Universität Bremen

AWI
Alfred-Wegener-Institut
für Polar- und Meeresforschung
in der Helmholtz-Gemeinschaft

POLMAR
Helmholtz Graduate School
for Polar and Marine Research

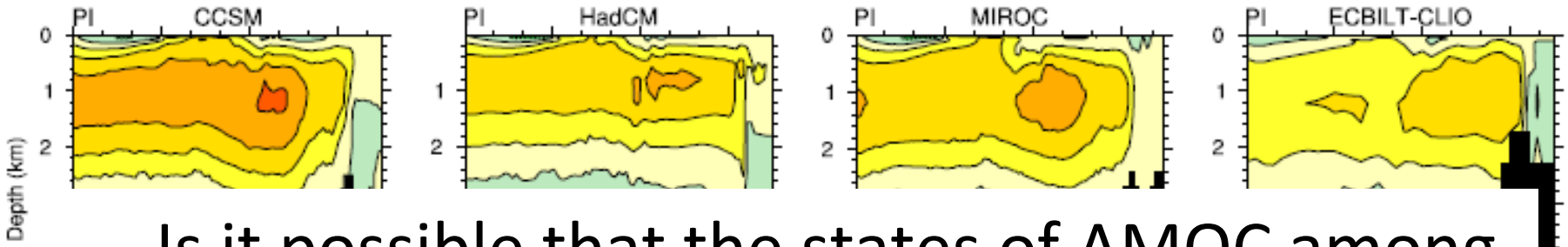
Two Ocean states during the Last Glacial Maximum

Xu Zhang*, Gerrit Lohmann, Gregor Knorr, Xu Xu
Alfred Wegener Institute for Polar and Marine Research

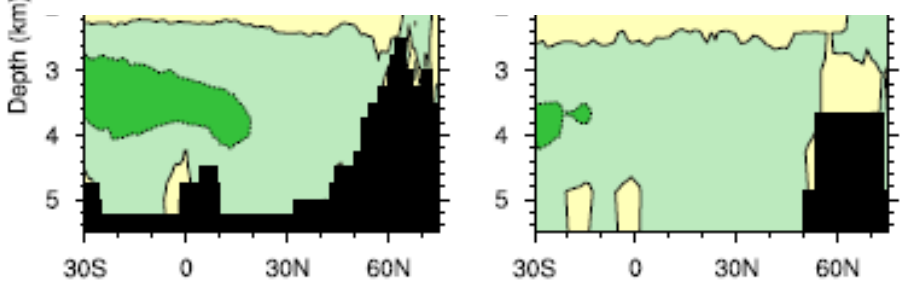
20th Mar. 2012

Zhang, X., G. Lohmann, G. Knorr, X. Xu., Two Ocean states during the Last Glacial Maximum. Submitted

Motivation

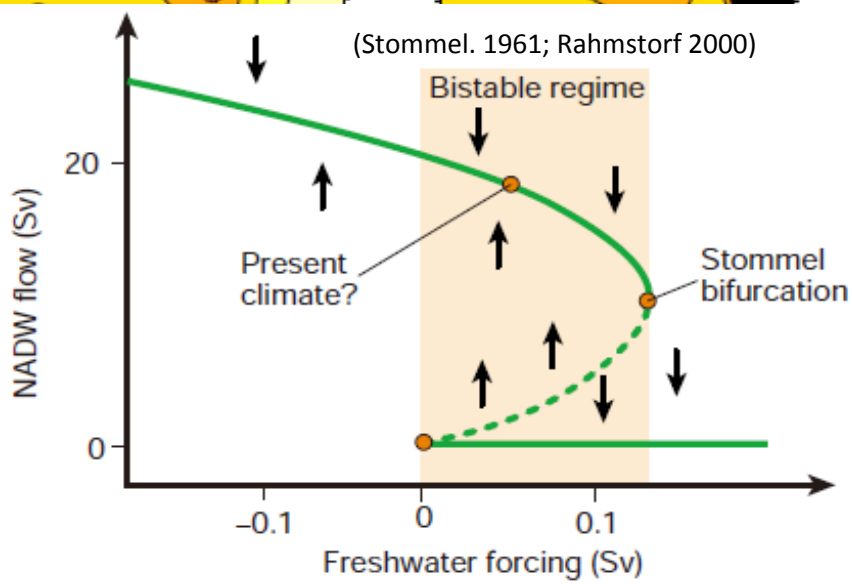


Is it possible that the states of AMOC among PMIP2 models are just in the different positions of a bistable regime?

