

# CMIP5 in China

**Bin Wang<sup>1,2</sup>**

## **Contributors:**

- 1. LASG, Institute of Atmospheric Physics, CAS**
- 2. CESS, Tsinghua University**
- 3. Beijing Climate Center**
- 4. Beijing Normal University**
- 5. First Institute of Oceanography**

# Outline

- ◆ **CMIP5 Groups and models in China**
- ◆ **Results of CMIP5 experiments**
- ◆ **Focus on FGOALS\_g2.0**
- ◆ **Issues in FGOALS\_g2.0**

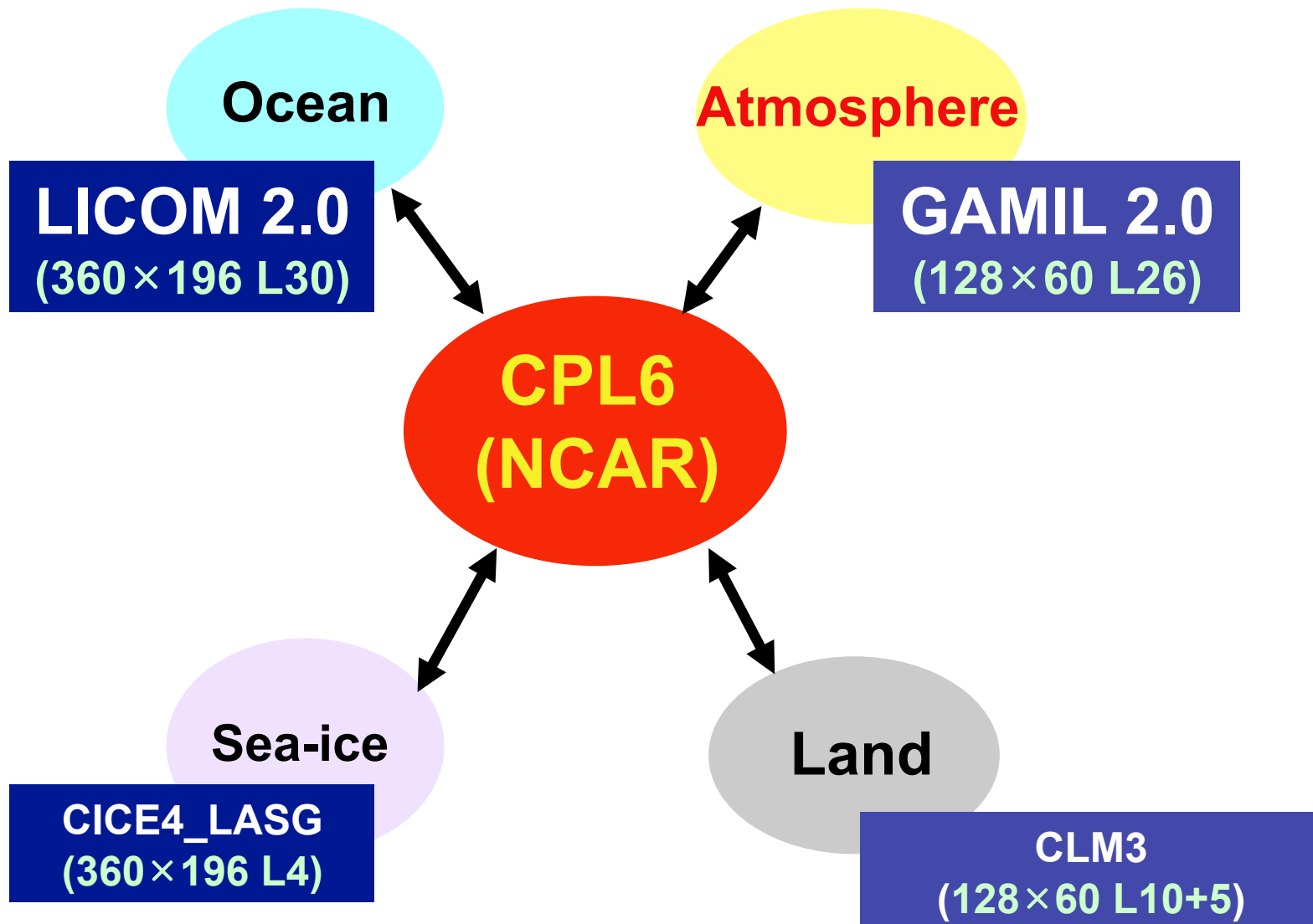
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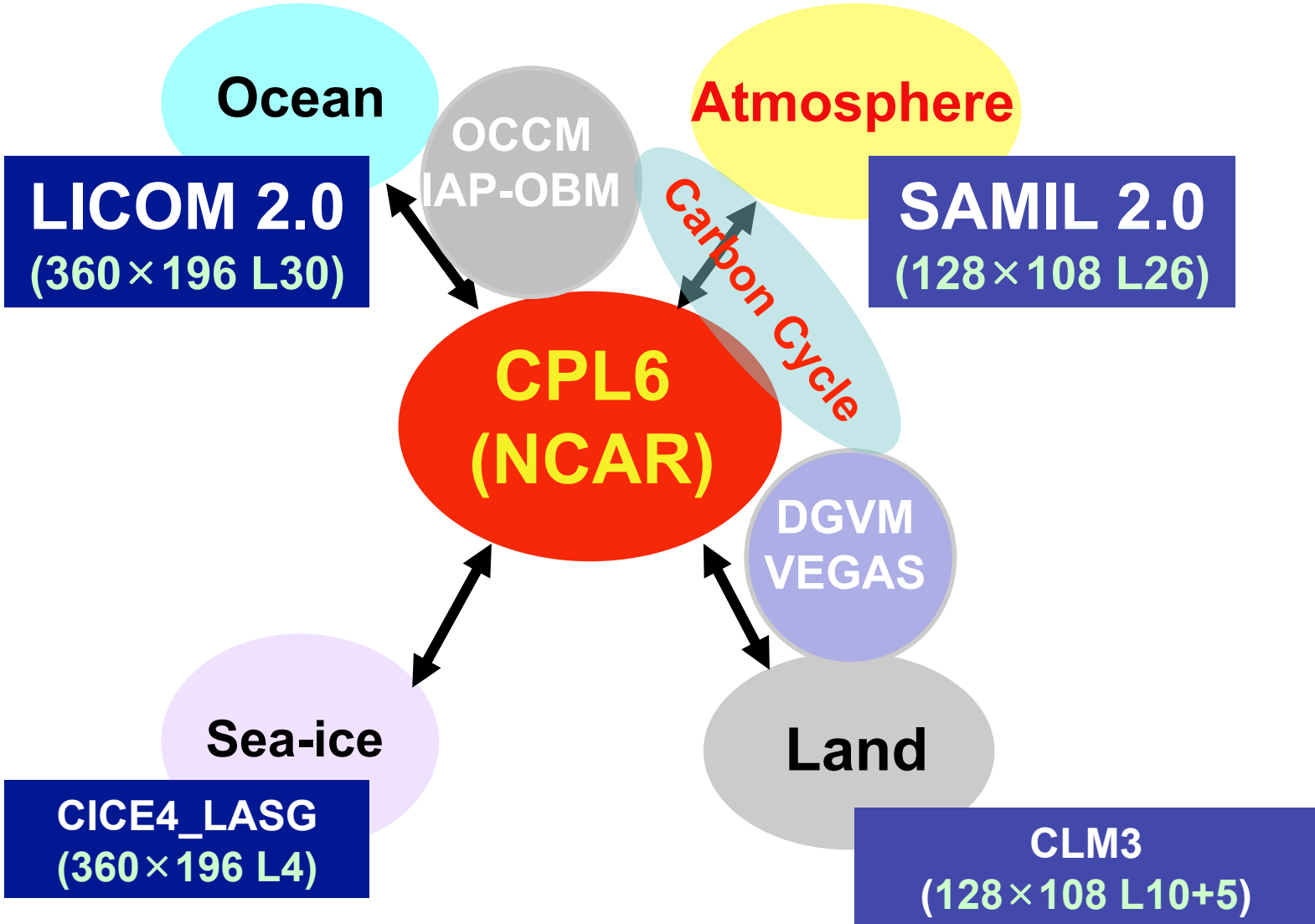
# CMIP5 groups and models in China

<b>Group Name</b>	<b>Institution</b>	<b>Model Name</b>
<b>LASG-CESS</b>	Institute of Atmospheric Physics, Chinese Academy of Sciences; Tsinghua University	<b>FGOALS_g2.0</b>
<b>LASG</b>	Institute of Atmospheric Physics, Chinese Academy of Sciences	<b>FGOALS_s2.0</b>
<b>BCC</b>	Beijing Climate Center	<b>BCC-CSM 1.1</b>
<b>BNU</b>	Beijing Normal University	<b>BNU-ESM</b>
<b>FIO</b>	First Institute of Oceanography	<b>FIO-ESM1.0</b>

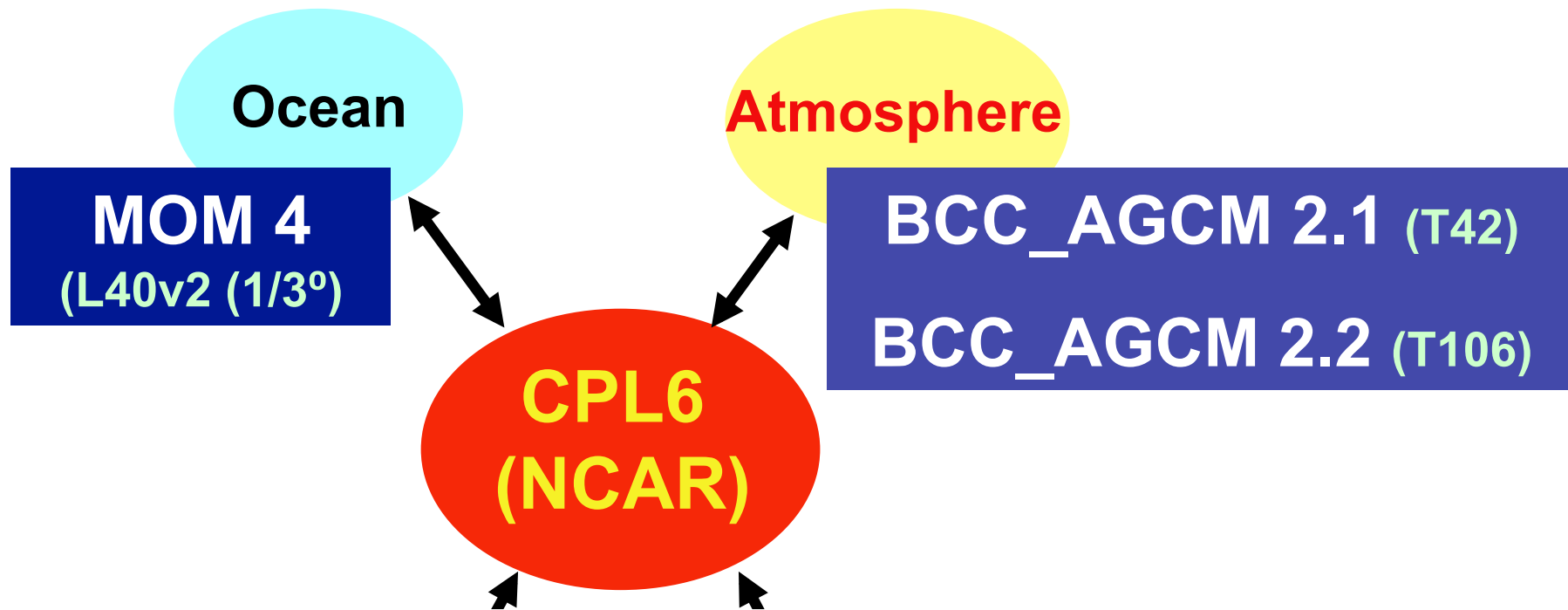
# Flexible Global Ocean-Atmosphere-Land System Model, Grid-point Version 2.0 (FGOALS\_g2.0)



