April 8, 2008

EarthScope Cascadia Interpretive Workshop

Susan Eriksson
UNAVCO
Boulder, CO

In 30 minutes

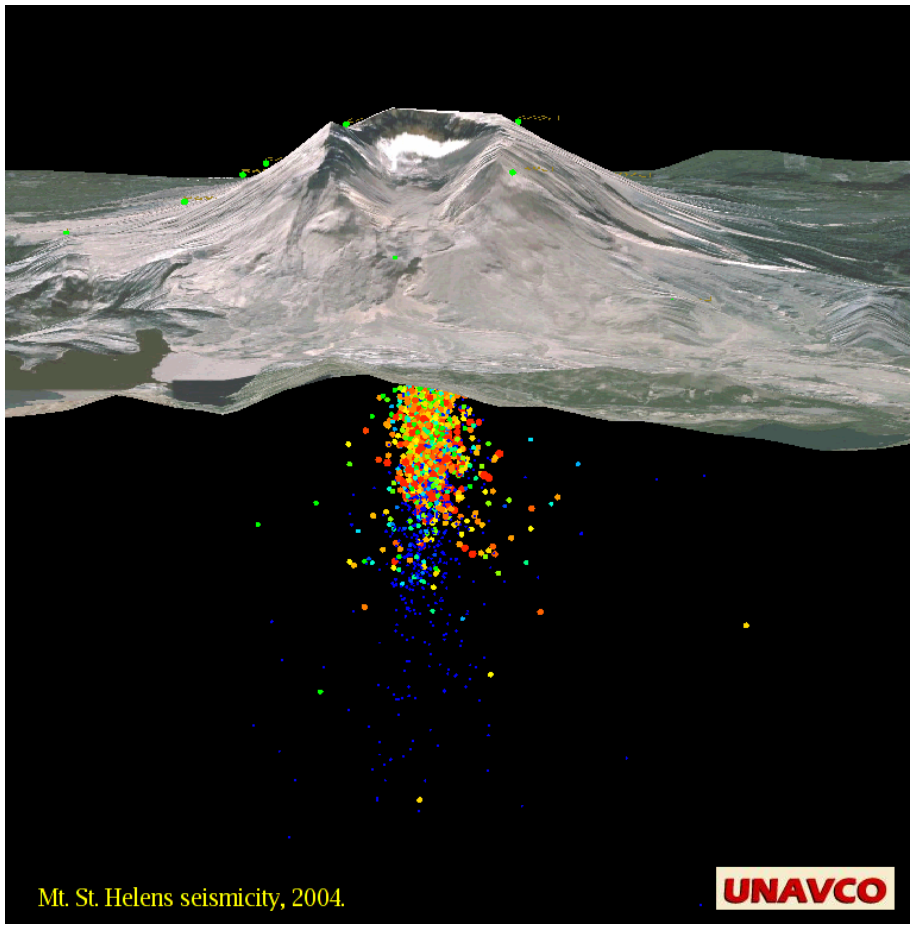
Share UNAVCO as a resource of data and educational materials

In 3 days

Think about how to add to your interpretation

In 30 days

Explore UNAVCO's website, use materials, and provide input for improvement or new materials



Materials are available at:

http://www.unavco.org/cws/UsingData/

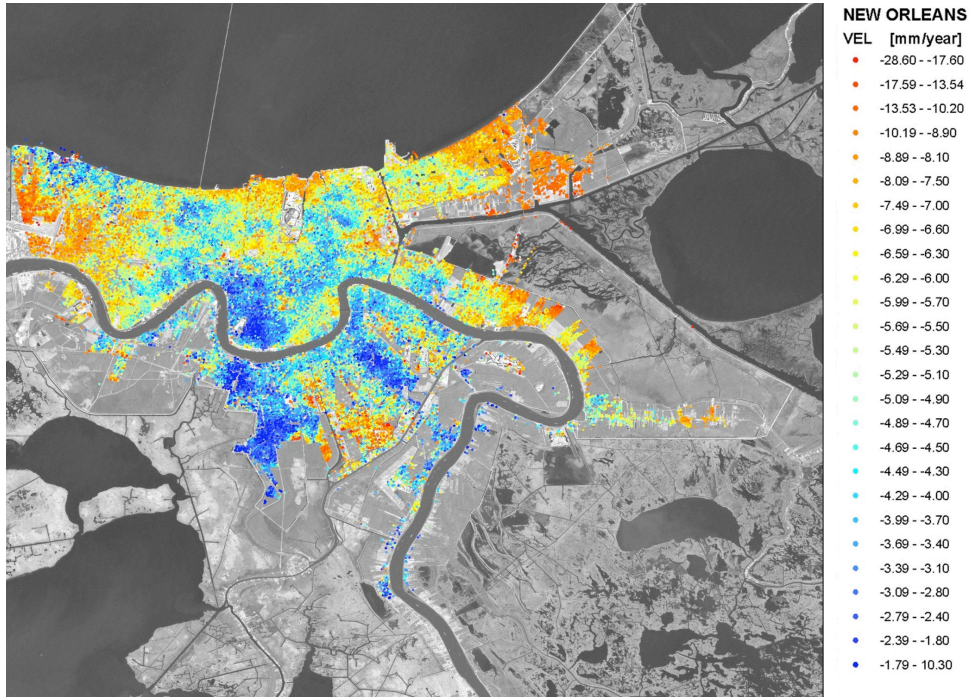
UNAVCO
www.unavco.org

Today

- **Explore concepts & relationships with visualization tools:**
  - *Jules Verne Voyager tools and Google Earth overlays*
- **Digging deeper: Examine evidence through data products.**
  - *Data for Educators & GPS time series plots*
- **Starting at the source: Access & analyze GPS data to investigate trends.**
  - *GPS data sets*

21st Century Science

- **Integrating research and education**
  - What is the cutting edge research in crustal deformation
  - How is it done
  - What new discoveries are being made
- **Nature of science**
- **Engaging students with Earth system data**
  - Quantitative skills
  - Visualization of data
  - Models – what are they, how do we develop
  - Integration of data
- **Careers in geosciences**



