

Program for 39th Annual Climate Diagnostics and Prediction Workshop
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Brief Introduction for

**China Arid/Drought Meteorology
Scientific Experiment Program (CAMEX)**

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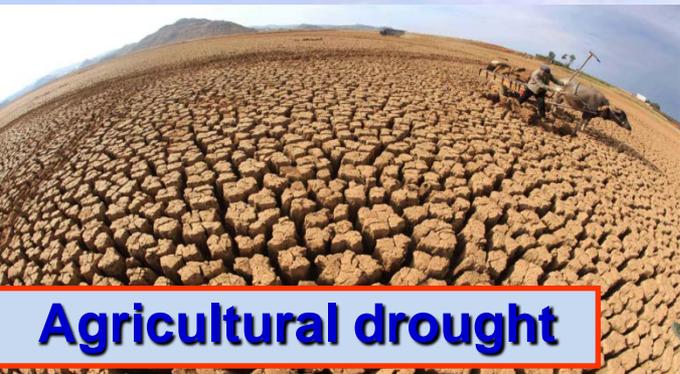


Outline

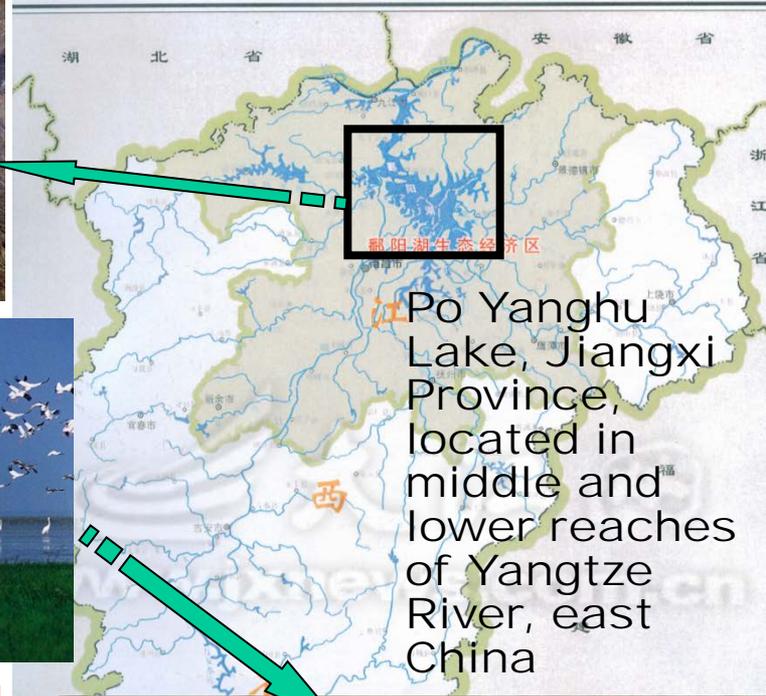
- 1. Motivation
- 2. Brief reviews on drought meteorology research
- 3. Key problems and difficult points in drought monitoring and early warning
- 4. Main points of CAMEX
- 5. Simple introduction of *IAM*
- 6. Next



1. Motivation



鄱阳湖生态经济区规划区域图 I



2011. 5



◆ As a kind of natural disasters, drought is becoming one of the most impactful event, and the most serious economic damage in China.

◆ The impact to national security and social economic development is significant and obvious.

In China, losses from meteorological disasters are about 71% of natural disasters, which 53% is from drought !



Time	Region	Status	
		Population on water shortage	Direct losses
2008.11-2009.2	About 15 provinces in north China	4.37 million	6.0 billion
2009.9-2010.5	5 provinces in southwest China	20.88 million	23.6 billion
2010.10-2011.5	5 provinces in east China	5.07 million	14.9 billion
2013、2014		billion

Losses of extreme drought events in the last several years.

■ Monitoring and prevention from extreme natural disasters (include drought) is one of the prior theme in “National medium and long term development planning of science and technology”



□ 2. Brief reviews on drought meteorology research-----in China



Relevant important projects:

- 1998, Researches on the formation mechanism and prediction theory of serious climate and weather disasters in China;
- 2005, projects about drying trend in north China and human adaptation;
- 2008, Energy and water cycle anomaly in east Asia and its impact on extreme climate events of China under the background of climate warming;
- 2011, 2012, 2013, climate change and climatic disaster in China

Five experimental plans of atmospheric science from 1996 to 2001, some drought researches are included in

Relevant plans:

- I** 阿尔泰山西风环流亚大陆型冰川观测区
- II** 天山东部大陆型冰川和积雪观测区
- III** 祁连山南亚季风亚大陆型冰川观测区
- IV** 青藏高原腹地冻土、冰川和积雪观测区
- V** 东北高纬度冻土和积雪观测区
- VI** 极地高寒环境综合观测区
- VII** 青藏高原东缘海洋型冰川观测区
- VIII** 青藏高原东缘冰川泥石流、滑坡、溜砂综合观测区
- IX** 金沙江下游暴雨泥石流与崩塌、沟蚀观测区
- X** 黄土高原沟蚀、泥流观测区
- XI** 秦岭山地水石流观测区
- XII** 长江三峡滑坡观测区
- XIII** 东南崩岗侵蚀观测区
- XIV** 台湾山地泥石流、滑坡观测区

TIPEX: 高原与干旱; 边界层特种观测

内蒙半干旱草原地区土壤-植被-大气相互作用和反馈过程

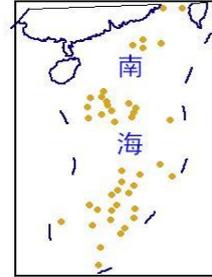
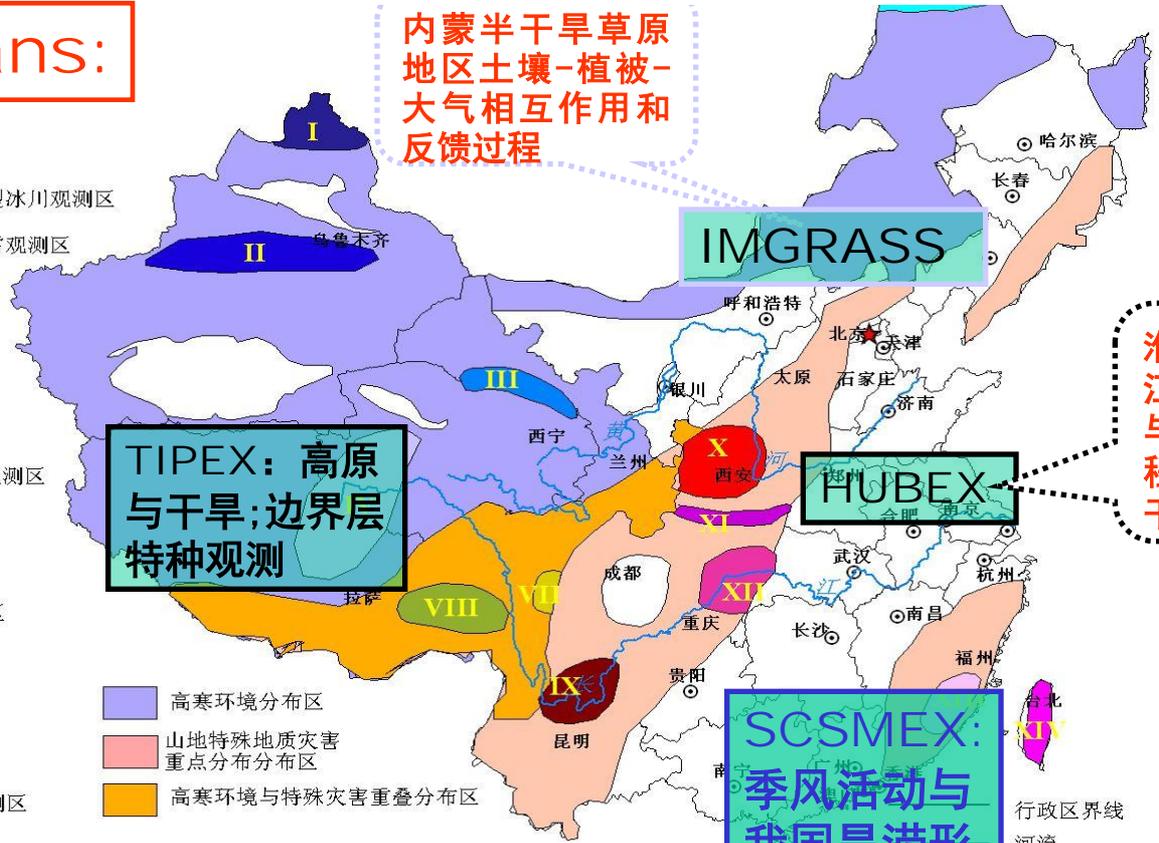
IMGRASS