# Flexible Global Ocean-Atmosphere-Land System Model, Spectral Version 2.0 (FGOALS\_s2.0)



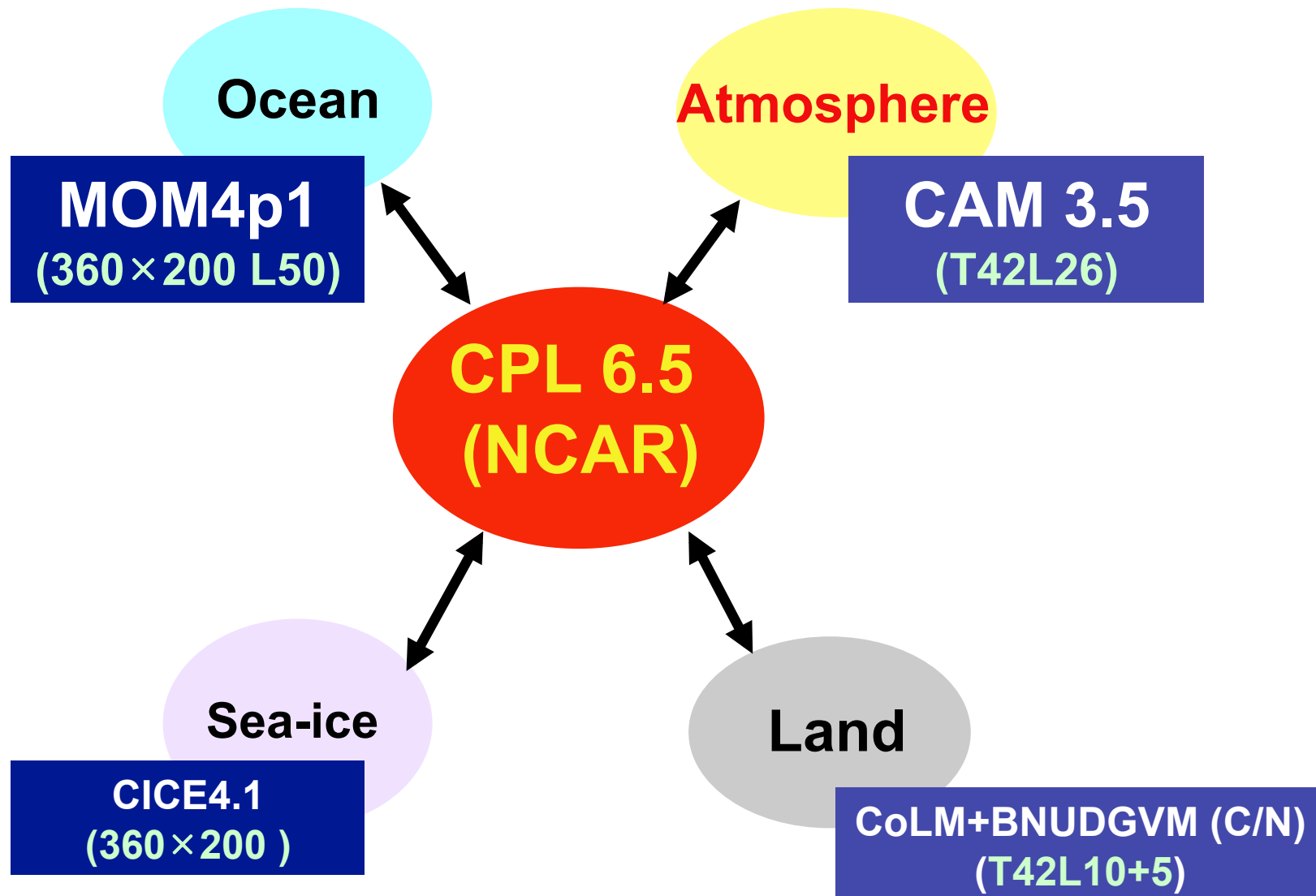
# Beijing Climate Center Climate System Model (BCC\_CSM)



**BCC\_CSM1.1 (T42 in atmosphere) for most CMIP5 experiments has finished and uploaded to ESG.**

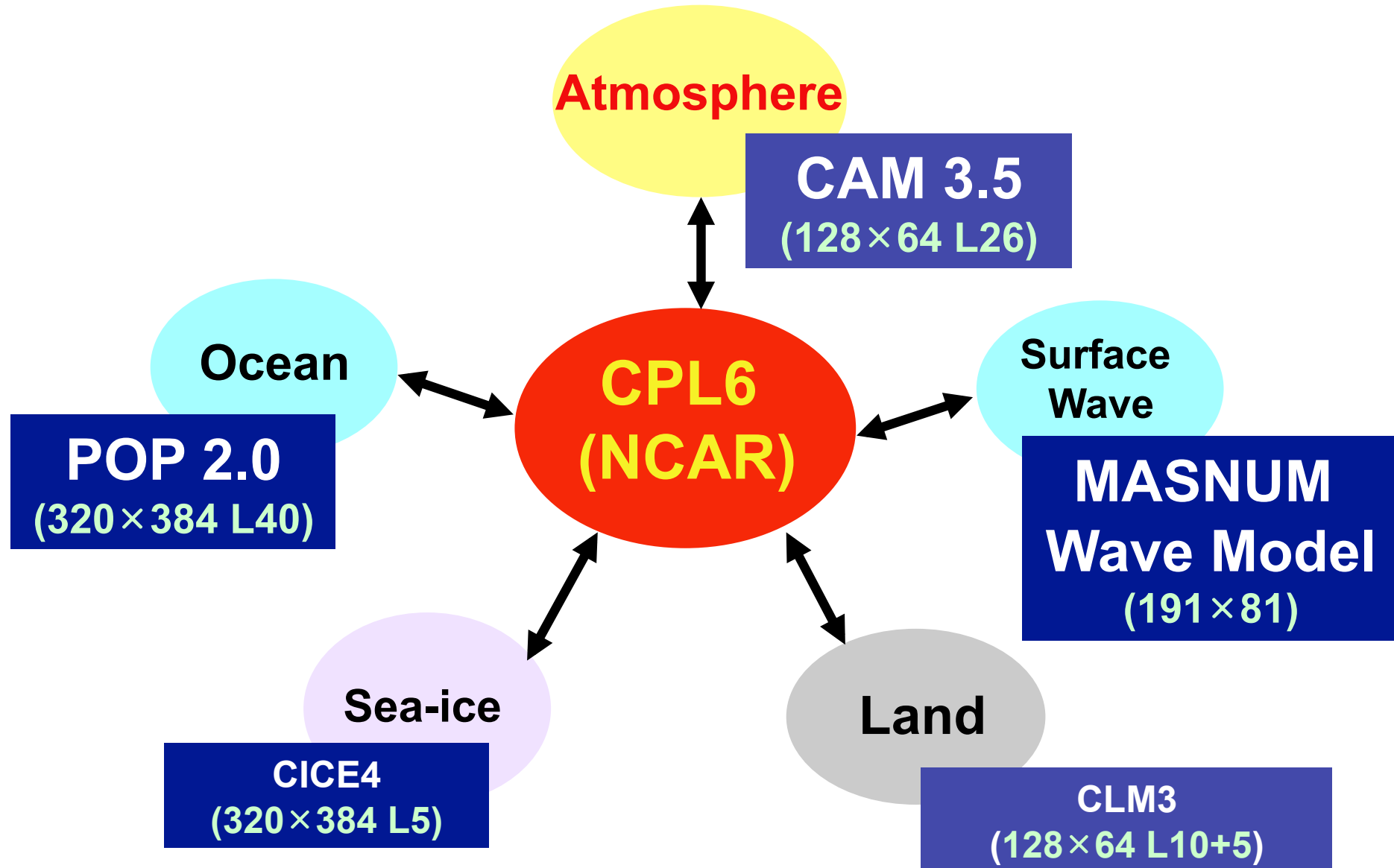
**BCC\_CSM1.2 (T106 in atmosphere) for core CMIP5 experiments will be finished before Feb. 2012**

# Beijing Normal University-Earth System Model (BNU-ESM)





# First Institute of Oceanography-Earth System Model Version 1.0 (FIO-ESM 1.0)



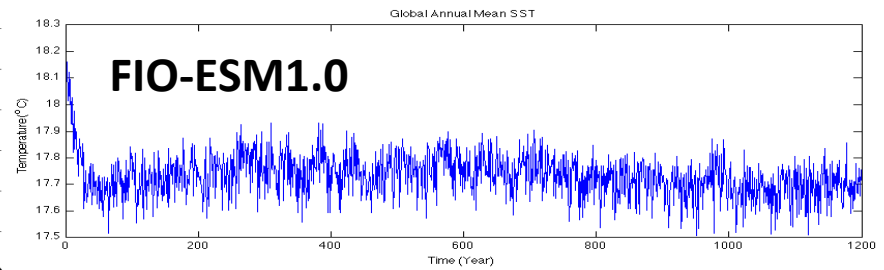
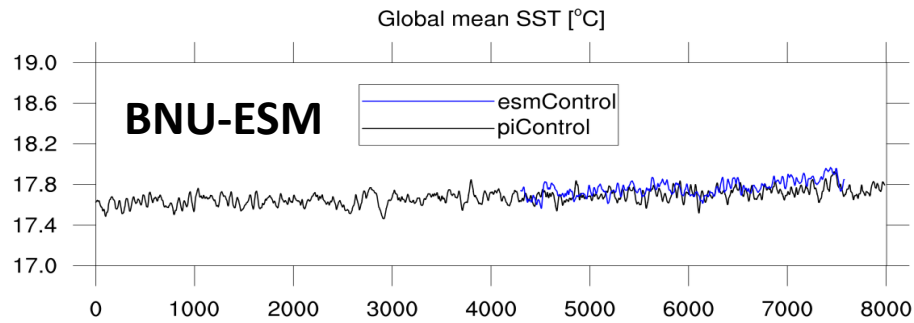
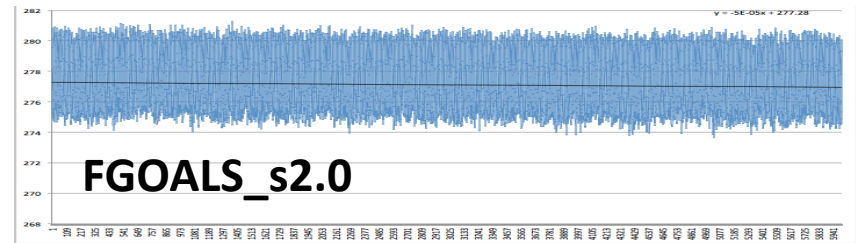
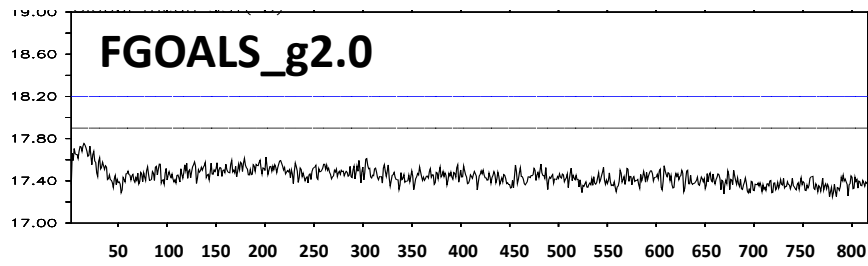
# Completed CMIP5 Experiments

<b>Model</b>	<b>Core</b>	<b>Ter. 1</b>	<b>Ter. 2</b>	<b>Ter.3</b>	<b>Decadal Prediction (core)</b>
FGOALS_g2.0	all	some	a few		all
FGOALS_s2.0	all	some			all
BCC-CSM1.0	all	some			all
BNU-ESM	some				
FIO-ESM1.0	some	some			

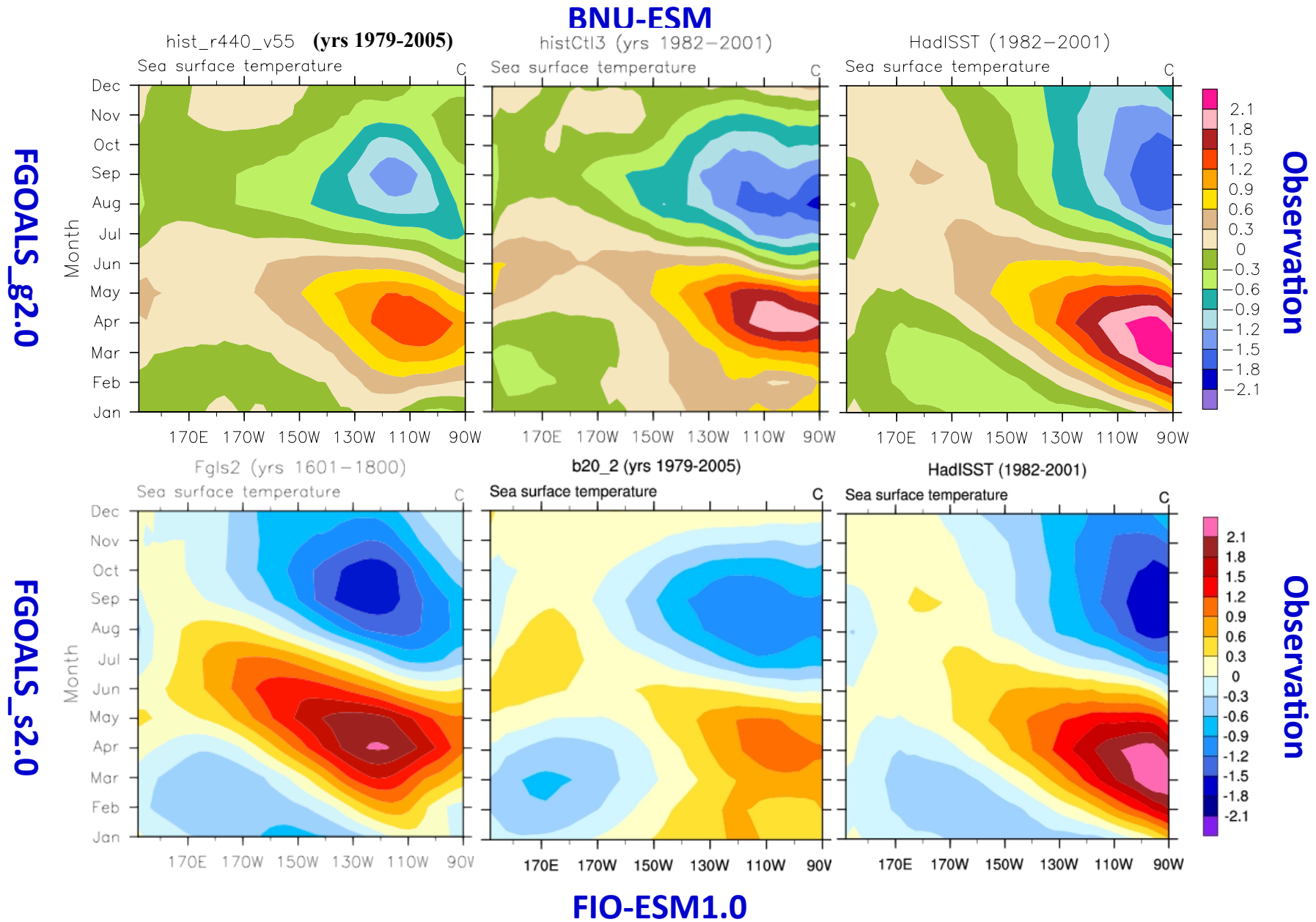
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# Spin-up in 4 China coupled models (Global Mean SST)

