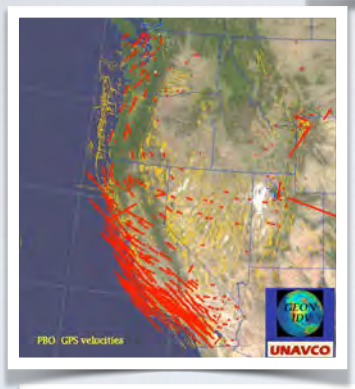
UNAVCO

EXPLORE PLATE TECTONICS & *MORE* THROUGH GPS DATA

Shelley Olds, UNAVCO
April 12, 2018
NGSS Webinar

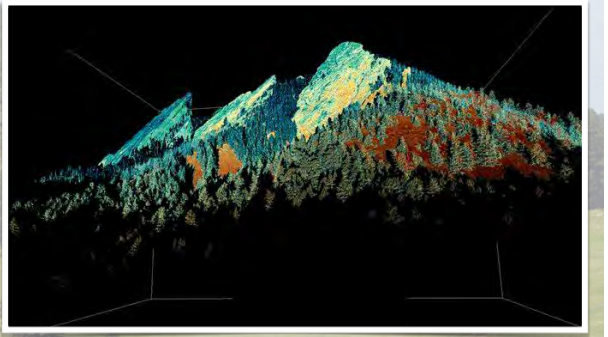
Today's Outline

- Central question: How do we know the tectonic plates are still moving? -- What evidence do we have to answer this question?
- UNAVCO Overview
- Education & Community Engagement Resources
- Activities & Modules w/ NGSS
  - High level explorations
  - Diving into the data

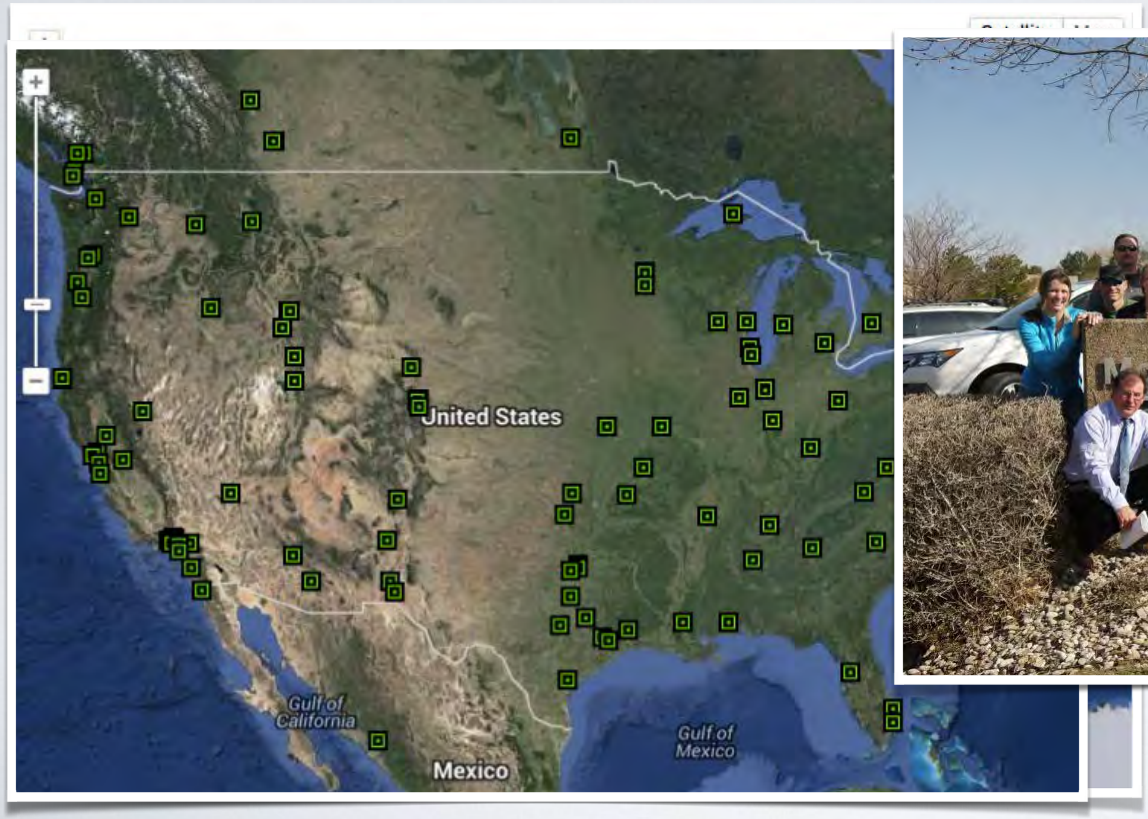


UNAVCO

a non-profit university-governed consortium, facilitating geoscience research and education using geodesy



UNAVCO = Community + Facility

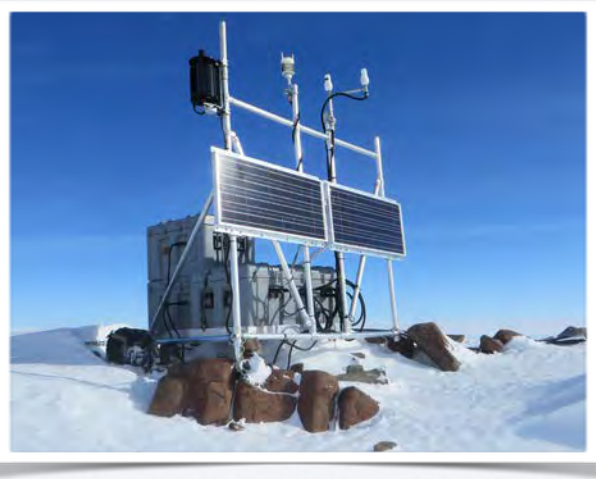


UNAVCO Program Areas

Geodetic Data Services

D. Zietlow

Geodetic Infrastructure



N. Bayou

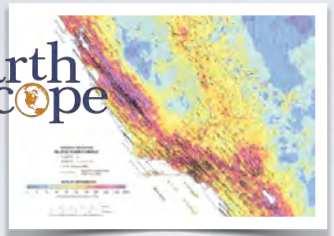
Education & Community Engagement

C. C. Edmunds

UNAVCO

Science Discoveries using Geodesy

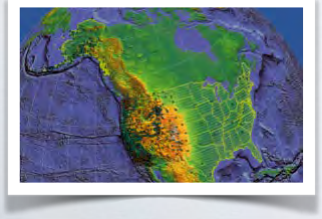
Crustal Kinematics and Mantle Dynamics



Understanding mantle and plate motions to enhance resilience to earthquakes, tsunamis and volcanic eruptions

