

# FROM CARTOGRAPHY TO GEOVISUALIZATION

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## ABSTRACT

Map, as a tool assisted humans exploring the world, has existed for a long time and there are plenty of accomplishments. During the course of using map readers experience and analyze it by their visual thinking. Map is regarded as a visualization production. However, with the development of modern computer technology, especially the development of computer graph and image technology and Visc (visualization in scientific computer), there is another new connotation about the map visualization.

Great changes have take place about the representation methods of traditional cartography. Map is not only displayed by the chartaceous medium firstly and CRT latterly, but it is, within GIS environment, integrated with many high technology, such as high interaction and dynamic, data mining, multi-media, virtual reality, internet and so on. It is becoming a powerful virtual experiment platform and a rapidly developing new discipline.

Many researchers have been studying this transform of map to geovisualization. They come from various specialty areas, for example, computer science, geography, cartography, mathematics, cognitive science, social –economy, etc. Several models about this new notion have been put forward by some experts in this area.

In China, GIS is more popular to general people than before. More and more scientists and researchers do their work with the help of Geovisualization, especially in some fields: traffic management, public utility, construction engineering environment protection and so on.

In this article, there are three major themes: (1) a review of the historic transformation from cartography to geovisualization. (2) discussion about several research themes. (3) introduction about actuality of geovisualization 's application in China.

## 1. INTRODUCTION

During the past years, cartography has taken place great changes. These changes are evoked by great needs for using geo-data in society and economy and the fast-developing geographical information technology. Geographical Visualization come from information processing and displaying technology, such as cartography, GIS, VR and visualization in scientific computer. Its appearance lead to a lot of fundamental changes in many fields, for example data exploring, making social decision and understanding how things work., and so on. It is a research focus presently.

## 2. GEOVISUALIZATION AND VISC

In 1987 a report submitted to the National Science Foundation in the US, and re-published in the journal of the Association of Computing Machinery Graphics Special Interest Group (McCormick et al., 1987) took the computer graphics community by storm, and introduced a wide readership to the concept of SCIENTIFIC VISULIZATION [1]. They go on to state that it is “a tool for both interpreting image data fed into a computer, and for generating images for complex multidimensional data sets”. It will make us break through the restriction of experiment and pure science. If no visualization technology, a pile of data in the computer will be worthless.

Estimates suggest that 80% of all digital data generated today include geospatial referencing (e.g., the geographic coordinates, address, postcode, etc.) [2]. The use and analyse for these data are Particularly urgent.

Representing geographical world is a topic paid close attention to in Cartography. The ability of computer processing enhanced day by day is the essential material base to GeoVis development. The ideas of VISC are slowly permeating the geographical and cartographic communities, particularly among those practitioners engaged in computer-based work.

An initial ICA working group on visualization was extended in 1995 to become the Commission on Visualization, then in 1999 reauthorized as the current Commission on Visualization and Virtual Environment. It took the lead in developing a comprehensive geovisualization research.

### 3. GEOVISUALIZATION AND CARTOGRAPHIC VISUALIZATION

At the beginning of absorbing new technology, some cartographic experts carry on discussion in theory in the future. These models put forward by DiBiase (1990), Taylor (1994), MacEachren (1994) respectively are influential.

