



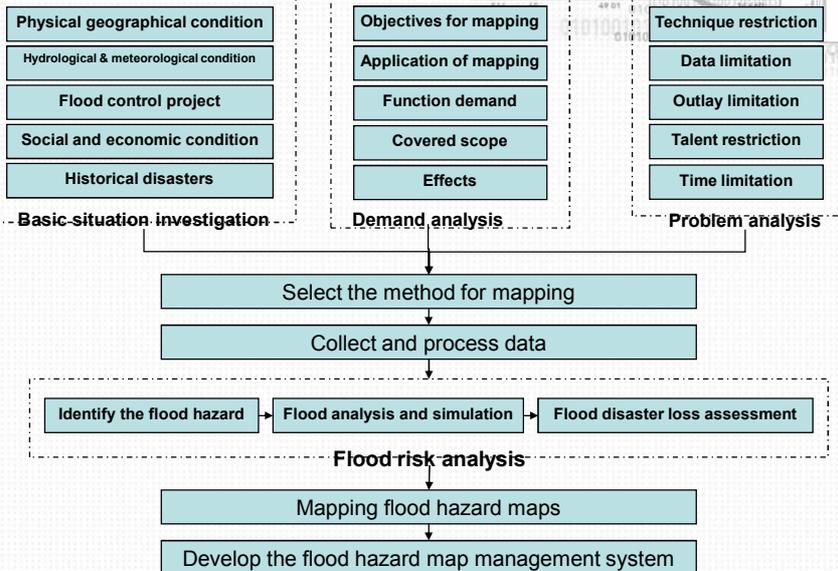
# Flood Hazard Mapping in Dujiatai and Honghu Flood Detention Areas

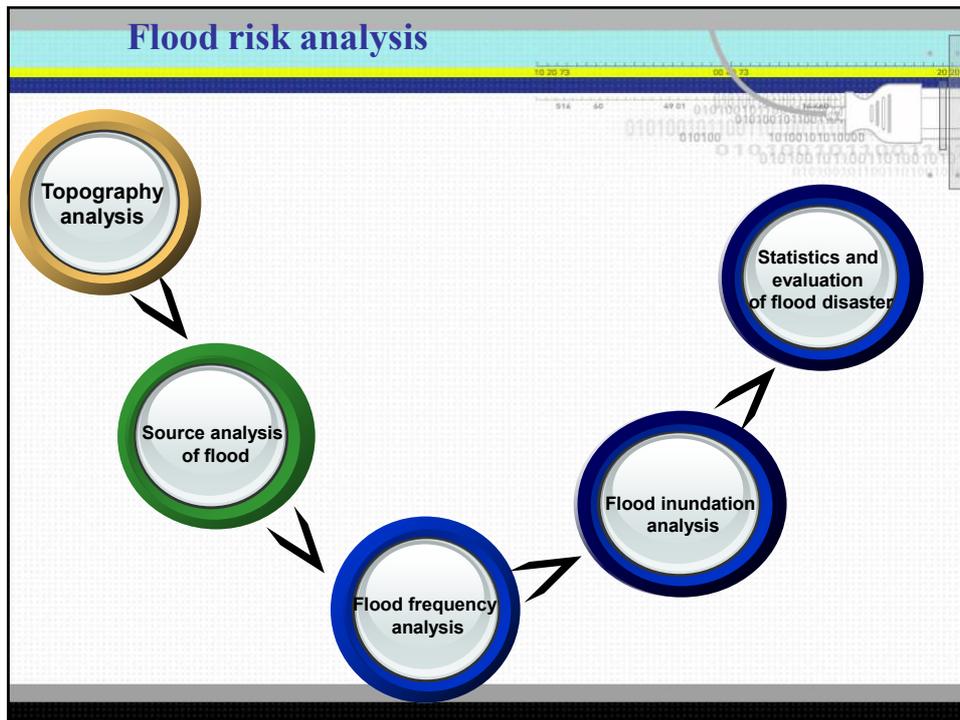
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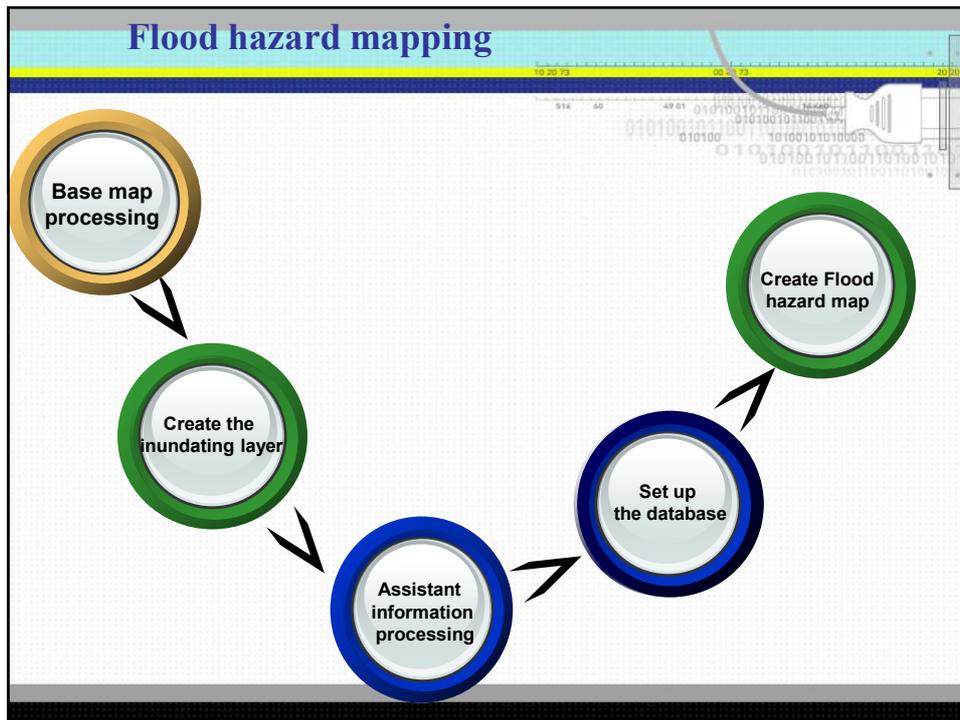
Feb.17, 2009

