

The logo for the ALOS satellite mission, featuring the word "ALOS" in a white, serif font against a dark blue background.A banner for the K&C Initiative, featuring a satellite image of a river delta in shades of green and blue. The text "K&C Initiative" is in a white, serif font, and "An international science collaboration led by JAXA" is in a smaller, white, serif font below it.

K&C Initiative
An international science collaboration led by JAXA

Mapping Deforestation in Riau, Indonesia by using 50m ALOS PALSAR MOSAIC Based on Amplitude and Texture Characteristic

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Background

- Riau province, in central Sumatra, is covered by **vast peatlands** estimated to hold Indonesia's largest store of carbon.
- Riau has had one of the **highest deforestation rates** in recent years which are largely driven by industrial plantation companies.
- Remote Sensing data can provide deforestation information. Especially, Microwave remote sensing is insensitive to cloud coverage.
- We examine the **possibilities of the 50m ALOS PALSAR mosaic in mapping land cover and deforestation in Riau, Indonesia** and to compare the effectiveness of classification algorithms.

Methodology - Data

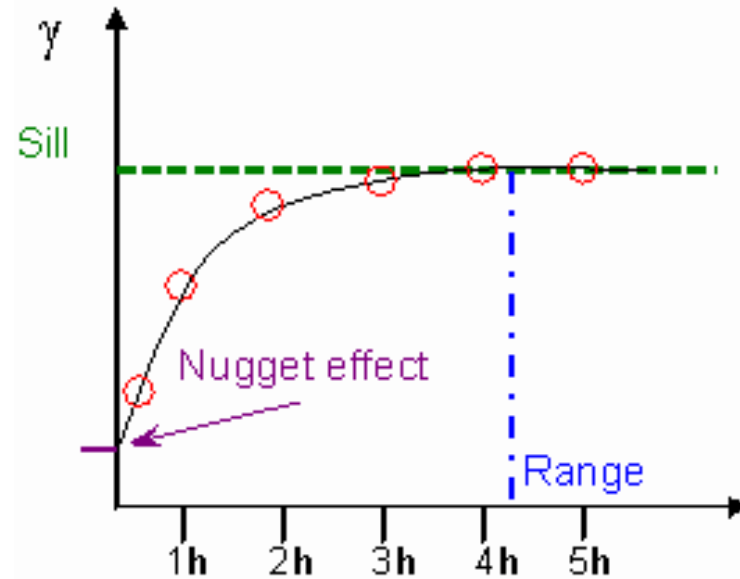
- The following datasets were obtained for the study:
 - 50-m ALOS PALSAR mosaic data from June to November 2007
 - WWF Land cover map in 2007

WWF Land cover map using Landsat ETM	Aug 3 2006, Aug 26 2006, Aug 1 2006, Apr 7 2007, Apr 16 2007, Apr 23 2007, May 23 2007, Jul 3 2007
50-m ALOS PALSAR mosaic data	Jun 23 2007, Jun 28 2007, Jul 3 2007, Jul 20 2007, Sep 11 2007, Nov 1 2007, Nov 25 2007, Nov 30 2007

Semivariance Statistic

$$\gamma(h) = \frac{1}{2n} \sum_{i=1}^n [z(x_i) - z(x_i + h)]^2$$

- A semivariogram describes the relationship between measurements taken some distance apart. Semivariograms define the range or distance over which spatial dependence exists.
- All samples $z(x)$ and $z(x+h)$, located a distance h from $z(x)$ called the *separation distance* or *lag distance*, are used to calculate the semivariance statistic $\gamma(h)$.
- n is the number of sample pairs



- **Range** – the extent of spatial trends, distance beyond which sampling is random
- **Nugget** – variability at zero distance, represents analytical, or theoretical errors
- **Sill** – variability of spatially independent samples

Texture filter

- **First order**

- **Mean**

$$S_M = \sum_{i=0}^{k-1} iP(i)$$

- **Variance**

$$S_D^2 = \sum_{i=0}^{k-1} (1 - S_M)^2 P(i)$$

- **Entropy**

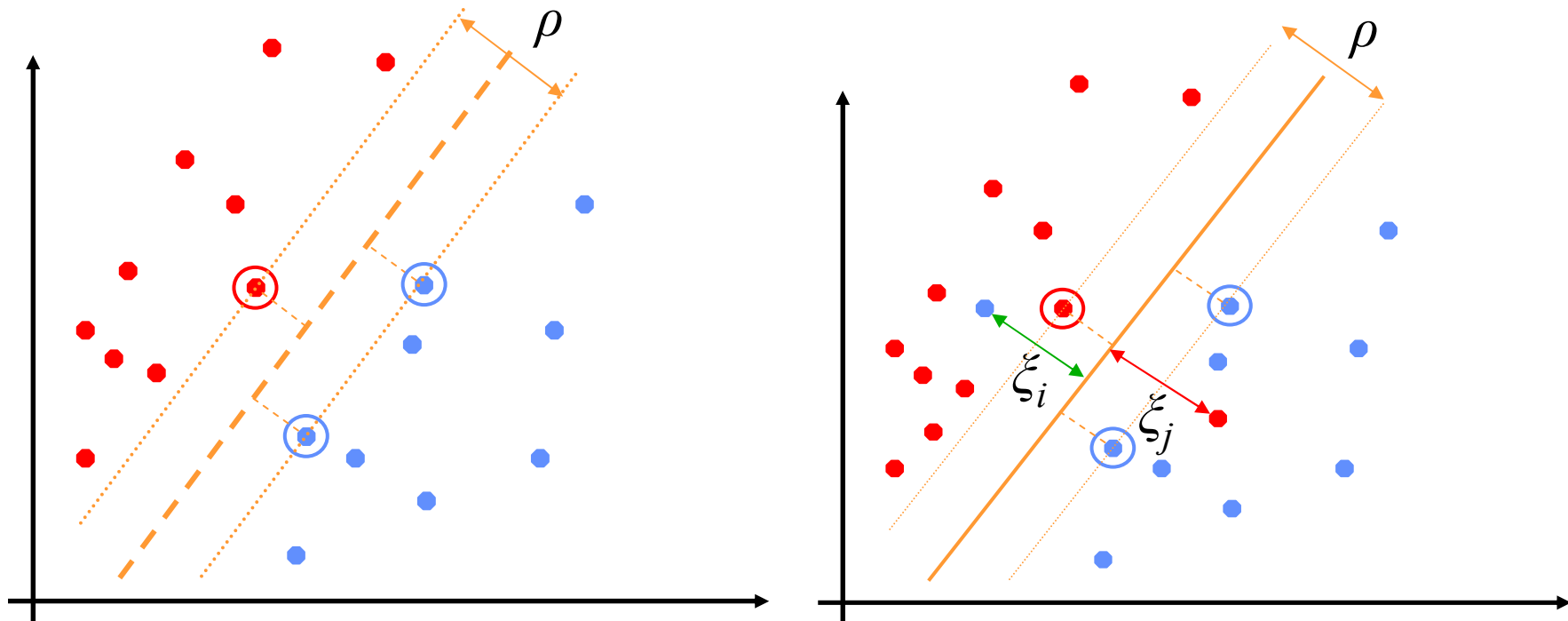
$$entropy = - \sum_{i=0}^{k-1} P(i) \log[P(i)]$$

