

Sensitivity of isotopes in the hydrological cycle to simulated vs. reconstructed Last Glacial Maximum surface conditions

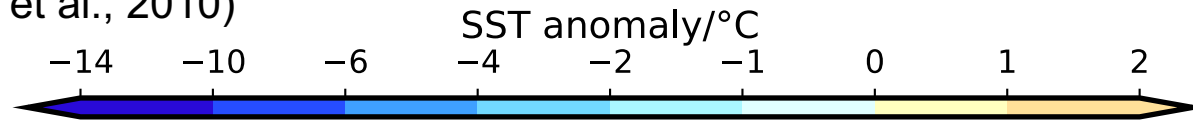
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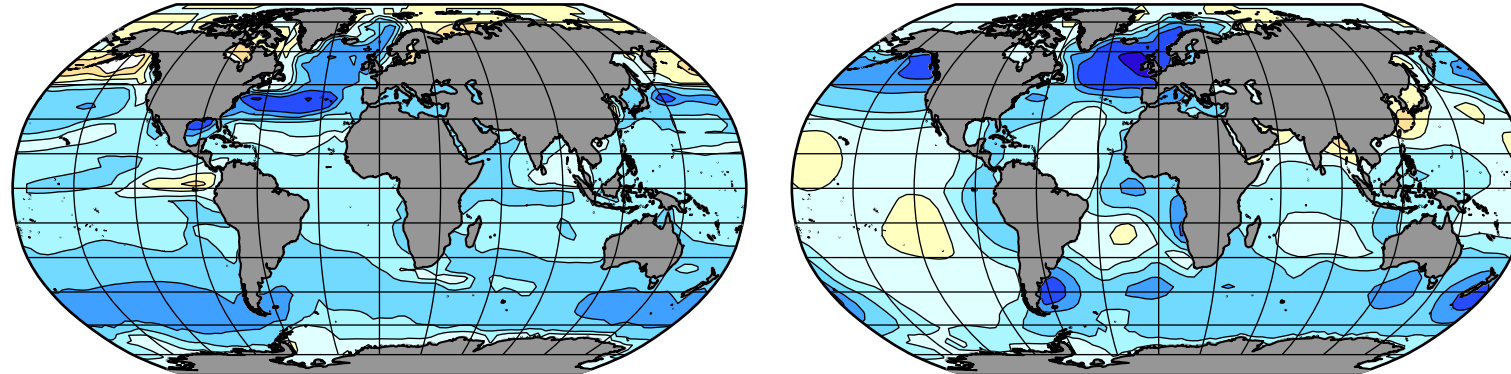


Simulated sea-surface conditions
 derived from CCSM3 (Merkel et al., 2010)
 larger global cooling
 more zonal structure

Reconstructed sea-surface conditions
 based on MARGO (2009)
 stronger polar cooling
 large zonal gradients



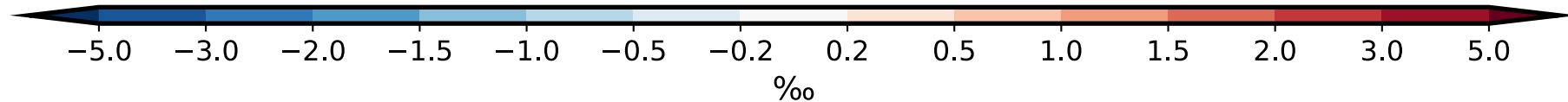
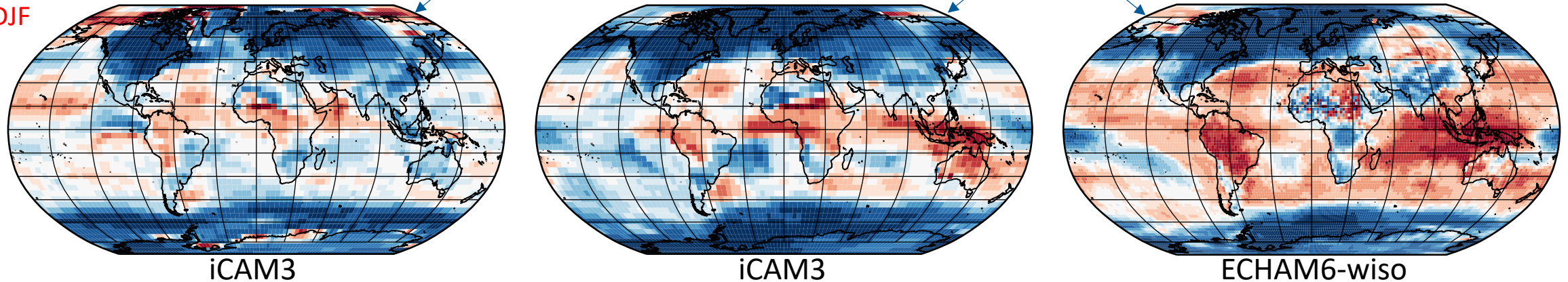
February