Dixon et al, 2007

21st Century Science

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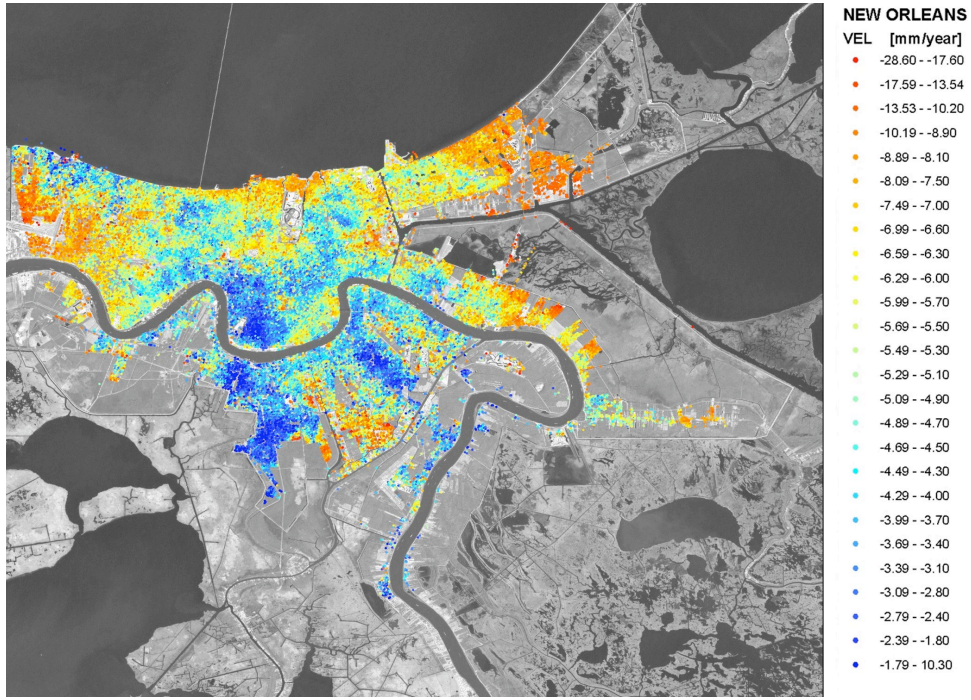
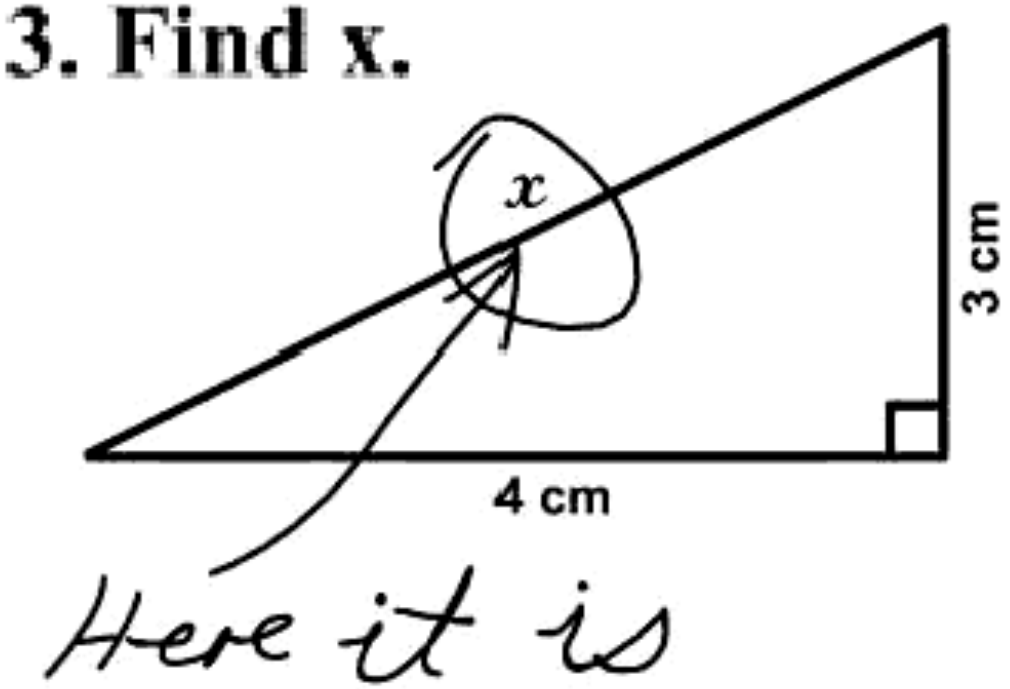


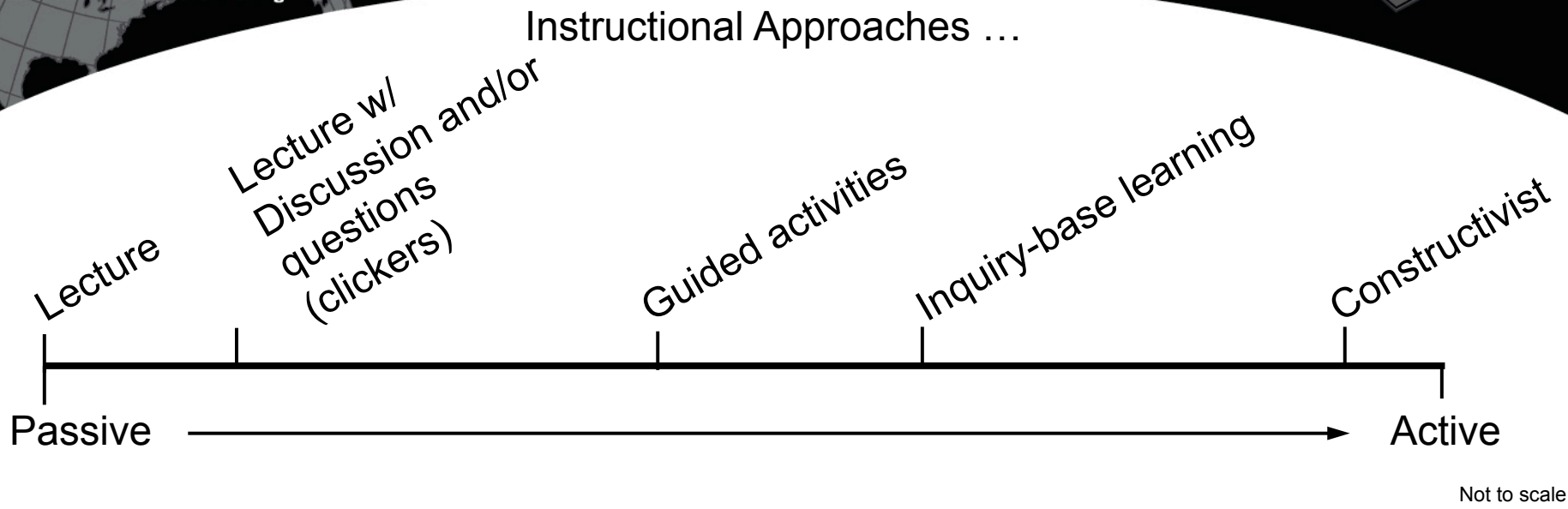
Dixon et al, 2007

….and relevance to society

Getting our populace beyond…



Think About…

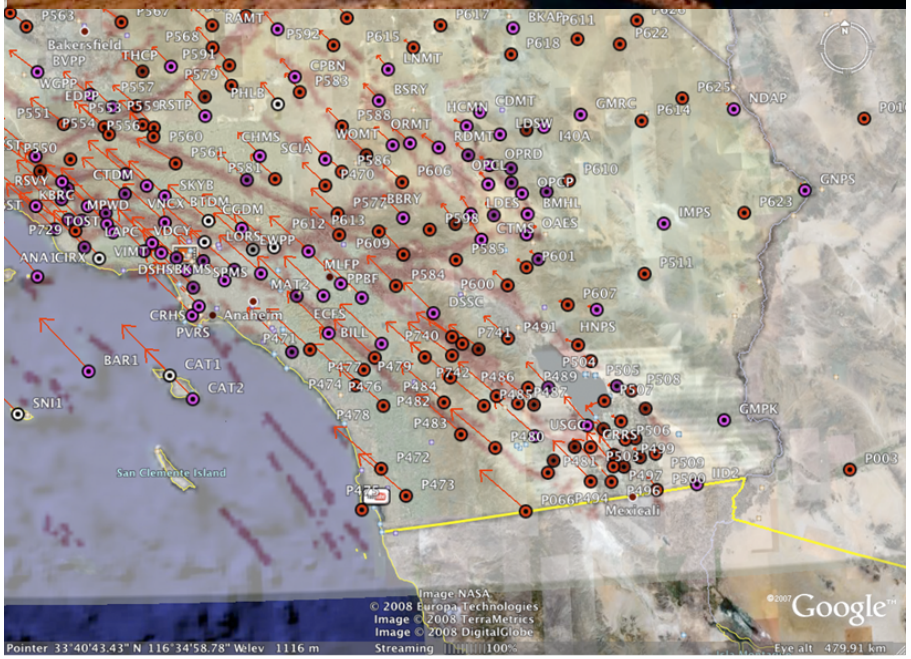


People need:

- Varied interpretive approaches …
  - Varied learning styles
  - Varied modes of processing information (verbal, written, visual, kinesthetic, etc)
- To learn how to ***think*** critically…

What is UNAVCO

- NSF and NASA funded
- Research Consortium
  - Membership-governed
  - Non-profit
- Supports and promotes Earth science by advancing **high-precision techniques** (such as GPS) for the **measurement and understanding** of Earth deformation

