



Getting to know EarthScope Plate Boundary Observatory & UNAVCO

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UNAVCO



About UNAVCO

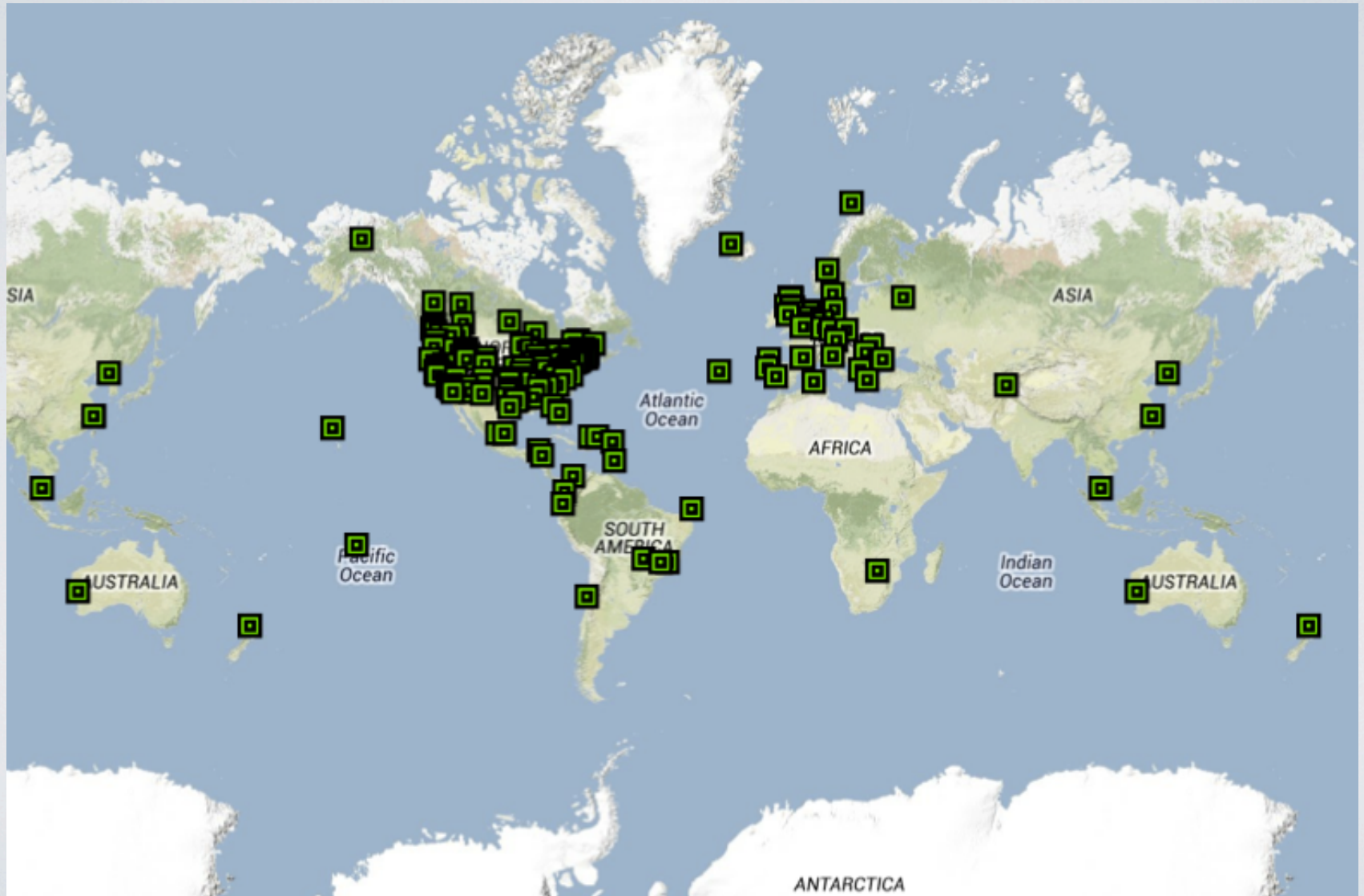
- NSF and NASA funded
- Non-profit
- Consortium
- Membership-governed
- **Facilitates geoscience research and education using geodesy**
- Operates the Nation's geodesy facility, including the Plate boundary Observatory on behalf of NSF



Broaden the use of UNAVCO data and products by a wide audience of educational and research users



UNAVCO Consortium Members



Meet the Plate Boundary Observatory

Geodesy Advancing
Geosciences &
EarthScope (GAGE)

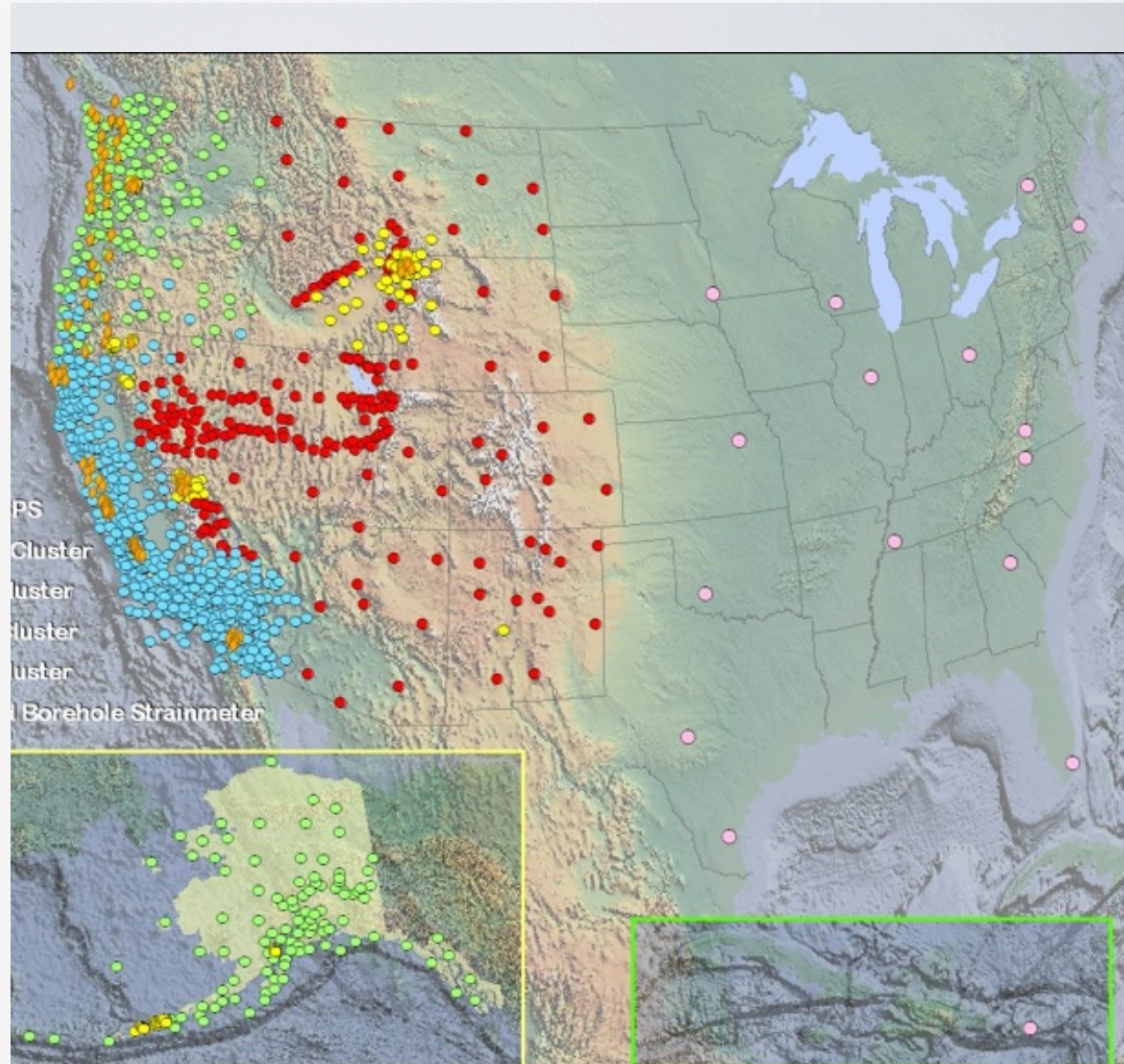
Continent-scale
network

- GPS
- Borehole strainmeters
- Laser strainmeters
- LiDAR

Focus:

