

Practicals on Land Use/Cover & Change Detection D4P1b

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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 consists of the following modules:

ArcMap is an application for viewing 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 efficient 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 maps you want to print, create a coverage, examine the values in a table, and find out which coordinate system is used for each data set or how accurately it was created.

ArcToolbox provides a way to create new information by applying a pre-defined algorithm to existing data. ArcToolbox is a collection of tools that you can use to perform all your data analysis and geospatial tasks. It can be a simple task, such as converting geographic data to a different format, or a task that requires more complex processing, such as those that clip, select, and then reinsert 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 existent project in ArcMap
2. Import image data into ArcMap
3. Browse through an image using ArcMap's visualization tools
4. Browse through an image using ArcMap's Bookmarks
5. Basic image enhancements
6. Create an image stack

1. Open an existent project in ArcMap
- a) File → Open (Figure 1) to select the ArcMap project file (.mapx).

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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. Specify sample visualization
4. Create signatures
5. Analyze 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-extended symbology to the produced map

1. Import input data into ArcGIS - ArcMap

- a) File → Add Data (Figure 1) to select the base file of importing 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 goal of an ArcGIS image class is to identify components of those units, which can be designated by further elements (e.g. water, non-vegetated area, landscape tree cover, etc. see also, section - see Fig. 2). Due to the constant development of land cover maps (landscape units mapped) with these images generated use of change per-pixel classification.



Fig. 1. Landscape units (mapping) by land cover.

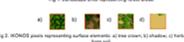


Fig. 2. ArcGIS pixel representing landscape units (e.g. water cover, Urban area, Urban area II) from land cover.

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 order, the methodology (IGP) consists in change classification of the pixel level, producing a Landscape Units Map (LUM). The ArcGIS image is also segmented to derive a Map of Classes (MOC) in landscape units. Then the MOC is overlaid on the LUM. A set of rules is then applied to assign a landscape unit to each pixel. These rules take into account the abundance and spatial arrangement of the classified pixels inside each object. In the last step, the pixel of rules are applied to the produced ESRI/MapInfo, in order to derive the final mapping product, i.e. the LUM.

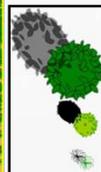
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Code	Class name	Description
1	Urban / Bare soil	Areas with < 10% trees and with > 70% of bare soil
2	Sparse vegetation	Areas with < 10% trees and with 30% - 70% of bare soil
3	Cropland	Areas with < 10% trees and with > 70% of herbaceous vegetation
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



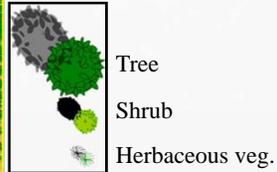
- Tree
- Shrub
- Herbaceous veg.

Pixel 30 m (e.g. Landsat)

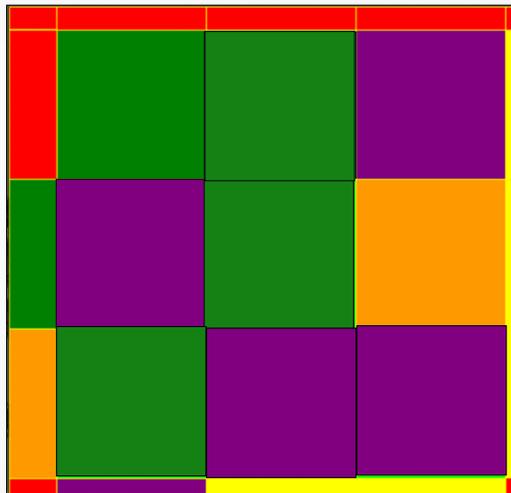


Map of landscape units

- Forest
- Shrubland

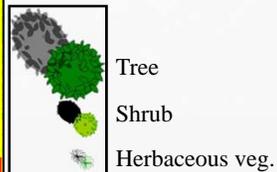


Pixel 30 m (e.g. Landsat)



