Appendix I

APPENDIX I

In the present appendix mid Holocene (MH, 6 kyrs BP) atmospheric variability (sea level pressure, SLP, and temperature) has been analyzed and it is compared to the pre-industrial (PI, 1750 AD) and Last Glacial Maximum (LGM, 21 kyrs BP) climate.

The MH shows a mean climate (sea level pressure) and an extratropical atmospheric variability that are similar to the pre-industrial (PI) climate state (Figs. AI1 and AI2). The leading mode of North Atlantic sea level pressure (SLP) variability at MH is mainly identical to the PI (Fig. AI3) and it is able to capture the temperature variability of the basin (Fig. AI5). Also the amplitude and the variability of the leading mode of SLP do not vary compared to the PI (Fig. AI4).

Finally, whereas the SLP variability is higher during MH and PI compare to LGM, the temperature interannual variability is lower in warmer climate states (Fig. AI6). This is in qualitative agreement with ice core data from Greenland that show higher temperature ($\delta^{18}O$) variability during glacial climate states.

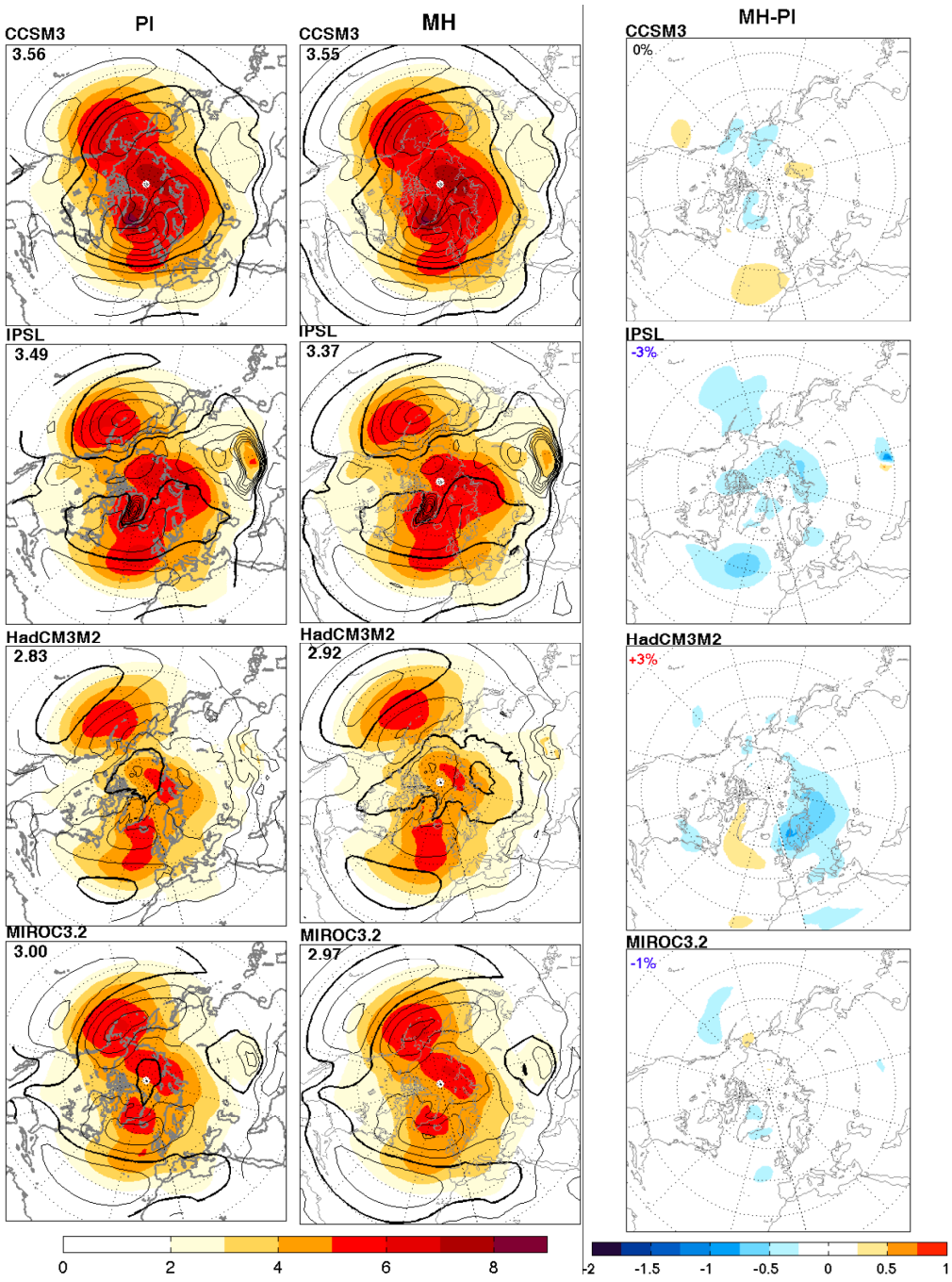

Fig. AI1: The mean (contours: 4 hPa interval from 1000 to 1040 hPa; higher values omitted for clarity; bold contour denotes 1016 hPa) and standard deviation (colored shading: hPa) of monthly SLP averaged over all months in simulations of PI (left) and MH (center) climate. Numbers show the SLP standard deviation area-averaged over the Northern Hemisphere. Differences (MH-PI) are shown in the right panels.

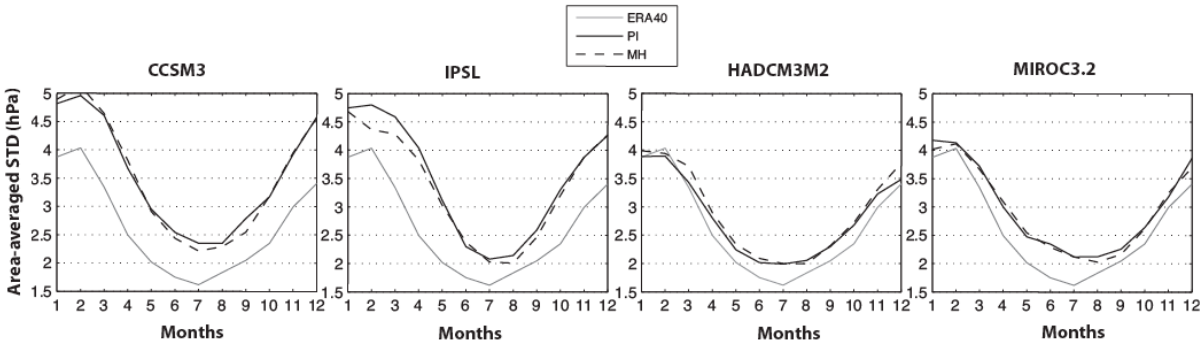

Fig. AI2: Seasonal cycle of interannual SLP standard deviation over the Northern Hemisphere in the PI and LGM simulations, and for the ERA-40 reanalysis 1957-2002.

