



国际气候与环境科学中心

International Center for Climate and Environment Sciences



Annual Report of ICCES

Center of excellence on
Climate and Environment Sciences

(2012.5-2013.4)

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

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I. ICCES Introduction

- Founded in **1991** with support from both CAS and Ministry of Science and Technology of China (MOST) ;
- Secretariat of CAS-TWAS-WMO Forum (CTWF) on climate science since 2000



ICCES currently has **46** staffs in total, with **40** research scientists, and **6** supporting staff . Besides, there are **7** Adjunct professors. As for 2012, there are **1** Postdoc, and **33** graduate students studying in ICCES



I. ICCES updated

- In March of 2013, ICCES was newly selected as the [CAS-TWAS center of excellence on Climate and Environment Sciences](#) through evaluation, one of the 5 CAS-TWAS CoEs.
- Video meeting between CAS-TWAS CoEs and TWAS have been organized on April 26, 2013, with Romain Murenzi, executive director of TWAS, and Officials from BIC, CAS and Directors of CoEs participating in the meeting
- In April, 2013, the Project on “Establishment of CAS-TWAS center of excellence on Climate and Environment Sciences” was approved by the Chinese Academy of Sciences, with total financial support of 8.8 Million CNY during 2013-2015.



I. Vision

The goal of *ICCES* is to become an international renowned research center on global climate and environmental sciences, as well as a cooperative base providing technology support, capacity building and talent training for developing countries, to take the lead in initiating, organizing, coordinating and implementing major international scientific cooperation between CAS and other developing countries.



I. Missions

- To conduct research on the key scientific problems in global climate and environmental changes, such as theories, simulation and prediction of global change, disaster detection and assessment
- To promote the capability of monitoring and forecasting of climatic and environmental disaster
- To provide consultancy for the national and international requirements on sustainable developments, and scientific policies in the negotiation of global climate change
- To provide services to the developing countries with scientific support and advisory, capacity building.

Measures for strengthening the collaboration with developing countries



- ❑ In order to provide services to the developing countries with scientific support and advisory, capacity building. The following measures will be taken:
 - ✓ Organizing the CTWF(CAS-TWAS-WMO Forum on climate science) international symposiums/workshops
 - ✓ Organizing international training workshops, with most participants from developing countries
 - ✓ Providing exchange programs for international visiting scholars and students from developing countries
 - ✓ Fostering key international cooperative projects with developing countries on the area of climate and environmental sciences, to enhance the research capability for developing countries

II. Major Research Fields

- ◆ 地球系统动力学模式研制和数值模拟

Development of Dynamical Earth System Model and Numerical Simulation

- ◆ 气象与环境预测及灾害评估理论和方法

Meteorological and Environmental Forecast and Related Disaster Assessment Theory and Technique

- ◆ 资料同化理论和方法

Data Assimilation Theory and Methodology

- ◆ 地球系统科学理论与自然控制论研究

Earth System Theories and Natural Cybernetics



II. On-going Projects

- On-going Projects

- **54** on-going research projects in total, including domestic research projects as well as international collaborative projects;
- Within the 54 projects, **14** are newly established in 2012;
 - 6 funded by MOST/MOF
 - 5 funded by National Natural Science Foundation of China
 - 1 funded by Chinese Academy of Sciences
 - 2 for international collaboration projects from MOST

III. Current Research Progress



- Development of Dynamical Earth System Model and Its Applications
- Seasonal climate and hydrological forecast



Brief History of CAS-ESM development

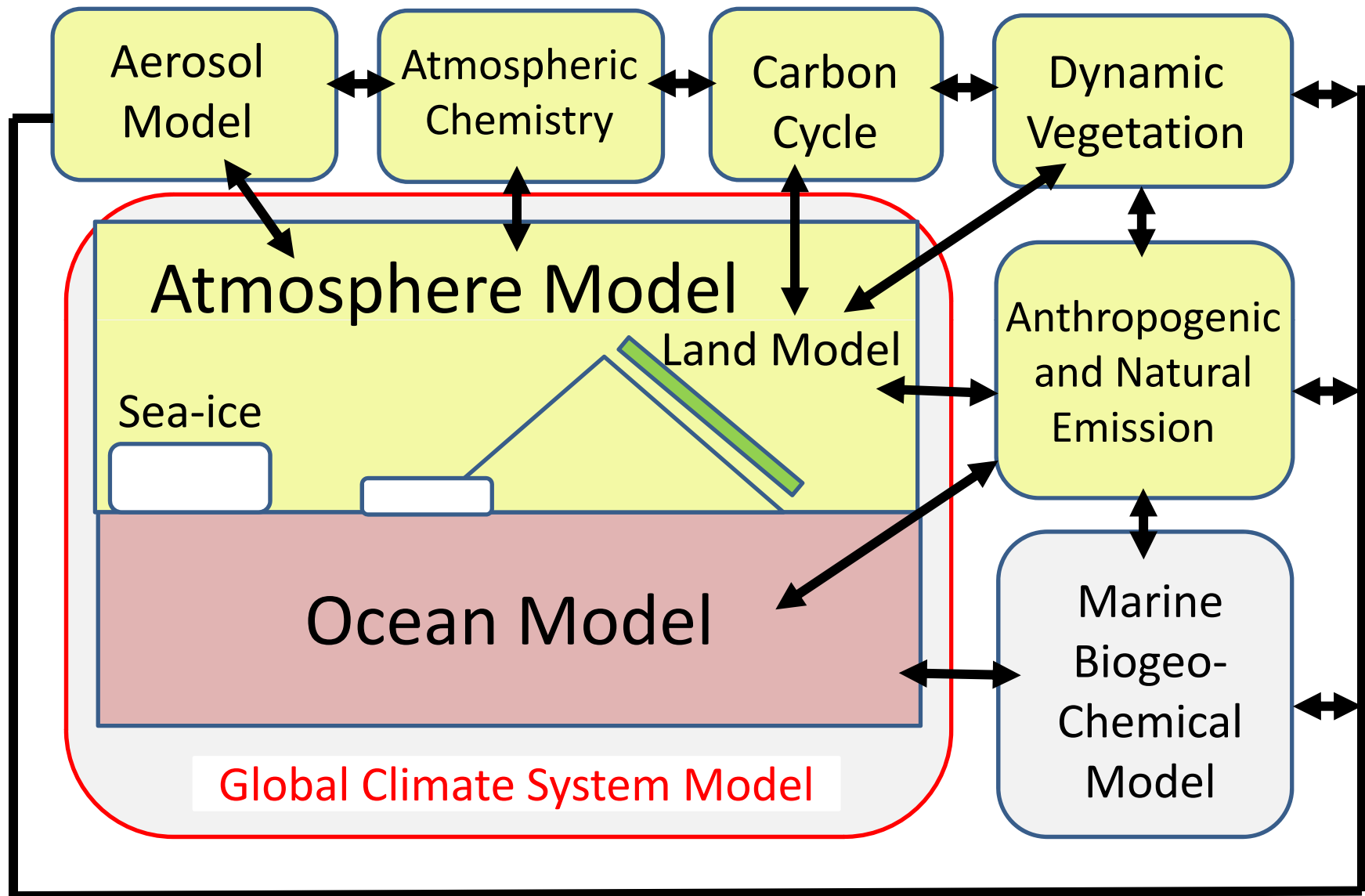
- **1980s:** IAP AGCM (2L) + IAP 4L OGCM
- **1990s:** IAP AGCM (9L) + IAP 20L OGCM + IAP94 LSM
- **2000s:** IAP AGCM (26L) + LICOM1.0 + CoLM1.0
- **2010s:** IAP AGCM with Chemical Module + LICOM2.0 with Sea Ice model + CoLM2.0 (CLM) with UCM+ IAP DGVM1.0 + Biogeochemical Model

Participates in AMIP, SMIP, CMIP, PILPS, IPCC AR1-AR5;
Widely applied in Seasonal forecast and climate studies

Projects related with ESM development

- **2007:** CAS Key project on Development of CAS Earth System Model launched (2007-2010) (Budget: 10 Million RMB \cong 1.2 million Euro)
- **2009:** NSFC first key project on the ESM framework launched (2009-2012)
- **2010:** MOST 973 key basic research program launched two projects
 - a) Development and improvement of Ecosystem and Environment Model
 - b) Development of High resolution climate system model and its evaluation (2010-2014; 30 million RMB for each project)
- **2011:** Sub-project of CAS strategic priority projects launched:
“Uncertainties on the climate simulation and projection using CAS climate system model” (2011-2015; 30 million RMB)
- **Development of CAS ESM is one of the three key goals of IAP for the CAS “Innovation 2020 Project” (2011-2020)**

