



# **Seasonal Climate Prediction Operation in Beijing Climate Center**

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**Oct. 29-31, 2014, Tokyo, Japan**



# Outline

- **climate characteristics in China**
- **Technique for climate prediction**
- **Procedures of making forecast**
- **Climate prediction service**

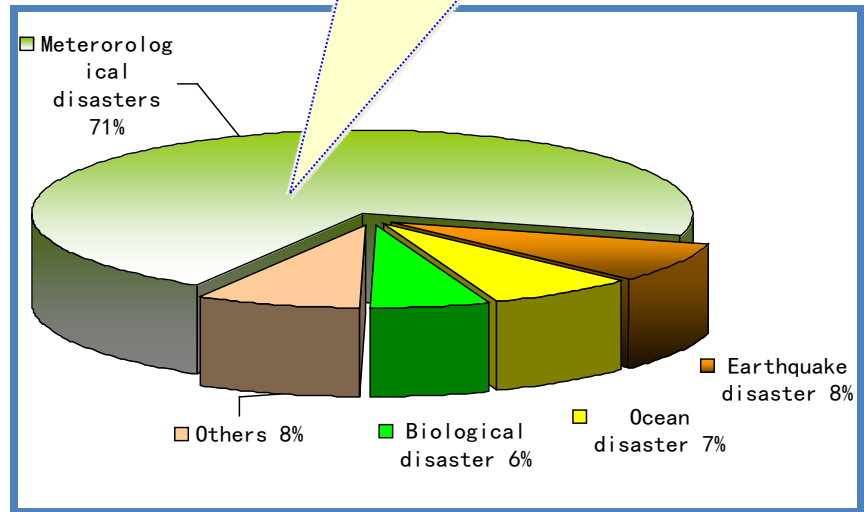


# Importance of climate prediction in China

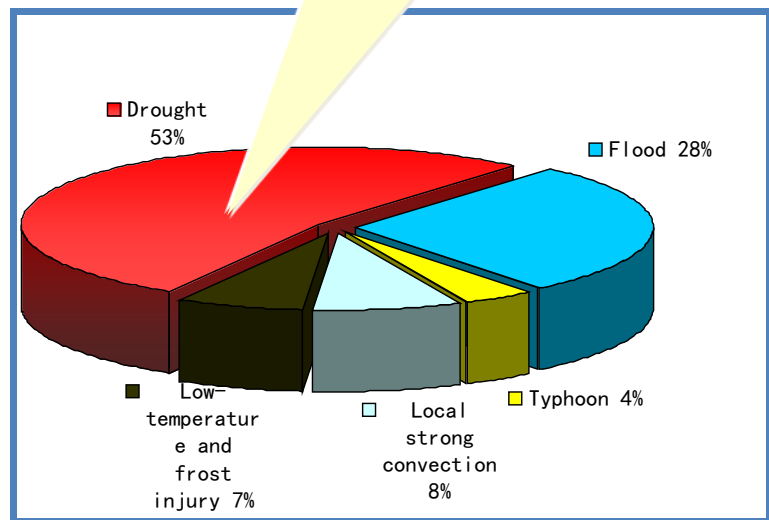
- China is located in the East Asia monsoon region where climate is characterized by strong annual monsoon cycles and variability. Meteorological Disaster (especially drought and flood disasters, typhoon activity) occurred frequently.
- A skillful forecast on drought/floods in advance is helpful to mitigate losses.

# Meteorological disasters occur frequently with great losses in China

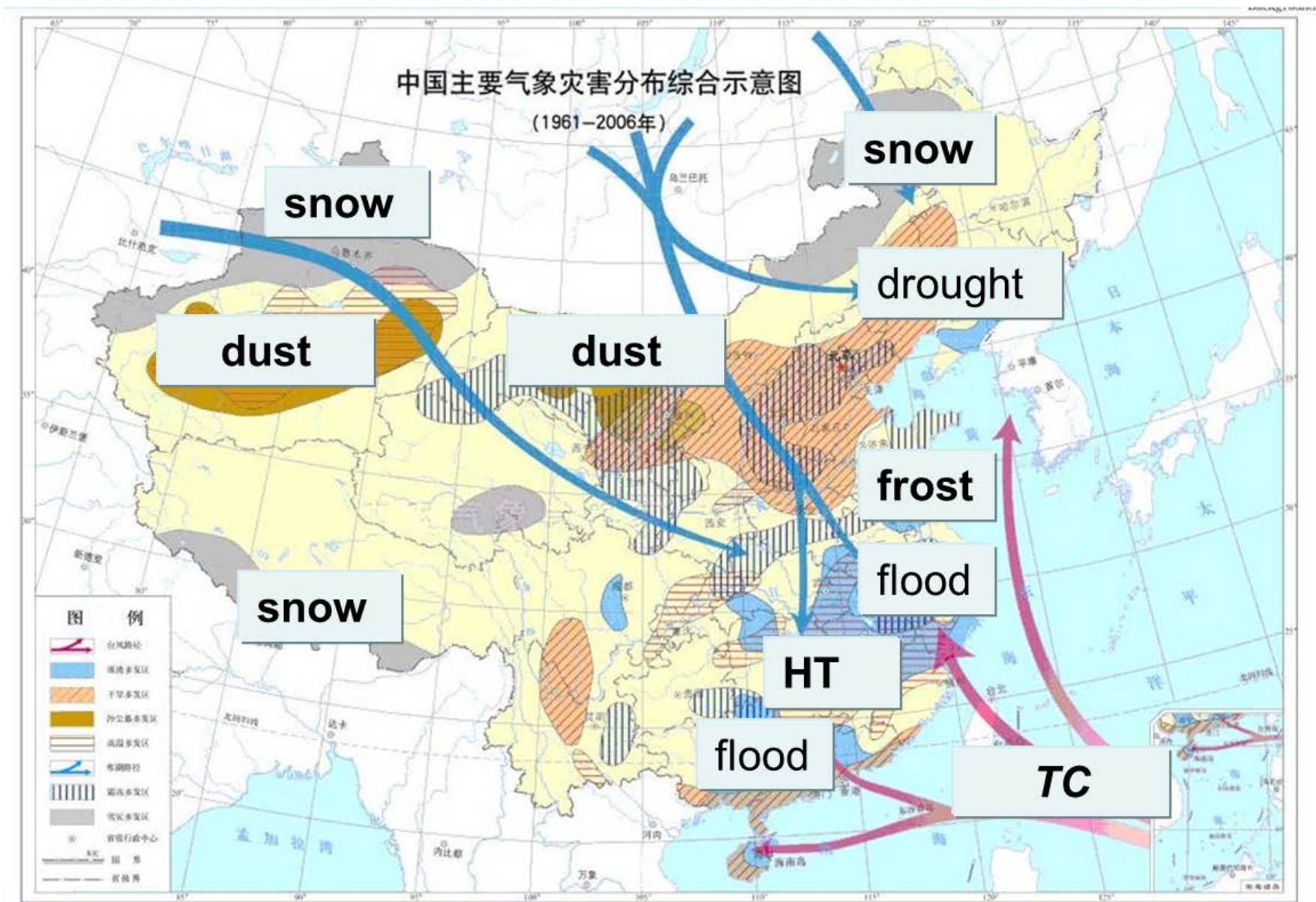
Great influence and heavy losses in meteorological disasters

