Action Plan toward Effective Flood Hazard Mapping in China

A) The role of flood hazard maps to mitigate flood damages in China

A-1) the flood status in China

China is endowed with about 50,000 rivers, including 1,600 rivers with water basin larger than 1,000 km^2 each. The topography of China is characterized by high west part and low east part, gradually descending in elevation from the west towards the east to form three steps. The main river systems consist of seven major rivers, the Yangtze, Yellow, Pearl, Haihe, Huaihe, Liaohe and Songhua rivers. Most rivers, including seven major rivers, flow from west to east, directly or indirectly emptying into the Pacific Ocean. And the total annual average runoff is about 2,800 billion m^3.

China is subject to strong monsoon climate and most of the areas are under the impacts of the southeastern and southwestern monsoons. The average annual precipitation in China is 648 mm. About 70% of annual rainfall is concentrated in the flood season lasting from June to September in most area. The floods have the characteristic of high peak discharge and great amount of flood volume. The water volume of one large flood may account for the annual runoff of the river. The extremely uneven temporal and spatial distribution of precipitation and river runoff constitute the fundamental cause of frequent floods and waterlogging in flood season.

Floods occurred frequently in China. According to statistics, in the past two thousand years, nearly one thousand comparable large floods have occurred altogether, and one flood disaster occurred in two years in average. During the 1990s, six out of 10 years witnessed major floods taking place in the major river basins. In some areas, floods occur every year. On average, there are seven typhoons that land on the mainland of China every year. Torrential rains also cause mudflow and landslide problems. The total flood-prone areas are about 1.06 million km2, nearly 11 percent of Chinese territory. In these areas there is a population of 840 million people, and GDP is about 6562.8 billion RMB. These areas are the major regions of Chinese social and economic activities.

In 1990s, annual economic losses caused by floods accounted for 1.7% of GDP. But in developed countries the flood damage rate to GDP is less than 0.5%. In 2005, up to October, 16.26 million hectares of farmlands were affected by flood and waterlogging, 212 million people affected, 1404 people killed in flood and sediment disasters, and the direct economic losses 160.7 billion RMB. Zhejiang, Fujian, Hainan, Guangxi, Sichuan, Anhui, Jiangxi, Liaoning provicnes heavily suffered from flood disasters. Generally speaking, the loss from flood and waterlogging disasters in 2005 was serious as compared with those in recent years.

The injury, death and property losses caused by floods, landslide and mudflow, rank the first among all natural disasters in China. Floods seriously threaten the social and economic development. As a significant strategic issue, flood control and flood security attract high attention all over the country.

A-2) the outline of the present countermeasures for mitigating flood damages in China

In China, the flood control systems are composed of structural and non-structural measures.

In the late 20th century, the floods in the Yangtze, Nenjiang and Songhuajiang rivers in 1998 were the most serious natural disasters. China made great efforts to implement the project to prevent floods. In China the flood control systems are composed of structural and non-structural measures. Combined these measures, the main goal of flood management is prevention of casualties and reduction of economic losses to the least.

Structural measures are aimed at releasing, detaining, confining, diverting and storing floodwater, to reduce the frequency and magnitude of flooding. Flood control facilities construction in the river basin is the basic way to mitigate flood risk and damage. These facilities include reservoirs, embankments, food detention areas, pumping stations, etc. Reservoirs were constructed in upstream areas to store floodwaters and decrease flood peak, to reduce flood magnitude. Levees and embankments along the rivers were constructed to confine extents of inundation. Flood detention areas, for temporary storage of floodwaters to control discharge to downstream, were built up in the lower rivers.

With the effort of fifty years, the comparable integrated flood and waterlogging mitigation system, which can control normal flood disasters, had been accomplished. It can be summarized as follows: about 246-thousand kilometers levees and embankments constructed; more than 860-thousand reservoirs with a total storage capacity more than 475.1-billion cubic meters; 98 national specified flood detention areas with total capacity near 100-billion cubic meters. According to incompletion statistics, the flood prevention system that has been built has reduced losses of 1,500 billion RMB from floods.

Up to now, the key flood control projects were constructed up in seven major rivers in China. The Xiaolangdi reservoir located at the lower Yellow River commenced its operation in 2000, to control floods and reduce aggradation rate in the lower Yellow River. Three Gorges Project is under construction, it will be completed in 2009. In Huaihe River, Linhuaigang hydraulic complex project will be completed soon, which will improve the flood control standard in the middle reach of Huaihe River to 100-year flood.

