

Climate Change & Water Resources:

Impact and adaptation in China

——气候变化与水资源：影响及适应

Dr. Guoqing WANG

Nanjing Hydraulic Research Institute, MWR

Research Center for Climate Change, MWR

April 14, 2015, Korea

Contents

✓ Climate Change and Water Resources

气候变化与水资源

⑩ Impact Assessment for Water Resources

对水资源的影响评价

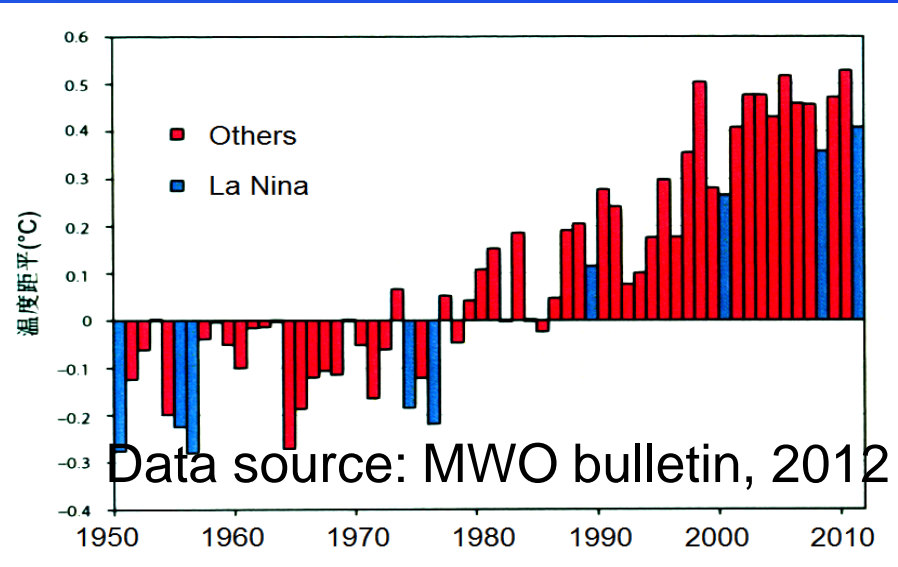
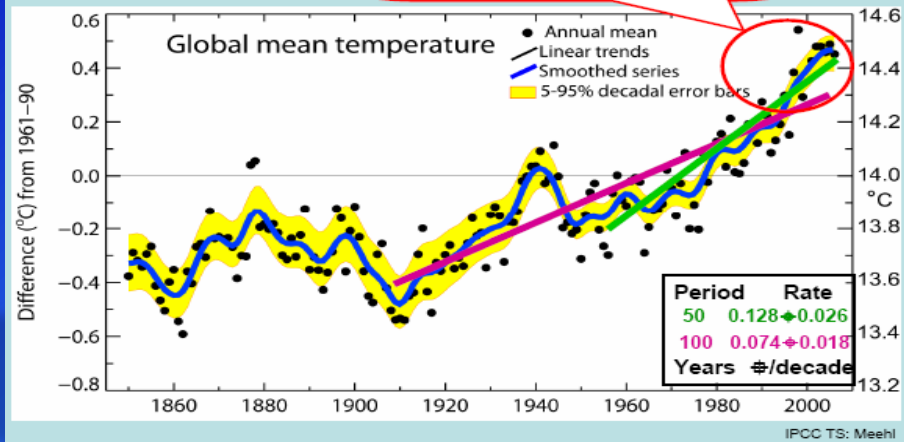
⑩ Adaptative Strategies to climate change

适应全球变化的对策

Global Temperature/ 全球气温变化

Global mean temperature

Warmest 12 years:
1998, 2005, 2003, 2002, 2004, 2006,
2001, 1997, 1995, 1999, 1990, 2000



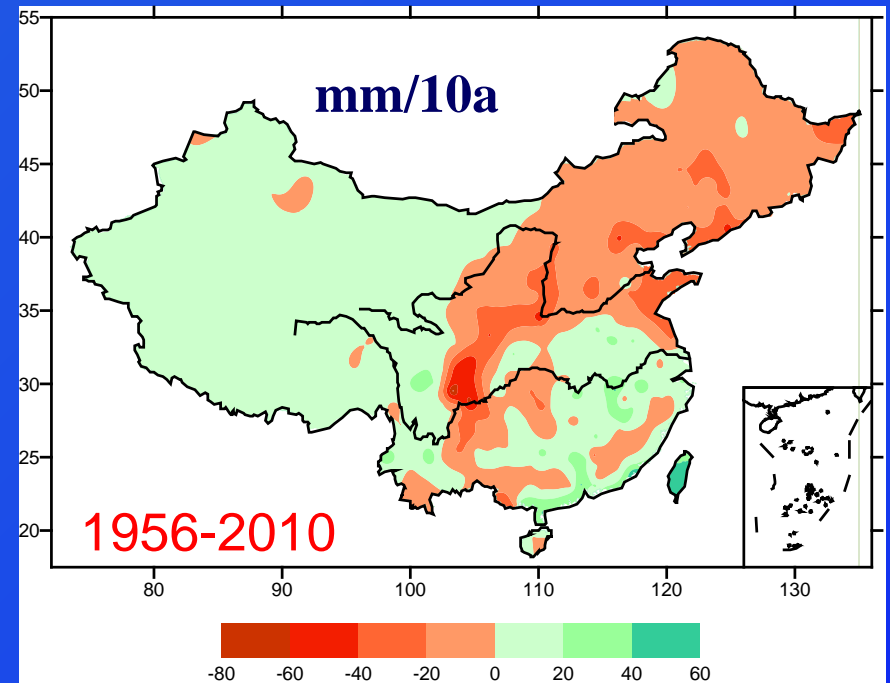
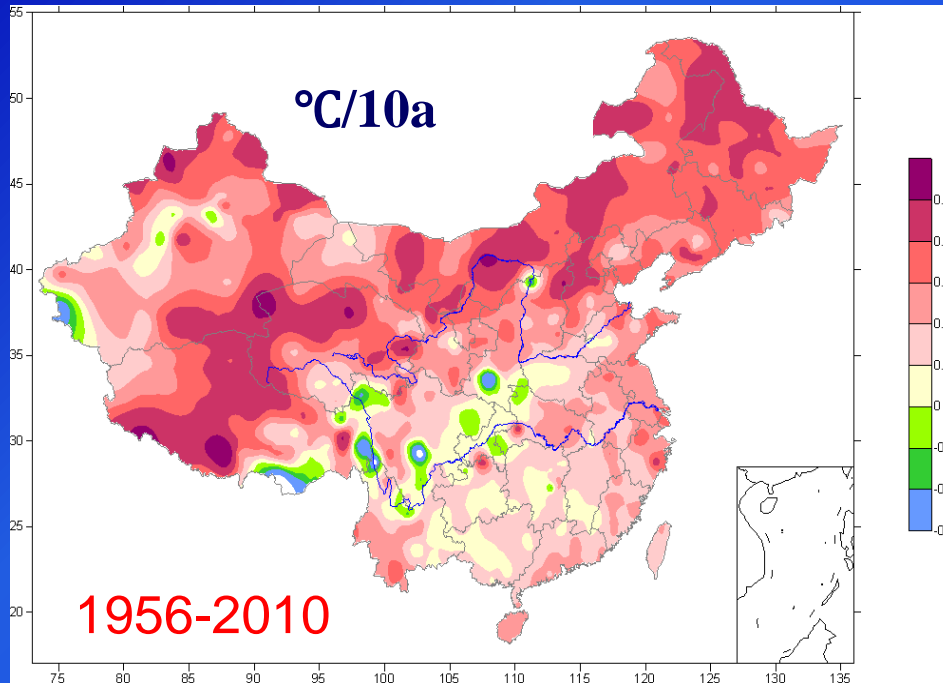
IPCC-AR4

