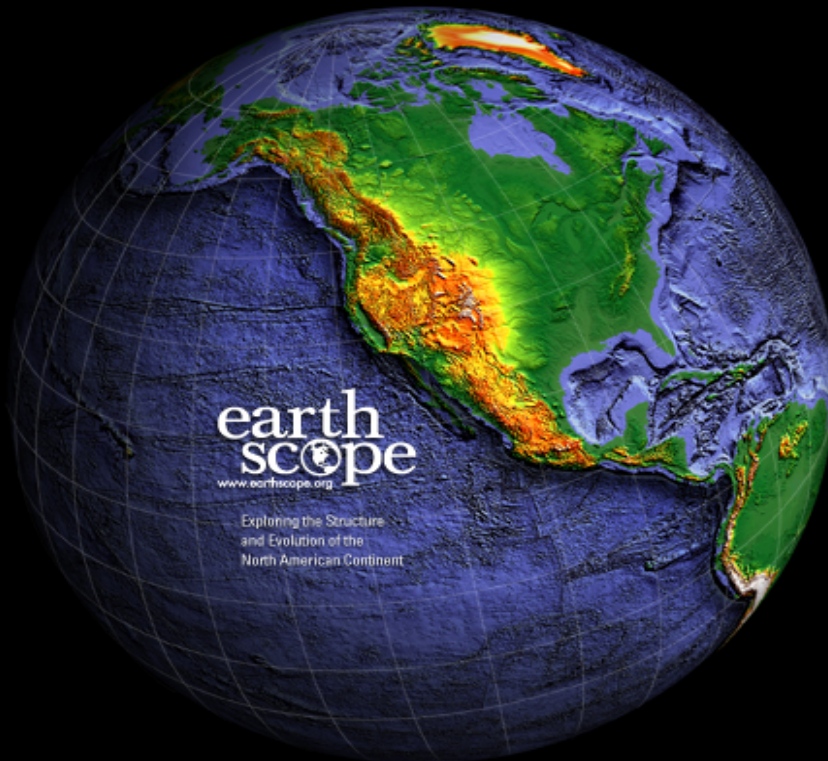


USArray Status



Bob Woodward
USArray Director

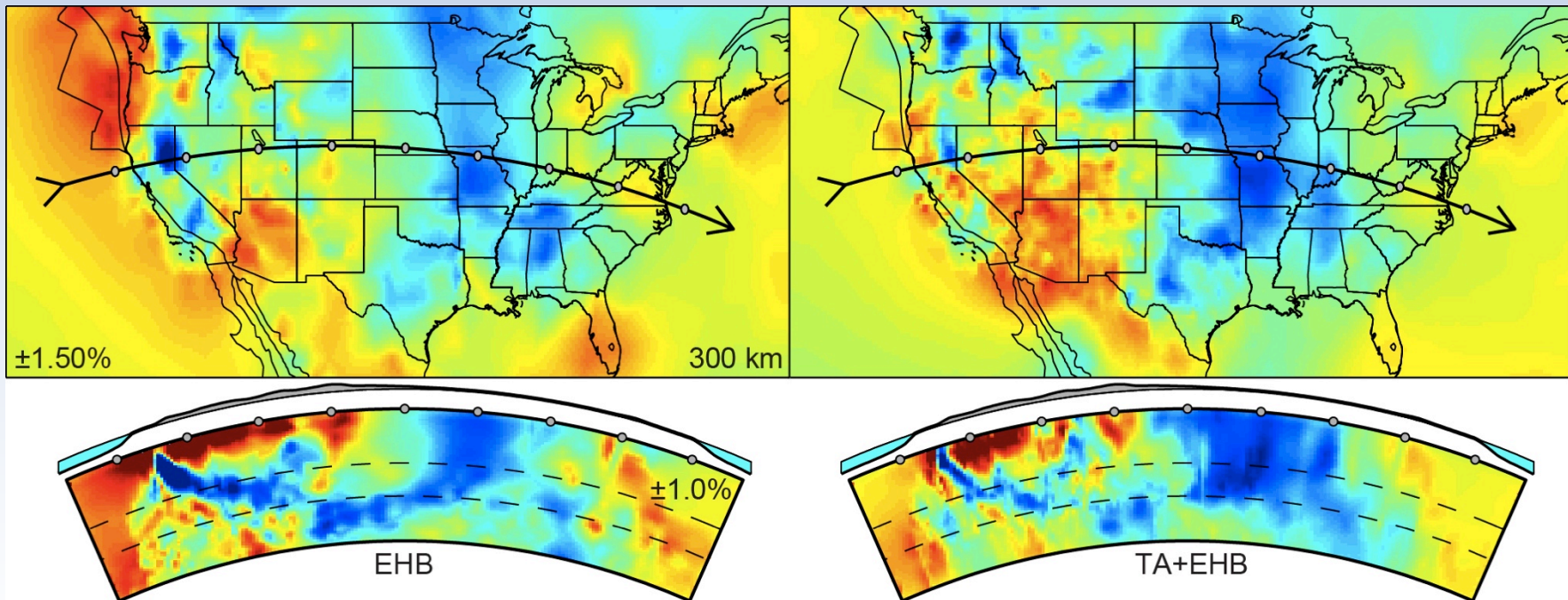
ESSC Meeting
Oct. 22-23, 2012
NSF
Ballston, VA

- Very brief status of USArray
 - Transportable Array
 - Flexible Array
 - Magnetotellurics
 - Data Management
 - Siting Outreach
- Looking ahead
 - Current activities
 - Funding
 - Planning discussions

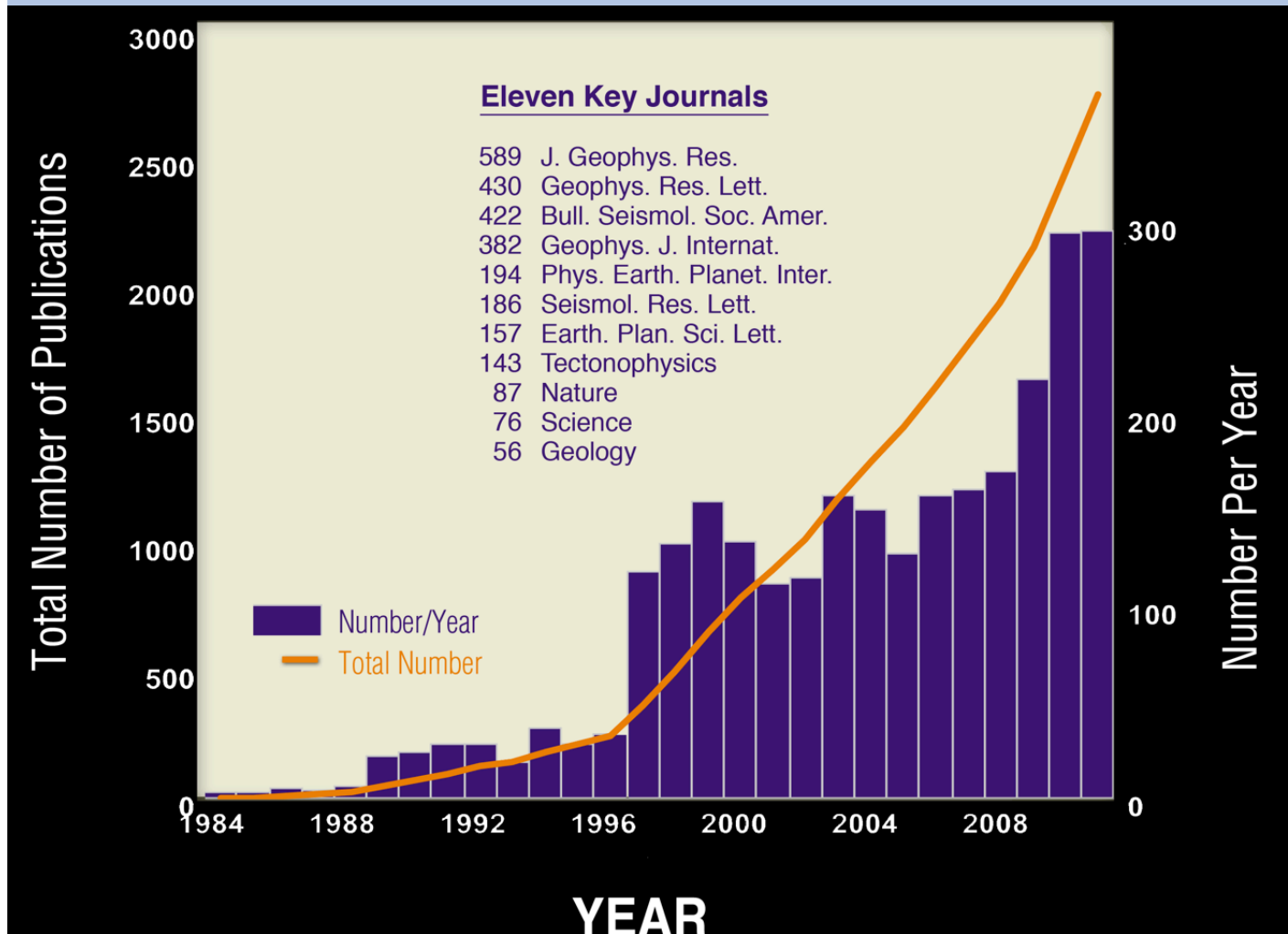
- Evolving view of the North America

“Before”

“After”



From Burdick, et al



Users

Primary Research

high hundreds

Supplemental Research and Education

low thousands

Occasional Users

tens of thousands

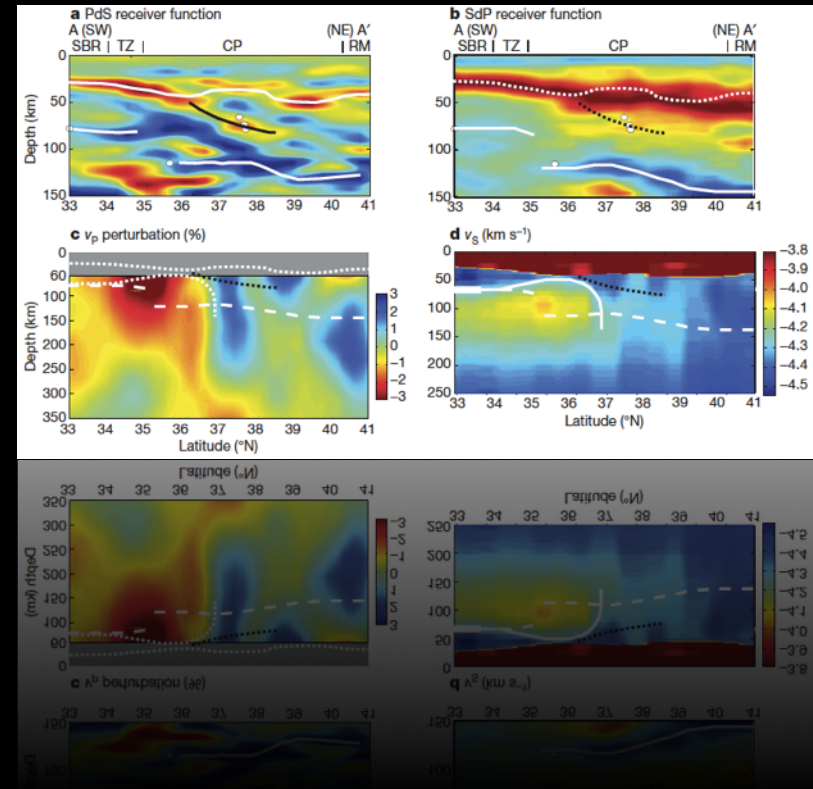
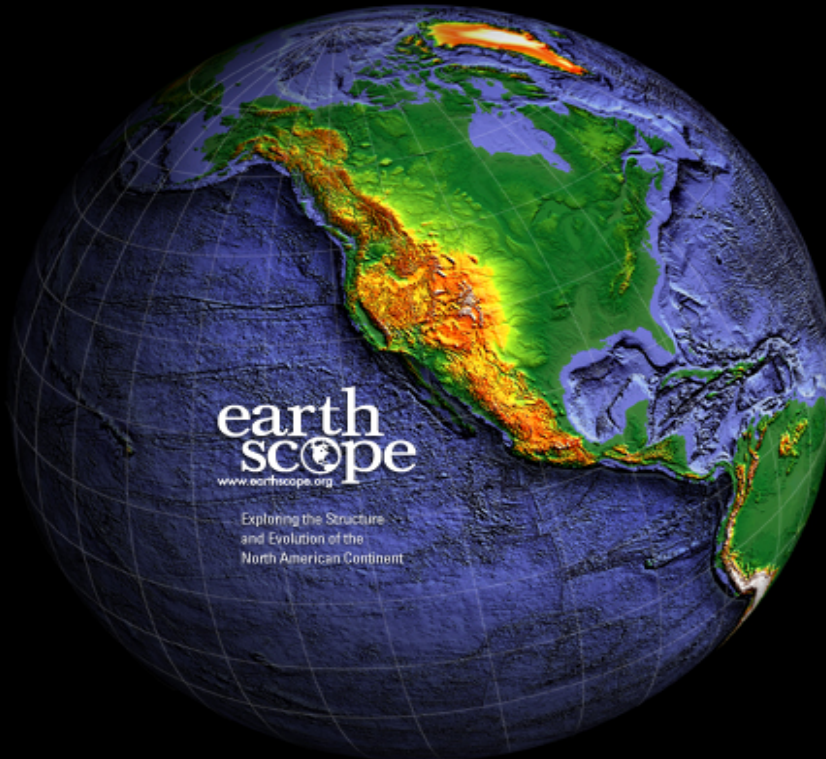
Informal Users

