BCC Climate System Model and Its Performance in Climate Prediction

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Beijing Climate Center

China Meteorological Administration

APCN Meeting 2004, Busan, Korea, Nov. 8, 2004

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- 1. Brief Introduction of BCC
- 2. Current Operational Climate Prediction System (current)
- 3. Current Status of Dynamical Model Prediction System in Experimental Operational Prediction (near future)
- 4. Development of CSM and Super-Ensemble Prediction System (future)

Beijing Climate Center

- A regional climate center for
  - Climate operational prediction
  - Climate research
  - Climate Data and Monitoring
  - Assessment of Climate Impacts
  - Training
- In East Asia, as well as in the world!

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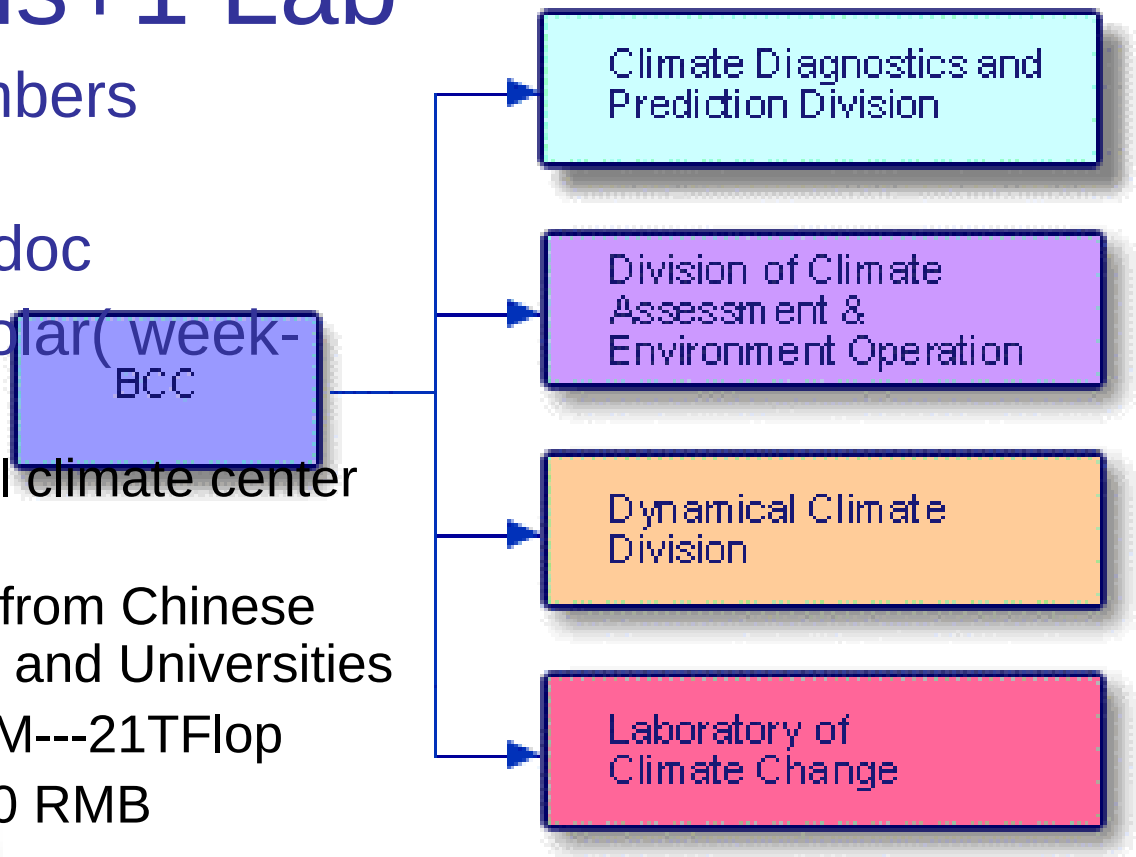
Structure of BCC

- –4 divisions+1 Lab
  - – ~120 staff members
  - – 40 graduate students+post.doc
  - – 20 visiting Scholar(week-month)
- 35 Provincial/city level climate center (~20 staffs)
- Involved 12 institutes from Chinese Academy of Sciences and Universities
- Super computer of IBM---21TFlop
- Bugets …~40,000,000 RMB



International Cooperational and Training

BCC's Training Activity

The latest training course, on short-term climate prediction co-sponsored by BCC, 20-31 Octorber 2003, Beijing CHINA

50 students and colleagues from developing countries in Asia and Africa participated

Asia: China, Kazakstan, Malaysia, Mongolia, Pakistan, Sri Lanka, Thailand and Vietnam

Africa: Algeria, Kenya, Niger and S. Africa

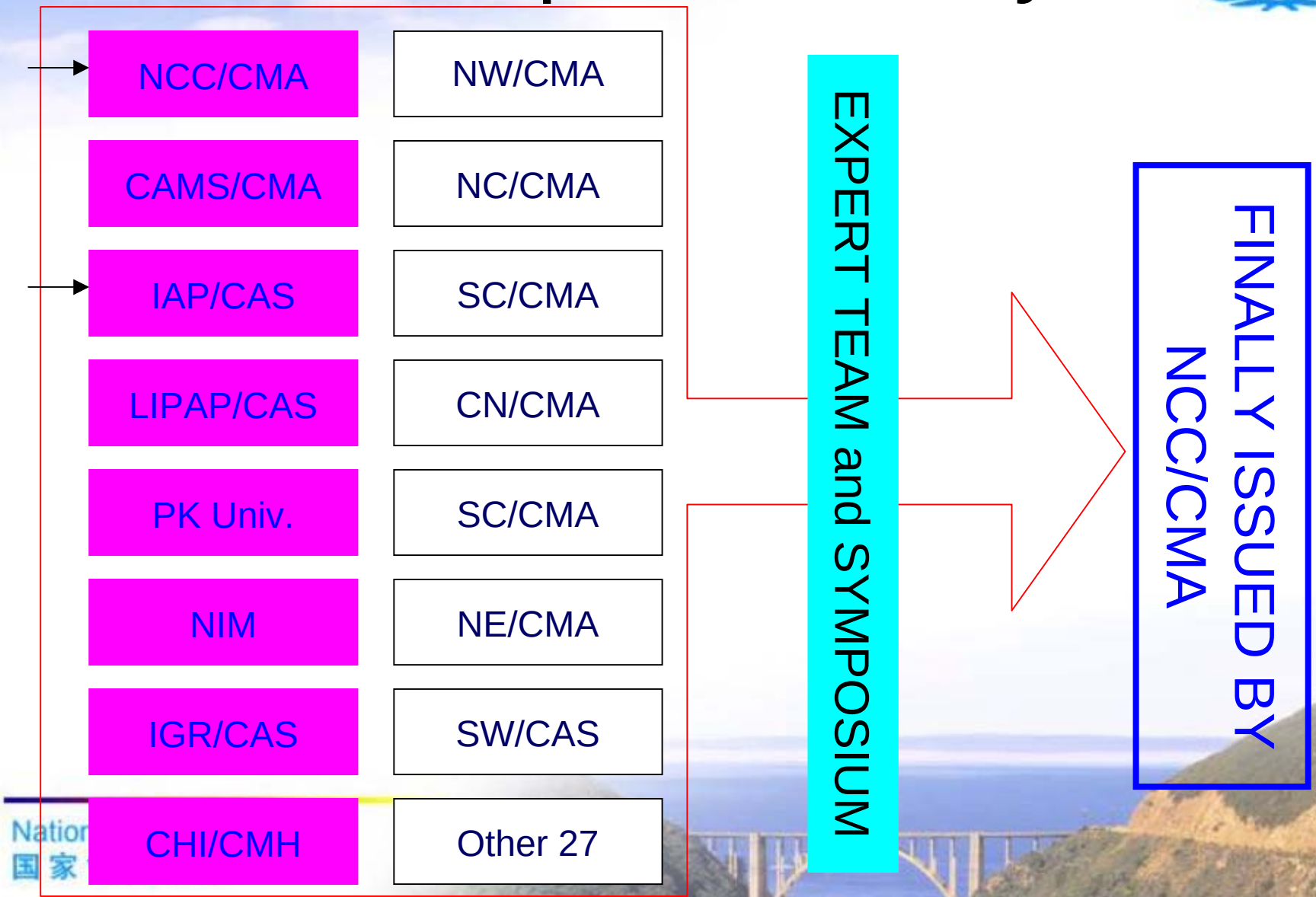
Different Needs & Services

- TO:
  - State Council, premier, local government: flooding and drought in flooding season, intensity and frequency of ENSO,typhoon, dust storm, forest fire, high temperature events. Help them to make decision, to help people (Prediction, Prevention)
  - Public Service: Climate system monitoring service and Climate concept training, tell people what has happened and are happening, Suggestion and Advices, through TV(one week, one month) and website, newspaper

Different Needs & Services

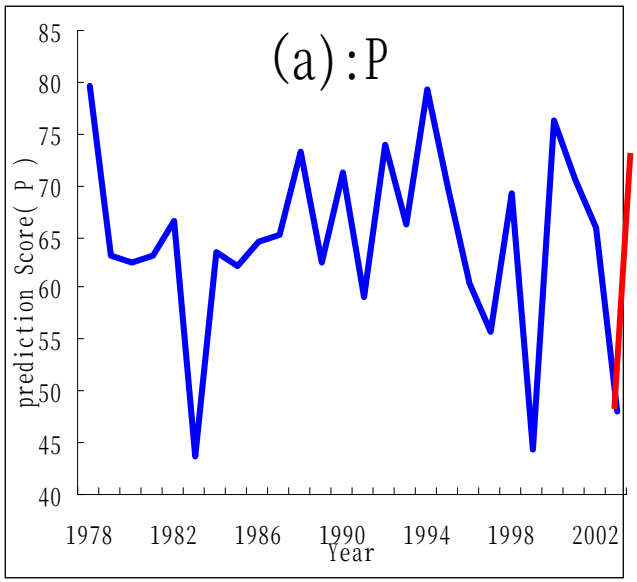
- Specialized Service (Cost-recovery service): Enterprises, Private, commercial Use, local governments, e.g. three gauges dam, company of transportation and power, trade (int'l)…….
- International Services: APCN(APCC), Training, Joint Summer/Winter Monsoon prediction(China/Japan/Korea/and), Israel for winter precipitation, India, Viet Nam CGCM output

Current Operational System

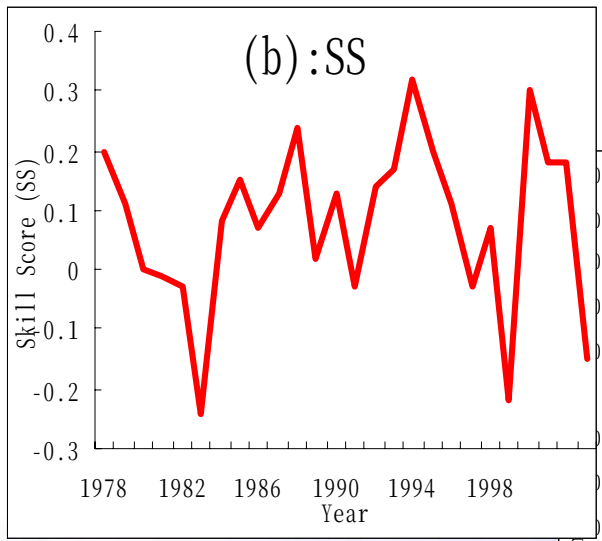


Skills of the operational flooding-season precipitation forecast

65%



0.09



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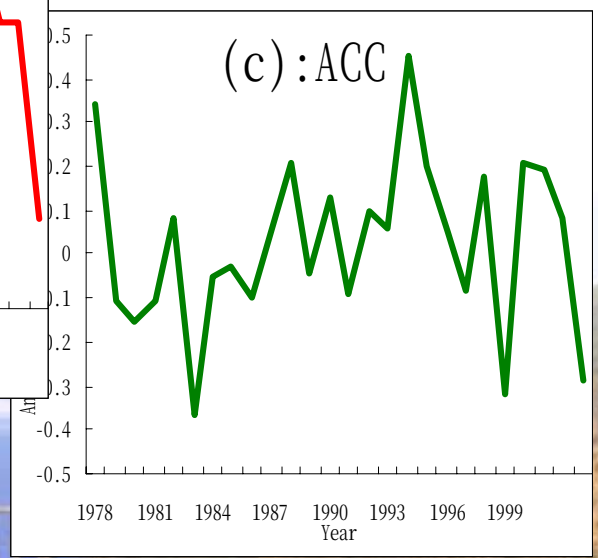

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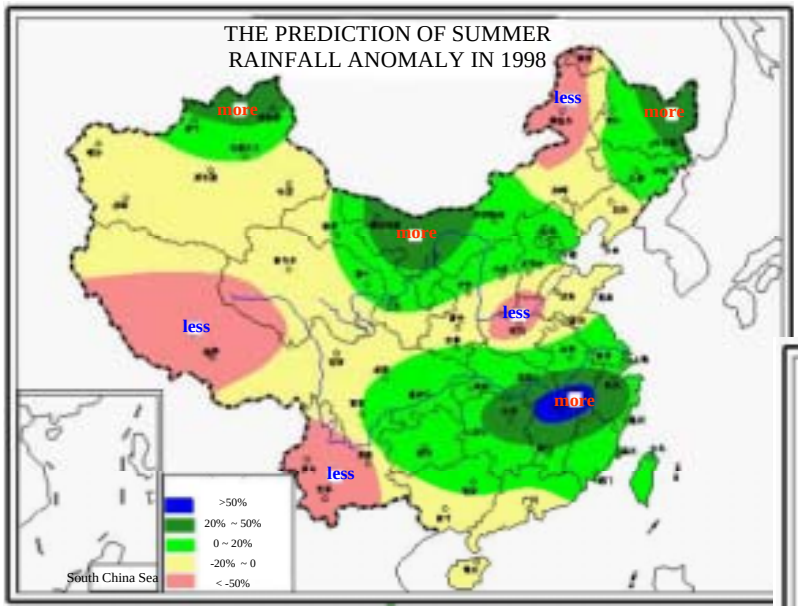
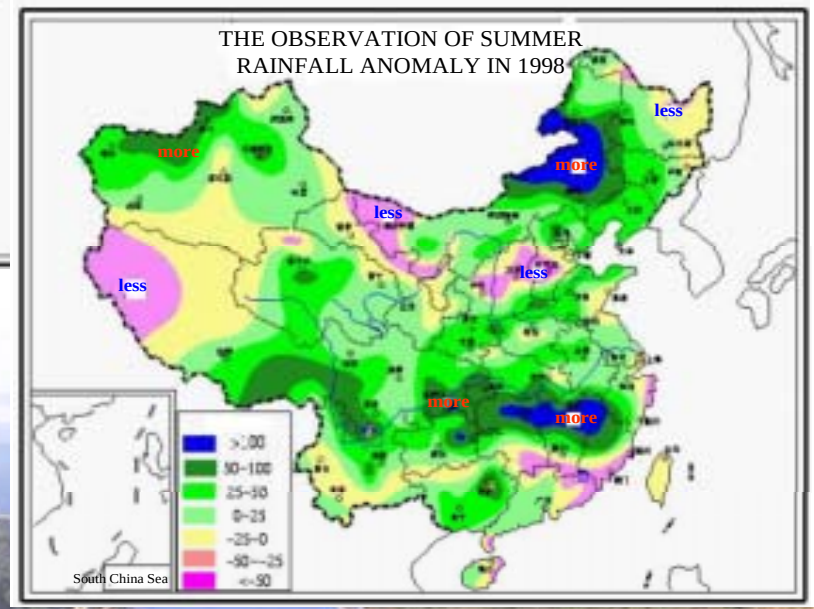
1998 example of successful summer precipitation forecast





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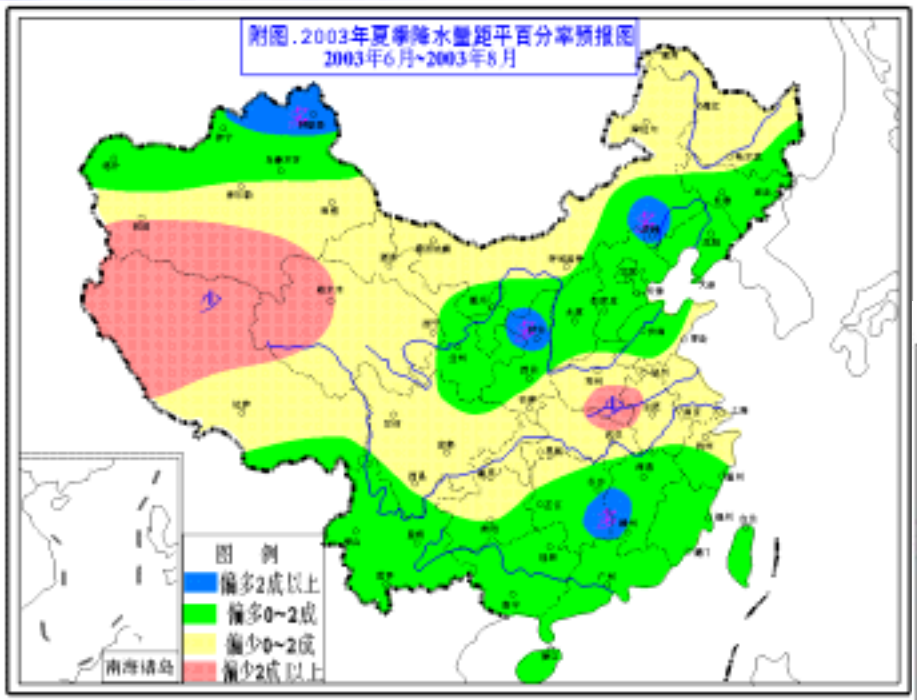
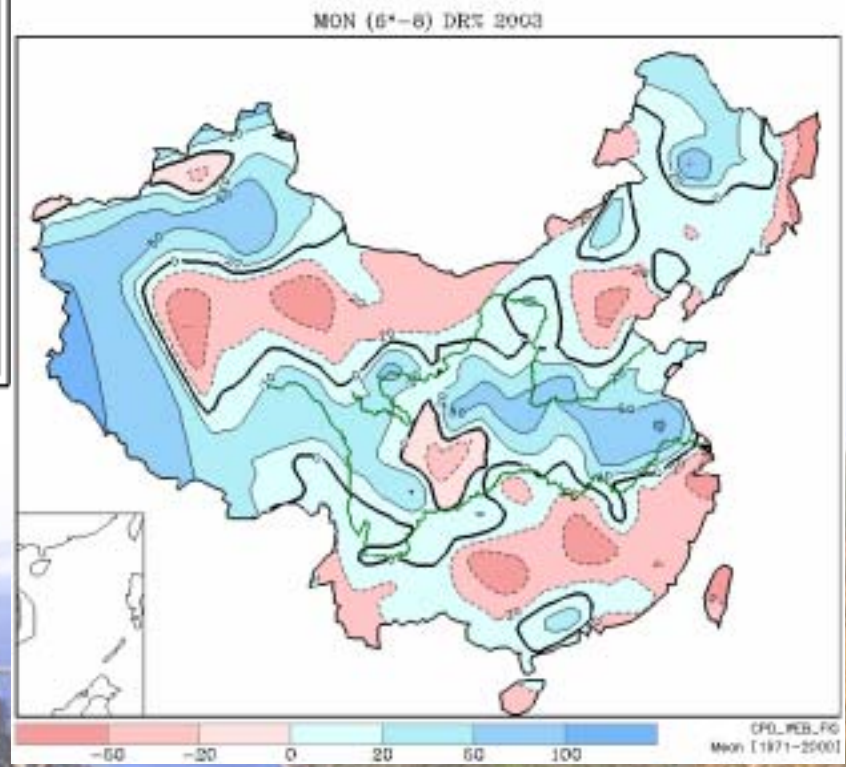
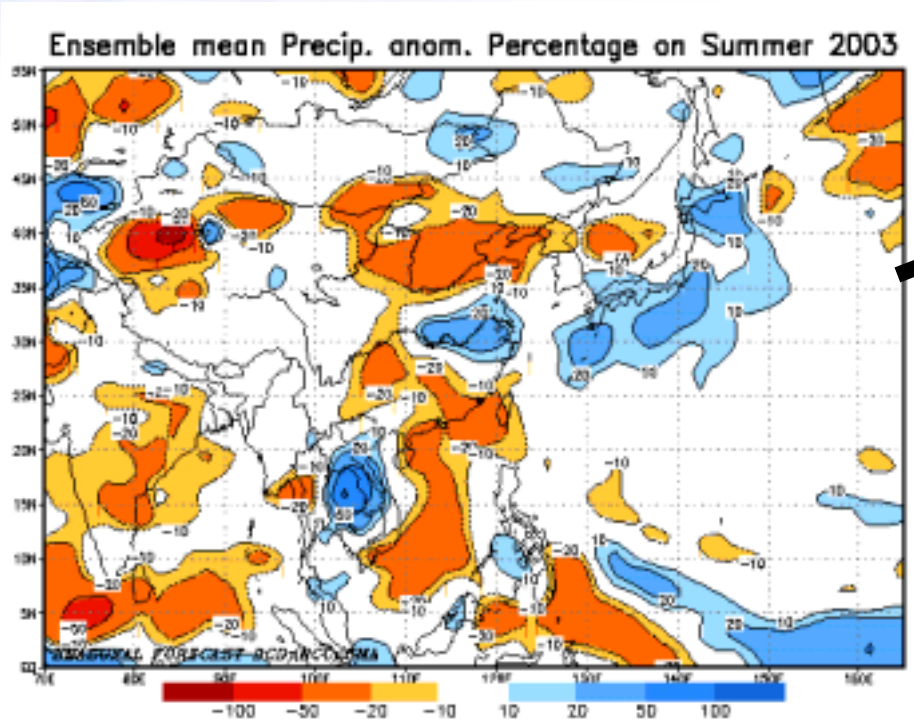
2003 example of unsuccessful summer precipitation forecast