Non-structural measures play a very important role in China. These methods include legal and institutional system, recovery of floodplain storage, flood forecasting and telecommunication system, flood emergency planning and response, and post-flood

recovery, etc. These activities directly modify the vulnerability of communities exposed to flood risk.

Till now, China has set up a series of flood control legal and institutional system. Flood Control Law was adopted on August. 29 1997, and came into force on January.1 1998. According to the law, all units and individuals shall have the obligations to protect flood control works and to take part in flood control and flood fighting. The administrative heads of people's governments at all levels have the obligation to assume overall responsibility for the work of flood control, this is the basic rule in Chinese flood management. So the local government, such as province, city and county, should be in charge of flood facilities construction and flood fighting. And central government and Ministry of Water Resources provide capital and technical support separately to the local government. Defense planning for the Seven Large Rivers are compiled by State Flood Control and Drought Relief Headquarters, which comprise the operation principle of flood facilities and the flood fighting obligation of local government concerned.

Recovery of floodplain storage in river systems is also used to increase flood storage capacity. After 1998 flood of Yangtze River, farmlands around the Poyang Lake and Dongting Lake, the two largest lakes in middle stream of Yangtze river, are returned to recover lakes and rivers, 2.42 million affected populations were resettled to nearby places, water area of 2900 km2 was recovered and flood storage capacity of 13 billion cubic kilometers was increased.

Flood forecasting is another non-structure measure widely used in China. Hydrological information system can collect and disseminate hydrological information promptly, and make hydrological forecasting. The real-time rainfall and flood information of the national hydrological stations can be collected within 30 minutes, and forecasting results can be obtained within 1 hour. The hydrological information is the most important data for flood-decision. Research is ongoing to maintain and improve technical capabilities.

In addition, China has formulated a compensation policy for the local people living inside flood detention areas since 2000. Central and local governments share the expenses on personal property and crop loss compensation due to flood detention in the national flood detention areas. In the past five years, ten flood detention areas were utilized to storage floods, nearly 200 million RMB capitals were compensated for the affected residents.

In 1998, extraordinary severe floods occurred in the Yangtze River basin. Flood-control system construction for rivers is oriented towards harmonious coexistence between man and nature. In other words, floods should be provided a way out, and thoughts should be gradually transformed from endless disorderly struggle for land between man and water to orderly and sustainable harmony between man and flood. A new flood thoughts, transfer from the flood control to flood management, has been brought forward since

2003. So In the process of flood management, flood, drought and water shortage issues are considered concurrently, firstly to ensure the flood safety, and utilize the flood source to mitigate water shortage.

A-3) do you think flood hazard maps will be useful in China? Why?

Flood hazard maps could be widely used for several aspects of flood management. For example, flood hazard map information facilitates flood hazard zoning, which is a prerequisite for land use planning and management to ensure that appropriate development occurs in flood risk areas. Delineations of inundation areas and estimates of water depths and velocities of flow in standard planning floods are an aid to land use planning and development controls, emergency planning, evacuations and response, raising public awareness of flood risk, and for establishment of flood insurance premiums.

Flood hazard mapping could be used to develop public education programs for schools, communities and companies, and could play an important role in raising people's awareness of flood risk. More effort is required in raising awareness of flood risk, so that people are better prepared and the losses incurred by those in flood risk areas in China are mitigated.

B) The allocation of roles in making flood hazard maps in China

B-1) which organization should hold the main responsibility for making a fundamental map such as an anticipated inundation area map?

Department of Water Hazard Research (DWHR) should hold the main responsibility for making a fundamental map. DWHR is both a non-profit research department of China Institute of Water Resources and Hydropower Research (IWHR) and technical entity of the Research Center on Flood and Drought Disaster Reduction (CDR) of the Ministry of Water Resources (MWR). With flood simulation technology they have developed flood inundation maps in some detention areas such as Jingjiang Detention Areas on the middle reach of the Yangtze River and some cities such as Guangzhou City and Shanghai City and so on. They also have developed real-time rainfall forecasting model for Tianjin City

B-2) which organization should hold the main responsibility for making and disseminating flood hazard maps?

Office of State Flood Control and Drought Relief Headquarters (OSFCDRH)

C) The 'Action Plan' of making flood hazard maps in China

C-1) which area do you choose for the target river basin area? Why?

