LAND DEGRADATION RISK MAPPING USING NOAA NDVI DATA

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Commission VII, Working Group 6

KEY WORDS: Land Degradation, NDVI, GVI, Land Cover, Vegetation, Global Data set

ABSTRACT :

Land degradation risk map was tried to be generated using NOAA 8k NDVI 10 days composite data set of 10 years from 1983 to 1992, and Global data set such as climate data, elevation data, and thematic maps. Before proceeding the time series analysis, the data quality was examined using the technique of moving average for 12 months(36 scenes). The quality of the NOAA 8km NDVI data was estimated as good enough to use for time series analysis with little data modification.
The fluctuation pattern of NDVI for several land cover type were defined from existing eco-regions map, and the map was resampled to low resolution to 8km resolution. In combination with the eco-region map with digital elevation data and precipitation data, soil erodability is checked. And eco-region classification map and vegetation degradation map shows the risk against the desertification, land degradation. The accuracy verification is not undertaken, however, the methodology can be applied to the LAC or GAC data set.

1. INTRODUCTION

Due to the increase of population pressure, climate change, etc., Land Degradation can be seen in many places on the earth. The importance for the assessment of land degradation and desertification by means of Remote Sensing technology is pointed out in Agenda-21, however, the methodology has not been established yet. In order to detect the land degradation using satellite imageries, an analysis is necessary with data which has high spatial resolution, and long observing period as possible. Data analysis, using the accumulated NOAA LAC(1km resolution) and GAC(4km resolution), are expected for global land cover change analysis. But we have to wait more some years until the compiled LAC and GAC data sets are distributed to us, and an advanced methodology and facilities should be developed for the management of such huge data sets volume.

At this moment, we can obtain NOAA complied data with 8km spatial resolution which includes daily data set as well as 10 days composite data set for more than 10 years observing period from 1981. The methodology by using rather long time series data set must be developed for global land cover change analysis. And it can be followed by a atudy using more high resolution data set such as GAC and LAC. As the basic analysis for long time series data set of NOAA data, this study aims following goal:
- to develop a methodology, which can be applied to LAC or GAC data set in the future, for the time series analysis on land degradation and vegetation degradation in continental scale as well as global scale, and
- to estimate the land degradation risk by monitoring long term land cover change using technology of GIS.

2. DATA

In this paper, 8km NDVI data of 10 days composite for 10 years from 1983 to 1992 which are distributed by NOAA are used to monitor the global vegetation degradation, and some GIS data such as average monthly temperature and precipitation data from Leemans and Cramer IIASA Climate data(30 minutes pixel resolution), Baily Ecoregions of Continents(10 minutes pixel resolution) and elevation data from GLOBE data set.

Before using 8km NDVI data for time series analysis, the data quality must be examined because the intensity of the NDVI is not same on the same vegetation conditions due to the differences of satellites(sensors), positions of sensor and so on. 10 points from the land of Japan were selected in order to examine the quality. Those are:
(a) Deciduous Conifer Forest Dominant area
(b) Deciduous Broad Leaf Forest area
(c) Rice Paddy Dominant area
(d) Urban Area
(e) Monsoon Evergreen Forest Dominant area

Fluctuation pattern of Figure-1 shows the NDVI fluctuation pattern for deciduous conifer forest in Hokkaido, Japan. Each curve for selected 5 points clearly demonstrate the characteristics of each land cover type, however there are some scattering points due to the climate variety and data error. To avoid such seasonal and annual data variety, moving average method are used to evaluate the tendency of the pattern as well as to examine the data quality. The moving average were calculated using one year data(36 scenes).

