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Analysis of Land Use Change Based on Landsat 8

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Abstract. Remote sensing image classification technology is applied to land use classification, which can quickly obtain land use information. Based on Landsat8 OLI image data of Jinan City in May 2017 and May 2018 and the latest vector map of Jinan in 2018, the paper analyzes the situation of land use change in Jinan City, draws the quantitative results of the change, and draws some conclusions. It provides certain decision support for scientific use, rational and sustainable development of land use in Jinan.

1. Introduction

With the acceleration of the urbanization process, the land cover is changed. The change not only affects the carbon cycle of the ecosystem, but also influences the global climate change. Simultaneously, the change affects the natural productivity factors such as soil, vegetation, water resources and biological diversity. So the sustainable development of the social economy is affected.

Land use change includes three factors, such as time, space and quality change. Spatial change is an important issue in land management and planning, which reflects the spatial types, distribution and regional differences of land use. Therefore, how to scientifically analyze and deal with the spatial change information of land use becomes the key to solve this problem.

At present, the main way to study the spatial change information of land use is to use remote sensing images to process and analyze the quantitative information in order to explore the situation of land use spatial change, which can provide technical support for the sustainable development of cities.

2. Description of Study Area

Jinan is the capital of Shandong province, located at north latitude 36°35'36" to 36°40'04" and east longitude 116°54'29" to 117°02'01". It adjoins with mountain Tai and the Yellow River. The terrain of Jinan is expressed as the south-high and the north-low. Jinan joins with capital economic circle in north and Yangtze River Delta economic circle in south. It connects Shandong Peninsula with central China. It is an important intersection of Bohai economic zone and Beijing-Shanghai economic axis.

After Laiwu city belongs to Jinan in 2018, the major administrative districts of Jinan include ten districts and two counties, such as Lixia, Shizhong, Huaiyin, Tianqiao, Licheng, Zhangqiu, Changqing, Jiyang, Laicheng, Gangcheng, Pingyin and Shanghe.



3. Data

The data used in the paper are from:

RS images: Landsat-8 OLI (WGS84 UTM ZONE 50, <http://www.gscloud.cn/sources>)

Vector map: administrative division map of Jinan city(WGS84 UTM ZONE 50)

The remote sensing image data is based on the data of May 16, 2017 and May 3, 2018 (strip number: 122; row number 34,35; cloud cover 0).

The data of administrative division are obtained from the data of land survey and transformed into projection WGS84 UTM ZONE 50.

In order to facilitate the classification of ground objects, after multi-band combination experiment, four bands such as 6, 5, 2, 8 are selected in the paper. The data information is shown in Table 1.

Table 1. Data Information of Bands Selected

Band	B2 (Green)	B5 (Near Infrared)	B6 (SWIR)	B8 (Pan)
Band rang(um)	0.45–0.51	0.85–0.88	1.57–1.65	0.50–0.68
GSD(m)	30	30	30	15
PCS	WGS84 UTM ZONE 50			

4. Data Processing

Landsat8 images downloaded have been handled through radiometric calibration, atmospheric correction, and geometric correction, so on top of this, follow-up pre-processing is performed.

4.1. Band Synthesis and Image Fusion

B2, B5, B6 bands are used in the paper. Firstly, these three bands are synthesized to produce multi-spectral image. The GSD of the multi-spectral image is 30m. B8 is panchromatic band with the GSD of 15m.

In order to improve the resolution of multi-spectral image, multi-spectral image and B8-band images are fused to obtain higher resolution multi-spectral image, so as to improve the accuracy of subsequent feature classification. The selected fusion method is Gram-Schmidt Pan Sharpening. Bands synthesis and fusion of the images are shown in figure 1.



Figure 1. Before Fusion(left,30m) and After Fusion(right,15m)(2018)

4.2. Image Mosaicking

Because Jinan is located in the two-scene image. The strip number is 122 and line numbers are 34, 35. In order to obtain the complete image of Jinan, the two images need to be mosaicking. The selected method is seamless mosaic.

4.3. Image Clip

In order to obtain the image of the study area, the two mosaic images are clipped by using Jinan administrative division data. The clipped images are shown in figure 2.

