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First steps to bridging the gap between CryoSat-2 and ICESat2: retrackers and slope induced error.

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Satellite radar altimetry is one of the most important tools for monitoring changes in the mass balance of the world's ice sheets. Different altimetry techniques however, come with their own pitfalls. In radar altimetry, signal penetration into the snowpack introduces ambiguity in the origin of reflected echo, a major issue not present in laser altimetry. Fine tuning the developed processing algorithms for the CryoSat-2 radar altimetry data, using the IceSat2 laser altimetry data as a benchmark, may allow for a more precise surface elevation and snowpack depth estimations. Furthermore, bridging the gap between radar and laser altimetry will result in larger spatial and temporal data coverage when the two data sets are combined. Focusing on Greenland Ice Sheet (GIS), we have developed a processing chain for the estimation of surface elevations and elevation changes from the ESA level-1 product (L1b) Baseline D. We investigated the importance of a retracker type, retracker threshold, Digital Elevation Model (DEM) in the slope correction, and how these affect the estimated surface elevation as compared to the ICESat2 data.

Firstly, ESA L1b Baseline-D data was processed at several different thresholds and with various waveform retracker algorithms, including threshold first maxima retracker algorithm (TFMRA) (Helm, 2012; Nilsson, 2015) and the offset center of gravity (OCOG) retracker algorithm (Bamber, 1994; Ricker et al. 2014). We then apply slope correction to adjust for the slope induced error in the radar altimetry data (Hurkmans, 2012), the correction was applied using three different DEMs, ArcticDEM Release 7 (Porter et al., 2018), Greenland Ice Mapping Project (GIMP) DEM (Howat et al., 2017) and 'Helm' DEM (Helm, 2014). We checked all of the produced data sets against IceSat-2 data (Smith et al., 2019) corresponding to the same time period, and selected by nearest neighbor calculation for specified maximum distance. We analyze and discuss the differences between IceSat-2 data and CryoSat-2 data and their dependence on several radar altimetry processing parameters and methodologies.