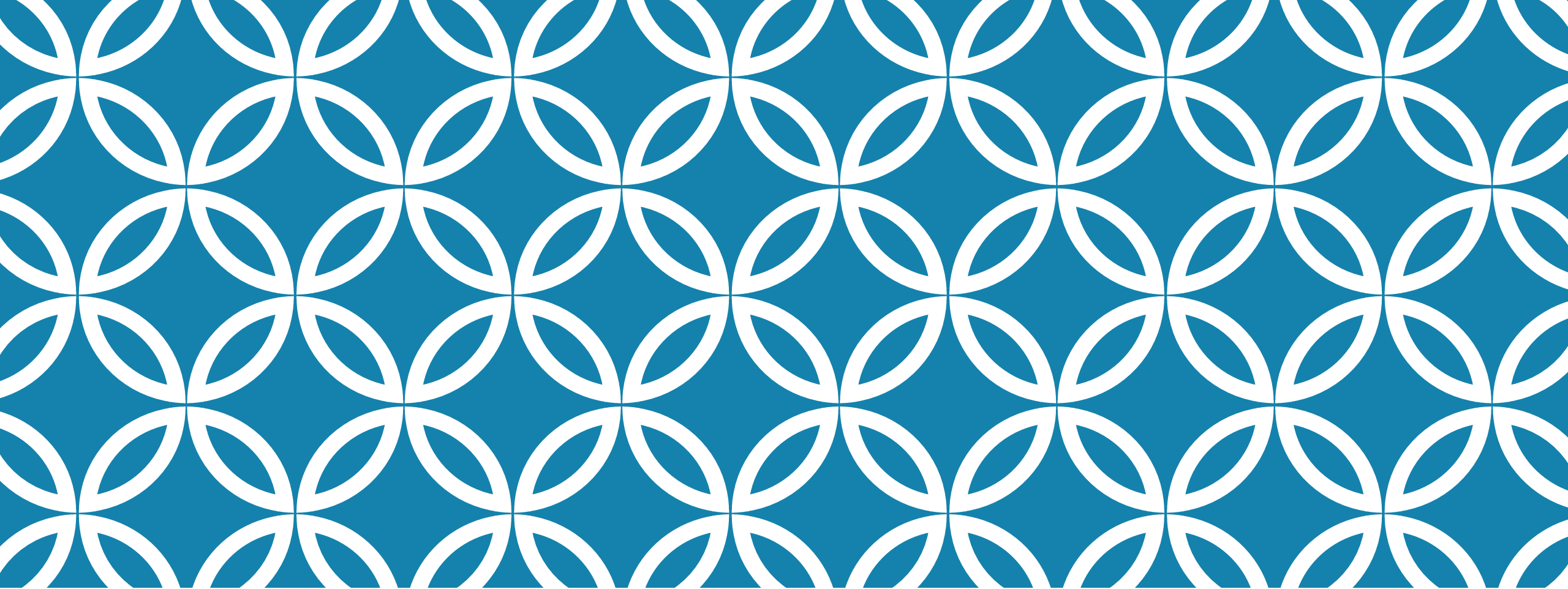


The background features a dark grey field filled with a pattern of small, dark green dots. Overlaid on this are several white, dashed contour lines that meander across the frame, primarily concentrated in the upper-left and lower-right corners. The main text is centered horizontally and vertically.