hundreds of thousands

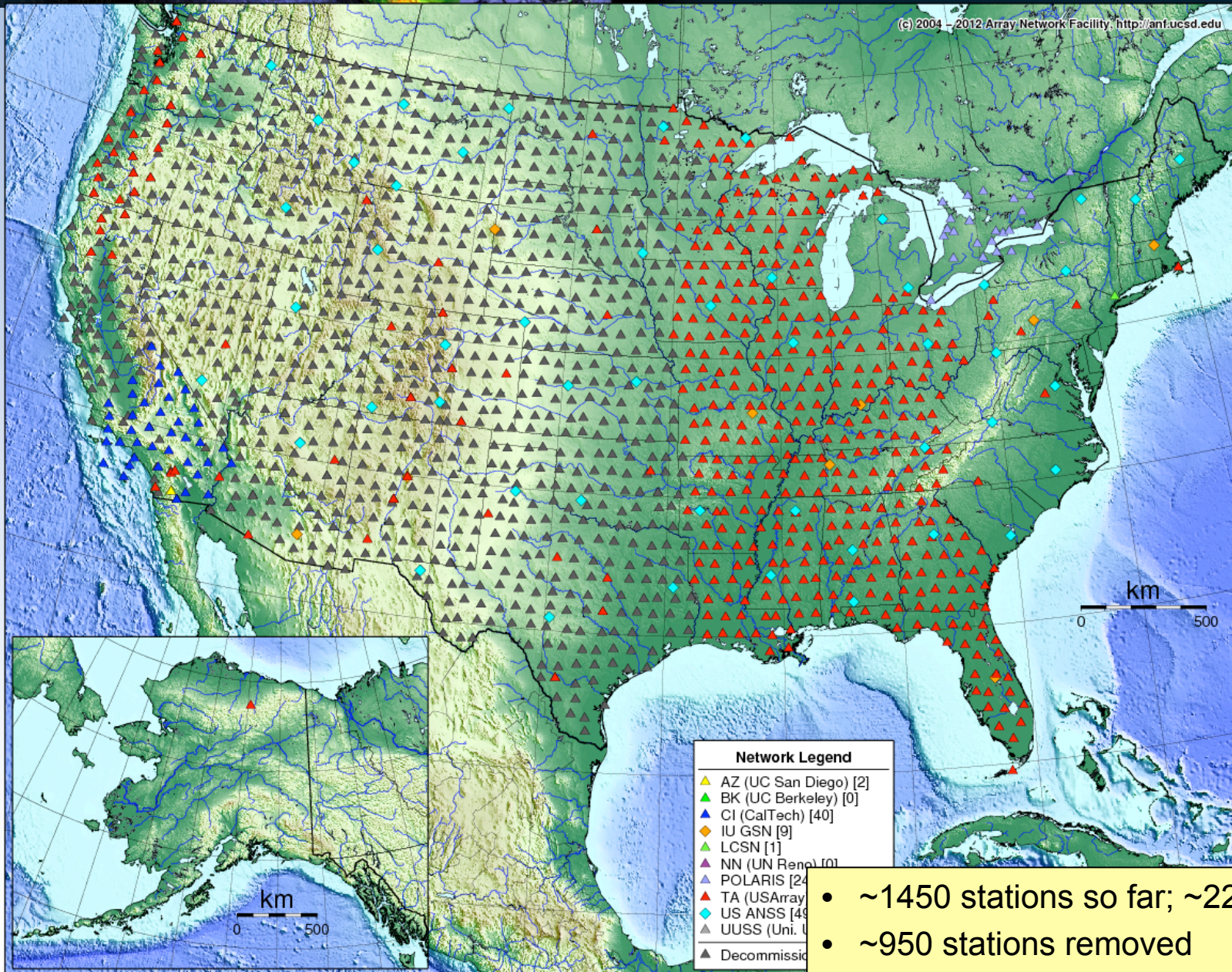
Widespread and growing use of IRIS / EarthScope resources

Transportable Array

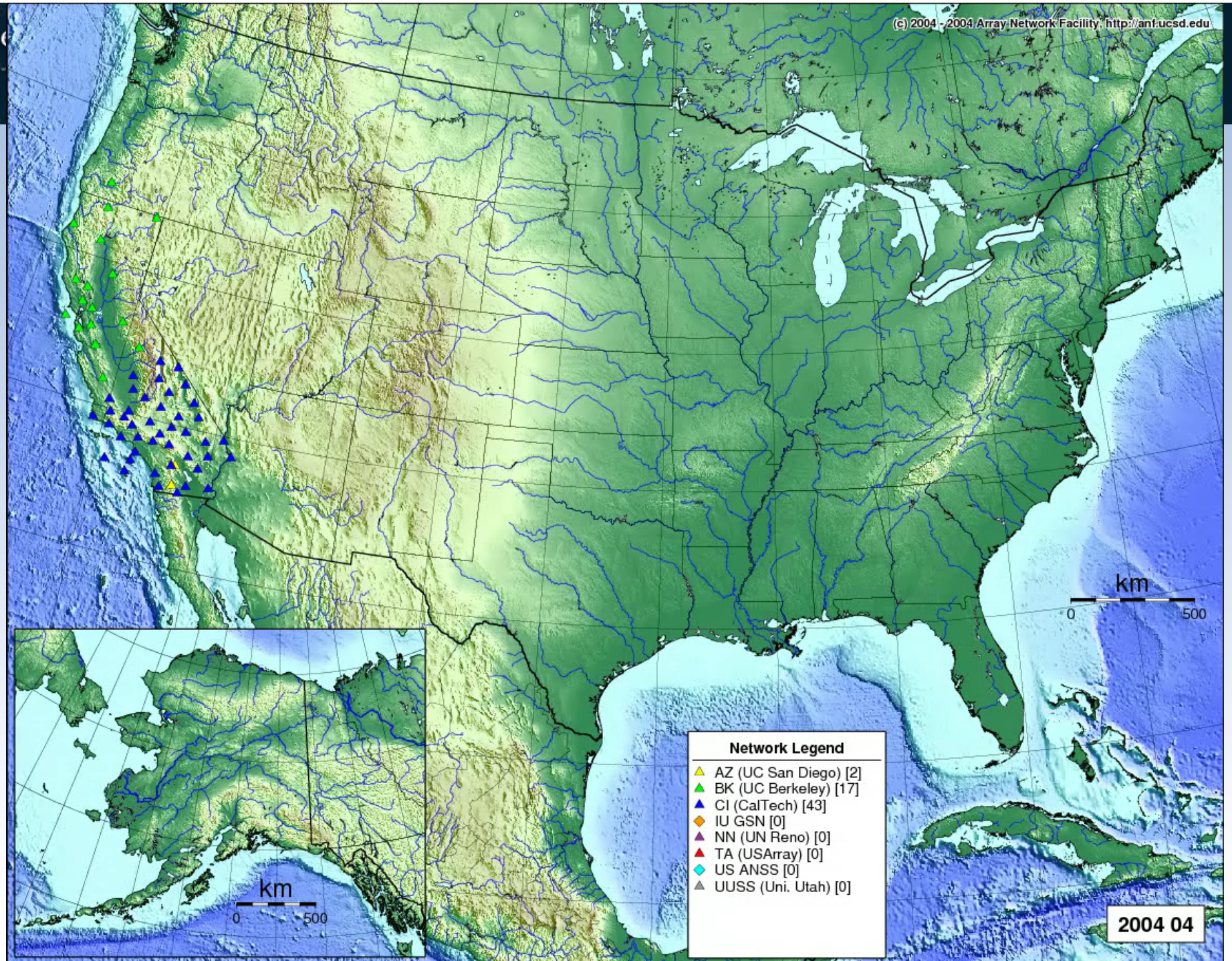
Lithospheric foundering: Levander et al.



Transportable Array



- ~1450 stations so far; ~225 to go
- ~950 stations removed





News



News

News From the Field

For the News Media

Special Reports

Research Overviews

NSF-Wide Investments

Speeches & Lectures

NSF Current Newsletter

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News Archive

News by Research Area

Arctic & Antarctic

Astronomy & Space

Biology

Chemistry & Materials

Computing

Earth & Environment

Press Release 12-028

First EarthScope 'Transportable Array' Seismic Station Reaches U.S. East Coast

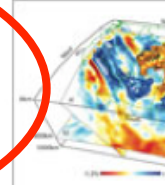
Data generate 3-D 'CT scan' of North American continent's interior



Transportable Array Station 457A in Florida: first such seismic station on the U.S. East Coast.

[Credit and Larger Version](#)

Email Print



From the array, a scan-like, 3-D image of Earth's mantle under Western North America is being generated. [Credit and Larger Version](#)

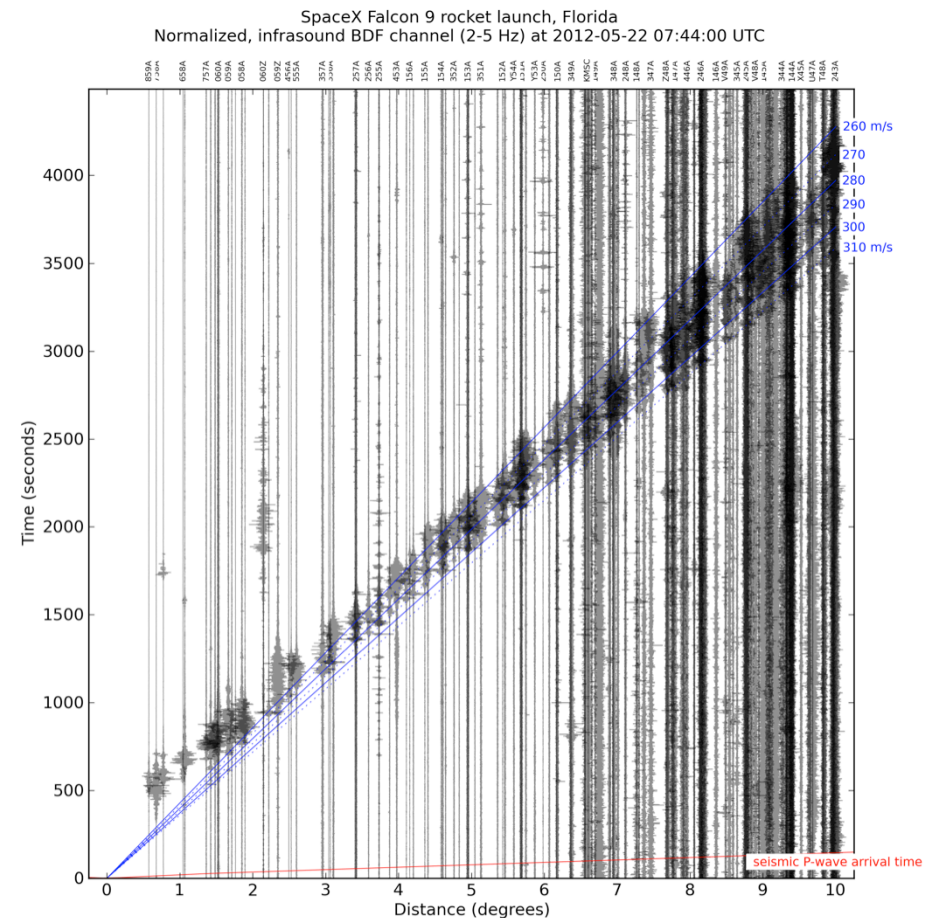
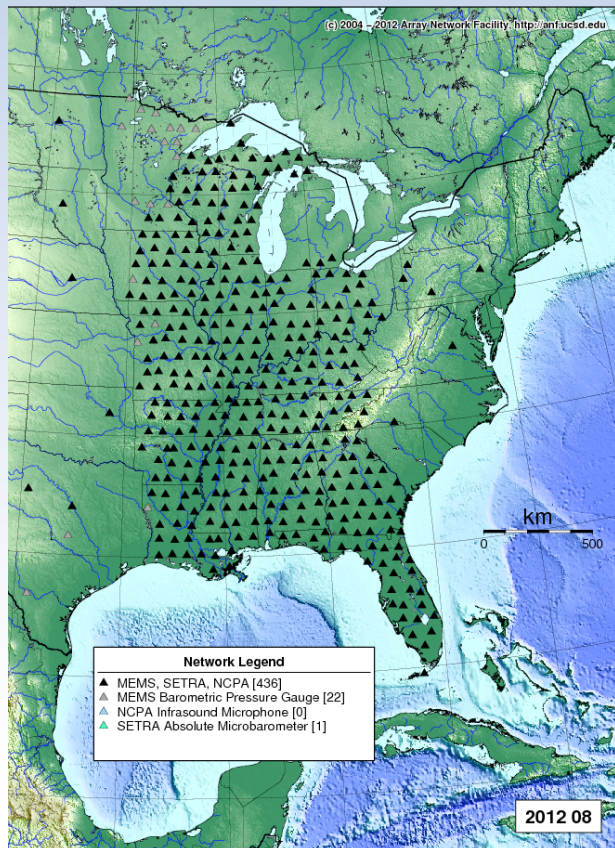


A vault with the transmitting seismometer is covered by a mound of soil. [Credit and Larger Version](#)

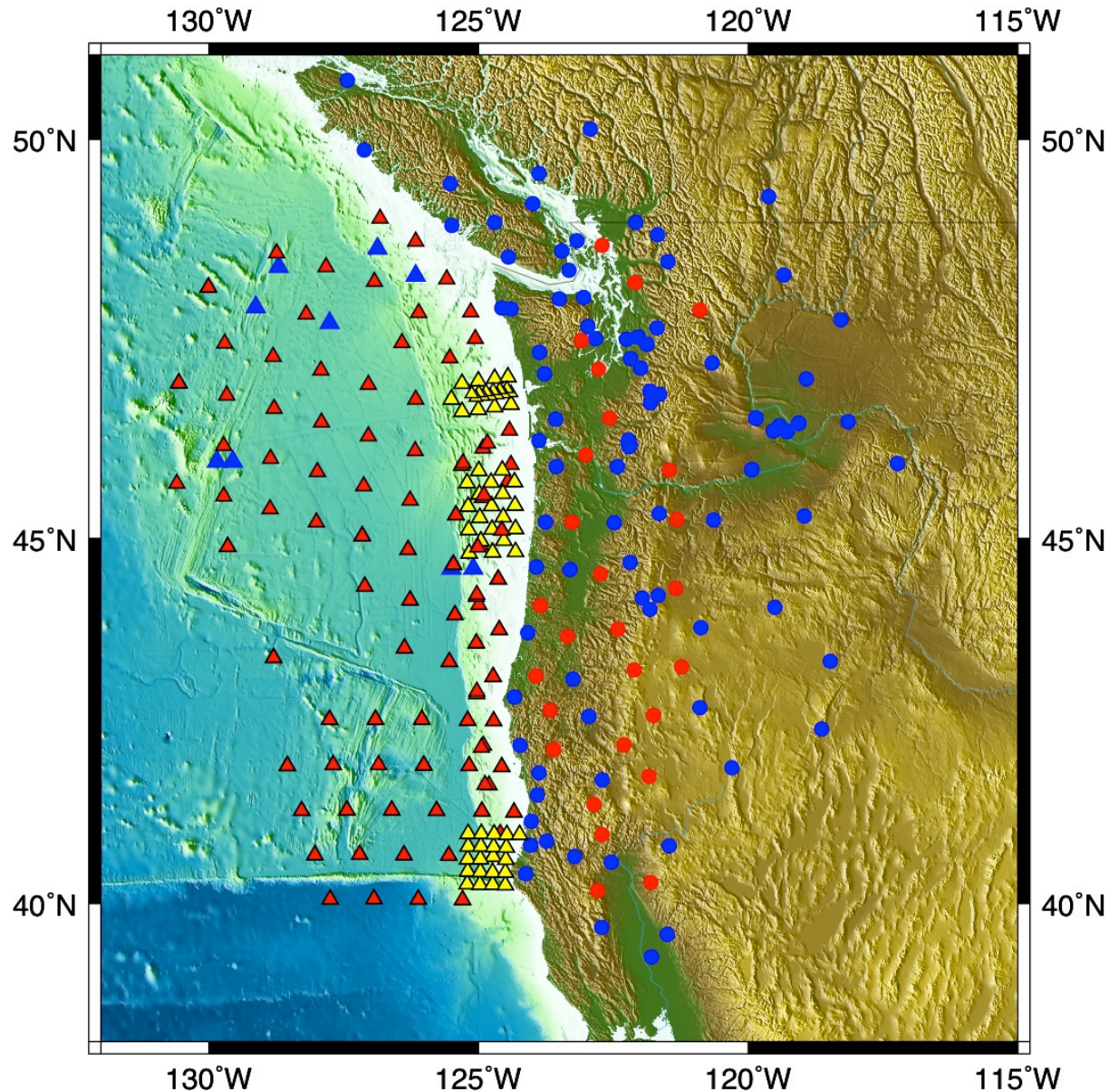


Atmospheric Acoustic Transportable Array

- Wide application of atmospheric data
 - Meso-scale atmosphere variation
 - Acoustic energy propagating in the atmosphere
 - Acoustic – seismic coupling
 - Noise induced on vertical and horizontal seismic channels



