


HAROKOPIO UNIVERSITY







→ 4th ADVANCED TRAINING COURSE IN LAND REMOTE SENSING


Practicals on Land Use/Cover & Change Detection D4P1b

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Practicals on Land Use/Cover & Change Detection

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Tutorial

Basics for image visualization and processing in ArcGIS

ArcGIS is a GIS software that contains some image processing tools. In this tutorial we will demonstrate how to use some of the basic image visualization and processing utilities of this software.

ArcGIS desktop has the following modules:

ArcMap is an application for displaying geographic information systems (GIS) and mapping. ArcMap provides all the tools you need to put your data on a map and display it in an effective manner.

ArcCatalog, after connecting to a folder, database, or geographic information system (GIS) server, you can browse through its contents with ArcCatalog. You can look for the map you want to print, create a coverage, examine the values in a table, and find out which coordinate system a raster uses or how accurately it was created.

ArcToolbox provides a way to create new information by applying a pre-defined operation to existing data. Any operation or information operation you want to perform on your data involves a geospatial tool. It can be a simple task, such as converting geographic data to a different format, or a complex multi-step task performed in sequence, such as those that clip, merge, and then intersect datasets.

The visualization tools are mainly explored in the ArcMap module. Next, in this tutorial, we will be showing you how to:

1. Open an existing project in ArcMap
2. Import image data into ArcMap
3. Browse through an image using ArcMap visualization tools
4. Browse through an image using ArcMap Bookmarks
5. Basic image enhancements
6. Create an image stack

1. Open an existing project in ArcMap

a) File → Open (Figure 1) select the ArcMap project file (.mapx)

FIGURE 1

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Tutorial

Supervised classification in ArcGIS

The supervised classification in ArcGIS is implemented with the several functions of the Multiclassify tool in the ArcToolbox.

For doing a supervised classification in ArcGIS you have to follow the steps:

1. Import input data into ArcGIS - ArcMap
2. Collect samples for training the algorithm
3. Identify sample visualization
4. Create expressions
5. Analyze of the training samples
6. Edit signatures
7. Run the supervised classification algorithm - the maximum likelihood is the only available supervised algorithm in ArcGIS
8. Apply a pre-existent symbology in the produced map

1. Import input data into ArcGIS - ArcMap

a) File → Add data (Figure 1) select the basic file of the mapping multi-band images

FIGURE 1

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Exercise

Land cover mapping with very high spatial resolution data using a multi-stage classification approach

Exercise rationale

In land cover map nomenclatures, classes usually define landscape units (e.g. Forest, Agriculture, Urban areas - see Fig. 1). Nevertheless, the pixel of an ArcGIS image, due to water non-polarized area, comprises the most data has been studied - see Fig. 2. Due to this constraint, development of land cover maps (landscape units maps) with these images cannot make use of simple per-pixel classifications.

FIGURE 1

FIGURE 2

In this exercise we apply a methodology developed in the Remote Sensing Unit of the Portuguese Geographic Institute (IGP) to produce a Landscape Units Map (LUM) with an ArcGIS image. In brief, the methodology (IGP) consists in image classification of the pixel level, producing a Surface Parameter Map (SPM). The SPM image is then segmented to derive a Map of Objects (MO) in landscape units. Then the MO is overlaid on the DEM. A set of rules is then applied to assign a landscape unit to each object. These rules take into account the abundance and spatial arrangement of the classified pixels inside each object. In the last step, the set of rules are applied to the produced SPM image in order to derive the final mapping product, i.e. the LUM.

FIGURE 3

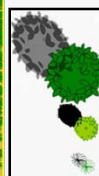
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Code	Class name	Description
1	Urban / Bare soil	Areas with < 10% trees and with > 70% of bare soil
2	Sparse vegetation	Areas with < 10% trees and with 30% - 70% of bare soil
3	Cropland	Areas with < 10% trees and with > 70% of herbaceous vegetation
4	Other natural vegetation	Areas with < 10% trees and that are not Urban / Bare soil, Sparse vegetation and Cropland
5	Broadleaf forest	Areas with >30% trees in which >70% are of the broadleaf type
6	Needleleaf forest	Areas with >30% trees in which >70% are of the needleleaf type
7	Mixed forest	Areas with >30% trees in which both broadleaf and needleleaf types are between 30% - 70%
8	Agro-forestry	Areas with 10% - 30% trees and with > 50% of herbaceous vegetation
9	Transitional-woodland forest	Areas with 10% - 30% trees and with < 50% of herbaceous vegetation
10	Water	Areas that are in their major part constituted by water