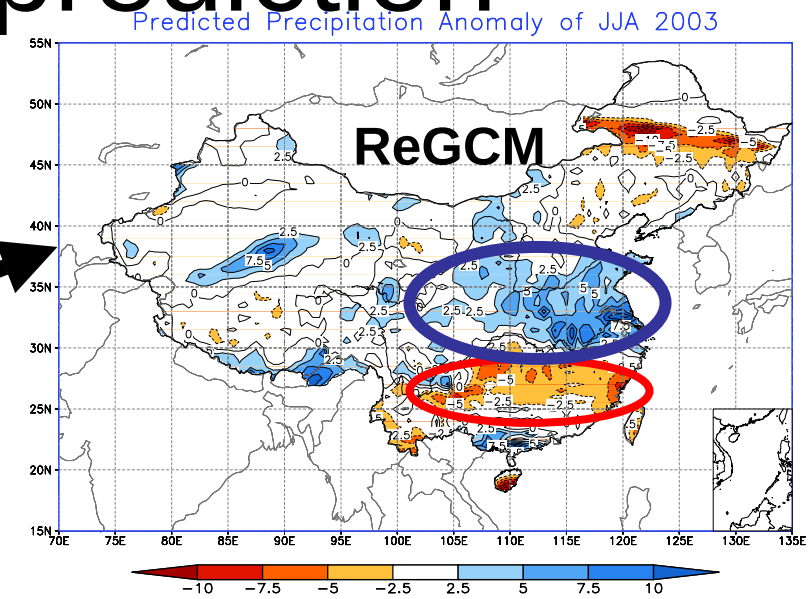


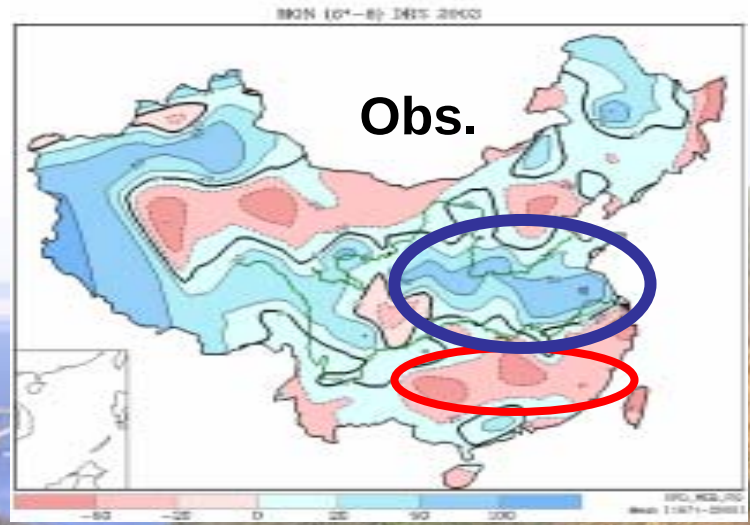


2003 summer precipitation NCC Model's prediction



CGCM





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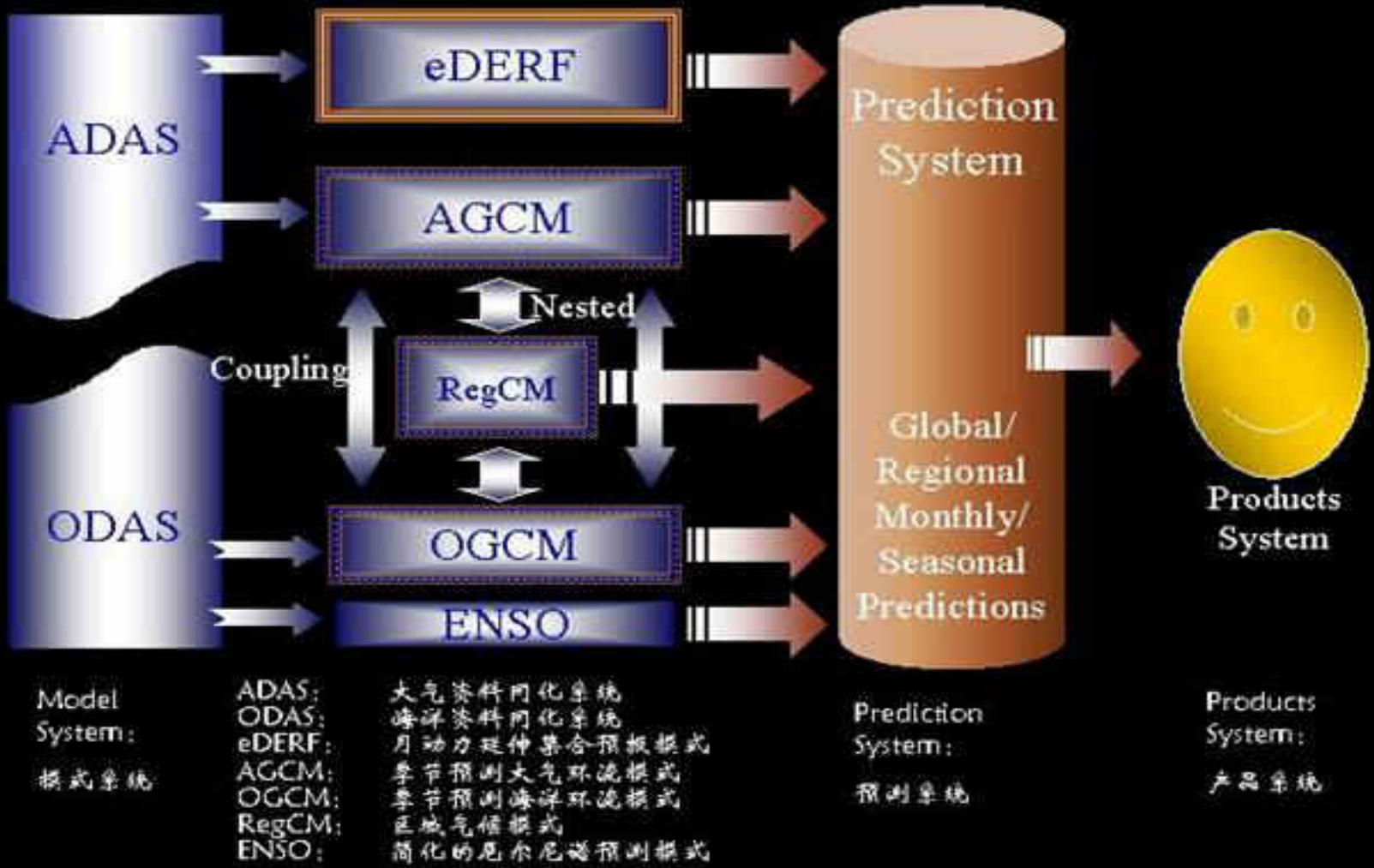
Current Operational Climate Prediction System

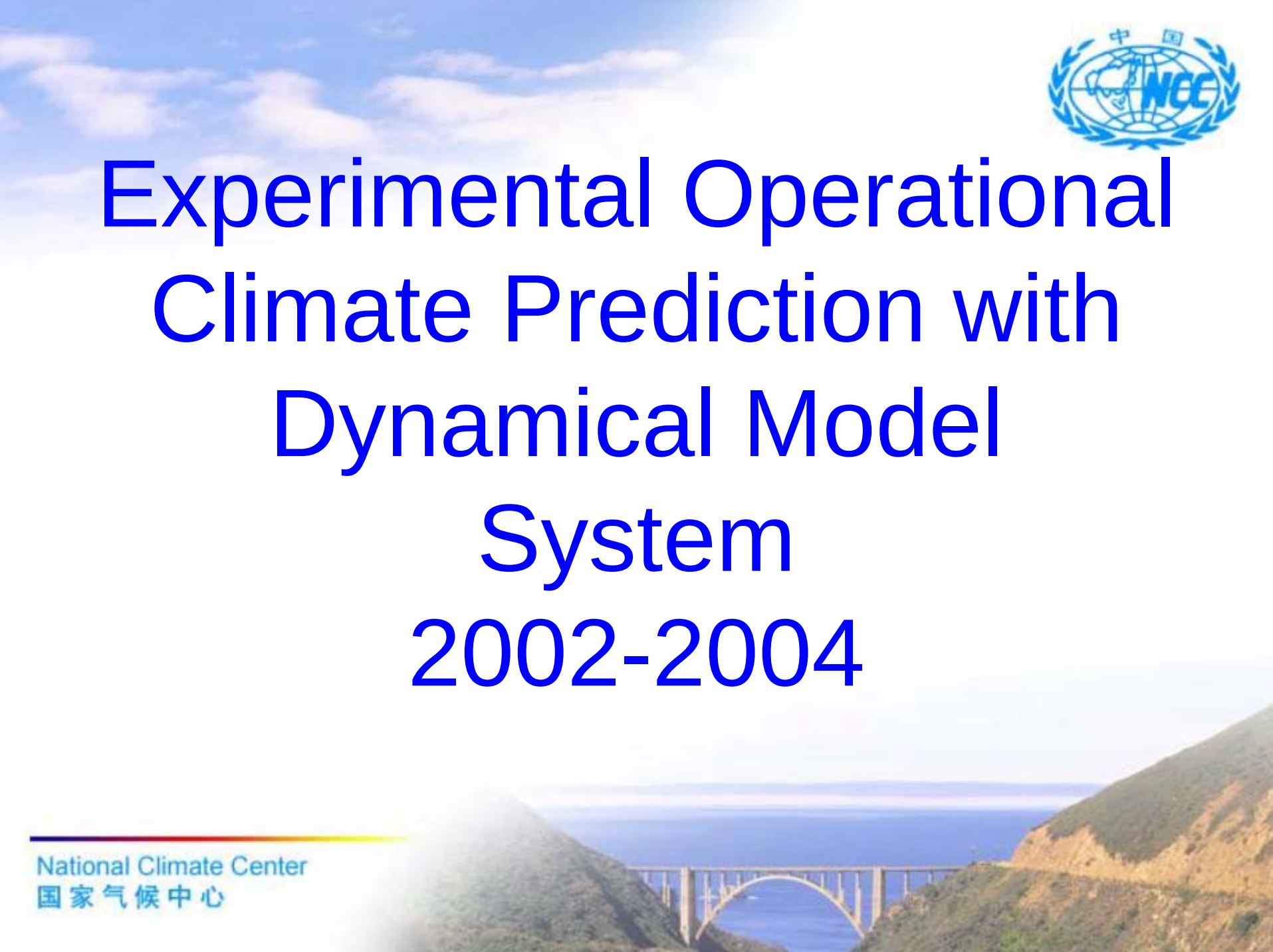
- Largely Based on Statistical Methods
- Only can make prediction for China Continental Area

- 1995, NCC founded
- NCC-CGCM/ReGCM/Siplified ENSO Models developed
- 2002, Started Experimental Operational Climate Prediction + 20 years hindcasts
- 2005, Completed Experimental Phase, Enters into Operational Phase

Members of BCC's Climate Model Family and their roles



Experimental Operational Climate Prediction with Dynamical Model System 2002-2004



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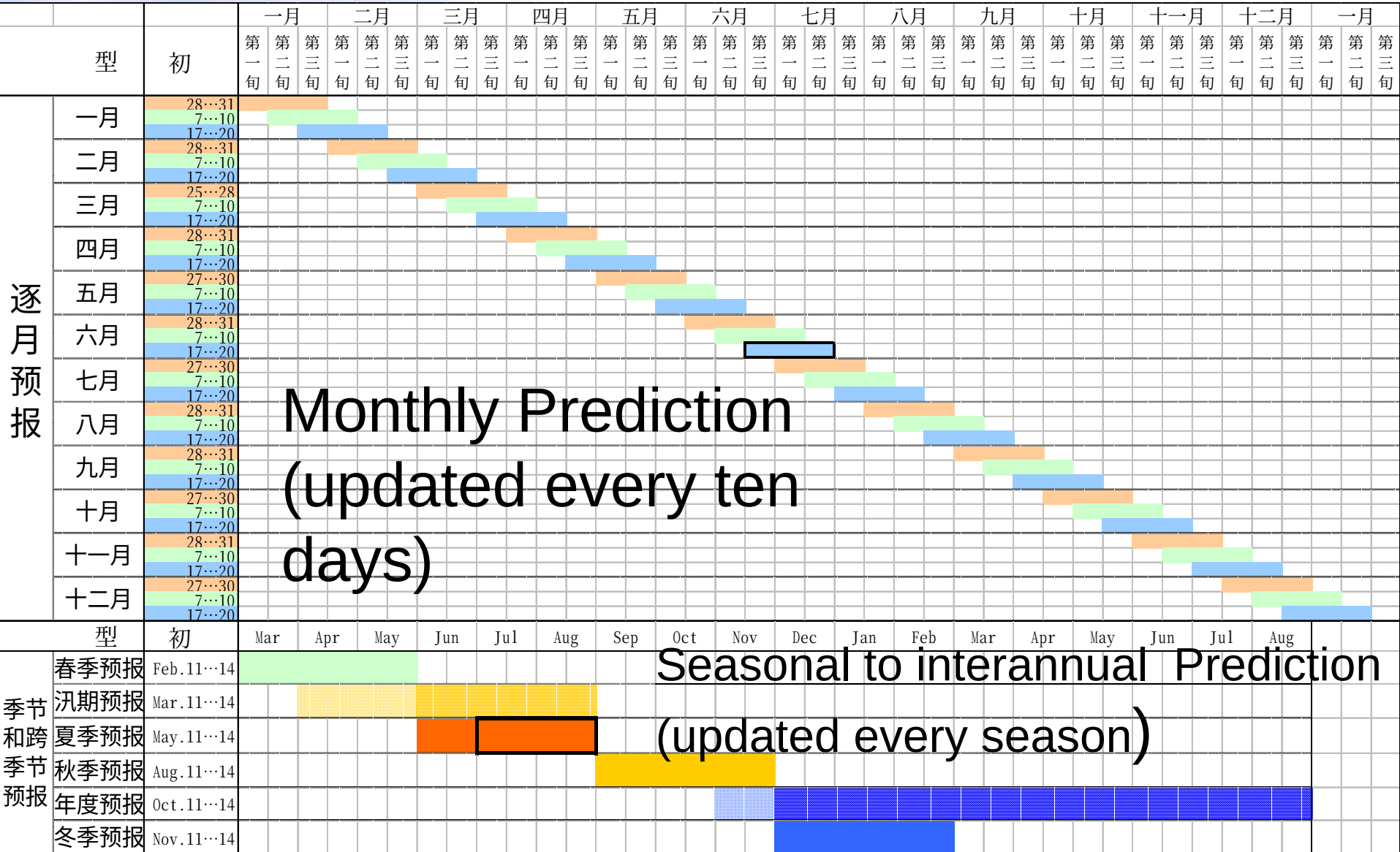
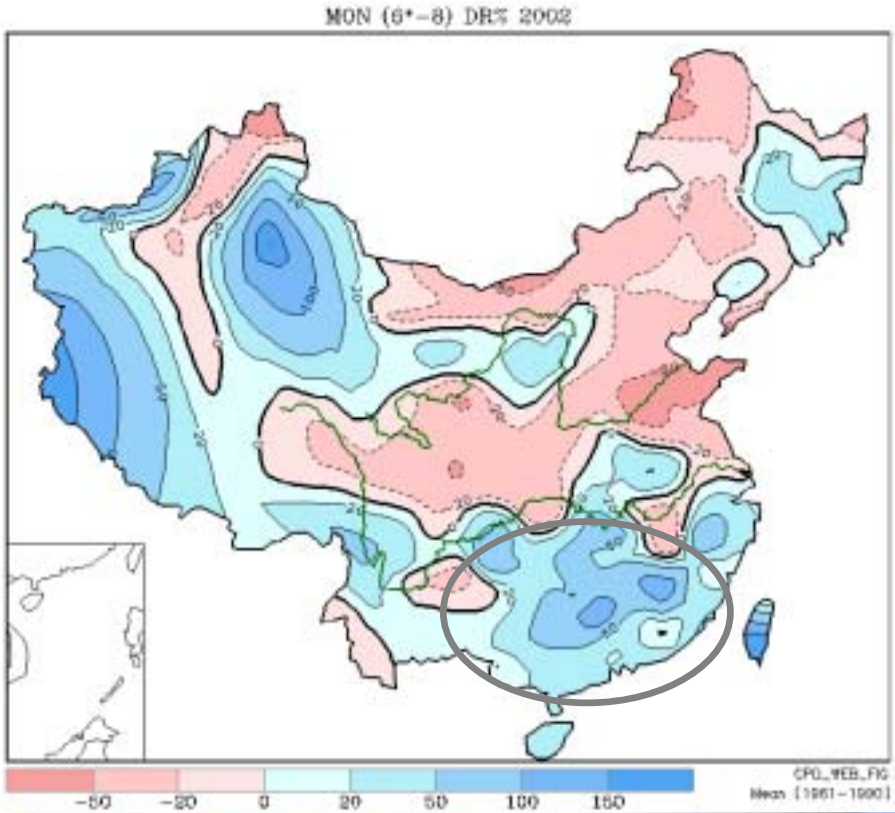
WWW.BCC.CMA.GOV.CN--Climate

