# The Growth of Seismology Education and Public Outreach

Advancing awareness & understanding of
seismology and geophysics while inspiring careers
in Earth Sciences

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Facilitate – Collaborate – Educate

IRIS NSF

# Overview

- Why E&O in a science facility?
- History
- Activities arranged by audience
  - Undergraduate students and faculty
  - Middle school/high school
  - General public

# Why E&O in a science facility?

- Incorporated Research Institutions for Seismology (IRIS) formed in 1984
  - Global Seismic Network (with USGS), portable seismographs, data management center
  - IRIS community wasn't initially in favor of including E&O
- Strong NSF encouragement to add E&O
  - Initiation of NSF Broader Impacts criteria (1997)
  - First staff member in 1998
- Value of a facility E&O program
  - National consortium with local university connections
  - Strong community involvement
  - Unique data and scientific resources
  - Stable consortium structure for long-term programs
  - Considerable emphasis on outreach

# Progression

- Then
  - Started as largely volunteer community efforts
  - K-12 and informal education focus
    - Seen as greatest need
  - Mainly paper-based and in-person professional development
- Now
  - Led by professional staff with community oversight
  - Providing undergraduate resources as well as training for the community
    - Serving Consortium members as well as broader community
  - Online professional development via videos, animations and data access tools
  - EPO is an integral part of the facility
  - EarthScope/USArray outreach is significant component

# 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

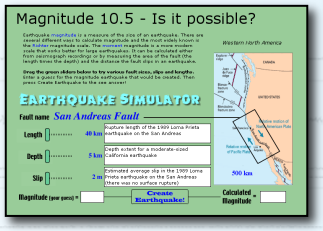
- Research Experiences for Undergraduates
  - 144 undergraduates since 1998
  - Over 40 Consortium member institutions as hosts
  - 85% of alumni go on to grad school
  - Past interns are now mentoring their own interns
  - Virtual REU
    - Student community established through 1-week orientation
    - Connection through rest of summer via online communication
- Creating labs and exercises for intro and upper level earth science courses

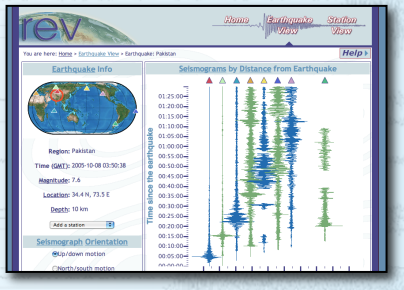

# Teacher and College Faculty Professional Development

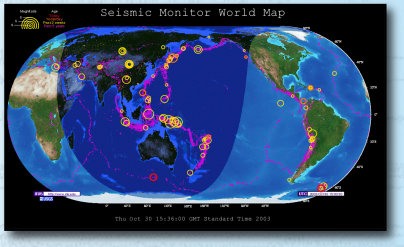
- Improve instructor knowledge and confidence
- In person workshops – 1 hour to 3 days
- Leverage via interactions with other groups
- Can't reach enough instructors with existing methods
  - Focus on online resources
    - Webinars
    - Creating a virtual professional environment

# Web Resources

- Activities developed for school and college classroom
- Interactive software
  - Simplified use of data available through IRIS
- Materials and interactions promoted via Facebook, Youtube, Twitter

