



# The Basic Performance of IAP Coupled GCM FGOALS2.0

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# Out line



1

· Introduction

2

· Model Description

3

· Mean Climatology

4

· Interannual and Interdecadal Variability

5

· Summary



# IAP Climate Model History



AGCM: 26L、~100km  
OGCM: 30L、10~100km  
Carbon cycle、atmospheric chemistry

Modularized and parallelized codes

AGCM: 26L、~300km

OGCM: 30L、~100km

**2009: FGOALS2.0**

**2004: FGOALS1.0**

**1997: GOALS**

9-L AGCM、Land model

**1995: M2+20**

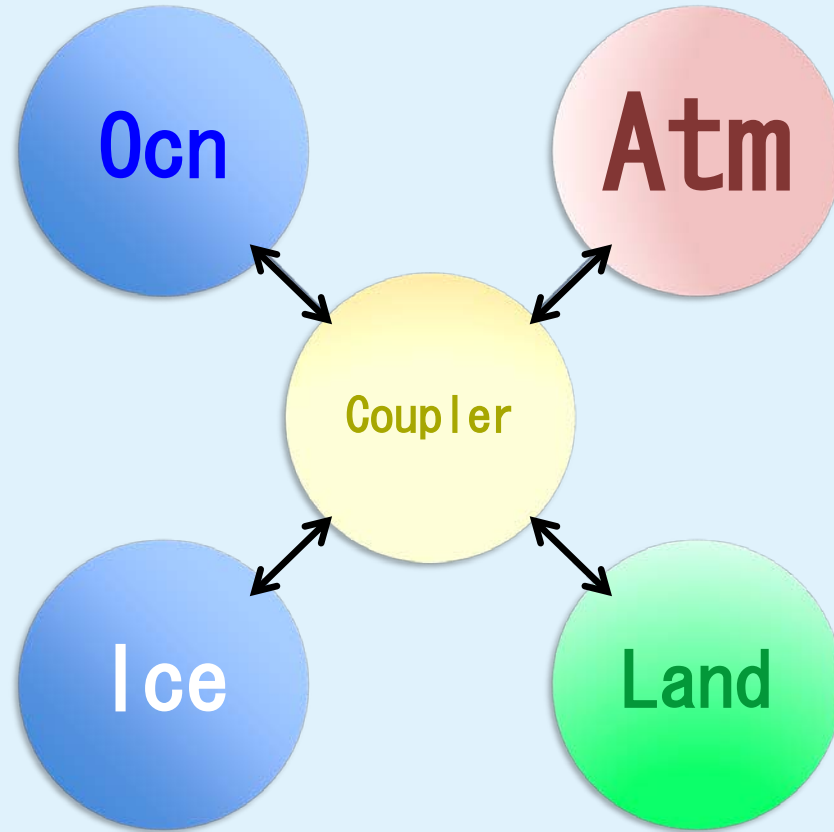
20-L OGCM, thermodynamic sea ice

**1992: M2+4**

2-L AGCM、4-L OGCM



# Basic Configuration of FGOALS



**F**lexible  
**G**lobal  
**O**cean-  
**A**tmosphere-  
**L**and  
**S**ystem



# Out line



1

· Introduction

2

· **AGCM and OGCM Simulations**

3

· Mean Climatology by the coupled GCM

4

· Climate Variability by the coupled GCM

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· Summary



# Brief description of AGCM

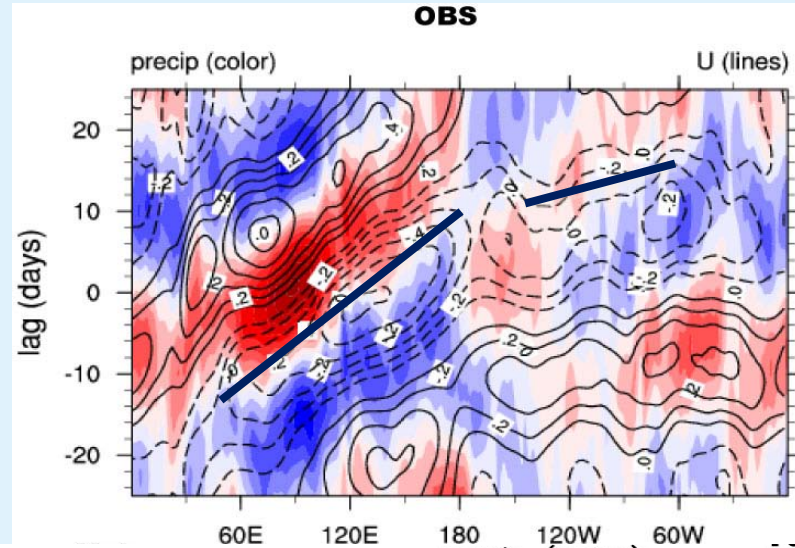
- Horizontal resolution from 3 degrees to 1 degrees without zonal filter in the polar region
- New physical parameterization schemes such as convective adjustment, cloud scheme etc.
- Improved model performance, such as East Asian Monsoon, MJO, Cloud-radiation feedback
- Develop an atmospheric chemistry module
- Participate in international model comparison projects, such as C20C, aqua planet experiments etc.



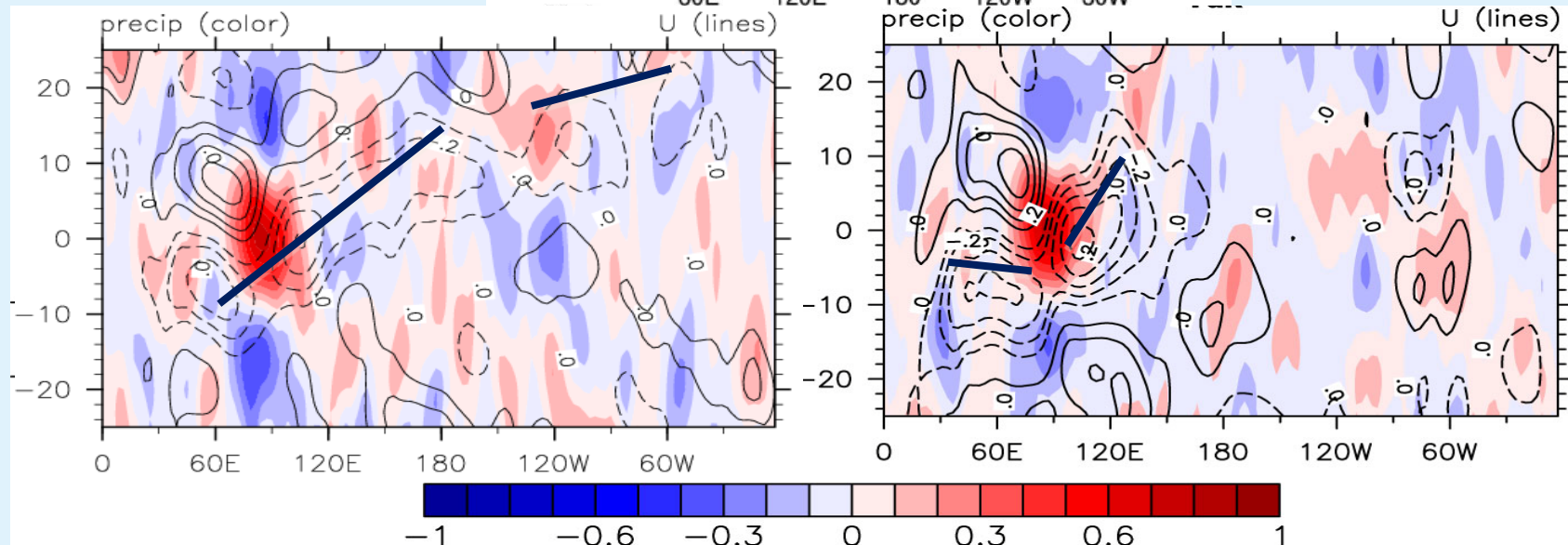




# Simulated MJO events



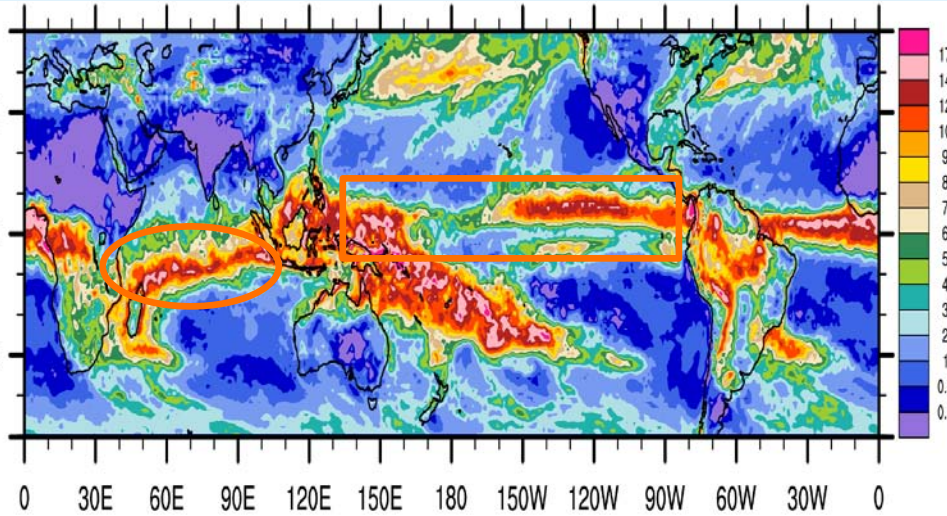
**OBS**



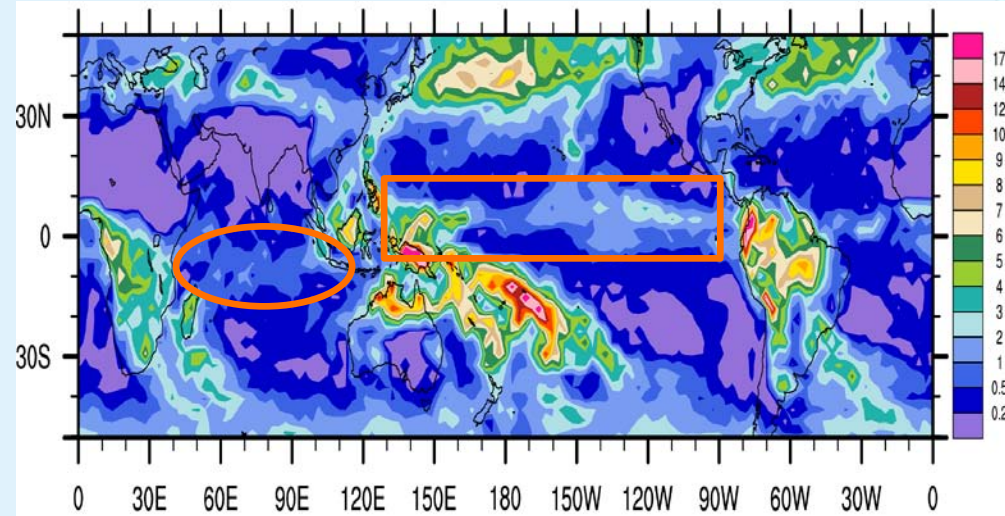
**Tideck convective scheme Zhang and Mc Flare scheme**



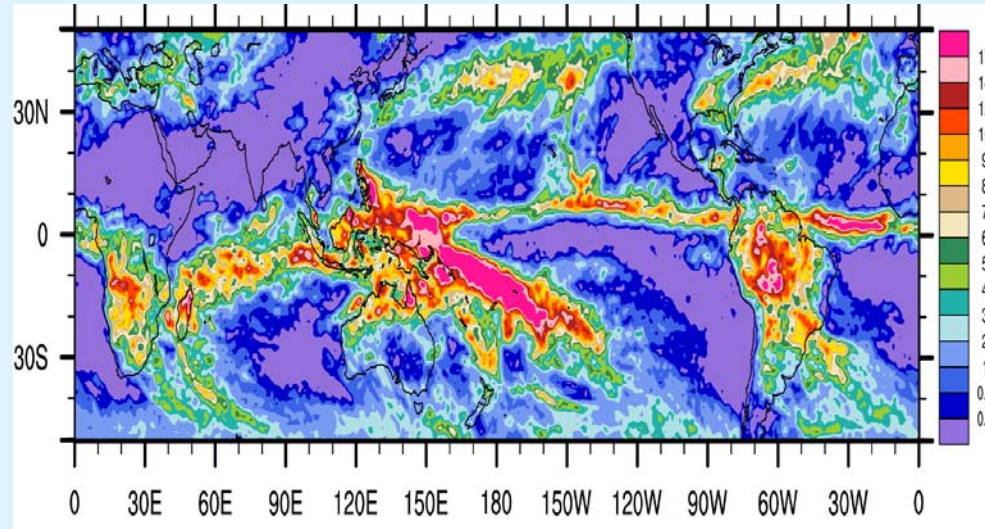
# Annual Mean Precipitation



1X1 degree



2.8X2.8 Degree



OBS





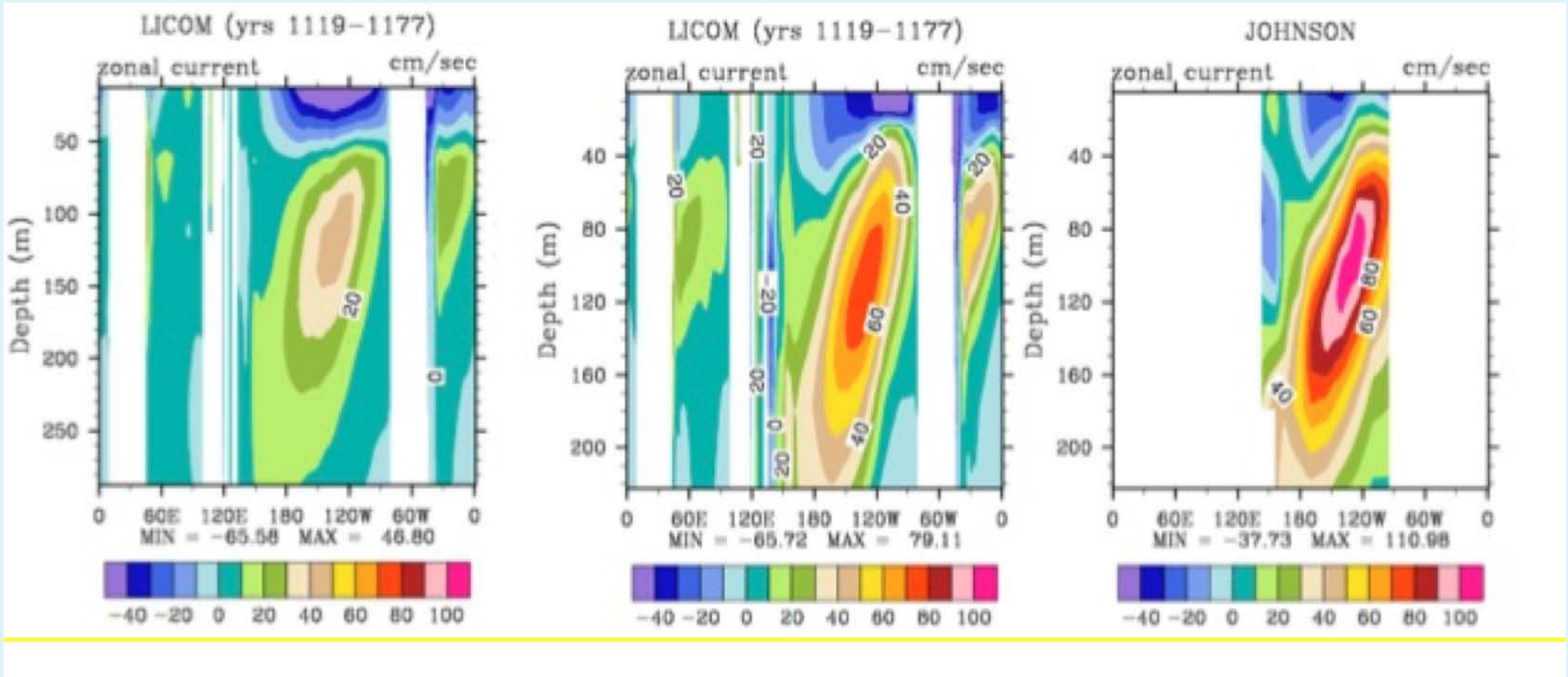
# Brief description of OGCM

	LICOM1.1	LICOM2.0
Horizontal Resolution	1°X1°	1°X(0.5°~1°)(global) 0.25°X0.25° (Pacific)
Vertical Resolution	30 levels (25m in upper 300m)	30 levels (10m in upper 150m)
Advection Scheme	2 order central difference	A shape-preserving (Yu, 1994)
Vertical Mixing	Pacanowski and Philander, 1981	Canuto et al., 2001
Mesoscale eddy parameterization	Gent and McWilliams, 1990	Gent and McWilliams, 1990; Large et al., 1997
Horizontal Viscosity	$2 \times 10^4 \text{ m}^2/\text{s}$	$3 \times 10^3 \text{ m}^2/\text{s}$
SW Radiation Penetration	Constant (Paulson and Simpson, 1977)	Chlorophyll depended (Ohlmann, 2003)

图2, LICOM2.0相对于之前版本的主要改进。



# Equatorial Undercurrent



(a) LICOM1.1, (b) LICOM2.0, (c) OBS. Unit: cm/s.



