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Retrieving improved multi-temporal CryoSat elevations over ice caps and glaciers - a case study of Barnes ice cap

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The CryoSat mission was launched in 2010 to observe the Earth's cryosphere. In contrast to previous satellite radar altimeters, this mission is expected to monitor the elevation of small ice caps and glaciers, which according to the IPCC will be the largest contributor to 21st century sea level rise. To date the ESA CryoSat SARiN level-2 (L2) elevation product is not yet fully optimized for use over these types of glaciated regions, as its processed with a more universal algorithm. Thus the aim of this study is to demonstrate that with the use of improved processing CryoSat SARiN data can be used for more accurate topography mapping and elevation change detection for ice caps and glaciers.

To demonstrate this, elevations and elevation changes over Barnes ice cap, located on Baffin Island in the Canadian Arctic, have been estimated from available data from the years 2010-2013. ESA's CryoSat level-1b (L1b) SARiN baseline "B" data product was used and processed in-house to estimate surface elevations. The resulting product is referred to as DTU-L2. The processing focused on improving the retracker, reducing phase noise and correcting phase ambiguities.

The accuracy of the DTU-L2 and the ESA-L2 product was determined by comparing the measured elevations against NASA's IceBridge Airborne Topographic Mapper (ATM) elevations from May 2011. The resulting difference in accuracy was determined by comparing their associated errors. From the multi-temporal measurements spanning the period 2010-2013, elevation changes where estimated and compared to ICESat derived changes from 2003-2009.

The result of the study shows good agreement between the NASA measured ATM elevations and the DTU-L2 data. It also shows that the pattern of elevation change is similar to that derived from ICESat data. The accuracy of the DTU-L2 estimated elevations is on average several factors higher compared to the ESA-L2 elevation product. These preliminary results demonstrates that CryoSat elevation data, using improved processing, can be used for accurate topographic mapping and elevation change detection on ice caps and glaciers. Future work would entail extending this processing to other regions of this type to support these results.