Inversion analysis of crustal movements associated with plate subduction: What are we looking at?

Takeshi Sagiya[1]

[1] Environmental Studies, Nagoya Univ.

Dramatic improvement of geodetic measurement accuracy with dense continuous GPS observation has enabled us to monitor crustal deformation associate with plate subduction. We infer mechanical plate interaction through an analysis of deformation data based on the 'slip-deficit' model (Savage, 1983). This approach assumes a steady plate motion and a part of the plate boundary is not fully accommodated by the plate boundary slip because of the interplate locking effect. This locking results in tectonic stress accumulation, leading to occurrences of large earthquakes. Thus the slip-deficit distribution roughly corresponds to the distribution of asperities that ruptures during large earthquakes. However, geodetic data tells us only about kinematic conditions, and nothing about the forces exerting on the plate boundary. If we assume distribution of mechanical locking, or frictional properties on the plate boundary, we can calculate slip-deficit distribution by solving a boundary value problem. On the other hand, slip-deficit distribution cannot provide unique information about the distribution of the frictional properties. Another point to be noted is the limited spatial resolving power of ground-based geodetic data for the slip-deficit distribution offshore, at the 20-30km under the ocean. At best we can estimate approximate location of slip deficit and total amount of accumulated seismic moment. It is impossible to estimate detailed distribution of slip-deficit from geodetic data only. Therefore it is crucially important to obtain quantitative relationship between actual distribution of frictional properties and apparent crustal deformation signal on the ground, with a certain confidence interval, based on numerical simulations assuming a variety of situations.