**Supplementary Information**

# The role of an interactive Greenland ice sheet in the coupled climate-ice sheet model EC-Earth-PISM

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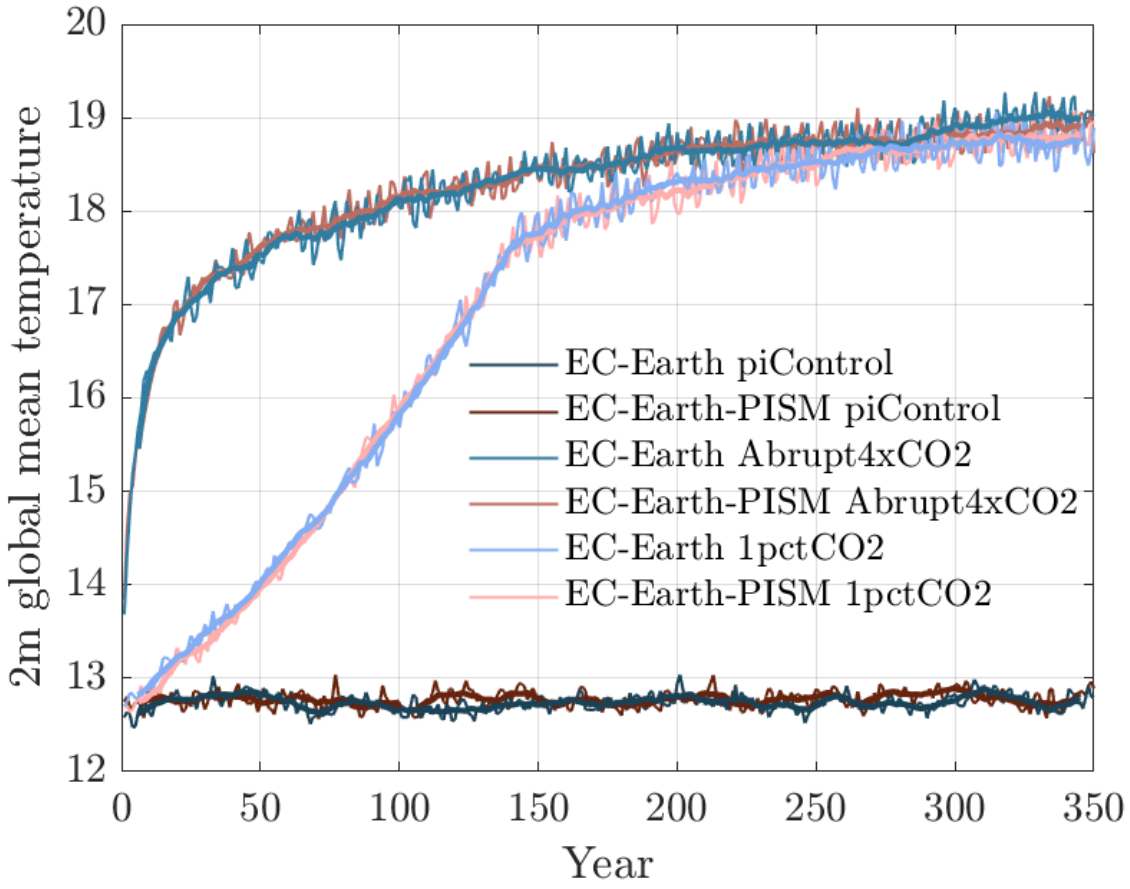


**Fig. S1** Global mean near-surface air temperature in the EC-Earth and EC-Earth-PISM experiments. Thin lines indicate annual means, and thick lines are 11-year running means.

