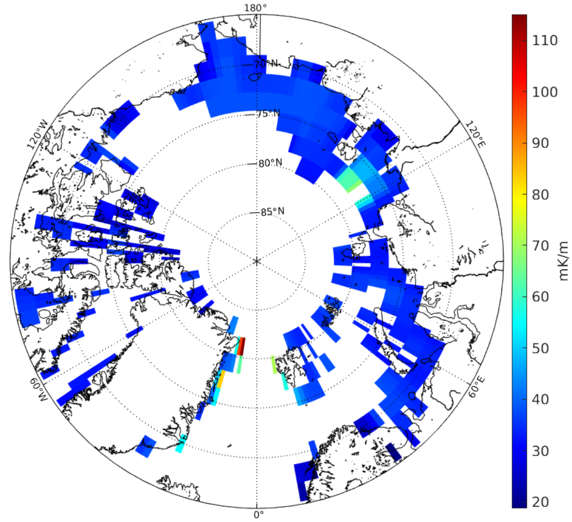
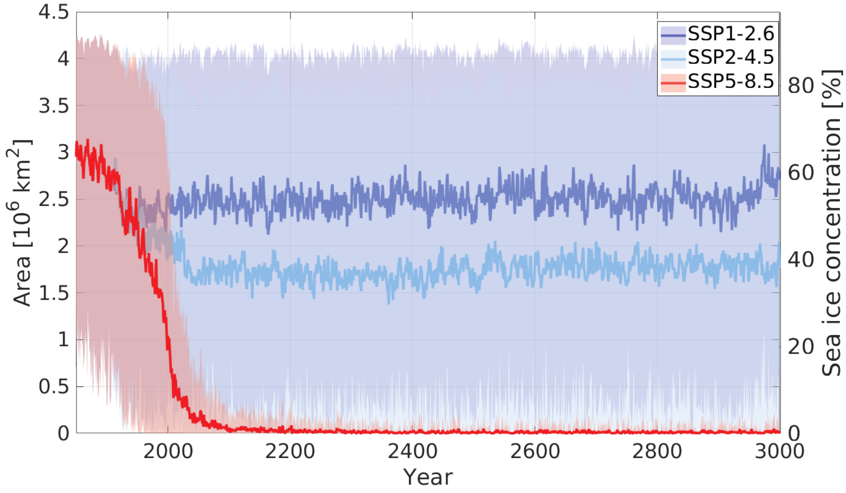
Supplement 1: Boundary condition figures

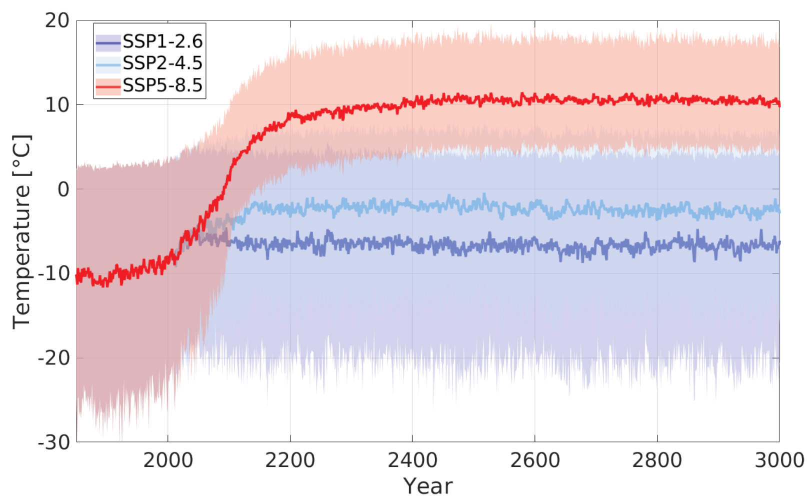


S1. Geographic distribution of geothermal temperature gradient [$mK\,m^{-1}$] applied for the most experiments. Based on data in Davies et al. (2013) as processed by Overduin et al. (2019) and for this study.

