Map, Geographical Information System and Digital Earth

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We human beings have now entered an information age with the wide use of man-made satellites and computers. Information Revolution is now giving the whole human society a great impact; Cartography, which has a long history, is also influenced. Over more than 5000 years, the expression of space information, which has gone through the Map-GIS-Digital Earth period, is a full embodiment the development of science and technology and the evolutionary development of our human society. This thesis tries to analyses the appearance of digital earth from three levels. its influence over Cartography, Geographic information System, and the relationship among them.

1 Traditional Analogue Maps

T functions of traditional Analogue maps have been greatly improved over centuries. Traditional analogue maps are carriers of geographic information and tools for transmission media for geographic information. The idea that they are visual symbol models for geographic environment has come to the minds of general public. Over a long period of time, they are honored as the second language of geography and are widely used in the study word of geography and its relative subjects. They also play an important role in the construction of motional economy and defense. Geographic information collected are stored in maps in the form of pictorial symbol, So people get much information from maps which are regarded as information resource. Maps are vital in solving political, military, economic, scientific, culture and daily problems. Maps are necessary in the construction of infrastructure, national defense. They are also important for military command, national land planning, resource management and sustainable national economy.

1.1Features of traditional analogue maps

The following are three major features of traditional analogue maps: Strict mathematical codes, scientific map generalization and vivid pictorial symbol language. Mathematical codes resolve the problems of displaying the geoid (or part of it) on the limited surface of maps. Maps compress the geographic information of a cartographic zone in a briefly scientific way, as a result, the clearness of maps is insured because of the selective, simplified classification and gradation display. Pictorial symbol language symbolizes the processed geography information. It also takes advantage of the changes of forms, sizes, structures and colors of map symbols in order to establish the deals and associations between geographic information and pictorial symbol languages, thus, it enables maps to be directly perceived. The above mentioned basic features reveal the connotation and essence of traditional virtual maps.

1.2The limits of traditional analogue maps

The following are the main limits of traditional analogue maps: the time-lag of information, limited storation, single method of transmission, limited virtual capability, a slow extraction and analysis of information.

The slow making of traditional imitative maps is, strictly speaking, a handicraft, with a complicated manufacturing process and a long cycle. The information on the maps takes a long time to update. The geography information extracted from traditional imitative maps is characterized by time-lag, a poor present situation, little practical use.

Traditional analogue maps are drawn (printed) on surface media (paper, polyester film, and textiles) according to map symbols system. Pictorial symbol language is the only means for traditional maps to store and transmit information.

Traditional analogue maps are matter models from the object world. They only use limited two-dimensional surface to express the cubic geographic environment, which seems to be endless. Confined to pictorial symbol language and the forms of traditional analogue maps, it is hard to display on the same map various subdivisions and quota system of the same key map element. It is also difficult to fully display the features and rules of the rich geographic information, which may vary in accordance with time and space.

People have long been using traditional maps to extract and analyses geographic information. Before computerized drawing machines come into being, people have to use simple apparatus to collect geographic information. Tremendous calculating work is a nuisance to wards scientific analysis. Technological operations are often needed in the process of information, such as drawing Wind Rose Map by extracting special elements, drawing profiles along a certain line, drawing a local cubic map or matching and superposition of various maps with specific subjects in the same locality. All those operations are not easy in terms of traditional maps, therefore, no reasonable working speed and accuracy can not be guaranteed.

2 Geographic information system (GIS)

2.1The features of geographic information system (GIS)

Geographic information system derives from maps. And has their similar functions of carrying and transmitting geographic information. By comparison, it has several features:

(1)It improves the geometric accuracy of space information. In GIS, geographic information is stored in digits, therefore, the geometric accuracy of all geographic information can be guaranteed.

(2)More space information can be stored in GIS.GIS is not limited by scales or width and the length of maps. With the ever-increasing storage capability of computers, SIS can carry as much as information as it wants to carry.