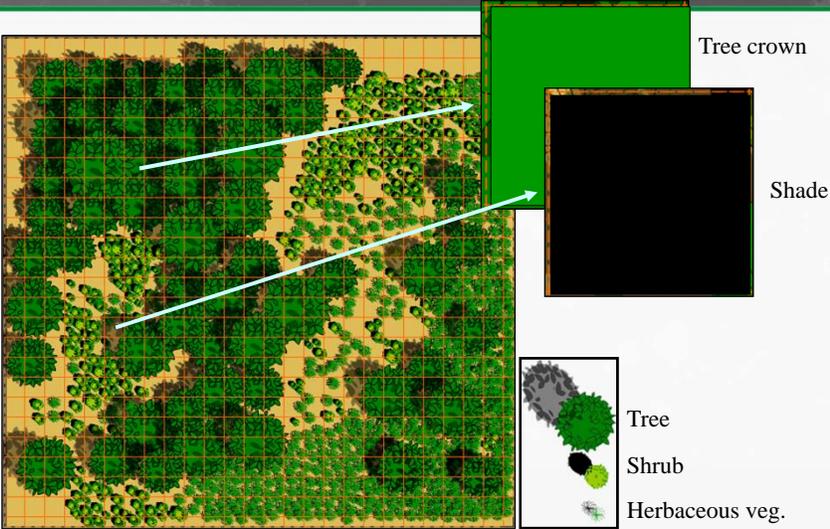
Map of landscape units

- Forest
- Shrubland

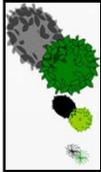


Pixel 30 m (e.g. Landsat)

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Tree crown
Shade

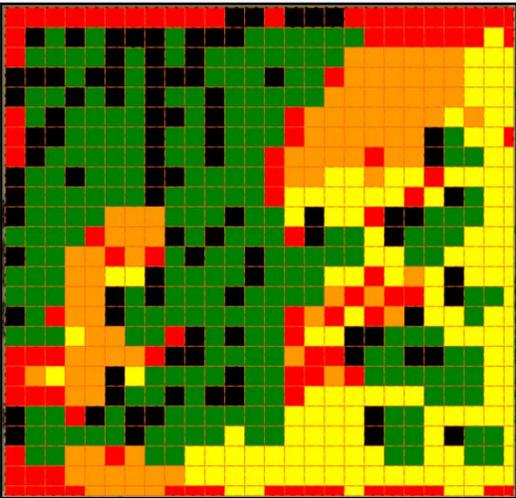


Tree
Shrub
Herbaceous veg.

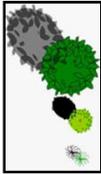
IKONOS 4 m (e.g. Landsat)

