How fast are we moving?

A quick guide to finding EarthScope Plate Boundary Observatory GPS station(s) near you

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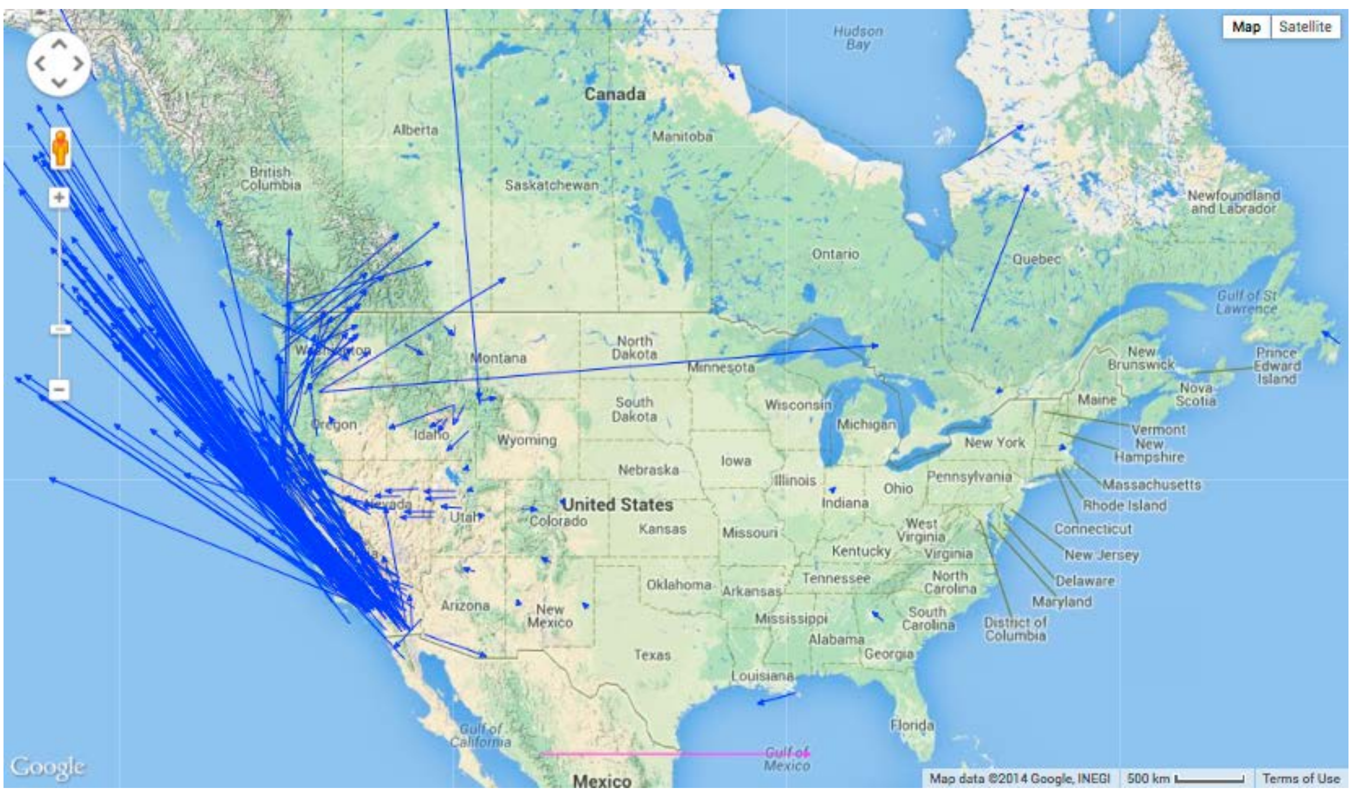
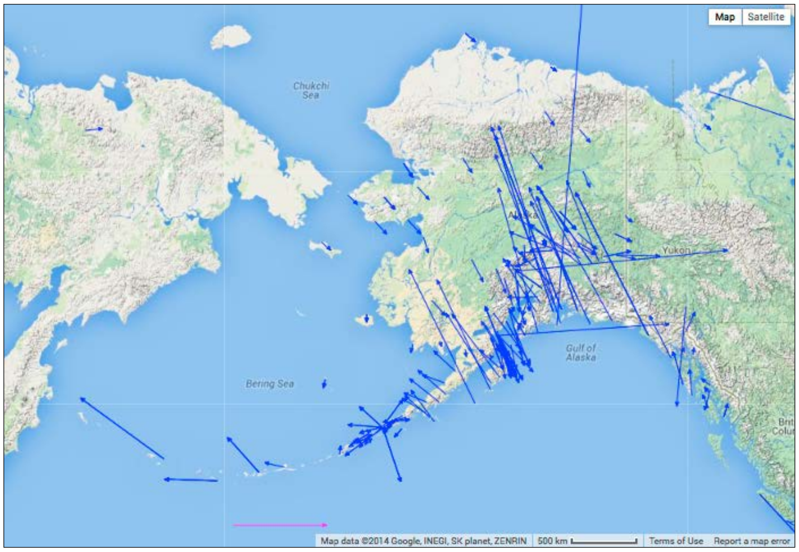
UNAVCO manages the EarthScope Plate Boundary Observatory of GPS stations in the United States on behalf of the National Science Foundation and manages other networks around the world. This data is free to the public and can be used to study plate motions, plate and regional deformation, regional hydrologic, volcanic, and other motions.

