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New method for computing post-seismic deformations in a realistic gravitational viscoelastic Earth model

He Tang (1) and Wenke Sun (2)

(1) College of Earth and Planetary Sciences, University of Chinese Academy of Sciences, Beijing, China (tanghe2014@mails.ucas.ac.cn), (2) Key Laboratory of Computational Geodynamics, University of Chinese Academy of Sciences, Beijing, China (sunw@ucas.ac.cn)

After extensive development of the dislocation theorem regarding static deformations that are due to earthquakes, co-seismic deformations can be well explained by the present elastic dislocation theorem. However, the inter- and post-seismic deformations are difficult to completely separate and interpret because various mechanisms are involved, including the coupling of the fault interface, aftershock activity, porous-elastic rebound, and viscoelastic relaxation. It is only possible to infer the dominant mechanism for an earthquake via multi-observation of post-seismic deformations in regions that have a dense geodetic network. Accurately simulating a process in a reasonable Earth model is a unique way to overcome this difficulty. Here, we present a new robust, accurate, and anti-oscillational method for modeling the post-seismic deformations that are due to viscoelastic relaxation in a realistic gravitational spherical Earth model with linear viscoelastic rheological models. The viscoelastic dislocation Love numbers are evaluated by comparing the results of Sun & Okubo (1993), those of Tanaka et al. (2006, 2007), and our newly derived analytical results. The satisfactory consistency between our new results and previous ones demonstrates that our proposed method is highly accurate. This robust and accurate forward modeling approach is helpful for investigating and separating the major mechanism of the post-seismic deformations and will greatly benefit the inverse investigation of the ground viscoelastic parameters from geodetic observations.