

How Tibetan Plateau Affects the Global Meridional Overturning Circulation?

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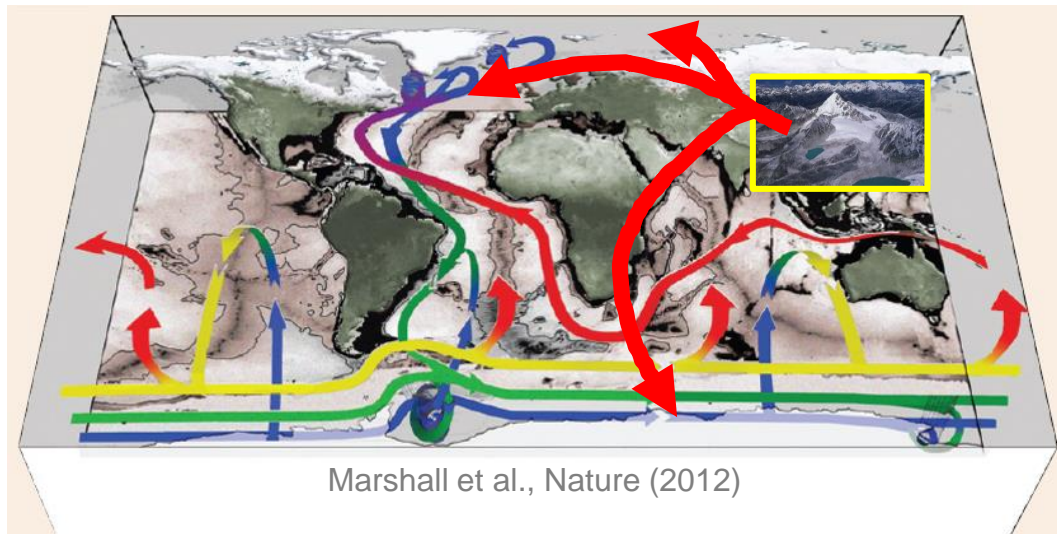
Email: yanghj@fudan.edu.cn



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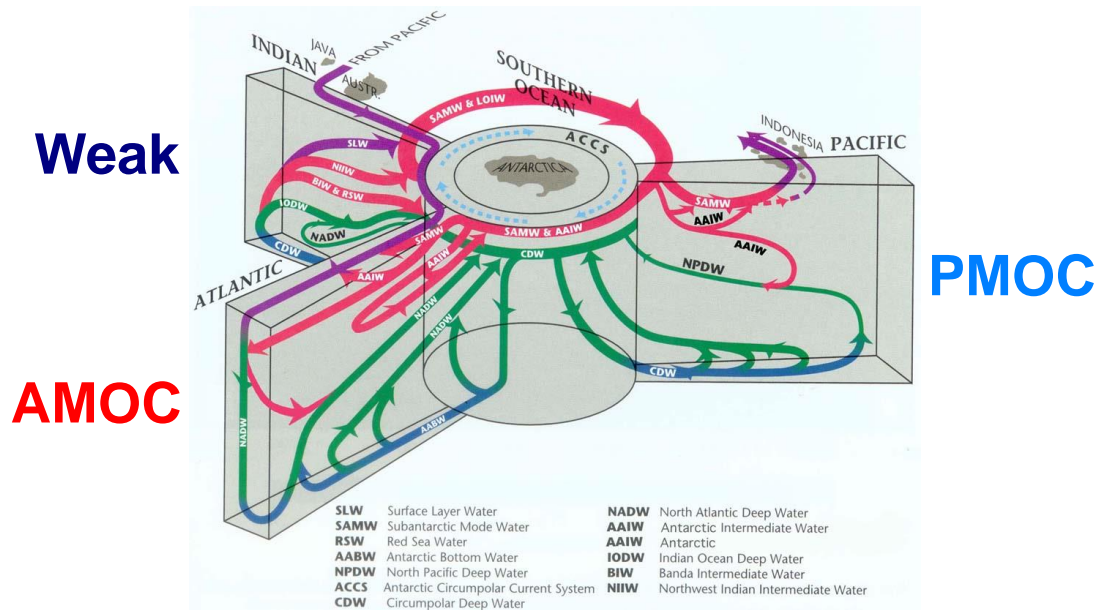
TP: A *Global* Perspective

How and to what extent?



Global Meridional Overturning Circulation

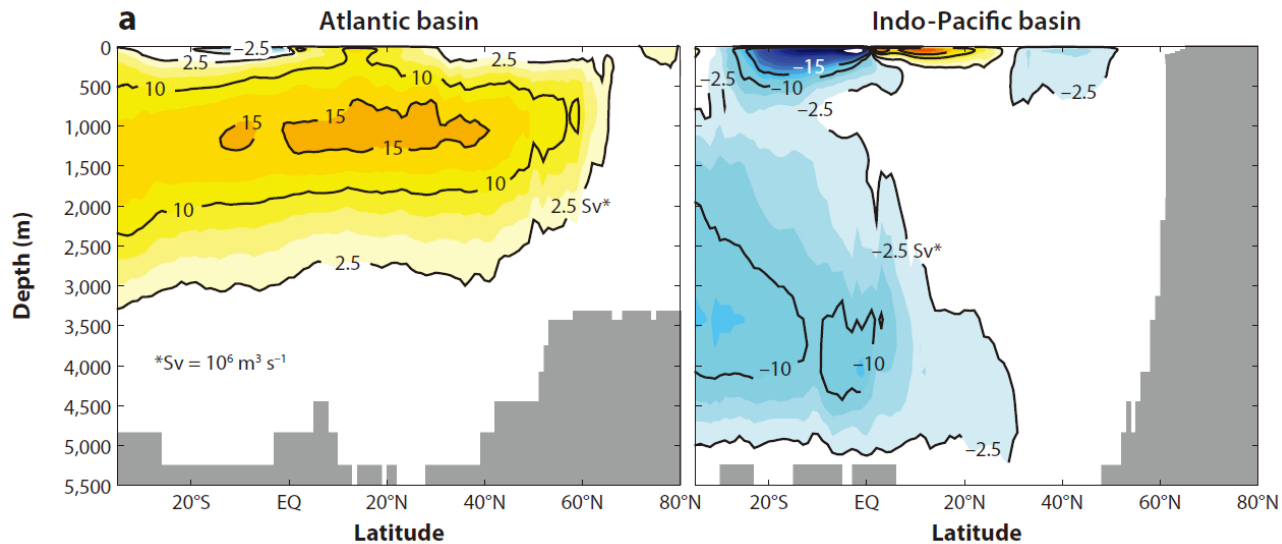
Energy and Freshwater Balance



Schmitz (1997) Overturning circulation: Southern Ocean View

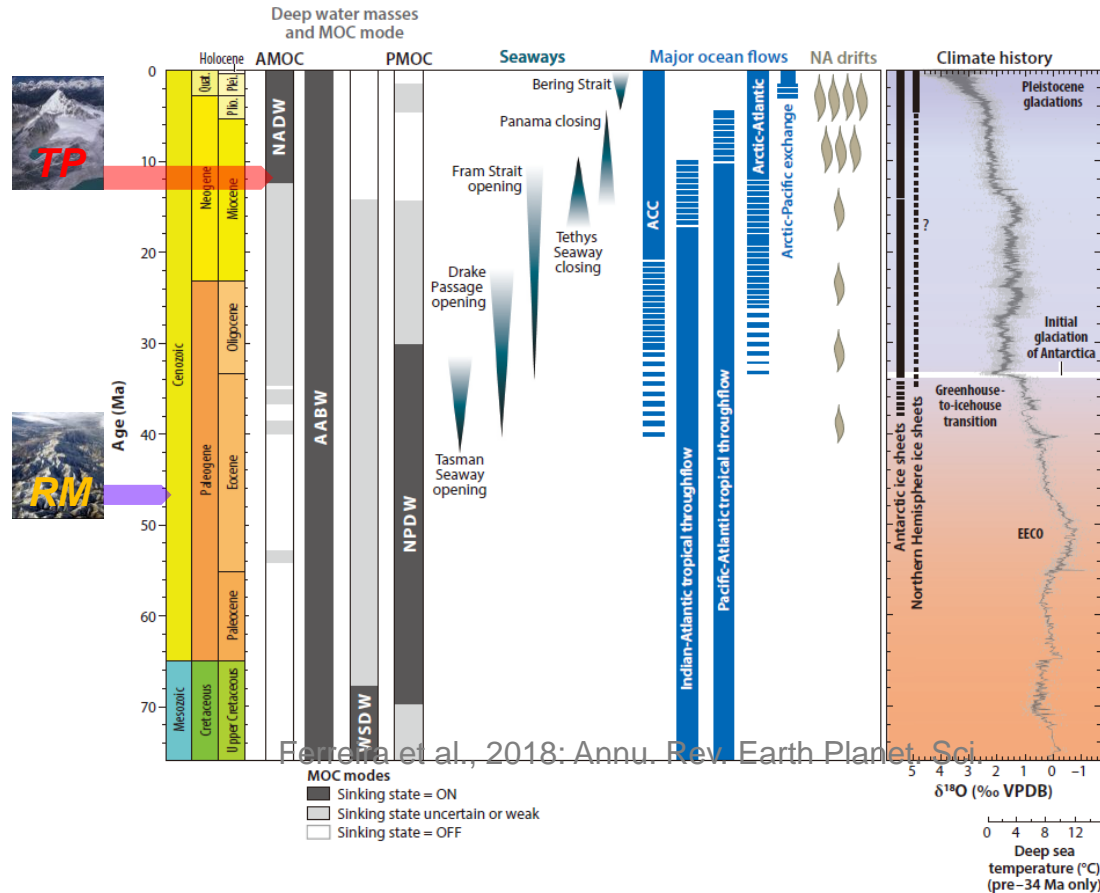
Strong AMOC

Weak PMOC



Ferreira et al., 2018: Annu. Rev. Earth Planet. Sci.

