The Use of RegCM_NCC in Seasonal Prediction over China

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Outline

- Model Introduction
- Seasonal Experiment Design
- General Assessment of Model Results
- Seasonal Forecast Experiments
- Summary

Model Introduction

- **RegCM_NCC**

One research result of the "95" National Key Project"Studies on short-term climate prediction system for China"

- **Model Base:**

NCAR/RegCM2 (1996)

- **Achievements:**

1. **Landuse data**
2. **Land-surface scheme**
3. **Radiation and cumulus convective scheme**
4. **New schemes of terrain dispose and PBL**
5. **Three dimensional nesting**
6. **Model pre- and post-process**

Physics of RegCM_NCC

Physics	NCC/RegCM2	*RegCM_NCC*
Land-surface	1. BATS	2. *LPM(Zhang, Shi)*
Cumulus Convective	1. Kuo－Anthes 2. Grell	3. *MFS (Liu)* 4. *Betts－Miller (Zhai)*
Rad. Trans.	1. CCM2	2. *CCM3 (Yi)*
PBL	1. Non-Holtslag 2. Holtslag	3-6. *TKE (Miao et al.)* (various fomula)

Note: the underlined are the schemes used for the seasonal experiments

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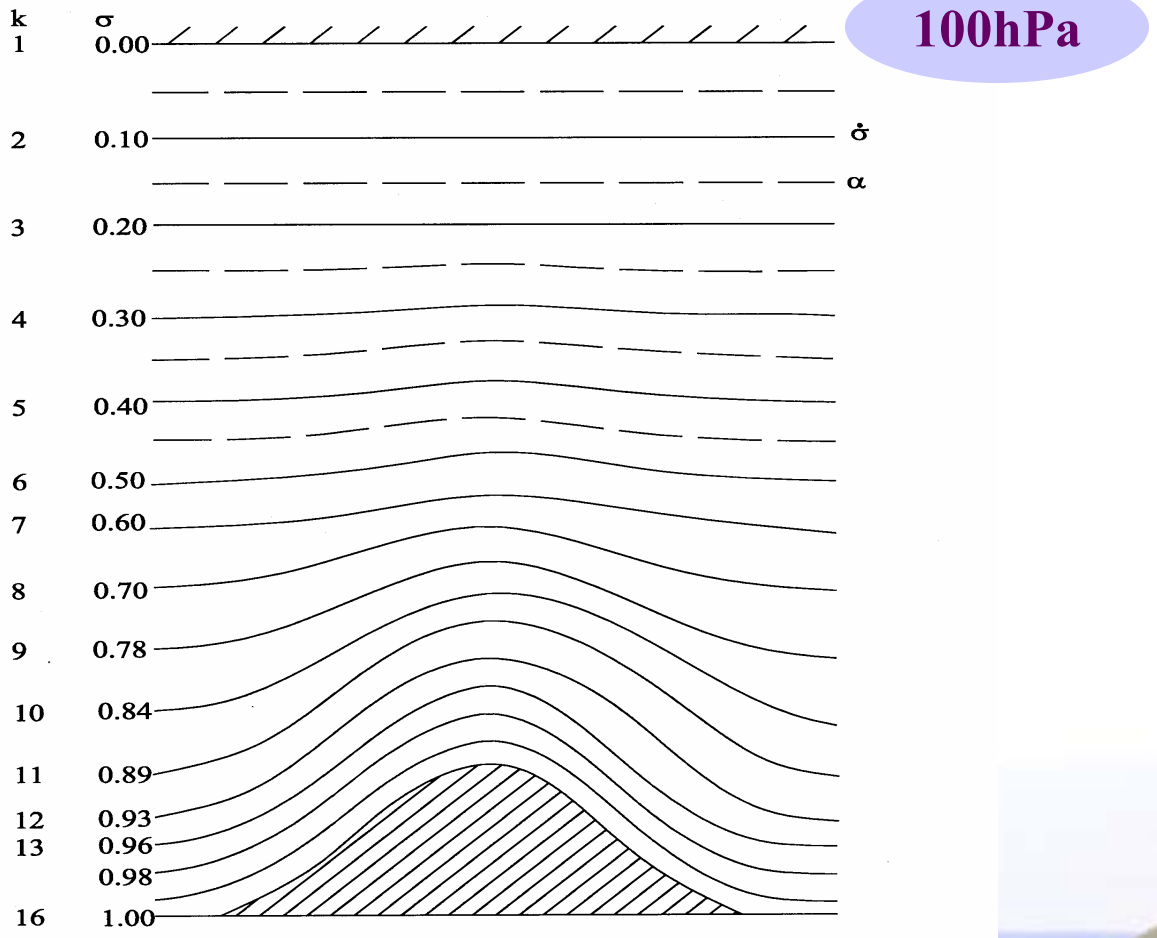
Vertical Structure



模式垂直网格结构。变量σ̇ 定义在整模式层上，
以α表示的其他变量定义在半模式层上。

Terrain height of the Model Domain

Model: RegCM_NCC

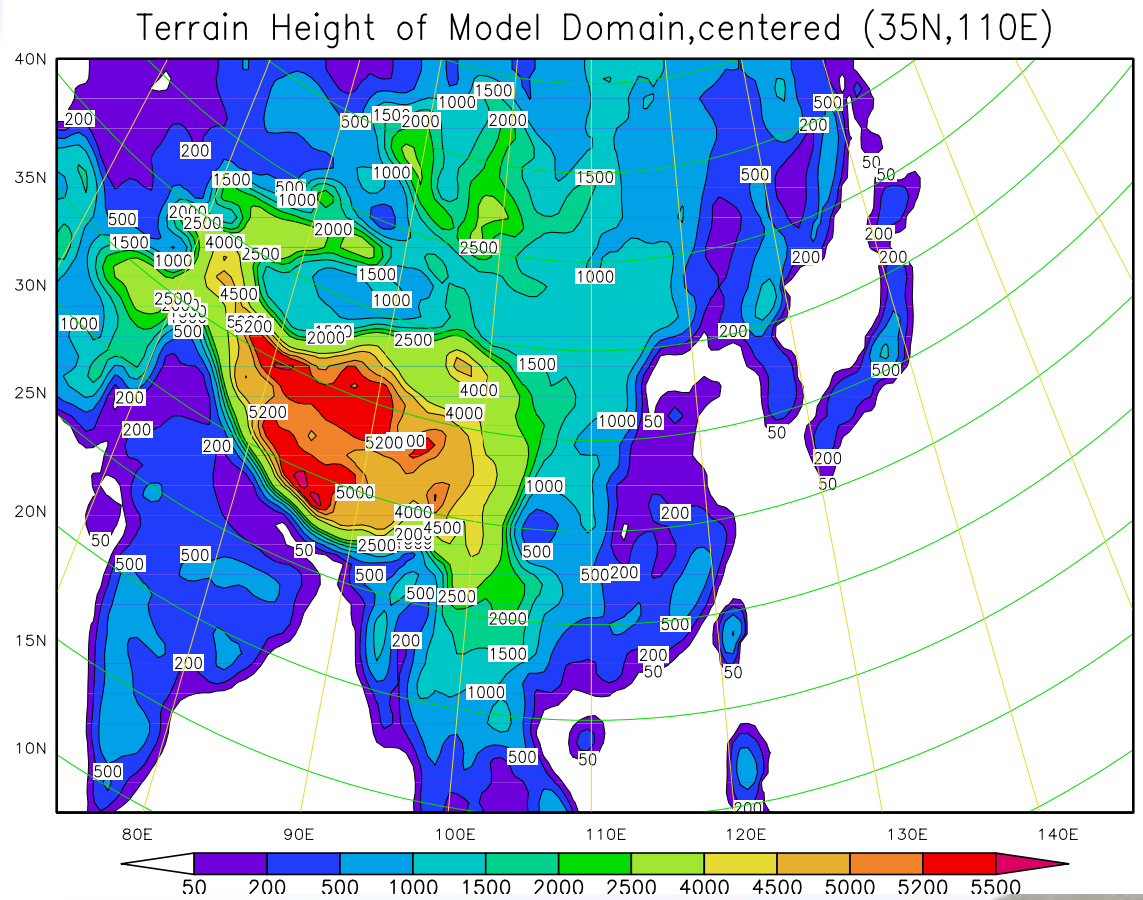
Physics:

BATS, MFS,CCM3 rad., Hostlag PBL

Resolution:60km

Grids:79×151 ×16

LB Update: 12hr



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Operational Routine of RegCM_NCC

Large-scale Data
（Model Output or Observation）

for Necessary variables

Model Pre-process

Initial&Boundary Conditions

RegCM_NCC running

Variables on σ-level

Model Post-process

Rainfall over 160 stations
Variables on p-level

Data Prepare

Pre-process

Model Run

Post-process

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Large-scale Data

For Operation: Summer (JJA) and Winter (DJF)

- CGCM(T63L16/T63L30) forecast results integrated from 17th Feb. and Oct. respectively

For Simulation and Hindcast:

- Summer of 1991-2000
- CGCM Hindcasts (from 17th Feb.)
  - → Model Hindcast <for model climatology>

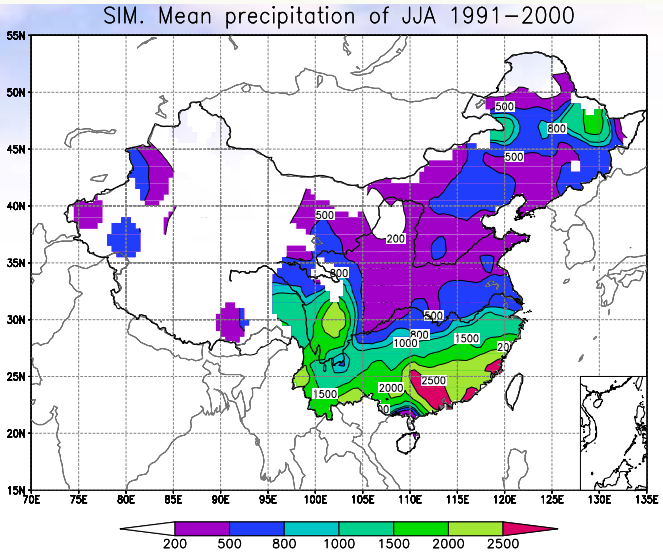
NCEP/Reanalysis and OISST

→ Model Simulation

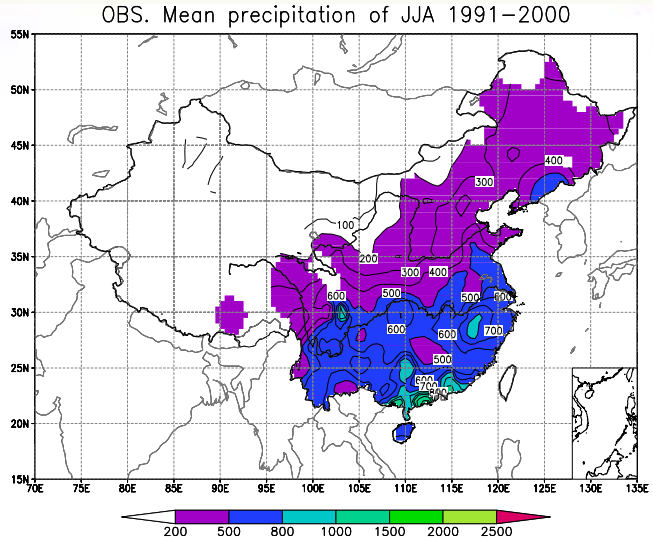
General Assessments of RegCM_NCC