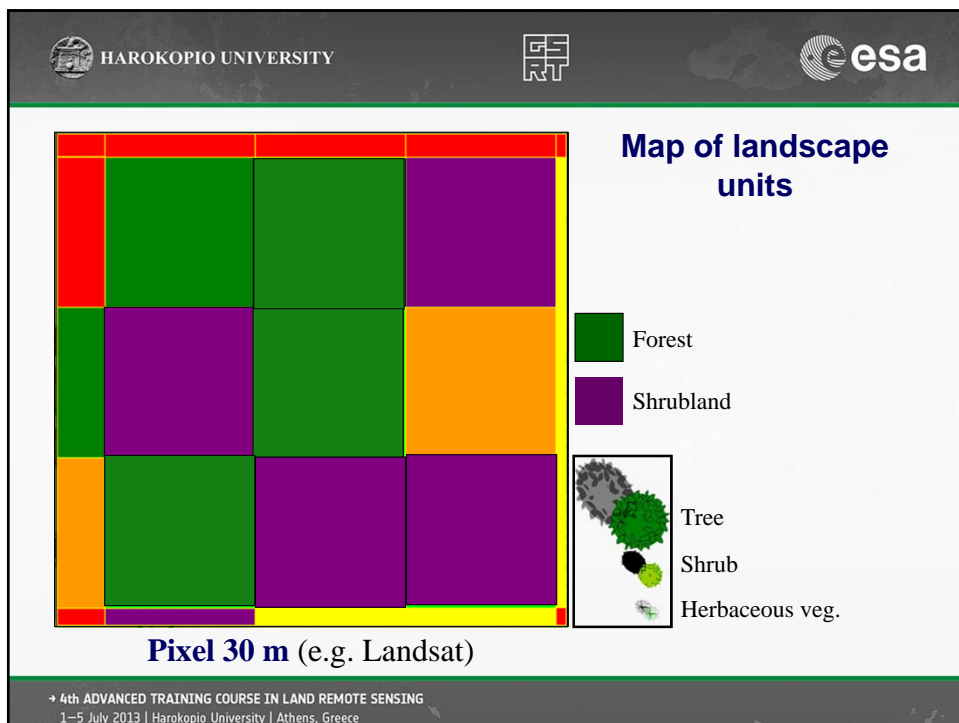
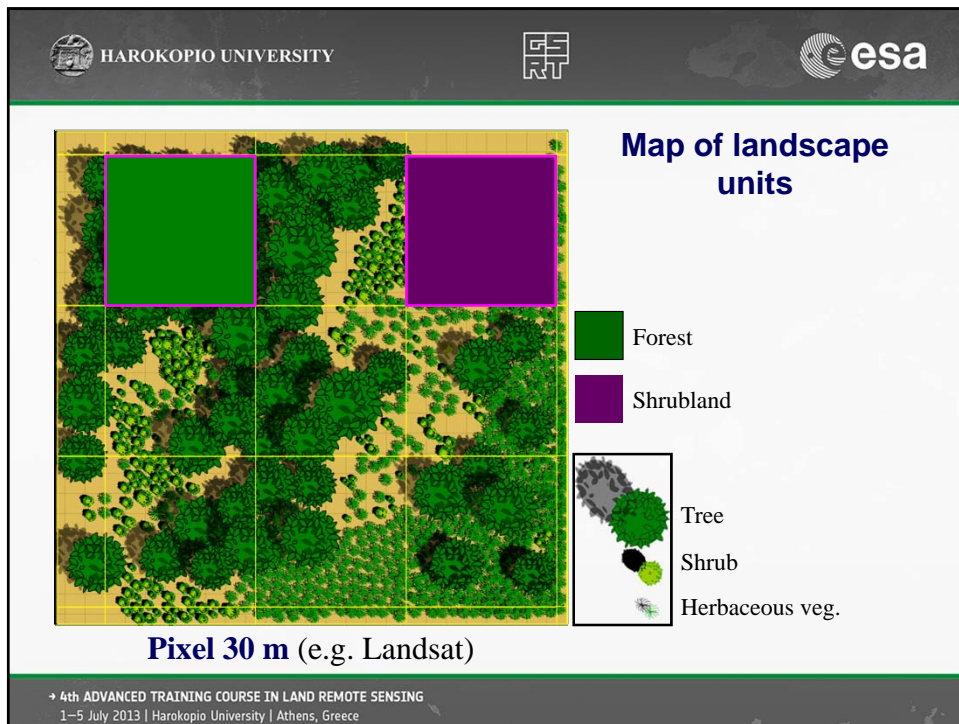


