



EXPLORE PLATE TECTONICS & MORE THROUGH GPS DATA

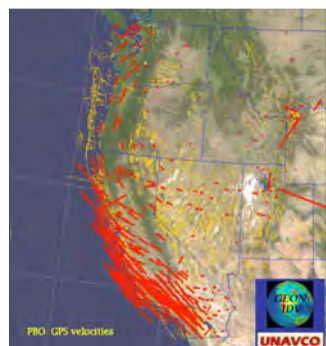
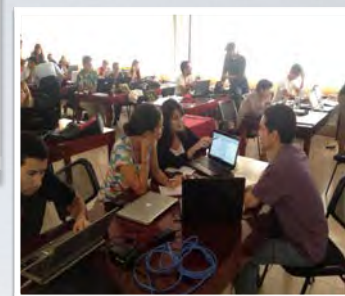


Shelley Olds, UNAVCO
April 12, 2018
NGSS Webinar



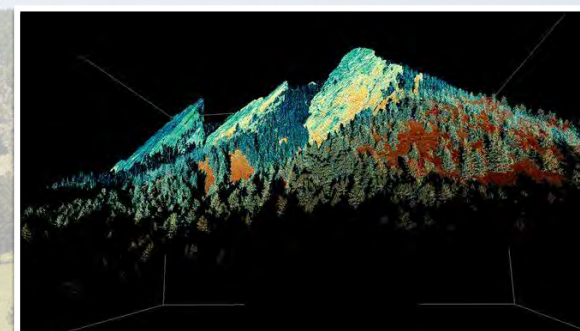
Today's Outline

- 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



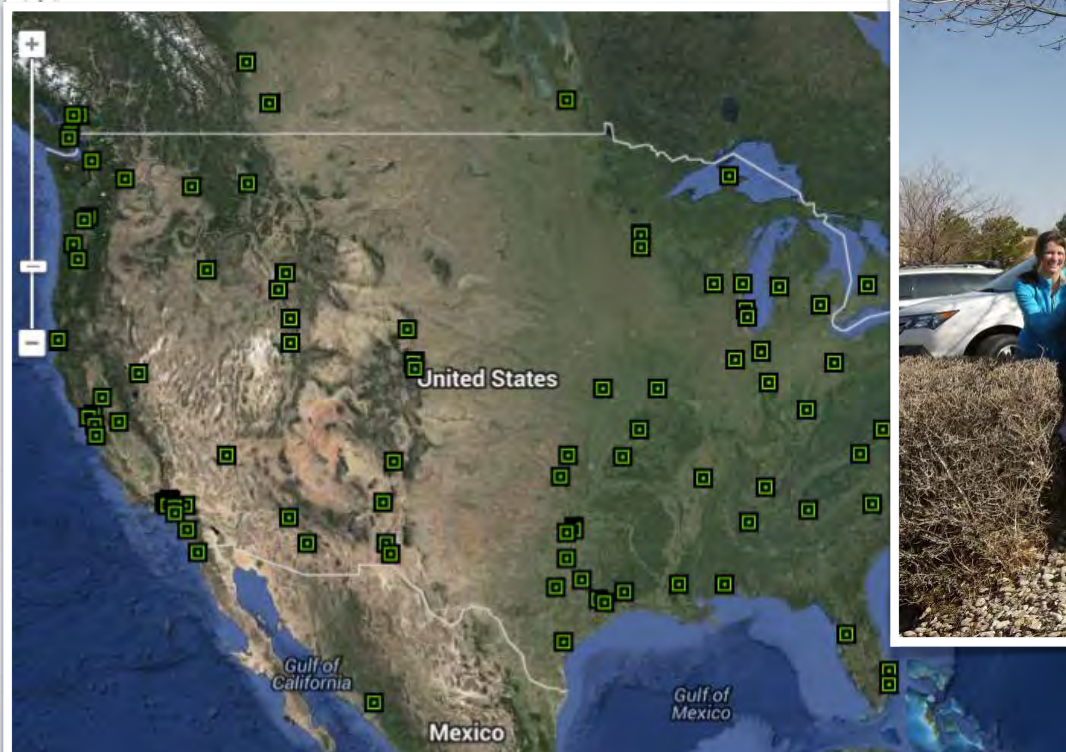
UNAVCO

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





UNAVCO = Community + Facility



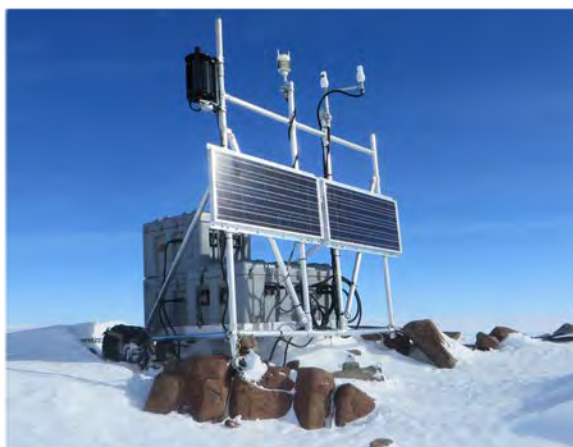
UNAVCO Program Areas

Geodetic Data Services



D. Zietlow

Geodetic Infrastructure



N. Bayou

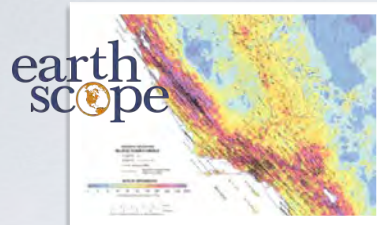
Education & Community Engagement



C. C. Edmunds

Science Discoveries using Geodesy

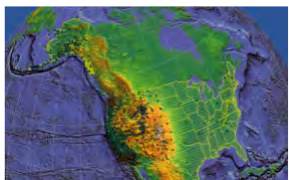
Crustal Kinematics and Mantle Dynamics



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

Coseismic Deformation and GPS Seismology

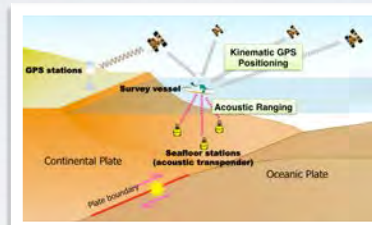
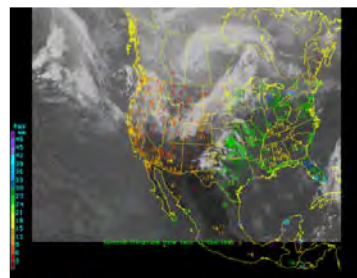
Earthquake and tsunami early warning to save lives



