

# Challenge of Climate Change in China

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# Outline

- Background of geography
- Changes: climate, environ. & cryosphere
- Impact and action



Land 9.6 million km<sup>2</sup>  
Ocean 3.0 million km<sup>2</sup>

*Topography : the three steps:  
4000m, 1000m, less 100m abs*

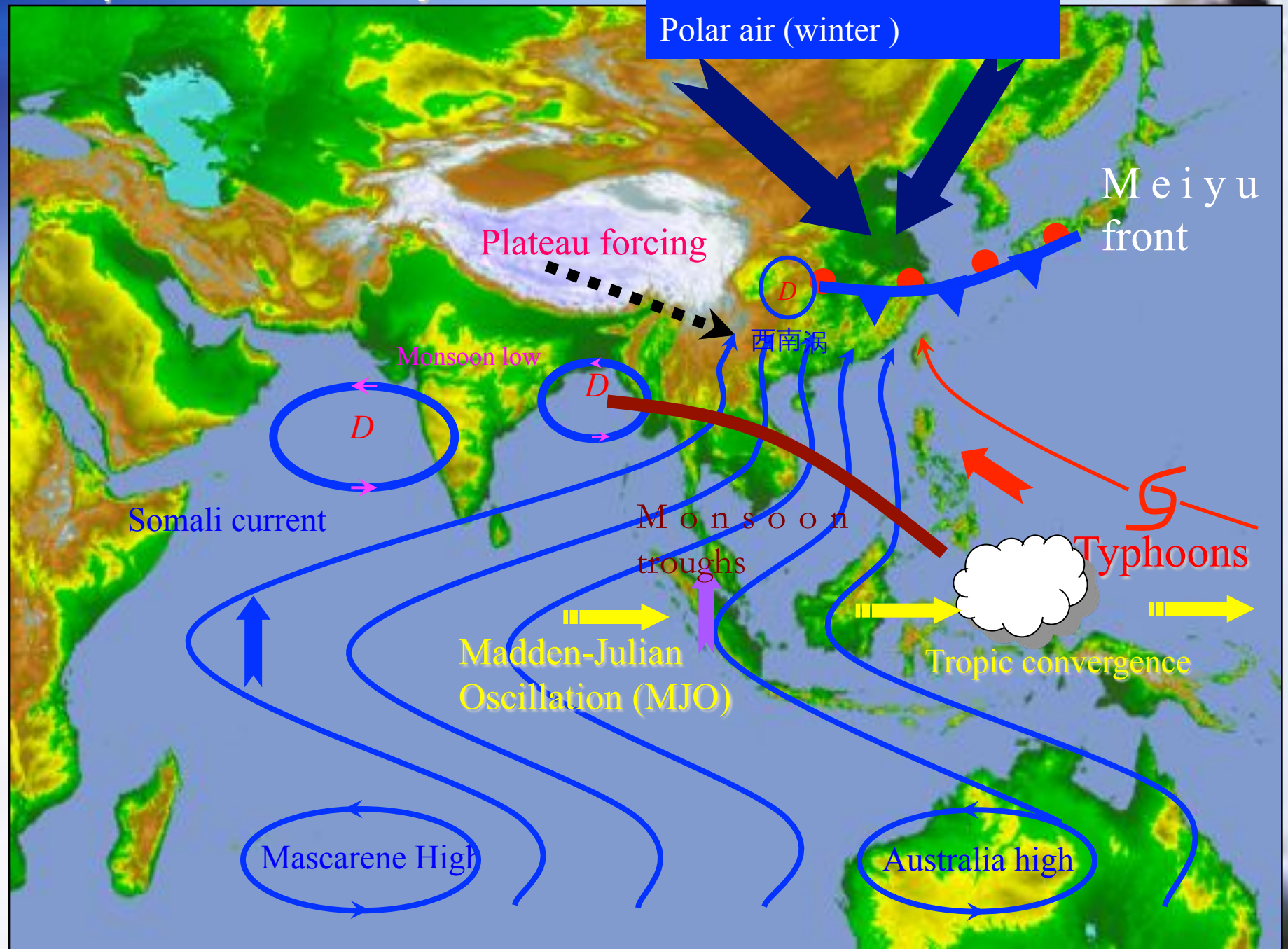
~ 60° longitude E (75°E-135°E)  
~ 50° latitude N (05°N-55°N)

