**S1.** Geographic distribution of geothermal temperature gradient applied for the main 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-S6) are plotted from the MPI-ESM experiments delivering the boundary conditions for the present study.
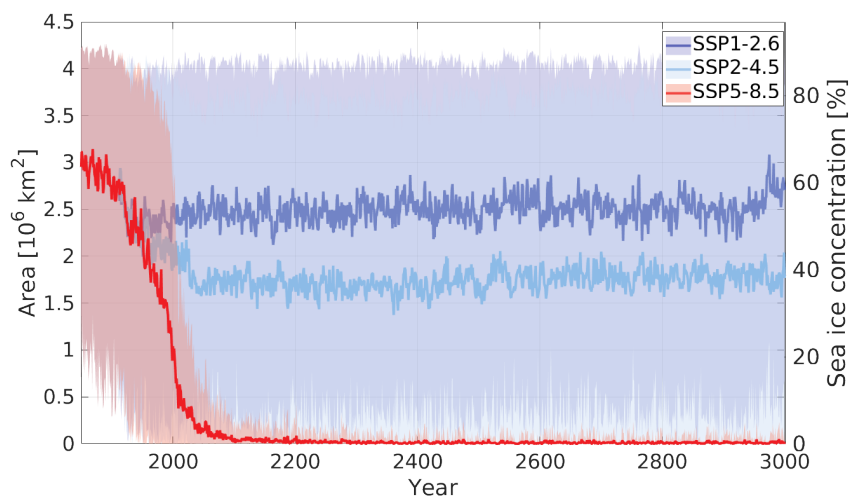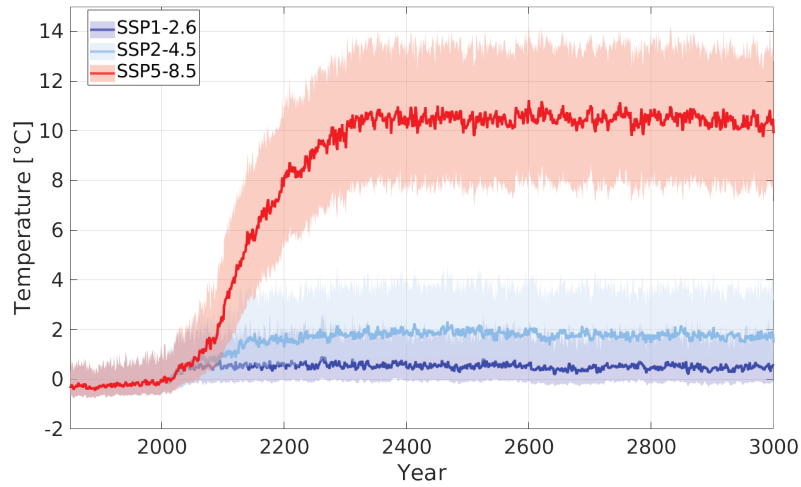

S2. Sea ice concentration. Lines are yearly averages averaged over the modelled area. Shaded areas show decadal means of the extreme months for each year and are combined RGB-wise.
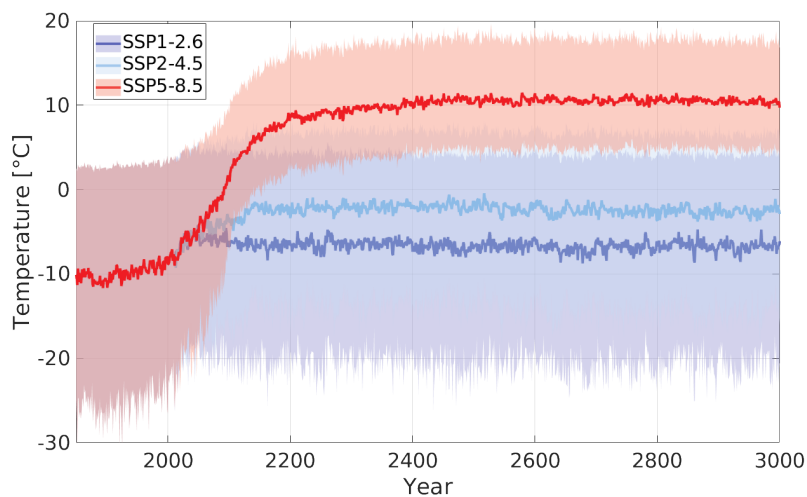
S3. 2m temperature. Lines are yearly averages over the modelled area. Shaded areas show decadal means of the extreme months for each year and are combined RGB-wise.
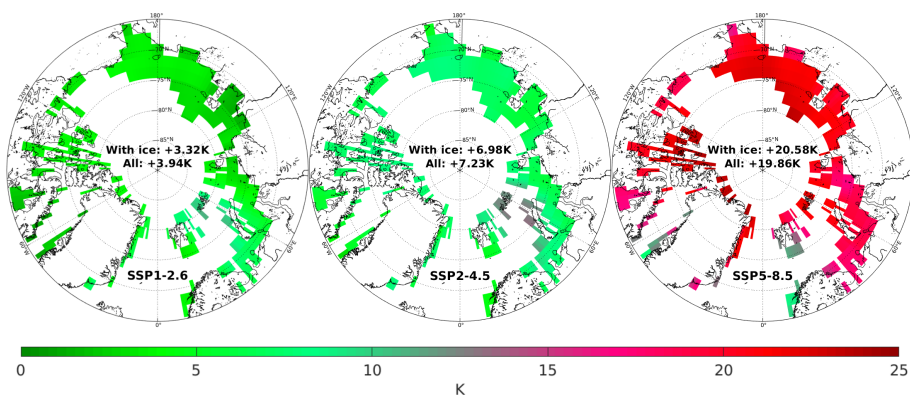
S4. Change in 2m temperature from 1850 to 3000 for the three main experiments. "With ice" is an average over points containing SSPF ice in 1850 (Fig. 1, left), "All" an average over all modelled points.

