Bedrock topography of the Renland Ice Cap, East Greenland - estimated by two methods

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Abstract
The Renland Ice Cap in East Greenland (71.30°N, 26.72°W) is a separate ice cap located on a high mountain plateau in the Scoresbysund Fjord. In 1988 a 324.35 m long ice core was drilled near summit on the eastern dome. The recovered ice core contains a climate record reaching back to the last interglacial period, the Eemian [Johnsen et al., 1992]. The Renland Ice Cap is thus perfectly suited for obtaining information on Eastern Greenland climatic conditions for the past 100,000 years from a shallow ice core. In the summer of 2015 a new ice core will be drilled at Renland.

Knowledge of the basal topography of Renland Ice Cap is very limited, however few old radar measurement tracks from 1985 and one from 1998 show that the bedrock topography is very mountainous. Two methods will be used to present an estimate of the subglacial topography of the Renland Ice Cap based on the knowledge of the surface topography and climate forcing only.

In the first method, a 2D ice flow model assuming perfect plasticity, where only surface topography from a digital elevation model (DEM) is used to estimate the ice thickness [Machguth et al., 2013]. The bedrock topography is calculated by subtracting modelled

ice thickness from the surface DEM. The method is sensitive to the surface elevation and thus the surface slope.

In the second method, the bedrock topography is calculated by an iterative inverse method, like in the work by van Pelt et al., 2013. In this method a high-resolution ice dynamical flow model, the Parallel Ice Sheet Model (PISM) [Bueler and Brown, 2009,

The PISM Authors, 2014], is used. The 3D ice flow model is based on the shallow ice approximation and the shallow shelf approximation. The input data to the ice flow model is surface elevation and climate forcing (surface mass balance and surface temperature). A plot showing the surface misfit versus the number of iterations is used to obtain a point beyond which further iterations was likely to deteriorated the recovered bedrock by overfitting. A number of experiments are run in PISM with different climate forcing schemes. It shows that the ice cap is sensitive to the climate forcing. Especially the surface mass balance has an influence of the ice thickness distribution and the recovered bedrock.