



# eCognition Developer

Tutorial 4 - analyzing areas of interest with regions & maps

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# Introduction

## About this Tutorial

This tutorial gives you an introduction on how to combine both the maps and regions concepts to classify areas of interest in a fast and efficient way. You should have gone through the tutorial 'working with regions' and 'working with maps' prior to this tutorial.

This Module has four lessons:

- Lesson 1 Introduction to the analysis workflow
- Lesson 2 Classifying regions of interest via a map with lower resolution
- Lesson 3 Detail analysis of water bodies using a detail map
- Lesson 4 The complete classification

Further information about eCognition products is available on our website:

[www.eCognition.com](http://www.eCognition.com)

## Requirements

To perform this Guided Tour, you will need:

- **eCognition Developer** installed on a computer
- A computer **mouse** is highly recommended

All steps of this tutorial can be done using the **eCognition Developer** or [the free-trial version](#).

This tutorial is designed for self-study.

## Data included with the Tutorial

### Image data

We will be working with a QuickBird satellite image (\*.tif) comprised of two files in this tutorial:

- '02MAR02\_multi\_Subset\_Maps\_Regions.TIF' contains the **RGB** and **NIR** data
- '02MAR02\_pan\_Subset\_Maps\_Regions.TIF' contains the **panchromatic** data

### Rule Sets

A Rule Sets is available representing the final state of Rule Set development. Whenever the tutorial refers to a Rule Set, it can be found in the tutorial folder.

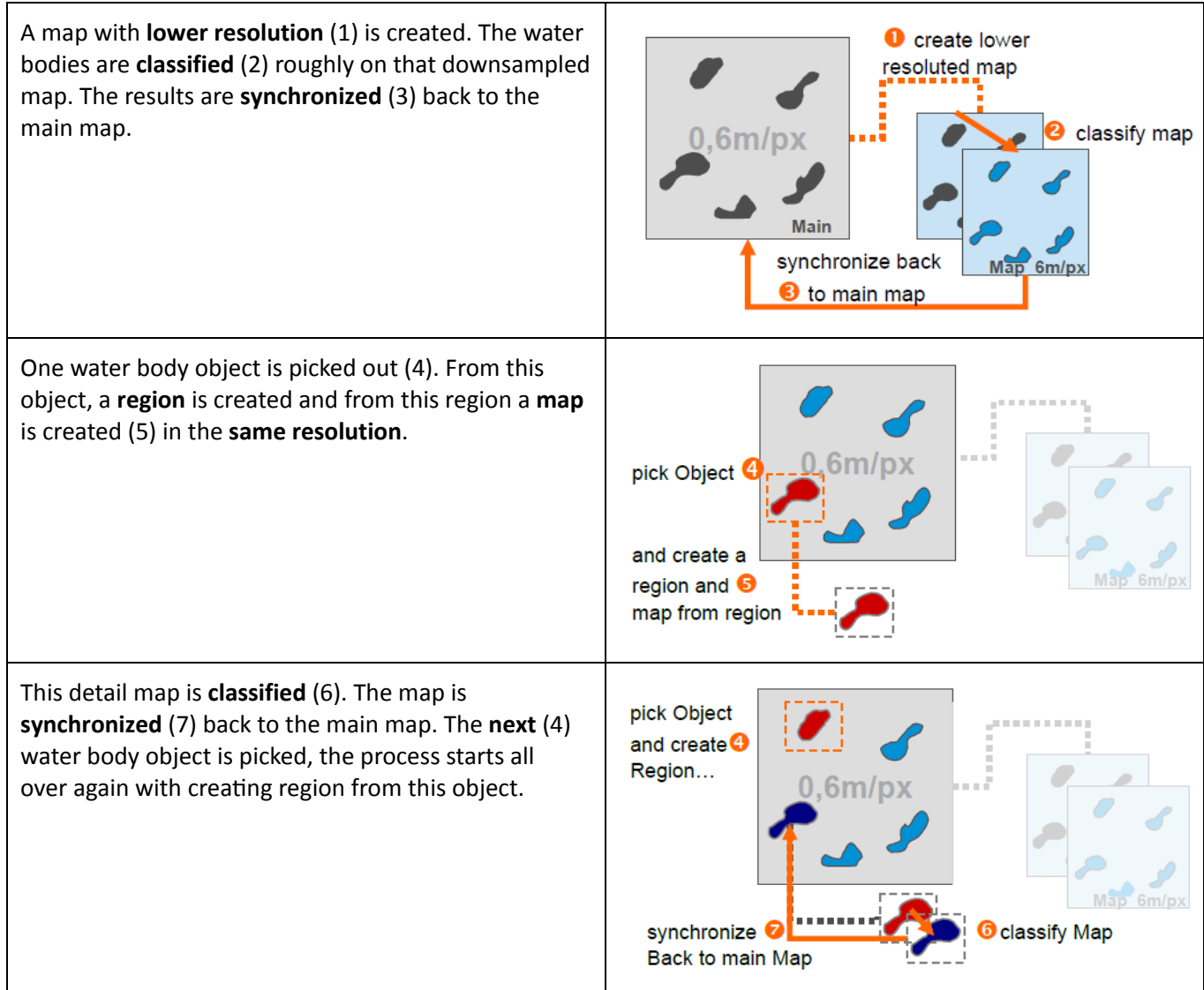
### Project

An eCognition Project is provided for this tutorial and can be found in the tutorial folder.

# Lesson 1 – Introduction to the analysis workflow

This tutorial gives you an introduction into combining both the maps and regions concepts to classify areas of interest in a fast and efficient way. The analysis in this example is a continuing interplay between maps, their classification and the synchronization of results.

The general setup of the Analysis routine:



## Lesson 2 - Classifying regions of interest via a map with lower resolution

### 2.0 Lesson content

- The process settings to create a map
- Classifying the map
- Synchronizing the results

In the first part of the Rule Set, a map with a lower scale is created and the water bodies are classified roughly in this map. The results are then synchronized back to the main map.

The advantage of this approach is that through the down-sampling the segmentation and classification is faster than running the classification on the original scene. For very large areas it is possible that the number of created objects is so high that processing is cancelled (i.e. due to lack of memory). This can be avoided by using the approach explained in this tutorial.

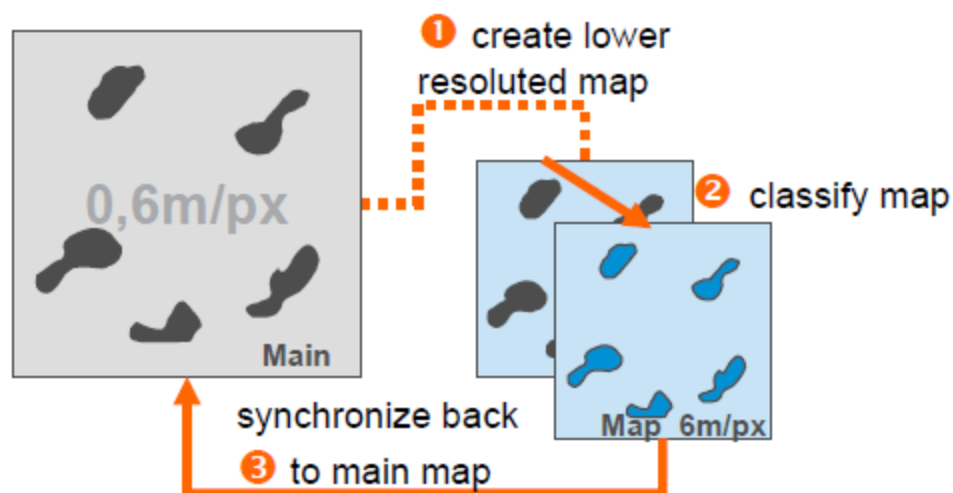


Figure 3: Schematic diagram showing the workflow to create a map, classify it and synchronize it back.

### 2.1 Process settings to create a map

The Project to be loaded contains a set of multispectral and panchromatic image layers from a subset of a Quickbird scene.

1. Start **eCognition Developer**.
2. Switch to predefined view setting number 4 '**Develop rulesets**'
3. In the main menu 'File' choose 'Open Project' or click on the 'Open Project' button in the toolbar.
4. Open the project '**AnalyzingRegionsOfInterest.dpr**' in the tutorial folder
5. Expand the parent process '**Create, classify and synchronize a lower resolution Map**'.

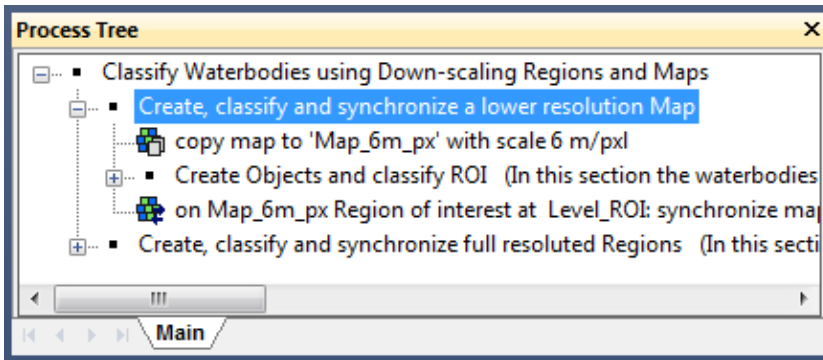


Figure 1: Process to create a map with lower resolution.

