国际气候与环境科学中心

International Center for Climate and Environment Sciences

# Annual Report of ICCES

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**International Center for climate and Environment Sciences**
**Chinese Academy of Sciences**

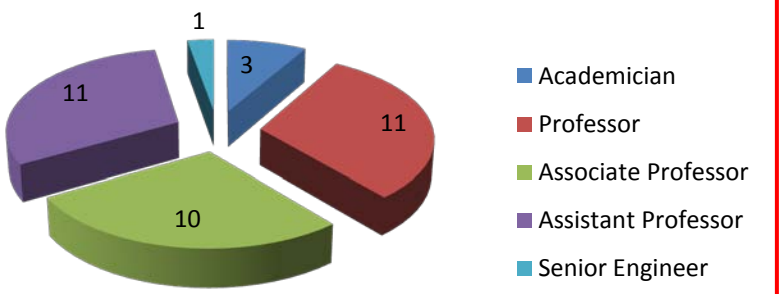
# Contents



# I. ICCES Brief Introduction

- **Founded in 1991 with support from both CAS and Ministry of Science and Technology of China (MOST) ;**

- ***Center Organization***



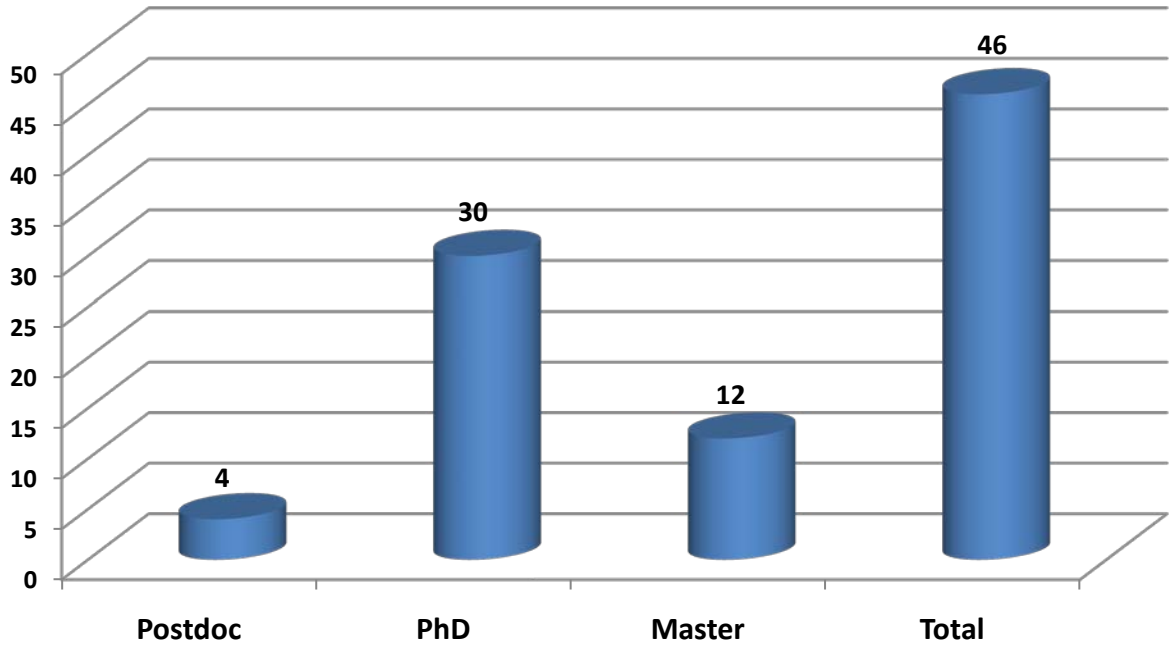

Current Research Team

ICCES currently has **42** staffs in total, with **36** research scientists, and **6** supporting staff . Besides, there are **7** Adjunct professors.

# I. ICCES Brief Introduction

## - *Current Postdoc and Graduate Students*

As for 2011, there are **4** Postdoc, and **42** graduate students studying in ICCES.



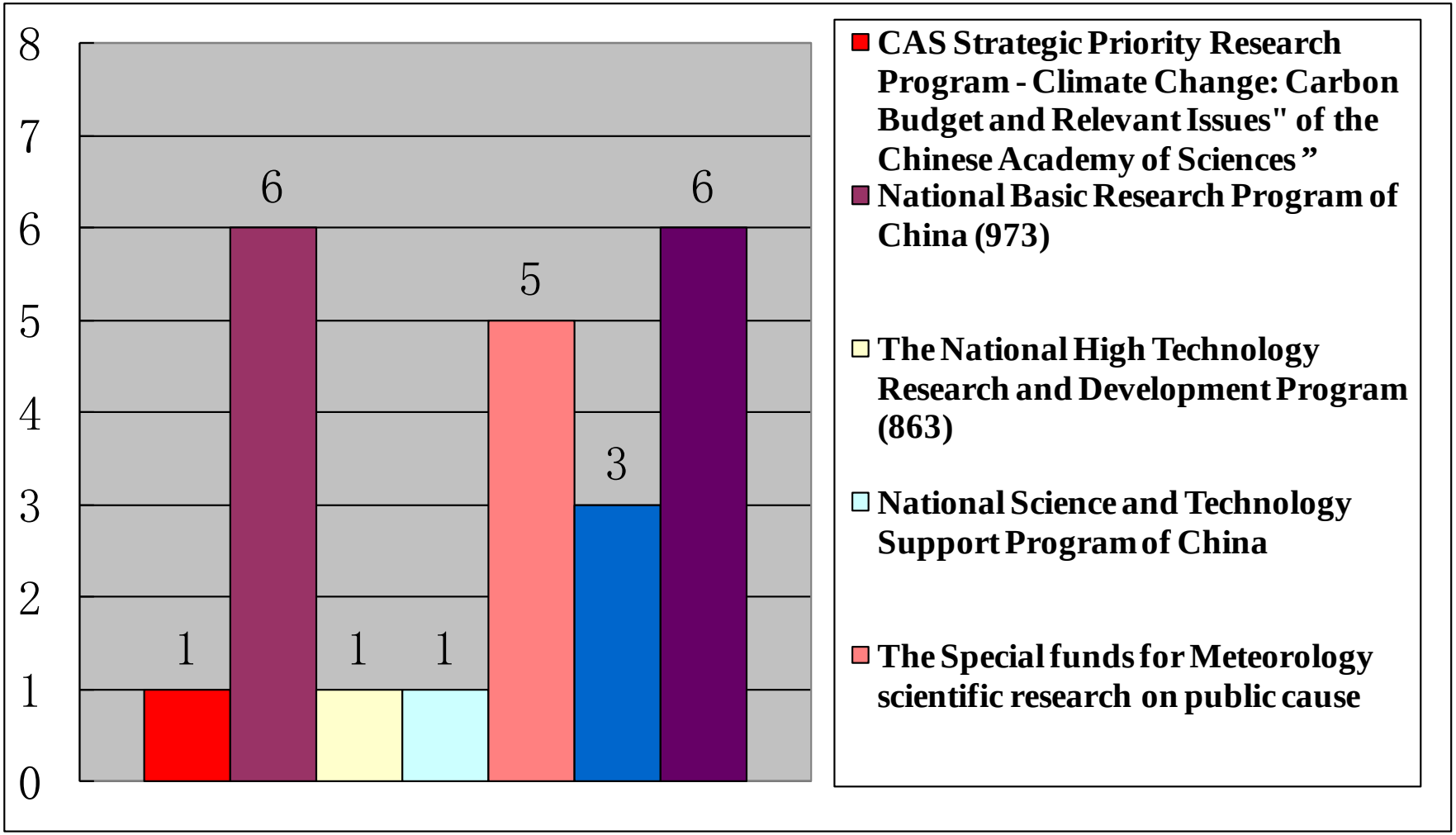

Number of Current Graduate Students

# II. Major Research Fields

- Development of earth system model
- Seasonal-to-interannual climate and hydrological prediction
- Data assimilation
- Monsoon and Climate dynamics
- Disastrous weather dynamics and prediction
- Ecological dynamics and natural cybernetics

# II. On-going Projects

- **On-going Projects (23 in total)**



# 2010-2011 New Projects

## Development of Earth System Model

- **National key Basic research Program for global change(973):Development of the ecological and environmental process model and its improvement**

  **（30,000,000 CNY，2010-2014) ( ~ 4.6 Million USD)**

- **National Basic Research Program of China（973）: Development and evaluation of high-resolution climate model**

  **(10,440,000 CNY,2010-2014) (~ 1.6 Million USD)**

- **Subproject of CAS Strategic Priority Research Program “ Uncertainties for the climate simulation and projection using CAS Climate System Model”**

  **（30,000,000 CNY，2011-2015) (~ 4.6 Million USD)**

# 2010-2011 New Projects

## Seasonal to Inter-annual Climate Prediction

- **National key Supporting Project for Science and Technology development: Monitoring, prediction and warning system for the extreme weather and climate disasters**

  **（2,000,000 CNY，2010-2014)**

- **Development of the second-generation Short-Term Climate Prediction System in National Climate Center**

  **(1,780,000 CNY,2010-2013)**

**……**

# II. On-going Projects --- Key Project

**- Climate System Model Development and the related uncertainties on the climate simulation and projection**

1. **Development of the CAS climate system model**
2. **Model evaluation and attribution of past climate change**
3. **Projection of future climate change and its sensitivity study**

- **Total Budget: 30 Million CNY (~ 120 Million USD)**
- **Funding Duration: 2011-2015**

- **CAS Strategic Priority Research Program- Climate Change: Carbon Budget and Relevant Issues**
- **Total Budget: 800 Million CNY (~ 120 Million USD)**

# Kick-off Meeting of the Project

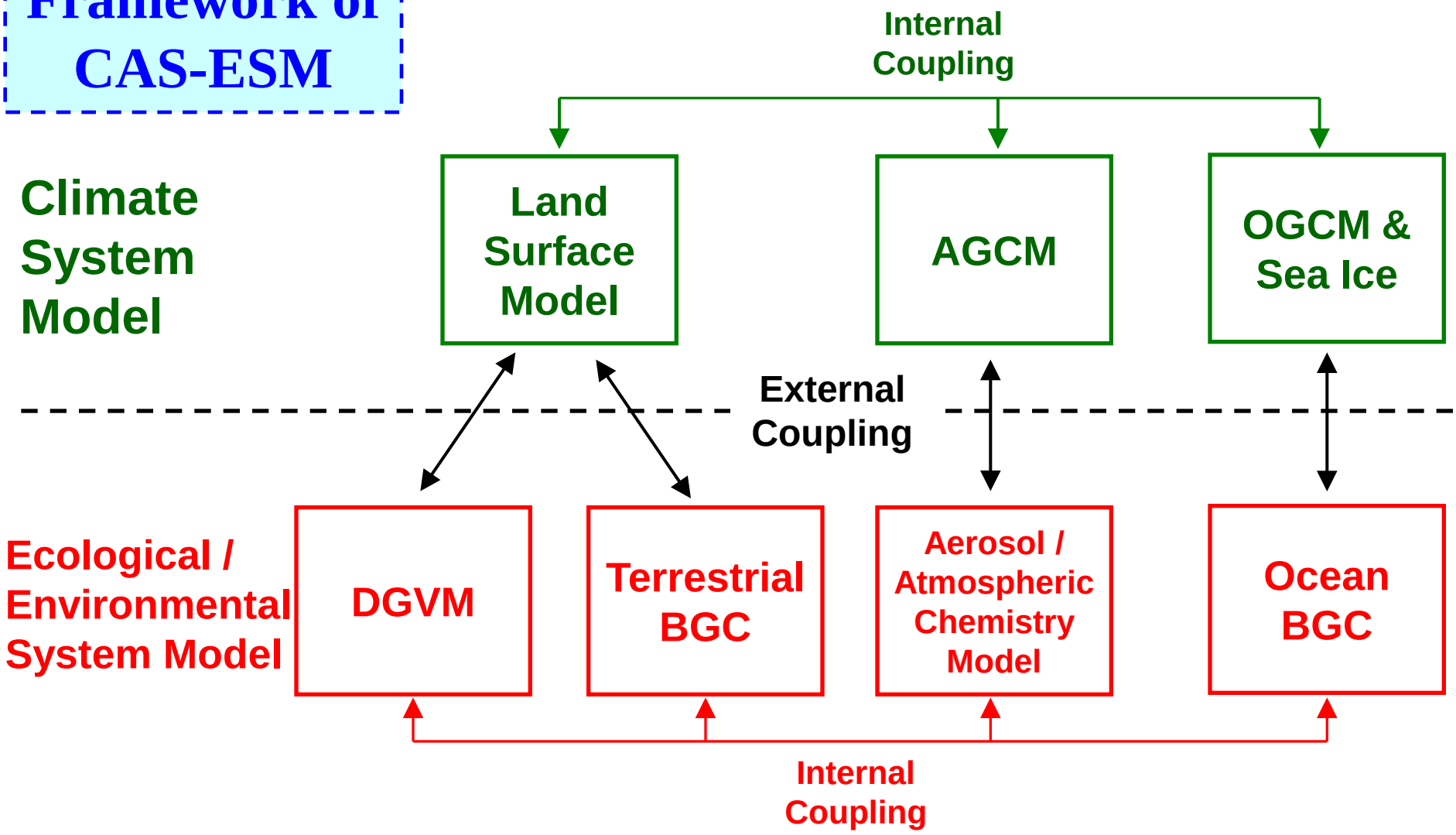
- **Officially launched on April 26, 2011**
- **5-year project during 2011.1-2015.12**

