**Using GPS data to analyze crustal strain**

**or**

**Where *is* the boundary between the Pacific and North American plates?**

INSTRUCTOR NOTES:

This is an adaption of the UNAVCO Educational Module “Infinitesimal strain analysis using GPS data,” authored by Vince Cronin (Baylor University), Shelley Olds (UNAVCO), Beth Pratt-Sitaula (UNAVCO), Phil Resor (Wesleyan University), and Nancy West (UNAVCO) with technical input provided by William Hammond and Corne Kreemer (University of Nevada Reno). It also borrows from an adaption of the module by Anne Egger at Stanford.

[*http://www.unavco.org/edu\_outreach/resources/gps-strain/majors-gps-strain/majors-gps-strain.html*](http://www.unavco.org/edu_outreach/resources/gps-strain/majors-gps-strain/majors-gps-strain.html)

Princeton graduate student Jonathan Husson has written additional Matlab code that calls upon Resor’s Matlab strain calculator, and then plots the strain ellipses for triads of stations. We have the students use this to plot multiple ellipses in the study area - after they have paid their dues and done a triad graphically by hand, and get a physical feel for how the method works.

Excellent resources explaining the graphical method are two PowerPoint presentations available at UNAVCO module website: “Intro to GPS” and “Using triangle of GPS velocities to determine strain.”

Husson modified the MATLAB analysis of the GPS data by writing two companion functions, and slightly altering the '**calcstrain**' function:

The function '**makemap**' creates a base map of southern California, with select cities labeled and GPS stations shown as black dots (this function uses the '**m\_map**' MATLAB mapping package, available freely online).

The function '**pickstations**' works with a culled dataset of North American GPS station data, and allows the user to select three stations that will be used to calculate crustal strain.

Finally, '**calcstrain**' has been slightly modified. Strain is now reported as nanostrain, and the strain ellipse is plotted on the base map (using the function 'calculateEllipse', found on the internet).

The absolute dimensions of the strain ellipse are arbitrary; the principal strain axes (in nanostrain) are added to a circle of radius 500, then each is multiplied by 25. These exaggerations are for convenience, and were chosen based on trial-and-error experimentation with the codes to maximize clarity for student users. Even though strain ellipse dimensions are arbitrary, the ellipse orientation is correct.