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LETTER TO THE EDITOR

Method of Time and Space Dynamic Monitoring for Vegetation Coverage in Villages and Towns Based on TM Imagery

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For the problem that the traditional method of spatial and temporal dynamic monitoring for vegetation coverage in villages and towns has low monitoring accuracy, a method of time and space dynamic monitoring for vegetation coverage in villages and towns based on TM imagery is proposed. The ARCGIS tool is used to vectorize the township boundaries, and the TM remote sensing image preprocessing is performed by histogram matching method. Using the normalized design vegetation index, the pixel dichotomy model is used to estimate and extract vegetation coverage information. The vegetation cover level is divided according to the status of township land use, the characteristics of vegetation cover and the analytical precision of TM imagery. In ArcGIS 10.0, the change of vegetation coverage at each level is judged according to the change of the number of pixels, and the spatial and temporal dynamic monitoring of vegetation coverage is completed. The experimental results show that the proposed method has high monitoring accuracy and lays a solid foundation for the research progress in this field.
TM imagery; villages and towns; vegetation coverage; time and space dynamic monitoring

1 Introduction

The vegetation coverage is an indicator reflecting the spatial characteristics of the regional vegetation and is the premise and basis for conducting the ecosystem health assessment in the villages and towns. Obtaining the status quo of surface vegetation cover and its change information reveals the law of surface space differentiation, explores the driving factors of changes in vegetation coverage, and evaluates the regional ecological environment quality has important practical significance. The measurement methods of the vegetation coverage can be divided into two categories of ground measurement and remote sensing measurement. Ground measurement methods include sampling method, visual estimation method, instrument method and model method. The accuracy of this method is high, but the efficiency is low, and the input cost and workload are also large. It is not suitable for measurement coverage measurement in a wide range of areas. Using remote sensing technology to quickly estimate and analyze the vegetation coverage can not only accurately and quickly extract the vegetation coverage information, but also help to improve the accuracy of the research. It has become an important tool for the research of vegetation coverage. This method has been used in many regions. There are many methods for estimating vegetation coverage based on remote sensing data, but most of the methods have the disadvantages of cumbersome operation, long measurement time, limited condition or only applicable to specific areas and specific vegetation types. The pixel binary model does not rely on the measured data. The pixel coverage model based on the TM data has higher estimation accuracy and strong generalization, and it is easy to carry out large-scale research in different regions.

Xinping Yuan, Yi Liu published an article in the Ekoloji (Issue 107, 2019), entitled "Analysis of Vegetation Landscape Adjacency Characteristics based on Rural Wetland Ecosystem". This article provides an in-depth analysis of the adjacency characteristics of vegetation landscapes in rural wetland ecosystems. The relative abundance, relative height and relative coverage of the vegetation landscape were calculated using the measurements of the relative coverage and relative density (Yuan and Liu 2019). The landscape pattern calculation software was used to analyze the types and their characteristics of vegetation landscape. On this basis, the relationship between characteristics and spatial configuration of vegetation landscape structure was obtained by using index analysis method for vegetation landscape pattern. According to the adjacent length, the percentage of adjacent length, the number of adjacent sides, and the ratio of the number of adjacent sides to the number of patches, the adjacent characteristics of vegetation landscape and wetland are analyzed. The wetland ecological safety analysis method was used to construct the vegetation landscape stress function. According to the degree of landscape stress and the degree of ecological security risk, the ecological security status of wetland ecosystem was analyzed. In this article, it was mentioned that the spatial and temporal dynamics of vegetation coverage in villages and towns should be monitored, but they were not thoroughly explored. In order to supplement and improve this article, this paper studies the methods of spatial and temporal dynamic monitoring for vegetation coverage in villages and towns.

He and He (2016) proposed the spatial and temporal evolution of vegetation cover in the Yellow River Basin based on SPOT-VGT. This method proposed that vegetation is the most important part of land cover and the natural link connecting soil, atmosphere and biology. The dynamic change of vegetation cover has an important impact on the global energy cycle and material cycle, and is one of the important contents of global change research. As an important grain production base in China, the Yellow River Basin directly affects the sustainable development of the basin economy (Zhang et al. 2017). In order to quickly and accurately extract the surface vegetation and understand the ecological environment in the Yellow River Basin, using the SPOT-VGT remote sensing data from 1998 to 2011, combined with geographic information technology, the mean method and trend analysis method were used to dynamically monitor the time and space distribution characteristics and trends of the vegetation NDVI in the Yellow River Basin. However, this method has the problem of low monitoring accuracy.

