Week 8 - Day 15 - October 13, 2009

Preliminaries

- Homework #3 questions
- Projects - Presentations Dec. 1 & 3, Ideas due this week.
- Syllabus changes - “Course corrections”

Reading

Savage, J. C., and W. H. Prescott (1978), Asthenosphere readjustment and the earthquake cycle, *Journal of Geophysical Research*, *83*, 3369-3376.

Fay, N. P., and E. D. Humphreys (2005), Fault slip rates, effects of elastic heterogeneity on geodetic data, and the strength of the lower crust in the Salton Trough region, southern California, *Journal of Geophysical Research-Solid Earth*, *110*, B09401, doi:10.1029/2004JB003548.

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*.

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.

Freund, L. B., and D. M. Barnett (1976), A two-dimensional analysis of surface deformation due to dip-slip faulting, *Bulletin of the Seismological Society of America*, *66*, 3, 667-675.

More on Dislocations

Lecture on blackboard today. These from my handwritten notes.

Okada 1985 equations calculate surface displacements in response to a dislocation inside an elastic half-space. This is a “forward” calculation in that our model parameters for the dislocation are used to calculate the observable displacements on the surface.

Here we have ingnored many possible complexities including:

- curvature of the Earth
- Possibility of viscoelastic response
- lateral heterogeneity
- vertical stratification of elastic properties
- complexity of source
- etc.

Homework #4 will be our last one, and will include the calculation of some forward models.

Interseismic Deformation

This is what is going on most of the time. Is the strain accumulation that occurs between earthquakes. In cases where recurrence times are long, and postseismic relaxation is done, we are seeing strain accumulation. In places where recurrence times are short and postseismic lasts a long time, “interseismic” can actually include contributions from both strain

accumulation and delayed strain release which are superimposed on one another. We will learn more about this in the coming days, and is the topic of the Savage and Prescott, 1978 paper that is assigned reading.

The Earthquake Cycle:

1) An earthquake “coseismic” is what happens during a rapid slip on a fault.
2) Postseismic. There are several flavors:
   - after slip (shallow or deep)
   - poroelastic effects
   - viscoelastic
   - possibly others
3) Interseismic strain accumulation.

That is the simple model which forms a basic framework for our understanding of the cycle.

Savage equation for a vertical strike slip fault, locked at the surface and slipping at depth as a screw dislocation buried in an elastic half-space:

$$v(x) = \left(\frac{v_0}{\pi}\right) \arctan\left(\frac{x}{D}\right)$$

where D is the locking depth of the fault, and v_0 is the far-field relative plate velocity.

Difference between “Interseismic”, “Long Term” rates. “Back slip” i.e. the sum of the coseismic displacements divided by the time over which they occurred.

Talked about setting up a simple linear inversion for the D and v_0 parameters.

Gm=d

were the v_i are the velocities in the direction parallel to the fault.

$$\begin{bmatrix} \frac{\partial v_1}{\partial D} & \frac{\partial v_1}{\partial v_0} \\ \frac{\partial v_2}{\partial D} & \frac{\partial v_2}{\partial v_0} \\ \vdots & \vdots \\ \frac{\partial v_N}{\partial D} & \frac{\partial v_N}{\partial v_0} \end{bmatrix} \begin{bmatrix} dD \\ d v_0 \end{bmatrix} = \begin{bmatrix} v_1 \\ v_2 \\ \vdots \\ v_N \end{bmatrix}$$

etc. etc....