United Nations International Conference on Space-based Technologies for Disaster Management "Risk Assessment in the Context of Global Climate Change

7-9 November 2012, Beijing, China

Drought Monitoring and Impact Evaluation

from Scientific Methods to Disaster Response

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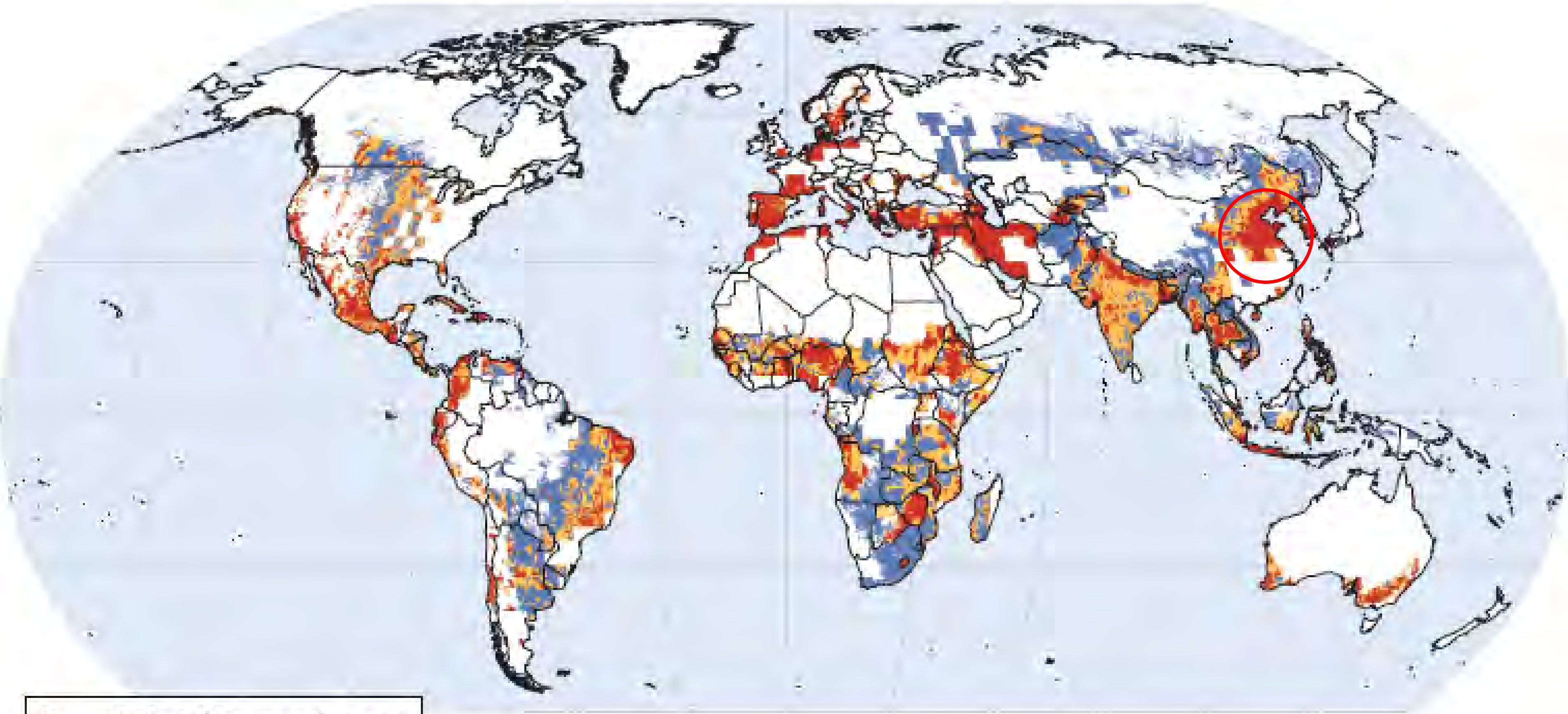
Global Distribution of Drought Risk

Total Economic Loss



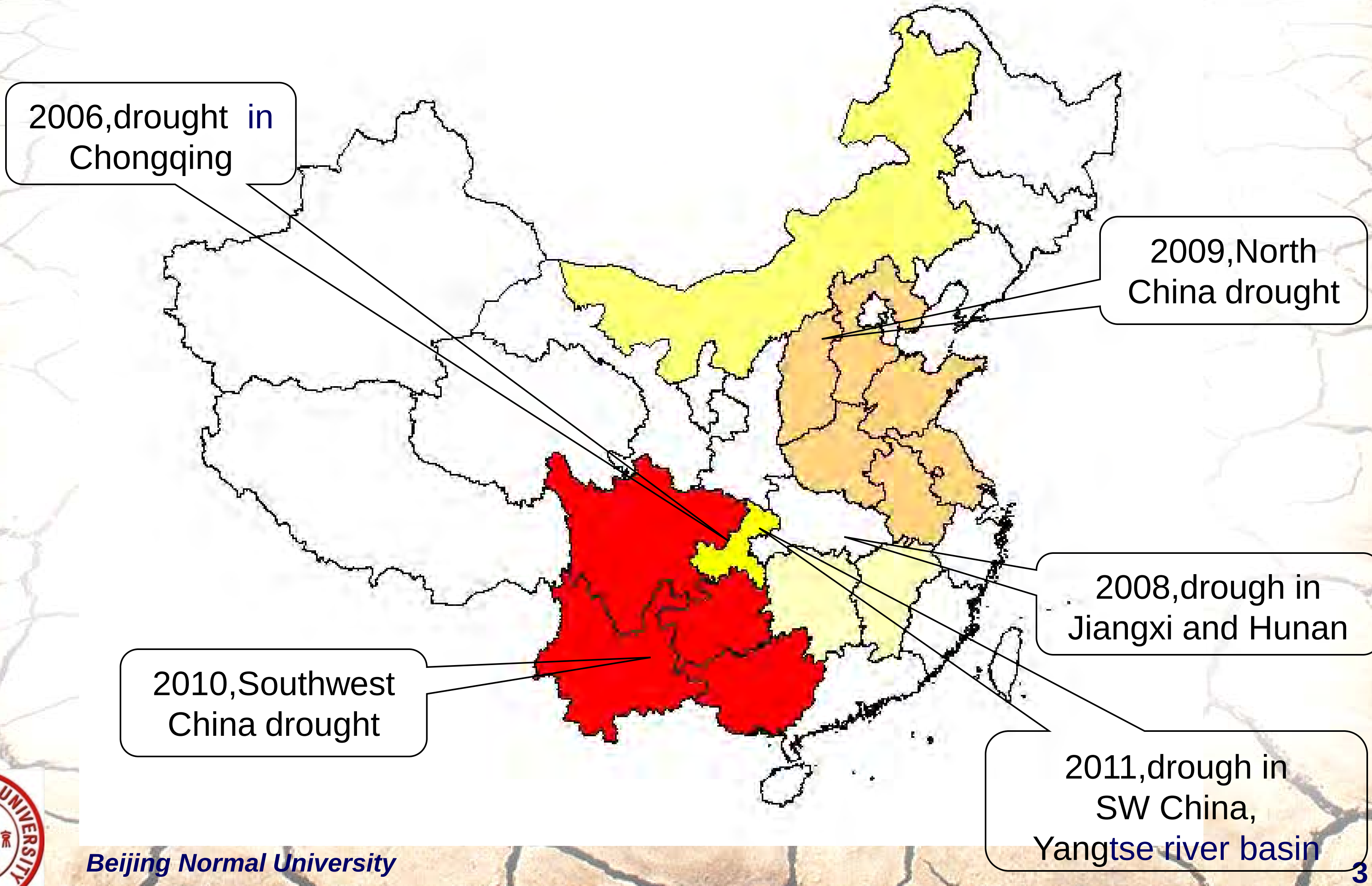
Drought Total Economic Loss

Risk Deciles

- 1^{st} - 4^{th}
- 5^{th} - 7^{th}
- 8^{th} - 10^{th}

Center for Hazards and Risk Research
The Earth Institute at Columbia University
www.ldeo.columbia.edu/chrr/research/hotspots

Drought events in China is increasing

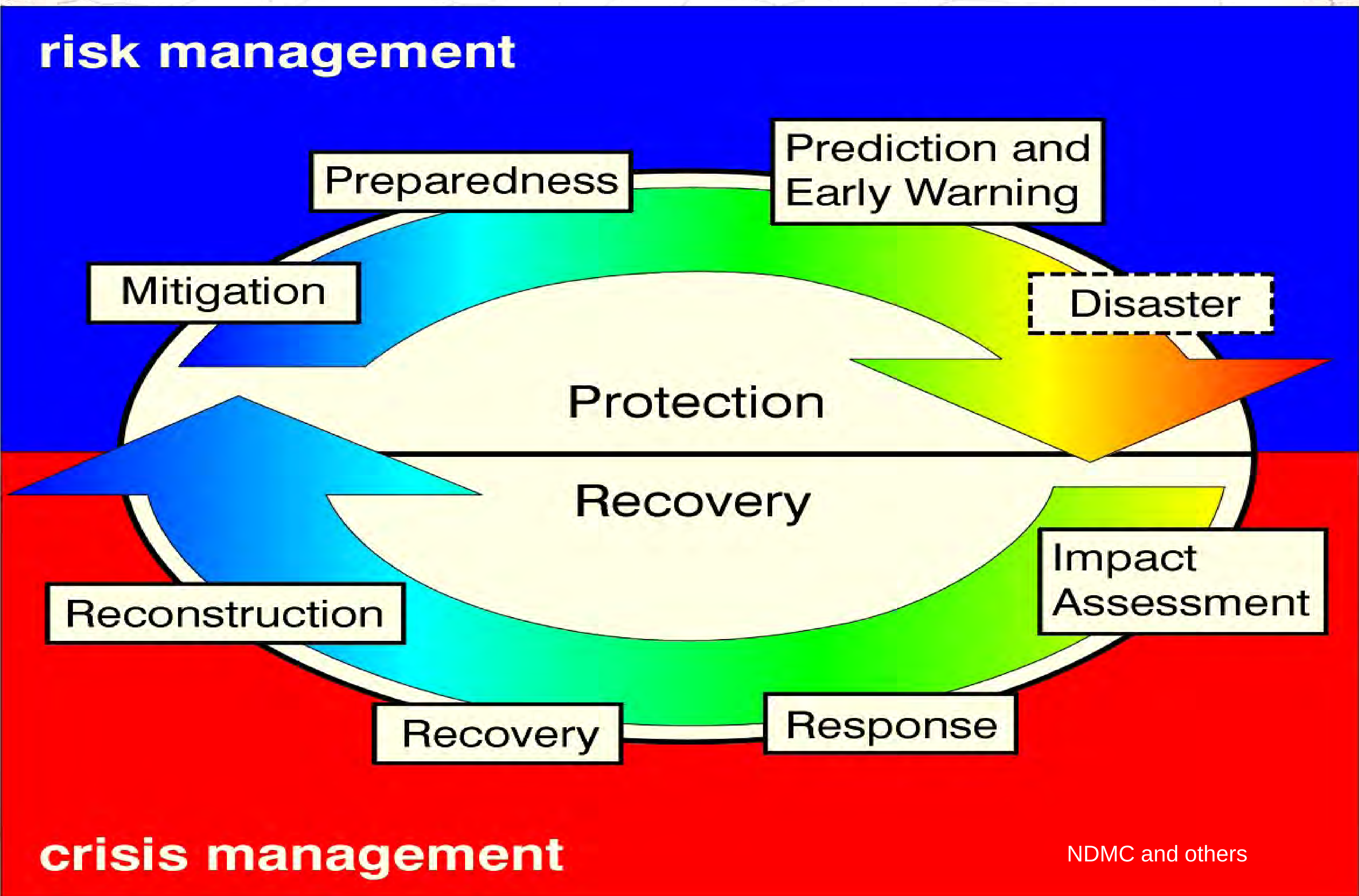


Drought is different and difficult

Drought differs from other natural hazards and is difficult to deal with

- *the absence of a precise and universally accepted definition-----difficult to be defined*
- *it is accumulate slowly----difficult to be monitored*
- *impacts are less obvious and spread over a larger geographical area------difficult to quantify the loss and to relief the disasters*

How We Should Handle Drought



NDMC and others

What is the most important for drought

- *Monitoring*

  to find out where is drought

- *Evaluating its impacts (or ,loss)*

  to investigate what is the drought result in, eg. agriculture, water resource

- *Assessing the risk*

  to identify where is potentially dangerous area, and where is most dangerous (risk)

Risk Mapping

Hazard, Vulnerability and Risk

- *Hazard, WDCC defined the hazard as a threatening event that would make supply inadequate to meet demand.*
- *Vulnerability, characteristics of populations, activities, or the environment that make them susceptible to the effects of drought.*
- *Risk, the potential adverse effects of drought as a product of both the frequency and severity of the hazard and corresponding vulnerability.*

Agricultural Drought Risk

Hazard describes the physical characteristics of drought , and can't be prevented. Reducing the vulnerability is the way to decrease drought risk.

Conceptual Model:

Risk= Hazards × Vulnerability

Based on the basic concept of natural hazard risk, the spatio-temporal pattern of agricultural drought risk in China was conducted on 10km*10km grid.

MODELING-Assessment for Hazard

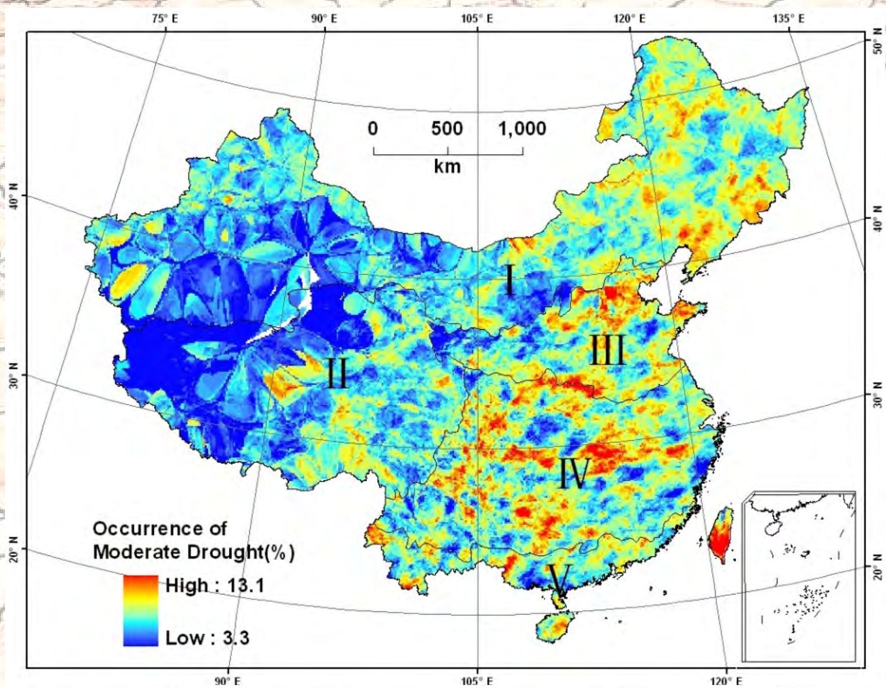
- *Droughts hazard analysis revolves around an understanding of the*
  - *Frequency*
  - *Intensity*
  - *Duration, and*
  - *spatial extent*

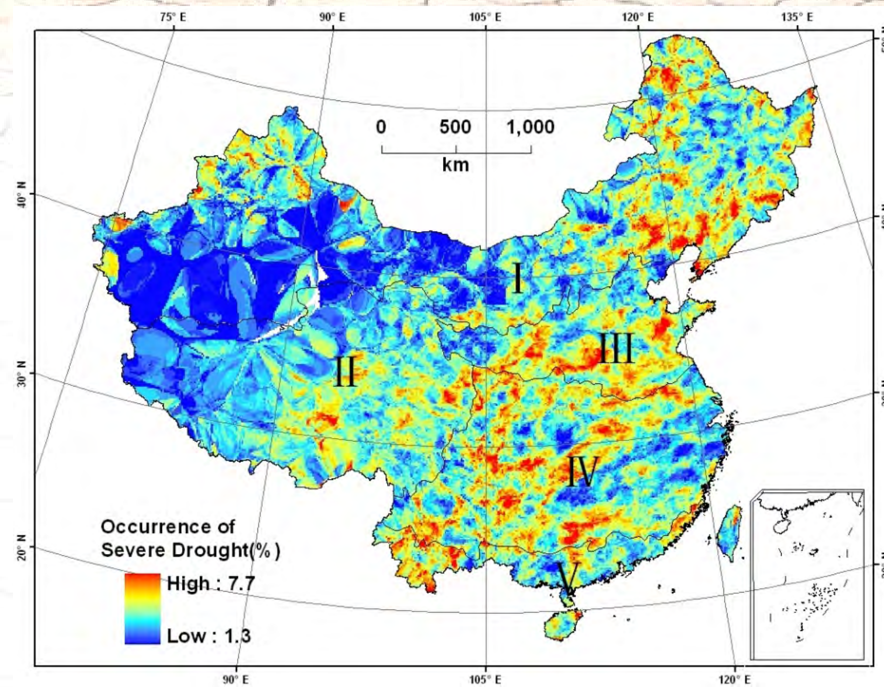
  of drought occurrences.
- *The Standardized Precipitation Index (SPI) at the three-month time scale is used to define the drought characteristics.*

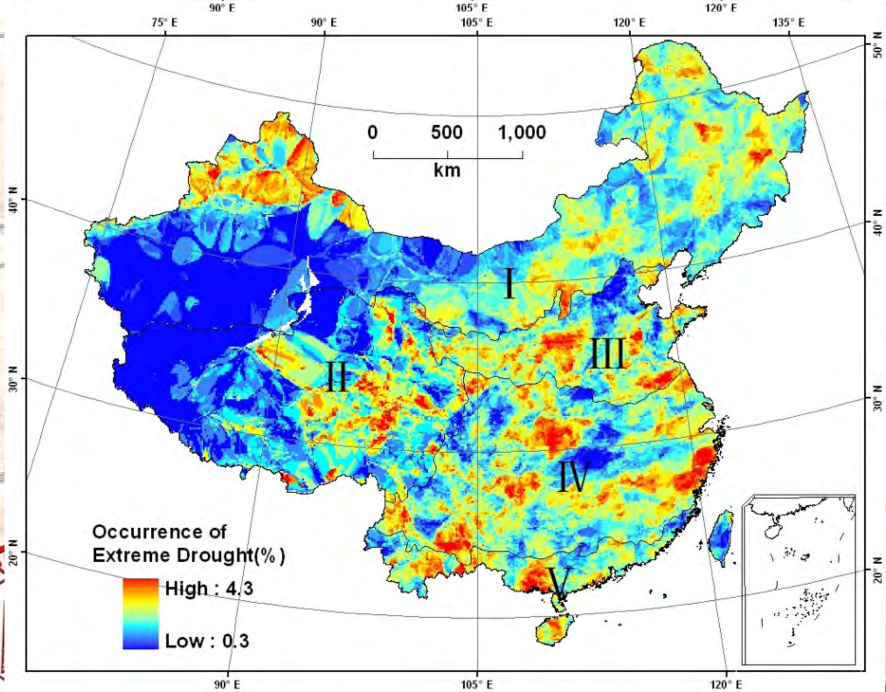
MODELING-Assessment for Hazard

$$DHI = (MD_r \times MD_w) + (SD_r \times SD_w) + (VD_r \times VD_w)$$

SPI	Drought severity	weight	Percentage of occurrence of	Rating
0～−0. 99	Mild drought	-	-	-
-1.0～−1. 49	Moderate drought	1	High	1
			Less high	2
			Moderate	3
			Low	4
-1.5～−1. 99	Severe drought	2	High	1
			Less high	2
			Moderate	3
			Low	4
⩽-2	Extreme drought	3	High	1
			Less high	2
			Moderate	3
			Low	4



