Absolute gravity and GNSS measurements on bedrock outcrops in Dronning Maud Land, East Antarctica

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The Antarctic ice sheet plays a significant role in the long-term global climate change, so the spatiotemporal variations in the Antarctic ice sheet should be precisely monitored to forecast future climate changes. The ice sheet variations can be detected as loading deformations of the solid Earth, which are composed of the elastic deformation due to the present-day ice melting and the viscoelastic deformation due to the past ice melting. These effects can be separated by measuring both of the crustal deformation and land gravity variation, but enough gravity data has not been collected in the Antarctic region as of now. In order to understand more about the ice sheet variations in terms of solid-earth geophysics, land gravity data should be repeatedly measured at more sites in the Antarctic region.
We therefore collected new absolute gravity data using the FG5-210 absolute gravimeter at two stations located on bedrock outcrops in Dronning Maud Land, East Antarctica in November-December 2018. We first stayed at the Norwegian station, Troll (72.01S, 2.53E) from November 13 to 26, and installed the gravimeter on the benchmark (Troll AA) of the gravity hut. We needed to take more time to vacuum the dropping chamber of the gravimeter during the installation, because vacuuming pumps did not work normally, mainly associated with the cold weather in Troll Station. We started to measure absolute gravity values on November 18, and obtained the average gravity value of 982,360,741.41 +/- 1.16 +/- 1.82 microGal from the 178 sets of the gravity data collected for 5 days. We also stayed at the Indian station, Maitri (70.77S, 11.73E) from November 26 to December 4, and started to measure gravity values on the benchmark (Maitri AB) of the gravity hut on November 28. We obtained the 112 sets of the gravity data for 4 days, and determined the average gravity value of 982,576,883.10 +/- 1.23 +/- 1.83 microGal.
Our absolute gravity values collected in November-December 2018 was found to be smaller than those obtained in January-February 2012 (Dr. Jaakko Mäkinen, personal communication) by -4.4 and -4.2 microGal at Troll and Maitri stations, respectively. The gravity decrease may be caused by ground subsidence and/or ice mass decrease around the stations. The cause of the gravity decrease will be investigated in detail by analyzing the GNSS data which was collected simultaneously with the absolute gravity data at two stations.

Keywords: Antarctic ice sheet, absolute gravity, relative gravity, GNSS, Troll Station, Maitri Station