- Extended plate boundary

Operated by UNAVCO



EarthScope PBO GPS Network

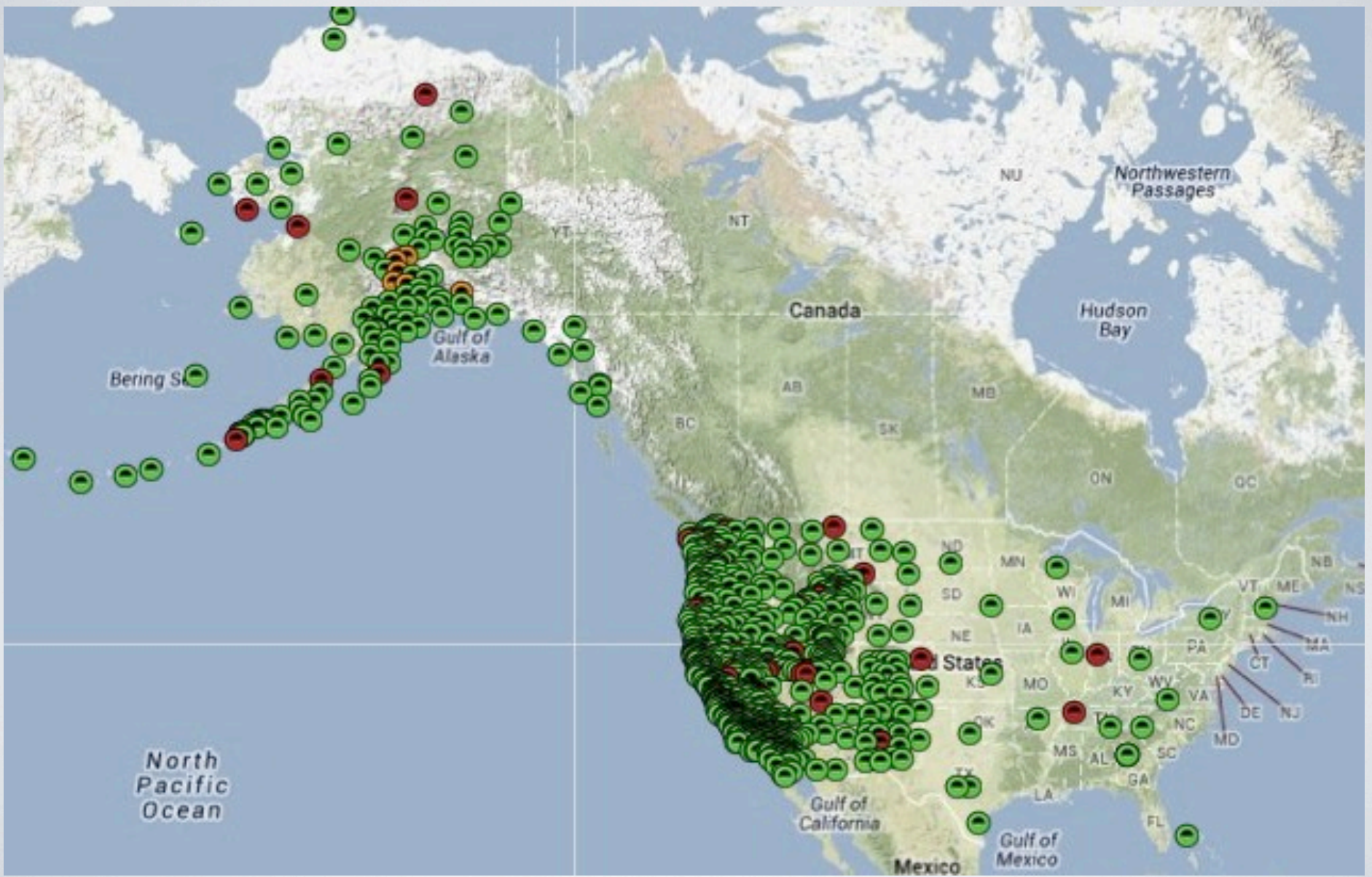


Plate Boundary Observatory Instruments

GPS: 1100 Continuous



5 Laser Strainmeters



74 Borehole Strainmeters
and 78 Borehole Seismometers

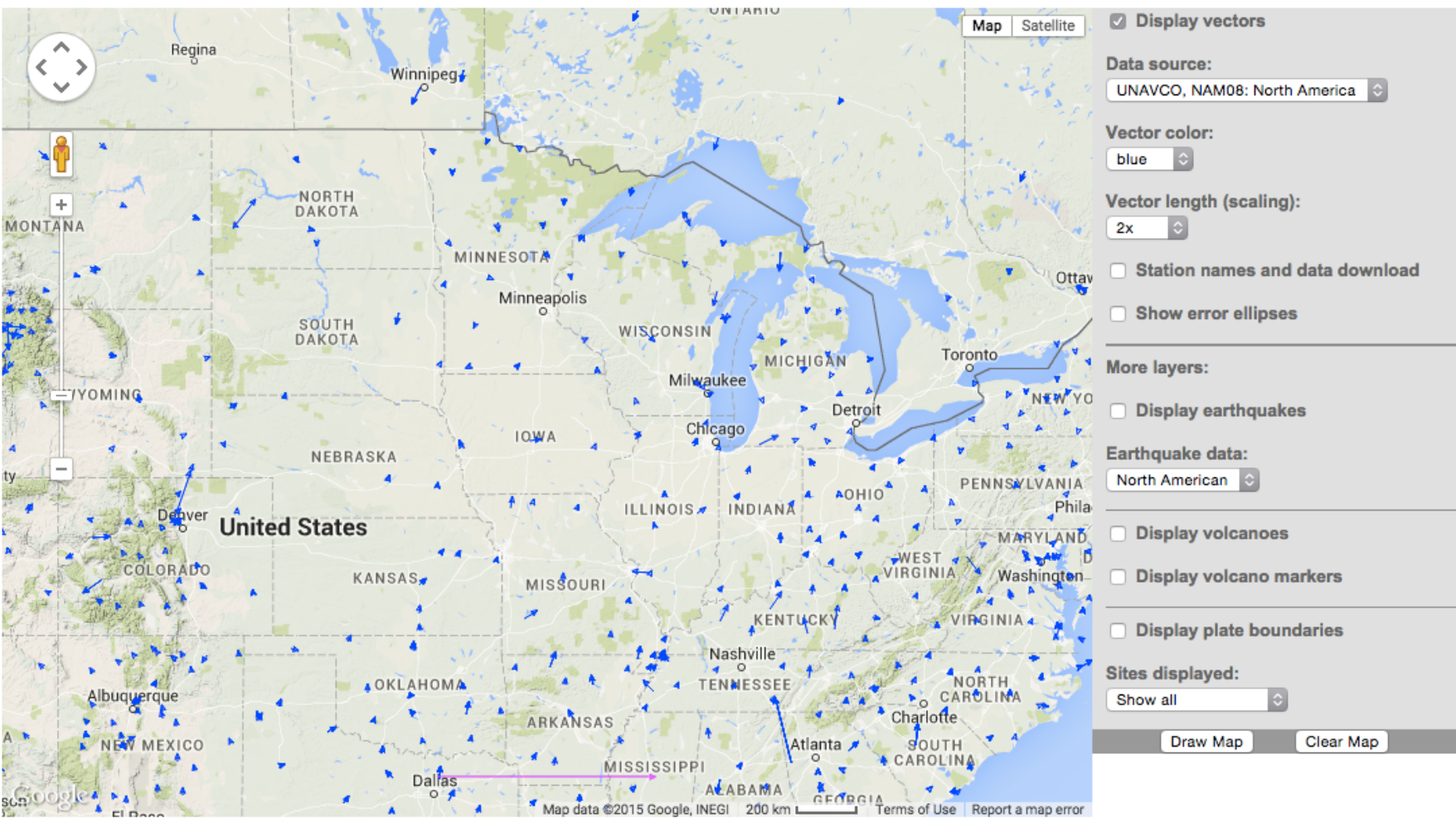


26 Shallow Borehole
Tiltmeters




Tectonic motions of Midwestern United States from GPS using a stable North America reference frame (NAM08)

GPS Velocity Viewer




Key

GPS Symbols:



Velocity vector and error ellipse



25 mm/year speed scale

At the tail of each blue vector, a GPS station is permanently mounted to the ground, measuring plate motion at that point.