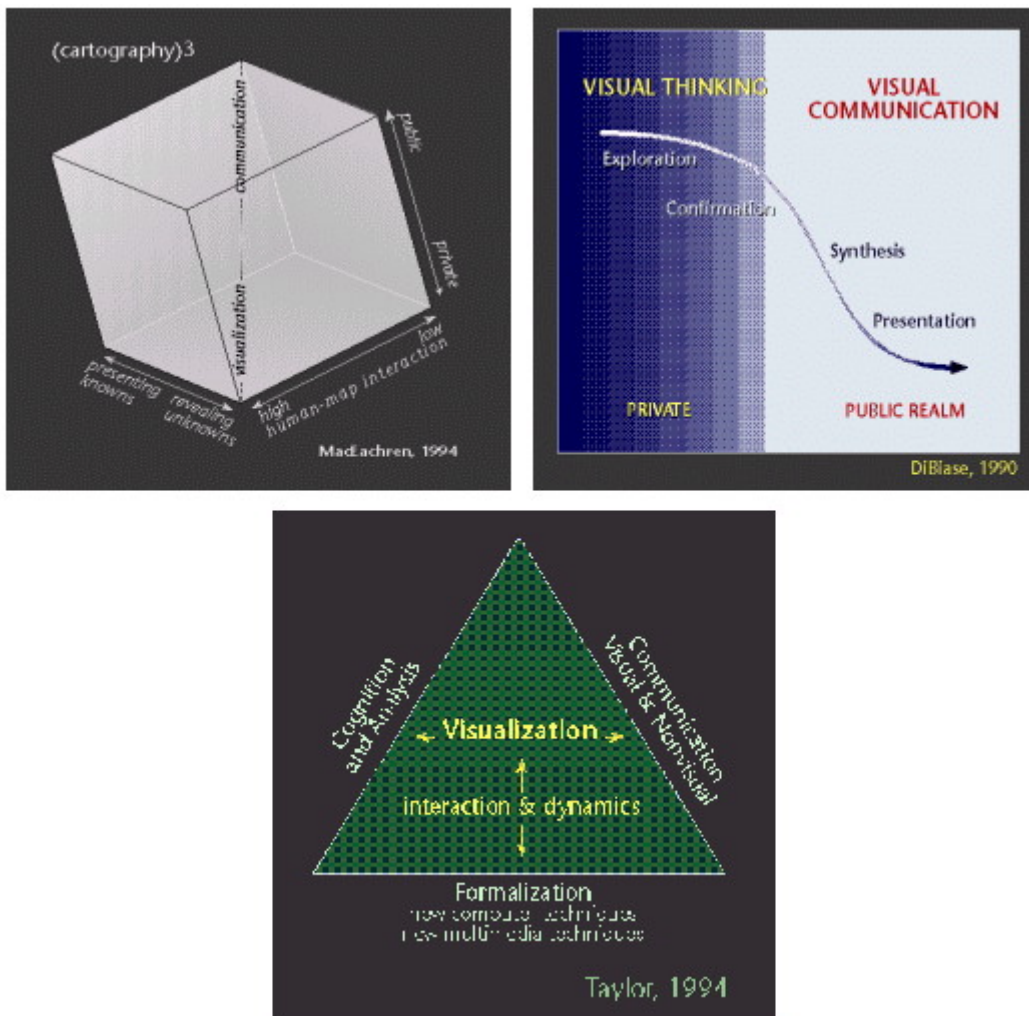


Figure 1. Three models from [http://www.geovista.psu.edu/sites/icavis/com\\_overview.html](http://www.geovista.psu.edu/sites/icavis/com_overview.html)

Three kinds of views have the same or similar place basically, for example they all put emphasis on transmitting and analyzing functions of map, and they all pointed out that highly-interactive individual exploring vision system is the future work of cartographic research.

It can be said that cartography visualization is introduced at the beginning of digital technology development. It still followed the information transmission theory of traditional cartography. Users have some interaction, but obtain the information only one side, passively mainly. Its output is still 2 or 2.5D maps.

Now hardware and internet technology are developing at full speed. It extends new expression methods on one hand and need to display new geography objects on the other hand. It is further deepening result of digital technology in cartography. Contrasted with traditional map and early cartographic visualization. The emphasis of GeoVIS lies in offering one highly-interactive, dynamic visual experiment platform, which can be used to analyze, explore and work in collaboration [3].

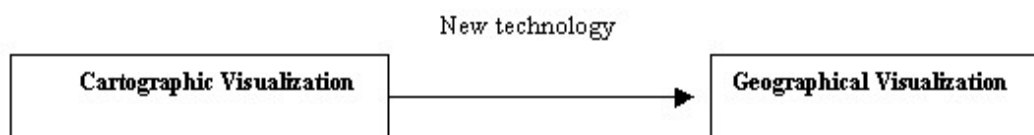


Figure 2. Cartography Visualization and Geographical Visualization.

#### 4. SOME RESEARCH ISSUES

Producing a kind of mental image to the unknown being is the most direct function of visualization in data exploring. Though we still need to examine the correctness of this hypothesis through other means, it promotes people's understanding and thinking to the objective reality. During the course of exploring, people's cognitive level and development of science and technology interact and improve each other.

