

DSD INTERNATIONAL CONFERENCE 2014
A3 Climate Change and Flood Risk Management
Hong Kong, December 12-14, 2014

Evolution of Urban Pluvial Flood Risks and Approaches to Urban Flood Resilience

CHENG Xiaotao

China Institute of Water Resources and
Hydropower Research (IWHR)

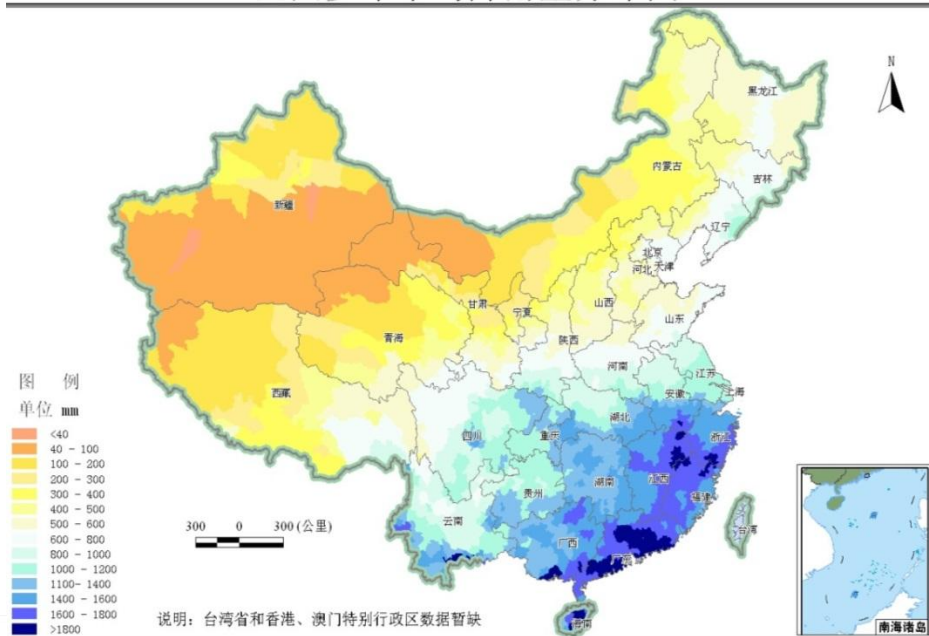
Contents

- **Introduction**
- **Pressure and challenges on urban flood prevention**
- **Scenario analysis on flood risk evolution**
- **Approaches to restrain the increasing urban flood risk**
- **Conclusions**

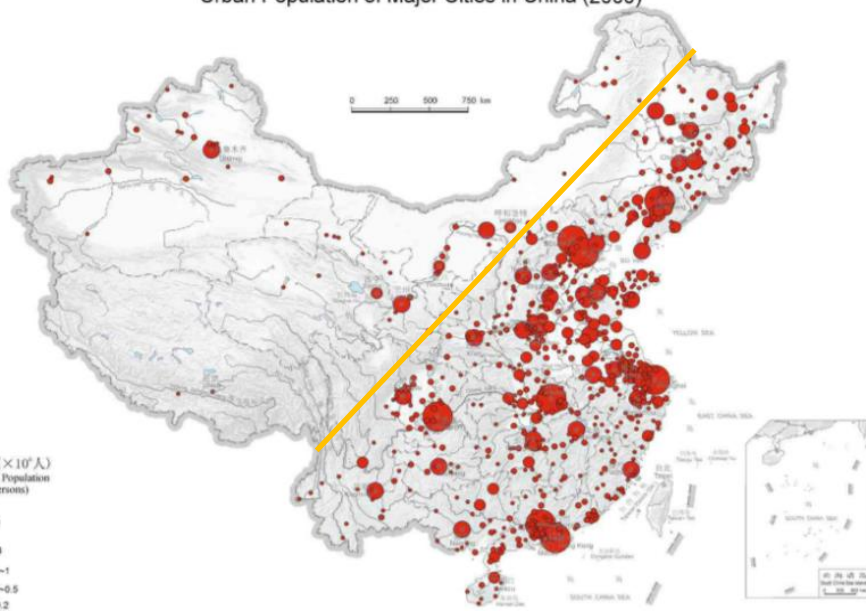
1. Introduction

- Among the current 654 cities in mainland China, 641 of them are under threat of floods.
- Among them, there are
 - Coastal cities: 57 (8.9%)
 - Plain cities: 288 (44.8%)
 - Hilly cities: 297(46.3%)

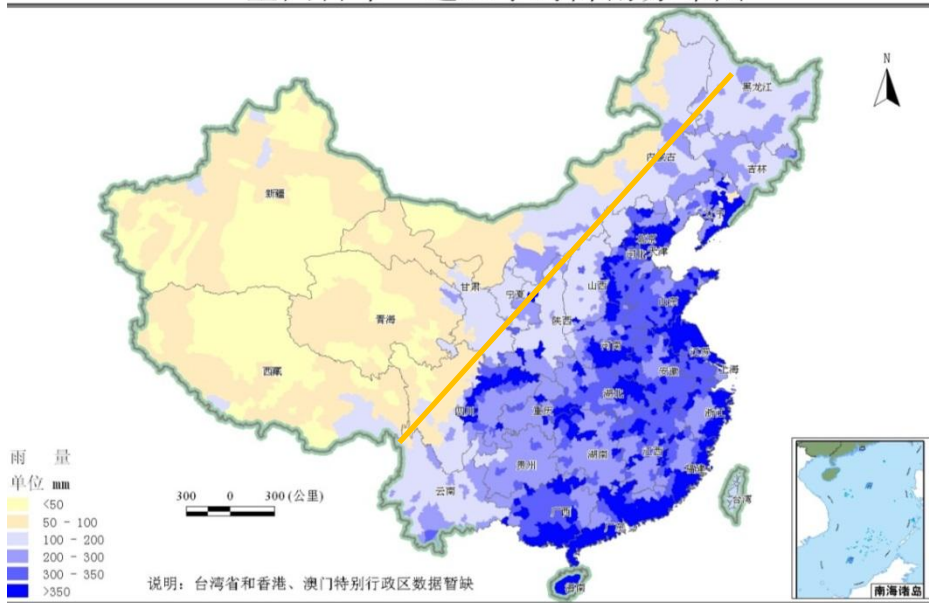
全国多年平均降雨量分布图



中国主要城市人口 (2000年)
Urban Population of Major Cities in China (2000)

