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A Survey on the Siltation Motoring Database for Ultra-large Reservoir Area

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Abstract. Based on the data source of CBERS-02B satellite, approaches such as computer density segmentation and statistical processing can be used first in combination with the research of water front monitoring in the ultra-large reservoir area, and then with Gray relevancy grade on water-depth monitoring. In line with the above, a suitable set of research plans on the siltation monitoring have been made including technical route and test methods.

Foreword

The geologically complex environment, frequent storms and floods, as well as the building of most reservoirs on the clastic and carbonate rocks, Jurassic silt stonesites included, decide that they are long affected by high-water immersion and up-and-down water levels, and face a growing frequency of geological disasters and a severely high tendency of disastrous harms along the shoreline. Therefore, there exist quite some theoretical and practical values to establish a global positioning satellite and remote sensing monitoring system over the reservoir area based on satellite monitoring database for the ultra-large reservoir area

Contents of research and technical route

Monitoring data of the reservoir area contains such a very wide range as storage capacity, siltation, water body pollution, soil erosion and vegetation coverage of the reservoir. This study limits its database to the establishment of reservoir siltation.

The reservoir has a great inflow of mud and sand each year, besides its water storage and landslides due to up-and-down water levels, which inevitably leads to siltation, and a dynamic change of shoreline and water depth. So, upon a collection of shoreline data for the database, a comparison of it with the data in the past by means of the mathematical model, the dynamic reflection of the reservoir sedimentation can be made possible. Since an ultra-large reservoir covers a vast area, the use of vehicles for the investigation of its shoreline is not only a heavy load, but also expensive, and what is worse, inaccessible to some places. To sample the water depth in a boat/ship would both slow the database updating and greatly reduce the value of sampling results due to the particularity of the ultra-large reservoir area. That is why satellite data has become the ideal source for the research of the shoreline and water depth concerning the ultra-large reservoir area.

The setup of a siltation database means that of a historical database. The key is how to maximize the data source associated with shoreline and water depth out of the vast amount of satellite database. The following are two aspects:

1.Access to the shoreline data

Plenty of the shoreline data are based on that of the U.S. Landsat satellite TM (Thematic Mapper,), the study of which is mostly aimed at the coastline. For example, Yu Jie[5], in his Research on Coastline Change of Daya Bay Using Remote Sensing Technology has, by means of Landsat satellite data, edge detection and color composite image processing, extracted Daya Bay coastline, analyzed its characteristics and studied its change over the past 18 years (1987~ 2005). In his Means of Withdrawing Coastline by Remote Sensing, Ma Xiaofeng [6] has discussed in detail the imaging mechanism of the coastline in different satellite images, introduced the calculation and development process by using satellite remote sensing images to extract various types of the coastline, and analyzed the future direction of such a calculation. In his The Satellite Investigation on the 2006 Water Area and Coastline Length of the Jiaozhou Bay and Their Historical Evolution ,Wu Yongsen [7] has calculated the existing water area and shoreline length in Jiaozhou Bay by using Landsat-5 TM satellite data.

Satellite CBERS-02B was launched in September 2007 from China's Taiyuan Satellite Launch Center. In its payload there are three sensors: charge coupling device camera (CCD), infrared multispectral scanner (IRMSS) and Wide Field Imager (WFI). The period of the image of global coverage is 26 days [8]. With the application of CBERS-02B data, the research focuses on the shoreline data access to identify the most suitable combination of the single-band and band in the ultra-large reservoir area and then puts the collection of these data into the database.

The access to reservoir shoreline data is relatively easy compared with the coastline, because there is no need to consider the tidal factors and land and water dividing line can be acquired directly as the shoreline of the current water level.

