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ACCURACY ASSESSMENT

ASSIGNMENT OBJECT BASED IMAGE UNDERSTANDING

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OBJECTIVE

Recognize different approaches to perform an accuracy assessment of a classification result

USED SOFTWARE

- ArcGIS Pro 3.0.0
- eCognition Developer 10.1
- eCognition Developer 10.2

USED DATA

- **Classification Data**
  - Considering that the Supervised/Sample-based Classification of Part 1 was created with eCognition Developer Trial 9, the results could not be exported. Then, the provided classification shapefile (validation_points_random_confmatrix.shp) was used instead
- **Reference Data**
  - Labelled Sample **Points**: result_NN_classification.shp
  - Riparian Zones **Polygons**: Riparian_zone_LULC.shp
  - **Image**: TTAmask_SPOT.tif and the associated *.csv file providing the class names

WORKFLOW AND OBSERVATIONS

ACCURACY ASSESSMENT WITH ARCGIS PRO 3.0

COMPARISON WITH PROVIDED LABELLED SAMPLE POINTS

The provided Validation Points (result_NN_classification.shp) were distributed along the whole study Area:

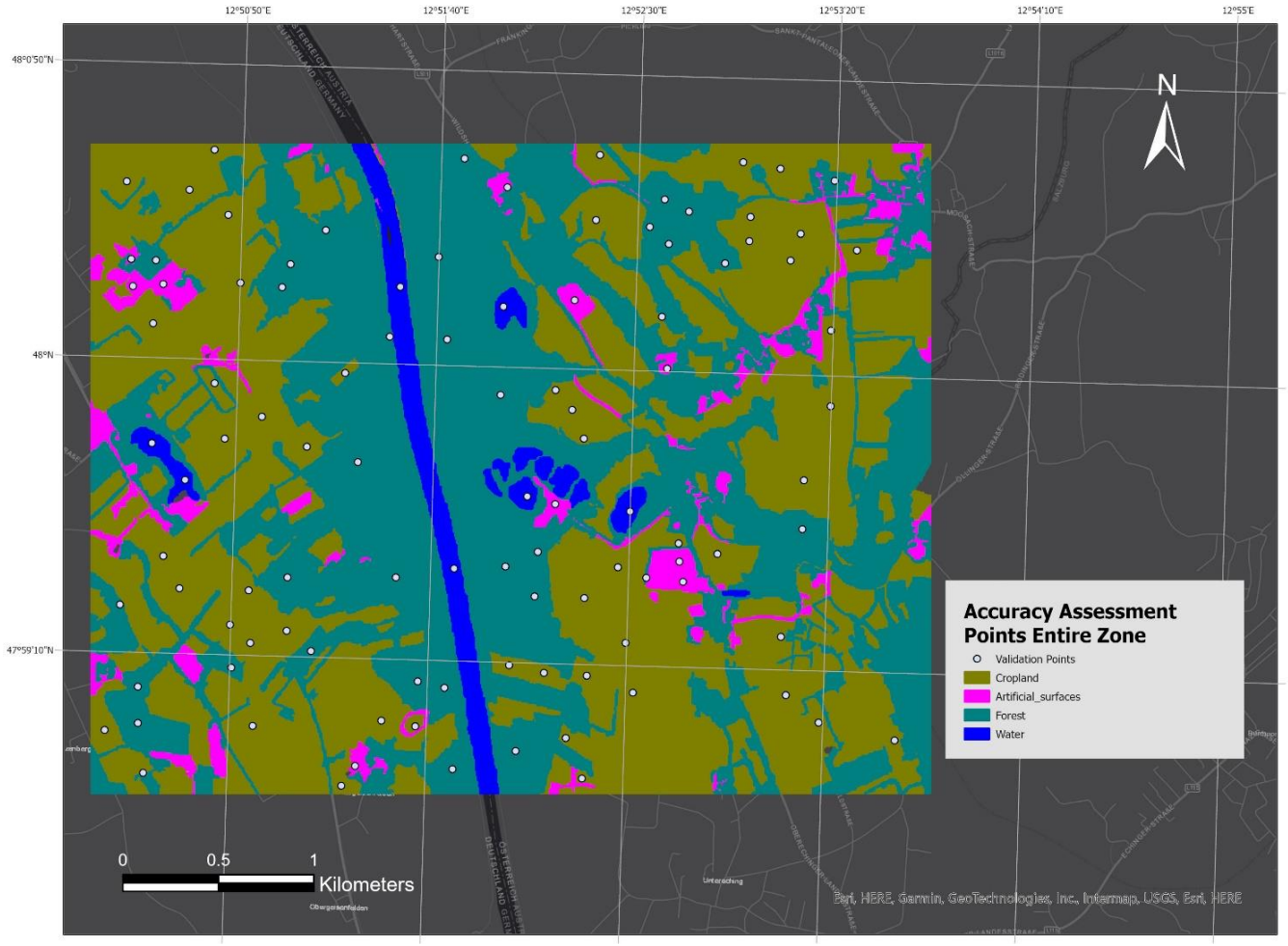


***Figure 1**. Distribution of Reference Validation Points*

Additionally, in its attribute table they already had two updated fields: **GROUND_TRUTH** and for **CLASSIFIED,** which could directly be compared using the Compute Confusion Matrix tool of ArcGIS Pro. Specifically, these fields contained the classification value given in each point by the Ground Truth data and by the performed Classification, respectively.

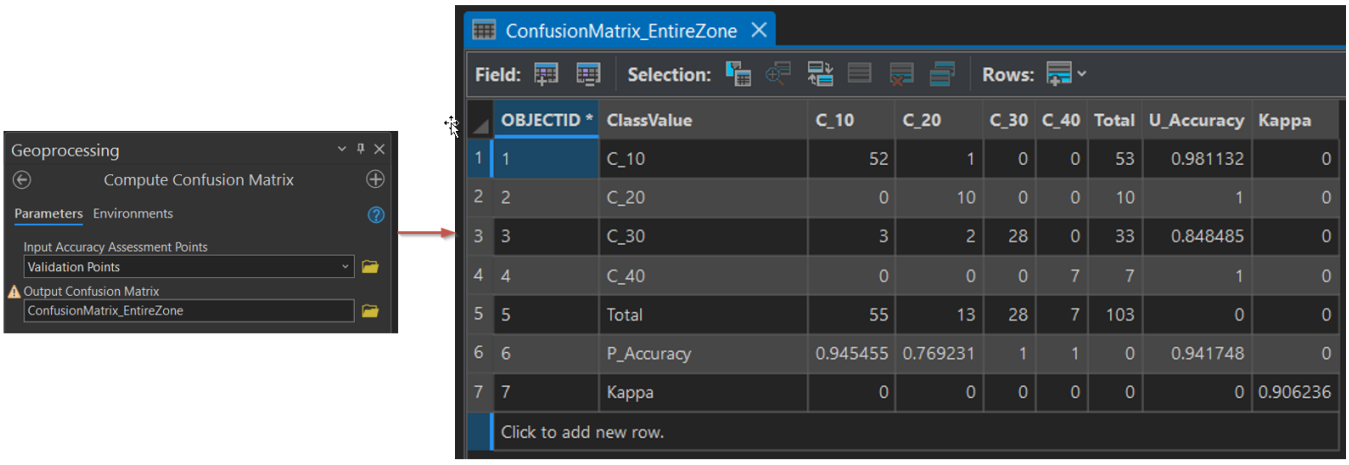


Figure 2. Confusion Matrix generation based on Validation Points

The obtained Overall Accuracy was **94.17%**. All the image objects classified as Artificial Surfaces (C_20) or Water (C_40) were correct. For the Forest class (C_30), it was obtained the lower User's Accuracy (**84.85%**), as three image objects were wrongly classified as Cropland (C_10) and two as Artificial Surfaces instead of Forest.

