A Thesis on the Changes of Environmental Characteristics Based on Multi-Temporal Remote Sensing Imagery--The Case of Changbaishan Region

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Abstract: The multidimensional classification feature dataset produced by using multi-temporal remote sensing data can fully exploit the vegetation information in remote sensing images to improve the classification accuracy of the surface cover information. In this paper, for example, the Songnen Plain in Changbai Mountain Range, which is one of the saline-alkaline soil distribution areas, is utilized to extract 11 types of surface cover information in the experimental area through different classification methods using the multidimensional classification feature dataset produced by multi-temporal Landsat8 remote sensing data, and the accuracy comparison analysis is carried out.

Keywords: Multi-Temporal Remote Sensing Data; Multi-Dimensional Categorical Feature Dataset; Surface Cover

1. Introduction

Land use/land cover classification research has always been a core and hot area of global concern. With the rapid development of 3S technology, land cover classification on a global scale has been studied in depth, and rich experience in multi-scale land cover classification has been accumulated. The rapid development of 3S technology in recent years has greatly broadened the horizons of traditional remote sensing monitoring of surface ecology, advanced the research depth of conventional methods, and also shown the future development potential of 3S technology as a new type of monitoring means and approach. The development of remote sensing technology makes it possible to monitor changes in large regions and long time series. Spectral data provide a richer data source for surface vegetation related research.

2. Overview of the study area and data sources

The data used in this paper are Landsat8 image data from the Land Resources Satellite (LRS). The data were obtained from the U.S. Geological Survey (USGS) free data posted online (http://glovis.usgs.gov/). The data were acquired for the entire year from January through December 2022, and data with less than 10% cloud cover over the study area were selected as monthly values for each month. The data product level is labeled as L1T, which has undergone geometric correction for terrain involvement and can generally be used directly without geometric correction. The terrain of the study area is low and flat, and the sensor acquires the reflected radiation energy uniformly, so the atmospheric correction process is mainly carried out in this paper. The correction process is realized on the ENVI software platform, and the algorithm FLAASH atmospheric correction model. The auxiliary data are the current land use data of Northeast China in 2007 (Northeast Ecological and Geological Survey Project, No. 1212010911084) and the DEM 30m resolution digital elevation data products downloaded from the International Scientific Data Mirror website of the Chinese Academy of Sciences.

3. Research methodology

The variance is the maximum variance value of the semi-variance function, which has a clear physical meaning. Half-variance calculation requires a long time series, but multi-seasonal remote sensing classification can make full use of

the limited characteristics, the growth characteristics of different vegetation types are not the same, based on which to construct a multi-dimensional data space for the remote sensing classification and extraction of features, improve the classification accuracy and simplify the calculation method.

3.1 Determination of the classification system

In order to further analyze scientifically and reasonably, this paper combines the actual situation of the experimental area, and determines that the extracted land cover types are: water, wetland (mainly natural swamp wetland and beach with vegetation), alkali soak (perennial water without vegetation), saline alkaline land, sandy land, forested land, grassland, paddy land and dry land, construction land and other (including land with no or little vegetation), a total of 11 land cover types (6 primary land cover types and 5 secondary land cover types).

3.2 Multi-temporal land cover classification schemes

The program selects surface vegetation, water body and soil condition information as the main indicator factors, and calculates the half-variance and standardized variance of the NDVI dataset as the main extraction pathway for these indicator factors.

(1) Information on seasonal changes in surface vegetation. Call gstat and geoR program package on R language platform - dedicated to geostatistical analysis, write image-by-image metric calculation algorithm to analyze the half-variance of NDVI time-series data for 1-12 months, and extract the location of the peak point when it reaches the maximum value, and choose Gaussian function for fitting function, and compute the variance as a continuous change of the feature Characteristic information. (2) Spatial characterization information of surface vegetation. The local mean square deviation calculation of texture is based on the average value of NDVI in May-October 2022 (the growing season of the study area) in the study area, and taking into account the parameter settings in the neighboring calculations, the local mean square deviation algorithm is finally determined to be calculated according to the window of 3×3, and the calculation results are used as the reference variables of the classification data.

(3) Water body information. On the remote sensing software ERDAS platform, the water body index (NDWI) was obtained by standard deviation calculation. The water body information was obtained from the homologous satellite data from May to October 2022, and the river water in the test area was in the abundant water period, and the surface tributaries were full of water. The ratio of the green and near-infrared bands of Landsat8 imagery was used to construct the Normalized Difference Waterbody Index (NDWI). The water body information was used as the 3rd variable of the categorized data.

