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Research on Monitoring Technology of Geographic Conditions for Poyang Lake Eco-economic Zone

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Abstract: This study is aimed at the first national strategic regional planning in Jiangxi Province-Poyang Lake Eco-economic Zone and systematically reflects on the key monitoring technology of geographic conditions for Poyang Lake basin. The study makes some preliminary discussions on monitoring the geographic conditions of Poyang Lake Eco-economic Zone from several aspects of research object, research contents, technical architecture, technical route and so on, laying the foundation for further study.

Key words: M poyang lake eco-economic zone, geographic conditions, monitoring

INTRODUCTION

The monitoring of geographical conditions is the combination of natural, human and geographic elements by means of spatial measurement, such as geographic location, area, height, length and trends, including both relatively-stable objective conditions and ever-changing facts. Its basic attributes refer to macroscopic, integrity, comprehensive and dynamics. The purpose of monitoring the change of geographic conditions and predicting the trends is to serve the national and local government decision-making and national geographic education (Su, 2012). Since 2011, the National Administration of Surveying, Mapping and Geo-information has carried out the monitoring of geographic conditions and conducted pilots in many provinces, to provide important experiences and assurance for generalizing the monitoring of geographical conditions all over China.

The geographical conditions of Jiangxi Province have the characteristics of steady promotion of urbanization, superior ecological environment and frequent occurrence of disasters. During the period of the "12th Five-year Plan", some important regional development strategies are actively boosted, including Poyang Lake Eco-economic Zone and revitalizing construction of Soviet Area in the south of Jiangxi Province, so the urgent need for monitoring the geographical conditions of Jiangxi Province is proposed, especially of Poyang Lake Eco-economic Zone and of Soviet Area in the south of Jiangxi Province (Su, 2012). As the first national strategy in Jiangxi Province, Poyang Lake Eco-economic Zone is a major milestone in the development history of Jiangxi Province and is of far-reaching significance to realize the rise and a new leap of Jiangxi Province.

In the research on the general investigation and key monitoring technology of geographic conditions for Poyang Lake Eco-economic Zone, the monitoring technology and demonstration of regional geographic conditions are used as typical cases and by in-depth development, the provincial or even national data of geographic conditions can be shared eventually. Through information deep processing as well as reproduced-hardware and software products, the socialized application of geographic conditions can be really driven, to promote the advancement of Jiangxi surveying, mapping and geo-information technology, to boost the social and economic development of Poyang Lake Eco-economic Zone.

OBJECT AND TYPE OF MONITORING RESEARCH

The object of research on the monitoring of geographical conditions can be summarized as three types, i.e. "natural environmental elements, industrial economic elements, social humanistic elements":

- Natural environmental elements refer to natural resources, ecological environment and its characteristics on the earth's surface and in a certain space (Yang *et al*., 2009), which are the basic

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contents of monitoring the geographical conditions, mainly including land element's area, location, shape, topography, soil, land cover, buildings and structures, water system, vegetation, mineral resources, ecological environment and so on

- Social humanistic elements refer to social construction and human elements within a certain scope, mainly including the progress of urbanization, spatial distribution of population, spatial distribution of humanities landscape and national relationship (Li and Lin, 2004). In the monitoring of geographical conditions, except for the information of geographical natural elements, we must grasp relevant social humanistic information, the law of social development and human activities, so as to realize the accurate presentation and predictive analysis of geographical phenomena and space-time evolution process within a certain scope (Zhang, 2010)
- Industrial economic elements are the media associating natural elements with social humanistic elements and also are a specific product of combination, including industrial structure, "distribution of productive forces", state of industrial development, characteristic industry

According to the relationship between industrial economic elements, natural elements and social humanistic elements, the industrial economic elements can further be divided into two aspects: industrial economic structure and industrial infrastructure. The industrial economic structure is the combination of industrial economic elements and social humanistic elements and the industrial infrastructure is the combination of industrial economic elements and natural elements (Fig. 1).

