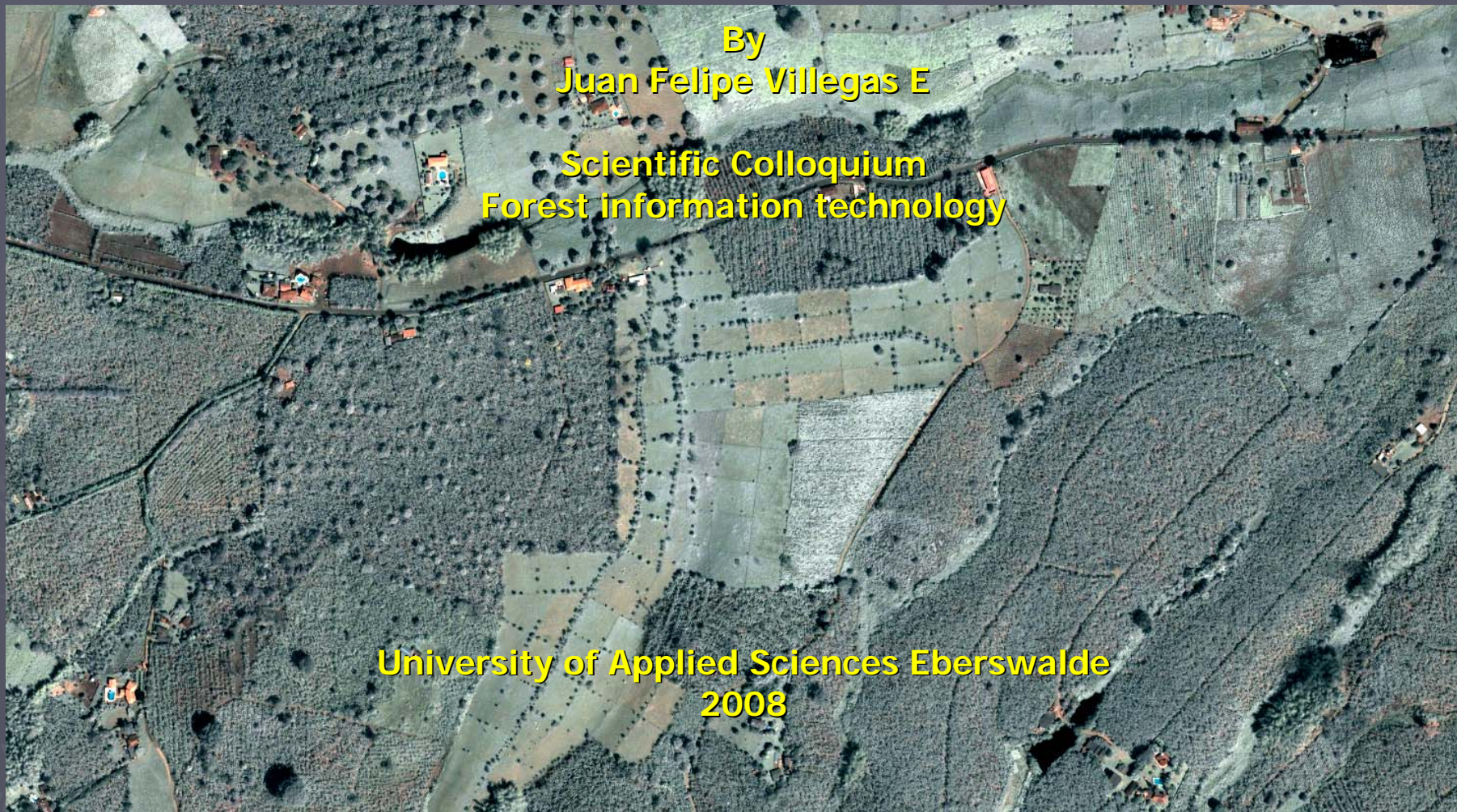


A comparison of three different Land use classification methods based on high resolution satellite images to find an appropriate methodology to be applied on a large area

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Content

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

Objectives

- To find an appropriate 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



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.