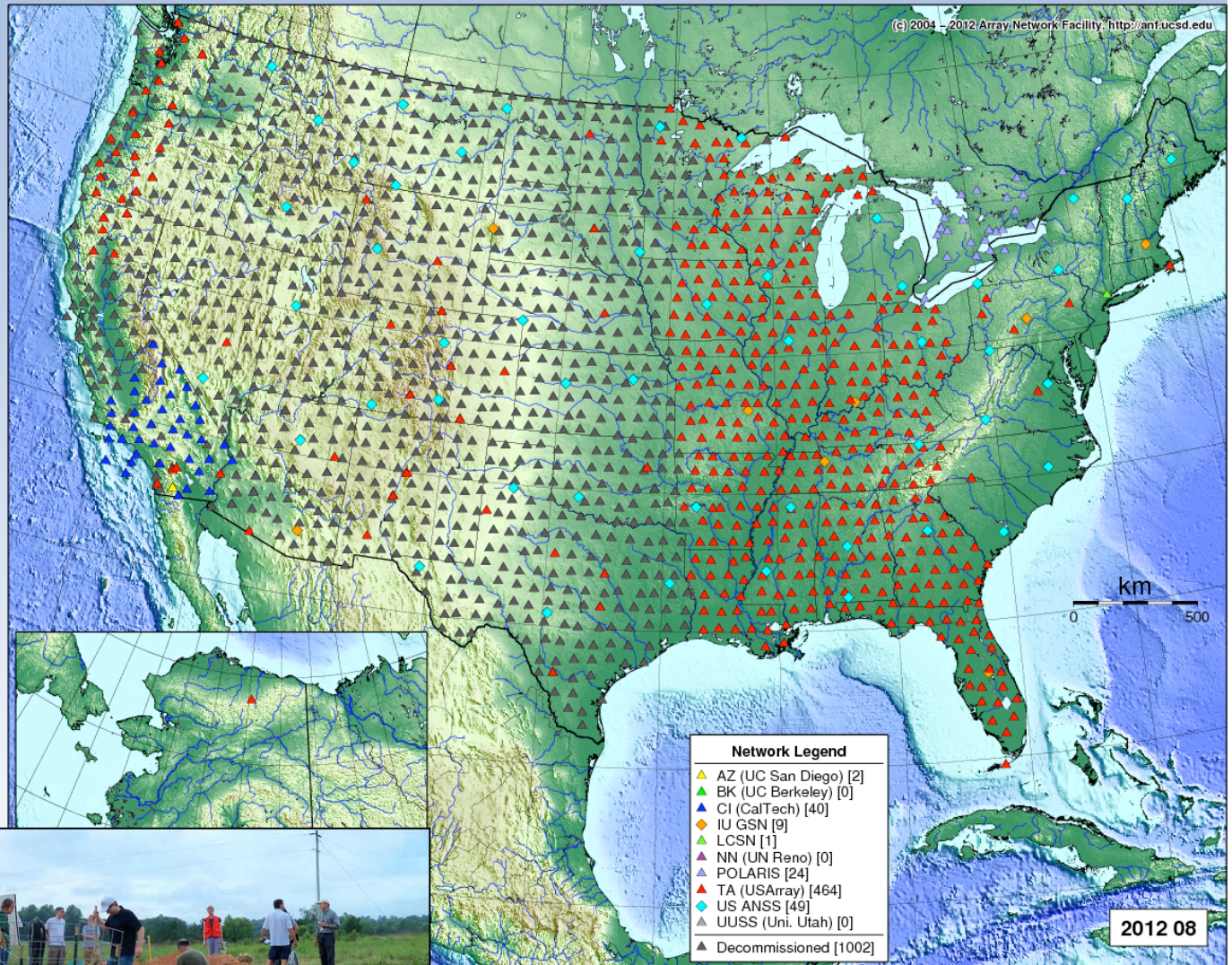
TA in Cascadia



- Our 27 TA stations anchoring the Cascadia Initiative
- Offshore experiment fully underway

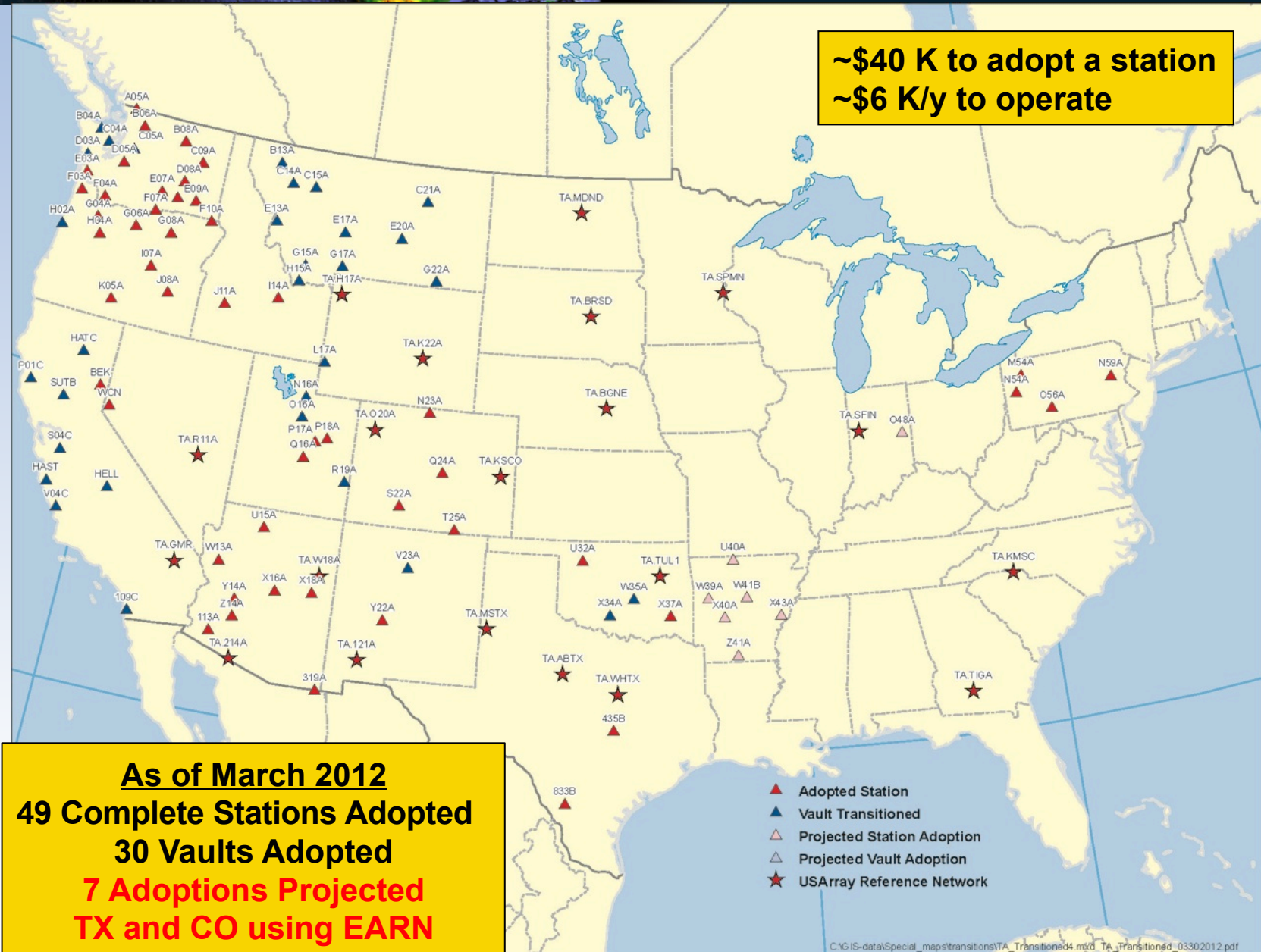
East Coast

Finishing the last
~200 stations



Adoption & EARN Status

~\$40 K to adopt a station
~\$6 K/y to operate



Flexible Array

SSIP: Fuis, et al.

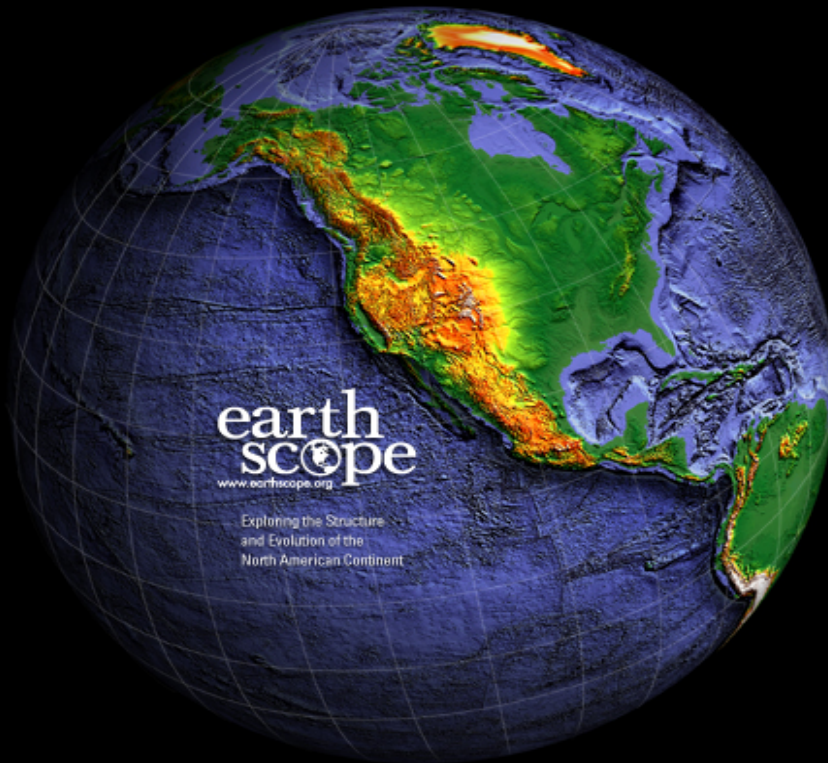


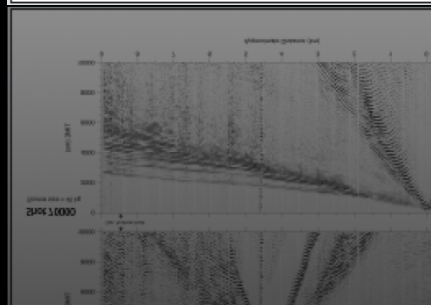
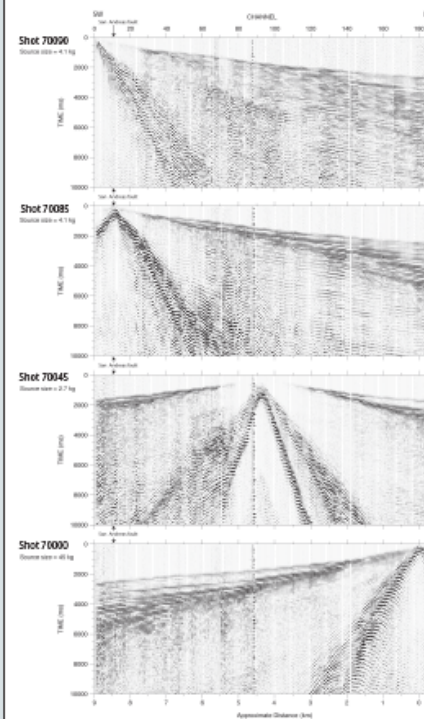
Figure 3. Seismic Profile 7

This 100 km long, 8 km deep profile spans the width of the San Andreas Fault zone near the paleoseismic study site at Salt Creek, on the eastern shore of the Salton Sea. This profile will illuminate the geometry of the San Andreas Fault in depth and time in the photo at right in the region where the next large earthquake is likely to rupture. The location photo on the right shows the earthquake as red dots. Larger dots indicate stations for which recordings are shown below. Stations are defined by blue triangles, OBS 1 and station shots extended this profile offshore (see Fig. 1).

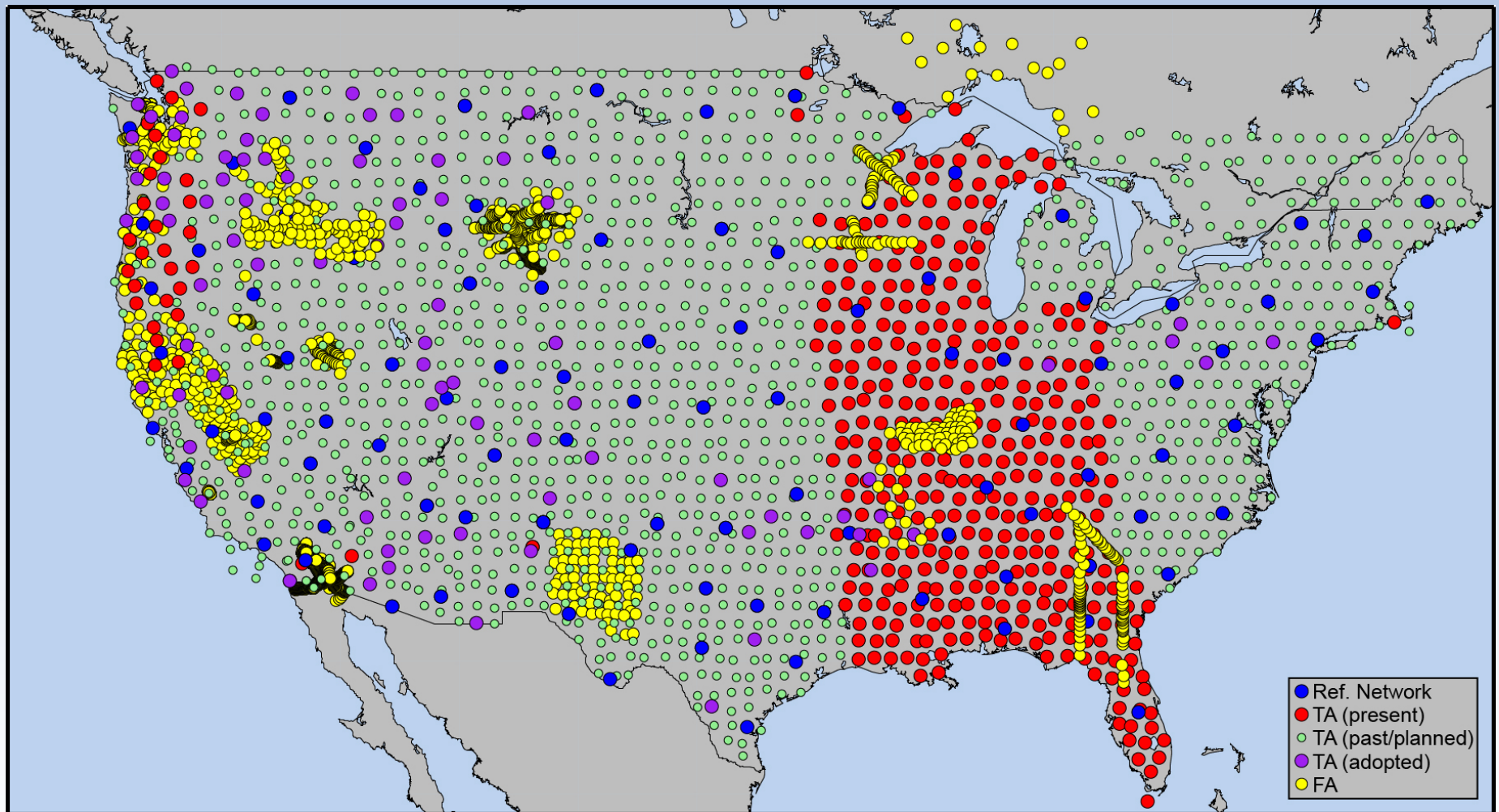


Compare this profile to that of Line 6 (see p. 10) and note that the results below were obtained with small amounts of explosives.