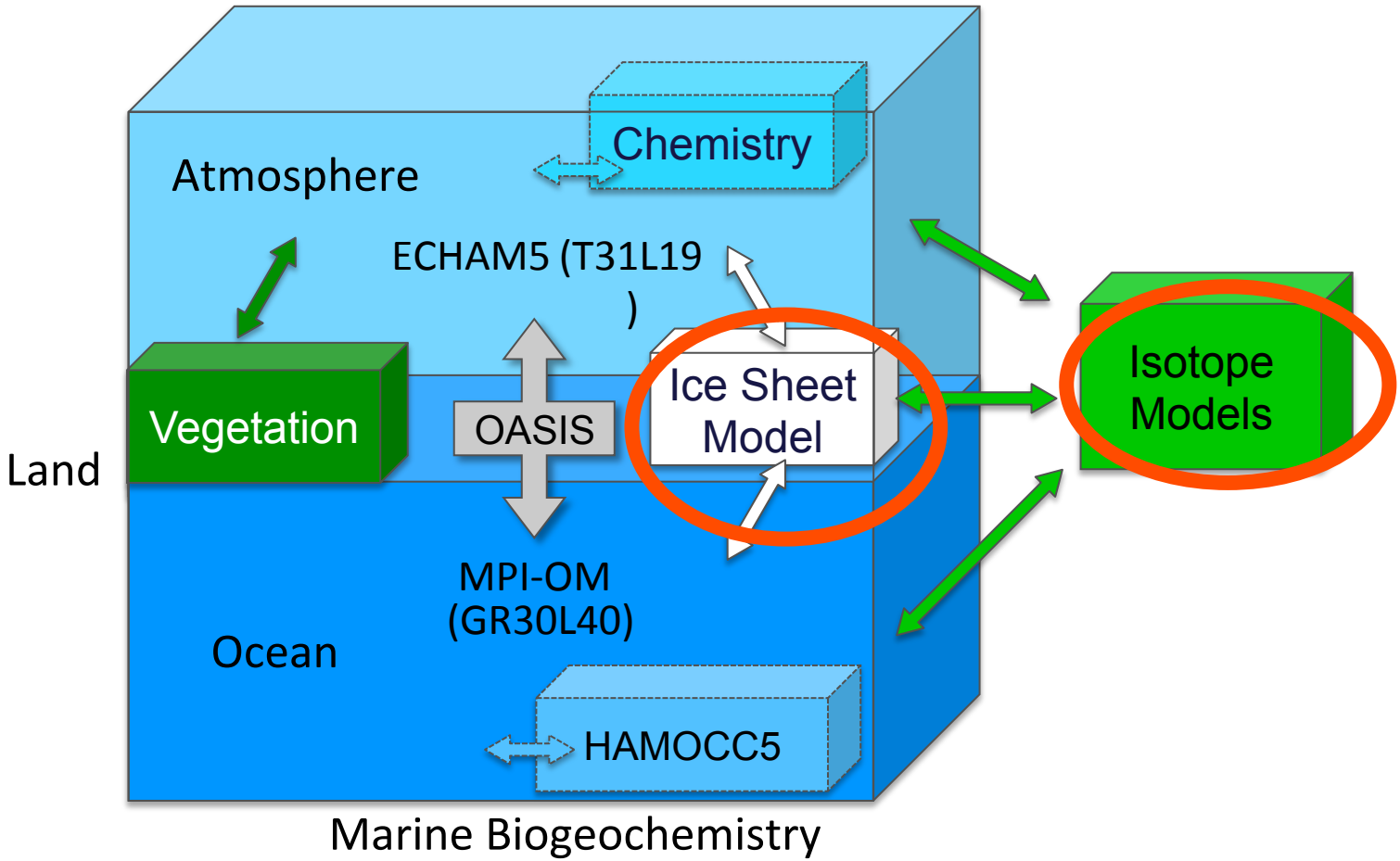


(Otto-Bliesner et al. 2007)

Large difference among PM



Model (COSMOS) configuration



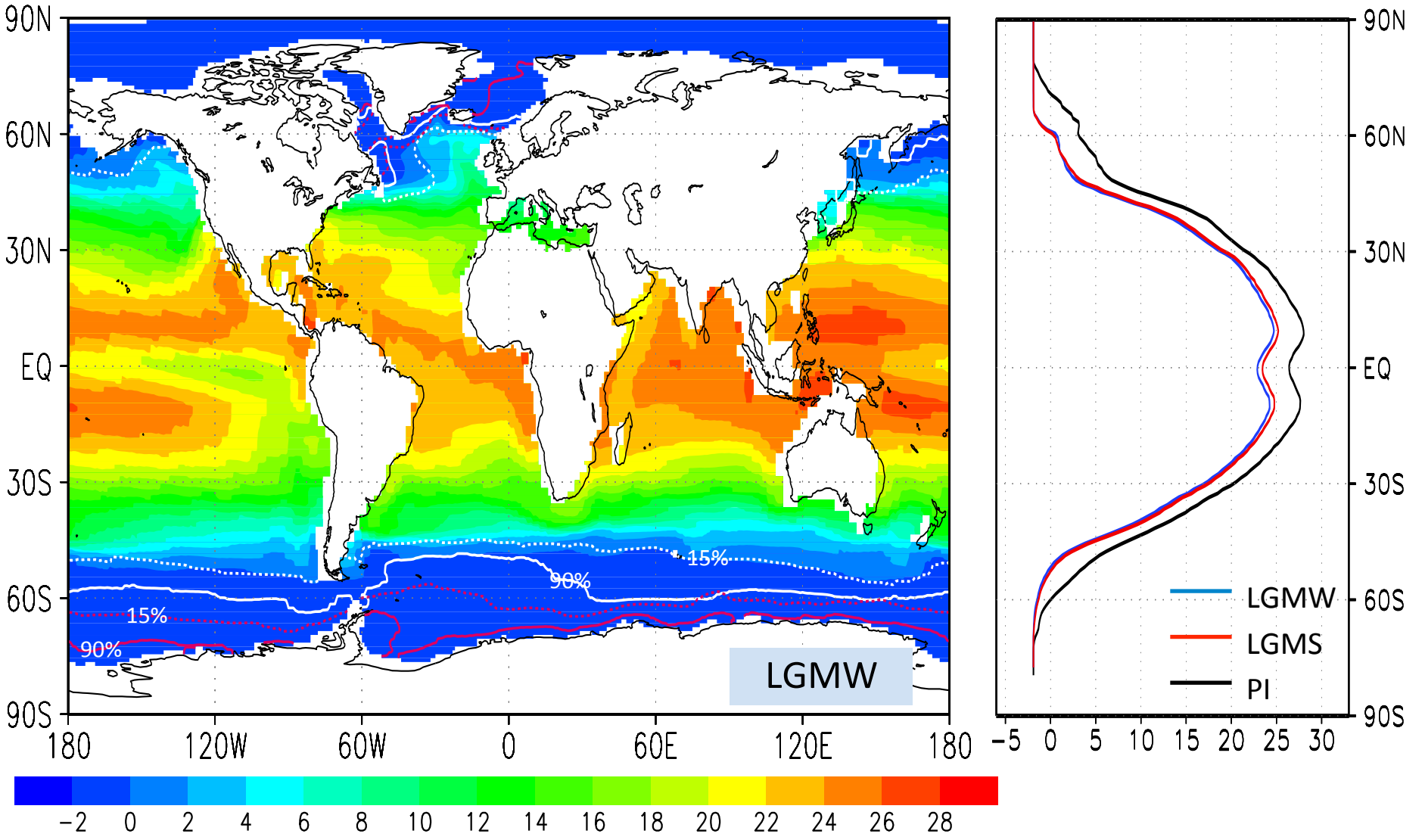
- PI
- 6k
- 21k
- MIS3 (32k)
- Eemian
- Pliocene
- Miocene