Comparison with Riparian Zones Layer

In this case, it was necessary to create first the accuracy assessment points based on the Riparian Zones layer before calculating the Confusion Matrix.

The "Crete Accuracy Assessment Points" geoprocessing tool was used to generate points labelled in the **GROUND_TRUTH** field based on the Reference Riparian Zones Layer. The output however did not include yet the label for the **CLASSIFIED** tool. To fill this field based on the performed Classification, the tool "Update Accuracy Assessment Points" was executed.

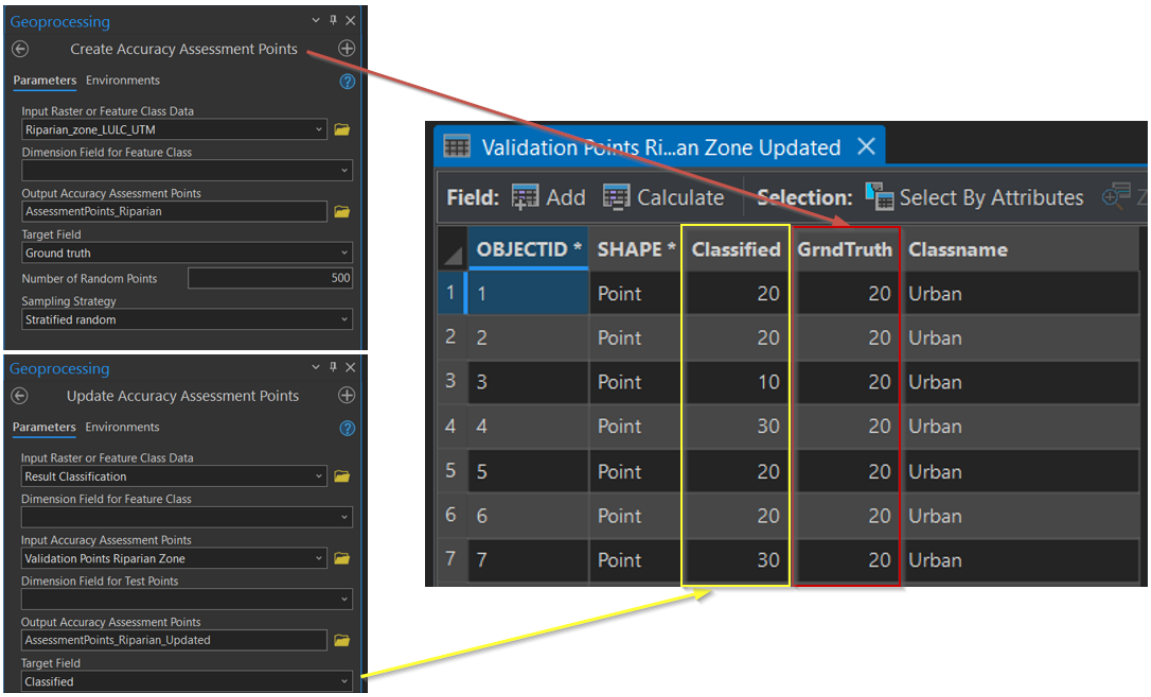


Figure 3. Creation of the Validation Points Layer

Additionally, the **STRATIFIED_RANDOM** sampling scheme was selected so that the points were randomly distributed within each class and each class had a number of points proportional to its relative area (Esri, 2023).

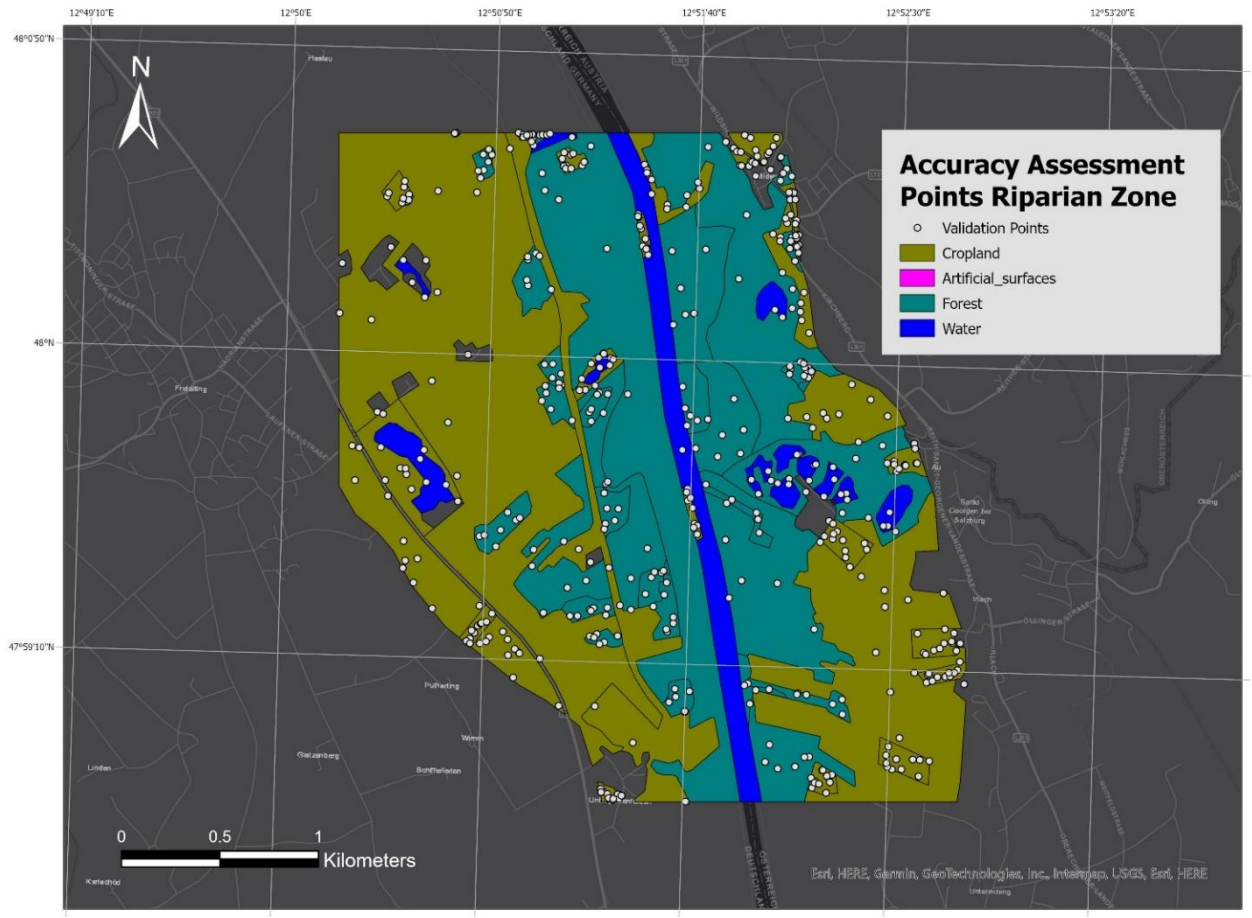
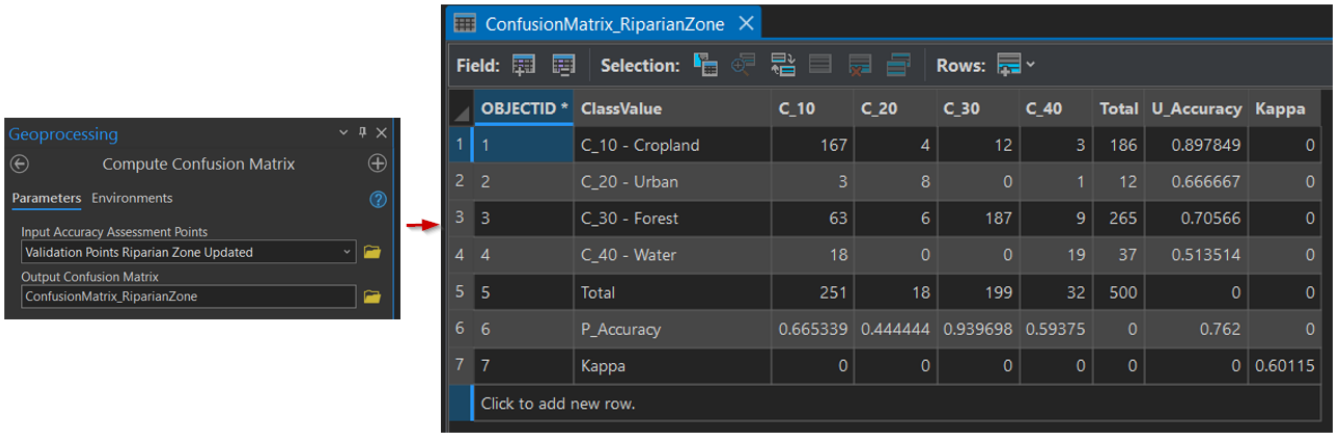


