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Multi Temporal GF-1 WFV Remote Sensing Data Monitoring of Forest Resources in Mount Tai

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Abstract: Compared with the traditional investigation method of forest resources, the remote-sensing technique has many merits as to be macroscopic, dynamic, quick, time-saving and so on. This article, extracted information of the Mount Tai forestry resources by using the Mount Tai phantom gained in January, April, July and September,2020 taken by GF-1 satellite 16m resolution multispectral camera (WFV), and did the comparative analysis with the on-the-spot investigation data (the geographic information system management statistics). A conclusion is reached that GF-1 WFV data has precise reliability in the classification between forest resources and other features in Mount Tai, especially with the advancement of civil technology of GF-1 satellite and the further study of the image process method, the GF-1 remote-sensing data will play more roles in investigating, monitoring, managing as well as in the consisting progress of traveling in forestry resources in Mount Tai.

Keywords: GF-1 WFV; Mount Tai; Forest Resources; Information Extraction

1. Introduction

Mount Tai is located in the middle of Shandong Province, between 116 ° 02 'and 117 ° 59' east longitude and 35 ° 38 'to 36 ° 28' north latitude. It has a superior geographical location and spans Tai'an and Jinan. It is a world cultural and natural heritage, a World Geopark, a national key scenic spot and a national demonstration forest park. Mount Tai not only has magnificent natural landscape, precious and rich cultural relics, but also has high plant species diversity. The forest resources of Mount Tai not only have high protection value, but also have high tourism landscape value, which has become a new capital for Mount Tai scenic spot to attract tourists [1].

Using multi-source, multi temporal and multi-resolution satellite remote sensing images to realize the automatic extraction and classification of remote sensing information and achieve the dynamic change monitoring of resources and environment has become one of the main trends in the wide research and application of spatial information technology [2].

GF-1 satellite is the first satellite in the major special space-based system of the national high-resolution earth observation system[3]. Using the latest GF-1 WFV data is representative and popularized for the investigation, analysis, evaluation, management and tourism of Mount Tai, which is the one of the famous mountains with dual Heritage identity .

2. Data acquisition

2.1 Remote sensing image data

The multi-spectral sensor of GF-1 satellite has two types of cameras, namely "GF camera PMS", which is composed of two cameras, PMS1 and PMS2, with a spatial resolution of 8m; "Wide camera WFV" is composed of four cameras, wfv1, wfv2, wfv3 and wfv4. At the same time, the imaging width can reach about 800km and the spatial resolution is 16m.

The data used in the experiment in this paper are the remote sensing images of GF-1 WFV camera launched by GF-1 satellite on April 26, 2013 in January (winter), April (spring), July (summer) and October (Autumn) of 2020. The image spatial resolution is 16m, the image quality is good, the vegetation information is rich, and the cloud amount of each image meets the project requirements, which is suitable for studying the changes of forest resources in Mount Tai, WGS-84

projection coordinate system is adopted, and the data products have been geometrically corrected by the system.

2.2 Field survey data

In order to facilitate the comparison, analysis and evaluation of the experimental results, according to the field survey data provided by the Management Committee of Mount Tai Scenic Spot, the map browsing data and attribute statistical data in ArcGIS format of GIS are established.

Forest area of Mount Tai is divided into 12 management areas such as Hongmen, Zhongtianmen, Nantianmen. It is divided into 110 forest classes and 1518 small classes. 20 information investigations and statistics such as area, stand composition, sea elevation, slope and slope position are made for each small class

2.3 Other spatial data

In addition to GF-1 WFV image and ArcGIS data, 1:50000 forest resources map of early forest area of Mount Tai farm, 1:5000 forest facies map of scenic spots, and relevant yearbook data were also collected.

3. Data processing

Due to the limitations of space, spectrum, time and radiation resolution of remote sensing system, the image can only be applied after a series of processing.

3.1 Radiometric calibration and atmospheric correction

Based on the remote sensing image processing system ENVI, this paper mainly carries out radiometric calibration and atmospheric correction for the remote sensing image of Taishan area, and obtains the real physical model parameters such as surface reflectance, emissivity and surface temperature for later application.

3.2 Study area clipping

There are 12 management areas in forest area of Mount Tai, and 10 are directly under the management of Mount Tai scenic spot management committee, of which Lingyan temple and the great wall are under the management of the other party. In order to facilitate the research, the boundary documents of the scenic spot are used to cut the research area

4. Forestry resource information extraction

There are two main methods of remote sensing image interpretation: one is visual interpretation, the other is computer interpretation. Due to the low resolution of GF-1 WFV image, fuzzy interpretation marks, great influence of human factors on visual interpretation and low interpretation accuracy, this study mainly uses computer interpretation for image classification and other applications, with visual interpretation as the auxiliary for evaluation.