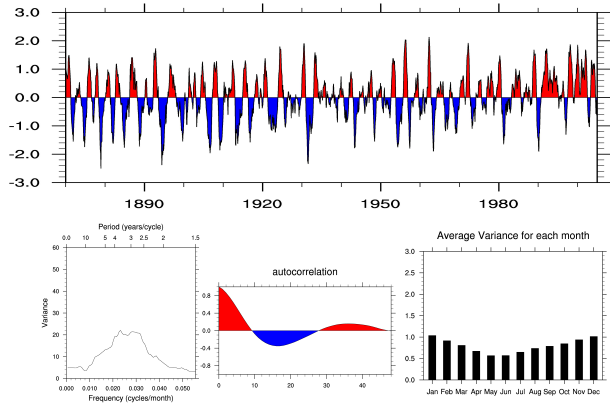


# Annual cycle in Equatorial Pacific Ocean (5S-5N)

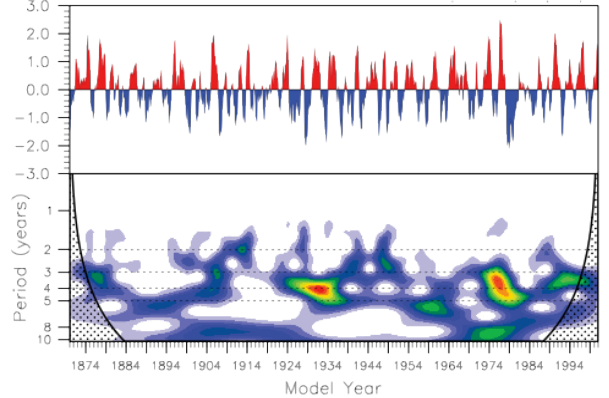


# Nino3.4 over 20<sup>th</sup> Century

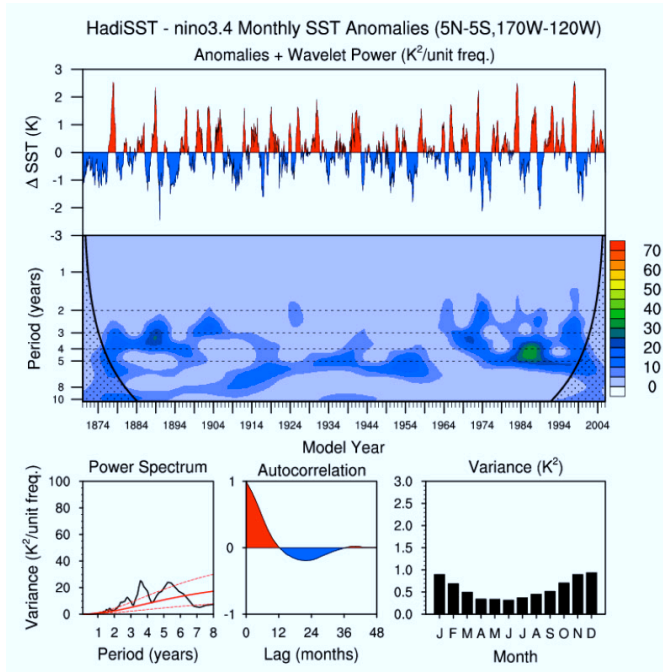
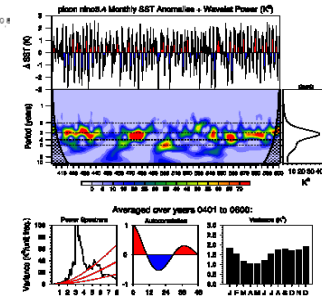
FGOALS\_g2.0



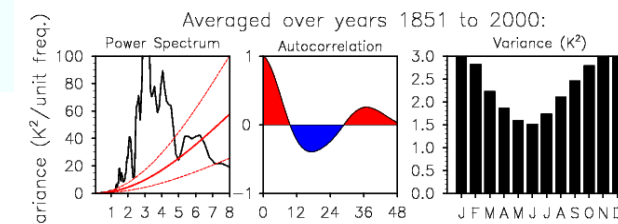
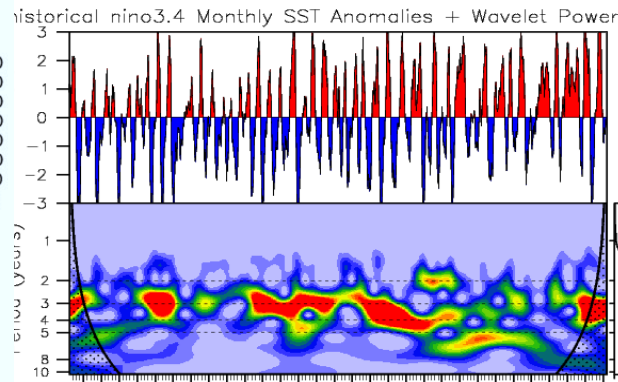
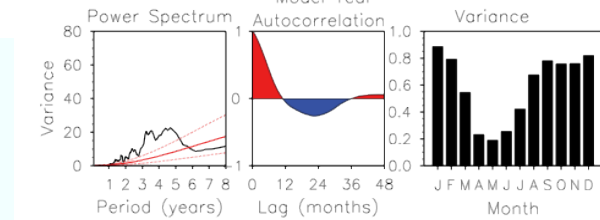
FGOALS\_s2.0



FIO-ESM1.0

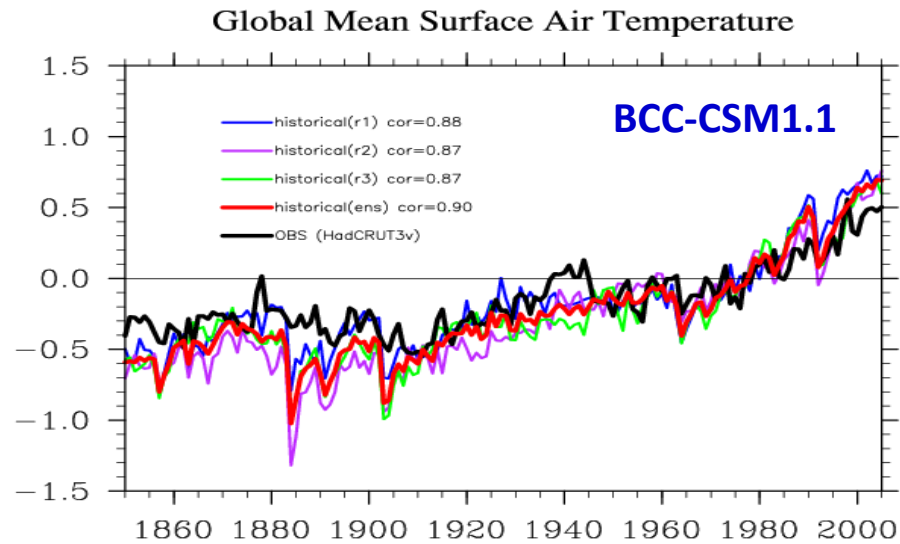
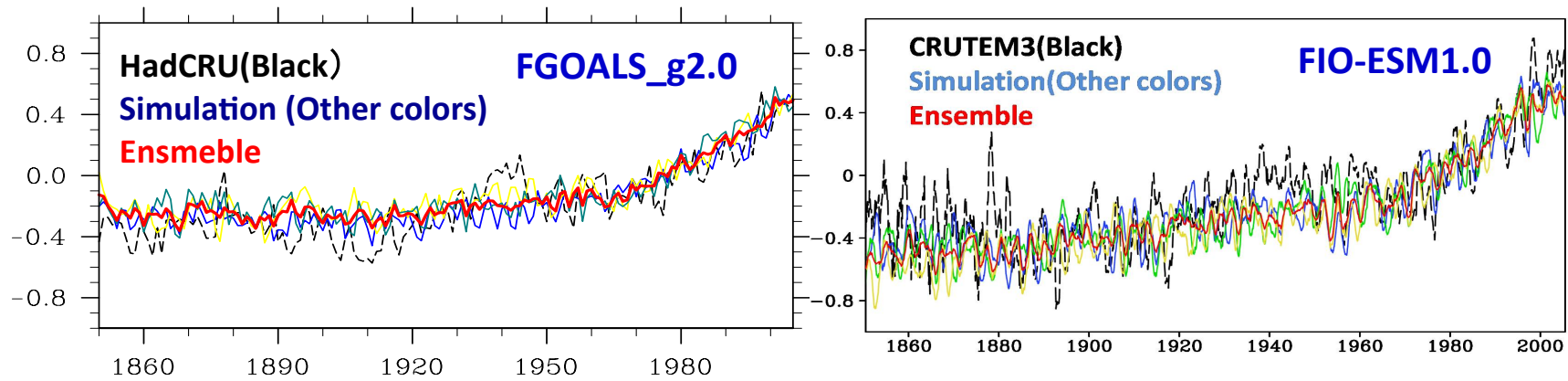


