



## **Uncertainty in GRACE estimates of the mass redistributions at the Earth surface and implications for the global water and sea level budgets**

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Observations from GRACE provide quantitative estimates of the global water budget components. However, these estimates are uncertain as they show discrepancies when different parameters are used in the processing of the GRACE data. We examine trends in ocean mass, ice loss from Antarctica, Greenland, Arctic islands and water storage in land and in glaciers from GRACE data (2005-2015) and quantify the associated uncertainty. We considered variations in 6 different GRACE processing parameters, namely the processing center of the raw GRACE solutions, the geocenter motion, C2,0, the filtering, the leakage correction and the GIA. Considering all possible combinations of the different processing parameters lead to an ensemble of 1800 post-processed GRACE solutions which is assumed to cover the uncertainty range of GRACE estimates. The ensemble-mean trend in all global water budget components agree within uncertainties with previous estimates based on different sources of observations. The uncertainty (at the 90% confidence level) in the global water budget is  $\pm 0.52$  mm/yr. It is systematically larger than previous estimates because it takes into account for the first time the uncertainty in the geocenter motion correction. We find that the uncertainty in the geocenter motion and GIA corrections dominate the uncertainty in GRACE estimate of the global water budget and hampers accurate closure of the global water budget and the global sea level budget. This uncertainty in GRACE estimate implies an uncertainty in the net warming of the ocean and the Earth energy budget of  $\pm 0.50$  W.m<sup>-2</sup> when inferred using the sea level budget approach.