

“3S”-based Environmental Protection Geographic Information System Research

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Abstract. To make the complicated environmental protection work simple, the data in various environmental work business systems were integrated together, and the accurate and effective analysis of decision-making and rapid response were made via the information application platform based on an intuitive and graphical 3D map. Thus, it put forward higher requirements for the construction of the information system. Therefore, in view of the main defects in the planning and compilation of the urban green space system in China, the application of the new technology and new theory, represented by 3S technology in the urban green space system planning, was discussed in order to enrich and perfect the general indication under the support of the 3S technology, in order to improve the rationality and scientific of the planning. The research showed that the application of 3S technology and its related theories in the planning of urban green space system were reasonable and effective. It makes up for the shortcomings of the traditional urban green space system planning theory and method and explores a new way of planning.

Keywords: environmental protection; three-dimensional map; 3S technology.

1. Introduction

At present, the computer is widely used in various fields of environmental protection in China, which greatly promotes the development of environmental protection information. The geographic information system in environmental management and the analysis can be referenced in government decision-making show that environmental protection work can move forward towards the direction of present generation and in-formation. Based on the integration of basic geographic database and pollution source census database, we should make full use of the advantages of RS, GIS and GPS to serve environmental protection. In order to realize the dynamic management of data, combine with the actual work of environmental protection, integrate the existing re-sources based on network and space technology and information system. It also ensures the conduct of the protection and construction of environmental resources through re-al-time monitoring and dynamic updating in the network environment, planning and environmental management projects.

The progress of modern production technology makes the types, quantity and spatial and temporal distribution of environmental information occur closely related to the developed degree of human society, the level of exploitation and utilization of resources, the scope, degree and frequency of the economic activities on the environment. And it is also influenced by the natural conditions and the



structure characteristics of the ecological system in the study area. Therefore, environmental management pays more and more attention to environmental information. In addition to the basic attributes of general information such as fact, hierarchical transmission, diffusible and sharing, environmental information also has the following characteristics which are different from the general information.

2. Literature review

2.1. Principle and application of 3S technology

“3S” technology is the general name of the new technologies, such as Remote Sensing, RS, Geographical Information System, GIS, Global Positioning System, GPS, and so on. It is a new space technology, which has effective input and storage for spatial data. It has such functions as storage, update, processing, query, retrieval, operation, analysis and output. 3S technology and its integration are the combination and comprehensive application of current surveying and mapping, photogrammetry, remote sensing, cartography, graphic and image technology, geographic information technology, computer technology, expert system, positioning technology and data communication technology. With rapid and real-time spatial information acquisition and analysis ability, it has been paid more and more attention in the research of global change research, dynamic monitoring of resources and environment, disaster monitoring and prevention and so on. It also has a wide application in the area of urban green space system planning.

2.2. The theory and method system of urban green space system planning supported by 3S technology

“The outline of urban green space system planning (Trial)” clearly points out that the main task of urban green space system planning is that the development targets of all kinds of urban green space are scientifically formulated and reasonable arrangements are made according to the city nature, development target, land layout and so on stated in “Urban Master Planning”, on the basis of in-depth investigation and research. The construction of various urban landscaping and green space and the spatial layout of city environment greening can achieve the purpose of protecting and improving the urban ecological environment, optimizing the urban human settlement environment and promoting the sustainable development of the city. At the same time, the main contents of the urban green space system planning are listed in detail. Therefore, the urban green space system planning under the support of 3S technology must be connected with the program of “The outline of urban green space system planning (Trial)”, and the results of urban green space system planning with operability must be compiled. In this way, the research can achieve practical meaning.

The planning of urban green space system is completed mainly through four steps: the investigation and arrangement of the data, the analysis and evaluation of the results of the survey, the determination and spatial layout of the target and index of the green space system planning and the completion of the planning results (text, drawings, planning instructions and material compilation, etc.). The key points and difficulties of urban green space system planning are as follows: first, investigation and analysis of the status information of urban green space. The accuracy of urban green space status information is related to the scientificity of the planning targets and instructions; second, whether the fairness and efficiency of the park green space is fair and efficient can be maximumly improved is the prerequisite for the success of the park green space system planning; third, using the layout of the green space system to the city’s most requisite and suitable land is key to the urban green space system planning.

Based on the above reasons, the paper put forward the theory and method system of urban green space system planning guided by the classification standard of urban green space, accessibility theory and suitability evaluation theory, supported by 3S technology. The theoretical and methodological system of the research was detailed in Figure 1.