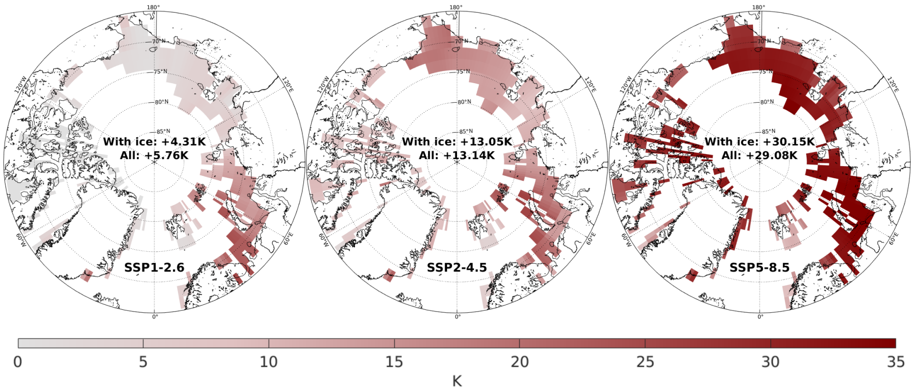
The remaining figures in this section (Figs. S2-S5) are plotted from the MPI-ESM experiments delivering the boundary conditions for the present study.



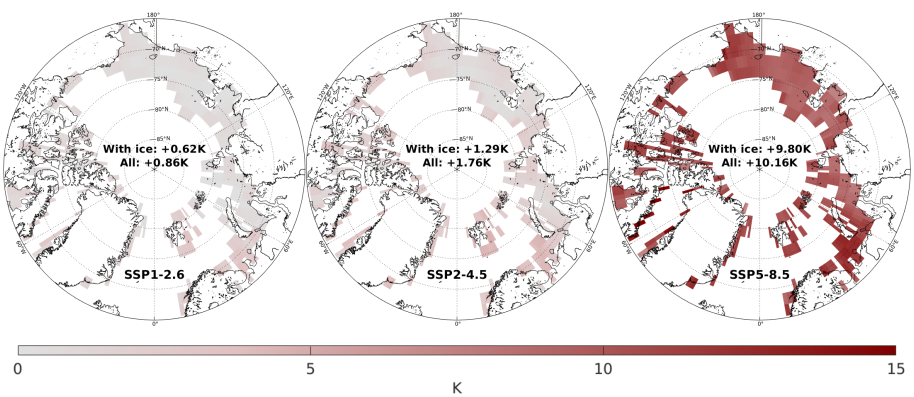
S 2. Sea ice concentration. Lines are yearly averages averaged over the modelled area. Shaded areas show decadal means of the extreme months for each year and are combined RGB-wise.



S 3. 2m temperature. Lines are yearly averages over the modelled area. Shaded areas show decadal means of the extreme months for each year and are combined RGB-wise.



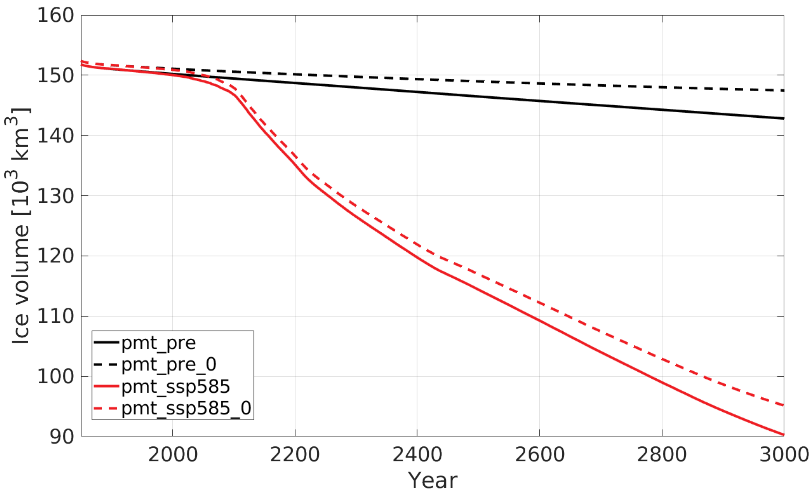
S4. Change in 2m temperature from 1850 to 3000 for the three main experiments. “With ice” is an average over points containing SSPF ice in 1850 (Fig. 1, left), “All” an average over all modelled points.