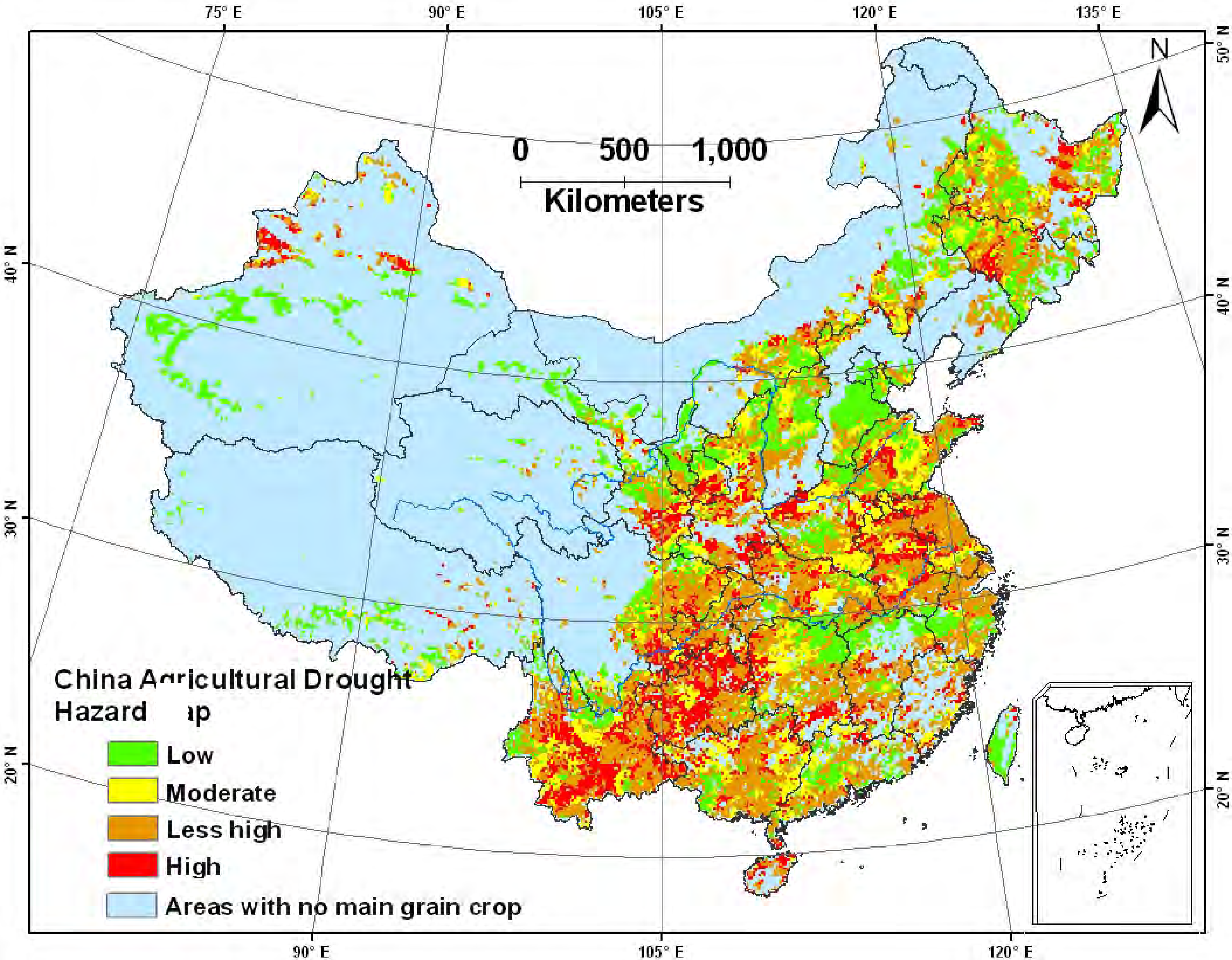




Spatial extent of
moderate,
severe and
extreme drought occurrences
at 3 months time step in China

Drought *Hazard*

B. He, J. Wu., 2011, Drought hazard assessment and spatial characters analysis in china, J. Chinese Geographical Sciences, 21(2):235-249



MODELING-Assessment for vulnerability

Drought vulnerability indicators

A holistic drought vulnerability index should take into account the ecological, socio-economic and planting conditions. Indicators could represent the vulnerability to agricultural drought are

- ✓ *climate, represented by seasonal crop water deficiency*
- ✓ *soil, represented by soil water holding capacity, and*
- ✓ *irrigation, represented by irrigation availability*

Model for agricultural drought vulnerability assessment

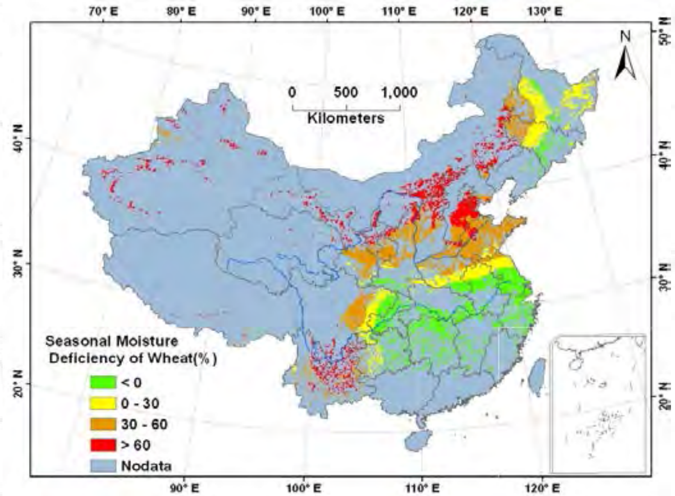
$$V = G(f(C), f(S), f(I))$$

Seasonal crop water deficiency

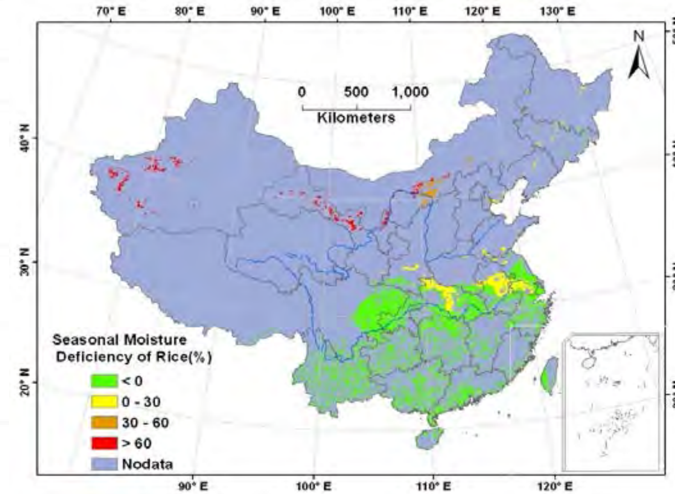
$$SCWD = \frac{ET - P}{ET}$$

$$ET = ET_0 \bullet Kc$$

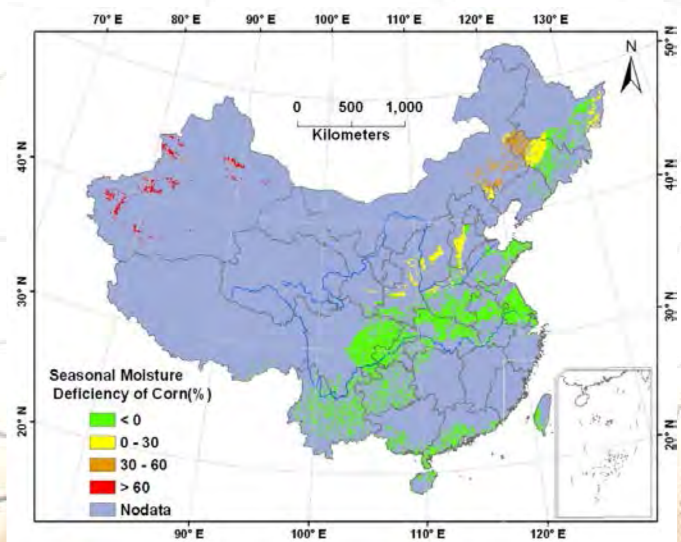
wheat



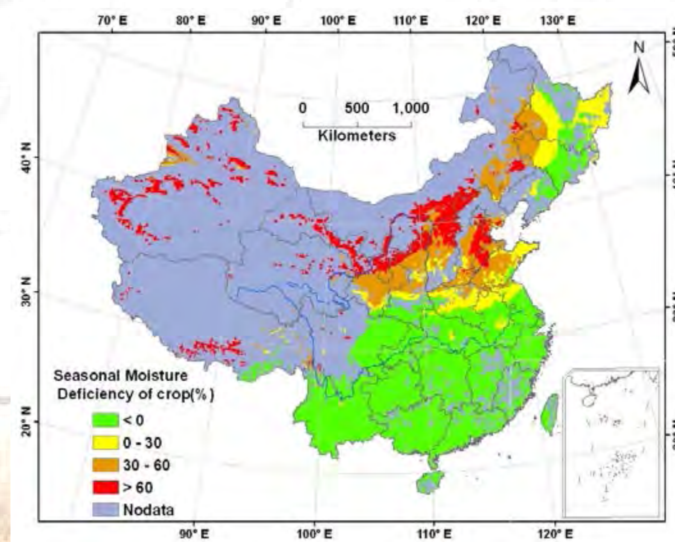
rice



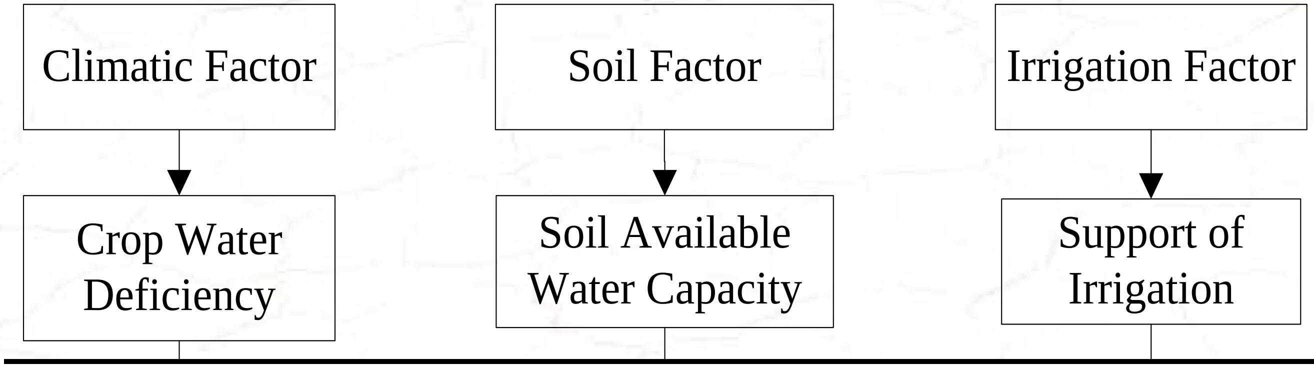
corn



crop

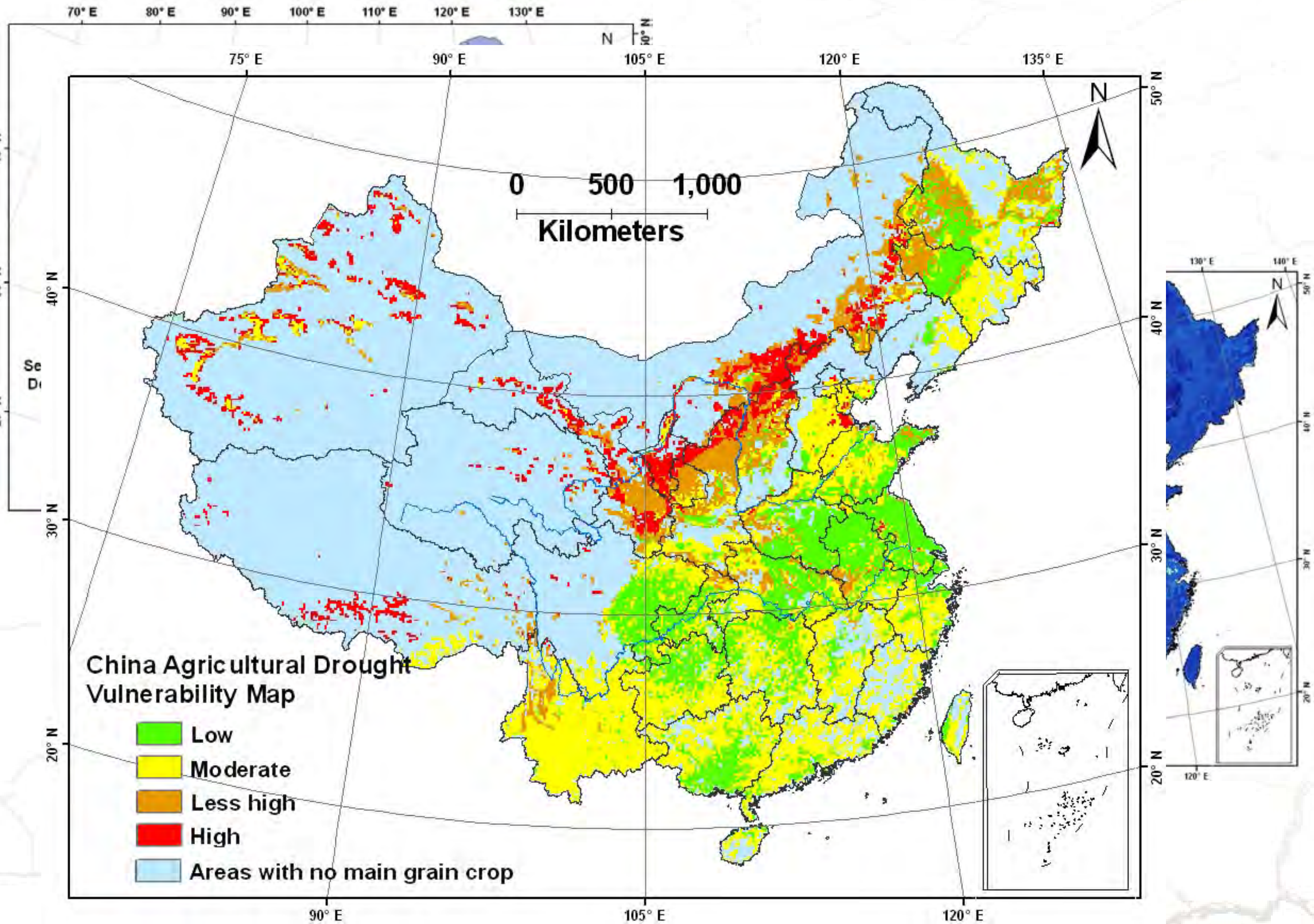


Vulnerability to Agricultural Drought



Agricultural drought vulnerability factor	Vulnerability class	weight
Soil AWC	< 100mm	4
	100–175mm	3
	175–250mm	2
	>250mm	1
Seasonal crop water deficiency	<0	2
	0-30%	3
	30-60%	4
	>60%	5
Irrigation support	Available irrigation	1
	No irrigation	4

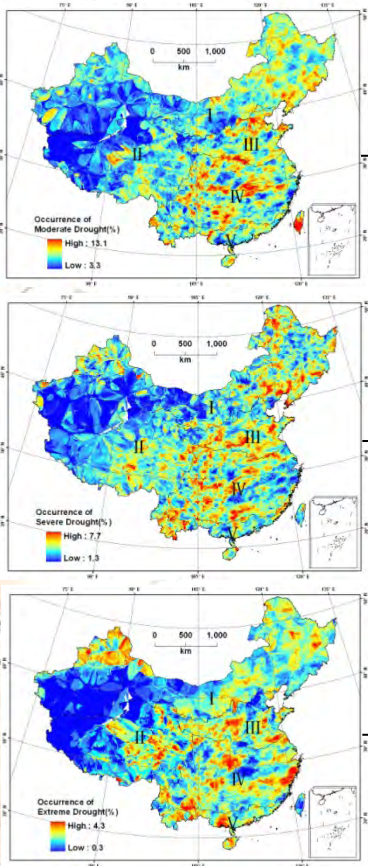
Vulnerability to Agricultural Drought



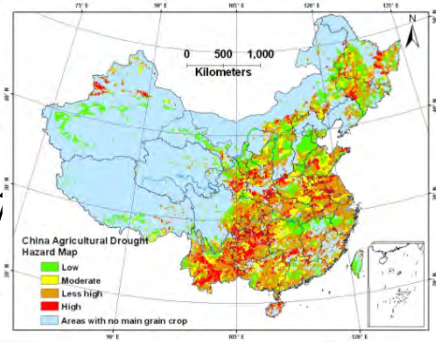
J. Wu, B. He., 2011, Quantitative assessment and spatial characteristics analysis of agricultural drought vulnerability in China, Nat. Hazards. 56: 785–801

Mapping for agricultural risk in China

Risk = Hazard × Vulnerability



Hazard



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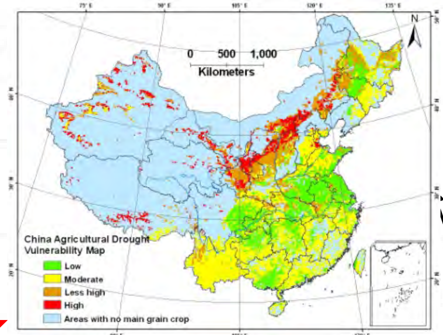
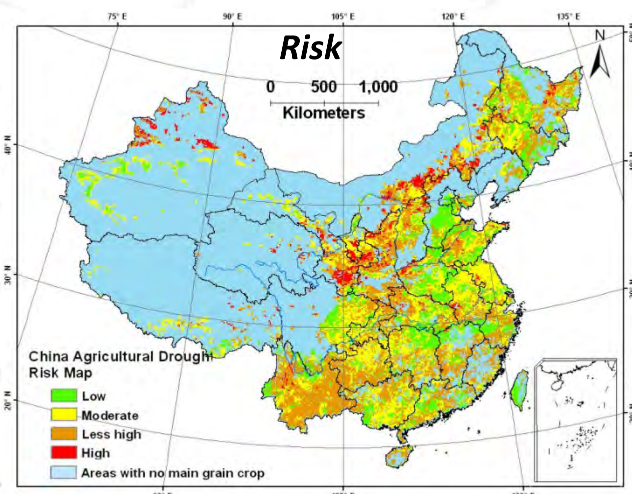
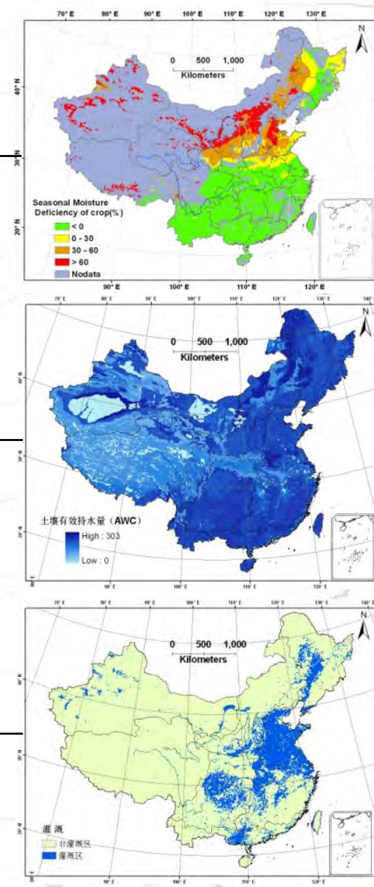
Vulnerability



Risk





B. He, J. Wu., 2011, Drought hazard assessment and spatial characters analysis in china, J. Geographical Sciences, 21(2):235-249

Quantitative assessment and spatial characteristics analysis of agricultural drought risk in China, Nat. Hazards (accepted)

J. Wu, B. He., 2011, Quantitative assessment and spatial characteristics analysis of agricultural drought vulnerability in China, Nat. Hazards. 56: 785–801

