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Systematic characterization of slow slip events along the Mexican subduction zone from 2000 to 2019

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Slow slip events (SSEs) represent a significant mechanism of strain release along several subduction zones, and understanding their occurrence and relations with major earthquake asperities is essential for a comprehensive understanding of the seismic cycle. Here, we focus on the Mexican subduction zone, characterized by the occurrence of recurrent large slow slip events (SSEs), both in the Guerrero region, where the SSEs are among the largest observed worldwide, and in the Oaxaca region, where smaller, more frequent SSEs occur. Up to now, most slow slip studies in the Mexican subduction zone focused either on the detailed analysis of a single event, were limited to a small area (Guerrero or Oaxaca), or were limited to data before 2012 [e.g.1-4]. In this study, our aim is to build an updated and consistent catalog of major slow slip events in the Guerrero-Oaxaca region.

We use an approach similar to Michel et al. 2018 [5]. We analyze the GPS time series from 2000 to 2019 using Independent Component Analysis (ICA), in order to separate temporally varying sources of different origins (seasonal signals, SSEs and afterslip of major earthquakes). We are able to isolate a component corresponding to seasonal loading, which matches the temporal evolution of displacement modeled from the GRACE data. The sources (independent components) identified as tectonic sources of deep origin are inverted for slip on the subduction interface. We thus obtain a model of the spatio-temporal evolution of aseismic slip on the subduction interface over 19 years, from which we can isolate around 30 individual slow slip events of $M_w > 6.2$.

The obtained catalog is coherent with previous studies (in terms of number of events detected, magnitude and duration) which validates the methodology. The observed moment-duration scaling is close to $M_0 \sim T^3$ as recently suggested by Michel [6] for Cascadia SSEs, and our study extends the range of magnitude considered in their analysis. Finally, we also investigate the spatio-temporal relations between the SSEs occurring in the adjacent regions of Guerrero and Oaxaca, and their interaction with local and distant earthquakes.

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