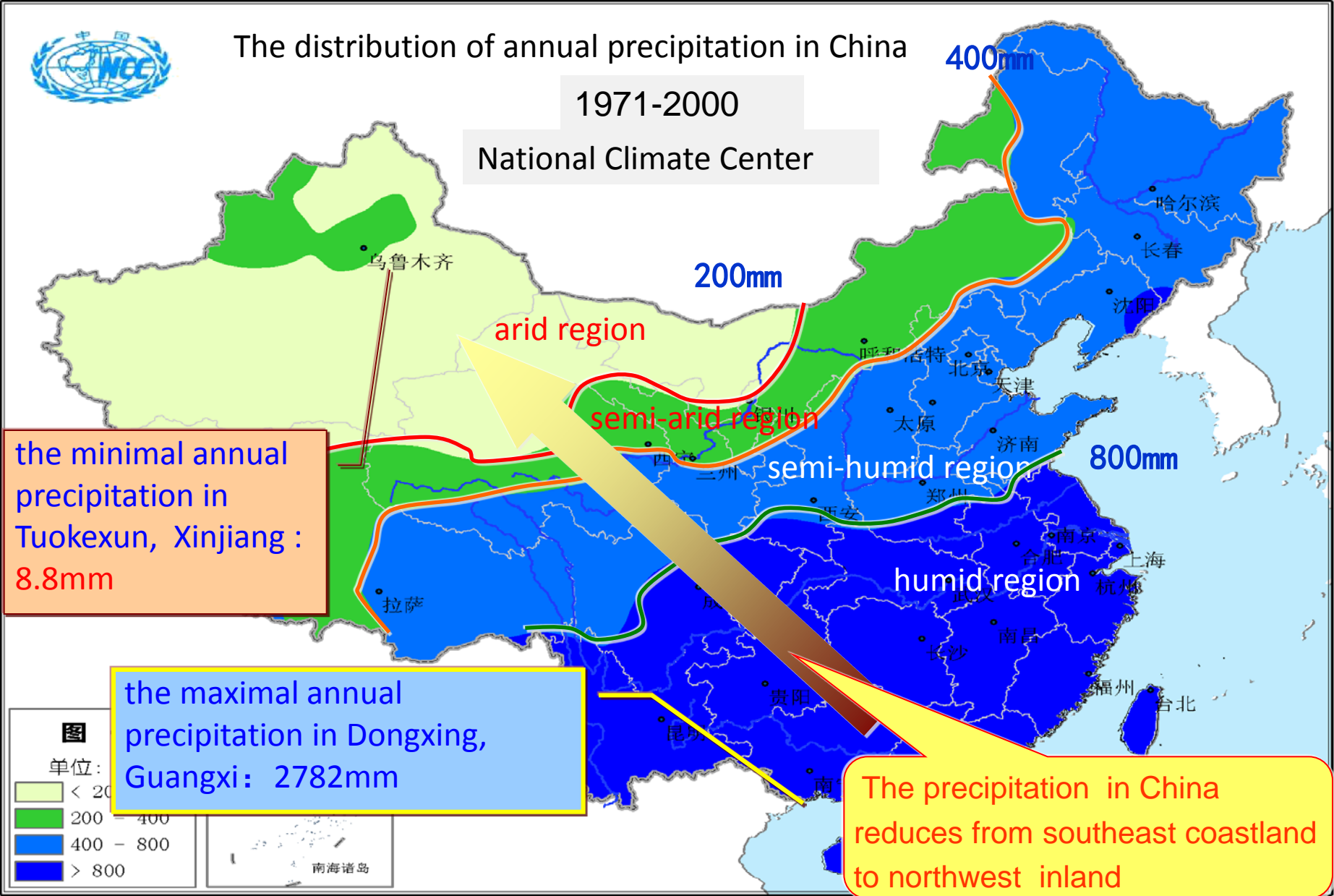


Drought and flood are the major contributors



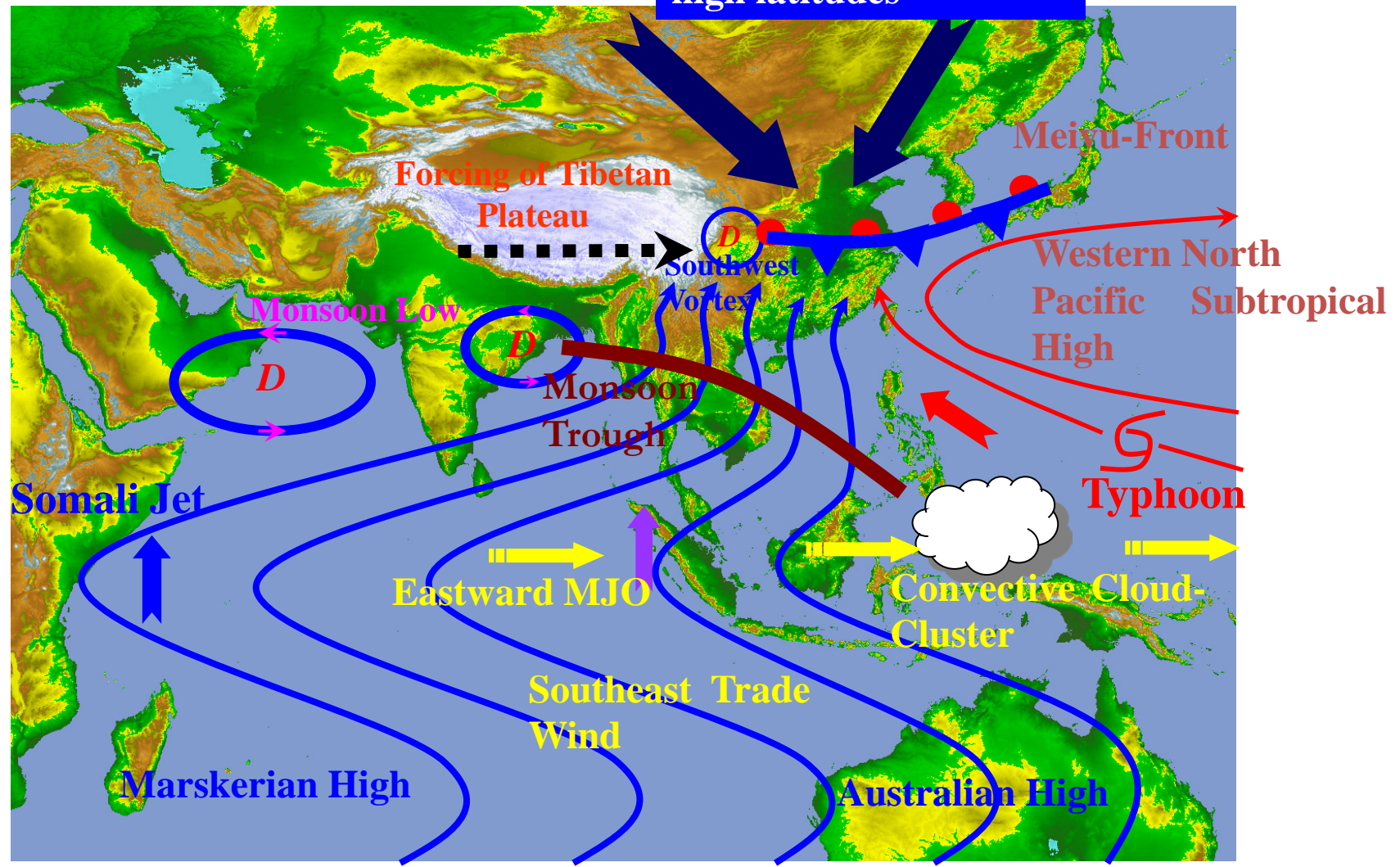
# Spatial Distribution of Meteorological Disaster



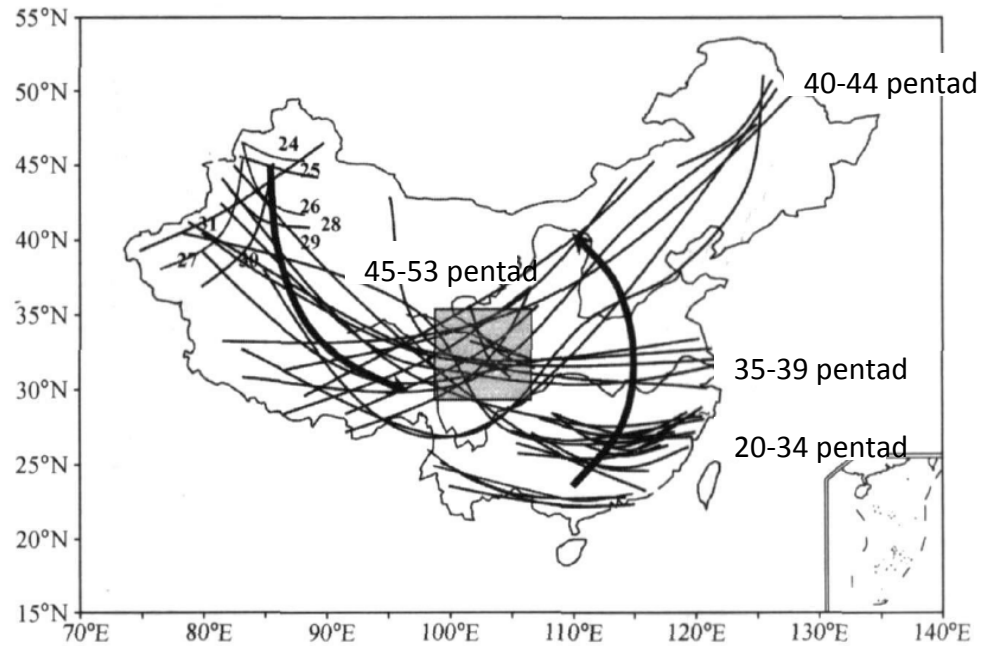
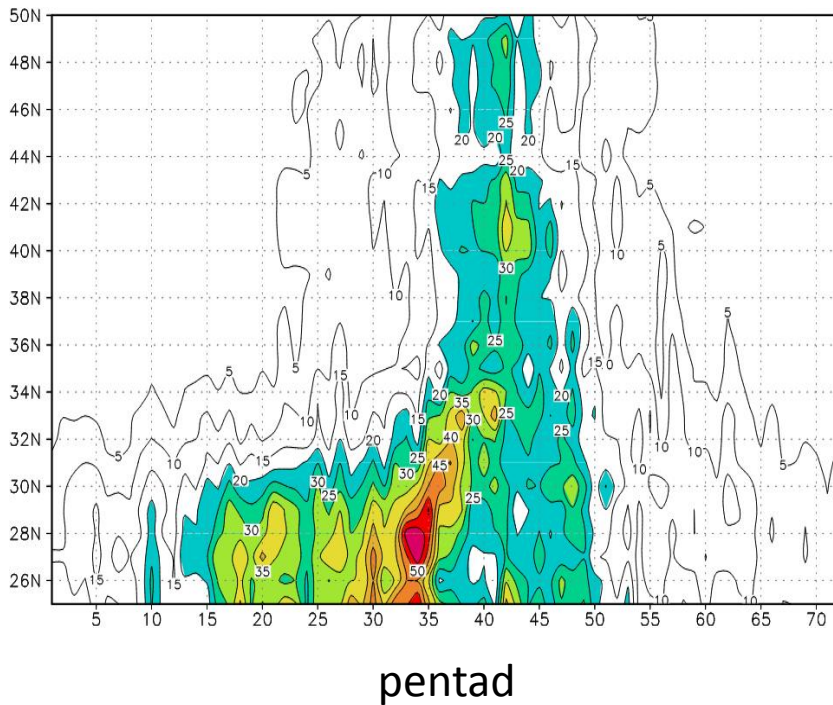


# East Asian Summer Monsoon System

Cold air from mid-and high latitudes



# Rain belts advance in Eastern China (climatology)



Sketch map of rain belt s advance in China during the major rainy seasons



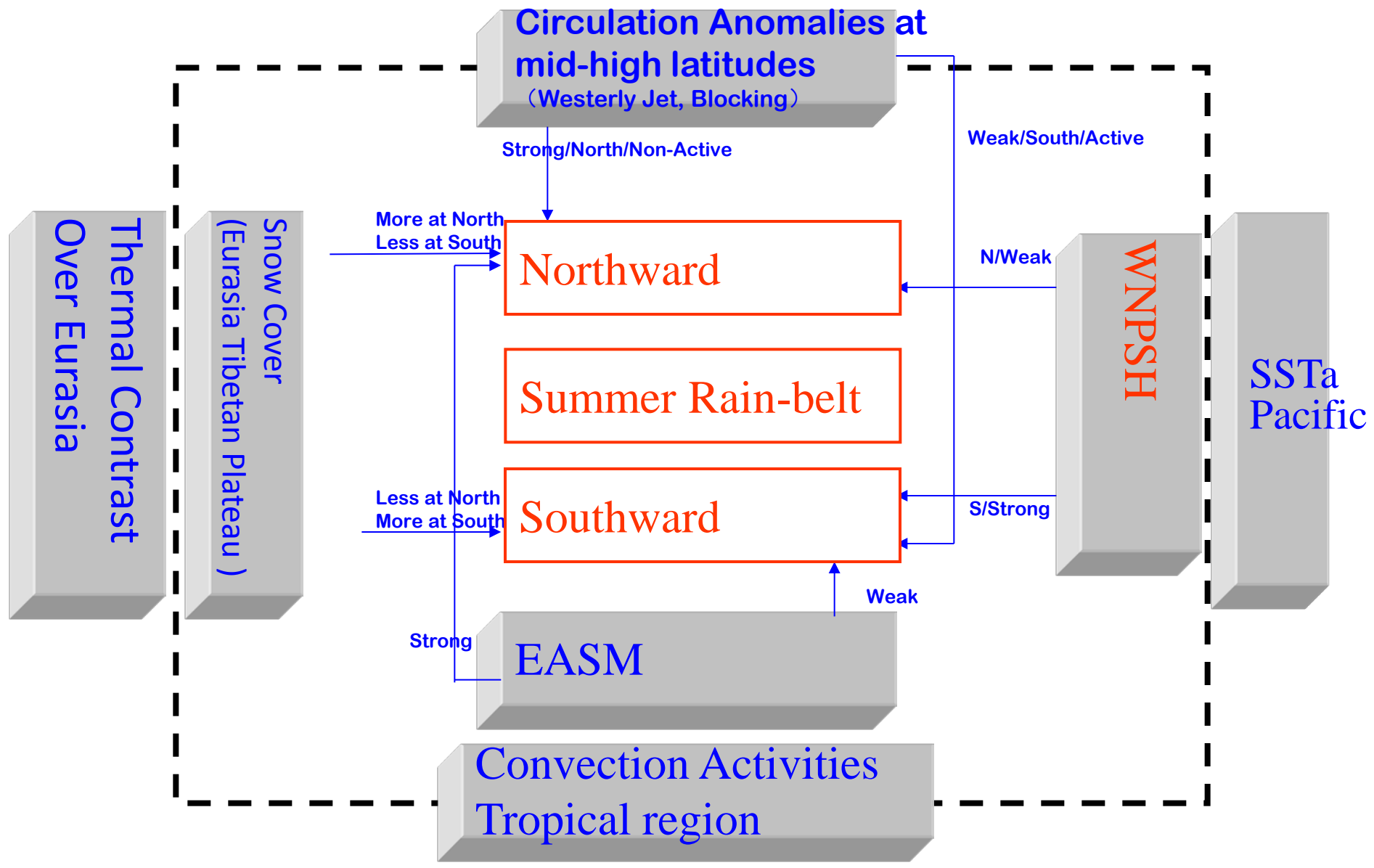


# Technique for climate prediction in the BCC

- First Phase (before 1958)
  - Empirical analysis
- Second Phase (1960s-1970s)
  - Statistical methods
- Third Phase (1980s-1990s)
  - Statistical methods and physical mechanism
- Fourth Phase (1990s- )
  - Dynamical-statistical methods



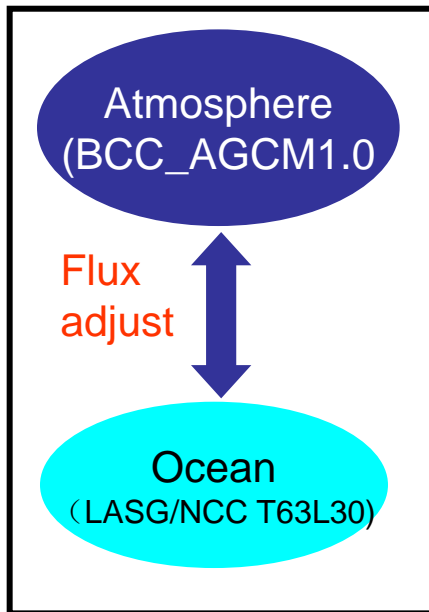
# Physical Conceptual Model for Summer Rainfall prediction



