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# Continental-scale deformation and fault coupling in northern central America (Guatemala, El Salvador, Honduras) from Sentinel-1 InSAR time series analysis

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## Résumé

Tectonic deformation in northern Central America results from the complex interactions among the Cocos, Caribbean, and North America plates. This deformation is accommodated by several structures, including the left-lateral Motagua and Polochic faults, grabens south of the Motagua Fault, the Middle America subduction zone, and right-lateral faults along the volcanic arc. Major earthquakes, such as the 1976 Mw 7.5 Motagua and 2012 Mw 7.5 Champerico events, have been associated with these systems.

To investigate present-day deformation, we applied a Persistent and Distributed Scatterers (PSDS) InSAR technique to Sentinel-1 data (2017–2020) from two ascending and two descending tracks covering most of Guatemala, El Salvador, and western Honduras. Time series were corrected for tropospheric and ionospheric delays and referenced to GNSS data. We decomposed the InSAR signals into a linear (tectonic) term and two seasonal components.

We analyze the line-of-sight (LOS) velocity fields for the linear term, identifying spatial variations across major faults. We first align GNSS velocities with the resolution of InSAR using the Bstrain code, a Bayesian transdimensional inversion method, to derive interpolated horizontal velocity fields. We fix the north component based on them and decompose the LOS maps into east and vertical components, the main added value of InSAR.

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Our results are consistent with GNSS observations and regional elastic block models (Ellis et al., 2019; Garnier et al., 2021), highlighting (1) the relative motion between the North America and Caribbean plates accommodated primarily by the Motagua and secondarily by the Polochic fault, (2) east-west extension of the Caribbean plate, and (3) right-lateral motion along the Mid-America volcanic arc. High-resolution InSAR also reveals a  $\sim 40$  km-long creeping segment along the Motagua fault. We analyze variations in creep behavior in relation to local geology and the 1976 earthquake slip distribution. Additionally, InSAR data help constrain how extension is partitioned across active faults within the Caribbean plate's wedge. Finally, they reveal along-strike velocity variations along the coast; forward models suggest that such variations may reflect spatially variable coupling along the subduction interface, previously unresolved by GNSS.

Gomba et al. (2024). doi:10.5194/egusphere-egu24-8645

Garnier et al. (2021). doi:10.1130/GES02243.1

Pagani et al. (2021). doi:10.1029/2021JB021905

**Mots-Clés:** Subduction, seismic cycle, creep, northern central America, InSAR