

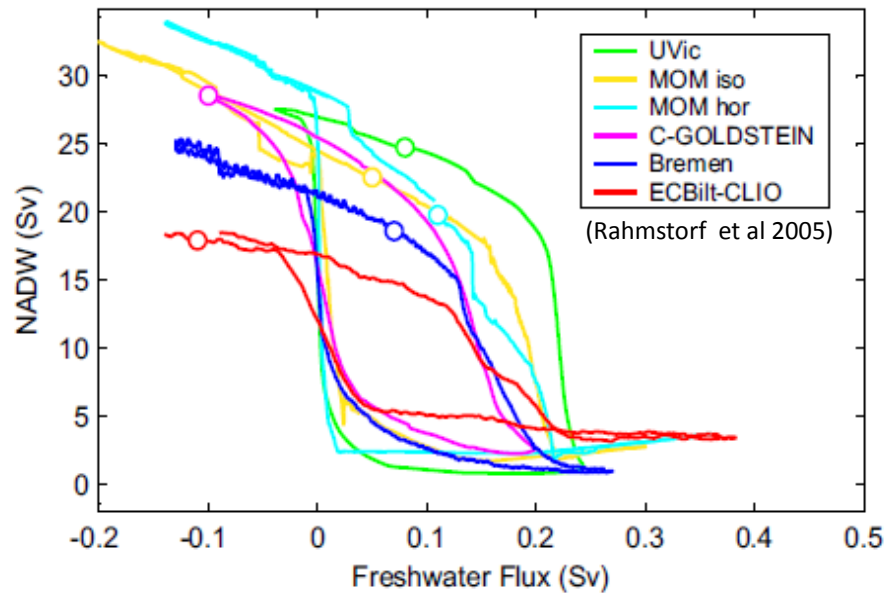
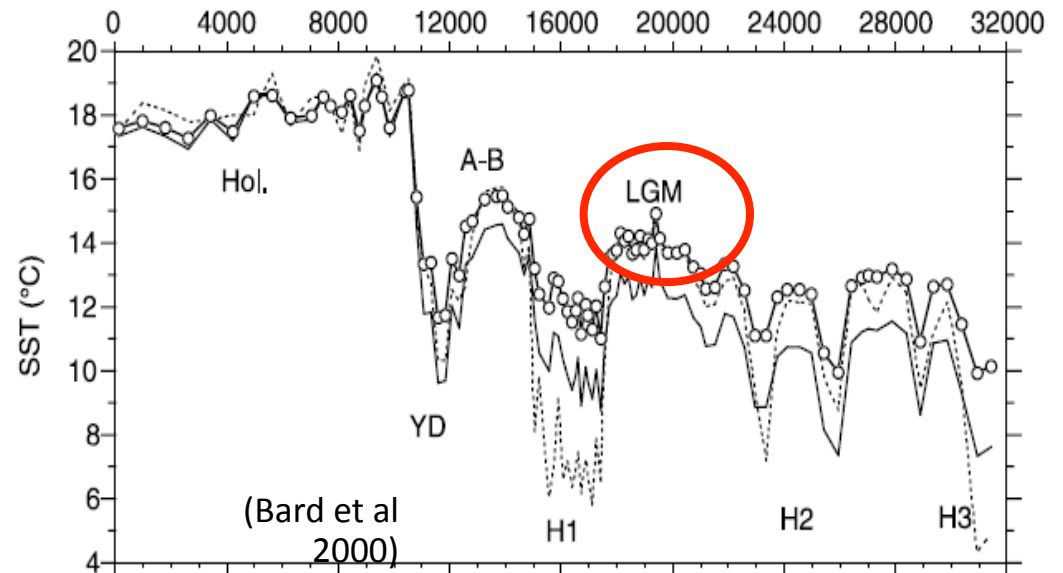
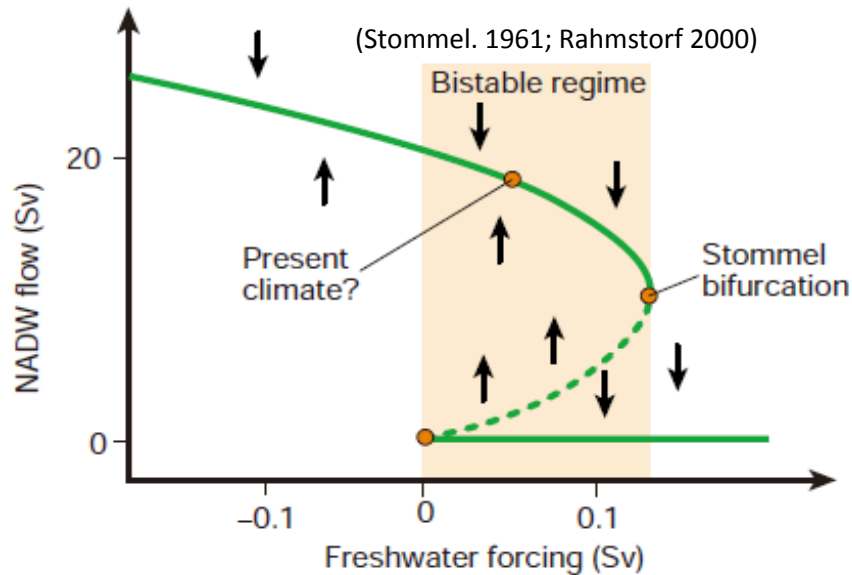
# Two quasi-steady states for the glacial ocean



