

CEETEP

Cascadia EarthScope Earthquake and Tsunami Education Program

*Professional development
workshops for coastal teachers,
interpreters, and emergency
management educators.*

Bob Butler

University of Portland

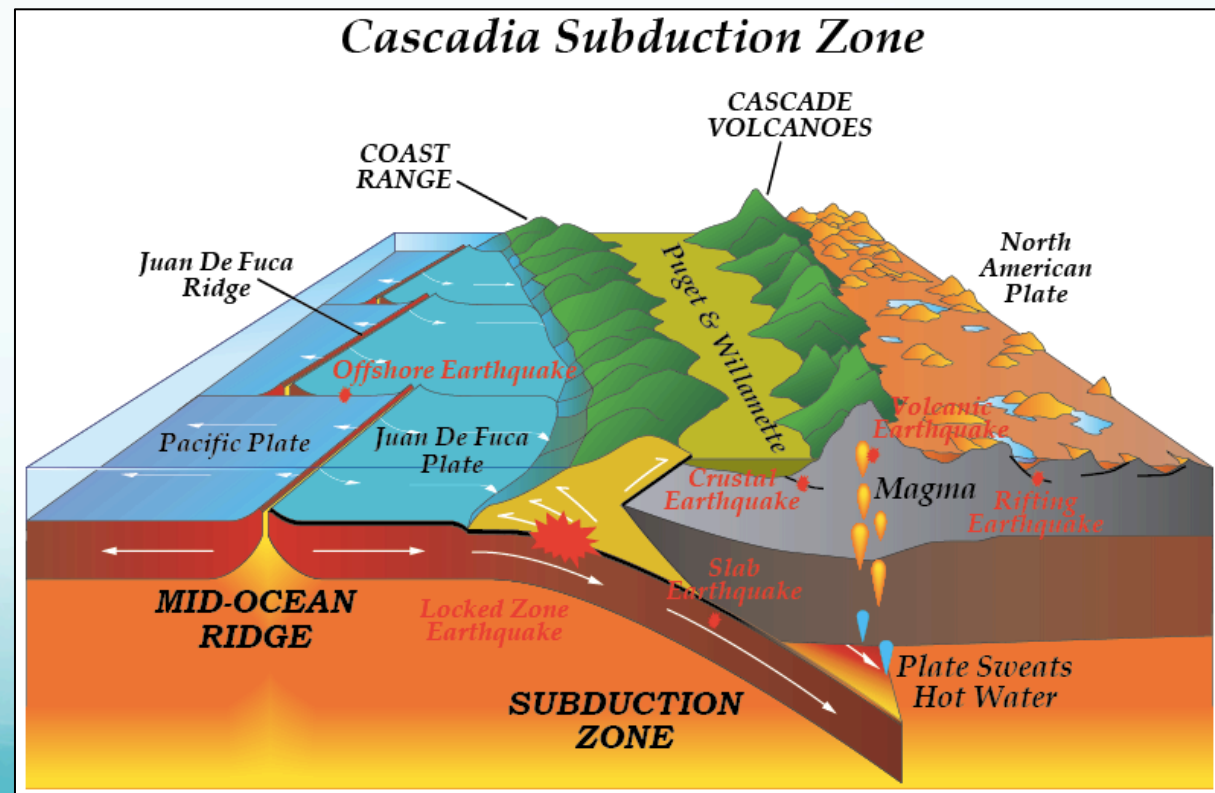
Nancy Hunter

Bob Lillie

Oregon State University

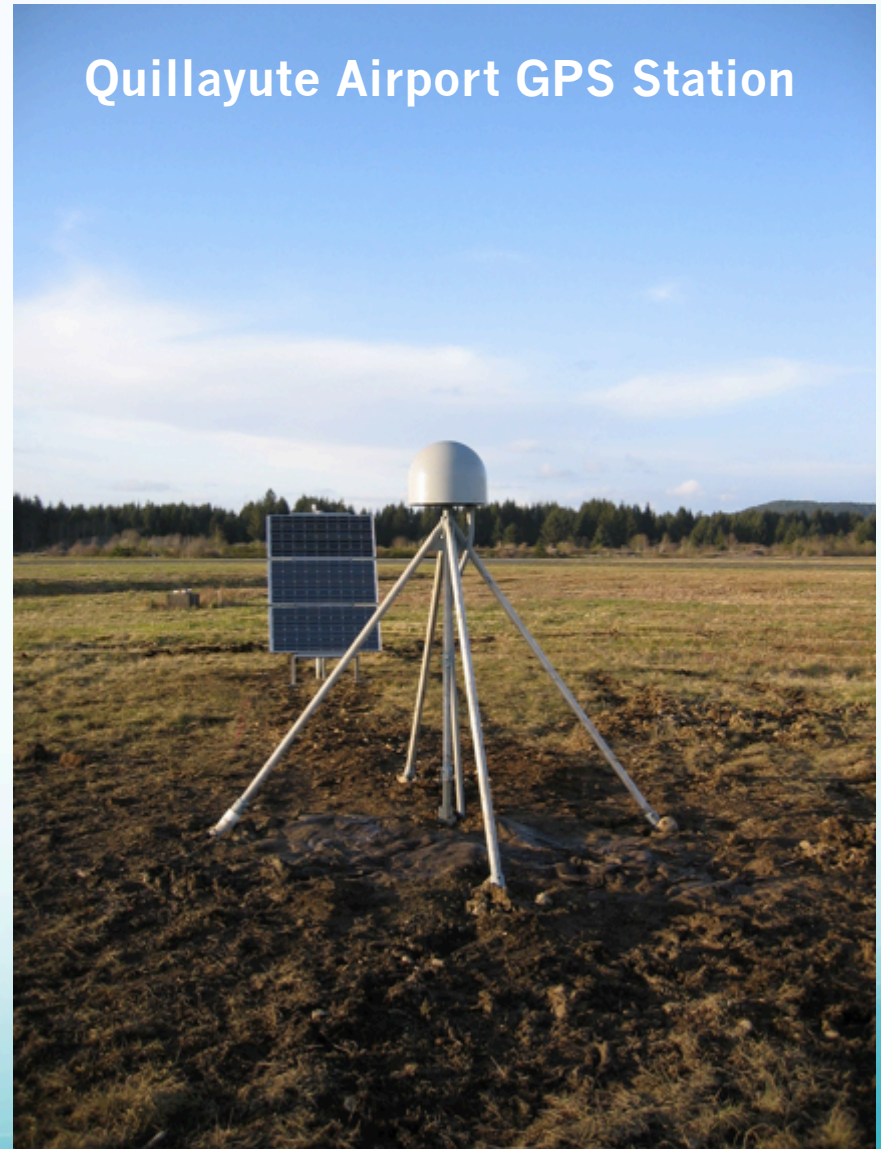
Beth Pratt-Sitaula

Central Washington
University



Introductions

- CEETEP
- Instructors
- Participants
- EarthScope



CEETEP

- Primary Aim: Improve disaster resilience through educator professional development
- Goals – Participants will:
 - **Learn Geoscience** and be able to communicate about earthquake and tsunami science and research
 - **Understand Risk** and be able to communicate about Cascadia geohazards
 - **Take Action** and be able to work with learners to improve preparedness
 - **Exchange Pedagogy** on how to teach about EarthScope, hazards/risk, and preparedness





Beauty and the Beast



“The same geological processes that threaten our lives with earthquakes and tsunamis also nourish our spirits by creating the spectacular headlands and beaches of the Pacific Northwest.” – Dr. “Ranger” Bob Lillie

Olympic National Park



CEETEP Precursors

Teachers on the Leading Edge (TOTLE)
Workshops for Earth Science Teachers
in Oregon and Washington
(2005 - 2011)

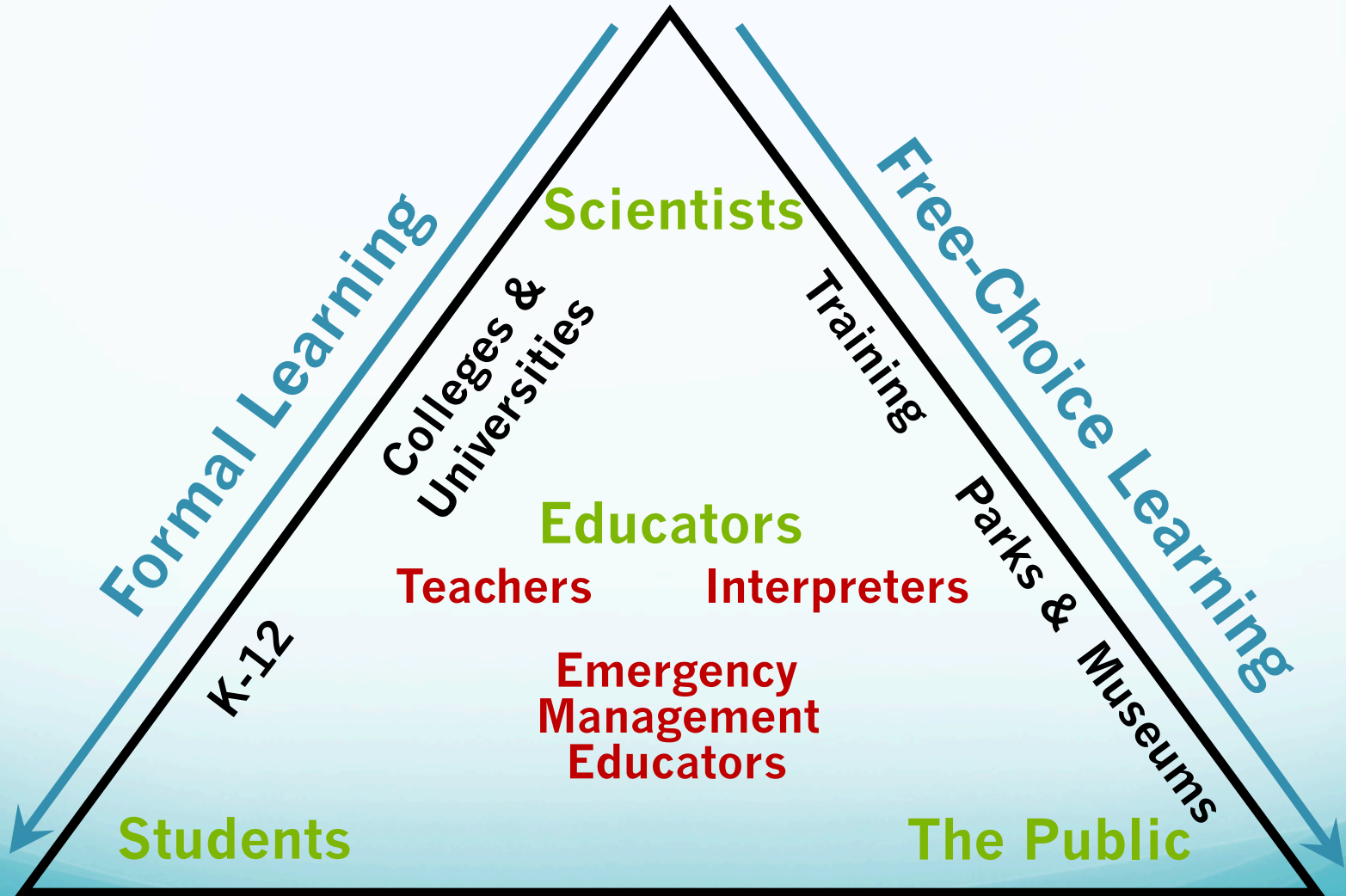


EarthScope Education and Outreach
Workshops for Interpretive
Professionals in Parks and Museums
(2008 - Present)



