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High resolution mapping of ice mass trend in Greenland using GRACE GFZ solution

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The gravity satellite mission GRACE has been measuring monthly variations of the Earth's gravity field since its launch in 2002. The GRACE data has updated from RL04 to RL05 in May 2012, and have been provided in the form of spherical harmonic (Stokes') coefficients with degree and order up to 60 (d/o60) from CSR and JPL. In addition, GFZ has provided Stokes coefficients with d/o90 as RL05a product in December 2013. In this study, we examine the measurement error of GFZ RL05a product (d/o90). Then we attempt to delineate a high resolution map of ice mass trend in Greenland by making use of the full Stokes' coefficients.

First, we examine the measurement error. Following the method of Wahr et al. (2006), we derive temporal and spatial variation of the measurement error from error variance matrix of GRACE data. The global average of RL05a error is about 100cm in equivalent water thickness. Because RL04 error is about 300cm, RL05a achieves triple the precision improvement. The temporal variation of error in global average is about 200 cm from January 2003 to July 2003, and reduces to about 100cm afterwards. The spatial distribution shows large error in equatorial region (about 130cm) and small error in polar region (about 40cm). Considering these results, it can be said that the quality of RL05a is especially high in polar region after August 2003.

Next, we derive ice mass trend in Greenland from GFZ RL05a (d/o90) product. Here we apply de-striping filter (Swenson and Wahr, 2006) to alleviate the noise. In addition, we employ spherical Slepian Basis (Harig and Simons, 2012) to extract ice mass trend in Greenland effectively. In doing so, we can successfully delineate a clear ice mass trend map with about 200 km spatial resolution, which is 1.5 times as high as before. We confirmed very good agreement with ICESat result.

Keywords: Satellite gravimetry, Greenland, Ice sheet mass variation, Space geodesy, GRACE, ICESat