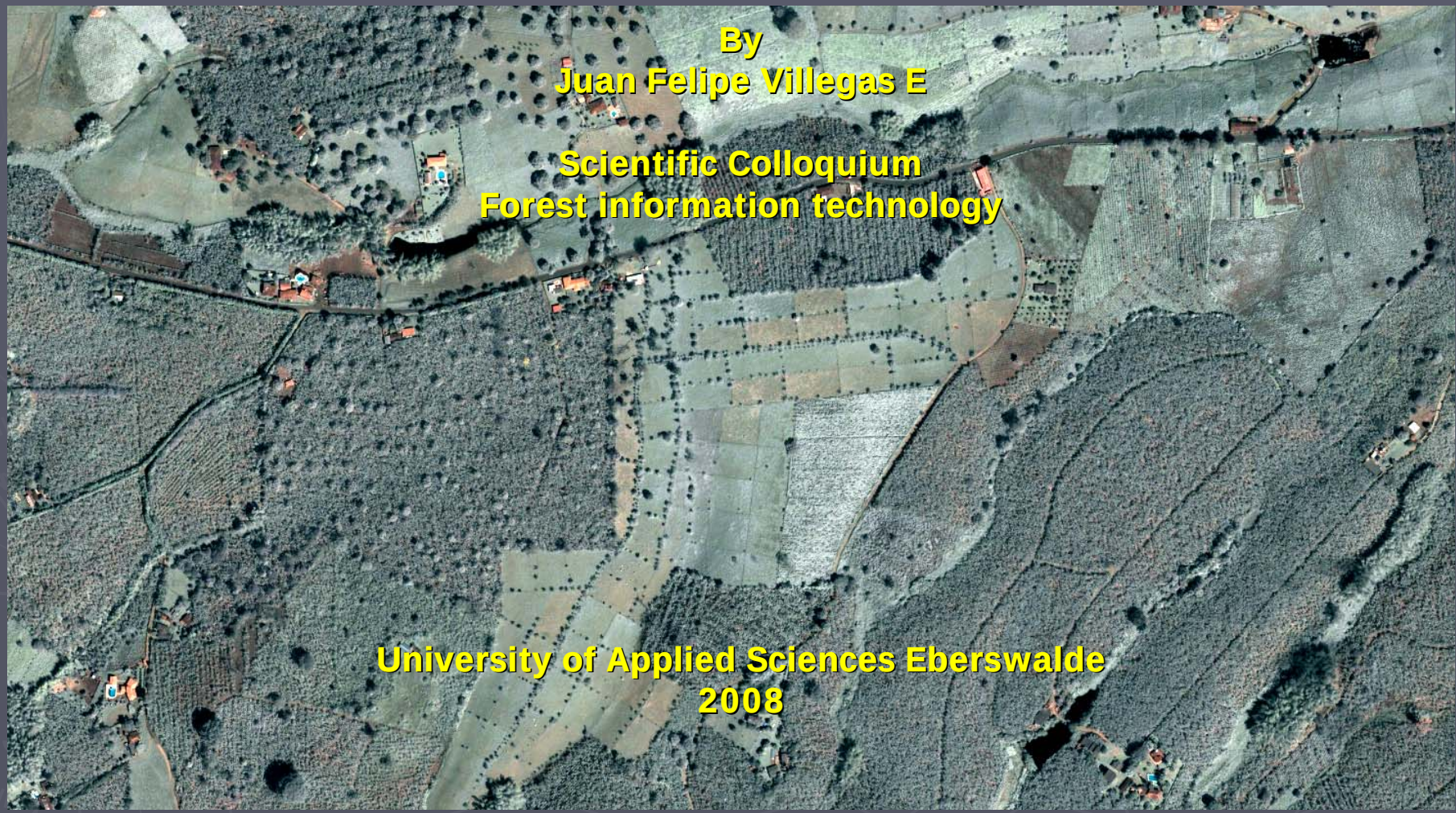
A comparison of three different Land use classification methods based on high resolution satellite images to find an appropriate methodology to be applied on a large area



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Forest information technology

University of Applied Sciences Eberswalde
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Content

- Objectives
- Background
- Methodology
- Results
- Conclusions and limitations

Objectives

-To find an appropiate method to classify a Large area based on high resolution quickbird satellite images.

-To classify the entire area under consideration with the selected method.

-To create a continuous surface with the total number of images to calculate some important patch ,class and landscape metrics .

Quickbird images

Multispectral Pixel Resolution

The table below describes the Multispectral resolution for QuickBird Products.

Spectral Band	Resolution	Product
Multispectral	2.44 - 2.88 m (changes with off-nadir angle)	Basic
		Basic Stereo Pair
	2.4 m or 2.8 m	Standard
		Ortho Ready Standard
		Orthorectified

The table below describes the Pan-sharpened resolution for QuickBird Products.

Spectral Band	Resolution	Product
Pan-sharpened	*Not Available*	Basic
		Basic Stereo Pair
	60 cm or 70 cm	Ortho Ready Standard
		Standard & Orthorectified

Source: DigitalGlobe, Inc. 1900 Pike Road Longmont, Colorado 80501

Natural Color (Pan-sharpened)

	Black & White	Color (3-band)	Multispectral	Pan-sharpened (4-band)	Bit Depth
Basic Imagery (one scene)	800 MB	NA	200 MB	NA	8
	1600 MB	NA	400 MB	NA	16
Standard and Orthorectified Imagery (8k x 8k tile)	75 MB	200 MB	20 MB	270 MB	8
	150 MB	400 MB	40 MB	540 MB	16
Standard and Orthorectified Imagery (14k x 14k tile)	200MB	600MB	50Mb	800MB	8
	400MB	1200MB	100MB	1600MB	16
Standard and Orthorectified Imagery (16k x 16k tile)	300 MB	800 MB	75 MB	1080 MB	8
	600 MB	1600 MB	150 MB	2160 MB	16

Source :DigitalGlobe, Inc. 1900 Pike Road Longmont, Colorado 80501

- Synonym: 3-band Pan-sharpened, color
  Imagery covers the Black & White, Red, Blue, and Green bands.
- Pan-sharpened using a proprietary algorithm to combine the spatial information of the black and white band with the visual information of three multispectral bands.
- All three spectral bands delivered as one image file.