Advanced Remote Sensing

+
Sample assignments

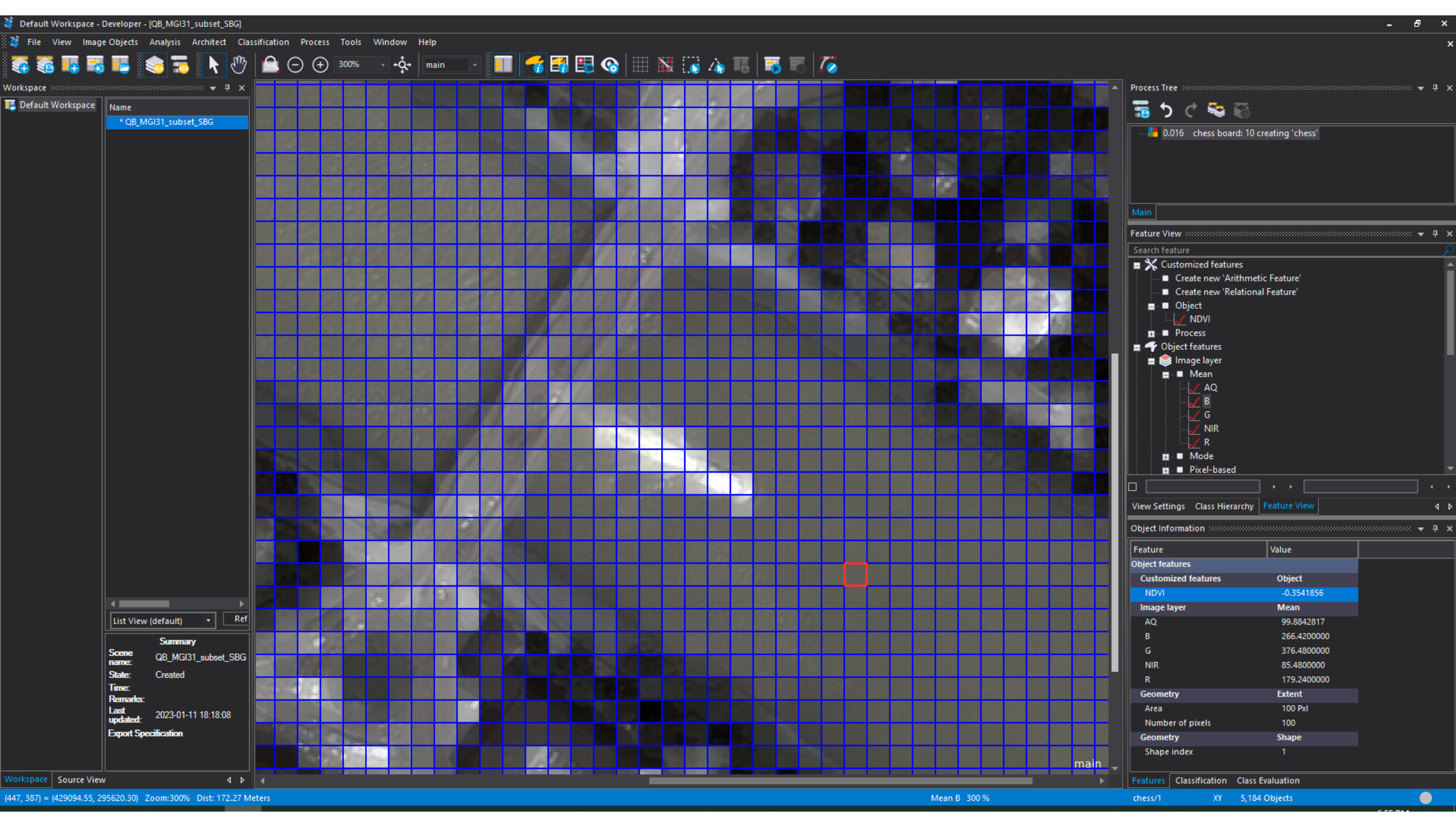


ADVANCED REMOTE SENSING ASSIGNMENT

Part II : Object features for
classification



EXAMPLE 1 + 2 |



Default Workspace

Name

* QB_MGI31_subset_SBG

Summary
Scene name: QB_MGI31_subset_SBG
State: Created
Time:
Remarks:
Last updated: 2023-01-11 18:18:08
Export Specification

Process Tree

0.016 chess board: 10 creating 'chess'

Main

Feature View

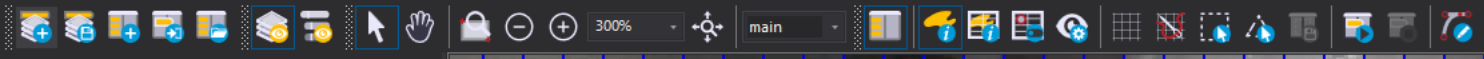
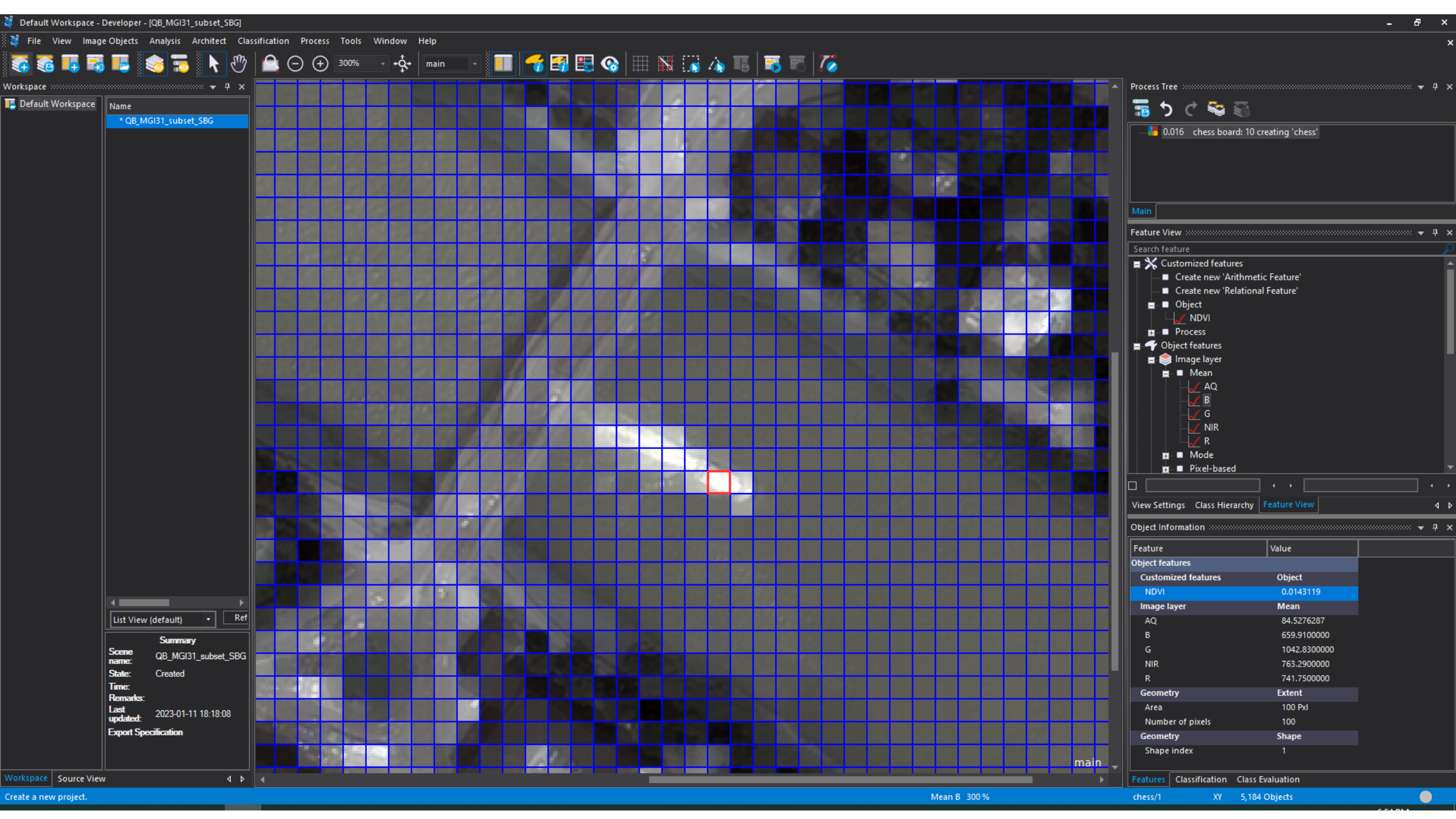
- Search feature
- Customized features
 - Create new 'Arithmetic Feature'
 - Create new 'Relational Feature'
- Object
 - NDVI
- Process
- Object features
 - Image layer
 - Mean
 - AQ
 - B
 - G
 - NIR
 - R
 - Mode
 - Pixel-based

