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Mass Loss in Greenland and Antarctica from 1993 to 2013 Determined from a Combination of GRACE and SLR Data

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The objective of this work is to extend the record of ice melt derived from space-borne gravity prior to the GRACE mission. We merge GRACE fields with conventional tracking data spanning 1993 to the present.

The conventional tracking data consist of satellite laser ranging (SLR) and Doppler Orbitography and Radiopositioning Integrated by Satellite (DORIS) data and are provided as weekly global fields of degree and order five. Their multi-decade timespan complements the monthly fields of GRACE of degree and order 60 that start in 2003 and will end when the GRACE mission terminates. The two datasets are combined via an empirical orthogonal function (EOF) analysis, whereby the GRACE fields are first decomposed into spatial and temporal modes that are reflective of interannual gravity variability. Conventional tracking data temporal modes are then obtained by fitting GRACE spatial modes via normal equations; combining those temporal modes with GRACE spatial modes yields the reconstructed global gravity fields.

We will show that the reconstructed Greenland and Antarctica mass changes capture the recent behavior of the ice melt over 1993 – 2013. The accelerating term, linear trend, and mass changes match with existing literature values, specifically, with similar GRACE analyses over 2002 – 2013 and with glaciological and altimetric evidence prior to the GRACE mission. We will also show current efforts to mitigate the limits of the reconstructions (e.g., in the EOF fitting process, the accuracy of the SLR/DORIS solutions, etc.) and their impact on the evolution and spatial accuracy of mass change in Greenland and Antarctica.

The technique also has important implications for bridging the potential gap in global gravity coverage between the GRACE and GRACE Follow On missions, slated to launch in 2017.