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Evolution of a Greenland Ice sheet Including Shelves and Regional Sea Level Variations

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Observational evidence, including offshore moraines and marine sediment cores infer that at the Last Glacial maximum (LGM) the Greenland ice sheet (GIS) grounded out across the Davis Strait into Baffin Bay, with fast flowing ice streams extending out to the continental shelf break along the NW margin. These observations lead to a number of questions as to weather the GIS and Laurentide ice sheet (LIS) coalesced during glacial maximums, and if so, did a significant ice shelf develop across Baffin Bay and how would such a configuration impact on the relative contribution of these ice sheets to eustatic sea level (ESL).
Most previous paleo ice sheet modelling simulations of the GIS recreated an ice sheet that either did not extend out onto the continental shelf or utilised a simplified marine ice parameterisation to recreate an extended GIS, and therefore did not fully include ice shelf dynamics.
In this study we simulate the evolution of the GIS from 220 kyr BP to present day using IMAU-ice; a 3D thermodynamical ice sheet model which fully accounts for grounded and floating ice, calculates grounding line migration and ice shelf dynamics.
As there are few observational estimates of the long-term (yrs) sub marine basal melting rates (mbm) for the GIS, we developed a mbm parameterization within IMAU-ice controlled primarily by changes in paleo water depth. We also investigate the influence of the LIS on the GIS evolution by including relative sea level forcing's derived from a Glacial Isostatic Adjustment model.
We will present results of how changes in the mbm directly impacts on the ice sheet dynamics, timing and spatial extent of the GIS at the glacial maximums, but also on the rate of retreat and spatial extent at the Last interglacial (LIG) minimum. Results indicate that with the inclusion of ice shelf dynamics, a larger GIS is generated which is grounded out into Davis strait, up to a water depth of -750 m, but significantly reduces the GIS contribution to Last interglacial ESL.