Study on examination of accuracy of natural environment assessment of satellite data using vegetation index and plant energy

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Abstract: The satellite remote sensing data is good in order to grasp the wide natural environment. The purpose of study is that it examines spectral reflection characteristic and vegetation index by the utilization of the plant energy (chlorophyll) for examining the reliability of satellite data and grasps the transition of the natural environment using the result. According to result of analysis, there were NDVI and mutual relationship on chlorophyll, and luminance compensation of NDVI was effective for all area. In vegetation transition, there were no luminance compensation and relation, and there was a decrease of vegetation in area in south and north. The reason was a result by the artificial and natural effect. This analysis is an effective method in order to confirm the change of specific vegetation.
Keywords: Satellite remote sensing data, Chlorophyll, Luminance, NDVI, Vegetation.

1. Introduction

Satellite remote sensing data is useful for the case in which environmental information of wide area is obtained. By the reason, it is utilized to many people as effective measures of grasp and evaluation of vegetation environment.

With the existing research, Kuwahara(1998) grasped the index characteristics using three vegetation indexes. Choi(2002) extracted vegetation information from satellite information using vegetation index, and the relationship between it and geographic information was analyzed. Research using vegetation index, there are many vegetation index's comparison and environment analysis.

At present, utilized vegetation index together shows vegetation vitality and biomass information. It is necessary that the vegetation index image verifies the reliability in the reason actually. Though there is field study as an inspection method, quantification is difficult, because the measured value fluctuates by distributions and landforms of vegetation, etc..

In this study, plant energy(chlorophyll quantity) and experimental verification on reflection spectroscopy characteristics and image processing(luminance compensation) are carried out for examine reliability of satellite data. Transition of natural environment was examined using its analysis.

Next is concrete content.

(1)Measurement of the chlorophyll quantity and measurement of the reflected light.

(2)Vegetation index's verification by (1).

(3)Verification of luminance compensation effect by vegetation index.

(4)Preparation of Vegetation transition figure.

2. Analysis of vegetation and satellite data

1) Study area and satellite data

Study area is around Ibaraki pref. Hitachi city in Japan, and it is shown in Fig.1.

Satellite image of NDVI which classified 3 in the picking spot selection of the leaf was used.

□Selection standard of spot is three.

□Accurately corresponding to field.

□Spot without land cover change.

□Spot of equal vegetation percentage.

Spot selected 4 places which satisfied three conditions. (Fig.2)

(1)Forest area

(2)Site with the land change

(3)Planting forest

(4)Site with many rock mass

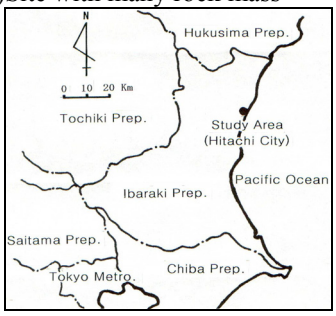

Fig.1 Location of Study Area

Fig. 2 Investigation Point

Satellite data utilized Landsat TM data of RESTEC of Japan.

2) Vegetation index.

Vegetation index absorbs solar light in chlorophyll visible region, and in near infrared area, features of showing reflection resistant are utilized.
NDVI(Normalized Differential Vegetation Index) shows existence and distribution density of vegetation.
Next showed vegetation index (NDVI).

NDVI=(Bm x － Bmn)/(Bmx+Bmn)

Bmx : near infrared region （Band 4）

Bmn : visible region （Band 2, 3）

3) Chlorophyll measurement.

The measurement by chlorophyll gauge did measuring point considering shape of leaf with three. Picking of leaf was supposed to be same of color and form.
The tree is Alnus sieboldiana which is abounding in Hitachi city.
Picking of leaf did 2 times in October and November 2000.
□2000.10.30 (daily mean temperature : 12.7 ℃, fine)
□2000.11.4 (daily mean temperature : 14.5 ℃, fine)
Collection position was made to be equal spot of height, south direction and sunshine condition. Quantity of leaf was done at each 10 sheets.
Chlorophyll value of leaf of the 10 sheets was averaged, and it was made to be chlorophyll value of each investigation spot.
Measurement result is shown in Fig.3.

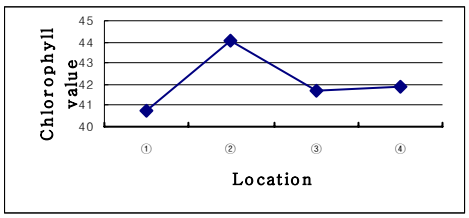

Fig.3 Chlorophyll Velue of Field Point

4) Spectral reflection measurement.

In light reflected from object, there is a characteristic property, and reflection percentage is written with ' reflectivity ' or ' reflection characteristic '. Reflection characteristic of each wavelength range shows ' spectral reflectance '. ' reflection characteristic ' is described with ' spectral reflection characteristic '.
Spectrometer was used, when mutual relationship of reflected light and chlorophyll value was examined.
Measurement utilized leaf for measurement of chlorophyll.

5) Verification of NDVI image

(1)Relationship between chlorophyll value and reflected light value
Mutual relationship of chlorophyll measuring result and measuring result of spectral reflection characteristic was examined.
According to the result, mutual relationship was obtained to both, and effectiveness was confirmed, when vegetation vitality was measured.