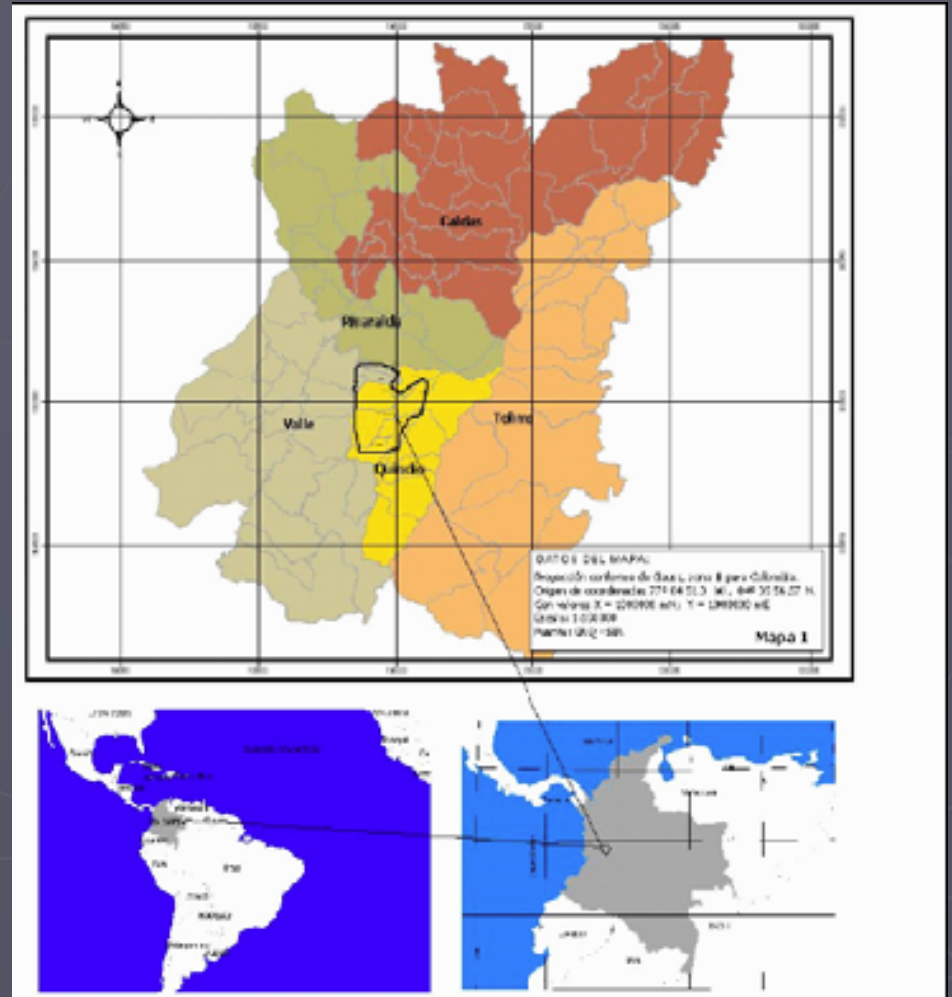
Methodology

► Area of study:

The area of study is located in Colombia in the north-west of Quindío department and in the north-east of Valle del Cauca.

The total region has an area of 518.12 Km² and it belongs to the municipalities 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 unclassified objects contain information about their spectral characteristic, shape, texture, position and information about their neighbourhood.

The workflow of classification consists of the following sequence

Load Data and Create Project

The input data can have different resolutions and cover different areas, as long as geoinformation is available. The thematic layers can be ASCII raster or *.shp vector format.

Image Layers

Thematic Layers



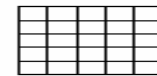
Create Image Objects

Depending on the task, various approaches to generating image objects can be used. Multiresolution segmentation generates objects resembling ground features very closely while being time consuming. A chessboard segmentation on the other hand is very fast.

multiresolution

Quadtree

chessboard



Create Image Object Hierarchy

The Generated image objects are arranged in an object hierarchy which allows a simultaneous representing of image features of various scale. These image objects are networked, allowing to utilize relations between objects.

large objects



small objects



Get Information on Image Objects

eCognition offers several tools which help find useful features and ways to separate classes

Feature View



Image Object Information



Sample Selection



Layer histograms

Classification

In iterative steps the image is classified. Initial classification results can be refined by an extension of the class descriptions and by restructuring the object hierarchy based on the first classification results.

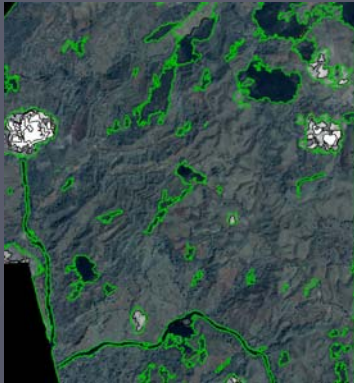
rooftops

roads

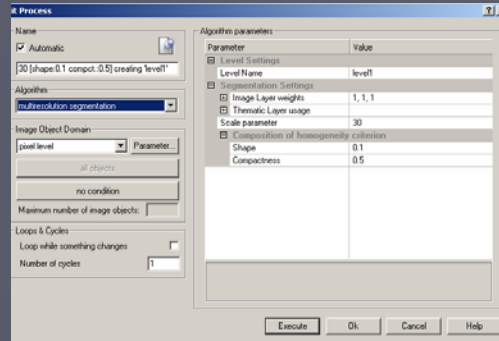
elevated

non elevated





Segmentation to
Classify clouds , shadows
And water bodies



Selection of scale ,shape
And compactness
parameters

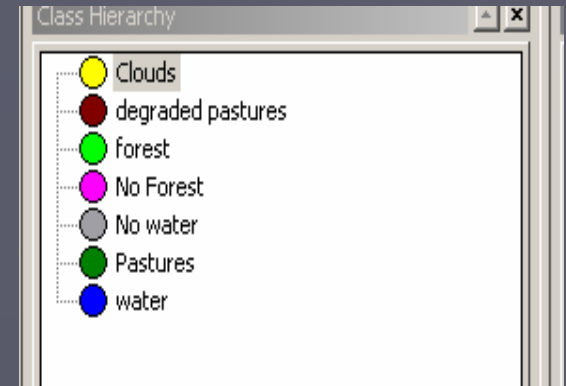
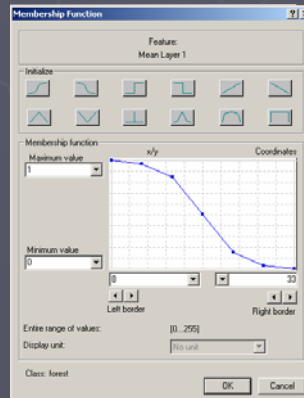
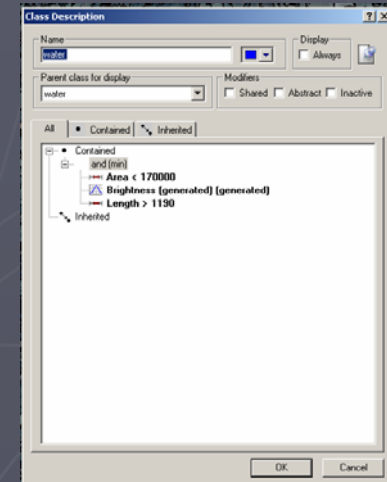