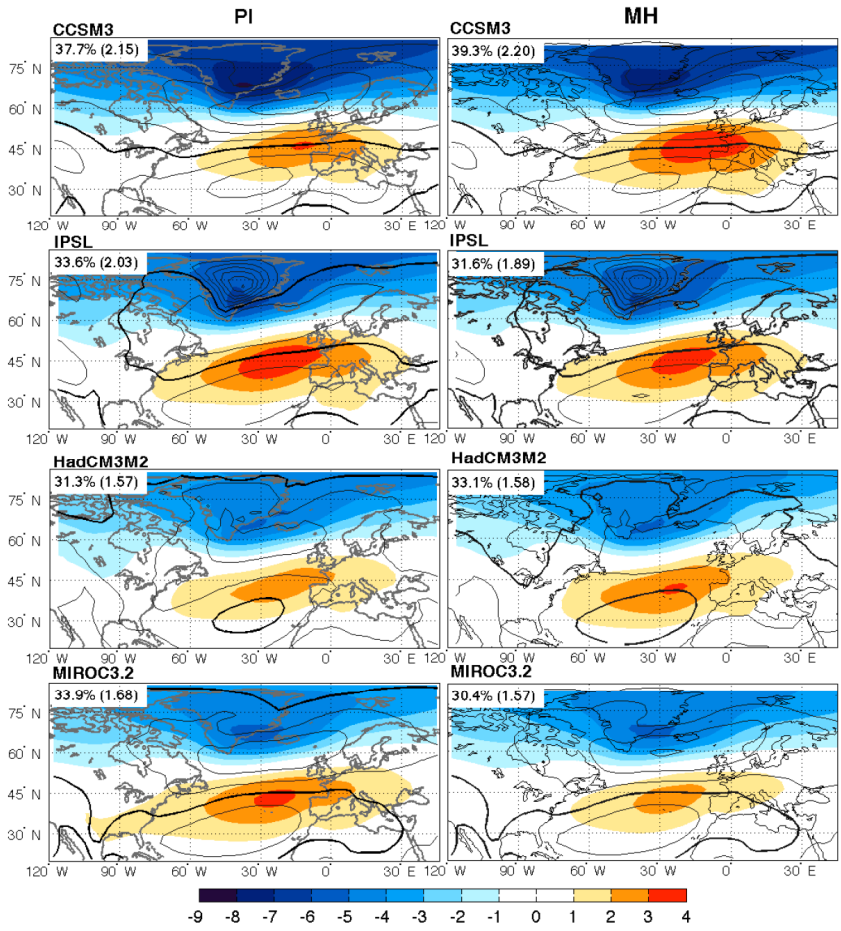

Fig. AI3: Leading EOF of monthly SLP anomalies (colored shading: hPa / standard deviation of PC) and SLP climatology (contours: 4 hPa interval from 1000 to 1040 hPa; higher values omitted for clarity; bold contour denotes 1016 hPa) in the North Atlantic sector (all months) for the PI and MH simulations. Numbers show the amount of variance explained by the first mode both as a percentage of the total variance (λ) and as a standard deviation in hPa ($\sqrt{[\lambda*(\sigma_{NA})^2]}$). these percentages reflect a decrease in standard deviation explained by the first mode.