HUBEX

SCSMEX: 季风活动与我国旱涝形成

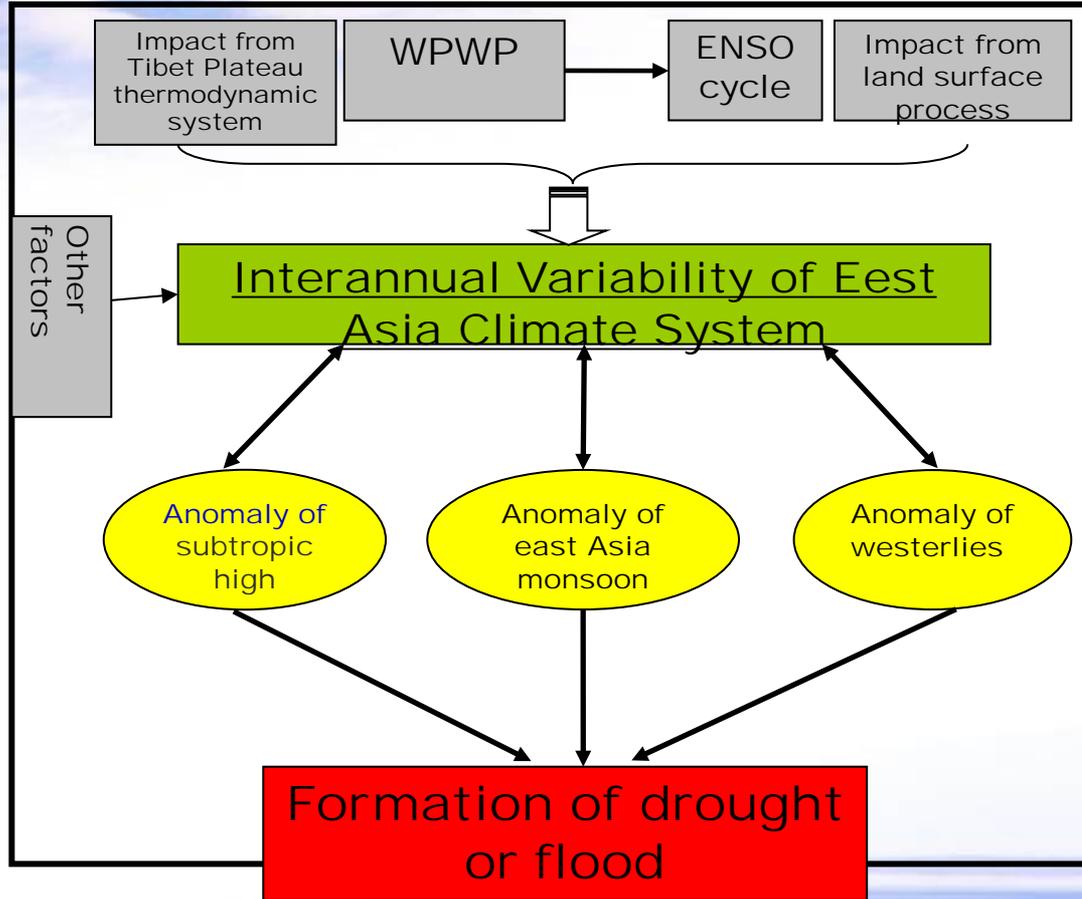
淮河流域乃至江淮流域能量与水分循环过程及其暴雨和干旱问题

- 高寒环境分布区
- 山地特殊地质灾害重点分布区
- 高寒环境与特殊灾害重叠分布区



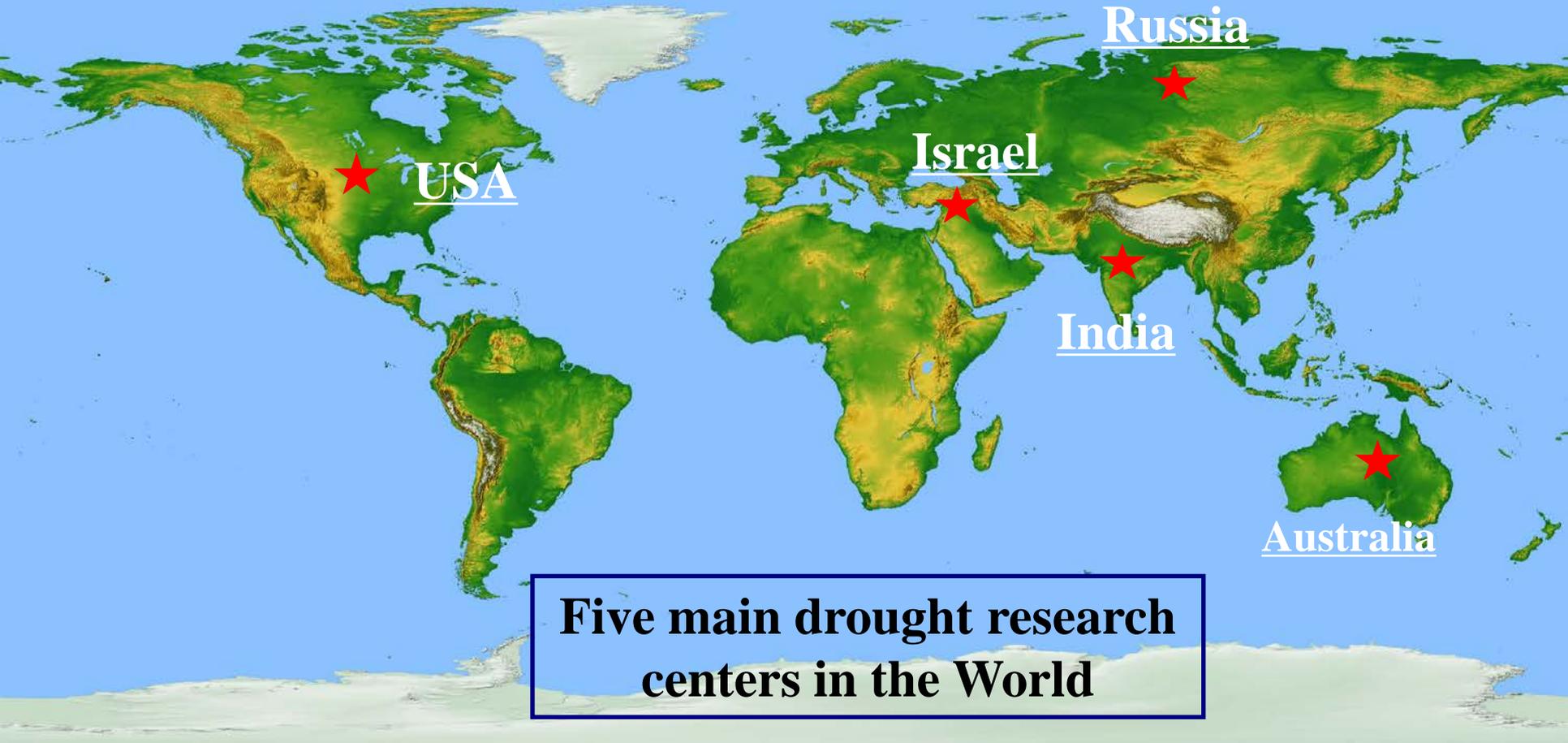
行政区界线
河流
观测区界线

◆ **Highlight progress:** a concept of east Asia climate system and its close relationship with climate anomaly in China was put forward



Schematic diagram of east Asia climate system (Huang, et al, 2003)

-----International research about drought/arid in recent years



National Drought Mitigation Center(NDMC)

(Subjective+Objective, use multi-index to monitor drought)

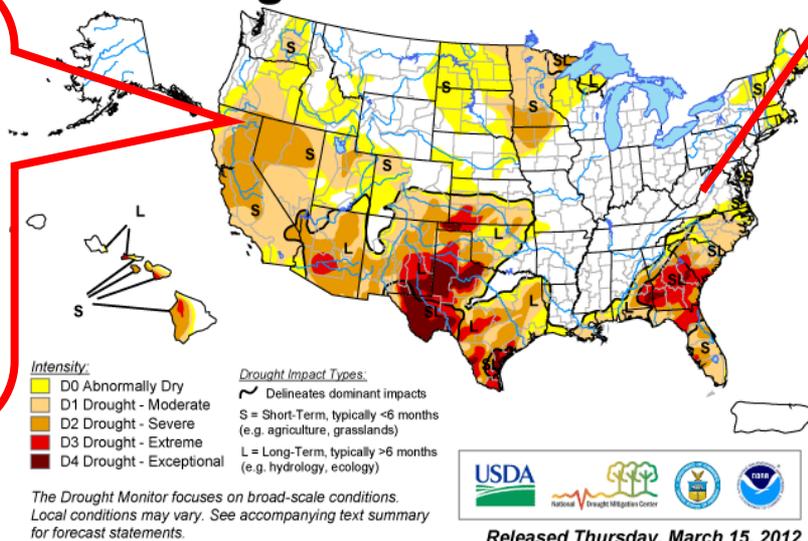


Target:

- 1、 To improve scientific;
- 2、 Assess the effects of drought to society;
- 3、 Service for government.

U.S. Drought Monitor

March 13, 2012
Valid 7 a.m. EDT



Intensity:

- D0 Abnormally Dry
- D1 Drought - Moderate
- D2 Drought - Severe
- D3 Drought - Extreme
- D4 Drought - Exceptional

Drought Impact Types:

- ~ Delineates dominant impacts
- S = Short-Term, typically <6 months (e.g. agriculture, grasslands)
- L = Long-Term, typically >6 months (e.g. hydrology, ecology)

The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.