LiDAR – looking below the trees

Open Topography: <http://www.opentopography.org/>

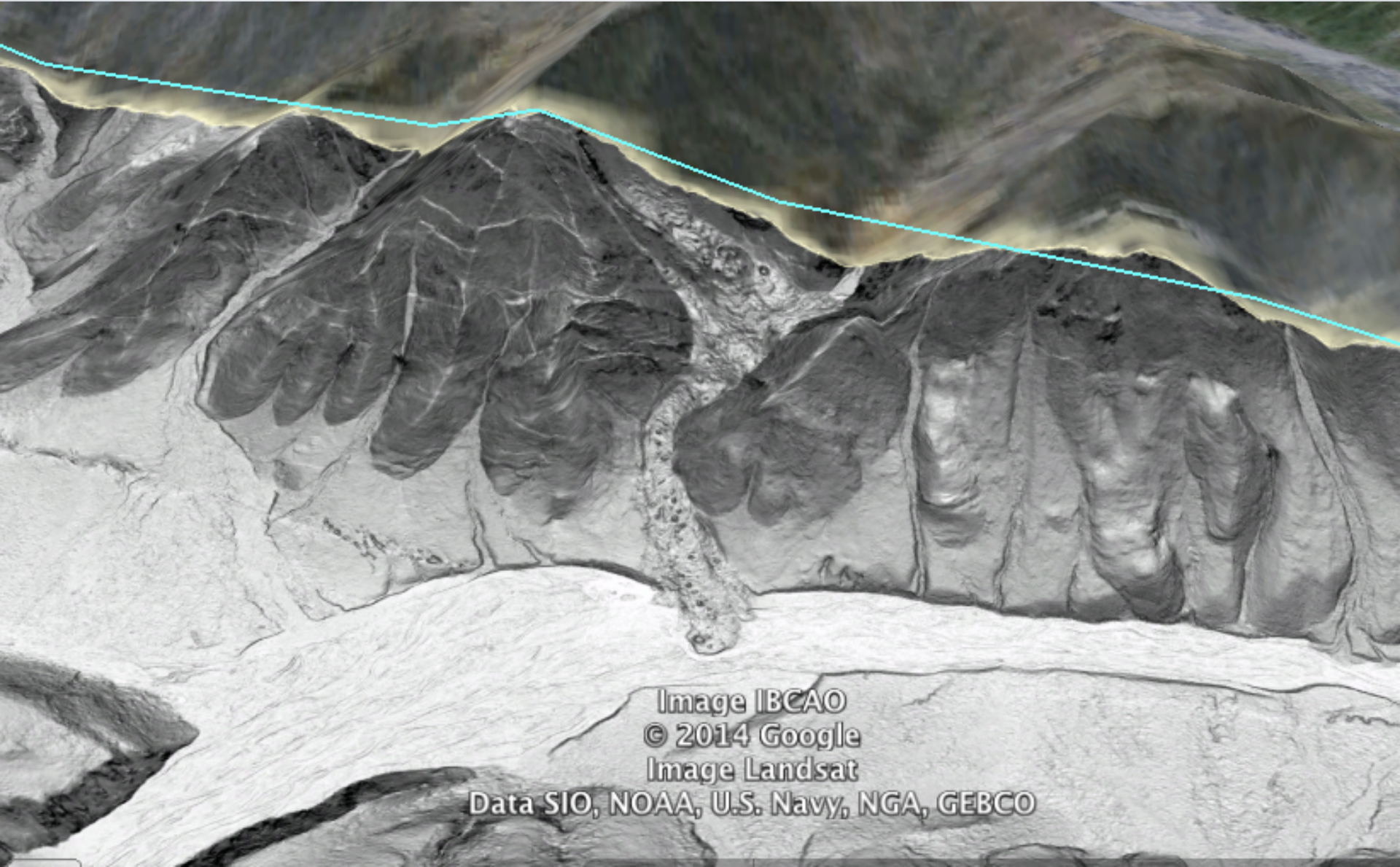
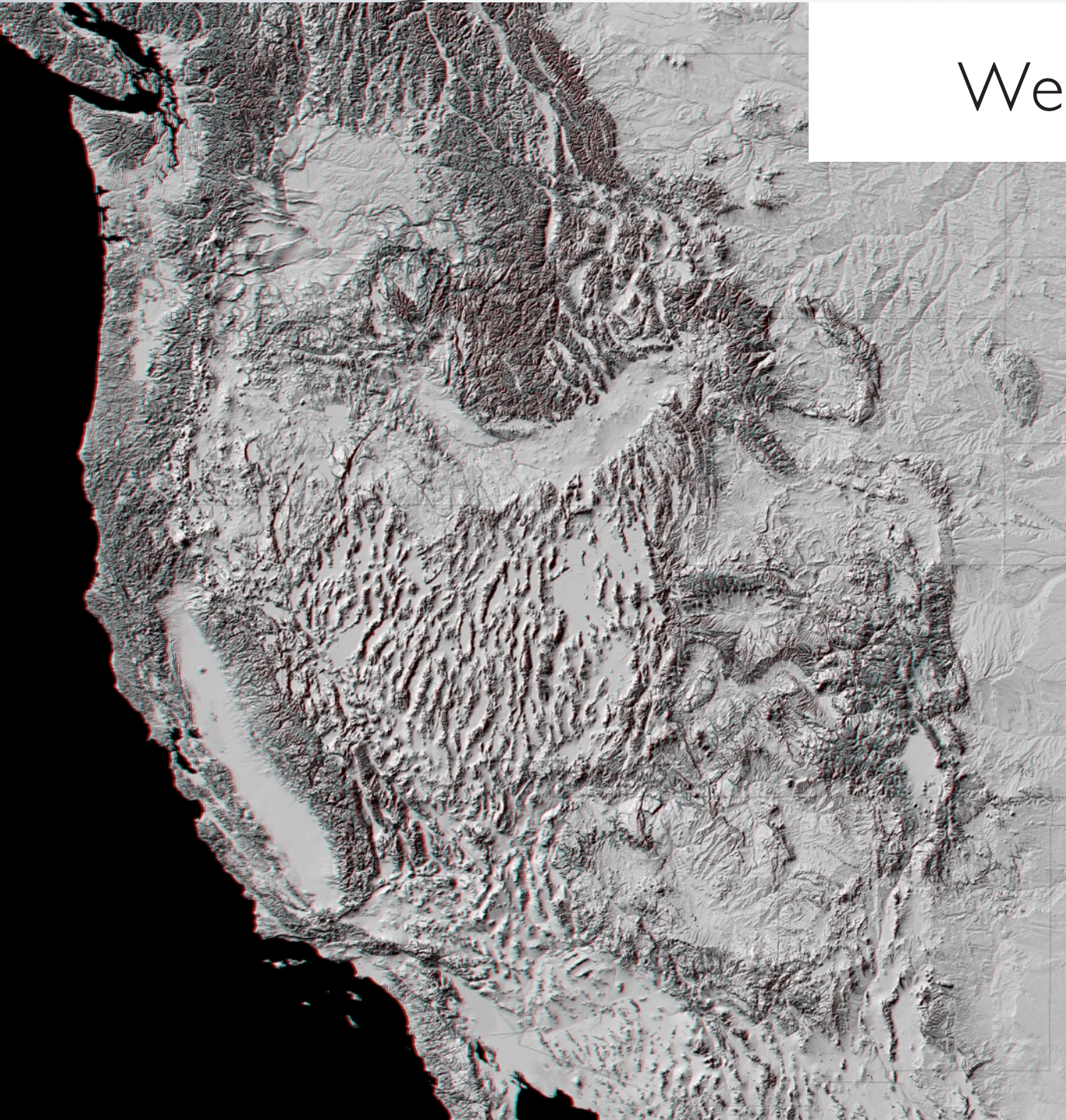


Image IBCAO
© 2014 Google
Image Landsat
Data SIO, NOAA, U.S. Navy, NGA, GEBCO

Western US in 3D



WESTERN UNITED STATES



Courtesy: Parul Morin, National Center for Earth-surface Dynamics
Data Repository
http://www.nced.umn.edu/Data_Repository.html
[retrieved on 08 March 2015]



Education & Community Engagement

Training

Education Materials

Communications

Workforce Development

• Training

Technical short courses, educational workshops, evaluation, new delivery methods

• Education Materials

Curriculum development (Strain module, GETSI project [NSF-TUES], existing learning materials

• Communications

Website, outreach materials, social media, conferences

• Workforce Development

RESESS, RESESS Alumni network, Science Workshop mentoring



Learning Materials, Exhibits, Social Media

- Tutorials & How to's
- Lessons
- Animations
- How to's for data
- Facebook, Twitter, etc

Based on time series inversion algorithm (2001) and Berardinelli

Computer Instructions

Visualizing Relationships between Earthquakes, Volcanoes, and Plate Boundaries in the Western U.S. Using the EarthScope Jr. Data Tool

Part I
Starting at www.unavco.org
➤ Click on maptools under the Education and Outreach section

➤ Click on **EarthScope Voyager Jr.** -The direct link is: <http://jules.unavco.org/VoyagerJr/EarthScope> A map of North America will load in several seconds.

➤ Next, click on the map two times to obtain a zoom view of the western United States.

Click on map to zoom in

Worksheet

Visualizing Relationships between Earthquakes, Volcanoes, and Plate Boundaries

Part I: Comparing earthquake and volcano locations

What you will need:

- Internet access (Mac and PC-compatible) or the map packet
- Dry erase pens and transparency paper with map of Western U.S. OR color pencils

Instructions

Work in teams of two. In your teams, designate one person to study the Earthquake map and one person to study the Volcano map. Separately study your designated map and answer the questions below.

