中国水利水电科学研究院
China Institute of Water Resources and Hydropower Research

UNIVERSITÉ CÔTE D'AZUR

FFP1: Seminar on Flash Flood Risk Management

Introduction on National Flash Flood Prevention Project

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China Institute of Water Resources and Hydropower Research (IWHR)

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Content

1 Water Hazard Research Center of IWHR

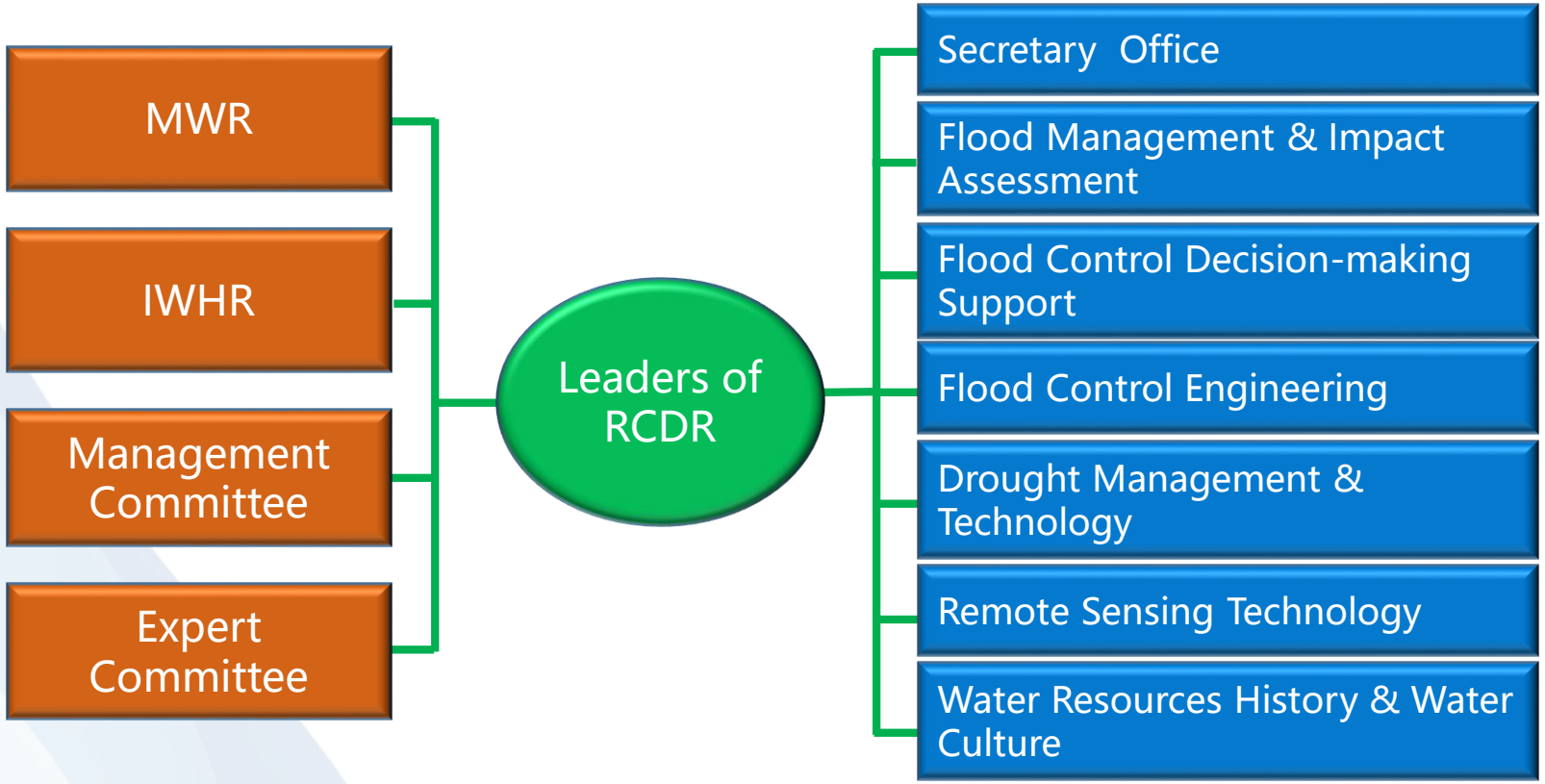
2 Introduction of the Project

3 Main achievements

4 National Platform

1. Water Hazard Research Center of IWHR

- Research Center on Flood and Drought Disaster Reduction (RCDR) of the Ministry of Water Resources, which is affiliated with IWHR
- Technical Support to the Office of State Flood Control and Drought Relief Headquarter



Major Projects under Support: **National Flash Flood Prevention Project**
National Flood Risk Mapping Project

1 Water Hazard Research Center of IWHR

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2. Introduction of the project

2005, Shanlan Town

117 death

105 student death

2006, Hunan Prov.

346 death

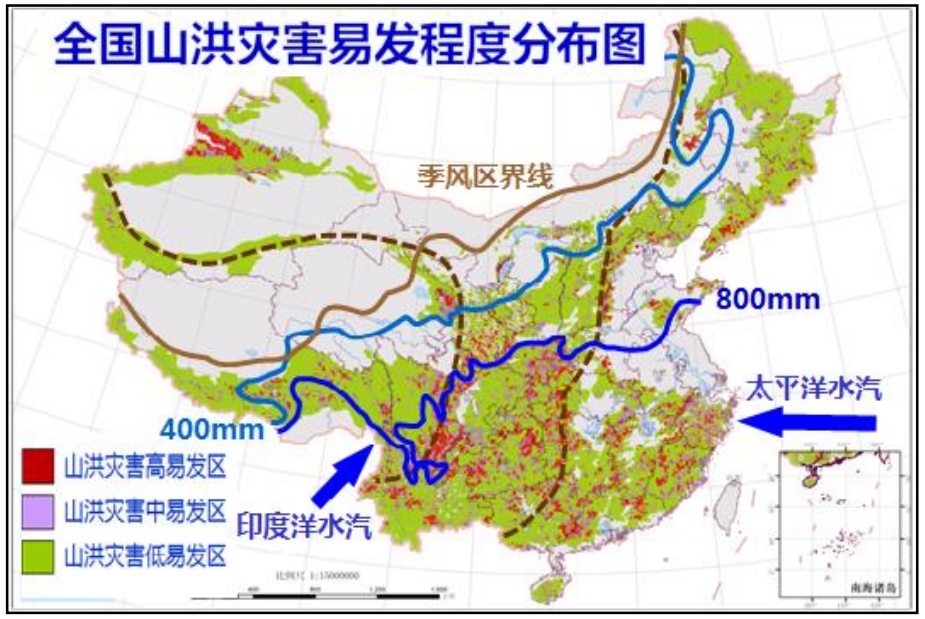
89 losing

2010, Zhouqu County

1501 death

264 losing

Disaster Event



Densely distributed in all mountain areas.
Frequently happened with many disastrous events.

