The transient and intermittent nature of slow slip

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Slow, aseismic slip (such as slow slip and surface creep) is now recognized as the glue at tectonic plate boundaries that holds the earthquake cycle together. Since the first observations of surface creep along the San Andreas plate boundary more than 50 years ago, advances in geophysical instrumentation and innovative observational approaches have revealed that faulting at major plate boundaries covers a broad spectrum of slip modes, from fast earthquake ruptures to intermittent slow slip.

Today, the continuous GPS record and satellite imagery reveal the jerky, intermittent nature of aseismic slip. The pattern that is emerging suggests that slow slip at plate boundaries and surface creep on major transform faults is not a steady, continuous process as once thought, but is rather a complex spatiotemporal cluster of interacting aseismic transients (Fig. 1). Aseismic slip rate variations have now been observed at all temporal scales, from seconds to decades. These new observations suggest slow slip is much more similar to earthquake slip than previously acknowledged, with strong implications on our understanding of the dynamics of active faults. These new observations call for new families of models with much broader dynamics that are able to reproduce the observed rich spectrum of slow slip.

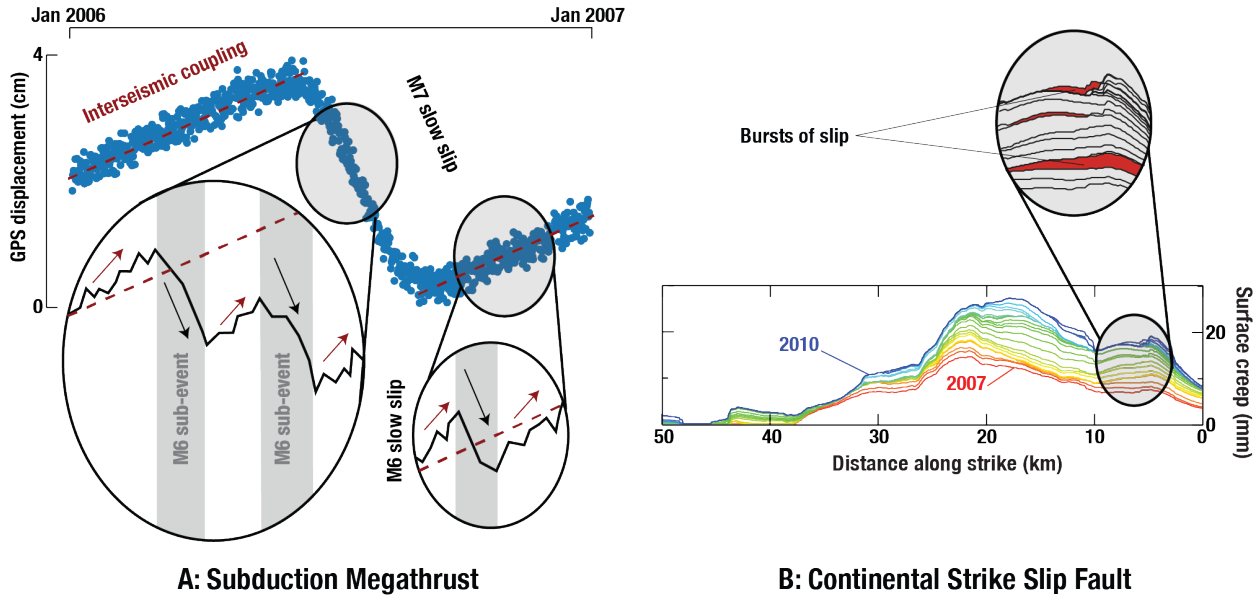

Figure 1: Slow slip at tectonic plate boundaries occurs as a complex sequence of aseismic transients, whether it be in (A) deep subduction zones or at (B) major transform faults. **A**: GPS-captured ground motion above the Mexican subduction zone. A major M7 slow slip event is an intermittent cluster of M6 slow transients that otherwise occur individually during the interseismic period. **B**: Ground motion measured by InSAR along the Haiyuan Fault (China). Rapid return times of more recent satellites allow for a high sampling rate of surface creep and reveals that the aseismic slip transiently occurs in bursts of activity.