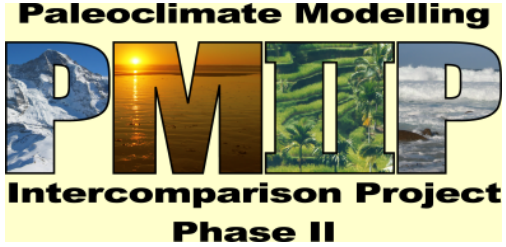
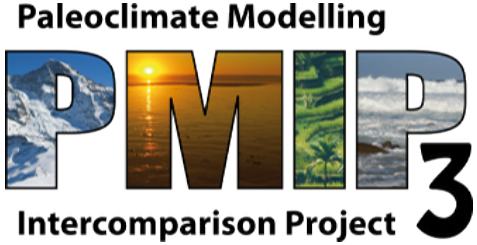
Drivers of LGM AMOC change from PMIP2 to PMIP4
-Role of density contrast of NADW & AABW-

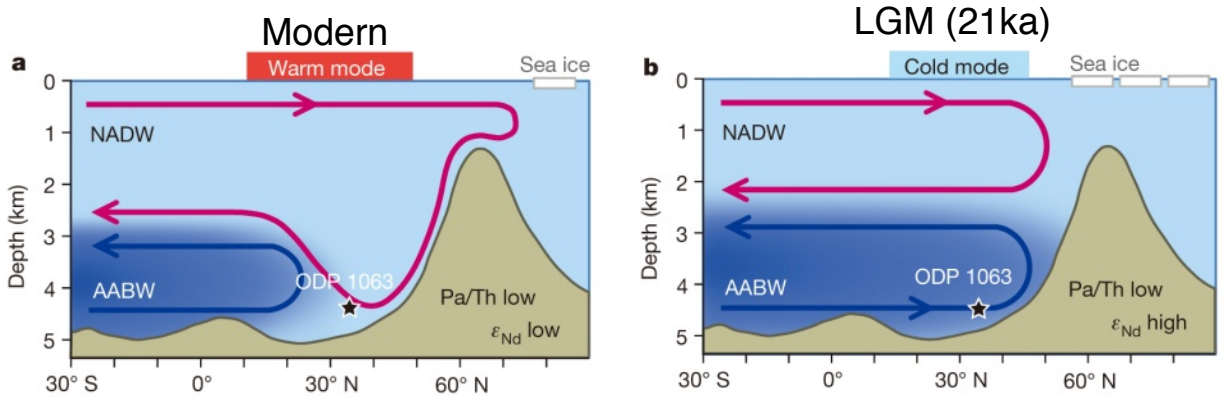
Marlene Klockmann[1] and Sam Sherriff-Tadano[2]

[1]Helmholtz-Zentrum Hereon, Institute of Coastal Systems - Analysis and Modelling, Geesthacht, Germany
[2]School of Earth and Environment, University of Leeds, Leeds, UK



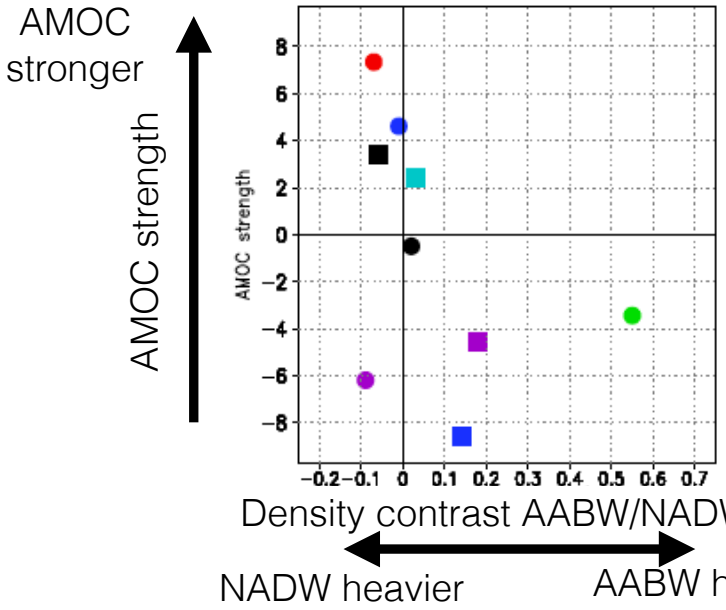


Schematic of AMOC



Bohm+ 2015

Relation of changes in AMOC and AABW/NADW density contrast in PMIP1.5, 2 models (LGM — PI)



