EGU21-13647
https://doi.org/10.5194/egusphere-egu21-13647
EGU General Assembly 2021

The effect of geothermal heat flux on the deglacial evolution of the Greenland ice sheet

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Geothermal heat flux (GHF) is known to be an important control on the basal thermal state of an ice sheet which, in turn, is a key factor in governing how the ice sheet will evolve in response to a given climate forcing. In recent years, several studies have estimated GHF beneath the Greenland ice sheet using different approaches (e.g. Rezvanbehbahani et al., Geophysical Research Letters, 2017; Martos et al., Geophysical Research Letters, 2018; Greve, Polar Data Journal, 2019). Comparing these different estimates indicates poor agreement and thus large uncertainty in our knowledge of this important boundary condition for modelling the ice sheet. The primary aim of this study is to quantify the influence of this uncertainty on modelling the past evolution of the ice sheet with a focus on the most recent deglaciation. We build on past work that considered three GHF models (Rogozhina et al., 2011) by considering over 100 different realizations of this input field. We use the uncertainty estimates from Martos et al. (Geophysical Research Letters, 2018) to generate GHF realisations via a statistical sampling procedure. A sensitivity analysis using these realisations and the Parallel Ice Sheet Model (PISM, Bueler and Brown, Journal of Geophysical Research, 2009) indicates that uncertainty in GHF has a dramatic impact on both the volume and spatial distribution of ice since the last glacial maximum, indicating that more precise constraints on this boundary condition are required to improve our understanding of past ice sheet evolution and, consequently, reduce uncertainty in future projections.