# Climate System Model development

First generation climate prediction model

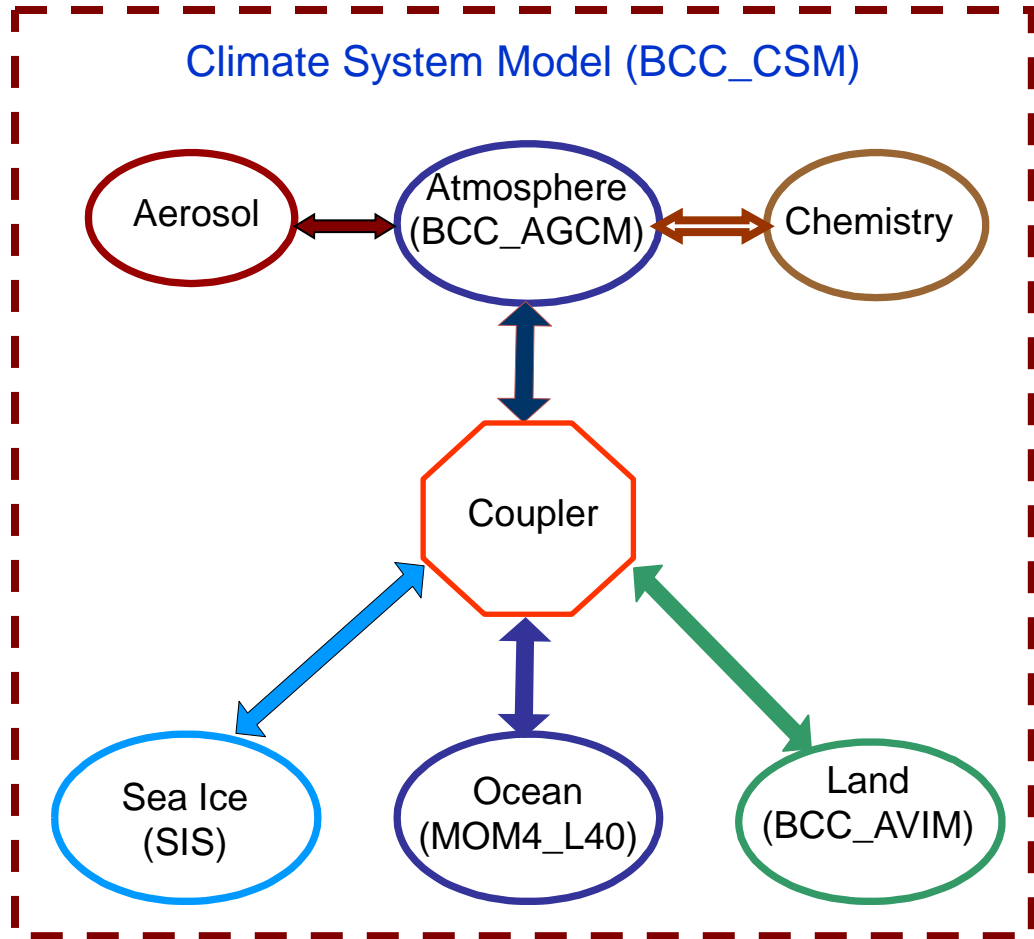
BCC\_CM1.0



From 1995 to 2004  
First generation CGCM  
(2005, operational)

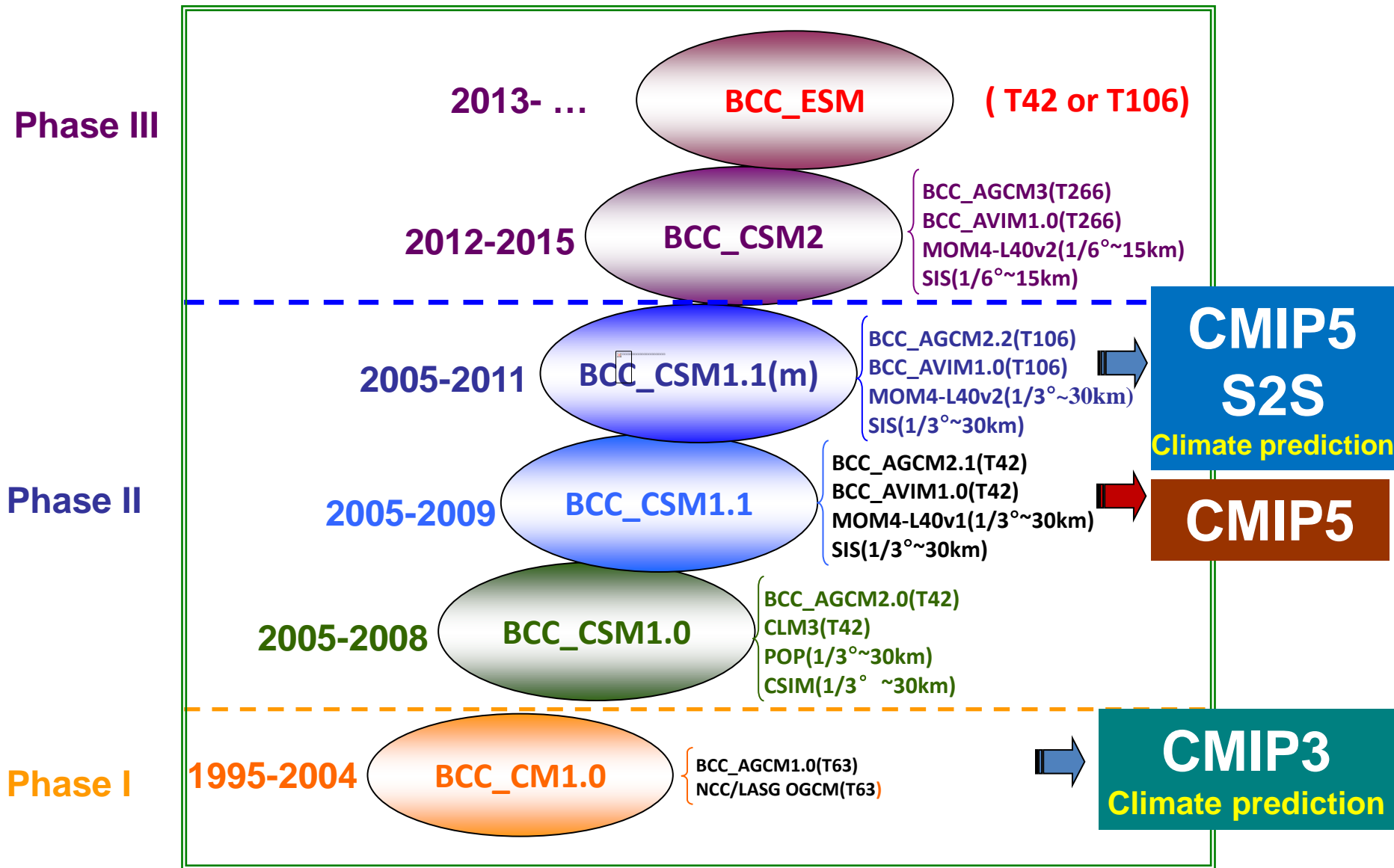
From 2005, New generation Climate System Model

Climate System Model (BCC\_CSM)





# Beijing Climate Center Climate System Model (BCC\_CSM)





# BCC\_AGCM development

Version	Description
<b>BCC_AGCM2.0</b> (T42L26)	<p>Originated from CAM3</p> <p>Model Dynamics: <b>Wu et al.(2008, <i>J.Atmos.Sci.</i>)</b></p> <p>Model Physics: <b>Wu et al. (2010, <i>Climate Dynamics</i>)</b></p> <ul style="list-style-type: none"><li>➤ <b>Deep convection:</b> modified Zhang and Mu (2005) scheme .</li><li>➤ <b>Dry Adiabatic</b></li><li>➤ <b>Snow cover fraction parameterization</b> (Wu T. and Wu G., 2004)</li><li>➤ <b>Sensible and latent flux parameterization</b> on the ocean-Atmosphere interface are modified.</li></ul>
<b>BCC_AGCM2.1</b> (T42L26) <b>BCC_AGCM2.2</b> (T106L26)	<ul style="list-style-type: none"><li>➤ <b>A new cumulus convective parameterization scheme suggested by Wu (2012: <i>Climate Dynamics</i>)</b></li></ul>



# Seasonal Prediction System



**BCC\_CM1:** AGCM\_1.0 (T63L16) + OGCM\_1.0 (GT63L30)  
coupling scheme of Daily Flux Anomaly (DFA)



**BCC\_CSM1.1(m):** BCC\_AGCM2.2 + BCC\_AVIM1.0 + MOM4\_L40v2 + SIS  
Atmos. resolution: T106L26  
Ocean resolution: 1/3~1°

**Hindcasts for validation: 1991-2013**

**Samples:** 15 LAF (Composed from 5 NCEP-R1 atmospheric initials on the last five days  
and 3 GODAS oceanic initial on the last three days every month)

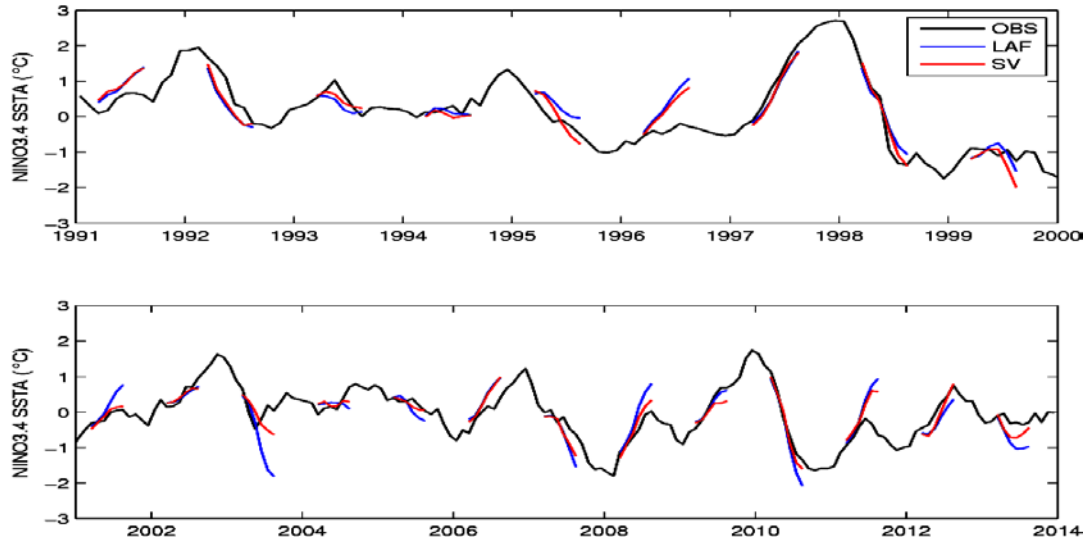
9 SV (different SV modes are added to the first LAF member)

**Prediction period:** 13 months

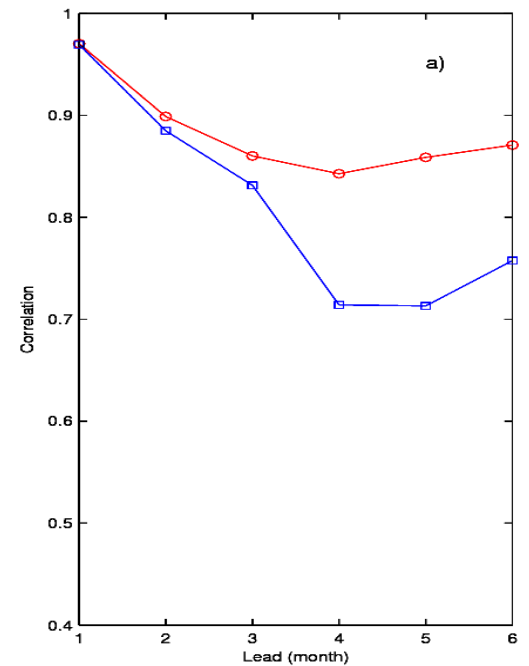


# Validation of SST

## BCC-CSM forecast Nino3.4 SSTA from March 1st



## The Nino3.4 SSTA Corr. (March 1st)





# ACC of 500 hPa geopotential height and temperature

**BCC\_CM1**

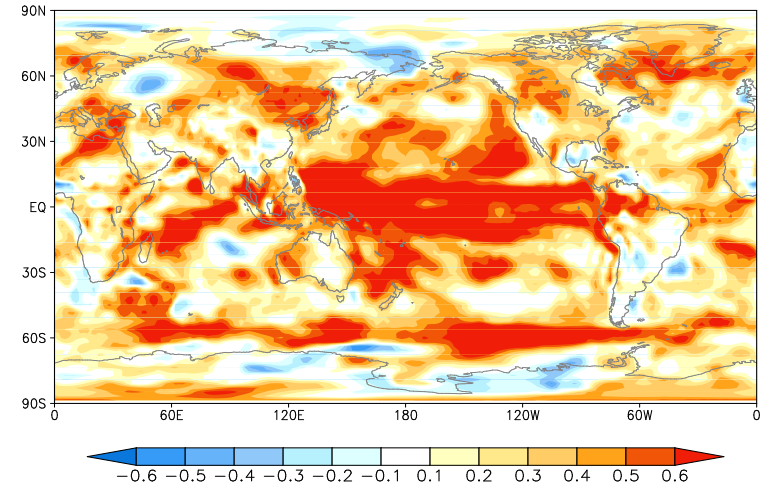
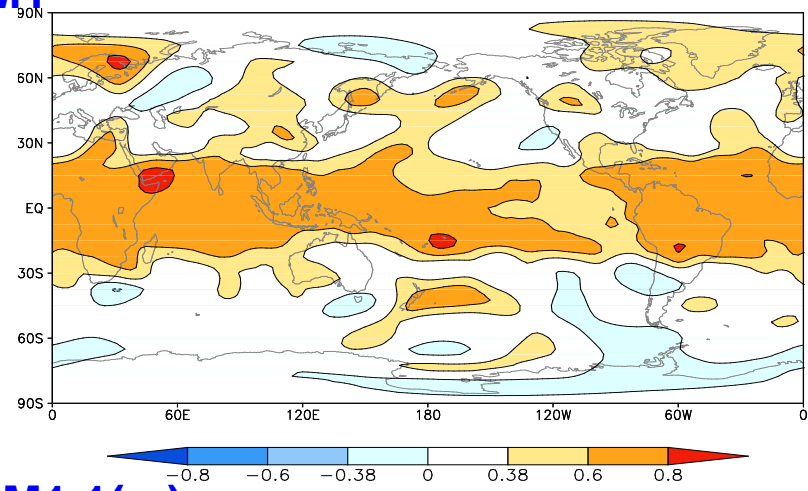
**Hgt500**

