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Spatial and temporal evolution of fault slip and deformation associated with the MW 7.6 September 5th 2012 Nicoya Megathrust Earthquake.

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On September 5, 2012, after years of slow-slip event observations, a large moment magnitude (MW) 7.6 megathrust earthquake occurred under the Nicoya peninsula in northern Costa Rica. A dense continuous GPS (CGPS) network is uniquely located above the seismogenic zone of the Cocos-Caribbean subduction boundary just above the rupture area of the 2012 event, allowed accurate measurement of deformation before, during and after the earthquake. Measurements before the event indicate the presence of slow slip events on the plate interface both up-dip and down-dip of the locked subduction interface. The network also measured aseismic slip in the hours after the main rupture and strong post-seismic deformation following the event. In this study, we compare the spatial distribution and temporal occurrence of the pre-seismic slow slip with the coseismic and early post-seismic slip in the first 24 hours after the earthquake. We focus on evaluating the cumulative aseismic slip and its relation to the early-postseismic deformation, including the sensitivity of solutions to modeling assumptions. More than one year out, the CGPS network continues to record strong post-seismic deformation. Here we evaluate the relaxation time, and show that multiple relaxation times are necessary to fit the data. Our results clearly indicate that observation of slip on the shallow part of the fault is very important to fully understand the subduction earthquake cycle.