

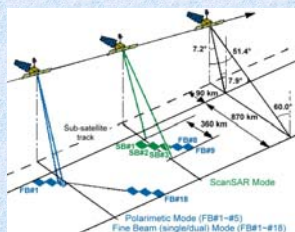
Land Cover Classification and Forest Mapping in Sumatra using ALOS-PALSAR

ABSTRACT – Deforestation and changes in land use play a significant role in global climate change because carbon dioxide is released into the atmosphere when forests or forest products are burned or destroyed. In Indonesia the deforestation rate has been very high over the last 23 years. More than 3 million hectares of forest have been lost due to fire and conversion of forest into land for farming, grazing, and paper production. This study is investigating the potential of ALOS-PALSAR L-band multi-polarised intensity data to monitor land cover changes. The Riau region in Sumatra has been chosen as a study area because it has excellent supporting ground data and forest maps based on field inventory made available by the Indonesian section of WWF. High resolution images acquired in HH and HV over the period July - August 2007 that cover nearly all of the Riau region have been processed. The processing methodology developed for this study includes multi-channel filtering and spatial filtering to increase the number of looks. The HH, HV and HH-HV (dB) data have been used as input to the Maximum Likelihood Algorithm for the classification. The results here reported are preliminary and they qualitatively show the ability of PALSAR to distinguish the major cover types and to monitor land cover change. The analysis of eight ScanSAR images acquired in 2007 with a repetition time of 46 days over the region is still in progress with the aim of comparing and combining the information content of multi-temporal HH backscatter with that of dual-polarisation data.

I. INTRODUCTION

THE SENSOR

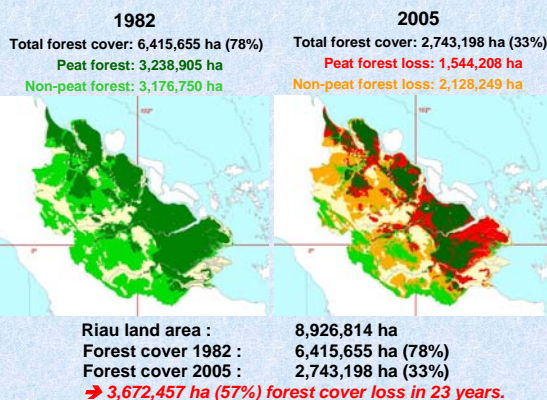
- > The Advanced Land Observing Satellite (ALOS) is a new-generation Earth Observation satellite, launched in January 2006 by the Japan Aerospace Exploration Agency.
- > The on-board Phased Array L-band SAR (PALSAR) operates at 1270 Mhz and provides enhanced sensor characteristics:
 - full polarimetry
 - variable off-nadir viewing
 - ScanSAR acquisitions



THE AREA OF INTEREST

The Riau region in Indonesia

- > The region covers about 11 million hectares
- > The deforestation rate was very high in the last years due to conversion for farming, grazing and paper production
- > The remaining primary forest mainly consists of swamp forest and there has been extensive conversion to oil palm and rubber plantations. Especially in the south of the region there are many previously cleared areas which now show evidence of tree cover possible of acacia or some other species.



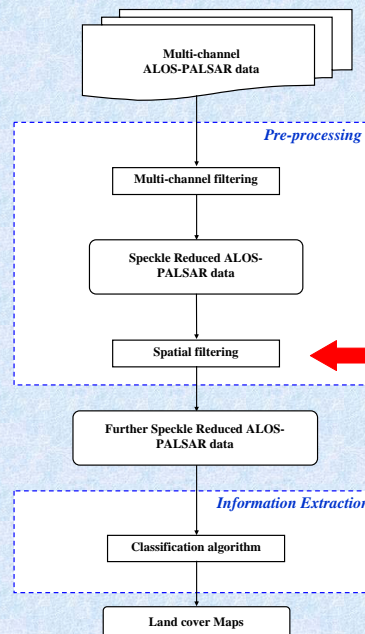
THE DATA AVAILABLE

- > The ALOS-PALSAR images consist of high resolution data (ground resolution (Rg x Az) of 12.5 m x 12.5 m) in HH & HV polarisation, with off-nadir angle of 34.4° and swath width of 70 km, and ScanSAR data (ground resolution (Rg x Az) 100 m x 100 m) in HH polarisation with off-nadir angle of 27.1° and swath width of 360 km. They provide nearly complete coverage of Riau.