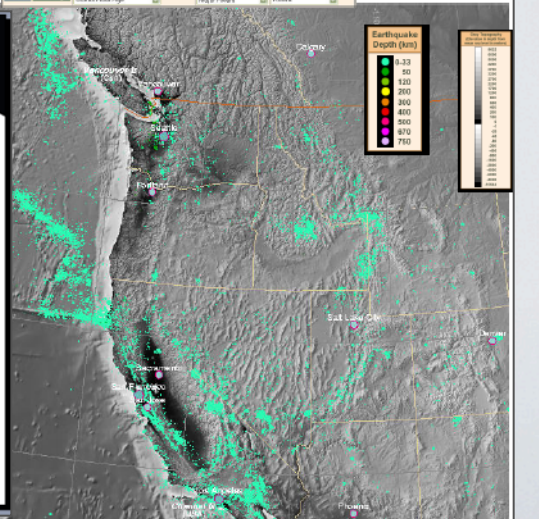
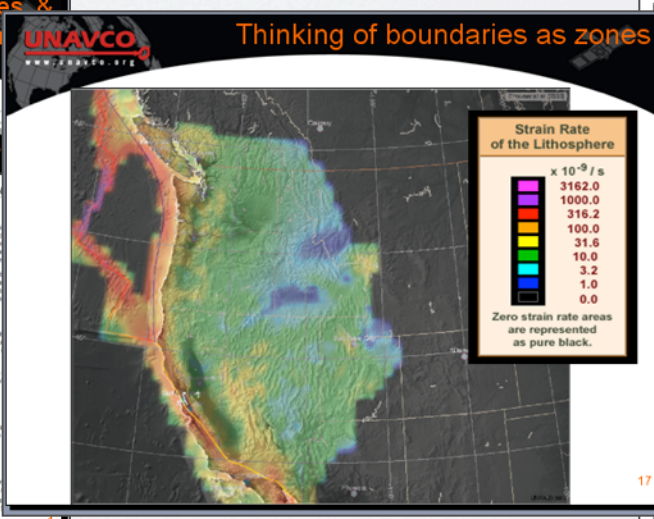
Earthquake Map Questions: Study where earthquakes are and are not located. Sketch the approximate locations of several earthquake "clusters" using a dry erase pen on the map of the western United States printed on a transparency or from the last page of the worksheet.

How are earthquakes distributed? If there is a pattern, how would you describe it? Are there more earthquakes? Are they located near the edges of the continents, mid-continent, in the ocean?

At what depth do the earthquakes occur?

Part I: Comparing Locations of Earthquakes & Volcanoes

Go to: <http://www.unavco.org/>



UNAVCO

Reading literacy with science highlights, snapshots , and GPS Spotlights

unavco.org

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SEARCH

Community Services Data Instrumentation Software Science Learning

2014 SCIENCE WORKSHOP

celebrating 30 YEARS of INNOVATION for SCIENCE

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

We challenge ourselves to transform human understanding of innovative technologies, open geodetic observations

GPS Spotlight

Spotlight Map Understanding GPS Station Webcams PBO H₂O Portal Contact

WHAT'S HOT

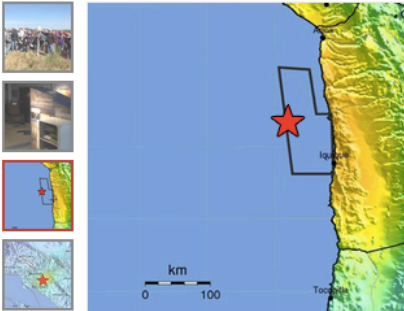
view all »

New Video: UNAVCO (Explained in 3 Minutes).

Notice to UNAVCO GPS Data Product Users: File Format Update on March 25th 2013.

HIGHLIGHTS

view all »

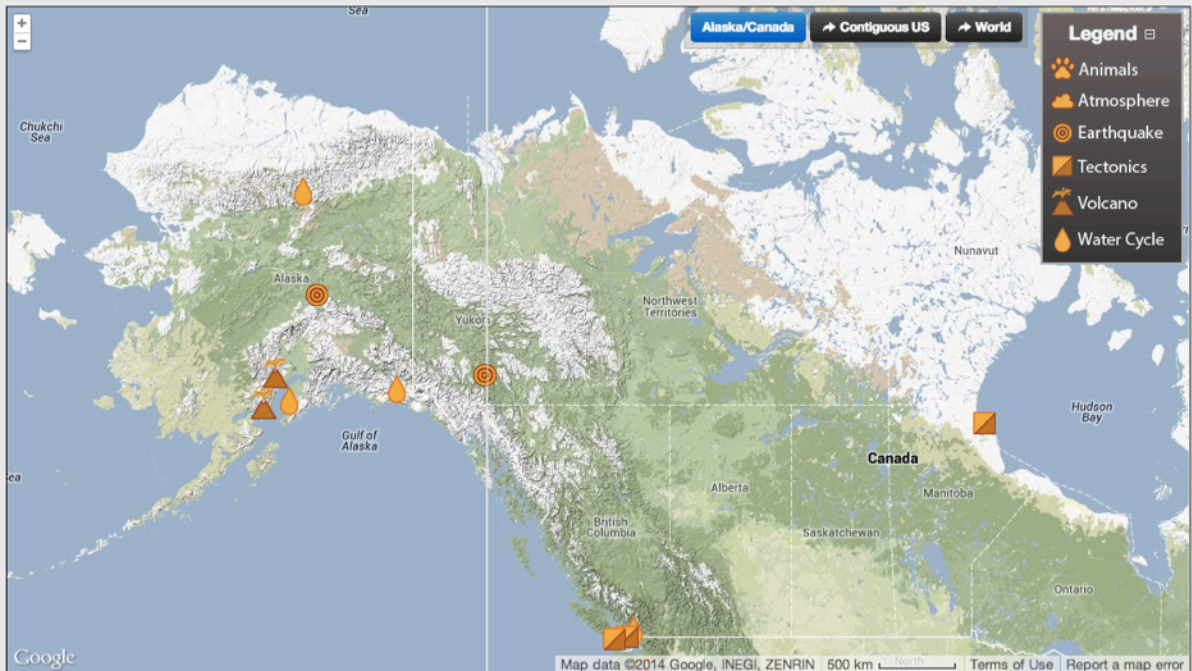


Event Response:
Mw 8.2 Earthquake 95km NW of Iquique, Chile
April 3, 2014

A magnitude Mw 8.2 earthquake ruptured the subduction off the coast of northern Chile at 11:46:46 p.m. GM 2014. The event occurred in the "Iquique seismic gap".

[read more »](#)

Spotlight Map



Alaska/Canada Contiguous US World

Legend

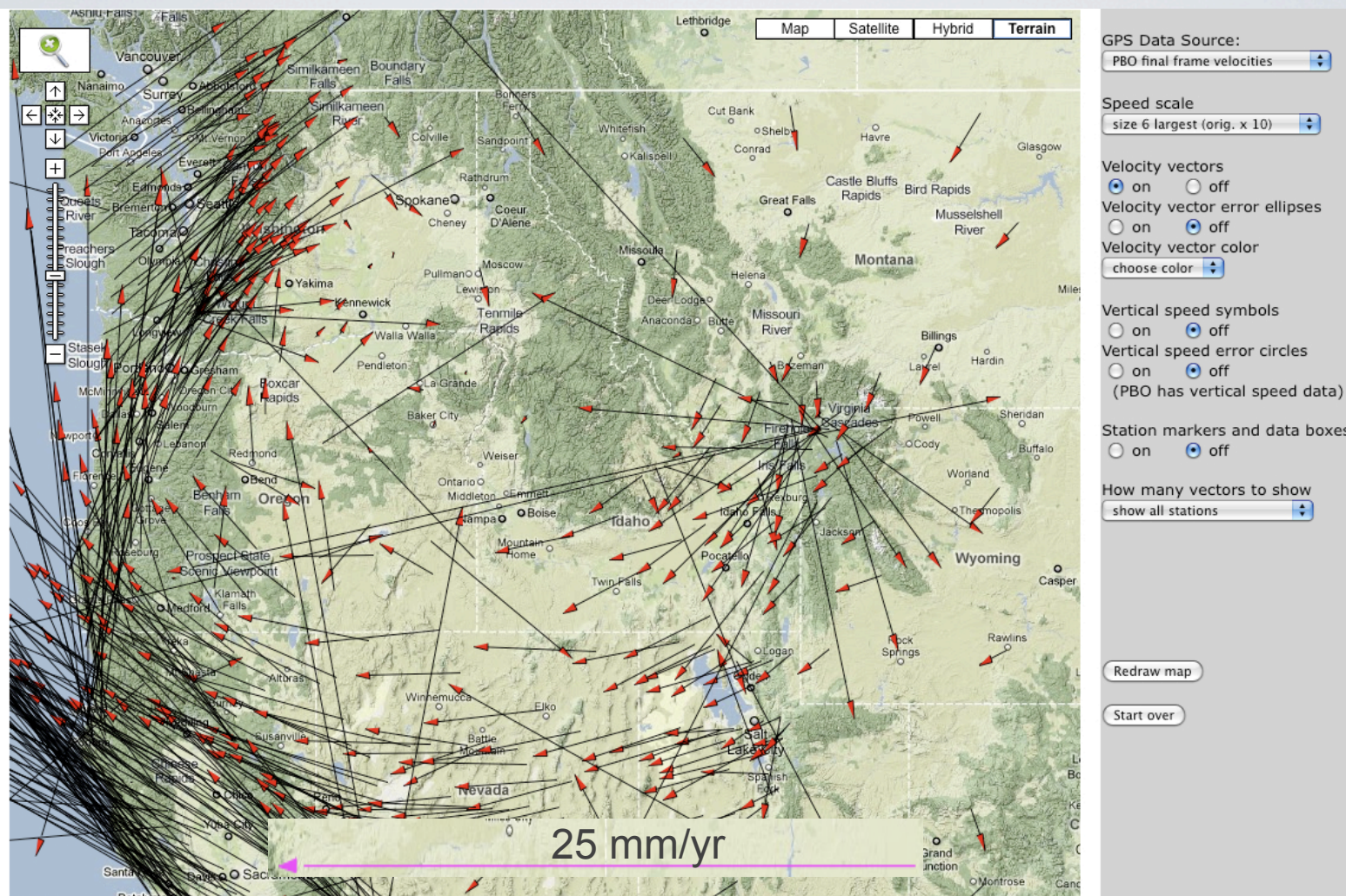
- Animals
- Atmosphere
- Earthquake
- Tectonics
- Volcano
- Water Cycle