- Mean climatology
- Statistical Diagnostic

Mean JJA Precipitation over China

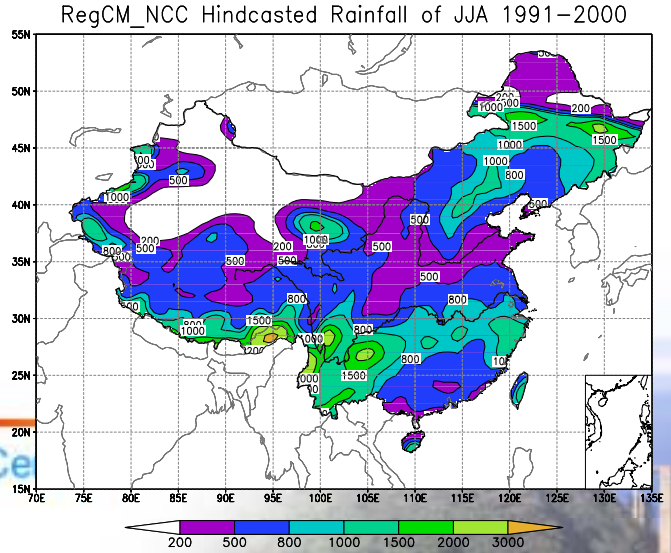


Simulation



Observation

Hindcast



Spatial pattern：

Decrease northwesterly，

Overestimate rainfall

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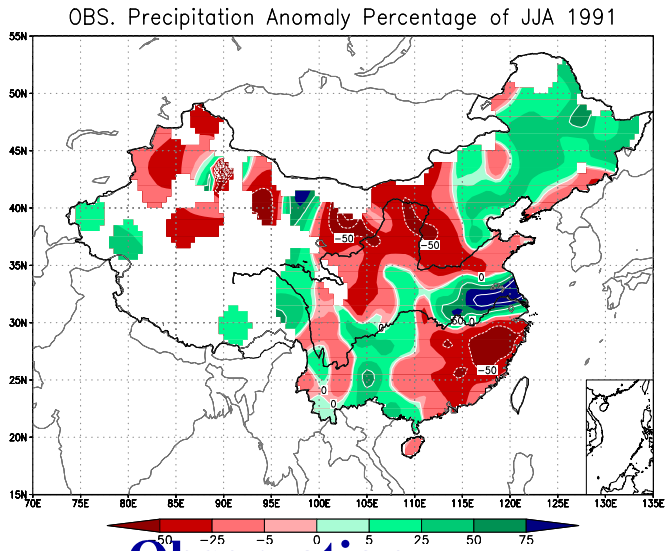
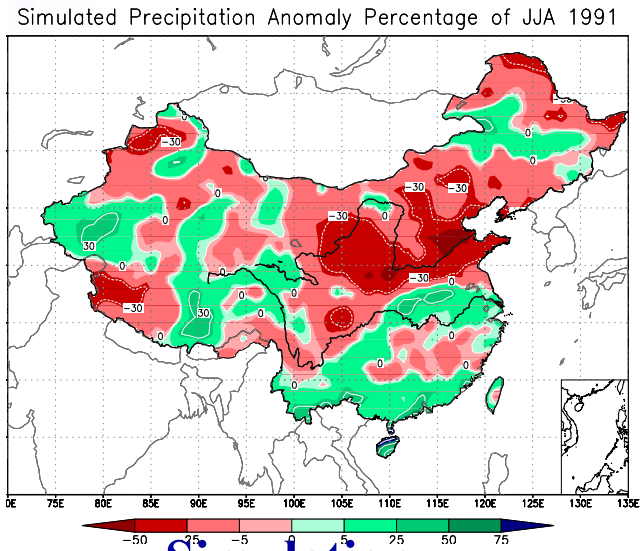
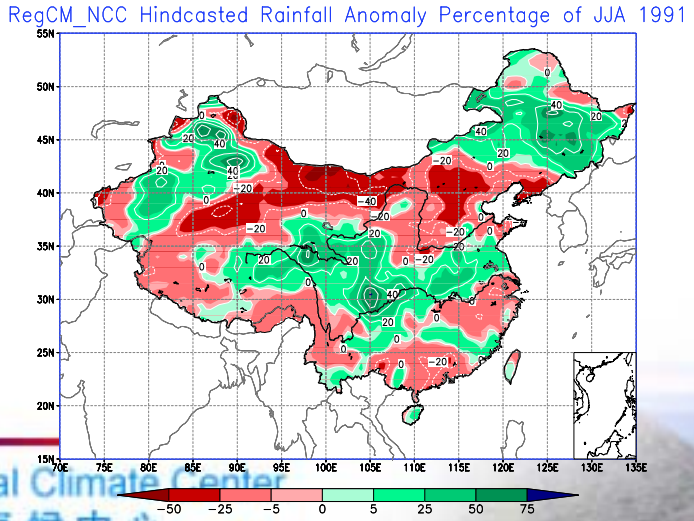
Summer rainfall anomaly of 1991 (%)



Observation



Simulation



Hindcast

Better regions：

Above normal: The mid-lower reach of Yangtze River Valley, part of the NE China;

Below Normal: the North China

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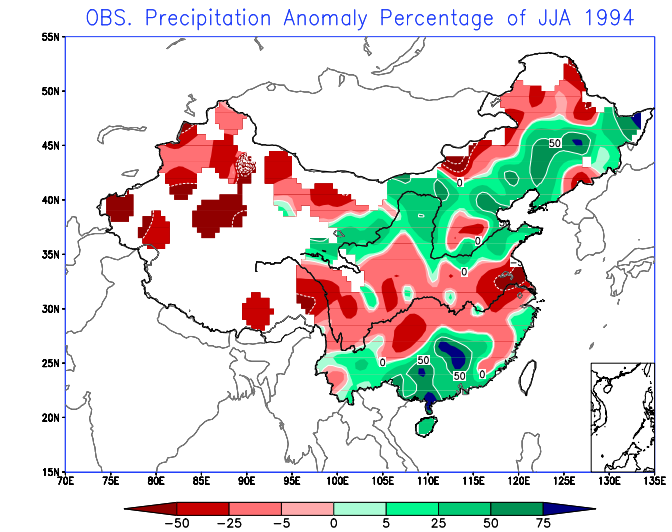
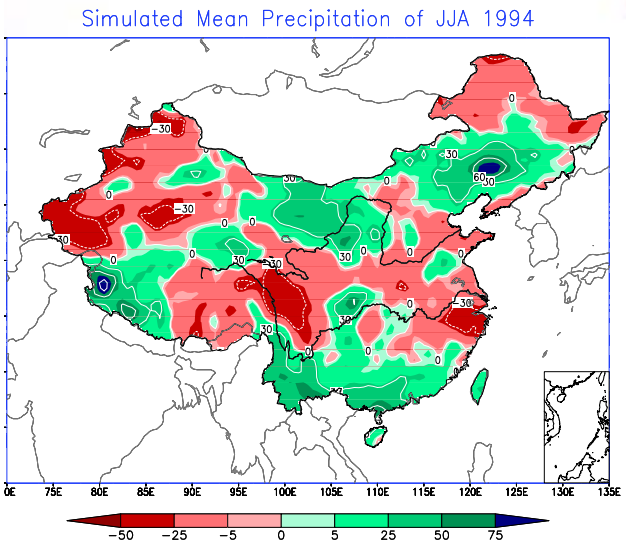
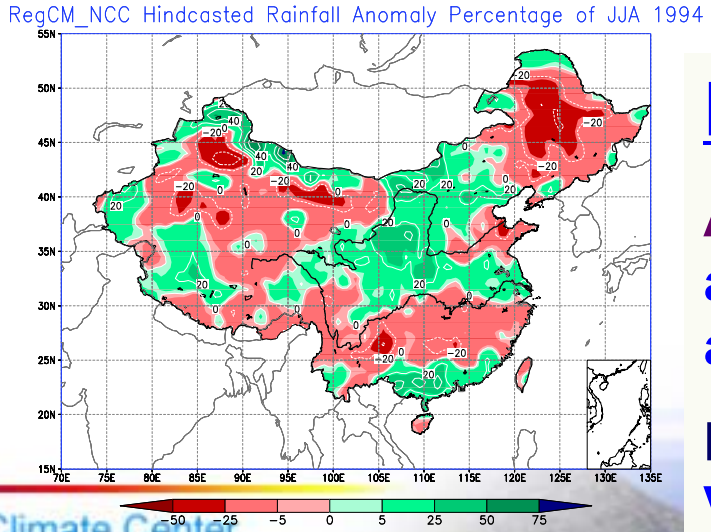
Summer rainfall anomaly of 1994 (%)



Observation



Simulation



Hindcast

Better regions：

Above normal: The South China, and some regions in North China and NE China;

