

TITLE

How to make old and dense gravity data consistent with the latest gravity data? --Example in Japan--

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ABSTRACT

Generally, old gravity data aren't consistent with newer data even if their markers remain intact. Such discrepancy often reaches more than 100 micro Gal, which is much larger than measurement errors. Therefore, to make use of the historic gravity data together with current gravity data for various uses e.g. geoid construction, estimation of subsurface structure, precise land gravity survey etc., the adjustment of old data to the latest gravity value. Here, we developed such a conversion method.

Simple interpolation method isn't useful for this purpose because raw gravity difference data include local contribution that reduce spatial coherence of gravity data. So we must correct the local tectonic effect assimilating other geodetic observations. We assume that differences between new and old gravity data are composed of contribution of crustal deformation effect and that of data processing method/reference system. Moreover, crustal deformation effect is decomposed into height variation and density variation of crust caused by earthquakes.

First, we estimated effect of height variation at a marker between the observations. We use continuous GNSS observation data to estimate contribution after 2003, and spirit leveling data before 2003. These data are interpolated in space and time. The gravity change by height variation was calculated using a Bouguer gravity gradient depending on the old observation period of each marker. Second, effect of density variation is estimated by a rectangle fault model using half-space elastic dislocation theory.

Then we assumed that residuals represent systematic offset caused by the difference of data processing method/reference system. Now the offset distribution may be evaluated by spatial interpolation thanks to the enhanced spatial coherence of residuals after correcting for local tectonic effect.

Consequently, we got a gravity difference distribution which can make old gravity data consistent with new one within 45 micro Gal in precision.