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**Integrated Geographic Information Services for
Wenchuan Earthquake^{*}**

^{*} Prepared by National Geomatics Center of China, Beijing Normal University (China)

Integrated Geographic Information Services for Wenchuan Earthquake

CHEN Jun¹, HAN Gang^{1,2}, HE Chaoying¹

1. National Geomatics Center of China, No.1, Baishengcun, Zizhuyuan, Haidian District, Beijing, P.R. China
2. Beijing Normal University, No.19, Xijiekou Wai Street, Haidian District, Beijing, P.R. China

Abstract: During the disaster relief of Sichuan Wenchuan Earthquake, NGCC (National Geomatics Center of China), under supervision of SBSM (State Bureau of Surveying and Mapping), had implemented an integrated geographic information emergency service for the rescue, mitigation and reconstruction works. Huge number of existing topographic data and new imageries taken after the earthquake were provided to thousands of users from different sectors. Three ad hoc GIS systems were developed respectively for the rescue operations, damage assessment and the reconstruction planning of the Earthquake affected area. On demand thematic mapping was implemented and a number of thematic maps as well as two atlases were produced. This integrated geographic information emergency service had played a very important role in the rescue operations, mitigation and reconstruction planning of the devastating natural disaster.

Keywords: Wenchuan Earthquake, Geographic Information Service, data services, ad hoc GISs, thematic mapping

1 Introduction

The field of disaster management has greatly benefited from recent advancements in geographic information services and related technologies. In particular, GIS (Geographic Information System), thematic mapping have had a significant impact, and are currently being used in a variety of ways during all phases of disaster management. In the Wenchuan earthquake relief, SBSM (State Bureau of Surveying and Mapping) and other departments integrated advanced geographic information technologies including RS (Remote sensing), GIS and thematic mapping, fast acquiring and integrating the latest imagery data of disaster area, producing variety thematic maps on demand, constructing ad hoc geographic information systems. The efficient geographic information services that we provided play a key role in the rescue, assessment and reconstruction planning of the Wenchuan earthquake.

In this paper, the framework of the integrated geographic information services is described briefly and then the services including data service, GISs and thematic mapping for Wenchuan earthquake disaster relief are addressed. The conclusions summarize these services and give the shortage and suggestion.

2 The framework of the integrated geographic information services

Wenchuan earthquake is the most destructive, affects the scope broadest, the most difficult in earthquake relief work since the founding of New China. After earthquake, SBSM responds quickly and takes immediate actions to organize and implement the geographic information integrated emergency services, which content mainly including result data service, geographic

information systems and thematic mapping service.