S 5. Benthic 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.
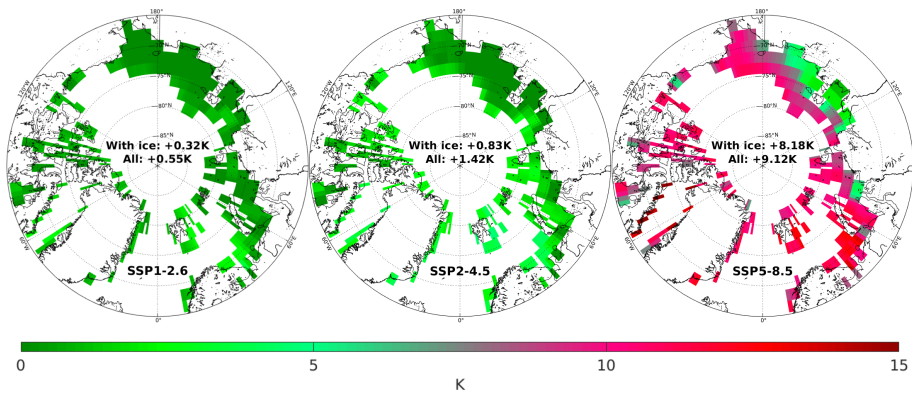

S 6. Change in benthic temperature from 1850 to 3000 for the three main experiments. "With ice" is an average over points containing SSPF ice in 1850 (Fig. 1, left), "All" an average over all modelled points.

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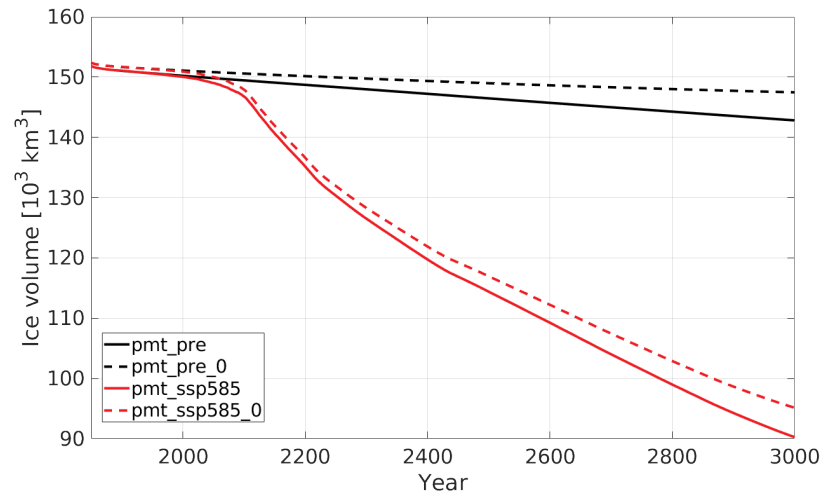