Traditional View

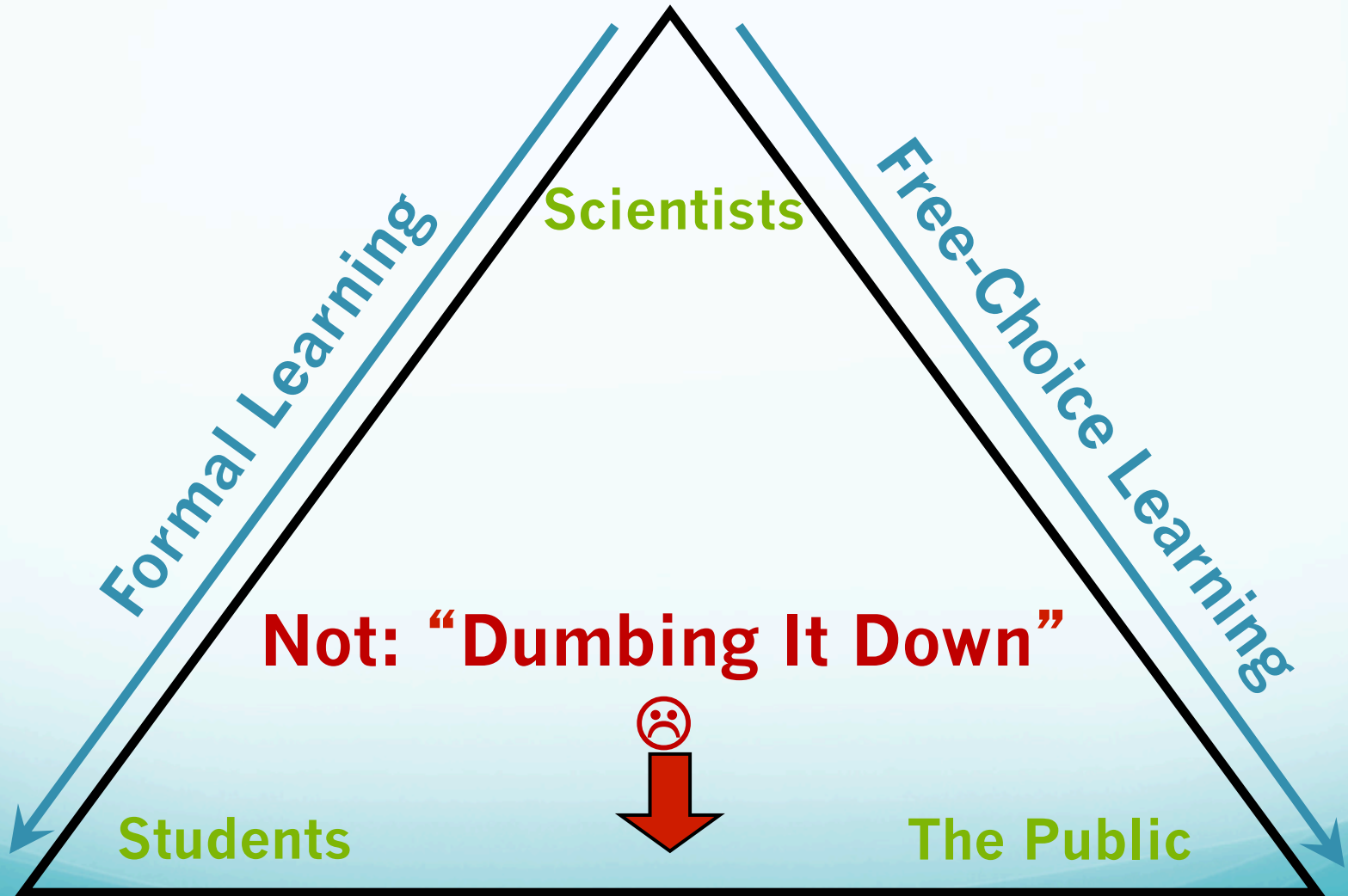
Science (EarthScope, Cascadia)



Meanings (Geoscience, Hazards, Preparedness)

Rethinking the View

Science (EarthScope, Cascadia)



Not: “Dumbing It Down”



Meanings (Geoscience, Hazards, Preparedness)

Greater resilience in Cascadia & America

Partner organizations & further dissemination

↑ **Meanings** (Geoscience, Hazards, Preparedness) ↑

Students

The Public



Instead: “Storying It Up” ☺

Formal Learning

Free-Choice Learning

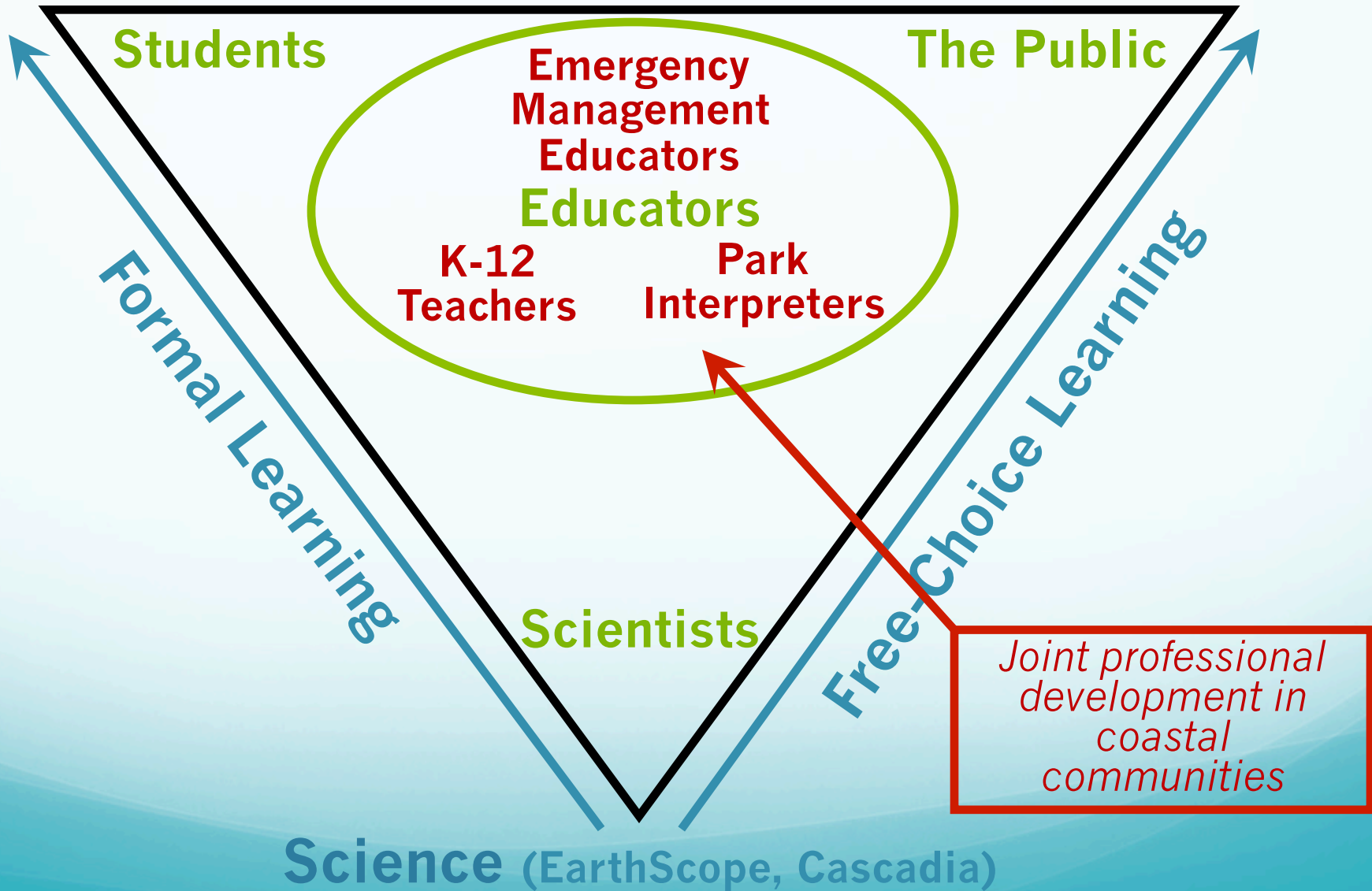
Scientists

Science (EarthScope, Cascadia)

Greater resilience in Cascadia & America

Partner organizations & further dissemination

↑ **Meanings** (Geoscience, Hazards, Preparedness) ↑



Galvanizing change in preparedness

- Research on behavioral change (Wood 2012; Mileti 2011)
 - Simple consistent messaging on what TO DO
 - From many trusted sources
 - For a long long time
 - Seeing others take preparedness steps
- FEMA (2010) suggests that science classrooms are under-utilized for hazard and preparedness connections

FEMA, Bringing Youth Preparedness Education to the Forefront: A Literature Review and Recommendations, Federal Emergency Management Administration. 21 pp., 2010. Available from:
<http://www.citizencorps.gov/resources/research/prepresearch.shtm>

Mileti and colleagues (National Hazards Center, University of Colorado) <http://www.colorado.edu/hazards/>

Wood, M. M., D. S. Mileti, M. Kano, M. M. Kelley, R. Regan, & L. B. Bourque, Communicating Actionable Risk for Terrorism and Other Hazards, Risk Analysis, v. 32, 601–615, 2012.

