

The new insight for earthquakes, based on the satellite gravimetry.

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The GRACE satellites observe gravity changes by huge earthquakes. Since the GRACE satellites were launched in 2002, several gravity changes have been reported such as the coseismic gravity changes by the 2004 Sumatra-Andaman earthquake, by the 2010 Maule earthquake, and by the 2011 Tohoku-oki earthquake. For the 2004 Sumatra-Andaman earthquake, not only the coseismic gravity change but also the postseismic gravity change has been reported.

I'll explain about three topics:

(1) Topic 1

The mechanisms of coseismic gravity changes by shallow-focus earthquakes have almost been revealed by previous studies. First, I'll introduce the knowledge about it.

(2) Topic 2

I researched the postseismic gravity changes with newer data than those used in previous studies and found the postseismic gravity changes had two components. After decreasing coseismically, the gravity continued to decrease for a first few months and turned to increasing. In my opinion, these two components can be related to afterslip and viscoelastic relaxation. These two phenomena are hard to separate, so they often get into topics in scientific meetings. The result of my study suggests that it would become possible by using the gravity data.

(3) Topic 3

The GRACE satellites also caught the coseismic gravity change of the 2013 Okhotsk deep earthquake (Mw8.3, depth at 604km) and I found it came from the ground deformation. The gravity field is changed coseismically by three main causes, i.e., (1) ground uplift and subsidence, (2) Moho uplift and subsidence, and (3) density changes under the ground. The density changes were dominant in the 2004 Sumatra-Andaman earthquake, the 2010 Maule earthquake, and the 2011 Tohoku-oki earthquake. But in the 2013 Okhotsk deep earthquake, the dominant cause was not density changes but ground deformations. The density changes occurred at a depth of about 600km. This was so deep that the GRACE could not catch it. But the ground uplift and subsidence had so long distance from each other that the GRACE was able to catch the signals. This means that the GRACE is the first tool for the two-dimensional signals of ground deformations by deep earthquakes.

Keywords: GRACE, Postseismic gravity changes, Coseismic gravity changes, Afterslip, Viscoelastic relaxation, Deep-focus earthquakes