

How Tibetan Plateau Affects the Global Climate? Part: I

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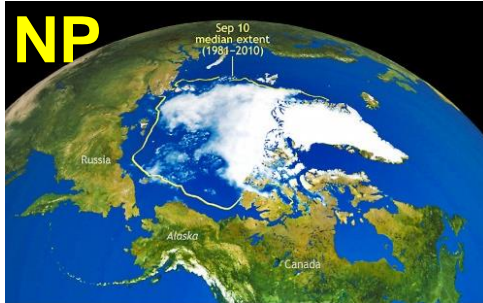
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Tibetan Plateau (TP): the 3rd Pole

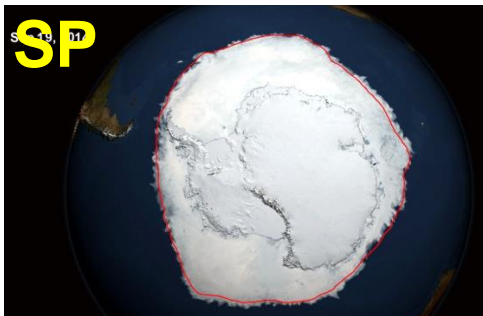
Total Area: 2.5 million km², Elevation: 4000 m



A Fundamental Question: *With / Without* TP



- Greenland Ice Melting → **+7m** ↑↑ global ocean



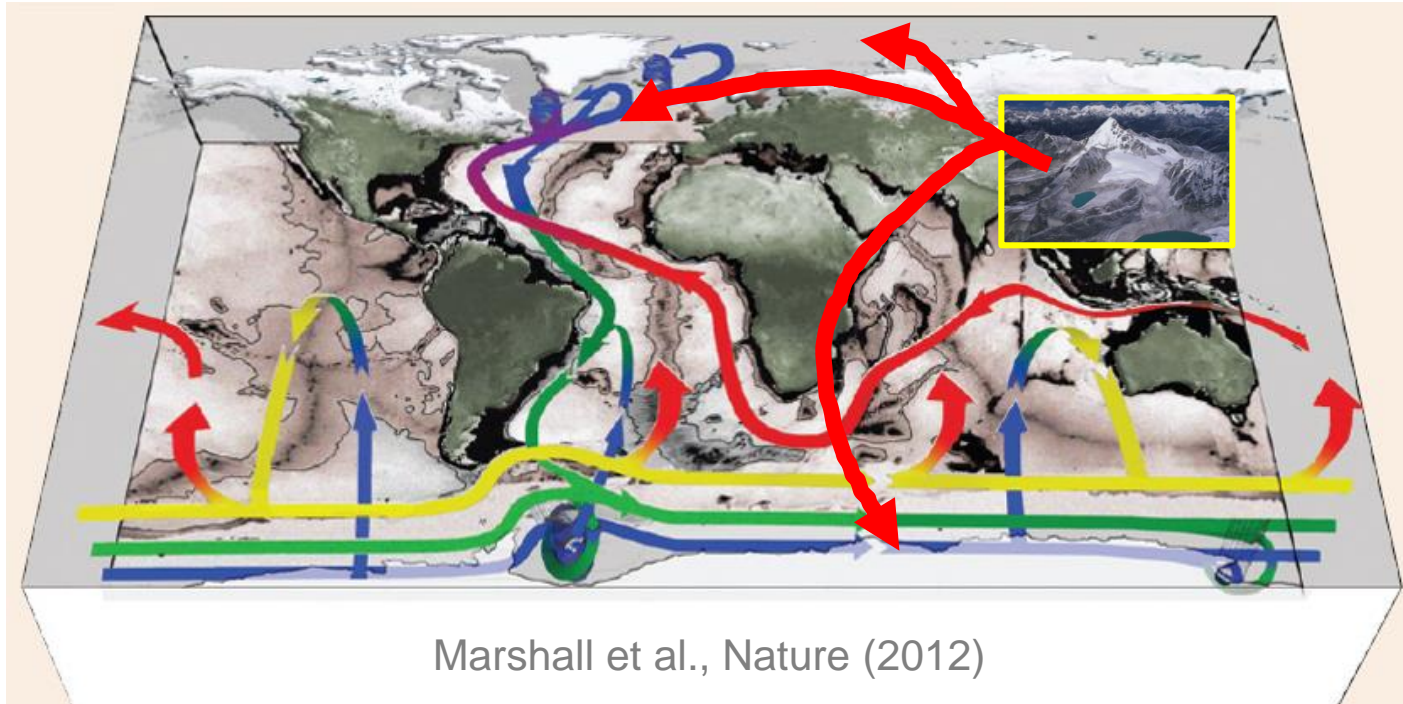
- Antarctic Ice: 70% FW, 90% Ice Melting → **+61m** ↑↑ global ocean



- ***With / Without*** TP: Sea level and fundamental climate differences?

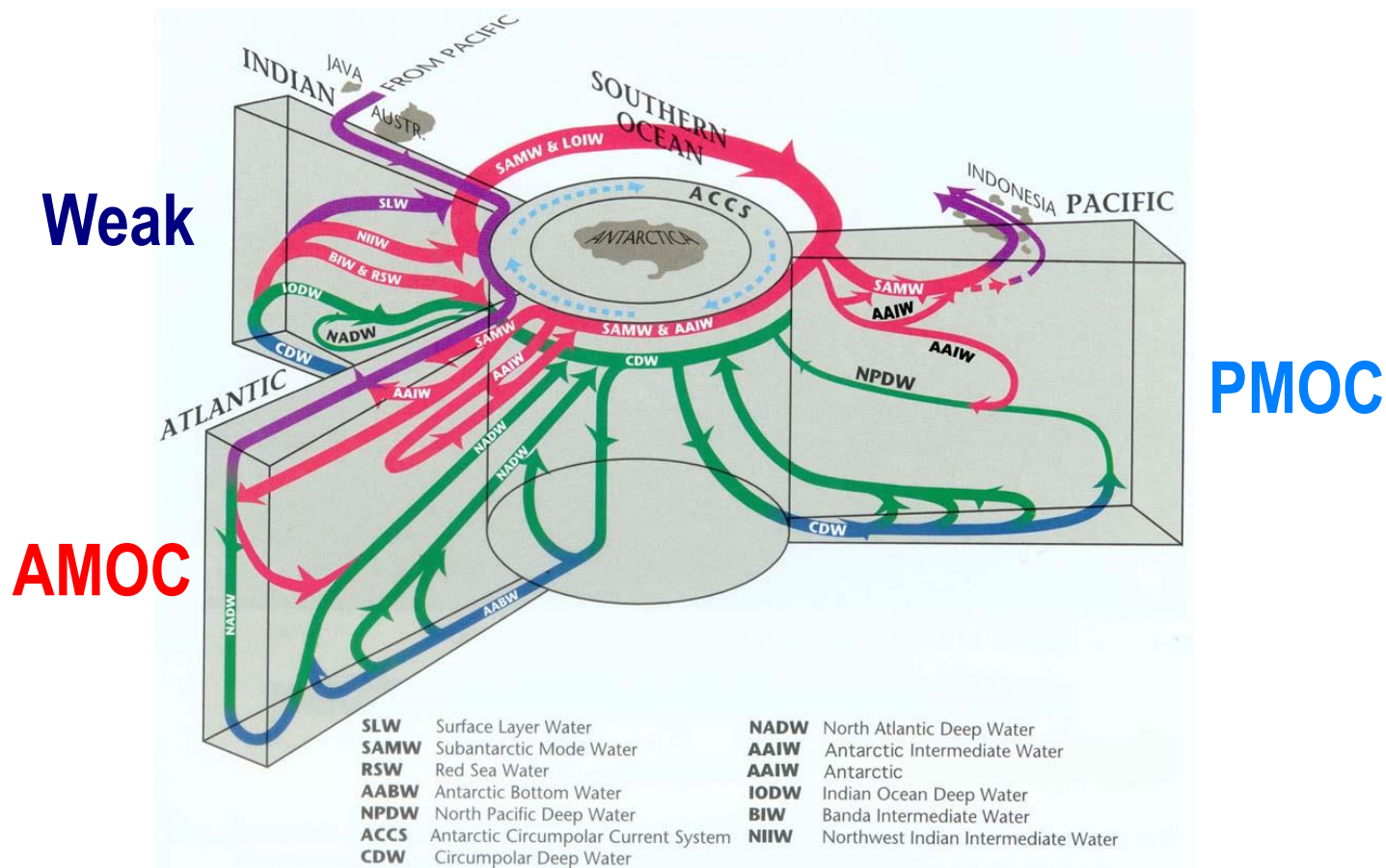
TP: A *Global* Perspective

How and to what extent?