Initial Ocean state	Glacial Ocean	Present day Ocean
	LGMW	LGMS
	Ocean only (3000 y)+coupled (3000y)	Coupled (3000 y)

The other model setup ➔ 21k experimental design in PMIP3

Surface Properties of the LGM runs

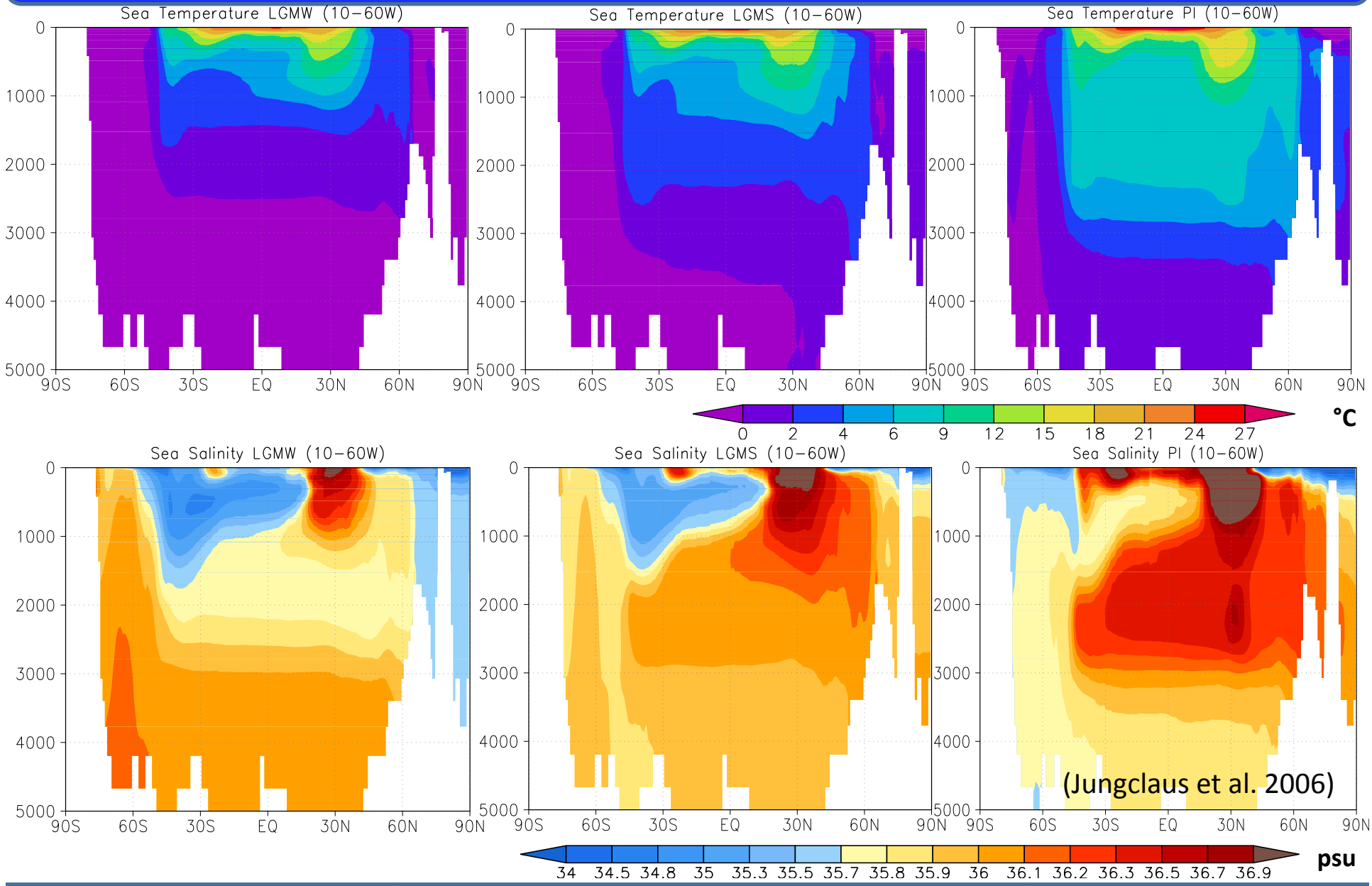
LGMW: from glacial ocean
LGMS: from present day ocean