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26<sup>th</sup> Oct. 2011

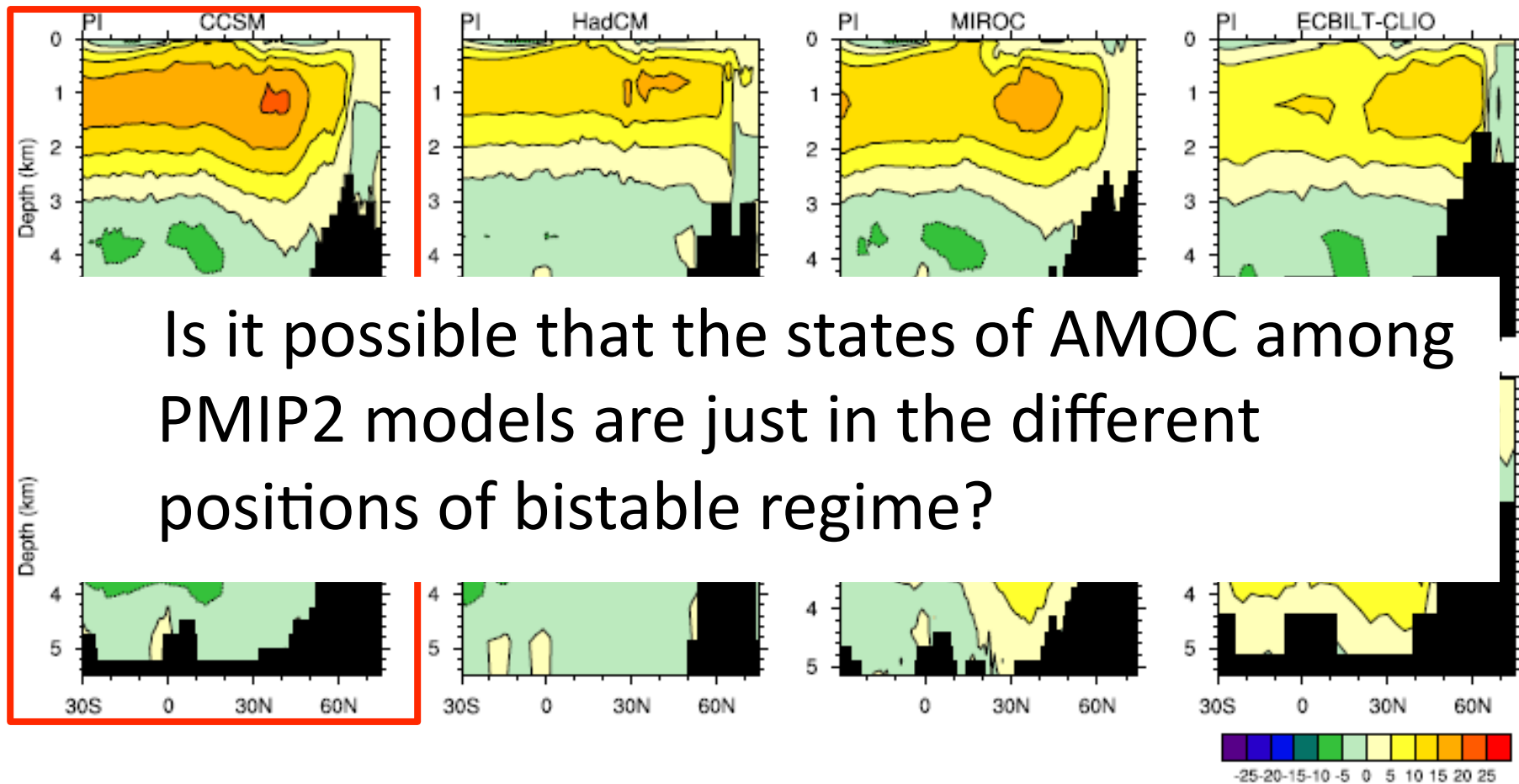
Funding: China Scholarship Council (CSC)

# Motivation



1. Important role of AMOC on climate system
2. Bistable with respect to hydrological cycle
3. Abrupt climate changes during last glacial cycle are related to AMOC variability.

# Motivation



Huge difference among PMIP2 models !!!

