GEOL 495/695 Geophysical Geodesy: Project Templates and Ideas

Class Presentations will occur on December 1 & 3. Write up is due December 8.

Below are some ideas for projects that can be used as described, changed to more closely follow your own research interests, or totally ignored in favor of different project ideas you may have. Check with Bill if you have a different idea you would like to pursue.

Project Idea #1: SCEC community exercise, infer unknown geophysical event from synthetic data
Starting data: Synthetic dataset Phase I or Phase II
End product: Estimate of source model
Challenges: May be a complex source with multiple individual events over time and space
Reading: See google groups site: http://groups.google.com/group/SCECtransient

Project idea #2. Transient event: Slide Mountain PBO site SLID.
Starting data: PBO GPS time series
End product: Model of continued activity
Challenges: small signal, not necessarily significant, no PBO time series data before 2004
Reading: Smith et al., 2004, von Seggern et al., 2008

Project idea #3 : Parkfield 2004 (or other) earthquake.
Starting data: PBO GPS time series
End product: Model of coseismic slip and postseismic
Challenges: complex signal with co- and post-seismic components
Reading: Langbein et al., 2006; Harris and Arrowsmith, 2006

Project idea #4: Secular Strain in Earth's crust: San Francisco Bay area/Carrizo Plain
Starting data: PBO Velocity field
End Product: Model of secular slip on relevant faults
Challenges:
Reading: Savage et al., 2004; Savage et al., 2001; d'Alessio et al., 2005, Pollitz and Nyst, 2005; Savage and Burford, 1973; Schmalzle et al., 2006

Project Outline

The final deliverables for your project are:

1) A write up what your project is about. Describe what you are investigating, what data you are choosing to look at, and where you got the data. Provide representative plots of the data. These should include a simple map of the area, and representative time series, or velocity vectors, depending on what you have chosen for your project.

2) A short presentation of your project to the class. 5-10 minutes long. This presentation should be well organized and use a few overheads (e.g. PowerPoint slides). The power point should include

- an introduction to the project
- description of what is being investigated
- a description of the data used and from where it was obtained
- a description of signals or anomalies seen in the data.
- a description of the model that was inferred

- a characterization of how well the model fits the data
- a summary.

Suggested Steps:

1) Find data on UNAVCO website (www.unavco.org) or class site (for Idea #1).

2) Download data to your computer.

3) Develop/Improve your Matlab scripts for reading in and plotting data.

4) Make presentable plots of representative (if not all) data files that illustrate the signals available
   • For time series data, i.e. positions as a function of time plot position in n,e,u
   • For velocity data make a map view plot (in GMT or Matlab) *and* plots of the velocity components as a function of distance across the network.
   • Be sure to label axes correctly with units, etc.

5) Observe time series, what do you see? Describe your observations. Write them down as a part of your writeup.

6) Propose a model that can explain this data, earthquake? interseismic strain? transient deformation? magmatic injection? slow slip?

7) Provide quantitative predictions of your model and compare them to the data. Calculate the measures of misfit between data and model (RMS and χ^2).

8) Make a brief presentation, 10 minutes, AGU style that includes a description of the data, signal and model.

Reference List

d'Alessio, M. A., I. A. Johanson, R. Bürgmann, D. A. Schmidt, and M. H. Murray (2005), Slicing up the San Francisco Bay Area: Block kinematics and fault slip rates from GPS-derived surface velocities, *Journal of Geophysical Research*, *110, B06403, doi:10.1029/2004JB003496*.

Harris, R. A. and J.R. Arrowsmith, Introduction to the Special Issue on the 2004 Parkfield Earthquake and the Parkfield Earthquake Prediction Experiment, Bulletin of the Seismological Society of America; September 2006; v. 96; no. 4B; p. S1-S10; DOI: 10.1785/0120050831

Langbein, J., J. R. Murray, and H. A. Snyder (2006). Coseismic and initial postseismic deformation from the 2004 Parkfield, California, earthquake, observed by Global Positioning System, Electronic Distance Meter, creepmeters, and borehole strainmeters, *Bull. Seism. Soc. Am.* 96, no. 4B,S304 –S320.

Savage, J. C., W. Gan, W. H. Prescott, and J. L. Svarc (2004), Strain accumulation across the Coast Ranges at the latitude of San Francisco, 1994-2000, *Journal of Geophysical Research*, *109,*

B03413, doi:10.1029/2003JB002612.
Savage, J. C., W. Gan, and J. L. Svarc (2001), Strain accumulation and rotation in the eastern California shear zone, *Journal of Geophysical Research*, *106*, B10, 21,995-922,007.
Pollitz, F. F., and M. Nyst (2005), A physical model for strain accumulation in the San Francisco Bay region, *Geophysical Journal International*, *160*, 302-317, doi:310.1111/j.1365-1246X.2005.02433.x.
Savage, J. C., and R. O. Burford (1973), Geodetic determination of relative plate motion in central California, *Journal of Geophysical Research*, *78*, B5, 832-845.
Schmalzle, G., T. Dixon, R. Malservisi, and R. Govers (2006), Strain accumulation across the Carrizo segment of the San Andreas Fault, California: Impact on laterally varying crustal properties, *Journal of Geophysical Research*, *111, B05403, doi:10.1029/2005JB003843*.
Smith, K. D., D. von Seggern, G. Blewitt, L. Preston, J. G. Anderson, B. P. Wernicke, and J. L. Davis (2004), Evidence for Deep Magma injection beneath Lake Tahoe, Nevada-California, *Science*, *305*, 1277-1280.
von Seggern, D., K. D. Smith, and L. Preston (2008), Seismic Spatial-Temporal Chacter and Effects of a deep (25-30 km) Magma intrusion below North Lake Tahoe, California-Nevada, *Bulletin of the Seismological Society of America*, *98*, 3.