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Cascadia EarthScope Earthquake and Tsunami Education Program

Workshops on Cascadia Science and Preparedness:

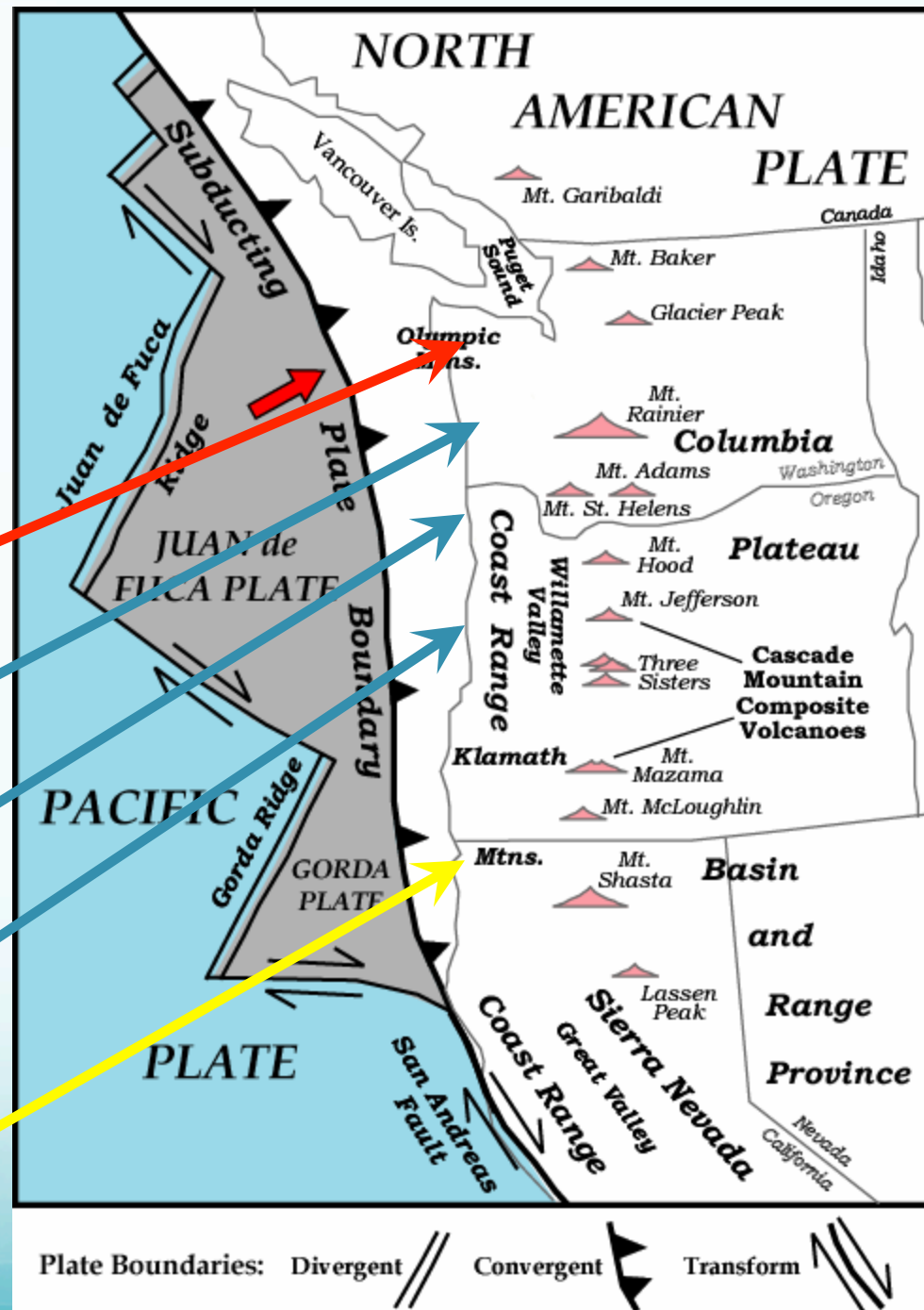
N. Olympic Peninsula
October 2013

Grays Harbor, Washington
August 2014

Astoria, Oregon
October 2013

Newport, Oregon
August 2013

Coos Bay & NoCal 2015



ONRC workshop space

- Hemlock Forest Room – Main room
- Social Hall – Breakfast (8:15-8:30 start) & lunch
- Foyer – snacks
- Water fountain & restrooms – in the hallway
- Library & classroom – breakout sessions, team planning space

CEETEP Binder

- OSU forms
- Feedback (white, front pocket)
- Agenda
- Contact lists
- Resources (thick section in the middle)
- Post-it notes (use them for questions)

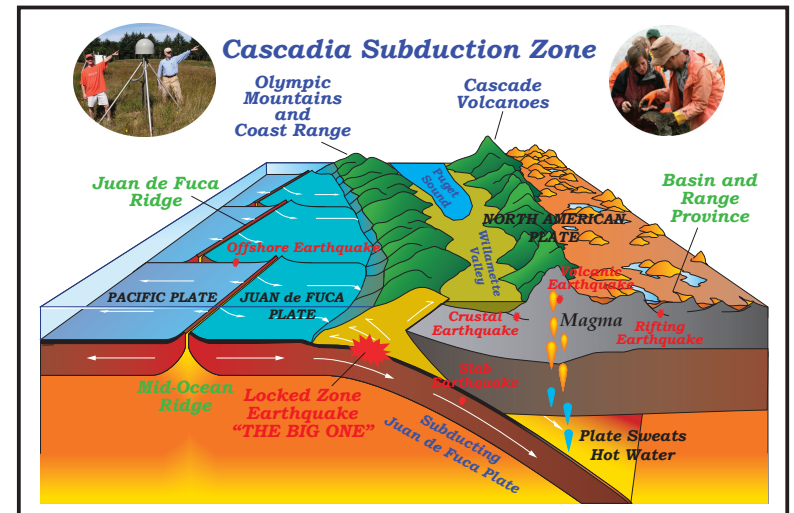
Cascadia EarthScope Earthquake & Tsunami Education Program (CEETEP)

Workshops for K-12 Teachers, Park/Museum Interpreters, and Emergency Management Educators

*Aberdeen, Washington, August 11-14, 2014
Forks, Washington, October 10-13, 2014*

Instructors: **Bob Butler**, University of Portland
Nancee Huner, OSU Hatfield Marine Science Center
Bob Lillie, Oregon State University
Beth Pratt-Sitaula, Central Washington University

Co-Instructors: **Brian Atwater**, U. S. Geological Survey
Bob de Groot, Southern California Earthquake Center
Roger Groom, Mt. Tabor Middle School
Bonnie Magura, Portland Public Schools (Retired)
Brynné Walker, Washington Emergency Management Division



<http://ceetep.oregonstate.edu>

Agenda Day 1- Getting started

Friday, October 10	
8:30	Coffee, tea, juice, snacks for those who arrive early
9:00	Introductions: CEETEP, EarthScope, Participants, Instructors <u>Please sit with your Action Team</u>
10:15	Break (Coffee, tea, juice, snacks)
10:30	Beauty and the Beast: Plate Tectonics and Geological Hazards of the Pacific Northwest
12:00	Thoughts/questions/reflection
12:15	Lunch
1:00	Basics of Earthquake and Tsunami Science and Hazards and Related Teaching Activities
3:15	Break (Coffee, tea, juice, snacks)
3:30	Surviving a Cascadia Subduction Zone Earthquake
4:30	Forms: Reimbursements; Stipends; Photo Permissions; Logistics for Day 2 Field Trip
4:45	Reflection, Questions, Implications
5:30	Adjourn

Agenda Day 2- Field Trip

Saturday, October 11

7:30	Coffee, tea, juice, snacks for those who arrive early
8:00	Depart
9:30	Stop 1: Waatch Prairie Tsunami Geology
11:00	Stop 2: Tsunami Evacuation Walk
12:30	Lunch & Stop 3 at Makah Research & Cultural Center (packed lunches)
3:20	Stop 4: Quillayute Airport GPS Station
4:30	Adjourn

Agenda Day 3 – Cascadia

Sunday, October 12	
8:30	Coffee, tea, juice, snacks for those who arrive early
9:00	Cascadia Earthquakes and Tsunami and Related Teaching Activities
10:30	Break (Coffee, tea, juice, snacks)
10:45	Cascadia Earthquakes and Tsunami and Related Teaching Activities
12:00	Thoughts/questions/reflection
12:15	Lunch
1:00	Tsunami: Are You Ready?
1:45	Native American Oral Histories
2:30	Science Storytelling through Interpretation
2:45	Birds-of-a-Feather Breakout Session
3:30	Break (Coffee, tea, juice, snacks)
3:45	Exchange of Pedagogies: Working together in Coastal Cascadia to engage students, visitors, and residents
4:15	Action Teams: Action Plan Development. Teams work on post-workshop plans (also prep 10-minute presentation for Day 4)
5:30	Adjourn

Agenda Day 4 – Bringing it together

Monday, October 13			
8:30	Coffee, tea, juice, snacks for those who arrive early		
9:00	Digital Resources		
9:55	Preparedness for Post-event Personal and Community Survival		
10:40	Break (Coffee, tea, juice, snacks)		
10:55	Break Out Sessions	Tsunami Vertical Evacuation Structures <u>Teachers</u>	Hazard Inventory <u>Interpreters & EM Educators</u>
11:45	Break Out Sessions	Tsunami Vertical Evacuation Structures <u>Interpreters & EM Educators</u>	Hazard Inventory <u>Teachers</u>
12:30	Lunch		
1:15	Action Teams: Final preparations for Action Plan and 10-minute presentation		
2:30	Action Teams: Presentations of plans		
3:45	Break (Coffee, tea, juice, snacks)		
4:15	Post-Workshop Assessment. Survey and focus groups.		
5:30	Adjourn		