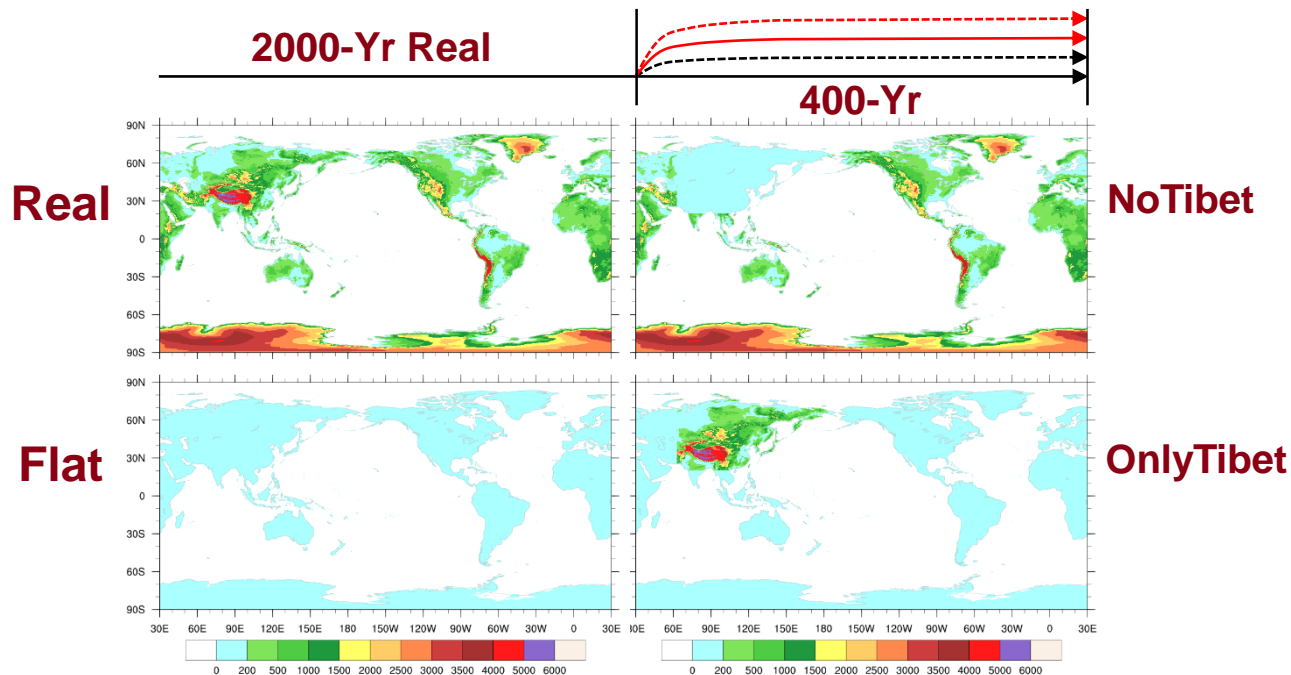
Geological History of **GMOC**



Ferreira et al., 2018: Annu. Rev. Earth Planet. Sci.

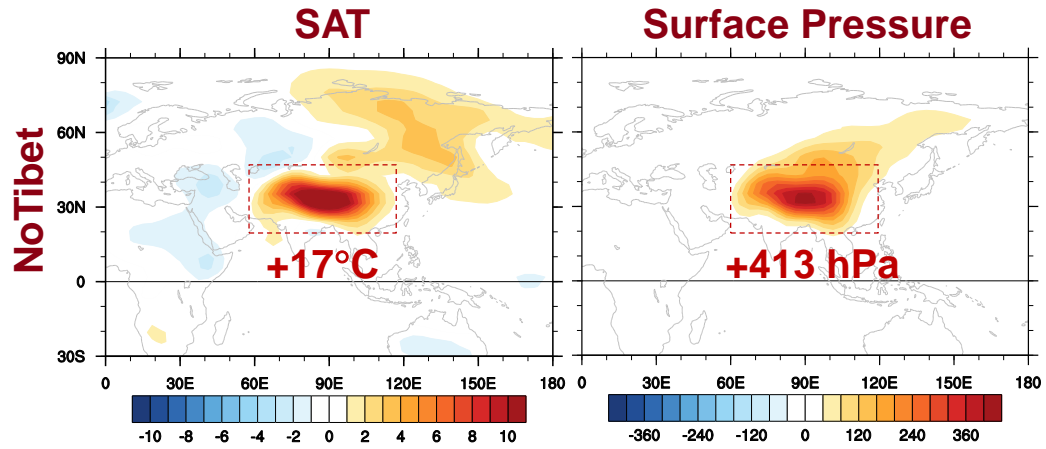


Coupled Earth System Model



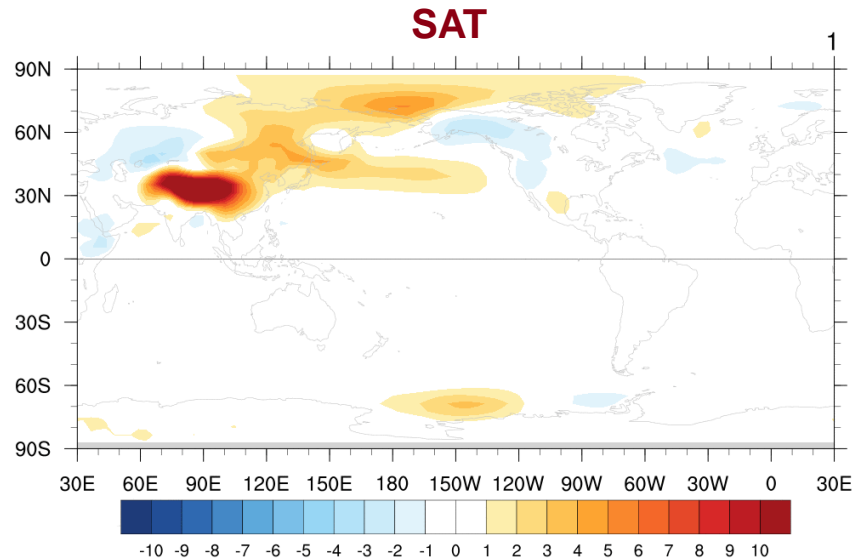
NCAR CESM1.0: CAM5 / POP2 / CLM4 / CICE4 / Glimmer-CISM

TP Forcing: *Thermal* and *Dynamical*



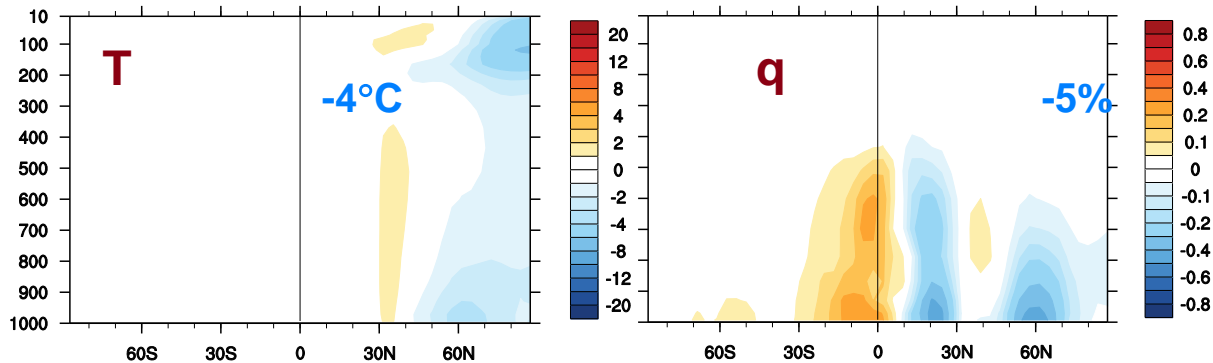
Lapse Rate $T \sim 4 \text{ km} \times 7 \sim 28^\circ\text{C}$

SAT Evolution w/o TP



Atmosphere T and Moisture

NoTibet



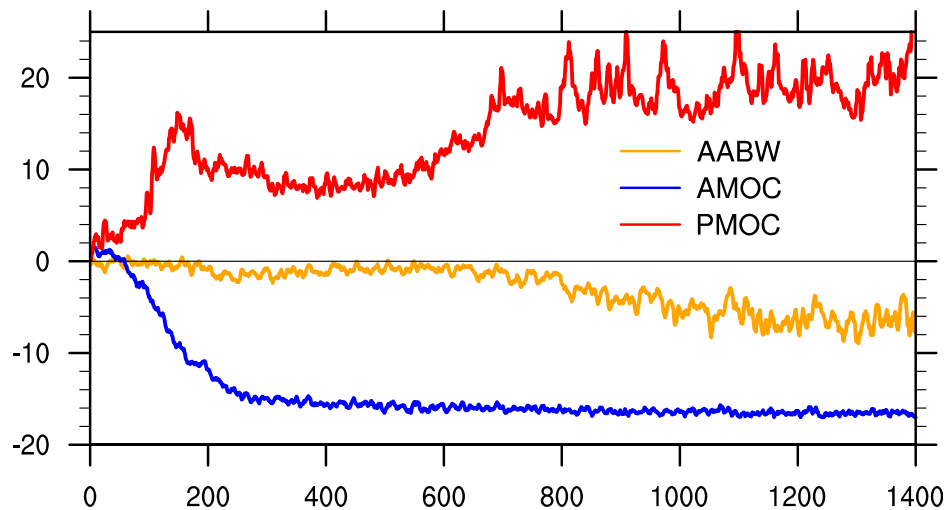
Cold and Dry without TP

Preliminary Results

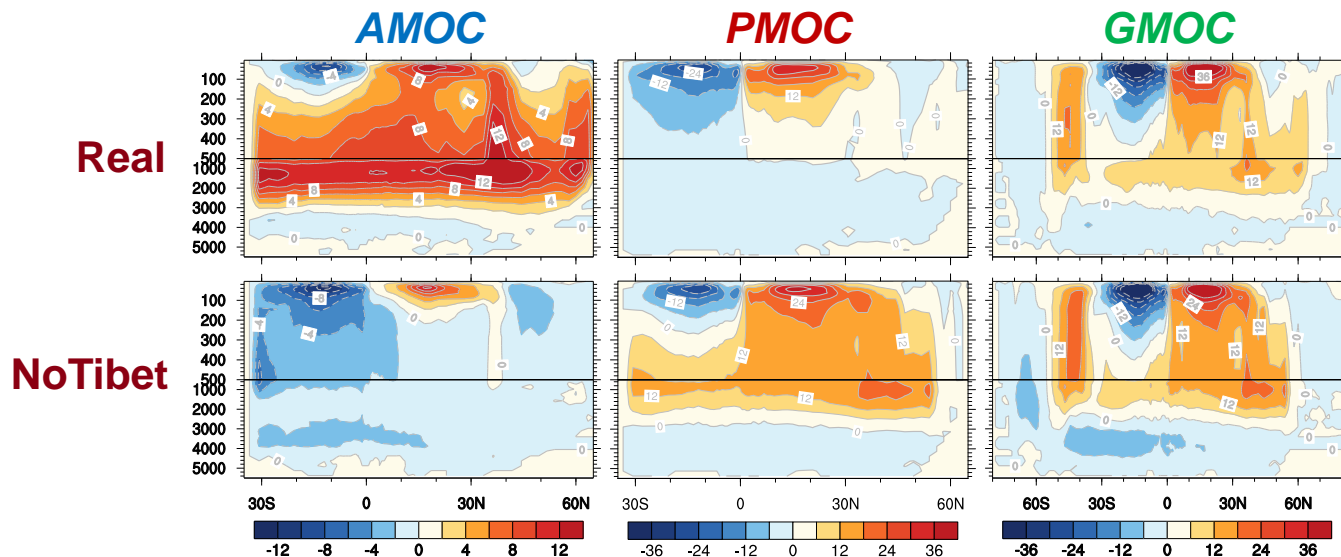
		NoTibet	OnlyTibet
Atmos	TOA (PW)	+0.2	-0.04
	Air T (°C)	-4.0	+6.0
	SAT (°C)	-18.0	+19.0
	Air q (%)	-5.0	+10.0
	HC (%)	+13	-20
Ocean	SST (°C)	-8.0	+10.0
	SSS (psu)	-4.0	+6.0
	SSD (kg/m ³)	-3.0	+4.0

0 → 1 : Critical in Shaping Global Climate!

