

Risk assessment of major meteorological disasters and quantitative assessment of water resources in China

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National Climate Centre, China Meteorological Administration

2023-9-14



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World Water Congress**
International Water Resources Association (IWRA)
Beijing, China | September 11-15, 2023



Content

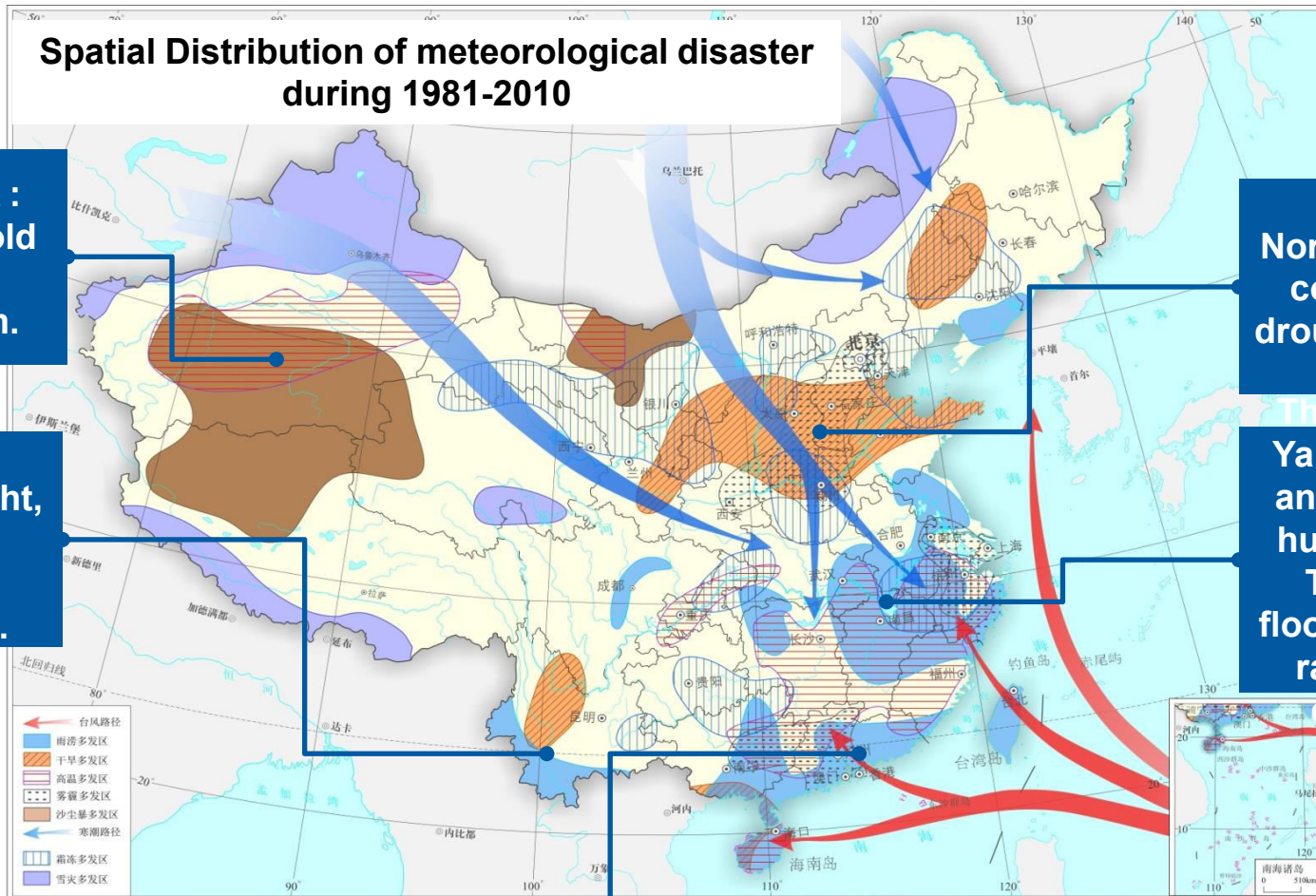
Meteorological disaster in China

Risk Management of meteorological disaster

Quantitative Assessment of water resources

Climate and meteorological disaster

Meteorological disasters are various and widely distributed



Northwest:
drought, cold wave,
sandstorm.

North China:
cold wave,
drought, frost.

Southwest:
flood, drought,
land-slide
high-
temperature.

Yangtze river and yangtze-huaihe river:
Typhoon,
flood, tornado,
rainstorm.

South China: flood,
typhoon, drought.

Climate and meteorological disaster

Meteorological disaster are uninterrupted throughout the whole year

- **Summer half year**

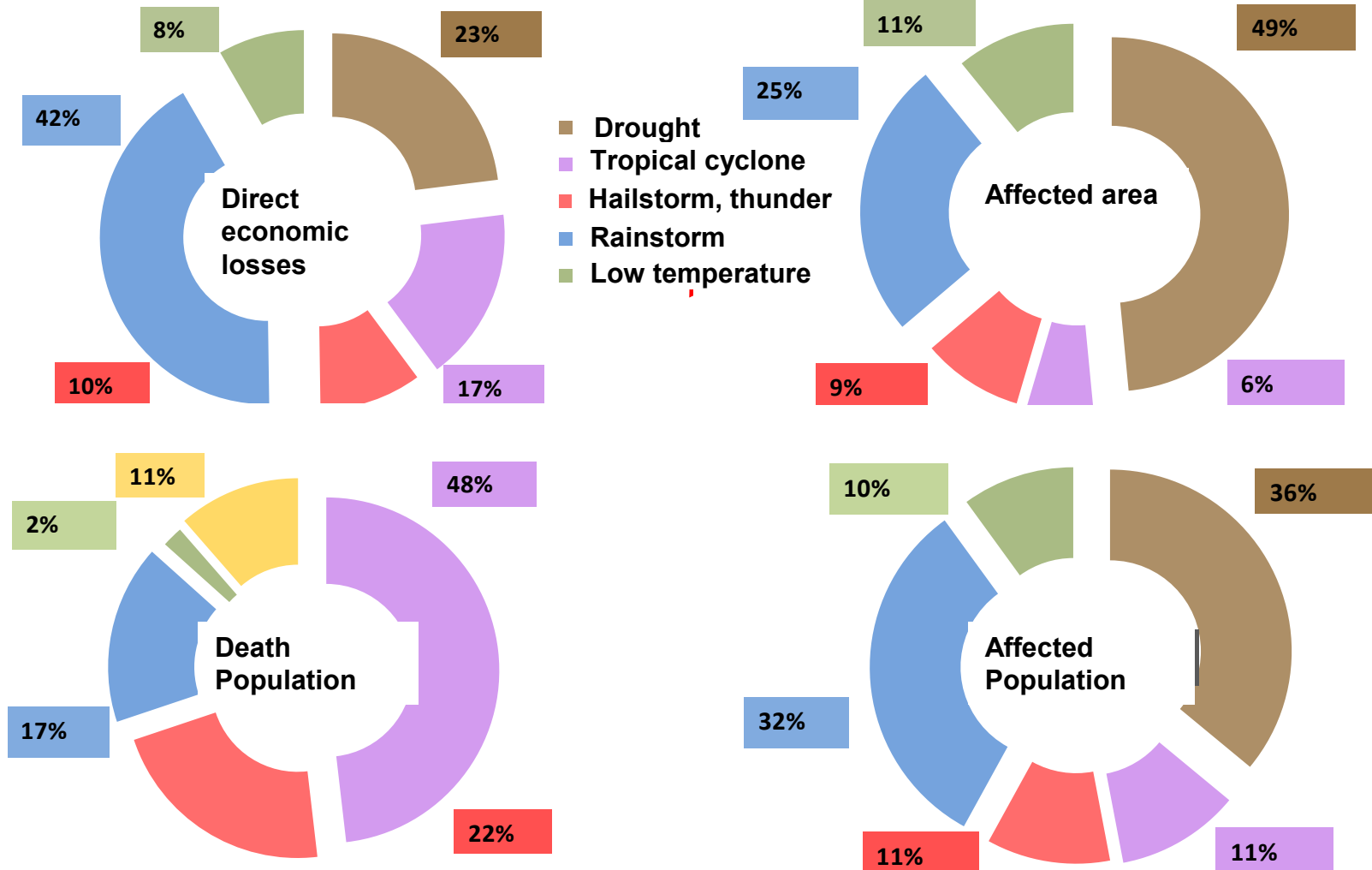
typhoon, heavy rain, strong convection, high temperature heat waves and so on.

- **Winter half year**

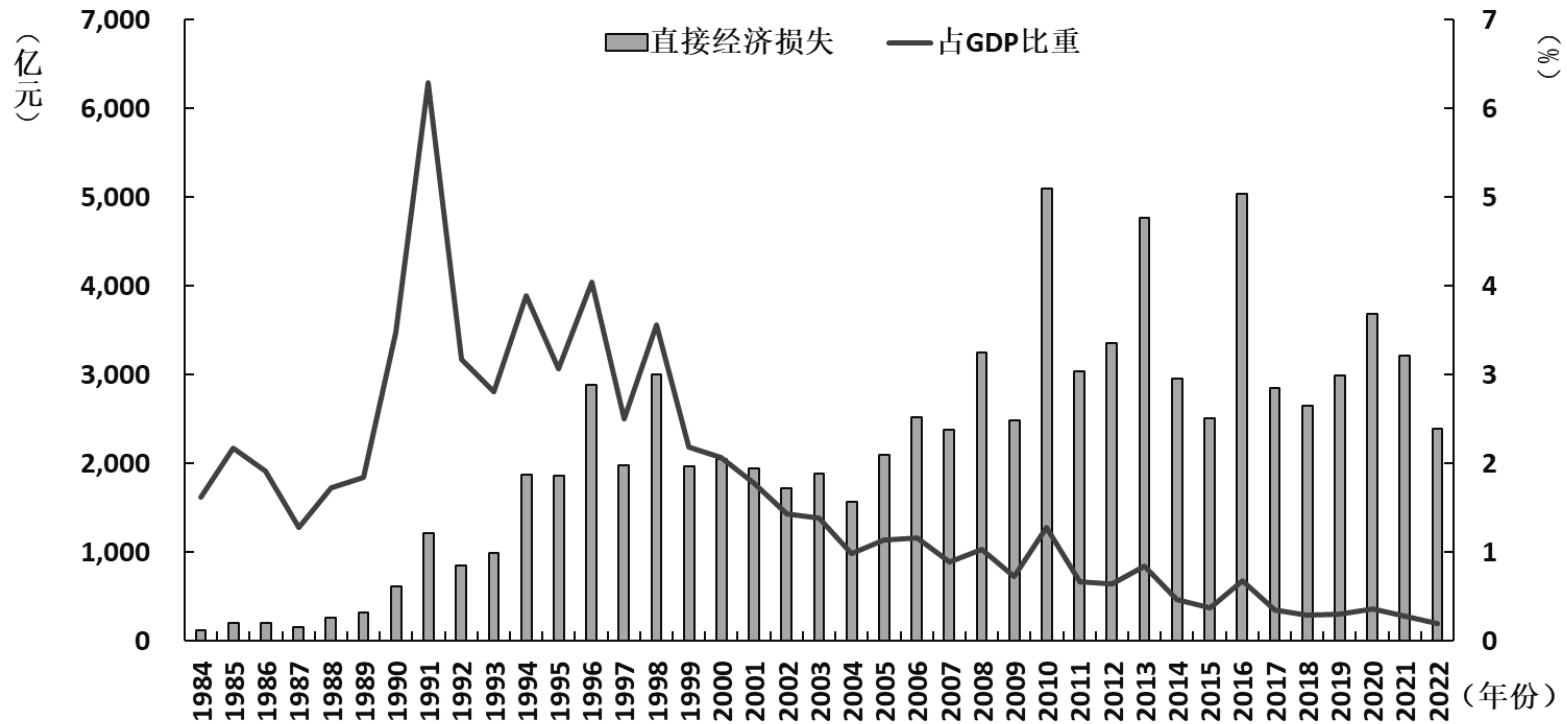
Fog, smog, low temperature, snow disaster, freezing and so on.