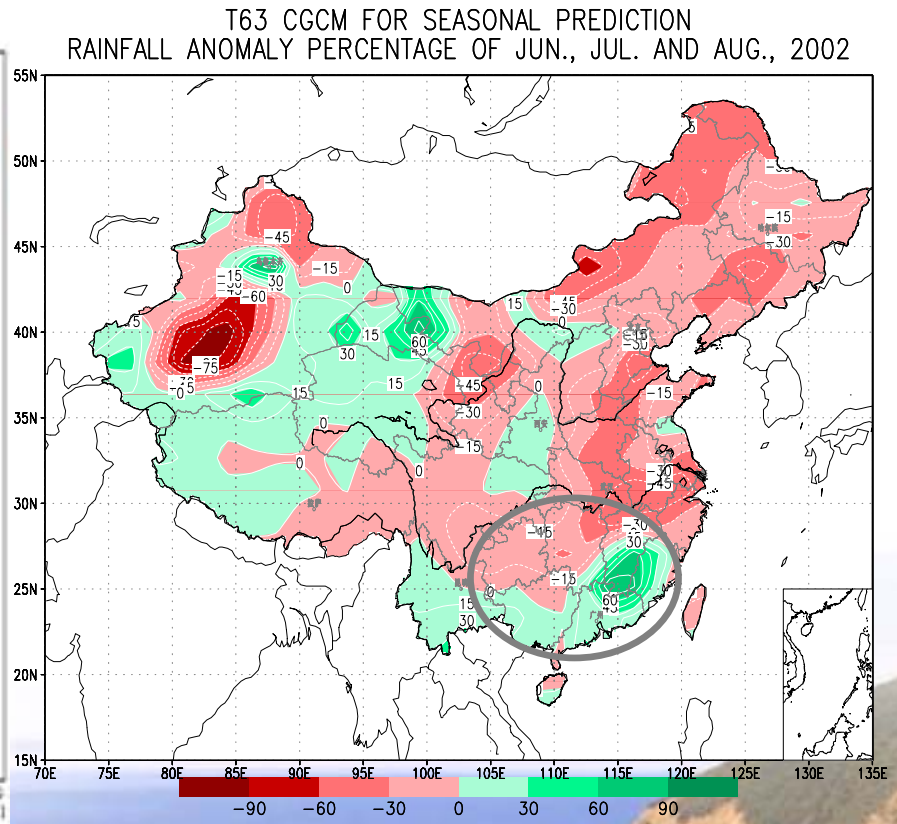
Prediction provided by BCC CGCM%



Precipitation prediction in 2002 summer

Left: Obs Right:Prediction





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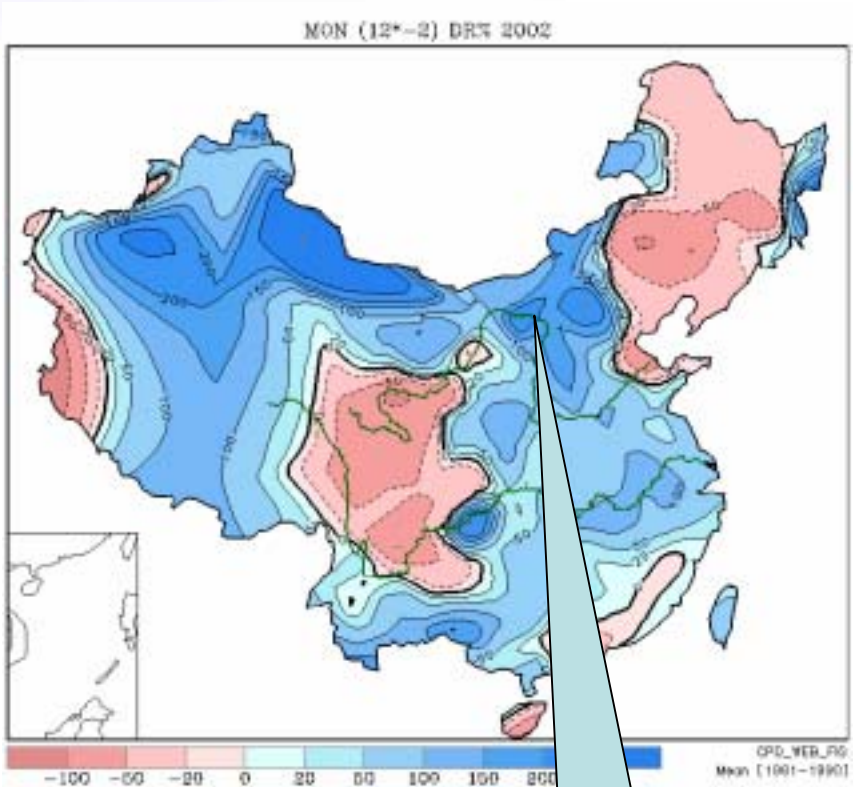
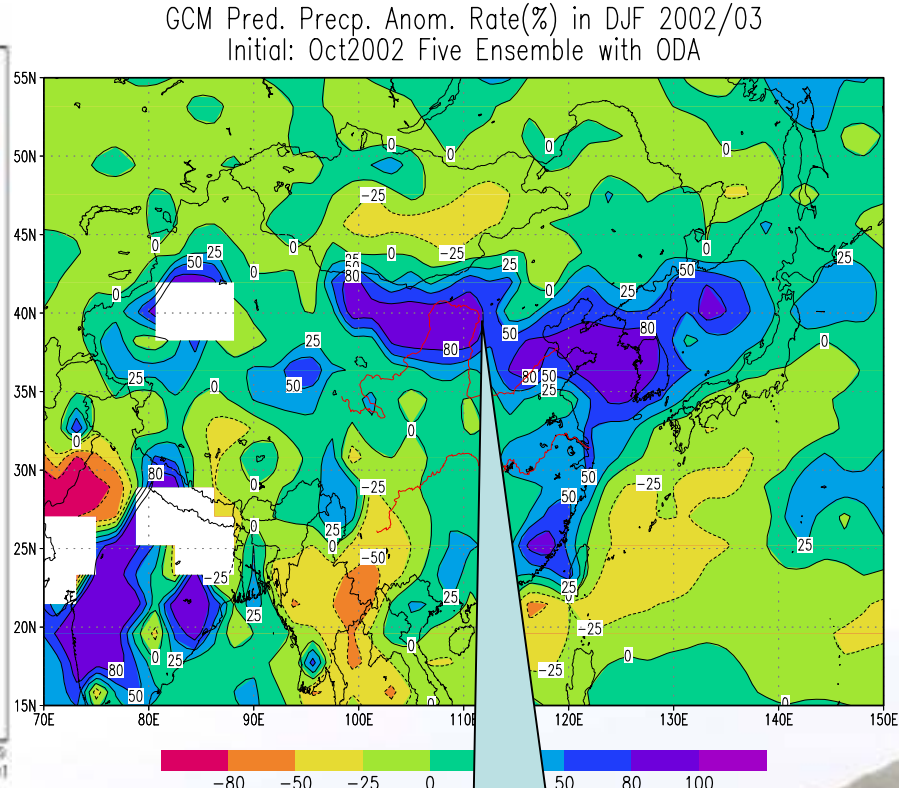
Precipitation Prediction 2002/03 Winter

Left: Obs Right:Prediction





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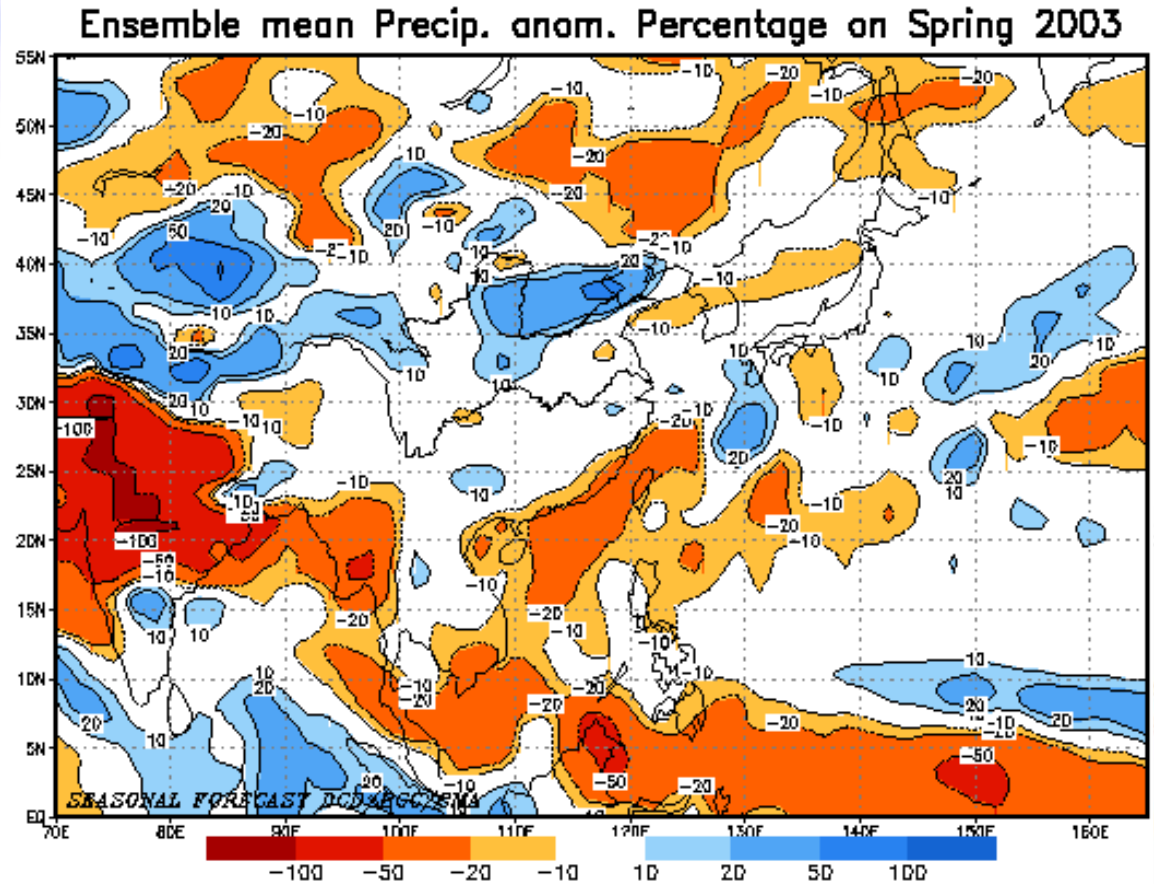
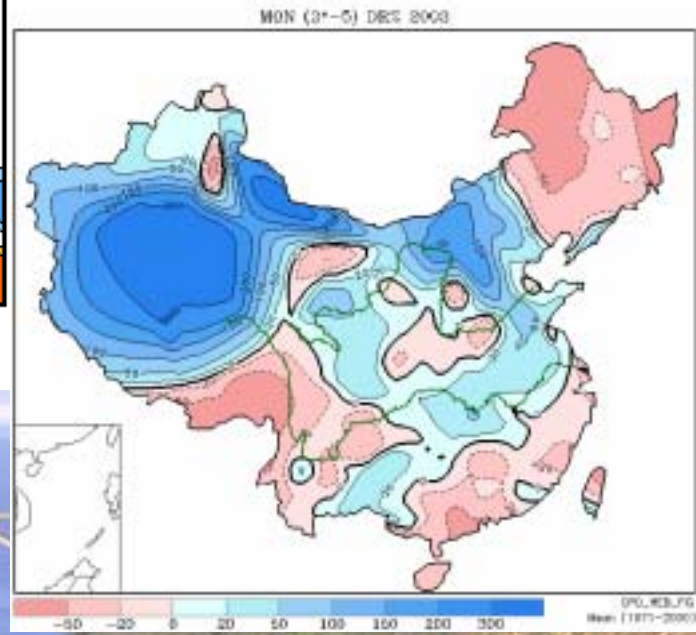
How about Spring 2003?



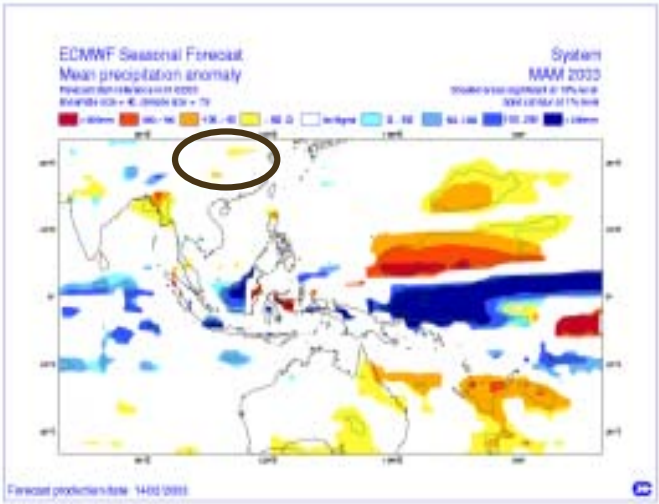


SPRING 2003 PREDICTION

(a)

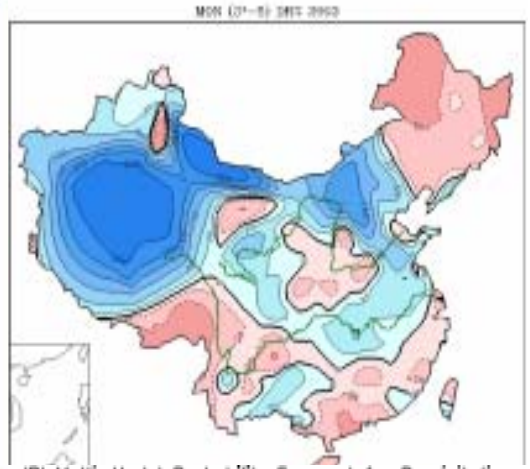
ECMWF

03/02/14



(d)

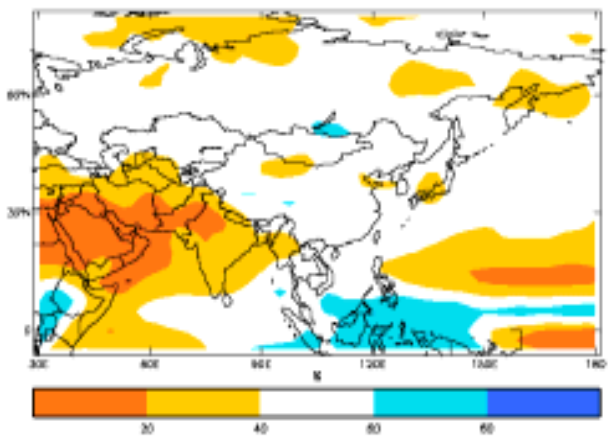
observed



(b)

HadleyCenter

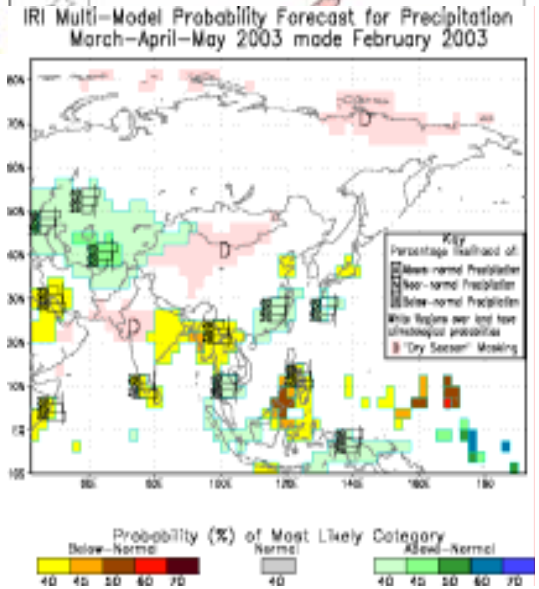
03/03/01



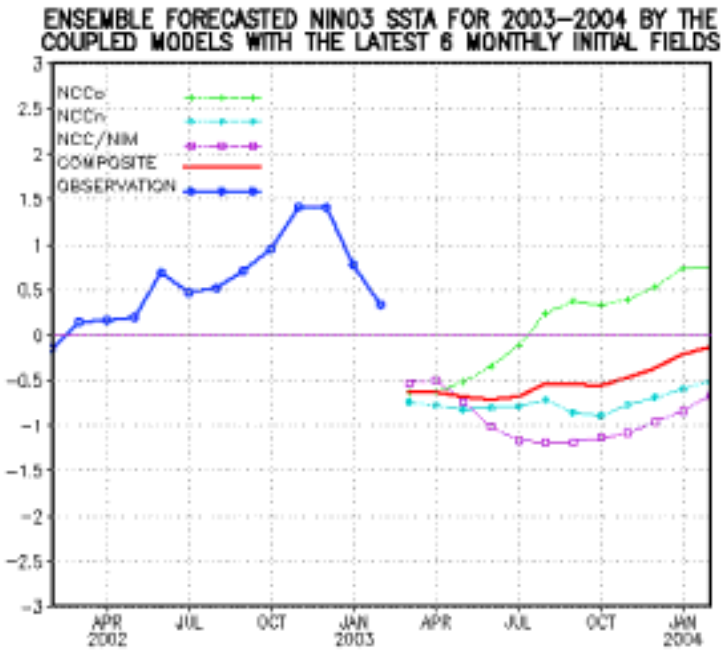
(c)

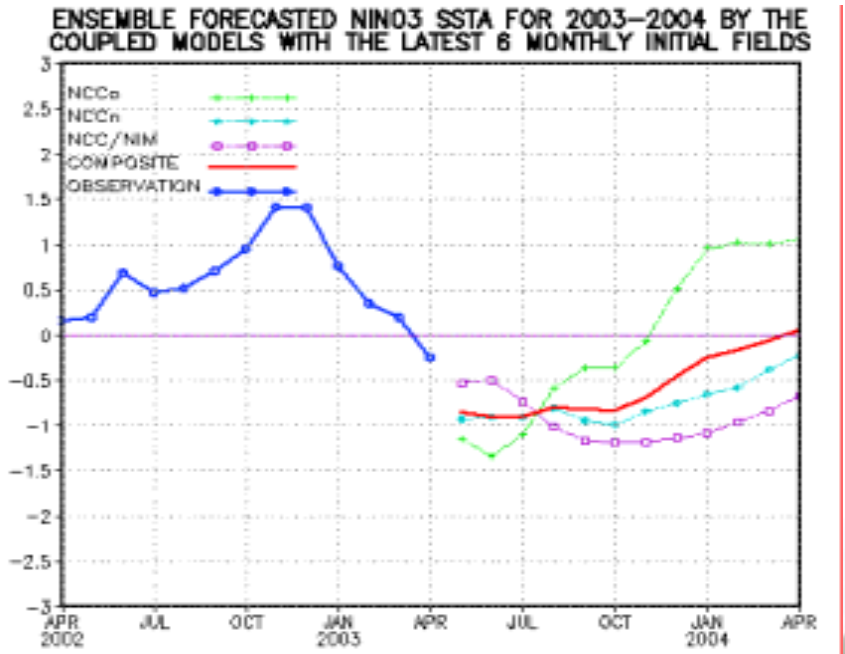
IRI

03/02

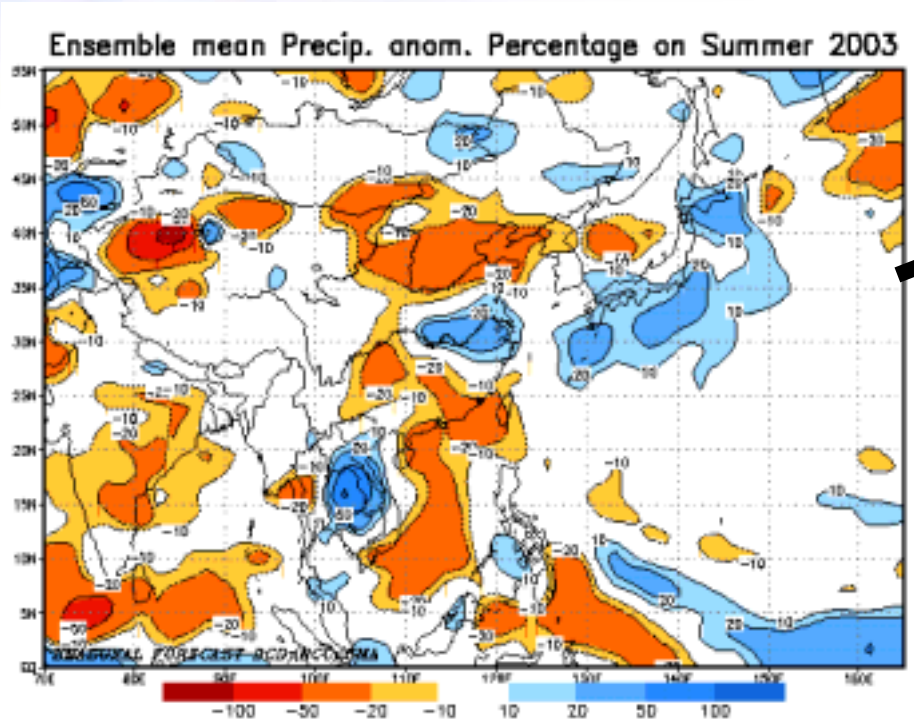


Prediction of Nino3 Index for 2003 with BCC's Simplified Coupled Atmosphere-Ocean Model





