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Sensitivity of Last glacial maximum ice sheets modelling to uncertainty in climate forcing

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Large uncertainties exist in the volume and thickness of the Last Glacial Maximum (LGM) ice sheets. To better constrain these characteristics, climate models have been used to force ice sheet models and simulate the geometry and dynamic of the LGM ice sheets (Abe-Ouchi et al., 2007; Charbit et al., 2007; Marshall et al., 2002). But recent efforts to improve models' representation of present day climate have not reduced the uncertainties in the modelling of past climates such as the LGM. We investigate the impact of parametric uncertainty in climate modelling on the simulation of northern hemisphere LGM ice sheets.

To model the last glacial maximum (LGM) northern hemisphere ice sheets we use the Glimmer 3D thermodynamic ice sheet model forced with outputs from a General Circulation Model (GCM) called FAMOUS. Starting from no initial ice, the northern hemisphere ice sheets are built up throughout the last glacial interglacial cycle. The ice sheet model is forced by interpolating present day and LGM GCM equilibrium runs through time using a climatic index derived from the NGRIP 18O record.

We force Glimmer with 5 different configurations of FAMOUS that result from a tuning exercise where physical parameters have been varied. While being the closest match to present day climatologies and palaeo proxies, the configurations result in significantly different LGM climates.

The surface mass balance of the ice sheets is strongly affected by the variations in the precipitation fields. Simulated ice volumes of the Laurentide and Fennoscandian ice sheets vary by more than $5.10^6 km^3$. This result shows the great sensitivity of the ice sheets to the climate forcing and the importance of climate forcing uncertainty in modelling the evolution of ice sheet over glacial-interglacial time scales.