Climate and meteorological disaster



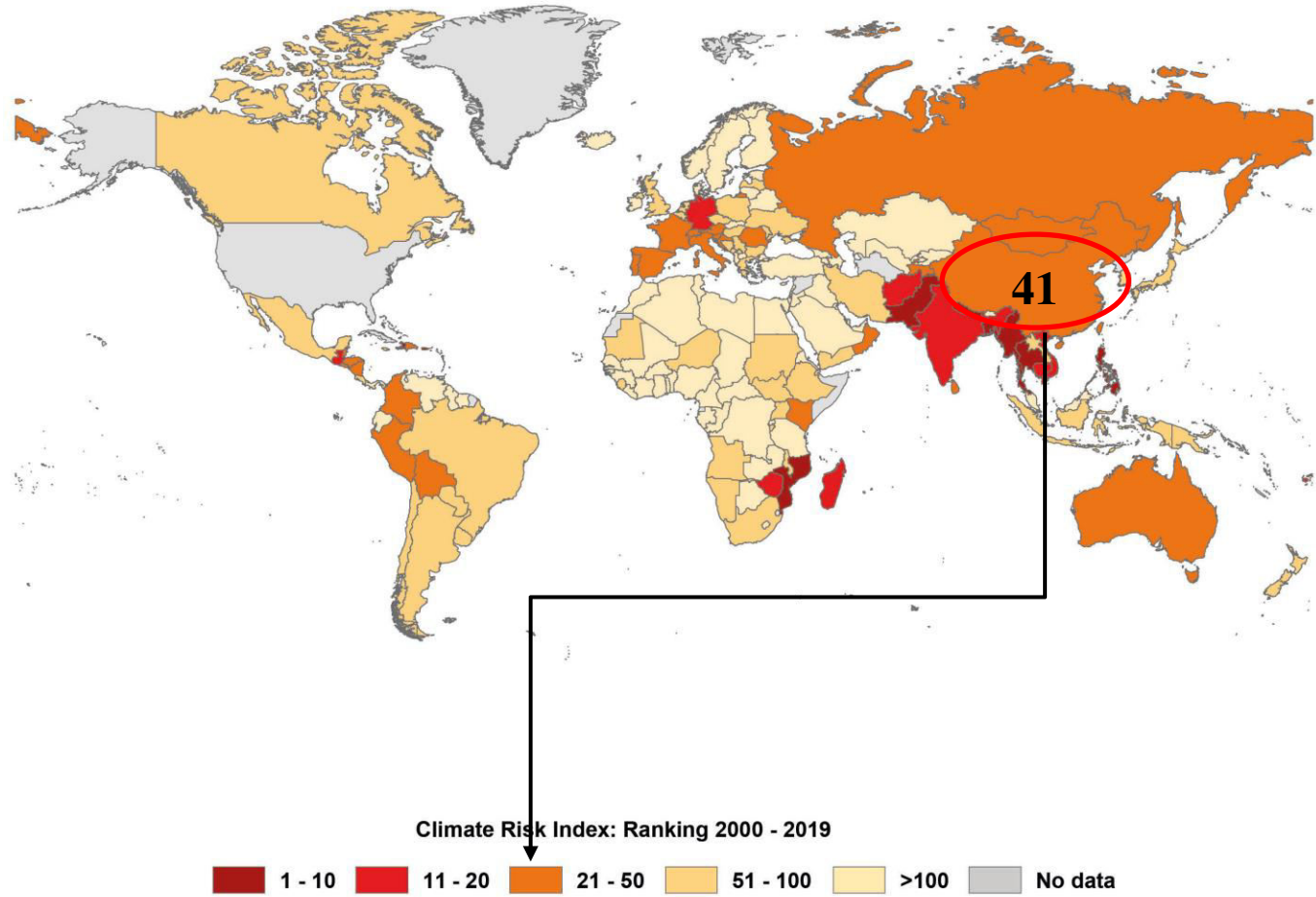
Climate and meteorological disaster



Direct economic losses of meteorological disasters in China and their proportion of GDP during 1984-2022

China's meteorological disasters have large direct economic losses (210 billion ¥), accounting for a high proportion of GDP (1.7%).

Climate and meteorological disaster



China is a country with high risk of meteorological disasters

Content

Meteorological disaster in China

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Risk Management of meteorological disaster

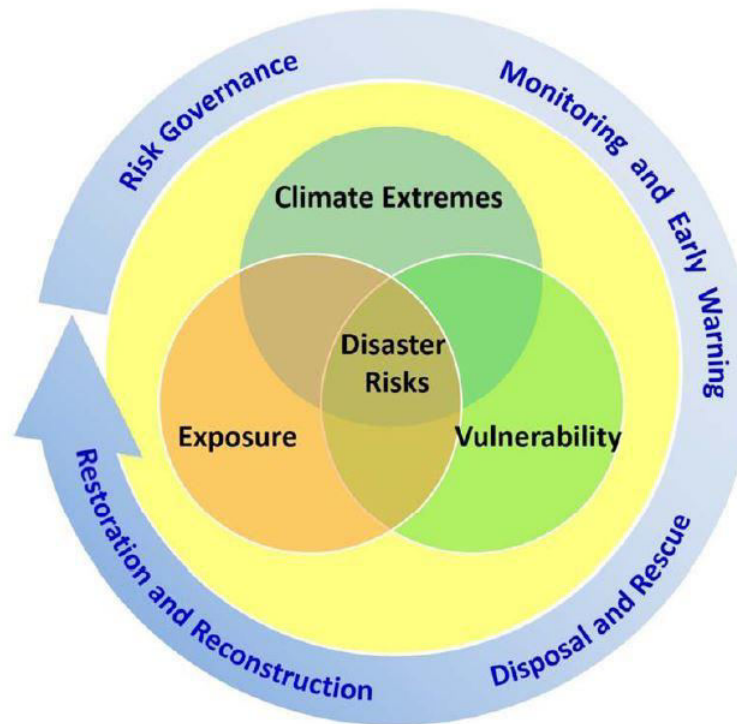


Illustration of Disaster Risk Management in China

Climate extremes: Weather-based, geophysical threat to life;

Exposure: Population and properties exposed to dangers;

Vulnerability: the capabilities to deal with the impact of hazards;

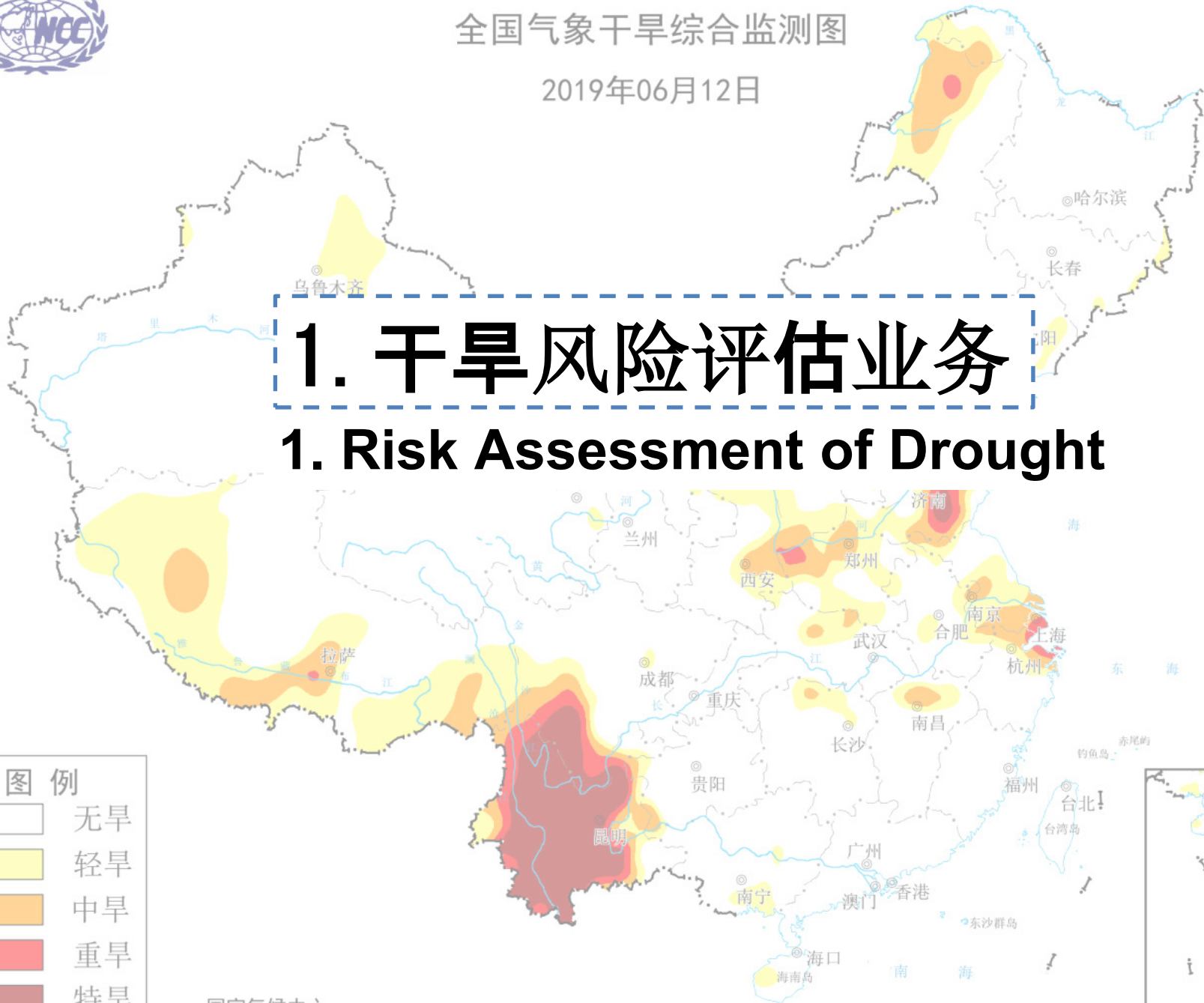


全国气象干旱综合监测图

2019年06月12日

1. 干旱风险评估业务

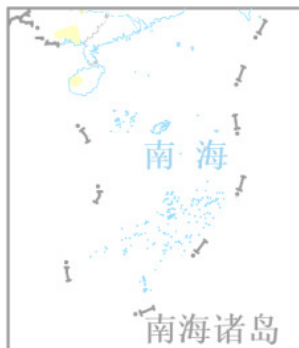
1. Risk Assessment of Drought



图例

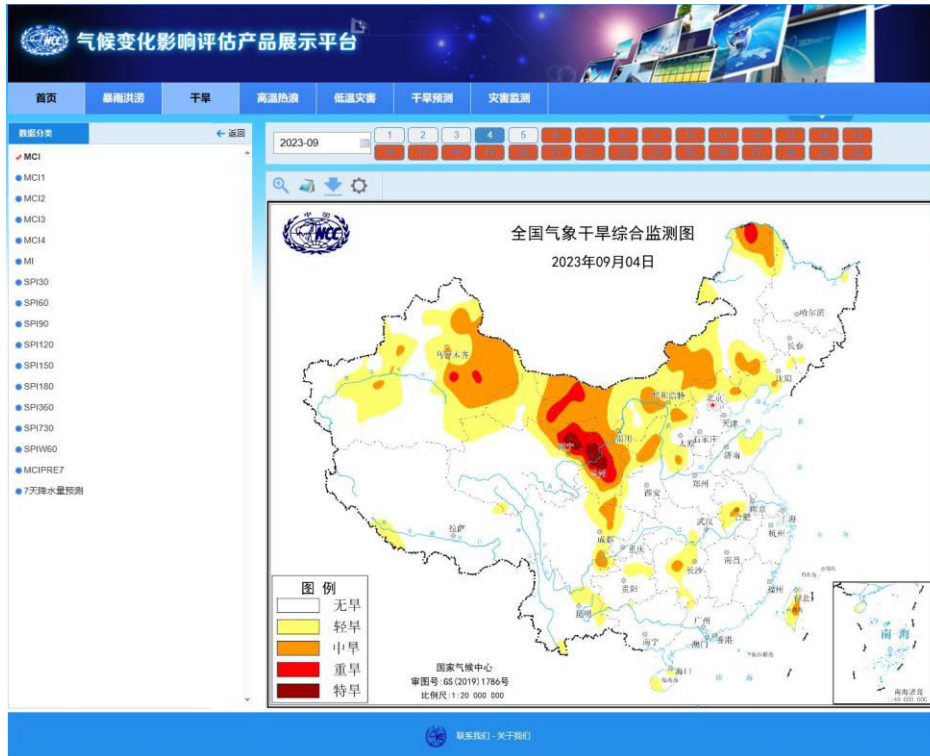
| |
|----|
| 无旱 |
| 轻旱 |
| 中旱 |
| 重旱 |
| 特旱 |

国家气候中心



Meteorological drought monitoring and early warning

Meteorological drought composite index



Daily drought monitoring

ICS 07.060
A 47



中华人民共和国国家标准

GB/T 20481—2017
代替 GB/T 20481—2006

People's Republic of China drought standard

气象干旱等级

Grades of meteorological drought

气象干旱综合指数(MCI)的计算见式(1):