# III. Current Research Progress

## Development of Earth System Model

# Development of the CAS Earth System Model

## Framework of CAS-ESM



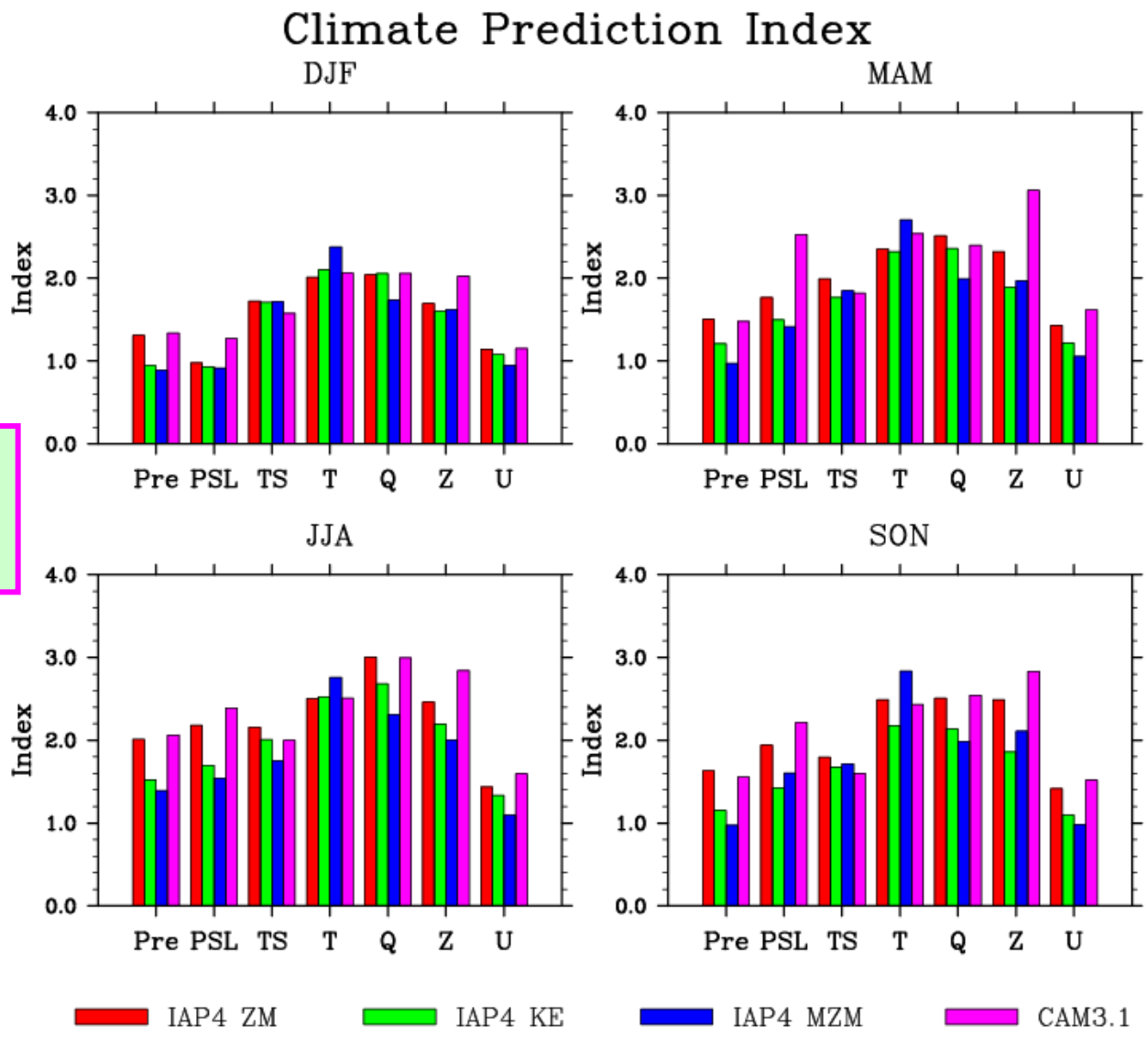
# IAP AGCM4.0 Model Description

- **Discretization: finite-difference at uniform lat-lon grids**
- **Resolution: 1.4°(lat)×1.4°(lon)×26L (2.2 hPa at top of the model)**
- **Vertical coordinate: terrain-following $\sigma$ coordinate**
- **Time integration scheme: nonlinear iterative method**
- **Vapor transport: semi-Lagrangian method**
- **Physical parameterizations:**
  - Cloud and precipitation: Zhang et al.,2003; Klein et al.,1993
  - Radiation: Rothman et al.,2003; Collins et al.,2006
  - Deep convection: Zhang et al.,1995; Emanuel et al., 1991; Richter et al, 2008; Neale et al., 2008
  - Shallow convection: Hack, 1994
  - Vertical diffusion and boundary layer: Holtslag et al.,1993; Boville et al.,2003
  - Aerosol and sulfur chemistry: Barth et al.,2000; Rasch et al.,2000

# Climatology

Climate prediction index
(CPI, Murphy et al., 2004)

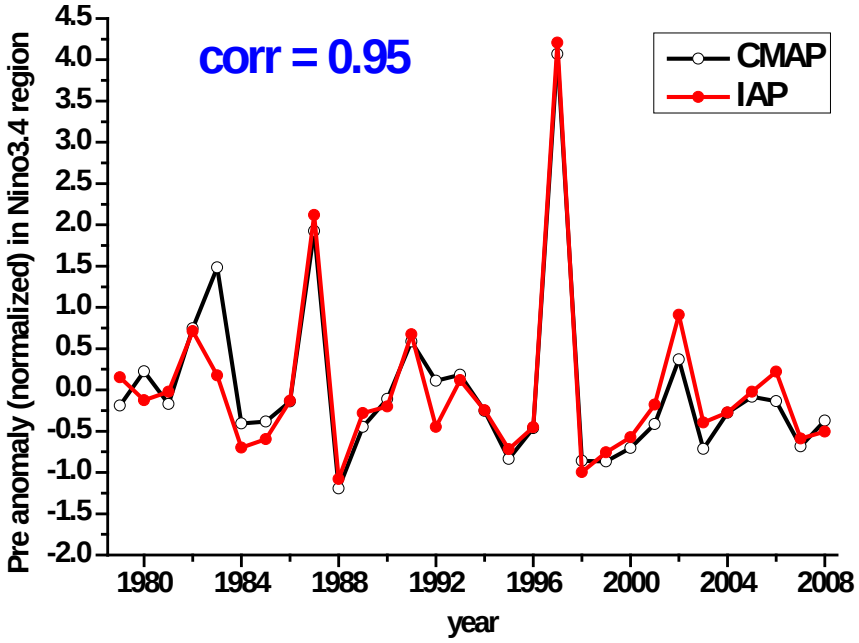
**the smaller CPI**
**the better simulation**



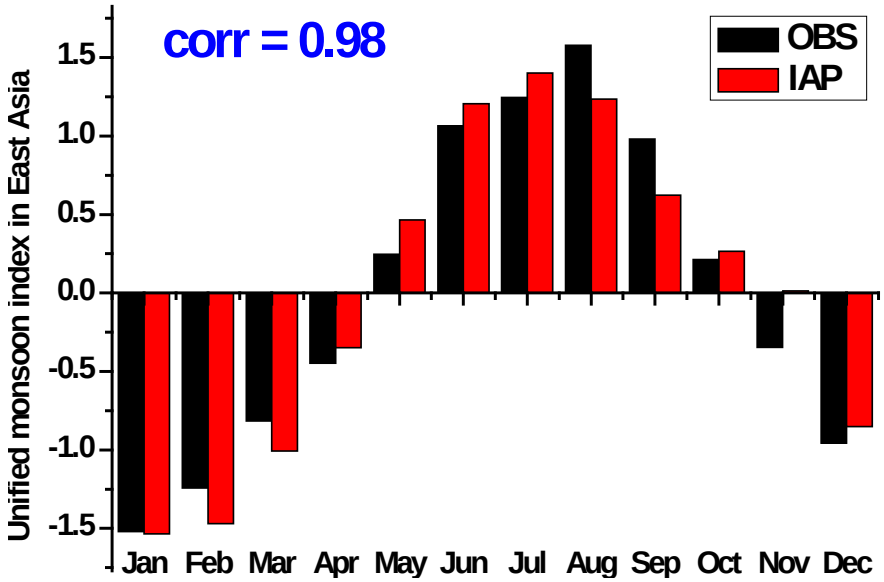
## Inter-annual Variability

## Annual Cycle

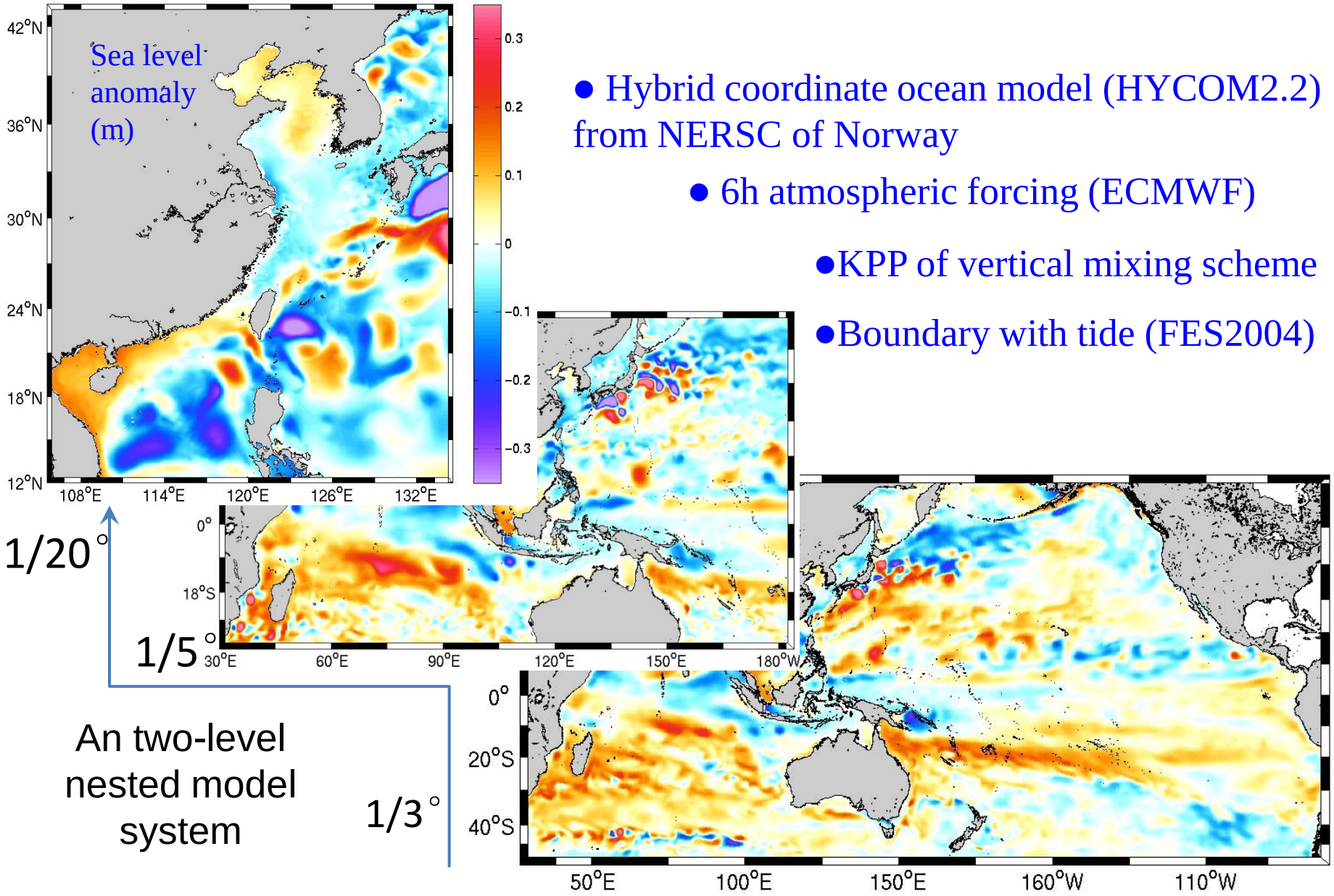
### DJF precipitation in Nino3.4 region




### Unified monsoon index in East Asia

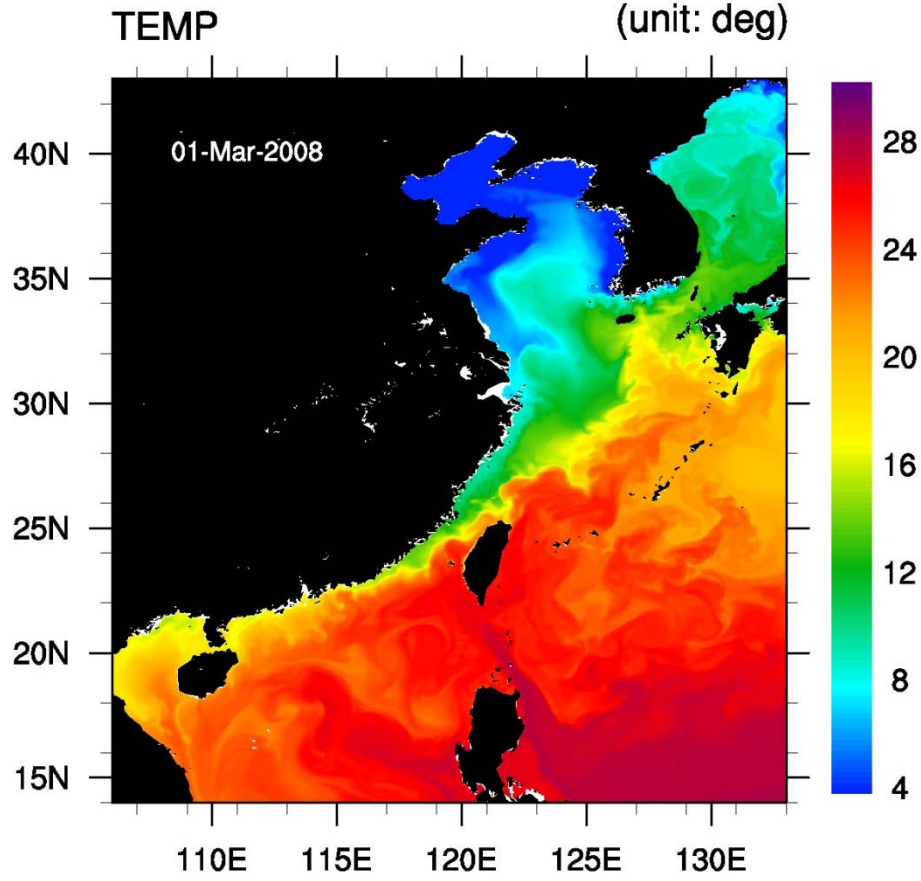


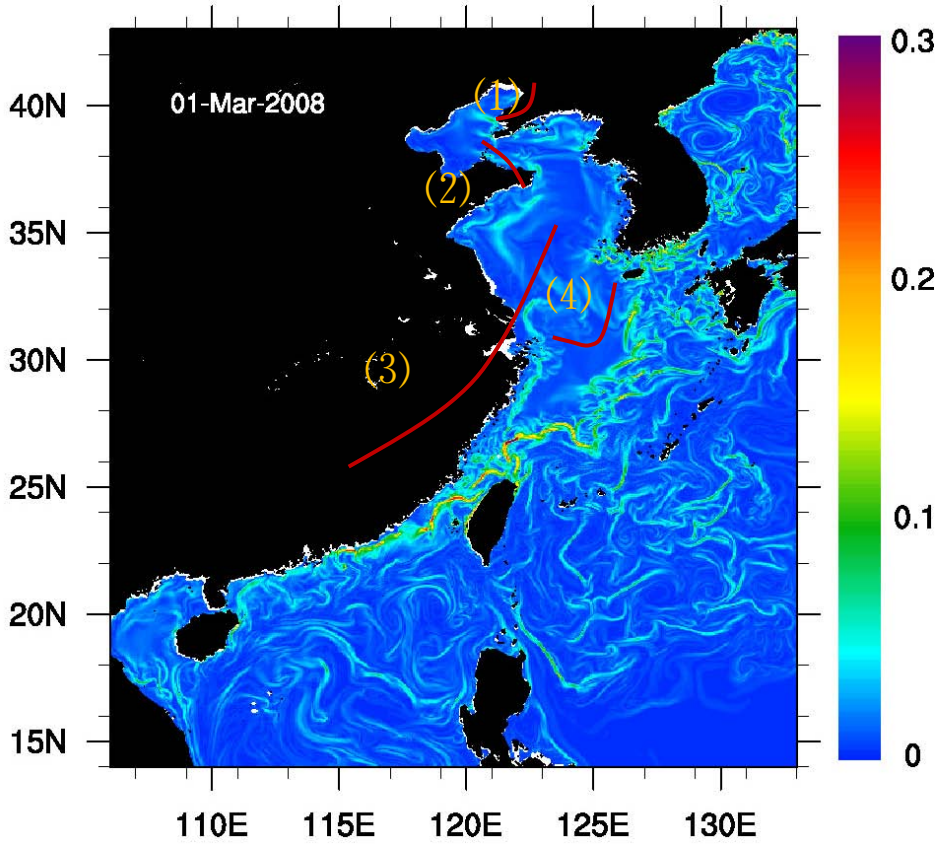
# High Resolution Ocean Model for the China Coast