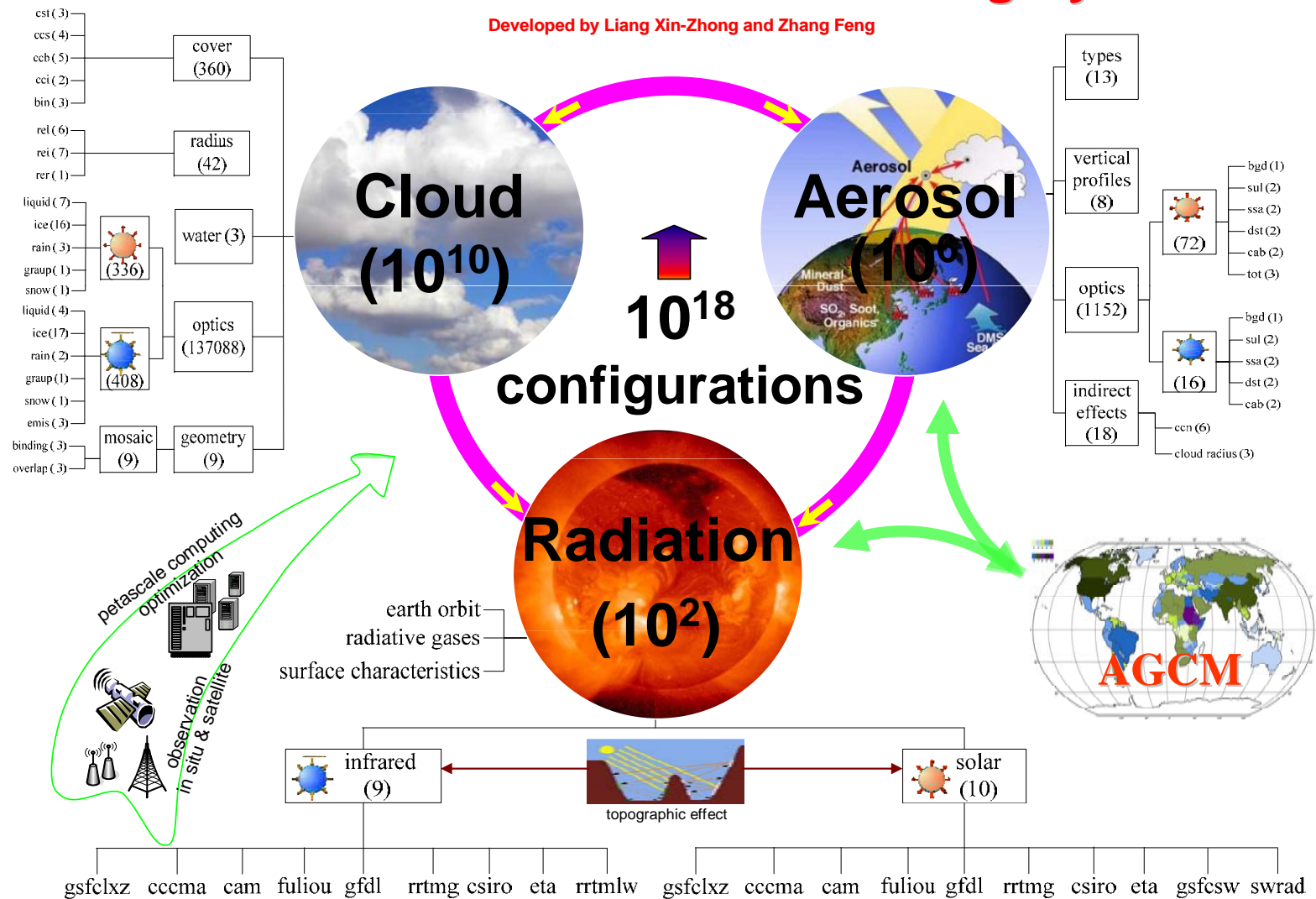
CAS Earth System Model



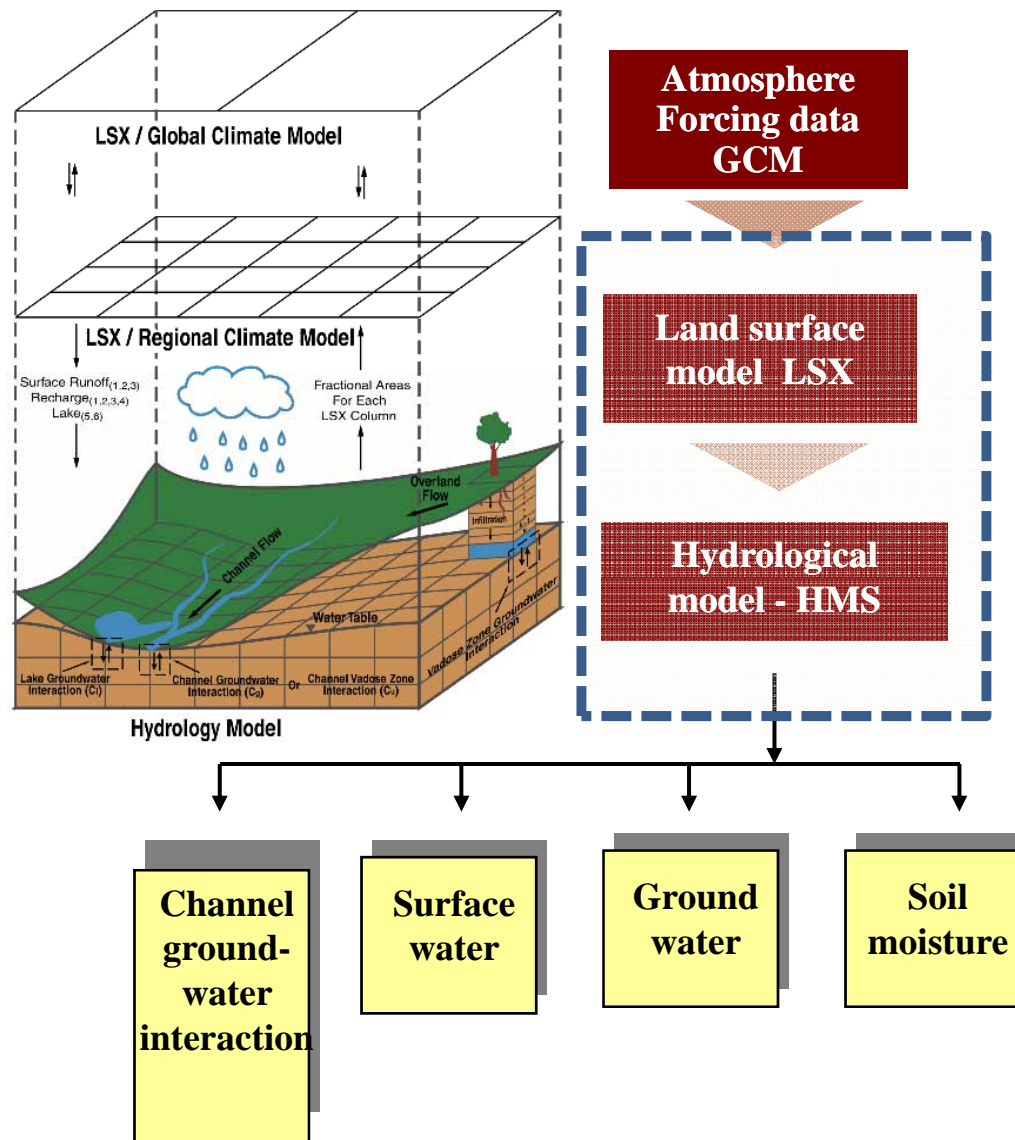
Research progress on AGCM – CAR System

Cloud-Aerosol-Radiation Modeling System

Developed by Liang Xin-Zhong and Zhang Feng



Land-Hydrological Model System

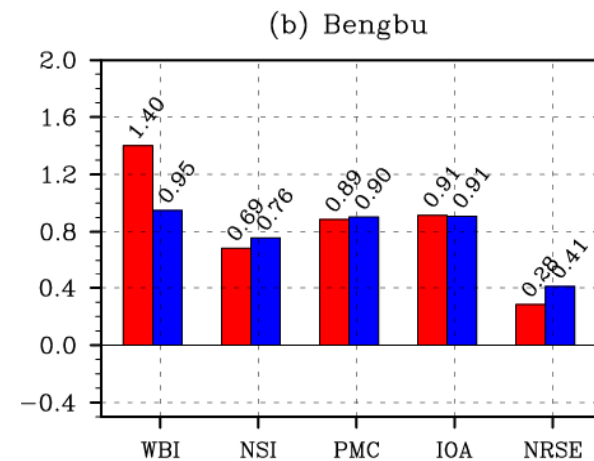
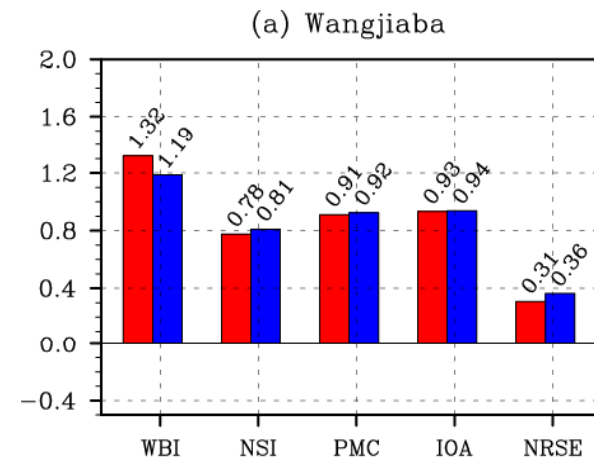
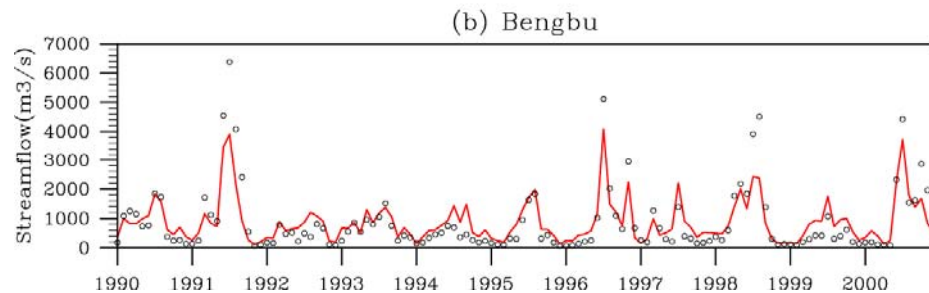
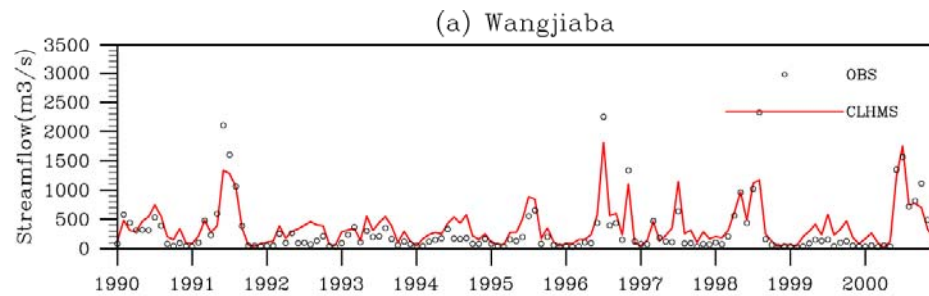
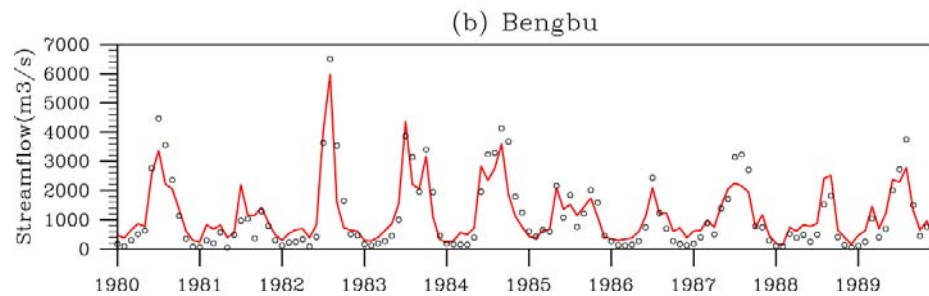
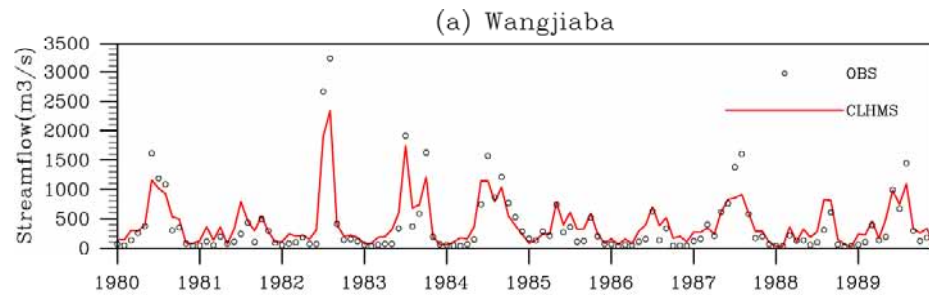


