Ekoloji 28(108): 651-655 (2019)

LETTER TO THE EDITOR

Data Mining Method for Vegetation Distribution in Mineral Resources Areas

Liya Cai*
School of Information Engineering, Suzhou Industrial Park Institute of Services Outsourcing, Suzhou 215123, China
*Email: caililia@126.com

In order to solve the uneven distribution of vegetation in mineral resources areas, a data mining method for vegetation distribution in mineral resources areas is proposed. The preparation and distribution of mineral areas follow the spatial distribution law. The longitude, latitude and elevation of ground control points are measured by RTK, and the UAV data images are obtained. The original aerial images are corrected by the precise coordinates of ground control points. Based on Orthophoto image of sample plot, decision tree algorithm is used to establish sample training data to obtain vegetation coverage grade of mineral resources. The theory of linear decomposition method is used to establish the corresponding linear mixed model, and the sample data is substituted into the linear element decomposition model to calculate the contribution rate of soil and vegetation coverage. The results show that the contribution rate of vegetation coverage in mineral resources areas is about 70%, and the vegetation coverage level is higher.
Mineral resources; Vegetation distribution; Data mining

1 INTRODUCTION

Plants need a certain amount of metal elements when they grow. Because of long-term adaptation, plants can not only absorb a lot of metal elements through roots, but also transport them to stems, leaves, flowers, fruits or seeds for storage. In this way, if a plant with a particular preference for certain metals is found in a place, it indicates that there may be some metal deposits in the area. Vegetation is an important part of the global ecosystem. It can slow down surface runoff, protect water and soil, and play a vital role in energy exchange on land surface, hydrological cycle and global environmental change. The study of the relationship between vegetation and environment has become one of the important fields of vegetation ecology. Different environmental factors on the earth's surface lead to the diversity of vegetation and vegetation distribution. At the same time, the formation and development of plants act on environmental factors. The exploitation of mineral resources has caused a series of environmental geological problems, resulting in environmental pollution, soil erosion, land subsidence, collapse, ground fissures, landslides and other disasters, which have a greater impact on the vegetation distribution in mineral resources areas (He et al. 2017). Data mining is a process of extracting implicit, previously unknown and potentially valuable information from a large number of incomplete, high-dimensional, noisy and random data. Data generally contains many attributes, and there may be interaction between data. Vegetation coverage is an objective index reflecting the basic distribution of vegetation in a mineral resource area. It is often used as a basic parameter or factor in many studies.

Xinping Yuan, Yi Liu published an article entitled “Analysis of Vegetation Landscape Adjacency Characteristics Based on Rural Wetland Ecosystem” in Ekoloji (Issue 107, 2009) (Yuan and Liu 2019). According to the degree of landscape stress and the risk of ecological security, the ecological security of wetland ecosystems was analyzed. The results showed that in the experimental rural wetland ecosystem, there was the most obvious adjacent relationship between Cape shrub and wetland, while there was no obvious adjacent relationship between grassland and wetland. The relationship between grassland neighbouring rat and land development and construction, the proportion of affected areas and the degree of stress were relatively large. The vegetation distribution can be analyzed according to the development and construction of mineral resources (Martire et al. 2018).

The commonly used methods for estimating vegetation coverage are surface observation and remote sensing monitoring. The surface measurement method is mainly used for monitoring vegetation coverage in a smaller area. For monitoring vegetation coverage in a larger area, it is often used as an auxiliary means of remote sensing monitoring and provides basic data for remote sensing monitoring. Establishment of empirical models of vegetation coverage and accuracy evaluation and verification of remote sensing coverage monitoring are subject to many constraints and inefficiencies (Ren 2018). Regression model method is a common remote sensing monitoring method. Using single or several bands of remote sensing monitoring data, vegetation index (NDVI) and vegetation coverage are calculated, and the corresponding statistical model is obtained by regression analysis. Then the extension model of space is used to estimate the vegetation coverage in a larger area. Regression model requires high spatial resolution of remote sensing image and the model has great limitations.

In view of the above problems, a data mining method for vegetation distribution in mineral resources areas is proposed. Decision tree classification method is used to estimate vegetation coverage. Based on remote sensing image data and Orthophoto image, through the theory of decision tree algorithm and linear decomposition method, a linear mixed model is established to calculate the contribution value of vegetation and soil (Mohammed and Yanling 2017). It has the characteristics of intuition, clarity and high operation efficiency. It can effectively eliminate redundant data and reduce data dimension.