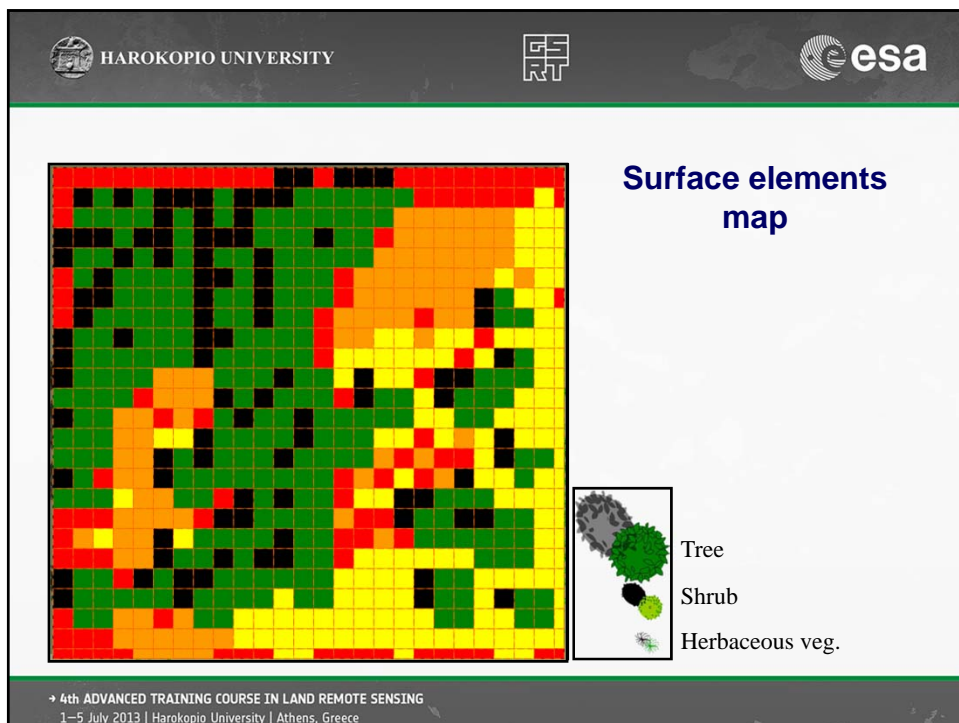
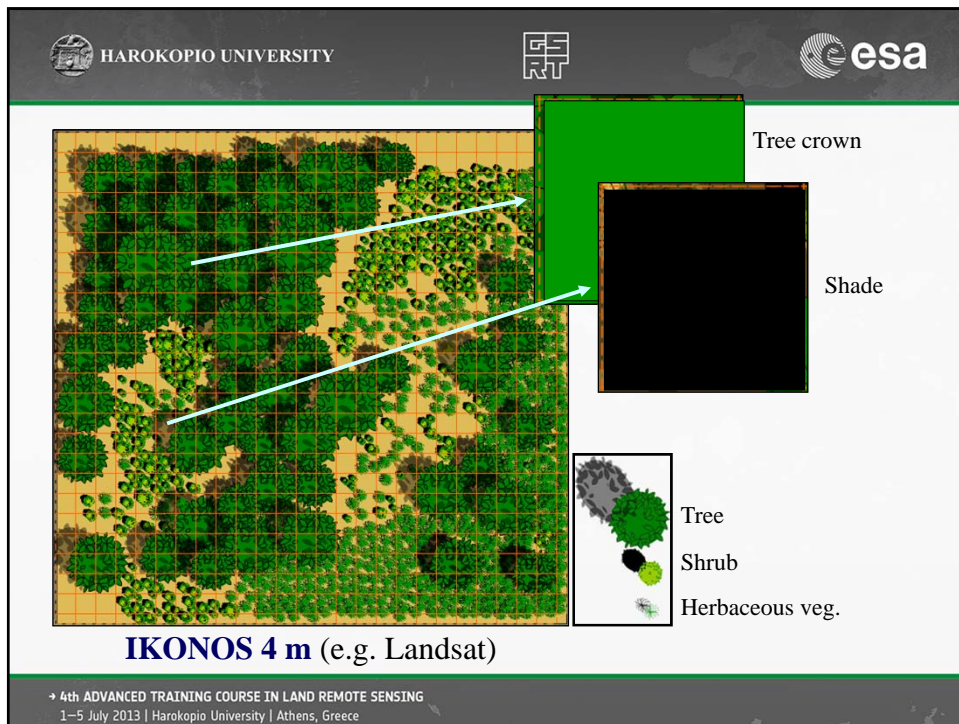
Map of landscape units

