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Coupled climate – ice-sheet simulations of the "Great Ice Sheets" of the Last Glacial Maximum: progress, pitfalls and lessons using the LOVECLIM-GRISLI coupled model

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In the course of proving that the insolation is the prominent driver of climate evolution over the Quaternary, as suggested by the so-called "Milankovitch theory", one need to reproduce the evolution of the ice sheets concurrently with the climate. As such, the Last Glacial Maximum with its extended ice sheets and cooler climate is one ideal testbed to show our ability to understand the primary mechanisms that drive the climate system. While the final goal is to perform transient simulations of the climate – ice-sheet system over glacial – interglacial cycles, performing adequate simulations of the Last Glacial Maximum period enables us to test the mechanisms at work and understand important processes within such a framework.

In this study, we will therefore present results of coupled (and uncoupled) climate – ice-sheet simulations for the Last Glacial Maximum using the Eath System Model of Intermediate Complexity LOVECLIM and the GRISLI ice-sheet model. We will particularly focus on three different mechanisms that affect the distribution of Last Glacial Maximum ice sheets in our coupled model: 1) the role of fast flow in shaping the ice sheets (including the related importance of ice shelves) 2) the influence of the orbital configuration in "equilibrium" simulations of the Last Glacial Maximum 3) the more technical aspect of the impact of asynchronous coupling between the climate and ice-sheet components.

Using known constraints on the ice-sheet extent and shape, we assess the likely role of the different mechanisms outlined above as well as the feedbacks between climate and ice-sheet. In particular we will discuss the role of planetary waves in setting the location of ice growth and the relative size of the different ice sheets that existed. We will end up with some lessons to carry on coupled climate ice-sheet simulations over the full glacial cycle.