The contents of research on the monitoring of Poyang Lake Eco-economic Zone, according different monitoring cycle, can be divided into four basic types, i.e., initial surveying and mapping, regular monitoring, routine monitoring and emergency monitoring. The initial surveying and mapping of geological conditions refer to surveying and mapping all the elements of geographical conditions within the full scope of monitoring area and are the basis of monitoring background. For the natural geographical elements having no obvious changes with time, only the initial surveying and mapping needs to be conducted basically, supplemented by necessary changes and update and then the monitoring information is achieved. For the information of geographic conditions having obvious smooth change with time, the regular monitoring is carried out according to its trends of development and evolution and a certain time sampling interval. For the information of geographic conditions

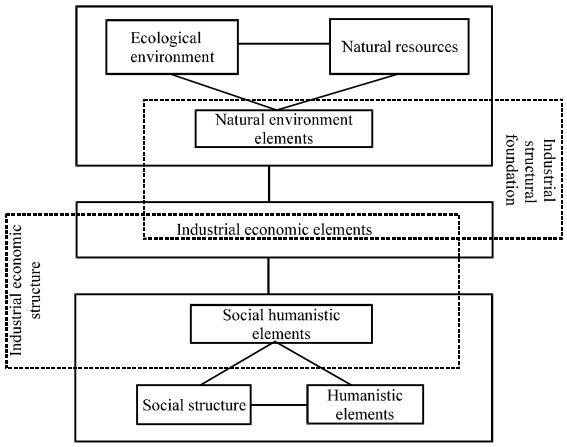

Fig. 1: Monitoring objects of geographical conditions

having obvious change with time, with fast change frequency but without obvious evolution law, the routine monitoring needs to be adopted. The emergency monitoring refers to the real-time monitoring of major events, such as earthquake, flood, debris flow, forest fire and major infectious diseases, for the purpose of auxiliary emergency rescue and disaster prevention and mitigation.

TECHNICAL ROUTE

For the general investigation and monitoring of geographic conditions for Poyang Lake Eco-economic Zone, the integration, authenticity and reliability of data are of great importance, so the stricter requirement for data collection and later-stage classification is proposed. However, under current circumstances, there is no ready-made and perfect technical system and there is no mature experience which can be used for reference to solve a series of problems, such as contents of geographical conditions, collecting standards and specifications, method and process. For the general investigation and monitoring of geographic conditions, therefore, we must complete the top-level design and made the bold exploration. On the basis of existing technology, standards and talent team, relying on the early-stage pilot and experiments, the content and index system of general investigation and monitoring of geographic conditions should be improved, the process and precipitation technology should be optimized and the technical team should be cultivated, to lay the foundation for general investigation and monitoring of provincial and national geographical conditions.

Key technology needing to be solved: According to the requirements for monitoring the geographical conditions,