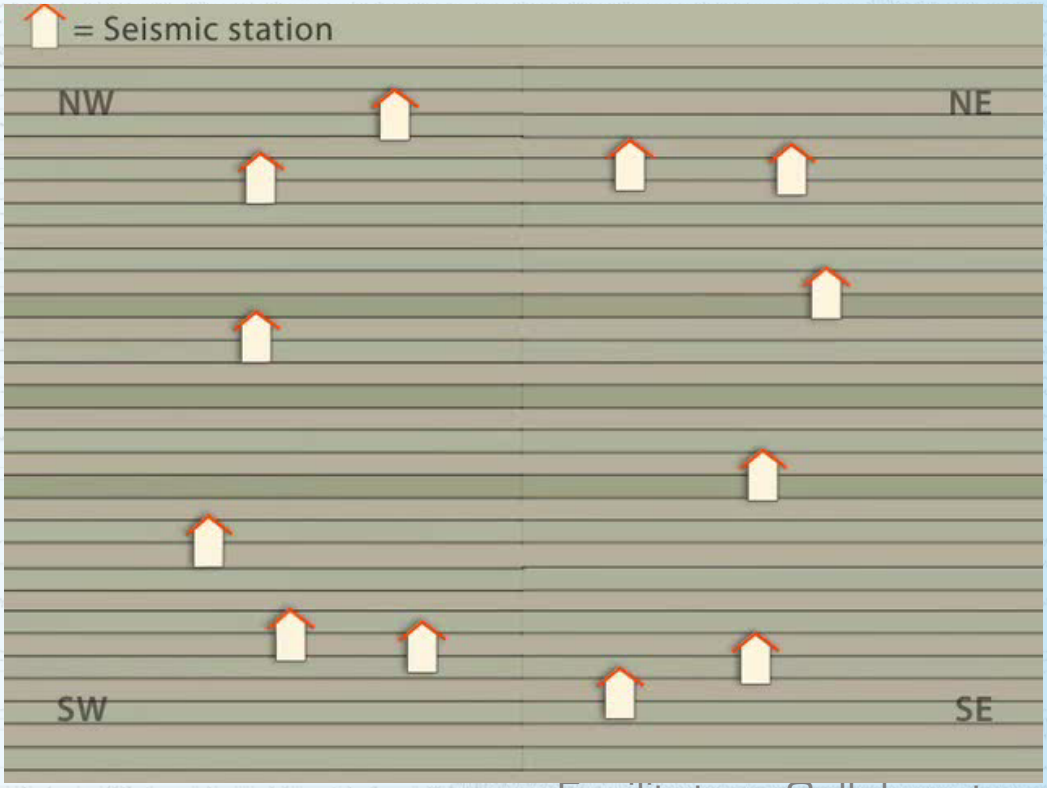


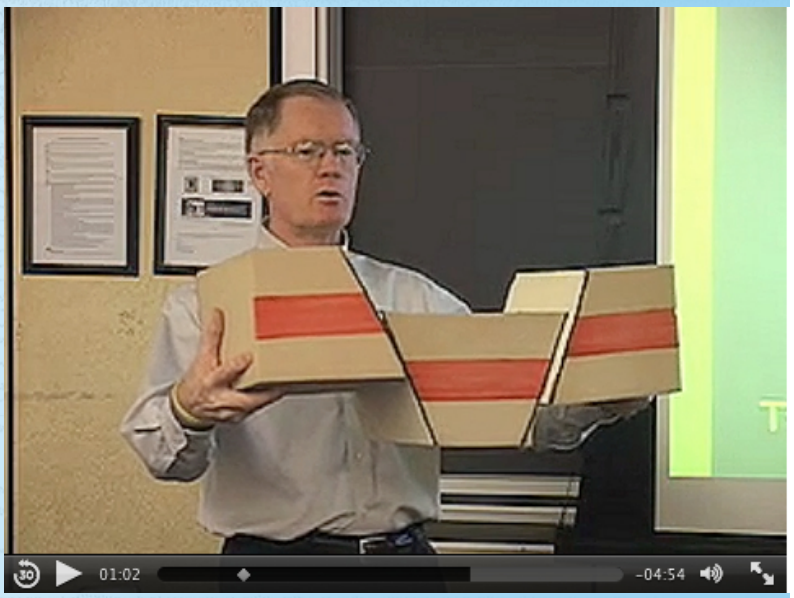




# Animations and videos

- Over 100 animations, visualizations and videos for use in teaching
  - Over 1.5 million visitors to YouTube+TeacherTube
- Designed to simplify and demonstrate concepts

