AVOIDING THE BLUE ROOF DATA DURING EXTRACTING VEGETATION FROM HIGH RESOLUTION IMAGES

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ABSTRACT:

The very high resolution multispectral satellites imagery, such as IKONOS and Quickbird satellite provides a level of detail compatible with urban mapping, it collect images which are a need to classify the land use and land cover in urban sites. Some methods have been developed to extract the information from these images. The texture algorithms for this test area represent the vegetation depend on Normalized Differences (ND), and Normalized Difference Vegetations Indices (NDVI). Global Environment Monitoring Index (GEMI) has been adopted to calcify the land cover in the study area while a new equation used to eliminate the non vegetation pixel such as blue roof, depend on the reflectance spectrum of items in the image. The study covers Nanjing, China. There are many blue roofs factory building, such as medicine factories and electronics workshops, and some houses. The case study for this test is located in Guluo district around the XuanWu Lake. The investigation shows that the urban vegetation cover in this district is distorted by the blue roofs, and considers how this can be then how it can be avoided.

1. INTRODUCTION

Multispectral sensors have a good advantage, over colour aerial photographs, for recording reflected light in the near infrared domain. Near infrared is the most sensitive spectral domain used to map vegetation canopy properties (Guyot 1990) and may improve the discrimination of vegetation communities. Automatic classification of digital images is traditionally employs a per-pixel approach, and thus mainly uses the spectral content of the images. This method is not well suited for very high-resolution images, especially in urban studies, which consist of a mosaic of small scale features made up of different materials (e.g. De Jong et al 2000, Hofmann 2001). As many urban or suburban land use features, such as roads, buildings, parking lots, and grasslands, are spectrally similar, spatial information such as texture and context must be exploited to produce more accurate maps (Shackelford and Davis 2003). The classical NDVI is useful for distinguishing between vegetated and non-vegetated surfaces if the hue of non-vegetated surfaces ranges from brown to red, while it fails completely if the hue is light green or light blue. So a modified NDVI (mNDVI) was developed for vegetation extraction using QuickBird data (Jianbo Hu, 2008) ， but the efficiency is not evaluated and application is limited by a lack of knowledge of spectral property of diverse artificial materials. This paper will develop a method to different and remove the blue hue at the roofs from that to the vegetation to give a more accurate description of the vegetation, using QuickBird imagery, and the case study is a part of Nanjing, China, which has two different historical building inside the city wall, and out of the wall, where we can see a new building with blue roofs colour.

2. STUDY AREA, AND DATA

The study area is located in the center of Nanjing around XuanWu Lake; and uses XuanWu Lake as the center, with a scope of approximately 25 square kilometer. The image was acquired by Quickbird sensor in 2007, with resolution 0.6 meter, and 4 spectrum bands, includes the blue (450-520nm), green (520-660nm), red (630-690nm), and the near infrared (760-900nm).

3. METHODOLOGY

The NDVI is the vegetation index most widely used for vegetation extraction (J. G. Lyon, D. Yuan, 1998). In this

Figure (1) Nanjing, the study area Xuan Wu lake asides in

research NDVI gives some confusion with blue roofs, while the vegetation index in the urban area surrounded the building as green belts or parks.

To evaluate the vegetation cover and the growth vigour in the urban and industrial zone, the blue roofs are affected by the vegetation extraction.

Other methods can be used such as the differential value vegetation index (DVI), ratio vegetation index (RVI) and vertical vegetation index (PVI) and so on, but affected by the same influence from the blue roofs. NDVI is sensitive to the green vegetation distribution, and also sensitive to the low density vegetation cover, commonly used in region and global vegetation condition research. It is defined in the formula:

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$$NDVI = (IR-R)/(IR+R) \quad (1)$$

As IR is the near infrared band and R is the red wave
When the NDVI was used the value to extract the green space shows a pseudo colour image, and the pattern value for NDVI was bigger than 0.2 .The green space spectral response reflection displays for the depth and brightness different blues on the false color synthesis image, causes the colour synthesis image the blue roofs mixed with the green space. But the roofs in the false image seems as a pink and light purple colour as in the figure (2).