- ◆ Global annual mean temperature: **+0.74°C**
- ◆ The warmest decade: **1990s**
- ◆ The warmest year: **1998**

IPCC-AR5

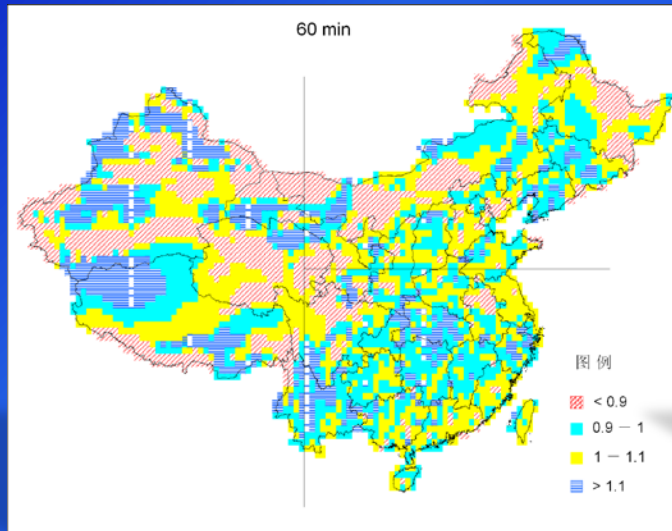
- ◆ The warmest decade: **2000s**
- ◆ The warmest year: **2010**
- ◆ 1998 ranks the 3rd among the **10 warmest years**

Climate Change in China / 中国气候变化

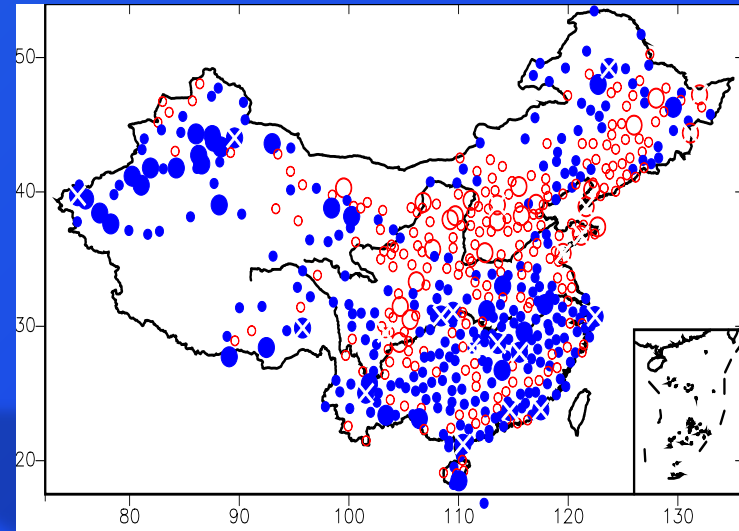


- ◆ **Temperature:** significant rise ($0.22^{\circ}\text{C}/10\text{a}$), especially for North China / 气温显著升高.
- ◆ **Precipitation:** slight change for whole China, visible decline for north China Plain and North east China / 降水变化不明显.

Extreme events/ 极端气候事件



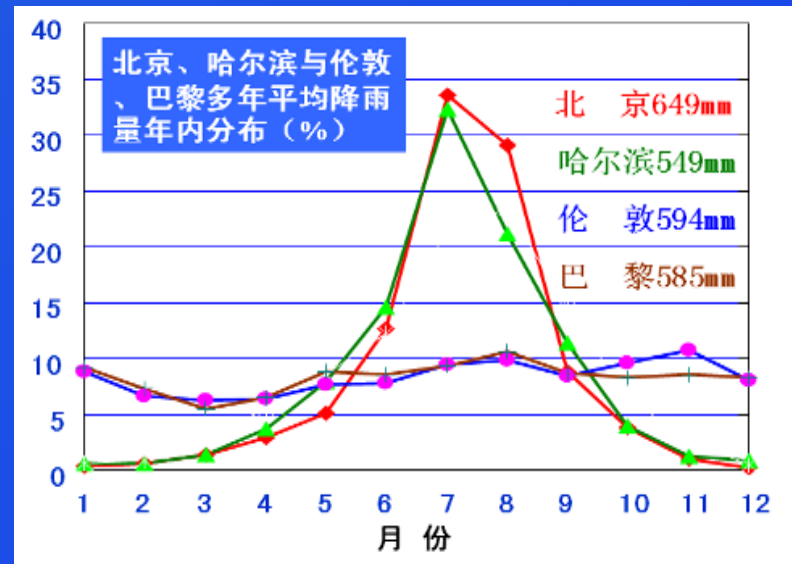
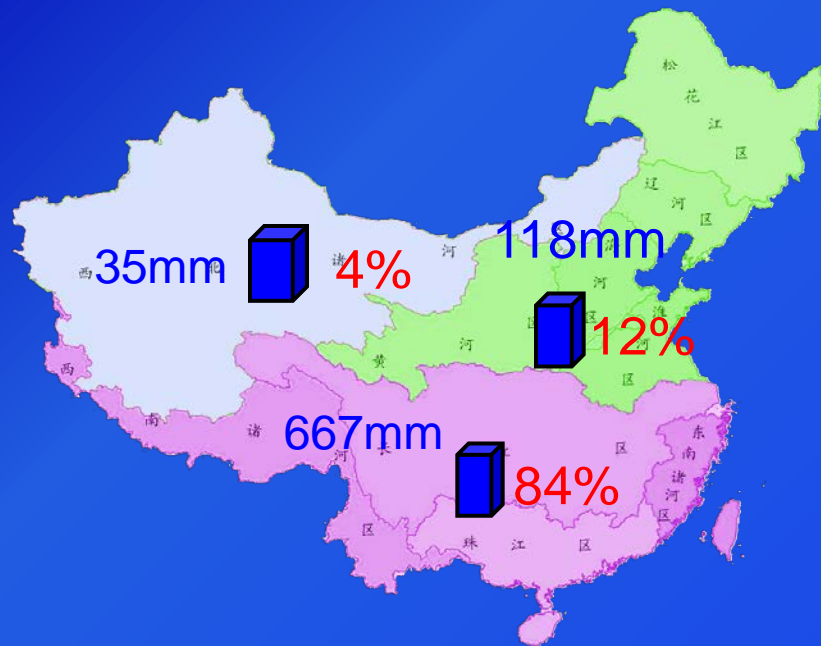
Changes in 60mins rainfall
before and after 1980



Trend rate of rain days of
extreme rainstorms

- ◆ Short duration rainfall intensity: **Increasing**
Kuanping, Shanxi: 1998.07, 1300mm/6-7hr
Zhanjiang, Guangdong: 2007.08, 1188mm/24hr Rain
- ◆ Days of extreme rainstorms: **Increasing**

