

## Development of Digital Earth in China

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**ABSTRACT** A knowledge-based economy is looming up as we are approaching the 21<sup>st</sup> century, which is claimed by many as an information age. "Digital Earth" will become the major area for the application of worldwide information infrastructures early next century, providing a technology-based support for the global industrial restructuring process and the sustainable development of global economy. How to create a Chinese version of "Digital Earth" has been put on the agenda, and I'd like to share with you some personal opinions on the development and applications of "Digital Earth" in China.

### I. Roles of "Digital Earth" in Future Development of China

The development of a "Digital Earth" is aimed at creating a digital environment. It is able to make things easy, such as to contain massive geographic information and provide a 3-D description of our planet in different resolutions, facilitating the efficient use of spatial information about the Earth, and opening a non-walled laboratory for us to understand our planet. There are 6 key technologies upon which the development of a "Digital Earth" is based on, *i.e.*, computing science, massive storage, satellite image, broad-band network, inter-operability and metadata. The objectives of creating a "Digital Earth" are as follow: to make the huge amount of earth observing data (especially the massive amount of satellite data on earth) available for use, and to create a virtual digital environment for us to understand the Earth.

The development of the technical fields mentioned above involves a series of key technological breakthroughs. These breakthroughs not only represent a brand new technological development stage of the information and knowledge application campaign in earth science and related industries, but also of concern to the national information application campaign in China as a whole. Initiation of "Digital Earth" marks the accelerated merging at a higher level of space information technology, computer network communication technology and earth science itself in the 90s. It also marks a new stage for the application of these technologies. With "Digital Earth", we will be able to conduct comprehensive analysis of the massive amount of real-time space information from satellites and aircraft and the multi-source information from various fields, and to express them in a way we can understand. "Digital Earth" can help us to overcome the time-spatial constraint of traditional techniques, provide a

powerful tool for us to solve the different problems concerning the Earth, improve our ability of understanding, developing and protecting the Earth, and carry with it the seeds of some promising new industries. Therefore, the concept of "Digital Earth" enjoyed a widespread concern and an active response in China upon its birth.

In economic activities, more than 80% of the commonly used information are geo-referred, in the application range of "Digital Earth" which involves in population, resources, environment and social and economic management, regarding our existence and development. At the turn of the century, China is at a critical stage of economic restructuring and of changing the way of economic growth, and the role of market mechanism and scientific advancement in driving economic restructuring and adjusting social resource allocation will become more important. As an important component of the national information application campaign during this period, "Digital Earth" is of special importance to the implementation of both the "revitalizing the nation with science and education" strategy and the sustainable development strategy of China, a nation with a huge population and a vast territory.

### II. Background for "Digital Earth" Development In China

As a populous developing country, China has not only a great potential need for "Digital Earth", but also a fairly good basis to develop it. The campaign for the application of information technologies in national economic activities has been fruitful in China since early 80s. During that period of time, the national data communication network consisting of long distance optical cables and communication satellites has been formed. The four backbone Internet-based communication networks, along with several special web service systems, have been put into use. Individual computers have been linked

together to form networks. The IT sector, which was formerly mainly driven by government investment, has begun to rely on market force.

From author's point of view, China is one of the countries in the world who have the richest earth survey information. In addition to the widely use of foreign satellites, China has developed and launched its own meteorological and land resource satellites. A remote sensing satellite for investigating marine resources will be launched in the near future. China has made great progresses in airborne remote sensing technology and its applications, and the technology has become a commonly used tool in engineering surveying. Since early 1990s, the nation-wide geographic databases on the scales of 1: 4000000, 1: 1000000, 1:500000, and 1:250000 respectively have been created, and the key regional databases on the scales of 1:50,000 and 1:10,000 have been listed in the special national plan to accelerate their establishment. Large scale research and development regarding the applications of remote sensing technology, geographic information system (GIS), and global positioning system (GPS) have been conducted in numerous sectors of the national economy, with a number of technologically advanced and economically fruitful results having been obtained.

The Chinese government has given privileged support to the promotion of web-based data sharing, technological integration, and their industrialization. Since 1996, several national key projects, such as National Spatial Information Infrastructure (NSII), National Resource Environment, Regional Economic Information System (NREDIS), the information sharing of sustainable development, geographic information system (GIS), remote sensing (RS), and global positioning system (GPS) as well as software industrialization, have been launched. A number of important results, such as a prototype of the national spatial information clearing house, monitoring systems for farming situation and natural disasters, a spatial information shared network regarding farmlands, waters, minerals, forests and marine resources, etc., have been made in China. Some of them have been put into use with satisfactory results. For example, network based flood quick reporting system has been used to monitor and evaluate the floods along Yangtze River and Songhuajiang River in 1998. We can say that the techniques needed to create a "Digital Earth" in China have been in place or have been in the process of development, and creating a "Digital Earth" with Chinese style is, in a sense, a continuation of the above-mentioned technological innovation activities.

