PROPOSING A METHOD TO ESTABLISH VIETNAM FOREST MAP BY USING MULTI-TEMPORAL GLI IMAGES AND ECOLOGIC MODELS

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ABSTRACT

Nowaday, Forest map in Vietnam has been established by field survey or visual remote sensing images. This job spends very much time, money, labor and in generally lost many years to complete a Vietnam forest map. So, it is too difficult to monitor forest resource annually, to manage forest resource in large areas. The new remote sensing image versions as ADEOS II - GLI or MODIS offer a new approach to monitor and manage forest resource. With wide swath (2300km), short cycle (2-4 days), spatial resolution 250, these images are suited for monitoring and managing forest resource in the local, region or country width. In addition, algorithm for multi-temporal images classification has been developed by Department of Environmental Information Study and Analysis allowing classification a large number of images of these satellites. Land cover map that is classified by this algorithm has high accuracy. Reclassifying that land cover map by ecological models to establish forest map that can replace original methods in any purpose and any scale is target of this research.

In this paper, ADEOS II - GLI images from 4/2003 to 9/2003 were used to make a composite dataset by combining data in the different months to remove cloud. Multi-temporal images classification method was used to make land cover map. Then, land cover map was reclassified by some ecological models to establish Vietnam Forest Map in 2003. Ecological characters in models were gotten from Rainfall map, Temperature map and DEM. These maps were collected from National Atlas of Vietnam. Result of this research is a forest map in Vietnam that can be printed in scale 1:500.000 or less.

1. INTRODUCTION

Only remote sensing data is usually not enough to establish thematic maps. Integrating land cover map classified from remote sensing data with GIS data by using professional knowledge to establish forest map is a new approach that will be presented in this paper. Conventional forest maps usually have been established by field survey or visual interpretation of remote sensing imageries. A complete Vietnam forest map was built by many people in many years so that result was not common among deferent regions and usually too old when it could come to managers. Therefore, to interpret remote sensing images, interpreters need to know information about ecology of study region and expertise knowledge about distribution of forest types. With development of information technology currently, GIS technology can support to integrate expertise knowledge of people into models to establish forest map instead of visual interpretation.

The new moderate remote sensing image versions as MODIS, GLI have wide swath, short cycle classified perfectly by multi-temporal image classification algorithm that is suited to monitor and manage forest resource in scale of region or country. GLI images are licensed copyright by JAXA, Japan. We warmly give thanks to JAXA provided images for this study.

2. DATA AND PROCESSING DATA

GLI is a sensor onboard ADEOS - II satellite of Japan that was launched in January 2003. GLI image has 6 channels for land study that are identical to landsat-TM image including:

Table 1: The specifications of GLI data

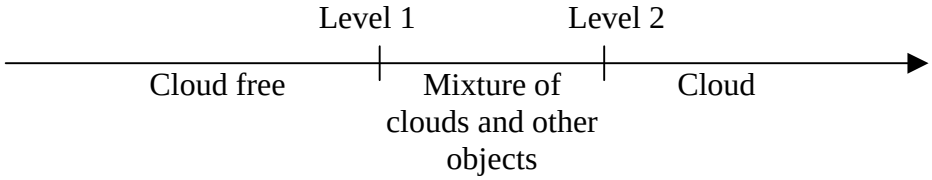
Channel	Bandwidth (nm)
1	450 – 520
2	520 – 600
3	630 – 690
4	760 – 900
5	1550 – 1750
6	2080 – 2350

With wide swath (2300km) GLI image can cover fully a large region, homogeneity about time so that is affected little by surrounding factors.

Spatial resolution 250m, this data is suited about geometric accuracy to establish maps in the areas of province, region or country in scale 1:500000 or less.

In this paper, 18 ADEOS-GLI images observed from 13/04/2003 to 28/09/2003 were used. Vietnam country has tropical monsoon climate, observed images are usually cloudy, we removed cloud by a model that is presented summarily as follows:

- Calculating total reflected radiance index TRRI (Nguyen Dinh Duong, 1999) for each image
- Using TRRI to divide two levels:



- Selecting from all images to get these images that are the most qualitative specified for growing reason of vegetation to make background images.

