

Quantitative analysis of inelastic crustal deformation in Central Japan

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The crustal stress accumulated in the interseismic time period is released in the form of future inland earthquakes. Inelastic deformation at depth is considered to be responsible for the stress build-up in the crust. Therefore, evaluating the inelastic deformation in the local crust is important. However, there is no standard method to separate the inelastic deformation from the local deformation field so far. It is necessary to develop a new method to separate inelastic deformation from geodetically observed signals such as Global Navigation Satellite System (GNSS).

In this study, we try to separate inelastic deformation in Central Japan, where major active faults are distributed and many hazardous inland earthquakes have occurred. We select several GNSS sites to form an optimum closed boundary and describe the outer contributions as boundary conditions. Under the assumption of perfectly elastic medium and plane stress conditions inside the boundary, the interior velocities caused by outer contributors can be predicted with a 2-dimensional interpolation approach using Green's functions of an elastic body under plane stress conditions (Sandwell and Wessel, 2016). The residuals between predictions and observations indicate deformations induced by inelastic deformation sources inside.

However, a single result still includes various biases due to crustal heterogeneity and inappropriate boundary selections. In order to cancel these biases, we generate a regular grid with 2 km intervals in Central Japan and batch-predict velocities inside each grid-centered boundary. This way, GNSS sites can be either boundary or interior sites. Averaged residuals for all sites are used to cancel out the errors. The averaged velocities pattern shows similar surface movements as fault motions in central Japan; SE-NW compression around the Kamishiro fault; left lateral strike-slip motion around the East-Matsumoto-Basin fault and the Gofukuji fault; right lateral strike-slip motion around the Atotsugawa fault.

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