



## Unit 6: GPS-Strain Module Final Research Project

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### Assignment

Identify a set of three adjacent PBO GPS sites that are located in an area of active crustal strain and have some nearby population and/or infrastructure (dams, transportation corridors, energy sources, or corridors). The sites should form a triangle whose interior angles are all greater than  $\sim 30^\circ$  and with no side is more than  $\sim 100$  km in length. An efficient way to identify an area where there is active crustal strain is to consult the Quaternary Fault and Fold Database of the United States online via <http://earthquake.usgs.gov/hazards/qfaults/>.

After you have identified three PBO GPS stations that you intend to study, do the following, at a minimum:

1. Compile the location and velocity data required for the GPS triangle-strain analysis.
2. Create an accurate map showing the relative locations of the three GPS sites, their component velocity vectors (N–S and E–W), and their total velocity vectors. (See Google Earth map-making directions on the following page.)
3. Input the location and velocity data into the strain calculator that you used in earlier exercises (Excel or MatLab).
4. Create an accurate map showing the relative locations of the three GPS sites, a circle that is concentric with (has the same center as) the triangle between the sites, and an exaggerated-but-proportionate strain ellipse concentric with the circle that accurately indicates the nature of the instantaneous horizontal strain in the area between the GPS sites.
5. Create an accurate map showing the relative locations of the three GPS sites, the strain ellipse, and the trace of all active faults in the map area, along with appropriate map indicators of the type and sense of motion of the faults.
6. Use the Strain Ellipse Visualization tool to make a strain ellipse figure.
7. Create and deliver a PowerPoint presentation of 5–7 minutes duration that includes:
  - a. Study area location and PBO GPS stations used
  - b. Why this area is of geologic interest
  - c. Maps you created (as detailed above)
  - d. Results (output of the strain calculator and strain ellipse visualizer)
  - e. Explanation/interpretation of the results with reference to active faulting in the area and your assessment of the type of earthquake hazard and risk considerations for local communities
  - f. Potential mitigation strategy/ies to reduce an identified earthquake risk and likely challenge for implementation
  - g. In the Notes section of the PowerPoint slides, write in what you intend to say during the presentation that is not already part of the main slide text. Include references and image sources, if any.
8. Digital documents to be turned in the day of the presentation:
  - a. Strain calculator file with your sites' data (if you used the Excel calculator)
  - b. Your PowerPoint file including the presentation slides and the associated Notes.

- c. Short Word document in which you reflect on this module and answer the questions:
- i. How have your ideas of earthquake hazard and ongoing strain changed over the course of this module? Give specific example/s.
  - ii. What would be a further application you would undertake with these or related tools/data?

Quick directions for making velocity graph plots in Google Earth

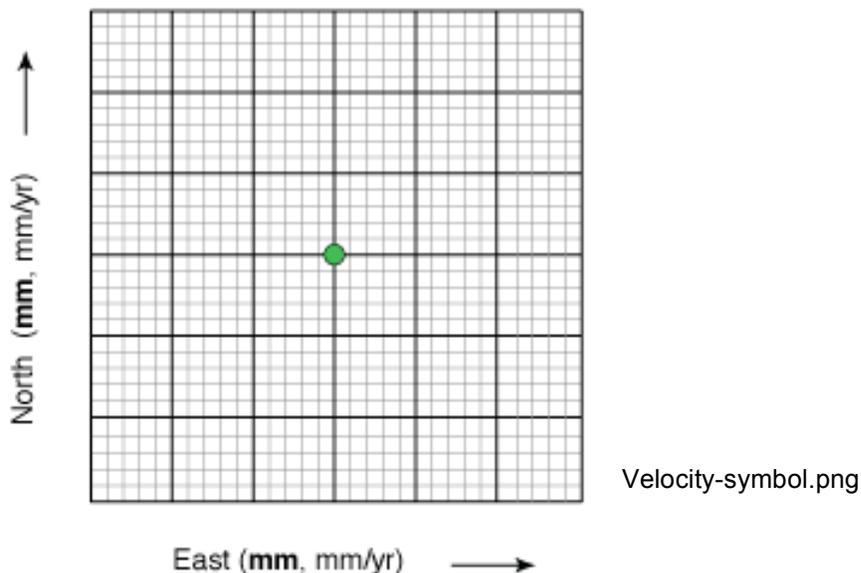
“Add” a placemaker in Google Earth.

An appropriate graphic file called "velocity-symbol.png" has been made available to you (example below).

Drag it to the appropriate location

In the info box you can (also available later by right-clicking on any map item in the “Places” window):

1. Rename your marker to the station name
  2. Click on the marker symbol to change it
- To change to a custom graph marker similar to that used in the class exercises:
- a. Choose “Add Custom Icon...”
  - b. Browse to the location where you have saved the image file “velocity-symbol.png”
  - c. Click Open and then OK
  - d. Under Style, Color you can adjust the symbol size and opacity to get the look you want.