In each background image, cloud free data was preserved. Cloud data was replaced by cloud free data taken from the nearest another image in the time. Mixture data includes thin clouds, sand, bare, and some other dry objects. This data was selected by preferential index as cloud index. Cloud index (CI) was calculated as following:

$$CI = \frac{Gr - SIR}{Gr + SIR}$$

In there : Gr : Green band

SIR : Short wave infrared band

From level 1 to level 2, the higher value of CI, the more possibility of cloud. So in background image and nearest another image, for each pixel, value of any image that have bigger CI would be got. Result of this process is a series of images including 5 points of time that is nearly cloudless, the same size, the same coordinate. This series of images can be used to classify establishing land cover map by multi-temporal image classification algorithm that will be presented in following part.

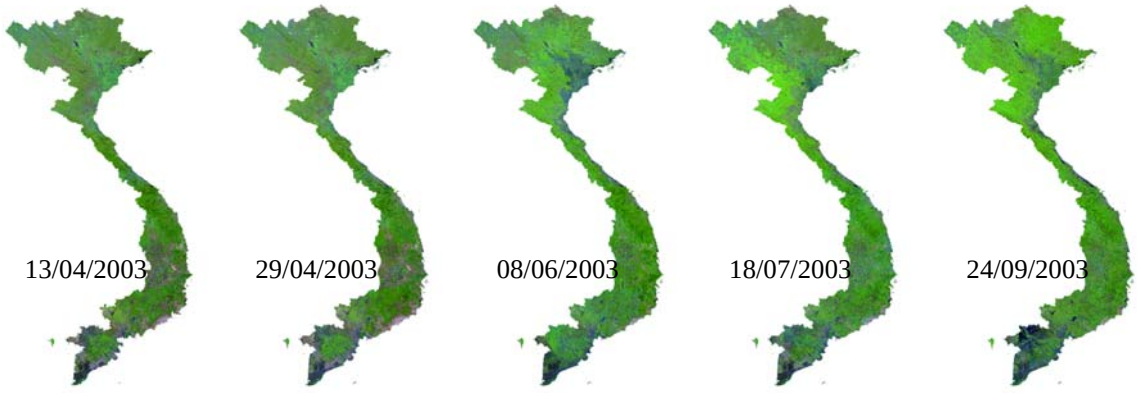


Figure 1. Five images were used to classify

3. METHODOLOGY AND RESULT

The distribution and particular traits of the forest types in the earth are determined mainly by the humid and temperate system of each region. Forests of Vietnam are covered mainly by mixture of evergreen broadleaf trees. Deciduous forest has not large area, distributed mainly in Tay Nguyen and the major factor effecting to defoliation of vegetation is seasonal rain system of that region. Needle leaf forest has small area, distributed mainly in Lam Dong. Mangrove forest is scattered distribution in the edge of sea provinces, the largest areas are Can Gio forest and Ca Mau forest (Le Mong Chan and Vu Van Dung,1992).

Vietnam country has monsoon tropical climate, territory spreads in many latitudes, covered mainly by hills and mountains. Although climate is different between North and South, terrain still is a very important factor to set up difference about climate among regions. The higher regions, the more transferred climate to the subtropical climate and to the temperate climate that bring about specific changes of vegetation types similar to increasing of latitude. Elevation 1000m in the South and 700m in the North that are determined are the clearest separate level between tropical vegetation types and subtropical vegetation types. Above 1000m in the South and 700m in the North are distributed mainly by rainy forest types, evergreen trees are preeminent in the forests, deciduous trees are not worth mentioning (Thai Van Trung, 1998). In generally, the mainly limited ecology factors effecting to distribution of forest types in Vietnam are created by terrain and seasonal rain system of each region.

