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A digital elevation model of the Greenland Ice Sheet derived from combined laser and radar altimetry data

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When estimating elevation changes of ice-covered surfaces from radar altimetry, it is important to correct for slope-induced errors. They cause the reflecting point of the pulse to move up-slope and thus return estimates in the wrong coordinates. Slope-induced errors can be corrected for by introducing a Digital Elevation Model (DEM).
In this work, such a DEM is developed for the Greenland Ice Sheet using a combination of Envisat radar and ICESat laser altimetry. If time permits, CryoSat radar altimetry will be included as well. The reference year is 2010 and the spatial resolution 2.5 x 2.5 km. This is in accordance with the results obtained in the ESA Ice Sheets CCI project showing that a 5 x 5 km grid spacing is reasonable for ice sheet-wide change detection (Levinsen et al., 2013). Separate DEMs will be created for the given data sets, and the geostatistical spatial interpolation method collocation will be used to merge them, thus adjusting for potential inter-satellite biases. The final DEM is validated with temporally and spatially agreeing airborne lidar data acquired in the NASA IceBridge and ESA CryoVex campaigns.

The motivation for developing a new DEM is based on 1) large surface changes presently being observed, and mainly in margin regions, hence necessitating updated topography maps for accurately deriving and correcting surface elevation changes, and 2) although radar altimetry is subject to surface penetration of the signal into the snowpack, data is acquired continuously in time. This is not the case with e.g. ICESat, where laser altimetry data were obtained in periods of active lasers, i.e. three times a year with a 35-day repeat track.
Previous DEMs e.g. have 2007 as the nominal reference year, or they are built merely from ICESat data. These have elevation errors as small as 10 cm, which is lower than for Envisat and CryoSat. The advantage of an updated DEM consisting of combined radar and laser altimetry therefore is the possibility of achieving a high spatial and temporal coverage, as well as the opportunity to continuously map surface changes relative to an updated topography and slopes.

References:

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