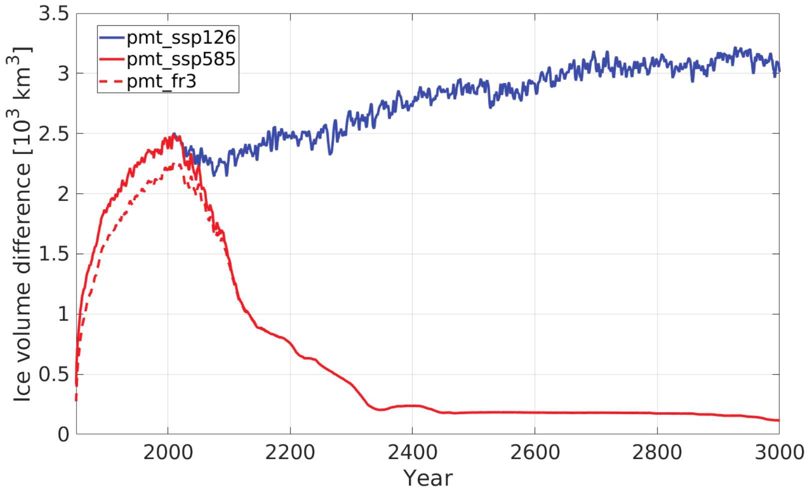
S5. Change in benthic temperature from 1850 to 3000 for the three main experiments. “With ice” is an average over points containing SSPF ice in 1850 (Fig. 1, left), “All” an average over all modelled points.

Supplement 2: Sensitivity experiment figures.

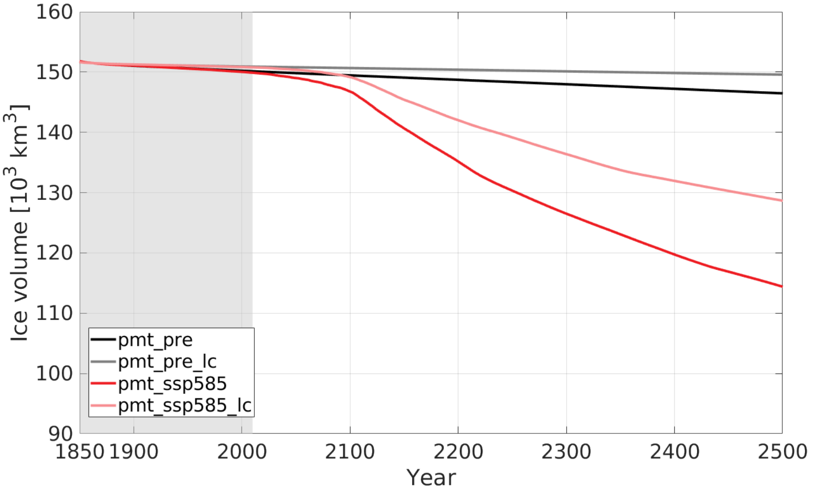
The figures in this section are plotted from experiments used to test the sensitivity to different model assumptions



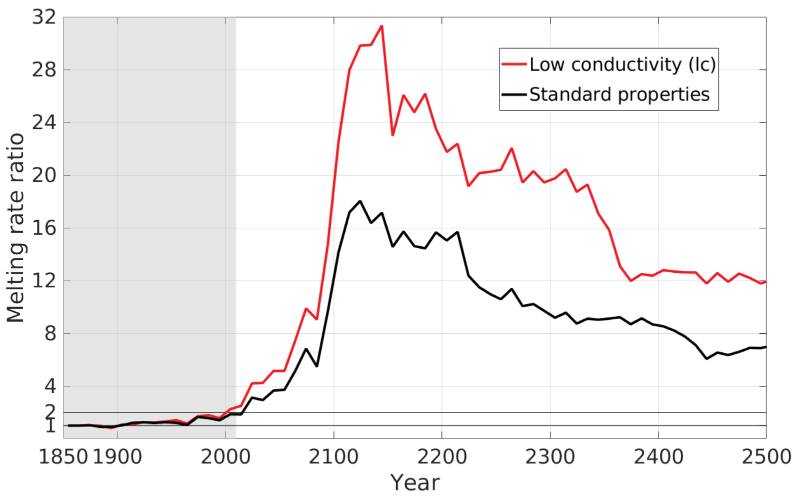
S 6. SSPF ice volume for experiments without geothermal heat flux (dashed) and the corresponding main experiment with geothermal heat flux (solid).