(Yu et al., 2006; Yang, Lin et al, 2010)

Forcing Data

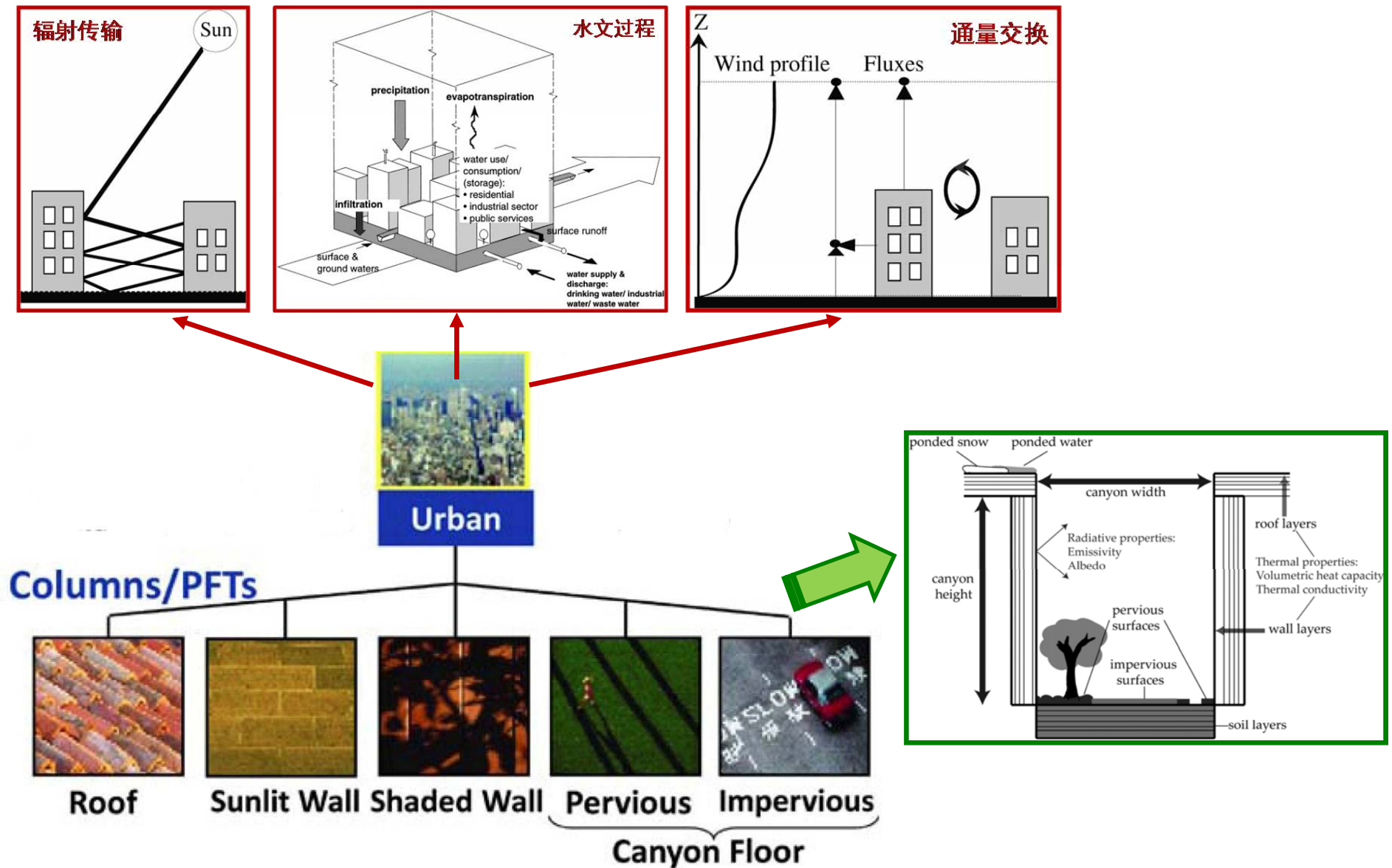
Variables	UNIT
2m temperature	K
2m humidity	Kg/Kg
Surface pressure	N/m ² (Pa)
Zonal wind	m/s
Meridional wind	m/s
Precipitation rate	Kg/ (m ² s)
cloud	-
Downward longwave radiative flux	W/ m ²
Visible beam downward solar flux	W/ m ²
Near IR beam downward solar flux	W/ m ²
Visible diffuse downward solar flux	W/ m ²
Near IR diffuse downward solar flux	W/ m ²

Validated with Natural streamflow



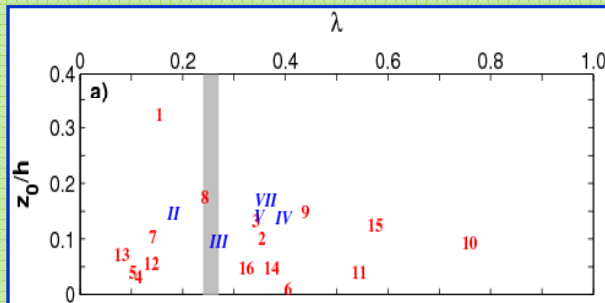
■ OBS ■ NTR

Introducing the Urban Canopy Model (UCM) in LSM

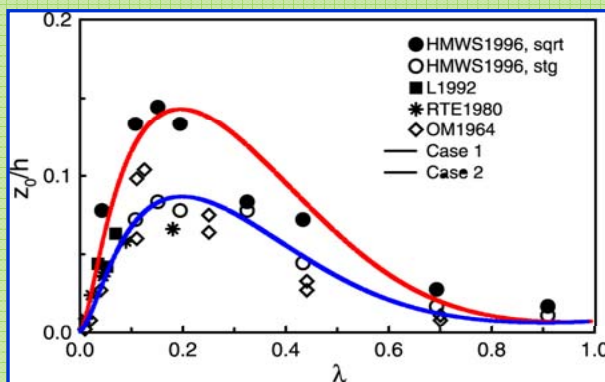


UCM development: A morphology-based roughness length parameterization for urban weather and climate modeling

