



# Results from Recent CCSM4 Control and 20<sup>th</sup> Century Simulations

## Preliminary Results

Susan Bates

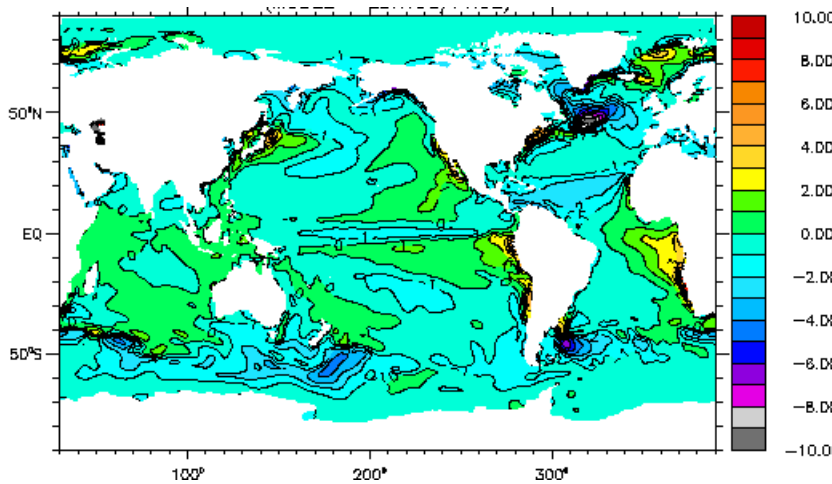
CCSM 2010 Workshop  
Breckenridge, CO

NCAR is sponsored by the National Science Foundation

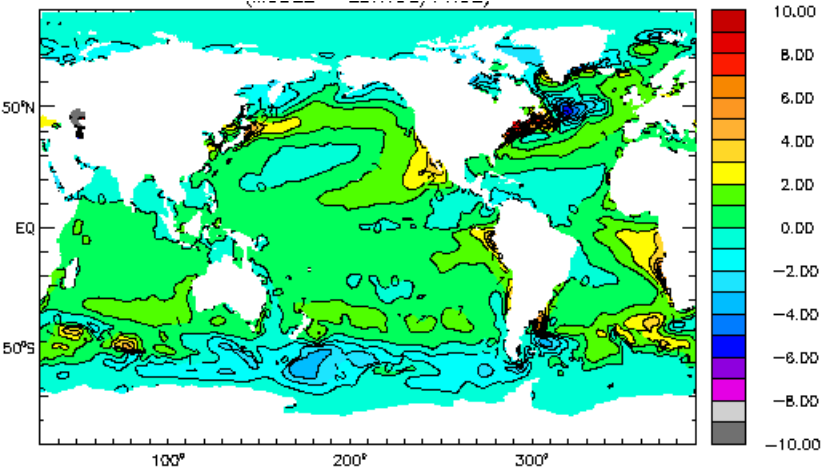
# Sea Surface Temperature Differences from Observations

20<sup>th</sup> Century CCSM3

20<sup>th</sup> Century CCSM4



Mean: -0.43  
RMS: 1.29



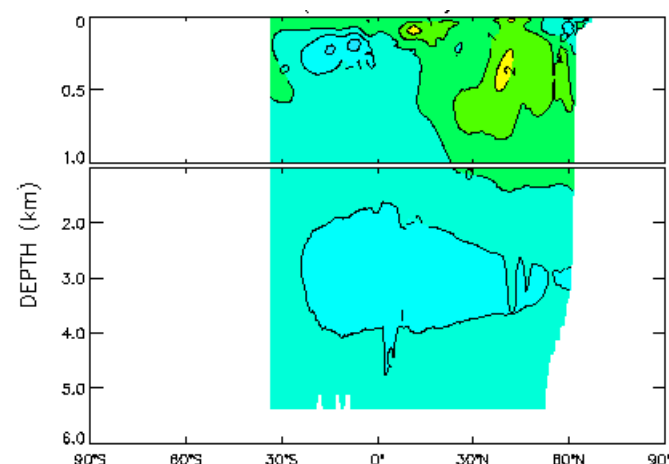
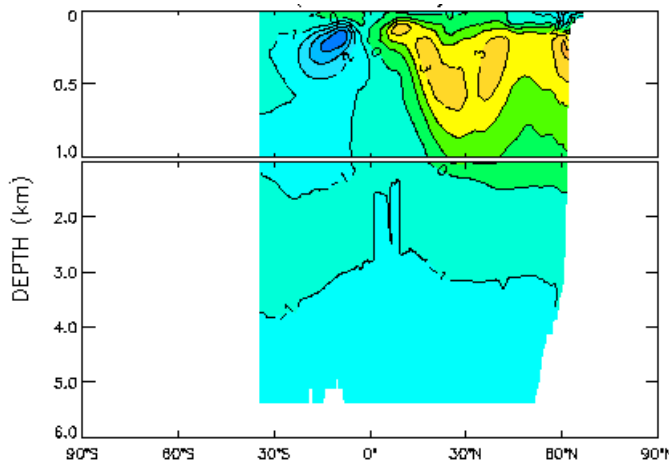
Mean: 0.35  
RMS: 1.17

# Zonal Average Temperature Differences from Observations

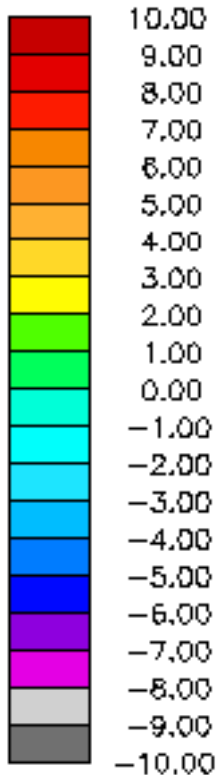
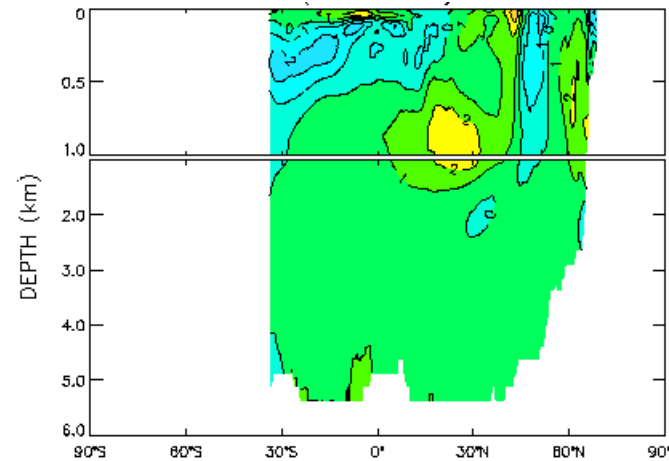
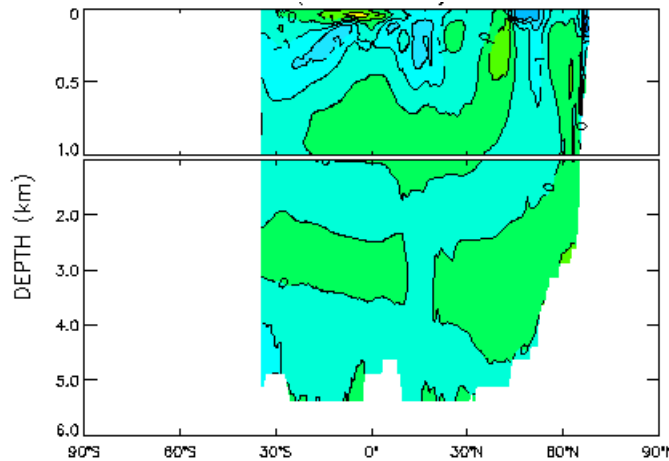
20<sup>th</sup> Century CCSM3