***Figure 4**. Distribution of the generated Validation Points for the Riparian Zone*

Lastly, as did before, the created layer was used to compute the Confusion Matrix



	OBJECTID *	ClassValue	C_10	C_20	C_30	C_40	Total	U_Accuracy	Kappa
1	1	C_10 - Cropland	167	4	12	3	186	0.897849	0
2	2	C_20 - Urban	3	8	0	1	12	0.666667	0
3	3	C_30 - Forest	63	6	187	9	265	0.70566	0
4	4	C_40 - Water	18	0	0	19	37	0.513514	0
5	5	Total	251	18	199	32	500	0	0
6	6	P_Accuracy	0.665339	0.444444	0.939698	0.59375	0	0.762	0
7	7	Kappa	0	0	0	0	0	0	0.60115

Figure 5. Confusion Matrix based on created Validation Points Layer for the Riparian Zone

The obtained Overall Accuracy was **76.2%**. This time, none of the classes had a perfect User's accuracy: the highest value was 89.78% for the Cropland class and the lowest value was 51.35% for the Water class. Only 19 of the 37 image objects classified as Water were correct.

ACCURACY ASSESSMENT WITH ECOGNITION 10.1

COMPARISON WITH PROVIDED REFERENCE IMAGE

In the Project in which the Classification was performed, the first step was to load the existing reference data (TTAmask_SPOT.tif and its .csv) as a TTA (Test and Training Area) mask without creating samples from the file.

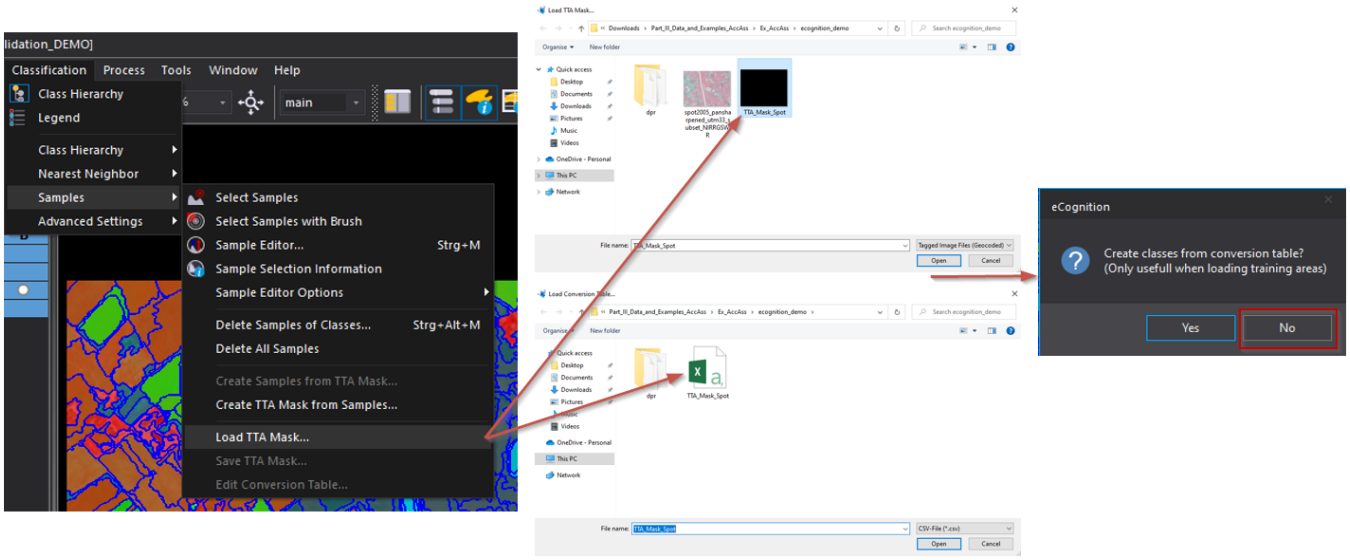


Figure 6. Load existing Image Reference data as a TTA

The classes names provided in the **Classification** were already matching with the **Reference** Image Classes names given by the .csv file. This information was validated by navigating to Classification→ Samples→ Edit Conversion Table