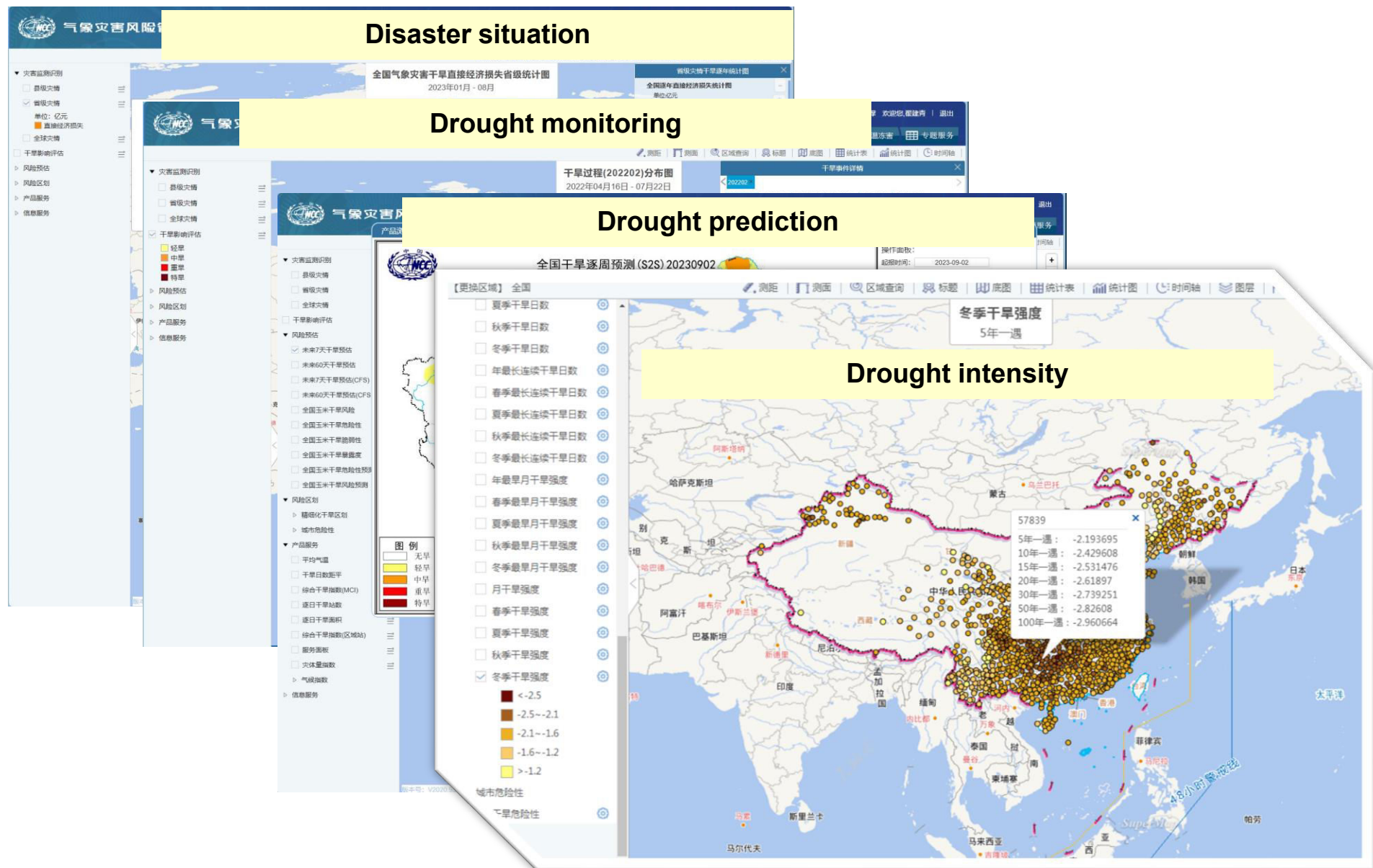
$$MCI = Ka \times (a \times SPIW_{60} + b \times MI_{30} + c \times SPI_{90} + d \times SPI_{150}) \dots\dots\dots (1)$$

式中:

- MCI —— 气象干旱综合指数;
- MI₃₀ —— 近 30 天相对湿度指数, 计算方法见附录 B;
- SPI₉₀ —— 近 90 天标准化降水指数, 计算方法见附录 D;
- SPI₁₅₀ —— 近 150 天标准化降水指数, 计算方法见附录 D;
- SPIW₆₀ —— 为近 60 天标准化权重降水指数, 计算方法见附录 G;
- a —— SPI₆₀ 项的权重系数, 北方及西部地区取 0.3, 南方地区取 0.5;
- b —— MI₃₀ 项的权重系数, 北方及西部地区取 0.5, 南方地区取 0.6;
- c —— SPI₉₀ 项的权重系数, 北方及西部地区取 0.3, 南方地区取 0.2;
- d —— SPI₁₅₀ 项的权重系数, 北方及西部地区取 0.2, 南方地区取 0.1;
- Ka —— 为季节调节系数, 根据不同季节各地主要农作物生长发育阶段对土壤水分的敏感程度确定(见 GB/T 32136), 取值方法参见附录 H。

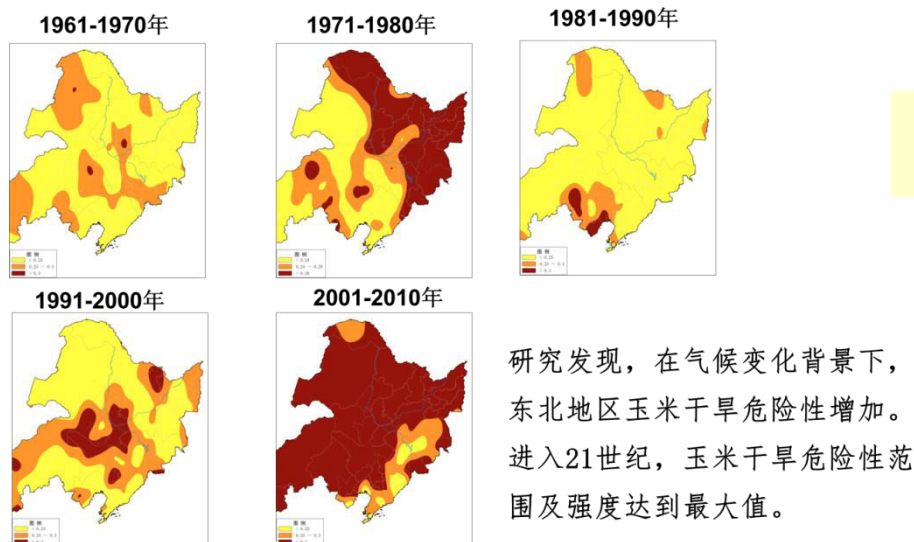
注: 本标准中北方及西部地区指我国西北、东北、华北和西南地区, 南方地区指我国华南、华中、华东地区等地。

Risk Management System of drought disaster



Drought risk assessment in major maize producing areas

The Drought hazard of maize is increasing in Northeast of China

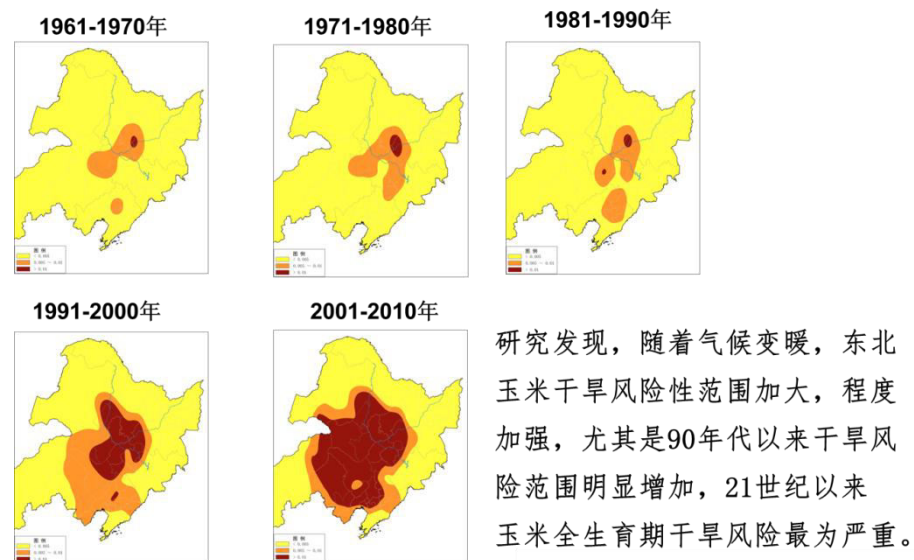


累积干旱指数的计算方法

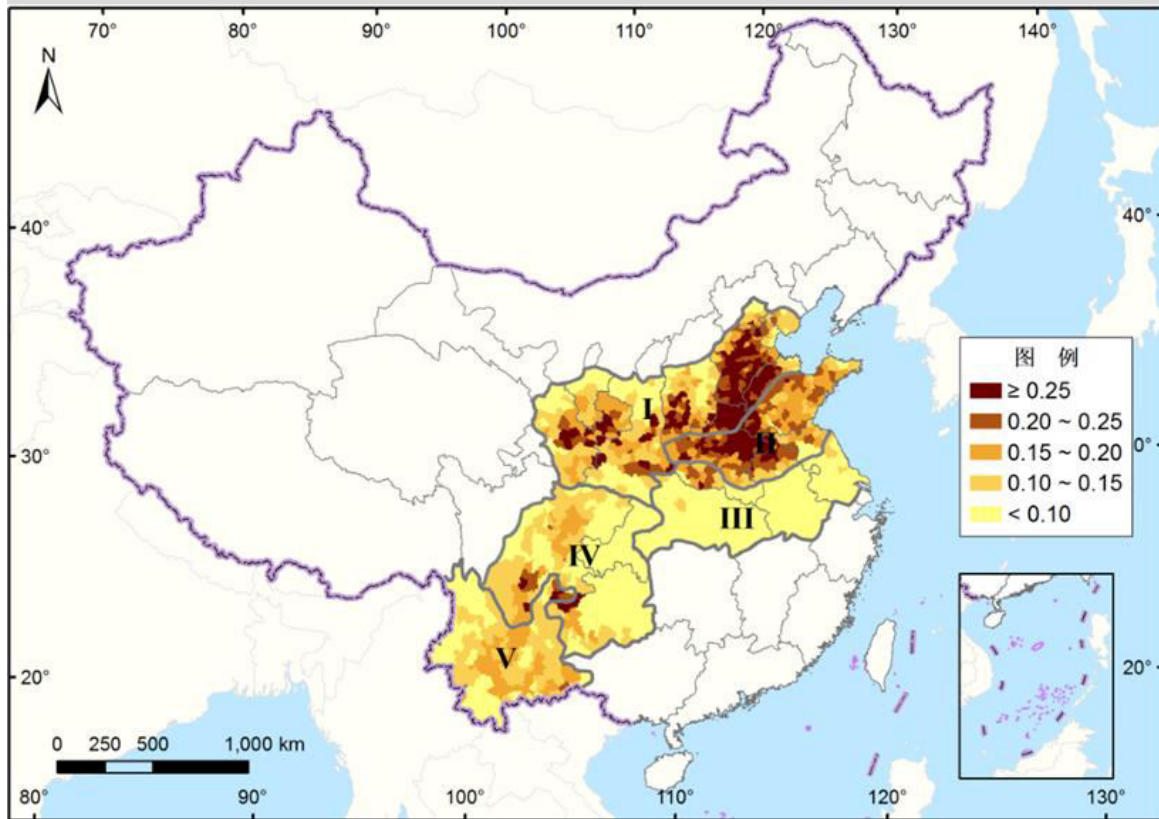
同一发育阶段：期间各干旱过程逐日值的累加——干旱累积指数； $dr_s = \sum MCI_i$

不同发育阶段及全生育期：期间各发育阶段累加值与历史上该时段干旱对产量影响的影响系数乘积之和——干旱累积指数。 $DR_s = \sum (A_i * dr_{s_i})$

The Drought risk of maize is increasing in Northeast of China



Risk regionalization of Drought for winter wheat



国家气候中心重点考核任务
“精细化气象灾害风险区划”