2003 summer precipitation NCC Model's prediction



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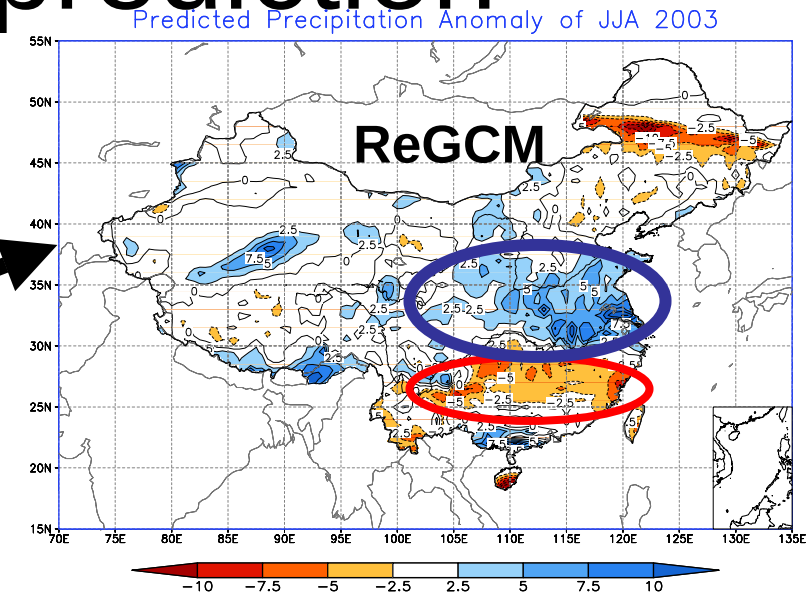

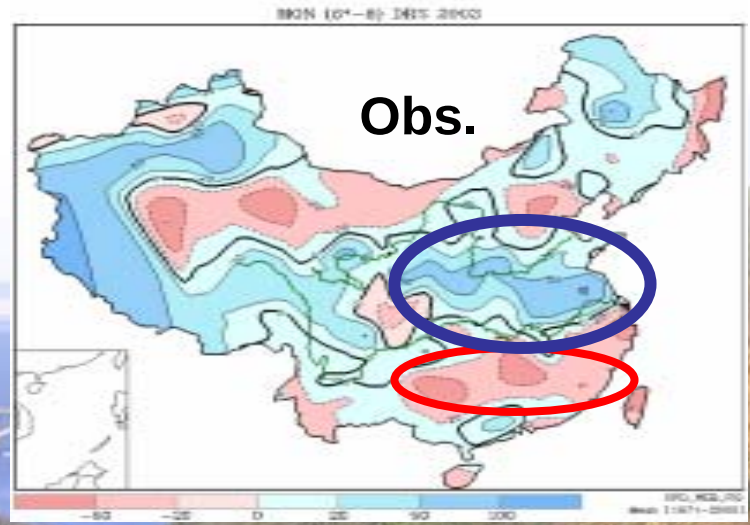

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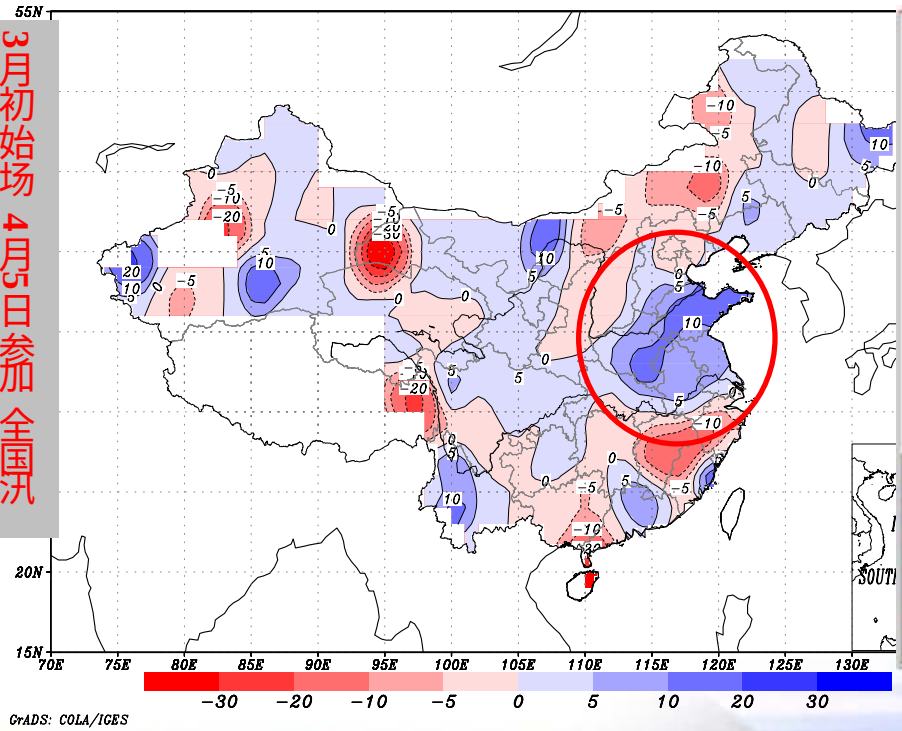
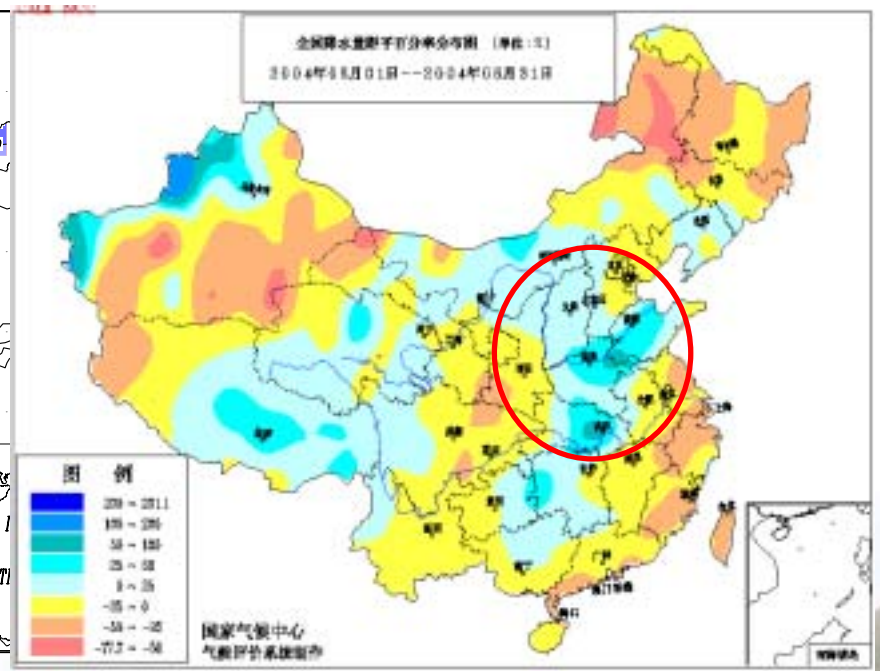
2004 Summer Precipitation

3月初始场 4月5日参加 全国汛期 会商T213初始场 订正后



实况



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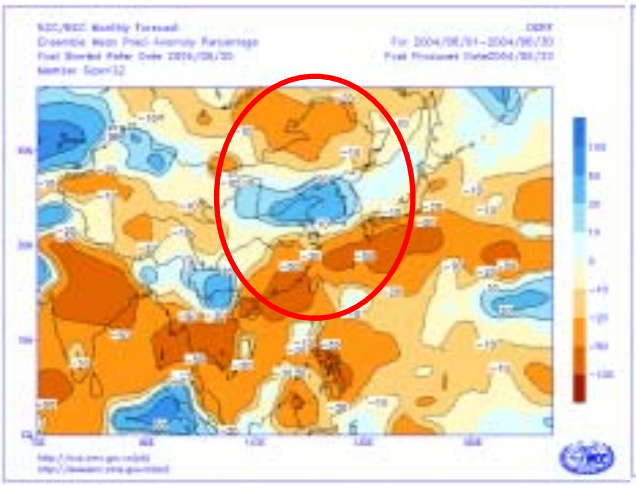
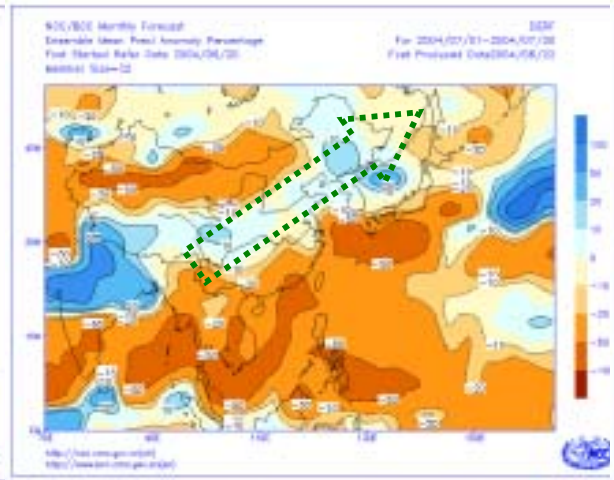
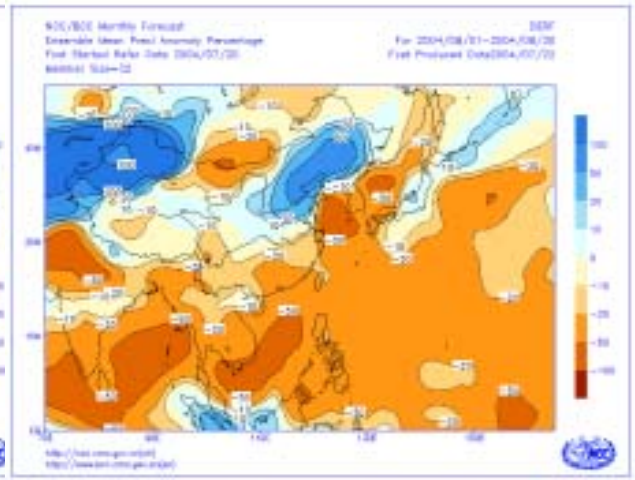
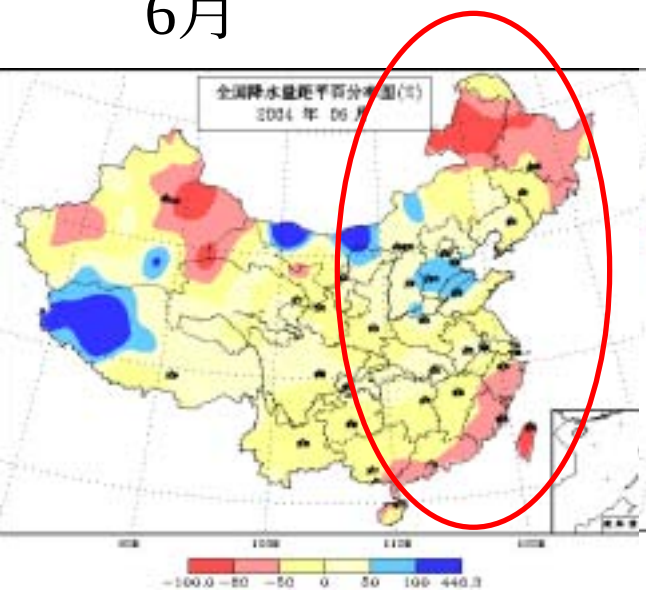
2004年夏季各月降水距平百分率　　及
(月　力 延伸　　)

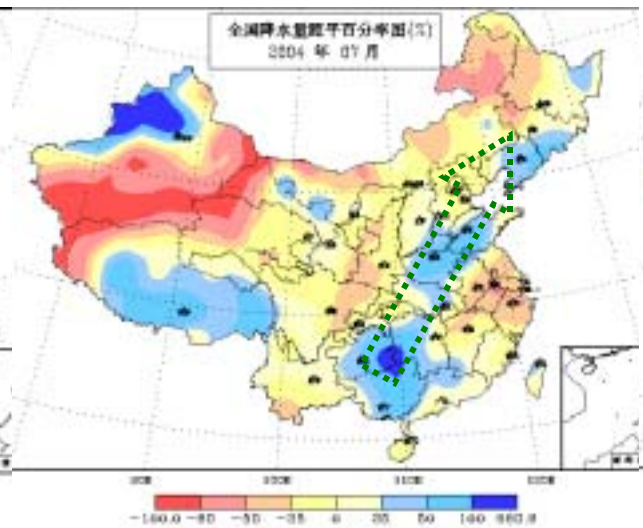


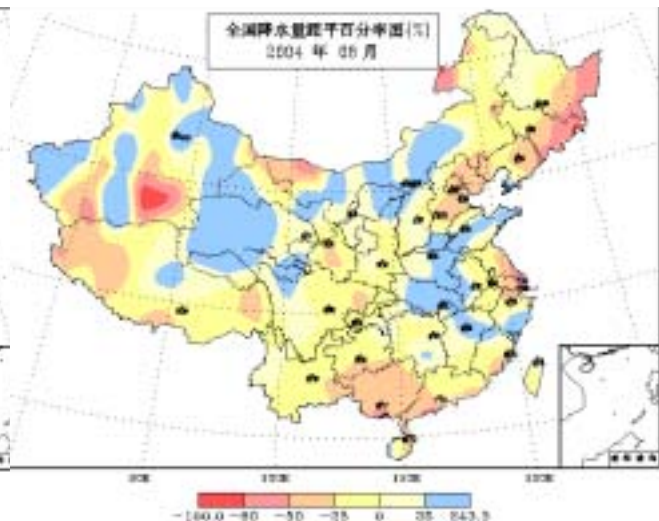




6月　　7月　　8月

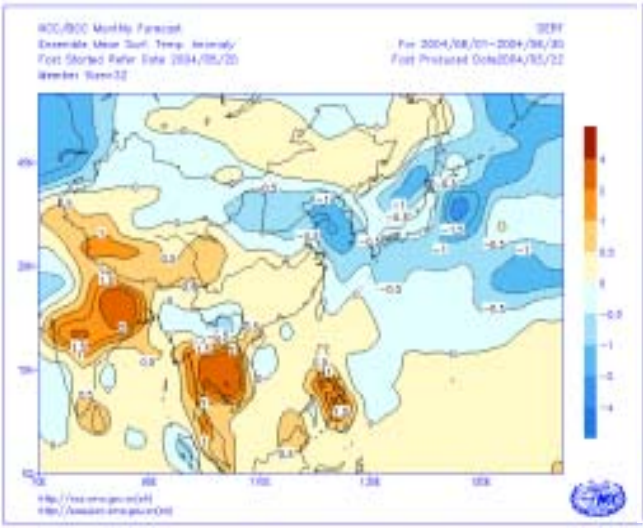




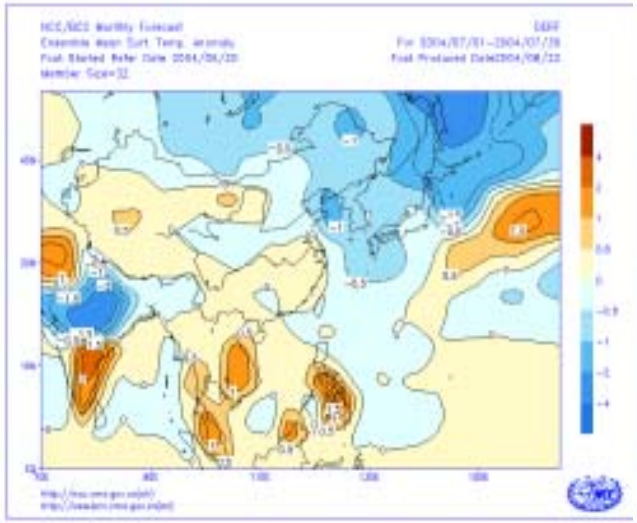


6月　　7月　　8月(　　)

2004年夏季各月　度距平　　及
(月　力 延伸　　)



6月



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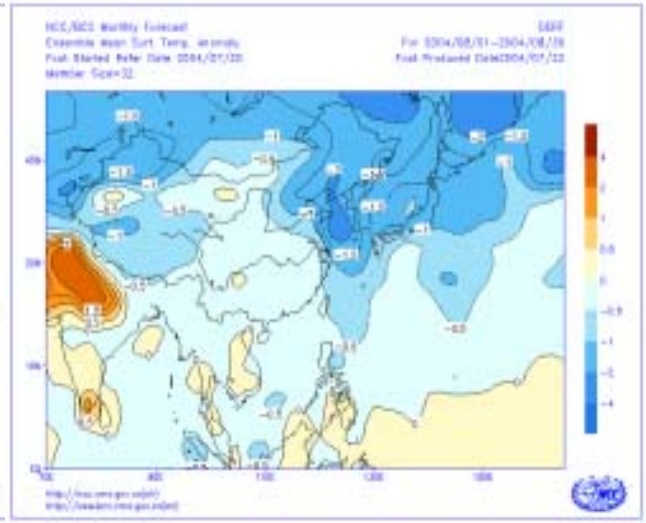
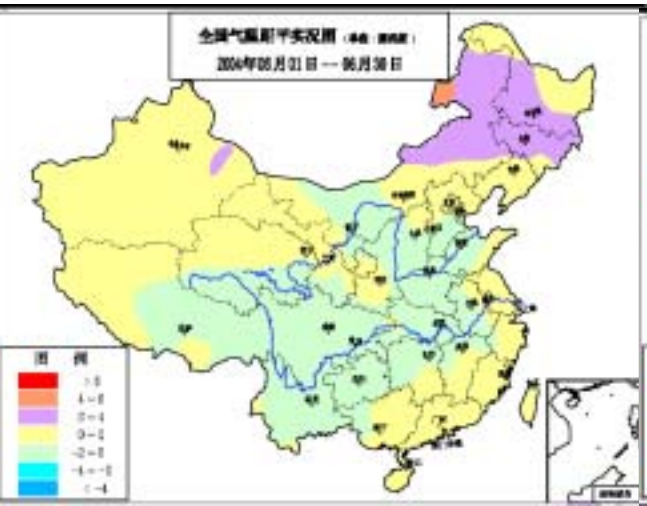


8月(月　力延伸　　)



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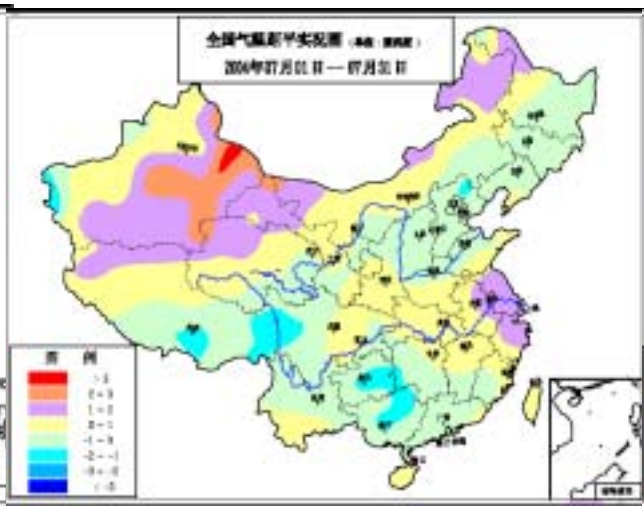

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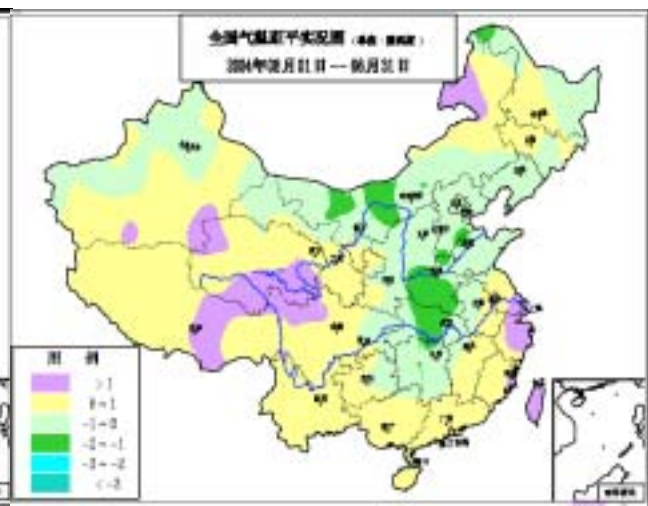
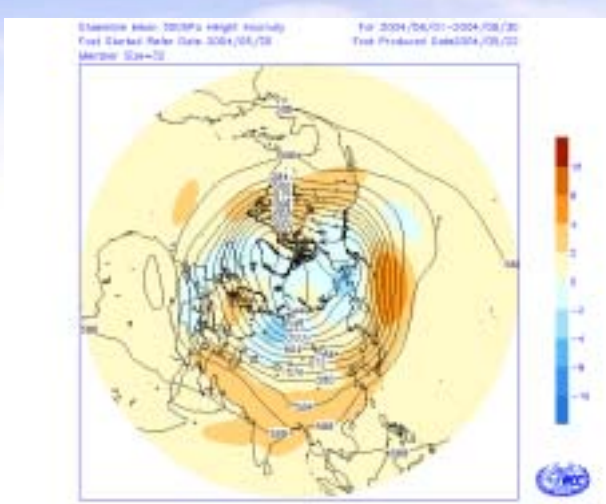
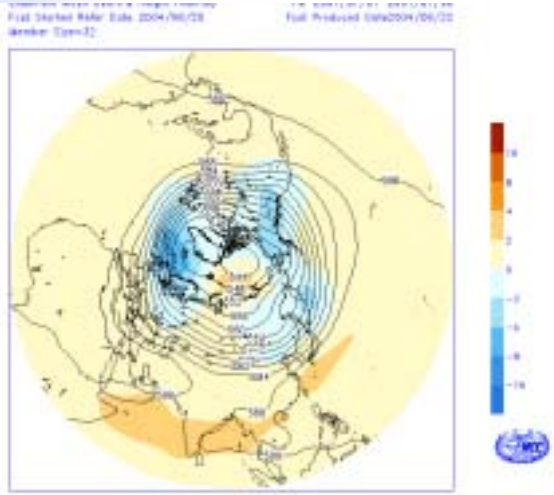


