10.18686/frim.v2i5.4503

Research on Construction Method of Water Body Database in Wuhan City

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Abstract: "Water" is the source of life, the factor of production and the basis of ecology. When controlling flood disasters and planning water use, it is necessary to use the local water body information, so how to grasp the local water body information accurately and real-time becomes crucial. With the development of modern science and technology, image information can be quickly obtained by remote sensing satellites, and corresponding water system information can be obtained by processing satellite image data, and water body database can be established. This paper takes Wuhan city as the research object, uses Landsat-8 satellite images in 2020 as the data source, adopts the normalized differential water index method (NDWI) to extract water system information, and then constructs the database of the obtained water system information of Wuhan City through ArcGIS software, which can provide basic information for water data management of Wuhan City.

Keywords: Remote sensing image; NDWI; Database

Introduction

With the rapid development of industrialization and economy, the problem of irrational exploitation and utilization of natural resources has become increasingly prominent, causing environmental pollution, destroying ecological balance, and bringing serious water resources problems to the world, seriously endangering people's life and development. Water resources are the basic elements of human life activities. The acquisition of water system information by traditional manual surveying and mapping is time-consuming, costly and dangerous, and it is difficult to meet the work of obtaining water body information with high frequency. However, the imaging cycle of remote sensing image is short, the timeliness is strong, and the macro is strong, which can make up for the shortcomings of traditional water body information acquisition.

Yin Yaqiu et al. [1] used the features of high-score images, selected appropriate scales to segment them, created an expert knowledge base, and extracted the water body information of Wuhan City. The accuracy of extraction reached 97%, higher than the traditional water body extraction methods, and effectively suppressed the generation of freckles by adopting object-oriented method. Cui Qi et al. [2] selected two experimental areas on high-resolution remote sensing images for water extraction with the object-oriented method based on vector constraints. Compared with the experiment without constraints, it was found that the method could extract small water bodies and was not susceptible to the interference of shadows such as buildings and mountains, and the comprehensive evaluation accuracy index F-Measure increased by more than 13% on average. Zhang Minghua et al. [3] analyzed the spectral features of Landsat ETM+ images, and improved the multi-band spectral relation method according to the spectral differences and variation rules between water bodies and impactor, ice and snow sediments, etc., to obtain ideal extraction effect.

1. Study area and data source

Wuhan City is called "Han" for short and "Jiangcheng" for another name. Its geographical location is 113°41 '~ 115°05' east longitude and 29°58 '~ 31°22' north latitude. The Yangtze River and the Han River converge in the center of the city, and the north and south tributaries flow into it. Many large and small lakes exist on both sides of the river. The data in this paper are collected from geospatial data cloud (http://www.gscloud.cn). Landsat-8 satellites have 11 bands, except for the panchromatic band with a resolution of 15 meters, the resolution of all other bands is 30 meters, Landsat-8 series satellites can scan the same area every 16 days to obtain remote sensing image data in the region, and carry out a global coverage of remote sensing data acquisition.

Table 1. Remote sensing image data information

Remote sensing image file	Satellite number	Sensor number	Image acquisition time	Cloud cover
LC81220392020049LGN00	LANDSAT_8	OLI_TIRS	2020-02-18	1.23
LC81230382020040LGN00	LANDSAT_8	OLI_TIRS	2020-02-09	0.18
LC81230392020040LGN00	LANDSAT_8	OLI_TIRS	2020-02-09	1.35

2. Experimental results

2.1 Image preprocessing

Remote sensing image preprocessing includes image atmospheric correction, image Mosaic, image clipping and other functions.

Atmospheric correction is a process of eliminating the radiation error caused by atmospheric influence and retrieving the real surface reflectance of ground objects. Image Mosaic refers to the technical process of combining two or more images together to form a whole image. The remote sensing image of Wuhan obtained in this paper is a three-scene image Mosaic. Image clipping can be divided into regular clipping and irregular clipping. This paper adopts vector data irregular clipping.

Figure 1. Remote sensing image of Wuhan

2.2 Normalized Differential Water Body Index (NDWI)

At present, the methods of water extraction include: supervised classification, unsupervised classification, decision tree, object-oriented, etc. Water extraction index models (NIR, NDVI, NDWI, SWI, MSWI). The normalized differential water index method (NDWI) has been used by many people because of its simple operation method, mature technology development and high precision of extracting water. Its expression is as follows:

$$NDWI = (p(Green)-p(NIR))/(p(Green)+p(NIR)) \quad (1)$$

The index uses the difference of spectral reflectance between green band and near-infrared band to enhance the spectral differentiation between water body and surface plants and soil through the normalization operation combined with band difference and ratio. It can effectively reduce the interference of soil and wetland vegetation around the water body, as shown in Figure2.

Figure 2. NDWI extraction results

Then the method of decision tree is used to distinguish water body from non-water body. The binarization thresholds were 0, 0.05, 0.06 and 0.1 respectively for comparison, as shown in FIG. 3. Through visual comparison, the binarization results with threshold 0 were found to have too many small patches. The information of river basin is incomplete in the binary graph with a threshold of 0.1. The error of paddy field

extraction is larger in the binarized result map with threshold of 0.05. The binarization results of 0.06 showed moderate small patches, relatively comprehensive river basins, and small paddy field error images. Therefore, 0.06 is selected as the final threshold. In Figure 3, water is white and non-water is black.

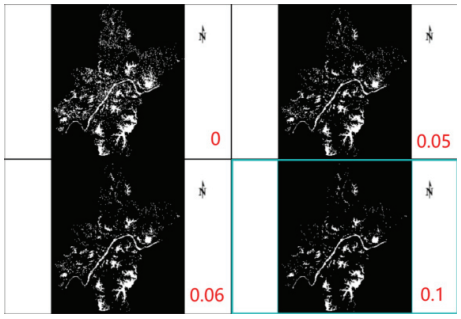

Figure 3. Image binarization results

2.3 Water system database construction

2.3.1 Follow the rules for creating an attribute database

(1) Current status of data. In order to ensure that the acquired water body information of Wuhan is the latest data, we have a good supply system and can continuously provide the latest basic information to improve the accuracy of the database.

(2) Accuracy of data. Ensure that the input data information is correct, so as to ensure that the correct data is applied to the actual work.

(3) Quick query ability. When using the database, you can quickly find the required data.

2.3.2 Database construction objectives

Water system database construction is mainly completed by ArcGIS gdb file database construction, which can directly reflect the distribution of water bodies in Wuhan. The water database of Wuhan is mainly composed of two parts: spatial data and attribute data. The spatial data part is the spatial information data of Wuhan water body stored in the computer, such as the geographical location of Wuhan city, which is mainly stored in the spatial database. The attribute data, such as water name, area, length and administrative ownership, is the attribute information stored and established through data tables.

2.3.3 Query function

ArcGIS software has query function, and database construction should meet the query function, so that the required data files can be quickly found.

3. Conclusion

With the steady development of modern science and technology in China, GIS is becoming more and more mature in the construction of database. In this paper, remote sensing image data of Wuhan City collected by Landsat 8 series satellites in 2020 is used as the data source, and normalized differential water index method (NDWI) is adopted in ENVI software to extract water system from remote sensing image data. Then the water body information database of Wuhan City was constructed by using ArcGIS software.

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Fund Project: Innovation and Entrepreneurship Training Program for College Students (Project Number: 202411430064)

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