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# Application of Remote Sensing data in Jinan City Land Use Changes

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## Abstract

**For a long time, land has been the most basic material to promote the development of productive forces, and it occupies a unique position in the development of mankind. Remote sensing technology is an effective monitoring technology, and it is also widely used in land use monitoring. This paper uses sensing image processing technology, taking Jinan as an example, using Landsat 8 OLI satellite data to research and analyze the application of remote sensing technology in land use change, and analyze and process the images of Jinan City from 2013 to 2018. The supervision classification has clarified the land change patterns in Jinan. Through the comparative analysis of image data, during the five years from 2013 to 2018, the change from cultivated land to woodland is the most obvious, grassland also has a larger increase, construction land has not expanded significantly, and land utilization has increased. Research can help understand Jinan in recent years. The changes and development of land use in the coming years provide certain data support for the reasonable allocation of land resources in Jinan City, which is conducive to the further development and planning of land use in Jinan City.**

## Keywords

**Land use; dynamic change; Landsat8; Jinan city.**

## 1. Introduction

Since the birth of human beings, land has been the material undertaker of human natural production and social activities. The change and development of each historical era can not be separated from land. As the technologies' developed, the remote sensing play more and more important in our life[1-5], especially in the land use. Many researchers are focused their study on that side. From 1992 to 1995, from the perspective of the integration of remote sensing image data processing, geographic information and expert theory, the Chinese Academy of Sciences conducted research and analysis on land use through the technical means mastered at that time, and further improved the accuracy of classification. After 2010, the state also made important instructions on land use monitoring, requiring the land and resources department to carry out comprehensive and dynamic monitoring of land use in China, and to conduct basic mapping and monitoring in many aspects such as land, agriculture, forestry, animal husbandry, water conservancy, and oceans. This paper used the Landsat8 data to analyze the land dynamic changes of Jinan area from 2013 to 2018, the areas of five kinds of land use were given.

## 2. Materials and methods

### 2.1. Area Analysis

Jinan is located in the northwest of the central and southern mountain area of Shandong Province. It is an important economic and trade center in China, as well as an important transportation construction center of "four horizontals and five verticals" in Shandong and "eight horizontals and eight verticals" in China. It covers an area of 10244 square kilometers.

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As it is located at the junction of the mountains in central and southern Shandong in the southeast and the lower Yellow River plain in the southwest, the overall terrain is high in the south and low in the north.

## 2.2. Data used

The data used in this study is Landsat 8 OLI from the Geospatial Data Cloud website_ For TIRS satellite digital products[6], based on the coverage of satellite images in Jinan, image data with center longitude of 117.3915 °, center dimension of 36.4674 °, strip number of 122, row number of 34 and image data with center longitude of 116.9698 °, center latitude of 36.0361 °, strip number of 122, row number of 35 must be selected The cloud cover and other information selected two images with cloud cover of 0.06 and 0.02 respectively on October 26, 2018 and two images with cloud cover of 0.06 and 0.45 respectively on September 26, 2013 as the data source of this study.

## 2.3. Data processing

In this paper, we performed the basic processing steps, which including the atmospheric correction, atmospheric correction, image fusion, image clipping and so on. After processing, the data of 2013 and 2018 are analyzed using the supervised classification, then the post classification comparison method is used. Using the Change Detection Statistics tool to select two images classified by maximum likelihood in time phase for statistical analysis. During the selection of samples for supervision and classification training in Jinan, six main types of surface features were determined, namely, cultivated land, grassland, forest land, water, construction land and unused land. The supervision and classification were carried out according to the characteristics of relevant surface features. After determining the training samples, it is necessary to check the separability of the training samples as showed in Table 1 and Table 2. If the separability between different training samples is greater than 1.8, it proves that the separability between ground object categories is good, which can achieve relatively effective supervised classification. After the supervised classification of image data is completed, the accuracy of the supervised classification results needs to be evaluated. In this study, the total classification accuracy is calculated through the mixture matrix and the Kappa coefficients are 0.9547 and 0.9473.

Table 1 Evaluation of training samples in 2013

| Classified samples | Separated degree | Classified samples | Separated degree |
|---|---|---|---|
| Forest land:cultivated land | 1.96604704 | Forest land: grass land | 1.99999540 |
| cultivated land:construction land | 1.97924419 | Construction land:unused land | 1.99999774 |
| cultivated land:grass land | 1.99778978 | water:cultivated land | 2.00000000 |
| water:forest land | 1.99827303 | Grass land:ununsed land | 2.00000000 |
| Forest land:construction land | 1.99842863 | Forest land:unused land | 2.00000000 |
| Construction land:grass land | 1.99997178 | water: | 2.00000000 |
| water:construction land | 1.99998401 | water:unused land | 2.00000000 |
| Cultivated land:unused land | 1.99999273 | | |

Table 2 Evaluation of training samples in 2018

| Classified samples | Separated degree | Classified samples | Separated degree |
|---|---|---|---|
| cultivated land:construction land | 1.95505185 | water:construction land | 1.9980052 |
| Forest land:construction land | 1.95645502 | water:Forest land | 1.99990005 |
| cultivated land:grass land | 1.96201965 | Forest land:unused land | 1.99999867 |