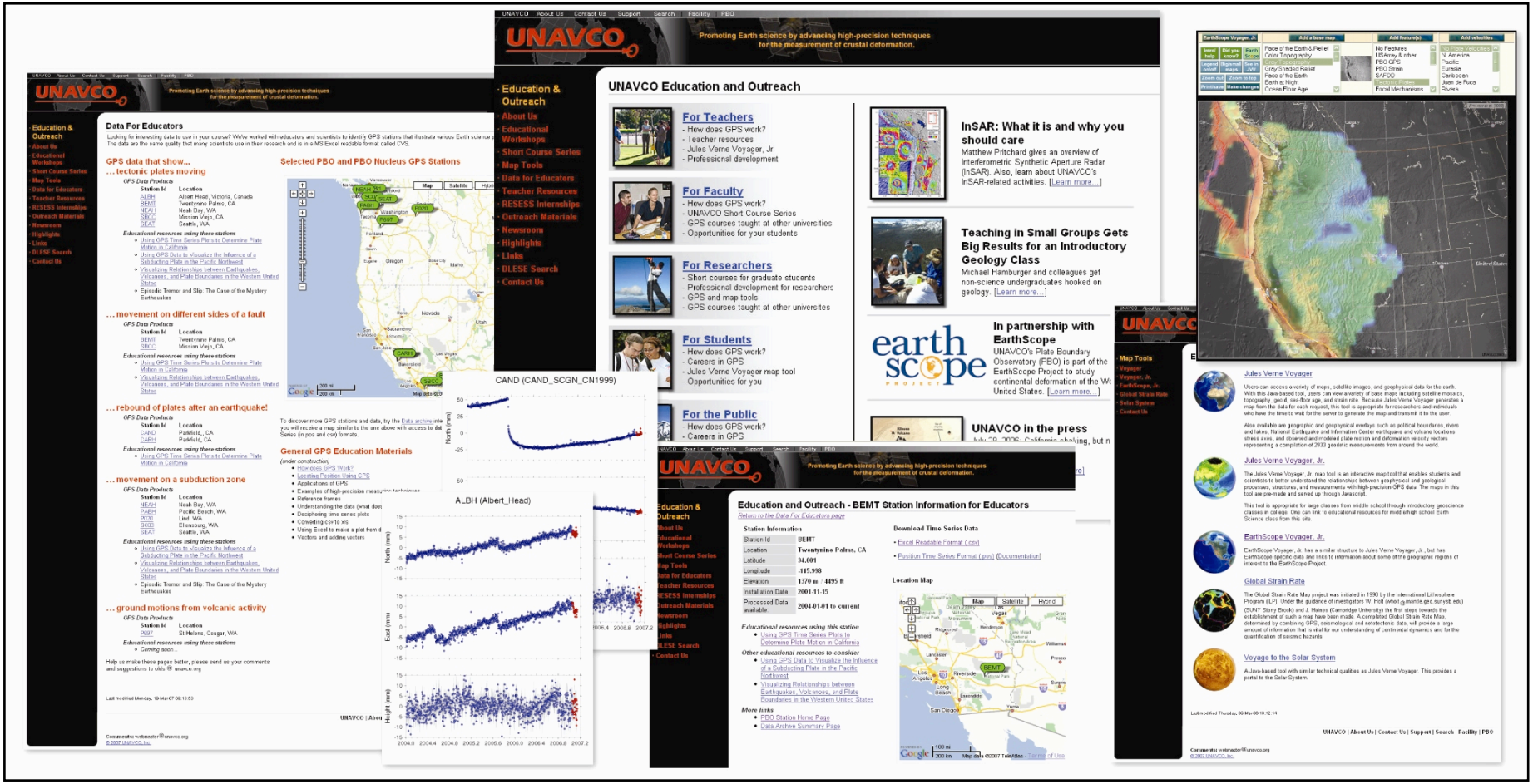


UNAVCO-supported science

- Plate movement
- Boundary zones
- Transient deformation
- Earthquakes and tectonics
- Volcanoes and active magmatic systems
- Glacial movements and isostatic adjustment
- Hydrologic/seasonal changes

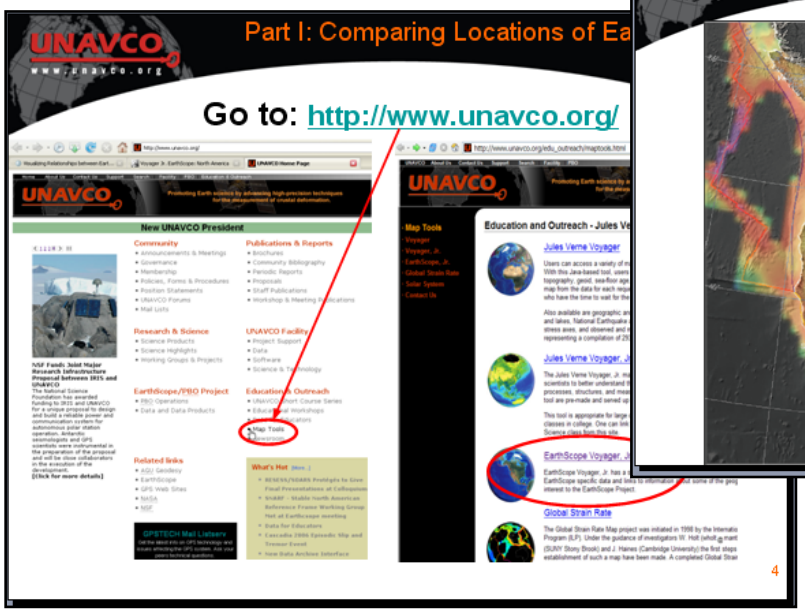
UNAVCO
www.unavco.org

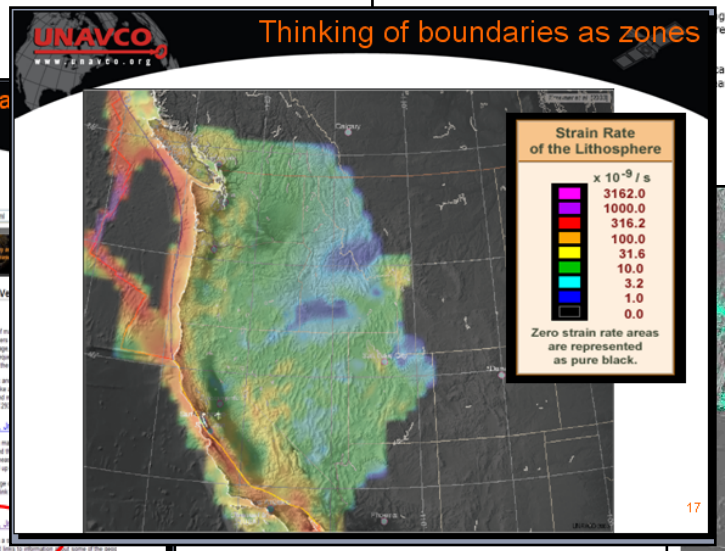
UNAVCO E&O Website

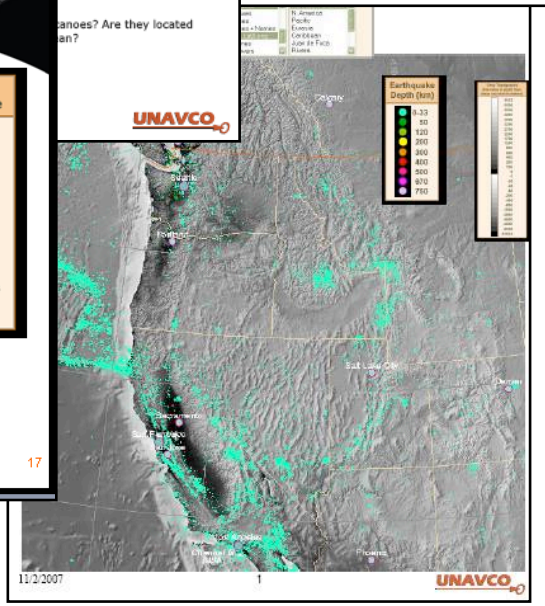


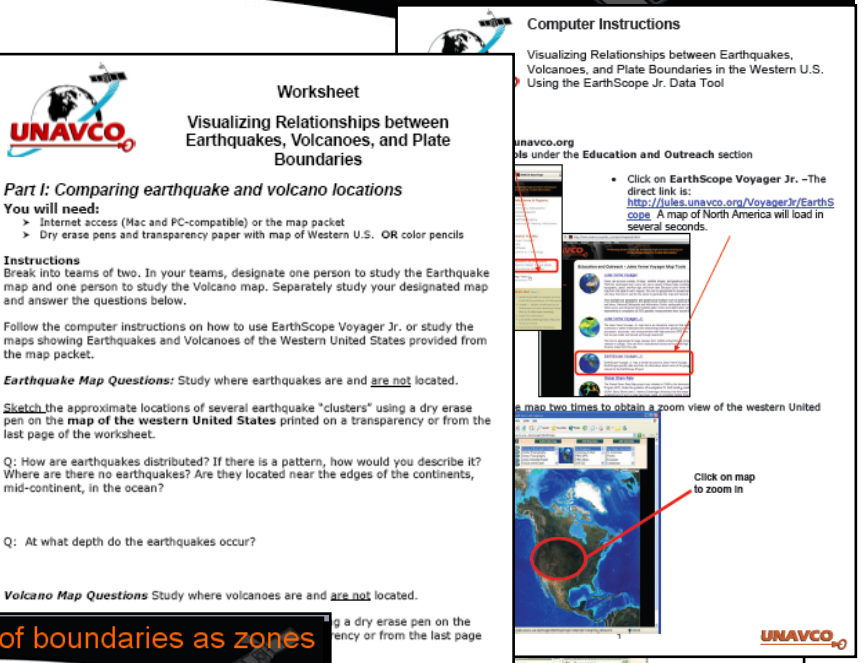
Learning Materials

- Instructor Presentations
- Computer instructions
- Student worksheets
- How to download the data









Data for Educators

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

- Visual display
- Interesting data
- Quick data preview
- Excel readable formats
- Associated Activities

Data For Educators

Looking for interesting data to use in your course? We've worked with educators and scientists to identify GPS stations that illustrate various Earth science processes. The data are the same quality that many scientists use in their research and is in a MS Excel readable format called CVS.