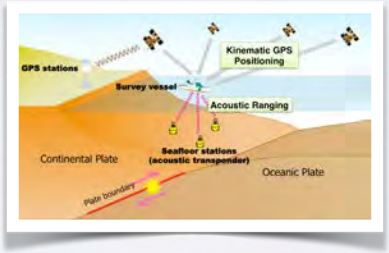
Coseismic Deformation and GPS Seismology

Earthquake and tsunami early warning to save lives



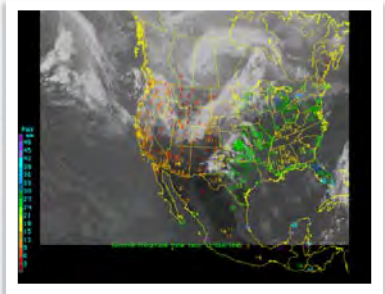
Hydrogeodesy

Helps with planning emergency response and for engineering structures in tsunami-prone areas



GPS Meteorology

Improve hurricane forecasting and severe storm tracking



Glaciology

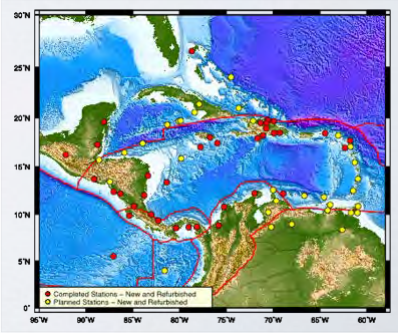
Assess ice mass, forecast melting and estimate climate

Volcanic Deformation

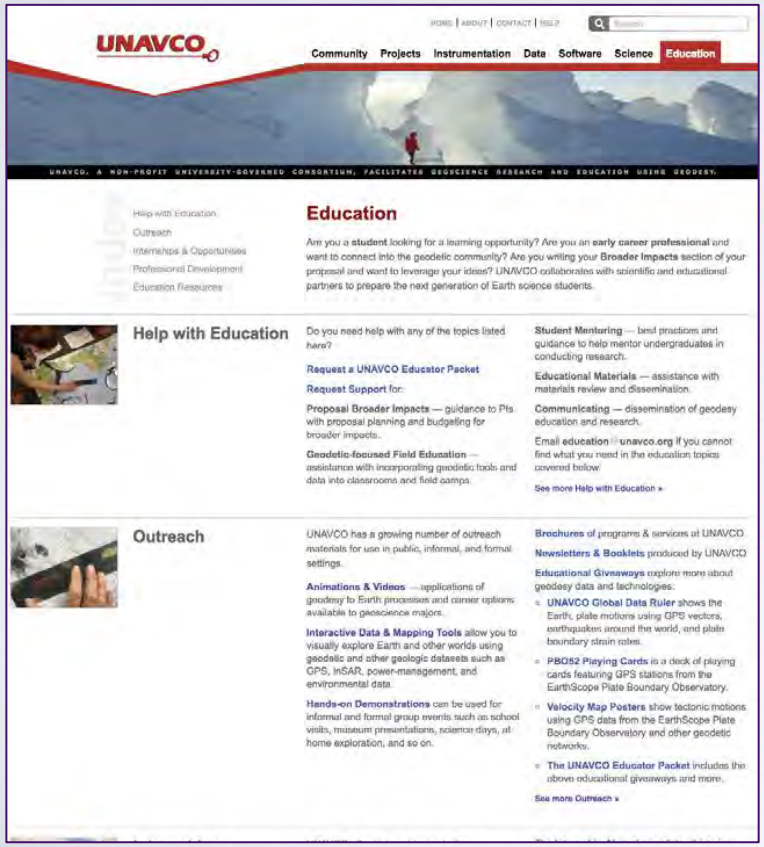
Decipher surface rise or fall related to magma movement with volcano early warning benefits

Earthquake Hazards

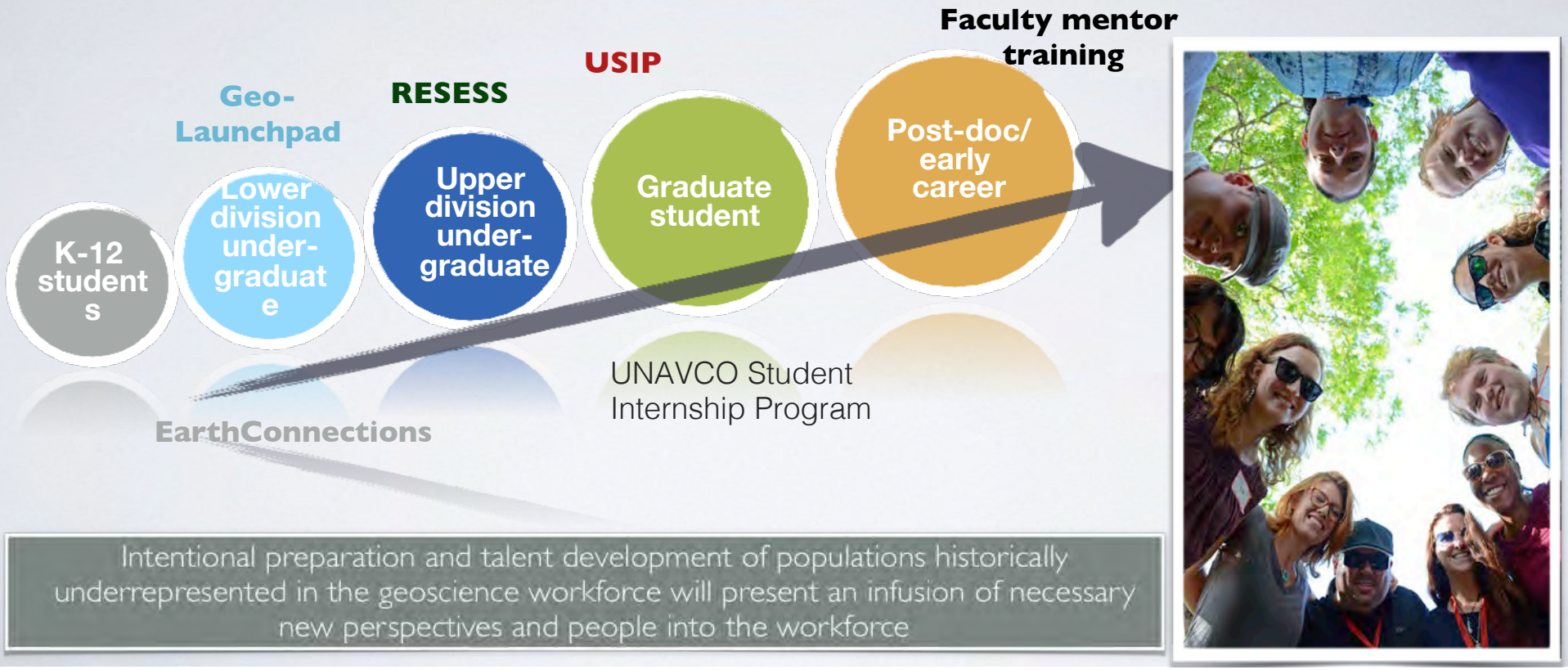
Assess earthquake hazard to mitigate future losses