<http://droughtmonitor.unl.edu/>

Released Thursday, March 15, 2012
Author: Michael Brewer/L. Love-Brotak, NOAA/NESDIS/NCDC

◆ Achievement :

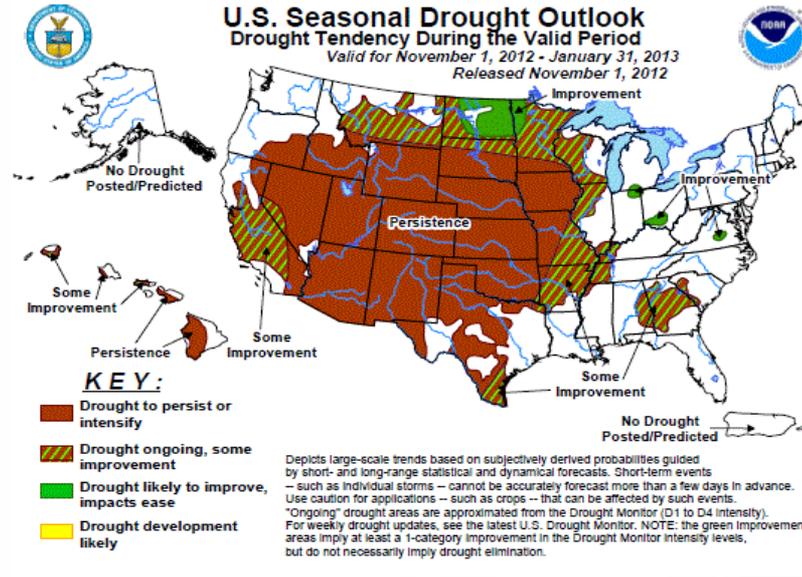
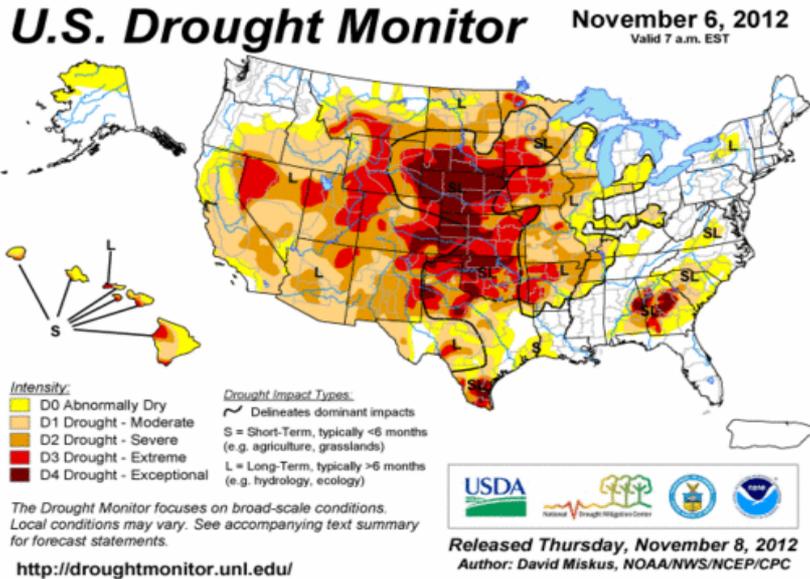
- ◆1 Planning Strategy for Disaster Reduction et al.
- ◆2 Product for drought monitoring(multi-index);
- ◆3 Drought impact reports;
- ◆4 Drought hazard Guide;
- ◆5 Popularize SPI.

◆ Highlights:

- ◆ Cooperation with the Ministry of agriculture, develop six products for farmers.
- ◆ VegDRI is a high resolution product for seven counties.

Mission

- CPC issues operational monthly and seasonal drought outlook and participates as U.S. Drought Monitor Authors.
- To support operational drought monitor and drought outlook.



□ Development tendency of drought meteorology research:



Focus on four aspects:

- (1) **Global view:** Regional drought and aridification occur under global scale background.
- (2) **Experiment means:** Regional land surface process and their interaction with atmosphere.
- (3) **Mechanism:** Research on drought/arid(aridification) mechanism and its regional climate model/land surface model.
- (4) **Data set:** Using many kinds of data, even proxy data to study on drought discipline and drought climate change.



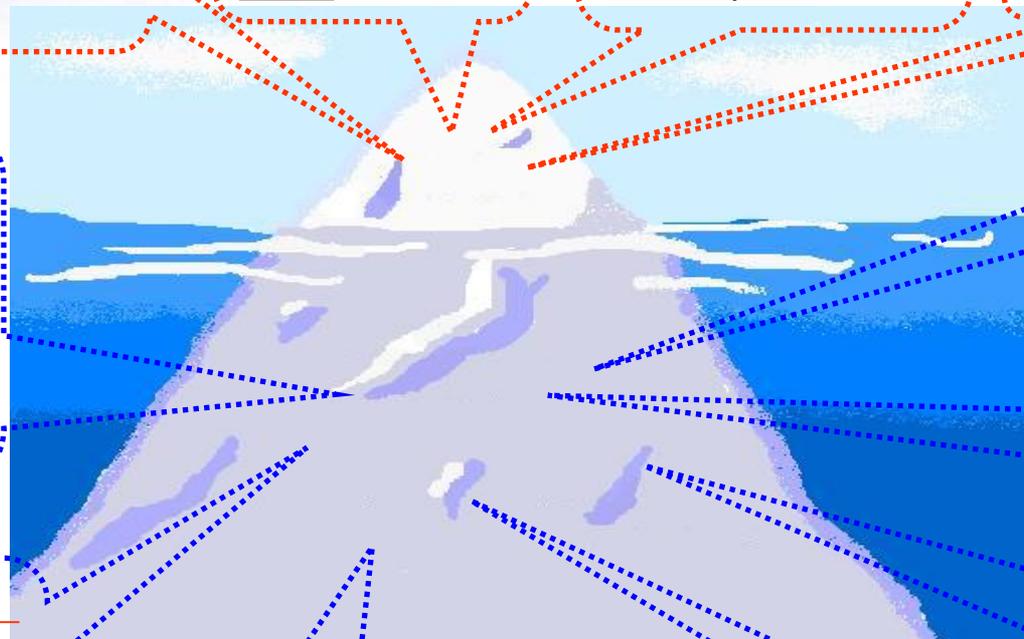
External forcing to climate-Plateau et al.

Typical underlying surface with extrem climate events

Relationship between anomaly of asian climate system and anomaly of Chinese climate system

Research on short-time climate system

Prob 2: Dynamic mechanism of formation of drought circulation ...



Prob 1: Arid Meteorology Experiment

Prob 3: Drought database and its sharing ...

Prob 4: Development of drought prediction theory...

Prob 5: Formation Mechanism of drought disaster...

Prob n: ...

Prob n: ...

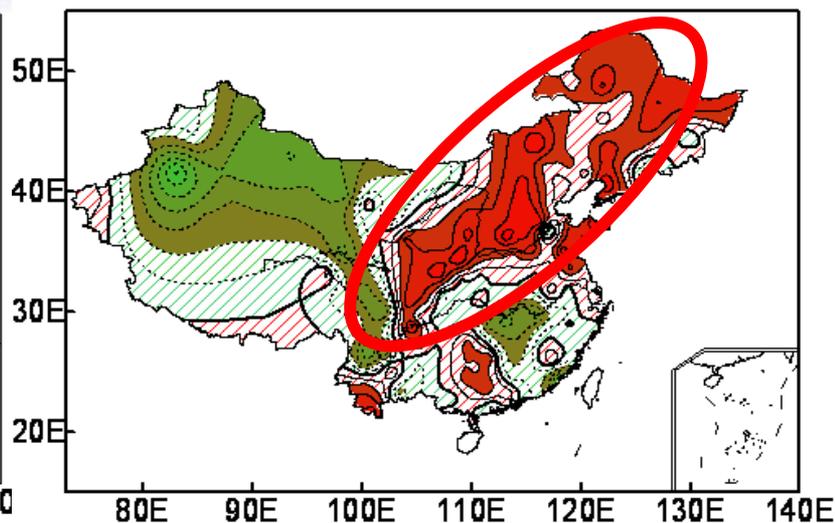
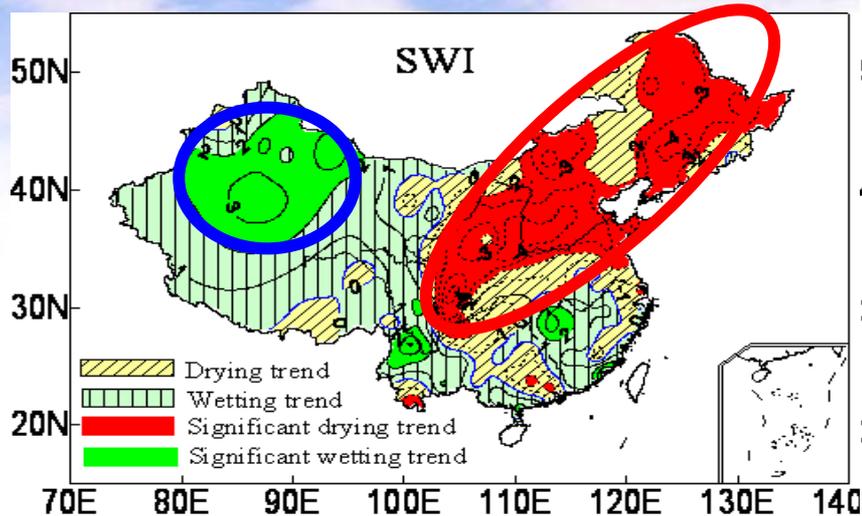
□ 3. Key problems and difficult points in drought monitoring and early warning