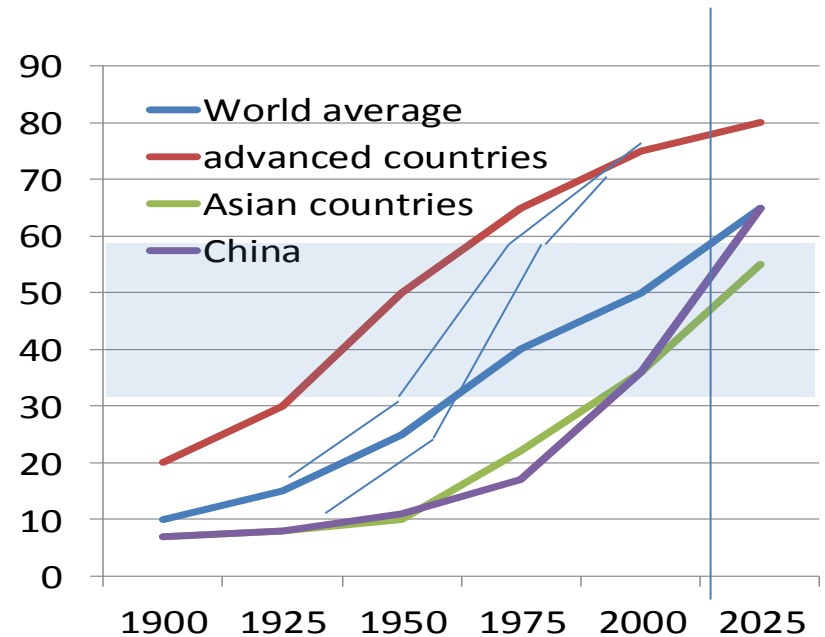
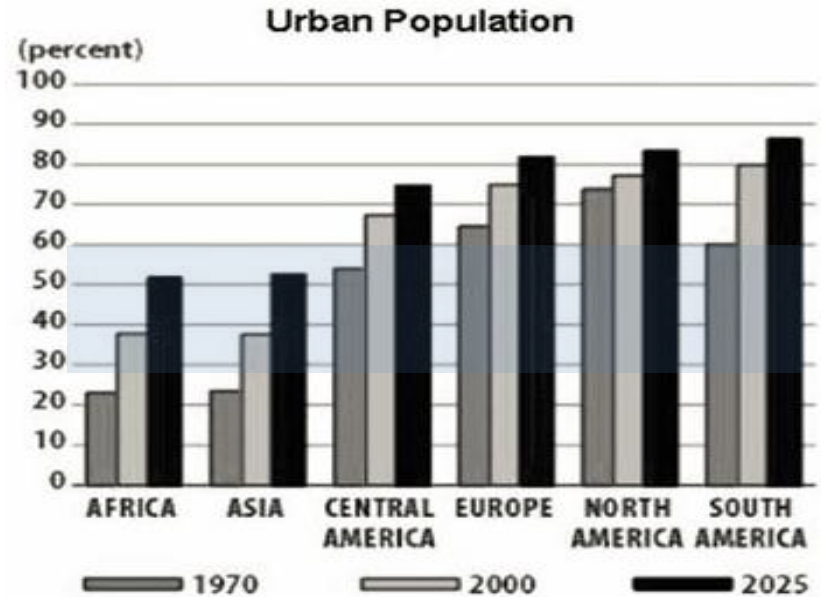


全国百年一遇24小时降雨分布图



Unprecedented urban expansion since 1998

- China's urban population exceeded 30% in 1998. Since then, it increased 20.4% in 15 years.
- In the past 35 years, a net increase of urban population in China is about 564 million, more than the combined population of the 28 countries in EU.
- Of the current 26 megacities, half are in Asia and the UN(2008) projects that there will be 37 in Asia alone by 2025.



Growing urban flood disasters



Beijing

July 10, 2004

- More than 130 cities flooded every year since 2008, 258 in 2010 and 234 in 2013;
- In particular, most of them suffered pluvial floods during local heavy rains.



Wuzhou, Guangxi

June 22, 2005



Beijing

July 21, 2012



Yuyao, Zhejiang

Oct. 9, 2013

The government's determination

- The frequently occurred urban floods have got much concern of the government and the communities.

Notice of the General Office of the State Council on Effective Conducting Construction Work for Urban Water Drainage and Flood Control Facilities issued in March, 2013;

Opinions of the State Council on Urban Infrastructure Construction” issued in September, 2013;

National New Urbanization Plan (2014 - 2020) published in March, 2014

Clearly stipulates that the capacity of urban drainage and flood control shall be improved comprehensively and a sound urban drainage and flood control system shall be built in 10 years.

2. Pressure and Challenges on Urban Flood Prevention

- With rapid urbanization, the development of urban flood control and drainage system is important for flood prevention of cities.

- In order to strengthen the urban flood control, 25 cities closely related to large rivers were assigned as the national key cities for flood control early in 1987, and the number of such cities increased to 31 till 1998.
- Later, another 54 cities were assigned in succession as the major cities for flood control after 1998.



- In 2013,
 - urban population in China : 731.11×10^6 , 53.7% of the total;
 - urbanized area : $44.5 \times 10^3 \text{ km}^2$, about 6 times that of 1981;
 - urban embankments : $28 \times 10^3 \text{ km}$;
 - protected area increased to $88 \times 10^3 \text{ km}^2$;
 - total length of the urban drainage pipelines : $43 \times 10^3 \text{ km}$, about 18 times that of 1981.

