Integration and Rapid Analysis Technology of Watershed Hydrological Information for Flood Control Demand

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Abstract: With the acceleration of global climate change and urbanization, flood control work is facing unprecedented challenges, and the management and analysis of watershed hydrological information has become the key to flood control decision-making. This paper aims to discuss the application and development of watershed hydrological information integration and rapid analysis technology in flood control work. In this paper, the basic concept and classification of watershed hydrological information are introduced firstly, and then the connotation, characteristics and practical application of rapid analysis technology in watershed hydrological information management are expounded in detail. Through in-depth analysis of the problems existing in the current technology, including the low quality of data integration and the limited forecasting ability of the analysis model, this paper puts forward the targeted improvement direction. The research shows that strengthening data quality control, developing intelligent data cleaning and verification algorithms, and developing accurate and efficient analysis models combined with advanced technologies are the keys to improve the effectiveness of watershed hydrological information integration and rapid analysis technology. The research in this paper provides new ideas and methods for watershed hydrological information management and flood control decision-making, and provides useful reference for research and practice in related fields.

1. Introduction

Flood control plays a vital role in safeguarding people's lives and property, maintaining social stability and promoting economic development [1]. As a natural disaster, flood is sudden, destructive and unpredictable. Floods usually bring huge casualties and property losses to the affected areas [2]. Strengthening flood control work and improving flood control and disaster reduction capacity is a major issue of common concern to governments and all sectors of society. With the acceleration of global climate change and urbanization, flood control is facing many challenges [3]. Climate change leads to frequent extreme weather events, and the risk and uncertainty of flood disasters are increasing. In the process of urbanization, land development, water system transformation and other activities have changed the original hydrological cycle process and aggravated the severity of flood disasters [4]. These challenges put forward higher requirements for flood control, which requires more scientific and efficient flood control decision-making and emergency management.

Watershed hydrological information is an important basis for flood control decision-making. Accurate and timely watershed hydrological information can help decision makers to know the real-time situation of flood and predict the development trend of flood, so as to formulate effective flood control measures and emergency plans [5]. Watershed hydrological information includes but is not limited to rainfall, water level, flow rate, soil moisture, etc. This information is obtained through monitoring stations, remote sensing technology and other means, and after processing and analysis, it provides strong support for flood control decision-making [6]. However, the acquisition and processing of watershed hydrological information is not an easy task. Due to the vast basin area and complex terrain, the layout and density of monitoring stations are often limited, which leads to the discontinuity and unevenness of hydrological information acquisition in time and space [7]. The processing and analysis of hydrological information also requires professional knowledge and

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technology, which puts forward higher requirements for the quality and ability of personnel.

In view of the challenges faced by flood control work and the key role of watershed hydrological information in flood control decision-making, this study puts forward the research theme of "integration and rapid analysis technology of watershed hydrological information for flood control demand". It aims to realize the rapid integration and accurate analysis of watershed hydrological information by researching and developing advanced technical means, and provide more scientific and efficient support for flood control decision. The purpose of this study is to explore and develop the integration and rapid analysis technology of watershed hydrological information for flood control demand, improve the efficiency of obtaining and processing hydrological information, and provide strong support for flood control decision-making. The significance of the research lies in: through the research and application of technology, the scientific and informational level of flood control work can be improved, and the efficiency and effect of flood control and disaster reduction can be improved; It can provide useful reference for the research and practice in related fields, and promote the progress and development of watershed hydrological information management and flood control decision-making technology.

2. Flood control background and current situation of hydrological information management in river basin

At present, flood control work is facing unprecedented challenges. The constant change of natural environment, especially the frequent occurrence of extreme weather events caused by global warming, has significantly increased the risk of flood disasters. Extreme weather, such as rainstorm and typhoon, occurs more frequently and with greater intensity, which brings great pressure to flood control work. The acceleration of urbanization also puts forward new requirements for flood control [8]. With the continuous expansion of the city, the original natural water system has been transformed or even destroyed, and the rainwater drainage system is facing unprecedented challenges. With the increase of urban hardened ground, rainwater can't seep effectively, the convergence speed is accelerated, and the flood peak flow is increased, which makes the risk of urban flood disaster rise continuously.

