2009 SCEC ANNUAL REPORT –- GPS Survey of the Brawley Seismic Zone and Imperial Fault, US and Mexico **David Sandwell, PI ($**6,180**)**

During the past year we have completed the following three field campaigns:

1) Brawley Seismic Zone (Field Surveys by UCSD graduate students led by Brendan Crowell)

Thus far, three separate rapid-static GPS surveys have been performed throughout the Imperial and Coachella Valleys looking at strain partitioning throughout the Brawley Seismic Zone. The surveys, carried out in March and October, 2008, and March, 2009 consisted of about 115 monuments. We also installed 3 dense transects of monuments across the Imperial Fault, 2 in the US and 1 in Mexico to identify shallow creep signatures.

Comparing the results of the three rapid-static surveys to SCEC's CMM, which contains velocities through 2003, we were able to identify a large strain signal that we associate with the 2005 Obsidian Buttes Seismic Swarm along the southern bank of the Salton Sea. Through field observations, we were able to identify a northeast trending fault centered along the strain anomaly that had a visible surface trace over 10 km that we call the Obsidian Buttes Fault (Figure 1). We performed a slip inversion to find that the strain anomaly was associated with a fault averaged increase of 9 mm/yr of left-lateral motion over the period between 2003-2009. From the results of the slip inversion, we concluded that motion along this fault will actually raise the static stress levels along the southern San Andreas Fault by 0.1 MPa/yr. We presented the findings at the 2009 AGU Fall Meeting [Crowell et al., 2009], and have just submitted the results to Nature Geoscience.

Since the previous surveys, we have been trying to develop a more thorough and consistent data set throughout the Brawley Seismic Zone. In January, 2010, we started surveying a dense array of monuments with half mile spacing around the Obsidian Buttes Fault and through the Mesquite Basin to try and fully capture strain transfer through the Brawley Seismic Zone (Figure 2). Unfortunately, the Easter Sunday, Mw 7.2 Sierra El Mayor earthquake occurred, significantly moving all of the monuments that we have surveyed throughout the past 4 months, so all of these measurements will need to be redone to properly assess interseismic coupling of the faults. However, we do have a great opportunity to look at triggered slip along the Obsidian Buttes and Imperial Faults with a very dense array of measurements.

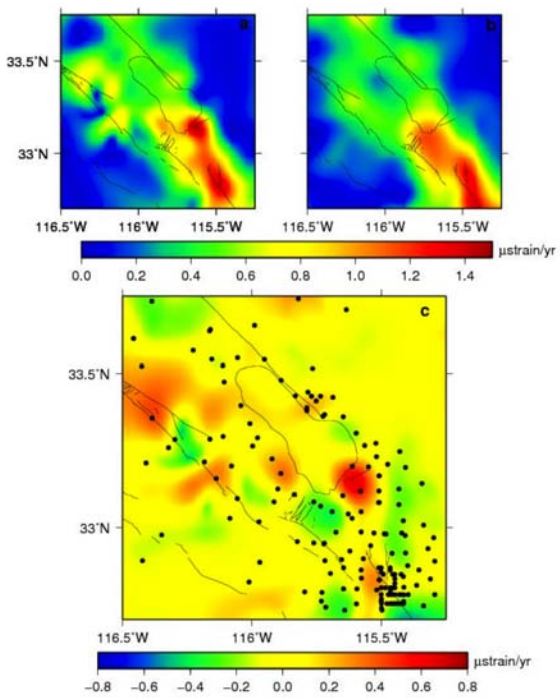

Figure 1: Maximum shear strain rate from (a) the 2008 and 2009 surveys, (b) SCEC's CMM, and (c) the difference between them. Notice the strain anomaly along the southern Salton Sea of 0.8 μstrain/yr.

