Land Information Extraction Based on Multi-temporal Remote Sensing Spectrum Character in Saline Alkali land Area of Jilin-Qian'an County

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ABSTRACT

In this paper, the typical saline-alkali soil in the western Songnen Plain is taken as the study area, and the spectral information of multi-temporal remote sensing images is extracted the spectral characteristics of various features in different months, and the classification is conducted according to the spectral curve characteristics of various features in different periods. The method is that the decision tree classification algorithm based on multi-temporal spectrum and phenological characteristics can effectively integrate multi-temporal and multi-spectral information, so as to overcome the defect of single-temporal image classification, and judge dry and paddy fields, light, moderate, severe saline alkali soil, alkali lake and other ground objects. The overall classification accuracy of target features is 76%, and the Kappa coefficient is 0.82. Among them, the classification effect is better for those with heavy saline-alkali soil, light to moderate saline- alkali soil, farmland (dry and paddy fields) and lakes. In the case of limited information in research area, we can get better classification results using spectrum character in multi-time image.

CCS CONCEPTS

• **Computing methodologies**; • **Computer graphics**; • **Image manipulation**; • **Image processing**;

KEYWORDS

Spectrum character, Multi-time remote sensing, Image land information extraction, Alkali soil

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1 INTRODUCTION

Land resources are the environmental conditions and basic means of production that human beings depend on for survival. To manage and use land resources well, we should not only grasp the quantity of land resources, but also know its quality condition [1]. With the increase of population, excessive reclamation and development of land by human beings have led to increasingly serious land degradation such as desertification, salinization and impoverishment, and the deterioration of ecological environment [2].

Northeast area in China is an important grain producing area, which is the guarantee of national food security. The transformation of saline-alkali soil is one of the important means to increase grain yield.

The saline-alkali land of Songnen Plain in western Jilin province is one of the three large areas of concentrated distribution of soda saline-alkali land in the world. Soil salt content is not high, containing sodium carbonate, sodium bicarbonate, PH value is very high, toxic to plants. There are more than 24 million mu of saline and alkaline land in the west of Jilin province. The salinized land in the west of Jilin province is relatively serious, and the degree of salinization is heavy and widely distributed, which restricts the sustainable and rapid development of local economy to a certain extent. At present, with the development of science and technology, we should not only see the negative side, but also regard it as a precious land resource. Therefore, it is necessary to investigate the land types and to understand the status of land use in the study area.

Different objects have different reflectance in respective bands, and the reflection curves of objects serve as the physical basis for interpretation and classification [3]. The study of soil spectral reflectance is the physical basis of soil remote sensing [4-6]. Peng Jie studied the regional heterogeneity of hyperspectral characteristics of salinized soil[9]. Zhao Zhenliang extracted salinization information from hyperspectral remote sensing images in Kuqa oasis[10].Multidimensional classification feature data set was used based on multi-temporal Landsat8 remote sensing image, through the different classification methods, extract the experimental area 11 kinds of land cover information and precision analysis in the Zhenlai County located in the one of the world's three largest saline-alkali soil by LI Xiangkun[11].

The study area is Qian 'an county in Jilin Province. Saline-alkali soil is mainly distributed in zonal chernozem soil zone. In the non-zonal soil, saline-alkali soil is mainly mixed with meadow soil, swamp soil and aeolian sand soil. All this makes it harder to classify. The spectral features are easy to obtain and directly reflect the features of ground features. Therefore, the reflectance spectral information of various ground objects and multi-temporal images are used to extract land use information in order to provide ideas for information extraction and dynamic monitoring of saline-alkali soil.

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Figure 1: Geographical Location of the Study Area.

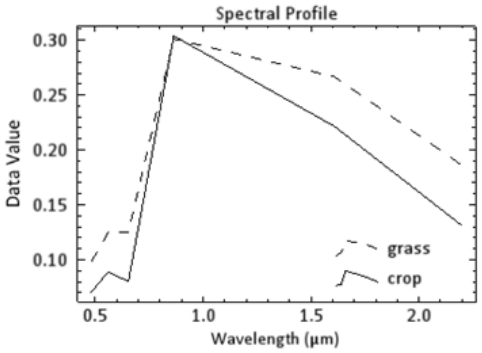

Figure 2: Reflectance Spectra of Crop and Grass.