Global Meridional Overturning Circulation

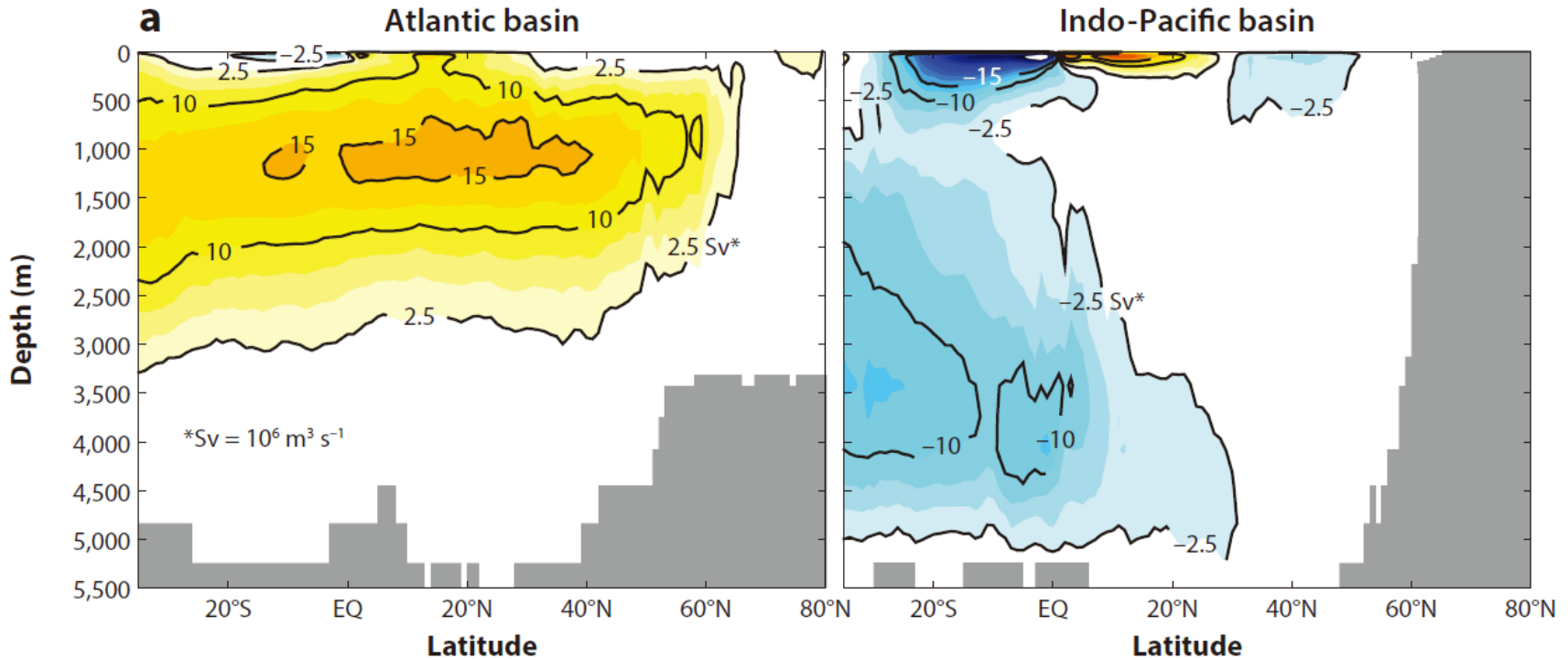
Energy and Freshwater Balance



Schmitz (1997) Overturning circulation: Southern Ocean View

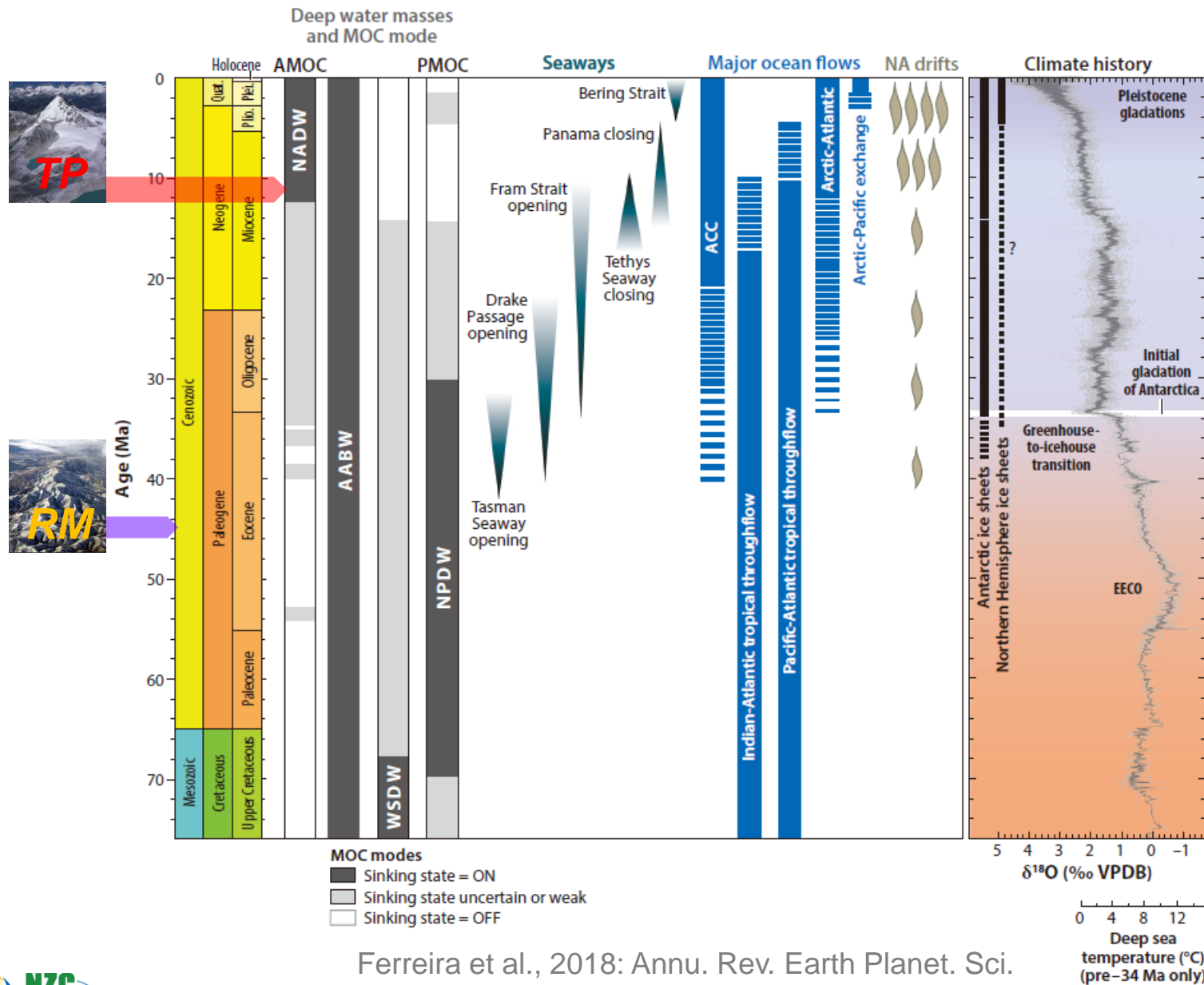
Strong AMOC

Weak PMOC



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

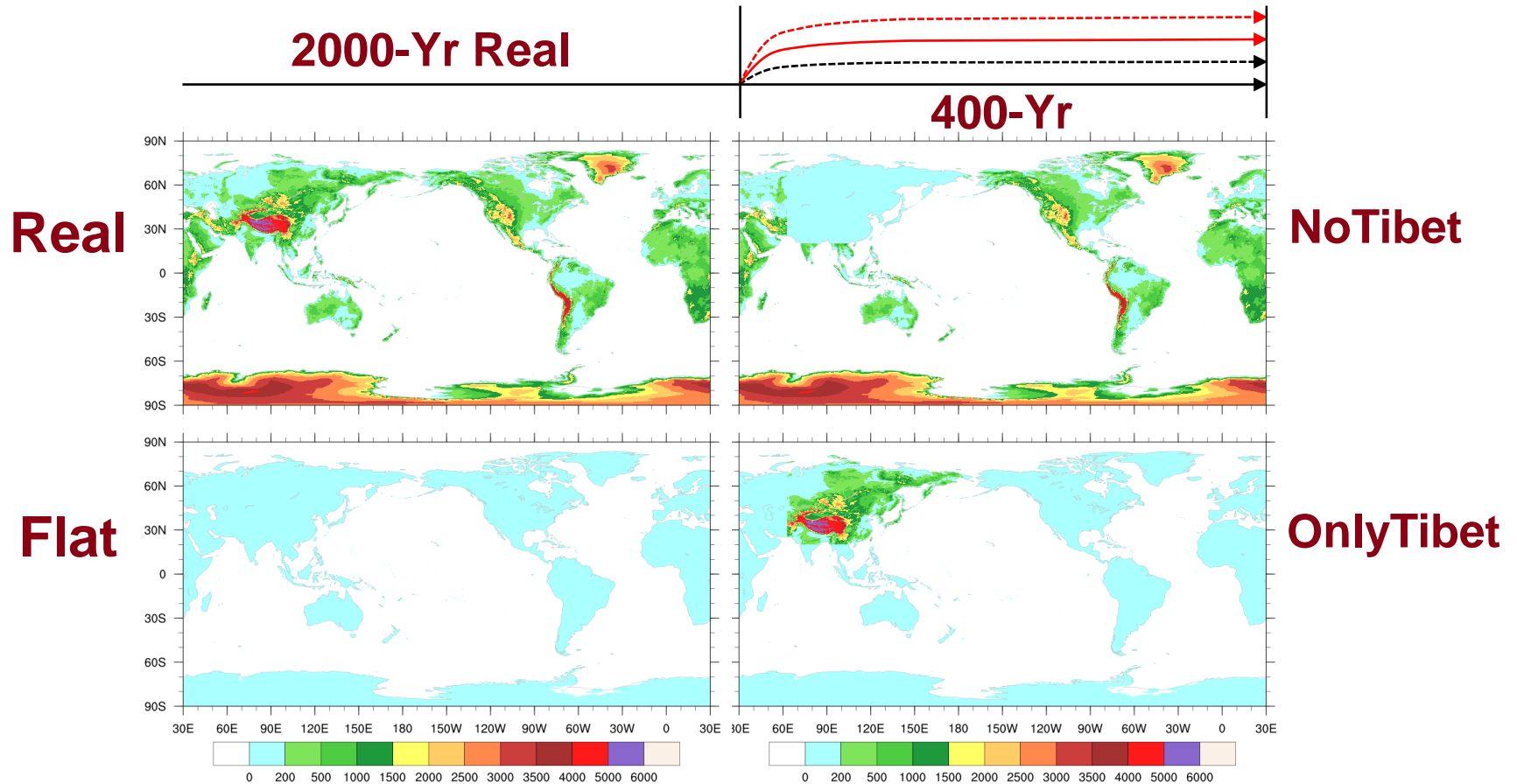
Geological History of *GMOC*