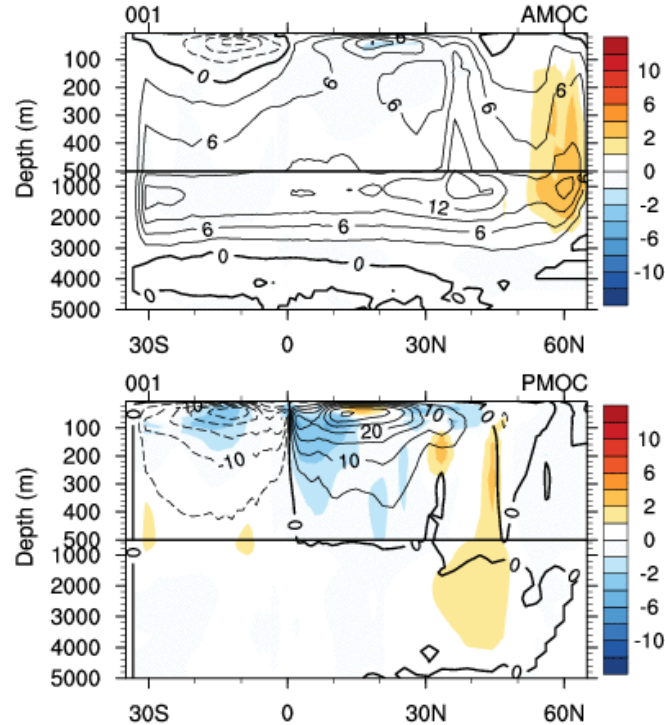
GMOC Index



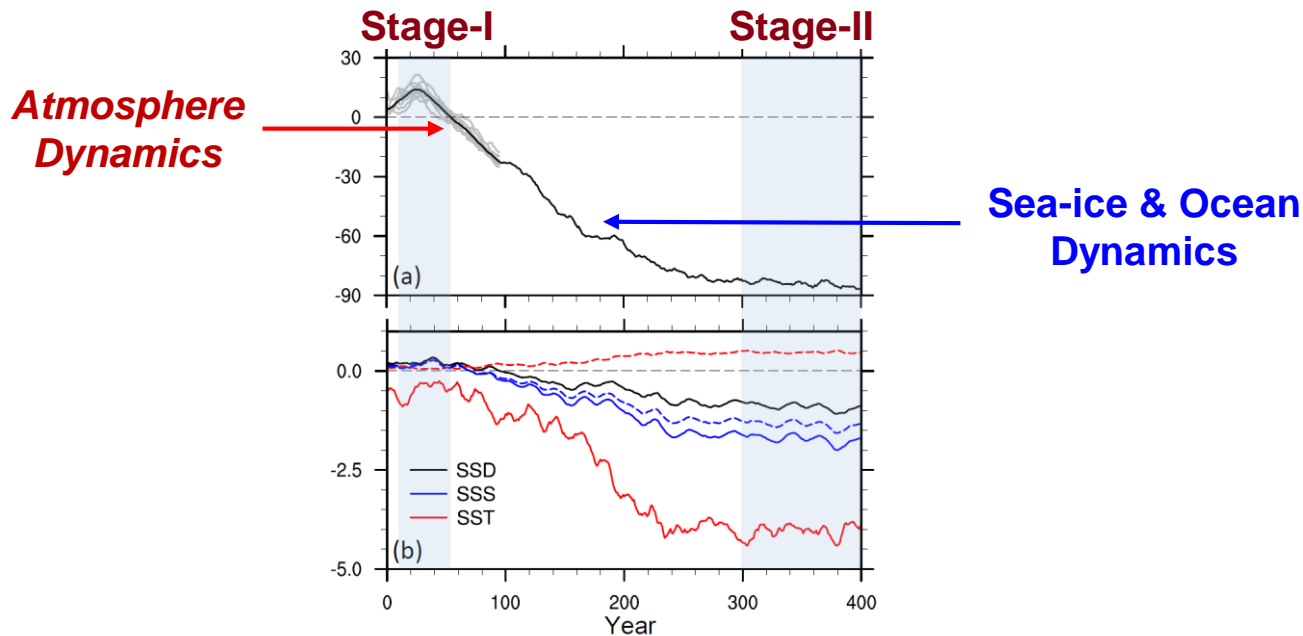
Global MOC



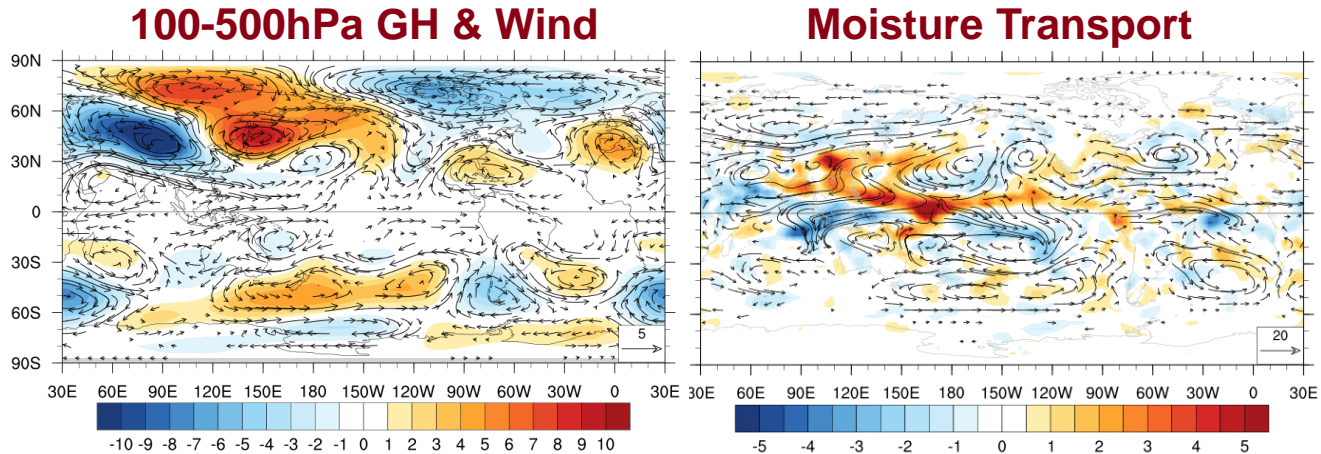
AMOC vs. PMOC: See-Saw?