$P(i) = N(i)/M$, $N(i)$ = number of pixels of same grey level in window, M = number of classes, i = pixel grey level, k = max possible grey level

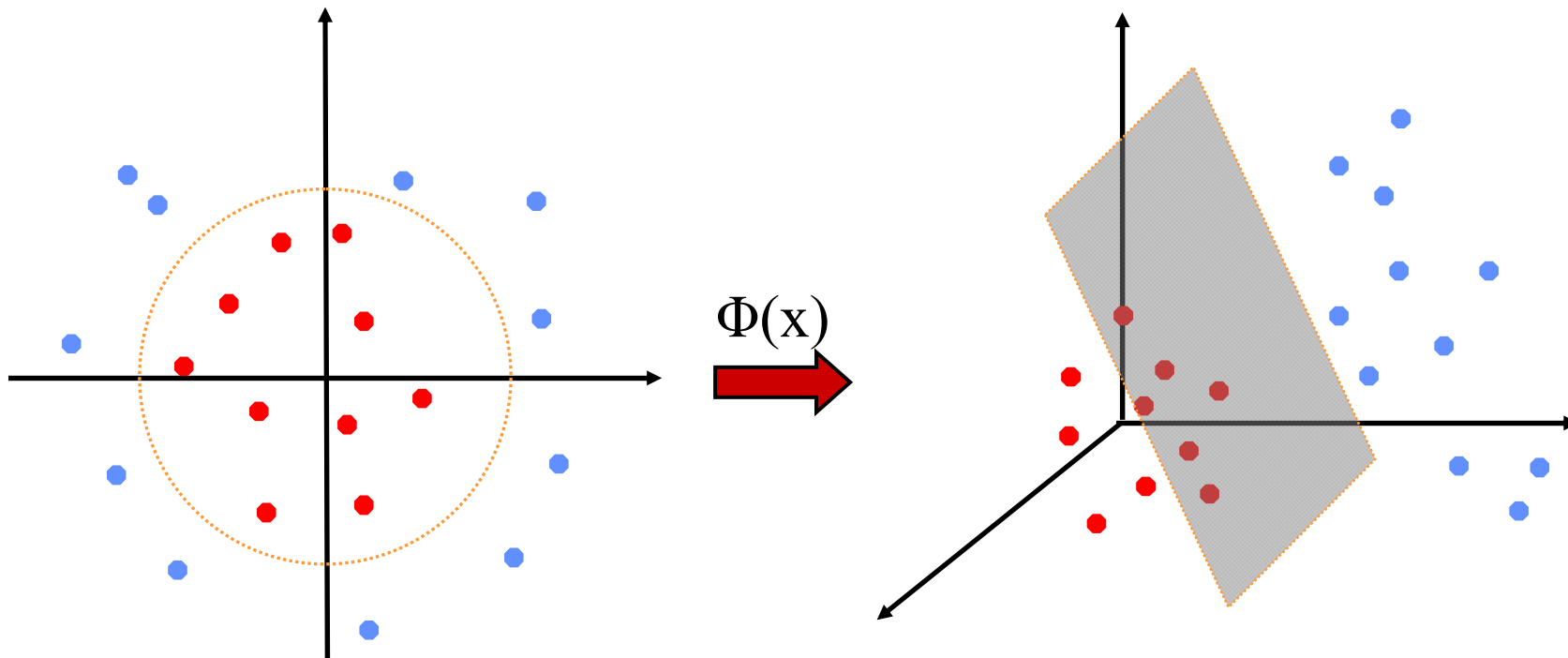
- **Window size = 9**

Support Vector Machine (SVM) Classifiers

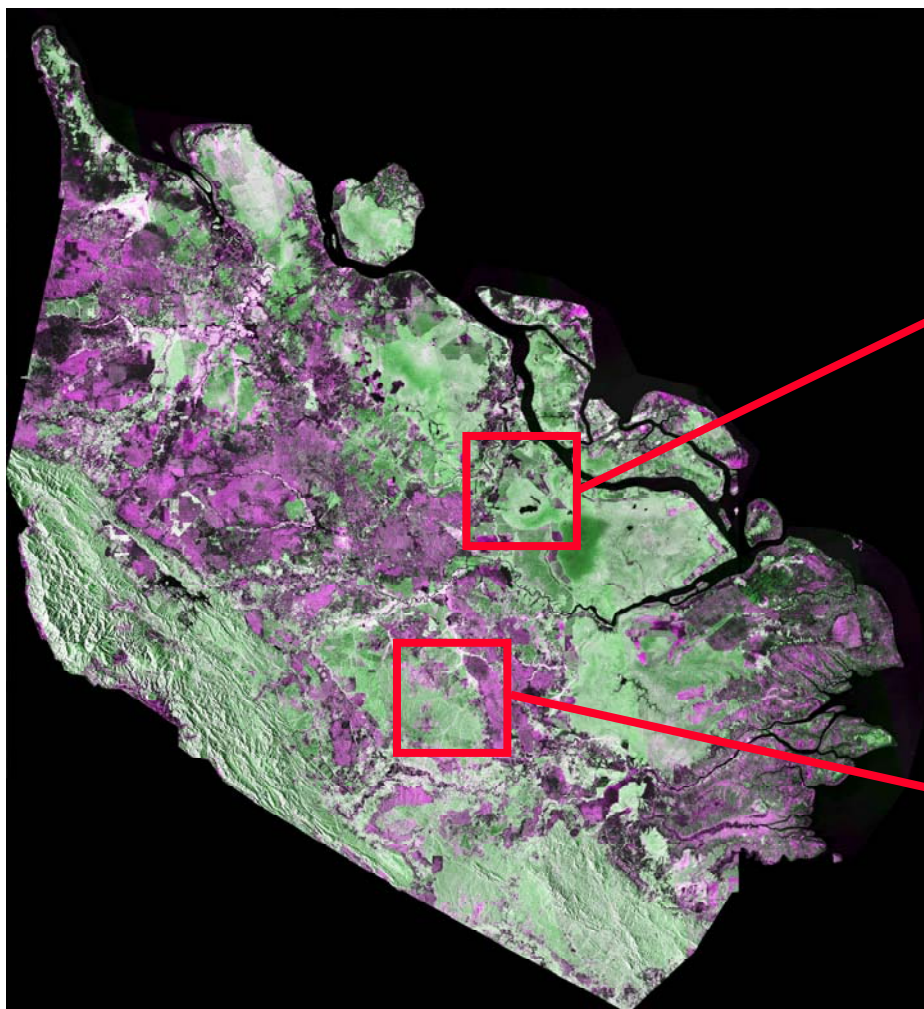
- **Linear Cases:** find the optimal linear separating boundary with (a) maximum margin ρ (b) best trade-off between maximum margin ρ and minimum classification errors ξ