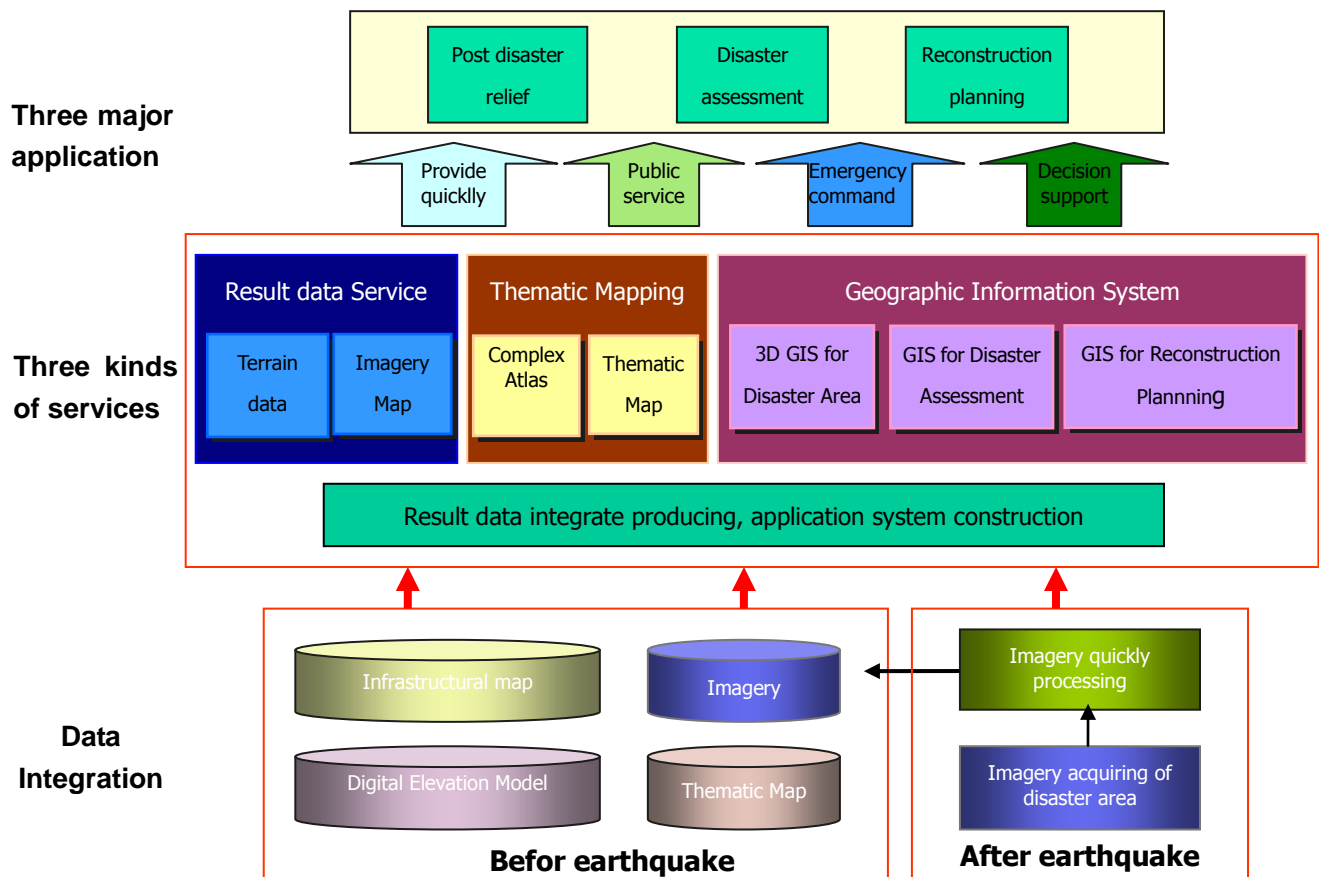


Fig1. The Framework of integrate geographic information system for earthquake relief

According with the requirements of the disaster relief, result data service is quickly processing and integrating the infrastructural surveying product and the last remote sensing imagery and providing terrain emergency information service for related leading office and customer. Three geographic information systems were designed and implemented for data integration and having the functions of 3D imagery exploration, imagery comparison between before and after disaster, thematic analysis, which considering the characteristics including the complex of the disaster area terrain, massive terrain and imagery data and data analysis. These systems are mainly providing a geographical data integration and analysis platform for the disaster assessment and reconstruction planning. Thematic mapping service is mainly to design and make variety thematic maps, which is for reflecting the disaster affected area, disaster degree, disaster response and planning thinking, and compile thematic atlas for effective expressing the disaster’s temporal and spatial distribution and reconstruction planning’s spatial distribution.

3 The Result data service

During the disaster relief period, infrastructural surveying result has been distributed to general office of the State council, emergency response office of the State council, NDRC(National Disaster Reduction Committeemen), CEA(China Earthquake Administration), MOEP(Ministry of Environmental Protection of the People’s Republic of China), MOHUR (Ministry of Housing and

Urban-Rural Development of the People’s Republic of China), MLR(The Ministry of Land and Resources P.R.C), MOC(Ministry of Transport of the People’s Republic of China), Peking University and Chinese Center for Disease Control and Prevention, which contents includes 1:50000, 1:100000, 1:200000, 1:250000, 1:1000000 topographical maps, 1:50000 DLG(Digital Line Graphic)/DEM(Digital Elevation Model)/DOM(Digital Orthophoto Map), navigable geographic framework data and administrative map of each county in disaster area.

Because of different formats, insufficient ground control material and poor quality of part imagery, the subsequent processing is difficult so new quickly methods are used to processing the last 110000 km² aerial image and 770,000 km² remote sensing imagery of disaster area. In image rectification, parameters of different images are used and differential rectification, aerial triangulation encryption, RPC parameter combined with control points, polynomial rectification or affine transformation model based on collimated beam projection are used to quickly process the image rectification. These methods reduce the quantity of the control points, improve the quality of rectification and accelerate the processing speed.