Land cover map of Vietnam was classified from the 5 processed images as above by multi-temporal image classification algorithm. This algorithm has been developing by Environmental Information Study and Analysis Department EISA in the framework of ADEOS-II Research announcement of JAXA, Japan. In additionally discriminating objects

from other objects by specific reflectance of them in one-temporal image, this algorithm can support to determine objects by change of them on the time. So, land cover map classified from multi-temporal images is more detailed than from one-temporal image. It can determine objects that change on season as between evergreen trees and deciduous trees, between crop land and natural land,.. . Information can be obtained from multi-temporal remote sensing data that is much more accurate and more detailed than visual images about both numbers of objects and boundary of them. So this land cover map is suited very much to establish thematic maps. Legend for land cover map was developed as following:

Legend for Landcover Map of Vietnam

1. Closed evergreen broadleaf forest
2. Opened evergreen broadleaf forest
3. Deciduous broadleaf forest
4. Evergreen needleleaf forest
5. Mangrove forest
6. Shrub and grass in wetland
7. Closed shrub
8. Opened shrub
9. Grass and small shrub
10. Long term fruit tree
11. Mosaic (Including gardens: house+long term tree + sort term tree+…; milpa + natural tree; mixture of wood tree and grass, shrub,…)
12. Rice land 1 crop a year
13. Rice land 2 crop a year
14. Urban
15. Barren land
16. Sand
17. Wetland (aquaculture land)
18. Water

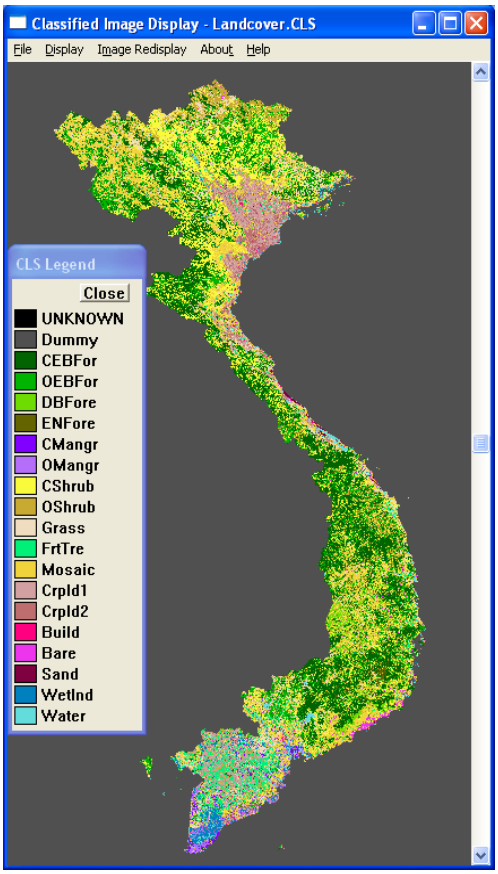


Figure 2. Landcover Map

According to Thai Van Trung, elevated levels 700m in the North and 1000m in the South are used to divide types of forest: tropical forest and subtropical forest, elevated levels 1600m in the North and 1800m in the South are used to divide types of forest: subtropical forest and temperate forest.

According to rainfall, we divided two levels: 0-1600mm/year is waterless and over 1600mm/year is humid.

Ecology map was used to divide the North and the South. Soil map was used to determine rocky mountain forest and validate mangrove forest.