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

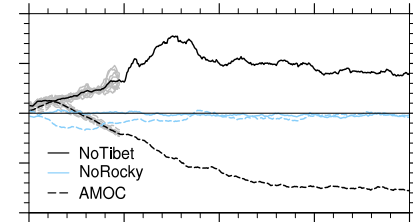
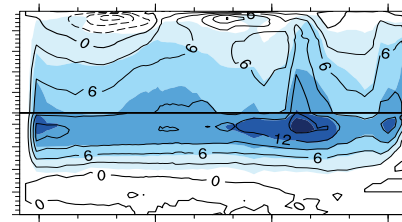
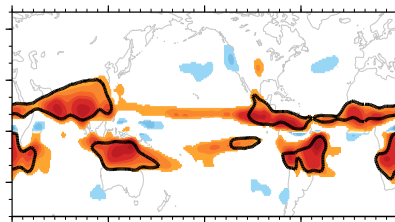
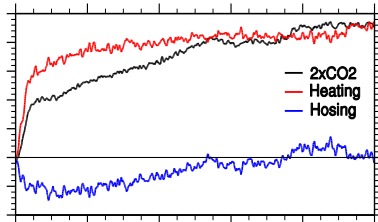
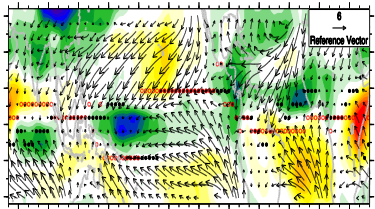
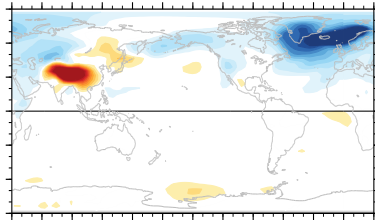
NZC Annual Meeting, Beijing, China, Oct. 16 – 17, 2018