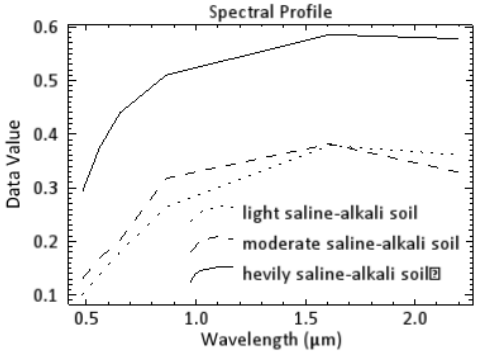

Figure 3: Reflectance Spectra of the Saline-alkali Soil.

2 STUDY AREA

Qian'an county, located in the northwest of Jilin province, west of Songyuan city, is located in east longitude 123°21'16"-124°22'50", north latitude 44°37'47"- 45°18'08". It is located in the south of confluence of Songhua River and Nenjiang river, belong to the second and third Songhua River terraces, the whole terrain flat, no mountains, hills and rivers. Saline-alkali soil is mainly interspersed in the zonal black calcium soil belt. In the non-zonal soil, saline-alkali soil is mainly distributed with meadow soil, swamp soil and wind-sand soil. All of these make classification more difficult. The study area is densely covered with lakes and vesicles, and these areas form the main salt accumulation areas (Figure 1).

3 DATA PREPROCESSING

When using multi-temporal images for remote sensing classification, radiometric correction and atmospheric correction are required for all images due to the differences in the performance of different sensors and the influence of imaging conditions and atmosphere. In order to reduce the differences between the images, the sensor radiation calibration and atmospheric correction were carried out on the images on June 22th, to obtain the surface reflectance image. The image is then used as a reference image, and the multiple iterative weighted automatic algorithm is used to process the radiation in the other images, and obtain the other time phase of the surface reflectance image.

Radiometric correction requires the image data format is BIL or BIP. But Landsat8 OLI image data format is BSQ, data format conversion must be performed first.

In the atmospheric correction, only some bands of the Landsat8 OLI are selected, so the position of the corresponding function of the spectrum corresponding to Landsat8 OLI should be manually set in the Multi-spectral Settings.

4 SPECTRAL CHARACTERISTICS OF GROUND OBJECT

4.1 Reflection

Different substances under the action of light, heat and so on will produce its own inherent characteristics of fixed wavelength electromagnetic wave radiation. The radiation and reflection ability of the object to electromagnetic wave changes with the wavelength, which makes various objects have different spectral characteristics under different circumstances. The characteristics of the object can be revealed according to the difference of the generated spectral signal. The reflectance spectrum of ground object is to study the law of the reflectance of ground object changing with wavelength.

It is usually represented by a curve in a two-dimensional geometric space. The abscissa represents the wavelength λ and the ordinate represents the reflectivity ρ.The spectral curve of the same object reflects the different reflectance of different bands, which is compared with the radiation data received by the corresponding band of remote sensing sensor, and the recognition law of remote sensing data and corresponding ground objects can be obtained.

The reflectance spectra of various ground objects were extracted and analyzed. Reflectance spectral curves of crops and grassland (Figure 2), and saline-alkali land (Figure 3), ground objects in the same place in different months (Figure 4).

5 FEATURE INFORMATION EXTRACTION

5.1 Feature Extraction of Surface Reflectance Spectrum

According to the longitude and latitude information of the sampling point in field investigation, the spectral information of the ground

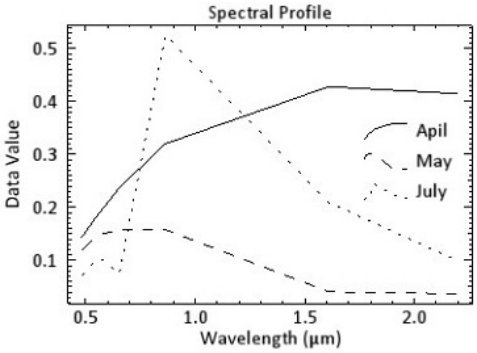

Figure 4: Reflectance Spectra of the Same Site.

object was obtained from Landsat 8 remote sensing image. Northeast in China has distinct four seasons and different crops have different characteristics in different seasons. Multi-temporal remote sensing is used to clearly identify some features of land features through remote sensing images in different seasons. For the features that are easy to misjudge and difficult to identify, spectral features and phenological features are combined with multi-temporal remote sensing images to distinguish them. For example, paddy fields and lakes, grasslands and farmland, etc.