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

GPS Meteorology

Improve hurricane forecasting and severe storm tracking



Volcanic Deformation

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

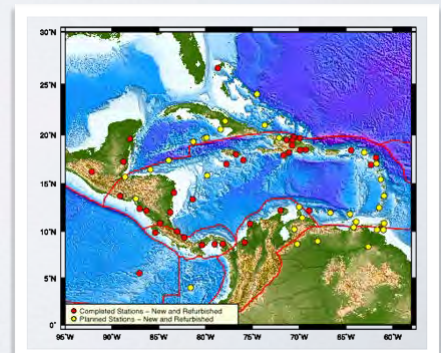


Glaciology
Assess ice mass, forecast melting and estimate climate

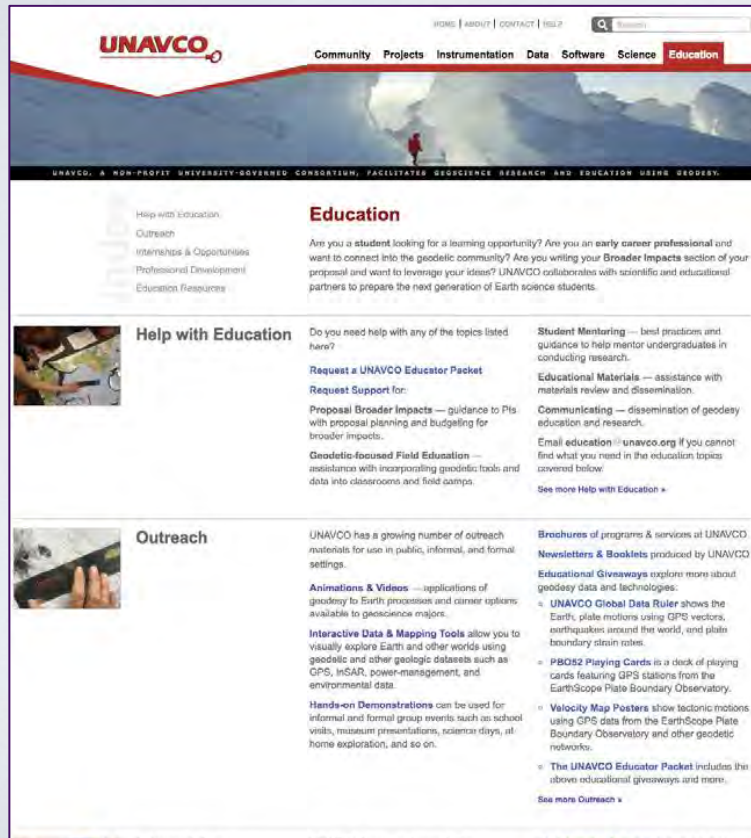


Earthquake Hazards

Assess earthquake hazard to mitigate future losses



Education & Community Engagement Resources



UNAVCO. A NON-PROFIT UNIVERSITY-GOVERNED CONSORTIUM, FACILITATES GEODESY RESEARCH AND EDUCATION USING GADGETS.

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Community Projects Instrumentation Data Software Science **Education**

Help with Education:
Outreach
Internships & Opportunities
Professional Development
Education Resources

Education

Are you a student looking for a learning opportunity? Are you an early career professional and want to connect into the geodetic community? Are you writing your Broader Impacts section of your proposal and want to leverage your ideas? UNAVCO collaborates with scientific and educational partners to prepare the next generation of Earth science students.

Help with Education

Do you need help with any of the topics listed here?

Request a UNAVCO Educator Packet
Request Support for:

Proposal Broader Impacts — guidance to PIs with proposal planning and budgeting for broader impacts.

Geodetic-focused Field Education — assistance with incorporating geodetic tools and data into classrooms and field camps.

Student Mentoring — best practices and guidance to help mentor undergraduates in conducting research.

Educational Materials — assistance with materials review and dissemination.

Communicating — dissemination of geodesy education and research.

Email education@unavco.org if you cannot find what you need in the education topics covered below.

[See more Help with Education »](#)

Outreach

UNAVCO has a growing number of outreach materials for use in public, informal, and formal settings.

Animations & Videos — applications of geodesy to Earth processes and career options available to geoscience majors.

Interactive Data & Mapping Tools allow you to visually explore Earth and other worlds using geodetic and other geologic datasets such as GPS, InSAR, power-management, and environmental data.

Hands-on Demonstrations can be used for informal and formal group events such as school visits, museum presentations, science days, at home exploration, and so on.

Brochures of programs & services of UNAVCO

Newsletters & Booklets produced by UNAVCO

Educational Giveaways explore more about geodesy data and technologies:

- UNAVCO Global Data Ruler shows the Earth, plate motions using GPS vectors, earthquakes around the world, and plate boundary strain rates.
- PBO2 Playing Cards in a deck of playing cards featuring GPS stations from the EarthScope Plate Boundary Observatory.
- Velocity Map Posters show tectonic motions using GPS data from the EarthScope Plate Boundary Observatory and other geodetic networks.
- The UNAVCO Educator Packet includes the above educational giveaways and more.

[See more Outreach »](#)

Internships & Opportunities

UNAVCO offers internships and other opportunities for students and recent graduates.

Geo-Launchpad is a paid summer internship program for students attending community college in Colorado.

RESESS is a paid undergraduate research internship, learning community, and mentoring program. Students can participate for up to three summers.

UNAVCO Student Internship Program (USIP) offers graduate and upper-level undergraduate students the opportunity to learn various aspects of geodesy research and education.

The **Internship Alumni** page lists all previous interns from each program, dating back to 1998. Take a look to see what past participants have worked on during their time with UNAVCO!

Institute for Broadening Participation (IBP) — Are you looking for other REU and internship opportunities? Check out the IBP's website for a comprehensive list of other geoscience opportunities.

[See more Internships & Opportunities »](#)

Professional Development

Strengthen professional skills through short courses, online resources, and networking opportunities.

Short Courses are single- or multi-day courses and workshops geared for researchers, early-career scientists, graduate students, and upper-level undergraduates, college and secondary education faculty, covering many applications of geodetic technologies.

Course Materials from UNAVCO-sponsored Technical Short Courses

Early Career Professionals — UNAVCO is helping early career professionals successfully navigate the transition from student to professional.

Science Communication — UNAVCO provides training and resources to strengthen scientists' abilities to communicate their work.

Mentor Resources are available for faculty and other professionals working with students, including **career exploration videos**, mentoring tips, and other resources for student professional development.

[See more Professional Development »](#)

Education Resources

Looking for geodesy resources that use geodetic data and modern teaching techniques to use in your teaching or after-school program? Do you want to expand your pedagogical horizons?

UNAVCO Educator Packet — materials for educators useful in teaching geodesy.

Field Geodesy Learning — Guidance for using geodetic methods in field education settings:

- Field Geodesy Education Support**: integration of terrestrial laser scanning (TLS) and GPS in undergraduate and graduate field courses.
- Educational Curricula**: developed to aid in teaching field geodetic methods.
- Learning Manuals**: useful for investigators and graduate students for research and to support teaching to undergraduates.

