The weakening of AMOC may highly linked to climate warming outside the Arctic

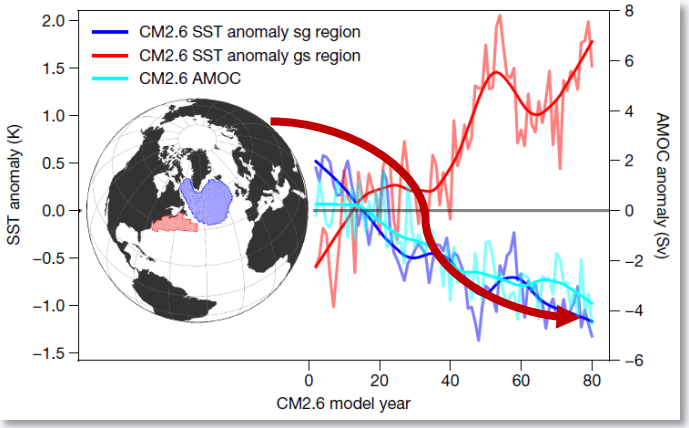
Jiao Chen, *Xidong Wang, and Xuezhu Wang*
Hohai University, College of Oceanography, China

201311040036@hhu.edu.cn

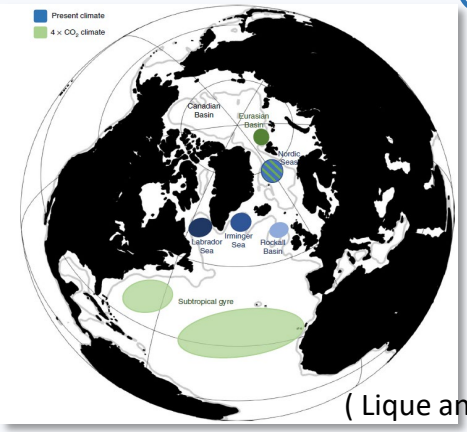
Sharing not permitted

This presentation participates in OSPP
Outstanding Student & PhD candidate Presentation contest

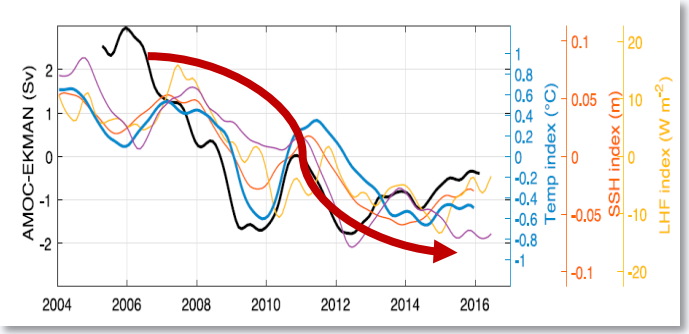
Introduction



(Caeser et al., 2018)



(Lique and Thomas, 2018)



(Smeed et al., 2018)

- AMOC has weakened or will soon weaken as a result of anthropogenic warming
- continued increase in CO2 emission may result in irreversible climate change (shifting of the deep convection zone)

Experiments and models

step1
CO_2 forcing

step2
Modelling anthropogenic warming that triggers AMOC weakening

tep3
To explore the main causes and mechanisms of AMOC weakening

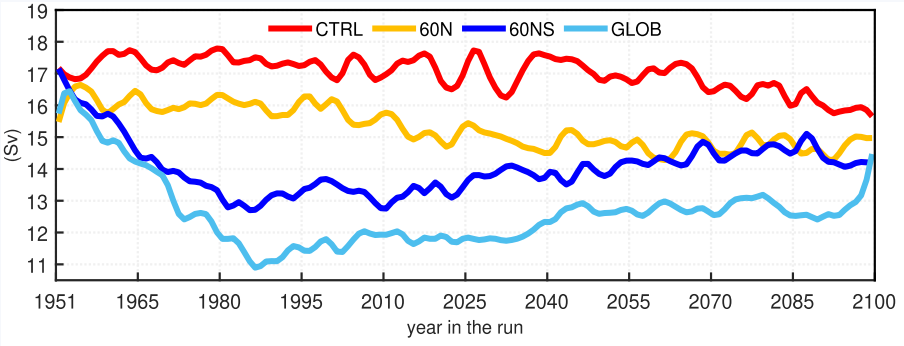
- Climate Model : AWI-CM 1.1 LR (in CIMP6)
- Ocean Model: FESOM 1.4
- Unstructured triangular meshes in the horizontal with 126859 wet nodes