S 7. Difference in SSPF ice volume for experiments with (partial) freezing of sediments (non-solid lines) and the corresponding main experiment without freezing enabled.



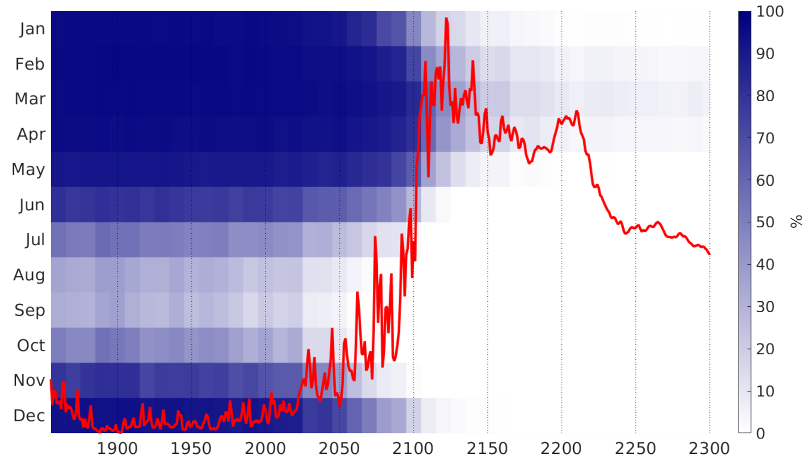
S 8. Total SSPF ice volume for the modified sediment thermal properties and their equvialents from the main/control experiment series (*pmt_pre* and *pmt_ssp585*). Same format as figure 3 in the main manuscript.



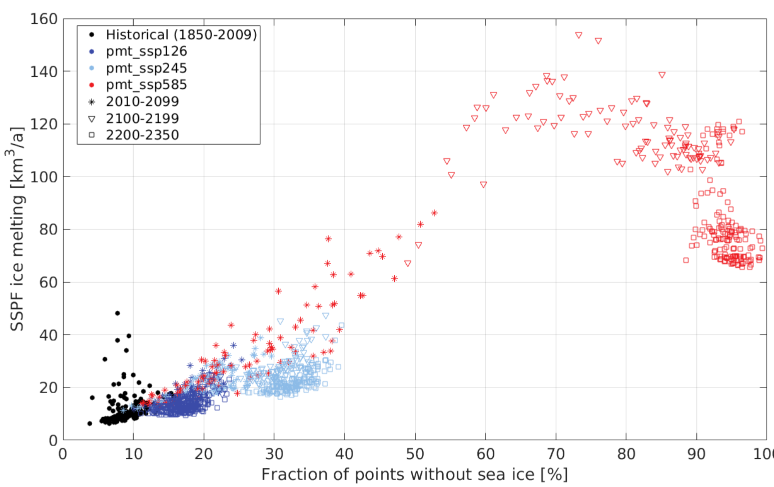
S9. Ratio of the melting of the SSPF ice between the high anthropogenic forcing and control simulations for standard and modified sediment thermal properties respectively. The black curve is identical to the red curve in figure 4 in the main manuscript (i.e. melting in *pmt_ssp585* divided by the melting in *pmt_pre*), whereas the red curve is the ratio of the meltings in *pmt_ssp585_lc* and *pmt_pre_lc*.

Supplement 3: Relation between sea ice and SSPF

This section contains figures explaining more details about the relation between sea ice concentration and the melting of SSPF ice.



