

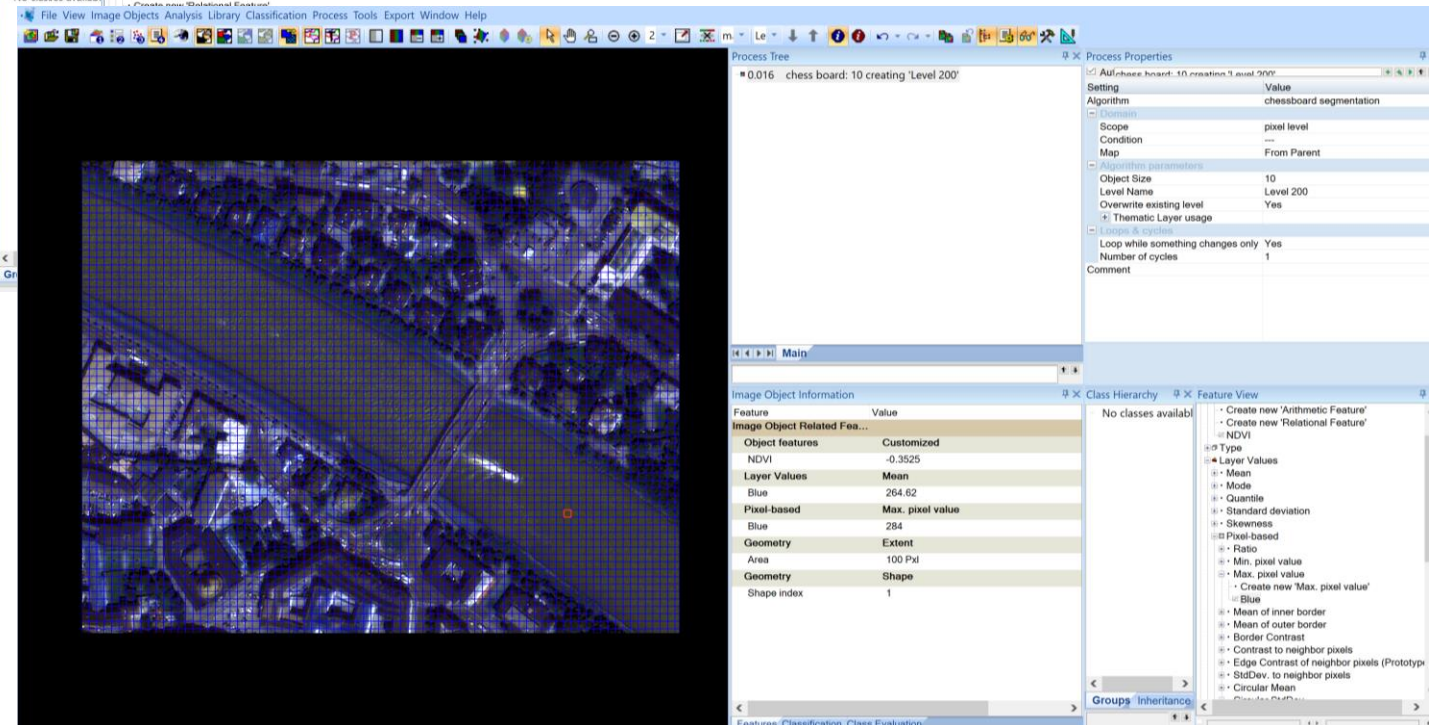
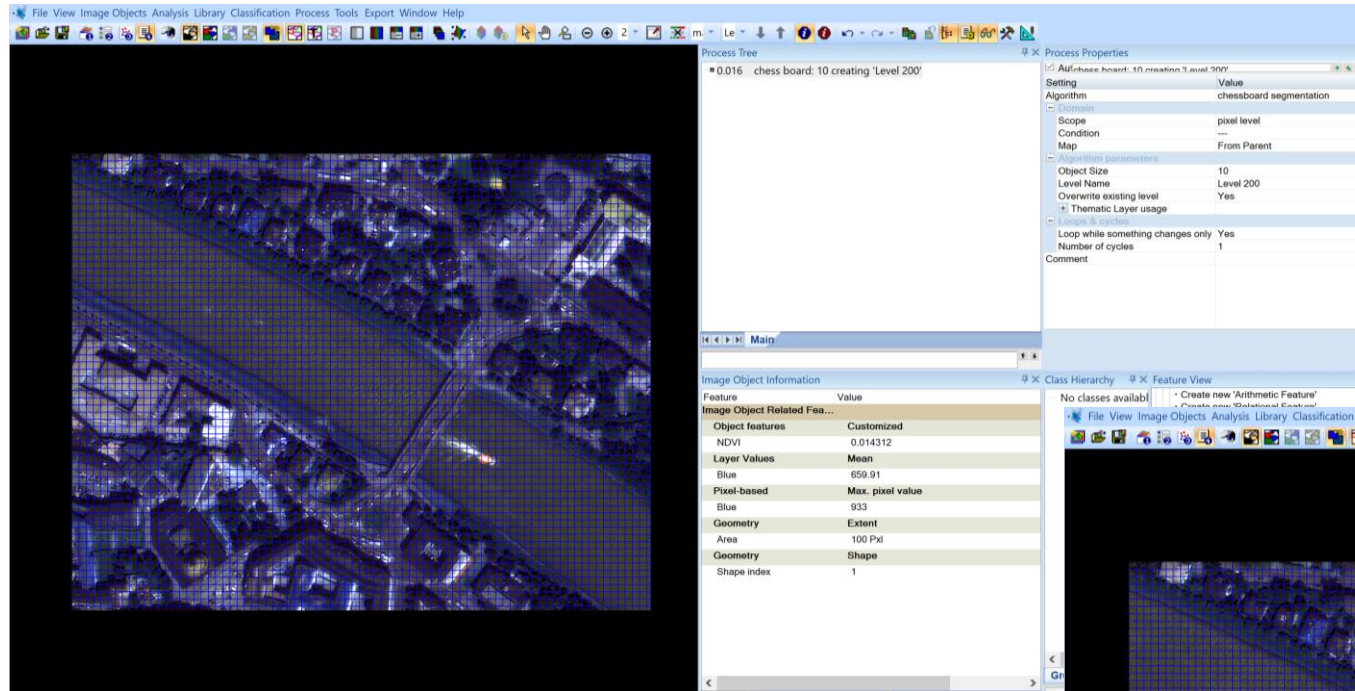
A satellite map of the African continent, showing the outlines of the major landmasses in shades of green and brown, surrounded by the blue oceans. The map is centered on the continent, with the Atlantic Ocean to the west and the Indian Ocean to the east.