6. Double-click on the first child process '**copy map to 'Map\_6m\_px' with scale 6m\pxl'** to open it.
  - In the Algorithm Parameters the name of the target map (map to be created) '**Map\_6m\_px'** is defined.
  - In the field '**Image Layers'** the Layers '**nir'** and '**pan'** are selected to be part of the new, downscaled map.
  - In the field '**Scale'** the resolution of the new map can be changed.

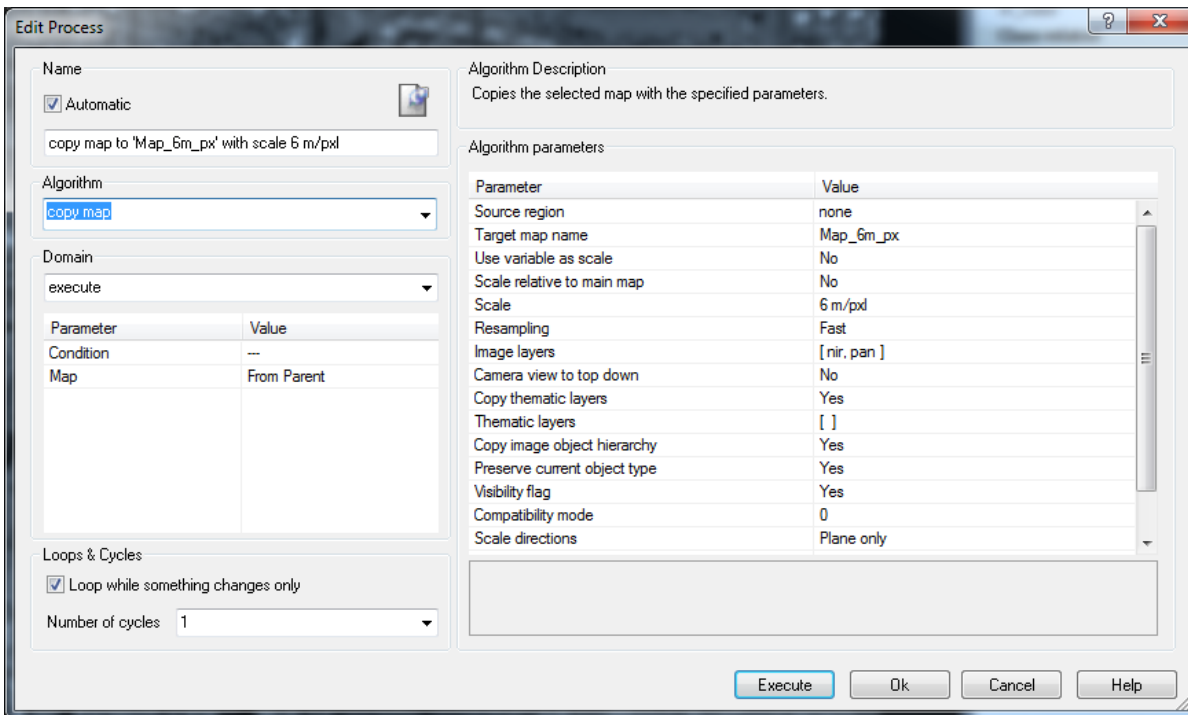


Figure 2: Process settings to create a down-scaled 'Map\_6m\_px'.

7. Click on the '**...**' next to the '**Scale'** field, to open the '**Select Scale'** dialog box.
  - '**Keep current scene scales'** must be deselected.
  - As '**Scale Mode'**, '**Units'** is chosen. Other scale modes are : magnification, percent and pixel.
  - As '**Scale'** the value **6** is defined.

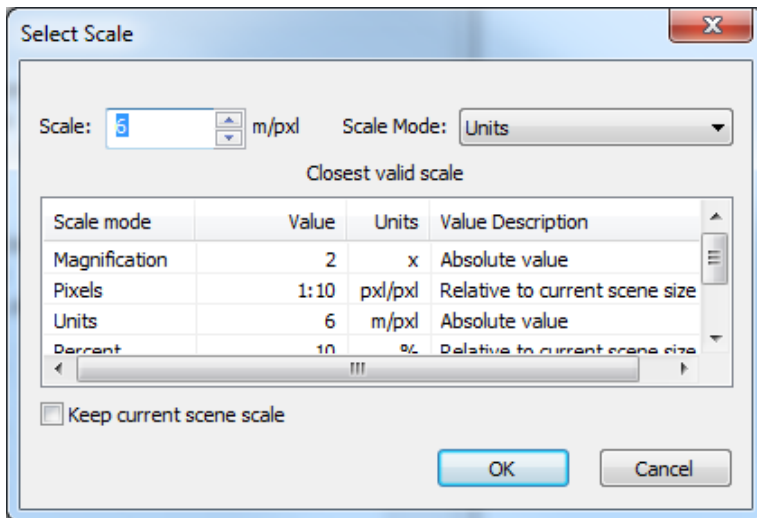


Figure 3: The 'Select Scale' dialog box with settings to create a 6 m/px map.

8. Click on the 'Cancel' button to close the dialog box.

### 2.1.1 Create and explore the new map

1. **Execute** the process.
2. Open a **second viewer**, display in the new created map and select 'Side by side view'.
3. Display the 'pan layer in both views.

The newly created map contains only the **panchromatic and near infrared** image layers and has a lower resolution of 6 m/px.

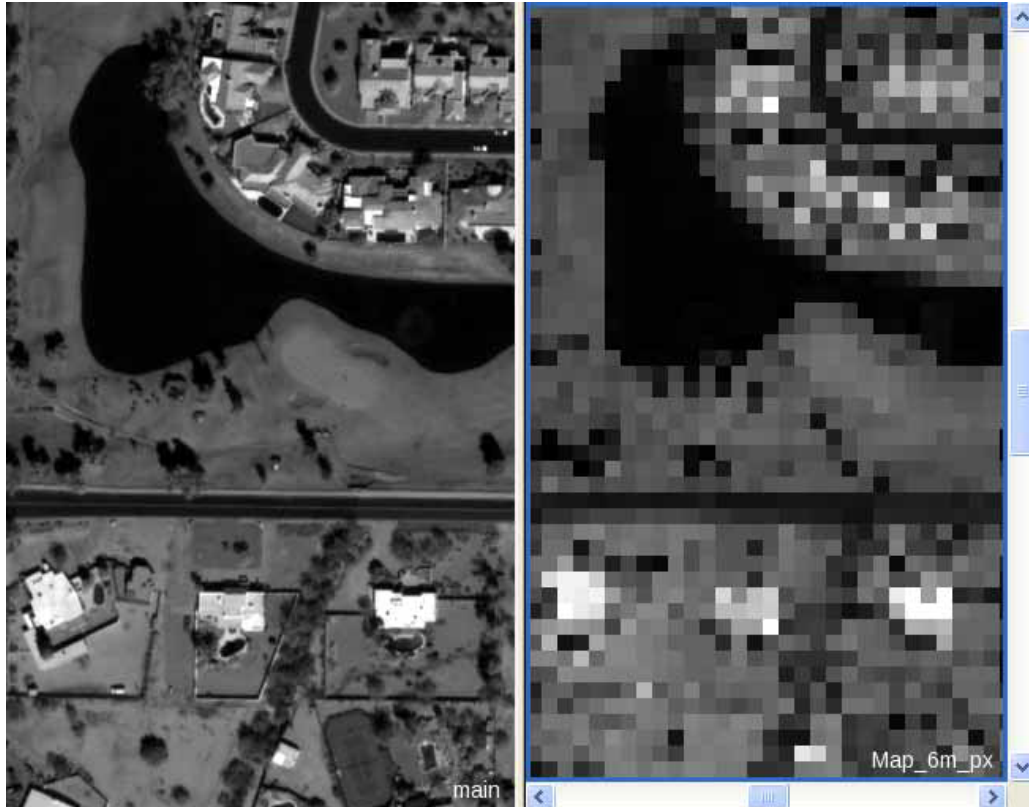


Figure 4: Main map in full resolution (left); new map with lower resolution 6 m/px (right).

## 2.2 Classifying the map

1. Expand the process section 'Create Objects and classify ROI'.
  - In parent process 'Create Objects and classify ROI' it is specified, that all subsequent child processes are applied only to 'Map\_6m\_px'.
  - A quadtree **segmentation** is executed.
  - All objects with a mean value  $\leq 210$  in the panchromatic layer are classified as 'Region of interest' (ROI).
  - Those 'Region of interest' objects with a mean 'nir' value  $\geq 160$  are declassified again.
  - The 'Region of interest' objects are **merged**
  - The 'Region of interest' objects with an area  $\leq 30$  pixel are de-classified
  - All unclassified objects are **merged**.
  - All 'Region of interest' objects are **grown by two pixels**.