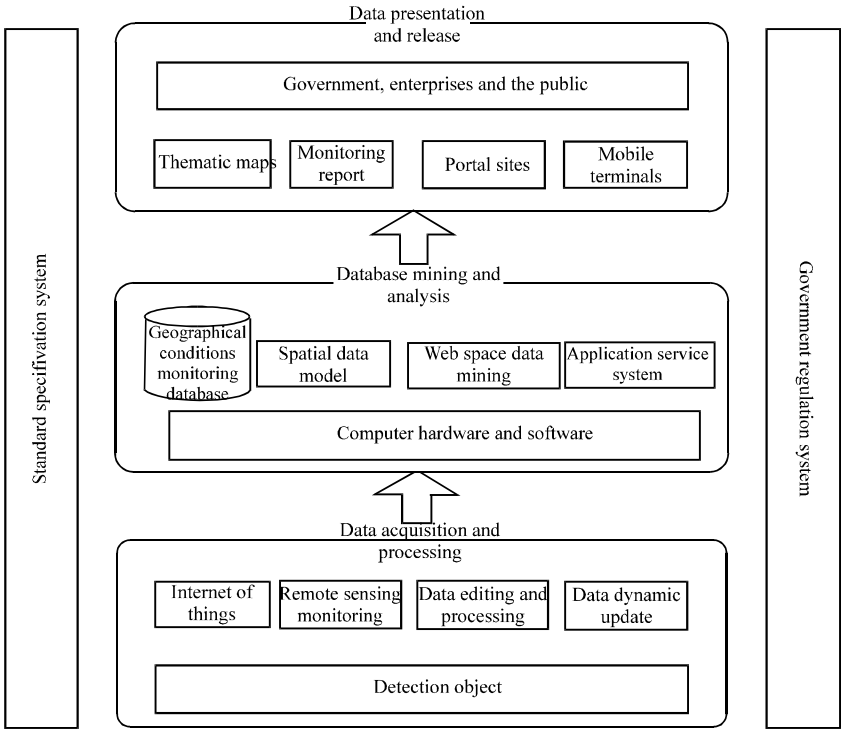

Fig. 2: Geographical conditions monitoring framework

in the monitoring technical system of geographic conditions for Poyang Lake Eco-economic Zone, the key problems needing to be solved is divided into three points: dynamic acquisition technology of the information of geographical elements, statistical analysis and comprehensive evaluation technology, product manufacturing and network release technology.

- In terms of the dynamic acquisition of geographical elements, with the completion of space-air-ground three-dimensional multi-observation system, the all-weather and multi-remote-sensing image global coverage will be realized, to basically meet the requirements for data source of real-time or quasi real-time monitoring of geographic conditions. So, it is required to realize the dynamic acquisition of the information of geographic elements, to solve the technologies of automatic discovery, identification, automatic extraction and automatic database incremental updating based on the changes of geographical elements of multi-remote sensing information
- The basic geographic information database is primarily used as the background for comprehensive analysis and evaluation, based on spatial statistical analysis and other related technologies, the quantitative statistics of territory area, such as Poyang Lake Eco-economic Zone, are conducted; the data of current situations of elements are analyzed, including topography, ground cover, drainage basin, traffic state and residential zone, to grasp the spatial distribution pattern of geographical conditions; in combination with the monitoring data of dynamic change, the monitoring process information of dynamic change of geographical conditions is deeply analyzed, to explore the trend and law of dynamic change of geographical conditions; the information from other departments is integrated, the auxiliary decision-making support is applied of disaster emergency, major engineering layout and industrial optimized layout
- In terms of production manufacturing and technology release, emphasis should be placed to solving key technologies, such as standardization of monitoring products of geographical conditions, quality control of product manufacturing, product release and online services, so as form the operational production of monitoring product of geographical conditions and the institutionalization of product release

Technical architecture: In accordance with the requirements of the "12th Five-year Plan" of Administration of Surveying and Mapping, six major tasks need to be completed in the monitoring of geographic conditions for Poyang Lake Eco-economic Zone. These tasks will be organically coordinated within the scope of the unified technical architecture as shown in Fig. 2.