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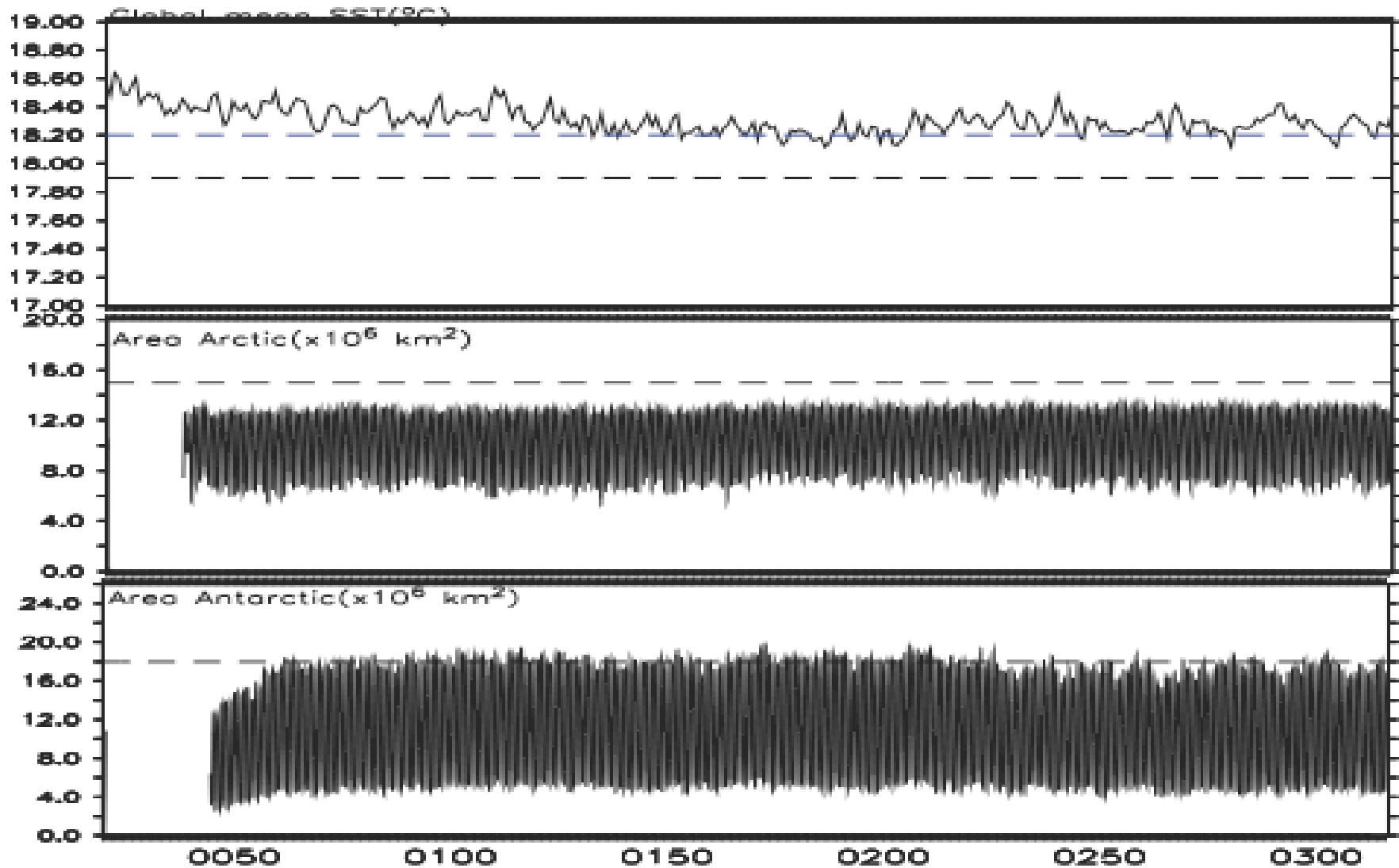
· Interannual and Interdecadal Variability

5

· Future Plan



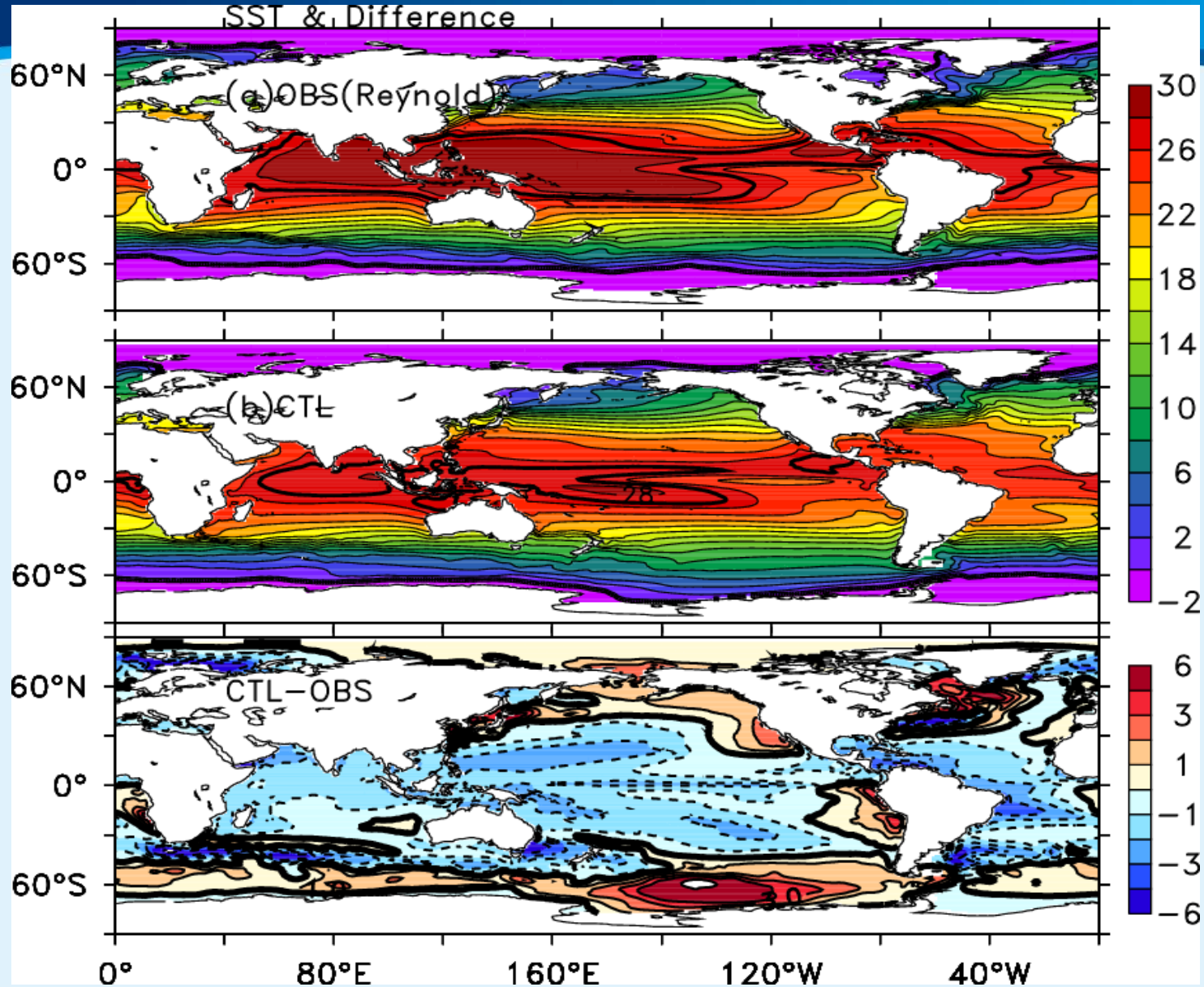
# Global mean SST, area of sea ice





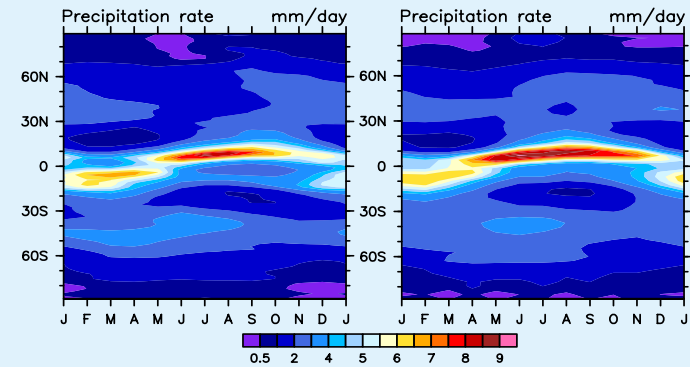
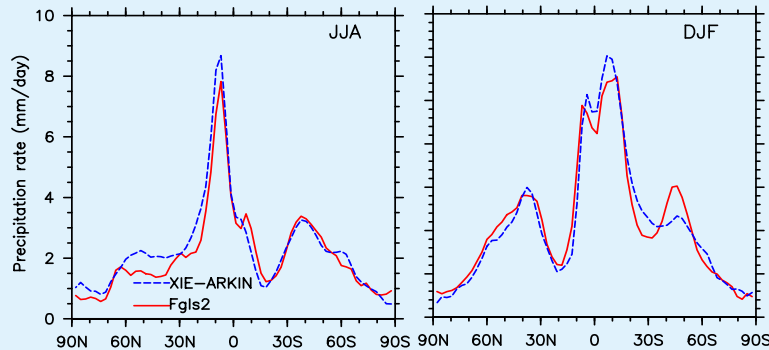
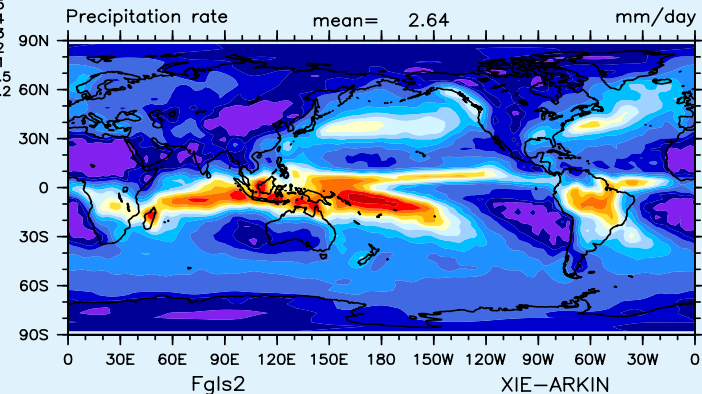
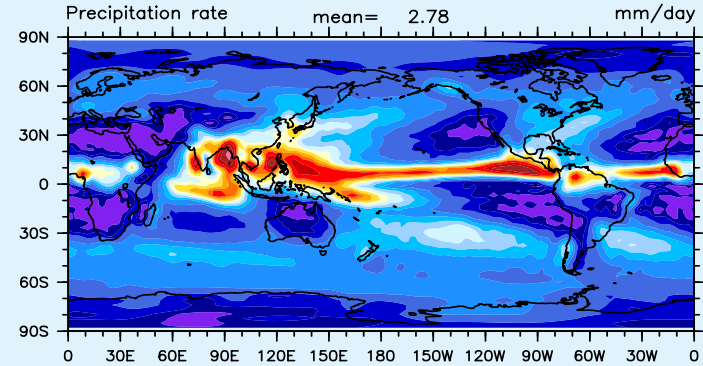
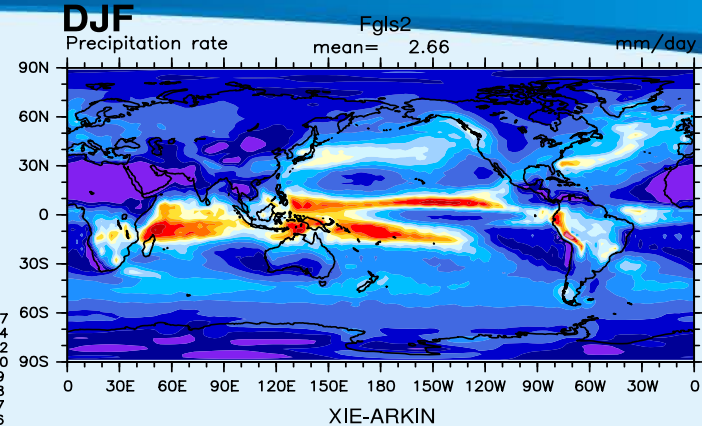
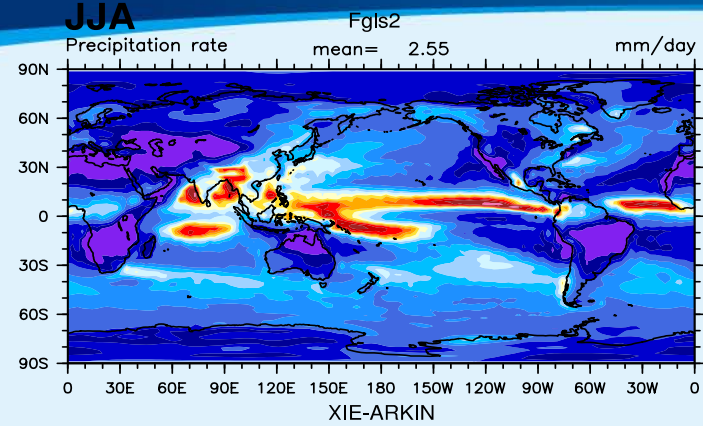