Since the water body strongly absorbs infrared light, the gray value of water in the bands of TM4, TM5 and TM7 is very low, esp. in MT7 band, which is almost close to 0 [3]. Therefore, at the bands of TM4, TM5 and TM7, there exists a strong contrast of water and land images, and the contrast of the border between water and land is very clear. By using the method of statistical processing of the computer density segmentation, and then calculating the water element number as the then multiplied by the number of pixel area covered by each pixel can the accurate number of water surface area be obtained. [2] By comparing the numbers of the reservoir area on the same water level in several phases, one can get the siltation data associated with cholestasis in the corresponding water levels.

From the US Landsat satellites, TM4, TM5 and TM7 bands correspond to the 0.76-0.90μm, 1.55-1.75μm, and 2.08-2.35μm. Through the corresponding of the related CBERS satellite bands and then a confirmatory test, one can get the combination of the CBERS satellites and water associated with a single-band and band, and at the same time create CBERS satellite-based high-resolution camera (HR) and water body- associated experiment.

2.Access to water-depth data

Currently, researches on water-depth data are mainly based TM (Thematic Mapper,) from the U.S. Landsat satellite. For example, in A Research on Coastal Bathymetry Retrieval from TM Image, Wang Jingjing [9] has respectively established a linear, logarithmic, exponential and exponential depth inversion model to study the suitable conditions on the different models of the areas 0 to 5 m, 5 to 10 m, 10 to 15 m water depth and the depth inversion accuracy. Huang Jiazhu [10], in his Experiment of water depth surveying in the Nantong section of the Yangtze River, has used Landsat TM data to carry out a depth test of remote sensing, remote sensing model for the depth of the river, riverbed underwater topography inversion. Shen Fang [11], in A Survey and Research of Qinghai Lake' Change in the Last 25 Years, has made use of TM data via remote sensing methods. Wang Jingjing [9] concludes the best results for the retrieval accuracy of the exponential model T-M4 / T M2 band ratio for different water depths, for example, when water depth is less than 5 m; the retrieval accuracy at TM4 / TM2 is the highest, and when it ranges from 5 to 1 5 m, the band ratio of the linear model accuracy is the best. The present study, based on the actual situation of the reservoir area, is to make use of the gray relevancy analysis as a tool to carry out a specific research.

In this very new emerging branch of science, the grey relevancy analysis is but an important branch. It is an analytical method based on the gray relational space. It requires not much of the amount of data, that is, any amount of data can be analyzed, whether they are regular or not. This means it can make up for what the mathematical statistical method lacks in systematic analysis. It has now been widely applied [4].

First, locate a typical group of test areas in the reservoir area, and as the satellite passes, select where water depth varies greatly, measuring point by point by way of ship quasi-synchronization. CBERS satellite bands enable the one-to-one correspondence for the depth value and remote sensing images of each band reflectance values. Use the statistical method and gray relevancy analysis, and find water depth band combination associated with the study area. Create a related model of water depth and satellite data.

Conclusion

In this study, by establishing a historical experimental database based on the special topography of the reservoir area selected for study, a number of representative study areas have been determined to identify the most suitable combination of a single-band and band for CBERS-02B satellite and such data have been input in the representative experimental database, which serves as the foundation for the actual development in future.

Many scholars now who focus on satellite data for the research of the coastline and water depth just base themselves on such conditions of open terrain as coastline, natural lake, and most of their data are from the U.S. Landsat satellite TM (Thematic Mapper,). Owing to the special landform of the reservoir, a narrow surface and peaks on both sides, its lush vegetation, which will surely be reflected on the water, forms an inevitable impact on the CCD signal. How to put into use the integration of CBERS CCD image data and synthetic aperture radar (SAR) satellite data for such a water surface, few related researches have been done yet.

Most studies are now based on the US satellite data, and the ones here are all based on the CBERS images. Although it is very difficult to establish a common mathematical model with the application of satellite data, this research aims at some particular water area of the reservoir, the measured water depth and area values and the corresponding facts of spectral values of remote sensing images are certainly guaranteed, the collected data into the database can be used for the study of the ideal data source for future researches.

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