As we know, there are some distinct characteristics of flood disaster of particular concern in China in recent years. These are: 1) Flash flooding and debris flows, which cause most casualties. 2) Urban flooding. 3) Detention areas, where conflicts between flood

management and socio-economic development remain a major problem. To help resolve the problems cited above that are particularly acute in recent years, flood hazard maps can first be developed for mountain cities, most large cities and some important detention areas.

Guidelines for flood hazard mapping were issued by the Office of State Flood Control and Drought Relief Headquarters in May, 2005. And order about carrying on the flood hazard mapping work in pilots was promulgated by OSFCDRH in November, 2005. 36 pilot studies in seven major river basins have been arranged, including some detention areas, cities, dike protected areas and dam failure events. Criterion for flood hazard mapping is going to prepare.

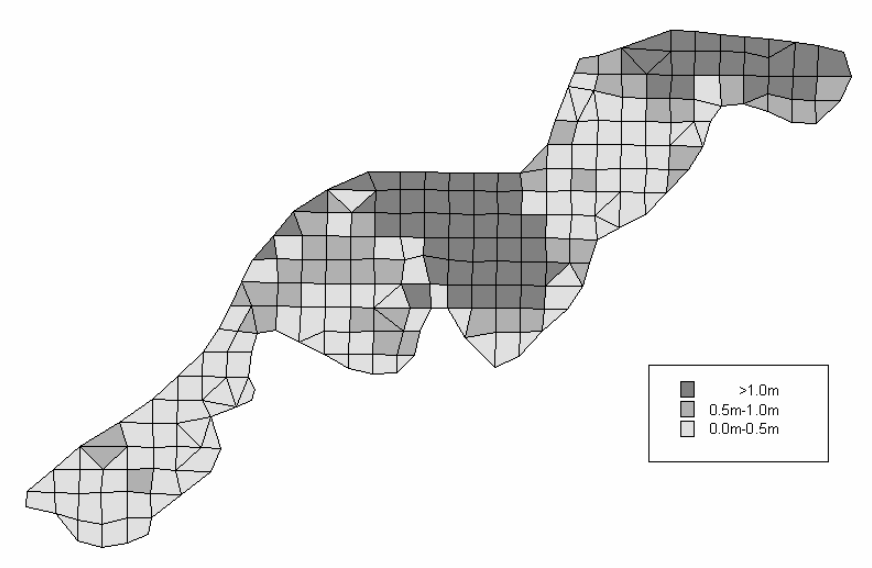
Up to now, task in most pilots has been finished and that in some pilots gets on comparatively slowly due to the lack of basic data. 20 pilot studies have finished the flood risk analysis or sketch maps. Studies in 11 pilots are on going. And studies of 5 pilots just startup. We have got much experience from the pilot studies of flood hazard mapping, and there are also some problems which should be solved in the next step.

For myself, I want to choose Mengwa flood detention area, which is located on the north bank of middle Huaihe River in Anhui Province, as my target area to make flood hazard map.

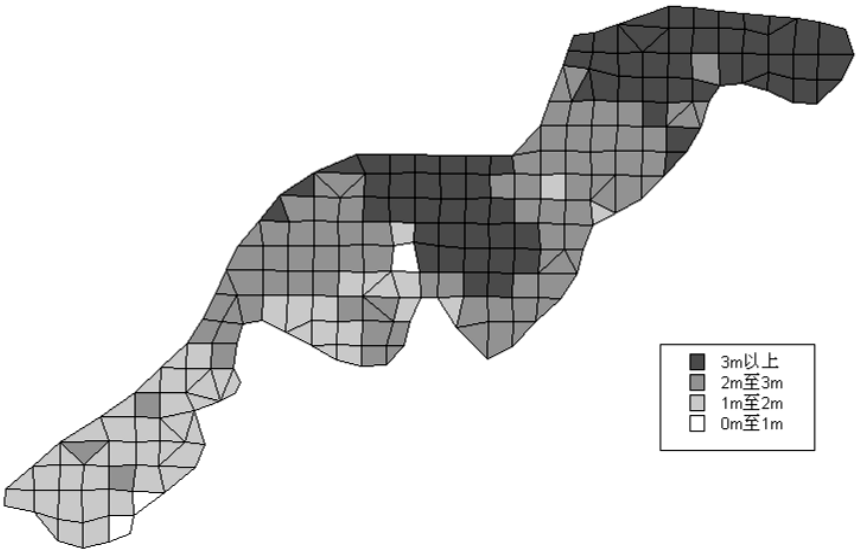
C-2) what do you think is necessary to make flood hazard maps in the chosen area? Do you have data, maps, or budgets necessary for making flood hazard maps?

