Geophysical Research Abstracts
Vol. 21, EGU2019-14659, 2019
EGU General Assembly 2019

An investigation into the co- and post-seismic deformation associated with the 2011 Tohoku-oki Earthquake considering non-linear viscoelastic response

Takeshi Iinuma (1), Ryoichiro Agata (1), Yusaku Ohta (2), Ryota Hino (2), and Takane Hori (1)

(1) Research and Development Center for Earthquake and Tsunami, Japan Agency for Marine-Earth Science and Technology (JAMSTEC), Yokohama, Japan, (2) Graduate School of Science, Tohoku University, Sendai, Japan

Many previous studies constructed coseismic slip distribution models of the 2011 Tohoku-oki earthquake (M9.0) using the daily global navigation satellite systems (GNSS) site coordinate time series, seafloor GNSS-Acoustic (GNSS-A), and/or ocean bottom pressure (OBP) data to estimate the coseismic displacements. Studies for these several years suggested that the coseismic displacements must include early postseismic deformation due to a low-viscosity zone beneath the Pacific plate that is necessary to explain terrestrial and seafloor postseismic crustal deformations. This low-viscosity zone may not be persistent but could result in huge changes in stress resulting from the coseismic slip with reflecting non-linear viscoelastic response in the asthenosphere. Because the effect of non-linear rheology is great immediately after a main shock, therefore, coseismic displacements based on the daily site coordinate time series and GNSS-A measurements cannot help including early postseismic deformation.
Thus, we derived “pure” coseismic displacements based on 1-Hz site coordinate time series at GNSS sites of the Geospatial Information Authority of Japan estimated by utilizing kinematic PPP (precise point positioning) analysis and based on 1-min average seafloor level time series at OBP sites. The residual displacements were obtained by subtracting the pure coseismic displacement from that based on the daily site coordinate time series. The data showed subsidence and trenchward motions in the entire Tohoku district. These broad deformations could not be explained solely by aftershocks nor by afterslip on the plate interface. Viscoelastic deformation that occurs immediately after the main shock is required to explain the displacement field. We present the results of our investigations into coseismic slip distribution and early postseismic deformation by applying Green’s function, which is calculated by considering the shapes of surface terrain and subducting slabs as well as heterogeneous thermal structures and power-law rheology.