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Spectral Finite-Element Approach to Postseismic Deformationin a Viscoelastic Self-Gravitating Spherical Earth (I)

Yoshiyuki Tanaka[1]

[1] GSI

Theoretical models of the viscoelastic relaxation of a spherical earth are derived to model large-scale post-seismic deformation resulting from great earthquakes over decadal time scales. Most existing models of post-seismic deformation do not consider strong lateral heterogeneities in mantle viscosity, in particular in the subducting slab where such events occur. In addition, the self-gravitation effect is treated only approximately. Both effects become important when observations from space geodetic techniques such as GPS and GRACE are interpreted. In this paper, we present a spectral finite-element approach that allows these two effects to be considered in a rigorous way. Furthermore, much larger lateral viscosity variations can be handled than by perturbation techniques. We derive interface conditions for an arbitrary shear fault in the form of double-couple forces that are equivalent to a prescribed dislocation, and simulate a relaxation process for an incompressible Maxwell earth with a 2-D viscoelastic structure. Computational results are validated for a spherically symmetric model by an independent method based on the inverse Laplace integration, and excellent agreements are obtained for all time scales.