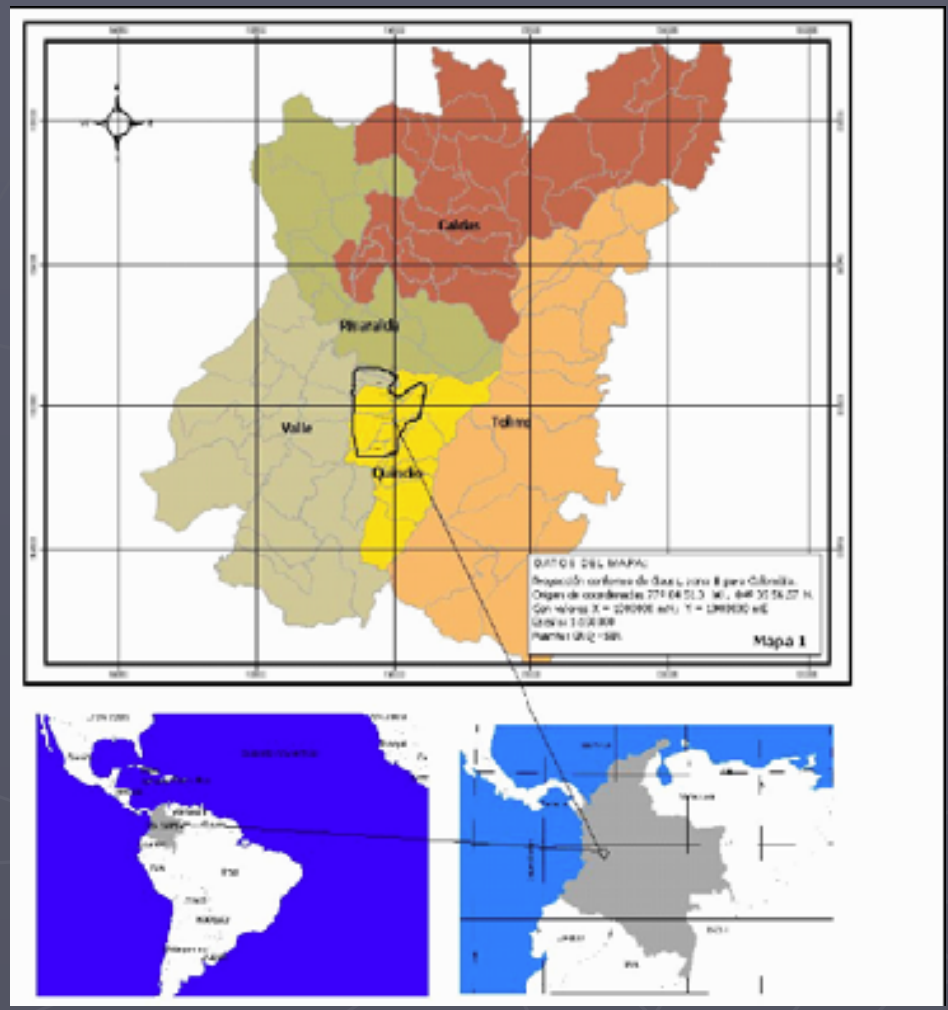
Methodology

- Area of study:

The area of study is located in Colombia in the nort-west of Quindio department and in the nort-east of Valle del cauca.

The total region has an area of 518.12 Km2 and it belongs to the municipalitys of Finlandia ,Circasia,Armenia ,Montenegro,La Tebaida, cartago,Alcalá and Ulloa .

The area Falls between 950 and 1800 m.a.s.l



Taken From Camargo 2005

Land use Classification methods

Pixel based classification

Unsupervised classification :

K-means unsupervised clustering was selected .

Five classes were selected.

Supervised classification

Five classes were expected to be classified

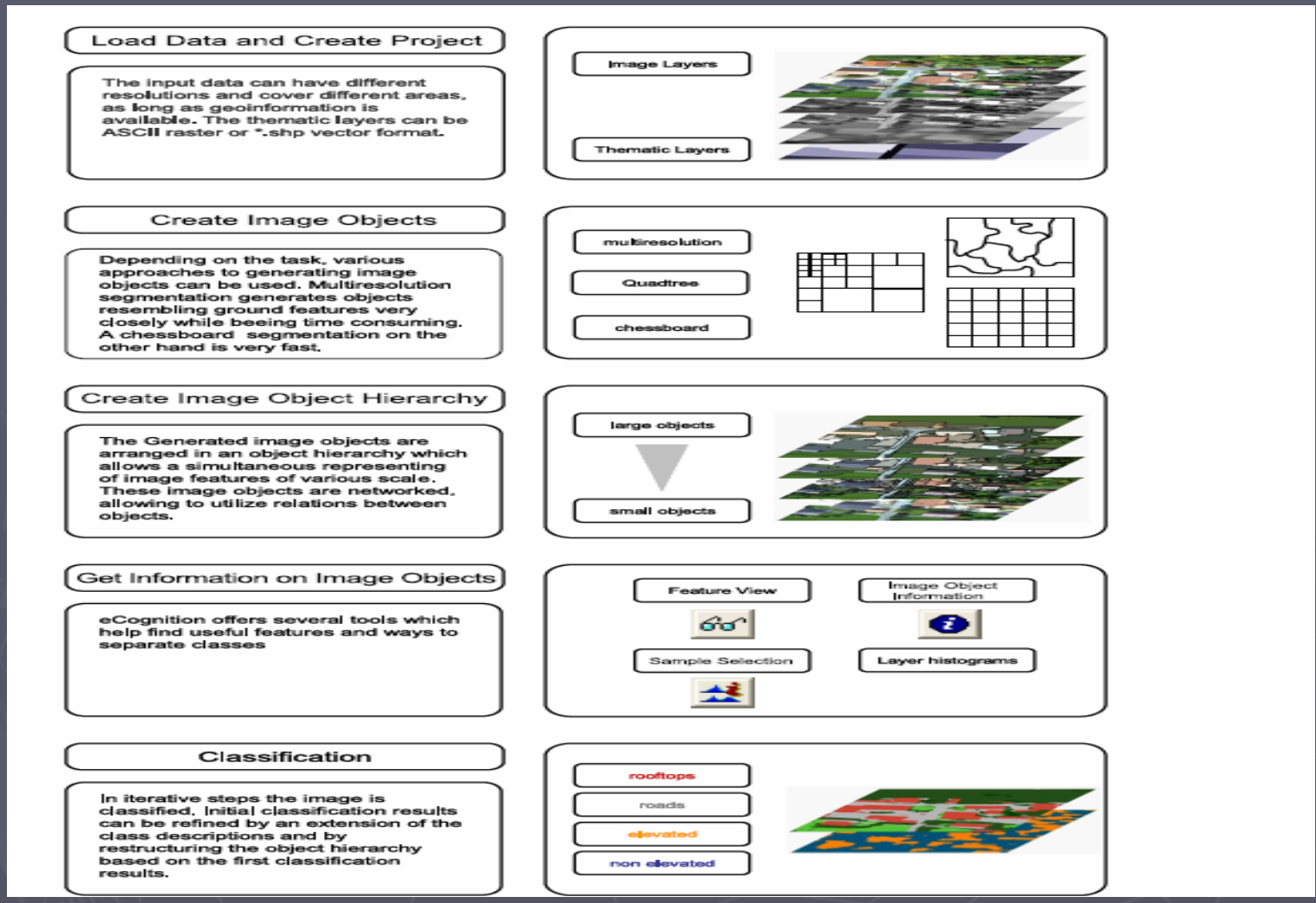
Forest, grassland , bare soil, water bodies and clouds .

Object Oriented classification

As a first step a segmentation process was executed to divide the images into unclassified objects.

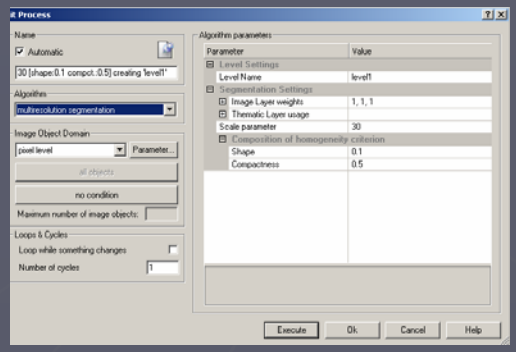
These unclassifiedobjects contain information about their spectral characteristic, shape, texture, position and information about their neighbourhood.