Observation

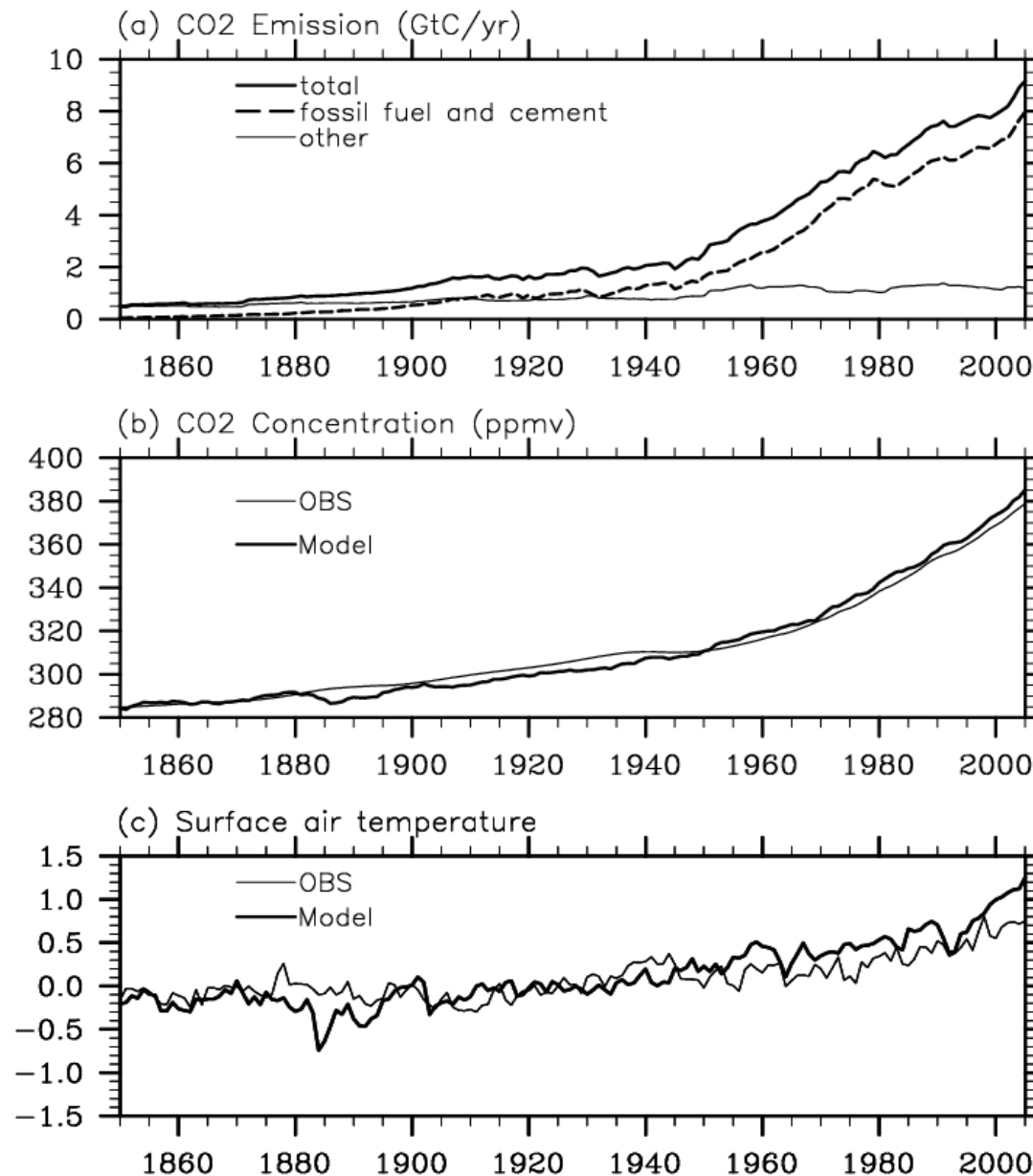


BNU-ESM

# 20<sup>th</sup> Century: Surface Temperature



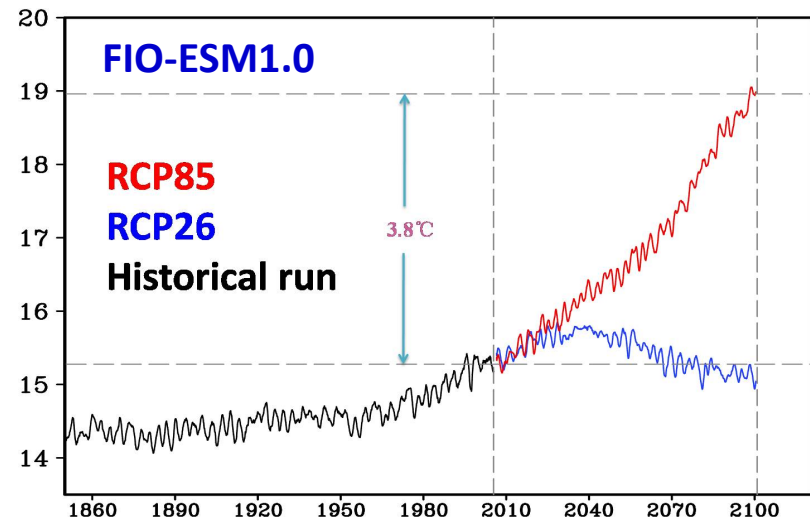
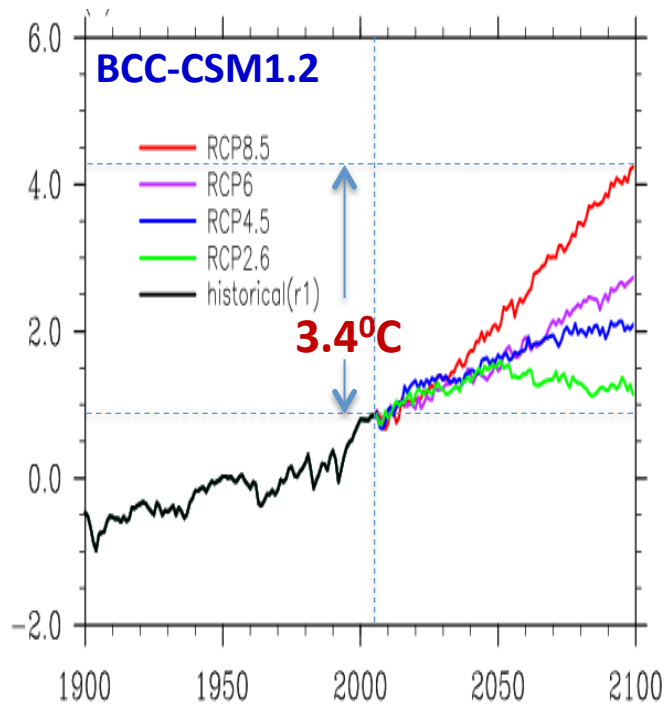
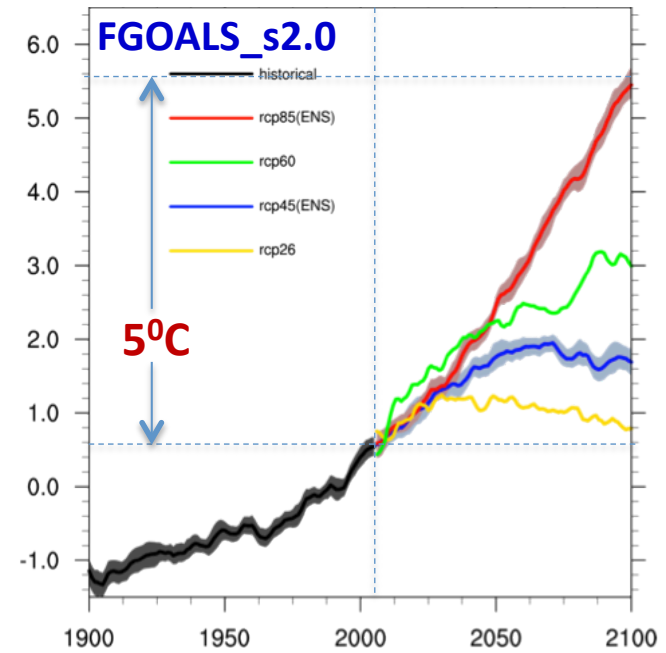
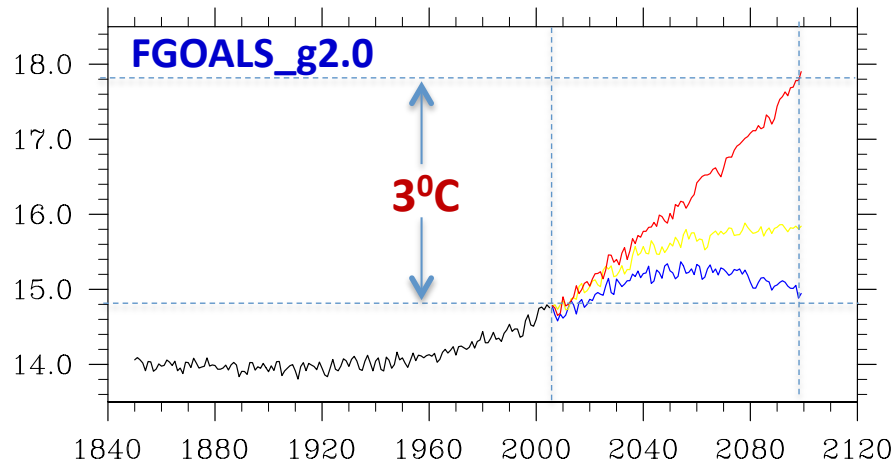
# The 20th century global CO<sub>2</sub> concentration simulated by BCC\_CSM1.1





# Global Surface Temperature

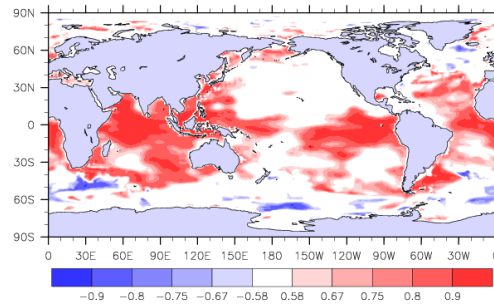
## Centennial Projection



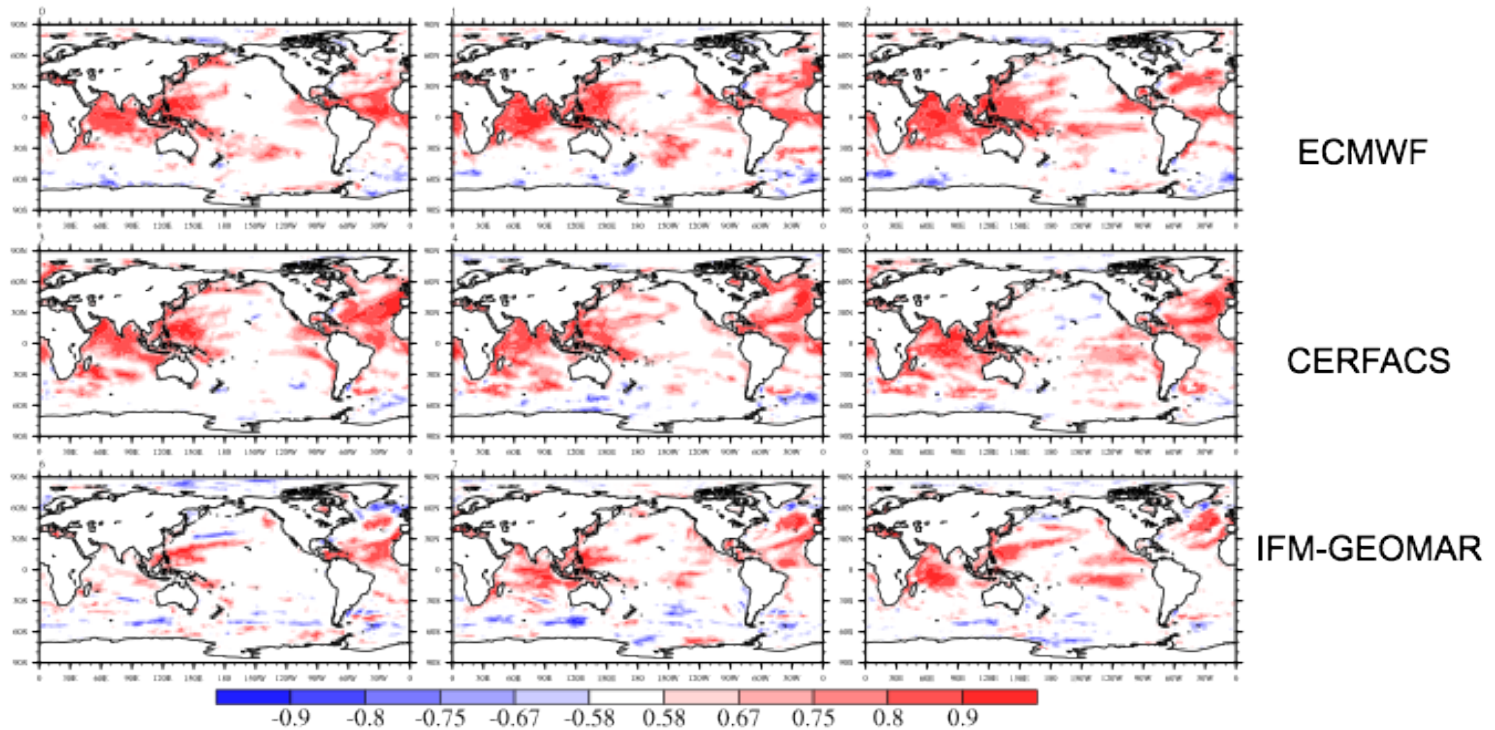
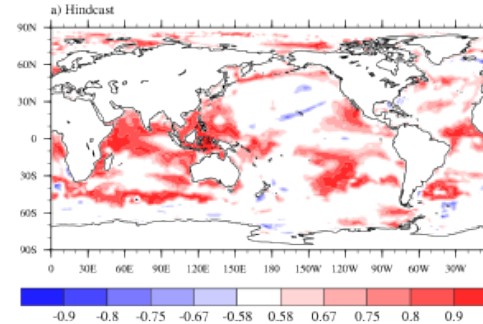
# Decadal prediction

## Correlations between hindcasts and observation (Decadal mean SST)

FGOALS\_g2.0



FGOALS\_s2.0

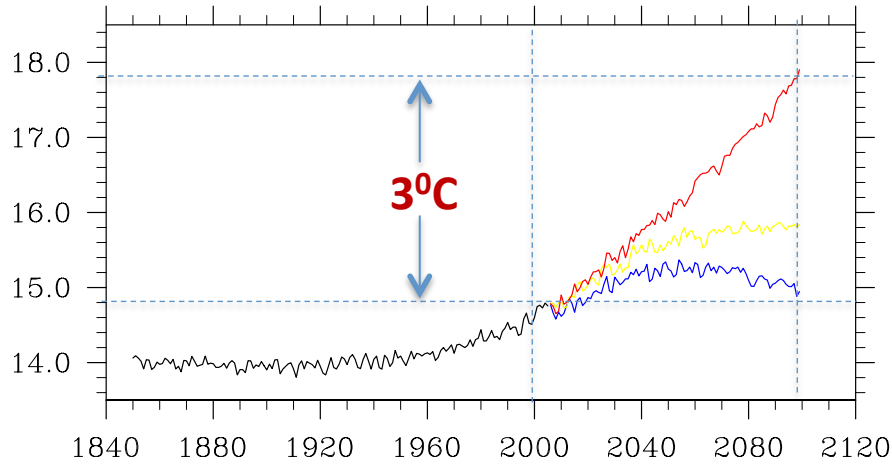


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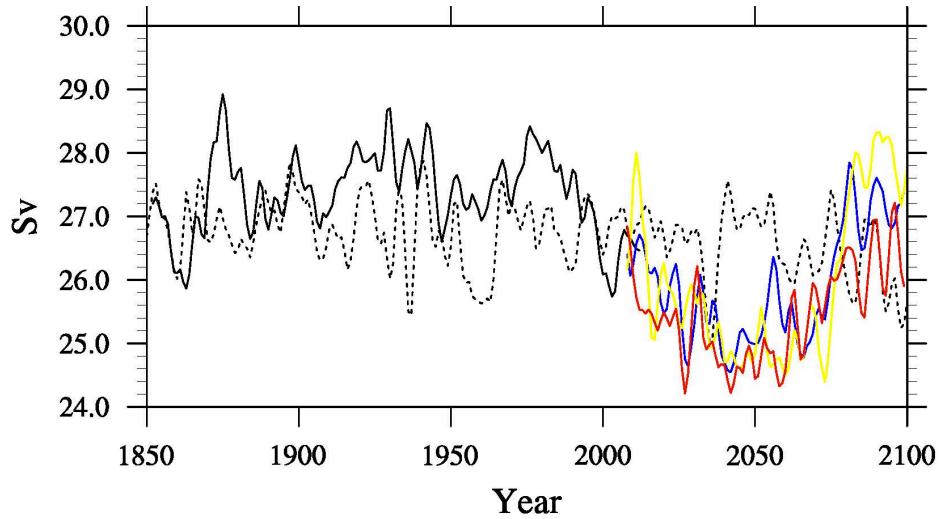
Centennial Projection

