

Supplementary Information for the article: Oceanic forcing of the Eurasian Ice Sheet on millennial time scales during the Last Glacial Period

1. On the sensitivity to the ocean heat flux coefficient

As advanced in the main text, in order to investigate the sensitivity of the results to the model parameters, eight additional OCN simulations, both for the surface and the subsurface, have been carried out with different κ parameters between 1 and 10 m/yr/K, i.e., bracketing our standard case of $\kappa = 5$ m/yr/K, both for the OCNsrf and the OCNsub cases.

This choice reflects the inferences based on measurements made on Antarctic ice shelves (Rignot and Jacobs, 2002)

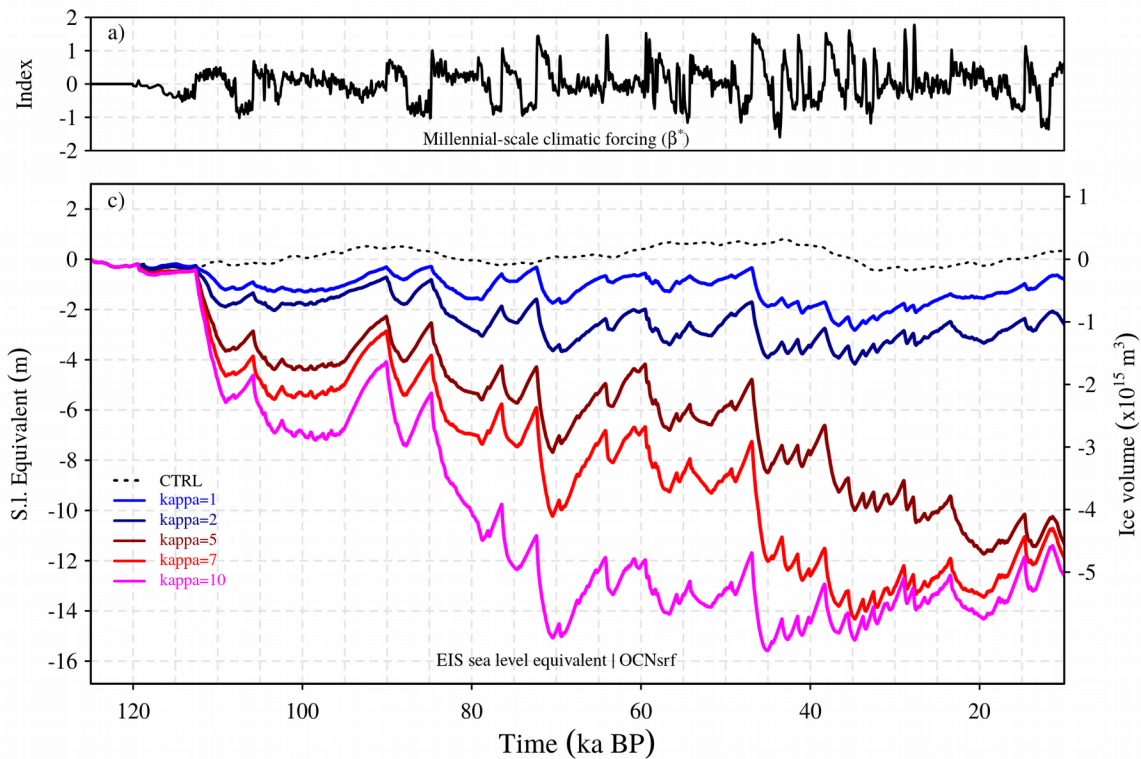


Figure S1 | Volume time series of the EIS for different values of the ocean heat flux coefficient corresponding to the OCNsrf forcing.

A robust response of the EIS is found, with a more reactive EIS response for increasing κ

values, as shown in Figures S1 and S2.