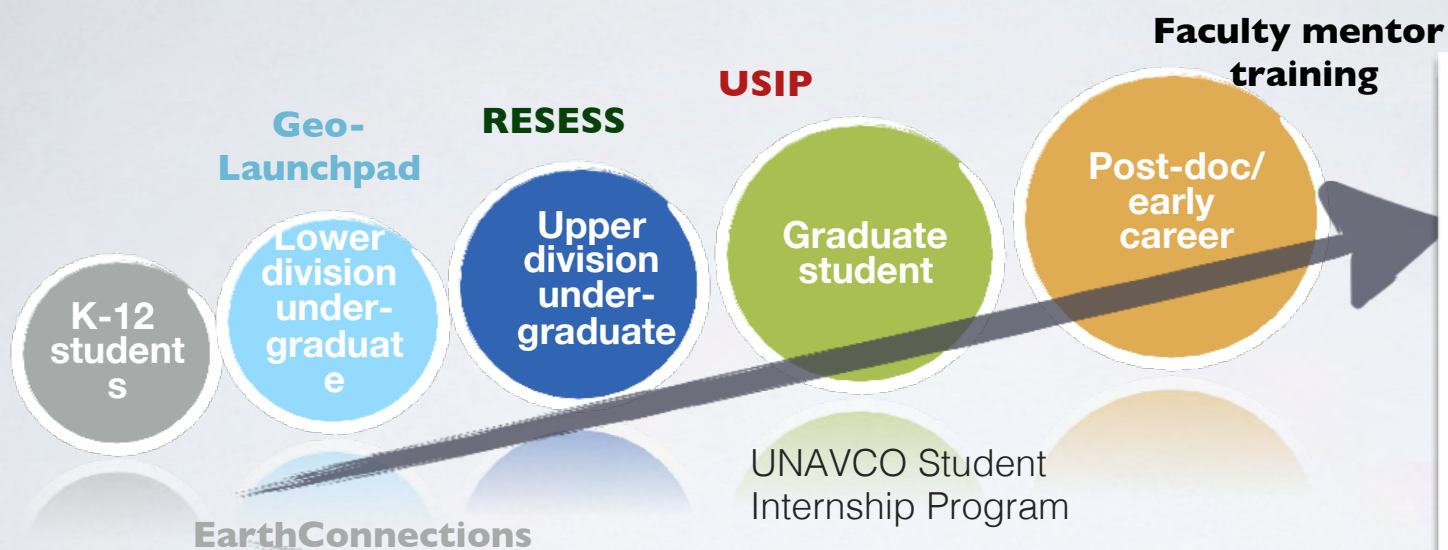
Modules & Activities — curricula which include geodesy data and technologies and often address societally important Earth science questions through the use of geodetic data: **GEodesy Tools for Societal Issues (GETSI)** Education Resources are displayed within the undergraduate categories:

- **Majors level undergraduate**
- **Introductory level undergraduate**
- **Secondary Education**

Data for Educators visually explore through a map view to find geodetic education resources that use high-precision GPS data, visualization tools, and educational modules/activities.

[See more Education 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

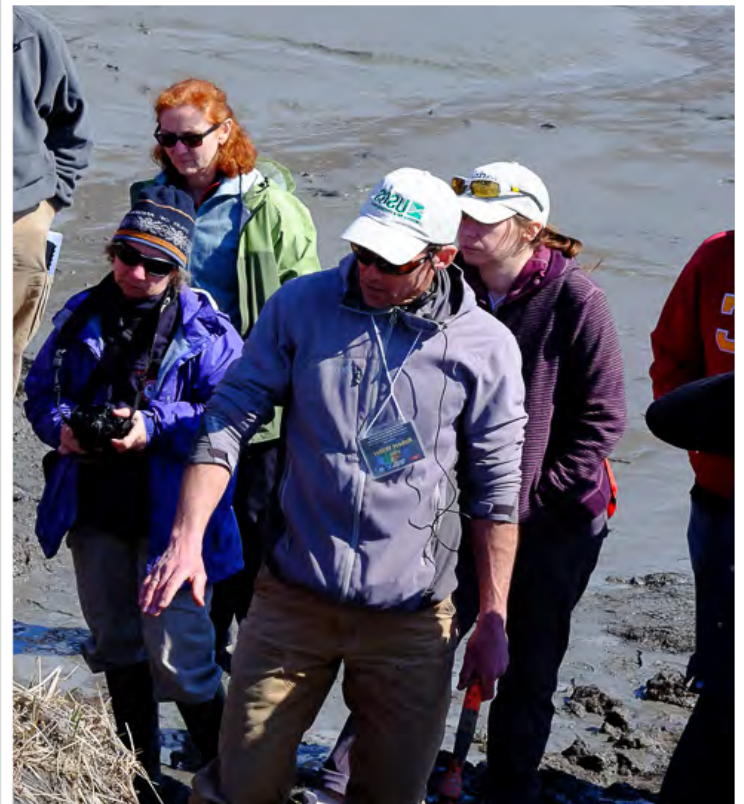


Access resources for working effectively with students from diverse backgrounds.



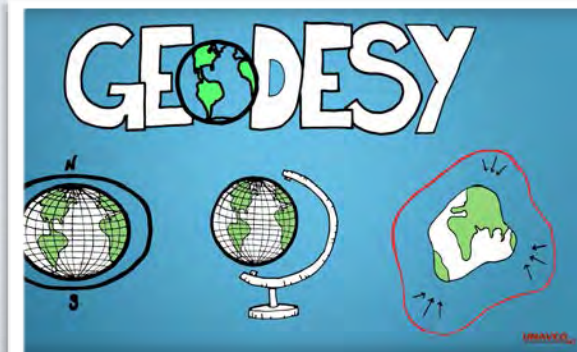
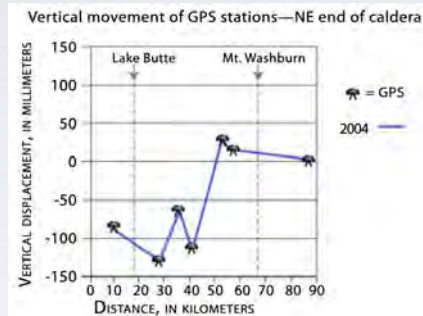
Short Courses & Webinars: Content for the classroom, Communicating Science, & Technical Tools

- 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

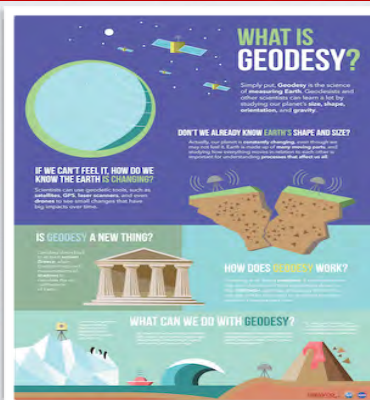
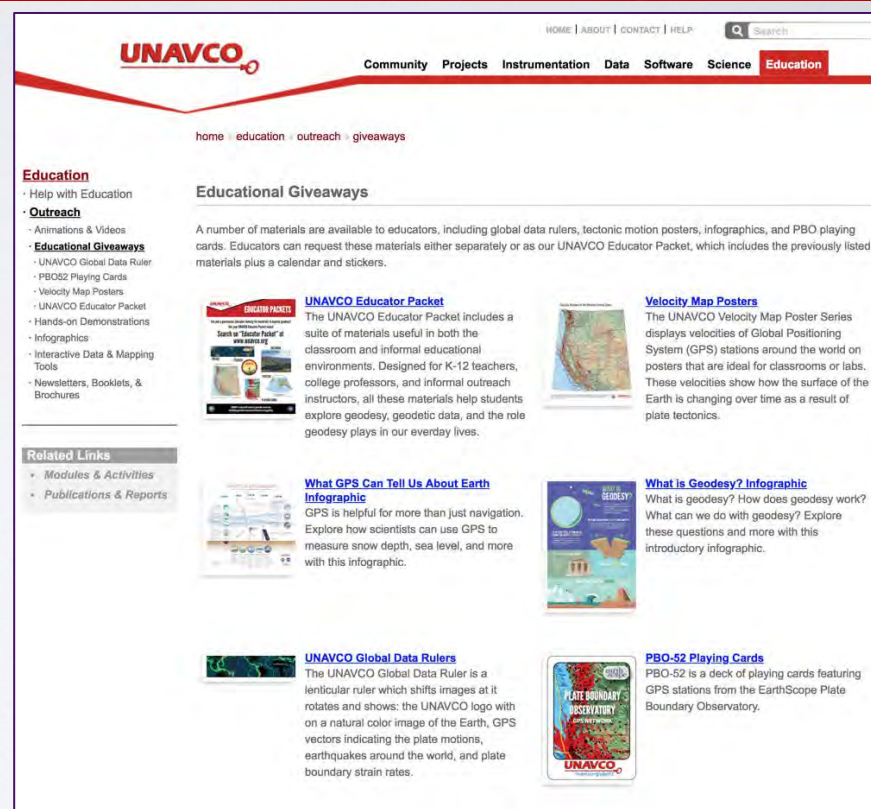