Figure-2 shows the moving average using 12 months for

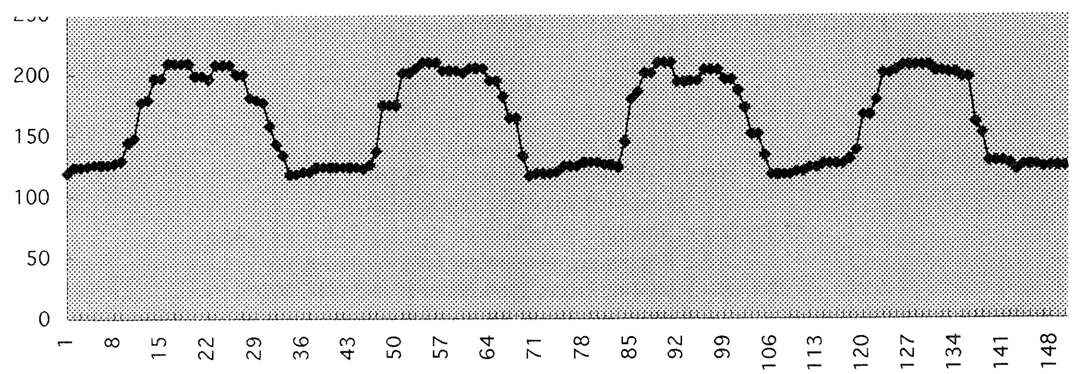

Figure-1 Fluctuation Pattern for Deciduous Conifer Forest area in Japan(sample)

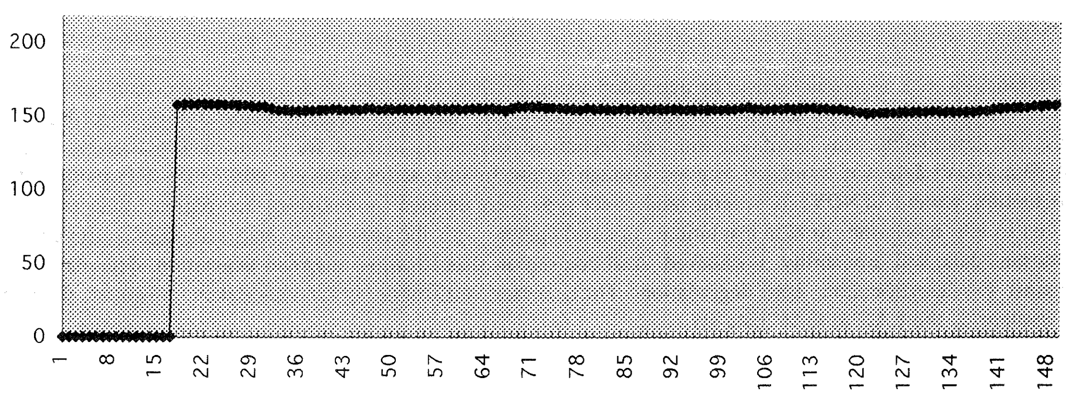

Figure-2 Moving average using 12 months for Deciduous Conifer Forest area in Japan(sample)