Education & Community Engagement Resources



Student Opportunities & Geo-workforce Development



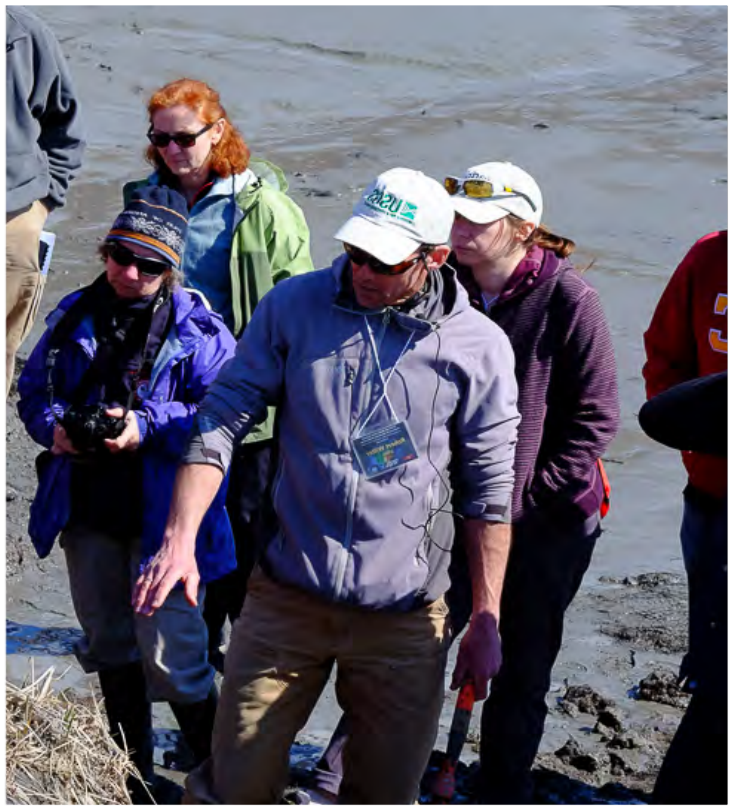
Intentional preparation and talent development of populations historically underrepresented in the geoscience workforce will present an infusion of necessary new perspectives and people into the workforce

Mentoring Resources

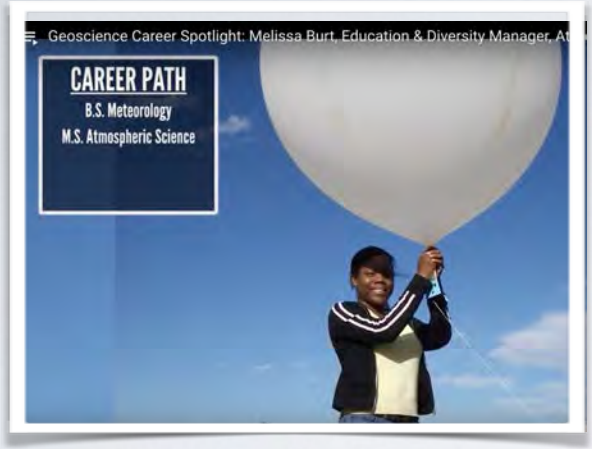
Access resources for working effectively with students from diverse backgrounds.

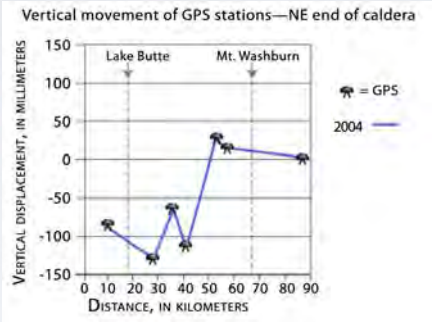
Short Courses & Webinars: Content for the classroom, Communicating Science, & Technical Tools

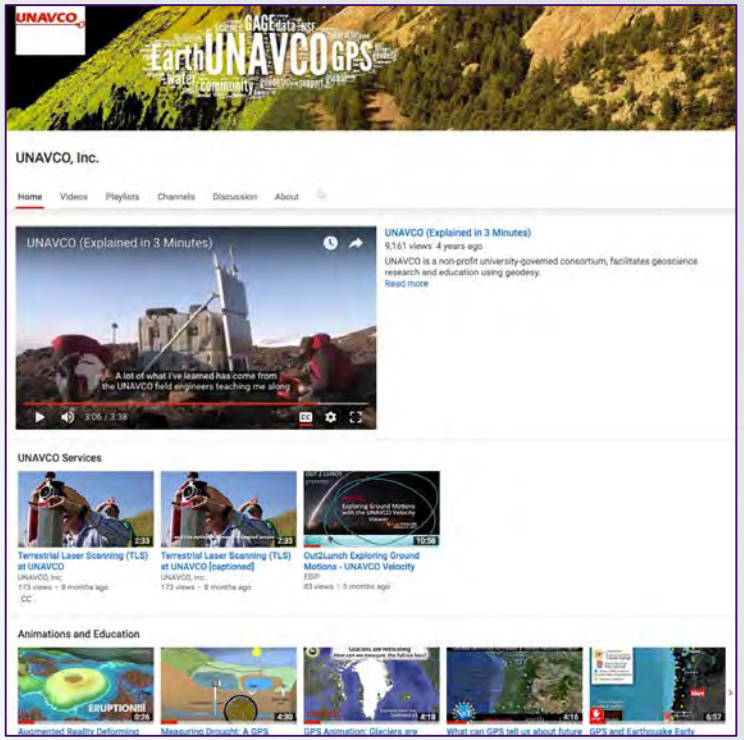
- Undergraduate & Secondary-level
  - Using high resolution topography, UAVs, and GPS in undergraduate field education
  - Using Recreational Drones for STEM Explorations
  - Using GPS data in undergraduate courses
- Communicating Science
  - Communicating Science for Impact
  - Communicating Science to the Public
- Geodesy Technical Tools
  - InSAR Processing and Theory
  - High Resolution Topography and 3D Imaging