CO_2 concentration is quadrupled either regionally (60N, 60NS) or globally (GLOB), and the concentration remains constant throughout the runs

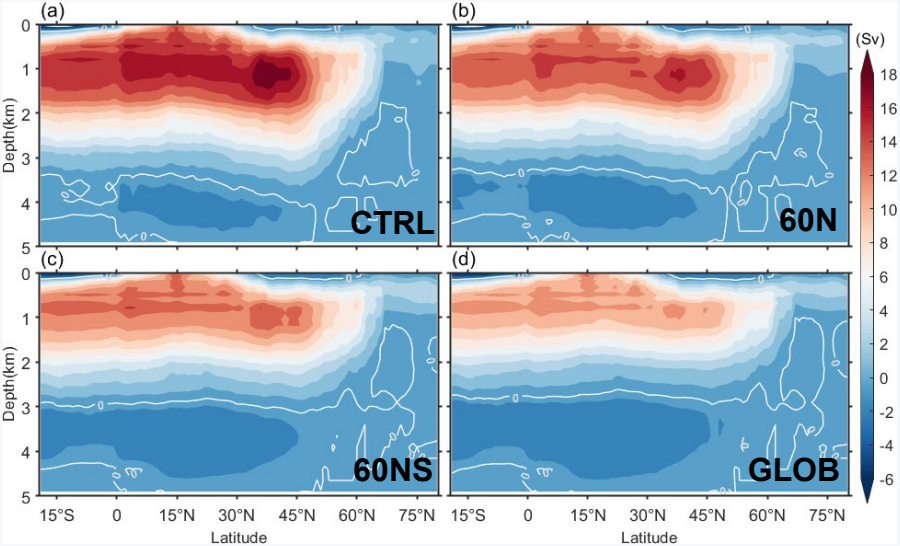
Control run	CTRL	No forcing	200 years	/
Sensitivity run	60N	north of 60°N	150 years	co2×4
	60NS	south of 60°N		
	GLOB	global		

Results

- a rapid weakening in a short term, and a limited recovery, but always weakens compared to CTRL.
- warming in extra-polar regions accounting for approximately 60%



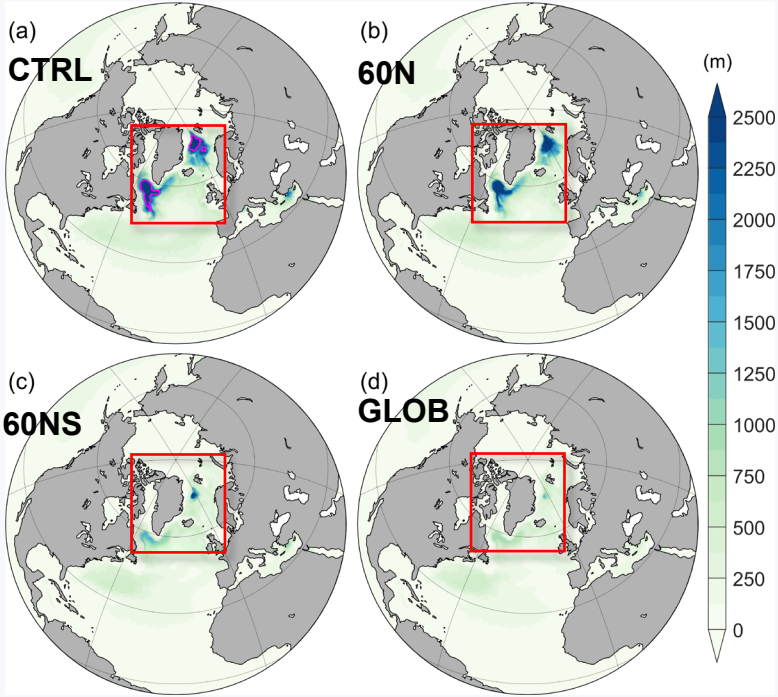
AMOC strength (Sv) at 26°N in different for experiments



