

Preliminary results on the characterisation of the Guaycume fault (El Salvador) from geodetic and seismological data

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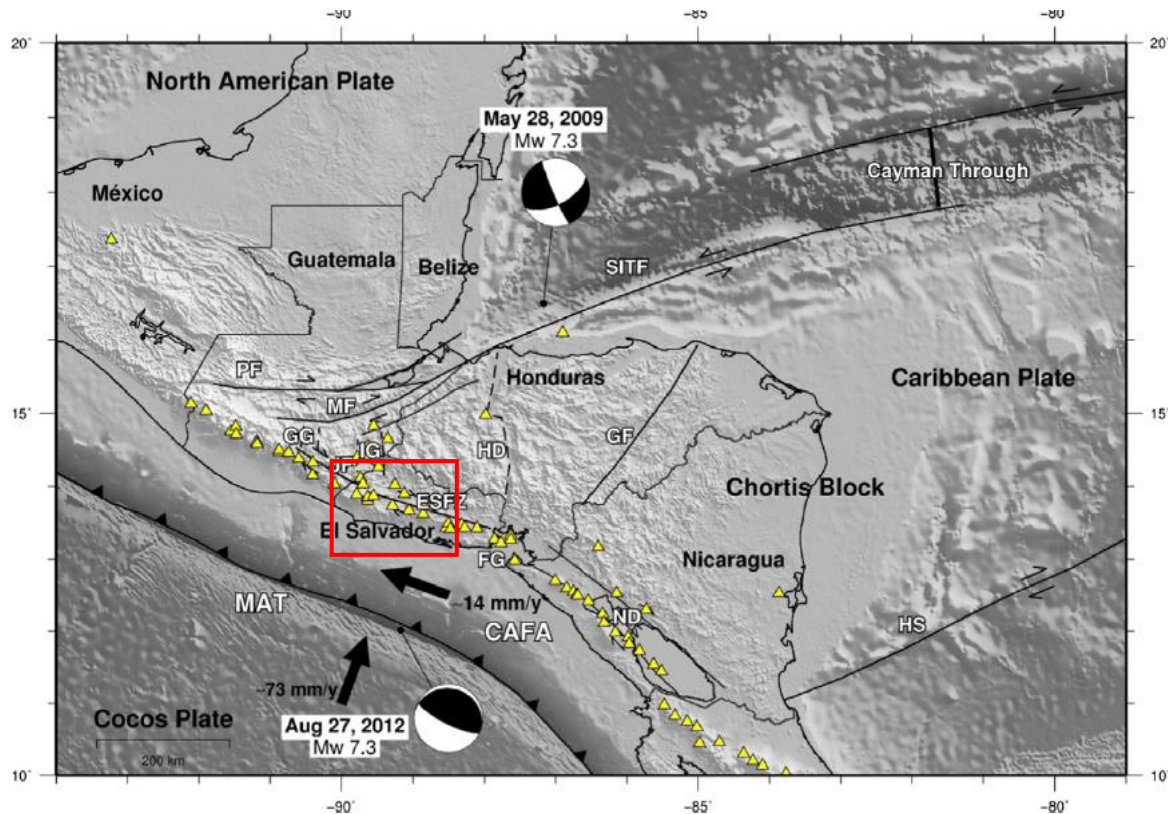
Portela Fernández, J. J.; Staller, A.; Béjar-Pizarro, M.; Martínez-Díaz, J.J.;
Álvarez-Gómez, J.A.; Hernández, D.