Object Based Image Analysis In E-Cognition

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Advance Remote Sensing

Example 1: Chessboard Segmentation

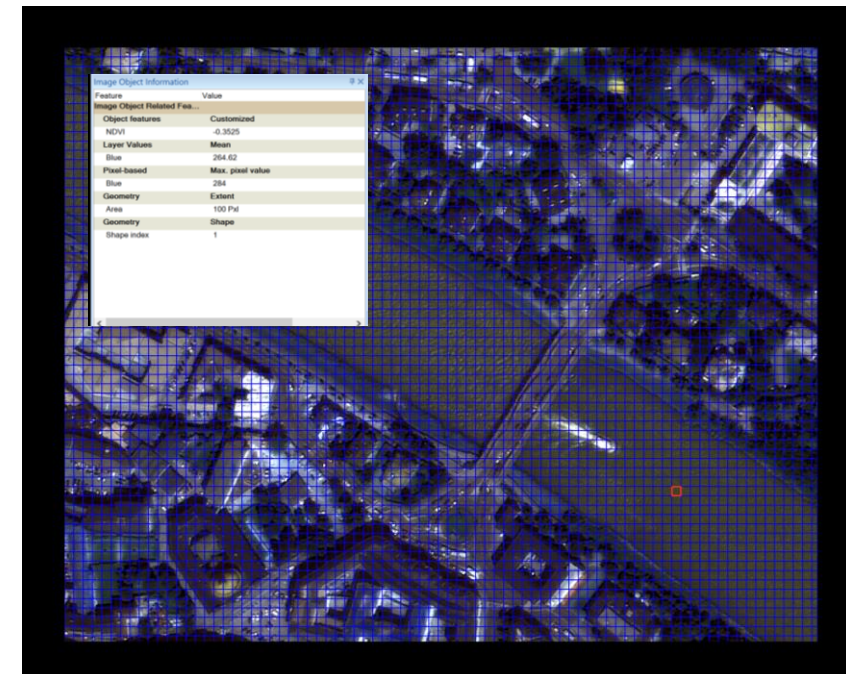
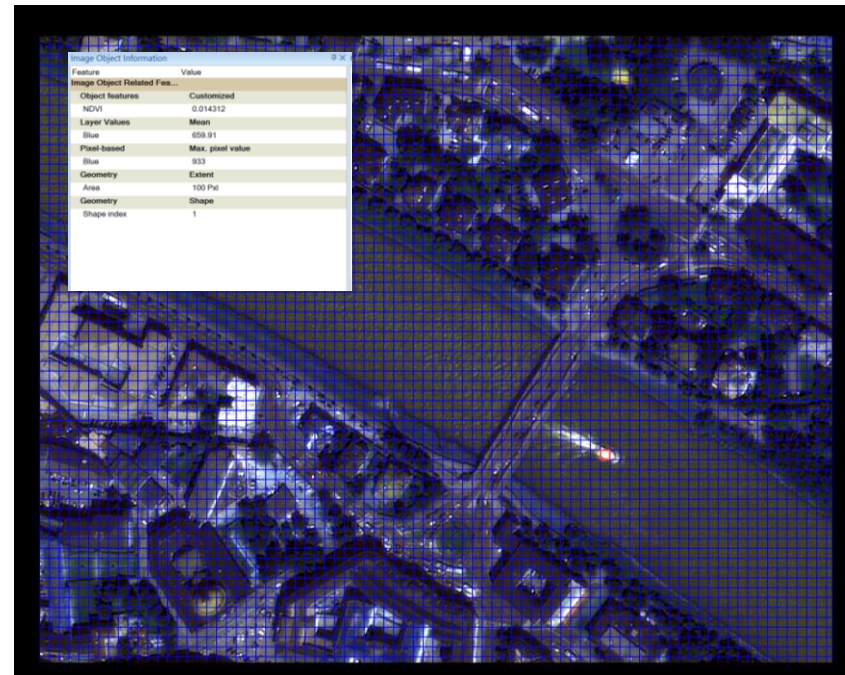


Question 1: What become obvious if you compare the values for the two objects of the chessboard segmentation (Boat and River)

Answer:

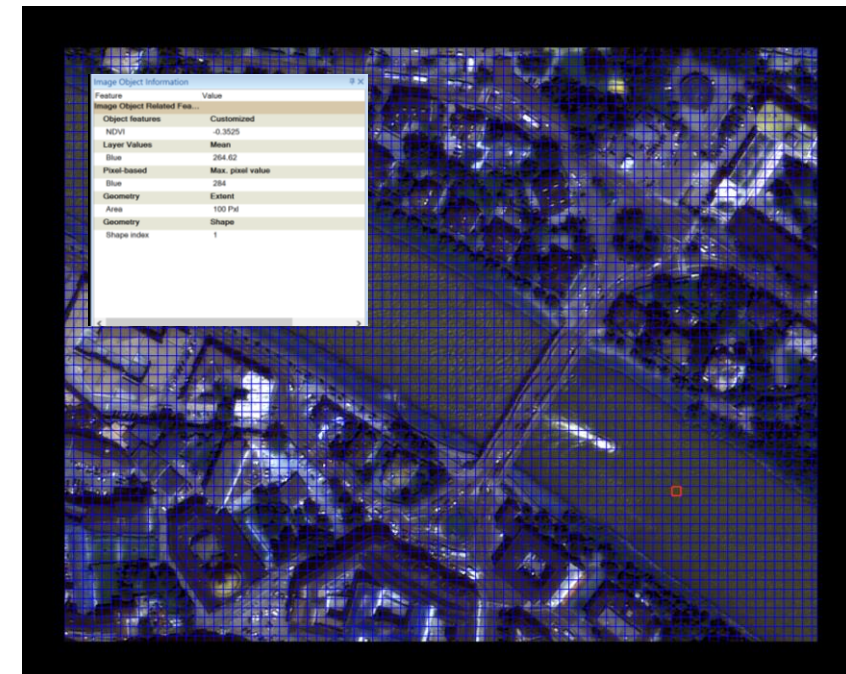
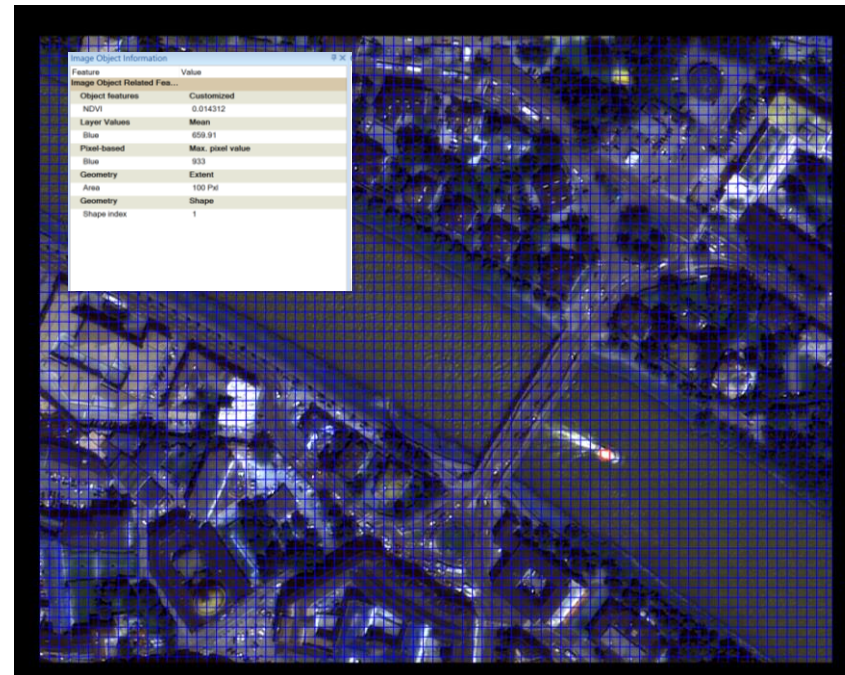
As evidenced by the screenshot to the right, the 10 by 10 px object at the center of the **Boat** has higher reflectance in the blue band, as well as all other band, with a corresponding low NDVI although not as low as the NDVI value in the middle of the **River**.

However, the low NDVI values are justified because NDVI is used to detect vegetation which is not present in the 2 instances.



Question 2: What features don't make sense.

Answer: The geometry and shape index are the same, meaning that object feature values are only considered by pixel, and not neighborhood values.



Example 2: Multiresolution Segmentation

The screenshot displays the QGIS Multiresolution Segmentation tool interface. The main window shows a processed aerial image with segmented features. The Process Tree on the right indicates the current step: "01.843 200 [shape:0.3 compact:0.5] creating 'Level 200'". The Process Properties panel on the right shows the following settings:

- Setting: Value
- Algorithm: multiresolution segmentation
- Domain
 - Scope: pixel level
 - Condition: --
 - Map: From Parent
- Algorithm parameters
 - Overwrite existing level: Yes
 - Level Settings
 - Level Name: Level 200
 - Compatibility mode: None
 - Segmentation Settings
 - Image Layer weights: 0, 1, 1, 0, 0, 0, 0, 1, 1
 - Thematic Layer usage: 200
 - Scale parameter: 200
 - Composition of homogeneity criterion
 - Shape: 0.3
 - Compactness: 0.5
 - Loops & cycles
 - Loop while something changes only: Yes

The Image Object Information panel on the left shows the following data:

| Feature | Value |
|-----------------------------|------------------|
| Image Object Related Fea... | |
| Object features | Customized |
| NDVI | -0.3111 |
| Layer Values | Mean |
| Blue | 265.81 |
| Pixel-based | Max. pixel value |
| Blue | 376 |
| Geometry | Extent |
| Area | 45593 Pxl |
| Geometry | Shape |
| Shape index | 2.000 |

The Class Hierarchy panel on the right shows the following structure:

- No classes available
- Create new 'Arithmetic Feature'
- Create new 'Relational Feature'
- NDVI
- Type
 - Layer Values
 - Mean
 - Mode
 - Quantile
 - Standard deviation
 - Skewness
 - Pixel-based
 - Ratio
 - Min. pixel value
 - Max. pixel value
 - Create new 'Max. pixel value'
 - Blue
 - Mean of inner border
 - Mean of outer border
 - Border Contrast
 - Contrast to neighbor pixels
 - Edge Contrast of neighbor pixels (Prototype)
 - StdDev. to neighbor pixels
 - Circular Mean

The bottom status bar shows the current layer: "RGB Blue Linear Level 200XY131 Objects".