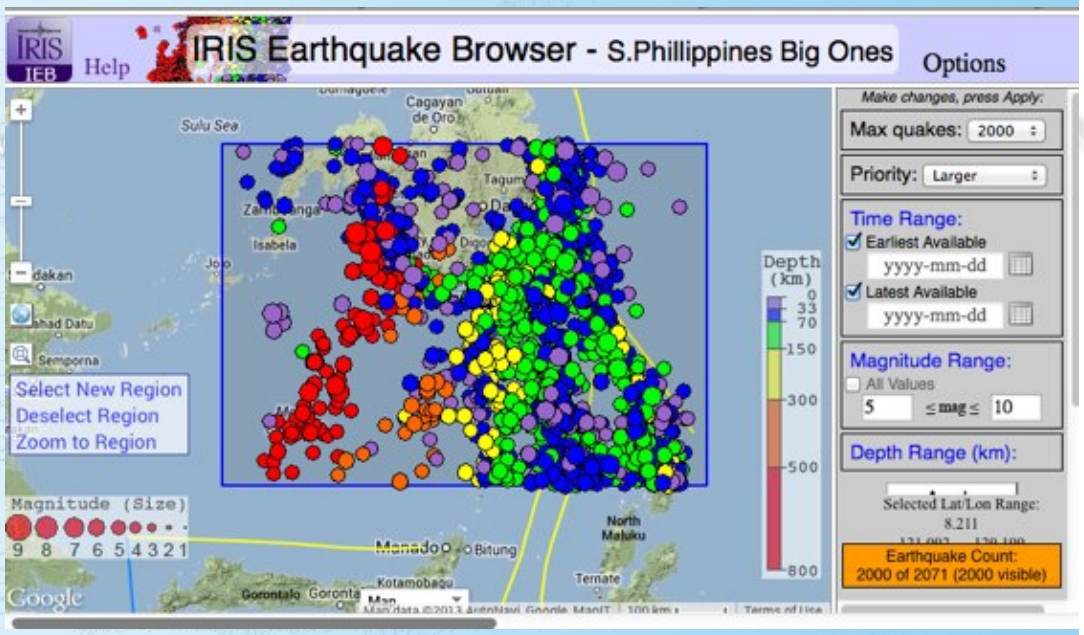


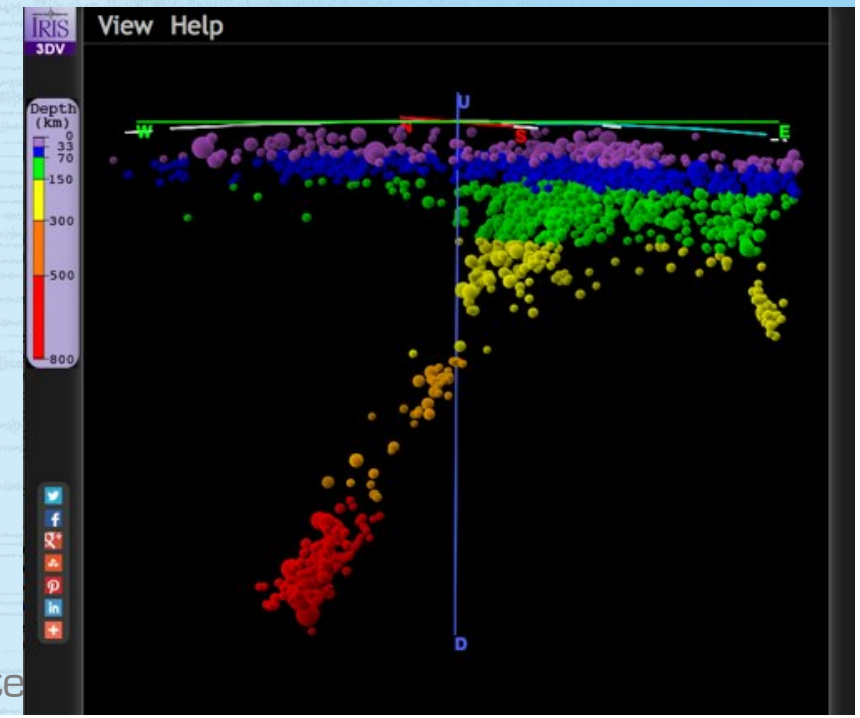



IRIS NSF

# IRIS Earthquake Browser



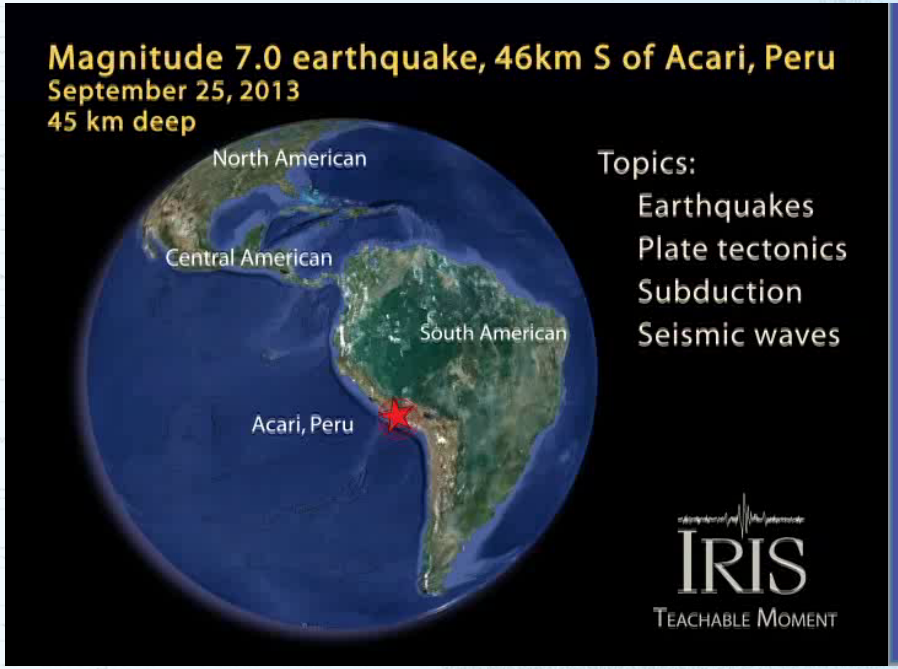

- Student exploration of plate boundaries
  - 3.3 million earthquakes spanning 50 years