anomaly
 = LGM – pre-industrial

DJF

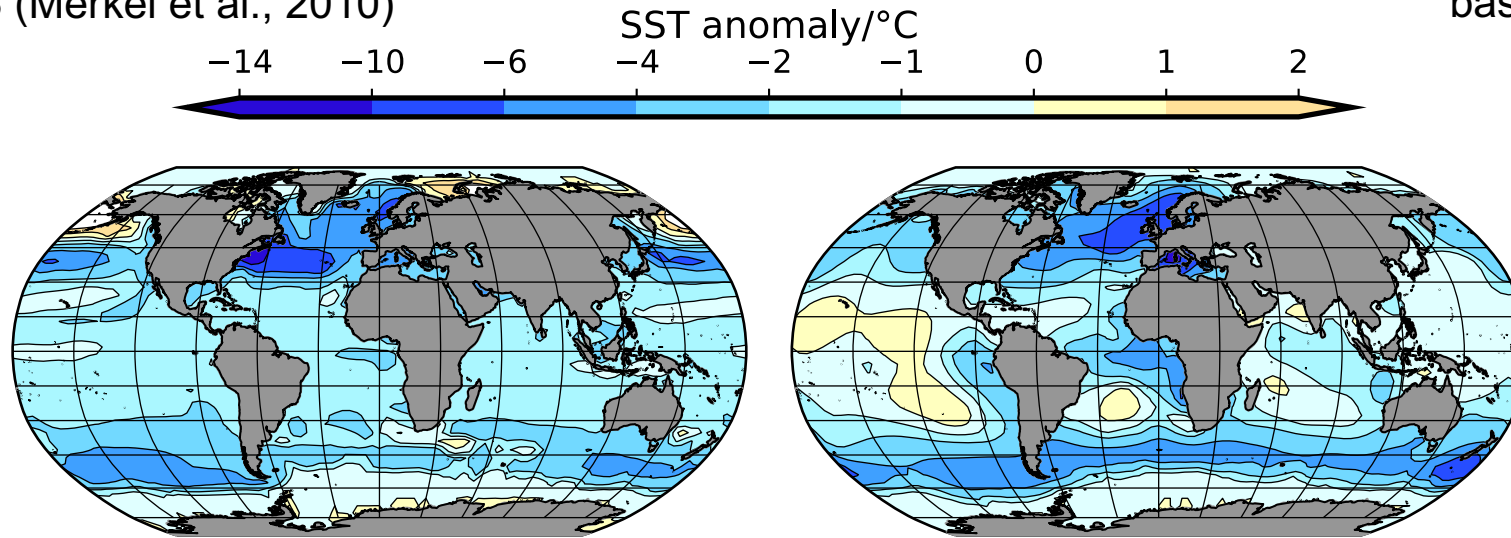
$\delta^{18}\text{O}$ in precipitation anomaly



Simulated sea-surface conditions
derived from CCSM3 (Merkel et al., 2010)

