




Flood Mapping in China

**China Institute of Water Resources and
Hydropower Research (IWHR)**

**General Institute of Water Resources and Hydropower Planning
and Design, Ministry of Water Resources (GIWP)**

The background features a light blue gradient with several wavy, horizontal bands of darker blue. Three spheres are positioned on the right side: a large light blue one at the top, a medium purple one below it, and a large dark blue one on the left side, partially overlapping the main title area.

I. Contents and Major Results

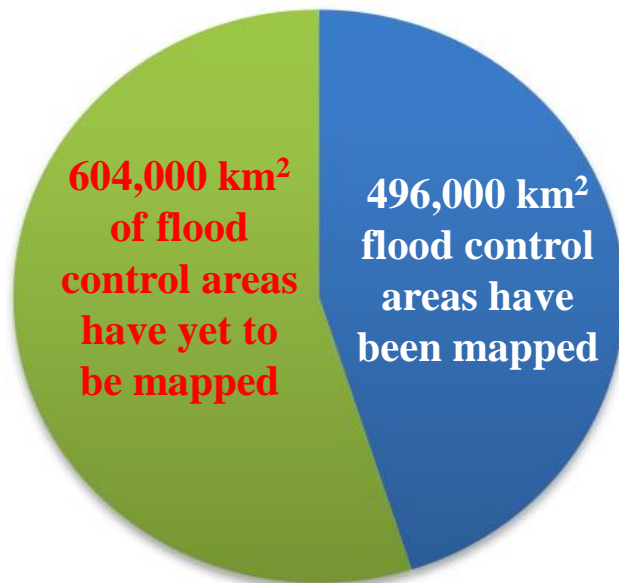


Based on a series of pilot studies since 1980s, China carried out a national flood mapping project in 2013, with a total investment of 1.302 billion yuan.

Leading teams with different levels were established by the Ministry of Water Resources, river basin water resources commissions and provinces (autonomous regions and municipalities), respectively. China Institute of Water Resources and Hydropower Research (IWHR) and General Institute of Water Resources and Hydropower Planning and Design, Ministry of Water Resources (GIWP) act as technical task force of the project, while various river basins and provincial design institutes or water resources and hydropower research institutes serve as regional technical supporting units. The project achieved expected outcomes.

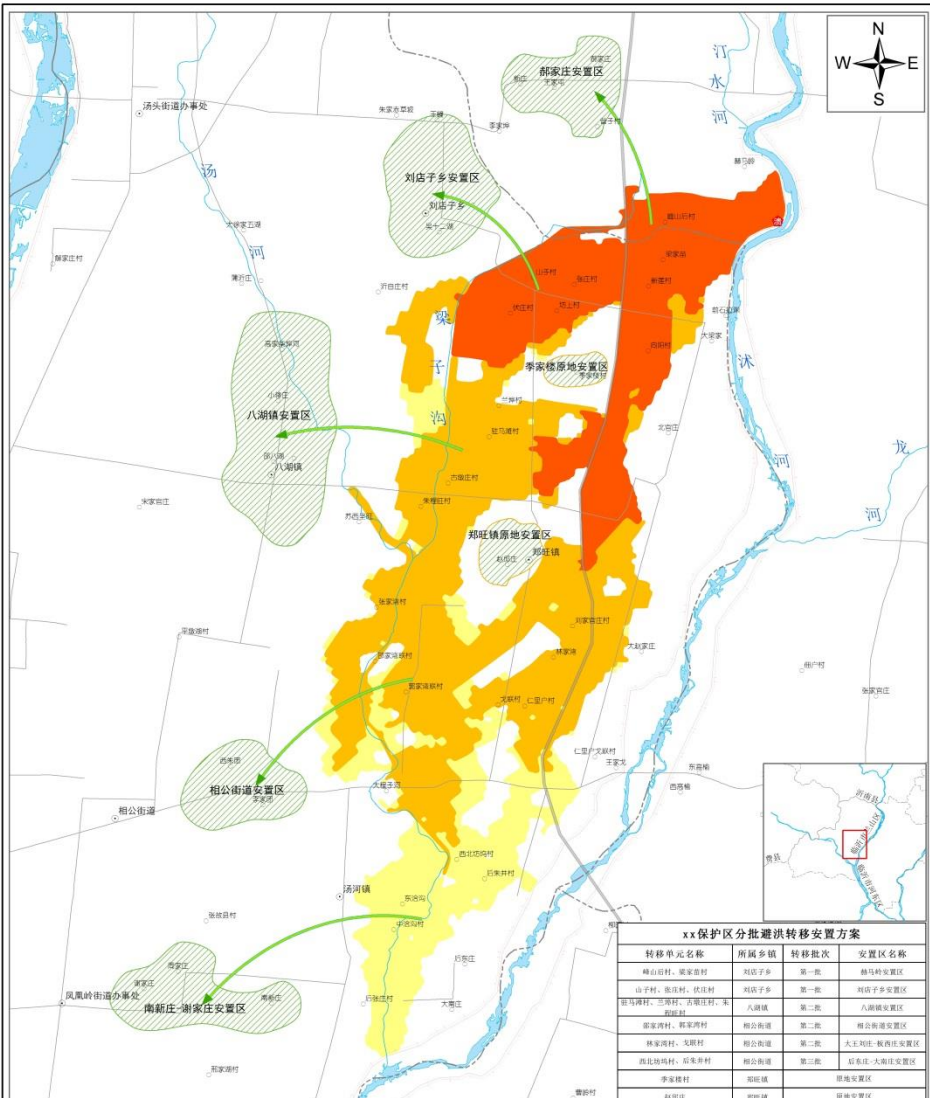
1. Flood mapping areas

The flood maps covered a total of **496,000 km²** flood control areas.
The products include flood hazard maps and flood evacuation maps.



