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The Seismic Strong Motion Array Project (SSMAP) and the September 5, 2012 Mw=7.6 Nicoya, Costa Rica Earthquake

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Seismic gaps along the subduction zones are locations where large earthquakes have not occurred in a long time. The Cocos plate is subducting beneath the Caribbean plate in Costa Rica, and the Nicoya Peninsula, located in northwestern Costa Rica, has been identified as a seismic gap. The previous major earthquakes in Nicoya occurred on 1853, 1900 and 1950, which indicates about a 50-year recurrence interval for the characteristic earthquake cycle. Since 2006, the seismic strong motion array project (SSMAP) for the Nicoya Peninsula in northwestern Costa Rica has been composed of 10 sites with Geotech A900/A800 accelerographs (three-component) and GPS timing. Our digital accelerographs array has been deployed as part of our ongoing research on large earthquakes, including the potential Nicoya event, in conjunction with the Earthquake and Volcano Observatory (OVSICORI) at the Universidad Nacional in Costa Rica.

From 2006 to 2012, 28 events were relocated using the SSMAP and OVSICORI data with moderate magnitudes (4 < Mw< 6.5), and were mainly located in Nicoya Peninsula region. On September 5, 2012, a Mw=7.6 earthquake occurred in the seismic gap and appears to be the expected event based on the 50 years recurrence interval, but was instead 62 years later. The main shock focal mechanism was thrust faulting, propagating downdip, of the Cocos plate in the Middle America trench with strike N54W and dip 20 degrees NE. The mainshock and 15 early aftershocks were relocated by using SSMAP, OVSICORI, and UCSC networks. The final location of the mainshock is 9.671 N and 85.878 W with a depth of 18 km. The maximum accelerations from two A900 stations perpendicular to the trench, Fortuna (distance 112km) and Pedernal (distance 128 km) are: 13.8% and 8.9 % g, respectively. In addition, the October 10 (MW 5.3) and 24(Mw 6.6) aftershocks recorded at Tamarindo (distances 40 km and 70 km, respectively) showed accelerations of 2.4% and 8.2% g; respectively. The mainshock acceleration data from SSMAP, University of Costa Rica, and National Electricity Institute networks were analyzed for a new attenuation relationship: Acceleration = -203 ln(R) + 1110 with M=7.6 and R = hypocentral distance.