8月(　　)

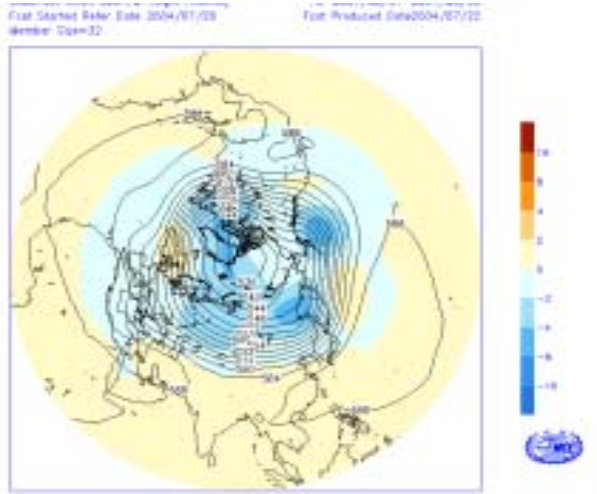
2004年夏季各月500hPa 流 及 (月 力 延伸)



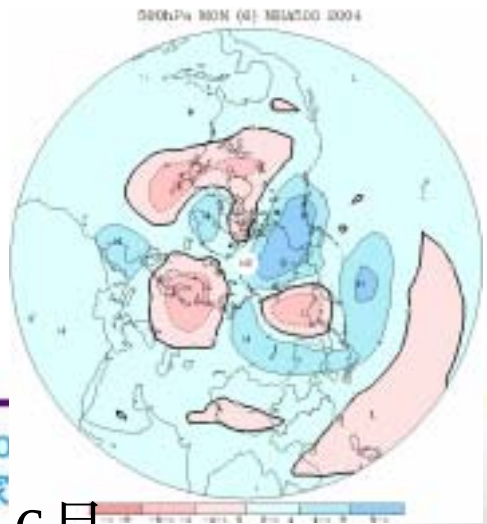
6月



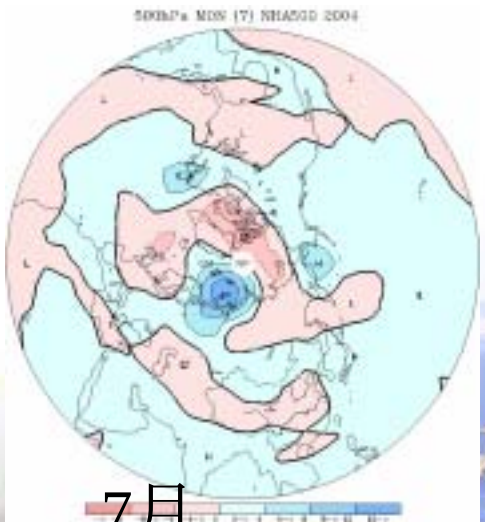
7月



8月



6月



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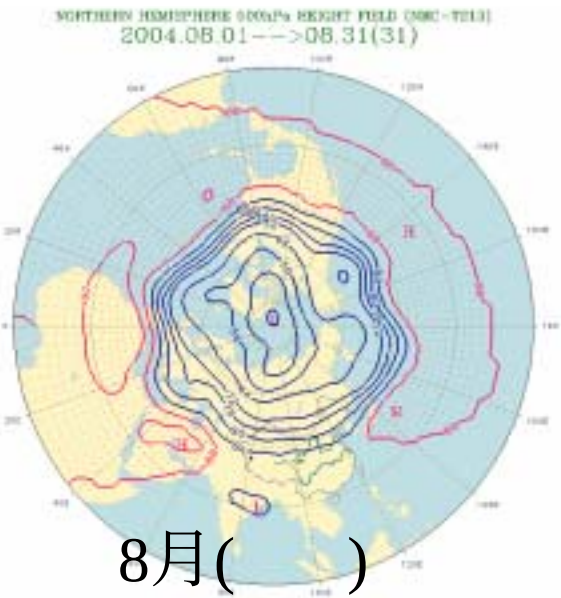
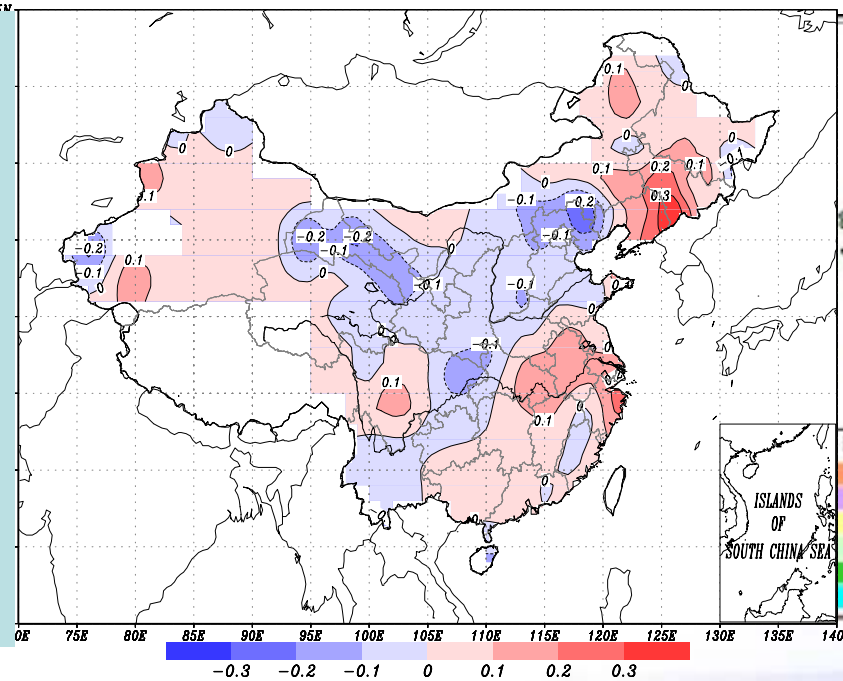
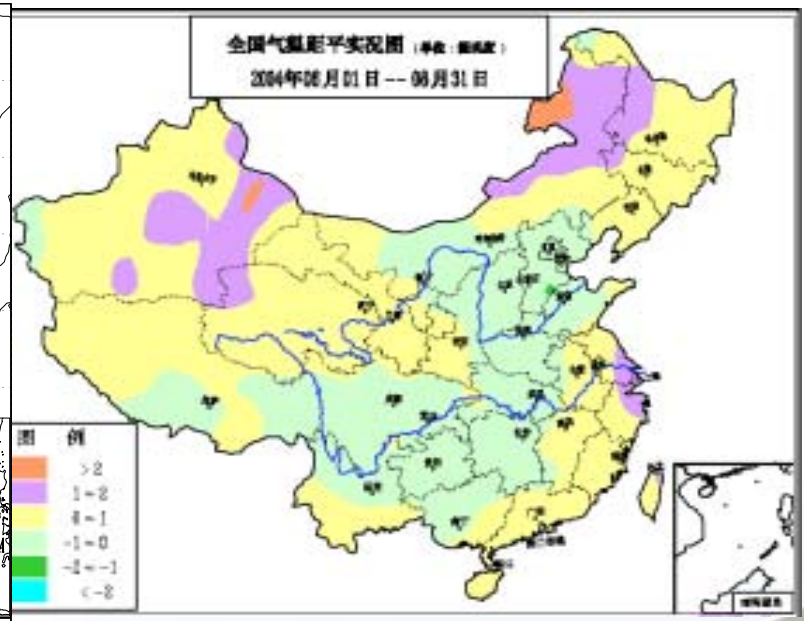


8月( )

2004 Summer temperature Anomaly

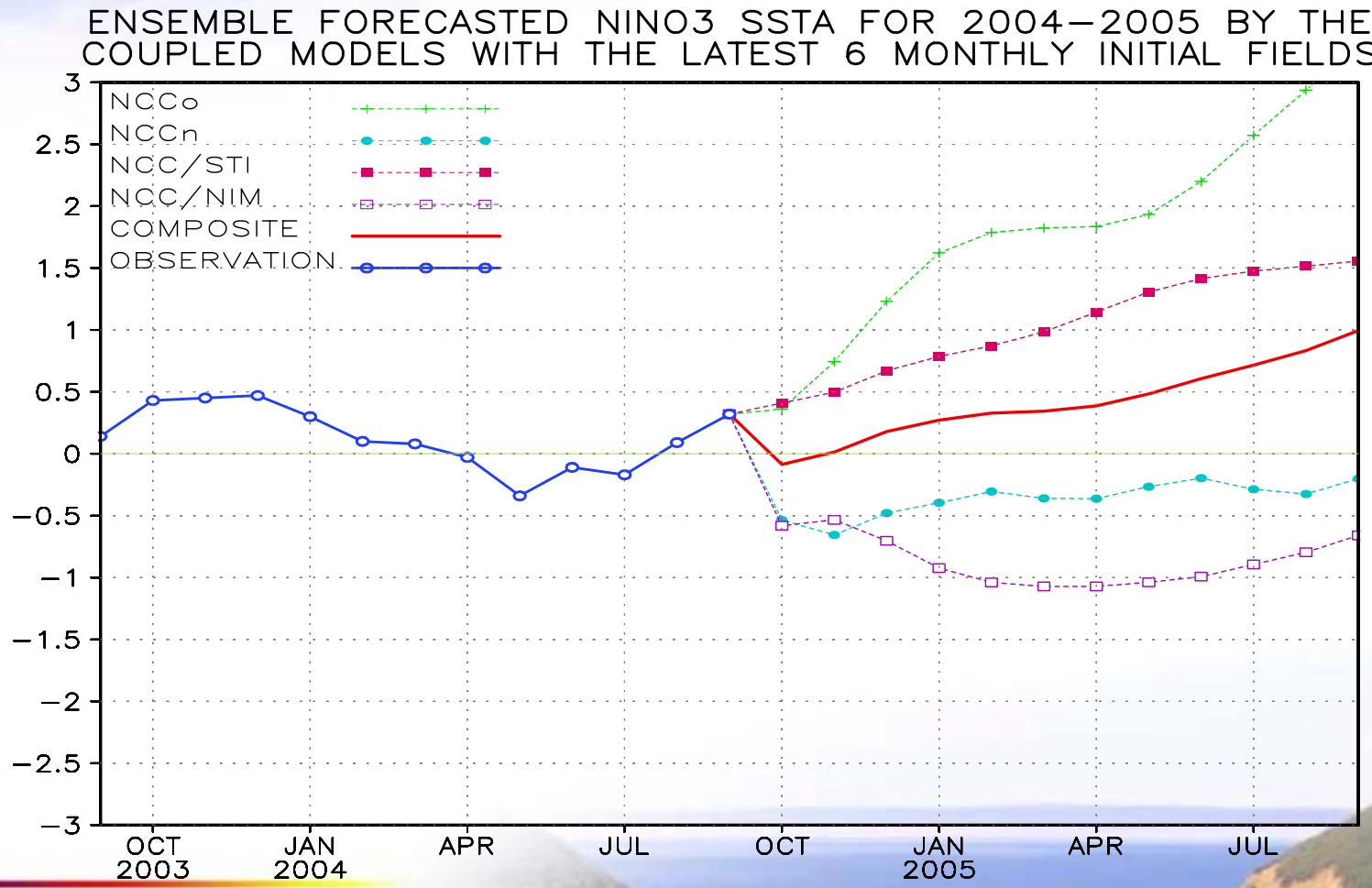
3月初始场 4月5日参加 全国汛期 会商
T213初始场 订正后





实况

太平洋NINO3 海表面 度距平
化模式 2004年9月初始



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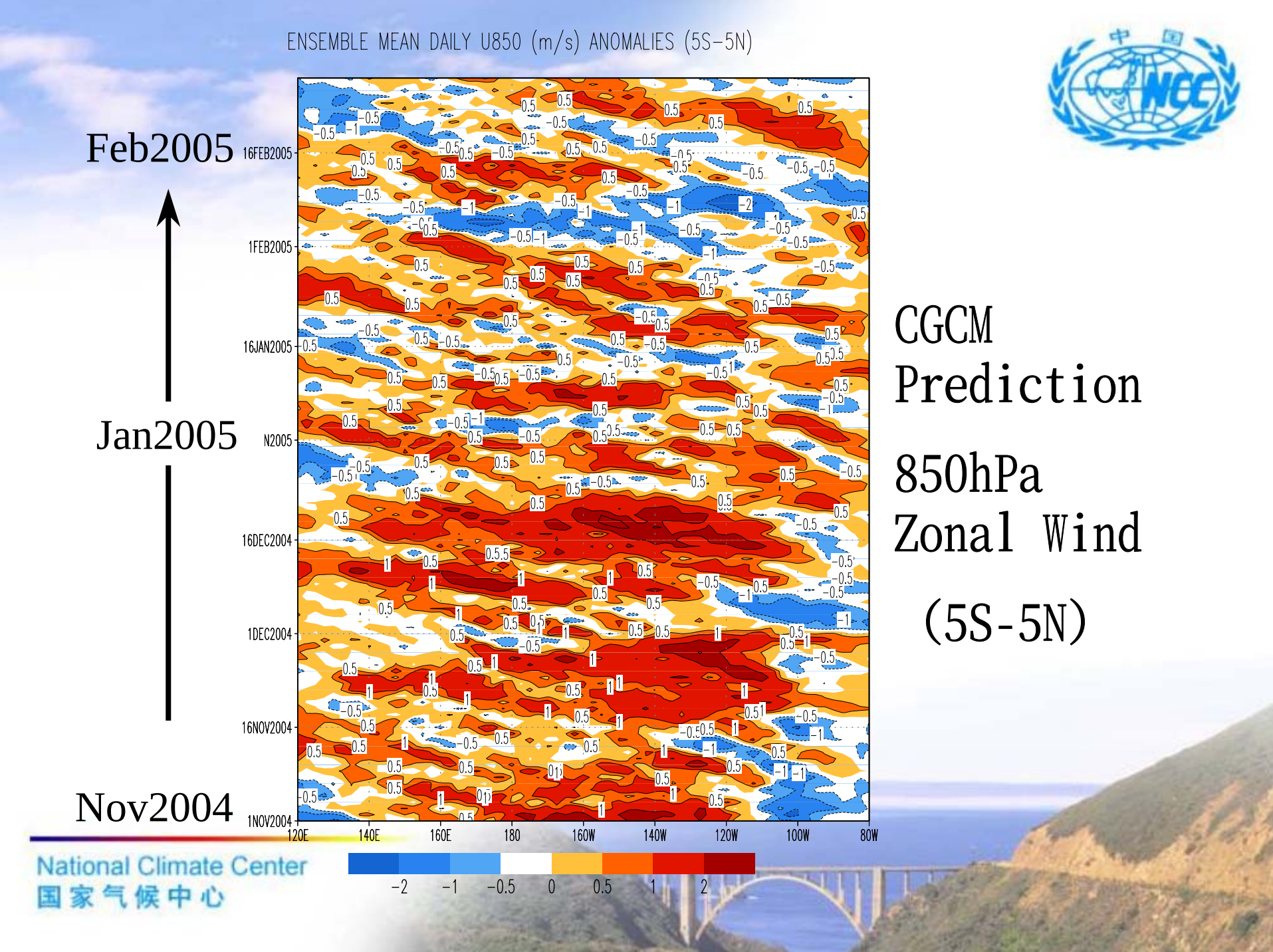
ENSEMBLE MEAN DAILY U850 (m/s) ANOMALIES (5S-5N)
Feb2005
Jan2005
Nov2004
16FEB2005
1FEB2005
16JAN2005
N2005
16DEC2004
1DEC2004
16NOV2004
1NOV2004
120E
140E
160E
180
160W
140W
120W
100W
80W
-2
-1
-0.5
0
0.5
1
2
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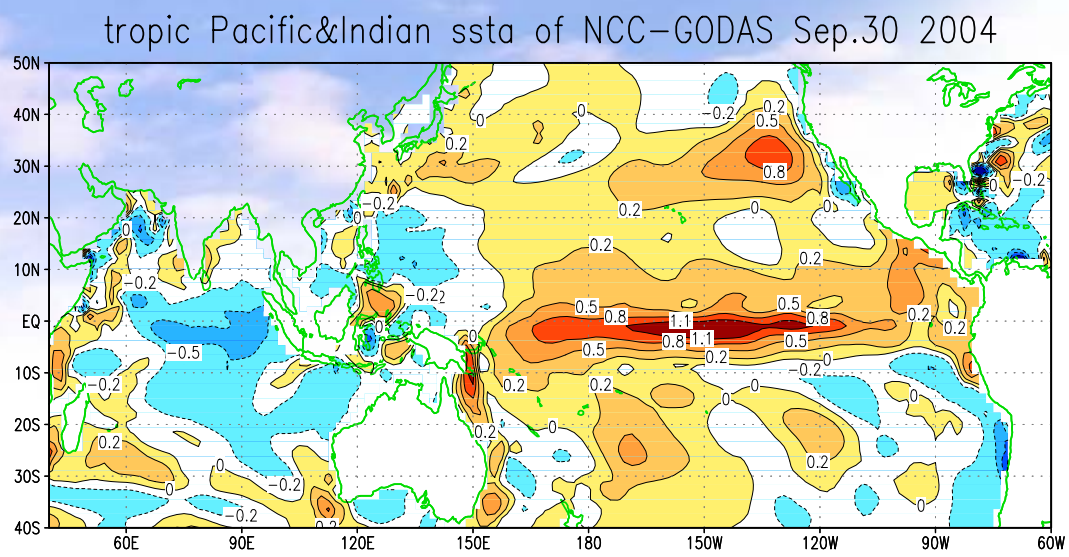
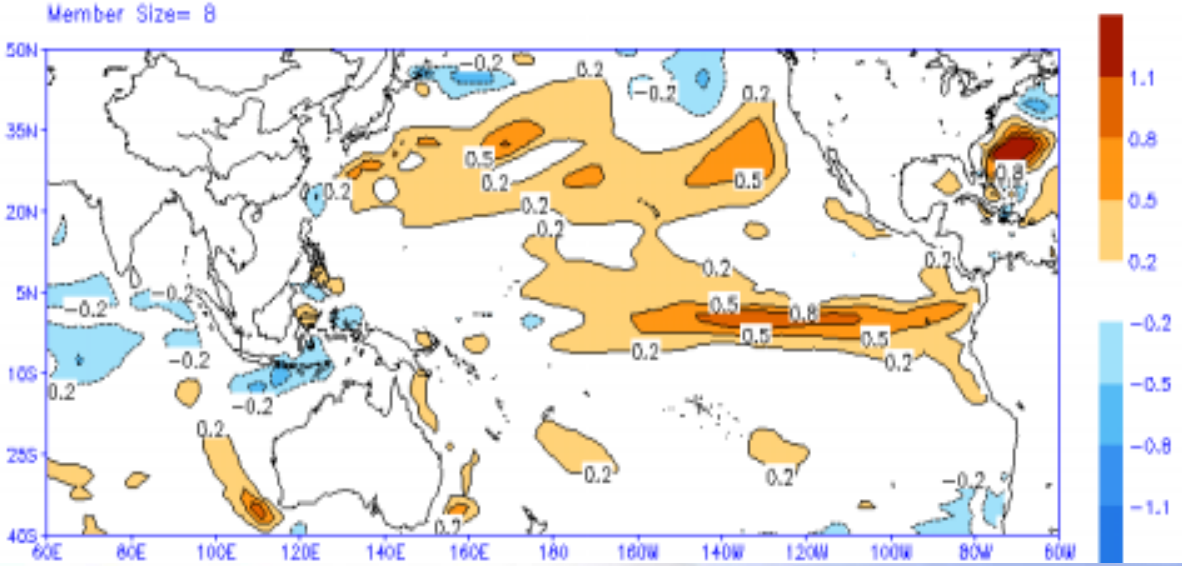
CGCM
Prediction
850hPa
Zonal Wind
(5S-5N)



