Advanced Remote Sensing

1. Loading the data

The first step is to load the necessary data into eCognition software. Firstly, the main image is loaded ("QB_MGI31_subset_SBG.tif") and it is important to choose the correct visualization settings, as seen in image 1.

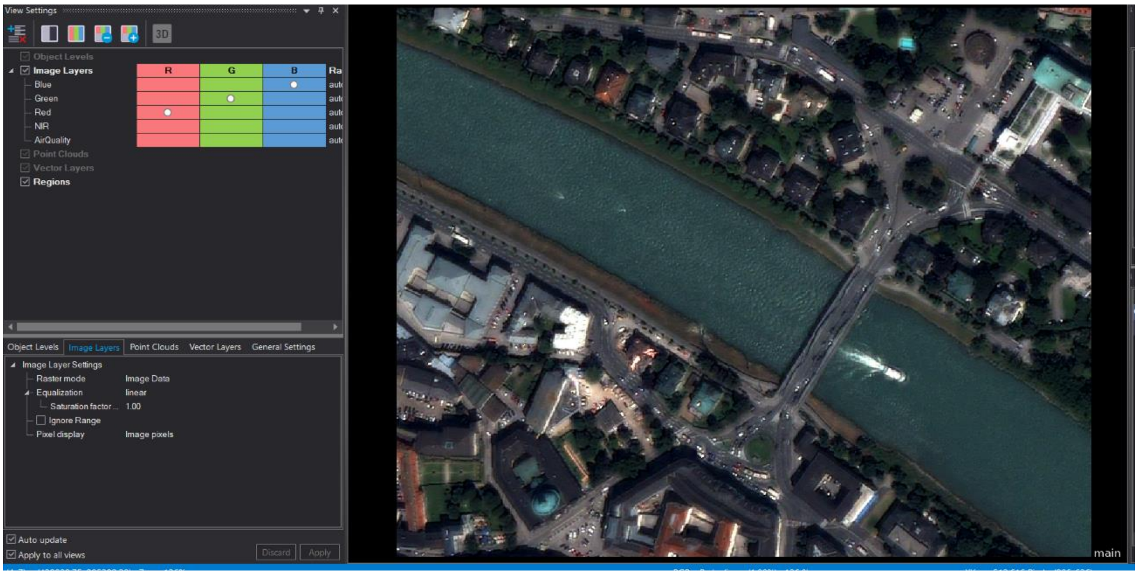

Image 1 – Visualization settings for the main image

After it, the second image is loaded, as an extra layer data. This image will be assigned as a fifth layer for our main image, as an air quality image layer (see image 2).

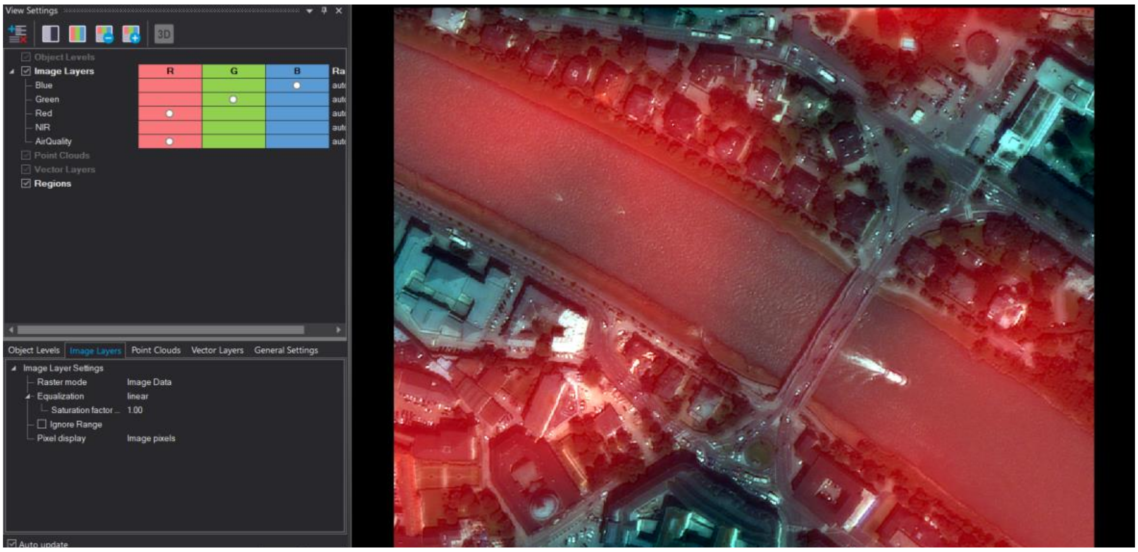

Image 2 – Second loaded image as a fifth layer

2. Chessboard segmentation

We add a new process to the Process Tree which is a chessboard segmentation (a way to segment an image by dividing it into an orthogonal matrix, like a chessboard). The input settings and the Process Tree can be seen on image 3.

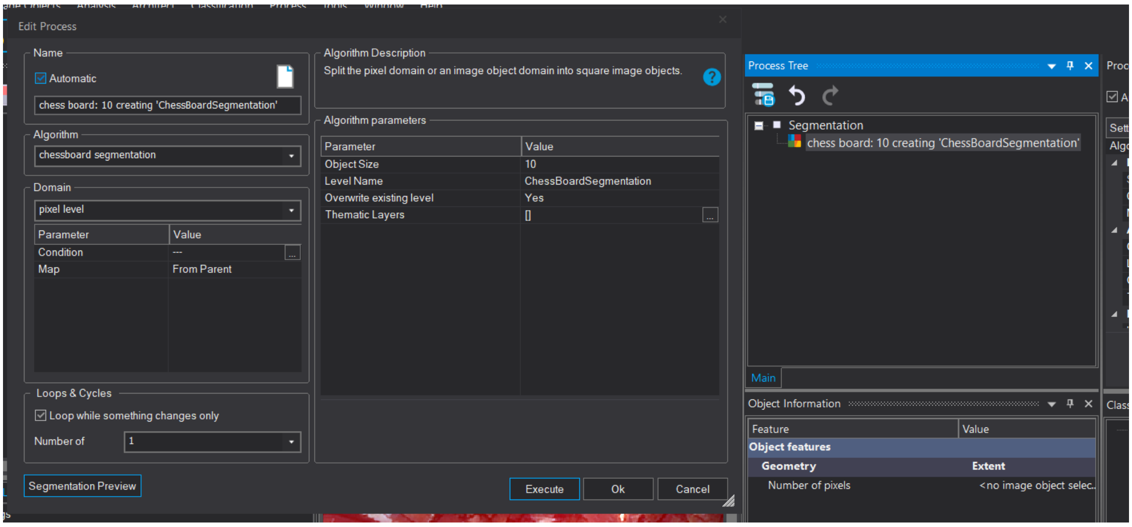

Image 3 – Chessboard segmentation settings and Process Tree

Selecting some object features, such as mean for each layer, and then selecting an image object (result from the chessboard segmentation), we can have a small statistic analysis (mean analysis) of the image object – see image 4.