State surveying departments implement disaster image map project to provide the most currency maps for disaster relief. Image map is made by overlay vector features on the orthophoto image with necessary map decoration. It has the advantages both image and map because one hand it can vivid display the geographic scenes with rich image details on the other hand it also can mark the area with simple line or mark symbol which image can’t display. The selection of vector features depends on the requirements of different scales image maps. Vector features on the image map as much as possible can give more information. The symbols of vector features and the configuration of mark is depends on the color of the image map.

According to the requirement of disaster relief and the facts of disaster area, three scales image map were designed. One scale is from 1:40,000 to 1:100,000 of county in disaster area mainly used for macro-scope analysis and decision. Another scale is 1:25,000 or 1:10,000 mainly used for disaster loss assessment, disaster investigation and monitoring. The third scale is 1:5,000 or 1:2,000 of townships in disaster area mainly used for reconstruction planning.

Image maps	Coverage area	Memo
County image map	98 counties	Scale from 1:40,000 to 1:100,000
1:25,000 image map	<ul style="list-style-type: none"> ● Cover 64 counties, such like Wenchuan county ● Cover partly 29 counties, for example Songpan county 	
1:10,000 image map	<ul style="list-style-type: none"> ● Cover Gansu province ● Cover partly 12 counties of Shanxi, for example Lueyang county. 	
1:5,000 image map	<ul style="list-style-type: none"> ● Cover 87 townships of Sichuan, for exmpale Hanwang township of Mianzhu county 	

	<ul style="list-style-type: none"> ● Cover partly 246 townships of Sichuan province, Qushan of Beichuan county 	
1:2,000 image map	<ul style="list-style-type: none"> ● Cover partly 4 township, Chengguan of Wenxian county in Gansu province 	

Table1. The image maps results

4 The Development of Geographic Information Systems

Because of the three phases- disaster relief, disaster assessment and reconstruction planning-in disaster management, three geographic information systems corresponding were developed-3D geographic information system of disaster area, disaster assessment geographic information system and reconstruction planning information integrated system.

3D geographic information system integrates the multi-scale infrastructural geographic data (1:1,000,000/1:250,000/1:50,000), multi temporal, multi resolution image data and thematic data including seismic intensity, seismic fault zone and dammed lake distribution. Its function consist of real time linkage between raster data and vector data, 3d imagery display, comparison between imagery before and after disaster, place name query and location, POI(point of interest) marking. After provided free of charge for 48 departments, the system has been timely updated the data and perfect functions.



Fig2. 3D geographic information system of disaster area

Disaster assessment geographic information system was integrated variety thematic geographic data including seismic geographic environment, geological environment, disaster area situation,

disaster assessment and disaster response. Its function has information mark, query exploration and 3D exploration. Experts can use it to investigate the disaster's spatial distribution, compare different factor overlay on disaster situation and quantitative research of disaster's loss degree.