In definite season and region.

Happened in very short time with catastrophic results.

Casualties take 70% of that caused by all flood disasters

Extremely difficult to forecast and prevent

Characteristics of Flash Flood in China

National Flash Flood Prevention Planning was approved in **2006**

General Planning on:

- Medium- & Small-sized River Training
- Rehabilitation of dams with defects flash flood
- Geological disaster prevention in 2011

Implementation Plan of National Flash Flood Prevention Project (2013-2015)
30 Province, 305 cities, 2058 counties

National Flash Flood Prevention Project (2010-2016).
Total investment **29 billion RMB**

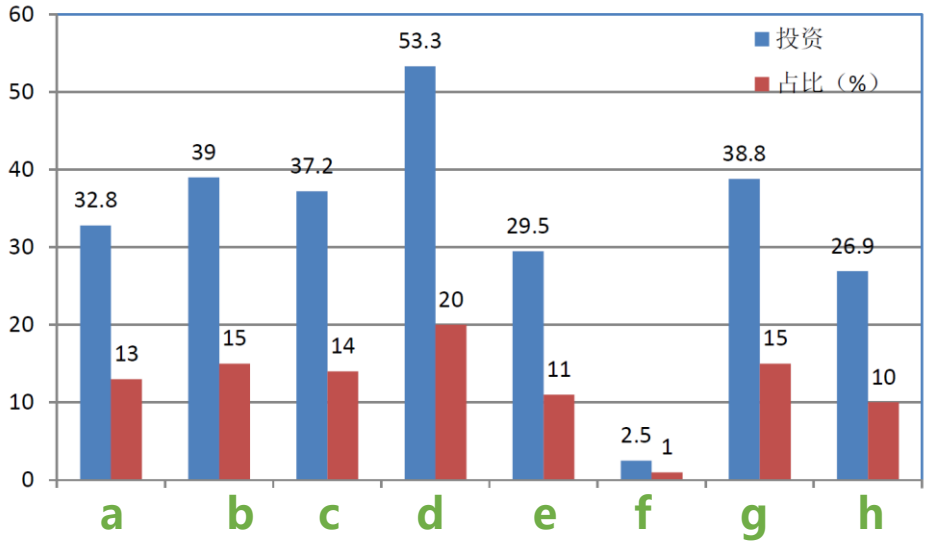
- Monitor and Warning **16.7 billion**
- Investigation and assessment, **3.3 billion**
- Community-based prevention system, **5.2 billions**
- Structural measures **3.9 billions**

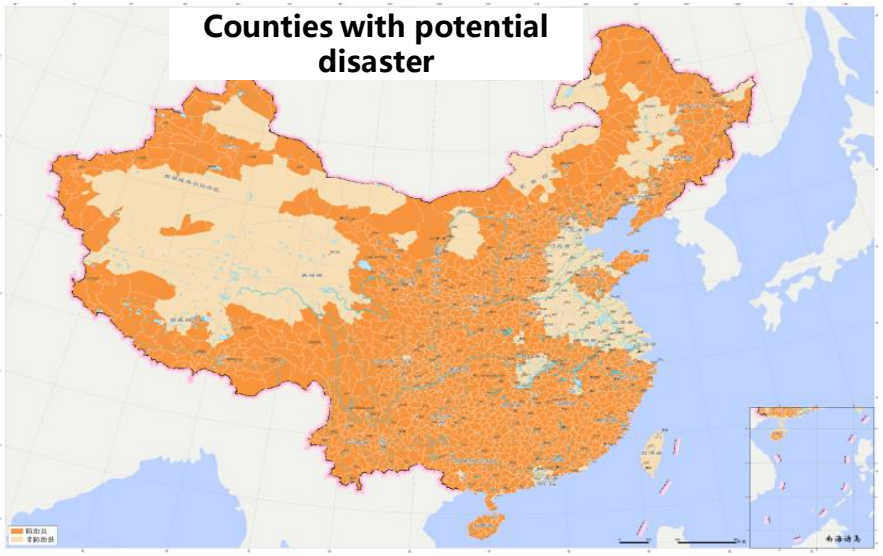
Prevention work in China

2. Introduction of the project

2010-2015, Project Contents and Investments

Project Contents	Invest. (billion)	Ratio (%)
Investigation and assessment (a)	3.28	13
Monitoring (b)	3.90	15
Warning system (c)	3.72	14
Operation platform (d)	5.33	20
Community-based system (e)	2.95	11
Emergency rescuing (f)	0.25	1
Structural measure (g)	3.88	15
Others (h)	2.69	10
Total	26.00	100





- Preliminarily understand the basic situations
- Fundamentally establish monitoring and warning system
- Gradually establish community-based prevention system
- Conduct structural measures for demonstration

2. Introduction of the project

Preliminarily clarify the disastrous areas, population distribution and underlying surface conditions

Counties	2,138
Administrative areas (million km^2)	7.55
Towns (thousand)	32
Villages (thousands)	470
Sub-villages (millions)	1.57
Total population(billions)	0.9
Areas with risk (million km^2)	3.86
Areas with high risk(million km^2)	1.2
Villages in risk area (millions)	0.197
Sub-village in risk area (millions)	0.564
Enterprise (millions)	0.15
Threatened zone (millions)	0.52
Population in threatened region (millions)	58.36

Past flash flood events	53,433
Investigated past flood	13,014
Projects in stream channel	25
Automatic monitoring station	88,969
Simple rain gauge	235,890
Simple water stage gauge	47,087
Wireless alert broadcast	201,057
Streams need structural measures	31,383
Investigated and assessed villages	157,183
Channel section group	171,762
Village with rainfall threshold for warning	142,026
Village with water stage threshold for warning	33,481
Map with threatened zone	102,969