20<sup>th</sup> Century CCSM4

Pacific



Atlantic

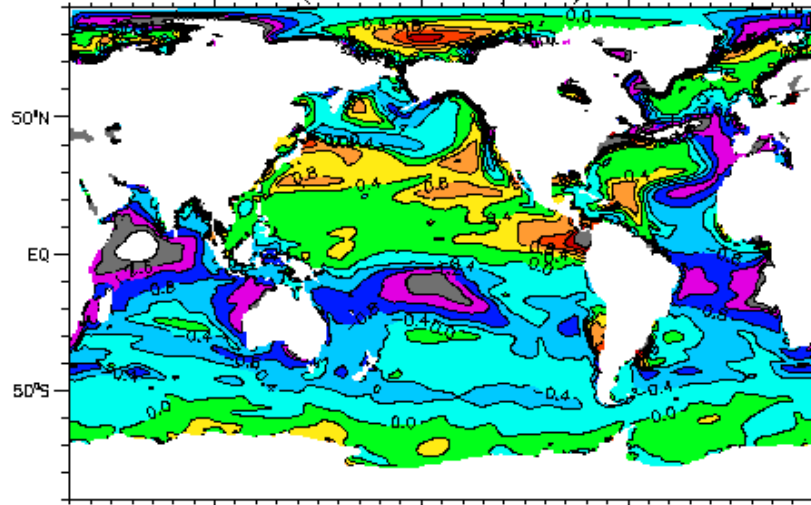


# SALINITY DIFFERENCES FROM OBSERVATIONS

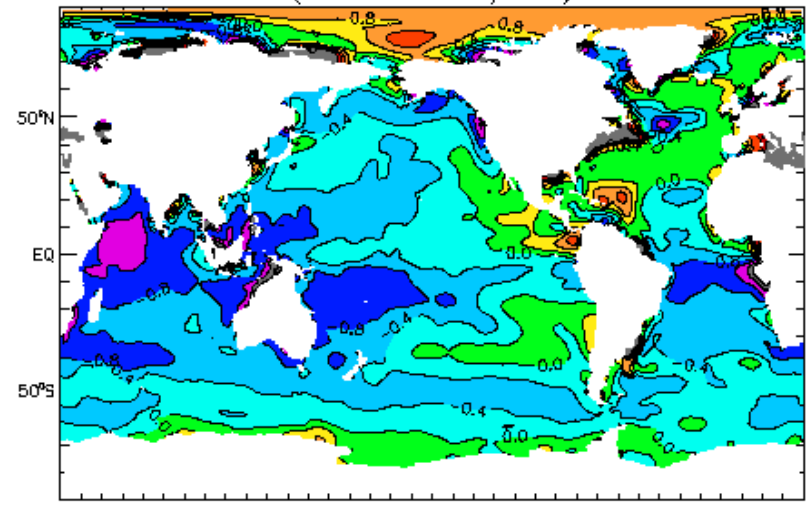
20<sup>th</sup> Century CCSM3

20<sup>th</sup> Century CCSM4

Surface

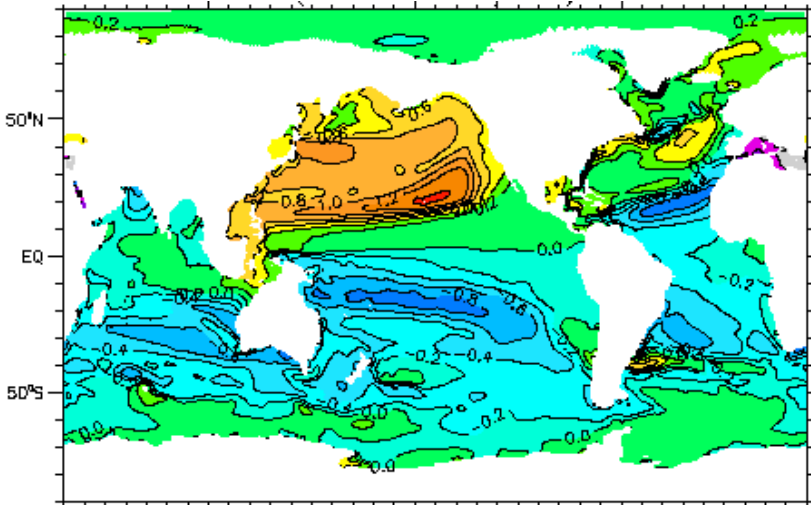


mean= -0.39 rms= 1.07 psu

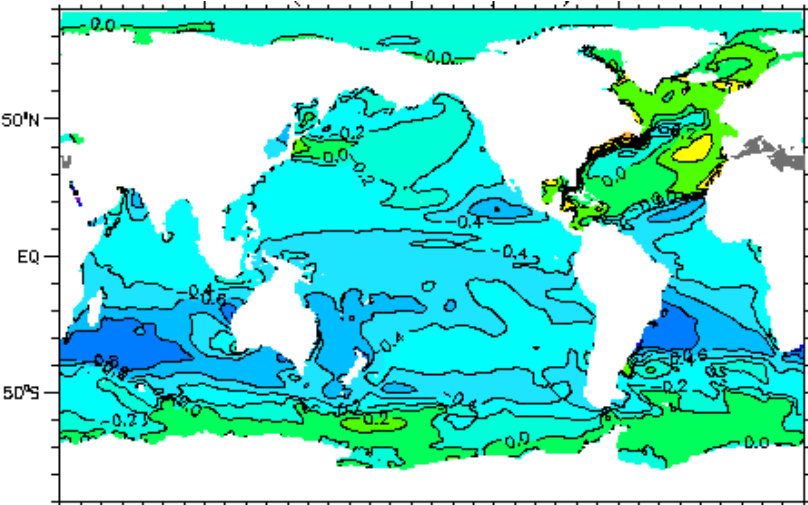


mean= -0.37 rms= 0.86psu

300m depth



mean= -0.04 rms= 0.48 psu

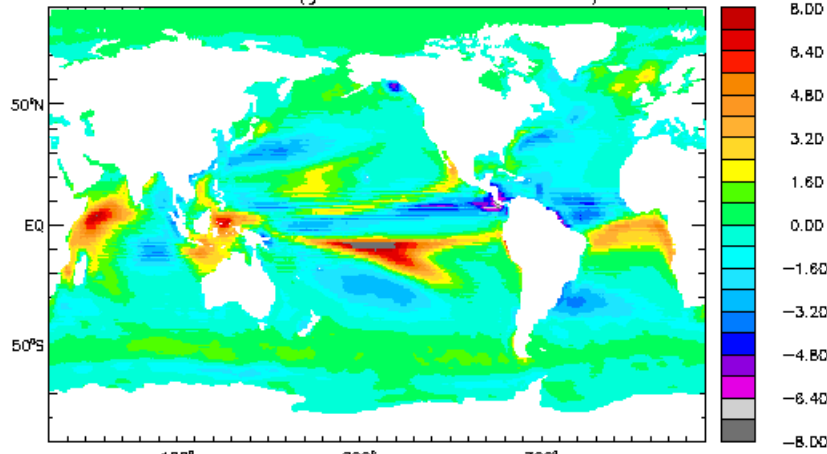


mean= -0.29 rms= 0.53 psu

Obs: PHC2 data; Levitus et al. (1998) and Steele et al. (2001)

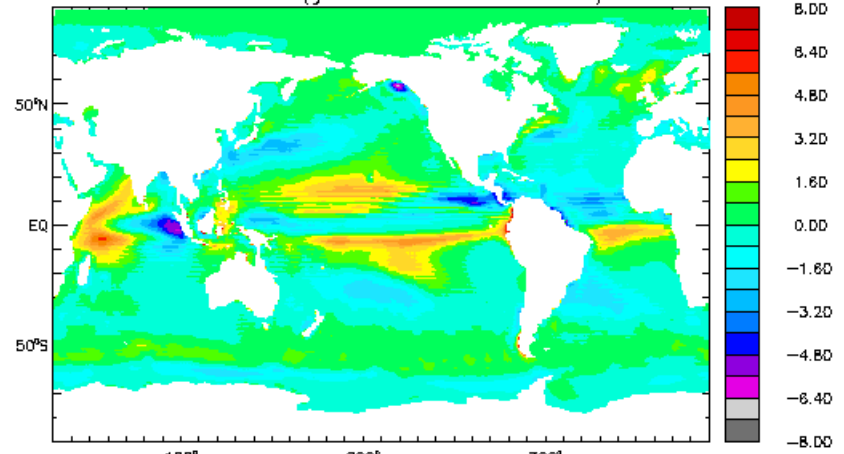
# Precipitation Differences from Observations (tied to surface salinity)

20<sup>th</sup> Century CCSM3

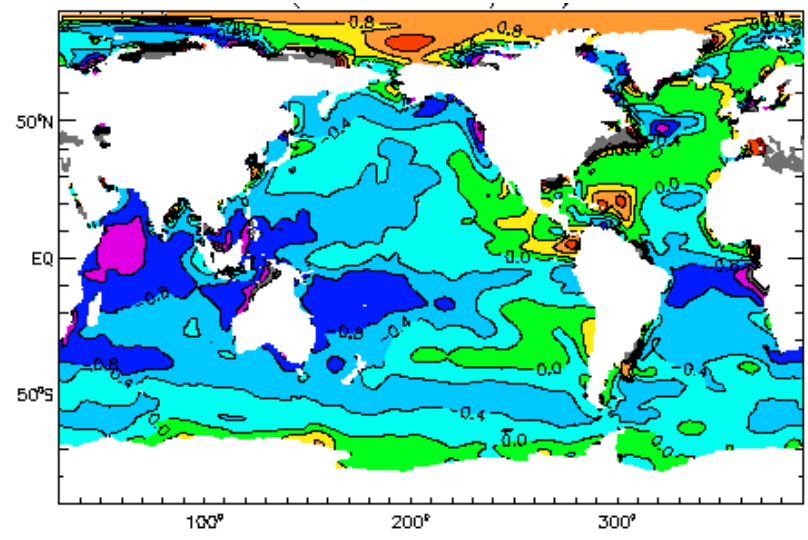
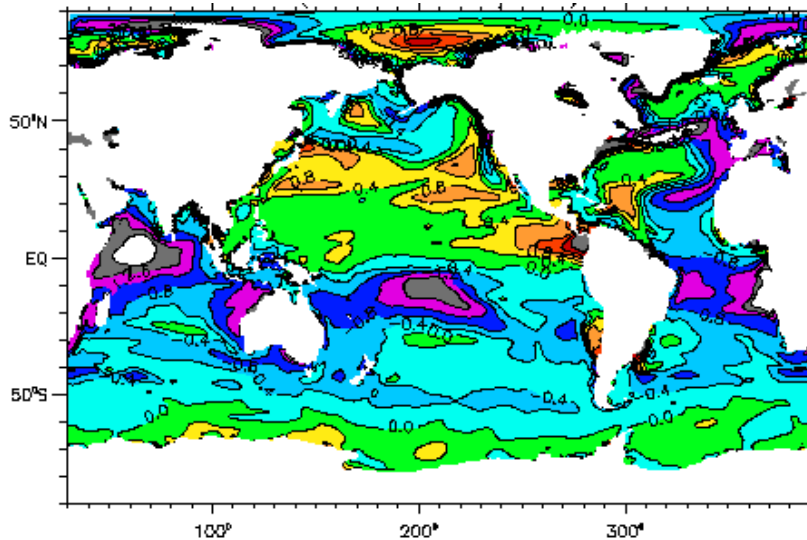