A huge task to build a perfect urban drainage and flood control system

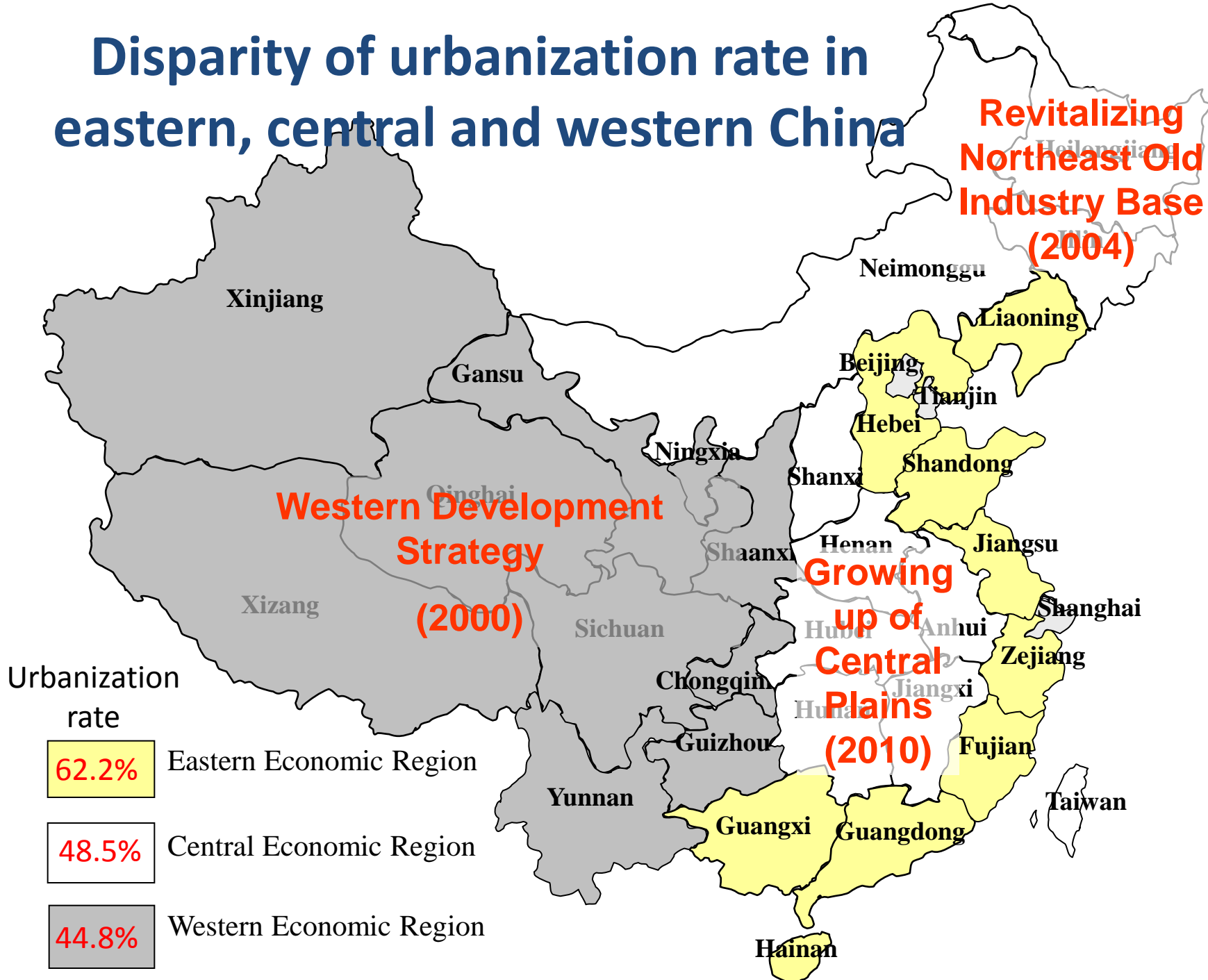
- For the 641 cities with flood prevention tasks, only 321 of them (51%) have reached the national flood prevention standards.

	total	up-to-standard	rate
Key cities	31	10	32%
Major cities	54	16	30%

- Six national key cities and 20 major cities for flood control, as well as 258 other cities have not completed plan formulation or modification due to the rapid changes of situation.
- It should be noted that, the total number of such cities was 170 in 2006, while 7 years later, instead of decreasing, the number increased to 284 cities.

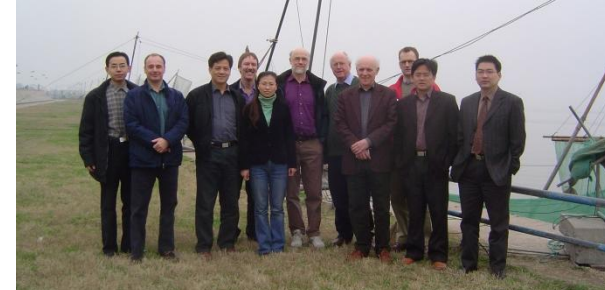
Grade	Importance	Non-agricultural population (thousand people)	Flood control standard [Return period (year)]
I	Very important cities	> 1500	>200
II	Important cities	1500 ~500	200 ~100
III	Medium- sized cities	500~200	100 ~50
IV	Small cities	<200	50 ~20

Disparity of urbanization rate in eastern, central and western China



3. Scenario Analysis on Flood Risk Evolution

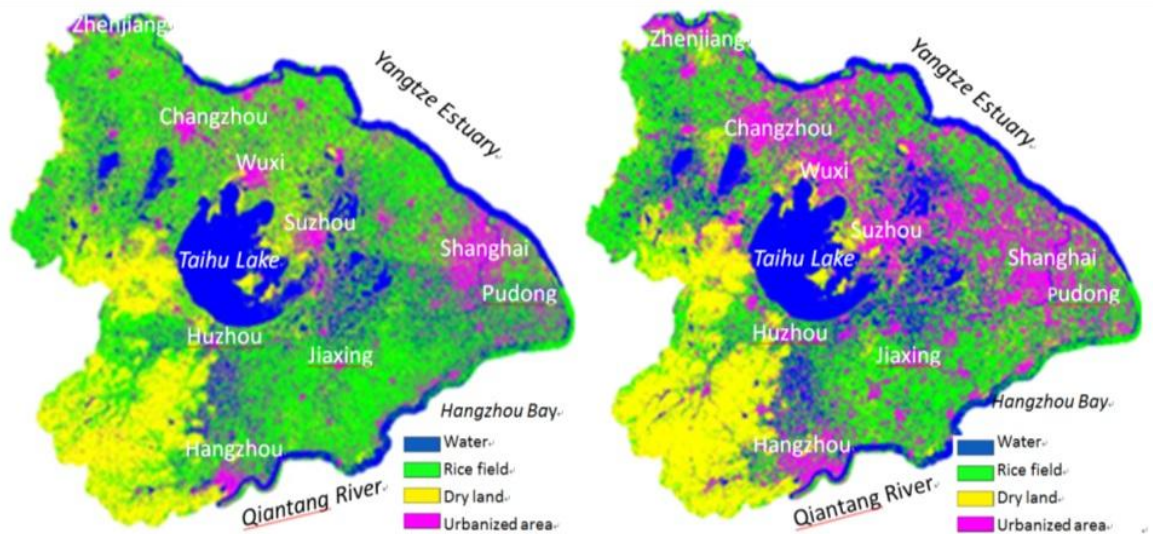
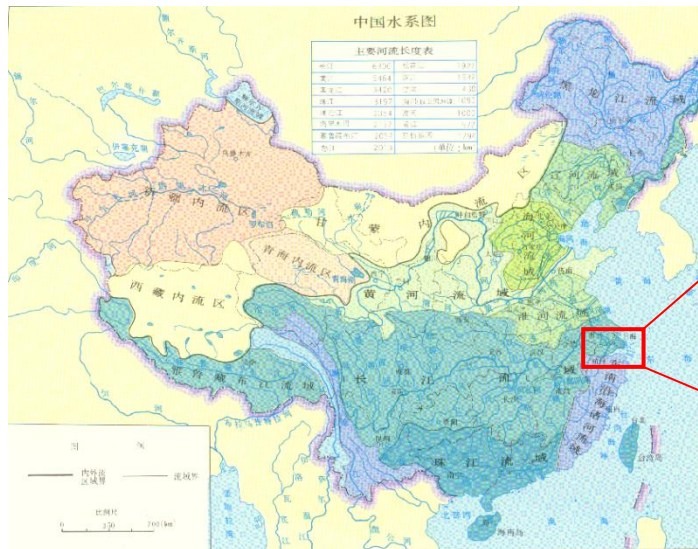
- In order to understand the flood risk evolution along with the rapid urbanization and global warming and to support the decision-making, a China/UK scientific cooperation project, Scenario Analysis Technology for Flood Risk Management in the Taihu Basin was conducted from 2007 to 2010^[1].
- The study has got the followed support by the National Key Technology R&D Program in the 12th Five-year Plan (2011-2015) for exploring the proper adaptation strategies to inhibit the growth of the flood risk and to support the sustainable development.