Image Object Hierarchy

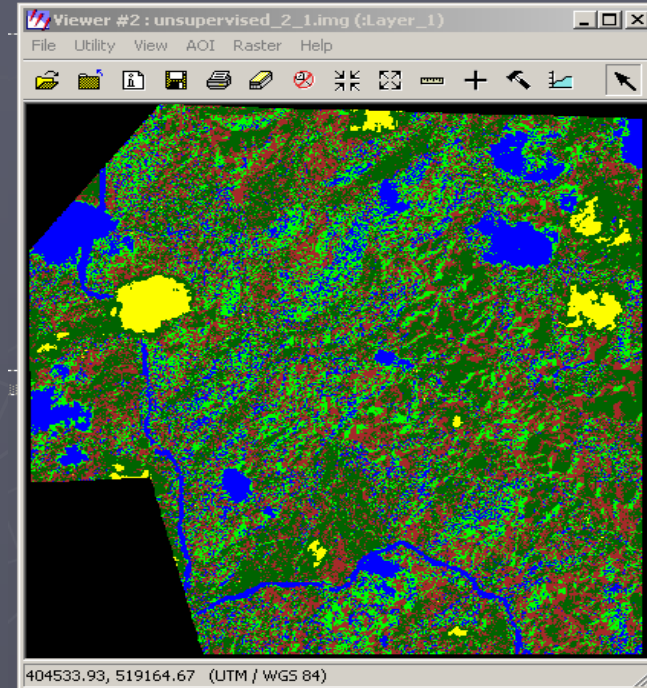
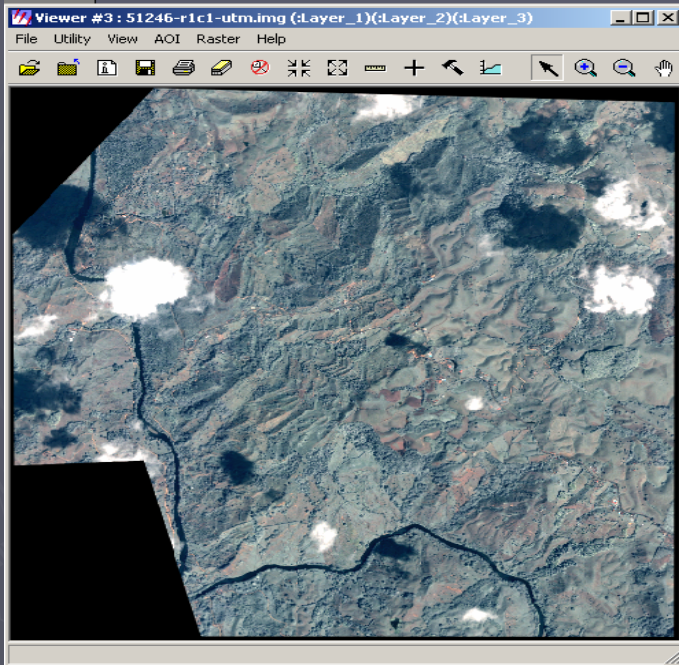


Selection of rules for an specific class using membership functions



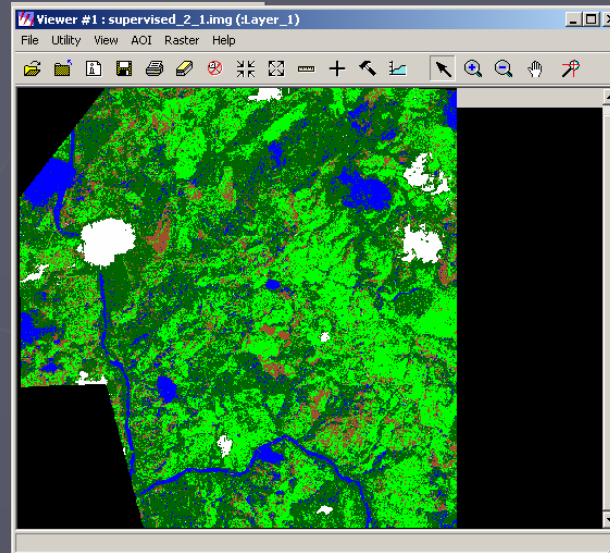
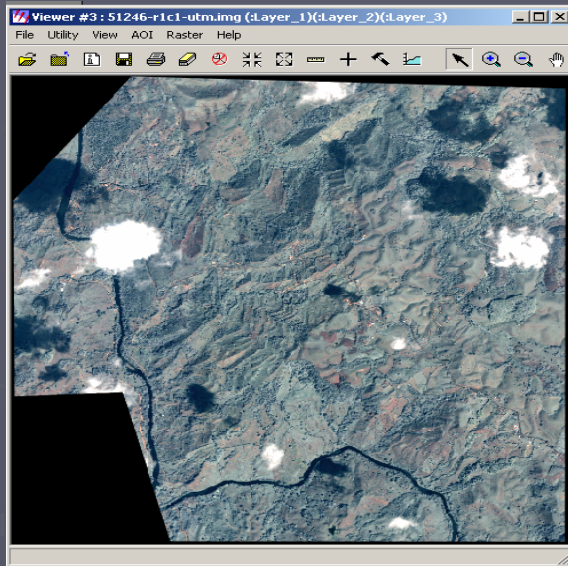
Results

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 classification.