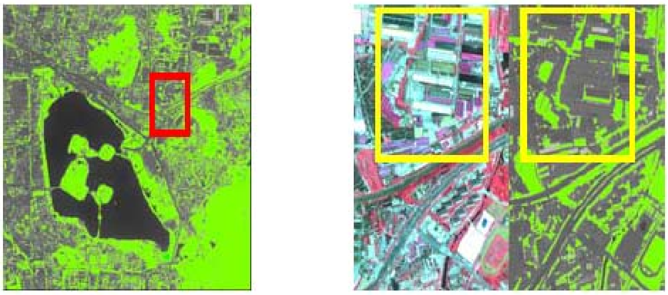


Figure (2) shows the roof in the false

The second methods used is the Global Environment Monitoring Index (GEMI) and is defined in the formula：

$$GEMI = \eta(1-0.25\eta)-(R-0.125)/(1-R) \quad (2)$$

As η defined in the formula:

$$\eta = [2(NIR^2 - R^2) + 1.5NIR + 0.5R]/(NIR + R + 0.5)$$

This paper uses the ERDAS9.1 software to make a modular model for this area GEMI index. The data transforms as commonly used 16bit, and uses the data type as the floating point. The blue roof information combines with the vegetation index and the green space information, so as to eliminate the blue roofs when all the wave are considered, because the vegetation index uses only used two spectrum bands the near-infrared and the red bands. We may consider that the green space and the blue roofs in the blue and the green bands the spectrum have different responses, and can further help to remove the blue roofs effect .Then ENVI software sampling was used, and considers for the roofs (1576 pixels) as in the blue colour, and for vegetation and green space (1795 pixels) as in the green colour sample. It shows that the blue colour curve indicates the blue roof to have higher spectral response than the vegetation in the blue band, as in Figure (3)：

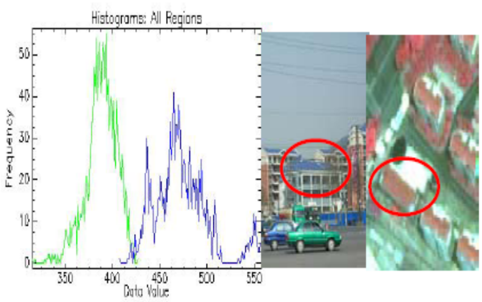


Figure (3) Sample in blue

The following curve shows the threshold value of 420 may be very good for vegetation and green space and eliminate the effect from the blue roofs. The maximum value for vegetation and green space is about 420, But the minimum approximately value for the blue roofs is bigger than 420 Figure (4).

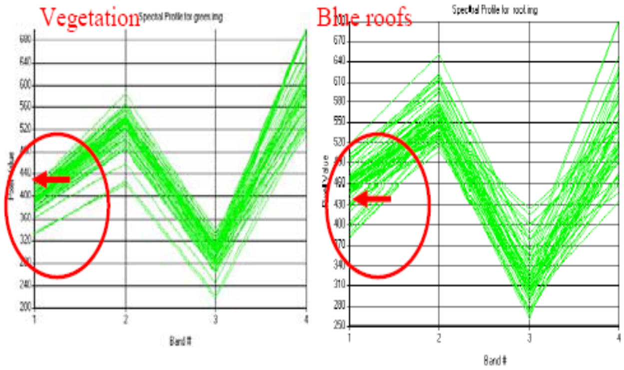


Figure (4) the vegetation and the blue roofs reflectance values

In this paper to get more accurate vegetation extraction using high spatial resolution imagery (HSRI), we have developed the GEMI methods with two steps to solve this distortion. The first step is extracting vegetation and confusing roofs effect together, and the second is to eliminate this blue roofs confusion then modify the equation MGEMI to provide the value of the blue band as a new parameter.

$$MGEMI = \eta(1-0.25\eta)-(R-0.125)/(1-R) \text{ and blue band} < 420 \quad (3)$$

eCognition Division extraction:

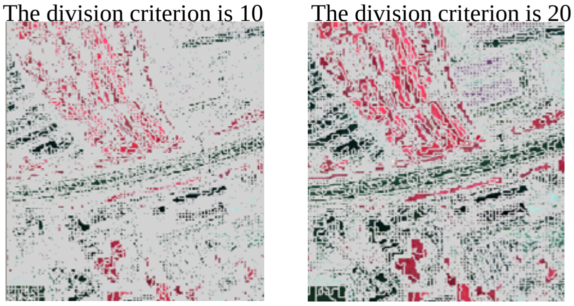
The original image has 4 bands, while the test image which is obtained by an overlap of eCognition software, and then the five bands participate in the division.

The test area uses many factors, such as a division criterion of 30, the color weight is 0.8, and shape weight is 0.2, also the evenness is 0.4, and compact is 0.6.After the division, the established green space and the non-green space form two categories, and defines five bands. The average values are taken from two category feature spaces; the small selection sample object uses the most standard close neighbours' taxonomic approach. The following figure shows the obtained classification.

