Annual Report of ICCES

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I. ICCES Brief Introduction

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

- **Center Organization**

  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)

- CAS Strategic Priority Research Program - Climate Change: Carbon Budget and Relevant Issues" of the Chinese Academy of Sciences”
- National Basic Research Program of China (973)
- The National High Technology Research and Development Program (863)
- National Science and Technology Support Program of China
- The Special funds for Meteorology scientific research on public cause
- 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)
• 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)

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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

Climate System Model

Land Surface Model

AGCM

OGCM & Sea Ice

Internal Coupling

External Coupling

Ecological / Environmental System Model

DGVM

Terrestrial BGC

Aerosol / Atmospheric Chemistry Model

Ocean BGC

Internal Coupling
Discretization: finite-difference at uniform lat-lon grids
Resolution: $1.4^\circ\text{(lat)} \times 1.4^\circ\text{(lon)} \times 26L$ (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

DJF precipitation in Nino3.4 region

- corr = 0.95

Annual Cycle

Unified monsoon index in East Asia

- corr = 0.98
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)

An two-level nested model system

Sea level anomaly (m)

1/20°  1/5°  1/3°
SST and its gradient simulated by the high resolution model of HYCOM for the China coast

TEMP (unit: deg)

01-Mar-2008

(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:

- **Soil Hydrologic Model (SHM)**
- **Terrestrial Hydrologic Model (THM)**
- **Groundwater Hydrologic Model (GHM)**
- **Channel-Groundwater Interaction Model (CGI)**
Streamflow simulation in Bengbu station

Bengbu station

- Observed
- Simulated at 10×10 km resolution
- Simulated at 20×20 km resolution

Streamflow (m³ s⁻¹)

Time (month)

Global Distribution of Shrub

Temperate Shrub

Boreal Shrub

Simulation

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

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

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

Mean ACC: -0.05 → 0.19

Mean ACC: 0.07 → 0.11
Real-time prediction (2009)

Prediction for percentage of rainfall anomalies by dynamical and statistical models

Drought over most part of west China
Positive rainfall anomaly over Yangtze-Huaihe River
Real-time prediction (2010)

Statistical model-1
Prediction for percentage of rainfall anomalies by dynamical and statistical models

Observation
Positive rainfall anomaly over Yangtze River

IAP2L
IAP9L
III. Current Research Progress

Data Assimilation
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.
Evaluation of AIPOCean1.0

Indonesian throughflow (ITF) transport

<table>
<thead>
<tr>
<th></th>
<th>Obs.</th>
<th>AIPOcean 1.0</th>
<th>ECCO</th>
<th>SODA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Annual Mean Inflow</td>
<td>13Sv</td>
<td>11.9Sv</td>
<td>10.2Sv</td>
<td>8.2Sv</td>
</tr>
<tr>
<td>Annual mean Outflow</td>
<td>15Sv</td>
<td>14.5Sv</td>
<td>11.7Sv</td>
<td>14.2Sv</td>
</tr>
</tbody>
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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 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)
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-temporal patterns of dry and wet spells and agricultural drought characteristics over China.
Preliminary Applications in Drought Monitoring over China
III. Current Research Progress

Monsoon and Climate Dynamics
Rainfall: wet over southern and drought over northern
The composite summer rainfall anomaly percentage in China during ENSO years(%)
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)
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

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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:
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!