

THE RESEARCH ON DESERTIFICATION LAND EXTRACTION BASED ON OBJECT-ORIENTED METHOD

L. LI^a, A. H. WANG^a, Y. B. CHI^{a,b}, Z. Y. WANG^a

^aBeijing Landview Mapping Information Technology Co., Ltd, Beijing 100096 - lili@21stc.com.cn

^bInstitute of Remote Sensing Applications, Chinese Academy of Sciences, Beijing 100101

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ABSTRACT:

Land desertification has become a significant issue of economy and ecological environment in global area. In this paper, we have applied the object-oriented method to the research of Zhenglanqi basin and the West of Badain Jaran Desert which present obviously different characters of china. On the basis of the multi-spectral images of Beijing-1 in June and September in 2006, under the standard classification system of desertification land, the object-oriented method is performed in the desertification land extraction from mid-resolution images, and the classification precision is evaluated in contrast to the traditional classification methods. Through the field investigation data and the panchromatic Beijing-1 data with 4 meters spatial resolution, the result shows the overall precision is appraised and can respectively reach 94% and 92%.

1. INTRODUCTION

Desertification is land degradation characterized by wind erosion mainly resulted from the excessive human activities in arid, semiarid and parts of sub humid regions in the north China. Land desertification has become a serious economic and ecological problem around the world. China has become one of the countries where the land has been seriously decertified^[1-2].

Extraction of desertification land is based on monitoring and evaluating desertification. It is chief technology of monitoring desertification using remote sensing data. The traditional remote sensing data, such as TM image, MSS image and aerial photograph, has disadvantage of long revisit periods, different temporal and slowly receiving ability. The successful launch of the Beijing-1 microsatellite, with advantages of wider swath, short revisit periods and rapid receiving ability, is a new prior source of remote sensing data in monitoring countrywide desertification land with RS.

Recently, the method of desertification land extraction mainly involves visual interpretation or automatic classification based on pixels^[3-5]. The problem with this method lies in the disturbance from human beings and high labour intensity, but low efficiency. The method of object-oriented classification depends on spectrum characteristics and geometry and structure information, interpreting an image that is represented not only by single pixels, but also in meaningful image objects and their mutual relationships^[6]. Compared with the traditional pixel-based classification methods, it could improve classification precision, reduce large data redundancy, enrich the semantic information for classification and be convenient for human interpretation and understanding^[7].

With the support of the project that the desertification land extraction in China based on remote sensing, we analysis the distribution features of desertification in China and select Zhenglan banner and Badain Jaran Desert in the western edge as typical test areas according to the geomorphologic characterization, spectrum information, texture features and so on. On the basis it discusses the applicability and potential of

desertification land extraction based on object-oriented method using multi-spectral Beijing-1 data, also the precision is evaluated by comparison with the traditional classification methods.

2. THE STUDY AREA

According to the image features and geomorphologic characterization, the desertification land of china can be divided into the three areas: smooth terrain area which it has similar texture feature and different spectrum characters, Desert-Oasis ecotone which texture feature and spectrum characters are all different, mixing area including gobi, desert and low mountains which texture feature and spectrum characters are all similar. Because we can easily extract the desertification land based on analysis of different image features in Desert-Oasis ecotone, so the Zhenglan Banner area and the west edge of Badain Jaran Desert were selected and studied as smooth terrain area and mixing area respectively.

Zhenglan banner, which belongs to Xilin Gole steppe in Inner Mongolia, is located in Yinshan Mountain and the Hunshandake Sand land, longitude 41°10'~43°20'N, 110°20'~112°55'E, the total area is 10288 km², have three types geomorphology: sand dunes, low hill area and valley landform, are the meso-temperate dry continental monsoon, Annual Precipitation has been decreasing from southeast to northwest, which is concentrated in the summer and autumn season. There are abundant nature resources. The water system development is divided by Wuerqin mountain, and the sand continental river is located in north of Wuerqin mountain which is surrounded by lakes and many rivers like stars. The quality of water in southern exterior water system is good. In that area temperature is very high in summer, which has a favorable effect on grass growth, so livestock keeping is the main economic means in Zhenglan banner.

Badain Jaran Desert in the western edge across four countries, namely the Jita County, Ejin Banner, Alxa Right Banner, Gaotai county, longitude 99° 3'-100°10' E, 39°44'-40°28', the total area

of 7597.16 km², are the meso-temperate arid and extremely-arid climate, rainfall scarce, and are mostly concentrated in 6-8 months, only 40-80 mm of annual precipitation, and evaporation is 40-80 times more than precipitation. The eastern and southwestern edge of the desert, have the vast endless Gobi, Huadanlin of various shapes, wind Mogudan, cellular stone, wind Stonehenge, the Grand Canyon, and other landforms.