Coupled Earth System Model



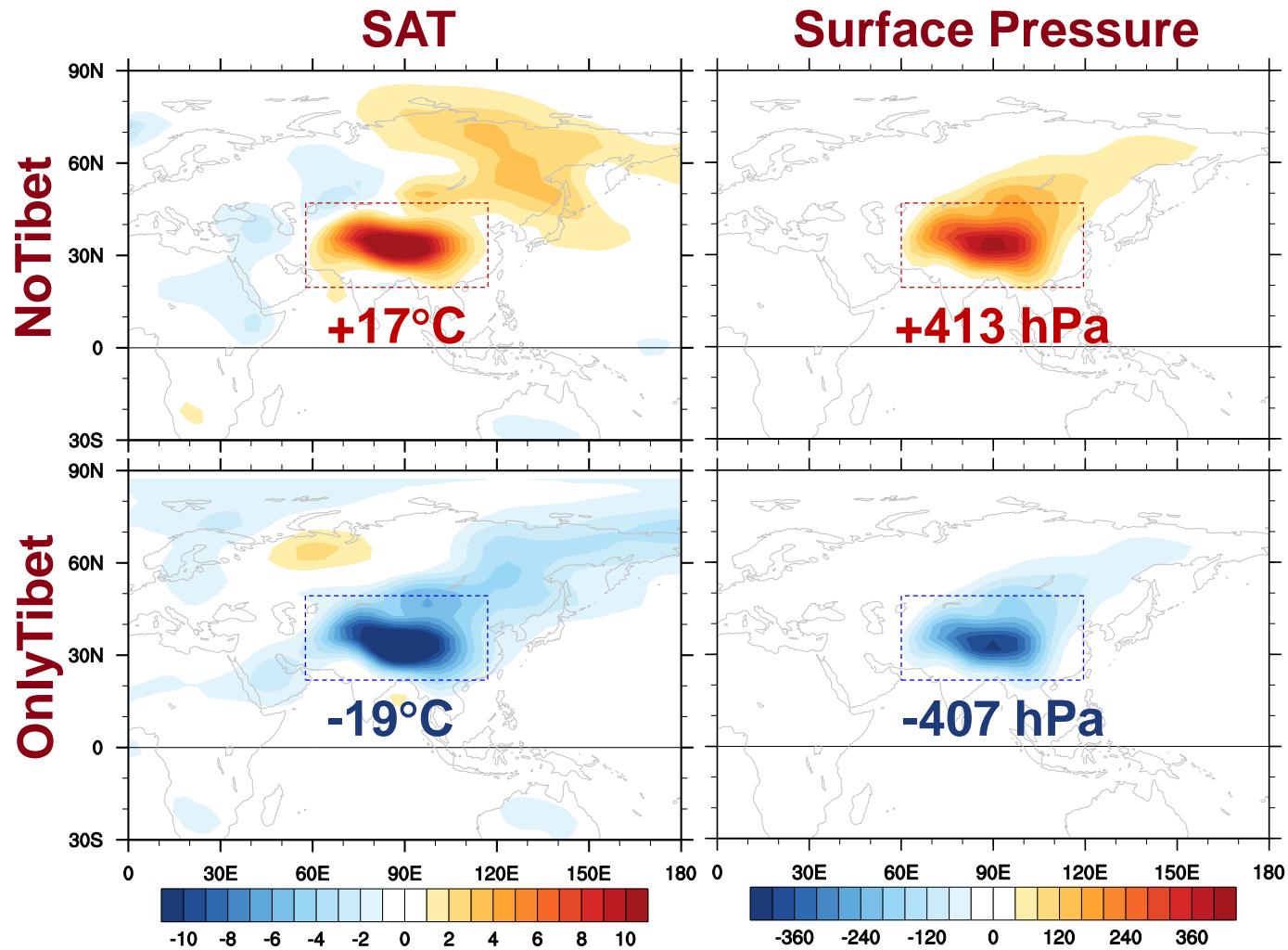
NCAR CESM1.0: CAM5 / POP2 / CLM4 / CICE4 / Glimmer-CISM

TP in Climate System



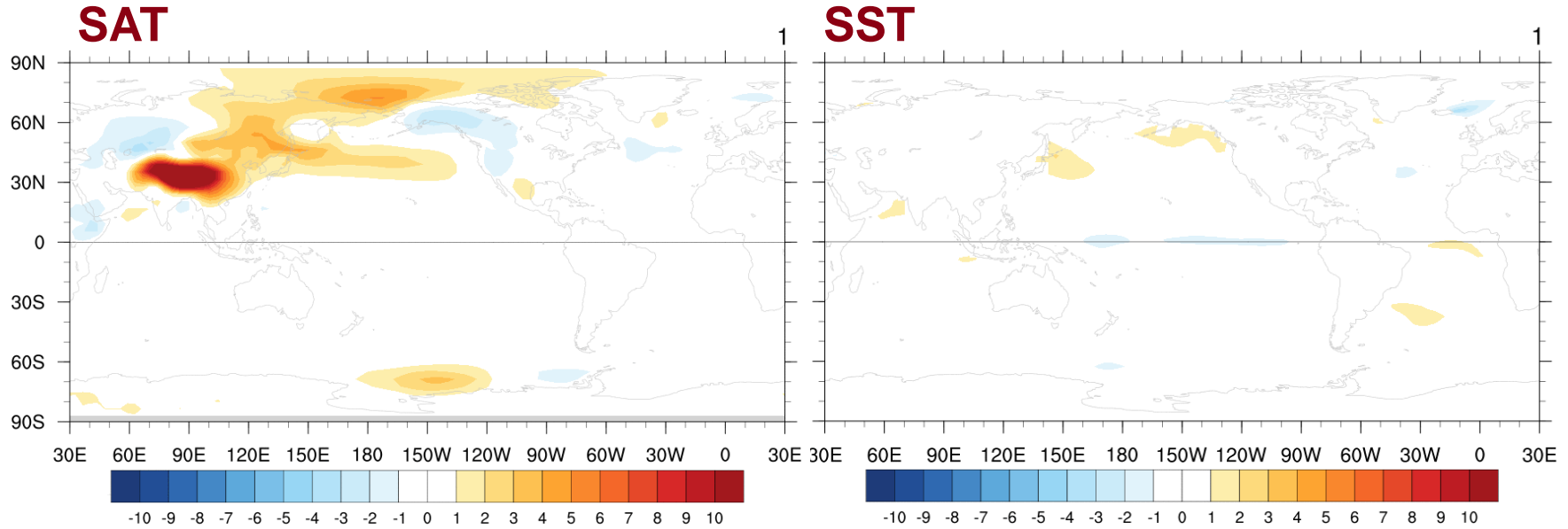
- Yao et al., TP role in global climate: annual mean (*Writing*)
- Yao et al., TP role in global climate: SC and monsoon (*Writing*)
- Wen et al., TP in shaping AMOC (*Writing*)
- Wen et al., TP in see-saw of PMOC and AMOC (*Writing*)
- Shen et al., TP effect on Atlantic ITCZ (*Writing*)

