

The PMIP4-CMIP6 Last Glacial Maximum experiments: preliminary results and comparison with the PMIP3-CMIP5 simulations

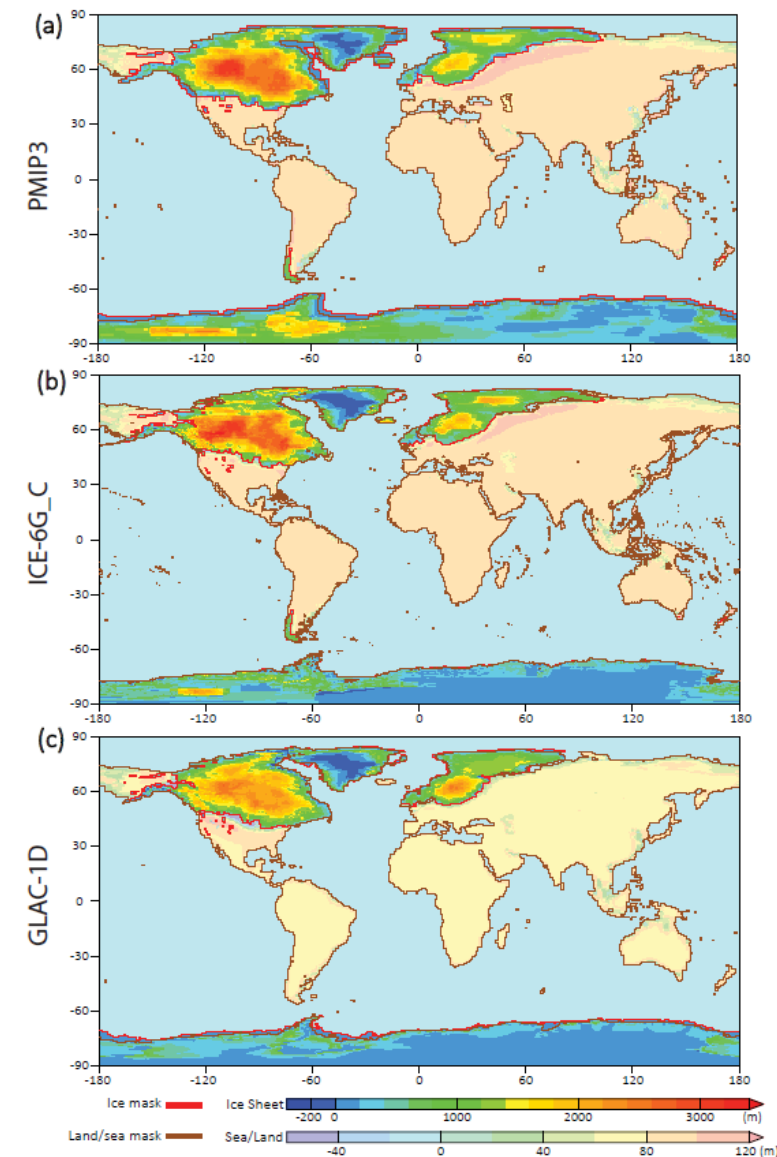
Masa Kageyama¹, Sandy P. Harrison², Marie-L. Kapsch³, Marcus Löfverström⁴, Juan M. Lora⁵,
Uwe Mikolajewicz³, Sam Sherriff-Tadano⁶, Tristan Vadsaria⁶, Ayako Abe-Ouchi⁶, Nathaëlle
Bouttes¹, Deepak Chandan⁷, Allegra N. LeGrande⁸, Fanny Lhardy¹, Gerrit Lohmann⁹, Polina A.
Morozova¹⁰, Rumi Ohgaito¹¹, W. Richard Peltier⁷, Aurélien Quiquet¹, Didier M. Roche^{1,12}, Xiaoxu
Shi⁹, Andreas Schmittner¹³, Jessica E. Tierney⁴, Evgeny Volodin¹⁴

¹LSCE, France, ²University of Reading, UK, ³MPI Hamburg, Germany, ⁴University of Arizona, Tucson, USA, ⁵Yale University,
USA, ⁶AORI, University of Tokyo, Japan, ⁷University of Toronto, Canada, ⁸NASA GISS, USA, ⁹AWI Bremerhaven, Germany,

¹⁰Institute of Geography, Russian Academy of Science, Russia, ¹¹JAMSTEC, Yokohama, Japan, ¹²VUA, the Netherlands,
¹³COAS, Oregon State University, USA, ¹⁴Institute of Numerical Mathematics, Russian Academy of Sciences, Moscow, Russia