**MAM**

**T2m**

ACC of 500hPa H between BCC\_CM1.0 and NCEP1 during MAM

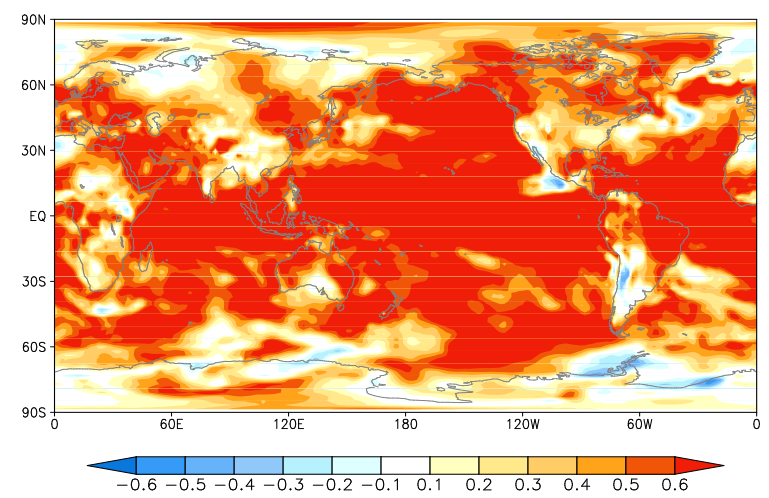
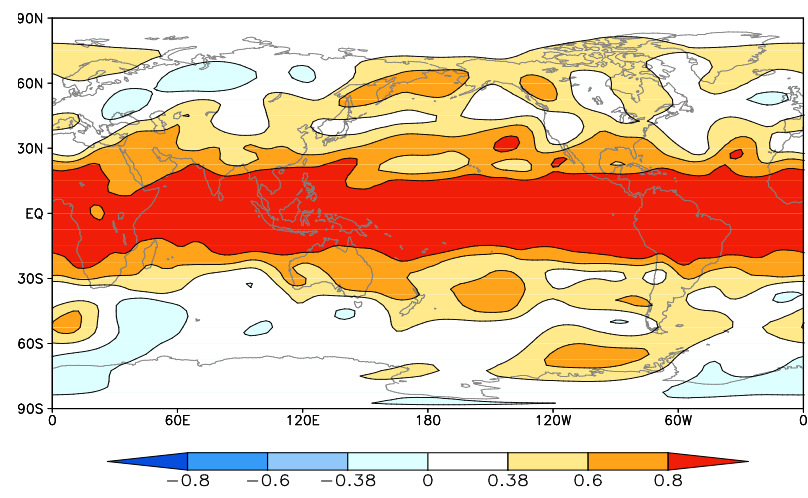
ACC of T2m between BCC\_CM1.0 and NCEP1 during MAM



**BCC\_CSM1.1(m)**

ACC of 500hPa H between BCCSM1.1m and NCEP1 during MAM

ACC of T2m between BCCSM1.1m and NCEP1 during MAM

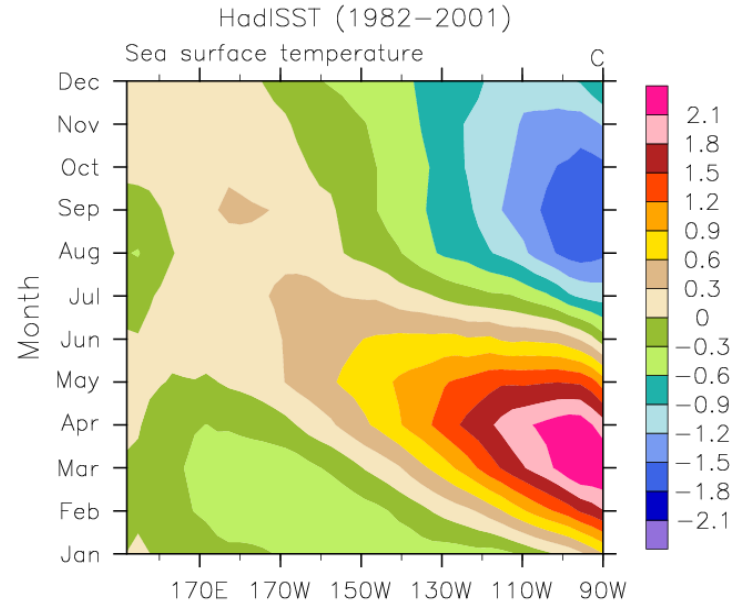






# SST Annual Cycle in Equatorial Pacific Ocean (5S-5N)

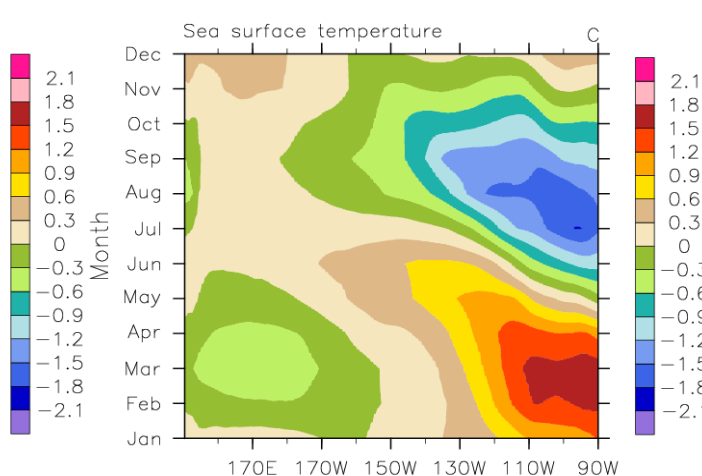
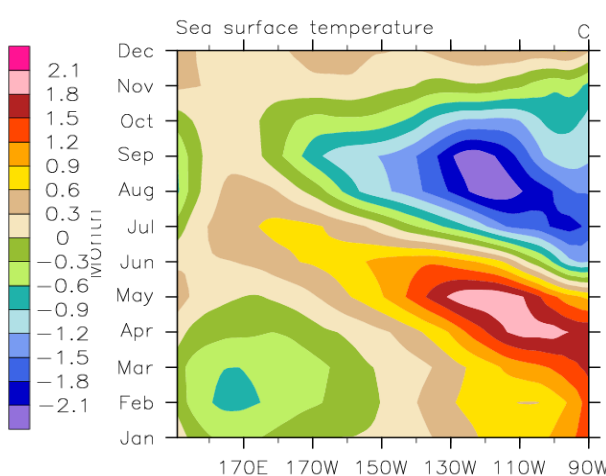
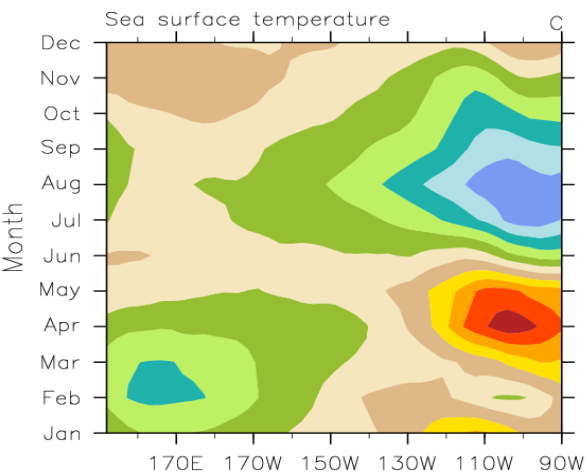
**HadISST (OBS)**



**BCC\_CSM1.1 (T42, ~280km)**

**BCC\_CSM1.1(m) (T106, ~110km)**

**BCC\_CSM2.0 (T266, ~45km)**

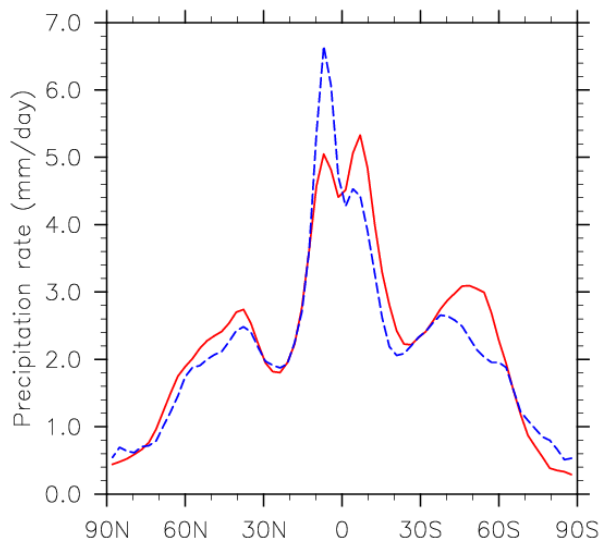




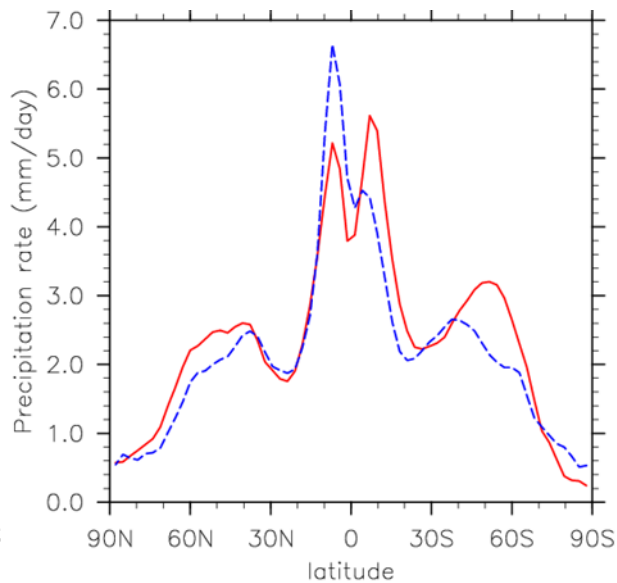
# Annual Mean Zonal Averaged Precipitation

--- OBS (Xie-Arkin)  
— MODEL

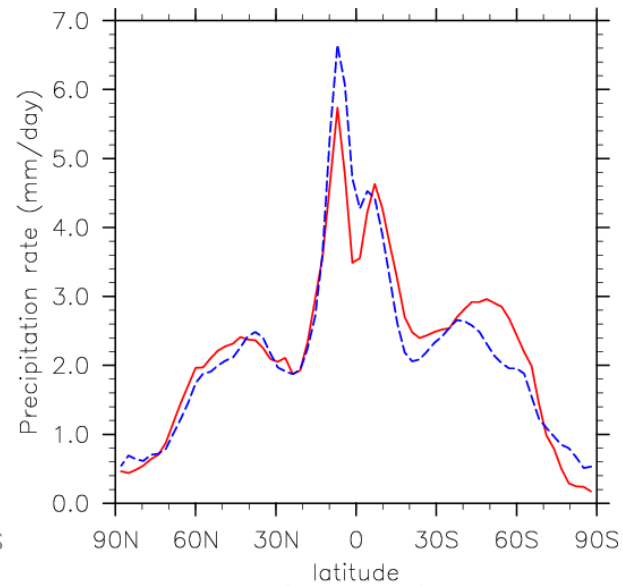
### BCC-CSM1.1 (T42)