The ground object spectral values of remote sensing images in April, May 22 and July were collected at the same place. It can be seen from Figure 4 that the spectral values of ground objects in the same place are different and greatly different at these three times.

It is difficult to distinguish the spectral characteristics of vegetation in remote sensing images of grassland and cultivated land in July. Grassland and cultivated land were distinguished by spectral curves, geographical locations, texture features, images in different seasons, and colors in standard false-color composite images (Figure 2).

The figure 3 shows the spectrum curve of typical light to heavy saline soil. The spectral curves of typical light and heavy saline-alkali soils are obviously different, and it is easy to distinguish. There are differences between light and moderate saline soils but there are areas of overlap.

5.2 Land Use Information Extraction

The decision tree classification based on expert knowledge is based on remote sensing image data and other spatial data. Through expert experience summary, simple mathematical statistics and induction methods, classification rules are obtained and remote sensing classification is carried out. The biggest feature of this classification method is the use of multi-source data. The basic idea is to dichotomy and refine the original data set step by step through some judgment conditions.

The classification of remote sensing satellite images is usually carried out with multispectral data. Spectral reflection of ground features is a comprehensive effect of various factors, and its characteristics are mainly determined by mineral composition, surface morphology, soil moisture, plant growth and other factors. Seasonal changes can lead to change in land cover, the season will cause interference to the extraction of saline-alkali soil information, and increase the difficulty of remote sensing change detection. The salt in the soil will dissolve in rainy season, and the spectral absorption characteristics of water not only directly affect the spectral characteristics of the soil, but also control the vertical movement of salt and the manifestation of physical and chemical properties. Therefore, rainy season affects the remote sensing information expression of saline-alkali soil. The newly grown green plants will increase the reflection value of the near infrared band, which will greatly interfere with the spectral information of soil, resulting in type confusion in classification.

According to the reflectance spectrum curves of various ground objects, the reflectance characteristics of various ground objects are obtained, and the discriminant functions or classification rules of various ground objects are formed. According to the rules, a decision tree algorithm based on multi-temporal spectrum and phenological characteristics was established, and the land use classification of Qian 'an county was carried out. For example, Comparing the reflectance spectra of crops and grasses, it can be seen that they can be distinguished in the visible and near infrared bands. A large number of spectral features are analyzed and the judgment rules are obtained through repeated calculation. Discrimination rules for grassland: (b4-b5) ge 0 and (b4-b5) le 0.03 and (b3-b1) ge 0.015. Discriminant rule of severe saline-alkali land:)b4/(b5-b6)(>12. The images in May and July were classified. In July, paddy fields and dry fields could not be distinguished, so paddy fields were extracted from images of May and treated with mask. The classification results were superimposed with images of July.

Finally, we used the images in July to extract the land use information Since paddy field and dry field could not be distinguished in July, remote sensing images in May were used to extract paddy field features in this study, and the classification results were superimposed on the final classification result map.

6 CONCLUSION AND DISCUSSION

The seasonal characteristics in northeast China, it is impossible to identify multiple land types from a single image. So multi-temporal image data is used in this study. The spectral characteristics of some features show different spectral features in different months. The study used images on May 22, when farmers had finished planting the some features are shown as the spectral characteristics of bare soil in April (Figure 4), while the same ground object are shown as the spectral characteristics of water on May 22 (Figure 4). In July, the spectral characteristics of the same features are shown as the characteristics of vegetation (Figure 4). Through the analysis of multi-temporal remote sensing images, there was basically no snow on the ground in April, and the land was all exposed. After a winter without any cultivation, the spectral characteristics showed as soil spectrum. At the end of May, rice seedlings were just planted, and the leaf area of rice seedlings was relatively small, so the spectrum of water was showed in the image the characteristics of vegetation was showed the same feature in July. The rice seedlings have grown tall and their branches and leaves can completely cover the water, so the spectral information of the feature reflects the vegetation. The surface features are in the shape of a grid and are relatively close to the water, so the surface features here are judged to be paddy fields. Paddy field, water area and dry land can be distinguished by

Table 1: Evaluation of Confusion Matrix

Class	Producer's Accuracy	User's Accuracy
Slight saline-alkali soil	78.81%	80.4%
Moderate saline -alkali soil	65.87%	66.53%
Heavy saline-alkali soil	82.81%	85.24%
Dry land	79.2%	80.4%
Town	81.41%	75.69%
water	91.33%	93.5%
Paddy field	86.01%	85%
Overall accuracy=76%		
Kappa 0.82		

comparative analysis of spectral characteristics of multi-temporal images.