- Hybrid coordinate ocean model (HYCOM2.2) from NERSC of Norway
  - 6h atmospheric forcing (ECMWF)
    - KPP of vertical mixing scheme
    - Boundary with tide (FES2004)

# SST and its gradient simulated by the high resolution model of HYCOM for the China coast

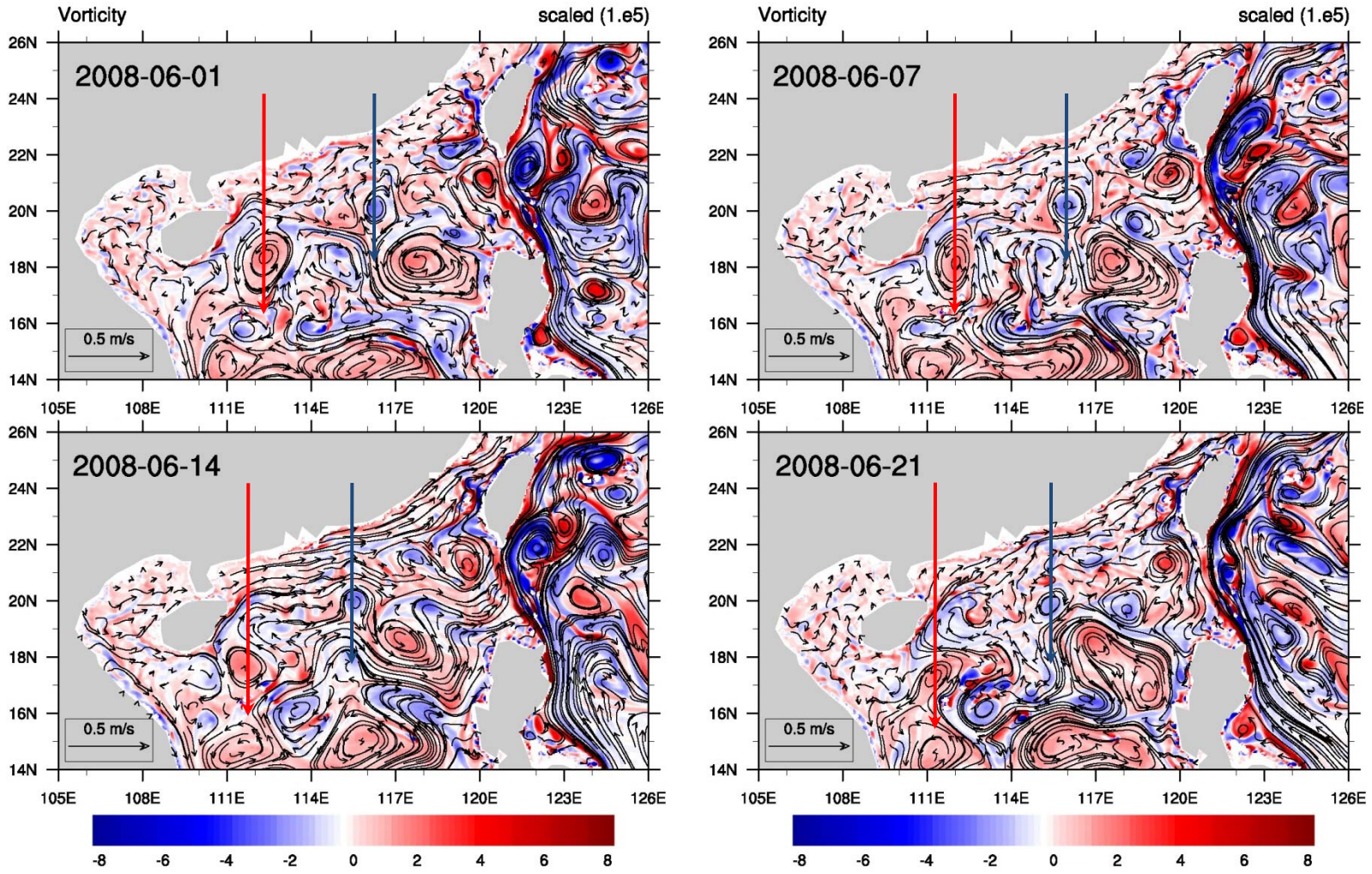



(1) Shandong Font (2) Jiangsu Font

(3) Zhejiang-Fujian Font (4) Kuroshio Font

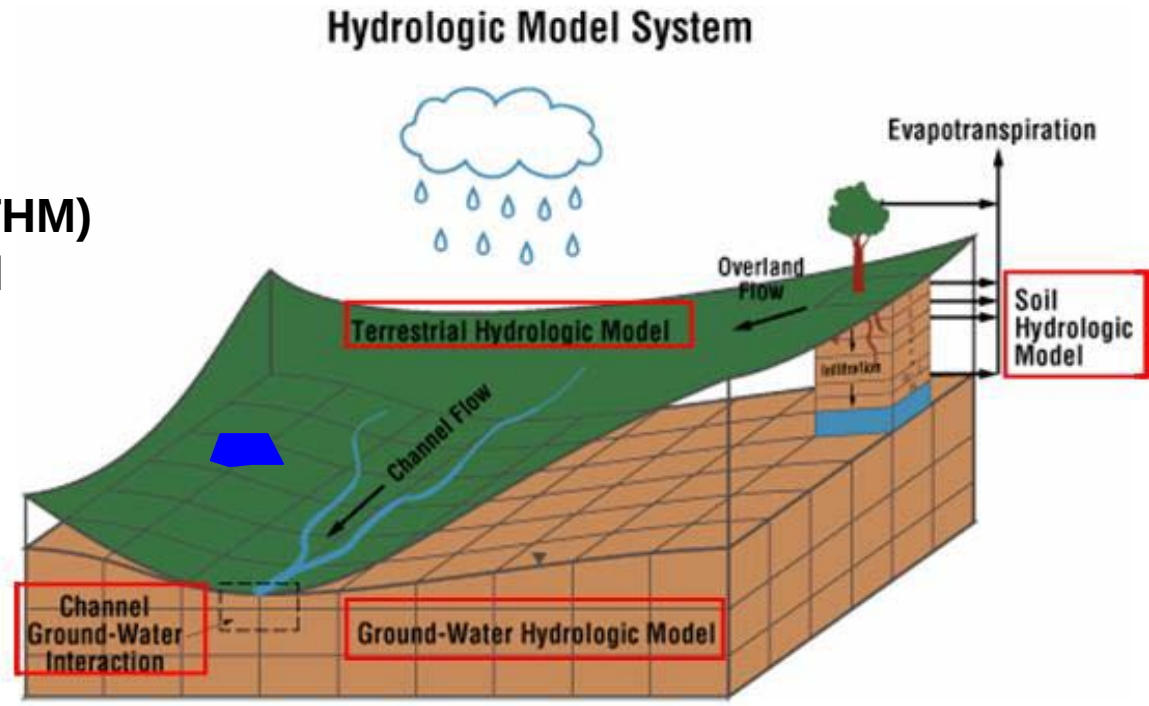
# Surface current and relative vorticity simulated by the model in the northern South China Sea



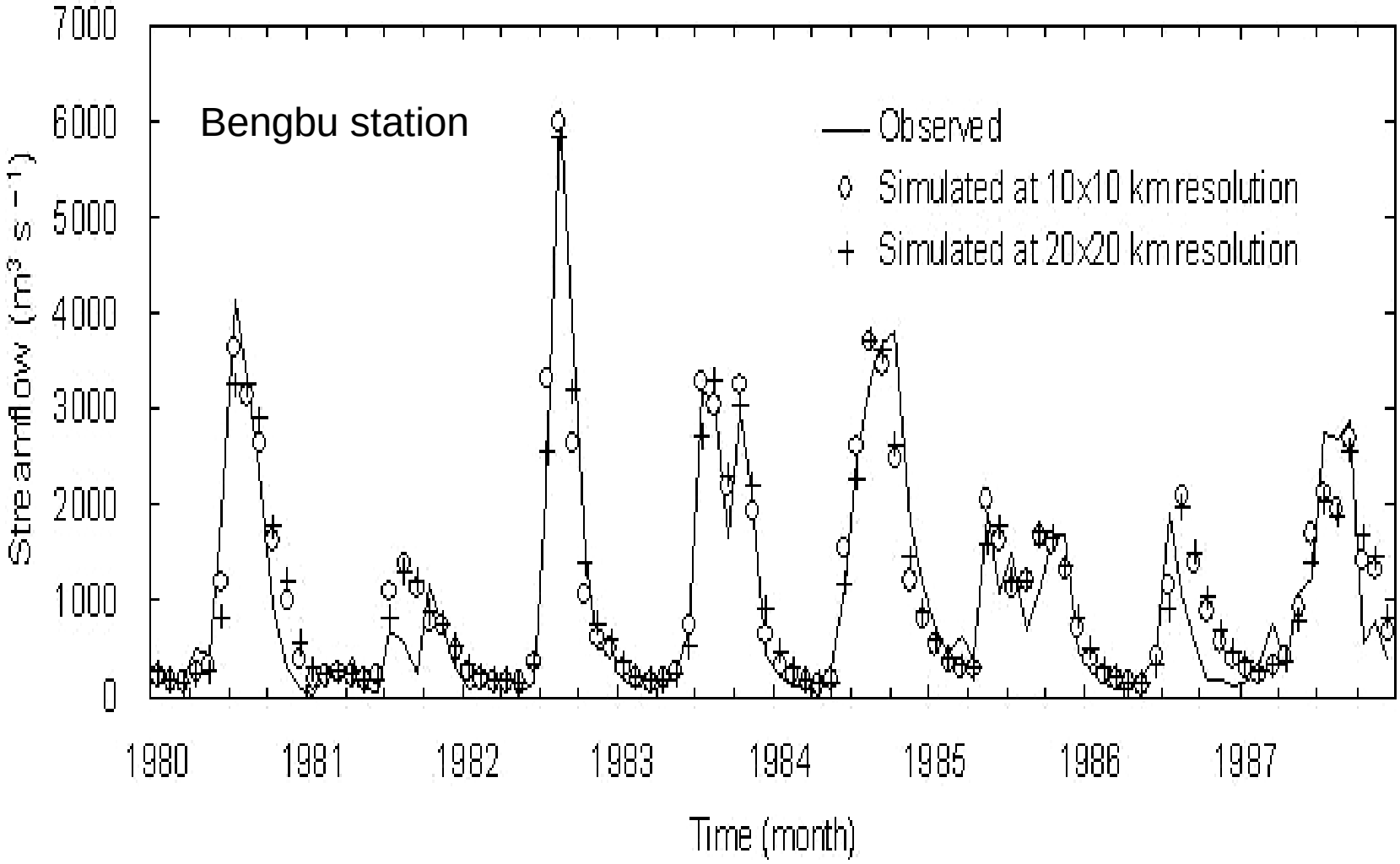
# Coupled Land-Hydrological Model System

HMS integrating terrestrial hydrology (rivers and lakes), soil moisture and groundwater, and contains following four modules：

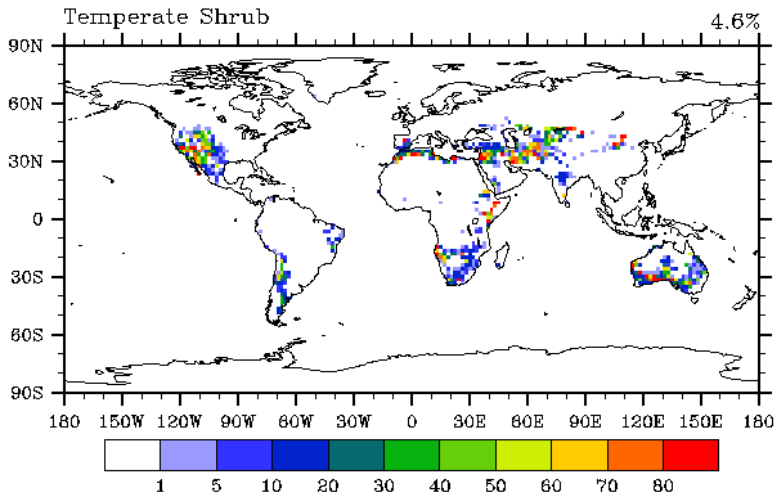
- **S**oil **H**ydrologic **M**odel **(SHM)**
- **T**errestrial **H**ydrologic **M**odel **(THM)**
- **G**roundwater **H**ydrologic **M**odel **(GHM)**
- **Channel-Groundwater Interaction Model (CGI )**