## Rubric

You will be graded on the assignment according to the following rubric.

	<b>Exemplary</b>	<b>Good</b>	<b>Basic</b>	<b>Nonperformance</b>
<b>Overview and selection reason</b> (10 points)	9–10 points: <u>Clearly</u> shows chosen region and specific GPS stations and <u>provides specific</u> geologic and scientific and/or personal reasons for site selection.	7–8 points: <u>Shows</u> chosen region/GPS stations and <u>provides</u> geologic and scientific and/or personal reasons for site selection.	5–6 points: <u>Some</u> understandable explanation site locations and reason for site selection.	0–4 points: <u>No reference</u> to site locations and reason for site selection OR location and reason given were <u>not understandable</u> .
<b>Accurate calculations</b> (15 points)	14–15 points: Strain calculator used <u>entirely correctly</u> .	11–13 points: Strain calculator results have <u>minor error</u> .	8–10 points: Strain calculator results have <u>minor errors</u> .	0–7 points: Strain calculator results <u>mostly or entirely wrong</u> .
<b>Required maps</b> (15 points)	14–15 points: All maps specified in the original assignment are included with <u>very clear and accurate</u> vectors and other required components.	11–13 points: All maps specified in the original assignment are included with <u>mostly clear and accurate</u> vectors and other required components.	8–10 points: <u>Most or all</u> of the maps are included with the required components but <u>messy or inaccurate</u> items hinder understanding.	0–7 points: <u>Multiple maps missing or required components not included</u> to the point that little is understood by the audience.
<b>Geological interpretation</b> (15 points)	14–15 points: Interpretation is <u>clearly stated</u> and <u>directly tied</u> to GPS velocities and regional faults. Surprising results are discussed.	11–13 points: Reasonable interpretation is <u>stated</u> and <u>tied</u> to GPS velocities and regional faults.	8–10 points: Interpretation is <u>stated</u> and <u>tied</u> to GPS velocities and regional faults but <u>details may be confused</u> or unclearly stated.	0–7 points: Key elements of the interpretation are <u>missing, wrong, or unclearly stated</u> to the point that little is understood by the audience.

<b>Hazard-risk assessment</b> (15 points)	14–15 points: <u>Direct and specific evidence</u> is provided to link geologic interpretation to <u>correct</u> earthquake hazard, particular risks faced by local communities, and possible mitigation and implementation challenges.	11–13 points: Geologic interpretation is <u>tied to correct</u> earthquake hazard, risks faced by local communities, and possible mitigation and implementation challenges.	8–10 points: Geologic interpretation is <u>tied to mostly correct</u> earthquake hazard and risks faced by local communities. Mitigation not included or not fully relevant.	0–7 points: <u>Little or no mention</u> of earthquake hazard, community risk, and mitigation OR the mention is <u>incorrect</u> .
<b>Slide composition</b> (5 points)	5 points: Slides are <u>very visually appealing</u> with <u>very clear but concise</u> text.	4 points: Slides have both graphics and text and are <u>definitely understandable</u> .	2–3 points: Slides have both graphics and text and but are <u>somewhat hard to understand</u> .	0–1 points: Missing or poorly composed <u>graphics/text impede understanding</u> .
<b>Slide notes</b> (5 points)	5 points: <u>Thorough and accurate</u> notes accompany all slides.	4 points: <u>Reasonably complete and accurate</u> notes accompany all slides	2–3 points: <u>Mostly understandable</u> notes accompany most or all slides.	0–1 points: <u>Notes absent or poorly written</u> to the point of being not understandable.
<b>Talk delivery style</b> (5 points)	5 points: <u>Excellent</u> delivery with <u>all</u> of the following: clear diction, easy-to-follow transitions, audience eye contact, confident tone, and voice modulation.	4 points: <u>Good</u> delivery with <u>most</u> of the following: clear diction, easy-to-follow transitions, audience eye contact, confident tone, and voice modulation.	2–3 points: Talk was <u>largely understandable</u> but lacked compelling delivery style.	0–1 points: Talk was <u>very hard or impossible</u> understand due to poor delivery style.
<b>Time limit</b> (5 points)	5 points: Finished talk within <u>30 seconds</u> of time limit.	4 points: Finished talk within <u>1 minute</u> of time limit.	2–3 points: Finished talk within <u>1.5 minutes</u> of time limit.	0–1 points: Had to be stopped or >1.5 short of limit.

<b>Reflection</b> (10 points)	9–10 points: <u>Detailed</u> and <u>thoughtful</u> answer about learning experience with <u>supporting evidence</u> .	7–8 points: Question <u>answered with at least some</u> supporting evidence.	5–6 points: Some answer about the learning experience but <u>may lack thoughtfulness</u> or supporting evidence	0–4 points: Answering lacking or inadequate and incomplete.
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