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Comparative simulations of the evolution of the Greenland ice sheet under simplified Paris Agreement scenarios with the models SICOPOLIS and ISSM

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Projections of the contribution of the Greenland ice sheet to sea level rise comprise uncertainties that arise from the imposed climate forcing and from the underlying mathematical and numerical description used by ice flow models. Here, we present a comparative modelling study with the models SICOPOLIS, using the shallow ice approximation (SIA) on a structured grid, and ISSM, using a higher-order (HO) approximation of the Stokes equation on an unstructured grid. Starting from a paleoclimatic spin-up produced by SICOPOLIS, the models are forced with two different, simplified warming scenarios based on RCP2.6 projections from climate models, which are in line with the limit of global warming negotiated for the Paris Agreement. ISSM/HO produces lower flow speeds at the glacier termini, but more acceleration in narrow outlet glaciers compared to SICOPOLIS/SIA. This leads to a larger elevation reduction for ISSM/HO, and thus a positive feedback on the surface mass balance (with that of ISSM/HO becoming $\sim$50 Gt/a more negative). Across the two models and scenarios, the projected mass loss by 2300 is $\sim$62 to 88 mm sea level equivalent.