Below Normal: the Yangtze River Valley, the West China

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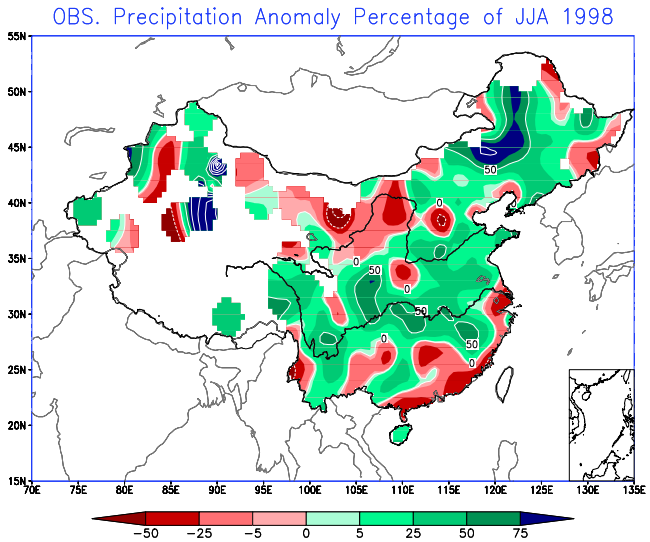
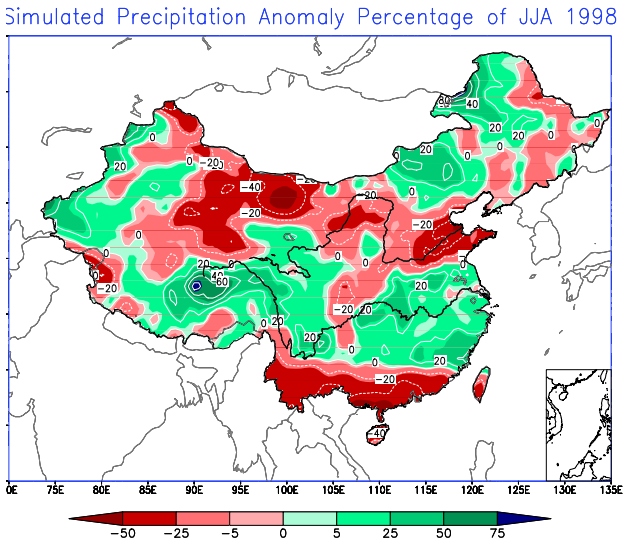
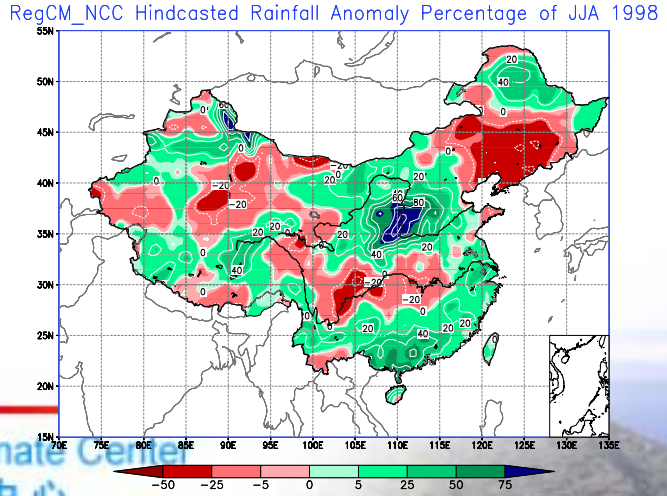
Summer rainfall anomaly of 1998 (%)



Observation



Simulation



Hindcast

Better regions：

Above normal: The Yangtze River Valley and regions south to the Yangtze River Valley;

Below Normal: the South China, the Inner Mongolia

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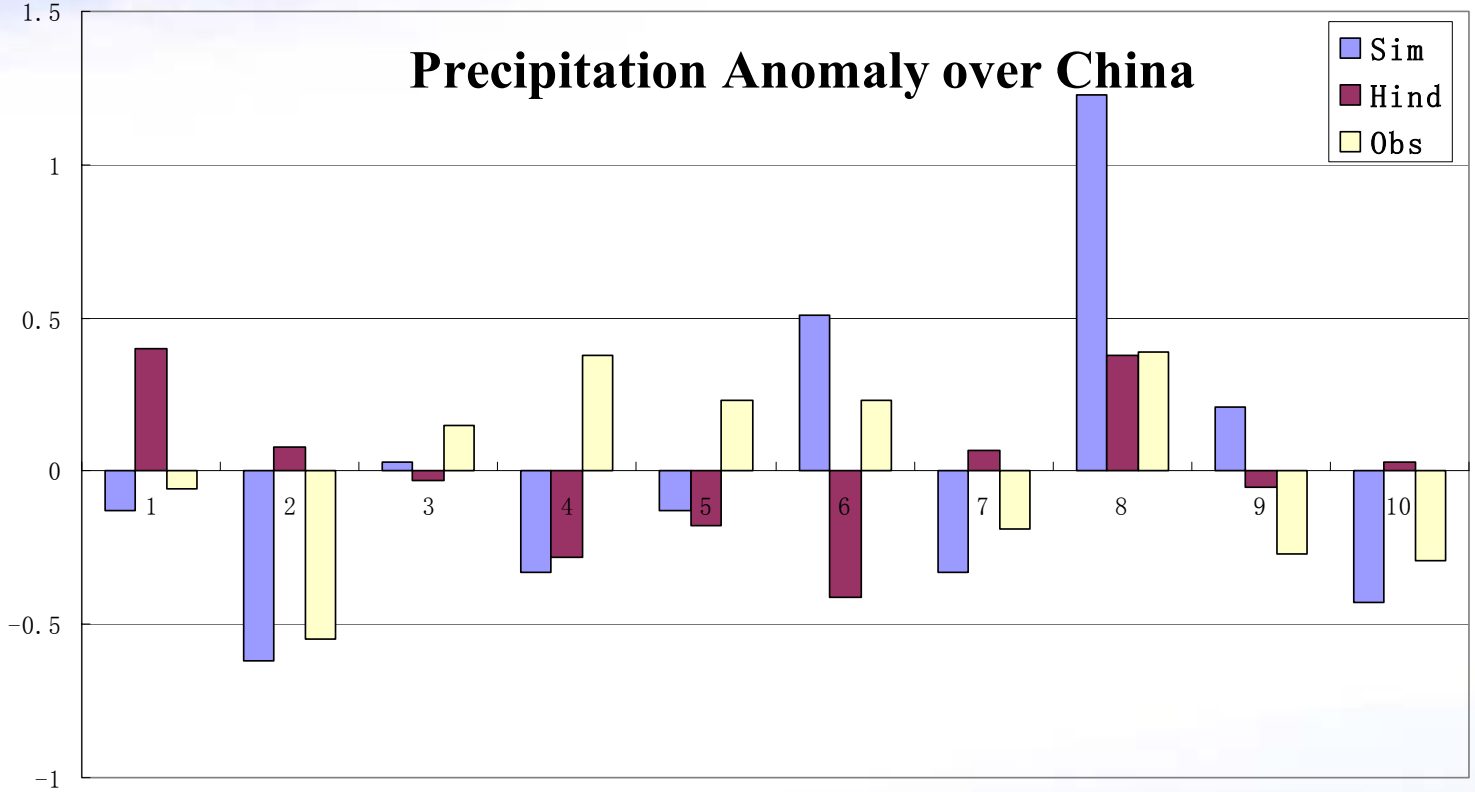
Interannual Variability of Precipitation Anomaly



Simulations better than hindcasts;

Overestimate rainfall anomaly

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Statistical Assessment methods

- **Five Assessment Methods**
  - a. **Anomaly correlation coefficient (ACC)**
  - b. **Forecast score (Pc)**
  - c. **Skill score 1 (SS1, for random forecast)**
  - d. **Skill score 2 (SS2,for climate forecast)**
  - e. **Anomalous climate score (Ts)**
- **Predicted/Sim. Prec. Anomaly Percentage:** **(Pp-Pc)/Pc×100%**