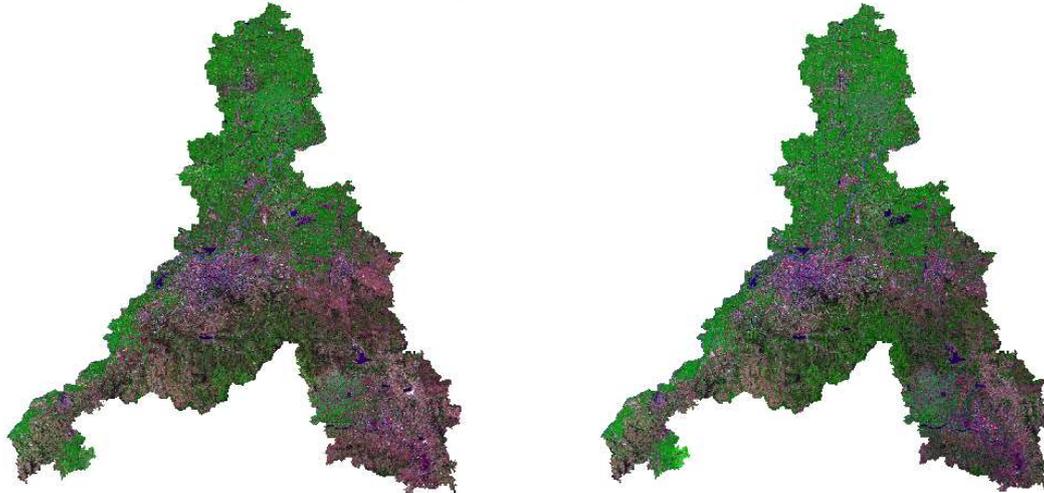


Figure 2. Clipped Image(2017(left),2018(right))

5. Land Use Classification

5.1. Types of Land Use

In the paper, the land use are divided into five types: forest, farmland, building, water area and unused land. The land use classification is carried out, and the maximum likelihood method in supervised classification is adopted.

5.2. ROI Trained

According to the requirements of supervised classification, ROI must be trained before classification. In the paper, the above land use types are sampled, and the training accuracy is evaluated. The training accuracy is shown in figure 3.

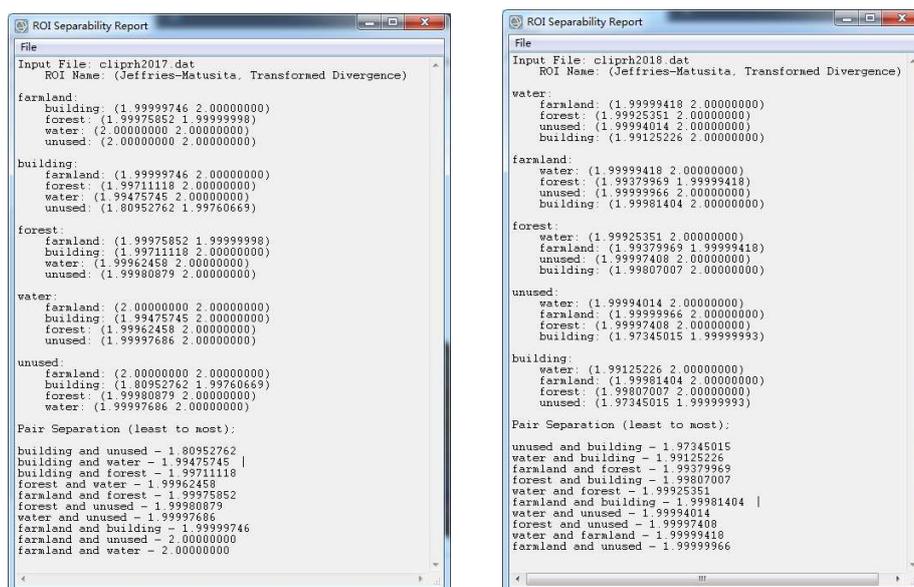


Figure 3. ROI Precision(2017(left),2018(right))

According to the evaluation results of ROI, the separation degree of ROI is more than 1.8, which satisfies the classification requirements and can be used for land use classification.

5.3. Supervised Classification

By using ROI, maximum likelihood classification is used in the paper. After images are classified, small image zones are merged through the clump classes method. The results are shown in figure 4.