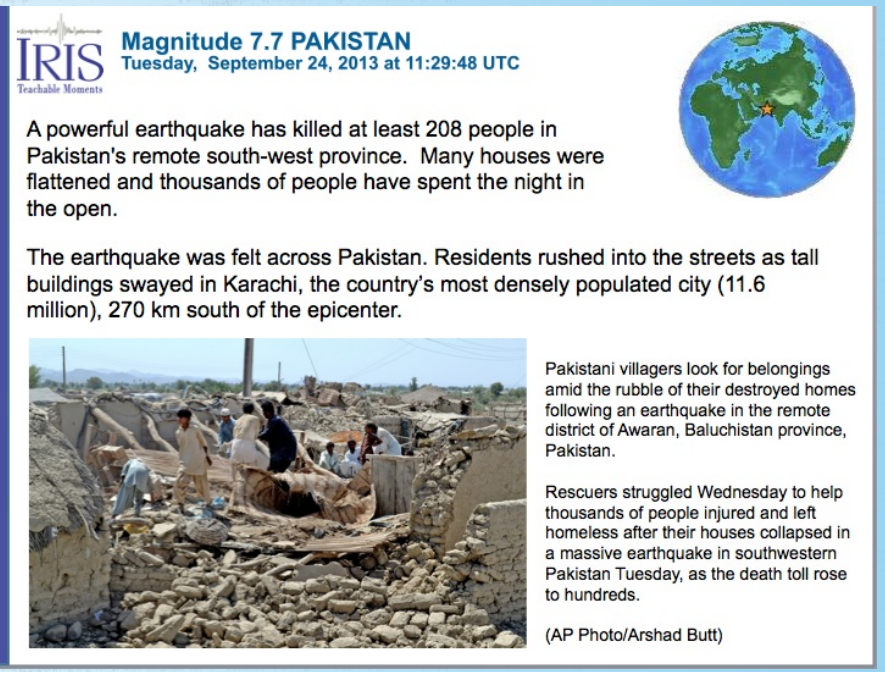



- New 3D interactive browser
  - Rotate and zoom through hypocenters
  - Up to 5000 events
- Can share links for social networking or giving assignments to students

# Teachable Moment slide sets

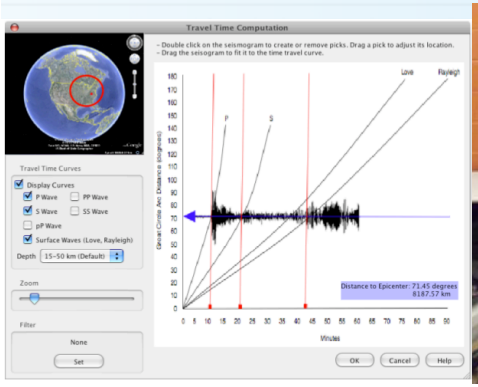
- Newsworthy earthquakes motivate students
- Slide sets produced within 1 day
  - Jointly produced with Univ. of Portland, collaborative content from USGS, UNAVCO, ESNO and others
  - Tell a story
  - In English and Spanish

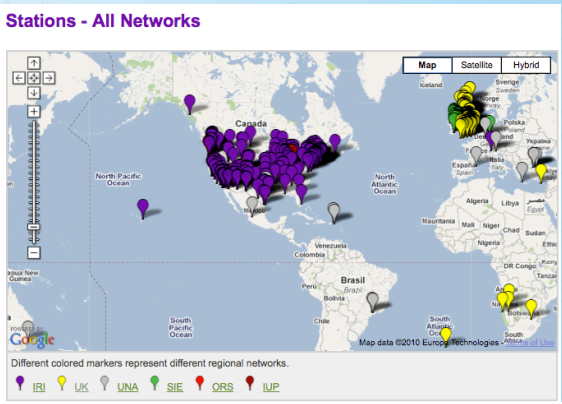


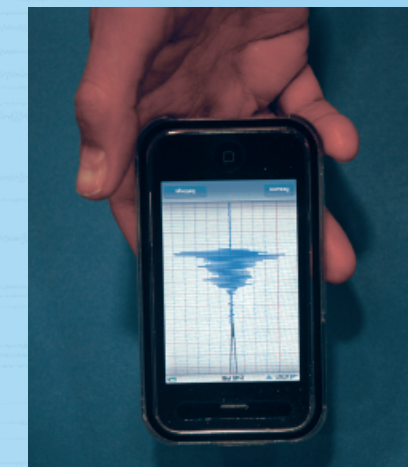



# Seismographs in Schools

- IRIS provides training and specialized software
- Web environment to improve connections between schools
  - Over 150 US schools
  - 250 international schools
- Student introduced to school seismograph in 8th grade became IRIS intern
  - Now a grad student in geophysics
- USB accelerometers and smart phones for engagement



