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Quantifying the response of the Greenland ice sheet in a high-end scenario until 2300 from a coupled high-resolution regional climate and ice sheet model

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The Greenland ice sheet comprises a volume of 7.4 m sea level equivalent and is losing mass rapidly as a result of global warming. It is widely thought that the ice sheet will exhibit tipping behaviour in a warmer climate. In other words, due to ice sheet – climate feedbacks (some of) its contribution to sea level rise may become irreversible once critical thresholds are crossed. This would severely affect the increasing number of people living in low-lying coastal areas worldwide. However, the current understanding of such thresholds and tipping behaviour is very limited, because most modelling studies up to date do not include (local) interactions or feedbacks between the ice sheet (topography and ice extent) and other climate system components (surface mass balance and atmosphere).

To investigate the irreversibility of Greenland's ice mass loss and the associated processes, we coupled our high-resolution Greenland Ice Sheet Model (GISM) with a renowned high-resolution regional climate model, the Modèle Atmosphérique Régional (MAR). The two-way coupling between both models provides a (more) realistic representation of (local) ice sheet – climate interactions for future ice sheet simulations.

Like all regional climate models, MAR needs 6 hourly atmospheric forcing from a global climate model (GCM). Several coupled model runs with forcing from different GCMs are envisioned over the coming months and years. As they are computationally intensive, simulations up to the end of the century and beyond take several weeks to a few months to complete.

The poster will present the preliminary results from our first coupled model run in an envisioned series of experiments: a two-way coupled MAR-GISM run forced by the IPSL-CM6 6 hourly output, which is available up to 2300. For this timescale, our coupled models can still be run in fully interactive mode, which means the information (surface mass balance and ice sheet extent/topography) between both models can be exchanged on a yearly basis. In addition to its long duration, the IPSL forcing is of particular interest as it is on the high end of the CMIP6 model ensemble projections regarding warming over Greenland. We thus expect the experiment to provide valuable insights regarding Greenland's potential contribution to future sea-level rise and the associated ice sheet – climate interactions or feedbacks.