

Postseismic gravity changes of the 2010 Chilean earthquake from GRACE gravimetry

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The Earth's gravity field is known to change after earthquakes. The changes occur instantaneously in the earthquake (coseismic gravity change) and/or slowly after the earthquake (postseismic gravity change). The coseismic gravity change was first observed after the 2003 Tokachi-oki earthquake by an array of superconducting gravimeters (Imanishi et al., Science 2004). Using the data of GRACE (Gravity Recovery And Climate Experiment) satellites, which is the twin satellite launched in 2002 to measure gravity field and its changes, Han et al. (Science, 2006) observed the two-dimensional distribution of coseismic gravity changes associated with the 2004 Sumatra-Andaman earthquake. In the present study, using the GRACE data, we try to detect co- and postseismic gravity changes of the 2010 Chile (Maule) earthquake. We found coseismic gravity decrease and its slow recovery. The coseismic gravity changes were mostly negative, and the maximum decrease was about 4 microgal. The postseismic gravity recovery had a time constant of about a year. The coseismic changes are already reported by Heki and Matsuo (GRL 2010).

Three mechanisms are known for postseismic gravity changes: afterslip, viscous relaxation of the upper mantle, and pore water diffusion. Afterslips would change the gravity in the same sense as the coseismic changes, and viscous relaxation would take a few years or more. These two mechanisms cannot explain the observed postseismic gravity changes, and consequently the pore water diffusion seems the most likely mechanism. Similar postseismic gravity changes were found after the 2004 Sumatra-Andaman earthquake (Heki and Ogawa, GRL 2007), and they suggested that the diffusion of supercritical pore water is responsible for the changes. In addition, the 2004 Sumatra-Andaman and the 2010 Chile earthquake show common features in the amount, time constant of the postseismic gravity changes. I also compared the 2011 Tohoku-oki earthquake, but the time elapsed after this earthquake is not long enough (the GRACE data available only up to 2011 October) to enable detailed discussion on the postseismic gravity changes. One unique point in the Tohoku-oki event is that the postseismic gravity increase occurs in the same region as the coseismic increase. In spite of such differences, overall tendency of the co- and postseismic gravity changes of the 2011 Tohoku-oki earthquake is similar to the other two earthquakes. Recently, its coseismic gravity change is published by Matsuo and Heki (GRL, 2011).

Keywords: coseismic gravity changes, postseismic gravity changes, 2010 Chile earthquake