### Global Surface Temperature



### FGOALS\_g2.0

### Atlantic Meridional Overturning Circulation (AMOC)



— RCP85

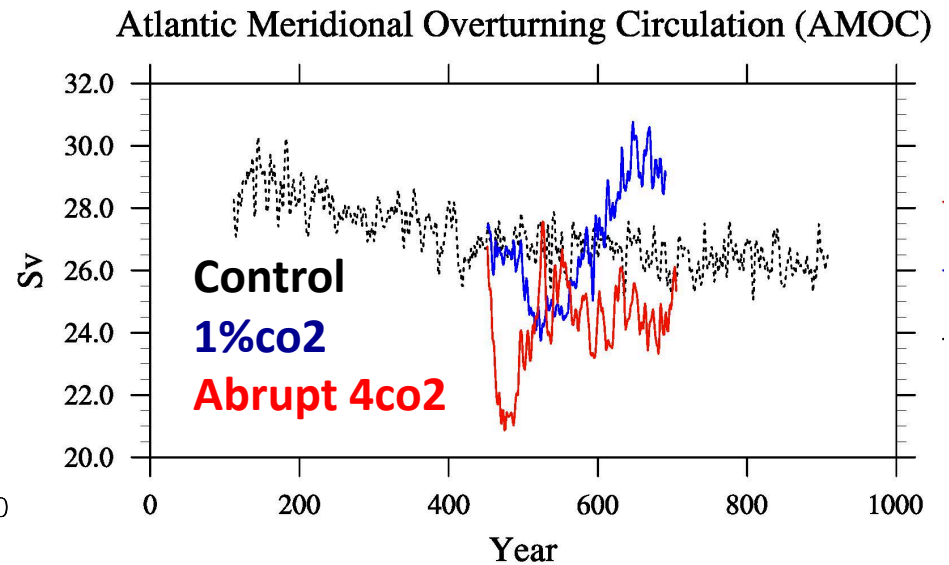
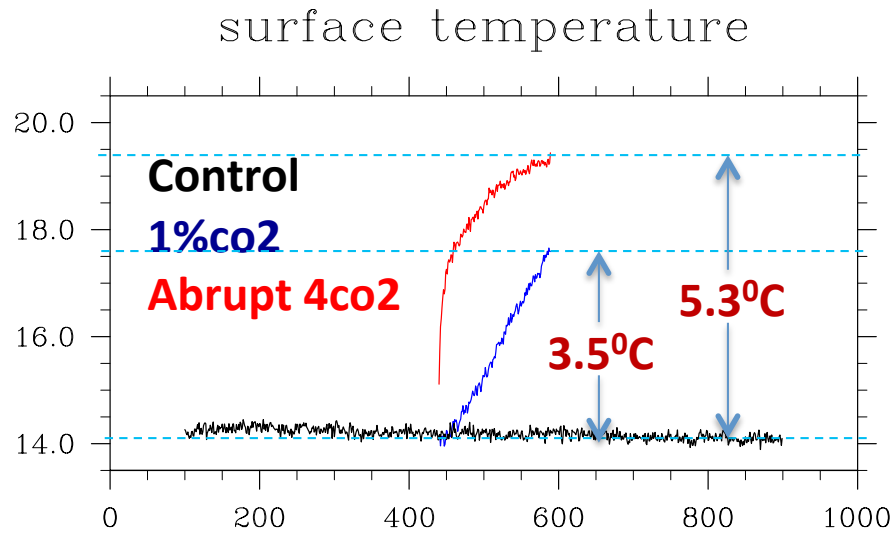
— RCP45

— RCP26

— Historical

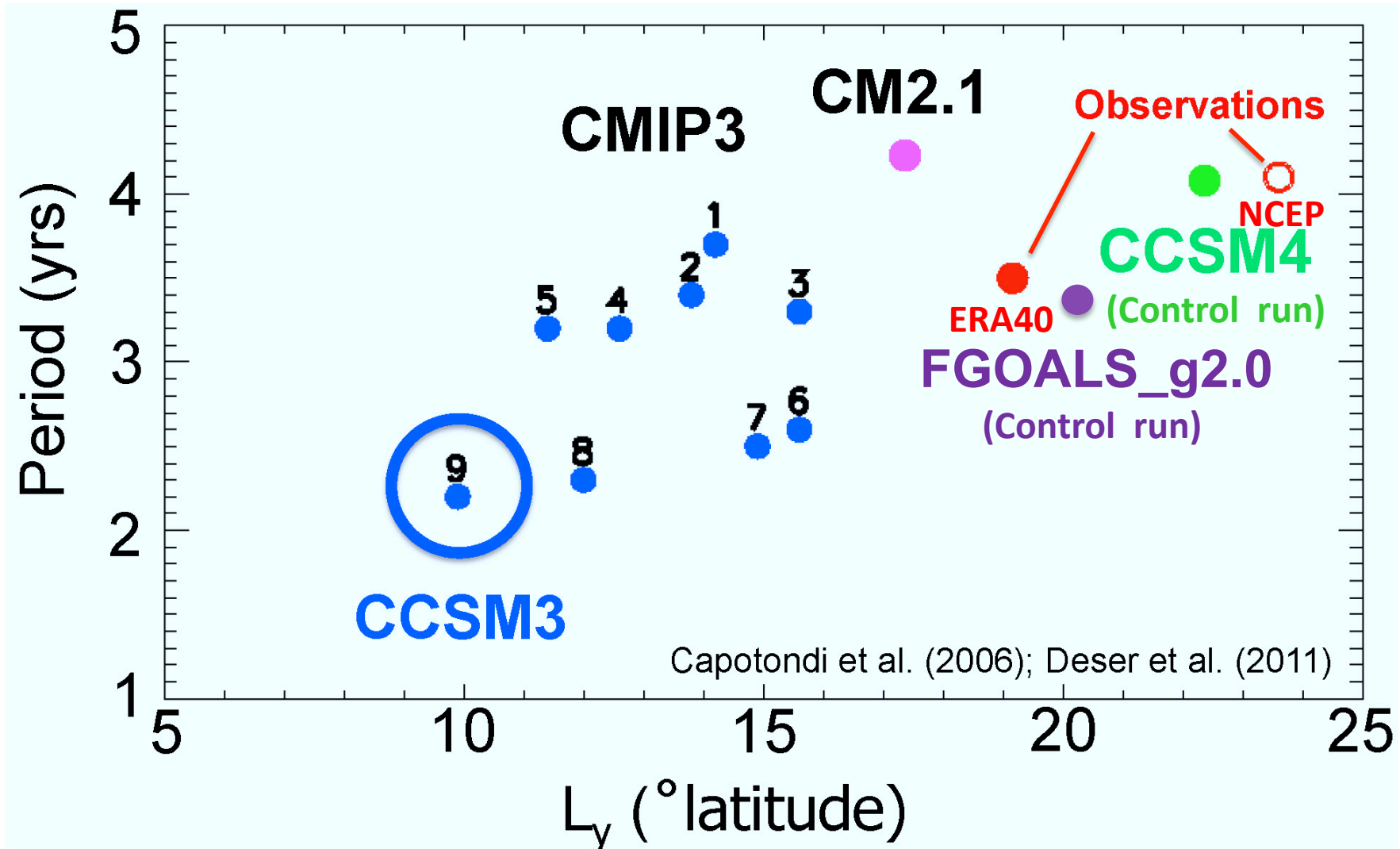
..... Control

# 1%pCO2 and 4CO2 experiments by FGOALS\_g2.0



Control:100-900年

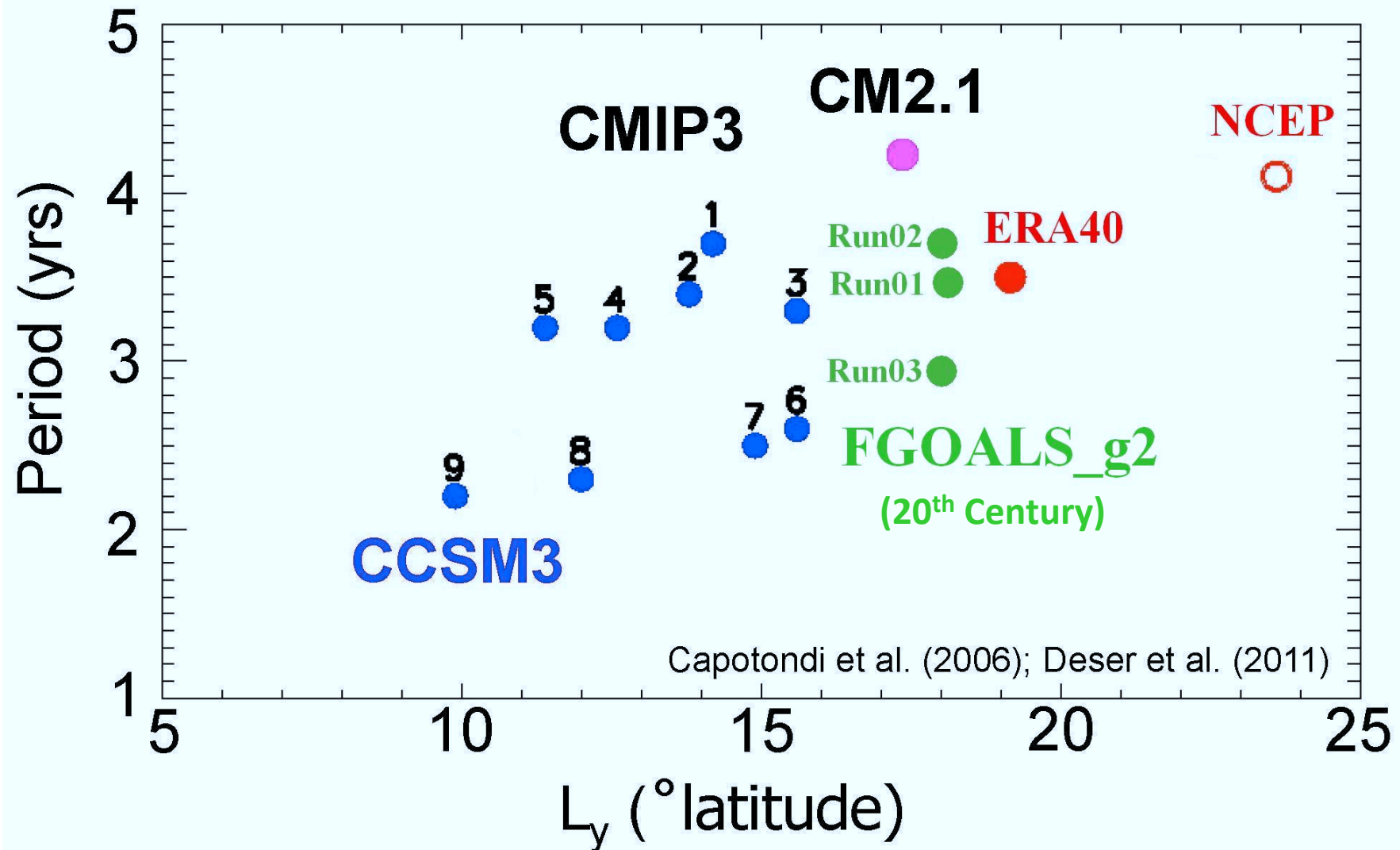
# ENSO in FGOALS\_g2.0 and other models



**Period** → freq of max spectral power of Niño3.4 SST

**$L_y$**  → width of zonal wind stress anomalies

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**Period** → freq of max spectral power of Niño3.4 SST

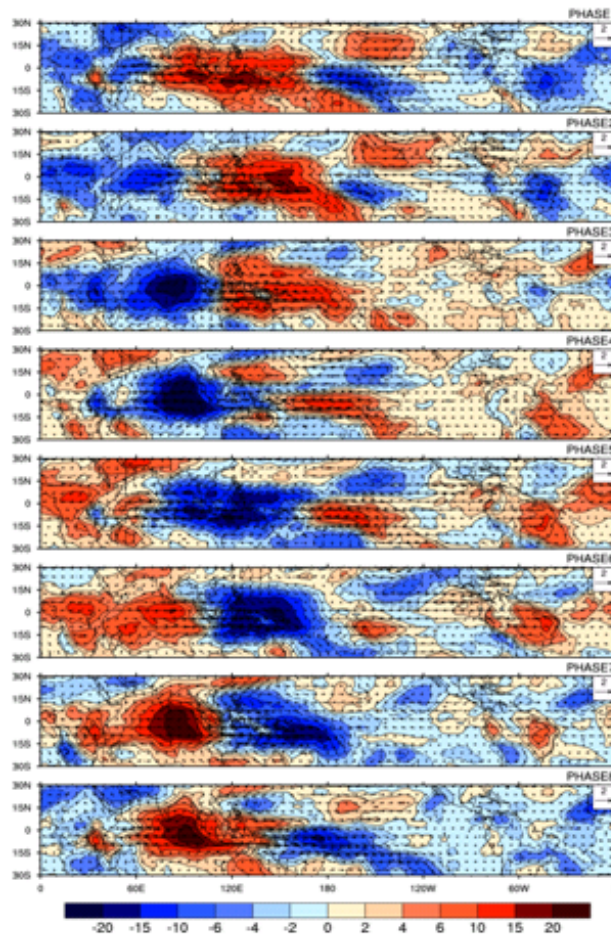
**$L_y$**  → width of zonal wind stress anomalies

