



Mass loss of the Greenland Ice Sheet since the Little Ice Age, implications on sea level

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TITLE: Mass loss of the Greenland Ice Sheet since the Little Ice Age, implications on sea level

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ABSTRACT BODY: The impact of mass loss from the Greenland Ice Sheet (GrIS) on 20th Century sea level rise (SLR) has long been subject to intense discussions. While globally distributed tide gauges suggest a global mean SLR of 15-20 cm, quantifying the separate components is of great concern - in particular for modeling sea level projections into the 21st Century. Estimates of the past GrIS contribution to SLR have been derived using a number of different approaches, e.g. surface mass balance (SMB) calculations combined with estimates of ice discharge found by in correlating SMB anomalies and calving rates. Here, we adopt a novel geometric approach to determine the post-Little Ice Age (LIA) mass loss of the GrIS.

We use high quality aerial stereo photogrammetric imagery recorded between 1978 and 1987 to map morphological features such as trim lines (boundary between freshly eroded and non-eroded bedrock) and end moraines marking the ice extent of the LIA, which thereby enables us to obtain vertical point-based differences associated with changes in ice extent. These point measurements are combined with contemporary ice surface differences derived using NASA's Airborne Topographic Mapper (ATM) from 2002-2010, NASA's Ice, Cloud, and Land Elevation Satellite (ICESat) from 2003-2009, and NASA's Land, Vegetation, and Ice Sensor (LVIS) from 2010, to estimate mass loss throughout the 20th and early 21st Century.

We present mass balance estimates of the GrIS since retreat commence from the maximum extent of the LIA to 2010 derived for three intervals, LIAMax (1900) - 1978/87, 1978/87 - 2002, and 2002 - 2010. Results suggest that despite highly spatially- and temporally variable post-LIA mass loss, the total mass loss and thus the contribution from the GrIS to global SLR has accelerated significantly during the 20th Century.

KEYWORDS: 0700 CRYOSPHERE, 0726 CRYOSPHERE Ice sheets, 0762 CRYOSPHERE Mass balance 0764 Energy balance, 0758 CRYOSPHERE Remote sensing.

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