Water resources / 中国水资源

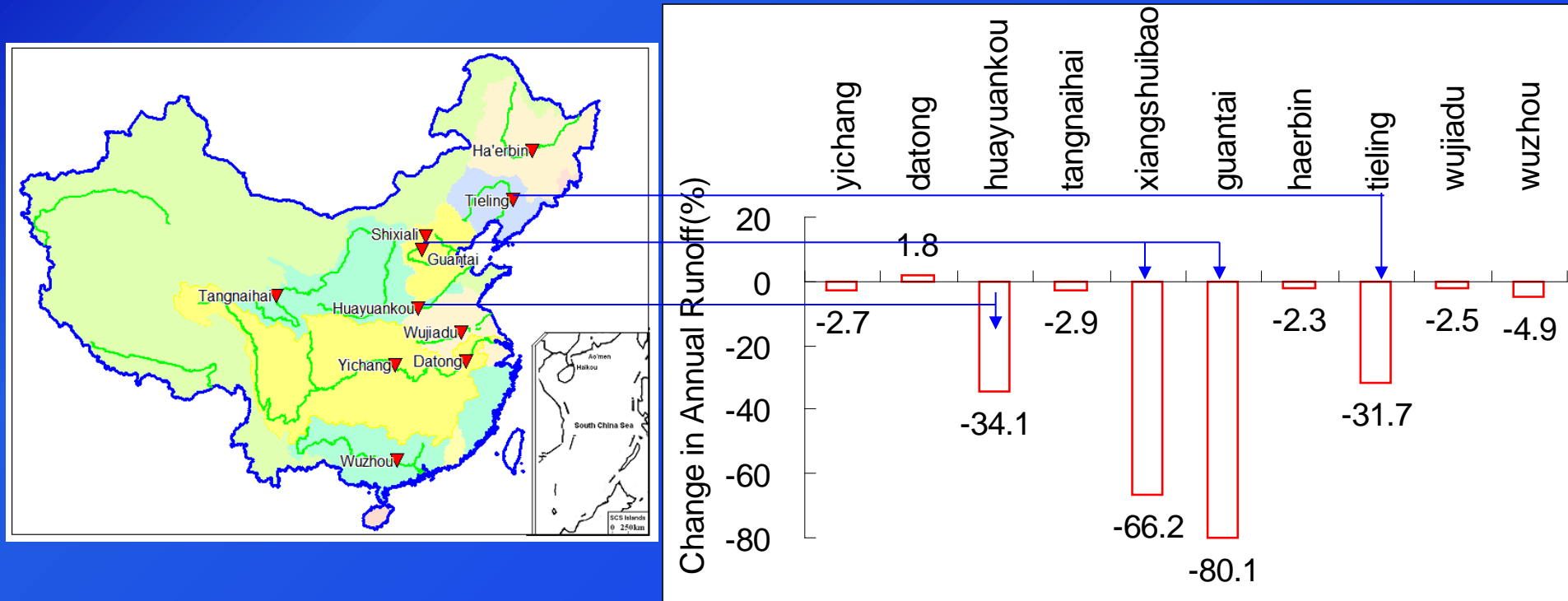


Spatial and temporal distribution

- ◆ Total water amount: ranks 6 in the world
- ◆ Uneven distribution in time and space: 60~80%
- ◆ Low water occupation per capita: 2200m³, < 30% world mean
- ◆ Serious shortage in water resources: 400/668 cities,
Gap=40-50bm³, in Normal Year

Change in runoff / 实测径流量变化

Change in runoff of 1980-2010 relative to 1950-1979



- ◆ Runoff decreasing in general / 总体呈现减少趋势
- ◆ Higher decrease in Hai River and Yellow River / 海河、黄河减少明显.

Regional flooding issues / 区域洪水问题

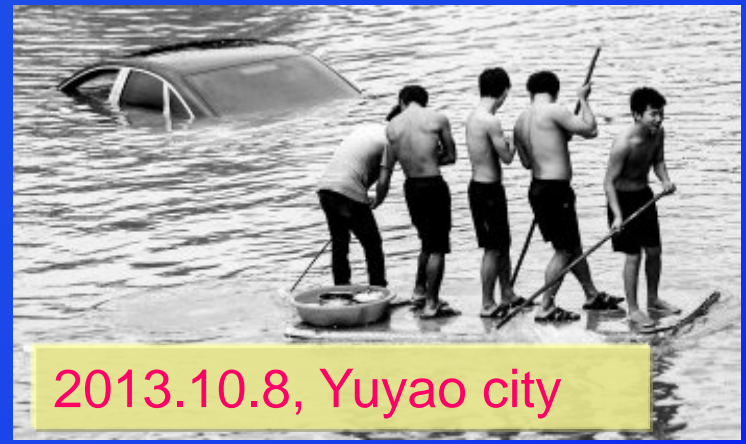
2012.7.21, Beijing



2013.7.19, Xiamen Uni



2013.10.8 Tongji University



2013.10.8, Yuyao city

- ◆ 2008~2012, 62% of China cities have suffered from serious flooding issues, caused very huge economic losses, such as Beijing in 2012.7.21 / 损失巨大

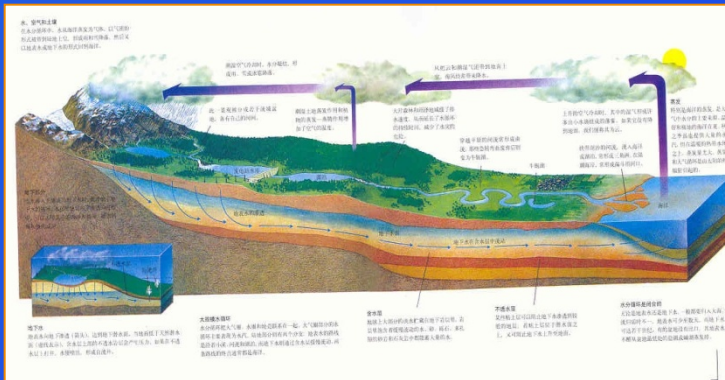
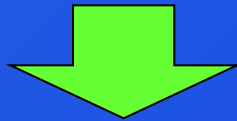
Climate change and Hydrological cycle