3. METHODOLOGY

This paper chiefly investigates the application potential of the object-oriented method in desertification land derived from multi-spectral Beijing-1 data in two different characters test areas, Figure1 shows the technologic process.

3.1 Data Processing

The multi-spectral Beijing-1 data with 32m is major remote sensing source on September 18, 2006 and June 16, 2006. Table1 shows main performance indices.

In the paper, Geometric and radiometric correction of the multi-spectral Beijing-1 images are performed by the 2000 TM data. The projection system is normal conic conformal projection with two standard meridians 25, 47 and central meridian 105. Finally, NDVI is calculated and applied.

Spectral range	Green band	520-600 nm
	Red band	630-690 nm
	Near - Infrared band	760-900 nm
Resolution	32meter	
Swath	600kilometer	
Revisit periods	3-5days	

Table1 The main performance indices of multispectral sensors Beijing-1

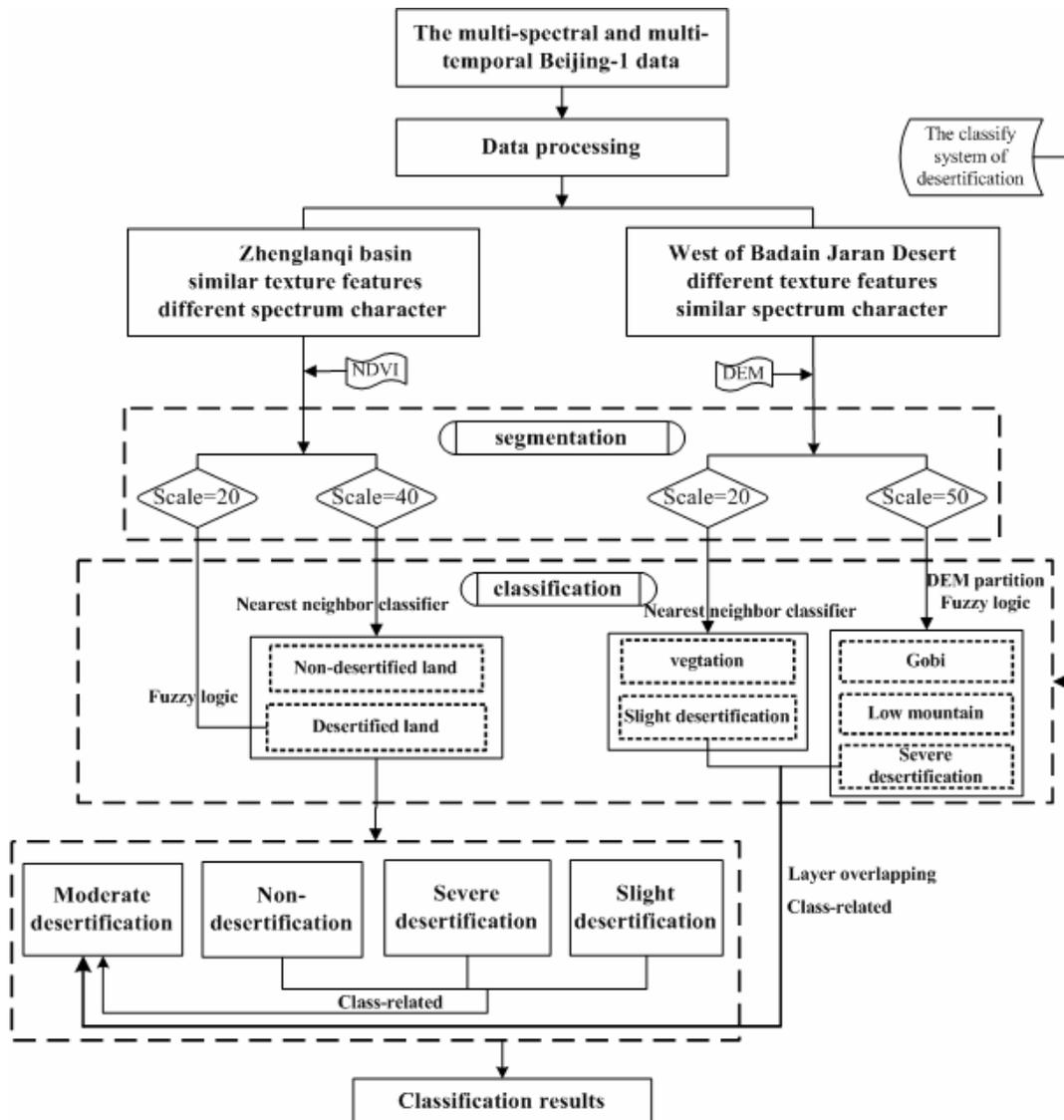


Figure1 The flow chart of technique

3.2 Segmentation

Scale is important for segmentation because it determines the maximum allowed heterogeneity of the objects and thus indirectly influences the precision of classification. We can segment the image to produce polygon objects with any scale by adjusting the scale and shape parameters. In order to get a

better segment objects, the paper has selected optimal scale based on different characters of two test areas.