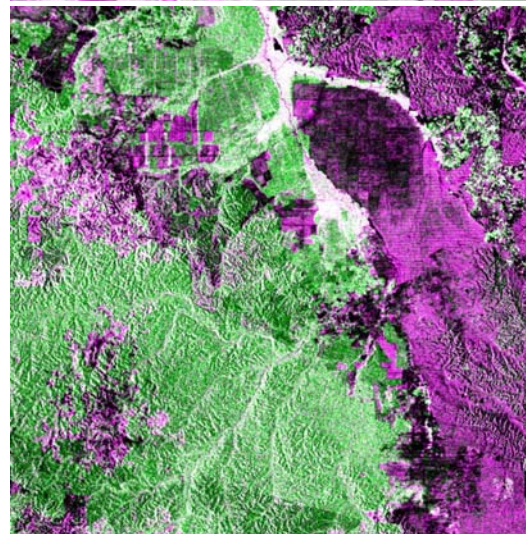
- **Non-Linear Cases:** find the optimal linear separating boundary in a transformed higher dimensional feature space



Study area



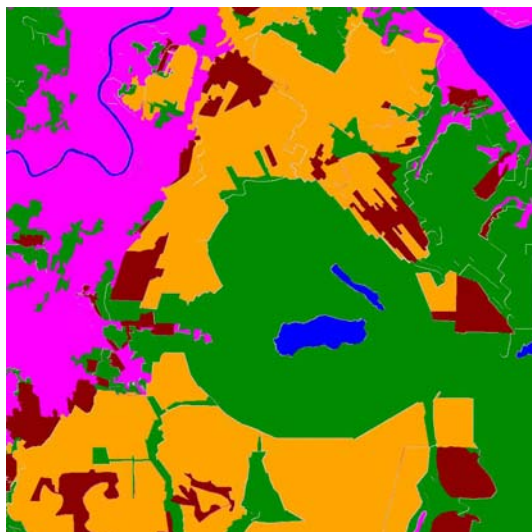
subset1



subset2

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Darkgreen = swamp, orange = acacia , red = clear,
blue = water, purple = other