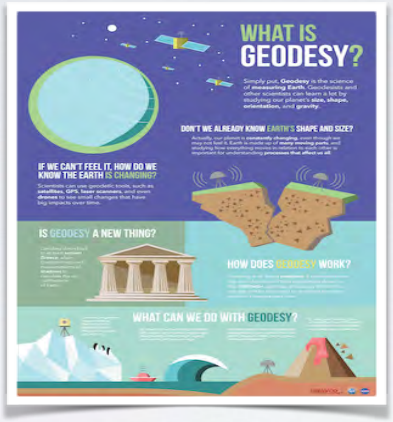
YouTube: Animations & Career Spotlights

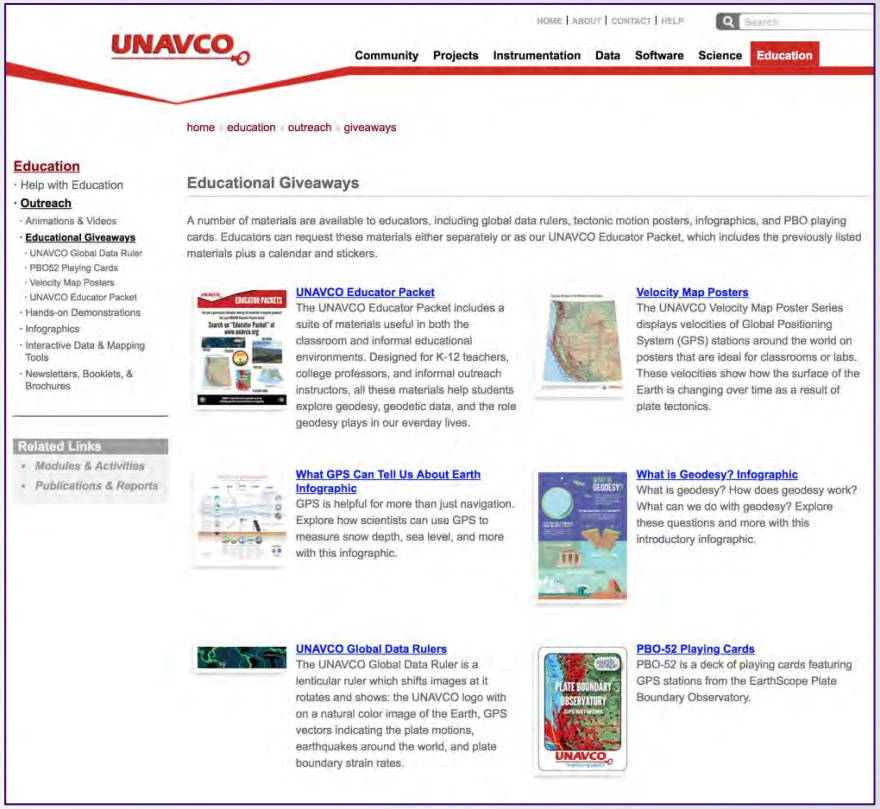






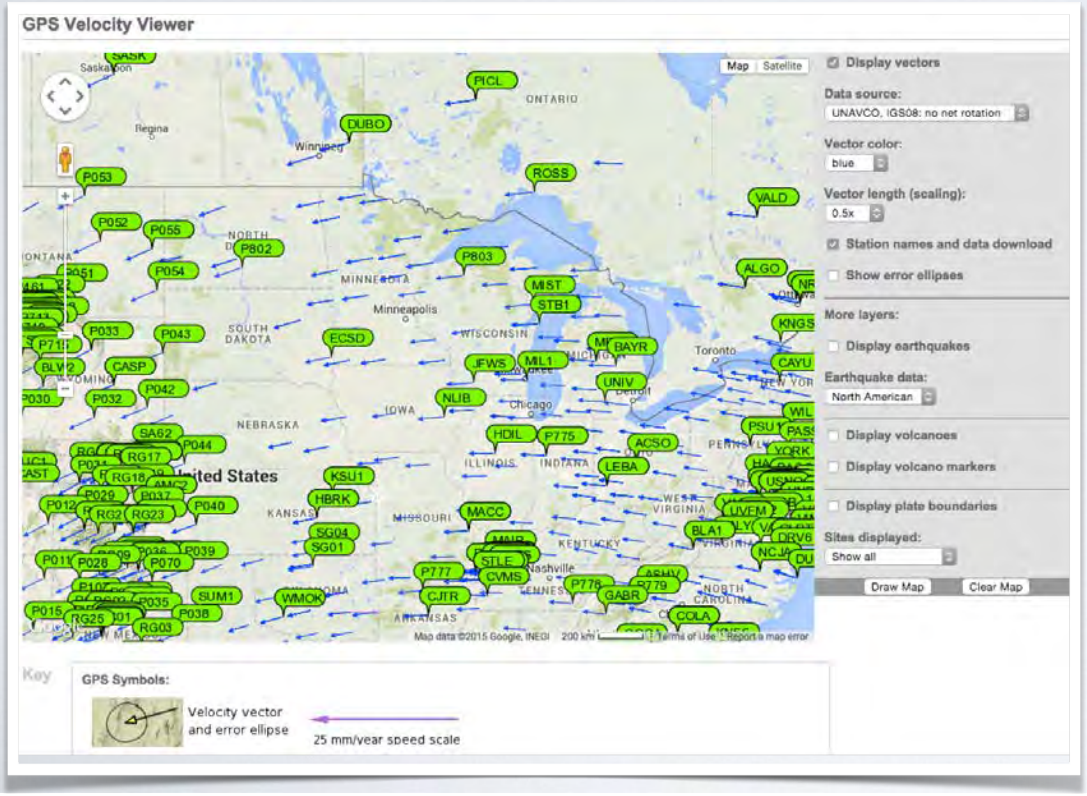
Posters & Infographics



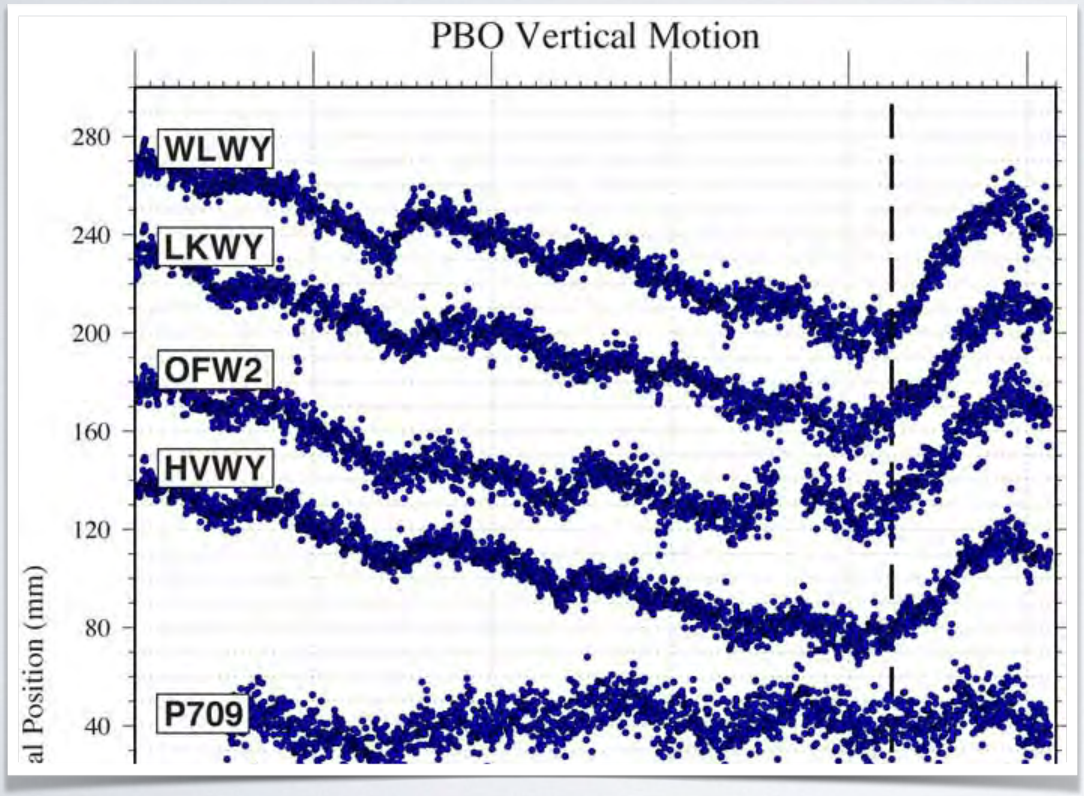


Interactive Data & Mapping Tools

- GPS Velocity Viewer

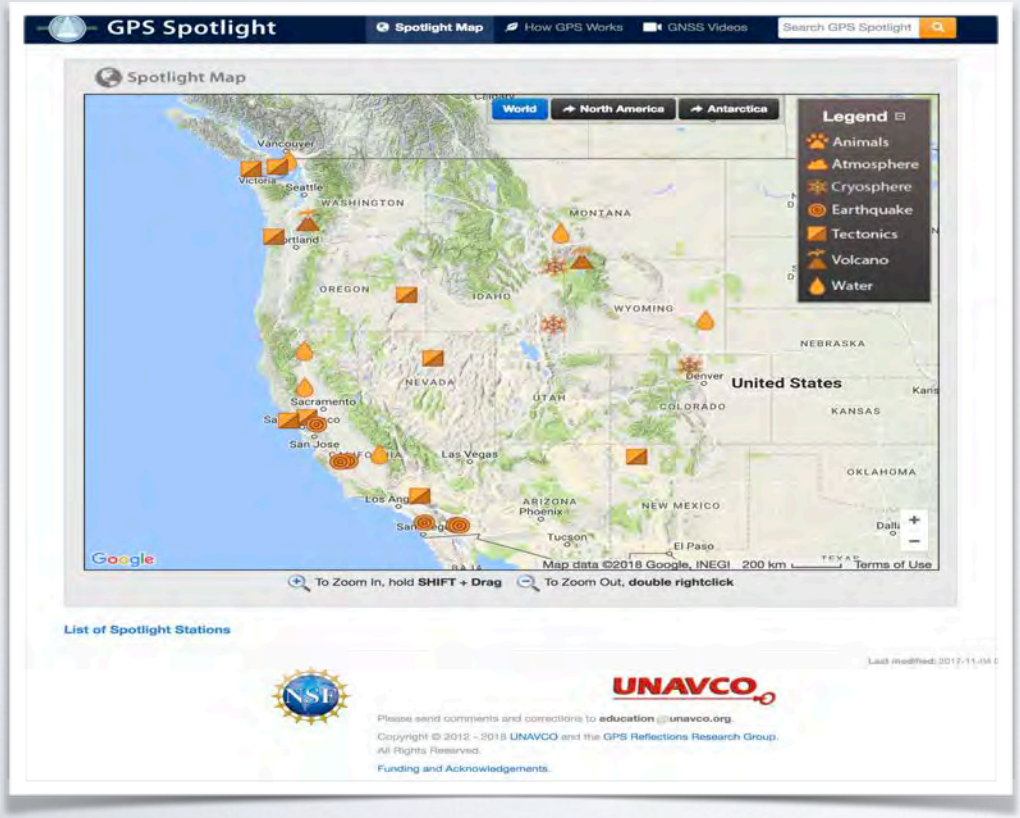


Interactive Data & Mapping Tools

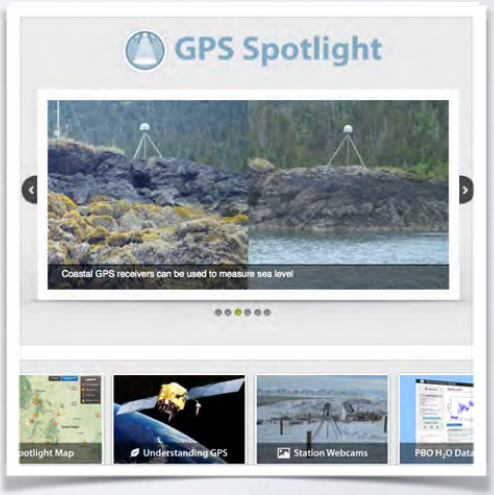