Features of the Taihu Basin

- Taihu Basin: one of the most important economic regions in China.
- Serious flood disasters caused by plum rains, typhoon and storm surge.
- In the course of rapid urbanization.
- Features of flood risk : very sensitive to both global warming and rapid urbanization.

Land use change in the Taihu Basin		
	Urbanized area /km ²	Cultivated area/km ²
1995	2,206.8	22,468
2010	9,476.4	12,999
	+ 329.4%	- 42%

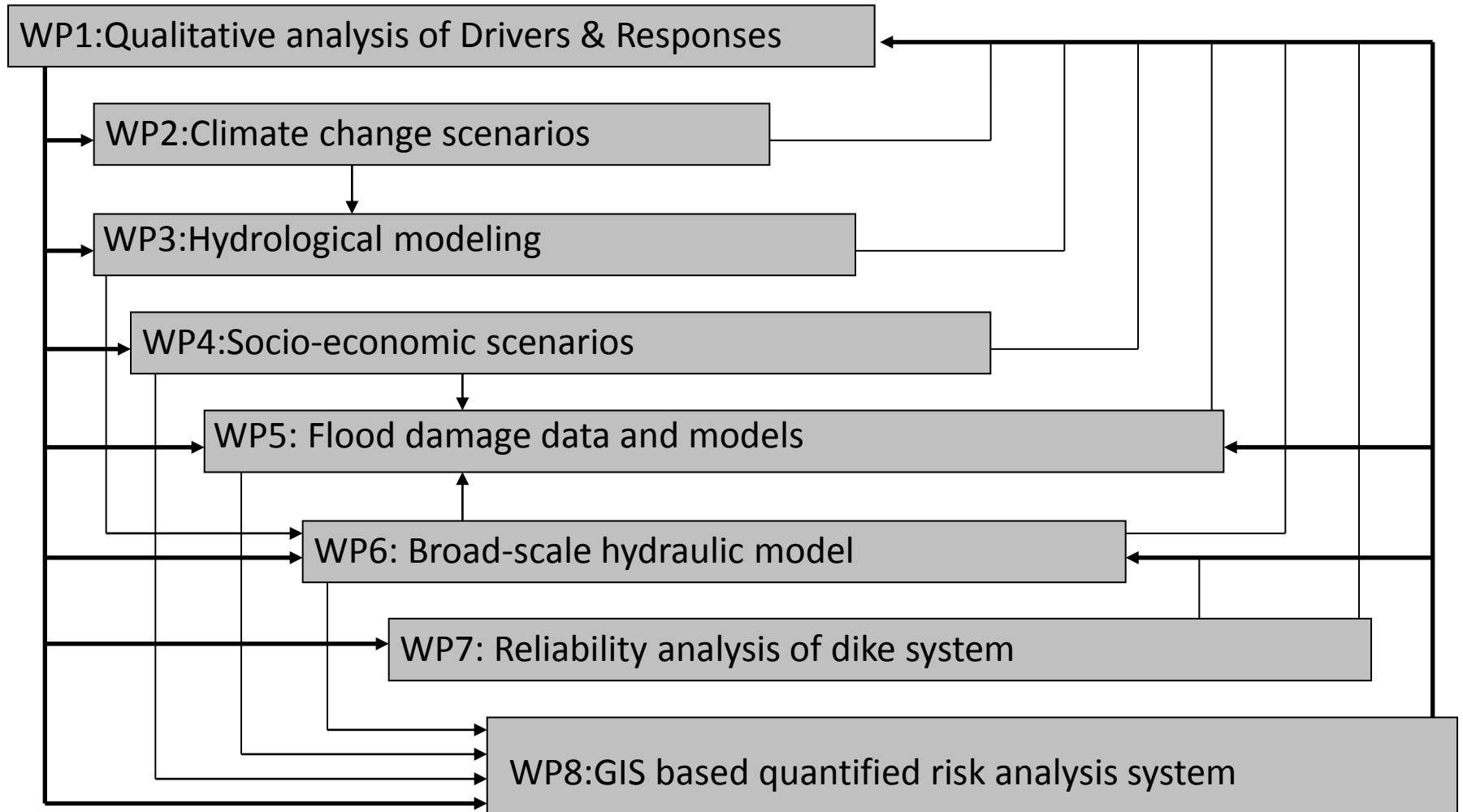


a. Land use in 2000/2001

b. Land use in 2009/2010

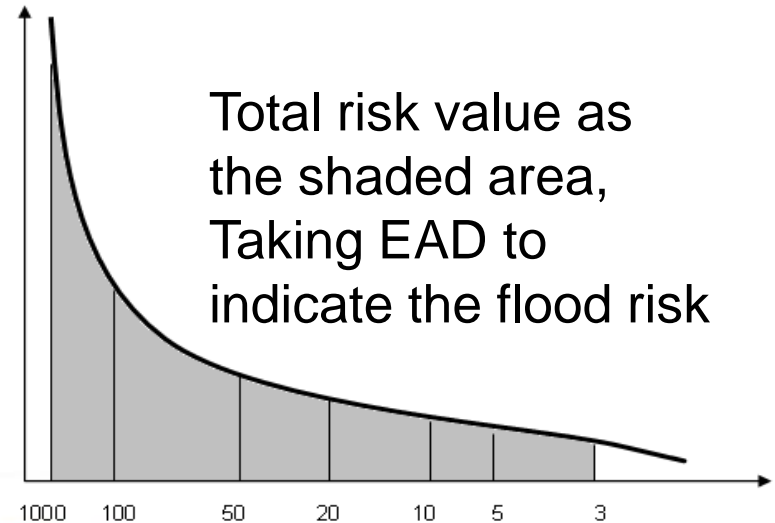
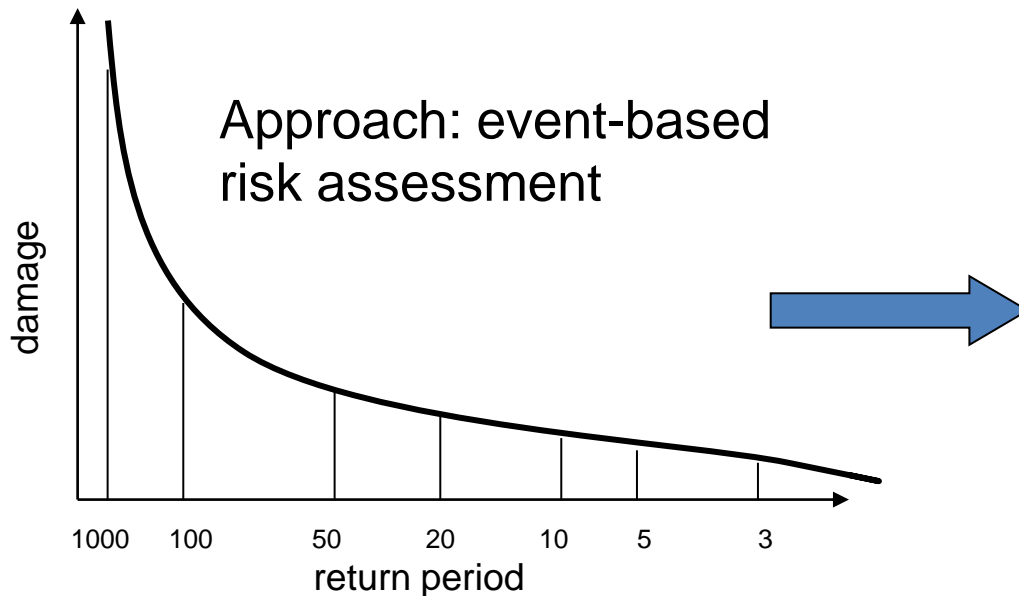
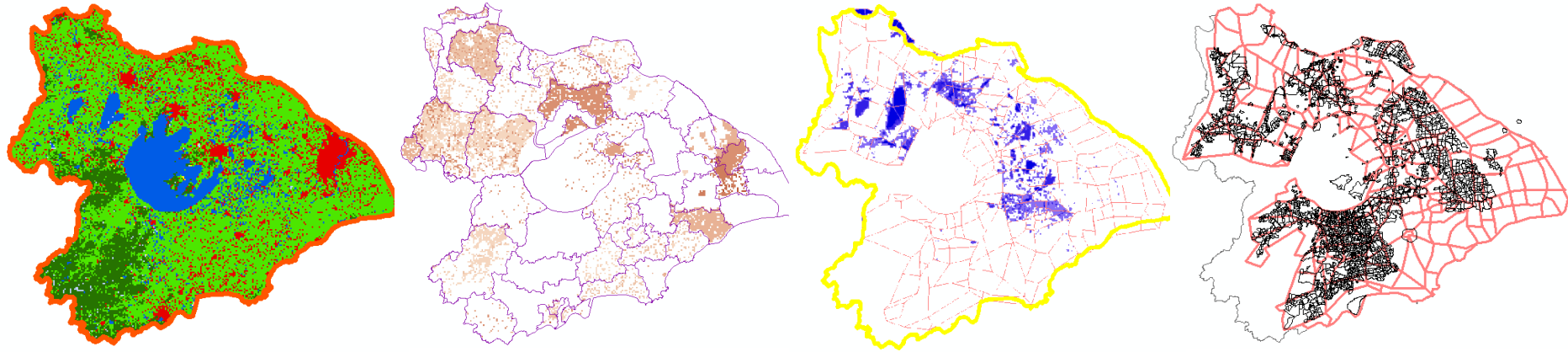
Scenario Analysis Technology for Flood Risk Management

- Framework of the Project (8 Work Packages)