The table2 shows the main parameters in two test areas.

The test area	scale	Weight value	Segment objects	
Zhenglan banner	20	Red band	1	Scattered distribution of the features and small area
		Green band		
	40	Near – Infrared band	0.5	Countious distribution of the features and large area
		NDVI band		
The west of Badain Jaran Desert	20	Red band	1	The edge of the Gobi and desert region
		Green band		
	50	Near – Infrared band	1	The inner of the Gobi and desert region
		DEM band		

Table2 The parameters of segmentation in two test areas

In Zhenglan banner, grassland and desertification land is alternate and distributed in a scattered way, if the scale is too small, the precision and work efficiency will be influenced, so the small scattered distribution should be segmented into independent objects and the same target from defferent spectrum should also be considered.

In the West of Badain Jaran Desert, Gobi, desert and low mountains are distributed widely and is only distinguished by their geometry and texture information because of similar spectrum characteristics. The selection of the scale in continuous distribution region is difficult due to shadow of mountains. When the scale is too large, the imitation degree of different type'boundary is poor ,but when the scale is too small, the precision is influenced by fragmented segment objects in inner desert caused by shadow. Finally, multi-scale segment is applied in the West of Badain Jaran Desert.

3.3 Classification

In contrast to traditional classification methods, the basic processing units of object-oriented classification are image objects or segments, rather than single pixels. It includes two methods: the nearest neighbor classification based on samples, the fuzzy logic through the establishment of member function category^[8]

Based on work done by our predecessors and remote sensing analysis consisted in classification system , the decertified land is divided according to surface morphology and vegetation fraction, and classified as: slight desertification, moderate desertification and severe desertification^[2-5].

The different classification method is applied to different levels of two test areas based on the characters of various types. The figure2-4 shows the analysis of image features.

(1) The difficult of classification lies in distinguishing crushed patches in in Zhenglan banner. The figure3 shows that the slight desertification is easily mixed with vegetation because of similar spectrum information, the figure2 shows that the value of feature spaces of moderate desertification is between slight and severe that the critical values is close, so the moderate desertification ,saline land and severe desertification near lake weren't extracted according to samples method.