larger global cooling
more zonal structure

August



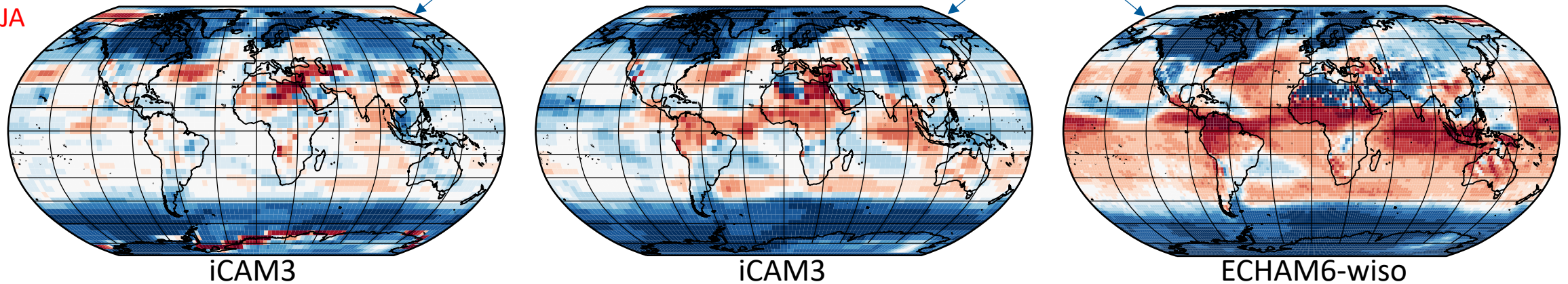
Reconstructed sea-surface conditions
based on MARGO (2009)

stronger polar cooling
large zonal gradients

anomaly
= LGM – pre-industrial

JJA

$\delta^{18}\text{O}$ in precipitation anomaly



-5.0 -3.0 -2.0 -1.5 -1.0 -0.5 -0.2 0.2 0.5 1.0 1.5 2.0 3.0 5.0

‰



Simulated sea-surface conditions
derived from CCSM3 (Merkel et al., 2010)

Reconstructed sea-surface conditions
based on MARGO (2009)

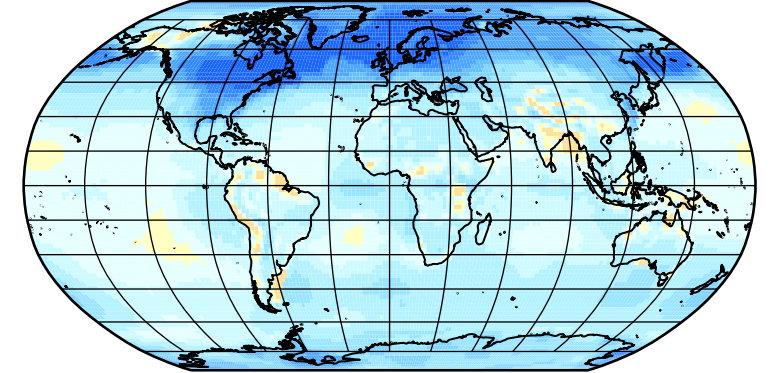
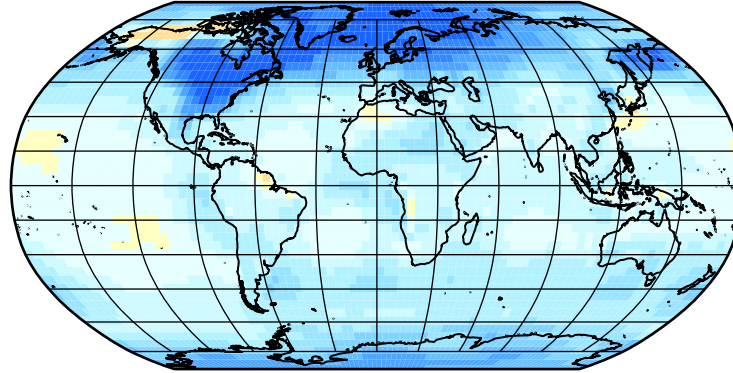
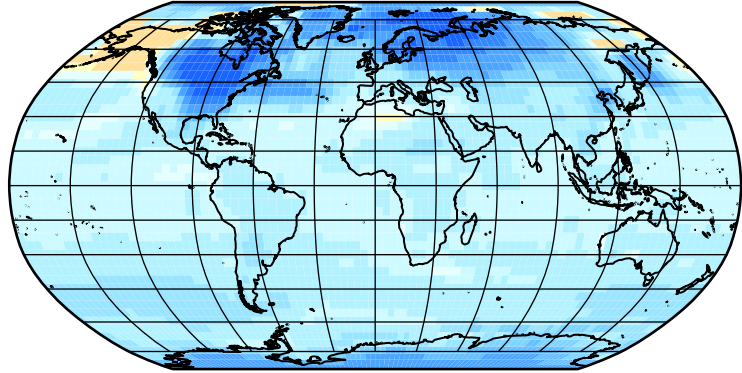
Surface air temperature anomaly/°C