Weber+ 2007

Background

- Proxies suggest a somewhat shallower AMOC at LGM with large uncertainties in its strength (e.g. Lynch-Steiglitz 2017)

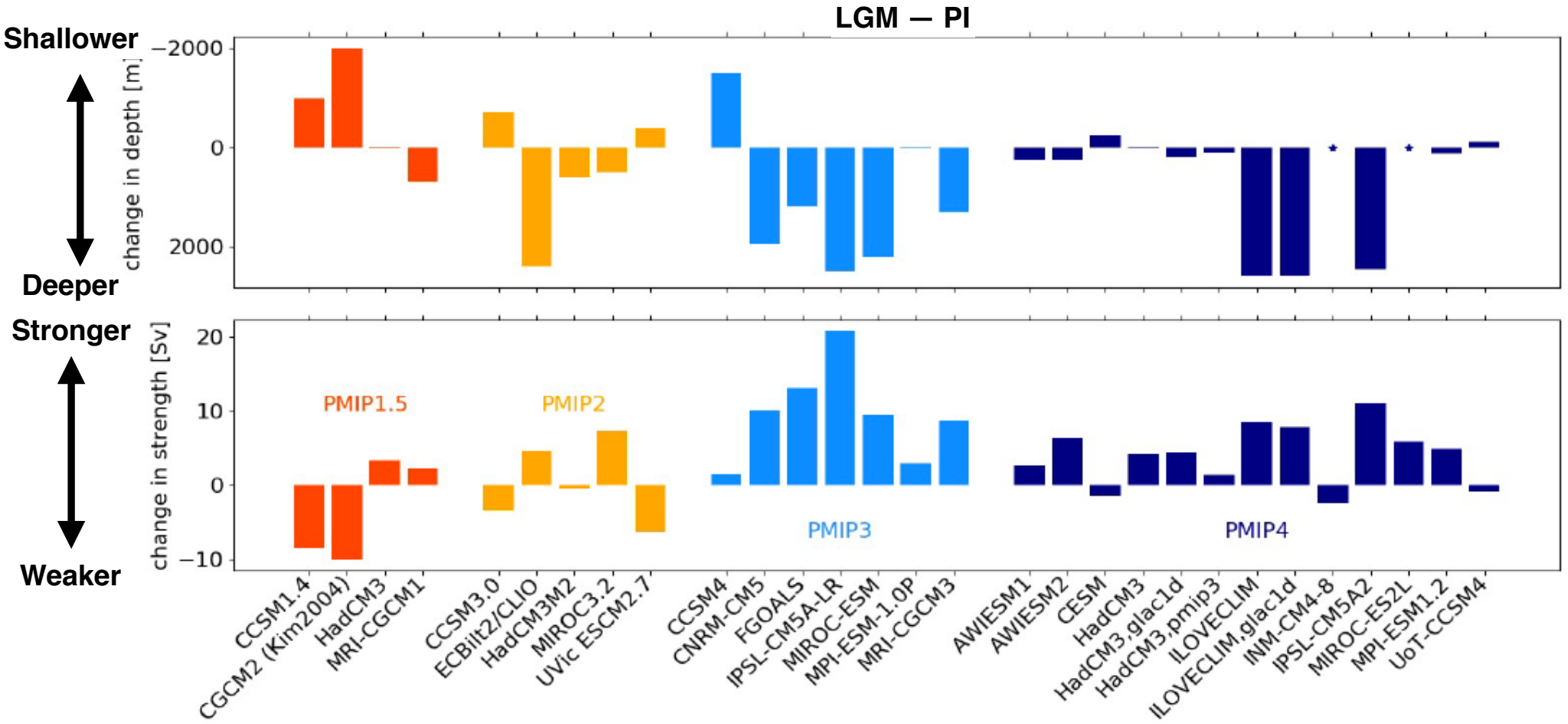
Aim of study

- Revisit LGM AMOC in PMIP2,3,4 models
- Explore possible driver causing variety in simulated LGM AMOC focusing on density contrast between NADW & AABW (e.g. Weber et al. 2007)