1 Water Hazard Research Center of IWHR

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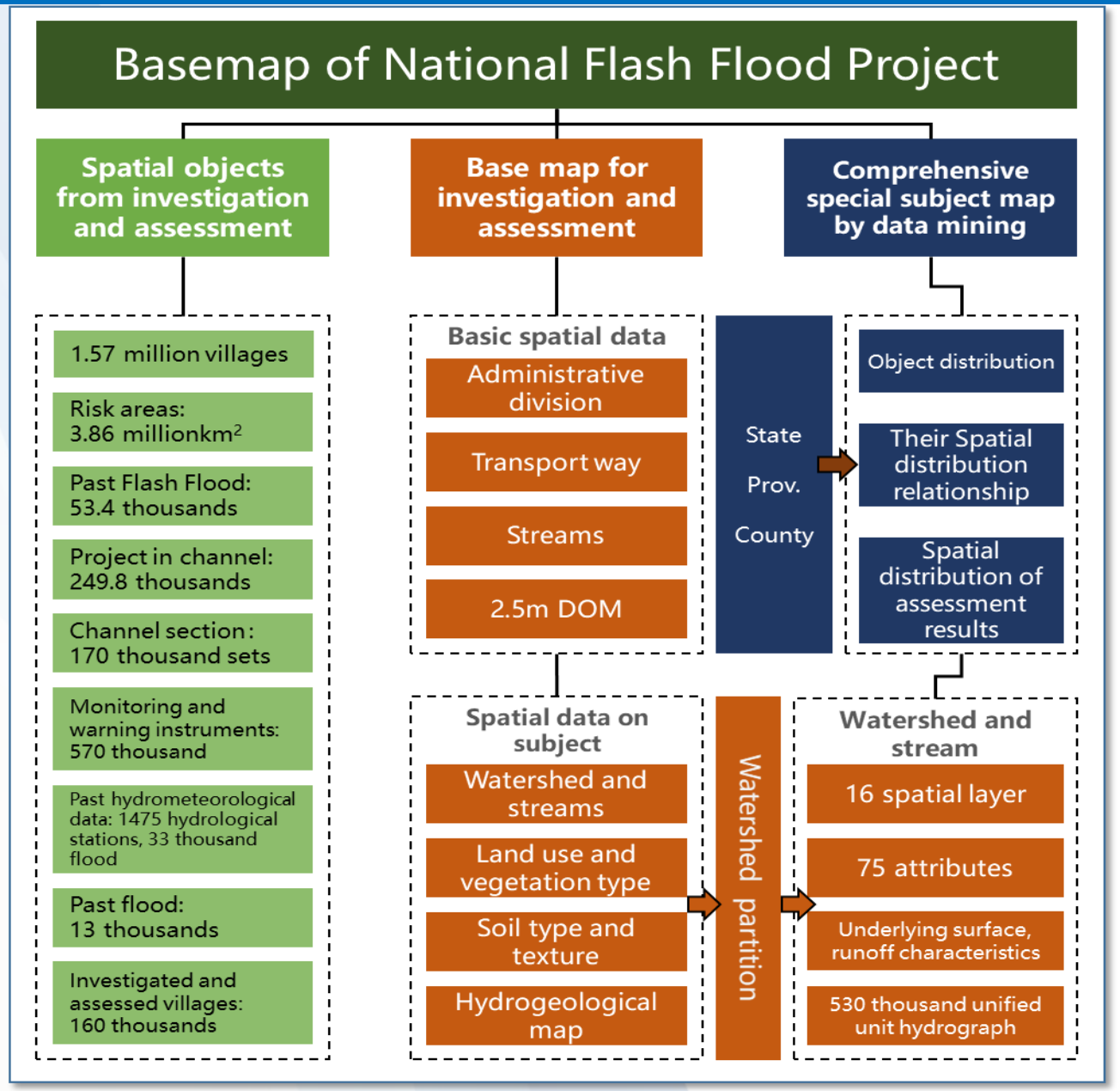
3. Main achievements



Spatial objects:
45.76 million

Watersheds:
530 thousand

Gullies and streams
3 million

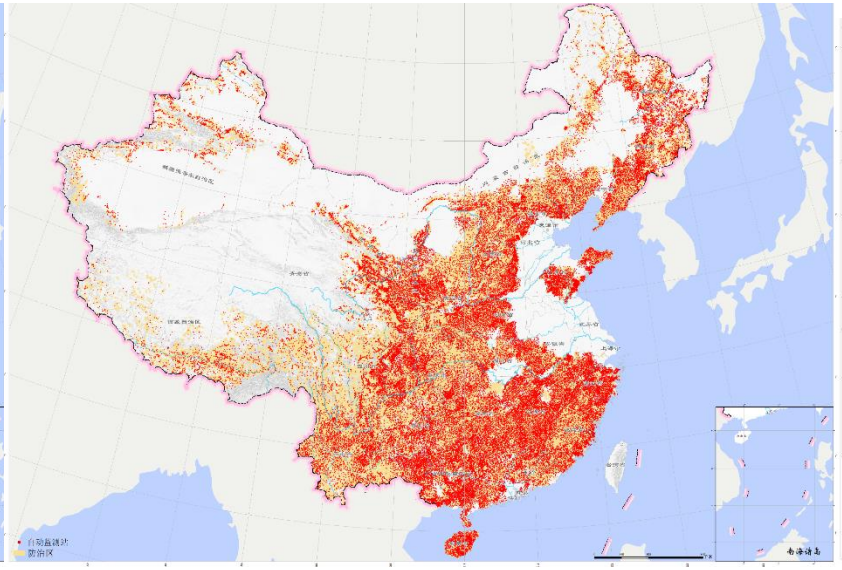
Basemap:
2,168 sets

Comprehensive special subject map
2,9246 sets

3. Main achievements

Distribution of Flash Flood Prevention Area

Distribution of Automatic Monitoring Stations



Present Flood Control Ability Distribution of Assessed Village

Basic information of Flash Flood Prevention Area	
Area (million km^2)	3.86
Area with high risk(million km^2)	1.2
Total population (billion)	0.3
Family (million)	84.88
House (million)	86.65
Town (thousand)	25.365
Village (thousand)	197
Sub-village (thousand)	560