Pp: P of the prediction year

Pc: Mean P of the other 9 years in 1991-2000

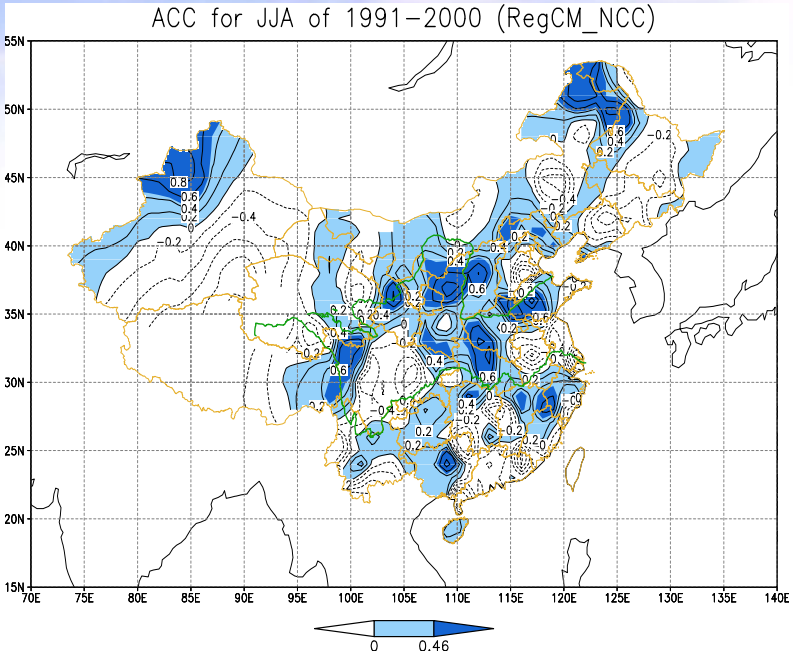
- **Observed Prec. Anomaly Percentage:** **(Po-Poc)/Poc×100%**

Po: observed P of 160 stations

Poc: Mean P of 160 stations in 1971-2000

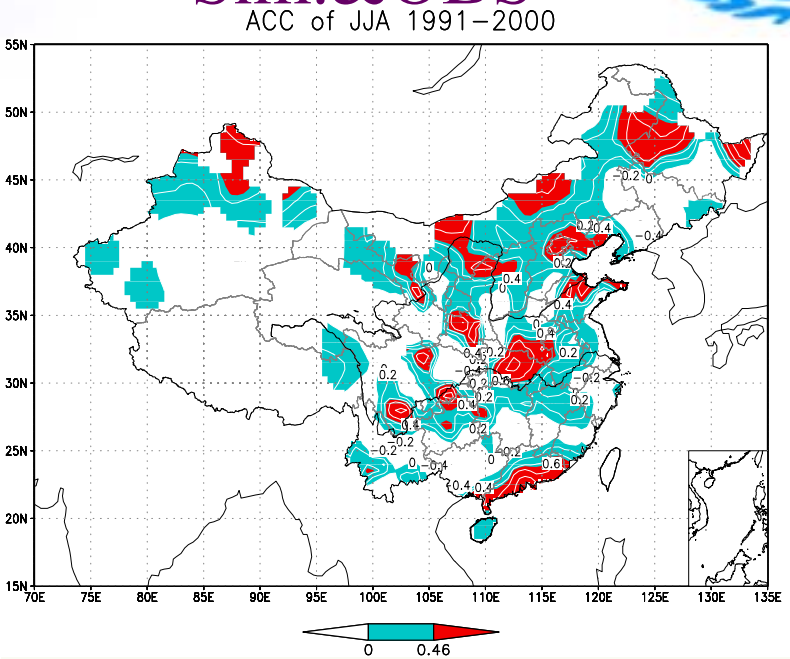
Spatial distribution of ACC

Hind.&OBS



- northern part of NE China,
- Inner-Mongolia, Big Bend of Yellow River,
- Western part of Xinjiang,
- regions to the south of the Yangtze River

Sim.&OBS



- northern and western part of NE China,
- Inner-Mongolia, and Big Bend of Yellow River,
- regions to the south of the Yangtze River
- between the huaihe and yellow river valley
- South china

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Shaded : Positive Area, dark shaded --- higher than the 90% confidence level

Detailed Assessments of RegCM_NCC hindcast

year	Pc	SS1	SS2	ACC	Ts
1991	61.50	0.02	0.17	0.00	0.14
1992	63.49	-0.02	0.14	0.05	0.14
1993	66.49	0.07	0.21	-0.02	0.18
1994	63.69	0.04	0.19	0.04	0.15
1995	62.90	-0.02	0.14	-0.07	0.13
1996	56.42	-0.12	0.05	0.00	0.11
1997	72.54	0.22	0.34	0.19	0.26
1998	56.04	-0.11	0.06	-0.05	0.13
1999	58.79	-0.12	0.05	0.04	0.14
2000	74.87	0.29	0.40	0.33	0.20
ave	63.67	0.025	0.175	0.051	0.158
Ave in NCC	67.9	-0.03	0.08	0.02	0.08