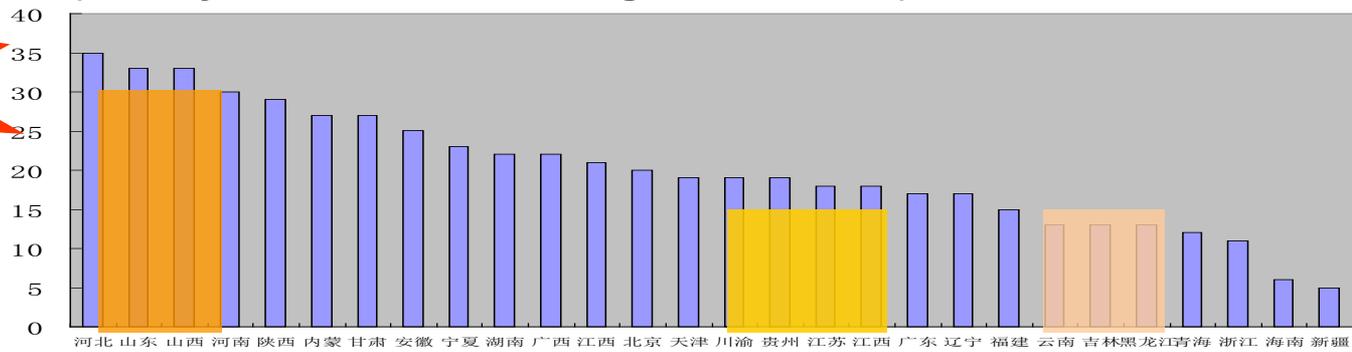
- Regular pattern: Complexity
- Prediction: Uncertainty
- Monitoring: No facticity



Extreme drought pattern 1951 to 2006, Ma, 2007



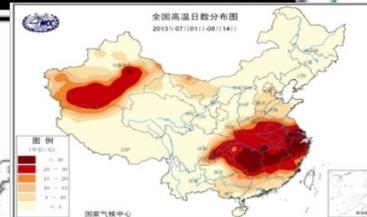
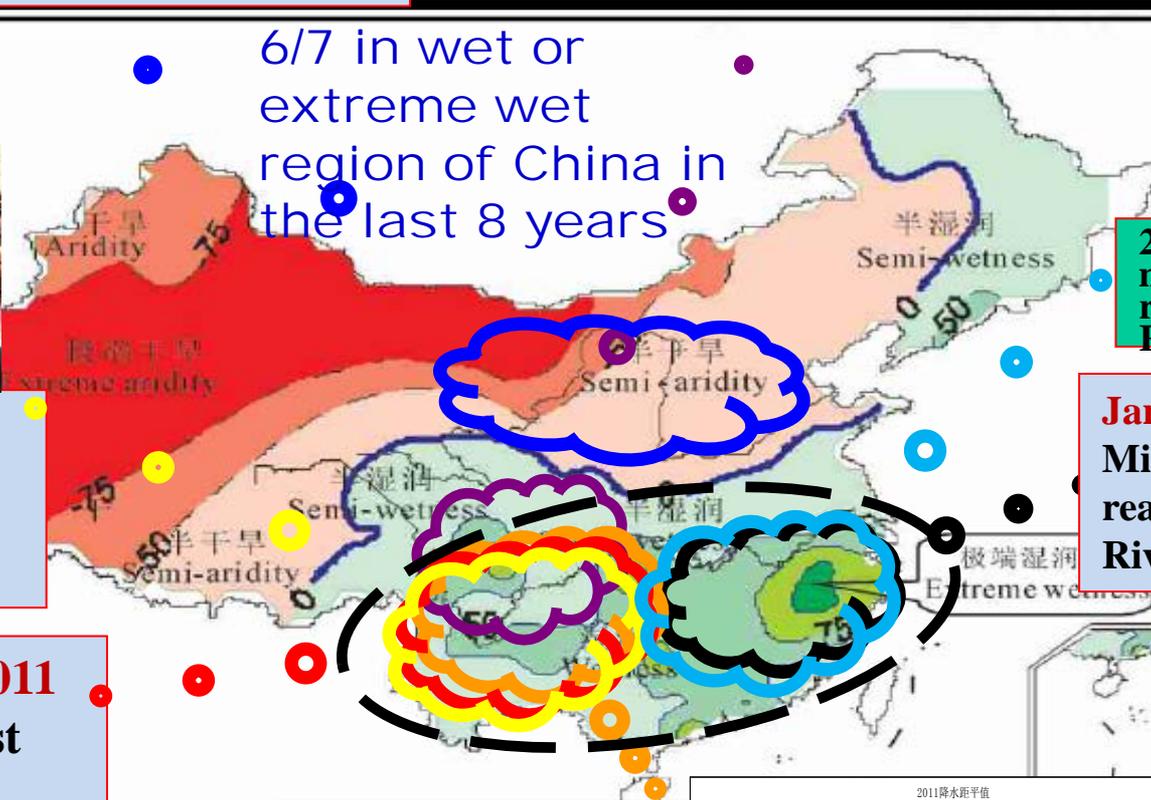
Frequency of extreme drought of each province (1951-2000)



2009 winter to next spring: 15 provinces in North China

2006 summer: Chongqing, Sichuan province, extreme drought.

6/7 in wet or extreme wet region of China in the last 8 years



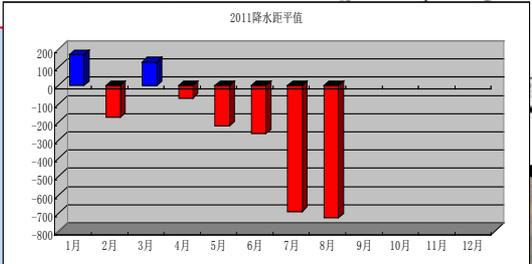
2013 summer, the middle and lower reaches of Changjiang River

Jan. to May, 2011: Middle and lower reaches of Changjiang River.

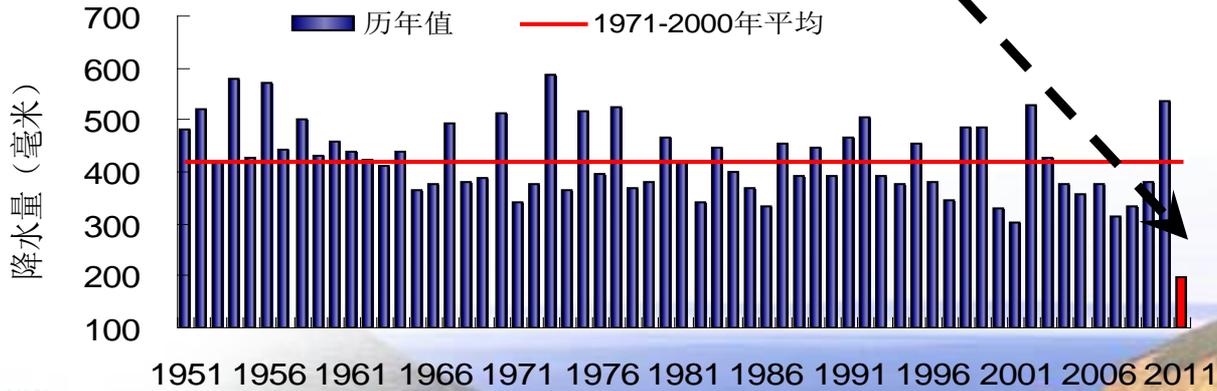
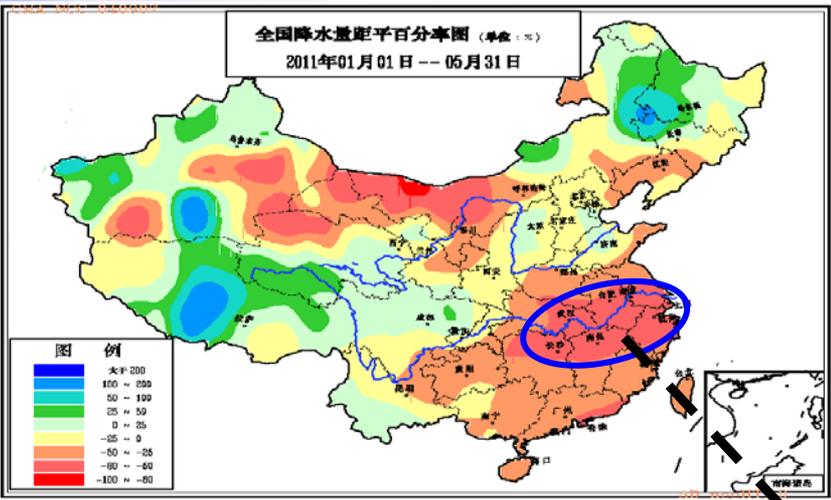
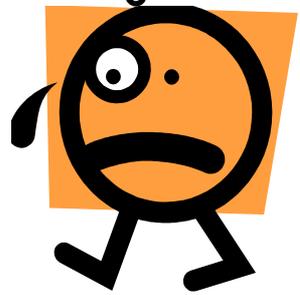
2011 autumn to 2012 spring: Yunnan province, Southwest China.