The workflow of classification consists of the following sequence



Source:Defiens Profesional 5 Users Guide

Segmentation to Classify clouds , shadows And water bodies



Selection of scale ,shape And compactness parameters

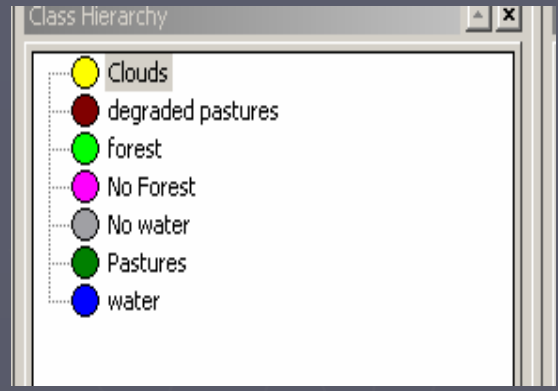
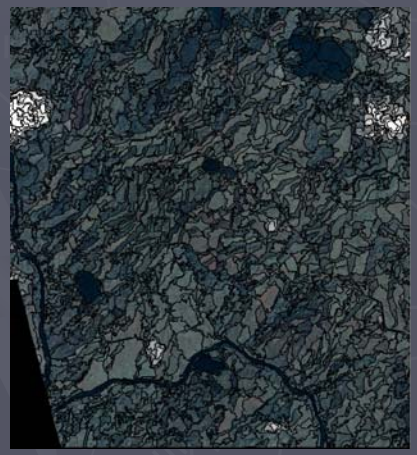
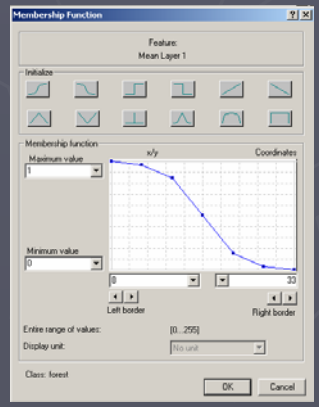
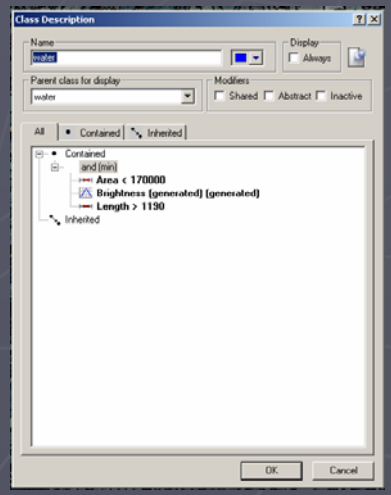