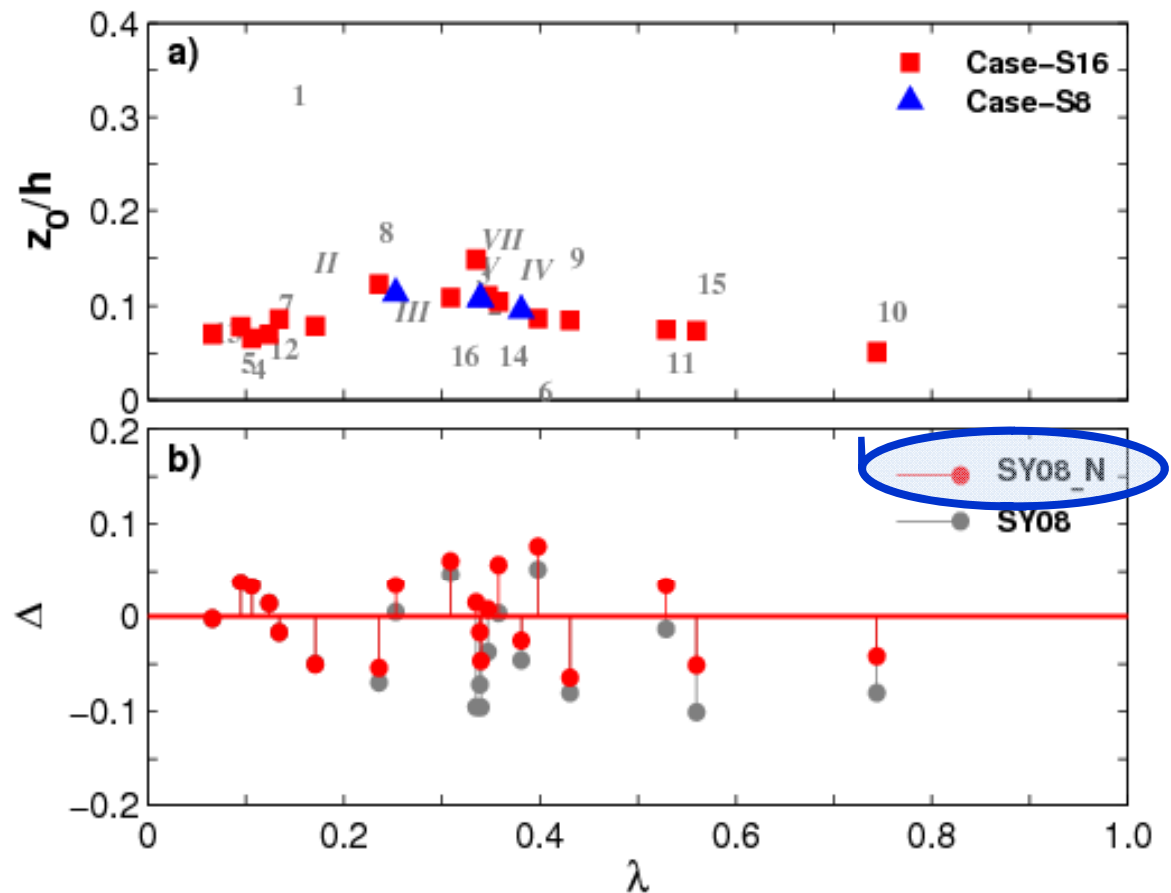
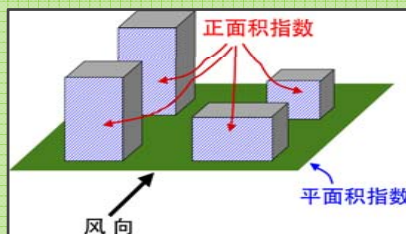
Observational basis



Theoretical scheme



Geometric parameters



$$z_0 = f(h, \lambda, \eta, \sigma_H)$$

高度 密度 覆盖度 高度变率

Development of IAP DGVM1.0

CLM-DGVM (Levis et al. 2004)

+Shrub Submodel

(Zeng et al. 2008; Zeng 2010)

+Fire Parameterization

(Li et al. 2012a; 2012b)

+Establishment Module

(Song 2012)

(Zeng et al. 2012, in prep; Li et al. 2012c, in prep)



Development of IAP DGVM1.0 – Establishment Module 1

Original Establishment Schemes (for woody vegetation)

Increment in Population density

Total Number of Saplings

Partitioning of Saplings

$$\Delta P_i = \left[\Delta P_{\max} \underbrace{(1 - e^{-5(1 - FPC_{\text{woody}})})}_{\text{shading effect}} \underbrace{(1 - FC_{\text{woody}})}_{\text{available area}} \right] \cdot \frac{g_i}{\sum_{k=1}^{n_{\text{est, woody}}} g_k}$$

$g_i = 1$

Same establishment for all PFTs

Major problems:

- Does not consider the different in establishment among PFTs
 - ✓ Saplings independent of PFT's current status (e.g., fractional coverage, productivity)
 - ✓ No difference in the relative establishment capability (competition-colonization trade-off)

Development of IAP DGVM1.0 – Establishment Module 2

New Scheme

- ✓ Number of saplings in proportion to PFT's fractional coverage
- ✓ Background establishment
- ✓ Mortality rates of saplings

$$\Delta P_i = [\Delta P_{\max} (1 - e^{-5(1-FC_{\text{woody}})})(1 - FC_{\text{woody}})] \cdot e^{-\gamma \cdot FC_{\text{woody}}} \cdot \frac{g_i}{\sum_{k=1}^{n_{\text{est}, \text{woody}}} g_k} \cdot (1 - \text{mortality})$$

shade tolerance

**Competition
among PFTs**

$$g_i = g_{i0} [\varepsilon_0 + (1 - \varepsilon_0) FC_i^{\frac{1}{2}}]$$

Relative
establishment
potential

Background
establishment

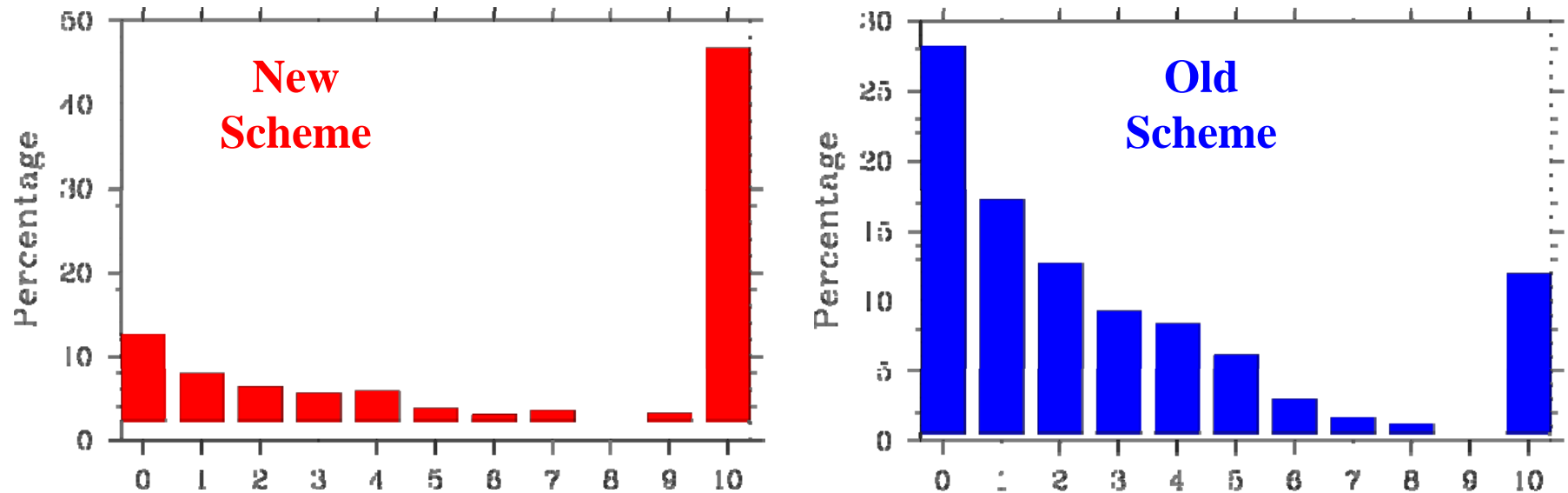
**Mortality rates
of saplings**

$$\text{mortality} = e^{-(\alpha \cdot \text{mort}_{\text{greff}} + \beta \cdot \text{mort}_{\text{heat}})}$$

background and heat
stress mortality of
mature individuals

Development of IAP DGVM1.0 – Establishment Module 3

Density distribution of tree crown area simulated by DGVM



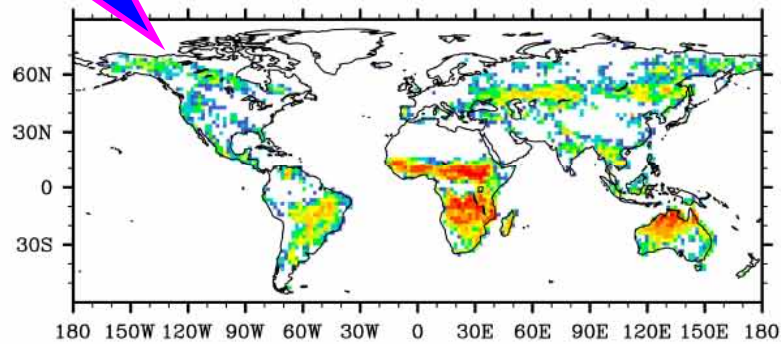
The old scheme underestimates tree crown areas, e.g., more than 80% of forest area grow trees with crown area less than 5m²;
This is significantly improved in the new Scheme.

Development of IAP DGVM1.0 – Fire Parameterization

OBS

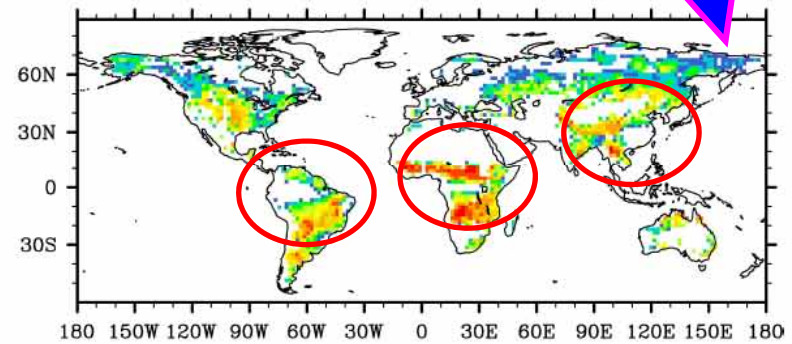
annual burned area fraction ($\% \text{ yr}^{-1}$)