(Otto-Bliesner et al. 2007)

# Model setup

LGMW: from glacial ocean  
LGMS: from present day ocean

## COSMOS-ASO :

atmosphere (*ECHAM5*/ *T31L19*)

vegetation dynamics (*JSBACH*/*T31*)

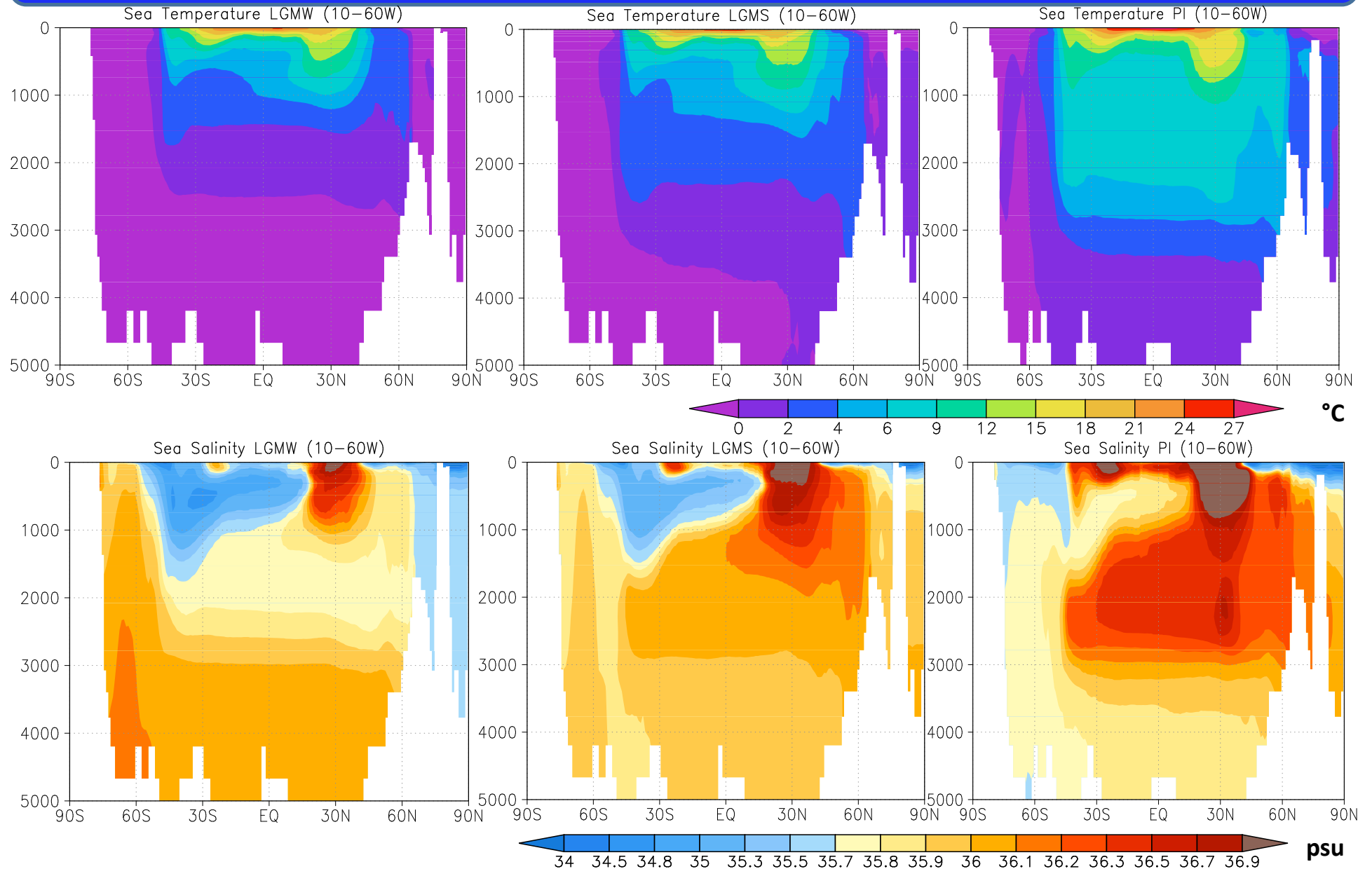
ocean (*MPIOM*/*GR30L40*).

	LGMW	LGMS
Initial Ocean state	Glacial Ocean <i>(Stratified ocean from CCSM)</i> Ocean only (3000 y)+coupled (3000y)	Present day Ocean (Levitus et al. 1998) Coupled (2500 y)

