

THE STEPS FORWARD OF GIS IN CHINA

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ABSTRACT: Researches and applications of Geographic Information Systems (GIS) in China started in the early 1980s. In the early period, the development of GIS was mainly depended on the progress and applications of remote sensing, aerial photography, as well as computer aided design (CAD). In recent years, with the development of Global Positioning System (GPS) and Internet technology, GIS has being developed vigorously in the county. Looking ahead to the 21st century, a new era of “Digital Earth” and “Cyberspace” is coming, which will provide a great opportunity as well as a challenge to the China’s GIS circles.

KEY WORDS: progress in GIS; regional difference; future trends

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1 HISTORICAL STEPS — A TEMPORAL ANALYSIS

Researches of GIS in China can date back to the early 1980s. At that time, a remote sensing application project was carried out in Southwest China using GIS method integrated with remote sensing data to solve the area measurement automatically. After the first successful test of GIS, a proposal to start GIS research was proposed by the Chinese Academy of Sciences (CAS). Since then a great success has been achieved both in research and application of GIS in China. While its history or progress can be divided into four periods (CHEN, 1993).

(1) From 1981 to 1985, the initial period of GIS in China. During this period, GIS was mainly kept in research and experimental stage, a number of scientists in CAS and some high learning institutes started to follow the tracks of GIS development in the world. With the support of the State Science and

Technology Commission (SSTC) and CAS, a number of research projects were initiated and conducted, leading to build up some typical case information systems. In this period, five systematical and experimental researches had been conducted. Those are geo data capture methods, regional information system modeling, national basic geographica databases building, development of geo analysis software and national geographica data standards and specifications. While the most influential one of those researches was the formulation of a draft of GIS technology specification in which over 50 scientists and specialists had been involved. The first State Key Laboratory of GIS was set up in the Institute of Geography, CAS, providing and open and new type research laboratory specialized in GIS in the county. Also, a large number of GIS personnel had got trained, and some of them are leading edge specialists today.

(2) In the period of 1986–1990, the importance of GIS technology had been generally recognized

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by governmental officials at different levels, and more scientists started to adopt this technology as a tool for their researches. In carrying out a state key research program on remote sensing application supported by the State Planning Commission and SSTC, a national level GIS research project was initiated within the program. The project was mainly focused on flood forecasting and prevention methods, soil erosion on Loess Plateau and Three North Forest Belts. The objects of these researches were to provide regional planning and management as well as decision-making services to the government. Also, during this period, some national level systems, such as national basic resource database, land resources database, mineral resources and forest resource databases had been built up. It should be noticed that the building of these systems was under the planned economic system. At this period all the built systems were in the domain of public welfare and supported by the governmental funds. There was no idea about GIS industry.

Besides personnel training and research sites building, the achievements of this period include the following two aspects. 1) A large number of geographic related databases had been designed and built, including 1: 1 000 000 China land resources information system, 1: 2 500 000 water and soil reservation information system and 1: 4 000 000 natural resources and environmental database and earthquake disaster database. Regional systems included those of Dongting Lake, the lower reaches of the Huanghe (Yellow) River, the Huanghe River Delta, the Loess Plateau, the Taihu Lake basin, the Wusulijiang-Heilongjiang-Songhuajiang Plains, as well as Liaoning Province and Changzhou City, etc. 2) A lot of achievements on technical methods of GIS had been made in the period, such as the use of "OR" model in aerial photograph interpretation. By directly inputted into computer, the photograph is automated for the whole process of rectifying, mapping, measurement and statistics. Other achievements include improvement of Chinese language version for some GIS software packages and PC based mapping systems, and a national grid system standard being formulized. 3)

From 1991 to 1996, it was a very important period for the development of GIS in China. With opening to the outside world and deepening of the economic reform, especially with urbanization and fast economic growth along the coastal areas of the country, the demands for GIS had been greatly increased, GIS applications in urban planning and land management had been springing up vigorously. As a whole, the applications of GIS in these areas had improved the abilities of database updating, spatial retrieving and office automation. With the increase of GIS, the demand for homemade GIS industry has risen. Meantime, under the impetus of the 21st Century Agenda of China, about 42 governmental departments and sectors had put information systems as their priority, financial and customs sectors had implemented their information infrastructure, among them GIS plays a very important role for management and planning. At the national level, lots of efforts have been made on GIS research and system building, including those activities of building up a National Basic Information System for the State Council, organizing an evaluation for home-developed GIS software, building up a fast response information system against disasters and a national agricultural evaluation information system.

