



Supplement of

Does a difference in ice sheets between Marine Isotope Stages 3 and 5a affect the duration of stadials? Implications from hosing experiments

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- 10 Supplementary information: Cause of the shorter duration in partially coupled experiments compared to
- 11 <u>original experiments</u>
- 12 The duration of staidial in PC-MIS3-5aiceH is shorter compared to MIS3-5aiceH by 200 years when comparing
- 13 the onset of AMOC recovery, or shorter by 300 years when comparing the timing of fully recovered AMOC
- state (Fig. 11). The shorter recovery period in the partially coupled experiment is associated with the thinner sea
- 15 ice over the deepwater formation (Fig. 12b and c). When the experiment is forced with the monthly climatology,
- 16 less sea ice is transported to the deepwater formation region. As a result, it gets easier for the deepwater to form,
- 17 which causes the early recover of the AMOC. This problem is resolved when the partially coupled experiment is
- 18 forced with raw daily fields obtained from the last 100 years of hosing experiment (Fig. S2, S4). Nevertheless,
- 19 partially coupled experiments forced with monthly climatology reproduce the general feature that MIS3-5aiceH
- 20 has longer recovery time compared to MIS3H, hence these experiments can be considered valid.
- 21
- 22 With respect to the abrupt recovery, the lack of stepwise recovery in the partially coupled experiment can be
- associated with weaker decadal variability and thinner sea ice over the deep water formation region. For
- example, in Fig. 9, it is shown that the temporal cessation of deepwater formation at Irminger and Norwegian
- 25 Sea associated with decadal variably can result in a temporal weakening of the AMOC. This temporal
- 26 weakening of the AMOC then causes a slower recovery of the AMOC during the abrupt resumption in MIS3-
- 27 5aiceH. However, we assume that this effect is weaker in partially coupled experiment since the coupling
- between the atmosphere and ocean is removed. Further detailed analysis should reveal this aspect, though it is
- 29 beyond the scope of the study.
- 30



32 Figure S1: Areas where the land-sea mask differ between MIS3 and MIS5a ice sheets.





Figure S2: Time series of AMOC. Freshwater hosing of 0.1 Sv is applied during year 0 to year S00. Black and red colors correspond to MIS3 and MIS3-5aice, respectively. The original experiments are shown in thin lines, while results of partially coupled experiments forced with raw daily fields obtained from the last 100 years of the hosing experiments are shown in thick lines. This figure shows that the partially coupled experiments reproduce the original experiment better when forced with raw daily values.



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Figure S3: Time series of AMOC in MIS3H (black) and new partially coupled experiments initiated after the cessation of hosing (starting from year 500). The new partially coupled experiments are forced with raw daily values from the last 100 years of the hosing experiment. Black: PC-MIS3H_daily. Blue: raw daily surface winds and atmospheric freshwater flux of the last 100 years in MIS3-5aiceH are applied to MIS3H (PC-MIS3H_windwater_daily). Yellow: raw daily atmospheric freshwater flux of the last 100 years in MIS3-5aiceH is applied to MIS3H (PC-MIS3-5aiceH_water_daily).



Figure S4: Temporal evolution of sea ice thickness over the Irminger Sea (35W-25W, 55N-63N).
Solid line corresponds to the original MIS3-5aiceH experiment, while the dashed line corresponds

54 to a new partially coupled experiment forced with raw daily fields obtained from the last 100

55 years of hosing in MIS3-5aiceH. The result shows an improved reproducibility of sea ice thickness

56 in partially coupled experiments forced with raw daily values compared to that forced with

- 57 monthly climatology.
- 58



60 Figure S5: Annual mean surface air temperature differences between MIS3H and MIS3-5aiceH