Line 7- Salt Creek- Shot Gathers
age = 10/200, horizontal 2.0-0.00

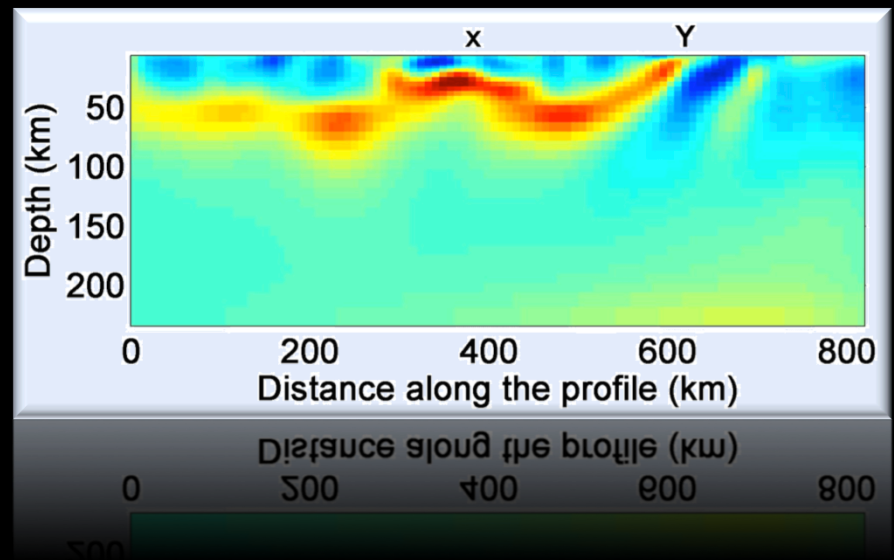
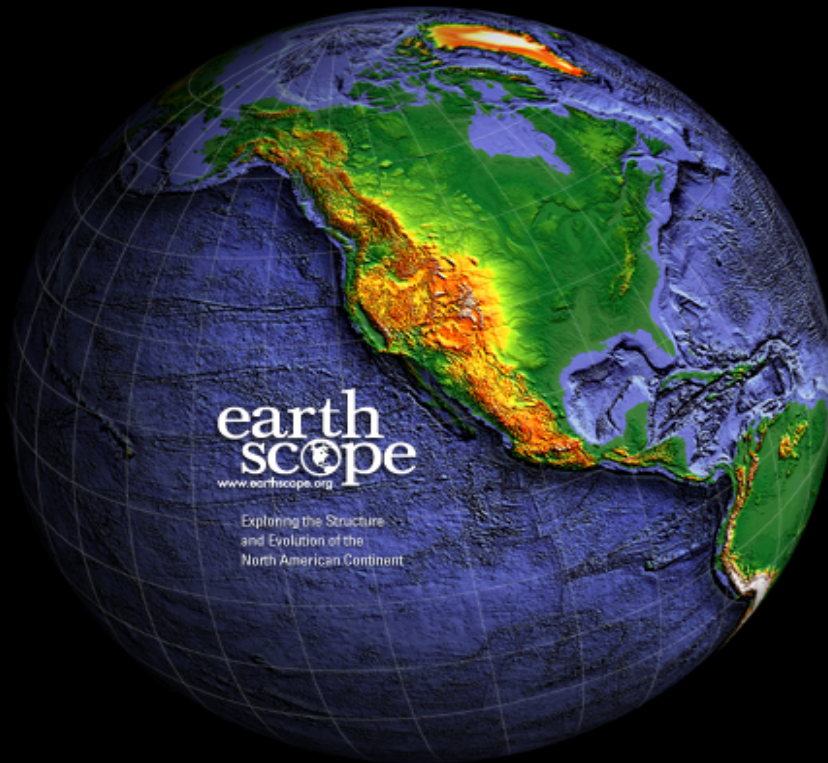


Other parts of USArray: Flexible Array



Magnetotellurics

Kelbert, et al.



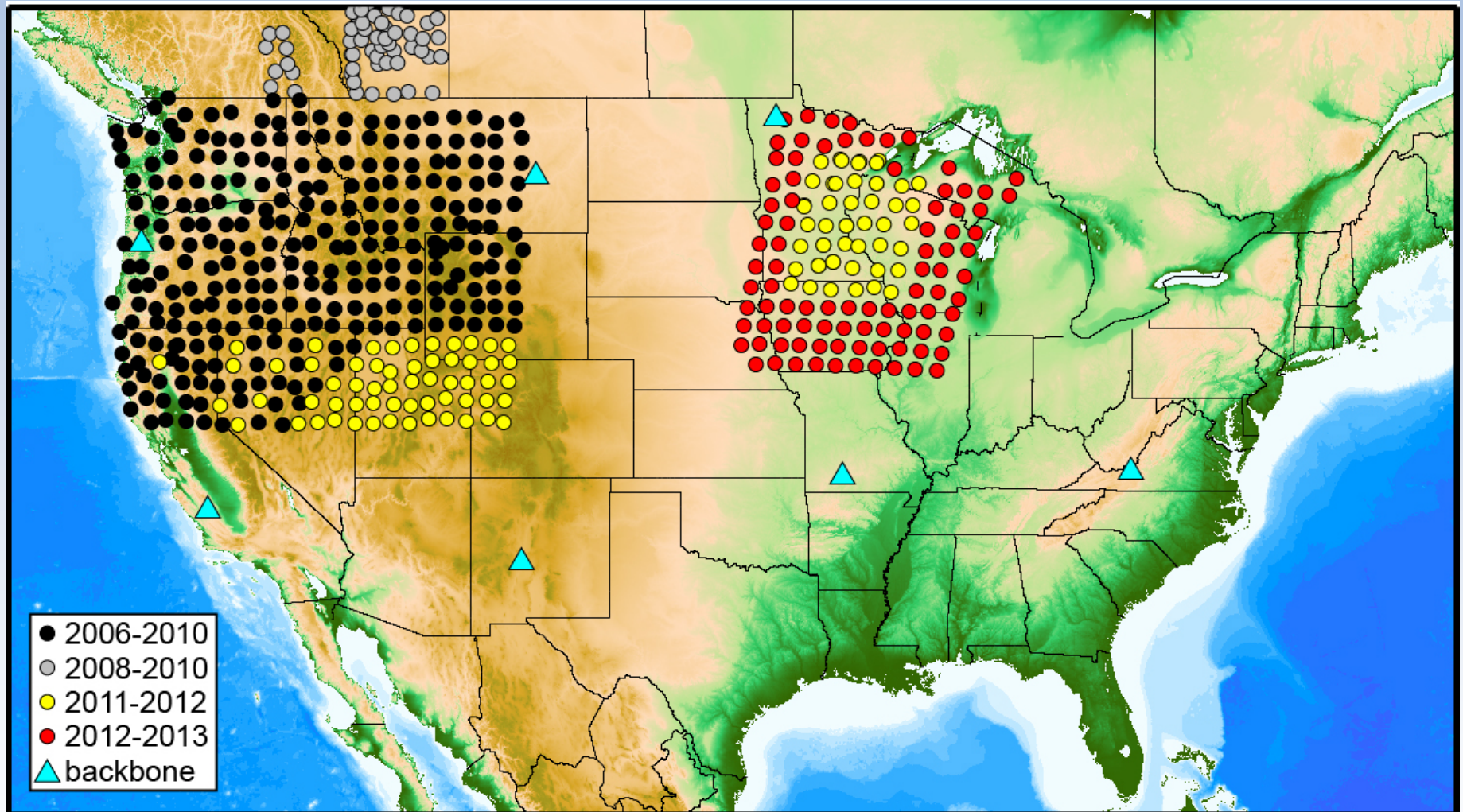
MT - Backbone

- Backbone stations operational
- Design objective to resolve MT transfer functions to 100,000 s or more already achieved at some sites
- Telemetry installed at all stations

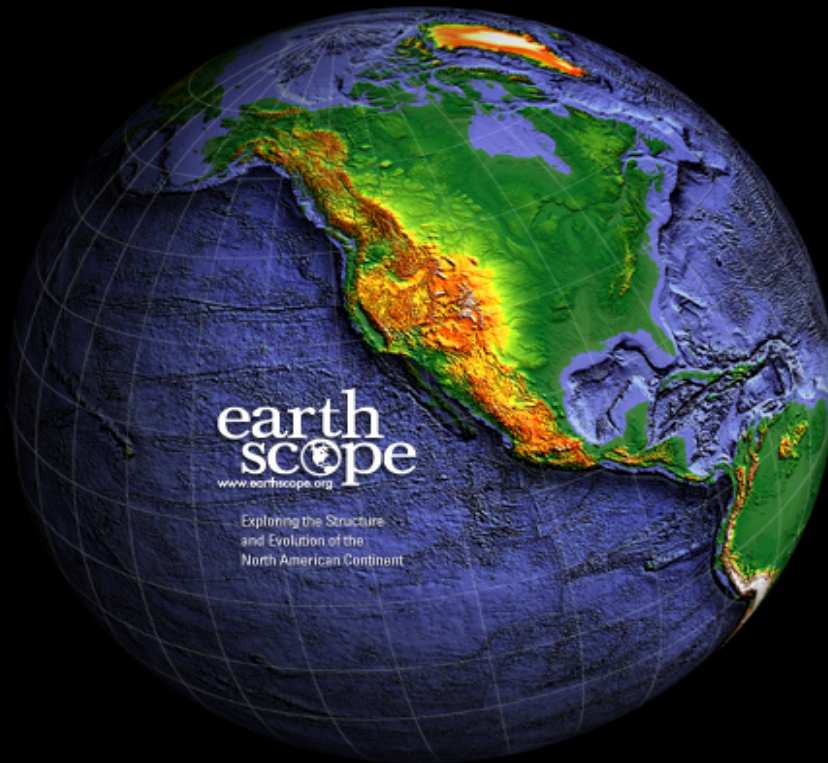
7 Permanent Backbone MT Stations



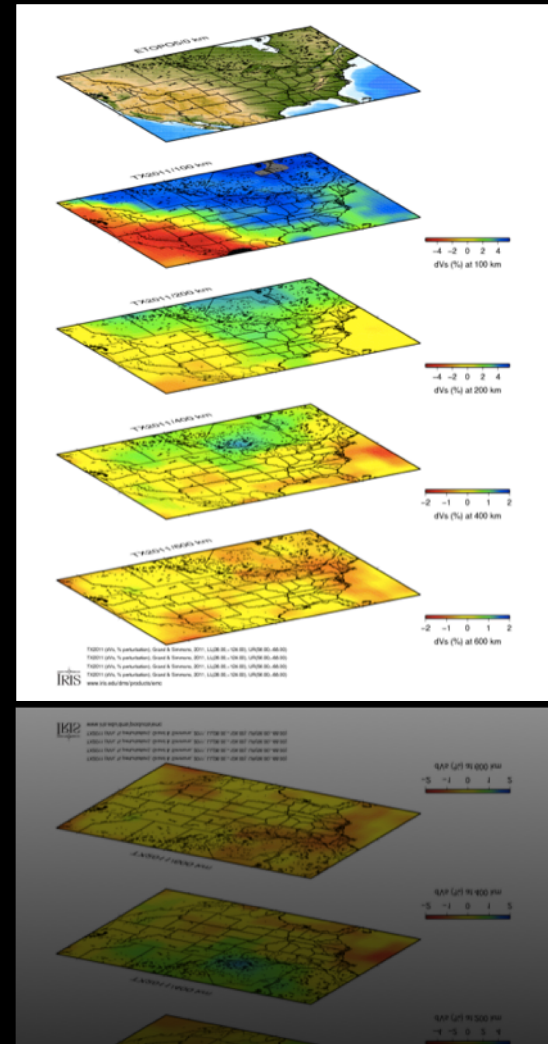
MT: Array



Data Management

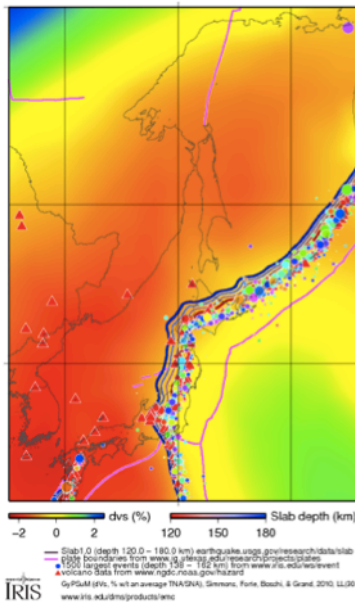


Earth Model Collaboration

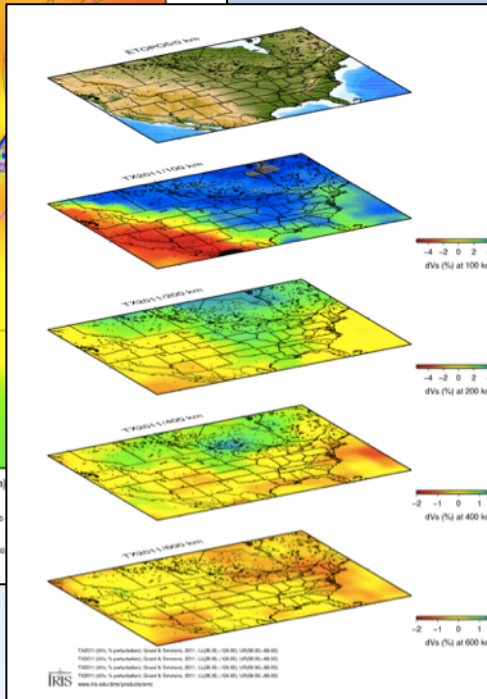


Slice

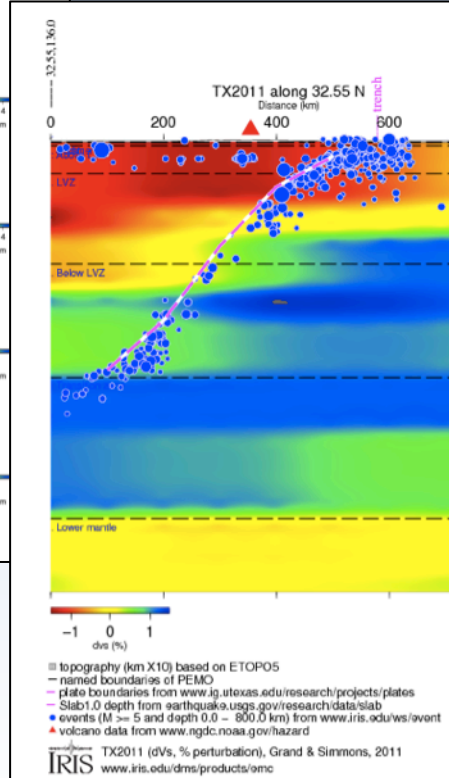
Kamchatka/Kurils/Japan, GyPSuM dvS, Depth 150 km