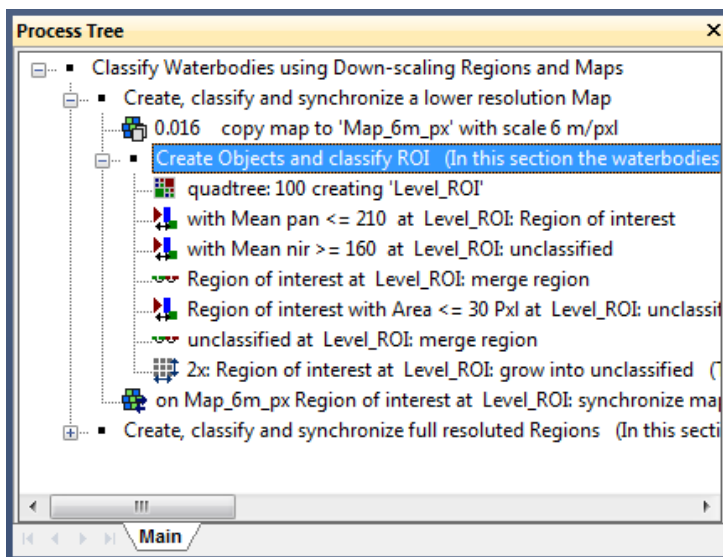


Figure 5: Process Tree with process sequence highlighted to classify the 'Map\_6m\_px'.

2. Execute the process sequence 'Create Objects and classify ROI'.

All water bodies are classified as 'Region of interest', a buffer of two pixels is added to every object.

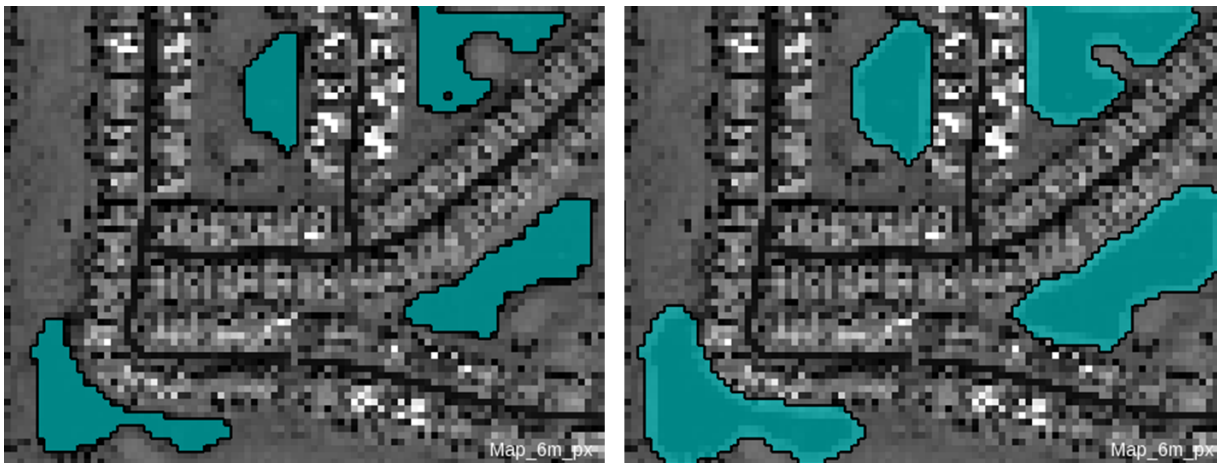


Figure 6: Classification before (left) and after (right) executing the growing process.



## 2.3 Synchronizing the results to the main map

The next step is to copy the classification results from 'Map\_6m\_px' to the main map. This classification will then become the basis for the creation of the regions and maps for a more detailed analysis.

1. Collapse the process section 'Create Objects and classify ROI'.
2. Double-click on the first child process on 'Map\_6m\_px Region of interest at Level\_ROI: synchronize map 'main'' to open it.
  - In the Image Object Domain it is specified, that only the 'Region of interest' objects of 'Map\_6m\_px' are copied.
  - In the Algorithm Parameters it is specified that the new created Level in the main map is named 'Level\_ROI', same as in the map with lower resolution.

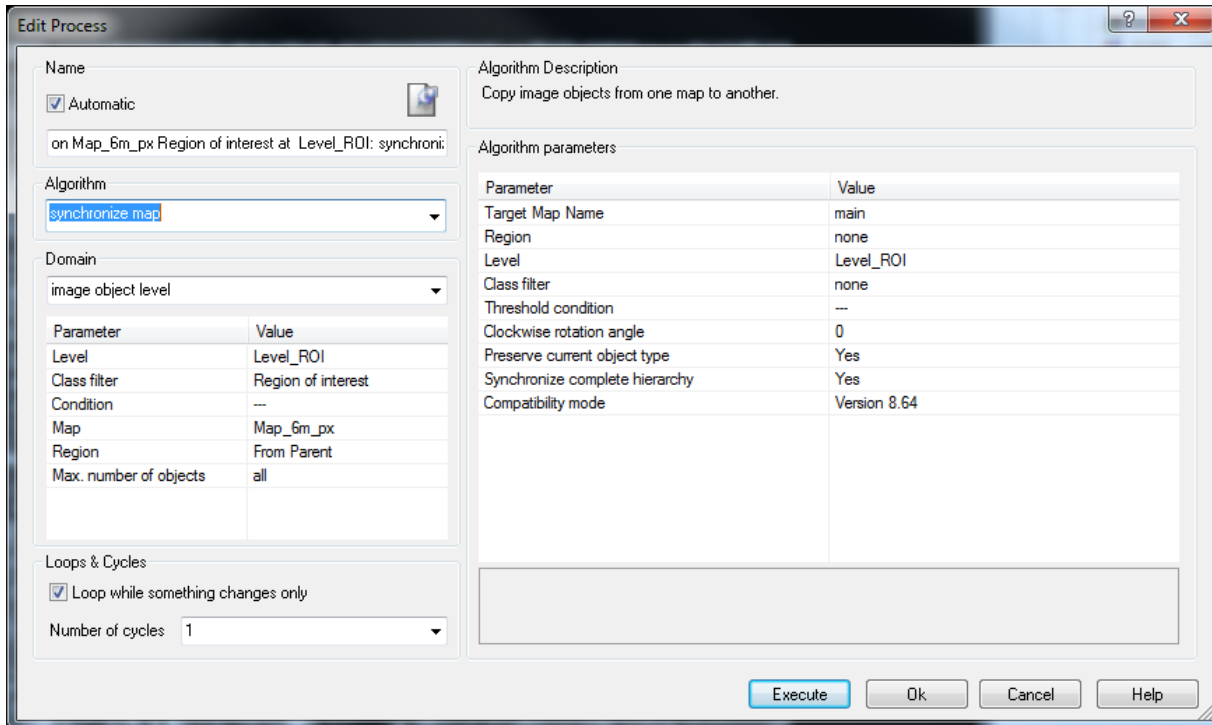


Figure 7: Process settings to synchronize the content of the 'Map\_6m\_px' to the main map.

3. **Execute** the process.

The main map contains now a 'Level\_ROI' with the 'Region of interest' objects.

