

Supplementary information for ‘Unravelling the mystery: The key role of tides in strengthening AMOC during the Bølling-Allerød epoch’

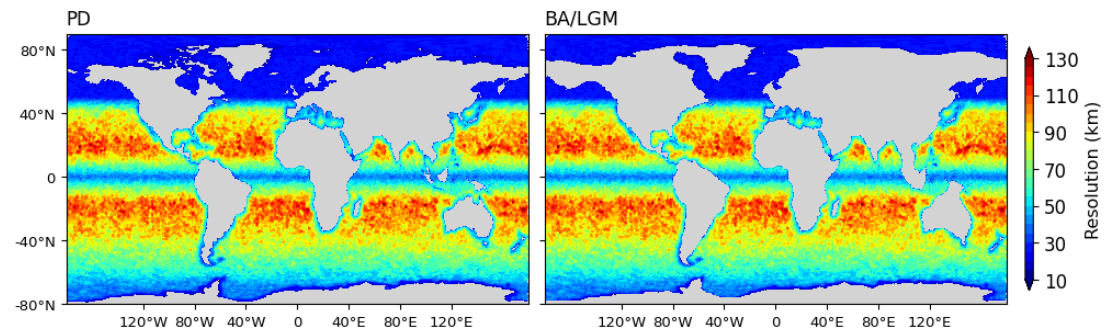
Supplementary Table 1 | Tide model RMS Error for four tidal constituents (Units: cm)

	Deep water regions	Shallow shelf seas
M2	4.87	15.14
S2	1.85	6.34
K1	1.67	5.23
O1	1.31	3.71

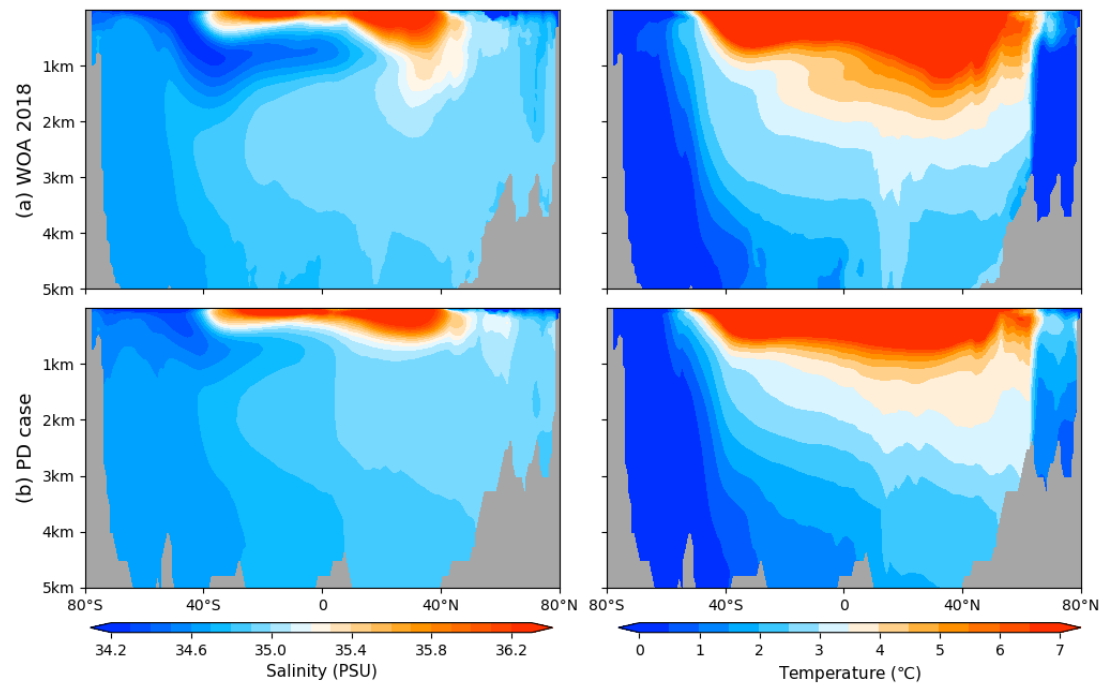
Supplementary Table 2 | Comparison of M2 RMS error in Forward Tide Models (Units: cm)

Model	Deep Water	Shallow Water	Global
Our Tidal Model	4.87	15.14	6.54
Egbert et al. ¹	< 5	NA	NA
Arbic et al. ²	7.26	NA	NA
Griffiths and Peltier ³	NA	NA	13.6
Wilmes and Green ⁴	3.86	NA	6.67
Schindelegger et al. ⁵	4.4	14.6	NA

