Interplate coupling in the Guerrero GAP using the adjoint method

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One of the main technical goals of the SATREPS project (japanese-mexican research project 2016-2021), is the monitoring of the Guerrero seismic gap (G-Gap) as it has never been done before. In total, we have installed 46 geodesic stations, with 7 ocean bottom pressure gauges (OBP) and 2 underwater acoustic positioning equipments (GPS-A). Besides the onshore instrumentation that comprises 32 seismic stations on land and 7 ocean bottom seismometers (OBS). The amount of collected data, so close to the trench, will allow us to better understand the complex behavior of the Mexican subduction zone during any tectonic deformation process.

In the framework of the SATREPS project, we have developed a new method to invert geodetic data for imaging the Slow Slip Events (SSE) that occurs in the Guerrero Gap. During my research stay with Professor Nishimura, we have improved and further extended this strategy to estimate the interplate coupling during an inter-SSE period within the framework of the back-slip model (Savage, 1984). The ultimate goal would be, that from these coupling studies, to further estimate the stresses and the frictional fault properties for hazard assessment of large earthquakes.

Our inversion strategy is inspired in the adjoint method that has been recently and successfully used for earthquake kinematics inversion (Tago et al., 2014; Sánchez-Reyes et al., 2018). We have adapted this strategy for solving the elastostatic inversion formulated as a constrained optimization problem. The strategy does not parameterize the slip vector in the fault (i.e. nether its magnitude nor its direction). We require the pre-computation of the Somigliana tensor, medium impulse response (i.e. the static Green's functions), such that the forward and adjoint problems can be solved efficiently.

We will present the 3D formulation of the method and show synthetic and real inversions. We will address the problem of dealing with sparse data coverage through penalization and regularization terms.

References:

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