Quick look: On the maps below, find the closest GPS velocity vector arrow to your school, park, or favorite location.

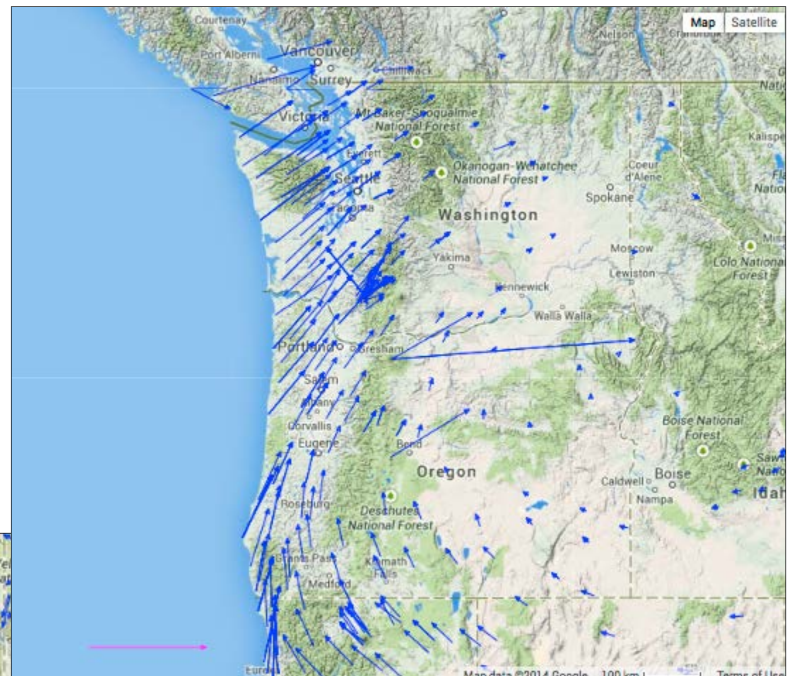
- Each vector arrow shows the velocity of a single GPS station installed permanently to the ground. If the Earth moves, the GPS stations record this movement.
- The GPS **vector's tail** is the starting location of the GPS monument.
- The **direction the vector points** is the direction the GPS station is moving.
- The **length of the vector** shows how fast the GPS station is moving.

- Keep in mind that there might be faults, such as the San Andreas fault, between your place and nearby GPS stations.