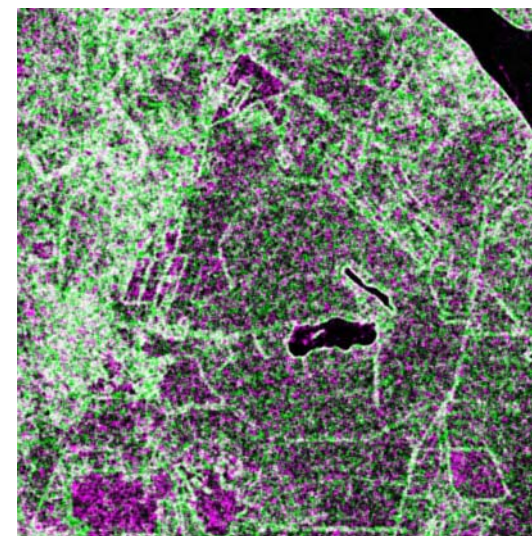
R = HH, G = HV ,B = HH



mean

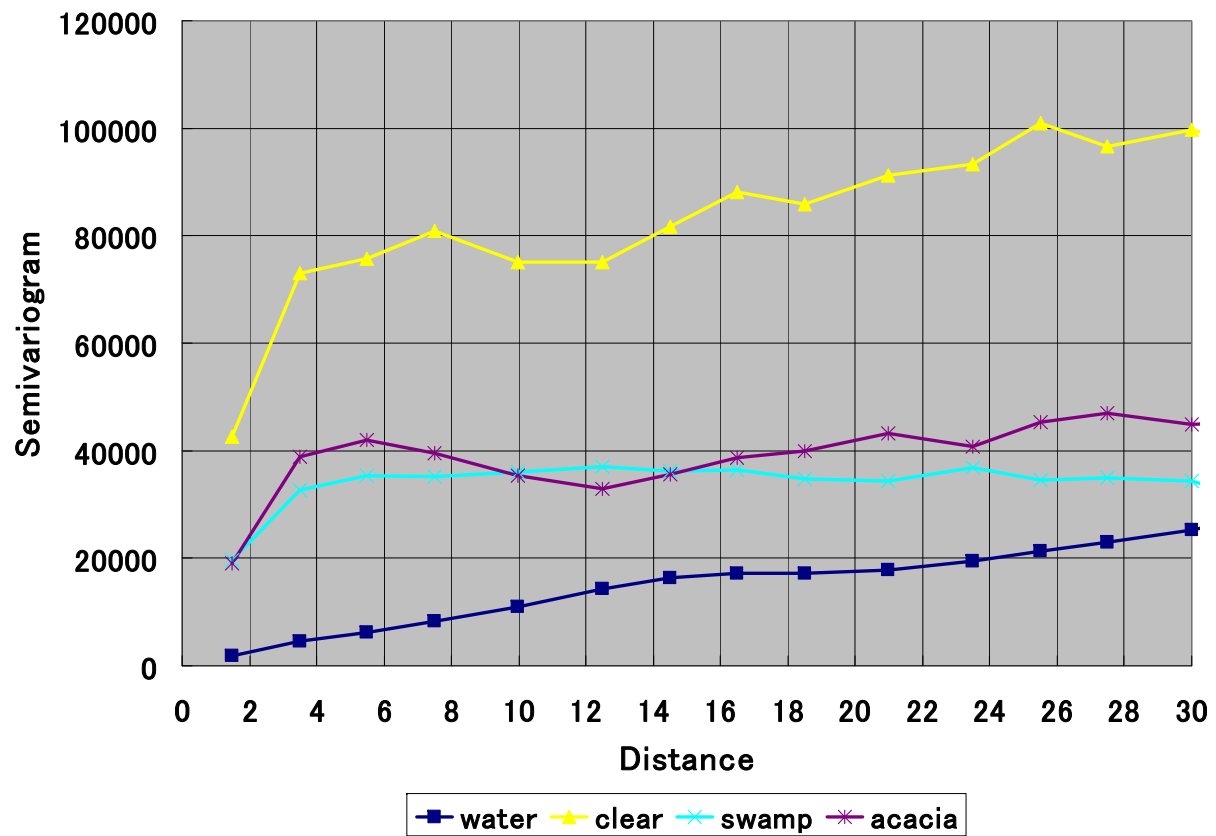


variance

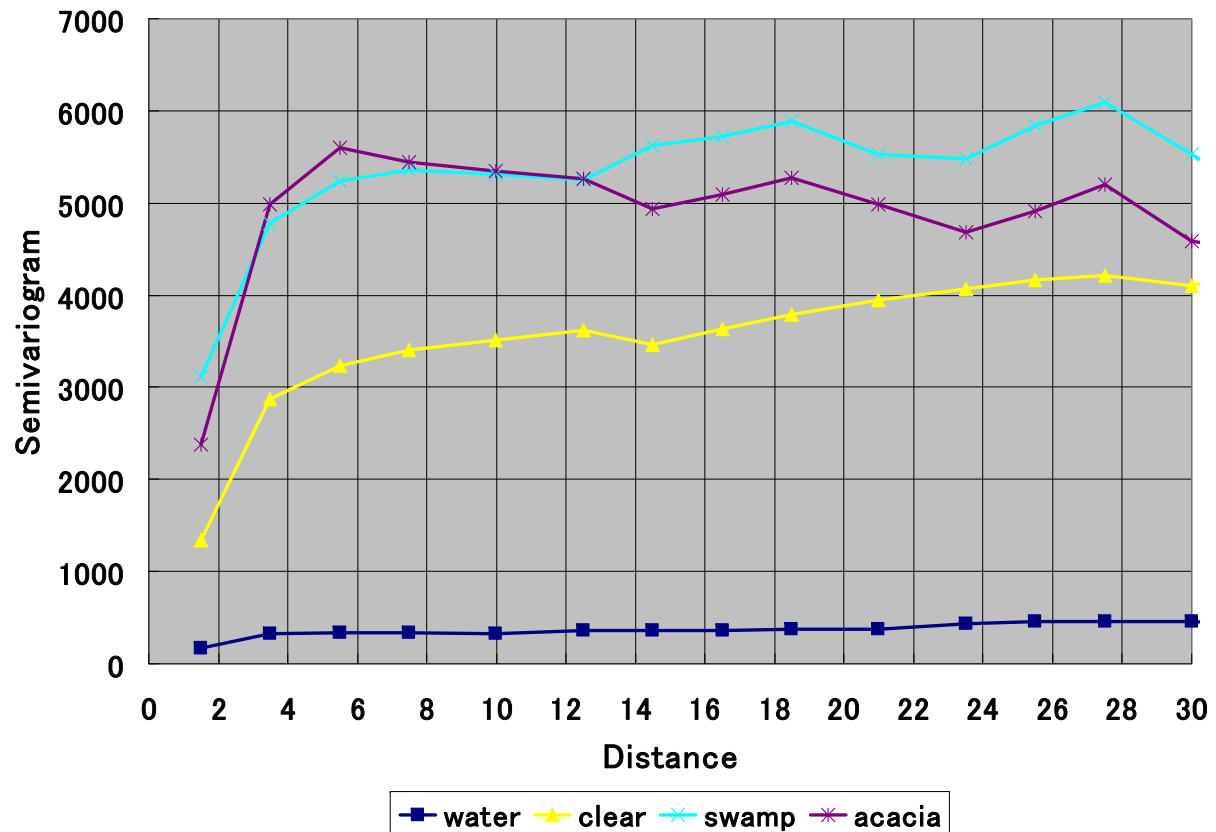


entropy

Subset 1, HH

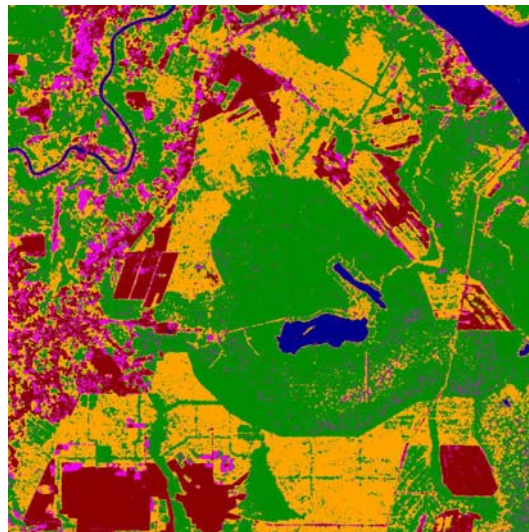


Subset 1, HV

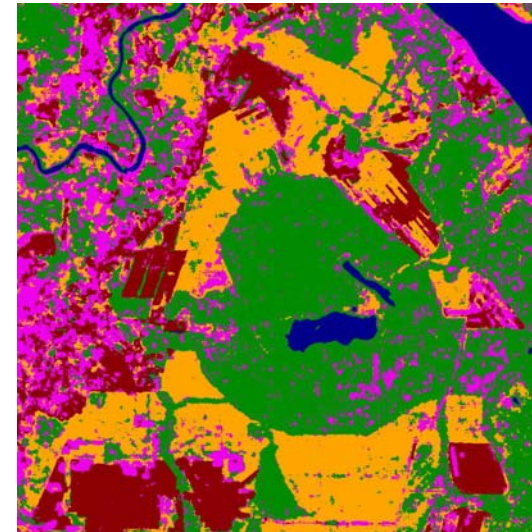




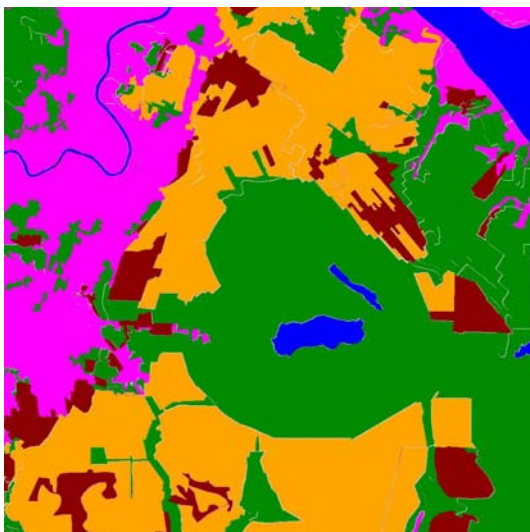
R = HH, G = HV, B = HH



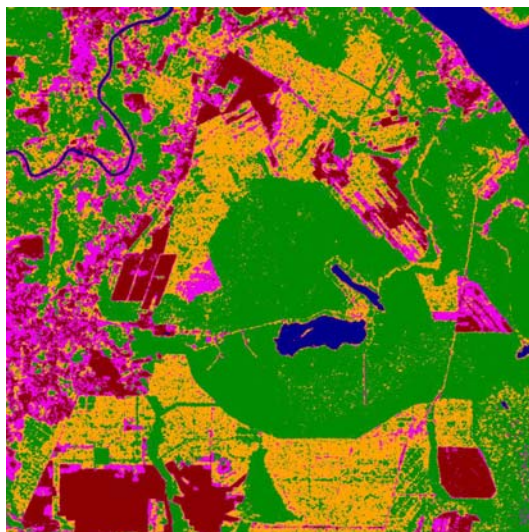
Maximum likelihood



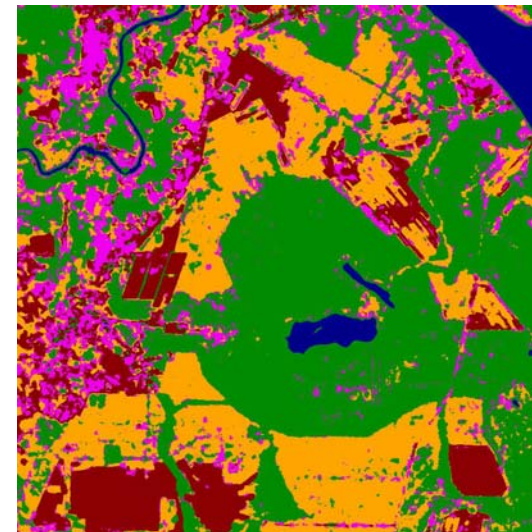