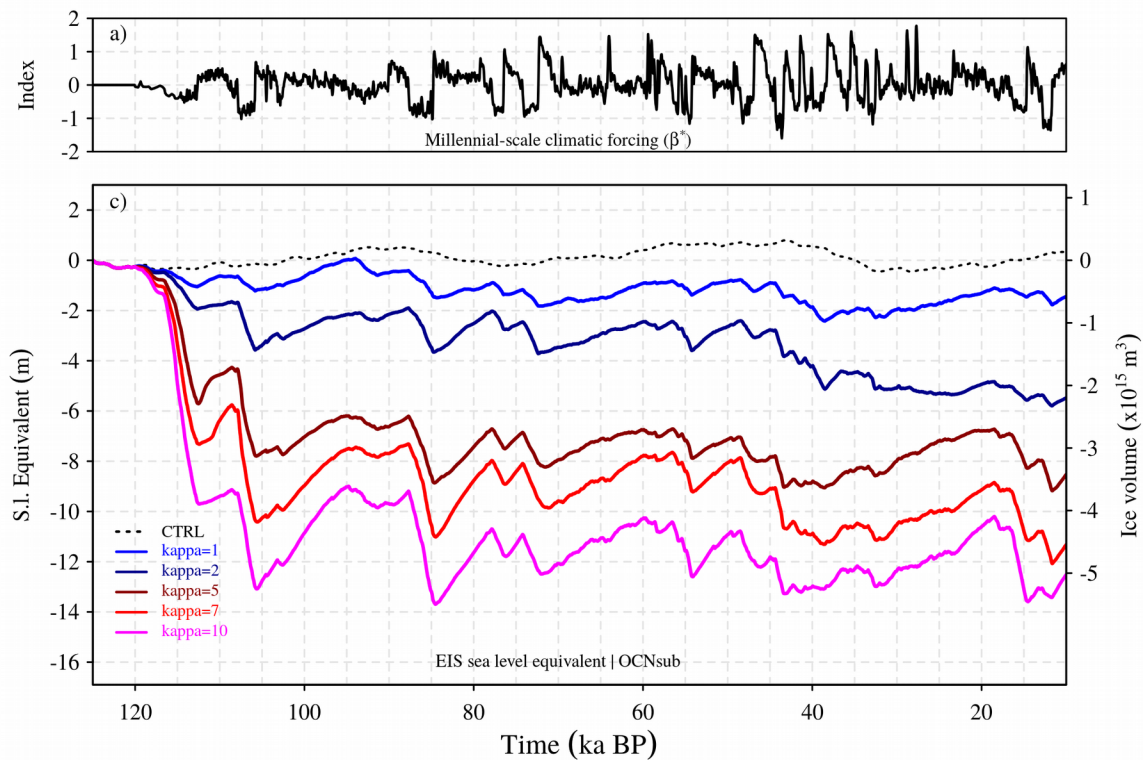


Figure S2 | Volume time series of the EIS for different values of the ocean heat flux coefficient corresponding to the OCNsub forcing.

2. On the sensitivity to the atmospheric forcing

To assess the uncertainty associated to the PDD approach and the response of the ice sheet to different oceanic sensitivities in terms of its dynamics, we performed new ensemble of simulations.

We first explored the uncertainty of the PDD model by changing the value of its parameters. The simulations shown in the main text correspond to the following values of the PDD model:

$\sigma = 5 \text{ K}$, $f_{\text{PDD_ice}} = 0.008 \text{ mwe/PDD}$ and $f_{\text{PDD_snow}}: 0.003 \text{ mwe/PDD}$

We have also explored the sensitivity of our ice sheet model to the following range of values of these parameters:

σ :	4,5,6	K
$f_{\text{PDD_snow}}$:	0.0015, 0.003, 0.006	mwe/PDD
$f_{\text{PDD_ice}}$:	0.004, 0.008, 0.016	mwe/PDD

Therefore, the sensitivity of our results to the values of the atmospheric mass balance model has also been explored in 91 additional simulations that are illustrated in Fig S3.

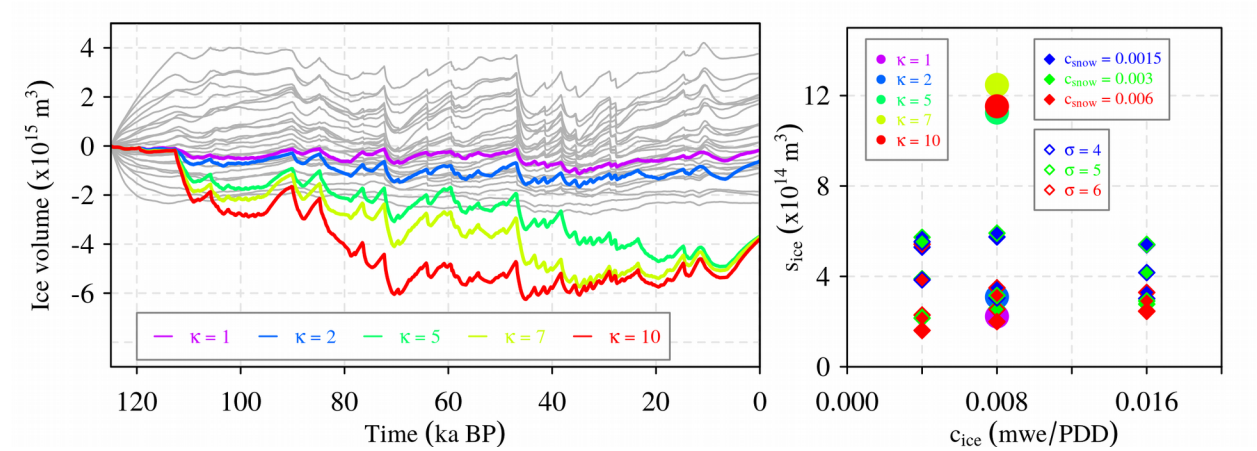


Figure S3 | Left: Time series of EIS volume. Gray trajectories represent the 91 realisations of perturbing the PDD parameters. The sensitivity shown by different values of the ocean heat flux coefficient, κ , is included by means of the OCNsrf time series in colors. Right: Scatter plot of the amplitude of the millennial oscillations (standard deviation of the volume time series) for the PDD ensemble (diamonds) together with the OCNsrf (circles)

Figure S3 (right panel) shows the variability of the 91 simulations exploring the uncertainty of the PDD model in terms of the standard deviation of the time series for the period 100 - 10 ky BP. This amplitude is compared with the one shown by exploring the values of κ (from 1 to 10 m/yr/K) in a OCNsrf ensemble. A greater amplitude when forcing with the ocean is found from $\kappa = 5$ m/yr/K.