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Effective vertical acceleration correction in airborne gravity measurements

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In Japan, air-borne gravity measurement systems mounted on helicopters have been developed since 1998. In particular, the helicopter-borne gravity measurement system, SEGAWA Model was developed in 2000. The SEGAWA Model consisting of all measuring systems excluding the global positioning system (GPS) is made in Japan, and has a high reproducibility of 1.6 mGal. However, some data correction methods, such as the vertical acceleration correction, the horizontal acceleration correction and the digital filter, could still be improved and optimized. In this study, we report on an optimized vertical acceleration correction method having the largest amount of correction calculations after observations.

The vertical acceleration correction subtracts the vertical acceleration due to the movement of a helicopter from data measured by a gravity meter. The SEGAWA Model measures the acceleration including both gravity and vertical accelerations of a helicopter and outputs data at a 0.1 s interval. Meanwhile, the vertical acceleration of a helicopter would be calculated from the data of the helicopter location measured by a GPS at a 1 s interval. Thus, there is a difference in data quality between the calculated vertical acceleration and the measured vertical acceleration by the gravity meter. In order to avoid the deterioration of gravity anomalies due to this problem, we improved the transformation procedure of the sampling rate, and the unification of the signal intensity.

In order to improve the transformation procedure of the sampling rate, we introduced a lag time. When transforming the data given by the sampling rate of 0.1 s measured using the gravity meter into the data given by the sampling rate of 1 s, we staggered the initial calculation time during the transformation in order to obtain the highest correlation between the calculated vertical acceleration and the measured vertical acceleration. Meanwhile, in order to improve the unification of the signal intensity, we applied the digital filter (a running mean of 3 s) to the vertical acceleration data due to the movement of the helicopter, and made the signal intensity between the measured data and the calculated data the same. As a result, the reproducibility was improved by approximately 1 mGal. These improvements also reduced the window width of the digital filter by approximately 50 s, and there was no serious quality deterioration in the gravity anomalies.

Keywords: air-borne gravity measurement, helicopter-borne gravity measurement system, vertical acceleration correction