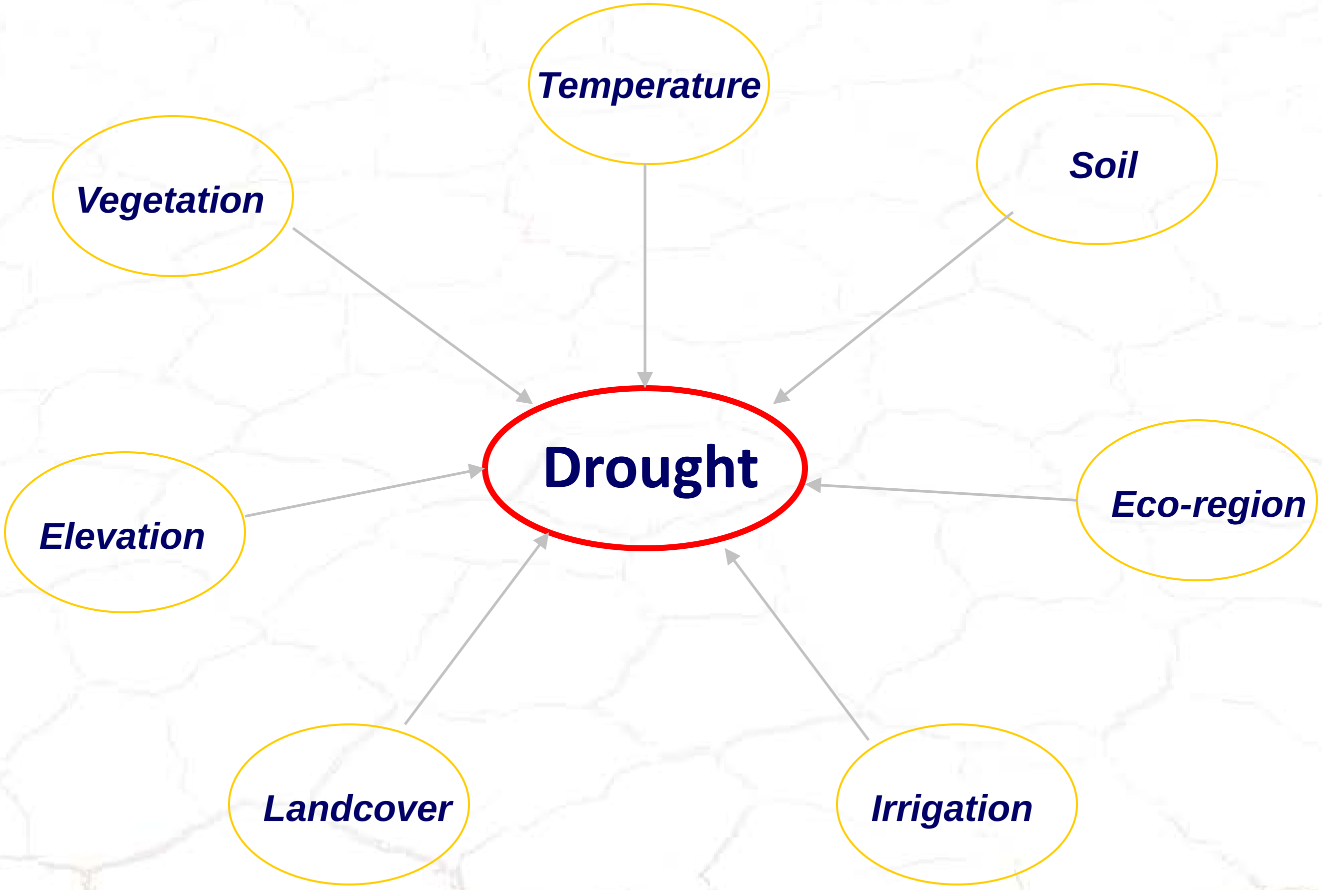
Summery-Risk Mapping

- *The research outcome generated map of drought risk to agricultural in China*
- *The risk assessment could provide essential information to help address the issue of drought risk and could also direct drought management strategies for mitigation purposes.*
- *Identifying regional vulnerabilities can lead to changing practices in water-dependent sectors and can help decision makers to incorporate droughts into resource planning for disaster mitigation.*
- *The outcome could be very helpful for the commercial insurance company, which is interested in the agricultural natural disasters insurance.*
- *The risk is relative in regional scale duo the weights measurements, which could be improved in the further analysis*

Monitoring Drought by Remote Sensing

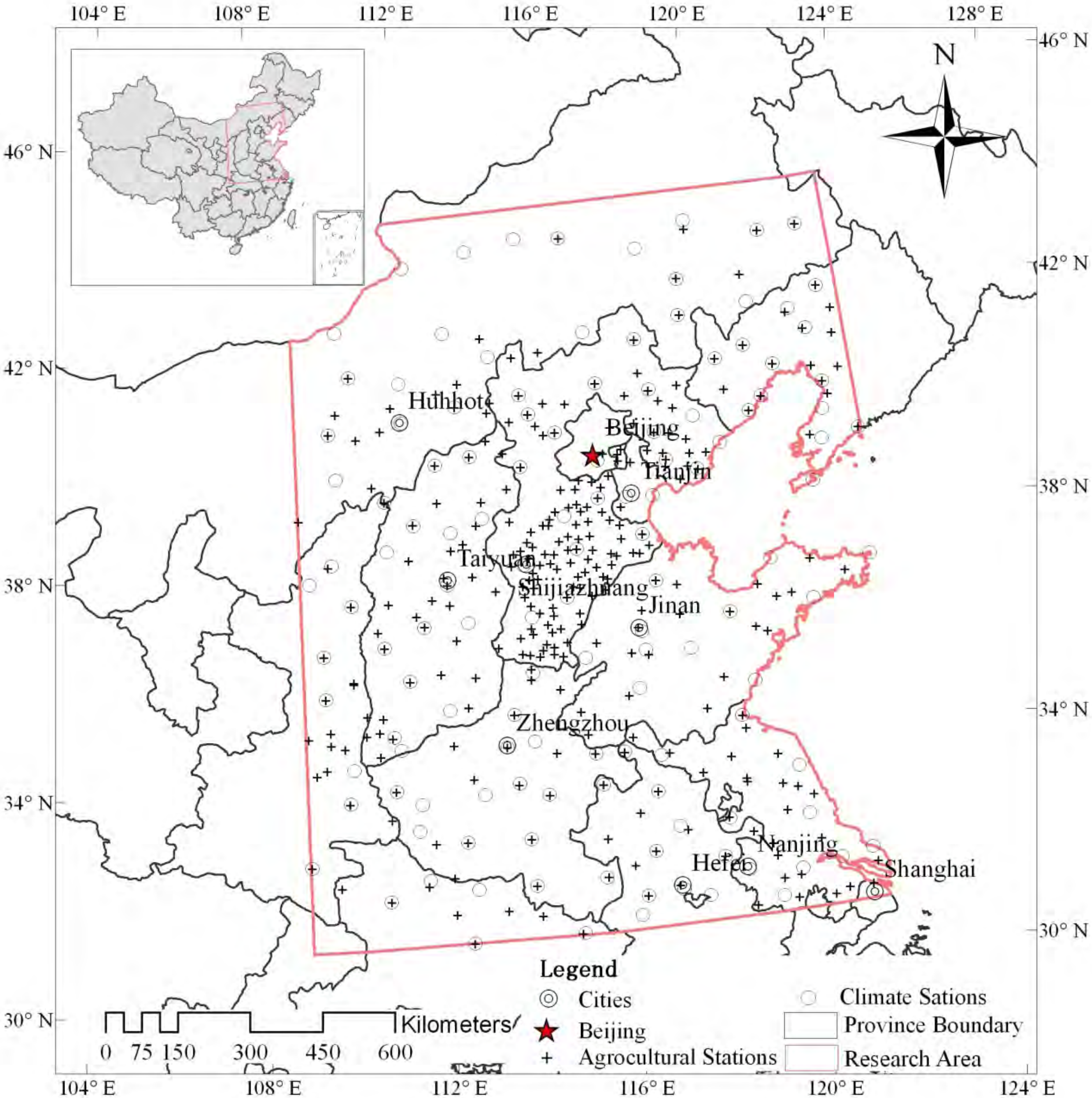
- *NDVI or NDVI anomolies*
- *VCI Vegetation Condition Index*
- *TCI Temperature Condition Index*
- *VSWI Vegetation Supply Water Index*
- *TVDI Temperature-Vegetation Dryness Index*
- *NDDI, NDWI, … …*

A New Method-Integrated Surface Drought Index (ISDI)

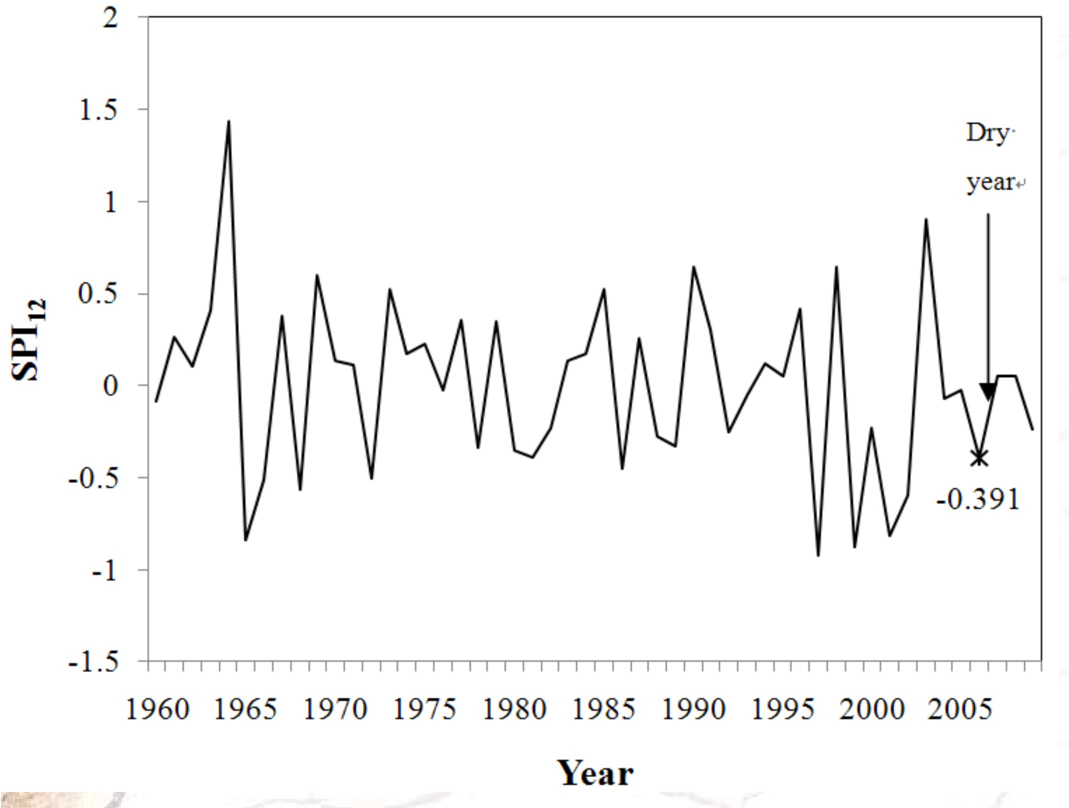


Motivity of improving the method

- Drought is a complex natural disaster but all traditional meteorological and remote sensed drought indices used to describe drought have their own weaknesses and shortcomings.
- The drought intensity differences caused by vegetation type, temperature, elevation, manmade irrigation, and other factors under the same water condition must be considered.
- Integrated drought index based on data mining provides a promising approach to better characterize the spatial extent and intensity of drought.
- ISDI can be established based on large numbers of variables because data mining can handle a variety of data types.


104° E
108° E
112° E
116° E
120° E
124° E
128° E
46° N
42° N
38° N
34° N
30° N
N
Huhhot
Beijing
Tianjin
Taiyuan
Shijiazhuang
Jinan
Zhengzhou
Nanjing
Hefei
Shanghai
Legend
Cities
Beijing
Agrocultural Stations
Climate Sations
Province Boundary
Research Area
0 75 150 300 450 600
Kilometers

Drought in 2006



- 2006 was selected as a typical partially dry year to compare the six MODIS images-derived and meteorological-measured drought indices.
- **Two comparative methods**
  - spatial drought detecting characteristics
  - Indices curve of 2006 was extracted using 9*9km window at the location of 11 agro-meteorological stations for the purpose of temporal trend comparison
- ***the precipitation of 2006 was also selected as the evaluation criteria.***

Drought investigated by field observation

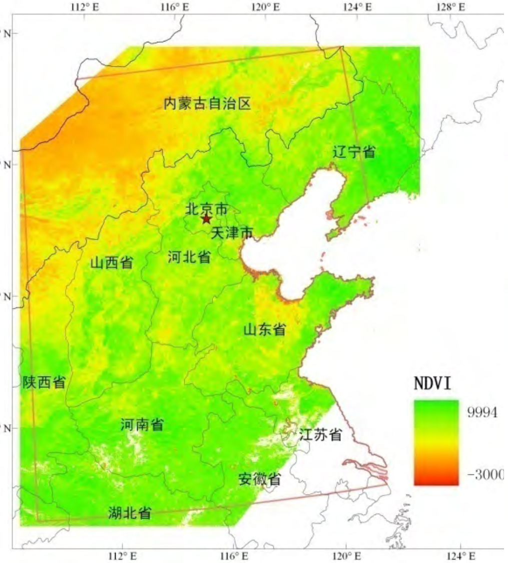
- The south of Shanxi province and North China plain region were affected by varying degrees of drought during April-June 2006.

Table 2 Field drought observations of Linfen, Taian and Xuchang during April-June 2006

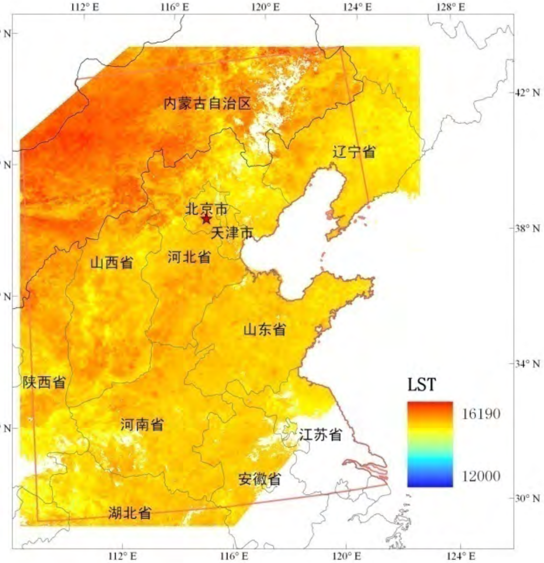
Station ID	Station Name	Year	Month	Disaster Type	Object	Intensity	Affected Area (Mu)	Percentage
53868	Linfen	2006	4	Drought	Winter Wheat	Mild	150000	30-39%
53868	Linfen	2006	5	Drought	Winter Wheat	Mild	200000	40-49%
53868	Linfen	2006	6	Drought	Winter Wheat	Mild	200000	40-49%
54827	Taian	2006	4	Drought	All Crops	Mild	150000	10-19%
54827	Taian	2006	5	Drought	All Crops	Mild	150000	10-19%
57089	Xuchang	2006	4	Drought	Winter Wheat	Mid	Unknown	Unknown
57089	Xuchang	2006	5	Drought	Winter Wheat	Mid	Unknown	Unknown

Field observation data are derived from China agro-meteorological disasters ten-day dataset of China Meteorological Data Sharing Service System.

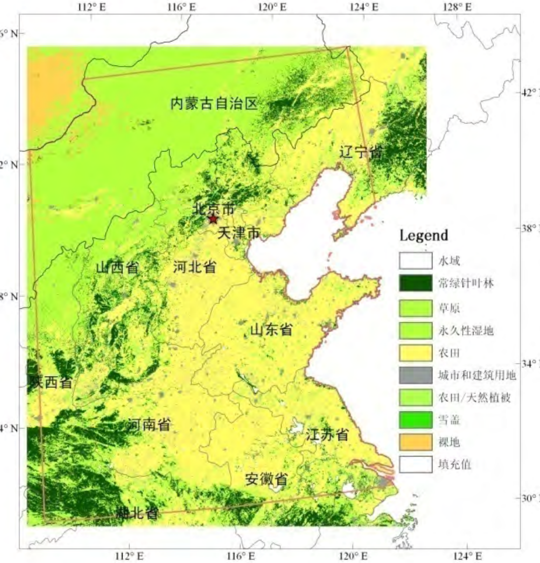
- Two typical periods (April 23th-May 8th and 9th May-24th may, 2006) of drought monitoring results were selected to compare the spatial monitoring characteristic of drought indices.



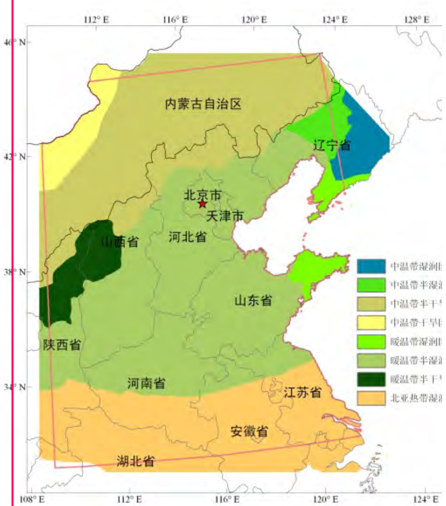
Vegetation Index



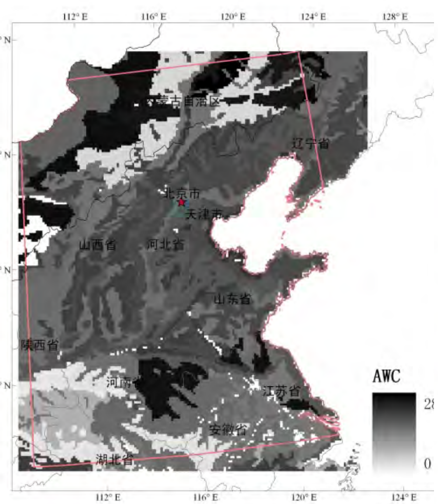
LST



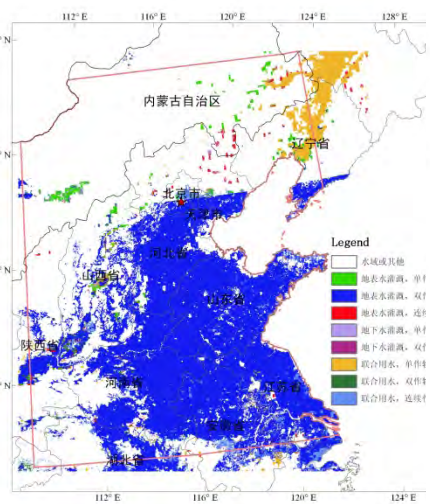
Land cover



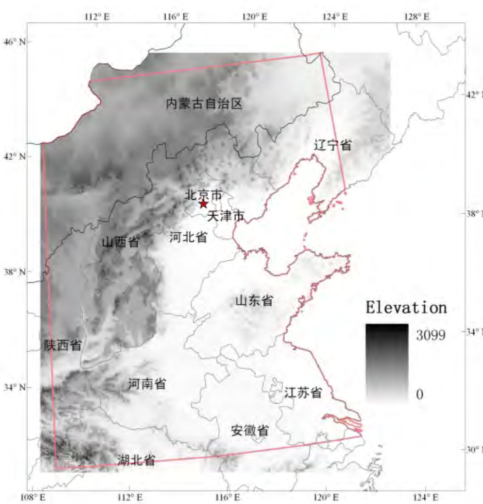
Eco-region



AWC



Irrigation



DEM

Data related in Drought

Name	Type	Acronym	Source
Palmer Drought Severity Index	Climate	PDSI	China Meteorological Data Sharing Service System
Standardized Precipitation Index	Climate	SPI	China Meteorological Data Sharing Service System
Normalized Difference Vegetation Index	Satellite	NDVI	Land Processes Distributed Active Archive Center (LP DAAC) LP DAAC
Land Surface Temperature	Satellite	LST	LP DAAC
Vegetation Condition Index	Satellite	VCI	LP DAAC
Temperature Condition Index	Satellite	TCI	LP DAAC
Vegetation Supply Water Index	Satellite	VSWI	LP DAAC
Start of Season Anomaly	Satellite	SOSA	LP DAAC
Percent of Average Seasonal Greenness	Satellite	PASG	LP DAAC
Elevation	Biophysical	Ele	Environmental & Ecological Science Data Center for West China, National Natural Science Foundation of China
Ecological Regions	Biophysical	EcoRe	China's Eco_Geographical Region Map
Land Cover	Biophysical	NLCD	NASA Goddard Space Flight Center (MODIS Land Products)
Soil Available Water Capacity	Biophysical	AWC	International Geosphere-Biosphere Programme, IGBP
Irrigated Agriculture Region	Biophysical	IrrAg	Global Map of Irrigated Area (GIAM)

- **MODIS data indices**
  - NDVI
  - LST
  - VCI
  - TCI
  - PASG
  - SOSA
  - VSWI
- **Meteorological indices**
  - PPA
  - SPI
  - PDSI

Biophysical Data

- **16 day PPA, SPI data in a tabular form were spatially interpolated into a raster image format by using spline method of ArcMap.**