# MJO in GAMIL 2.0

The composite life cycle of MJO in Boreal winter (NDJFMA)

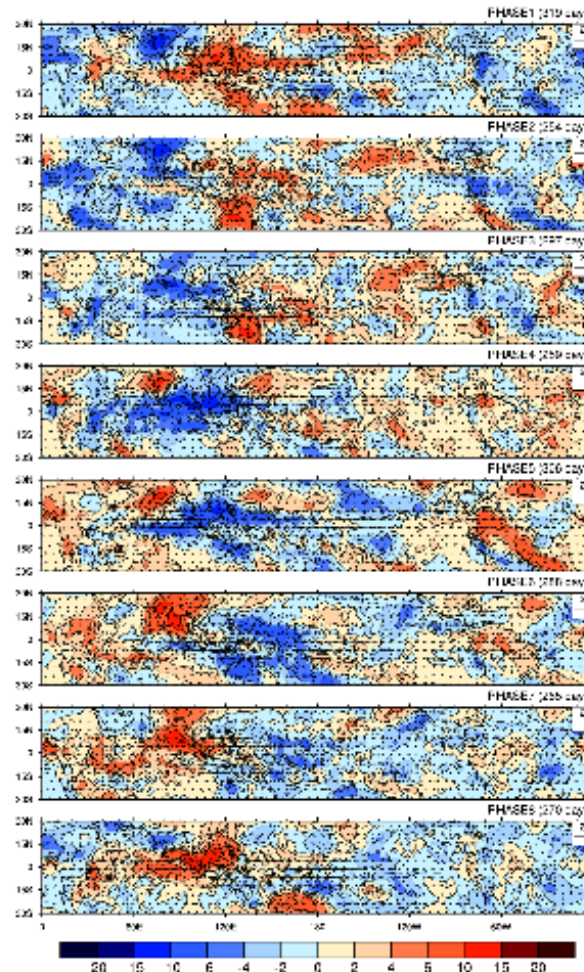
## OBS

1980-1999: Nov to Apr (obs)



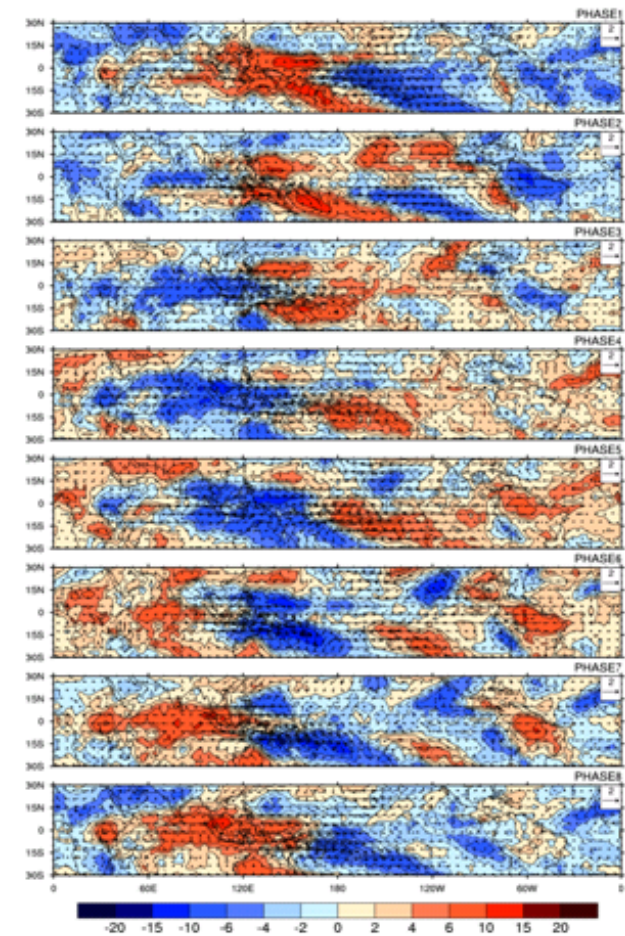
## GAMIL1.0-AR4

1980-1999: Nov to Apr (gamil1z)



## GAMIL2.0-AR5

1980-1997: Nov to Apr (gamil2)



OLR (shaded) and 850hPa wind (vector)



Cloud Fraction in GAMIL 2.0

Total

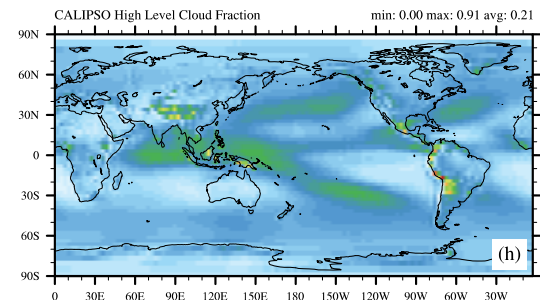
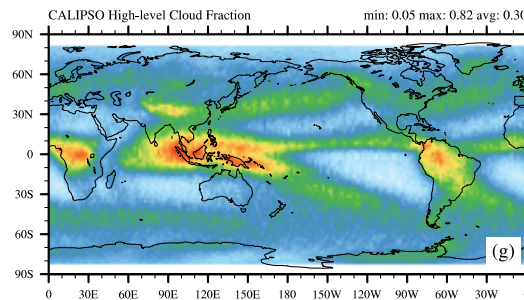
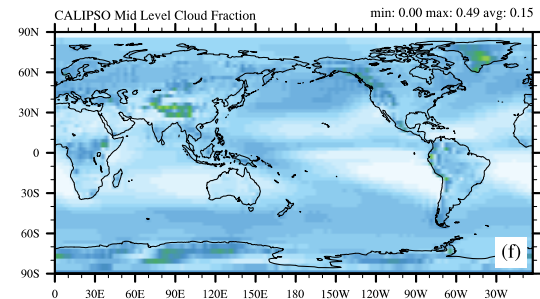
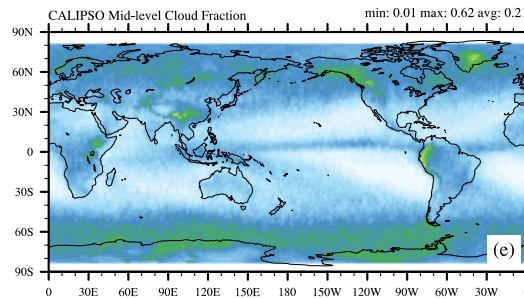
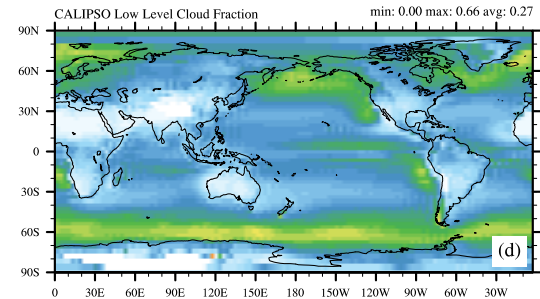
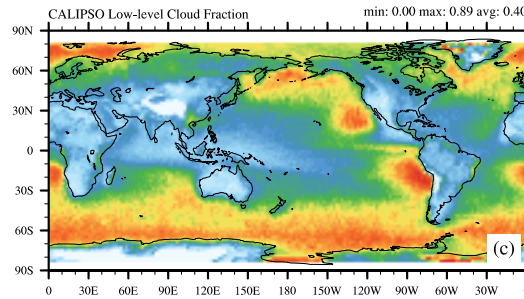
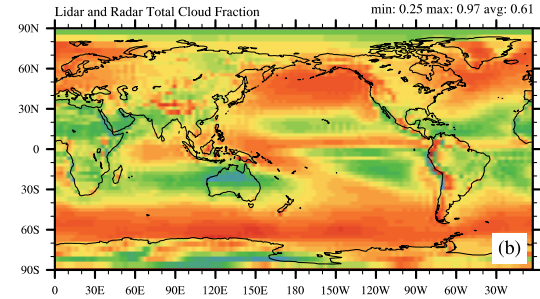
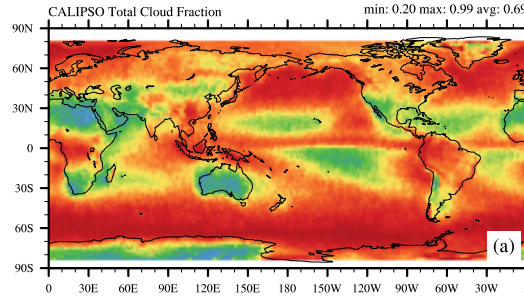
Low-level