S7. SSPF ice volume for experiments without geothermal heat flux (dashed) and the corresponding main experiment with geothermal heat flux (solid).
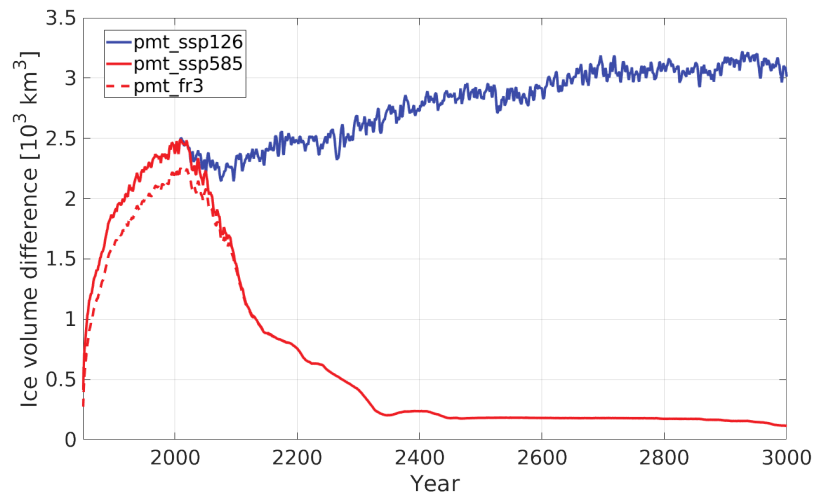

S 8. Difference in SSPF ice volume for experiments with (partial) freezing of sediments (non-solid lines) and the corresponding main experiment without freezing enabled.

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.
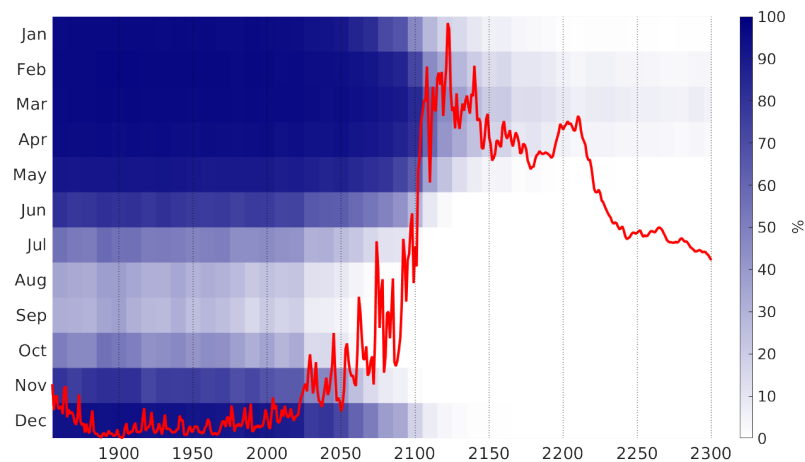

S 9. SSP5-8.5 sea ice concentration (blue shading, %) and pmt_ssp585 melting rate (red line). Sea ice concentrations are averages over a decade for each month individually. The melting rate show yearly values in arbitrary units to use the plot.
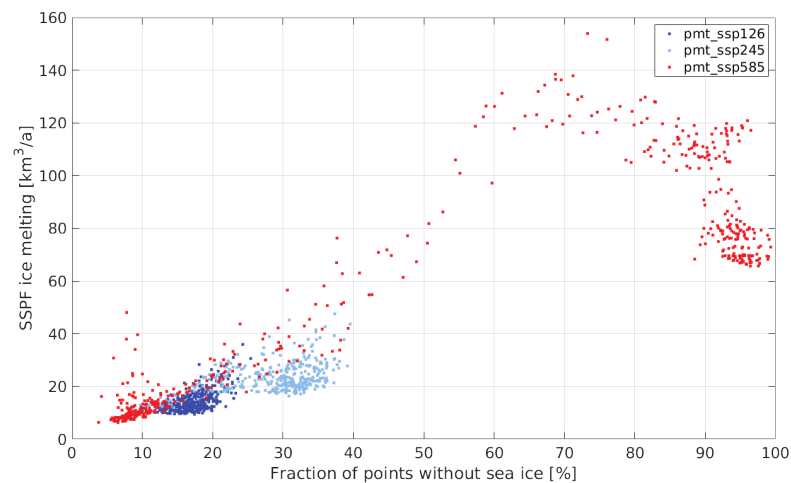

S10. Yearly SSPF ice melting vs. number of points with no sea ice for the period 1850–2349. The sea ice free points are counted each month for a year, so that each point is counted 12 times if the point is completely ice free for the entire year. Only sea ice for points containing SSPF ice in 1850 is considered.

