Evaluation of shadow influence in NOAA AVHRR data

Dong-hee, Kim
CEReS Chiba University
1-33 Yayoi-chou Inage-ku Chiba-si Chiba-ken 263-8522, Japan
kdonghee@graduate.chiba-u.jp

Ryutaro Tateishi
CEReS Chiba University
1-33 Yayoi-chou Inage-ku Chiba-si Chiba-ken 263-8522, Japan
tateishi@ceres.cr.chiba-u.ac.jp

Javzandulam Tsend-Ayush
CEReS Chiba University
1-33 Yayoi-chou Inage-ku Chiba-si Chiba-ken 263-8522, Japan
javzaa@graduate.chiba-u.jp

Abstract: There is various problem in grasping change of vegetation by NDVI, PVI, etc.

It is very difficult especially to remove various noise ingredients in the received satellite data. Until now, it is difficult to compensate for shadow effect when NDVI is used in vegetation analysis.

The essence of this study is to describe data simulation and then applied the result to the NOAA AVHRR data.

When a pixel contains shadow more than 60% then this pixe1 is extracted for shadow effects on NDVI.

Keywords: vegetation, shadow, NOAA AVHRR, NDVI

1. Introduction

Various environmental problems in the earth are generated in many cases by human's social activity. In order to reduce the damage by such environmental problem, it is necessary to respond by predicting the change pattern of a natural phenomenon early more. Then, in order to grasp change of such land use, the land covering classification using the artificial satellite data which can observe a wide range area periodically is studied actively. Since vegetation shows the unique spectrum characteristic compared with other substances, if such the characteristic is used, it can presume the change pattern of land. For example, generally, although photosynthesis coloring matter absorbs an electromagnetic wave well in the wavelength belt of 300 to 500 nm, especially chlorophyll shows a high absorbs in the red wavelength (600 to 700 nm) which other coloring matter seldom absorbs. On the other hand, vegetation shows high reflectance in near infrared (800-1300nm). Thus, vegetation has an absorption belt and a reflective belt in visible and near red infrared, and reflectance is very large. Then, various methods of performing the monitoring of vegetation paying attention to the absorption wavelength region and reflective region of vegetation are proposed. However, there are various problems in grasping change of vegetation by NDVI, PVI, etc. It is very difficult especially to remove various noise ingredients in the received satellite data.

In NDVI used for analyzing change of vegetation especially until now, the compensation about the vegetation influence of such a shadow was difficult.

Then, necessity of the study of influences of shadow in NOAA (National Oceanic and Atmospheric Administration) AVHRR data (Advanced Very High Resolution Radiometer)

2. Analysis of spectral reflectance

In order to investigate the in influence of shadow on vegetation reflectance, contributions of cloud shadows is analyzed. The spectrum of dryness ground is also influenced by shadows. These influences were measured using the reflective meter..

Figure 1 shows the result of GTD survey.

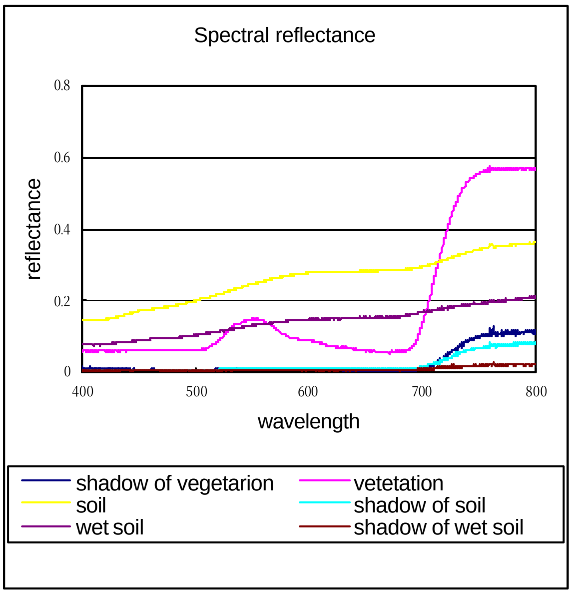

Figure 1. Spectral reflectance of GTD(Ground truth data)

1) Gradient Methods

A certain 1-pixel spectral reflectance p(?) in the pixel observed on wavelength ? is given by the following formula by spectral reflectance m(?) representing each category, when the influence of atmospheric can be disregarded.

$$p(l) = \sum_{j=1}^{k} a_j * m_j(l) \qquad (1)$$

$$\sum_{j=1}^{k} a_j = 1 \qquad (2)$$

$$a_j \geq 0 \qquad (3)$$

where, a and k is the area ratio and the number of categories which each category has within 1 pixel, respectively.

In this research, comparison of a shadow and vegetation was carried out based on gradient method.

$$R(l) = aRsl + (1-a)Rll \qquad (4)$$

where, a is an area ratio in a certain pixel.

Figure2 show is results of Gradient Method.