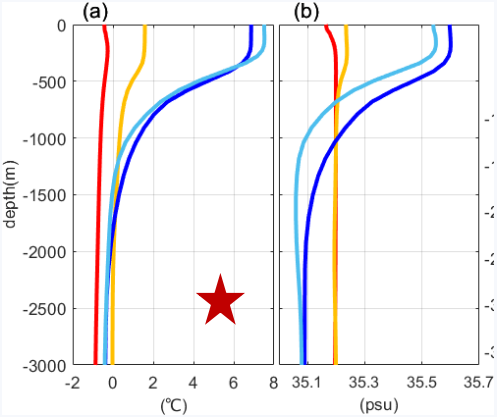
zonal integrated meridional overturning stream function (Sv) in the Atlantic

Results

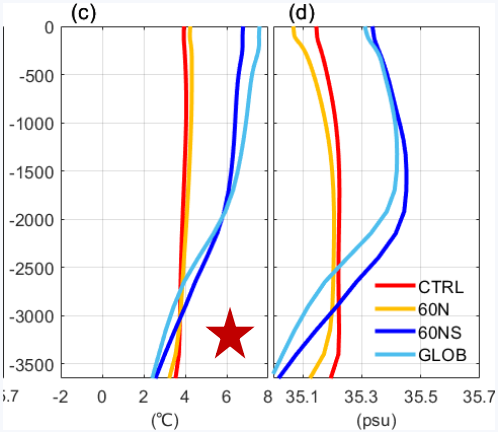
March climatology mixed-layer depth



Nordic seas



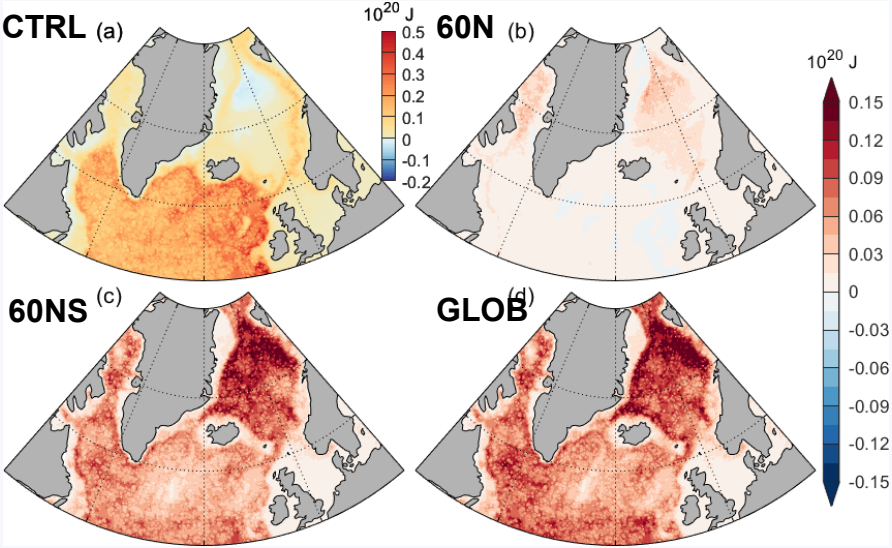
Labrador sea



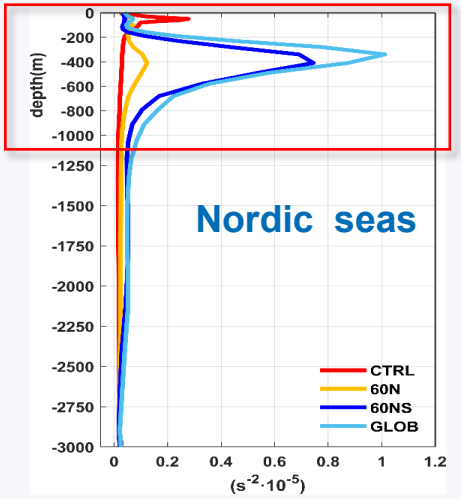
- MLD decrease most at Nordic Seas, Labrador Sea
- Changes in thermohaline properties of the upper ocean inhibit mixing

