EGU21-10208
https://doi.org/10.5194/egusphere-egu21-10208
EGU General Assembly 2021

Physically-based oscillations of the Laurentide Ice Sheet under glacial conditions

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The climate during the last glacial period was far from stable. Evidence has shown the presence of layers of ice-rafted debris (IRD) in deep-sea sediments, which have been interpreted to reflect quasi-periodic episodes of massive iceberg calving from the Laurentide Ice Sheet (LIS). Several mechanisms have been proposed, yet the ultimate cause of these events is still under debate. From the point of view of ice dynamics, one of the main sources of uncertainty and diversity in model response is the choice of basal friction law. Therefore, it is essential to determine the impact of basal friction in glacial transport and erosion, deposition of sediments and ice streams. Here we study the effect of a wide range of basal friction parameters and laws under glacial conditions over the LIS by running ensembles of simulations using a higher-order ice-sheet model. Importantly, the potential feedbacks between basal hydrology and thermodynamics are also considered to shed light on the behaviour of the ice flow. Our aim is to determine under what conditions, if any, physically-based oscillations are possible in the LIS with constant boundary conditions. Increasing our understanding of both basal friction laws and basal hydrology will improve not only reconstructions of paleo ice dynamics but also help to constrain the potential future evolution of current ice sheets.