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Postseismic deformation for over three years following the 2003 Tokachi-oki earthquake as observed by GPS measurements

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We investigate postseismic deformation for over three years following the 2003 Tokachi-oki earthquake ($M \sim 8$). Earlier studies of postseismic deformation for one month (Miyazaki et al., 2004), half-year (Ozawa et al., 2004), and one year (Baba et al., 2004) assumed that postseismic deformation is solely caused by the afterslip. All of those studies inverted continuous GPS data and Baba et al. (2004) additionally used ocean bottom pressure gauge data that were converted to the vertical displacements, and found that the afterslip distributes around the rupture zone. This is consistent with numerical simulation based on the rate- and state-dependent friction law.

It may not be problematic to ignore viscoelastic effect for earlier postseismic stage (say, shorter than one year). However it would not be negligible when we model longer postseismic deformation. We first evaluate the viscoelastic effect for this earthquake using dislocation in elastic layer overlying a viscoelastic half-space (Johnson et al., 2005). Then we subtract the calculated surface displacements from GPS time series and run the network inversion filter to infer the space-time evolution of the afterslip and shear stress change on the fault. Afterslip is distributed around the rupture zone, as found by earlier studies. The rate-dependence of the shear stress change implies steady-state velocity strengthening with the constitutive parameter $(a - b)\sigma_{eff} \sim 0.1$MPa. This parameter could be used for numerical simulations.