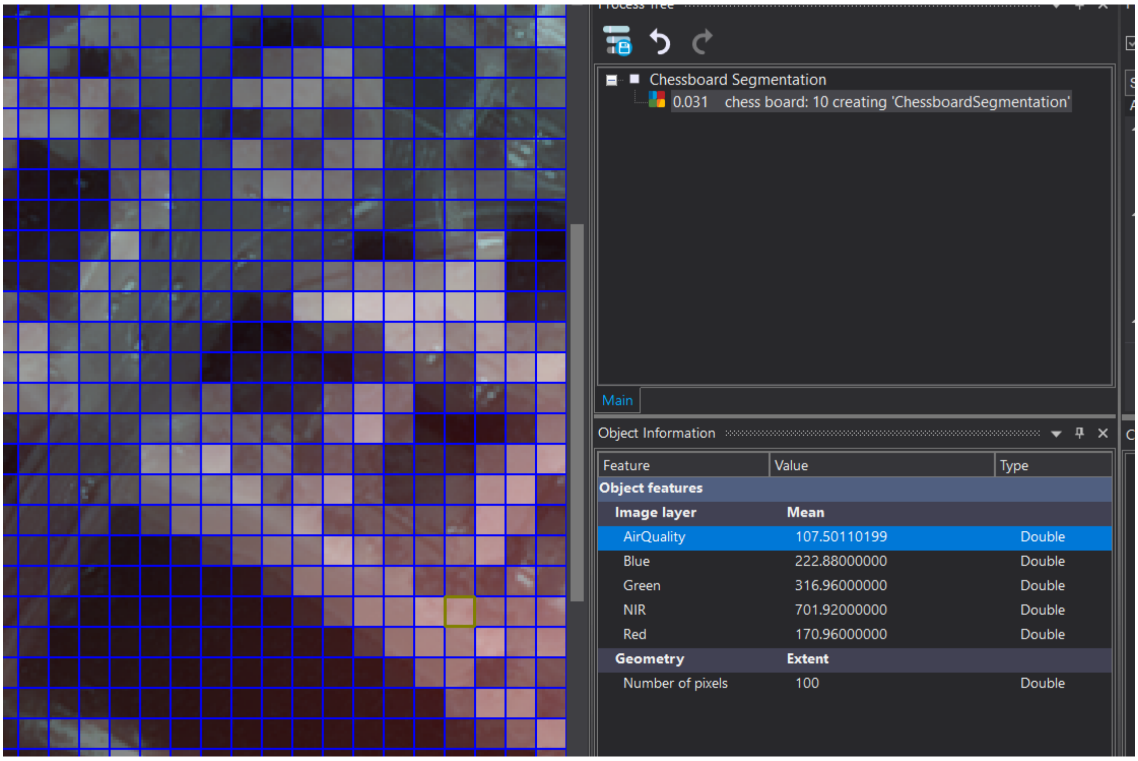

Image 4 – Mean values for each selected image object

3. More object features

Just like we add the mean as an object feature, we can add more and they can be found under Select displayed Features window. We are adding the following features (see image 5):

- Mean value of the blue band;
- Maximum pixel value of the blue band;
- Area of the selected object;
- Shape Index of the selected object;

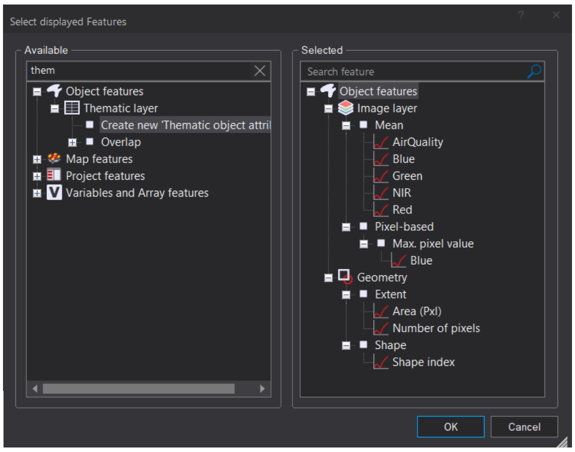

Image 5 – Adding features

It can also be interesting to compare different image objects (pixels) with different spectral values using the added object pictures, as seen on image 6.

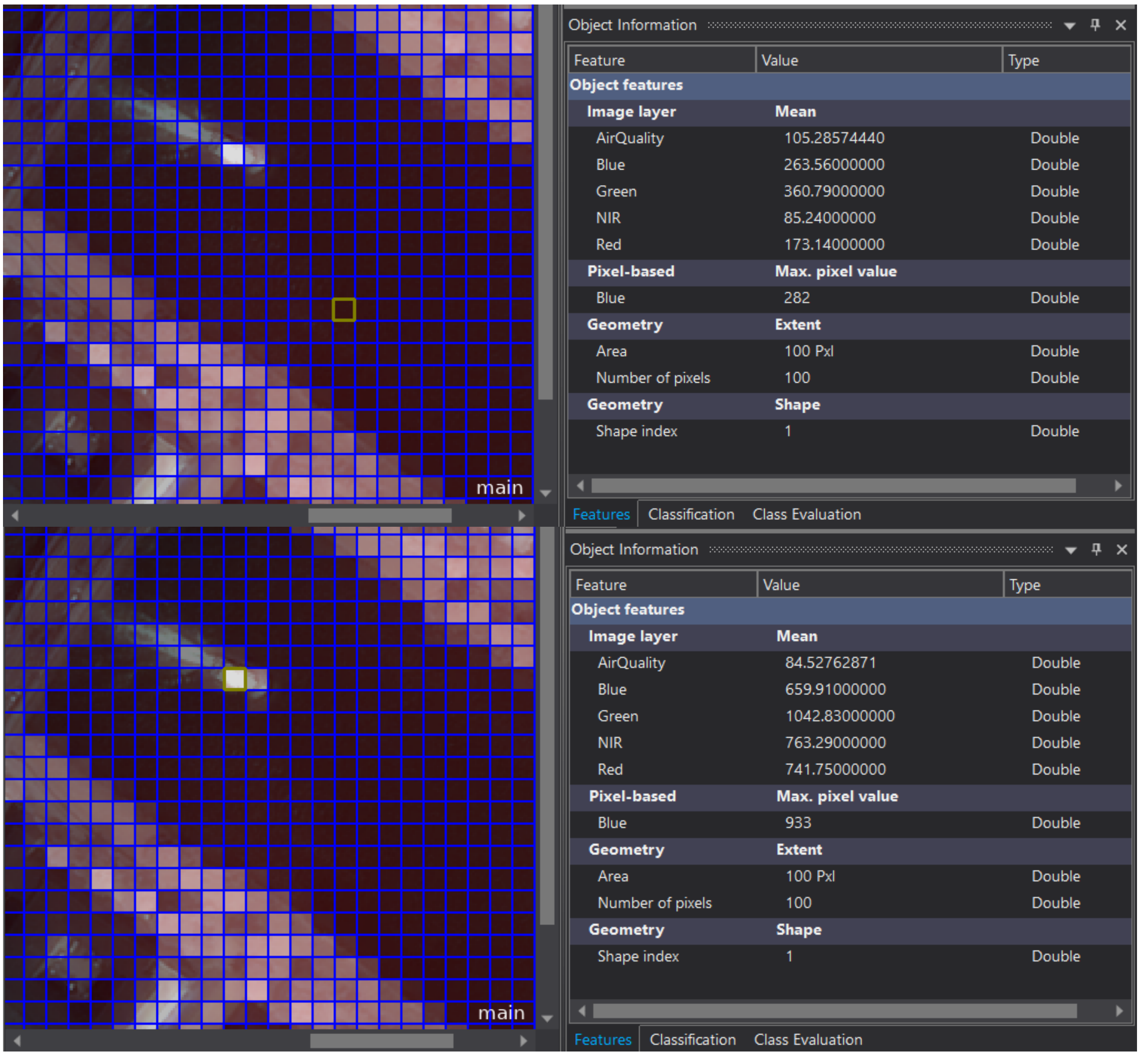

Image 6 – Comparison between two different image objects using the new added features

Besides the already prepared eCognition features, it is also possible to customize your own features. For example, it would be interesting to customize a new feature representing the NDVI (Normalized Difference Vegetation Index):

$$NVDI = \frac{(NIR - RED)}{(NIR + RED)}$$

To do so we create a new customize feature, following the input settings, as seen on image 7.