Spatial monitoring characteristic of drought indices

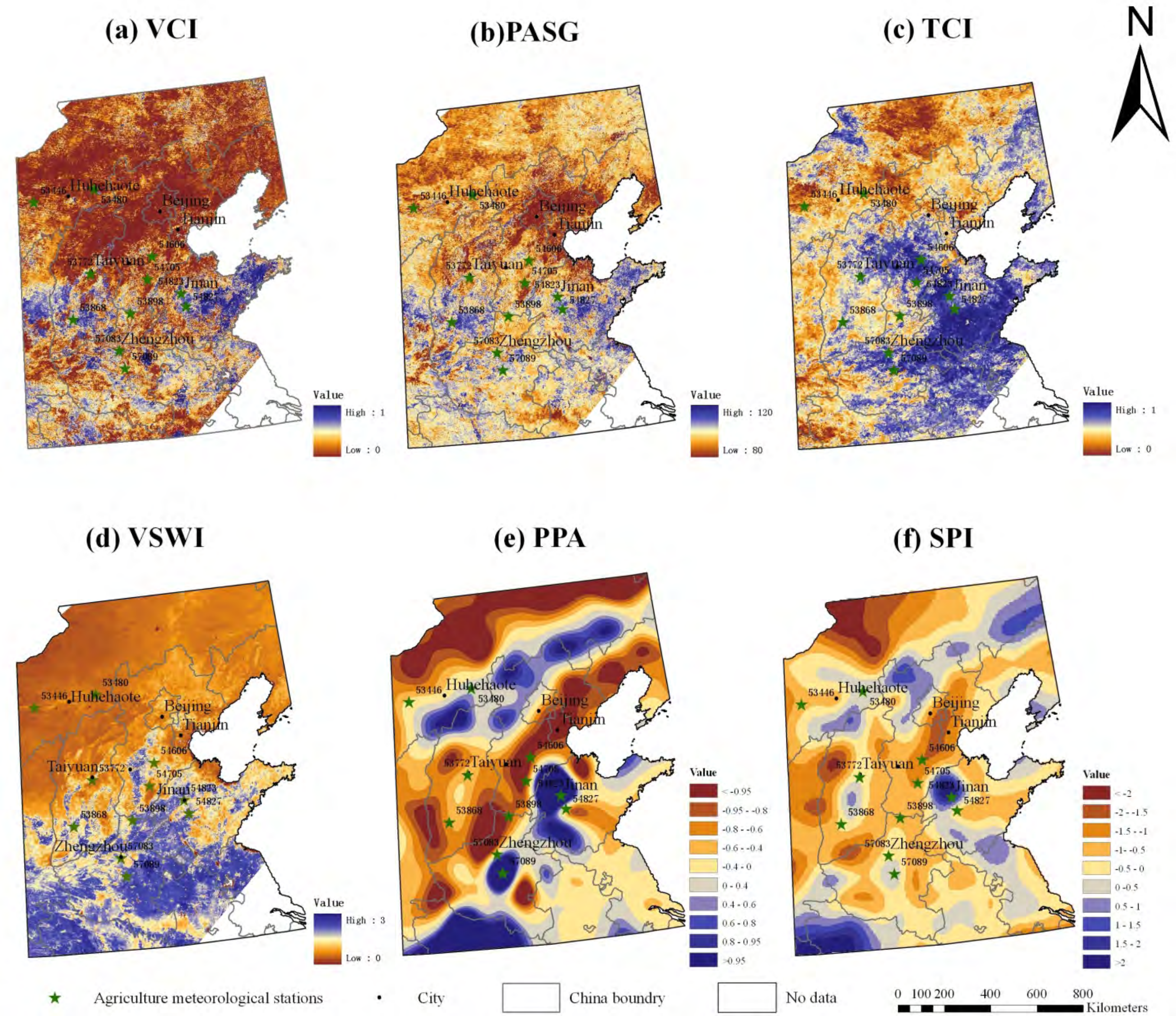


Fig.5 Comparison of MODIS- and meteorological-derived drought indices in the study area for the 113th day in 2006 (April 23-May 8)

Spatial monitoring characteristic of drought indices

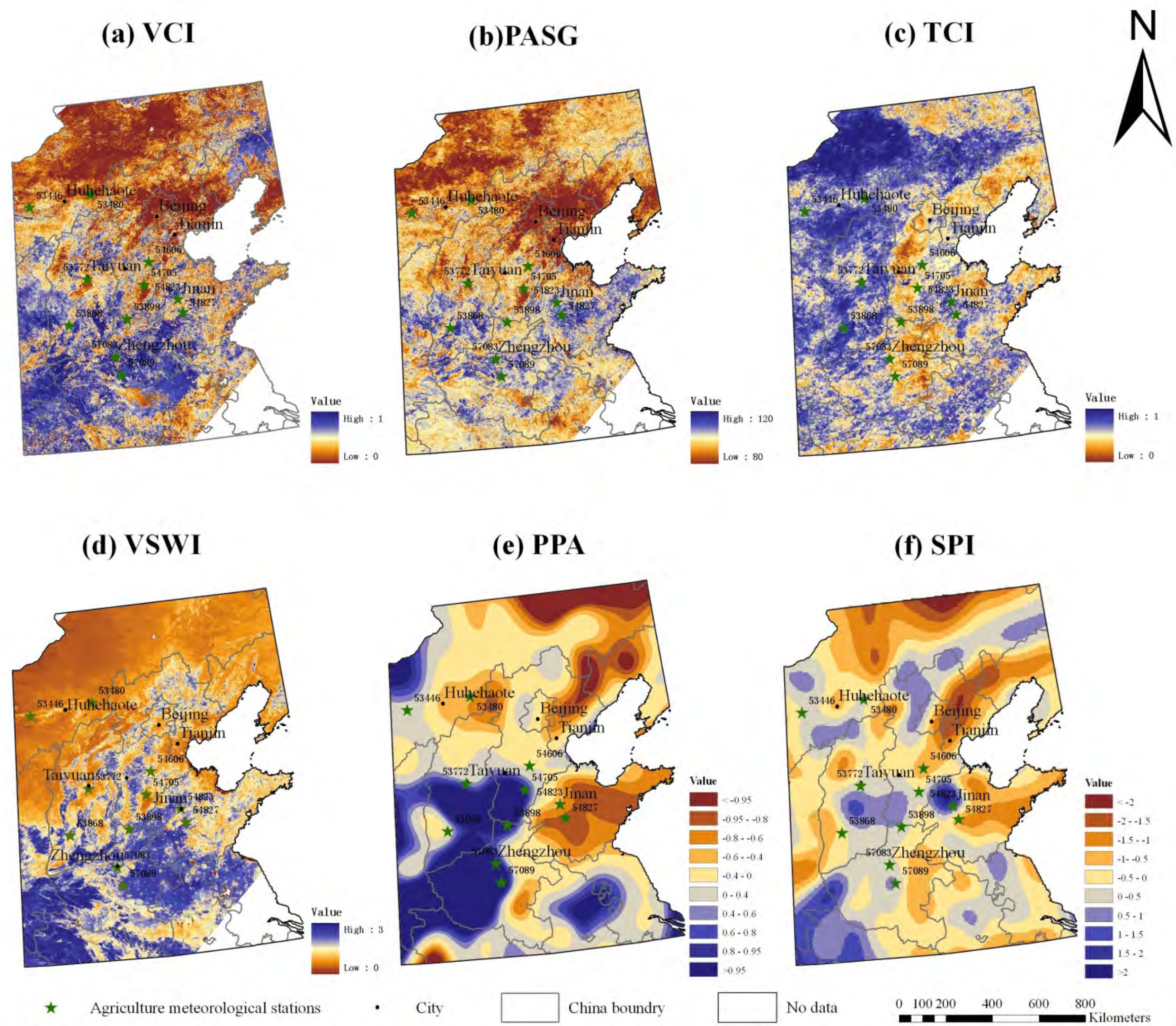


Fig.5 Comparison of MODIS- and meteorological-derived drought indices in the study area for the 129th day in 2006 (May 9th-24th)

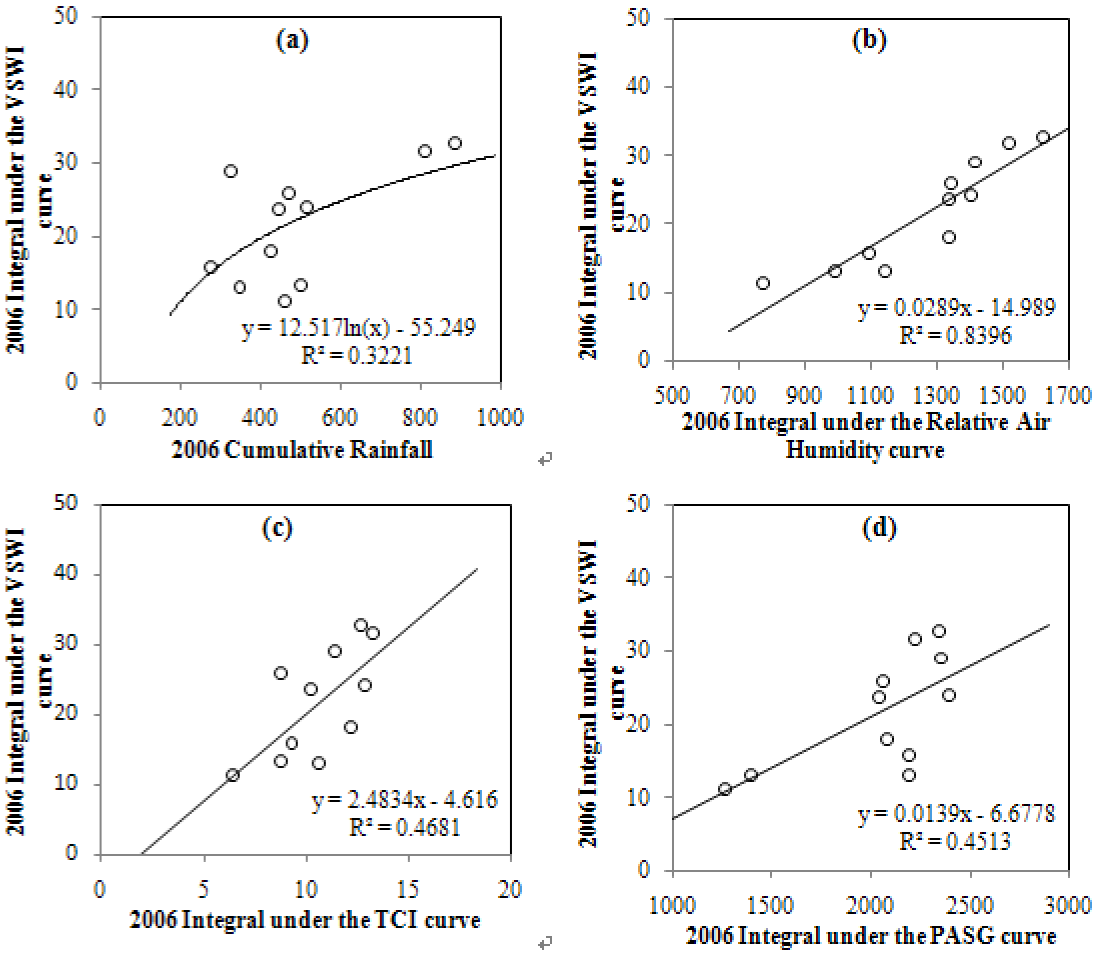
correlation and regression analysis among the drought indices

Correlation matrix among the integrals under the curves of MODIS- and meteorological-derived drought indices as well as integral of relative air humidity curve and cumulative rainfall at the location of 11 agro-meteorological stations for 2006

Drought indices	Precipitation	Relative air humidity	VSWI	VCI	TCI	PASG	PPA	SPI
2006 (a dry year)								
Precipitation	1							
Relative air humidity	**0.545***	1						
VSWI	**0.620****	**0.916*****	1					
VCI	-0.289	0.486	0.295	1				
TCI	0.474	**0.866*****	**0.684****	0.520	1			
PASG	0.132	**0.829*****	**0.672****	**0.825*****	**0.800*****	1		
PPA	**0.507**	0.081	0.024	-0.540*	0.007	-0.187	1	
SPI	0.255	-0.229	-0.372	-0.347	-0.133	-0.308	**0.781*****	1

Higher correlations are marked in bold. *** represent the significant values at the p<0.01.** represent the significant values at the p<0.05. * represent the significant values at the p<0.1.

Cross plots of the integral under the indices for typical sites during 2006

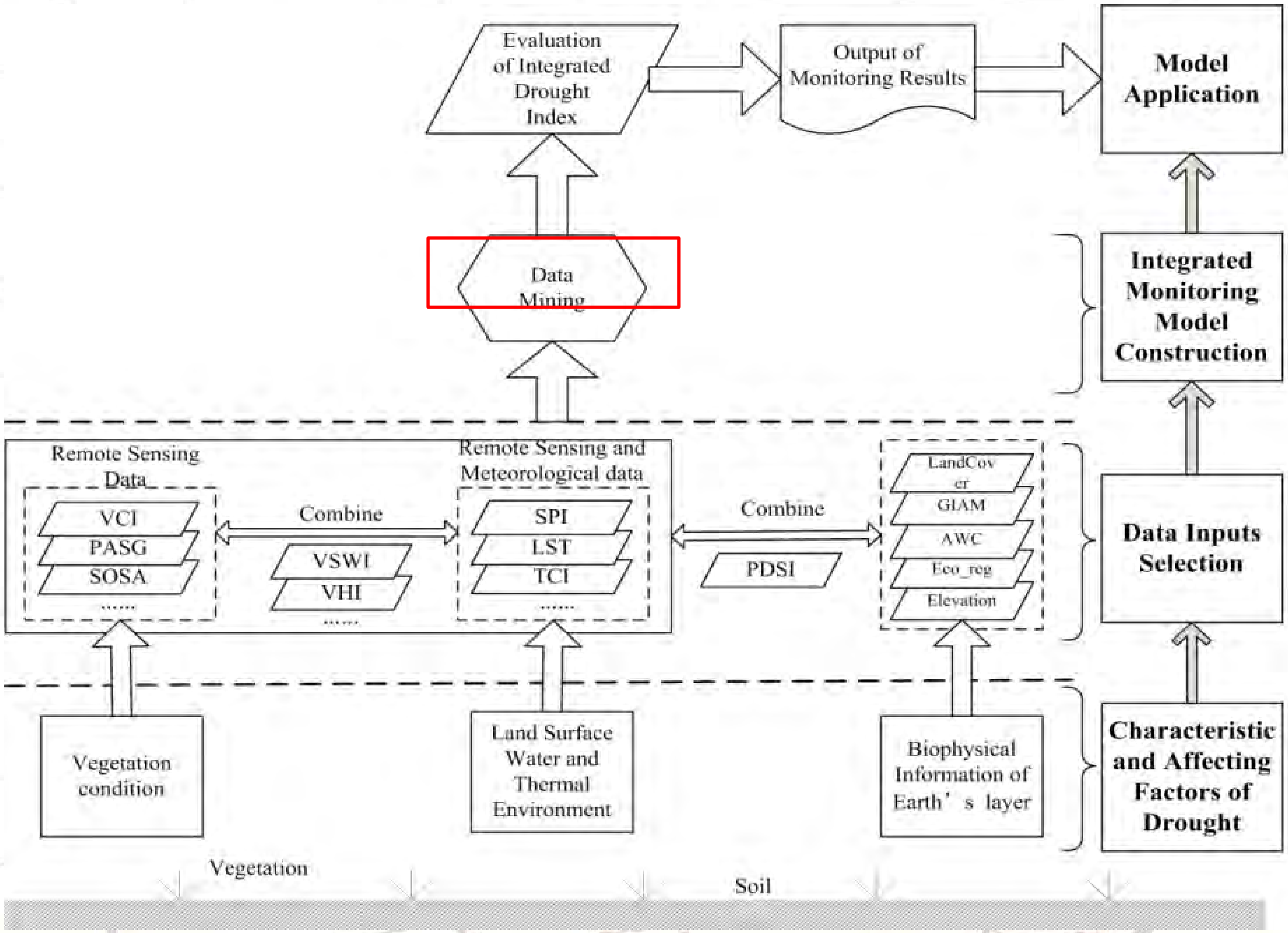


- **VSWI curve has remarkable correlations with the cumulative precipitation. Land surface temperature (LST) contributes more to the result of hybrid index (VSWI) than reflective information such as NDVI.**

Figure
and th

•**L. Zhou, J. Wu., Comparison of Remote Sensed and Meteorological Data Derived Drought Indices in Mid-Eastern China， International Journal of Remote Sensing . 2012, 33(6): 1755-1779.**

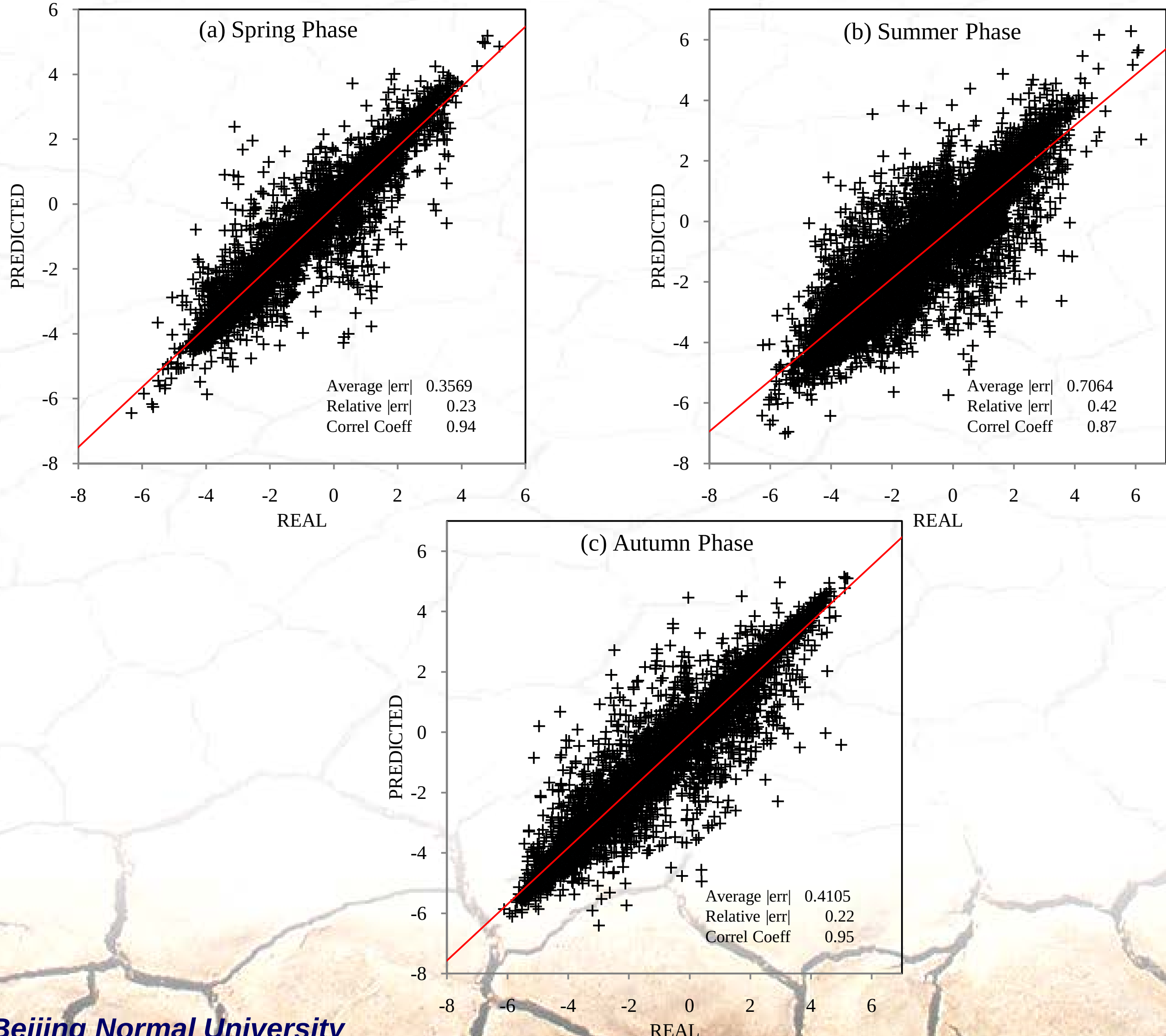
Integrated Surface Drought Index for drought monitoring