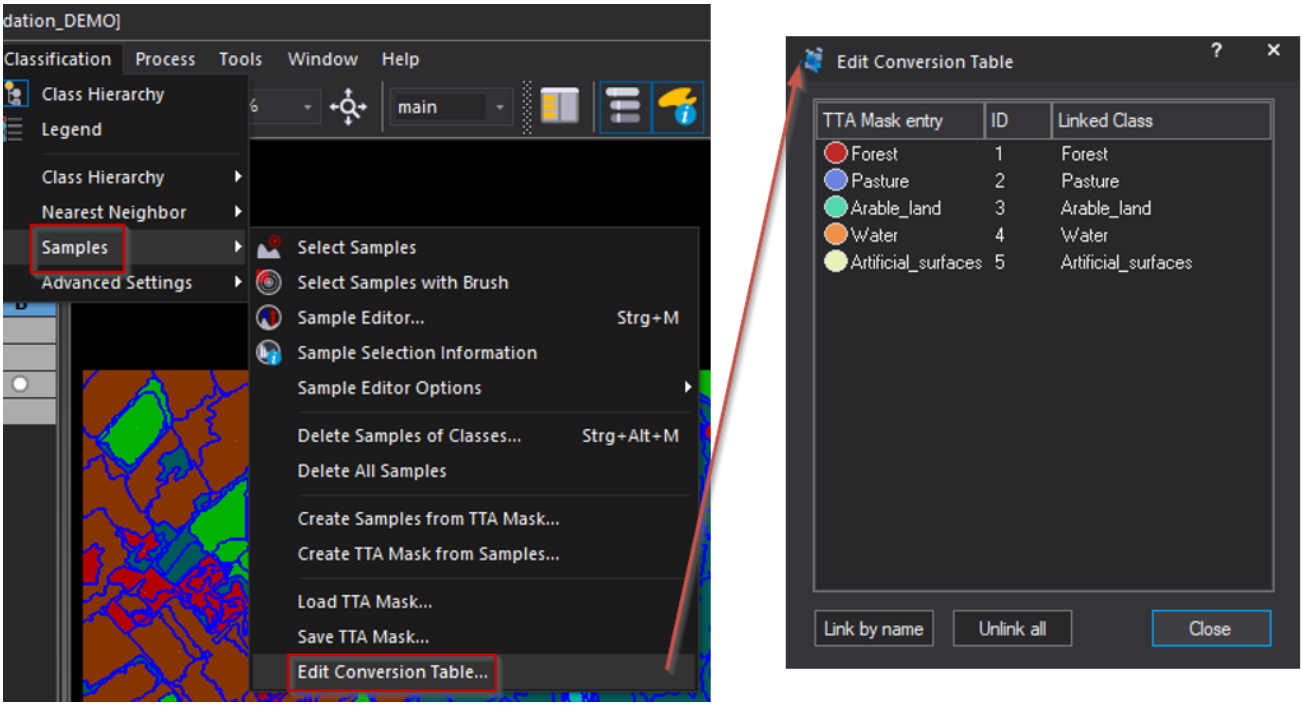


Figure 7. Edit Conversion Table to link class names of the Classification and Reference Data

Finally, the confusion matrix was calculated by clicking on Tools→Accuracy Assessment

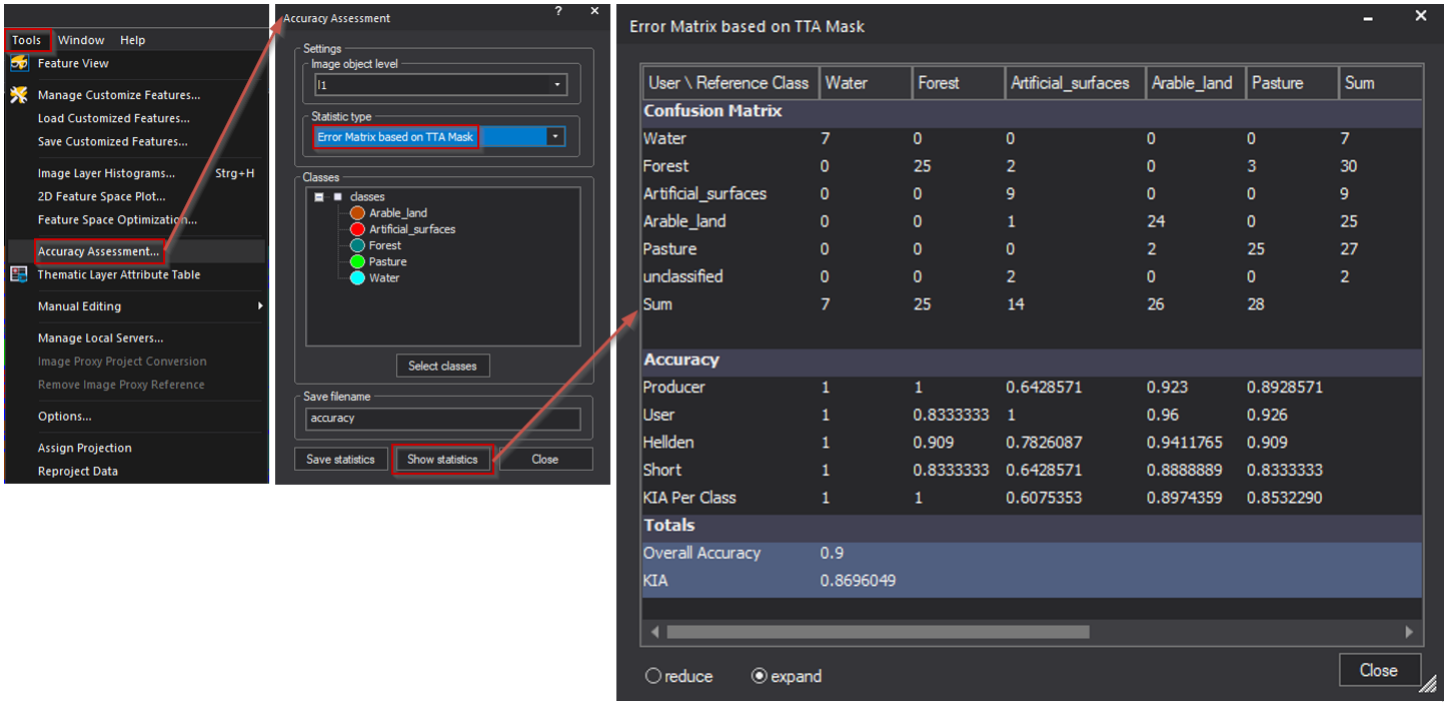


***Figure 8**. Error Matrix generation based on TTA Mask*

The Overall Accuracy was **90%**. All the image objects classified as Water and Artificial Surfaces were correct. For this assessment, Arable Land and Pasture classes were evaluated independently. The Pasture class had the lowest User's Accuracy value (92.6%) as 2 of its 25 image objects were incorrectly classified as Arable land.