Map data ©2014 Google, INEGI, ZENRIN 500 km North Terms of Use Report a map error

<http://unavco.org/>

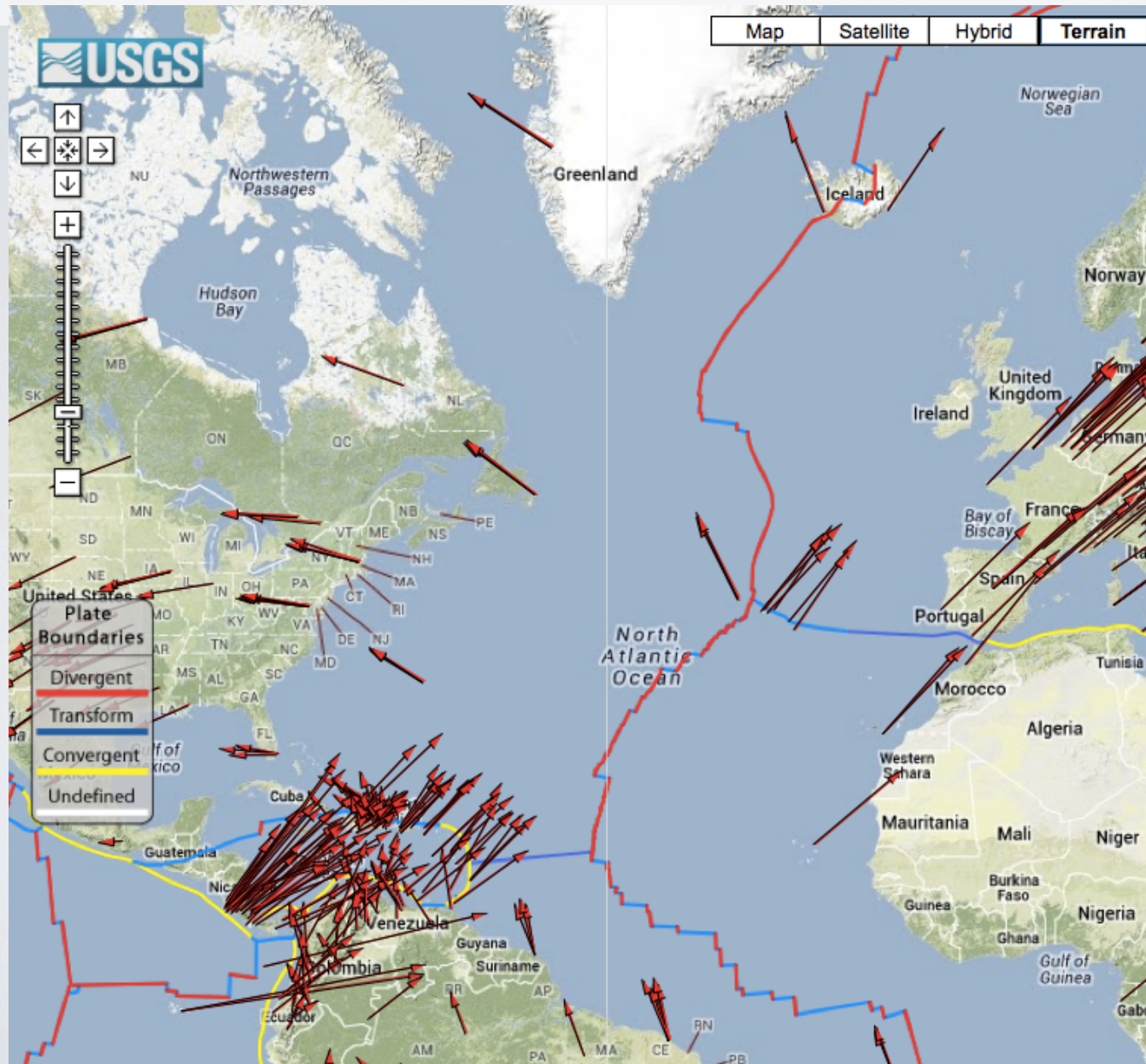
<http://xenon.colorado.edu/spotlight/index.php?action=map>

Use Data Tools: GPS Velocity Viewer

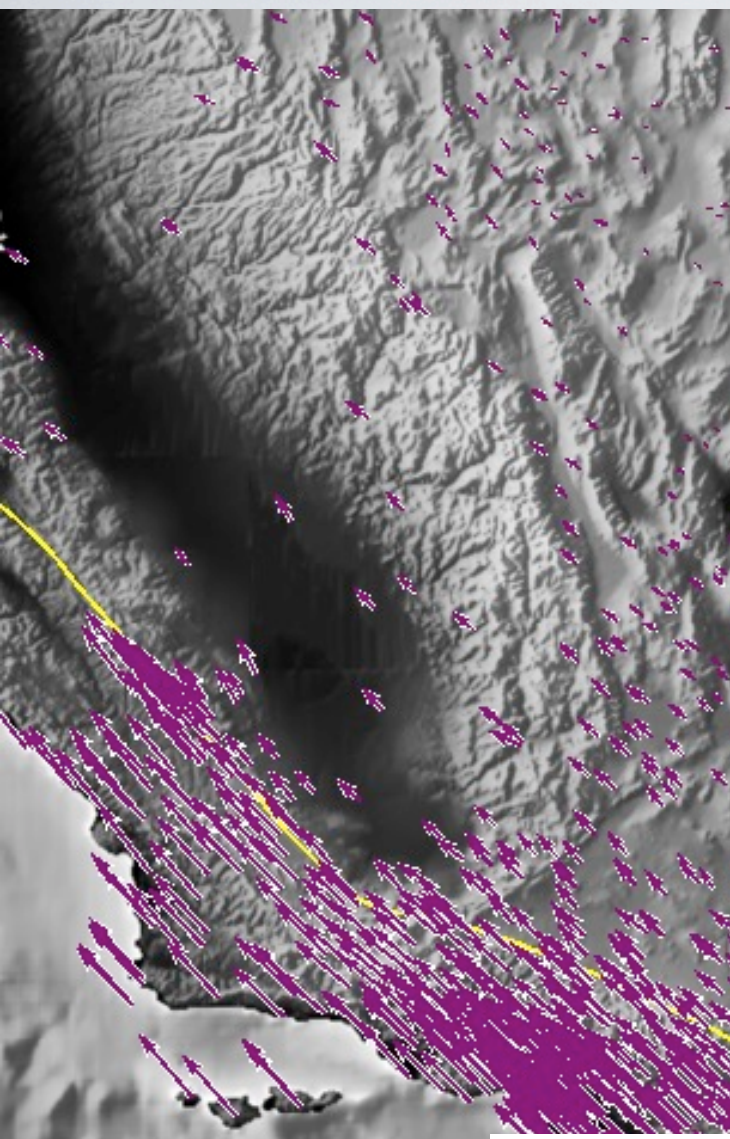


Data Source: UNAVCO Plate Boundary Observatory: North American Reference Frame
UNAVCO GPS Velocity Viewer

