GPS Triangle-Strain Project

Refer to the grading rubric as you prepare your project: http://CroninProjects.org/Vince/Geodesy/GPS-Strain-Project-Rubric.pdf . Identify a set of three adjacent PBO GPS sites that are located in an area of active crustal strain. The sites should form a triangle whose interior angles are all greater than ~30°. 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/

Given three suitable PBO GPS sites, you are to do the following, at a minimum.

(1) Compile the location and velocity data required for the GPS triangle-strain analysis. For example, complete http://CroninProjects.org/Vince/Geodesy/GPS-strain-datasheet.pdf

(2) Create an accurate map showing the relative locations of the three GPS sites and their component velocity vectors (N-S and E-W), choosing an appropriate secondary scale for the velocity vectors (e.g., 1 cm = 1 mm/yr) so that the largest vector arrow still fits within your map.

(3) Create an accurate map showing the relative locations of the three GPS sites and their total velocity vectors

(4) Input the location and velocity data into the Excel strain calculator that was distributed in class and that is available online via https://d32ogoqmya1dw8.cloudfront.net/files/getsi/teaching_materials/gps_strain/gps_strain_calculator_excel.v3.xls

RENAME the spreadsheet that has your data, using your last name as the beginning of the new spreadsheet name. For example, I might use Cronin-GPS-project.xls . Do the same if you use one of the other strain calculators (e.g., in *Mathematica* or *MatLab*).

(5) 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.

(6) 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.

(7) Create and deliver a PowerPoint presentation of 5 minutes duration that describes where your study area is, why this area is of geologic interest, which PBO GPS sites were used, includes the maps you created, presents the results (output of the Excel triangle-strain calculator), and explains/interprets the results with reference to active faulting in the area. The text of your presentation should be in the "notes" part of the PowerPoint file that you will turn in.

Your presentation will be recorded with a digital video camera.

Digital documents to be turned-in the day of the presentation:

- gps-triangle-strain-calculator.xlsx with your sites' data, ***RENAMED*** using your last name, and
- your PowerPoint file including the presentation slides and the associated text, ***USING YOUR LAST NAME*** in the name of the file.

Files/sites you might want to use as you prepare your project

PowerPoint files

Introduction to GPS http://CroninProjects.org/Vince/Geodesy/GPS_Intro.ppt

Introduction to the GPS triangle-strain problem
http://CroninProjects.org/Vince/Geodesy/GPS_Triangle_Strain.ppt

Word/Acrobat files

Primer on instantaneous strain http://CroninProjects.org/Vince/Geodesy/GPS_Strain_Primer.doc

Algorithm for triangle strain http://CroninProjects.org/Vince/Geodesy/TriangleStrainAlgorithm.doc

How to find PBO GPS data http://CroninProjects.org/Vince/Geodesy/FindingGPSdata.pdf

How to interpret the strain calculator output:
https://d32ogoqmya1dw8.cloudfront.net/files/getsi/teaching_materials/gps_strain/explanation_gps_strain_calculator.v3.pdf

Library of triangle-strain images http://CroninProjects.org/Vince/Geodesy/TriangleStrainPics.pdf

Vectors and simple vector math summary sheet http://CroninProjects.org/Vince/Geodesy/VectorSummary.pdf

Matrices and simple matrix math summary sheet http://CroninProjects.org/Vince/Geodesy/Matrices-and-Matrix-Math.pdf

How to do orthogonal coordinate transformations: http://CroninProjects.org/Vince/Geodesy/orthogonal-coord-transform.pdf

How to find eigenvectors: http://CroninProjects.org/Vince/Geodesy/FindingEigenvectors.pdf

GPS triangle strain calculator...

... in *Excel*:
https://d32ogoqmya1dw8.cloudfront.net/files/getsi/teaching_materials/gps_strain/gps_strain_calculator_excel.v3.xls

... in *Mathematica*: http://croninprojects.org/Vince/Geodesy/Calculators/gps-strain-calculator-mathematica.pdf

... in *MatLab*:
https://d32ogoqmya1dw8.cloudfront.net/files/getsi/teaching_materials/gps_strain/gps_strain_calculator_matlab.zip

Web

Plate Boundary Observatory, GPS network map, maintained by UNAVCO
http://www.unavco.org/instrumentation/networks/status/pbo

GETSI student resources for the GPS, Strain, and Earthquakes module:
https://serc.carleton.edu/getsi/teaching_materials/gps_strain/student_materials/index.html

Quaternary Fault and Fold Database of the United States, maintained by the USGS with help from numerous state agencies http://earthquake.usgs.gov/hazards/qfaults/