



Mass loss of Greenland's glaciers and ice caps 2003-2008 from ICESat data

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The melt water of the glaciers and ice caps (GIC) on Greenland could make a substantial contribution to global sea-level rise during this century. The recently finalized Greenland glacier inventory classified all GIC according to its connectivity to the ice sheet (CL0: no connection, CL1: weak connection, CL2: strong connection). This dataset allowed us for the first time to determine their mass changes separately from the ice sheet using space-borne laser altimetry data from the ICESat GLAS sensor. The accuracy of the altimetry measurements of about ± 0.5 m even over rough surfaces along with their small footprint (about 70 m) is making them very suitable to assess elevation changes over GIC. A major challenge with ICESat data is the sparse density of the tracks (horizontal separation is about 30 km in southern and ~ 10 km in northern Greenland), and the fact that the repeat tracks can be several hundred metres apart. A further challenge is the volume to mass conversion. We extrapolated the elevation changes based on the glacier hypsometry and applied corrections for firn compaction and ice density based on climatic conditions. The Greenland GIC which are clearly separable from the ice-sheet (CL0, CL1) lost 30.1 ± 9.4 Gt a-1 or 0.08 ± 0.026 mm a-1 sea-level equivalent (SLE) between 2003 and 2008. When considering all hydrologically separable GIC (CL0-2, including the Geikie Plateau) the loss is 46.8 ± 13.4 Gt a-1 (0.12 ± 0.038 mm a-1 SLE). This is a significant fraction (about 20%) of the reported overall mass loss of Greenland (including the ice sheet) and up to 10% of the estimated contribution from the world's GIC to global sea-level rise. The mass loss of the GIC is per unit area about 2.5 times higher than for the ice sheet, and marine-terminating glaciers account for about half of the mass loss. The loss was highest in the south-eastern sector and lowest in the northern sector of Greenland.