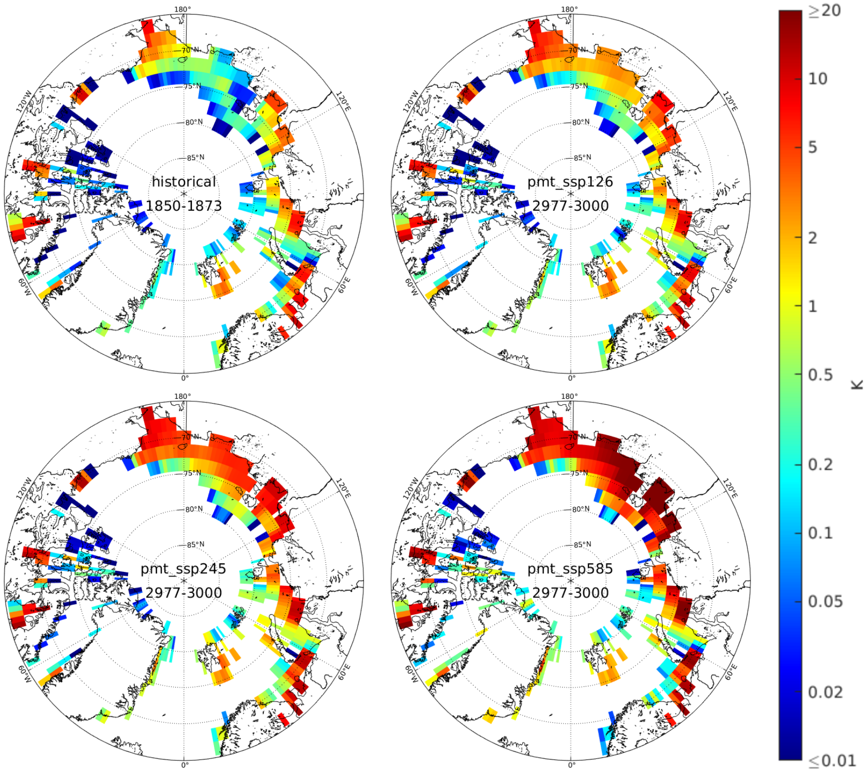
S10. SSP5-8.5 sea ice concentration (blue shading, in %) and pmt_ssp585 melting rate (red line). Sea ice concentrations are averages over a decade for each month individually. The melting rate show yearly averages and is scaled to fit the plot.



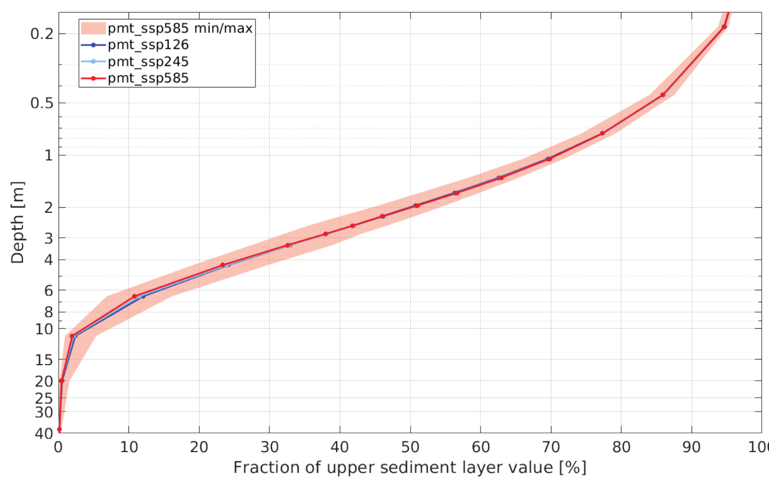
S11. Yearly SSPF ice melting vs. number of points with no sea ice for the period 1850–2350. Different symbols are assigned to different sub-periods, different colors to different scenarios. The sea ice free points are counted each month for a year, so that a point is counted 12 times if the point is completely ice free for the entire year. Only sea ice for points containing SSPF ice in 1850 is considered.

Supplement 4: Seasonal cycle

This sections contains figures highlighting the seasonal cycle and it's development in the study results and boundary conditions.



S 12. Amplitude of seasonal cycle in the benthic temperature (boundary condition) averaged over the beginning of the experiments (1850–1873) and the end of the experiments (2477-3000) for the different scenarios. The amplitude is defined as the temperature of the warmest month minus the temperature of the coldest month for each year. Notice the logarithmic scale.



S 13. Amplitude of the seasonal temperature variation in the sediments relative to the seasonal amplitude of the upper sediment layer averaged over the entire experiment period (1850–3000) for the three main experiments. For pmt_ssp585 also the 1850–3000 interanual range (mininium to maximum) has been shaded. The amplitude is defined as the temperature of the warmest month minus the temperature of the coldest month for each year and model layer individually. Points marks the model layers.