AMOC Evolution w/o TP

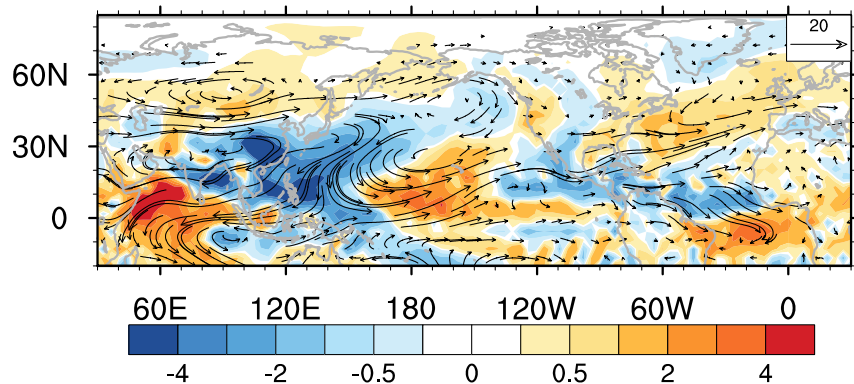


Planetary Wave and Moisture Transport

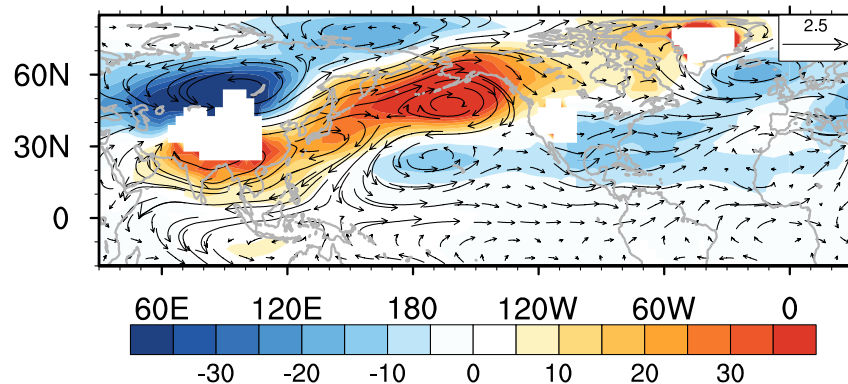


Teleconnection: From *TP* to *Atlantic*

Moisture Transport

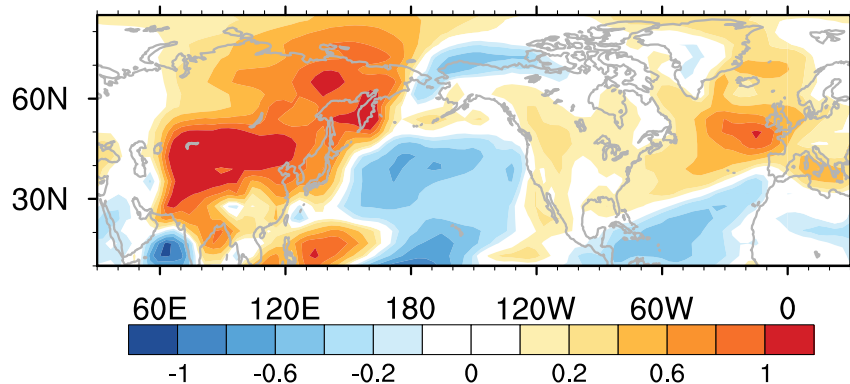


850 hPa GH and Wind

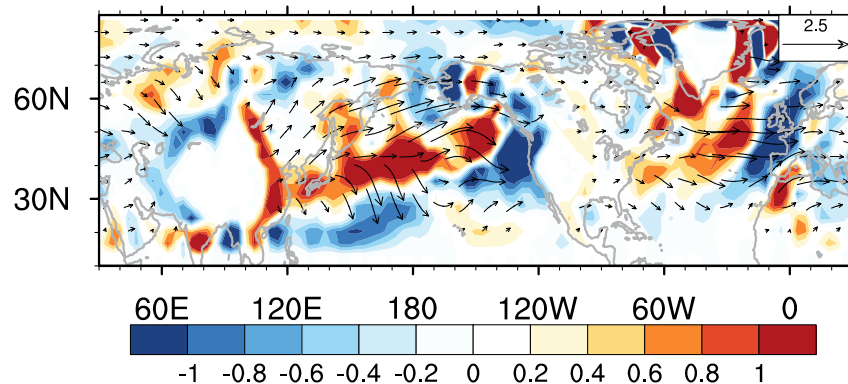


Teleconnection: From *TP* to *Atlantic*

10-m Wind Speed

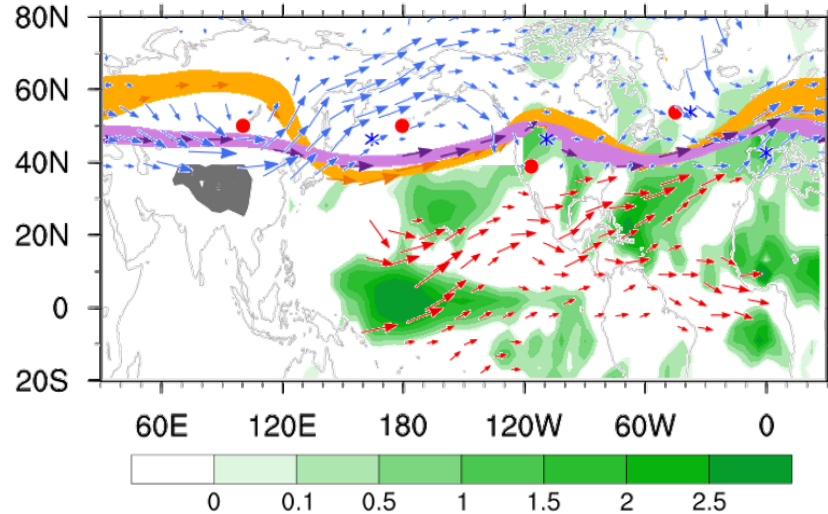


850 hPa Wave Activity



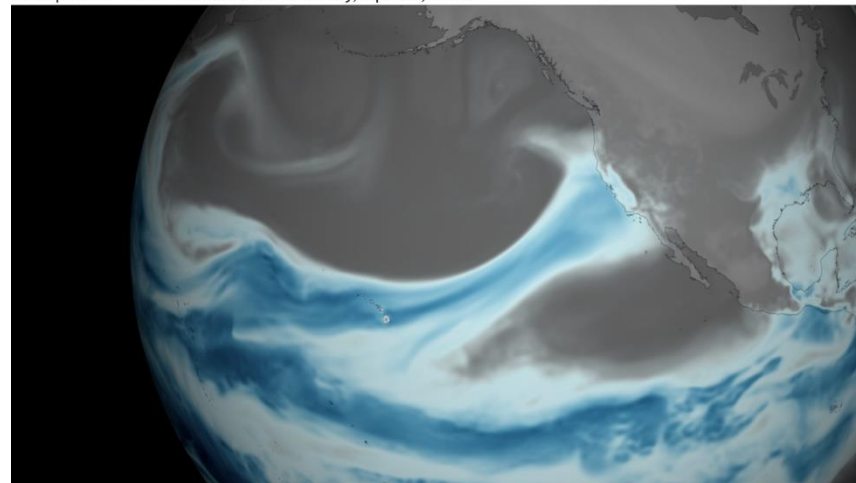
Alan Plumb, JAS, 1985; Takaya & Nakamura, JAS, 1998

Stationary Waves with Tibetan Plateau



Atmosphere River

Precipitable water forecast for mid-day, April 6, 2018



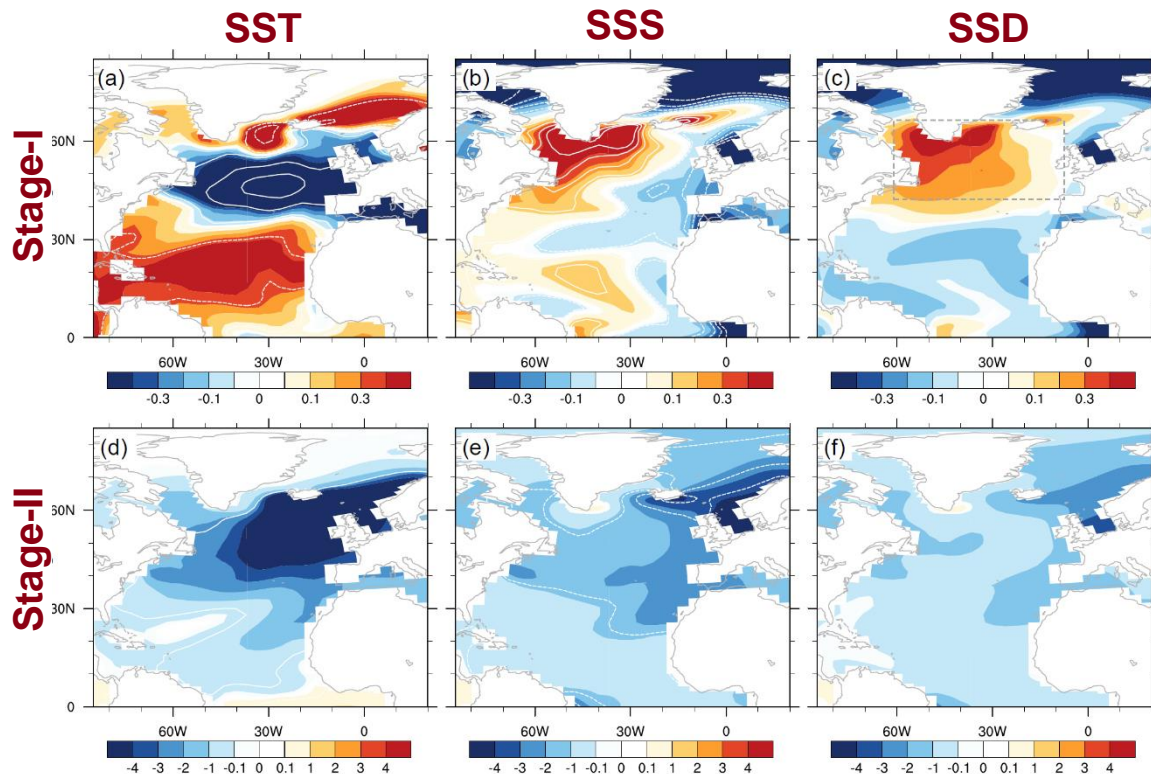
Apr 6, 2018, 11am (PDT)
model run on
Apr 5, 2018, 11pm (PDT)

Precipitable Water (mm)