- GPS Velocity Viewer
- Processed GPS data formatted for ease of use

Interactive Data & Mapping Tools



- GPS Velocity Viewer
- Processed GPS data formatted for ease of use
- GPS Spotlight



Interactive Data & Mapping Tools

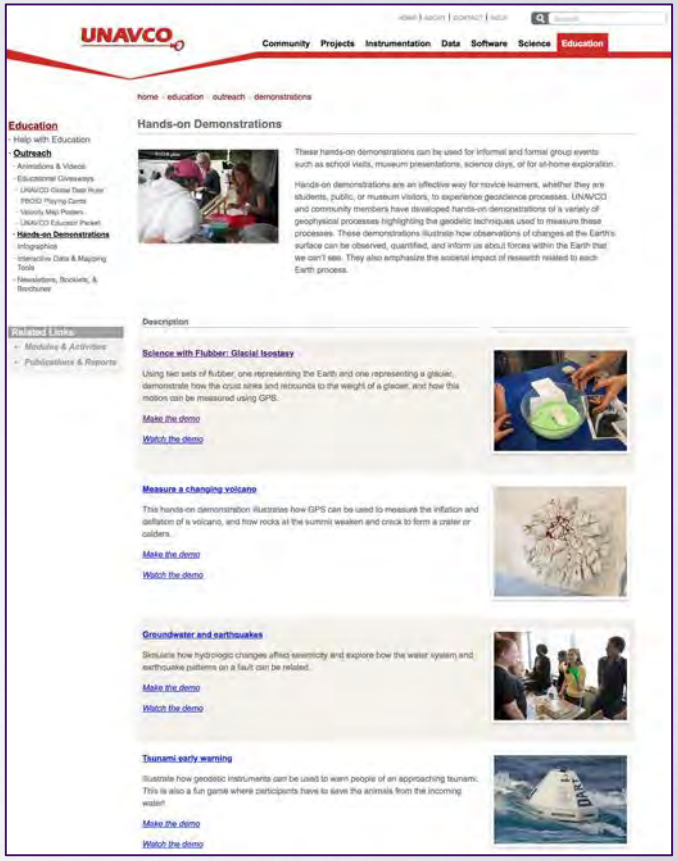
- GPS Velocity Viewer
- Processed GPS data formatted for ease of use
- GPS Spotlight
- Power through the Night

