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Validation and inter-comparison of surface elevation changes derived from altimetry over the Jakobshavn Isbræ drainage basin, Greenland – Round Robin results from ESA's Ice_Sheets_CCI

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Satellite observations have been used to monitor changes occurring on Earth's surface for more than a decade. The high temporal and spatial resolution of such measurements provides us with unique possibilities for monitoring the effects of the climate changes over glaciers and ice sheets. In order to ensure long-term climate records, ESA has launched the Climate Change Initiative (ESA CCI), which puts focus on 13 different Essential Climate Variables, one of them being Ice Sheets. In this program, four selected key parameters will be determined: Surface elevation changes (SEC), surface velocities, calving front locations, and grounding line locations.

This work focuses on the first mentioned parameter, and the goal is to develop the best routine for estimating SEC on the Greenland Ice Sheet using radar altimeter data. In order to find the most optimal approach we have completed a Round Robin experiment in which researchers from various European and US institutions have provided SEC estimates derived from either ENVISAT or ICESat data, for the test area by Jakobshavn Isbræ drainage basin. This has allowed us to compare the results from radar vs. laser altimetry, cross-over vs. along-track analyses, and the use of time series vs. a direct estimation of SEC. The results were validated against airborne lidar data from NASA's IceBridge and ESA's CryoVex campaigns. It was found that both radar and laser altimetry resolve the surface elevation changes quite well, and that the erroneous results found mainly in the coastal region can be improved by combining the methods of repeat-tracks and cross-overs. The former has a higher spatial resolution however is limited by rarely overlapping ground tracks, and hence interpolation methods need to be introduced. Furthermore, errors are introduced particularly along the ice margin due to slope effects while, for both methods, penetration of the signal into the firn pack needs to be accounted for. Cross-overs have a lower spatial resolution as well as lower errors due to the possibility of using measurements from ascending and descending tracks in cross-over points to disregard the slope effects. Thus, cross-over data can be used to correct the repeat-track results along the ice margin, so SEC values can be obtained in all regions of the ice sheet with both small error estimates and a high spatial resolution.

With this poster, we wish to present the SEC results from the Round Robin exercise, more specifically the inter-comparison of the individual contributions as well as the validation against NASA and ESA airborne lidar data.