The effect of signal leakage and glacial isostatic rebound on GRACE-derived ice mass changes in Iceland - DTU Orbit (01/12/2018)

The effect of signal leakage and glacial isostatic rebound on GRACE-derived ice mass changes in Iceland

Monthly gravity field models from the GRACE satellite mission are widely used to determine ice mass changes of large ice sheets as well as smaller glaciers and ice caps. Here, we investigate in detail the ice mass changes of the Icelandic ice caps as derived from GRACE data. The small size of the Icelandic ice caps, their location close to other rapidly changing ice covered areas and the low viscosity of the mantle below Iceland make this especially challenging. The mass balance of the ice caps is well constrained by field mass balance measurements, making this area ideal for such investigations. We find that the ice mass changes of the Icelandic ice caps derived from GRACE gravity field models are influenced by both the large gravity change signal resulting from ice mass loss in southeast Greenland and the mass redistribution within the Earth mantle due to glacial isostatic adjustment since the Little Ice Age (~ 1890 AD). To minimize the signal that leaks towards Iceland from Greenland, we employ an independent mass change estimate of the Greenland Ice Sheet derived from satellite laser altimetry. We also estimate the effect of post Little Ice Age glacial isostatic adjustment, from knowledge of the ice history and GPS network constrained crustal deformation data. We find that both the leakage from Greenland and the post Little Ice Age glacial isostatic adjustment are important to take into account, in order to correctly determine Iceland ice mass changes from GRACE, and when applying these an average mass balance of the Icelandic ice caps of -11.4 +/- 2.2 Gt yr^{-1} for the period 2003-2010 is found. This number corresponds well with available mass balance measurements.

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