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Main Urban Land of Jinan City Dynamic Changes based on the Landsat8 Images from 2016 to 2021

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Abstract

In recent years, remote sensing data has been increasingly applied to land use change with its advantages. In this paper, the dynamic land use of Jinan city over ten years are analysed based on Landsat 8 data. After the pre-processing, there are five land use types are given using the supervision classification. It can be seen from the analysis that in the main urban area of Jinan, part of the cultivated land has changed into construction land, and most of the unused land has changed into construction land. From the comparative analysis of the classified images, it can be seen that the construction land in the main urban area of Jinan has increased significantly by 195.2577 km².

Keywords

Land Dynamic Use; Remote Sensing; Jinan City; Landsat8 Data.

1. Introduction

Land cover is a complex of various elements of the earth's surface covered by various substances on the earth's surface. It has specific temporal and spatial attributes, and its shape and state can change on multiple space-time scales. As the technologies' developed, the remote sensing play more and more important in our life[1-2], especially in the land use. Many researchers are focused their study on that side. Yu et al selected three-period (1995, 1998 and 2003) remote sensing images in Jinan City, China, and gave the changes between the green land, construction land, woodland and water body[3]. Liu et al analysed 34 years of Laoshan land use and the future change trend[4]. Zhai et al applied two methods to obtain Xiongan New District in April 2014 and April 2018[5].The paper used the Landsat8 data to analyse the main urban land dynamic changes of Jinan city from 2016 to 2021, the areas of five kinds of land use were given.

2. Materials and Methods

2.1. Area Analysis

Jinan City is located at the intersection of the low mountains and hills in the southeast of Shandong Province and the alluvial plain in the northwest of Shandong Province. It is adjacent to Mount Tai in the south, and the Yellow River in the north crosses from the middle. Therefore, the overall terrain trend of Jinan City is from south to north, and the terrain gradually decreases. Jinan is located in the central and western part of Shandong Province, backed by tall mountains. It borders Tai'an and Laiwu in the northeast of Liaocheng, the south of Binzhou, Dezhou, the west and south of Zibo.

2.2. Data Introduction

The data used in this experiment is Landsat8 data[6]. The data used are 2016 and 2021, respectively, and the cloud cover is less than 5%. The data is downloaded through the geospatial data cloud.

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2.3. Data Processing

In the data processing, we use the radiometric calibration and atmospheric correction, geometric correction, image enhancement, image stretching, image colour synthesis, image clipping to process the original image. The details processing are showed as follows.

2.3.1. Radiometric Calibration

Two images are opened for two years in ENVI and the radiometric calibration tool are used here. Entering the Radiometric Calibration tool in the toolbar to select the image to be calibrated, and select Apply FLAASH Settings to set the output path. This step is mainly to prepare for the next FLAASH atmospheric correction.

2.3.2. Atmospheric Correction

Performing FLAASH atmospheric correction on the radiometric calibrated image, in which the average elevation of the region is calculated from the global DEM data provided by ENVI. We select File Open World Data Elevation and search for Compute Statistics tool in the toolbox and use it to calculate the average height of the region as 1675 meters. Then input FLAASH in the toolbox, select FLAASH Atmospheric Correction, select the data after radiometric calibration, and set the file output path, sensor type, regional average elevation, atmospheric model as mid latitude winter, aerosol model as Rural (there are many forests and mountains in the region) in the setting page, and set Over Land Retrieval standard in the multispectral parameter setting, and click Apply.

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2.3.3. Geometric Correction

The image registration workflow process tool is used to make geometric correction using the panchromatic band (i.e. the eighth band) of the OLI image and the panchromatic band that has just undergone FLAASH atmospheric correction.

Entering Image Registration Workflow in the toolbar, and selecting base image as the panchromatic band and warp image as the band of FLAASH atmospheric correction. In the Tie Points Generation, the Main tab remains the default setting, and the three pages remain the default setting.

2.3.4. Image Enhancement

In this paper, the multi spectral band and panchromatic band after geometric correction and atmospheric correction are used for image fusion. Brovey transformation is used. In the toolbar, enter the Color Normalized (Brovey) Sharpening tool. In the Select Input RGB dialog box, select the RGB band after the above processing. In the High Resolution Input dialog box, select the panchromatic band. In the output result dialog box, select the resampling method and output file name.

2.3.5. Image Clipping

Subset Data from ROIs is used to crop the image using the vector boundary of Xichang City and the image for geometric correction and atmospheric correction.

3. Results

After processing, the data of 2016 and 2021 are analyzed using the supervised classification, then the post classification comparison method is used. Use the Change Detection Statistics tool to select two images classified by maximum likelihood in time phase for statistical analysis.

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In this paper, the maximum likelihood method in the supervised classification method is used for classification. In the toolbox, search for the Maximum Likelihood Classification, input the corresponding preprocessed image of the study area, and set the corresponding parameters and output path to analyze. with five land kinds, including the forest land, the urban green land, the construction land, the water and the bare land. The ROI separability of every kinds are showed in Table1,almost all of each two kind can reach 1.99, which indicate that it can meet the requirments. According to the confusion matrix analysis, the overall classification accuracy in 2016 is 98.0187%, the overall classification accuracy in 2021 is 94.6835%, and the kappa coefficient in 2016 is 0.9700, and the kappa coefficient in 2021 is 0.9295, which has certain credibility. The year of 2016 classification accuracy of the main urban area of Jinan is high, and part of the year of 2021 cultivated land is wrongly classified as construction land.