Mean: -0.07 RMS: 1.70

20<sup>th</sup> Century CCSM4



Mean: 0.07 RMS: 1.32

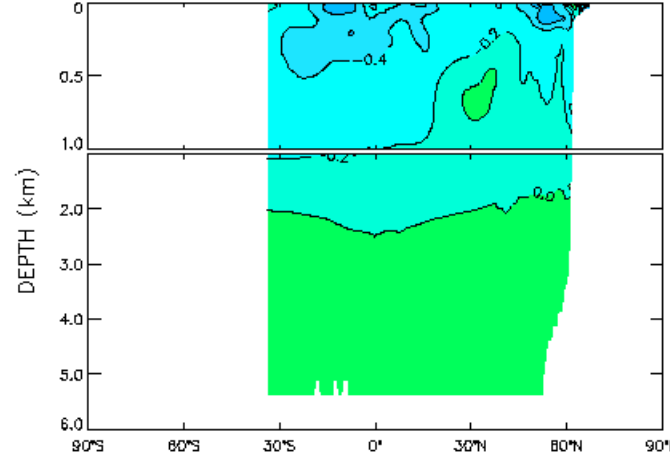
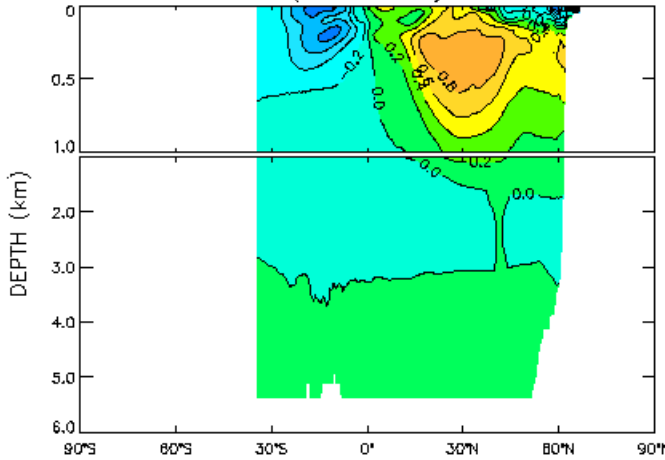


# Zonal Average Salinity Differences from Observations

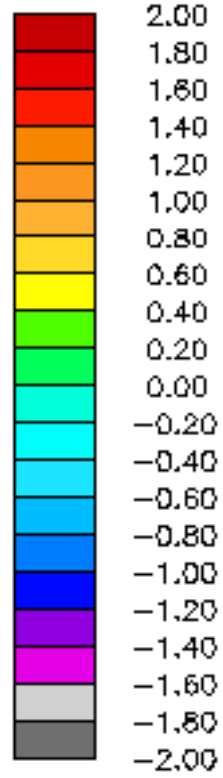
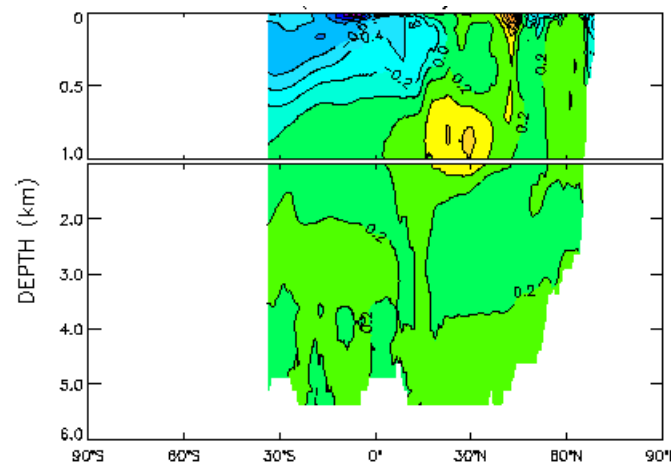
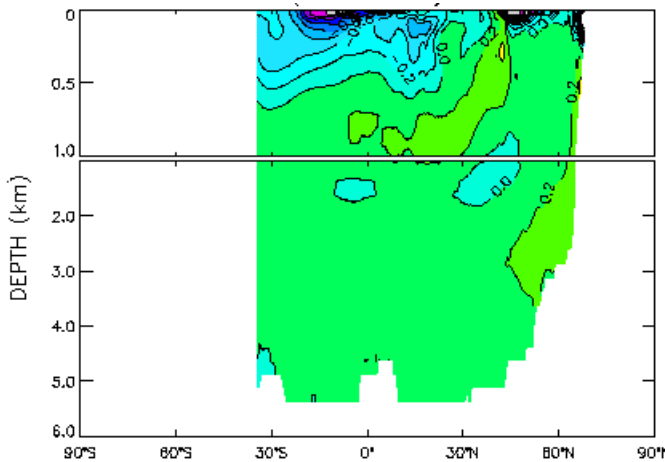
## 20<sup>th</sup> Century CCSM3

## 20<sup>th</sup> Century CCSM4

Pacific



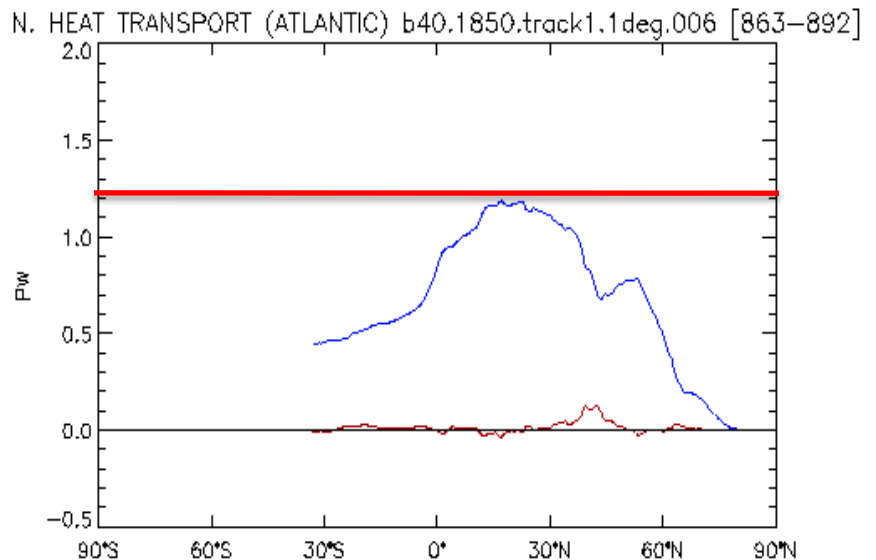
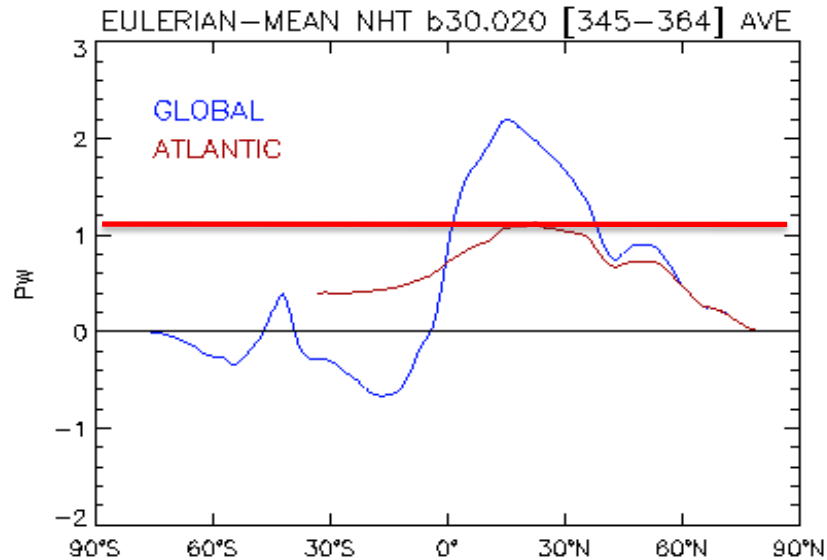
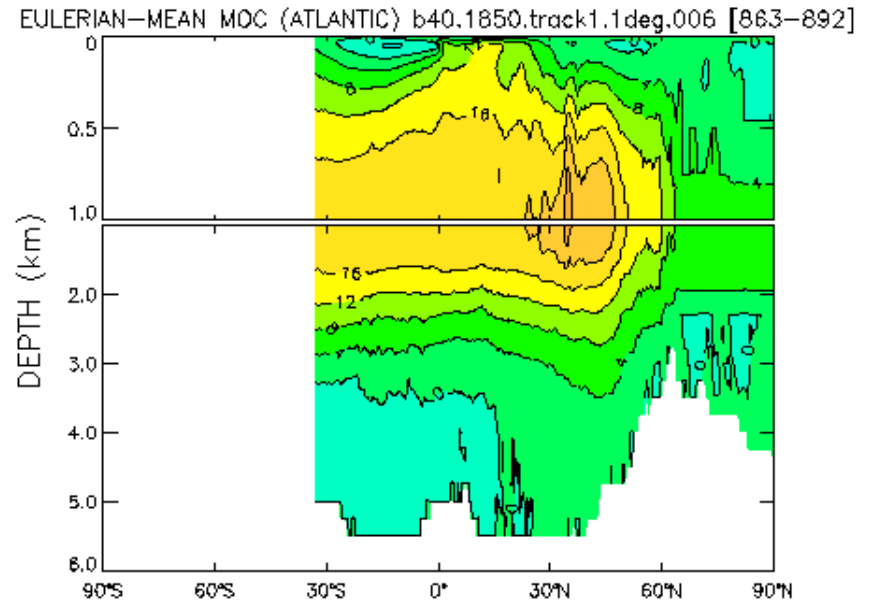
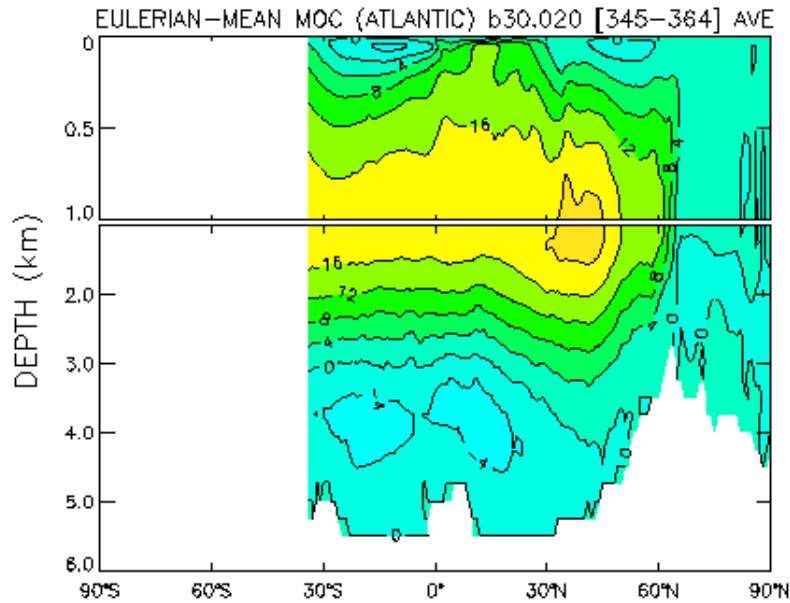
Atlantic