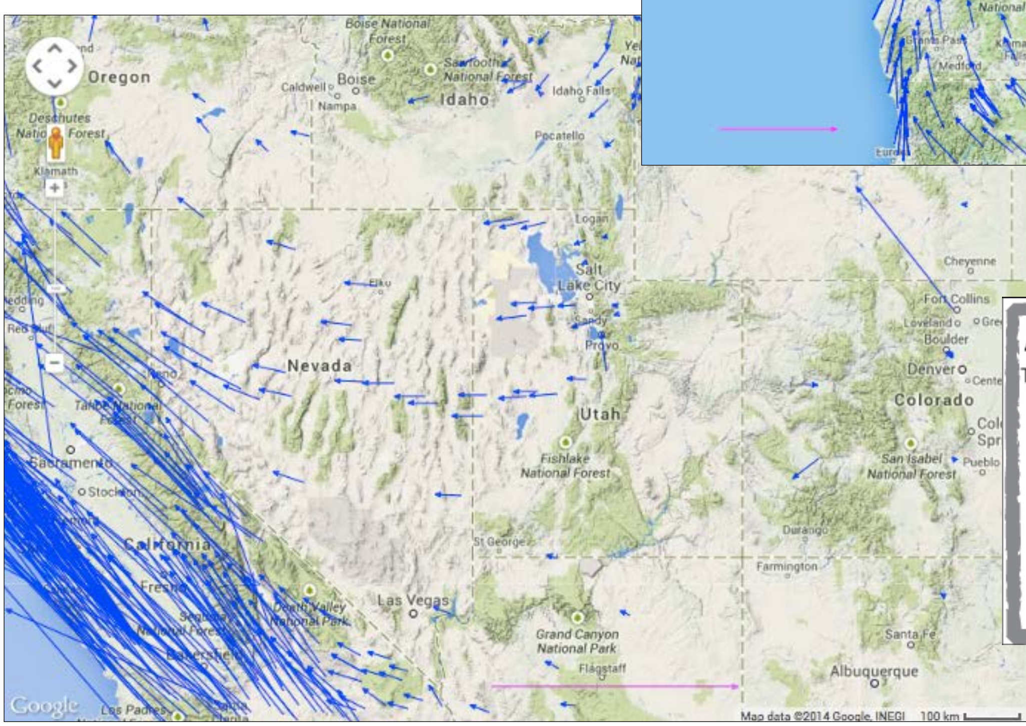


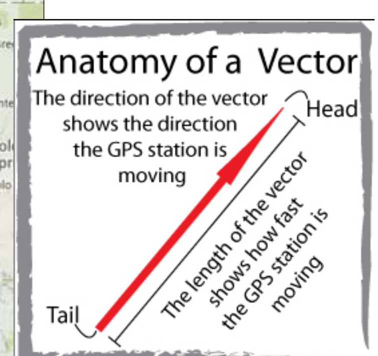
Note about plate motion and reference frames:
Every tectonic plate on Earth is in motion. Scientists compare the motion relative to another tectonic plate to view the differences in motion. The maps shown here and above use the North American Reference Frame where the interior regions of North America, such as Kansas or Nebraska, are not moving.



Changing the reference frame changes the perspective of plate motion; the vectors will change length and direction.

The purple vector at the bottom of the map illustrates a vector moving 25 mm/yr.

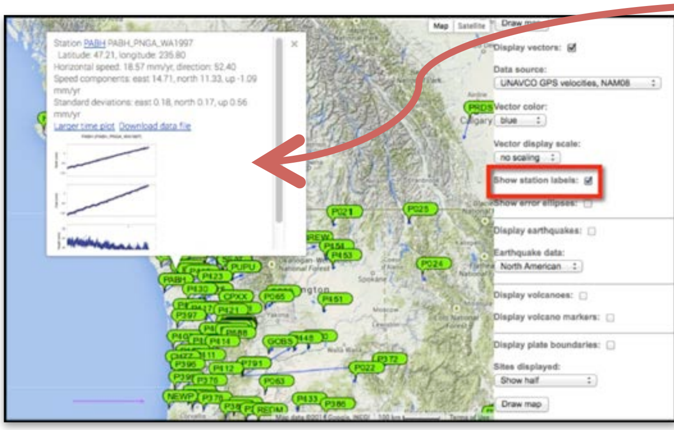




UNAVCO earthscope

I. To explore plate motion and deformation by viewing the GPS velocity vectors near a favorite place:

1. **Explore further:** Google Search for *UNAVCO Velocity Viewer*.
2. Use the **Data Source** *UNAVCO GPS velocities, NAM08* to use the North America Reference Frame. The interior of the North American plate is set to zero to more easily see motion and deformation of the edges of the plate boundary. Or choose another plate as your reference frame.
3. Change *Sites displayed*, select ***show one in ten*** to help the map display more quickly.
4. **Once you have zoomed into an area,** display more vectors using *Sites displayed*, such as *show one in three*.
5. **Are the vectors very short?**
   - In the mid-continent, the North American plate does not move much in the North America Reference Frame - change the **Data Source** to see how the mid-continent moves compared to another reference frame.
   - Change the length of the vectors using *Velocity display scale***.**