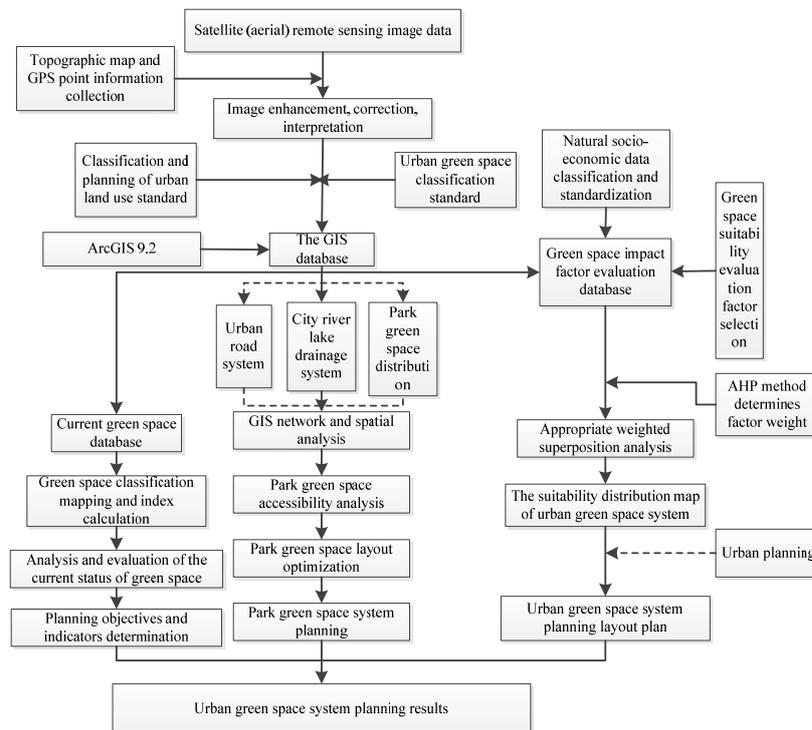


Figure 1. The theories and methods system of the thesis studies

2.3. technique integration

“3S” Technique Integration refers to a new comprehensive technical field, based on RS, GIS, and GPS, which organically form a whole in the three independent technical fields of RS, GIS, GPS and other high-tech fields. The flow of information flows through the entire process of information acquisition, information processing, and information. The “3S” Technique Integration technology is based on the “3S” geoscience parameters, focused on the compatibility of the temporal and spatial features of “3S”, the complementarity of technical methods, the consistency of the application targets, the feasibility of the software integration, the compatibility of the data structure and the support of the database technology.

The integration of GIS, RS and GPS can form a highly automated, real-time and intelligent geographic information system. This system can not only analyse and use data, but also provide scientific decision-making basis for various applications, so as to solve complex problems of users. According to the core of the integrated system, there are two main types. One is an integrated system with GIS as the centre. The purpose is asynchronous data processing. By using GIS as the central platform of the integrated system, the spatial data of various sources, including RS and GPS, are coped with integrated treatment, dynamic storage and integrated management. It can be considered as an extension of integration of RS and GIS. The second one is based on the integration of GPS and RS. It aims at synchronous data processing and provides online spatial information support services for dynamic management and real-time decision-making through the real-time dynamic spatial information provided by RS and GPS and the database and analysis function of GIS. The mode requires integration of various information collection and information processing platforms. Meanwhile, it requires real-time communication support.

Therefore, the integration of “3S” technology is the inevitable result of the development of GIS, GPS and RS. At first, the three have independently developed, but each has its advantages and disadvantages. Since the rise of “3S” two-two combination, of which the most widely used and with the most mature technology is the combination of the GIS and RS. The key to the combination of the two is the software, that is, to realize the real integration of the graphics. Later, with the expansion of

the application field of 3S technology, the complete integration of “3S” has been pushed to the stage of history, and it has become an important research method and means in the field of space information. The paper is a preliminary research on the theory and method of urban green space system planning under the support of “3S” technology and its integration.

3. Methodology

Technology roadmap for investigation and analysis of urban green space based on 3S technology:

The following procedures are generally used in the investigation of urban present green space status based on 3S Technology: collecting data (aerial film, satellite image, etc.) - image processing (geometric correction, image fusion, enhancement, etc.) - selection of interpretation marks - external industry investigation, visual interpretation, human-computer interaction correction - the extraction of green space information – statistical analysis and calculation.

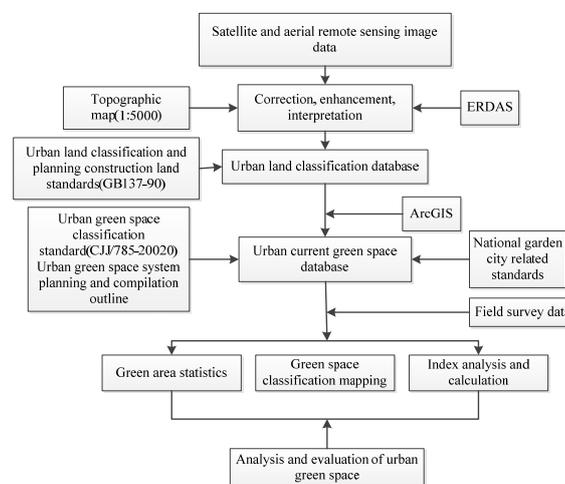


Figure 2. The technical route to Investigation and analysis of urban green space

The spatial resolution of remote sensing images determines the minimum area and precision of the green space obtained by remote sensing. The resolution of the remote sensing image refers to the size of the actual ground range represented by each pixel, that is, the instantaneous field of view of the scanner, or the smallest element that the ground objects can distinguish. The spatial resolution of remote sensing image has 3 forms [63]: pixel (Pixel size), image resolution rate (Photographic resolution) and field angle (IFOV). The remote sensing images, which are used for urban green space investigation, have higher requirements for the time phase, image type and resolution. According to the scope of application of remote sensing information, the best selection of remote sensing image information sources for urban green space investigation are high resolution remote sensing image information source, such as IKONOS, QuickBird-2 satellite remote sensing image and aero remote sensing image information sources. With high resolution, they can identify and identify the classification of urban green space. In this paper, the aerial image data of the imaging scale of 1:5000 is used in the investigation of the current urban greenbelt in Changzhou.