Example 3 and 4 : NDVI Based Classification (Water, Vegetation, Boat)/ Related Boarder to water

The screenshot displays the QGIS interface with a map showing a river and surrounding land. The land is classified into three categories: Vegetation (green), Water (blue), and Boat (pink). The Boat is located in the river. The Process Tree on the right shows the steps taken to create the 'Level 200' classification.

Process Tree

- 01.750 200 [shape:0.3 compact:0.5] creating 'Level 200'
- <0.001s with NDVI >= 0.25 at Level 200: Vegetation
- 0.015 with NDVI <= -0.15 at Level 200: Water
- <0.001s with Rel. border to Water = 1 at Level 200: Boat

Process Properties

| Setting | Value |
|-----------------------------------|--------------------------|
| Algorithm | assign class |
| Domain | |
| Scope | image object level |
| Level | Level 200 |
| Class filter | none |
| Condition | Rel. border to Water = 1 |
| Map | From Parent |
| Region | From Parent |
| Max. number of objects | all |
| Algorithm parameters | |
| Use class | Boat |
| Loops & cycles | |
| Loop while something changes only | Yes |
| Number of cycles | 1 |
| Comment | |

Image Object Information

| Feature | Value |
|-----------------------------|----------------|
| Image Object Related Fea... | |
| Object features | Customized |
| NDVI | -0.1305 |
| Relations to neighbor o... | Rel. border to |
| Water | 1 |

Class Hierarchy

- classes
 - Boat
 - Vegetation
 - Water

Feature View

- Vector features
- Object features
- Class-Related features
 - Relations to neighbor objects
 - Existence of
 - Number of
 - Border to
 - Rel. border to
 - Create new 'Rel. border to'
 - Water
 - Rel. area of
 - Distance to
 - Mean diff. to
 - Overlap of two objects
 - Relations to sub objects
 - Relations to super objects
 - Relations to Classification
 - Linked Object features
 - Scene features
 - Process-Related features
 - Region features
 - Image Registration features
 - Metadata
 - Feature Variables

Groups Inheritance

Features Classification Class Evaluation

RGB Blue Linear Level 2CXY131 Objects

Example 4 :Classifying Vegetation by Air Quality

The screenshot displays the QGIS interface with a map of a river area. The map shows a river (blue) and surrounding land (green for vegetation, brown for buildings). A small pink object is highlighted on the riverbank. The interface includes several panels:

- Process Tree:** Shows a sequence of processing steps:
 - 01.750 200 [shape:0.3 compact:0.5] creating 'Level 200'
 - 0.001s with NDVI >= 0.25 at Level 200: Vegetation
 - 0.015 with NDVI <= -0.15 at Level 200: Water
 - 0.001s with Rel. border to Water = 1 at Level 200: Boat
 - 0.016 Vegetation with Mean Air Quality >= 50 at Level 200: high_air_Q
 - 0.001s Vegetation with Mean Air Quality < 50 at Level 200: low_air_Q
- Process Properties:** Shows the settings for the 'Assign Class' process:
 - Setting: Value
 - Algorithm: assign class
 - Domain: image object level
 - Scope: image object level
 - Level: Level 200
 - Class filter: Vegetation
 - Condition: Mean Air Quality < 50
 - Map: From Parent
 - Region: From Parent
 - Max. number of objects: all
 - Use class: low_air_Q
 - Loop while something changes only: Yes
 - Number of cycles: 1
- Image Object Information:** Shows the features of the selected object (Boat):