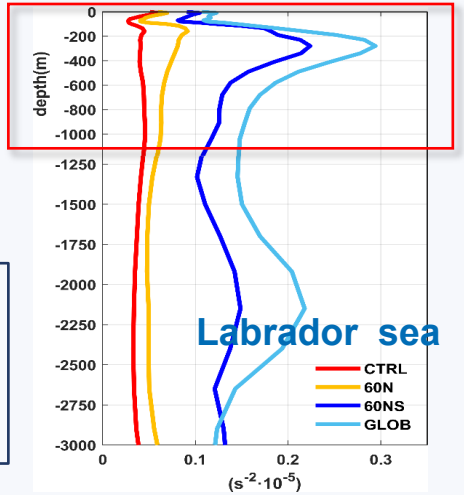
regionally weighted potential temperature and salinity

Results



Maps of heat content in the upper ocean (above 1200 m)

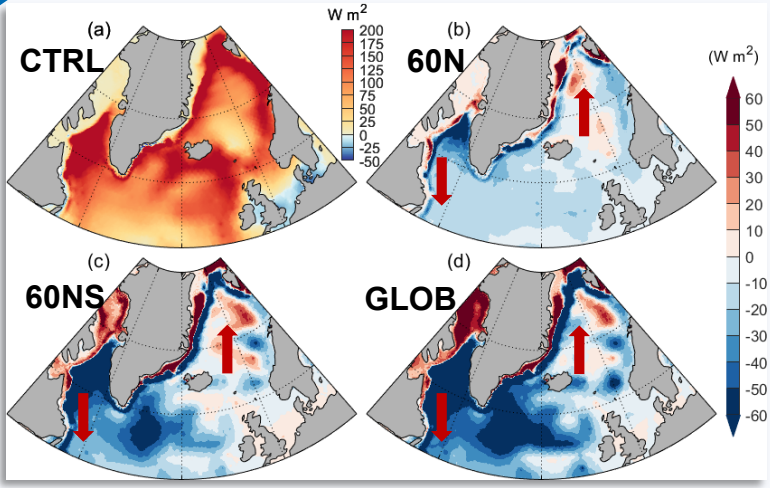




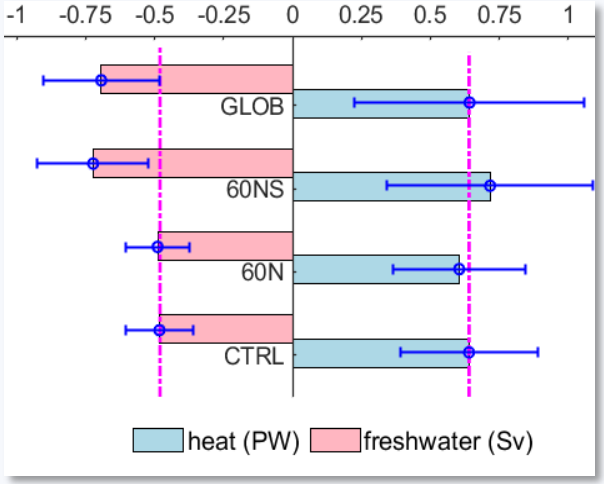
Regionally weighted buoyancy frequency

- significant increase in heat content in the Nordic seas and Labrador sea
- upper ocean stratification in two-deep convective zones indeed experience a robust intensification

Results



net surface heat flux (W m-2)



heat and freshwater transport along 53°N

Ocean heat content

- air-sea heat flux
- advection heat transport
- diffusive mixing

- heat loss increasing in Nordic Seas, decreasing in Labrador sea but still plays a relatively minor role;
- advection heat transport from extra-polar regions dominant heat content increase and then strengthen upper ocean stratification

Results

Summary

- The weakening of AMOC may highly linked to climate warming outside the Arctic.
- In a warming condition, the increase of northward advection heat transport is expected to enhance the upper ocean stratification over the deep convection zone and inhibit vertical mixing, thus weakening the AMOC to a large extent.

Next work

- Further diagnosis , determine the extent to which these two factors affect the changes of AMOC respectively.

EGU General Assembly 2022

HOHAI UNIVERSITY 1915

Thank you for your attention!