Contribution of linear and non-linear viscoelastic relaxation as postseismic deformation following an earthquake

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Postseismic deformation following the 2011 Tohoku-oki earthquake has been observed at GPS and GPS/Acoustic stations. Previous studies have estimated the contribution of viscoelastic relaxation as the postseismic mechanism as well as afterslip. Those studies employed Maxwell rheology or Burgers rheology for asthenosphere. Some studies advocate non-linear rheology. However, it is still unclear which rheology is the most suitable to the real Earth.

Barbot and Fialko (2010) presented a theory that represent any types of postseismic processes given the constitutive equations. Viscoelastic relaxation, afterslip and poroelastic rebound were involved in the theory. This representation enables us to use both linear and non-linear viscoelastic rheology as postseismic viscoelastic relaxation. In this study, we developed a numerical code referencing this theory. The process of the calculation is following. (1) Coseismic displacements and stress changes are calculated based on Okada (1992). (2) In each time step, the field of moment density rate derived from the postseismic mechanisms is calculated analytically given the stress field. (3) Fields of velocity and strain rate are calculated from the moment density rates. (4) Fields of displacement and stress at the next time step are obtained by integrating velocities and stress rates with time, respectively.

In this presentation, we calculate postseismic deformation including viscoelastic relaxation, for a dip-slip and a strike-slip earthquakes. Results for different rheology models are compared to examine the suitable model to reproduce the characteristics of postseismic displacement data. We plan to compare calculated results with the observed postseismic GNSS data following earthquakes, such as the 2011 Tohoku-oki earthquake.

Keywords: rheology, postseismic deformation, viscoelastic relaxation