# Annual Mean SST



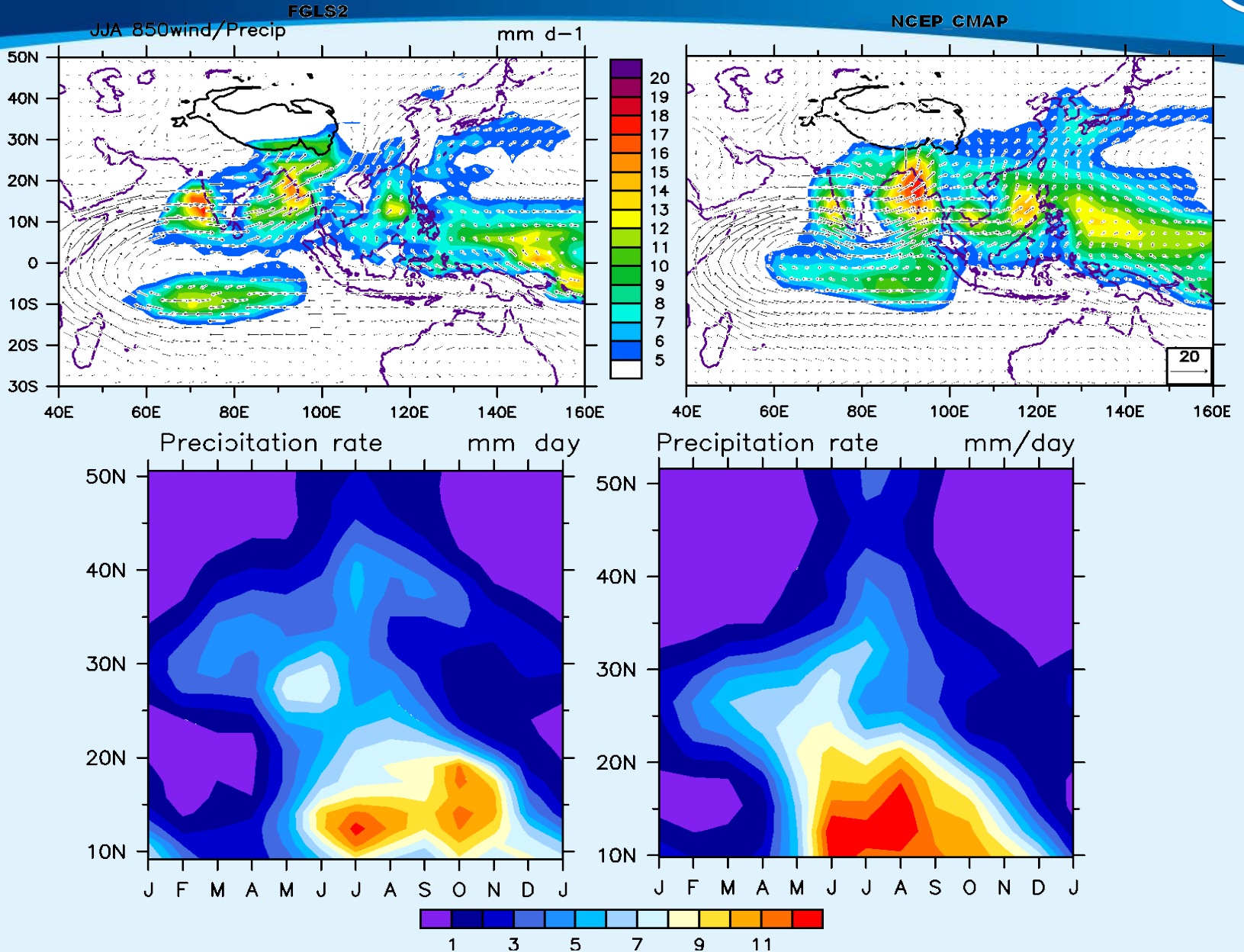


# Precipitation



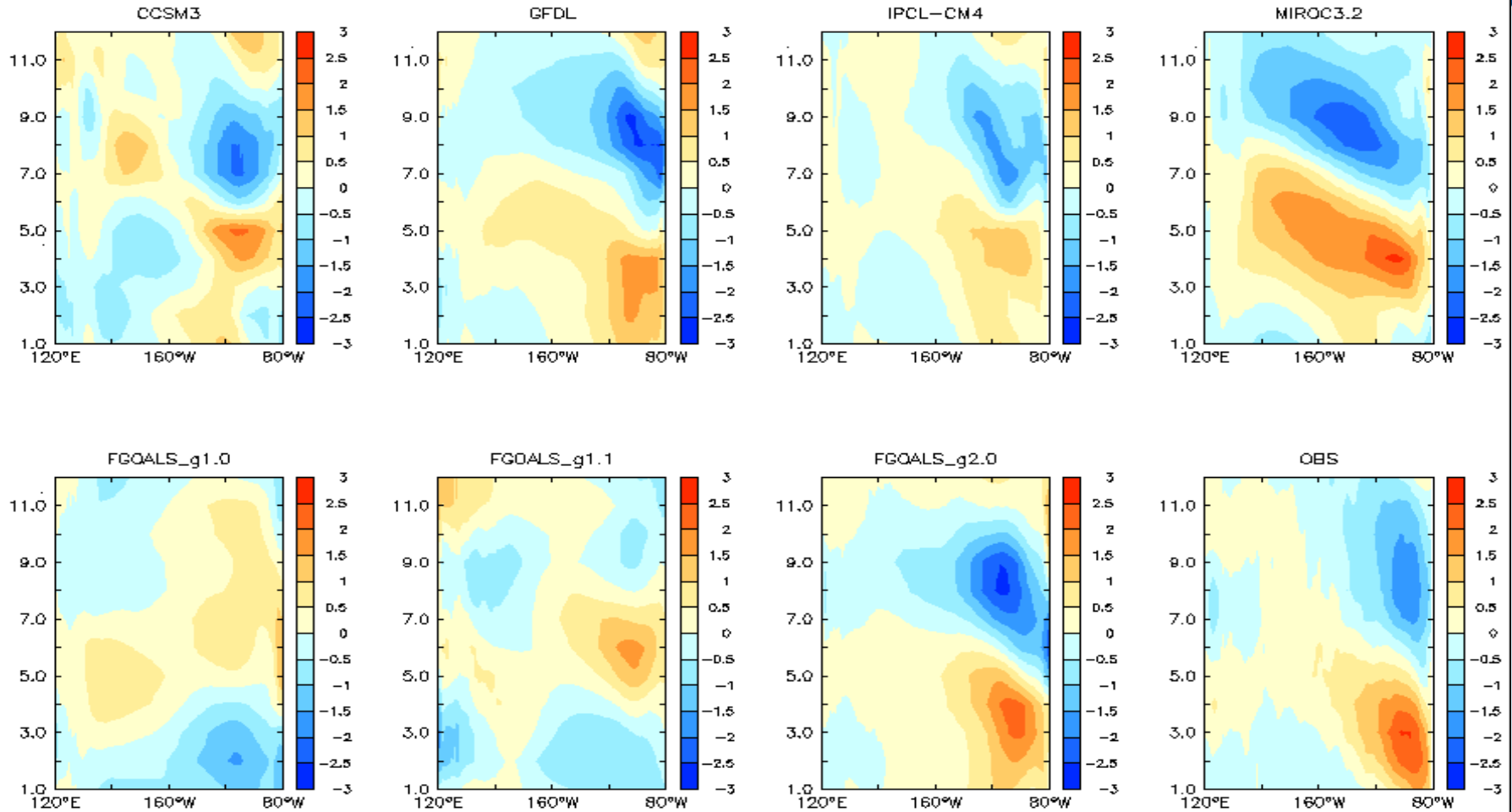


# Asian Monsoon





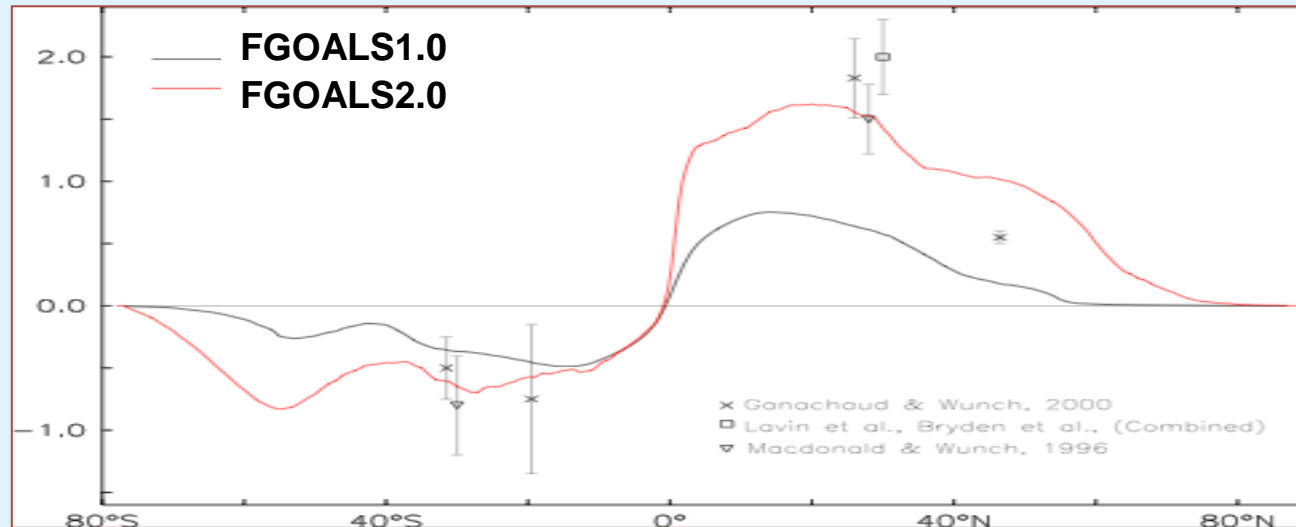
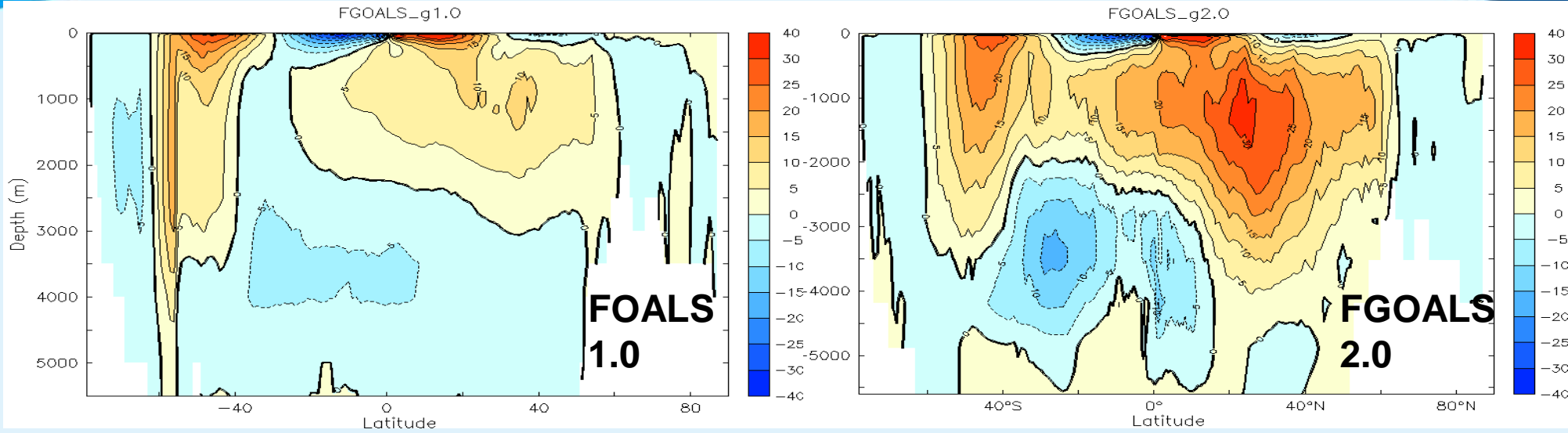
# Seasonal cycle of Equatorial SST averaged 2S-2N







# Cooling bias in High latitudes



**Both poleward heat transport and MOC are improved!**



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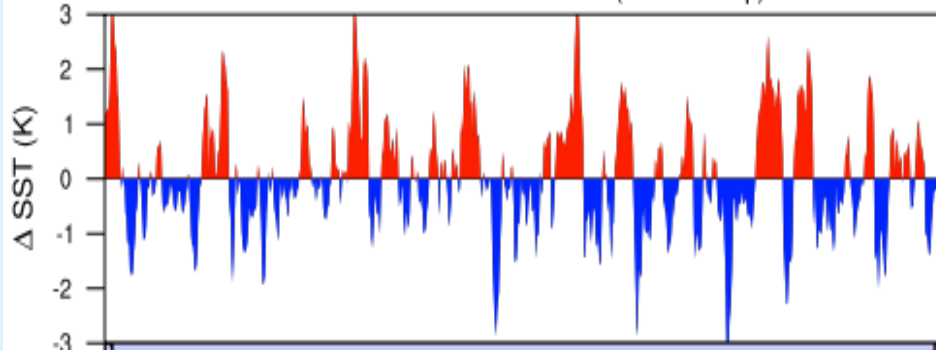
· Future Plan



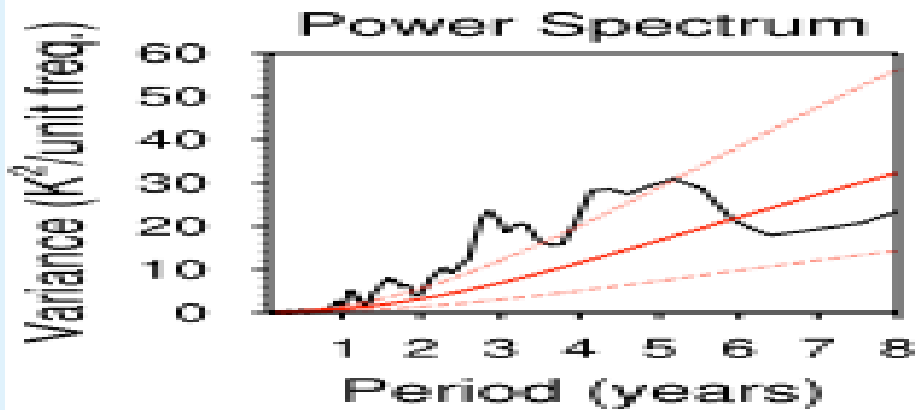
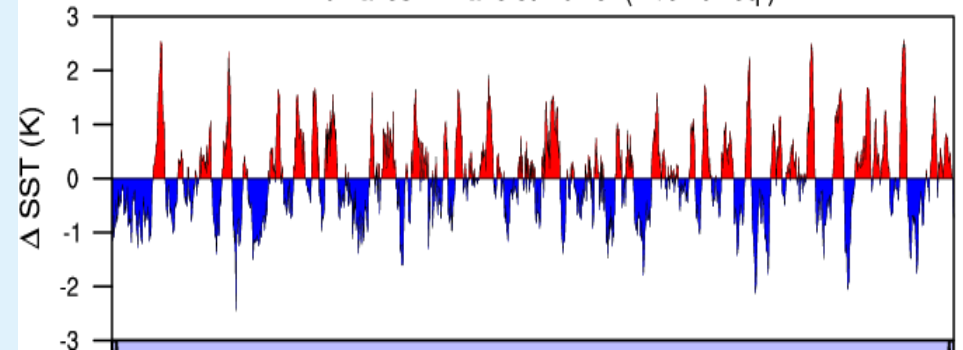
# ENSO Simulations