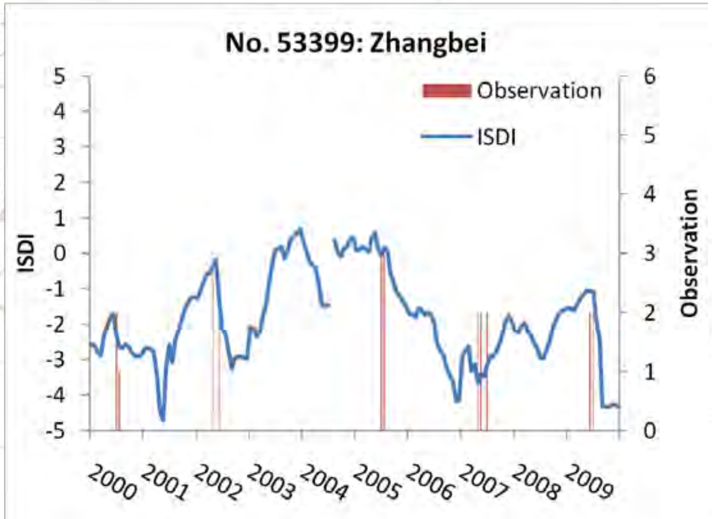
Model construction results and intersect validation

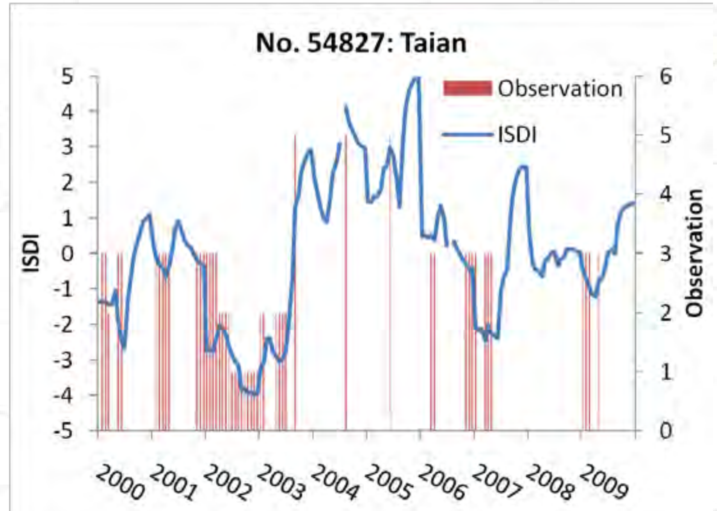
7	**VSWI、SOSA、SPI、elevation、Landcover、AWC、GIAM、Eco_region，PDSI**	**8**	**Spring**	**0.3569**	**0.23**	**0.94**
			Summer	**0.7064**	**0.42**	**0.87**
			Autumn	**0.4105**	**0.22**	**0.95**
8	TCI、SOSA、SPI、elevation、Landcover、AWC、GIAM、Eco_region，PDSI	8	Spring	0.5522	0.36	0.90
			Summer	0.7922	0.46	0.86
			Autumn	0.4625	0.24	0.94
9	LST、SOSA、SPI、elevation、Landcover、AWC、GIAM、Eco_region，PDSI	8	Spring	0.4467	0.29	0.92
			Summer	0.7257	0.43	0.87
			Autumn	0.4078	0.21	0.95
10	NDVI、SOSA、SPI、elevation、Landcover、AWC、GIAM、Eco_region，PDSI	8	Spring	0.3619	0.24	0.94
			Summer	0.6376	0.37	0.89
			Autumn	0.4291	0.22	0.94
11	PASG、TCI、SOSA、SPI、elevation、Landcover、AWC、GIAM、Eco_region，PDSI	9	Spring	0.5399	0.35	0.89
			Summer	0.7398	0.43	0.87
			Autumn	0.4524	0.24	0.94
12	VCI、TCI、SOSA、SPI、elevation、Landcover、AWC、GIAM、Eco_region，PDSI	9	Spring	0.6209	0.41	0.88
			Summer	0.7976	0.47	0.86
			Autumn	0.5579	0.29	0.92

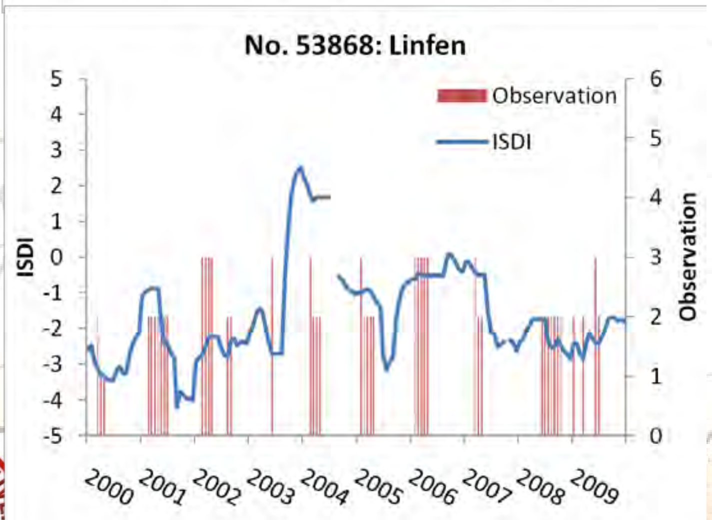
The construction results of plan 7 which was used to build the ISDI

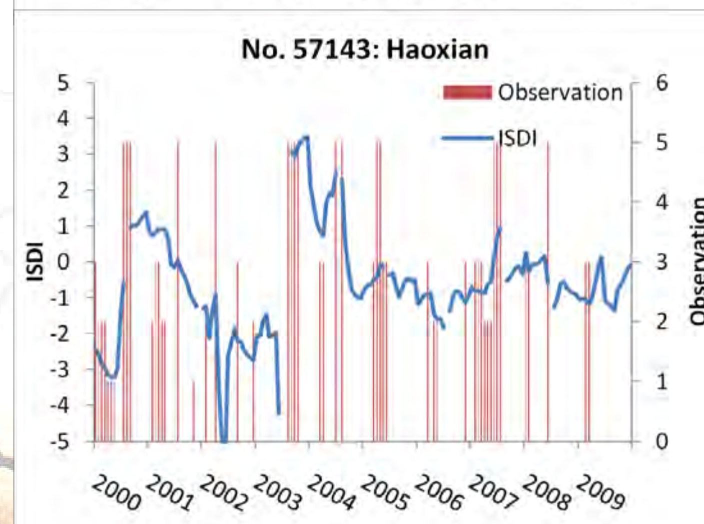


Relationship between the years of ISDI monitoring of the drought intensity and the result of the site observations

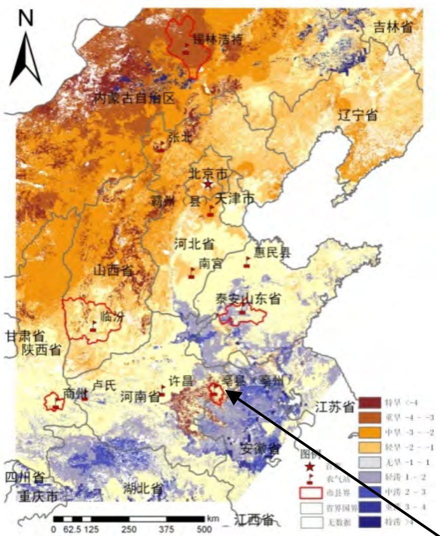




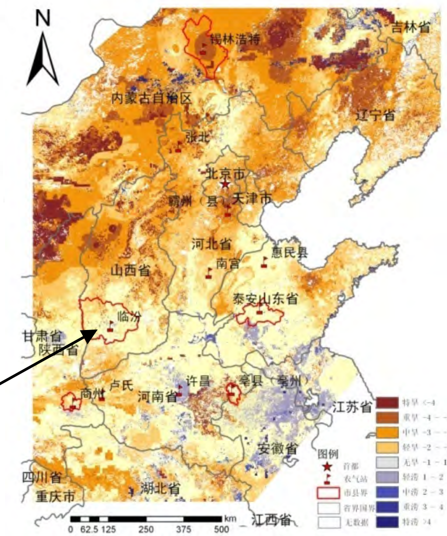




Regional scale validation on ISDI model for drought monitoring



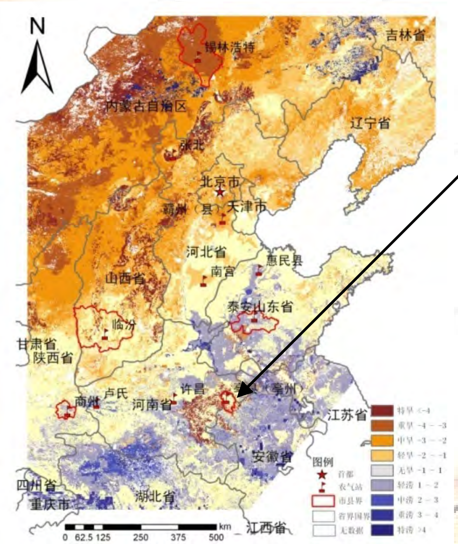
May 25



Aug. 29

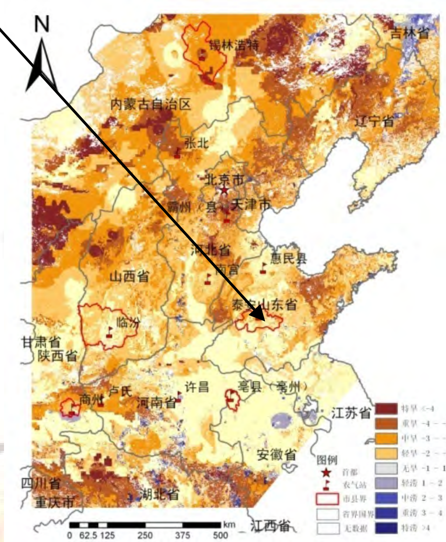
Table 4 Field observations of selected 6 agro-meteorological stations in study area for 2006

Site name	Longitude (° E)	Latitude (° N)	Drought occurrecce time (2006)
Linfen	111.5	36.06	April
Linfen	111.5	36.06	May to early June
Xilinhot	116.12	43.95	Early May to early September
Taian	117.15	36.16	Late April to early May
Taian	117.15	36.16	Late October to early November
Taian	117.15	36.16	Mid-November to late November
Taian	117.15	36.16	December
Xuchang	113.85	34.01	Mid-April to early May
Shangzhou	109.96	33.86	In mid-June
Haoxian	115.77	33.87	Late April to mid-June



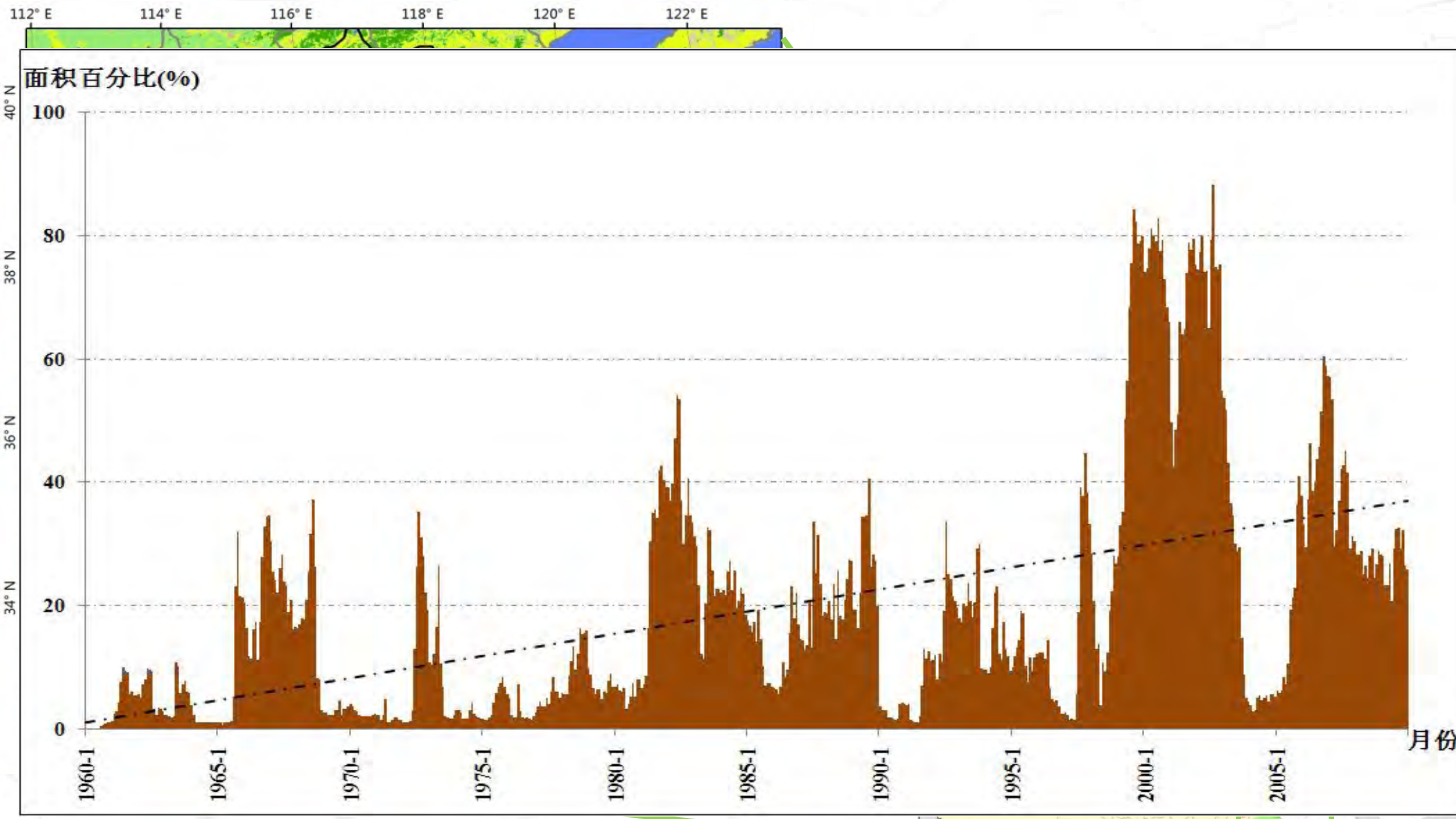
June 10

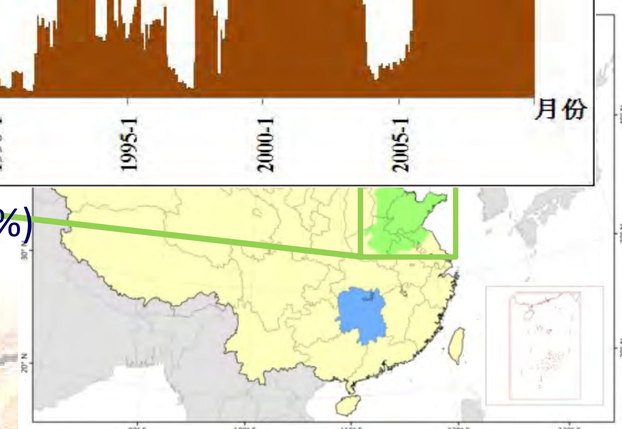
- **J. Wu, L. Zhou., Generating an Integrated Surface Drought Index (ISDI) for drought monitoring in Mid-Eastern China, Agricultural and Forest Meteorology(under review)**



Nov. 1

Evaluating the impact on agriculture from drought



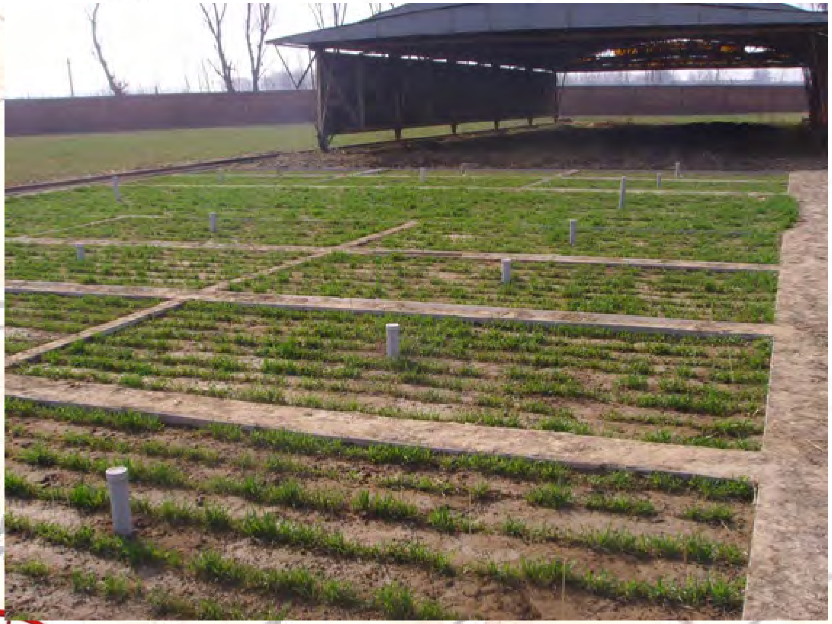


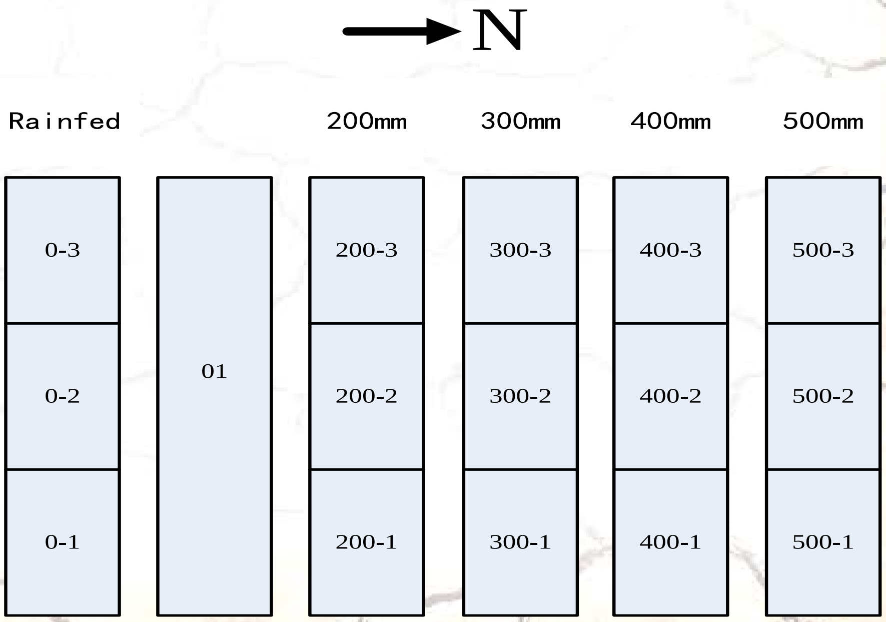
Drought-affected Area (%)

Huanghuaihai Plain is of more importance for Chinese agriculture

(1)Experiments

- Location: Gucheng, Hebei
- Crop: winter wheat
- Objective of the experiment:
  - To obtain crop growth parameters under different water conditions