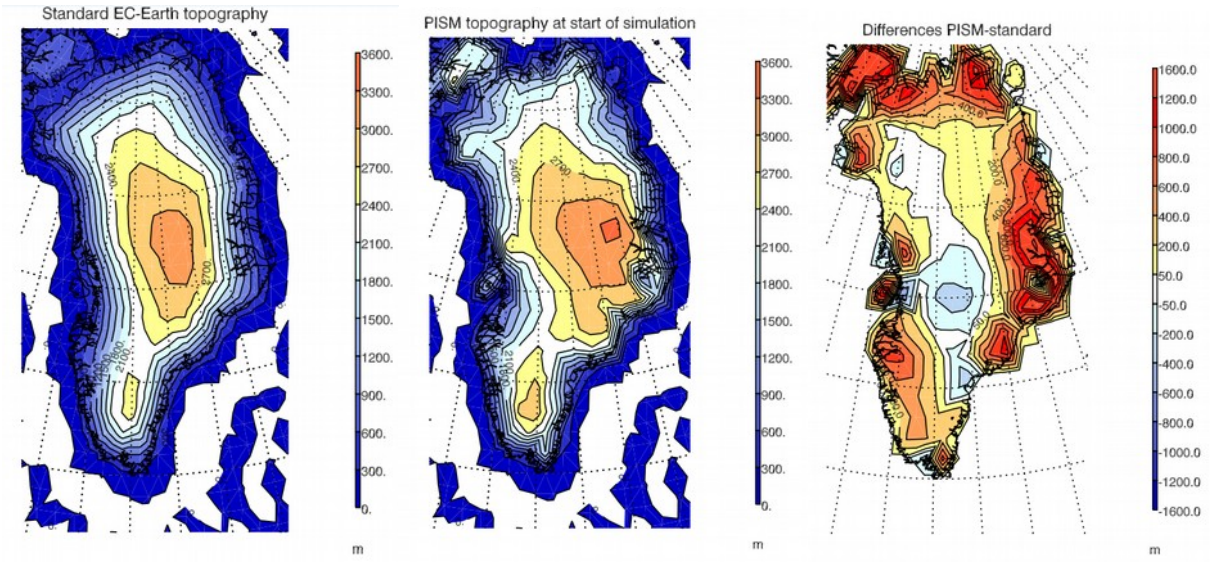


**Fig. S2** (*left*) EC-Earth standard topography (in m), (*middle*) topography at the beginning of the EC-Earth-PISM piControl, interpolated from the PISM to the IFS grid and (*right*) the difference between (middle) and (left).

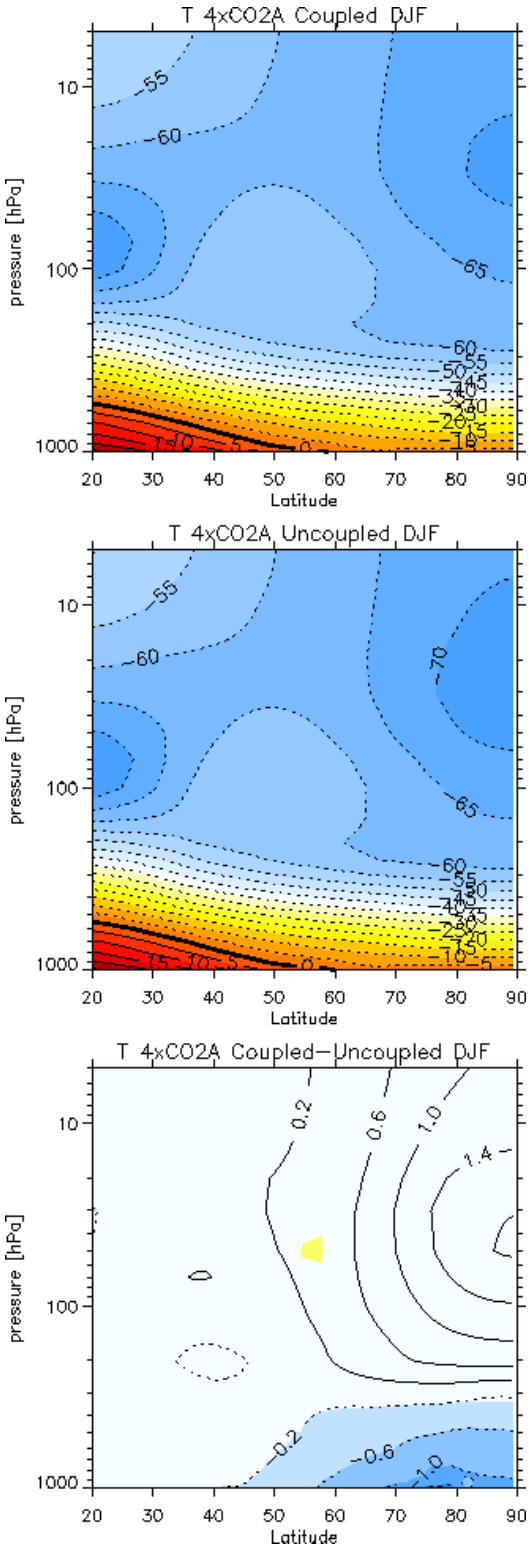


**Fig. S3** Mean atmospheric winter temperature (°C) in EC-Earth-PISM (*top*) and EC-Earth (*middle*) and the difference between the two (*bottom*). All values are averaged over the years 301-350. Differences significant at the 99 % level are shown in color