Image Object Hierarchy



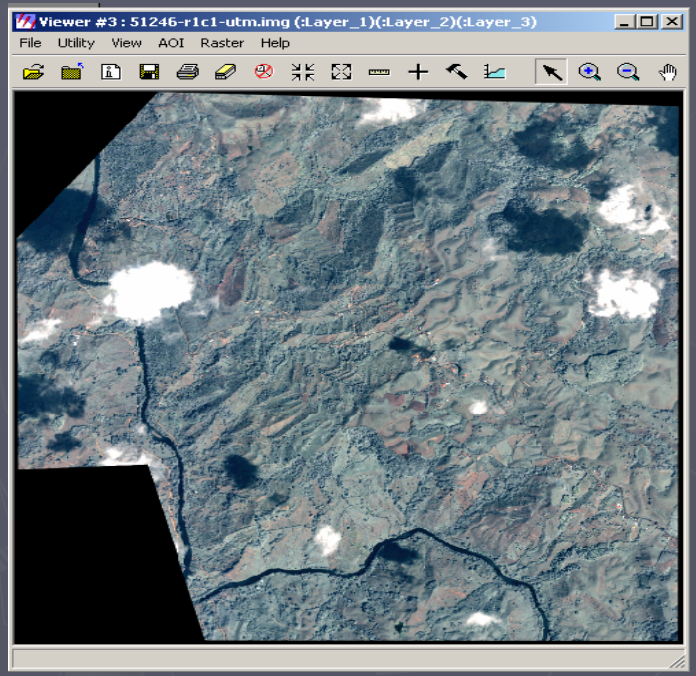


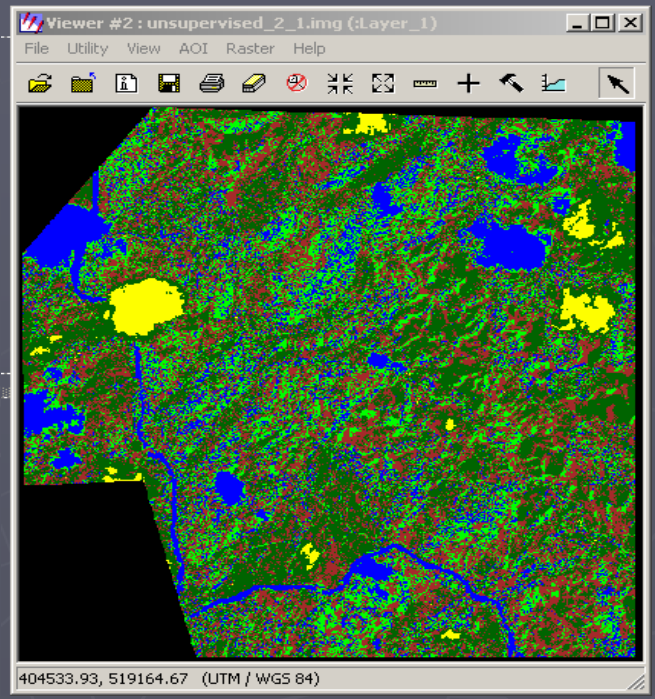


Selection of rules for an specific class using membership functions

Results

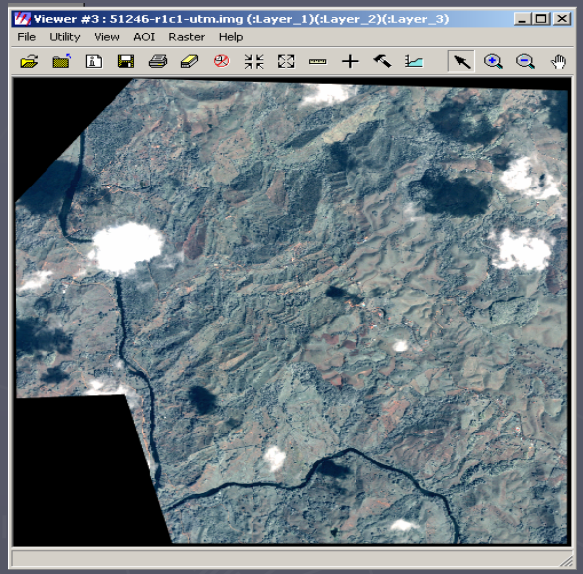
Pixel Based Unsupervised classification

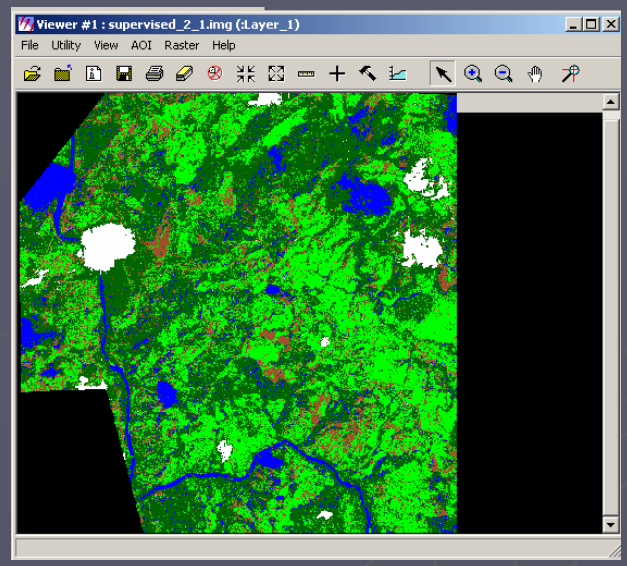




- The unsupervised classification presented confuse patterns for all the classes that were included in the analysis procedure .
- Clouds were easily recognized . Water bodies are dispersed on the whole area
- It was not even possible to define a legend for the classified areas among the different land cover types.

Pixel Based Supervised classification





Theoretically a training sample should be just composed of pixels that belong to its corresponding class.

Error matrix for Pixel Based Supervised classifiation.

Best result After several attempts for the classification.

The error matrix shows that 40.47% of the forest area of the training samples could be also classified as grass .Forest was also represented in a high percentage by water 16.67 %. This high representation was observed just between these two types of land covers.

Table 2 .Error matrix for the pixel based supervised classification .Here the best result are presented after several attempts .

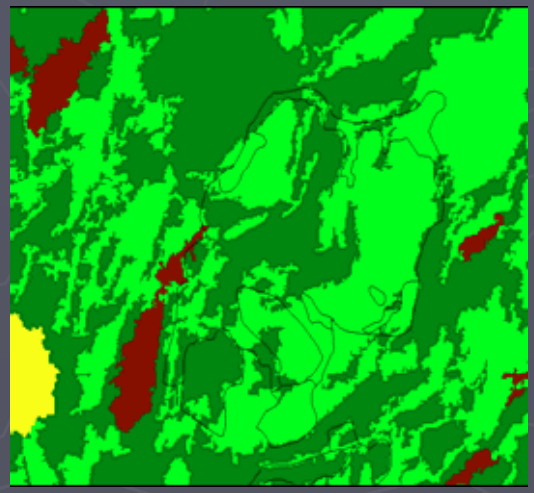
	Reference Data					
Classified Data	degraded	clouds	grass	forest	water	Row Total
degraded	58.66	0.00	14.62	24.62	0.07	108195
clouds	0.00	95.88	0.00	0.00	0.00	43291
grass	21.85	4.12	73.90	40.47	0.00	188240
forest	12.06	0.00	10.37	18.24	0.00	46029
water	7.43	0.00	1.11	16.67	99.93	59493
Column To	106017	45151	175757	82362	35961	445248

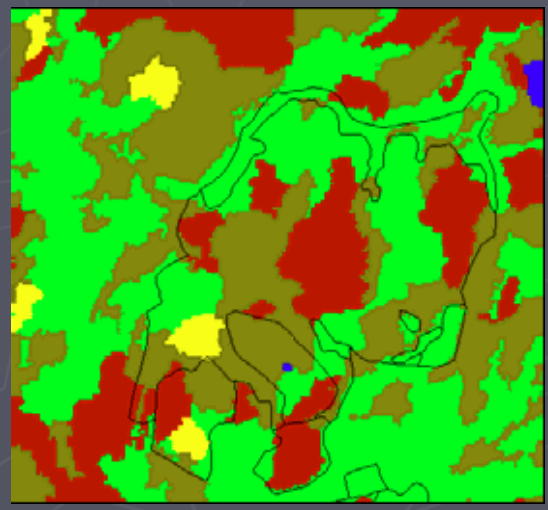
Object Oriented Classifiation

- Different parameters were tested as a trial and error experiment to find the appropriate scale , shape and compactness.

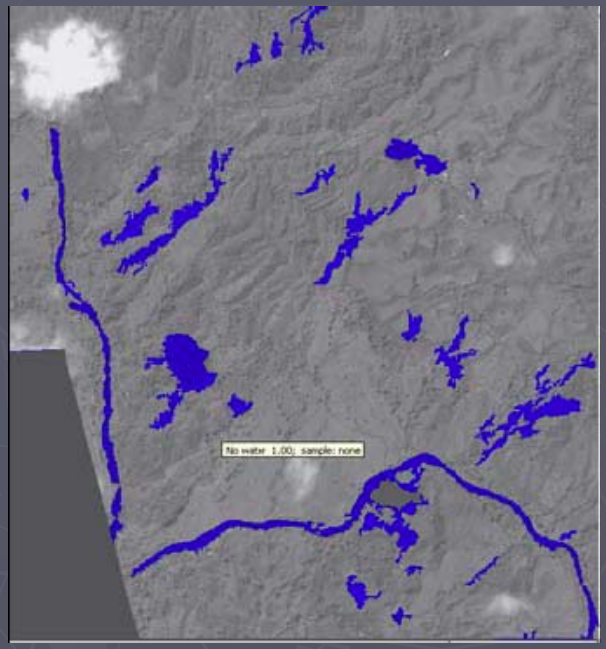
  The Scale parameter is an abstract term which determines the maximum allowed heterogeneity for the resulting image objects.

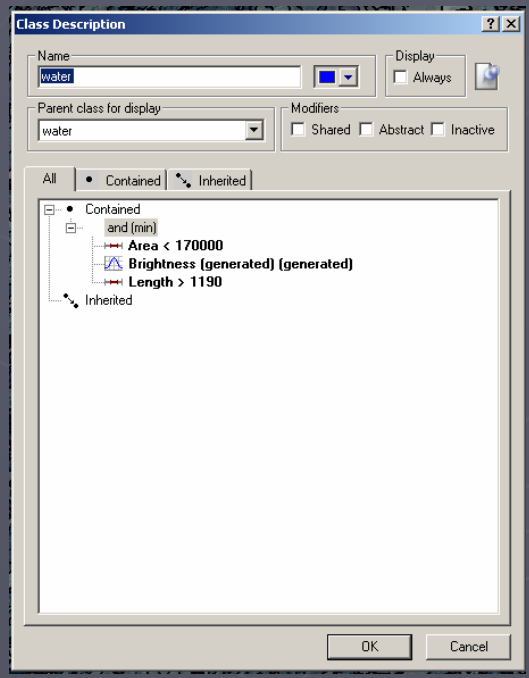
- Applied parameters were . 17 for scale 0,1 for shape, and 0,9 for compactness .