Mostly higher than the AVE NCC

Sub-regions in China

West China（40stations）: to the west of 105E

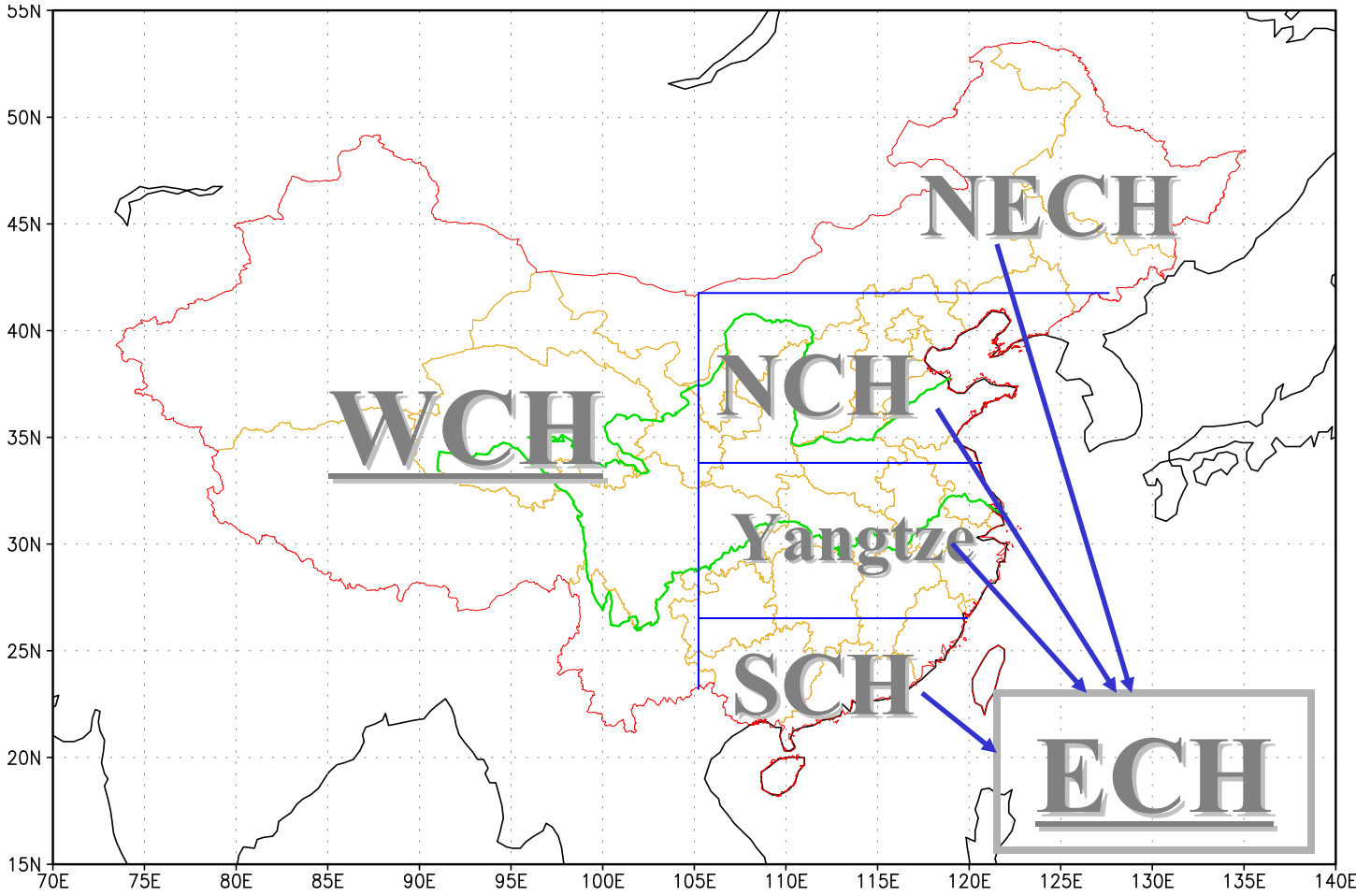
East China（120stations）: to the east of 105E

South China（20stations）: to the south of 26N

Yangtze River（43stations）: 26-34N

North China（36stations）: 34-42N

Northeast China（21stations）: to the north of 42N



RegCM_NCC Hindcast Skill of different sub-regions in China

Sub-Regions	Pc	SS1	SS2	ACC	Ts
West China	68.01	0.08	0.22	0.04	0.18
East China	61.89	0.01	0.16	0.01	0.15
South China	58.36	-0.02	0.14	0.06	0.16
Yangtze River	63.22	0.00	0.16	0.01	0.16
North China	58.32	-0.06	0.10	-0.05	0.14
Northeast China	67.36	0.15	0.29	0.12	0.16

West China: West of China, east of 105 ° E;

East China: East of China, east of 105 ° E;

South China: to the east of 105 ° E, to the south of 26°N),

The Yangtze River Valley: to the east of 110 ° E, 26—34°N,

North China: to the east of 105 ° E，34—42°N ,

Northeast China: to the east of 105 ° E, to the north of 42°N

Seasonal Prediction experiments

- Cases:

  Summer of 2001 - 2003

  (JJA, anomaly forecast from summer 2002)

  Winter of 2002/3 and 2003/4

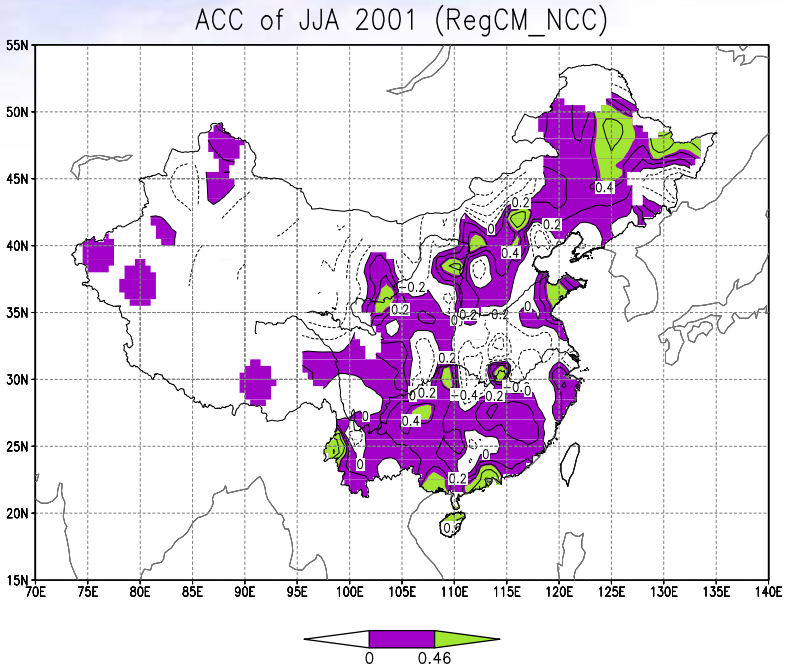
  (DJF,anomaly forecast from 2003/4)

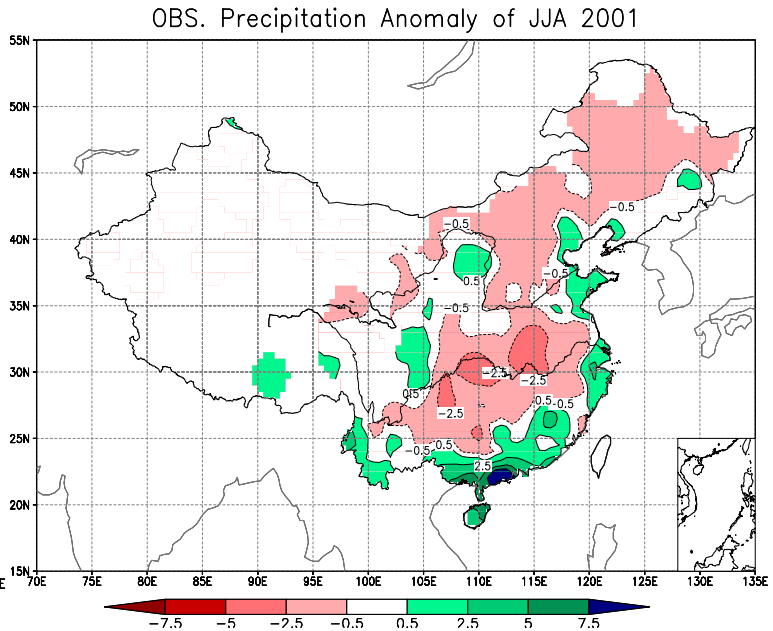
- Large-scale Data:

  Predictions of CGCM

  (initiated at 17th of Feb. and Oct.)