Maximum likelihood with texture



Darkgreen = swamp, orange = acacia, red = clear,
blue = water, purple = other



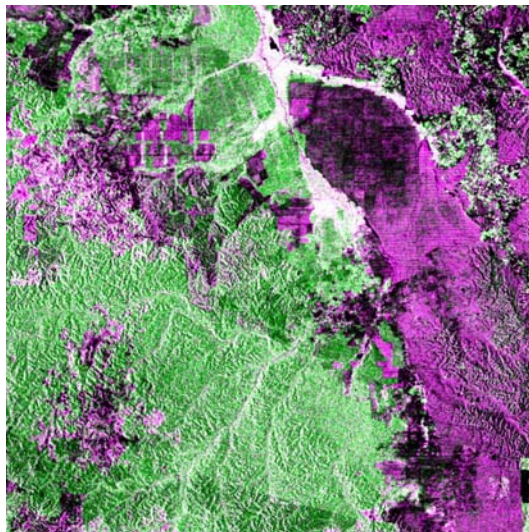
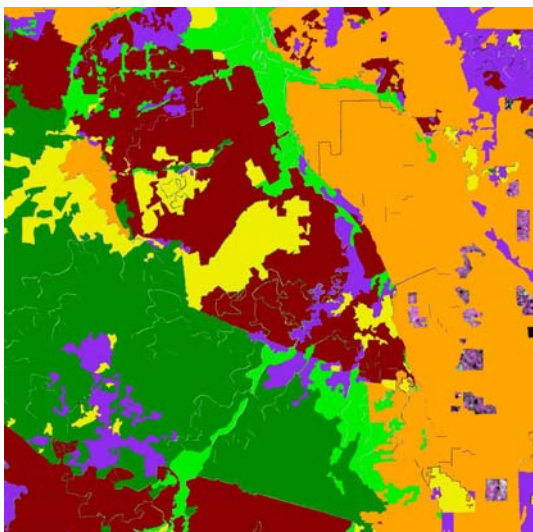
svm



svm with texture

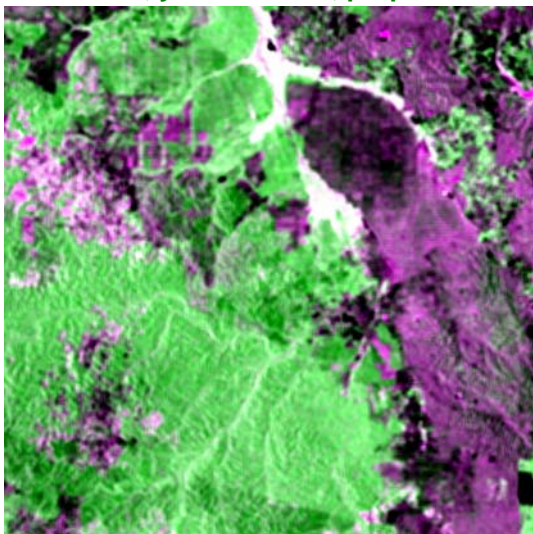
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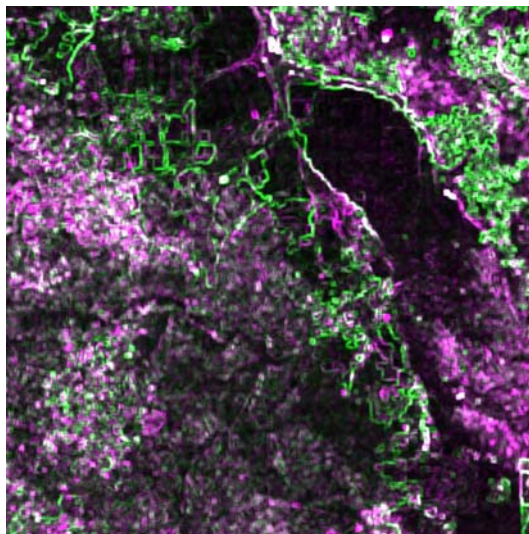


Darkgreen = dry forest, lightgreen=swamp, orange= palm,
red = acacia, yellow = clear, purple = other

