Plate interaction and stress change along the Japanese islands

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It is well known that plate interaction at the Japanese islands generates stress change (accumulation/release), which leads to large interplate earthquakes. However, the
relationship between the plate interaction and stress change has not been quantitatively investigated. In this study, we use the known geometry of subducting slabs, plate
motion data, and GPS horizontal displacements to quantify the relationship between the plate interaction and stress change along the Japan subduction zones. A three-dimensional plate interaction model has been constructed to simulate the motion of the subducting slabs along the Japanese islands. This model statistically fits the
GPS horizontal displacements to +/-5 mm, and its resultant stress concentration zones encompass most of the historical interplate earthquake locations.

In Southwest Japan, the maximum (principal) stress accumulation rate of about 1.9 bar/yr at a depth of 20 km was estimated along or near the Nankai trough. A stress
concentration zone, which encompasses the sites of most of the historical earthquakes (M = 7.0 and above), was diagnosed with a stress accumulation rate of ~ 0.5 bar/yr.
These results indicate the potential earthquake danger at the Nankai subduction zone, which was previously inferred based mainly on the analysis of seismicity in the
region.

In Kanto-Tokai region, the horizontal motion vector is estimated to be 61 mm/yr for the Philippine sea plate, slightly larger than that (~50 mm/yr) estimated from
earthquake slip vectors and geological data, and 121 mm/yr for the Pacific plate, which significantly exceeds that (~79 mm/yr) deduced from earthquake slip vectors. This
discrepancy suggests that steady-slip on a plate interface at depth might not necessarily be comparable with the average slip of earthquakes, because such steady-slip is
largely aseismic. Further stress analysis indicates that tectonic stress is accumulating with the maximum rate of about 1.5 bar/yr at a depth of 15 km on the northeastern
portion of the Suruga trough, which confirms the potential earthquake danger in the Tokai area.