

# Applications of GIS in Environment Monitoring

YANG Fan, LIANG Fahong, SHI Jianping

Technical Division of Surveying and Mapping, Xi'an, Shaanxi, China, 710054

Yangfan1111@163.com

**Abstract:** This paper introduces the characteristics of Geography Information System (GIS) and the actuality and assignment of environmental monitoring. The authors expound GIS applications in ecological monitoring, water monitoring, air monitoring and environmental noise monitoring, then illuminate the vital role of GIS in environmental protection. GIS is the computer information system that can collect, manage, analyze and visualize space data. It can combine location and associated attribute information and show to the user truly and illustrative. Basing on GIS and other new technology, development and application of integrated environmental monitoring information system will enable sharing of information resources, will enter and analyze effectively the spatial data and the attribute data, and will study the characteristics and the compositive effects of pollutants. It will provide the information for decision-making and promote scientific analysis and decision-making in environmental protection. GIS applications in environmental monitoring is ascendant. And GIS application in informationization management of environmental monitoring will bound to the cause of environmental protection to a new historical process.

**Keywords:** GIS, Environment monitoring, Application

## 1 Introduction

With the rapid economic development, environmental pollution is serious. It brings great threat to the social sustainable development and the health of human beings. Environmental protection is complex and dynamic. It involves spatial information from multi-sectoral, multi-region and multi-field and a lot of data processing. An Effective environmental protection information system is needed so that many factors hidden in the complex relationships will become clear and visually. Using advanced information technology, environmental data is stored, transmitted, processed and analyzed in order to achieve scientific management.

Geographic information system (GIS) is a new technology emerging with the development of geographical science, computer technology, remote sensing technology and information science. It is the computer information system that can collect, manage, analyze and visualize space data. According to actual needs, GIS combines location and associated attribute information and shows to the user truly and illustrative. The spatial information of environmental protection is very large. Management and analysis of spatial information is the advantage of GIS. Therefore, GIS is the ideal choice to a government department in pollution monitoring and environmental resources protection.

## 2 Situation and Task Analysis of Environmental Monitoring

Environmental monitoring is the process of determining the various signs data of environmental quality. It is divided into three sorts those are research monitoring, surveillance monitoring and particular purpose monitoring. Its mission is to identify and test the contaminants composition in the environmental sample, and to study the nature, composition and structure of the environmental quality within a certain historical period and a certain space. So that we can test and judge if the quality of the environment is in compliance with environmental quality standards set by the state and determine the pollution caused by pollutants.

Informatization construction of environmental monitoring started late in china, and the primary construction is immature. For example, software ENSIS developed by ENSYS company in Norway can

establish water monitoring and air monitoring information system at the national level, and the Chinese version has been developed. But for various reasons, the primary workstations knew little about this. It is far less than Arcgis, Mapinfo and some other mature GIS software. In data analysis, we only use Essrsl2004 statistical software. It is lack of powerful GIS analysis functions, does not combine with 3S, and can not monitor environment dynamic and continuously.

Basing on GIS, GPS, RS and other new technology, development and application of integrated environmental monitoring information system will enable sharing of information resources, will enter and analyze effectively the spatial data (vector data, raster data) and the attribute data (indicators of environmental pollution) obtained from GPS and RS by GIS, and will study the characteristics and the compositive effects of pollutants. It will provide the information for decision-making and promote scientific analysis and decision-making in environmental protection.

### **3 GIS Applications in Environmental Monitoring Construction**

#### **3.1 GIS used in ecological monitoring**

Ecological monitoring, also known as the ecological environment monitoring, using of ecology methods and means, measures spatial and temporal patterns of ecosystem structure and function in different scales, which obtains mainly by monitoring the condition, the condition change, the reflection and trend because of the environmental pressure. Ecological monitoring platform is the basis of the macro monitoring. It must be supported by GIS, GPS and RS technology and must have sufficiently large capacity computers and aerospace information processing device. The three techniques form a complete technical system for space observation, space positioning and spatial analysis of the earth, which can reflect the changes and mutual relationship of various elements of the ecosystem in global scale. The mathematical model basing on the RS and GIS will promote the transition from qualitative described to quantitative analysis, promote the transfer of space from the wild into the indoor, and promote the development of time from the research on the past and the present to the quantitative prediction in three-dimensional space. Powerful mapping function of GIS allows users to easily obtain accurate position and informative thematic maps. The establishment of environmental information system not only provides important background data for future, but also formats a unified environmental information network with the relevant information systems of other departments and relates systems of international networking. 3S technology is the direction of macro-environment monitoring development. Using remote sensing and environmental information technology, Neimenggu Environmental Monitoring Central Station investigated ecological environment in Yimeng areas for the first time, and obtained encouraging results it was basis for the establishment of ecological environment dynamic monitoring information system. Through a great deal of research and practice on micro-ecological monitoring and macro-remote sensing monitoring by 3S technology, Xinjiang Ecology Environmental Monitoring Central Station sought out an ecological environment monitoring method. It is consistent to environmental regional characteristics of Xinjiang. They established ecological monitoring index system and comprehensive evaluation which combined of macro and micro, monitoring and investigation and collection of data. Practice since 1995 showed the satisfactory effect.