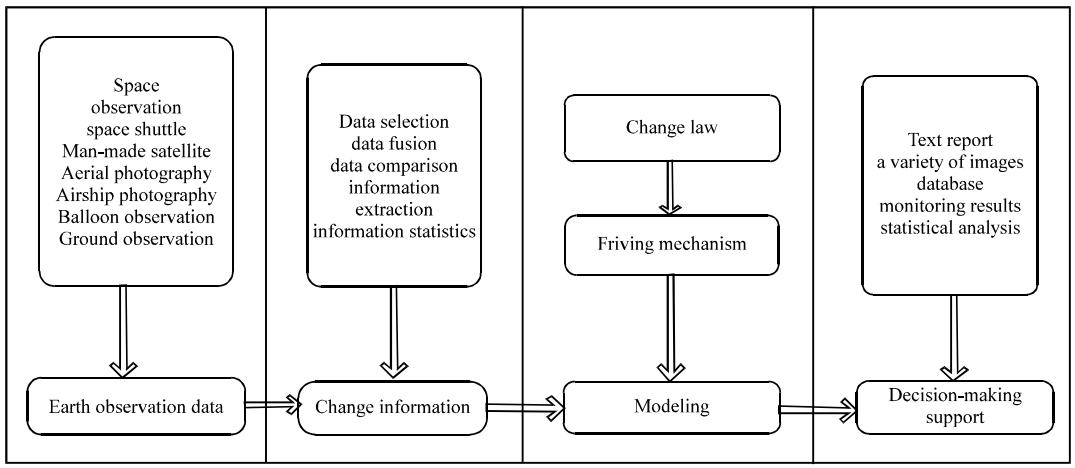

Fig. 3: Flow chart for overall geographical conditions monitoring technology

Geographical conditions monitoring technique process: The monitoring of geographical conditions need the Remote Sensing (RS) technology to quickly, dynamically and accurately provide the geographical information about the earth's surface, to provide people with the remote sensing data of high time resolution and spatial resolution, so as to satisfy the timeliness of the monitoring and supervision of regional geological conditions, as well as the basic geographic information required by the monitoring of geographical conditions. Through the organization, management, analysis and visualization of GIS spatial data, a powerful tool is provided, suitable for the management of basic geographic information data, having strong graphing capabilities.

The overall technical process is shown in Fig. 3:

In the face of challenge, according to the deployment requirements of the National Administration of Surveying, Mapping and Geo-information, different technical means and processes are adopted in different stages:

- In the stage of general investigation, the multi-source remote sensing detection technology and the technology integrating office work with field investigation are established. On the one hand, the macroscopic, dynamic, rapid, accurate and timely characteristics of remote sensing technology, with multi-resolution, multi-time frequency optics, radar and LiDAR remote sensing data as the main data source, are used to acquire the remote sensing data reflecting the information of geographic conditions from a large range, multi-level and multi-perspective. The latest achievements and technologies in terms of earth observation of aviation, aerospace and ground remote sensing are fully used, in combination with field investigation and verification, on the ground, to ensure the authenticity, reliability and accuracy of monitoring results of geographical conditions. The general investigation and monitoring of geographic conditions, on the other hand, requires the means integrating office work and field investigation and is implemented according to the office work anticipation, field investigation, mapping supplementation and annotation methods. On the basis of office work high-resolution remote sensing image interpretation, the global navigational satellite system, wireless communication and mobile terminal technical and equipment are used to carry out the mobile-style and networked field investigation and verification of elements of geographical conditions, for rapid acquisition and edition of survey data, so as to ensure the monitoring results objective and reliable as well as the results accurate and unified
- Taking Yingtan City as an example, the production process for general investigation and monitoring of geographical conditions includes database foundation in the control point, remote sensing image processing and ortho-image production, office work acquisition and update, field verification, acquisition of sample information of remote sensing interpretation, database foundation, statistical analysis and mapping, thematic data analysis, quality inspection and other links, as shown in Fig. 4
- In the later stage of data processing, the multi-source data fusion and processing technology and the remote sensing information and interpretation technology are determined. On the one hand, in the light of the characteristics of different general