## General method for mapping



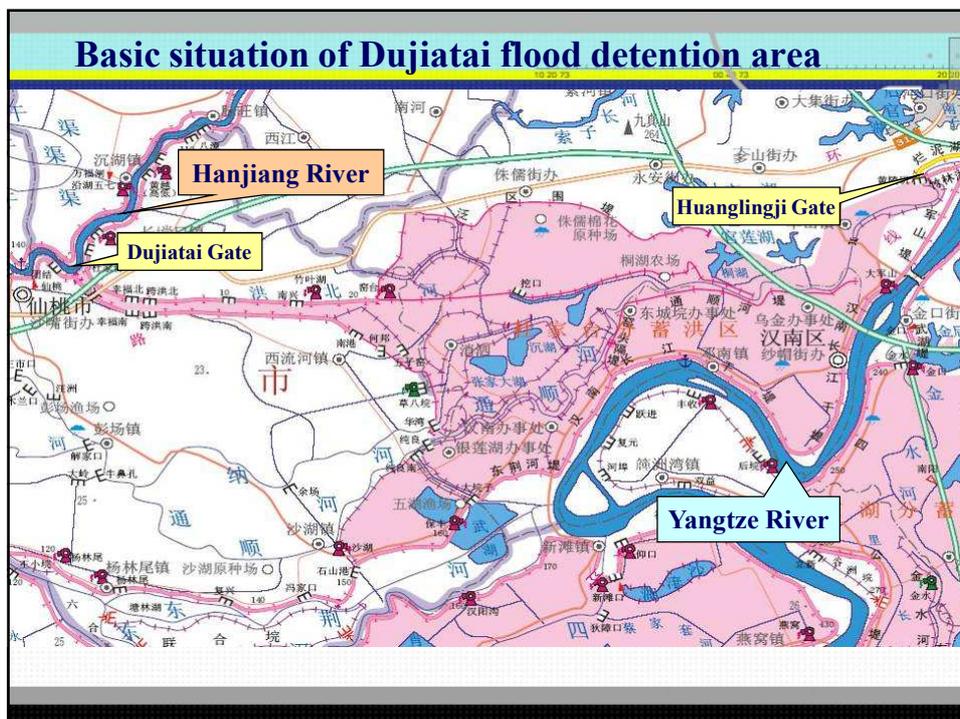


- ### Flood risk analysis
- Topography analysis
  - Source analysis of flood
    - Rainstorm, flash flood, high tidal level, projec damage, etc.
    - Flood frequency analysis
    - Stage, discharge and frequency, etc.
  - Inundation analysis
    - Area, water depth, duration of flooding and velocity of flow, etc.
  - Statistics and evaluation of flood disaster
    - Possible affected population, assets, loss, etc.



- ## Flood hazard mapping
- Base map processing
    - Topography map, district map, water conservancy project map, socioeconomic map
  - Create the inundating map
    - inundated area, water depth, duration of flooding and inundated process, etc.
  - Assistant information processing
    - Name of map, basic legend, inundating legend, scheme explanation, statistic and evaluation information of flood disaster, north arrow, producer and date, etc.
  - Create the flood risk map
    - Base map, inundating map layers and assistant information.

# Flood hazard mapping in Dujiatai flood detention area



## Situation of polder area

- In Dujiatai flood detention area, there are 20 polder areas, 9 polder areas in river beach. The population is 256,200 and the total cultivated area is 31,000 ha.
- The area of flood detention area is 613.98 km<sup>2</sup>. The total length of dike is 183.25 km.
- The storage capacity of the detention area below 28.00m is 3.861 billion m<sup>3</sup>, and 2.671 billion m<sup>3</sup> below 26.00m.
- Intake gate: Dujiatai flood diversion gate with 4,000 m<sup>3</sup>/s of design discharge and 5,300 m<sup>3</sup>/s of check discharge.
- Gate for retreating flood: Huanglingji gate with 1,535 m<sup>3</sup>/s of design discharge and 2,008 m<sup>3</sup>/s of check discharge.

## Function of the detention area

- The function of Dujiatai detention area is to discharge the excessive floodwater in the lower reaches of Hanjiang River in order to ensure the safety of the lower reaches of Hanjiang River and Wuhan city.
- When a big flood happens in Yangtze River, it also needs to store and adjust the excessive flood in the main reaches of Yangtze River.

## Use of Dujiatai detention area in history

The Dujiatai detention area has been used for 20 times since 1956.

Num.	Year	The maximum discharge of intake flood(m <sup>3</sup> /s)	The highest storage volume of flood (billion m <sup>3</sup> )	Duration for flood diversion (h)	Num.	Year	The maximum discharge of intake flood(m <sup>3</sup> /s)	The highest storage volume of flood (billion m <sup>3</sup> )	Duration for flood diversion (h)
1	1956	2,510	0.514	100	11	1964	2,060	1.028	169.7
2	1956	3,120	0.837	131.28	12	1964	4,350	1.52	148.34
3	1957	1,380	0.313	63.31	13	1964	5,600	2.509	172.4
4	1958	3,230	0.73	87.1	14	1974	1,790	0.283	53.6
5	1958	4,800	0.257	190.34	15	1975	3,300	0.324	49.48
6	1958	2,305	0.543	79.47	16	1975	3,980	0.682	72.18
7	1958	2,270	0.738	93.15	17	1983	5,100	2.306	182
8	1960	4,755	1.977	234.24	18	1983	2,860	0.596	81
10	1964	2,400	0.438	70.8	20	2005	1,648	0.368	85