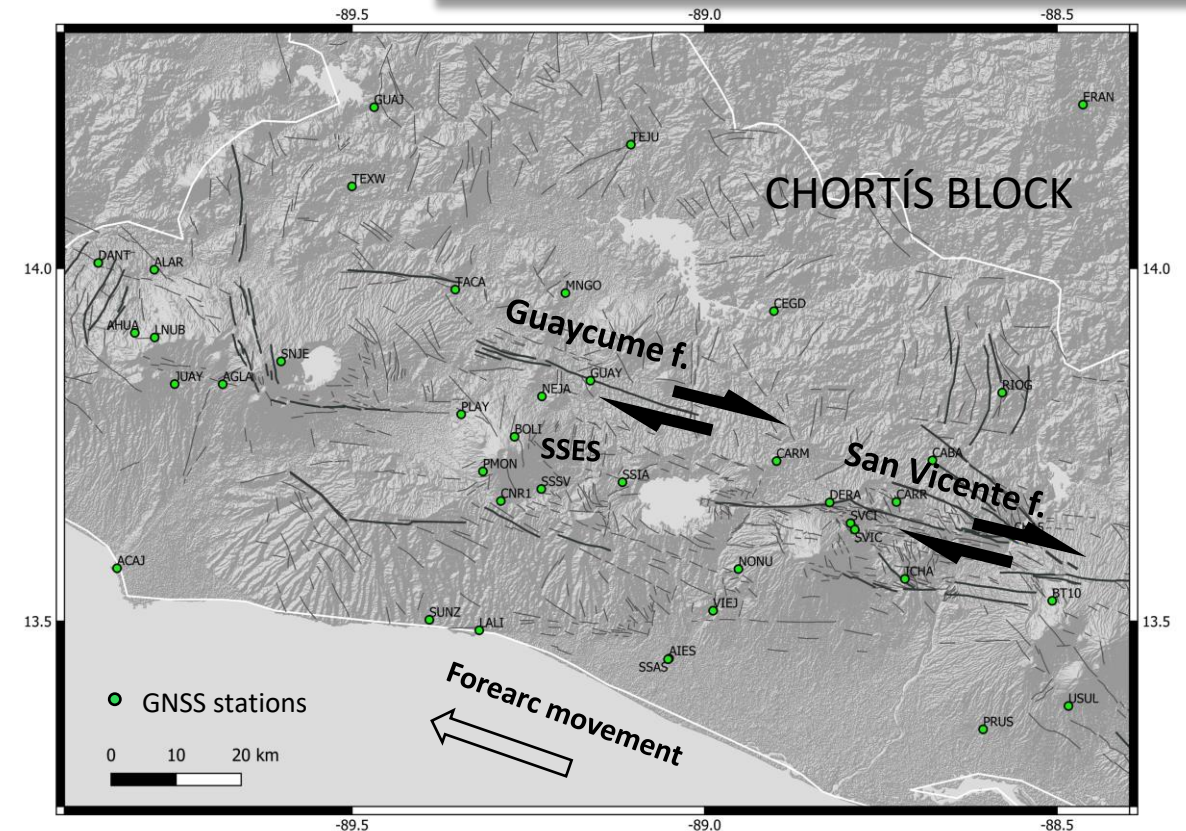
The Guaycume fault is a right-lateral strike-slip structure located in Western El Salvador, within the El Salvador Fault Zone (ESFZ). The ESFZ consists of a strike-slip fault system extending through the Central American Volcanic Arc, on the western margin of the Chortís block, where the Cocos plate subducts under the Caribbean plate.

The Guaycume fault has been proposed as a possible source for the Mw 6.4 1917 El Salvador destructive earthquake, presenting high seismic potential in close proximity to San Salvador (Alonso-Henar et al., 2018). Its geomorphological expression has been clearly identified (Martinez-Diaz et al., 2016); however, few specific studies are currently published, and its behaviour and kinematics remain widely unknown. Notably, there is a lack of precise information about the amount of deformation that this fault currently absorbs of the westward movement (relative to the Chortís block) of the forearc sliver.

We process GNSS data in the area from 2007 to 2020 in order to retrieve the GNSS velocity field surrounding the Guaycume fault. We use these data to perform a thorough kinematic study, updating the previously existing slip rates (Staller et al., 2016). Combined with seismological data, this information allows us to understand the seismic cycle of the fault to a better extent, thus leading to a better comprehension of its seismic potential.