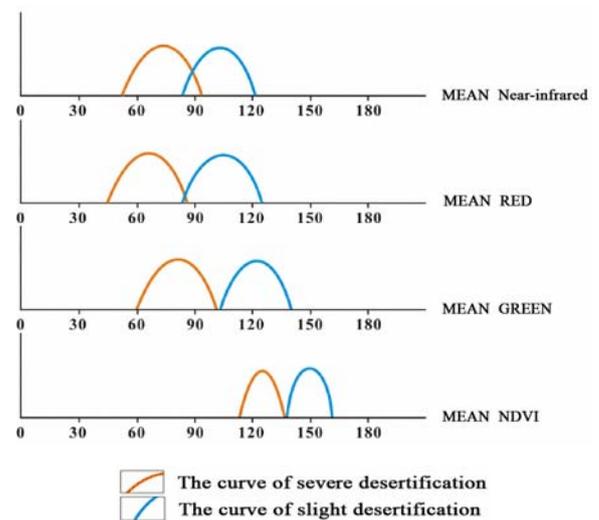


Figure2 The comparison with DN of severe and slight desertification

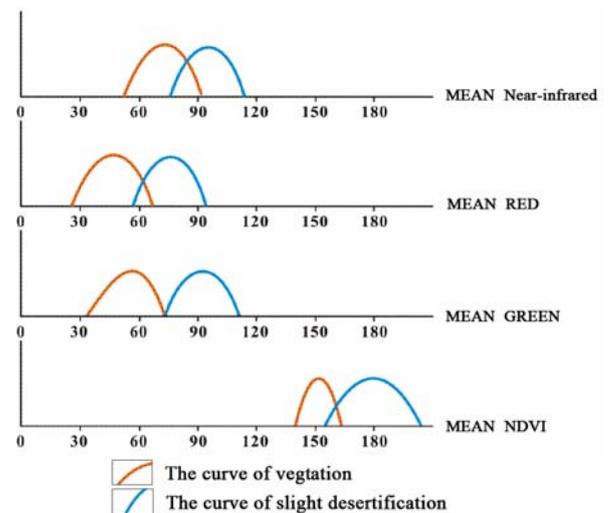


Figure3 The comparison with DN of vegetation and slight desertification

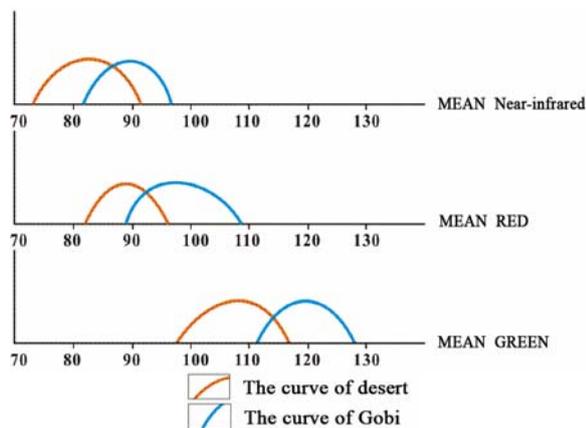


Figure4 The comparison with DN of desert and Gobi

(2) The key to classification of the West of Badain Jaran Desert is how to distinguish Gobi, low mountains and Desert. The figure4 shows the cases. Considering the different characters which desert is wavy and Gobi is smooth, texture feature is used to extract indexes.

Through the analysis of spectrum and texture feature, we select the optimum methods to different areas.

In Zhenglan banner, firstly, the global scope is extracted by means of the nearest neighbor classify selecting samples as much as possible in level2. Secondly, through DNVI as an assisted band to classify, we take advantage of fuzzy logic extracting slight desertification and vegetation of fragment within the global scope in level1, meanwhile, using the class-related features and setting the distance function, the severe desertification and saline land were distinguished and the mixtures of moderate desertification and others types were avoided.

In the West of Badain Jaran Desert, the first steps extracted the fragment of vegetation and slight desertification using the nearest neighbor classify in level1, and according to the rule of desert are generally higher than the ground, the test area is divided into three elevation regions by DEM and the types of Gobi, low mountain and desert were distinguished using partition fuzzy logic.

3.4 The post-classification

The post-classification is edit results of classification of different level in two test areas, including merge of level, merge of types, edge smoothing, editing attributes and so on.

4. ASSESSMENT AND ANALYSIS

Accuracy assessment is an indispensable step in the process of classification of remotely sensed data. On the basis of the field investigation data and the panchromatic Beijing-1 data with 4 meters spatial resolution, the overall precision is appraised and can respectively reach 94% and 92% in Zhenglanqi country and West of Badain Jaran Desert. Meanwhile, comparisons are also made between the object-oriented method and NDVI method and texture feature method, the result shows that the total precision of this new method is 7% higher than the NDVI method in Zhenglanqi country and 12% higher than the texture feature method in the west of Badain Jaran Desert. Besides, For the results of different grade desertification land of the three

methods, the precision of object-oriented method is better than the other two methods, especially the severe desertification land, avoiding the confusion with Saline-alkali land and Gobi.

Test area	NDVI	Texture	Object-oriented
Zhenglan Basin	0.87	0.56	0.94
The West of Badain Jaran Desert	0.45	0.80	0.92

Table3 The results of precision

The result shows the object-oriented method integrates the advantages of NDVI method and texture feature method, not only improving the classification precision, but also enhancing the level of automatization and intelligentization of remote sensing data process and application.

5. CONCLUSION

The object-oriented method in desertification land derived from multi-spectral Beijing-1 data in two typical areas is investigated, and compared with the traditional pixel-based classification methods, Finally the following conclusion can be drawn.

(1) The object-oriented method in desertification land derived from multi-spectral Beijing-1 data bringing into full play of the spectrum characteristics and texture features, and making full use of wider swath and rapid receiving ability of Beijing-1 microsatellite, Favorable to dynamic monitoring desertification land.

(2) The greatest advantage of the object-oriented method in desertification land is the multi-scale segmentation, through considering the spectrum and texture information, the different desertification land is segmented to separate object efficiently, avoiding to mixed with pixel-based classification and satisfying the precision requirement of scale.

(3) Through comparing the three methods, the object-oriented method integrates the advantage of NDVI and texture features method. Based on the results of segmentation and through reasonable setting the image segmentation parameters, a high classification precision has been achieved in different characteristic areas of china.

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