2010 autumn to 2011 spring: Southwest China.

2011 summer: Southwest China, most extreme drought.



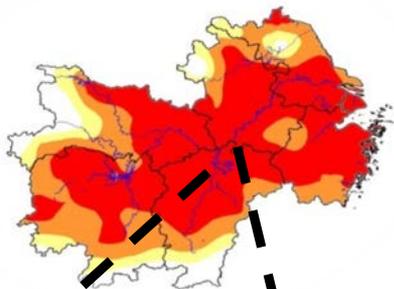
Spring, 2011, extreme drought appeared in middle and lower reaches of Changjiang River



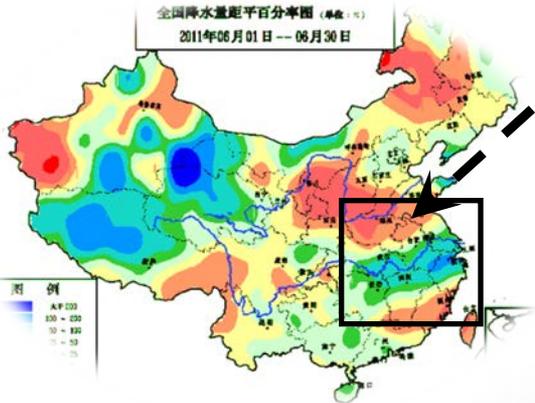
Total precipitation of January to May in lower and Middle Reaches of Yangtze River from year 1951 to 2011. Ye Dianxiu, et al, 2011)

- ◆ June, just one or two days later, drought sharply change to flood.
- ◆ How can we predict the ending time of such a drought event!?

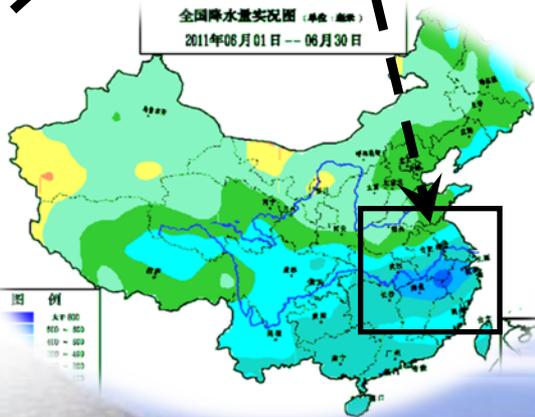
长江中下游气象干旱分布图
2011年06月01日

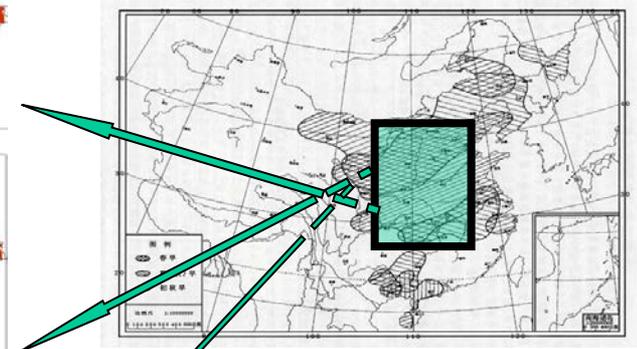
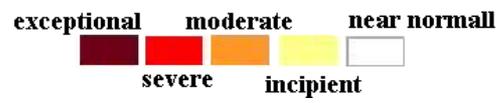
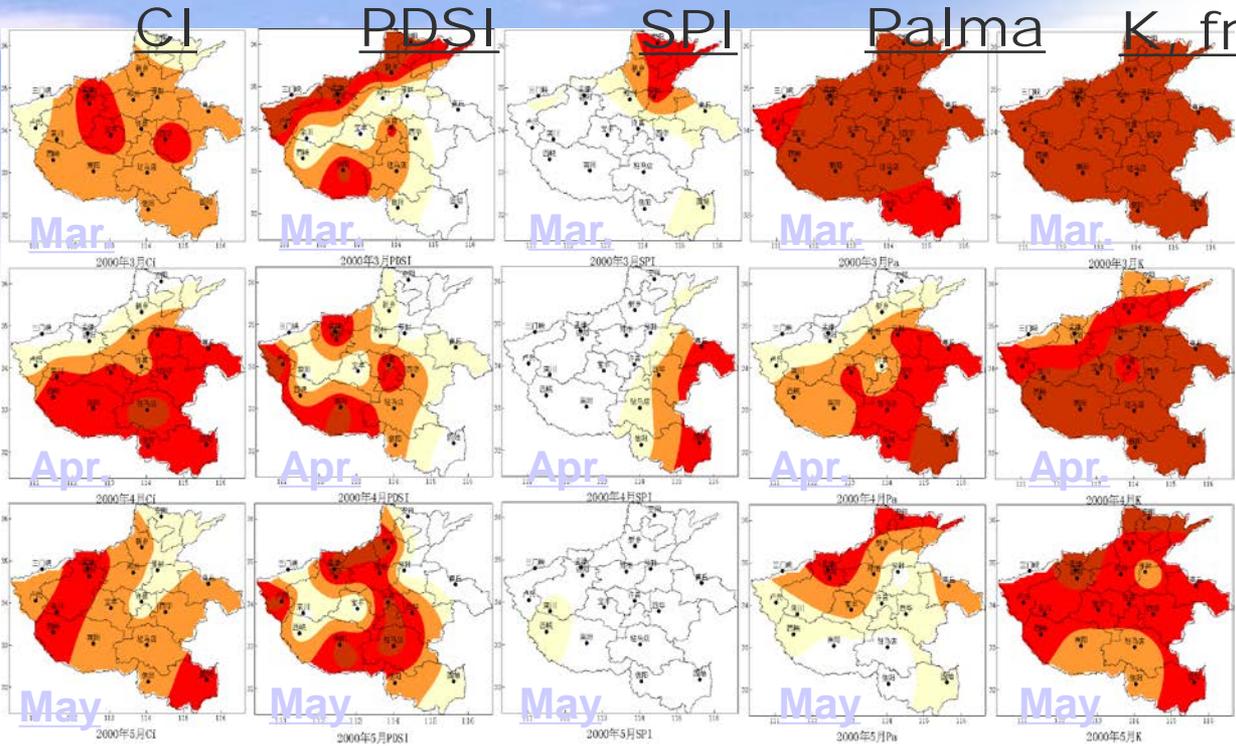


全国降水量距平百分率图 (单位: %)
2011年06月01日 -- 06月30日



全国降水量实况图 (单位: 毫米)
2011年06月01日 -- 06月30日





Which is the truth?

➤ For monitoring:
No facticity

□ So, the key problems are:



- Atmospheric dynamic mechanism of the extreme regional drought formation
- Regular pattern and future trend of extreme drought events evolution with climate change
- Process characteristic and mechanism of a drought event from beginning to drought disaster to the end , also, the relationship between the atmospheric drought and agriculture/ecological drought
- Improvement of drought index and its adaptability in different regions
- Climate models and land surface models for drought prediction, monitoring and research.
- Multisource data set and its sharing.



□ 4. Main points of CAMEX

Will be one of the CMA's major specialized profession project in the next several year



Target Of CAMEX



The key research in science and technology.

Model
Mechanism
Prediction
Index
Physical characteristics

Technical way

Observation Experiment
Data
Numerical simulation
Multidisciplinary technology and methods

General objective:

- **Technology support:** improve drought disaster prevention, food security and eco-security
- **Science:** develop drought theory
- **Business application:** to improve drought monitoring and prediction and assessment skills

Business objectives:

- Development of numerical model for the core of drought monitoring, forecasting, and warning of new technologies, improving regional adaptability of drought index.
- Upgrading major drought impact assessments, in particular the risk assessment of technical capacity
- Includes historical drought drought-proof data and integrated databases information
- Arid meteorological observation layouts provide scientific reference

□ Basic thought

✧ Take the major drought events as the breakthrough, make analysis of multiple cases, summarize characteristics and discipline, basing on meteorological drought and service for other areas.