The other model setup → Paleoclimate Modeling Intercomparison Project 3

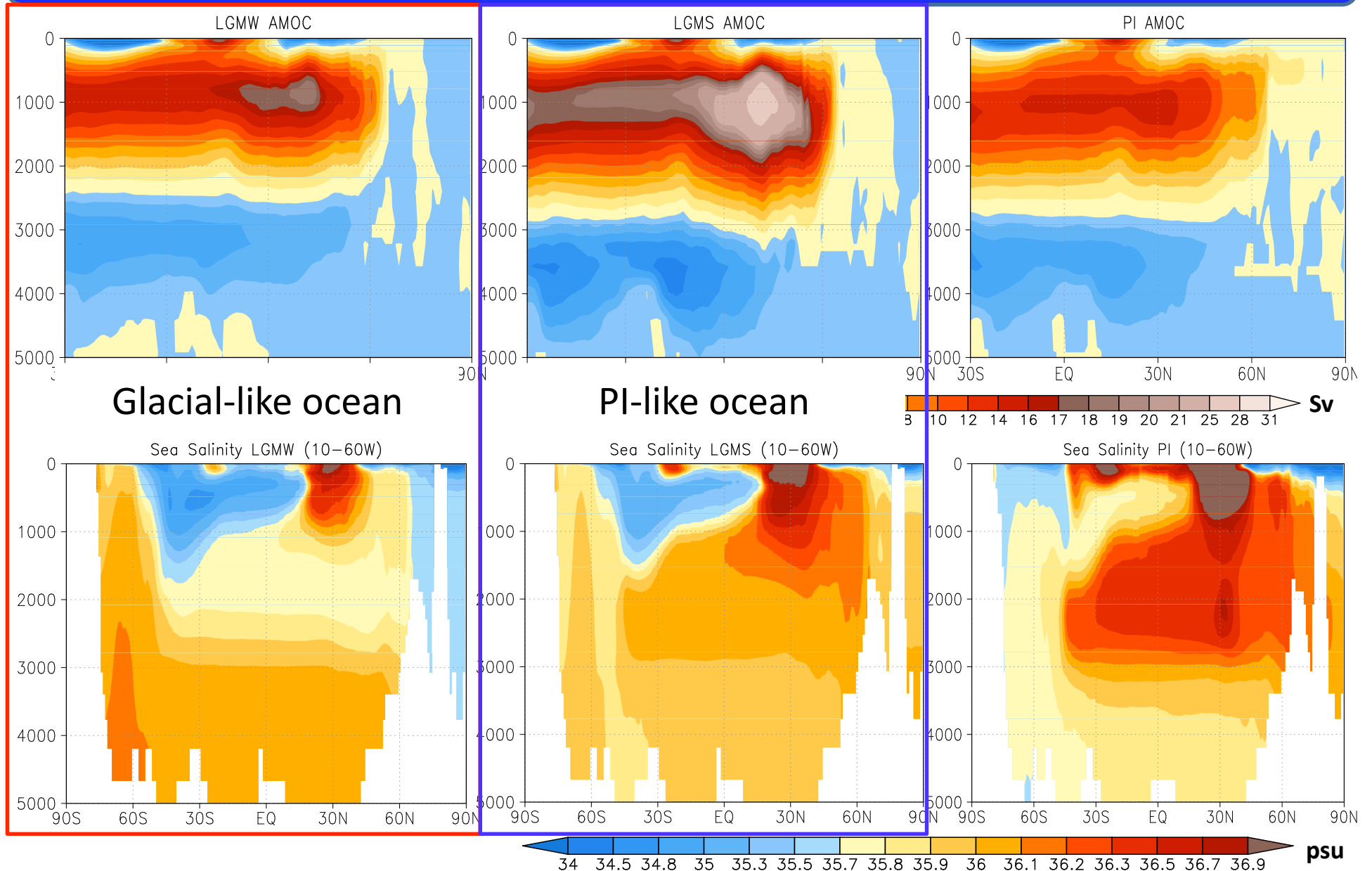
# Bistable AMOC during the LGM

LGMW: from glacial ocean  
LGMS: from present day ocean