GFED3

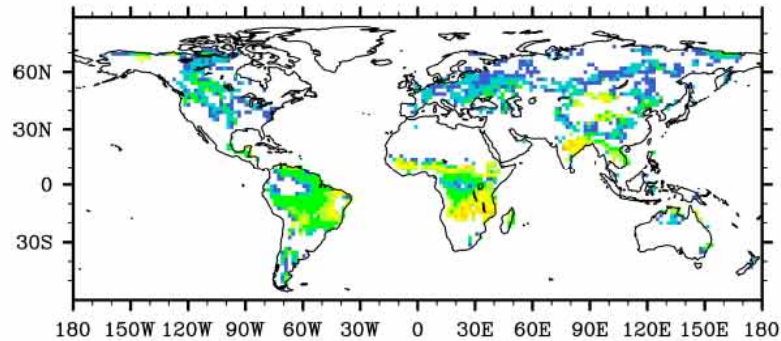


New

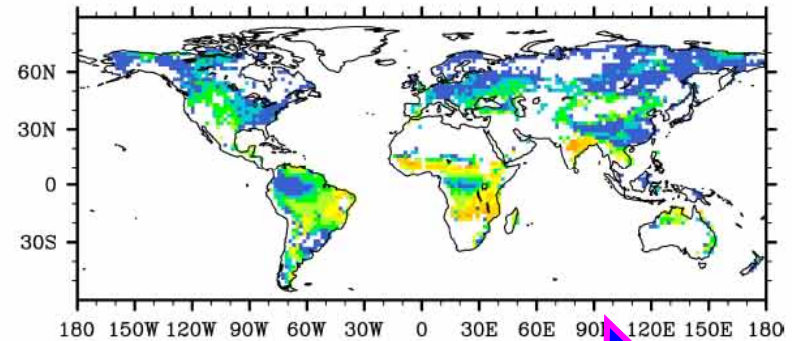
Mod-new (Cor=0.60)



Glob-FIRM (Cor=0.39)



Mod-old (Cor=0.44)



Default

Role of natural aerosols in climate system – sea salt and mineral dust aerosols

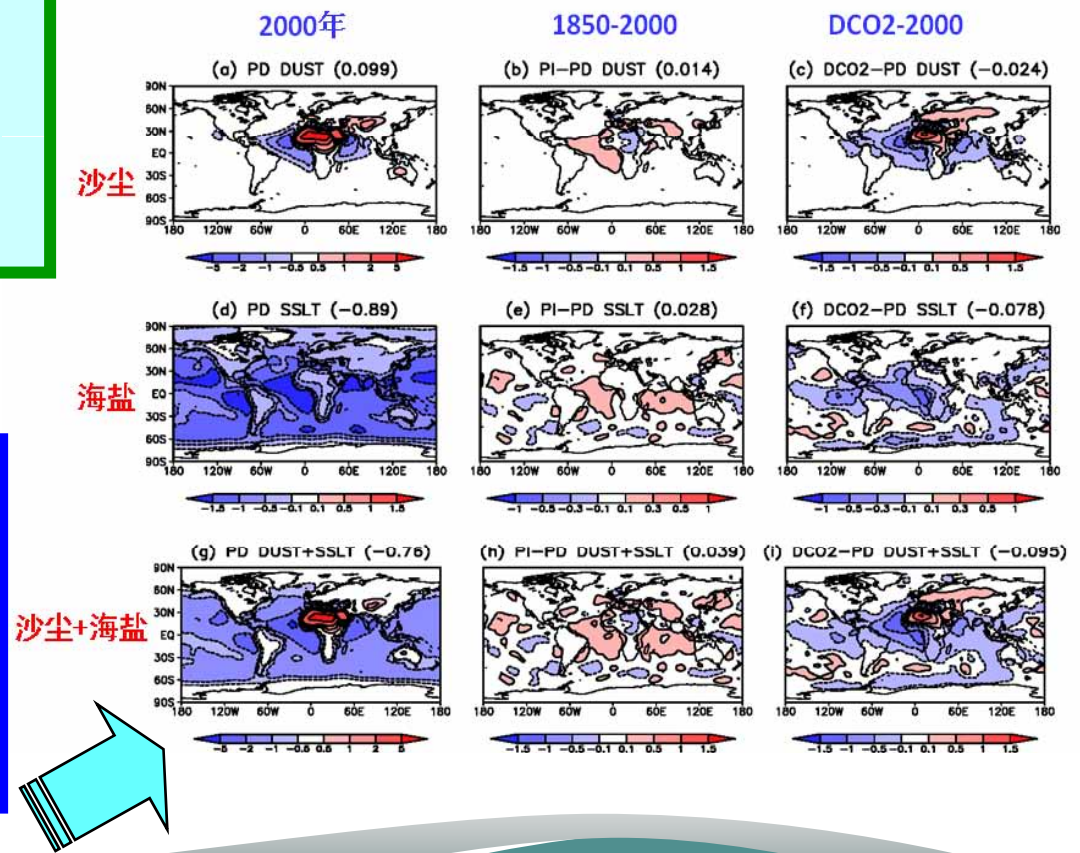
➤ Implemented a sea salt scheme in IAP mode, considering aerosol particles with diameter $\leq 10 \mu\text{m}$; simulated present-day global sea salt emission is 4253 Tg;

➤ Examined the climatic effect (longwave plus shortwave) of sea salt in present day and LGM.

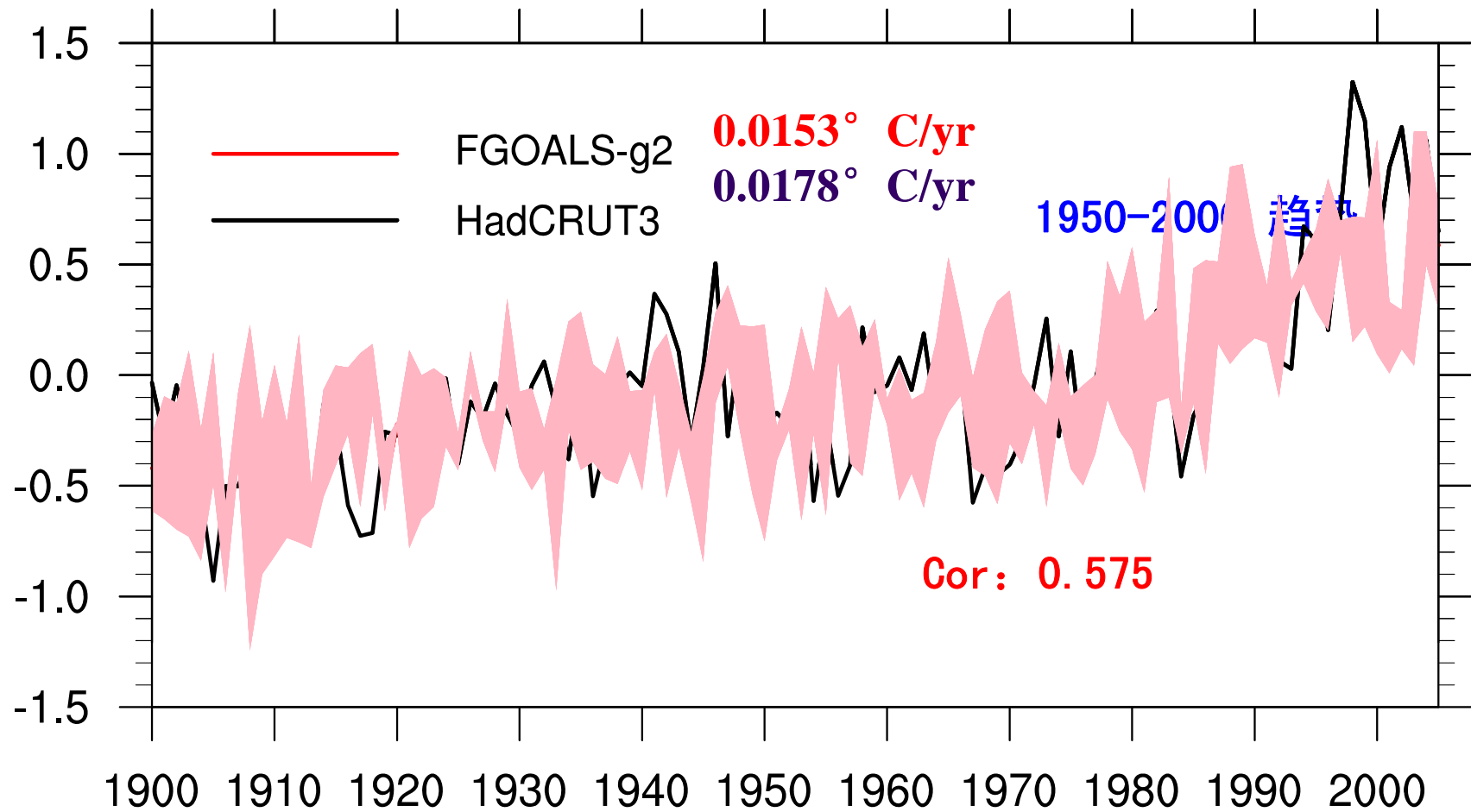
--(Yue and Liao, *Climate Dynamics*, 2012)

➤ From 1850 to the doubled CO_2 future atmosphere, changes in radiative forcing by sea salt and dust is estimated to be -0.13 W m^{-2} , which is smaller than the radiative forcing by anthropogenic aerosols.

