CMIP5 in China

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4. Beijing Normal University
5. First Institute of Oceanography

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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

<table>
<thead>
<tr>
<th>Group Name</th>
<th>Institution</th>
<th>Model Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>LASG-CESS</td>
<td>Institute of Atmospheric Physics, Chinese Academy of Sciences; Tsinghua University</td>
<td>FGOALS_g2.0</td>
</tr>
<tr>
<td>LASG</td>
<td>Institute of Atmospheric Physics, Chinese Academy of Sciences</td>
<td>FGOALS_s2.0</td>
</tr>
<tr>
<td>BCC</td>
<td>Beijing Climate Center</td>
<td>BCC-CSM 1.1</td>
</tr>
<tr>
<td>BNU</td>
<td>Beijing Normal University</td>
<td>BNU-ESM</td>
</tr>
<tr>
<td>FIO</td>
<td>First Institute of Oceanography</td>
<td>FIO-ESM1.0</td>
</tr>
</tbody>
</table>
Flexible Global Ocean-Atmosphere-Land System Model, Grid-point Version 2.0 (FGOALS_g2.0)

Ocean
- LICOM 2.0 (360×196 L30)
- CICE4_LASG (360×196 L4)

Atmosphere
- GAMIL 2.0 (128×60 L26)

Land
- CLM3 (128×60 L10+5)
Flexible Global Ocean-Atmosphere-Land System Model, Spectral Version 2.0 (FGOALS_s2.0)
Beijing Climate Center Climate System Model  
(BCC_CSM)

Ocean

MOM 4  
(L40v2 (1/3°))

Atmosphere

CPL6  
(NCAR)

BCC_AGCM 2.1  
(T42)

BCC_AGCM 2.2  
(T106)

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)

Ocean

MOM4p1 (360×200 L50)

Atmosphere

CAM 3.5 (T42L26)

Sea-ice

CICE4.1 (360×200)

Land

CoLM+BNUDGVM (C/N) (T42L10+5)
First Institute of Oceanography-Earth System Model
Version 1.0 (FIO-ESM 1.0)

Atmosphere

CAM 3.5
(128×64 L26)

Ocean

POP 2.0
(320×384 L40)

Surface Wave

MASNUM
Wave Model
(191×81)

Sea-ice

CICE4
(320×384 L5)

Land

CLM3
(128×64 L10+5)
## Completed CMIP5 Experiments

<table>
<thead>
<tr>
<th>Model</th>
<th>Core</th>
<th>Ter. 1</th>
<th>Ter. 2</th>
<th>Ter. 3</th>
<th>Decadal Prediction (core)</th>
</tr>
</thead>
<tbody>
<tr>
<td>FGOALS_g2.0</td>
<td>all</td>
<td>some</td>
<td>a few</td>
<td></td>
<td>all</td>
</tr>
<tr>
<td>FGOALS_s2.0</td>
<td>all</td>
<td>some</td>
<td></td>
<td></td>
<td>all</td>
</tr>
<tr>
<td>BCC-CSM1.0</td>
<td>all</td>
<td>some</td>
<td></td>
<td></td>
<td>all</td>
</tr>
<tr>
<td>BNU-ESM</td>
<td>some</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FIO-ESM1.0</td>
<td>some</td>
<td>some</td>
<td></td>
<td></td>
<td></td>
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</tbody>
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◆ Issues in FGOALS_g2.0
Spin-up in 4 China coupled models

(Global Mean SST)
Annual cycle in Equatorial Pacific Ocean (5S-5N)

20th Century

FIO-ESM1.0

FGOALS_g2.0

BNU-ESM

FGOALS_s2.0

Observation

Sea surface temperature

Month
Nino3.4 over 20th Century

FIO-ESM1.0

Observation

BNU-ESM
20th Century: Surface Temperature

![Graph showing temperature changes over time for different simulations and ensemble models.](image-url)
The 20th century global CO2 concentration simulated by BCC_CSM1.1

(a) CO2 Emission (GtC/yr)

(b) CO2 Concentration (ppmv)

(c) Surface air temperature
Global Surface Temperature

Centurial Projection

FGOALS_g2.0

3°C

FGOALS_s2.0

5°C

BCC-CSM1.2

3.4°C

FIO-ESM1.0

RCP85

RCP26

Historical run

17°
Decadal prediction

Correlations between hindcasts and observation

(Decadal mean SST)
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Global Surface Temperature

Atlantic Meridional Overturning Circulation (AMOC)

Centurial Projection

FGOALS_g2.0

RCP85
RCP45
RCP26
Historical
Control
1%pCO2 and 4CO2 experiments by FGOALS_g2.0
ENSO in FGOALS_g2.0 and other models

CMIP5

Period (yrs)

L_y (° latitude)

Capotondi et al. (2006); Deser et al. (2011)

Period ➔ freq of max spectral power of Niño3.4 SST
L_y ➔ width of zonal wind stress anomalies
ENSO in FGOALS_g2.0 and other models

Period (yrs)

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

$L_y$ → width of zonal wind stress anomalies

Capotondi et al. (2006); Deser et al. (2011)
CFMIP

MJO in GAMIL 2.0

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

OBS

GAMIL1.0-AR4

GAMIL2.0-AR5

1980-1999: Nov to Apr (obs)

1980-1999: Nov to Apr (gamil1)

1980-1997: Nov to Apr (gamil2)

OLR (shaded) and 850hPa wind (vector)
CFMIP

Cloud Fraction in GAMIL 2.0

Total

Low-level

Middle-level

High-level
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

Observation

GAMIL 2.0
Cloud ice in GAMIL 2.0

Observation

Gettelman et al., 2010, JGR
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Low resolution in FGOALS_g2.0

<table>
<thead>
<tr>
<th>Component</th>
<th>Resolution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Atmosphere</td>
<td>128×60 L26</td>
</tr>
<tr>
<td>Ocean</td>
<td>360×196 L30</td>
</tr>
<tr>
<td>Land Surface</td>
<td>128×60 L10+5</td>
</tr>
<tr>
<td>Sea Ice</td>
<td>360×196 L4</td>
</tr>
</tbody>
</table>
Double ITCZ in FGOALS_g2.0

Annual mean precipitation

hist_r440_v55 (yrs 569-598)

Precipitation rate mean = 2.82 mm/day

ANN

Min = 0.05 Max = 11.32

XIE-ARKIN

Precipitation rate mean = 2.69 mm/day

ANN

Min = 0.03 Max = 11.39

hist_r440_v55 - XIE-ARKIN

mean = 0.13 rmse = 1.14 mm/day

ANN

Min = -5.59 Max = 7.24

test-49-1.3 (yrs 1979-1997)

Precipitation rate mean = 2.66 mm/day

ANN

Min = 0.08 Max = 29.48

test-49-1.3 - XIE-ARKIN

mean = 0.17 rmse = 1.36 mm/day

ANN

Min = -6.18 Max = 24.01

CMIP-FGOALS_g2.0

AMIP-GAMIL2.0
Short-wave Cloud Forcing

CMIP-FGOALS_g2.0

CMIP-FGOALS_g2.0

AMIP-GAMIL2.0

AMIP-GAMIL2.0
Bias in Snow simulation

Snow over North Hemisphere Land

Snow height

Fractional snow cover

Snow water Equivalent

- **Run01 (20th Century)**
- **USAF**
- **CMC/NOAA-AVHRR**
Weak seasonal variation in North Hemisphere
Overestimation in South Hemisphere

Sea ice extent

(Dunne and Stouffer, 2011)
Thank you