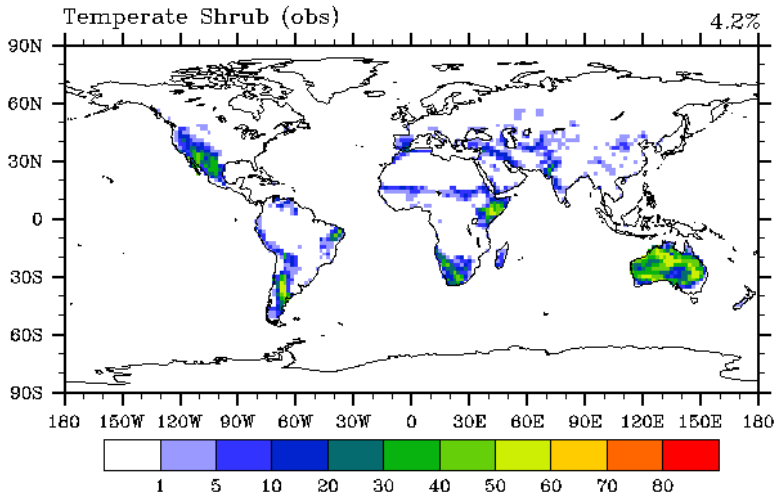


# Streamflow simulation in Bengbu station

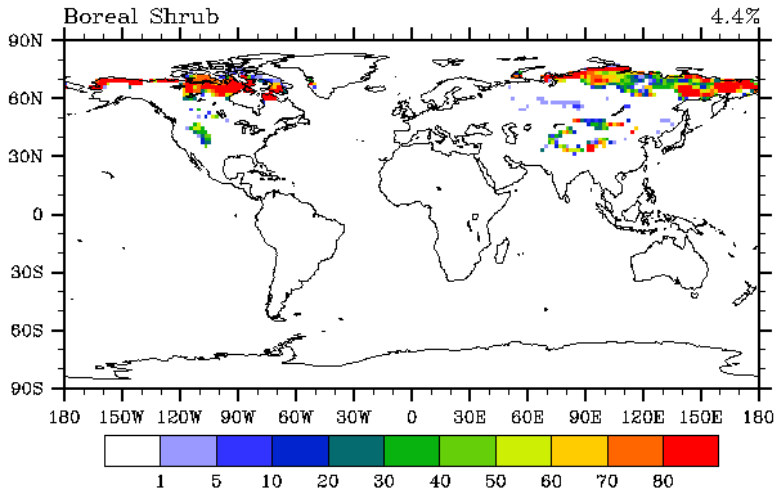


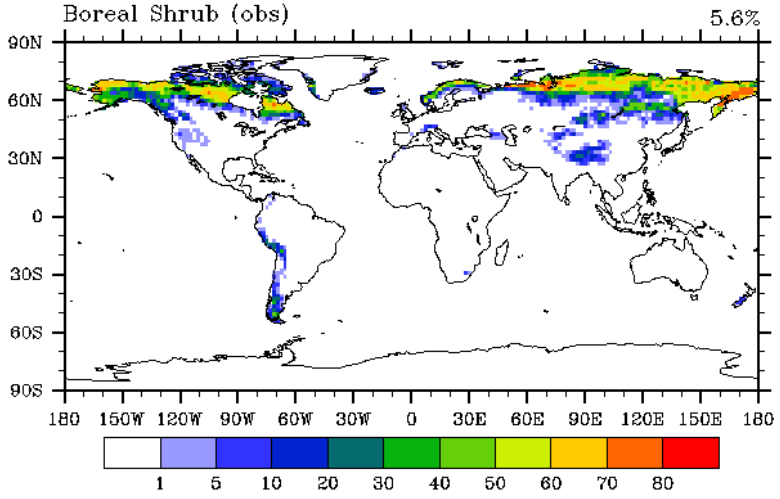
# Global Distribution of Shrub




**Temperate Shrub**

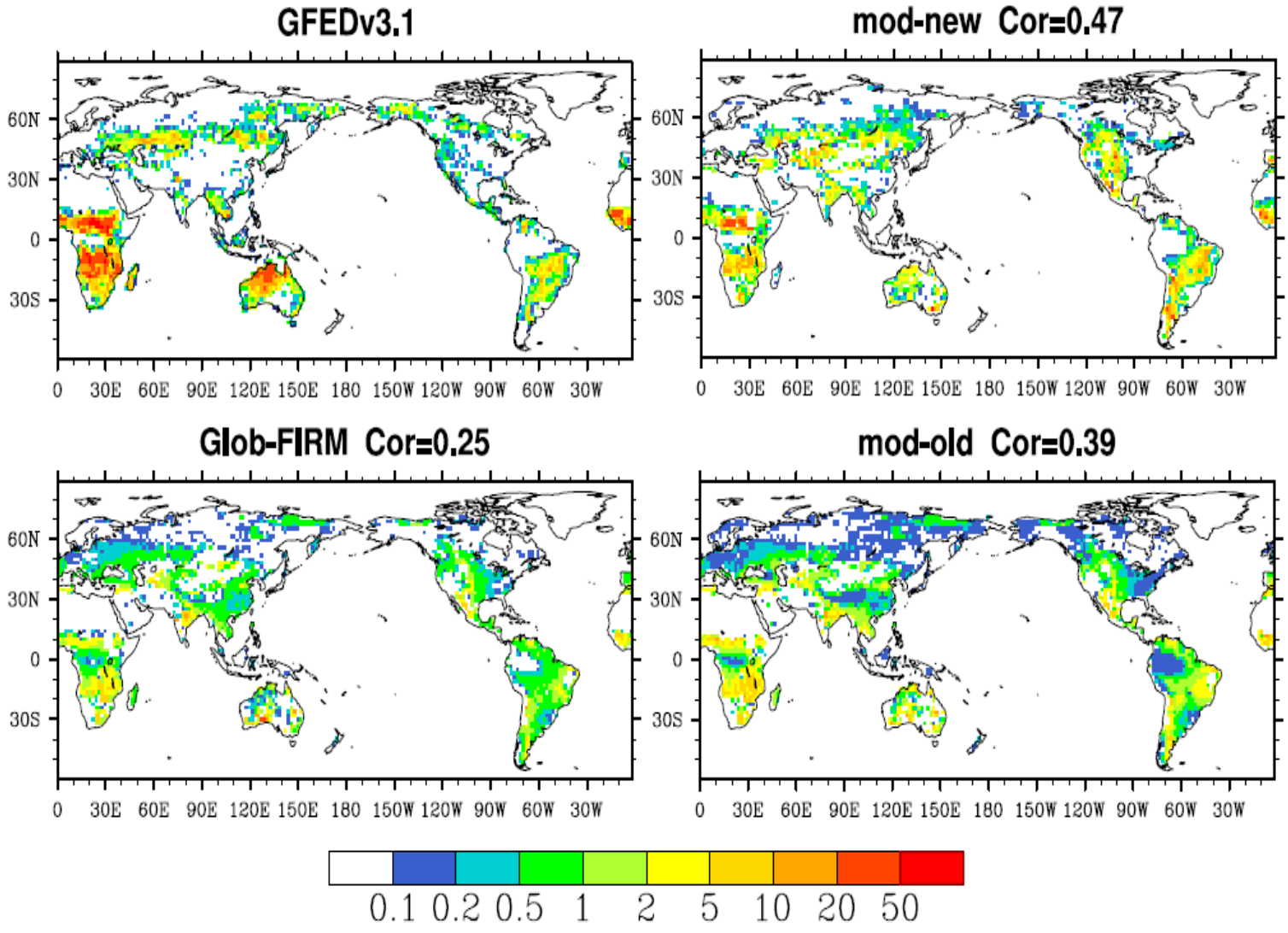



**Boreal Shrub**

**Simulation** **Observation**

# Burned Area Fraction Simulated by IAP Model



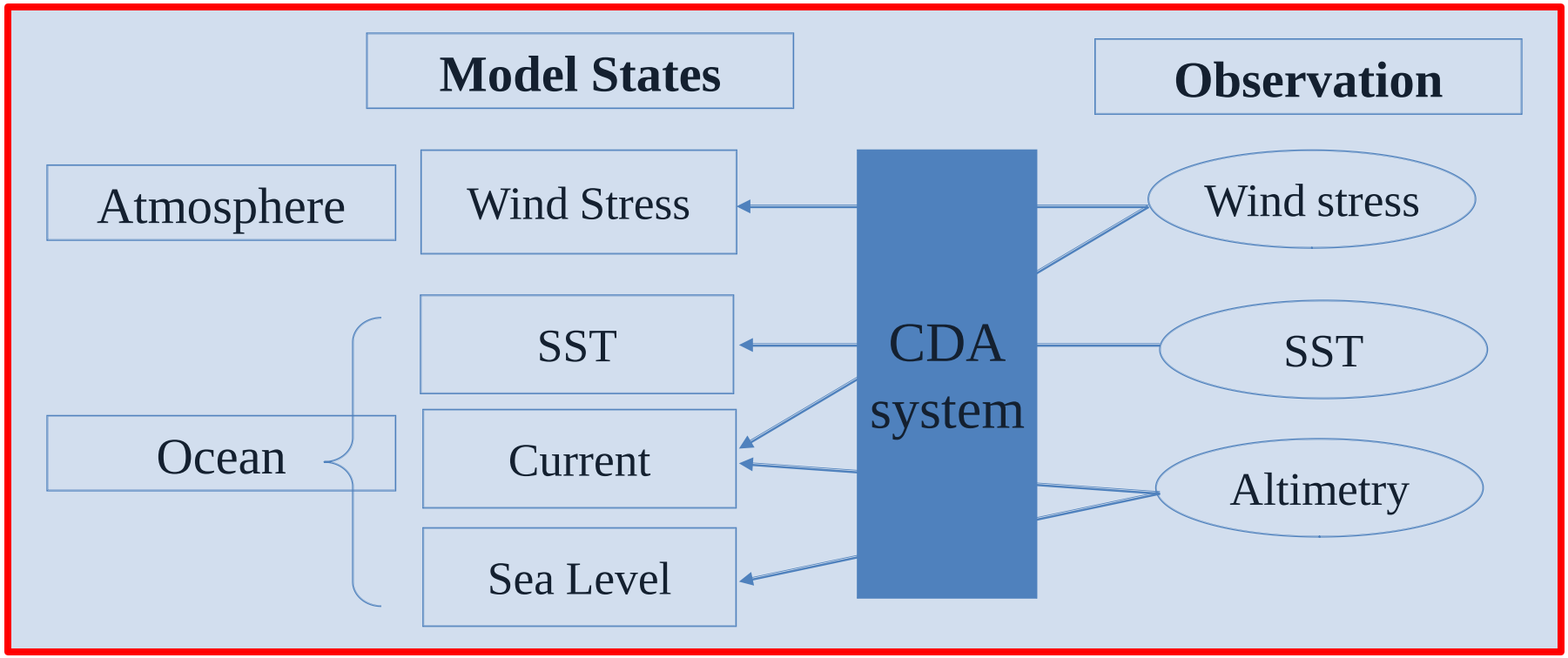

The new scheme successfully reproduces the **global spatial distribution of annual burned area fraction.**

It is more skillful than existing models, e.g., mod-old and Glob-FIRM, especially in the **tropics** and in the **middle-high latitude**

# III. Current Research Progress

## Seasonal-to-interannual climate and hydrological prediction

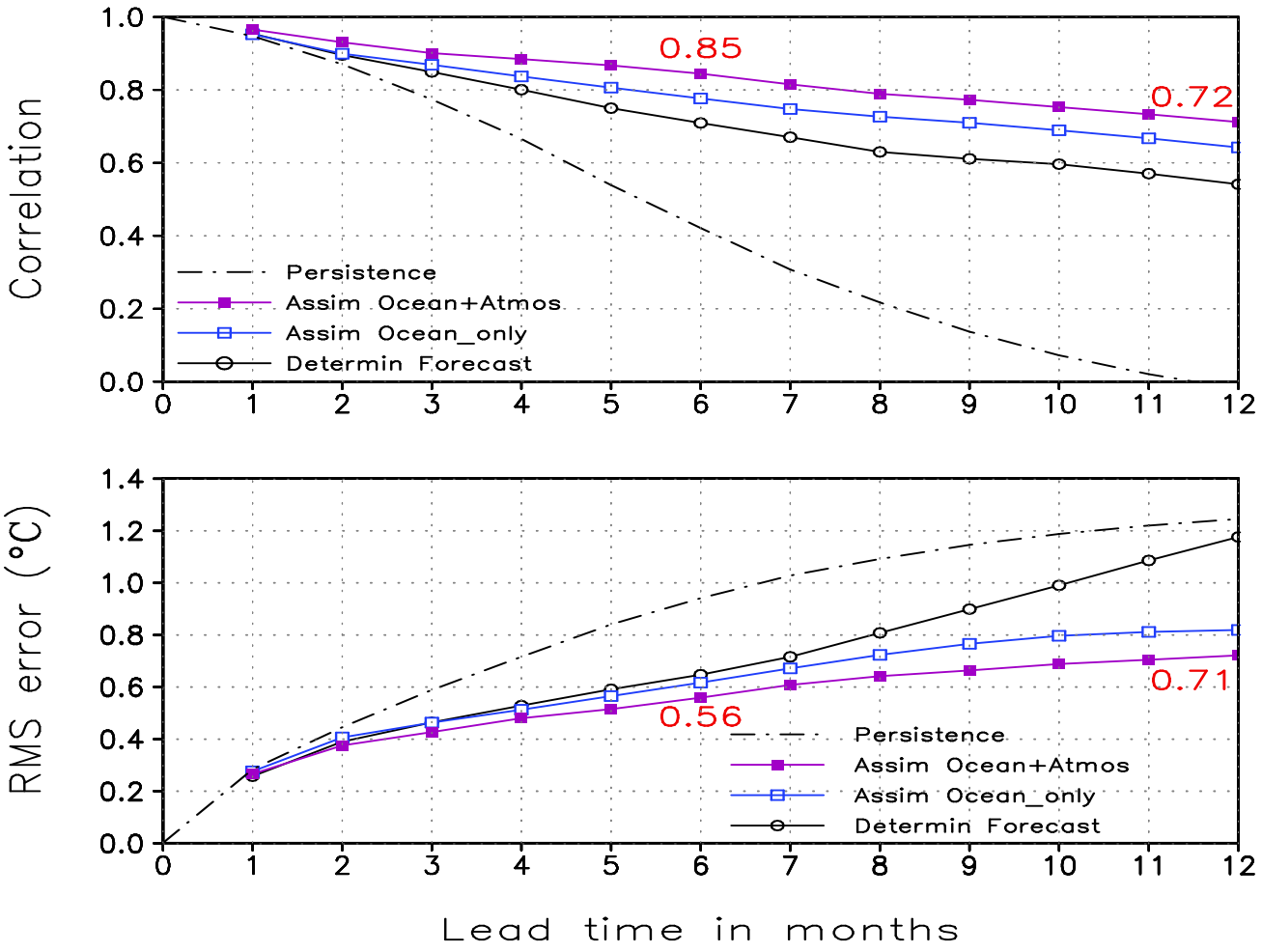
# A large size ensemble ENSO forecast system with coupled data assimilation (Leefs_CDA)




Coupled Data Assimilation (CDA) Scheme

The improved ENSO prediction skills are achieved through assimilating available atmospheric and oceanic observations to provide more accurate initial conditions for ICM.