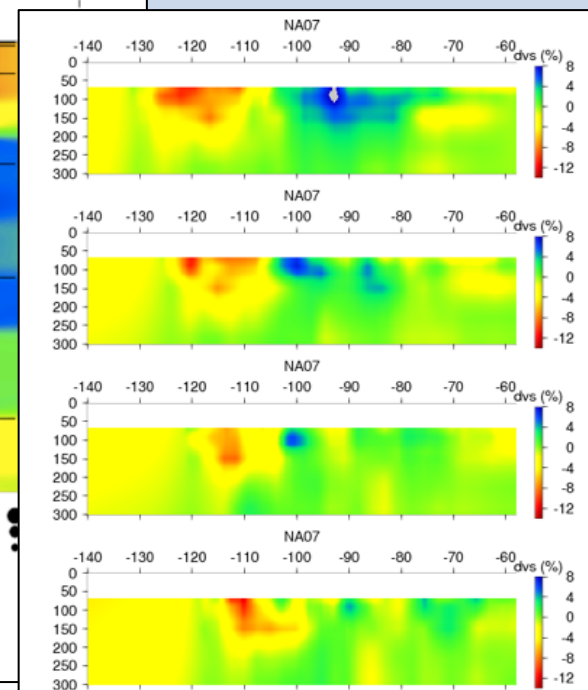
Slice - stack



Cross-section



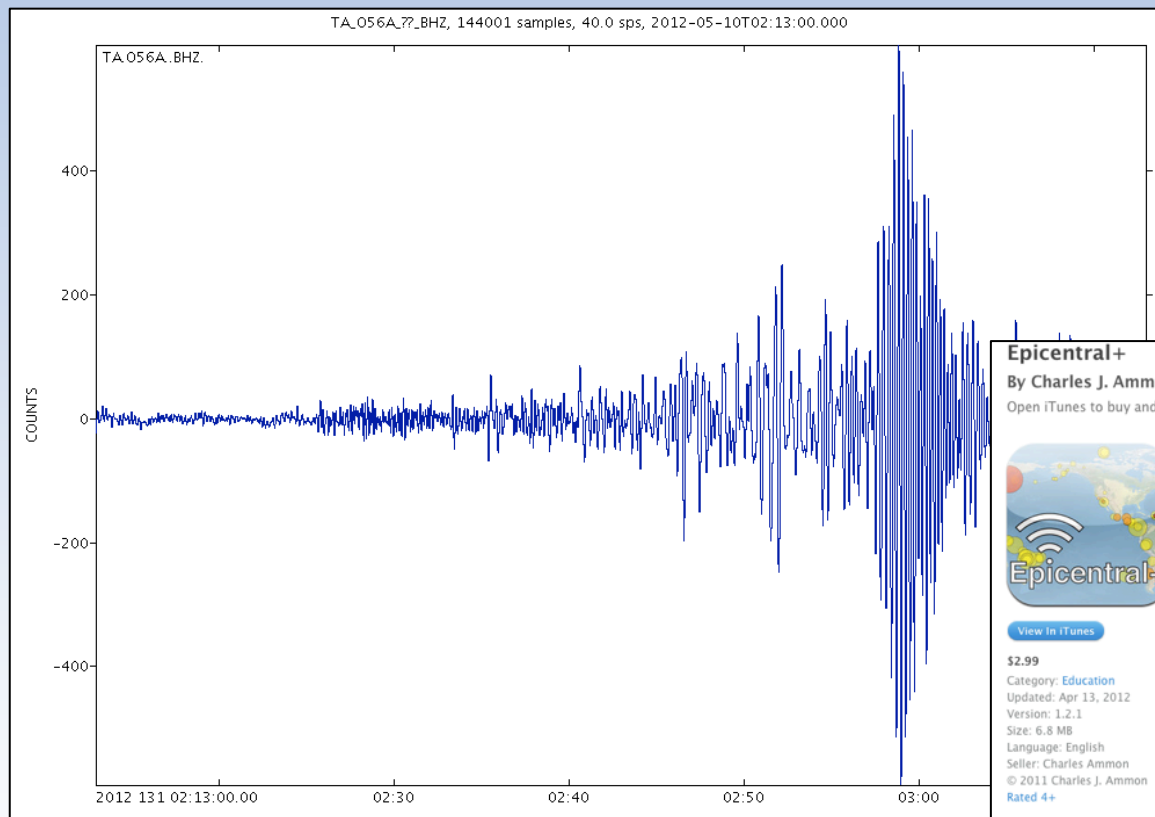
Cross-section stack



- User contributed models
- Web interface

More products on the way

<http://www.iris.edu/ws/timeseries/query?net=TA&sta=O56A&cha=BHZ&loc=--&start=2012.131T02:13:00&end=2012.131T03:13:00&lp=.1&hp=.001&output=plot>



Epicentral+

By Charles J. Ammon

Open iTunes to buy and download apps.



View in iTunes

\$2.99

Category: Education

Updated: Apr 13, 2012

Version: 1.2.1

Size: 6.8 MB

Language: English

Seller: Charles Ammon

© 2011 Charles J. Ammon

Rated 4+

Requirements: Compatible with iPad. Requires iOS 5.0 or later.

Customer Ratings

We have not received enough ratings to display an average for the current version of this application.

All Versions:

[View More By This Developer](#)

Description

Epicentral+ is an education app designed to allow you to use your iPad to explore global earthquake (and volcanic) activity.

[Charles J. Ammon Web Site](#) [Epicentral+ Support](#)

[...More](#)

What's New in Version 1.2.1

I've redesigned the seismogram amplitude zooming to use a persistent, simpler approach that is also faster under iOS 5. The update also includes minor bug fixes and changes.

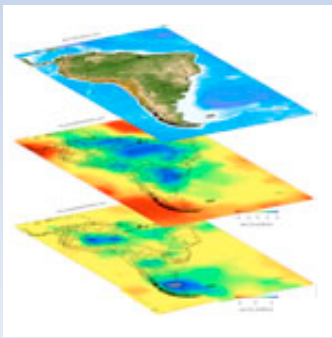
iPad Screenshots



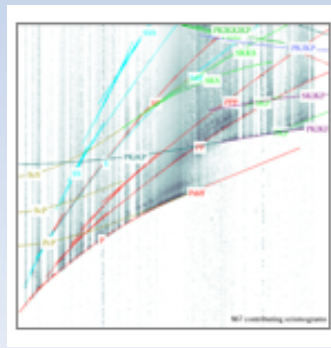
Level 0-1 Time series data

Level 2-3 Products

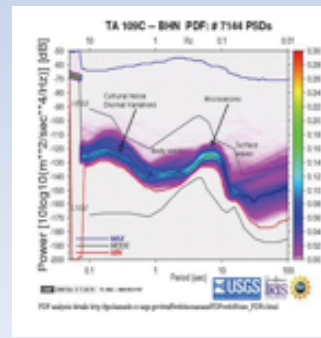
Earth Model Collaboration



Event Plots



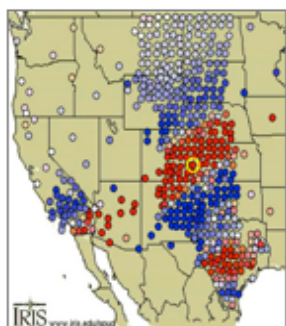
PDF/PSD Bulk Data Delivery



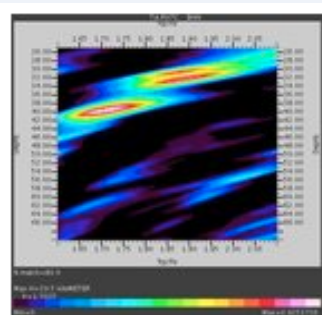
MT Transfer Functions



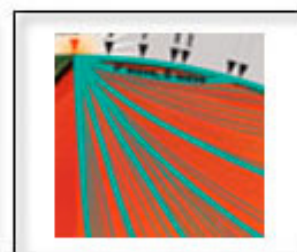
Ground Motion Visualizations



EARS Receiver Functions



Event Bulletins



TA Station Digests



Film Chips



GSN Calibrations

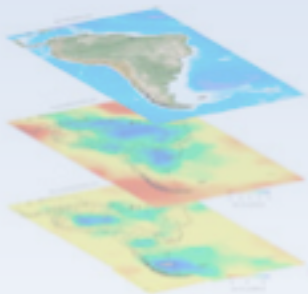


Global CMTs

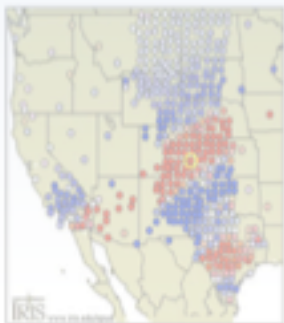


Level 0-1
Time series data

Earth Model
Collaboration



Ground Motion
Visualizations



MT Transfer
Functions



Film
Chips



GSN
Calibrations

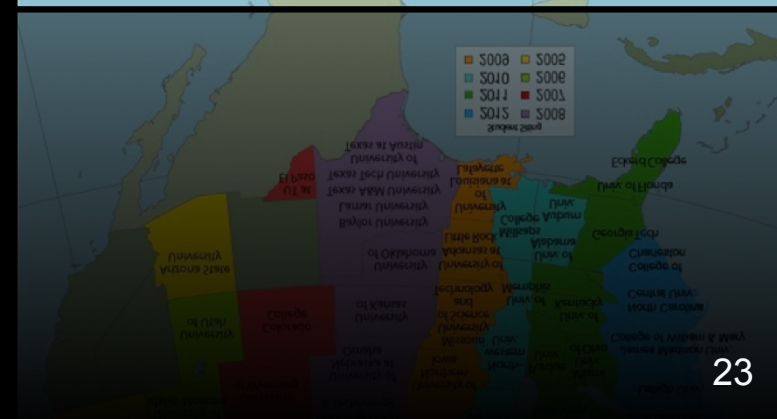
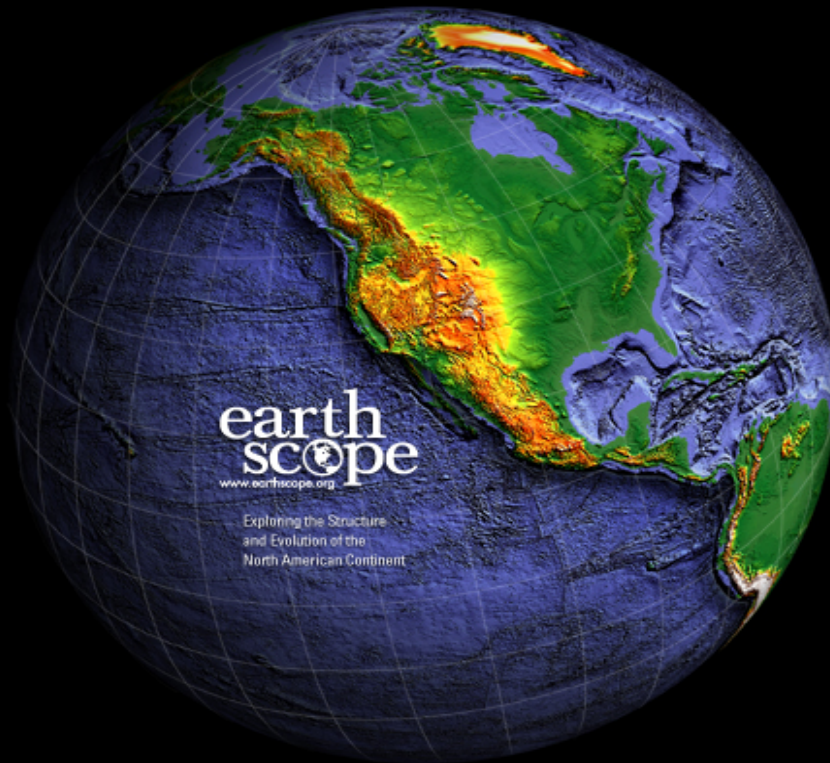