Middle-level

High-level

CALIPSO-GOCCP

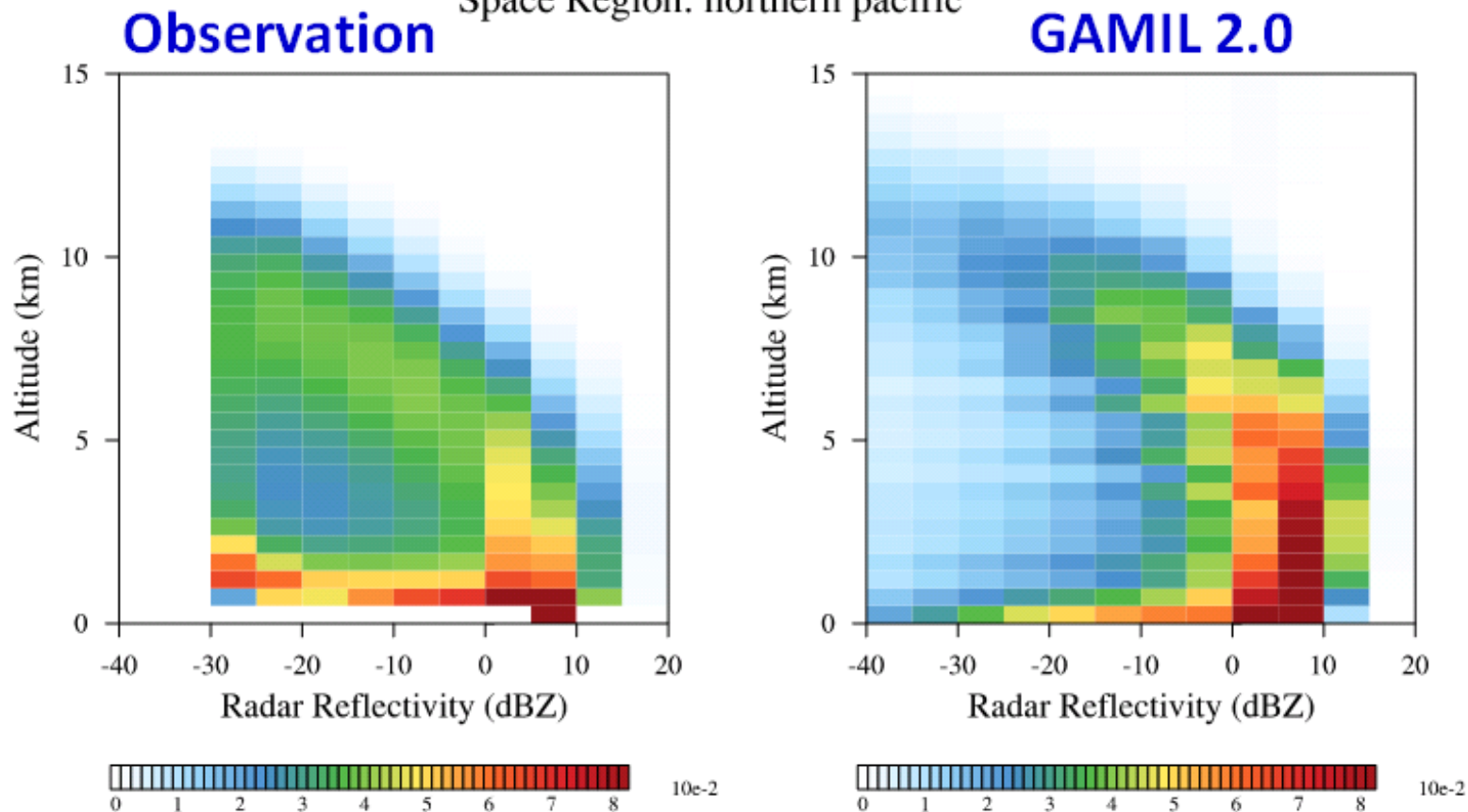
GAMIL 2.0



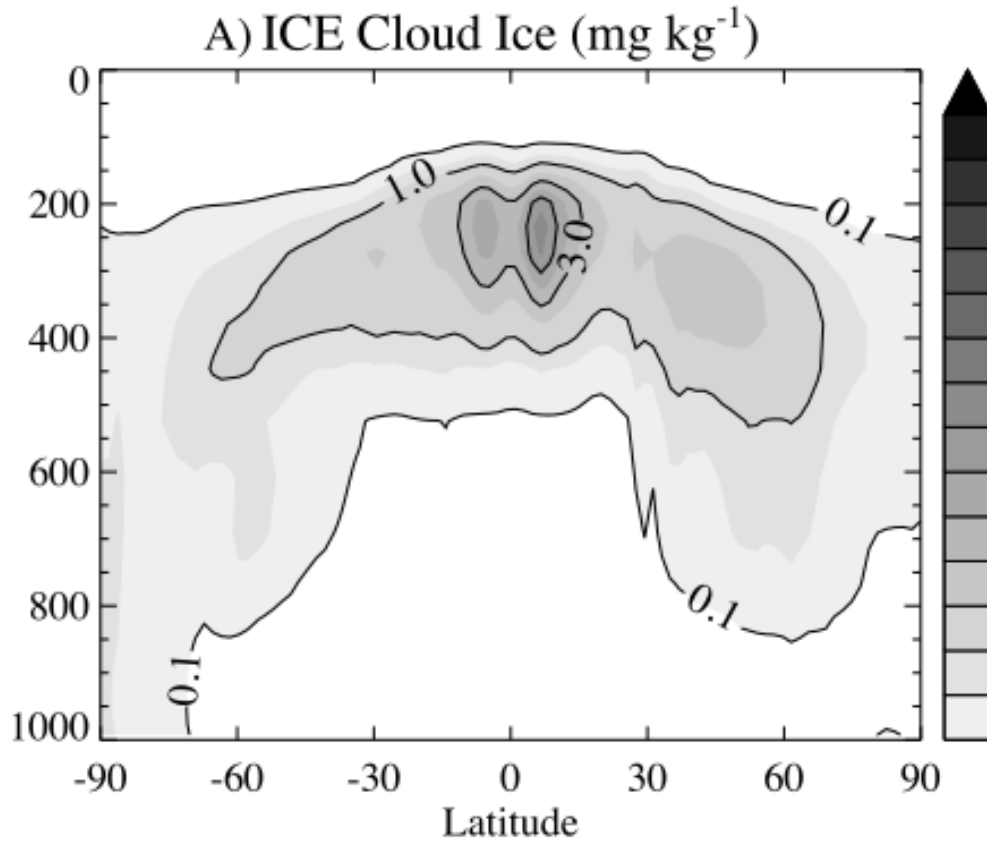
# Cloud Frequency in GAMIL2.0

Cloud Frequency Altitude Diagram (CFAD) from CloudSat Radar Reflectivity  
(Left: Observation, Right: Model)

Experiment ID: cfmip-4  
Time Range: 1979-2008:ANN  
Space Region: northern pacific

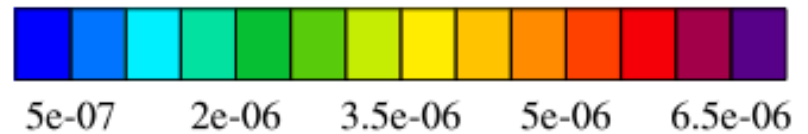
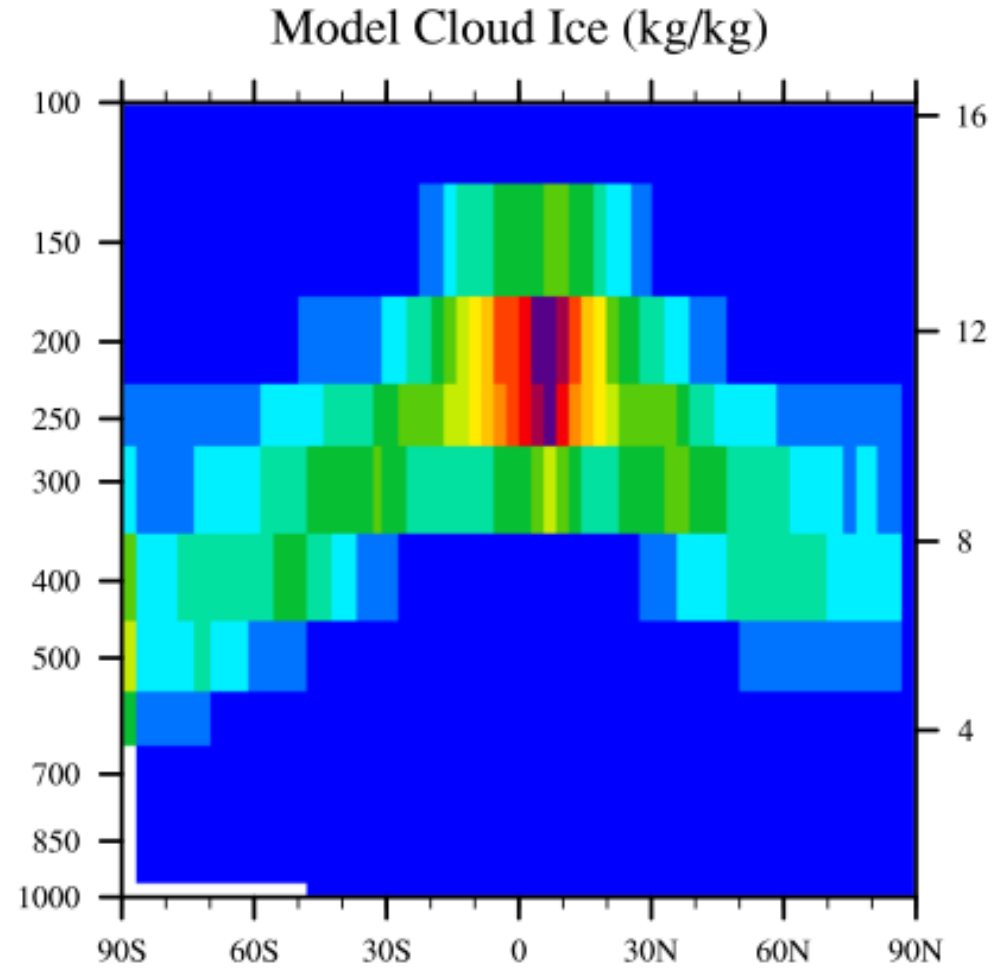


# Cloud ice in GAMIL 2.0



Observation

Gettelman et al., 2010, JGR



GAMIL 2.0

# Outline

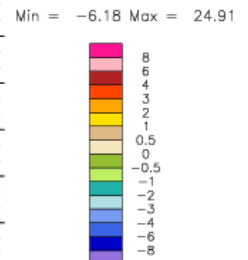
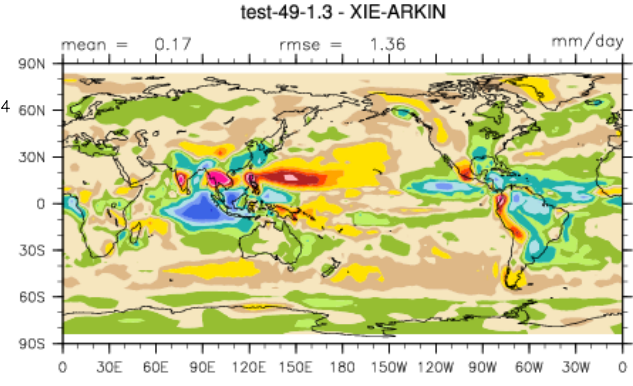
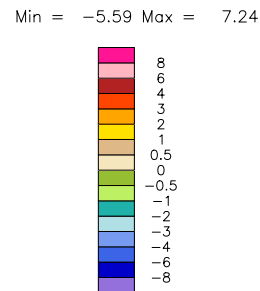
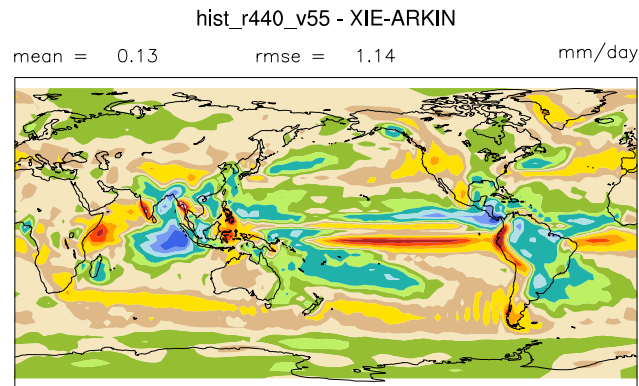
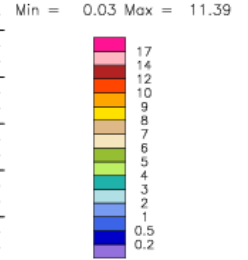
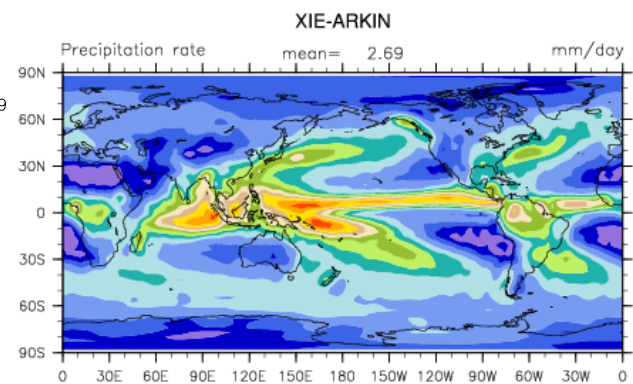
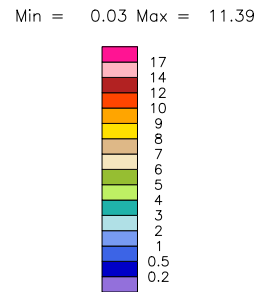
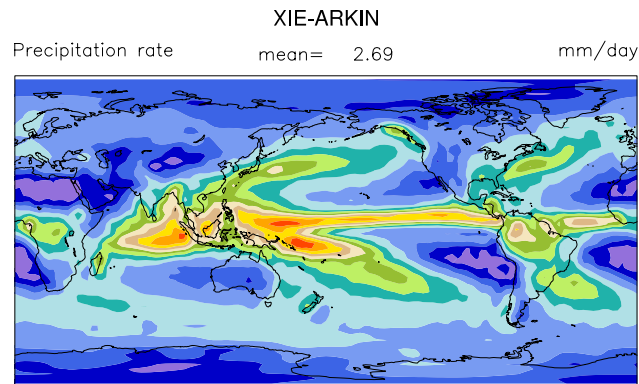
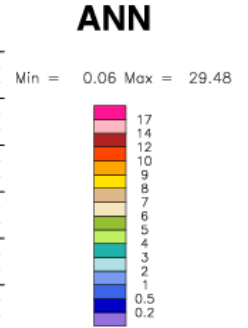
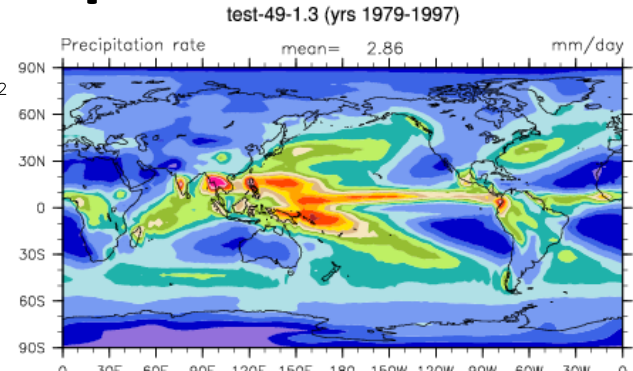
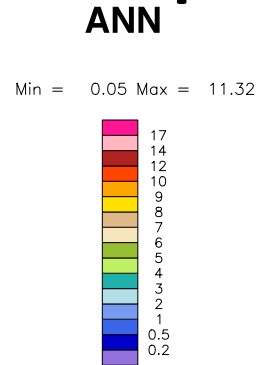
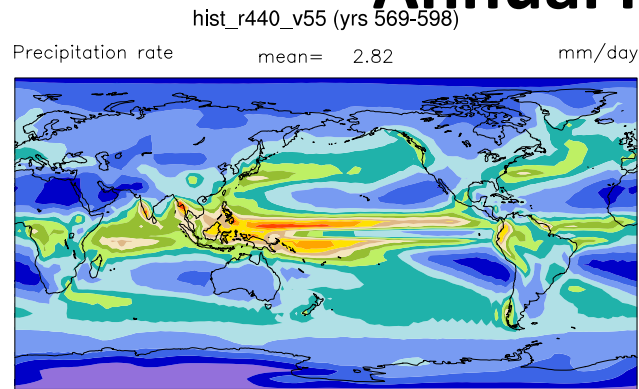
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# Low resolution in FGOALS\_g2.0

<b>Component</b>	<b>Resolution</b>
<b>Atmosphere</b>	<b>128×60 L26</b>
<b>Ocean</b>	<b>360×196 L30</b>
<b>Land Surface</b>	<b>128×60 L10+5</b>
<b>Sea Ice</b>	<b>360×196 L4</b>