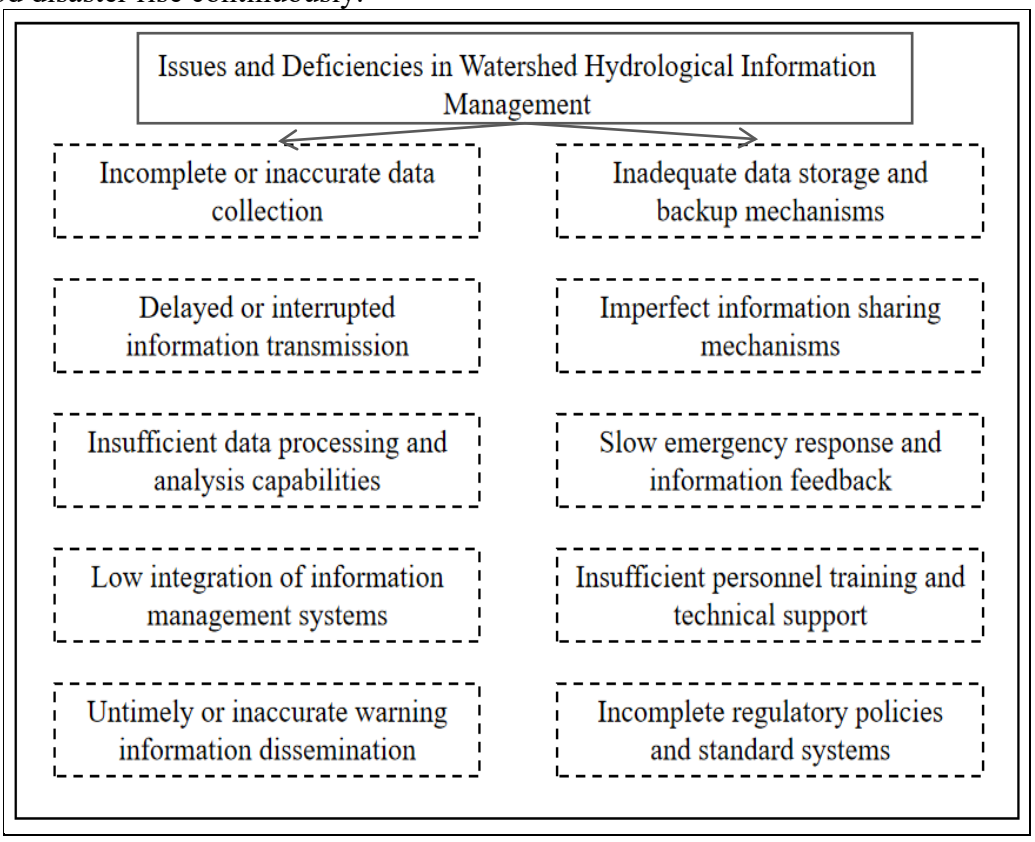

Figure 1 Issues and Deficiencies in Watershed Hydrological Information Management

As an important part of flood control work, hydrological information management in river basins has undergone a historical development from manual recording to information management. In the early days, the hydrological information of river basin mainly depended on manual observation and recording, and the efficiency of data acquisition and processing was low, and it was easily influenced by human factors. With the progress of science and technology, advanced technologies such as automatic monitoring equipment, remote sensing technology and geographic information system have been gradually introduced into watershed hydrological information management, and real-time data collection, transmission and processing have been realized. This greatly improves the efficiency and accuracy of information management. However, the existing management mode also has some advantages and disadvantages. The advantage lies in the advanced technology, which can realize the rapid acquisition and processing of data. The disadvantages are low system integration, obstacles in data sharing and interoperability, and insufficient monitoring facilities in some areas, resulting in incomplete data coverage. In the practice of flood control, there are still the following deficiencies in watershed hydrological information management.

As shown in Figure 1, there are many problems and deficiencies in watershed hydrological information management, and corresponding measures need to be taken to improve and perfect it to improve the effectiveness and safety of flood control work.

3. Integration technology of watershed hydrological information

3.1. Basic concepts and classification of watershed hydrological information

Watershed hydrological information refers to all kinds of data and information related to hydrological cycle process in the basin. These data and information cover rainfall, evaporation, runoff, water level, water quality and other aspects of the basin. They are an important basis for describing hydrological conditions, analyzing hydrological processes and predicting hydrological changes. According to the nature and use of information, watershed hydrological information can be roughly divided into several categories: ① Real-time monitoring data, such as rainfall, water level and flow. These data are collected in real time by various monitoring stations arranged in the basin, which reflects the real-time changes of hydrological conditions in the basin. ② Historical data, including historical flood records and hydrological yearbooks. These data provide valuable information for analyzing the long-term change trend of basin hydrology and making flood control planning. ③ Remote sensing data, obtained through remote sensing platforms such as satellites or unmanned aerial vehicles, can quickly monitor the hydrological characteristics of the basin surface in a large area. This provides a new perspective and means for watershed hydrological information management.