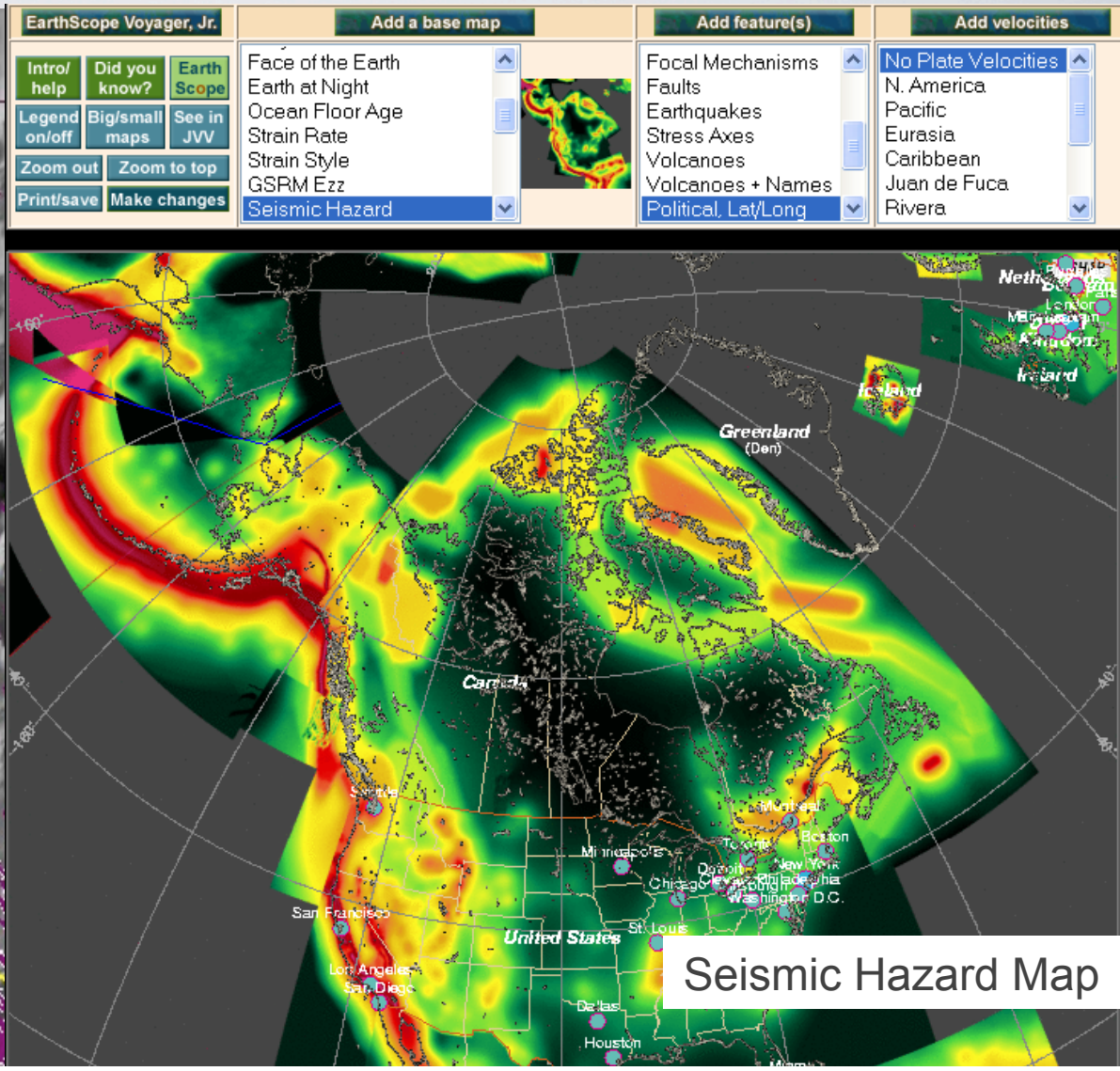
Comparing Plate Movement



Jules Verne & EarthScope Voyager Jr.



Velocity Vector

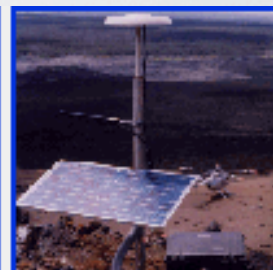


Seismic Hazard Map



UNAVCO & PBO supported science

- Plate movement
- Earthquakes
- Volcanoes
- Glacial movements and isostatic adjustment
- Hydrologic changes
- Atmospheric – water vapor





Study & Apply Geodesy & Measuring Gravity

Geodesy is the science of ...
measuring Earth's

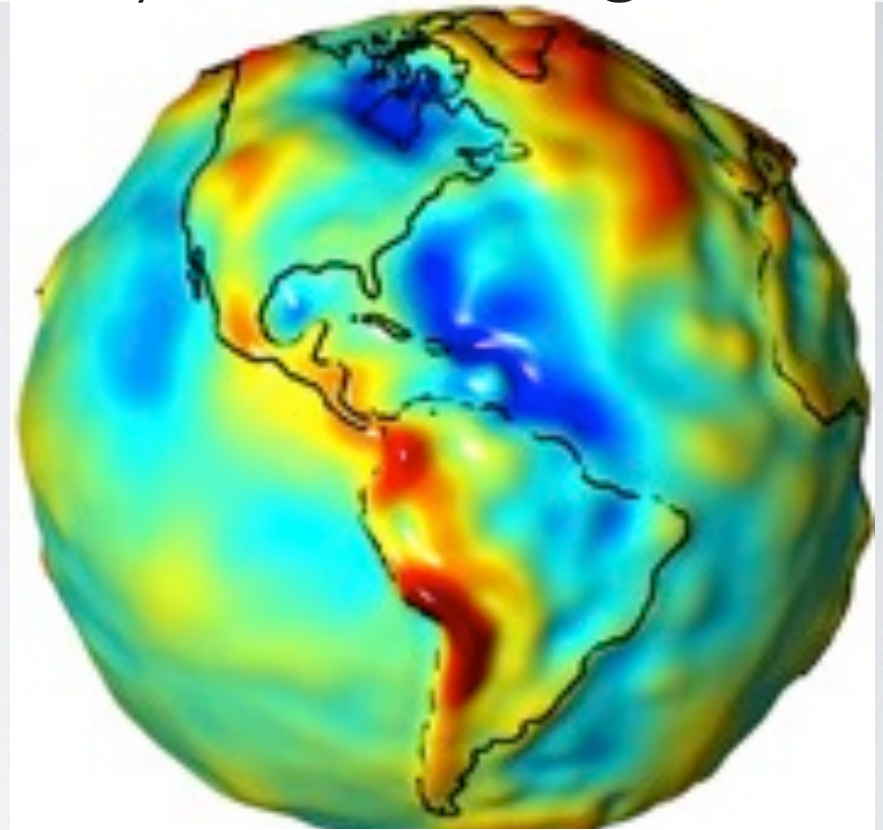
size, shape

orientation,

Gravitational *Field*

And

variations of these
with time



NASA GRACE

Map showing variations in the strength of
the gravitational force over the surface of
the Earth

Blue = less gravity
Red = more gravity

Anatomy of a High-precision Permanent GPS Station



GPS antenna inside of dome

Monument solidly attached into the ground with braces.

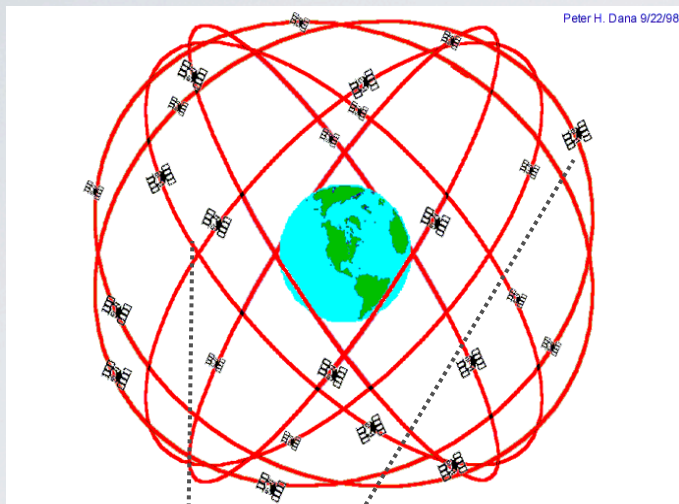
If the ground moves, the station moves.

Solar panel for power

Equipment enclosure

- GPS receiver
- Power/batteries
- Communications/ radio/ modem
- Data storage/ memory