CEETEP

Forks, WA

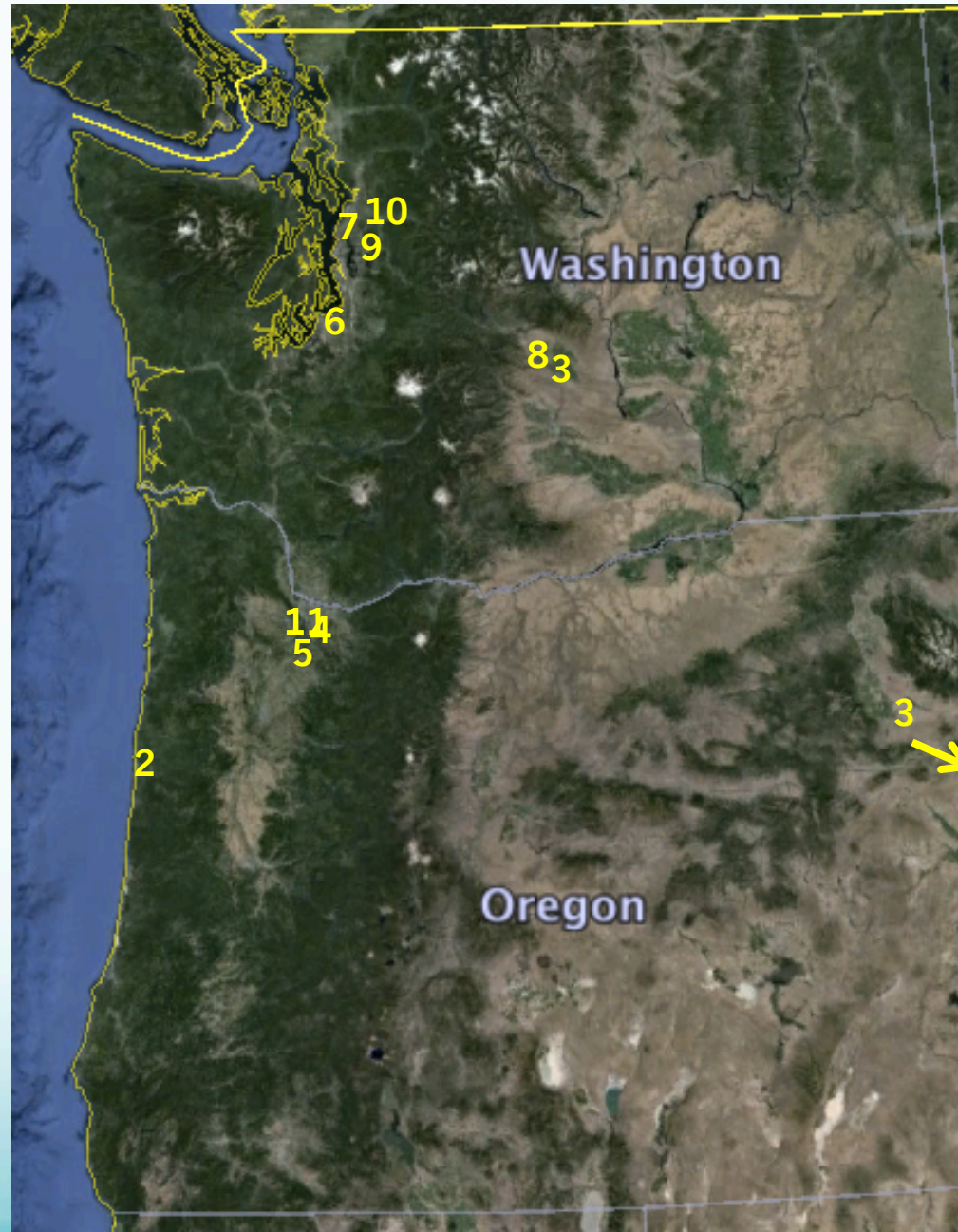
October 10-13, 2014

CEETEP Principle Investigators and Instructors

1. Bob Butler, University of Portland, Portland
2. Nancee Hunter, OSU Hatfield Marine Science Center, Newport
3. Beth Pratt-Sitaula, Central Washington University, Ellensburg & UNAVCO, Boulder, CO

Master Teachers and Co-Instructors

4. Roger Groom, Mt. Tabor Middle School, Portland
5. Bonnie Magura, Portland Public Schools (retired), Portland
6. Brynne Walker, Washington State Emergency Management, Camp Murry
7. Brian Atwater, U. S. Geological Survey, Seattle
8. Ken Austin, UNAVCO, Ellensburg
9. **Paul Gleason**
10. David Yamaguchi, Seattle



CEETEP

Forks, WA

October 10-13, 2014

CEETEP Partner Organizations

11. Bob de Groot, Southern California
Earthquake Center, Los Angeles, CA

External Evaluator

12. Michael Coe, Cedar Lake Research,
Portland

Animator/Videographer

13. Jenda Johnson, Portland

Student Assistant

14. Lisa Akers, Oregon State University,
Corvallis



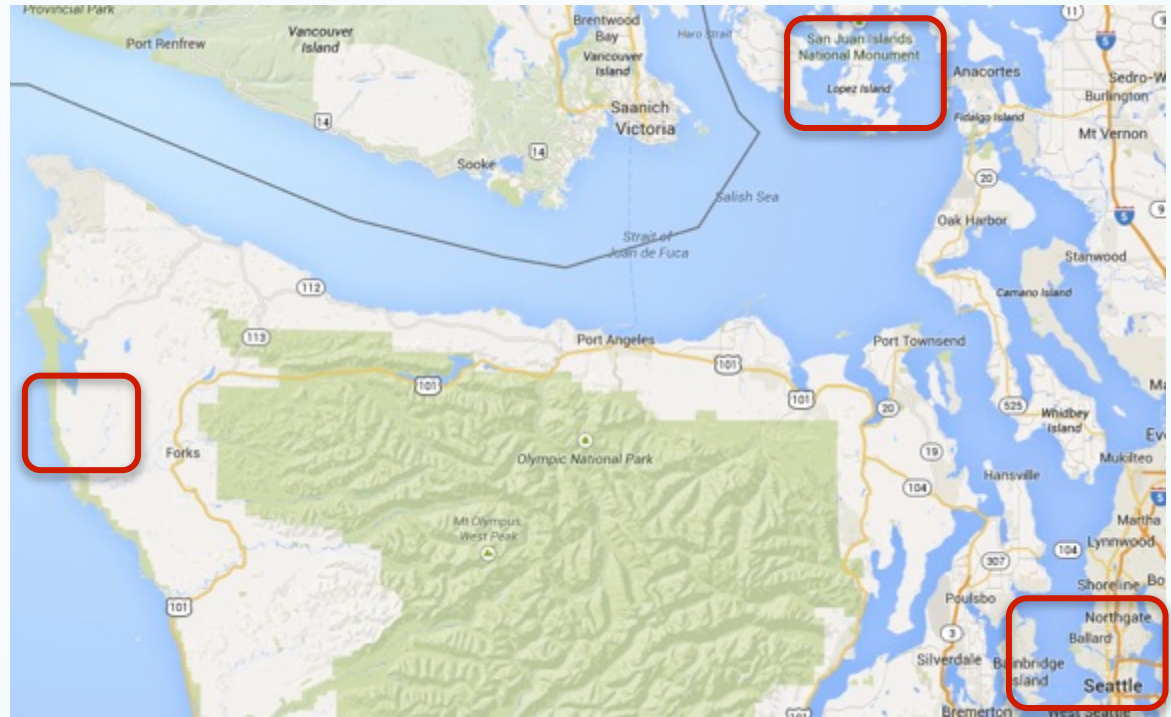
Action Team 1

20-second Intro

1. Who are you?
2. Your organization and/or educational setting?

Optional:

3. What you particularly hope to get from CEETEP?



K-12 Teacher

Sheri Crippen

LaPush

Quileute Tribal School

Park/Museum Interpreter

Raena Parsons

San Juan Is.

San Juan Island National Historical Park

Steven Ray

San Juan Is.

San Juan Island National Historical Park

Emergency Management Educator

Ben Marple

Seattle

American Red Cross

Action Team 2 – Neah Bay

20-second Intro

1. Who are you?
2. Your organization and/or educational setting?

Optional:

3. What you particularly hope to get from CEETEP?



K-12 Teacher

Krystal Russell
Mike Schermer

Neah Bay
Joyce

Neah Bay Middle School
Crescent School

Park/Museum Interpreter

Polly DeBari

Neah Bay

Makah Cultural & Research Center

Emergency Management Educator

Andrew Wincke

Neah Bay

Makah Tribe Emergency Manag.