技术报告

中国冬小麦旱灾风险评估及区划研究

报告名称：中国冬小麦旱灾风险评估及区划研究

负责人：孙 劭，蔡雯悦，侯 威

单位（处室）：气象灾害风险管理室

联系方式：010-58994133

国家气候中心气象灾害风险管理室

二〇一八年十月 编制

Drought risk zoning of winter wheat



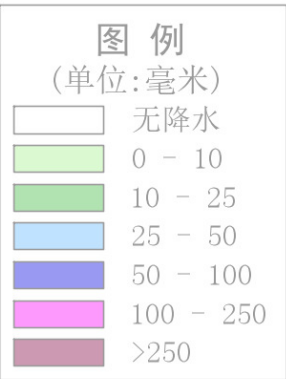
全国日降水量分布图

2019年06月12日

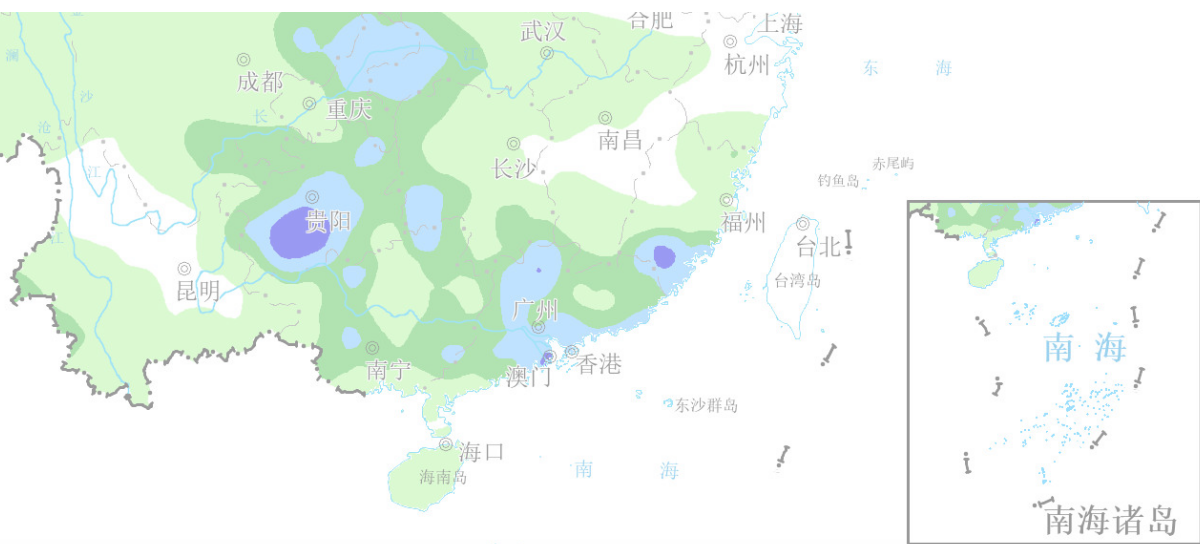


2. 暴雨风险评估业务

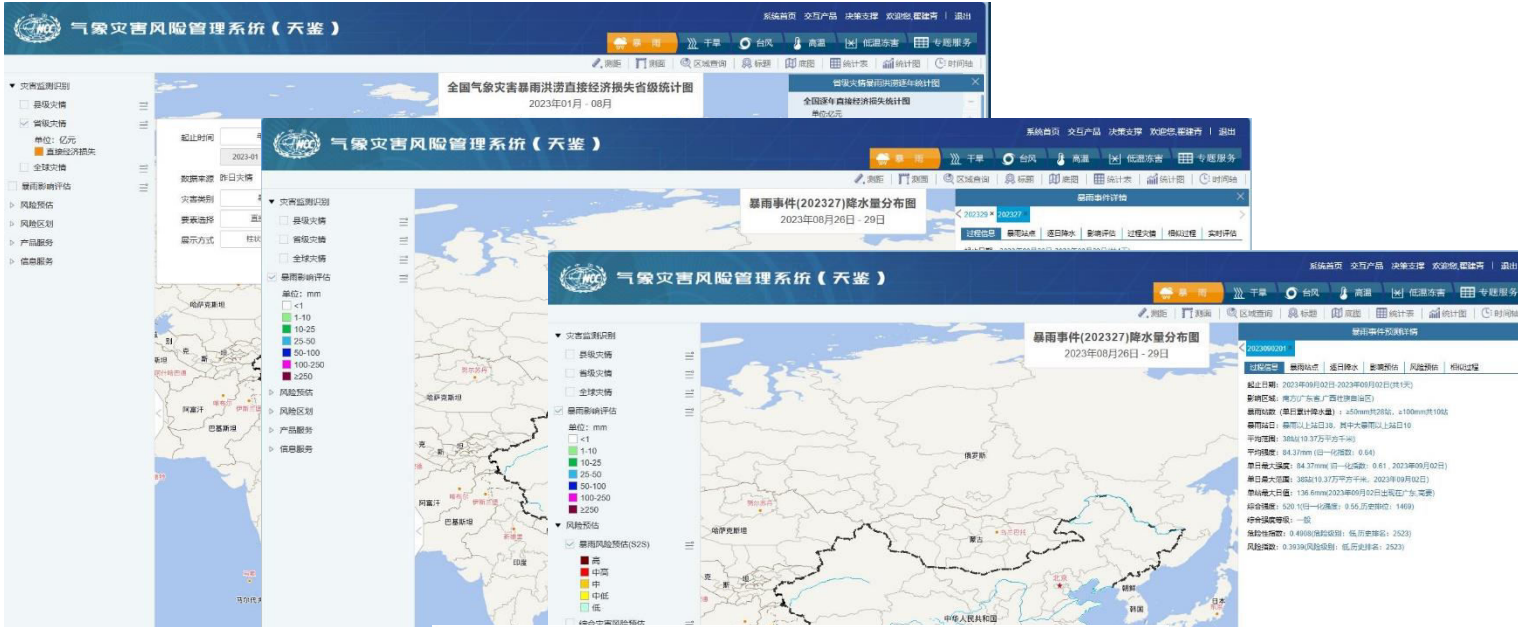
2. Risk Assessment of Rainstorm



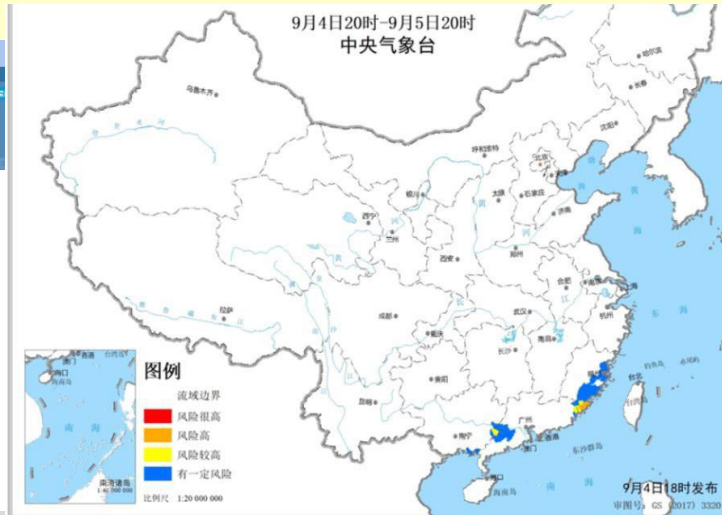
国家气候中心



Real time assessment of Rainstorm



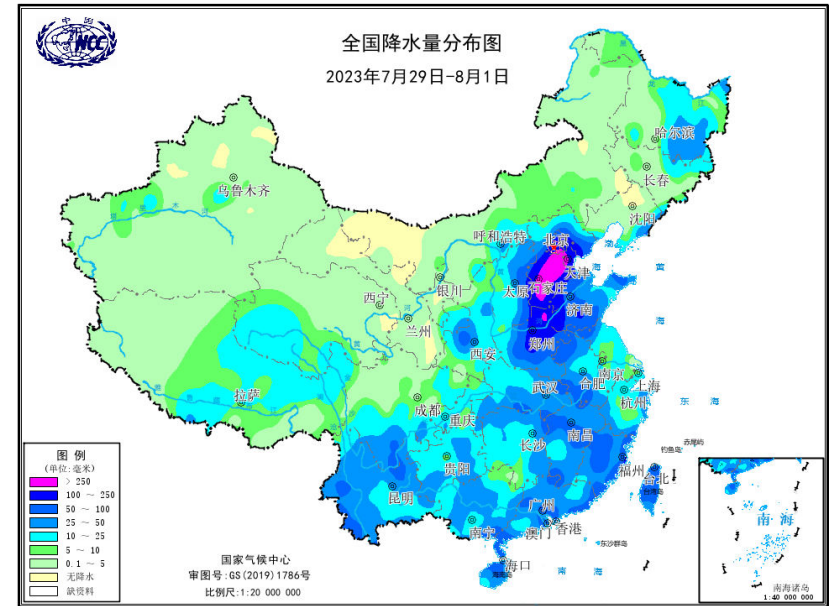
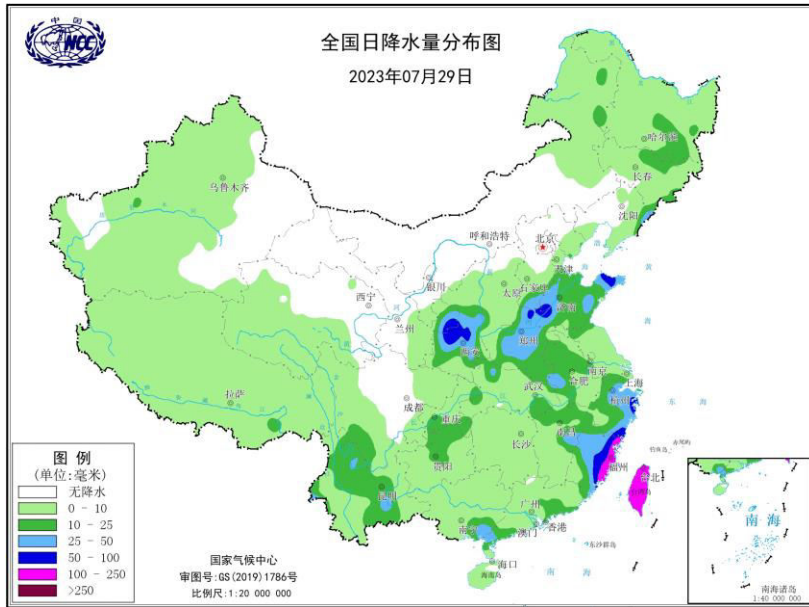
Flood risk warning in the Middle River basin



Flash flood risk warning

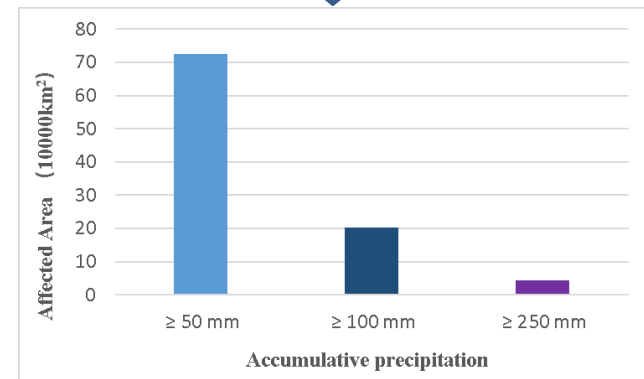


Real time assessment of Rainstorm



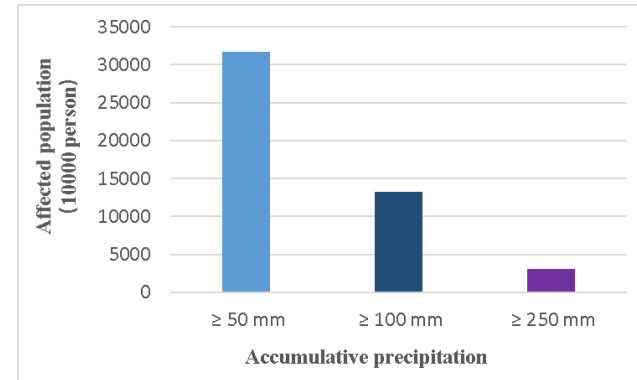
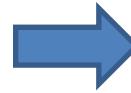
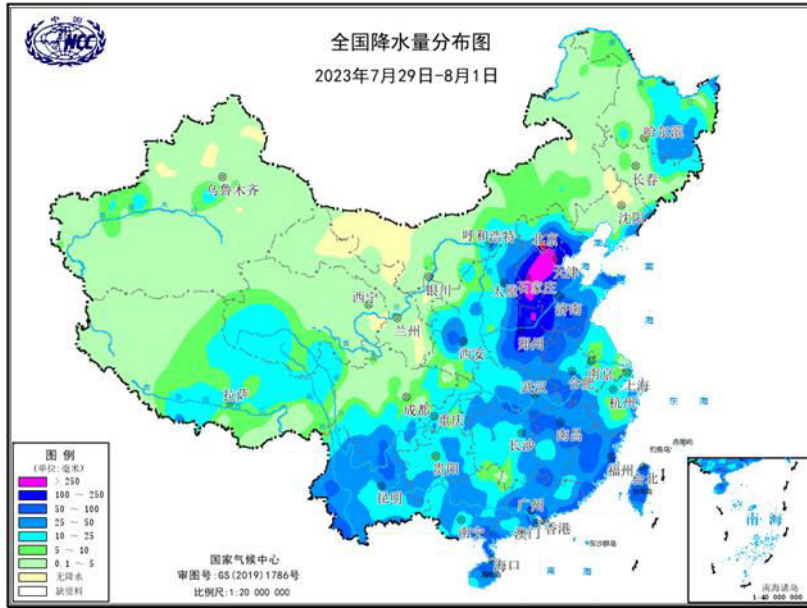
Identification of heavy rain process on July 29 to Aug. 1, 2023