Global
CMTs



www.iris.edu/spud

Siting Outreach

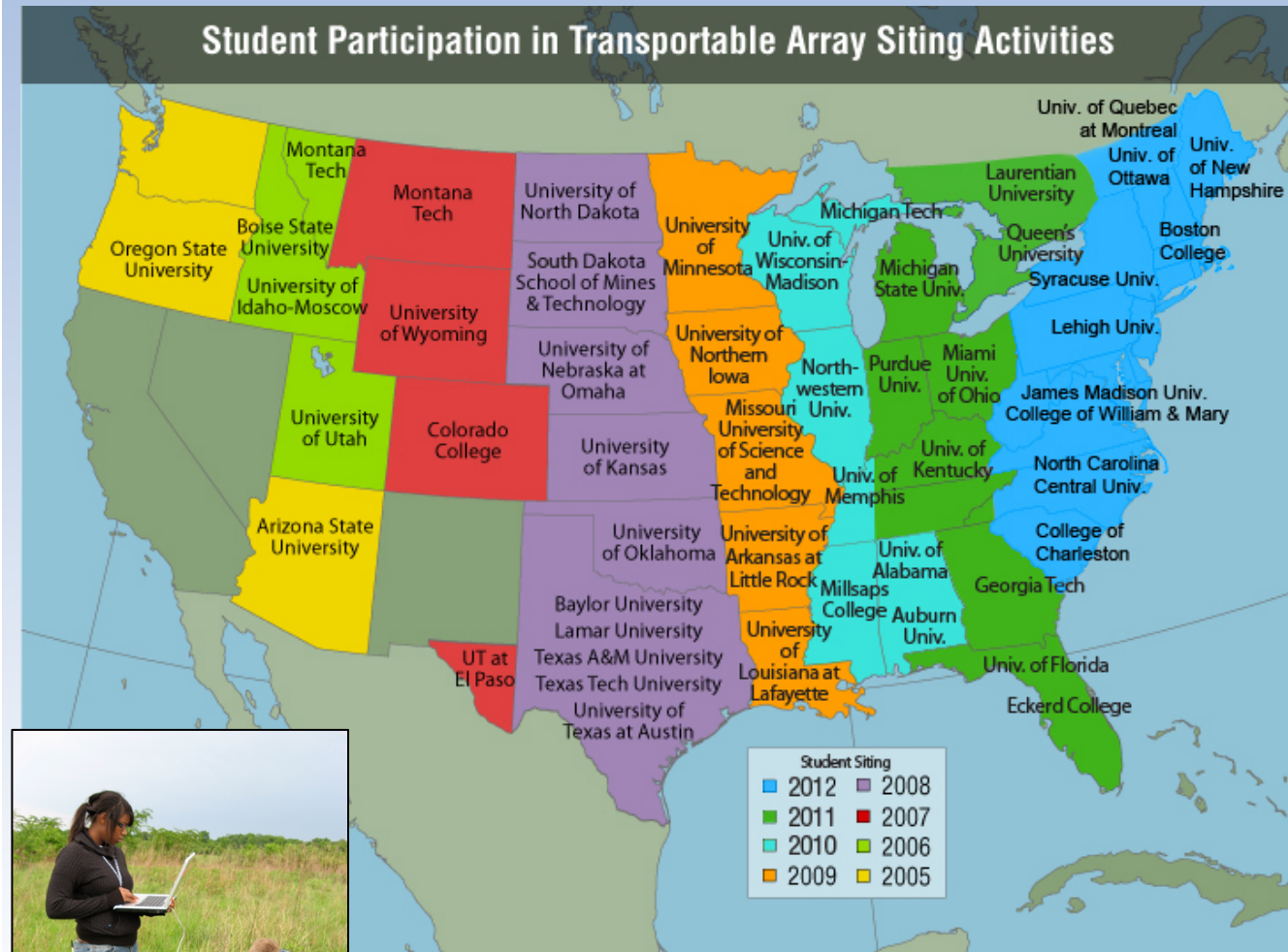




earth scope
www.earthscope.org

NSF

Student Siting Program



SUMMARY

2005 – 2012

- **135 students**
- **More than 50 universities**
- **~1375 sites**



- State Geologists
- Capitol Hill Exhibits
- Regional events
 - Missouri Earthquake Awareness Week
 - Northeast and Southeast Regional GSA meetings
- USA Science and Engineering Festival
 - 2011: ~500,000 visitors on the National Mall
 - 2012: ~200,000 visitors in the National Convention Center

Response to ESSC discussion



University News



Home > News

News

3 NCCU Students Join Project to Look Deep Inside the Earth

Published: Monday, August 06, 2012

Three North Carolina Central University students are participating this summer in the EarthScope project, a vast nationwide effort aimed at developing a broad understanding of the formation and structure of the North American continent.

The NCCU students — Philip Martin, James Howard and Thomas Horne — are seeking suitable locations in North Carolina and southern Virginia for 25 USArray seismic stations. The USArray component of EarthScope consists of 400 seismic stations that are deployed in a grid about 75 kilometers apart and transmit data for two years before moving to the next location.

The project began a decade ago in the West, and is now reaching the East Coast. Gordana Vlahovic, associate professor in the NCCU Department of Environmental, Earth and Geospatial Sciences, and post-doctoral associate Pierre Arroucou are overseeing the NCCU portion of the project, which is funded by the National Science Foundation. Last year, EarthScope was named "the most epic project in the universe" by Popular Science magazine's website www.popsci.com.

"We think of EarthScope as being like a telescope, only instead of looking up we're looking down," Vlahovic said. "We're looking very deep into the earth to understand more about it." Each USArray station includes instruments to continuously sense, record, and transmit ground motions from a wide range of seismic sources — local and distant earthquakes, artificial explosions, volcanic eruptions and other natural and human-induced activities.

"Distant earthquakes are like X-rays of the earth," Vlahovic said. They transmit a wide frequency range of seismic waves through the Earth, and differences in arrival time tell us about the structure."

The ideal sites for the stations are far from roads, railroads and other sources of noise that can interfere with seismic signals. They must have good cell phone reception so that data can be transmitted in real time, and the sites must belong to landowners willing to host the station for two years. Each station is about the size of a large refrigerator, containing instruments locked inside a vault and powered by solar panels.

"We look for sites in the middle of nowhere, but with good access," said Vlahovic. Martin, one of the three students, said finding ideal sites has been a challenge. "There's less middle-of-nowhere in North Carolina than you'd think," he said. "We like to be at least 3 kilometers from a big highway and at least 1 kilometer from a local two-lane road. It's hard to find a site without multiple oncrossing highways."

"The golden ticket is a private landowner with enough land that you can get away from houses, trees and roads," said Martin, a master's student in earth science specializing in seismology. The general approach to finding a site said, was to first scan aerial and satellite photos of a given region to locate large roadless areas — usually on farms — and then use tax records to identify the owner.



NCCU students (from left) James Howard, Thomas Horne and Philip Martin practice working with modern and GPS during EarthScope project field training in Pennsylvania.

Tuesday, July 17, 2012

Professor and Student Scoping out Seismic Sites Project seen as helpful to monitoring quakes and other activity

07/12/12



John Elbel, center, and Allison Kotowski '14 with Westfield State student Malcom Richardson are involved in the EarthScope Project. (Photo by Lee Pellegrini)

By ED HAYWARD | CHRONICLE STAFF
Published July 12, 2012

Earth and Environmental Sciences Professor John Elbel and rising junior Allison Kotowski are leading an effort to find two dozen sites throughout New England to house seismic monitoring stations as part of the EarthScope Project, the most far-reaching seismic investigation of any continent in the world.

Kotowski is part of a two-person team cross-country the region asking landowners if they'd be willing to place a monitor the size of a large soup pot on their property as part of a government effort to blanket the nation with 400 seismometers capable of producing the most detailed profile ever of earthquakes and other seismic activity.

Property owners are being asked to provide space for 2-4 stations that will become part of the latest phase of the Transportable Array, a rotating nationwide web of measuring devices that relay data about seismic activity to a central computerized warehouse of information that is the basis of EarthScope, says Elbel, director of the University's Weston Observatory.

The stations have been deployed throughout the United States for the better part of the past decade and for the next two years they will be monitoring the northeast, says Elbel, who adds that the project will produce a huge volume of data for analysis both during active monitoring and far into the future.

"For the two years the stations are in operation in New England, we get a bonanza of data," says Elbel, who coordinates the project

News > News Article

Helping seismologists see the complete picture

Two undergraduates are spending the summer working in Pennsylvania and other Mid-Atlantic states as part of a decade-long nationwide project that will help record earthquakes and measure seismic activity across the United States.

Earth and environmental sciences majors Brian Rodriguez '13 and Anna Lim '14 are identifying locations where seismic stations can be installed. They are working with **EarthScope**, a program that deploys thousands of seismic, GPS and other geophysical instruments to study the structure and evolution of the North American continent and the processes that cause earthquakes and volcanic eruptions.

Once installed, the stations will contain instruments that record and transmit ground motions from earthquakes, explosions, volcanic eruptions and other seismic sources. This nationwide network will provide data that can help explain geological events and lead to better detection of coming events.

Seismometers are more commonly installed in the western U.S., where earthquakes occur more frequently. The addition of instrumentation in the eastern part of the country will provide a more complete data picture of geological activity nationwide.

Rodriguez and Lim are charged with identifying potential locations in Pennsylvania, Delaware, New Jersey and Maryland. Some of their work is taking them into densely populated areas such as Philadelphia, Pittsburgh and Washington, D.C.

First Google, then a personal approach

According to Lim, stations will be placed 70 kilometers apart from one another on a grid-like map of the U.S. For their region, Lim and Rodriguez are searching Google Earth to determine where open fields exist within 30 kilometers of where each site is needed.

"A good area is out of the way, quiet, far from roads—pretty much in the middle of nowhere," says Lim, who has so far staked five of the sites.

Once the coordinates are identified, Lim and Rodriguez travel to the location to ask landowners if they would be willing to host a site on their property. The 66 stations in their region will be installed between October 2012 and April 2013.

The EarthScope Student Siting Program in which Lehigh is participating is a collaborative effort by U.S. universities that is being organized by the **Integrated Research Institutions for Seismology (IRIS)**. Rodriguez and Lim are working under the direction of Lehigh seismologist **Anne Molnar**, professor of earth and environmental sciences, who has been playing an active role in the EarthScope project.

"We were both very excited and eager to work for EarthScope, meet new people, and be a part of a science-changing project," said Lim.

Posted on Tuesday, June 19, 2012

— [Travis Long](#)



Anna Lim '14 and Brian Rodriguez '13 are looking for places like these—quiet and off the beaten track—to locate seismic stations in Pennsylvania and three neighboring states.

National Coverage

- Discover Magazine – October 2012





International Coverage

Gruppe5 Film – Cologne, Germany
L49A near Milan, Michigan



USArray Advisory Committee

Meltzer, Anne (Chair)	Lehigh University
Christensen, Doug	University of Alaska, Fairbanks
Hansen, Roger	University of Alaska, Fairbanks
Karlstrom, Karl	University of New Mexico
Levin, Vadim	Rutgers University
Long, Maureen	Yale University
Schmerr, Nick	NASA Goddard Flight Center
Shillington, Donna	Lamont Doherty Earth Observatory
Snyder, David	Geological Survey of Canada
Weiss, Chet	Virginia Tech
Benz, Harley	USGS (ex officio, non-voting)

Transportable Array Working Group

Vera Schulte-Pelkum, Chair	University of Colorado
----------------------------	------------------------

Electromagnetic Working Group

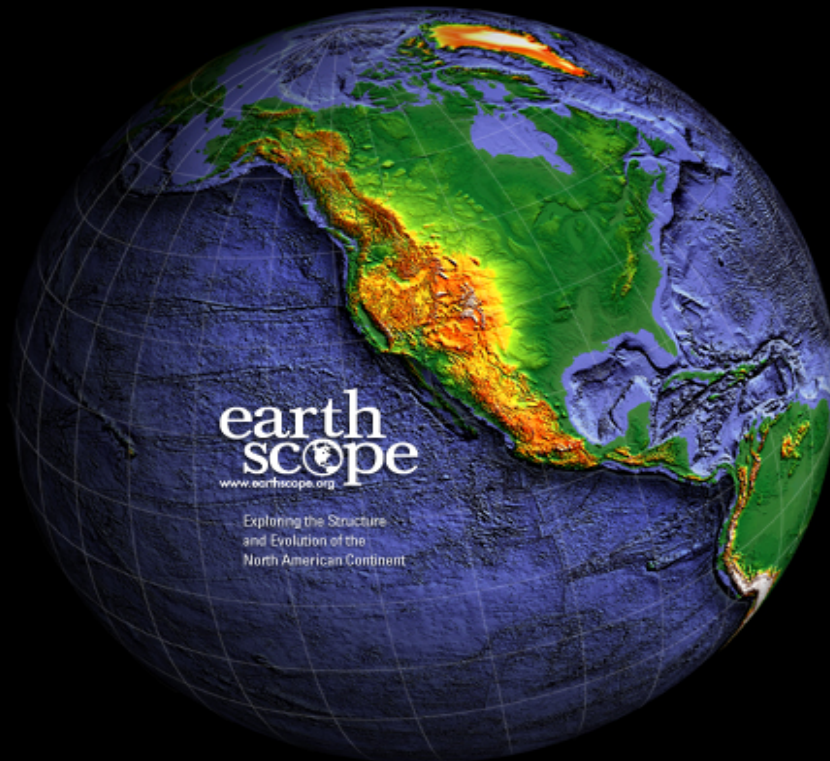
Paul Bedrosian, Chair	US Geological Survey
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USAAC meeting December 2011