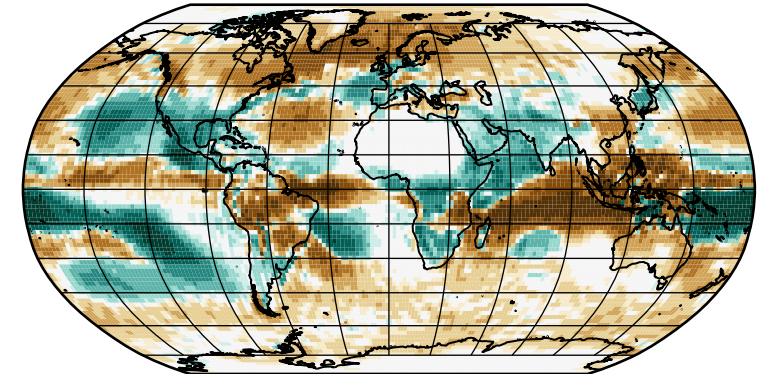
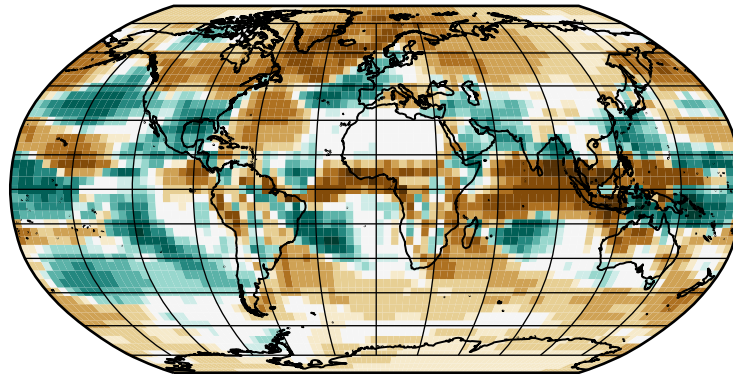
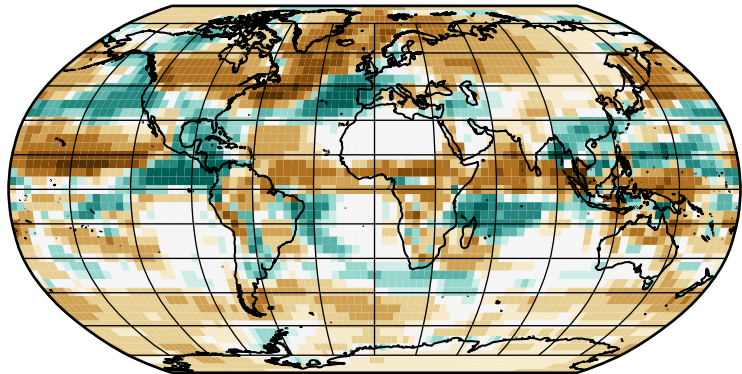
iCAM3

iCAM3

ECHAM6-wiso



DJF



iCAM3

iCAM3

ECHAM6-wiso



Total precipitation anomaly/(mm a⁻¹)



Simulated sea-surface conditions
derived from CCSM3 (Merkel et al., 2010)

Reconstructed sea-surface conditions
based on MARGO (2009)

