# Investigation of method that makes Japanese old and dense gravity data consistent with Japan gravity standardization net 2013

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Geospatial Information Authority of Japan (GSI) have established a new gravity standardization network of Japan, named the Japan Gravity Standardization Net. 2013 (JGSN2013), from the latest absolute and relative land gravity measurements covering the whole country. The accuracy of JGSN2013 is evaluated around 10μGal in standard deviation from the residuals of network adjustment and the leave-one-out cross validation, and this means JGSN2013 achieves more accurate gravity standard than the former gravity standard, the Japan Gravity Standardization Net. 1975 (JGSN75), by an order of magnitude. GSI also conducted relative gravity measurements at benchmarks and some of triangular control points from 1967 to 1993 in order to obtain dense spatial distribution of surface gravity and also utilize them for orthmetric height correction of levelling survey. The data obtained by the measurements comes to 14,000 in total, refers JGSN75 and has been utilized for calibration of measurement devices etc. as nationally authorized gravity standard.

This gravity data refer to JGSN75, which was established in 1976, thus are not consistent with recent measurements referring JGSN2013 and the difference sometimes exceeds range of the measurement error. The major sources of the difference are difference in measurement procedure or difference of referred standard, temporal vertical variation of ground at observed sites caused by crustal deformation or pumping of groundwater. The maximum difference between JGSN75 and JGSN2013 at the gravity station of GSI is over 100μGal.

GNSS-derived orthmetric height determination has been recently developed. As a result, the importance of land gravity data densely covering the whole country has been gradually increasing because the data has been increasingly utilized as fundamental data for modeling of geoid, a reference surface for orthometric height. The latest, Highly-reliable land gravity data covering the country are essential for improving accuracy and reliability of geoid model. However, it is almost impossible to obtain new data referring JGSN2013 with in several years by newly conducting time- and cost-consuming gravity measurement for the whole country.

To resolve these problems, a method that makes JGSN75 gravity consistent with JGSN2013 gravity is developed. In this research, difference between two gravity reference system is explained with two causes thus, (A): “observation error that is originally included in JGSN75” and (B): “effects of crustal deformation that is imposed on observation point while old and new observation interval”.

(B) can be estimated using spirit leveling data and GNSS continuous observation data for determination of variation of observation point and its effect for gravity value. Furthermore, co-seismic and post-seismic gravity change are estimated using rectangular fault model and viscoelastic relaxation model calculation. These crustal deformation effects are subducted from difference gravity data and we obtain (A). And we can adapt appropriate method for interpolation of difference of gravity data that are corrected using (B).

By this research, gravity change that are caused by crustal deformation is estimated. And relation of old and new gravity data is revealed. Thus old and dense gravity data recover accuracy. Consequently, basic data for developing more precise geoid are provided.

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