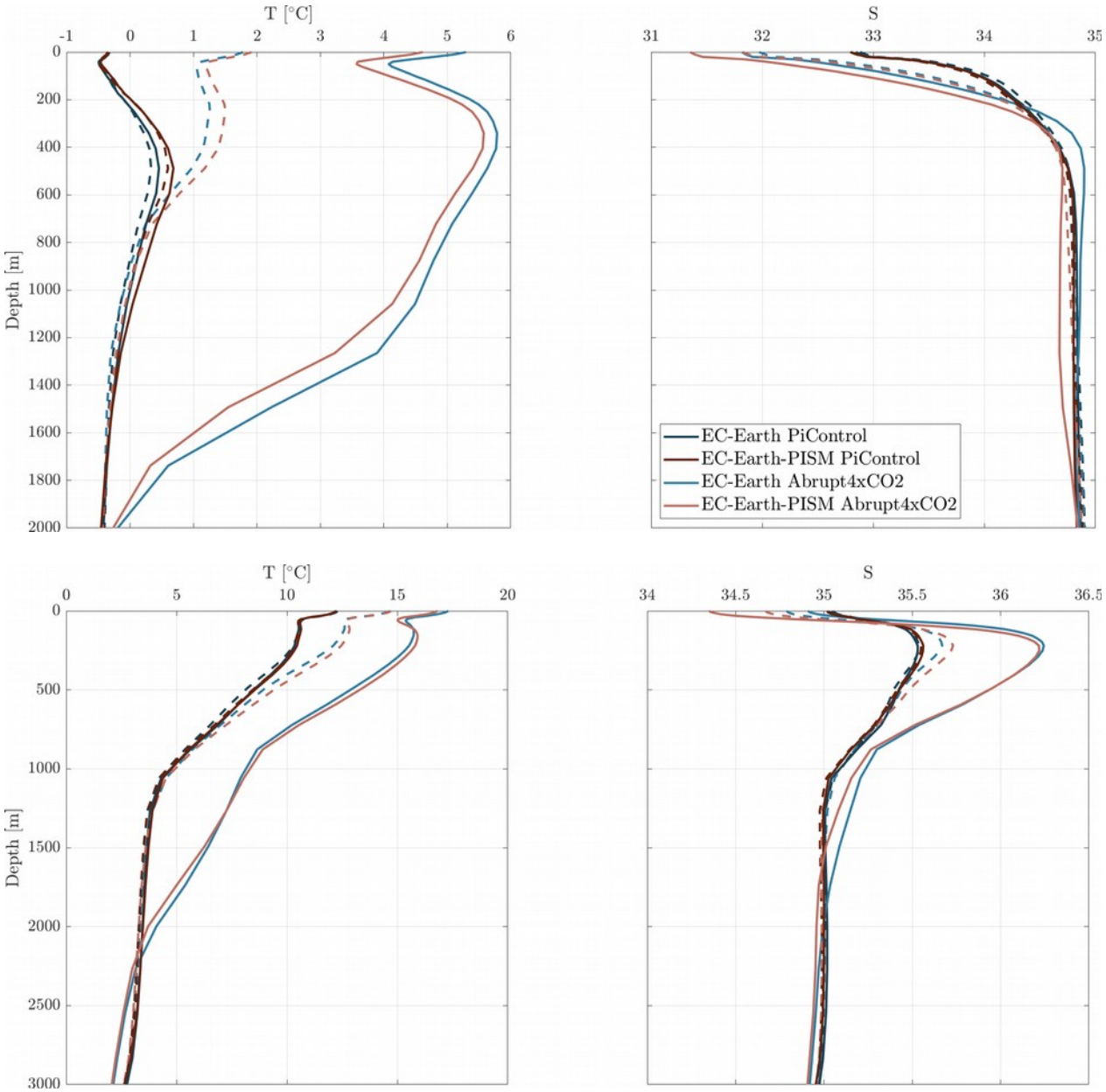


**Fig. S4** 30-year mean temperature (*left*) and salinity (*right)* profiles for the Arctic Ocean (60-90°N; *top*) and North Atlantic Ocean ([30-60°N, 60W-10E]; *bottom*). Full (dashed) lines are first (last) 30 year averages of the 350 simulation years. Note that 30-year averages are shown in this figure to illustrate the transient change in Abrupt4xCO2.

