Queen Elizabeth Island glacier and ice cap mass loss from airborne altimetry 1995-2012

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Rapid warming and enhanced melt from glaciers and ice caps have made the Queen Elizabeth Islands (QEI), Arctic Canada, one of the largest glacier contributors to the non-steric component of global sea level rise, after the major ice sheets in Greenland and Antarctica (Gardner et al. 2013). Between 2005 and 2009 mean summer surface temperatures in the QEI were 0.8°C to 2.2°C warmer than those of the previous pentad (2000-2004) (Sharp et al. 2011) and field based mass balance measurements reported 2005-2009 as being the most negative pentad since records began in the early 1960s (Koerner 2005). In light of observed warming it would be expected that QEI glacier surface elevation will have decreased since the year 2000.

Total QEI ice volume loss for the period 1995-2000, 2000-2006, and 2006-2012 is computed via extrapolation of surface elevation change measurements derived from NASA's L4 IDHDT airborne altimetry product. Although surface lowering is often assumed to indicate a reduction in glacier mass, higher rates of firn compaction in a warmer climate can also result in surface lowering. Firn and ice cores from the Devon and Penny ice caps reveal an increase in firn density since ~1955 (Bezeau et al. 2013, Zdanowicz et al. 2012). Snow, firn and ice have different reflectance properties allowing for the use of surface albedo, derived from satellite imagery, to identify corresponding regions. We use this information to refine mass loss calculations according to the following criteria: a) glacier ice density is used where glacier ice is exposed at the surface in the summer b) where glacier ice is not exposed in the summer we quantify the difference in mass loss that would result if i) surface reduction equates to mass loss at a density of firn ii) surface lowering is due solely to firn compaction, hence there no mass loss from this region.

References:

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