

Absolute gravity measurements near the Sor-Rondane Mountains, Antarctica

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In order to detect the gravity changes due to ice sheet mass changes, Glacial Isostatic Adjustment (GIA) and other effects, we have conducted absolute gravity measurements at Princess Elisabeth Station (PES) near the Sor-Rondane Mountains, Antarctica, as part of the 55th Japanese Antarctic Research Expedition (JARE-55). In addition, the first absolute gravity measurements using a field absolute gravimeter have also been conducted on the Seal rock near the Asuka station, where the gravity reference point (No.26-01) established by JARE-26 is located.

The absolute gravimeters employed were FG5#210 and A10#017, and a relative gravimeter LaCoste #805 was also used for dg/dz measurements and gravity connections. Using DROMLAN (Dronning Maud Land Air Network), we moved to PES with the instruments via Novolazarevskaya from Cape Town in South Africa. The length of our stay in PES was for 18 days from Nov. 29 to Dec. 16, 2013. Belgian researchers have already conducted absolute gravity measurements using a FG5 in North Shelter (NS), a small observation hut built on an outcrop a few hundred meters apart from the main base of PES. One of the main purposes of this project is to monitor long-term gravity changes by means of successive absolute gravity measurements at the same gravity point in NS. Since NS has not enough space for adjusting the gravimeters before measurements, we borrow a room in the main base for the purpose and test measurements as well. We established a tentative gravity point in the room and compared the gravity values measured by A10 and FG5. The result showed the discrepancy was within 2 micro-Gals. This means that A10 was well calibrated. Unfortunately a crucial fault arose in the dropping chamber of the FG5, and it could not be recovered to the last. For this reason, the measurements in NS were carried out using A10. The gravity value on the reference point was calculated to be 982302155.21 micro-Gals with the measured dg/dz of -4.4529 micro-Gals/cm. Although the exact comparisons with the gravity values obtained by the Belgian team have not been completed yet, the gravity values seem to be in agreement within several micro-Gals. Therefore the temporal gravity change would be very small, even if it existed.

The gravity measurements on the Seal rock have been conducted on Dec. 5th and 6th. Since No.26-01 is located near the summit of the Seal rock, where strong wind blows constantly, it is very difficult to conduct absolute gravity measurements even using A10. Therefore a tentative gravity point was set up at the foot of Seal rock, and measurements with A10 were conducted at the point. Then gravity connection to No.26-01 was conducted with the LaCoste gravimeter. The gravity value thus obtained at No.26-01 was 982406.109 mgal with the accuracy of about 15 micro-Gals including the errors due to the gravity connection.

The gravity values of No.26-01 so far obtained were 982405.33mgal by JARE-26 (GSI, 2002), and 982402.817mgal by JARE-27 (Fukuda, 1986). The new value is 0.779 mgal and 3.292 mgal larger than those of JARE-26 and JARE-27, respectively. In JARE-27, two sets of LaCoste gravimeters were employed for the gravity connection between Seal rock and Syowa Station. Since a large discrepancy between the values obtained by two gravimeters was found, Fukuda (1986) applied a step correction of 3.765mGals to the suspected gravimeter. However, judging from the present result, the correction could be applied to the wrong gravimeter. If the correction was applied to the other gravimeter, the difference of 3.292 mgal was set to about 0.5mGals, and it would be likely as the accuracy of the gravity connection. The gravity value of No.26-01 has been used as a reference value for the gravity surveys so far conducted in the Sor-Rondane area. Therefore the revisions of those values should be required from now on.

Keywords: absolute gravity measurement, Sor-Rondane, Antarctica, ice sheet movement, gravity changes, gravity reference point