## Flood disaster losses of the flood diversion in history

Name of district	Year	Number of locations where dike break happened	Cultivated area inundated (ha)	Inundated building	Affected population (person)	Death (person)	Loss (×10 <sup>4</sup> yuan)
Caidian district of Wuhan city	1958	1	2,400			13	60
Xiantao city	1960		720		1,050		180.5
Caidian district, Xiantao City	1964	6	2,163	641	10,545		468.5
Xiantao city	1974	2	720		1,100		263.2
Caidian district, Xiantao City	1975	7	3,967		1,150		585.5
Caidian district, Xiantao Cit	1983	13	3,053	6,360	45,564	1	9,175
Caidian district, Xiantao Cit	1984	10	3,780	1,429	8,005		5,123
Caidian district, Xiantao City	2005	2	108		7,381		4,848
	Total	41	16,912	8,430	74,795	14	20,703.7

## Flood risk analysis

**Continuity equation:**

$$\frac{\partial H}{\partial t} + \frac{\partial M}{\partial x} + \frac{\partial N}{\partial y} = q$$

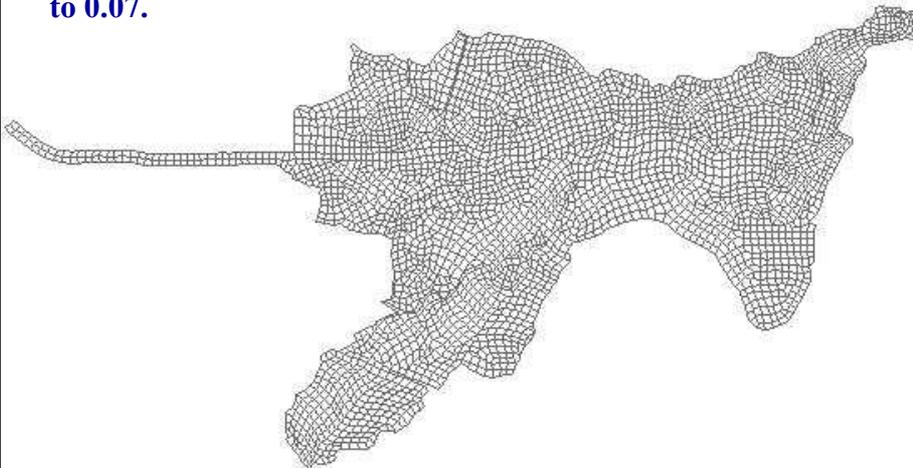
**Momentum equations:**

$$\frac{\partial M}{\partial t} + \frac{\partial(uM)}{\partial x} + \frac{\partial(vM)}{\partial y} + gH \frac{\partial Z}{\partial x} + g \frac{n^2 u \sqrt{u^2 + v^2}}{H^{1/3}} = 0$$

$$\frac{\partial N}{\partial t} + \frac{\partial(uN)}{\partial x} + \frac{\partial(vN)}{\partial y} + gH \frac{\partial Z}{\partial y} + g \frac{n^2 v \sqrt{u^2 + v^2}}{H^{1/3}} = 0$$

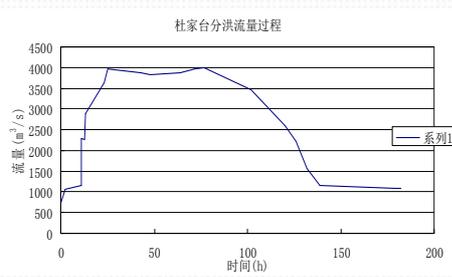
## Flood risk analysis

The study area is divided into 3108 irregular meshes. The roughness of river type mesh is 0.027 and others are from 0.04 to 0.07.

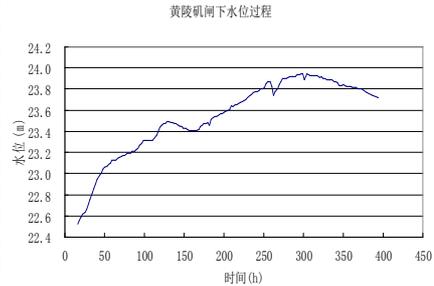


## Calculation conditions

- Upper boundary condition : flood discharged from Dujiatai Gate
- Lower boundary condition : flood discharged from Huanglingji Gate