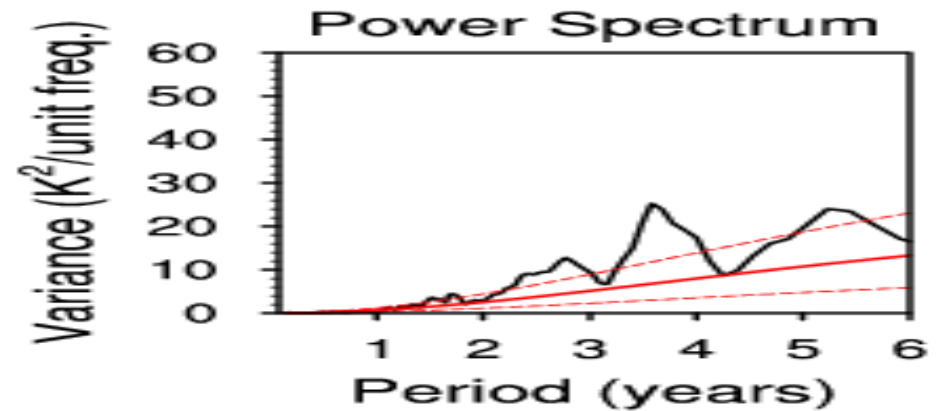
me - nino3.4 Monthly SST Anomalies (5N-5S,170W-120W)  
Anomalies + Wavelet Power ( $K^2/\text{unit freq.}$ )



HadiSST - nino3.4 Monthly SST Anomalies (5N-5S,170W-120W)  
Anomalies + Wavelet Power ( $K^2/\text{unit freq.}$ )



**Model**



**OBS**

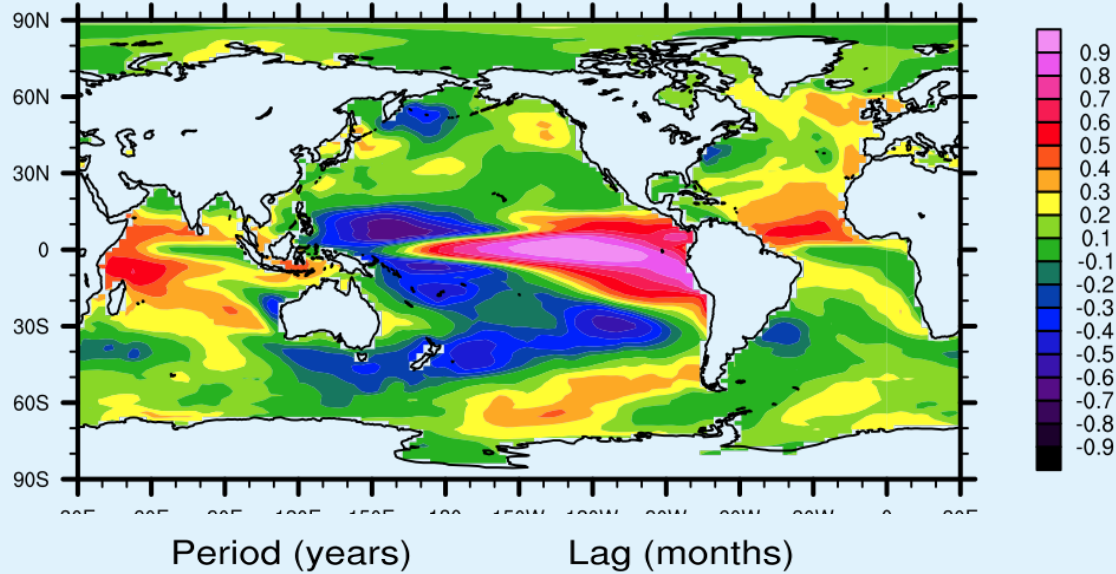


# Correlation between Nino3 and SST

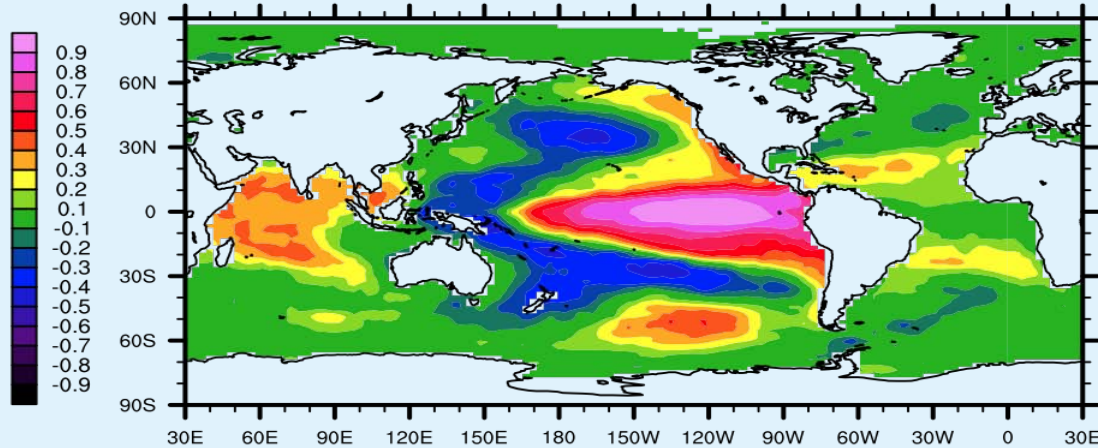


MODEL

Correlation of Nino 3 and SST Anomaly Timeseries



Correlation of Nino 3 and SST Anomaly Timeseries



OBS



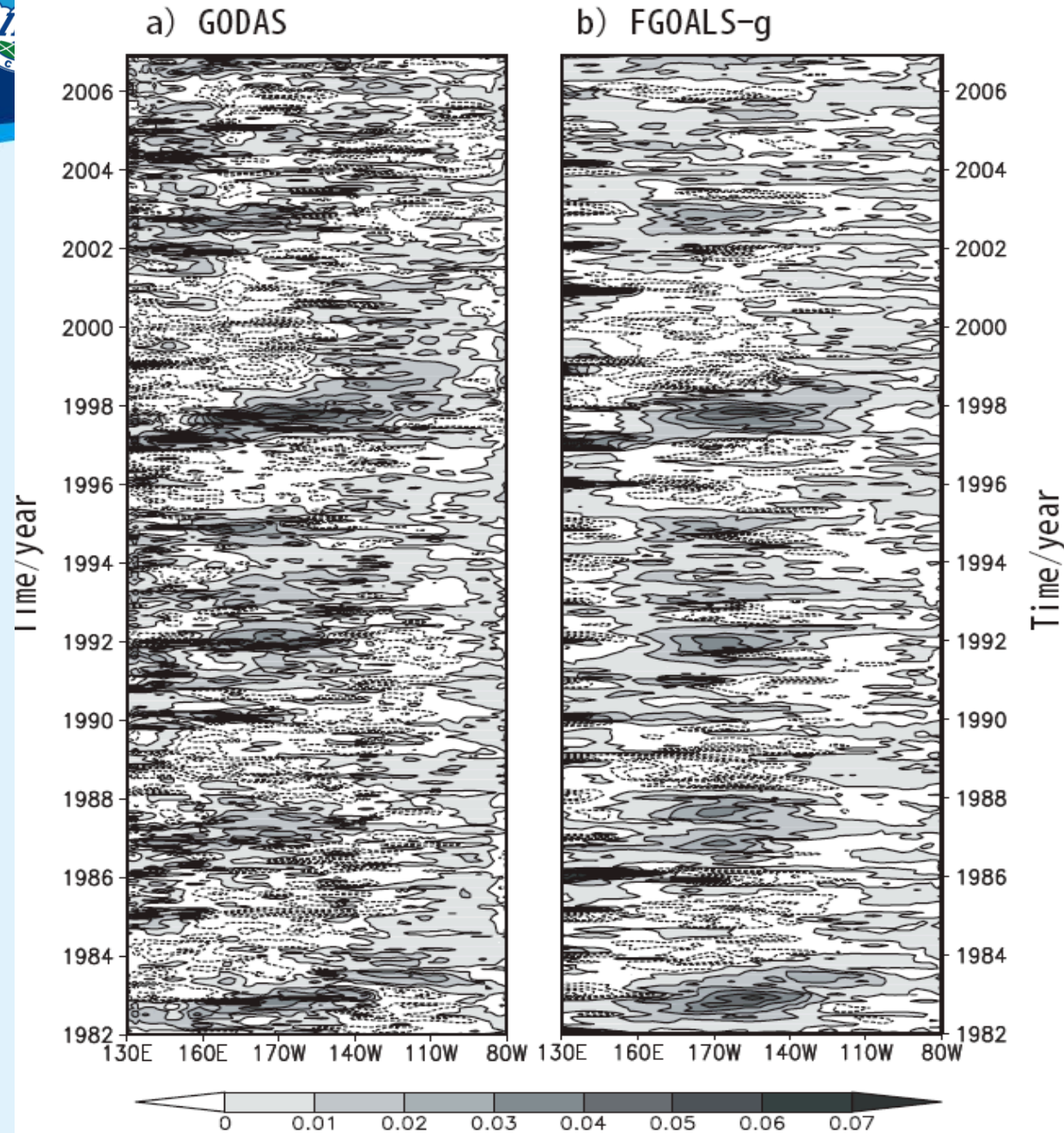


## 1. Initialization Procedure

**Sea surface temperature (SST) is nudging to the observed SST with 5-days e-folding time scale in the coupled model FGOALS as Luo et al. (2005) from 1970-2007.**

## 2. Prediction Procedure

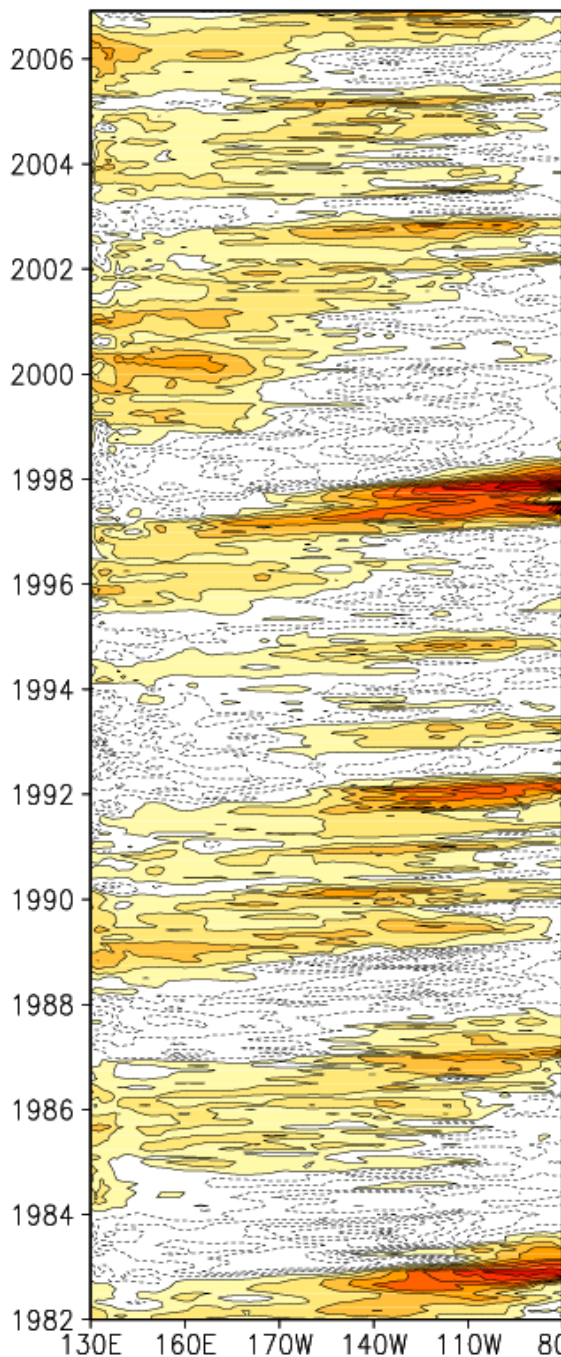
**Starting from the 1<sup>st</sup> Jan, 1<sup>st</sup> April, 1<sup>st</sup> July, and 1<sup>st</sup> October of each model year in the initialization run above, to integrate the coupled model one year without any nudging term.**