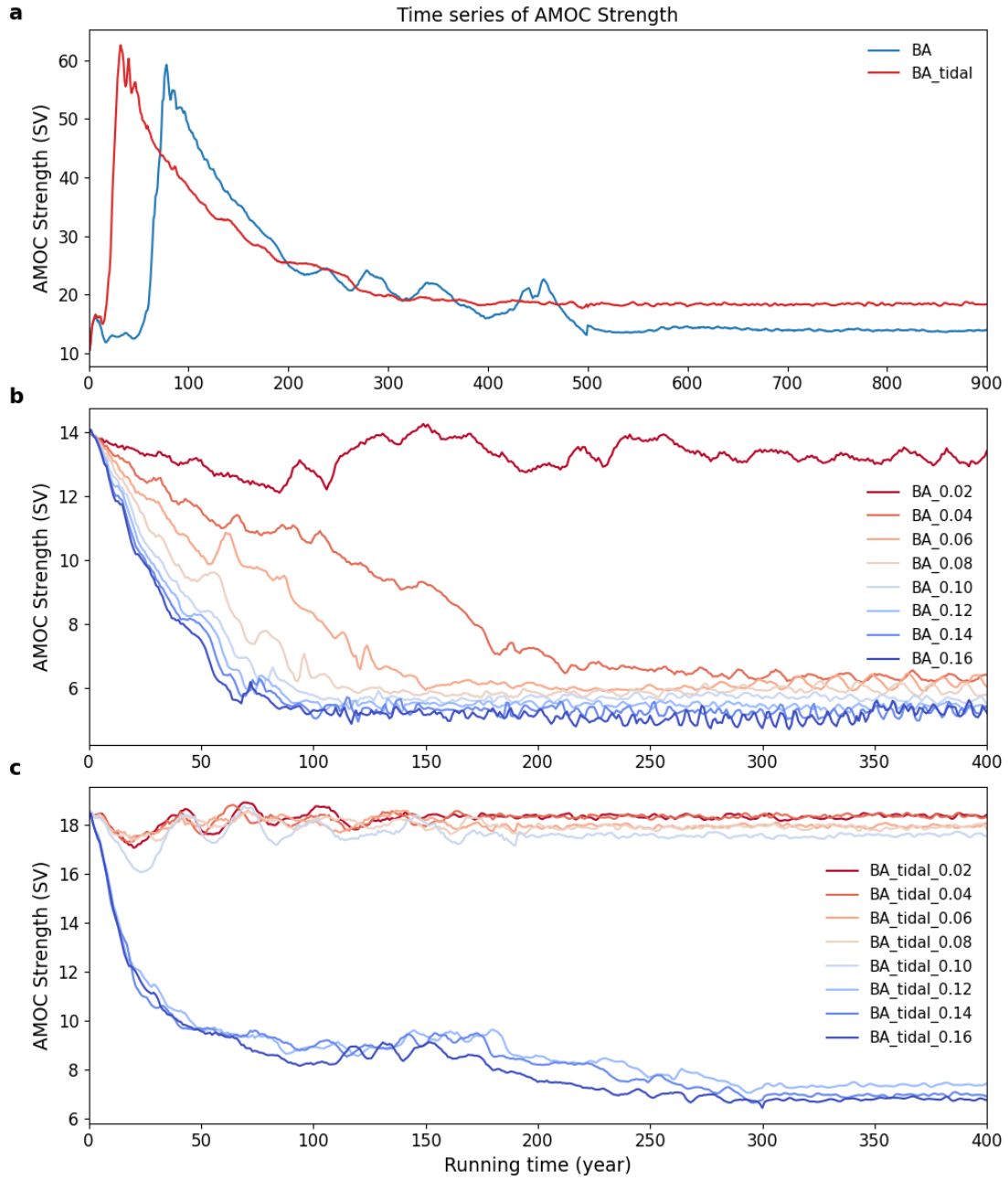
*Note: Differences in the observed models selected across different studies may influence the results.



Supplementary Data Fig. 1 | Horizontal resolution of PD (left) and BA/LGM (right) mesh configurations used in this study.



Supplementary Fig. 2 | Comparison of salinity and temperature between WOA 18 data and PD simulation in the Atlantic Ocean.



Supplementary Fig. 3 | Time series of AMOC strength for all BA experiments, where AMOC strength (Sv) is defined as the maximum AMOC streamfunction below 300 m at 26.5°N. (a) Simulations without freshwater hosing: BA and BA_tidal represent experiments without and with tidal mixing, respectively. **(b)** Simulations with freshwater hosing of varying intensities introduced after the BA experiment reaches a stable state. **(c)** Simulations with freshwater hosing of varying intensities introduced after the BA_tidal experiment reaches a stable state.

- 1 Egbert, G. D., Ray, R. D. & Bills, B. G. Numerical modeling of the global semidiurnal tide in the present day and in the last glacial maximum. *Journal of Geophysical Research: Oceans* **109** (2004). <https://doi.org:10.1029/2003jc001973>
- 2 Arbic, B. K., Garner, S. T., Hallberg, R. W. & Simmons, H. L. The accuracy of surface elevations in forward global barotropic and baroclinic tide models. *Deep Sea Research Part II: Topical Studies in Oceanography* **51**, 3069-3101 (2004). <https://doi.org:10.1016/j.dsr2.2004.09.014>
- 3 Griffiths, S. D. & Peltier, W. R. Modeling of Polar Ocean Tides at the Last Glacial Maximum: Amplification, Sensitivity, and Climatological Implications. *Journal of Climate* **22**, 2905-2924 (2009). <https://doi.org:10.1175/2008jcli2540.1>
- 4 Wilmes, S. B. & Green, J. A. M. The evolution of tides and tidal dissipation over the past 21,000 years. *J Geophys Res-Oceans* **119**, 4083-4100 (2014). <https://doi.org:10.1002/2013jc009605>
- 5 Schindelegger, M., Green, J. A. M., Wilmes, S. B. & Haigh, I. D. Can We Model the Effect of Observed Sea Level Rise on Tides? *J Geophys Res-Oceans* **123**, 4593-4609 (2018). <https://doi.org:10.1029/2018jc013959>