Action Team 3 – Port Angeles-Sequim

20-second Intro

1. Who are you?
2. Your organization and/or educational setting?

Optional:

3. What you particularly hope to get from CEETEP?



K-12 Teacher

Kat Dadd	Port Angeles	Stevens Middle School
John Gallagher	Port Angeles	Port Angeles High School
John Henry	Port Angeles	Port Angeles High School
Brenda Manson	Port Angeles	Stevens Middle School

Park/Museum Interpreter

Nicole Harris	Port Angeles	Olympic Coast Nat. Marine Sanct.
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Emergency Management Educator

Sterling Epps	Sequim	Clallam County CERT
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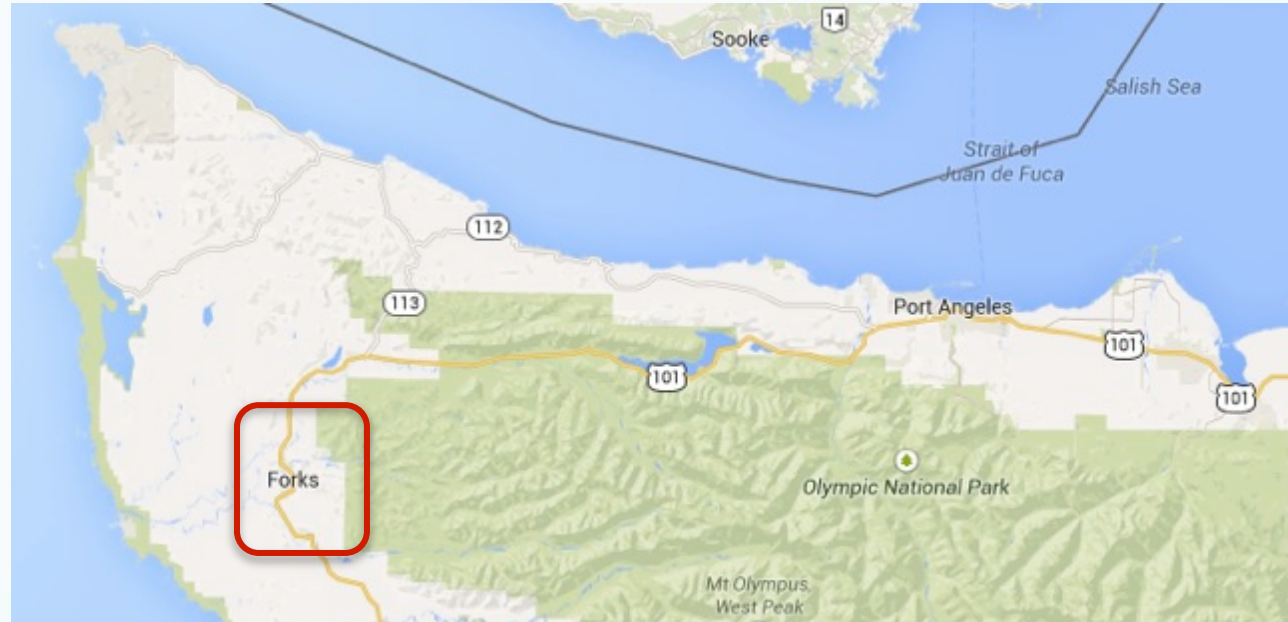
Action Team 4 – Forks

20-second Intro

1. Who are you?
2. Your organization and/or educational setting?

Optional:

3. What you particularly hope to get from CEETEP?



K-12 Teacher

John Hunter	Forks	Forks High School
Stephanie Miller	Forks	Forks Middle School
Megan Raines	Forks	Forks High School
Cari Rohrer	Forks	Forks Middle School

Park/Museum Interpreter

Judy Lively	Forks	Olympic National Park
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Emergency Management Educator

Jayne Wisecup	Clallam	Clallam County Emergency Man.
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Action Team 5

20-second Intro

1. Who are you?
2. Your organization and/or educational setting?

Optional:

3. What you particularly hope to get from CEETEP?



K-12 Teacher

Michael Kenney

Amanda Park

Lake Quinault School

Park/Museum Interpreter

Tami Pokorny

Jefferson County

N Pacific Coast Marine Reserve

Jon Preston

Hoh Visitor Center

Olympic National Park

Emergency Management Educator

David Shannon

Seattle

American Red Cross

Get to know your team

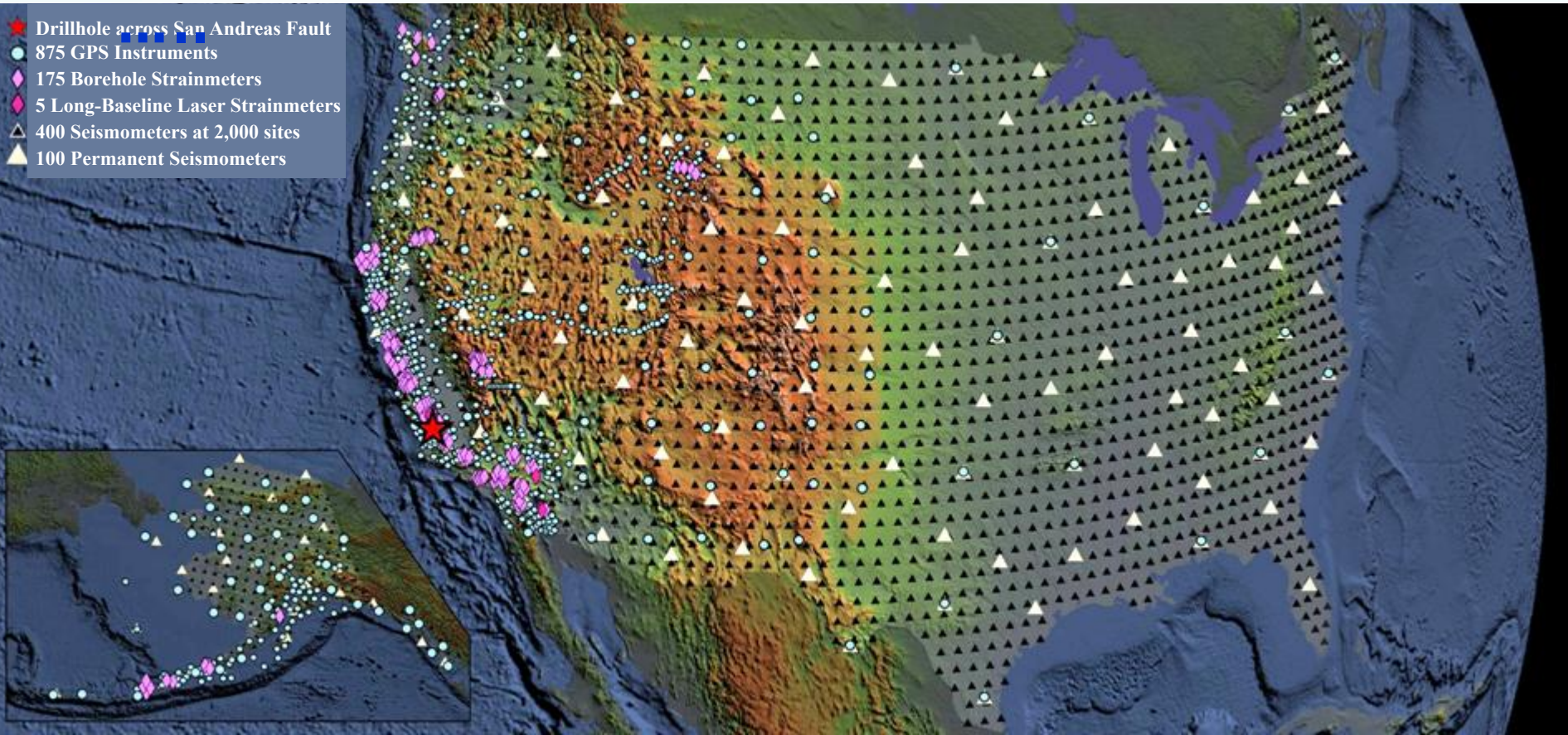
- Several minute intro – Each member of the team should share a little more details about their:
 - Teaching setting and audience
 - Existing strengths or experience with geoscience and preparedness
 - Goals for gaining knowledge and abilities in teaching tsunami and earthquake education

A National Science Foundation (NSF) effort to

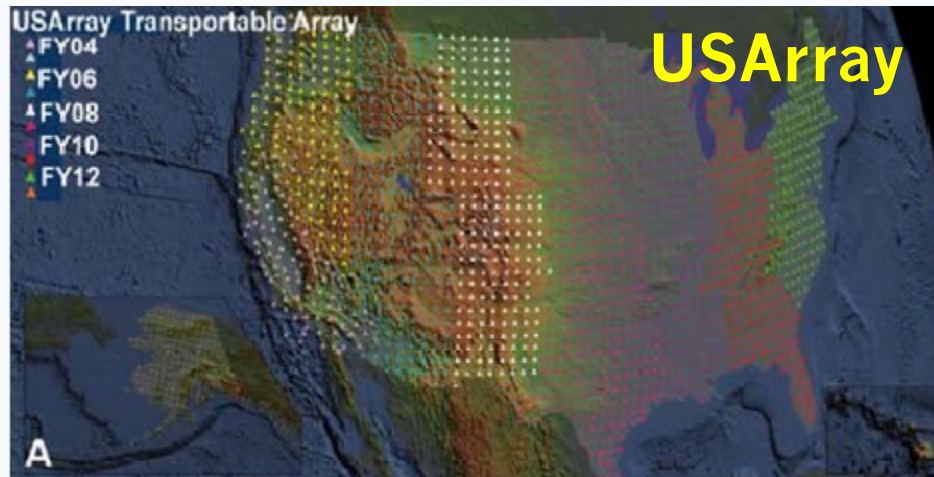
- Explore the structure and evolution of North American continent
- Study processes that cause earthquakes and volcanic eruptions

EarthScope has three main “observatories”

- ★ Drillhole across San Andreas Fault
- 875 GPS Instruments
- ◆ 175 Borehole Strainmeters
- ◆ 5 Long-Baseline Laser Strainmeters
- △ 400 Seismometers at 2,000 sites
- ▲ 100 Permanent Seismometers