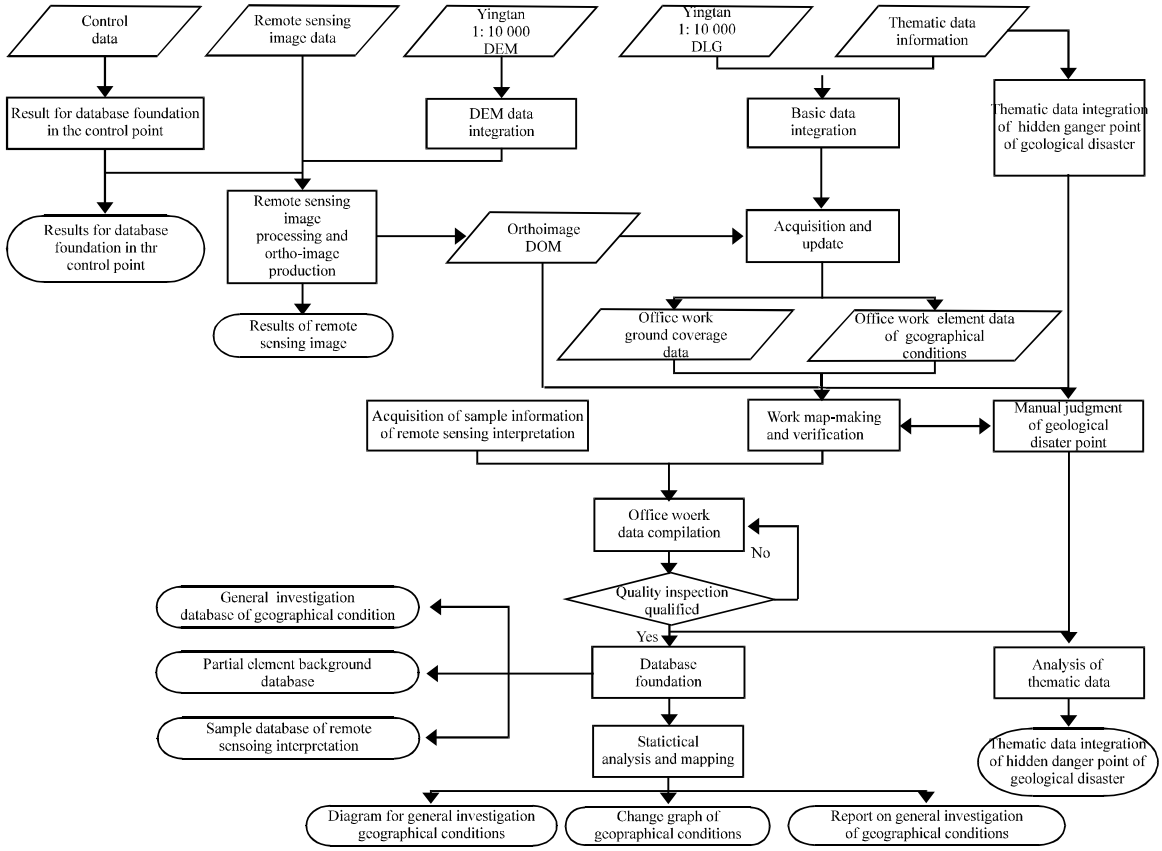

Fig. 4: Production flow chart for general investigation and monitoring of geographical conditions

investigation and monitoring areas, various remote sensing data sources are comprehensively used to make its in-depth excavation from the perspectives of spatial information, spectral information, etc.; different technologies are adopted, including panchromatic image and multispectral image fusion processing, optical image and radar image fusion processing, to provide the basis for the acquisition of high-precision information of geographical conditions. At the same time, the monitoring data of geographic conditions has a large quantity and a variety of types, so the technological means are used, such as remote sensing image data clumped processing, ground survey data real-time dynamic processing and thematic data spatial processing, to realize the rapid and efficient processing of monitoring data of geographical conditions. On the other hand, according to the characteristics of different natural and humanistic geographic elements, the feature database and interpretation knowledge base for geographical elements are established; he hierarchical system of monitoring information extraction of geographical conditions is constructed; he technologies are adopted, such as the extraction and interpretation technology of typical natural geographic elements, that of important humanistic geography elements, etc., to establish a feature extraction and the method of optimized combination of multi-dimensional dynamic remote sensing data forms, tenses, texture, spatial relationships, etc., to realize the extraction and interpretation of networked information, as shown in Fig 5

- In the later stage of data monitoring, change monitoring technology of geographic elements, technology of information statistics and analysis of geographical conditions, data dynamic management and visualization technology. First, the technical means are used, such as multi-source remote sensing image contrast, comparison of high-resolution remote sensing image with existing basic geographic information data, etc., to monitor the change of geographic elements, to judge whether the geographic elements are changed, to determine the change area, to identify the type of change, to