Hands-on Demonstrations

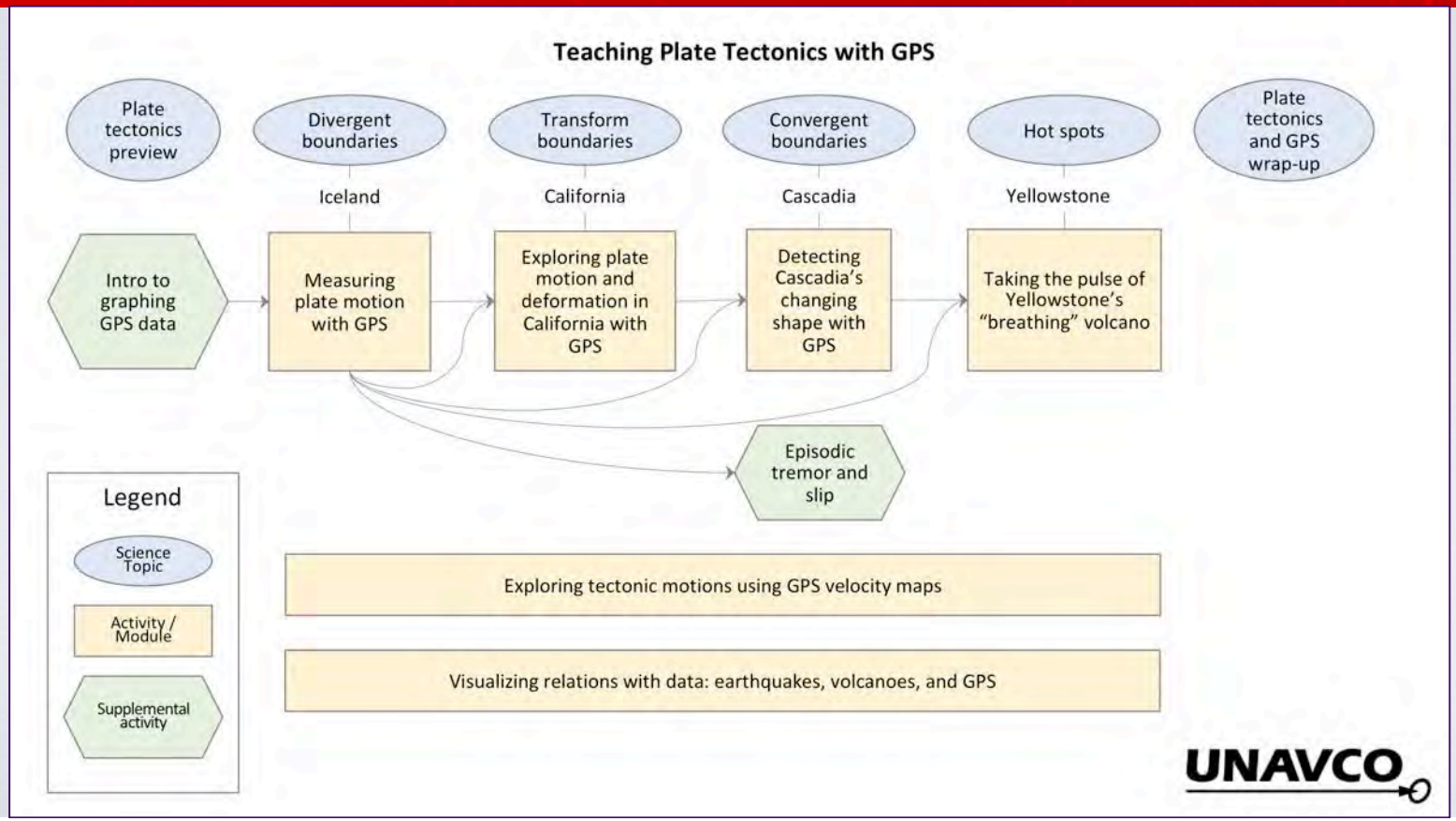
Make tectonic plates converge

Measure a changing volcano

Science with Flubber: Glacial Isostasy



Activities & Modules w/ NGSS

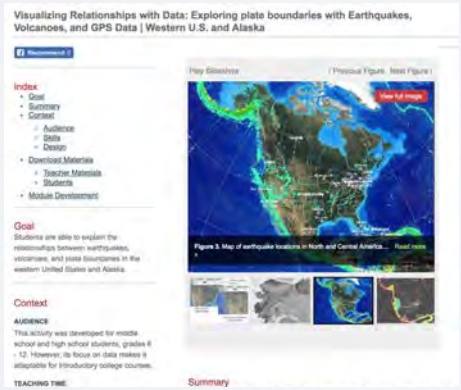


Activities & Modules w/ NGSS

- High level explorations using data visualizations
- Detailed data dive through process of science
- Connecting multiple lines of evidence: in-depth project-based modules

High level explorations using data visualizations

- Poster based - Exploring Tectonic Motions of Alaska & Western United States
- Online tool based - Visualizing Relationships with Data: EarthScope Voyager Jr or Velocity Viewer



Science & Engineering Practices Emphasized:

- Analyzing and interpreting data
- Using mathematics and computational thinking
- Constructing explanations (for science) and designing solutions (for engineering)

Crosscutting Concepts Emphasized:

- **Patterns:** Graphs, charts, and images can be used to identify patterns in data. (MS-ESS3-2)
- **Scale, proportion, and quantity:** Time, space, and energy phenomena can be observed at various scales using models to study systems that are too large or too small. (MS-ESS2-2)
- **Stability and change:** Change and rates of change can be quantified and modeled over very short or very long periods of time. Some system changes are irreversible.