2 IDEA DESCRIPTION

2.1 Overview of the research area

The mineral resources area is located in the sample positioning area to monitor grassland in long-term, belongs to the typical distribution area of elm sparse forest. The climate of study area belongs to the continental semi-arid monsoon climate in the middle temperate zone. The annual average temperature is 2.1℃. The annual average rainfall is 365 mm. The seasonal distribution of precipitation is uneven, mainly in July-September.

2.2 Design of vegetation coverage calculating method

The preparation and distribution of mineral areas follow the spatial distribution law. It refers to the vertical, horizontal and vertical-horizontal joint distribution of plants in geographical space. Vertical distribution refers to the distribution of spatial objectives along geographical harmonization, such as elevation changes of vegetation cover and biodiversity. The horizontal distribution refers to the planar distribution of vegetation along the geographical region, such as the regional differentiation of rice yield per mu (Yu et al. 2017), and the difference between urban and rural infrastructure; The vertical-horizontal joint distribution refers to the simultaneous change of elevation and regional aspects of the target.

2.2.1 Ground control point measurement

Twenty-two cement piles with red tops are set up as permanent ground control points in the sample plot of mineral resources area for the correction of UAV data images. The longitude, latitude and elevation of ground control points are measured by RTK (horizontal accuracy < 3m, elevation accuracy < 5cm).

2.2.2 Orthophoto production

Firstly, the original aerial image is corrected. Based on the image feature matching algorithm, the uniform feature points between adjacent images are searched and matched to get the three-dimensional point cloud of the sample plot. In this process, the precise coordinates of the ground control points are used to correct the geographic position of the matched feature points (Zhou and Liu 2018).

2.2.3 Estimation of vegetation coverage

Based on the Orthophoto image of sample plot, the decision tree algorithm is used to establish the training data of sample, and the vegetation coverage level of mineral resources is obtained as shown in Table 1.

Table 1 Vegetation coverage levels

Coverage level	Vegetation coverage/%
High	≥70
Medium-high	50~70
Medium	30~50
Medium-low	10~30
Low	≤10

Based on the theory of linear decomposition method, the corresponding linear mixed model is established, and the sample data is substituted into the linear element decomposition model (Su et al. 2017). Supposing that the information of a pixel can be divided into two parts: soil and vegetation. The information returned by sensors can be decomposed into contribution value of vegetation S_V and contribution value of soil S_S.

$$S = S_S + S_V \tag{1}$$

In the mixed pixel composed of soil and vegetation, the proportion of vegetation coverage is the vegetation coverage f_c of the pixel, corresponding to the proportion of soil (Zhou et al. 2017). For a mixed pixel consisting of soil and vegetation, the vegetation coverage ratio in the pixel is the vegetation coverage f_c of the pixel, while the soil coverage ratio is f_c.

$$S_V = f_c \cdot S_{veg}, S_s = \left(1 - f_c\right) \cdot S_{soil} \tag{2}$$

In the above formula, S_{veg} represents the contribution value of pure vegetation cover, S_S represents the contribution value of pure soil information, and S_V represents the contribution value of vegetation in mixed pixels. By substituting pure vegetation and soil information into the information formula transmitted by sensors, the formula for calculating vegetation coverage can be deduced as follows:

$$S = f_c \cdot S_{veg} + \left(1 - f_c\right) S_{soil} \tag{3}$$

In the above formula, S_{soil} and S_{veg} represent parameters, and remote sensing information can be used to estimate vegetation coverage according to vegetation coverage formula.

3 RESULTS

In the growing season of 2017, Four-rotor UAVs were used to acquire UAV images of mineral resource areas. According to the geographic coordinates of boundary points in mineral resources area, the flight route is planned by calculating the position of navigation points. The flight altitude of UAV is 100 m, the side direction overlap of flight route is 70%, and the course overlap is 75%. Aerial photography usually takes place from 11:00 to 14:00, because the sky conditions are better and the area of shadows on the ground is the smallest. The ground console is built by using the UAV flight control software Litchi for DJI Drones to complete the UAV flight and data acquisition.

By calculating the contribution rate of vegetation coverage in mineral resources areas in different periods, it can be seen from Figure 1 that the contribution of herbaceous vegetation to total vegetation coverage is the lowest of 67%, the average of 73%, and that of woody vegetation to total vegetation coverage is the highest of 33%, the average of 27%. In the early and middle stage of growing season, the contribution rates of herbs and woody vegetation are 72% - 76% and 24% - 28%, respectively, showing that the contribution of herbs and woody vegetation to total vegetation coverage remains stable. At the end of the growing season, the contribution of woody vegetation to the total vegetation coverage increased to 1/3 due to the complete withering of herbaceous vegetation. Compared with stable woody vegetation, herbaceous vegetation coverage is greatly affected by external environment. The contribution of herbaceous vegetation to total vegetation coverage in the whole growing season is much greater than that of woody vegetation. Therefore, the vegetation distribution in mineral resources areas is mainly affected by the coverage of herbaceous vegetation.