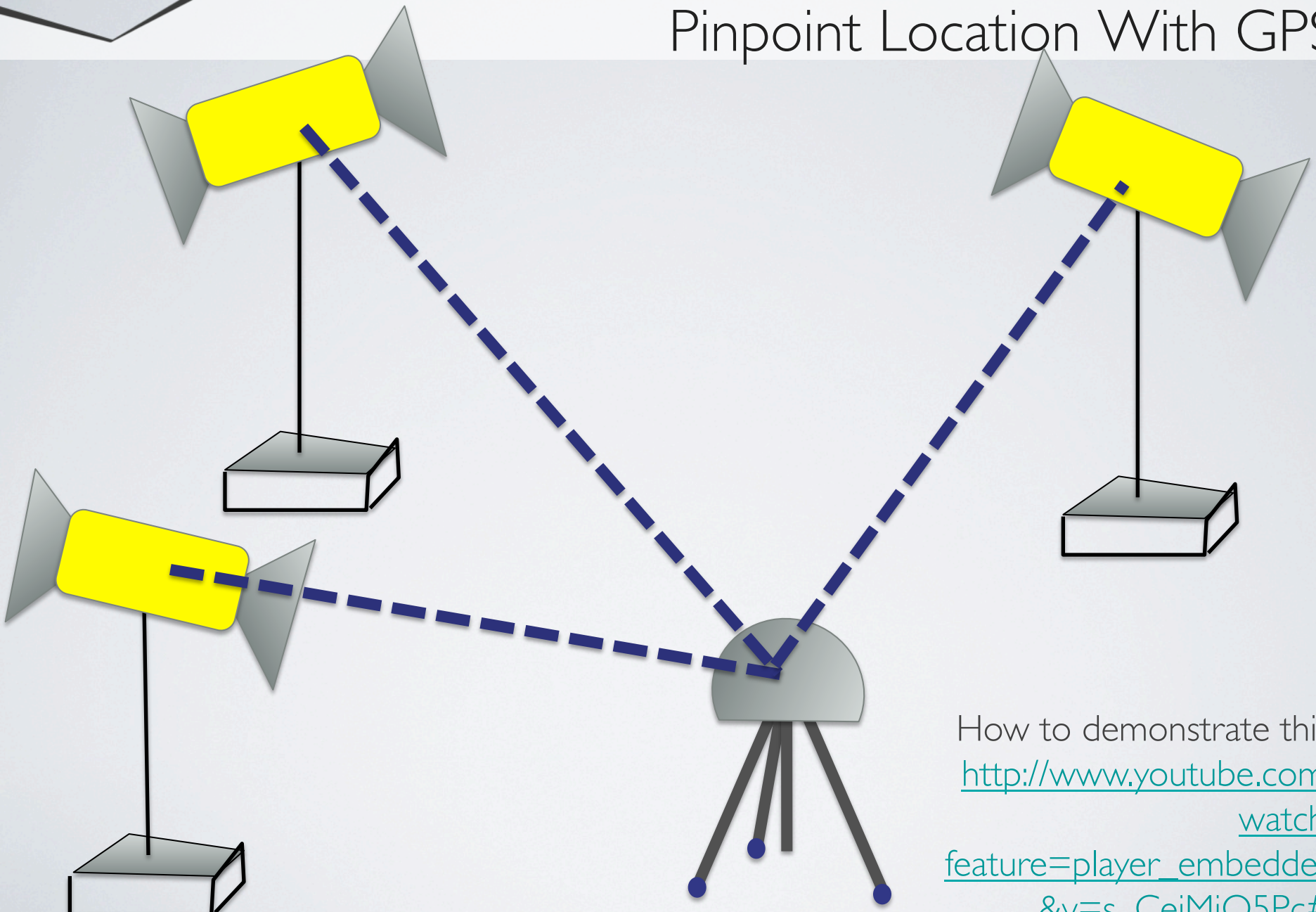
Introduction: GPS Basics



- Four satellite signals are needed to locate the receiver in 3D space.
- The fourth satellite is also used for time accuracy.
- Position can be calculated within to a millimeter.
- Needs ground control and time quality



Demonstration Pinpoint Location With GPS

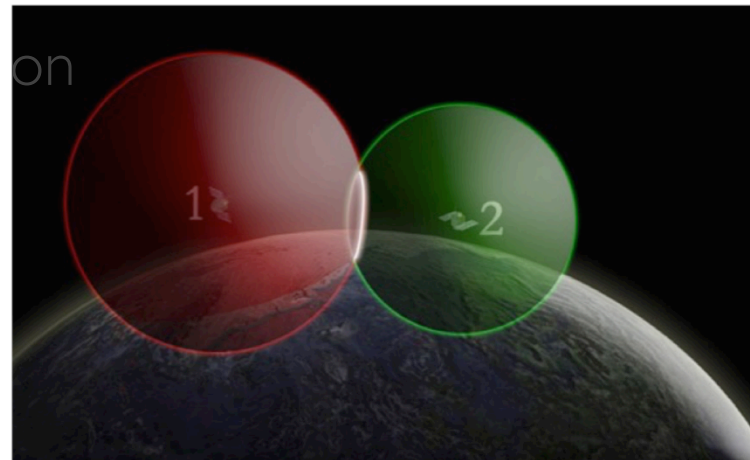
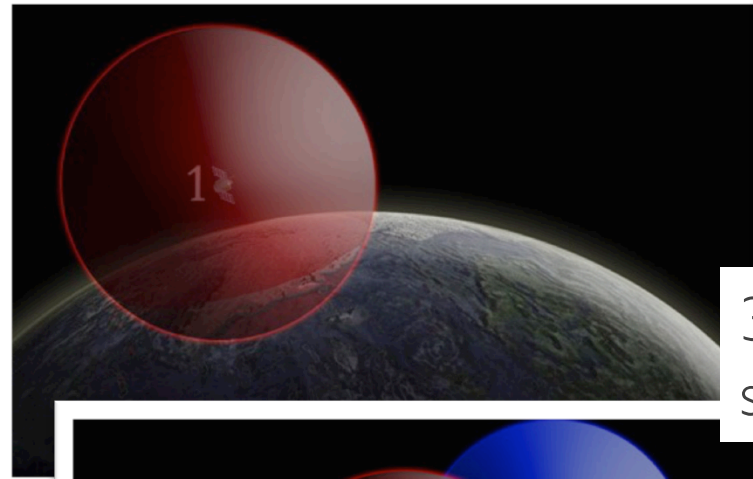


How to demonstrate this:
[http://www.youtube.com/
watch?
feature=player_embedded
&v=s_CeiMjO5Pc#!](http://www.youtube.com/watch?feature=player_embedded&v=s_CeiMjO5Pc#!)



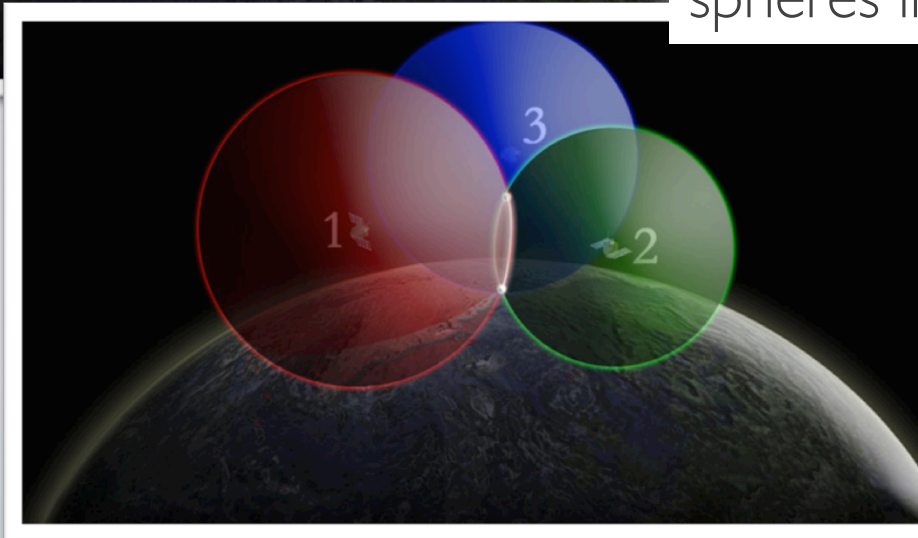
Find your location using GPS – 4 intersecting spheres

One satellite,
the GPS could be anywhere on
the edge of the sphere.



Two satellites,
GPS could be on the circle
where
spheres
intersect.

3 satellites:
spheres intersect in 2 places.



4 satellites,
spheres
intersect in
one place.



Thank You!

Contact: Shelley Olds

[Education –at- unavco.org](mailto:Education-at-unavco.org)