ACCURACY ASSESSMENT WITH ECOGNITION 10.2

In the Project where the Classification was done, three processes were required to carry out the Accuracy Assessment:

- Delete any existing samples→ to avoid mixing samples associated to a Supervise Classification and the Reference samples
- Convert the Reference Validation Points or Polygons to Samples
- Generate the Confusion Matrix

COMPARISON WITH PROVIDED LABELLED SAMPLE POINTS

As mentioned before, the Validation Points were distributed along the Study Area. Furthermore, they already had a **text field** indicating the class name

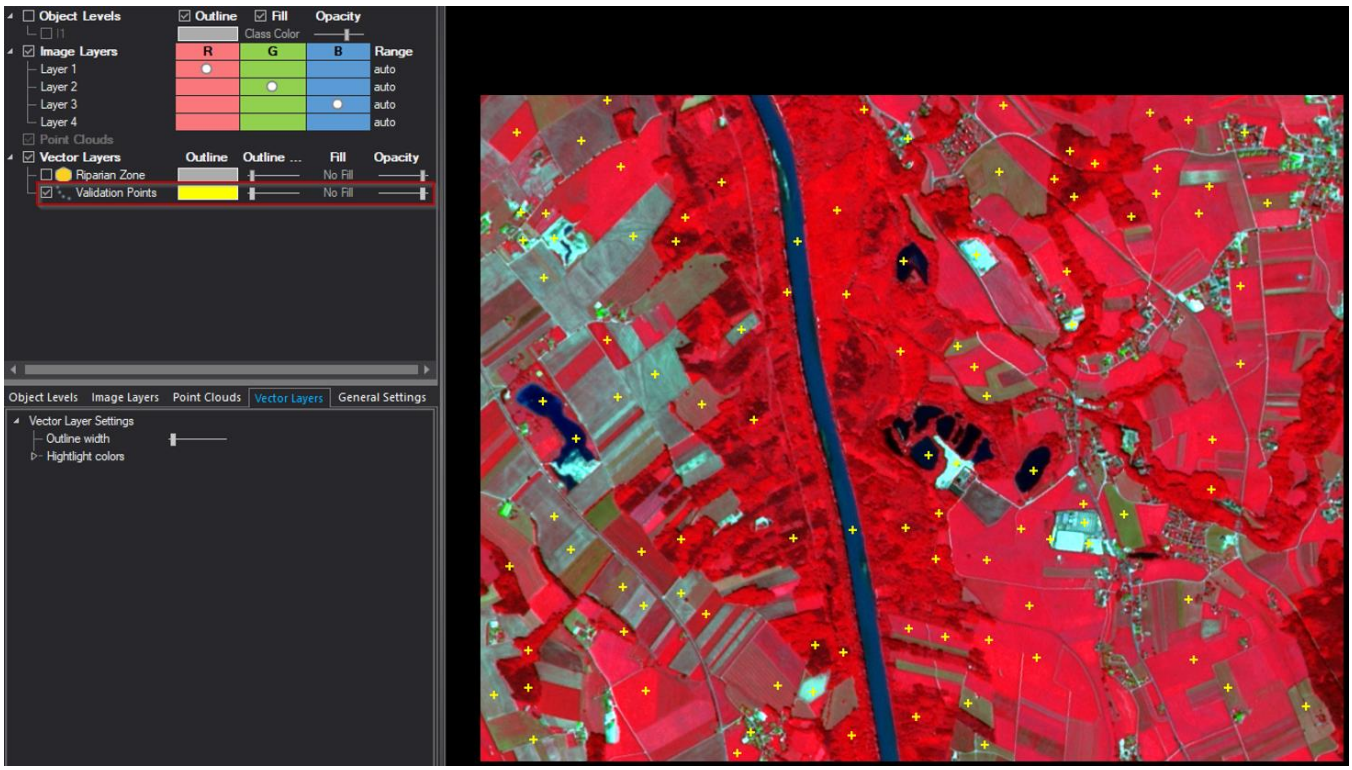


***Figure 9**. Validation Points location within the Study Area*

First, the samples associated to the Classification Level were deleted with the “delete samples” algorithm.

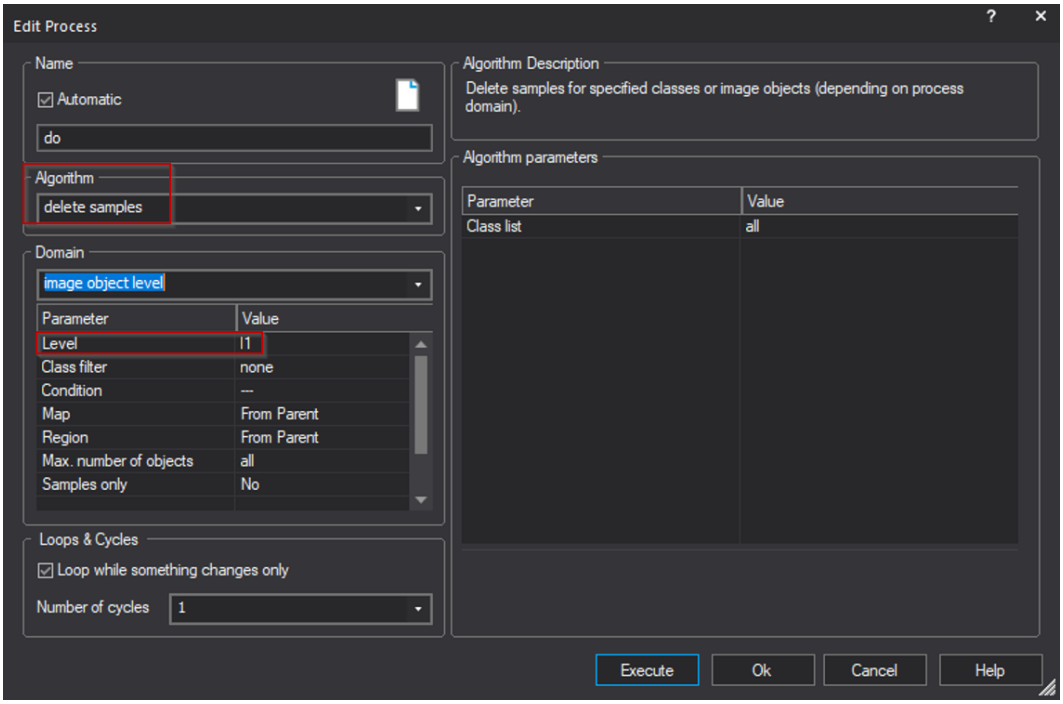


Figure 10. Delete existing samples

To convert the Points to Samples, the “Convert Thematic Objects to Samples” algorithm was executed. For the “Class name attribute” parameter, the string field with the classification associated to the points was selected. Likewise, considering that the class names for the points layer was different to the class names of the performed classification, it was necessary to remap the names.