YouTube: Animations & Career Spotlights



Posters & Infographics

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UNAVCO

Community Projects Instrumentation Data Software Science **Education**


home | education | outreach | giveaways

Education

- Help with Education
- Outreach
- Animations & Videos
- Educational Giveaways**
 - UNAVCO Global Data Ruler
 - PBO52 Playing Cards
 - Velocity Map Posters
 - UNAVCO Educator Packet
 - Hands-on Demonstrations
 - Infographics
 - Interactive Data & Mapping Tools
 - Newsletters, Booklets, & Brochures


Educational Giveaways

A number of materials are available to educators, including global data rulers, tectonic motion posters, infographics, and PBO playing cards. Educators can request these materials either separately or as our UNAVCO Educator Packet, which includes the previously listed materials plus a calendar and stickers.




UNAVCO Educator Packet

The UNAVCO Educator Packet includes a suite of materials useful in both the classroom and informal educational environments. Designed for K-12 teachers, college professors, and informal outreach instructors, all these materials help students explore geodesy, geodetic data, and the role geodesy plays in our everyday lives.




Velocity Map Posters

The UNAVCO Velocity Map Poster Series displays velocities of Global Positioning System (GPS) stations around the world on posters that are ideal for classrooms or labs. These velocities show how the surface of the Earth is changing over time as a result of plate tectonics.




What GPS Can Tell Us About Earth Infographic

GPS is helpful for more than just navigation. Explore how scientists can use GPS to measure snow depth, sea level, and more with this infographic.



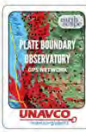
What is Geodesy? Infographic

What is geodesy? How does geodesy work? What can we do with geodesy? Explore these questions and more with this introductory infographic.



UNAVCO Global Data Ruler

The UNAVCO Global Data Ruler is a lenticular ruler which shifts images at it rotates and shows: the UNAVCO logo with on a natural color image of the Earth, GPS vectors indicating the plate motions, earthquakes around the world, and plate boundary strain rates.

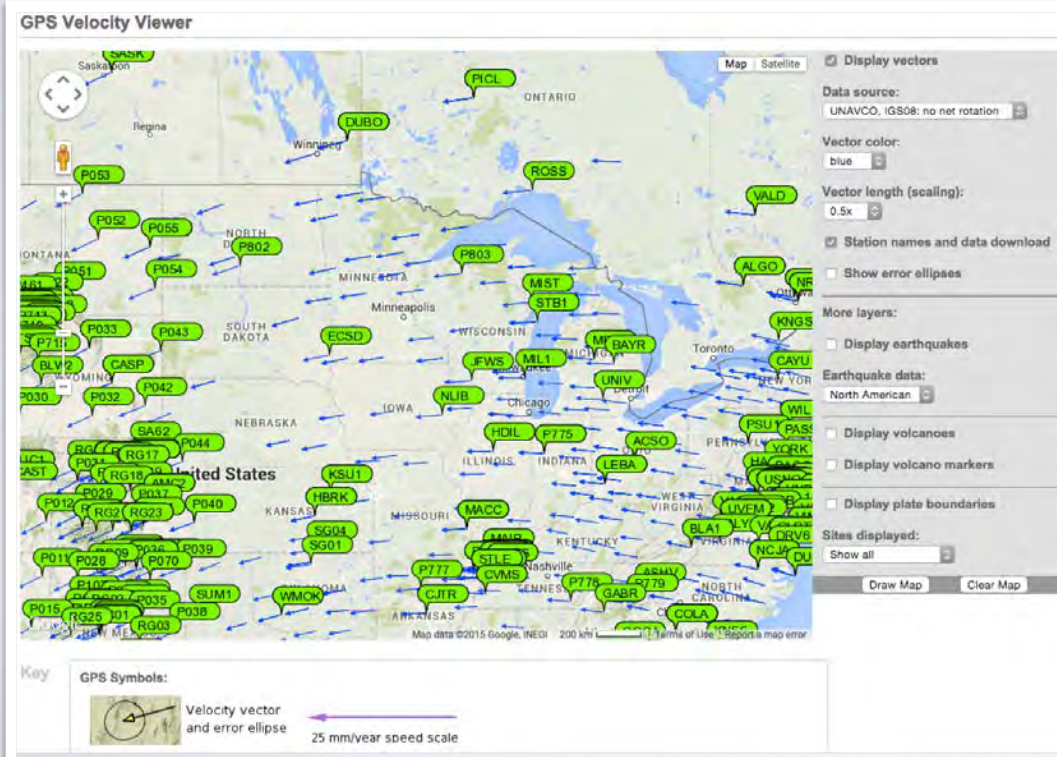


PBO-52 Playing Cards

PBO-52 is a deck of playing cards featuring GPS stations from the EarthScope Plate Boundary Observatory.

Interactive Data & Mapping Tools

- GPS Velocity Viewer



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[education](#)
[outreach](#)
[interactive data and mapping tools](#)

Education

Help with Education

Outreach

- Animations & Videos
- Educational Gateway
- UNAVCO Data Data Ruler
- IMOD Menu Guide
- Velocity Map Posters
- UNAVCO Educator Pages
- Hands-on Demonstration
- Infographics

Interactive Data & Mapping Tools

- Newsletters, Booklets, & Brochures

Related Links

- Brochures & Activities
- Publications & Reports

Interactive Data & Mapping Tools

GPS Velocity Viewer
Explore the motions of Earth's crust as measured by GPS stations around the globe.

Plate Motion Calculator
Calculate tectonic plate motion at any location on Earth using one or more plate motion models.

GPS Stationing
Learn how GPS is used to study faults, volcanoes, weather, water resources, and more.