GPS data that show...

...tectonic plates moving

GPS Data Products

Station Id	Location
ALBH	Albert Head, Victoria, Canada
BEMT	Twentynine Palms, CA
NEAH	Neah Bay, WA
SBCC	Mission Viejo, CA
SEAT	Seattle, WA

Educational resources using these stations

- Using GPS Time Series Plots to Determine Plate Motion in California
- Using GPS Data to Visualize the Influence of a Subducting Plate in the Pacific Northwest
- Visualizing Relationships between Earthquakes, Volcanoes, and Plate Boundaries in the Western United States
- Episodic Tremor and Slip: The Case of the Mystery Earthquakes

...movement on different sides of a fault

GPS Data Products

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BEMT	Twentynine Palms, CA
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Educational resources using these stations

- Using GPS Time Series Plots to Determine Plate Motion in California
- Visualizing Relationships between Earthquakes, Volcanoes, and Plate Boundaries in the Western United States

...rebound of plates after an earthquake!

GPS Data Products

Station Id	Location
CAND	Parkfield,, CA
CARH	Parkfield, CA

Educational resources using these stations

- Using GPS Time Series Plots to Determine Plate Motion in California

...movement on a subduction zone

GPS Data Products

Station Id	Location
NEAH	Neah Bay, WA
PABH	Pacific Beach, WA
P020	Lind, WA
SC03	Ellensburg, WA
SEAT	Seattle, WA

Educational resources using these stations

- Using GPS Data to Visualize the Influence of a Subducting Plate in the Pacific Northwest
- Visualizing Relationships between Earthquakes, Volcanoes, and Plate Boundaries in the Western United States
- Episodic Tremor and Slip: The Case of the Mystery Earthquakes

...ground motions from volcanic activity

GPS Data Products

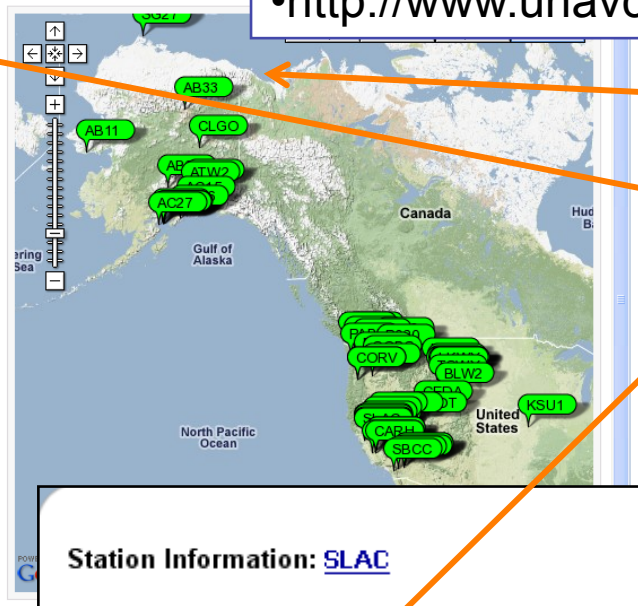
Station Id	Location
P697	St Helens, Cougar, WA

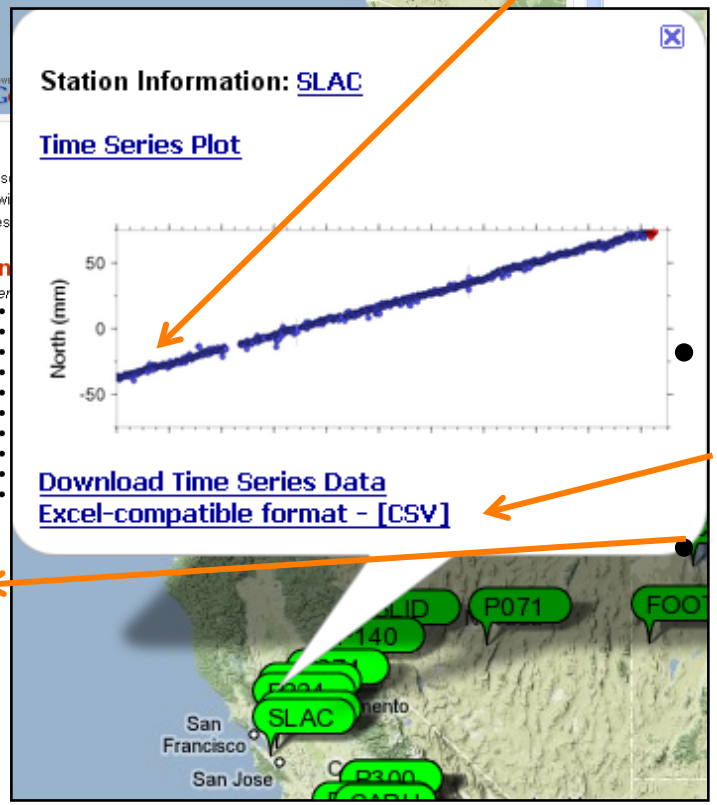
Educational resources using these stations

- *Coming soon...*

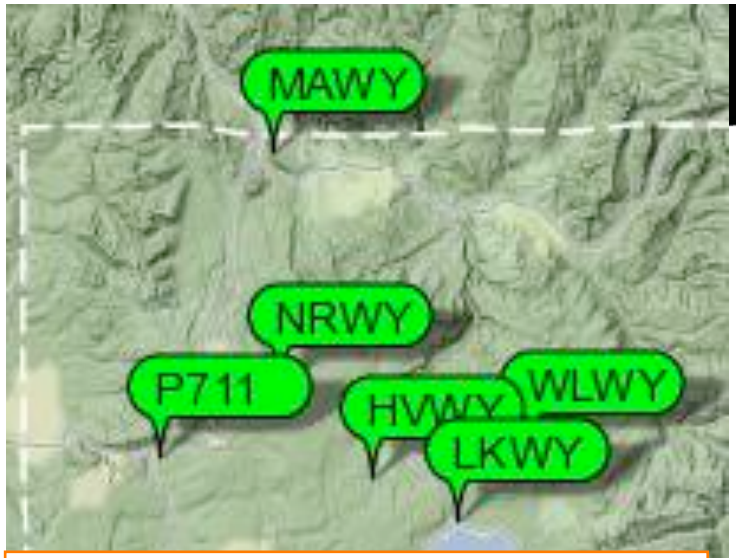
Help us make these pages better, please send us your comments and suggestions to olds @ unavco.org