Committee membership lists available on: www.iris.edu

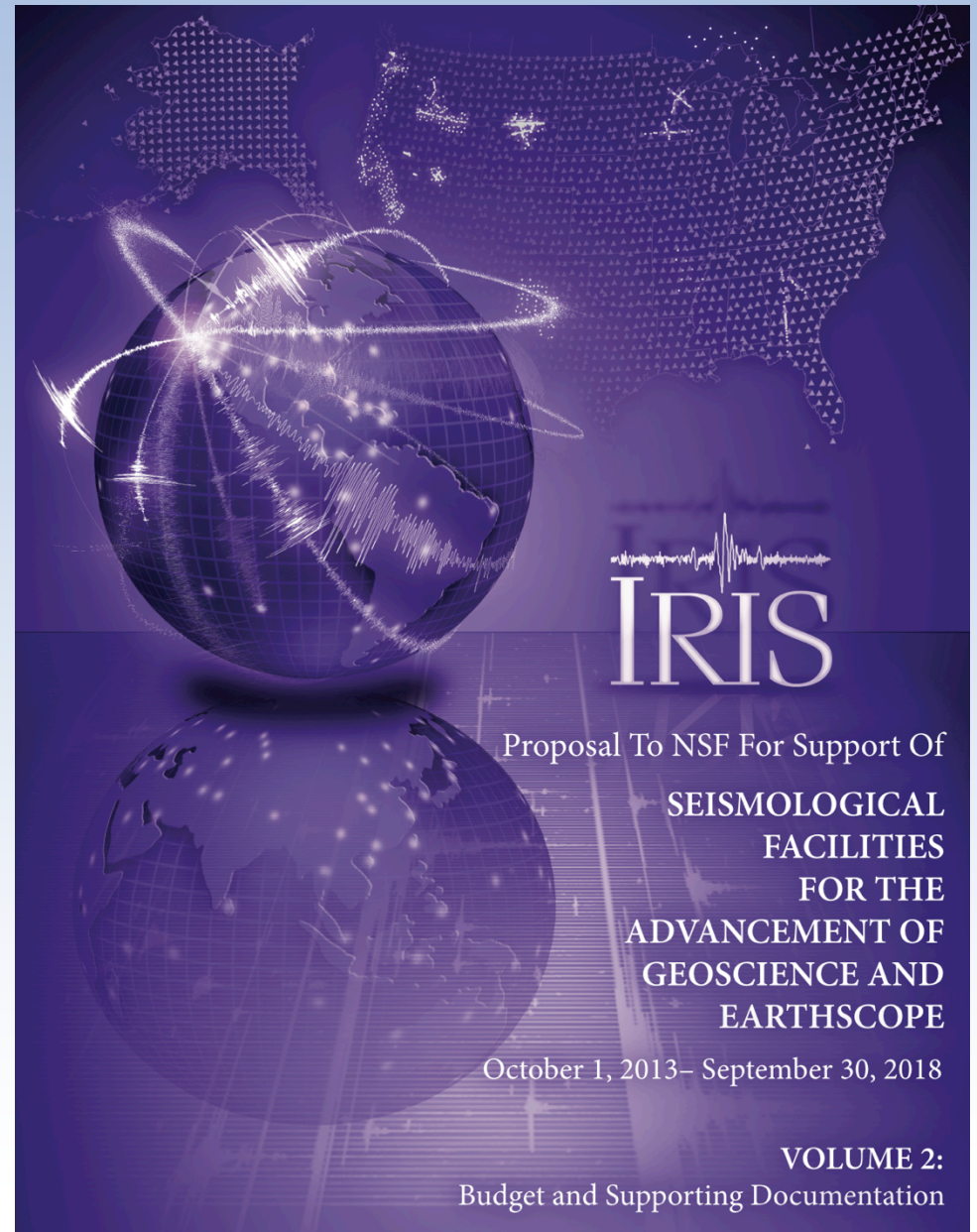
Looking Ahead



IRIS SAGE Proposal



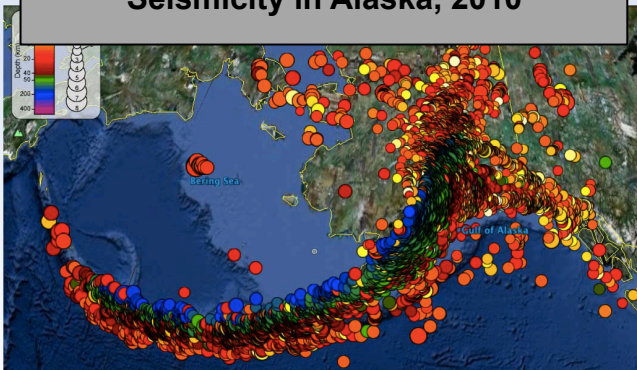
- EarthScope funded in 5 year increments
- Currently in Year 10
- Delivered the proposal for 2013 – 2018 (for funding to start in October 2013)



TA in Alaska / Yukon

- ~300 sites
- 85 km spacing
- Broadband & atmospheric
 - Some strong motion
 - Some met packages
- Communications
- Emphasis on high quality data

Seismicity in Alaska, 2010



Station Design for Performance

- Sensor emplacement to achieve highest quality data
- Power strategies to balance weight, reliability, complexity
 - Solar panels, advanced chemistry batteries, fuel cells
- Communications scaled by volume and latency vs. cost



Burial Test Stations

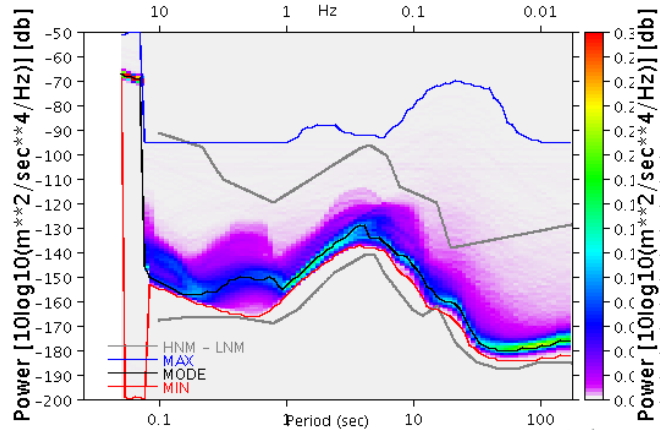
Station	Location	Hole Type	Sensor	Depth (m)	Started
TOLK (--)	Toolik Lake, AK	Augered with PVC	CMG3T	5	8/13/2011
TOLK (01)	Toolik Lake, AK	Augered with PVC	CMG3T	4	8/13/2011
TASL (--)	Abq. Seis. Lab, NM	Cored in rock	T120PH	1.1	4/24/2012
TASL (01)	Abq. Seis. Lab, NM	Cored in rock	STS-2.5	1.1	4/24/2012
TASM (--)	Abq. Seis. Lab, NM	Augered with PVC	T120PH	5	5/1/2012
TASM (01)	Abq. Seis. Lab, NM	Augered with PVC	STS-2.5	10	5/1/2012
TFRD	Anza, CA	Cored in rock	T120PH	1.1	6/21/2012



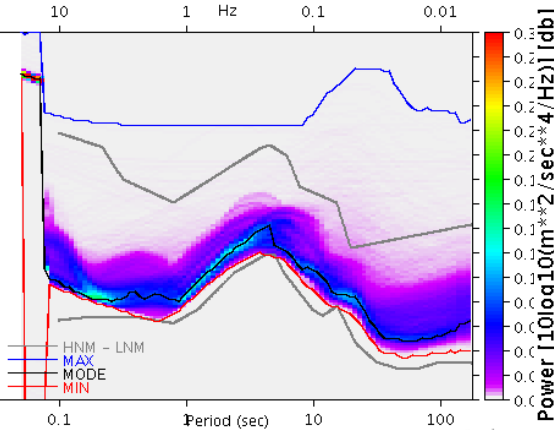
Motivation: Alaska, all equipment designed for transport in fixed wing aircraft or helicopter.

Alaska Stations

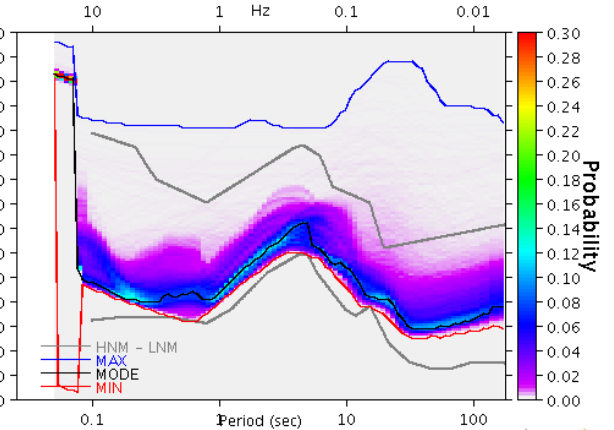
TA TOLK -- BHZ : YEARLY
2012.001 - 2012.366



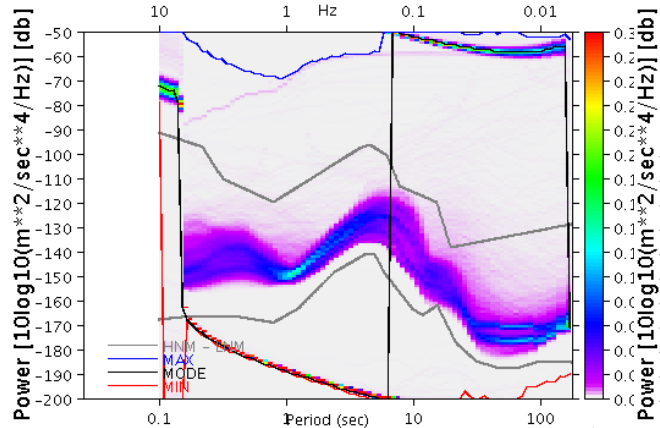
TA TOLK -- BHE : YEARLY
2012.001 - 2012.366



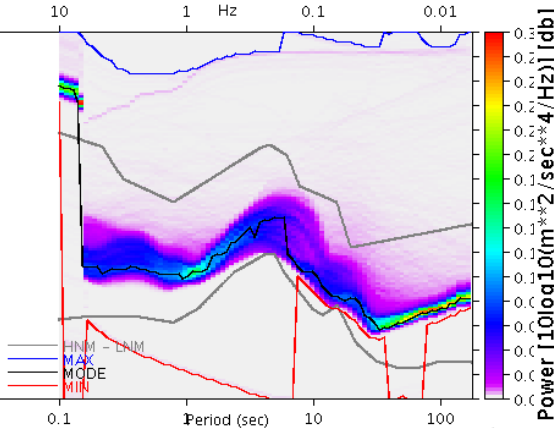
TA TOLK -- BHN : YEARLY
2012.001 - 2012.366



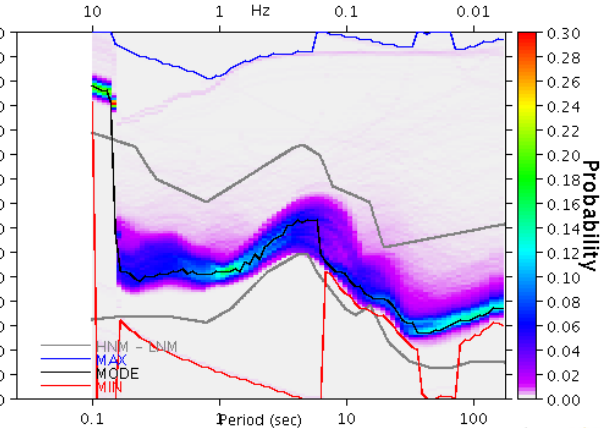
IU COLA 00 BHZ : YEARLY
2012.001 - 2012.366



IU COLA 00 BH1 : YEARLY
2012.001 - 2012.366

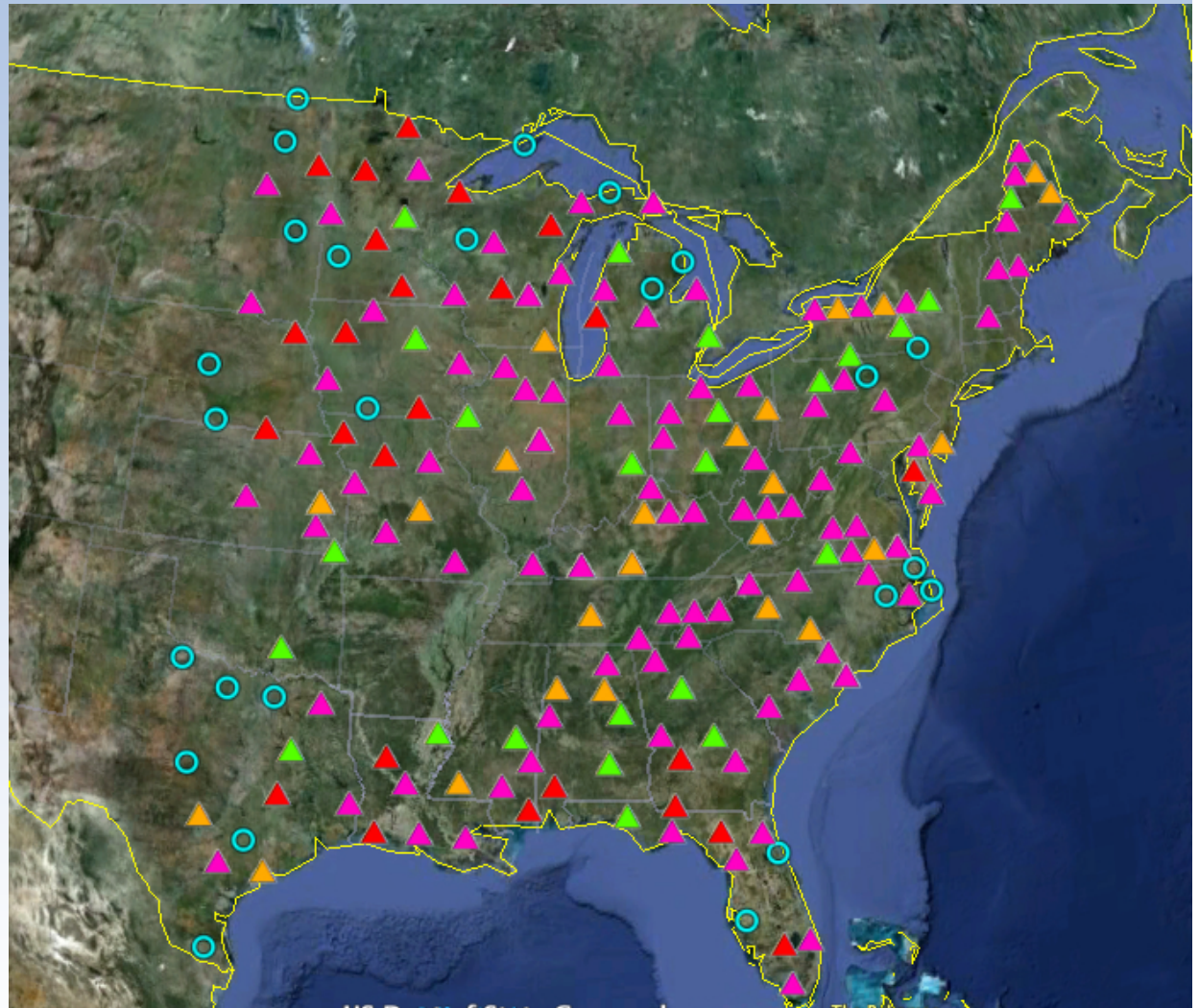


IU COLA 00 BH2 : YEARLY
2012.001 - 2012.366

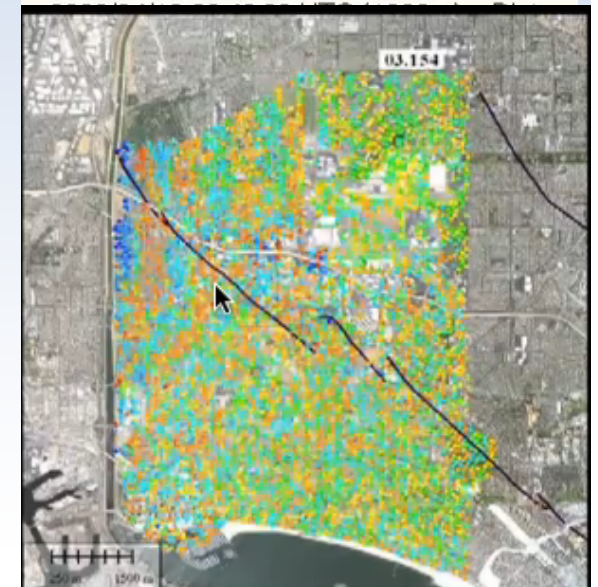
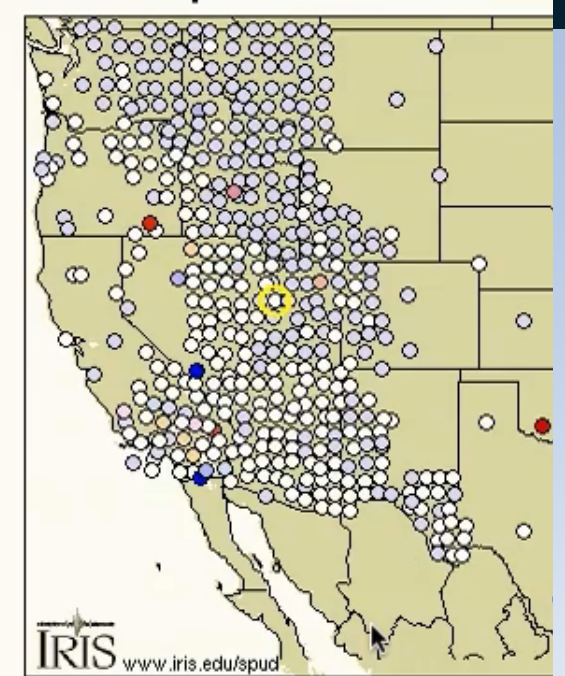