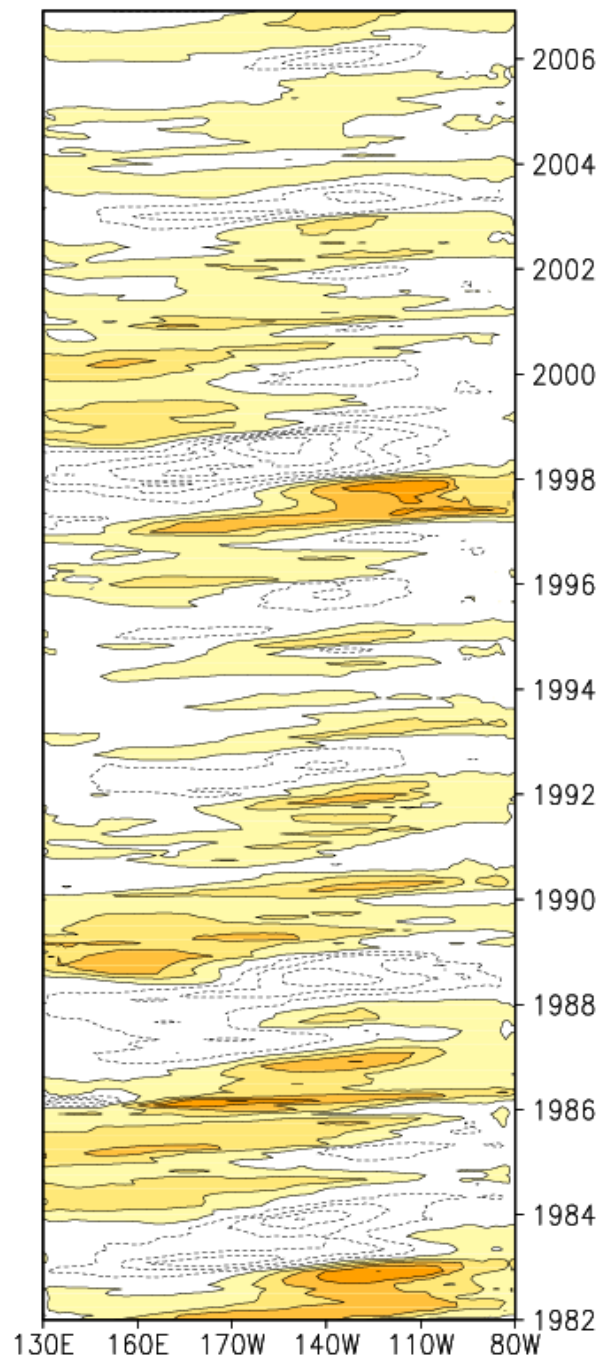
# Zonal Wind Stress Anomalies from the initialization Run



a) GODAS



b) FGOALS-g



# Thermocline Depth Anomalies

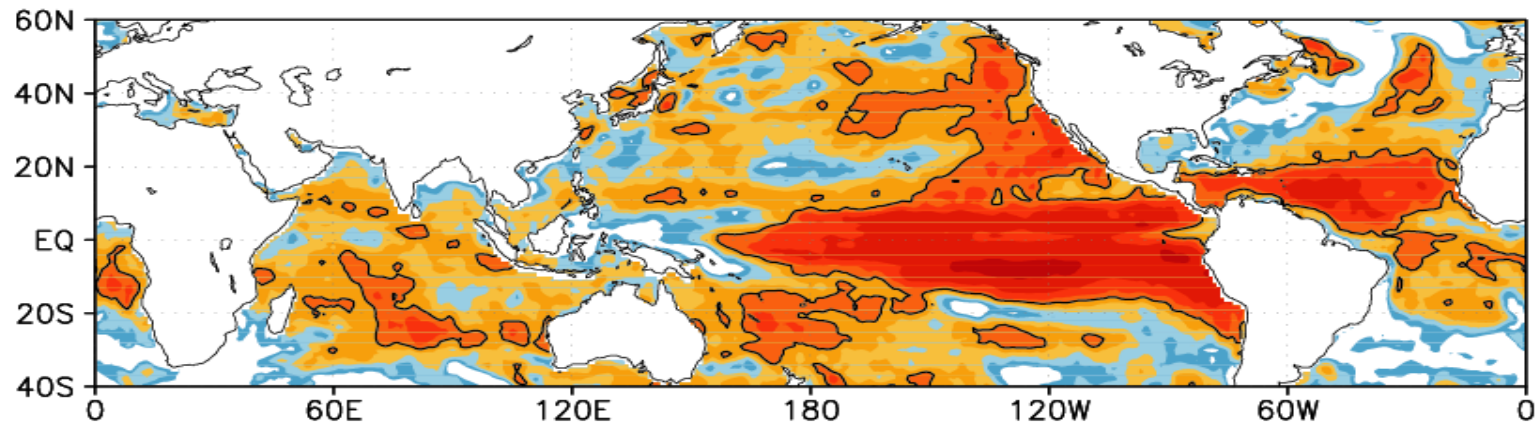




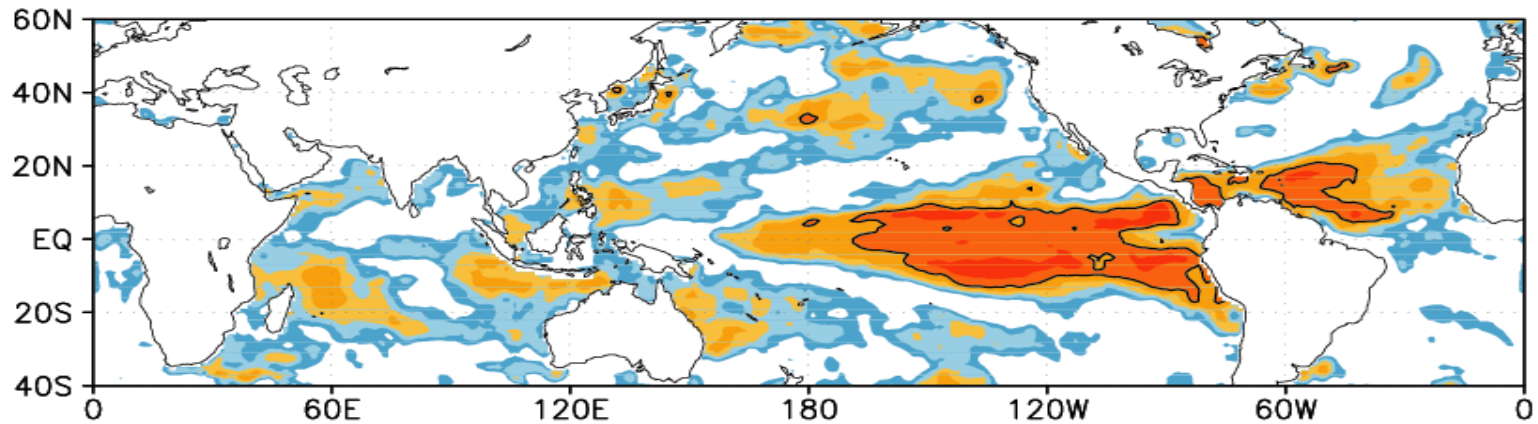
# Anomaly Correlation Coefficient of SSTA



a) 3 month lead

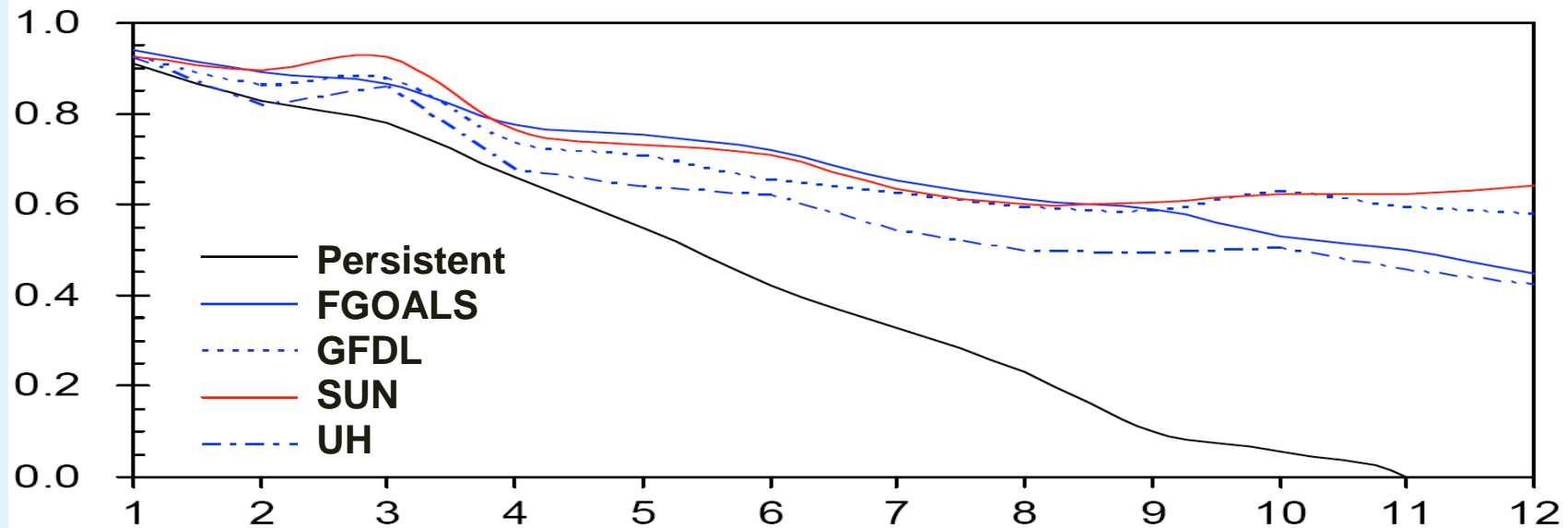
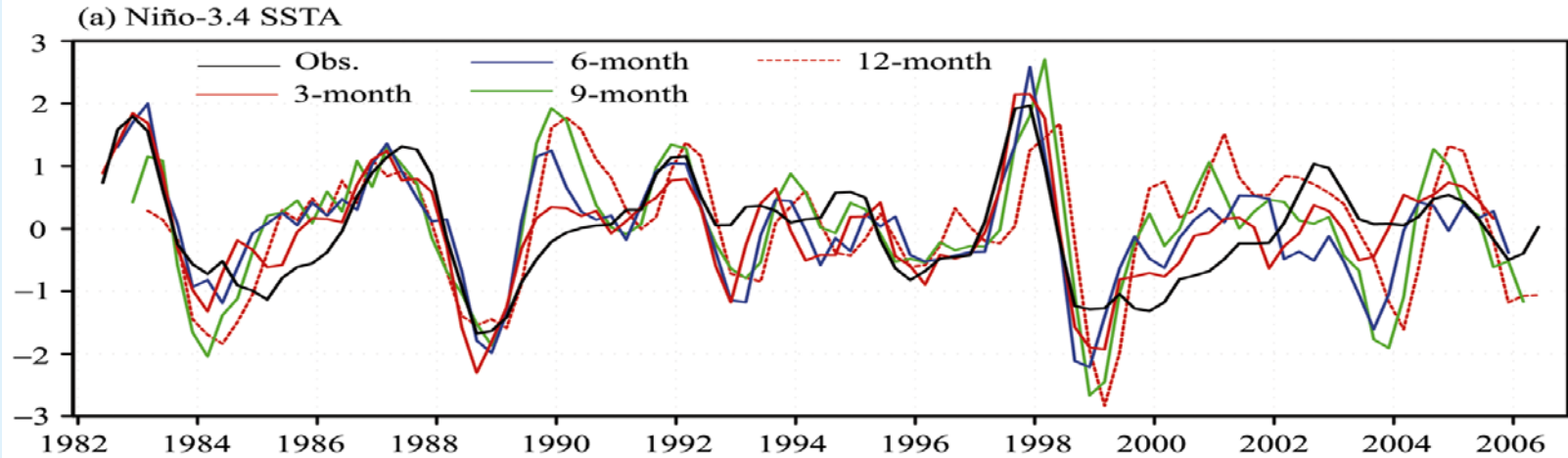