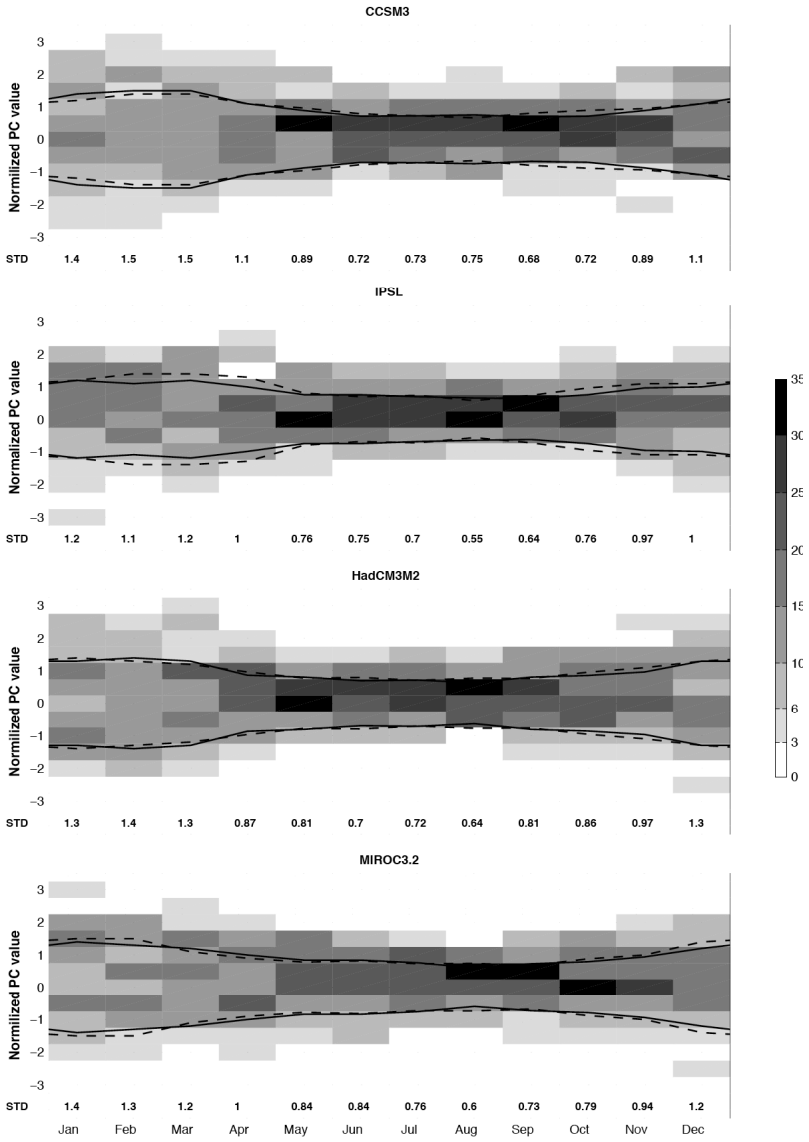

Fig. AI4: The seasonality of NAO-like variability in MH and PI simulations. For each month, the shading in each 0.5 standard deviation bin (y-axis) represents the occurrence frequency of the NAO-like PC1 within that interval. The monthly PC1 time series from both simulations of a given model is normalized by the standard deviation of the annually averaged PC1 from the model's PI simulation. This standardization enables a comparison between the model's simulation of the two climate states. The spread of the normalized PC1s in a given month is an indication of the interannual variability in the leading mode for that month: a wider spread suggests that the amplitude of NAO-like oscillations is increased. The standard deviations of the PC in these normalized units are indicated along the x-axis for each month and are marked by the lines (dashed for PI, solid for MH).