NDVI used for analyzing change of vegetation especially until now, the compensation about the vegetation influence of such shadow was difficult

NDVI = (Ch2-Ch1)/(Ch2+Ch1) (5)

where, ch1, ch2 is NOAA channel 1(0.58-0.68μm), channel 2(0.725-1.1μm)

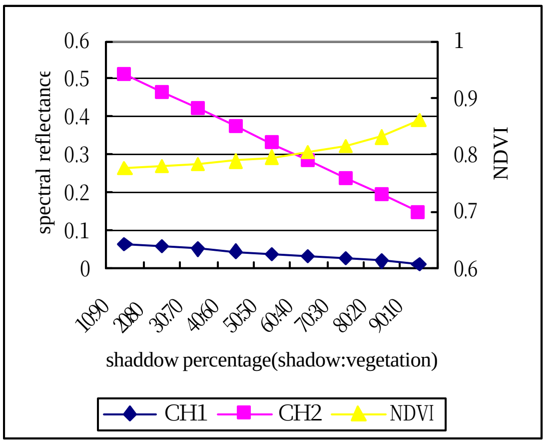

Figure 2. Vegetation and correlation of a shadow

In channel 1 as the shadow increases from to about 60% the spectral reflectance decreases from 0.05 to 0.01. In channel 2 the spectral reflectance decreases from 0.5 to 0.15. However, as its shadow increase in % the NDVI also increase.

3. Application using NOAA AVHRR data

In Chiba University, the data which will include Japan, and a part of South Korean, a part of China from 1998 is received.

This research, the influence of the shadow by clouds, it analysis the whole of Japan. In Japan, there is especially much influence of the shadow by the typhoon etc. from June to August. For example, figure 3 shows the 10day composite for August 1-10 1998 of sampling point near Gifu Prefecture shows that there is a shadow by clouds.

Using AVHRR color composite image show in figure 3, sample points were selected from shadow effect area and from no shadow effect area.

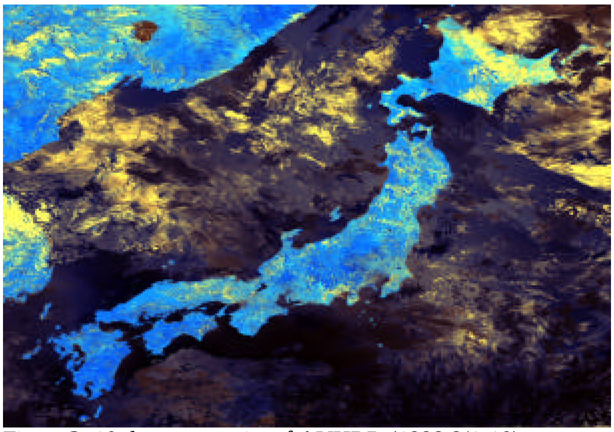

Figure 3. 10 day composite of AVHRR (1998 8/1-10)

The thickness of clouds is deep when the color is thick. RGB is ch1, ch2 and NDVI of NOAA AVHRR, respectively.

Figure 3 shows the NDVI Composite picture.

Figure 3 shows the one sample point 1 is not influenced by shadow, sample point 2 which is influenced by shadow chosen.

Figure 4 shows the land-cover map of Japan used for selecting sample points.