### BCC-CSM1.1(m) (T106)

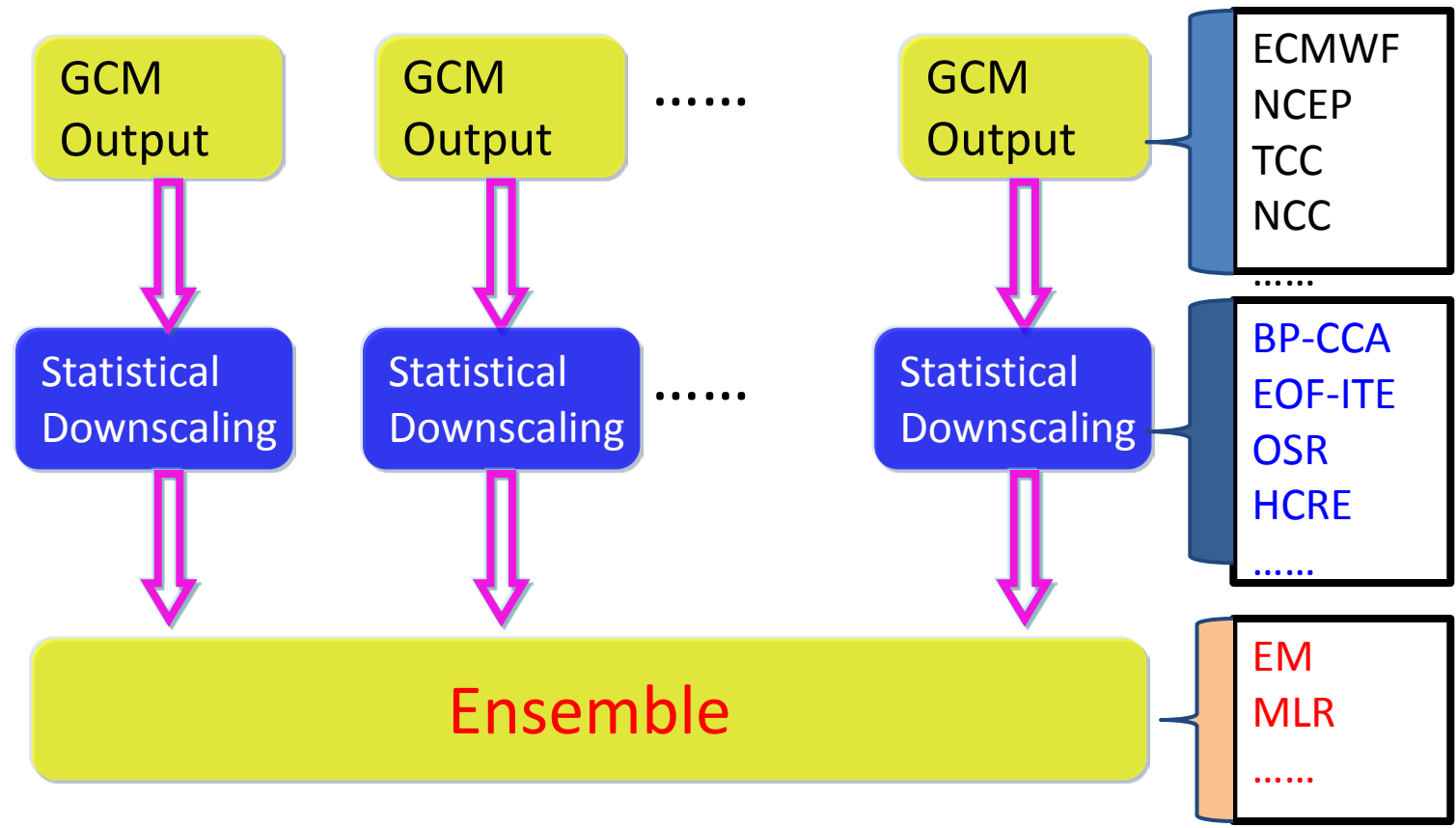


### BCC-CSM2.0 (T266)





# Multi-model Downscaling Ensemble Prediction System (MODES)

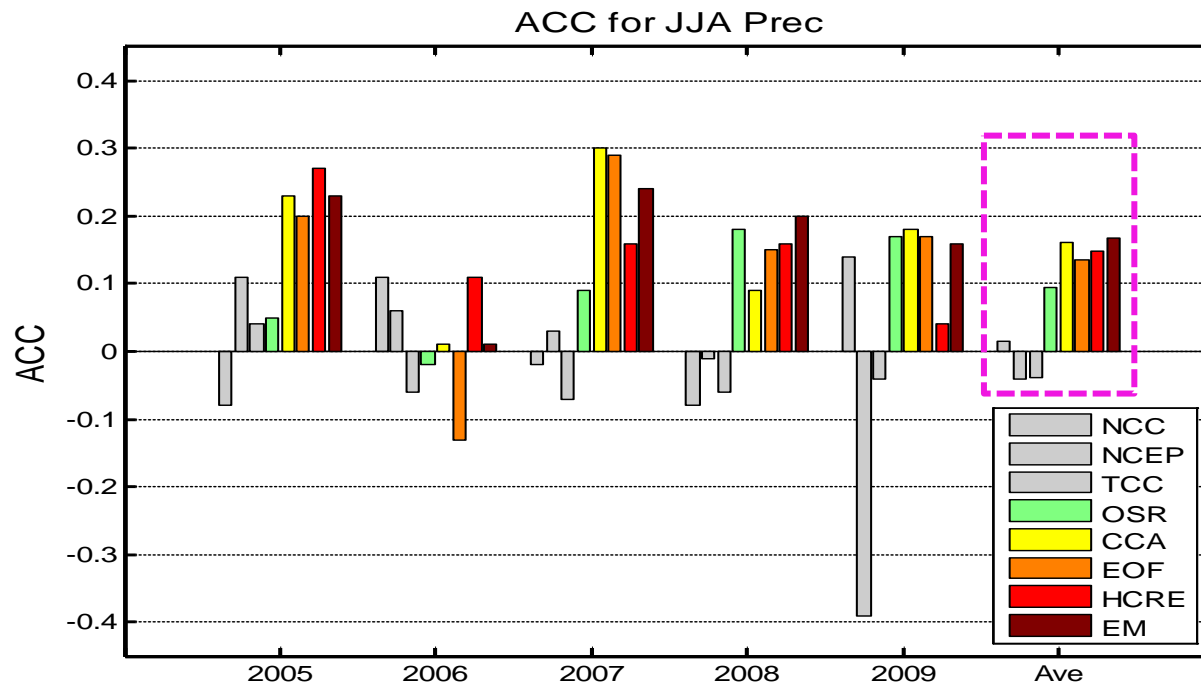


Previous study shows that forecast by **downscaling and ensemble** perform better than that by **ensemble and downscaling**. (Kang H. W. et al.,2009)



# Validation of summer precipitation prediction

ACC





# Forecast System on Dynamical and Analogy Skills (FODAS)

**Data sets**  
 Model data  
 Real Obs. data  
 Climate Indices

Corr. Ana.



Mainly indices sets closely correlated with the forecast error



**Optimal multi indices assemble**

**Extreme abnormal indices**

History forecast error sets



**History analogy forecast errors**



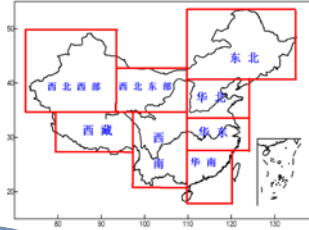
Season climate forecast



**The new forecast result of BCC\_CGCM**



**Final forecast product**

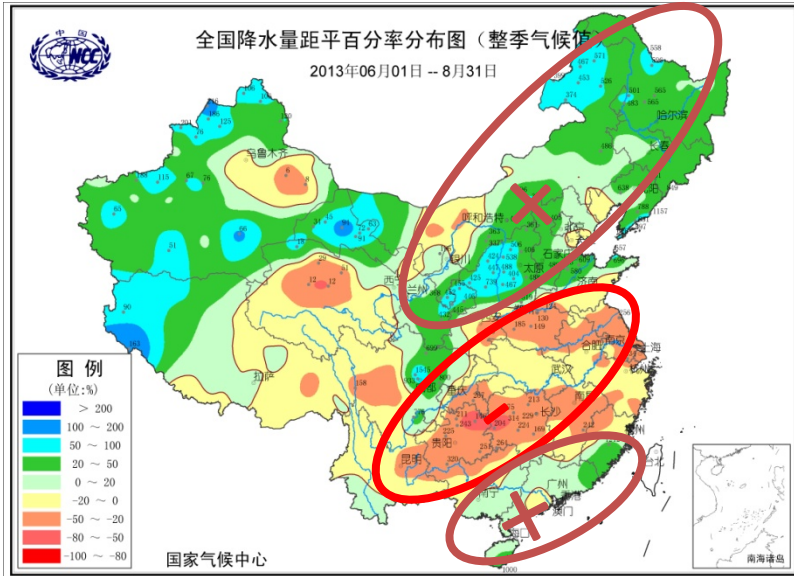




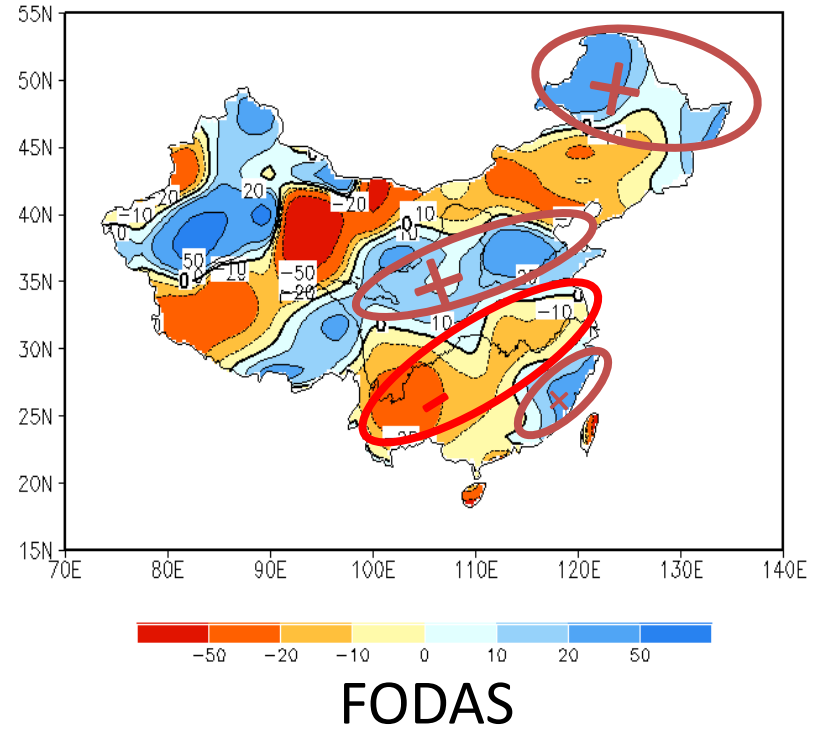
# Validation of summer precipitation prediction

	BCC_CGCM	FODAS
Year	ACC	ACC
2003	0.01	0.20
2004	0.04	0.15
2005	-0.06	0.15
2006	-0.01	0.00
2007	-0.21	0.02
2008	0.15	0.19
2009	0.22	0.38
2010	-0.04	0.10
2011	0.06	0.12
2012	-0.09	0.03
Ave.	0.02	0.15

# Summer precipitation forecast in 2013



Observation



FODAS Prediction Validation:0.20 (ACC)