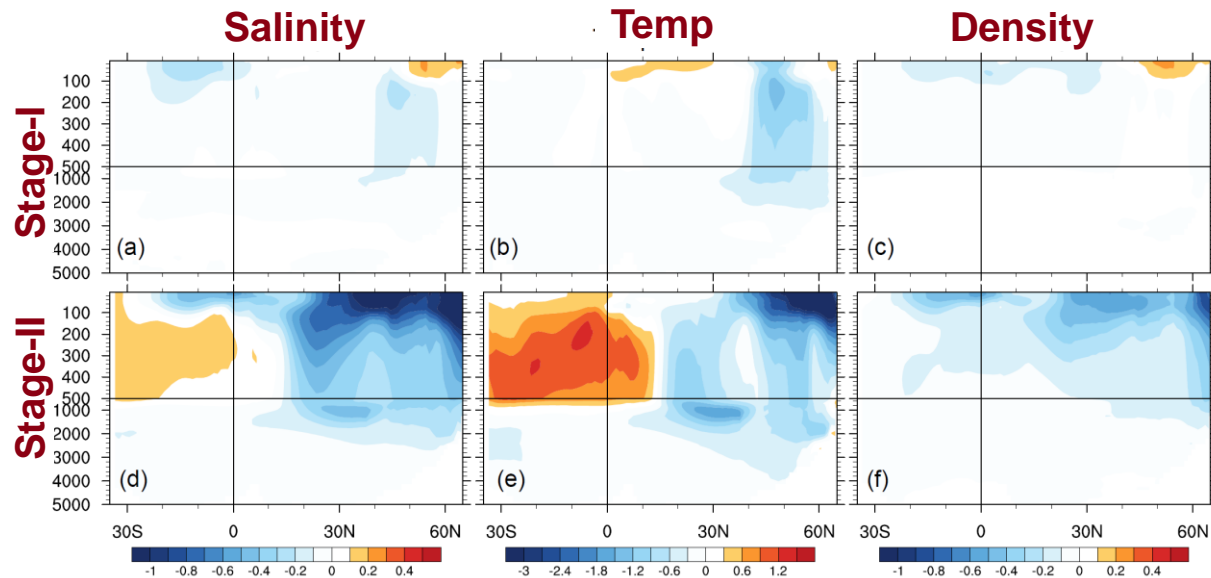


NOAA Climate.gov
Data: NESDIS

Ocean Change

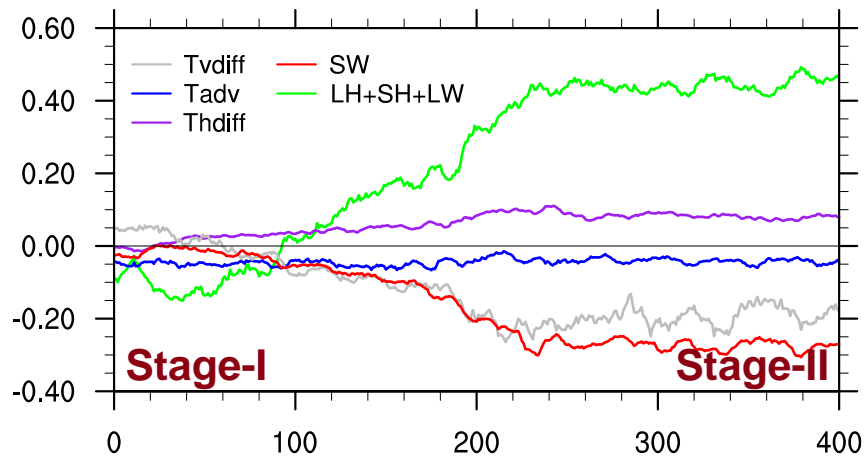


Ocean Change

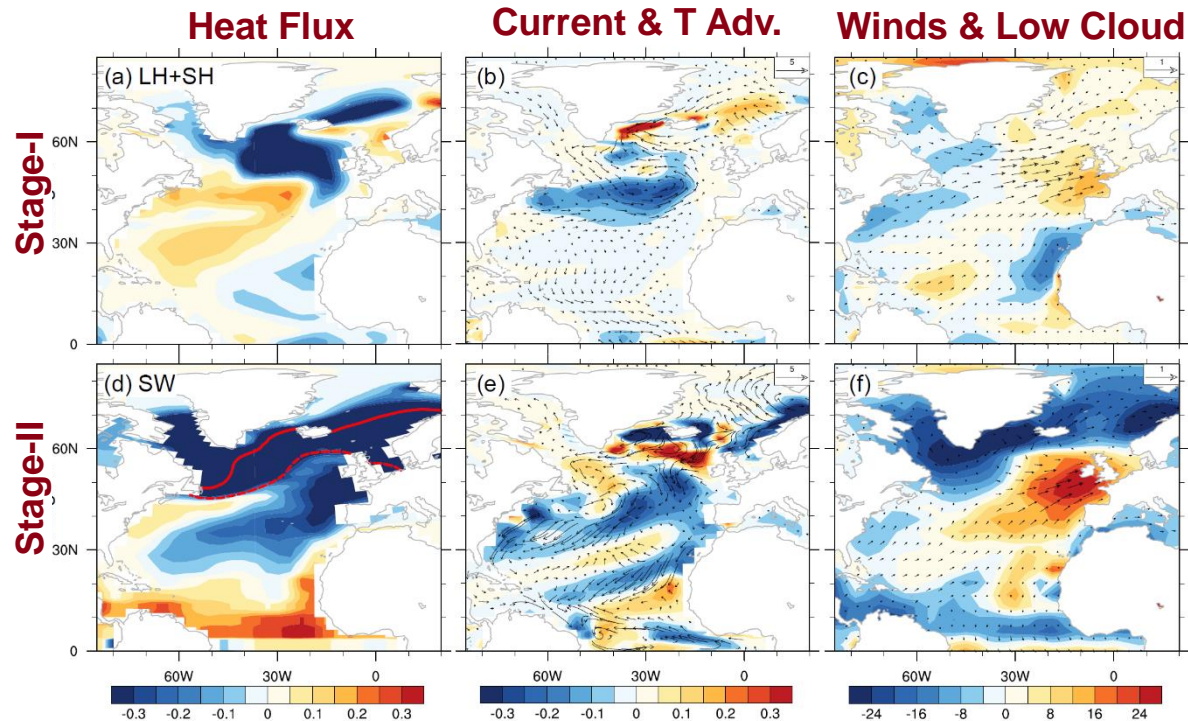


Mechanism for *Temp* Change

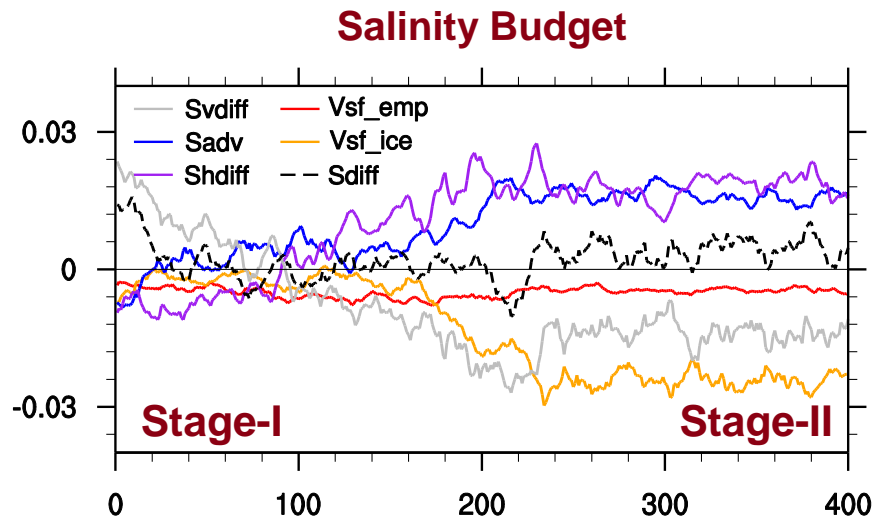
Temperature Budget



Mechanism for *Temp* Change

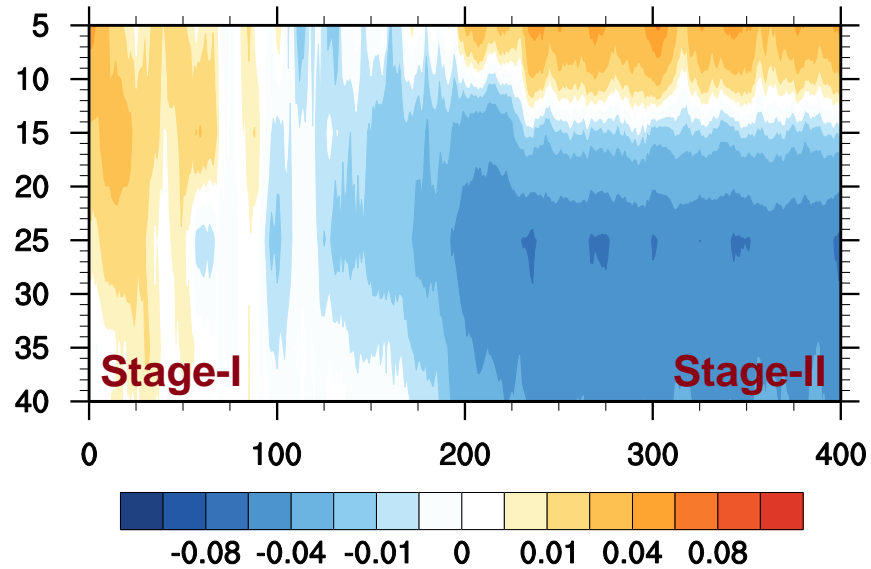


Mechanism for *Salinity* Change