TP Forcing: *Thermal* and *Dynamical*

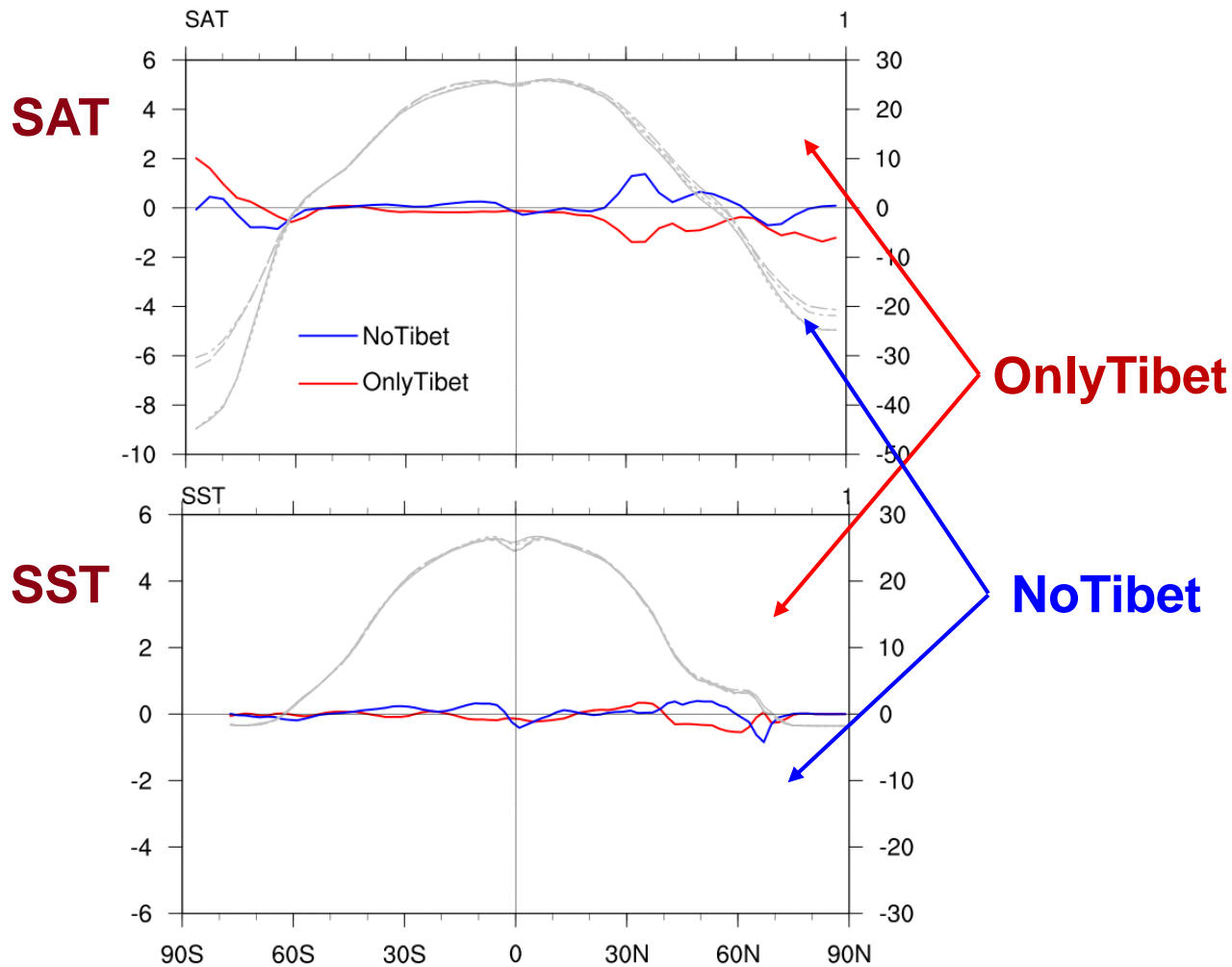


Lapse Rate $T \sim 4 \text{ km} \times 7 \sim 28^\circ\text{C}$

Surface Temperature w/o TP

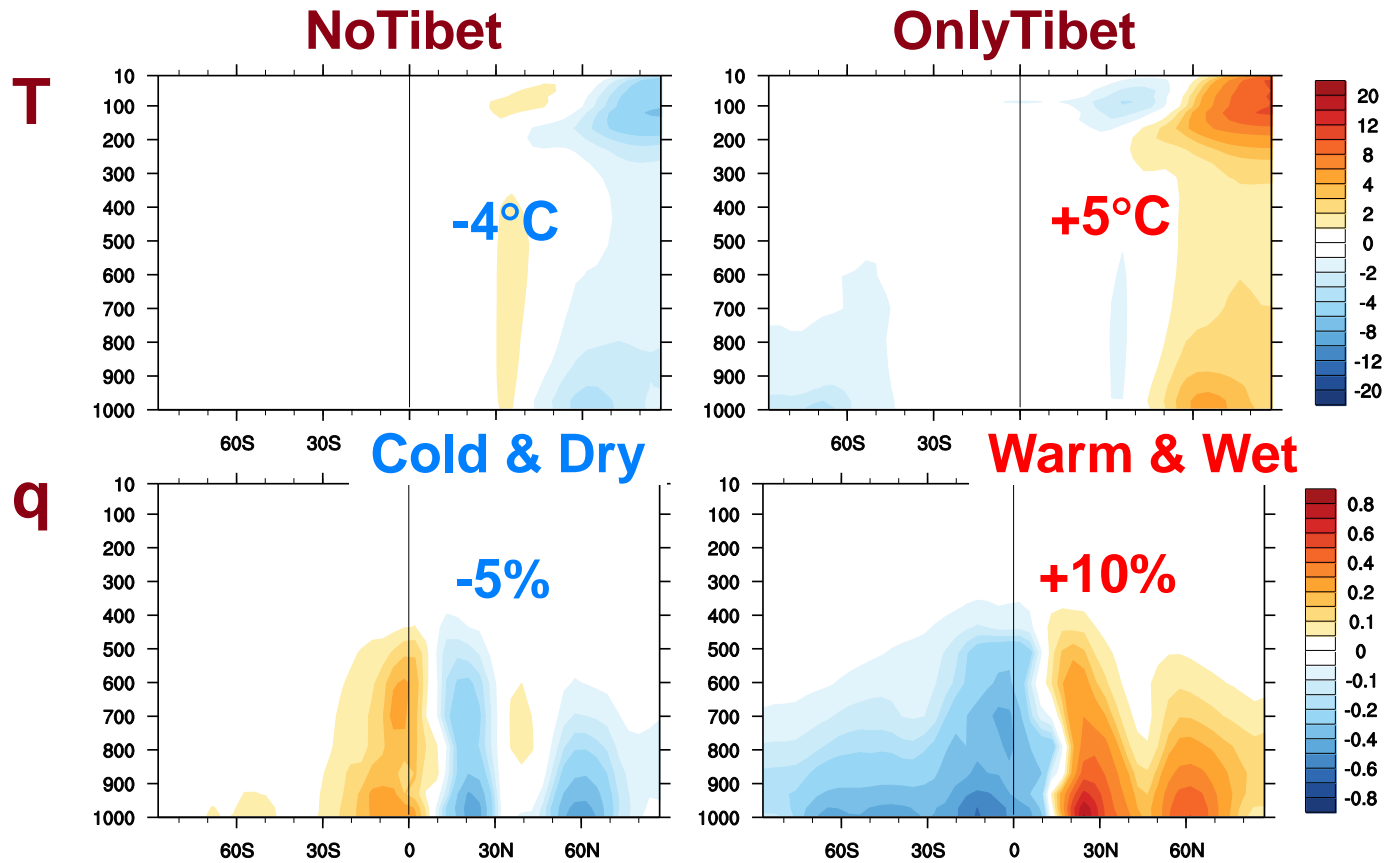


Mean SAT and SST

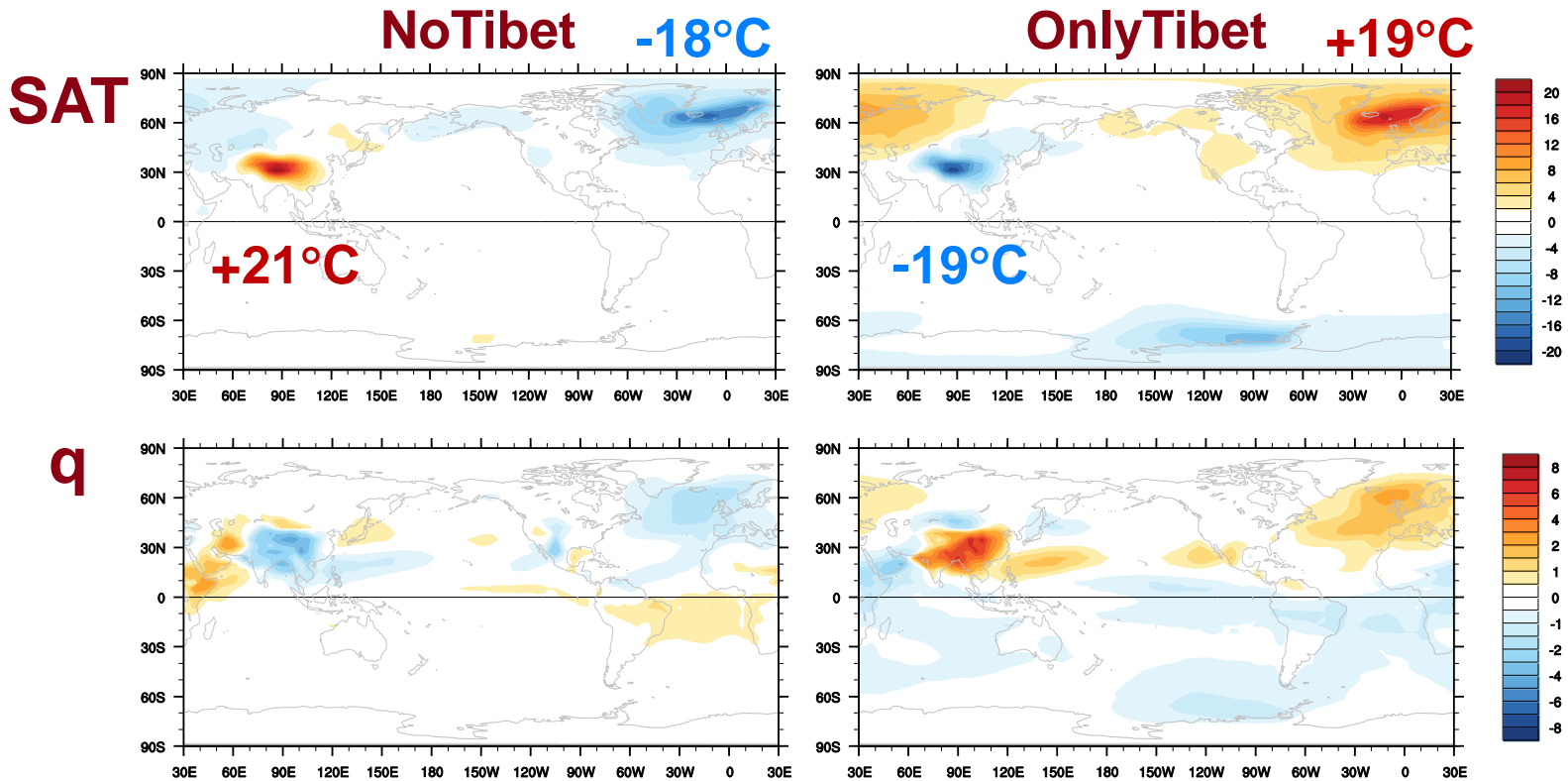


NoTibet: -0.4°C / OnlyTibet: +0.1°C