Changes in radiative forcing by sea salt and mineral dust from 1850 to the doubled CO_2 future atmosphere

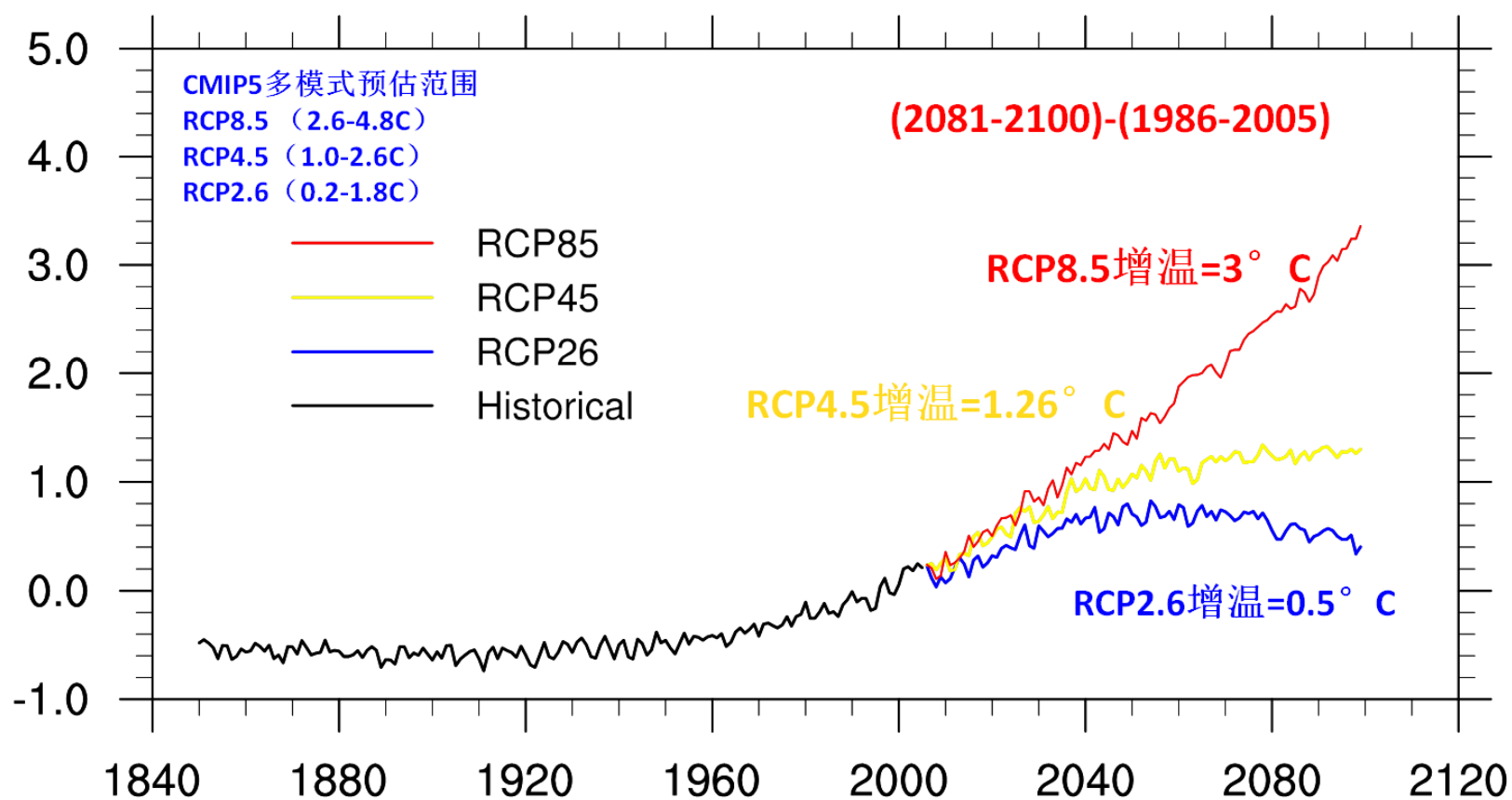


Model Applications: 20 Century simulation



Model Applications: Future climate change projection

Projection of future TAS change (RCP8.5、RCP4.5、RCP2.6)



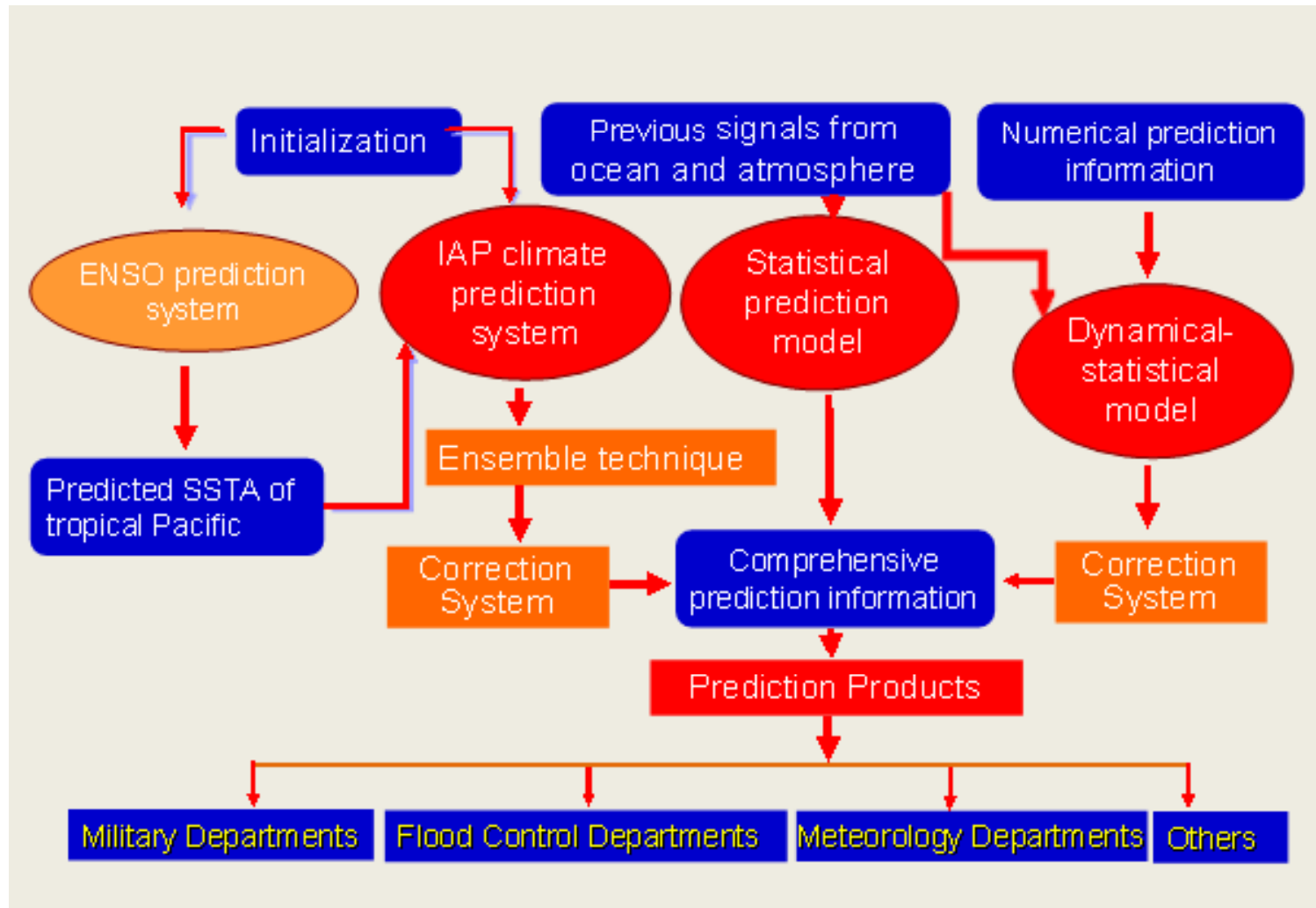
III. Current Research Progress



- Development of Dynamical Earth System Model and Its Applications
- Seasonal climate and hydrological forecast