Dujiatai Gate



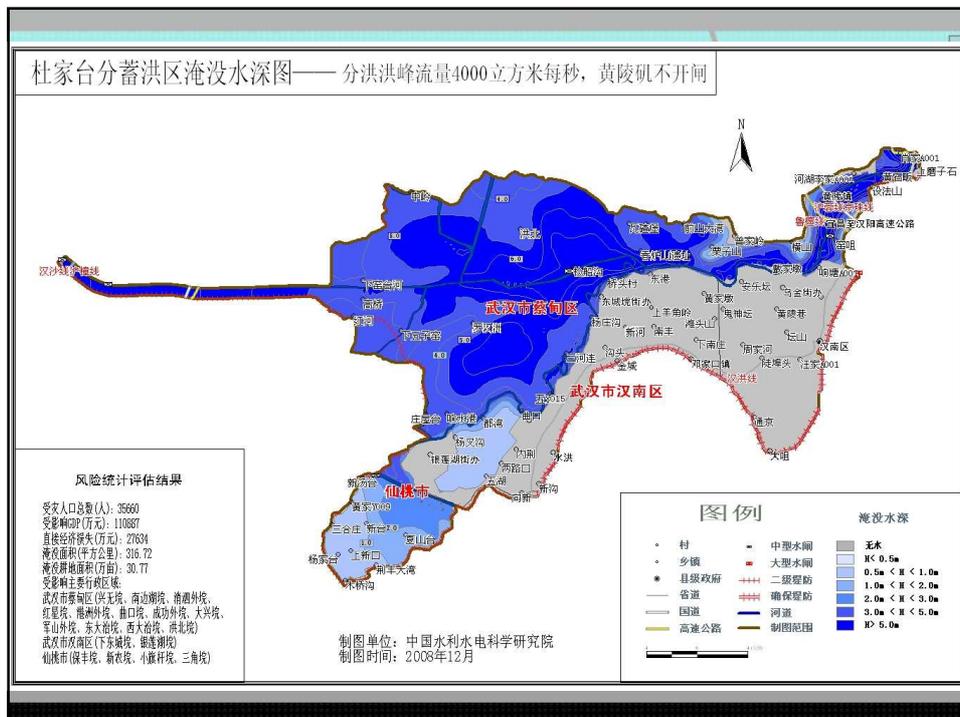
Huanglingji Gate

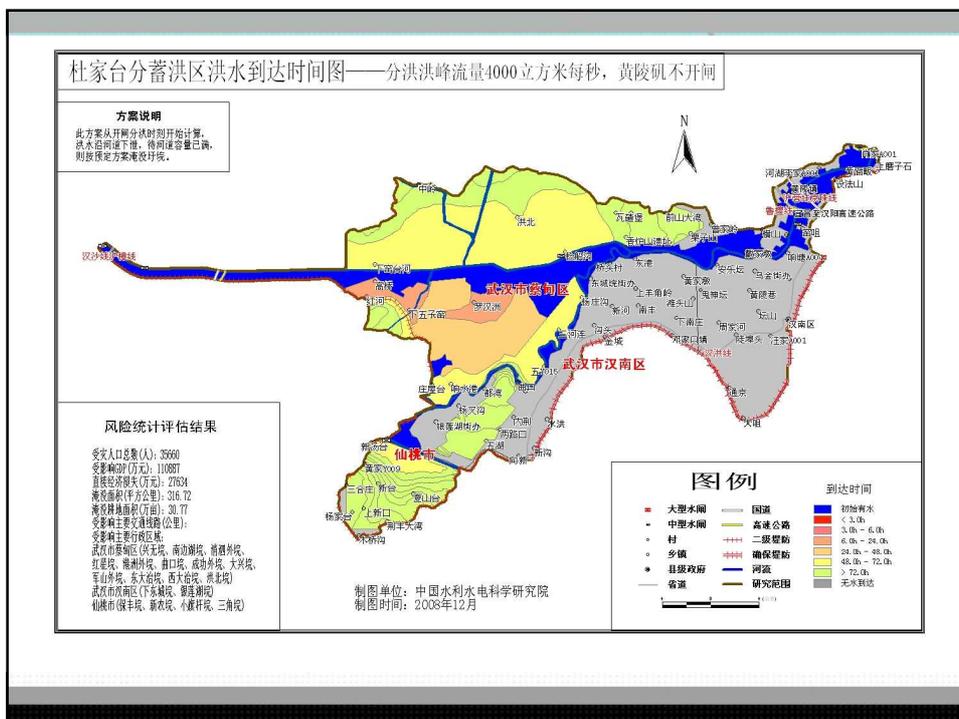
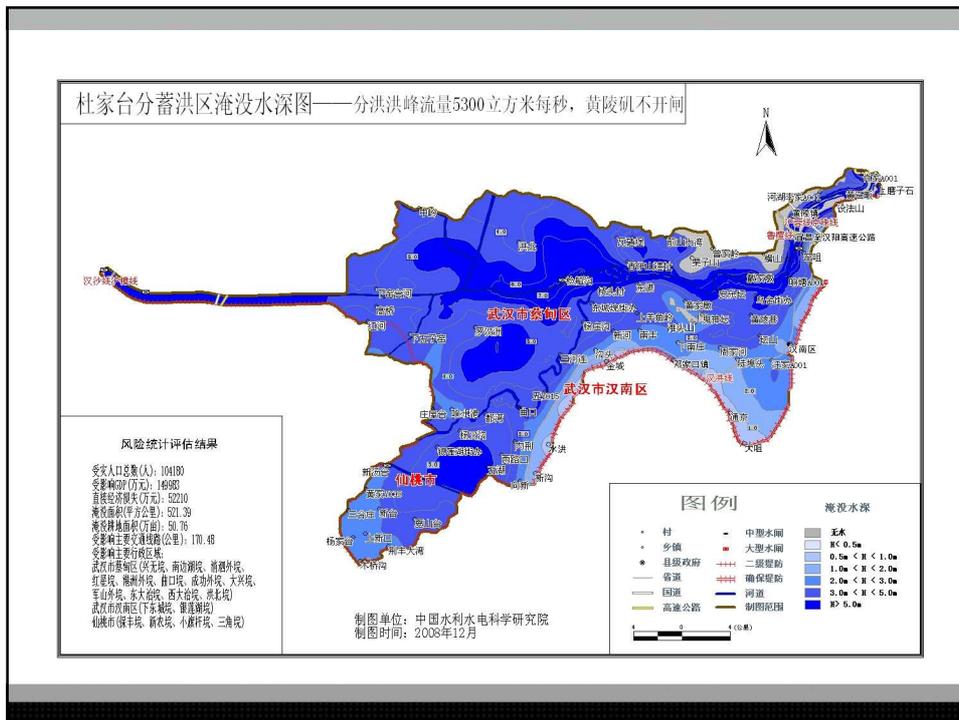
## Calculation conditions