View Settings Class Hierarchy Feature View

Object Information

Feature	Value
Object features	
Customized features	Object
NDVI	-0.3541856
Image layer	
Mean	
AQ	99.8842817
B	266.4200000
G	376.4800000
NIR	85.4800000
R	179.2400000
Geometry	
Extent	
Area	100 Pxl
Number of pixels	100
Geometry	
Shape	
Shape Index	1

Features Classification Class Evaluation



Workspace

Default Workspace

Name

* QB_MGI31_subset_SBG

Summary

Scene name: QB_MGI31_subset_SBG

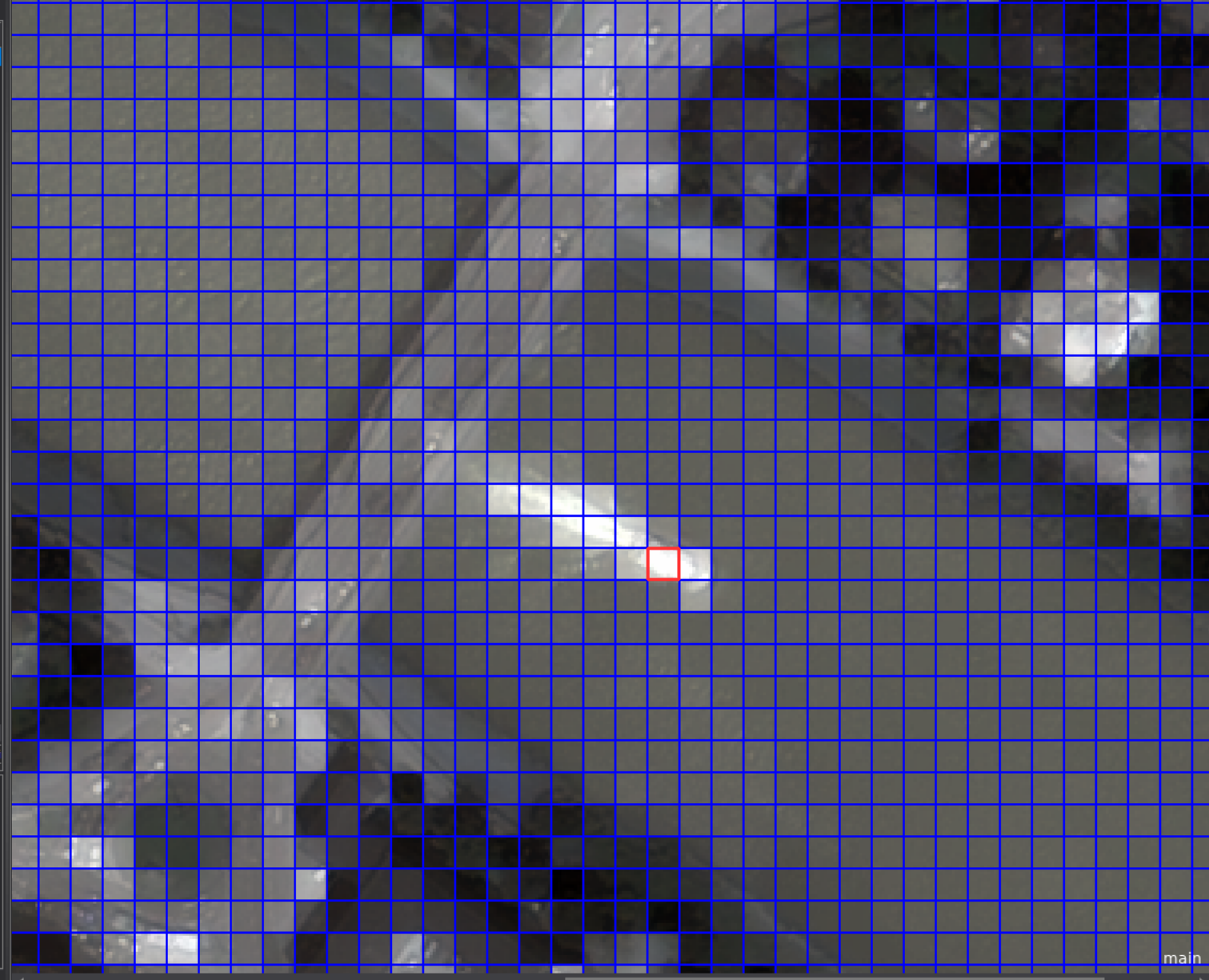
State: Created

Time:

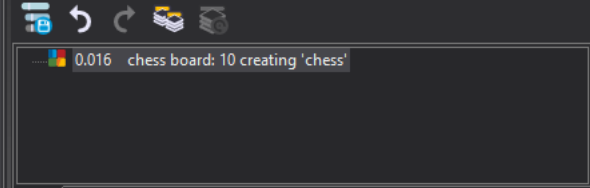
Remarks:

Last updated: 2023-01-11 18:18:08

Export Specification



Process Tree



Main

Feature View

Search feature

- Customized features
 - Create new 'Arithmetic Feature'
 - Create new 'Relational Feature'
- Object
 - NDVI
 - Process
- Object features
 - Image layer
 - Mean
 - AQ
 - B
 - G
 - NIR
 - R
 - Mode
 - Pixel-based

View Settings Class Hierarchy Feature View

Object Information

Feature	Value
Object features	
Customized features	Object
NDVI	0.0143119
Image layer	
Mean	
AQ	84.5276287
B	659.9100000
G	1042.8300000
NIR	763.2900000
R	741.7500000
Geometry	
Extent	
Area	100 Pxl
Number of pixels	100
Shape	
Shape index	1

Features Classification Class Evaluation

QUESTION 1:

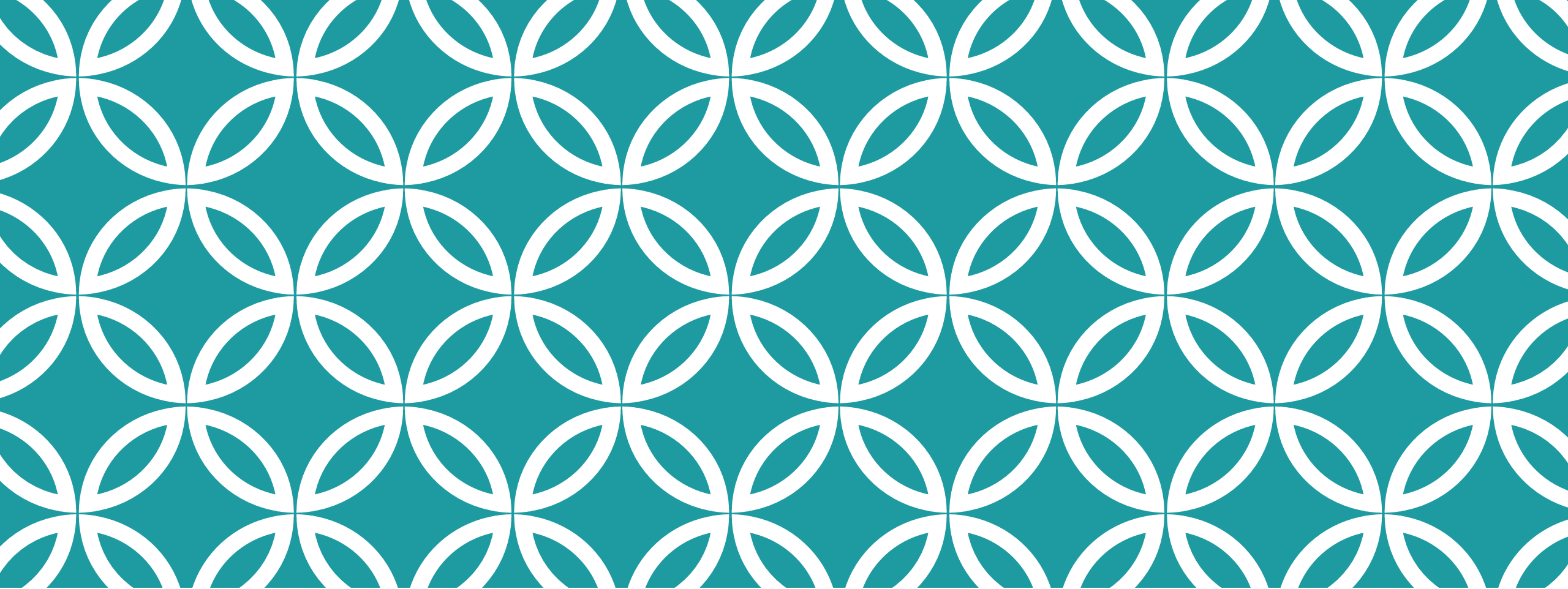
What becomes obvious if you compare the values for the two objects of the chessboard segmentation?

- The object representing a part of the boat is more reflective in all bands than the river which absorbs most wavelengths

QUESTION 2:

Which features don't make that much sense in the case of the chessboard classification?

- The geometry , since all the objects have the same geometry.
- The multisegmentation classification gives more meaningful objects since it takes into consideration the shape as well as the spectral properties:



EXAMPLE 3 + 4 |

Workspace

Default Workspace

Name

- * QB_MGI31_subset_SBG

List View (default) Ref

Summary

Scene name: QB_MGI31_subset_SBG

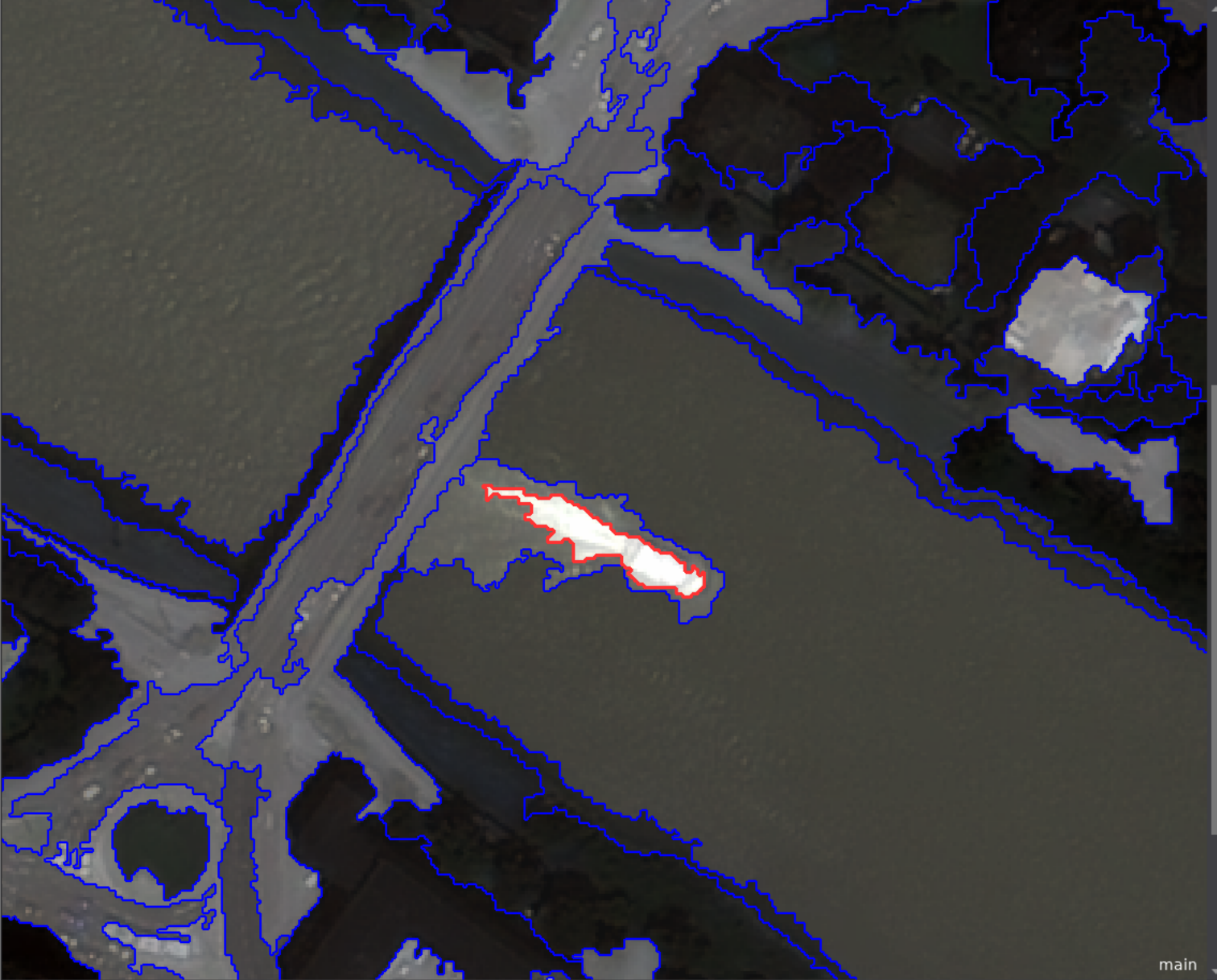
State: Created

Time:

Remarks:

Last updated: 2023-01-11 18:18:08

Export Specification



Process Tree

- 0.016 chess board: 10 creating 'chess'
- 01.984 multi-resolution: 200 [shape:0.3 compct.:0.5] creating 'multires_200'

Main

View Settings

3D

Object Levels

- multires_200

Image Layers

	R	G	B	Range
B	•			auto
G		•		auto
R			•	auto
NIR				auto
AQ				auto

Object Levels | Image Layers | Point Clouds | Vector Layers | General Settings

Object Level Settings

- Object outline: Outlines Draw Skeleton
- Available Classes
- unclassified No Color

Auto update

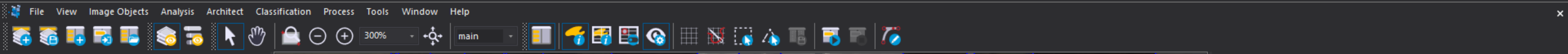
Apply to all views

Discard Apply

View Settings | Class Hierarchy | Feature View

Object Information

Feature	Value
Object features	
Customized features	
Object	
NDVI	-0.1304628
Image layer	
Mean	
AQ	77.5295992
B	553.7603550
G	868.1952663
NIR	438.6094675
R	570.2248521
Geometry	
Extent	
Area	676 Pxl
Number of pixels	676
Geometry	
Shape	
Shape index	2.2692308