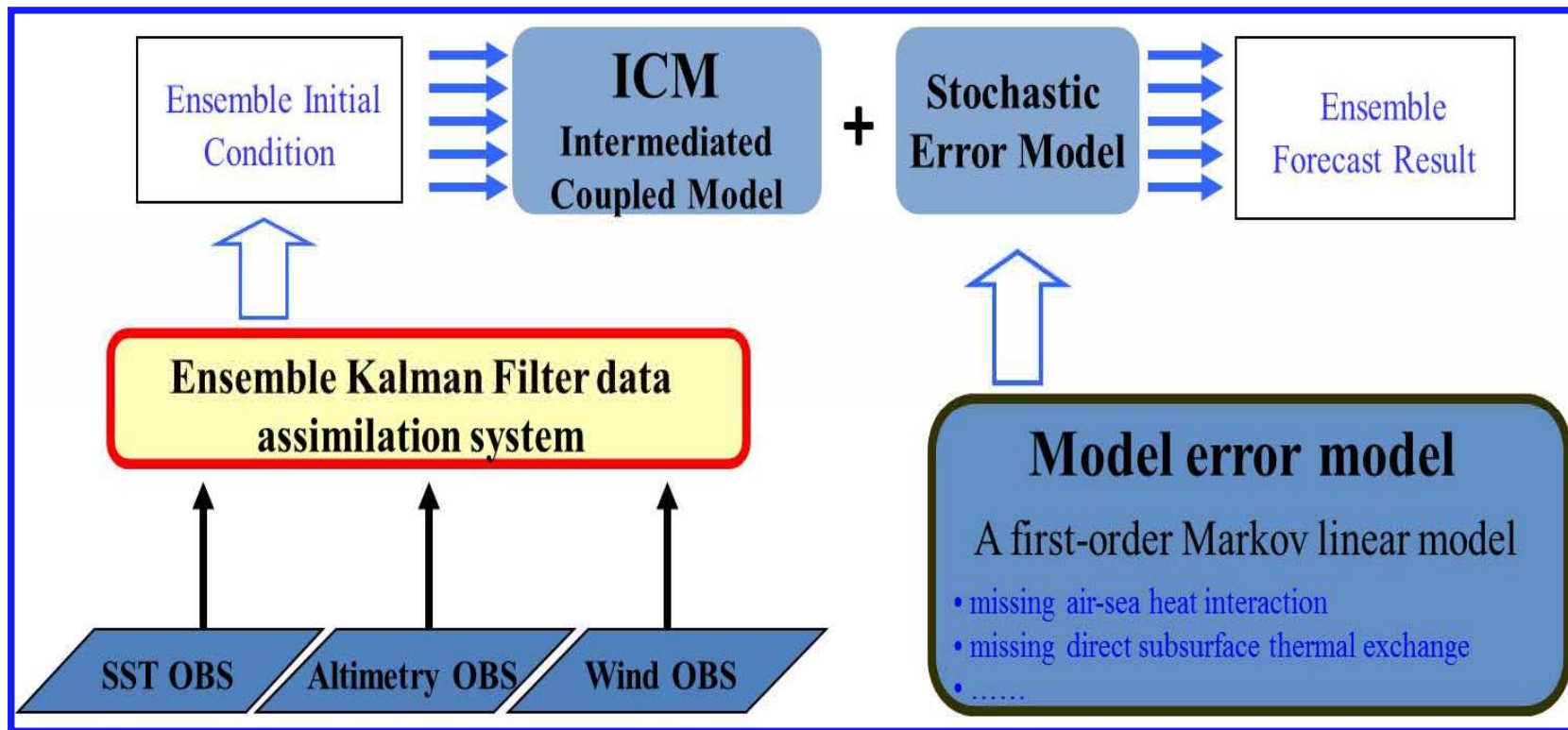


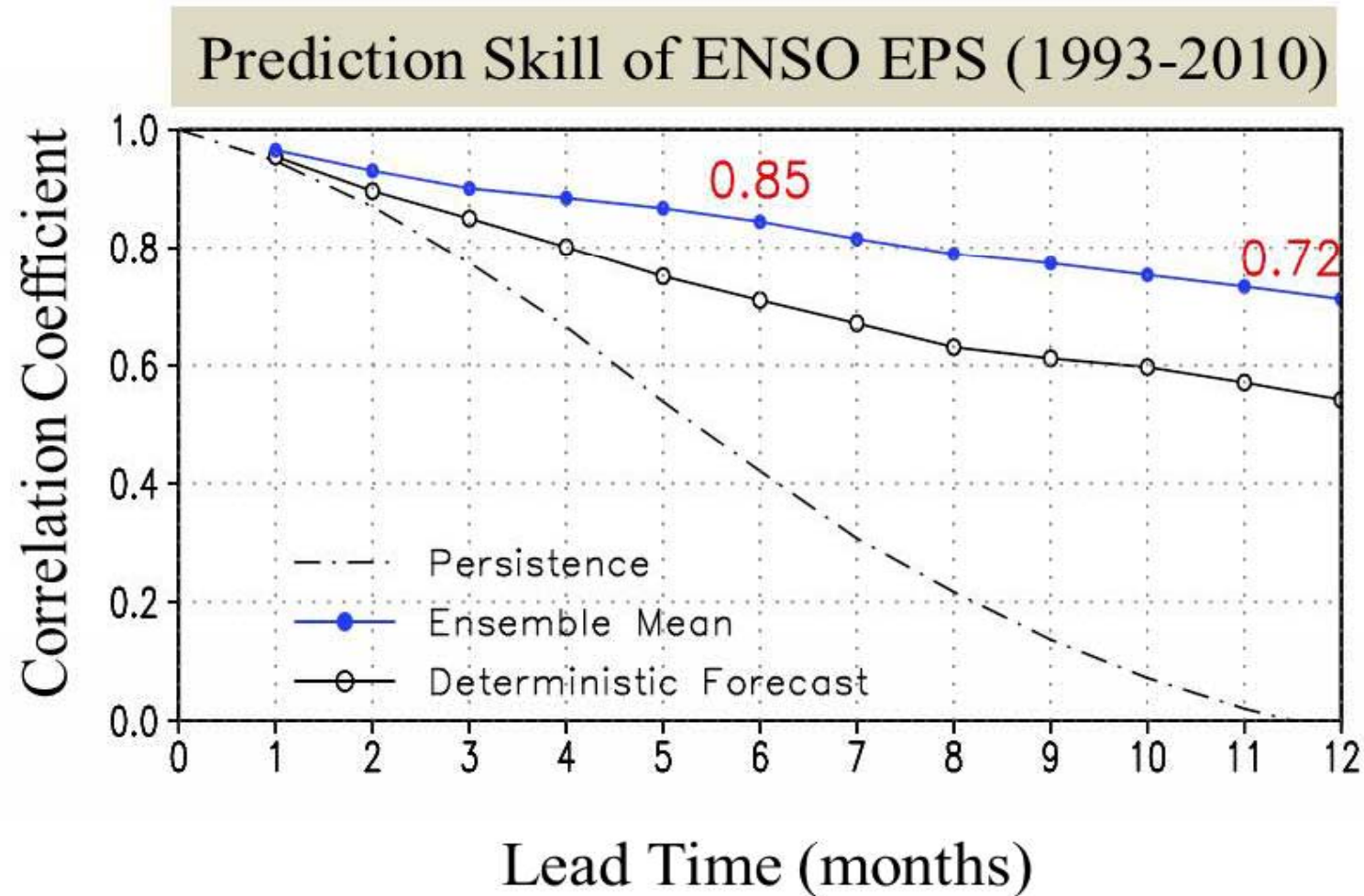
IAP Seasonal climate and hydrological Prediction System



Framework of IAP Seasonal to inter-annual Prediction System

IAP ENSO Ensemble Prediction System

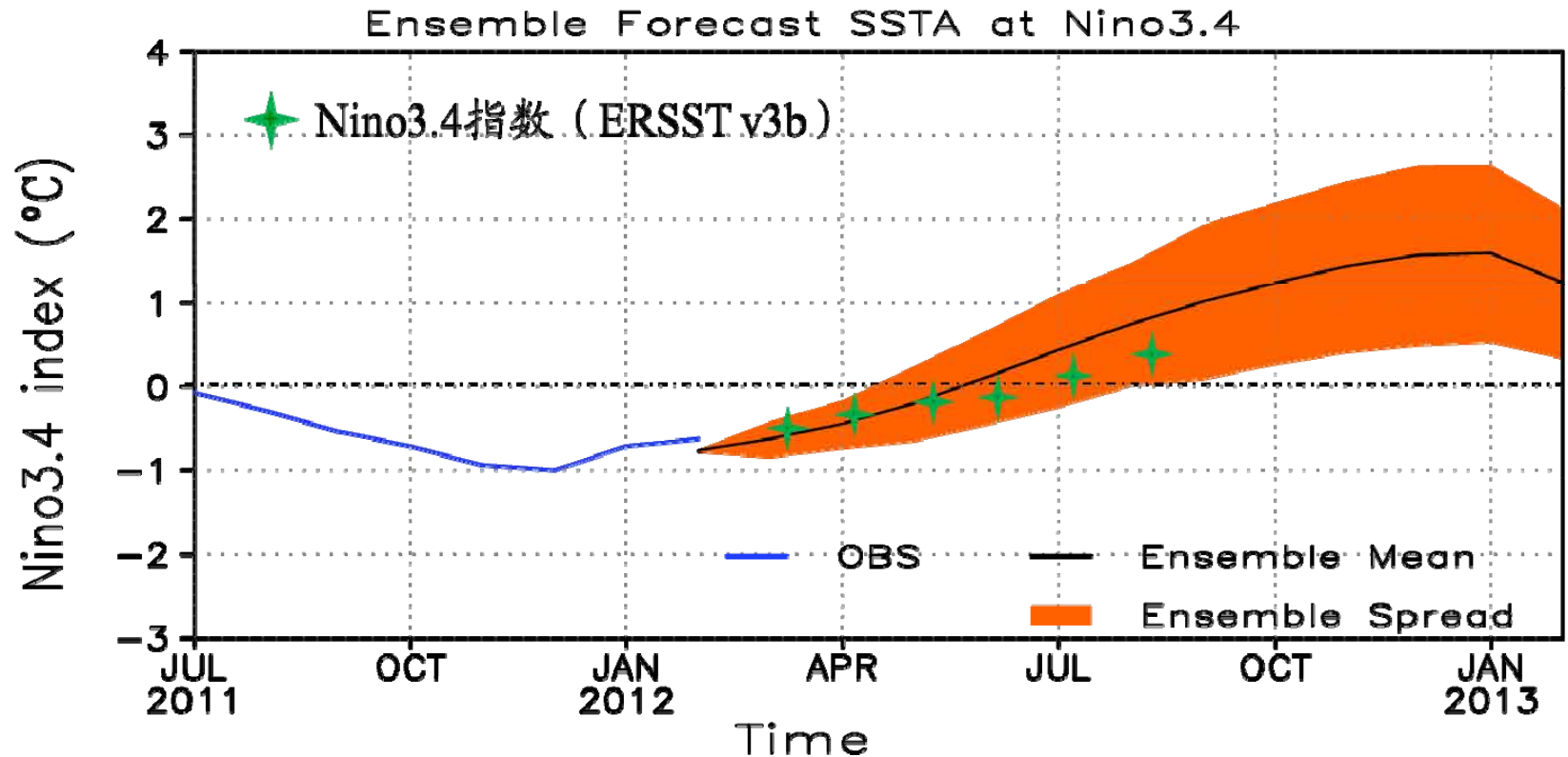




Prediction skills (anomaly correlation) of the Niño3.4 index for the ensemble-mean forecast, the deterministic forecast, and the persistence forecast as functions of lead time. Results are obtained from the ensemble/deterministic predictions made during the period from 1993 to 2010 regardless of starting month.