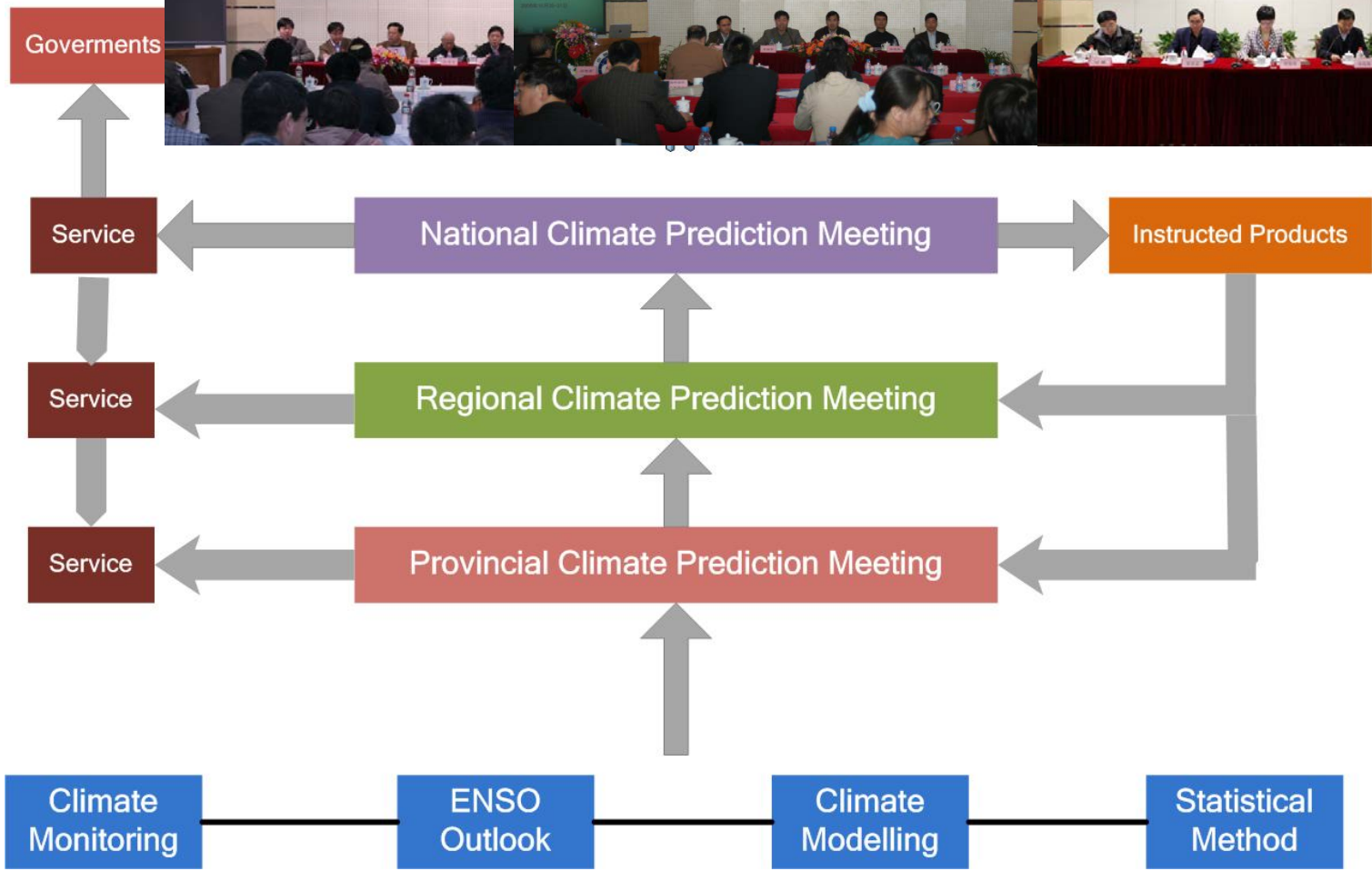
# Procedure of making forecast

- Forecast group
  - BCC forecaster group:
    - Chief forecaster—Senior forecaster—Junior forecaster
  - Provincial/regional forecasters
  - Consultants from Institutes and universities
- Conference system
  - Provincial—Regional—National—International



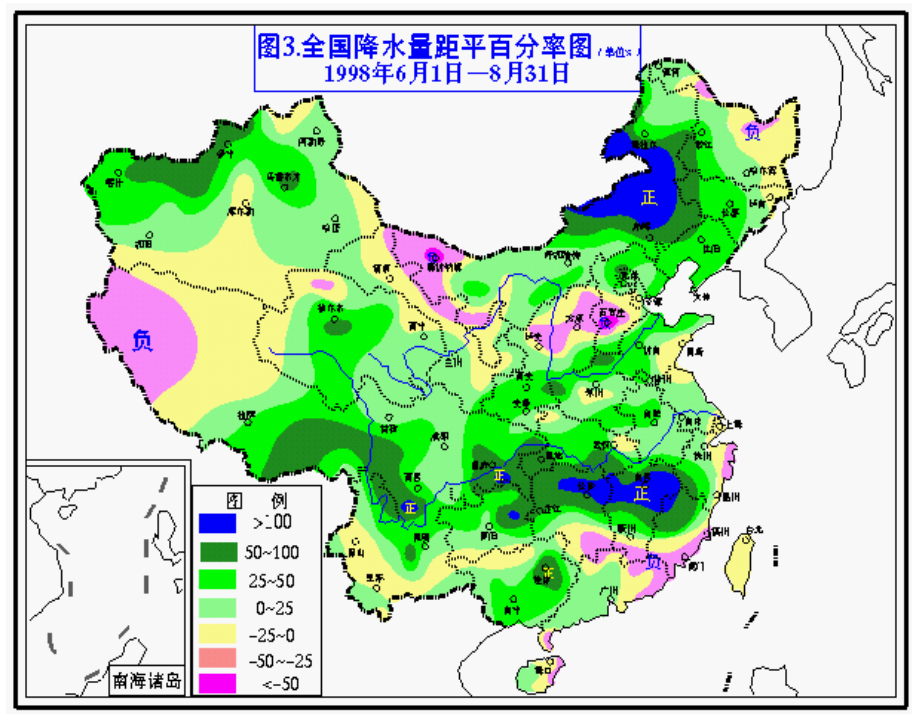
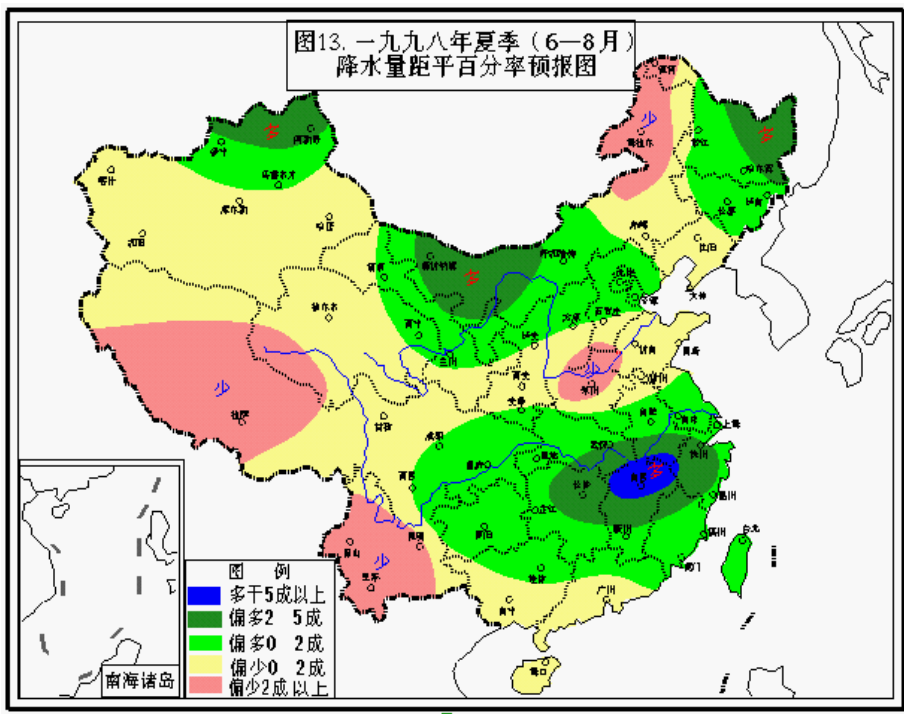


# Conference system for climate prediction



# Successful prediction case

## The summer rainfall anomaly percentage forecast (left) and observation (right) in 1998



# Successful prediction case

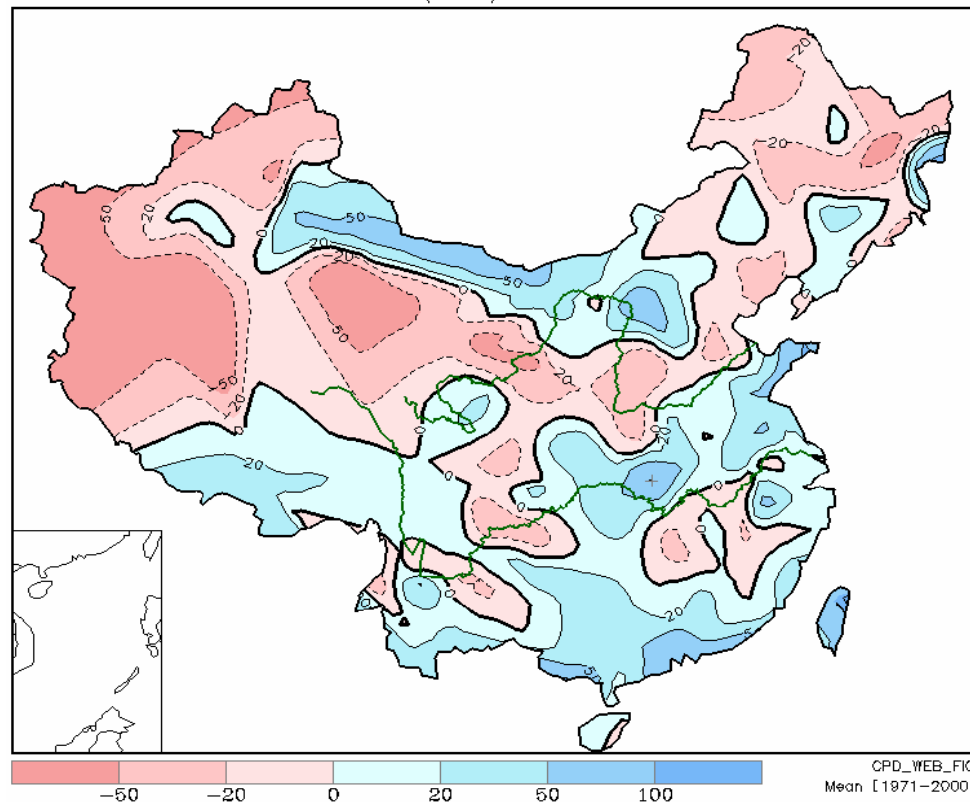
## The summer rainfall anomaly percentage forecast (left) and observation (right) in 2008