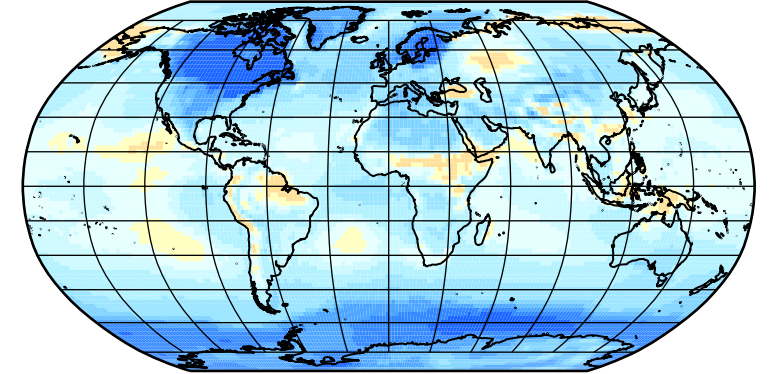
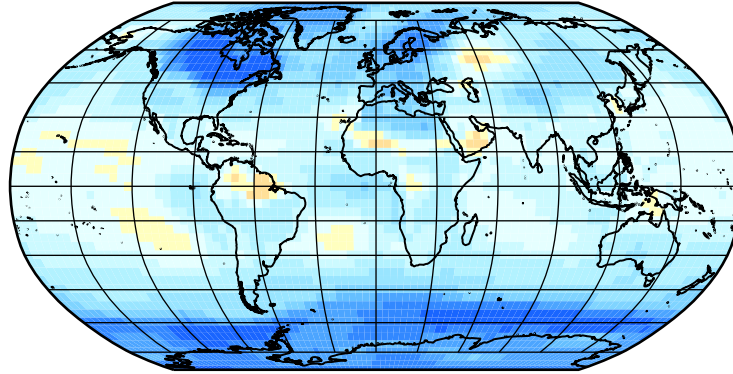
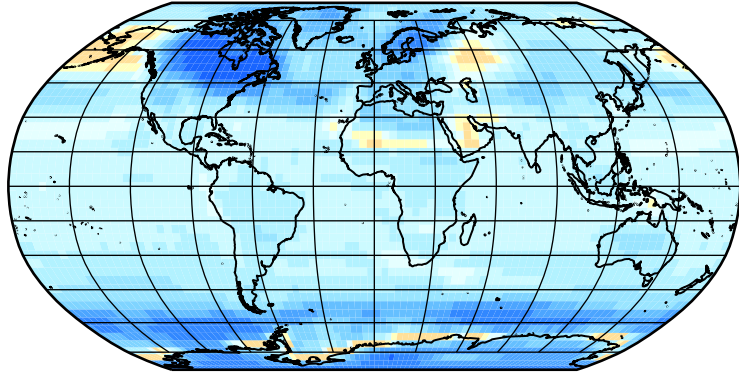
Surface air temperature anomaly/°C

-25 -20 -15 -10 -8 -6 -4 -2 -1 0 1 2

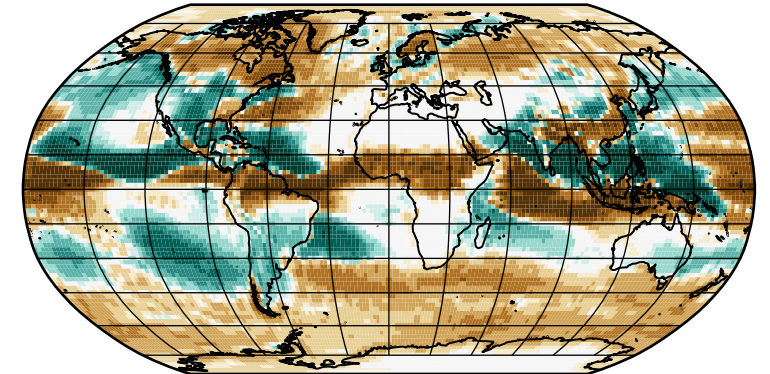
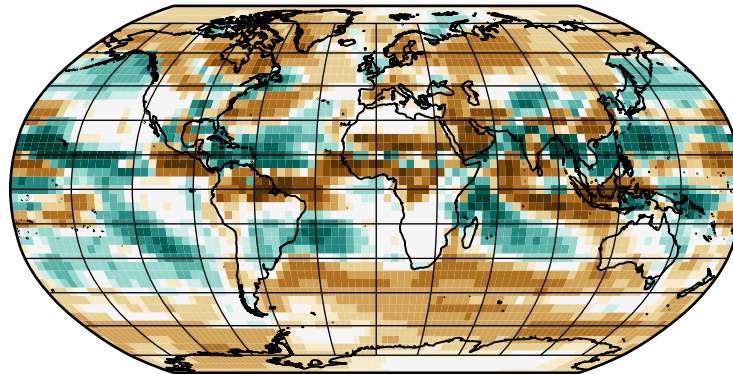
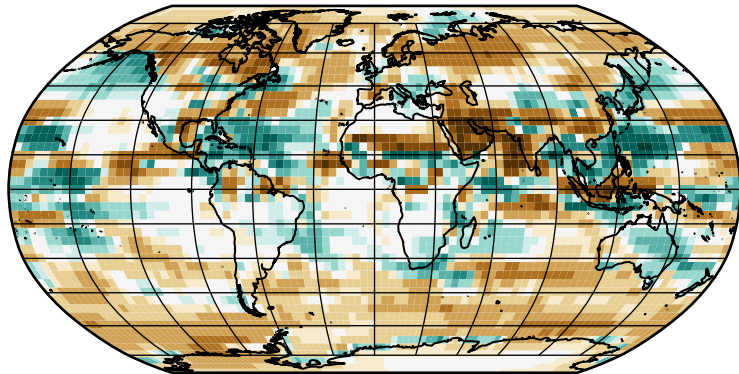
iCAM3

