



## Seismogenic behaviour in the Lesser Antilles: Insights from geodetic observations

Elenora van Rijnsingen<sup>1</sup>, Eric Calais<sup>1</sup>, Romain Jolivet<sup>1</sup>, Jean-Bernard de Chabaliér<sup>2</sup>, Jorge Jara<sup>1</sup>, Steeve Symithe<sup>3</sup>, Richard Robertson<sup>4</sup>, and Graham Ryan<sup>4</sup>

<sup>1</sup>École Normale Supérieure, Laboratoire de Géologie, Department of Geosciences, PSL Research University, CNRS UMR 8538, Paris, France

<sup>2</sup>Institut de Physique du Globe de Paris, Sorbonne Paris Cité, CNRS UMR 7154, Paris, France

<sup>3</sup>URGéo Laboratory, State University of Haiti, Port-au-Prince, Haiti

<sup>4</sup>Seismic Research Centre, University of the West Indies, St. Augustine, Trinidad and Tobago

The Lesser Antilles subduction zone is a challenging region when it comes to unravelling its seismogenic behaviour. Over the last century, it has been seismically quiet, with no large thrust events recorded, leading to the question whether this subduction zone is able to produce large interplate earthquakes or not. The slow subduction velocity of ~20 mm/yr complicates this even further, as mega-earthquake recurrence times would be up to many hundreds of years in the case of a fully locked subduction interface, and up to several thousands of years for a partially locked interface. The record of two large historical earthquakes, a M ~8 in 1839 and M ~8.5 in 1843, is often referred to as evidence supporting the seismic character of the Lesser Antilles subduction zone. It remains, however, questionable whether these events actually occurred along the subduction interface.

Here we use GPS data acquired on various islands within the Antilles to infer interseismic coupling along the Lesser Antilles Arc. Previous block models have suggested low coupling of the subduction interface, making the occurrence of large megathrust earthquakes less likely. However, the non-uniqueness of these inversions, as well as uncertainties related to the distance between GPS stations and the subduction trench, cast doubts on how well the inferred coupling represents the actual degree of locking along the subduction interface. In this study, we attempt to improve these estimates, by using a Bayesian approach to derive a meaningful set of uncertainties on the distribution of interseismic coupling. By exploring the entire range of model parameters, we are able to provide a probabilistic estimate of interseismic coupling. To further improve our analysis with respect to previous models, we incorporate a layered elastic structure, as well as a more realistic fault geometry, testing two different slab models.

Our results suggest that the subduction interface of the Lesser Antilles subduction zone is most likely to be uncoupled. A sensitivity analysis highlights the deeper part of the interface (i.e., 30-60 km depth) as the region with higher sensitivity, since the GPS stations are distributed mostly above that portion of the subduction. A test regarding the proposed 1843 rupture contour reveals that this area is very unlikely to be locked. This apparent aseismic character of the Lesser Antilles raises

questions about the role of slow slip along the interface. We therefore also analyse GPS time series to assess the spatial and temporal distribution of transient deformation signals in the region.