Data of Experiments

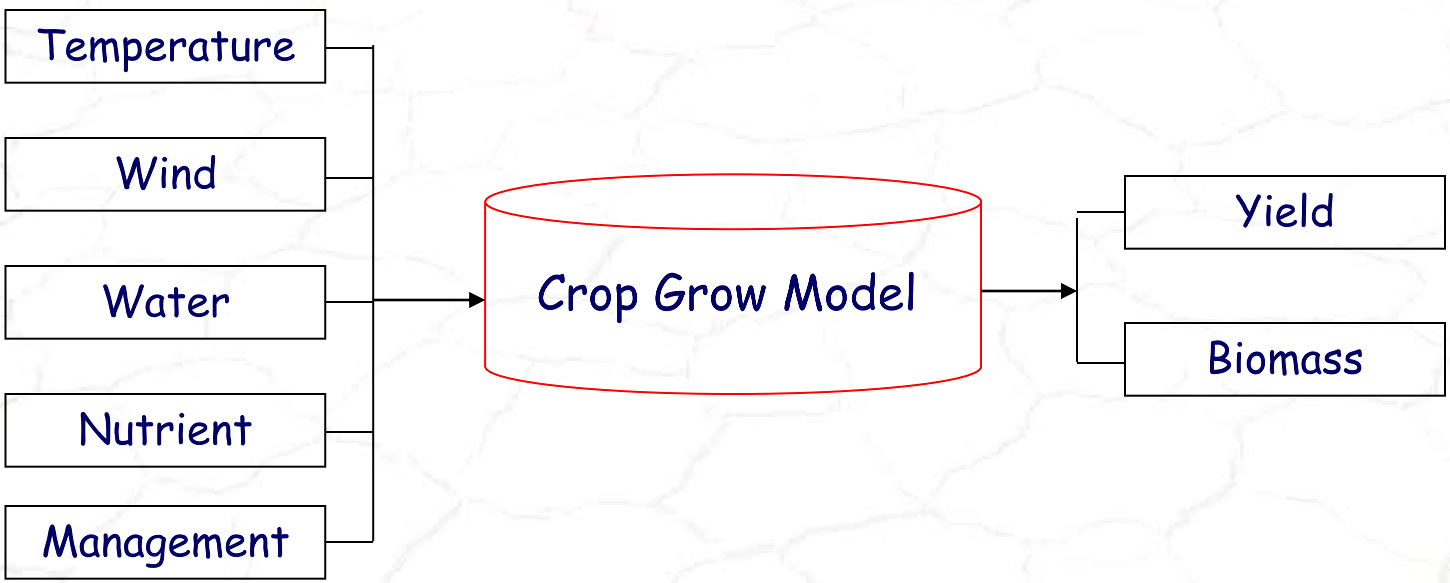
NO.	Parameters	method	Observation times	Samples
1	Canopy water content	Dry Weight	4	300
2	Leaf water content	Dry Weight	4	300
3	Soil moisture	Dry Weight	4	60
4	Canopy spectrum	ASD	4	600
5	Leaf spectrum	ASD	4	300
6	Biomass		4	60
7	LAI	LI-2000	1	15
8	Chlorophyll content	SPAD-502	1	15
9	Crop Yield		1	15

Evaluation of Crop yield decrease based on Crop Growth Model

- *Crop growth model integrates the major processes that occur in the soil-crop-atmosphere-management system*
- *Simulate weather, hydrology, soil erosion by wind and water, nutrient cycling, tillage, crop management and growth, and field-scale costs and return*
- *Well suitable for modeling agricultural drought*

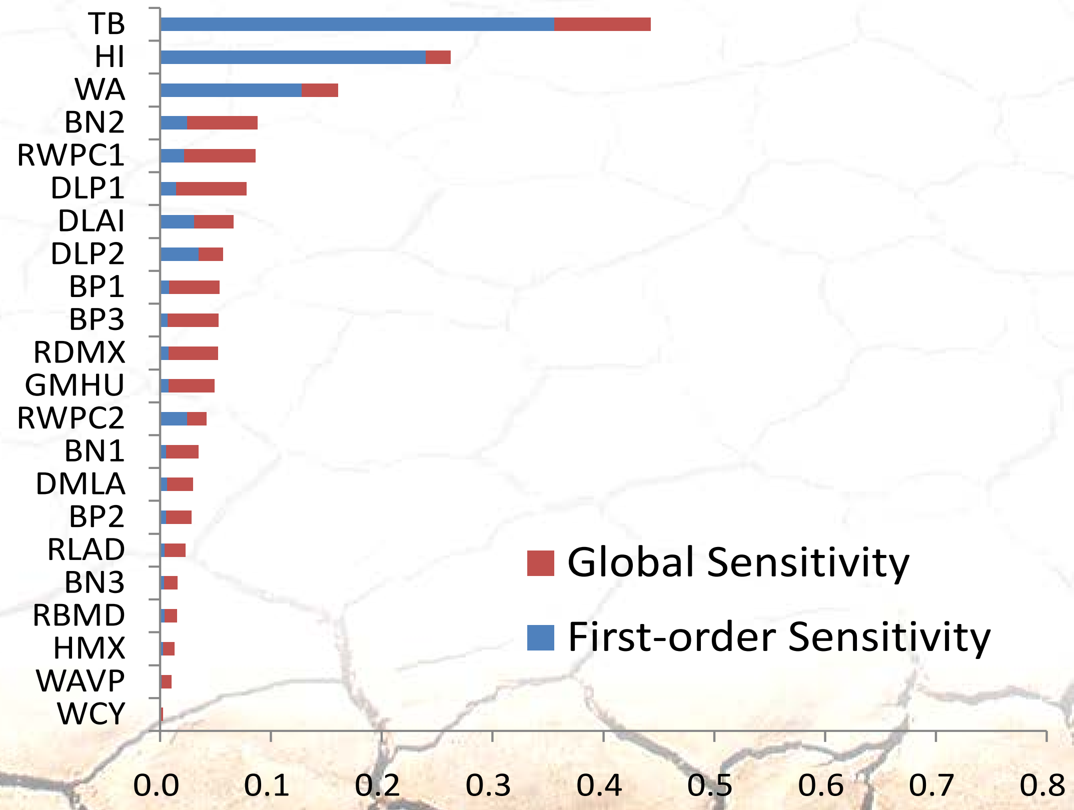
Crop Growth Model

- *Flow Chart of Modeling*



Sensitivity analysis for model

Through calibrating the parameters which are sensitive to the model output can reduce the workload in estimating parameters.

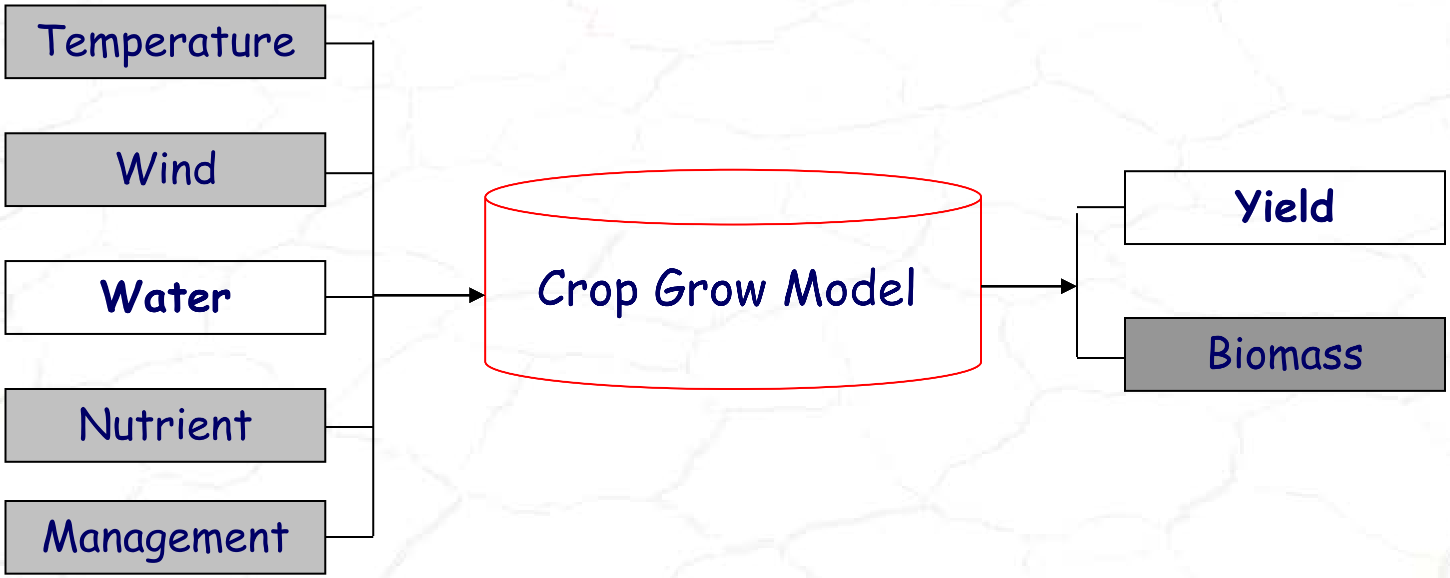


model calibration

PARAMETER	DESCRIPTION	VALUE
WA	Potential radiation use efficiency	34.8
HI	Normal harvest index	0.45
DLAI	Point in the growing season when leaf area begins to decline due to leaf senescence	0.45
DLP1	Crop parameter control leaf area growth of the crop under non-stress control	15.1
DLP2	Crop parameter control leaf area growth of the crop under non-stress control	48.0
DMLA	Maximum potential LAI	6.5
RLAD	Point in the growing season when leaf area begins to decline due to leaf senescence	1.0

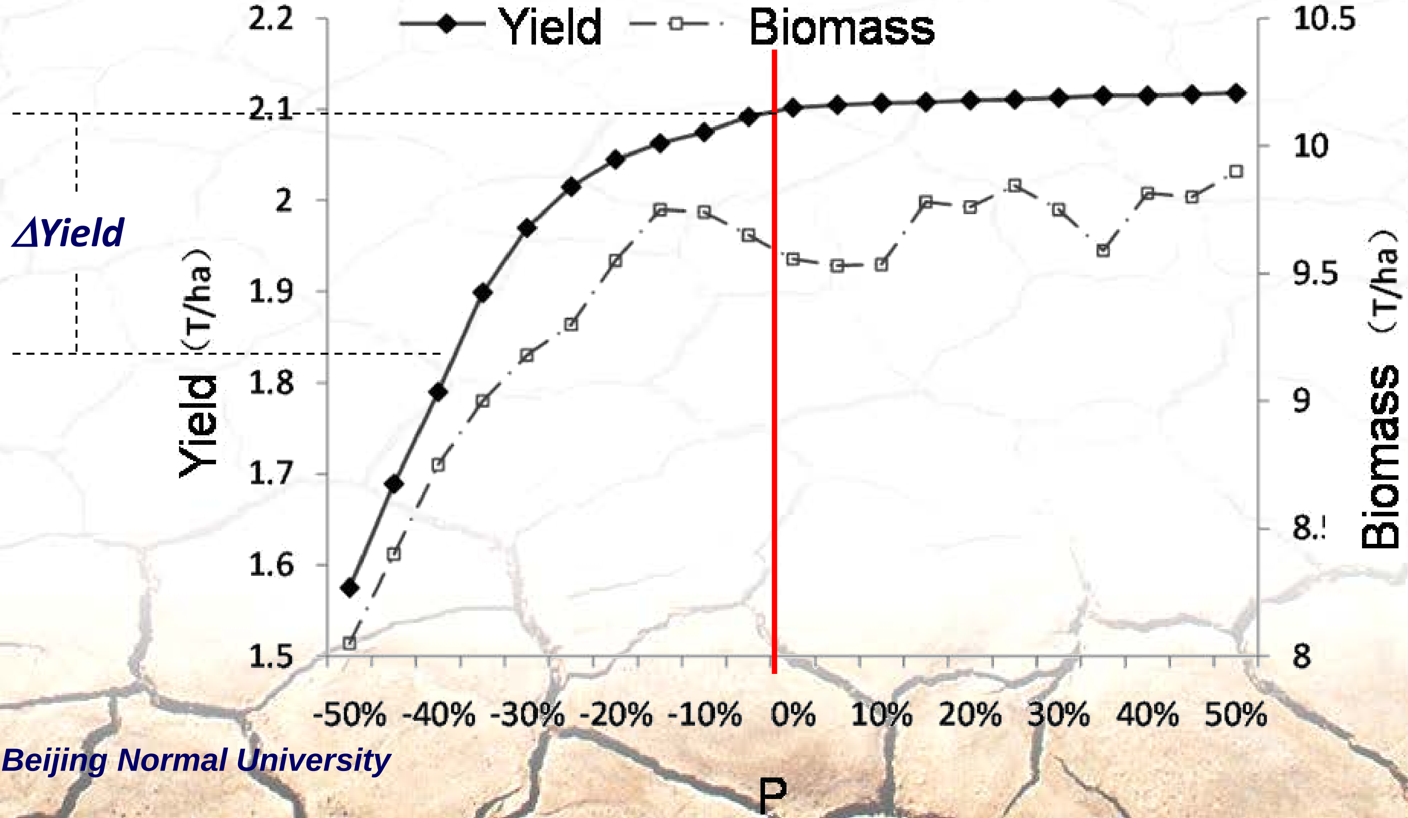
Crop Growth Model-Real-time Risk Model

- Well suit for modeling agricultural drought



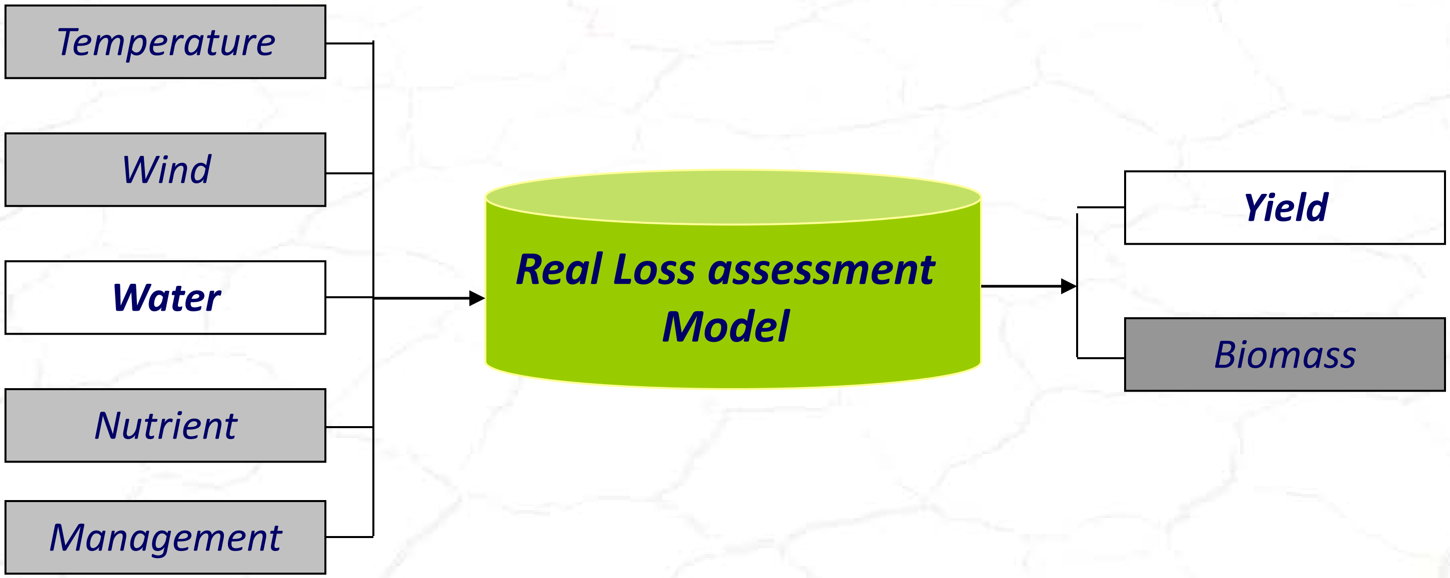
Yield Reduction due to drought

- *assess the reduction of crop yield caused by drought*
- $Y_{Reduction} = \Delta Yield = Y_n - Y_d$
  - *Y_n is the yield under normal condition in growth season*
  - *Y_d is the yield suffered from drought events*

