Validating firn compaction model with remote sensing data

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Abstract

A comprehensive understanding of firn processes is of outmost importance, when estimating present and future changes of the Greenland Ice Sheet. Especially, when remote sensing altimetry is used to assess the state of ice sheets and their contribution to global sea level rise, firn compaction models have been shown to be a key component. Now, remote sensing data can also be used to validate the firn models. Radar penetrating the upper part of the firn column in the interior part of Greenland shows a clear layering. The observed layers from the radar data can be used as an in-situ validation of firn models over large length scales. Here, a simple empirical firn model that is forced with the output of high-resolution (5km) regional climate model (HIRHAM5) is explored. The model is capable of describing a layered structure of the firn column and has previously been used to estimate changes of firn compaction to correct ICESat measurements and assessing the present mass loss of the Greenland ice sheet. Validation of the model against the radar data gives good results and confidence in using the model to answer important questions. Questions such as; how large is the firn compaction correction relative to the changes in the elevation of the surface observed with remote sensing altimetry? What model time resolution is

necessary to resolved the observed layering? What model refinements are necessary to give better estimates of the surface mass balance of the Greenland ice sheet from remote sensing altimetry?

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