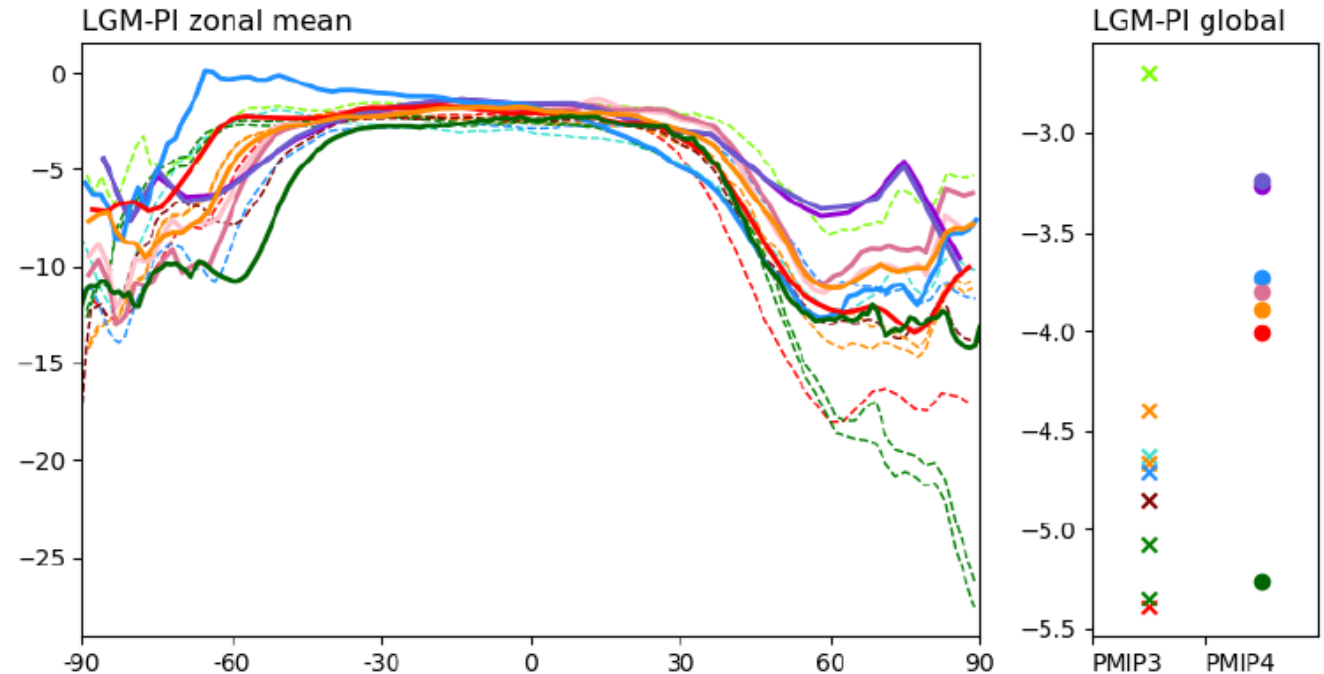
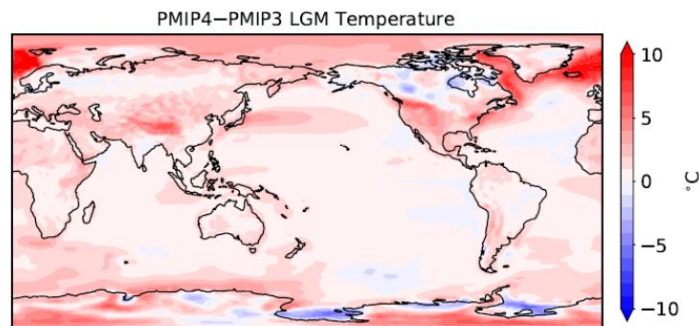
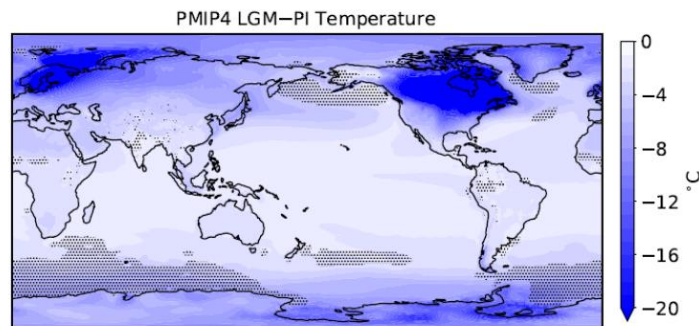
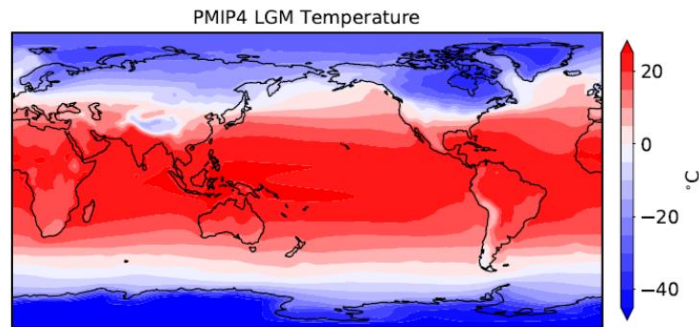
From PMIP3-CMIP5 to PMIP4-CMIP6