*1.3 billion people  
(1.6 for 2050?)*

Monsoon climate

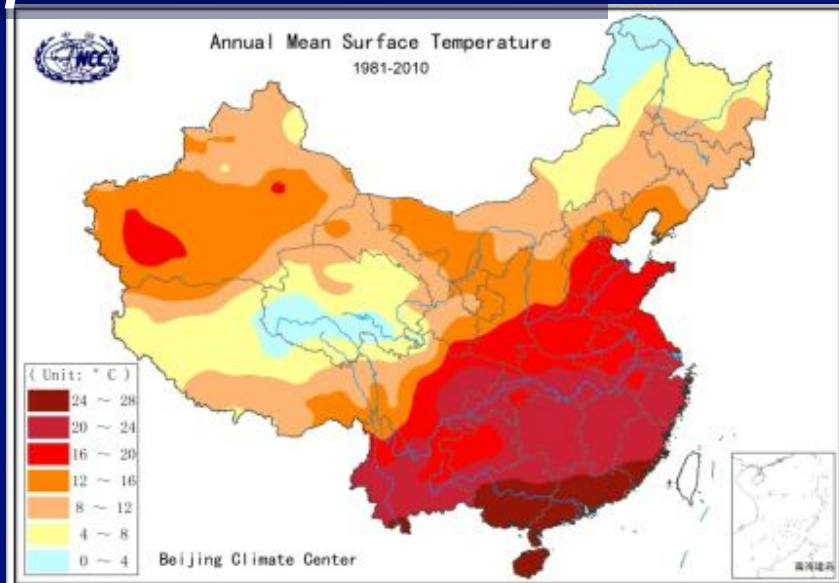


# Complex monsoon system in East Asia

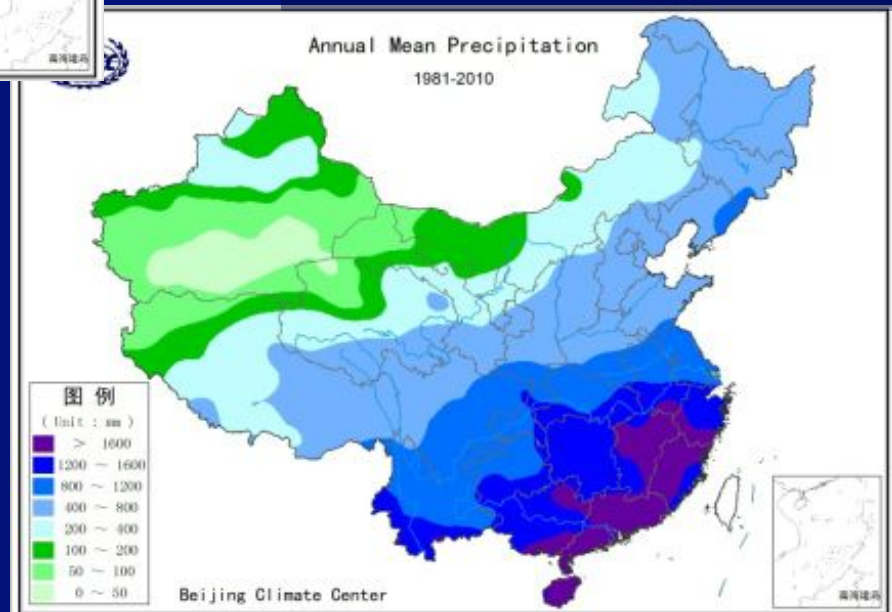


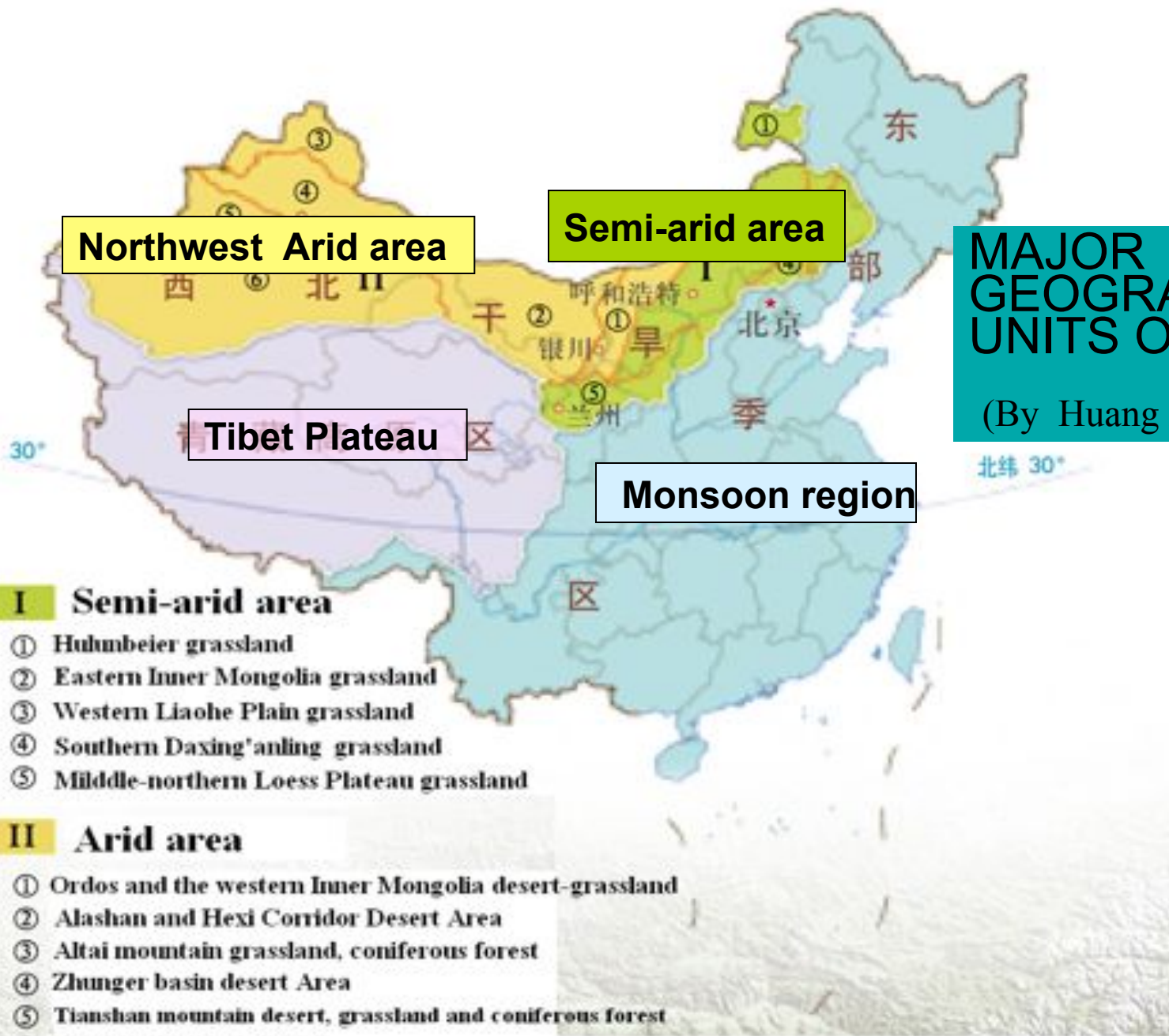
# Temperature and Precipitation

*mean annual  
temperature: 9.6°C*



*mean annual  
precipitation: 629.9mm*



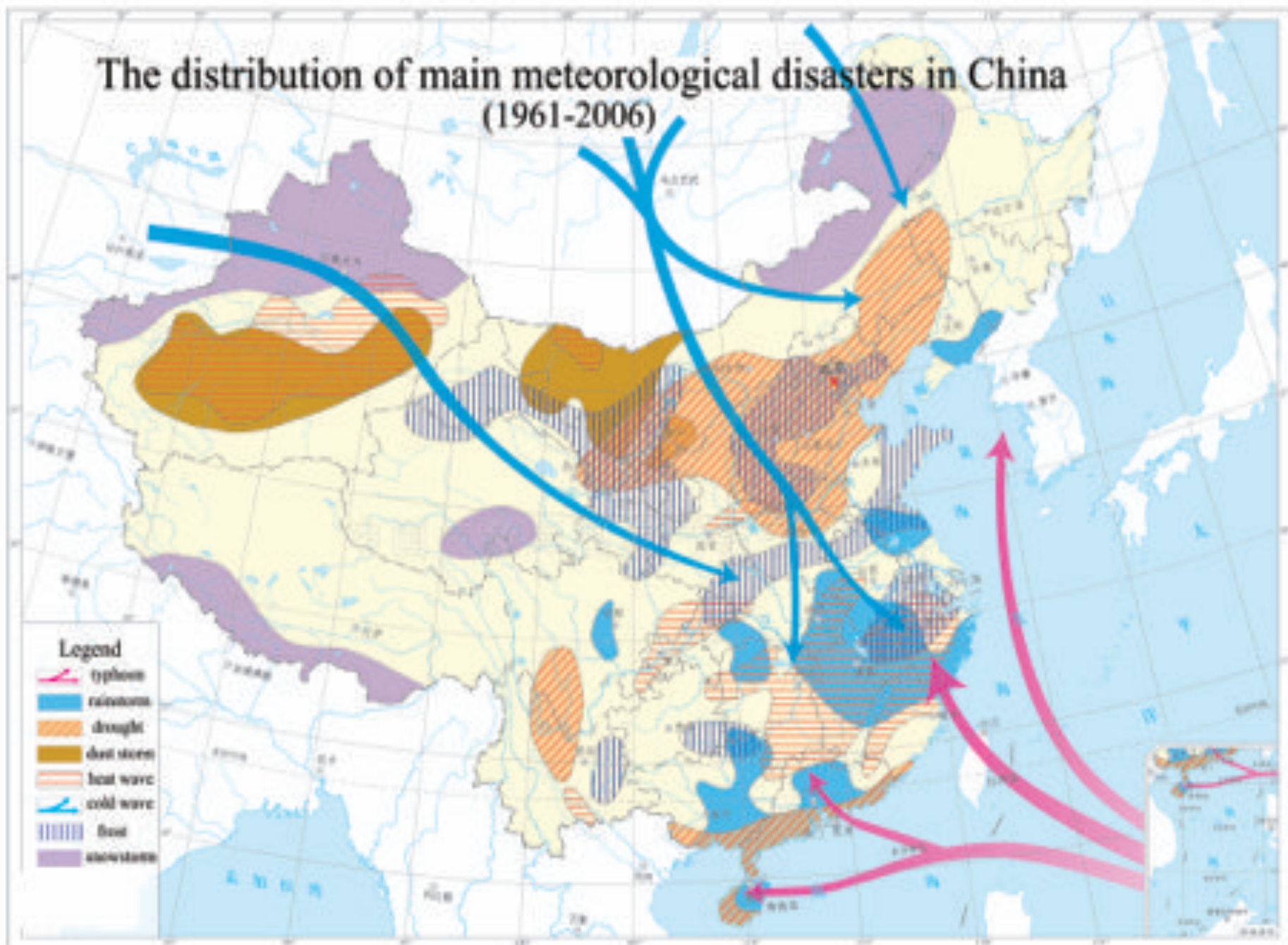


# MAJOR GEOGRAPHICAL UNITS OF CHINA

(By Huang Binwei, 1959)



# The distribution of main meteorological disasters in China (1961-2006)



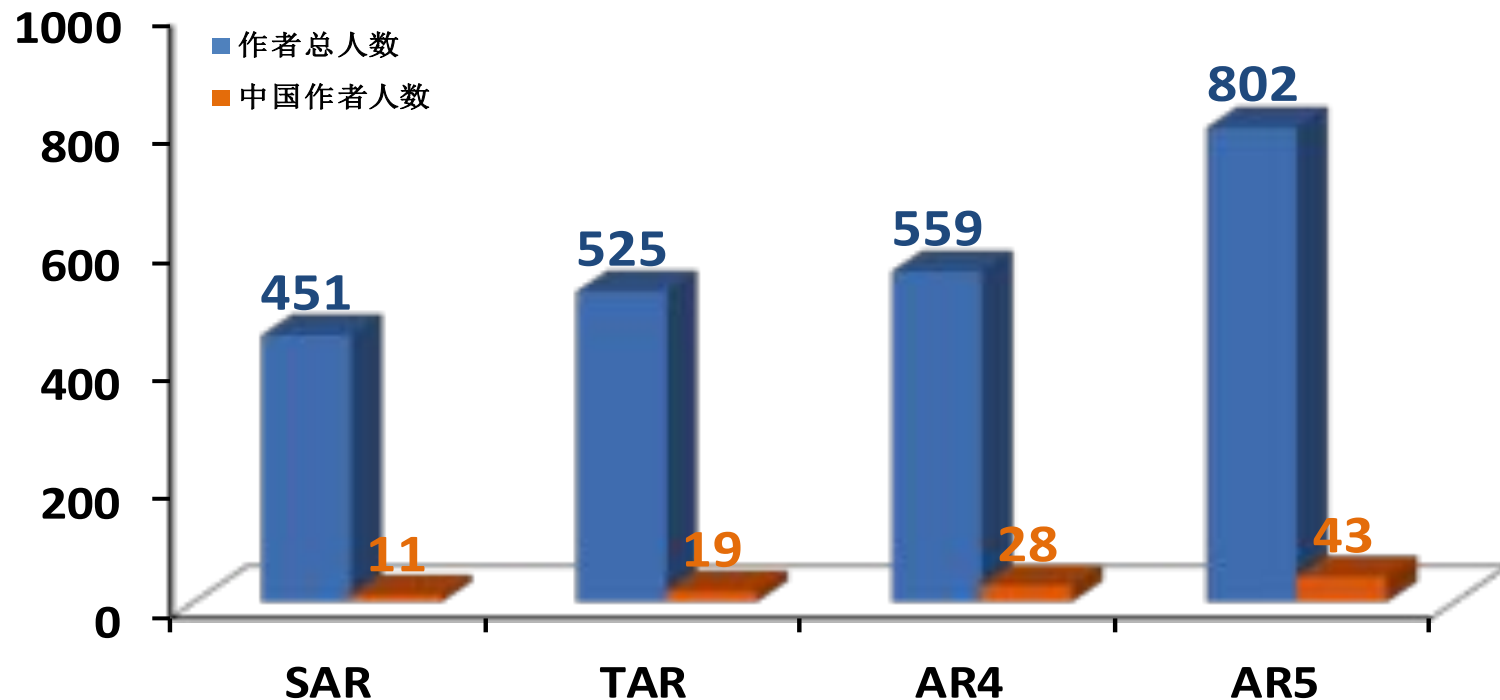
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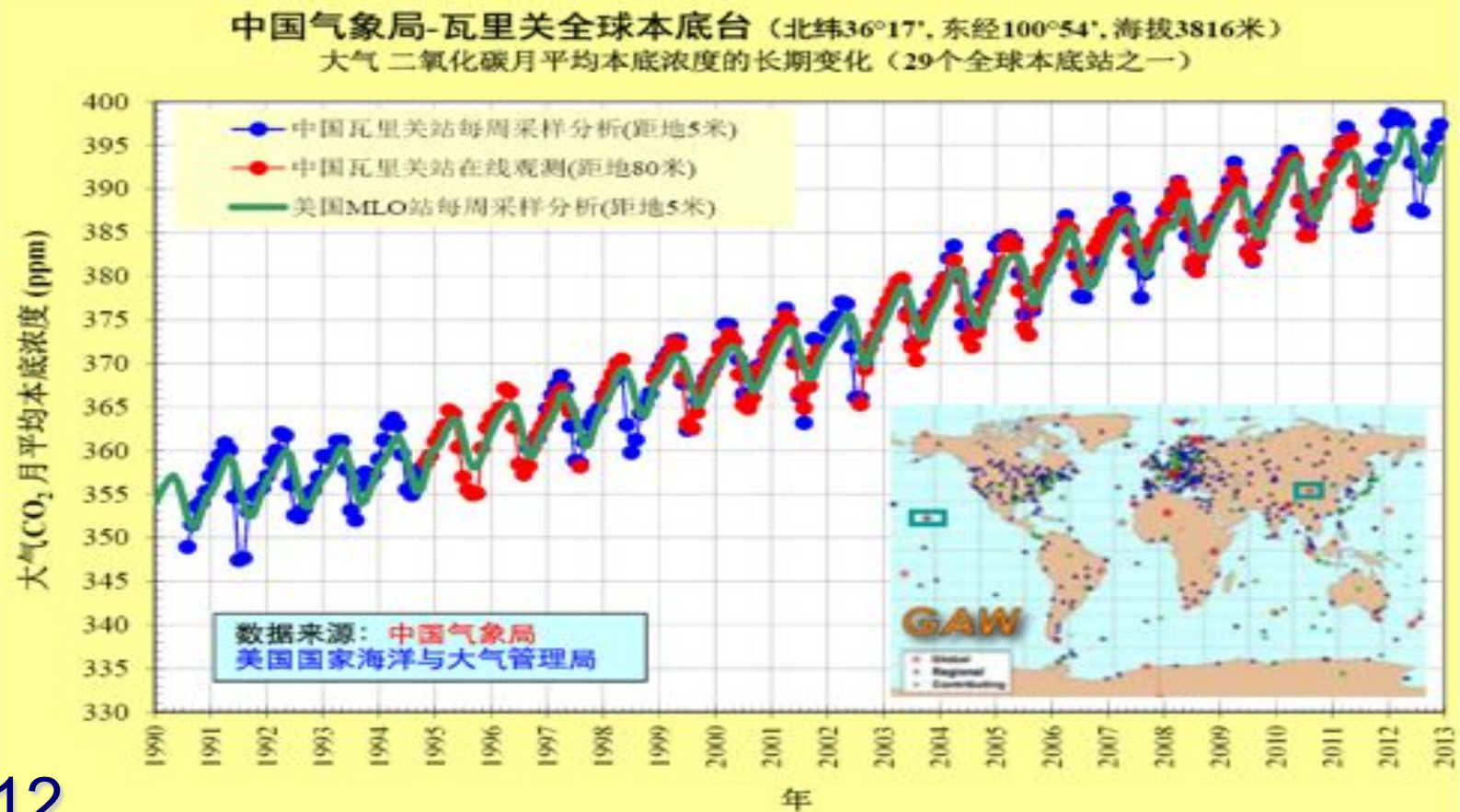


# The contribution to IPCC from China

- Participate in all of assessments
- Focal point: CMA
- Ding and Qin: Co-Chair of WG1, TAR, AR4 & AR5;  
also 111 authors, too.



