Rain gauge improvement and the comprehensive effect of hydrological calculation on water resources protection

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Abstract. Water is the basis of human survival. With the rapid development of the society and economy in China in the new era, people have been concerned about the efficiency of water resources utilization. Hydrological calculation does good to water conservation and predict future circumstance of using water such as droughts or floods in agriculture, industry, and daily life. The water resources protection mentioned in this paper involves rainfall and water consumption, water quality, satisfaction with water supply time of residential water, water waste and pollution and so on. Water quantity forecasting, water quality pollution and treatment include various factors and multiple aspects. The existing natural rainfall method of hydrological stations is to use artificial or computer to read the rainfall scale on the rainwater bottle, and measure the rainfall depth within the specified time period. This method serves as the basis for subsequent hydrological calculations and provides a guarantee for further prediction of water quantity calculation.

1. Introduction
The concept of hydrology and advanced integrated hydrological calculation methods originated in the United States and Germany. China actively learns and absorbs excellent experience, and then develops into a hydrological forecasting system that conforms to China's hydrological situation. In the management of hydrology and water resources, it is necessary to compare and optimize the parameters such as reservoir design and flood control standards, improve the flood-resisting capacity and supply capacity of large-scale water storage projects such as reservoirs, and fully exert the comprehensive benefits of hydrological management. Hydrological information calculation and monitoring are closely related to hydropower stations, water conservancy projects, and dispatching water policies, and thus a new era of people's livelihood projects. Through extensive study, independent research and development and integration of modern technology, China has realized a number of technologies such as hydrological information monitoring, early warning and forecasting, automatic allocation of water resources, automatic monitoring of water resources, water ecological protection in key areas, and water ecological restoration in key areas. Good results have been achieved in production and common life. [1]

2. Problems of nowadays water resources
China has a large amount of water resources, more in the southeast, less in the northwest, but really lacking in water resources per capita, there are serious water pollution and conflict in time and space dispatching system when it comes to supplying and demanding. China is a big agricultural country, and agriculture is a big water user and needer. In the country with a large population, the shortage of water resources needs to be improved. The fresh water resources that humans can really use are part of
rivers and lakes and groundwater. The limited freshwater resources that can be used are limited, and reasonable planning and forecasting are necessary to make timely control and prevention measures. Judging from the current social development and the ideology of the masses, China's environmental protection and water conservation efforts are gradually increasing in the process of continuous social development, and the people's awareness of environmental protection is also constantly improving. At present, the most prominent problem is how to effectively develop relevant technologies to keep up with the change of ideology, so as to achieve efficient calculation of water quantity and comprehensive utilization of water resources. Especially, during the modernization of the city, a large number of buildings and roads were built, which increased the area of the impervious layer, reduced the amount of infiltration and evaporation, increased runoff, and increased the peak flood flow. Under this circumstance, the research of water use efficiency, opening up new key to taking advantage of water resources and how to accurately measure and reasonably predict rainfall are of great significance.

3. Hydrological forecasting current problem
The efficiency and effect of water’s quality and quantity monitoring are closely related to hydrological monitoring equipment and technology. Only when the state pays full attention to the construction of hydrological monitoring infrastructure can our country’s hydrological monitoring accuracy be effectively improved. The main work content of hydrology and water resources monitoring is to monitor the data of water resources flow, reserves, and unit flow. There is a contradiction between capacity and precision in the rainfall reading facilities of many hydrological stations in China. The widely used tipping bucket rain gauge can accurately and accurately calculate the percentile reading, but this type of rain gauge can not collect a large amount of rainwater in a short time. It is not applicable to the seasons and regions where rainfall is frequent. The early warning system of mountain rainstorms has sufficient rainfall capacity but the accuracy is not up to the requirements, and the rainfall of storm floods cannot be accurately measured and predicted. Droughts and floods are in a certain period of time. They have a wide range of spreads and long-lasting impacts. Only by making accurate predictions in advance and forming countermeasures can minimize damage and loss. Innovative technologies for hydrological prediction and comprehensive utilization in China are being further explored. In recent years, our country has established a relatively complete and hydrological station network to form a reasonable hydrological information collection, calculation, prediction and feedback system, with an expectation to predict the four major waters which is called flood prevention and control, drought and water shortage, water pollution and soil erosion as a significant role.