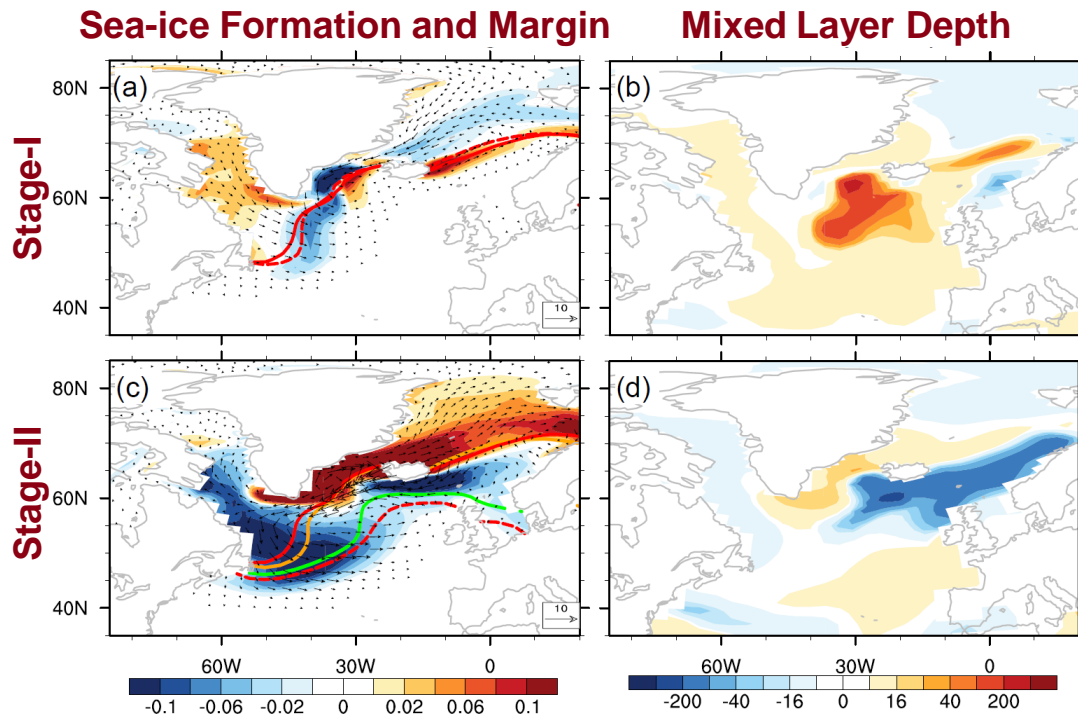


Mechanism for *Salinity* Change

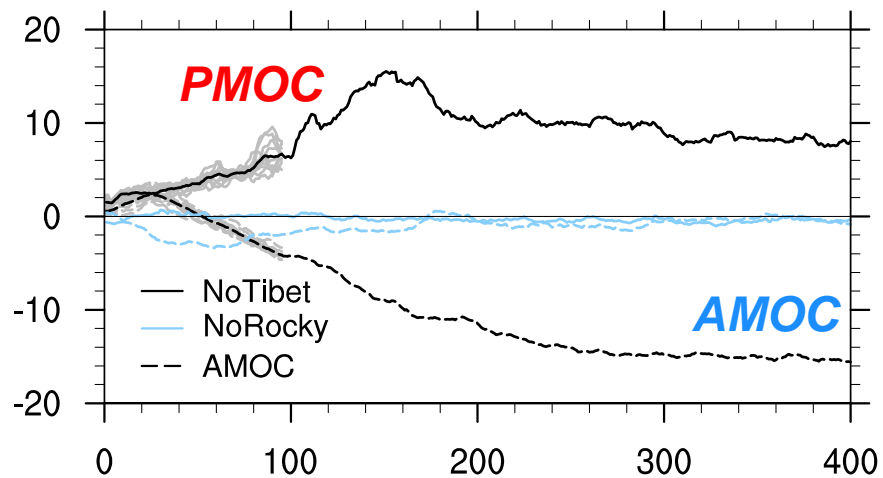
Vertical Salinity Diffusion



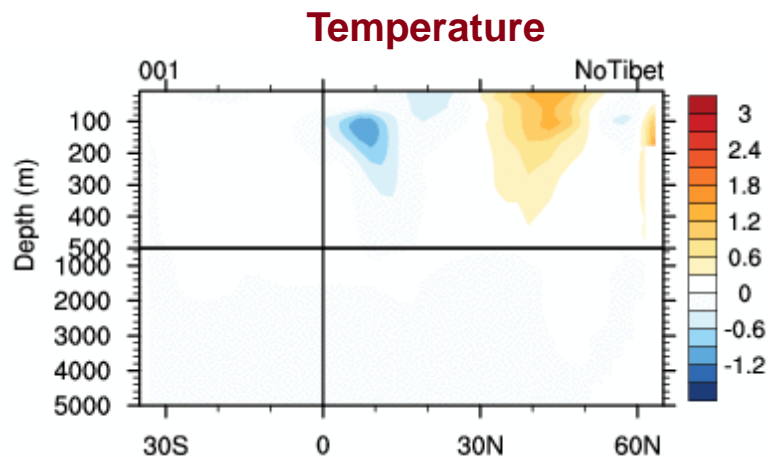
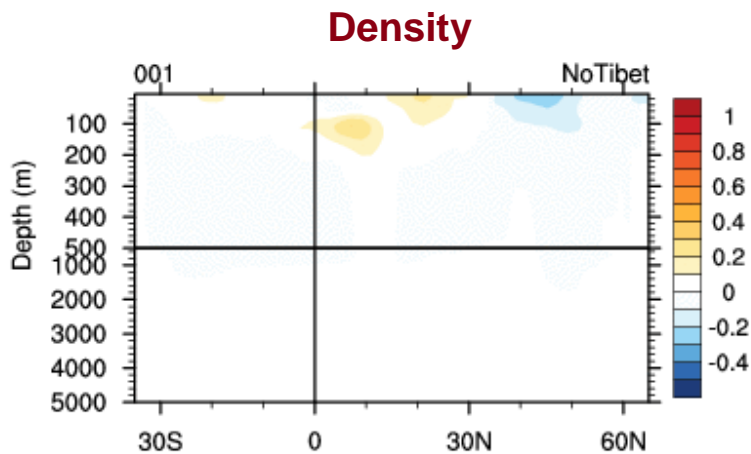
Mechanism for *Salinity* Change



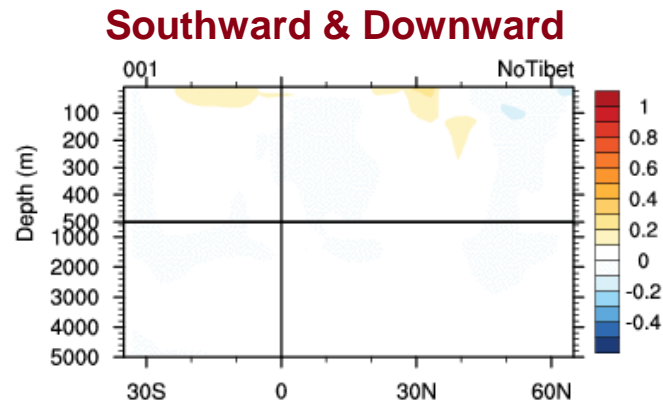
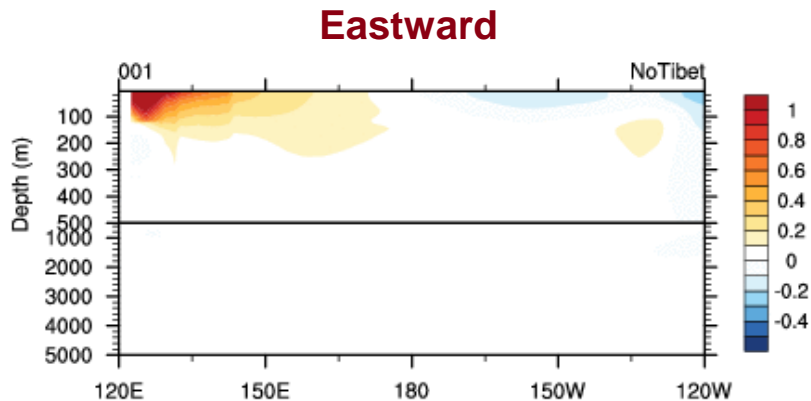
AMOC vs. PMOC



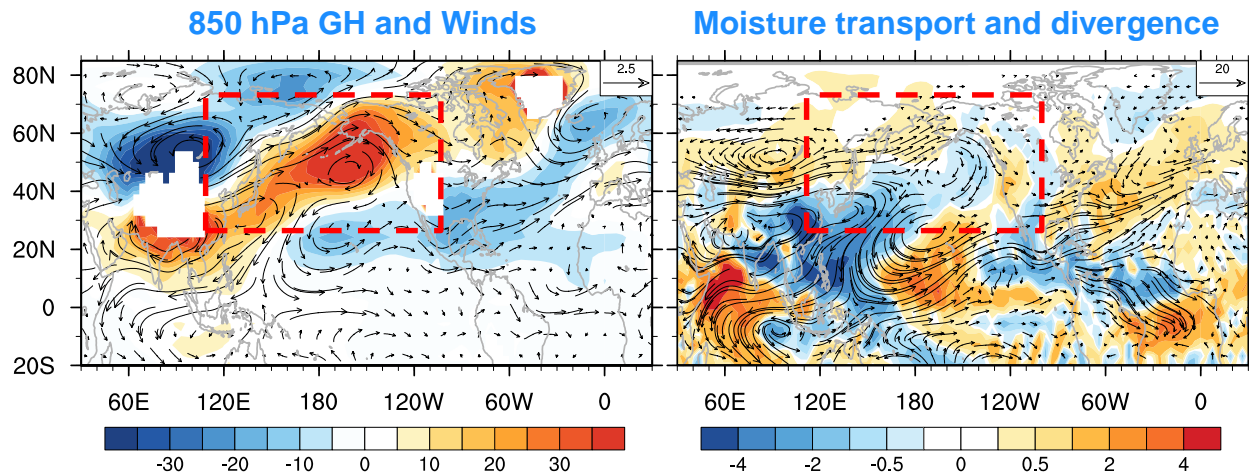
PMOC: Mechanism?