Data

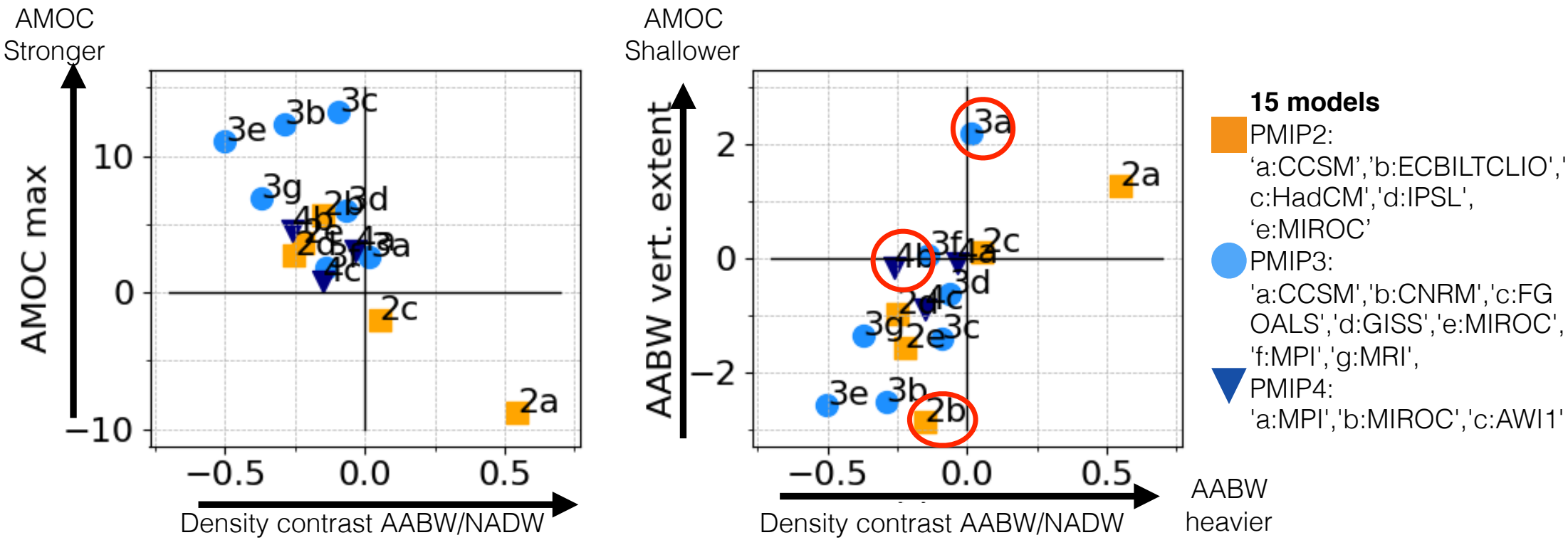
- Available data from PMIP2, 4 server & ESGF repository

Result: 7 out of 29 simulations show shallower LGM AMOC & Large diversities among models



Sherriff-Tadano & Klockmann (2021, Pages magazine)

Can density contrast of NADW & AABW explain variety in PMIP LGM AMOC?