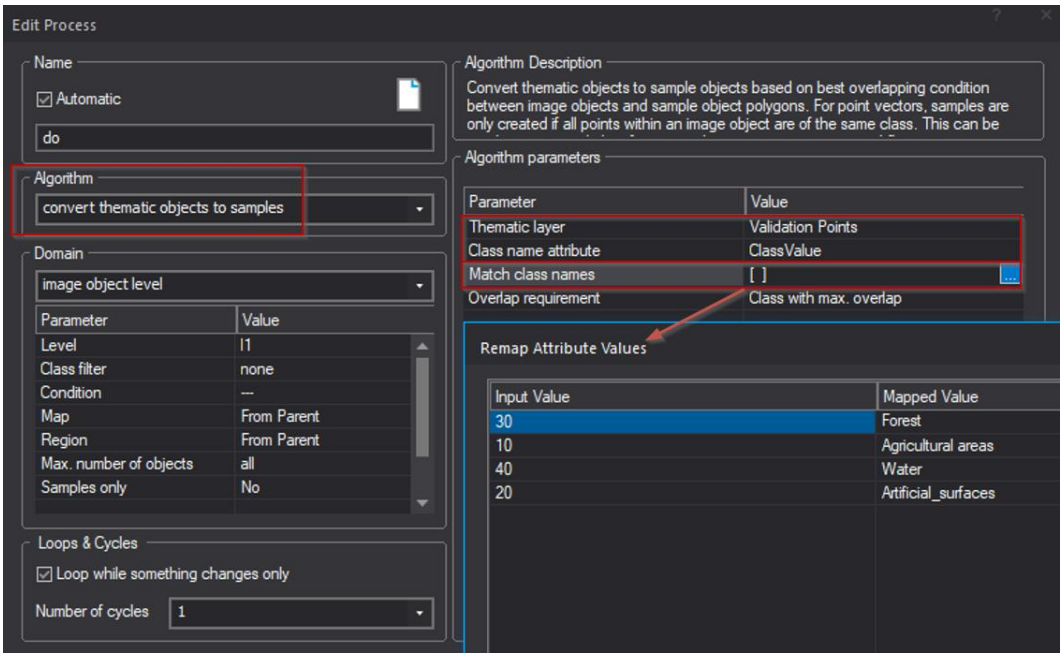


Figure 11. *Convert Reference Points to Samples*

The created samples could be shown on the Map View. Every object that overlapped the Validation Points was classified as a sample.

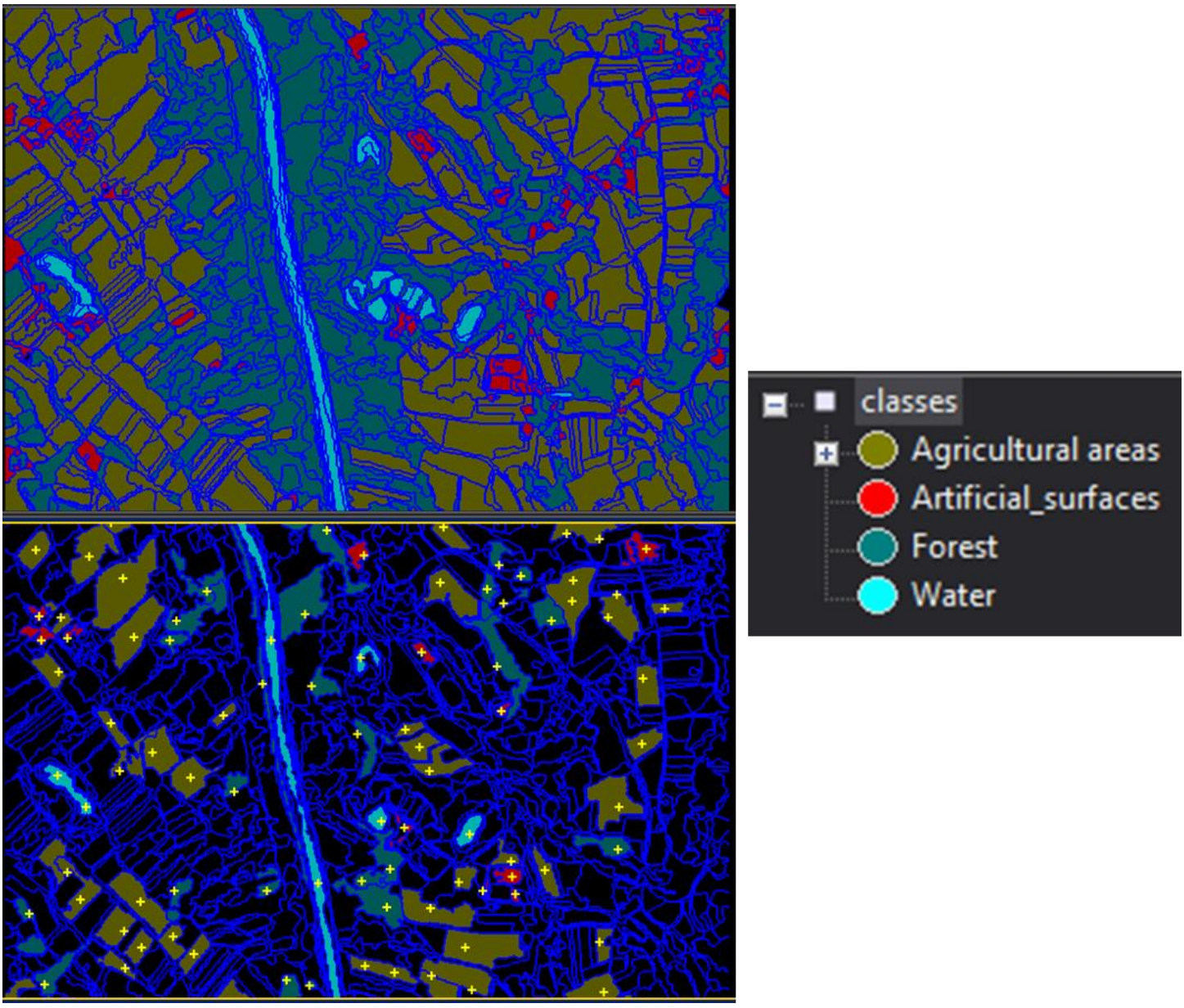


***Figure 12**. Above: User Classification and Below: Samples created based on the Reference Validation Points*

The classified objects were then compared with the samples using Tools→ Accuracy Assessment and in this way the Confusion Matrix was generated

