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Active fault characterization throughout the Caribbean and Central America for seismic hazard modeling

Richard Styron, Marco Pagani, and Julio Garcia
Global Earthquake Model Foundation, Pavia, Italy (richard.styron@globalquakemodel.org)

The region encompassing Central America and the Caribbean is tectonically complex, defined by the Caribbean plate's interactions with the North American, South American and Cocos plates. Though active deformation over much of the region has received at least cursory investigation the past 50 years, the area is chronically understudied and lacks a modern, synoptic characterization. Regardless, the level of risk in the region – as dramatically demonstrated by the 2010 Haiti earthquake – remains high because of high-vulnerability buildings and dense urban areas home to over 100 million people, who are concentrated near plate boundaries and other major structures.

As part of a broader program to study seismic hazard worldwide, the Global Earthquake Model Foundation is currently working to quantify seismic hazard in the region. To this end, we are compiling a database of active faults throughout the region that will be integrated into similar models as recently done in South America. Our initial compilation hosts about 180 fault traces in the region.

The faults show a wide range of characteristics, reflecting the diverse styles of plate boundary and plate-margin deformation observed. Regional deformation ranges from highly localized faulting along well-defined strike-slip faults to broad zones of distributed normal or thrust faulting, and from readily-observable yet slowly-slipping structures to inferred faults with geodetically-measured slip rates >10 mm/yr but essentially no geomorphic expression. Furthermore, primary structures such as the Motagua-Polochic Fault Zone (the strike-slip plate boundary between the North American and Caribbean plates in Guatemala) display strong along-strike slip rate gradients, and many other structures are undersea for most or all of their length.

A thorough assessment of seismic hazard in the region will require the integration of a range of datasets and techniques and a comprehensive characterization of epistemic uncertainties driving the overall variability of hazard and risk results. For this reason and in order to leverage from the knowledge available in the region, datasets and the hazard model will be developed in close collaboration with local experts coherently with GEM's principles of transparency and collaboration.

For what pertains active faults in shallow crust, we are currently working on assigning slip rates to structures based on geologic and geodetic strain rates, though this will be challenging in areas of sparse constraints. An additional area of ongoing work is the delineation of 3D seismic sources from disjoint fault traces; we are currently evaluating methods for this. Though work in the region is challenging, we anticipate that our results will not only lead to more robust seismic hazard and risk estimates for the region, but may serve as a template for workflows in other zones of poor or inhomogeneous data.