- **Updated models**
 - some models have a large climate sensitivity, but none of these are included in the present study (yet)
- **Updated boundary conditions**
 - in particular, a choice between three ice sheet reconstructions (cf. Figure =>)



LGM ice sheets and associated land sea masks: Bright colours show the LGM – modern altitude anomaly over the LGM ice sheets; pale colours show the altitude anomalies outside the ice sheets, both in metres. The ice-sheet and land–sea masks are outlined in red and brown, respectively.

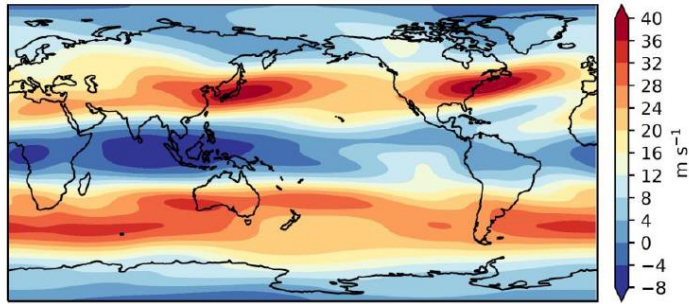
A first glimpse into the PMIP4-CMIP6 results, compared to PMIP3-CMIP5 : mean annual temperatures



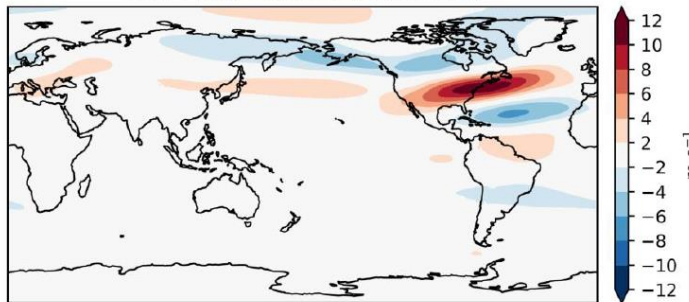
LGM PMIP4 mean annual temperatures mostly warmer than the PMIP3 ones, especially at mid to high northern latitudes
=> impact of new ice sheet reconstructions
(northern hemisphere ice sheets lower than the PMIP3 ones) ?

