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LETTER TO THE EDITOR

Space-time Dynamic Monitoring Method for Vegetation Cover of Football Field under TM Image Analysis

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Vegetation is closely related to human survival and development, which seriously affects the sustainable development of human beings. Monitoring vegetation coverage is the focus of human beings for a long time. In order to provide a good ecological environment in football field, a TM image analysis method for temporal and spatial dynamic monitoring of vegetation cover in football field is proposed. A football field in Guilin is selected as the research object to analyze the vegetation cover of the football field from 2013 to 2016. The data source is given, and the remote sensing image is preprocessed. On this basis, vegetation cover monitoring is completed based on linear mixed pixel decomposition. The experimental results show that the vegetation cover area of football field shows a downward trend from 2013 to 2016. Among the four vegetation types, the area is the most middle vegetation cover area, and the proportion of low vegetation cover area is the smallest.
TM image; Football field; Vegetation cover; Monitoring

1 Introduction

With the increase of population and the development of science and technology, urban greening has become a hot topic. Among them, vegetation coverage is an index to reflect the spatial characteristics of regional vegetation, and it is also the premise and basis of urban ecosystem health assessment. Vegetation is the general name of plant community on the earth surface and one of the important reference indexes of ecological environment. To a certain extent, the difference of plant coverage reflects the functional perfection of the ecosystem and the stability of the ecosystem. The temporal and spatial pattern of vegetation is related to climate, topography and human factors. Under the influence of different factors, the distribution and density of vegetation have certain changes, and the vegetation basically grows in a certain area. There is a close relationship between the change of vegetation and each element. In football field sports competition, good vegetation cover ecosystem is helpful to the development of sports and the promotion of people's health. Therefore, it is of great practical significance to obtain the present situation and change information of vegetation cover in football field in order to reveal the spatial differentiation law of football field, explore the driving factors of vegetation coverage change, and analyze and evaluate the quality of regional ecological environment.

Yuwei Zhang, Luhe Wan, Zhendong Li published an article in 2019 in the journal Ekoloji, Issue 106, entitled: "Forest Vegetation Type Extraction and Dynamic Monitoring — A Case Study of Heilongjiang Province, China". The purpose of this study is to establish an effective method to monitor forest vegetation succession or dynamic change by remote sensing. Taking Heilongjiang Province as an example, maximum likelihood classification and support vector machine classification are used to extract forest vegetation type information. Comparing the classification accuracy of the two methods, the support vector machine classification method is effective for vegetation change detection.(Khan Pathan, 2018) It can be seen that support vector machine is an effective vegetation change detection method. By extracting change information and superposition analysis, the dynamic changes of large area forest types can be monitored, so as to promote the sustainable development of forests. The research method in this paper is innovative and can provide a certain reference.

Reference (Wang Duan and Bai 2018) taking the five peaks of Wutai Mountain and the mountain areas within the extension range of the mountains as the research object, the vegetation coverage of the six stages of TM images from 1990 to 2015 is estimated by using the normalized vegetation index, and the changes of the estimated results were detected. The temporal and spatial variation characteristics of vegetation coverage in the study area are analyzed. Reference (Wang Liu and Jia 2017) provides an in-depth understanding of the temporal and spatial evolution characteristics and driving mechanism of vegetation coverage in the Aksu Basin. Based on Landsat TM and high score 1 remote sensing images, the NDVI pixel binary model and difference calculation method are used to map the Aksu basin. Monitoring and analysis of vegetation cover dynamic changes from 2005 to 2015. On the basis of the above-mentioned research, this paper puts forward a method to monitor the space-time dynamic of the coverage of the football field under the TM image analysis.

2 Idea Description

2.1Subject investigated

In this paper, a football field in Guilin is selected as the research object. Guilin is a world-famous scenic tourist city, located in the northeast of Guangxi Zhuang Autonomous region, longitude 109 ° 45 "~ 104 ° 40" east, latitude 24 ° 18 "~ 25 ° 41" north, located in the southwest of Nanling Mountain system. Belongs to the subtropical monsoon climate, the territory climate is mild, the light is abundant, the four seasons are clear and the rain heat is basically the same season; The regional zonal vegetation belongs to subtropical evergreen broad-leaf forest. Due to the destruction of human long-term development activities, some natural vegetation in Shishan area on the outskirts of the city has gradually evolved into limestone deciduous broad-leaf forest and bushes, forming Pinus massoniana forest and Pinus massoniana forest. Shrubs and grass slopes are the main types of secondary vegetation, and the built-up area of football field is mainly artificially planted vegetation, mainly Osmanthus osmanthus tree, shade fragrant tree, camphor tree, holly spears, paulownia and other evergreen broad-leaf ornamental trees and irrigation vegetation (Yang Xiong and Xiao 2018).