Workspace

Default Workspace

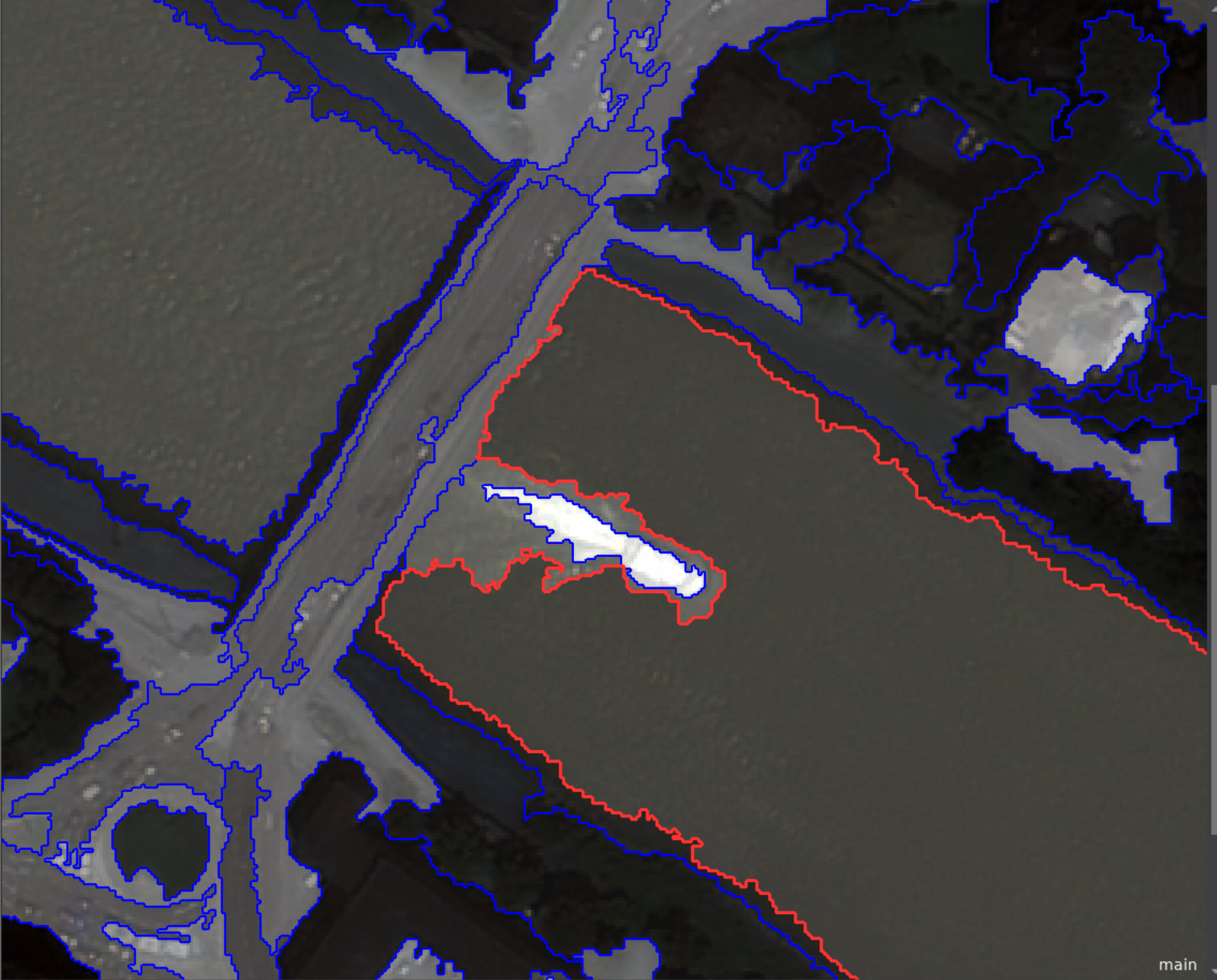
Name

- * QB_MGI31_subset_SBG

List View (default) Ref

Summary

Scene name: QB_MGI31_subset_SBG
State: Created
Time:
Remarks:
Last updated: 2023-01-11 18:18:08
Export Specification



Process Tree

- 0.016 chess board: 10 creating 'chess'
- 01.984 multi-resolution: 200 [shape:0.3 compct:0.5] creating 'multires_200'

View Settings

3D

Object Levels

- multires_200

Image Layers

	R	G	B	Range
B	•			auto
G		•		auto
R			•	auto
NIR				auto
AQ				auto

Object Level Settings

- Object outline: Outlines Draw Skeleton
- Available Classes
- unclassified No Color

Auto update
 Apply to all views

View Settings | Class Hierarchy | Feature View

Object Information

Feature	Value
Object features	
Customized features	Object
NDVI	-0.3102526
Image layer	
AQ	95.5486521
B	266.0275300
G	370.7408544
NIR	94.2356268
R	179.0111567
Geometry	
Extent	
Area	45623 Pxl
Number of pixels	45623
Geometry	
Shape index	1.8773811

Features | Classification | Class Evaluation

Workspace

Default Workspace

Name
* QB_MGI31_subset_SBG

List View (default) Ref

Summary

Scene name: QB_MGI31_subset_SBG
State: Created
Time:
Remarks:
Last updated: 2023-01-11 18:18:08
Export Specification



Process Tree

- 0.016 chess board: 10 creating 'chess'
- 01.984 multi-resolution: 200 [shape:0.3 compct.:0.5] creating 'multires_200'
- <0.001s with NDVI >= 0.25 at multires_200: Vegetation
- <0.001s with NDVI <= -0.15 at multires_200: Water

Main

View Settings

3D

Object Levels

- multires_200
 - B
 - G
 - R
 - NIR
 - AQ

Class Col	Range
R	auto
G	auto
B	auto
NIR	auto
AQ	auto

Image Layers

Object Level Settings

- Object outline Outlines Draw Skeleton
- Available Classes
- unclassified No Color

Auto update
 Apply to all views

Discard Apply

View Settings Class Hierarchy Feature View

Object Information

Feature	Value
Object features	
Customized features	Object
NDVI	-0.3102526
Image layer	
AQ	95.5486521
B	266.0275300
G	370.7408544
NIR	94.2356268
R	179.0111567
Geometry	
Extent	
Area	45623 Pxl
Number of pixels	45623
Geometry	
Shape	
Shape index	1.8773811