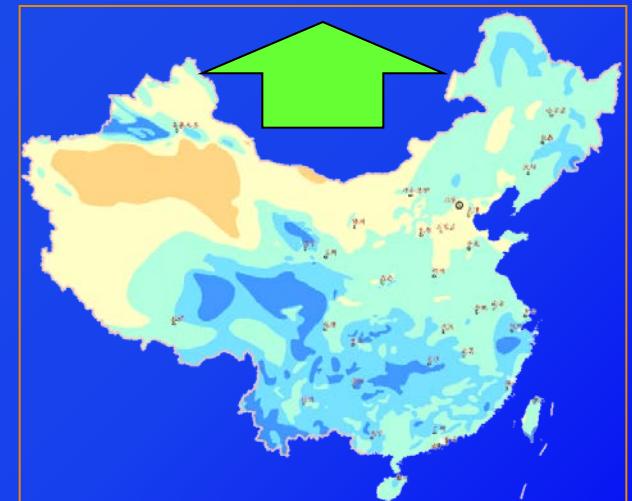
Global Warming



Sustainable utilization



Hydrological cycle



Changes in rainfall

Contents

- **Climate Change and Water Resources**

气候变化与水资源

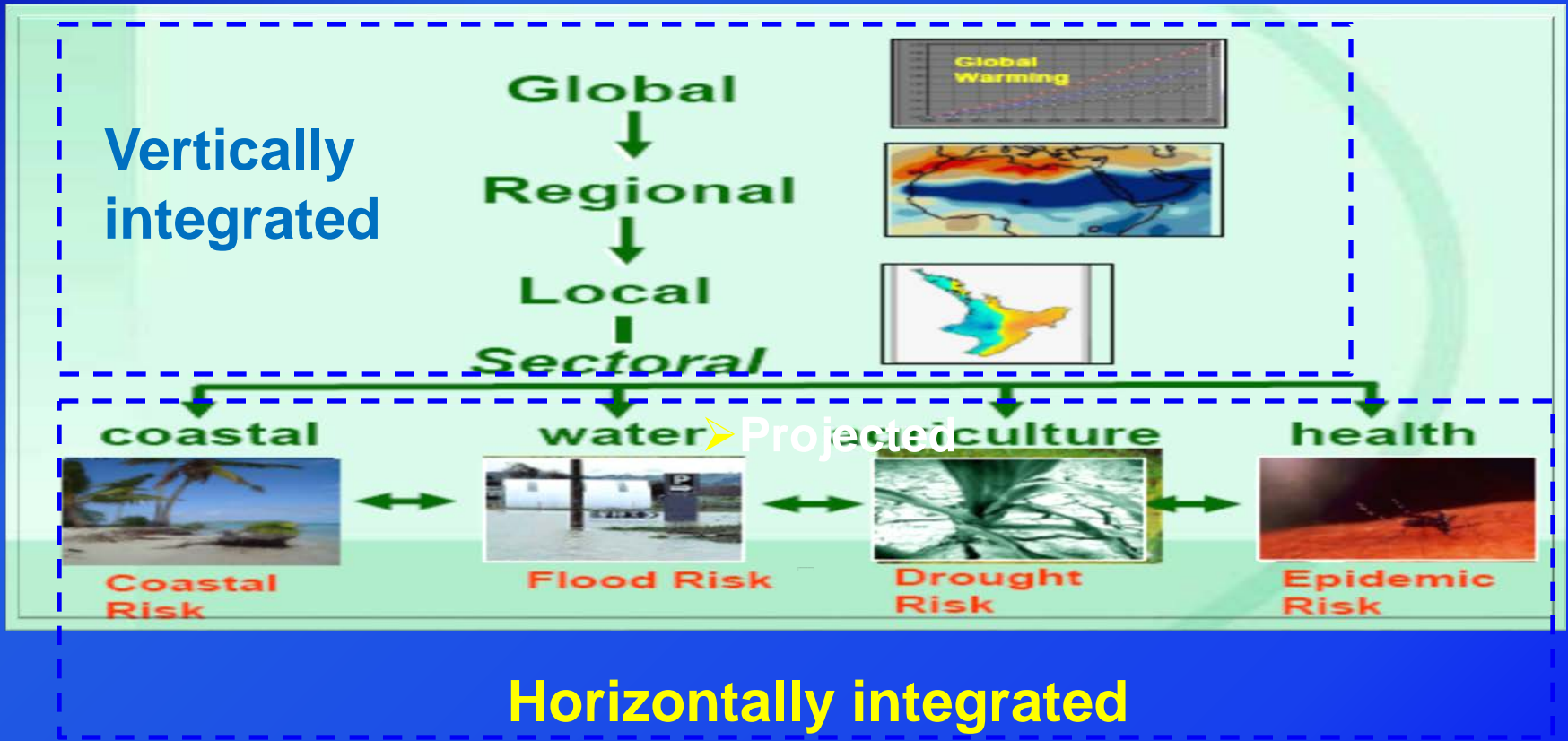
- ✓ **Impact Assessment for Water Resources**

对水资源的影响评价

- **Adaptative Strategies to Climate change**

适应全球变化的对策

Assessment approach



■ Scenario / 情景

- Projected
- Hypothetical

■ Assessment / 评价

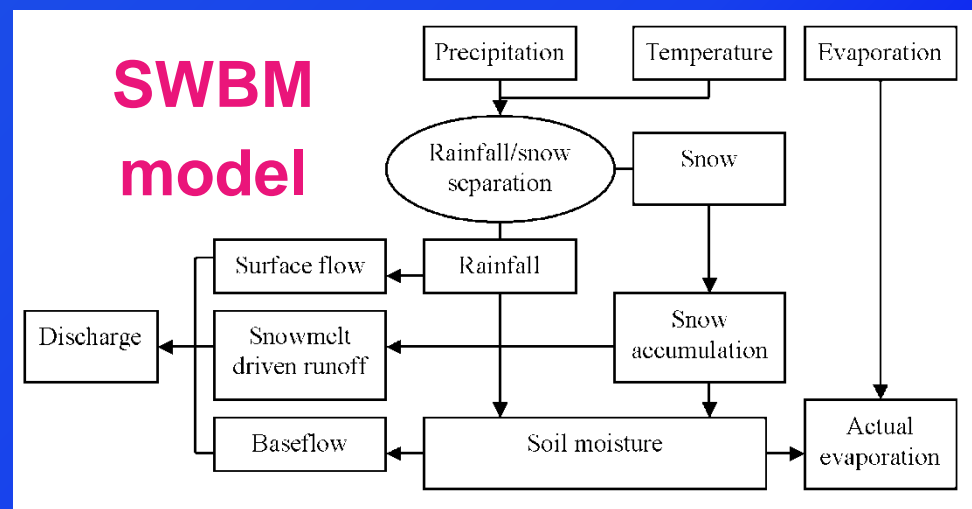
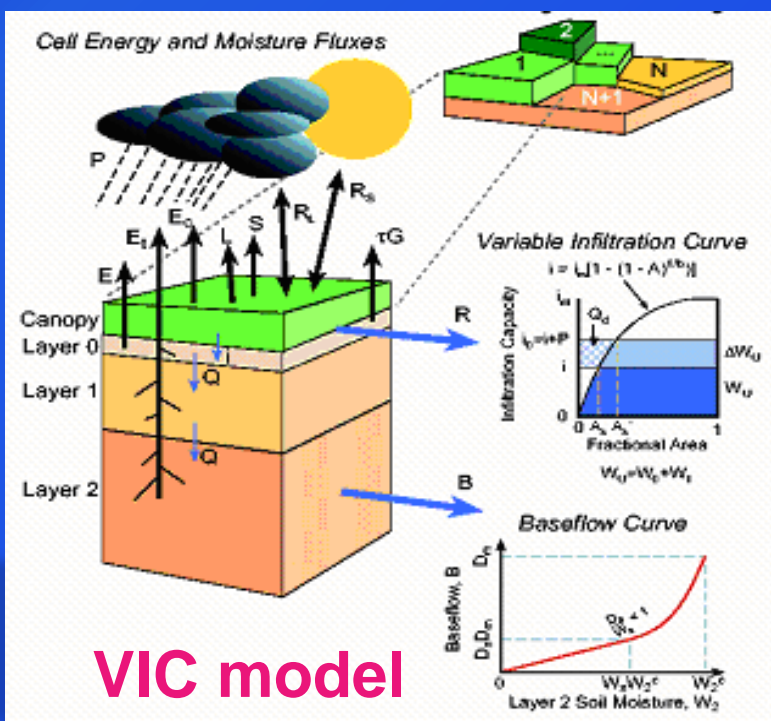
- Model
- Impacts