Forecast

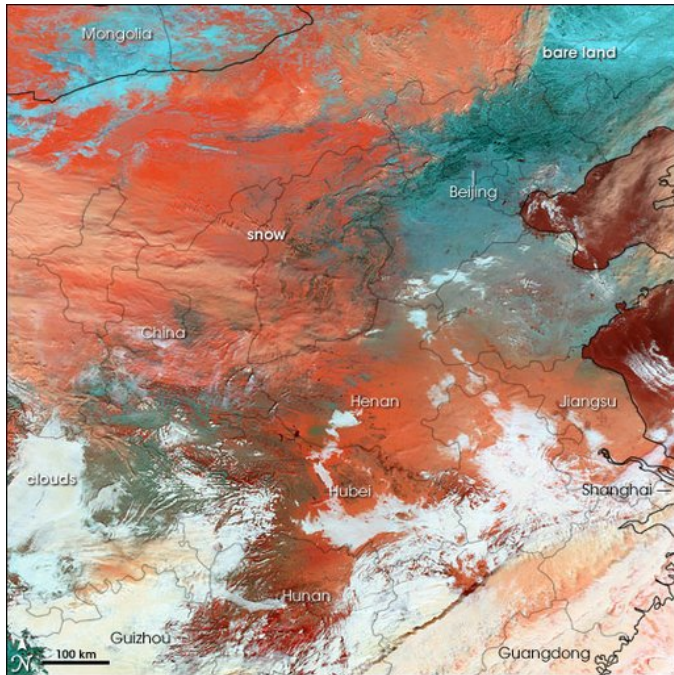


Observation

MON (6\*-8) DR% 2008

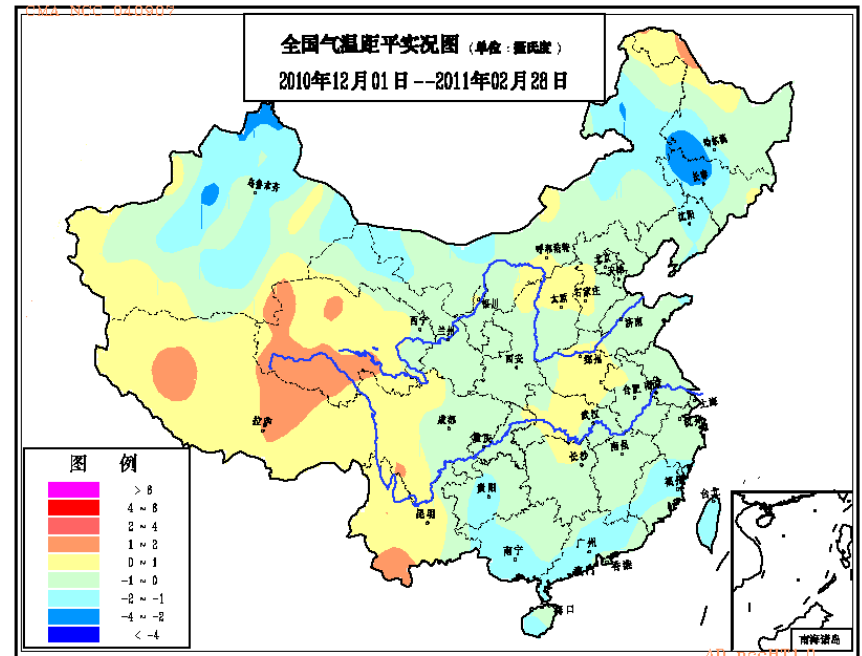
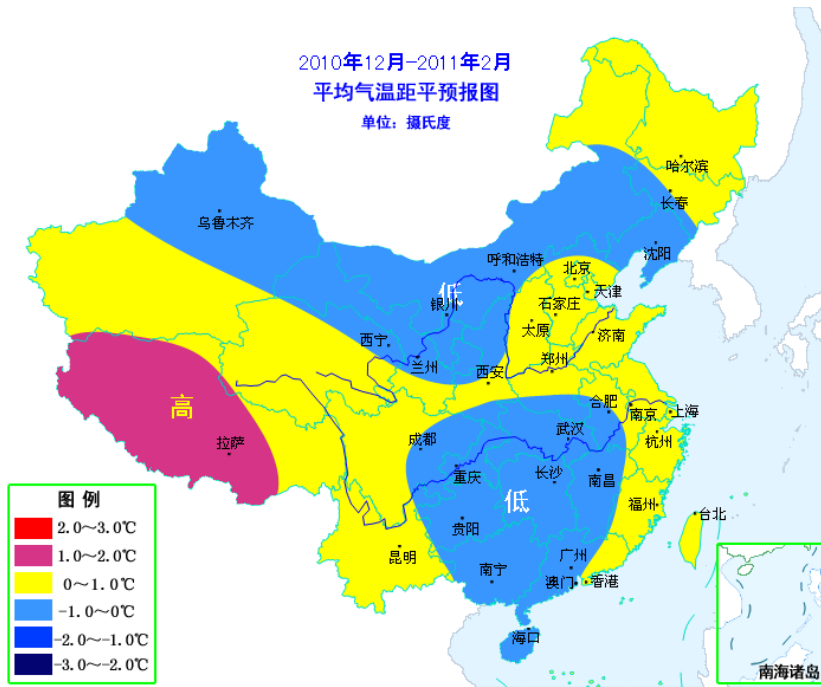


# The memorable winter (Jan.-Feb. 2008)



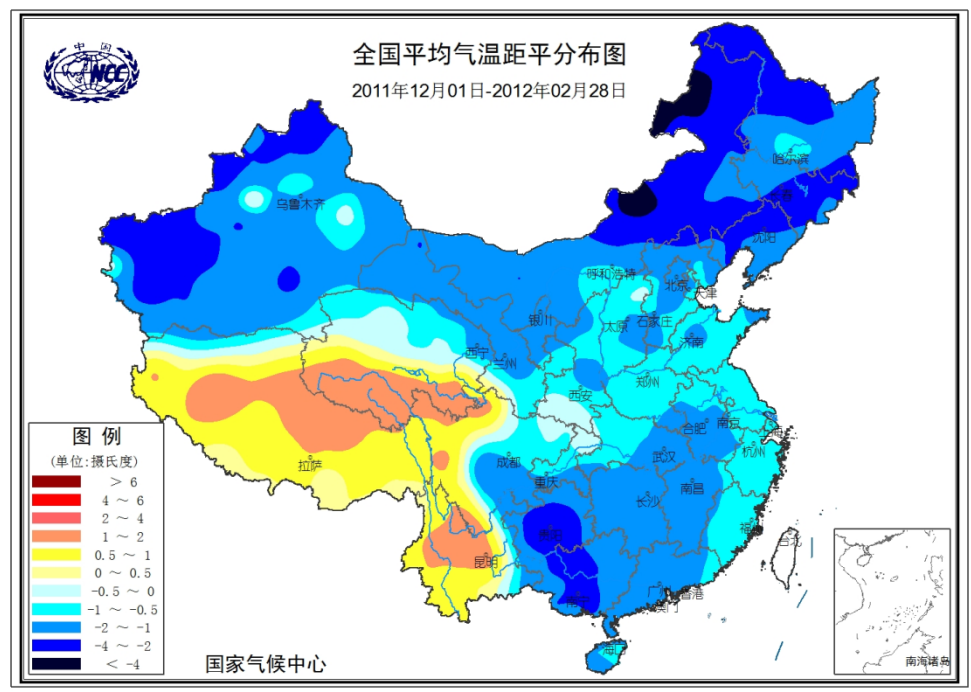
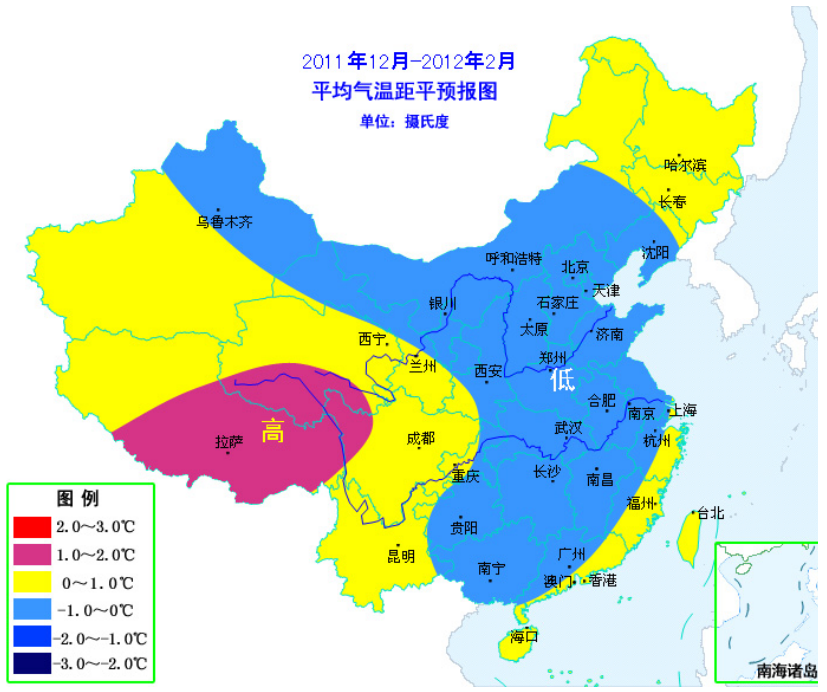
# Successful prediction case

## The winter temperature anomaly forecast (left) and observation (right) in 2010/2011



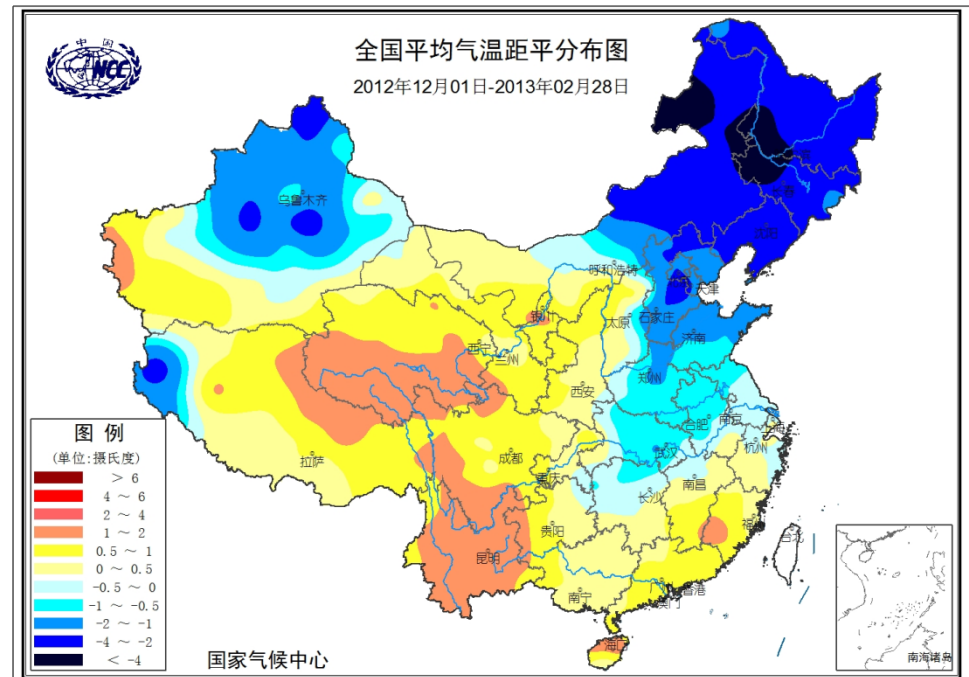
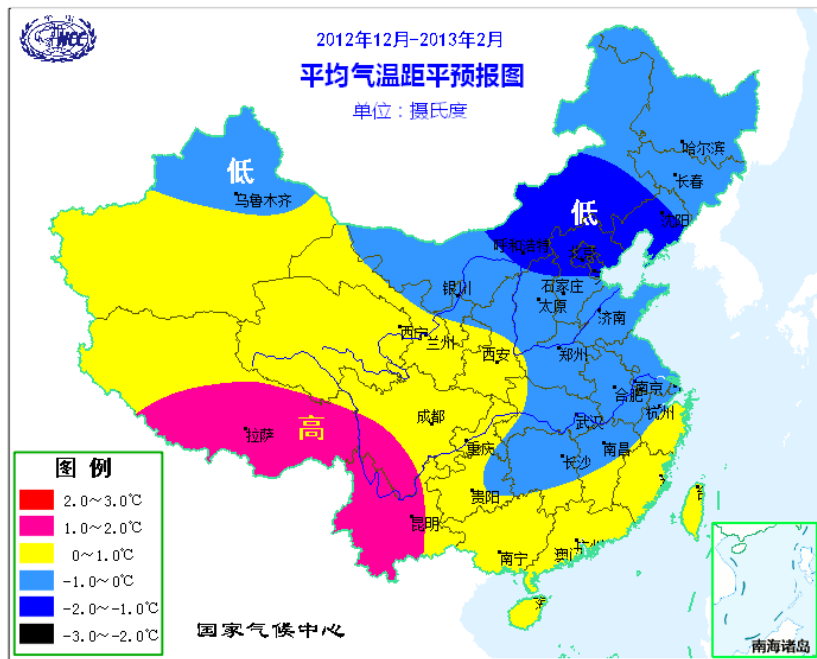
# Successful prediction case