ACC and Obs. Rainfall Anomaly in summer 2001
----- Hindcast



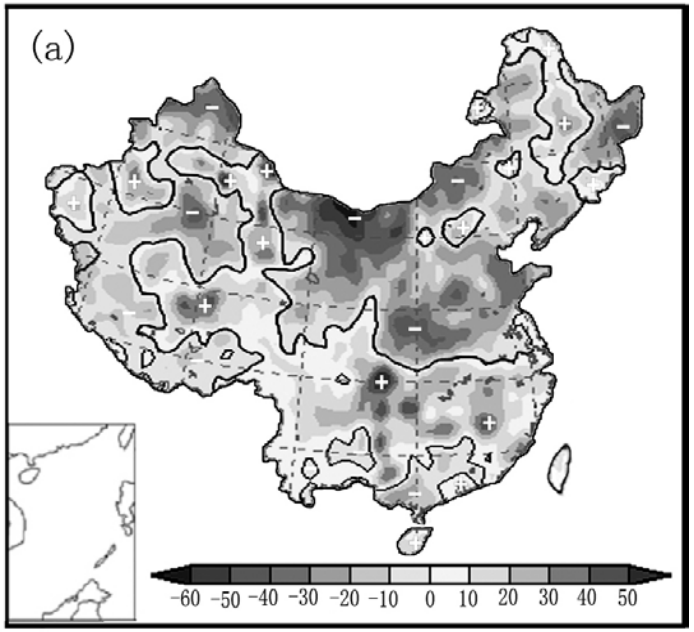


Positive ACC Area:

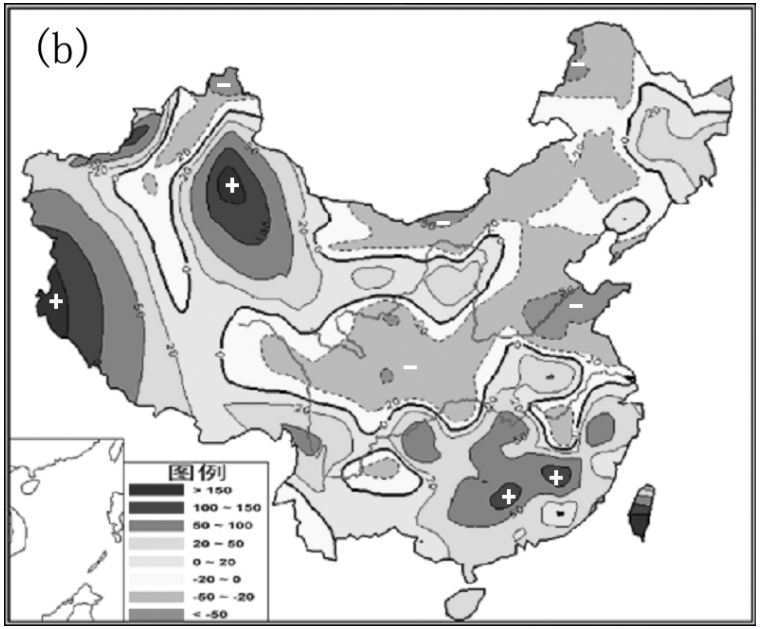
the East Coastal Area, the S-W China region, and the North China

Precipitation Anomaly of summer 2002 (%)
---- Real time

Prediction



OBS

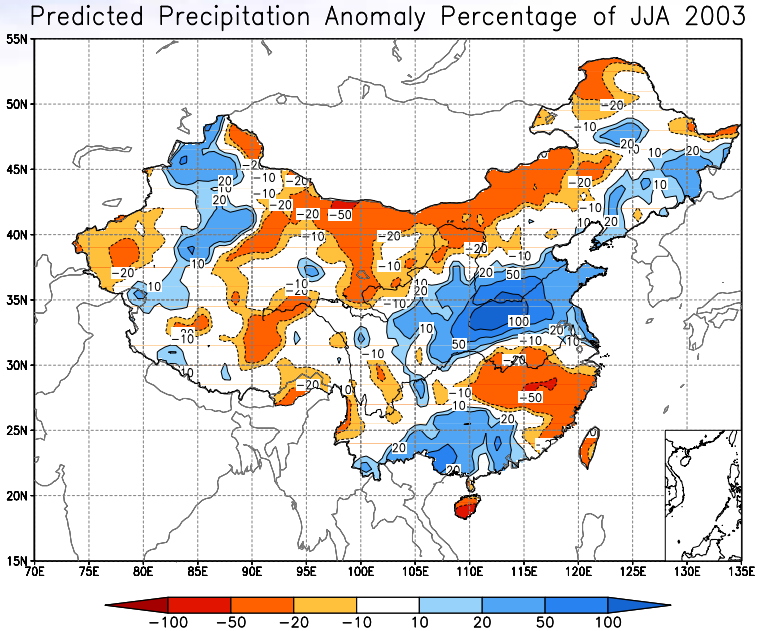


Above normal: Most regions south to the Yangtze river valley

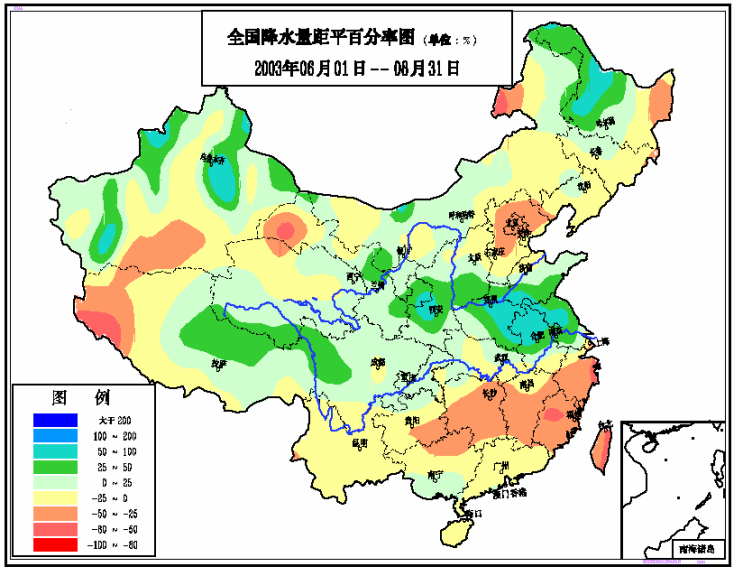
Below normal: regions north to the Yangtze River valley