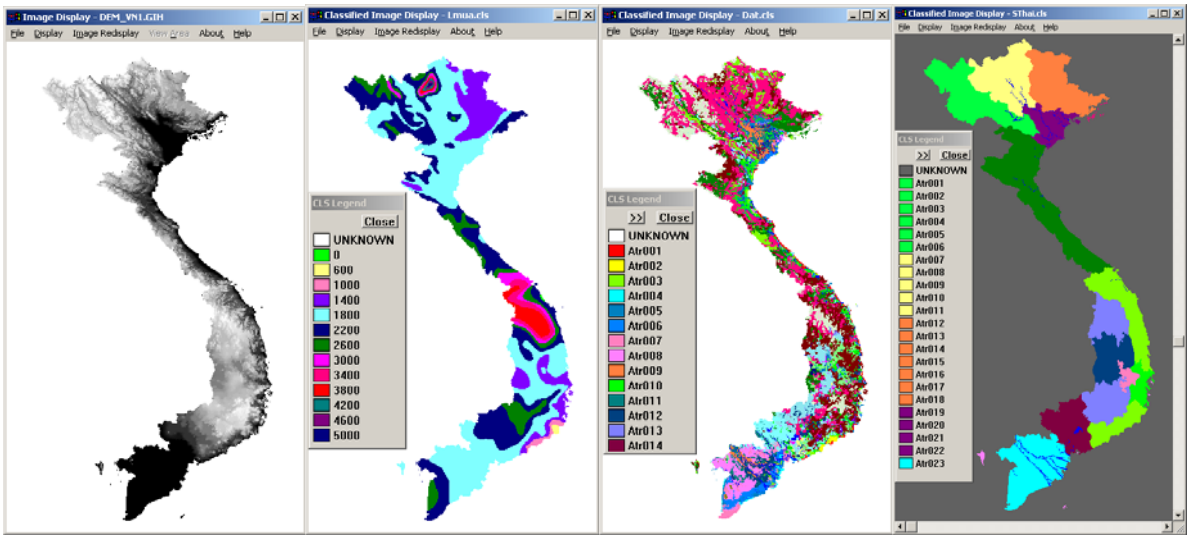


Figure 3. Thematic maps were used in the models

In this paper, to develop the legend for forest map and to get ecologic characters of forest types, we base on list of main forest types of Vietnam in the book "Plant and special plant of forest" written by Le Mong Chan and Vu Van Dung - Forestry University of Vietnam. The legend was developed as following:

Legend for Forest Map of Vietnam

I. Forest land

1. Closed evergreen broadleaf humid tropical forest (Including: Closed evergreen broadleaf humid tropical forest, secondary bamboo forest, closed plantation forest (specials: Eucalypt, Acacia, rubber,…)
2. Closed evergreen broadleaf humid subtropical forest
3. Closed evergreen broadleaf humid temperate zone forest
4. Closed evergreen broadleaf waterless tropical forest
5. Opened evergreen broadleaf humid tropical forest
6. Opened evergreen broadleaf humid subtropical forest
7. Opened evergreen broadleaf waterless tropical forest
8. Deciduous broadleaf forest
9. Rocky mountain forest
10. Needleleaf forest
11. Mangrove forest

II. Unforested land

1. Mosaic (Including gardens: house+long term tree+sort term tree+…; milpa +natural tree; mixture of wood tree and grass, shrub,…)
2. Shrub and grass in wetland
3. Closed shrub
4. Opened shrub
5. Grass + small shrub
6. Long term fruit tree
7. Rice land 1 crop a year
8. Rice land 2 crop a year
9. Urban
10. Barren land
11. Sand
12. Wetland (aquaculture land)
13. Water

Each object of land cover map was divided some objects of forest map by ecologic criteria of them. Example, Close Forest of land cover map was divided three units by elevated levels: Close tropical forest is lower than 1000m in the South and 700m in the North, Close subtropical forest is from 1000 to 1800m in the South and 700 to 1600m in the North and Close temperate forest is above 1800m in the South and 1600m in the North. Each object as above was divided again by differently dry and humid conditions:

- If Close forest type distributes in humid region, it is capable of density forest.
- If Close forest type distributes in dry region, it is hardly capable of density forest, so we determined that is only a dry evergreen forest type.

The similar to all objects of land cover map were transferred to objects of forest map. Result is a Vietnam forest map as next figure.