Spatial distribution of cumulative precipitation during heavy rains on July 29 to Aug. 1, 2023

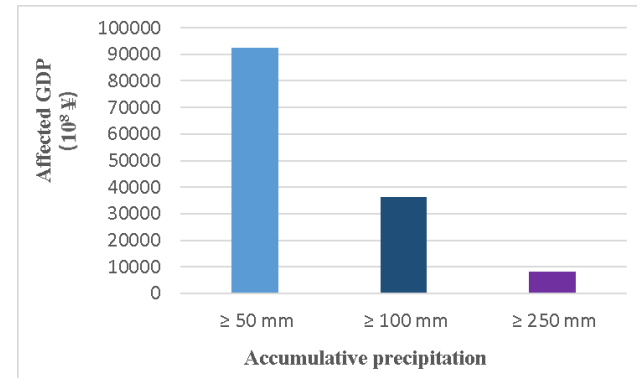


Affected area of cumulative precipitation (10,000km²)

Real time assessment of Rainstorm



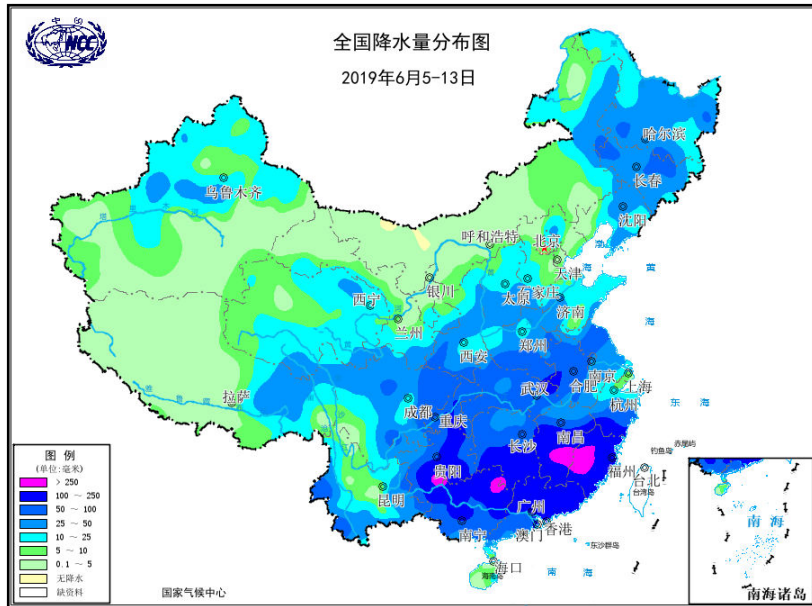
Affected population(10,000 person)



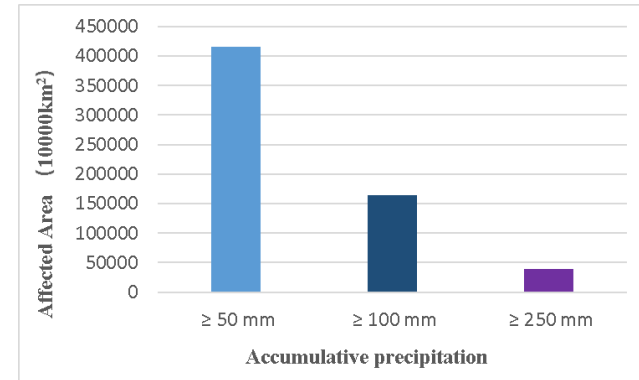
Affected GDP (0.1 billion RMB)

Spatial distribution of cumulative precipitation during heavy rains on July 29 to Aug. 1, 2023

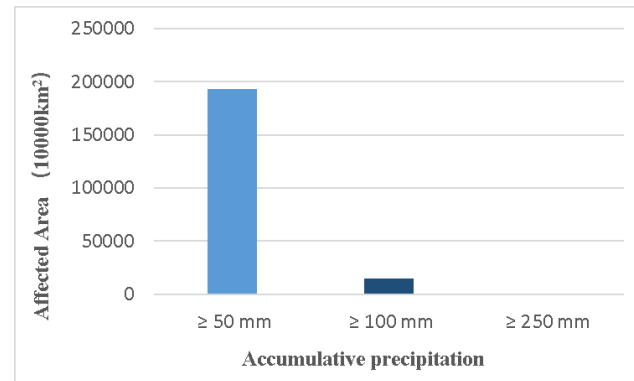
Real time assessment of Rainstorm



Spatial distribution of cumulative precipitation during heavy rains on June 5-13, 2019

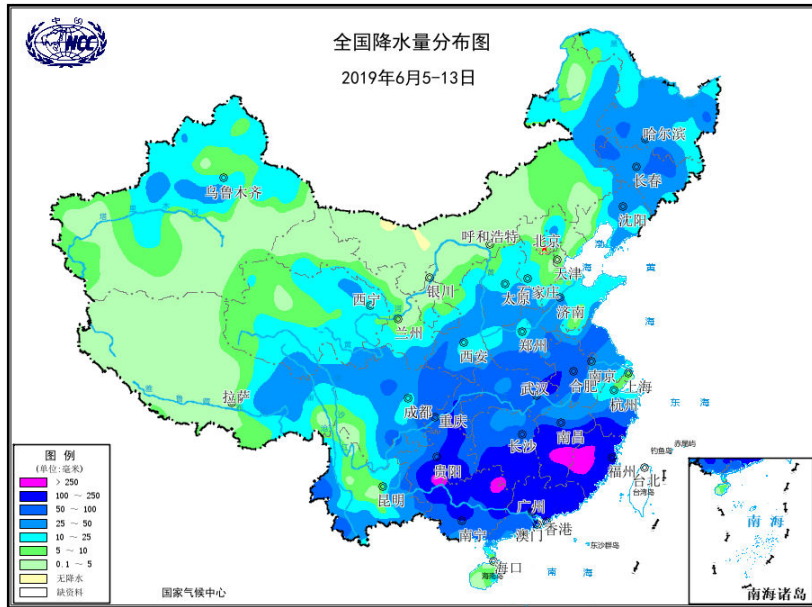


Affected farmland area (km²)

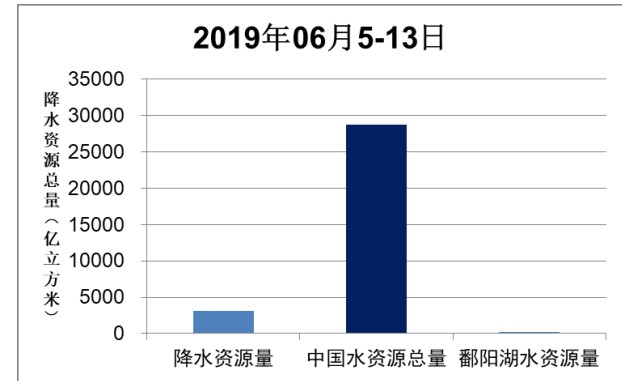


Affected forest area (km²)

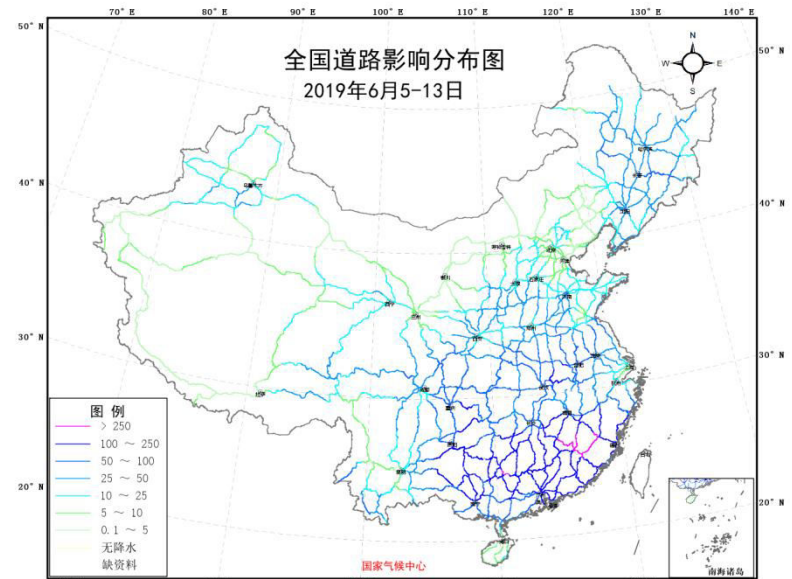
Real time assessment of Rainstorm



Spatial distribution of cumulative precipitation during heavy rains on June 5-13, 2019