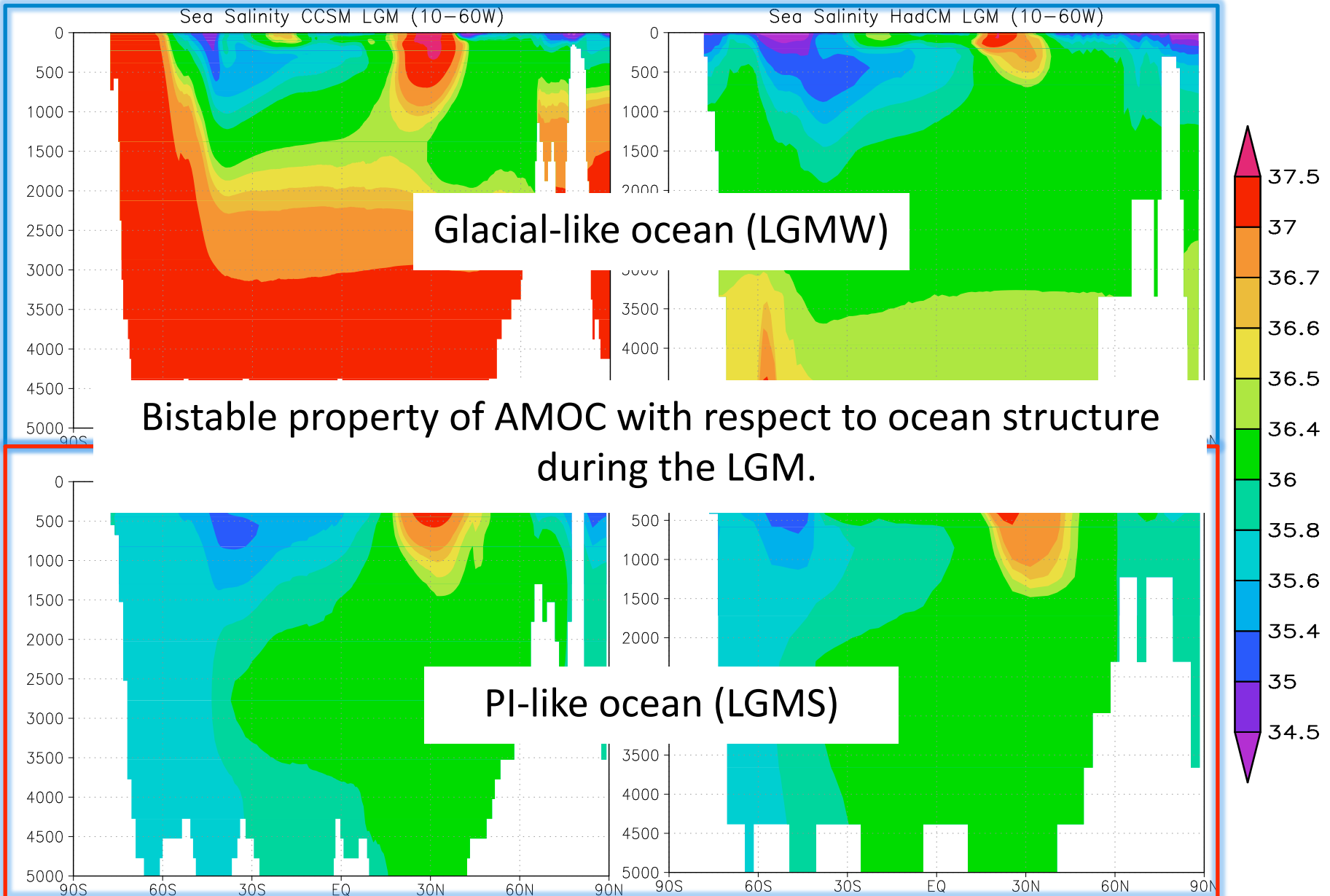


# Bistable AMOC during the LGM

LGMW: from glacial ocean  
 LGMS: from present day ocean



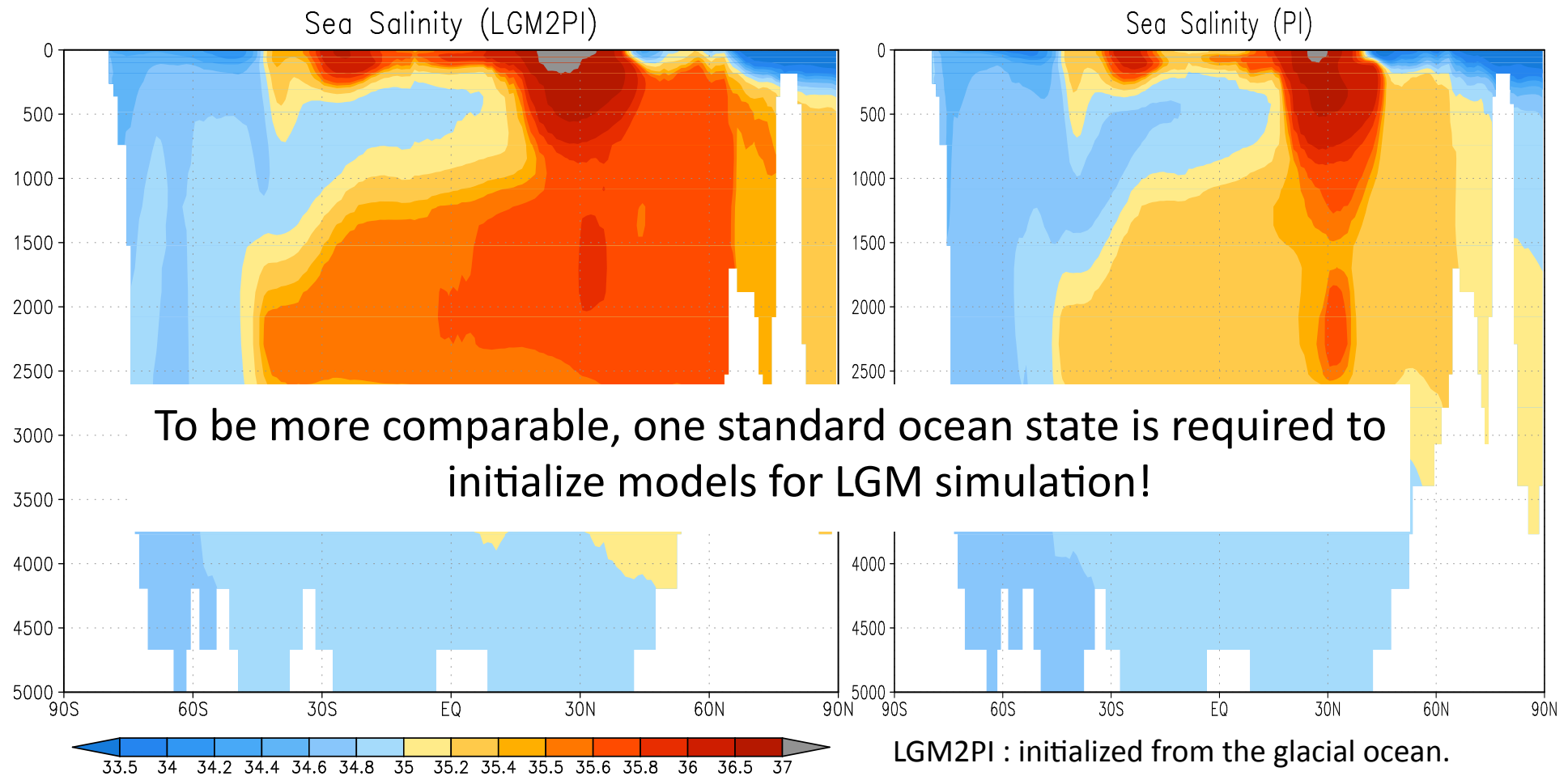
# Salinity transect in PMIP2 models



Bistable property of AMOC