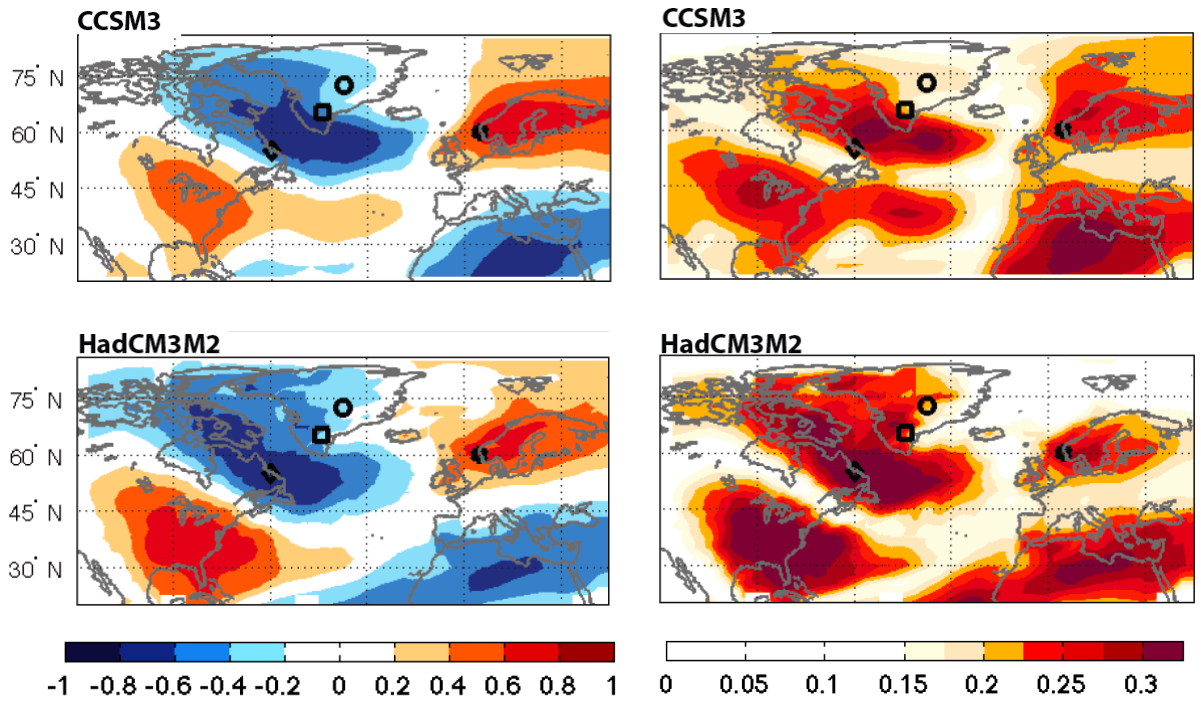

Fig. AI5: MH correlation between North Atlantic winter surface air temperature (November to April) and PC1 (NAO-like index) for CCSM3 (top left) and HadCM3M2 (bottom left). An indicator of temperature coherence in the sector for CCSM3 (top left) and HadCM3M2 (top right): the value at each point is the absolute value of the area-averaged correlation between temperature at that point and the rest of the North Atlantic basin. Only the winter months are included, as this is when the NAO-like signal is strongest. When including all months the result is the same, but with slightly weaker correlation patterns. Markers indicate the following locations: Summit (73° N, 37° W, circle), Dye-3 (65° N, 44° W, square), Labrador (52° N, 60° W, diamond), Norway (60° N, 6° E, star).