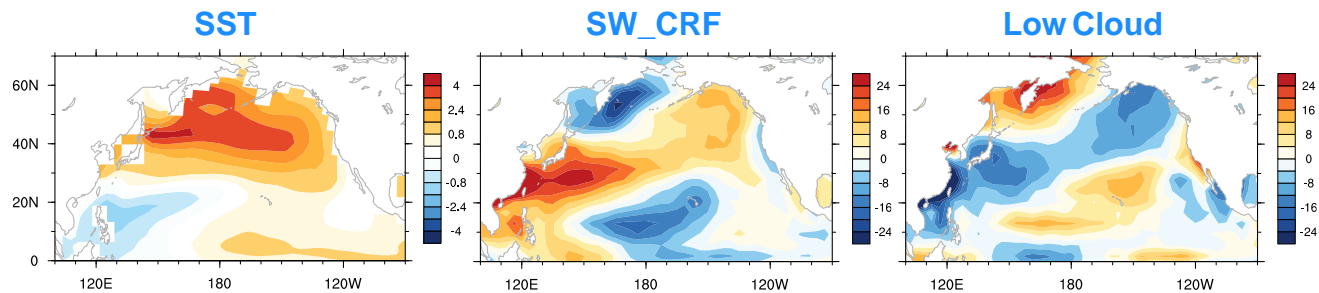
PMOC: *Salinity* Mechanism



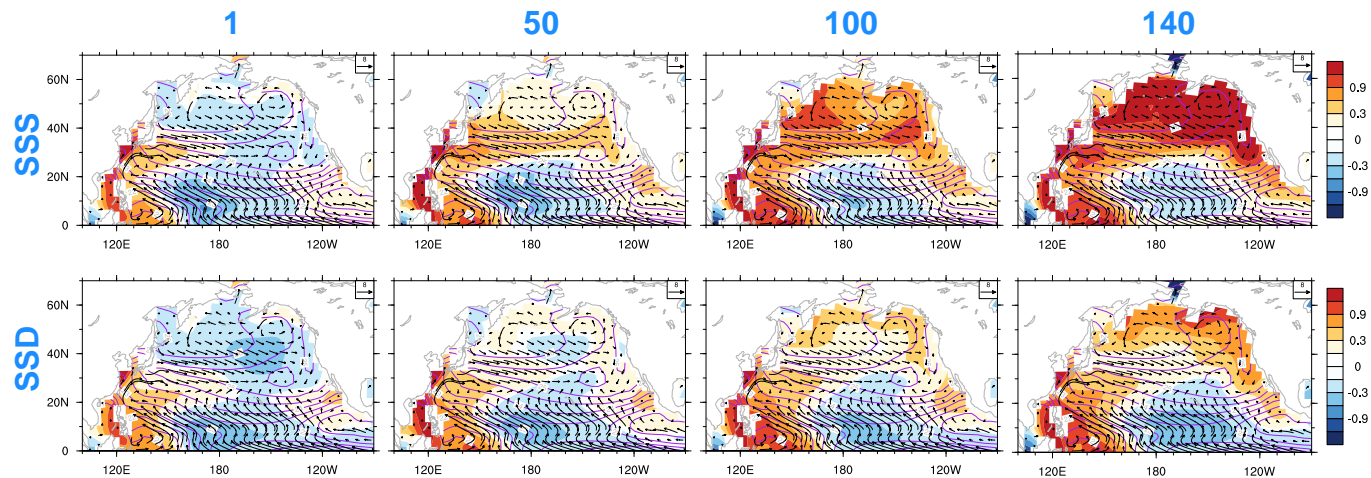
Atmospheric Changes



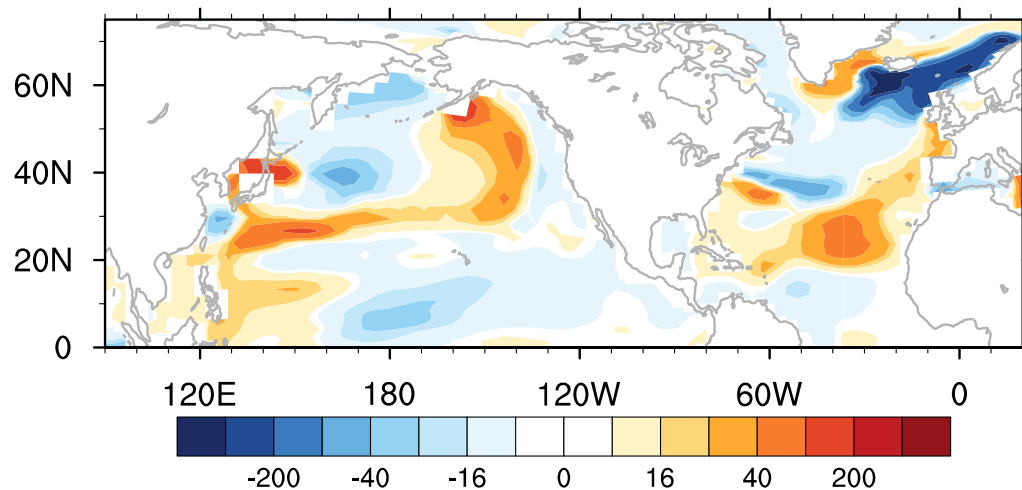
SST Change



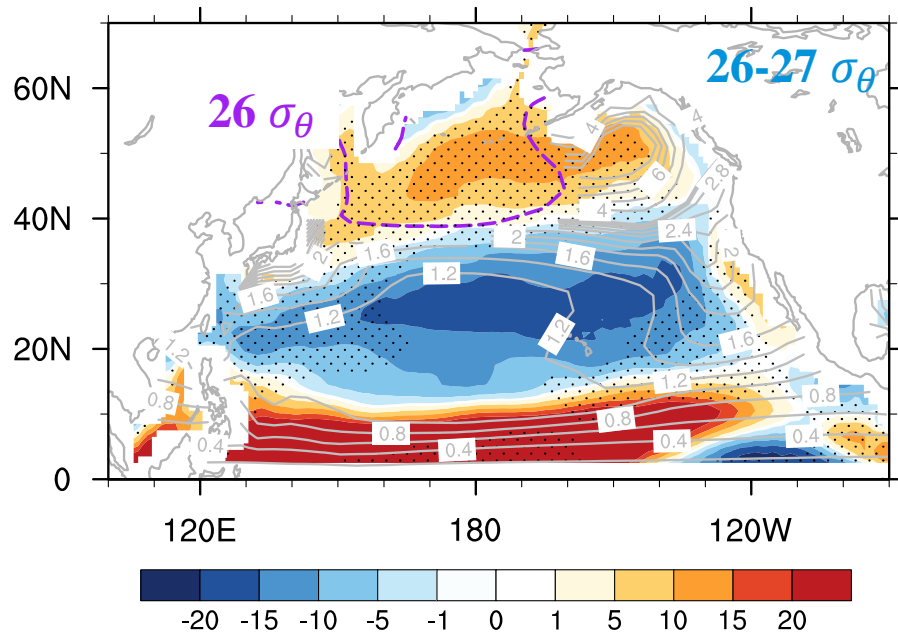
Surface Salinity and Density Changes



Mixed Layer Depth Change

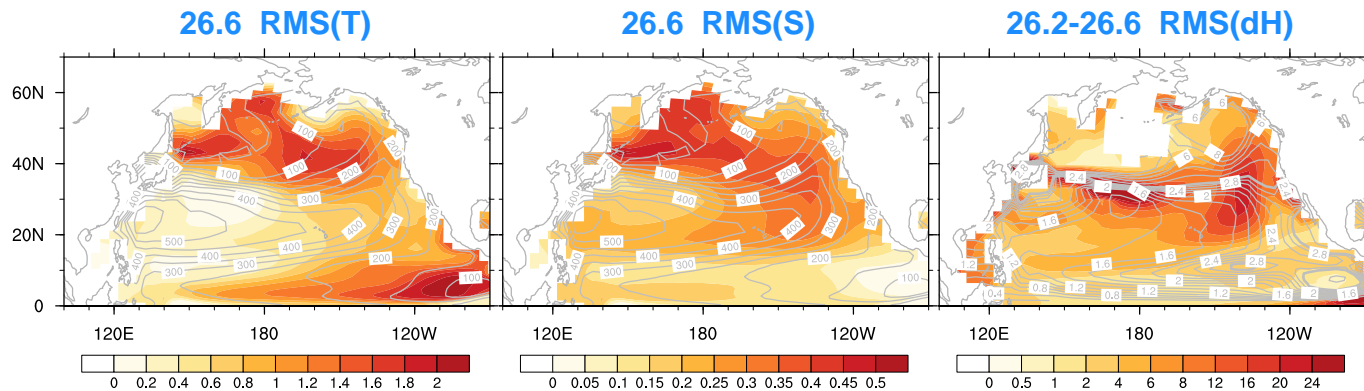


Ekman Pumping and PV

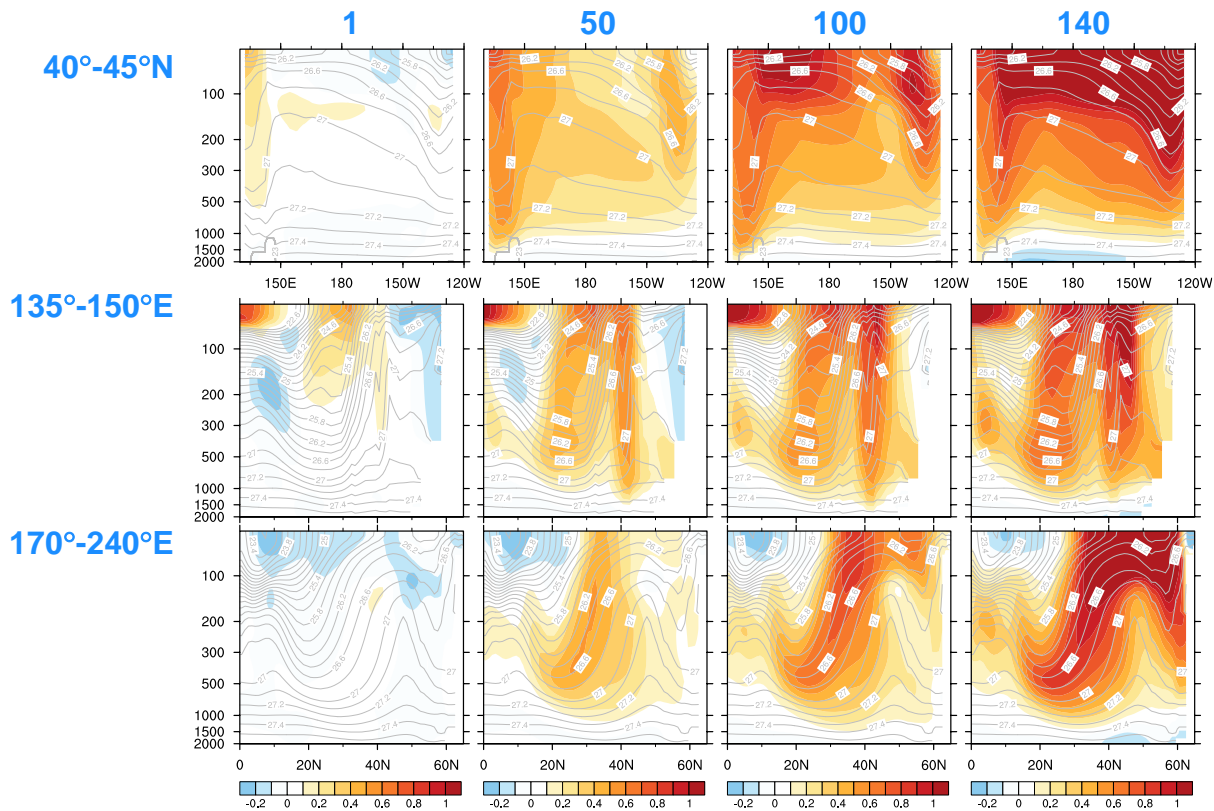


Black Dots: Enhanced Ekman Downwelling

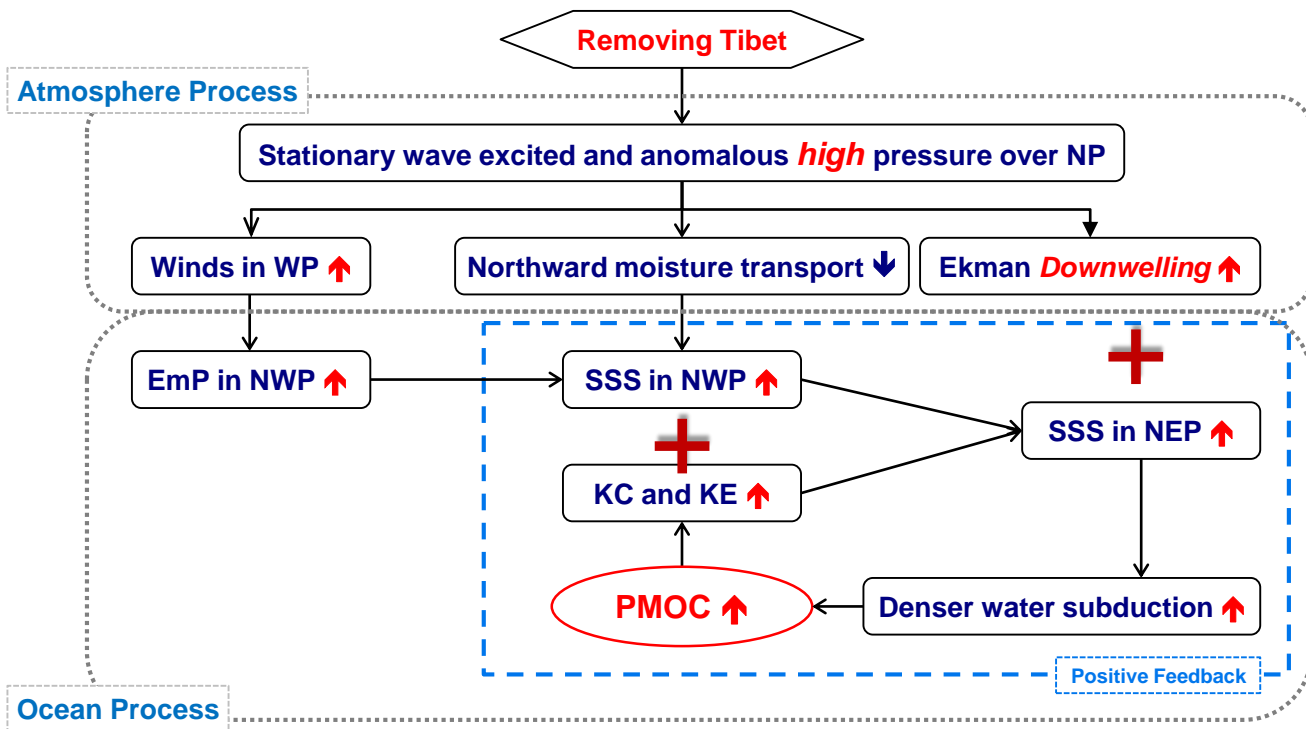
RMS of *Temp*, *Salinity* and *Thickness*