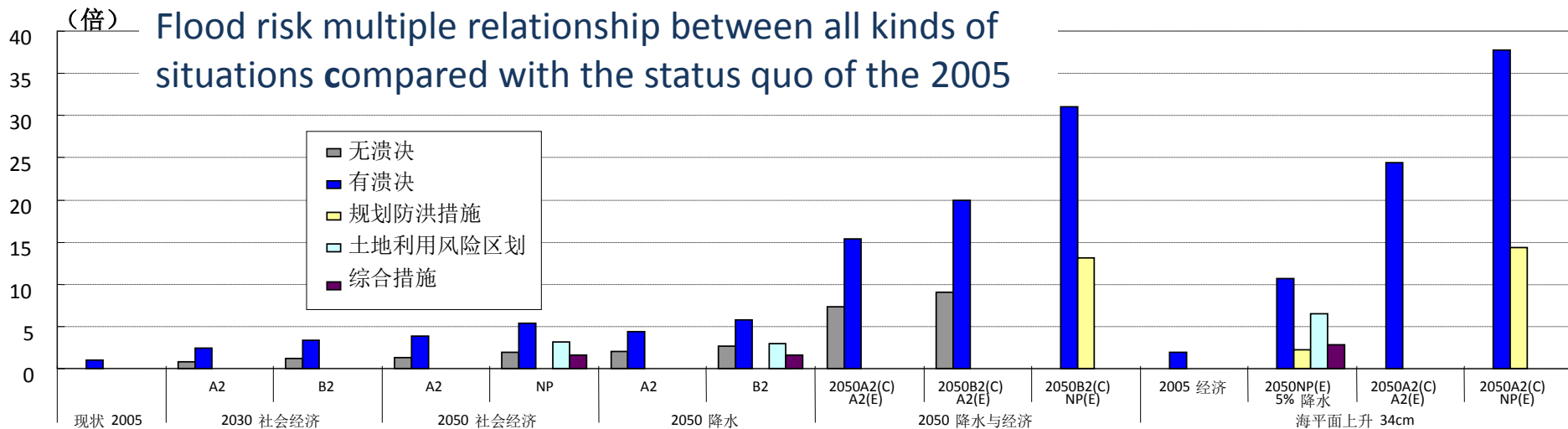


WP8: Quantified risk analysis system

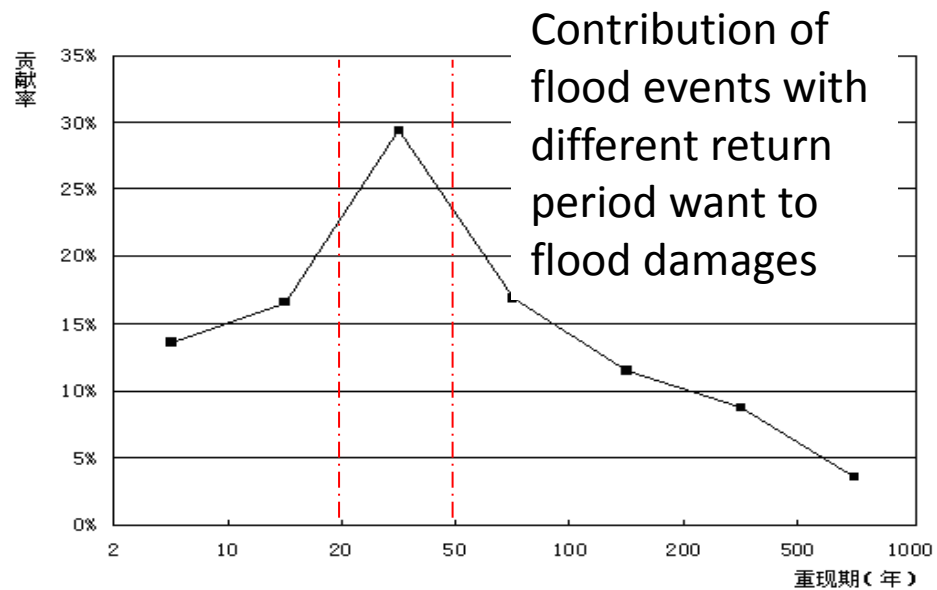
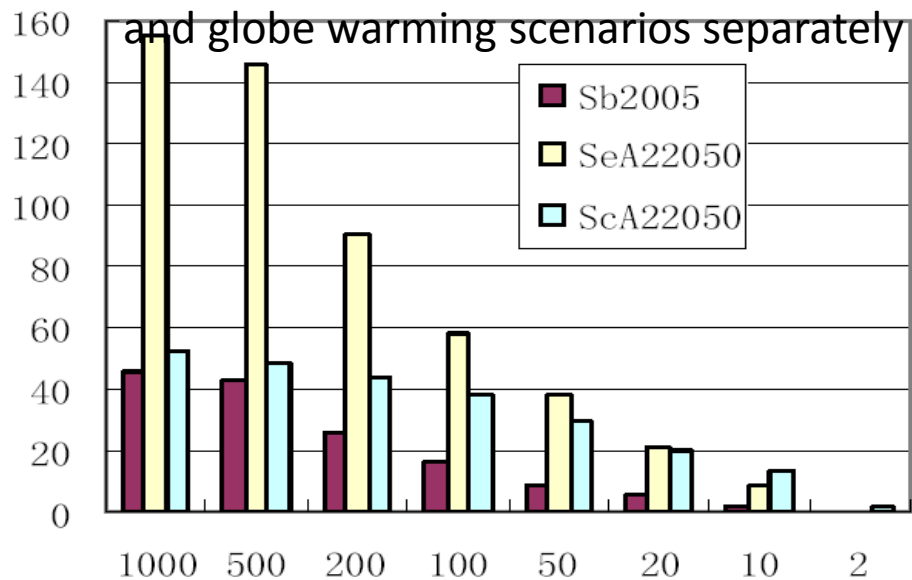
—A GIS-based flood risk analysis system has been primarily developed



Scenario analysis results



Impacts of social economic development and globe warming scenarios separately



Outcomes of the Project

- What are the impacts of
 - rapid urbanization and economic development
 - development of flood control system
 - Climate changes

on

- the features of future flood and flood damages in the Taihu Basin?