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| | | | |
|---|---|---|---|
| Forest land:grass land | 1.96832033 | grass land:unused land | 1.99999961 |
| cultivated land:Forest land | 1.98048449 | water:unused land | 1.99999998 |
| cultivated land:unused land | 1.98400708 | water:cultivated land | 2.00000000 |
| construction land:unused land | 1.98744227 | water:grass land | 2.00000000 |
| Forest land:construction land | 1.99783537 | | |

## 3. Results

The following data are obtained through statistical analysis of the supervised classification results of image data from 2013 to 2018 According to the analysis of the results of the supervision classification, there was no significant change in water body, unused land and grassland from 2013 to 2018. From 2013 to 2018, the area of unused land decreased by 27.27 square kilometers, while the area of water body and grassland increased by 2.68 square kilometers and 29.77 square kilometers respectively. The change of cultivated land, forest land and construction land is more obvious. From 2013 to 2018, the area of cultivated land decreased by 1150.13 square kilometers, while the area of construction land and forest land increased by 150.71 square kilometers and 994.42 square kilometers respectively.

Table 3 Land use in Jinan City in 2013

| Types | water | Forest land | grassland | cultivated land | Construction land | Unused land |
|---|---|---|---|---|---|---|
| areas/km2 | 124.38 | 2523.52 | 155.93 | 4280.04 | 3017.07 | 92.79 |
| proportion | 1.22% | 24.78% | 1.53% | 41.99% | 29.59% | 0.91% |

Table 4 Land use in Jinan City in 2018

| Types | water | Forest land | grassland | cultivated land | Construction land | Unused land |
|---|---|---|---|---|---|---|
| areas/km2 | 127.06 | 3517.94 | 185.70 | 3129.73 | 3167.18 | 65.52 |
| proportion | 1.24% | 34.51% | 1.82% | 30.70% | 31.06% | 0.64% |

After the classification of the image data, the data results of the study were summarized and analyzed, including the changes of forest land, cultivated land, grassland, water, construction land and unused land. The main feature of the period from 2013 to 2018 is the transfer of cultivated land to forest land. The rapid increase of forest land area and the transfer of various types of surface objects are as follows(Table5):

(1) The Water area transferred out 34.10km$^2$ and transferred 36.78km$^2$, the increasing area is 2.68km$^2$, which is mainly transferred out as forest land and construction land.

(2) Forest land area transferred out 584.8km$^2$ and transfer to 1579.22 km$^2$， and the area increasing by 994.42km$^2$. It is mainly transferred out as cultivated land and construction land.

(3) There are 1690.33km$^2$ of cultivated land transferring out and transferring to 540.02km$^2$. The area were reduced by 1150.13km$^2$and the main types of transfer out are forest land and construction land.

(4) Grassland area transferred out 98.34km$^2$ and transfer 128.11km$^2$, with the area increasing by 29.77km $^2$. The main types of transfer out are forest land, cultivated land and construction land.

(5) There are 569.45 km$^2$ of construction land transferring out and transferring 720.16km$^2$ with area increasing by 150.71km$^2$.The main types of transfer out are forest land and cultivated land.

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(6) Unused land area transferred out 55.6km$^2$ and transfer to 28.33 km$^2$. The area reduced by 27.27km$^2$ and the main types of transfer out are forest land, cultivated land and construction land.

Table5 Land use transfer matrix from 2013 to 2018 (km$^2$)

| | water | Forest land | Cultivated land | Grass land | Construction land | Unused land | total |
|---|---|---|---|---|---|---|---|
| water | 90.28 | 6.21 | 6.81 | 0.55 | 22.29 | 0.92 | 127.06 |
| Forest land | 9.05 | 1938.72 | 1293.2 | 35.44 | 226.94 | 14.59 | 3517.94 |
| Cultivated land | 1.09 | 184.57 | 2589.71 | 36.59 | 295.15 | 22.62 | 3129.73 |
| Grass land | 0.67 | 33.81 | 70.83 | 57.59 | 22.76 | 0.04 | 185.70 |
| Construction land | 21.3 | 346.83 | 313.23 | 21.37 | 2447.62 | 17.43 | 3167.78 |
| Unused land | 1.99 | 13.38 | 6.26 | 4.39 | 2.31 | 37.19 | 65.52 |
| total | 124.38 | 2523.52 | 4280.04 | 155.93 | 3017.07 | 92.79 | |

## 4. Conclusion

In this paper, we obtain the green land changes of Nanjing City from 2017 to 2018.After the pre-processing of the Remote sensing data, including radiometric calibration and atmospheric correction, geometric correction, image enhancement, image stretching, image color synthesis, image clipping and so on then the supervision classification method is used from analysis. The main conclusions are as bellows,

(a)The city land is classified by three types, which include the green land, the non-green land and water. In 2017, the overall accuracy is 98.8158% and Kappa Coefficient is 0.9595 of Nanjing supervision classification results, while in 2018, the values changes to 98.5124% and 0.9686.

(b) Comparing the results of supervision and classification in 2017 and 2018, the area of green area in 2017 was 2511531675m$^2$, and 2507723325m$^2$ in 2018. Two years of comparison showed that the green area in 2018 was 3808350m$^2$ less than that in 2017, which is showing an incresing trend.

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