About **1.1 million km²** flood control areas are required to be mapped nationwide

Flood evacuation map



图例

	渡口		县界
	原地安置区		第一批0-12h
	转移安置区		第二批12-24h
	转移方向		第三批>24h

0 1.25 2.5 5 Km

注: 可根据实际情况填写信息统计

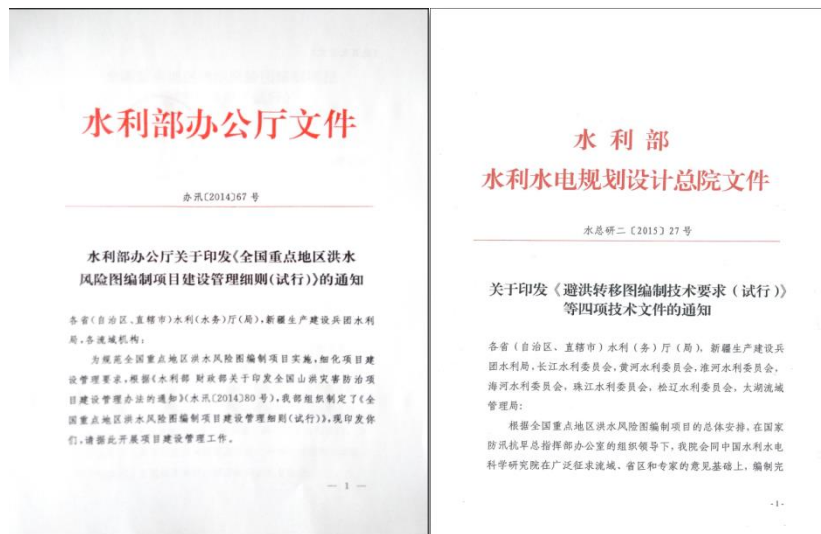
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2. Technical standards of flood mapping

A systematic flood mapping technical standards and codes have been established.

Multiple management normative documents (6)

- *Measures for the Administration of Project Review and Acceptance of Flood Mapping*
- *Measures for the Cost Calculation of flood mapping (Trial)*
- *Measures for the Administration of flood map Application (Review Draft)*
-



Multiple technical normative documents (12)

- *Flood Risk Mapping Guidelines*
- *Detailed Rules for Flood Mapping Technology*
- *Technical Requirements for the Flood Evacuation Mapping*
- *Data Classification, Encoding and Table Structure of Flood Maps*
- *Technical Requirements of flood mapping*
- *Requirements for Result Submissions of flood maps*
- *Specification for Result Summary and Integration of flood maps*
- *Technical Requirements for the Management and Application of Flood Maps at River Basin and Provincial Levels*
- *Specification for Service Interfaces of Flood Maps*
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3. Flood mapping technical tools and systems

Flood analysis software, flood damage assessment software, flood mapping software, and flood map management and application system have been developed.

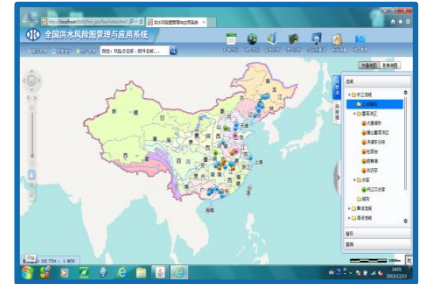
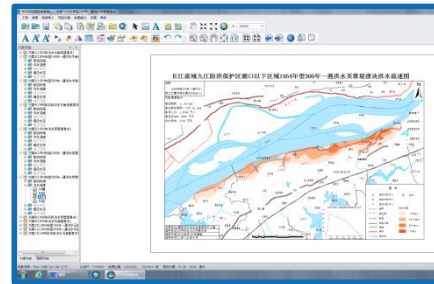
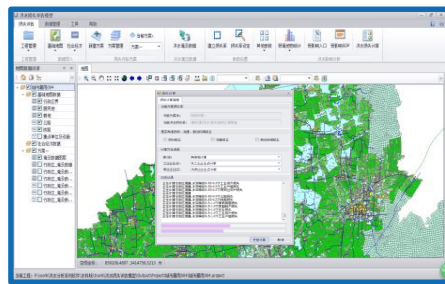
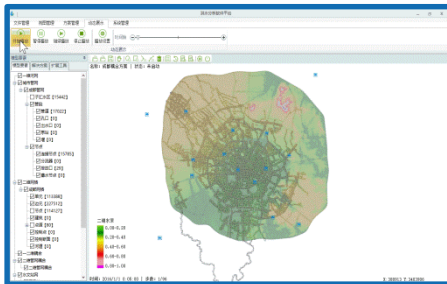
Universal technical platform for flood mapping

Flood analysis software

Flood damage assessment software

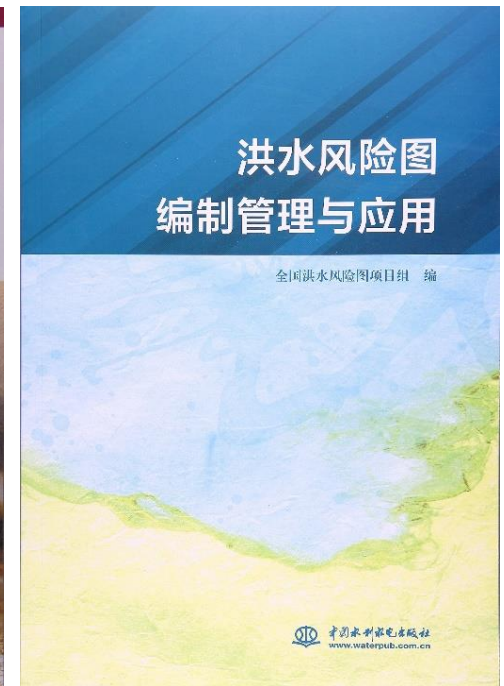
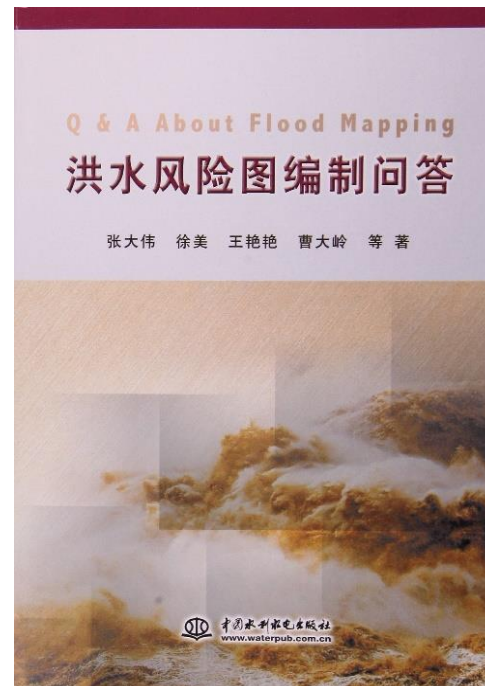
Flood mapping software

Flood map management and application system



4. Training

86 units and about **800 people** have taken part in flood mapping projects. Over **2,000 people** have been trained during the progress of the project.



5. Overall scheme of flood mapping formulation

The *Overall Scheme of the National Flood Mapping* was formulated. It figured out the demands and distributions of flood mapping nationwide, proposed **the general goal and key tasks at different stages** of the national mapping work, and put forward **the highlights of classified mapping** based on it.

