

Short to medium-term ice sheet mass changes and long-term mass trends in Antarctica revealed by GRACE

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Antarctic ice sheet mass balance is one of the most concerned topics because it directly affects global sea level changes. It had been a difficult problem to measure the mass changes for a long time. But thanks to the recent satellite observations, the accuracy of the Antarctic ice sheet mass trends has been improved significantly in a couple of past decades. According to the studies based on satellite altimetry, SAR (Synthetic Aperture Radar) interferometry and satellite gravimetry, the mass trends in East and West Antarctica show slightly positive and negative, respectively, for the period from 1992 to 2011. However, due to the limited data periods of the satellite observations, these results may depend on the time spans of the data employed, because the estimated linear mass trends may suffer from the influence of short to medium-term climate anomalies. For a better estimation of the long-term ice sheet mass trend, which connects to century-scale global sea level changes or global warming, it is important to estimate and remove such short to medium-term mass fluctuations. In this study, using the most updated GRACE (Gravity Recovery and Climate Experiment) satellite gravity data for the period from 2002 to 2012, we assessed the effects of short to medium-term climate anomalies on the Antarctic ice sheet mass trend. We first divided Antarctic area into 27 drainage systems in consideration with regionally different mass change mechanism. And then we statistically evaluated the uncertainties of the mass trend values caused by the differences of the data time spans for each area. Further, the estimated mass variations were compared with climate indices and global hydrological/meteorological data sets to identify the dominant sources of the short to medium-term mass anomalies. Finally we discussed the effects of the short to medium-term anomalies on the estimations of the long-term ice sheet mass trends in East and West Antarctica and the global mass balance as well.

Keywords: GRACE, Antarctic ice sheet, mass balance, global sea level changes