- the features of flood and ecosystem?
- the future flood control situation in the Taihu Basin?

A framework for long-term scenario analysis in the Taihu Basin, China

X.T. Cheng¹, E.P. Evans^{2,*}, H.Y. Wu³,
C.R. Thorne⁴, S. Han¹, J.D. Simm⁵, J.W.
Hall⁶

Article first published online: 5 FEB 2013

DOI: 10.1111/jfr3.12024

© 2012 Blackwell Publishing Ltd and The
Chartered Institution of Water and Environmental
Management (CIWEM)

Issue



**Journal of Flood Risk
Management**

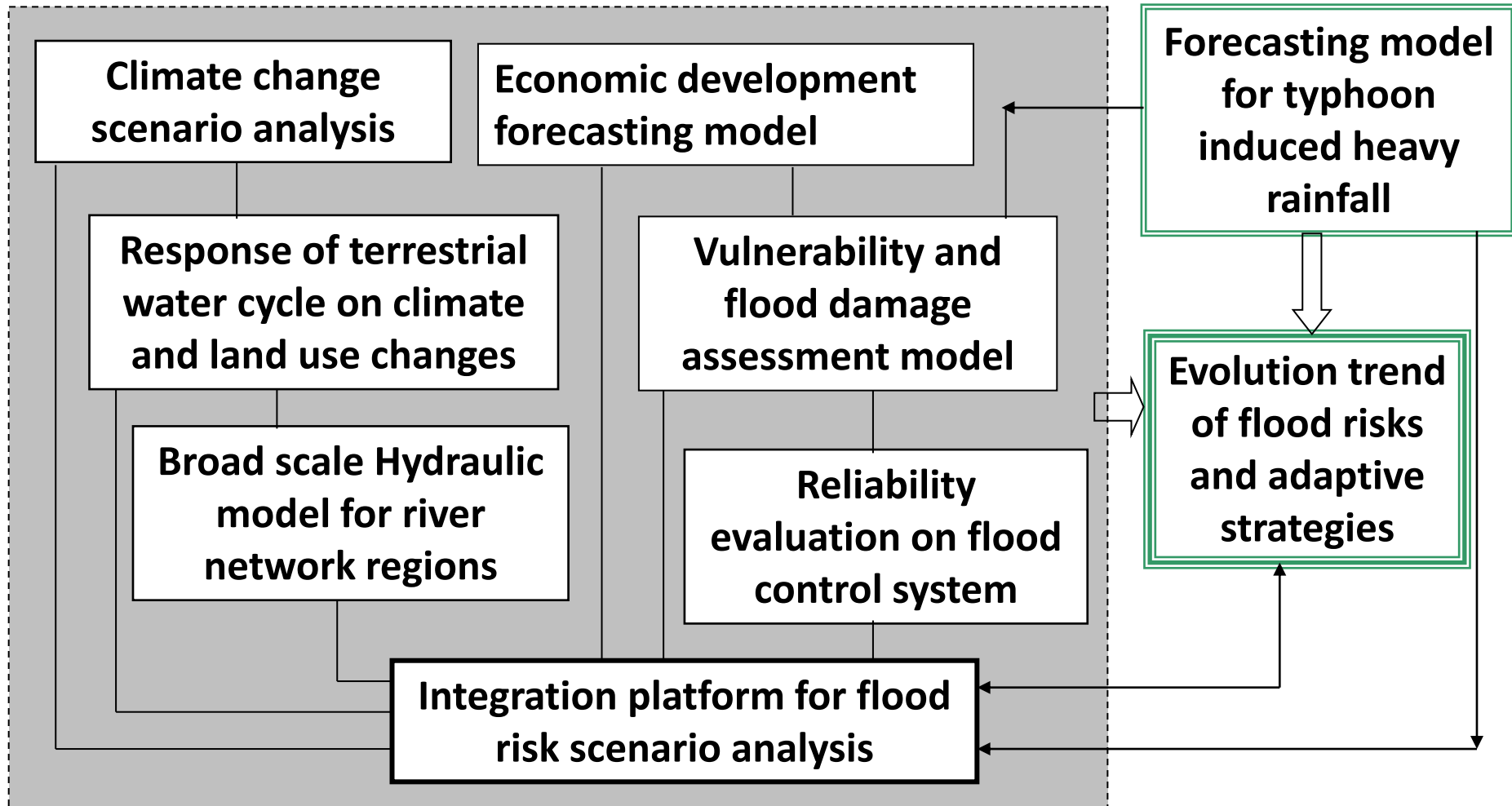
Taihu Basin Foresight Project
Special Issue