(3) The transudation and transmission of space information are far more convenient in GIS. Due to the variety of projection modes and scales, it is hard to put together information from various traditional maps; On the contrary, IS can be easily managed by one geographic coordinate. Different maps with different scales, projection modes and themes can be easily put out by GIS.

(5) GIS enables people to calculate accurately and quickly. In GIS, Users can directly

put information in through keyboards or menus and wait for them to be processed by computers accurately and quickly.

(4) GIS increases the functions of drawing maps. By GIS, people can acquire a higher-degree automation while drawing maps, which now can be updated more quickly than before. Some tough problems in map-drawing can now be easily tackled by GIS. The editing module provided by GIS can put together two neighboring, or even more maps in a perfect way. What's more, the jobs of curve interpolation, drawing cubic maps, continuous profiles, shaded-relief maps are not problems any longer.

(6) Automatic Analysis is available in GIS.GIS is superior to traditional maps in speed, accuracy and operability in terms of multilayer superposition analysis, the joint analysis of pictorial and attributive data, path analysis, dynamic monitoring and information composite.

2.2 The functions of maps in GIS.

Maps began to shape in the new form of digital information in 1960s, then GIS came into being. Despite the fact that GIS put fresh blood into the map-drawing field, it still can not do without traditional maps.

Maps are the resource of space data for GIS. Before remote sensing technique appeared, Variety of space data can only be acquired through maps. Nowadays the very technique has experienced great development, but maps are still important resource for space data and they also lay a good foundation for attributive data and the remote data space location.

In one word, maps are indispensable to space analysis of GIS. They are also necessary when people use GIS to do the following jobs: Dynamic resource monitoring, quality estimate, environmental simulation, space analysis, the location of best routes, Conclusion lf planning and the implementation of forecasting. The principles and approaches of Map Analysis are preliminaries to those of GIS Analysis .

Maps are the best outcome of the visualization of GIS. The tremendous analysis function of GIS can help various scientific researches to bear their "fruits", which may be displayed in the forms of digits ,words, sounds ,images and maps. Maps are regarded as the best outcome of the visualization of GIS because of their advantages in transmission of space information, such as direct and artistic image, scientific location, proper generalization. thus ,comparatively speaking, they are irreplaceable.

2.3 GIS challenge against traditional maps

There exist three major features in traditional analogue maps: strict mathematical codes, scientific map generalization and vivid pictorial symbol language, But the above mentioned will under go series changes with the development of GIS.

By using maps as carriers of geography information, it means that different scales should be employed in accordance with different maps, while in GIS, magnetic medium plays the role of scales counterpart. Users can zoom windows freely. With a proper digitization, the powerful function of GIS can easily produce maps of various areas with different scale standards labor intensity and production cost of the maps are also drastically reduced.

Traditional map projection is only confined on the globe ellipsoid, that is ,set up

coordinate grids on the surface of papers .By contrast, three –dimensional cartography is now a trend in GIS, which paves the way to the direct map-drawing on the globe ellipsoid with bent-surface coordinate. The projection range of traditional maps can not be other than vector maps. The two ever-increasingly important data resources of GIS---scanning maps and remote sensing images are not included in traditional map projection. In one words, this kind of projection concerned and it is really a severe limitation to users' vision. The future of traditional map projection is dubious, for it can not adapt itself to the fast development of space information express way.

While map-drawing is still a handicraft, there is a conflict between the innumerable geographic matters in the broad space and their way to getting a clear expression, To settle this conflict, people use map summary, which means selective choices, the simplification of forms, the summary of and displacement an of their quality and aquantity, But in GIS, map summary will not do, as we know, it is impossible to do the composite and overriding analysis with two different scales.

Naturally, the concept of map summary has experienced changes: it is not necessarily arranged according to the size of scales; the changes of maps from digital models to maths models to visual models have now become a focus. With the non-stopping development of Information Science, GIS will issue many challenges to cartography and further its development .