Risk mapping statistics in centralized flood control areas of middle and lower reaches of big rivers


Middle and Lower Reaches of Seven Rivers		Type				Total Area (km ²)
		Flood Control Reserve Area	National Flood Storage and Detention Area	Regional Flood Storage and Detention Area	Flooded Area	
Yangtze River	Number	70	40	7		105556
	Area (km ²)	83487	12035	721	9312	
Yellow River	Number	4	2	0		134206
	Area (km ²)	126078	2943		5185	
Huaihe River	Number	47	21	1		174989
	Area (km ²)	166408	5651	695	2235	
Haihe River	Number	41	28	3		122002
	Area (km ²)	109334	10692	708	1267	
Pearl River	Number	31	1	0		9831
	Area (km ²)	7548	80		2202	
Songhua River	Number	12	2	2		81305
	Area (km ²)	41070	2680	372	37183	
Liao River	Number	13	0	0		35708
	Area (km ²)	21457			14251	
Total	Number	218	94	13		543597
	Area (km ²)	435383	34082	2496	71635	

Status and highlights of urban flood mapping

		Number	Key Flood Control City	Major Flood Control City	Common Flood Control City	Total
Required			31	54	544	629
	Mapping area (km ²)		12326	13317	28014	53657
Finished			21	20	3	44
	Mapping area (km ²)		8425	4252	547	13224
Unfinished	Completely unfinished city		10	34	541	585
	Mapping area (km ²)		2007	8611	27467	38085
	City with inadequate mapping area		13	12	1	26
	Mapping area (km ²)		3245	1872	32	5149
Total		Mapping area (km ²)	5252	10483	27499	43234
Key Arrangements			10	34	35	79
		Mapping area (km ²)	2007	8611	5961	16579



II. Application of flood maps

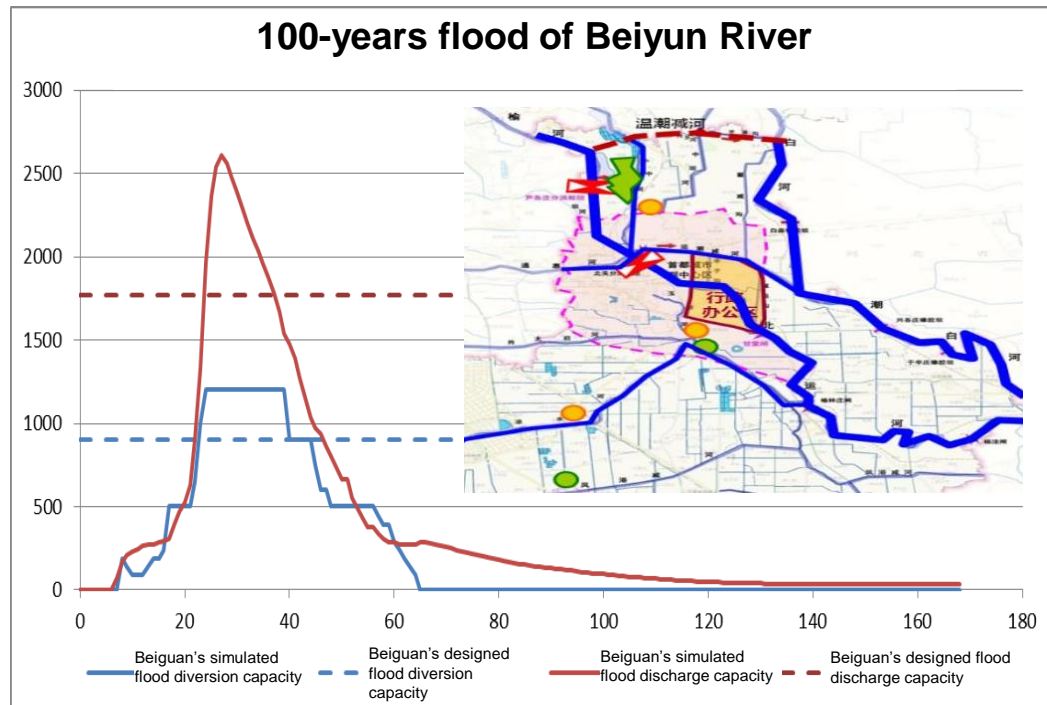


With both mapping and application at the core, the pilot applications of flood maps have been organized at the right time, and more efforts have been made in the application of flood mapping products.

- ✓ In July 2015, the *Circular on Strengthening the Quality Management and Application of flood maps* and, in May 2016, the *Circular on Carrying Out the Pilot Application of flood mapping products in 2016* were issued, with **the pilot application guide** included.
- ✓ Since the launch of the project, the flood maps have been preliminarily applied to such areas as **flood control planning, contingency plan making, emergency response, flood defense decision support, compensations for detention basins, flood impact evaluation, public awareness and flood insurance.**

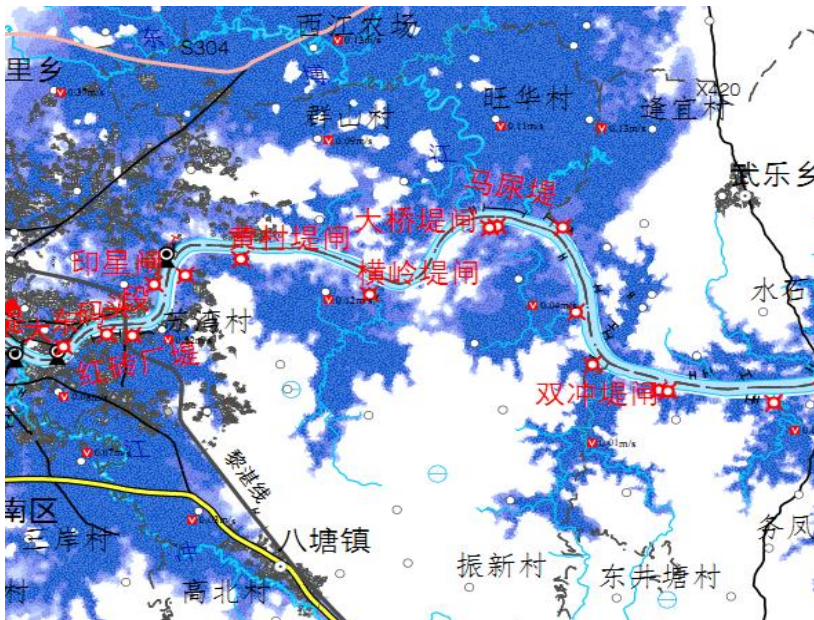
1. Flood control planning

- ✓ Beijing has calculated the design flood process and flooding area of the Wenchaojian River and the Yunchaojian River using flood analysis software, providing support for the planning on flood control works of Beiyun River and a flood detention area in Tongzhou District as the subcenter of Beijing.