# AMOC and Northward Heat Transport in Pre-Industrial Control Simulations

CCSM3

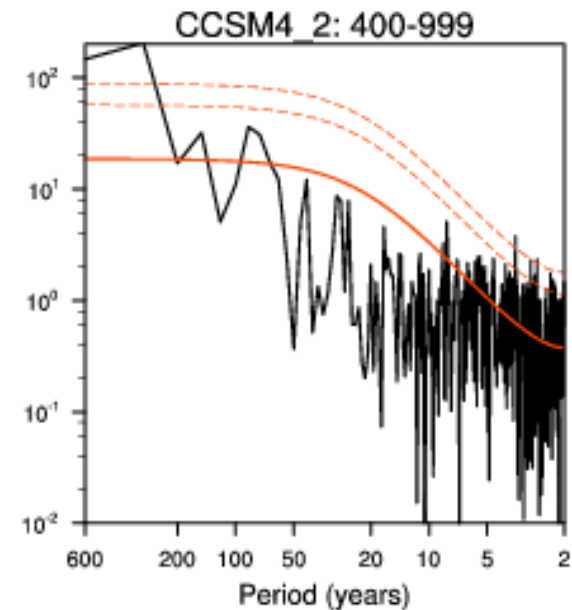
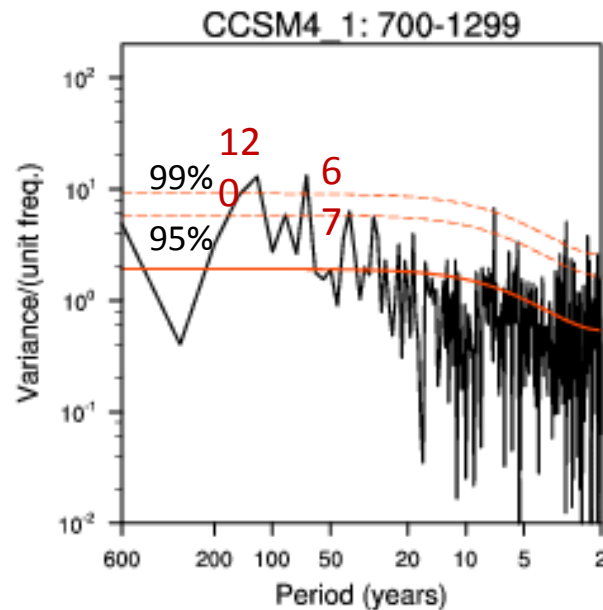
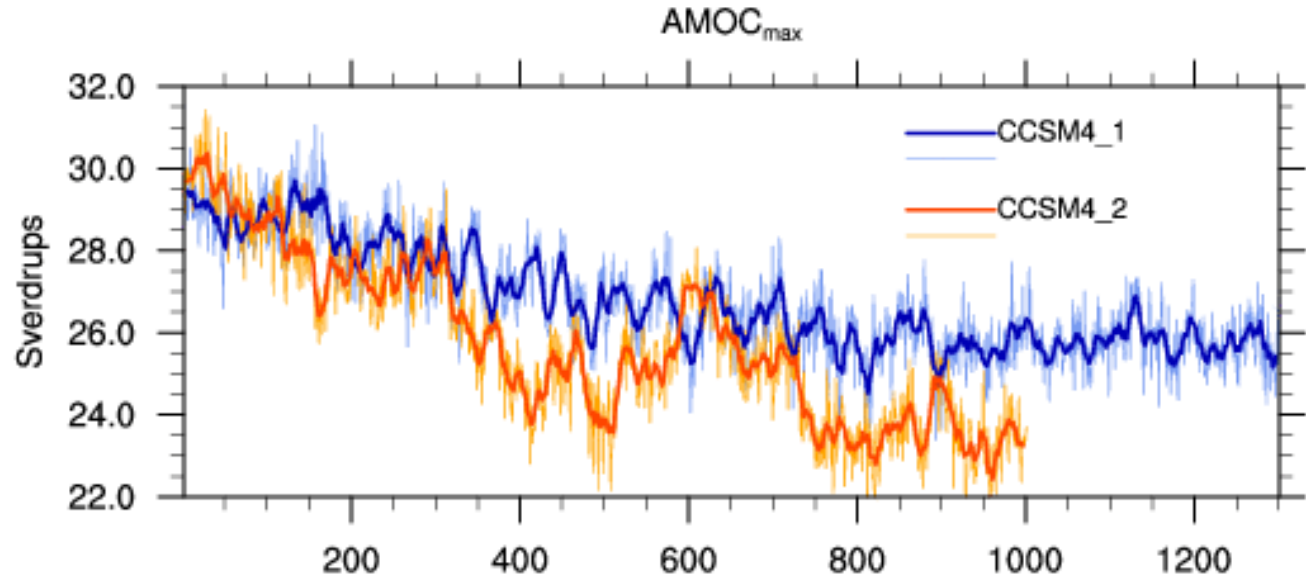
CCSM4



# AMOC Maximum Transports in CCSM4 Pre-Industrial Control Simulations

CCSM4\_1: 1° FV atmosphere:  
blue line

CCSM4\_2: 2° FV atmosphere:  
red line





## Low Resolution Simulation

*Christine Shields, Gokhan Danabasoglu, Dave Bailey*

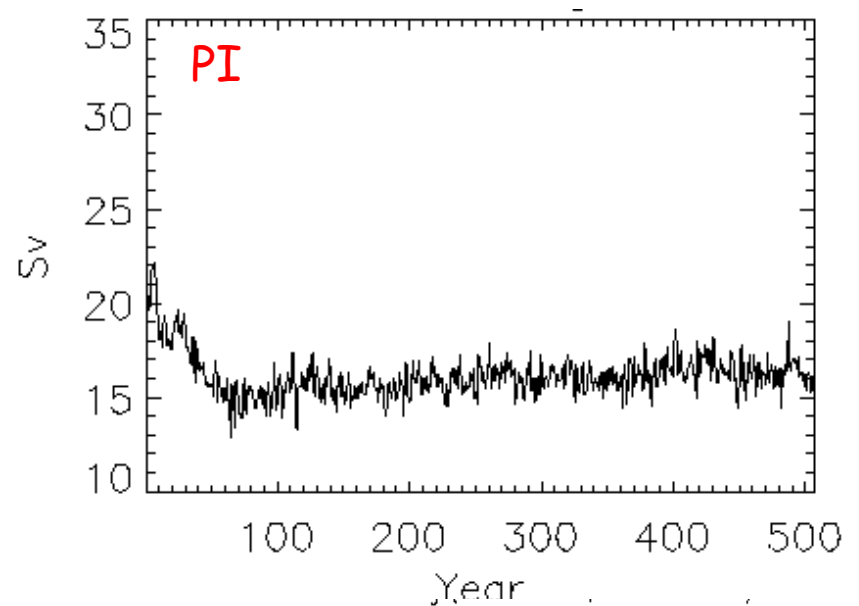
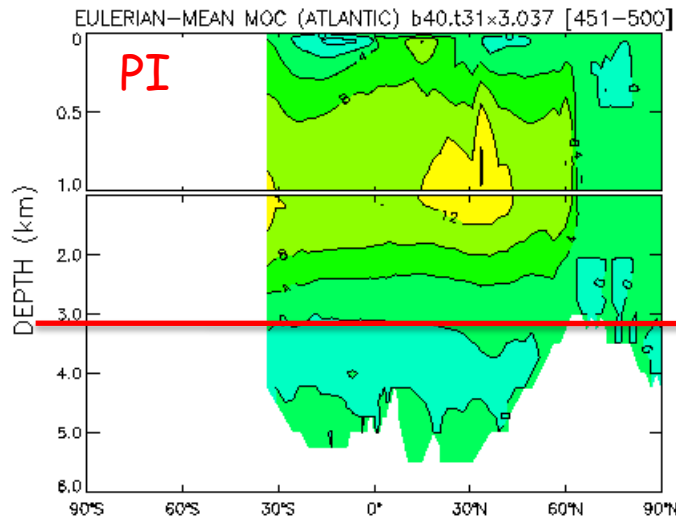
- Motivation: Provide a low cost model for the paleo and BGC community, outside university users, and model development testing
- Timing: ~50 model years per wallclock day on 2 bluefire nodes  
~70 model years per wallclock day on 3 bluefire nodes
- Goals: stable AMOC, reasonable ENSO, and reasonable sea ice
- T31x3
- Ocn: identical physics to the 1 degree model
- Ice: Low Ice Albedos
- Atm: Base + Atm tuning + TMS (turbulent mountain stress)
- Lnd: no Ice Runoff