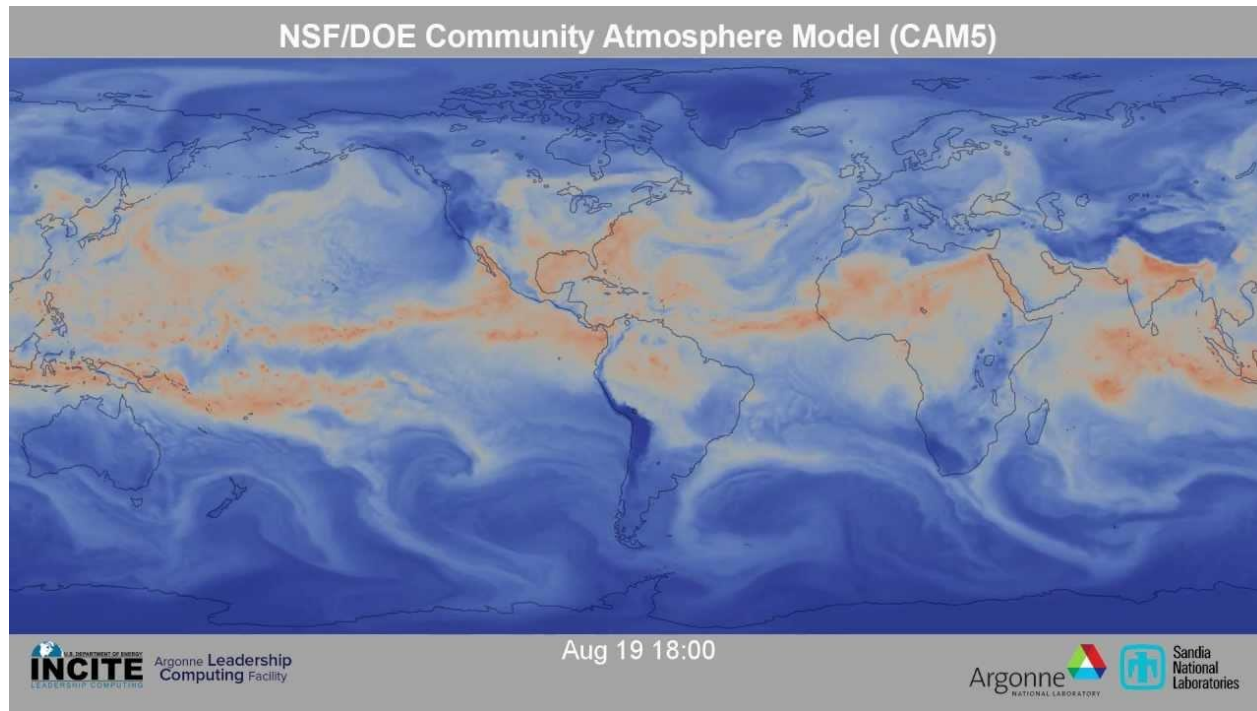
Salinity Subduction



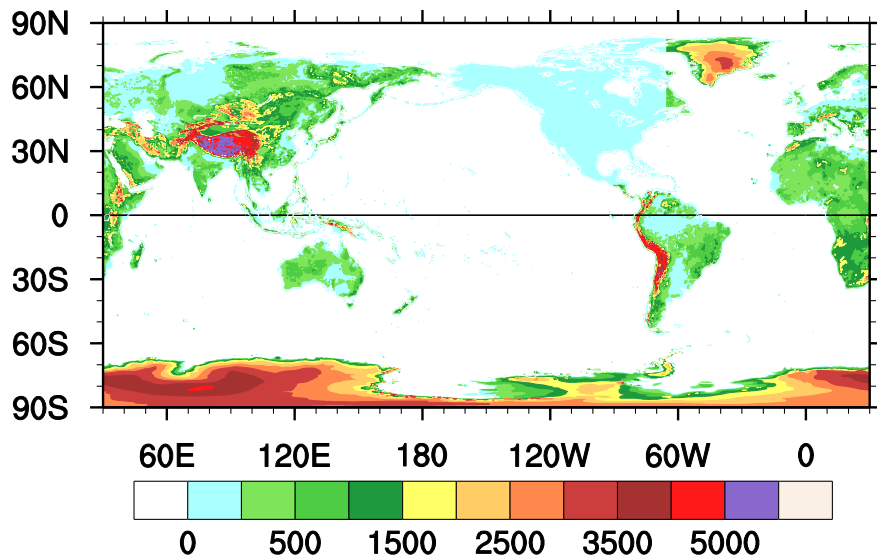
Mechanism



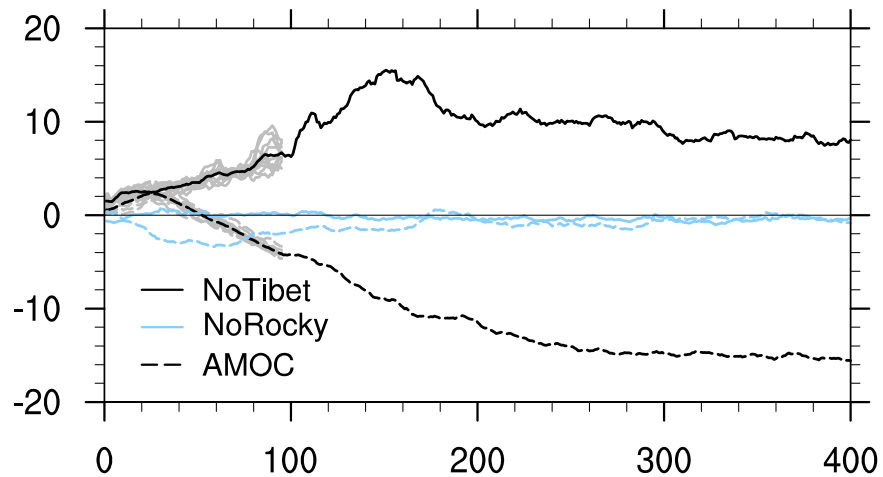
Atmosphere River



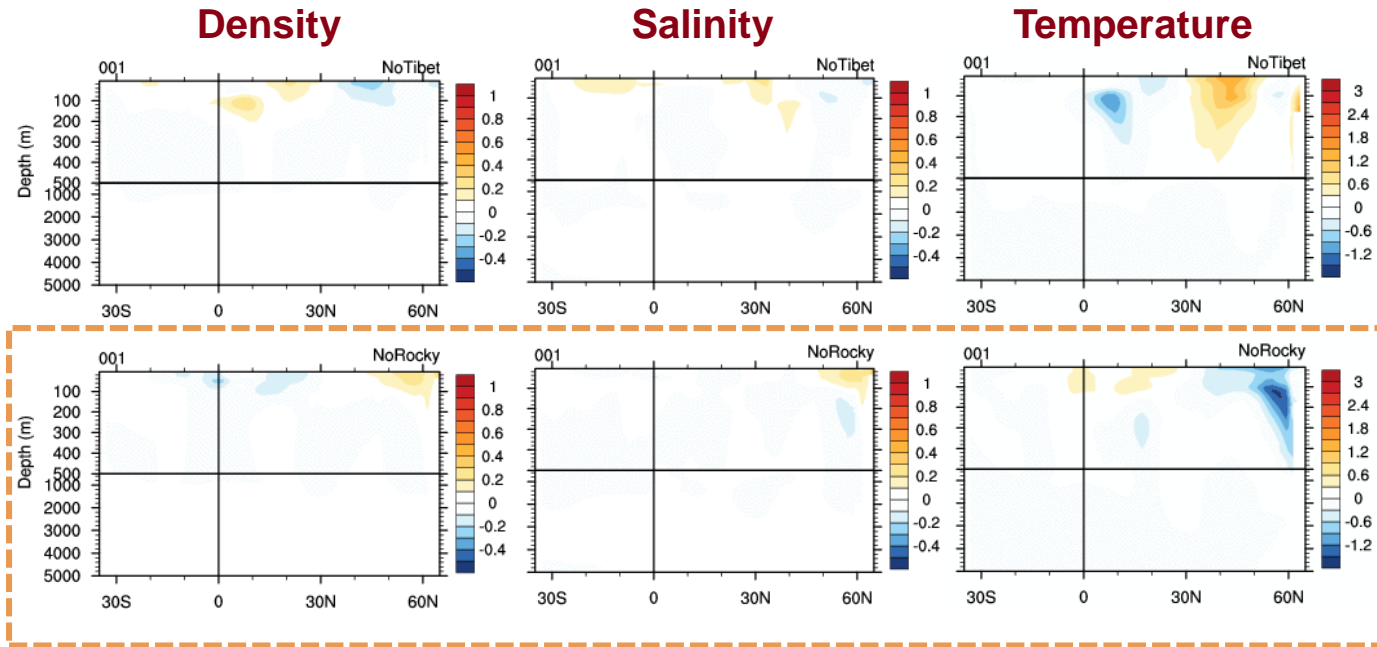
Role of *Rocky Mountain*?



Rocky Mountain: No Role?



Rocky Mountain: No Role in MOC



Summary

0 → **1** : Critical to **AMOC**, **PMOC**,

Energy and moisture transport

in / between SH and NH

1 → ∞



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谢谢