Atmosphere T and Moisture

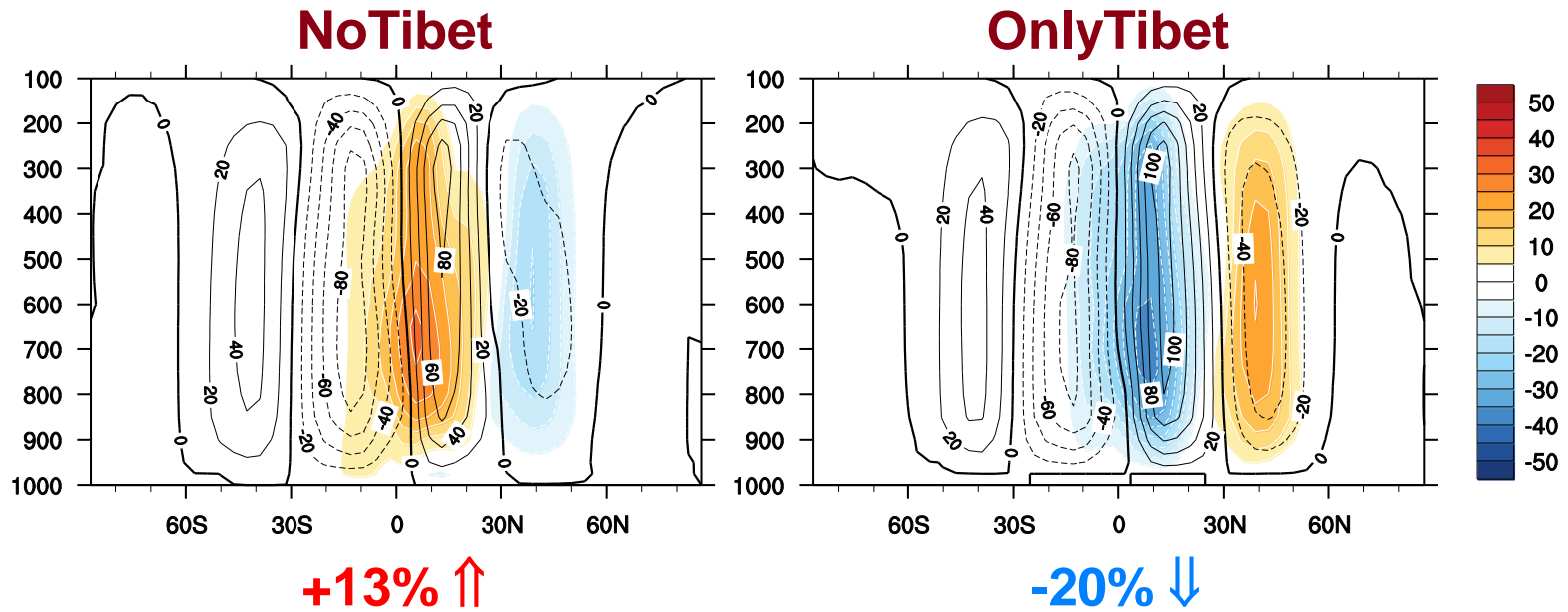


SAT and Specific Humidity

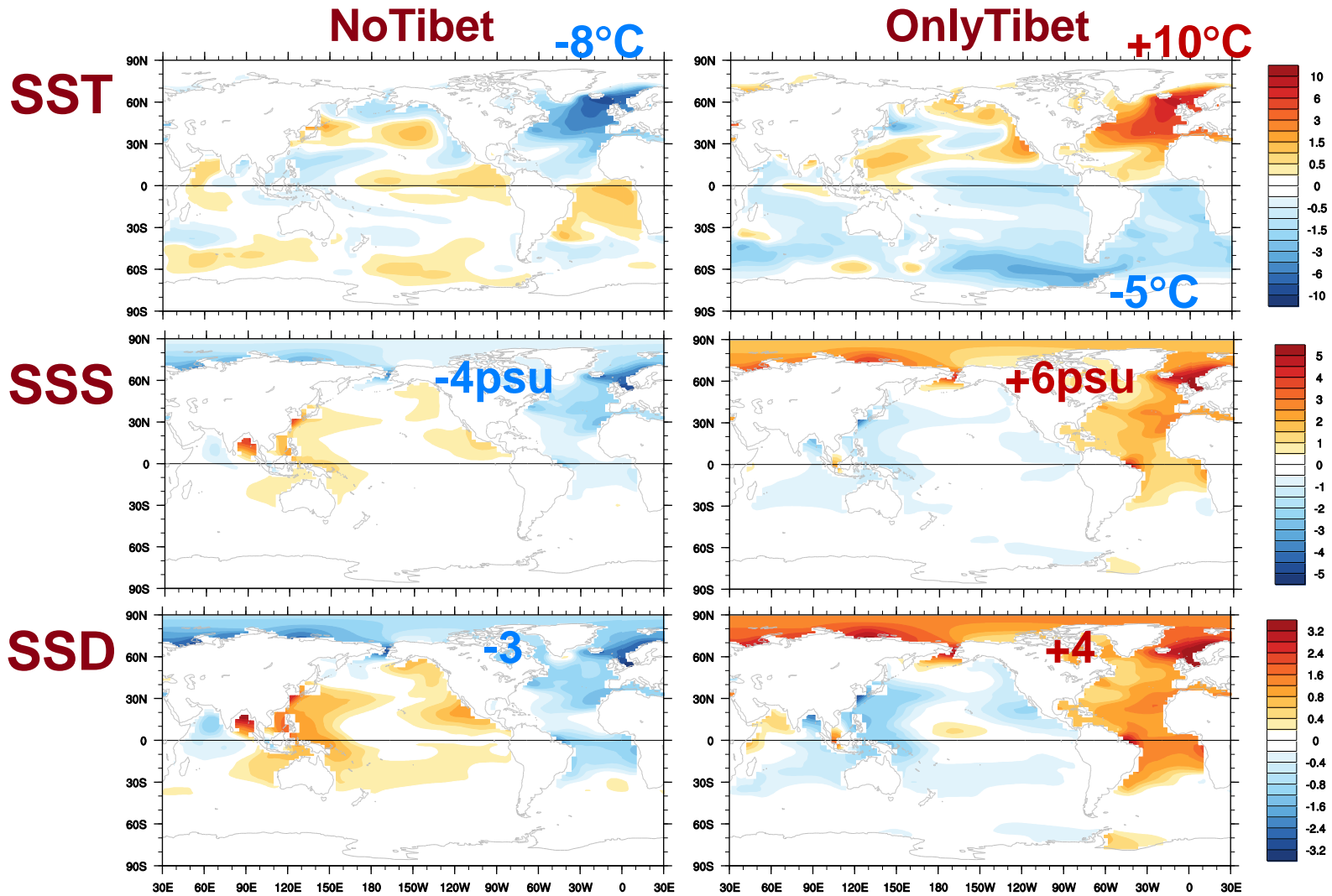


- Local: around Tibetan Plateau
- Remote: Atlantic & Southern Ocean

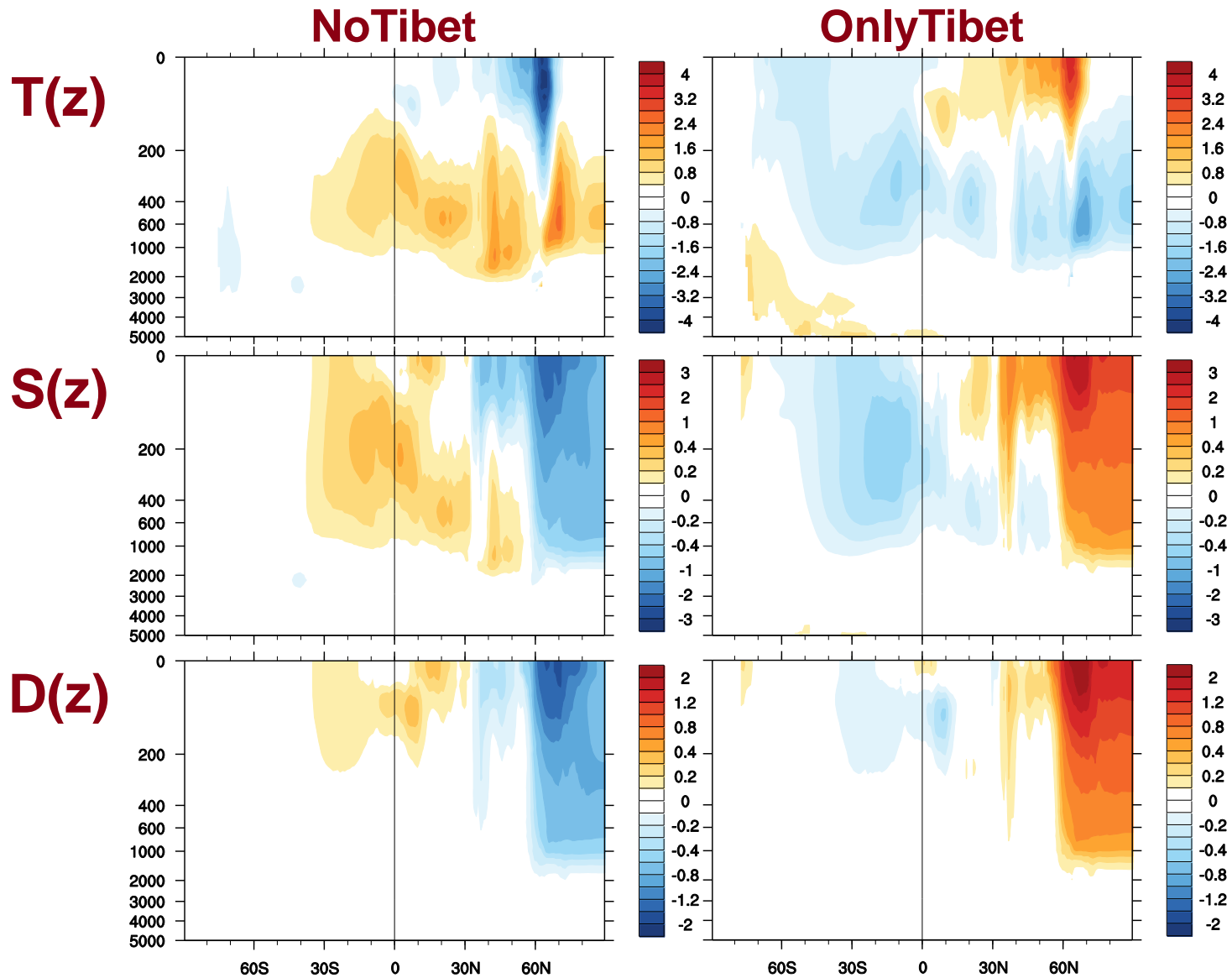
Hadley Cell



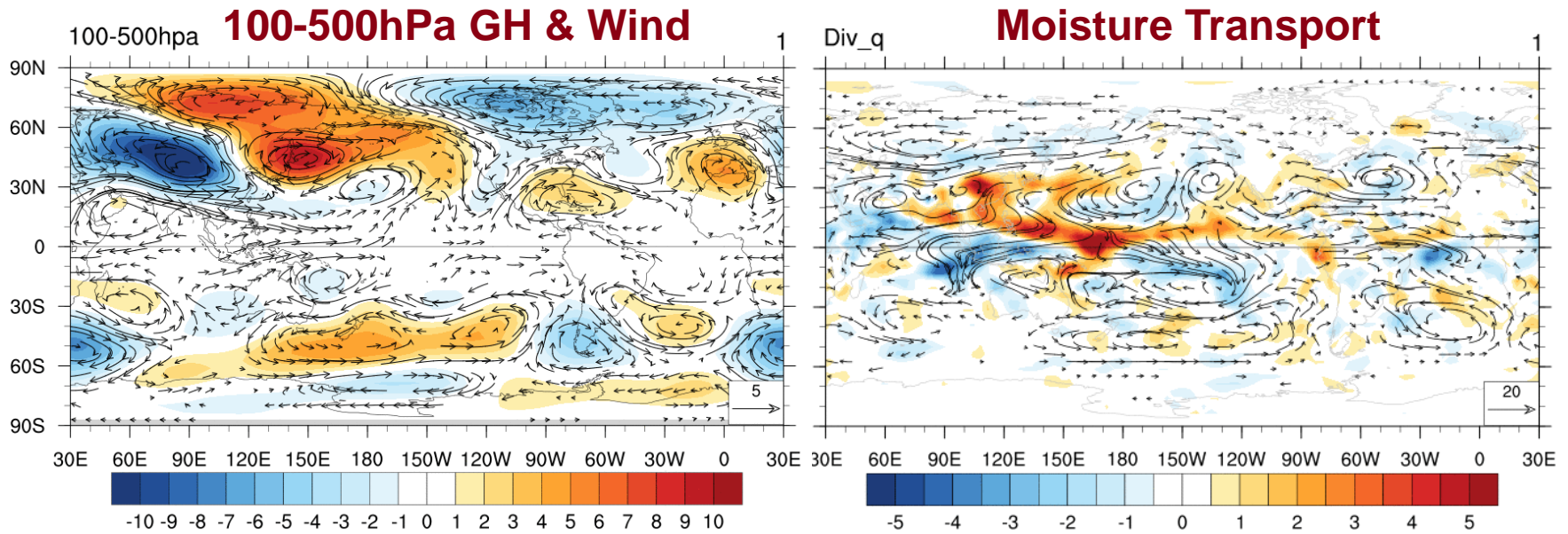
SST, SSS and SSD



T, S and D