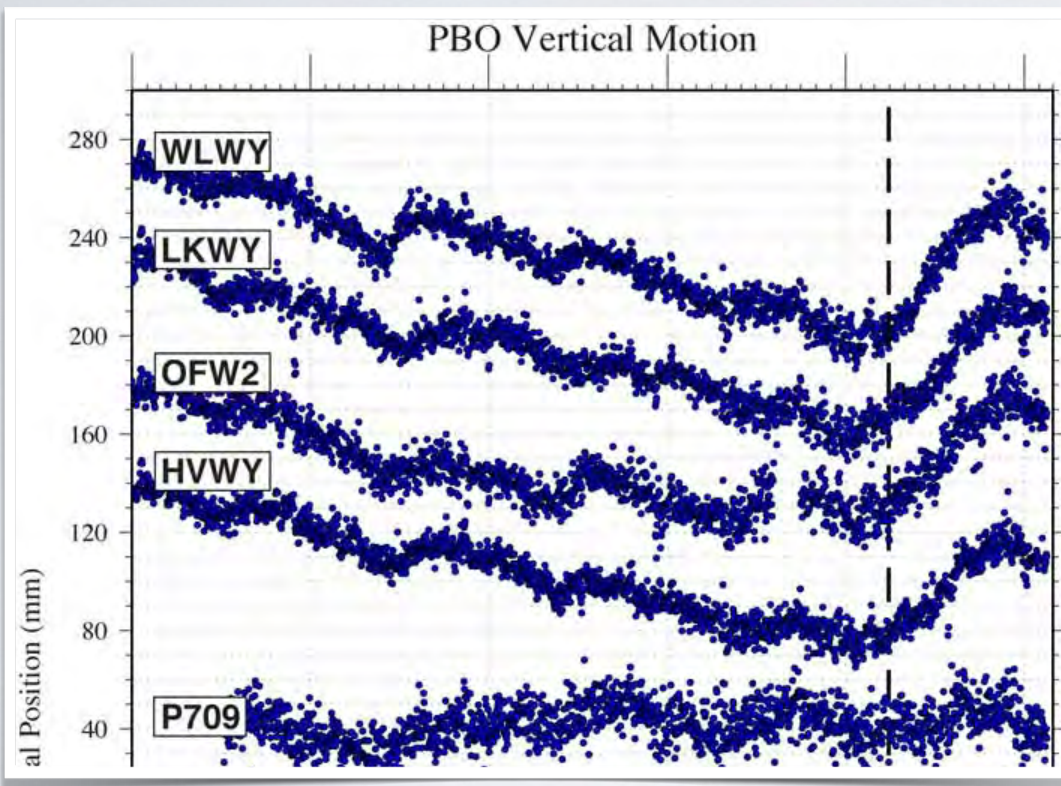
PBO HDO Data Portal
Access GPS reflection data from NSF's Pacific Boundary Observatory (PBO) to study the water cycle.

Visible Earthquakes
Model real earthquakes measured through INAR data. Sign in is required but free!

Power Through the Night
Design a power system to run GPS equipment through the long polar night. Balance cost and weight to ensure the data keeps flowing!

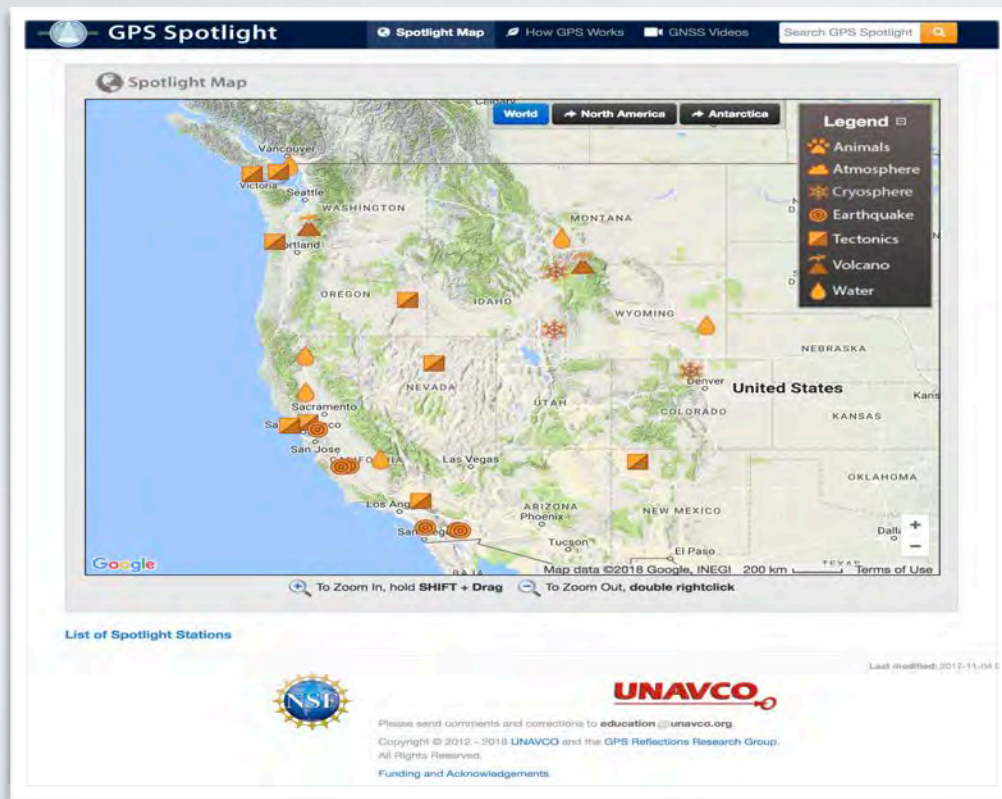
Interactive Field Trip: Valley and Ridge to Blue Ridge Province - Shenandoah National Park: EarthScope Workshop
Explore the central Appalachian Mountain belt and the Blue Ridge Province in this virtual field trip.

Interactive Data & Mapping Tools

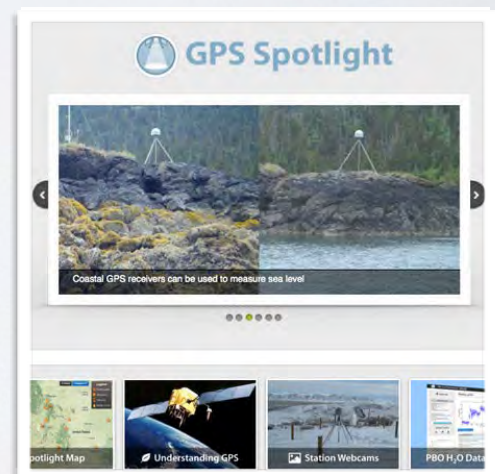


- GPS Velocity Viewer
- Processed GPS data formatted for ease of use

Interactive Data & Mapping Tools



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



Interactive Data & Mapping Tools

Power Through The Night

Introduction

How do we keep instruments running near the poles?

Because sites are difficult and expensive to get to, scientists and engineers have to design systems that can run without anyone visiting them for several years.



POLENET
Studying Earth and Ice



Far from power outlets, how do you keep equipment running all through the year?



In most parts of the world, this is not a problem: solar panels can be used to harness the sun's energy year-round. But in the polar regions, one long polar day gives way to one long polar night. The closer to the poles you go, the longer the night. At the south pole, night means six months without the sun!