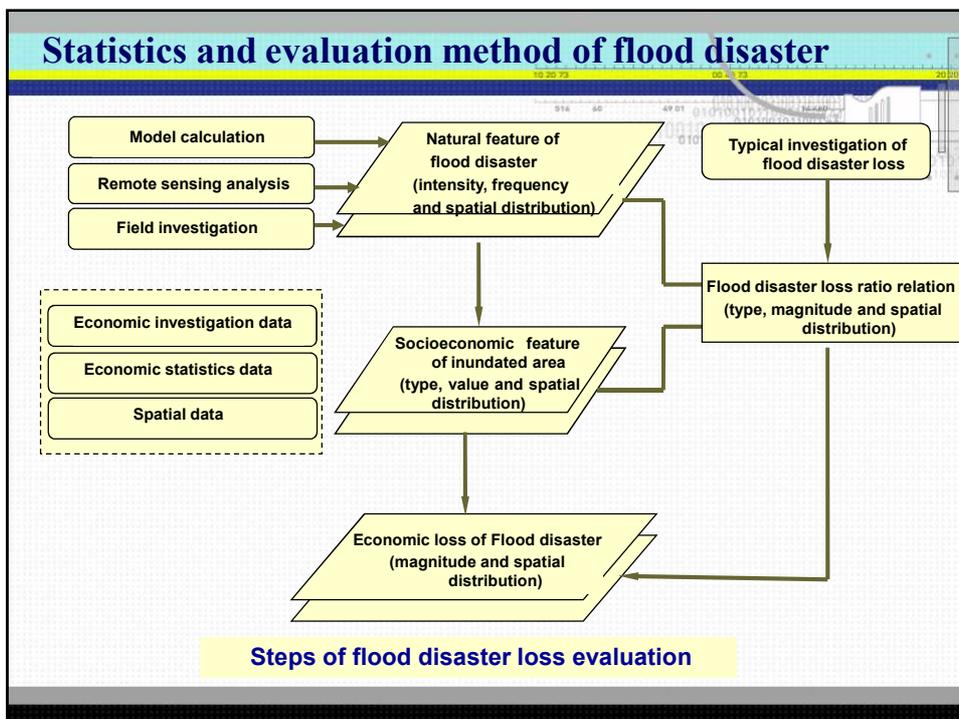
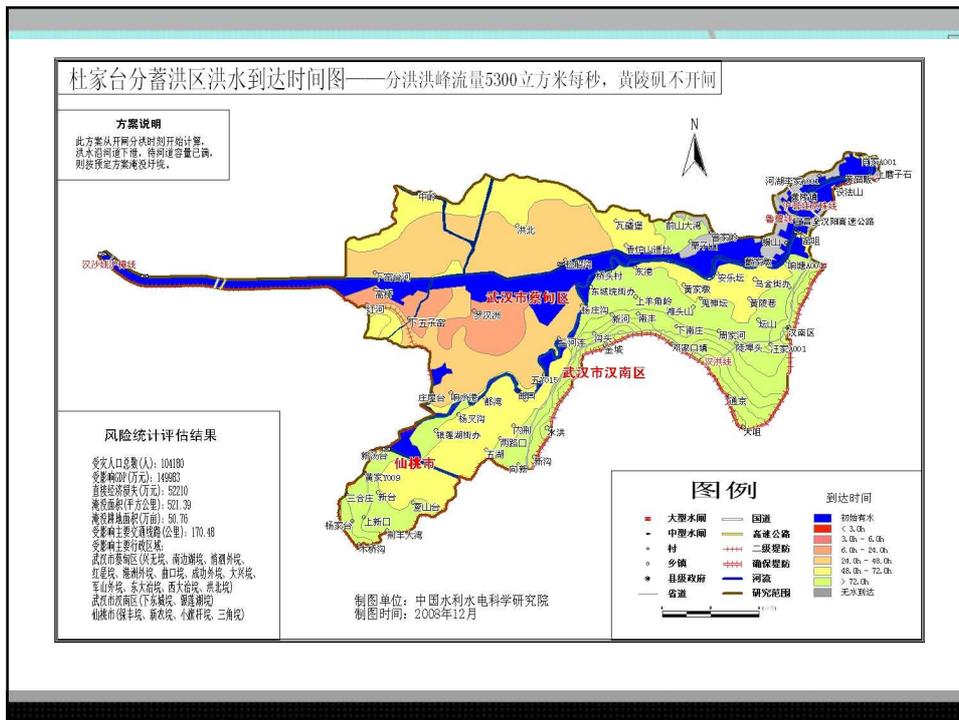
- The gates and dikes inside the study area are the inner boundary conditions of the model.
- The operation schemes of flood control projects in study area are considered in the calculation.

## Calculation schemes

Num.	Name of scheme	Description
1	djt_4000	Typical flood diversion process whose flood peak discharge is equal to the design flood diversion discharge (4000m <sup>3</sup> /s) of Dujiatai gate. Huanglingji gate is closed because of the backwater effect of Yangtze River.
2	djt_5300	Typical flood diversion process whose flood peak discharge is equal to the check flood diversion discharge (5300m <sup>3</sup> /s) of Dujiatai gate. Huanglingji gate is closed because of the backwater effect of Yangtze River.
3	djt_4000_38	Typical flood diversion process whose flood peak discharge is equal to the design flood diversion discharge (4000m <sup>3</sup> /s) of Dujiatai gate and the total flood diversion volume is 3.861 billion m <sup>3</sup> . Huanglingji gate is closed because of the backwater effect of Yangtze River.
4	djt_5300_38	Typical flood diversion process whose flood peak discharge is equal to the check flood diversion discharge (5300m <sup>3</sup> /s) of Dujiatai gate and the total flood diversion volume is 3.861 billion m <sup>3</sup> . Huanglingji gate is closed because of the backwater effect of Yangtze River.
5	djt_4000-d	Typical flood diversion process whose flood peak discharge is equal to the design flood diversion discharge (4000m <sup>3</sup> /s) of Dujiatai gate. Typical downstream stage process of Huanglingji gate.
6	djt_5300-d	Typical flood diversion process whose flood peak discharge is equal to the check flood diversion discharge (5300m <sup>3</sup> /s) of Dujiatai gate. Typical downstream stage process of Huanglingji gate.
7	djt_4000_38-d	Typical flood diversion process whose flood peak discharge is equal to the design flood diversion discharge (4000m <sup>3</sup> /s) of Dujiatai gate and the total flood diversion volume is 3.861 billion m <sup>3</sup> . Typical downstream stage process of Huanglingji gate.
8	djt_5300_38-d	Typical flood diversion process whose flood peak discharge is equal to the check flood diversion discharge (5300m <sup>3</sup> /s) of Dujiatai gate and the total flood diversion volume is 3.861 billion m <sup>3</sup> . Typical downstream stage process of Huanglingji gate.