3 Digital Earth

3.1The connotation of Digital Earth

Digital Earth is a three-dimensional, multistage-resolution digital total expression based on massive global spatial data. It offers us human beings a net bounding surface and a super-media virtual practical surroundings. It is based on NII and NSDI. It is a brand-new innovation resulted from the interpenetrating and combination of several relative fields. It consists of two main parts. One part deals with the space technology and its development, including traditional maps, remote sensing,

,GIS, Global Position System (GPS), Intelligentual Expert System, and Global Information Science. The other part tackles Global Information Science, including Local Area Network, Internet and Global Information Express way. With the growing awareness of the human pressure to the global system, we human beings need to better understand all the information about it. We need to evaluate the information better so as to supply the government and policy-markets with reliable scientific data, which can facilitate their policy-making about environment pollution, resource management, sustainable development and global climatic changes. The concept of Digital Earth can not come into being without the full development of space technology, information technology, network and its concerning technology. It offers us human beings an attractive technological system which is rich in relative fundamental the oriels and new high-technology:(1)Network technology. Digital Earth System is running on the Internet. Wide band high-speed net is needed because of its large amount of data,apart from that, powerful and efficient GIS softwares which can be run on the internet need to be designed and produced. (2)GIS. Digital Earth is a data volume consisting of multi-scaled, multi-dimensional, multistage-resolutioned and dynamic images-graphs-characters, with the necessary

priliminary that all the data must be seamless and is globally available on ghe Internet.Obviously, Digital Earth is three-kiminsional space infoumation based on theories of Cartography(such as projection,symbol system,visualization). RS and GPS are powerful tools of acquiring ,locating and updating space information, while the job of data analysis,display and procession is given to GIS,RS etc.In this sense,Global Earth is a highly useful system based on Cartography, GIS, RS,GPS. (3)The technology of vertualizing the rdalities.It is an innovation of traditional GIS' visualization, visualizing analysis, artificial simulation technique and it can fully express geography information data.This enables users to be absorbed in global environment and feel and understand the analysis and simulation to global enneronment from multiangular, multilayer, multitense point of view.

3.2 Digital Earth's challenges to GIS.

3.2.1 challinges to maps:Digital Earth consist of satellite image data with high resolution, basic and specific digital maps and various global infoumation concerning population, economy and society,etc.Digital Earth can not be built and used wethout traditional maps and electric maps.In the future ,space infoumation expressde in the form of maps will take an ever-increasing percentage of Internet infoumation,therefore, users of Digital Earth will make better use of the functions of maps such as transmission, carrying 'simulation and Cognition of geography information.Another advantage of Digital Earth is that it can makes maps better meet their expression needs, including a profound study of maps visualization, multi-dimensional and dynamic expression, an instant mutical convension among traditional maps ,electric maps and digital maps,an increase of analysis functions of electric maps and digital maps and an enlargement of their applied scope. In one word,Digital Earth will prompt cartography to come into a new era.

3.2.2 challenges to GIS:Digital Earth has a close relationship with GIS. GIS can extract geotraphy information from Digital Earth and return the analysed data to it. What counts is that Digital Earth takes advantage of the present and developing thories, technology and data from an more advanced systematic,unuversal point of view.It can serve the socerty more efficiently and more economically, and its service scope and content are also broadened. The distinction between Digital Earth and GIS lies in :(1)the data base of GIS is often planar while the data layers of Digital Earth can not only be planar,but also be spherical and radiantly cubic; (2)Digital Earth is a combination between immarginate, seamless distributed data base and an information system. Their mutual manipulation, calculation, the fusion, expression and vitual experience technology of the multistage-resolution, multi-dimension, multi-media data, are different from the extant traditional ones, so are the storage and management techniques of the large amount of data. (3)The extant GIS often fulfills specialized tasks which need special space analysis. Digital Earth, being a strategically important, advanced system, does not focus on some minor details, but concentrate itself on comprehensive problems which bear global importance.

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