Precipitation Anomaly of summer 2003 (%) ------ Real time

Prediction



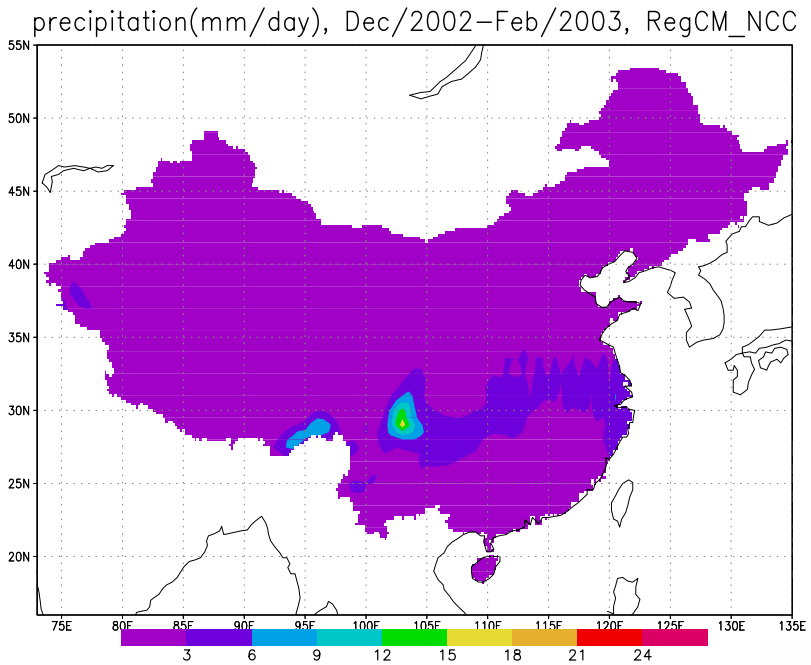
OBS

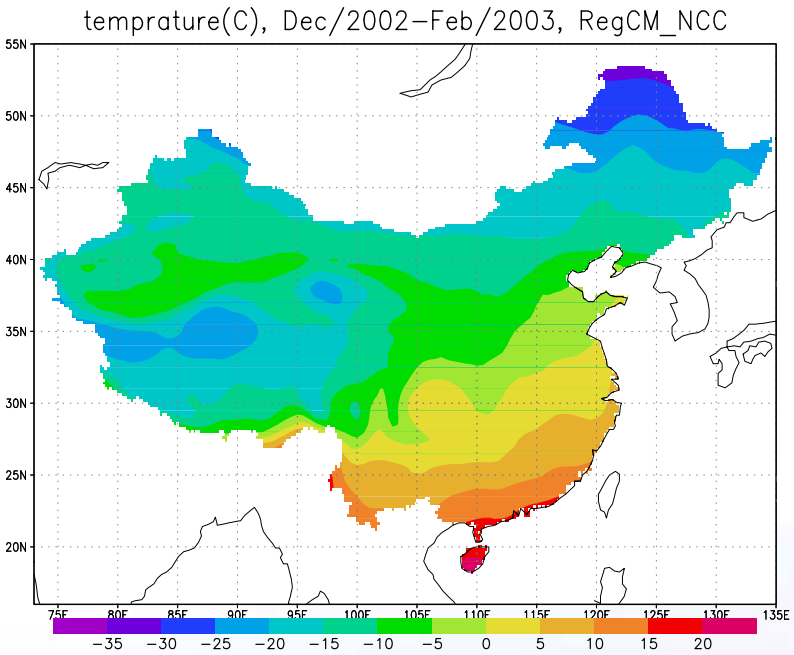


Above normal: regions between the Huaihe and the Yellow river valley, some regions of the western China;

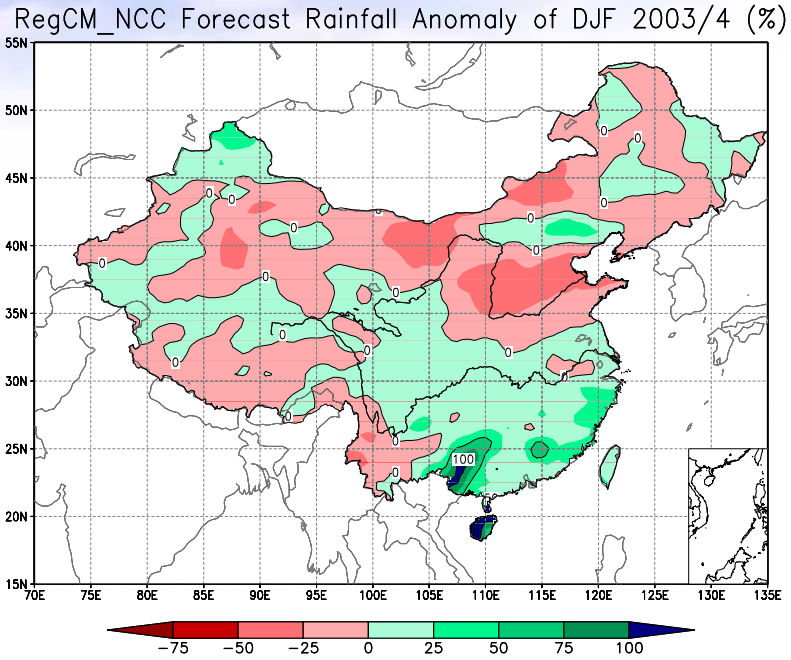
Below normal: regions south to the Yangtze River Valley, SW part the NE China

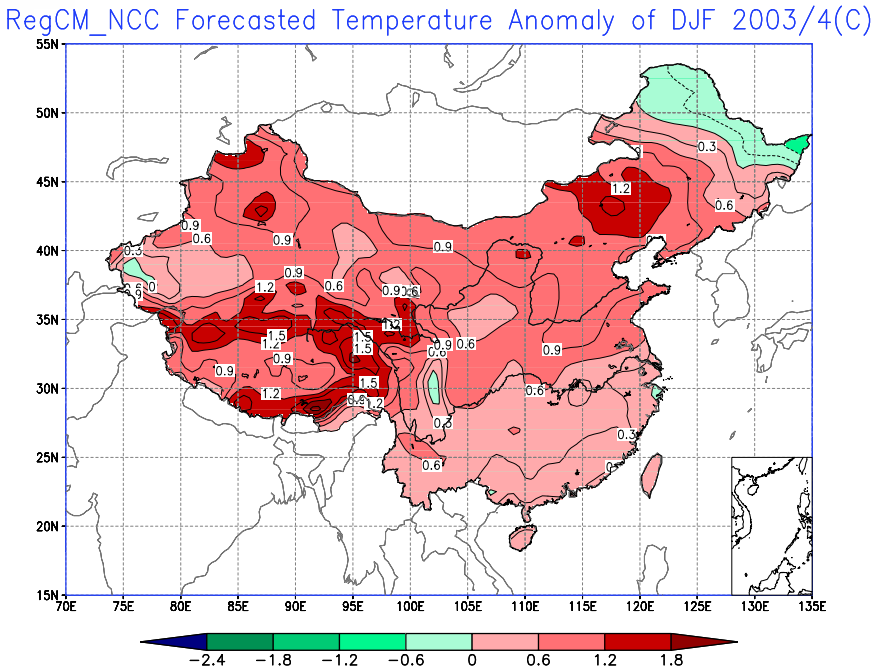
Predicted Prec. & Temp. of winter 2002/03 --------- Realtime





Predicted Temp. & Rainfall of winter 2003/4





Predictions: Temperature will probably above normal in most regions during the following winter.

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Summary

- The model hindcasts and simulations of ten summers were compared with observations, the preliminary results show that the RegCM_NCC has some capabilities in reproducing the major seasonal rain belts. The best regions include the Northeast China, theWest China and Yangtze-Huaihe River basin.
- The prediction experiments of summer in 2001-2003 are basically consistent with the observations. Especially for the summer 2003, it successfully forecasted the abnormal rainfall over regions of the Huaihe river valley.

Summary -continued

- The prediction of winter season has also been made by nesting with the predictions of CGCM. It seems that the temperature will be above normal in most regions during the following winter.

Further studies

- More cases for further verification;
- Establish of model error correction system;
- Further improvement of model physics

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The End,

Thanks!