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Constraining mechanisms for dynamically triggered Sudden Displacement Events (SDEs) in the northern Chilean Subduction Forearc using collocated creepmeter and broadband seismic data

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The Atacama Fault System is located in the northern Chilean subduction forearc region and hosts a complex system of trench-parallel faults with mapped surface ruptures. Previous work based on continuous monitoring of aseismic fault slip by the IPOC Creepmeter Array over the last ~15 years has shown that the Chomache, Cerro Fortuna, Salar del Carmen, and Mejillones Faults host Sudden Displacement Events (SDEs) that are often triggered by passing seismic waves, showing a clear temporal correlation between SDE signals and local, as well as teleseismic, earthquakes. Here we present a new study using data from two creepmeter sites that are instrumented with two collocated broadband seismometers to investigate the correlation between SDEs, the ground motions of preceding earthquakes, and the consistency of transient stress changes with observed deformation inferred from the creepmeter time series.

Our analysis reveals two primary observations. First, we identify a seasonal trend in the polarity of SDEs, suggesting modulation of the system response over the annual cycle. Second, we observe a dependency between the peak ground velocity (PGV) of the preceding earthquakes recorded by the collocated seismometers and SDE occurrence. We observe an absence of SDEs below a PGV threshold of approximately 0.07–0.15 cm/s that suggests that the triggering mechanism is at least partly amplitude-controlled.

Based on the apparent seasonal polarity changes and dependence on ground shaking, we will present results that test whether SDEs reflect tectonic fault slip processes or a non-tectonic, seasonally modulated response of near-surface sediments to dynamic triggering. We will test the hypothesis using the back azimuth of triggering seismic waves to resolve the dynamic stresses imposed on the well-constrained geometry of the monitored fault planes in comparison to the volumetric changes in the surrounding fault zone. This study will contribute to a deeper understanding of dynamic triggering and the underlying processes that control fault behavior in forearc settings.