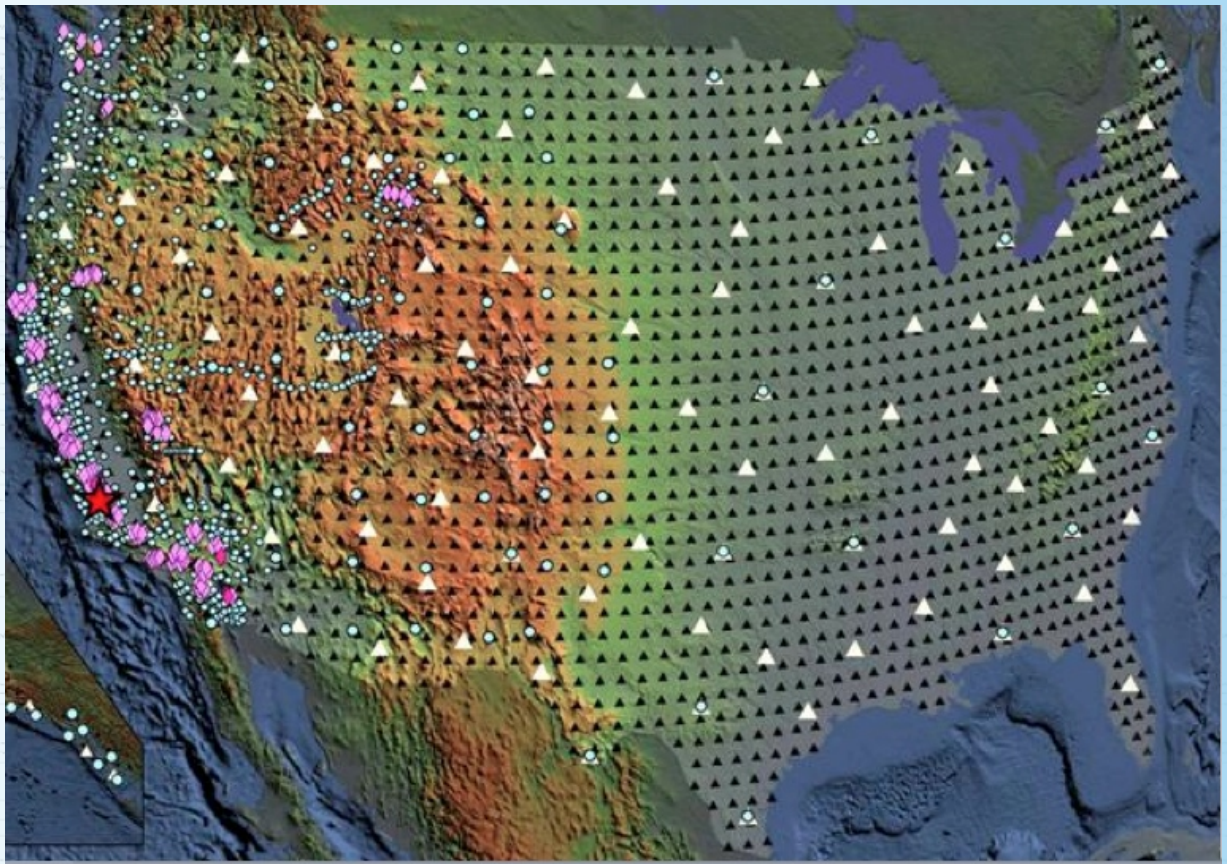



# EarthScope/USArray

- How to engage the public in

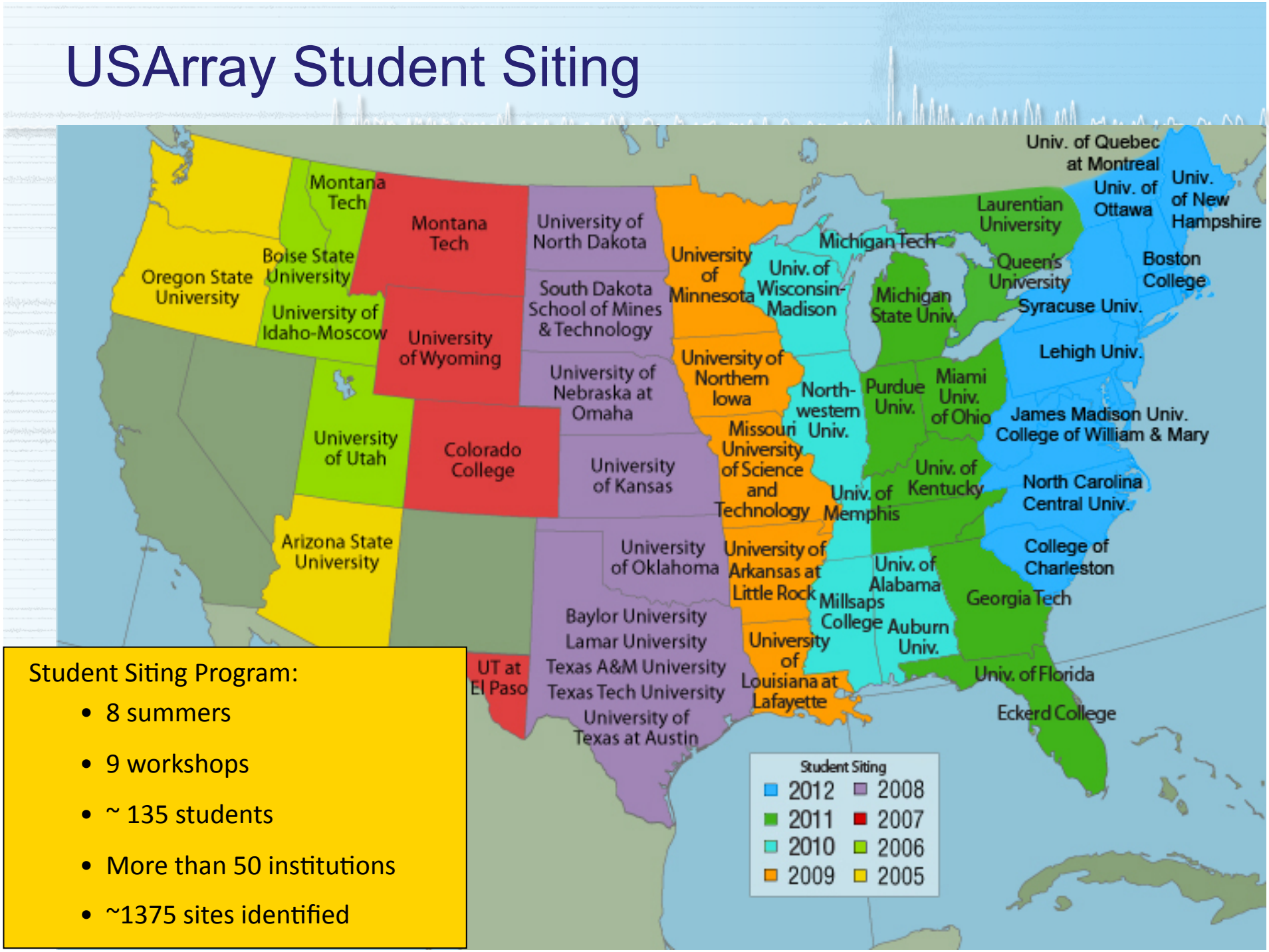
*The #1 most awesome experiment in the Universe*