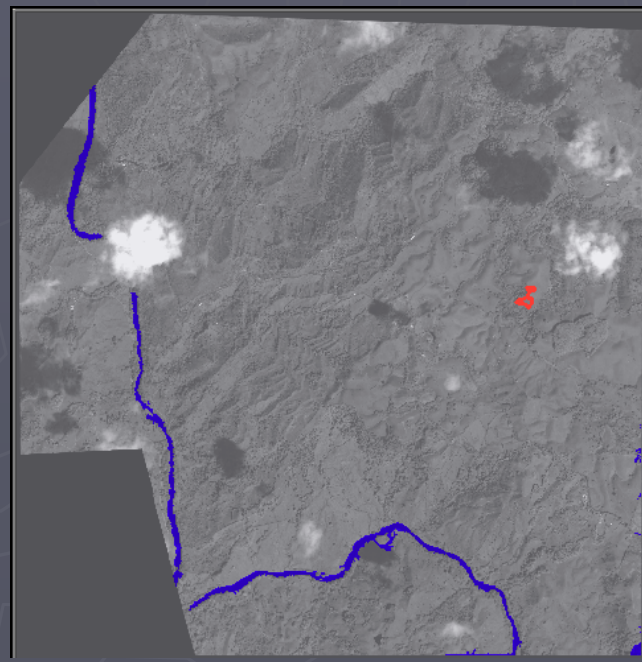


Miss classified areas

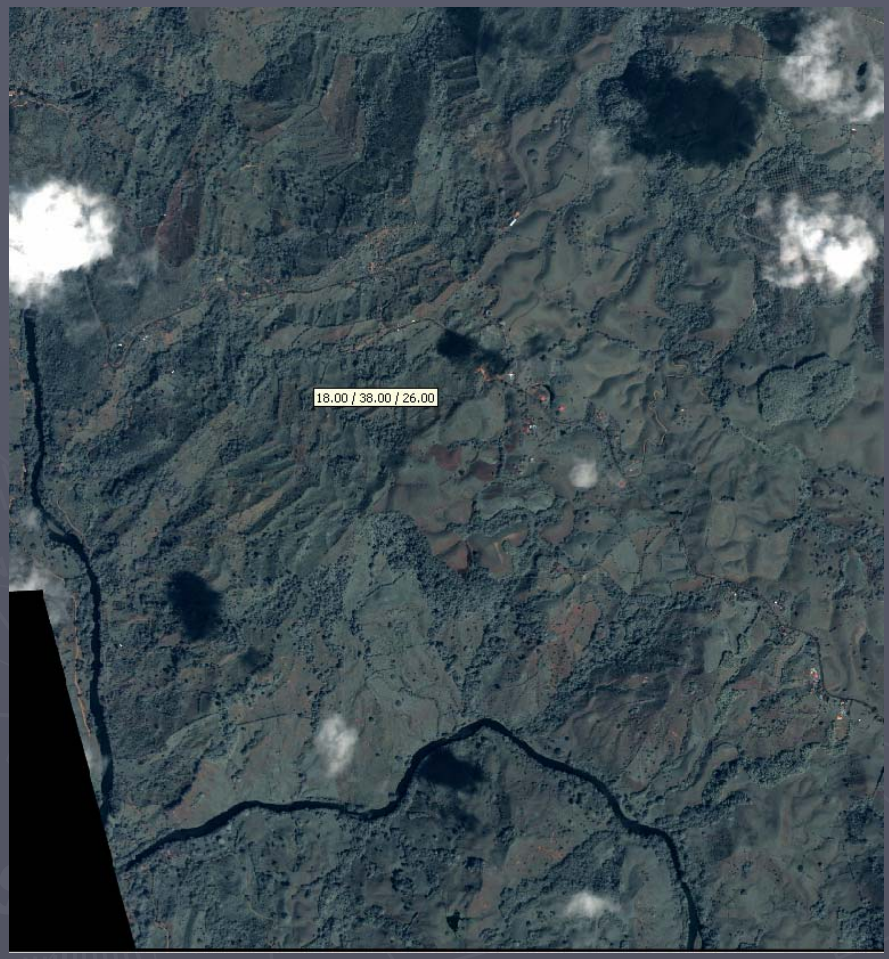


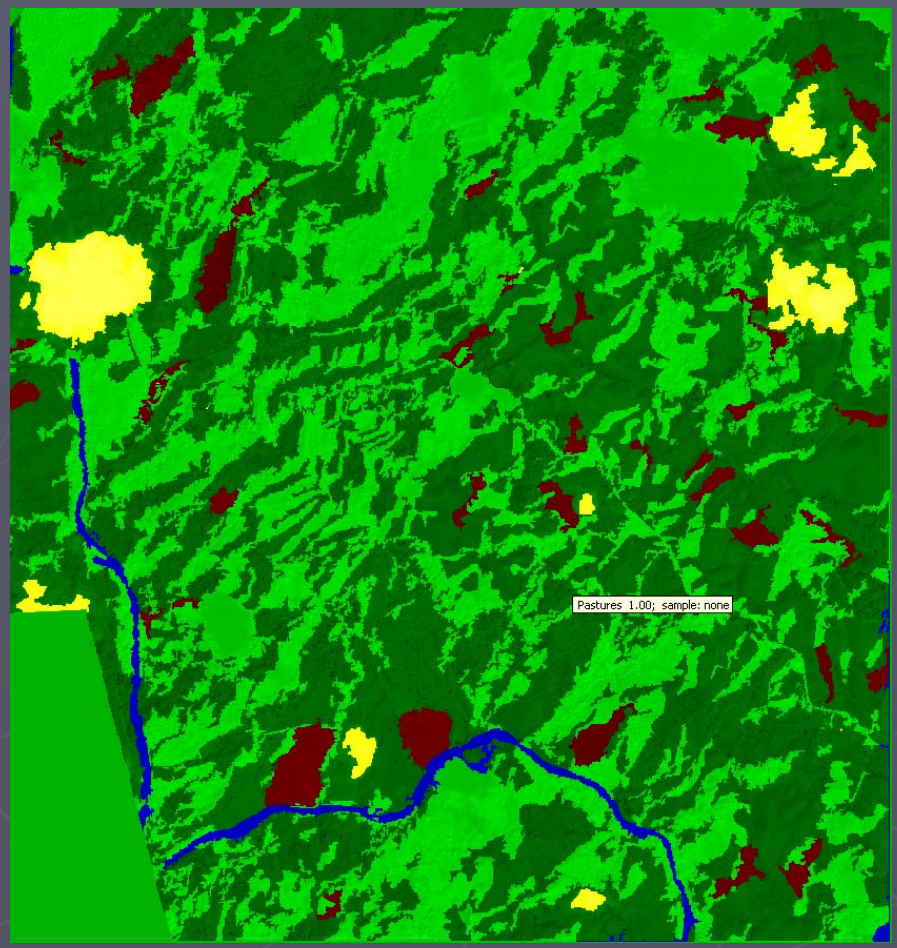


Addition of area and length
For the feature domain

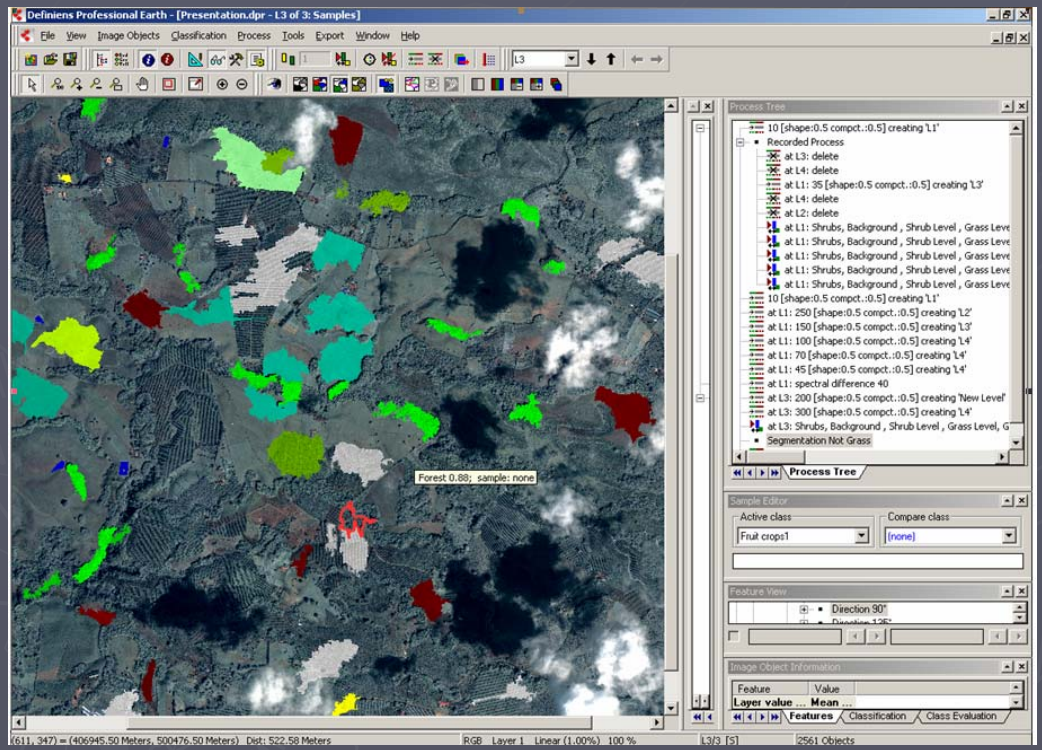


Final Classification result

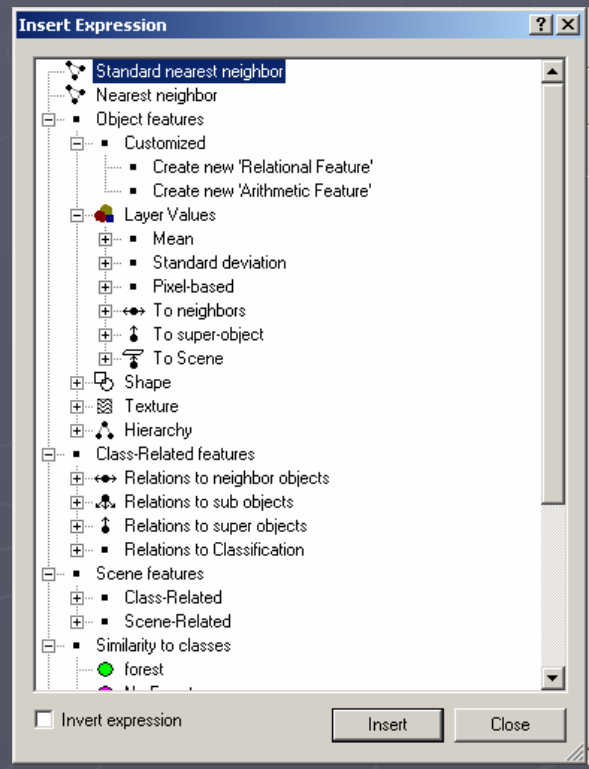


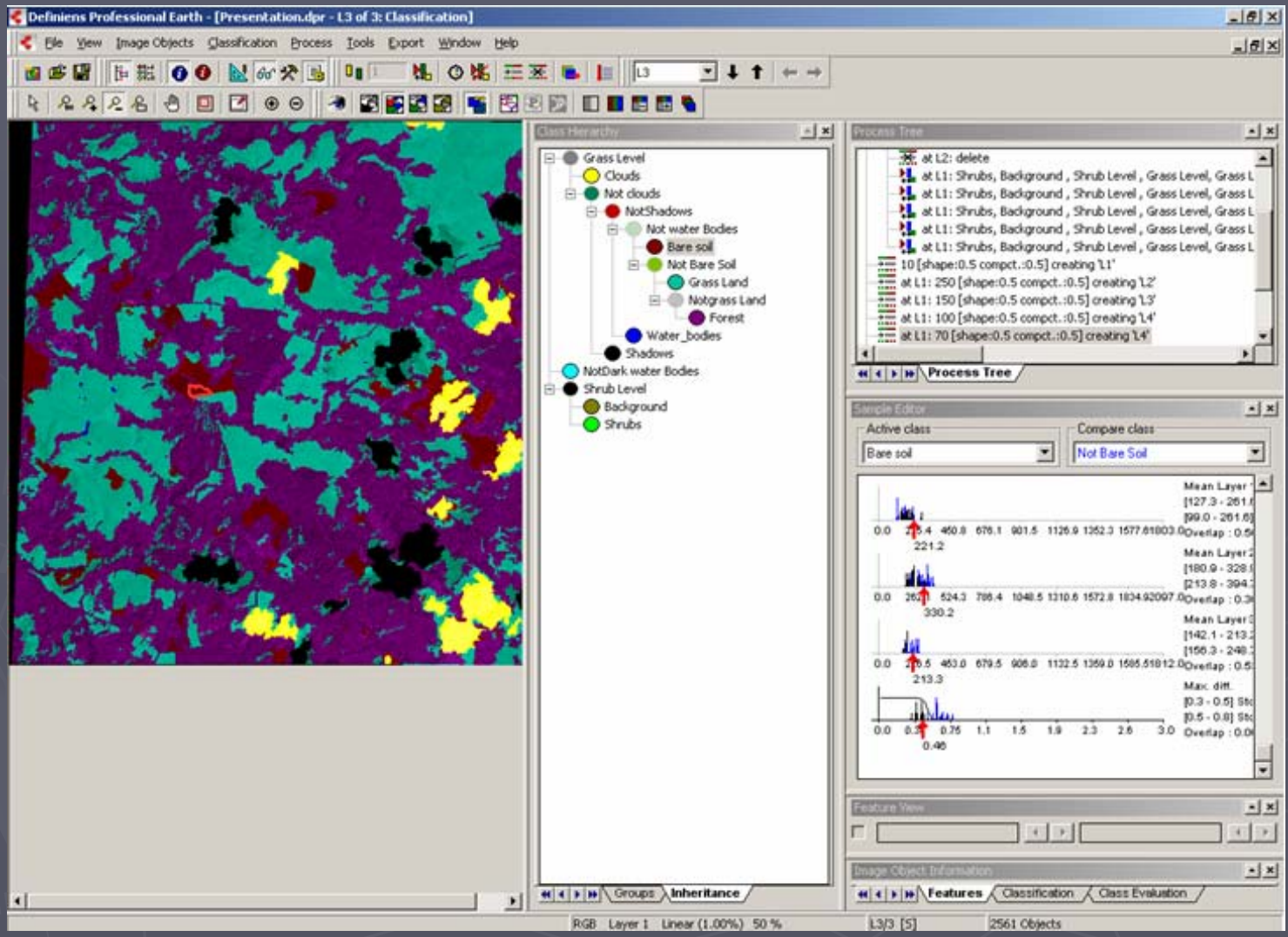


Selection of samples

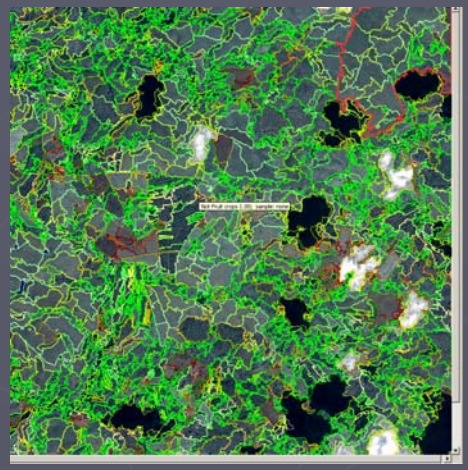


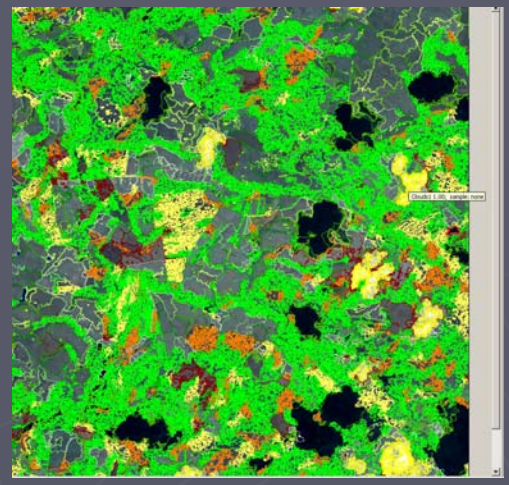
Available features for the classification

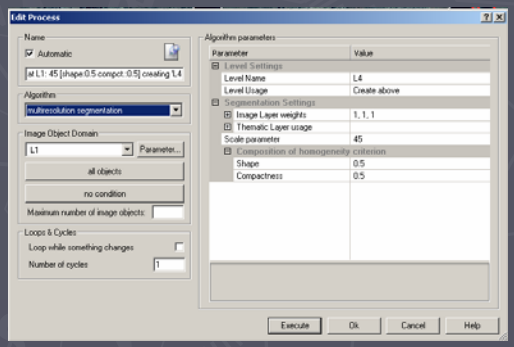