■ Adaptation / 适应

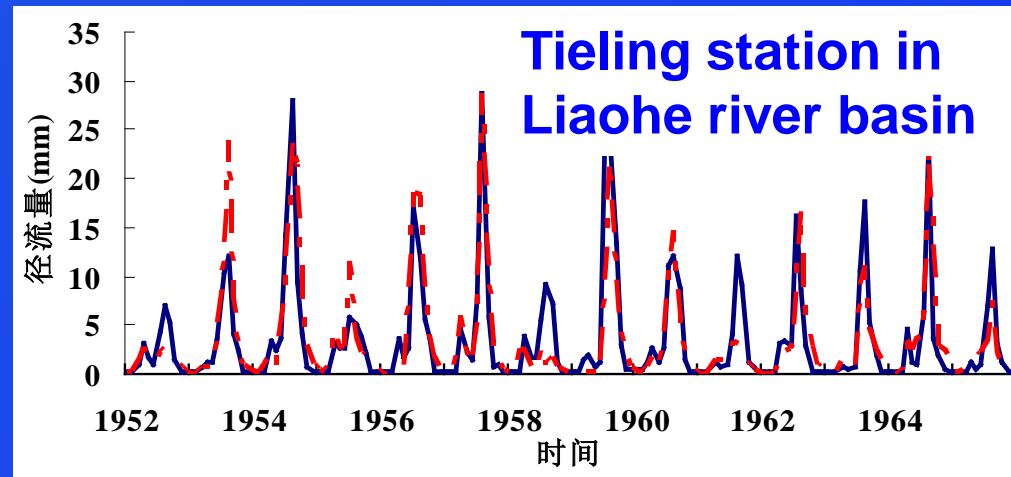
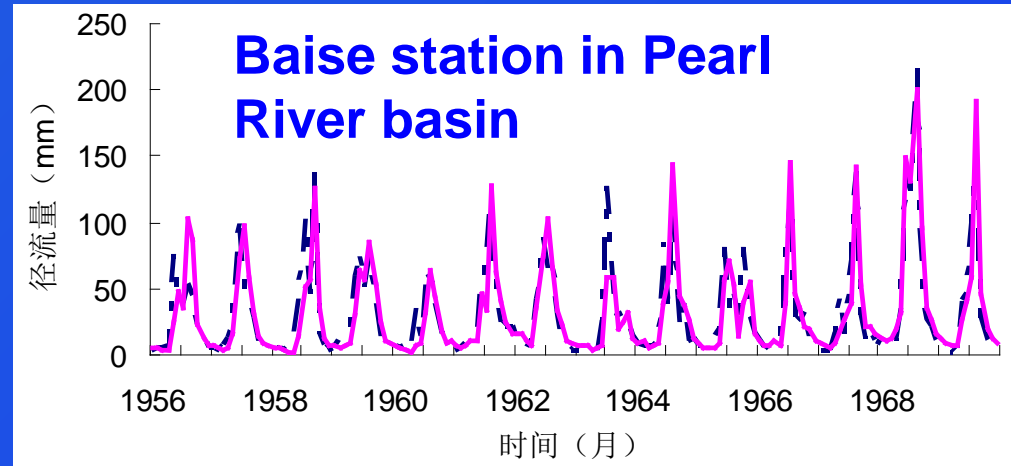
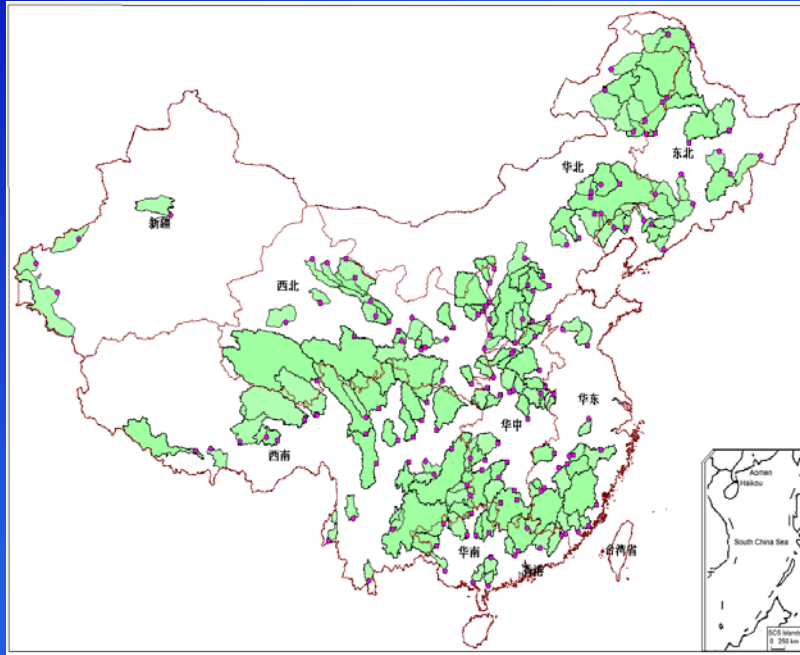
- Policy
- Technology

Grid-based assessment models / 评价模型

- ◆ Study area: China-wide
- ◆ Resolution: 0.5°
- ◆ Grid cells: 4160
- ◆ Models: VIC, SWBM



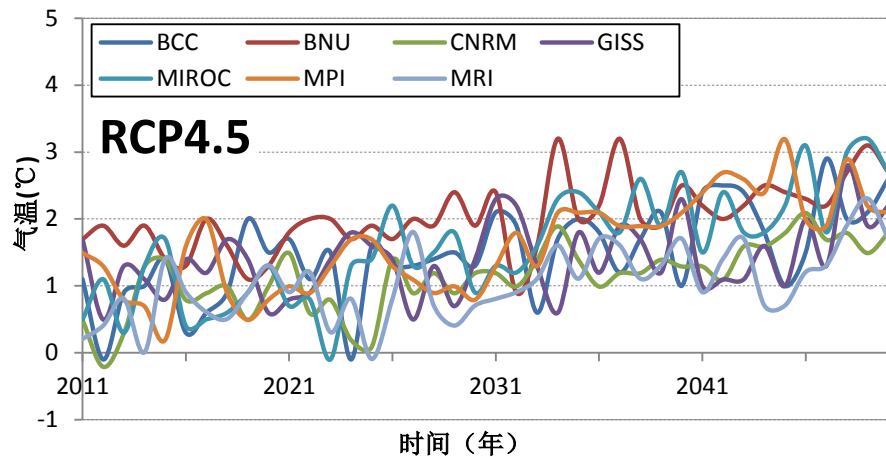
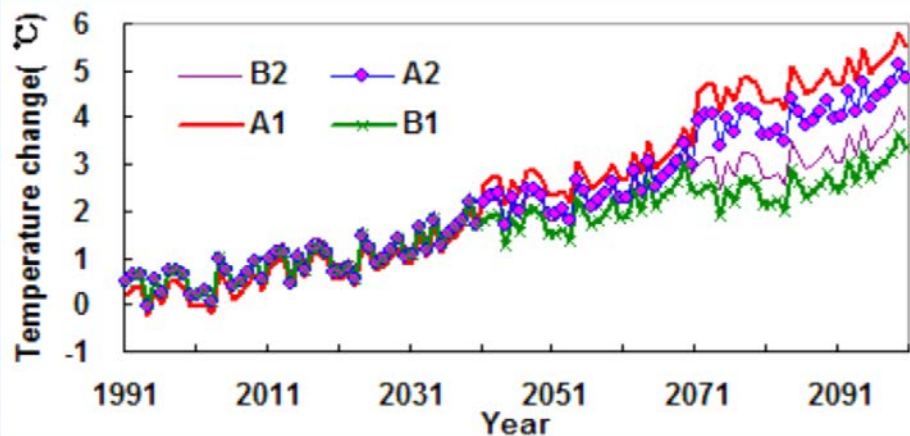
Grid-based assessment models / 评价模型



■ **215 typical catchments for model calibration**

■ **The model performs well not only for humid catchments but also for arid catchments / 模型应用效果较好**

