Things That go Bump in the Night:
Comments on Recent Activity near the San Andreas fault
In Southern California (June 6, 2006)
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In recent months a number of small earthquakes have occurred on or very close to segments of the southern San Andreas fault that are generally regarded to be especially quiet. Recent events include a M4.2 north of Indio on 6/1/2007 and a M3.5 event north-northwest of Frazier Park on 6/5/2007 (Figure 1.)

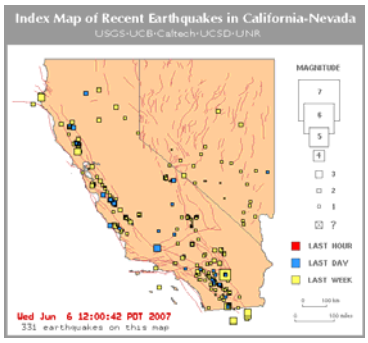

Figure 1. Recent Earthquake Map as of noon, 6/6/2007

It is not clear how one would interpret an upsurge of activity in proximity to the fault, but one can first address the question of whether there has in fact been an upsurge of activity. We consider all M>2.2 earthquakes in the Southern California Seismic Network catalog between the beginning of 1984 and 6/5/2007. The start time is chosen such that the catalog can be considered (reasonably) uniformly complete and consistent.

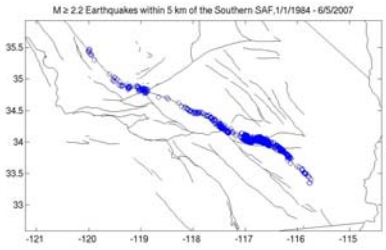

Figure 2. M>2.2 earthquakes within 5 km of the southern San Andreas fault, 1/1/1984-6/5/2007

All M>2.2 earthquakes within 5 km of the southern San Andreas fault are shown in Figure 2. As a first observation, one can note that small events do occur along—or at least, in proximity to—nearly the full extent of what we consider to be "locked" fault segments.

We next investigate possible fluctuations in activity over the time period. Figure 3 presents the cumulative number of M>2.2 events. Two significant increases are

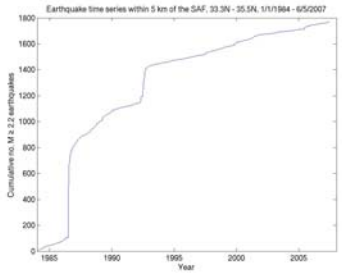

Figure 3. Cumulative M>2.2 events shown in Figure 2 as a function of time.

apparent: the first caused by aftershocks of the 1986 North Palm Springs earthquake, the second caused by aftershocks of the 1992 Landers and Big Bear earthquakes.

One can repeat the same exercise focusing on the so-called Big Bend region of the San Andreas fault (Figures 4a and b, below). Again, there is no evidence for any significant fluctuation in activity rates.

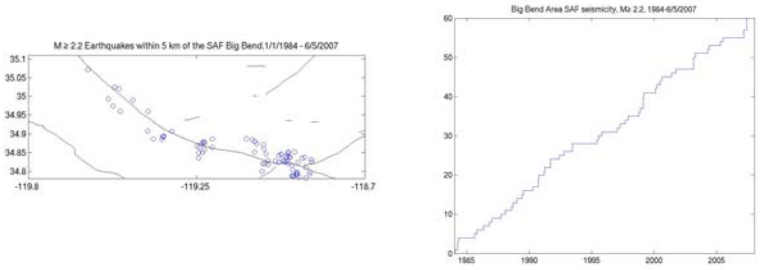

Figure 4. (a) Events within 5 km of the Big Bend area, (b) cumulative rate of events shown in Figure 4a.

As is typically the case for background microseismicity, earthquakes do pop up in regions that have been quiet for years or even decades. One also notes that our impression of activity along the southern San Andreas is based on a short catalog that does not include a large mainshock or its aftershocks. Meltzner and Rockwell (BSSA, 2004) conclude that a M5.6 event in 1916 probably occurred either on or very close to the San Andreas fault near Tejon Pass.

Based on established foreshock statistics, any event in California has about a 5-6% of being followed by something larger within 3 days. Larger events following foreshocks will be characterized by the standard Gutenberg-Richter distributions of magnitudes. For example, following a M4 event, the most likely mainshock, if one occurs, would be close to M4. It is about 10 times less likely that the mainshock would be a full magnitude unit larger, 100 times less likely (e.g., 0.05%, or 1-in-2000 odds) that it would be as large as M6, etc.

When the next big earthquake does occur on the southern San Andreas, there are about 50-50 odds that it will be preceded by a foreshock within 3 days. But while any small event is a candidate foreshock, there is little statistical basis for concern following an individual small event.