Best result After several attempts for the classification.

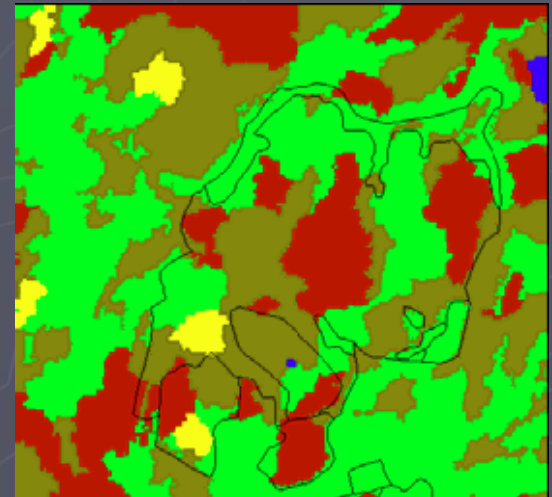
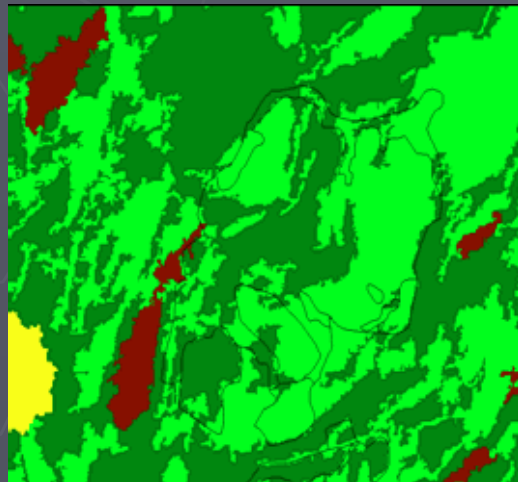
The error matrix shows that 40.47% of the forest area of the training samples could be also classified as grass .Forest was also represented in a high percentage by water 16.67 %. This high representation was observed just between these two types of land covers.

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

C l a s s i f i e d D a t a	R e f e r e n c e D a t a					R o w T o t a l
	d e g r a d e d	c l o u d s	g r a s s	f o r e s t	w a t e r	
d e g r a d e d	5 8 . 6 6	0 . 0 0	1 4 . 6 2	2 4 . 6 2	0 . 0 7	1 0 8 1 9 5
c l o u d s	0 . 0 0	9 5 . 8 8	0 . 0 0	0 . 0 0	0 . 0 0	4 3 2 9 1
g r a s s	2 1 . 8 5	4 . 1 2	7 3 . 9 0	4 0 . 4 7	0 . 0 0	1 8 8 2 4 0
f o r e s t	1 2 . 0 6	0 . 0 0	1 0 . 3 7	1 8 . 2 4	0 . 0 0	4 6 0 2 9
w a t e r	7 . 4 3	0 . 0 0	1 . 1 1	1 6 . 6 7	9 9 . 9 3	5 9 4 9 3
C o l u m n T o	1 0 6 0 1 7	4 5 1 5 1	1 7 5 7 5 7	8 2 3 6 2	3 5 9 6 1	4 4 5 2 4 8

Object Oriented Classification

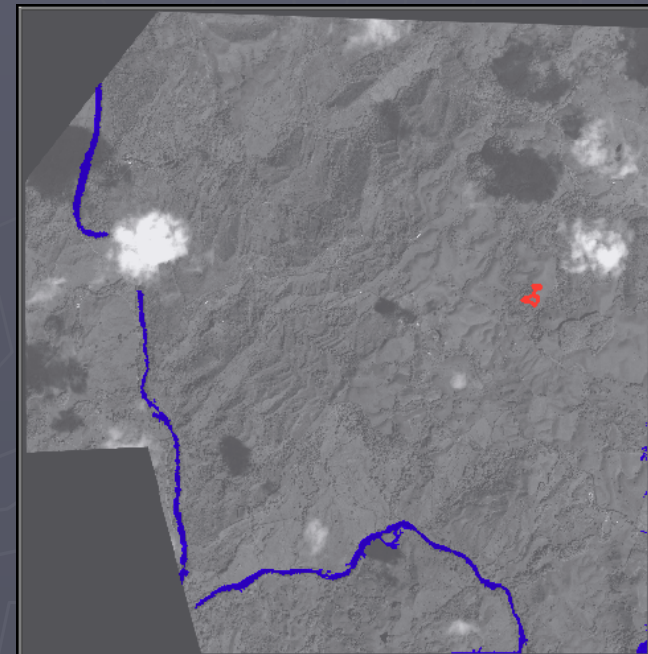
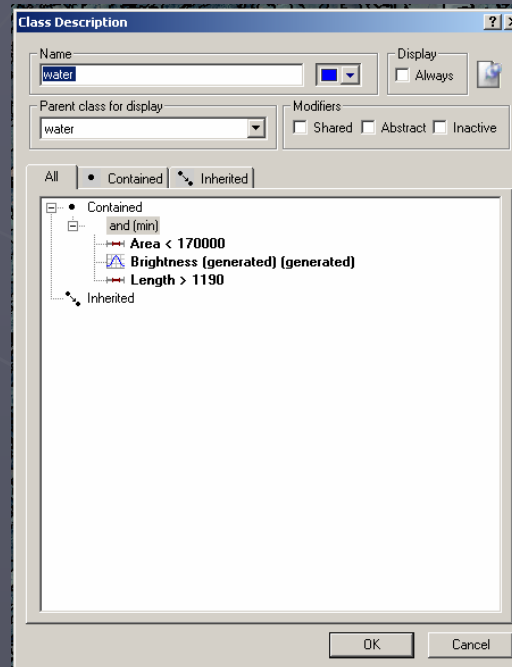
- ▶ Different parameters were tested as a trial and error experiment to find the appropriate scale , shape and compactness.
The Scale parameter is an abstract term which determines the maximum allowed heterogeneity for the resulting image objects.
- ▶ Applied parameters were . 17 for scale 0,1 for shape, and 0,9 for compactness .