Modified from Staller et al., 2016



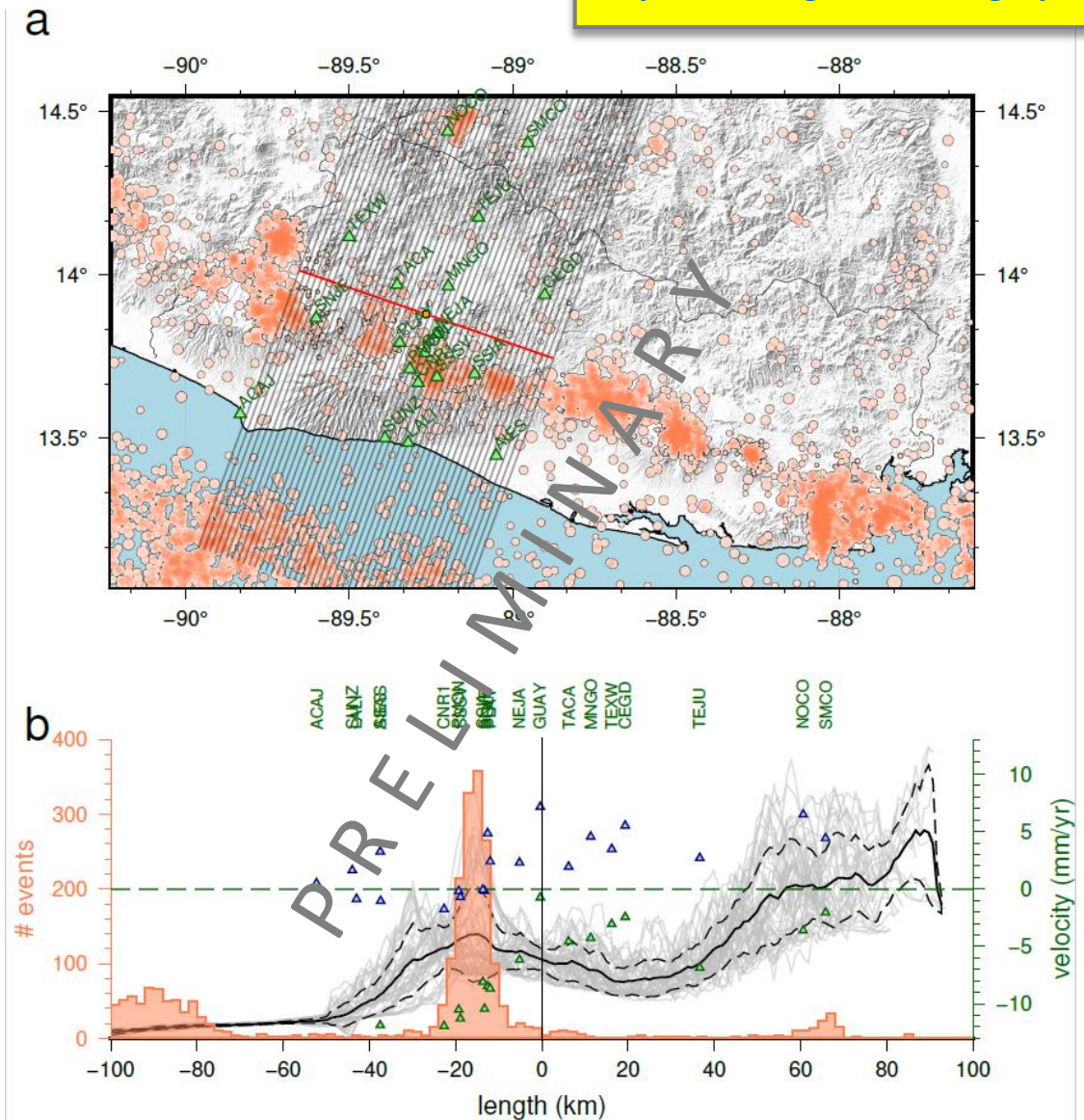
- The northwestward movement of the Central American volcanic forearc with respect to the Chortís block accumulates deformation along the El Salvador Fault Zone (ESFZ)
- **How much deformation is the Guaycume fault accumulating?**
 - It has a clear surface expression (Martinez-Diaz et al., 2021)
 - Some sources (e.g. Alonso-Henar et al., 2018) relate this fault with the destructive 1917 earthquake

SEISMIC ANALYSIS

- International Seismological Centre (2021)
- Period: 1915-2021(04)
- Shallow seismicity: < 30 km
- 8626 events up to Mw 7.1

Guaycume fault: No seismic activity detected

- Is it heavily locked?
- Aseismic behavior?



