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Transient deformation in the Guerrero seismic gap, Mexico, observed by GPS

M. Vergnolle (1), N. Cotte (1), A. Walpersdorf (1), P. Tregoning (2), V. Kostoglodov (3), and J.A. Santiago (3)

(1) LGIT, Université Joseph Fourier, CNRS, Grenoble, France (mathilde.vergnolle@ujf-grenoble.fr, +33 4 76635252), (2) Research School of Earth Sciences, The Australian National University, Canberra, Australia, (3) Instituto de Geofisica, UNAM, Mexico, Ciudad Universitaria, Del. Coyoacan, Mexico

The precise knowledge of the occurrence time of aseismic slow slip events (SSEs), their spatio-temporal evolution and the amount of deformation they produce are prerequisites to any deeper understanding of the loading/unloading process on faults and thus on earthquake cycles. We re-process and re-analyze observations from permanent GPS stations located in the Guerrero subduction zone, Mexico, where the world's largest SSEs have been observed in 2002 and 2006. Our objective is to refine the characteristics of these two major SSEs as well as smaller quasi-annual SSEs that have previously been reported in this zone and that have been interpreted as climate-driven SSEs. Using an improved GPS processing that takes into account time-varying climatic parameters and tropospheric mapping functions, and oceanic, atmospheric and hydrologic loading corrections, the resulting position time series show a noise reduction of about 50 % with respect to the published PPP analysis. We find no longer clear evidence of the small, quasi-annual SSEs suggesting that the previously identified signals may actually be artifacts of the GPS analysis strategy. However, non-periodic anomalous displacements with an amplitude of less than about 3 mm are present in some time series. Moreover, the improved GPS analysis allows the determination of a complex spatio-temporal evolution of the large SSEs. The 3D surface slip evolution should help to constrain the slip propagation on the subduction interface. The tested slip inversions, currently using the total 3D surface displacements, strongly suggest that the seismogenic zone is involved in the SSE generation. Finally, the improved constraints on the Mexican GPS position time series permit us to suggest that the next SSE may begin in 2010.