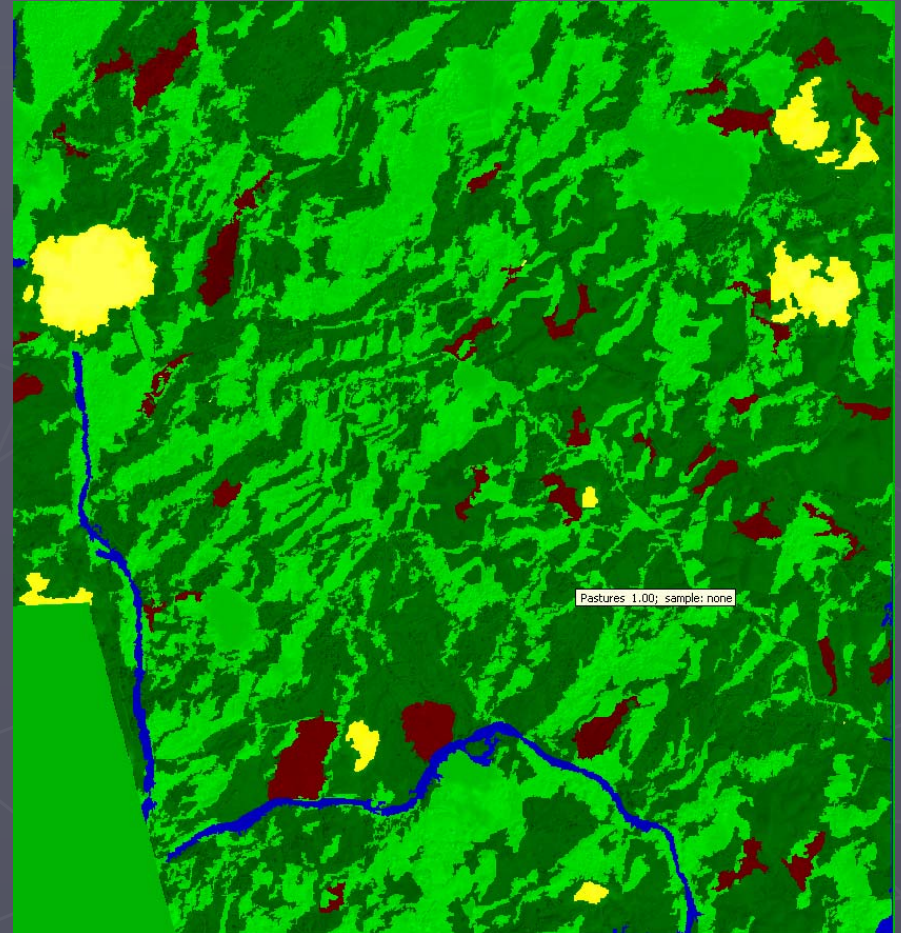
Miss classified areas



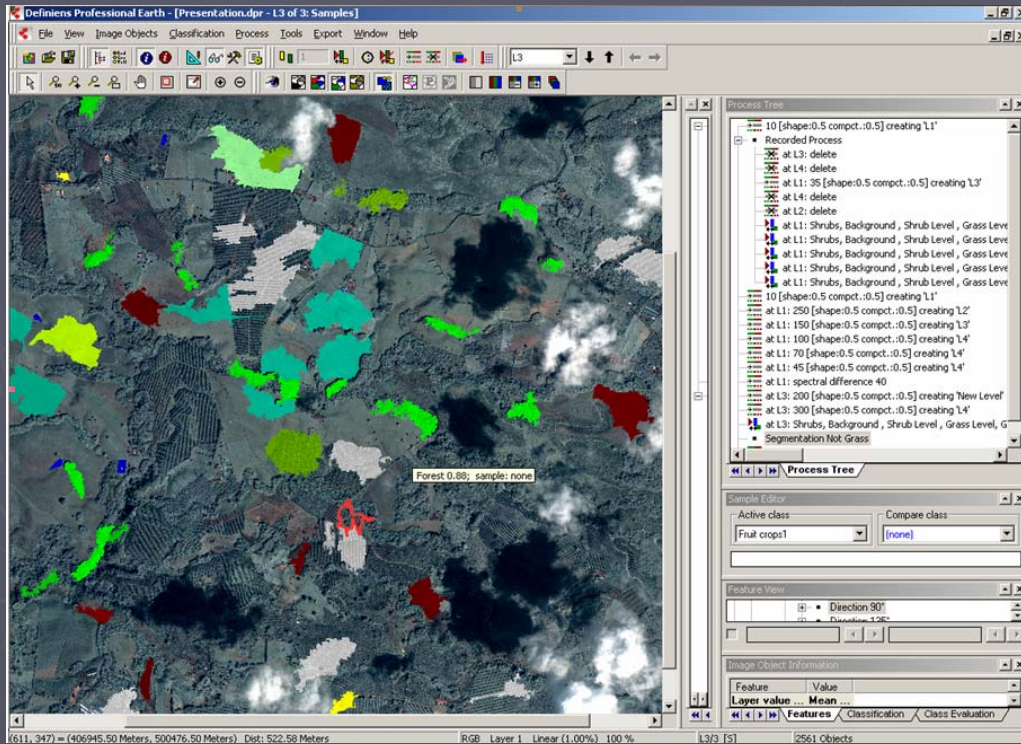
Addition of area and length
For the feature domain



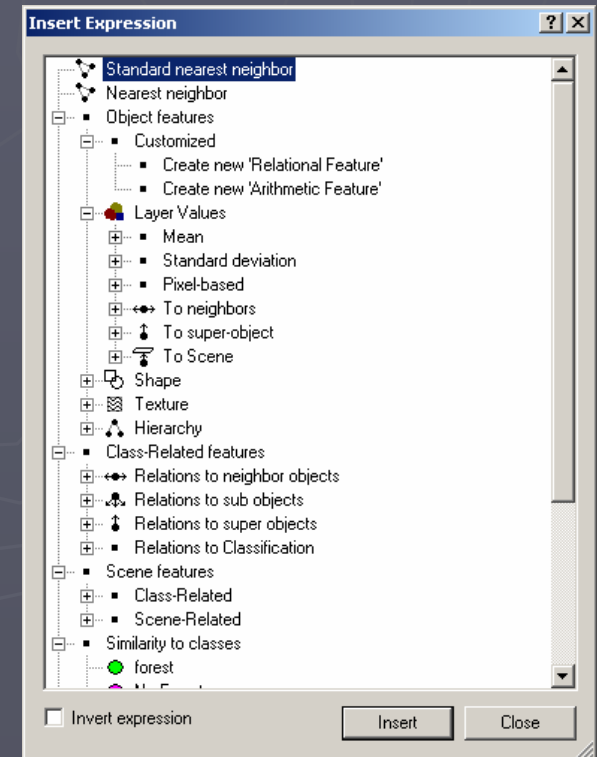
Final Classification result



Selection of samples



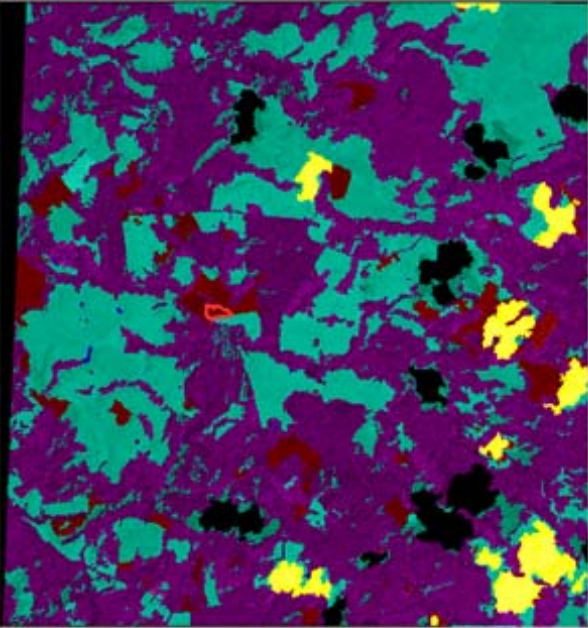
Available features for the classification



Definiens Professional Earth - [Presentation.dpr - L3 of 3: Classification]

File View Image Objects Classification Process Tools Export Window Help

L3



Class Hierarchy

- Grass Level
 - Clouds
 - Not clouds
 - Not shadows
 - Not water Bodies
 - Bare soil
 - Not Bare Soil
 - Grass Land
 - Notgrass Land
 - Forest
 - Water_bodies
 - Shadows
 - NotDark water Bodies
 - Shrub Level
 - Background
 - Shrubs

Process Tree

- at L2: delete
- at L1: Shrubs, Background, Shrub Level, Grass Level, Grass L
- at L1: Shrubs, Background, Shrub Level, Grass Level, Grass L
- at L1: Shrubs, Background, Shrub Level, Grass Level, Grass L
- at L1: Shrubs, Background, Shrub Level, Grass Level, Grass L
- 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'