- Savage and Burford (1973) model

$$v = \frac{v_{far}}{\pi} \operatorname{atan}\left(\frac{x}{D}\right)$$

Far-field velocity $\uparrow$

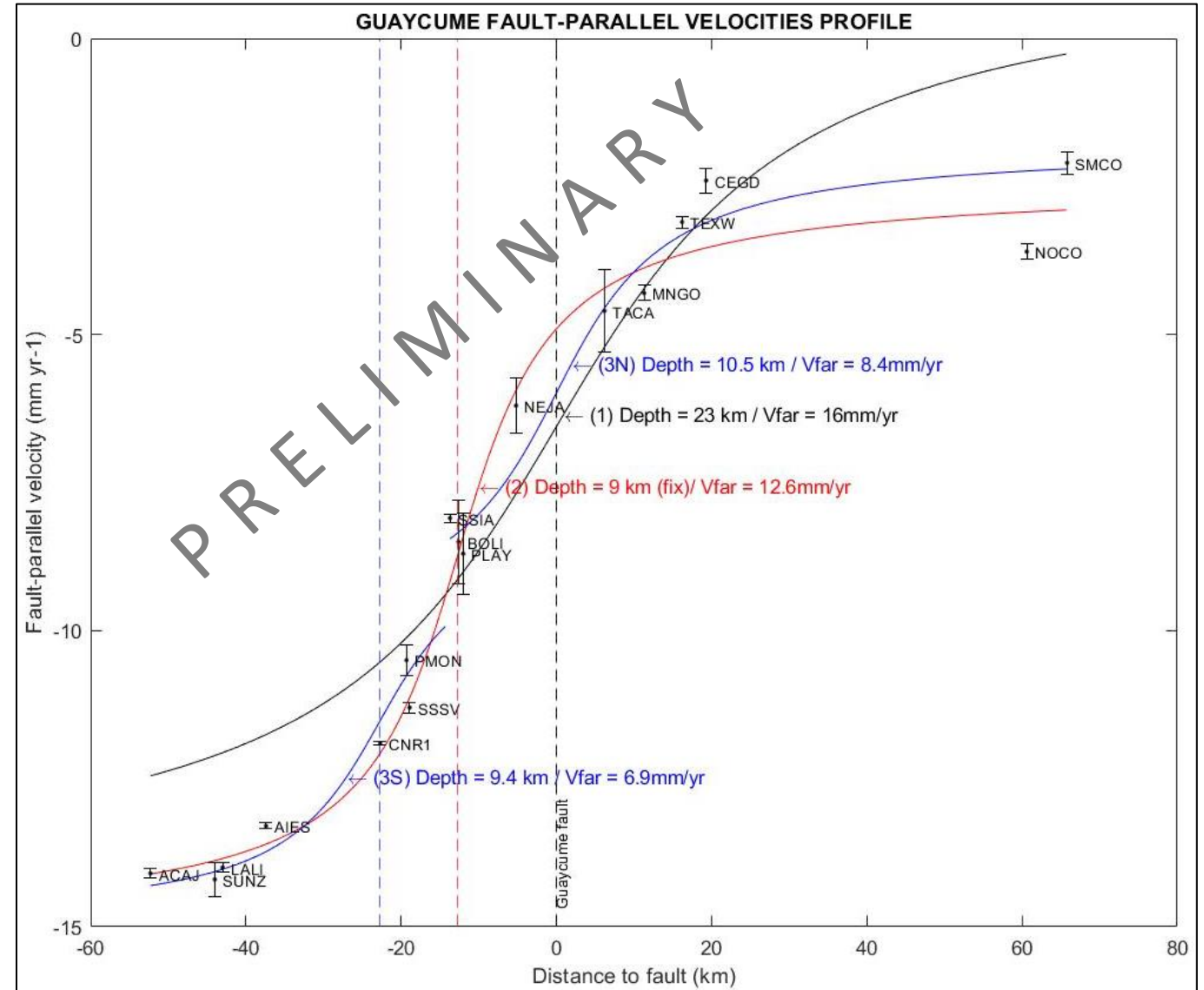
