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Article 3: 3S Technology Application on Biodiversity Monitoring and Assessment/3S 技术在生物多样性监测与评价领域的应用研究（英文）

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Abstract

This article presents an improved method for the object-oriented classification of high-resolution remote sensing imagines, with Quickbirds imagines selected as an example of illustrating this methods, in combination with the application of GIS and GPS.

1.Introduction

The application of the object-oriented classification of high-resolution remote sensing imagines on biodiversity monitoring was summarized previously by Liu et al., (2014)[1]. However, the limitation of these cases was not discussed in article. This article aims to point out the main limitations of these cases and illustrate the improved methods for object-oriented classification of high-resolution remote sensing imagines, with further development on the GIS.

2.Remote Sensing

Chen etc [2] classified QuickBird remote sensing imagines for shrubs, crops, broadleaf forest and needle leaf forest on the basis of object-oriented and multi-level segmentation methods in HeiShiDing Nature Reserve of GuangDong Province. Compared with pixel-based method, the methods adopted by Chen etc resulted in higher accuracy of classification, more distinct boundary of classification and more internally uniform homogeneity [2]. However, the unsatisfactory accuracy (less than 40%) of classification in this research should be mainly attributed to the absence of geometric precision correction of high resolution remote sensing image. Wang etc [3] used eCognition software to extract the dominant tree crown's information from Quickbird RS imagines, and the classification method of membership function was selected on the basis of three spectral characteristics (brightness, adjacent characteristic and asymmetry). The extracted tree crown's information was transformed into vector data, which facilitated statistical analysis on ArcGIS software [3]. However, the geometric precision correction has not been conducted in this research as well, possibly explaining part of inaccuracy of classification in this research. Long etc [4] adopted the object-oriented classification method by eCognition software for identifying wetland plant species in Natural Reserve of

HanShiQiao wetland of Beijing, according to the spectral characteristic analysis of SPOT5 imagines. Spectral characteristic of each plant species (Phragmites australis, Echinoch loacrusgallii and Nymphaea tetragona) was extracted and identified by field survey work; spectral correlation analysis of each plant species was conducted by SPSS software to identify the specific spectral band or combination of bands which reflected the most distinct difference between species; the weight of each spectral band was consequently determined for segmentation of remote sensing images step in eCognition; as to compare with object-oriented classification without spectral analysis, spectral analysis played a essential role in the improvement of object-oriented classification accuracy [4]. However, compared with Wang etc [3], three spectral characteristics (brightness, adjacent characteristic and asymmetry) have not been considered in Long etc [9] research, which would be a deficiency due to lack of reflecting all spectral bands of high-resolution imagines, particularly for the more complex species composition in a national forest park. Additionally, in a forest park with complex topography, the extraction of spectral characteristics for each species should be sampled separately between sunshine and shading area.

There are five spectral characteristic criteria recommended for the membership function by this article, including the ratio characteristic (three bands for Quickbirds imagines): the ratio of each spectral band value to the sum value of all spectral bands; the brightness characteristic: the sum value of all spectral bands divided by the number of pixels in an object; the adjacent characteristic: the weighted average of brightness difference between an object and the adjacent objects [3].

Table 1. Multivariate cluster analysis is conducted on the basis of these parameters below for QuickBirds imagines (See PDF version below):

	Ratio Characteristic (band 1)	Ratio Characteristic (band 2)	Ratio Characteristic (band 3)	Brightness Characteristic	Adjacent Characteristic
Object 1	Value	Value	Value	Value	Value
Object 2	Value	Value	Value	Value	Value
.....	Value	Value	Value	Value	Value
.....	Value	Value	Value	Value	Value
Object n	Value	Value	Value	Value	Value

To estimate the value range of each spectral characteristic for membership function of eCognition software, multivariate cluster analysis on the basis of five spectral characteristic should be conducted for the differentiation among various plant species, with verification of each species (particularly to verify the boundary of spectral value range for each species) in the sampling work. The objects are classified as different species distribution by cluster analysis with field validation (Table 1).

3.Geographic Information System (GIS)
Multivariate cluster analysis on the basis of five spectral characteristic should be conducted by GIS, which also facilitates the calculation of distribution area of each species. By the way, the GIS does not only allows the Chemistry Transport Model (CTM) to incorporate for the assessment of climate change effect (e.g. Ozone depletion (UV-B radiation), or carbon balance) on the temporal and spatial dynamics of vegetation ecosystem [6], but also allows the numerical model, creatively presented in another article of this journal [9], to integrate for carbon sink calculation.

Particularly, the concentration of atmospheric carbon dioxide modeled by CTM would significantly influence the Light Use Efficiency (LUE) calculated by the atmospheric transmissivity. Atmospheric transmissivity is significantly determined by the atmospheric CO2 [7]. However, as discussed by Drayson [7], the inconsistence was reported between theoretical and experiment data, and the influence of absorbing gases with variable mixture ratio on atmospheric transmissivity was further found [8]. Consequently, the site-specific regression model of atmospheric transmissivity based on atmospheric CO2 concentration is advised to integrate into GIS, due to the geographic heterogeity of atmospheric chemistry. The theory of atmospheric transmissivity effects on the LUE would be that atmospheric transmissivity is the indicator of the proportional utilizable radiation waves received by canopy, and other part of light waves absorbed by atmospheric gases or reflected outside the atmosphere of this planet mainly contain non-utilizable radiation waves by most vegetation species (such as UV-B and Infrared).

4.Global Position System (GPS)
Geometric precision correction is to eliminate the geometric deformation of remote sensing images, resulting in the error of RS location which is less than 0.5 pixel of high-resolution RS. For the high-resolution RS images (e.g. Quickbirds RS with a resolution of 0.61m), the application of static differential Global Position System (GPS) with inaccuracy of ± 5mm is advantageous, compared with the expensive RKT GPS. The steps of geometric precision correction is specified by Wan et al., (2013) [5], which is essential not only to extract spectral information for object-oriented classification of RS imagines, but also to exactly select objects for verification of classification accuracy. In addition, the application of static differential GPS also provides supportive data for the correction of digital elevation of high-resolution RS, which becomes important for the calculation of drainage area in ecosystem, an element of assessment of ecological function for water conservation.

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