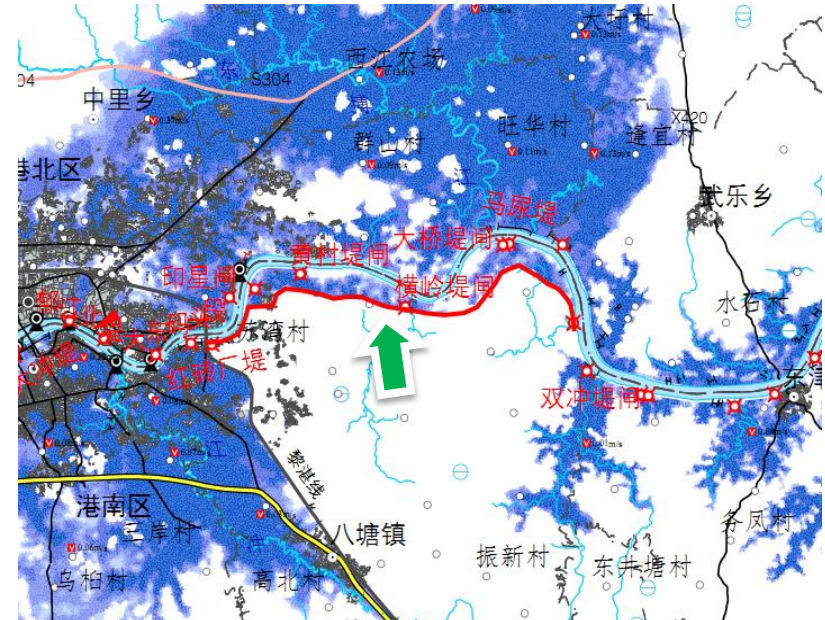


1. Flood control planning

- ✓ Anhui province has analyzed urban flood hazard and inundation areas using the Hongquan flood maps, providing consultation for the selection of urban levees in Fuyang city, and optimizing the urban flood control pattern.
- ✓ Guangxi province has mapped the inundation situation of the Guigang reach of the Yujiang River due to the dike construction. After levee construction, the region will decrease the inundation area by about 18 km² and increase the protected population by around 100,000 in case of flood of 50 year return period, bringing remarkable benefits.



Inundation situation before embankment construction

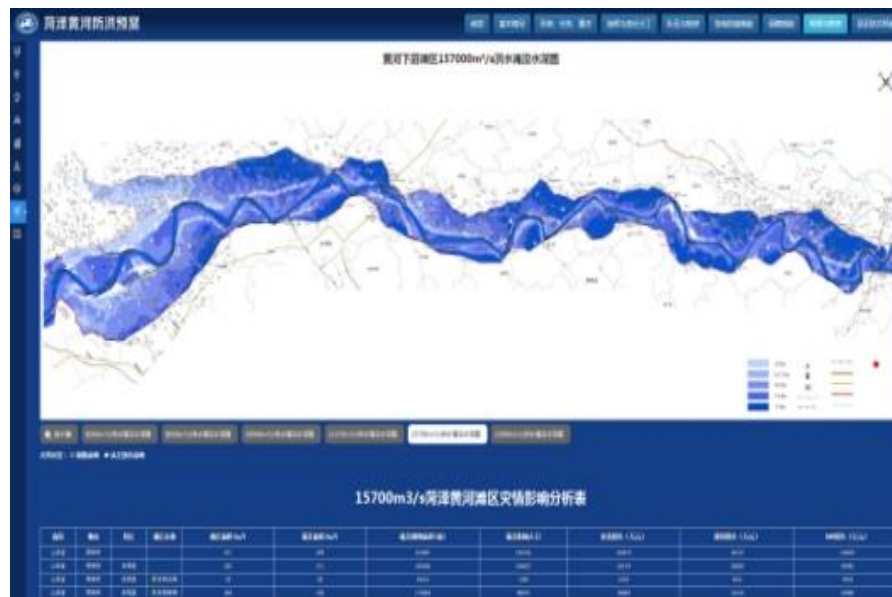


Inundation situation after embankment construction

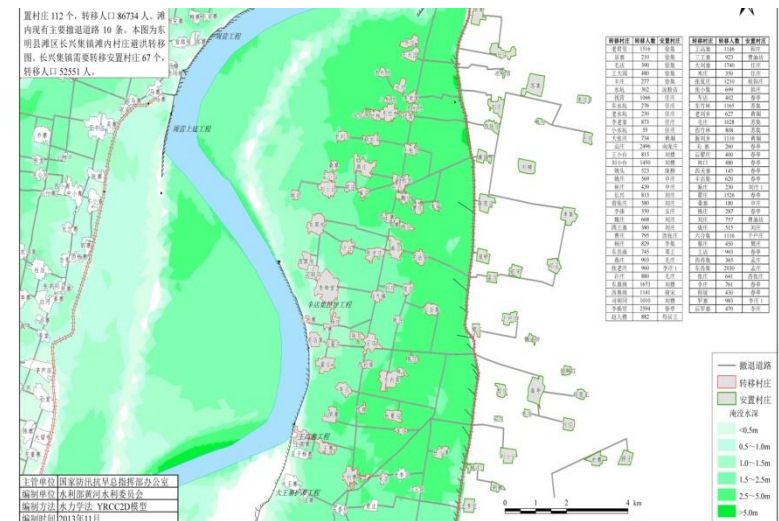
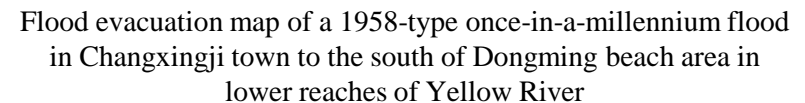
2. Contingency plan making and amendments

- ✓ Henan province has analyzed the impact and damage of flood diversion by setting different forced flood diversion location of Laowangpo detention basin, and proposed the optimizing flood diversion way, which can reduced the number of villages to be inundated and people required to be evacuated.
- The flood map indicates that if the right bank levee located in the east of Yangzhuang of the Xiaohonghe River is forced to divert flood, exceeding design flood will pose a threat to Xiping county, National Highway 107 and the Beijing-Guangdong Railway, inundate a lot of villages and bring huge damages.
- If the forced diversion location is changed to the left bank of lower reaches of the Yangzhuang sluice, the damage will be smaller and the solution is feasible.