# Waliguan Atmospheric Baseline Station, CMA (36°17'N, 100°54'E, 3816m asl) (GAW Station In China)

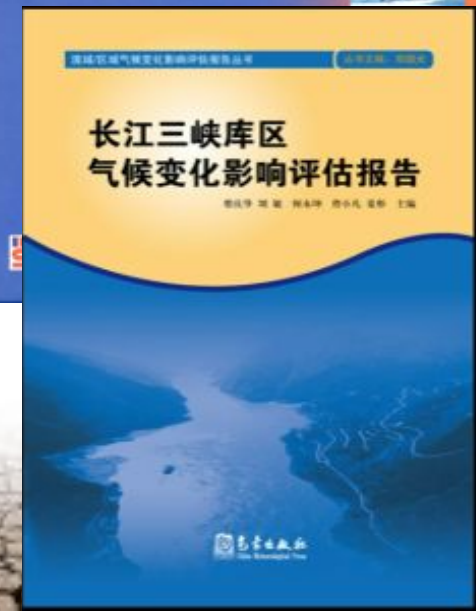
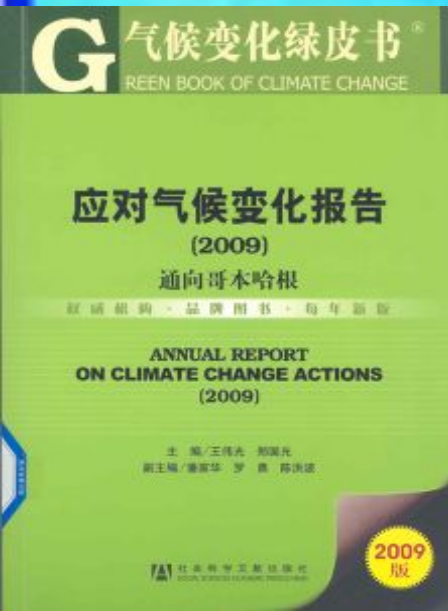
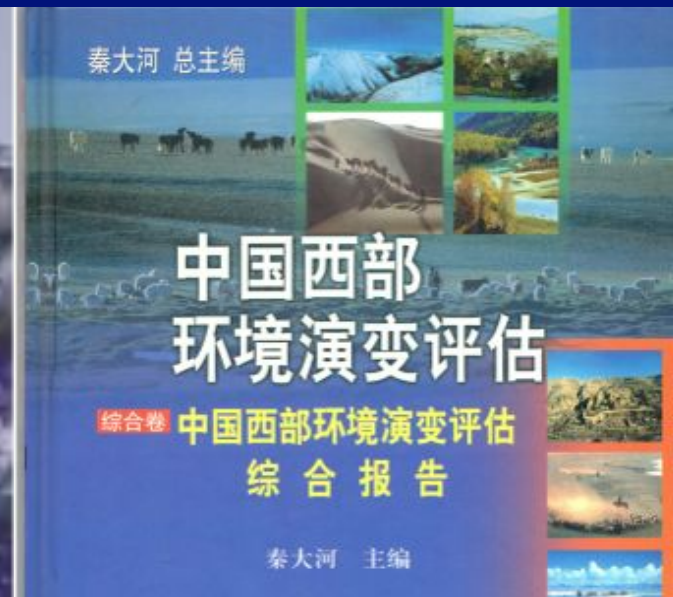


2012

China: CO<sub>2</sub> 394.8 ppm, CH<sub>4</sub> 1878 ppb, N<sub>2</sub>O 325.6 ppb

Global: CO<sub>2</sub> 393.1 ppm, CH<sub>4</sub> 1819 ppb, N<sub>2</sub>O 325.1 ppb

# Assessment Reports on Climate and Environment Change in China

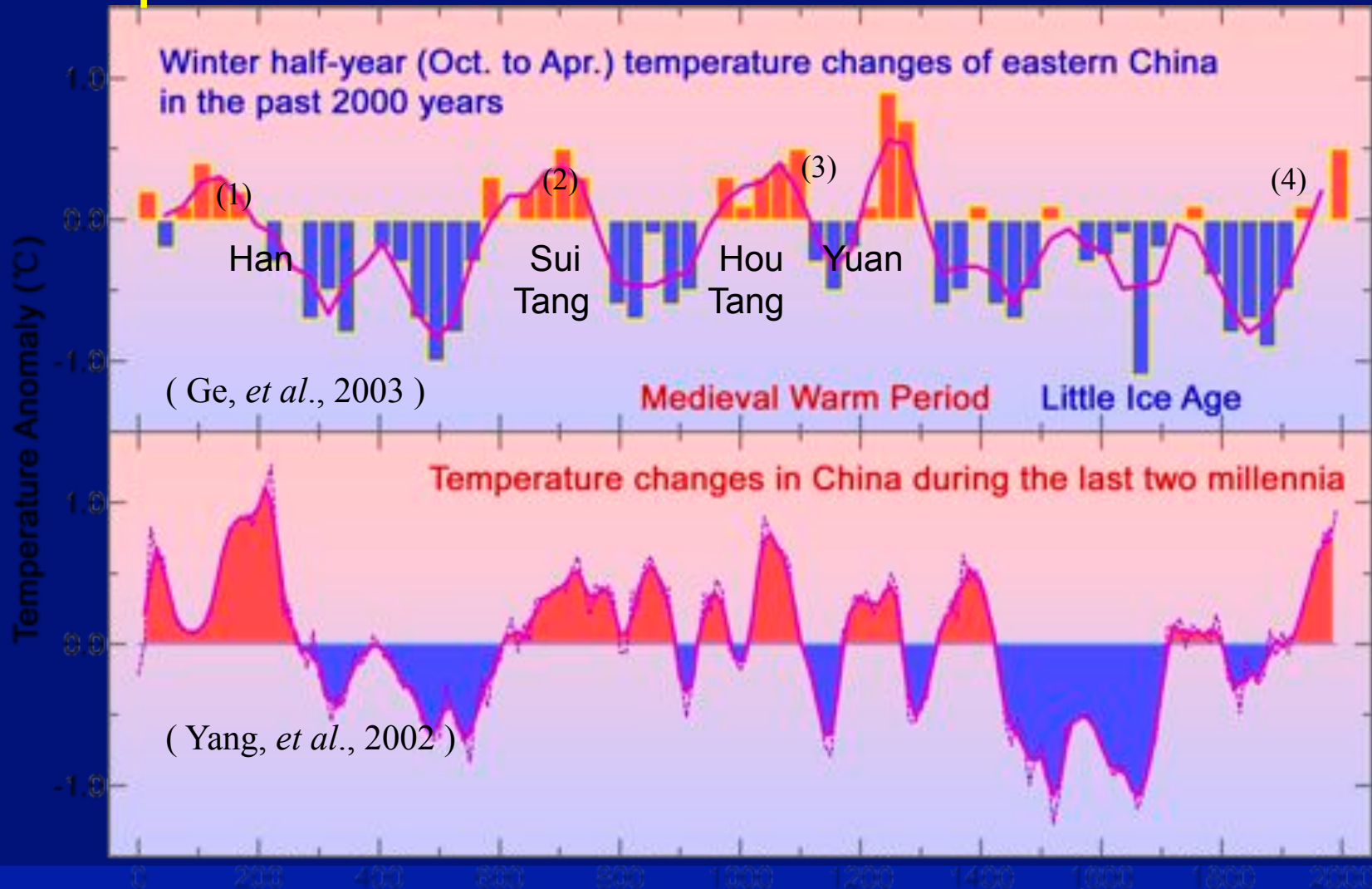




# The First Lead Author Meeting(LA1), WG1 of IPCC Kunming, China 8-11 November 2010

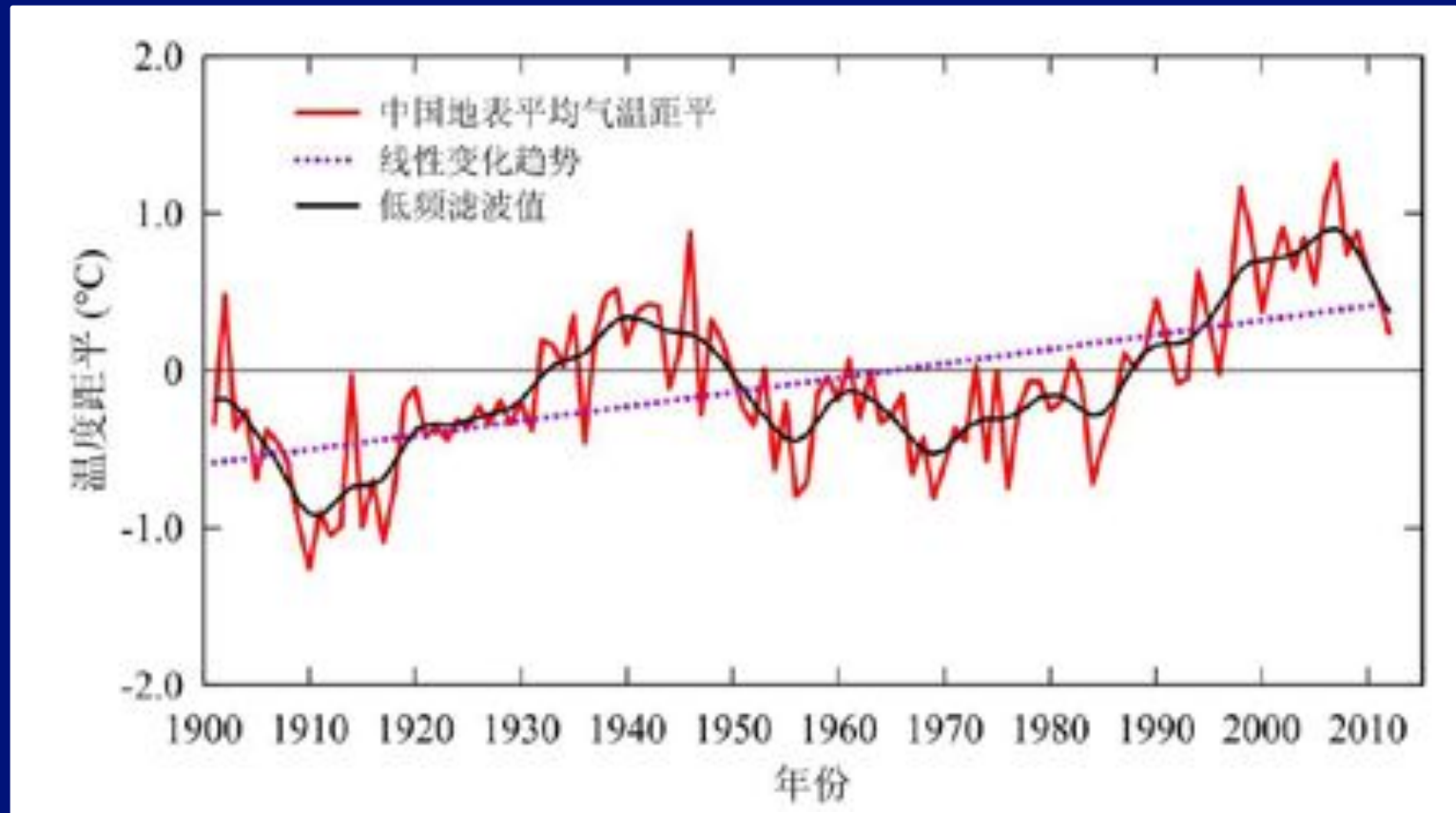


# Temperature Variation at millennium scales



During the past 2000 years, there were at least **four warm periods**  
(1) 1-200 AD; (2) 570-780 AD; (3) 930-1320 AD; (4) 1920 AD-present