with respect to ocean structure during the LGM.

# Response of Present day ocean

LGM2PI: from glacial ocean  
PI: from present day ocean

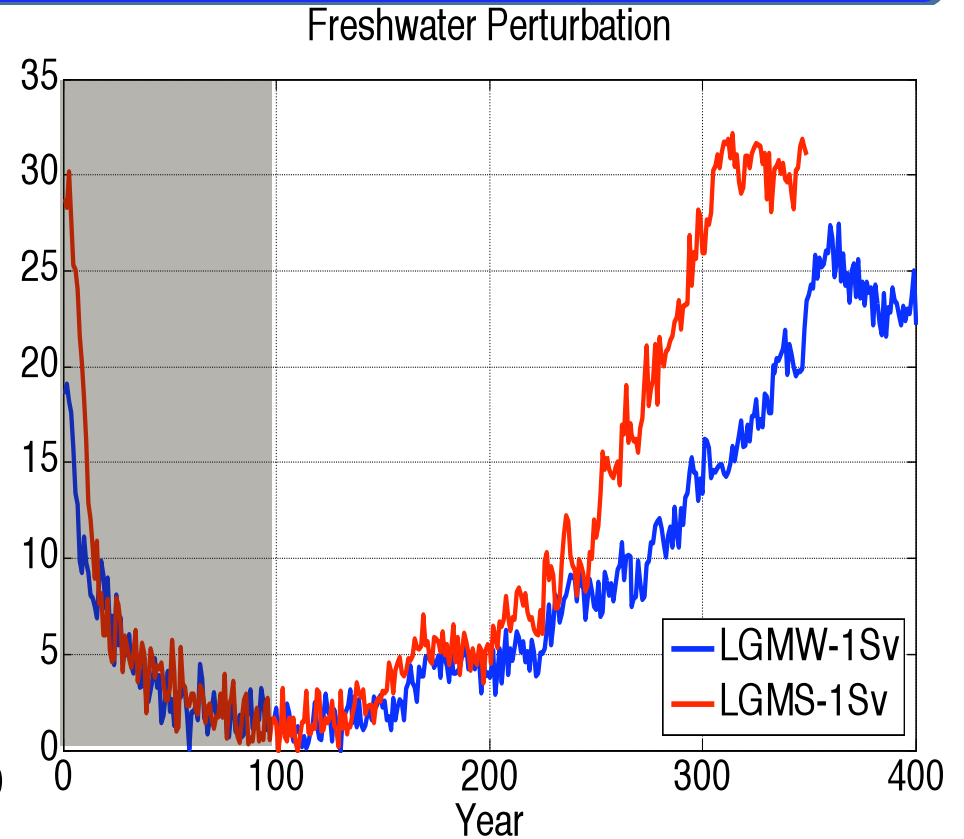
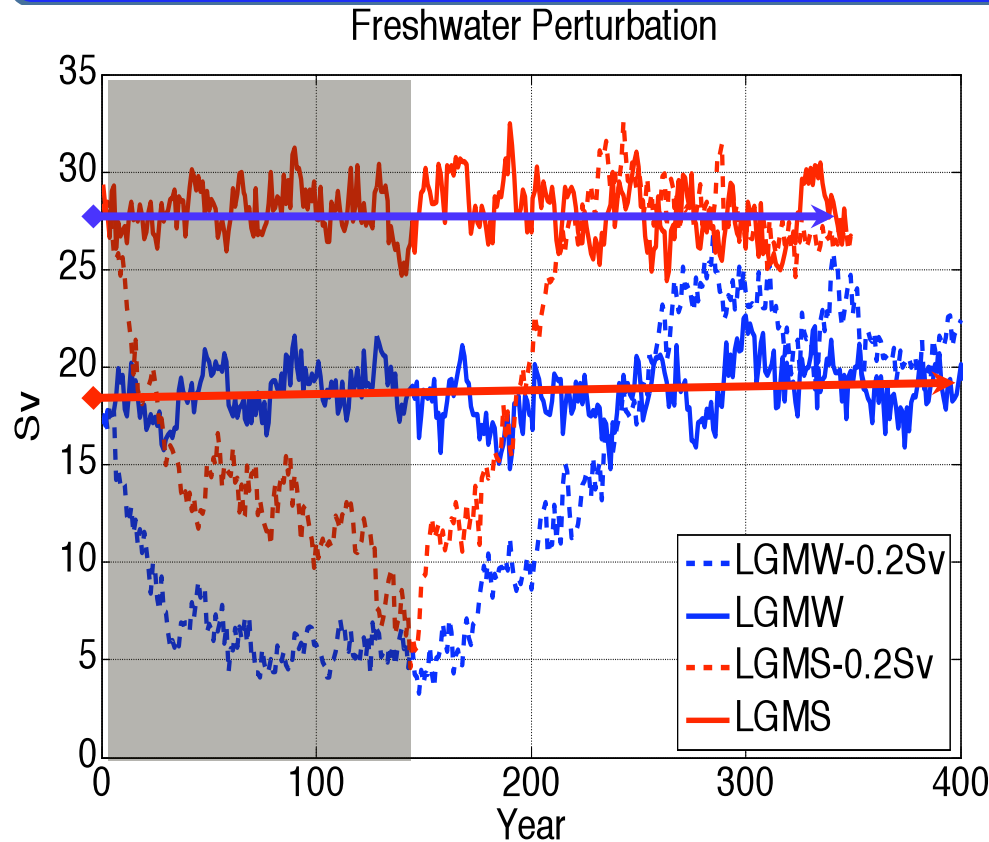