Based on the flood depth map, the flood routing map, the flood evacuation map, etc., the Yellow River Conservancy Commission has improved and optimized the flood control contingency plan in the middle reaches and the lower reach of Yellow River .



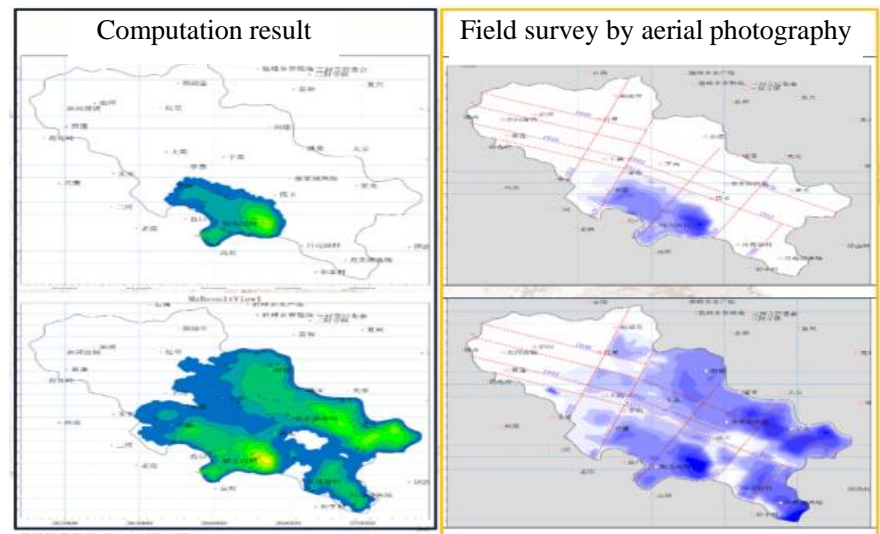
Flood maps of Yellow River visualized internet flood control contingency plan application in Heze City



Flood evacuation map of Dongming beach area in lower reaches of Yellow River

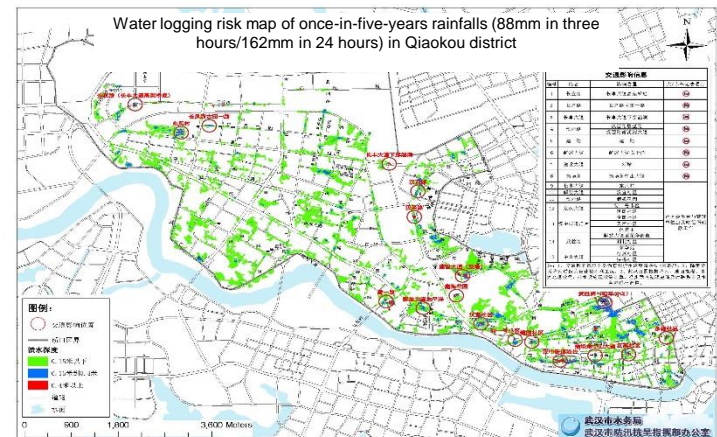
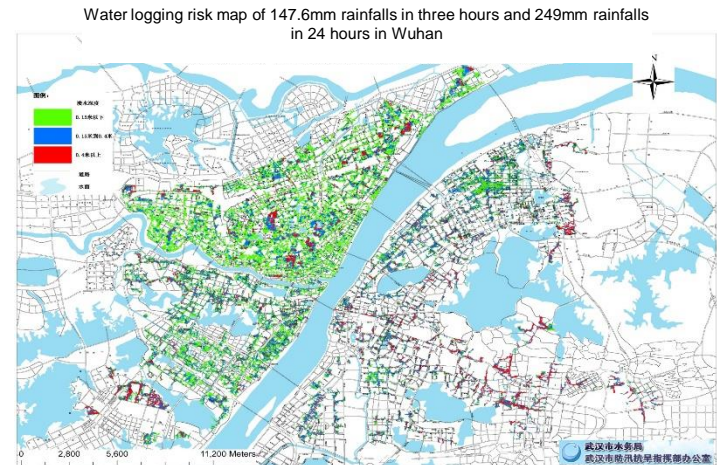
3. Emergency response

As the dyke of Xinquayuan in Huarong county of Hunan province breached on July 10, 2016, the flood analysis model of Qianliang Lake detention basin was used to calculate the inundation area and depth maps at 6, 8, 12, 24, 36 and 48 hours after the breach within two hours. Based on this results and flood maps, the Office of Hunan Flood Control and Drought Relief Headquarters was able to achieve real-time scheduling, and organize personnel evacuation timely, thus leading to zero casualty.



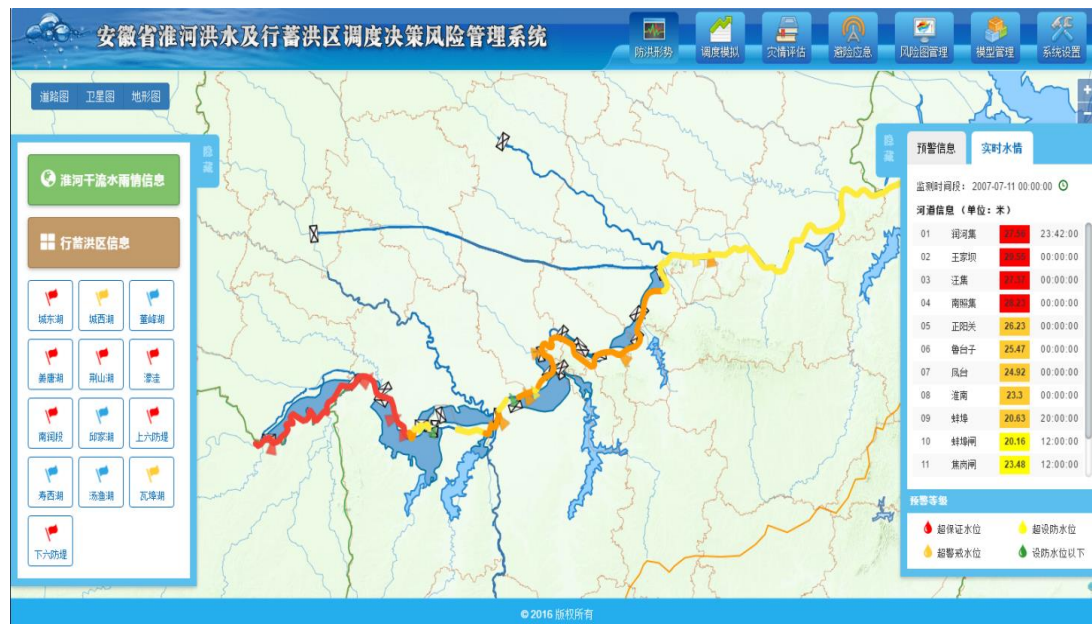
Comparisons of the inundations between computation and field survey by aerial photography

During the torrential rain period between June 30 and July 6, 2017, Wuhan city anticipated the urban flooding using the flood maps, issued early warning to the public timely, and proposed emergency drainage measures, thus reducing the inundation area and mitigating the flood damages. After the flood, the city used the flood analysis model to calculate storm flood situation, providing a planning basis for the upgrading and renovation of drainage systems.



