atmosphere

Supplementary Materials

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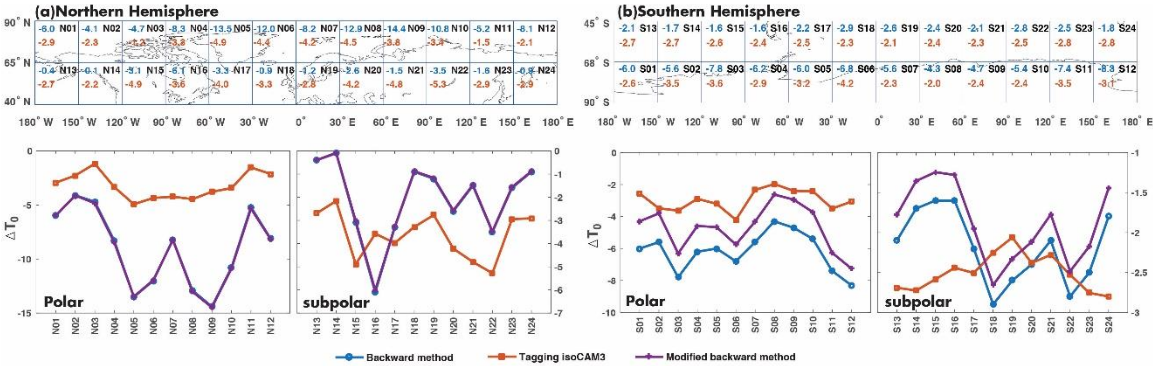

Figure S1. The estimated source temperature changes of the sub-regions in the Northern Hemisphere (left) and Southern Hemisphere (right). (**a**) The upper panel gives the locations of the 24 sub-regions in the Northern Hemisphere marked as N01, N02, …, N23, N24 on the upright corner. The estimated source temperature changes of each sub-region (backward method: blue; Tagging isoCAM3, namely, T_{e0}; red; modified backward method: purple) are listed in the corresponded box, and also plotted in the lower panel with corresponding colors. As for the Northern Hemisphere, the estimated source temperature changes based on backward method (blue line) is overlapped with the modified backward method (purple line). (b) The same as (a), but for the Southern Hemisphere.

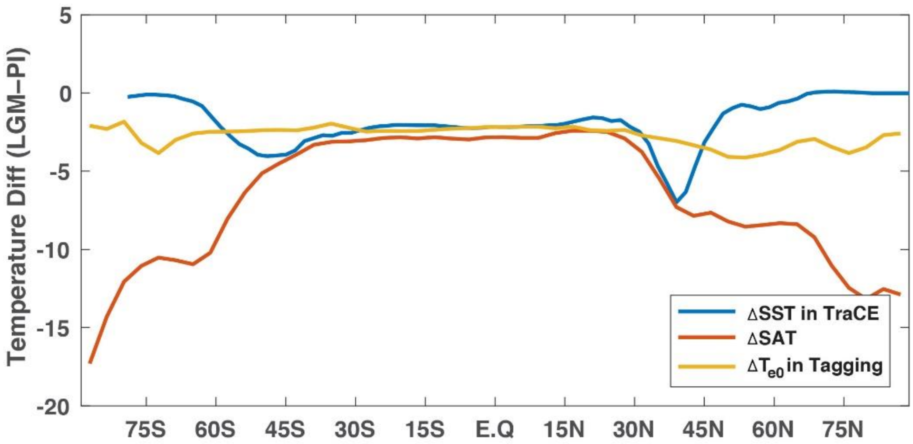

Figure S2. The difference between LGM and PI for zonal mean of annual mean sea surface temperature in TraCE (blue), annual mean surface air temperature (red) and T_{e0} (yellow) in isoCAM3.

Inversion Layer Strength Effect

$$\begin{aligned}\delta^{18}O(x,t) &= \alpha_i T_i(x,t) - bT_0(t) + d(t) \\ &= \alpha_i T_s(x,t) + \alpha_i \delta T(x,t) - bT_0(t) + d(t)\end{aligned} \quad \text{(S1)}$$

Here, we promoted the Equation (S1) (similar as the Equation (S2) in the section 4 of our previous paper [1] takes the inversion layer strength as a local effect in consideration while understanding the temporal slope. Here, for a specific local region, if there is no inversion layer, the spatial slope α_i will equal to α_s, and the Equation (S1) will be the same as the Equation (2) in Guan et al. (2016).

According to Equation (S1), firstly, we do the difference between LGM and PI, and then divide the both sides by $\Delta T_s(x)$, we get the relations between the temporal slope and spatial slope shown on below,

$$\alpha_t = \alpha_i\left(1 + \frac{\delta T(x)}{\Delta T_s(x)}\right) - \frac{b\Delta T_0}{\Delta T_s(x)} + \frac{\Delta d}{\Delta T_s(x)} \tag{S2}$$

So, the backward method with inversion layer strength changes considered is

$$\Delta \mathrm{T}_0 = \frac{1}{b} \times (\alpha_\mathrm{i} \times \Delta \mathrm{T_s}(x) + \alpha_\mathrm{i} \times \Delta\delta\mathrm{T(x)} + 1.1 - \Delta\delta^{18}\mathrm{O}) \tag{S3}$$

In this study, the spatial slope (α_i) between annual mean inversion layer temperature and precipitation weighted annual mean $\delta^{18}O$ over middle and high latitudes is 0.71 ‰ $\times$ $℃^{-1}$ in Northern Hemisphere and 0.74‰ $\times$ $℃^{-1}$ in Southern Hemisphere.

References

1. Guan, J.; Liu, Z.; Wen, X.; Brady, E.; Noone, D.; Zhu, J.; Han, J. Understanding the temporal slope of the temperature-water isotope relation during the deglaciation using isoCAM3: The slope equation. *J. Geophys. Res. Atmos.*, **2016**, *121*, 10–342, doi:10.1002/2016JD024955.