**September 5, 2012 M 7.6 Costa Rica Earthquake: Geodetic Data Available for Research**

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On September 5, 2012, a magnitude 7.6 earthquake occurred in the Nicoya Peninsula of northwestern Costa Rica, along a locked segment of the subduction boundary between the Cocos and Caribbean plates. These plates converge at approximately 8 cm/yr. The region has experienced numerous large (M>7) earthquakes, including similar events in 1853, 1900, and 1950 (M 7.8). The 1950 event is thought to have ruptured essentially the same part of the plate boundary as the 2012 event. In addition, a M 7.2 event in 1978 occurred roughly 10 km north-northeast of the 2012 event, and a M 7.3 event occurred roughly 50 km east-southeast in1990.

In many subduction zones, the locus of seismic slip lies far offshore, making it challenging to infer seismic processes from on-shore geodetic observations. In contrast, the Nicoya Peninsula lies quite close to the trench in this portion of the Middle America subduction zone, allowing observations to be made directly over the rupture zone of major earthquakes.

The favorable observation geometry, combined with the frequency and apparent regularity of large earthquakes, has made the Nicoya Peninsula the focus of intense seismic and geodetic monitoring for more than two decades. The discovery of slow slip events and concurrent seismic tremor in other subduction zones, including Cascadia, Mexico and Japan, has also motivated geophysical monitoring in Nicoya. At least five slow slip and tremor events in the last decade have now been identified and characterized in this section of the Middle America Trench.

USF currently operates a network of high precision, continuously recording GPS receivers in the Nicoya Peninsula, installed and maintained in collaboration with UNAVCO, and OVSICORI, a university group in Costa Rica charged with natural hazard research and mitigation. UC Santa Cruz operates a seismic network in the region, also in collaboration with OVSICORI. In addition, Georgia Tech has periodically re-occupied a network of campaign GPS sites to improve spatial sampling of the deformation signal. Campaign GPS observations were first made in Costa Rica in 1988, and have been continued episodically ever since. Data from the mid-1990's are sufficiently precise to define deformation time series spanning a significant fraction of the earthquake cycle. Related projects in Nicaragua and southern Costa Rica and Panama by other groups help to define the regional tectonic context.

Data from the various Nicoya networks will give an unprecedented image of the spatial extent and magnitude of the 2012 rupture, and the extent, magnitude and time variation of post-seismic processes. In addition, southwest motion of the fore-arc crust relative to the volcanic arc could unload northwest-striking vertical strike slip faults that accommodate

motion of the fore-arc relative to the volcanic arc, stimulating subsequent seismic activity on these shallow crustal faults. Such events could actually be more damaging than the September 5 event, given their proximity to urban areas. Also, since it has been a long time since a major earthquake struck the region, it is possible that seismic shaking and crustal motion will stimulate volcanic activity in the nearby volcanic arc. Volcan Arenal and Rincon de la Vieja are closest to the earthquake's epicenter, but Poas and Turrialba also bear watching. Turrialba's fumarolic activity has been increasing since 2001, but this volcano has not experienced a major eruption since 1866, implying the possibility of significant volumes of stored magma.

The fact that the 2012 earthquake occurred essentially in the middle of our observation networks provides an incredible research opportunity. Data from the continuous GPS network is archived at UNAVCO and is publicly available. I encourage anyone with an interest in seismic processes and high precision geodetic data to use these data in their research. Rapid time series analysis results generated by the ARIA project at the Jet Propulsion Lab are available at ftp://sideshow.jpl.nasa.gov/pub/JPL_GPS_Timeseries/20120905_CostaRica. 5 Hz GPS data are also available for selected stations. High precision time series (based on high precision ephemeris data) and other results will be posted to the USF web site as they become available (http://labs.cas.usf.edu/geodesy/).

In addition to process-oriented research, there are more immediate hazard-related aspects for this event to be considered. The apparent rupture area of the earthquake is smaller than the locked patch we infer from recent GPS-based models, and rather deep (~ 40 km). This raises the possibility of a second earthquake in the near future, rupturing up-dip of the current event. Being shallower than the September 5 event, the subsequent event could be more damaging, and perhaps stimulate a tsunami (there was no significant tsunami associated with the September 5 event). The role of past and future slow slip events at relieving some of this accumulated strain is only poorly known.

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