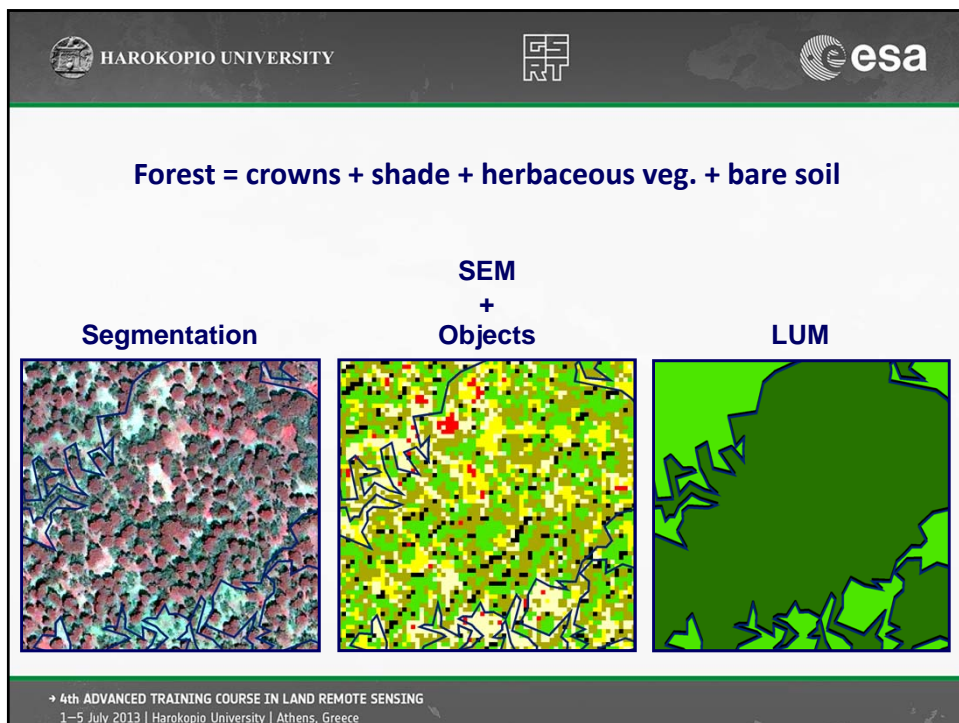
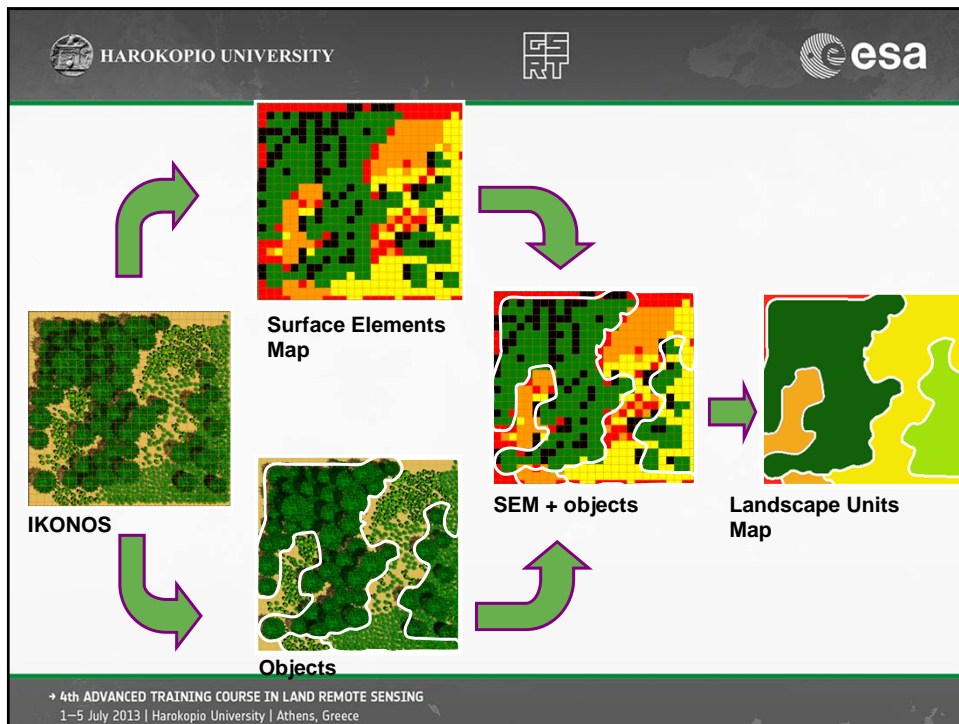