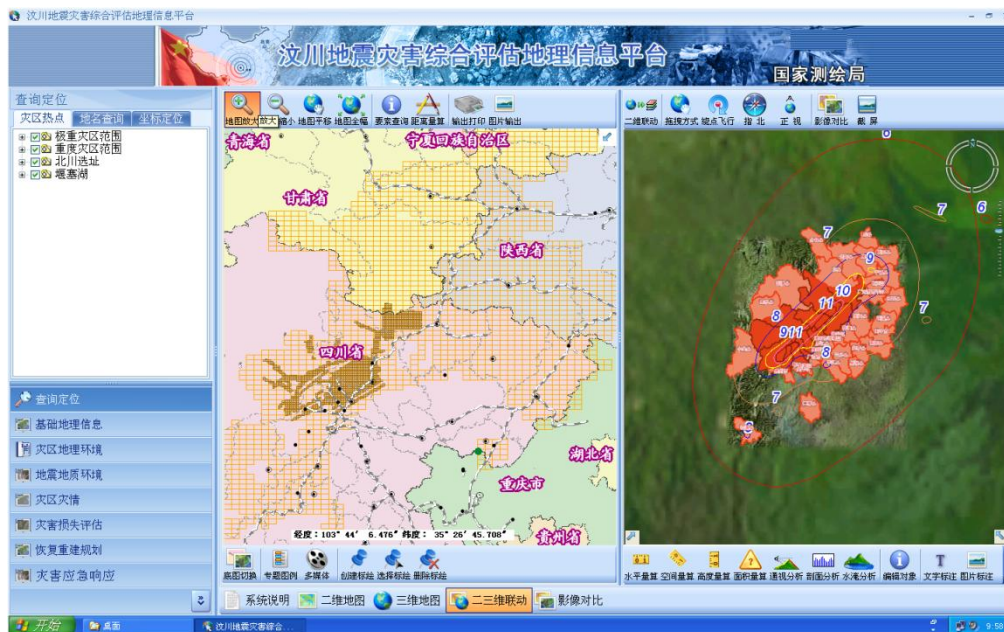


Fig3. Disaster assessment geographic information system

Reconstruction planning information integrates system integrates the reconstruction planning result of area covered 51 extreme heavy and heavy disaster areas based on the newest 1:25000 and 1:5000 scale remote sensing imagery, which provides the general planning result representation and visualization and achieves the organic integration of disaster assessment result , reconstruction planning and infrastructural geographical information. According the requirements of reconstruction planning consultation decision, the system also use message convert and forward mechanism to achieve the linkage between planning report power point document and 3D imagery.

5 The thematic mapping service

During disaster relief period, thousands of hundreds kind thematic maps have been produced. The first is compile thematic maps based on infrastructural geographic information results such like seismic landform map, heavy seismic affected area map. The second is use experts analysis data and result from different departments to vivid show the temporal spatial distribution of disaster, such lick Wenchuan seismic intensity map, Wenchuan seismic affected area assessment map, Wenchuan heavy cultivated land damage map and ecological impact assessment area map. According to the requirements of disaster assessment, three kinds of map were compiled for whole area of seismic affected, administrative area for 40 extremely server and server county and 30 server townships of disaster area.

For recording the whole process of Wenchuan great earthquake's concurrency, response, relief, reconstruction, 'Wenchuan seismic disaster atlas' was compiled. The atlas has 36 subjects and

129 special subjects, which contents includes preface map, inducing environment, bearing body, inducing factors, assessment, response, reconstruction and appendix.

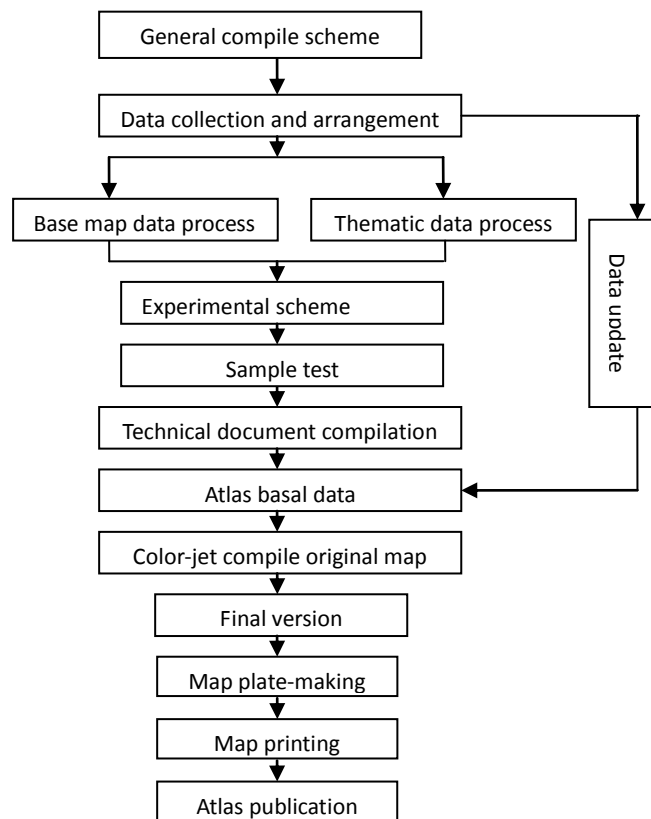


Fig3. The procedure of atlas complication

6 Conclusions

In the progress of Wenchuan great earthquake relief, the departments of surveying and mapping have efficiently organized to provide result data service, thematic mapping service and ad hoc geographic information system service. These services satisfied the urgently requirements in relief, assessment, monitor and reconstruction of state related departments. The integrated emergency services also provide a reference model for comprehensive disaster reduction and risk management in the future. But clearly, there are many deficiencies in real time acquisition of geographic information, fast integration and emergency service. From now, the geographic information resources in three-level of nation, province and city should be enforced to integrate hence for constructing a unified public service platform.

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