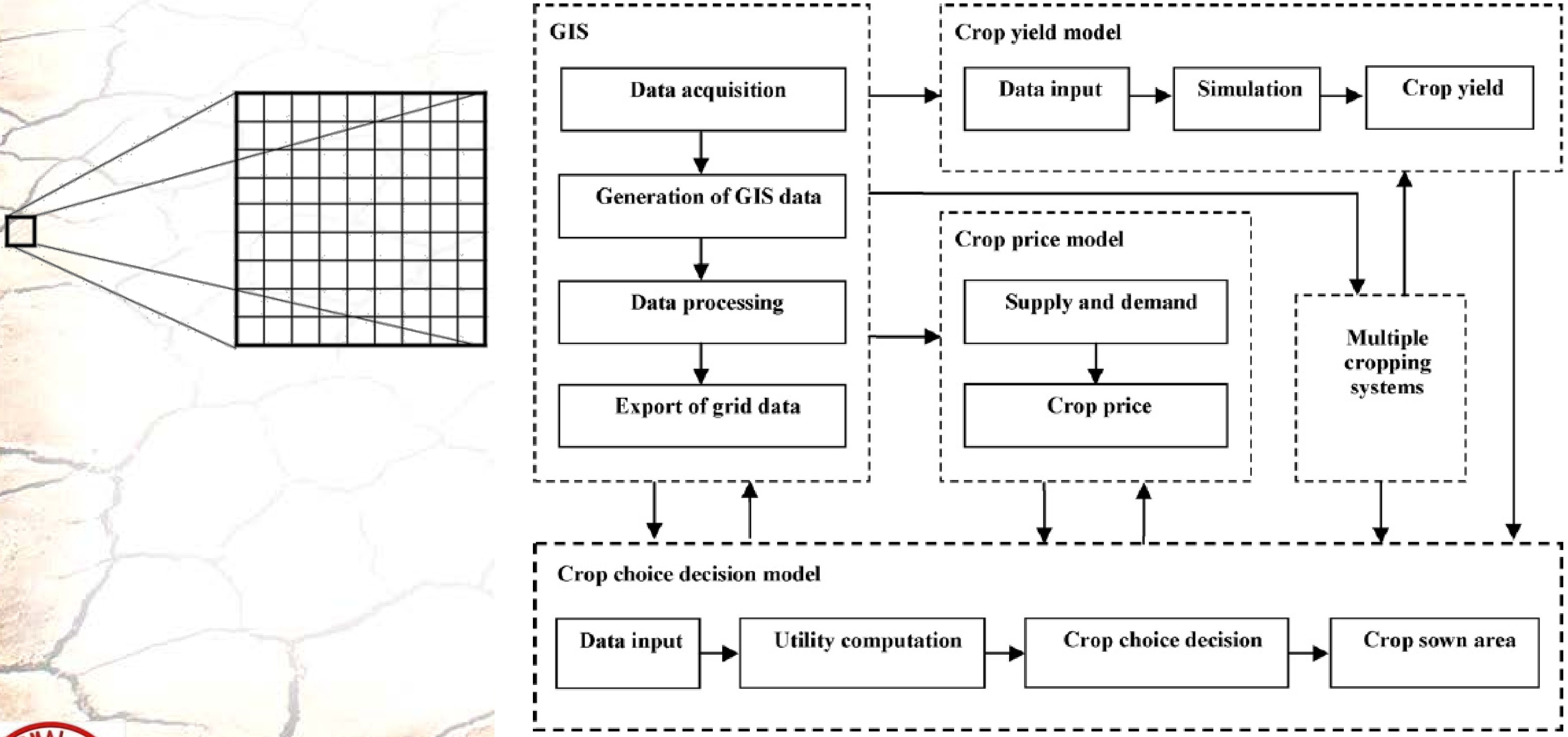


Real-time (Yield Decrease)Risk Model

- *Well suit for modeling agricultural drought*

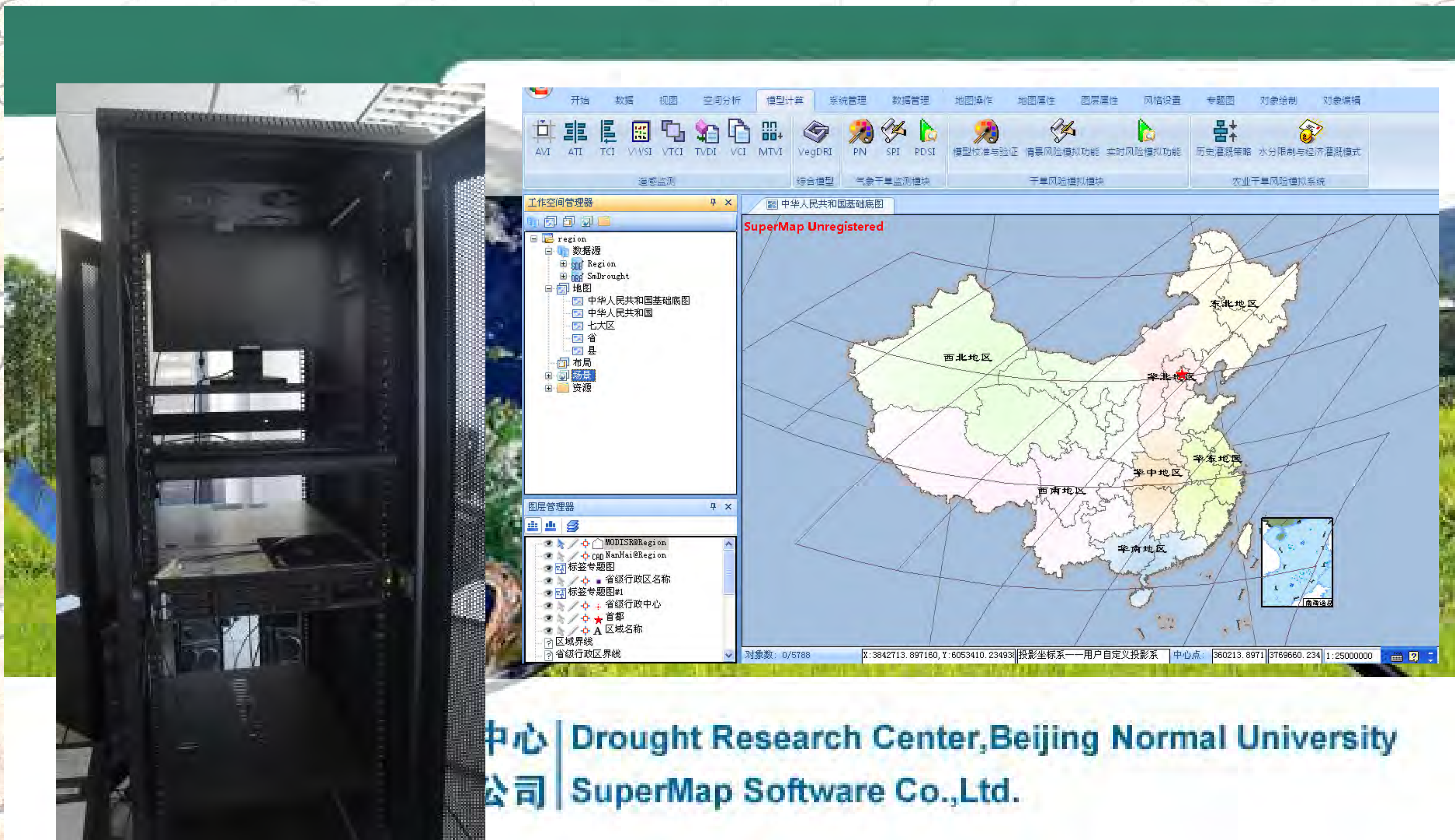


GIS-Real time Loss Assessment Model for Drought



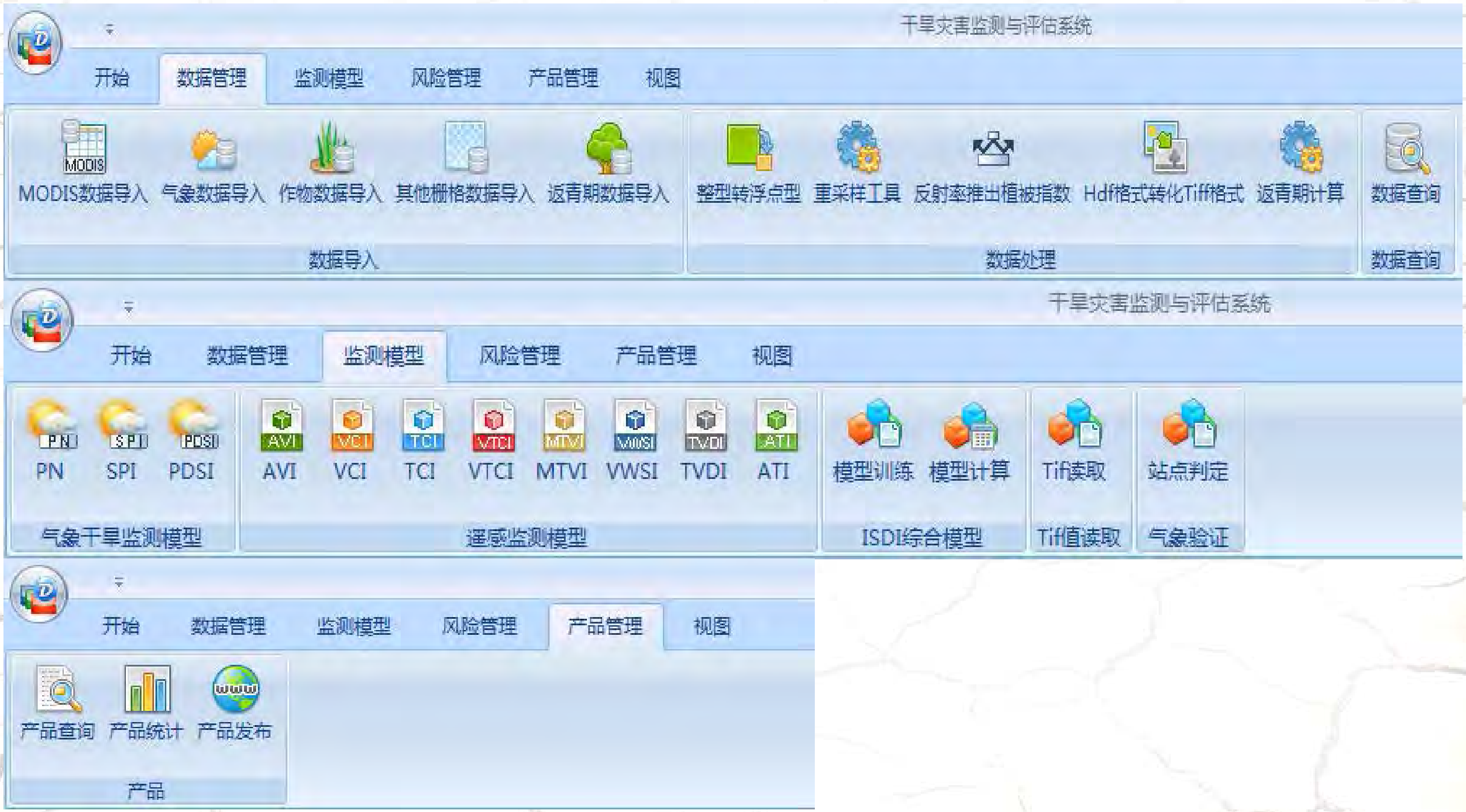
(WU *et al* 2007)

Drought monitoring and evaluation system



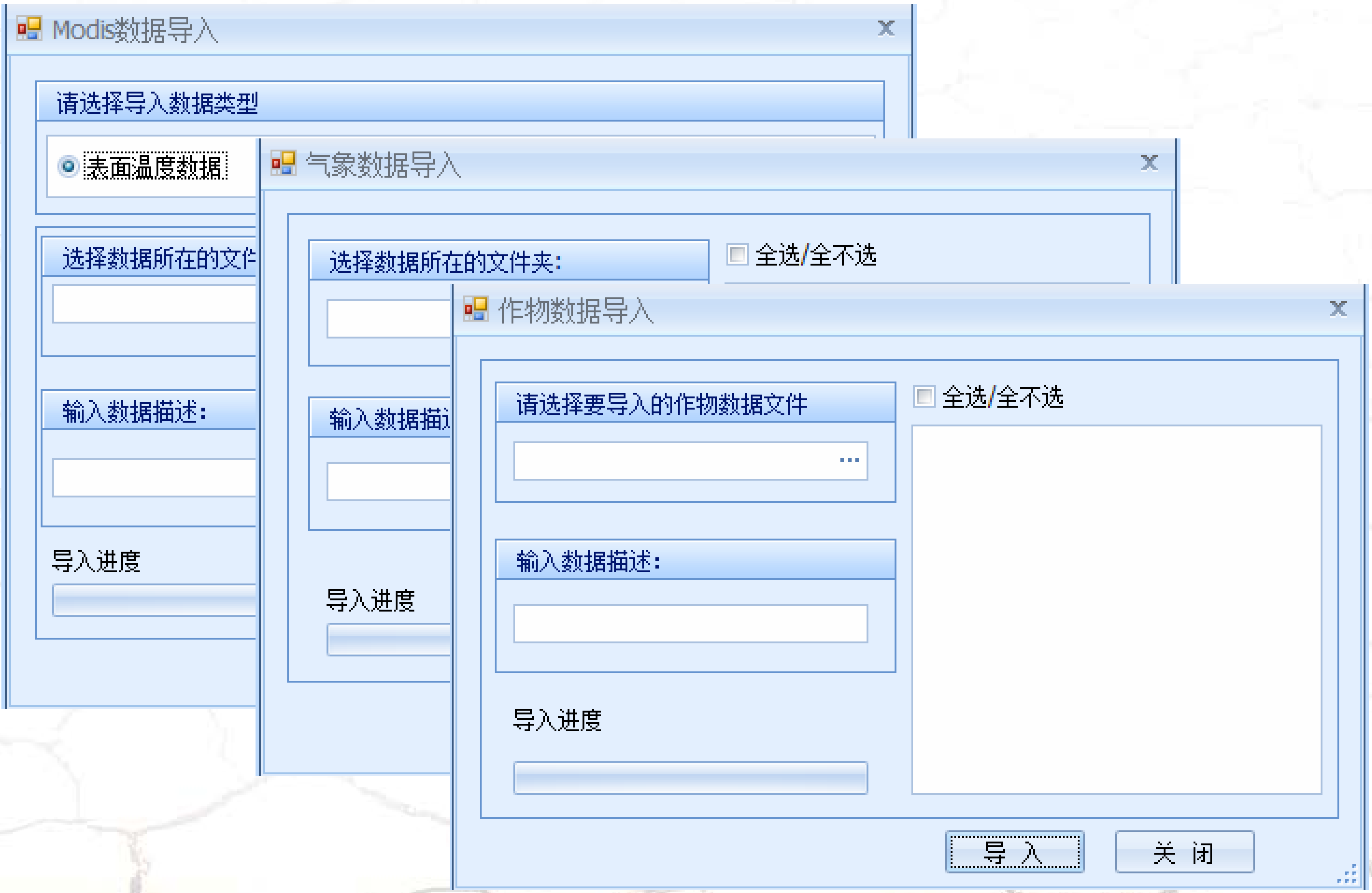
Drought monitoring and evaluation system

Drought monitoring and evaluation system



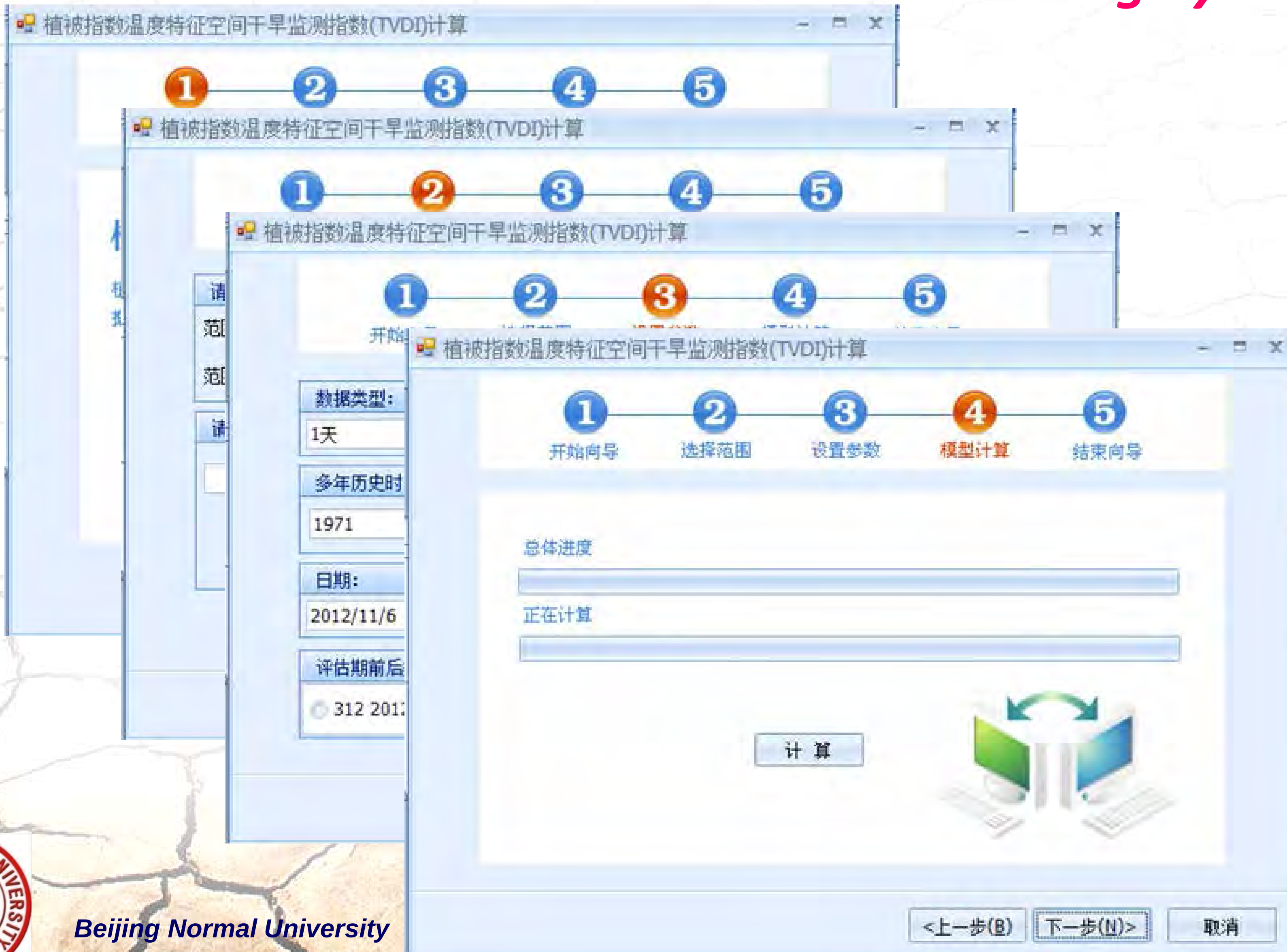
Drought monitoring and evaluation system

-Data Management



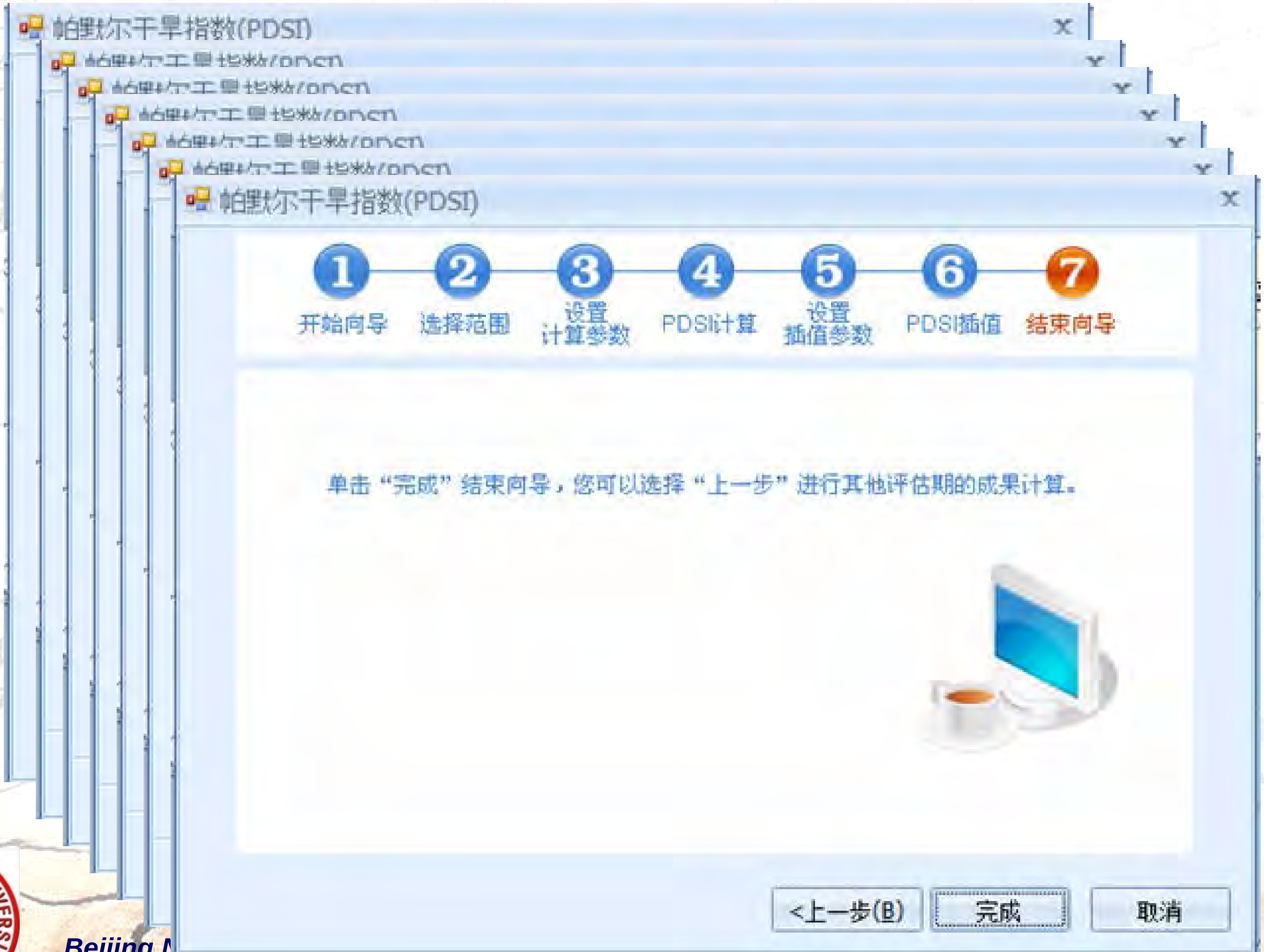
Drought monitoring and evaluation system