Automatic raingauge density: 71km^2/station
For high risk region: 50km^2/station

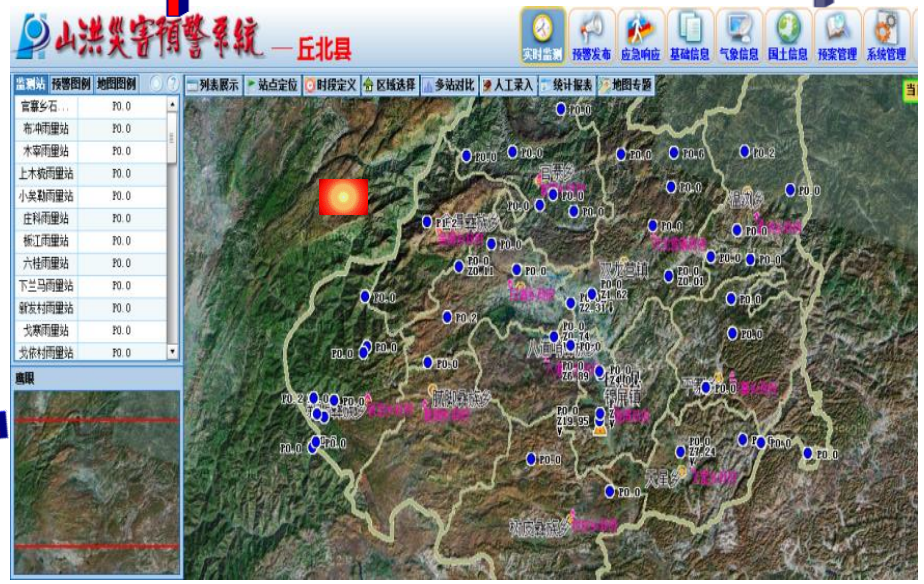
Shared stations	88,969
Automatic rainfall gauge	53,937
Automatic water stage gauge	21,022

Assessed Villages	
Channel section	171,762
Assessed village	150,063
<5 years	25,977
5-10 years	31,964
10-20 years	24,959
20-50 years	23,271
50-100 years	11,524
>100 years	32,368

3. Main achievements

Monitoring and warning information management system at state, province and city level

Automatic Monitoring
(46000 Raingauge and 20000 stage gauge)



County-level monitoring and warning operation platform

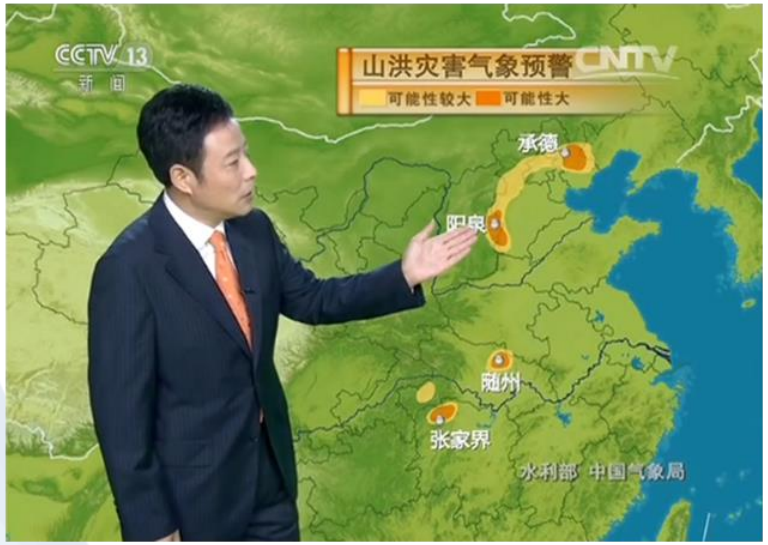
Alert system

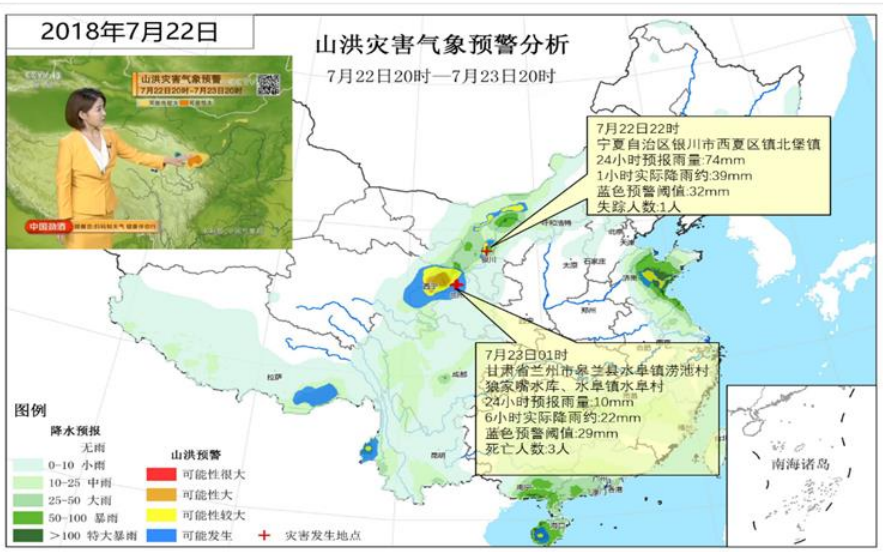
Warning message transfer, evacuation

- Monitoring and warning operating platforms are established in 2058 counties, 30 provinces, 305 cities and the state, extended to 18924 towns.
- The State flood control and drought command system is expanded. Local flood prevention decision-making and command ability are greatly improved.