The white lines represent winter for each hemisphere, while the red for summer.
The dashed lines indicate 15% SIC, and solid lines 90% SIC.

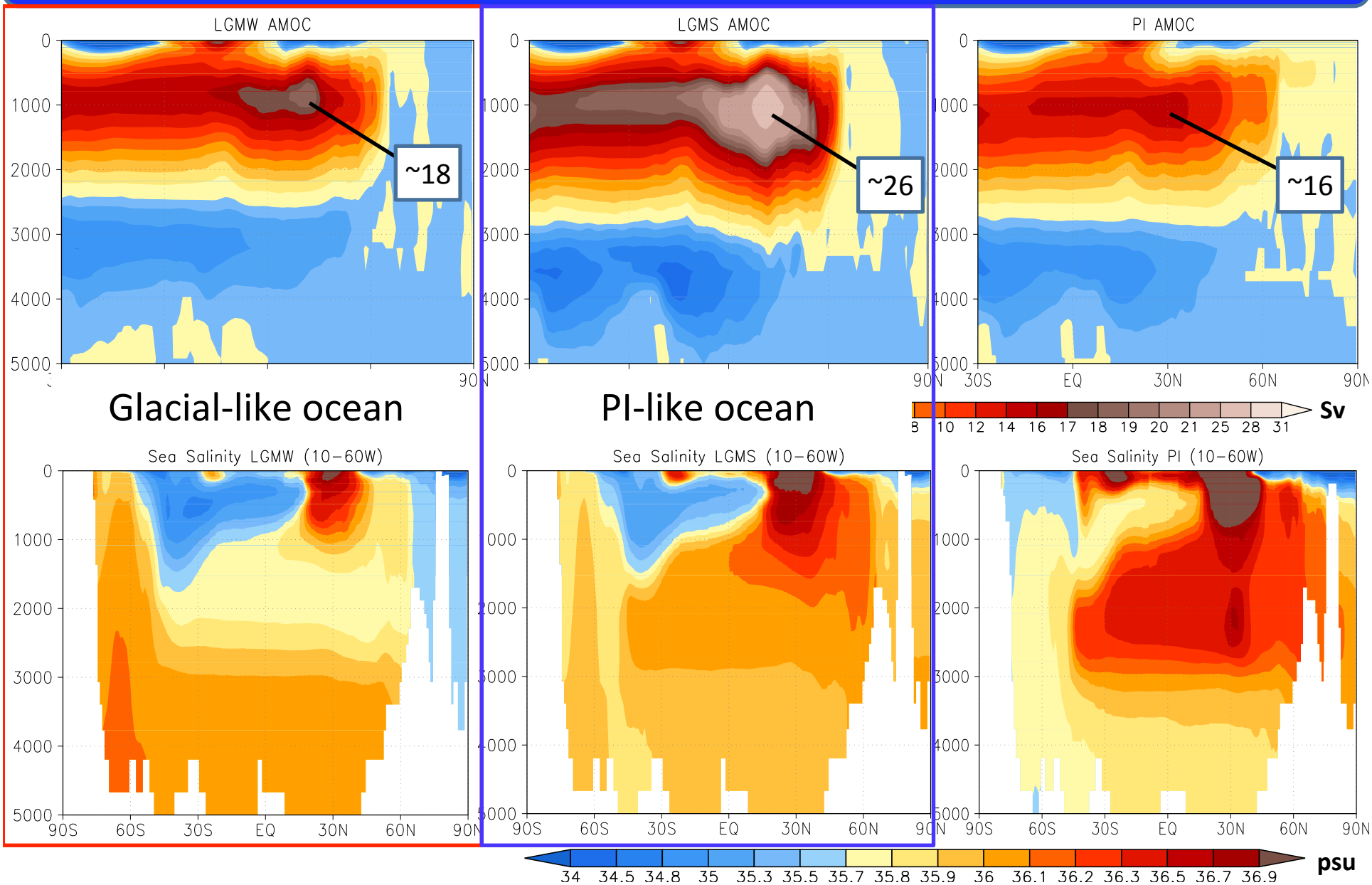
Internal properties of the LGM runs

LGMW: from glacial ocean