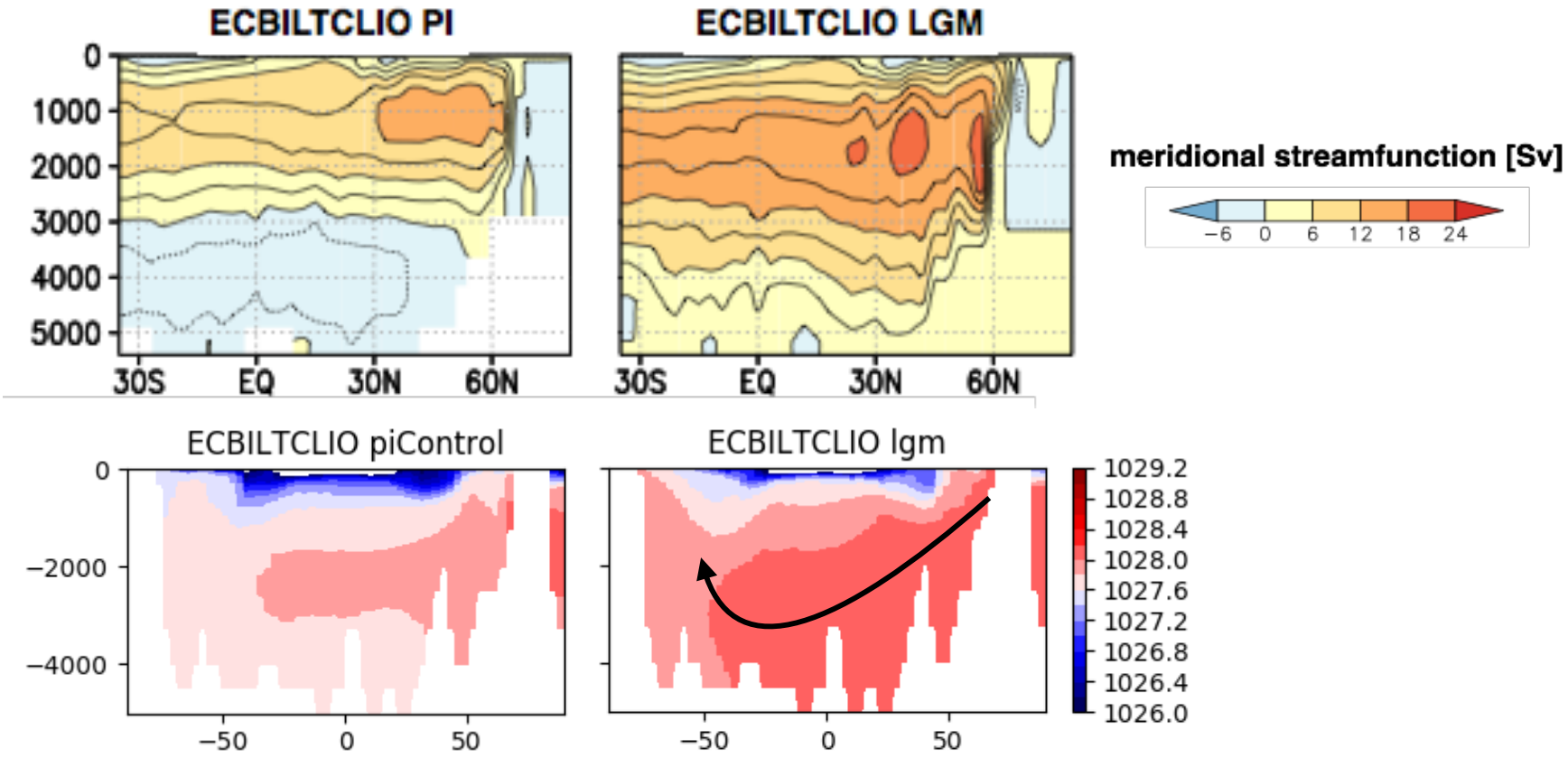
Yes, but

-Small numbers of models show an increase in density contrast

-ECBILTCLIO(2b), CCSM4(3a) & MIROC-ES2L(4b) don't seem to follow density contrast

Possible cause of outliers?