Monitoring by RS



Drought monitoring and evaluation system

Monitoring by PDSI

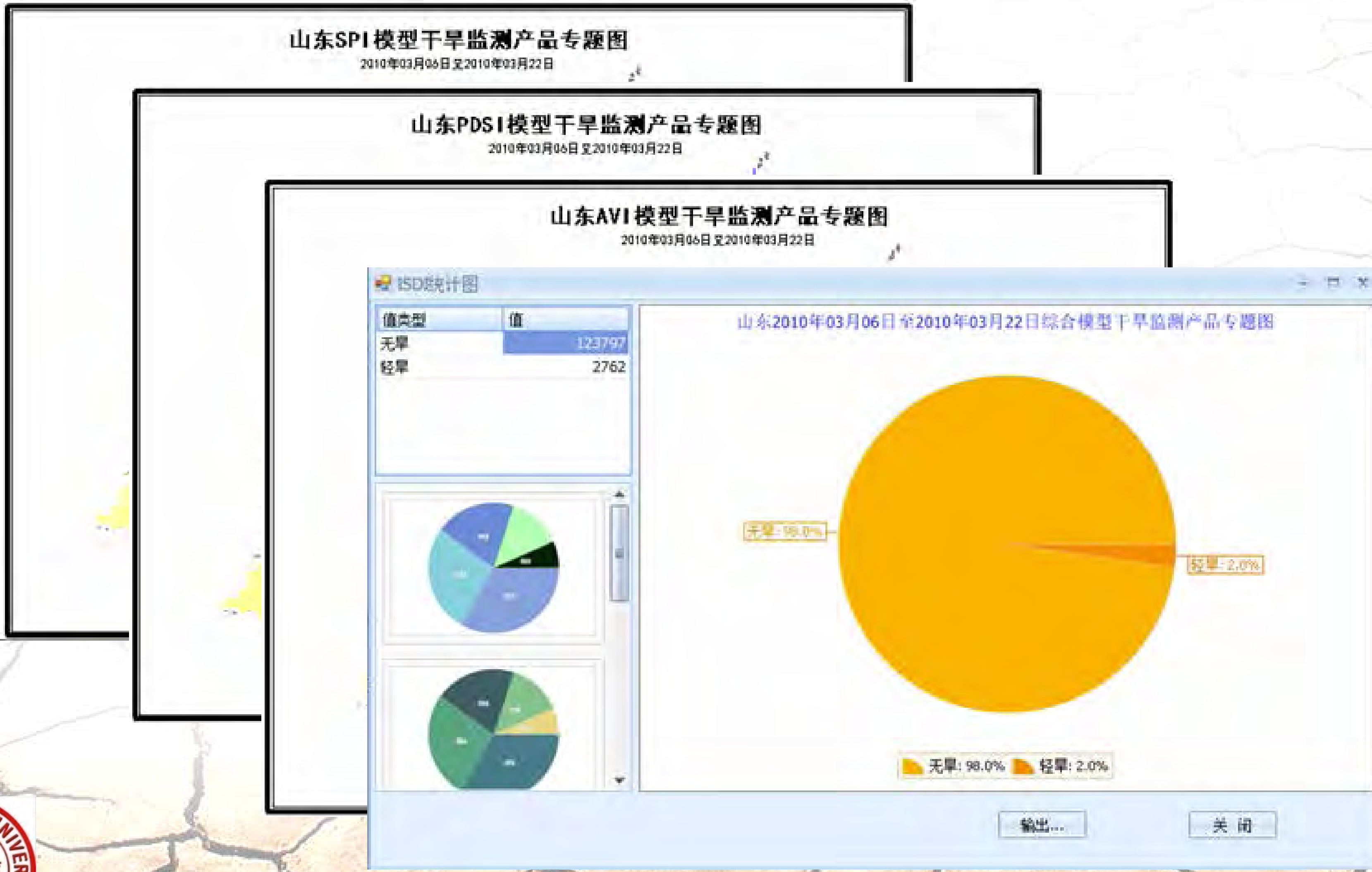


Drought monitoring and evaluation system

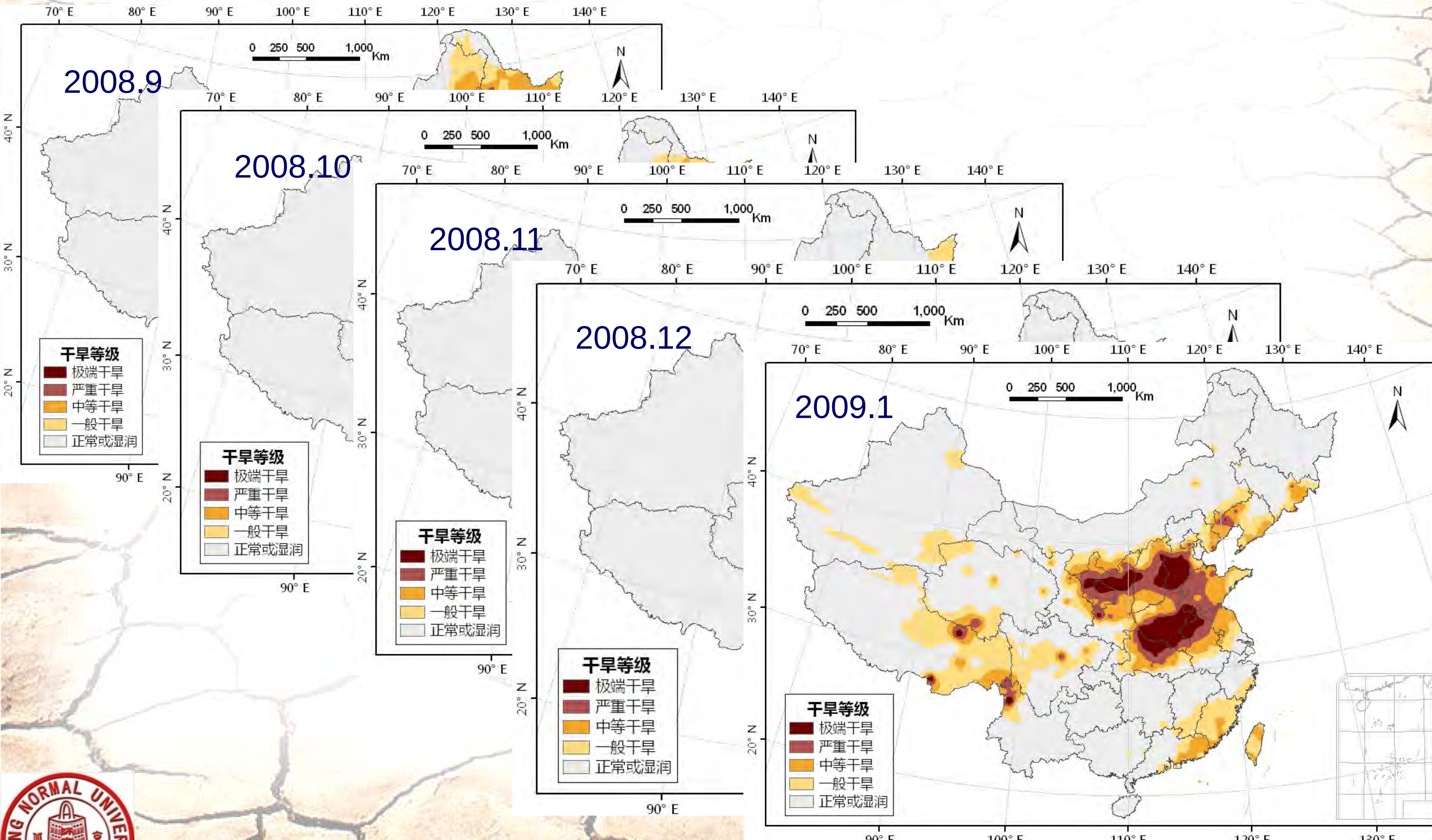
Monitoring by ISDI

Drought monitoring and evaluation system

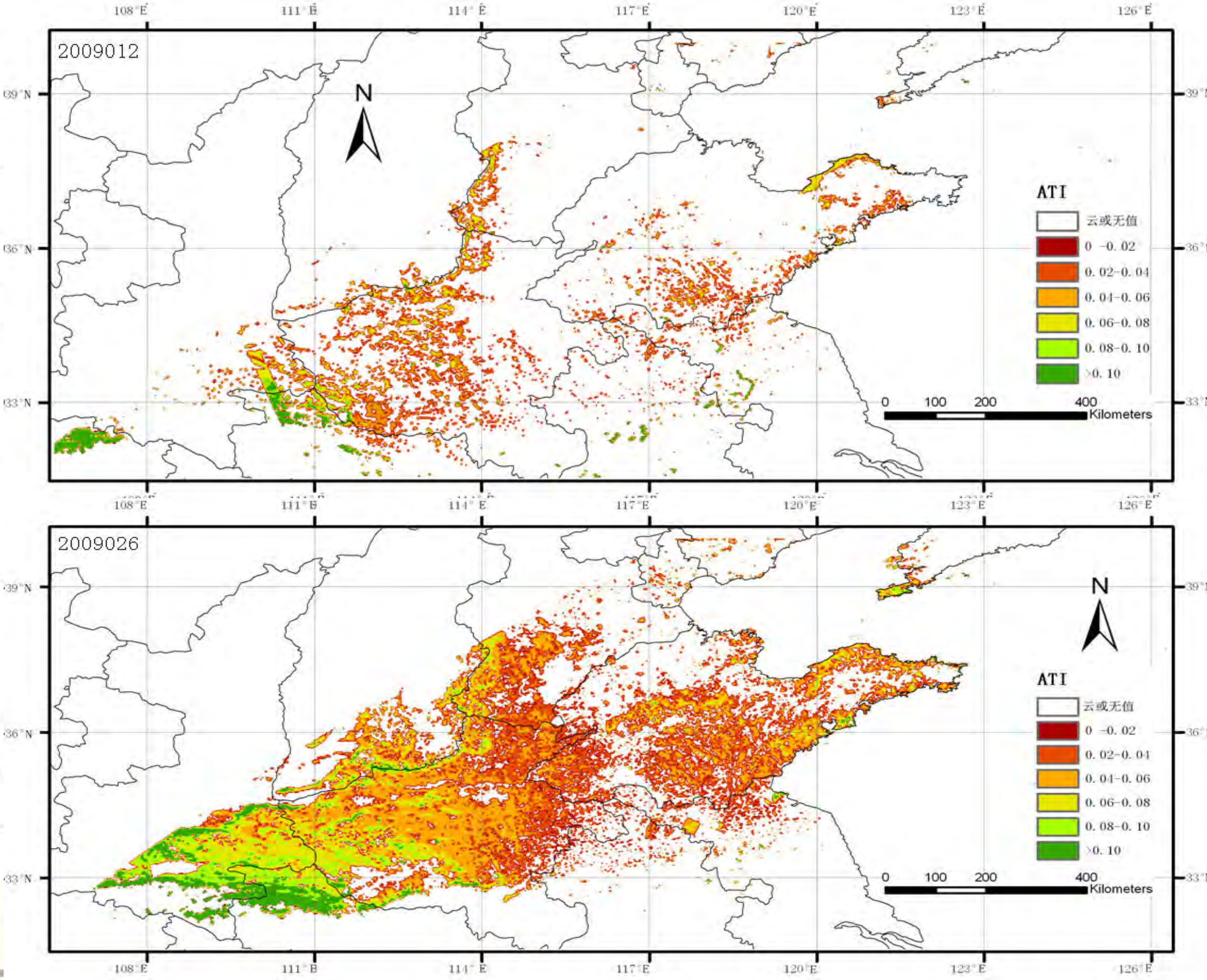
Mapping subsystem



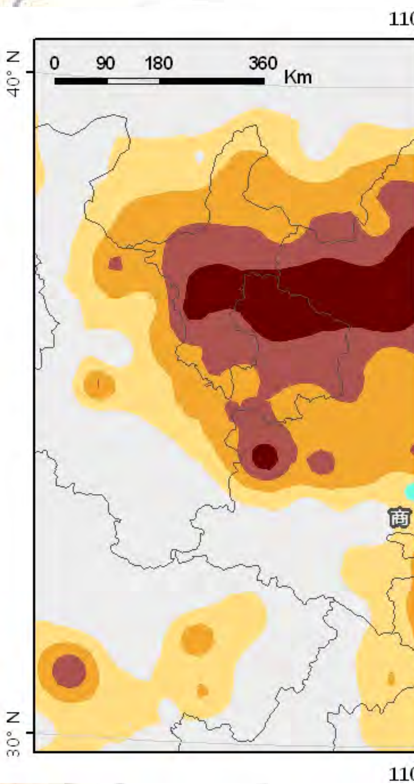
Response to Drought Event

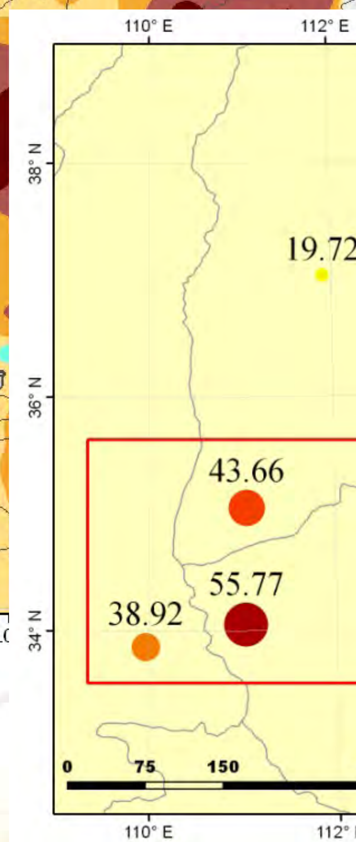


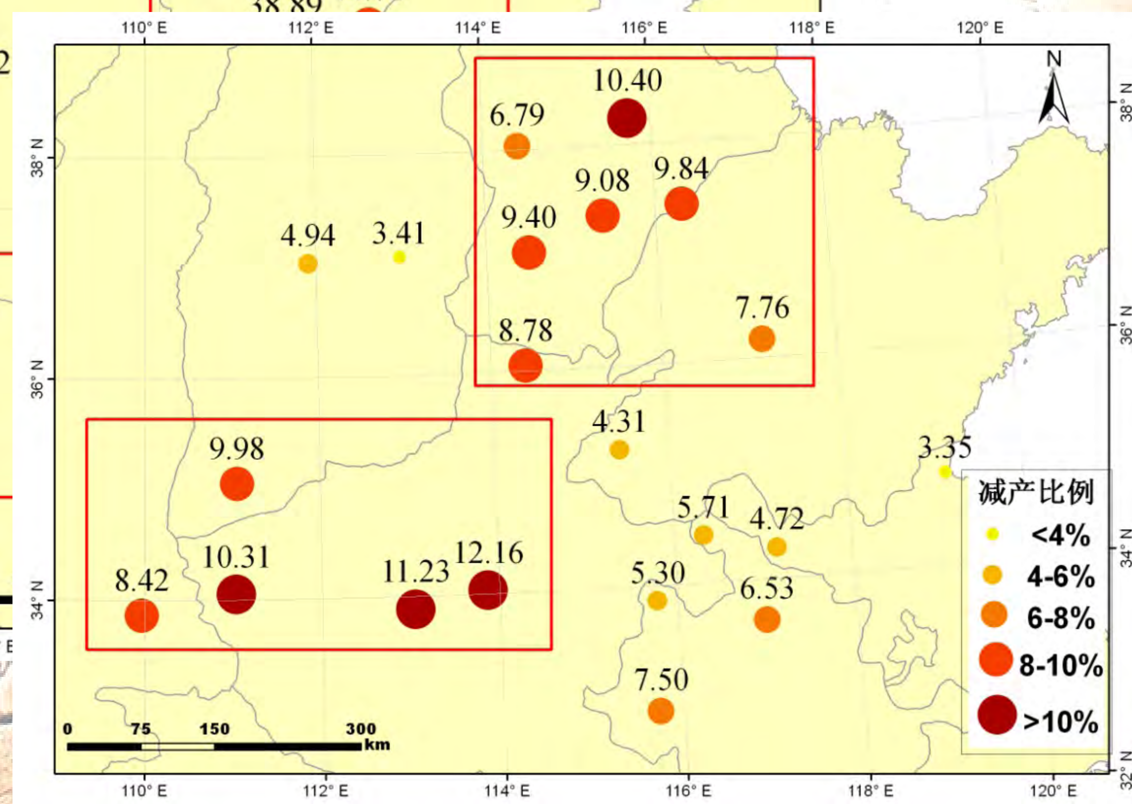
Response to Drought Event



Response to Drought Event







ADREM

National Drought Mitigation Center

Proposed Action Plan For Drought Research Collaboration
Between
The Academy of Disaster Reduction and Emergency Management (ADREM)
at Beijing Normal University (BNU), China
And
The U.S. National Drought Mitigation Center (NDMC)
at University of Nebraska-Lincoln (UNL), U.S.A.

July 6, 2011, in Beijing, China

On July 6, 2011, a
National Drought M
U.S.A. and the Acad
Beijing Normal Univ
parties discussed the
expressed a strong d
agreed on the followi

1. **General state** cooperation. T and mutual vi scientific dis knowledge sh
2. **Overall goals** drought monit
3. **Project coop** support from sources. ADR issues.
4. **International** two parties ag system develo similar droug the World Me
5. **Expert kno** scholar roles professor in t board member

ADREM

National Drought Mitigation Center

6. **Joint education cooperation:** The two parties conduct joint education cooperation to train Master and Ph.D. students in drought research fields. The ADREM at BNU recommends young scholars to conduct research at the NDMC at UNL. The ADREM at BNU invites scholars from UNL to conduct joint research in drought fields in China.
7. **Publication cooperation:** The two parties cooperate in research publications and scientific dissemination of newly derived knowledge. The two parties support co-authorship in journal publications and academic books in drought field. Regarding the journal publications, the two parties could joint-invite international drought experts to publish a special drought session in the International Journal of Disaster Risk Science in 2012. The two parties could also joint-invite international drought scholars to co-publish a drought book in 2012.

wo parties agree to a special drought parties could also in the co-hosted

s conduct regular re with each other ularly discuss the Wilhite at UNL to C invites the Vice convenient time of

o facilitate mutual agement, natural l regional planning. e signature signing EEMENT (MOA)

duction and t, (BNU)

7/6/11

Date

International Workshop
"Drought Monitoring, Assessing and Planning under Global Climate Change"

Beijing Normal University, Beijing, China: June 3-5, 2012

Overview

Drought is one of the major natural hazard threats to people's livelihoods and community socio-economic development. Each year, disasters originating from prolonged drought not only affect tens of millions of people, but also cause serious social, economic, environmental, and political problems in both the developing countries and developed counties. Many countries have recently experienced severe droughts, with the consequence of loss of life, injury or other health impacts, property damage, loss of livelihoods and services, social and economic disruption, or environmental damage. Along with increasing water demands and the uncertainty associated with climate change, drought is expected to be a serious long-term global challenge.

The workshop on "Drought Monitoring, Assessing and Planning under Global Climate Change", will provide an opportunity to present the findings and to share the experiences on the drought related research for the scientists from different countries and organizations. The language of this workshop will be English.

Limited resource will be available for the participants; the host will decide the final funded participants based on Abstract and requests. Some of the full paper will be organized as a special issue in the *International Journal of Disaster Risk Science* published by Springer. Please submit the abstract and full paper to Dr. Ying Li by email ying.li@sei.se. The website of workshop is http://www.adrem.org.cn/dmapgcc/

Topics

- Drought Monitoring and Forecasting
- Drought Risk and Impact Assessment
- Latest Initiative for Drought Research
- Drought Mitigation and Planning
- Space Technology on Drought Reduction

Important Dates

- **Abstract submission:** April 30, 2012
- **Registration:** June 3, 2012
- **Full paper submission:** May 20, 2012
- **Workshop:** June 4 - 5, 2012

Venue and Accommodation

The workshop will be held at the Beijing Normal University (BNU), Beijing, China. The organizing staff of this workshop can book your accommodation in the JINGSHI hotel, which is located in BNU campus. Please visit the hotel website (http://www.ciae.bnu.edu.cn/english_ver/index.htm) and get information you need.

Organising Committee

Jianjun Wu, Ph.D	Beijing Normal University
Michael J. Hayes, Ph.D	U.S. National Drought Mitigation Center
Siquan Yang, Ph.D	International Center for Drought Risk Reduction
Suju Li Ph.D	UN SPIDER
Zhenghong Tang, Ph.D	University of Nebraska-Lincoln

Sponsors

- Beijing Normal University, China (BNU)
- U.S. National Drought Mitigation Center (NDMC) and University of Nebraska–Lincoln, USA.
- UN Platform for Space-Based Information for Disaster Management and Emergency Response (UN-SPIDER)
- International Center for Drought Risk Reduction (ICDRR)

Contact

The contact for this event is Wenjuan Zhang(DMAPGCC@yahoo.cn Tel: +86 10 58805461), she will glad to provide the information and assistance what you need.

National Drought Mitigation Center

UNITED NATIONS
Office for Outer Space Affairs

中文版 | English

全球气候变化下的干旱灾害监测、评估和管理研讨会

2012年6月4-5日
中国北京 · 北京师范大学

- 概述
- 重要时间节点
- 注册
- 会议主题
- 摘要提交
- 会议组委会
- 会议组织单位
- 会议地址
- 会议住宿
- 会议联系人

概述

干旱是一种危害人类生活和社会经济发展的主要自然灾害。无论是发展中国家还是发达国家，每年由长期干旱引发的灾害不仅影响了数千万的人的生命和生活，而且导致了严重的社会、经济、环境和政治问题。许多国家近来都经历了严重的干旱，伴随着生命损失，人员受伤或其他健康影响、财产损失、失去生计和服务、社会和经济瓦解、环境破坏等后果。随着水资源需求量的逐渐增加和干旱与环境变化的不确定性的增长，干旱将是一个长期的全球性的挑战。

全球气候变化下的干旱灾害监测、评估和管理研讨会将为不同国家和组织的干旱研究专家提供一个展示研究成果、分享研究经验的机会。会议将于2012年6月4-5日在北京举行，会议语言为英语。会议举办方将根据参与人员提交的论文摘要和需求，利用有限的资源为申请者提供部分资助。

National Drought Mitigation Center

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Website of workshop:
http://www.adrem.org.cn/dmapgcc/

Contact: Wenjuan Zhang
DMAPGCC@yahoo.cn
Tel: +86 10 58805461

Thank you for your attention!

Academy of Disaster Reduction and Emergency Management
Beijing Normal University, Beijing 100875, China
http://adrem.org.cn/
http://adrem.org.cn/Faculty/WuJJ/Index.html

Seasonal crop water deficiency

$$SCWD = \frac{ET - P}{ET}$$

SCWD : Seasonal crop water deficiency;

ET : Seasonal crop water use;

P : Precipitation during crop growing season.

$$ET = ET_0 \bullet Kc$$

ET_0 : potential evapotranspiration ;

Kc : crop coefficient.