2.2 Data sources

The remote sensing data used in the study are Landsat 8 satellite images from a football field in Guilin on June 4, 2013 and Landsat 7 ETM satellite images on May 31, 2016. In these two years, the vegetation growth is good, the remote sensing image can better reflect the vegetation condition, the time is close, and the vegetation condition is comparable.

2.3 Remote sensing image data preprocessing

The remote sensing image has a series of errors due to the influence of atmosphere, cloud, water vapor, sensor, earth rotation, imaging time and earth curvature. The existence of the error will affect the accuracy of the vegetation extraction and the accuracy of the study results. Therefore, the remote sensing image should be pre-processed and the influence of such errors can be reduced, and the acquired data can be pre-processed such as radiation calibration, atmospheric correction, image cutting and the like.

2.3.1 Radiation calibration

Radiometric calibration is to convert the dimensionless DNA value recorded by the sensor into the radiance or reflectivity of the top layer of the atmosphere with practical physical significance. The principle of radiation calibration is to establish the quantitative relationship between the digital quantitative value and the radiation luminance value in the corresponding field of view in order to eliminate the error caused by the sensor itself.

Radiation calibration: The original DNA value is converted to the reflectivity of the outer surface of the atmosphere, the purpose of which is to eliminate the error of the sensor itself and determine the accurate radiation value at the entrance of the sensor.

2.3.2 Atmospheric correction

Different wavelengths of light interact with the atmosphere when they pass through the atmosphere, which reduces the energy of the wavelength and changes the spectral energy of the obtained data. The energy absorption and scattering of different wavelengths are different in the atmosphere, and the energy of different wavelengths shows different attenuation trend. In addition, if the geometric relationship between the sun, the target and the remote sensor is different, the length of the atmospheric path is different, so that the pixel gray value of the ground objects in different areas of the image is affected by the atmosphere. And the pixel gray value of the same ground object is affected by the atmosphere at different acquisition time, the degree of atmospheric influence is also different (Zhang et al. 2018)

The data used by the research institute is not the data of the same time point, because of the difference of various natural factors, the acquired data is subjected to atmospheric correction to obtain the real reflectivity data of the figure. In this way, the effects of various gases and aerosols in the atmosphere on the reflection of ground objects can be weakened, so as to obtain the reflection value closest to the ground objects.

2.4 Vegetation cover monitoring based on linear mixed pixel decomposition

The linear spectrum hybrid model can be used to distinguish the main surface covering type, and can decompose the mixed image elements well, directly determine the vegetation coverage. The model refers to the spectral reflectivity of the pixel, which combines the end element reflectivity of the pixel and the percentage weight value of the pixel area (Chen Zhao and Yu 2018). The specific expression is:

$$R_{ib} = \sum_{k=1}^{n} F_{ki} RE_{kb} + \varepsilon_{ib} \quad (1)$$

In the formula, R_{ib} is the reflectance of the ith image element of the b-band; F_{ki} is the ratio of the pixel area of the ith image element to the k-th end element; RE_{kb} is the reflectivity of the k-th end element of the b-band; ε_{ib} is the residual value of the ith image element of the b-band; n is the number of terminal elements, n is the number, n$\leqslant$ band number+1.

Among them, the selection of end elements is the key to the linear spectral mixing model, and is directly related to the fitting accuracy of end elements. In this study, the end elements are selected according to the main surface cover types contained in TM image information. The specific steps are:

1) The minimum noise transformation (MNF) of three phase TM images is carried out to obtain six MNF principal components. By visual inspection and characteristic value analysis, more than 90% of the image information is concentrated in the first 3 main components, and then the 3 main components are mainly noise;

2) The first three principal components obtained by MNF transformation are calculated by pixel purity index (PPI), and the N-dimensional divergence analysis is carried out by using the results of PPI calculation into MNF space. The vertex selection end element of PPI Polyhedral in MNF space, and the vertex position corresponds to three main surface cover types in the study area: vegetation, soil and shadow;

3) The MNF images of the first three principal components are decomposed by using the above three end elements,

and the images of vegetation, soil and shadow are obtained.