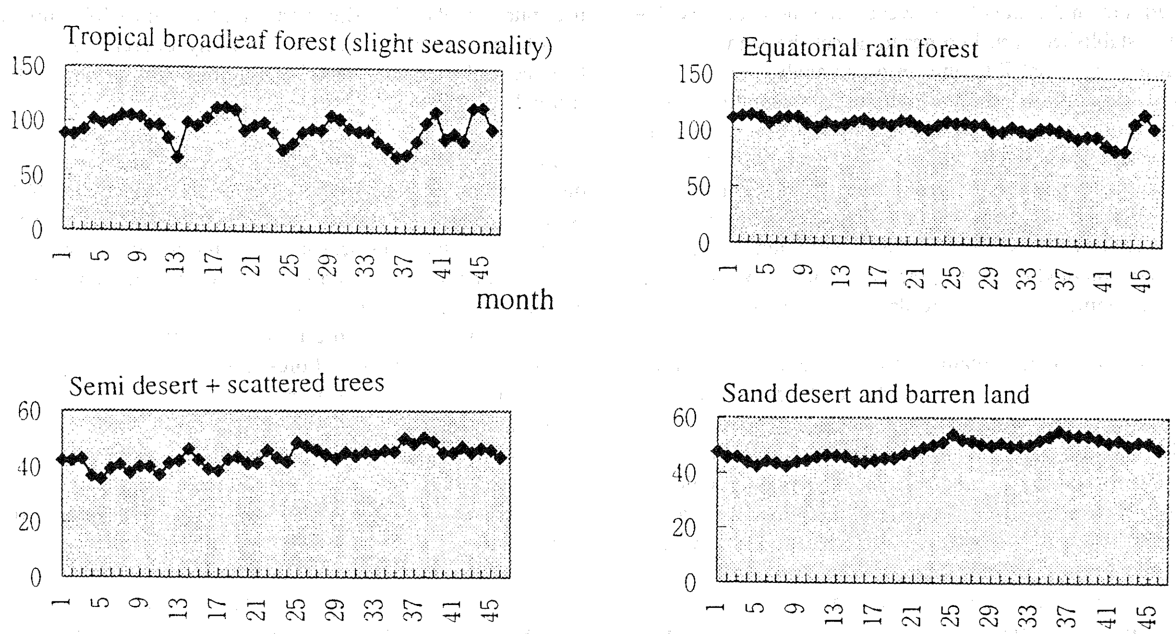

Figure-3 GVI Fluctuation Pattern for eco-regions categories
(a)Tropical Broadleaf Forest;(b)Equatorial Rain Forest;(c)Semi Desert;(d)Sand Desert and Barren Land"

ciduous Conifer Forest which is the sample point of Figure-1. By using the moving average method, the time series tendency of the vegetation activity can be seen without small scattering of the NDVI value.

3. METHODOLOGY

After preprocessing of the data, the characteristics of 8km NDVI fluctuation pattern can be obtained and a major pattern is selected to represent each class. The represented patterns are used to reclass the existing map from low spatial resolution to 8km resolution. The new time series maps for 10 years data shows the vegetation class during the 10 years and the changes of vegetation map, which had not been generated with satellite data, with little ground investigation.

On the other hand, the NDVI fluctuation patterns may change depending on the climate conditions in each year, however, the long term tendency of the fluctuation is expected to be stable in rather long period e.g. 10 years. Figure-3 shows samples of average "GVI" fluctuation pattern for "Tropical Broadleaf Forest", "Equatorial Rain Forest", "Semi Desert" and "Sand Desert and Barren Land" from April, 1985 to December, 1988. From these figures tendencies of the fluctuation patterns which is declining, increasing or stable can be seen. A index which is called vegetation degradation index is proposed to indicate the vegetation degradation tendency which is defined as the inclination of the line-f(x) to fit the following formula.

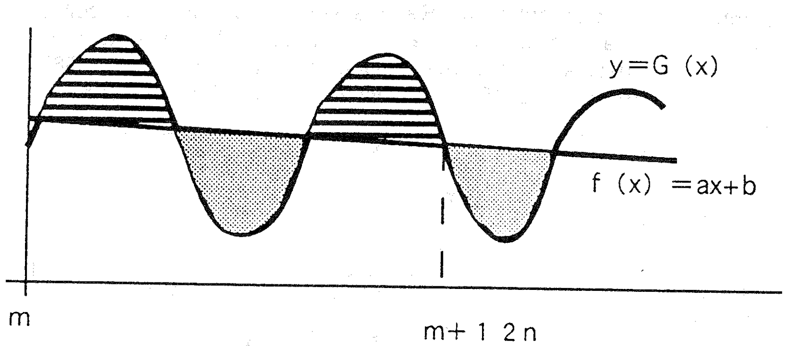

Figure-4 Illustration of Definition of Vegetation Degradation Index

4. RESULT AND DISCUSSION

Outcome(Slide) demonstrates how to define the degradation tendency of GVI fluctuation pattern - G(x) - ,and line - f(x)- is set to make the area above the line and below the line to be same. Points with smaller inclination of the tendency line is the area where serious vegetation degradation is proceeding. After calculation of the vegetation degradation index for each pixel, a map of vegetation degradation is generated. Outcome(Slide)shows the global map of the vegetation degradation index using GVI data. The vegetation degradation affected area are seen in South America especially in the basin of the Amazon and the La Plata, Middle Africa, and South East Asia. There are some unreasonable spots showing vegetation degradaion where the vegetation condition is considered to be rather stable. For the future study, the modification method to make standerdize data which include the variety of the sensors, and position should be considered.

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