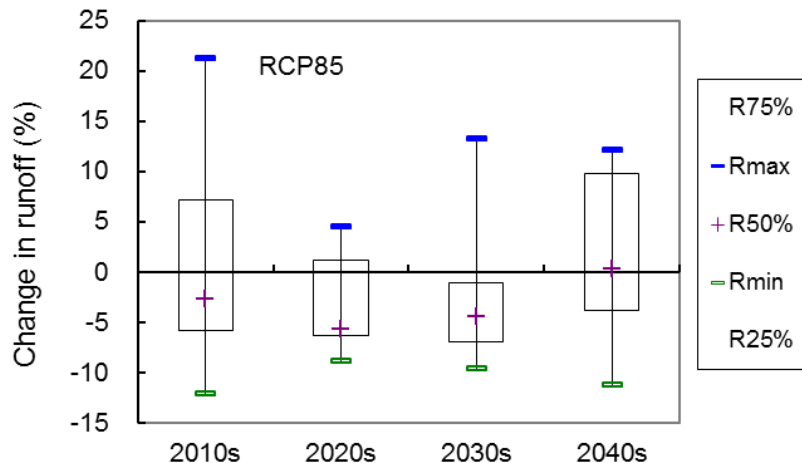
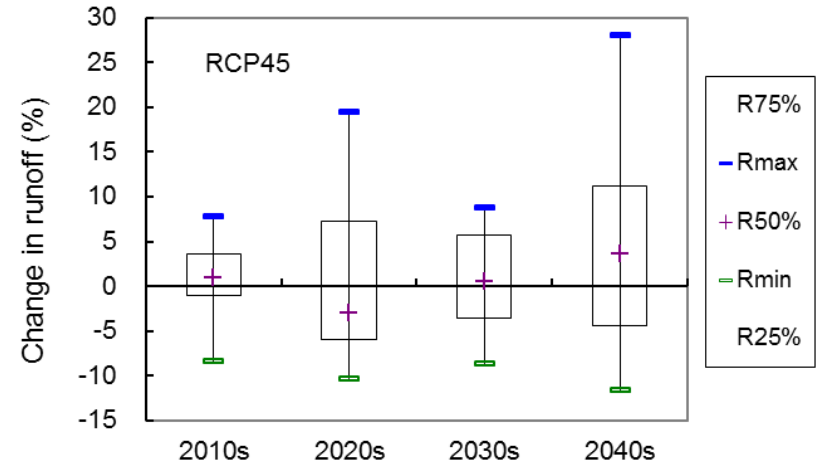
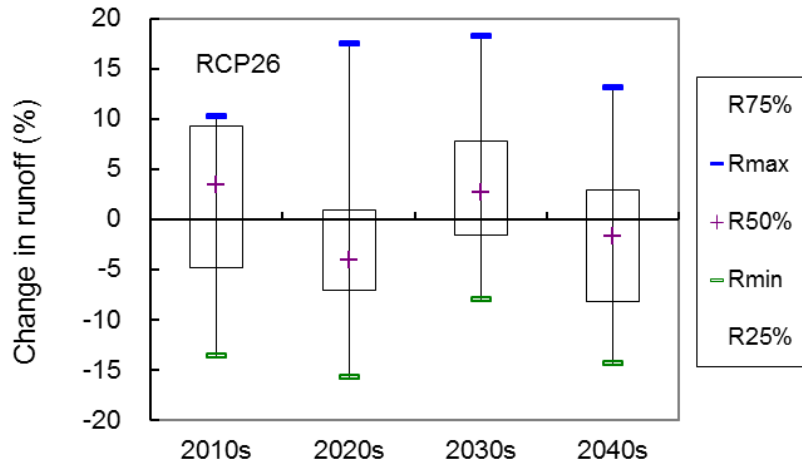
Climate change for China / 未来气候变化



- ◆ Scenario: SRES and RCP / 两种气候情景
- ◆ Temperature: Steady significant rising trend, 0.24-0.42°C/10a / 气温稳定升高
- ◆ Precipitation: No significant variation trends, but showing higher variability in the next decades / 降水变异性增大.

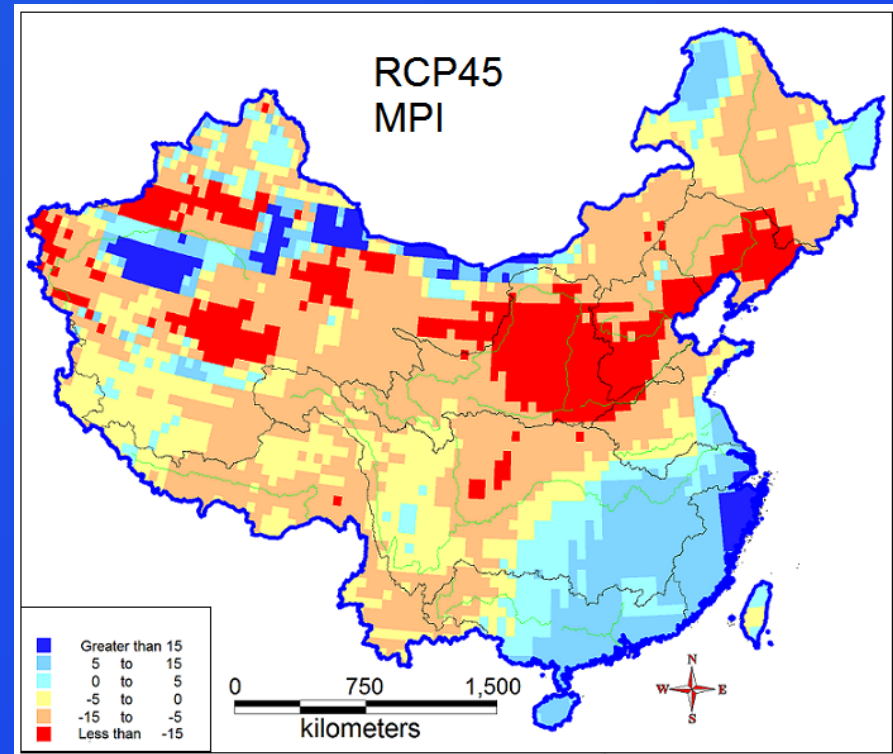
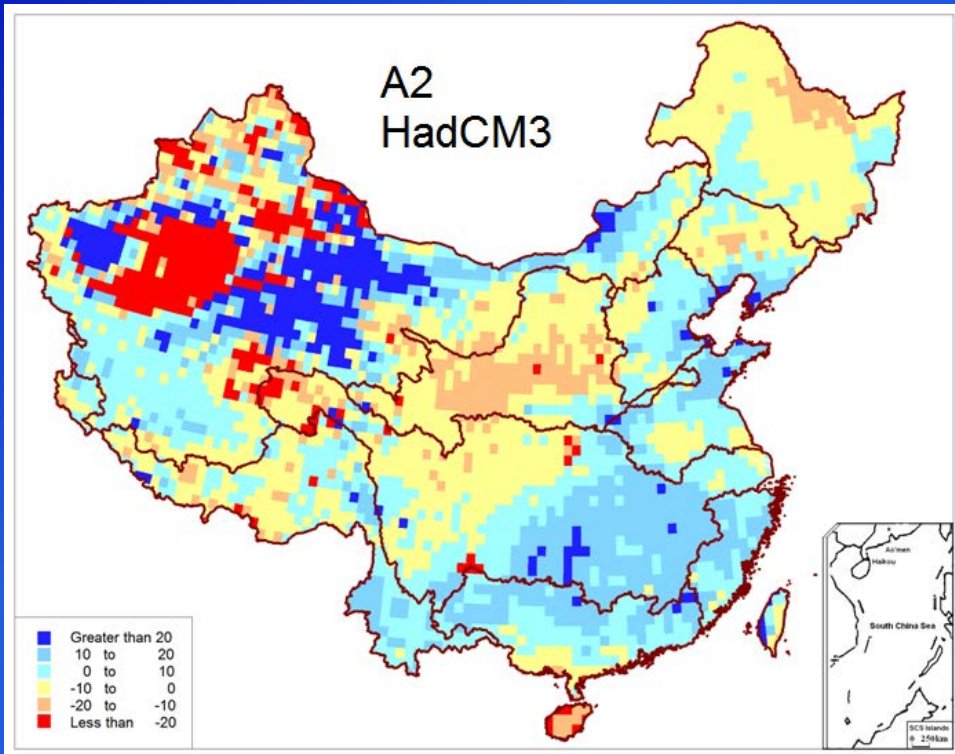
Change in Water Resources / 水资源变化