The correlation between bands was eliminated by principal component analysis to determine the feature classification categories, and the sample points were collected under the ENVI remote sensing software platform to train the sample area for supervised classification, and the classification algorithm used the support vector machine algorithm.

In this paper, the design of the land cover classification scheme of surface vegetation seasonal variation information combined with SVM is completed by constructing a multidimensional feature space classification dataset, and the specific process is shown in Figure 1.

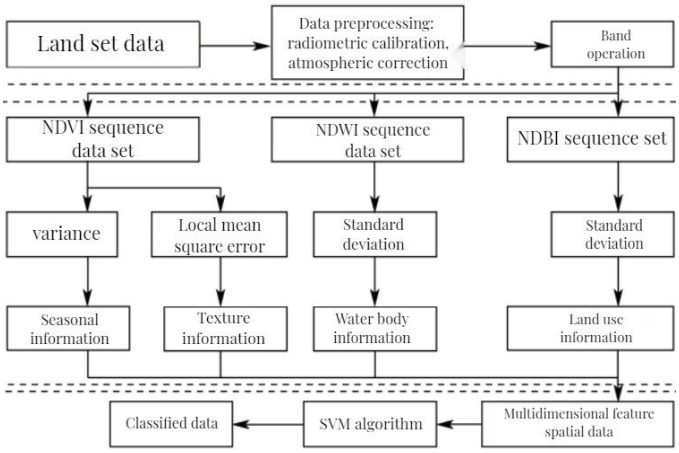

Fig. 1 Main flow of land cover type recognition algorithm

3.3 Selection of validation samples

The common methods of classification accuracy test are 2 methods of field survey and high-resolution image reference. In order to maximize the representativeness of the selected samples, the full text takes the 2018 Northeast land use status statistics as the main validation data, combined with auxiliary data (GoogleEarth high-resolution contemporaneous images). Various types of representative sample areas were selected on the remote sensing image map, and the selected samples were randomly divided into two parts: 70% for classification and 30% for accuracy evaluation.

4. Classification results and evaluation

4.1 Classification results

The program of this paper identifies a total land area of 5294.894km^2 participating in the classification, and extracts a total of 11 land cover types, including constant waters, marshes, mudflats, saline and alkaline land, wasteland and others, paddy fields, dry fields, forests, and grasslands.

Natural wetlands (mainly in the form of constant waters, marshes and Nenjiang River floodplains) account for 16.44% of the area; drylands are the main ecological landscape type of the Songnen Plain, and the existing area (22.30% of the total area of the county) is much larger than that of all the other land types. Paddy fields are mostly distributed in low-lying areas prone to waterlogging, and are the main artificial wetland type in the region; the main dryland farming areas are concentrated within the area south and north of Songnen Plain City, and are the most dominant form of farming in the study area.

4.2 Program analysis and evaluation

The confusable land cover types in the test area are determined by the size of separability between land classes. Specific realization process: OLI data B2-B5 + texture information combination data of the test area on the 191st day of 2022 (Resource Satellite Spectral Data (RSD) during the growth bloom period of the surface vegetation) were selected to calculate the separability size among land classes (land classes with JM distance less than 1.9 were identified as confusable), and finally, a total of 14 pairs of confusable land classes were identified, which involved 10 land classes in the test area.

The results show that the scheme has the following advantages in the remote sensing classification extraction of certain confusable land classes in the test area: 1) The land cover classification scheme with seasonal variation information of surface vegetation combined with SVM realizes the effective remote sensing classification extraction of the forest land (divisibility > 1.9, classification accuracy of 98.57%). The forest land and the surrounding crops have the same vegetation growth, but the climatic information of the forest land is much longer than that of the crops; 2) the dry land and the paddy field also have similar growth indices, and the classification based on the original waveband does not get the ideal

classification effect. This scheme improves the classification accuracy of paddy fields and drylands to 99.79% and 97.73% with separability >1.9 by combining the climatic information of the two, which differs by about 10 d, with the information of the water bodies in the test area; 3) The spectral information of beachlands and marshes is similar, and the scheme improves the classification accuracy of beachlands and marshes to 98.07% by means of the different vegetation growth periods and the degree of vegetation growth and prosperity of the two, 99.9%, with separability >1.9.

5. Conclusion

This paper constructs a multidimensional feature space dataset classification scheme. The main index factor is the seasonal change information of surface ecological factors extracted based on spatial statistical methods such as standard deviation and semi-variance function, and the introduction of a certain classification feature variable cannot improve the remote sensing extraction accuracy of all land cover types, but the introduction of surface vegetation seasonal information and land information can significantly improve the overall classification accuracy of land cover in the experimental area.

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