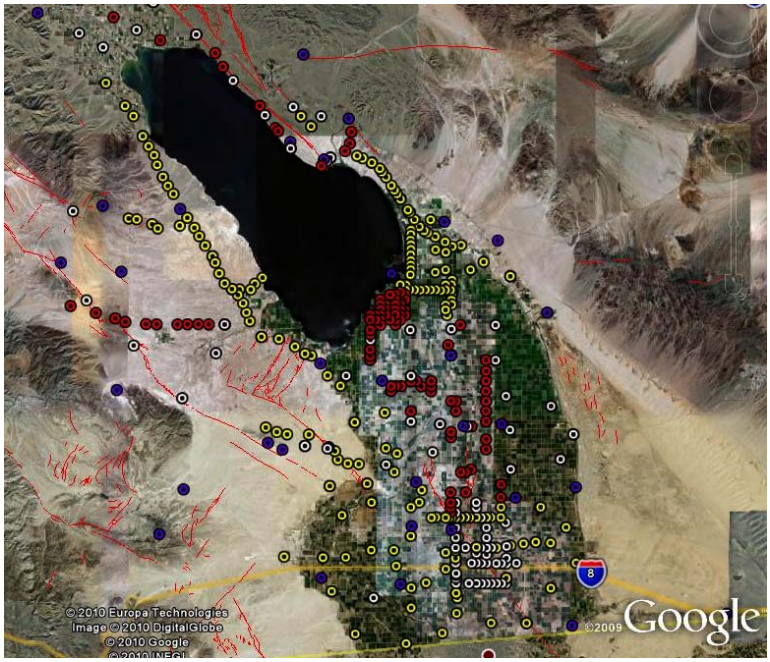

Figure 2: A map of future survey plans with previous surveys shown. The blue dots are current continuous GPS stations, the yellow dots are monuments never surveyed before, the red dots were surveyed between January and March, 2010, and the white dots are previous surveys in 2008 and 2009.

2) Imperial Fault, Baja California (Field Surveys by SIO faculty and students in collaboration with CICESE faculty and staff)

During the 2009-2010 field season we installed a 17 GPS monuments across the Imperial Fault near Mexicali to monitor interseismic and coseismic displacements. This is the DD-line (red Figure 3) The monuments were installed in January of 2010 and surveyed for the first time in May of 2010.

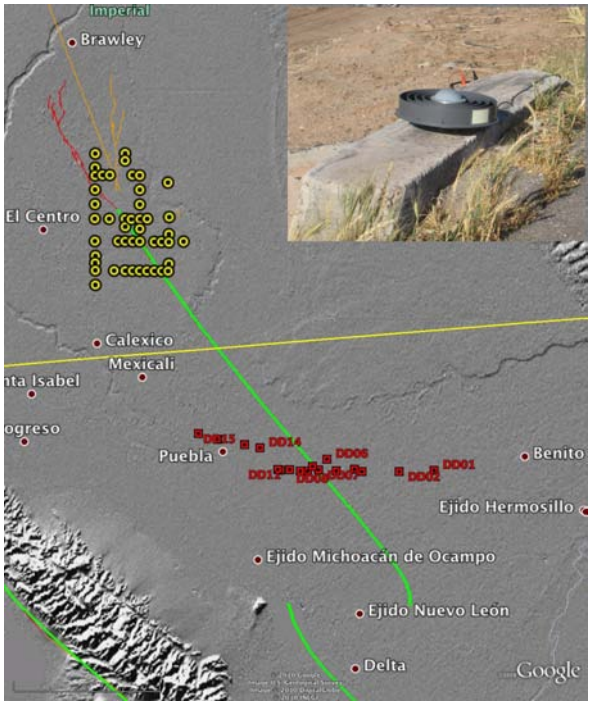

Figure 3. Seventeen new monuments (red) installed across the Imperial fault in Mexicali. The momuments consist of stainless steel couplers cemented into existing concrete structures (inset). This minimized setup time and error. The Imperial array (yellow) provides a dense network on the US side of the border.