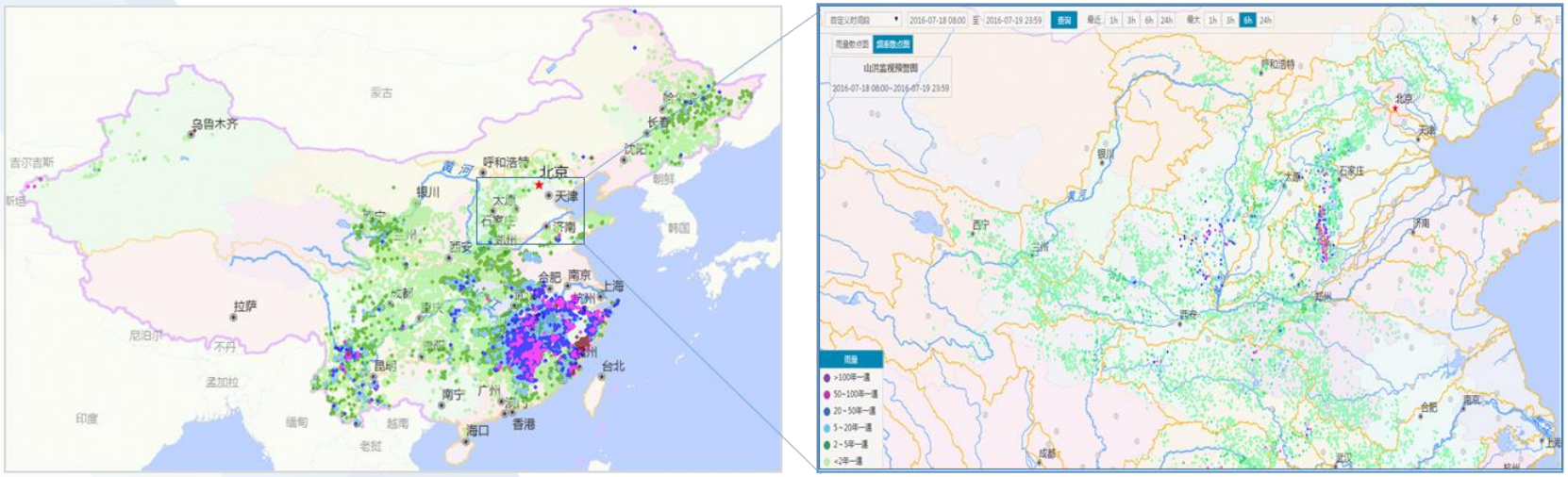
3. Main achievements

The national weather warning information of flash flood disaster was released on CCTV for the first time in 2005

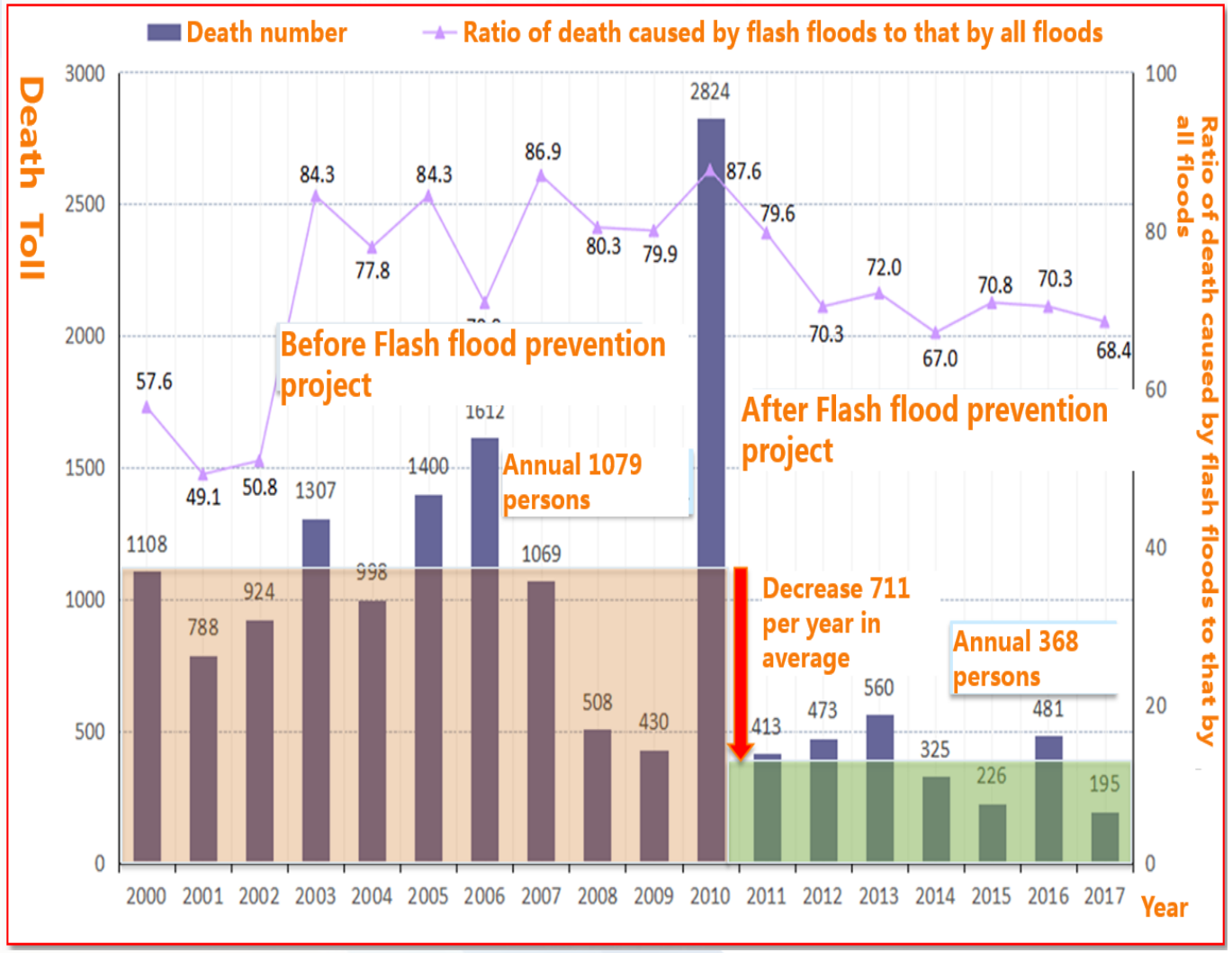




- **Information platform for flash flood disaster monitoring and warning**



3. Main achievements



Local governments and the public praised the project as the "umbrella for life safety" and "the project of cost-saving, efficient and beneficial to people's livelihood"

From 2000 to 2010, the annual averaged number of deaths caused by flash flood disasters was 1,079. Since the project come into play in 2011, the death toll of flash flood is 368 per year, reduced about 66%.

- The system of flash flood disaster prevention combined with community-based prevention fills the gap of flash flood disaster monitoring and warning system in China, explores the characteristics of flash flood disaster in different regions, effectively improves the defense capability of flash flood disaster at the community level, and brings into play the remarkable benefits of disaster prevention and reduction.
- It extends and expands the national flood control and drought relief commanding system, significantly enhances the flood control decision-making and command capacity at the community level, and lays the foundation for flash flood disaster prevention in China.