# Deterministic Prediction Skill



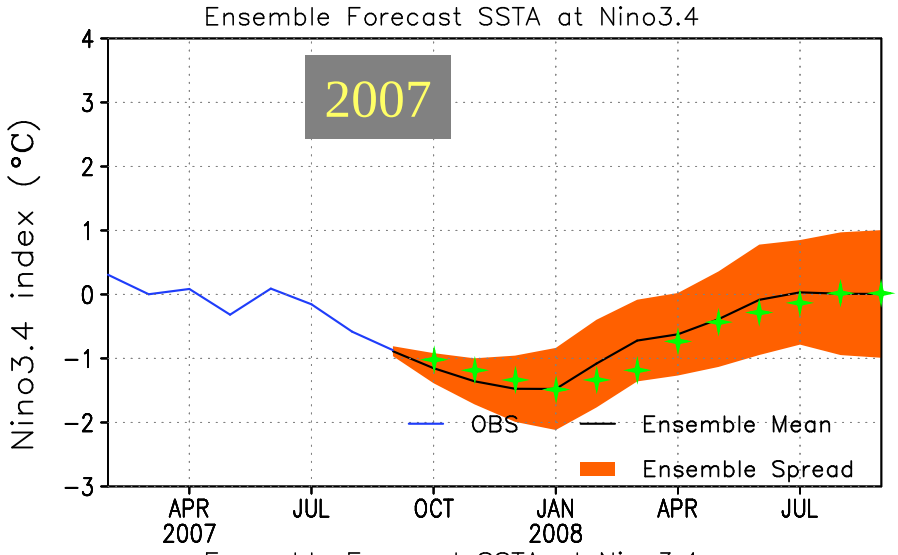

Hindcast Verification: 12-month ensemble prediction experiments are performed with 100 members during the period from 1993 to 2009

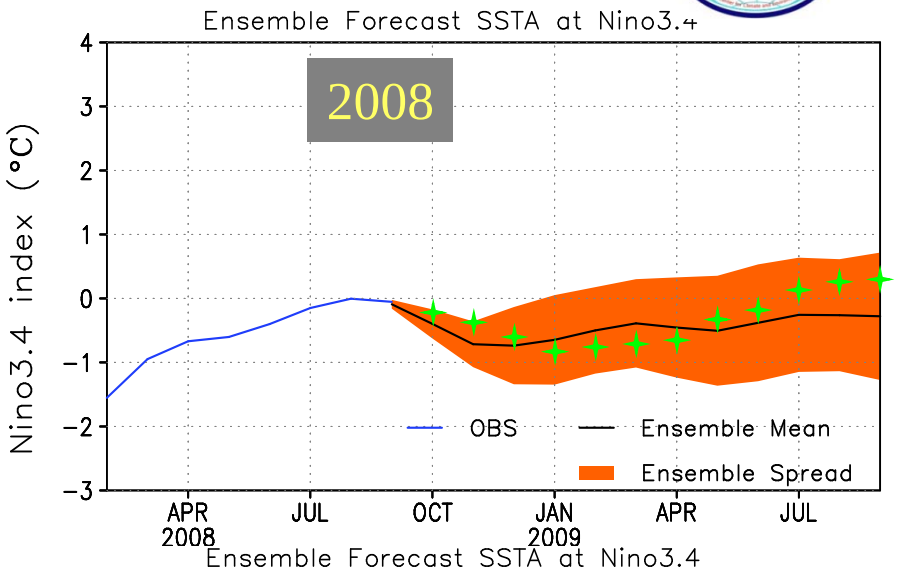
Purple Line: Coupled data assimilation scheme – Assimilating atmospheric and oceanic observations

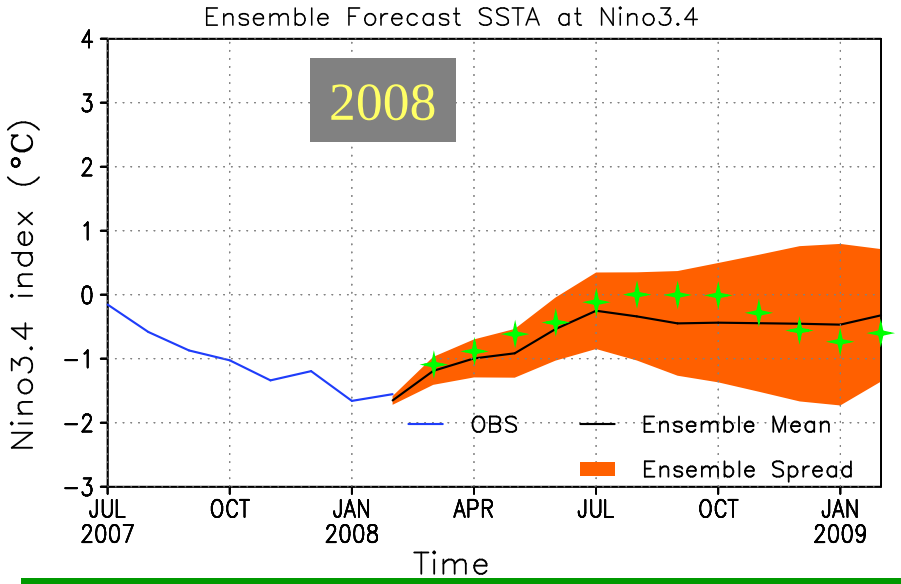
Blue Line: Ocean-only data assimilation scheme – Assimilating oceanic observations

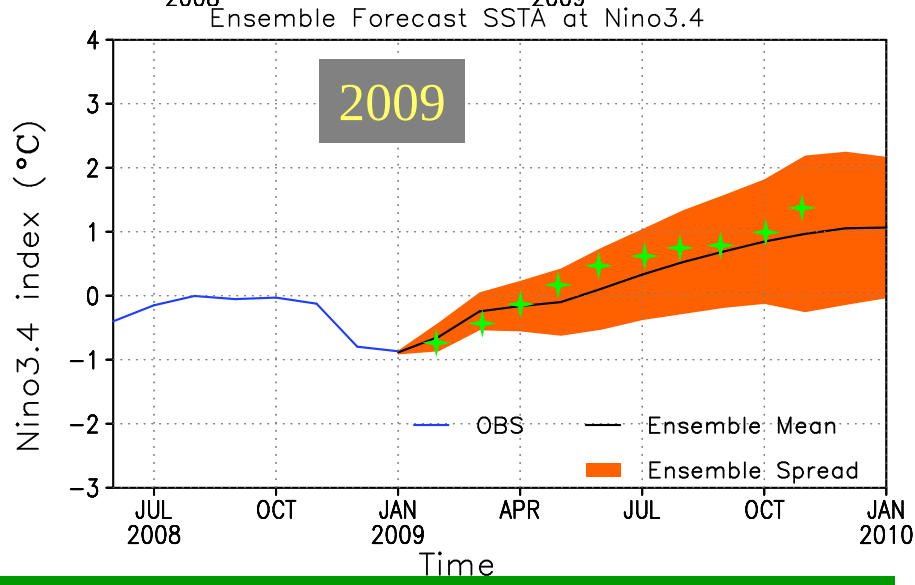
Black Line: Deterministic prediction scheme

Black Dashed Line: Persistence



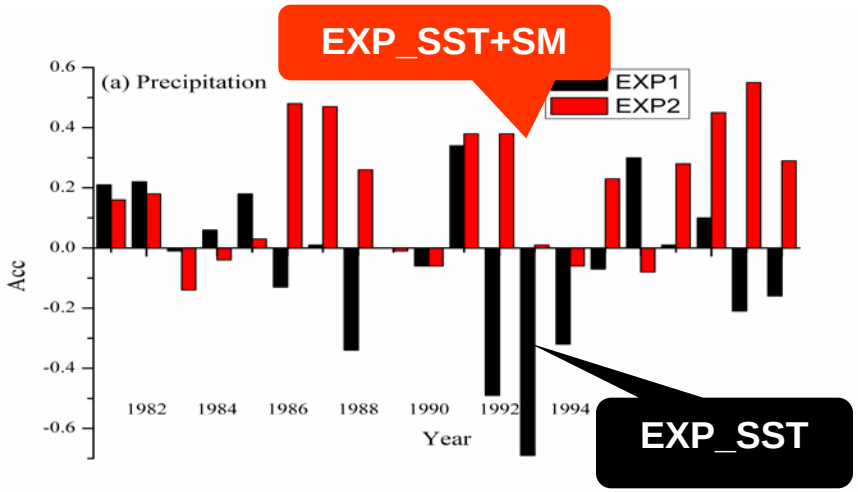




Ensemble forecast results provided to “National Climate Discussion” in China (is OBS)

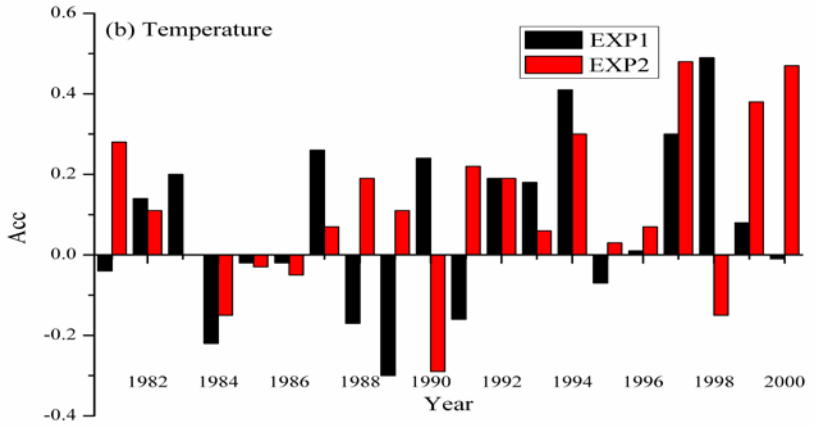
# Impact of soil moisture on climate predictability over China

## ACC for precipitation over China




Mean ACC：-0.05→0.19

## ACC for Ts over China from 1980 to 2000

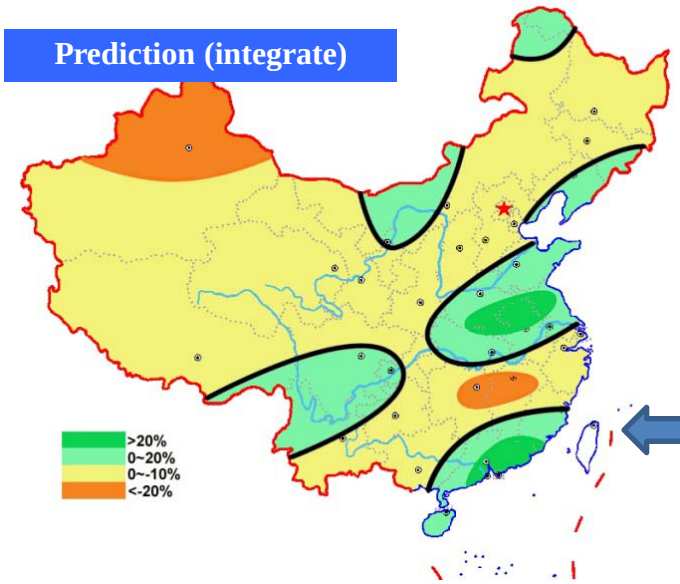



Mean ACC：0.07→0.11

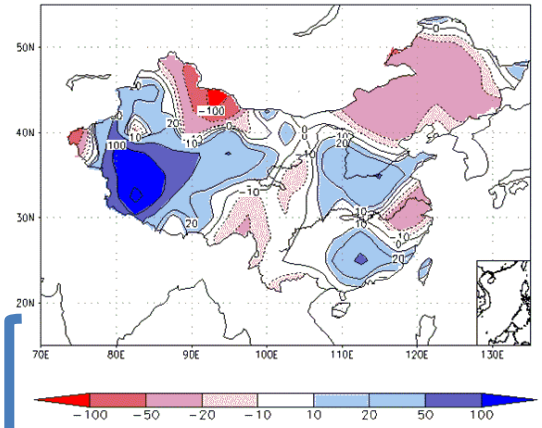
**To consider the impact of soil moisture, the potential predictability of summer precipitation and surface air temperature has been improve over China: anomaly correlation coefficients (ACC) increased from -0.05 to 0.19 for precipitation, increased from 0.07 to 0.11 for Ts.**

# Real-time prediction (2009)

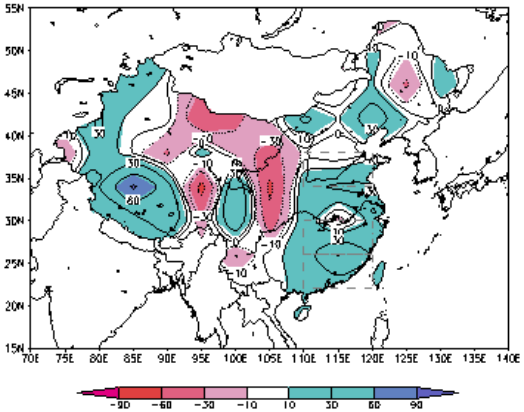
Prediction (integrate)