Computer classification mainly includes supervised classification and unsupervised classification. Experience shows that although unsupervised classification is fast and has few human factors, the classification accuracy of supervised classification is higher than that of unsupervised classification. Of course, the difference of researchers' experience also has a great impact on the classification accuracy. This study uses supervised classification on the basis of experiment.

4.1 Classification template definition and accuracy evaluation

Supervised classification is to select the feature parameters according to the training samples, establish the discriminant function, and then classify the pixels to be classified, so the selection of training samples is very important. In order to facilitate the selection and research of training samples, it is comprehensively determined into five sub categories, namely forest, bare land, snow, water body and buildings. Among them, snow only appears on the image in January (winter) and is classified separately. After the classification category is determined, the training samples can be selected and the classification template can be established with the support of ENVI.

The statistical distance between categories is converted into transformed divergence to measure the separability of training samples.According to the sample separation report, the maximum separation degree of these five types of ground objects is 2.000, and the minimum value is 1.9457 between forest and bare land in July. According to the requirements, the separation degree is between 1.8-2.0, indicating that the samples have good separability and are qualified samples. The

resolution of image samples in the fourth phase of this experiment meets the accuracy requirements, and the samples are available.

4.2 Supervise the implementation of classification and accuracy evaluation

After the training samples are established and evaluated to be qualified, the classification can be implemented. The common classifiers for supervised classification include parallelepiped, minimum distance, Markov distance, maximum likelihood, neural network, support vector machine, etc. based on the experiment, this paper chooses to use support vector machine to perform supervised classification.

Classification accuracy evaluation is to compare the specific pixels in the thematic classification image with the reference pixels of known classification to evaluate the classification results. In this paper, the confusion matrix method is used to evaluate the classification accuracy with the overall accuracy and kappa coefficient. As shown in Table 1, the classification accuracy highly meets the requirements.

Table 1 Overall accuracy and Kappa coefficient

Evaluating indicator	January	April	July	October
Overall accuracy	94.1019	90.6250	93.6471	93.2292
Kappa	0.9256	0.8732	0.9021	0.9082

4.3 Classification results

The classification results of the four phases are shown in Figure 1-4. The statistical results of each category are shown in Table 2.