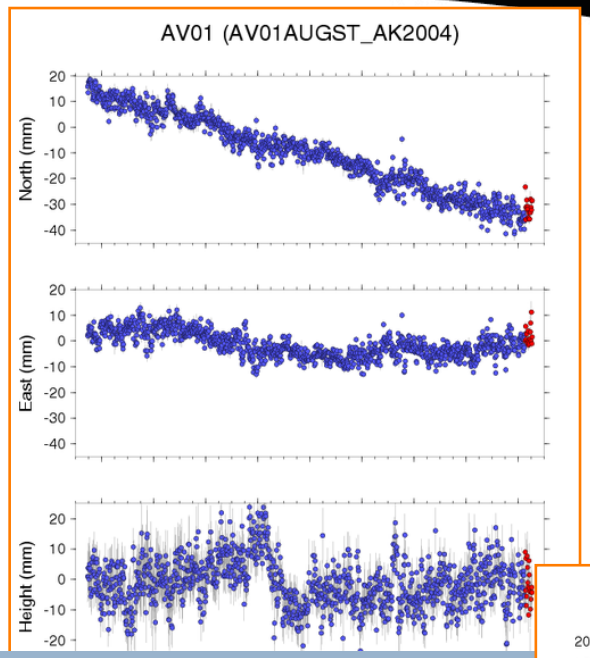
Selected GPS Stations

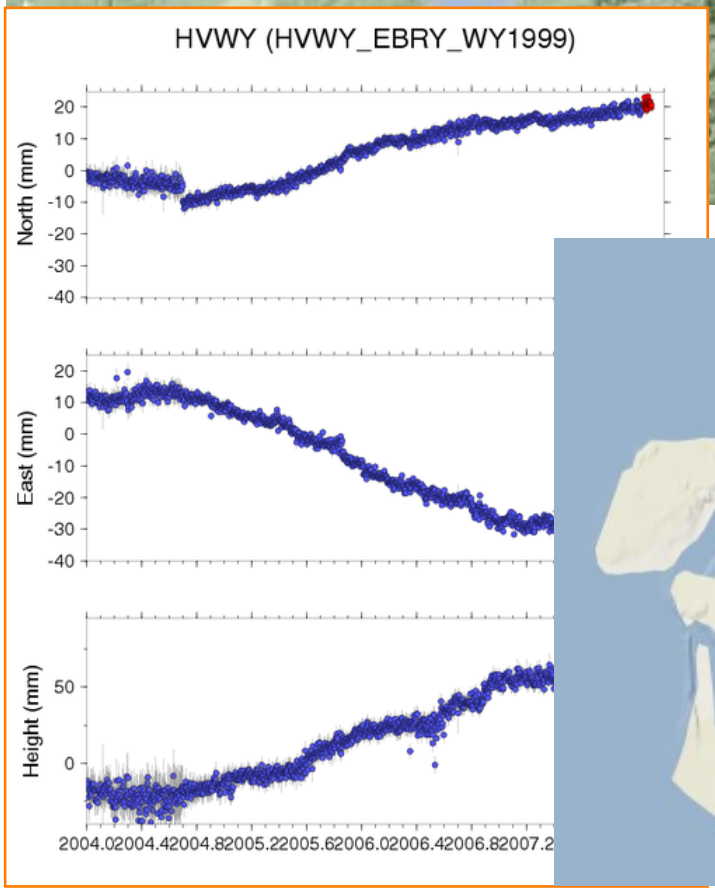


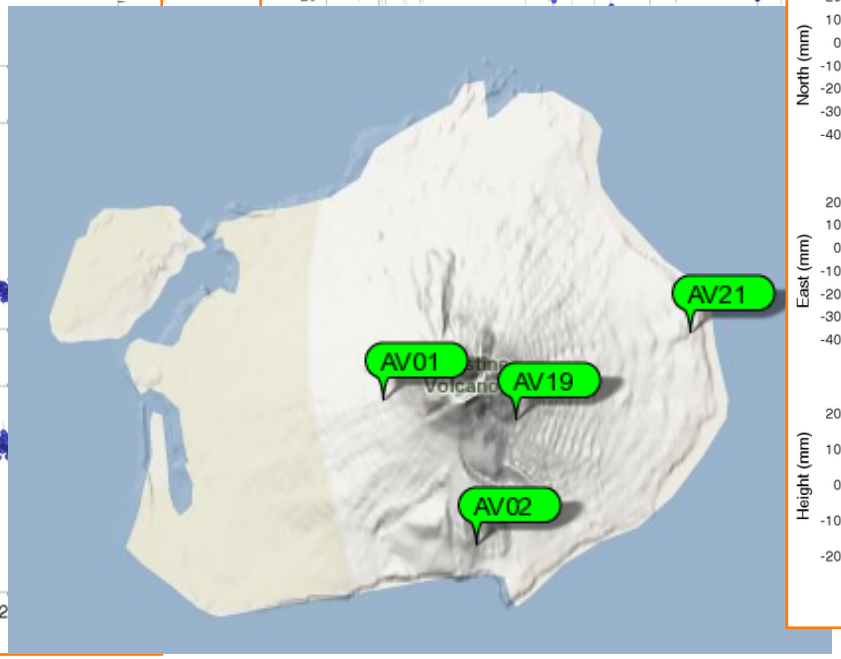


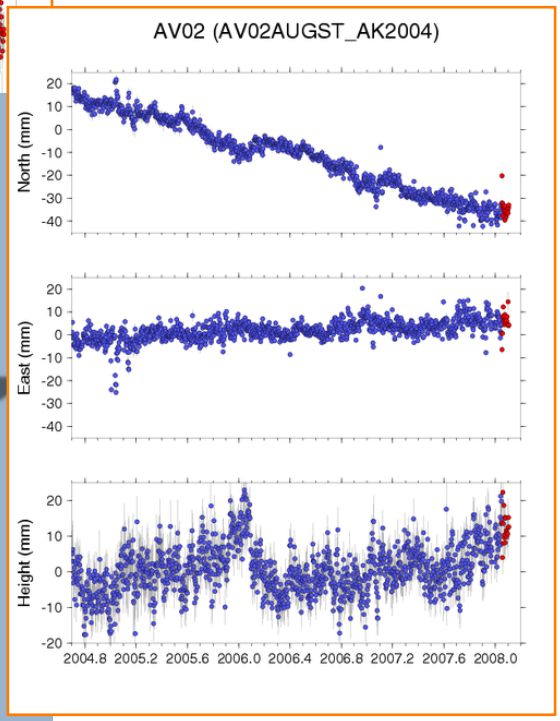
Students can explore data

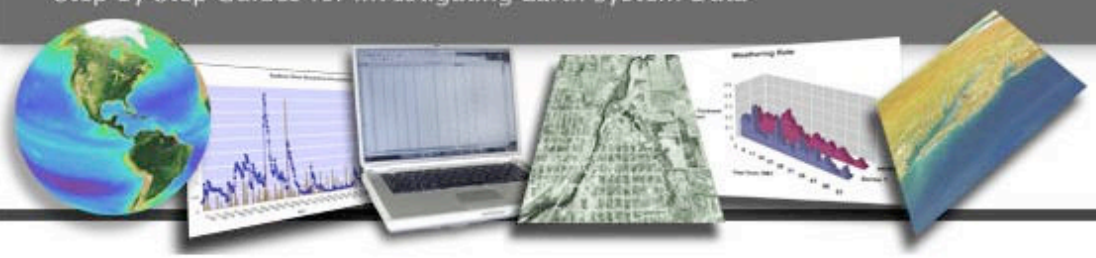












Earth Exploration Toolbook
How can I use the EET?
Chapters in the EET
Contribute a chapter
The EET Team
About EET

Photo by Keith Weller, ARS/USDA

What is the Earth Exploration Toolbook?

The Earth Exploration Toolbook is a collection of computer-based Earth science activities. Each activity, or chapter, introduces one or more data sets and an analysis tool that enables users to explore some aspect of the Earth system.

Step-by-step instructions in each chapter walk users through an example-a case study in which they access data and use analysis tools to explore issues or concepts in Earth system science. In the course of completing a chapter, users produce and analyze maps, graphs, images, or other data products. The ultimate goal of each activity is to build user's skills and confidence so they can use data to conduct their own investigations of the Earth system.