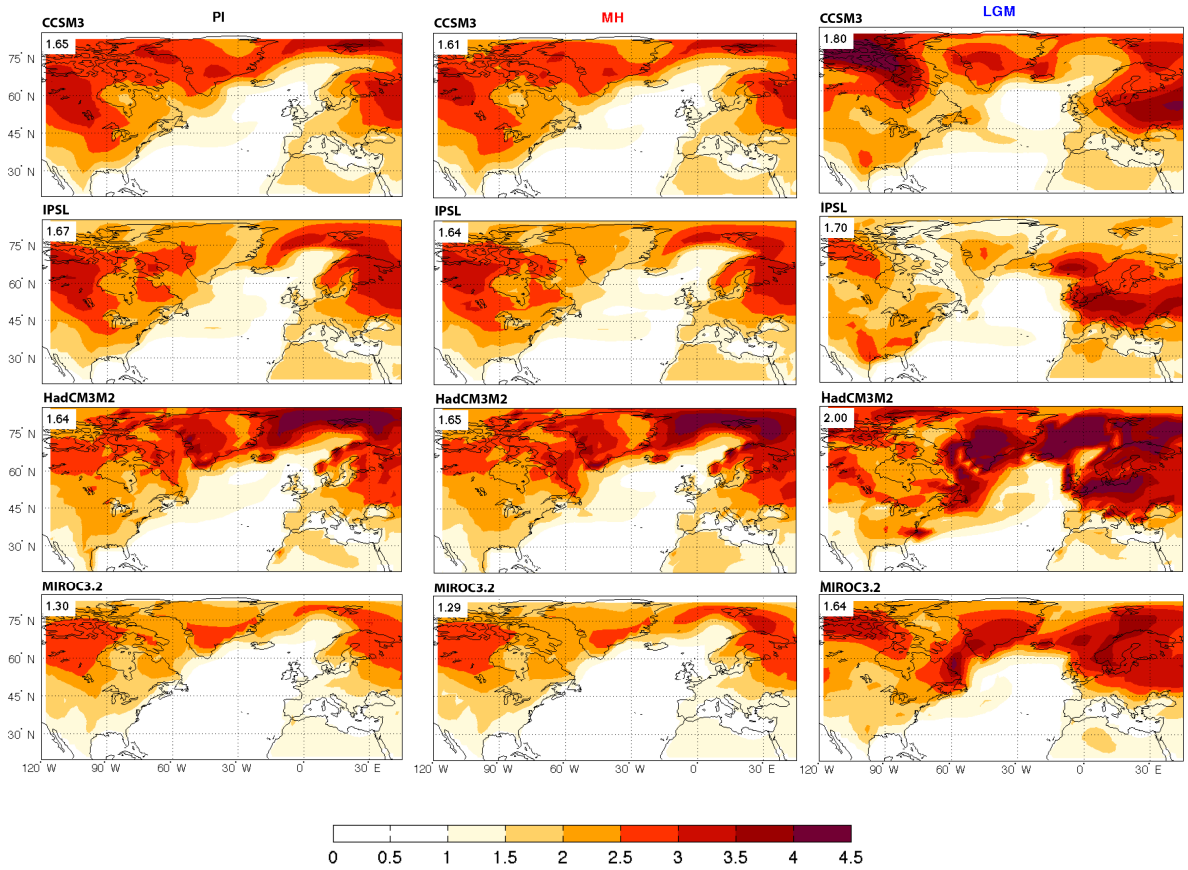

Fig. AI6: Standard deviation (colored shading: hPa) of monthly air surface temperature averaged over all months in simulations of PI (left), MH (center) and LGM (right) climate. Numbers show the SLP standard deviation area-averaged over the North Atlantic.

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