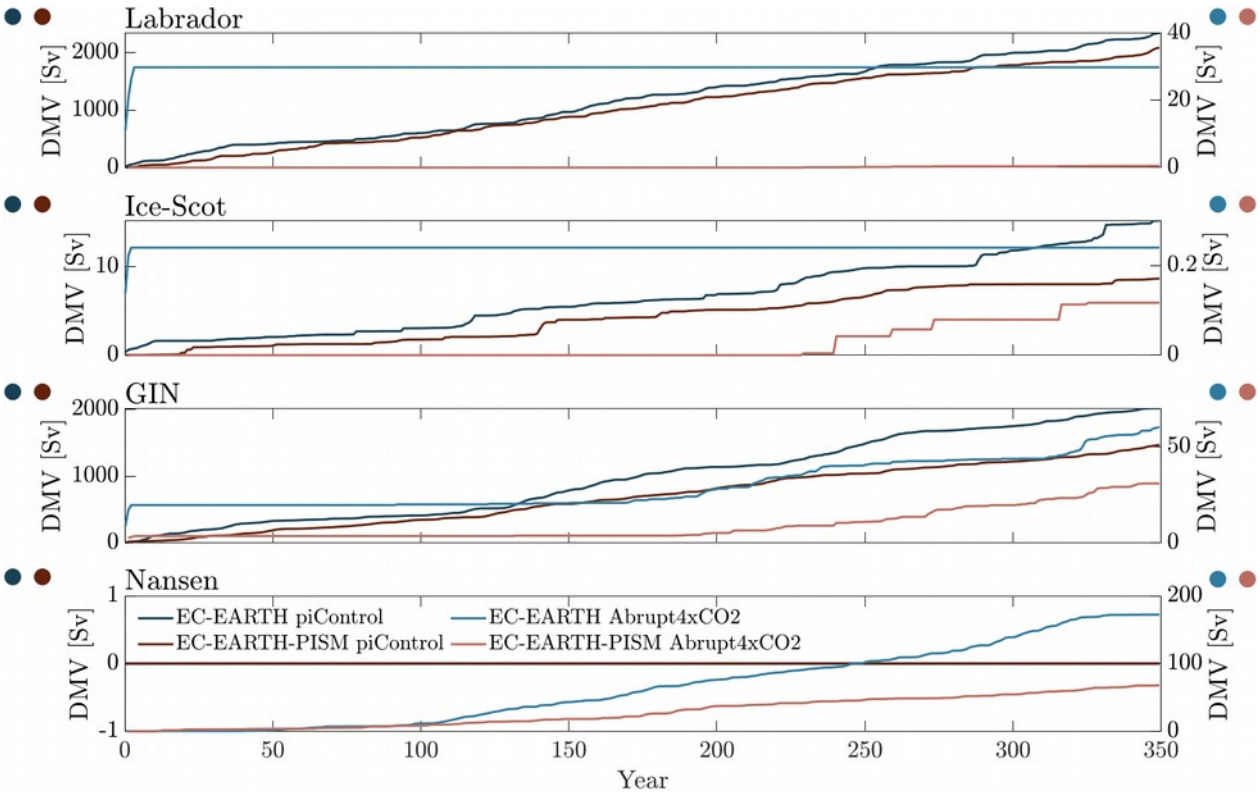


**Fig. S5** Accumulated Deep Mixed Volume (DMV) for piControl (left axis) and Abrupt4xCO2 (right axis) for the four regions Labrador Sea, Iceland-Scotland, GIN Seas, and Nansen (see Fig. 9). DMV is calculated as the mean mixed volume in March following Brodeau and Koenigk (2016). It includes only points deep enough for the convection to contribute to deep water formation, i.e., below 750 m for GIN Seas and Nansen and below 1000 m for Labrador and Iceland-Scotland. Note that for both EC-Earth piControl and EC-Earth-PISM piControl DMV is zero in Nansen (bottom panel).