Distance to fault $\nearrow$

Locking depth $\searrow$

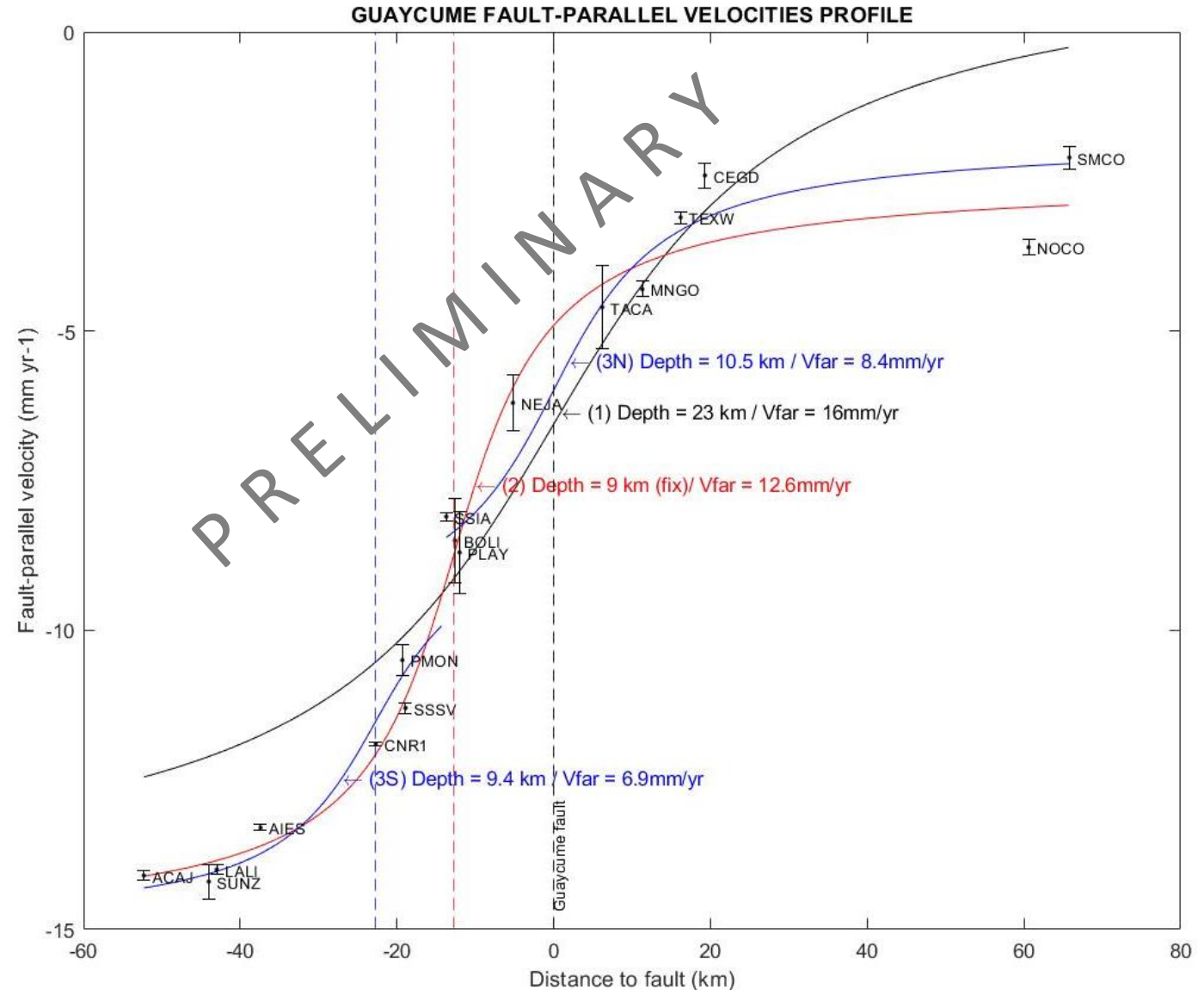
We tried to fit (l.s.) three different models:

- (1) Guaycume fault as the main structure accumulating deformation
- (2) A single fault with “unconstrained” position *
- (3) Two main features accumulating deformation at Northern and Southern borders of the San Salvador graben (respectively, the Guaycume fault and a non-constrained structure to the South)

* Regarding the good performance of this adjustment, we constrained locking depth to 9 km (probable value)



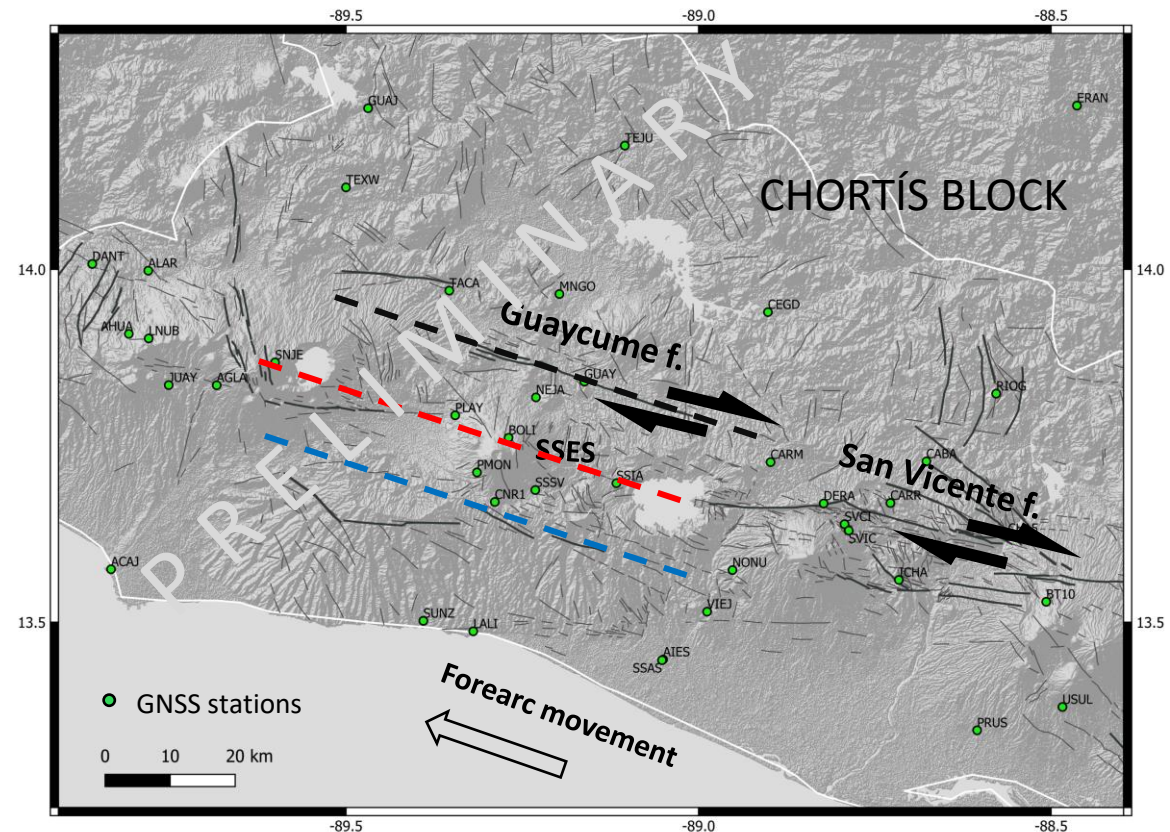
- (1) The Guaycume fault does not seem to be the only feature accumulating the relative movement of the forearc
- (2) A single fault model (going through the San Salvador extensional stepover) fits the observations. However, this may be representing the complete movement of the forearc.
- (3) The two-features model seems to be a feasible option, although the southern block is not well constrained (due to scarce observations)