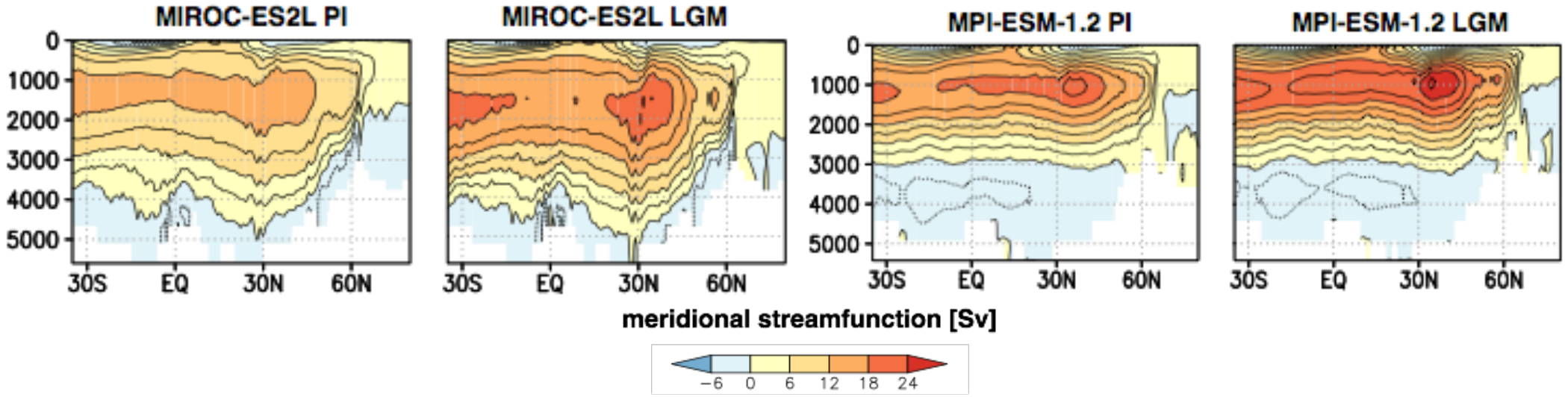
AMOC



Density at 30W

- Deep & bottom ocean at Southern Ocean affected by AMOC
- Using surface + further south latitude density for AABW improves the relation of density contrast and AMOC change (not shown)

Models close to origin: example of PMIP4 models



No room to get deeper at LGM due to deep modern AMOC

AMOC is already shallow at PI might be difficult for further shoaling?

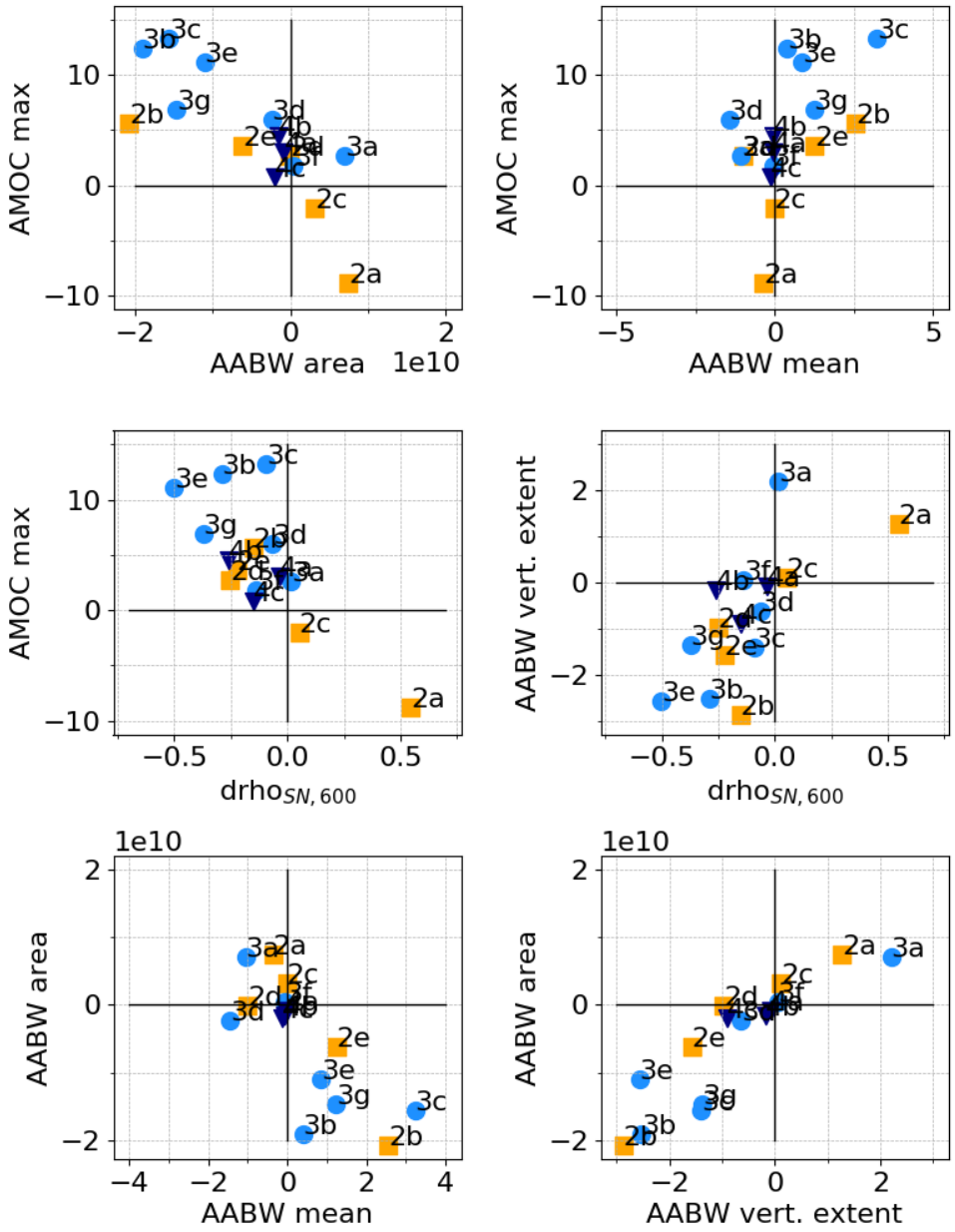
- Change in LGM AMOC and the effectiveness of NADW/AABW contrast may depend on the structure of AMOC in PI

