

A Study of Antarctic ice sheet mass variation using GRACE satellite gravity data

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An accurate knowledge of the mass balance in Antarctic ice sheet is an important problem for the studies of global water mass balance, sea level change and climate change. The geographical and geological feature is different between East and West Antarctica so that the melting speed and mechanism of the ice sheet are also different. GRACE satellite gravity data give us the information of the temporal mass variation on the Earth as the gravity field variation in relatively large spatial scale. The data can be used to know the mass balance in East, West Antarctica and the entire Antarctic continent and greatly contribute to the study of Antarctic ice sheet mass variation.

So far, using about 2.5 years GRACE data of 2002-2004, we estimated the trends of the mass variation excluded the J2 contribution in the East, West Antarctica and in the entire continent as the values of -5.0 mm/yr, -7.7 mm/yr and -4.1 mm/yr in equivalent water thickness, respectively. However, it is reported that the GRACE data used for the estimation (UTCSR Release 01) have; 1) large errors in the ocean model correction and J2 values, 2) large differences in the data precision. Therefore the estimated values may not be reliable.

Recently, new GRACE data sets were released from 3 data centers (UTCSR Release 02, GFZ Release 03 and JPL Release 02). In these data sets, the ocean tide models and the short period ocean models employed for the corrections as well as the J2 value are extremely improved. Thus we expect these data sets give more reliable values of the ice sheet mass variation rates.

In this study, we firstly evaluate the qualities and accuracies of the data sets by comparing each of the new (from 3 data centers) and the old (UTCSR Release 01) GRACE data sets to the others. Then we estimated the Antarctic ice sheet mass variation from the most reliable data set. In this process, we also checked the accuracies of the ocean and the land water models by which the loading effects were calculated. Finally we discuss the Antarctic ice sheet mass variations by comparing the obtained results with the values expected from other observations and/or meteorologically estimated.