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Global coupled climate - ice sheet model simulations for the penultimate deglaciation and the last interglacial

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Glacial-interglacial changes of the Earth's climate are largely controlled by internal mechanisms that drive changes in greenhouse gases and ice sheets. In this study, we present model experiments of the penultimate deglaciation into the the last interglacial period, obtained with the Earth system model of intermediate complexity iLOVECLIM (v. 1.1.4). We show experiments with an imposed ice-sheet scenario together with initial results with both North and South interactive ice sheets using the GRISLI (v. 2.0) 3-D ice-sheet model. To this aim, we use a recently developed dynamical downscaling procedure to compute temperature and precipitation fields from the relative low resolution atmospheric model grid (T21, ~5.6°) to the GRISLI spherical grids of both the Northern Hemisphere and Antarctica (both 40 x 40 km). We investigate the separate impact of variations of greenhouse gases (GHG), orbital parameters and ice sheets on glacial-interglacial climate change over the past 240 kyr. Using prescribed greenhouse gases or ice sheets induce comparable changes in global mean temperature. Greenhouse gases, predominantly CO₂, mainly have a global impact through radiative forcing on atmospheric temperatures. On the other hand, ice sheets have a more regional impact over the Northern Hemispheric (NH) continents and Antarctica during glacial times. Henceforth, polar amplification is more pronounced during glacial periods following large ice-sheet induced changes. Overall these results are comparable to other studies using a similar experimental design. In order to initiate the coupling between the ice sheets and climate model, we perform a large ensemble of experiments to calibrate ice-sheet model parameters for the present day. We will present how the optimal settings for the two ice-sheet regions are selected, based on a comparison with the present-day ice sheets on Antarctica and Greenland. For the coupling, iLOVECLIM generates downscaled SMB, surface temperatures, ocean temperature and salinity, and GRISLI provides surface elevation and ice extent, the coupling interval is 5 years. These experiments are started during the penultimate glacial maximum. We initialize the coupled iLOVECLIM - GRISLI experiments from a climatic forcing experiment using prescribed greenhouse gases and ice sheets, and generate a spin-up simulation of GRISLI using the optimal settings for three different time points at 136, 135 and 134 kyr ago. Initial experiments show a clear linkage between changes in ice sheets, sea ice and ocean circulation. Following the forced rise in atmospheric GHGs, the magnitude of retreat varies between ice sheets, related to location and insolation change (which increases for the NH but decreased for Antarctica). Moreover, sea ice both decrease following GHGs increase, and vary more in phase with global

mean temperature.