Tree
Shrub
Herbaceous veg.

Pixel 30 m (e.g. Landsat)

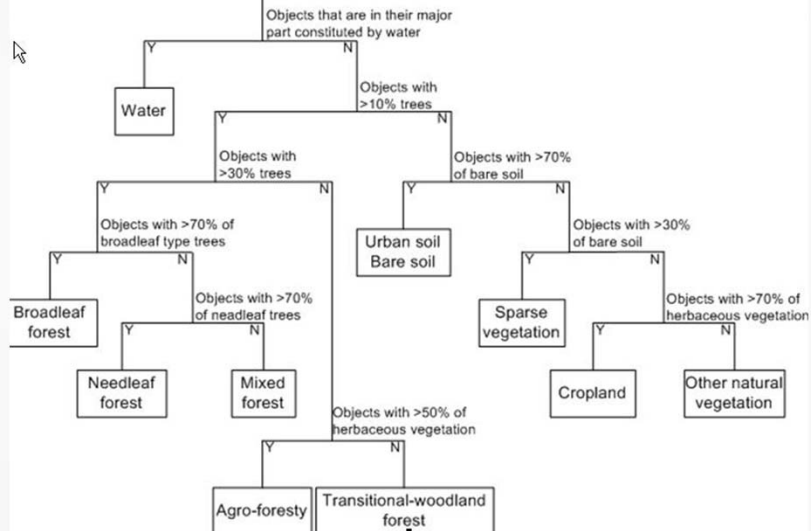








SEM+Objects



Classes

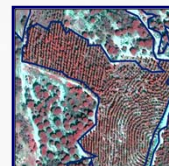
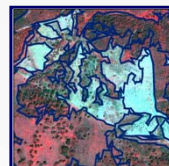
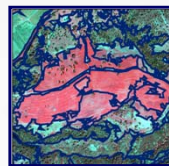
Water

Agriculture

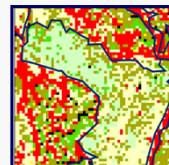
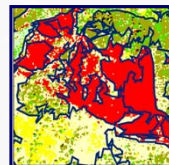
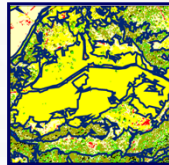
Bare soil/urban