LGMS: from present day ocean

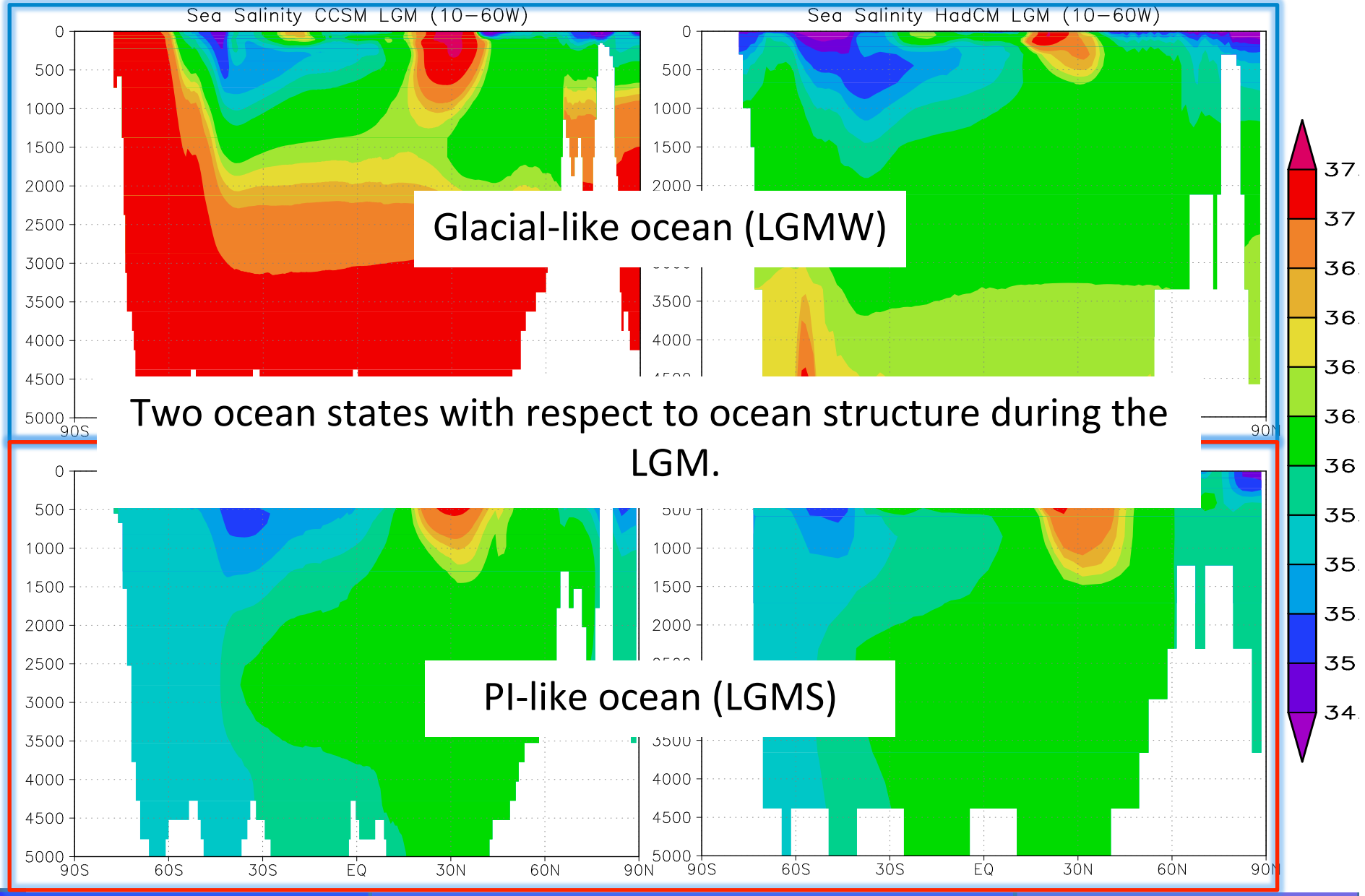


Internal properties of the LGM runs

LGMW: from glacial ocean
LGMS: from present day ocean

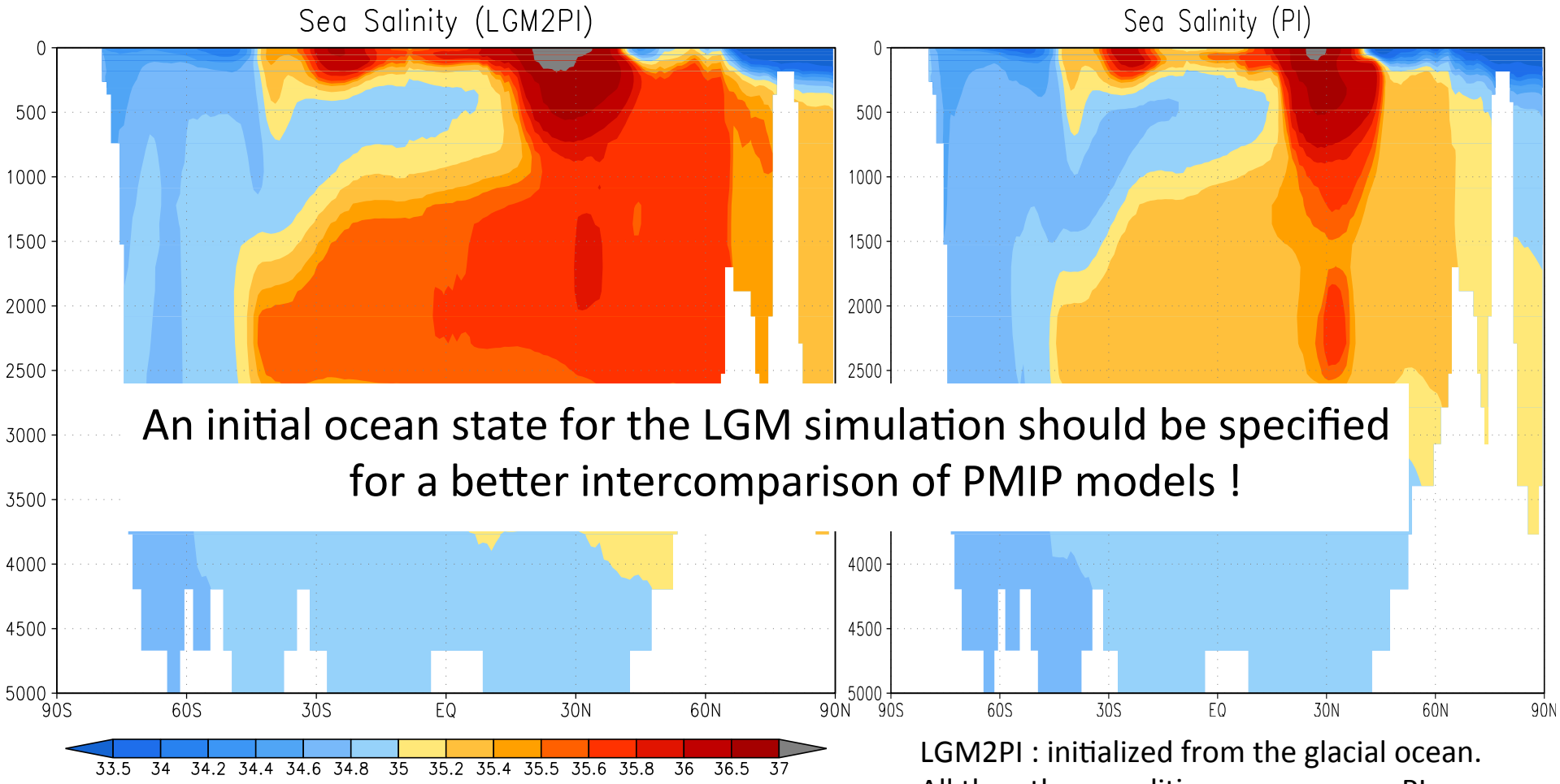


Meridional transect of Salinity in PMIP2 models