Features Classification Class Evaluation



Workspace

Default Workspace

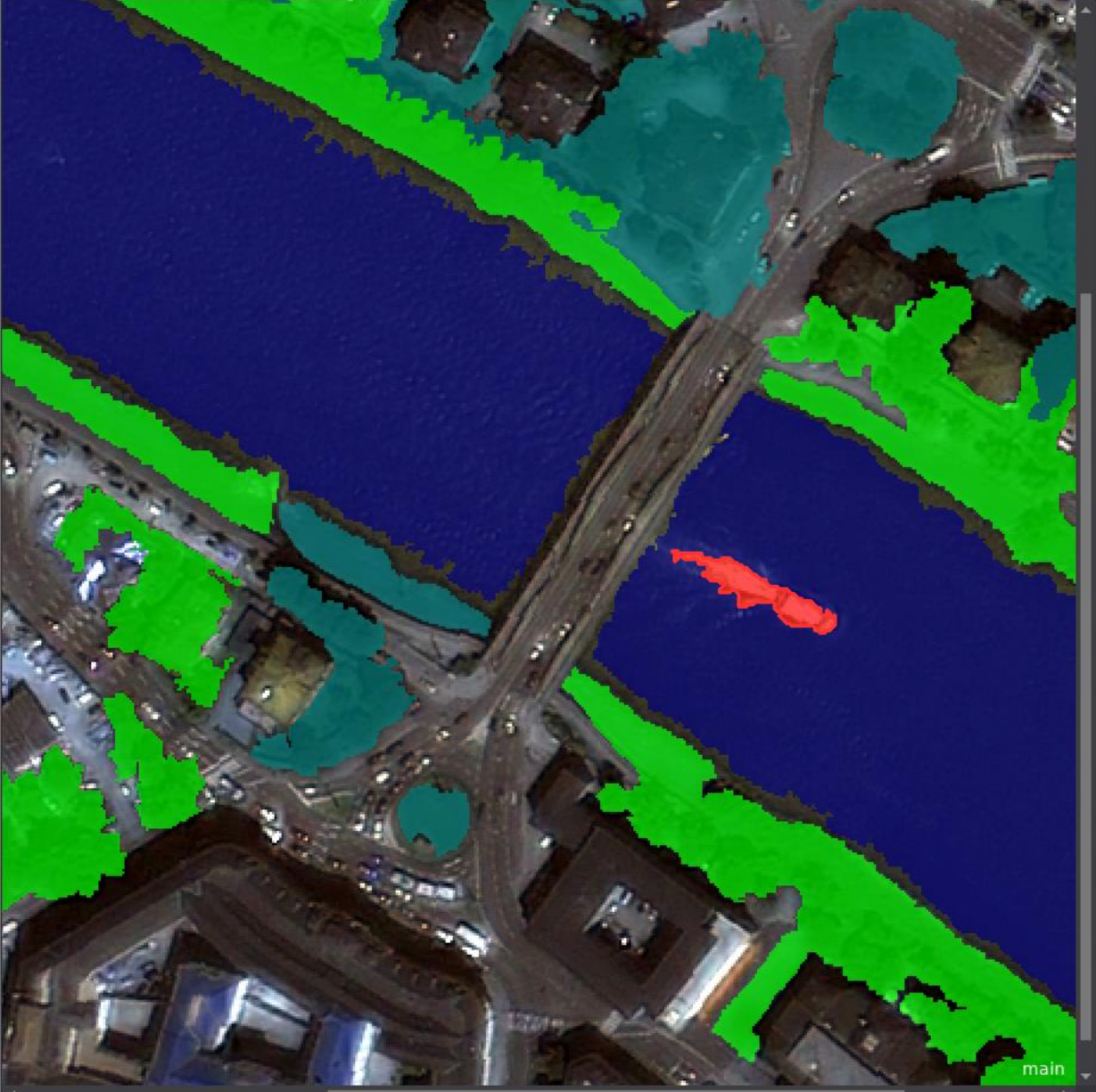
Name

- * QB_MGI31_subset_SBG

List View (default) Ref

Summary

Scene name: QB_MGI31_subset_SBG
 State: Created
 Time:
 Remarks:
 Last updated: 2023-01-11 18:18:08
 Export Specification



Process Tree

- 0.016 chess board: 10 creating 'chess'
- 01.984 multi-resolution: 200 [shape:0.3 cc
- <0.001s with NDVI >= 0.25 at multires_200
- <0.001s with NDVI <= -0.15 at multires_200
- <0.001s with Rel. border to Water = 1 at multires_200
- <0.001s Vegetation with Mean AQ >= 50 at multires_200
- <0.001s Vegetation with Mean AQ < 50 at multires_200

Class Hierarchy

- classes
 - Boat
 - Vegetation
 - HQA
 - LQA
 - Water

Groups Inheritance

View Settings Class Hierarchy Feature View

Object Information

Feature	Value
Object features	
Customized features	Object
NDVI	-0.1304628
Image layer	Mean
AQ	77.5295992
B	553.7603550
G	868.1952663
NIR	438.6094675
R	570.2248521
Geometry Extent	
Area	676 Pxl
Number of pixels	676
Geometry Shape	
Shape index	2.2692308
Neighbors Rel. border to	
Water	1



Workspace

Default Workspace

Name

- * QB_MGI31_subset_SBG

List View (default) Ref

Summary

Scene name: QB_MGI31_subset_SBG

State: Created

Time:

Remarks:

Last updated: 2023-01-11 18:18:08

Export Specification



Process Tree

- 0.016 chess board: 10 creating 'chess'
- 01.984 multi-resolution: 200 [shape:0.3 cc
- <0.001s with NDVI >= 0.25 at multires_20
- <0.001s with NDVI <= -0.15 at multires_2
- <0.001s with Rel. border to Water = 1 at
- <0.001s Vegetation with Mean AQ >= 50
- <0.001s Vegetation with Mean AQ < 50 a

Class Hierarchy

- classes
 - Boat
 - Vegetation
 - Water

Groups Inheritance

View Settings Class Hierarchy Feature View

Object Information

Feature	Value
Object features	
Customized features	Object
NDVI	-0.1304628
Image layer	
Mean	
AQ	77.5295992
B	553.7603550
G	868.1952663
NIR	438.6094675
R	570.2248521
Geometry	
Extent	
Area	676 Pxl
Number of pixels	676
Geometry	
Shape	
Shape index	2.2692308
Neighbors	
Rel. border to	
Water	1

Features Classification Class Evaluation



What happens if you collapse the vegetation super-class?