初始SSTA(170-120W)

Nino3.4 SSTA=0.77



CGCM

2004/05冬季SSTA

Nino3.4 SSTA=0.5

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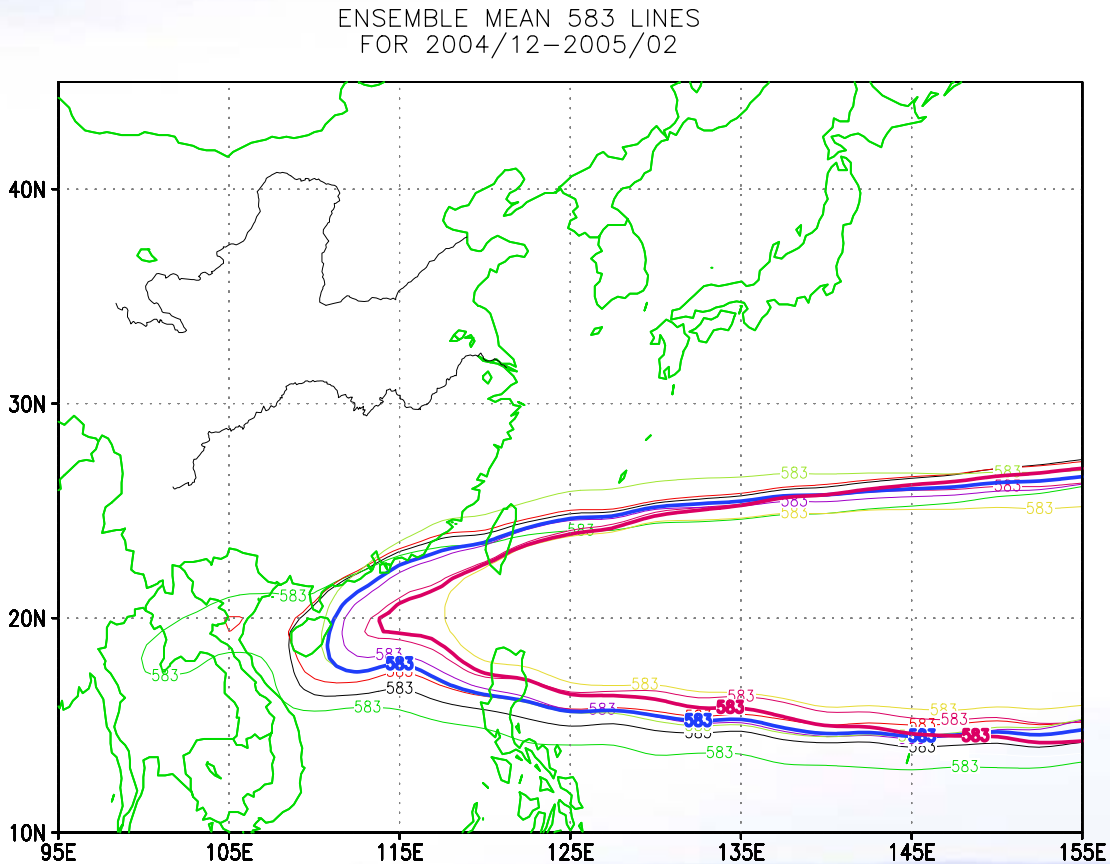
CGCM 冬季583 位置

：模式 候； ：2004/05冬季

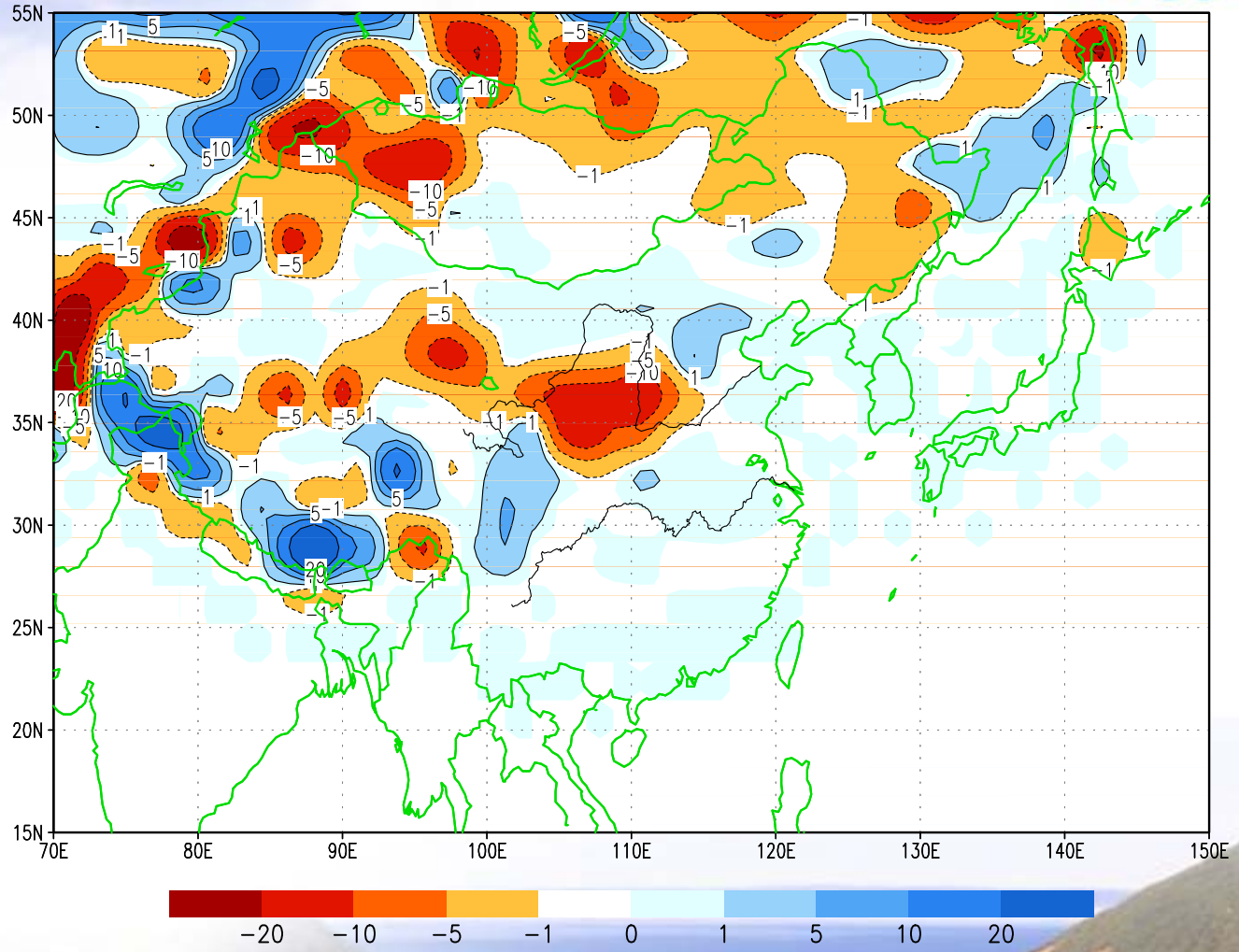


副高

偏西

偏强

ENSEMBLE MEAN SURF. SNOWDEPTH(mm). ANOMALIES
FOR 2004/12-2005/02
INITIAL DATE: 2004/10 MEMEMBERS: 08



CGCM

高原冬季
雪　常

偏多

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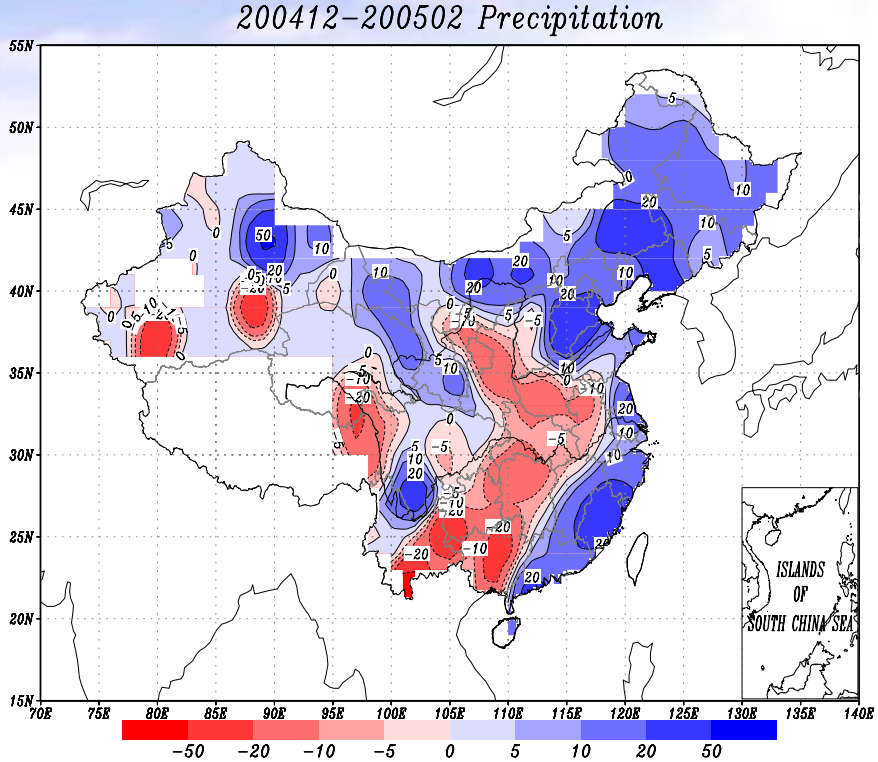
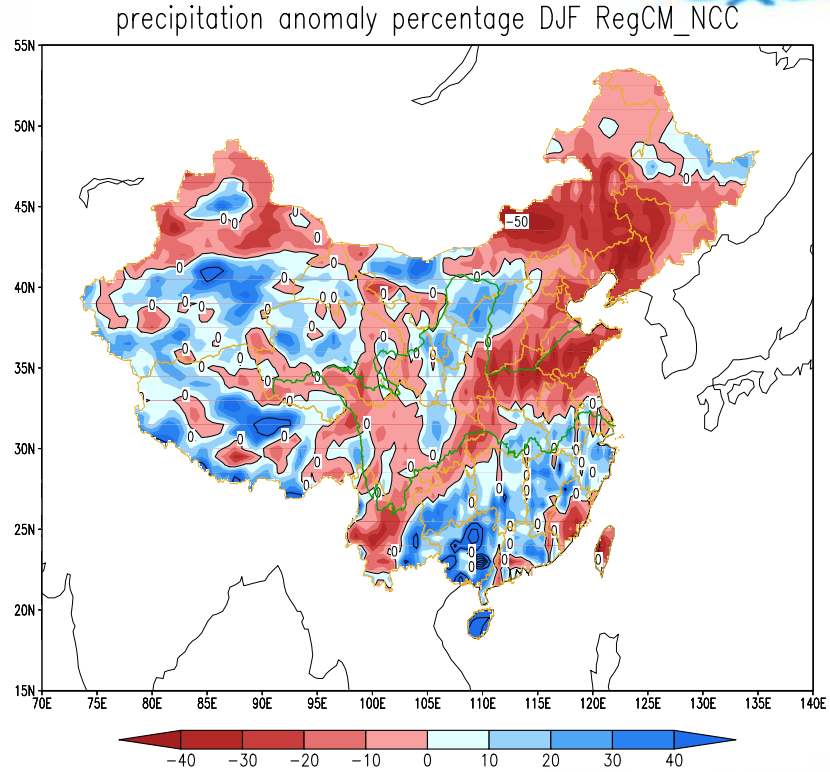
冬季降水

CGCM



RegCM



北方大部、　部沿海、　南 地　、在　北和　南 西部的四川南部偏多1-2成；

　中 至江南西部、西藏　部 偏少1-2成。

　果 与CGCM　果差异　大，　乎相反。

Experimental PHASE 2002-2004

Hindcast periods 20 years 1982-2001

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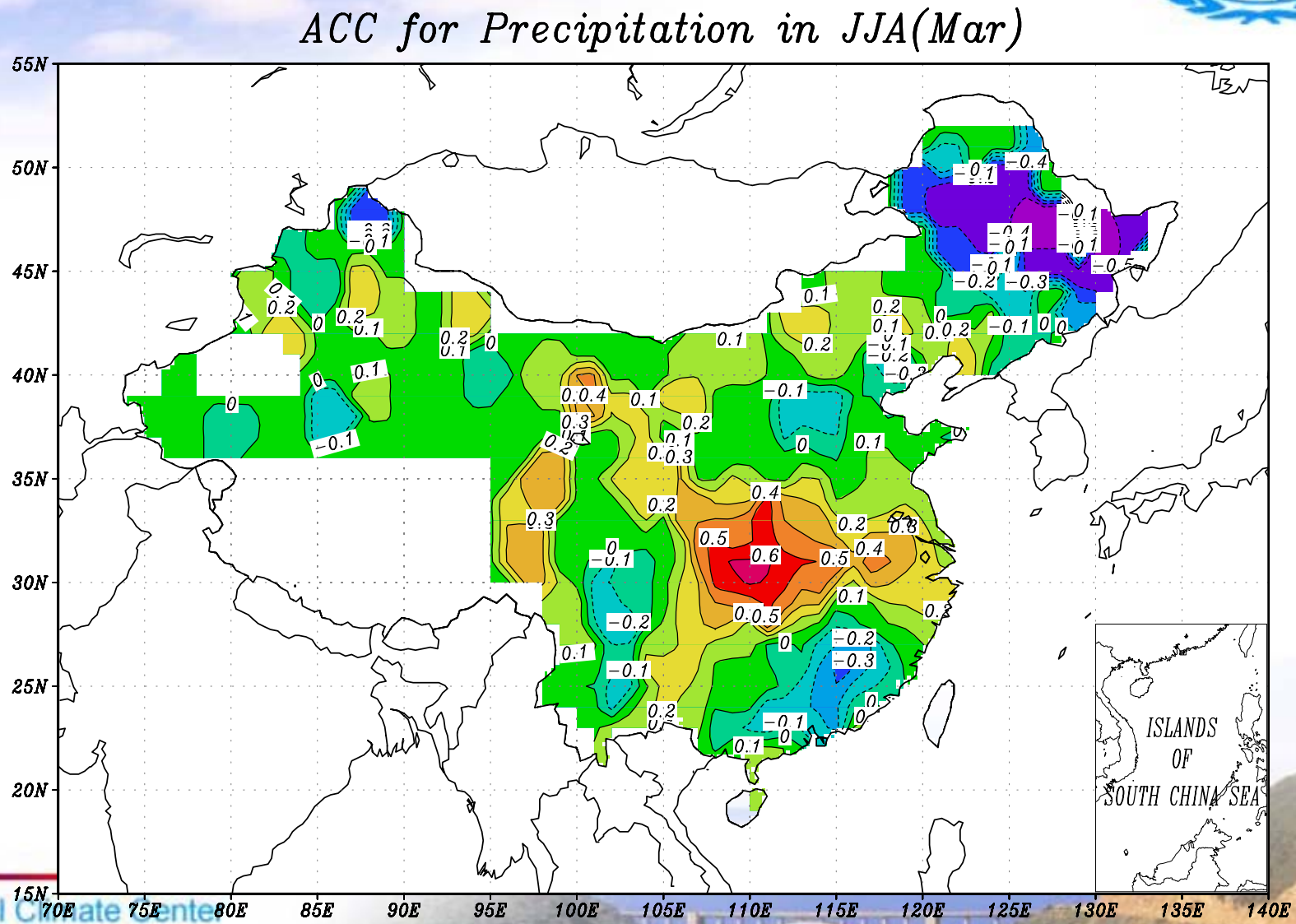
Anomaly correlation coefficient between predicted and observed summer precipitation during recenter 20 years (Ensemble, initial Mar)



Anomaly correlation coefficient between predicted and observed summer temperature during recenter 20 years

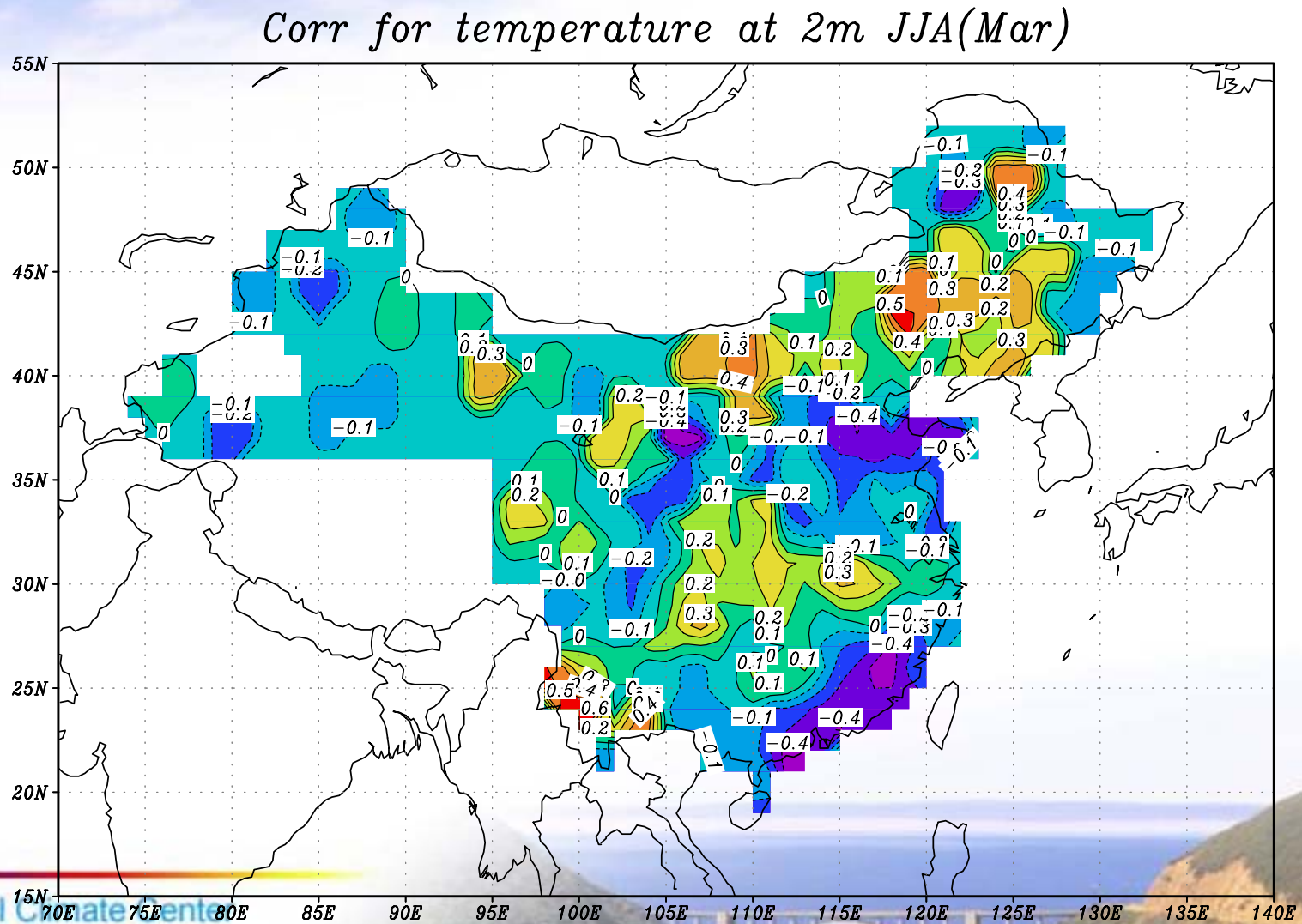


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Table 2(a) Skills for flooding season rainfall hindcast by CGCM-NCC during 1991-2001