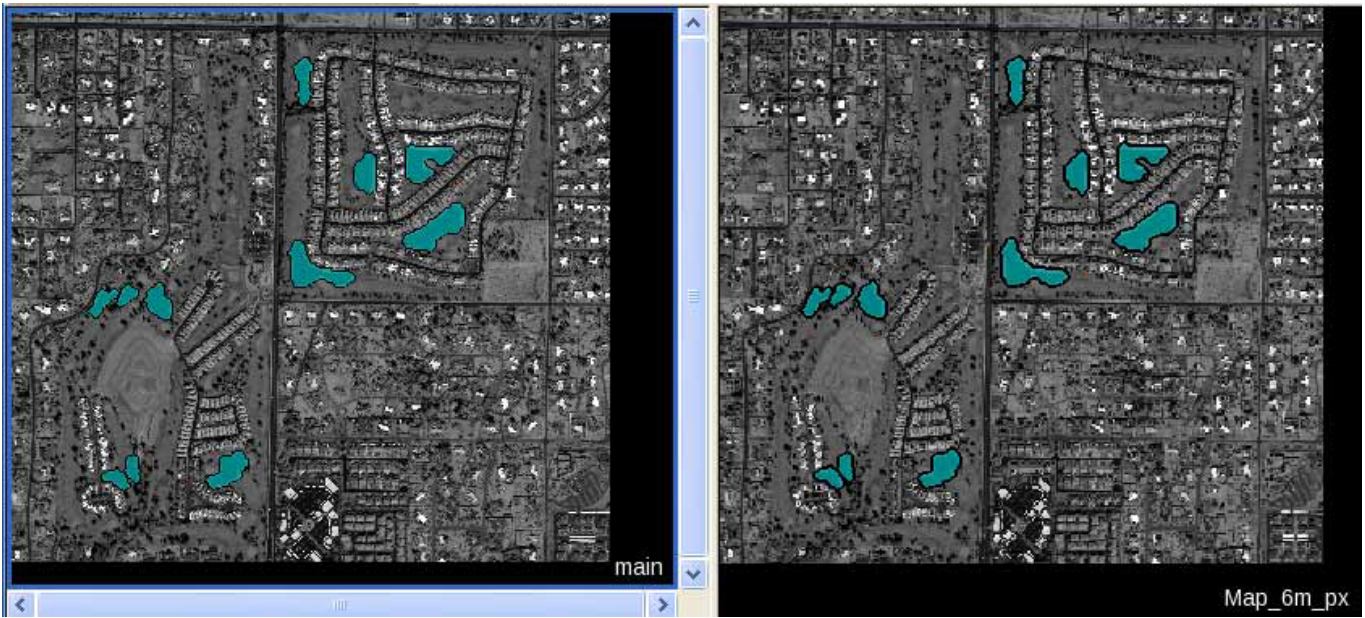


Figure 8: Main map with synchronized content of the 'Map\_6m\_px' (left); content of 'Map\_6m\_px' (right).

# Lesson 3 Detailed analysis of water bodies

## 3.0 Lesson content

- The overall looping processes
- Picking out an object and creating a region and a map
- Processing on 'Map Detail' and synchronization

In this section, the 'region of interest' objects are **selected** one after the other. A **region is created** from the selected object and a **new map** with full resolution is created from the region. A detailed **segmentation and classification** is then applied only to the detailed map. In addition, objects are **reshaped** to ensure smooth outlines. In a final step, the detail map is **copied back** to the main map and the procedure **continues** with the next object until all are analyzed in detail.

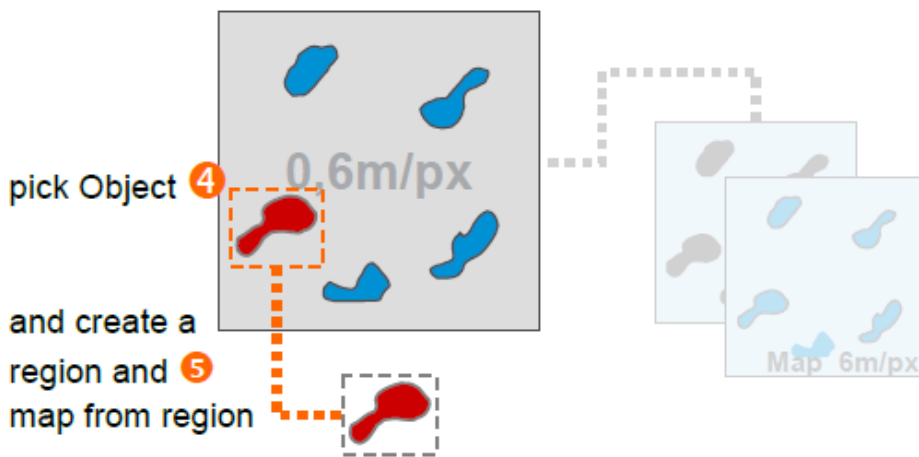


Figure 9: Schematic diagram showing the workflow to select an object and create a region and a map from it.

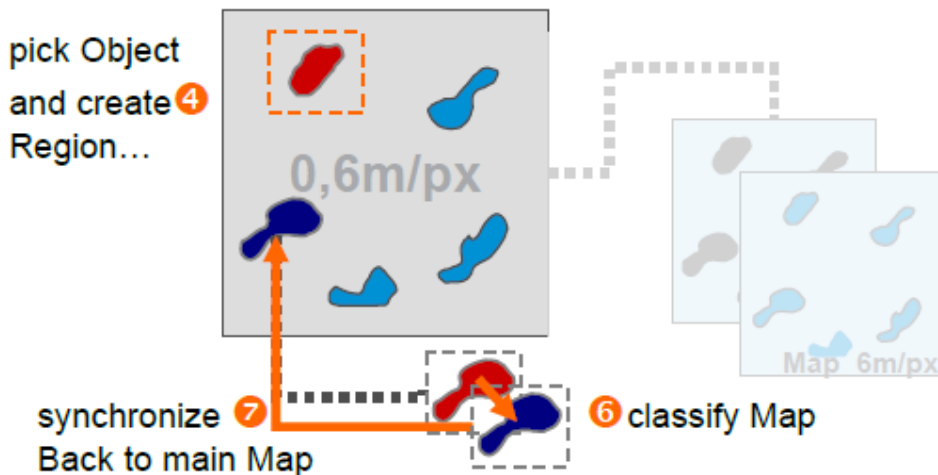


Figure 10: Schematic diagram showing the classification of the new map and the synchronization.

### 3.1 The overall looping process

1. Collapse 'Create, classify and synchronize a lower resolution map' and expand '**Create, classify and synchronize full resolution Regions**'.
2. Double-click on the first child process on '**loop: while No. of Region of interest > 0**' to open it.
  - In the Domain of the parent process, a Condition is set. The feature used is a Class-Related Scene feature 'Number of classified objects'. The condition is that **the Number of 'Region of interest' objects must be more than 0**. This means at least one has to exist, otherwise the process (and all child processes) are not executed.
  - The 'Loops and Cycles' is set to '**Loop while something changes only**'. As long as the Threshold condition is **fulfilled**, the process will be re-executed. Only if all 'region of interest' objects are classified as 'Water' the processing stops automatically.

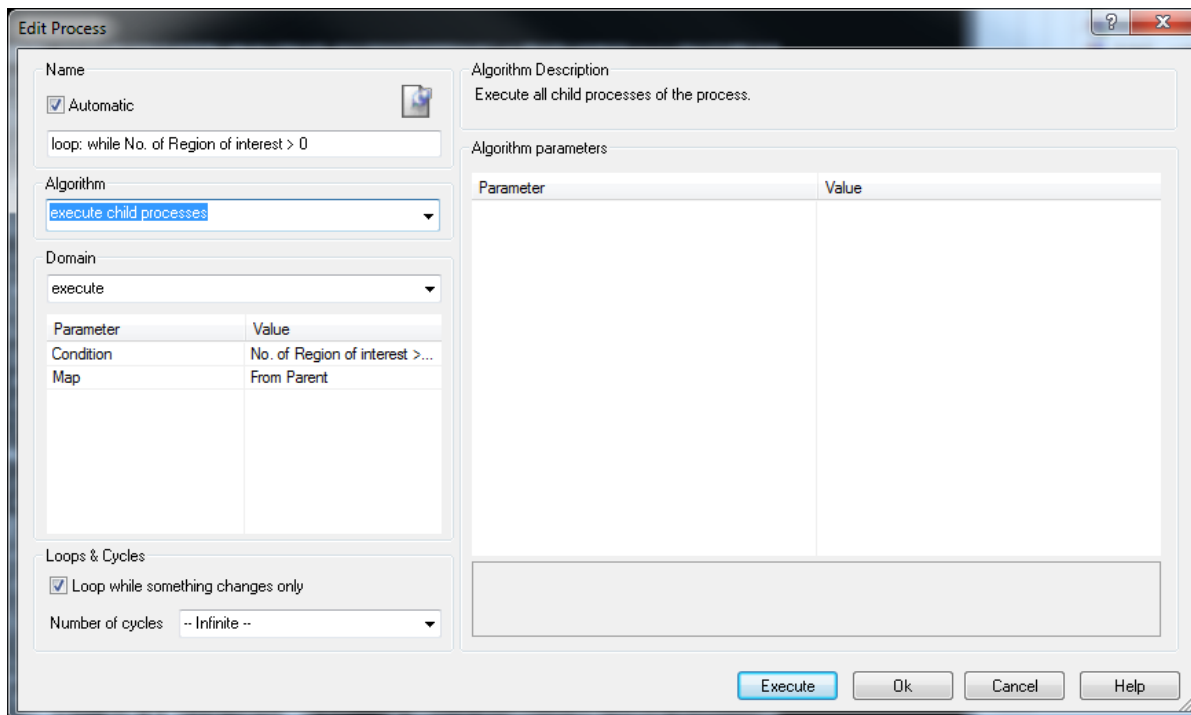


Figure 11: Process settings to execute the child processes, as long as the Condition is fulfilled.

3. Close the 'Edit Process' dialog box by pressing the 'Cancel' button.

### 3.2 Selecting one object and creating the region and map

In this routine, one object is selected (the one with the minimum in X), a region is created around this object and a detailed map is created from this region.

#### 3.2.1 Selecting the object

The objects are selected randomly, the object with the minimum value for X is classified to a class '\_active'. It is also possible to use other features, e.g. standard deviation or size. But it is important that the process is not classifying two objects at once to the '\_active' class.