3) Field response to the April 4, M7.2 El Major Earthquake (Field Surveys by SIO faculty and students in collaboration with CICESE and UC Riverside faculty and staff)

We have spent a significant amount of time performing GPS field surveys following the April 4, 2010 M7.2 El Major Earthquake (Figure 4). This work continues our SCEC-funded analysis of the interseismic deformation of the Imperial and Cerro Prieto faults. Although the field work was funded by SCEC, David Sandwell, Yuri Fialko, Matt Wei, and Xiaopeng Tong have spent a considerable amount of time (NSF-funded) collecting GPS campaign data in Mexico. This response is unique since the there are no permanently operating GPS stations south of the US border and the USGS field program cannot extend south of the border. This is a collaborative effort between CICESE, SIO and UC Riverside. GPS progress and plans are being coordinated at SIO and the initial results can be found at ftp://topex.ucsd.edu/pub/baja_eq/EL_MAJOR_GEODESY.kmz

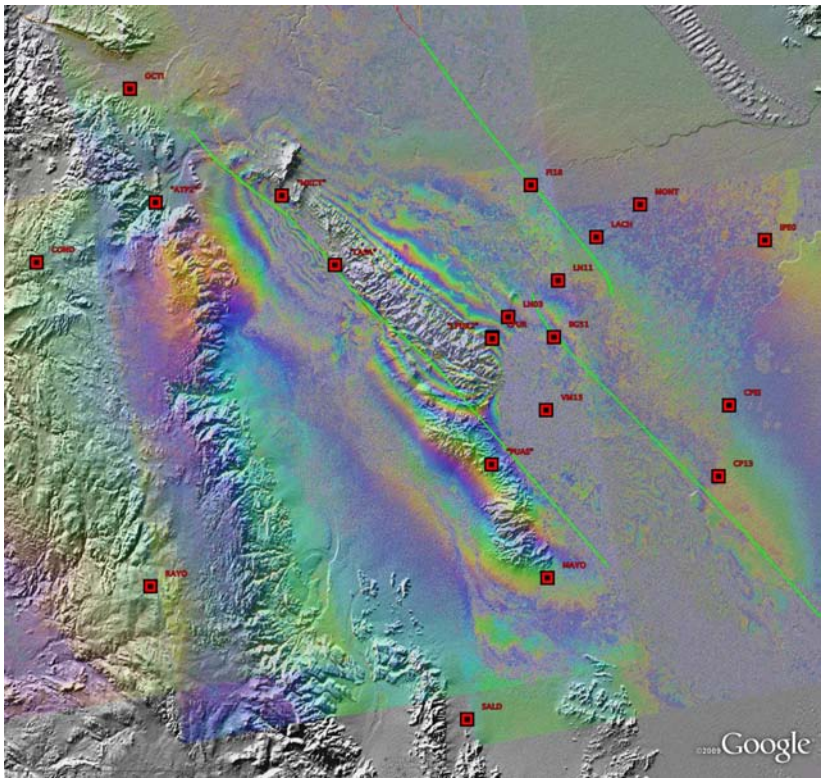

Figure 4. GPS monuments in Baja Mexico resurveyed following the April 4, M7.2 earthquake (red) will provide large-scale calibration of radar interferograms from ALOS as well as long-term measurements of postseismic rebound.

Related Abstracts:

Crowell, B.W., Y. Bock, and D.T. Sandwell (2009), Interseismic Strain Accumulation in the Imperial Valley and Implications for Triggering of Large Earthquakes in Southern California, *Eos Trans. AGU*, 90(54), Fall Meet. Suppl., Abstract T33E-02.

Crowell, B.W. and Y. Bock (2008), Near Real-Time Processing and Archiving of GPS Surveys for Crustal Motion Monitoring, *Eos Trans. AGU*, 89(53), Fall Meet. Suppl., Abstract G41C-0637.

Crowell, B.W., Y. Bock, D.T. Sandwell, Y. Fialko and R.B. Lohman (2008), Near real-time processing of results from the 2008 Imperial Valley, California, GPS survey, *(2008 SCEC Annual Meeting poster 2-030)*.