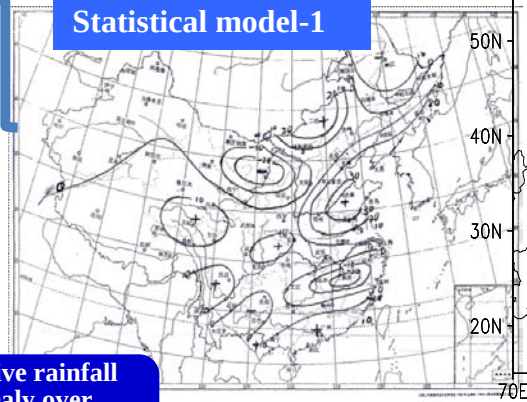

IAP2L



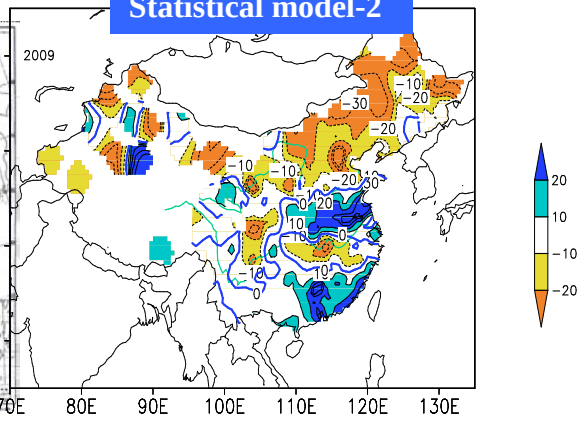
IAP9L



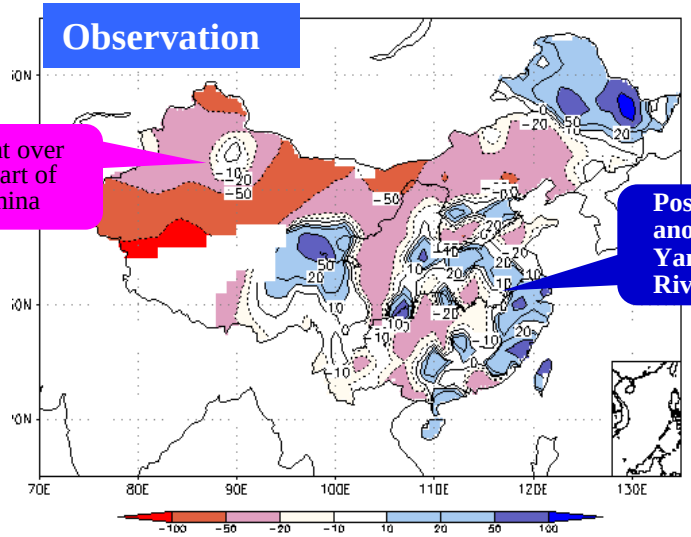
Statistical model-1



Statistical model-2




Observation



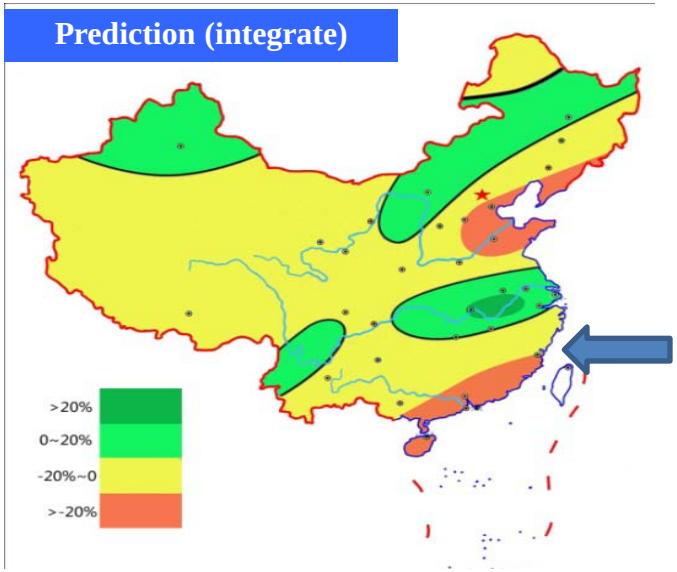
Drought over most part of west China

Positive rainfall anomaly over Yangtze-Huaihe River

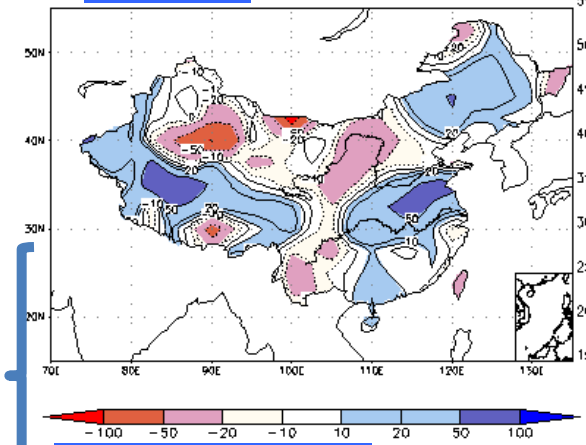
Prediction for percentage of rainfall anomalies by dynamical and statistical models

# Real-time prediction (2010)

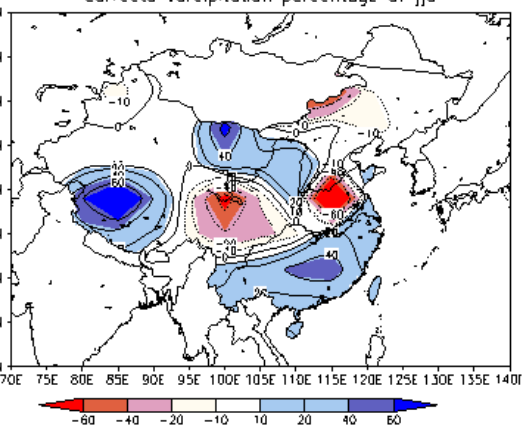
**Prediction (integrate)**



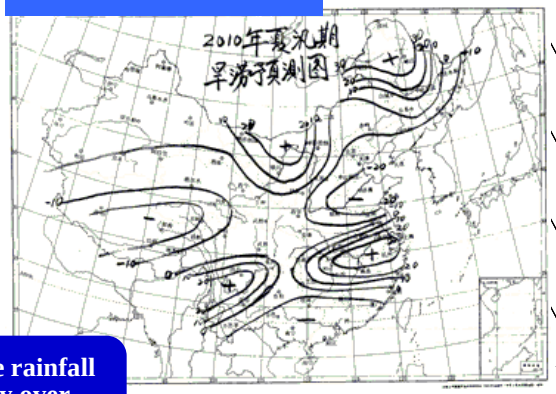

**IAP2L**



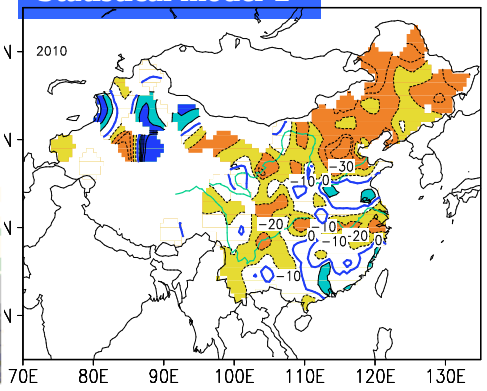
**IAP9L**



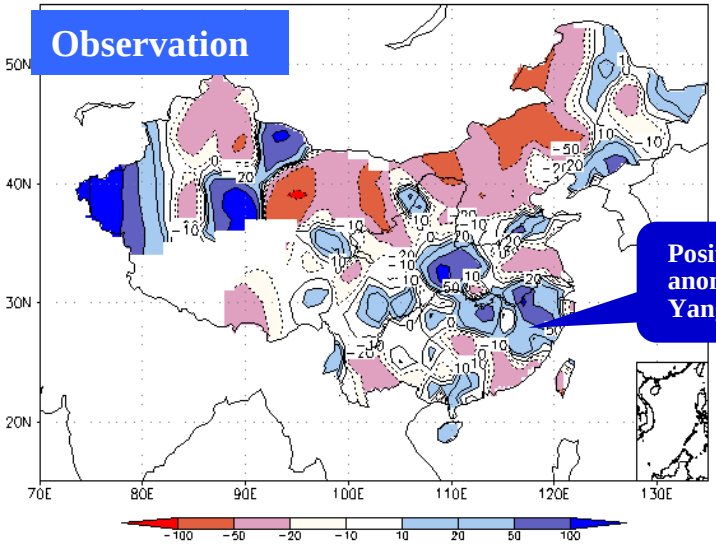
**Statistical model-1**




**Statistical model-2**




**Observation**



**Positive rainfall anomaly over Yangtze River**

Prediction for percentage of rainfall anomalies by dynamical and statistical models

# III. Current Research Progress

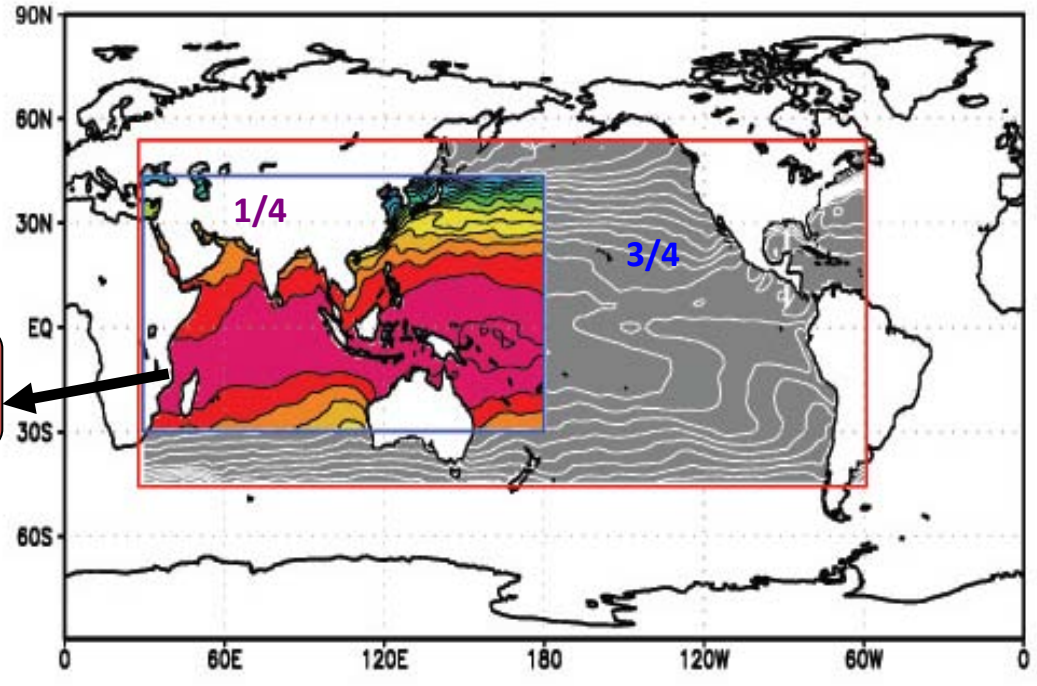
## Data Assimilation

# Asian-Indian-Pacific Ocean Reanalysis Data

## Reanalysis dataset AIPOcean1.0

- Reanalysis dataset is produced by assimilating various observations into the HYCOM via EnOI.
- AIPOcean 1.0 resolution: 1/4x1/4x22, and nested in a large outer region with the resolution of 3/4x3/4x22.

AIPOcean region

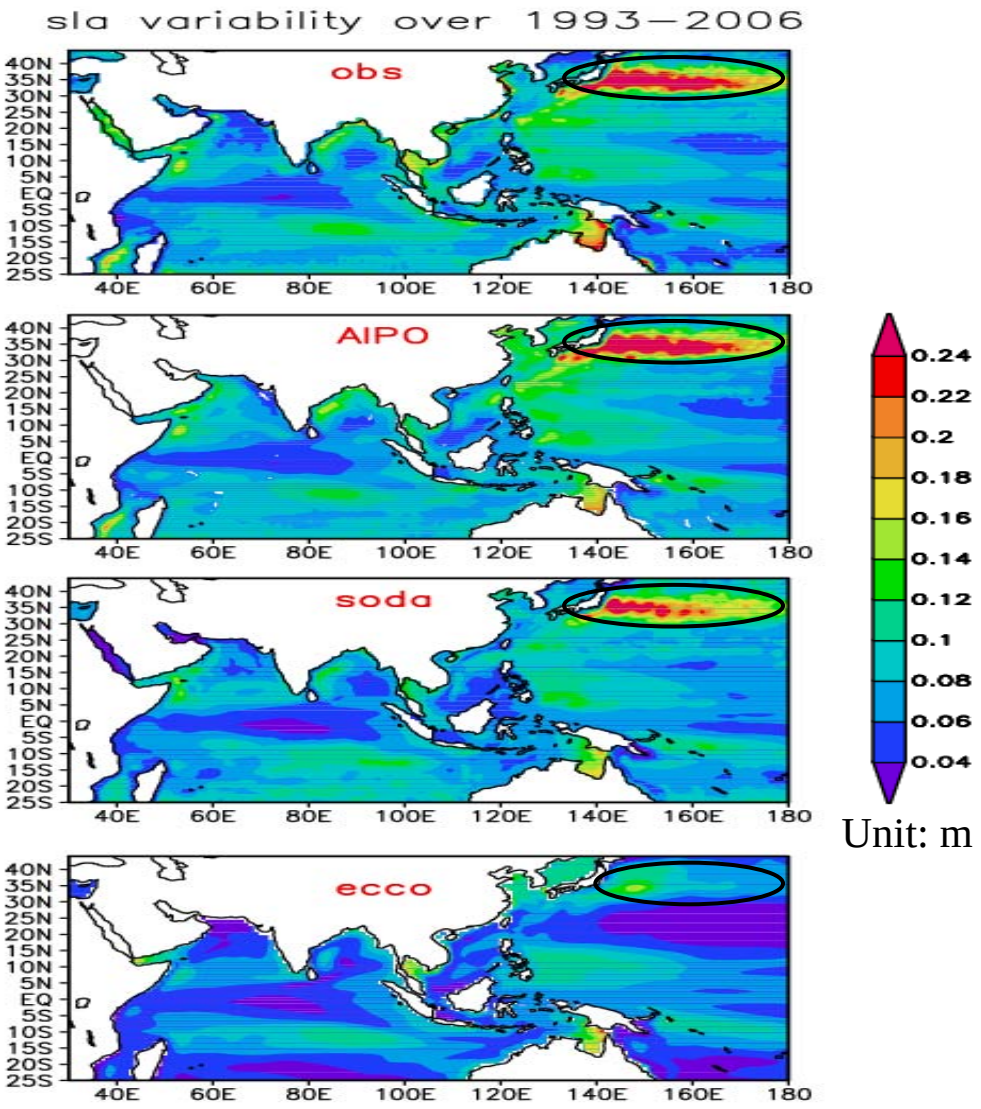


# Evaluation of AIPOCean1.0

**Indonesian throughflow (ITF) transport**

| | Obs. | AIPOcean 1.0 | ECCO | SODA |
|---|---|---|---|---|
| Annual Mean Inflow | 13Sv | 11.9Sv | 10.2Sv | 8.2Sv |
| Annual mean Outflow | 15Sv | 14.5Sv | 11.7Sv | 14.2Sv |