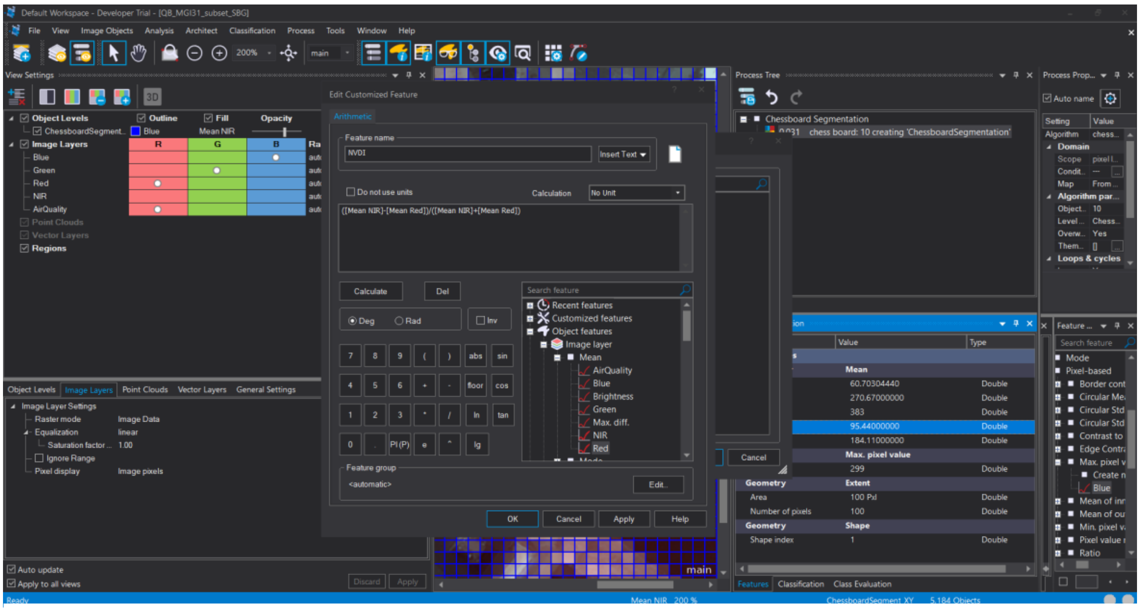

Image 7 – Input settings to create a customize feature to calculate NDVI

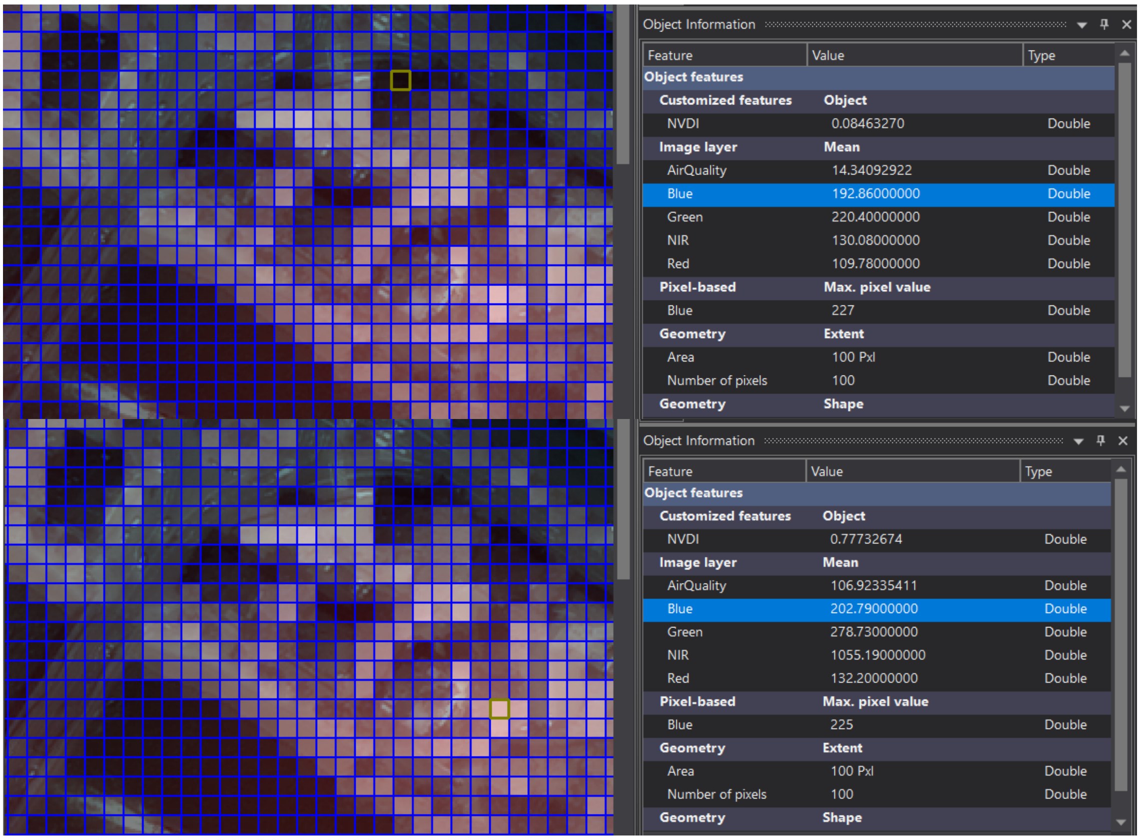

Image 8 – Comparing the values between two different image objects of different image areas

4. **Question 1:** What becomes obvious if you compare the values for the two objects of the chessboard segmentation?

It becomes obvious that chessboard segmentation is not ideal for analyzing and comparing image objects because it does not divide the image based on its features. Instead, it arbitrarily divides the image into uniform tiles. For example, when comparing NDVI between vegetation and water, it is harder to find objects that solely contain vegetation or water pixels, as each object may mix pixels from different features. This can lead to inaccurate comparisons, as the segmentation does not reflect the true boundaries of the study objects.

5. **Question 2:** Which features don't make that much sense in this case?

It doesn't make sense to use any features that rely on meaningful object boundaries since the segmentation doesn't take in consideration boundaries or object properties. Any geometry features, such as area or number of pixels don't make sense in this context because they will always be the same since the segmentation divides the images into same size and shape objects. Also, the shape index of the selected object feature doesn't make much sense because all the features objects that result from a chessboard segmentation have the same shape.

6. **Multiresolution segmentation**

To proceed with a supervised classification, it is better to have a multiresolution segmentation rather than a chessboard segmentation. Thus, we will delete the chessboard classification level and create a new process for the multiresolution segmentation, following the input settings as seen on image 9.