iCAM3

ECHAM6-wiso



JJA



iCAM3

iCAM3

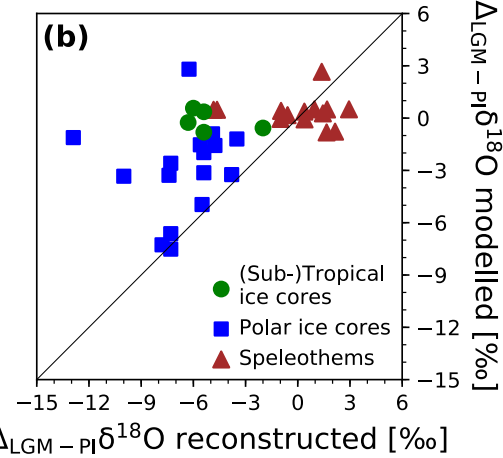
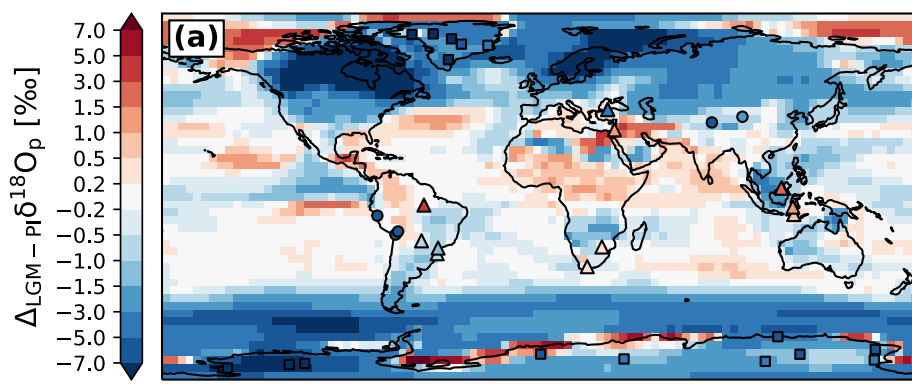
ECHAM6-wiso

-4.0 -2.0 -1.0 -0.5 -0.2 -0.1 0.1 0.2 0.5 1.0 2.0 4.0

Total precipitation anomaly/(mm a⁻¹)

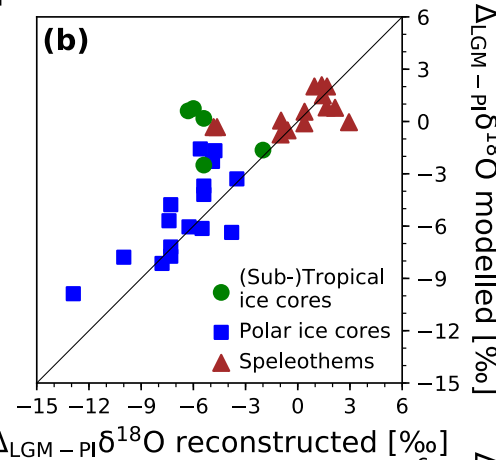
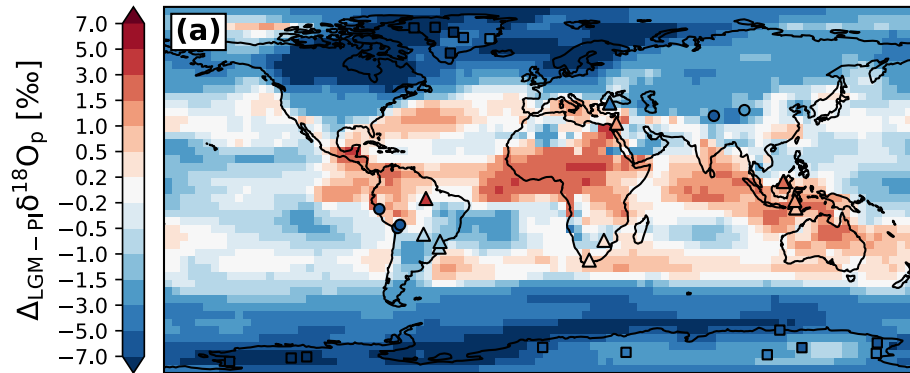


