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# Greenland mass balance by 2100 using a coupled atmospheric (MAR) and ice sheet (PISM) models

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The Greenland ice sheet (GrIS) is a key contributor to see level rise. By melting in surface, ice sheet is thinning and reaches higher temperature which accelerate the melting processes coming from Global Warming. The main goal of our research is to improve the representation of melt-elevation feedback, which is crucial to determine how and when GrIS will melt and will involve in a near future, by coupling two kind of numerical models. The difficulty to model this feedback relies on the fact that ice-sheet models (ISMs) can reproduce the dynamic of the ice sheet and thus provide an evolution of the surface elevation, whereas (regional) climate models (RCMs) can represent the ice/snow and atmosphere interactions trough the surface mass balance (SMB). A coupling between these models appears as a solution and has already been accomplished. However, ISMs responses to a same forcing field may be quite different, while SMB from different RCMs are relatively more similar with the same forcing. Coupling could therefore be dependent of which ISMs are used. To avoid a coupling, costly in computing time, SMB vertical gradient as a function of local elevation variations could be used by ISMs to correct SMB. Nonetheless, these SMB gradients are computed with a RCM using a fixed topography, which could introduce biases if the surface elevation vary significantly. Here we decide to full couple the RCM MAR, specifically developed for polar climate and forced at his lateral boundaries by CESM2 (a CMIP6 model, scenario ssp585), with the ISM PISM. The coupling means that, each year, we exchange ice thickness from PISM to update the topography and ice mask of MAR, and SMB from MAR to update forcing fields of PISM. First of all the aim is to analyze what became the GrIS in 2100 with this extreme scenario. Then we want to define a coupling time threshold to determine after how much years an update of the topography in MAR is needed by varying the time step (from 1 to 5, 10, 20, 30 and 50 years) of the coupling. The final aim is to determine until when the MAR based SMB gradients are valid for a same topography in MAR.