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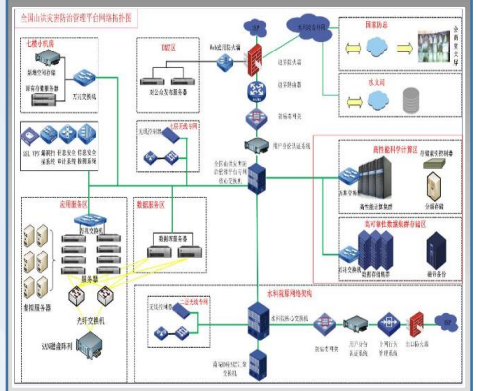
4. National Platform

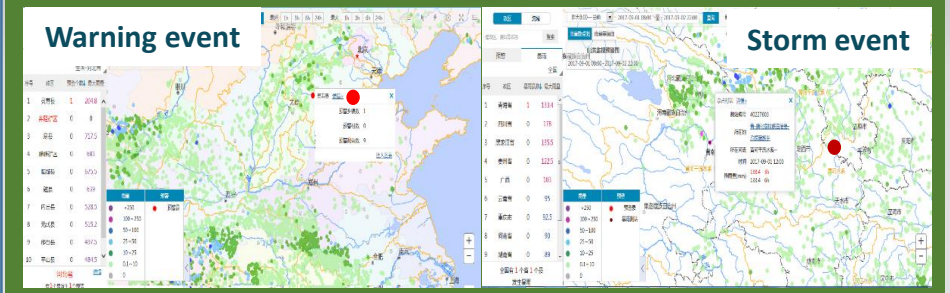
Hardware and Network



- High-performance computer cluster. Flop operating speed 12.9 trillion times/sec
- High-reliability storage cluster, capacity 668TB
- Special Network connection with water, weather, satellite sectors

Information Service Mode

Four typical levels, to supply information service in different scale



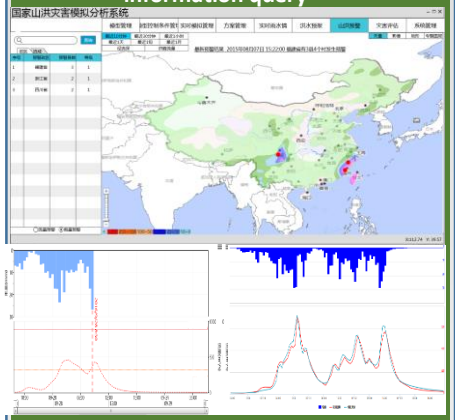
Two type of events, to drive around central tasks

Two Principle path, to organize disaster prevention information

Platform and software

Monitoring and warning

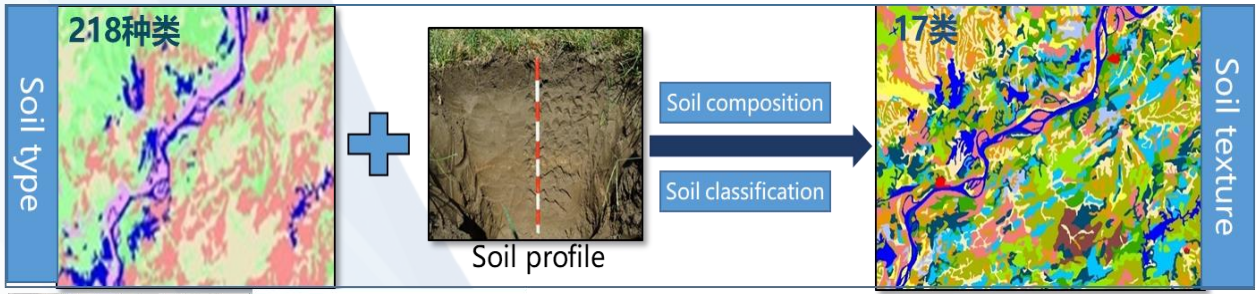
Mobile monitoring and warning information query

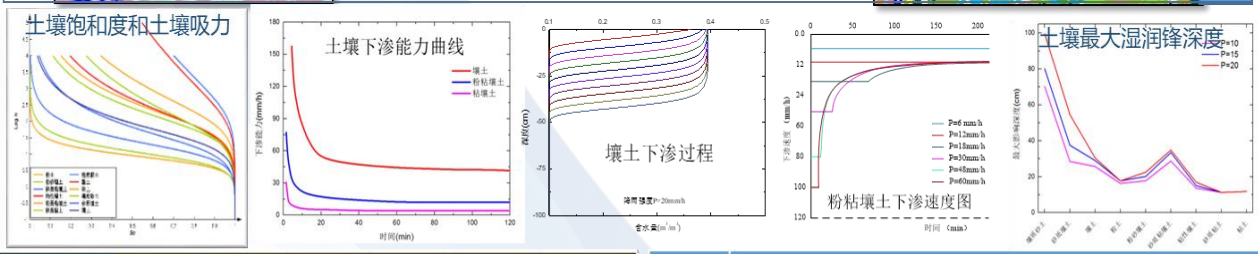


Flood simulation and warning system

4. National Platform

(1) The land is divided into 132 forecast and warning partition and 5,013 secondary partition, according to sub-basin, investigated data, rainstorm characteristics, and historical flash flood disaster events.





土壤类型	饱和含水量 θ_s	残余含水量 θ_r	土壤田间持水量	土壤湿润锋毛管吸力(mm)	水力传导度 K_s(mm/h)	VG 模型参数 α	VG 模型参数 n
砂土或壤砂土	0.43	0.025	0.05	49.02	291.0	0.145	2.68
砂壤土	0.41	0.057	0.105	60.96	145.2	0.124	2.28
壤土	0.41	0.065	0.19	109.98	42.0	0.075	1.89
粉壤土	0.43	0.078	0.232	88.9	10.2	0.036	1.56
砂粘壤土	0.46	0.034	0.025	134.62	2.4	0.016	1.37
粘壤土	0.45	0.067	0.284	169.93	4.2	0.2	1.41
粉粘壤土	0.39	0.1	0.244	220.00	12.0	0.059	1.48
砂粘土	0.41	0.095	0.41	210.06	2.3	0.019	1.31
壤粘土	0.43	0.089	0.342	270.00	0.6	0.01	1.23
粉粘土	0.38	0.1	0.321	240.03	0.7	0.027	1.23
粘土	0.36	0.07	0.371	290.07	0.2	0.005	1.09
重粘土	0.38	0.068	0.378	320.04	1.6	0.008	1.09

