GPS Constraints on 34 Slow Slip Events within the Cascadia Subduction Zone

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Improvements to analysis techniques of GPS measurements from the Cascadia subduction zone show that 34 slow slip events (SSE) have occurred along the megathrust since 1997 and hint at variable seismogenic coupling along-strike from California to BC. Roughly 30 PBO-NUCLEUS, PANGA, and WCDA continuous GPS stations constrain slow slip events through 2005, with the densest concentration in northwestern Washington State and southwestern British Columbia. In this region, the station distribution permits us to track the creep fronts as they migrate laterally across the plate boundary and reveals a wide variety of slip behavior among these events. To isolate deformation caused by transient creep events, we factor time series into distinct physical bases functions that represent steady-state tectonic deformation, hardware steps, tectonic steps, and annual and semi-annual signals and use these in both reference frame stabilization and time-series filtering.

At the latitude of the northern Washington State and southwestern British Columbia, the 14-month average recurrence interval still holds true, four events after first recognition. Along northern Vancouver Island, a 14-month periodicity is also observed, but six months out of phase with its southern counterpart. Smaller, non-periodic events appear to take place along the central Vancouver region. In southern Washington State, large transient displacements are seen, but lack any obvious periodicity in their recurrence. Many of these events have equivalent moment magnitudes of 6.4 (smallest resolvable with GPS) to 6.8, and 2 to 3 cm of slip. Along central Oregon, there is some evidence of an 18-month recurrence, while in northern California (Yreka) an 11-month periodicity has been proven with both GPS and seismic tremor. Together, these geodetic inferences of temporal and spatial creep distributions along the otherwise enigmatic Cascadia megathrust paint a picture of a wide range of coupling heterogeneity along the margin.