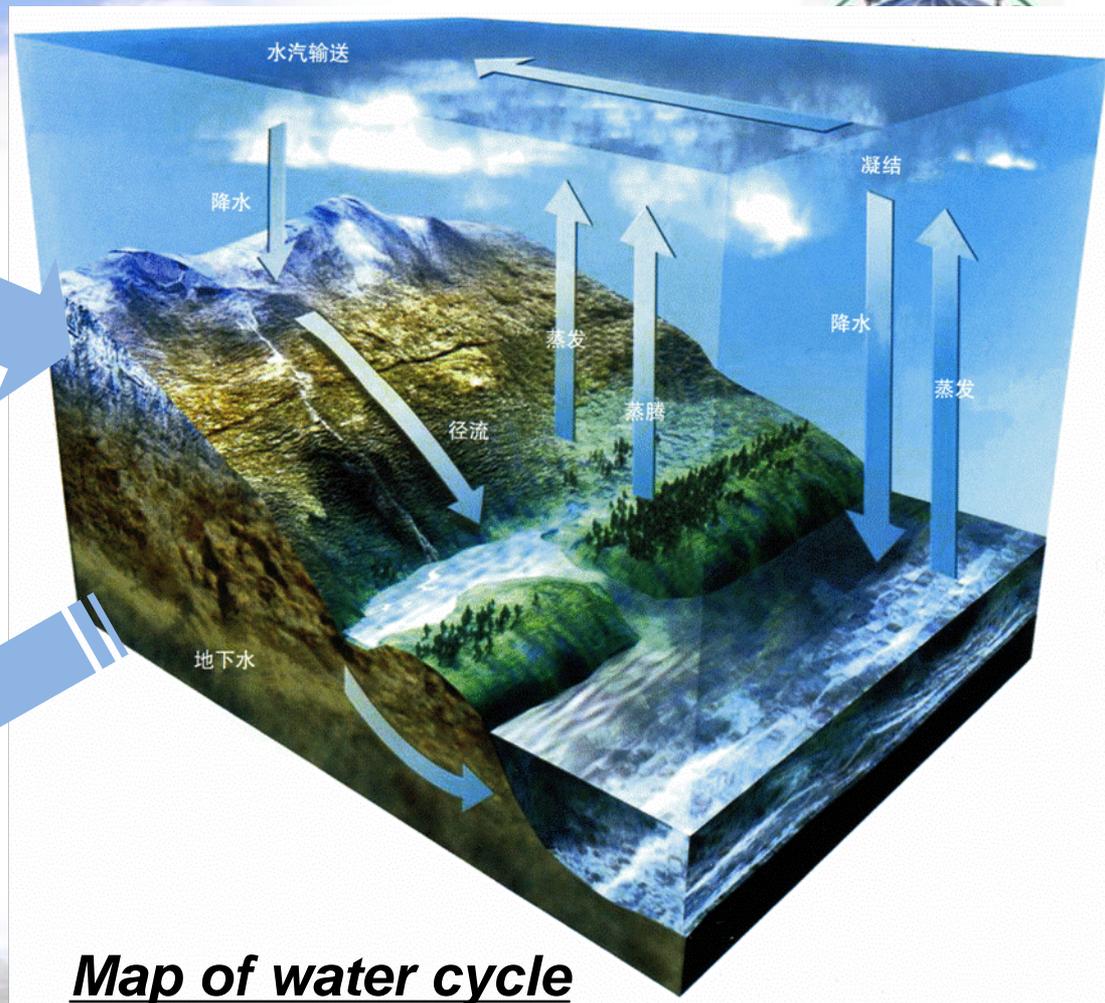
Two key points, essentially

◆ **Drought:** anomaly of interaction between external forcing and inner-atmosphere – drought or flood

◆ **Drought disaster:** anomaly of the interaction of atmosphere-landsurface – soil, water, vegetation

中国气象局兰州干旱气象研究所

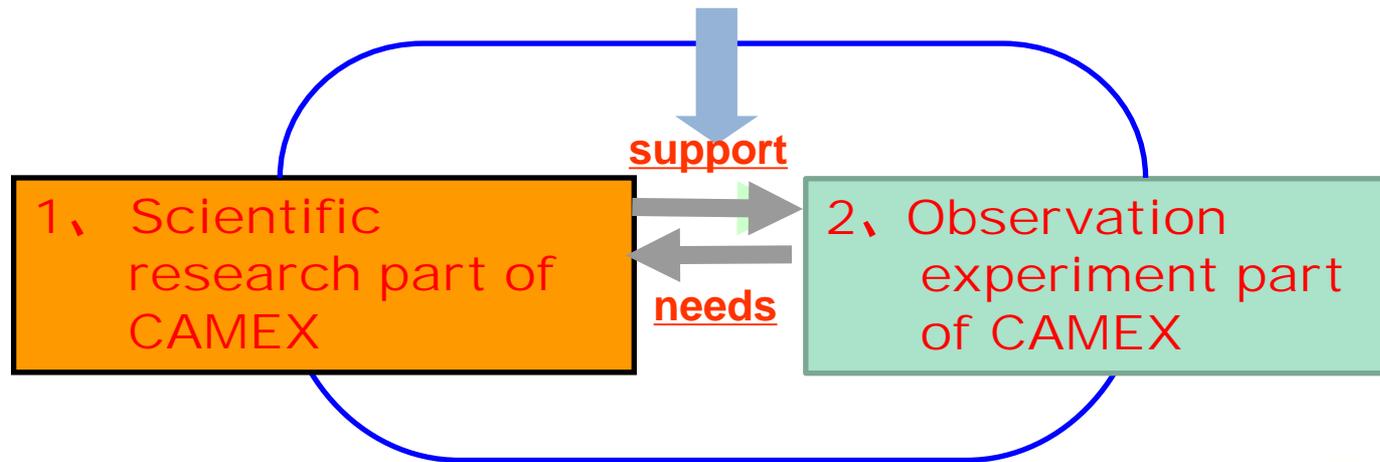
Institute of Arid Meteorology, CMA, Lanzhou



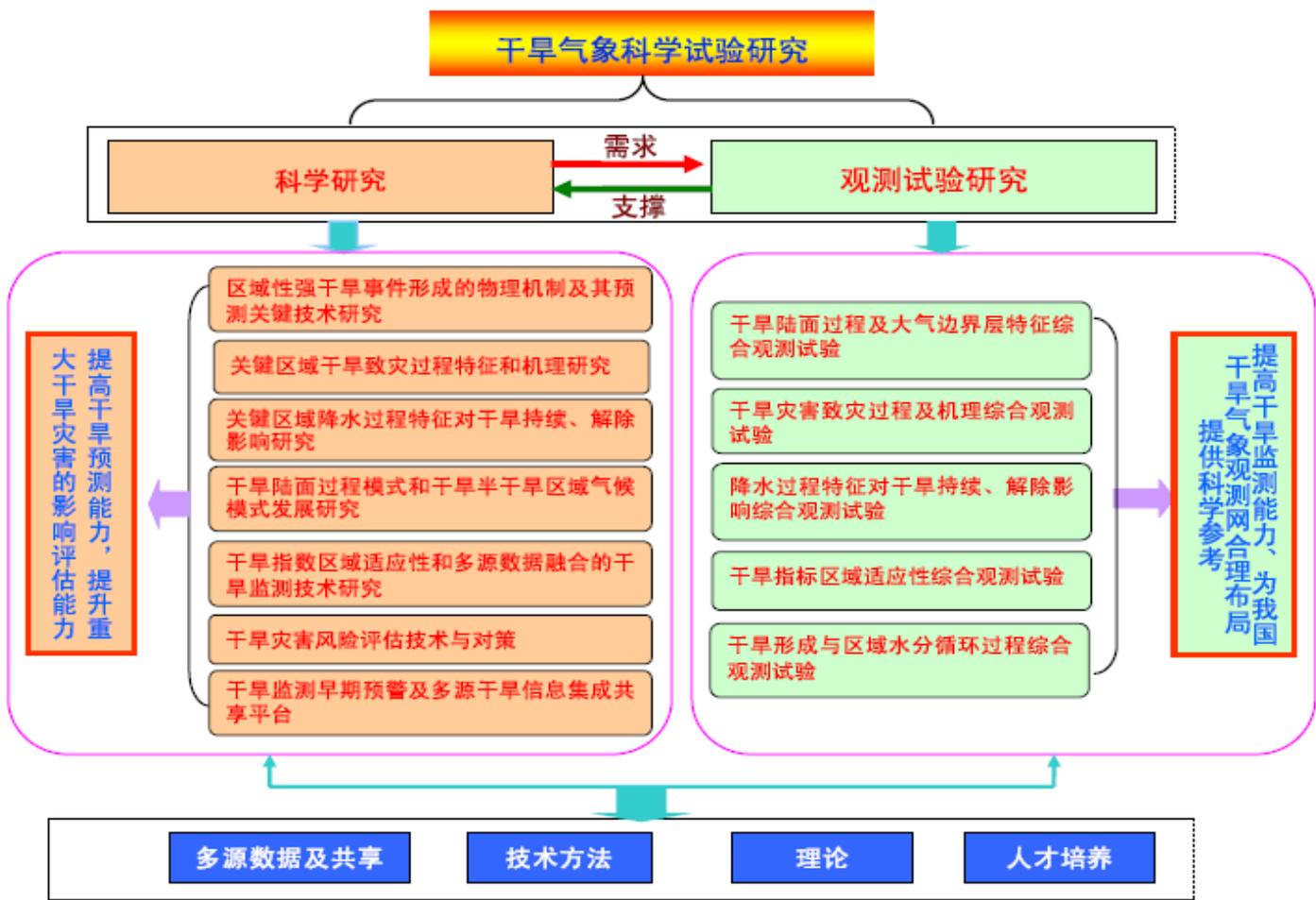
Map of water cycle



Basic framework of CAMEX



Framework of CAMEX



Scientific research (7 points)