Han (2016) proposed a dynamic monitoring of vegetation in the control area of Beijing-Tianjin sandstorm source project based on MODIS. The Beijing-Tianjin Sandstorm Source Project Management Area was selected as the research area. The MODIS-NDVI time series imagery was taken as the main data source, and the vegetation cover change process and driving mechanism of the study area were systematically studied. Through the regression analysis between NDVI and natural factors, the main reason for the unequal spatial distribution pattern of vegetation in the study area is rainfall. In the arid and semi-arid regions of Northwest China, the vegetation level is the lowest, which is particularly prone to desertification. However, this method has the problem of low monitoring accuracy, and the actual application effect is not satisfactory.

Aiming at the problems existing in the above methods, the method of spatial and temporal dynamic monitoring for vegetation coverage in villages and towns based on TM imagery is proposed.

2 Idea description

Vegetation is an important part of the villages and towns ecosystem, which plays an important role in maintaining ecosystem stability and improving regional environmental quality. For example, alleviate the "heat island effect" in villages and towns, purify the air, regulate the regional microclimate, and beautify the landscape. However, with the rapid development of the villages and towns economy and the rapid expansion of the population size, especially the area of transportation and construction land is expanding, the phenomenon of green vegetation in villages and towns is very prominent (Wu et al. 2016). Rapid townships have caused vegetation to decay in villages and towns, which has become one of the major eco-environment issues facing development in villages and towns (Bian et al. 2017). The vegetation coverage is an indicator that reflects the spatial characteristics of the regional vegetation and is the premise and basis for conducting the ecosystem health assessment in the villages and towns.

2.1 Preprocessing of TM remote sensing images

First, the TM multi-band false color image was geometrically corrected. Based on the administrative division map, 16 control points (GCP) were selected, and the quadratic polynomial was used to register the TM remote sensing images of 2008 and 2018. Image sampling uses the two-line interpolation method to control the correction error (RMS) within one pixel. Secondly, according to the research needs, the ARCGIS tool is used to vectorize the boundaries of townships, and the remote sensing image map of the study area is masked and cropped. Finally, the histogram matching of the two-stage images makes the spectral characteristics of the TM remote sensing images similar, thus eliminating the differences in image effects of different phases in the study area caused by factors such as the solar elevation angle or atmospheric influence. According to previous research results, when multi-temporal remote sensing data is used to carry out surface dynamic monitoring and analysis, and the histogram matching method is used to perform TM remote sensing image radiation correction, the comparability of data is significantly enhanced.

2.2 Vegetation index and vegetation coverage

Vegetation index is a characteristic index used to extract information on vegetation growth, coverage, and seasonal dynamics (Xiao et al. 2017). It utilizes green vegetation with a strong absorption of the visible red band and a highly reflective near-infrared band. Implicit plant information is enhanced or revealed by ratio, differential, linear combination, etc. of the data for these two bands. Up to now, scholars at home and abroad have proposed dozens of planting index models. The normalized vegetation index is the most widely used indicator. It is not only sensitive to the biophysical characteristics of vegetation, but also effectively reduces the impact of sensor observation angles, solar radiation intensity, terrain shadows and soil background. Therefore, the normalized vegetation index is often used for regional and global vegetation dynamics monitoring studies. The conversion of the vegetation index to the vegetation coverage can be estimated by the pixel binary model method, that is, the NDVI value of a pixel can be expressed as the information contributed by the green vegetation part and the information contributed by the non-vegetation cover (bare soil) part. Part of the composition. In this way, information on vegetation coverage in villages and towns is obtained.

2.3 The level of vegetation coverage in villages and towns

In study on remote sensing monitoring of vegetation in the villages and towns, the threshold of the vegetation coverage level has not yet formed a unified standard (Symeonakiset al. 2016). Based on the relevant reference, combined with the status of land use in the villages and towns, vegetation cover characteristics and TM imagery analysis accuracy, the vegetation coverage in villages and towns is divided into four categories. Class 1 is a non-vegetation area, and the vegetation coverage is 0, which refers to areas other than vegetation, including water bodies, bare soil, traffic and construction land. 2 is a low vegetation coverage area with vegetation coverage of less than 30%, mainly referring to low-yield grassland, sparse forest land, and abandoned wasteland vegetation. Class 3 is a medium vegetation coverage area with vegetation coverage of 30% to 60%, mainly referring to middle-class grasslands, woodlands, gardens and cultivated land. Class 4 is a high vegetation coverage area with a vegetation coverage of more than 60%, which refers to densely populated forests and fine pastures.