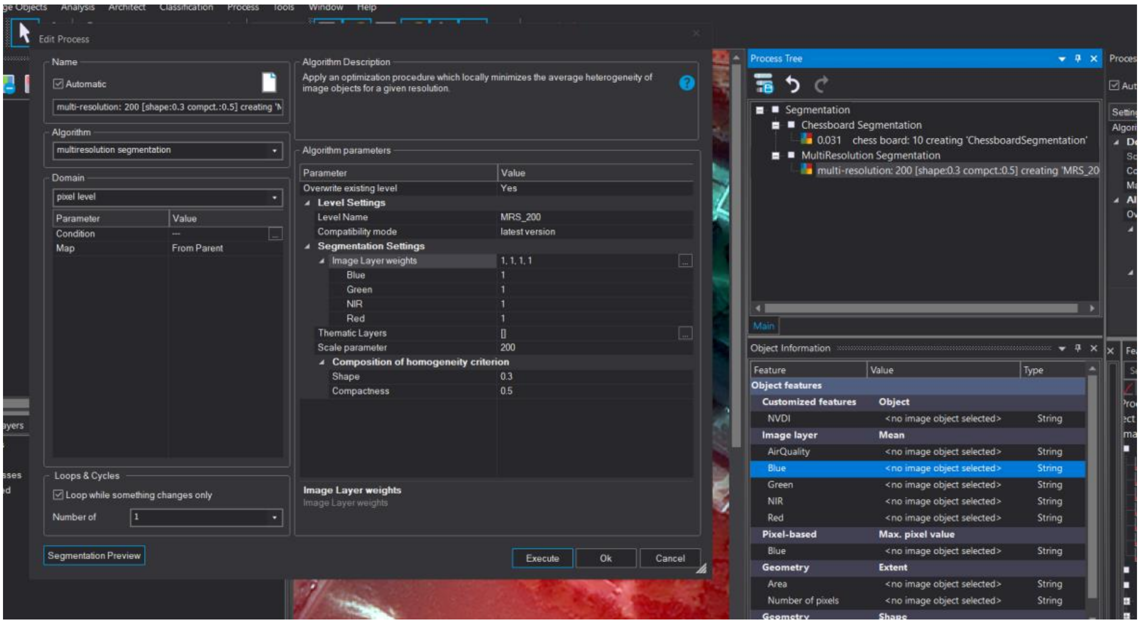

Image 9 – Multiresolution segmentation input settings

Using this segmentation method, it also makes more sense to use and compare certain image object with most of the object features talked before. See image 10 to look at the differences between two different image object and how their features differ from each other.

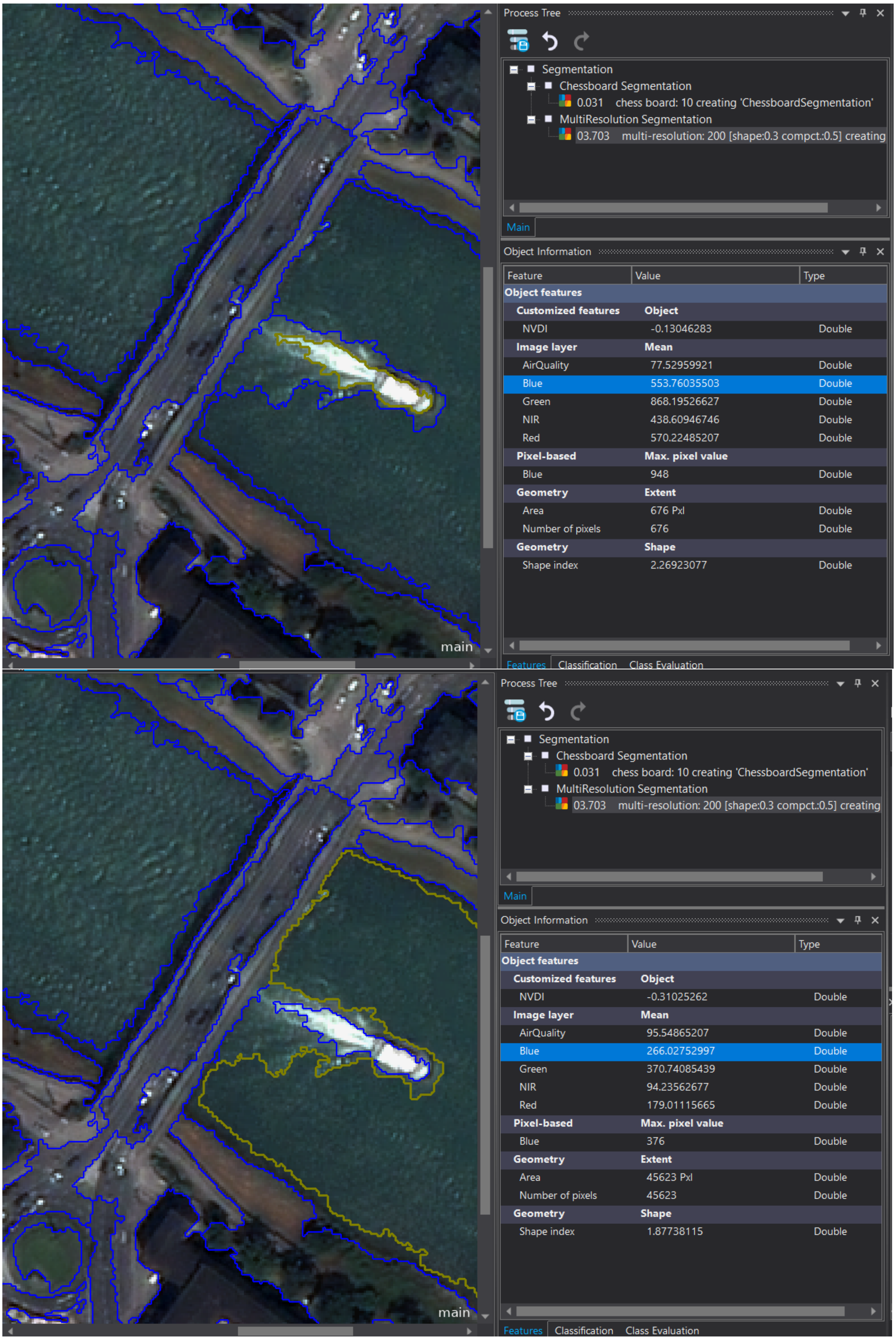

Image 10 – Comparison between two different image objects coming from a multiresolution segmentation

7. Updating NDVI features

Having an improved segmentation, we should find a good threshold value to distinguish between vegetation and non vegetation areas and water bodies. After updating the values and displaying them on the segmentated image, we'll get a similar result as the one shown on image 11.

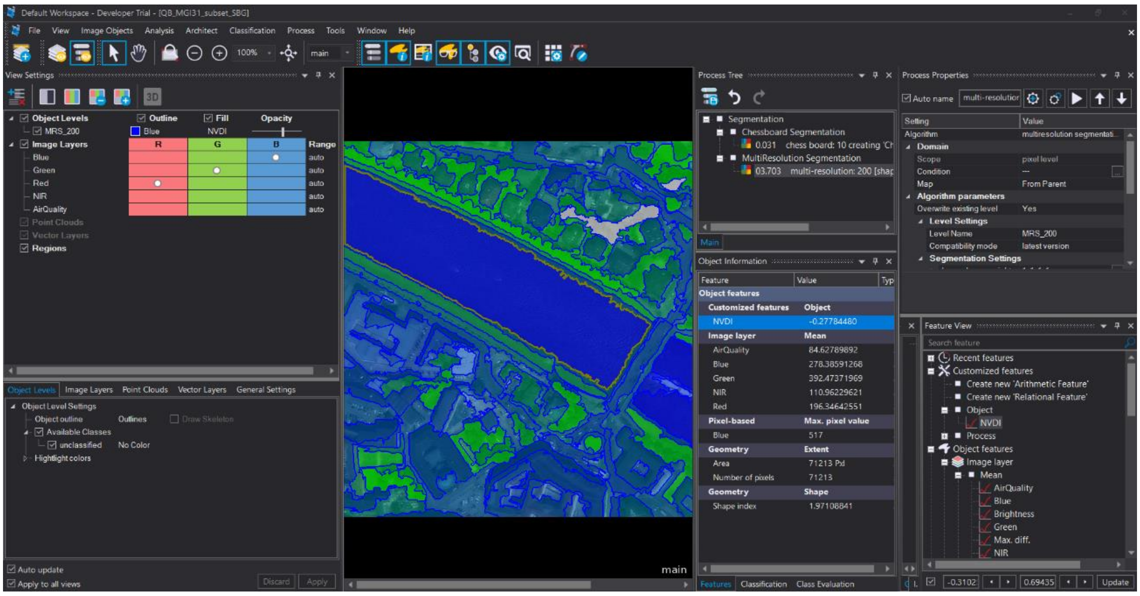

Image 11 – Updated NDVI values and displaying them

8. Creating and assigning classes

With a good segmentation done, we can start creating classes, like vegetation or water. We can create a process to assign classes concerning each class already created. This algorithm will make sure that our image will have assigned classes according to the NDVI parameters created just before. See images 12 and 13 for the input settings for both vegetation and water assignment class.