(According to Popular Science)



IRIS NSF

# USArray Student Siting

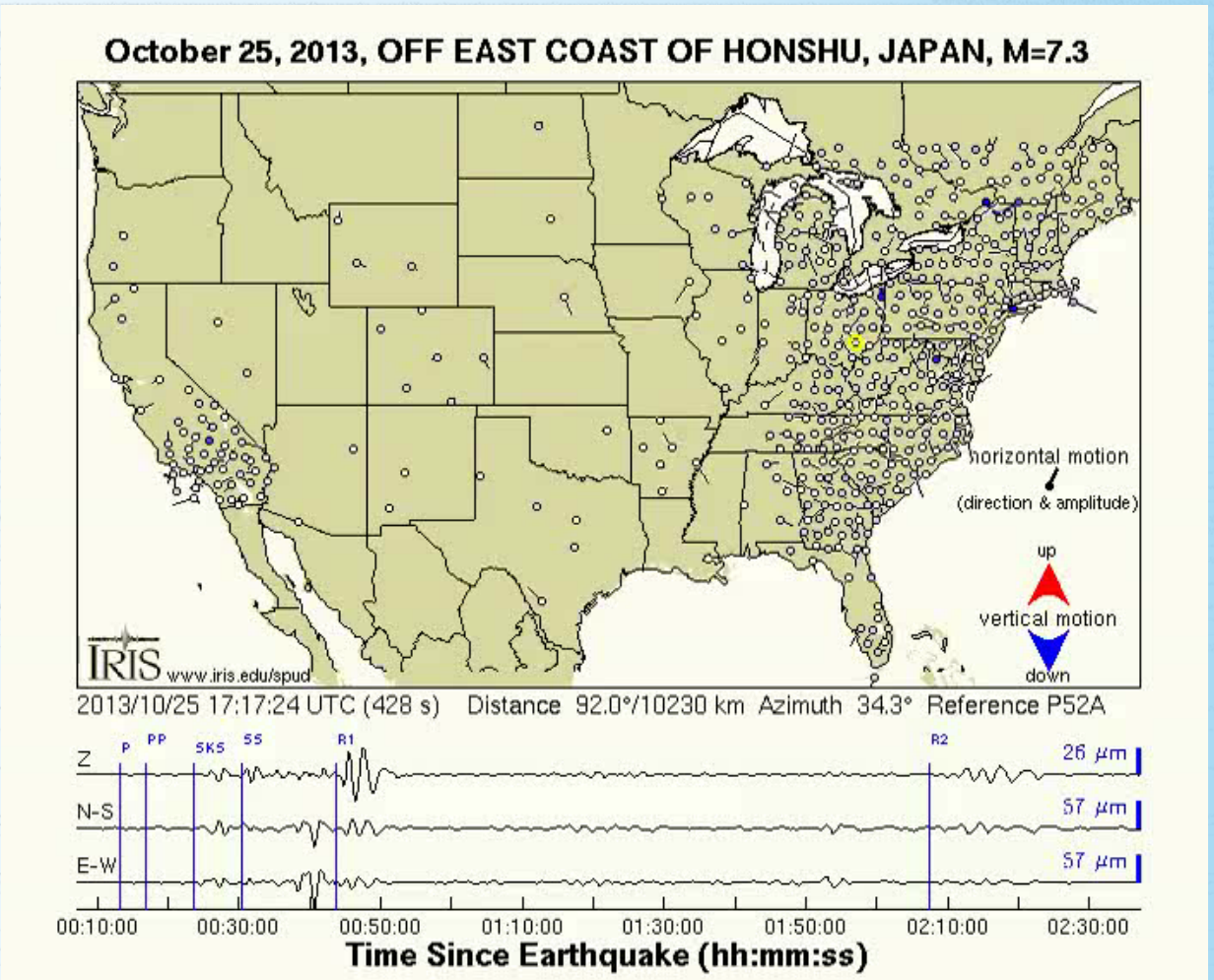



Student Siting Program:

- 8 summers
- 9 workshops
- ~ 135 students
- More than 50 institutions
- ~1375 sites identified

# USArray Ground Motion Visualizations

- Automatically produced at the IRIS Data Management Center
- Teaching sequence tutorial on web

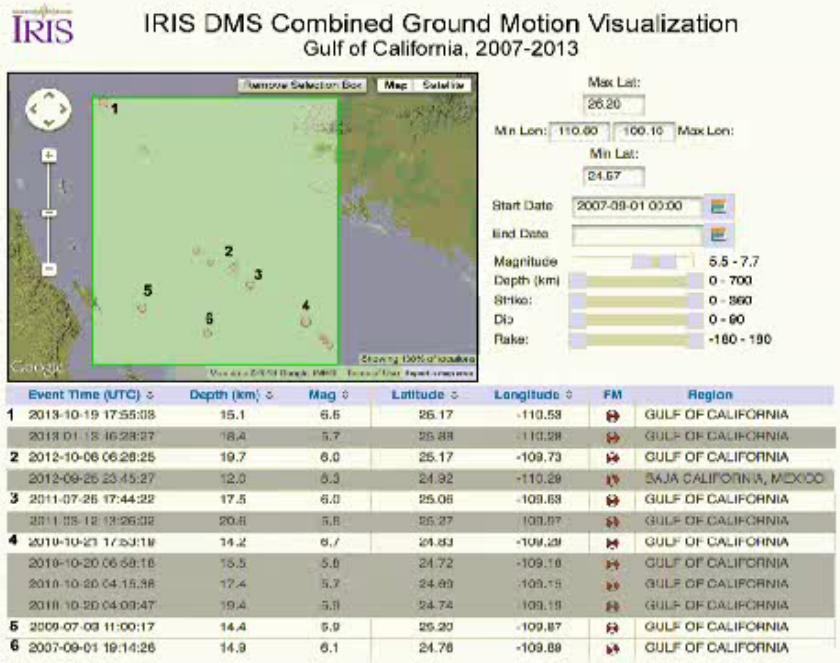


# USArray Ground Motion Visualizations

- Combined Ground Motion Visualization

## IRIS DMS Combined Ground Motion Visualization

GULF OF CALIFORNIA 2007 - 2013




| | Event Time (UTC) | Depth (km) | Mag | Latitude | Longitude | FM | Region |
|---|---|---|---|---|---|---|---|
| 1 | 2013-10-19 17:55:08 | 15.1 | 6.6 | 26.17 | -110.58 | | GULF OF CALIFORNIA |
| | 2013-01-13 16:28:27 | 18.4 | 5.7 | 25.88 | -110.28 | | GULF OF CALIFORNIA |
