Improved retrieval of land ice topography from CryoSat-2 data and its impact for volume-change estimation of the Greenland Ice Sheet - DTU Orbit (02/12/2018)

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A new methodology for retrieval of glacier and ice sheet elevations and elevation changes from CryoSat-2 data is presented. Surface elevations and elevation changes determined using this approach show significant improvements over ESA's publicly available CryoSat-2 elevation product (L2 Baseline-B). The results are compared to near-coincident airborne laser altimetry from NASA's Operation IceBridge and seasonal height amplitudes from the Ice, Cloud, and Elevation Satellite (ICESat). Applying this methodology to CryoSat-2 data collected in interferometric synthetic aperture mode (SIN) over the high-relief regions of the Greenland Ice Sheet we find an improvement in the root-mean-square error (RMSE) of 27 and 40% compared to ESA's L2 product in the derived elevation and elevation changes, respectively. In the interior part of the ice sheet, where CryoSat-2 operates in low-resolution mode (LRM), we find an improvement in the RMSE of 68 and 55% in the derived elevation and elevation changes, respectively. There is also an 86% improvement in the magnitude of the seasonal amplitudes when compared to amplitudes derived from ICESat data. These results indicate that the new methodology provides improved tracking of the snow/ice surface with lower sensitivity to changes in near-surface dielectric properties. To demonstrate the utility of the new processing methodology we produce elevations, elevation changes, and total volume changes from CryoSat-2 data for the Greenland Ice Sheet during the period January 2011 to January 2015. We find that the Greenland Ice Sheet decreased in volume at a rate of $289 \pm 20 \text{ km}^3 \text{ a}^{-1}$, with high interannual variability and spatial heterogeneity in rates of loss. This rate is $65 \text{ km}^3 \text{ a}^{-1}$ more negative than rates determined from ESA's L2 product, highlighting the importance of CryoSat-2 processing methodologies.

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