(4) Since 1997, GIS has entered a new stage. Firstly, GIS has been generally recognized as an important part of Information Technology (IT) in the country. The government had given a priority to the development of GIS. In December 1997, the first National Working Conference for GIS was held by SSTC in Beijing, which was aiming to promote GIS technology and GIS application. Over 100 local officials in charge of new technology applications and noted GIS experts attended the conference. Local officials had expressed their interests and enthusiasm in adopting GIS for assisting the local planning and management. And in 1998, a lot of GIS activities have been carried out. Fig. 1 shows the regional development and distribution of urban GIS in China.

The rapid development of IT is astonishing in the 1990s around the world, particularly those of computer and network technologies. For China it has

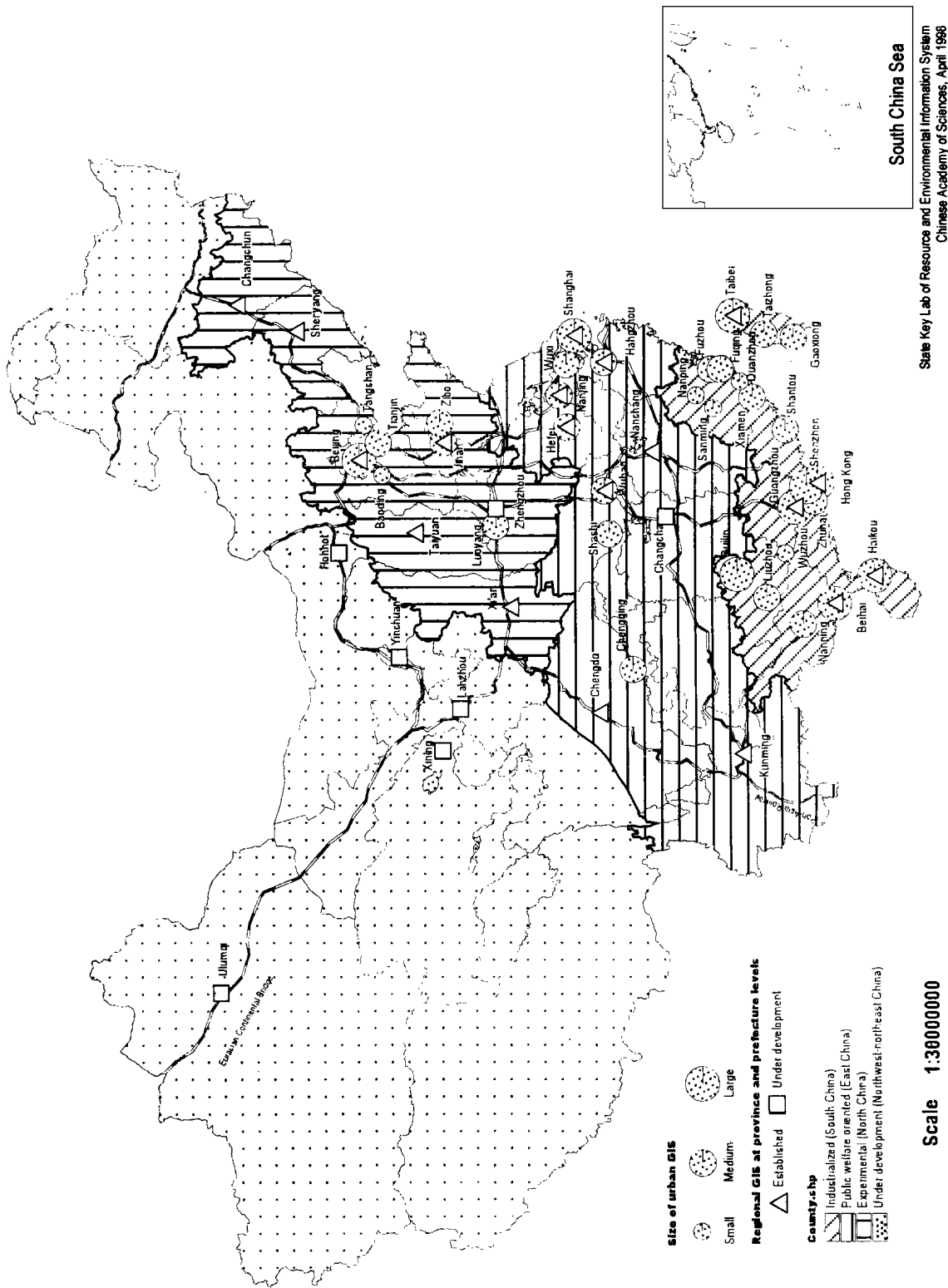


Fig. 1 Progress of GIS in China 1997

also been connected with the outside world through optical fibers and submarine cable, as it having connected with the United States via San Francisco and Los Angeles and with Japan and South Korea. China is actively involved in international cooperation. For example, it recently had successfully participated in the launch of the "Iridium" satellite series. Because of fast economic growth and social development, more and more areas have shown the interests in GIS. In recent years, a lot of operational GIS systems have been seen in the country. There are some good examples, such as the Hong Kong GIS for the Hong Kong Troops of the PLA, the China Ecological Research Network (CERN), National Marine Information System and National Land Information System which will be soon available in the market. It should be noticed that the situation for China's GIS circles is severe, as there are too many things ahead in meeting the demands for GIS from the society and keeping up with the development of modern technology.

2 STEPS IN DIFFERENT REGIONS — A SPATIAL ANALYSIS

Generally, in a developing country like China the demand for GIS is much greater in the urban area than that in the rural area and greater in the coastal area than that in the inland. The development and applications of GIS technology in management and planning is usually keep with the development of regional economy. It is estimated that only when the average land price has increased to a certain level that can maintain the running systems, it is possible to build GIS in the region. Generally speaking, the economic development in China is uneven and the development of GIS applications is also uneven. After two decades' efforts, a regional GIS development gradient has emerged in China. We divide it into four categories (CHEN, 1998).

