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Greenland ice mass balance estimation from GRACE: a reexamination

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In recent years there have been several studies using GRACE satellite data to analyze the melting of the Greenland ice sheet. The results of the different investigations vary considerably. In this study, monthly GRACE solutions calculated by the Institute of Geodesy and Geoinformation of the University Bonn (ITG-GRACE2010 time series) are evaluated to obtain a new estimate for the mass balance of the Greenland ice sheet including the corresponding error estimate.
One of the major issues when dealing with mass variations in Greenland is the leakage problem. In the contribution at hand, leakage-in effects caused by external mass variations are addressed by estimating a regional adjustment of the applied ocean model. The approach assumes time-invariant spatial patterns of ocean mass variations to be correctly reproduced in the circulation model but their time-variable amplitudes to be improvable. New amplitudes are determined by comparison to the GRACE observations in a least-squares estimation process. Leakage-out can be compensated for by rescaling the ice mass changes with a constant factor. In addition to a simple technique, a more complex approach developed by Baur et al. (2009) is applied in this investigation to obtain the rescaling factor. Besides mass variations in the area of Greenland also mass variations in an extended area around Greenland are taken into account in this procedure.
A further important aspect is the problem of signal separation, especially separating the ice mass variations from mass trends caused by glacial isostatic adjustment (GIA). A comparison of different GIA models shows why this is one of the major sources of uncertainty when trying to determine the Greenland ice mass balance.