1. Expand '**loop: while No. of Region of interest > 0**' and expand '**Pick out one 'Region of interest' Object**'.

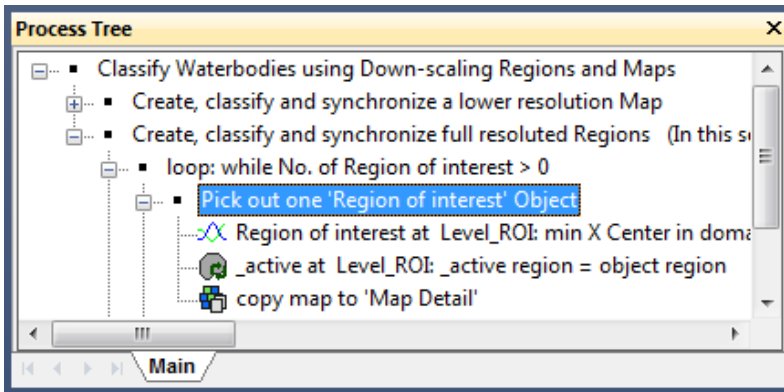


Figure 12: Process Tree with process sequence highlighted to select one 'Regions of interest' object, create a region from it and to create a map from this region.

In the parent process 'Pick out one 'Region of interest' object' the main map is specified as domain. All child processes refer to this setting.

2. Double-click on the first child process on '**Region of interest at Level\_ROI: min X Center in domain : \_active**' to open it.
  - The algorithm '**find domain extrema**' is used to select an object.
  - In the Domain, it is defined that only the 'Region of interest' objects are analyzed with the algorithm.
  - The '**Extrema Type**' is set to Minimum.
  - As feature '**X Center**' is chosen.
  - The field '**Accept equal extrema**' is set to 'No'.
  - The field '**Active class**' is set to '\_active'. The object with the minimum X-center will be classified to this class.

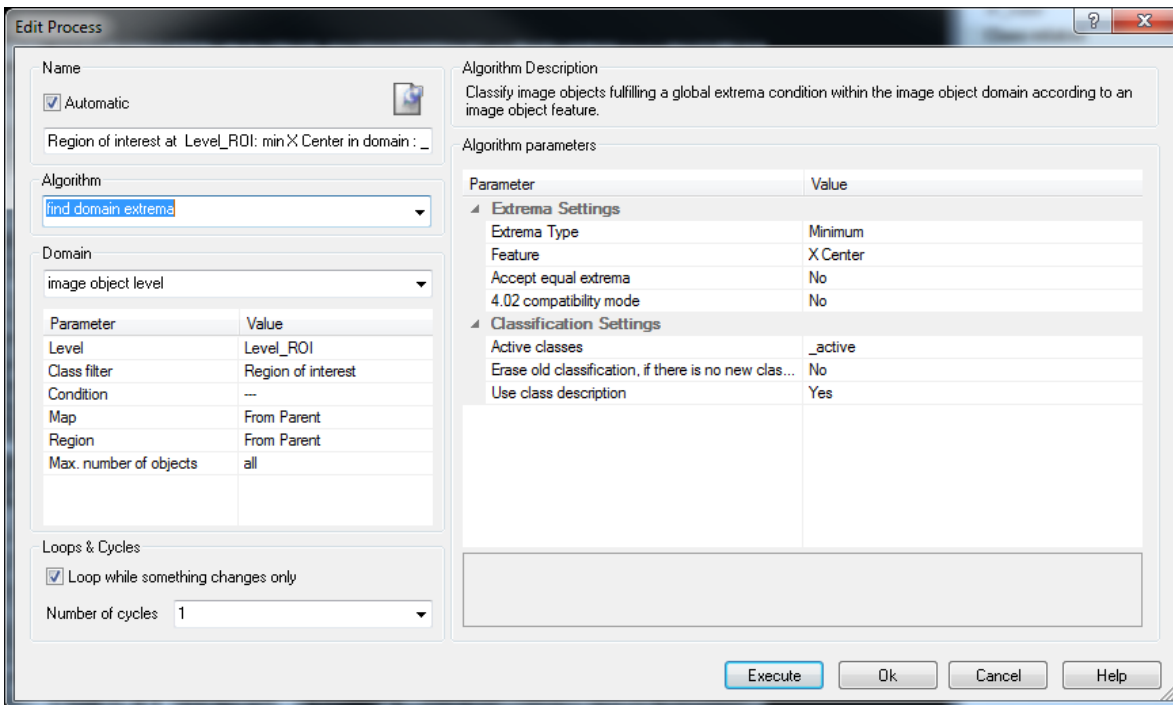


Figure 13: Process settings to classify an '\_active' object.

3. Execute the process.

The first 'Region of interest' object is selected and classified as '\_active'.



Figure 14: Main map with one '\_active' object classified.

### 3.2.2 Creating a region and a map

The last two processes of the sequence 'Pick out one 'Region of interest' object' create a region from the '\_active' object and from the region a map.

1. Double-click on the second child process on '**\_active at Level\_ROI: \_active region= object region**' to open it.
  - The Domain is set to '**image object level**'. It is defined that the source for the region extent is class '\_active' in the 'Level\_ROI'.
  - The name of the new region is defined as '**\_active region**'.
  - The 'Mode' is set to '**From object**'. Only if this mode is set, the Domain can be used.

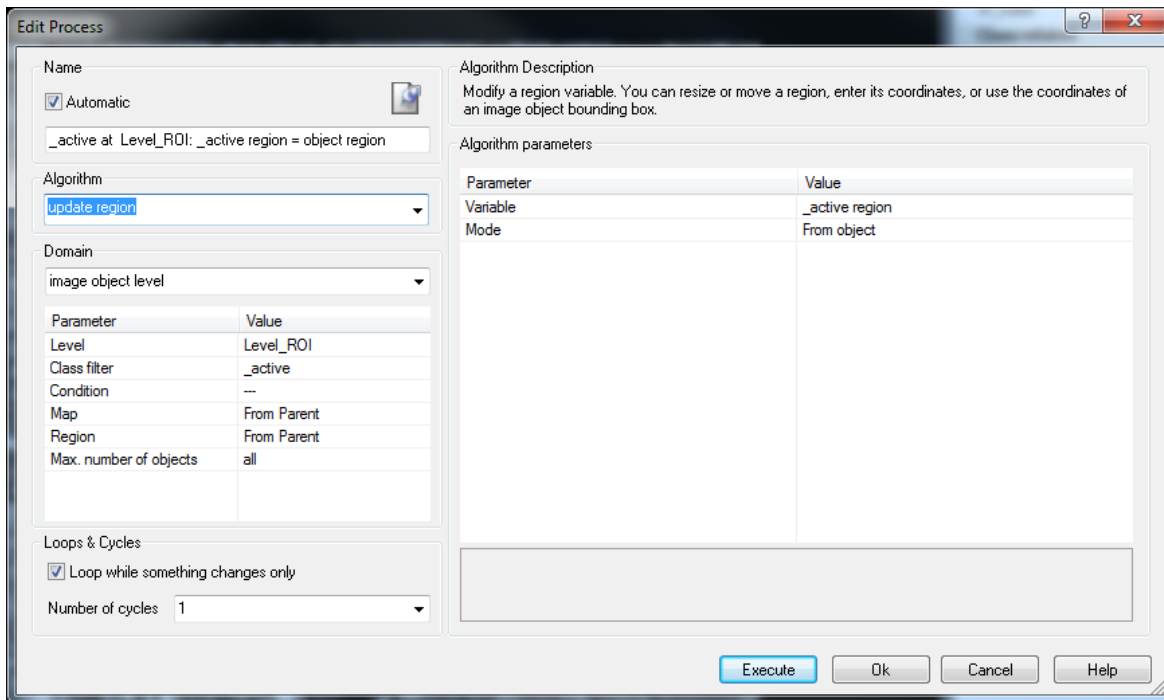


Figure 15: Process settings to create a region ‘\_active region’ from the current ‘\_active’ object.

2. **Execute** the process.
3. Double-click on the next process on copy map to 'Map Detail' to open it.
  - In the field ‘Source Region’ it is defined that the ‘\_active Region’, created with the process before, is the basis for the map extent.
  - All other parameters are set as **default**, all image layers are copied in the new map and also the image objects with classification.