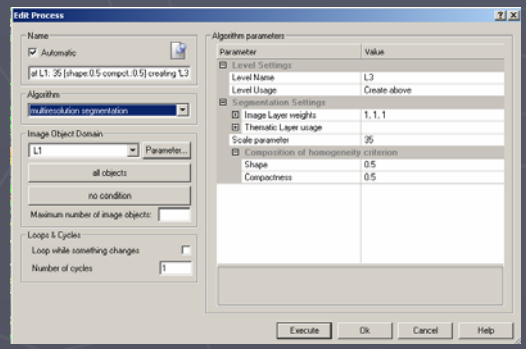

Definiens Professional Earth - [Presentation.dpr - L3 of 3: Classification]
File View Image Objects Classification Process Tools Export Window Help
Class Hierarchy
Grass Level
Clouds
Not clouds
NotShadows
Not water Bodies
Bare soil
Not Bare Soil
Grass Land
Notgrass Land
Forest
Water_bodies
Shadows
NotDark water Bodies
Shrub Level
Background
Shrubs
Groups Inheritance
Process Tree
at L2: delete
at L1: Shrubs, Background , Shrub Level , Grass Level, Grass L
10 [shape:0.5 compct.:0.5] creating 'L1'
at L1: 250 [shape:0.5 compct.:0.5] creating 'L2'
at L1: 150 [shape:0.5 compct.:0.5] creating 'L3'
at L1: 100 [shape:0.5 compct.:0.5] creating 'L4'
at L1: 70 [shape:0.5 compct.:0.5] creating 'L4'
Process Tree
Sample Editor
Active class
Bare soil
Compare class
Not Bare Soil
Feature View
Image Object Information
Features Classification Class Evaluation
RGB Layer 1 Linear (1.00%) 50 %
L3/3 [5]
2561 Objects

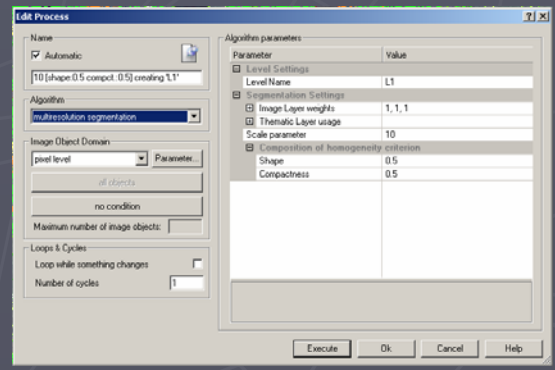
Three different segmentation levels for the classification of the area