1. Similar Ocean structure, even initialized from the glacial ocean.
2. Two quasi-steady states with respect to ocean structure are unique at the LGM



# Freshwater Perturbation

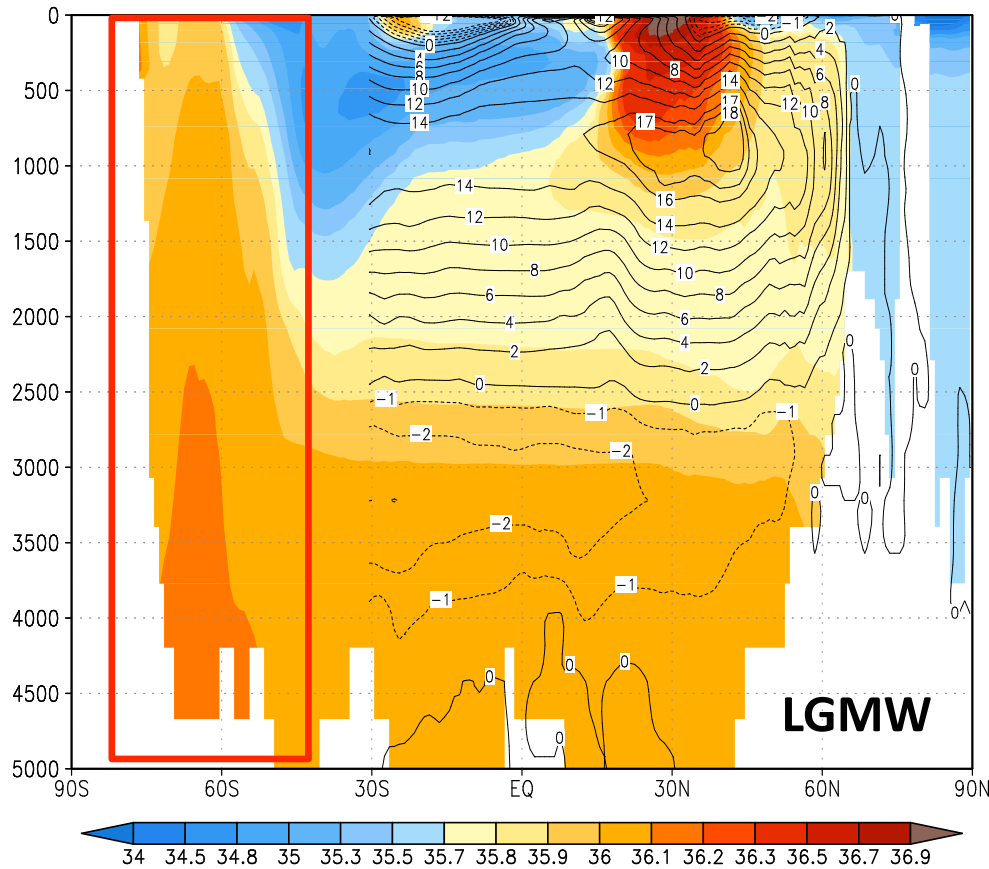
LGMW: from glacial ocean  
LGMS: from present day ocean