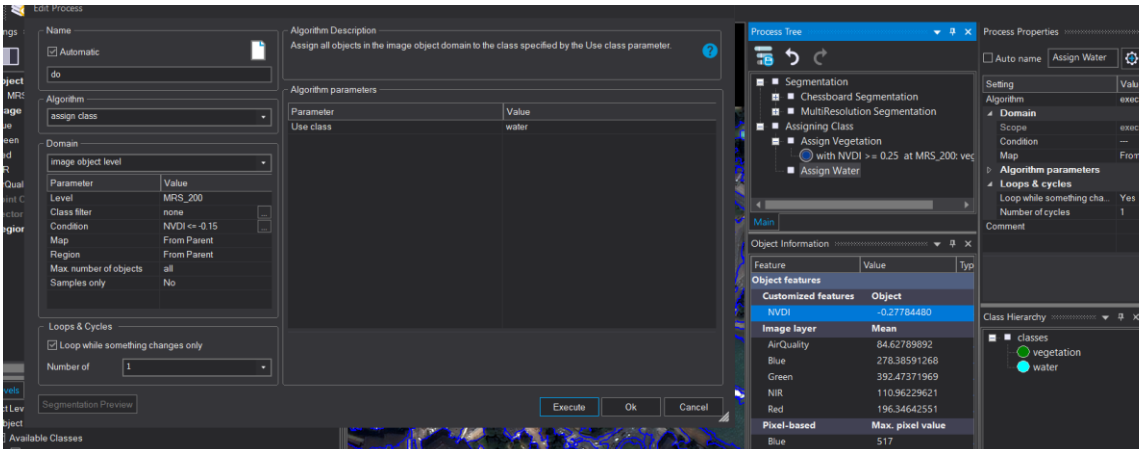

Image 12 – Input settings to assign class water

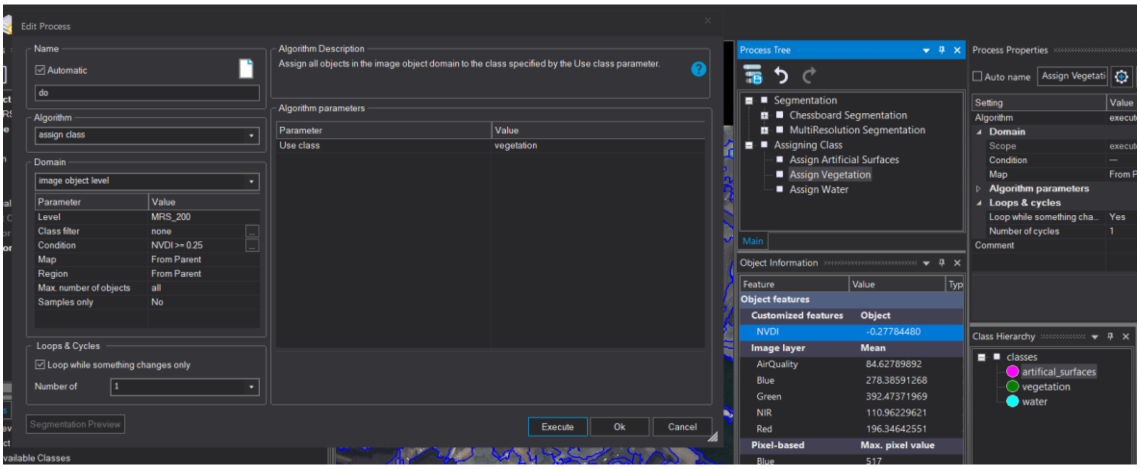

Image 13 – Input settings to assign class vegetation

The result should be similar to the one shown on image 14.

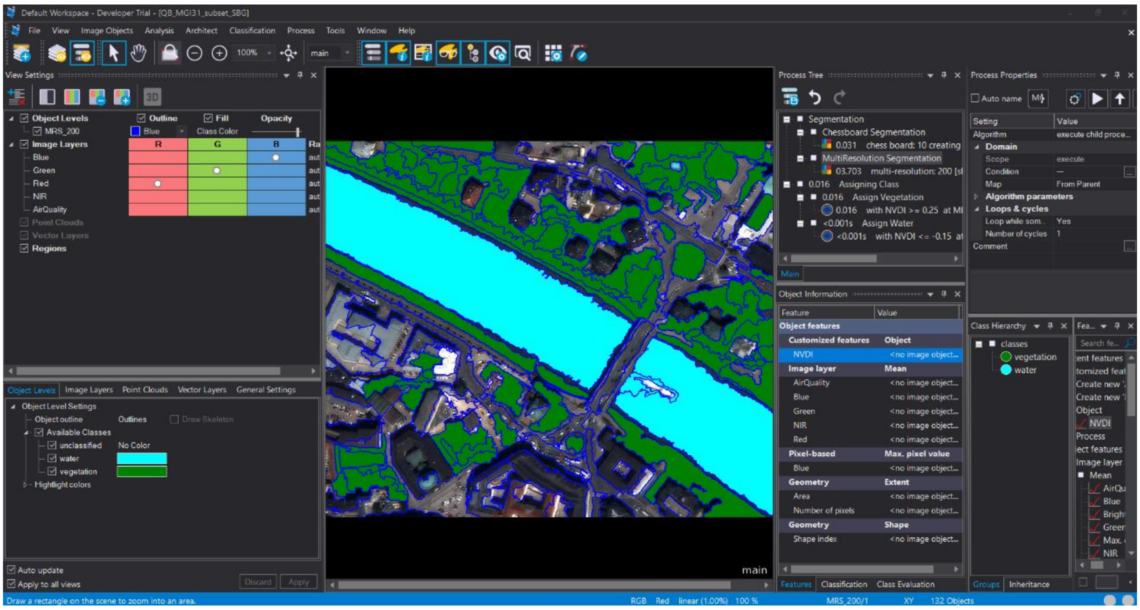

Image 14 – Result after assigning water and vegetation classes

We can create a new feature called Relative border to… any already created class, such as water or vegetation. This will show the index value of how much an image object is in contact with another object with an assigned class. The best example for it is the boat on the river, which is surrounded by water assigned image object – take a look at image 15 to see the values for the boat image object.

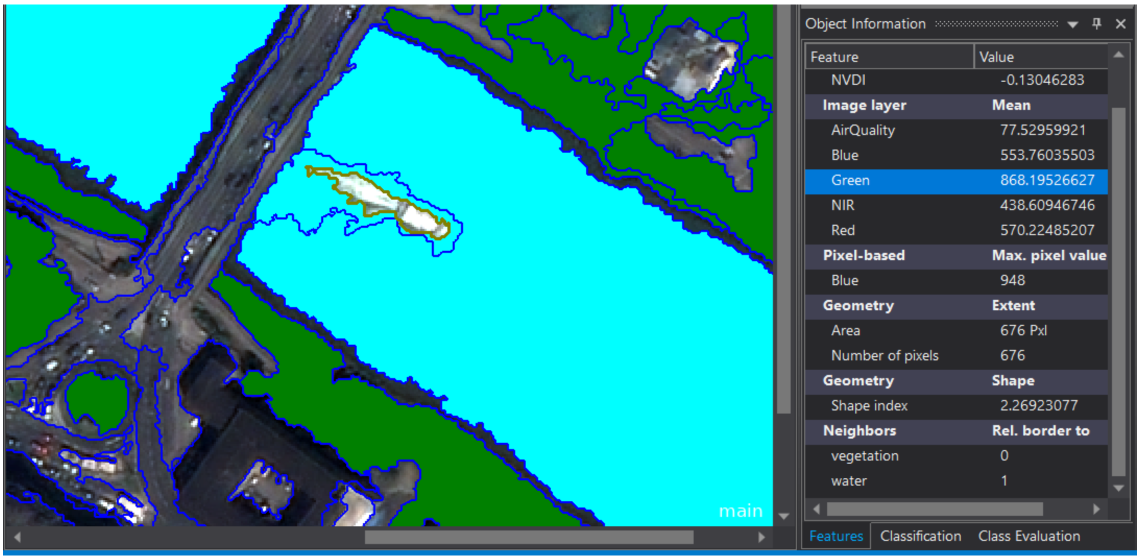

Image 15 – Relation between boat image object and water image object

Knowing this, we can create a new class specially for the boat and use the assign class algorithm along with the relative border to feature to classify it. We will use the unique relationship with the water to have the perfect class assignment (see image 16).