| Feature | Value |
|----------------------------|----------------|
| Object features | Customized |
| NDVI | 0.5312 |
| Layer Values | Mean |
| Air Quality | 49.76 |
| Relations to neighbor o... | Rel. border to |
| Water | 0 |
- Class Hierarchy:** Shows the classification hierarchy:
 - classes
 - Boat
 - Vegetation
 - high_air_Q
 - low_air_Q
 - Water
- Feature View:** Shows the features of the selected object (Boat):
 - Vector features
 - Object features
 - Class-Related features
 - Relations to neighbor objects
 - Existence of
 - Number of
 - Border to
 - Rel. border to
 - Create new 'Rel. border to'
 - Water
 - Rel. area of
 - Distance to
 - Mean diff. to
 - Overlap of two objects
 - Relations to sub objects
 - Relations to super objects
 - Relations to Classification
 - Linked Object features
 - Scene features
 - Process-Related features
 - Region features
 - Image Registration features
 - Metadata
 - Feature Variables

Boat is related by boarder to water 100% therefore 1

Example 4 : Creating multiple levels

The screenshot displays the QGIS interface with the following components:

- Main Map View:** Aerial imagery of a residential area with blue outlines representing classified objects. A specific area is highlighted with a red outline.
- Process Tree:** A list of processing steps:
 - 01.750 200 [shape:0.3 compact:0.5] creating 'Level 200'
 - 02.016 at Level 200: 50 [shape:0.5 compact:0.5] creating 'Level 50'
 - 03.001s with NDVI >= 0.25 at Level 200: Vegetation
 - 04.015 with NDVI <= -0.15 at Level 200: Water
 - 05.001s with Rel. border to Water = 1 at Level 200: Boat
 - 06.016 Vegetation with Mean Air Quality >= 50 at Level 200: high_air
 - 07.001s Vegetation with Mean Air Quality < 50 at Level 200: low_air
- Process Properties:** Settings for the 'multiresolution segmentation' algorithm:
 - Setting: Value
 - Algorithm: multiresolution segmentation
 - Domain:
 - Scope: image object level
 - Level: Level 200
 - Class filter: none
 - Condition: ---
 - Map: From Parent
 - Region: From Parent
 - Max. number of objects: all
 - Algorithm parameters:
 - Level Settings:
 - Level Name: Level 50
 - Level Usage: Create below
 - Compatibility mode: None
 - Segmentation Settings:
 - Image Layer weights: 0, 1, 1, 0, 0, 0, 0, 1, 1
 - Thematic Layer usage: 50
 - Scale parameter: 50
 - Composition of homogeneity criterion: (expanded)
- Image Object Information:** A table showing features and their values:

| Feature | Value |
|----------------------------|----------------|
| NDVI | -0.2731 |
| Layer Values | Mean |
| Air Quality | 74.42 |
| Relations to neighbor o... | Rel. border to |
| Water | 0 |

Scene Related Features

| Class-Related | Number of classified objects |
|---------------|------------------------------|
| Boat | 1 |
| high_air_Q | 28 |
| low_air_Q | 19 |
| Vegetation | 47 |
| Water | 3 |

Class-Related

| | Area of classified objects |
|------------|----------------------------|
| high_air_Q | 0.039817 km² |
| low_air_Q | 0.015739 km² |
| Vegetation | 0.055556 km² |
- Class Hierarchy:** A tree view showing the hierarchy of classes:
 - classes
 - Boat
 - Vegetation
 - Water
- Feature View:** A list of features and their values, including:
 - Vector features
 - Object features
 - Class-Related features
 - Linked Object features
 - Scene features
 - Scene Variables
 - Map Variables
 - Class-Related
 - Number of classified objects
 - Number of samples per class
 - Area of classified objects
 - Create new 'Area of classified objects'
 - Vegetation (km²)
 - high_air_Q (km²)
 - low_air_Q (km²)
 - Area percentage of
 - Layer mean of classified objects
 - Layer stddev of classified objects
 - Statistic of object value (prototype)
 - Histogram of object value (prototype)
 - Scene-Related
 - Rule set-Related
 - Architect-Related
 - File-system
 - ILL-related

The status bar at the bottom indicates the current layer is 'Level 50' with 1,139 objects.