(1) GIS Industry Region: This region is mainly located to the south of the Lingnan Mountain, equal to the Ling Nan Culture influential area, including the Guangxi Zhuang Autonomous Region, Guang-

dong, Fujian, Hainan provinces, Hong Kong and Macao, as well as Taiwan Province. Early urban GIS applications were started from the coastal cities of Hong Kong, Shenzhen, Guangzhou, Zhongshan, Beihai and Xiamen as well as Taiwan's Taipei and Taizhong. And in this area GIS applications are going into small cities and towns, for example a town called Xiaolan near Zhongshan City has built up a GIS for township planning. It is likely to form a three-level of GIS applications from the regional GIS to urban and to township GIS. It is the most active region in the country of GIS applications and is in somewhat forming a industry of GIS.

(2) Public Welfare Oriented GIS Region: It includes the region of those provinces and regions along the Long-Hai (Lianyungang – Lanzhou), Zhe-Gan (Hangzhou– Kunming) Railway and the Changjiang (Yangtze) River industry belt. GIS is very active in the region with GIS specialized organization being formed in some places. In Shanghai Municipality, Jiangsu, Zhejiang and Jiangxi provinces, provincial level GIS centers have been set up recently for organizing GIS applications. In Chongqing and other large and medium-sized cities such as Wuhan, Ningbo, Hangzhou, Changzhou, Suzhou and Shashi have also started their GIS programs. However GIS application in this region is still supported by the governments and is far to reach an industrial stage.

(3) Experimental GIS Application Region: It includes North and Northeast China. GIS programs in this region are usually planned by the central and local governments. As there are many research institutes located in this region, it has a stronger technical support in developing GIS systems. The early experimental GIS systems, such as those of the Three North Forest Belt, the Loess Plateau, are built in the region and most of them had not been used for direct management and planning. And even in Beijing, Tianjin and Zibo City, there are still some problems remained in using the built GIS systems.

(4) GIS Developing Region: It includes five provinces in Northwest China and Inner Mongolia. GIS is still in a developing stage in this region. This

region is the conjunction with large engineering projects. The building of the pan-Asia Railway and development of the Meigong River and the Tumen River has increased the demand for GIS application both for regional planning and project possibility study.