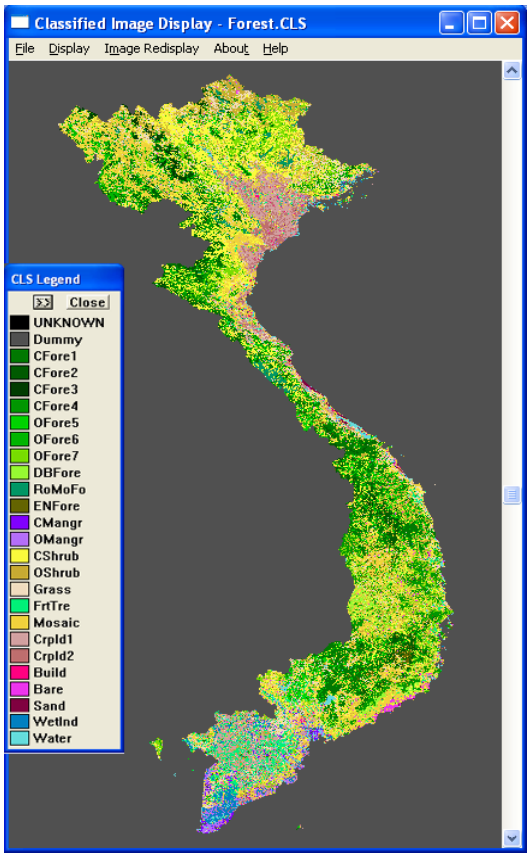
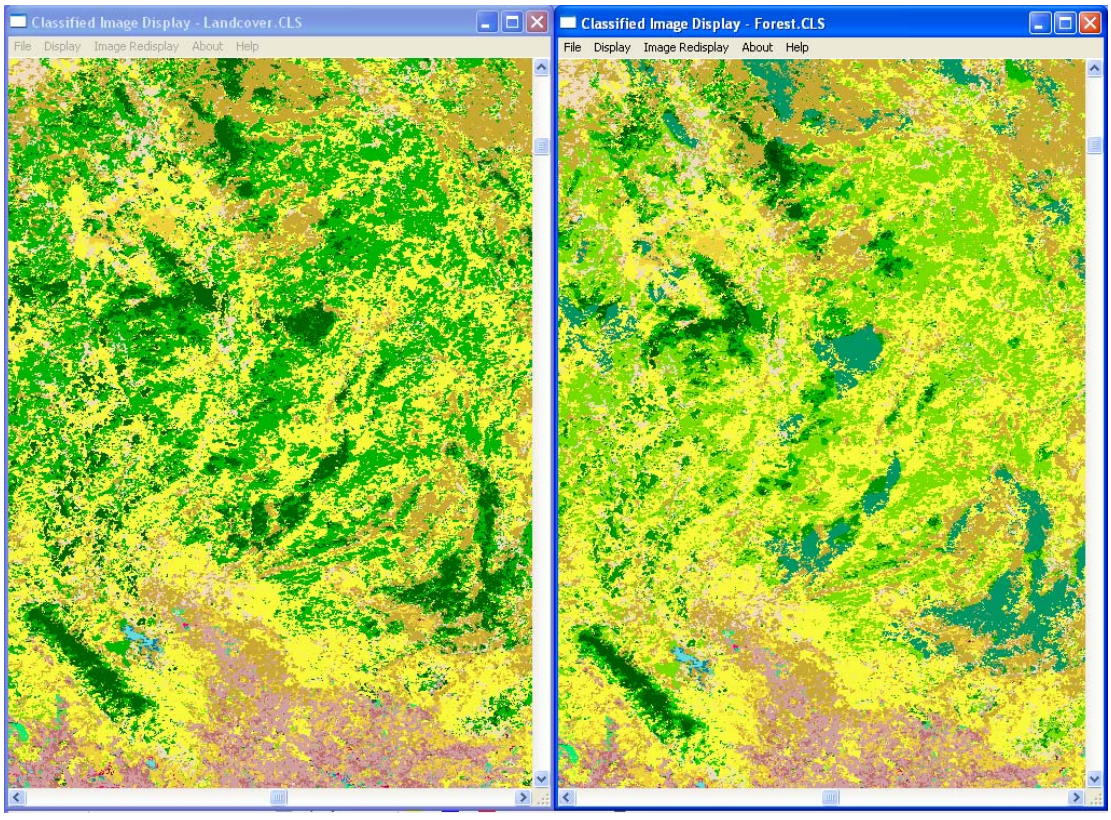


Figure 4. Forest Map

A example of one object of land cover map was converted to some objects of forest map that is showed in following figure:



Landcover Map Forest Map

Figure 5. Comparison between Land cover Map and Forest Map

4. CONCLUSION

Moderate remote sensing images as GLI have advantages in monitoring, managing natural resource in large areas. In there, monitoring and managing forest resource is one of the most feasible applications. Forest resource usually distributes in hill and mountain terrains and in very large areas. The advantages of moderate remote sensing data are suited very much to difficulties of forest managers in solving requires to monitor and manage forest resource quickly and accurately.

Integrating land cover map classified from multi-temporal images with ecologic information using professional knowledge to establish forest map is perfectly realizable. These forest maps can replace original maps in some applications. Current GIS technology can support to integrate knowledge of forestry experts into models to establish forest map replacing visual images. Because ecologic information is not enough and not synchronous, knowledge about distribution of forest types is still poor, the model to establish forest map presented in this paper is still experimental . Although result can not still apply in actually, it can prove that forest map is possibly established perfectly by digital processing remote sensing images.

5. REFERENCES

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