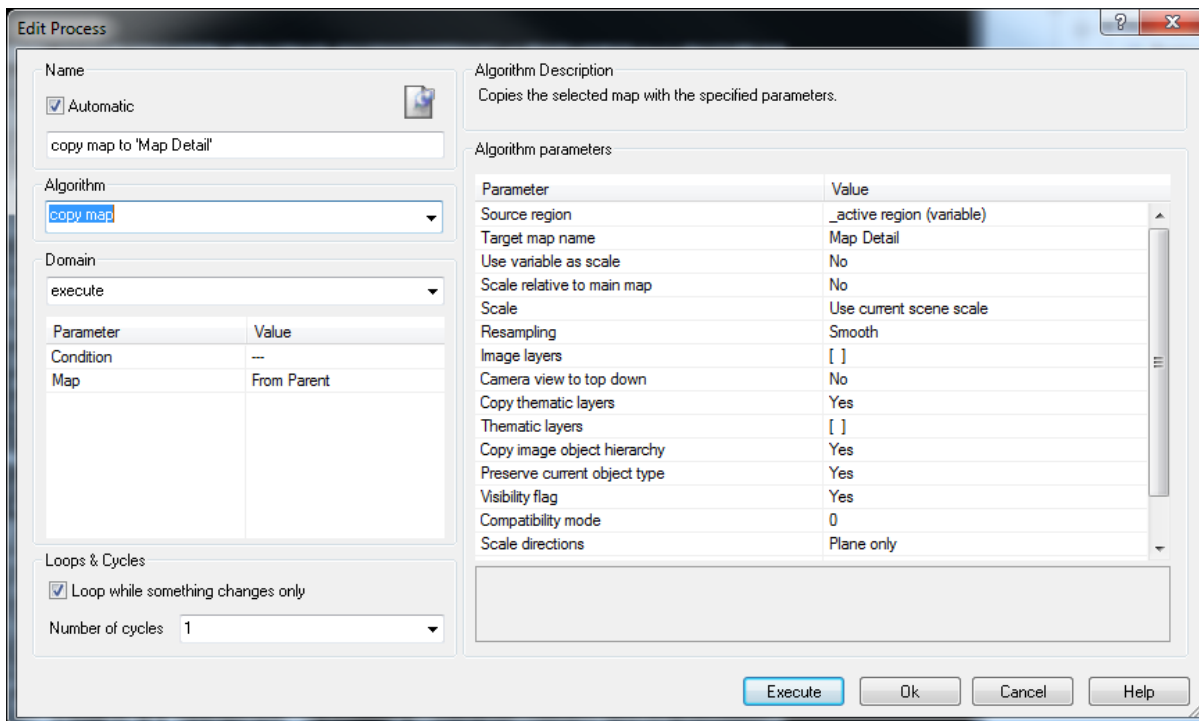


Figure 16: Process settings to create a ‘Map Detail’ from the current ‘\_active region’.

4. Execute the process.
5. Display 'Map Detail' in the viewer.

From the '\_Active Region' in the main map a new map 'Map Detail' is created, containing the objects and classification from the main map.

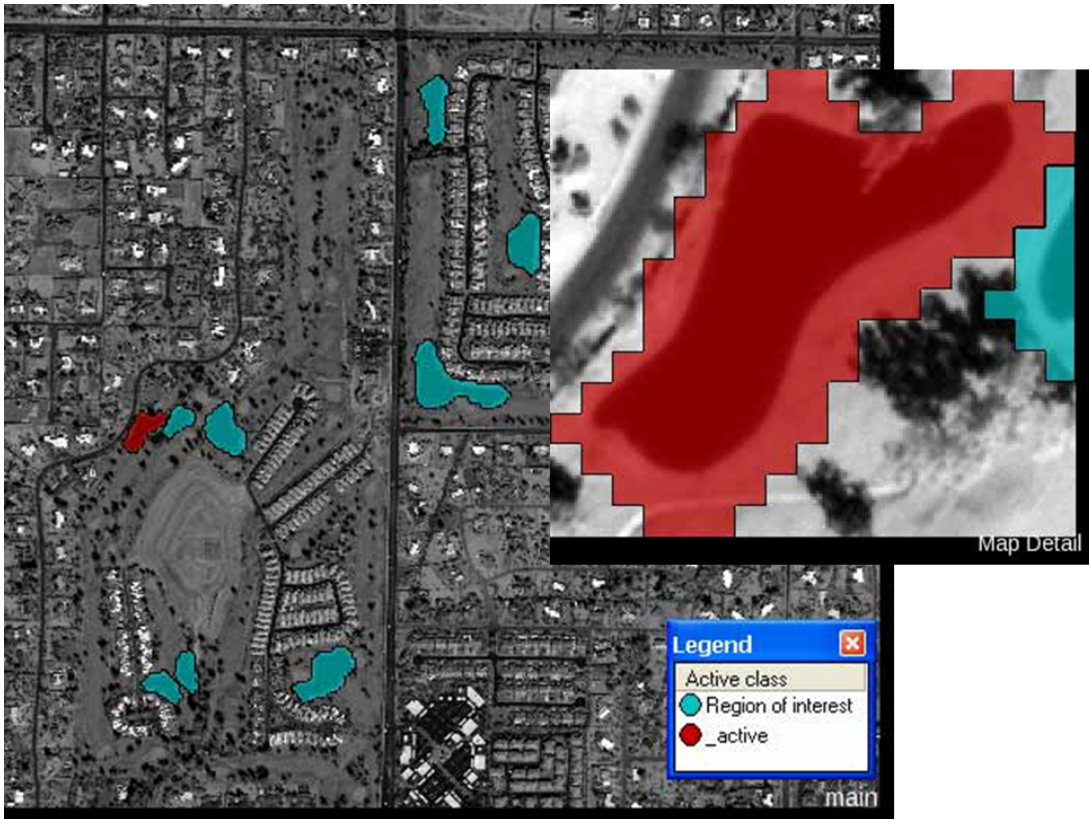


Figure 17: Main map with '\_active' object classified; newly created 'Map Detail' (inset).

### 3.3 Processing on 'Map Detail' and synchronization

In the sequence 'Process on Map Detail and synchronize' the classification of the 'Map Detail' is defined, as well as the synchronization back to the main map.

After this sequence is executed, the remaining '\_active' objects in the main map are declassified and the processing starts again with selecting the next 'region of interest' in the main map.

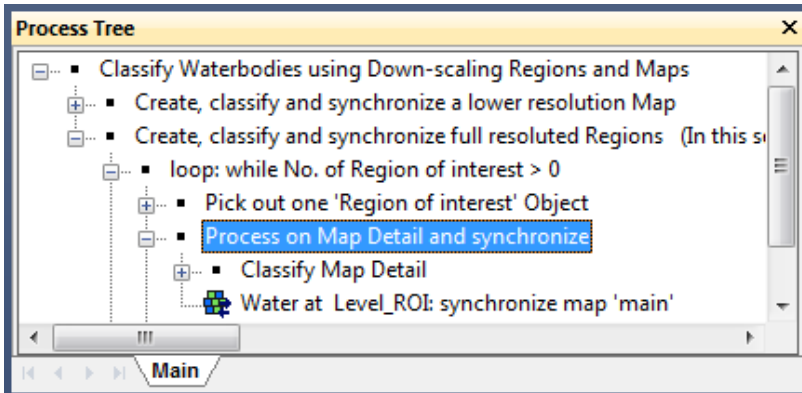


Figure 18: Process Tree with process sequence highlighted to classify and synchronize the current 'Map Detail'.



### 3.3.1 Classifying 'Map Detail'

In this section, the content of the water body in the current 'Map Detail' is classified.

1. Collapse 'Pick out one 'Region of interest' object'.
2. Expand 'Process on Map Detail and synchronize' and expand 'Classify Map Detail'.

The process sequence 'Classify Map Detail' has 5 sections:

- The map is split up to pixel-sized objects using the **chessboard segmentation**.
- In the section '**Find Seeds**', first 'Water' objects are classified by measuring and classifying the darkest values for the panchromatic layer.
- In the section '**Grow**', the first 'Water' objects are grown into spectrally similar neighbors.
- In the section '**Clean up**', holes are filled and small 'Water' objects are declassified.
- In the section '**Object reshaping**' growing and shrinking processes are applied to get smooth outlines for the 'Water' object

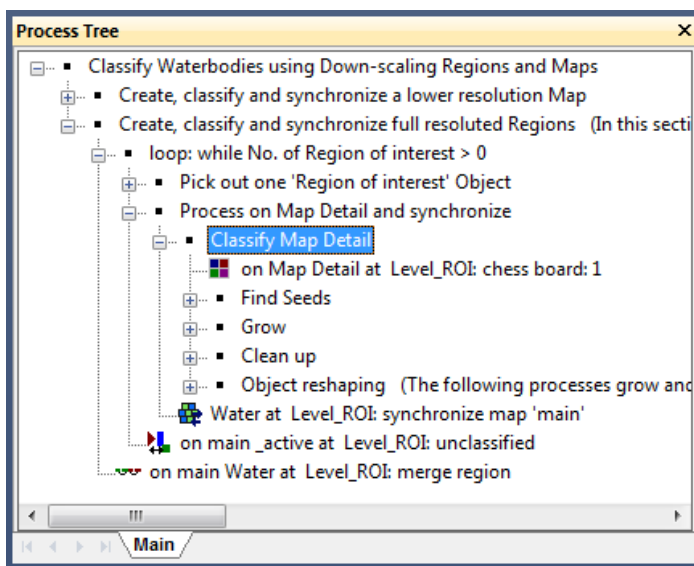


Figure 19: Process Tree with process sequence highlighted to classify the current 'Map Detail'.