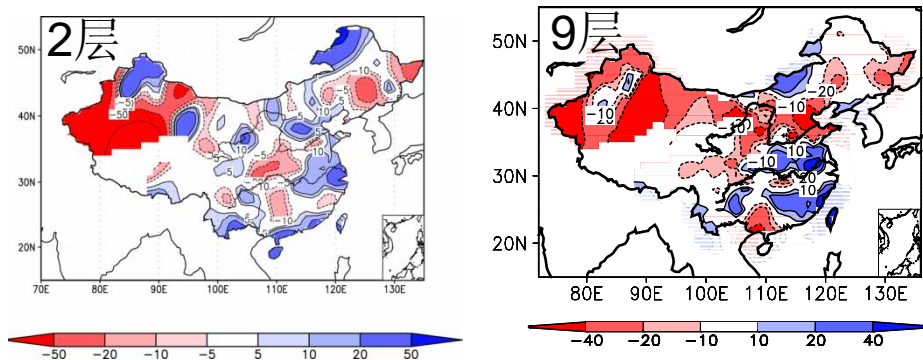
Updated prediction for 2012 – *Nino3.4 index*



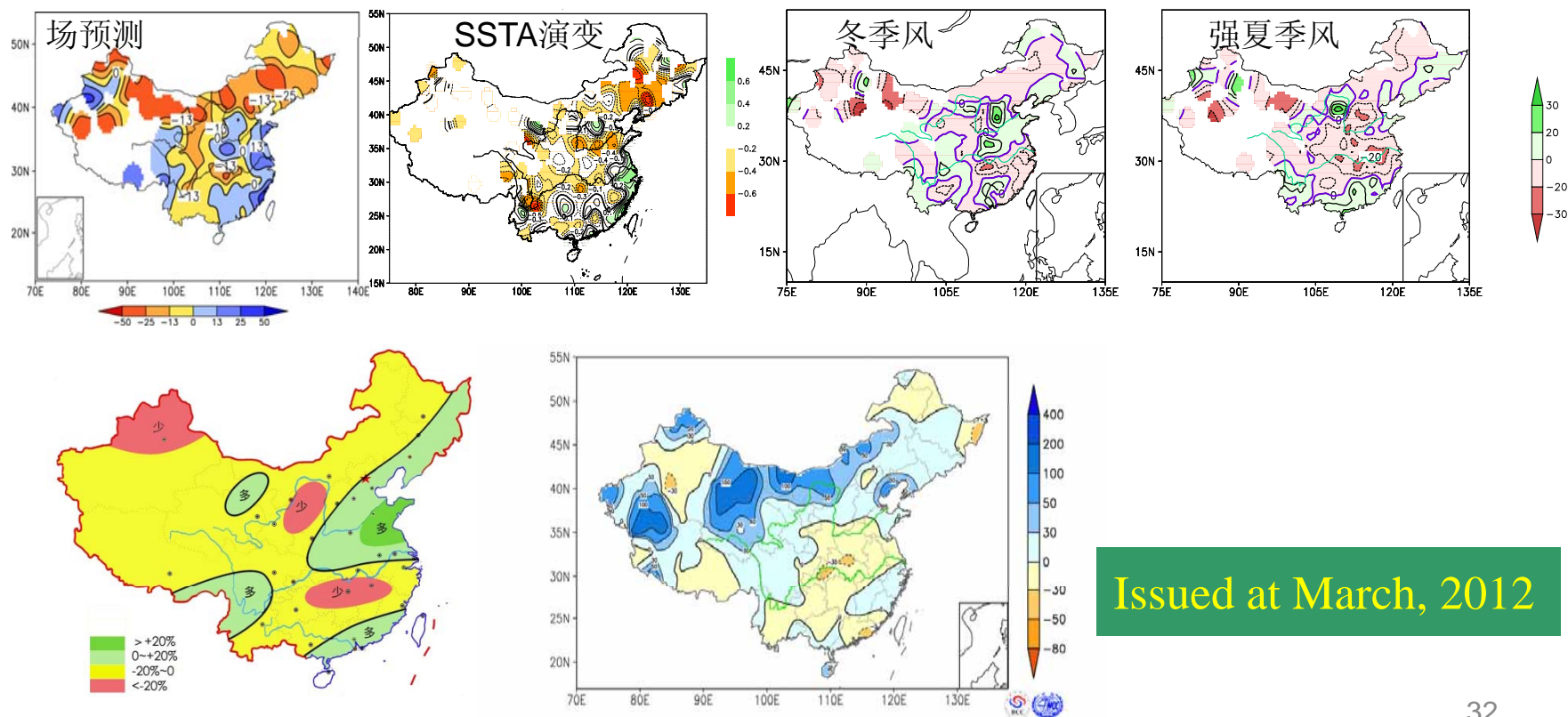
The decay of La Nina event during 2011-2012 has been well predicted by the IAP ENSO prediction system, along with the ending time of the La Nina event.

Real-time prediction of Summer rainfall anomalies over China (2012)

Model Forecast



Statistical Forecast



Issued at March, 2012

Research Outcome Distribution

- Series of News Letter of Climate Prediction



IV. International Cooperation



Statistics:

- ◆ More than **30** foreign experts visited ICCES in 2011.
- ◆ Research scientists from ICCES attended more than **20** international conferences.
- ◆ More than **70** experts from over **10** countries, mostly from developing countries attended 2012 CTWF workshop in Beijing.

2012 CTWF International Workshop



Theme: “Terrestrial Ecosystems under the Changing Climate”

More than **70** participants attended the 2012 CTWF, including **19** representatives from **10** overseas institutions and government departments.

Time: September 2-5, 2012

Venue: Beijing, China.



2012 CTWF International Workshop



12th CTWF Workshop on operational oceanography for developing countries,



12th CAS-TWAS-WMO Forum

International Workshop on Operational Oceanography for Developing Countries
September 9-12, 2013 Beijing

Welcome About CTWF Committees Important Dates Venue Visa Information Tour Information Contact Us

- Programme
- Invited Speakers
- Registration
- Payment
- Abstract Submission
- Hotel Reservation
- Useful Info

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Welcome

On behalf of the organizing committee, We would like to cordially invite you to the 12th CAS-TWAS-WMO Forum, the international workshop on operational oceanography for developing countries, which will be held in Beijing, China, September 9-12, 2013.

Operational oceanography is an emerging research field devoted to the science, technology and applications on observing and forecasting our oceans and seas. It is important for improving the safety and efficiency of maritime transport and marine operations; enabling the sustainable exploitation and management of ocean resources, such as fisheries; supporting safe and efficient offshore energy related activities; mitigating the effects of environmental hazards and pollution spills; contributing to ocean climate variability studies and seasonal-to-interannual climate prediction.

Despite the fact that developing countries are more vulnerable to hazards in ocean region due to lack of capacity in operational oceanography, marginal and coastal seas around developing countries are much less studied than these regions around developed countries. Some large developing countries such as China, India, Brazil and South Africa have been building their own operational ocean forecasting systems in recent years along with their fast economy growth. As a result, the operational oceanography community in these developing countries is growing at high rates. Therefore, it is time to create a dedicated forum for operational oceanographers from developing countries.

The 12th CAS-TWAS-WMO Forum, the *International workshop on operational oceanography for developing countries* will be a starting point to strengthen collaboration among all developing countries interested in operational oceanography by discussing common scientific and infrastructure issues.

The topics of the workshop include:

- Demands, Current Services and Challenges
- Capability Building
- Ocean Observations
- Modelling and Data Assimilation
- Operational Forecast: from short-range to ENSO

The international workshop on operational oceanography for developing countries, is sponsored by CAS-TWAS-WMO Forum, and will be organized by International Center for Climate and Environment Sciences (ICCES), Institute of Atmospheric Physics (IAP), Chinese Academy of Sciences (CAS).

We wish you all a pleasant stay and a fruitful meeting in Beijing. Looking forward to meeting you all.

Local Organizing Committee

Time: Sep 9-12., 2013

Venue: Beijing

<http://2013ctwf-icces.csp.escience.cn>

More scientists from developing
countries are welcome to attend the
workshop

International Training Workshop on Extreme Events



International Training workshop on
"Extreme weather and climate events: detection, monitoring, prediction and risk management for developing countries"
14-23, July 2013 Beijing, China

Overview Programme Committees Sponsorship Important Dates Venue Visa Information Contact Us

Registration
Financial Support
Abstract Submission
Invited Speakers
Hotel Reservation
Useful Info

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Workshop Theme:
Extreme weather and climate events: detection, monitoring, prediction and risk management for developing countries

Workshop Objective:
The extreme weather and climate event is one of the most severe natural disasters, and can affect all sectors of the economy and the environment, including human health and well-beings. There is scientific evidence that a warming climate will be accompanied by changes in the intensity, duration, frequency, and geographic extent of weather and climate extremes, and future changes in extremes associated with global warming will present additional challenges.

In order to reduce the adverse impact of those extreme events, many international and domestic efforts have been taken in monitoring and forecasting such events. Moreover, all countries in the world have been making great efforts to improve their monitoring, forecasting, warning and risk management systems.

However, although all countries have made great effective efforts in reducing the vulnerability to weather and climate extremes, we are still confronting with many challenges to reduce weather and climate-induced disasters. Especially for developing countries, due to the insufficient innovative research capability, and the lack of capacity to detect, monitor and predict the extreme events and to manage the risk related with extreme events, they are much more vulnerable to those extremes.

In order to enhance the capacity building for developing countries to tackle with the extreme weather and climate events, the international training workshop titled: "Extreme weather and climate events: detection, monitoring, prediction and risk management for developing countries" will be organized. The international renowned scientists from both developed and developing countries will be invited to deliver lectures related with extreme events, and share their experience with the participants mostly from the developing countries, in coping with the extremes from detection, monitoring, predicting and managing the risk, and finally to foster the sustainable development in developing countries.

Topics:
• Observation of extreme events and its detection

orkshop.csp.escience.cn/dct/page/70005

Topics:

- Observation of extreme events and its detection
- Monitoring and prediction of extreme events
- Risk management of extreme events

Time: July 14-23., 2013

Visit our website: <http://icces-trainingworkshop.csp.escience.cn>

More young scientists from developing countries are welcome to attend the training workshop

THANK YOU !

Prof. Dr. Zhaohui Lin

Director of ICCES

Email: lzh@mail.iap.ac.cn

<http://www.icces.ac.cn>