| 2 | 2012-10-06 06:28:25 | 19.7 | 6.0 | 25.17 | -109.73 | | GULF OF CALIFORNIA |
| | 2012-09-25 23:45:27 | 12.0 | 5.3 | 24.92 | -110.29 | | BAJA CALIFORNIA, MEXICO |
| 3 | 2011-07-26 17:44:22 | 17.5 | 6.0 | 25.08 | -109.68 | | GULF OF CALIFORNIA |
| | 2011-08-12 13:26:02 | 20.6 | 5.6 | 25.27 | -109.97 | | GULF OF CALIFORNIA |
| 4 | 2010-10-23 17:53:19 | 14.2 | 6.7 | 24.83 | -109.29 | | GULF OF CALIFORNIA |
| | 2010-10-20 06:58:16 | 15.5 | 5.6 | 24.72 | -109.16 | | GULF OF CALIFORNIA |
| | 2010-10-20 04:15:38 | 17.4 | 5.7 | 24.69 | -109.19 | | GULF OF CALIFORNIA |
| | 2010-10-20 04:03:47 | 19.4 | 5.8 | 24.74 | -109.18 | | GULF OF CALIFORNIA |
| 5 | 2009-07-03 11:00:17 | 14.4 | 5.9 | 25.20 | -109.87 | | GULF OF CALIFORNIA |
| 6 | 2007-09-01 19:14:26 | 14.9 | 6.1 | 24.78 | -109.89 | | GULF OF CALIFORNIA |