Eucalyptus forest

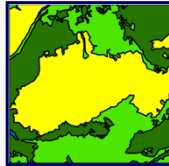
Segmentation

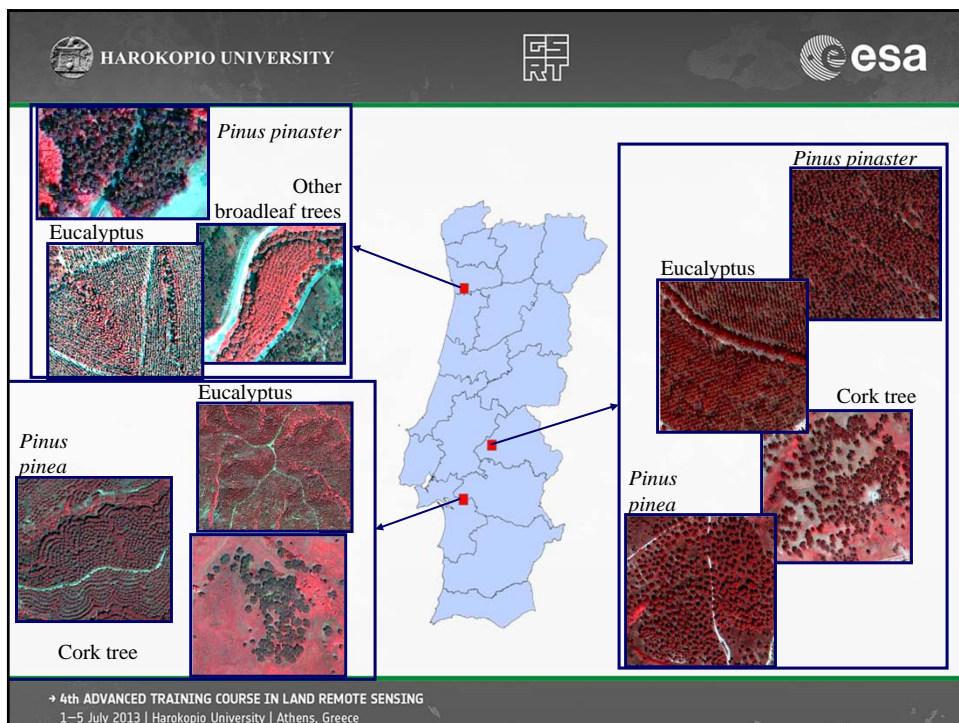
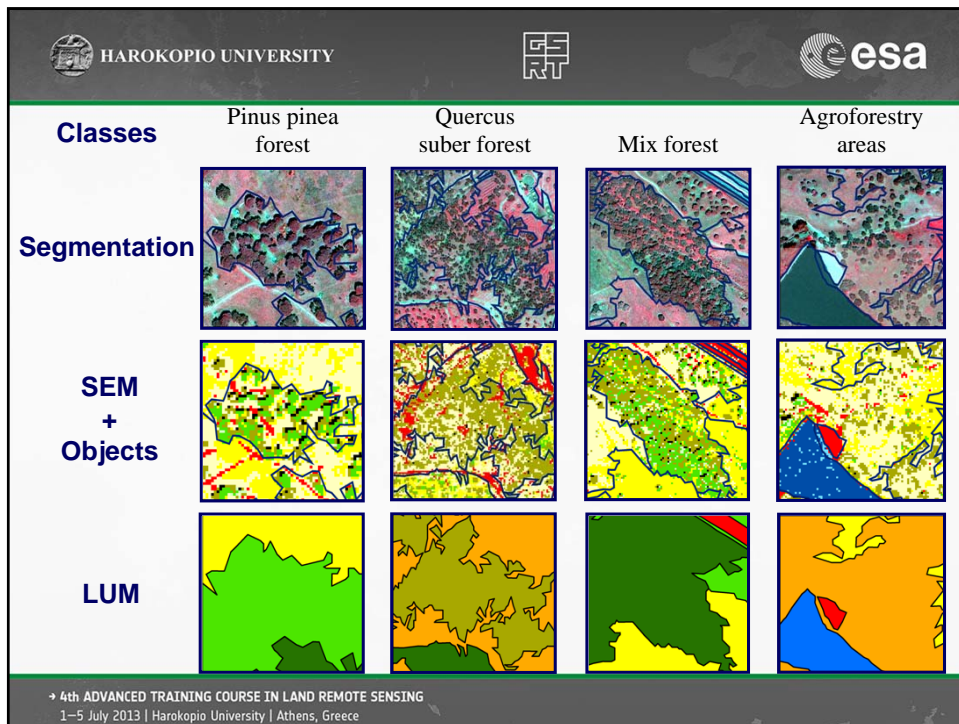