## The winter temperature anomaly forecast (left) and observation (right) in 2011/2012



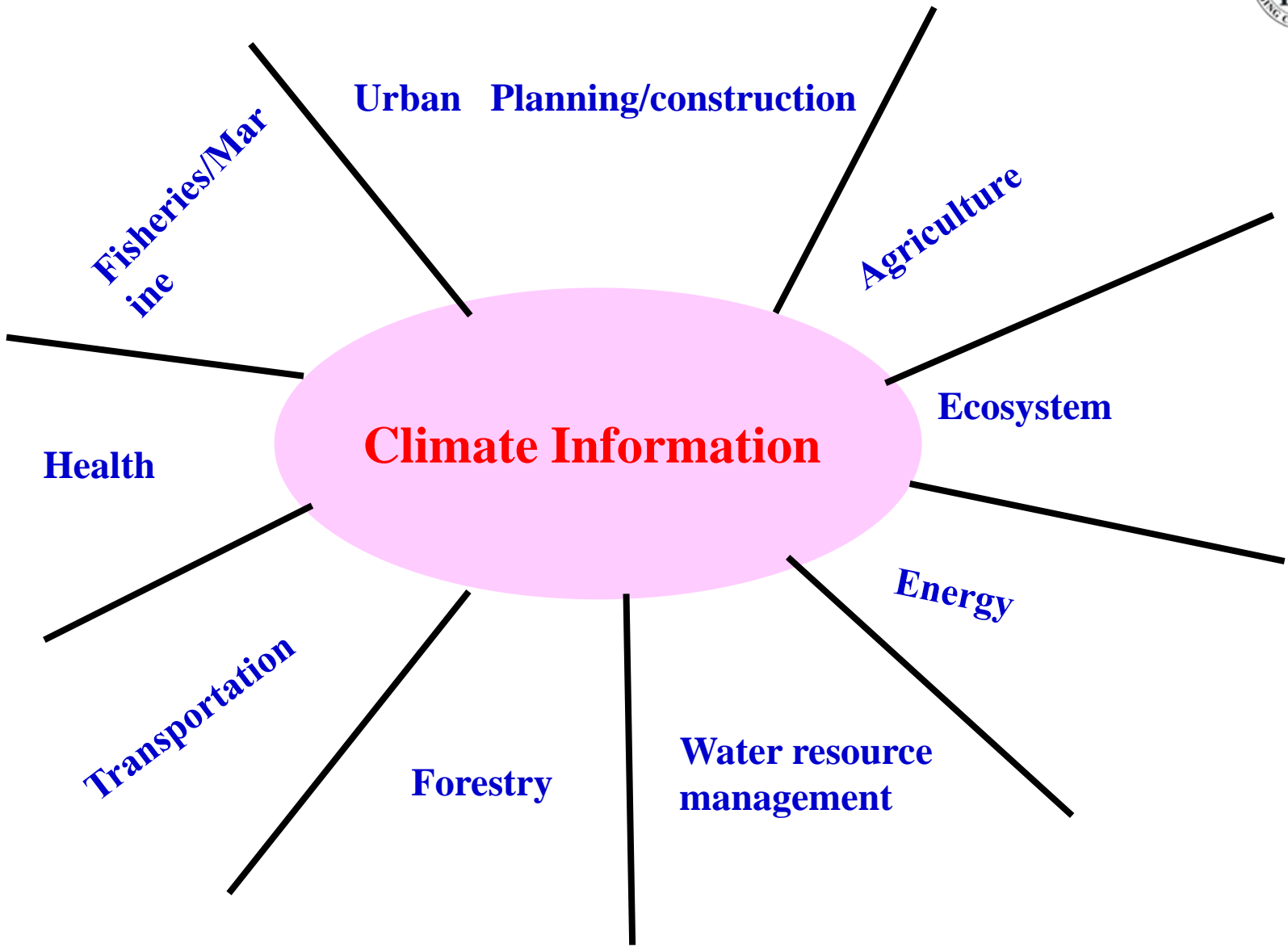
# Successful prediction case

## The winter temperature anomaly forecast (left) and observation (right) in 2012/2013





# Climate services for various sectors





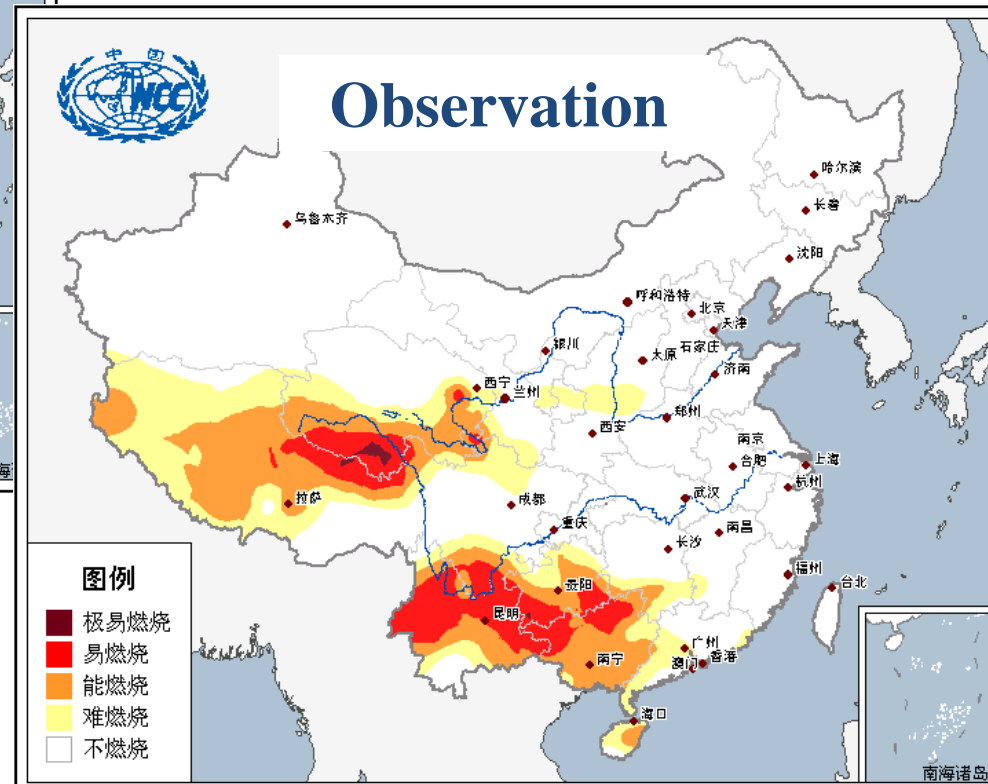
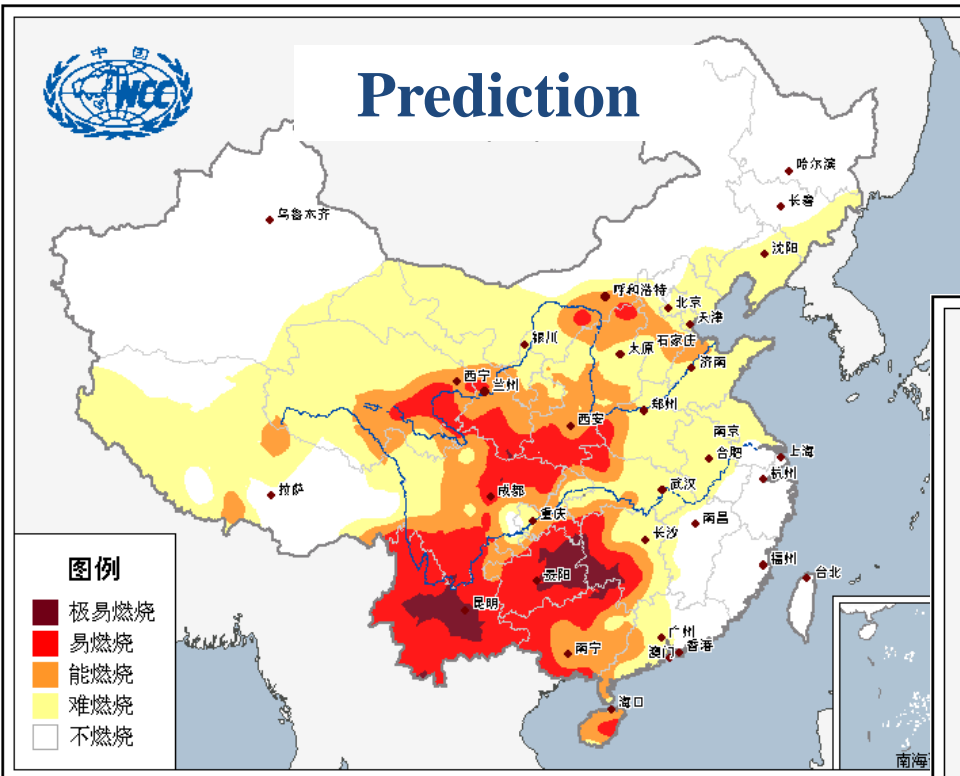


# Climate prediction service for agriculture and forest

- Jan.-Feb.: Meteorological conditions for spring sowing in South China and the middle-low reaches of Yangtze River;
- Mar. : summer temperature tendency for Northeast China;
- Aug. : the first date of frost in Northern China;
- Sep. : strength of cold dew wind in Southern China;
- Spring, Autumn, Winter: cold wave frequency and intensity;
- Month/season: forest fire risk tendency.

# Forest Fire Risk Prediction

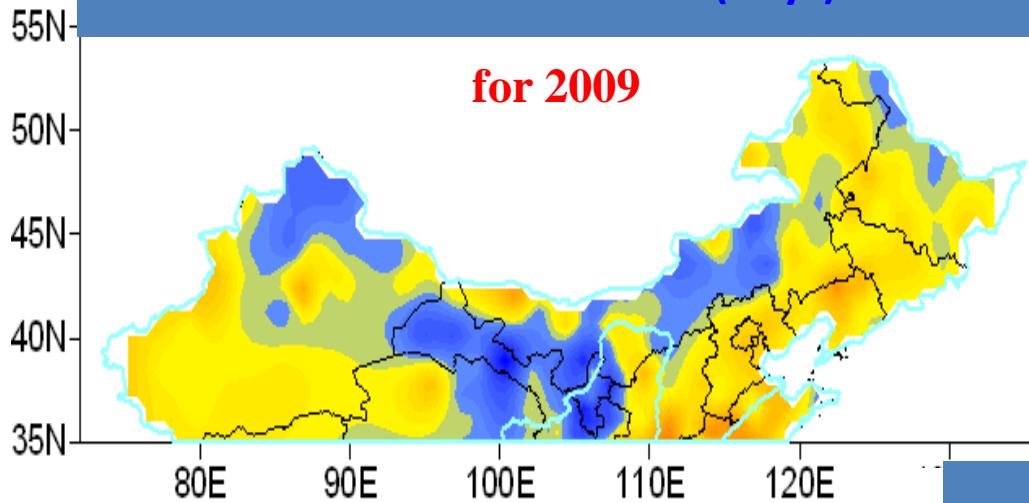
We jointly provide monthly and seasonal forecast of fire risk with **National Forestry Bureau**





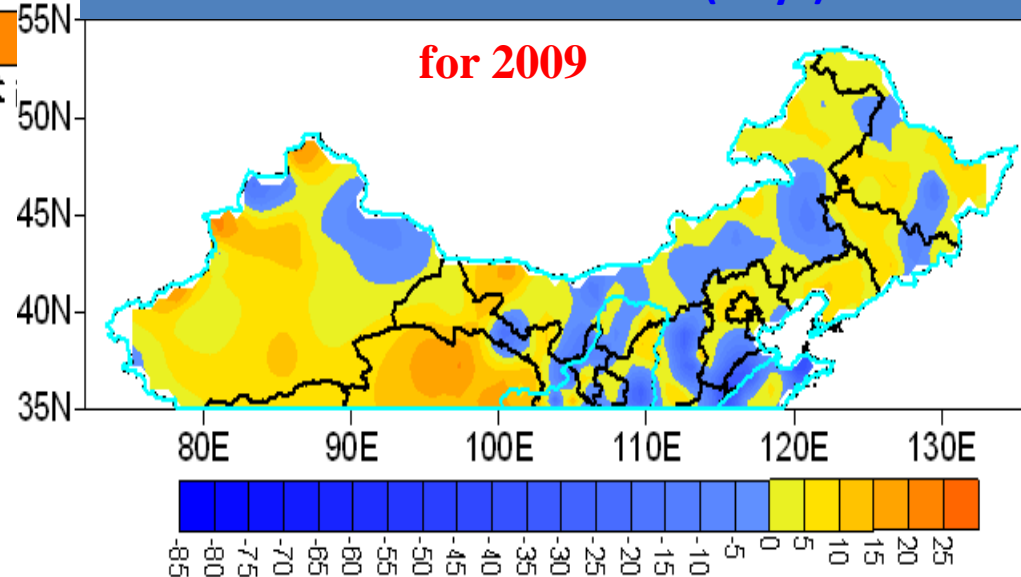
# First-frost date prediction

## Anomalies Prediction (Days)



We predict first-frost date  
in August every year with  
Ministry of Agriculture

## Observed anomalies (Days)





# Future Development

- To develop next generation climate model
- To provide timely, accurate and tailored climate services for the safety and well-being of people
- To develop more helpful climate prediction products, especially for climate extremes



Thanks for your attention!