Local support team

This is the challenge facing POLENET engineers.
Are you ready to build a polar power system?

Continue

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

Hands-on Demonstrations

Plate Convergence

Major concepts covered:

- The Earth is not always rigid
- Juan de Fuca Plate and North America plates are 'locked' together at the plate boundary, forcing the North American plate to be pushed and compressed inland. The land near the coast crumples the most while farther inland the land compresses less... very similar to a spring
- We can measure the deformation of the land using GPS
- The western edge of the North American plate will spring to the west during a subduction earthquake along the plate boundary.



Materials needed

- Option 1: Compression spring (4 to 8 inches in length - easily compressible), ribbons, printed map of Pacific Northwest with GPS vectors & plate boundaries clearly visible.
- Option 2: Two compression springs of same length, 2 small dowel rods, map printed onto stretchy fabric (when adhering the map to the fabric, stretch the fabric first). -10 twist ties, stickers, transparency, tape

Assembly

- Option 1: Place spring on top of paper map so it overlaps the coast to inland. Tape the right edge of the spring to the paper.
- Tie ribbons to the spring in three places: at the coast, 100km inland, and near the right edge of the spring
- Option 2: Connect dowel rods and springs to form a box - springs form two opposite sides of the box, rods form the other two opposite sides.
- Attach fabric map to the spring/rod frame with twist ties. Stretch fabric before attaching and ensure the springs run east-west. Attach transparency film.



Leading the demonstration

- Ask visitors to observe closely and have them compress the spring (or elastic). They might need/want to do this multiple times. Lead through questions to discuss spring analogy & the major concepts.



Sample questions

- Where does the spring move the most?



Make tectonic plates converge

Measure a Changing Volcano Demonstrati...



Measure a changing volcano



Science with Flubber: Glacial Isostasy

Education

Help with Education

Outreach

- Animations & Videos
- Educational Gateways
- UNAVCO Global Team Hour
- PBIOO Playing Cards
- Heavy Map Posters
- UNAVCO Educator Packet
- Hands-on Demonstrations
- Infographics
- Interactive Data & Mapping Tools
- Newsletters, Booklets, & Brochures

Related Links

- Modules & Activities
- Publications & Reports

Hands-on Demonstrations



These hands-on demonstrations can be used for informal and formal group events such as school visits, museum presentations, science days, or for at-home exploration.

Hands-on demonstrations are an effective way for novice learners, whether they are students, public, or museum visitors, to experience geoscience processes. UNAVCO and community members have developed hands-on demonstrations of a variety of geophysical processes highlighting the geodetic techniques used to measure these processes. These demonstrations illustrate how observations of changes at the Earth's surface can be observed, quantified, and inform us about forces within the Earth that we can't see. They also emphasize the societal impact of research related to each Earth process.

Description

Science with Flubber: Glacial Isostasy

Using two sets of flubber, one representing the Earth and one representing a glacier, demonstrate how the crust sags and rebounds to the weight of a glacier, and how this motion can be measured using GPS.

[Make the demo](#)

[Watch the demo](#)



Measure a changing volcano

This hands-on demonstration illustrates how GPS can be used to measure the inflation and deflation of a volcano, and how rocks at the summit weaken and crack to form a crater or caldera.

[Make the demo](#)

[Watch the demo](#)



Groundwater and earthquakes

Simulate how hydrologic changes affect seismicity and explore how the water system and earthquake patterns on a fault can be related.

[Make the demo](#)

[Watch the demo](#)



Tsunami early warning

Illustrate how geodetic instruments can be used to warn people of an approaching tsunami. This is also a fun game where participants have to save the animals from the incoming water!

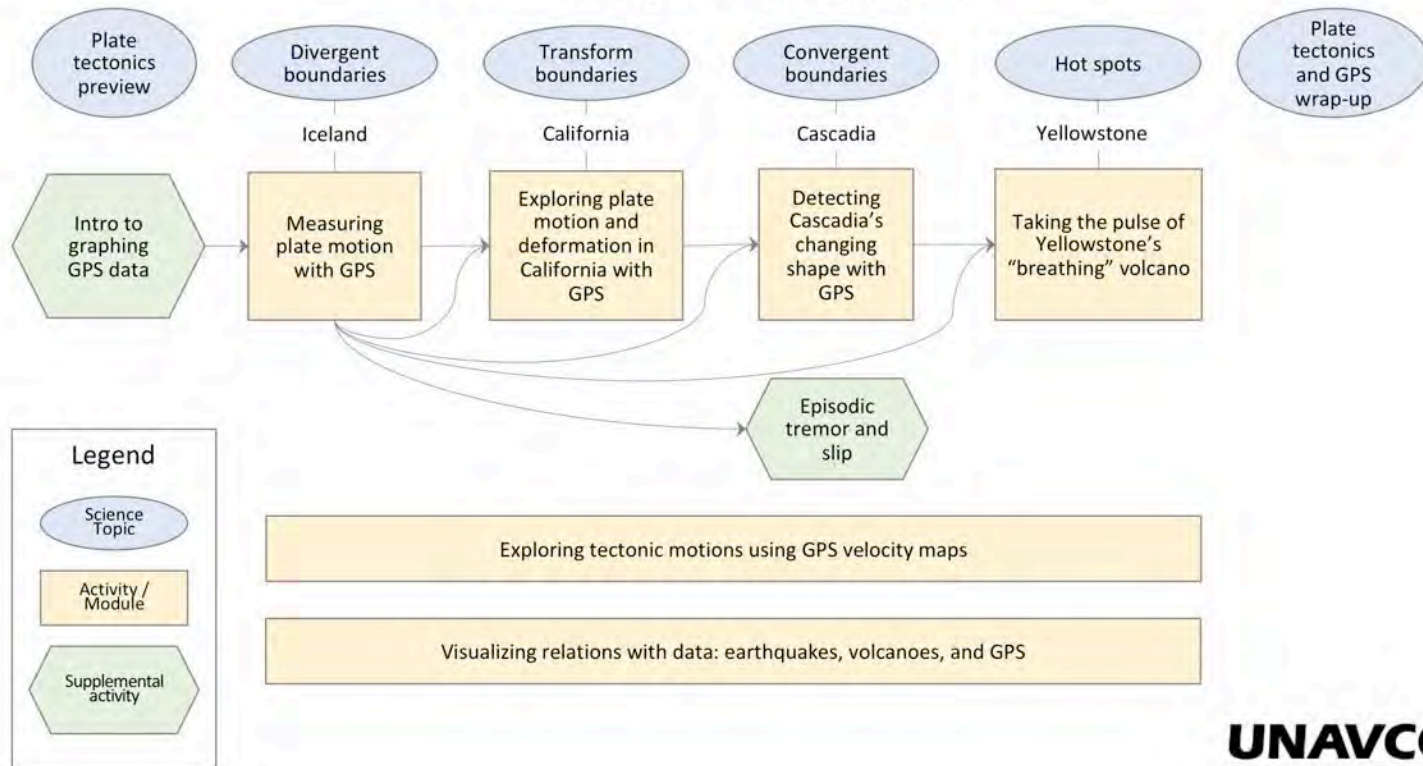
[Make the demo](#)

[Watch the demo](#)



Activities & Modules w/ NGSS

Teaching Plate Tectonics with GPS



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



The screenshot shows the UNAVCO Education website. The header includes the UNAVCO logo and navigation links: Home, Education, Resources, Modules and Activities. The main content area is titled "Learning Modules and Activities for the Classroom" and describes how geodesy is integrated into the secondary and undergraduate curriculum. It lists various resources and activities, including "Exploring tectonic motions using GPS velocity maps", "Measuring plate motion with GPS: Iceland", and "Exploring plate motion and deformation in California with GPS". Each activity includes a description, a thumbnail image, and links to activity pages, student worksheets, and presentations.

