks

Other Potential Tasks for Working Groups

These ideas were proposed by Provider Summit participants but were not addressed at the Summit for lack of time. They are archived here for reference. They are not listed in any particular order of importance.

- Sequencing of content or lessons; Developing learning progressions in Earth science
- Teaching with places: Generating ideas and resources for interpretation and place-based education
- Using the AGI "Big Ideas" webpage as a template for a topical page
- Teaching with data: Effectively incorporating data into informal and formal education
- Figuring out how to avoid duplication of effort; establishing some form of clearinghouse
- Determining which other organizations and programs should be incorporated into this process
- Should working groups be broken out by solid-Earth versus Earth-surface primary interests?
- REUs: How-tos and best practices

E-mailed Responses to Open Request for Post-Provider Summit Evaluation from all participants, February 2012
(transcribed with personal and organizational names omitted; original responses are on file)

I thought it was a very productive meeting, and I appreciate [*org*]'s inclusion. I learned a lot about what the providers can offer to the science ed community. We'll be incorporating much of that into our K-5 program this summer and into the UK program in the fall. I'm going to send an email around today asking if anyone wants to participate in Earth Science Week this year (several have indicated that they wanted to join in). I'm also feeding the information about REUs to our Workforce Department. Thanks for organizing a great meeting!

This was a well-organized meeting with a clear agenda. it brought together a range of different players in a manner which successfully allowed the sharing of expertise, experience, and perspectives around a set of common themes. It also tapped into the group's collective wisdom in a constructive way, creatively discussing and developing potential ways of addressing several important geoscience issues. Participants formed strong and purposeful connections in both professional and personal ways, producing optimistic "beginnings" which are likely to bear fruti if this momentum is continued. It would certainly have enabled other topics to have been tackled if there had been more time available. We will look forward to pursuing the goals of EarthScope in any way we can.

1. The meeting was very well organized and provided ample opportunities for exchange of information.
2. I was nervous about the format of the agenda and worried that each individual/group would give a data dump. This did not happen. Every one gave shortrelevant presentations that fed into useful exchanges.
3. In future exchanges and correspondence care should be taken to enlist the support and participation of groups that were did not attend. I would particularly reference the Integrated Ocean Drilling Program folks.
4. I felt that the summaries were imbalanced in that the importance of the K-12 student and teacher community was not emphasized. Earthscope and other NSF programs and facilities really need to concentrate on selling their wares to this group. The NPS focus is fine but the K-12 populations are much more important. Special attention needs to be made to provide accessible data, material and activities. With care and over time much of this NSF-facility product could end up in curricula and significantly improve K-12 awareness of the earth sciences.
5. I enjoyed working with a dedicated group of colleagues and made some very helpful contacts.

I found the meeting very useful and only regretted that we didn't accomplish our new hire in time for her to attend. As a newcomer, I made a number ofimportant connections at this meeting and learned a lot about what the other, more established Earth Science Education Providers were doing. This provided a lot of fodder for us to consider as we advance our programs. I think we could also combine forces to increase our public profile.

Hello and thanks for hosting a great meeting! The [*org*] are in the nascent stages of developing our sites into a network. We do not yet have a formal national office or dedicated education and outreach staff, so our efforts in that regard, while generously supported by NSF, have been somewhat ad hoc. From the [*org*] perspective the meeting was quite informative. The first day was excellent —I left with 13 pages of notes and many examples of successful education initiatives thatcan serve as models for us as we develop our education and outreach plan. The opportunity to meet and network was also fabulous. The second day was less productive for me though I believe this is a function of our relative immaturity with respect to the others - with no formal budget or staff it is difficult for me/us to commit to future collaborations. Having said that, lunch on the second day provided an excellent moment to meet and discuss the overlap and similarities between [*orgs*], and to develop personal ties. Invaluable.

[T]hanks again for hosting and conducting the Summit. I found it very useful and informative.
On the plus side:

- Great to know that there is a whole community of E&O people within EAR IF;
- Putting a face with a name makes collaboration easier;
- It is a willing group to bounce ideas off of;
- So much work has already been done that I don't feel the need to reinvent the wheel.

I can't really think of anything negative about the Summit. I really enjoyed it and thank you and the EarthScope team for inviting me!

Thanks again for organizing the workshop. I think it was very useful to get the groups together to share what we are doing and discuss future possibilities, and I feel it was definitely worth the time for [*name*] and I. In fact if I had better anticipated how the workshop discussion would evolve, I would have brought [*name*] as well, as he is dealing with many of the issues that were discussed. Here are a few of my thoughts on the workshop:
Positive aspects:

- Hearing Lina's views on how she would like us to work together
- Meeting some new E&O people and having a chance to talk with those that I already knew
- Hearing descriptions of all the programs, which led to discussions of new avenues for collaboration with other programs
- Discussion on sharing and promoting online resources
- Listing and then voting on potential discussion groups for the 2nd day.

Potential areas for improvement

- I think the 2nd day might have been more productive and increased the amount of interaction if the time had been broken into 2 different discussion topics, as it felt to me like we were running out of steam by the end.
- Lina's charge to create a short list of common goals gave our group more focus, but without it I think we might have had trouble coming up with a deliverable.
- I was personally a little unsure about focus of the workshop beforehand, as I thought there was going to be an EarthScope focus. Once I was there, it became

clearer that while ESNO was organizing the workshop, Lina really was interested in the overall interactions between the groups.

Again, a big Thank You to you, Wendy and Cindy for organizing this meeting! I think it was fantastic to get the GEO E&O providers together in one room! Finding out what other organizations are doing, learning about different perspectives, and havingcontact with the E&O leaders was very beneficial. I think there needs to be periodic interaction as one meeting usually isn't sufficient to form strong alliances and/or collaborations. And there are other groups with overlapping interests who were not present at this meeting. I plan to follow up with the others in my break-out group to work on an info sheet about fracking. If we develop this product, it will be a great outcome for [*org*] in particular, but for the E&O Providers Summit as well.

Thanks once again for having us attend the Provider Summit. I think it was a very worthwhile opportunity to intersect with some exciting scientists who are in key positionsto further exciting and fundamental research. For [*name*] and I, it meant the chance to initiate partnerships that may prove very useful for our students and teachers. We had thechance to interact with people running programs that will definitely benefit our teachers and lead to introduction of new materials into the classroom on coring and on Earth week. We talked with [*org*] and the [*org*] about potentials for [*org*] education to collaborate with them on reaching a diverse audience. I think this will lead to somedefinite positive interactions. And we heard about many possibilities for internships which we can share with our undergraduates. Thanks again for the opportunity!

Thank you again for the invitation to the Provider Summit and for all the attention that was given to our comfort. If only every meeting could be like that! I know exactly how much behind-the-scenes work goes into a big meeting. It's really nice to be on the receiving end. Although I understand why [*org*] was invited, I don't think that I had much to contribute. I fear that I was a poor substitute for [*name*]. However, I certainly learned alot about NSF-funded organizations and I made some excellent contacts. There's no substitute for meeting people face to face and spending some time with them. I do periodically refer people to education groups like those at the meeting, so it's great to get a feel for the scope of what's out there.

Once again, thank you very much for organizing this workshop. I am already talking to my colleagues at NSF about it and see what plans there may be to engage the large Geosciences community.