**Volume 6, Issue 1, pages 3
–13, March 2013**

Flood risk evolution and adaptive measures

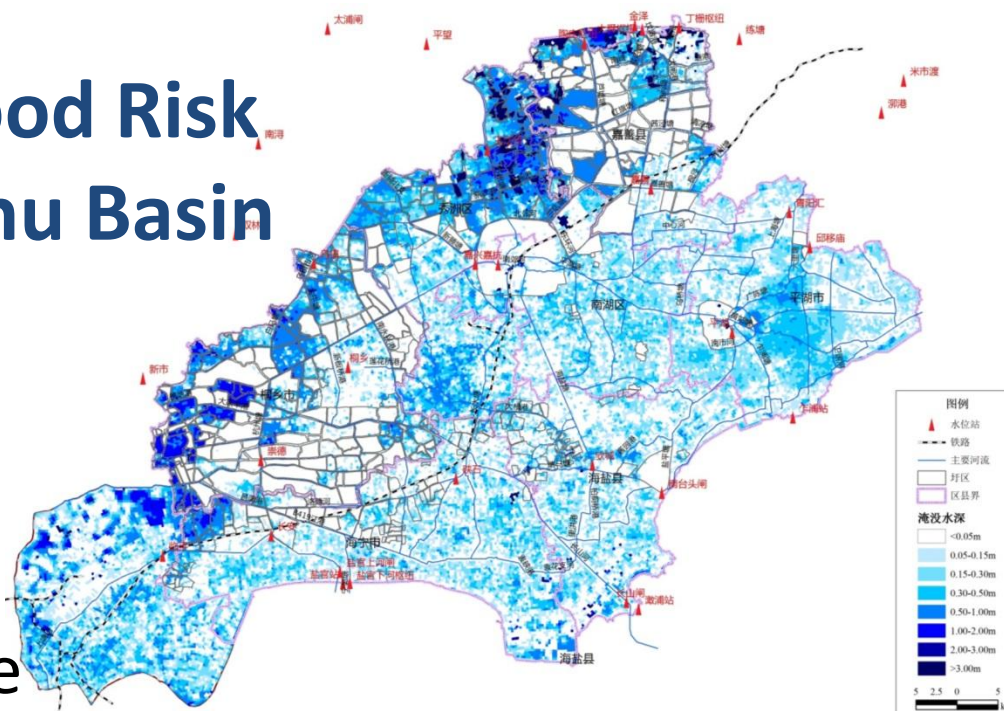
- supported by the Key research project of the 12th 5-year planning

The framework of the project



Main Challenges for Flood Risk Management in the Taihu Basin

- Pros and cons of the ring dike building
- Inadequate flood control capacity at the basin scale
- Lack of coping strategies and mechanisms for the whole basin.
- Difficulties for coordinating conflicts on the water security among the relevant regions.



4. Approaches to Restrain the Increasing Urban Flood Risk

- Rapid progress of urbanization and industrialization
- Increasing demands on food and energy security
- The gap between rich and poor
- More uncertainties in climate change
-

How to meet the basic needs of survival?

Lower demands in security

Flood control system developed in a whacky circle

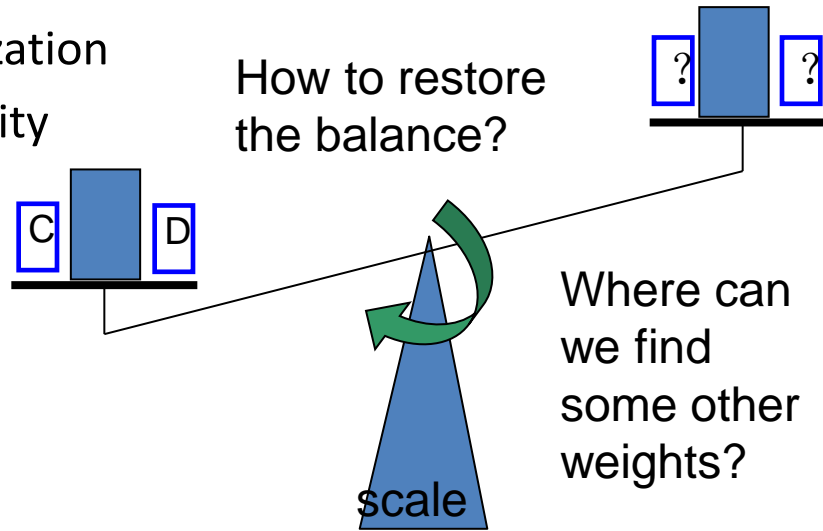
Lower technical ability

Low level of urbanization

Undeveloped stage

How to enhance or create new balance step by step to meet the demands of rapid and smooth development?

Developing stage



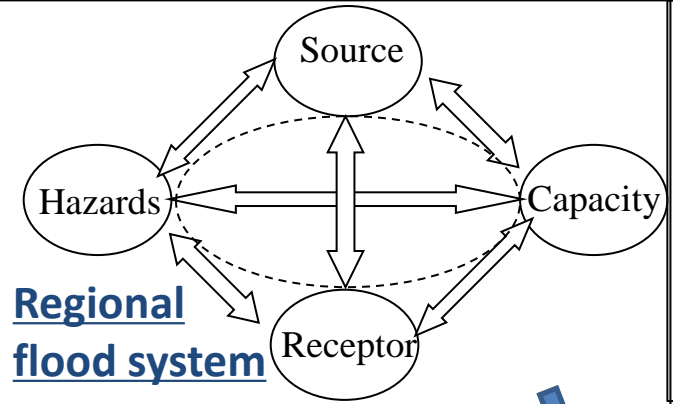
How to keep or restore the existing balance?

How to cope with the challenges coming in the future?