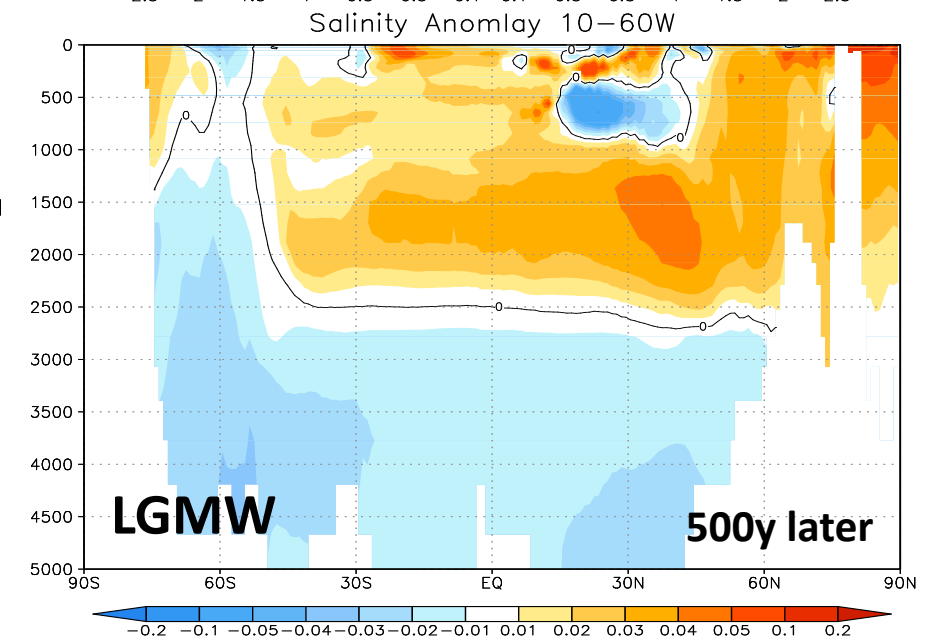
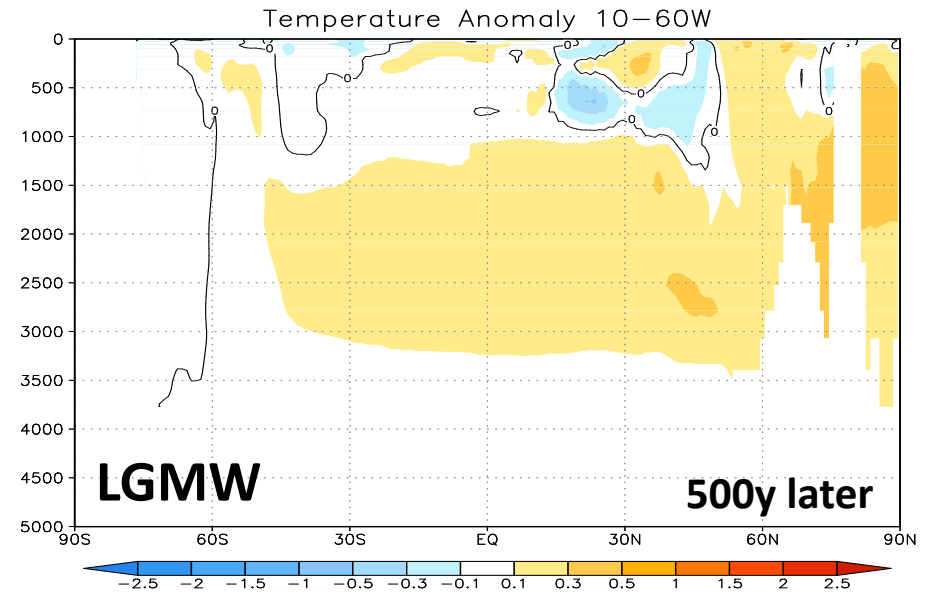
1. Bistability of LGM ocean is not related to FWP !!
  2. AMOC in LGMW increases slowly by itself.
- Why?**

# Upwelling in the Southern Ocean

LGMW: from glacial ocean  
 LGMS: from present day ocean



Robust upwelling in the Southern Ocean at the LGM!



## Take home message...

- Last Glacial Maximum – possesses two quasi-steady states
- Upwelling in the Southern Ocean is crucial to glacial/interglacial cycle.

**Thanks for your attention...**

Funding: China Scholarship Council (CSC)

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