# Low Resolution AMOC

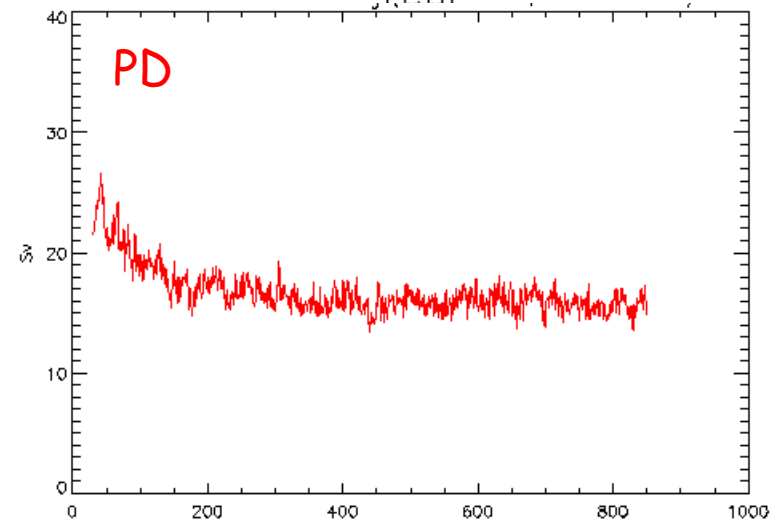
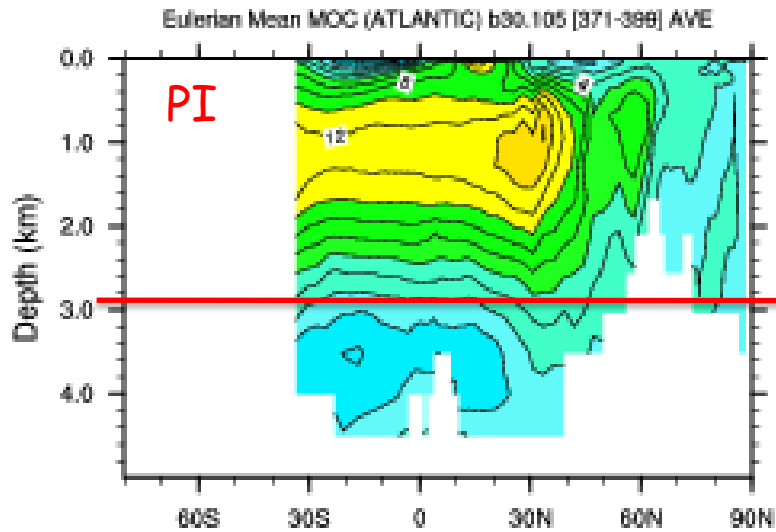
## Eulerian Mean

## Maximum Overturning

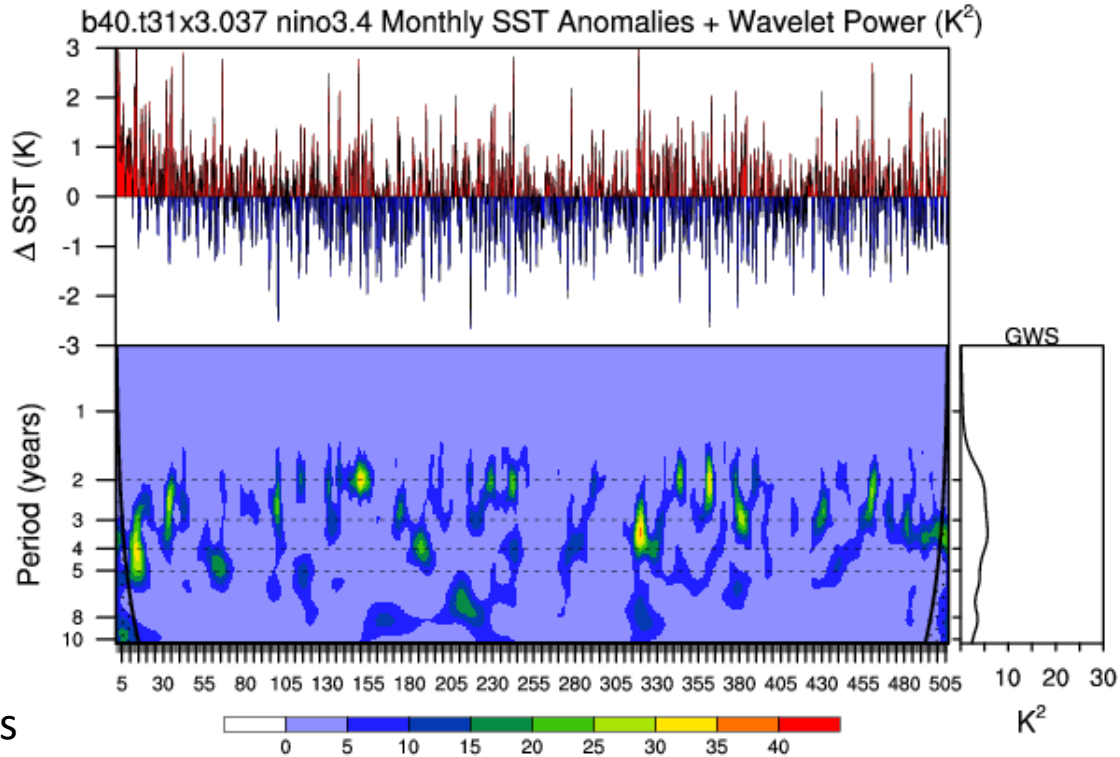
CCSM4



CCSM3

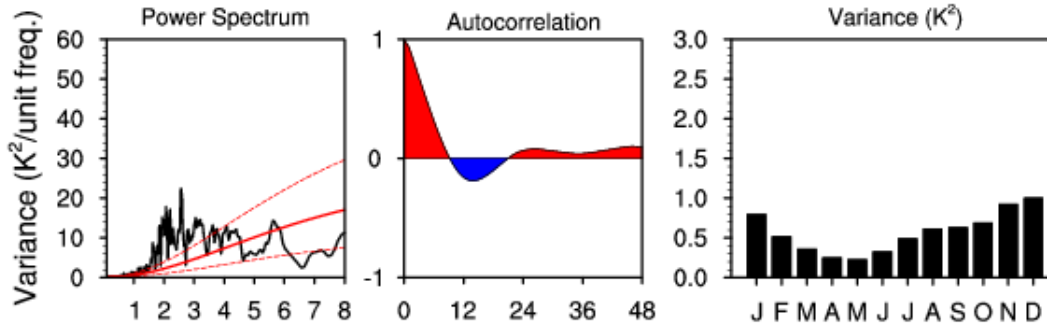


# Low Resolution ENSO



Nino3.4 time series  
 Model Std. dev.: 0.775  
 Obs. std. dev.: 0.824

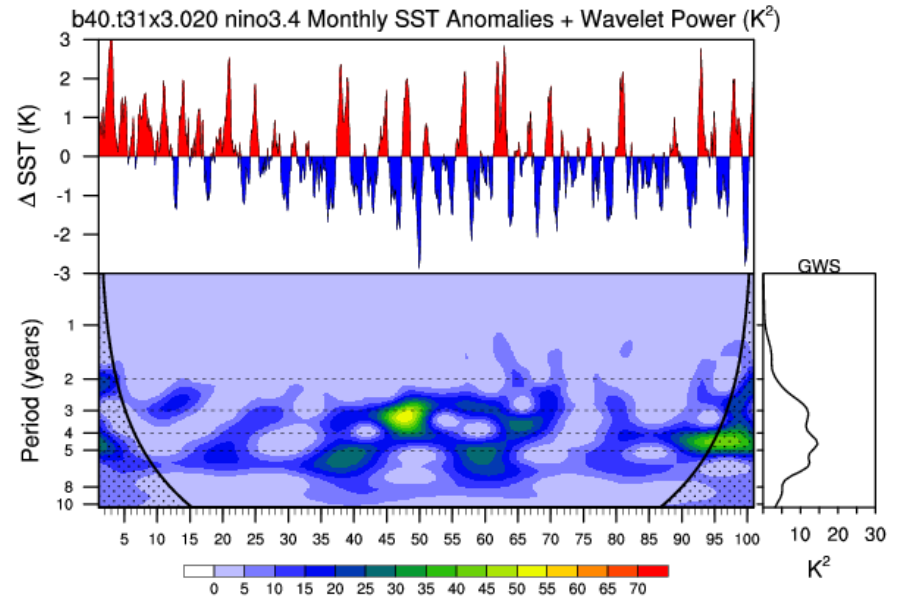
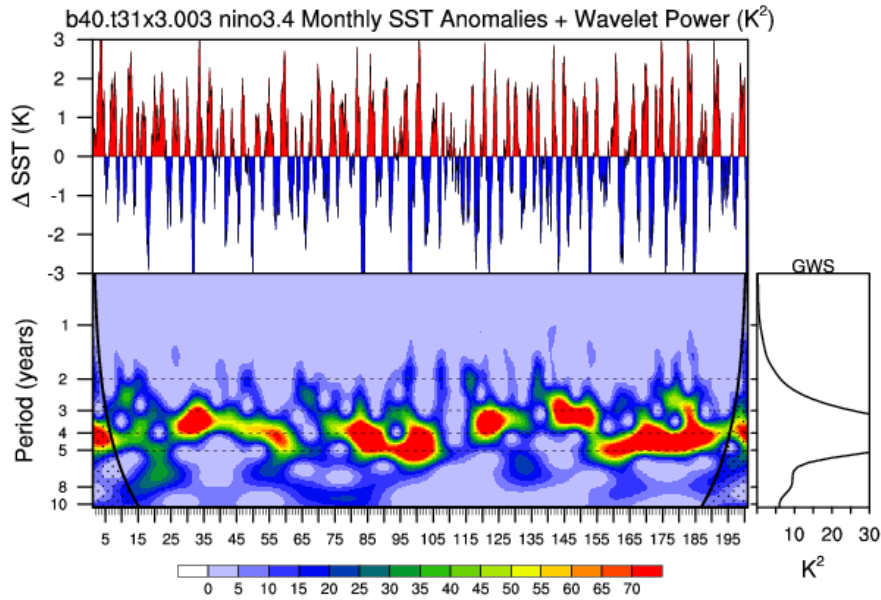
Averaged over years 1 to 506:



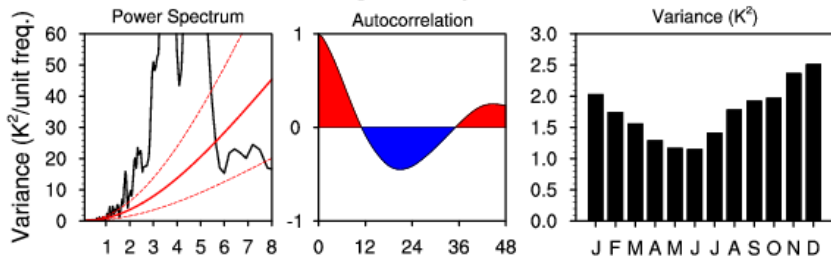
# Low Resolution ENSO: TMS Experiments

TMS off

TMS on



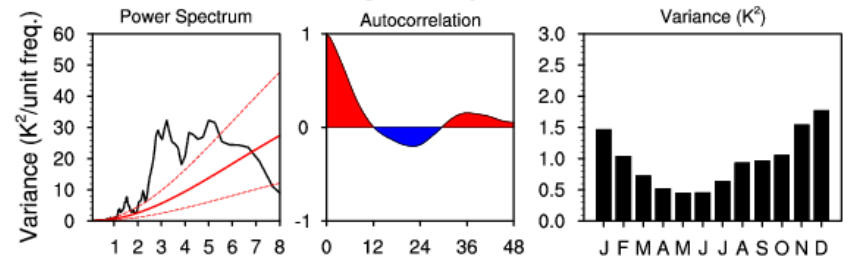
Averaged over years 1 to 180:



Model Std. dev.: 1.306

Nino3.4 time series  
Obs. std. dev.: 0.824

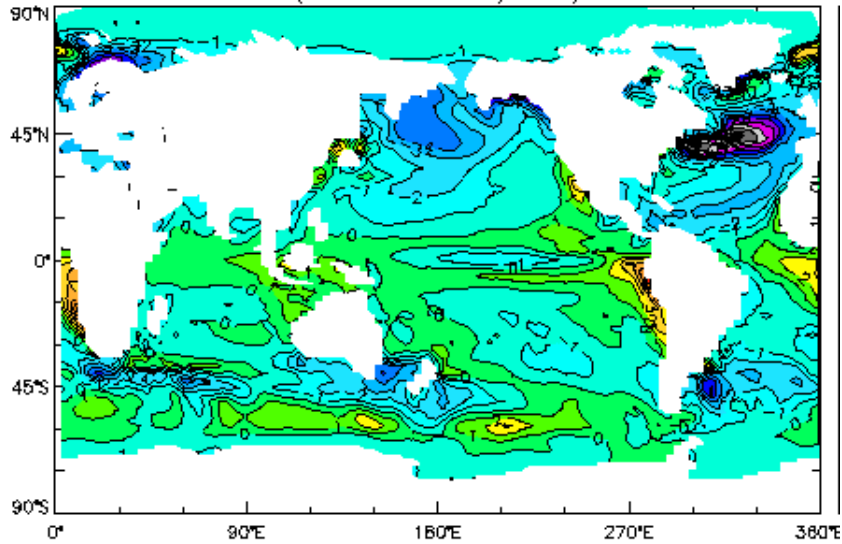
Averaged over years 1 to 100:



Model Std. dev.: 0.958

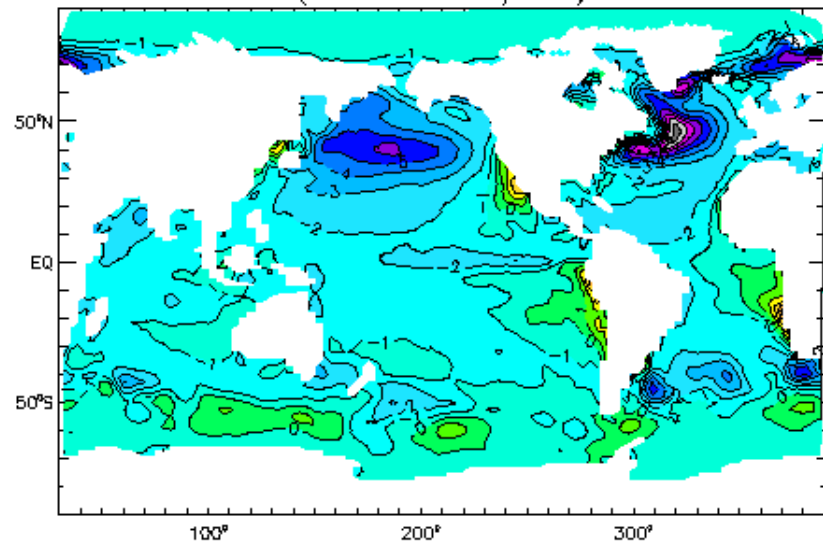
# Low Resolution SST Bias

## CCSM3-Present Day

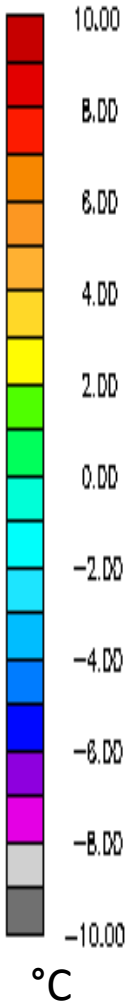


Mean: -0.65

## CCSM4-PreIndustrial



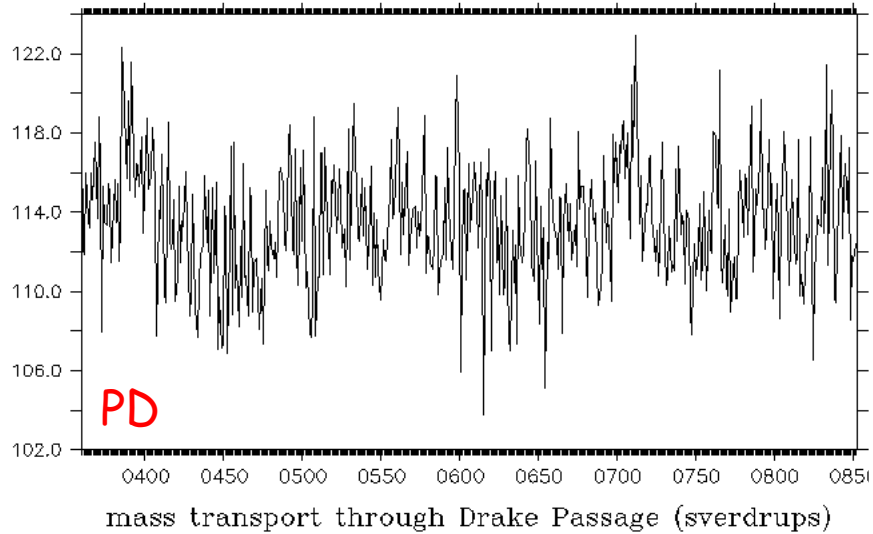
Mean: -1.54  
RMS: 2.09



# Low Resolution Drake Passage Transport

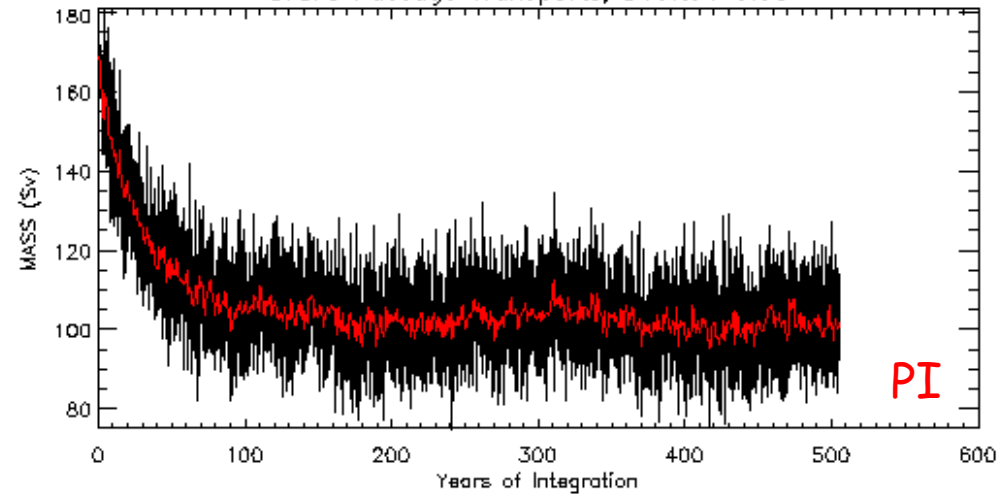
CCSM3

b30.031



CCSM4

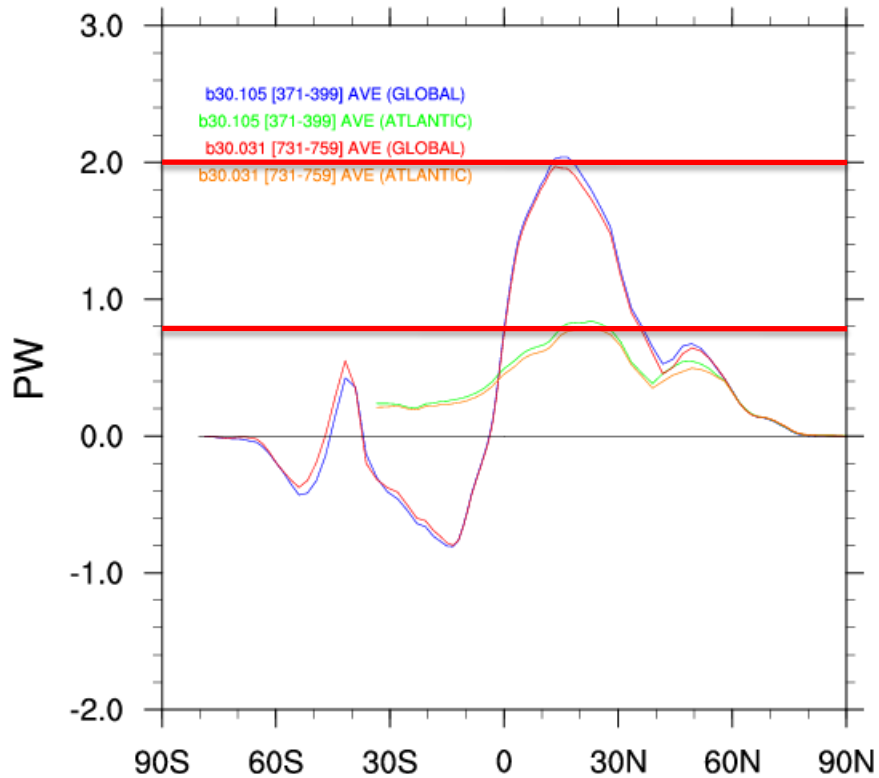
Drake Passage Transports, b40.t31x3.037



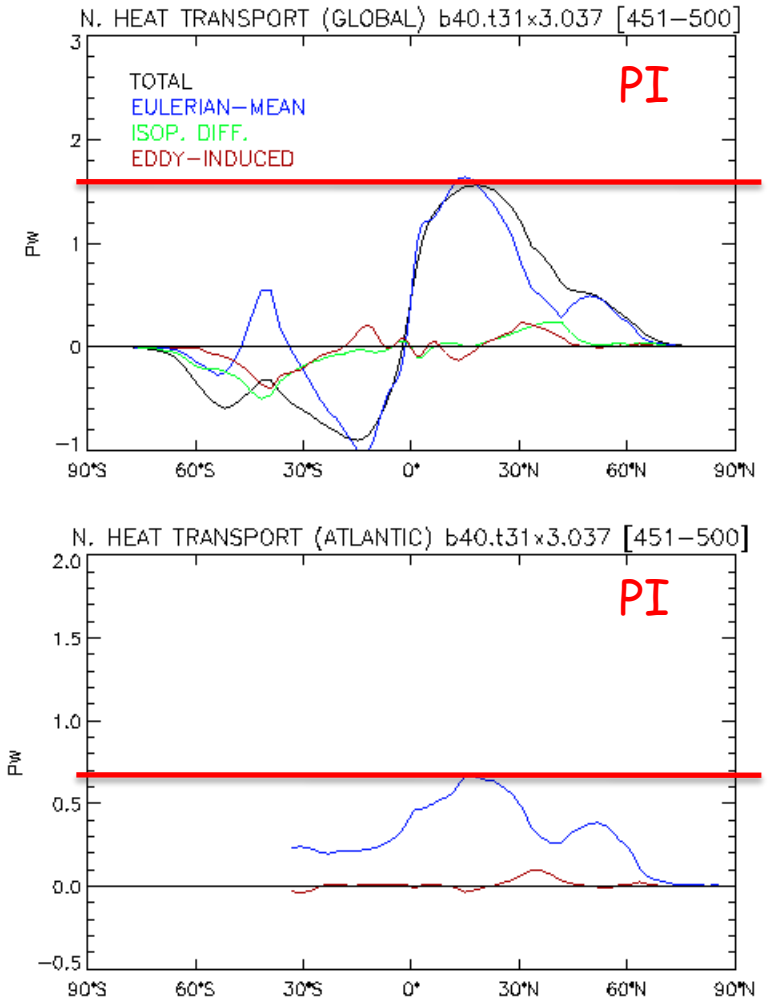
# Low Resolution Northward Heat Transport

CCSM3

EULERIAN-MEAN NHT



CCSM4



- CCSM4 contains improved physics in the ocean.
- Though there is improvement in ocean biases, they are still present...

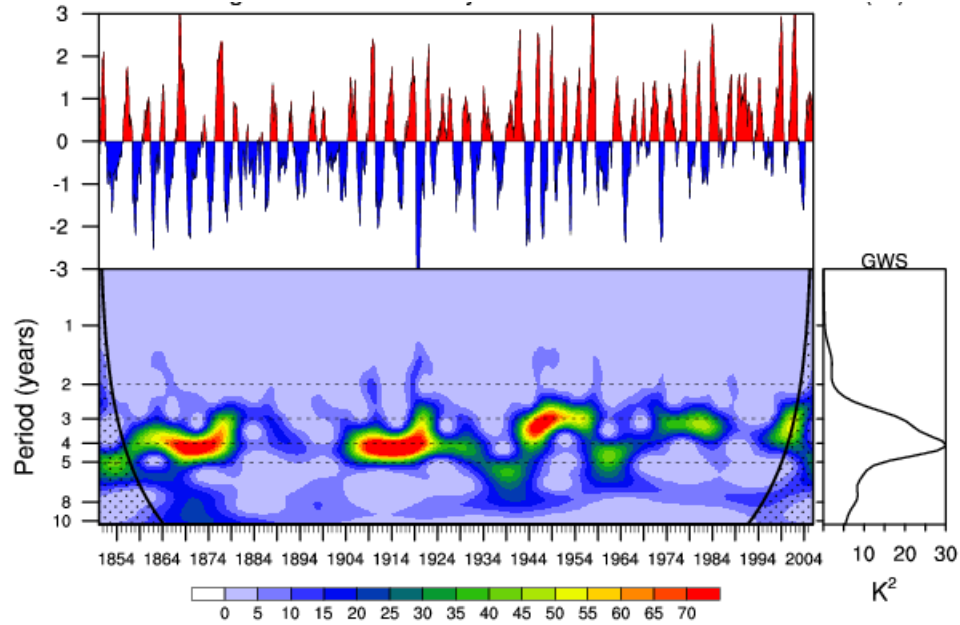
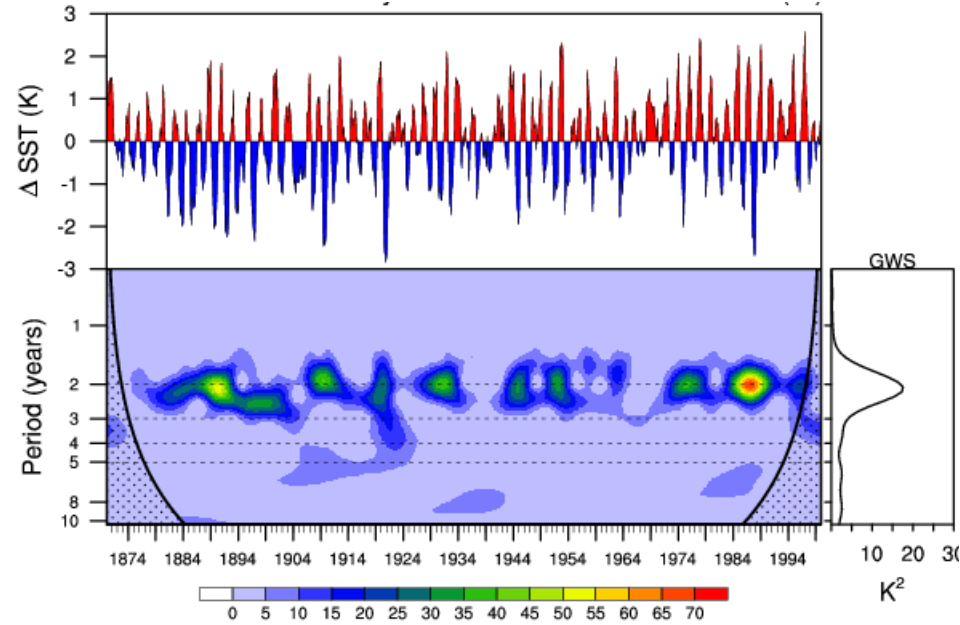
We still have work to do!