4. Flood defense decision support

- ✓ Beijing, Shanghai, Zhejiang, Jiangsu, Anhui, Jilin, Henan and other regions have included the flood analysis model and the flood maps products into their flood defense decision systems, providing technical support for flood defense.



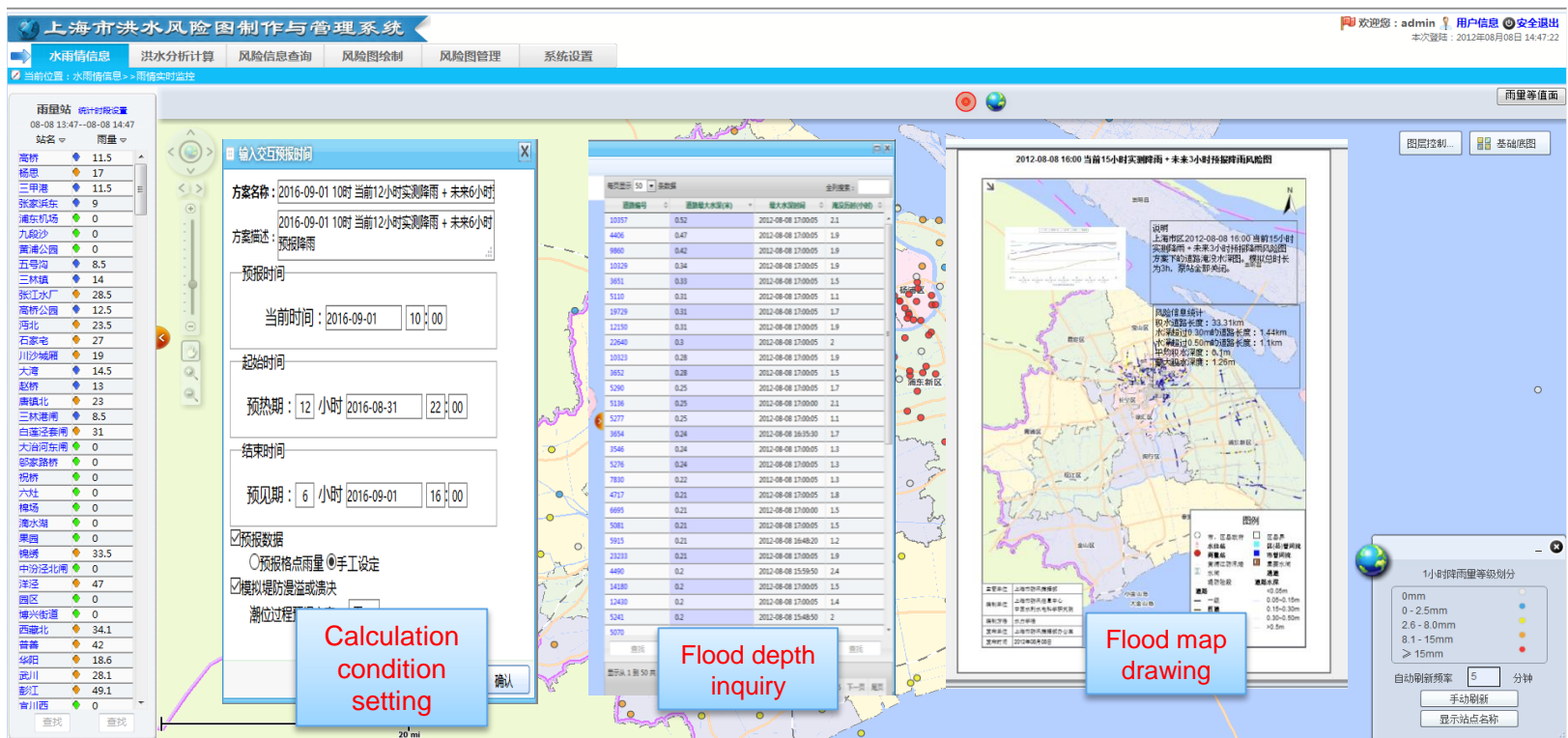
Flood control situation analysis and early warning information display



Comparison of water levels at different nodes before and after scheduling

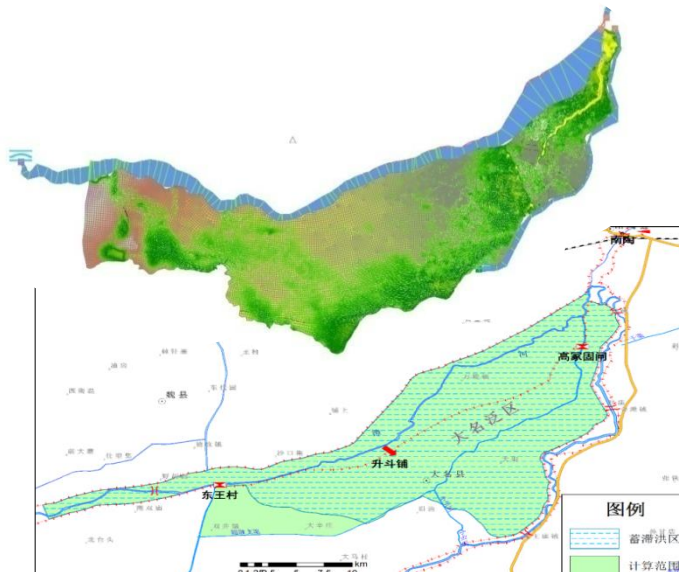
4. Flood defense decision support

- ✓ Cities such as Beijing, Shanghai, Chengdu, Wuhan, Jinan and Ningbo have achieved on-line analysis of storm flood by deeply docking storm forecast data with the flood map system, thus providing decision support for defense of storm flood disasters.