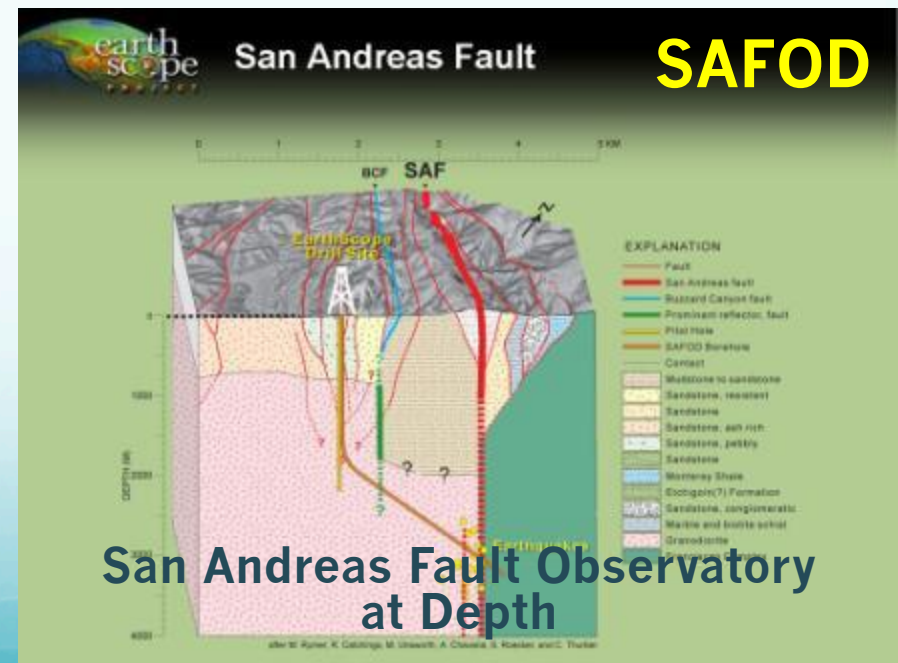
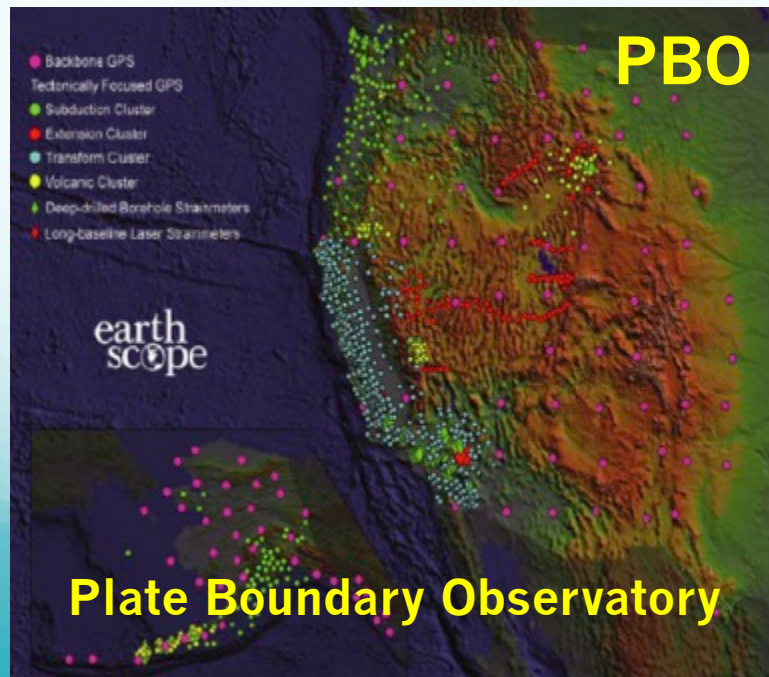
EarthScope Observatories



**Geodetic
Instruments**

Seismometers

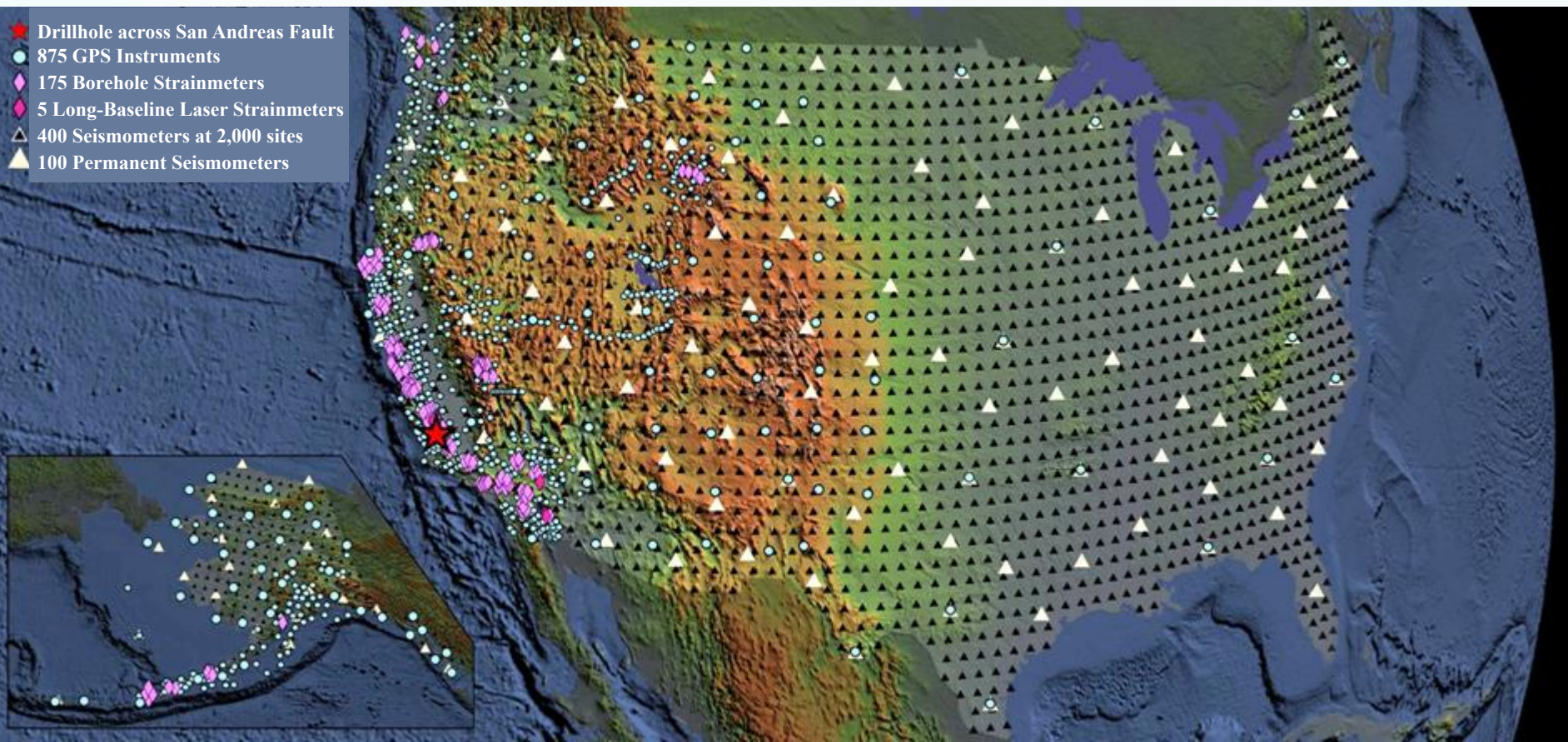
**Deep
Drillhole**



“Like a Hubble Telescope aimed into the Earth”



- ★ Drillhole across San Andreas Fault
- 875 GPS Instruments
- ◆ 175 Borehole Strainmeters
- ◆ 5 Long-Baseline Laser Strainmeters
- △ 400 Seismometers at 2,000 sites
- ▲ 100 Permanent Seismometers



1. USArray

- Includes 400 Transportable Seismometers
- Each station occupies a site for 1½ to 2 years
- 10 years to leap-frog across the country

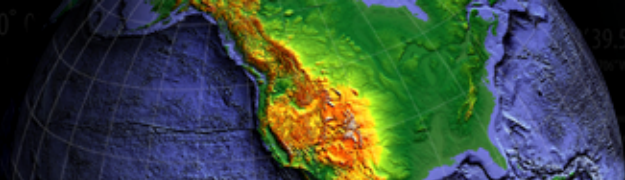
Transportable Seismic Stations:

- ▲ FY04
- ▲ FY05
- ▲ FY06
- ▲ FY07
- ▲ FY08
- ▲ FY09
- ▲ FY10
- ▲ FY11
- ▲ FY12
- ▲ FY13



Seismometer

IRIS
(Incorporated Research
Institutions for Seismology)
Washington, DC



39.53°N 120.05° 12' 20.02"W
0.153° 25' 41.852889"N 138° 28' 30.575289"W
46.644°N 146° 8' 43.08"W

Visualizations

Seismic Waves Moving Across USArray

China, 2008

Bob Woodward - IRIS

Animation of Wenchuan China Earthquake

Robert Woodward
IRIS



earth
scope
www.earthscope.org

Lighting the Structure
and Evolution of the
North American Craton

www.earthscope.org

2. PBO

Plate Boundary Observatory

- High precision GPS
- Strainmeters



GSP Station

- Backbone GPS
- Tectonically Focused GPS
- Subduction Cluster
- Extension Cluster
- Transform Cluster
- Volcanic Cluster
- Deep-drilled Borehole Strainmeters
- Long-baseline Laser Strainmeters