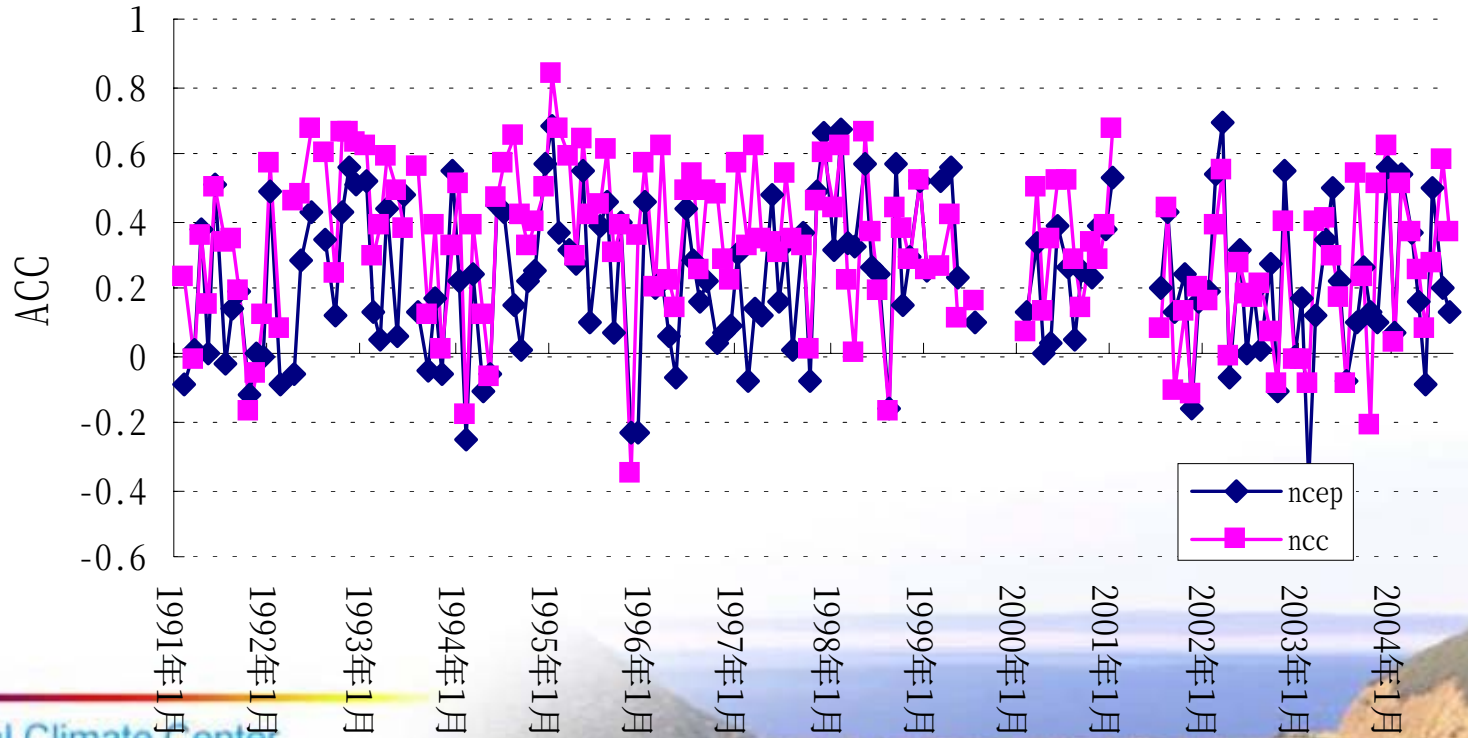
Year	RATc	P	RMSSS	ACC	TS
1991	63.75	77.82	42.65	0.14	0.33
1992	42.5	56.32	53.2	-0.11	-0.7
1993	48.75	68.78	44.25	0.11	0.8
1994	53.75	72.93	14.86	-0.01	0.16
1995	51.88	66.13	70.58	0.03	0.13
1996	50	64.92	49.5	0.03	0.11
1997	53.75	70.35	57.3	0.05	0.11
1998	54.38	72.44	60.08	0.07	0.18
1999	52.5	65.98	52.65	0.005	0.11
2000	52.5	72.89	59.94	0.23	0.16
2001	47.5	59.79	38.96	0.005	0.2
AVE	51.93	68.03	49.45	0.05	0.12
Ave-NCC		67.9		0.02	0.08

Table 2(b) Assessment score for flooding season rainfall hindcast by RegCM-NCC during 1991-2001

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-NCC	67.9	-0.03	0.08	0.02	0.08

ACC of Monthly Forecast of 500hPa Height

ACC：0.32



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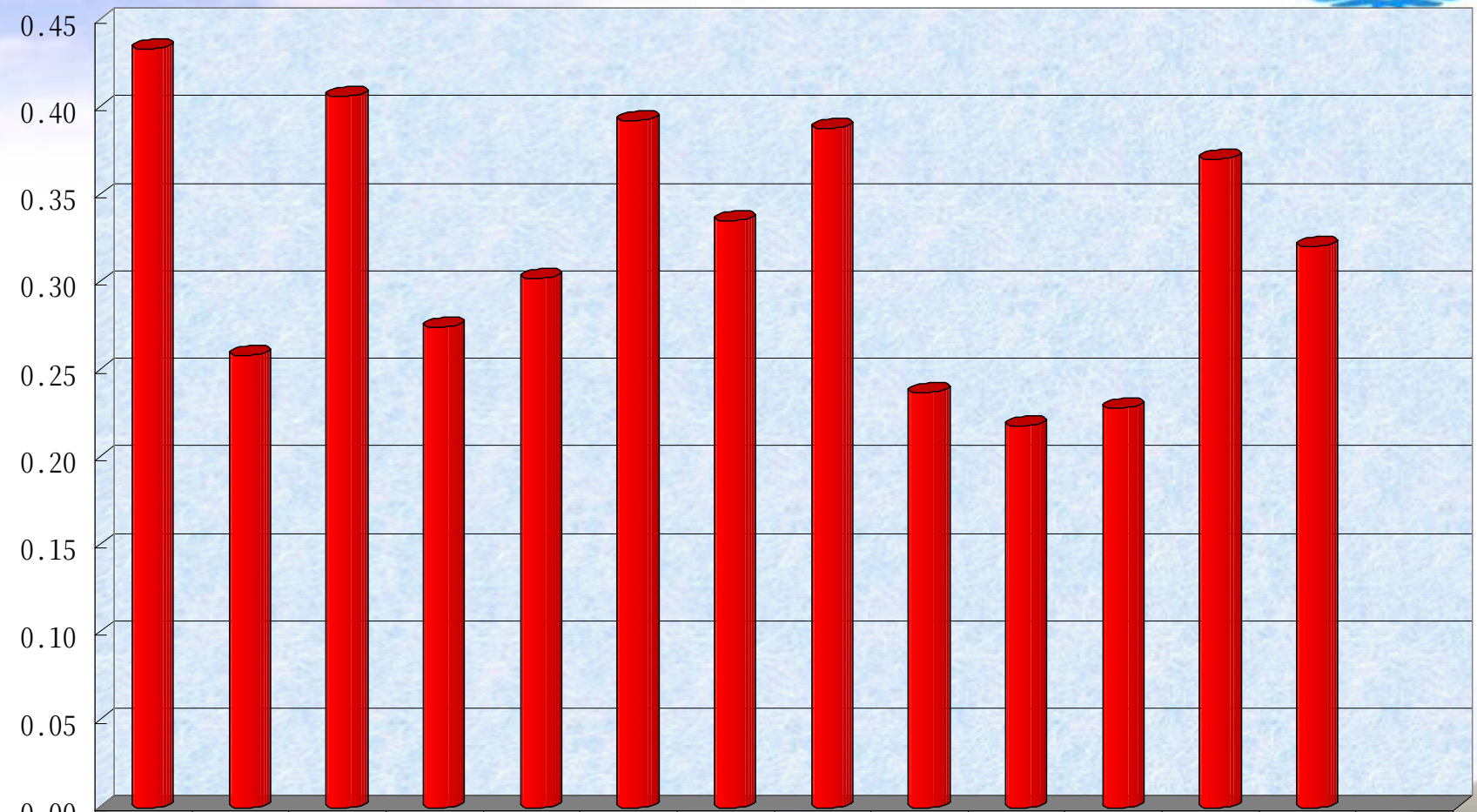
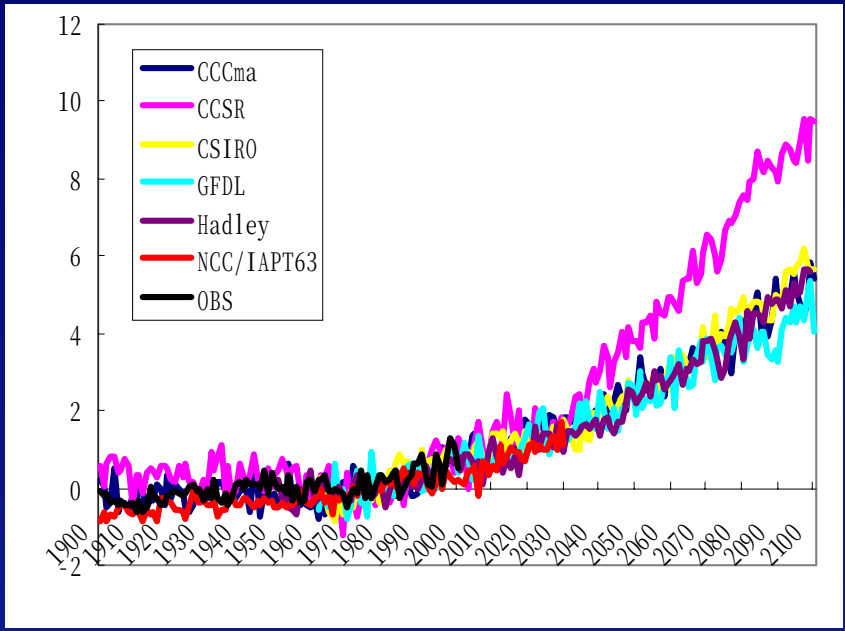
各月平均ACC



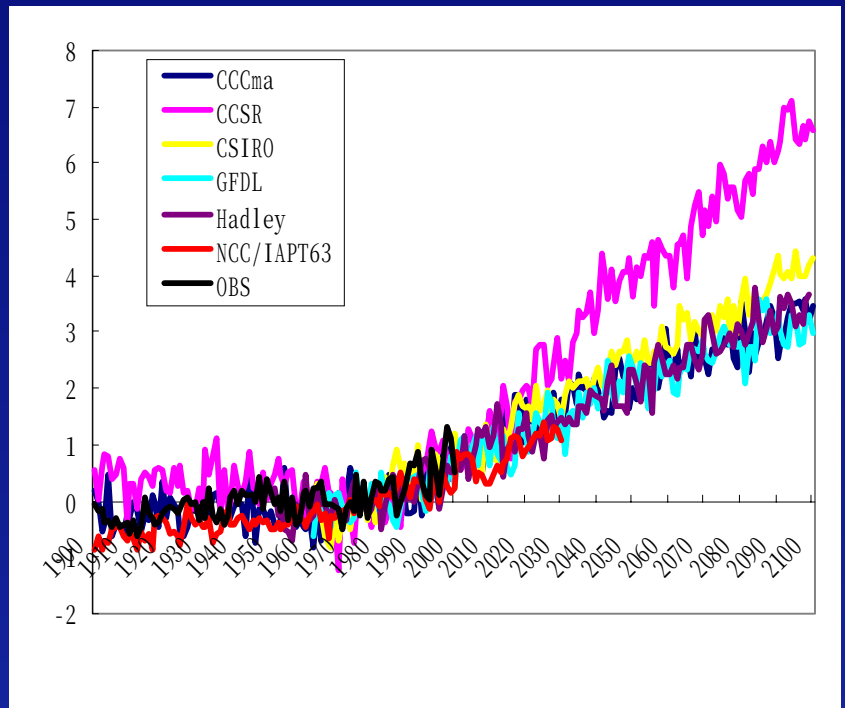
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
平均	0.43	0.26	0.41	0.27	0.30	0.39	0.34	0.39	0.24	0.22	0.23	0.37	0.32

Temperature Change in East Asia During1900-2100(℃) (SRES)

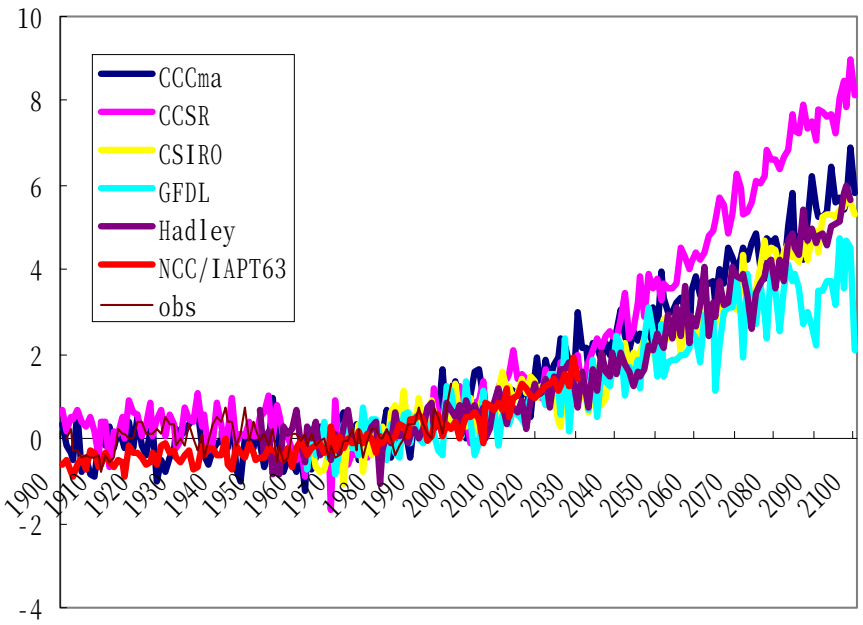


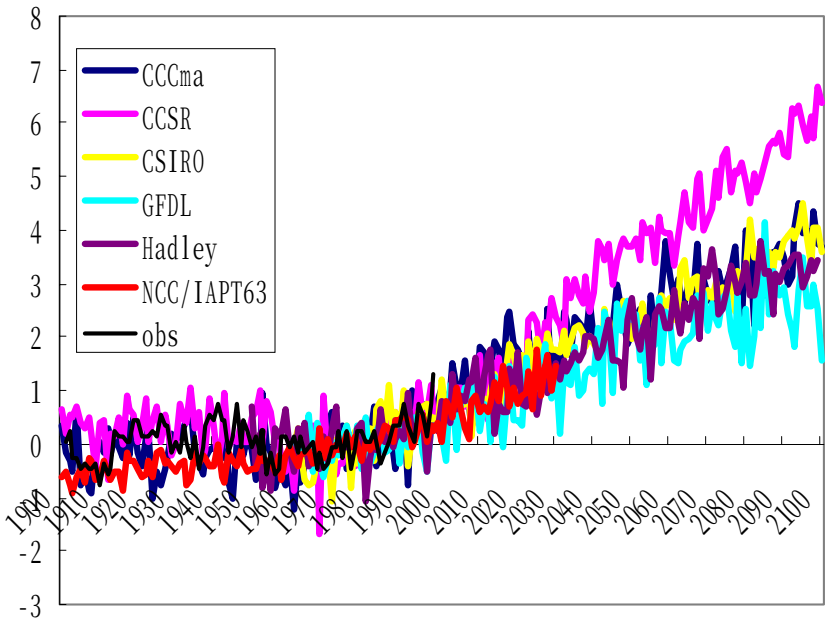
Scenario A2: Mean Temperature increases 1.1~1.8 ℃ in 2030, 1.9~3.8℃ in 2050, 5.3~9.5℃ in 2100。

Scenario B2: Temperature increases 1.0~1.8 in 2030， 1. 9~3.6℃ in 2050， 3.2~6.9℃ in 2100。



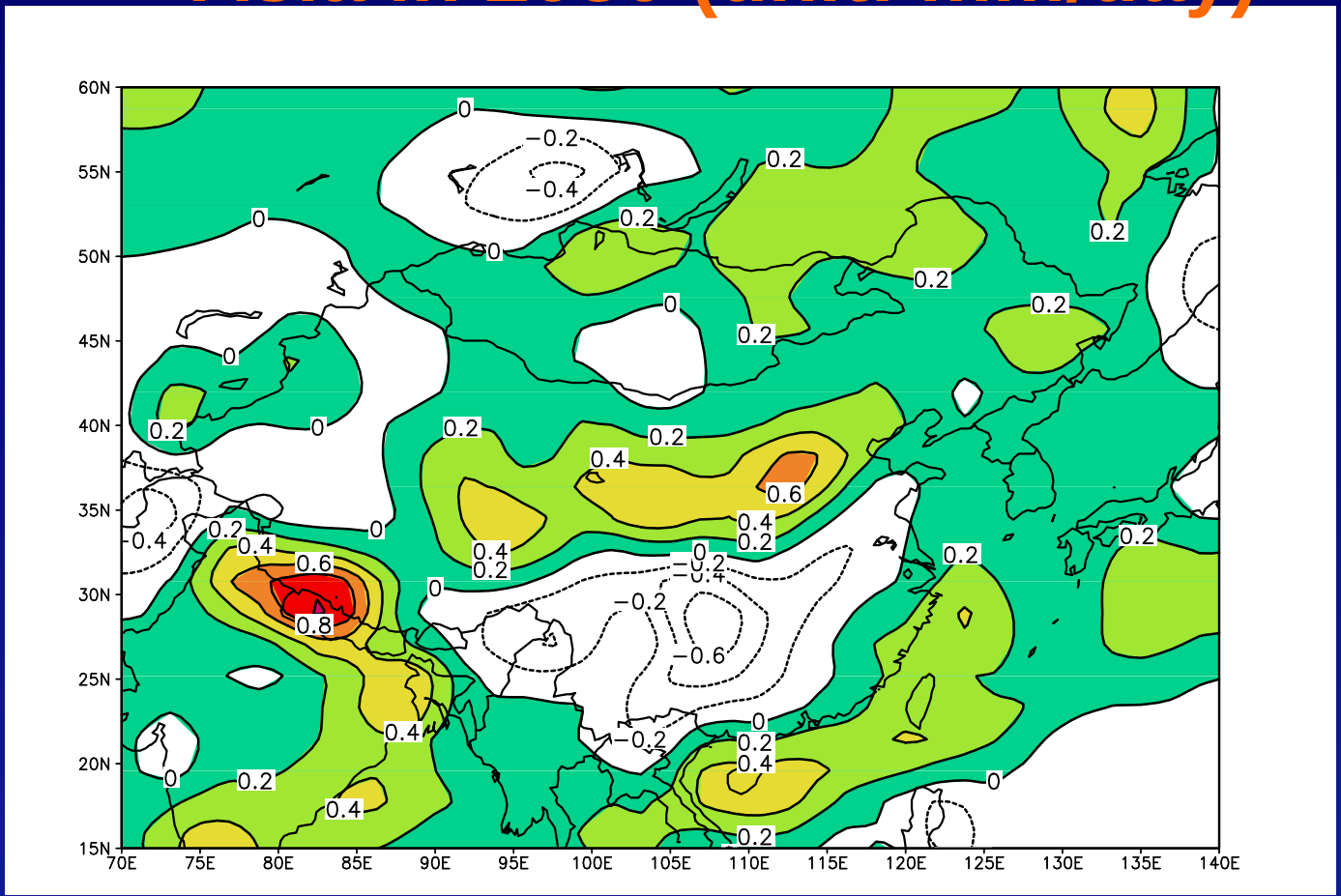
Temperature Change in China During1900-2100(℃) (SRES)