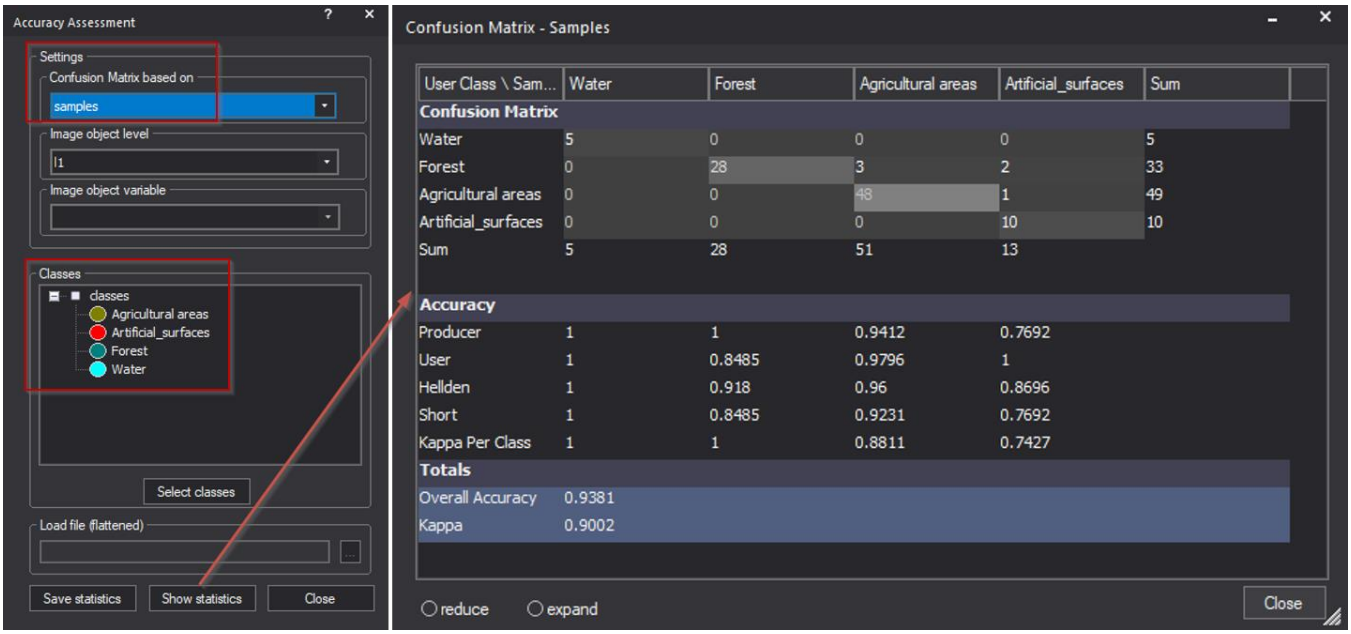


Figure 13. Error Matrix generation based on Points Samples

The overall accuracy was **93.81%**. According to the result, the user wrongly classified 5 of the 33 Forest image objects as Agricultural areas or Artificial Surfaces. In contrast, all the Water and Artificial surfaces image objects were appropriately classified.

Comparison with Riparian Zones Layer

The Riparian Zones were also used to perform the Accuracy Assessment. Their distribution was not uniform across the Study Area

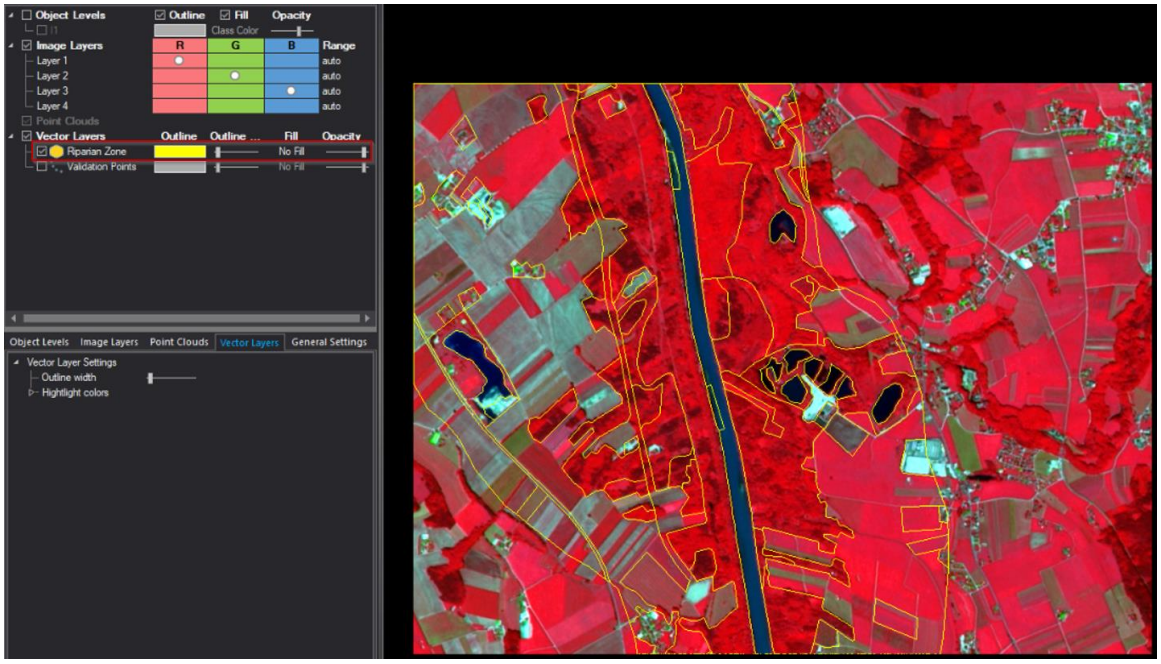


Figure 14. Validation Polygons (Riparian Zones) location within the Study Area

Same as for the points, first, the "delete samples" algorithm was executed. Moreover, to convert the Riparian Zones to samples, the "Convert Thematic Objects to Samples" was applied. This time, as the Riparian Zones were Polygons, the **"Overlap Requirement"** parameter was set in two different ways:

- **Class with max. overlap: w**ith this configuration, all objects that were overlapping the Riparian Zones polygons were used as samples
- **Class with max. overlap and a 70% threshold:** with this setup, only the objects that overlapped in a 70% the Riparian Zones polygons were added to the samples

