Geophysical Research Abstracts
Vol. 19, EGU2017-1551, 2017
EGU General Assembly 2017

Modelling the mechanical response of an idealized ice stream to variations in geothermal heat flux

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The spatial distribution of geothermal heat flux beneath the Greenland Ice Sheet is largely unknown partly due to difficulties in accessing the bed, and bore hole data providing point measurements only. Studies using tectonic, seismic and magnetic models to retrieve the geothermal heat flux show very different results indicating large uncertainties. However, modelling studies point to a geothermal heat flux anomaly that may influence the Northeast Greenland Ice Stream (NEGIS).

Previous studies have investigated the impact of the uncertainty in geothermal heatflux on ice dynamics. These studies are mainly focusing on the impact on the ice rheology as the basal condition are derived from inverse modelling methods (including the geothermal heat flux variability in the variability of the friction coefficient). Another important feedback is the increase in subglacial meltwater production which may affect the sliding velocities of an ice stream, and has not been taken into account in preceding studies.

In this study we investigate the impact of variations in geothermal heat flux on ice dynamics by analysing the mechanical response of a synthetic ice stream simulating NEGIS using the Ice Sheet System Model (Larour et al. 2012). We present results from model experiments using different heat flux configurations, friction laws and a hydrology model, showing the importance of geothermal heat flux on basal conditions of fast flowing ice.