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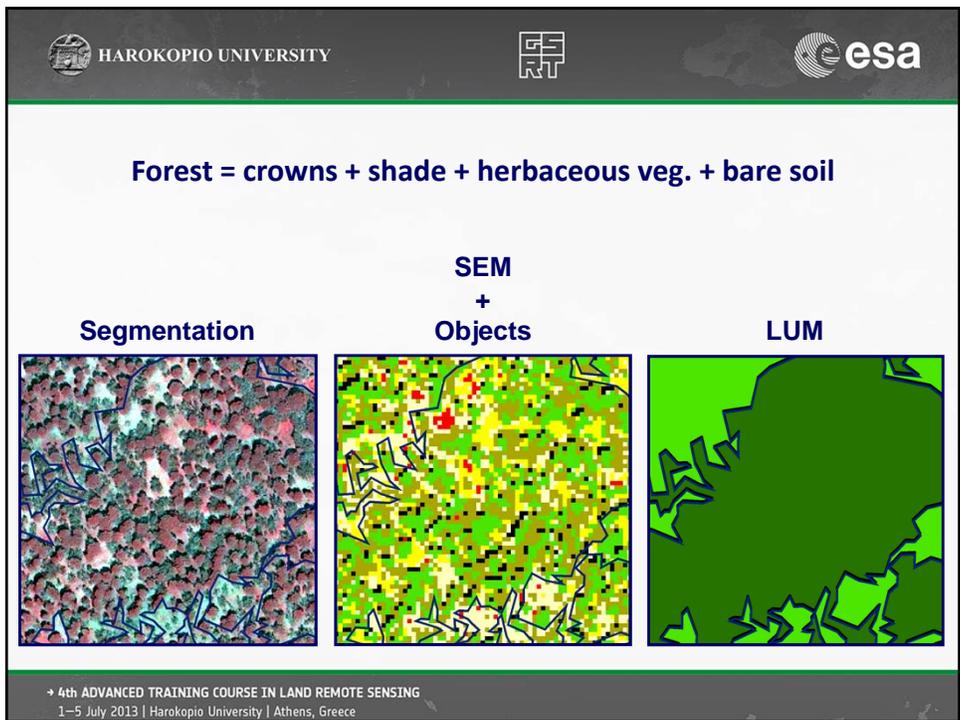
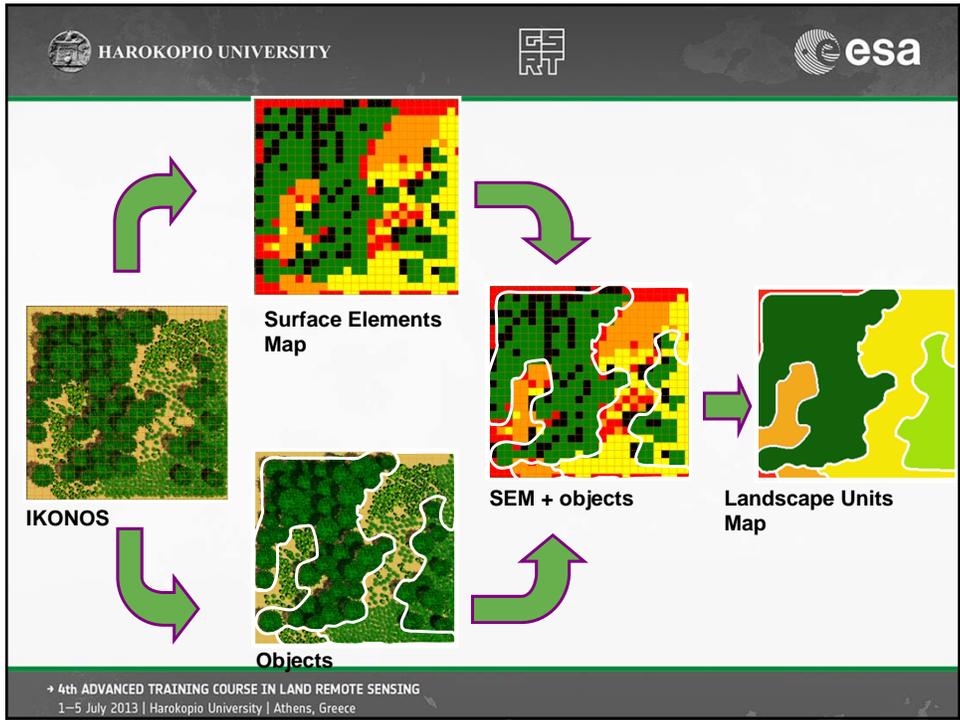


Surface elements map



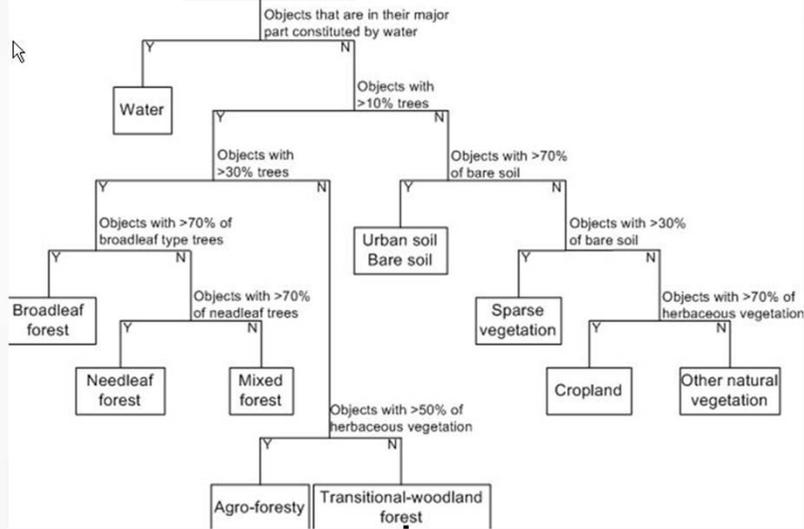
Tree
Shrub
Herbaceous veg.

