Change detection of typhoon damaged area using multitemporal Landsat/TM data

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Abstracts: It is very important to monitor change of a forest. We compare the different seasonal remote sensing data to detect forest damaged by typhoons and build a method to detect the area damaged by typhoons. Study site is located in western Oita prefecture. The multitemporal satellite dataset of this study were consisted of four Landsat TM scenes taken before and after the typhoons. As compared with non-damaged area, it was shown that the reflective characteristic of the damaged area becomes high by band 3, band 5, and band 7. These bands are effective in extracting the typhoon damaged area.
Keywards: typhoon, Landsat/TM, change detection

1. Introduction

One of the most valuable uses of remotely sensed imagery is for environmental monitoring including forest change. In Japan, one of the causes of forest change is the windfall tree by the typhoons.

Typhoons bring severe damage to agriculture or forestry and are also the factor which reduces not only economical damage but also management mind to forester. It is important to recognize the areas change vegetation condition because of restoration or forestry planning. Most of change detection techniques can be grouped into two general classes :(1) spectral categorization (classification) and (2) radiometric changing. Takao (1992) detected areas damaged by the typhoons by the image diffrencing method using MOS-1 MESSR band 2 (visible red band) data. Mukai et al. (2000) extracted typhoon damage area by maximum likelihood classification using the TM data of before and after damage, respectively. Maximum likelihood classification requires training area for categories. In order to actually use remote sensing, being simpler and a sub-automatic technique are required. The purpose of this study was to compare the different seasonal remote sensing data to detect forest damaged by typhoons and to build a method to detect the area damaged by typhoons.

2. Study Site and Data

Study site is located in western Oita prefecture. This area was attacked by typhoons twice in September 1991. Oita Prefecture is one of the areas where forestry is prosperous in Japan, and forest area occupies 72% of prefecture area.

The multitemporal satellite dataset of this study were consisted of four Landsat TM scenes taken before and after the typhoons; 27^{th} April, 1989(TM89), 8^{th} November, 1990(TM90), 13^{th} December, 1991(TM91), 21 May, 1992(TM92). The natural environment information GIS of the Environment Agency issue was used to extract a forest. As geographical feature information, the digital map 50m mesh (altitude) and the digital map 25000 of the Geographical Survey Institute issue were used. The aerial photographs were taken on October 7, 1991 and acquired by request of Oita prefecture office.

Digital image processing was performed using ERDAS IMAGINE8.6 software.

3. Methods

The Landsat TM images used in this study were geometrically corrected. In order to build a simple technique, atmospheric and topographic correction was not carried. The typhoons damaged area and the non-damaged area were selected, referring to aerial photographs taken just after typhoon striking. In case satellite data is used in the forest of the mountains ground, the topographical feature effect is a big problem. Even if it is the same land cover, apparent reflective intensity is changed by unevenness of geographical feature, or the difference in the irradiation situation of sunlight. Therefore cosine of effective solar incidence angle was used in order to take the geographical feature effect into consideration[2], cosi of the data used for analysis is a sample more than 0.7. Effective solar incidence angle is defined by the angle of sunlight and slope of the terrain surface. cos$i$ was computed by following equation(1). Solar zenith angle and solar azimuth angle established a certain coordinates, and calculated the value at the time of satellite data observation. The temporal response of the damaged area and the non-damaged area was compared about each band. The residual image of the band with which characteristics of damaged area and non-damaged area differs is created. The area which class is Japan cedar-cypress-Spanish mackerel community was extracted as a part of forest area using natural environment information GIS. ISODATA classification was performed using residual image in that forest area.

cos$i$=cosè$_s$ cosè$_n$+sinè$_s$ sinè$_n$ cos(ö$_s$-ö$_n$) (1)

i: effective solar incidence angle
è$_s$: solar zenith angle
è$_n$: slope of the terrain surface
ö$_s$: solar azimuth angle
ö$_n$: surface aspect angle

4. Results and Discussion

Fig.1 shows the characteristics of band 3, band 5,and band 7. It was shown by these bands that change of the damaged area and the non-damaged area after typhoons striking differs clearly in TM92. In the band 3, digital number of the damaged area was high compared with digital number of the non-damaged area. Generally, the refrectance of red is high as vegetation decreases. The thing with high digital number of the damaged area is because windfall trees were observed. Band 5 and band 7 as well as band 3 react to change of vegetation. Therefore, also in band 5 and band 7, there was a significant difference about digital number in the damaged area and the non-damaged area. The results indicated that the difference in digital number was caught in the damaged area and the non-damaged area. Compared with TM92, it would be difficult in TM91 to detect change of the vegetation by damage. This reason is reduction of the reflective intensity of the appearance which the fall of the irradiation conditions of sunlight causes.

Acknowledgement

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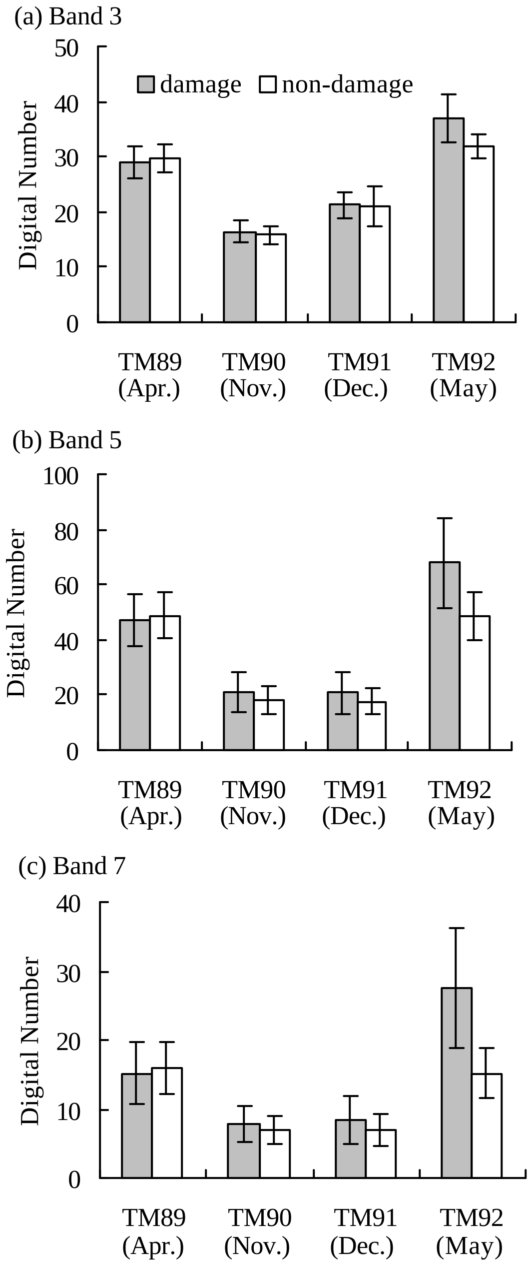

Fig.1 Temporal change of refrectance factor in (a)band 3, (b)band 5, and (c)band 7.