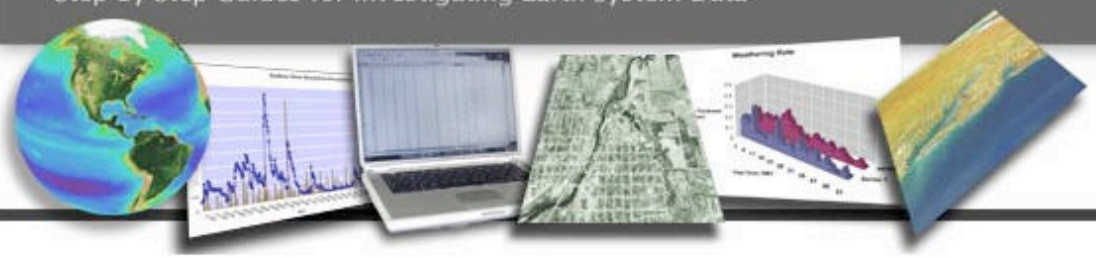
Register for an EET Workshop

Field Testing Opportunity

Next Page »

Earth Exploration Toolbook

Step-by-Step Guides for Investigating Earth System Data



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Next Page »

UNAVCO has 2 chapters:

1. **Making maps using the Jules Verne Voyager**
2. **Cascadia and EarthScope Data**

TERC NSF NSDL DLESE

Science Education Resource Center @ Carleton College

Exploring Subduction in the Cascadia Region Using EarthScope GPS and Seismic Data

Shelley Olds, UNAVCO, olds@unavco.org, Author
Susan Eriksson, UNAVCO, eriksson@unavco.org, Author
TBD, UNAVCO, email, Reviewer
Deborah Munson, TERC, dmunson@terc.edu, Contributor

Description

Learning about plate tectonics requires an excellent imagination. Tectonic plates move on

geologic time, something most people have a hard time comprehending, and a lot happens underneath the surface of the earth that can't be seen directly. Most plates move around 1-5 cm/yr, or, in more familiar units, 50 billionths of a mile per hour. This movement is essentially imperceptible to humans, however, 1-5 cm/yr translates to 10-50 km over a million years. This slow but relentless motion leads to soaring mountains, rumbling earthquakes, and exploding volcanoes.

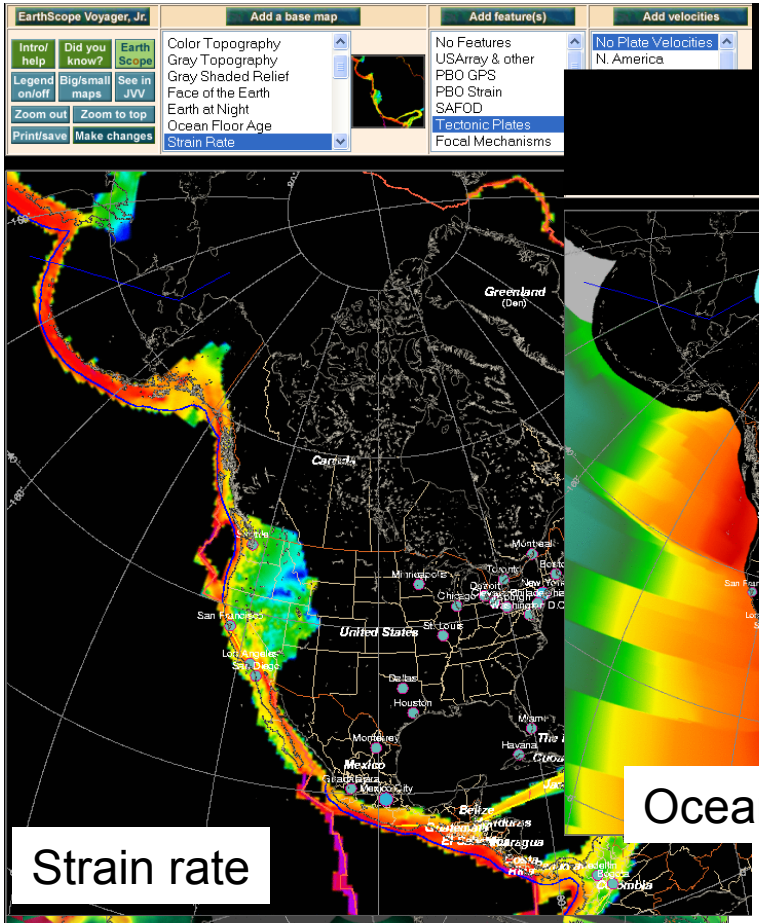
Global Positioning System (GPS) technology has progressed to the point that not only can we record the centimeters of motion happening over a year, but we can record the millimeters of motion happening every day. Large projects like EarthScope are facilitating the installation of networks of high-precision continuously recording GPS units, which means that we can see the intricate details of daily plate tectonic motion. GPS units attached to the ground allow us to constantly track the motion of that particular spot with millimeter-scale accuracy.

n this chapter, you will be using GPS data from the Plate Boundary Observatory (PBO) to monitor the motion caused by the subduction of the Juan de Fuca plate under the North American plate in the Pacific Northwest. You will also look at the distribution of earthquakes in the context of plate tectonics. The subduction zone creates much of the scenic landscape the area is know for such as the Cascade and Coast Range Mountains, as well as being responsible for large earthquakes and volcanic eruptions. You will learn how to access and download GPS data from UNAVCO, map GPS velocity vectors either by hand or using a graphics program (ImageJ), and interpret how the velocity vectors and earthquake distribution relates to the regional geology of the Pacific Northwest. Users will also learn about a newly recognized geologic process, Episodic Tremor and Slip (ETS, see the EarthScope OnSite newsletter Winter/Spring 2007), which is a recently recognized subduction zone phenomena in the Pacific Northwest. The inclusion of ETS makes this an exemplary case study by which to convey to students the questioning nature of science and the process of new theory development.

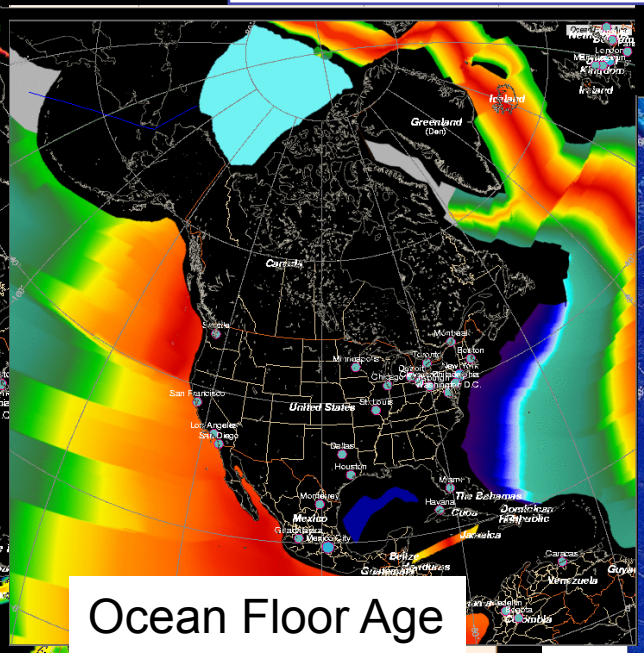
EarthScope is a national Earth Science program funded by the National Science Foundation (NSF) to study the structure and evolution of the North American continent and understand processes controlling earthquakes and volcanoes. EarthScope is building three observatories: The Plate Boundary Observatory (PBO) is installed by UNAVCO (who is funded by NSF and NASA), the USArray is installed by the Incorporated Research Institutions for Seismology (IRIS), and the San Andreas Fault Observatory at