➤ Change in runoff relative to 1961-2000



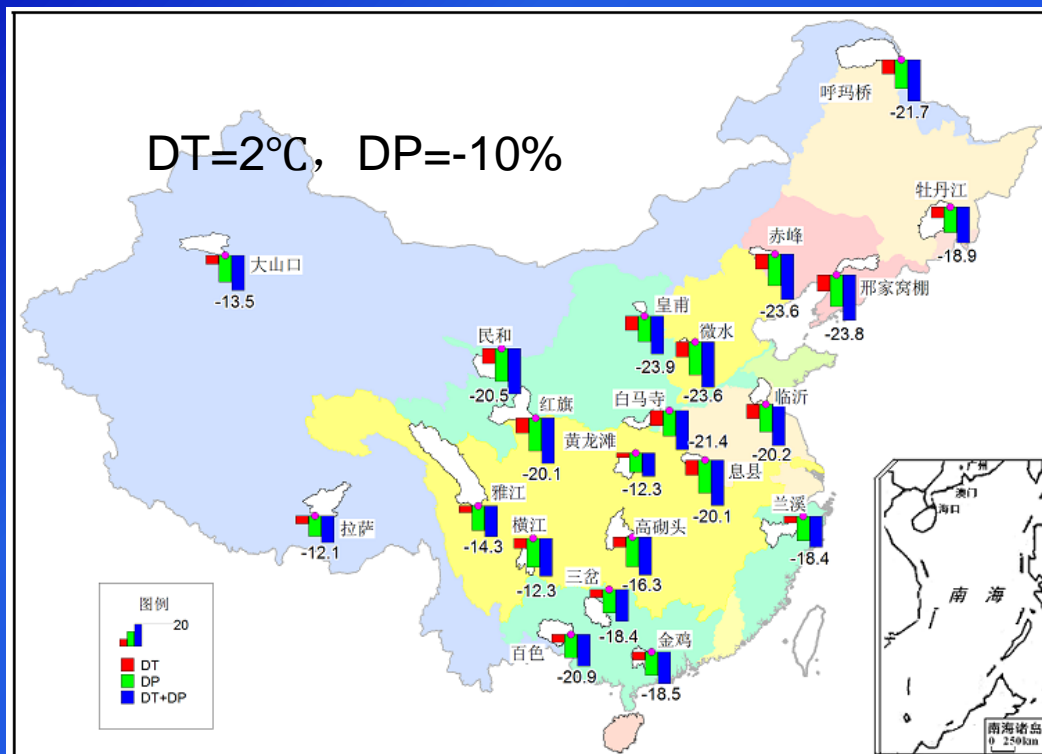
- ◆ Different scenarios associated with different runoff changes.
- ◆ Runoff are likely less but with a large variability and uncertainty
- ◆ 2020s, may be a dry period.

Change in Water Resources / 水资源变化

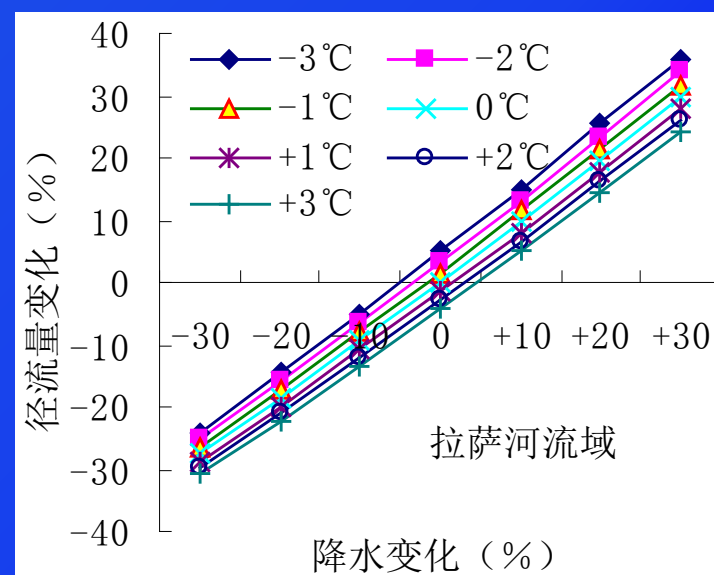
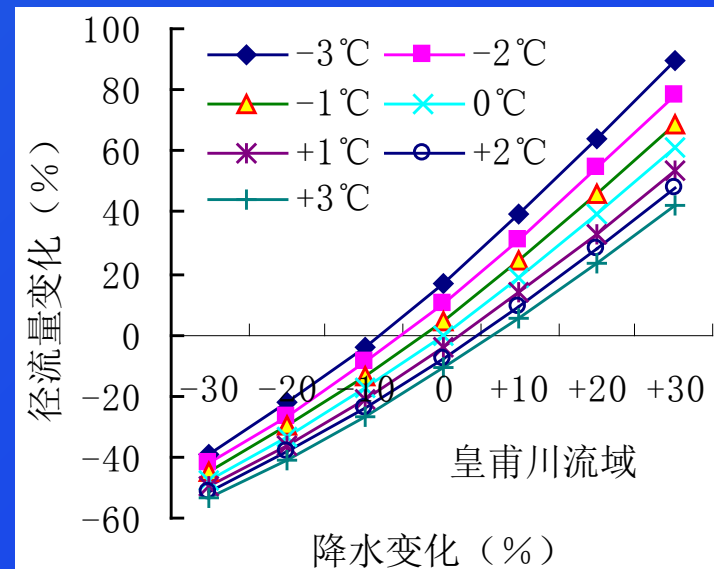


- ◆ Regional flood and drought hazards will probably increase
- ◆ The pattern of south-flood and north-drought will likely be aggravated / 水资源南多北少的分布格局可能加剧.

Sensitivity analysis / 敏感性分析



- ◆ Arid areas, most sensitive area / 干旱地区对气候变化最为敏感
- ◆ Water is more sensitive to change in P than to change in T



Contents

- **Climate Change and Water Resources**
气候变化与水资源
- **Impact Assessment for Water Resources**
对水资源的影响评价
- ✓ **Adaptative Strategies to climate change**
适应全球变化的对策

Climate Change, IWRM and Resilience

- Many challenges not new, nor product of climate change alone.



- Water resources are already stressed due to economic growth, population pressure and lifestyles.

- Many climate change impacts are just extreme examples of existing challenges.



3.1 Water-saving society building/ 节水型社会建设

■ Index of water usage

China

Developed Countries

■ Water use/ 10000GDP

537 m³

4 × World Mean value

■ The effective-utilization coef

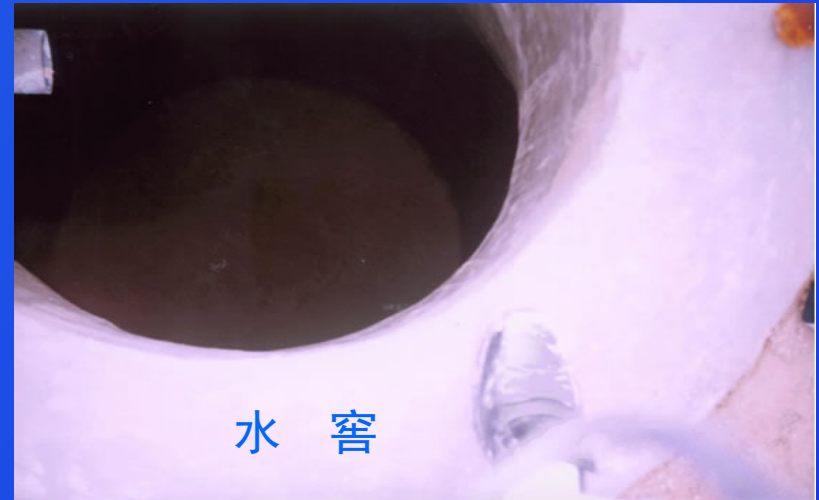
0.4—0.5

0.7~0.8

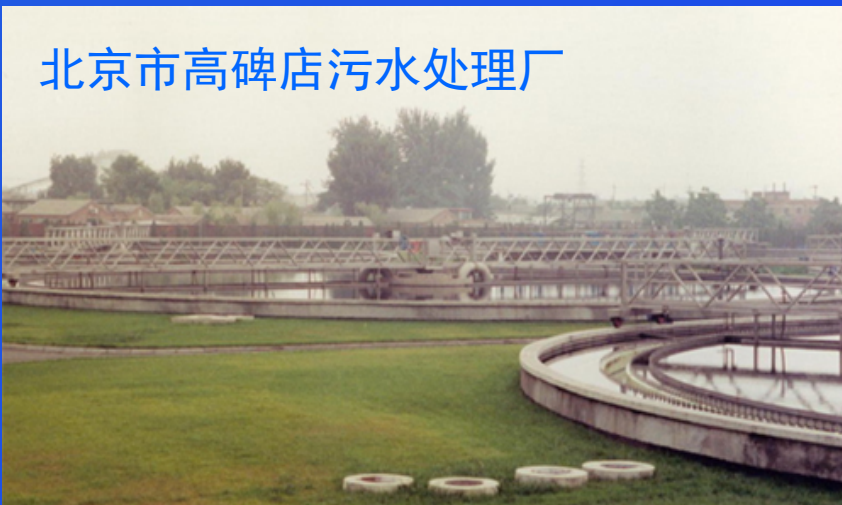


3.2 Non-traditional water sources Development

- ◆ Waste water treatment
废水处理
- ◆ Storm water harvest
雨洪资源利用
- ◆ Sea water desalination
海水淡化