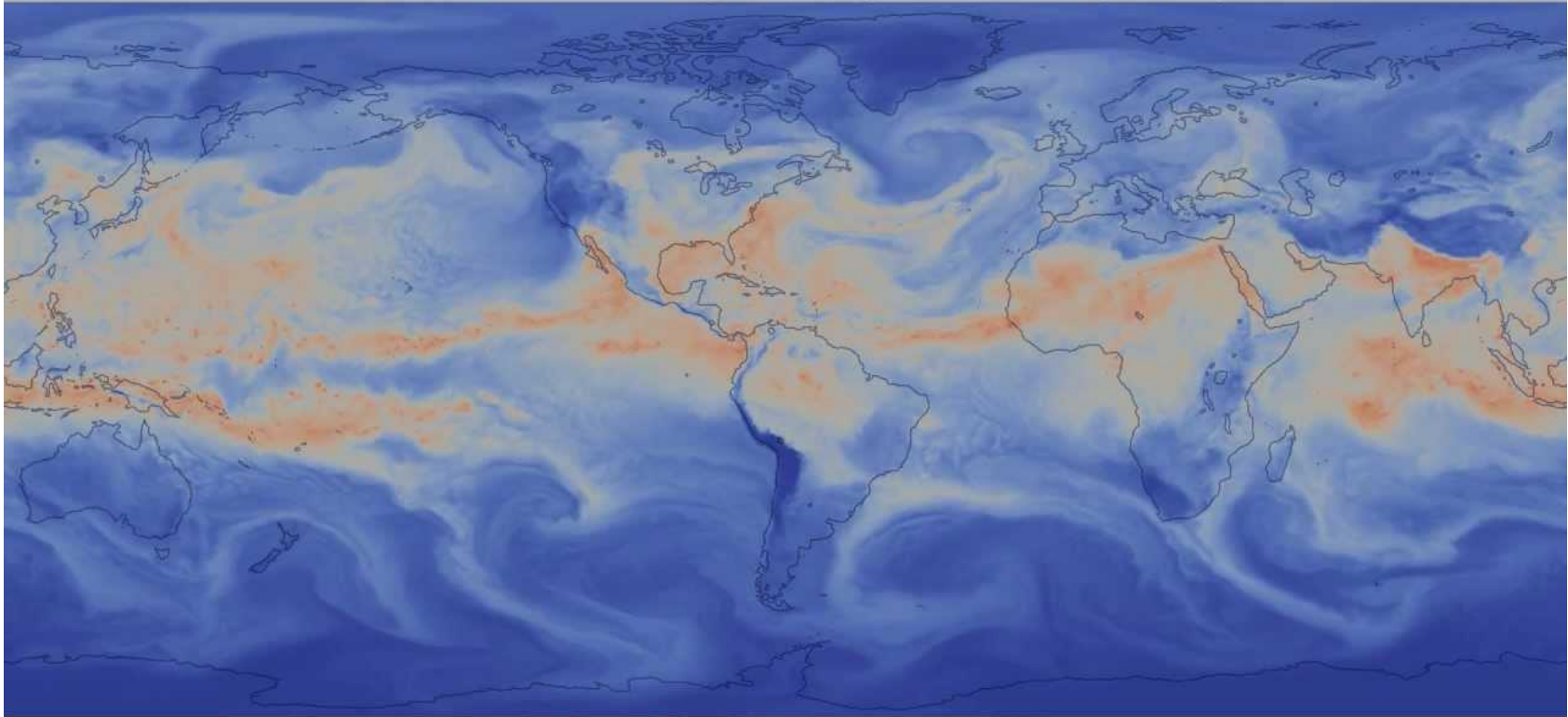


Planetary Wave and Moisture Transport



Atmospheric River

NSF/DOE Community Atmosphere Model (CAM5)



Aug 19 18:00

U.S. DEPARTMENT OF ENERGY
INCITE
LEADERSHIP COMPUTING
Argonne Leadership
Computing Facility

Argonne NATIONAL LABORATORY
Sandia National Laboratories