Compare datasets

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

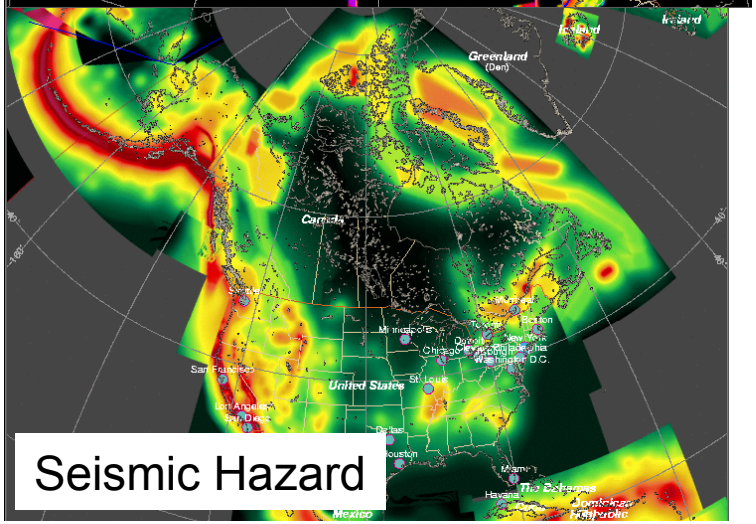


Strain rate

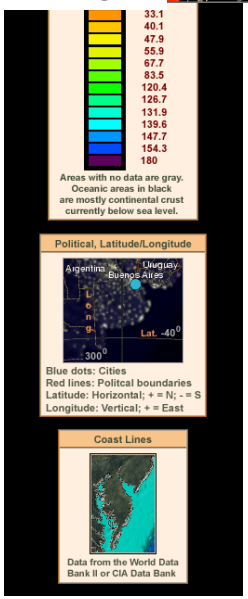


Ocean Floor Age

Face of the Earth & Relief



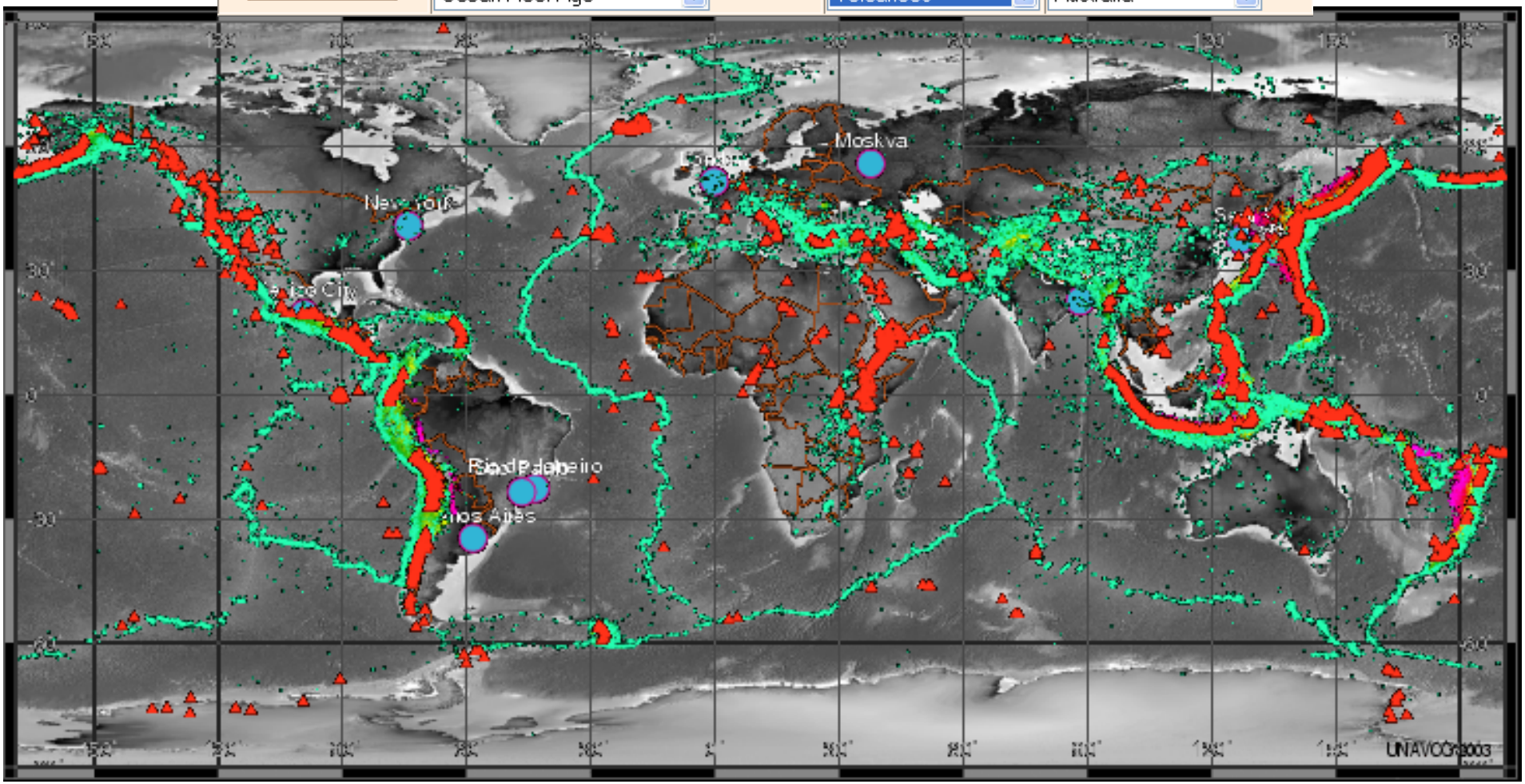
Seismic Hazard



Color Topography

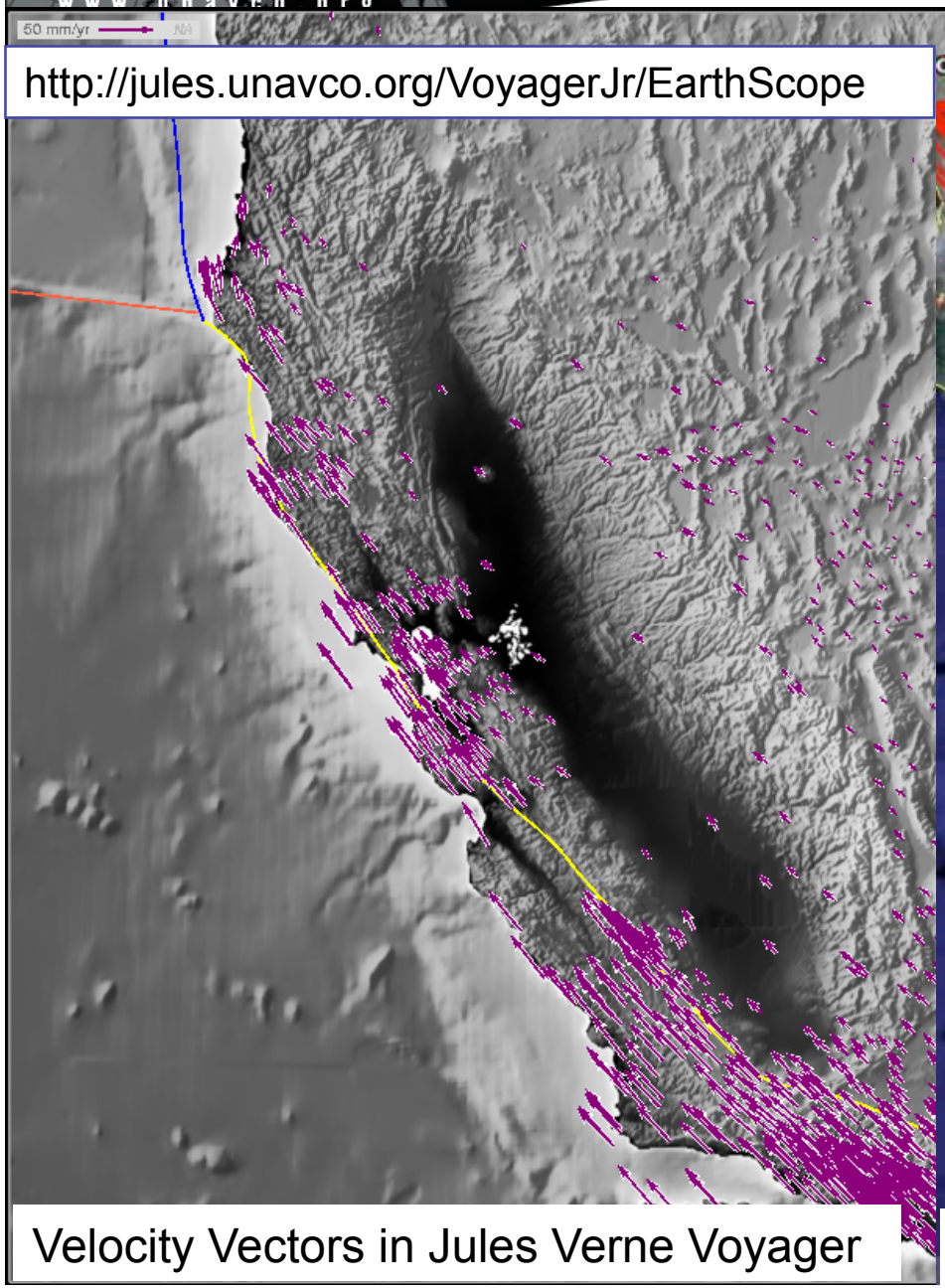
Investigate spatial relationships

http://jules.unavco.org/VoyagerJr/Earth



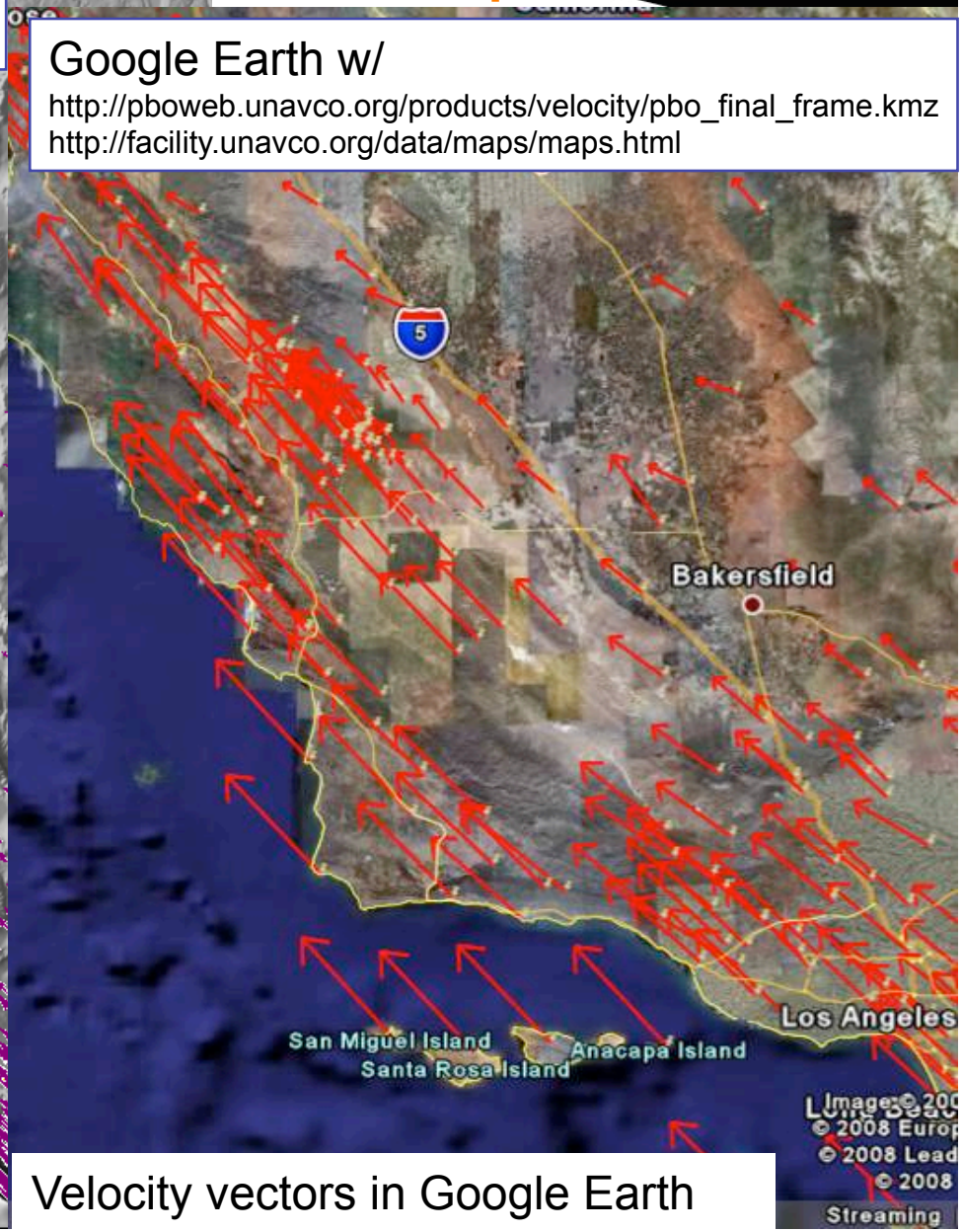
Use GPS velocity vectors to study plate motion

http://jules.unavco.org/VoyagerJr/EarthScope



Velocity Vectors in Jules Verne Voyager

Google Earth w/
http://pboweb.unavco.org/products/velocity/pbo_final_frame.kmz
http://facility.unavco.org/data/maps/maps.html



Velocity vectors in Google Earth

UNAVCO
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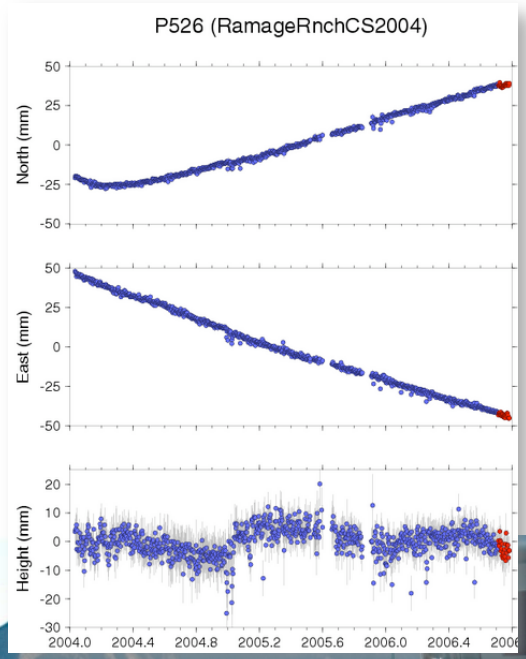