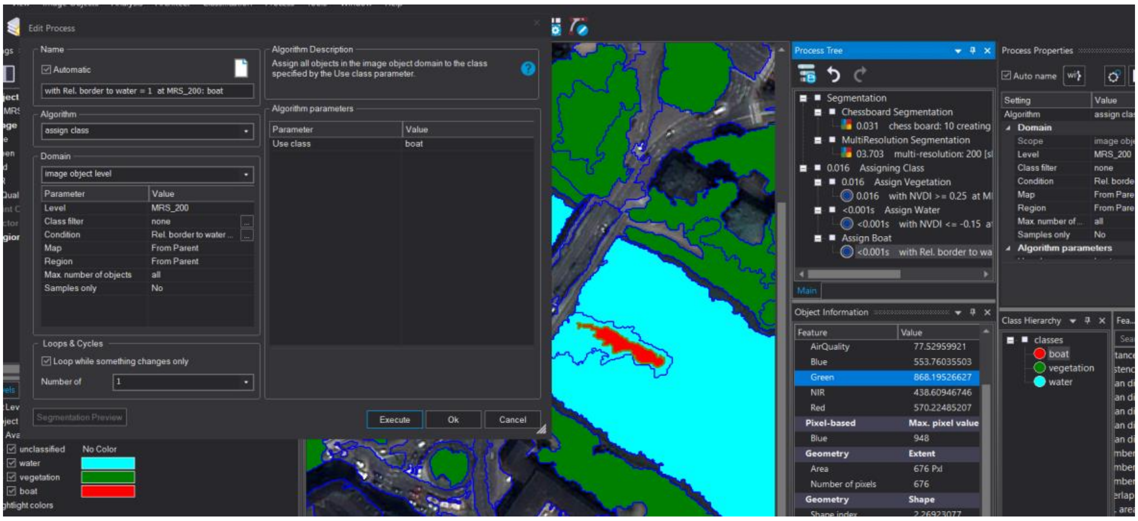

Image 16 – Assigning a class to the boat with relative border to feature

9. Using air quality level

Now we will take advantage of the air quality level to improve our classification and class assignment. To do so we will create two new sub classes for the vegetation class (high_air_quality and low_air_quality). After it we will use the assign class algorithm again but taking into consideration the new created classes and the air quality image layer. In the end, the algorithm will divide the classified image objects as vegetation into high and low air quality. Take a look at image 17 for the input settings and image 18 for the final result.

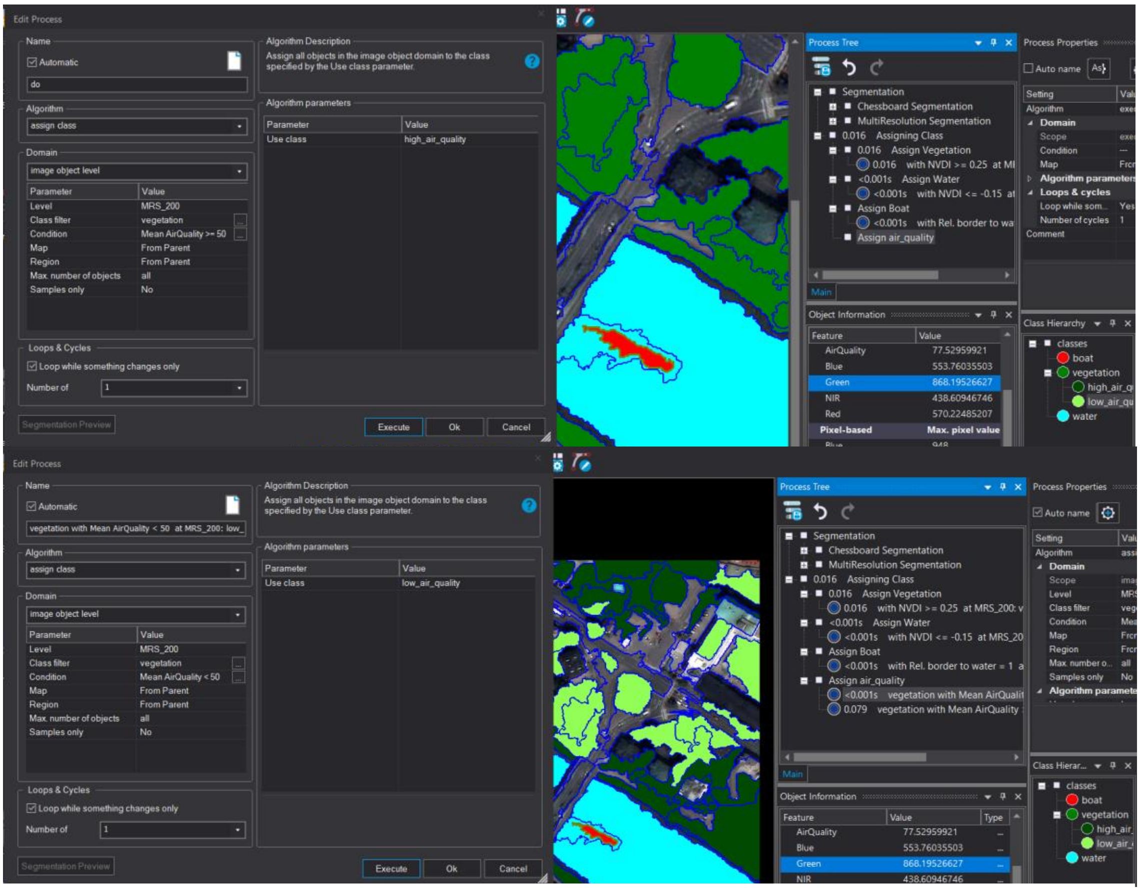

Image 17 – Input settings to assign class algorithm for the high and low air quality