SEM + Objects



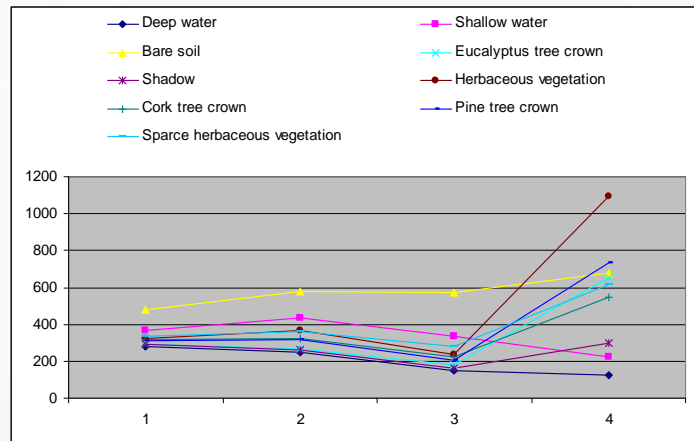
LUM







Spectral class means IKONOS



The mixed pixel problem

The problem of mixed pixels exist in coarse and fine resolution images:

In course resolution images the mixed pixels are mainly due to co-existence in the same pixel of different classes.



MERIS FR

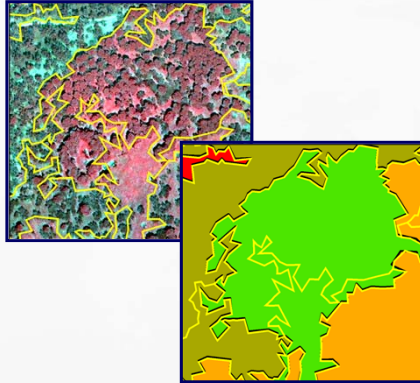
In fine resolution images the mixed pixels are mainly due to co-existence in the same pixel of different components (e.g., houses, trees).



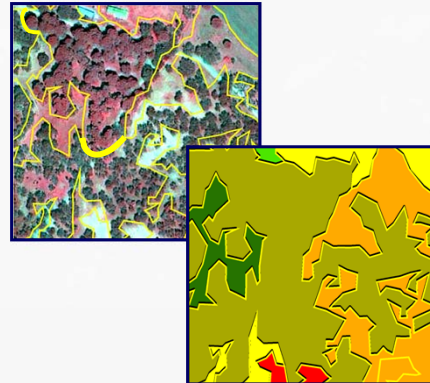
IKONOS



Meaningful segmentation



Meaningless segmentation



Thematic information extraction from satellite images

- 1 Definition of the mapping approach *
- 2 Geographical stratification
- 3 Image segmentation
- 4 Feature identification and selection *
- 5 Classification *
- 6 Ancillary data integration
- 7 Post-classification processing
- 8 Accuracy assessment *

* mandatory

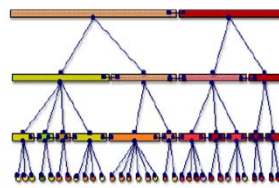


Sample ID (ID)	Surface element – your decision	Surface element – our decision
12		7 - Cork tree crown
13		3 - Bare soil
104		9 - Sparse herbaceous vegetation
151		5 - Shadow
254		1 - Deep water
614		8 - Pine tree crown
630		4 - Eucalyptus crown
713		6 - Herbaceous vegetation



3. Image segmentation

A type of segmentation that is very common is the **multi-resolution segmentation**, because of its ability to deal with the range of scales within a single image.



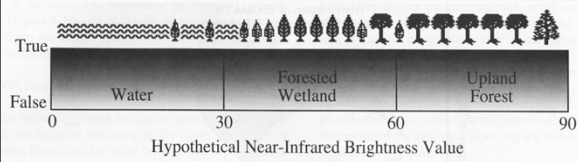
Super-objects

Sub-objects



6. Classification

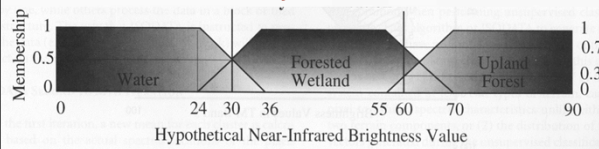
Hard classification



Decision rules

- 0 – 30 -> Water
- 30 - 60 -> Forest wetland
- 60 - 90 -> Upland forest

Fuzzy classification



Decision rules are defined as membership functions for each class.

Membership functions allocate to each pixel a real value between 0 and 1, i.e. membership grade.



But, how can we represent the sub-pixel information?

Source: Jensen (1996)