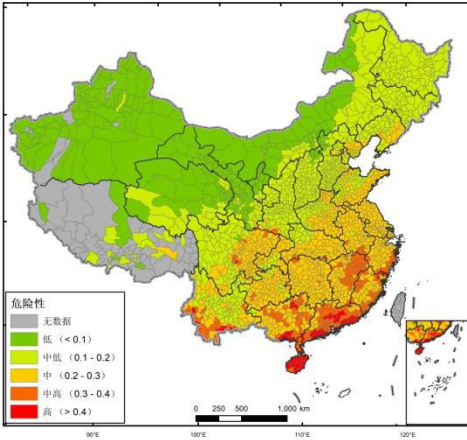
Cumulative water resources



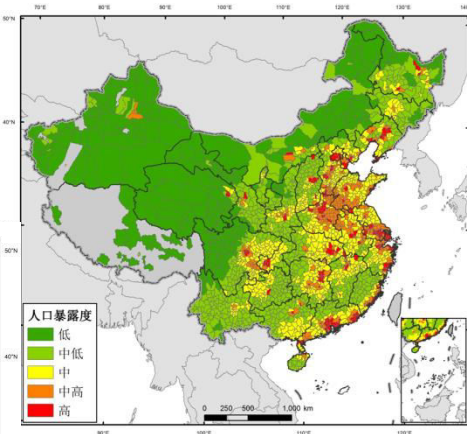
Affected road

Risk regionalization of Rainstorm

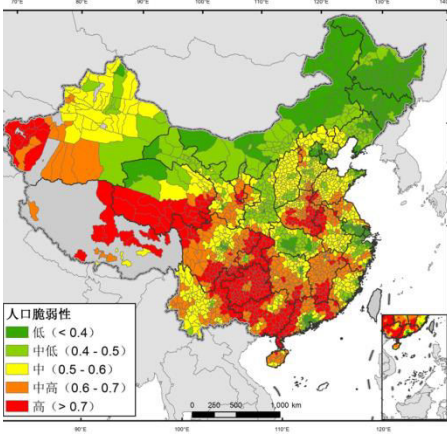
Rainstorm of recurrence period 100yr



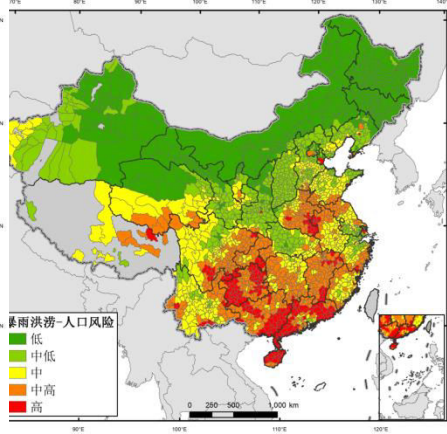
Exposure of population



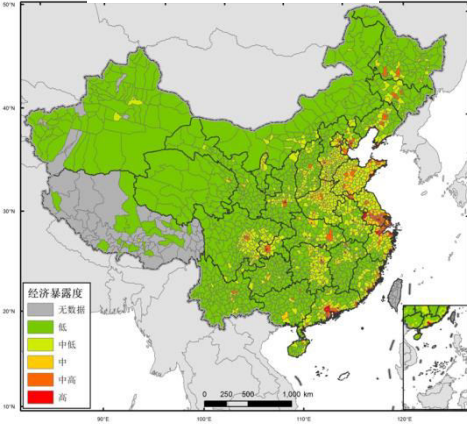
Vulnerability of population



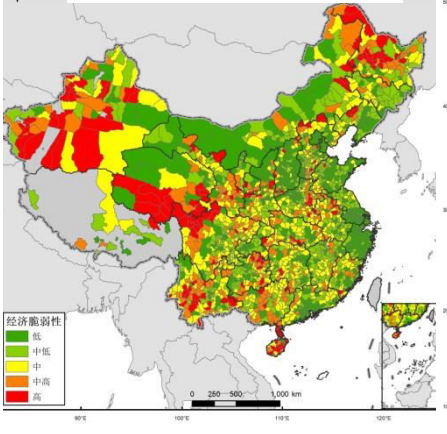
Risk of population



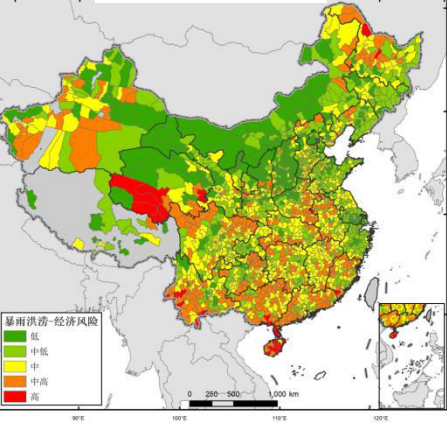
Exposure of economy



Vulnerability of economy



Risk of economy



- 台风
- 台风之最
- 预警信号
- 海区预报
- 降水预报
- 灾害天气
- 卫星云图
- 雷达拼图
- 天气实况



3. 台风风险评估业务

3. Risk Assessment of Typhoon

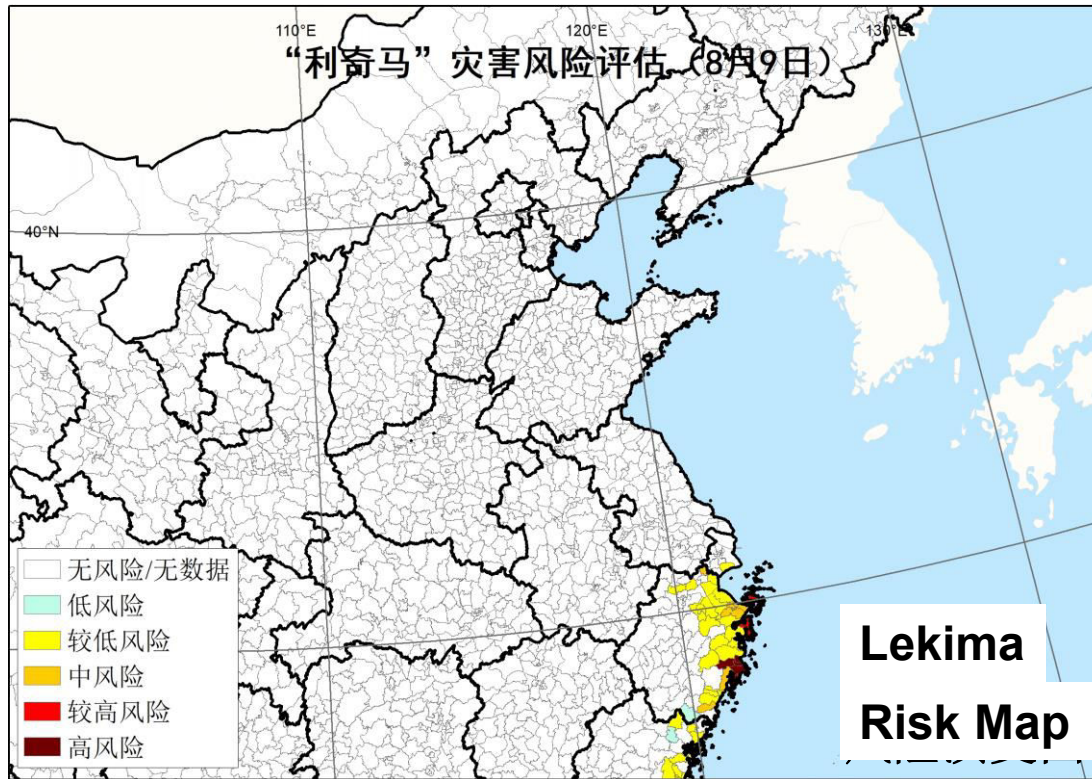
台风 1902 蝴蝶

| | | |
|------|------|-------|
| 热带低压 | 热带风暴 | 强热带风暴 |
| 台风 | 强台风 | 超强台风 |

图例



Pre-assessment of Typhoon



| Area affected by medium and above disaster risk | |
|---|--------|
| | 9日-14日 |
| Area (km ²) | 19,400 |
| Affected population (billion person) | 0.17 |
| Affected GDP (Trillion RMB) | 15.9 |

The direct economic loss is expected to be 50-60 billion yuan.

结合数值预报，8月9日-14日，中等及以上风险区主要集中在浙江东部及福建东部、河北东部等地。统计显示，预计8月9日-14日全国中等及以上灾害风险覆盖面积为19.4万平方公里，涉及人口达1.7亿人，涉及GDP为15.9万亿元，**预计直接经济损失为500~600亿元。**

Losses statistics of Lekima

据应急管理部统计，截止8月14日7时，台风“利奇马”造成河北、辽宁、吉林、上海、江苏、浙江、安徽、福建、山东 9 省（直辖市）59 市 353 个县（市、区）1402.4 万人受灾，**56 人死亡**（浙江 45 人、安徽 5 人、山东 5 人、江苏 1 人），**14 人失踪**（山东 7 人、安徽 4 人、浙江 3 人），209.7 万人紧急转移安置，3.7 万人需紧急生活救助；**1.5 万间房屋倒塌**，13.3 万间不同程度损坏；农作物**受灾面积 1137 千公顷**，其中**绝收 93.5 千公顷**；直接经济损失 **515.3 亿元**。

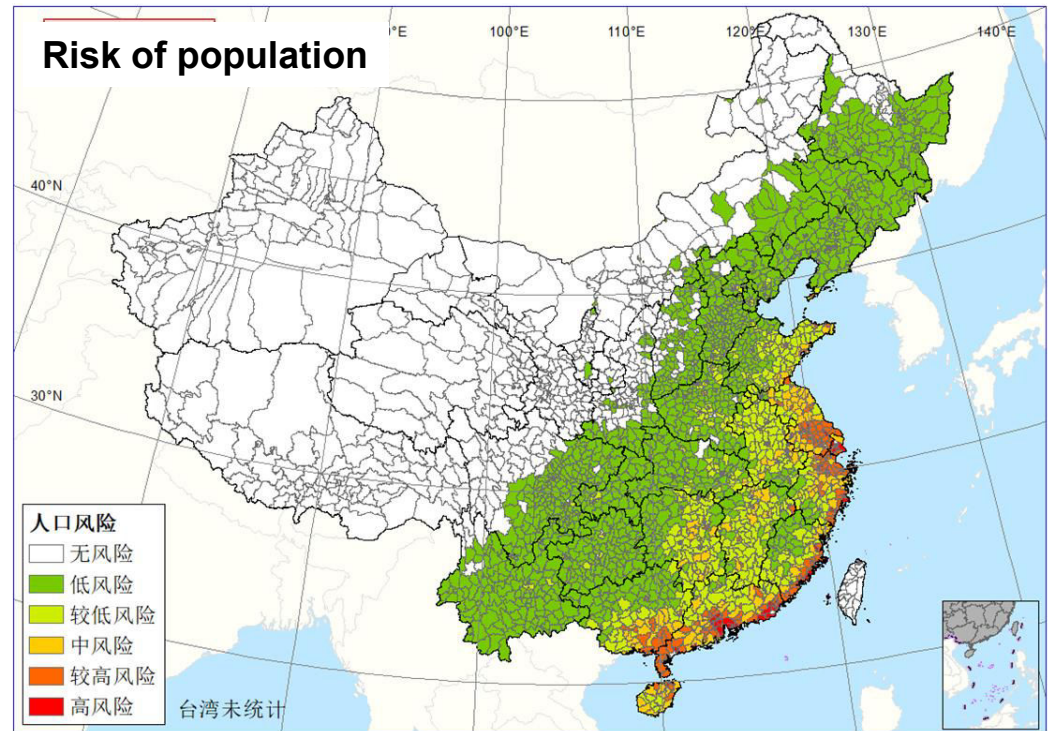
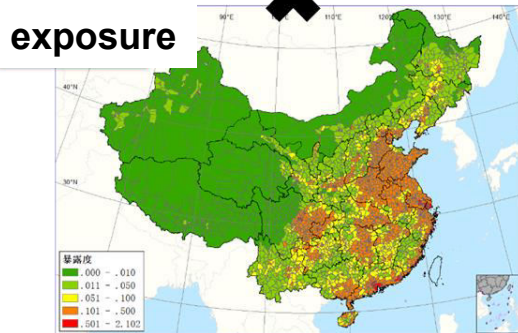
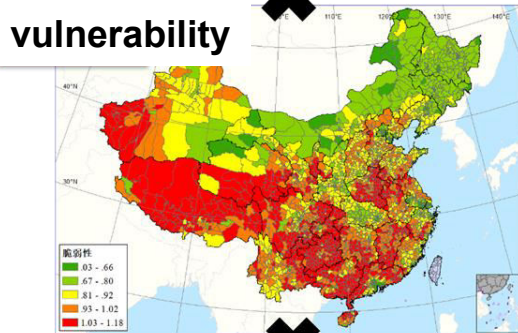
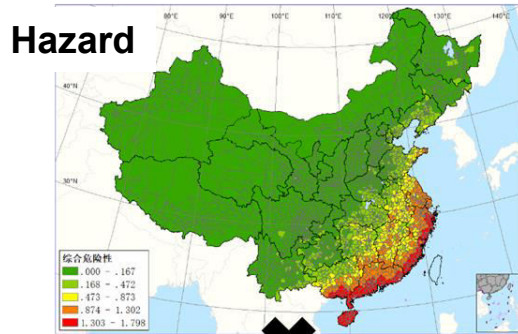
表 台风“利奇马”灾情 (截止8月14日7时)

| | 死亡（失踪）人数 （人） | 倒塌房屋 （间） | 农作物受灾面积 （千公顷） | 绝收面积 （千公顷） |
|----|-----------------|-------------|------------------|---------------|
| 浙江 | 45 (3) | 6100 | | |
| 上海 | | | | |
| 江苏 | 1 | 400 | 155.4 | 4.6 |
| 安徽 | 5 (4) | 1900 | 24.4 | 32.9 |
| 福建 | | | | 0.02 |
| 山东 | 5 (7) | 6700 | 643 | 90.1 |
| 河北 | | | 16.6 | 0.84 |
| 辽宁 | | | 25.2 | 0.79 |
| 吉林 | | | 12 | 0.18 |

The direct economic loss is 51.53 billion yuan.