- Central and Eastern US Network
- A five year plan to leave behind ~200 TA stations
- Funding “could” start in FY13

001-100: magenta
 100-125: orange
 126-150: green
 151-175: red
 176-200: blue circles

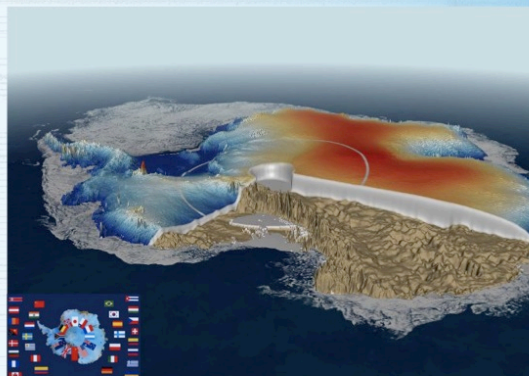


- Objective: Create a system that is smaller, lighter, lower-power, lower-cost
- Science motivation
 - Enhanced spatial coverage
 - Avoid spatial aliasing
 - Simplified field logistics
 - Ability to deploy in extreme environments
- Key discussions to-date
 - Large N meeting, Seattle, May 2012
 - IRIS Workshop, June 2012



The “Next Big Thing”

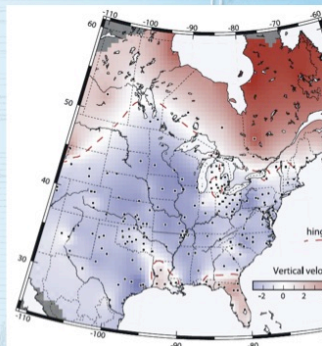
A Big Idea: Antarctica Array



CPOM / UCL / ESA / Planets
Facilitate – Collaborate – Educate

A Big Idea: A Plate Interior Observatory

- Synoptic science of central and eastern North America
- Multiple targets
 - Vertical deformation
 - Intra-plate earthquakes
 - Passive margins
 - Failed rifting

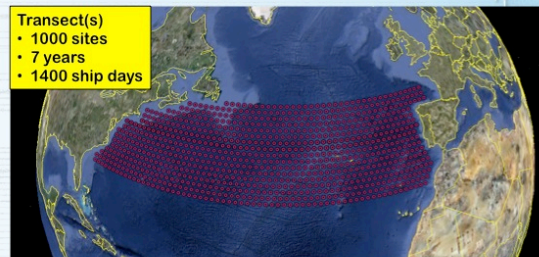


Calais, et al, 2006 JGR

Facilitate – Collaborate – Educate

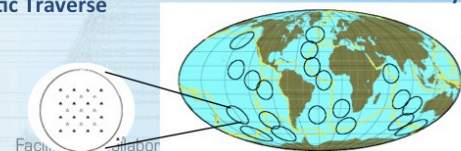
A Big Idea: An Ocean Basin Transect

Transect(s)
• 1000 sites
• 7 years
• 1400 ship days

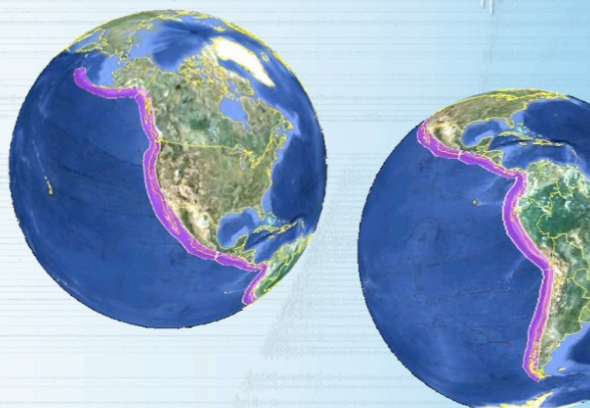


Example: The Atlantic Traverse

Discrete Arrays



A Big Idea: Subduction Zone Observatory



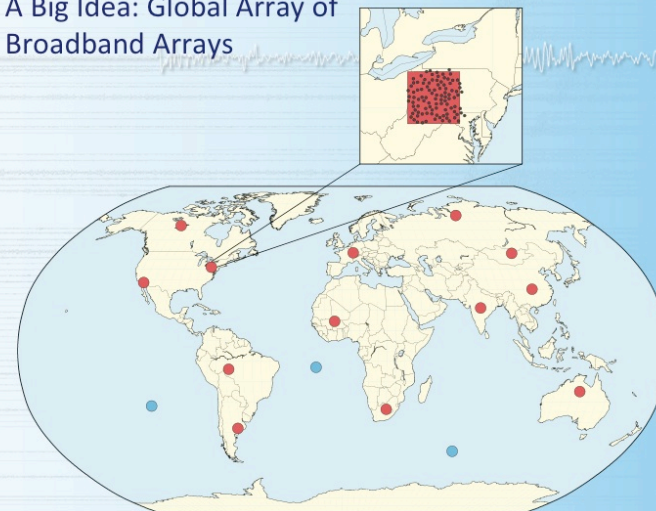
Facilitate – Collaborate – Educate

Continental Crustal Observatory

- A second wave of understanding, after EarthScope
 - The shallow crust and near surface



A Big Idea: Global Array of Broadband Arrays



Fun session at IRIS Workshop in Boise, June 2012

- Field trip to TA station installs near Washington, DC
- Celebration of “First 10 Years”
 - Science symposium
 - Reception



Bob Busby explaining USArray equipment to staff from Senator Harry Reid's office

- Wed., April 29, 2009, Washington D.C.
- Community sponsored
 - IRIS, UNAVCO, SSA, NMT, Stanford, AGI, GSA, AGU
- Goals
 - Recognize success achieved
 - Encourage long-term support
- Attendance
 - Congressional, NSF, agencies, etc.



Afternoon Symposium - Standing Room Only



Evening Reception

~165 attendees

- 17 congressional offices RSVP'ed
- Tim Killeen provided keynote



Summary

- All components of USArray are fully operational and running smoothly
- USArray is a success by all measures
 - Producing high quality data
 - Significant scientific return
 - USArray is under budget
 - USArray is on schedule
- Impact on students and general community
- Inspiring / motivating a host of similar projects
- We are planning for the future



On the Web

- EarthScope
www.earthscope.org
- USArray
www.usarray.org
- PBO
pboweb.unavco.org
- National Science Foundation
www.nsf.gov

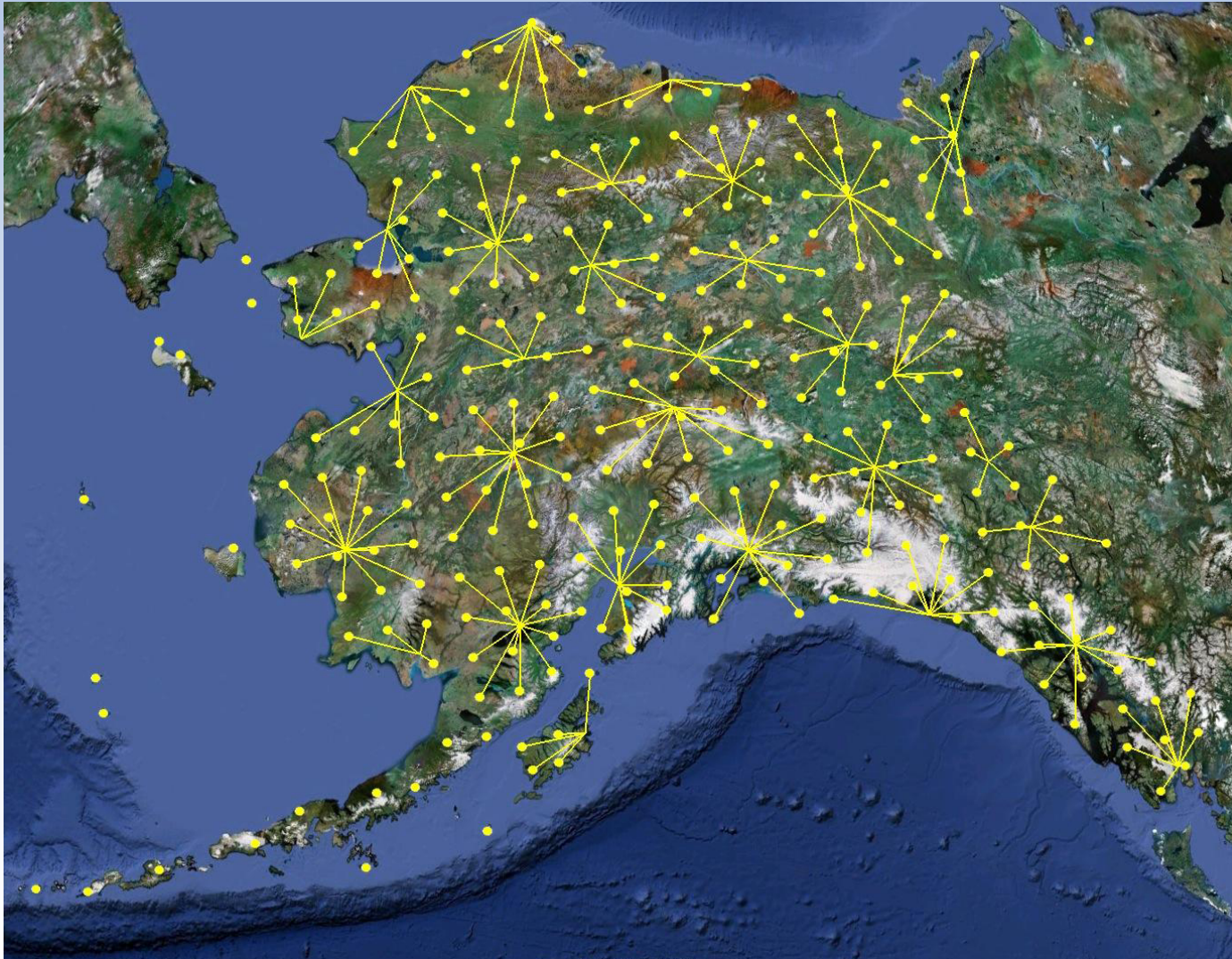
EarthScope is funded by the National Science Foundation.

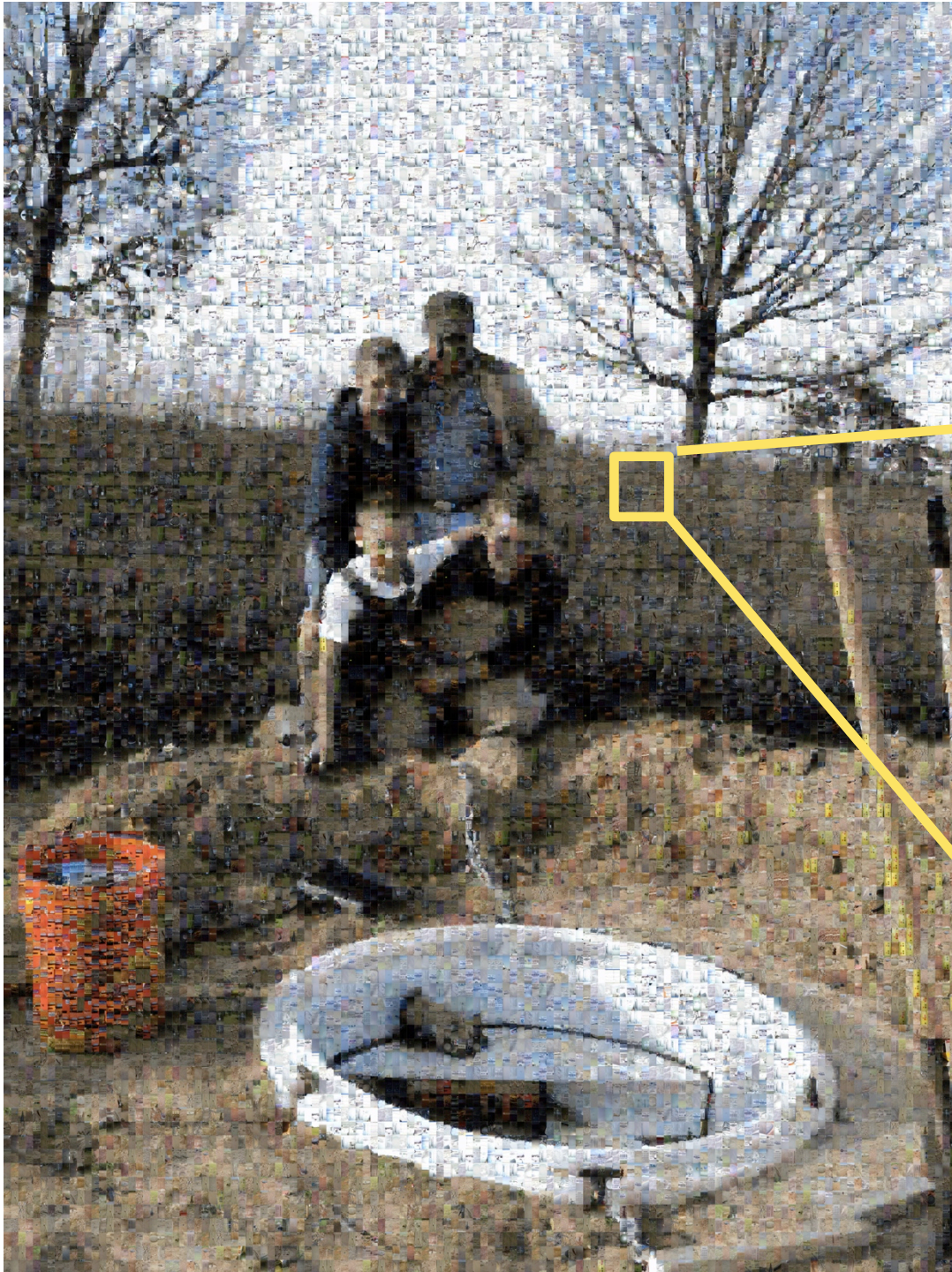


EarthScope is being constructed, operated, and maintained as a collaborative effort with UNAVCO, IRIS, and Stanford University, with contributions from the US Geological Survey, NASA and several other national and international organizations.

What is Ahead: Alaska

- ~300 stations





0.02"W
1.98° 30' 50.5752000"W
13.08"W

