Japan Geoscience Union Meeting 2011
(May 22-27 2011 at Makuhari, Chiba, Japan)

SGD022-P01 Room:Convention Hall Time:May 23 10:30-13:00

Compilation of the Gravity Database of Japan, DVD Edition.

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Geological Survey of Japan, AIST has compiled new Gravity Database of Japan, DVD edition in 2011. This DVD includes gravity measurement point data, mesh data and image map data.

The mesh data consist of Bouguer anomalies with assumed densities of 2.00, 2.30 and 2.67 g/cm3 and free-air gravity anomaly. The mesh data size is 500m x 500m. The image maps are Bouguer anomaly map, free-air anomaly map and geological map.

Keywords: Japan, Gravity, Database, CD-ROM, DVD

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Latest Gravity Database of Japan (CD-ROM) and new Bouguer gravity maps of Tohoku District, northern Japan

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In 2001 we published the gravity database CD-ROM of Southwest Japan (Shichi and Yamamoto, 2001; hereafter referred to as CD2001), in which the absolute gravity values and their coordinates of 90,298 net gravity data were digitally included. CD2001 consists with gravity data by Nagoya University (NU) (DB1, 54.3% of total) and those by organizations other than NU (DB2, 45.7% of total). Besides this database, we archived more than 100,000 net gravity data (DB3) by other sources that were not published in CD2001. DB3 contains a part of published database by Geological Survey Japan (GSJ, 2000, 2004) and unpublished database by Geographical Survey Institute and private companies. At that time we focused our attention to Southwest Japan in order to collect and compile gravity database from many organizations, because many blank-areas of gravity data have been left untouched in Northeast Japan. After the publication of CD2001, we have performed extensive gravity surveys especially in the regions with sparsely-measured gravity data (chiefly in Northeast Japan) until the Autumn of 2010. Consequently, we obtained about 23,689 new gravity data (DB4), which may fill most of the blank-areas of gravity data in Northeast Japan. DB4 consists with gravity data by Chubu University (CU) (22,406, 94.6% of total) and those by Nagoya University (NU) (1,283, 5.4% of total). Finally we archived more than 214,000 original gravity data (DB1+DB2+DB3+DB4).

DB1: 49,615 (published in CD2001, data by NU+CU)
DB2: 40,683 (published in CD2001,
data by 35 organizations other than NU+CU)
DB3: 100,000 (unpublished data)
DB4: 23,689 (new data by CU+NU)
DB1+DB4: 73,304 (CD2001 and new data by CU+NU)

We have carefully revised and/or updated previously-measured data (DB1) in CD2001. Here we publish the updated version of DB1 and newly archived database DB4 with their coordinates, gravity, and related values in a digital form. Most of this updated database has not yet been published in a tabulated list nor in computer-readable form. We present new Bouguer gravity maps of Tohoku District, northern Japan, which were created using gravity data compiled from this CD-ROM and other sources.

Keywords: gravity anomaly, database

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Gravity measurement at segment boundary of Yamasaki fault zone

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A high dense gravity measurement composed of 336 points was carried out at segment boundary of Yamasaki fault zone, in order to reveal the depth distribution of basement. The measurement was conducted with two CG-3 type gravimeters.

The obtained distribution of gravity shows the negative anomalies ranging from 0.5 - 1.0 mGal parallel to Hijima and Yasutomi fault. On the other hand, there are no negative anomalies around western part of Kuresakatouge fault.

We assume that the negative anomalies are from distribution of fracture zone, from which it is deduced that Hijima and Yasutomi fault are connecting, and Kuresakatouge fault is independent fault.

Keywords: active fault, gravity measurement

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Support mechanism for a relative gravimeter using two-axes gimbal on a mobile carrier

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Modeling ground structure is one of the most important topics for the estimation of seismic hazard these days. It is said that there are high correlation between the density structure of the ground and the seismic velocity structure of the ground. The gravity survey is comparatively easier than other exploration method to estimate the density structure, so that it is very suitable for the aspect of the seismic hazard projection.

For the measurement of gravity, development of a simplified relative gravimeter is ongoing, in which a force-balanced-type accelerometer is applied as a sensor. Because these accelerometers are simple and inexpensive, the observation can be performed much easier than by using a conventional spring-type relative gravimeter which is usually used. The gravimeter is also expected to perform the observation on a mobile carrier, such as vehicle, ship, and so on, so that we can obtain gravity anomaly at the place where is difficult to measure by using other sensors.

In such a situation, we decided to use a two-axes gimbal system to support the gravimeter on a carrier. There are two main purposes: to maintain the gravity meter horizontally and to attenuate a vibration caused by the body. The 2D and 3D numerical model of the supporting system are proposed, and the equations of motion are derived by means of the Lagrange equations. By using the leap-frog method, frequency response functions of the gimbal model are obtained numerically from the equations.

Furthermore, we made an actual prototype of the gimbal. By using the support system, we conducted an excitation test. Results of the test are compared with that of the numerical analysis. Numerical model can explain the behavior of the actual gimbal partially. However, the degree of freedom of model is not enough to represent responses of the gimbal. Furthermore, the effects of cables may not be neglected to follow the real behaviors.

Keywords: gravity survey, gimbal, force-balanced accelerometer, frequency response function

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Gravity change associated with local land-water redistributions: its observations and modeling at Isawa Fan

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Gravity observation is one of the powerful tools in detecting mass redistributions in the solid earth, such as earthquake deformations and magma transfer in volcanoes. Many previous studies have detected the above solid-earth gravity signals, by correcting "hydrological disturbances" (i.e. gravity change associated with spatiotemporal land water redistributions) with empirical models in advance. However, physical hydrology should be taken into account in order to correct the hydrological disturbances with high accuracy. We were thus motivated to utilize a physical groundwater flow solver "Gwater-1D" (Kazama, 2010) to model the hydrological disturbance observed by a superconducting gravimeter at Isawa Fan (Iwate Prefecture). We found the following results:

(1) The local soil moisture change can be reproduced within the observation error, if soil parameters observed by soil tests are applied to Gwater-1D.

(2) The hydrological disturbance during 50 days (amplitude: 5 micro-gals) can be reproduced within about 0.4 micro-gals in RMS, because Gwater-1D models the local-scale groundwater distribution and the consequent short-term (~< several months) gravity change.

(3) The annual component of the hydrological disturbance (amplitude: about 1.3 micro-gals) cannot be reproduced, because Gwater-1D does not model regional and/or global land water redistributions, such as snow loading and ocean height change.

In the coming presentation, we will explain details about estimating the hydrological disturbance, and discuss how to reproduce hydrological disturbances with higher accuracy.

Keywords: gravity change, Isawa Fan, superconducting gravimeter, groundwater, soil water, snow cover