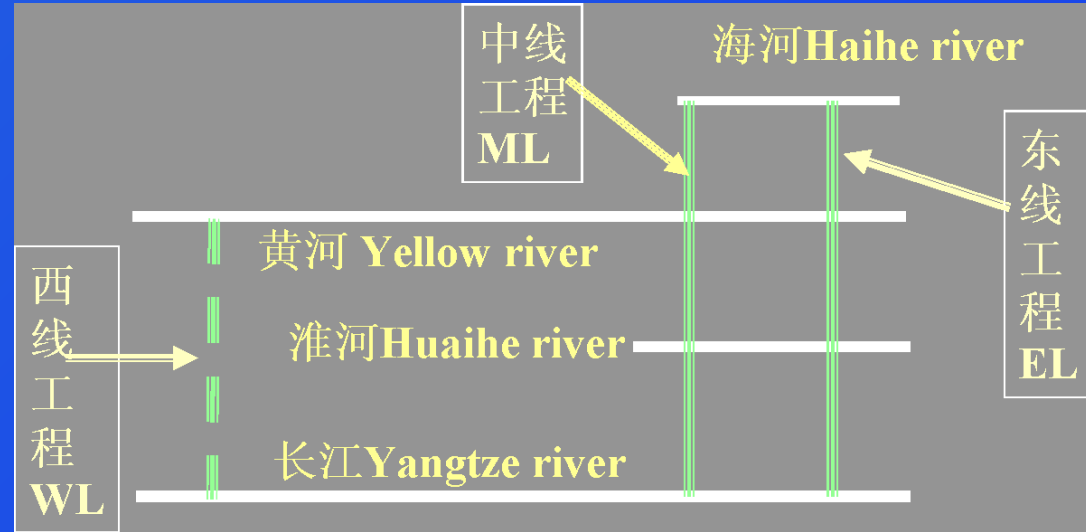


北京市高碑店污水处理厂



3.3 Water Controlling Projects /控制性工程建设

Three Gorge Reservoir



- ◆ **Reservoirs** for water resources optimization and effective water resources management
- ◆ **Flood retention areas** for solving regional flooding issues
- ◆ **Water Transfer Project** from South to North for water resources sustainable utilization

3.4 Water Resources Management /有效水资源管理



- ◆ Policy, laws, and regulations
- ◆ Early warning system and forecasting system
- ◆ Public education /公众教育

◆ Toward WDM rather than WSM /强化需水管理



中华人民共和国水法
中华人民共和国水土保持法
中华人民共和国水污染防治法
中华人民共和国防洪法

中国民主法制出版社

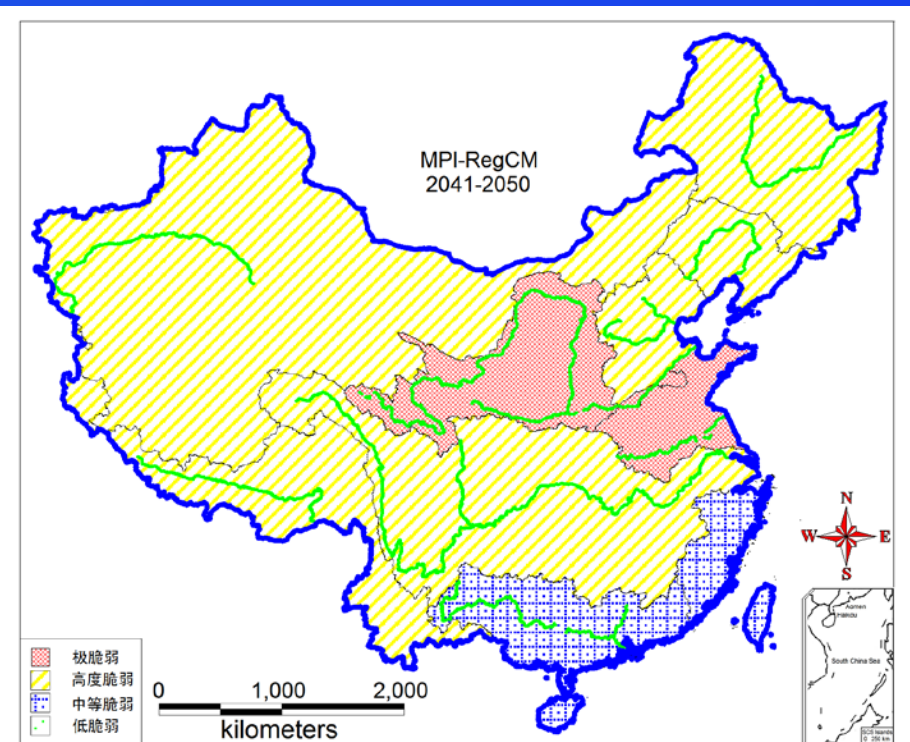
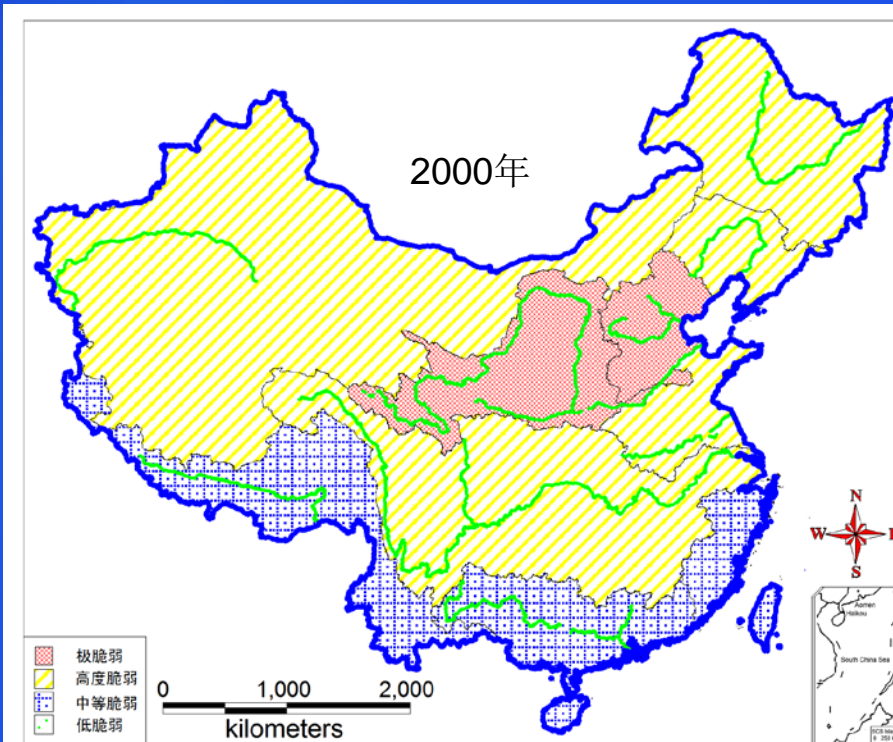


取水许可和水资源费
征收管理条例

中国法制出版社

Regional adaptation strategies / 区域性适应

- Different issues for different regions
- Different adaptation strategies for different regions
- Huang-Huai-Hai area, the most vulnerable area



谢谢

Thanks for your attention

