Revealing the cascade of slow transients behind a large slow slip event

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Capable of reaching similar magnitudes to large megathrust earthquakes (Mw > 7), slow slip events play a major role in accommodating tectonic motion. These slip transients are the slow release of built-up tectonic stress along the roots of plate boundaries and are thought to represent a predominantly aseismic rupture along the plate interface that is smooth in both time and space. We demonstrate here that large slow slip events are in fact a complex cascade of short slow transients. Using a dense catalog of low-frequency earthquakes as a guide, we investigate the Mw7.5 slow slip event that happened in 2006 along the subduction interface 40 km beneath Guerrero, Mexico. We show that while the long-period surface displacements as recorded by GPS suggest a six month duration, motion in the direction of tectonic release only sporadically occurs over <60 days and its surface signature is attenuated by rapid relocking of the plate interface. These results demonstrate that our current conceptual model of slow and continuous rupture is outdated and is an artifact of low-resolution geodetic observations of a superposition of small, clustered slip events. Our proposed model of slow slip as a cascade of slow transients has important consequences for the scaling of slow slip events as it implies that we overestimate the duration T and underestimate the moment magnitude M of large slow slip events.

Keywords: slow slip, slow earthquakes, low-frequency earthquakes, subduction