The next images show the mask operation. We hold the original image and the division extraction result. After obtaining the preliminary green space extraction it seems that most of the effect of the blue roofs has been eliminated.
The images show the green area with very small affect of the blue roofs. This affects the test point and depends on the statistical analysis for the result. We calculated for each classified test point in eight neighbourhoods by clustering the area. The record of the region with the greatest value of the test point was merged the small test point of the neighbouring region using the elimination analysis.

4. RESULTS AND DISCUSSION

After clustering the rejection analysis for the image, the division result which was obtained when using the threshold value as



fragmentary, and produced some isolated points, break points,

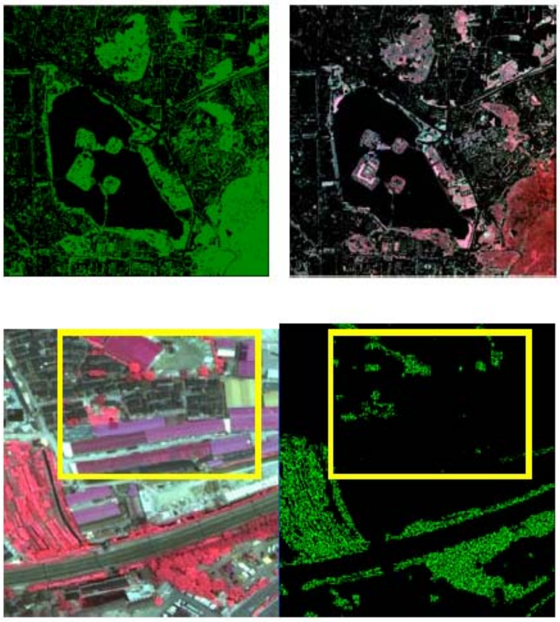


Figure (5) the mask image upper right, and the green space image upper lift, the green image after removing the blue roofs down

holes, and so on, the following statistics give adverse effects. For this reason needs the holes to be filled, the break point eliminate, and the isolated point removed, and so on. The mathematics morphology can maximize and retain the limit of the information and the noise elimination.

Quantification and statistical analysis
To carry on the quantification in this study we used ArcGIS9.2 software for the statistical green space area. According to this study plan, the test required a belt shaped green space with minimum area 100 m2, and the massive green space required minimum area of 200 m2, the statistical table is as follows：

request area	Block number	Smallest area （m2）	Smallest area （m2）	Total area （m2）
Research area	27798	0.722	13950800	24179804.690
The area is bigger than 100m2 the green space	2925	100.08	2309680	8998281.887

Table (1) show the result for green space

Ground landscape survey

The case study looked at typical ground landscape such as the water, lawn, forest land, workshop, roads, and buildings with blue roofs. This conforms to the area that is more than the open country, so that the investigation in the open country is relatively easy and the green space extraction confusion will not be affected by blue roofs .We have to provide the reference for the accurate extraction of green space information in the urban and sub urban areas.

The next figure shows the final products after the green image is located and mixed with the original image.

Figure (6) shows the test area after extracting the vegetation and avoiding the blue roofs

5. CONCLUSION

This research has demonstrated that vegetation in urban areas can be accurately extracted using multispectral remote sensing techniques. During the investigation two methods have been developed, the NDVI and GEMI, to obtain more accurate vegetation extraction in the urban environment using QuickBird imagery, and to try to deal with blue roofs confusion in order to avoid their affect when extracting the urban vegetation information, based on the spectral response reflection in the image for green space and the blue roofs.

Displays for the depth and brightness of different blues, results in the optical and original image of the blue roofs mixed with the green space. The roofs in the false image however seems as a pink and light purple.The original classification for vegetation categories successfully shows the request area can be extracted if it is about 100 m2, and it can discriminate the forests, exotic plantations, tree groups, mixed scrubs, pastures, grasslands, private gardens.

eCognition was efficient to automatically extracting patches of vegetation as small as 100 m2. In particular, small patches of private gardens were mapped with a high degree of accuracy in the residential areas. Variations of garden density across the area are evident.

The use of Quickbird images and the Modified Global Environment Monitoring Index (MGEMI), and classification techniques were encouraging in mapping vegetation communities in urban areas compared to the Global Environment Monitoring Index (GEMI).

The low (and decreasing) cost of fine resolution satellite imagery such as IKONOS Quickbird may motivate planning departments, with considerable time saved.

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