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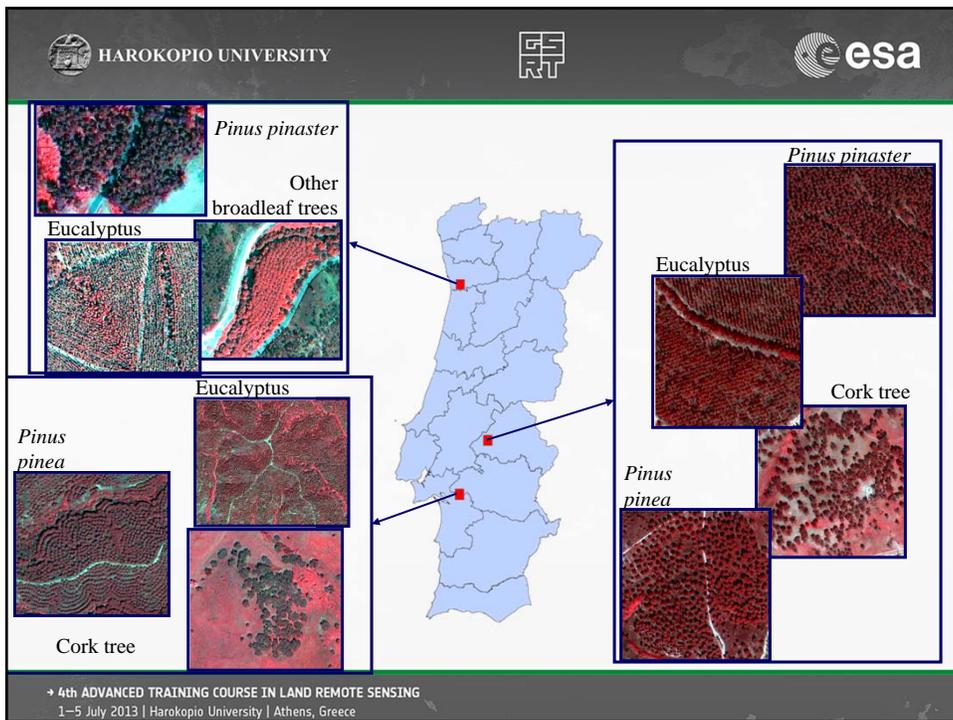
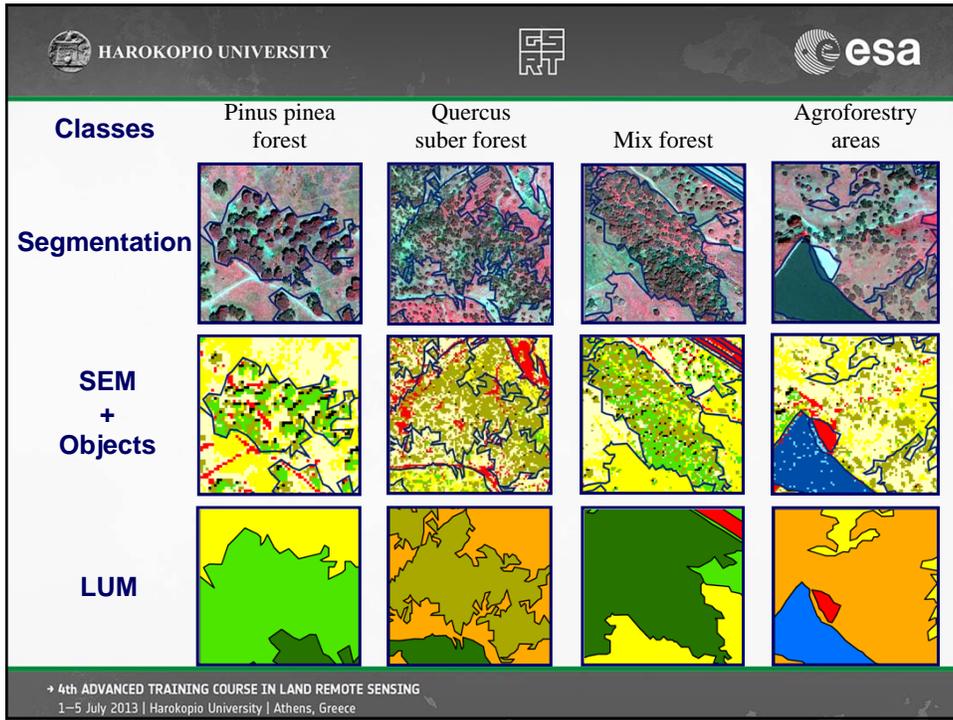