UNAVCO

Home | Education | Resources | Modules and Activities

Education

Help with Education

Education Resources

- UNAVCO Educator Portal
- Field Geodesy Learning

Modules & Activities

- Microscopy Undergraduate
- Introduction to Undergraduate
- Secondary - Grades 6-12
- Desk for Educators
- Tutorials & Handouts
- GPS Tutorials
- 3D Imaging Tutorials
- Geodesy Education Handbook & FAQs
- Lab Book Links

Related Links

- Animations & Videos
- Interactive Data & Mapping Tools
- Research On Demand/Referrals
- Short Course Materials
- GETSI Scholarships
- Research at SERI
- GETSI Project

Learning Modules and Activities for the Classroom

Integrating the applications of geodesy into the secondary and undergraduate curriculum broadens students' exposure to modern measurement techniques such as global positioning system (GPS), airborne or terrestrial laser (TLS), and gravity. Scientists use geodesy as an approach to understand the changing face of our planet to study plate motion, sea level changes, earthquakes, glacial movements and isostatic changes, volcanic deformation, landslides, glaciers, vegetation change, subsidence, soil moisture, precipitation, water vapor, the water cycle, and more.

Modules and Activities use geodesy as an approach to understand the changing face of our planet. They are organized by the intended learning level of the resource. In many cases, the resources can be used in more advanced or novice levels with simple modifications.

Microscopy Undergraduate | **Introduction to Undergraduate** | **Secondary - Grades 6-12**

Secondary, Grades 6 - 12, Middle and High School

While these resources have been used in middle school and high school, they have been successfully implemented in introductory Undergraduate with minor modifications.

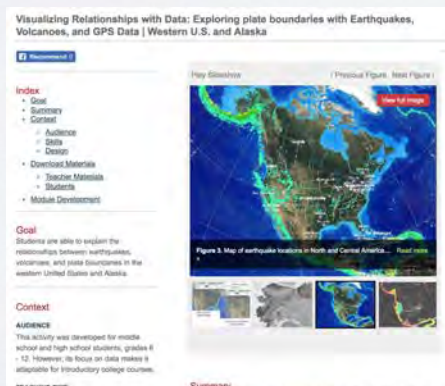
Description	Important links
<p>Exploring tectonic motions using GPS velocity maps</p> <p>In this 1-2 hour activity, students use their observational skills to discover the tectonic motions of Alaska or the western United States by exploring the UNAVCO Tectonic Motion posters.</p>	<p>Activity page (link)</p> <p>Student Worksheet (link)</p> <p>United States (link)</p> <p>Alaska (link)</p> <p>Geologic Hazard Map</p> <p>Continental United States (link)</p> <p>Alaska (link)</p> <p>Tectonic Motion posters</p>
<p>Measuring plate motion with GPS: Iceland</p> <p>In this session, students learn to interpret GPS data collected from permanently installed high-precision GPS stations in Iceland. They analyze time series plots of the data as the station's position moves over time in the north-south and east-west directions. Students learn how to represent time series data as velocity vectors and how to graphically and the vectors to create a total horizontal velocity vector. They apply their skills to calculate the direction and speed of motion for two GPS stations.</p>	<p>Activity page (link)</p> <p>Full zip file of all presentations, worksheets, and documents (link)</p>
<p>Exploring plate motion and deformation in California with GPS</p> <p>Students analyze GPS data to study the motion of the Pacific and North American tectonic plates. From this data, students detect relative motion between the plates in the San Andreas fault zone with and without earthquakes. They interpret time series plots from an earthquake in Parkfield, CA to calculate resulting slip on the fault and (optionally) the earthquake's magnitude.</p>	<p>Activity page (link)</p> <p>Full zip file of all presentations, worksheets, and documents (link)</p>

Module: Taking the pulse of Yellowstone's

Activity notes ([link](#))

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)
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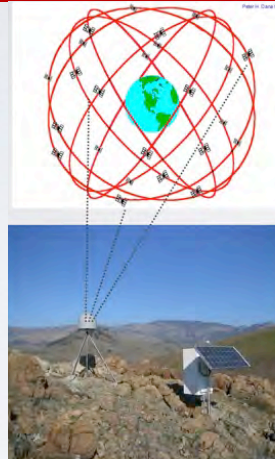
Embedded:

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

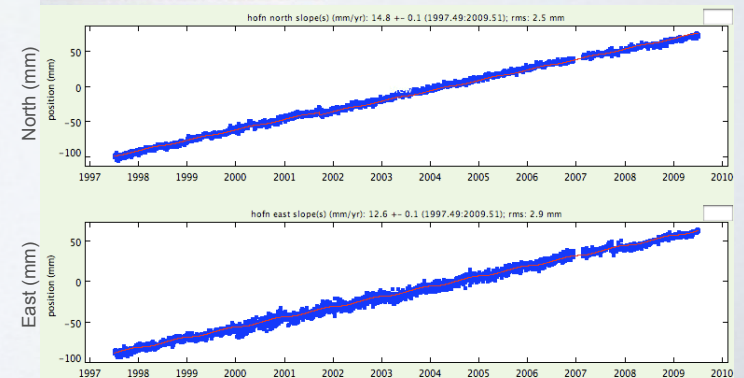
Detailed data dive through process of science

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



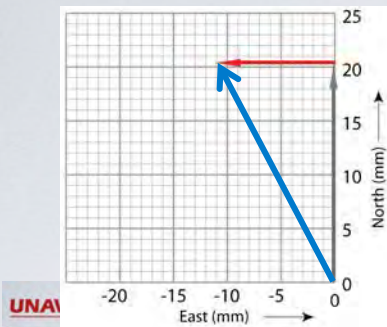
Date	North (mm)	East (mm)	Vertical (mm)
1/1/2004	-37.67	36.57	2.33
1/2/2004	-38.04	35.73	5.63
1/3/2004	-37.16	35.83	4.69
1/4/2004	-37.34	36.34	5.36
1/5/2004	-37.59	36.44	9.11
...
1/1/2005	-9.43	9.63	2.36
1/1/2006	16.48	-18.09	7.35
1/1/2007	45.98	-43.42	-6.43