High level of management, with strong economic and technical capacities, environmentally sound

Sustainable development stage

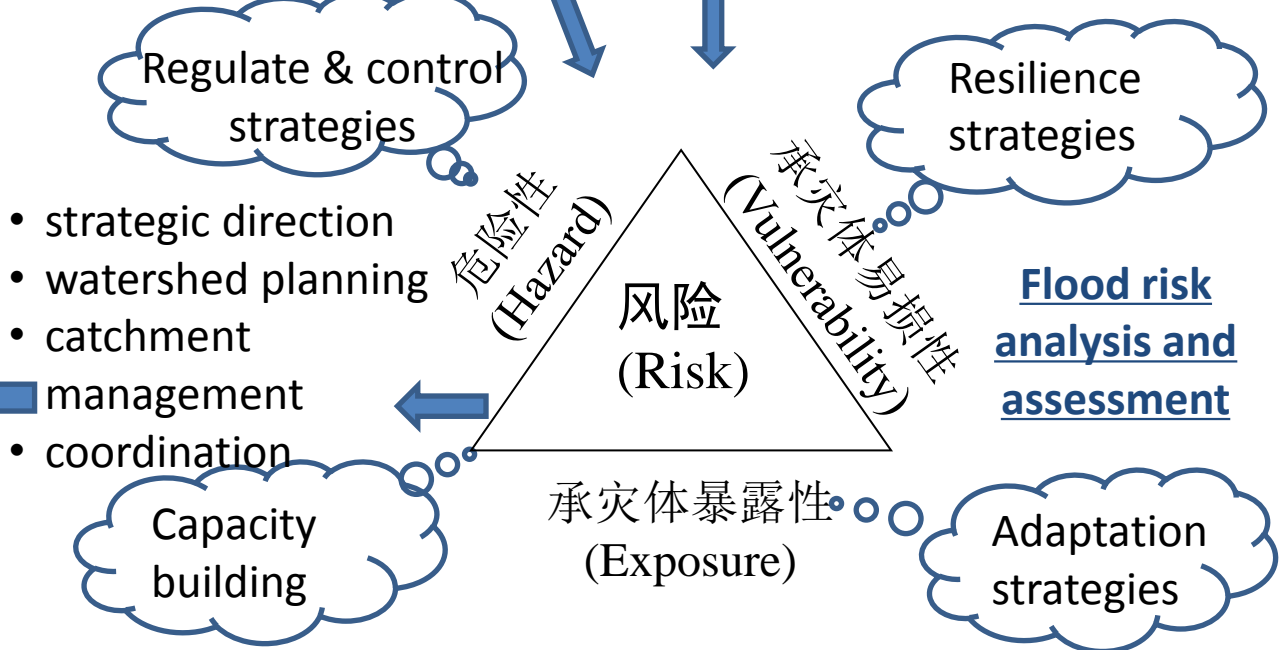
Basic concept for exploring Flood risk evolution and adaptive measures in the Taihu Basin



Foresight: theory+ technology

Global observation, Remote sensing, simulation, Scenario analysis, evaluation models, GIS, DB, system integration, etc.

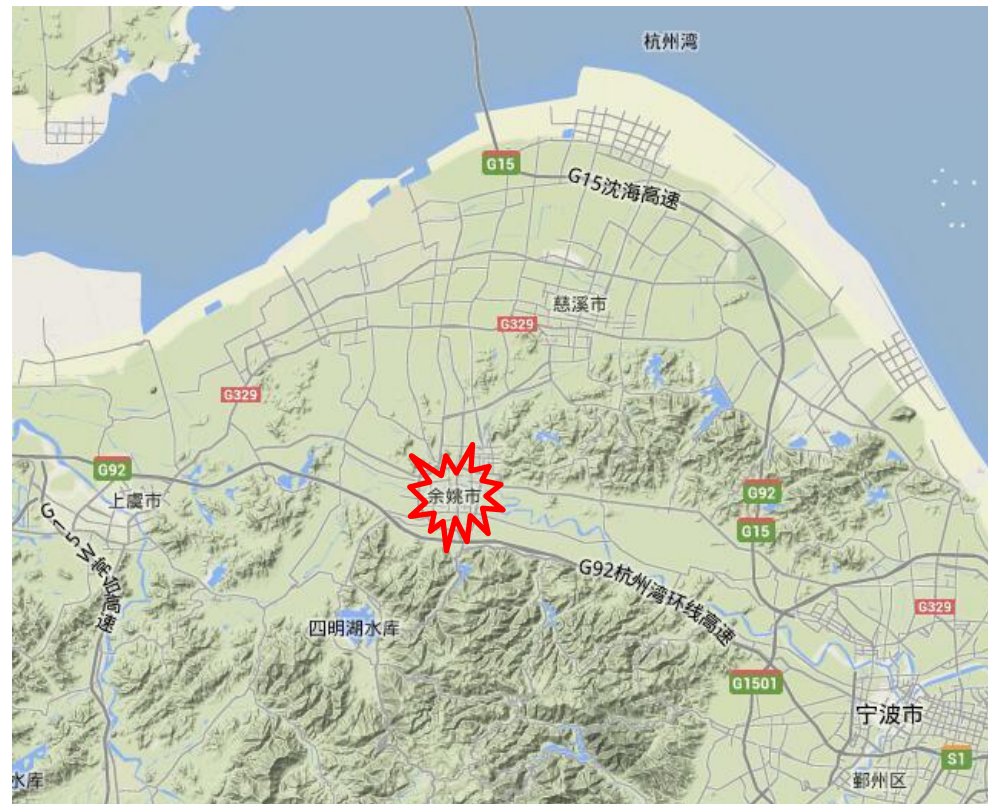
- Rapid urbanization and land use change;
- Flood-prone area with regional conflicts ;
- Impacts of economic development modes on the features of flood risk ;
- Sustainable development depends greatly on water management system;
- Sensitive to globe warming and sea level rising.



Crichton, David. The Risk Triangle. Natural Disaster Management. London: Tudor Rose, 1999

Urgent work: urban drainage planning at three scales

- Formulation and modification of flood control and urban drainage planning is an urgent work, which includes planning at three scales, river basin, municipality and community.



5. Conclusions

- Frequently occurred urban floods have become a serious threat to the public security, and smooth and rapid development.
- Aggravating trend of urban flood risks has not been effectively curbed and will last for a longer period, which should be fully recognized in decision making.
- Urban flood prevention is a system engineering with longevity and complexity, involving numerous departments and communities, which needs approaches to urban flood resilience with unified planning, comprehensive measures, and sustainable and stable investment support .

Thank you for your attention!

CHENG Xiaotao Professor, PhD

Vice Chief Engineer of IWHR

Deputy Coordinator of GWP China Regional Secretariat

Executive Chief Editor of Journal of Hydraulic Engineering - CHES

e-mail : chengxt@iwhr.com

Add: A-1 Fuxing Road, Beijing 100038, China



Legend

● Key cities

○ Major cities