Atmosphere & ocean circulations

PMIP4 LGM 250 hPa zonal wind

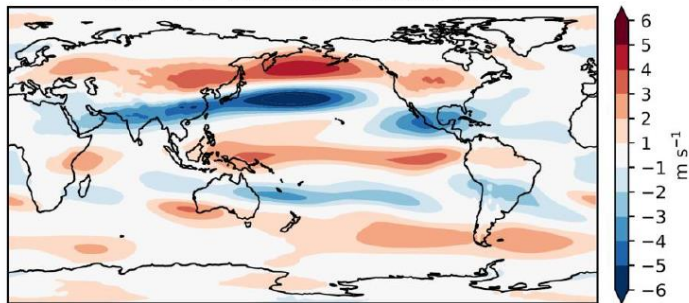


PMIP4 LGM-PI 250 hPa zonal wind



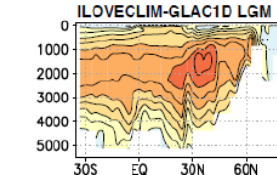
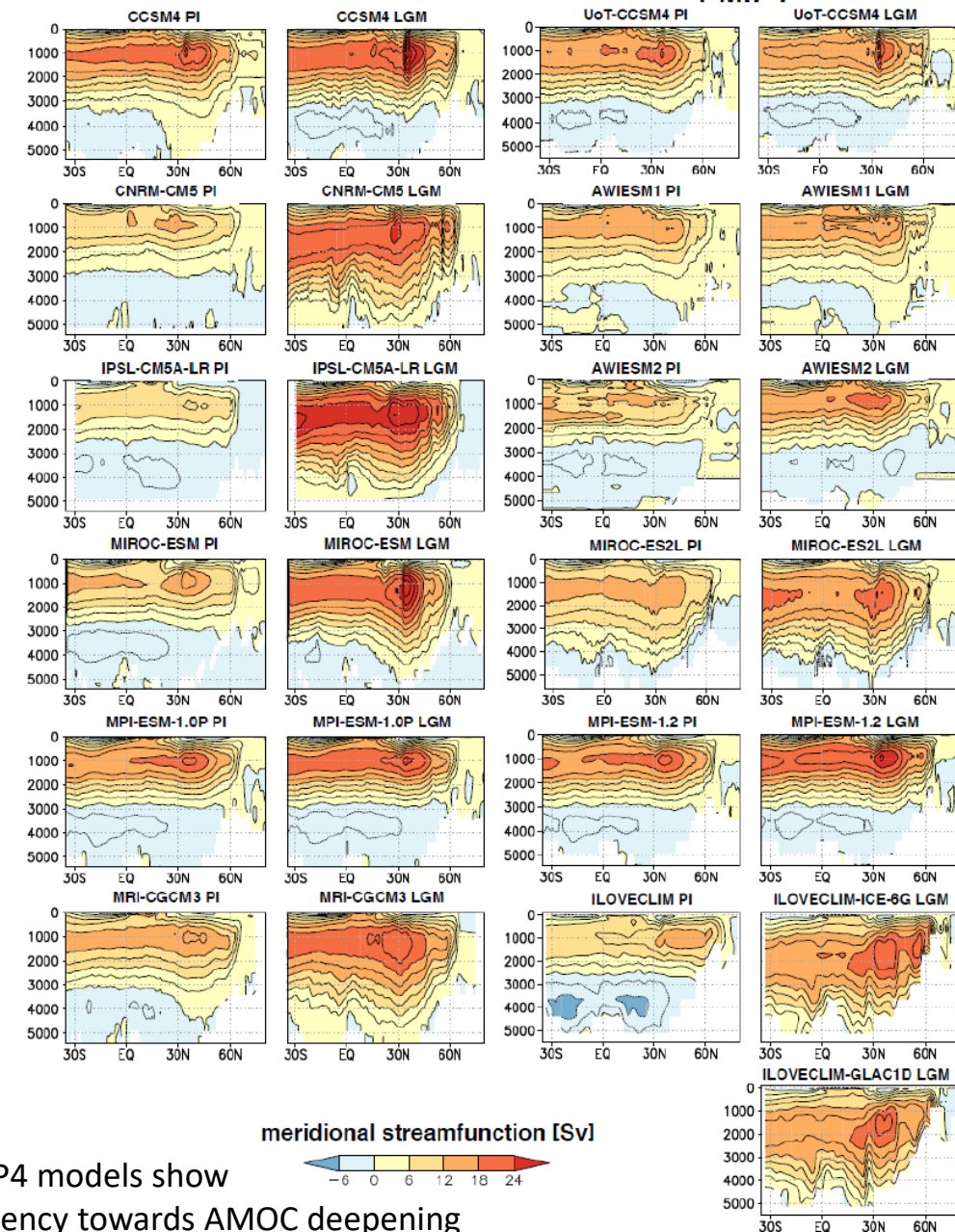
Atlantic westerlies are stronger and less wide in the meridional direction

PMIP4-PMIP3 LGM 250 hPa zonal wind



PMIP4 vs PMIP3 models show a shift of the westerlies over the Pacific and N America

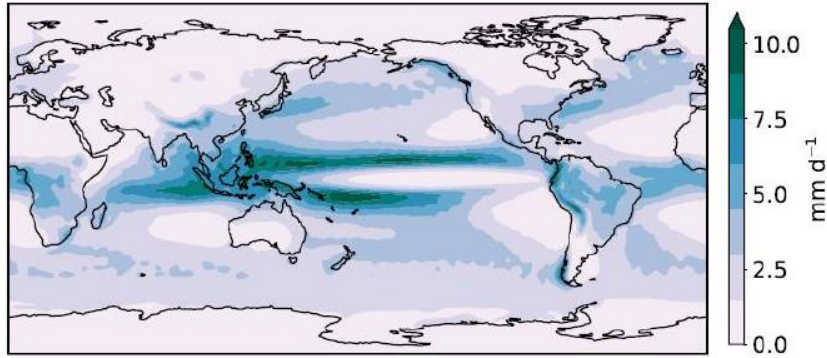
PMIP3



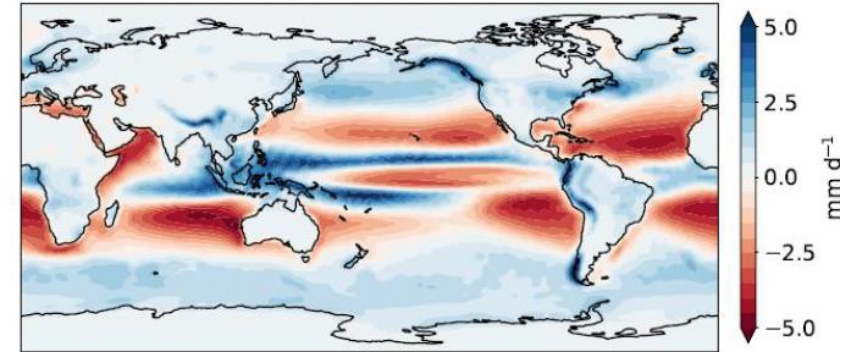
The PMIP4 models show less tendency towards AMOC deepening from LGM to PI than PMIP3 models, but the AMOC does tend to get stronger compared to PI