##### 4.1 From plane to 3D simulation and VR

Since the map emerged, there has been the contradiction between abstractness and intuition. Cartographers have been searching a representation method that accord with people's vision physiology and reconstruct the true terrain all along. Now the theory of computer graphics and relative discipline give us some possibility. A range of display technology methods is already used for cartographic representation and embedded into visualization systems for handling spatial data [4].

Three-dimension simulation has broken the restriction of displaying and processing geographical space information. It is wildly used in urban planning, basic geography of city, etc.

In general 3D simulation system, user is only an external observer, and only can see the graphics that computer generates through screen. But Virtual Reality let user become an inside participant of environment through all kinds of functions combination. This is an achievement achieved by thinking theory and computer technology at certain level. We can say it is a new way for man to explore the world.

Those greatest characteristics of VR are "3P": interactivity, immersion, imagination. In order to get sense of immersing, it is necessary to research man's kinds of senses, not only vision, but also sound, tactile and kinaesthetic feedback. Say from this, the means of GeoVIS are not merely limited to studying the visual effect, but all kinds of perceive ability.

##### 4.2 From static to dynamic

Traditional chartaceous map can only reflect a certain moment or some moments of geographical space. It is limited to show the course of thing and lacked of time information. So it is named as static map. In traditional cartography, we only use moving line or set of several maps to show changes. This is far from enough.

Now we use the term dynamic representation to refer to displays that change continuously, either with or without user control [5]. One form of dynamic representation is the animated map. An argument for utilizing animation is that it is natural for depicting temporal data because change in real world time can be reflected by changes in display time. And interactive exploration can also be considered in the context of animation maps. It can permit users to understand better.

There are some other research issues mentioned in the research agenda: Collaborative Geovisualization, Web Geovisualization, Visualization-computation integration, Interface design and Cognitive or Usability issues, and so on.

#### 5. GEOVISUALIZATION'S APPLICATION IN CHINA

In recent years, the process that GIS applying accelerates with the rapid development of economy. It plays an important role in those fields of urban planning management, communication and transportation, surveying and mapping, etc.

The mediums of map are not only the single chartaceous medium, but also many others, such as chemical fibre, internet, CD, floppy disk, etc. The map of sense of touch, screen map, electronic map of compact disk, multi-media emap, webmap are new lately. Successful representative works are "Beijing emaps" of IGSNRR (Institute of Geographical Sciences and Natural Resources Research, CAS) "Shenzhen emaps atlas" and "Hubei province emaps atlas of flood prevention" produced by Wuhan Technical University of Surveying and Mapping. They all combine graph, text, sound and image together and make good effect.

Another is webmap. People can get geography information at any time anywhere through map website. Two famous map website have been established: <http://www.go2map.com/>, <http://www.chinaquest.com/>.

There are some others. People can make place inquiry, facility inquiry, measure distance conveniently and print them out. Even can make the street map or position map that oneself needs. It brings very great convenience to somebody's daily life.

Some professional geospatial database systems have been built in Shenzhen, Beijing, Haikou, Guangzhou, etc. And China has already listed the project of "digital city" as key research project of our country. Digital city is closely 3D simulation of true city. People are able to manage the natural and human information about city and interact with it. Three-dimension display is regarded as an important part of it. In order to control the complexity of the scene and accelerate the displaying complicated scene of 3D in real-time and visually, multiple details level (LOD, level of detail) model has been used widely. And at the same time, photo texture should be dealt with to increase its fidelity. But this will make database larger than before. Management for magnanimity data becomes the research focus.

GeoVIS has been applied to many fields, such as meteorological analysis, mine, preventing flood and so on. But it is only primary. It should have much to research and have great potential.



Figure 3. Three-dimensional view model of Shenzhen Chinese Overseas Town area. Survey on 3D City Models and CyberCity GIS, Zhuqing, et al. The second "virtual reality and geography" scientific seminar, Beijing, 2002.

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## **Biography**

### **Education**

B.Sc. (1998) School of Land Science, Wuhan Technical University of Surveying and Mapping  
Major: computer cartography

M.Sc (2001) School of Resource and Environment Science, Wuhan University  
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