Estimation of postseismic deformation at the seafloor GPS-A sites following the 2004 off the Kii Peninsula earthquakes

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Dense near-fault GPS-A seafloor geodetic and on-shore GPS GEONET observations provide significantly improved resolution of the interseismic slip deficit in the Nankai trough, Japan [Yokota et al., 2016]. In a previous study, we included additional seafloor data at the Kumano basin collected by Nagoya University [Tadokoro et al., 2012] to estimate expected seafloor deformation during a large subduction zone earthquake as input to tsunami models [Watanabe et al., 2016 AGU]. However, in order to derive the stable velocities from GPS-A or GNSS data, the displacements caused by episodic events should be quantitatively estimated. Whereas the coseismic and postseismic deformations at the GPS-A sites associated with the 2011 Tohoku-oki earthquake had been already removed in the previous studies, the postseismic deformation of the southeastern off the Kii Peninsula earthquakes (on Sep. 5, 2004 JST, M_{JMA} 7.1, 7.4) have not been quantified. In this study, we constructed the FEM model to calculate the viscoelastic relaxation following these events. At first, we re-estimated coseismic finite fault source models, referencing the source parameters provided by Yamanaka [2004], Saito et al. [2010], Tadokoro et al. [2006] and Kido et al. [2006] for the mainshock, and those by Bai et al. [2007] and Yamanaka [2004] for the foreshock. The viscoelastic deformation was calculated using a 3D FEM model with a realistic subduction geometry. Whereas the oceanic slab and the continental lithosphere were assumed to be an elastic body, the oceanic mantle, the mantle wedge, and the weak asthenosphere which underlay the slab were assumed to have a bivisocous Burgers rheology. The displacements due to afterslip occurring around the rupture planes were also estimated to reproduce the residuals between observed and FEM-calculated viscoelastic displacements. Calculating the observation-calculated misfit values, the different parameter sets for viscosities of the mantle and the asthenosphere, and thickness of the continental lithosphere were tested. The preferred model with the lowest misfit value provided the southward displacements of up to 1 cm/year (between July 2006 and July 2009) in the Kumano Basin. Our result affects the estimation of the slip deficit rate in the Nankai subduction zone, such as provided by Yokota et al. [2016], where megathrust earthquakes have repeatedly occurred. In the presentation, we will show the possible impacts of these events and their postseismic deformation on the slip deficit estimate.

Keywords: Postseismic deformation, Finite element method (FEM) modeling, GPS-A seafloor geodetic observation, 2004 southeastern off the Kii Peninsula earthquakes, Viscoelastic relaxation

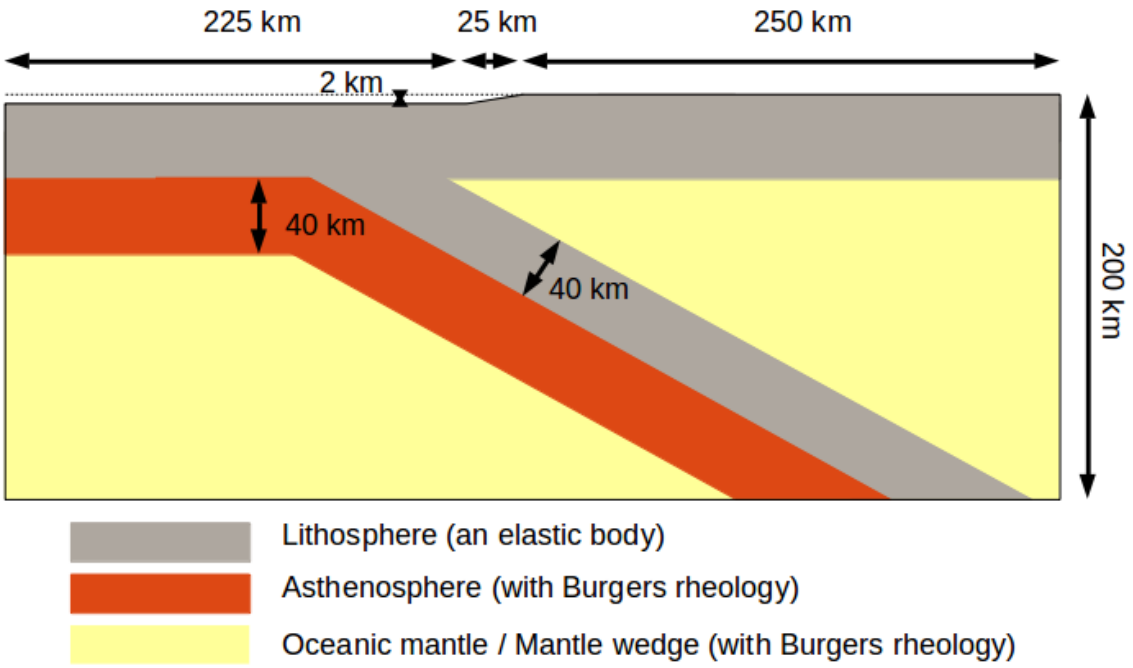

Fig. Schematic picture of FEM structure (cross section)

