EOSC 562 Assignment: Carrizo GPS data
January 31, 2011
Due in class Wednesday, February 9, 2011

(1) Using equations from Segall Chapter 2 (p. 41) and GPS velocity profile data (provided), estimate slip rate and locking depth for the SAF in this region, assuming that the SAF is located at x = 0. To do this you have to minimize the weighted residual sum of squares (WRSS), that is,

$$WRSS = \Sigma_{i=1}^{n} \frac{v_{i,GPS} - v_{i,model}}{\sigma_i} \quad (1)$$

where there are n stations, $v_{i,model}$ is modeled velocity for site i, $v_{i,GPS}$ is GPS velocity for site i, and σ_i is the velocity uncertainty. Any method is fine, just state what you did (grid search, trial and error, inversion). Tell me:
a.) slip rate
b.) locking depth
c.) shear strain rate at x = 0
d.) shear stressing rate at x=0 in Pa / year (assume shear modulus μ is 30 GPa.
e.) plot the data (scatter plot: points with error bars) and the best-fitting model profile (as a curve - this may require using equally-spaced points for x coordinates to make it look nice).

(2) Large earthquakes occur about every 150 years along this segment of the SAF (and the last one was in 1857). Estimate the expected moment (in Newton meters) and moment magnitude for the big one (assume characteristic earthquakes). Hint: you need the coseismic slip (slip rate times 150 years), the locking depth (computed above), and the rupture length (get this from your coseismic slip and the Wells and Coppersmith plot showing how slip scales with rupture length).

(3) Using equations from Segall (p. 39), calculate the coseismic displacements for the GPS sites in the profile above, and (a) plot a curve showing coseismic displacements within 150 km on either side of the fault. (b) What is the coseismic shear strain? (c) What is the coseismic shear stress change? (signs should be opposite to that of the interseismic stressing rate in 1d.)