However, as a populous developing country, China is now in the mid process of its industrialization effort, and there is still a long way to go for China to catch up with the developed countries in terms of economic and technological standards. Therefore, in the one hand, China has to rely on itself to solve the problems in the development and application of "Digital Earth"; in the other hand, China would like to cooperation with other foreign countries in the fields wholeheartedly.

### III. Strategies for Development of "Digital Earth" in China

Development of "Digital Earth" is the common target of the whole humankind, and each country should take different routes in accordance with its real situation. The situation in China is quite different with US. China is the largest developing country in the world and one of the countries where "Digital Earth" applications have the biggest potential market. The development of "Digital Earth" with Chinese style has to focus on the nation's social and economic progress in a new period, and serve the need of economic restructuring and the implementation of the sustainable development strategy. China's "Digital Earth" efforts must be controlled by the government, be driven by the market, be supported by adequate infrastructure and basic research. The limited resources must be concentrated on key application fields and regions where the time is ready.

#### 1) Focus on Development of National Spatial Information Infrastructure (NSII) in China.

We should speed up the construction of NSII so as to resolve the problems concerning the limited digital basic information on the Earth, the low sharing and poor use of geographic spatial information, and the repeating construction projects. In fact, the macro-control and political support of government are very helpful to facilitate the utilization of spatial information resources at different technological levels and to create a good environment for development and applications of "Digital Earth" in China. This is also consistent with the unbalanced developing situation in the aspects of information technology and economic power in different professions, regions, and enterprises. At present, the focus of NSII development in China should be put in the following two aspects:

(1) To create a framework and a standard of NSII, to give an overall control of the construction of some national and regional spatial data centers and their information service system, so as to facilitate the standardized sharing of currently available data. These centers include the National Basic

Geographic Data Center, the National Satellite and Airborne Remote Sensing Data Center, Land Data Center, Regional Economic and Social Data Center and Urban Geographic Data Center. They should be seen as the necessary preparation to create a "Digital Earth".

(2) To create the National Spatial Information Exchange Center or Clearinghouse and its network service system, so as to make the spatial information databases of major sectors and regions compatible and sharable. We should reform and integrate the resource and environment databases derived from different governmental projects, and turn them into practical use for the state's economic construction in accordance to the state unified regulations.

*2) Creation of Self-owned Earth Observation Information Sources and Service Systems.*

Through overall planning and policy guidance of the government and selection of a reasonable technological route, we have to streamline the investment channel and operation mechanism for development and management of Chinese satellites in order to form wide and in-depth applications and a strong capability of providing data continuously. In the meantime, we have to facilitate the industrialization of corresponding scientific result in order to improve our international competence in the field of Earth observation.

*3) Pay More Attention to Development of Key Techniques Regarding "Digital Earth".*

In order to narrow the gap between China and developed countries, and to improve the operational capability of NSII, we have to pay more attention to development of key techniques regarding "Digital Earth". The 6 key techniques as mentioned before almost include all of the key techniques in NSII. Therefore, the scientific innovation effort in China should be focused on some selected areas, and introducing foreign techniques should be combined with the self-relied innovation, with the construction of information basic infrastructure, and with the development of various application systems.

*4) Conduct Pilot Application Programs in Key Fields and Key Regions.*

We should conduct pilot programs of the application of "Digital Earth" in these fields and regions where there is a relatively good application basis and a relatively satisfactory predicted economic and social return to make the techniques practical and commercially usable. Based on current situation and future estimate, the key application fields should be precision farming, crop yield estimation, resource inventories, monitoring and assessment of environment (including disaster), long distance education, urban and regional planning and management, and satellite navigation and positioning. The pilot applications of "Digital Earth" should be market-oriented. And through the policy guidance of the government, a number of hi-tech enterprises engaged in the development of both the software and hardware products of "Digital Earth" and related data services are expected to be emerged, which will gradually form corresponding industrial sectors.

*5) Promote International Cooperation and Exchange in the Field of "Digital Earth".*

The application field of spatial information should be further opened up to the outside world and actively involved in international technological cooperation, especially research of the application of "Digital Earth" in global change. We should make an adequate use of both domestic and international resources and markets, and, through involvement in international scientific cooperation and competition, narrow the gap with developed countries, improve our international competence, and contribute to the global sustainable development effort.

The development and applications of "Digital Earth" are of importance to the whole nation's information technology development and require the macro-control and coordination of the government. Therefore, referring to the practice of developed countries, a high level authoritative coordinating body, which is inter-department and inter-regional, needs to be created to centrally plan and coordinate this work. I am sure that we can succeed in our development and application efforts of "Digital Earth" in China so long as we can catch the chance provided by the globalization of economic activities and technological development from China's own situation.