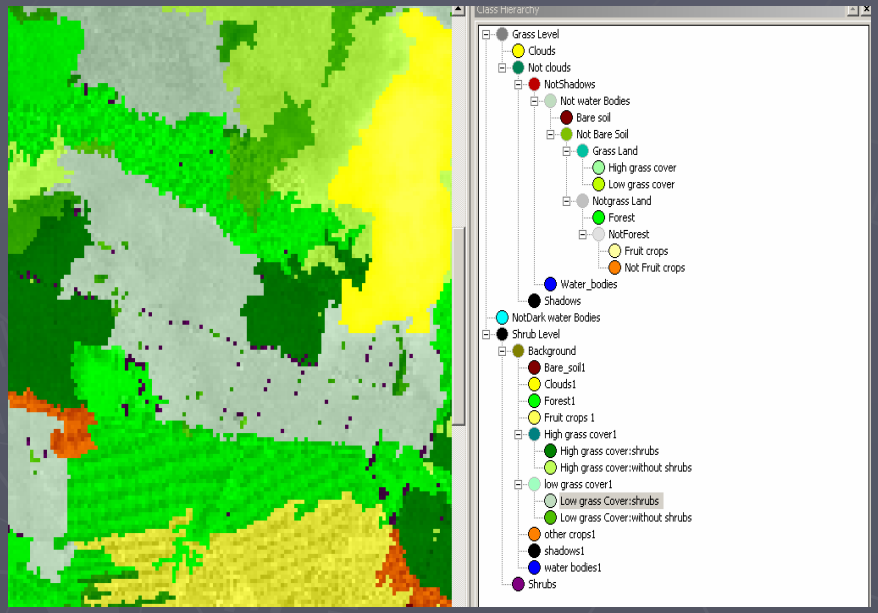


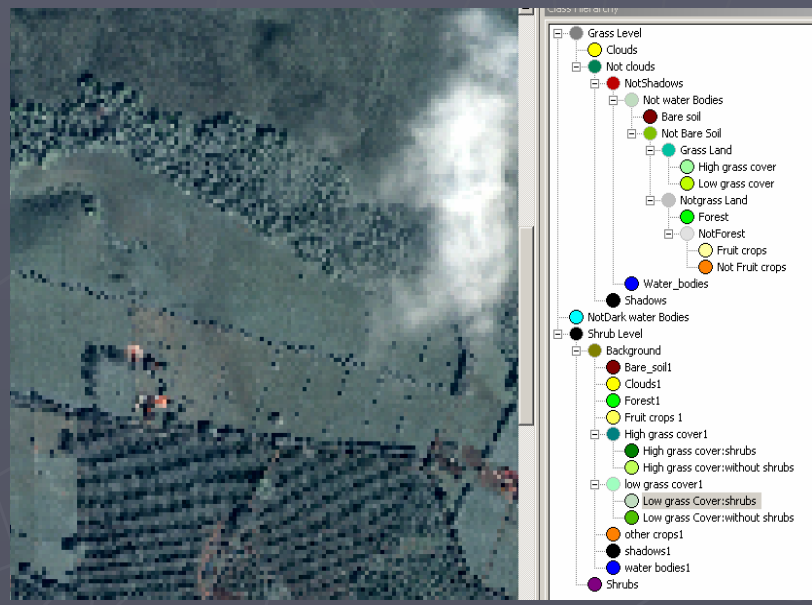






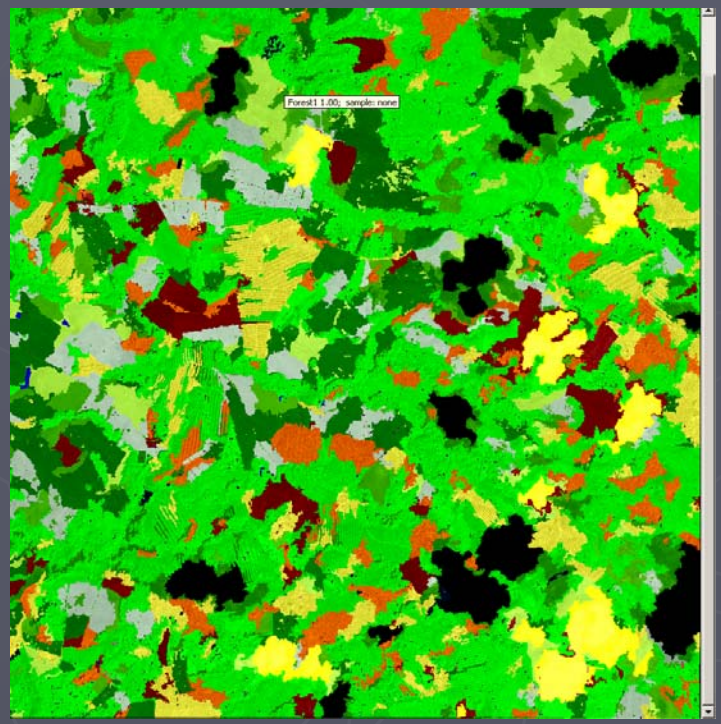
Classification of shrubs and trees creating a new segmentation level

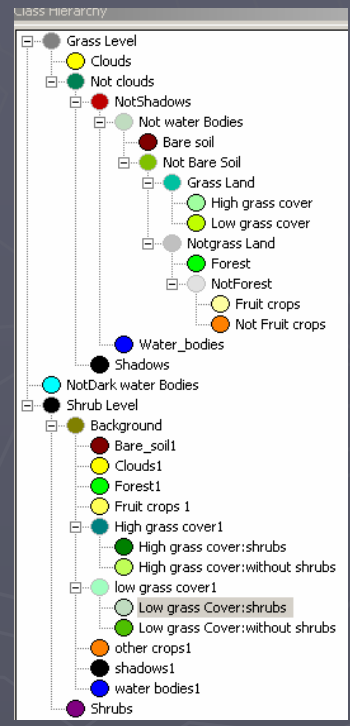




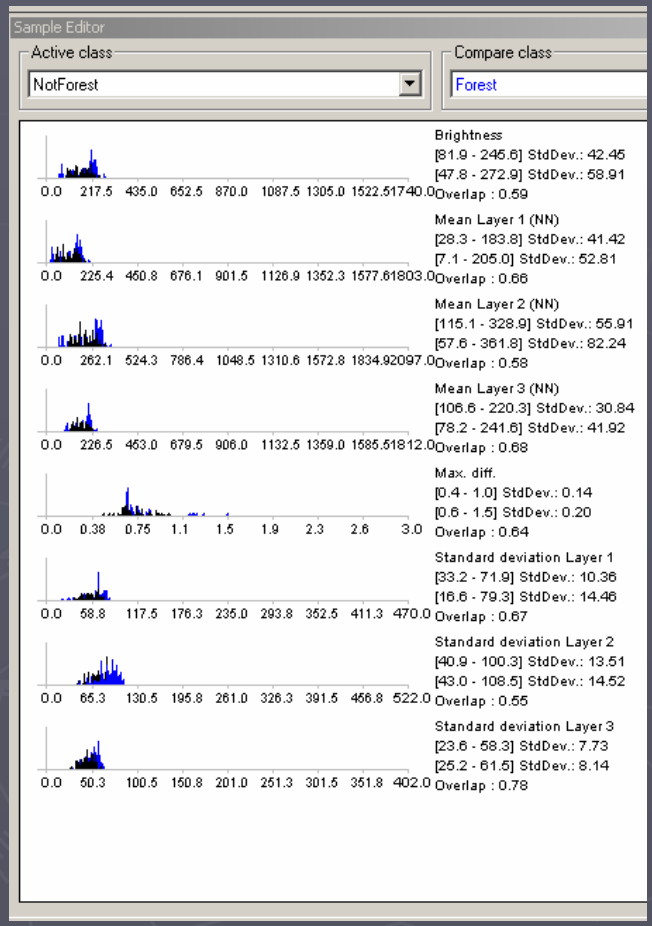
Miss classified areas are observed for agriculture areas and forest

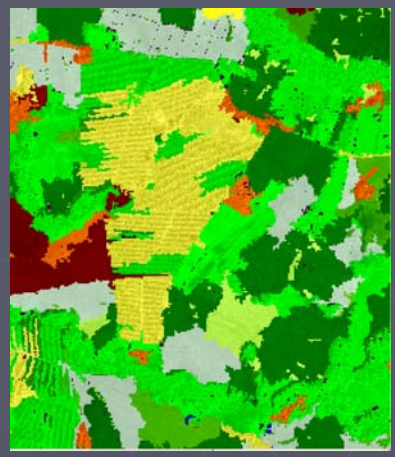
Final classification result with 12 different land use classes





Sample editor to compare the spectral Properties of two different classes





Conclusions and limitations

- Several differences among all the methods were found
- The high resolution of the images produced in both the unsupervised and in the Pixel oriented classification the so called “Salt pepper effect”
- Object oriented classification offers a flexible environment for the classification that can be adapted to the specific task . Nonetheless this technique requires an advance knowledge and experience to find the correct parameters for the segmentation that is needed to start with the classification of the area .
- Pan-sharpened images are absolutely negative for the performance of the computer hardware that is required for the analysis . Therefore it is strictly recommended to work with the original spectral images(Multispectral images) with a coarse resolution (2.6 m) and use the panchromatic layer just when additional segmentation processes are needed .
- Classification results are seriously influenced by the experience of the person .
- Developing an appropiate set of rules for the classification is a very time consuming activity .