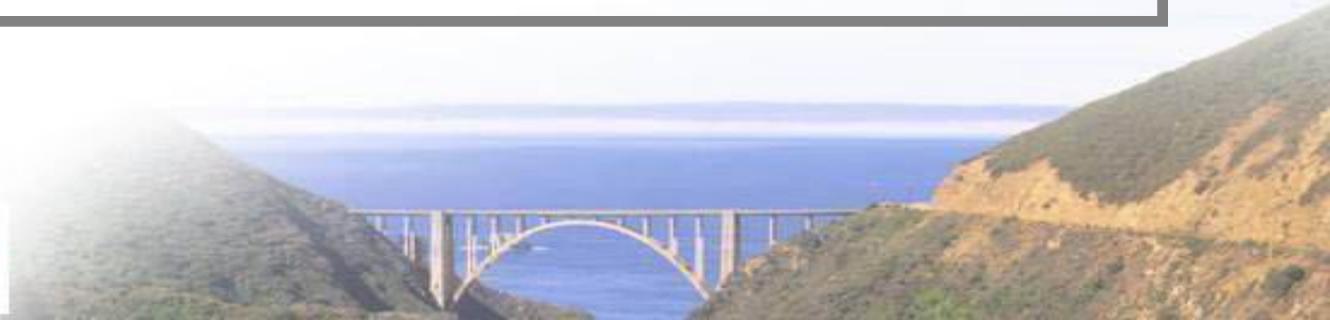


1. Physical mechanism of regional severe drought events and the key technology of drought prediction .
2. Process characteristic and disaster-causing mechanism of severe drought in an important region.
3. Influence of rainfall characteristic on drought duration and relief.
4. Improvement of arid land-surface model and arid and semi-arid regional climate model in China.
5. Regional adaptability of drought indices and drought monitoring of multi-source data fusion technology.
6. Technique development for drought risk assessment and adaptive strategy.
7. Multi-source shared drought information system, and drought monitoring, early warning and assessment system.

Observation and experiment (5 points)

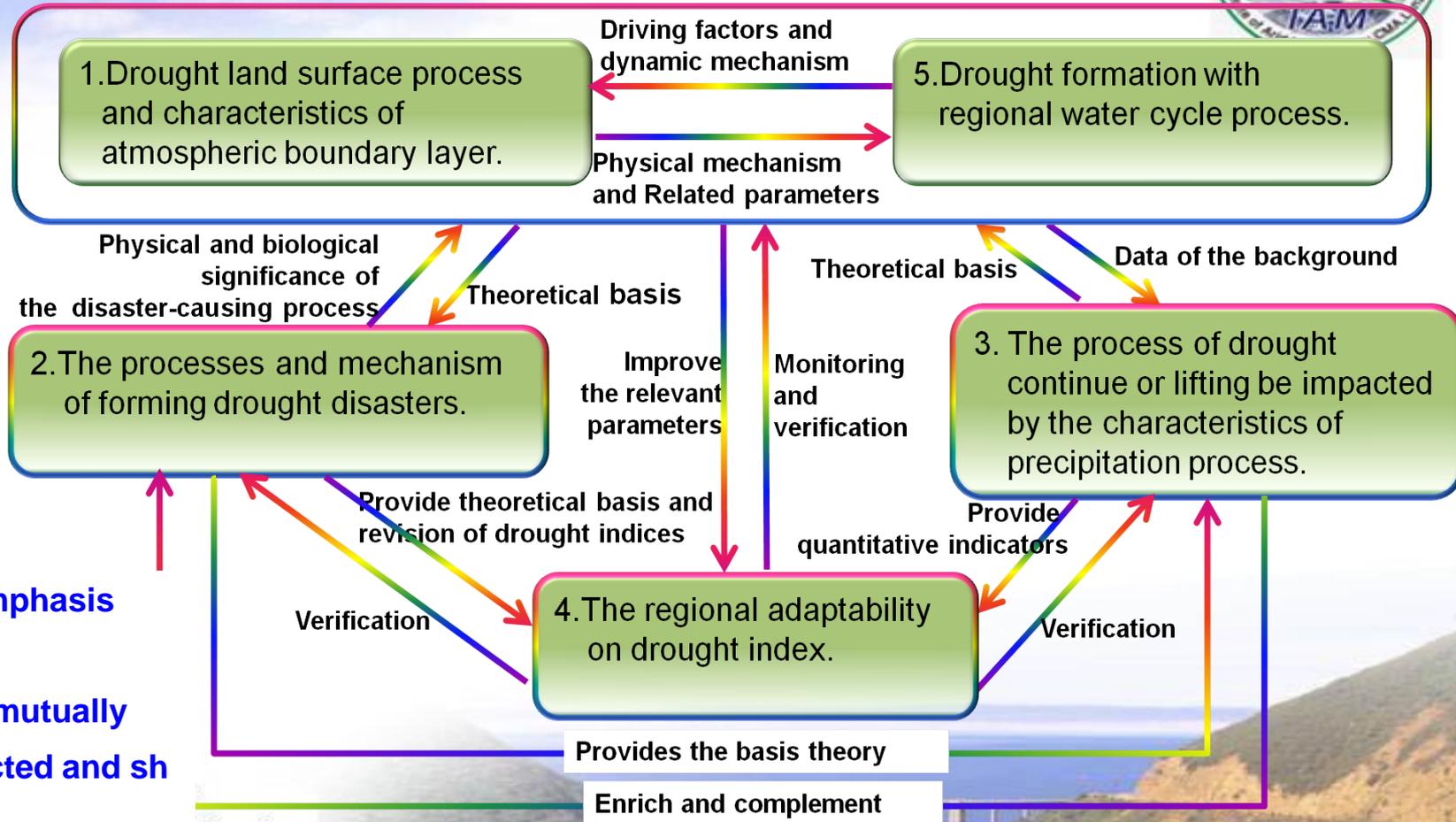


1. Comprehensive observation of arid/drought land-surface process and boundary layer characteristics.
2. Synthesized experiment of drought disaster-causing.
3. Observation and experiment for influence of rainfall characteristic on drought duration and relief.
4. Regional adaptability of drought.
5. Impact of water cycle on drought formation.





The interrelationships within and among the five experiments.

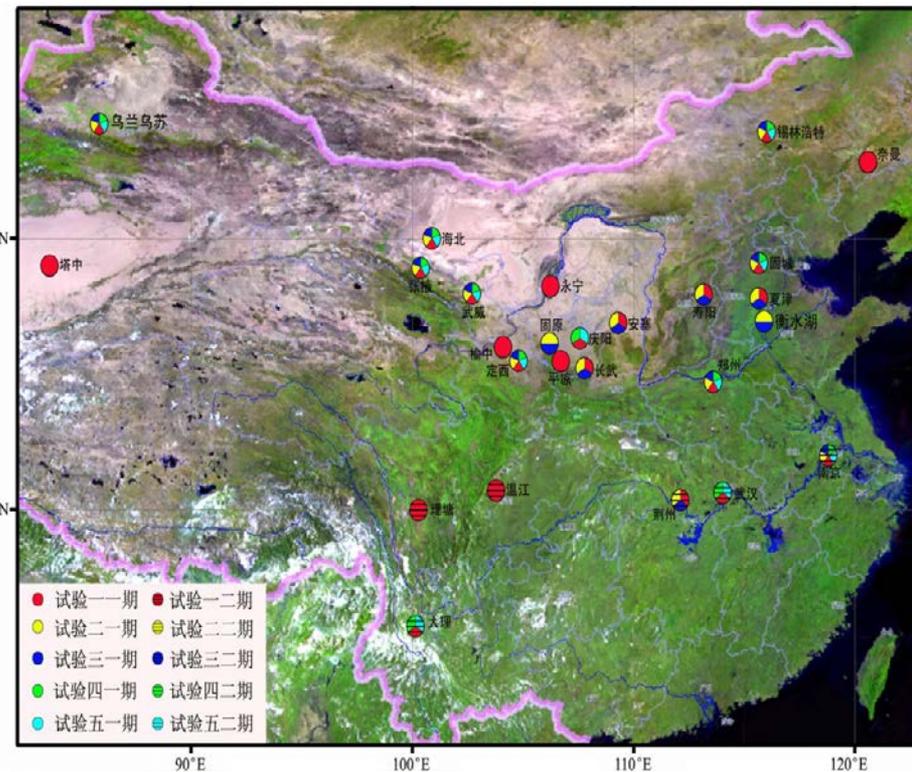
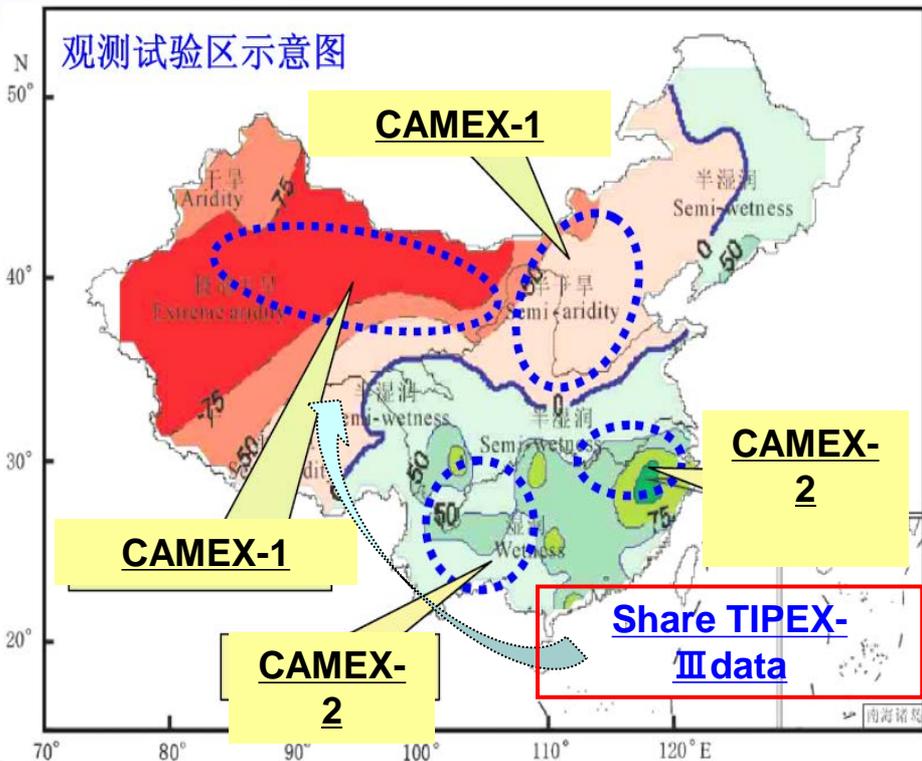