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

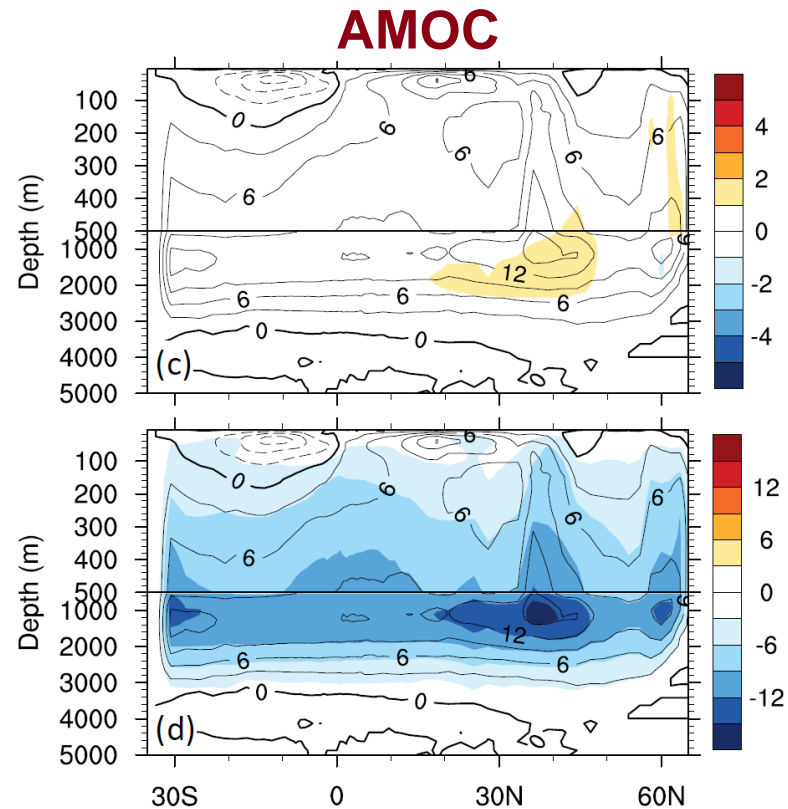
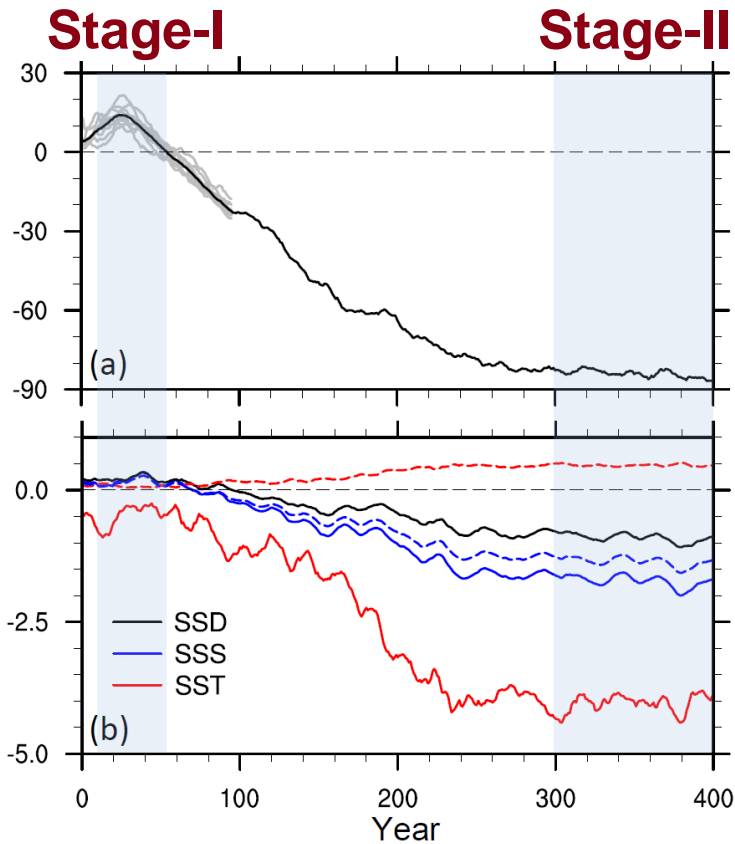
0 → 1 : Critical in Shaping Global Climate!



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Thanks

AMOC Evolution w/o TP



From *TP* to *AMOC*: Atmosphere Dynamics

Stationary Waves with Tibetan Plateau