2.4 Temporal and spatial dynamic monitoring of vegetation coverage

Based on the vegetation coverage level, the reclassification module was used in ArcGIS 10.0 to obtain the rating map of the vegetation coverage in villages and towns according to the above classification criteria. According to the change of the number of pixels (area), the change of each level of vegetation coverage is judged, and the analysis of the spatial and temporal dynamic monitoring methods of the villages under the TM imagery analysis is completed.

3 Results

Using the Reclassfy Ding of the spatial analysis module in ARCGIS9.2 software, according to the above-mentioned vegetation coverage classification standard, combined with the actual situation of field investigation, the monitoring and classification of the vegetation index images of the two cities in 2008 and 2018 were carried out. Finally, query the attribute table of the classification layer, count the total number of pixels in different regions and calculate the coverage area of each hierarchical region. The statistical results are shown in Table 1.

Table 1 Spatial and temporal dynamic monitoring results of vegetation coverage in villages and towns

level	2008		2018		Amount of change (hm^2)	Rate of change (%)	Average annual rate of change (%)
	Area (hm^2)	Proportion (%)	Area (hm^2)	Proportion (%)			
I	6578.26	11.64	7757.22	13.73	1178.96	17.92	1.19
II	14367.80	25.43	9456.76	16.96	-4941.04	-34.39	-2.29
III	23004.34	40.72	24358.58	43.12	1354.23	5.89	0.39
IV	12541.59	22.20	14949.44	26.46	2407.85	19.20	1.28

As can be seen from Table 1, during the decade of 2008-2018, the area of vegetation coverage in villages and towns showed a general downward trend. In 2008 and 2018, the vegetation coverage in villages and towns was 49,913.74 and 48,734.78 hm^2, respectively. The proportion of vegetation coverage in the total area was reduced from 88.36% to 86.27%, and the area of vegetation land was reduced by 1178.96 hm^2. In 2018, among the three types of vegetation types, the area is the most middle vegetation cover area with an area of 24,358.58hm^2. Its value accounts for about half of the total area covered by vegetation in the region. In 2018, it increased by 1354.23 hm^2 compared with 2008, with a rate of change of 5.89%. Followed by high vegetation coverage area, the area increased from 12541.59 hm^2 in 2008 to 14949.44 hm^2 in 2018, the net increase area is 2407.8 hm^2, and the annual average change rate is 1.28%. The area of low vegetation coverage is the smallest and shows the gradual decrease. Its area decreased from 14367.80 hm^2 in 2008 to 9426.76 hm^2 in 2018. The net area decreased by 4941.04 hm^2, with an average annual decrease of 2.2%.This shows that the proposed method can achieve vegetation cover of spatial and temporal dynamic monitoring in villages and towns.

In order to further verify the comprehensive practicability of the proposed method, the monitoring accuracy was analyzed on the simulation platform. The experimental results are shown in Table 2.

Table 2 Monitoring accuracy

Number of experiments/time	Monitoring accuracy

5	96.7%
10	97.2%
15	97.3%
20	98.5%
25	98.3%
30	97.6%

Analysis of the above table shows that the accuracy of spatial and temporal dynamic monitoring in villages and towns based on TM imagery is above 96%. The main reason is that the method uses the normalized vegetation index to design the vegetation index, and uses the pixel binary model to estimate and extract the vegetation coverage information. Based on the status of land use in the villages and towns, vegetation cover characteristics and TM imagery analysis accuracy, the vegetation cover level is divided. In ArcGIS 10.0, the change of each level of vegetation coverage is judged according to the change of the number of pixels. Therefore, the monitoring accuracy of the proposed method is high.

4 Conclusions

Retrieving vegetation cover using remote sensing images is a practical technique in the field of ecological environment monitoring. The vegetation coverage is the characteristic indicator reflecting the growth and coverage of surface vegetation. The NDVI index is calculated by combining the different band information of TM imagery. Based on the principle of the binary model of the pixel, the vegetation index is constructed and the empirical model of the vegetation coverage is estimated. The model can be applied to vegetation cover monitoring, classification and ecological mapping in villages and towns. The evaluation results can reveal the spatial pattern and dynamic characteristics of regional vegetation ecology, which can provide the basis for the evaluation of ecological environment quality in villages and towns and ecological planning. The rapid population growth has put tremendous pressure on the ecological environment in villages and towns. The temporal and spatial variation of the vegetation coverage in villages and towns is an indirect response to this pressure. For managers and decision makers in villages and towns, while developing the economy and improving the living standards of residents, we must pay full attention to the protection and planning of green vegetation in villages and towns, and curb the decline of vegetation coverage. Continuously improve the quality of the ecological environment in villages and towns to promote the healthy development of towns and villages.

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