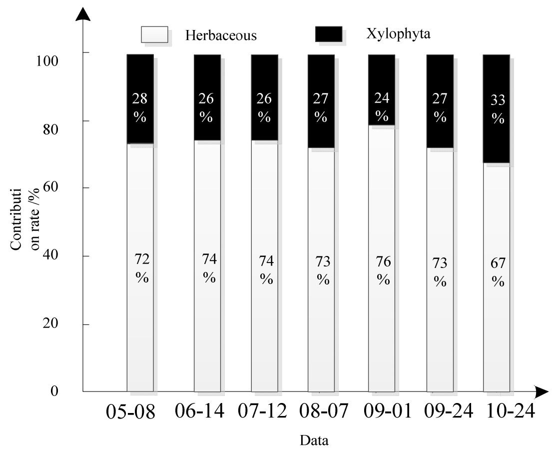

Figure 1 Contribution rate of vegetation coverage in mineral resources areas in different periods

From the macro point of view, the vegetation coverage in the study area shows an increasing trend, and the vegetation coverage in the study area shows a static state at a saturated stage, reaching the rebalancing of the natural environment. The greater the soil coverage is, the greater the vegetation coverage is, and there is a positive correlation between them.

4 DISCUSSION

The research on vegetation coverage and its accurate estimation has the following important significance:

(1) As the necessary basic data for the study, it provides basic data for the quantitative study of forest valleys such as ecology, water conservation, soil, water conservancy and plants, and ensures that the relevant research results and theoretical models are more scientific and credible;

(2) As an important indicator of ecosystem change, it can provide guidance for the study of frontier issues such as

regional or global land cover change and landscape differentiation, and promote the continuous development of the natural environment.

5 CONCLUSION

The data mining method of vegetation distribution in mineral resources area constructed in this paper mainly includes two steps: acquiring vegetation image and calculating the contribution rate of vegetation coverage. Corresponding decision tree classification model and sample training data are established firstly, determining the subdivision level of vegetation coverage in the study area, and estimating vegetation coverage using remote sensing information. The results show that the change of different ecosystem coverage of mineral assets resources is mainly affected by herbaceous vegetation.

However, although the spatial resolution limitation of remote sensing images has been improved by introducing decision tree algorithm, it is difficult to use thorn method for fine estimation of smaller local areas. If the estimation of vegetation distribution in mineral resources areas needs to be further improved, intervention of artificial forces is necessary to further improve its estimation accuracy and enhance the natural restoration ability of the environment to the greatest extent.

References

He BZ, Ding JL, Wang F, et al. (2017) Research on data mining of salinization information based on phenological features. Journal of Ecology (9): 3133-3148.

Martire S, Mirabella N, Sala S (2018) Widening the perspective in greenhouse gas emissions accounting: The way forward for supporting climate and energy policies at municipal level. Journal of Cleaner Production 176:842-851.

Mohammed OW, Yanling G (2017) Yearly energetic and exergetic performance of solar absorption refrigeration system in the region of northern Sudan. International Energy Journal 17 (3):141-154.

Ren XW (2018) Application of geochemical data mining in gold prospecting and target optimization-A case study in Yushishan area, Gansu Province. Journal of Rocks 34 (11):61-70.

Su H, Li J, Chen XZ, et al. (2017) Remote sensing inversion of forest biomass in Fujian Province based on forest community and spectral curve differentiation. Journal of Ecology 37 (17):5742-5755.

Yu JD, Zheng M, Li P, et al. (2017) Geological data mining and evaluation of tight oil source rocks in Chang7 member of Dingbian-Qingyang area, Ordos Basin. Journal of Chengdu University of Technology (Natural Science Edition) 44 (4):478-488.

Yuan X, Liu Y (2019) Analysis of Vegetation Landscape Adjacency Characteristics based on Rural Wetland Ecosystem. Ekoloji 28 (UNSP e107360107):3207-3217.

Zhou M, Wu XC, Chang XJ, et al. (2017) Research on Automation Technology in Energy Saving and Emission reduction of Power Plant. Automation & Instrumentation (11):193-194.

Zhou YK, Liu JW (2018) Spatial-temporal characteristics analysis of vegetation phenology in Qinghai-Tibet Plateau based on MODIS NDVI and multi-methods. Remote sensing technology and applications 33 (3):112-124.