Precipitation

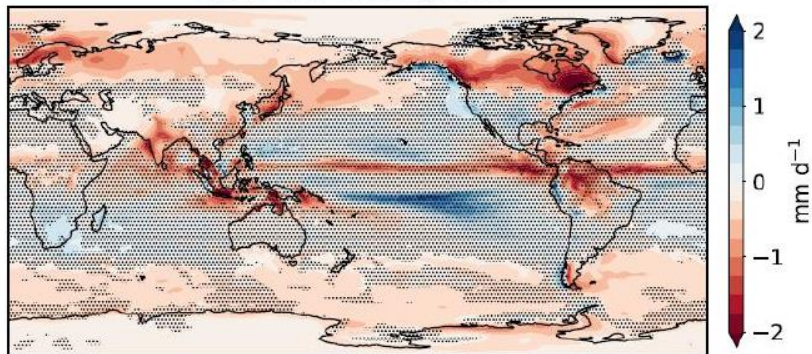
PMIP4 LGM Precipitation



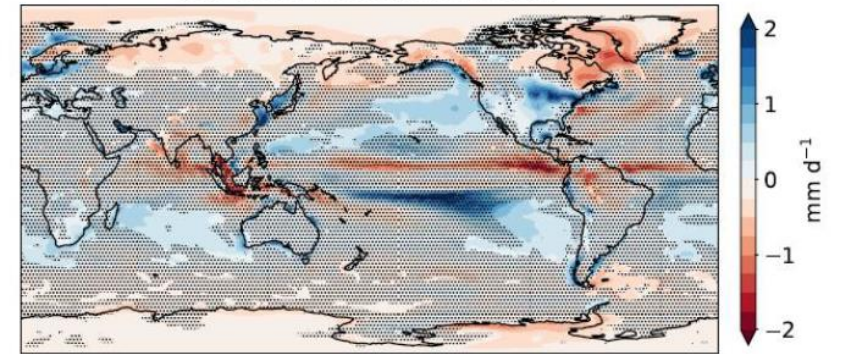
PMIP4 LGM Precipitation minus evaporation



PMIP4 LGM-PI Precipitation

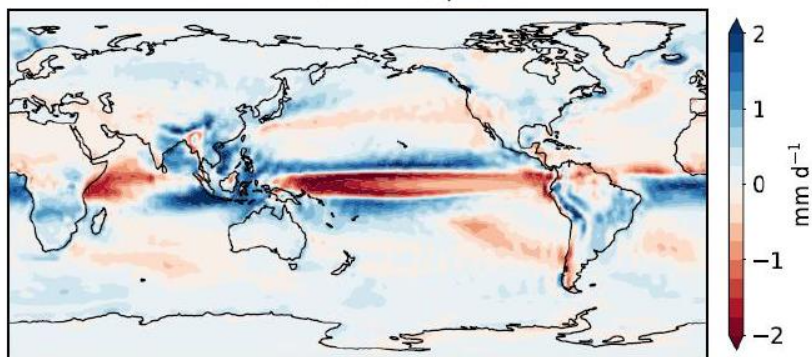


PMIP4 LGM-PI Precip. minus evap.

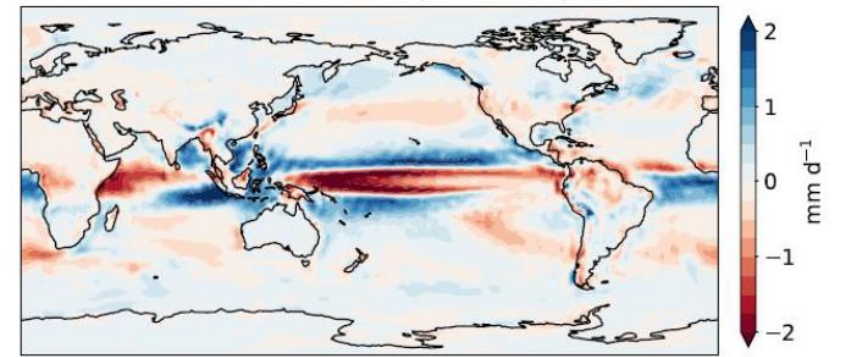


LGM climate is drier but
this signal is partly offset
by less evaporation

PMIP4-PMIP3 LGM Precipitation



PMIP4-PMIP3 LGM Precip. minus evap.