Data-model comparison

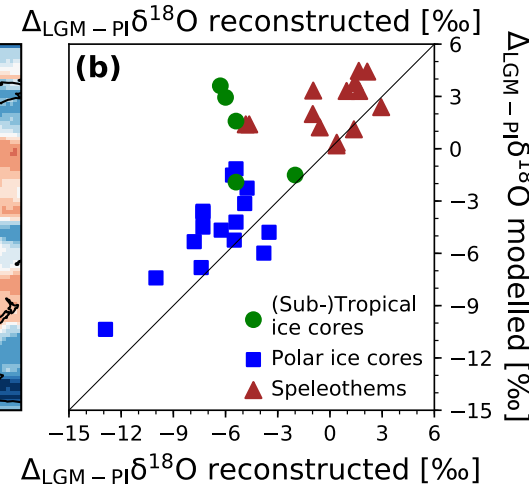
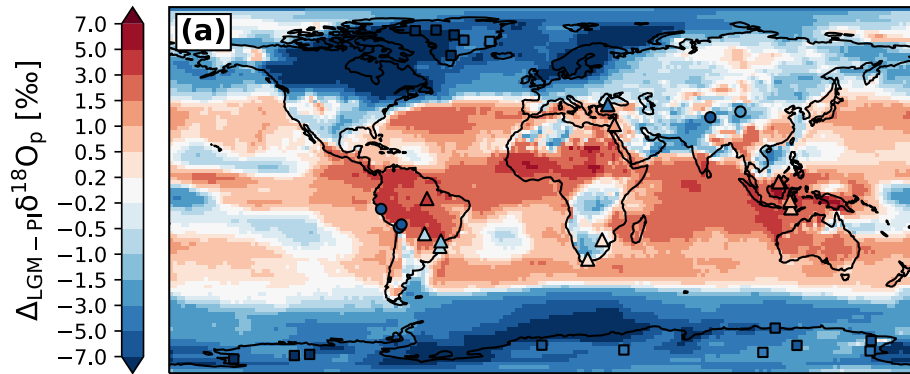


iCAM3 (T31) with simulated sea-surface conditions

iCAM3 (T31) with reconstructed sea-surface conditions



ECHAM6-wiso (T63) with reconstructed sea-surface conditions



Data-model comparison

Experiment	Coefficient of determination R^2	Root-mean square error RMSE/‰
iCAM3 with simulated anomalies	0.26	4.1
iCAM3 with reconstructed anomalies	0.64	2.7
ECHAM6-wiso with reconstructed anomalies	0.59	3.7

South-polar ice-core data: Vostok, Dome F, EDC, EDML, Taylor Dome, Talos, Byrd, Siple Dome, Law Dome, WDC

North-polar ice-core data: GRIP, NGRIP, NEEM, Camp Century, Dye 3, Renland, Agassiz

(Sub-) Tropical ice-core data from Risi et al. (2010)

Speleothem data from SISAL compilation (converted after Comas-Bru et al., 2019)

Reconstructed sea-surface conditions:

Paul et al., A global climatology of the ocean surface during the Last Glacial Maximum mapped on a regular grid (GLOMAP), under review for Climate of the Past, <https://doi.org/10.5194/cp-2019-154>



Conclusions

- The model-data fit for both models (iCAM3 and ECHAM6-wiso) forced by reconstructed sea-surface conditions (LGM SST anomalies and sea-ice concentrations) is comparably good.
- The model-data fit is much better for forcing one of the two models (iCAM3) with reconstructed as compared to simulated LGM sea-surface conditions.