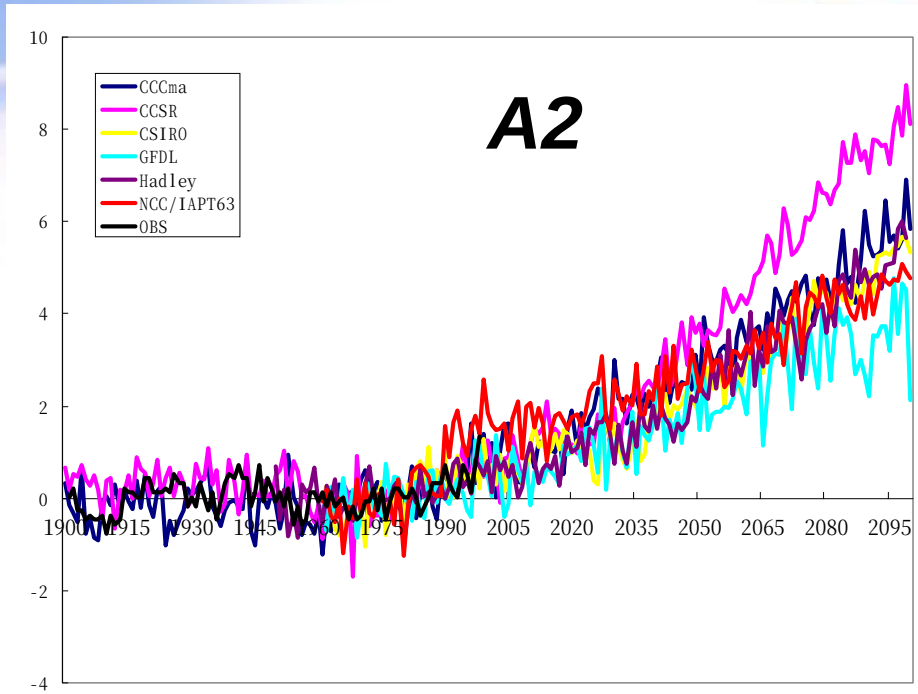
SRES A2: increases 5.5℃ in 2100, B2: increases 3.9 ℃

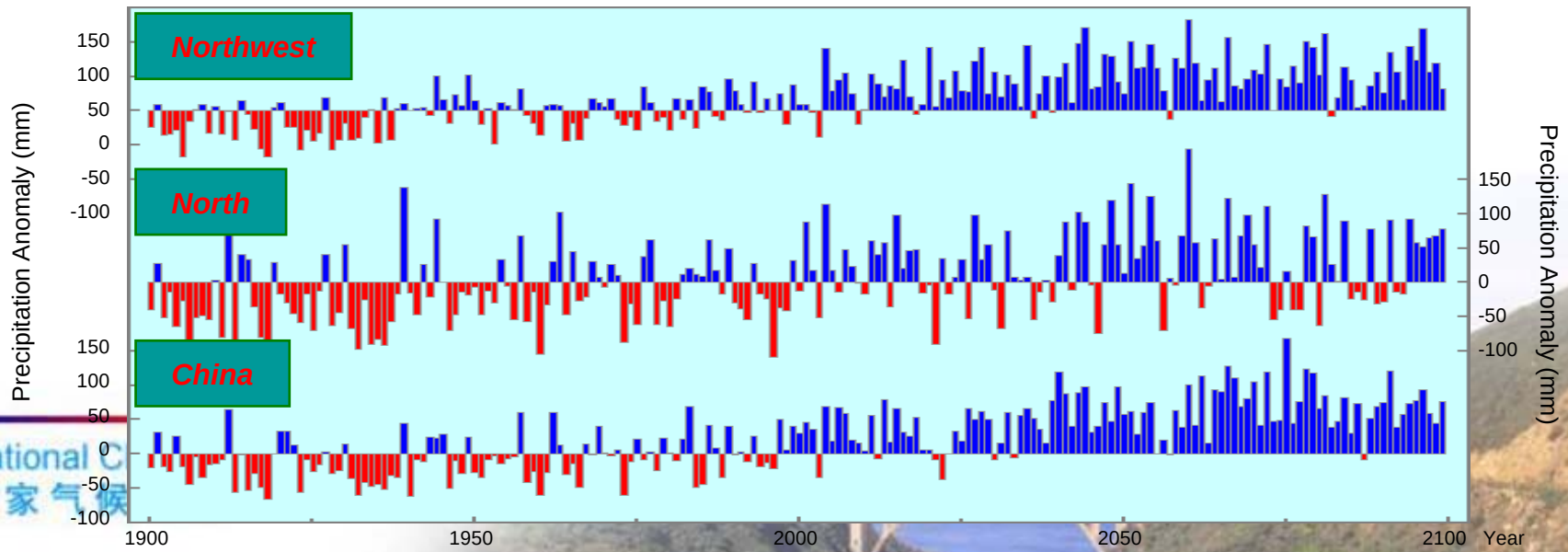
Precipitation Change in China and East Asia in 2030 (unit: mm/day)



IPCC AR4

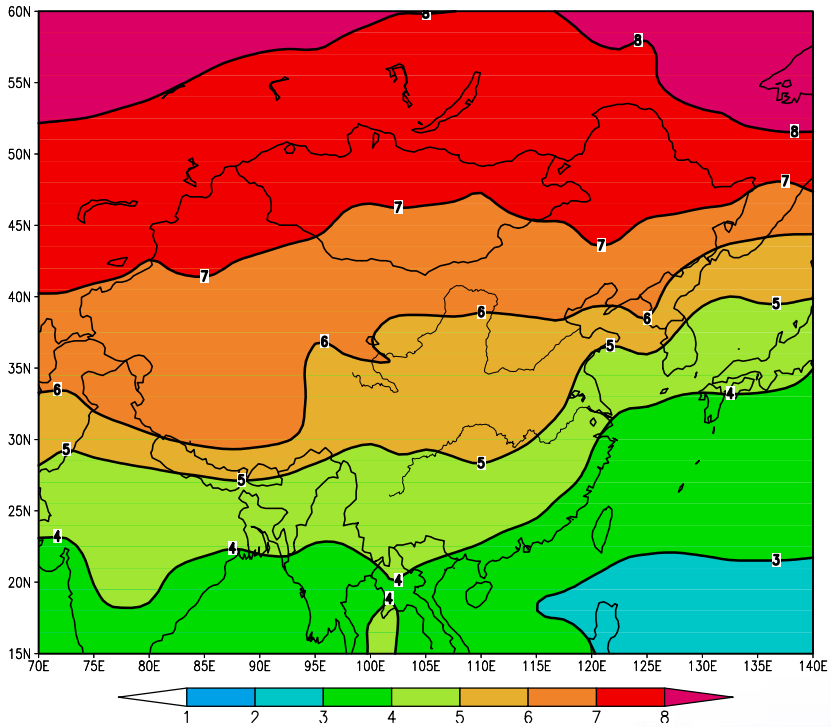
Temperature and precipitation changes in China projected by the DDC/IPCC and NCC/IAPT63 models (SRES-A2) (unit: ℃)

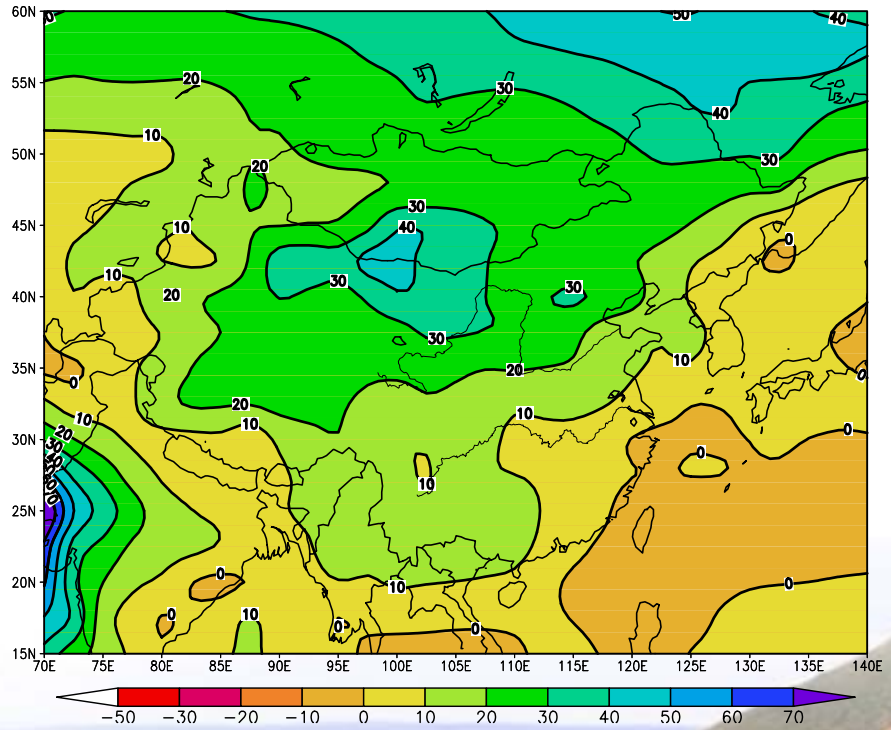




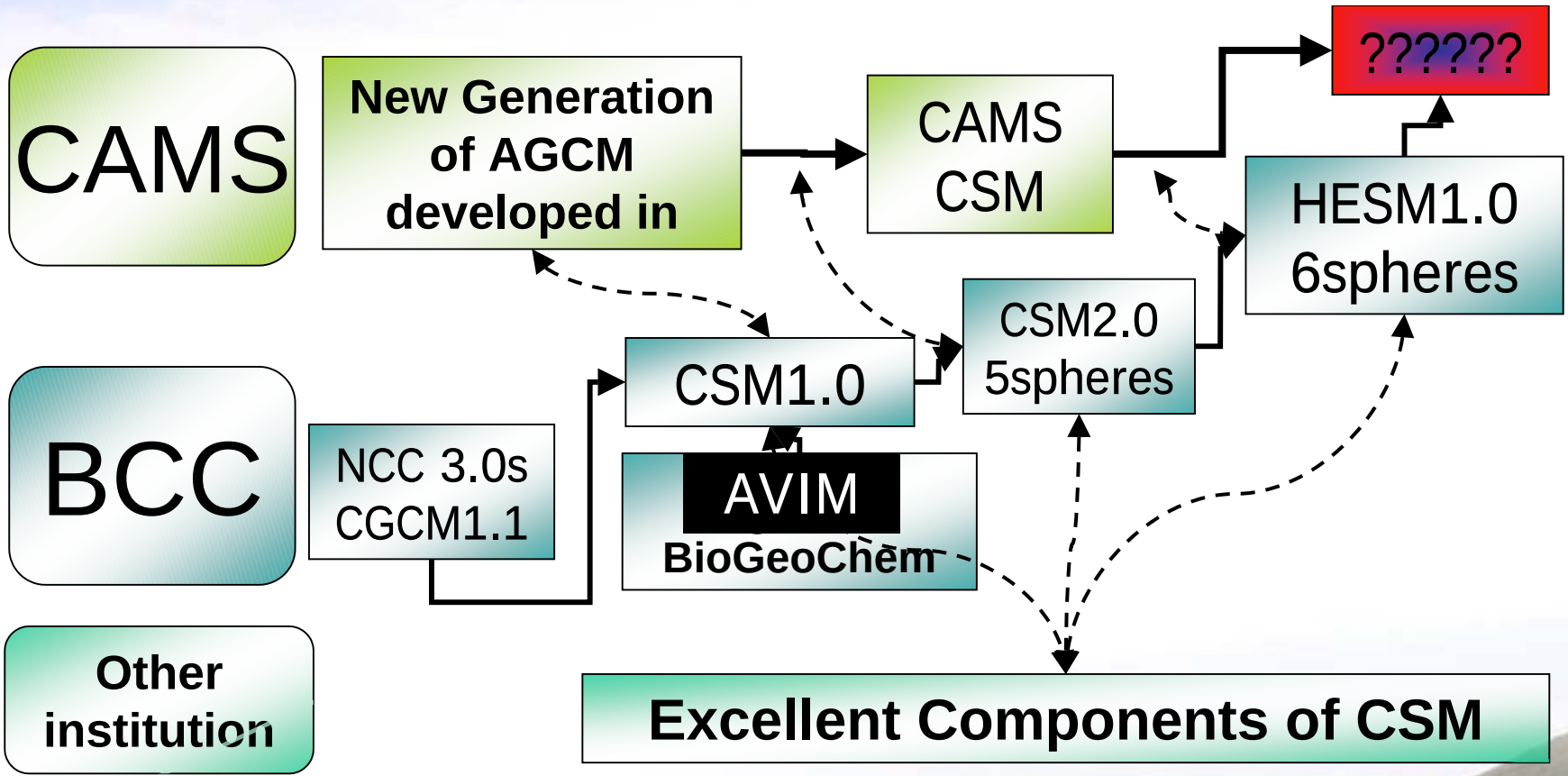
IPCC AP4

The spatial distribution of temperature (℃) and precipitation (%) changes in 21st century （2090~2099）over East Asia (SRES-A2) (left: Temperature; right: Precipitation)





BCC-CSM's Future Plan



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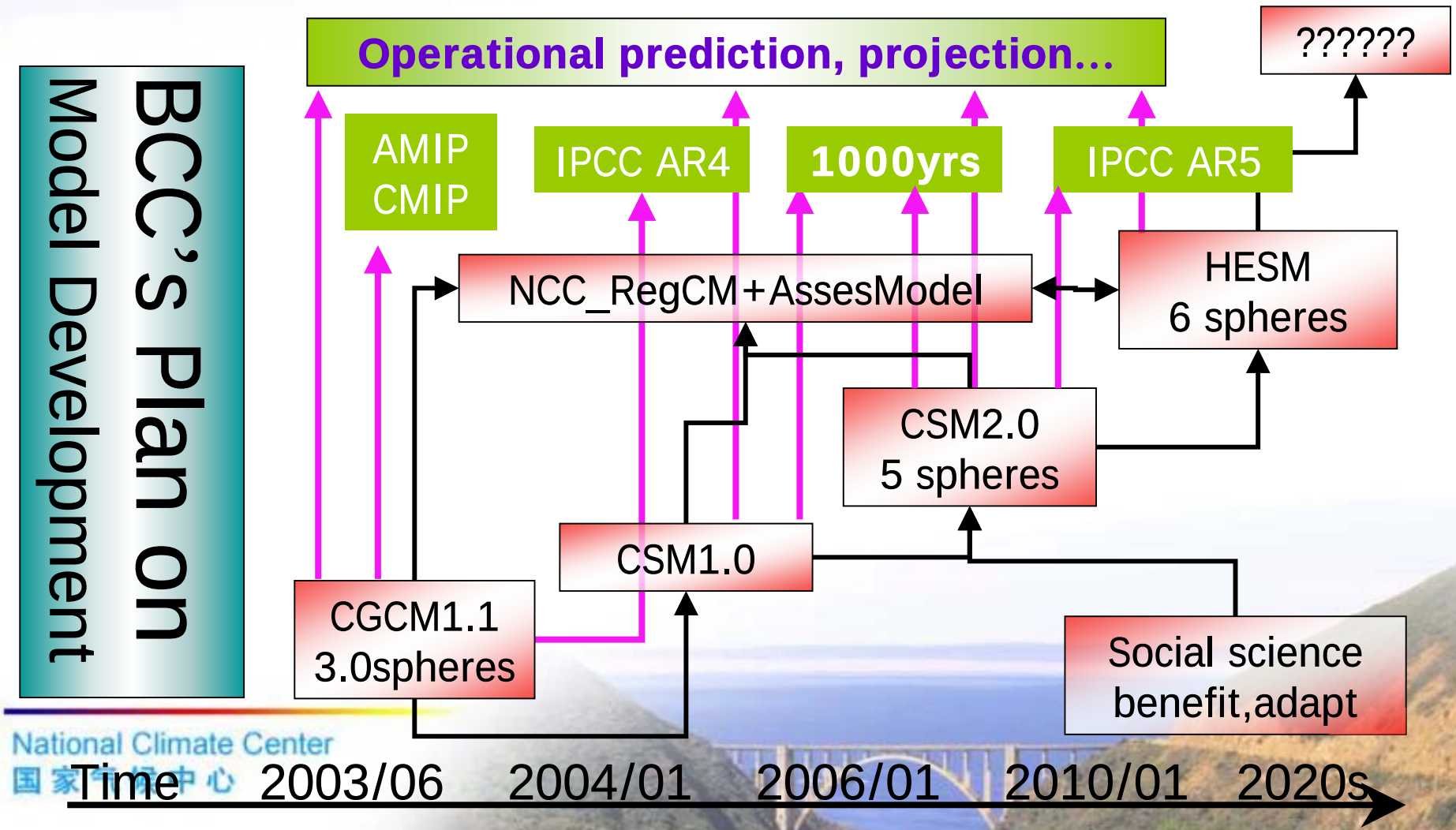
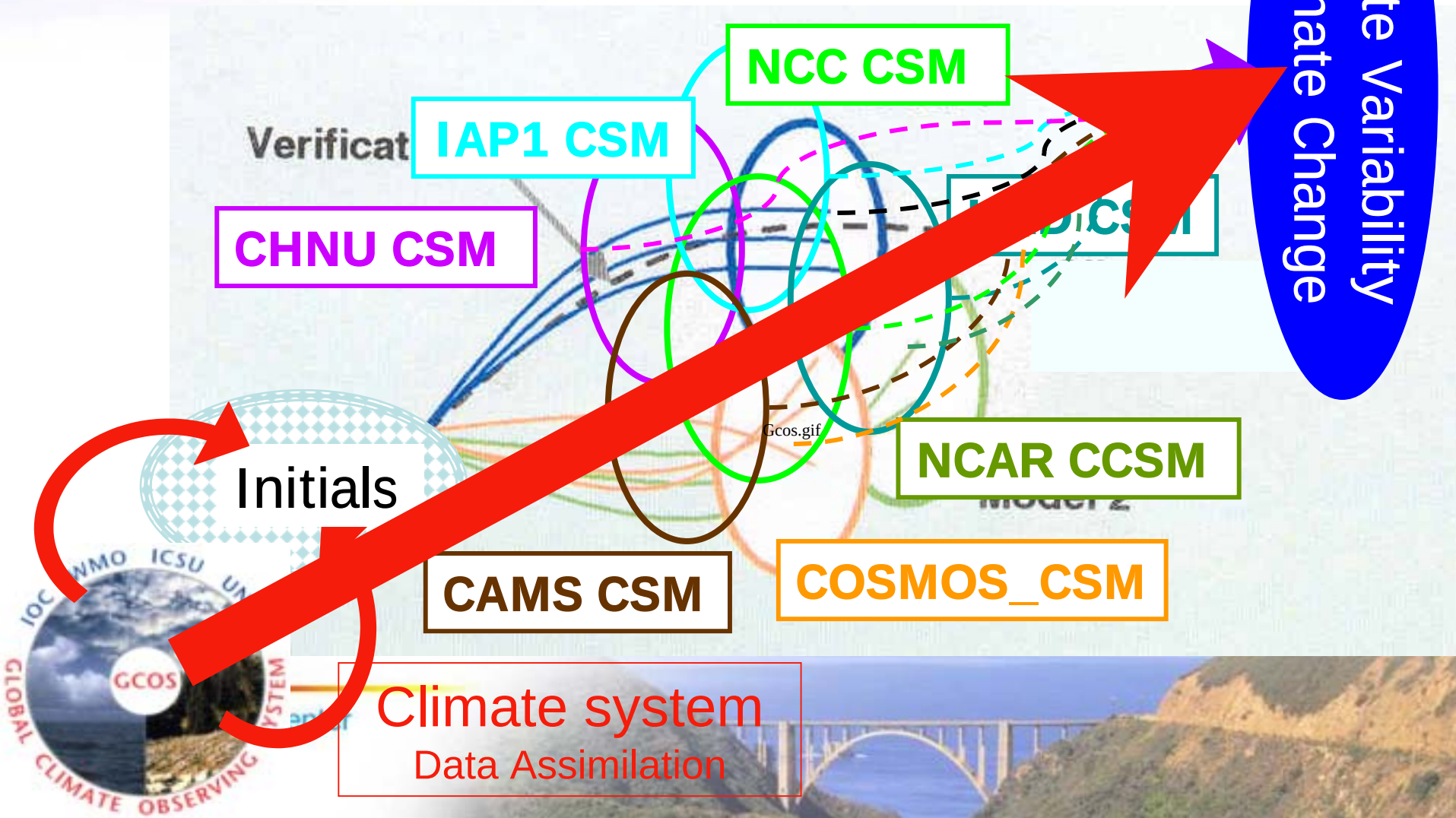
What can we provide to public and policy maker through BCC-CSM during process ?



Super-ensemble System (



THANK YOU!

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