b) 6 month lead





# Nino 3.4 ACC from ENSO hindcasting



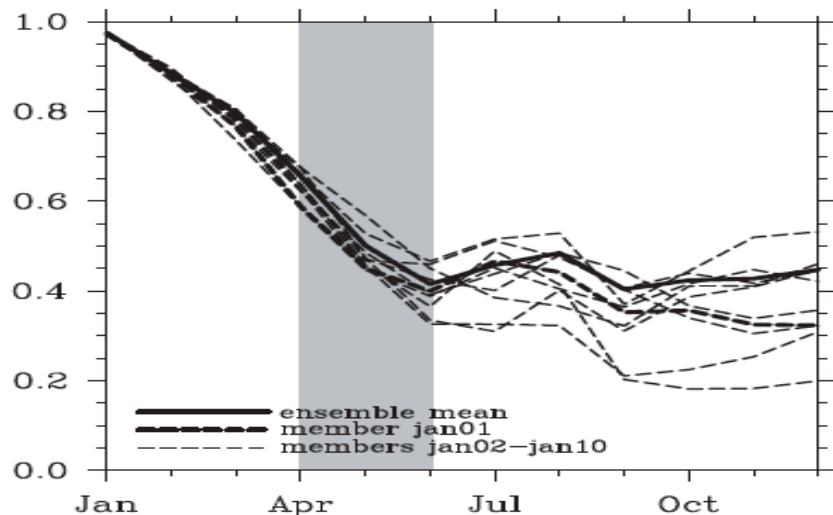




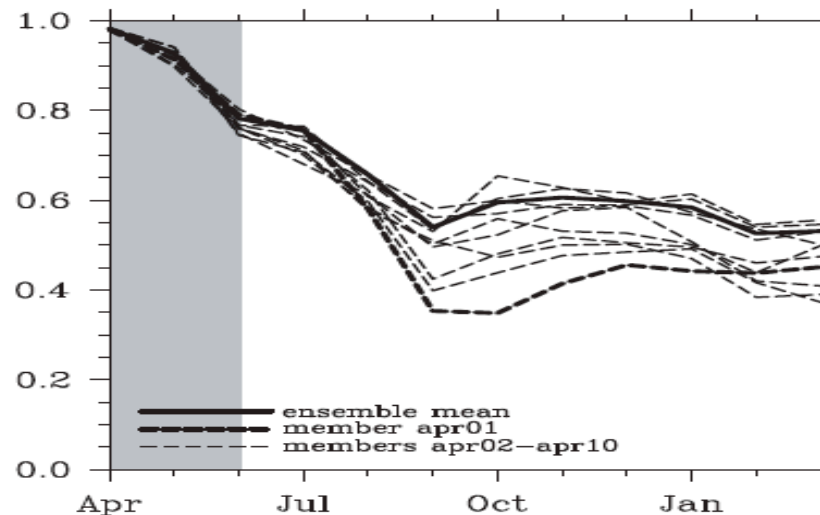
# ENSO Spring Prediction Barrier



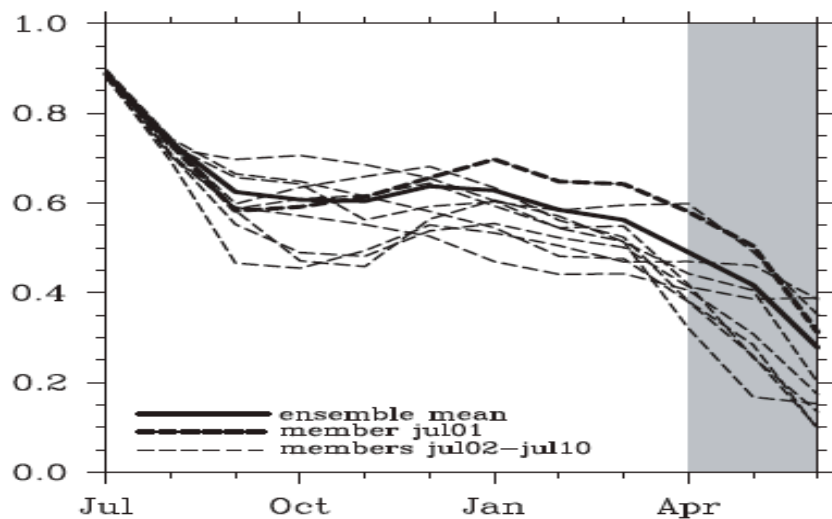
a) start in Jan



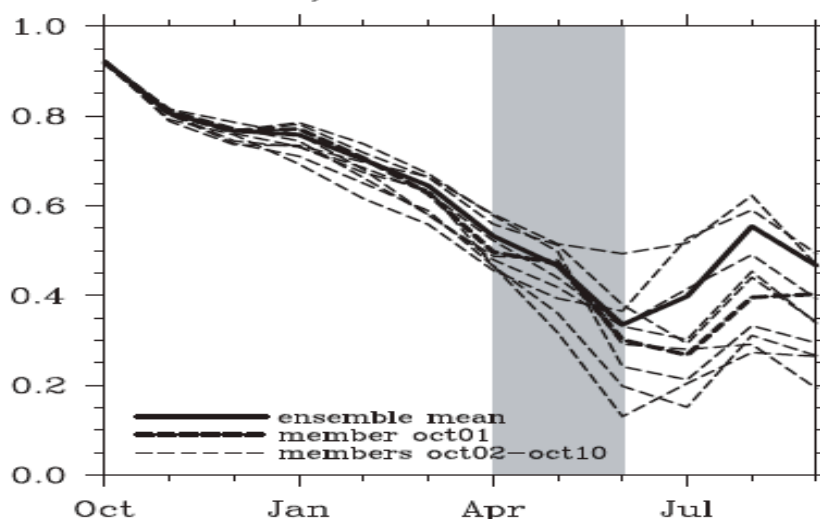
b) start in Apr



c) start in Jul

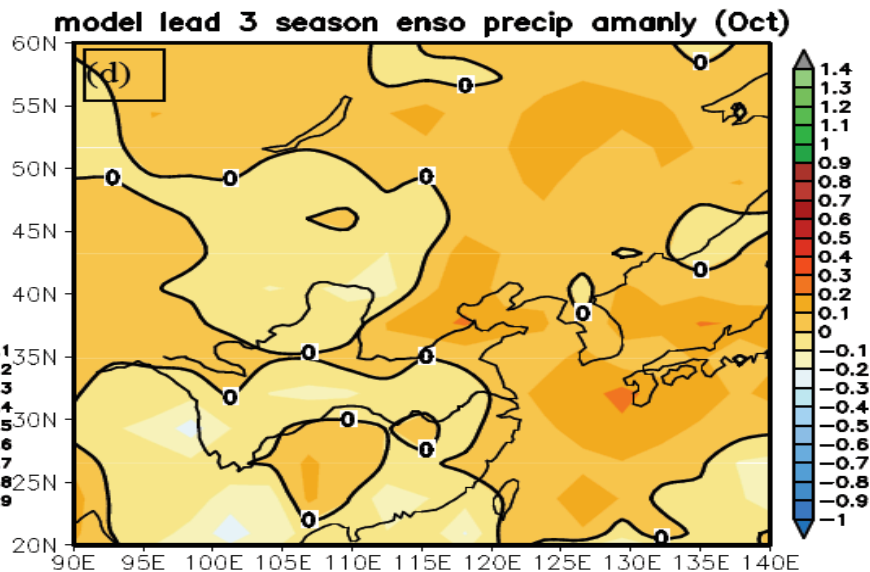
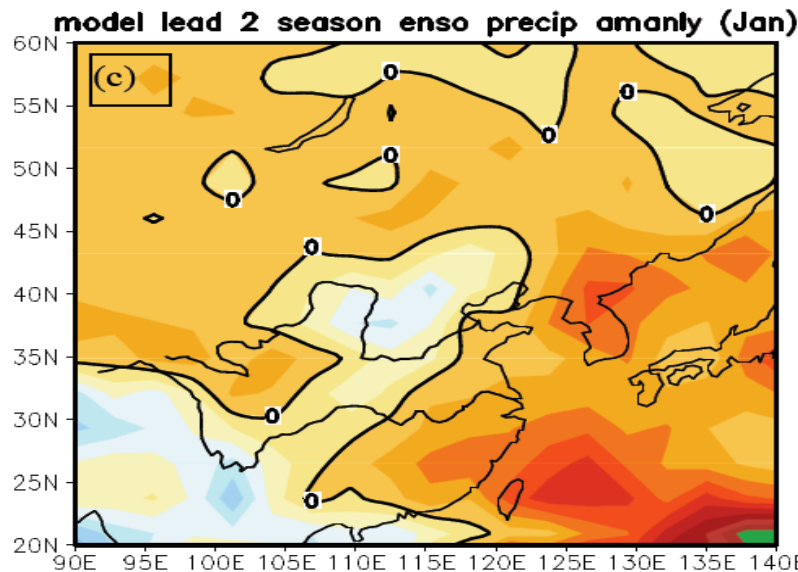
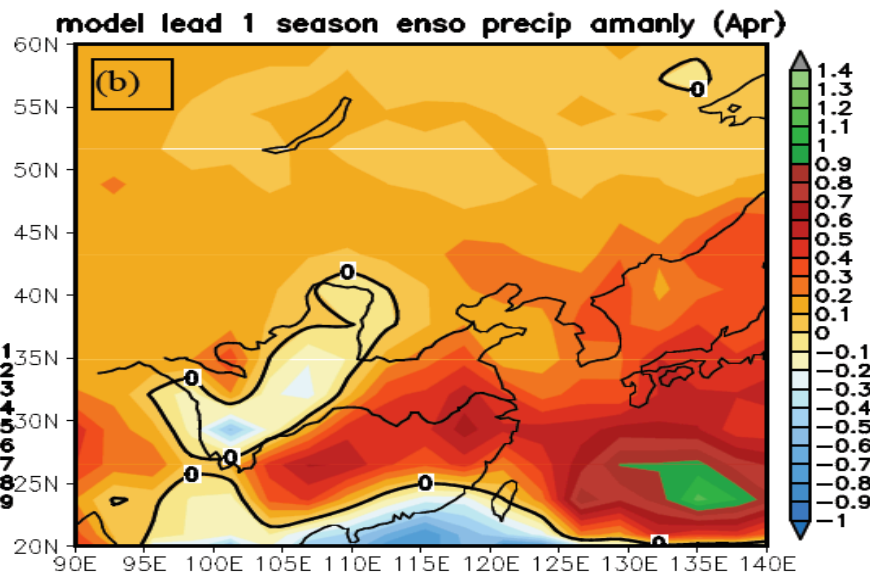
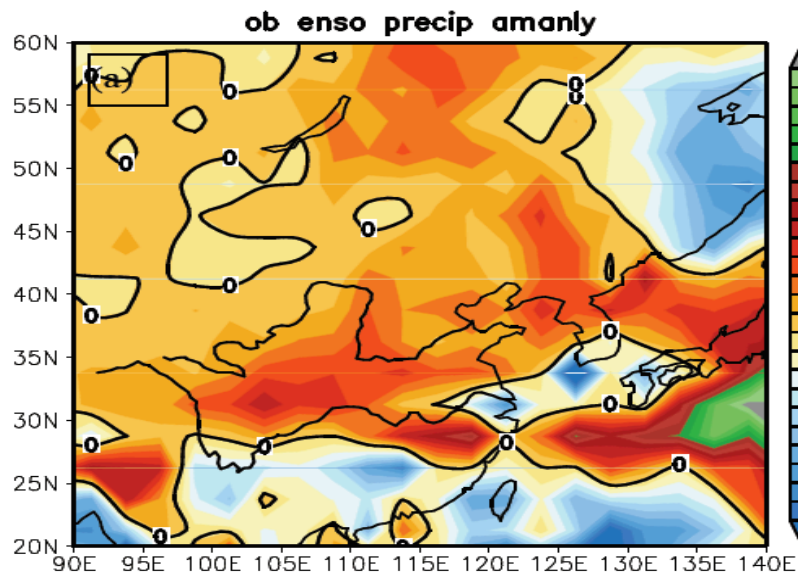


d) start in Oct

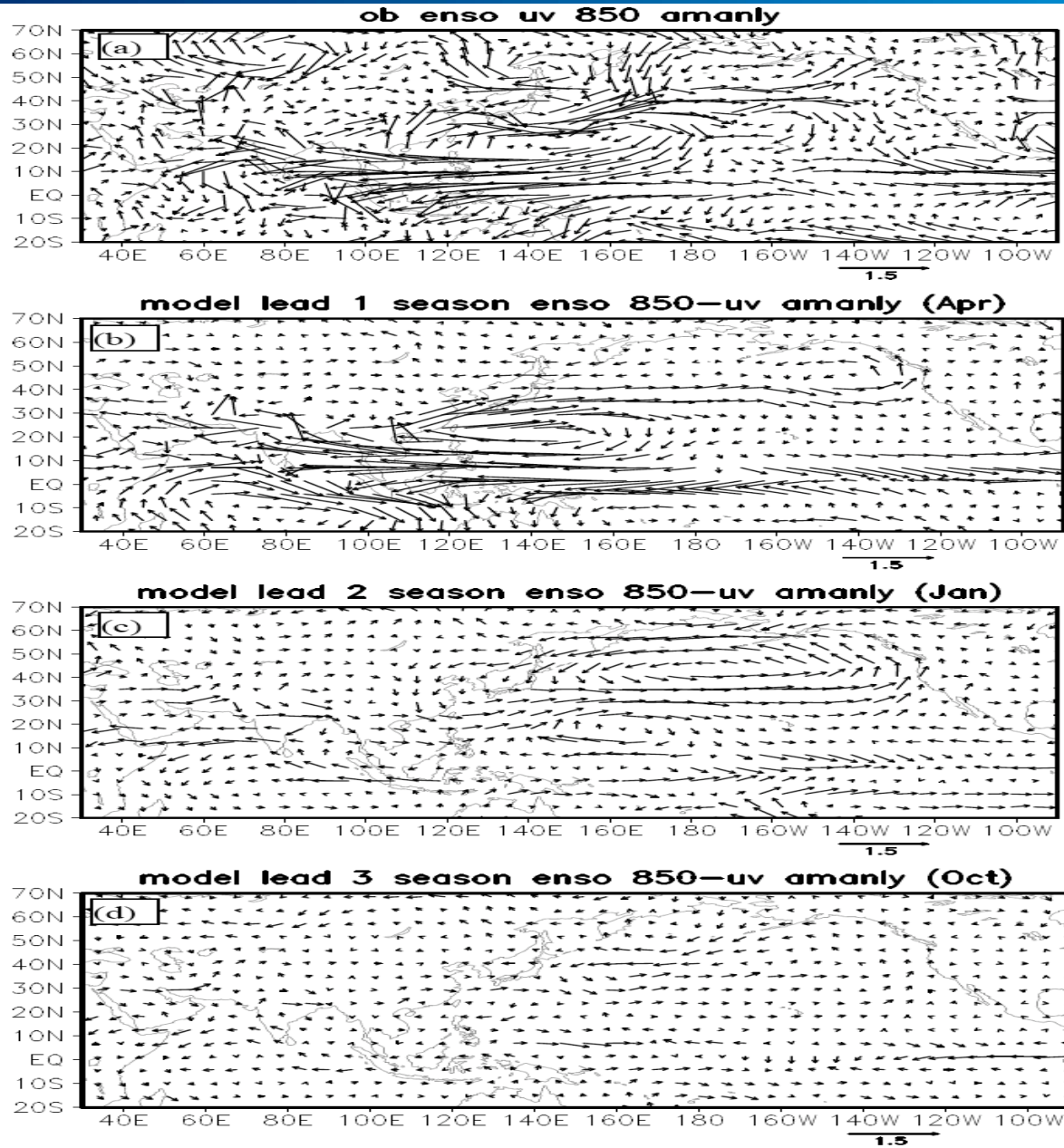




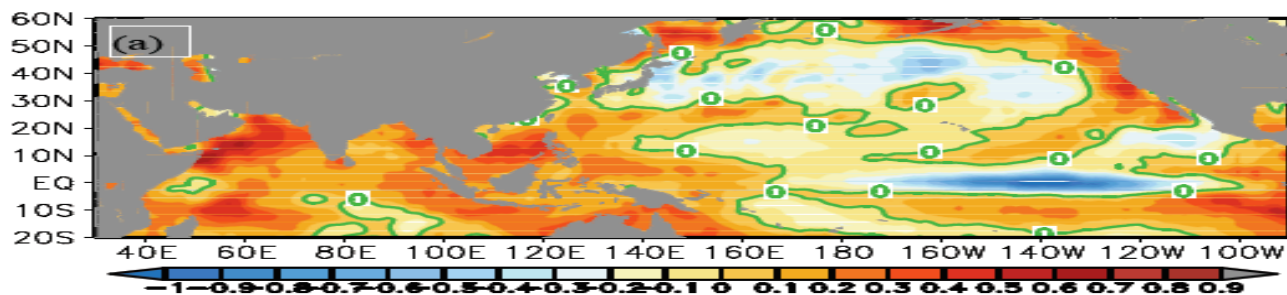
# Composite Rainfall Anomalies in JJA of El Nino Decaying Year



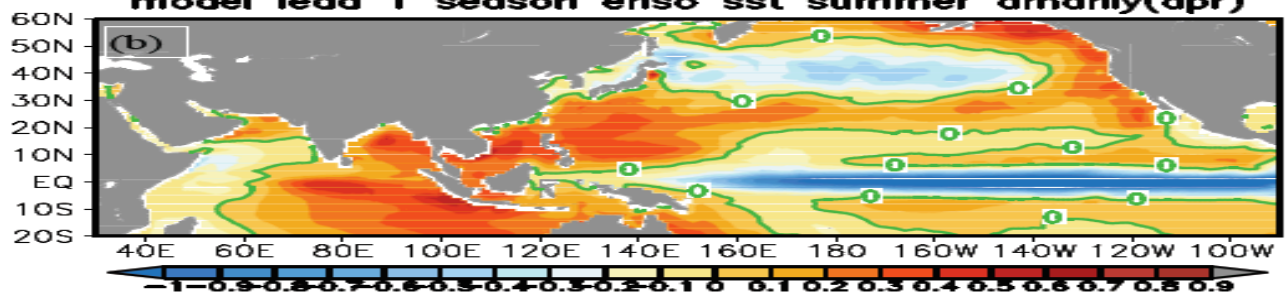
# Composite 850Hpa Wind Anomalies in JJA of El Nino Decaying Year



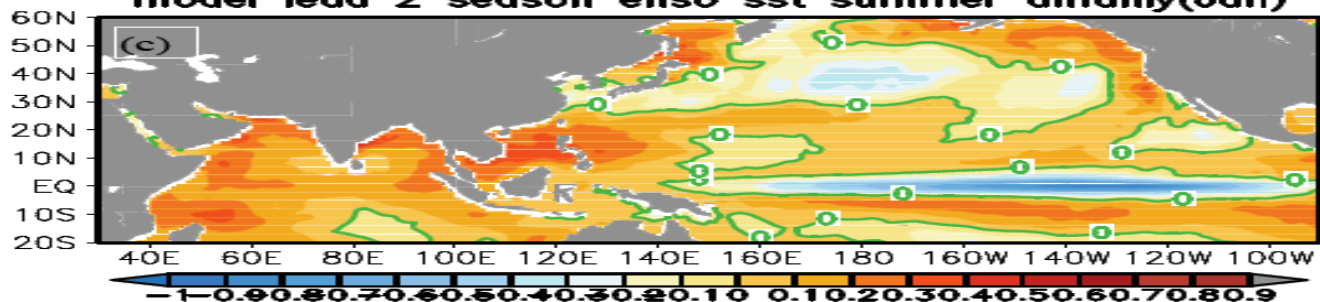
# Composite SST Anomalies in JJA of El Nino Decaying Year