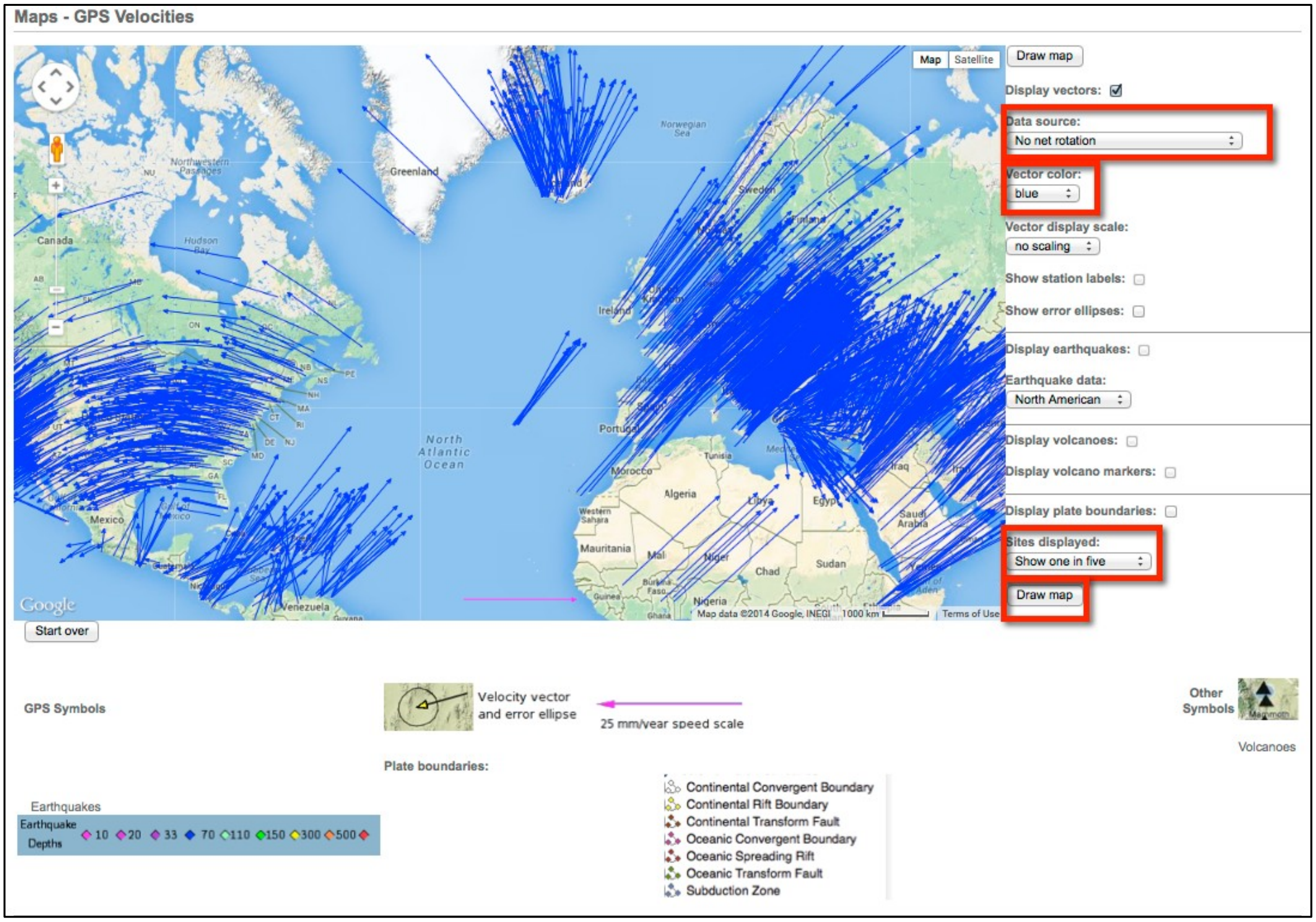
6. Learn more about the motion of one GPS station.

- **Click a green balloon** on the map to show
- Select ***Show Station labels and Data Download*** then ***Draw Map***
  - The GPS station name.
  - Horizontal speed – of the ground beneath the GPS station.
  - The direction of motion in degrees from North.
  - GPS time series plots and data download (for UNAVCO GPS stations).

7. Further customize your map by using the controls at the side of the map.
   - ➢ *Velocity display scale* changes the length of the vectors.
   - ➢ *Velocity vector color changes the color of the vectors.*
   - ➢ *Error ellipses* – Shows the relative accuracy of the GPS data. A small ellipse at the arrowhead (or no ellipse at all) is more accurate than a large ellipse
   - ➢ View the *tectonic plate boundaries*, *faults,* recent *earthquakes*, *volcanoes, and vertical velocities* by turning their symbols on and off.
8. To learn more about graphing this data, see a step-by-step tutorial: http://serc.carleton.edu/eet/platemotion/all_parts.html

Guiding Questions as You Explore:

- Find areas with high rates of motion - where are these areas? Find areas that have high rates velocities near low velocities… or different directions from each other. What could this mean long term?'
- Look at the same part of the world and view with different reference frames. What do you notice?
- Using just the GPS velocity vectors, can you predict the types of plate boundaries in different areas of the world? Check your predictions by turning on the plate boundaries layer. What other types of data are useful for understanding the plate motions? How do they complement each other?



II. Five steps to show the spreading of the mid-Atlantic ridge:

- **Google Search for *UNAVCO Velocity Viewer*.** The viewer starts zoomed in on the western United States and shows the overall velocities measured at a subset of GPS stations in the Plate Boundary Observatory network.

1. **Move** and **Zoom out** the map to show Europe and the East coast of the United States.
2. Under *Data Source*, choose ***no net rotation.***
3. Under *vector color*, choose ***blue.***
4. Under *Sites displayed*, select ***show one in ten.***
5. Click on **"*Draw map*".**

Now that you have explored the plate motion for one location, roam the world and discover what you can find! Where can you find where plates collide, split apart, and slide past each other? How about the plate boundaries – where are they narrow? Where are there wide boundary zones?