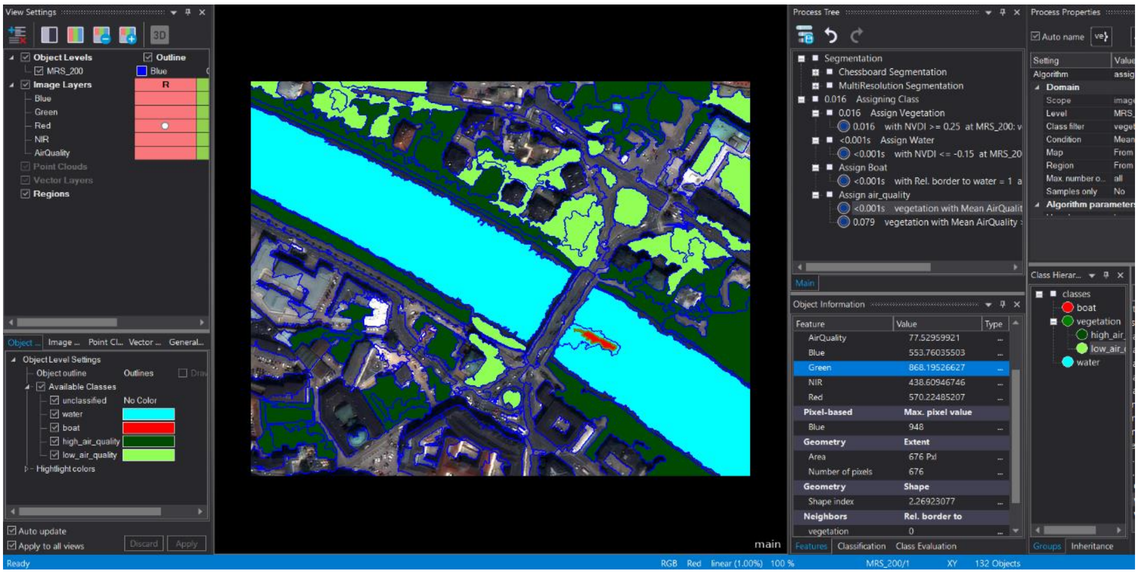

Image 18 – Image result of the class assignment

10. **Question 3:** How many objects were classified as „water"?

To answer this question we should create a new feature (Map Features > Objects > Number of Classified Objects > choose water class). We have 3 objects classified as water, as seen on image 19.

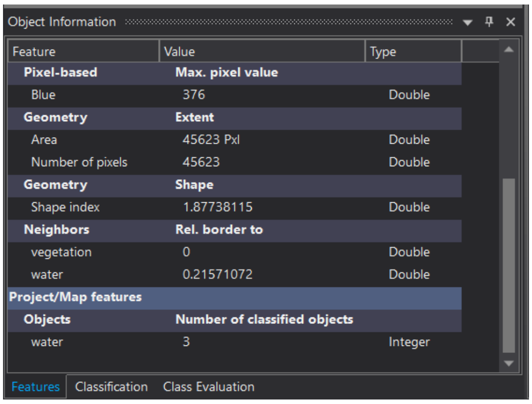

Image 19 – Number of object classified as water

11. **Question 4:** What is the area of the whole vegetation class (if you select the vegetation class to generate the feature, it will summarize the values from the grouped sub-classes)?

To answer this question, we should create a new feature (Map Features > Objects > Area of Classified Objects > choose the whole vegetation class). The whole vegetation class has 158660 pixels or 57117.6 m2, as seen on image 20.

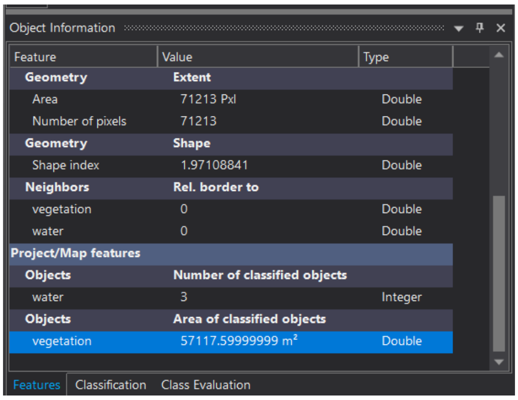

Image 20 – Area of the whole vegetation class

12. **New multiresolution segmentation**

We will create a new multiresolution segmentation on a new level using the input settings seen on image 21. After executing this process, it is interesting to compare the two multiresolution segmentation that were performed so far (see image 22 for the comparison between the two of them).