<http://www.unavco.org/>

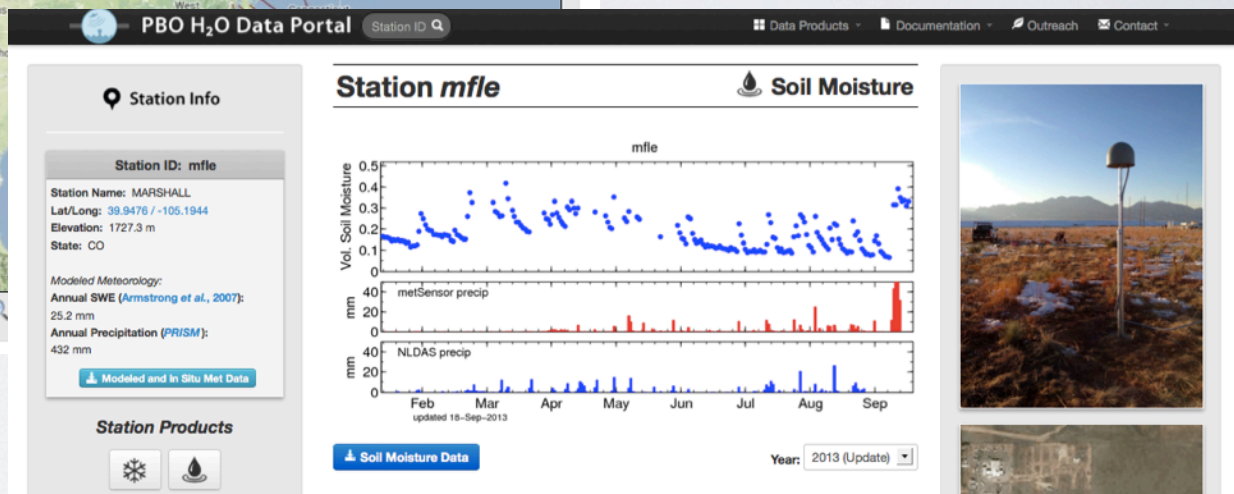
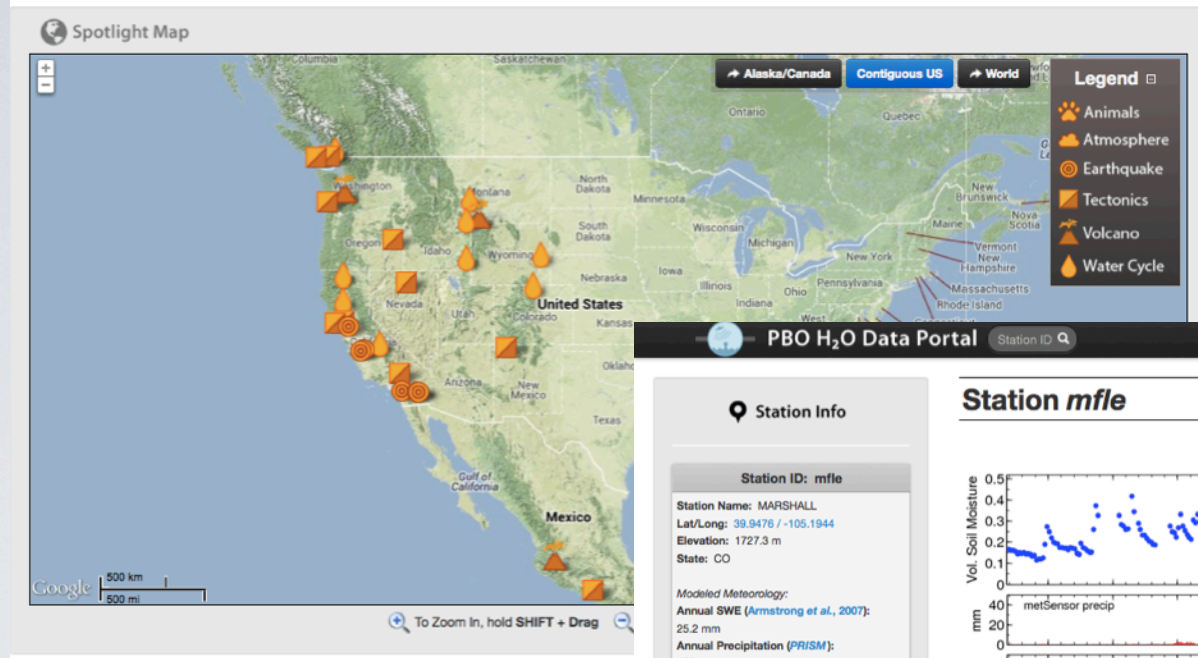
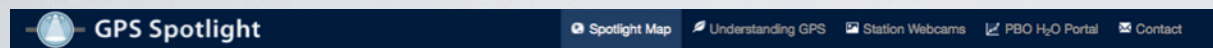
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More websites of interest

Learn more about how GPS works and the science learned through research

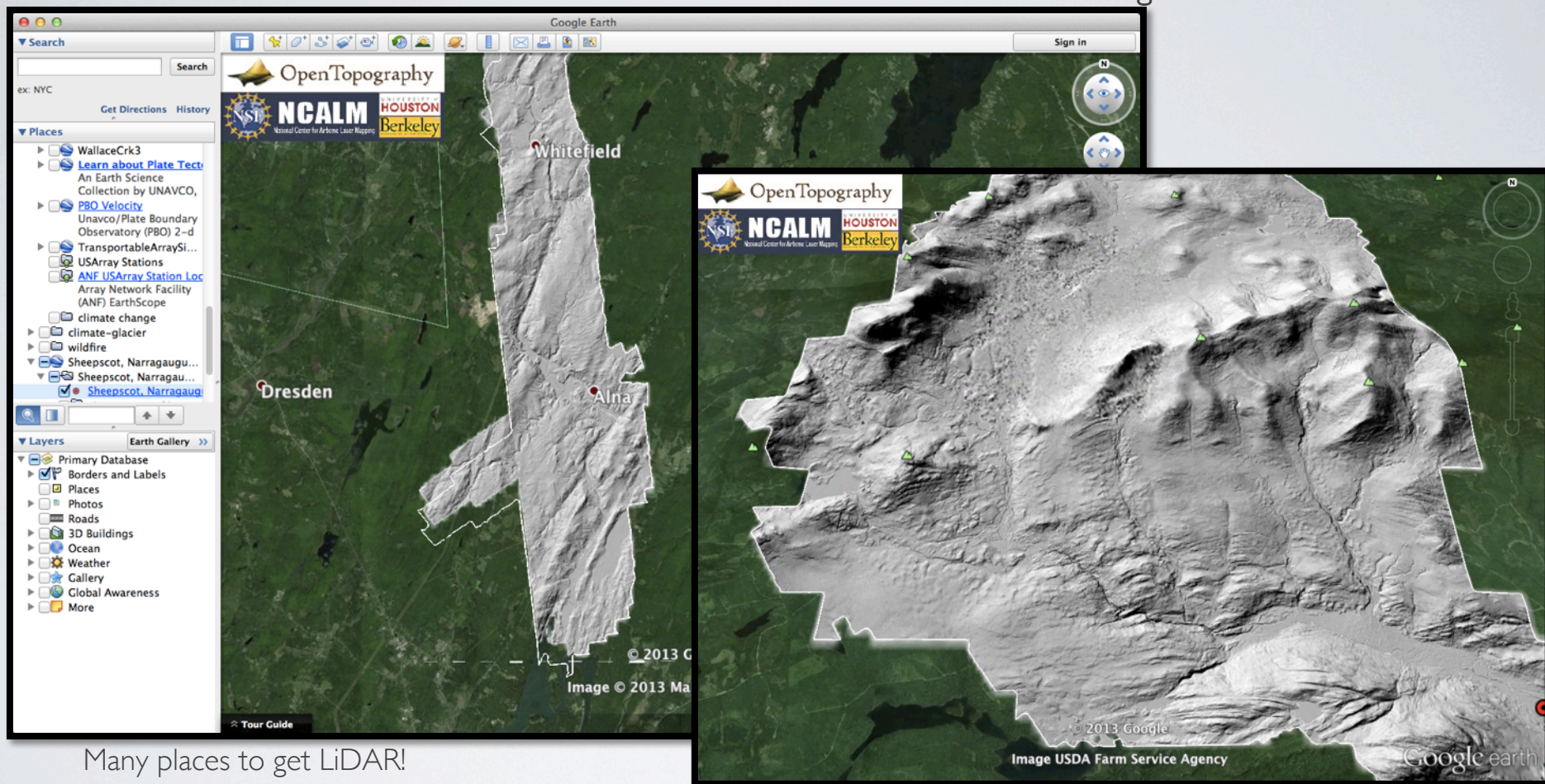


GPS Spotlight: <http://xenon.colorado.edu/spotlight/index.php>

PBO H₂O: <http://xenon.colorado.edu/portal/index.php>

More websites of interest

See the ground and forests with LiDAR



Many places to get LiDAR!

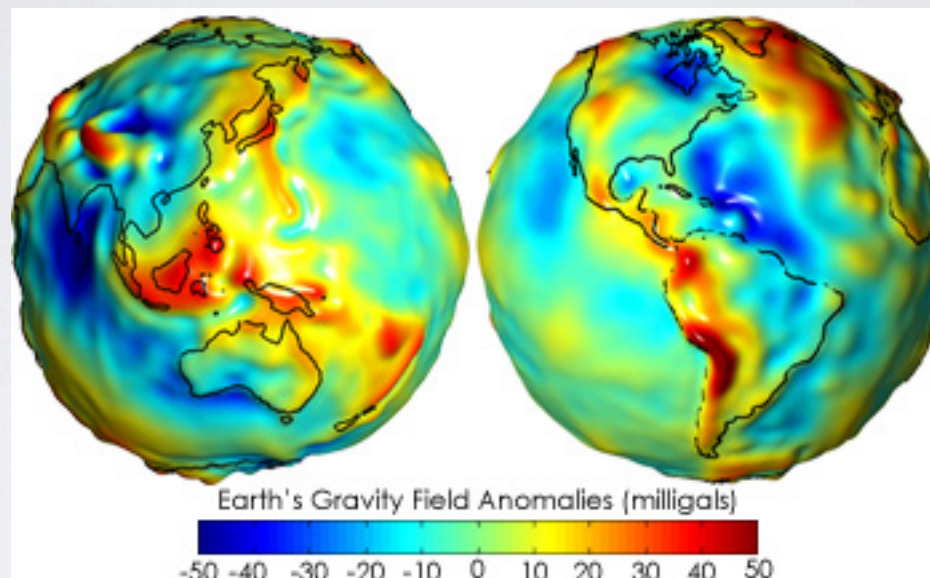
Open Topography: <http://www.opentopography.org/>

New York: <http://gis.ny.gov/elevation/lidar-coverage.htm>

Maine: <http://www.maine.gov/megis/projects/lidar.shtml>

Vermont: http://vcgi.vermont.gov/warehouse/products/ALL-LDR_MIX_LIDAR_STATE_ALL

New Hampshire: <http://www.granit.unh.edu/resourcelibrary/specialtopics/lidar/>



<http://earthobservatory.nasa.gov/Features/GRACE/page3.php>