Disciplinary Core Ideas Emphasized:

ESS2.B: Plate Tectonics and Large-Scale System Interactions: Plate tectonics is the unifying theory that explains the past and current movements of the rocks at Earth's surface and provides a framework for understanding its geologic history. Plate movements are responsible for most continental and ocean-floor features and for the distribution of most rocks and minerals within Earth's crust. Maps of ancient land and water patterns, based on investigations of rocks and fossils, make clear how Earth's plates have moved great distances, collided, and spread apart. [Grade 8]

ESS3.B: Natural Hazards: Mapping the history of natural hazards in a region, combined with an understanding of related geologic forces can help forecast the locations and likelihoods of future events. [Grade 8]

ESS3.B: Natural Hazards: Natural hazards and other geological events have shaped the course of human history by destroying buildings and cities, eroding land, changing the course of rivers, and reducing the amount of arable land. [Grade 12]

Detailed data dive through process of science

- Measuring plate motion with GPS: Iceland
- Exploring plate motion and deformation in California with GPS
- Episodic tremor and slip: The Case of the Mystery Earthquakes
- *supporting*: Introduction to graphing GPS data - Lessons on Plate Tectonics

Science & Engineering Practices
Emphasized:
- Analyzing and interpreting data
- Using mathematics and computational thinking
- Constructing explanations (for science) and designing solutions (for engineering)
- Engaging in argument from evidence

Embedded:
- Developing and using models
- Planning and carrying out investigations
- Obtaining, evaluating, and communicating information

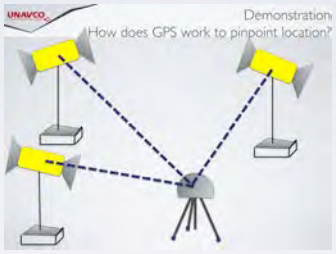
Crosscutting Concepts
Emphasized:
- **Patterns:** Graphs, charts, and images can be used to identify patterns in data. (MS-ESS3-2)
- **Scale, proportion, and quantity:** Time, space, and energy phenomena can be observed at various scales using models to study systems that are too large or too small. (MS-ESS2-2)
- **Stability and change:** Change and rates of change can be quantified and modeled over very short or very long periods of time. Some system changes are irreversible.

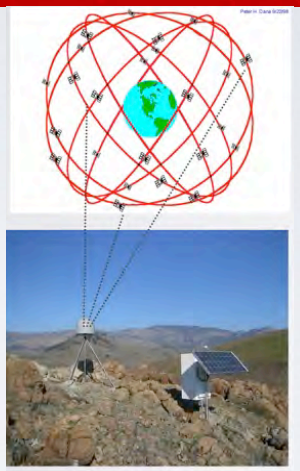
Embedded:
- Cause and effect
- Energy and matter
- Stability and change
- Influence of science, engineering, and technology on society and the natural world

Detailed data dive through process of science

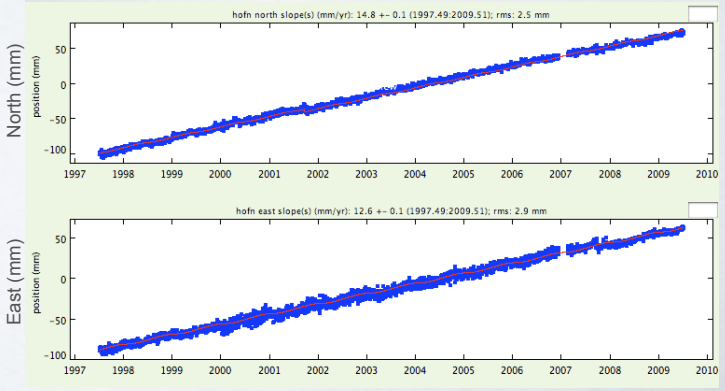
Basic Outline

- The data collection instrument: GPS
  - How does GPS work to pinpoint a location on Earth?
- Exploring the data: What can GPS data tell us about ...
  - Looking at the data ... as numbers & as time series plots graphs
  - Analyzing & interpreting the data

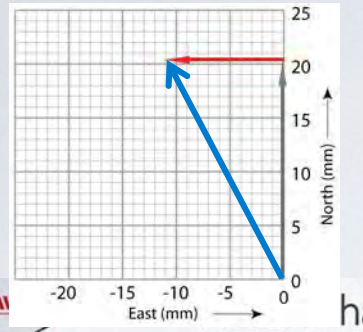




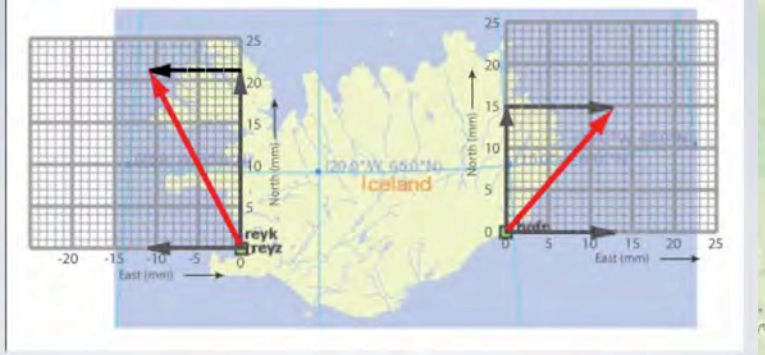
Date	North (mm)	East (mm)	Vertical (mm)
1/1/2004	-37.67	36.57	2.33
1/2/2004	-38.04	35.73	5.63
1/3/2004	-37.16	35.83	4.69
1/4/2004	-37.34	36.34	5.36
1/5/2004	-37.59	36.44	9.11
…	…	…	…
1/1/2005	-9.43	9.63	2.36
1/1/2006	16.48	-18.09	7.35
1/1/2007	45.98	-43.42	-6.43



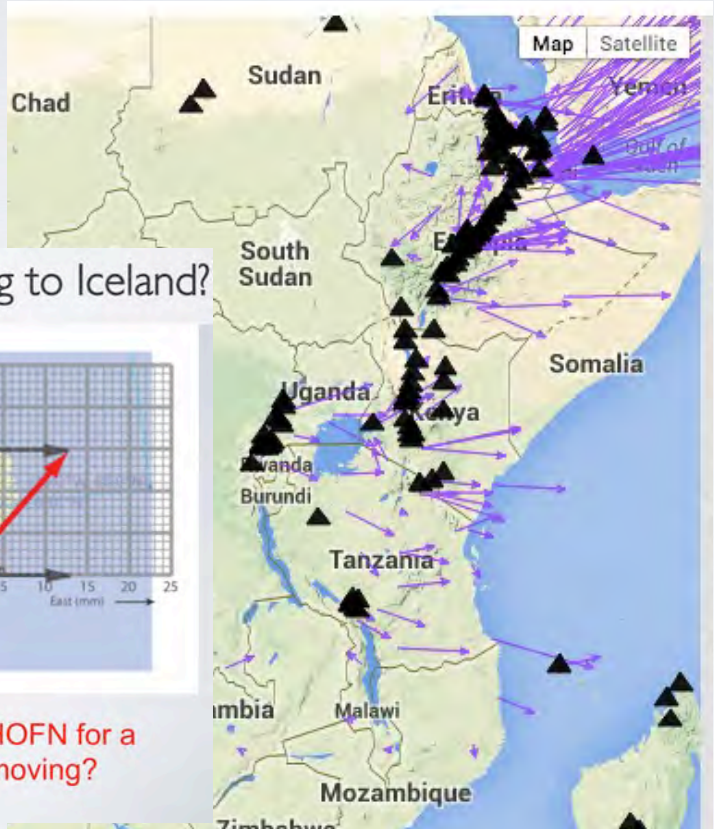
Detailed data dive through process of science



happening to Iceland?