In addition to that, national level GIS systems in different subjects are under construction. Census data, agricultural, industrial and resources inventory data as well as other geographic related data are needed to handle. Meanwhile, with the development of remote sensing technology and computer network, more systems will be built up in the country soon.

Generally, from the central government to the locals, it is uneven in GIS applications in the country. And the regional GIS applications are in a developing stage. It is concluded that GIS applications are mainly rely on the local economy and technology.

3 STEPS FORWARD TO THE 21ST CENTURY

GIS is a part of knowledge-based economy. The GIS industry and market are never isolated. GIS industry can not be considered as simply importing advanced equipment and technology or developing some software systems. It needs the understanding of the whole knowledge-based economy and changes the traditional concept of the industry. It is also related with the management system, science and technology background, education quality and projective forces as well(MARBLE, 1998).

Looking ahead into the new era of the 21st century, a new type society of information and knowledge-based industry will come. Although a great success has obtained in GIS development and application in China, there is a long way to go for GIS research and GIS industry.

3.1 Digital Earth and Networked World

A new revolution of technology is on the way that has made profound change on data capture, data handling and displaying. It makes possible for us to handle and utilize large amount of data of environ-

ment and cultural phenomena. Most of those data are geographically referenced. There exists a critical problem about data and data handling(CHEN *et al.*, 1997). On one hand, many people are thirst for data for some purposes. On the other hand there are a large number of data in waste. For example, the landsat satellite is capable of taking a complete photograph of the entire earth's surface every two weeks. It has been operating for nearly 20 years. Yet more than 95% of those images, which might be valuable to farmers, educators, environmental scientists, geologists and city planners, have never been served to the public. With the development of remote sensing sensors, high resolution of 1-m remote sensing images will be available in the near future. With the development of the technology, the speed of next generation Internet will increase by 100 to 1000 times. This had lead to the development and application of Web GIS.

A key question for China GIS circles now is that it needs to build more databases and develop basic systems. ARC/CHINA, a 1: 1 000 000 map database has been completed and ready to be published for the market and 1km × 1km meteorological satellite images have been included in the database of World Meteorology Organization (WMO). In Hong Kong, Shanghai and other major municipalities, Information Ports are under construction. These moves will surely lead to develop more database meeting the demands of the society.

3.2 Geographical Models and Dynamical Modeling

Presently the development of GIS in China is still in the stage of database building to meet the general management and data retrieving. The urgent thing needed to do is to make the data mining understandable and usable to people. It is a comprehensive process to attract information from data, and then to knowledge(LI, 1994). In order to solve the problems of population and resources we faced today, it needs to study all linear or non-linear problems on the earth system to find out the laws of those phenomena. Remote sensing provides a powerful earth observation

tool that can monitor the changes of land and marine environments. In understanding of the mechanism of the above problems, analysis and modeling capabilities in GIS are very important, as they should be used to solve the problems. The Chinese scientists are making their efforts on sea level change modeling, urban flood disaster modeling, agricultural output estimation modeling, earthquake prediction, in trying to build a system for social economy prediction. On this situation, besides the general software system, practical application models and specialized GIS software should be developed and make GIS more intelligent.

3.3 Cyberspace and “Virtual Communication”

With the development of computer science and communication technology, literature, arts, and building or crafts designs, even a war can be depicted in computer by a virtual way. Probably this is a new way of thinking and doing things in the 21st century. In a classic fission named “Red Chamber”, it depicts “virtual scenery” for the characters and story of the whole book and predicts the development in the first chapter (SHUNJI *et al.*, 1998). Cyberspace is a special space for people to visit through computer display and network. Then people can use “Virtual Communication” for communication, trade, and research. Cyberspace, like a standing wave existing in the network is interactive and can interact with people's

thinking. Cyberspace, the fourth media after the oral language, writings, television, and broadcasting, integrates computer, digital media, network and virtual reality. This has provided a new challenge to GIS and it is a new base for applications.

China's GIS circle should not only work on building operational systems but also follow the trend of the new development of IT. To meet the demand of the knowledge-based economy, we should face the country's reality and make more efforts to open up a new way for developing GIS both in the technology and application.

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