## Statistics results of flood disaster

Name of scheme	Inundated area	Inundated cultivated area	Affected persons	Main traffic line affected
	(km <sup>2</sup> )	(ha)	(person)	(km)
djt_4000	265.76	16,400	26,008	61.78
djt_4000_38	520.17	33,827	103,966	164.83
djt_4000_38_D	525.35	34,153	105,843	174
djt_4000_D	316.72	20,513	35,658	73.35
djt_5300	505.74	32,660	98,079	161.13
djt_5300_38	523.46	34,033	105,013	172.29
djt_5300_38_D	525.35	34,153	105,844	173.99
djt_5300_D	521.39	33,840	104,175	170.48

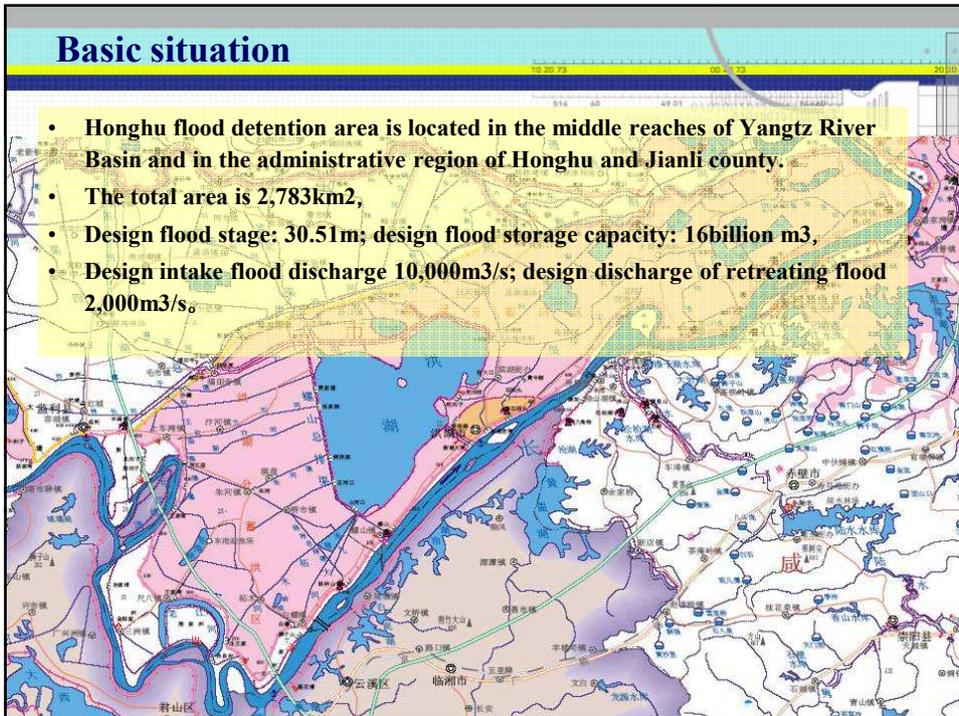
## Evaluation results of flood disaster

Name of scheme	Loss of residential building	Loss of family property	Agricultural loss	Loss of road	Total
	(×10 <sup>4</sup> yuan)	(×10 <sup>4</sup> yuan)	(×10 <sup>4</sup> yuan)	(×10 <sup>4</sup> yuan)	(×10 <sup>4</sup> yuan)
djt_4000	5,372	1,077	17,306	579	24,334
djt_4000_38	21,185	4,327	25,859	1,064	52,435
djt_4000_38_D	25,345	5,455	28,059	1,385	60,244
djt_4000_D	6,407	1,281	19,283	663	27,634
djt_5300	18,560	3,648	23,818	917	46,943
djt_5300_38	22,048	4,534	26,415	1,129	54,126
djt_5300_38_D	25,345	5,455	28,057	1,380	60,237
djt_5300_D	21,064	4,262	25,784	1,100	52,210

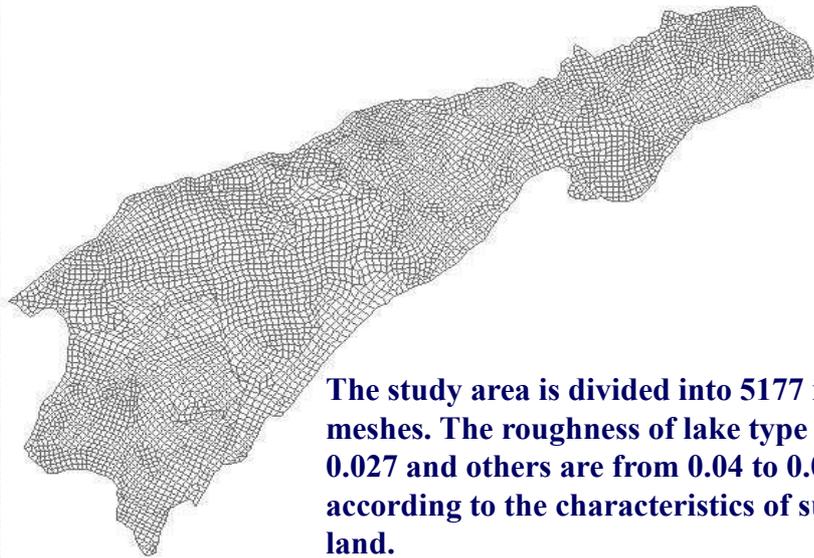
# Flood hazard mapping in Honghu flood detention area

## Basic situation

- Honghu flood detention area is located in the middle reaches of Yangtz River Basin and in the administrative region of Honghu and Jianli county.
- The total area is 2,783km<sup>2</sup>,
- Design flood stage: 30.51m; design flood storage capacity: 16billion m<sup>3</sup>,
- Design intake flood discharge 10,000m<sup>3</sup>/s; design discharge of retreating flood 2,000m<sup>3</sup>/s.



