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The two components of postseismic gravity changes and their mechanisms

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The time series analysis of the gravity changes of the three Mw9-class mega-thrust earthquakes (2004 Sumatra-Andaman earthquake; 2010 Chile (Maule) earthquake; and 2011 Tohoku-oki earthquake) gives the strong possibility that the gravity observation separates postseismic phenomena. There are three sensors for earthquake observations: the first sensor is seismographs, the second sensor is GNSS (Global Navigation Satellite System) or SAR (Synthetic Aperture Rader), and the third sensor is the gravity observation. Seismographs cannot be used to catch the signal of postseismic phenomena because they do not shake the ground. GNSS like GPS (Global Positioning System) and SAR catch the signal of postseismic phenomena but they cannot separate those phenomena because the phenomena move the ground with the same polarities. However, the polarities to gravity changes of postseismic phenomena can be different each other. This suggests that the gravity can become the first sensor to catch the separated signals of postseismic phenomena.

GRACE (Gravity Recovery And Climate Experiment), which is the twin satellites launched in 2002 by NASA and keeps on observing the gravity field of the earth, gives the two-dimensional gravity data and the insight into phenomena under the ground when and after earthquakes occur. The results of time series analysis of postseismic gravity changes with GRACE data show that the gravity which decreases coseismically keeps on decreasing for a few months and increases for a longer period; the postseismic gravity changes have two components (short- and long-term gravity changes). This is a new discovery and this also suggests that the gravity observation gets the different postseimic phenomena with different polarities.

The mechanisms of coseismic gravity changes are well known but those of short- and long-term postseismic gravity changes are not clear completely. They are explained with afterslip and viscoelastic mantle relaxation to some extent but each of them has each problem.

Although the mechanisms of postseismic gravity changes have rooms to be discussed, the gravity observation can do what the seismographs, GNSS and SAR cannot do; the gravity observation separates the postseismic phenomena.