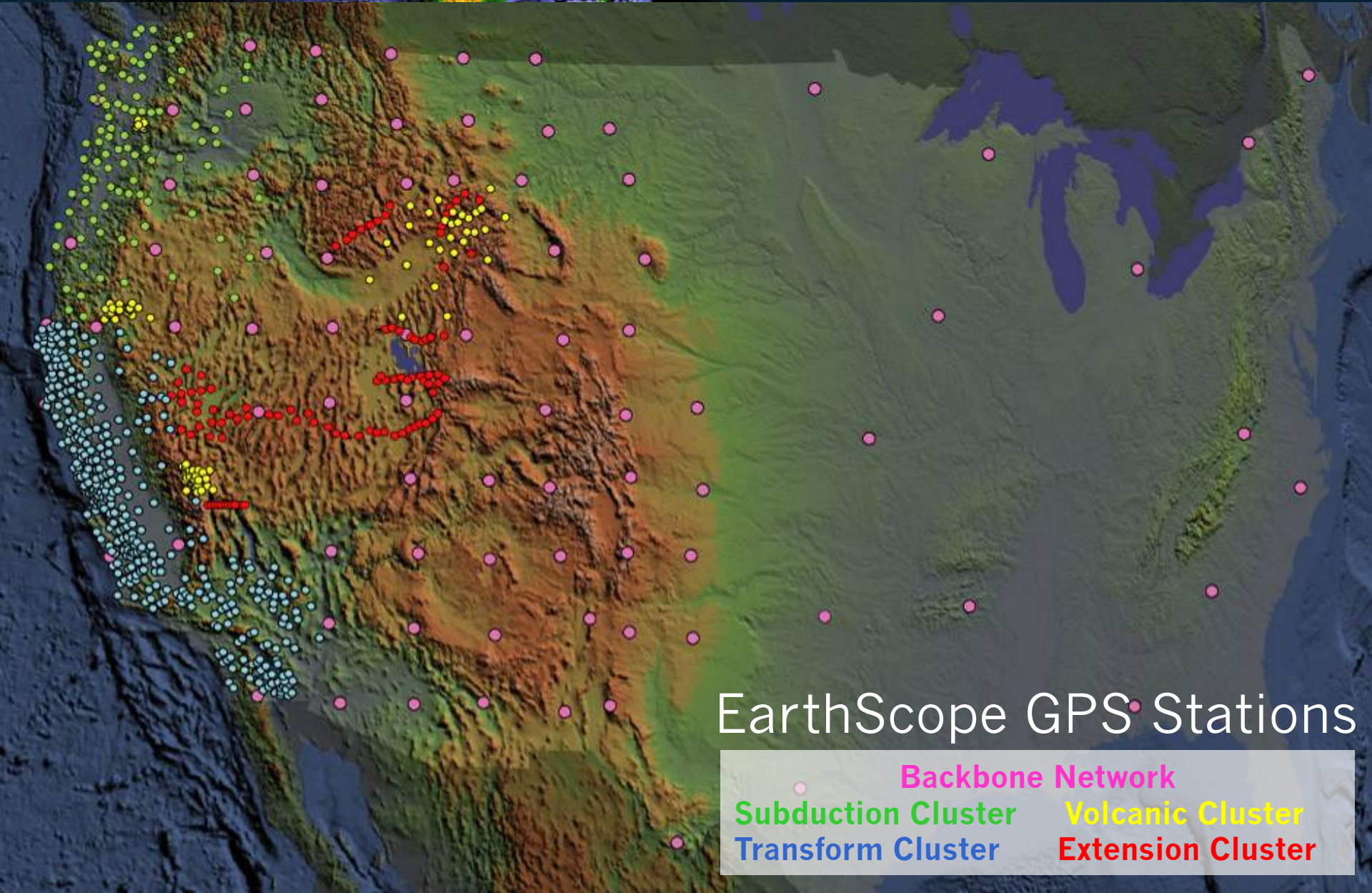
earth
scope

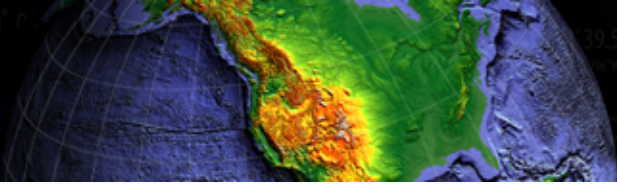


*UNAVCO
Boulder, CO*

2. PBO

Plate Boundary Observatory

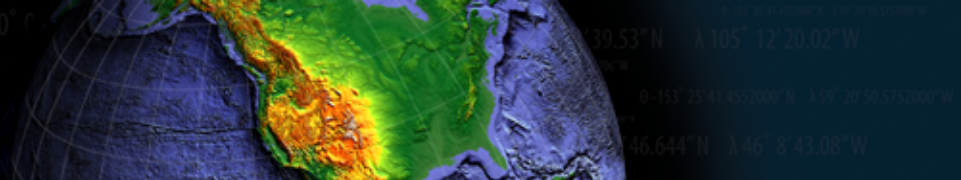




2. PBO

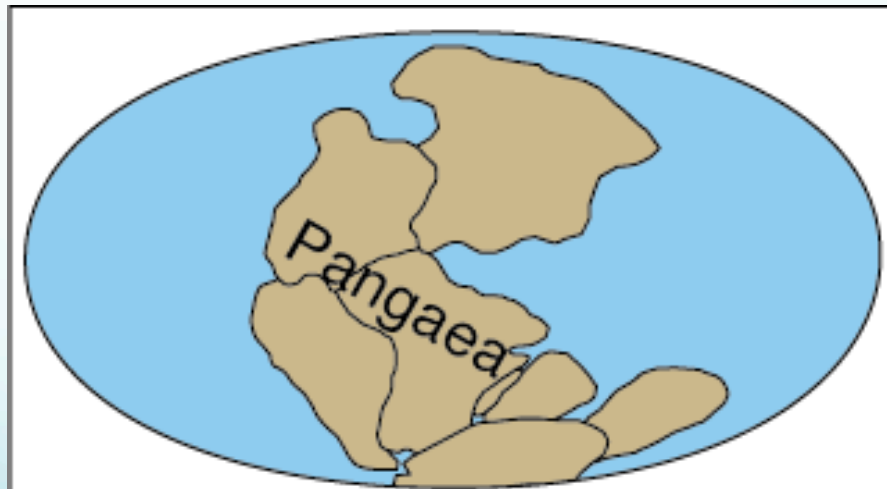
Plate Boundary Observatory

Jump to local map



Wegener's Dream

"This [direct measurement of continental drift] must be left to the geodesists. I have no doubt that in the not too distant future we will be successful in making a precise measurement of the drift of North America relative to Europe."-- Alfred Wegener, 1929



200 million years ago all of the present-day continents combined to form a single supercontinent called Pangaea.



A satellite map of the Atlantic Ocean and surrounding continents (North America, South America, Europe, and Africa). A dashed red line traces the mid-Atlantic ridge. Two white arrows point away from the ridge, indicating the direction of tectonic plate movement. Text labels provide spreading rates in different units.

Geologically-measured spreading rates

20-30 kilometers/million years
20-30 millimeters/year
~1 inch/year

GPS Measurements:
Motion of North America relative to Europe.
Wegener's Dream come true!