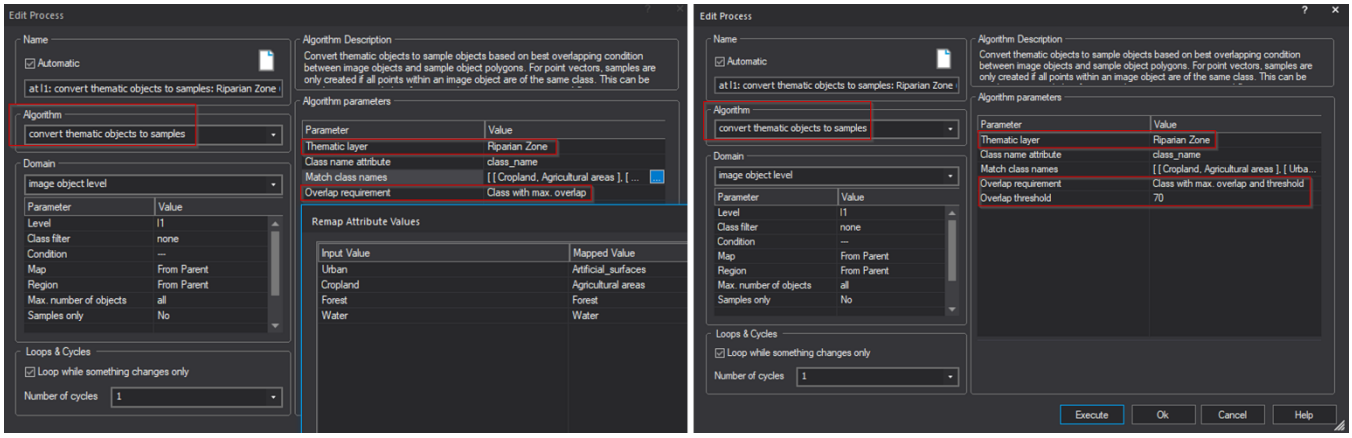


***Figure 15**. Convert Riparian Zones to samples with different Overlap Requirements*

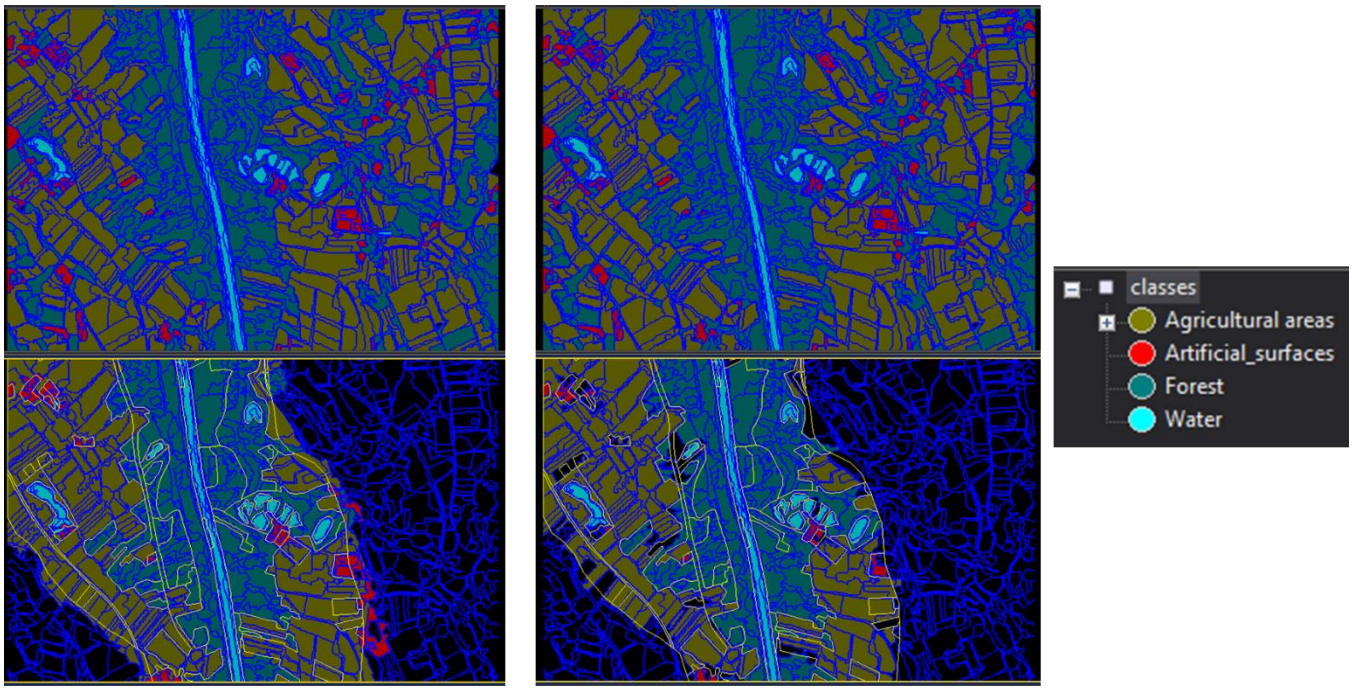


***Figure 16**. Above: User Classification and Below: Samples created based on the Reference Validation Polygons (Left: Class with Max. Overlap & Right: Overlapping Threshold of 70%)*

Finally, the confusion matrixes were generated on both cases

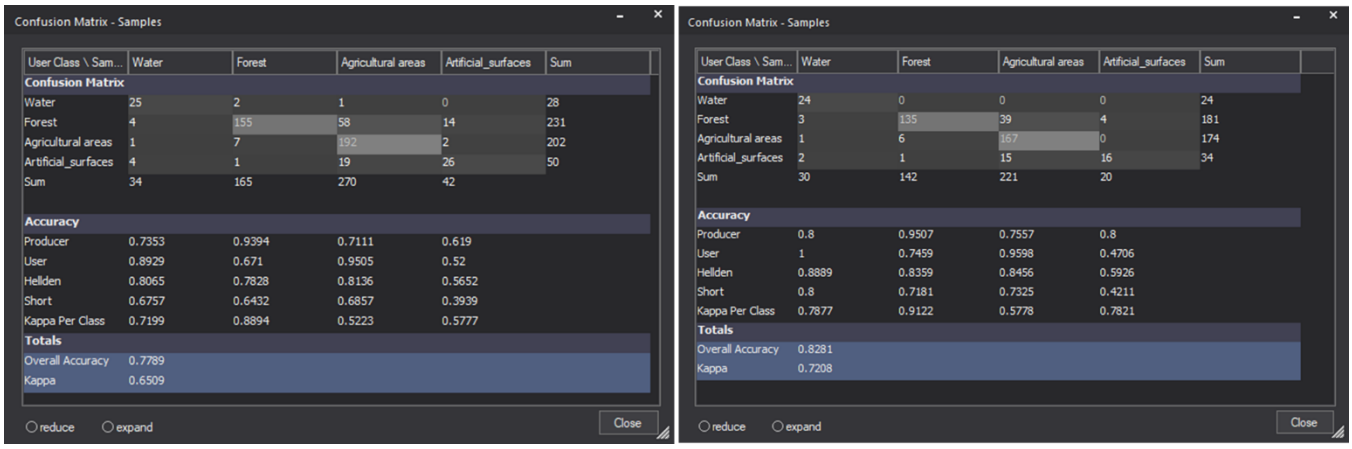


Figure 17. Confusion Matrixes. Left: Class with Max. Overlap & Right: Overlapping Threshold of 70%

As expected, the overall accuracy was higher when setting an overlapping threshold (**82.81%**). Additionally, in both cases, the Artificial Surfaces class presented the highest amount of false positive (errors of commission).

CONCLUSIONS

The accuracy of the provided Classification was assessed by using different types of Reference datasets (Raster or Vector Layers) in multiple software like ArcGIS Pro or eCognition. In this assignment, the Accuracy Assessment was only done with a site-by-site comparison between the Classification and Reference Data to generate the error matrix. However, it is important to consider that this method cannot access the spatial dimension of the object delineation (Schöpfer et al., 2008). Additional overlay techniques with set tolerances are required to continue with the geometry assessment of the objects.

REFERENCES

Esri (2023). Create Accuracy Assessment Points (Spatial Analyst)-ArcGIS Pro | Documentation. Retrieved January 6, 2023, from https://pro.arcgis.com/en/pro-app/latest/tool-reference/spatial-analyst/create-accuracy-assessment-points.htm

Schöpfer, E., Lang, S., & Albrecht, F. (2008). Object-fate analysis-spatial relationships for the assessment of object transition and correspondence. In *Object-based image analysis* (pp. 785-801). Springer, Berlin, Heidelberg.