SEM+Objects

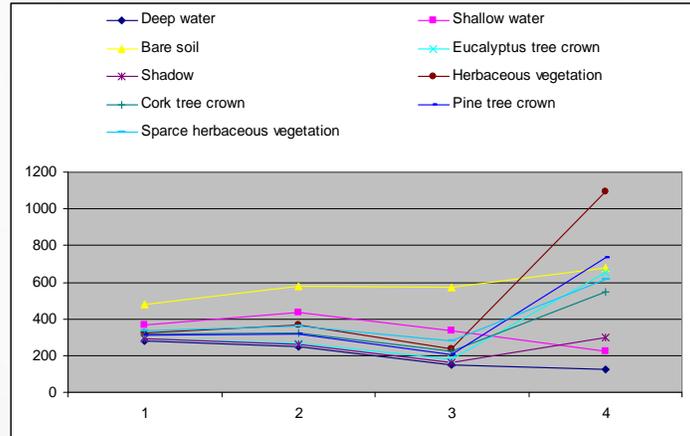


Classes	Water	Agriculture	Bare soil/urban	Eucalyptus forest
Segmentation				
SEM + Objects				
LUM				





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.



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

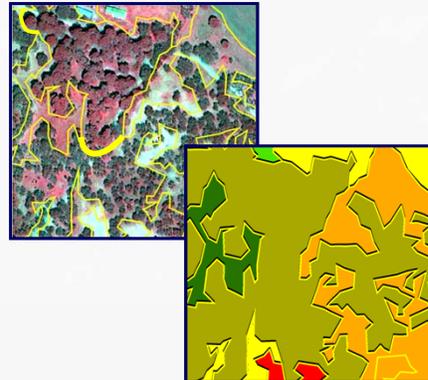
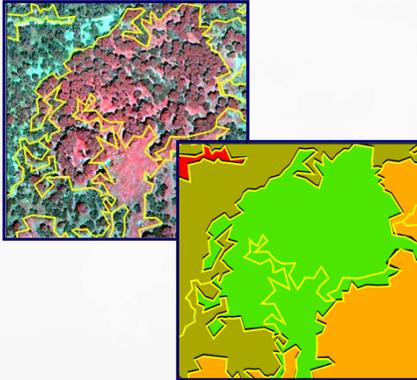


IKONOS



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

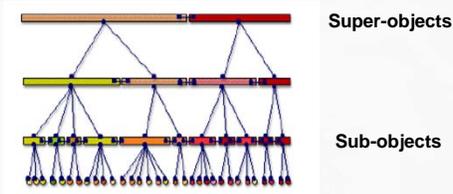


Sample ID (ID)	Surface element – your decision	Surface element – our decision
12		7 - Cork tree crown
13		3 - Bare soil
104		9 - Sparse herbaceous vegetation
151		5 - Shadow
254		1 - Deep water
614		8 - Pine tree crown
630		4 - Eucalyptus crown
713		6 - Herbaceous vegetation



3. Image segmentation

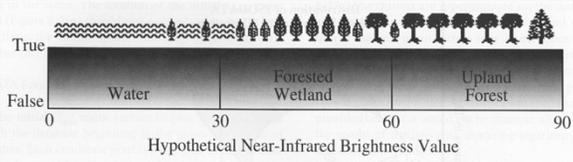
A type of segmentation that is very common is the **multi-resolution segmentation**, because of its ability to deal with the range of scales within a single image.





6. Classification

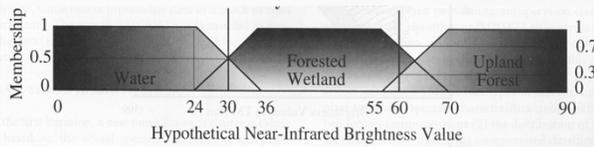
Hard classification



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 allocates 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)