Summary

- **7 out of 29 simulations show shallower LGM AMOC**
- **Density contrast of NADW & AABW have some control on LGM AMOC changes**
- **Structure of AMOC in PI can also have an impact on effectiveness of NADW/AABW contrast on LGM AMOC**
- **The original Weber findings can be extended to the PMIP2-PMIP4 ensemble**

Please join as co-author! (contact: S.Sherriff-Tadano@leeds.ac.uk)

Supplementary



Relations of metrics associated to AMOC, AABW & density contrast

15 models

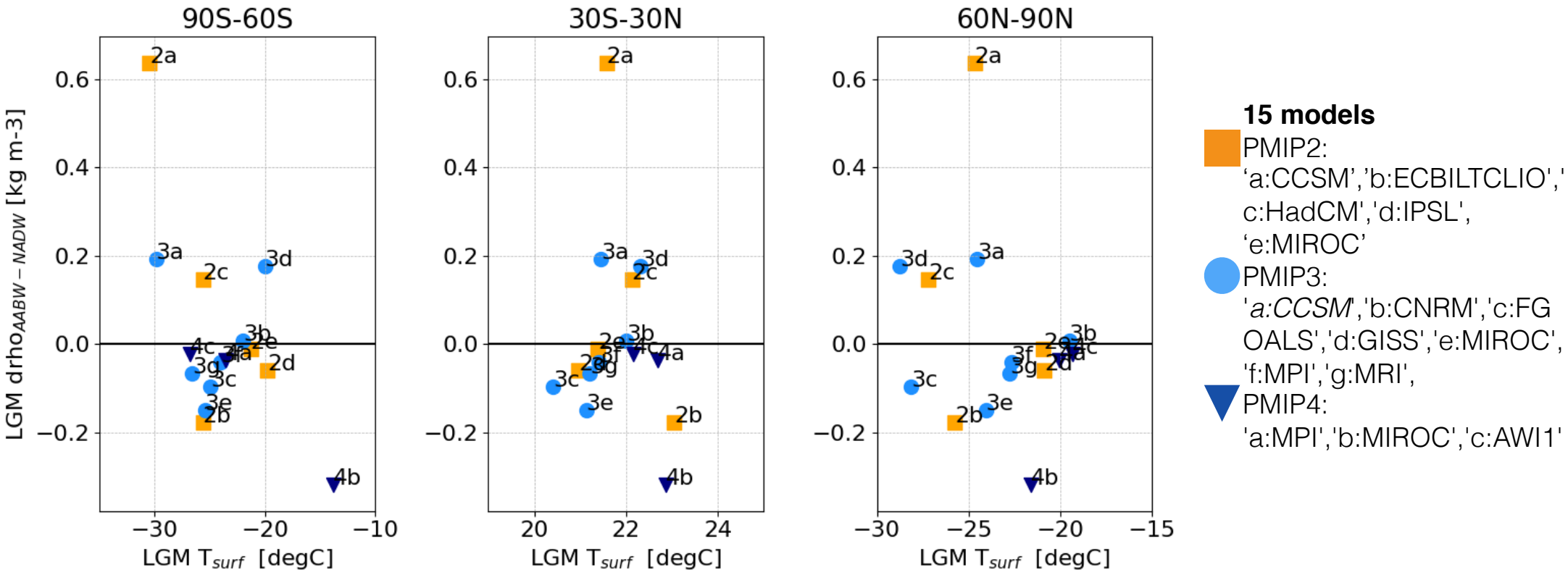
PMIP2:
'a:CCSM','b:ECBILTCLIO','c:HadCM','d:IPSL', 'e:MIROC'