In July 2003, Mengwa flood detention area was utilized to storage floodwater twice. Near 200,000 people have been evacuated to the earth platforms and embankment village polders. During the past 53 years from being established in 1953, this detention area has been used 14 times in 11 years. Mengwa flood detention area is an extremely important part of Huai River flood control system which taking on the duty of cutting flood peak and storing floodwater.

In April 2005, I went to Anhui province to investigate the utilization and compensation of Mengwa detention area. There were some problems emerged. Then I just focused my research on the compensation policy and finished my thesis about compensation policy in flood detention areas with the case study of Mengwa detention area. I developed the inundation map of Mengwa detention area for identifying the inherent risk and additional risk. These maps are as follows:



Anticipated inundation map caused by rainfall



Anticipated inundation map caused by both rainfall and division water

It is very important for the residents living in the detention areas to evacuate fast when the detention area is utilized. Flood hazard mapping is an effective measure to solve this problem. And now national flood hazard mapping is planning to be carried on in China. It is a good chance to budget for making flood hazard map.

After the completing of flood hazard map, it will be disseminated to every household. When the government determines to use the flood detention area during flood seasons the local government issues order to organize residents to evacuate to designed shelters which have been shown in flood hazard maps. It can greatly shorten the evacuation time.

Residents are aroused to adjust plant category to reduce crop losses according to anticipated inundation duration and depth, such as appropriate places to plant grain, vegetables or fruit.

C-3) Propose your own 'Action Plan' within the next five years

National flood hazard mapping in China is proposed to make right now. And my department will offer the technical support to this big project. So my action plan is corresponding with this project. The following is a draft of my action plan:

- Dec. 2006 Report to my office.
  Introduction of history, procedure, method, effectiveness, practice, etc of Japanese flood hazard maps.
- Jan. ~ Jun. 2007 Produce record flood maps
  - Cooperate with related provinces office of flood control headquarters.
  - Choose research institutions.
  - Collect past floods information, topography data, flood damage, etc.
  - Compile history inundation maps
- July. ~ Dec. 2007 Produce flood risk maps
  - Through hydraulic calculation and simulation, estimate the anticipated inundation areas (such as extent of inundation, water depth, flow rate, arrival timing etc.)
  - Compile flood risk area
- Jan. ~ April. 2008 Produce flood hazard maps
  - Calculation population required to evacuate, accommodation provided by shelters.
  - Formulation of an evacuation plan
  - Inquire the public suggestion
  - Compile flood hazard maps
- May. ~ Jun. 2008 Publication and dissemination of flood hazard maps
  - Approval by the local government
  - Dissemination
  - Flood prevention education in schools
- July. 2008~ 2010 Verification and actual application
  - Survey report and verification the effectiveness of flood hazard maps in the emergency of flooding
  - Modify and improve the flood hazard maps

C-4) what seems a problem in making flood hazard maps in China?

In China, because of the number, scale and complexity of structural flood management systems, flood hazard mapping will be an enormous undertaking. The resources required in the PRC in terms of funding, basic data, technical personnel and training skills are considerable. These challenges require reliable funding sources for future recurrent expenditure, and regular updates of flood hazard maps to reflect hydrological and catchment changes, future development, and improvements in flood control and flood management systems.