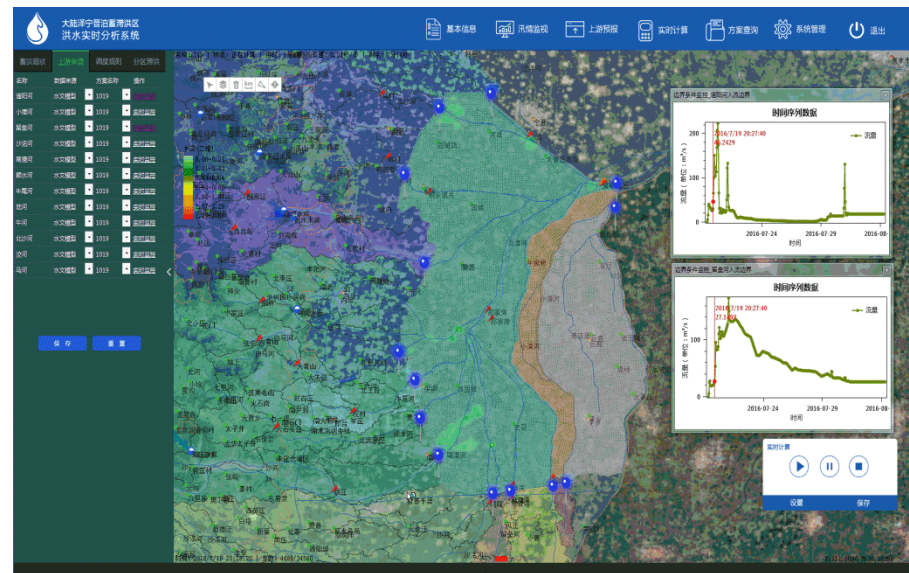


4. Flood defense decision support

- ✓ The Haihe River Water Conservancy Commission, MWR, has established the real-time flood analysis systems in Daluze and Ningjinpo detention basins, which can be used to provide evacuation decisions support for local government.



Real-time simulation of flood evolution



Real-time flood analysis system

5. Evacuation

- ✓ Based on the flood maps, the Yellow River Conservancy Commission, MWR, has built a early warning and evacuation platform for the beach areas in the lower reaches of the Yellow River. The platform aims to release early warning information to primary level flood defense agencies via WeChat, and can own 100,000 users. It is easy to use, transmits information quickly and covers a wide range.

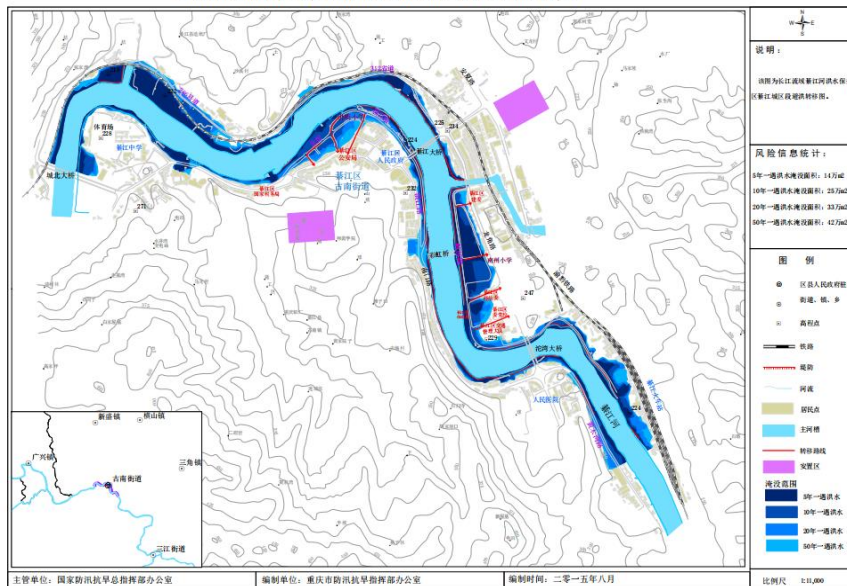


Evacuation early warning platform for the beach areas in the lower reaches of the Yellow River available for trial operation

5. Evacuation

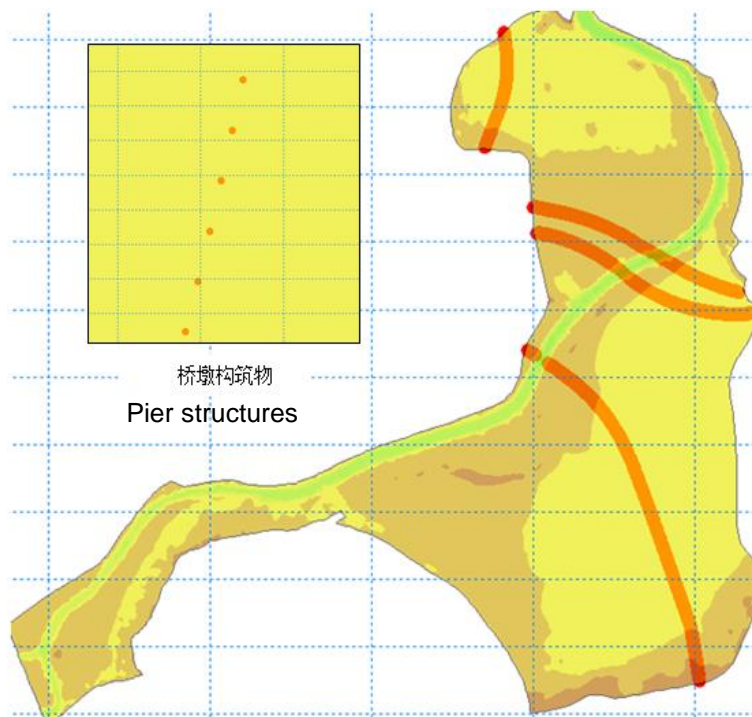
In June, 2016, Qijiang district of Chongqing city used the flood maps to issue early warning to the public, and inform citizen evacuating routes.