Supplement 4:   Seasonal cycle

This sections contains figures highlighting the seasonal cycle and it's development in the study results and boundary conditions.
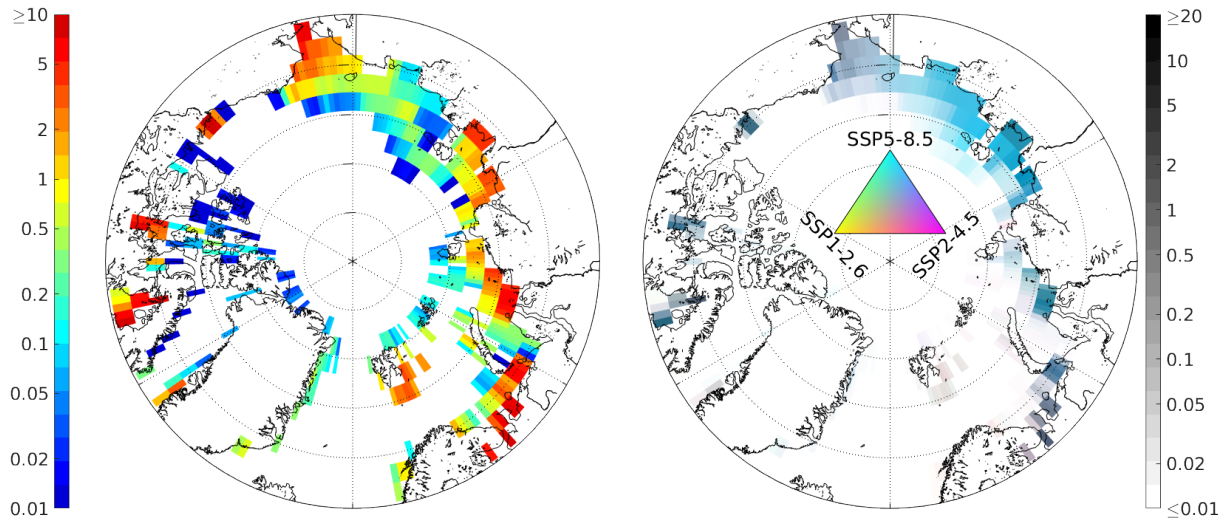
S 11. Amplitude of seasonal cycle in the benthic temperature (boundary condition) averaged over 1850–1873 (left) and 2477-3000 (right). The amplitude is defined as the temperature of the warmest month minus the temperature of the coldest month for each year. In the right figure, the three scenarios are each assigned a color which are combined RGB-wise. Gray colors indicate same amplitude in all scenarios. The color intensity is the amplitude commonly scaled with the maximum amplitude ($26.2\,K$ found in pmt_ssp585. Notice the logarithmic scale in both panels.
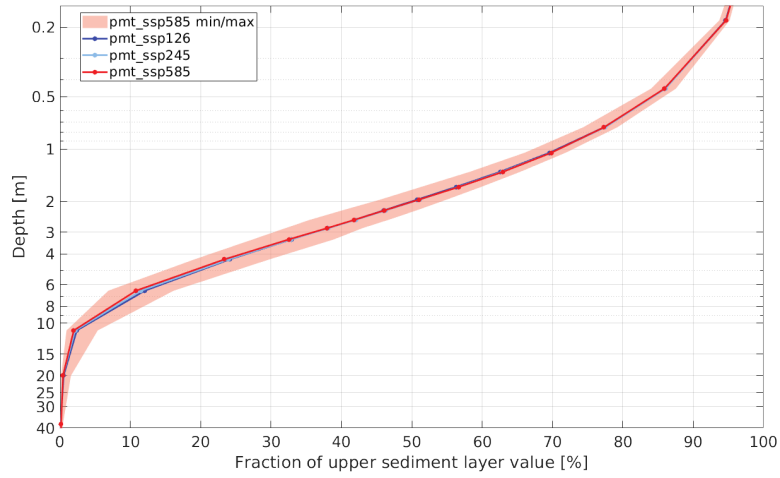
S 12. Amplitude of the seasonal temperature variation in the sediments relative to the seasonal amplitude of the upper sediment layer averaged over the entire experiment period (1850–3000) for the three main experiments. For pmt_ssp585 also the 1850–3000 interanual range (mininium to maximum) has been 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.