PMIP3:
'a:CCSM','b:CNRM','c:FGOALS','d:GISS','e:MIROC', 'f:MPI','g:MRI',

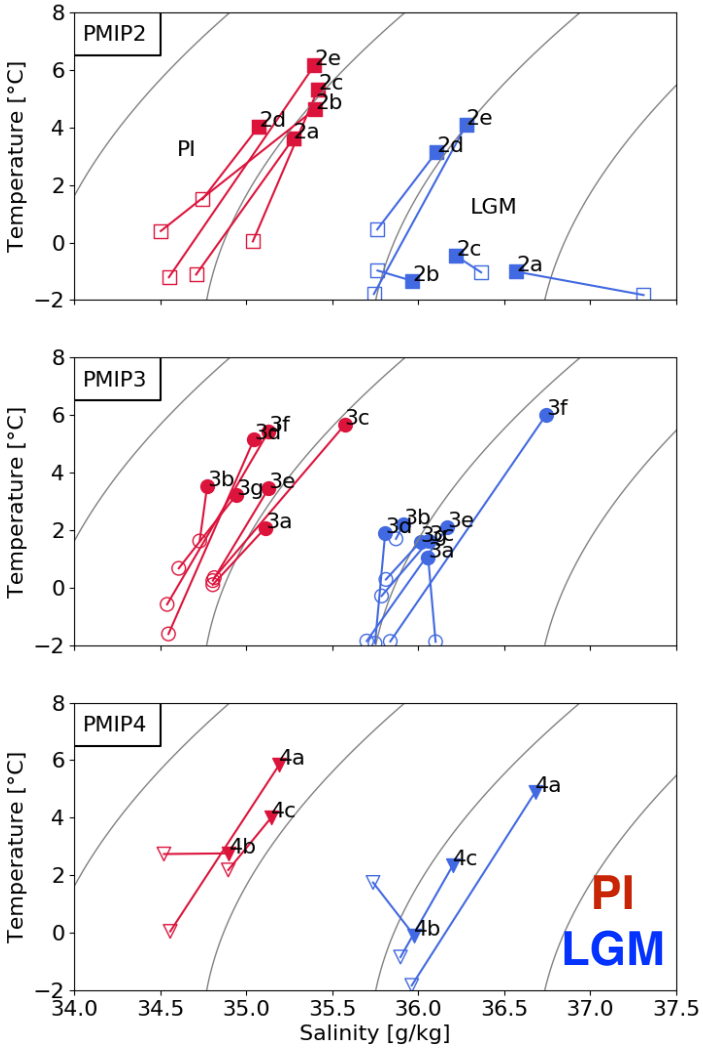
PMIP4:
'a:MPI','b:MIROC','c:AWI1'