# Mean annual temperature anomalies in China (relative to 1971-2000)



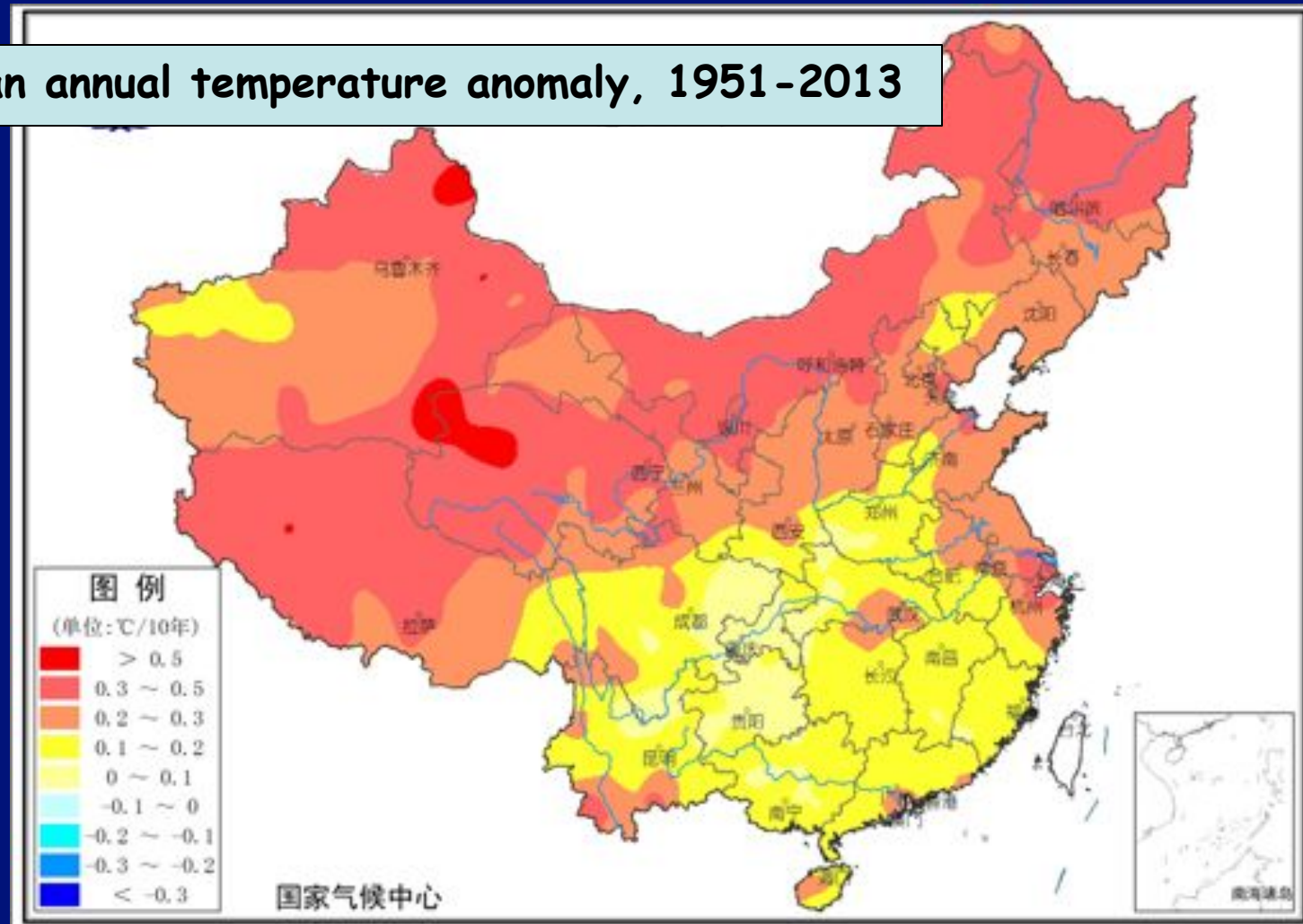
Temperature rising rate 1910-2010 :  $0.91^{\circ}\text{C}$

Temperature rising rate 1950-2010:  $0.23^{\circ}\text{C}/10\text{a}$



# Trends of mean annual temperature in China

Mean annual temperature anomaly, 1951-2013

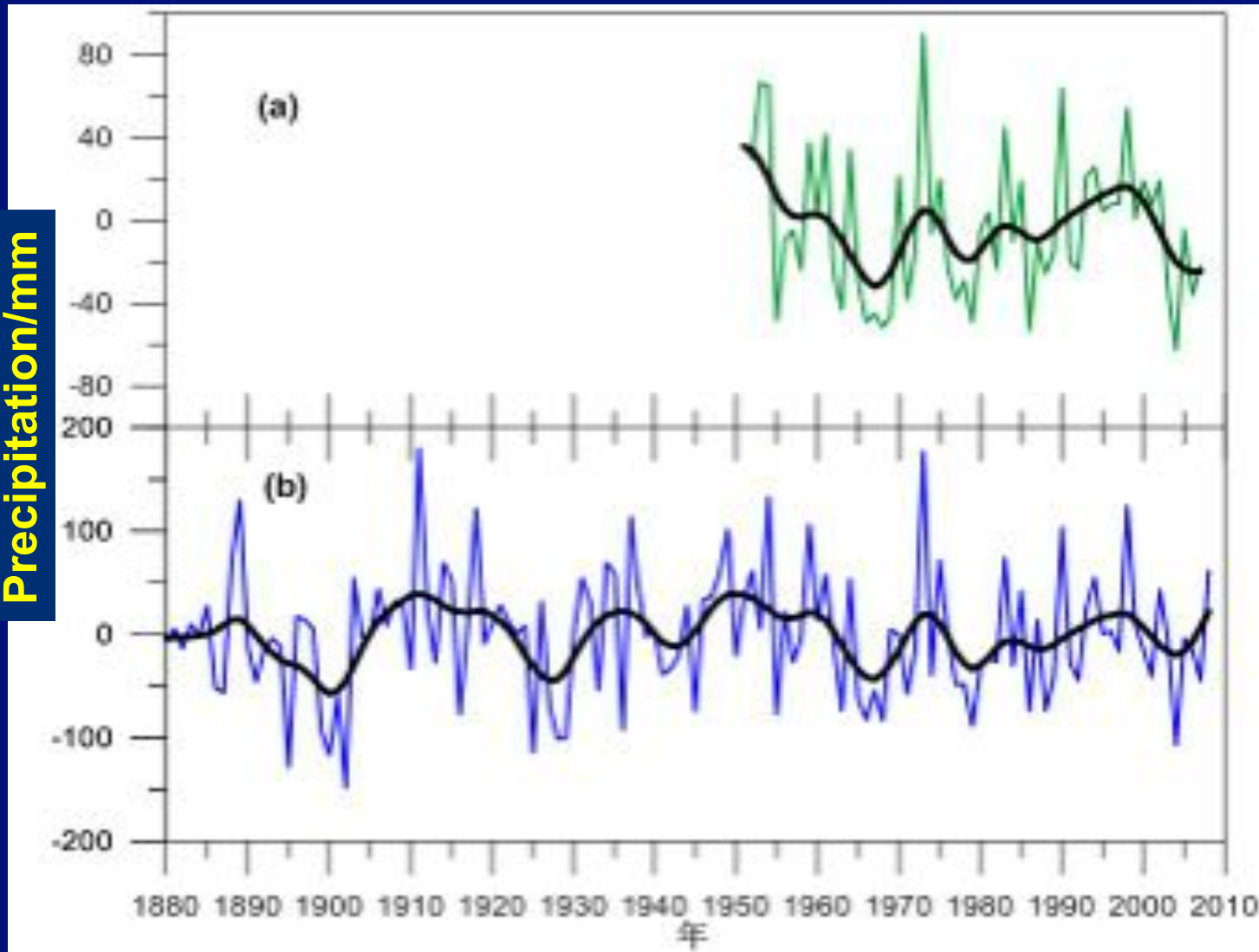


A warming trend is mostly significant in northern China

# Annual mean precipitation anomalies, 1880-2008

(a. 2200-station series; b. 71-station series of eastern China)