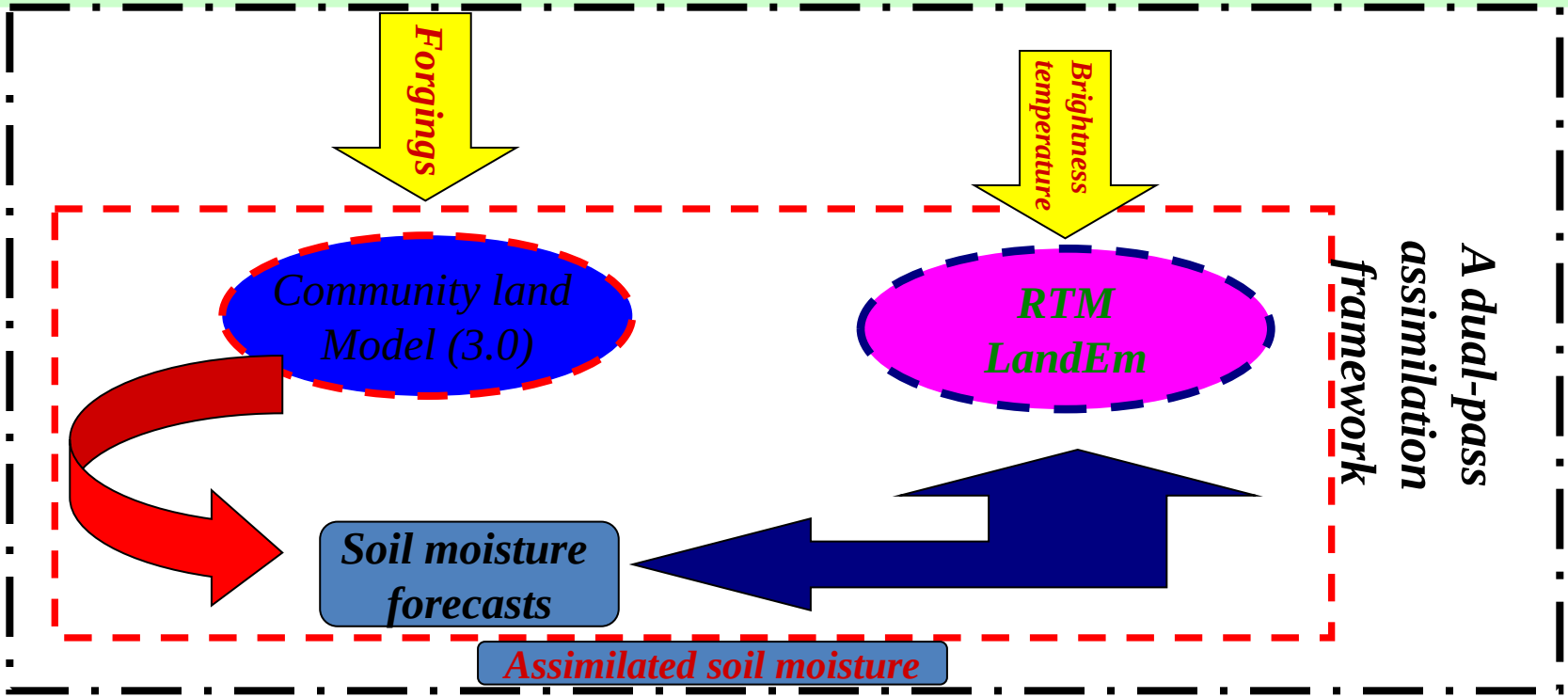
AIPOcean1.0 product is freely available from Information Center of Institute of Atmospheric Physics. URL is: http://dell2.iap.ac.cn/index.php/component/mtree/142



# Land Data Assimilation

## Land Data Assimilation Studies in ICCES

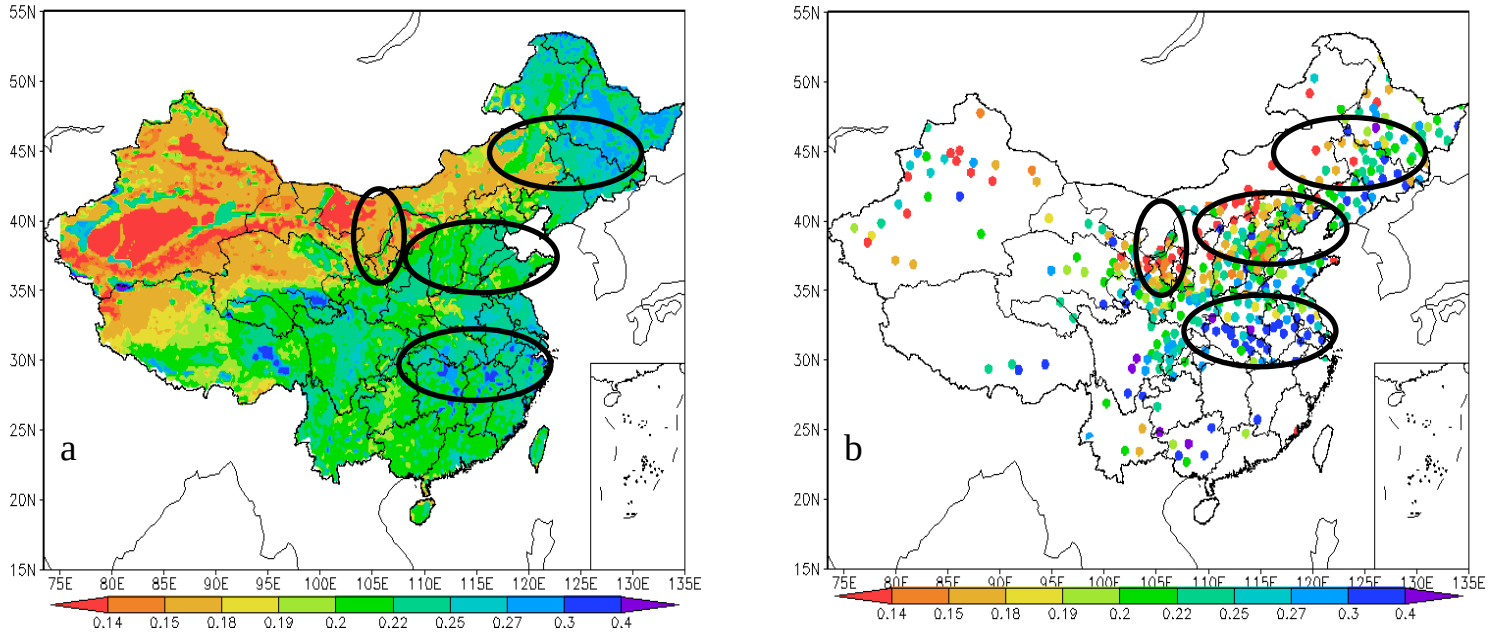
The Global Microwave Land Data System of Institute of Atmospheric Physics, Chinese Academy of Sciences




- A Dual-pass Assimilation-Calibration strategy (Tian et al.,2009,JGR)
- A POD-based ensemble 4DVar method (Tian et al., 2011,Tellus-A; 2008, JGR)
- A EnCNOP-P parameter calibration method (Tian et al.,2010, WRR)
- A BMA-based observation operator framework (Tian et al., 2011, Science in China)

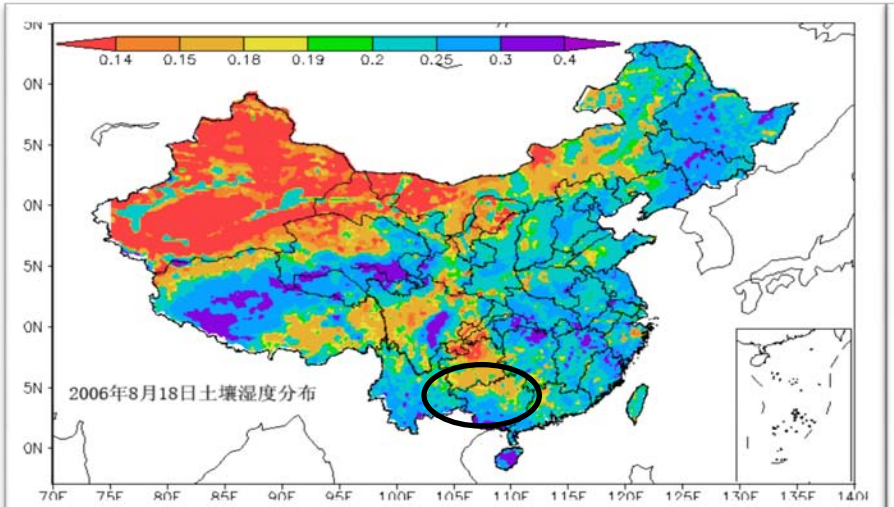
# Preliminary Evaluations over China

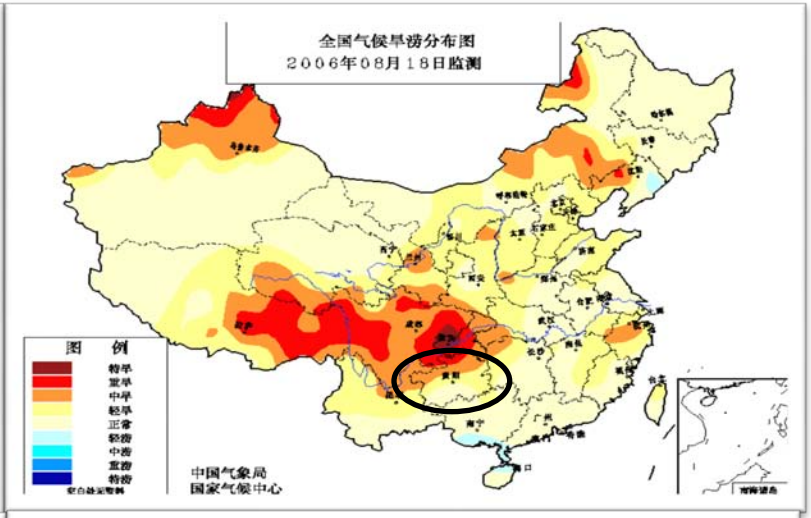
## Mean soil moisture (m3/m3)from (a) assimilations and (b) observations

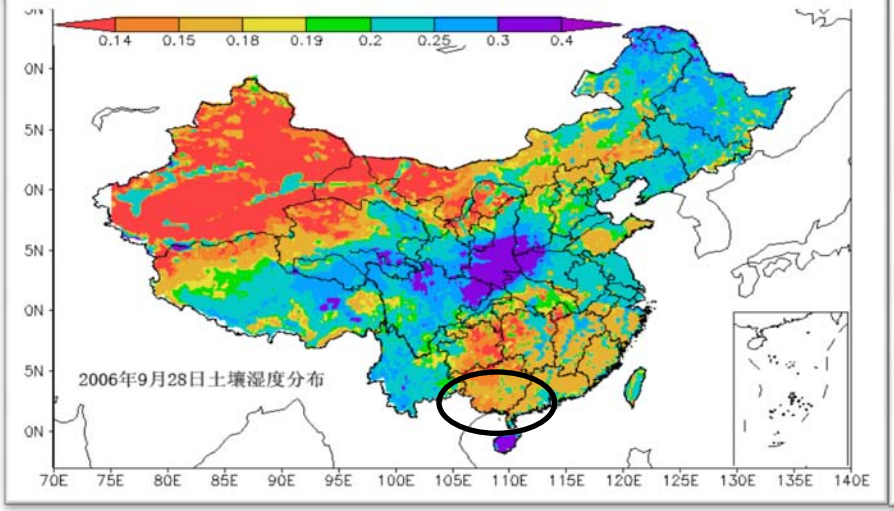


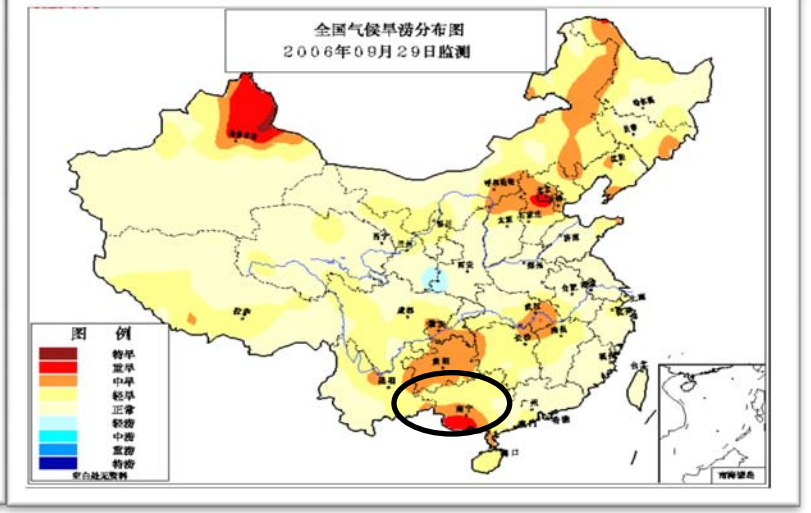

**Comparisons between the observed and assimilated soil moisture content show that the assimilated soil moisture covaries closely with the in-situ observations and can reflect well the observed spatio-temperal patterns of dry and wet spells and agricultural drought characteristics over China.**