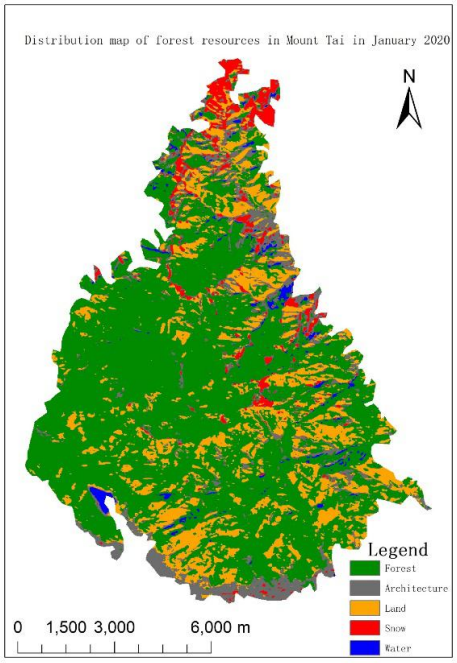

Fig. 1 Distribution of forest resources in Mount Tai in January

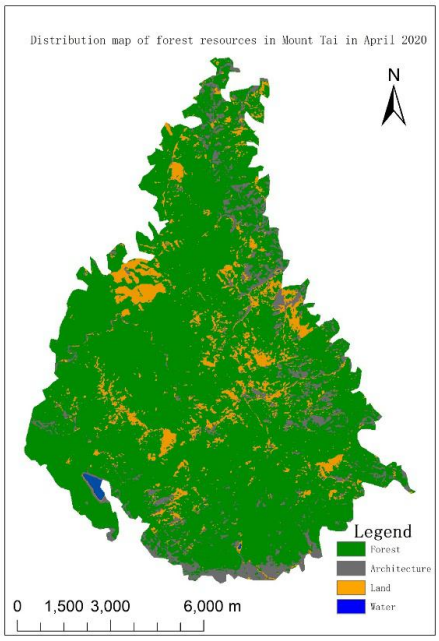

Fig. 2 distribution of forest resources in Mount Tai in April

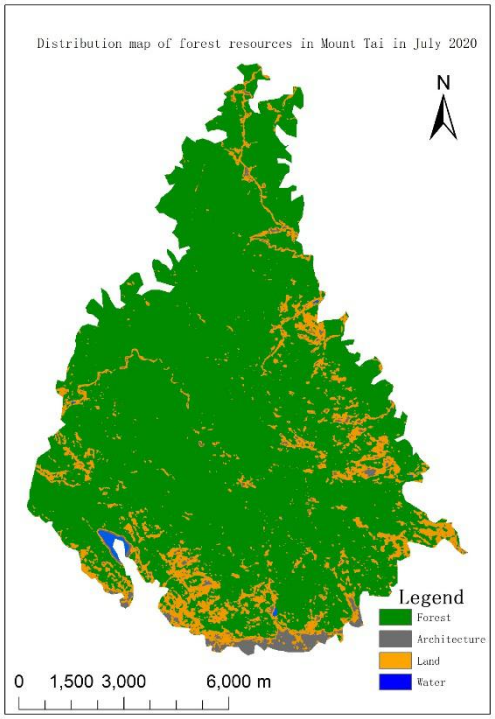

Figure 3 distribution of forest resources in Mount Tai in July

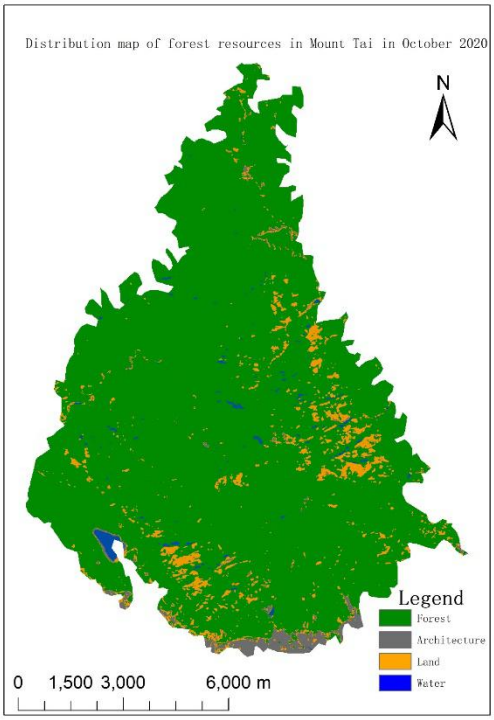

Figure 4 distribution of forest resources in Mount Tai in October

Table 2 land use type area of four phase images

Type	Area in January /hm²	Area in April /hm²	Area in July /hm²	Area in October /hm²
Forest	6945.6640	8927.2320	9242.2400	9906.9440
Water body	151.5008	29.5424	27.5456	87.1680
Architecture	1216.8960	863.1808	201.7024	215.6544
Naked	2041.9072	939.2384	1285.1968	551.5520
Snow	149.1200			
Forest coverage /%	64.5539	82.9730	85.9208	92.0607

5. Conclusion and discussion

Through the analysis of computer classification results and verification and comparison with field survey data, the following conclusions can be drawn:

（1）The forest area in the four phases is different, and the minimum in January is 6945.6640 hm²， The maximum in October is 9906.9440 hm²， The forest coverage rates are 64.5539%, 82.9730%, 85.9208% and 92.0607% respectively. According to the field survey data, the forest coverage rate of Mount Tai is 92%. Therefore, the classification results of 10 images are the most accurate, and the error is only 0.06%.

（2）In terms of season, January and April are cold winter and early spring. July and October are midsummer and late autumn, with lush branches and leaves, high spectral reflectance, high classification accuracy and good interpretation effect. It is the best time for remote sensing data to monitor forest resources.

（3）Because the spatial resolution of gf-1wfv image is only 16m, the effect of visual interpretation is not good. Higher resolution images or fusion processing with other high-resolution images can be used to improve the interpretation accuracy.

（4）From the above analysis, it can be seen that the application of gf-1wfv remote sensing data in the investigation of forest resources in Mount Tai is meaningful, and its application value is obvious. Especially with the improvement of image spatial

resolution, temporal resolution and spectral resolution, and with the in-depth study of image processing methods, gf-1wfv remote sensing data will play an increasingly important role in the investigation, monitoring, planning, management and tourism of forestry resources in Mount Tai and other famous mountains.

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