The level 50, with a scale parameter of 50 is created below level 200 (Scale parameter 200)

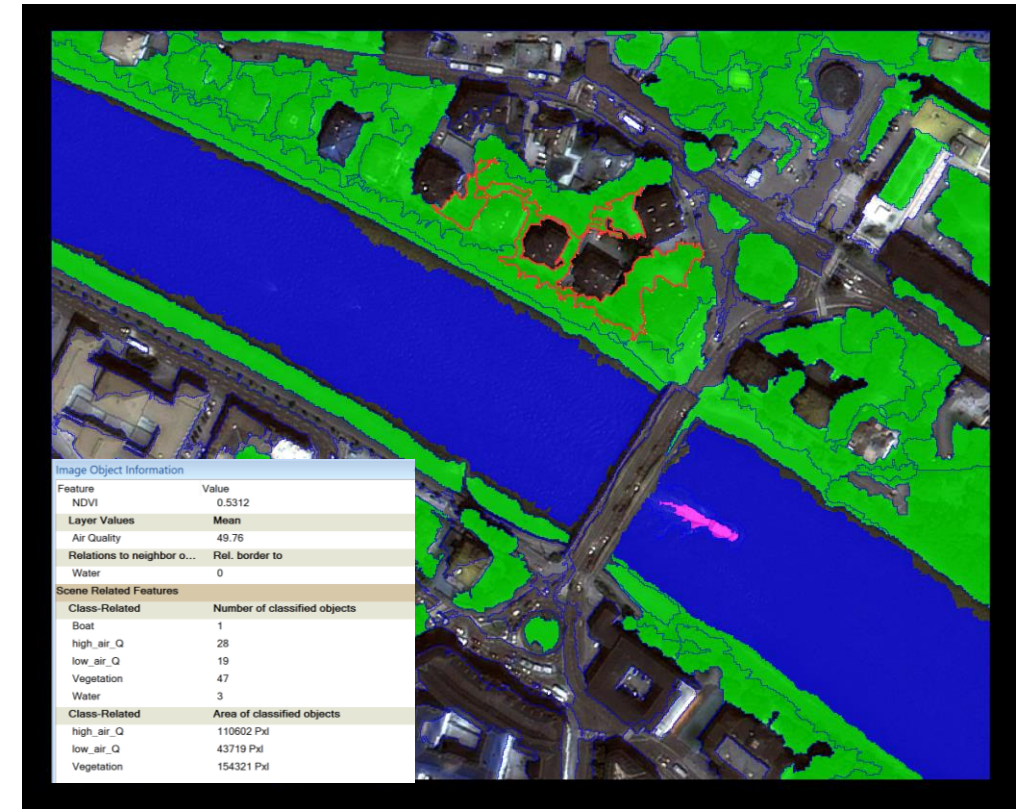
Question 3 and 4: How many objects were classified as “water”, and Area of the whole vegetation class.

Answer

3 image objects are classified as **water**, as seen in the screenshot, while the **total area classified as vegetation is 154321 pxl** or 0.056km (screenshot below).

As suggested, the vegetation area is a summation of its subclass values. (110602pxl + 43719pxl = 154321pxl)

| Image Object Information | |
|----------------------------|------------------------------|
| Feature | Value |
| NDVI | 0.5312 |
| Layer Values | Mean |
| Air Quality | 49.76 |
| Relations to neighbor o... | Rel. border to |
| Water | 0 |
| Scene Related Features | |
| Class-Related | Number of classified objects |
| Boat | 1 |
| high_air_Q | 28 |
| low_air_Q | 19 |
| Vegetation | 47 |
| Water | 3 |
| Class-Related | Area of classified objects |
| high_air_Q | 0.039817 km² |
| low_air_Q | 0.015739 km² |
| Vegetation | 0.055556 km² |



Question 5: What is the meaning of the distance value when you create the feature?

Answer

The feature created is **Relation to existence of superclass objects**.

This means that the algorithm identifies and select only features whose superclass has been assigned a classification. In this case belong to the vegetation superclass. i.e. it creates a distinction between all objects that have a superclass-subclass relation, in this case only vegetation and its subclasses high and low air quality, which are assigned a value of 1.

Others that don't share such relationship with the vegetation class (therefore whose superclass is unclassified) are assigned 0.

This relationship is useful to analyse and classify features based on their object hierarchy level.

Please see screenshot below.