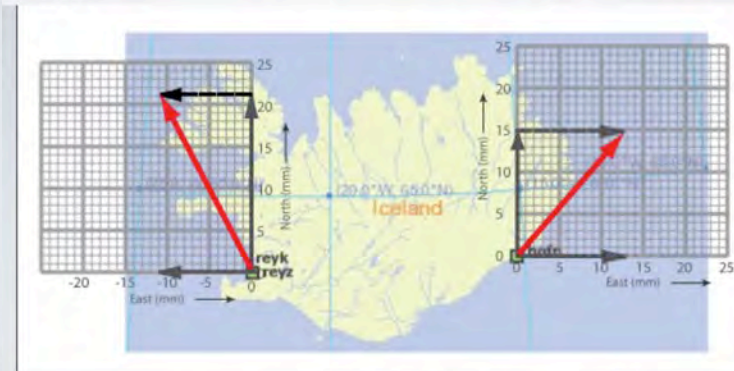
Detailed data dive through process of science

Basic Outline (continued)

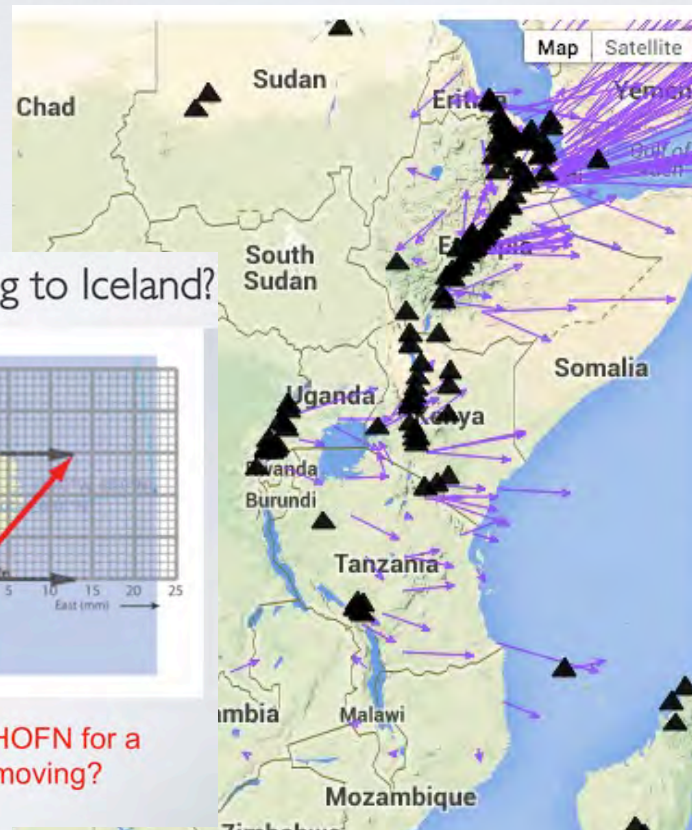
- Creating vector plots from the data
- Displaying vectors on a map
- Interpreting the vectors ... in the context of plate tectonics
- Extending to more settings



happening to Iceland?



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



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.

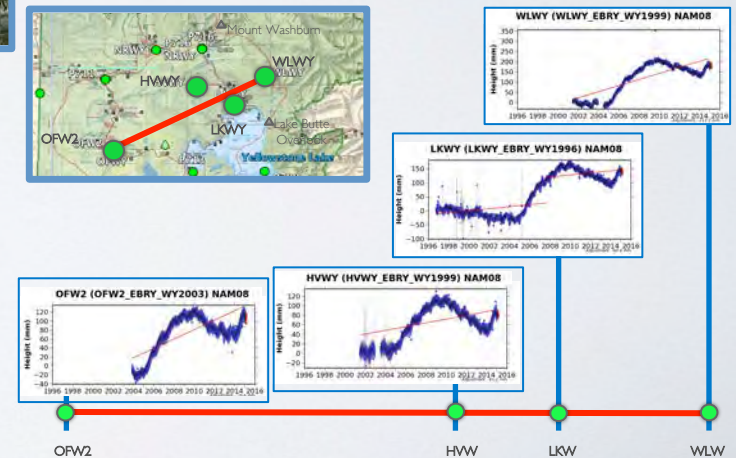
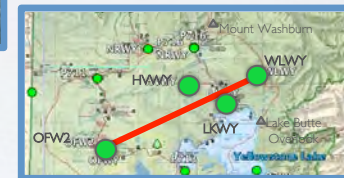
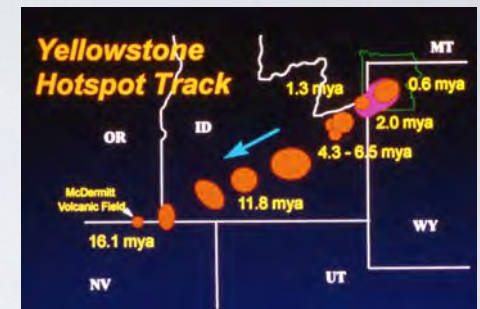
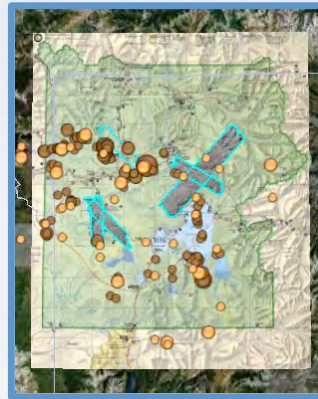
Embedded:

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

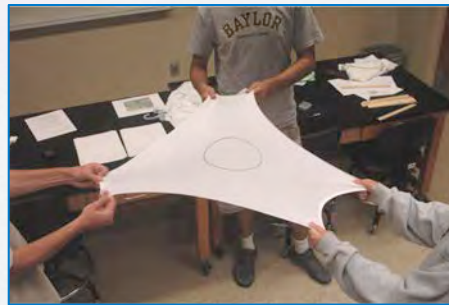
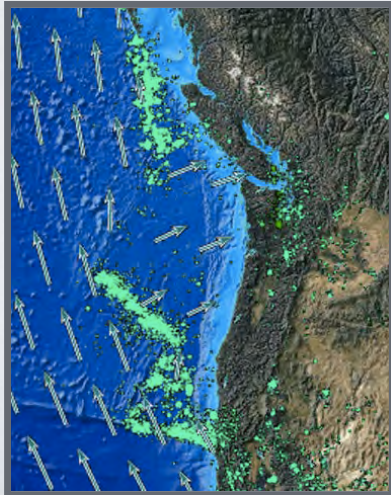
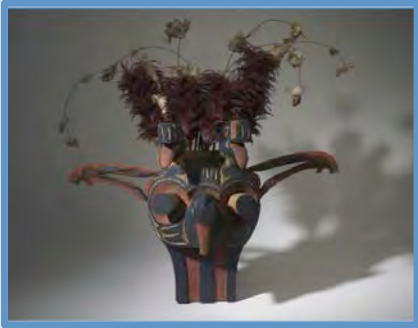
In-depth project-based modules w/ multiple lines of evidence

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.



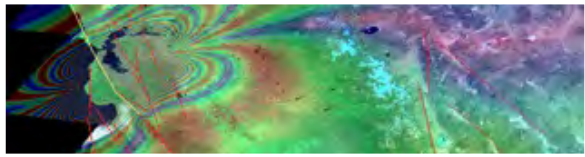
In-depth project-based modules w/ multiple lines of evidence



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

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