Extra credit – – if you were sitting at HOFN for a very long time, how would REYK be moving?



Basic Outline (continued)

- Creating vector plots from the data
- Displaying vectors on a map
- Interpreting the vectors ... in the context of plate tectonics

- Extending to more settings

In-depth project-based modules w/ multiple lines of evidence

- Taking the pulse of Yellowstone's "breathing" volcano: Problem-based learning in America's first national park
- Detecting Cascadia's changing shape with GPS

Science & Engineering Practices
Emphasized:
- Analyzing and interpreting data
- Using mathematics and computational thinking
- Constructing explanations (for science) and designing solutions (for engineering)
- Engaging in argument from evidence

Embedded:
- Developing and using models
- Planning and carrying out investigations
- Obtaining, evaluating, and communicating information

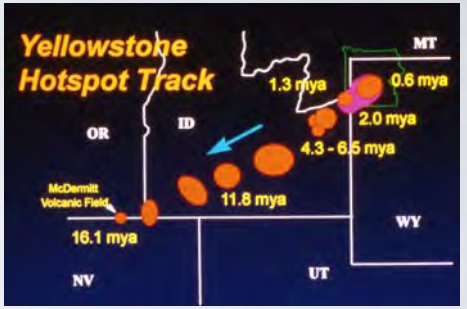
Crosscutting Concepts
Emphasized:
- **Patterns:** Graphs, charts, and images can be used to identify patterns in data. (MS-ESS3-2)
- **Scale, proportion, and quantity:** Time, space, and energy phenomena can be observed at various scales using models to study systems that are too large or too small. (MS-ESS2-2)
- **Stability and change:** Change and rates of change can be quantified and modeled over very short or very long periods of time. Some system changes are irreversible.

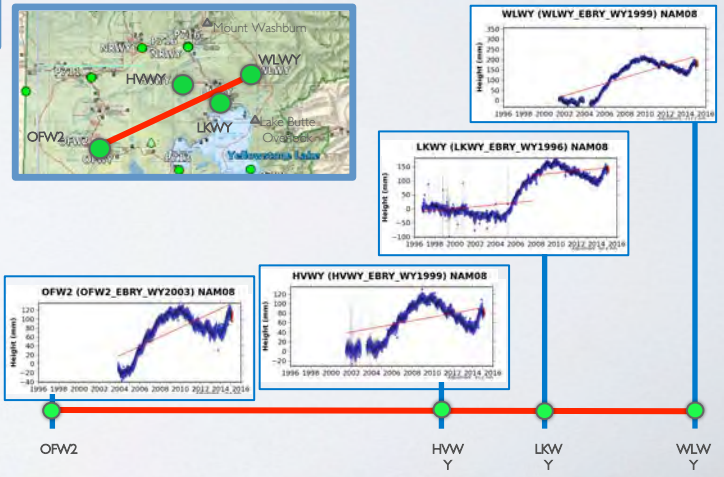
Embedded:
- Cause and effect
- Energy and matter
- Stability and change
- Influence of science, engineering, and technology on society and the natural world

In-depth project-based modules w/ multiple lines of evidence

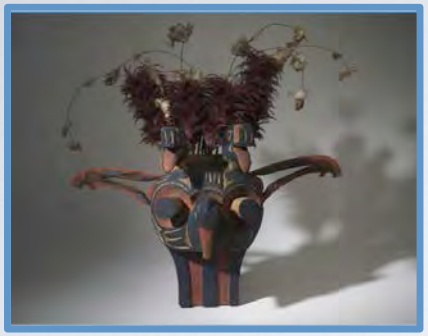
Taking the Pulse of Yellowstone's "Breathing" Volcano

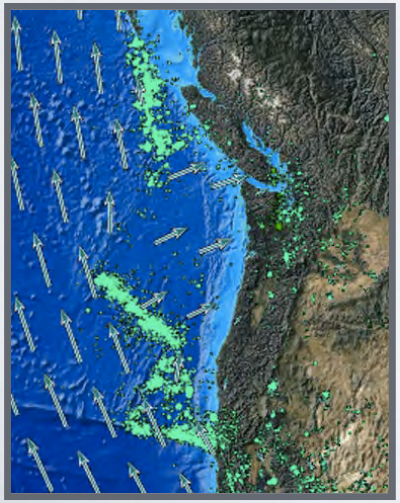
- Where can the Park place a safe long-term research station?
- Monitoring Volcanic Activity
- Jigsaw
  - History of eruption
  - Current seismicity
  - Hydrothermal events
  - Ground deformation.

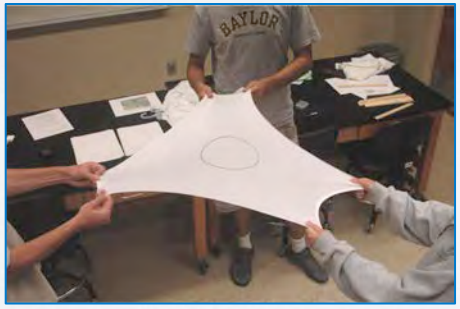




In-depth project-based modules w/ multiple lines of evidence



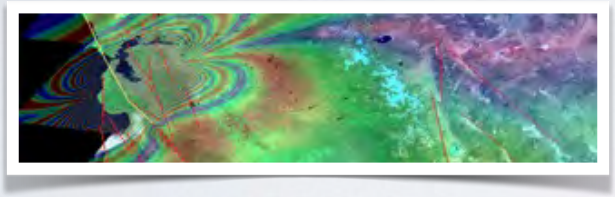




Detecting Cascadia's changing shape with GPS

- Jigsaw:
  - Ghost forest
  - Orphan tsunami
  - Eye-witness accounts
  - Physical evidence
- Hands on deformation and strain
- Determining strain graphically
- Societal relevance

Learning Modules from GEodesy Tools for Societal Issues (GETSI)



Geodetic data and quantitative skills applied to societally important issues

Introductory-level

- **Changing Ice Mass and Sea Level** **(Sea level altimetry, InSAR, ICESat, GRACE, vertical GPS)**
- **Surface Process Hazards** **(topographic maps, slope and aspect maps, Lidar, digital elevation models, InSAR, aerial imagery, and precipitation data)**

Majors-level

- Measuring Water Resources with GPS, Gravity, and Traditional Methods
- Analyzing High Resolution Topography with TLS and SfM
- Imaging Active Tectonics with InSAR and LiDAR data
- GPS, Strain, and Earthquakes

Thank You!

education@unavco.org