Response of Present day ocean

LGM2PI: from glacial ocean
PI: from present day ocean



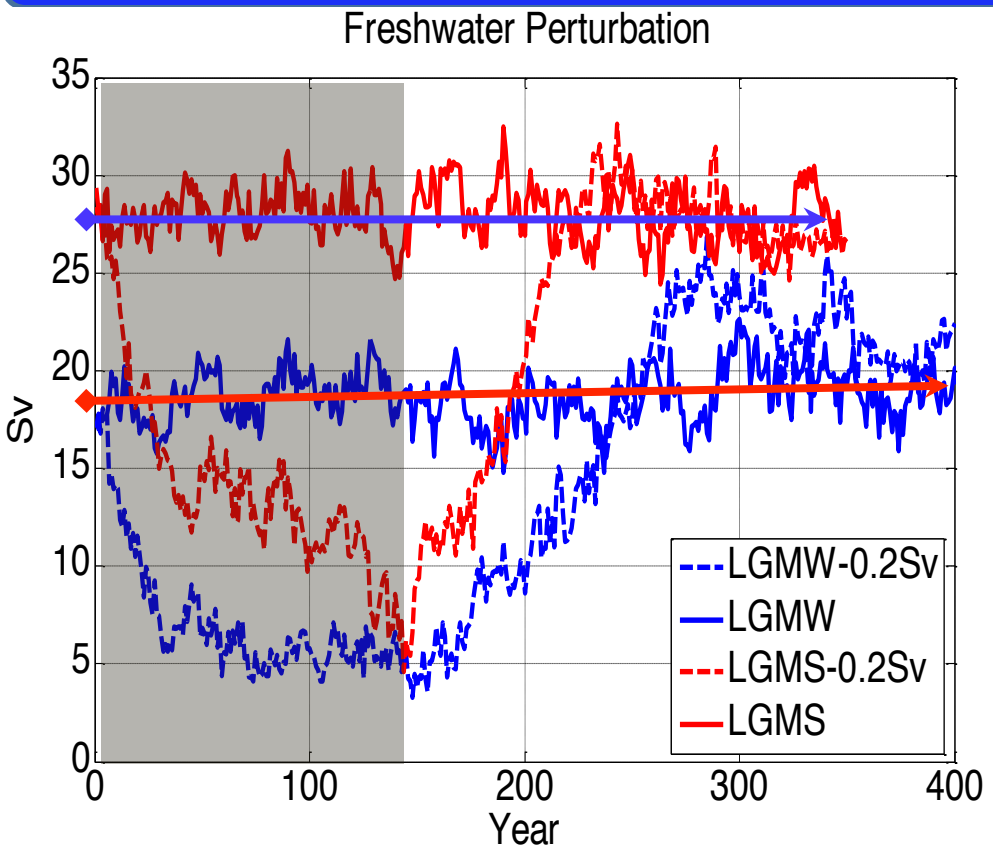
An initial ocean state for the LGM simulation should be specified for a better intercomparison of PMIP models !