Precipitation/mm

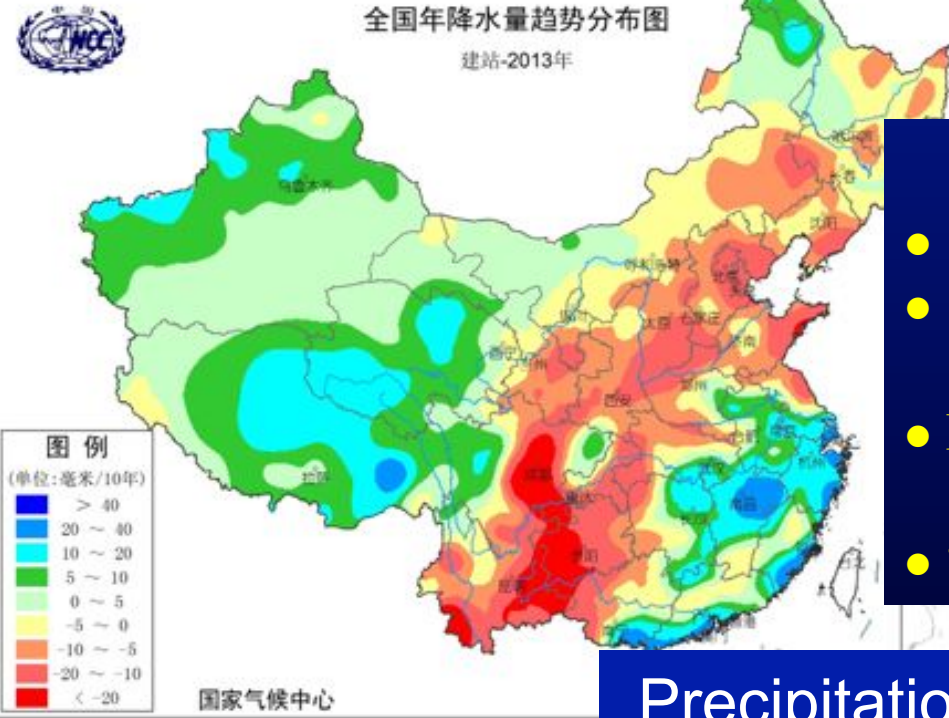


No significant linear trend, but with 20-30a fluctuations



全国年降水量趋势分布图

建站-2013年

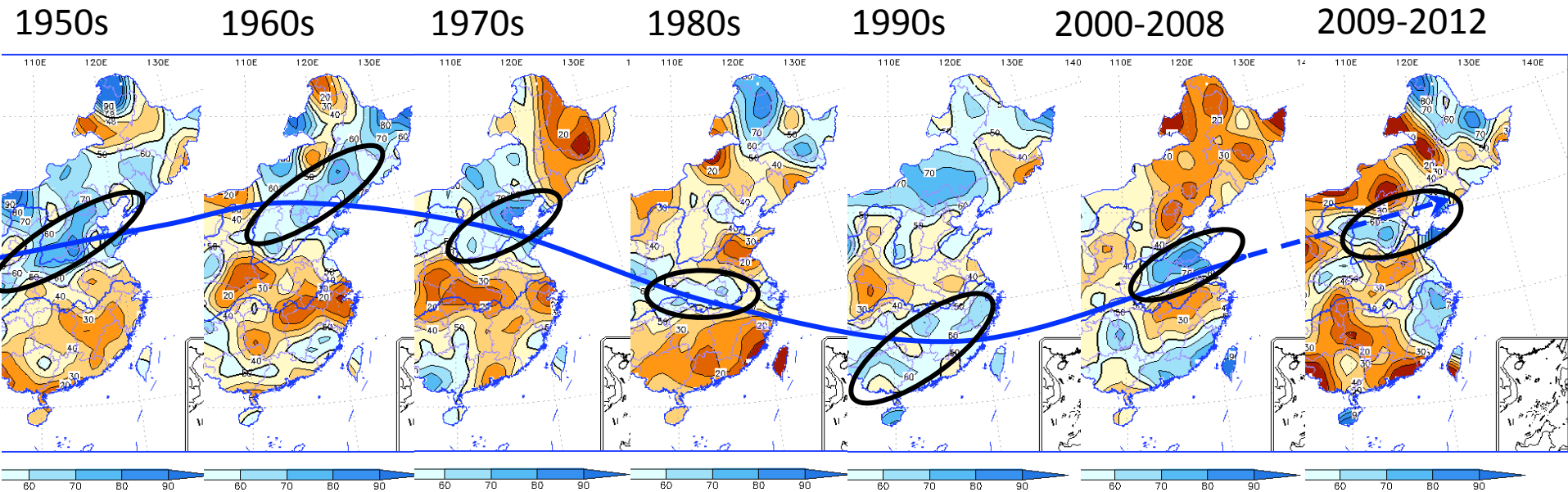


Instrument Observing

## In recent 60 years: precipitation

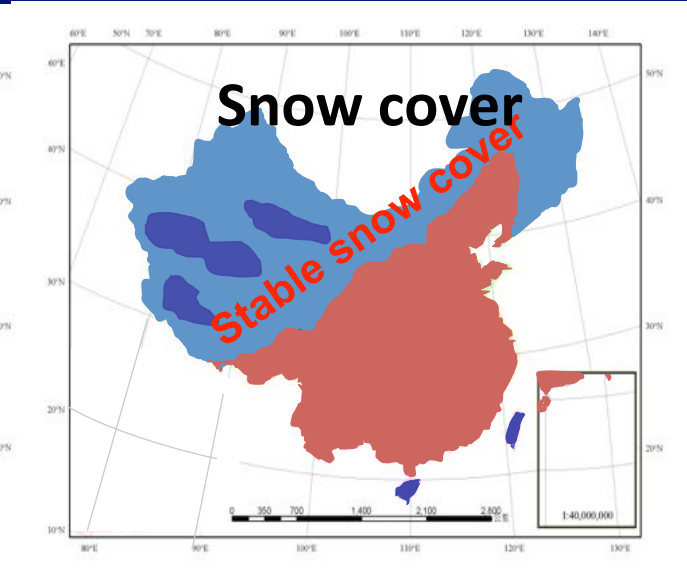
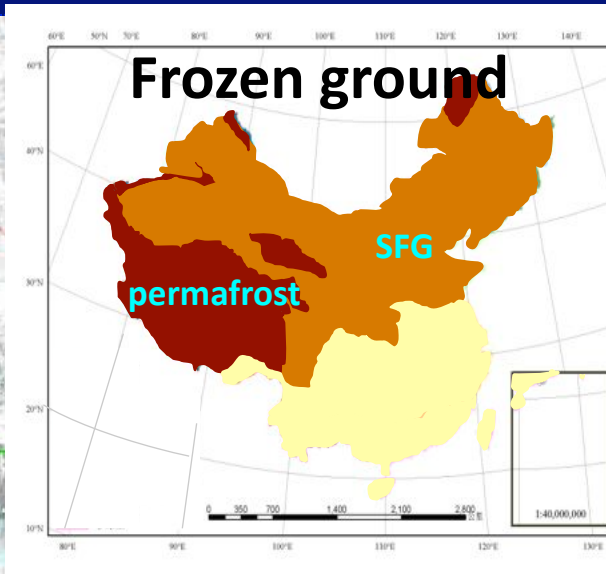
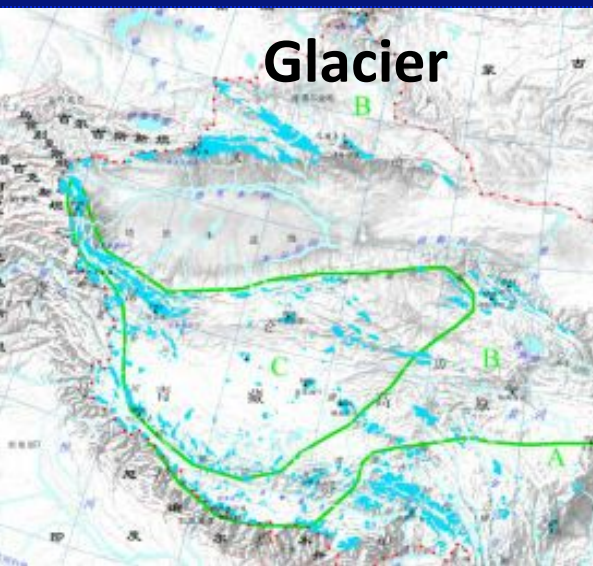
- Western China increased: 15-50%
- North China & most parts of the Northeast China decreased : 10-30%
- Eastern China: *wetter in the south and drier in the north*
- South China increased: 5-10%