Risk regionalization of Typhoon

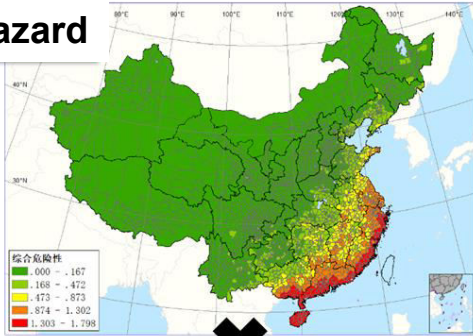
台风灾害对人口影响的风险



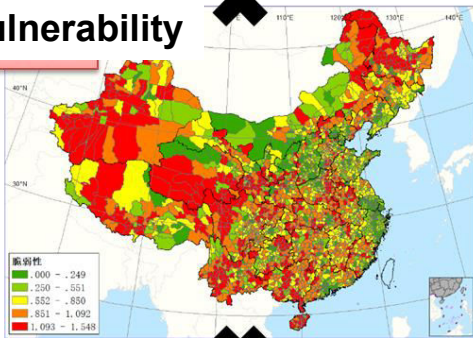
Risk regionalization of Typhoon

台风灾害对经济影响的风险

Hazard



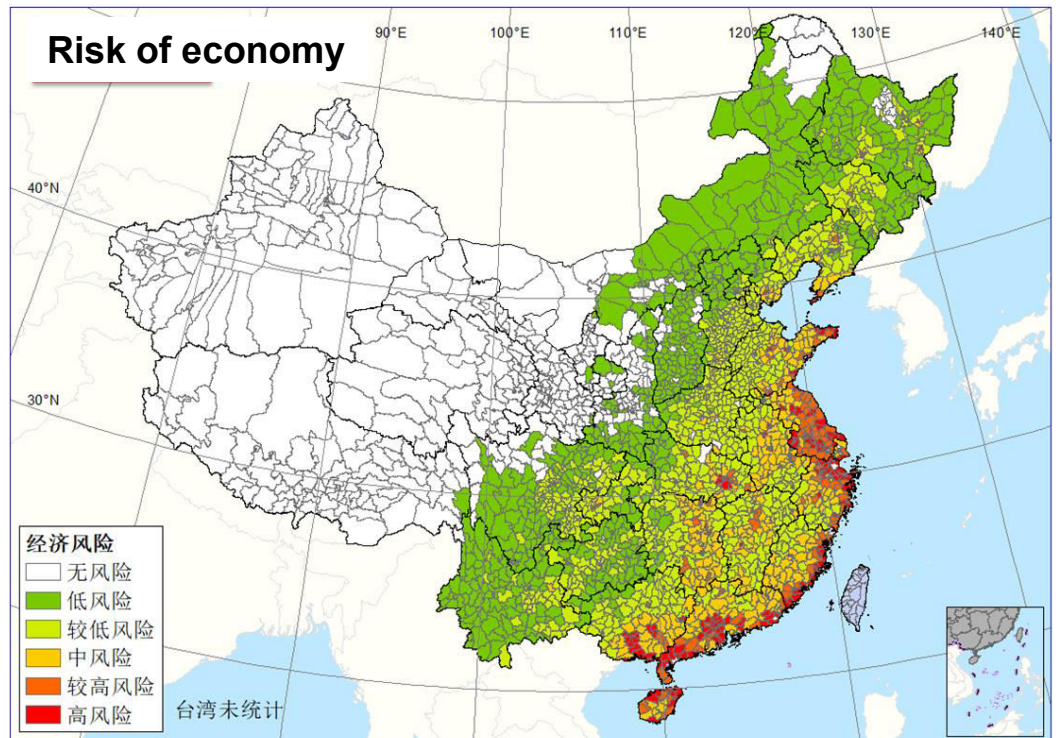
vulnerability



exposure



Risk of economy



4. 风险普查

4. Risk Survey

M-DISASTER

HAZARDS

EXPOSURE

VULNERABILITY

RISK

RAINSTORM

DROUGHT

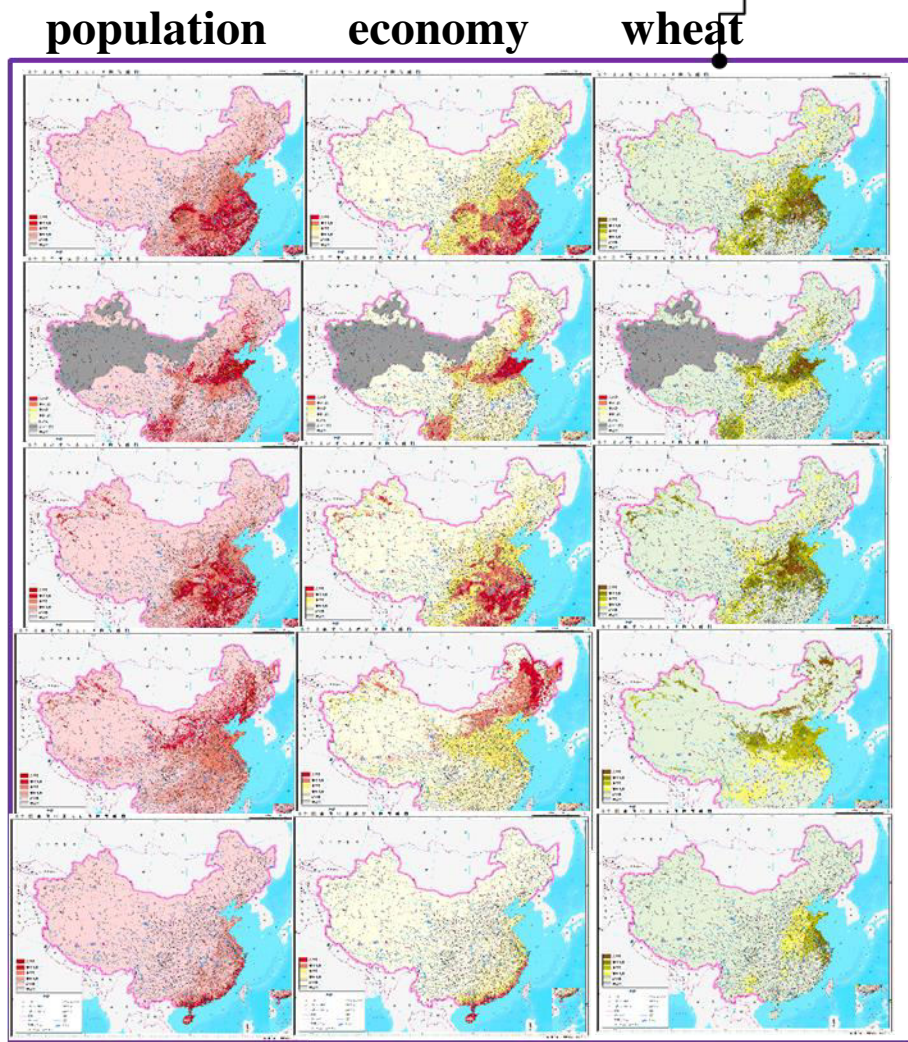
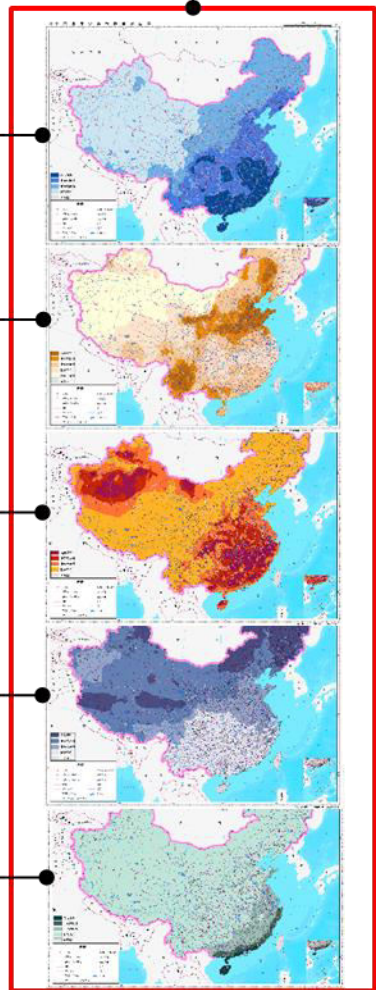
HIGH temp.

LOW temp.

TYPHON

.....

10 DISASTERS



Content

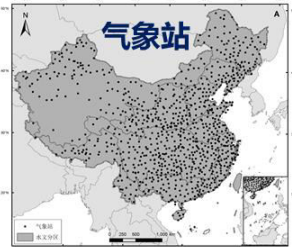
Meteorological disaster in China

Risk Management of meteorological disaster

Quantitative Assessment of water resources

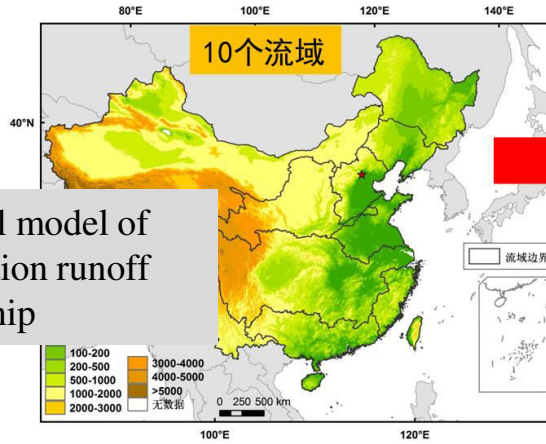
Risk assessment for water resources

Meteorological station



mean basin precipitation

降水



Ten large river basins

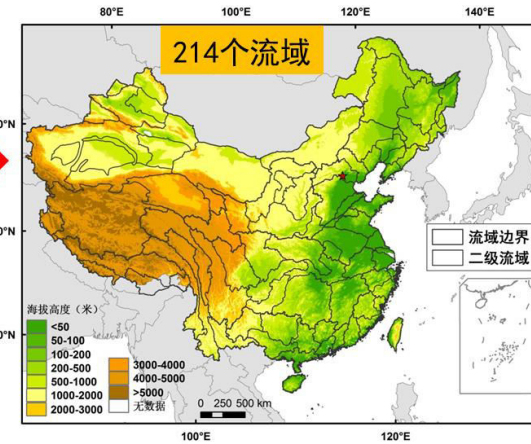
Statistical model of precipitation runoff relationship

Catchment runoff

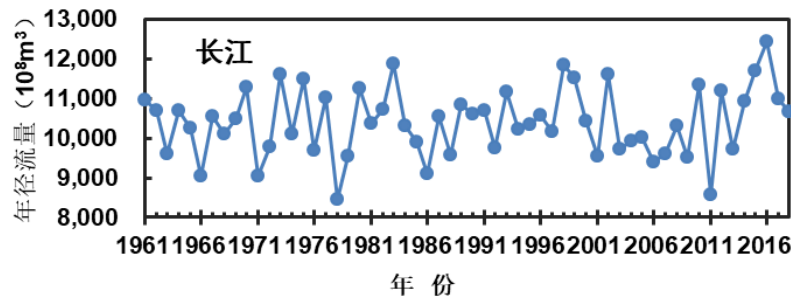
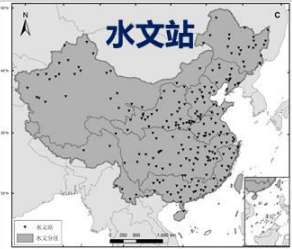
汇流

计模型

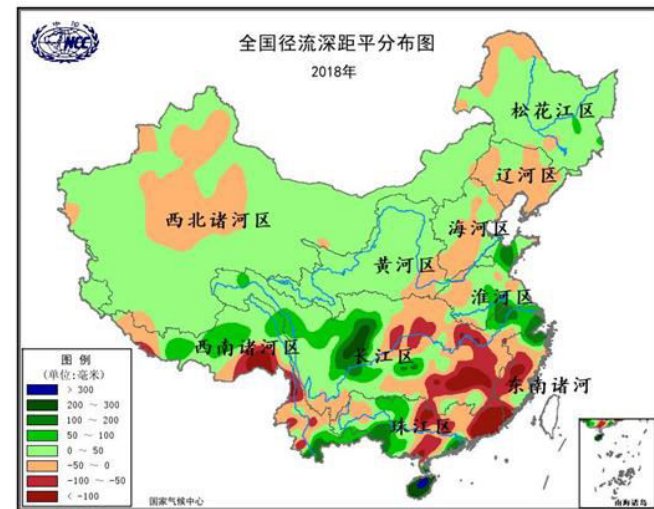
The third level of hydrologic zoning



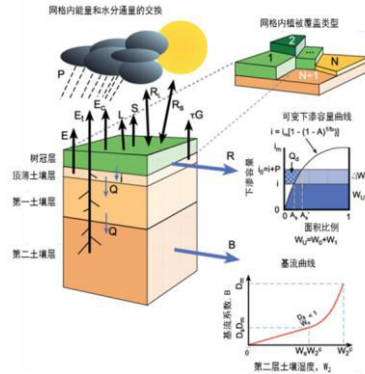
hydrometric station



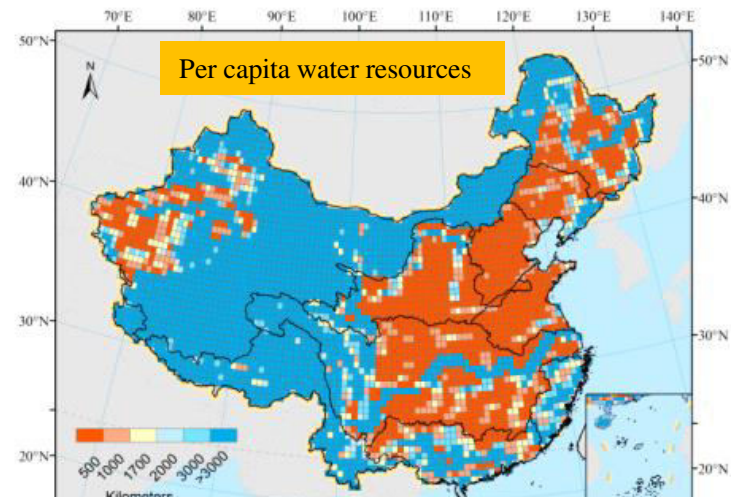
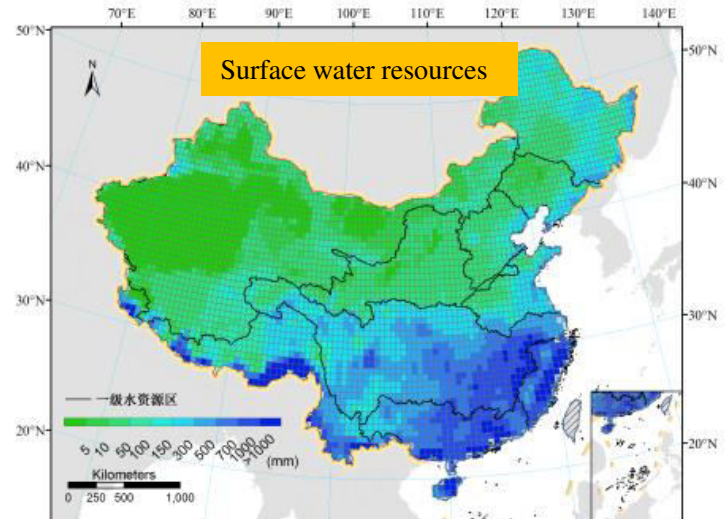
Provide monthly, annual scale water resources quantitative assessment products