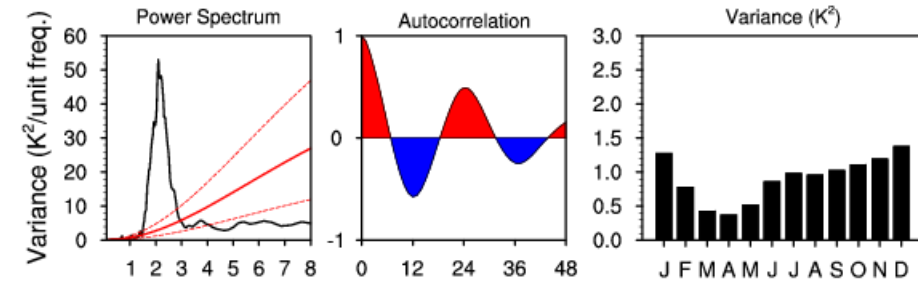
# Nino3.4

## 20<sup>th</sup> Century CCSM3

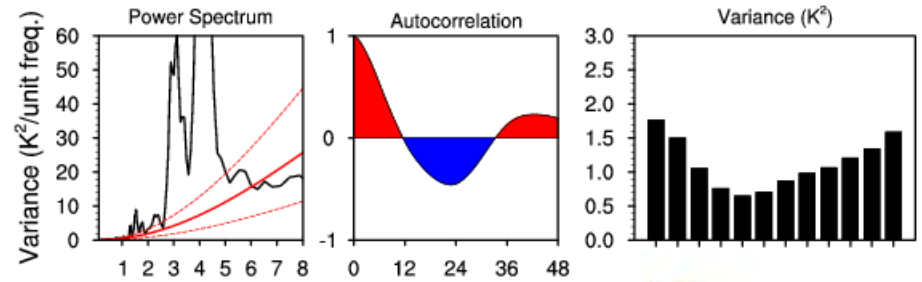
## 20<sup>th</sup> Century CCSM4



Averaged over years 1870 to 1999:



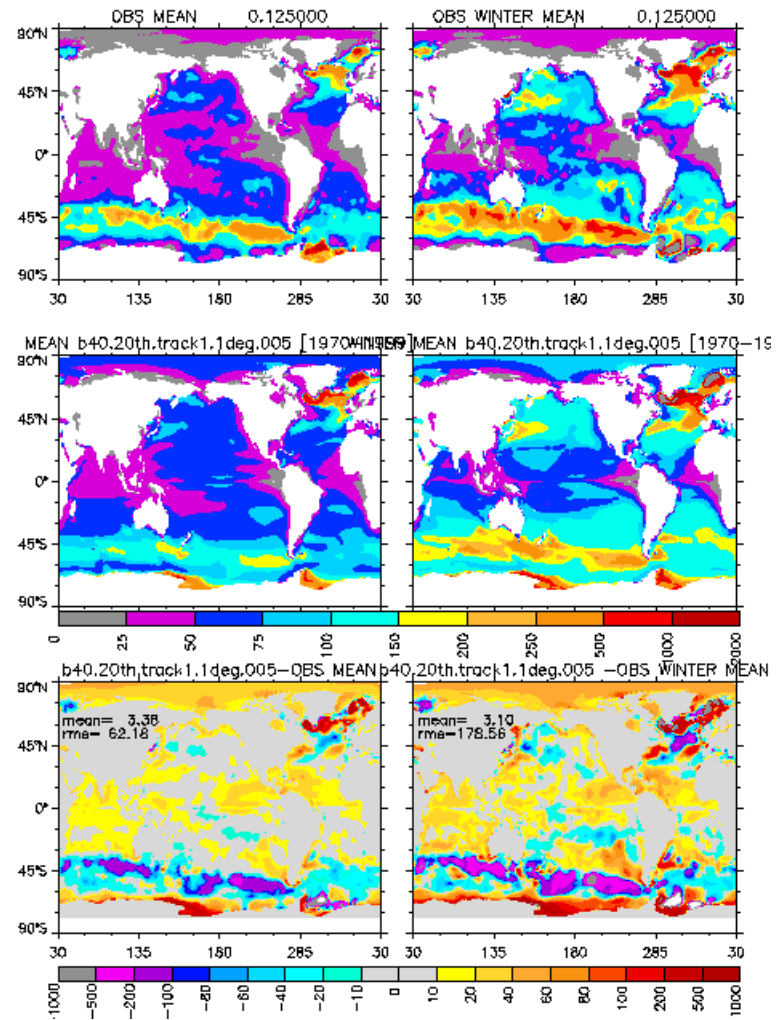
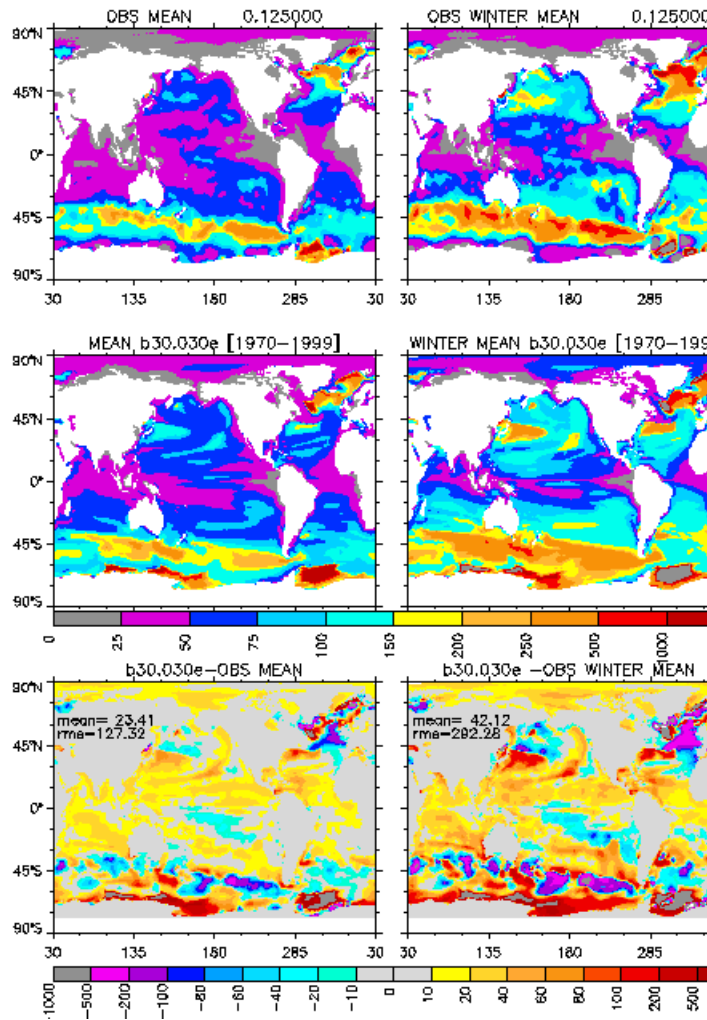
Averaged over years 1850 to 1999:



# Mixed Layer Depths

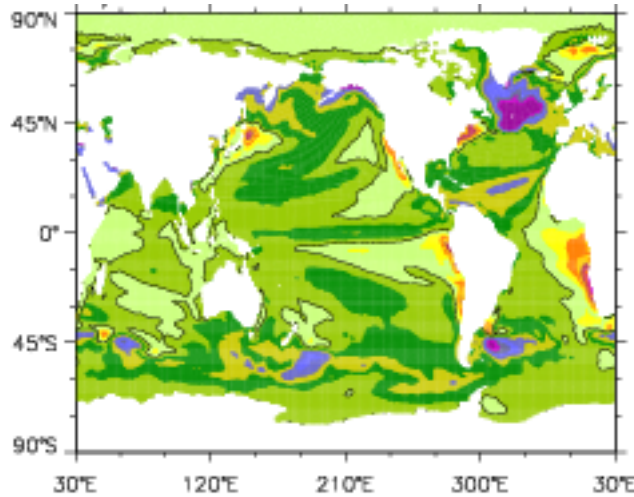
## 20<sup>th</sup> Century CCSM3

## 20<sup>th</sup> Century CCSM4



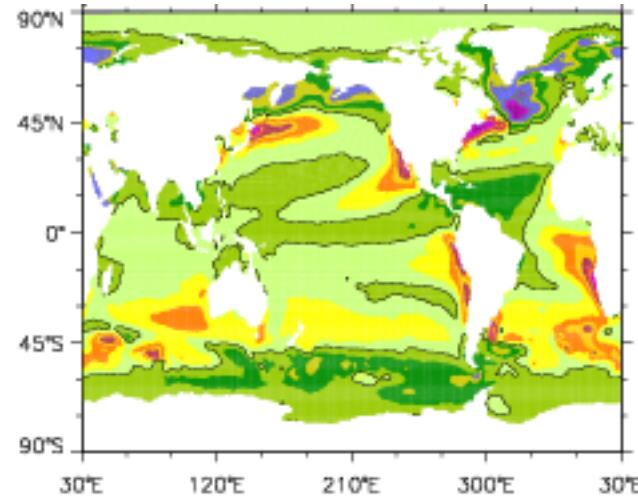
# SST DIFFERENCES FROM OBSERVATIONS

## PreIndustrial 1° CCSM3



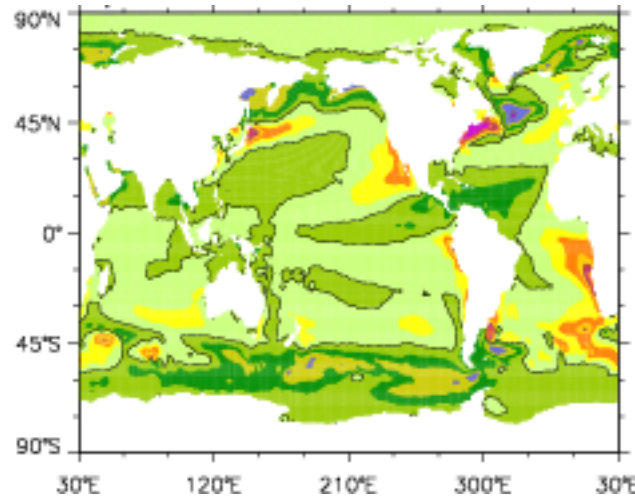
mean=  $-0.76^{\circ}\text{C}$   
rms=  $1.57^{\circ}\text{C}$

## PreIndustrial 2° CCSM4



mean=  $0.30^{\circ}\text{C}$   
rms=  $1.46^{\circ}\text{C}$

## PreIndustrial 1° CCSM4



mean=  $0.07^{\circ}\text{C}$   
rms=  $1.11^{\circ}\text{C}$



Obs: Hurrell et al. (2008)

# EQUATORIAL PACIFIC SST IN 20<sup>th</sup> CENTURY SIMULATIONS