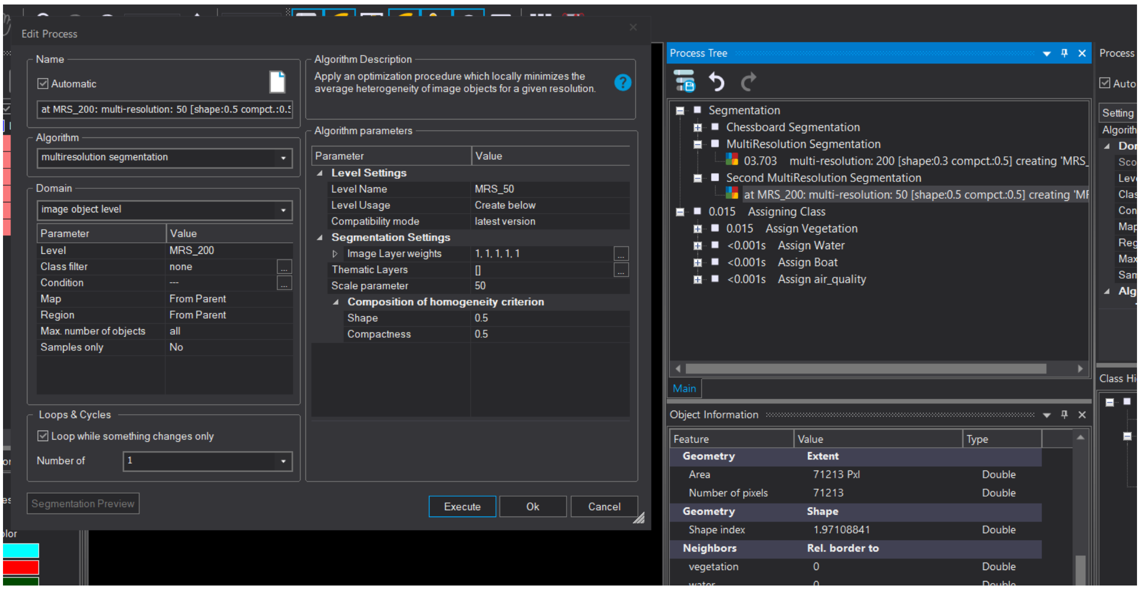

Image 21 – Multiresolution segmentation input settings

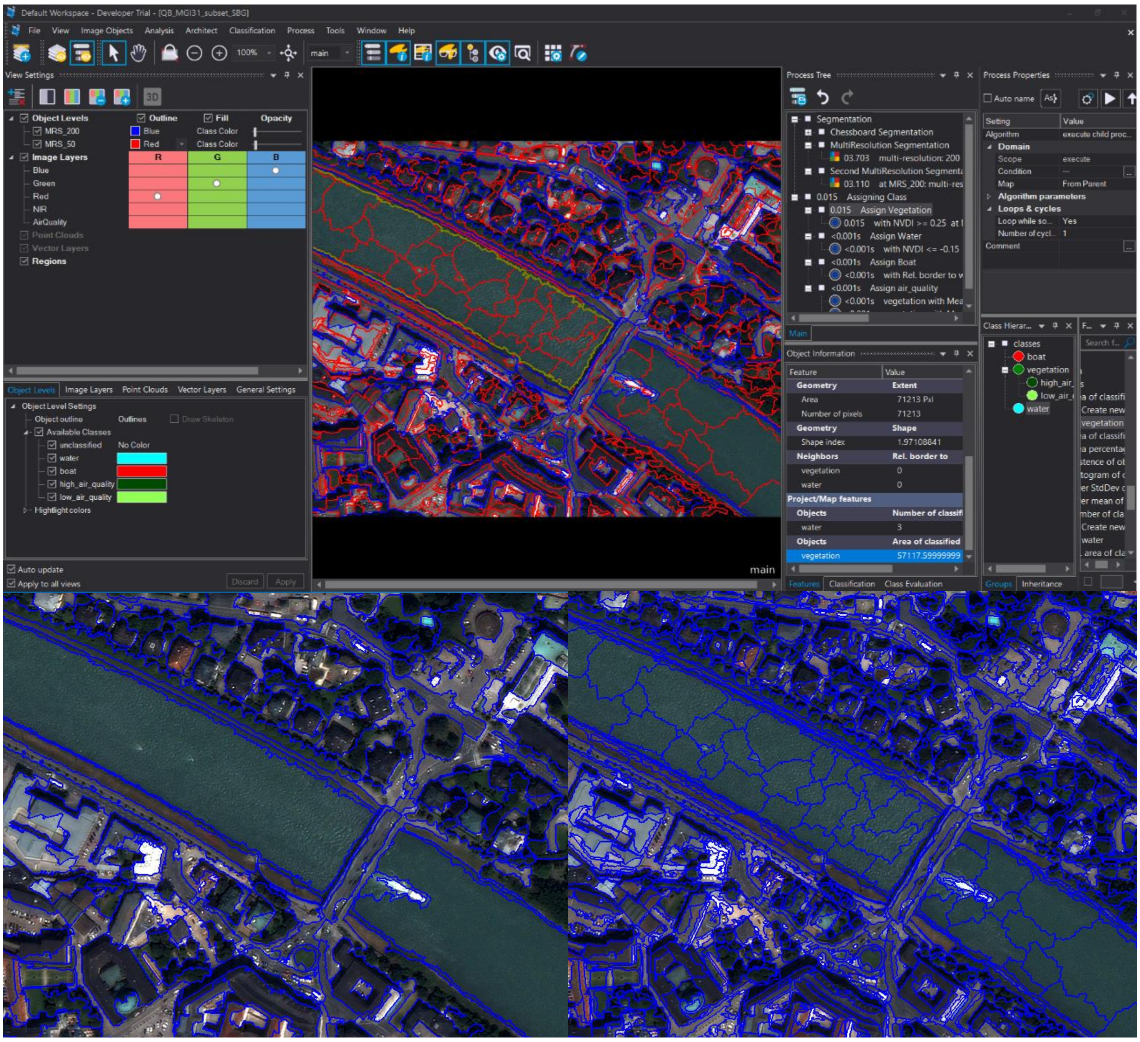

Image 22 – Comparison between the two multiresolution segmentations. Blue segmentation at top image and bottom image at left with scale parameter of 200 and red segmentation at top image and bottom image at right with scale parameter of 50

We will use a new feature called Existence of super object, which is directly connected wit the vegetation class, since it has two sub classes in it. We will use a the class vegetation and a distance value of 1. The result can be seen on image 23.

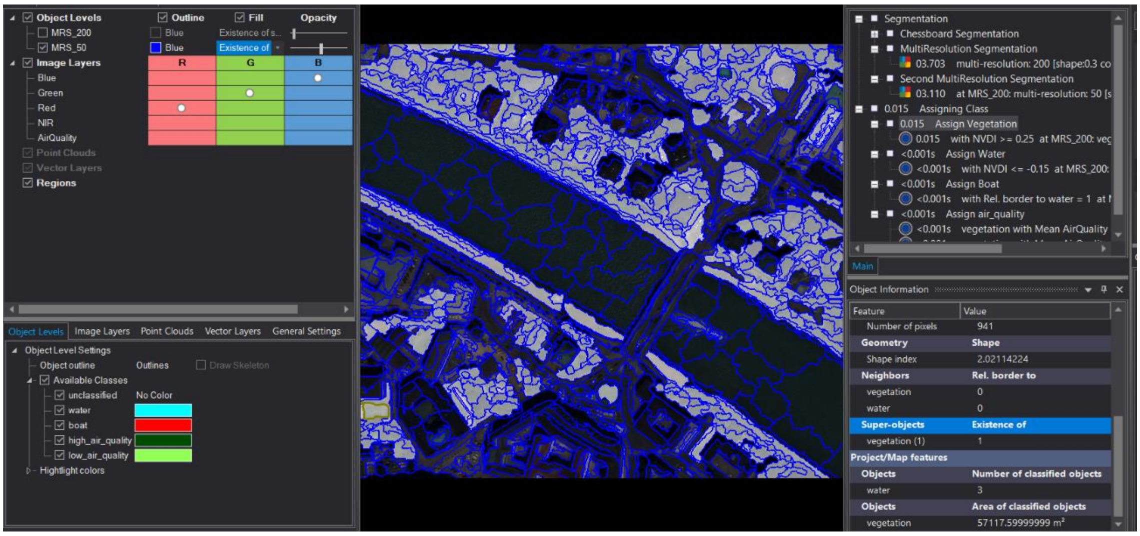

Image 23 – Result of Existence of feature visualization

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

The distance value is basically a Boolean value, meaning that 1 is considered true and 0 false. In this context, since we created the feature related to the vegetation class it will show if the class is either vegetation (distance value 1) or non vegetation (distance value 0). Also, the display colors on the image represent the vegetated or non vegetated areas. See image 24 to better understand the distance value.

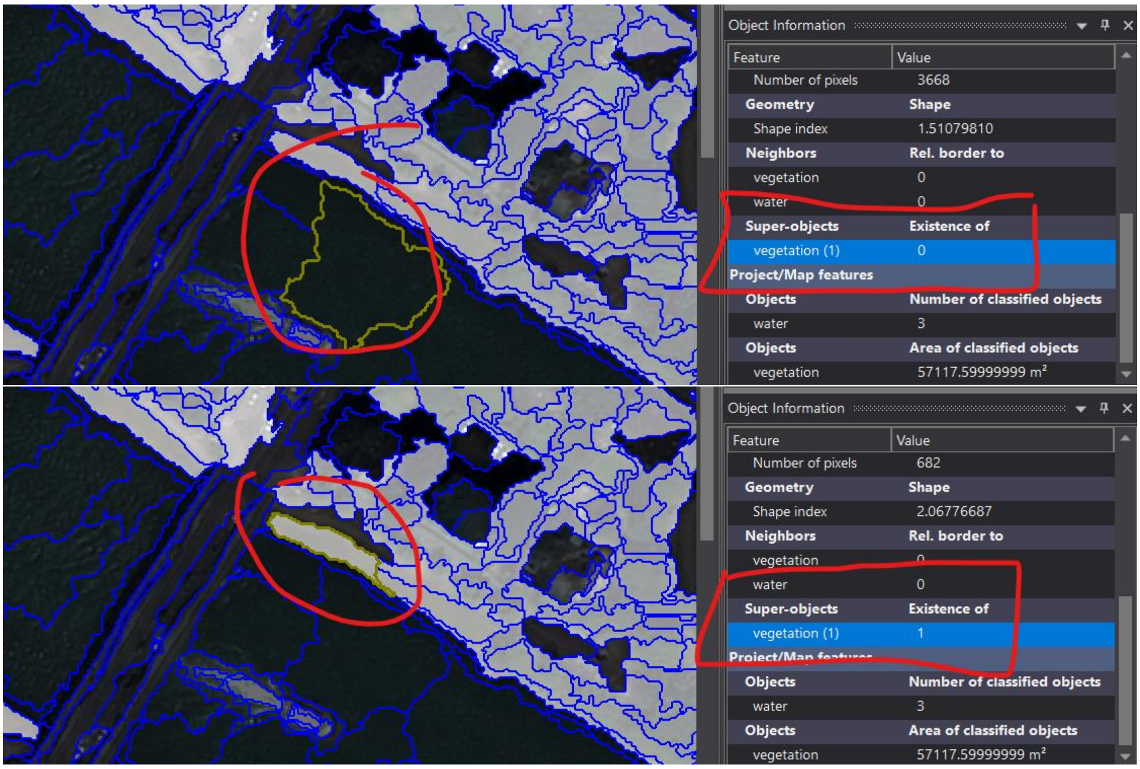

Image 24 – Comparison of Existence of feature