3.2. Principles and methods of watershed hydrological information integration technology

River basin hydrological information integration technology refers to a series of technical methods to integrate, process and analyze river basin hydrological information from different sources and formats. Its principle lies in the unified collection, storage and management of scattered and heterogeneous hydrological data through modern information technology means to form a complete and consistent hydrological information database. On this basis, the hydrological information is deeply processed and analyzed by using data fusion, data mining and other technical methods, and valuable information and knowledge are extracted to provide support for flood control decision-making.

The methods of watershed hydrological information integration technology include data acquisition and transmission, data storage and management, data processing and analysis. In the process of data collection and transmission, hydrological data are collected in real time or regularly through various monitoring stations and remote sensing platforms arranged in the basin, and transmitted to the data center through the communication network. Establish a unified data storage and management system in data storage and management, classify, code and store the collected data to ensure the integrity, consistency and security of the data. In the stage of data processing and

analysis, it is necessary to use a variety of data processing techniques and analysis models to clean, verify, complete and statistically analyze the preserved hydrological data, and to dig out valuable information and knowledge to support the scientific decision-making of flood control. Through the organic integration of these technologies, watershed hydrological information integration technology has significantly improved the efficiency of hydrological information acquisition and processing accuracy, and contributed a solid technical support for flood control.

4. Application of rapid analysis technology in watershed hydrological information management

4.1. The connotation and characteristics of rapid analysis technology

Rapid analysis technology specializes in quickly processing and analyzing complex data sets and quickly extracting key information and knowledge. In the field of watershed hydrological information management, this technology plays a vital role with its rapid and accurate analysis ability. It not only pursues speed, but also devotes itself to deeply mining data in a limited time to reveal the patterns and trends behind it. The advantages of this technology are mainly reflected in the following aspects in Table 1:

Table 1: Advantages of Rapid Analysis Technology in Watershed Hydrological Information Management

Advantages	Additional Description
Rapid processing of large datasets	Capable of handling large-scale, multi-dimensional data sets
Quick extraction of key information and knowledge	Extracts core information through algorithm optimization
Deep data mining to reveal patterns and trends	Utilizes advanced analysis techniques to discover data patterns
Provides accurate analysis results within limited time	Ensures the accuracy and reliability of analysis results
Enhances the timeliness and accuracy of data processing	Responds to data changes in real-time, improving decision-making efficiency
Supports real-time monitoring and warning	Analyzes data instantly, providing warning information

These characteristics make rapid analysis technology have broad application potential in watershed hydrological information management.

4.2. Practice of rapid analysis technology in watershed hydrological information management

In watershed hydrological information management, rapid analysis technology is widely used in practice. In real-time monitoring and early warning, rapid analysis technology can quickly process real-time data from monitoring stations, and discover hydrological anomalies and potential risks in time through data analysis and model prediction. This provides timely and accurate information support for flood control decision. In the aspect of flood risk assessment and management, rapid analysis technology deeply analyzes historical flood data and explores the law, frequency and intensity of flood occurrence. This provides a scientific basis for flood risk assessment and helps to formulate more effective flood control strategies and emergency plans. In addition, in the management and protection of water resources, rapid analysis technology can also monitor and analyze data such as water quality and quantity in real time, and provide decision support for rational allocation and protection of water resources.

To sum up, the practical application of rapid analysis technology in watershed hydrological information management has greatly improved the management efficiency and quality, and made remarkable contributions to flood control and disaster reduction and water resources protection. This technology provides strong support for watershed hydrological information management with its fast and accurate analysis ability, and promotes the progress and development in the field of hydrological management.

5. Conclusions

Through the research of this paper, we can deeply understand the importance and development potential of the technology of hydrological information integration and rapid analysis in flood control. The research shows that although the current watershed hydrological information management has made some progress, it still faces some problems such as low quality of data integration and limited forecasting ability of analysis models. These problems restrict the timeliness and accuracy of flood control decision-making and pose a challenge to flood control work. Therefore, this paper puts forward targeted improvement directions, including strengthening data quality control, developing intelligent data cleaning and verification algorithms, and deeply studying the physical mechanism of hydrological processes, and developing accurate and efficient analysis models with advanced technologies.

With the continuous progress of technology, we will be able to realize the comprehensive perception and dynamic monitoring of watershed hydrological information, and provide comprehensive and accurate information support for flood control work. The development of intelligent analysis model and decision support system will greatly improve the efficiency and accuracy of flood control work and lay a solid foundation for the sustainable development of water conservancy. The research in this paper provides new ideas and methods for watershed hydrological information management and flood control decision-making, and also provides useful reference for research and practice in related fields. We expect more scholars and practitioners to devote themselves to the research in this field in the future to jointly promote the development of hydrological information integration and rapid analysis technology in river basins and make greater contributions to flood control and disaster reduction and water resources protection.

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