雨强 (mm/h)	6小时最大湿润锋深度(cm)								
	壤质砂土	砂质壤土	壤土	粉土	粉砂壤土	砂质粘壤土	粘性壤土	砂质粘土	粘土
10	70	29	26	16	18	29	14	11	12
15	80	38	29	18	20	34	15	11	11.5
20	100	55	31	18	23	35	17	11	
40	138	78	32		23	36	17		
60	142	90	33						
80	153	92	33						
100	170	93							
180	180	93							

Partition of national flash flood forecast and warning

132 first class partition
5,013 secondary partition

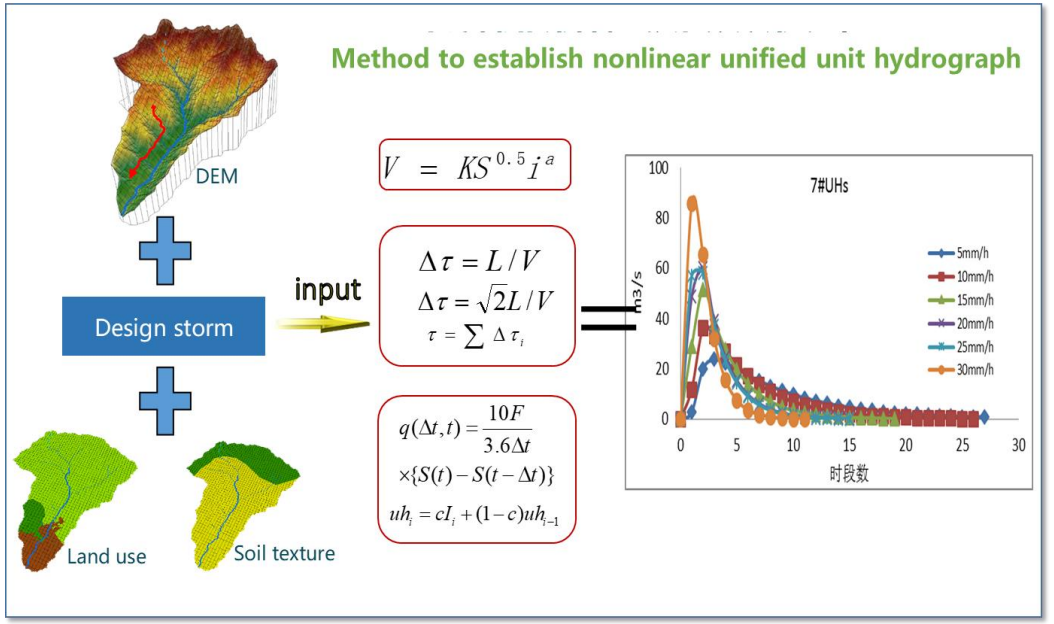
(2) Runoff production:

- The soil texture data was developed. 7 indicators were summarized as the range of infiltration parameters;
- The maximum infiltration depth in 6 hours of typical soils was analyzed.

4. National Platform

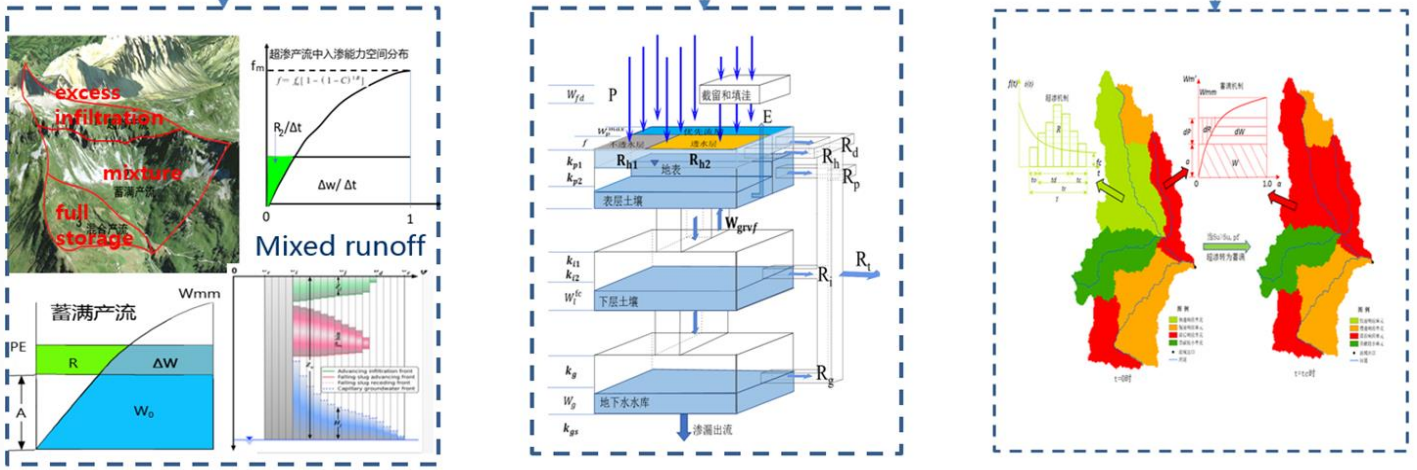
(3) Flow concentration:

- The standardized unit hydrograph method is introduced based on high-accurate geomorphological data.
- The corresponding model was calibrated by measured data for more than 10,000 rainfall events from 330 hydrographic stations.



Mixed runoff production model with spatiotemporal variable sources

Horizontal mixture			Vertical mixture			Time interval mixture		
Divide geomorphic hydrological response unit	Mechanism of runoff generation	runoff yield model	Carto infiltration model	Infiltration calculation based on the movement of wetting front	Subdivide excess infiltration and full storage runoff	Instantaneous infiltration rate and infiltration capability	Soil moisture and water-storing capacity	Transformation of excess infiltration and full storage