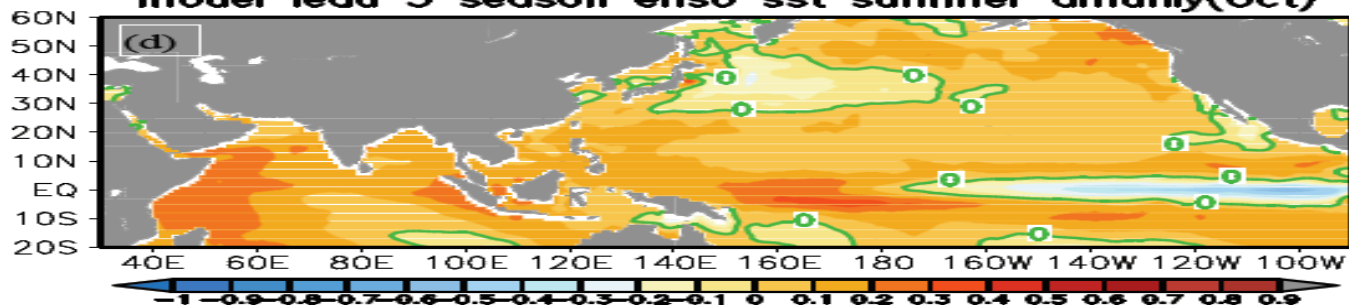
**model lead 1 season enso sst summer amany(apr)**



**model lead 2 season enso sst summer amany(Jan)**



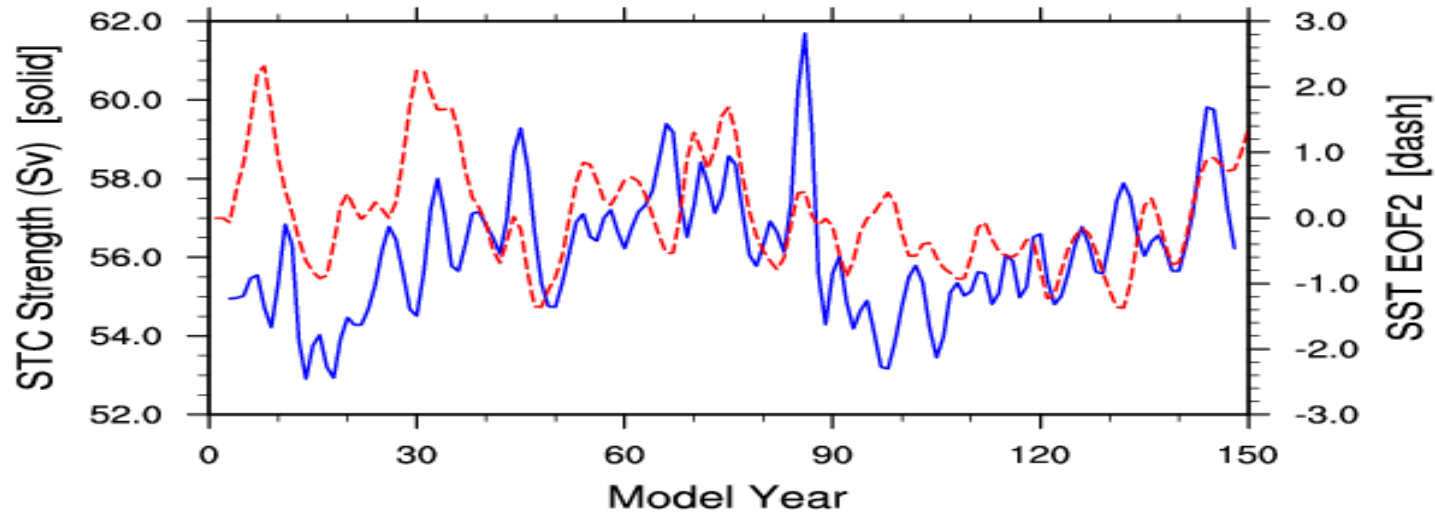
**model lead 3 season enso sst summer amany(Oct)**