RESULTS AND DISCUSSION

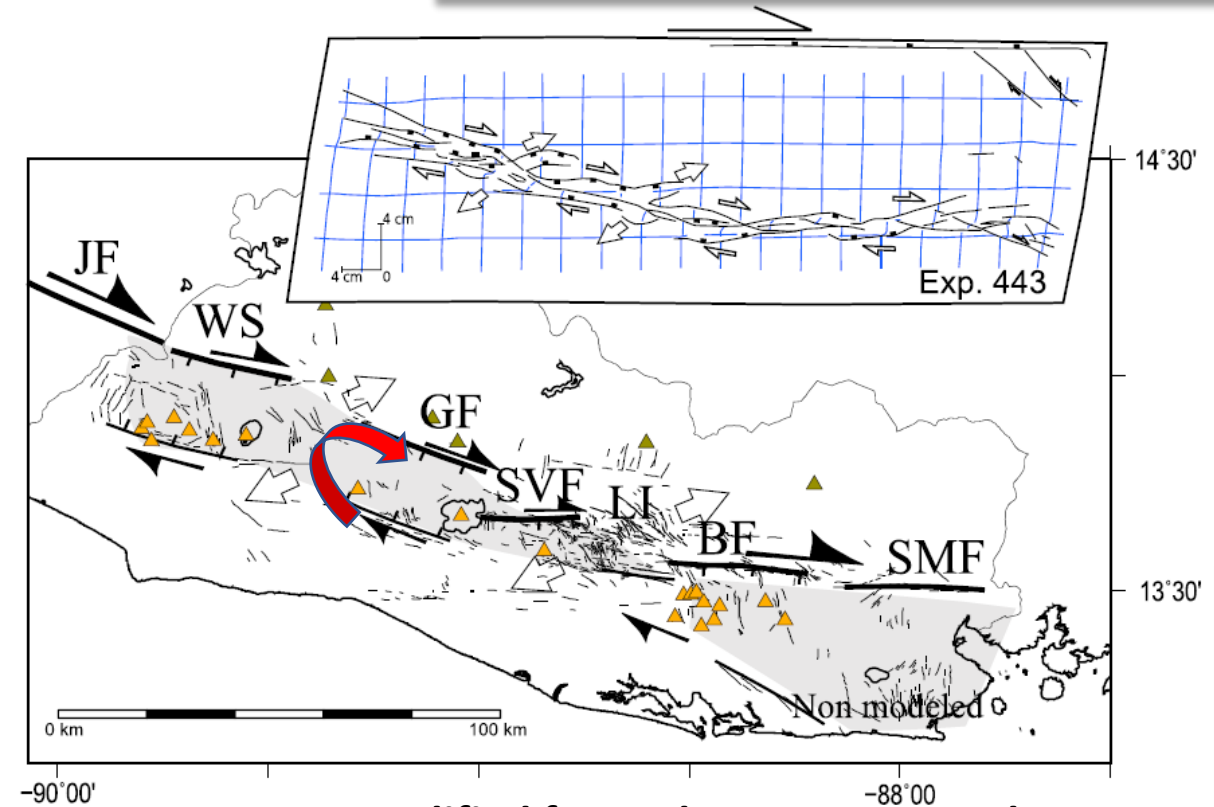
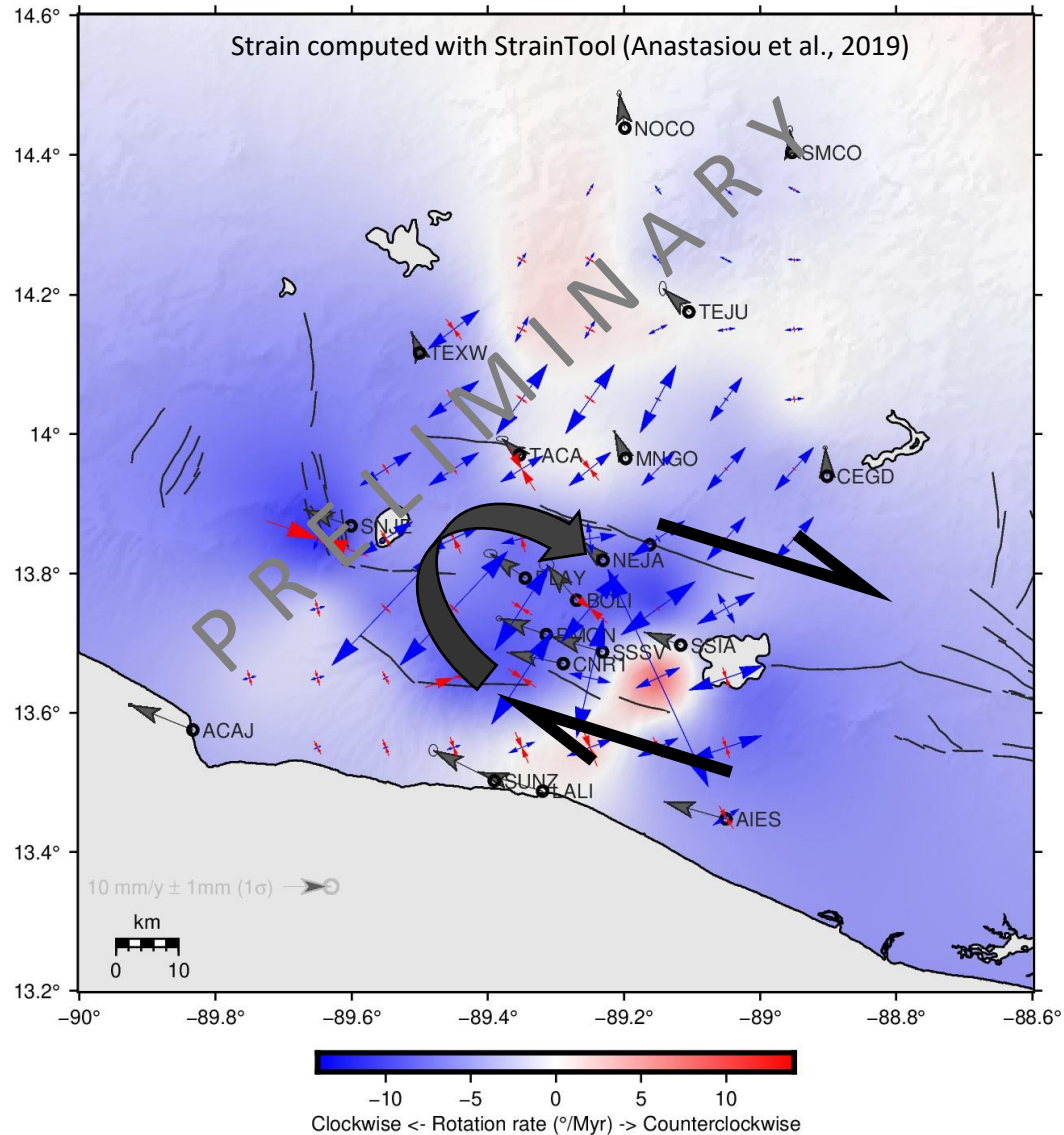
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- Clockwise rotation in the SSES
- Partially consistent with Alonso-Henar et al., 2015 and Legrand et al., 2020

- The Guaycume fault does **not** seem to be the **only feature** accumulating the relative movement of the forearc
- A single fault model (going through the San Salvador extensional stepover) improves the fit to the observations. However, this may be representing the complete movement of the forearc (rather than an actual fault)
- The two-features model could be a realistic option (considering the known faults), although the southern block is not well constrained (due to scarce observations)
- The behaviour of the San Salvador tectonic depression is still unknown
- **Research still ongoing!**

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