According to the above analysis steps, the temporal and spatial dynamic monitoring of football field vegetation cover can be completed.

3 Results

Using the Reclassify tool of spatial analysis module in ARCGIS9.2 software, according to the above vegetation coverage classification standards, combined with the actual situation of field investigation, the vegetation index images of the football field in Guilin in 2013 and 2016 are monitored. Finally, inquiring the attribute table of the classified layer, counting the total number of the different area image elements and calculating the vegetation coverage area of each classification area, the statistical results are as shown in Table 1:

Table 1 Statistics of vegetation cover area change

Grade	Proportion 2013	Proportion 2016	Variation （hm^2）	Change rate（%）
First-class	11.64	13.73	1178.96	17.92
Second-class	25.43	16.69	-4941.04	-34.39
Third-class	40.72	43.12	1354.23	5.89
Four-class	22.20	26.46	2407.85	19.20

In Table 1, First-class is non-vegetation areas, with a vegetation coverage of 0, refers to areas other than vegetation, including water, bare soil, traffic and building land; The second-class is low vegetation cover area, vegetation coverage is less than 30%, mainly refers to low-yield grassland, sparse forest land, abandoned wasteland vegetation and so on; The third-class is the middle and middle vegetation cover areas, the vegetation coverage rate is 30% ~ 60%, mainly refers to the middle-production grassland, the forest land, the garden area, the cultivated land and so on. The four-class is high-vegetation cover areas, the vegetation coverage is more than 60%, which means that the vegetation is dense, such as the forest, the good pasture and the like.

The analysis table 1 shows that the area of the vegetation cover area of the football field in the period from 2013 to 2016 shows a downward trend. From 2013 to 2016, the proportion of vegetation cover areas in the total area decreased from 88.36% to 86.27%. In 2016, the area of the four vegetation types divided into four types of vegetation is most in the middle vegetation cover area, which accounted for about half of the total vegetation cover area in the region. In 2016, the coverage rate increased compared with 2013, with a change rate of 5.89%; The second is the high vegetation cover area, the average annual change rate is 1.28%, and the proportion of low vegetation cover area is the smallest, and showed a decreasing trend, with an average annual decrease of 2.29%.

4 Discussion

Temporal variation characteristics of vegetation coverage: The dynamic change of regional surface vegetation cover can be accurately and comprehensively reflected by the combination of remote sensing and geographic information system. Through the estimation and comparative analysis of vegetation coverage in different periods of the study area, the present situation and dynamics of vegetation in the study area can be well reflected, and the disturbance course of urbanization process to urban vegetation can be revealed. The main figure types of vegetation cover change include forest land, garden area and grassland. The direct driving factor of vegetation coverage is the occupation of urban and rural construction land, adjustment of agricultural structure, deforestation and so on. With the development of the process of urbanization, the land use has changed greatly, mainly because of the transformation of the agricultural land to the non-agricultural land, and the expansion of the non-agricultural land mainly includes: Firstly, the expansion of urban construction land; Secondly, the rural development of traffic network, farmland water conservancy construction and so on also occupy a large amount of farmland. At the same time, the role of natural disasters can not be ignored, natural fire, debris flow and so on are also one of the reasons for the change of vegetation cover. While economic development and natural disasters destroy surface vegetation, people are more and more aware of the importance of ecological environment, more and more pursuit of near-natural environment, a large number of tree planting recommendations, improve the ecological environment, so as to improve the coverage of surface vegetation.

5 Conclusion

This study is a dynamic monitoring of the vegetation coverage of a football field in Guilin, which is of great significance to the improvement of the ecological environment quality. However, only two nodes in the time period are selected for analysis, and the vegetation status is not monitored in real time, resulting in some limitations in the results. Therefore, in the future work, the research should be more detailed in many dimensions, and its influencing factors should be analyzed, the corresponding control measures should be put forward to improve the practical guiding role of the research.

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