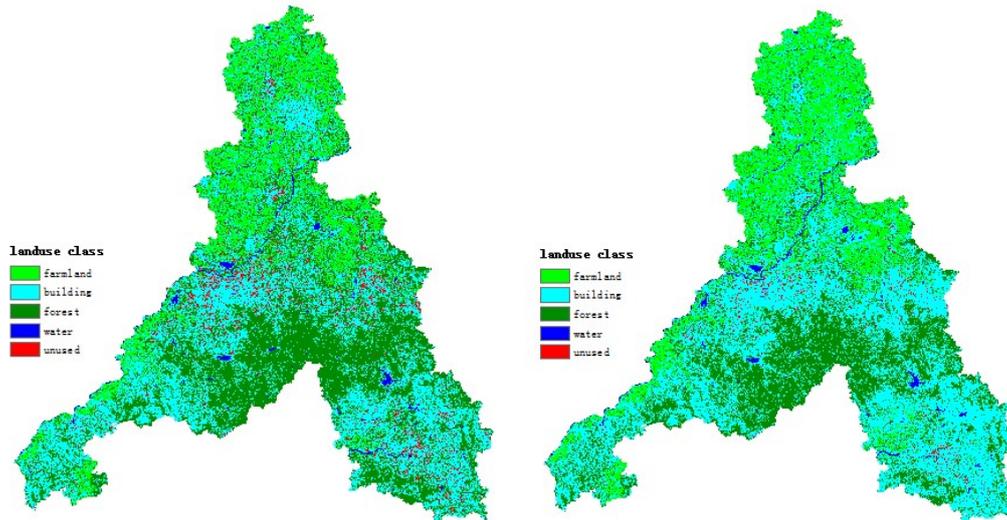


Figure 4. Classification Result(2017(left),2018(right))

The classification accuracy for 2017 is:
 Overall Accuracy = (131320/152896) 85.8884%
 Kappa Coefficient = 0.8078
 The classification accuracy for 2018 is:
 Overall Accuracy = (138758/152896) 90.7532%
 Kappa Coefficient = 0.8676
 The results meet the requirements of classification accuracy.

6. Conclusion

The classification results of the two time phase are analyzed quantitatively and land use change is detected by using change detection statistics tool. The results are shown in figure 5(a,b,c).

		Initial State				
		water	farmland	forest	unused	building
Final State	Unclassified	0	0	0	0	0
	water	483398	75	8257	5710	94552
	farmland	257	5999501	1404339	7363	1348272
	forest	5837	491863	12006438	7293	1303802
	unused	377	1882	8134	432561	106339
	building	75161	294036	4216466	1491116	15571154

a: Pixels

		Initial State				
		water	farmland	forest	unused	building
Final State	Unclassified	0.000	0.000	0.000	0.000	0.000
	water	85.553	0.001	0.047	0.294	0.513
	farmland	0.045	88.392	7.959	0.379	7.318
	forest	1.033	7.247	68.050	0.375	7.077
	unused	0.067	0.028	0.046	22.251	0.577
	building	13.302	4.332	23.898	76.702	84.515

b:Percentage

		Initial State				
		water	farmland	forest	unused	building
Final State	Unclassified	0.00	0.00	0.00	0.00	0.00
	water	108764550.00	16875.00	1857825.00	1284750.00	21274200.00
	farmland	57825.00	1349887725.00	315976275.00	1656675.00	303361200.00
	forest	1313325.00	110669175.00	2701448550.00	1640925.00	293355450.00
	unused	84825.00	423450.00	1830150.00	97326225.00	23926275.00
	building	16911225.00	66158100.00	948704850.00	335501100.00	3503509650.00

c: Area(unit:square meters)

Figure5. Land Use Transfer Matrix(a,b,c)

From figure 5(b), during 2017 to 2018, four types of land use have not undergone fundamental changes, such as water area, farmland, forest and building of Jinan. 13.3 percent of the water turned into construction land; 23.9 percent of the woodland became construction land; 14.9 percent of the construction land became water, farmland and forest. This is because that more and more attentions are paid to the construction of ecologic and civilize for Jinan in recent years. From urban to counties, owns, villages, a large number of shantytown transformation, new rural construction are carried out. 76.7 percent of the unused land has been converted into construction land, which is due to the completion of the renovation of shanty towns and the completion of the construction of new rural areas. This is also an important embodiment of the process of urbanization.

It is worth mentioning that the selected image was in May, during the dry season in Jinan, so the area of the water area was reduced, the growth of nursery stock is affected, the growth was not obvious, and it was reasonable to be misclassified into other land types. For more accurate analysis, higher GSD images can be used in order to reduce misclassifications and omissions.

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