Large changes in tropical
precip from PMIP3 to
PMIP4 models

Comparison to reconstructions

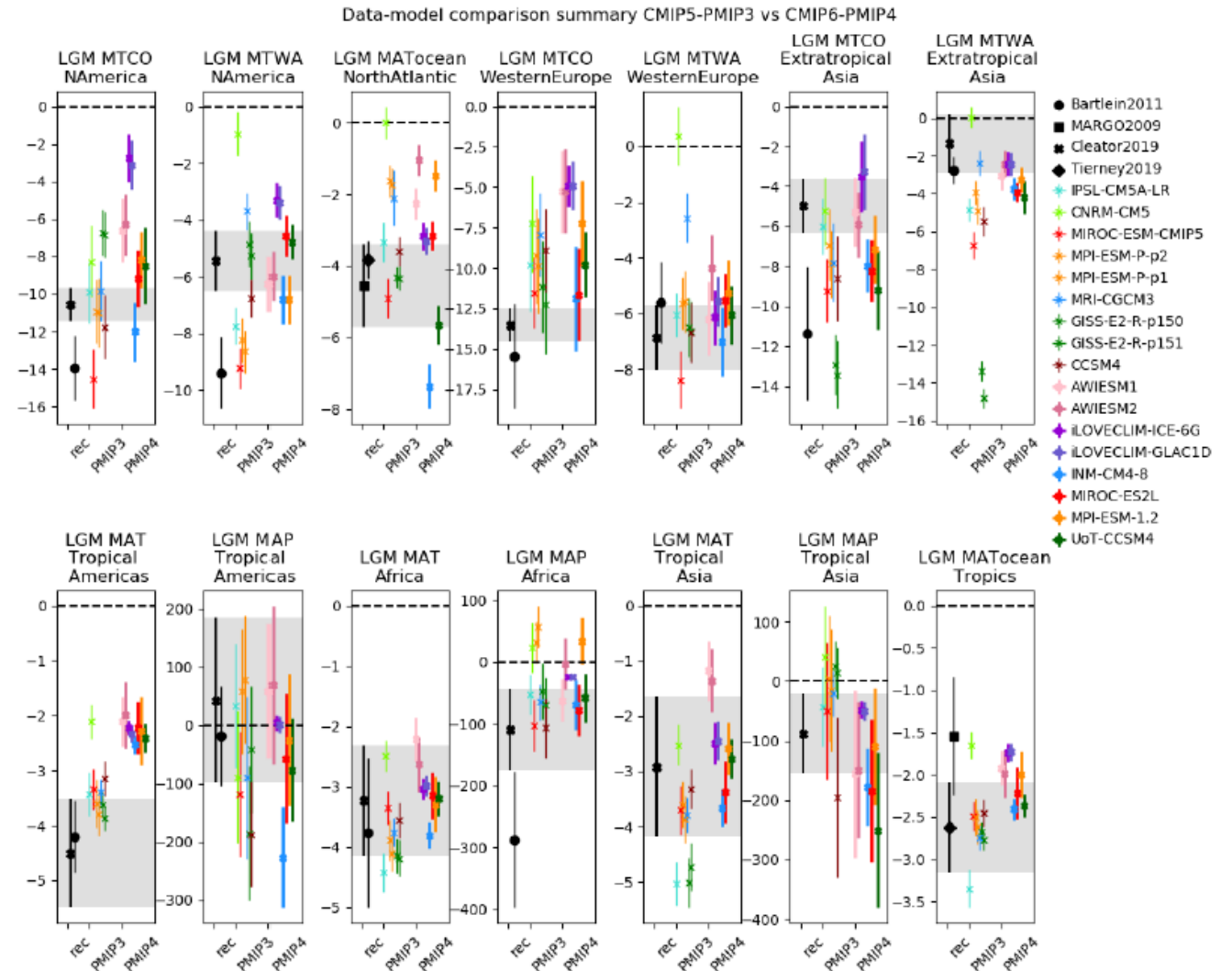
- Comparison to previous data sets:

- Bartlein et al., 2011 for continental reconstructions
- MARGO, 2009, for sea surface temperatures

- + comparison to new data sets:

- Cleator et al., 2019 for continental reconstructions
- Tierney et al., 2019 for sea surface temperatures