## Flood hazard analysis



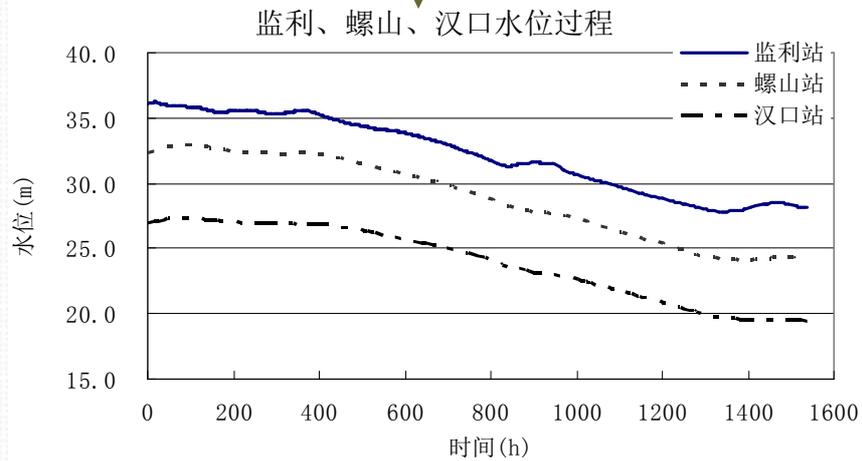
The study area is divided into 5177 irregular meshes. The roughness of lake type mesh is 0.027 and others are from 0.04 to 0.07 according to the characteristics of surface land.

## Calculation condition

- Upper boundary condition: stage process of the breaches where dike break happened in 1998.
- Discharge of flood diversion is calculated using broad crest weir formula.
- The time when dike break happens is determined by flood peak level.
- The shape of breach is rectangle with a width of 600m.
- Ground elevation near dikes is taken as the bottom elevation of breach.

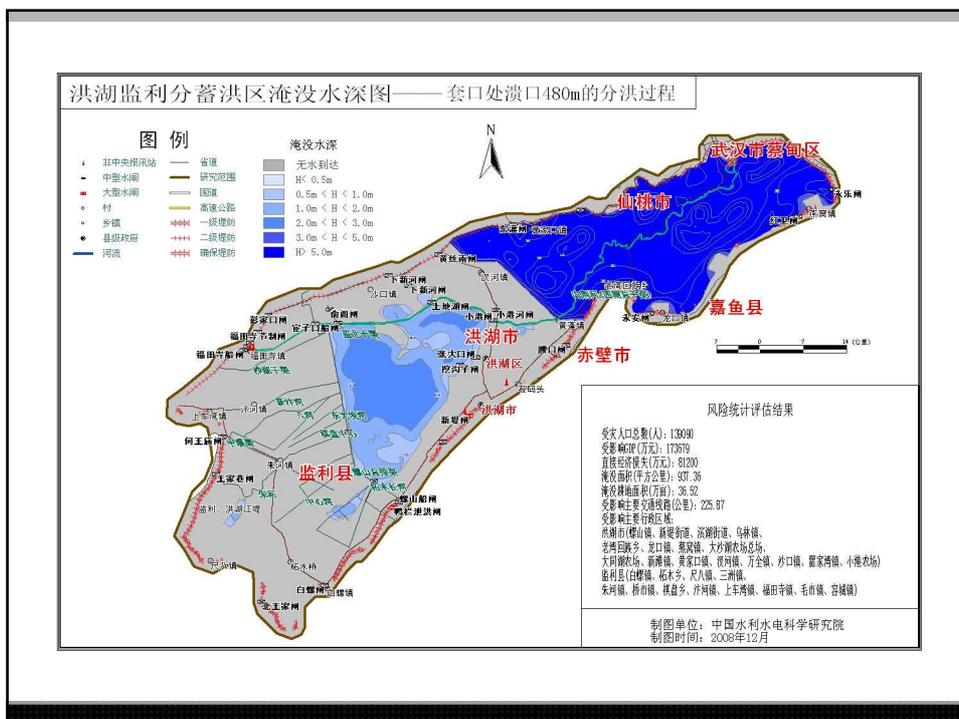
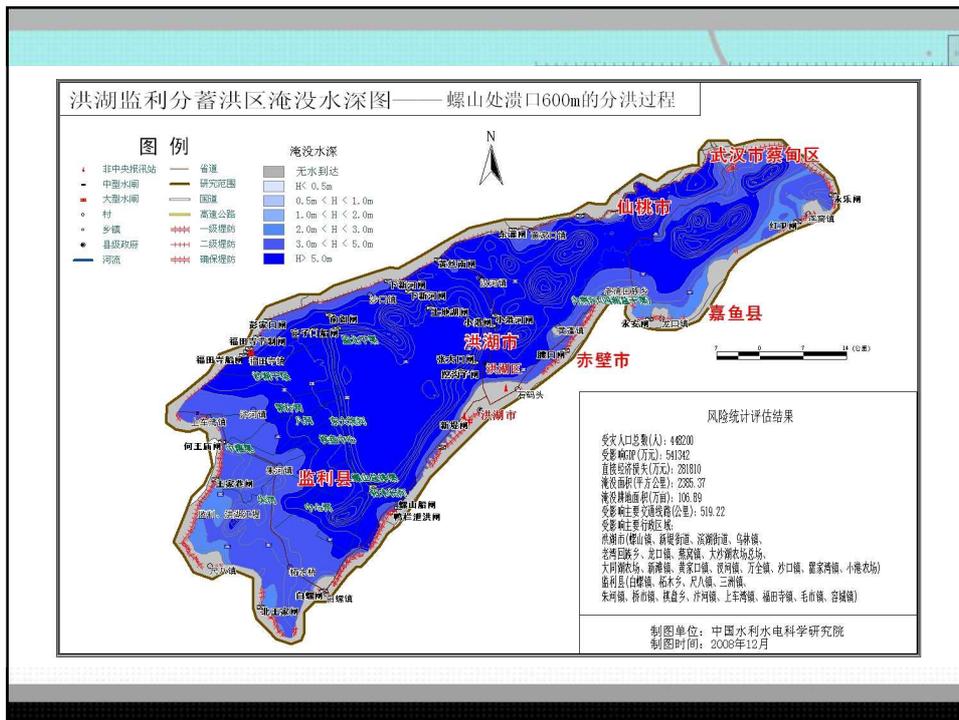
## Calculation condition