Precipitation pattern has a significant change





# China is one of most cryosphere-developed countries in the mid-latitude



Number: 46377

Area: 59425 km<sup>2</sup>

Volume: 5600 km<sup>3</sup>

Area: Permafrost

220 × 10<sup>8</sup> km<sup>2</sup>

Ice content: 9500 km<sup>3</sup>

Extent: Stable SC

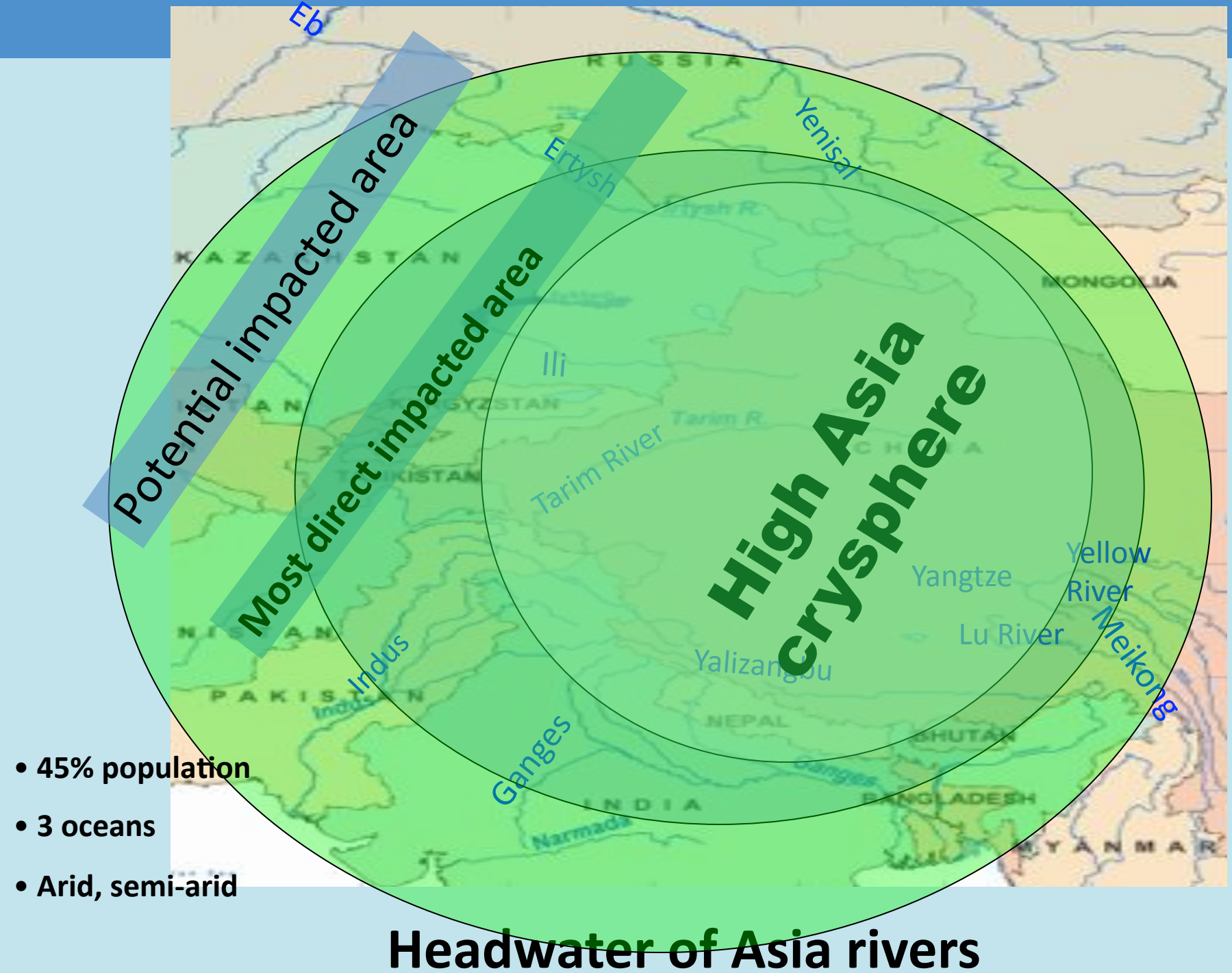
420 × 10<sup>4</sup> km<sup>2</sup>

SWE: 750 × 10<sup>8</sup> m<sup>3</sup>

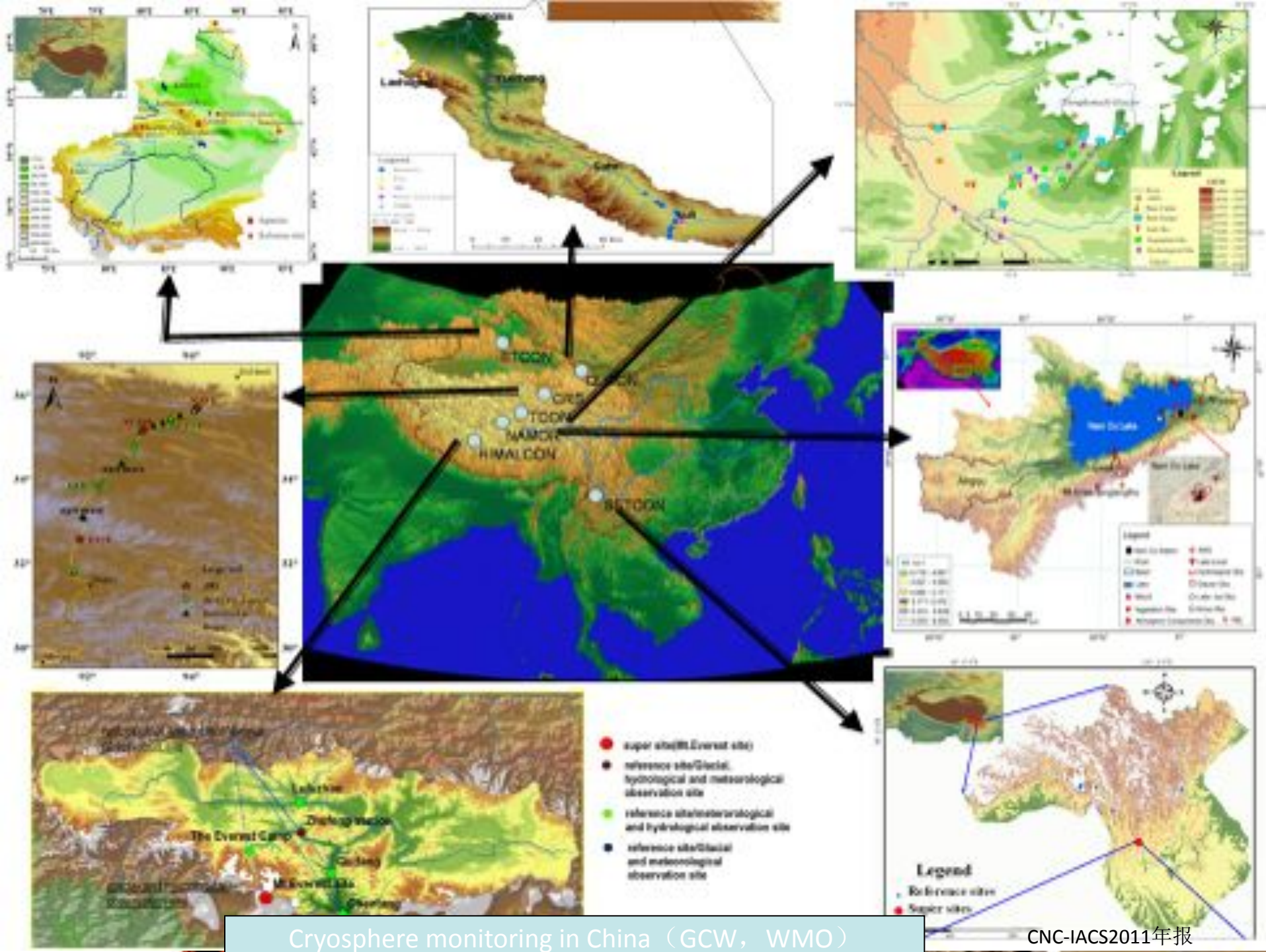


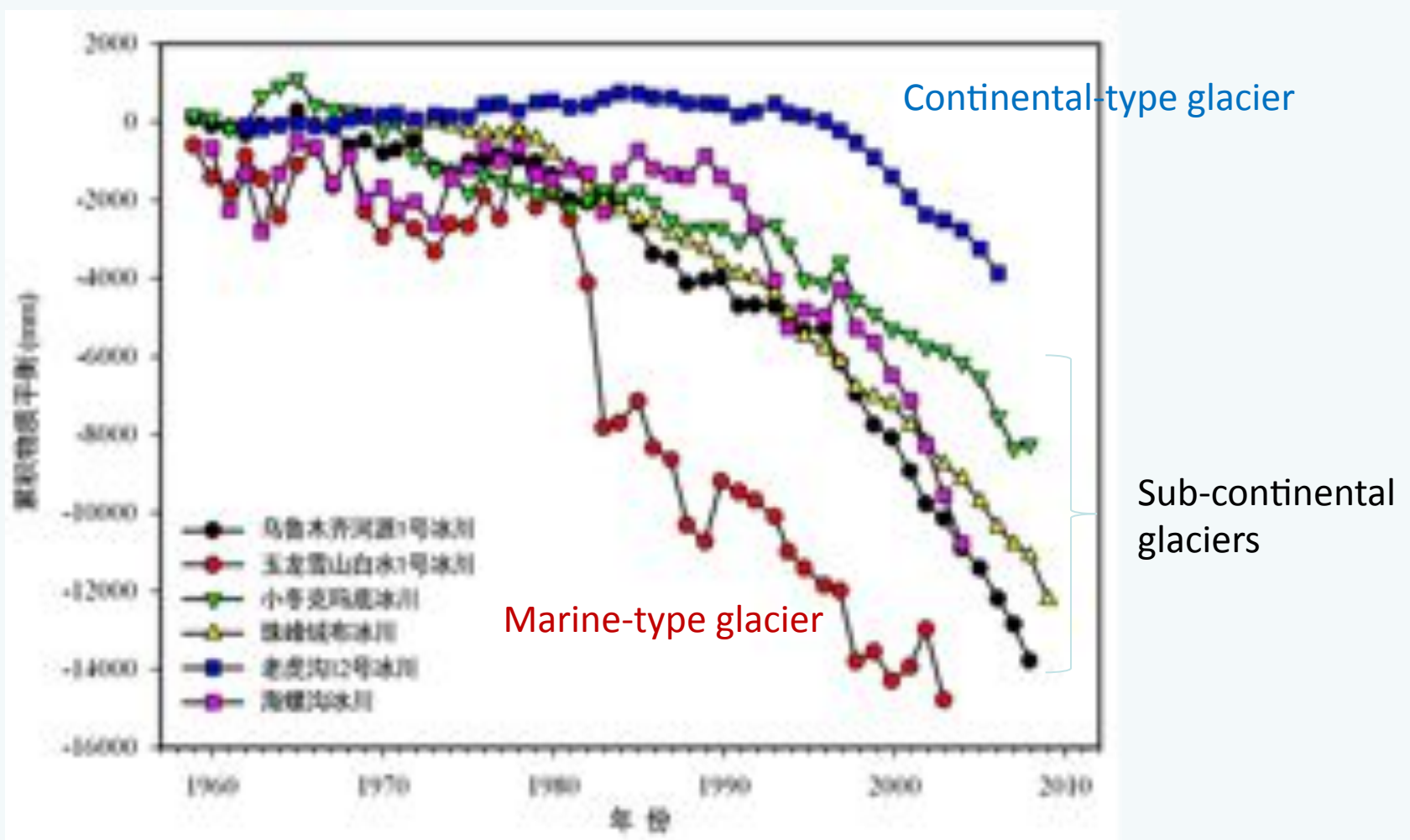
**Tibetan Plateau**

**Cryospheric areas located in China**







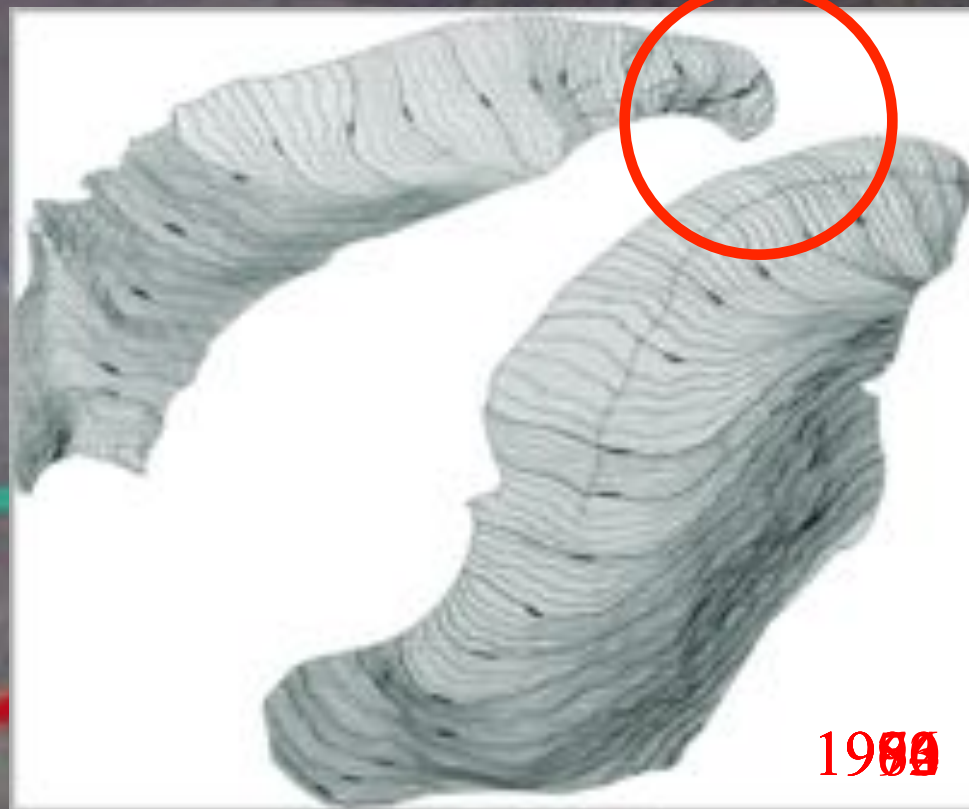


- Different types of glaciers experienced different rates of changes
- Strong negative mass balance since 1990s



# Retreat of Glacier No. 1 in head water of Urumqi River, Tianshan Mountains

断开



1960

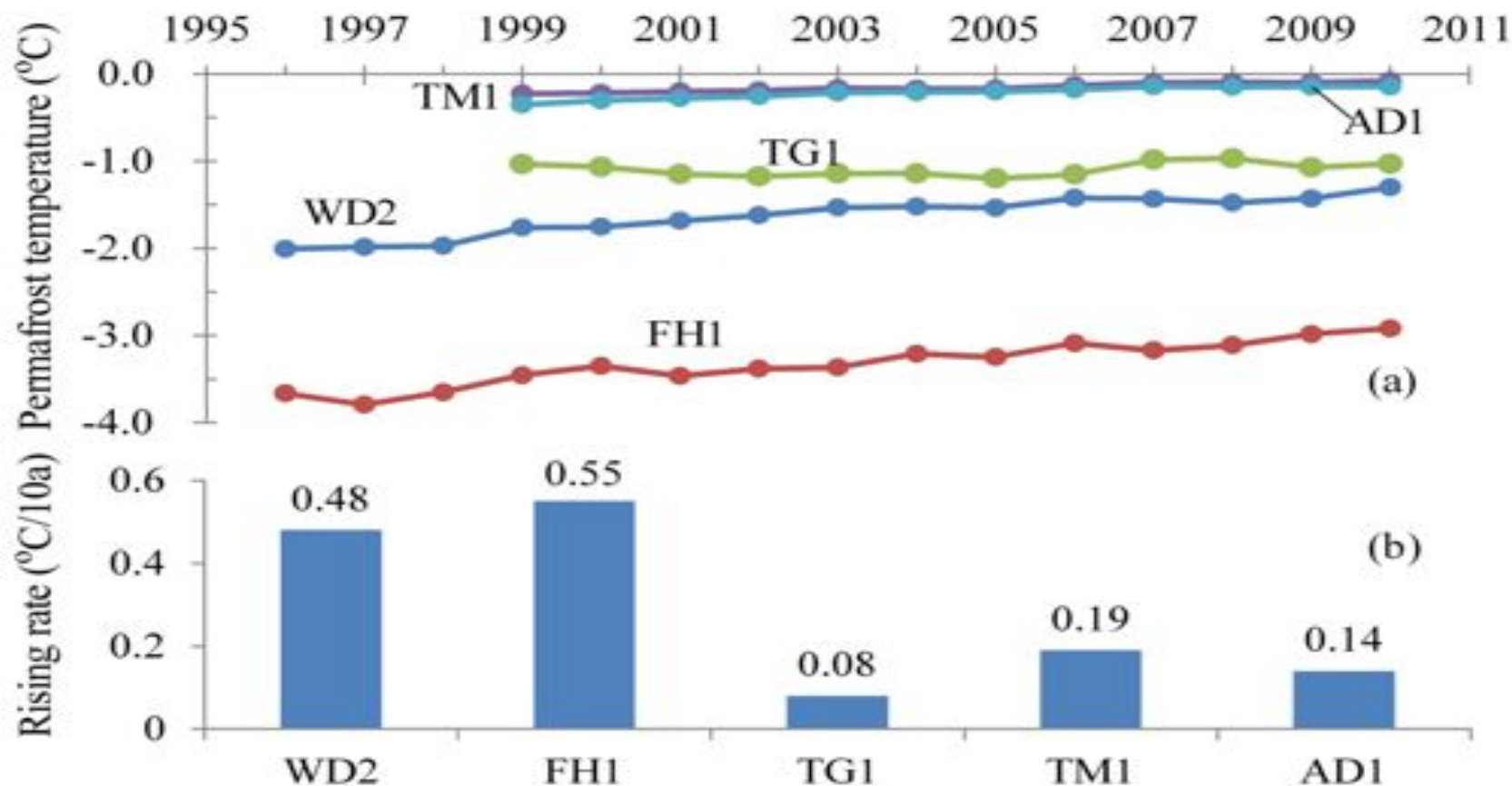
小冰期 (LIA) 以来的变化  
1962年以来连续退缩过程





# Permafrost warming!

据青藏铁路沿线  
1995/1998-2010年监测资料



- *Warming at 6m depth*
- *Rising rate higher in mountains than the lower area*

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# Climate Change Impact

Haze

- ◆ Food security
- ◆ *Climate extremes*
- ◆ *Water resource*
- ◆ *Croosphere*
- ◆ Ocean acidity
- ◆ Healthy
- ◆ Biodiversity
- ◆ .....