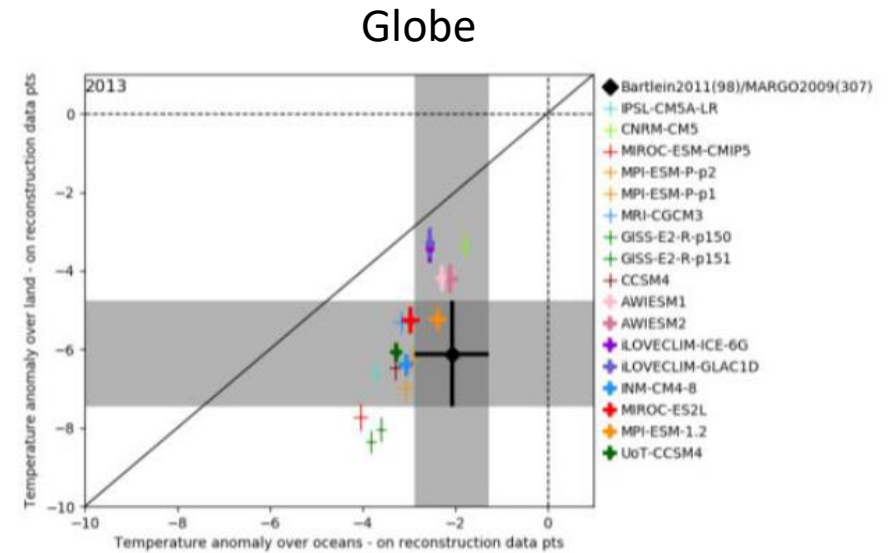
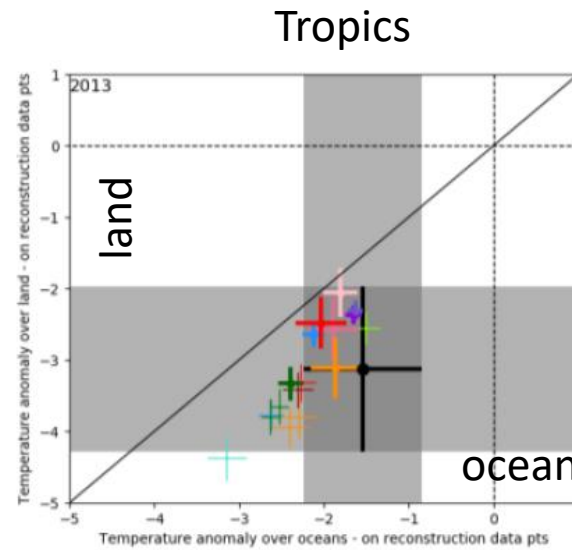
➔ Regional comparison still often unsatisfactory



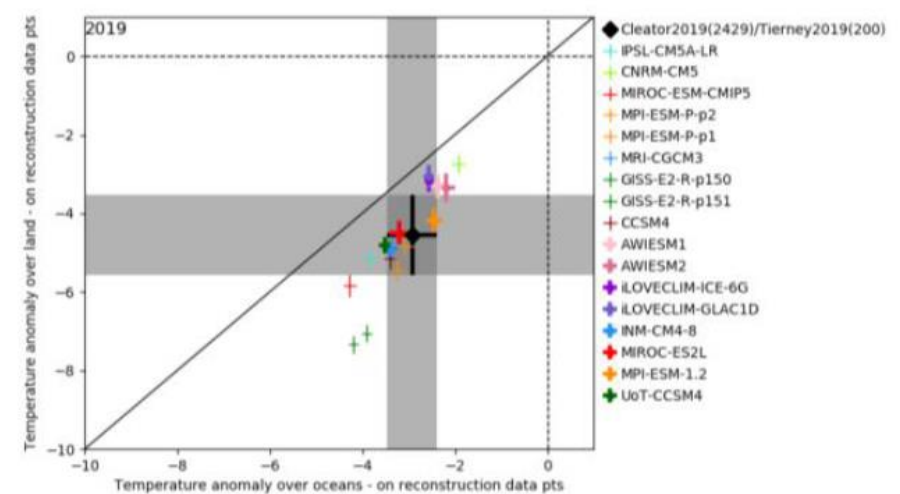
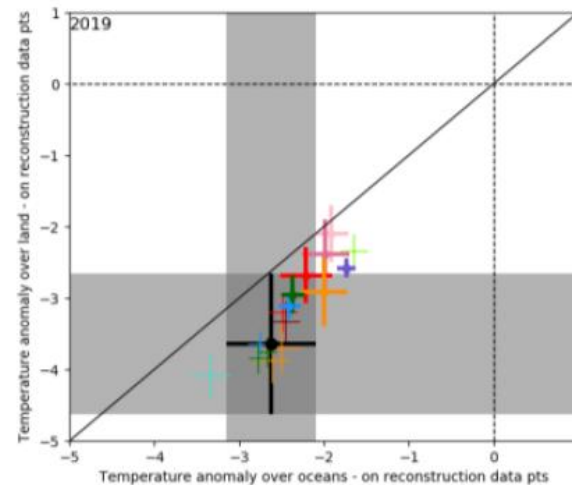
Comparison of large-scale indicators: land vs ocean temperature anomalies