### Stage process of Jianli, Luoshan and Hankou station

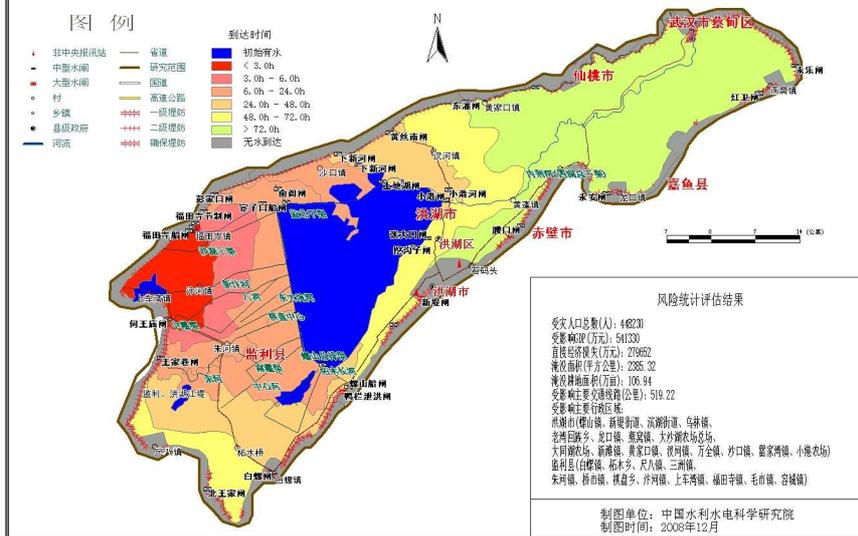


## Calculation schemes

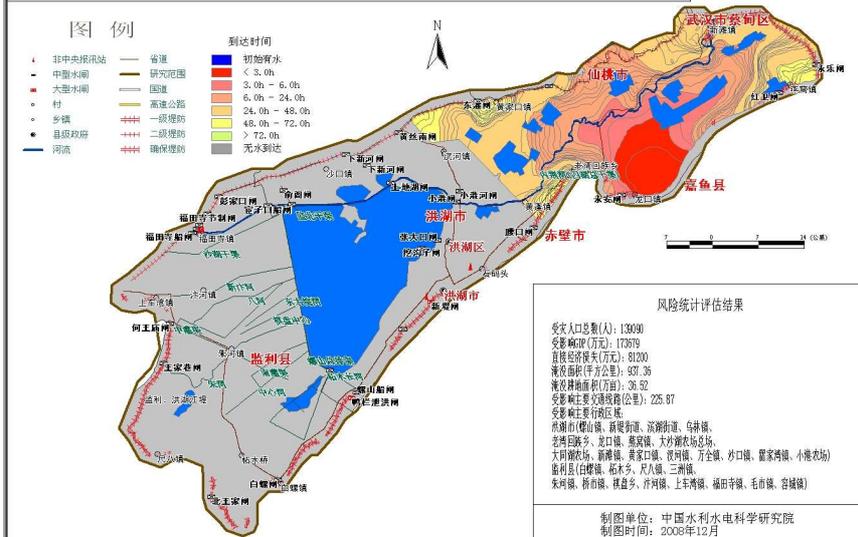
Num.	Name of scheme	Description
1	hh_scw_600	The type of flood in 1998 happens in Yangtze River; Dike break happens at Chewan in the Honghu main dike in Jianli with a width of 600m.
2	hh_ls_600	The type of flood in 1998 happens in Yangtze River; Dike break happens at Luoshan in the Honghu main dike in Jianli with a width of 600m.
3	hh_tk_600	The type of flood in 1998 happens in Yangtze River; Dike break happens at Taokou in the Honghu main dike in Jianli with a width of 600m.
4	hh_tk_1630	The type of flood in 1998 happens in Yangtze River; Dike break happens at Taokou in the Honghu main dike in Jianli with a width of 1630m.
5	hh_tk_480	The type of flood in 1998 happens in Yangtze River; The width of Yangtze River flood diversion gate in Jianli Honghu is 480m.
6	hh_yw_600	The type of flood in 1998 happens in Yangtze River; Dike break happens at Yanwo in the Honghu main dike in Jianli.



洪湖监利分蓄洪区洪水到达时间图——上车湾处溃口600m的分洪过程



洪湖监利分蓄洪区洪水到达时间图——套口处溃口480m的分洪过程



## Statistics results of flood disaster

Name of scheme	Inundated area	Inundated cultivated area	Affected persons	Main traffic line affected
	(km <sup>2</sup> )	(ha)	(person)	(km)
hh_ls_600_360	2,385.37	71,260	448,200	519.22
hh_yw_600_600	2,384.25	71,193	448,060	518.61
hh_tk_1630_250	2,385.35	71,247	448,230	519.26
hh_tk_600_360	2,385.34	71,253	448,230	519.27
hh_scw_600_188	2,385.32	71,293	448,230	519.22
hh_tk_480_210	937.36	24,347	139,090	225.87

## Evaluation results of flood disaster

Name of scheme	Loss of building	Loss of family property	Agricultural loss	Loss of industrial property
	(×10 <sup>4</sup> yuan)	(×10 <sup>4</sup> yuan)	(×10 <sup>4</sup> yuan)	(×10 <sup>4</sup> yuan)
hh_ls_600_360	94,976	20,761	132,531	16,004
hh_yw_600_600	87,602	18,709	126,957	15,606
hh_tk_1630_250	93,691	20,405	131,057	15,918
hh_tk_600_360	94,080	20,499	131,633	15,950
hh_scw_600_188	94,667	20,685	132,784	16,078
hh_tk_480_210	22,019	4,281	47,758	3,578
Name of scheme	Loss of industrial output value	Loss of road	Direct economic loss	
	(×10 <sup>4</sup> yuan)	(×10 <sup>4</sup> yuan)	(×10 <sup>4</sup> yuan)	
hh_ls_600_360	11,993	5,545	281,810	
hh_yw_600_600	11,978	5,080	265,932	
hh_tk_1630_250	11,837	5,500	278,408	
hh_tk_600_360	11,974	5,516	279,652	
hh_scw_600_188	11,663	6,059	281,936	
hh_tk_480_210	2,124	1,440	81,200	



Thank you for your attention!