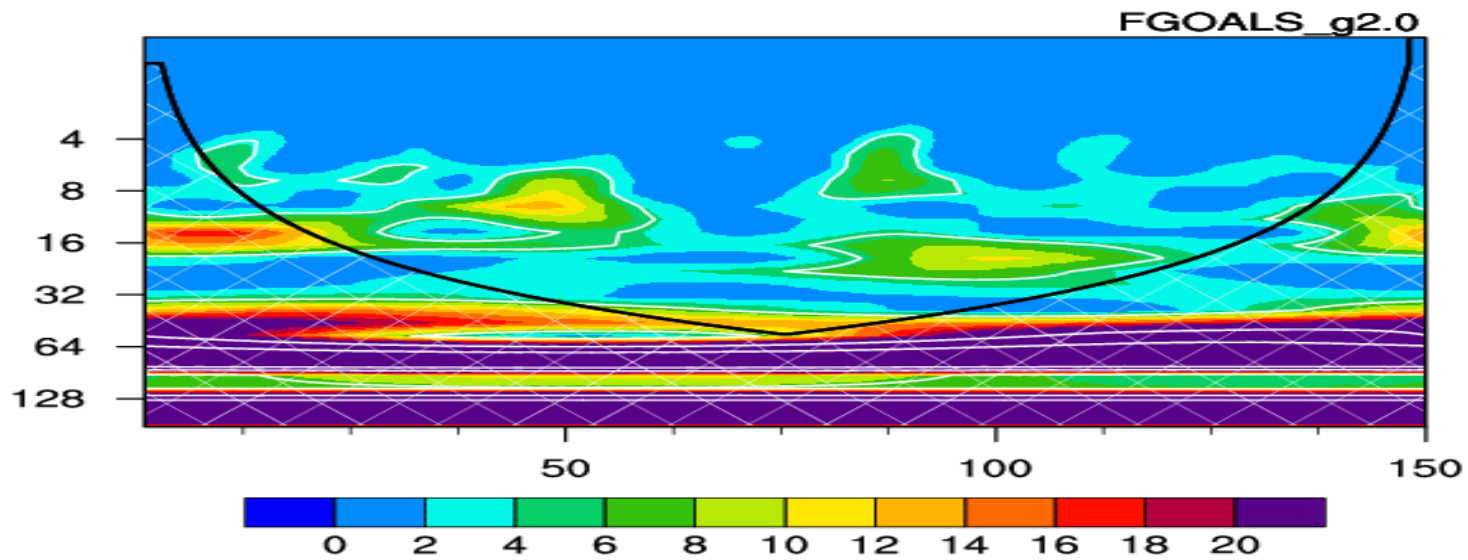




# Time series of STC amplitude



## Wavelet for STC





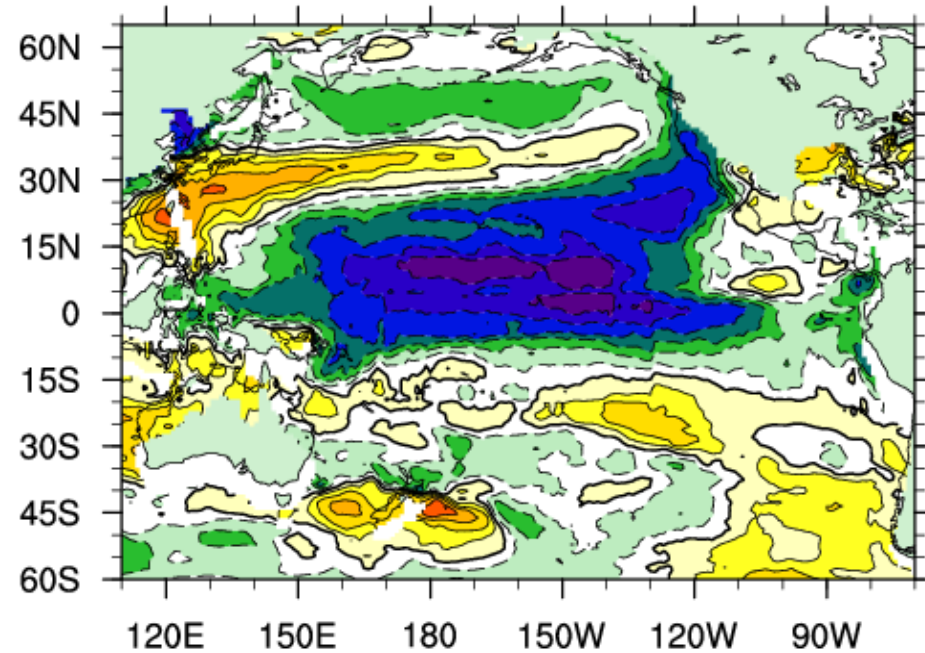


# Correlation between STC and SST, SSH



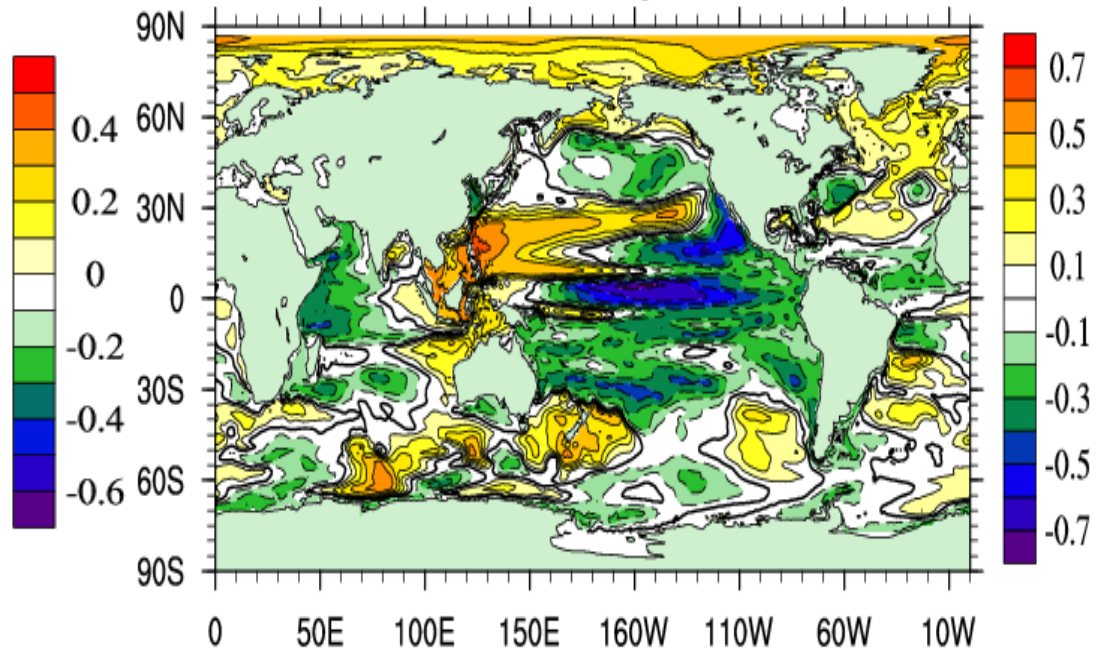
### Correlations of STC and SST

FGOALS\_g2.0



### Correlations of STC and SSH

FGOALS\_g2.0

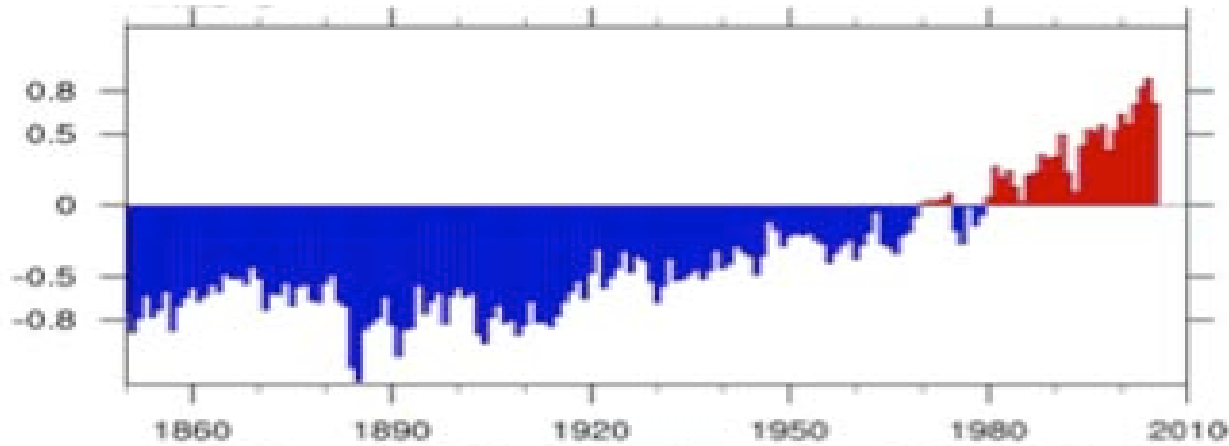




# Global mean SAT in the 20<sup>th</sup> century Run

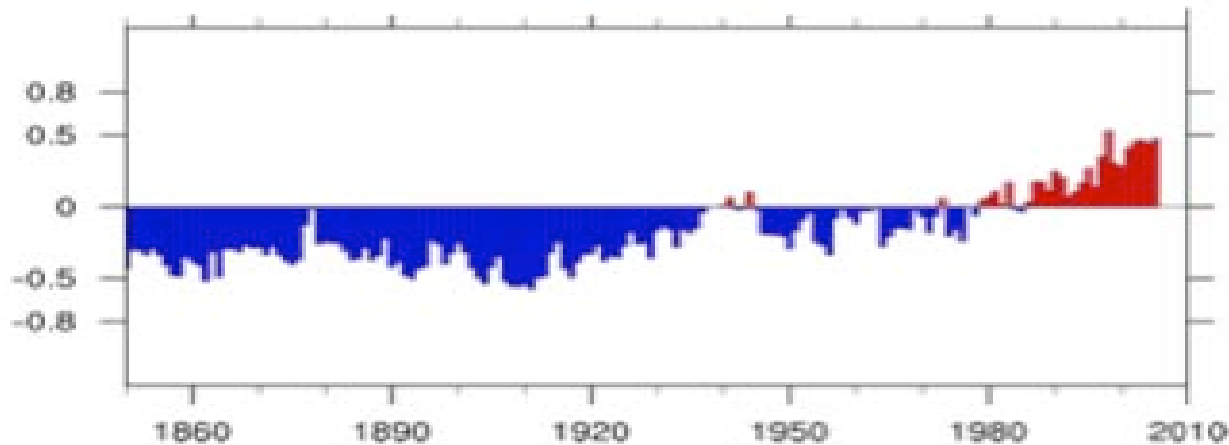


Fgoals



**1.2°C**

OBS



**0.7°C**



# Summary and Future Plan



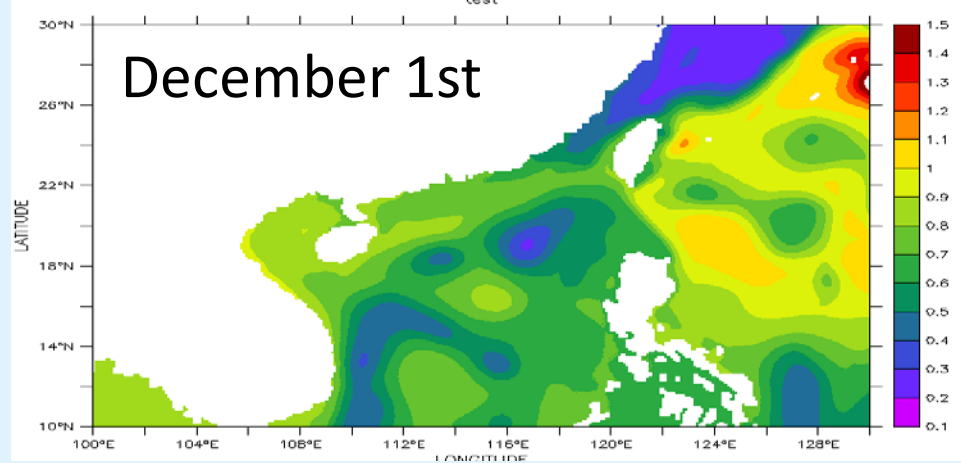
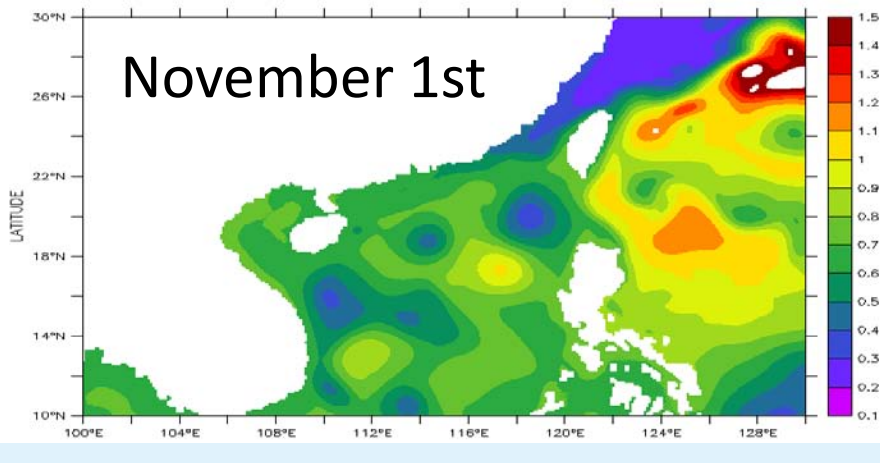
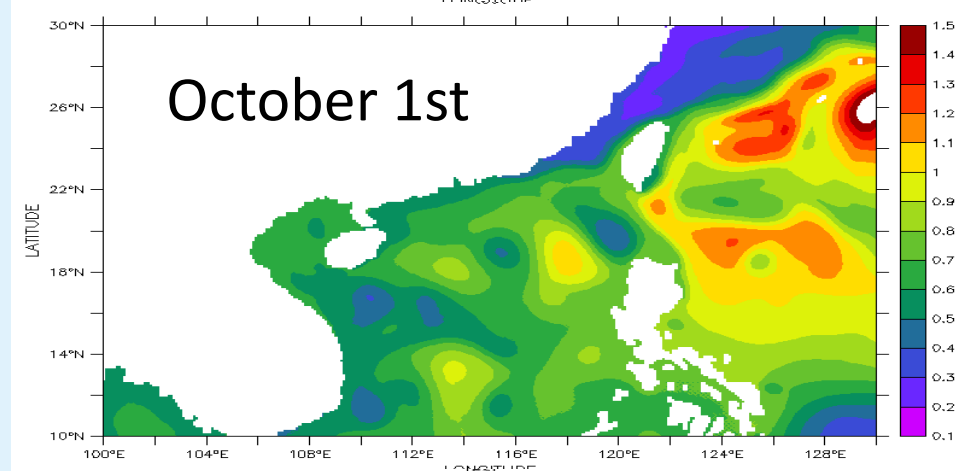
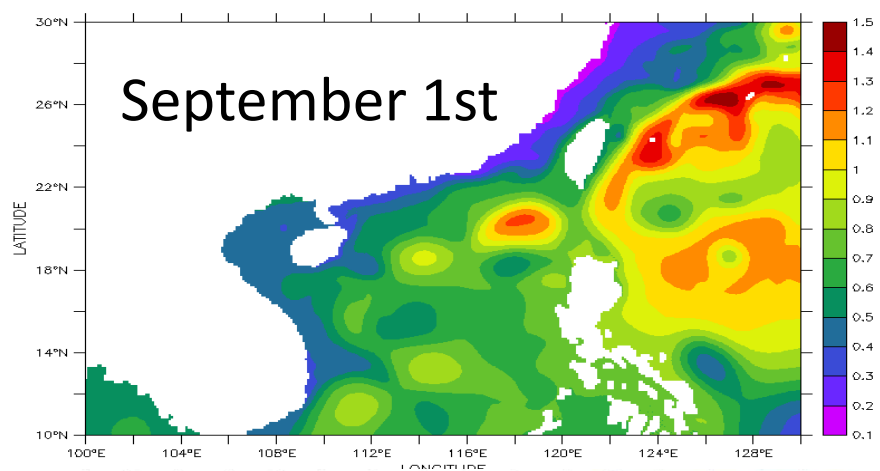
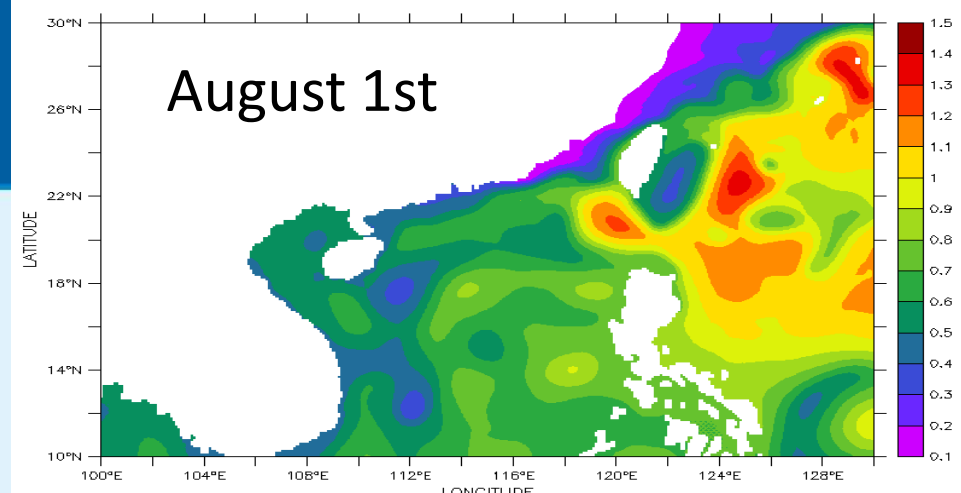
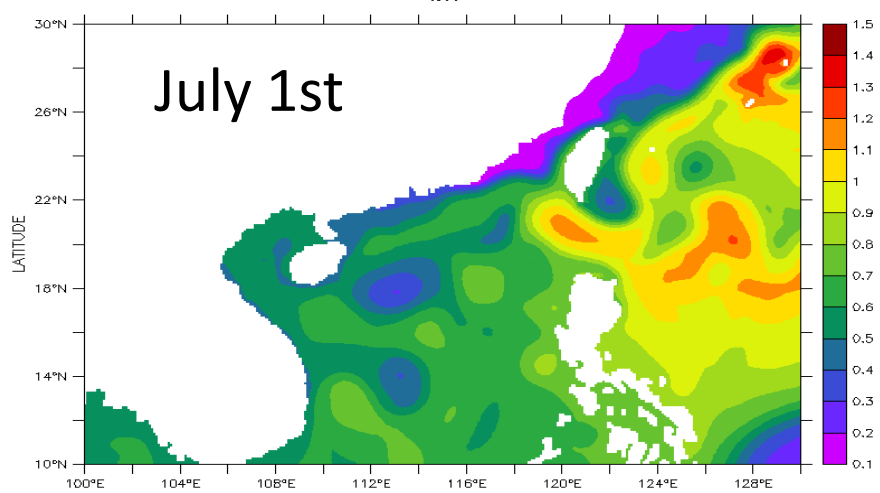
- 1. The coupled GCM FGOALS2.0 shows much improvements in the low and high latitudes.**
- 2. A 5-10km eddy-resolving OGCM with new dynamical framework will be developed in the next five years.**
- 3. A 10-25km AGCM will be developed in the next 5 years.**
- 4. Based on the new AGCM and OGCM, the high resolution coupled GCM will be developed and applied in many fields, especially such as short-range climate prediction.**

# LASO

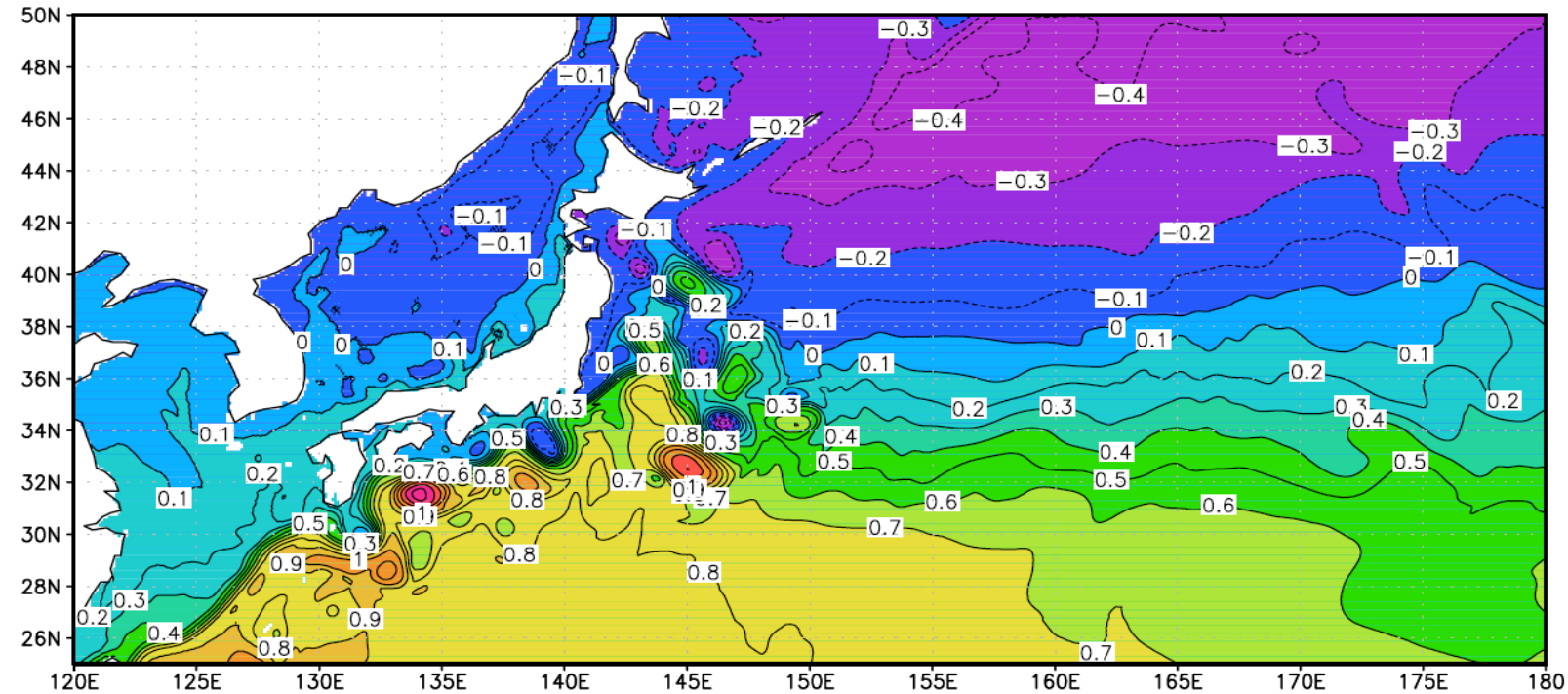
The logo for LASO, where the letter 'O' is replaced by a circular emblem. The emblem features a green globe with white wavy lines representing water or clouds, and the acronym 'LASG' is written in white across the center of the globe.

THANKS

[www.lasg.ac.cn](http://www.lasg.ac.cn)

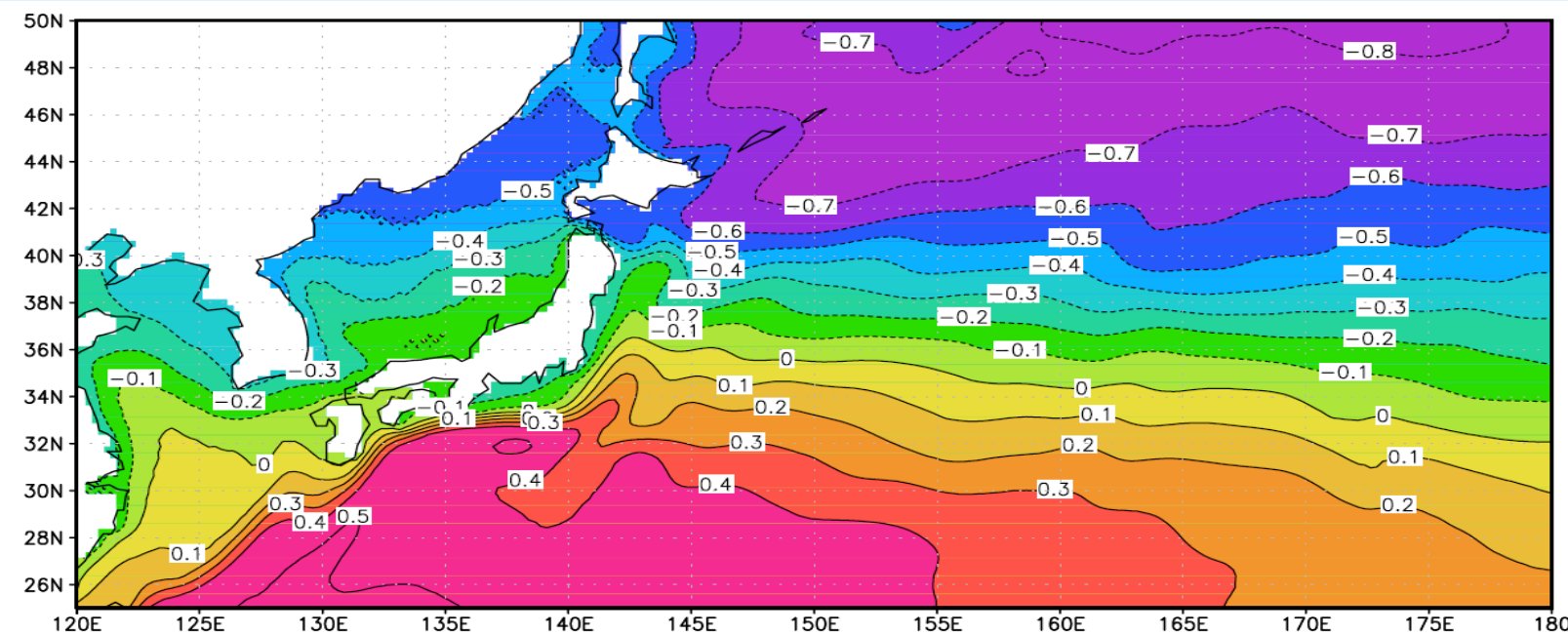






1/10  
Degree

**SSH**



1/4  
Degree