Averages over data
sites only

« old » reconstructions



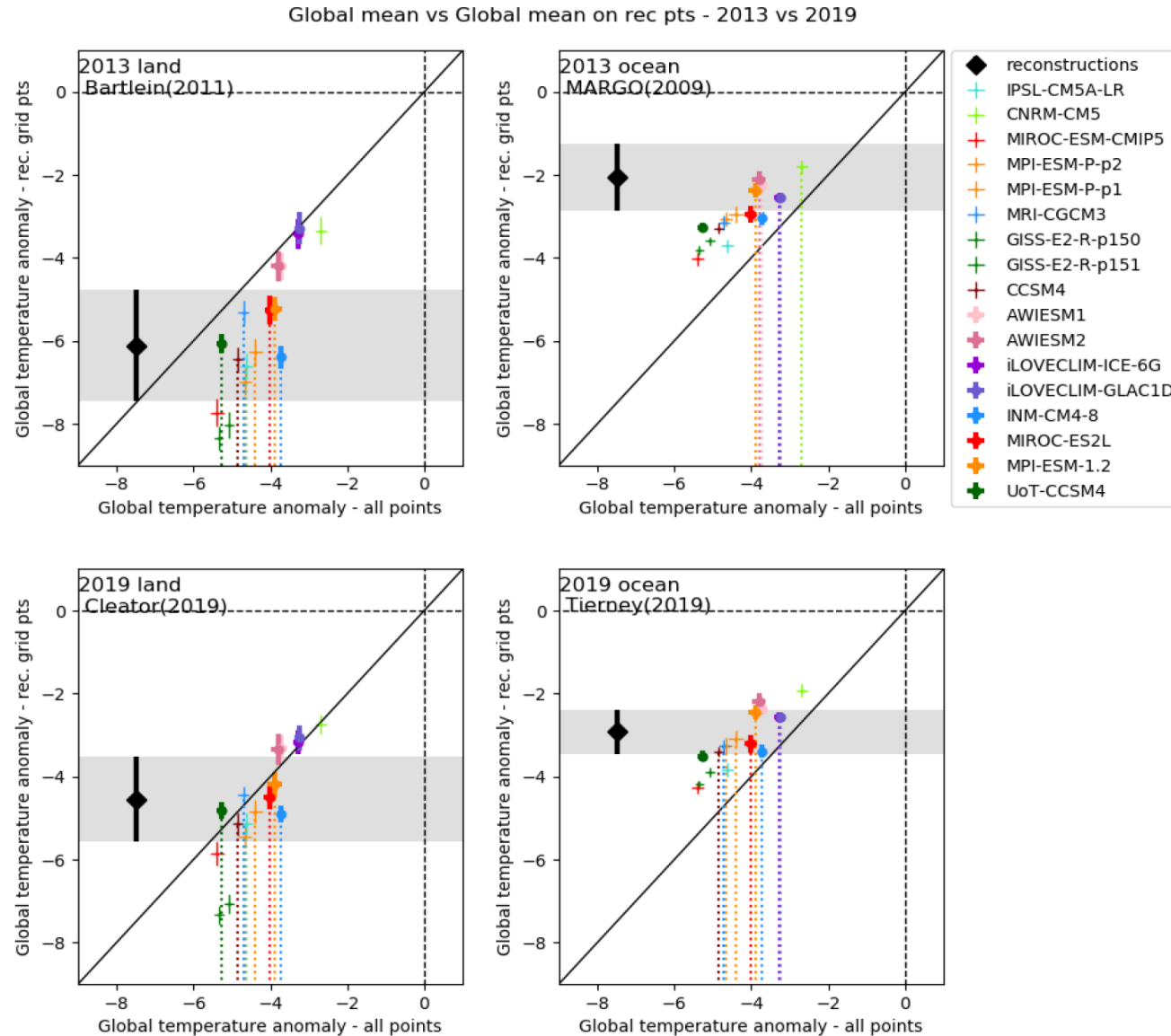
« new » reconstructions



The new reconstructions cover more points,
their average is colder and models
underestimate this cooling in the tropics

The comparisons improve at the global scale

Getting the global cooling using the models + reconstructions ?



These plots show a relationship between the global cooling and the global cooling averaged over the documented sites, for each reconstruction (continental and marine).

These, given by the grey bar, can therefore yield a constrain on global cooling from PI to LGM. The results from both continental data sets are in agreement, while the SST reconstructions yield different global estimates. More work is needed to unravel why.

Thank you for your interest!