Simple Editor

Active class: Bare soil Compare class: Not Bare Soil

Mean Layer: [127.3 - 261.1] [99.0 - 261.6] Overlap: 0.54

Mean Layer: [180.9 - 328.1] [213.8 - 394.2] Overlap: 0.38

Mean Layer: [142.1 - 213.2] [155.3 - 248.2] Overlap: 0.51

Max. diff. [0.3 - 0.5] 5% [0.5 - 0.8] 5% Overlap: 0.04

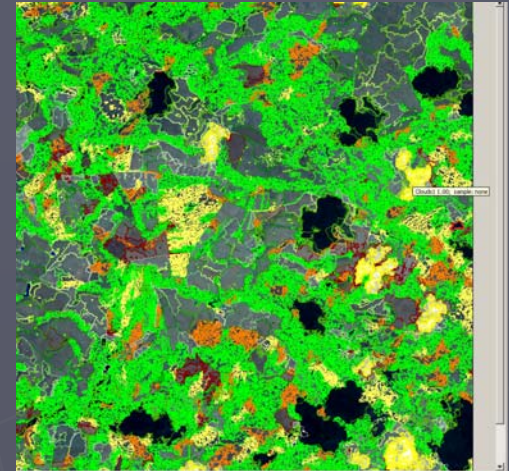
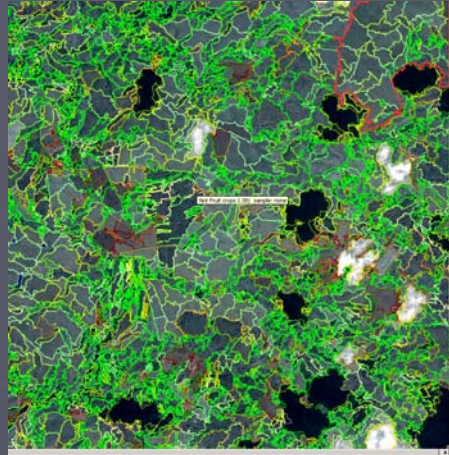
Feature View

Image Object Information

Groups: Inheritance 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



LdR Process

Name: Automatic
 [a] L1: 45 [shape: 0.5 compact: 0.5] creating L4

Algorithms: **multiresolution segmentation**

Image Object Domain: **L1** Parameters...
 all objects
 no condition
 Maximum number of image objects:

Loops & Cycles:
 Loop while something changes:
 Number of cycles:

Algorithm parameters:

Parameter	Value
Level Settings	
Level Name	L4
Level Usage	Create above
Segmentation Settings	
Image Layer weights	1, 1, 1
Thematic Layer usage	
Scale parameter	45
Composition of homogeneity criterion	
Shape	0.5
Compactness	0.5

Execute Ok Cancel Help

LdR Process

Name: Automatic
 [a] L1: 35 [shape: 0.5 compact: 0.5] creating L3

Algorithms: **multiresolution segmentation**

Image Object Domain: **L1** Parameters...
 all objects
 no condition
 Maximum number of image objects:

Loops & Cycles:
 Loop while something changes:
 Number of cycles:

Algorithm parameters:

Parameter	Value
Level Settings	
Level Name	L3
Level Usage	Create above
Segmentation Settings	
Image Layer weights	1, 1, 1
Thematic Layer usage	
Scale parameter	35
Composition of homogeneity criterion	
Shape	0.5
Compactness	0.5

Execute Ok Cancel Help

LdR Process

Name: Automatic
 [10] [shape: 0.5 compact: 0.5] creating L1

Algorithms: **multiresolution segmentation**

Image Object Domain: **peel level** Parameters...
 all objects
 no condition
 Maximum number of image objects:

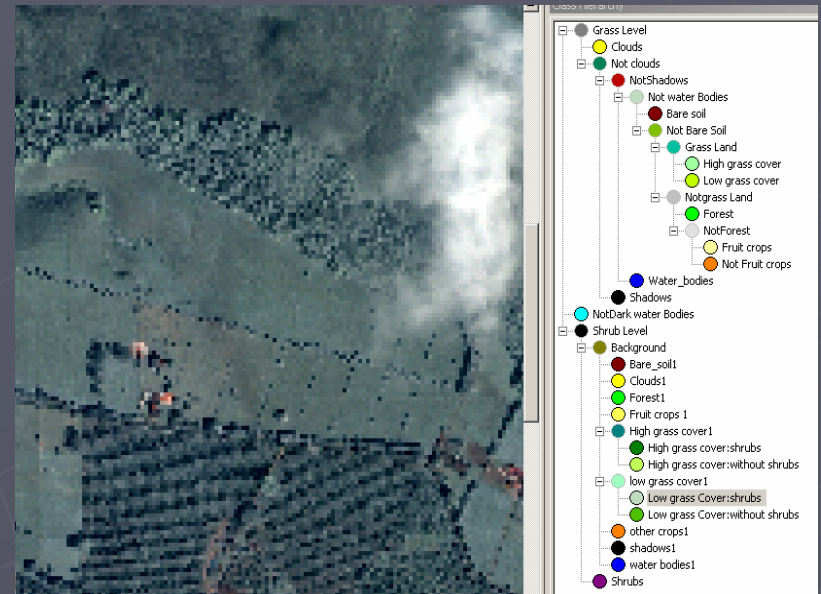
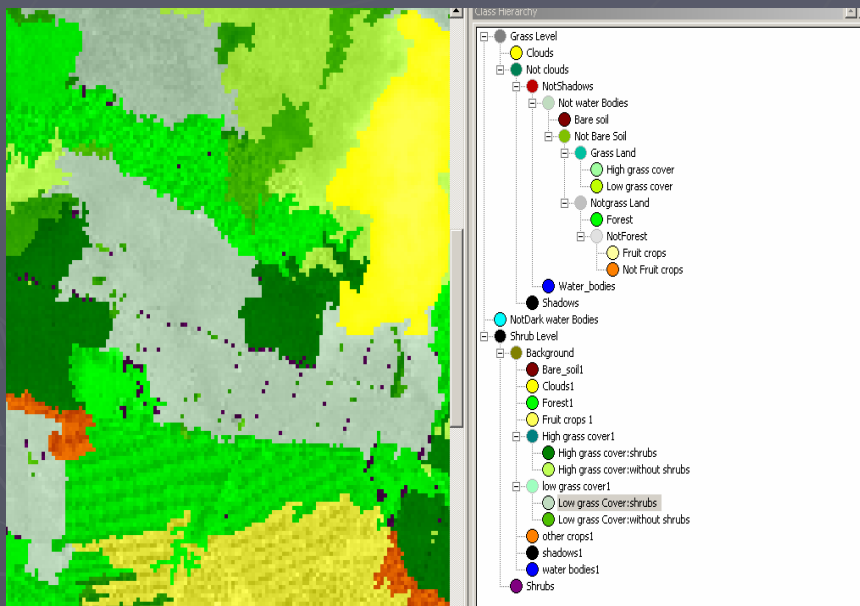
Loops & Cycles:
 Loop while something changes:
 Number of cycles:

Algorithm parameters:

Parameter	Value
Level Settings	
Level Name	L1
Segmentation Settings	
Image Layer weights	1, 1, 1
Thematic Layer usage	
Scale parameter	10
Composition of homogeneity criterion	
Shape	0.5
Compactness	0.5

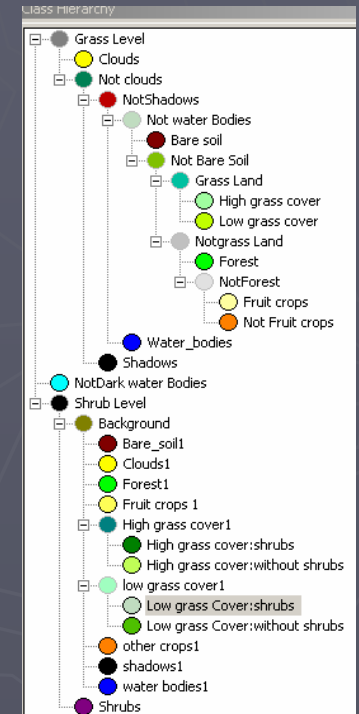
Execute Ok Cancel Help

Classification of shrubs and trees creating a new segmentation level

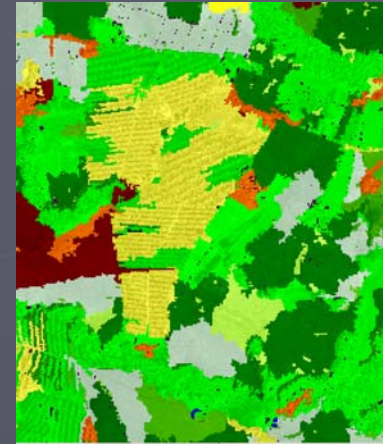
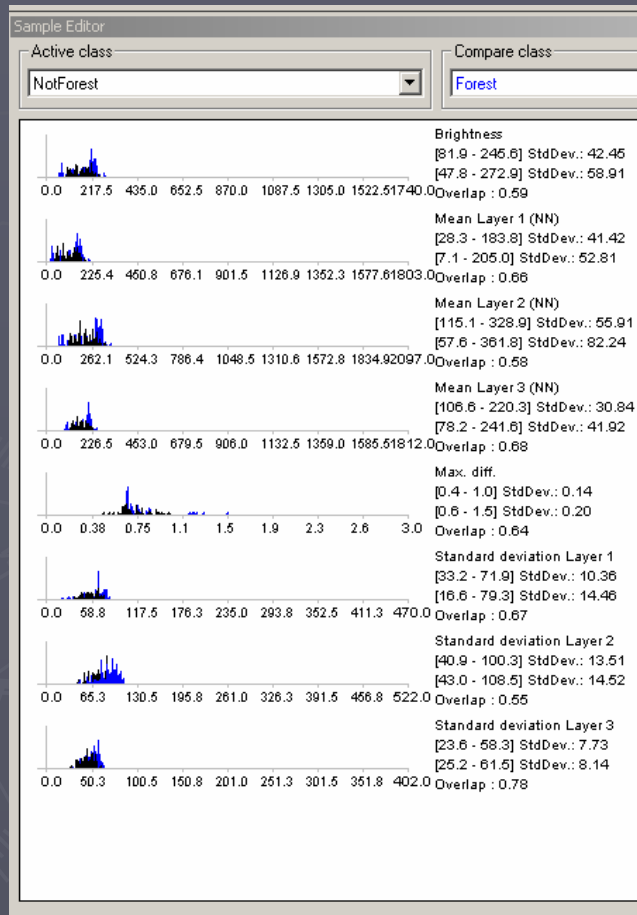


Miss classified areas are observed for agriculture areas and forest

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 appropriate set of rules for the classification is a very time consuming activity .