(2)Relationship between chlorophyll value and NDVI value
Mean value was calculated by extraction of satellite information (Band 4) and NDVI information. It was examined to mutual relationship with mean value and chlorophyll value of NDVI.
There was mutual relationship except for Location3, when 5 results were observed. Though it is estimation assumption from its result, satellite information can be utilized as data which grasps vegetation situation.

6) Luminance compensation

(1) Luminance calibration method
The sensor of the satellite receives slope and effect of the direction in order to measure the luminance reflected from the ground level of solar light.
Satellite information is photographed in the morning, and the south direction is bright, and the north-side slope tends to be dark.
Lambertan Reflectance Model of Colby(1991) was utilized as a luminance calibration method.

$BVn = VBob/\cos i$

BVn : Luminance value after compensation

VBob : Observed luminance value

Cos*i* : Incidence angle

(2) Verification of luminance compensation effect
For luminance compensation examination, luminance value of the region which receives effect of the shadow for the image of before and behind of luminance compensation and not receiving region was compared.
In result of analysis, it was confirmed that effect of luminance was generally small.
However, difference of luminance was big in sudden precipice division.(Fig.4)

7) Vegetation transition figure.

In this chapter, in making, vegetation index value to be a standard, vegetation transition assessment was done.

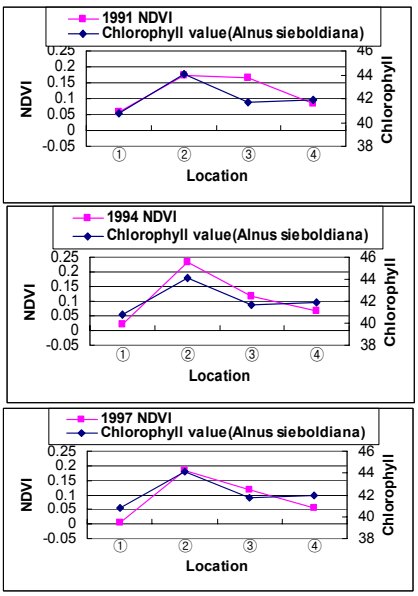

Fig. 4 Relationship Between NDVI and Chlorophyll

Vegetation transition figure is satellite information's image which analyzed vegetation vitality for observation fiscal year. (Fig.5)
Taking not had spot (park, golf course, etc.) of vegetation change as a standard, whole area was extracted in order to grasp vegetation change.
The image is transition assessment figure of vegetation.(Fig.6)
According to analysis of vegetation transition assessme nt figure, vegetation decrease of north and south was grasped regardless of existence of luminance compensation.
Especially, it was able to be confirmed that there was a quarry on southern area and that it decreases by effect.

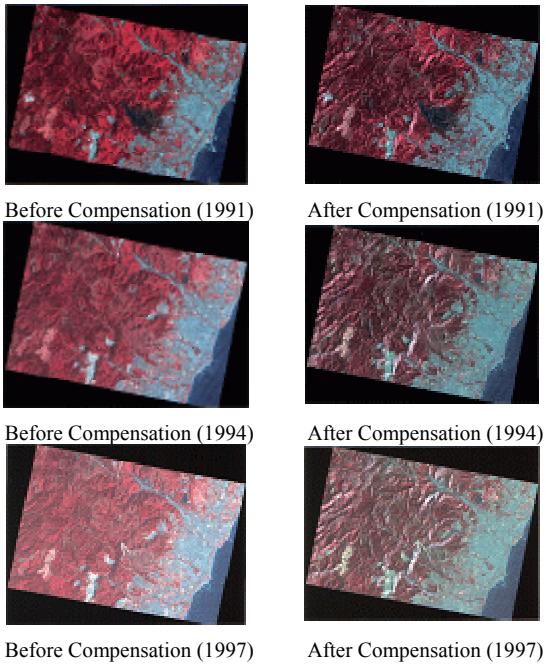

Fig. 5 luminance compensation

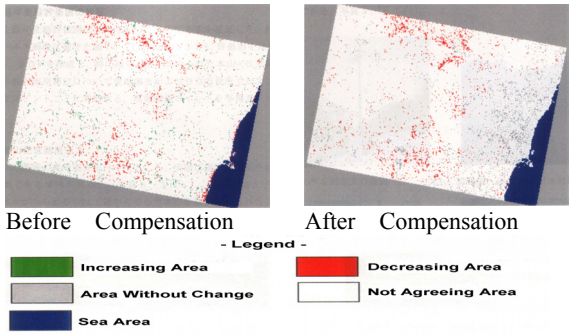

Fig. 6 Change Evaluation Figure of Vegetation

It can be grasped that decrease of vegetation generally progresses. Though it was not possible that Northern area investigated cause for forest site, it was able to be confirmed that vegetation decreases by some physical and natural effect.

3. Conclusions

This study carried out luminance compensation in order to raise vegetation index's verification and reliability using experiment and satellite information. Experimental verification and analysis are based on next, and they are got results.

(1)There are spectral reflection and mutual relationship on plant energy, and spectral reflection characteristic is effective for vegetation vitality measurement.
(2)There was mutual relationship between plant energy and NDVI.
(3)There was relation on luminance compensation with geomorphological factor and direction factor, and it was generally effective.
(4)Vegetational change also had except for artificial factor by natural factor.

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