#### **3.2 GIS used in water monitoring**

Water environment information has obvious spatial attributes and levels attributes, so the use of GIS will reveal the different regions of the water environment more clearly, reflect the water environment quality trend in space, and monitor flood disasters, forecast the development trend of flood. It will also reflect directly the spatial distribution of environmental elements such as sources of pollution, sewage outfall and monitoring sections. GIS can also use in the water quality prediction, water environmental capacity, pollution prediction, the distribution of the amount of pollutant reduction. It can provide multi-faceted and multi-form support with table and graphics for the water

environmental management decisions.

"Digital River" construction integrated used of 3S technology, network technology, multimedia technology, virtual reality and other modern high-tech. It can provide a basin-wide unified integrated information platform to achieve visual query various types of information in watershed and virtual reproduction of the whole basin in the computer. For example, the "Digital River" platform established on GIS technology for "Danjiang Reservoir" environmental monitoring, the relevant data including: Danjiang Reservoir satellite images obtained on RS technology (raster data), the geographic information data obtained on GPS technology (vector data), all kinds of water information (property data). GIS provides a variety of methods of spatial data entry. The data organization is an effective form of database management, updating, maintenance, fast search and inspection. It can output geospatial information in many ways. And using of the model function and the spatial dynamics prediction capability of GIS, it can provides the management and decision support for environmental protection together with expert systems, decision support systems and other technology (RS and GPS). Relying on "digital watershed" basic platform, to promote the process of virtual reality digital environment monitoring will be very important for the scientific management of the water environment.

### **3.3 GIS used in atmospheric pollution monitoring**

Atmospheric pollution continuous automatic monitoring system relies on the GIS platform. The System task is monitoring pollutants in the air continuously and automatically, accessing continuous instantaneous information of air pollution and analyzing the data. At the same time, we can also control air pollution status and weather conditions through continuous instantaneous monitoring when the atmospheric pollution accident happens. It will provide first-hand information for the analysis of the pollution incident and provide the basis for verifying the air pollutant dispersion model and air quality management.

In recent years, for preventing, controlling and eliminating the harm of environmental emergencies effectively and standardizing all kinds of emergencies emergency work, basing on establishing automatic mechanism for monitoring and forecasting air quality, many city governments established atmospheric environmental emergency monitoring system, which was composed mainly by the emergency command center, on-site command vehicle, emergency environmental monitoring vehicles, air quality monitoring network and environmental emergency monitoring plan, a list of libraries of major pollutants dangerous goods, electronic maps and other components. Atmospheric environmental emergency monitoring system made full use the advantages of GIS. In the event of accidental pollution incidents, environmental protection departments could rush to the scene to monitor and analyze concentration of harmful substances in the atmospheric quantitatively and qualitatively. We can grasp of the pollution of pollution incidents timely and accurate, identify the nature of the incident and the harm, and provide the technical basis to decision-making for the development of contingency measures. In addition, the system can also provide services for the environmental quality assessment, prediction, warning and enforcement in the regional environment and major projects, do the background measurement for the major events predicted air pollution, and provide the basis for subsequent conclusions.

### **3.4 GIS used in environmental noise monitoring**

Urban environmental noise pollution is a kind of energy pollution, which is instantaneous in the time and discontinuous in the space. Only multi-point sampling measurement and to monitor frequently as possible will reflect average the level of regional noise pollution more really. Most cities in China have followed the noise monitoring methods that is monitoring some frequencies and some hours every year. Environmental noise automatic monitoring system has the character of no staff on duty and continuous operation. It is a great solution to the current noise monitoring problem such as time-consuming, laborious, and poor representation. It not only can provide timely, reliable and effective basis for

environmental noise enforcement, evaluation and treatment, but also can provide timely and accurate means of environmental noise monitoring for the implementation of quiet works in large and medium cities of China. Environmental monitoring data and statistical information have spatial attributes besides temporal and dynamic attributes. It is best suited to express by GIS. And noise prediction can be achieved through the analysis.

China has not yet sophisticated noise automatic monitoring techniques. Foreign equipment is expensive, so wide use will not meet the actual conditions of China. Harbin Environmental Information Center sum up foreign experience and the actual situation in our country and study this problem in-depth as a subject. The ultimate goal of the system is nationwide online automatic environmental noise monitoring and to constitute a new environmental noise monitoring system by combination of GIS technology, sensor technology, communications technology and network technology.

#### **4 Conclusion**

GIS applications in environmental monitoring is ascendant. Its direction is: to combine the work with the state information, to base on e-government related projects, to promote GIS application in informationization management of environmental monitoring, to develop to specialization, to progress the environmental assessment, monitoring, tracking analysis, to accelerate the application of 3S technology integration, to drive technical and software development.

In short, GIS technology will apply more and more in informationization of environmental monitoring, but also bound to the cause of environmental protection to a new historical process.

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