AMOC max = mean of stream function between 25N and 50N, 1000-2000m
AABW mean = mean of negative stream function values between 30S and 50N, 2000m-bottom
AABW area = sum of "area" (depth*latitude) covered by the AABW cell (i.e. negative stream function) between 30S and 50N, 2000m-bottom
AABW vert. extent = average depth of cell division between 25N and 50N
drhoSN, 600 = density differences between 60S (upper 600m) vs 55NA (upper 600m)

Relation of local LGM temperature & AABW/NADW density contrast



The approximate linear relationship between SO LGM temperatures and LGM AABW/NADW density contrast likely reflects the importance of SO sea ice for AABW formation (Klockmann+ 2016, Galbraith+ 2018)



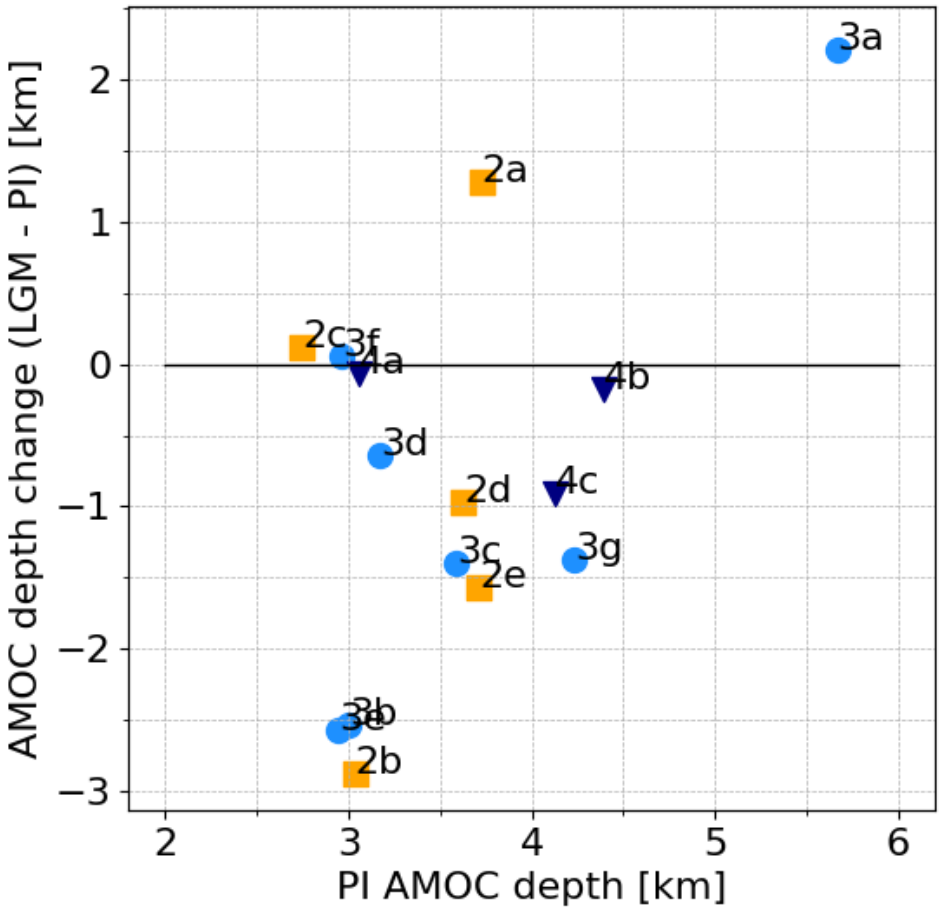
Comparison of water mass properties between PI & LGM

15 models

PMIP2:
'a:CCSM','b:ECBILTCLIO','
c:HadCM','d:IPSL',
'e:MIROC'
PMIP3:
'*a:CCSM*','b:CNRM','c:FG
OALS','d:GISS','e:MIROC',
'f:MPI','g:MRI',
PMIP4:
'a:MPI','b:MIROC','c:AWI1'

1 psu of salinity is added to those models that did not account for the global LGM salinity increase due to sea level drop for better visualisation (2b,c,d,e; 3c, 3e)

Relation of AMOC depth at PI and changes in AMOC depth at LGM



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PMIP4:
'a:MPI','b:MIROC','c:AWI1'