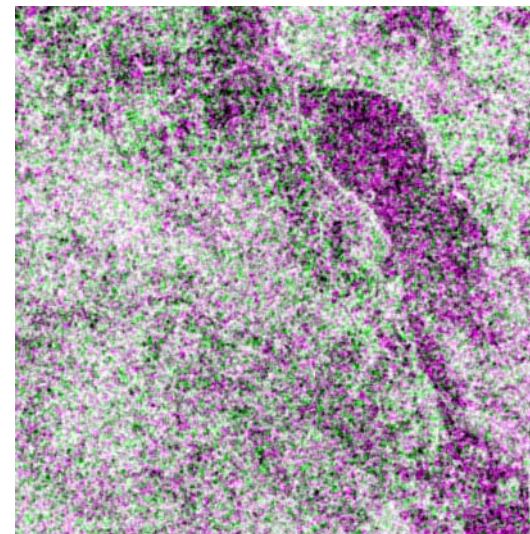
R = HH, G = HV ,B = HH



mean

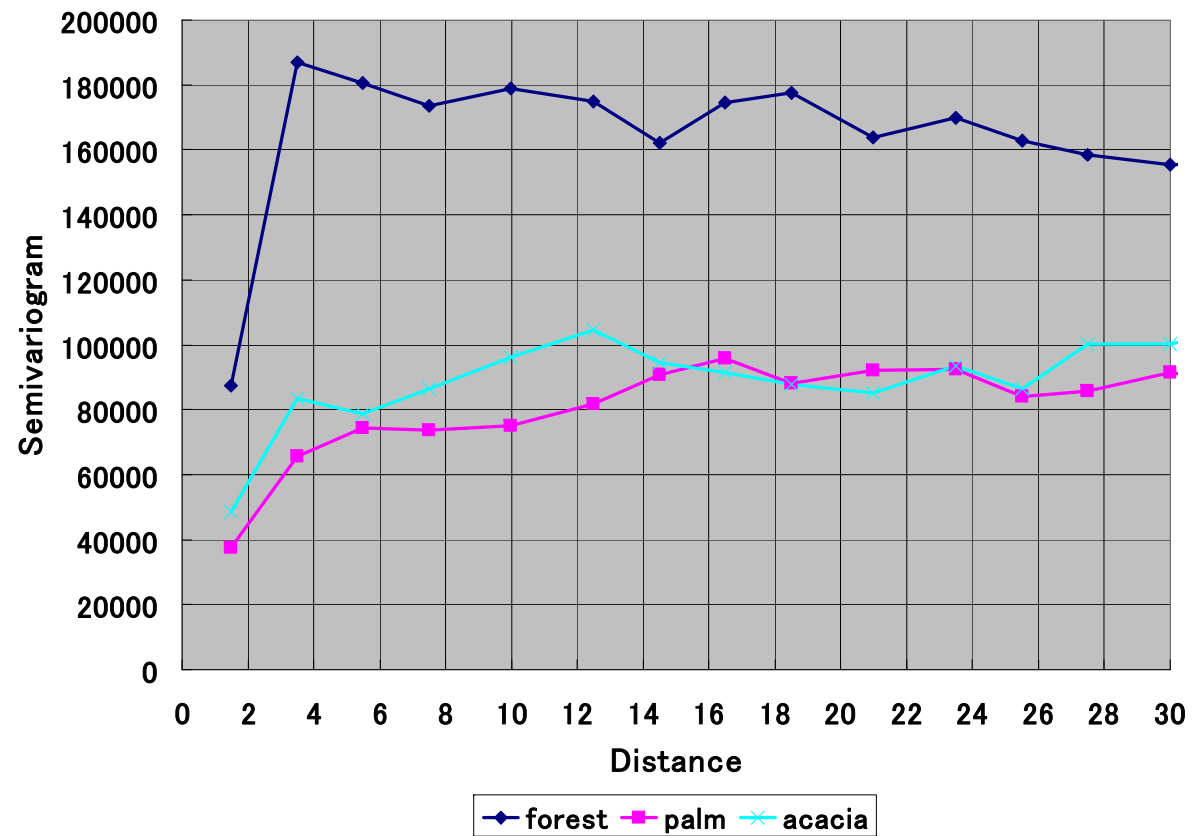


variance

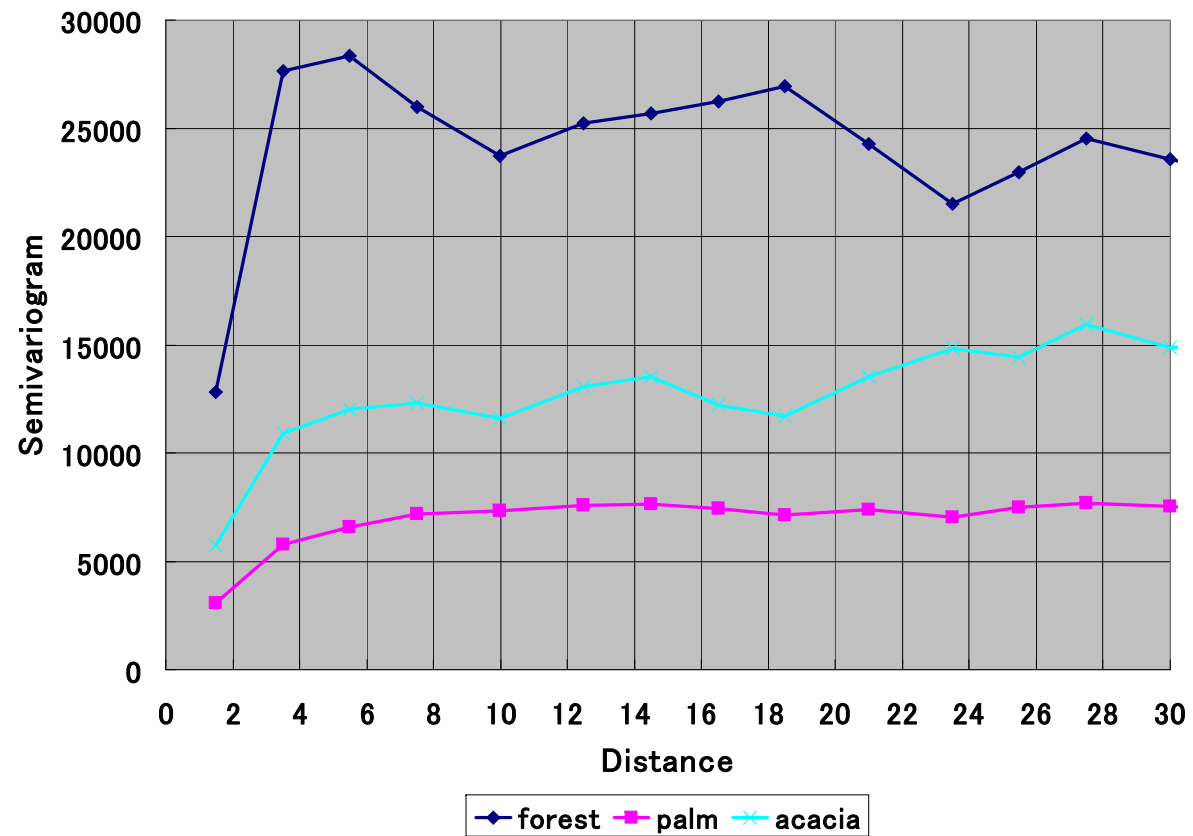


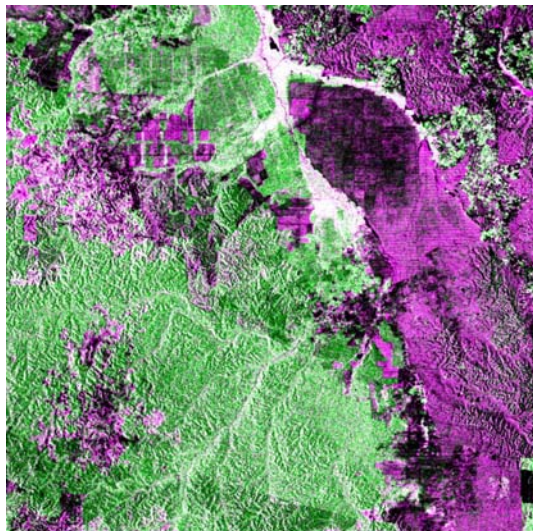
entropy

Subset 2, HH

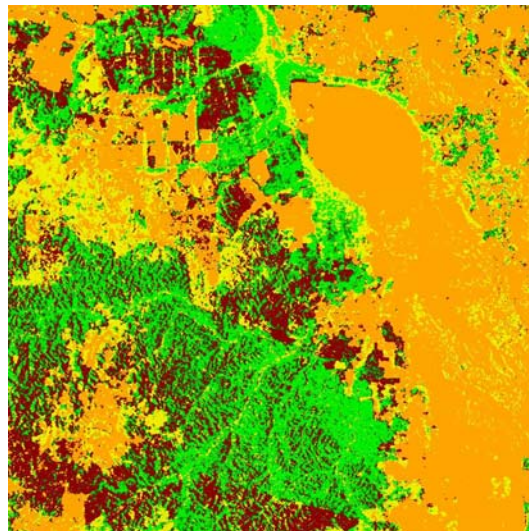


Subset 2, HV

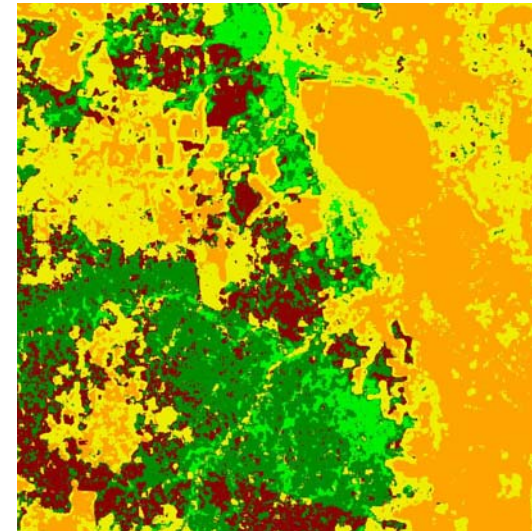




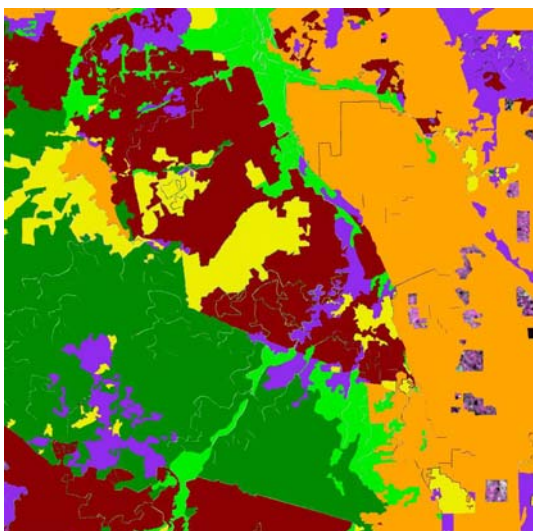
R = HH, G = HV, B = HH



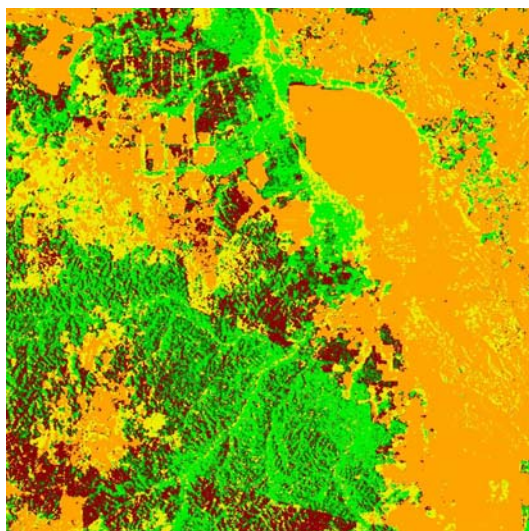
Maximum likelihood



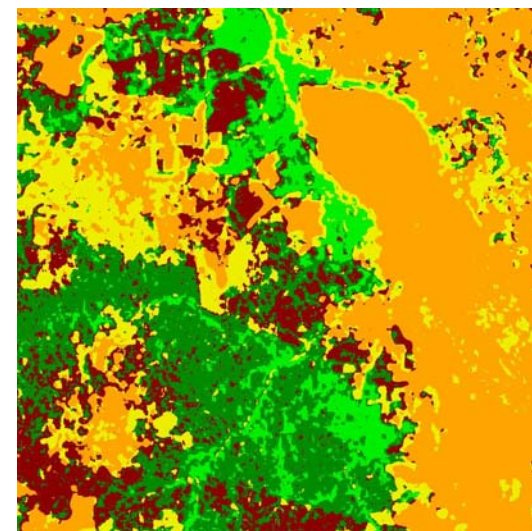
Maximum likelihood with texture