# Public Displays

- Started with IRIS/USGS displays in major museums
- Now focused on Active Earth Monitor
  - Designed for visitor centers, small museums, universities, schools, highway rest area
  - Regional content sets and customizable selection of pages to display
    - Content development with UNAVCO, ESNO, CERI, SCEC



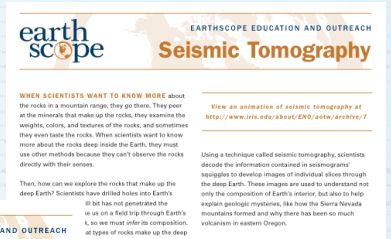

# Public Outreach

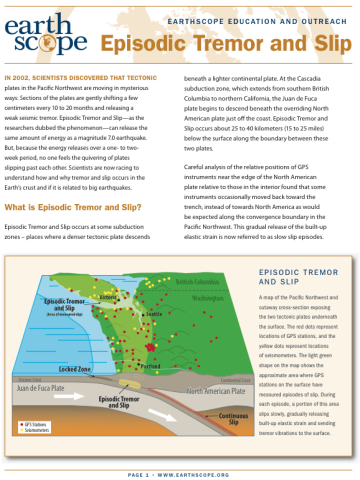
- IRIS/SSA Distinguished Lecture Series
  - Convey the excitement of seismology to a general audience
  - 19 Lecturers have given over 110 presentations to up to 400 people
- Temporary exhibits for the public
- National and international filming and broadcasting of EarthScope and USArray

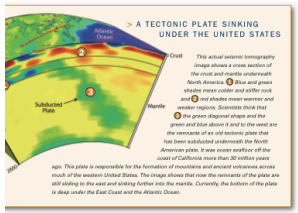


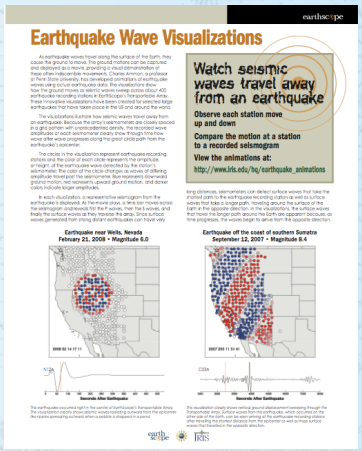

# Publications

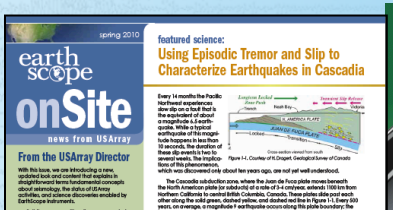
- Provide fundamentals of seismology and broaden awareness
- Many EarthScope-related publications are collaborative with UNAVCO and ESNO
- Printed material is less common, but still has value

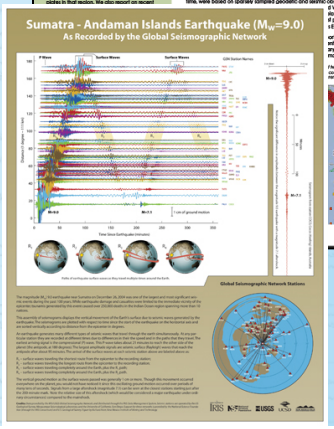


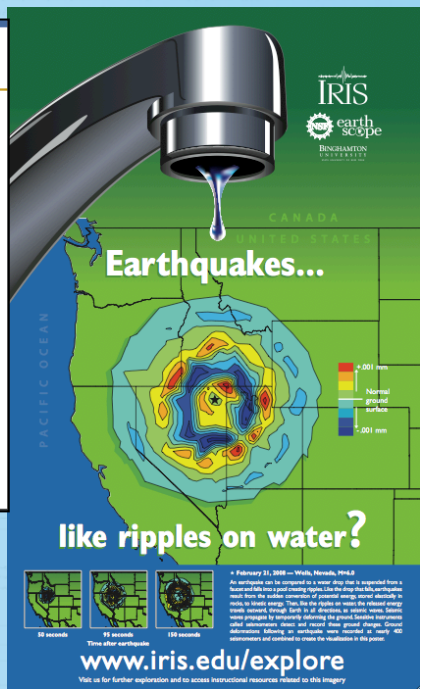





# Evaluating our progress

- How well do the individual activities support the mission and goals of IRIS and the EPO program?
- Does the balance of activities adequately address the needs of the target audiences?
- Is the quality of services and products appropriate?
- Importance of evaluation continues to increase
  - Primarily internal formative assessment
  - Occasional external assessment of individual elements or entire program
  - IRIS EPO Standing Committee provides ongoing oversight of the program

# Summary

- Stability of a facility-based program allows for long term growth and improvement of products and services
- Elements are designed for specific audiences and desired depth of involvement
- Increased emphasis on virtual delivery and interactions, but some face-to-face interaction still needed
- Impact is leveraged through collaborations