- ➔ Different emphasis
- ➔ Intercross
- ➔ Supported mutually
- ➔ Interconnected and shared

Experiment area



Observation experiment area



Expected results



Research



Experiment

1. Multi-layer interaction of atmosphere—hydrosphere—biosphere on drought mechanism.
2. Theory.
3. Models.
4. Multi-technique for monitoring, prediction and assessment
5. Multi-source drought information and data platform.
6. Talents and professional team.





Period for design and implementation

Total period: eight years (4 + 4).

2015-2018
CAMEX-1

The first step test area: North China, Northwest China.

The data collection.
The instrument calibration.
Model selection

The experimental will be perfected.
Build models.
Complete technology research.
Results will be applied to practical business

2019-2022
CAMEX-2

The second step test area: the middle and lower reaches of the Yangtze river, Southwest China.

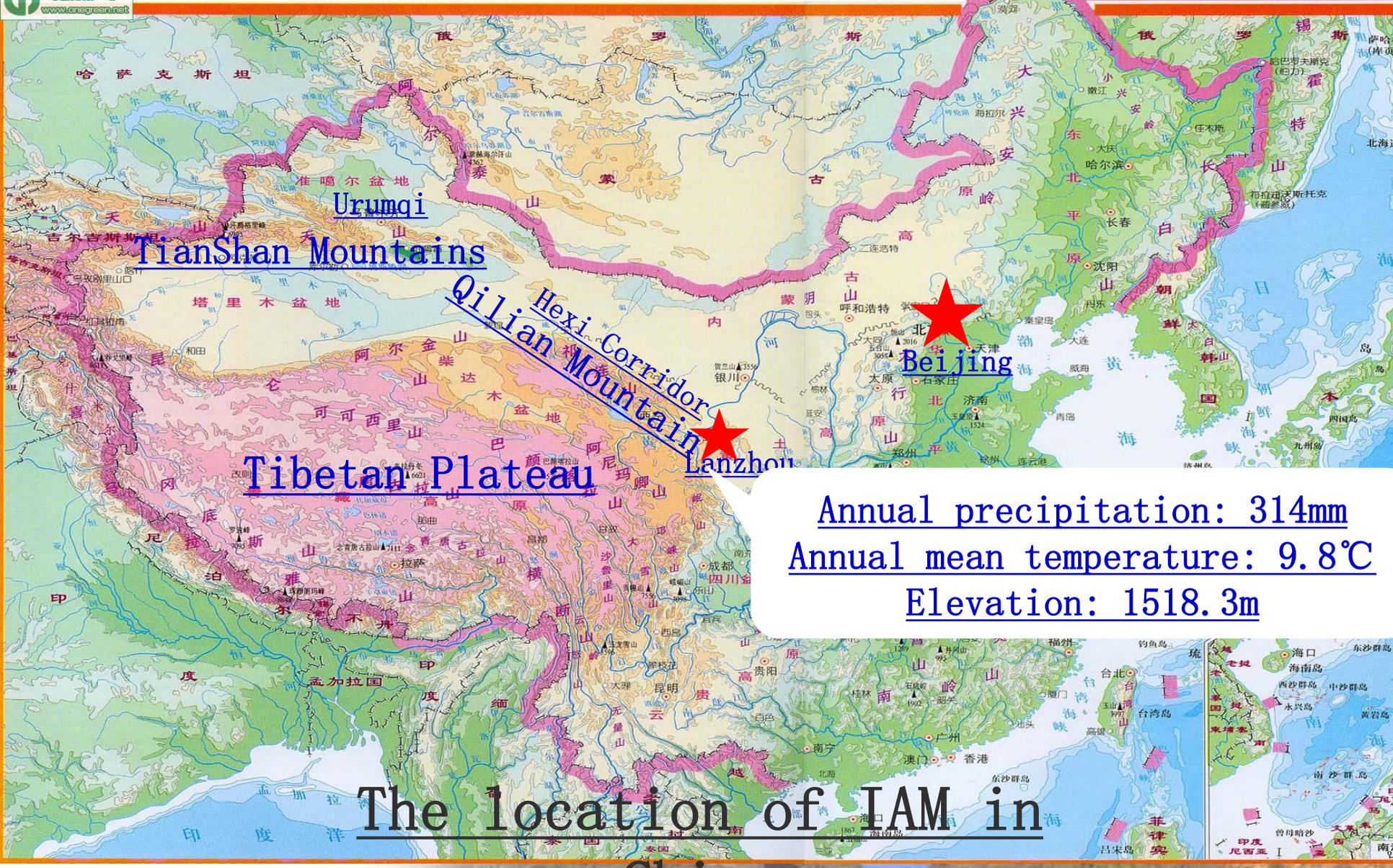
Observation
Built in data integration system
The physical mechanism
The model is applied in the actual business

□ 5. Simple introduction of IAM



- A national specialized research institute, and one of a main research department under CMA.
- Focuses on arid/drought meteorology, arid climate change and its impacts on arid/ semi-arid agriculture and ecological environment and weather disasters such as sand-dust storm caused by drought.
- Pays much attention to the development and application of techniques for drought monitoring and early warning.





Urumqi
Tian Shan Mountains

Hexi Corridor
Qilian Mountain

Tibetan Plateau

Lanzhou

Beijing

Annual precipitation: 314mm
Annual mean temperature: 9.8°C
Elevation: 1518.3m

The location of IAM in

Observational and experimental base stations of

IAM

Sand-dust Storm Observation System

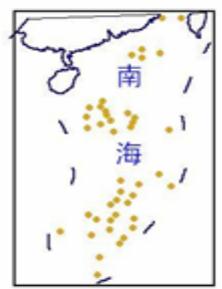
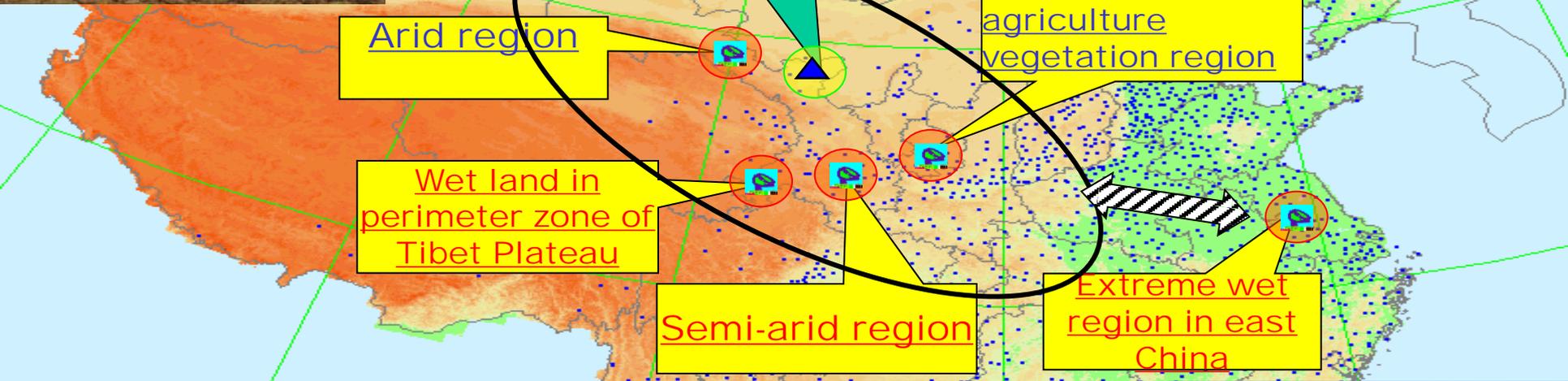
Arid region

Rainfed agriculture vegetation region

Wet land in perimeter zone of Tibet Plateau

Semi-arid region

Extreme wet region in east China



□ 6. Next



- *Implementation of CAMEX.*
- *More deep collaboration with NCEP/NOAA and other research institutes.*



●



Thank You for
Your Attention ...

