

APPLICATION OF KOMPSAT II IMAGERY FOR CARBON EMISSION INVENTORY MAP

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ABSTRACT:

Various approaches have been tried to estimate carbon emission model from leaf to globe. Satellite imagery is one of the sources to make land cover and land use data, usually in national or continental levels. Efforts to reduce carbon dioxide have started to be made in local governments. We tried to get LULC data for City of Boryong, Chungnam Province, using KOREAN Multi-Purpose Satellite II, 1 meter resolution data and other GIS data. Training vectors are selected from data of Korean Land Information System, supervised and unsupervised classifications were mixed to get the 5 classes and 18 classes. The more classes we get, the more error were turned out. To convert to carbon inventory, greenhouses and other point source data were digitized and weighted to make carbon emission maps. Natural ambient carbon sink can be added into policy for carbon emission inventory map, on the base of satellite images.

1. INTRODUCTION

1.1 Background of Study

Climate change is one of the critical issues in 21 century. IPCC have made a lot of effort to measure, analyze and forecast greenhouse gases. Fossil fuels have been a main target to decrease to solve the problem, but rapid industrialization has accelerated the increase in greenhouse gases. In 2009, Republic of Korea published <Comprehensive countermeasure for climate change adaptation> for planning for continuous sustainable development. Carbon emission inventory showed less than 2.5percent contribute agricultural activity to total emission in Korea, but the effect of forest and grassland have not been focused as a sink tank for carbon inventory. Parameterization of CO₂ flux over the ecosystem has been investigated in Japan (Kondo, *et als.* 2001), so the similar latitude situation can be applied into Korean peninsula. Carbon emission inventory for local administration levels are needed for the feasible action items development, so gridded data from satellite imagery can be used for generalization and localization of carbon emission inventory based on CO₂ flux over the ecosystem by Condo.

1.2 Study Purposes

It is necessary for Chungnam Province to prepare carbon emission inventory to prepare adaptation strategies before carbon trading between the provinces. It is also necessary to estimate natural emission from vegetation and crops and livestock. We aim to try a method to use KOMPSAT II imagery to estimate carbon inventory with various geographic information.

Gridded data calculated from Kondo's model can be tested at the local level of carbon emission inventory. Classification Procedure with KOMPSAT II data with other GIS data for the land cover map is an addition objective, as KOMPSAT II data are affordable for the local government- Province or County.

Data set	Year	format
<u>Imagery</u>		
Quickbird	2008	GeoTIFF
KOMPSAT II	2009	GeoTIFF
<u>GIS data</u>		
Forest Class data	2006	Shape
Digital Map(1:5000)	2007	NGII
Digital Maps etc	2007	Shape
KLIS data (cadastral data with land use)	2007	Shape
DEM	2004	txt

Table 1. Data for the Boryong City

This paper covers only results from one year study, further elaboration and verification of the result from field test will be needed. Here different approaches are tested with various GIS data to show the emission and net flux and carbon emission inventory at the level of different units of administration.

1.3 Methods

1.3.1 image processing

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Images are obtained and pre-processed with ENVI and Erdas Imagine software. Detailed processes are shown in the figure 1 and figure 2.