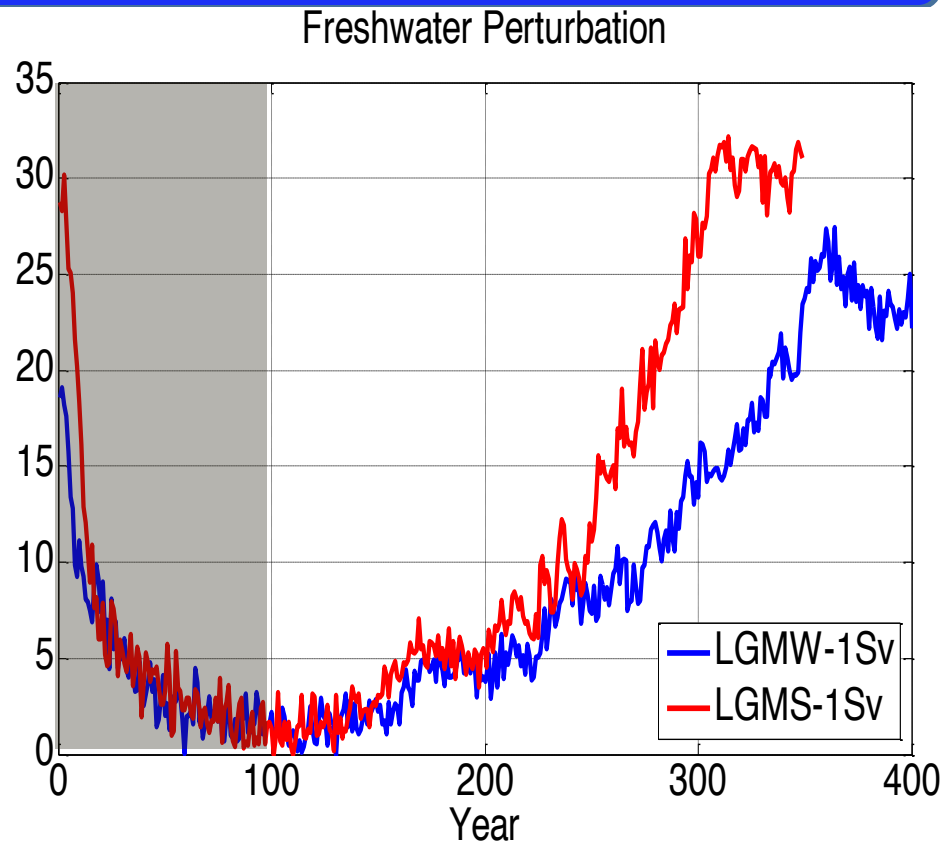
LGM2PI : initialized from the glacial ocean.
All the other conditions are same as PI.

1. PI Ocean state independent on initial ocean stratification.
2. Two ocean states with respect to ocean structure are unique during the LGM

