

Gravity changes due to the 2016 Kaikoura earthquake

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The 2016 Kaikoura earthquake occurred at 11:02 on Nov. 13, 2016 UTC (00:02 on Nov. 14, 2016 NZDT) in the South Island of New Zealand. Its epicentre was located about 60 km south-west of Kaikoura at a depth of 15 km. The magnitude 7.8 (Mw) earthquake lasted about 2 minutes. One of the characteristics of the earthquake was its complicated ruptures towards north-east and large crustal movements along major faults. In-SAR analysis, GNSS measurements, as well as in-situ observations revealed that more than 8 meters uplift was occurred as a block motion along the fault boundaries. Also 1-2 meters uplift was widely observed along the north-east coastal area.

Since the gravity changes due to the vertical crustal movements provide the information about the subsurface density changes, which would be useful for considering the rupture mechanism, we have conducted relative gravity measurements at bench marks along State Highway 1 (SH1) from Blenheim to Christchurch. The obtained gravity values were compared with those of the 1980's precise gravity network. Although the uncertainties of the comparisons were not small, the results clearly show the gravity changes due to the widespread uplift. In particular, the gravity changes around Ward are significant and a step of the gravity change of about 0.5 mGal is clearly detected across the Kekerengu Fault.

In addition to the relative gravity measurements, we conducted absolute gravity measurements at 2 sites in Marlborough region in Sep. 2017, and we plan to reoccupy the same points in April-May 2018 to detect the possible gravity changes due to postseismic deformation. We also plan to conduct GNSS survey at the gravity bench marks to evaluate height changes more precisely. These data will be used to estimate the ratio between the gravity changes vs height changes, which should provide useful information about the mechanism of the crustal movements.

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