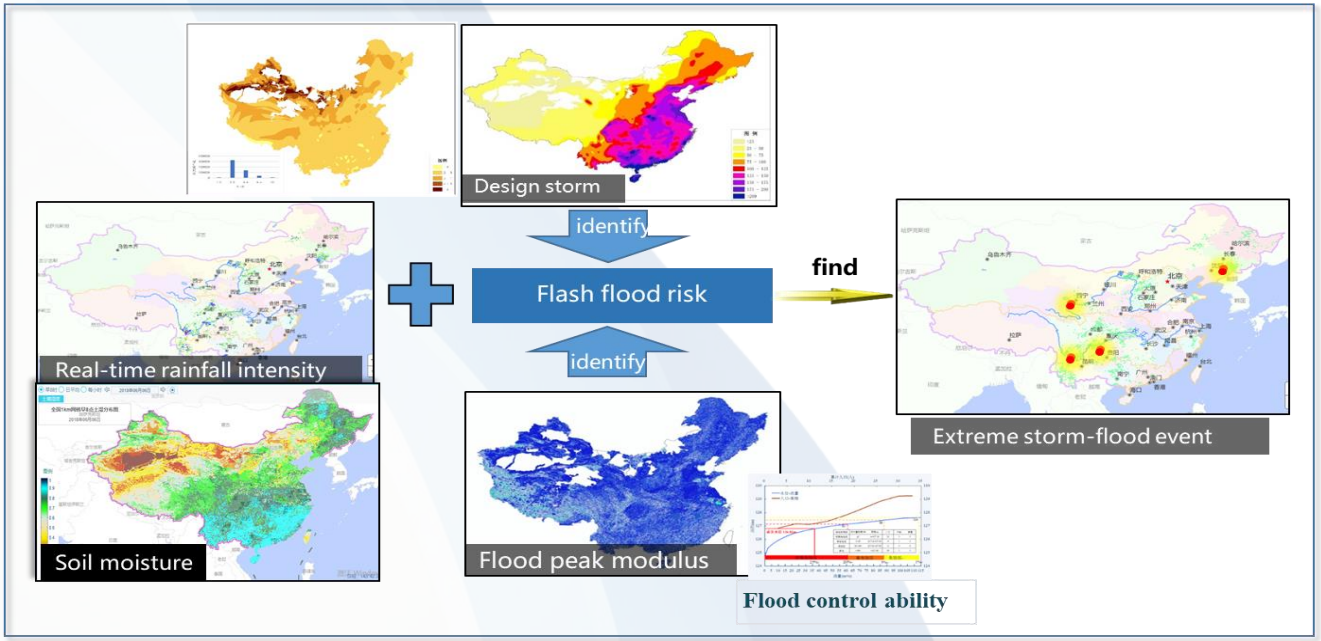
(4) Mixed runoff production model with spatiotemporal variable sources was developed.

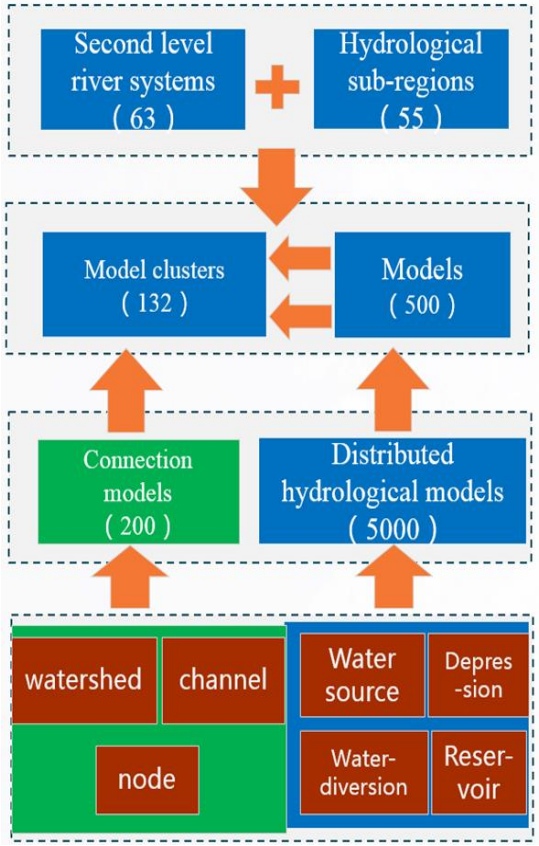
- This method can calculate the runoff according to the rainfall intense-infiltration-time curve.
- It avoids the defects of Dunne/infiltration excess runoff, and fits a wide spectrum of soil conditions.

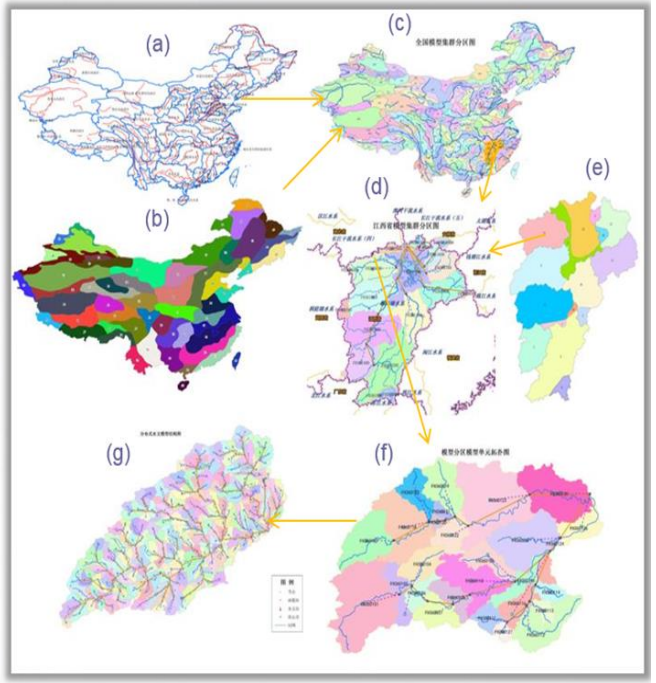
4. National Platform

(5) Taking sub-basin as a unit, 7 hydrological elements were generalized(watershed, stream, node, diversion, source, depression, and reservoir).

A distributed hydrological model cluster was developed with control sections such as hydrological stations, large reservoirs, confluence points of major streams, and the points where geomorphological attributes change abruptly.







(6) A set of real-time data normalized processes was developed, which can identify flash flood in a national scale.

This method provides strong support for the information service of multi-scale flash flood disaster prevention.

Conclusion

Flash flood disaster is extremely difficult to prevent.
It is necessary to solve key scientific and technical problems

Potential Research Program

A program in 13th Five-year Research Plan is on Flash Flood Prevention, supported by the Ministry of Science and Technology (MOST), will be launched this year.

- The temporal and spatial evolvement characteristics of storm in mountain area
- Innovative method to determine flash flood disaster threshold
- Development of flash flood simulation model
- The integration application of real-time dynamic forecasting and warning technologies

IWHR is ready

- To share experiences
- To strengthen exchange and cooperation

Thank you!