Velocity maps

Teacher Guide

In this activity, students manipulate velocity vectors that they pulled from GPS time series data. Their immediate goal is to determine the total horizontal velocity for each station. This activity is an early step in the activity "Determining strain graphically."

Instructor's notes

Students will need to have N-S and E-W velocity vectors associated with the three NOTA GPS sites in hand for this exercise. You can provide it, or they can seek it out themselves. Students learn how to get the data in the lab sheet for "Determining strain graphically." See "Getting Started with GPS" for a lengthier explanation of how to download NOTA GPS station data, along with a worked example. These instructions assume that you will tell your students which three GPS stations they will work with.

You will want to prepare a map for your students to work on like that in Figure 1. The map will be the second page of their handout. You will need to add your base map.

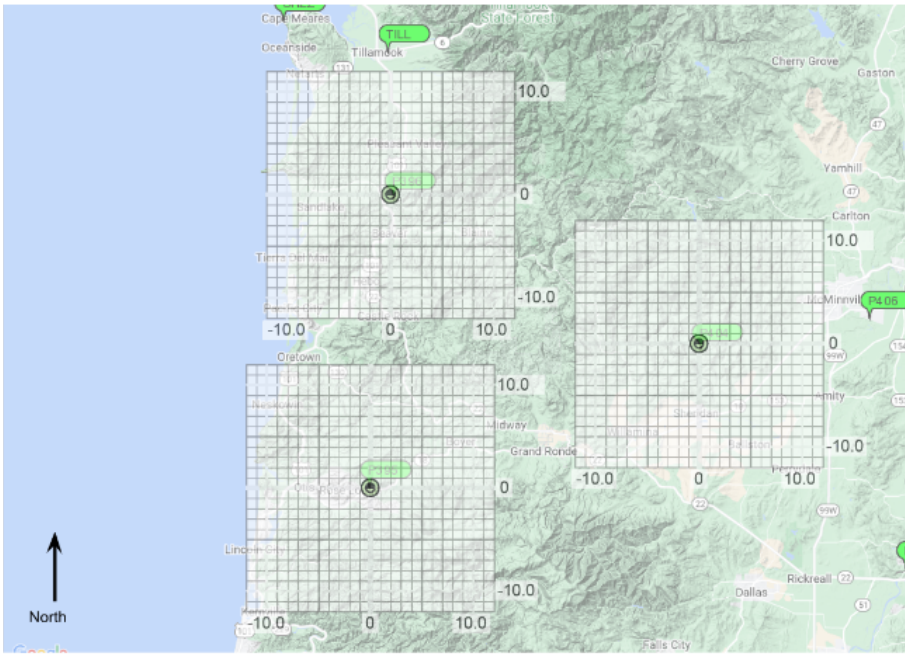
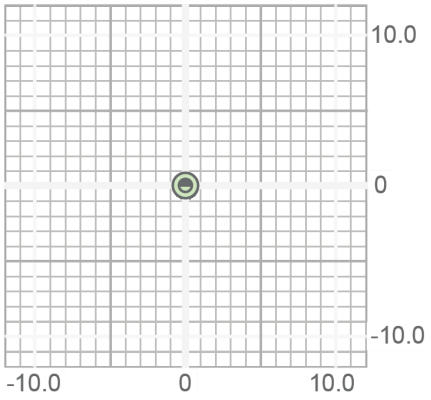


Figure 1. Example of a base map with grids placed over the GPS station symbol and a grid upon which students draw velocity vectors.



1. You will need to identify three GPS stations that will show something that fits into your content. Consider these sets:

Strike-slip faulting on the San Andreas fault: **P538, P539, P541**	Used as examples in "GPS strain analysis examples," with an explanation of how the tectonic setting influences the strain
Normal faulting along the Wasatch front: **P116, P088, and COON**	
Compression, rotation, and episodic tremor and slip in the Cascadia subduction zone: **NEAH, P401, and P403**	
Deformation along the Oregon Coast ranges: **P395, P396, and P404**	Used as an example for retrieving data from GPS in "Finding location and velocity data for NOTA GPS stations"
Deformation in Oregon's coastal ranges: **CHZZ, P395, and P406**	Picked arbitrarily to work the examples shown in Appendix A

2. Once you have chosen three stations, use the UNAVCO Velocity Viewer to make a base map. Take a screenshot of the map and leave space around the edges, or the next step becomes a challenge.

Before going further, download the Velocity Map Student Worksheet. This is provided as a MS Word file (in the absence of MS Word, you can convert it to Google docs and still complete the described process NOTE: The Velocity Map IS included in the student worksheet packet but it cannot be used as described as a PDF.

3. Insert the base map into the second page of the student lab sheet. Under Format Picture, make the map about 50% transparent so that pencil lines can be seen. Also, set the Layout option to Square.
4. Copy and paste the grid in Figure 1, also on the student sheet, over the icon for a GPS site. You can adjust with the grid's transparency if the setting that it currently has does not work.
5. Repeat for the other two stations.
6. Replace "XXXX" on the student sheet with station names.
7. Have your students do the exercise.
8. Discuss, in small groups or as a class, what they can infer about strain in the area defined by the triangle of GPS stations—based solely on the horizontal velocity vectors.
9. Move on to the rest of "Determining strain graphically." Students can stop with the graphical analysis or go all the way through the activity, culminating in quantitative analysis done by a spreadsheet calculator.

Optional

Ask students also to get a sense of distances between sites. They could do this:

- on a map with a scale (although probably with grumbling);
- with the ruler tool on Google Earth. If students open the Add menu, they can add a placemark by entering latitude and longitude. They can then click and drag the ruler

between two placemarks (showing as pushpins) to learn the distance and azimuth between them; or

- with an on-line calculator into which they plug in latitude and longitude. An example is the National Hurricane Center's calculator. (Search for "NOAA latitude longitude calculator.")

When completed, student worksheets will look something like the image below.