# Preliminary Applications in Drought Monitoring over China



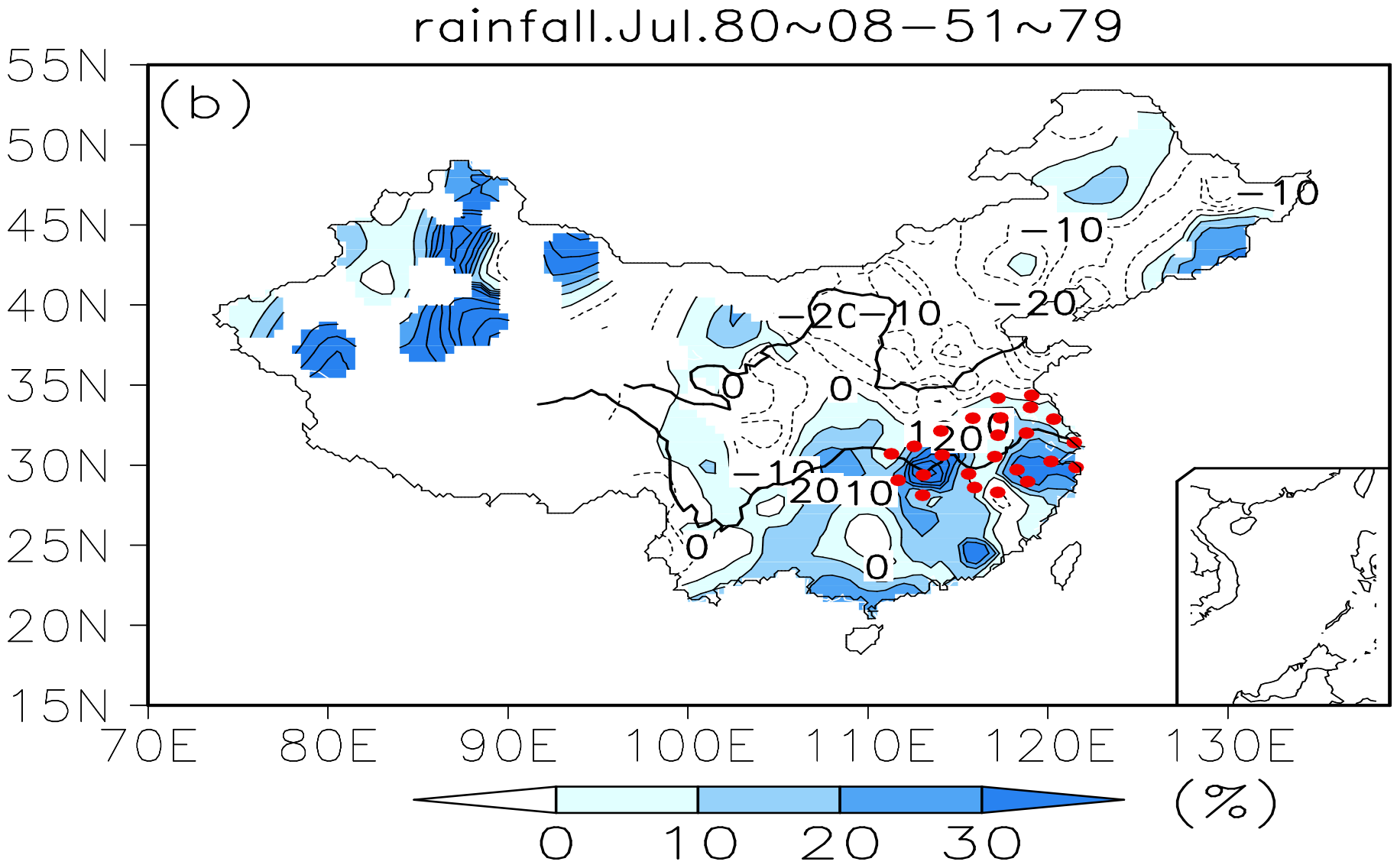



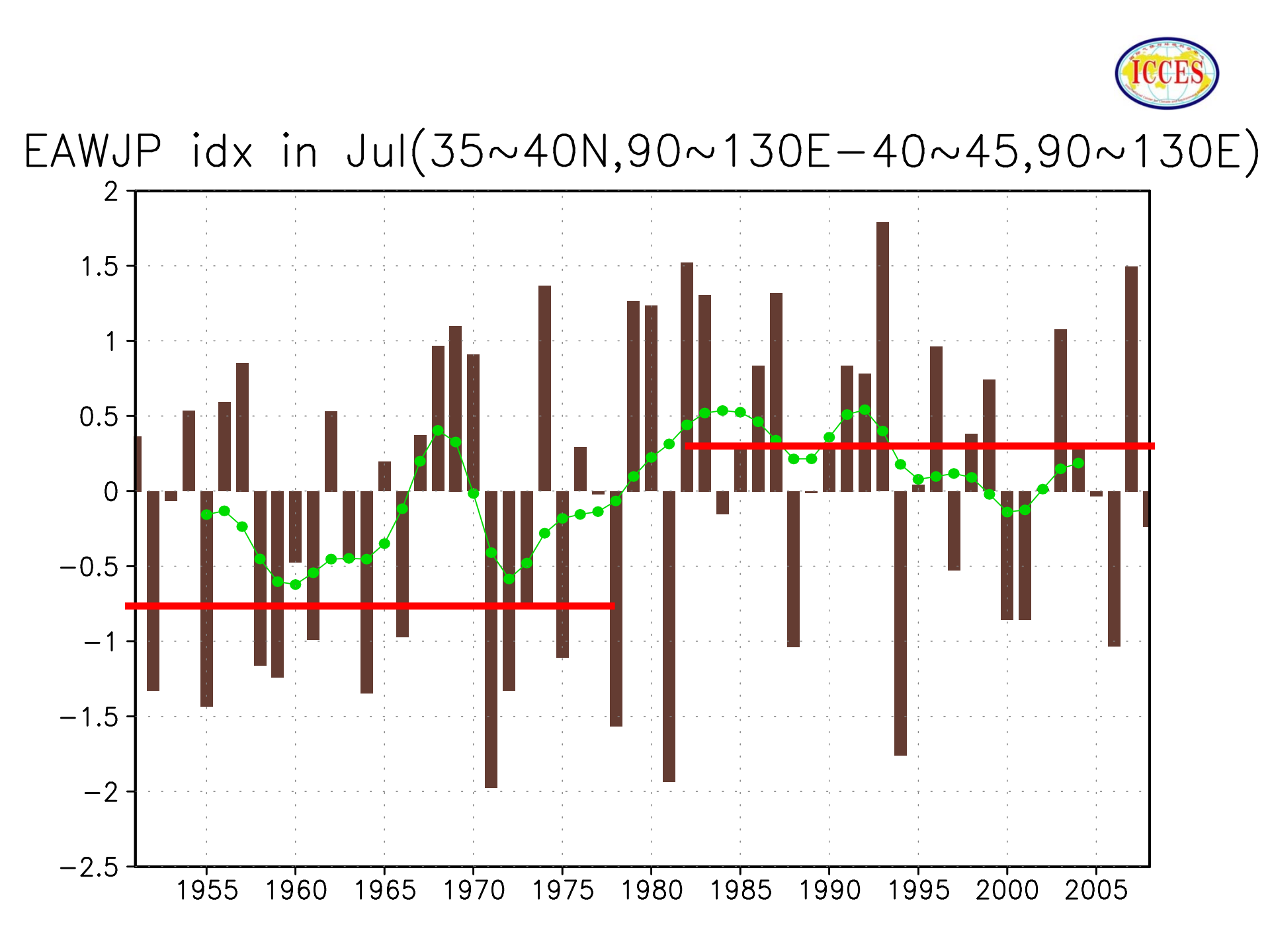



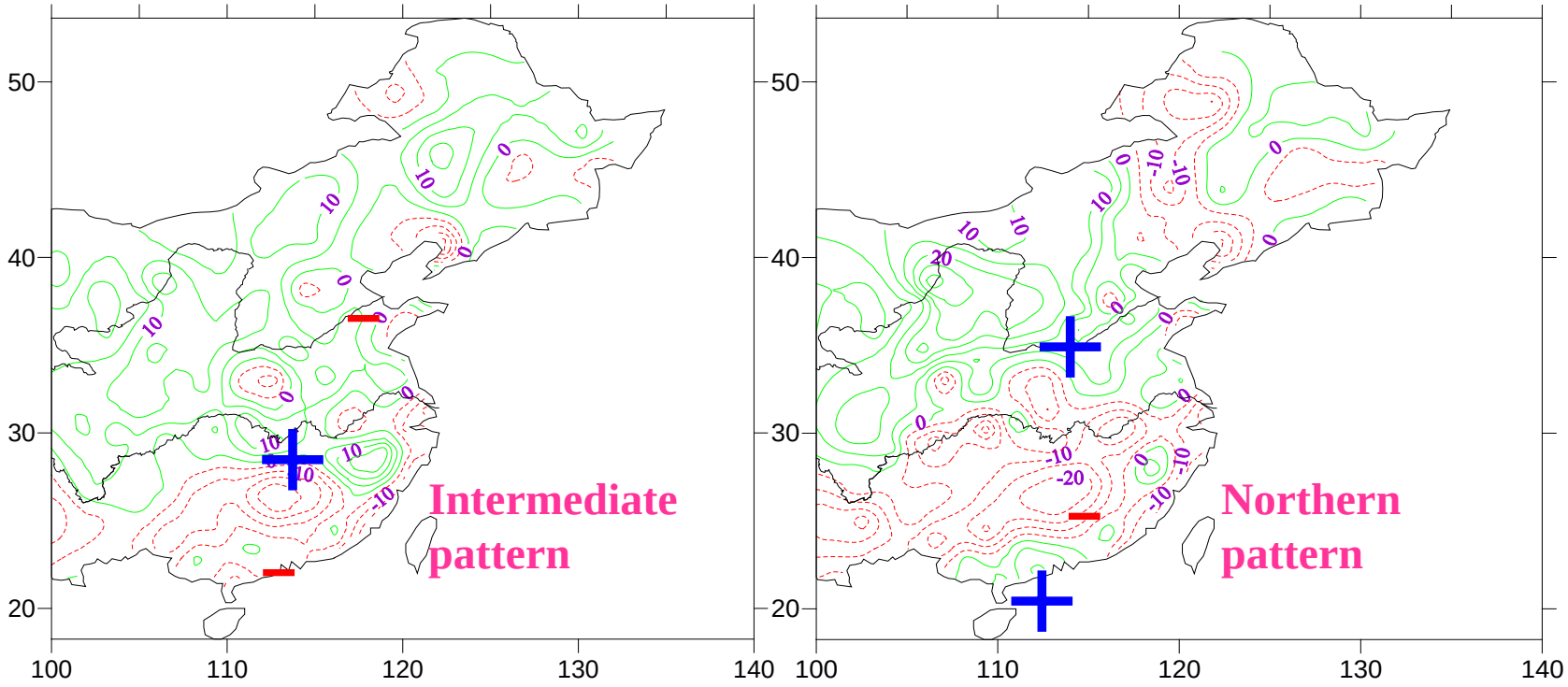
# Monsoon and Climate Dynamics

# Rainfall: wet over southern and drought over northern




EAWJP idx in Jul(35~40N,90~130E-40~45,90~130E)
2
1.5
1
0.5
0
-0.5
-1
-1.5
-2
-2.5
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005

# The composite summer rainfall anomaly percentage in China during ENSO years(%)




**Strong ENSO years:**

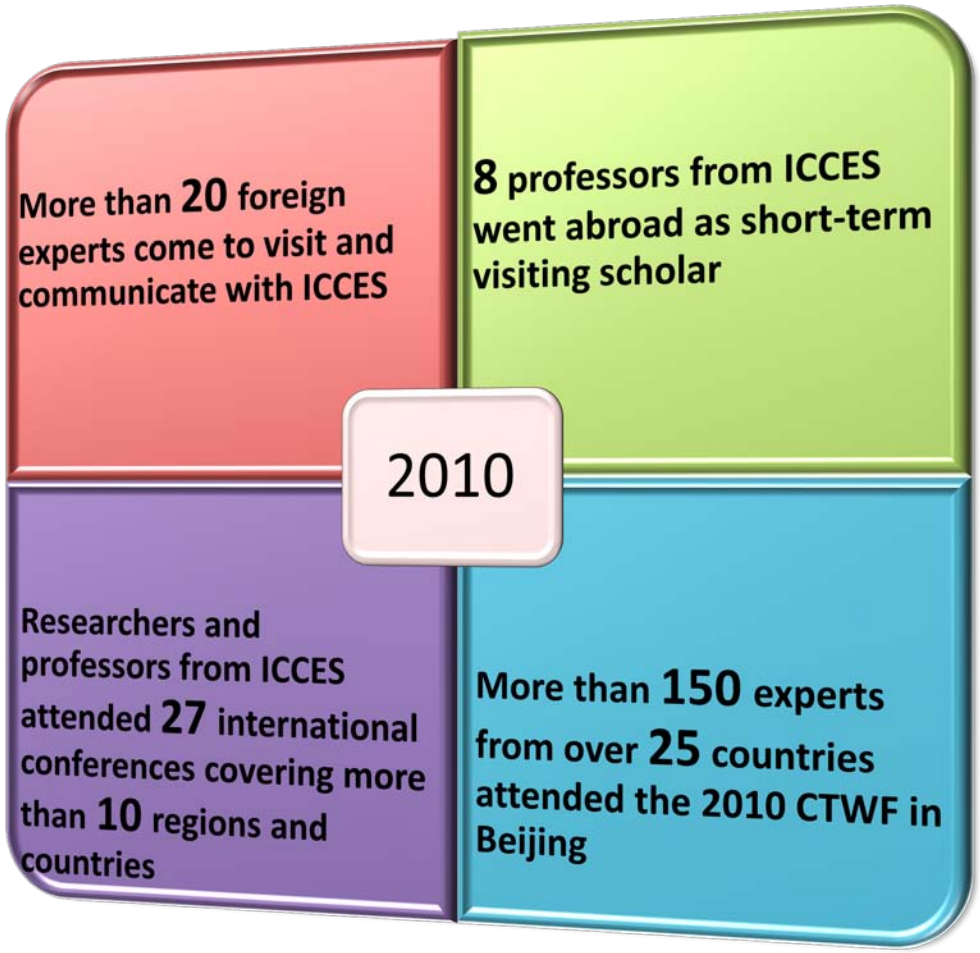
more rainfall in Yangtze River basin

Moderate ENSO years

More rainfall in northern China

# IV. International Cooperation

- **International cooperation and exchange has always been the emphasis of ICCES;**
- **Since 2000, ICCES has become the secretariat of CAS-TAS-WMO Forum on Climate Sciences (CTWF)**



# 2010 CTWF International Workshop

**Theme: "Climate and Environmental Change: Challenges for Developing Countries**

More than **150** participants attended the 2010 CTWF, including 45 representatives from **18** oversea institutions and government departments.

**Time:** November 17-19, 2010
**Venue:** Foreign Experts Building, Beijing, China.

# 2010 CTWF International Workshop

## Sessions of the Forum：

- ✓ Climate Change: Observation and Modeling
- ✓ Impact of Climate Change on Water Resources
- ✓ Impact of Climate Change on Agriculture and Ecosystem
- ✓ Adaptation to the Climate Change for Sustainable Development

**Including 5 keynote speeches, 59 oral presentations and 11 posters.**

# 2010 CTWF International Workshop

**COMSATS Member Country representatives in 2010 CTWF**

- Zimbabwe Meteorological Services Department;
- Pakistan Meteorological Department
- Global climate change impact study center (GCISC);
- COMSATS Institute of Information Technology (CIIT);
- Department of natural resources, TERI University;
- Malaysian Meteorological Department;
- HICCDRC, Nepal

……



# The Foundation Meeting of COMSATS' Thematic Research Group


**The Foundation Meeting of COMSATS' Thematic Research Group on 'Climate Change and Environmental Protection' was jointly held by COMSATS and ICCES.**

**More than 22 research scientists attended the meeting， namely from Pakistan, Sudan, Iran, Malaysia etc..**

# CTWF 2011 ---- Call for Participants

**Joint International Training workshop on**
**"Regional Climate Change and Its Impact Assessment"**

**Basic Information:**

1. **Tentative date: Sep. 26-31, 2011**
2. **Venue: Beijing**
3. **Topics:**
   a) Regional Climate Change: Observation and Projection
   b) Impact of climate change on regional water resources and agriculture
   c) Application of regional climate model on the regional climate change study

**Sponsorship:**

# CTWF 2011 ---- Call for Participants

## Two- ways to Contribute

1. You are welcome to participants as lecturers
2. Please recommend young scientists working on climate change related issue to join in the training workshop

**Sponsorship:**

# THANK YOU !

Prof. Dr. Zhaohui Lin

Director of ICCES
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http://www.icces.ac.cn