There was a special spectral curve of a class of ground objects near alkali bubbles from July to September (Figure 2). In general, in the standard false color image, the vegetation color is red, but the color of such ground object is gray mixed with deep red. Although the spectral curve of the ground object reflects the characteristics of the vegetation spectral curve, it is not exactly the same with the vegetation. There is a small reflection in the green band (0.5613um) and an obvious steep slope in the near-infrared band (0.8646um), showing the spectral characteristics of the green vegetation. There was no significant downward trend. SWIR1 (1.609um) and SWIR2 (2.201um). The spectral curves of Figure 2 are quite different. In combination with the field band (0.8646um), showing the spectral characteristics of the green vegetation. There was no significant downward trend. SWIR1 (1.609um) and SWIR2 (2.201um). In combination with the field survey, some grass grew in July on the saline-alkali soil next to the alkali lake. However, due to the soil quality of the saline-alkali soil, the grass grew moderately and the color was relatively light. This kind of grass is halophytic or highly salt-tolerant. It can also be inferred that the soil is mildly or moderately saline.

Qian 'an county contains a large number of lakes containing salt, alkali, nitrate, iodine and so on. Although the composition of the lake is different, its spectral curve is generally not different, and it can be distinguished from other features by the near infrared band.

Heavily saline-alkali soil shows bright white, and its spectral reflectance of each band is significantly higher than that of farmland in multi-temporal remote sensing images.

Surface object spectrum curve features was analyzed in multi-temporal remote sensing images from April to October, and judged the types of surface object contained in the study area. Then, regularities were summarized to extract characteristics of typical surface object spectrum curve. The rules are summarized, the characteristics of typical spectral curves of ground objects are extracted, and finally the discriminant rules are formed. The discriminant rules are expressed in the mathematical expression form that can be recognized by ENVI software, and input into the classifier for image classification. This process is not completed at one time. After classification, the classification results are viewed through visual interpretation, and the spectrum curves of the ground features with unsatisfactory classification results are analyzed again, and the discrimination rules are modified. Visual interpretation and field investigation were used to evaluate the accuracy of classification through confusion matrix. The overall classification accuracy of target features is 76%, and the Kappa coefficient is 0.82. Among them, the classification effect is better for those with heavy saline-alkali soil, light to moderate saline- alkali soil, farmland (dry and paddy fields) and lakes (Table 1, Figure 5).

Through the analysis of multi-temporal remote sensing images, the types of features in different periods can be analyzed, which can't be achieved by one-stage images. In this study, the spectral information of multi-temporal Landsat 8 OLI remote sensing images was analyzed and the spectral characteristics of various features were extracted, and the classification was conducted according to the spectral curve characteristics of various objects. Light to moderate and severe saline soil can be judged by the growth of grass near alkali blistering, which provides a simple classification method for subsequent studies on saline soil. Especially in the case of limited information in the study area, the classification can be realized by spectral features. However, there is a misclassification of mild and moderate salinity in the study. At the same time, the terrain is flat with small ups and downs in the study area, so the

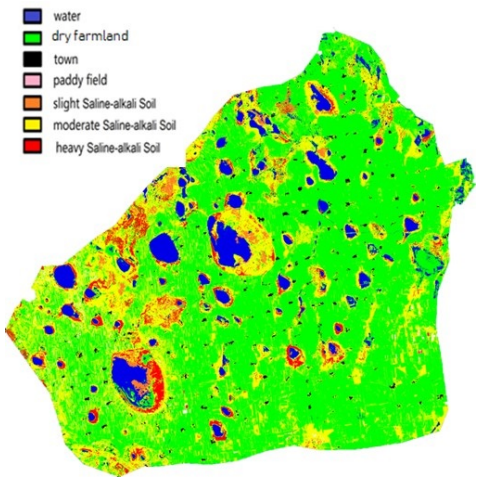

Figure 5: Classification Result Map.

topographic factors have little influence on classification. Other areas need to consider terrain.

The spectrum character is easy to get and have important meaning of dynamic detection research and feature extraction of alkali soil in large scale.

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