# Double ITCZ in FGOALS\_g2.0

## Annual mean precipitation

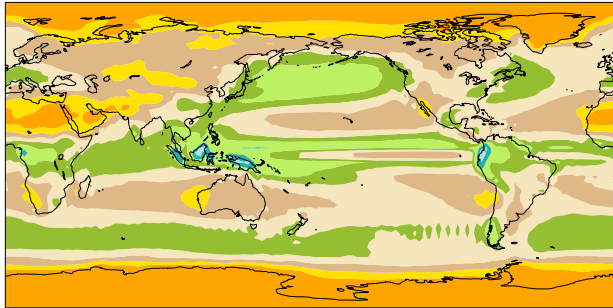


CMIP-FGOALS\_g2.0

AMIP-GAMIL2.0

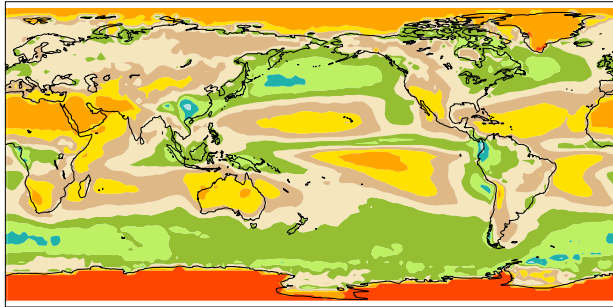
# Short-wave Cloud Forcing

hist\_r440\_v55 (yrs 569-598)  
TOA SW cloud forcing mean = -49.69 W/m<sup>2</sup>



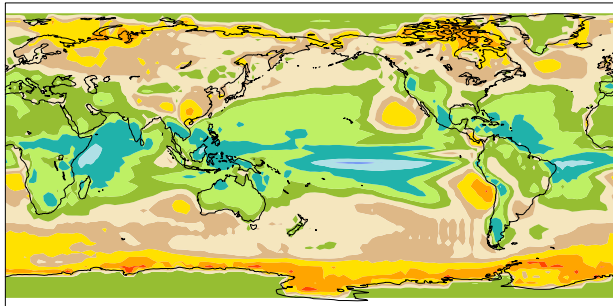
CERES

TOA SW cloud forcing mean = -48.59 W/m<sup>2</sup>



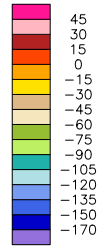
hist\_r440\_v55 - CERES

mean = -1.16 rmse = 18.35 W/m<sup>2</sup>



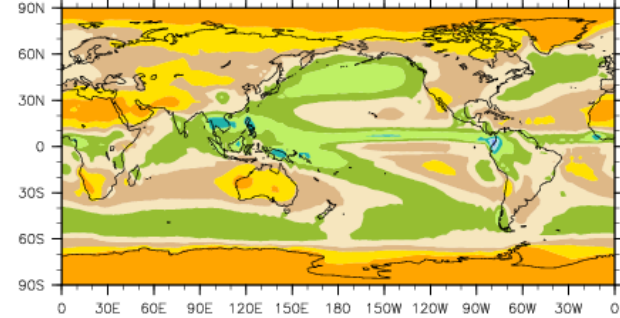
ANN

Min = -121.64 Max = -0.38



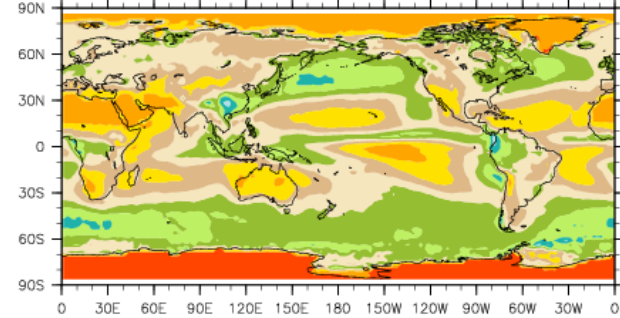
test-49-1.3 (yrs 1979-1997)

TOA SW cloud forcing mean = -48.29 W/m<sup>2</sup>



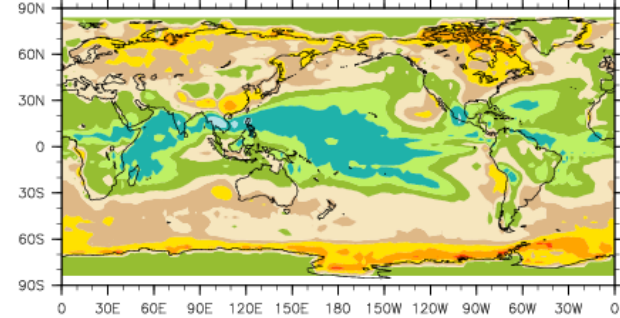
CERES

TOA SW cloud forcing mean = -48.59 W/m<sup>2</sup>



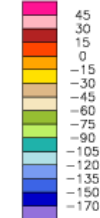
test-49-1.3 - CERES

mean = 0.24 rmse = 16.83 W/m<sup>2</sup>



ANN

Min = -131.51 Max = -0.50

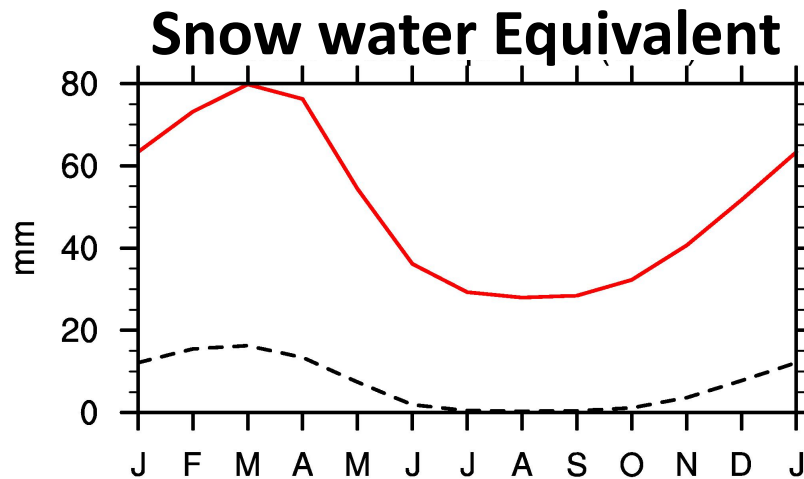
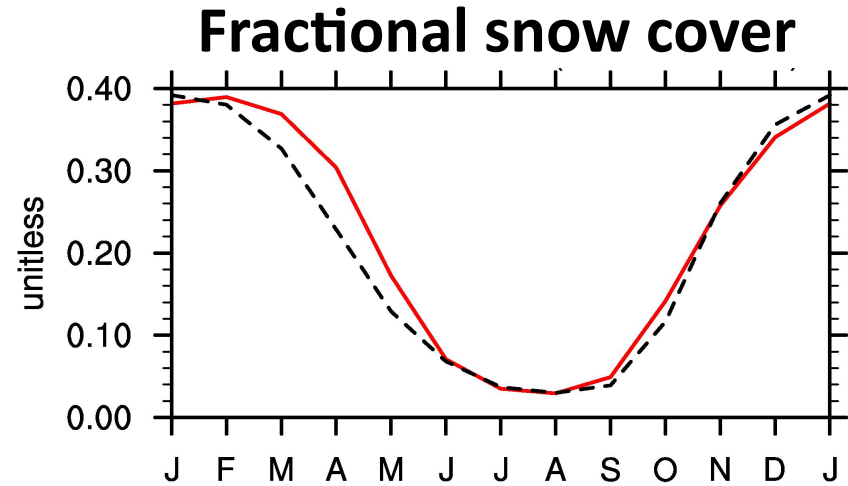
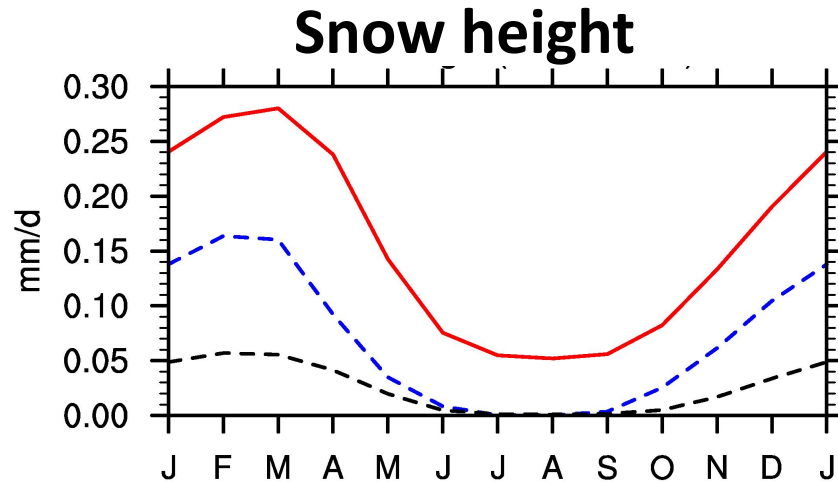


CMIP-FGOALS\_g2.0

AMIP-GAMIL2.0

# Bias in Snow simulation

## Snow over North Hemisphere Land



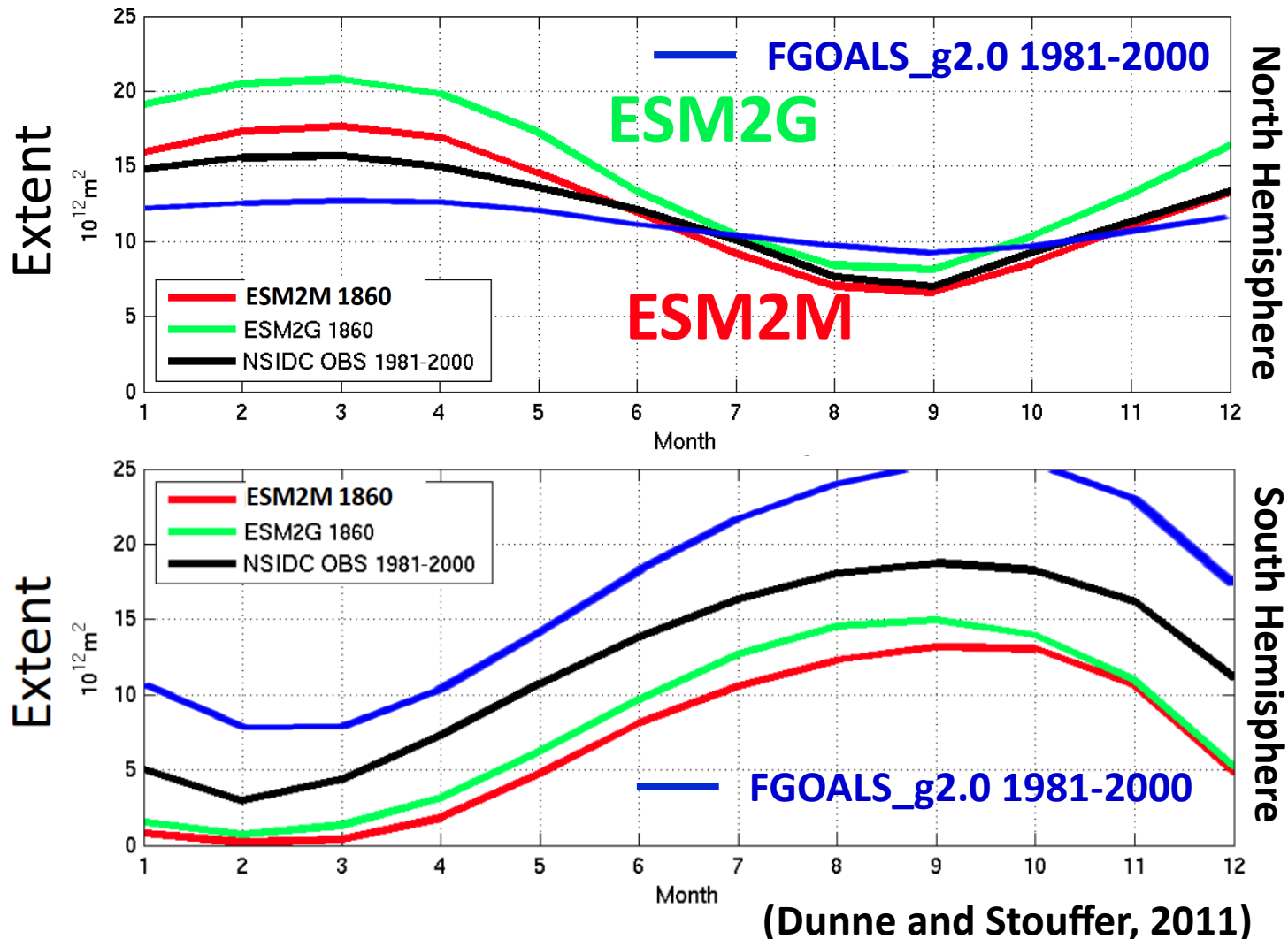
- Run01 (20<sup>th</sup> Century)
- - - USAF
- - - CMC/NOAA-AVHRR



# Weak seasonal variation in North Hemisphere

## Overestimation in South Hemisphere

### Sea ice extent



(Dunne and Stouffer, 2011)

Thank you