Risk assessment for water resources



Grid water resources physical assessment model (Variable infiltration capacity hydrological model, VIC)



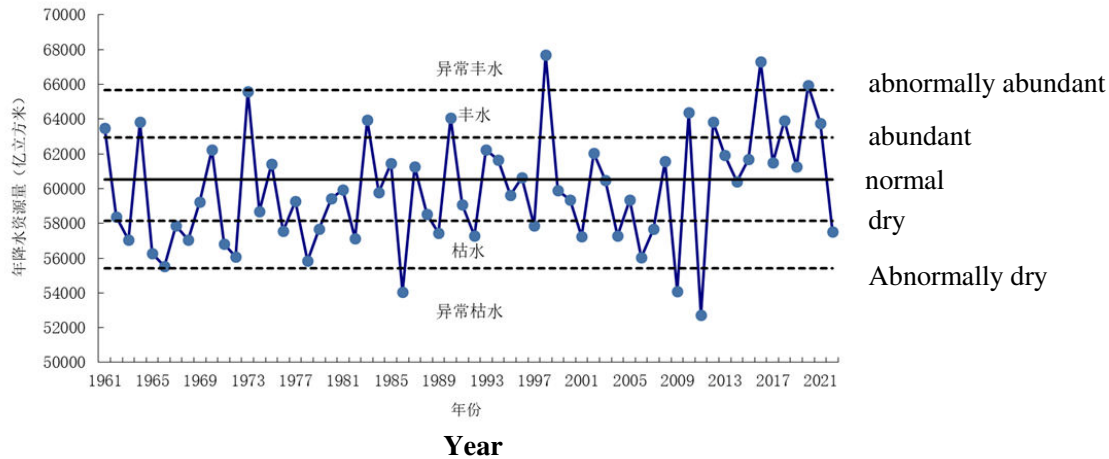
| 流域名 | 暴露面积 | | | 占流域总面积百分比 | | |
|------|--------------------|---------------------|---------------------|--------------------|---------------------|---------------------|
| | <500m ³ | <1000m ³ | <1700m ³ | <500m ³ | <1000m ³ | <1700m ³ |
| 松花江 | 33.22 | 41.98 | 47.22 | 36.4 | 46.1 | 51.8 |
| 辽河 | 18.17 | 22.10 | 24.87 | 56.9 | 69.2 | 77.8 |
| 海河 | 27.04 | 30.03 | 30.44 | 88.1 | 97.9 | 99.2 |
| 黄河 | 56.02 | 61.83 | 67.31 | 66.9 | 73.8 | 80.4 |
| 淮河 | 25.70 | 28.71 | 30.26 | 80.4 | 89.9 | 94.7 |
| 长江 | 94.60 | 110.11 | 124.01 | 52.9 | 61.6 | 69.3 |
| 珠江 | 17.53 | 27.27 | 32.09 | 30.5 | 47.5 | 55.9 |
| 东南诸河 | 0.33 | 2.94 | 7.20 | 1.6 | 14.3 | 35.0 |
| 西南诸河 | 2.18 | 4.23 | 9.84 | 2.4 | 4.6 | 10.8 |
| 西北诸河 | 34.15 | 45.73 | 51.27 | 39.9 | 53.5 | 59.9 |

Water shortage exposed area

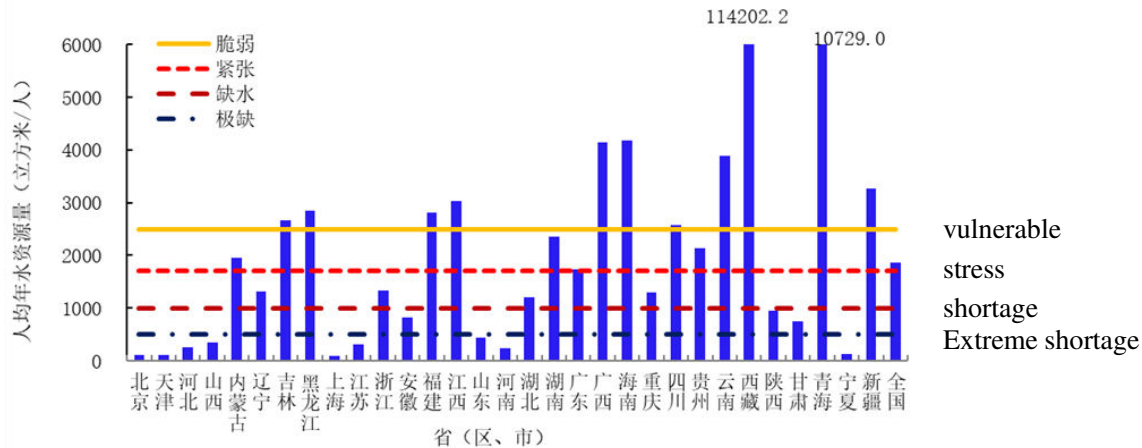
Provide monthly, seasonal and annual scale water resources quantitative assessment products

Risk assessment for water resources

Annual precipitation resources (0.1 billion m³)

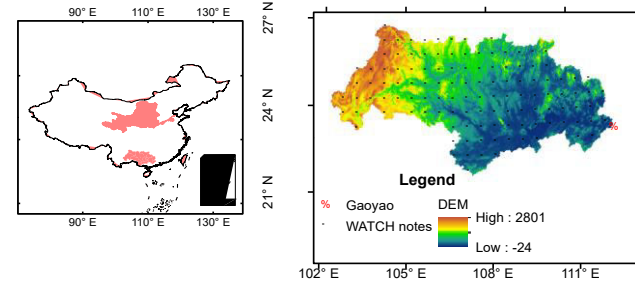
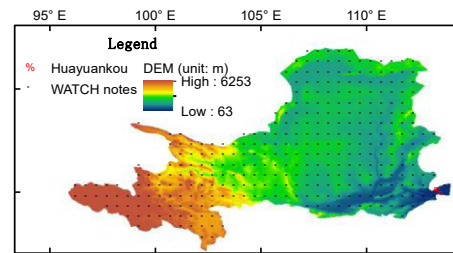
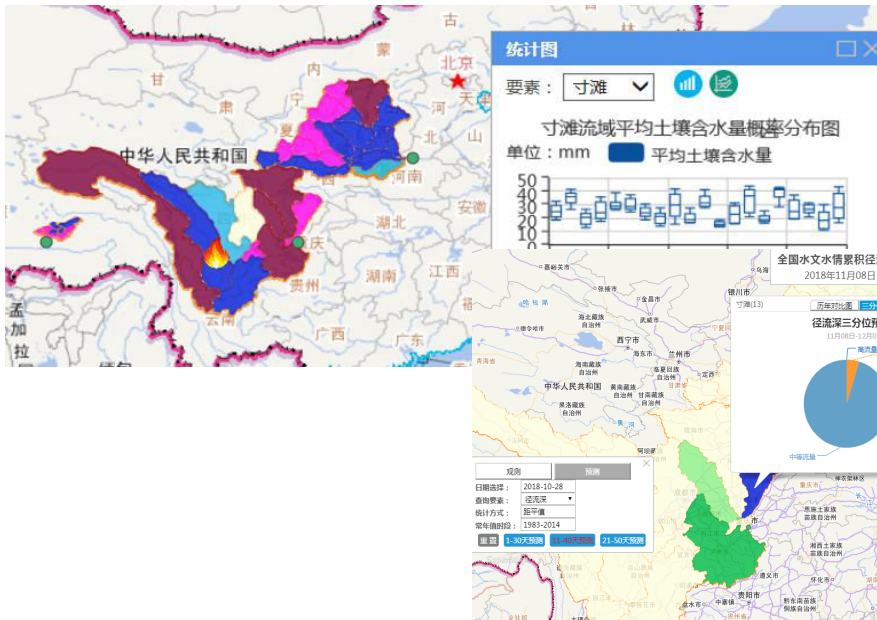
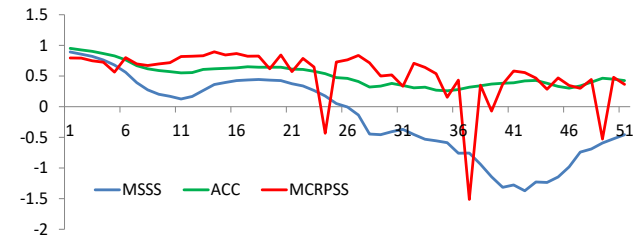
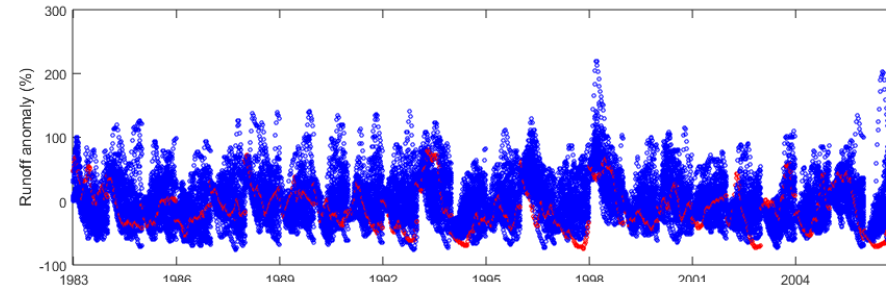
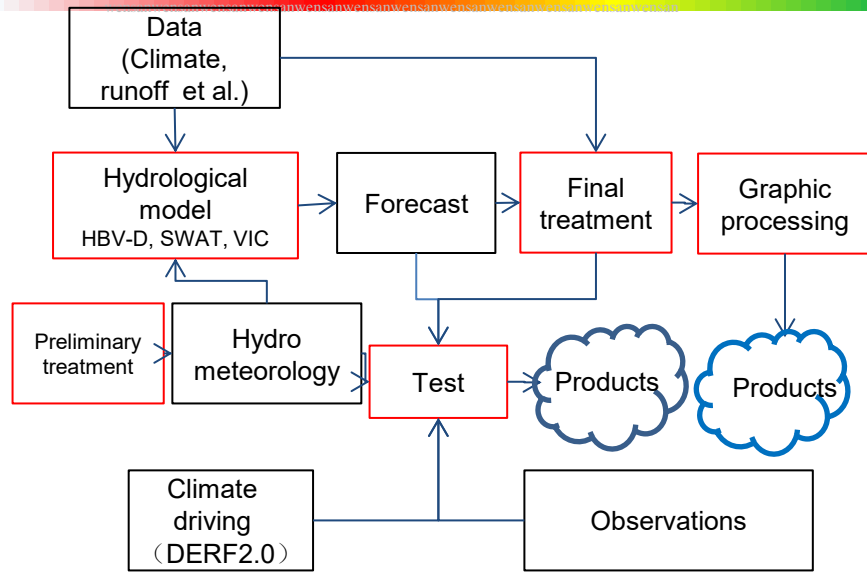


Annual precipitation resources from 1961 to 2022 in China



Assessment of water shortage for province and china

Risk assessment for water resources



A faint, light blue world map is visible in the upper portion of the slide, serving as a background element. The map shows the outlines of continents and is centered horizontally.

Thanks for your attention !