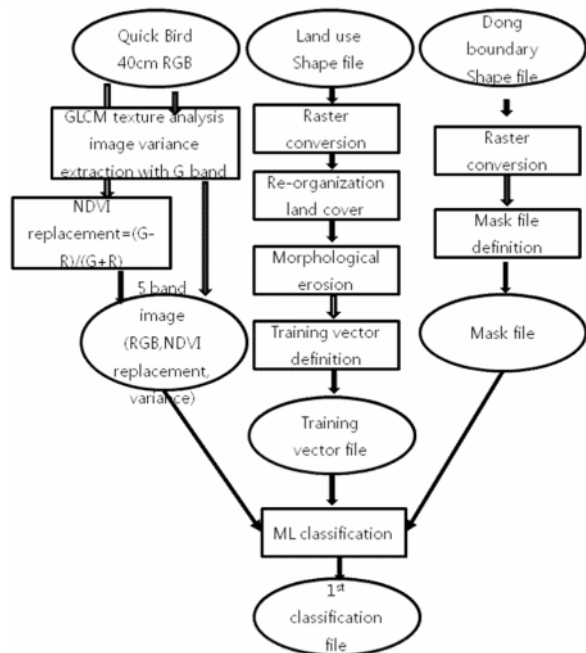


Figure 1. The first stage of image processing

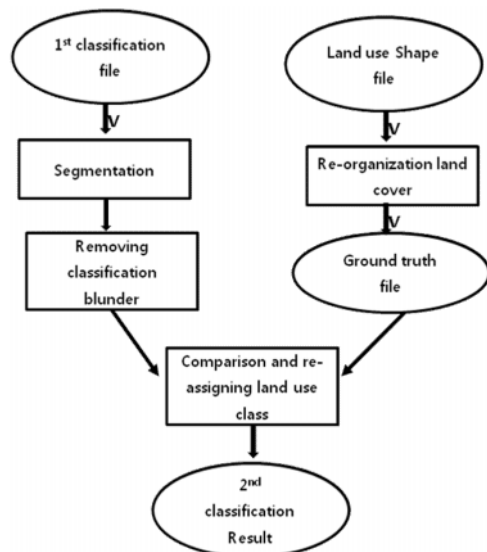


Figure 2. The Second Processes for image classification

1.3.2 Flux data conversion

Classified images are converted to net flux data using the following model based on the Kondo Model.

$$F_{CO_2} = -[bL(1+aI)] + R \quad (1)$$

$$R = R_{10} \exp \left[309 \left[\left(\frac{1}{283.15 - T_0} \right) - \left(\frac{1}{T - T_0} \right) \right] \right] \quad (2)$$

F_{CO_2} : CO₂ flux(mgCO₂m⁻²s⁻¹)

I: surface radiation (observed)

R: canopy carbon CO₂ flux

R₁₀: R value at the 10 °C (0.12364 mgCO₂m⁻²s⁻¹)

T: temperature °K}

T₀: 234.13 °K

a, b: net flux parameters

2. RESULTS

2.1 Image Classification Result

The output of the first stage of classification is shown in the figure 3.

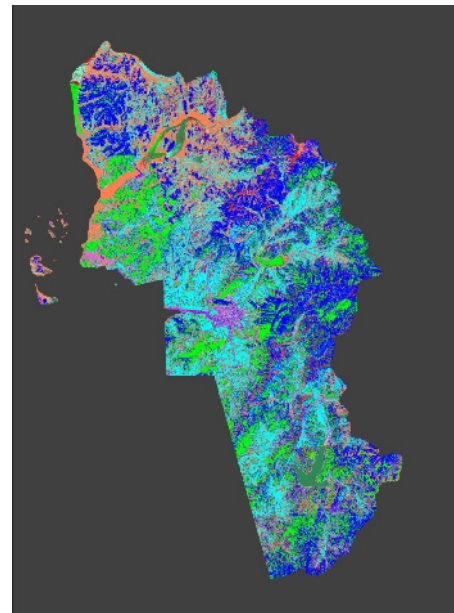


Figure 3. The output of the first classification

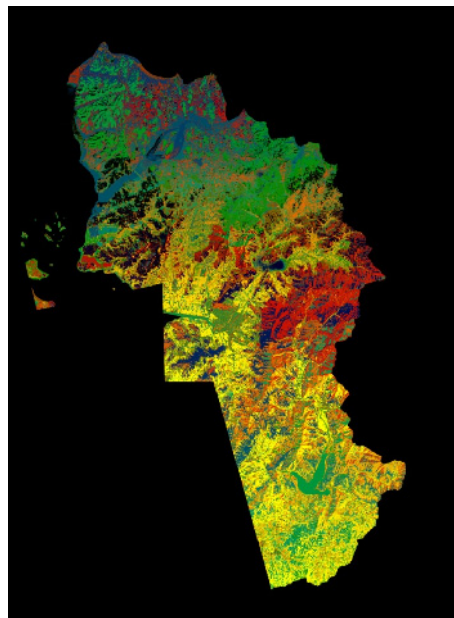


Figure 4. Segmented classification Results

Segmentation results are shown in Figure 4 for the Boryong County in Chungnam Province.

Final Classification image are shown in figure 5.