© Yann Arthus-Bertrand / Altitude



The rare low-temperature, freezing rain and snow hazards in early 2008



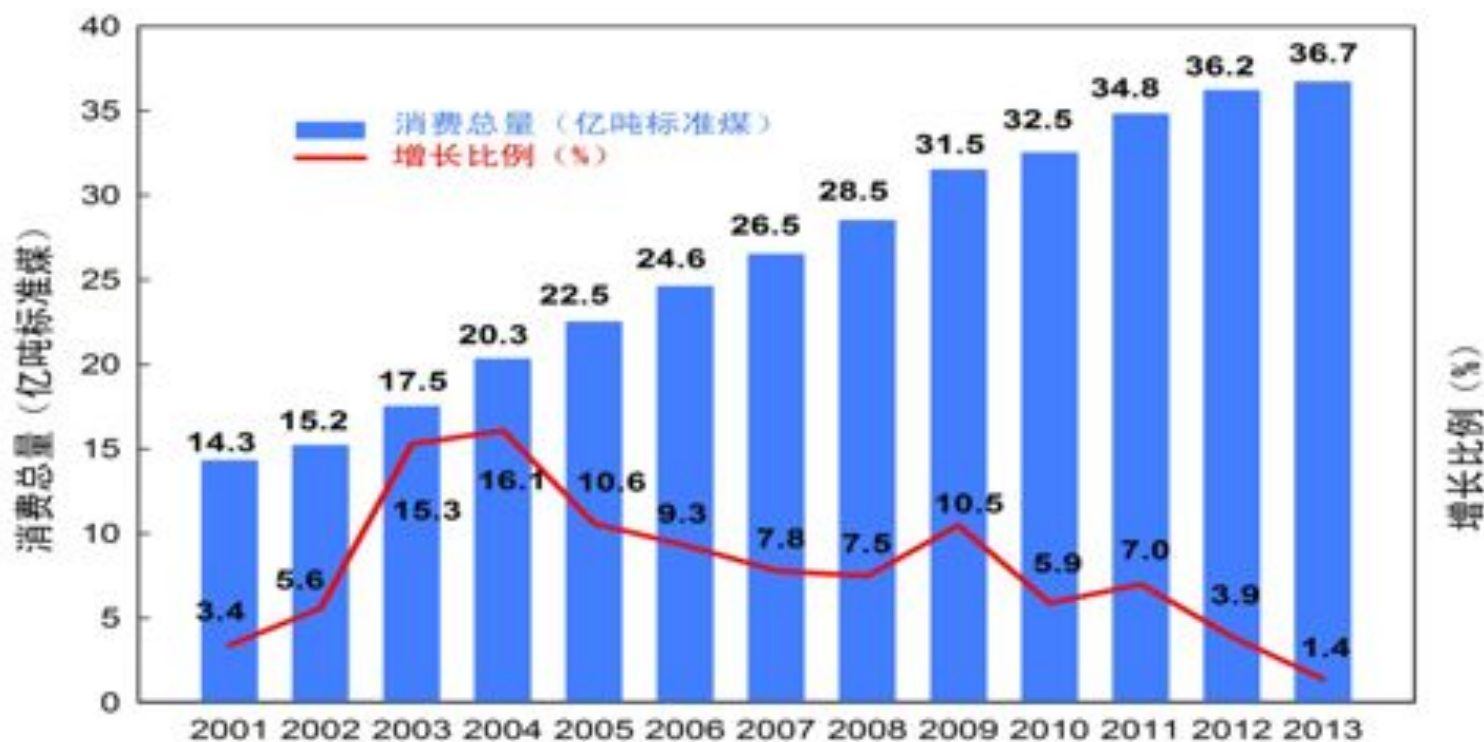








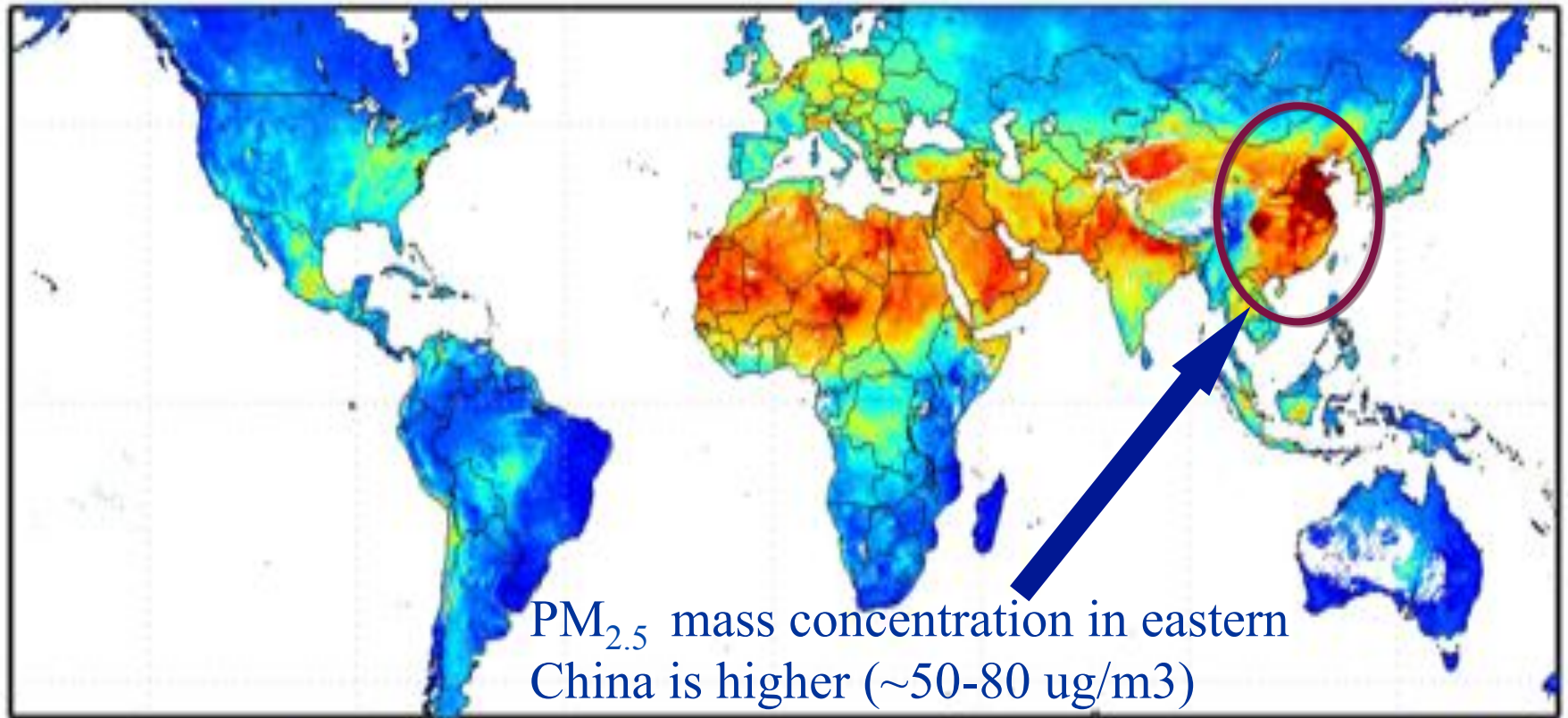
# China's Energy Consumption continue to increase



数据来源：中国统计年鉴

中国气象局气候变化中心制作

# Big Challenge in Environment



PM<sub>2.5</sub> mass concentration in eastern China is higher (~50-80 ug/m<sup>3</sup>)



Satellite-Derived PM<sub>2.5</sub> [ $\mu\text{g}/\text{m}^3$ ]

WHO standard: < 10

# Haze in China



北京



北京

Beijing



# Haze in China



天津  
Tianjin

# Haze in China

石家庄  
Shijiazhuang



# Haze in China



民众抱怨，对环境恶化有意见；政府备受困扰：产业升级、淘汰落后产能一直在做，为什么污染还越来越重呢???





glacier, snow cover  
and frozen land



alluvium

oasis

desert

One case in arid area



# Water shortage, desert expansion, and oasis shrinkage



One case in arid area

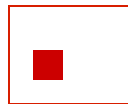
**Badanjilin Desert**

Qilian Mountains

Minqin Oasis under the threat  
of deserts' penetrating

**Tenggeli Desert**

# Ten people village, Fuchenggou, for four families



One case in arid area





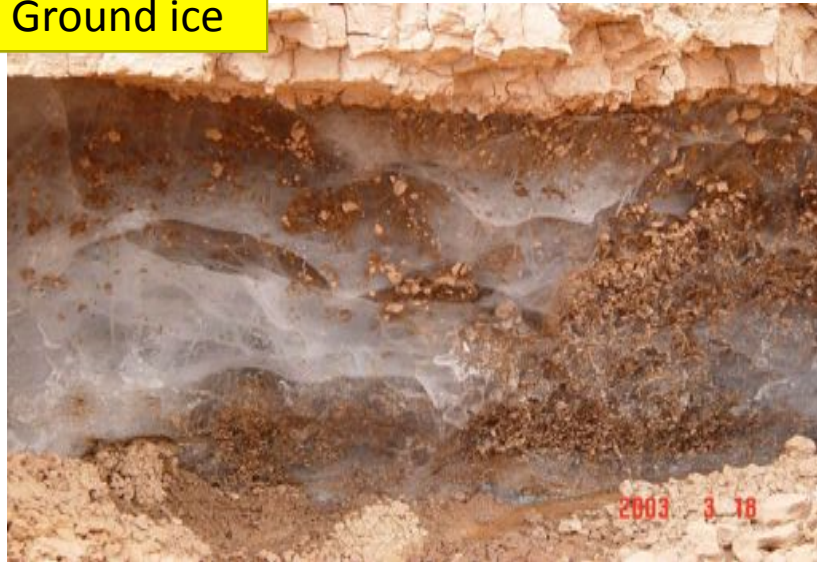
Salinity of water is very high! Can not drink, even can not washing.