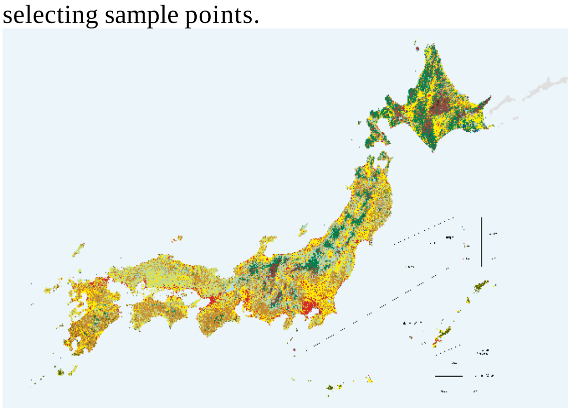

Figure 4. Land-cover map of Japan

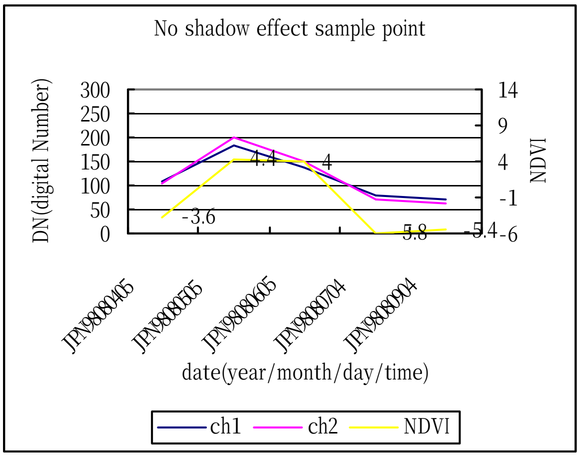

Figure 5. NO shadow effect of sample point1

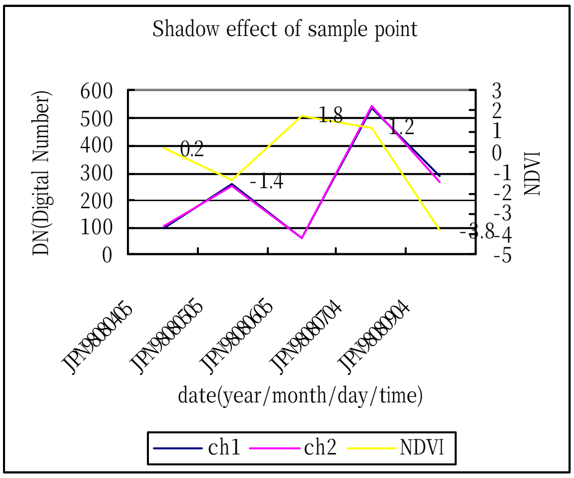

Figure 6. Shadow effect of sample point2

As shown in figure 6, NDVI value of the sample point 2 on August has a .shadow effect highest value due to the pixel of the sample point 2 has 60% or more shadow by the analysis of Gradient Method.

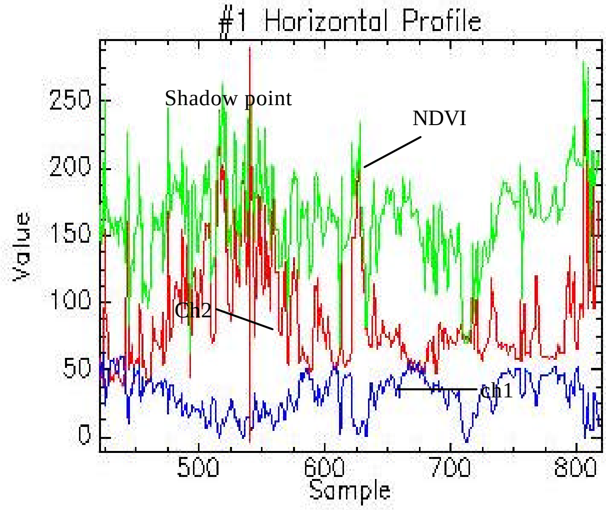

Figure 7. X-profile of sample point2

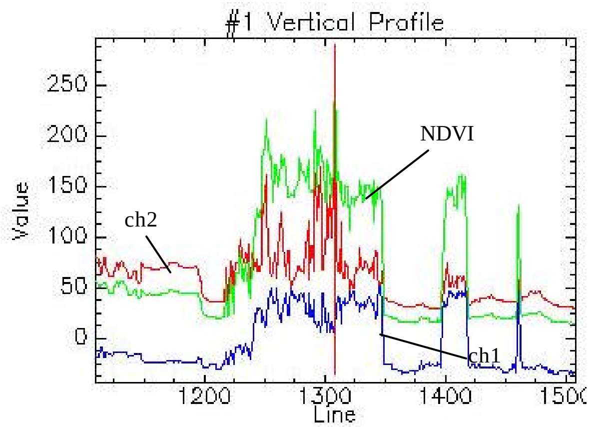

Figure 8. Y-profile of sample point2

Figure 7 and 8 show cross sections of digital number of channel 1, channel 2, and NDVI in X and Y directions, respectively, around the sample point 2.

The value of NDVI of shadow effected area around the sample point 2 is higher than other areas

Figure 9 shows the change for one year of sample point 2.

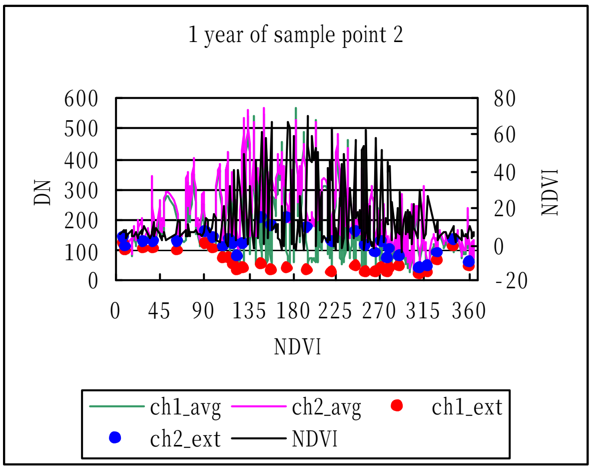

Figure 9. Change for one year of the sample point 2

4. Conclusions

Although the influence on the NOAA data due to shadow effects was investigated in this research covering change, have conventionally the possibility of carrying out the composite of the data with which the influence of a shadow remains as it is.

Based on the simulation a pixel effected by shadow more than 60% area of the pixel has high NDVI value

In order to solve the problem, it is suggested that before MVC is chosen analysis for the detection of influence of shadows should be carried out any other methods.

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