4. Results and discussion

It is more scientific to determine the service radius and service area of the park green space based on the accessibility analysis under the support of 3S technology than in the simple buffer analysis of the geometric centre or boundary of the park green space. Through the analysis of 20min buffer area, the urban park service area is 16330.92ha, accounting for 42.09% of the research area (Table 1). In the same way, the service area of urban park green space is 13789.52ha based on 20min network accessibility analysis, which accounts for 35.54% of the area of the research area, and the service area

of the buffer zone method is reduced by 2541.4ha. Similarly, if the two analysis methods are compared with the standard of 30min minutes, the difference is greater and reaches 3728.68ha. The difference is due to the different distance calculation methods adopted by the two methods and the different understanding of park greenbelt service radius

Table1. Buffer area of park green space

Time (minutes)	Area (ha)	Percentage (100%)
<5min	4892.68	12.61
5-10min	4403.80	11.35
10-20min	7034.44	18.13
20-30min	6370.96	16.42
>30min	16098.12	41.49
Combined	38800	100

The planning outline of urban green system only stipulates three main evaluation indexes of green land rate, green coverage rate and per capita park green area, which focuses on the quantity statistics, and does not involve the actual spatial distribution and usage. In 2007, the green space rate of the Changzhou Jiancheng district was 37.2%, the green coverage rate was 41.6%, and the park green area per capita was 9.2m², all of which exceeded the national standard of the national garden city. In fact, the city of Changzhou also passed the evaluation of the National Garden City in 2007. However, through the above analysis we should also see that the distribution of park green space is very different. It mainly concentrated on the both side of in the Beijing-Hangzhou Grande Canale in the Old-city district. However, in the exterior area, especially in the northern New Area, no matter the number or accessibility of the park green space is inferior. In addition, the green space with natural attributes not only provide leisure and entertainment for people, but also improve the ecological environment of the city, reduce the concentration of air pollutants, balance the oxygen and carbon dioxide in the atmosphere, improve the microclimate and reduce the runoff of the ground. The service area and ratio of park green space and the distribution of population can be used as an important index to evaluate the ecosystem service function of a region. It can be seen that the layout planning of park green space based on accessibility index is necessary and feasible.

Compared with the “hardware” environment, such as urban construction and infra-structure, urban green space is a “flexible” space with the function of earthquake relief and disaster reduction, and the urban green space system occupies a very important position in the urban comprehensive earthquake disaster reduction and disaster reduction system. The green space of earthquake relief and disaster reduction meets the requirement of area but cannot guarantee the effect of disaster reduction. It must also require the reasonable space distribution of the disaster reduction green space, which is to meet the requirements of the service radius. Therefore, according to the accessibility analysis of the park green space, it is a scientific practice to plan the emergency system of urban park green space with reasonable spatial distribution on the basis of combining the spatial distribution of urban population.

Based on the network analysis method of 3S technology, the paper analyses the spatial accessibility and service radius of urban park green space. There is no doubt that the service scope of park green

space should be shown by taking the city as a homogeneous and non-resistance space, taking the geometric centre of the park green space as the centre and using the artificial distance as the radius of the park. It also provides a new idea and new method for urban park green space planning. However, there are still some problems in the research: the parameters (service radius, walking speed, etc.) are used for reference to foreign related research, which may not accurately express the behaviour and preference of recreation people in domestic park. It is necessary to strengthen the study on the behaviour preference of urban park recreation people and provide more reasonable accessibility for urban parks.

5. Conclusion

Urban green space system, as an important green ecological infrastructure in the city, is an important guarantee for the city and its residents to continually obtain natural eco-logical services. The urban green space system planning directly affects the ecological security and sustainable development of the city. But for a long time, the traditional irrational urban green space system planning theory and method has been difficult to adapt to the challenges brought under the background of China's rapid urbanization. Based on this, the paper starts with the application of 3S technology in the planning and construction of urban green space, puts forward the theory and method system of urban green space system planning supported by 3S technology, and probes into the investigation and analysis of the present situation of urban green space, the theory and analysis method of urban park green space planning and spatial layout of urban green space system under the support of 3S technology on the basis of the analysis of the shortcomings of the traditional urban green space system planning. By the recent construction planning practice of urban green space system, it shows the scientific and feasibility of urban green space system planning supported by 3S technology.

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