**“Raking” cropland**

One case in arid area



Ground ice



Settlement in  
railway roadbed



Settlement in  
highway roadbed

# Permafrost challenges on railway/highway



# Techniques for cooling roadbed

**“Low Tech., high value”**





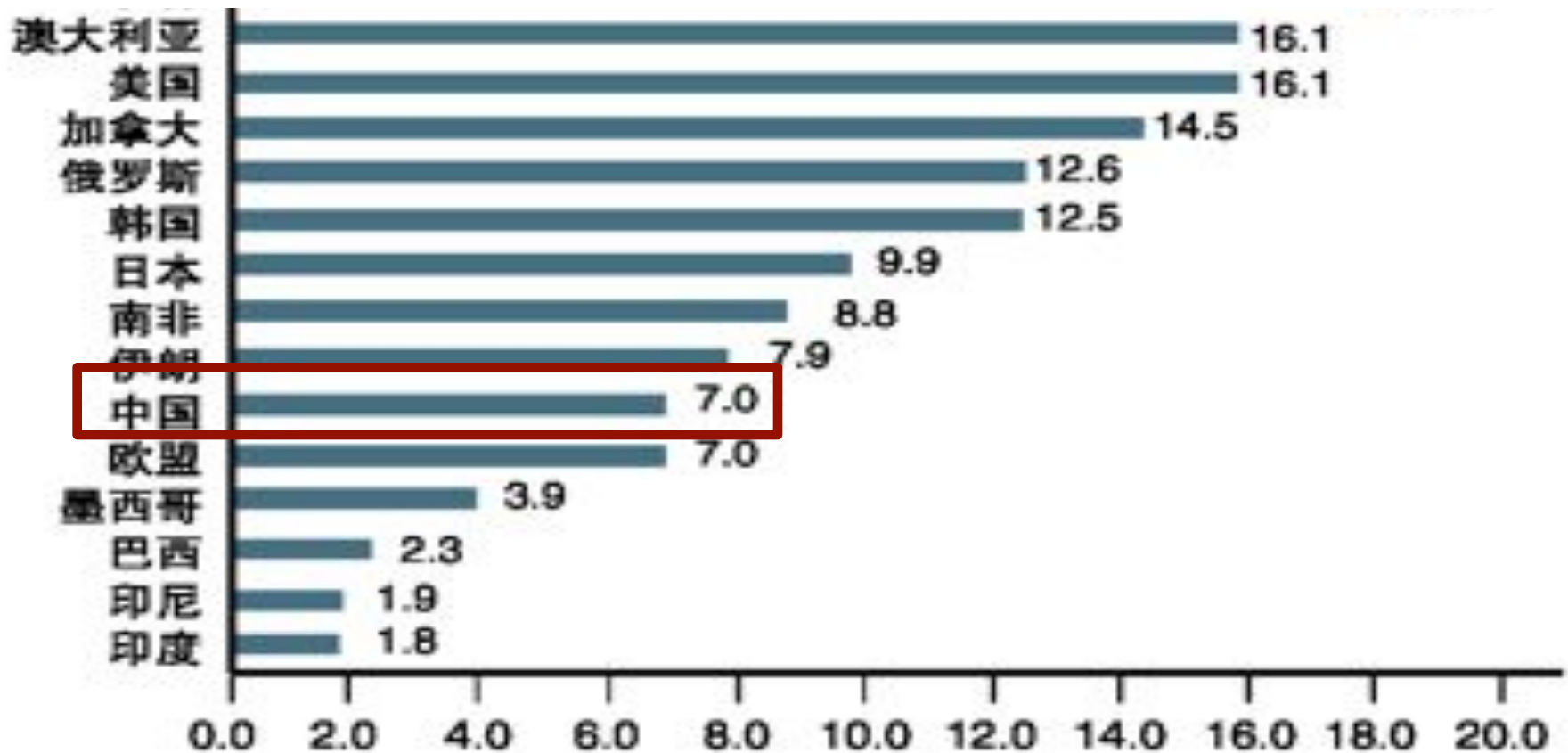


**Projection:** most segments of the railway will be safe  
--- temperature increase less than 3 °C

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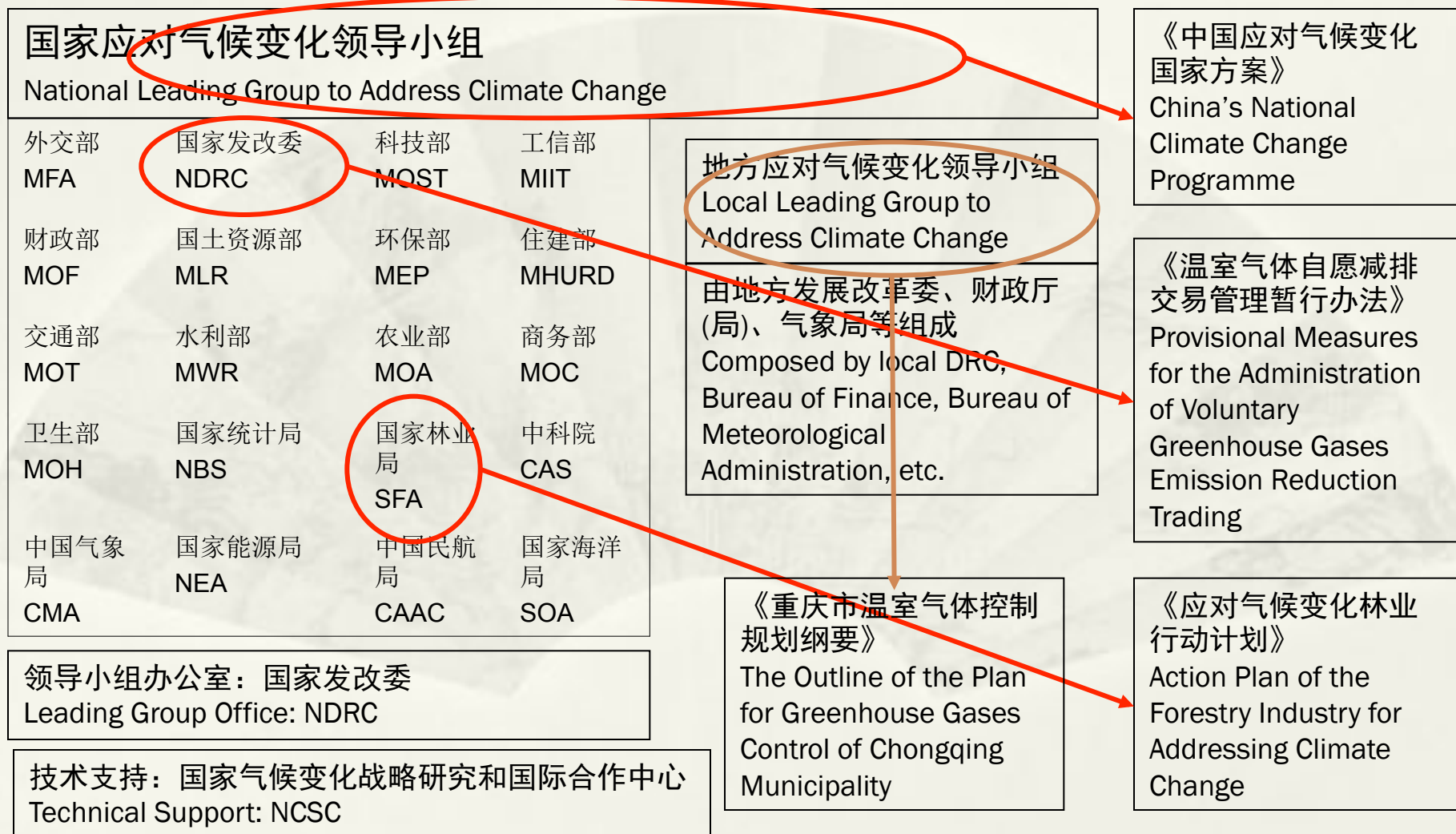
# Carbon emission per capita of China reaches the EU's level



CO<sub>2</sub> emission per capita in 2012 (unit: Ton per capita)



# Institutional arrangement and mechanism for addressing climate change



# China has declared targets for GHGs emissions

In 2009, the Chinese government announced:

- by 2020 CO<sub>2</sub> emission per unit of GDP will be reduced by *40-45%* compared with 2005,
- the non-fossil energy will account for about 15% of the total primary energy consumption,
- the forest area will be increased by *40 million hectares* and the forest stock volume will be increased by 1.3 billion m<sup>3</sup> relative to 2005.

In Sep 2014, state council issued 《National Plan for addressing climate change (2014-2020)》, clarifying the roadmap and timetable of low carbon development in the next six years

# Low-carbon Pilot Projects

- ✱ **Low-carbon Pilot Projects in Provinces and Cities:**
  - ✓ 1st batch: 5 Provinces and 8 Cities
  - ✓ 2nd batch: more cities and provinces involved (more than 20)
- ✱ **Pilot Programs for Carbon Emissions Trading:**
  - ✓ Conducting carbon emission trading pilot programs (5 Cities and 2 Provinces)
  - ✓ Establishing a voluntary emission trading system in 2012
- ✱ **Low-carbon Pilot Programs in Relevant Areas:**
  - ✓ Trials of low-carbon industry park, communities and commerce
  - ✓ Trials of low-carbon products
  - ✓ Low-carbon transport systems pilot city
  - ✓ Green and low-carbon pilot and demonstration projects in key small towns



Wind farm



Solar panel



Hydro power

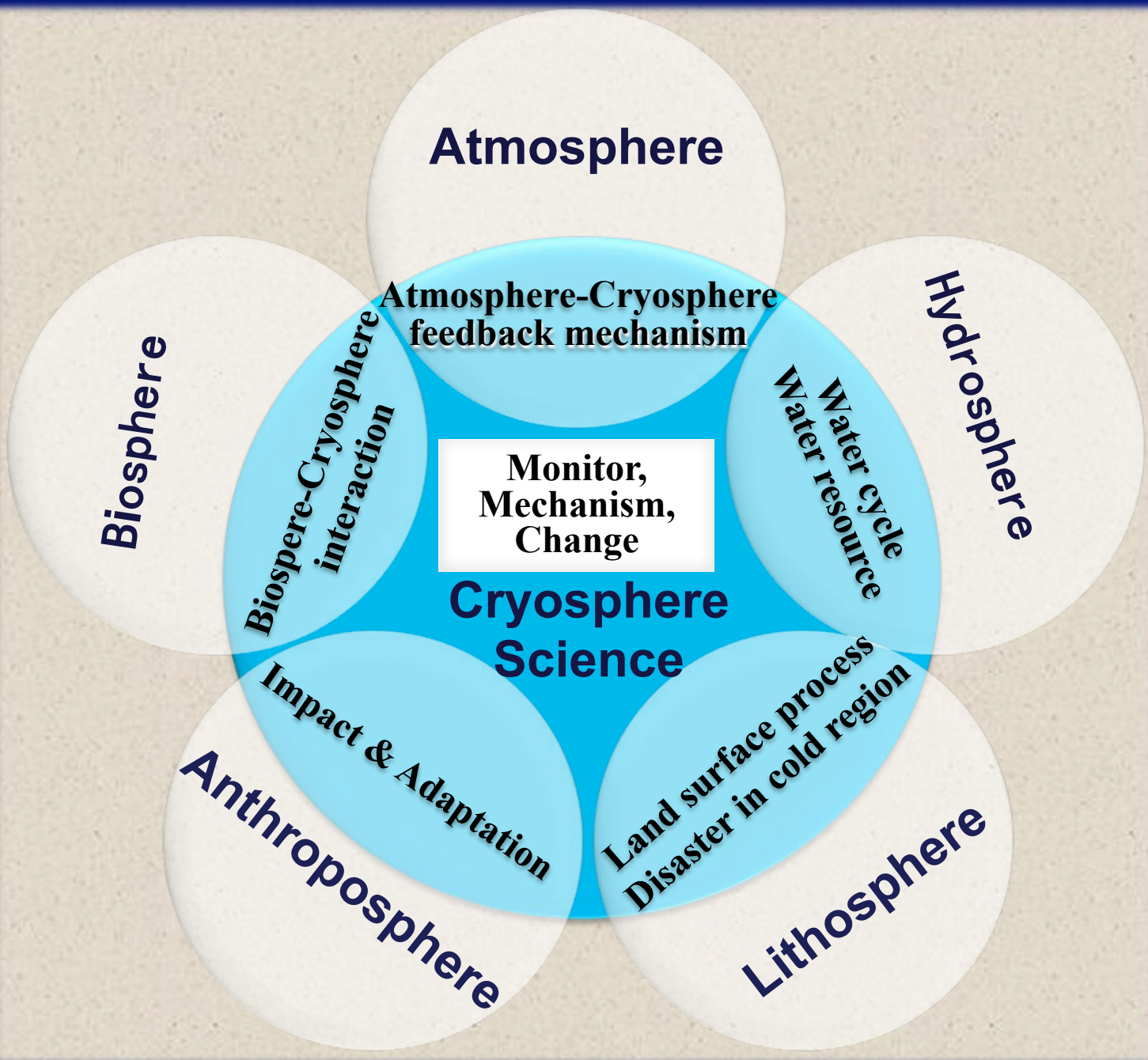


中国核电站分布图

Nuclear power plants



# Cryosphere Science



**Thank you!**