Freshwater Perturbation

LGMW: from glacial ocean
LGMS: from present day ocean



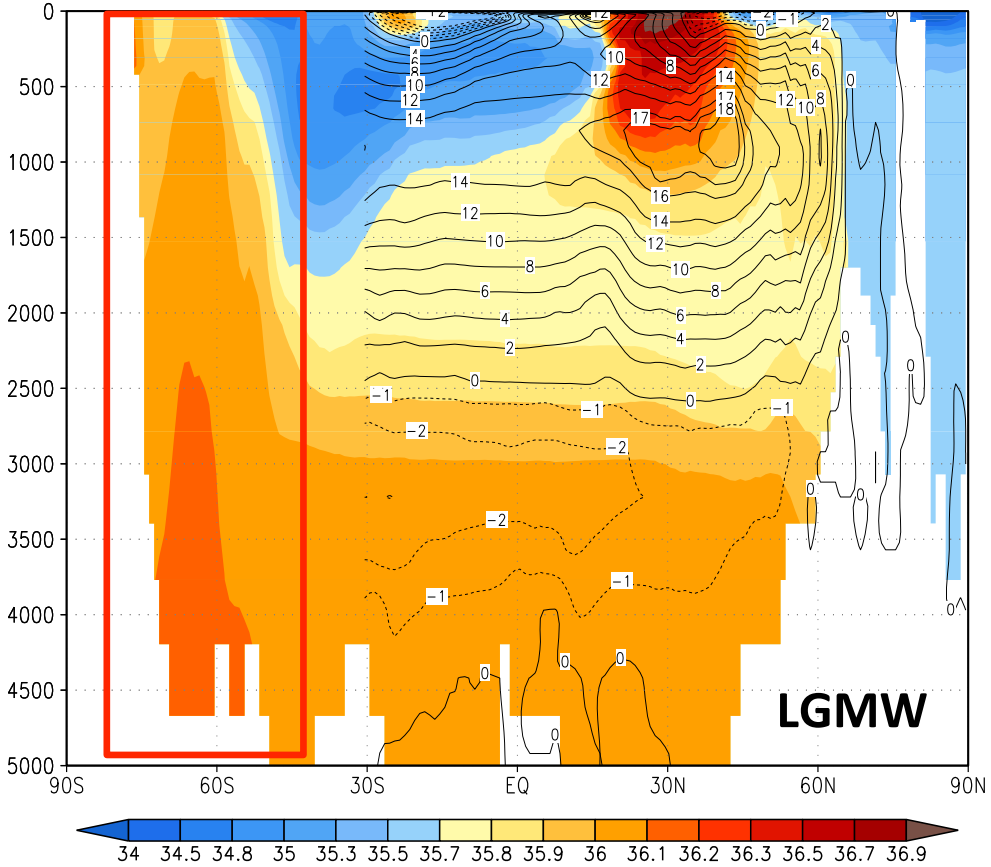


1. Bistability of LGM ocean is not related to FWP.

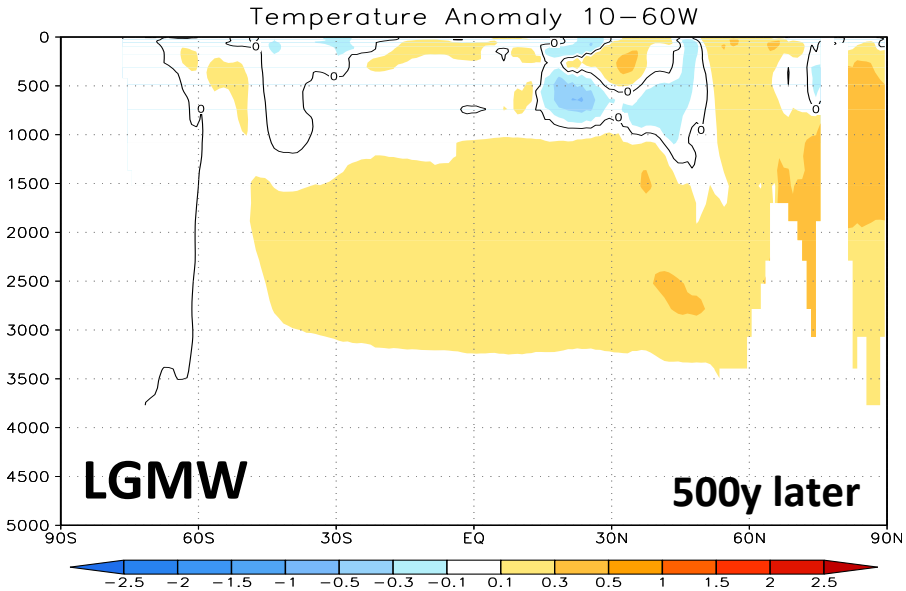
2. AMOC in LGMW increases slowly by itself. **Why?**

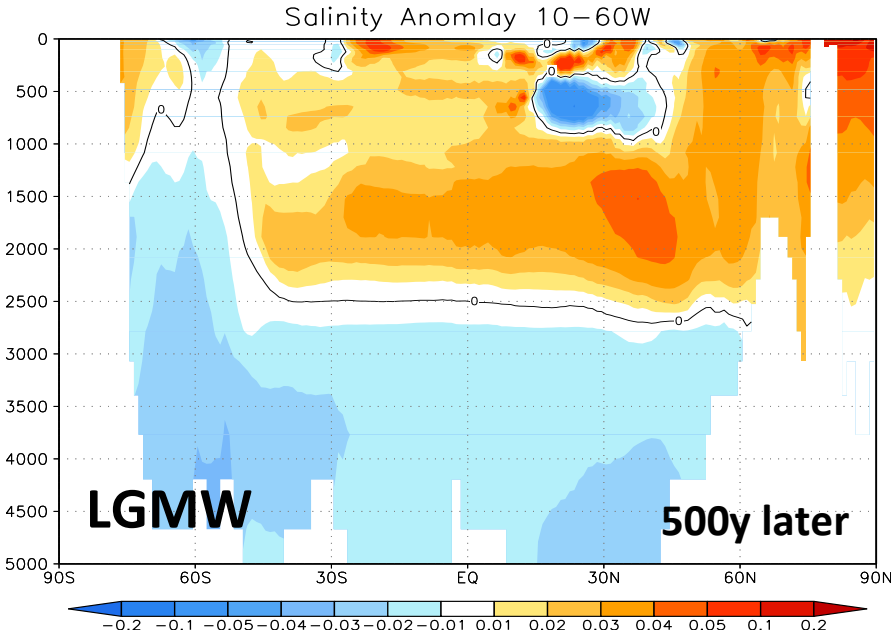
Upwelling in the Southern Ocean

LGMW: from glacial ocean
LGMS: from present day ocean



Upwelling in the Southern Ocean during the LGM!





Summary

- **Last Glacial Maximum possesses two ocean states dependent on the ocean stratification. Only one state is consistent with reconstructions, but is not fully equilibrated with coeval boundary conditions, representing a new paradigm for the last deglaciation.**

- **LGM ocean state has an coherent transient nature. Upwelling in the Southern Ocean is crucial for us to understand the transition from weak mode to strong mode of the LGM.**

Thanks for your attention…

Funding: China Scholarship Council (CSC)

Email: xu.zhang@awi.de