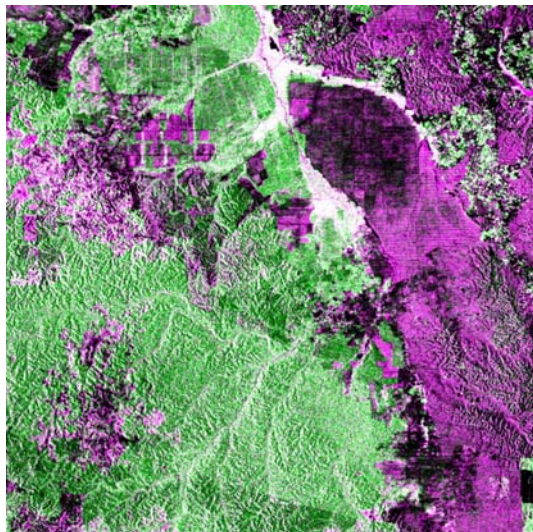
Darkgreen = dry forest, lightgreen=swamp, orange= palm,
red = acacia, yellow = clear, purple = other



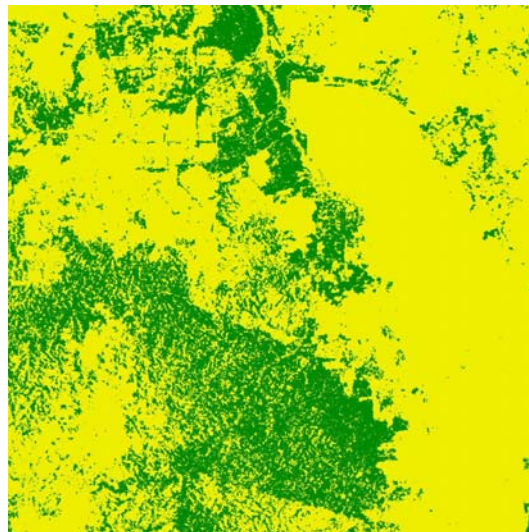
svm



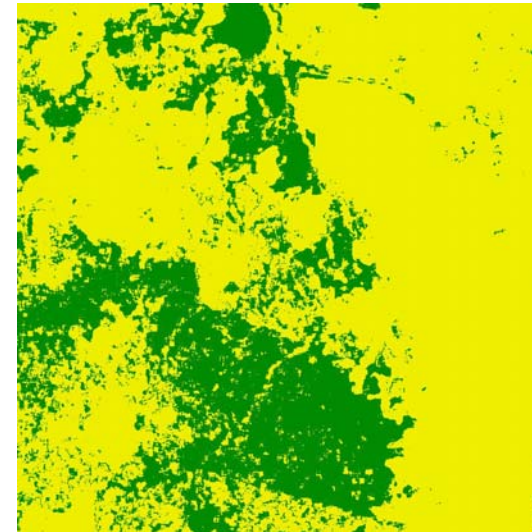
svm with texture



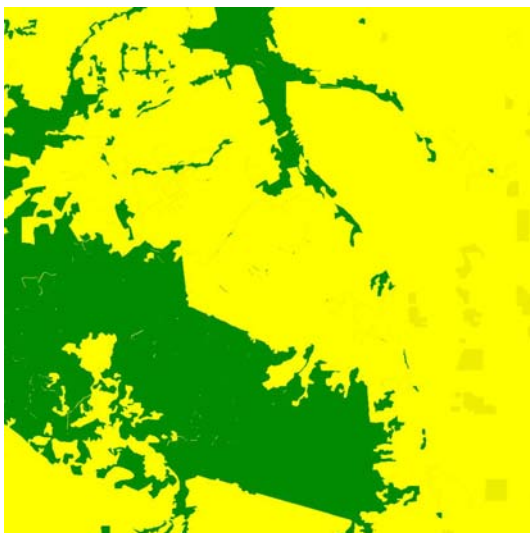
R = HH, G = HV, B = HH



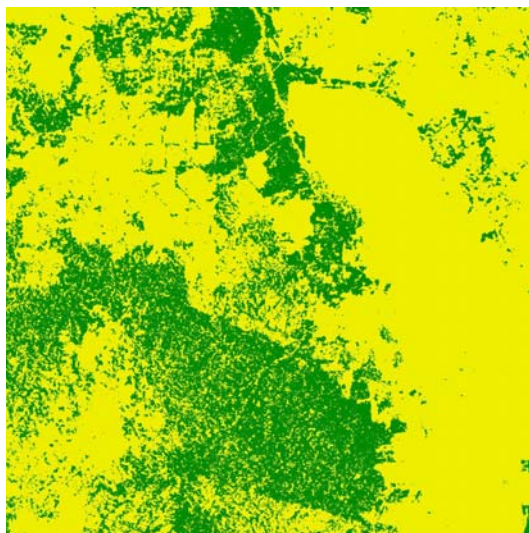
Maximum likelihood



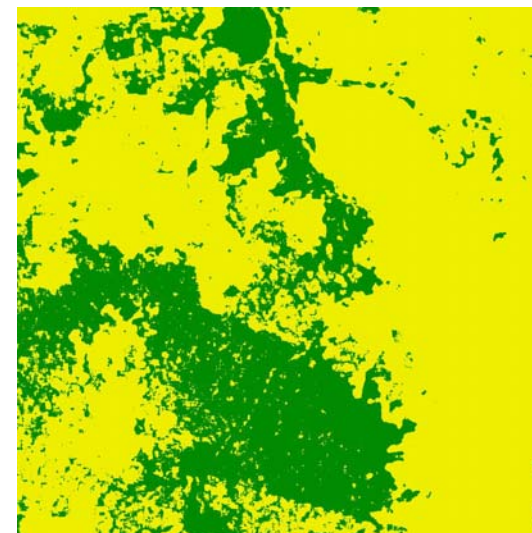
Maximum likelihood with texture



Darkgreen = dry forest, yellow = nonforest



svm



svm with texture

Classification accuracy

	Subset 1	Subset 2
SVM with texture	68.53%	80.92%
ML with texture	66.19%	80.19%
SVM	65.36%	77.90%
ML	63.93%	77.80%

Summary

- From the results, it can be found that SVM algorithm with texture gave better results compared with the other algorithm.
 - Acacia is very difficult to differentiate from dry forest and peat swamp (depended on growth stage)
- AVNIR 2 could be used to be a reference image. (depend on the cloud coverage)
- Grey Level Co-occurrence Matrix (GLCM) will be investigated. (Haralick, R.M. 1979)