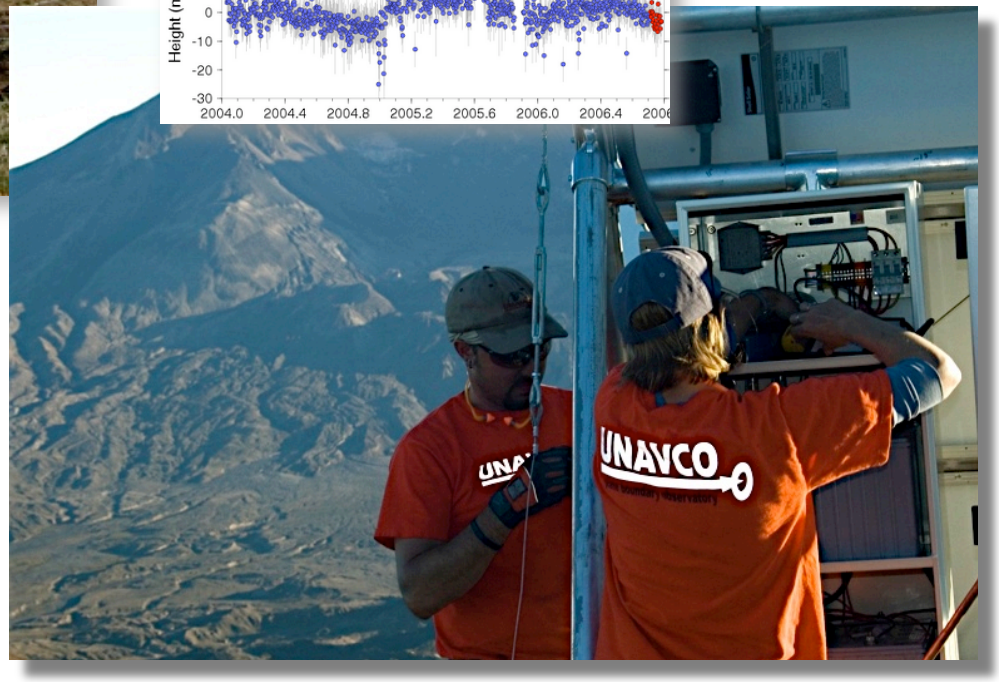
GPS Stations





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

URLs

- **NSTA Short Course Materials**
  - http://www.unavco.org:8080/cws/UsingData/
- **UNAVCO Data for Educators**
  - http://www.unavco.org/edu_outreach/data.html
- **UNAVCO Educations Resources**
  - http://www.unavco.org:8080/cws/modules/
- **Jules Verne Voyage map tools**
  - http://www.unavco.org/edu_outreach/maptools.html
    - http://jules.unavco.org/VoyagerJr/Earth
    - http://jules.unavco.org/VoyagerJr/EarthScope
- **Google Earth w/**
  - http://pboweb.unavco.org/products/velocity/pbo_final_frame.kmz
  - http://facility.unavco.org/data/maps/maps.html
- **IDV GEON**
  - http://geon.unavco.org/unavco/IDV_for_GEON.html
- **EET Chapters**
  - http://www.carleton.edu/serc/eet