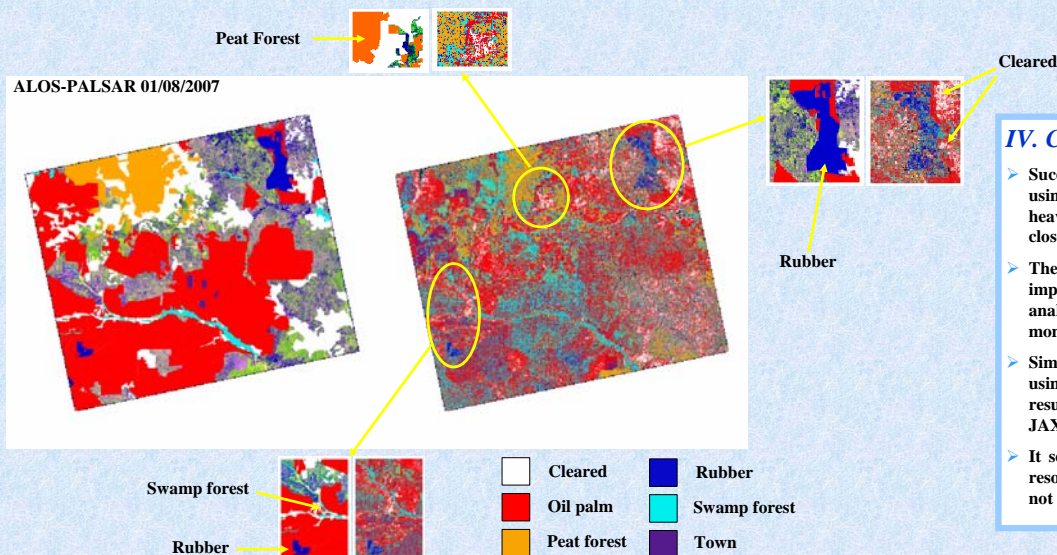
II. PROCESSING OF ALOS-PALSAR IMAGES

- > The processing chain consists of two main steps needed for successful classification:
 - preprocessing
 - information extraction
- > The preprocessing stage consists of applying on both the HH and HV images the multi-channel filtering and a simple average spatial filtering (windows size of 5 x 5 pixel) in order to reduce speckle.
- > The information extraction step uses the Maximum Likelihood Algorithm on HH, HV and HH-HV (dB) data for the classification



III. CLASSIFICATION RESULTS

- > The Maximum Likelihood classification algorithm has been trained on six classes. To give a results that are statistically significant requires substantial speckle filtering in the pre-processing step. The ML algorithm applied on images processed using textural filtering gives poor classification due to the highly non-Gaussian statistics, but it seems likely that texture information can be exploited in more refined classification methods.
- > The classification results have been compared with land cover maps from 2006-2007 based on field inventory furnished by the Indonesia WWF section.
- > The classification of the image acquired the 1st August 2007 shows that different land cover types can be distinguished: Rubber, Oil Palm, Peat and Swamp forest. We are still working on quantitative measures of classification accuracy.
- > Moreover, land cover change patterns can be revealed: several cleared areas in the land cover map appear to have become Oil Palm plantations.



IV. CONCLUSIONS

- > Successful classification of high resolution ALOS images using Maximum Likelihood or Isodata methods requires heavy speckle filtering to make the class distributions close to Gaussian.
- > The PALSAR data seem capable of identifying different important cover types, but this still needs quantitative analysis. ALOS-PALSAR data can also be used to monitor land cover change.
- > Similar analysis will be applied to the whole Riau region using both high resolution and ScanSAR images and the results will be compared with classifications obtained by JAXA using 50 m mosaics of Riau.
- > It seems likely that the texture measurable in the high resolution data will be useful information but we have not properly assessed this yet