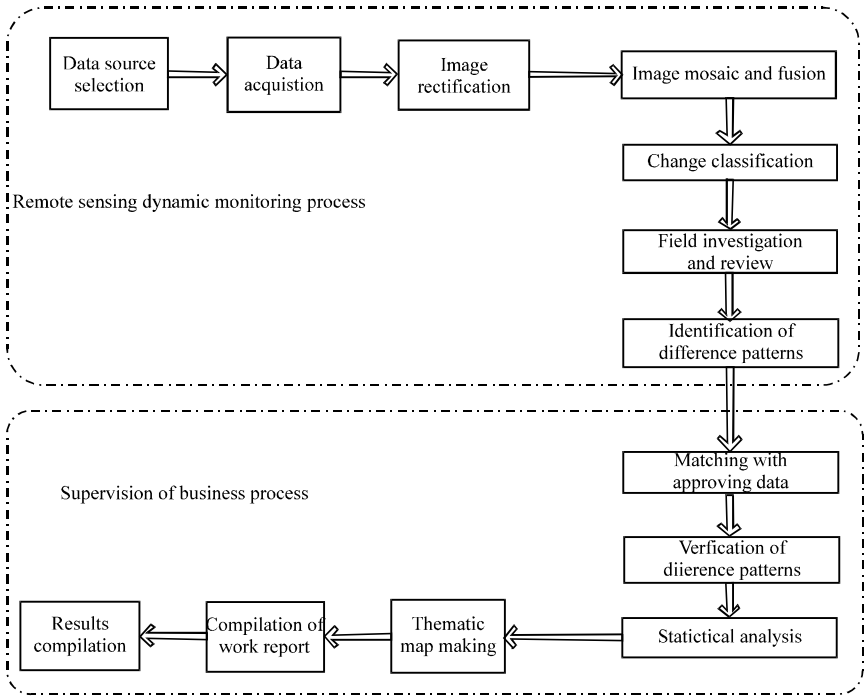

Fig. 5: Flow chart for temote sensing data processing

evaluate the space-time distribution pattern of change, to acquire the change information about important geographic elements and key areas, to accurately reveal the change law of spatial distribution and development. Secondly, the models of basic statistics, analysis and evaluation, simulation and prediction as well as data mining are uniformly stored and managed; the method base of statistics and analysis model for the information of geographic conditions is established; according to different statistical units, the spatial description information and quantity information of geographical conditions are counted and the internal spatial characteristics and interrelationship of geographic conditions are comprehensively analyzed from different dimensions, to reveal its distribution laws and development trend. Again, the space-time coding of partial element classification is established; the dynamic correlation of monitoring data of multi-version geographic conditions is realized; the monitoring information of geographic conditions is managed dynamically. The efficient time index technology, computer animation technology and so on are used to simulate the information change of geographic conditions for truly reflecting the change process of monitoring elements of geographic conditions and the dynamic symbol, dynamic statistical charts, dynamic annotation and so on are utilized to vividly, visually and dynamically show the actual situation and changes

CONCLUSION

At present, the monitoring of geographic conditions has become a priority of the National Administration of Surveying, Mapping and Geo-information, "Sunshine Project" and the "12th Five-year Plan of the State Council: "improve the national spatial dynamic monitoring management system covering the county, uniformly coordinated and timely updated and carry out the follow-up assessment for the construction of the main functional area." In September 2011, the state council approved that "the National Administration of Surveying, Mapping and Geo-information shall be responsible for organizing and implementing the monitoring of geographical conditions". In September 2012, the monitoring project of geographical conditions received the project approval of Ministry of Finance and since 2012, the Central Government passed the budget of the National Administration of Surveying, Mapping and Geo-information and lay out a special fund to support the monitoring of geographic conditions. On February 28, 2013, the State Council issued Notice on the Implementation of the First-time General Investigation of

Geographic Conditions, explicitly requesting that in July 2013 the first-time national general investigation of geographic conditions should be fully launched.

This study is aimed at the first national strategic planning region in Jiangxi Province-Poyang Lake Eco-economic Zone and has carried out an exploratory research on key monitoring technologies of geographic conditions, strongly supported by Jiangxi Administration of Surveying, Mapping and Geo-information, School of Geography and Environment of Jiangxi Normal University, the Sino-U.S Joint Center for Lake, Watershed and Wetland Study, other platforms, talents, technologies and resources. We hope that through further deepening key technology, method and typical application, the statistical analysis of all indexes of geographic conditions is specifically conducted in the zone, so as find out the extract details of geographic conditions for the Poyang Lake Eco-economic Zone, to provide the solid theoretical evidences and technical support for the leadership to make strategies and policies of the sustainable development of regional economy and resource environment.

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