1. Execute 'Classify Map Detail'.

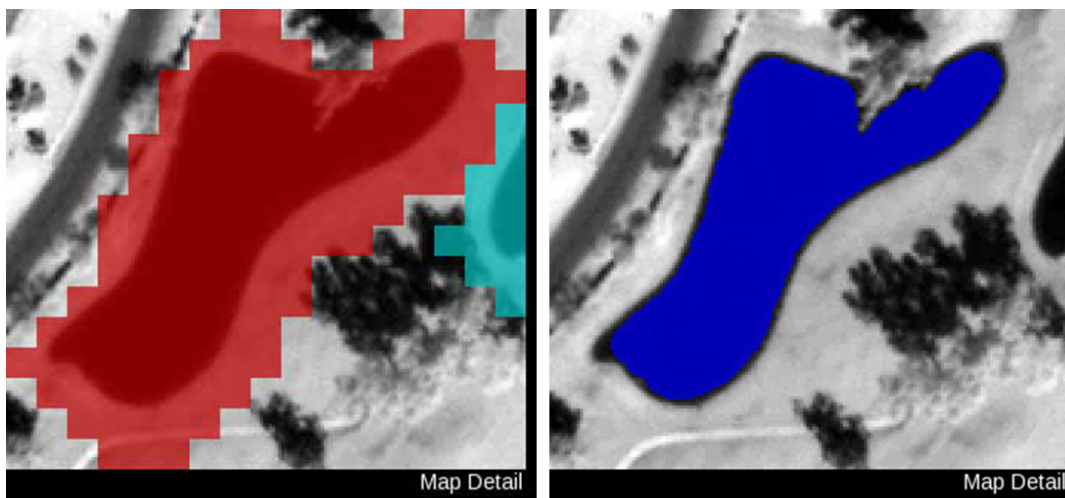


Figure 20: 'Map Detail' before and after classification.

### 3.3.2 Synchronize the results back to main map

The last process in the 'Process on Map Detail and synchronize' section of the Rule Set is the synchronization of the 'Map Detail' with the main map.

1. Collapse 'Classify Map Detail'.
2. Double-click on the process '**Water at Level\_ROI: synchronize map 'main''** to open it.
  - In the Domain it is specified, that the 'Water' objects are the objects to be synchronized.
  - In the Algorithm Parameters it is specified, that main map is the target of synchronization and the objects shall be synchronized in 'Level\_ROI'.

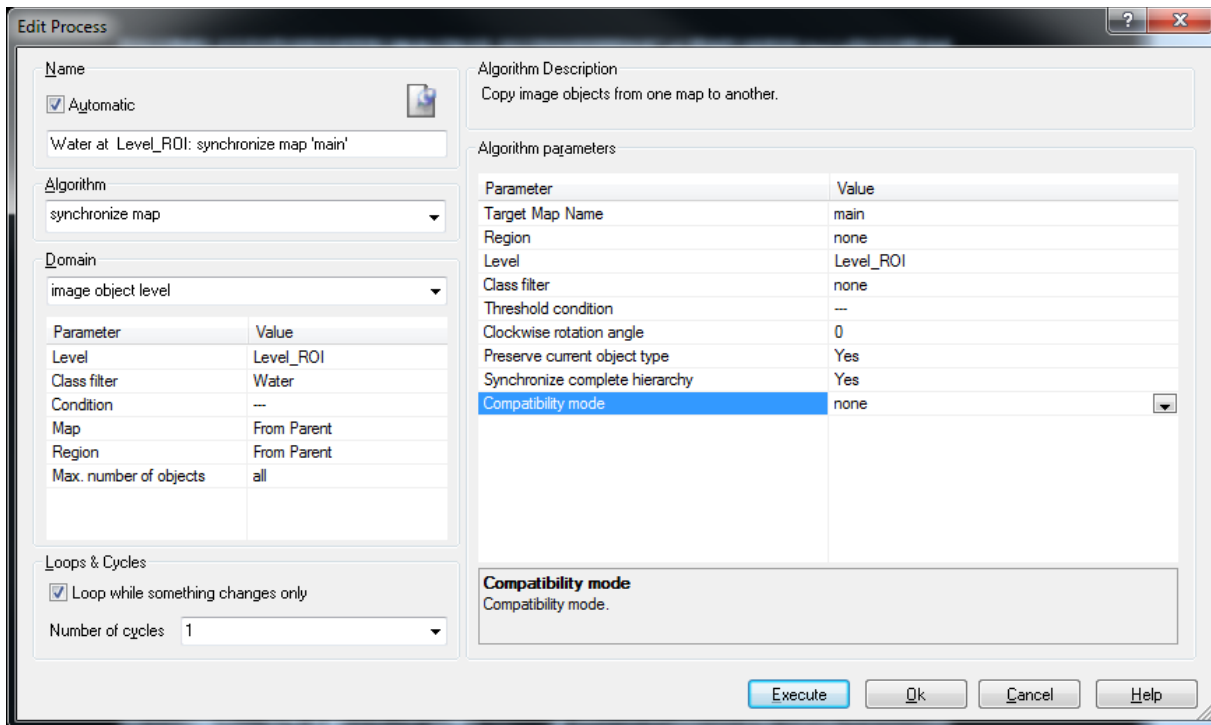


Figure 21: Process settings to synchronize the 'Map Detail' with the main map.

3. Execute the process.
4. Open a second viewer and display in one viewer the 'Detail Map' in the other the main map. Zoom to the synchronized 'Water' object.

The classification of the 'Water' object in the 'Map Detail' has been copied in the main map.

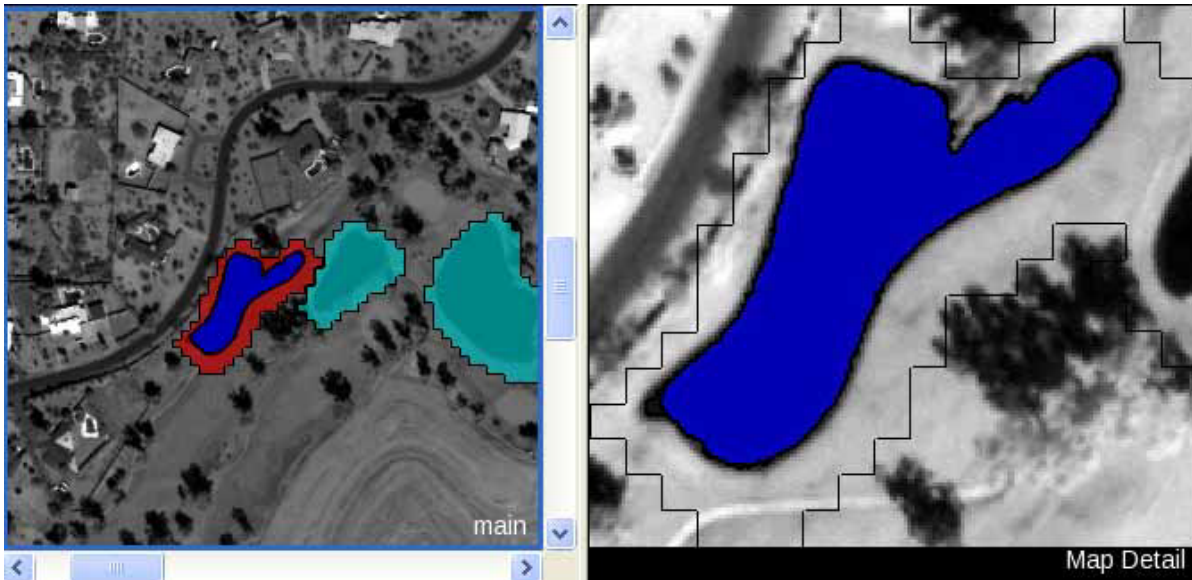


Figure 22: The 'Water' object is synchronized in the main map (left); 'Map Detail' with 'Water' classified (right).

## Lesson 4 The complete classification

### 4.0 Lesson content

- Prepare the next looping sequence
- Execute the complete sequence step by step
- Execute the sequence with 'looping' on

### 4.1 Prepare the next looping sequence

To have everything cleaned up, the existing '\_active' objects have to be declassified. Then the next 'Region of interest' object can be classified as '\_active' and analyzed in detail.

1. Collapse 'Process on Map Detail and synchronize'.
2. Select 'on main \_active at Level\_ROI: unclassified' and execute the process.

The remaining '\_active' objects are de-classified.