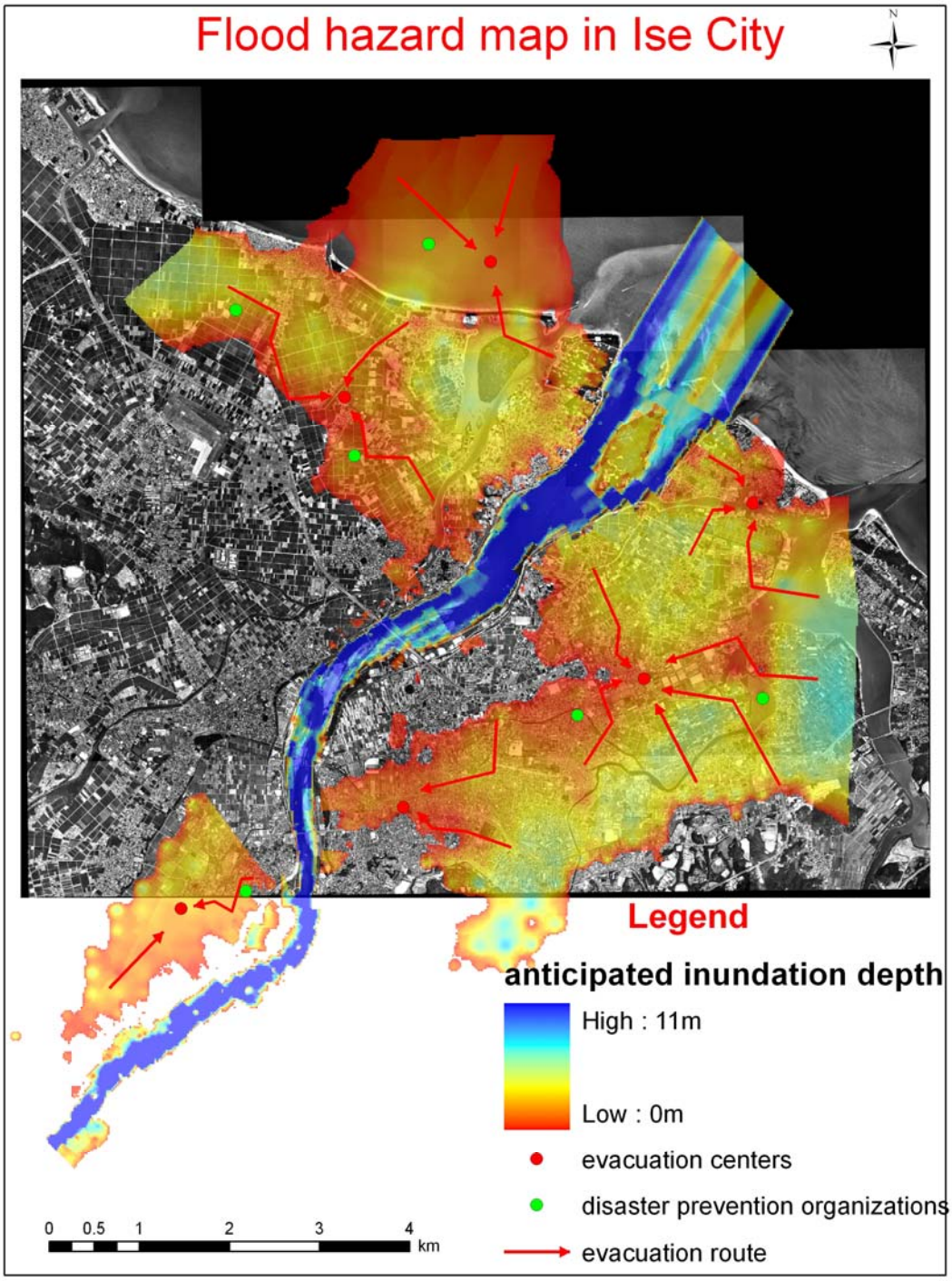
If there is insufficient funding to complete all flood hazard maps at present, it is possible to progress it step by step. As we know, there are some distinct characteristics of flood disaster of particular concern in China in recent years. These are: 1) Flash flooding and debris flows, which cause most casualties. 2) Urban flooding. 3) Detention areas, where conflicts between flood management and socio-economic development remain a major problem.

To help resolve the problems cited above that are particularly acute in recent years, flood hazard maps can first be developed for mountain cities, most large cities and some important detention areas.

Key elements of flood hazard mapping are: 1) Data acquisition. 2) Methodology. 3) Information display. 4) Updating. 5) Public release and education. Each of these key elements deserves special attention in developing maps for flood management systems in China.

At present, data acquisition is difficult in China. Many types of data are required when generating flood hazard maps, including hydrological, topographic and land surface classifications, river cross sections and flood control works information. In China, this data is stored and managed by different administrative departments. Unsatisfactory data sharing mechanisms and management attitudes are serious constraints for flood hazard mapping. Development of Digital Terrain Models (DTMs) is another major constraint, since much more remains to be done in the PRC, and DTMs are extremely valuable in achieving good accuracy in hydraulic simulation of flood behavior.

D) My own Flood hazard map in Ise city



D-1) what is the improvement from the FHM on Ise city currently available?

The improvement from the FHM on Ise city currently available is I have added evacuation routes to the new FHM and it is more convenient for the residents to evacuate. It can greatly decrease the evacuation time.