Flood evacuation map of Qijiang downtown in
Qijiang River flood protection area of Chongqing

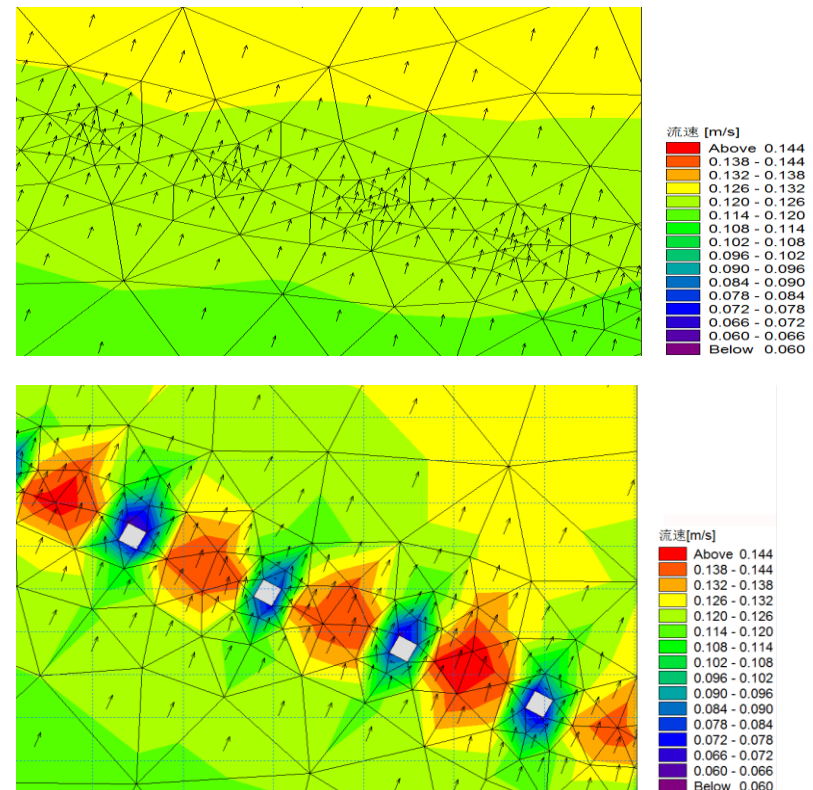


6. Flood impact evaluation

- ✓ Anhui province has used the flood maps of the Dongfeng Lake and Shouxi Lake flood passage areas to provide support for the flood impact evaluation of the Shangqiu-Hefei-Hangzhou Railway.



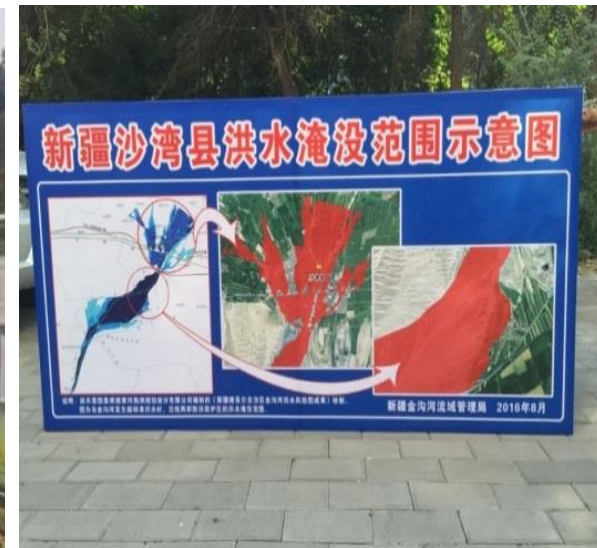
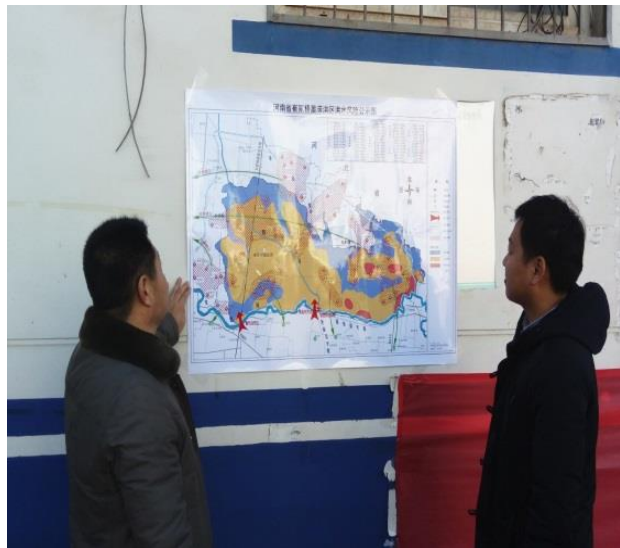
Sketch map of pier structures of three bridges in flood analysis model



Sketch map of flow fields of 307#~310# piers in Shouxi Lake flood passage area before and after the construction of the bridge

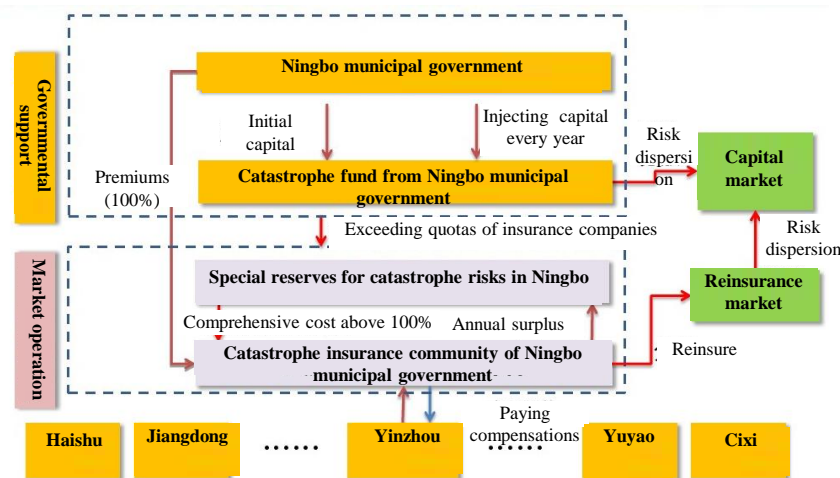
7. Public awareness

- ✓ Henan and Anhui provinces have set up flood risk bulletin boards in Cuijiaiao, Laowangpo, Mengwa flood detention areas, etc., marked with the profiles of detention basins, flood depth distribution, safety zones, and evacuation routes, etc.
- ✓ The Xinjiang Uygur Autonomous Region has set up display boards in key reaches of the Toutun River, carrying out on-site flood risk awareness education.



8. Flood insurance

- ✓ The urban flood maps of Ningbo city provide flood hazard information for insurance companies to confirm the insured value and its flood risk; the city utilizes the flood analysis system to release flood early warning information to insurance companies, then insurance companies inform insurant to take actions mitigating damages.
- ✓ China Institute of Water Resources and Hydropower Research (IWHR) and China Reinsurance Group signed a strategic cooperation agreement, according to which both parties selected Beijing and Shanghai as pilot cities to carry out the flood insurance study base on the flood maps .



Framework of urban catastrophe insurance in Ningbo



IWHR and China Re Group signed strategic cooperation agreement