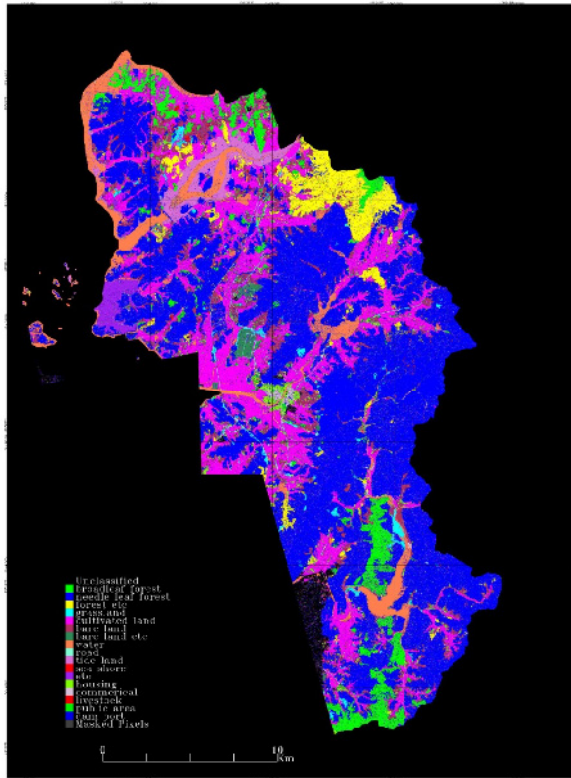


Figure 5. Final Output of Classification with Quick bird imagery

2.2 Map Algebra result

Classified images are converted into 6 classes to apply Kondo's a, b coefficients.

Type of land cover	a ($J^{-1} \text{ m}^2 \times 10^{-4}$)	b ($\text{mgCO}_2 \text{ J}^{-1} \times 10^{-3}$)
Agriculture	5.96	3.68
Dry land	5.96	4.76
Coniferous forest	5.96	3.02
Deciduous broadleaf forest	5.96	3.04
Mixed forest	5.96	2.02
Grassland	5.96	3.37

Data: Kondo *et al.* (2001).

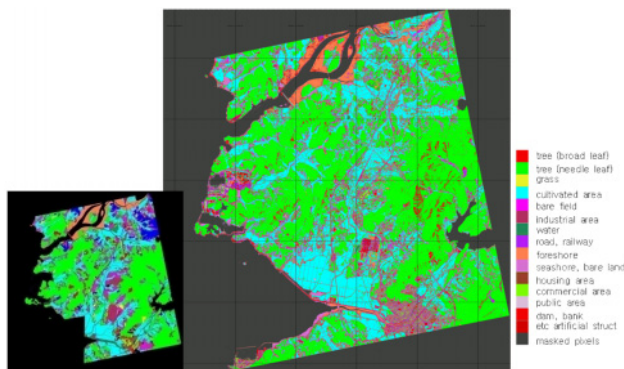


Figure 6. Classification of KOMPSAT II

2.3 KOMPSAT II data processing

The similar process are done for the KOMPSAT II image, of which the results are shown in

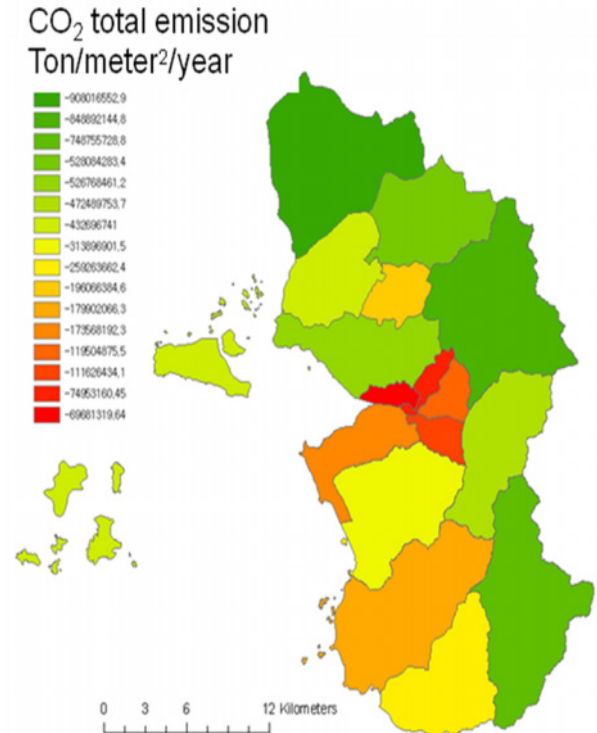


Figure 7. Map algebra data regrouped into lower level of administration unit (myun)

Figure 7 shown aggregated data for the CO2 emission for the city of Boryong, which can be compared statistics from the government document. The original gridded map with 3X3 meter also gives information on the distribution of the carbon absorption areas and carbon emission areas.

3. DISCUSSIONS AND CONCLUSIONS

Various emission inventory guidelines are being used for artificial emission focused on the fossil fuel consumption. The forest effect of absorption of carbon dioxide is estimated into earth tree saving with less powerful evidence in average. Species level experiment can give us rigid bio-atmospheric interface model, but it is difficult for policy makers. Satellite imagery with other GIS data can be used for the CO2 emission maps. The logical leap between the map algebra model and final aggregation are a limiting aspect of this study. Verification from the field study and comparisons between the images are not analyzed yet. But the output of several image classification and map algebra gives us additional and detailed information on CO2 flux. Rigid model verification will be added too.

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