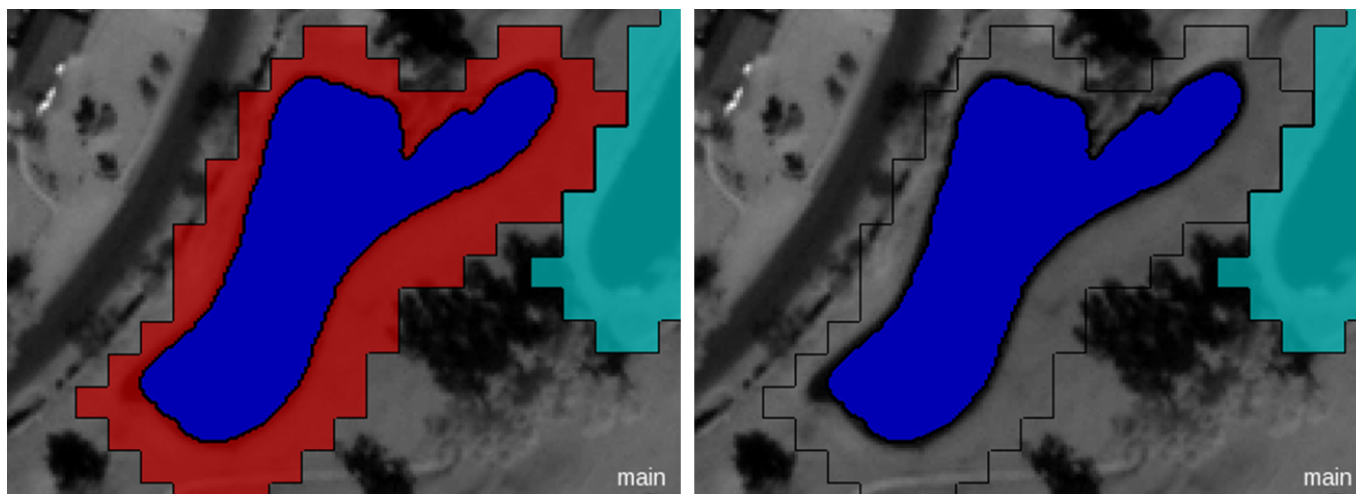


Figure 23: Before (left) and after (right) executing the declassification of the remaining '\_active' objects.

### 4.2 Execute the complete sequence step by step

1. Double-click on the process 'loop: while No. of Region of interest > 0 'main'' to open it.
2. In the field 'Number of cycles' insert 1.
3. Confirm the change with 'OK' button.
4. Execute the sequence 'if No. of Region of interest > 0' several times.

After each execution another 'Map Detail' is classified and another 'Water' object is synchronized in the main map.

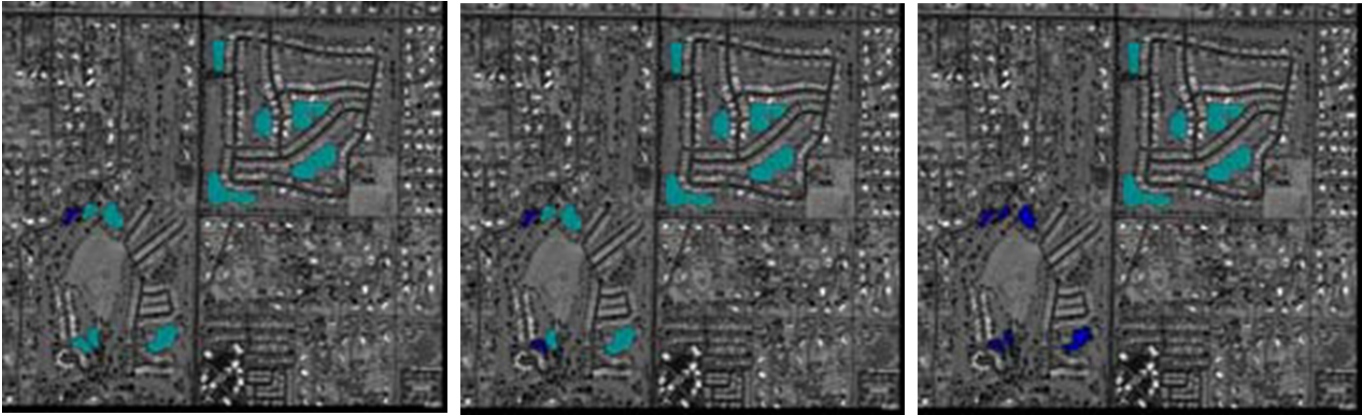


Figure 24: Stepwise one 'Region of interest' object after the other is classified.

### 4.3 Execute the sequence with 'looping' on

1. Double-click on the process 'if No. of Region of interest > 0' to open it.
2. In the field 'Number of cycles' choose 'Loop while something is changing'.
3. Confirm the change with 'OK' button.
4. Execute the sequence 'loop: while No. of Region of interest > 0 'main'.

All 'Region of interest' objects are analyzed in a 'Detail Map' and synchronized back in the main map.

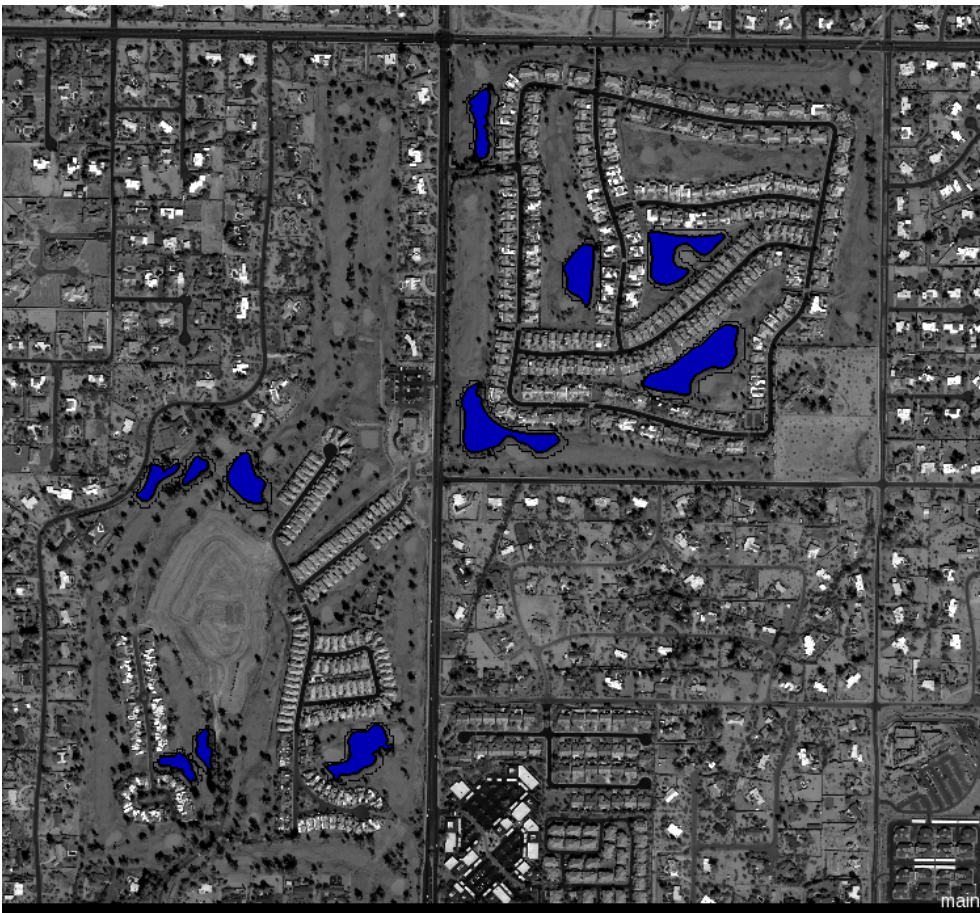


Figure 25: Classification of the main map after executing the complete sequence with 'looping'.

## Where to get additional help & information?

### The eCognition Community

The eCognition Community helps to share knowledge and information within the user, partner, academic and developer community to benefit from each other's experience.



The Community contains content such as:

- **Wiki:** collection of eCognition related articles (e.g. Rule Set tips and tricks, strategies, algorithm documentation...).
- **Discussions:** ask questions and get answers.
- **File exchange:** share any type of eCognition related code such as Rule Sets, Action Libraries, plug-ins...
- **Blogs:** read and write insights about what's happening around our industry...

Share your knowledge and questions with other users interested in using and developing image intelligence applications for Earth Sciences at:

<http://community.ecognition.com/>.

### The User Guide & Reference Book

Together with the software a User Guide and a Reference book is installed. You can access them in the Developer interface in the main menu 'Help>eCognition Developer User Guide' or Reference Book.

The Reference Book lists detailed information about algorithms and features, and provides general reference information.

### eCognition Training

eCognition Training Services offer a carefully planned curriculum that provides hands-on, real-world exercises. We are dedicated to enhancing customers' image analysis skills and helping these organizations to accomplish their goals.

Our courses are held in our classrooms around the world and on-site in our customer's facilities. We offer regular Open Training courses, where anyone can register and In-Company Training. We also offer Customized Courses to meet a customer's unique image analysis needs, thereby maximizing the training effect.

For more information please see our website or contact us at: [eCognition\\_Training@trimble.com](mailto:eCognition_Training@trimble.com)