~1 inch/year

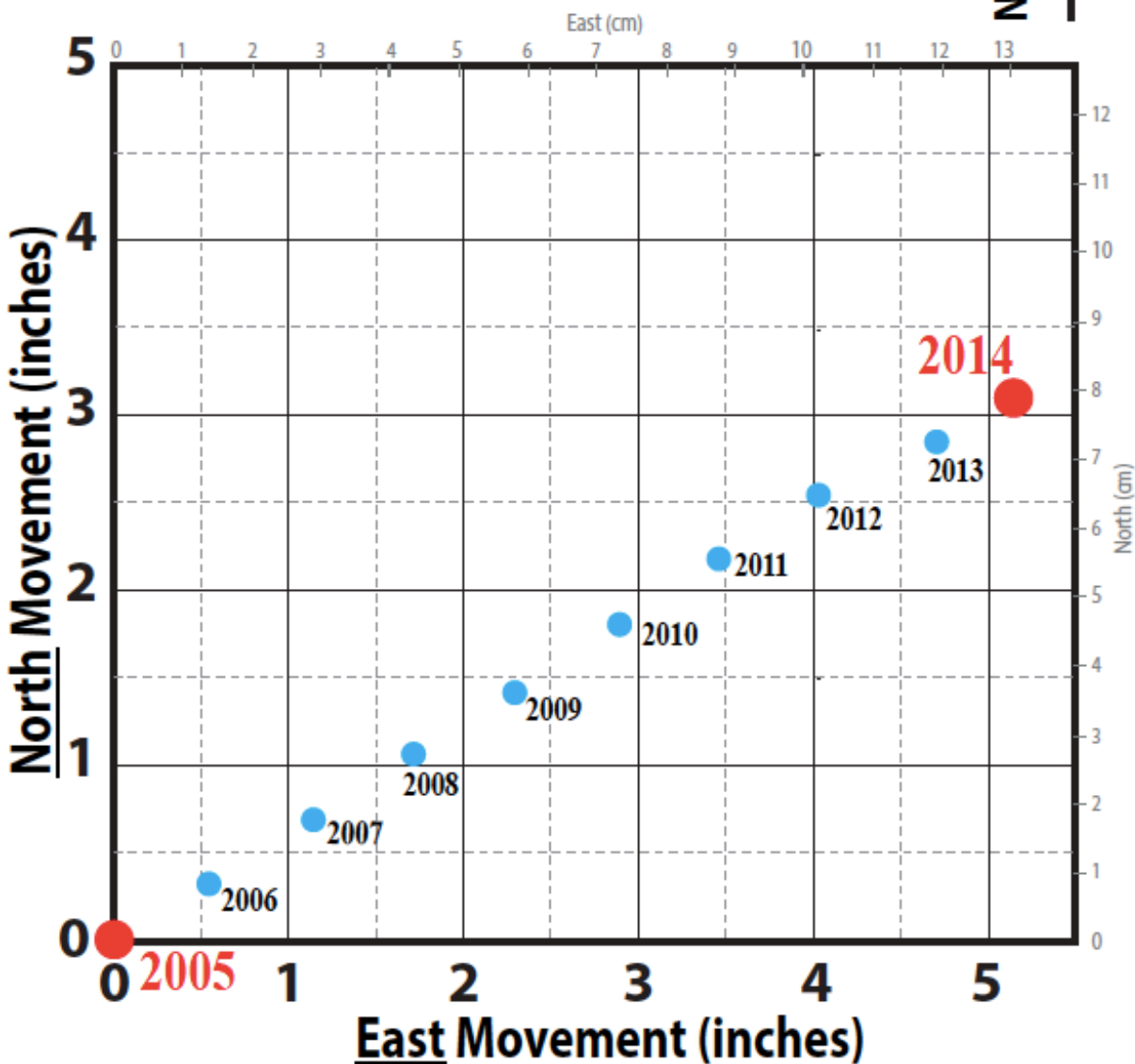
~1 inch/year



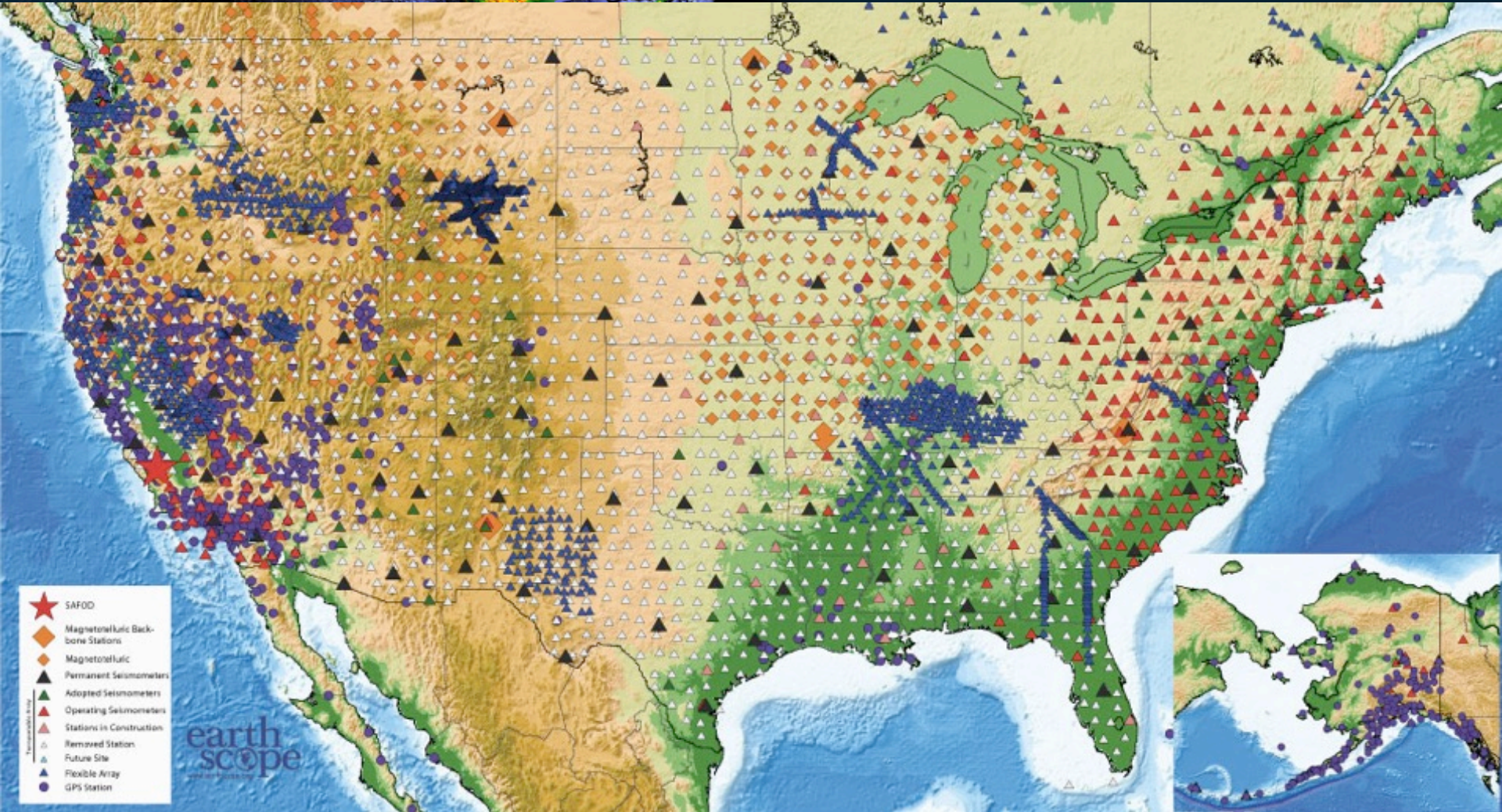
Quillayut, Washington GPS Station

Yearly Movement, 2005 - 2014

(Referenced to Stable North America)



EarthScope Station Status September 2014



http://www.earthscope.org/current_status

Cascadia Initiative

New seismometers being deployed offshore and onshore to complement existing onshore seismometers and GPS instruments

Four year project:

2011 - 2014

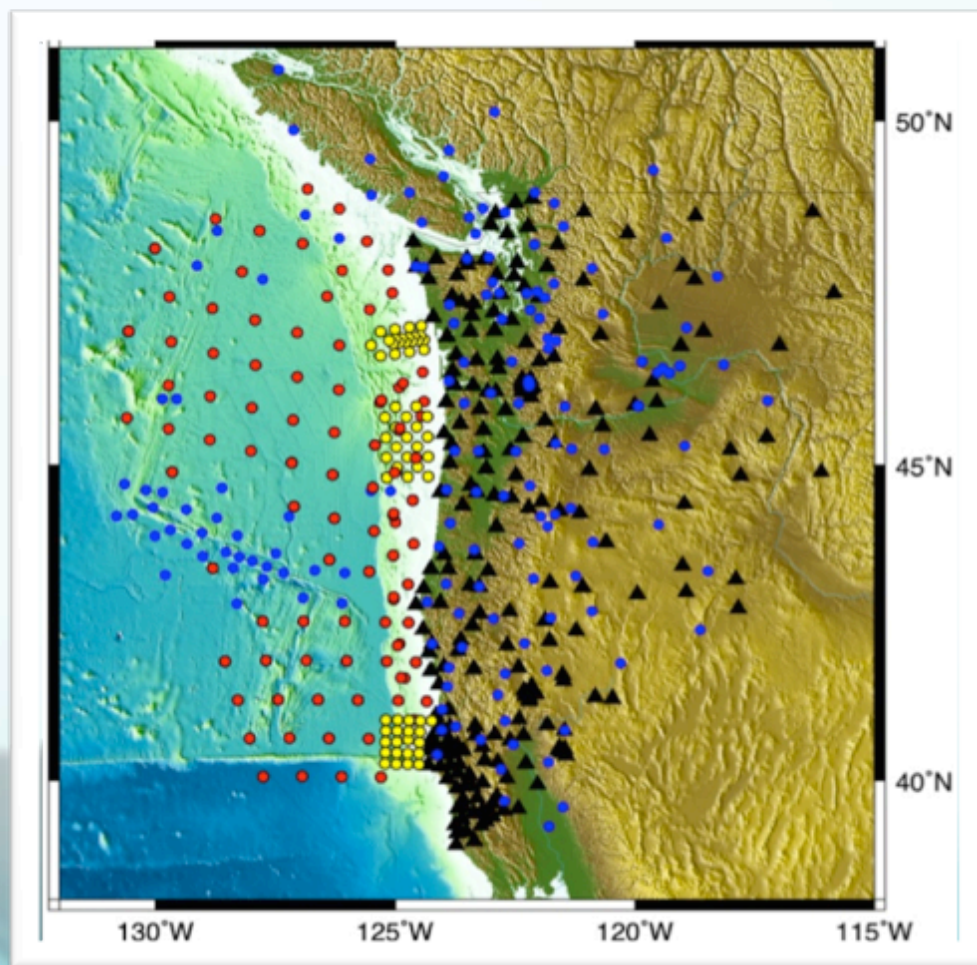
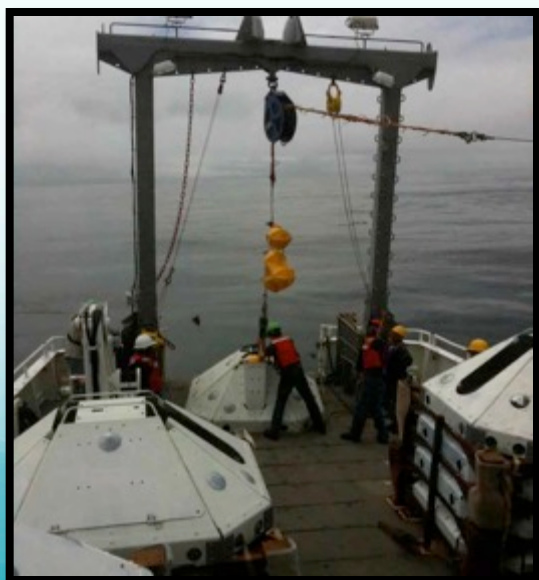
Onshore:

232 GPS stations

27 seismometers

Offshore:

60 ocean-floor seismometers



EarthScope Cheat Sheet



EarthScope is a ~15 year long geophysics initiative to study the crust of North America – what it is made of, how it was assembled, and the geohazards it has. Funded by National Science Foundation



EarthScope also funds science and education projects like CEETEP

EarthScope Facility has 3 Parts

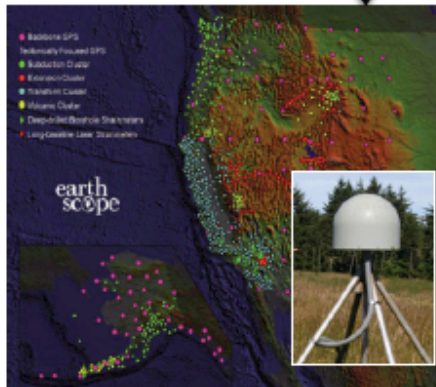
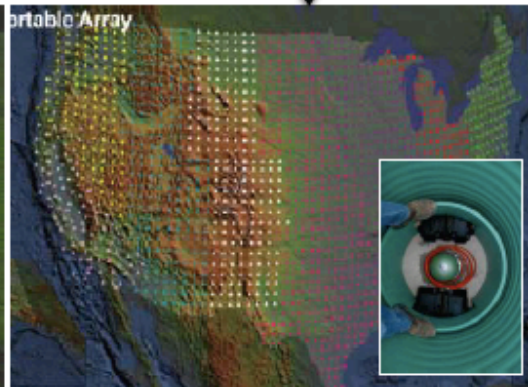
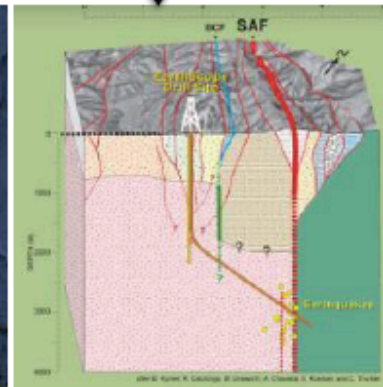


Plate Boundary Observatory (PBO) – >1100 GPS stations and strainmeters to measure crustal movements



USArray – 400 Transportable Array seismic stations that have been stepping across lower-48 and now Alaska for last 10 years.



San Andreas Fault Observatory at Depth (SAFOD) – drilling to San Andreas fault at 3-4 km

UNAVCO

(NSF's Geodetic Facility)
runs PBO

IRIS

(NSF's Seismic Facility)
runs USArray



Cascadia EarthScope Earthquake and Tsunami Education Program has 3 collaborating universities

- Oregon State Univ.
- Univ. of Portland
- Central WA Univ.

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



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.

EARTH SCIENCE
LITERACY PRINCIPLES



The Big Ideas and Supporting Concepts of Earth Science

www.earthscope.org

Sense of Place

- Our hometowns and other special places are part of exciting new exploration and discovery.
- Our communities are not standing still—they are moving!

