FUSION OF ALOS PALSAR AND LANDSAT ETM DATA FOR LAND COVER CLASSIFICATION AND BIOMASS MODELING USING NON LINEAR METHODS

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ABSTRACT

This work demonstrated the use of reduced resolution ALOS Palsar data for land cover classification and biomass mapping in the tropical forests of Indonesia. We used a free version of ALOS Palsar data available at K&C initiatives project website, combined with Landsat 7 ETM+ image for land cover classification. The classifications were conducted using: (1) ETM image, (2) ALOS Palsar image, and (3) combination of ETM and Palsar data. Image classifications were carried out using a Machine Learning based classifier, so-called Support Vector Machine (SVM), and conventional Maximum Likelihood method. An ensemble of neural networks classification method using Kalman Filter and scaled conjuged gradient algorithms was applied. The classification accuracy was assessed using confusion matrices and Kappa Statistics.

The second part of this study concerned with the development of empirical model using HH, HV, HV/HH and HH-HV bands of ALOS Palsar data for the estimation of forest above ground biomass (AGB). There were 38 temporary sample plots collected during dry season in September 2004, using which we estimated the biomass with tree diameter (dbh) – biomass allometric model developed for our study area in Berau District, East Kalimantan Province, Indonesia. We modeled each band of Palsar data and the biomass estimate, resulting in a simple empirical model for the AGB estimation. Validation of the prediction results was carried out by comparing the biomass estimates with those predicted from the allometric model.

Keywords : ALOS Palsar, Landsat ETM, Kalman Filter, SVM, Neural Networks, Land cover classification, above ground biomass

1. INTRODUCTION

Above ground biomass (AGB) is one of the main indicators which depict the current state of forests. Estimation of the AGB is useful for environmental purpose and carbon accumulation assessment over a forest region. This study demonstrated to combine the capability of SAR data and Landsat ETM data for land cover mapping and to estimate above ground biomass over tropical forest environment. This study focuses on a forest area located in Labanan concession, Berau municipality, East Kalimantan Province, Indonesia. This area is geographically situated along equator at the coordinate of 1◦ 45’ to 2◦ 10’ N, and 116◦ 55 to 117◦ 20’ E and has a size of 83,000 hectares.

2. DATA AND METHODS

This work used 38 circular sample plots to estimate the AGB applying a tree diameter (*dbh*) – above ground biomass (*AGB*) equation. We used a 30 m orthorectified mosaic product of ALOS

Palsar data and multi-spectral bands of Landsat ETM image for land cover classification. Grey Level co-occurrence matrix (GLC) textures features, i.e. mean (GLC-Mean), variance (GLC-Var), homogeneity (GLC-Hom), dissimilarity (GLC-Dis), contrast (GLC-Con), entropy (GLC-Ent), second moment (GLC-Secmom) and correlation (GLC-Cor), were calculated from HV band of SAR data. The MLC, SVM and KFSCG-NN methods were implemented and variations of ETM bands, SAR data and SAR textures were used as input data (**Fig.1**).

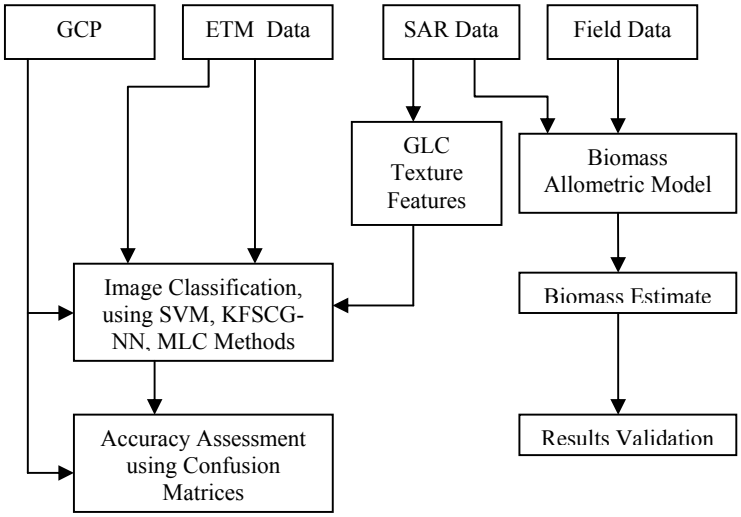

Fig.1 Workflow of the study

The MLC is a conventional classification technique that applied Gaussian distribution principle for data segmentation. This method is robust and well-known for general classification problems, but may have difficulty to classify data coming from different sources, such as ETM and SAR data. The SVM is basically a binary class classification technique based on machine learning and using support vector in the data classification. This method is grouped into a non linear method, as the data segmentation was carried out using so-called kernel algorithm [1]. Neural networks method on the other hand lies between parametric and non-parametric principle. This method works based on interconnected networks, and training algorithm is the main parameter that should be carefully selected, because the classification accuracy greatly depends on how the network is trained. We used ensemble training algorithm, using combination of scaled conjugate gradient and kalman filter algorithm for training the neural network. This alternative training algorithm is more efficient than standard back-propagation method [2]. The classification accuracy was assessed using confusion matrices and the results were discussed.

In the second part of this study, HV and HH bands of radar backscattering (σ) were correlated with the AGB showing a non-linear relationship. Non-linear least square method was conducted using Levenberg-Marquardt algorithm to find the model which can minimize the error estimate. The reduced resolution SAR data has HH and HV polarizations and was acquired during dry season in June-July 2007.

3. REFERENCES

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