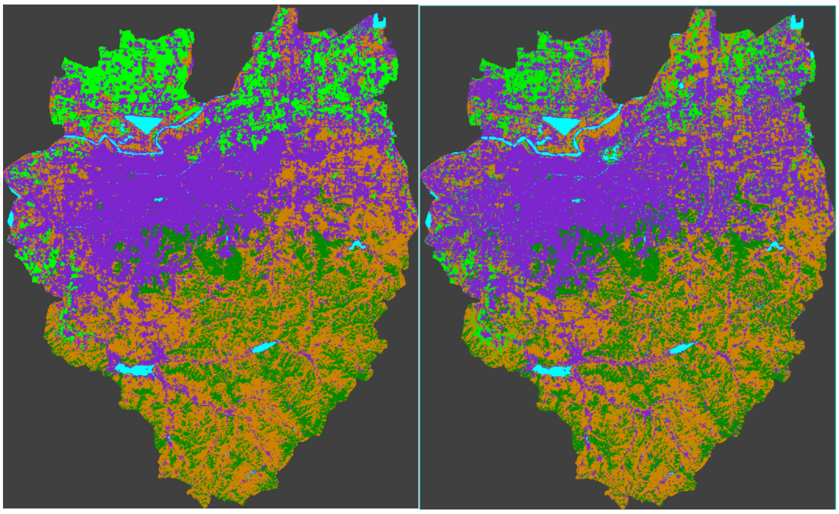

Figure 1. The supervision results(left:2016;right:2021)

Note: In the figure, dark green is forest land, bright green is farmland, purple red is construction land, blue is water, and brown is unused land.

Through analysis after the land use transfer matrix(Table1 and Table2), it can be seen that in the main urban area of Jinan, part of the cultivated land has become construction land, and most of the unused land has become construction land. From the comparative analysis of classified images, it can be seen that the construction land in the main urban area of Jinan has increased significantly, with an increase of 195.2577 km^2.

Table 1. Land use transfer matrix (pixel)

pixel	Cultivated land	forest land	Construction land	water	Unused land
Cultivated land	123754	3804	51596	6	25889
Forest land	960	275299	21634	165	51601
Construction land	81889	17242	735333	2175	5114
water	882	1512	6827	27450	602
Unused land	34085	41888	93868	28	604802

Using the process dynamic monitoring tool Thermal Change Workflow to analyze the land use change of the classification results of the two time phases. Next twice in a row, and set the output path of the corresponding results. Flow based dynamic monitoring results are shown in Figure 8. Flow based dynamic monitoring results are shown in Figure2. The black part is the unchanged part, the green part is the cultivated land converted into construction land, and the

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flesh part is the unused land converted into construction land. It can be seen that the red part is the area where the surface feature type changes.

Table 2. Land use transfer matrix (km^2)

pixel	Cultivated land	forest land	Construction land	water	Unused land
Cultivated land	113.7860	3.4236	46.4364	0.0054	23.3001
Forest land	0.8640	247.7691	19.4706	0.1485	46.4409
Construction land	73.7001	15.5178	661.7997	1.9575	119.6001
water	0.7938	1.3608	6.1443	24.7050	0.5418
Unused land	30.6765	37.6992	84.4812	0.0252	544.3218

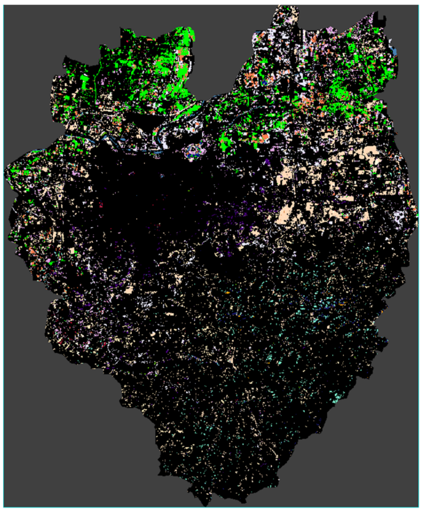

Figure 2. The results after thermal change workflow

4. Conclusion

In this paper, we obtain the land dynamic changes of the main urban land of Jinan City from 2016 to 2021 with the dynamic analysing of the land changes. After the pre-processing of the remote sensing data, including radiometric calibration and atmospheric correction, geometric correction, image enhancement, image stretching, image colour synthesis, image clipping and so on, then the supervision classification method is used from analysis. The main conclusions are as bellows,

(1) In the area we choose in this paper, part of the cultivated land has become construction land, and most of the unused land has become construction land. What's more, the construction land in the main urban area of Jinan has increased significantly with an increase of 195.2577 km^2.

(2) Using the process dynamic monitoring tool Thermal Change Workflow to analyse the land use change of the classification results of the two-time phases, we can see that the construction land in the main urban area of Jinan has an obvious trend of moving eastward, which is in line with the objective fact.

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