4. The recommendations of hydrological data monitoring and processing
The information age is running fast, and the data collection methods are changing with each passing day. Many hydrological stations and hydropower stations use the Internet to directly read and manually check the accuracy of the work mode to ensure that the accuracy of hydrological information reading has a certain reference value. Basic hydrological information technology is the basis for the modernization of hydrology. By setting up a hydrological station network, rationally planning the density of the station network, and obtaining the hydrological element information of the basin manually or using advanced instruments, it is used for hydrological forecasting, hydrological cycle and water balance calculation, hydrological water Resource deduction simulation. The combination of smart devices and manual inspections helps increase the credibility and timeliness of data. However, the imperfection of monitoring equipment and sudden failures or the occasional failure of hydrologists to check data in time still exist. Obviously, these unavoidable practical problems have caused the hydrological data processing to be impeded to varying degrees. In response to the above-mentioned situations, program development to update the computer software version and related calculation record data in a timely manner can be used to ensure that the terminal processing system connected to the rainfall collection equipment works correctly. Hydrological monitoring equipment also needs to be updated in time to ensure the sensitivity of the machine when collecting data. The
supervision of the hydrological industry includes the supervision of water resources, the supervision of hydrological projects, the supervision of the flow of hydrological funds, the supervision of water and soil conservation, and the supervision of related administrative affairs. It is familiar with laws and regulations in relevant fields and actively implements them. The establishment of data sharing mechanisms as the premise of the norms will help hydrological stations to obtain comprehensive information. At the same time, timely and effective training for hydrologists is also essential. Strengthening the training intensity and density and developing the ability to deal with emergencies in the work will help improve the practical operation ability.

5. Rain gauge improvement suggestions

In the construction of hydrological and water resources management informatization, monitoring equipment is set up in the irrigation area to monitor the water quality in the area in real time. After the pollution situation in the water resources is found, the hydrological and water resources management system can be used to separate the pollutants. [8] The diffusion path is simulated, and the same can be used for the prediction and treatment of flash floods to ensure that the monitoring equipment or system is in a good and effective operating state. At present, the rain gauge is used for rainfall collection and estimation, and it will be introduced in detail below and suggestions for appropriate improvement will be given below.

The rain gauge is the carrier of rainfall collection in the hydrological information. The rain gauge reads the rainfall value and periodically monitors the rainfall intensity within the time period, which provides an important support basis for further hydrological calculation, rainfall forecast, flood control and so on.

Nowadays, the rain gauges used in China's existing hydro meteorological stations are divided into rainwater bottles and corresponding measuring cylinders. The rainfall collected in the rainwater bottles is poured into the measuring cylinders for scale reading. The rainfall information is collected at 8:00am and 8:00 pm, and read these numbers. Take the accumulated rainfall intensity during this time period. The process of introducing the collected rainwater into the cylinder reading is a waste of time and labor. However, the existing rainwater bottle has a large thickness at the bottom of the bottle in response to heavy rainfall. If the scale reading is directly used on the bottle, an observation error of about 10 mm will be generated. Especially in the dry season with less rainfall, the bottom forms shallow water and it is difficult to accurately read and judge.

In order to effectively solve the contradiction that the accuracy and the rainfall capacity are difficult to meet at the same time, it is possible to accurately read the scale and improve the ability to accept strong rain. It can be used during the heavy rainstorm period of the mountain torrent. Now design a rain bottle for the thin bottom glass structure. A series of process technologies such as chemical polishing make the thick-bottom glass of the conventional rain bottle into an ultra-thin structure similar to the bottom of the corresponding measuring cylinder. Only the tempered glass is used at the bottom of the bottle to enhance the impact resistance against strong rain. In the case of heavy rain, the surface of the tempered glass The pre-stress is pre-stressed. When the impact is broken, the visible small discrete particles are formed first, which is convenient for the worker to have enough reaction time to replace the rain bottle without causing safety hazard to the operator who replaces the glass.

It is seamlessly connected with the surrounding side wall glass by a glass adhesive. The side wall is marked with a scale corresponding to the standard measuring rainfall measuring cylinder, forming an integrated device. When the measurement in the traditional rain measuring device is reduced, the rainwater is poured into a special one. The step of reading the millimeter of precipitation in the rain cup can accurately read the rainfall directly on the rain bottle for the basic hydrological data collection, which is convenient for the next hydrological calculation.

Rainwater flows into the rainer through the funnel duct for rain data collection. The funnel is inclined outwardly to facilitate the collection of oblique rainfall. In the natural rainfall state, the rainwater cannot fall vertically into the rainer. The funnel opening has a large diameter and is used to
collect the obliquely falling rainwater into the catheter and into the rain bottle for reading. Take rainfall and collect natural rainfall in all directions.

As is shown in the figure, the structure of the rain gauge: 1 - rain bottle, 2 - funnel, 3 - outer cylinder, 4 - scale, 5 - tempered glass bottom.

Figure 1 Schematic diagram of the improved rain gauge concept design

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