- The extra subclasses taking into consideration the air quality aren't displayed and only the superclass Vegetation (classified from only NDVI values) is shown.

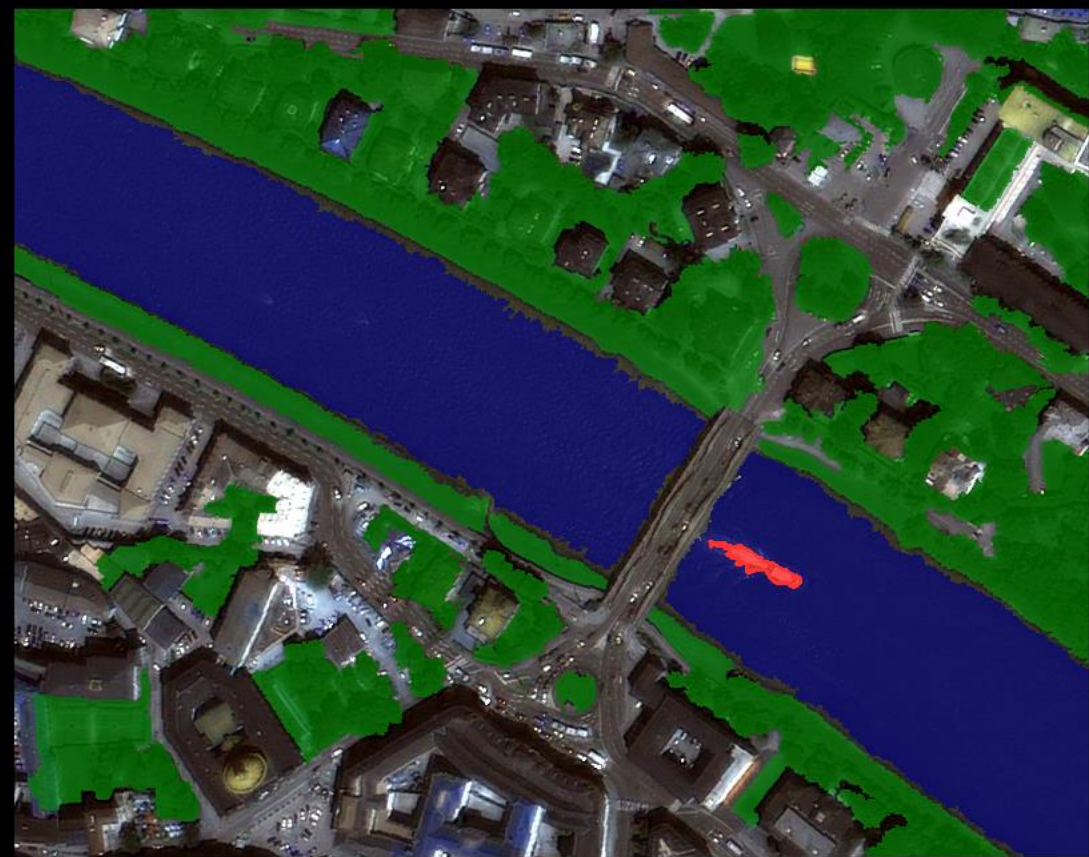
Workspace

Part2ARS

Name

- * QB_MGI31_subset_SBG

List View (default) Ref



Process Tree

- 0.016 chess board: 10 creating 'chess'
- 01.984 multi-resolution: 200 [shape:0.3 c
- <0.001s with NDVI >= 0.25 at multires_2
- <0.001s with NDVI <= -0.15 at multires_2
- <0.001s with Rel. border to Water = 1 at
- <0.001s Vegetation with Mean AQ >= 50
- <0.001s Vegetation with Mean AQ < 50 a

Feature View

Search feature

- Vector features
- Point features (point cloud)
- Map features
 - Map
 - Region
 - Objects
 - Area of classified objects
 - Create new 'Area of classified objects'
 - HQA (m²)
 - LQA (m²)
 - Vegetation (m²)
 - Area of classified objects in region
 - Area percentage of
 - Existence of object level
 - Histogram of object value
 - Layer StdDev of classified objects
 - Layer mean of classified objects
 - Number of classified objects
 - Create new 'Number of classified objects'

View Settings Class Hierarchy Feature View

Object Information

Feature	Value
NDVI	-0.1304628
Image layer Mean	
AQ	77.5295992
B	553.7603550
G	868.1952663
NIR	438.6094675
R	570.2248521
Geometry Extent	
Area	676 Pxl
Number of pixels	676
Geometry Shape	
Shape index	2.2692308
Neighbors Rel. border to	
Water	1
Project/Map features	
Objects Number of classifi...	
Water	3
Objects Area of classified ...	
HQA	39163.3200000 m ²
LQA	17954.2800000 m ²
Vegetation	57117.6000000 m ²

QUESTION 3:

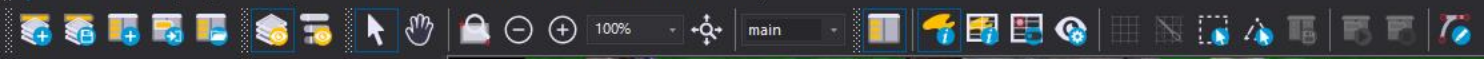
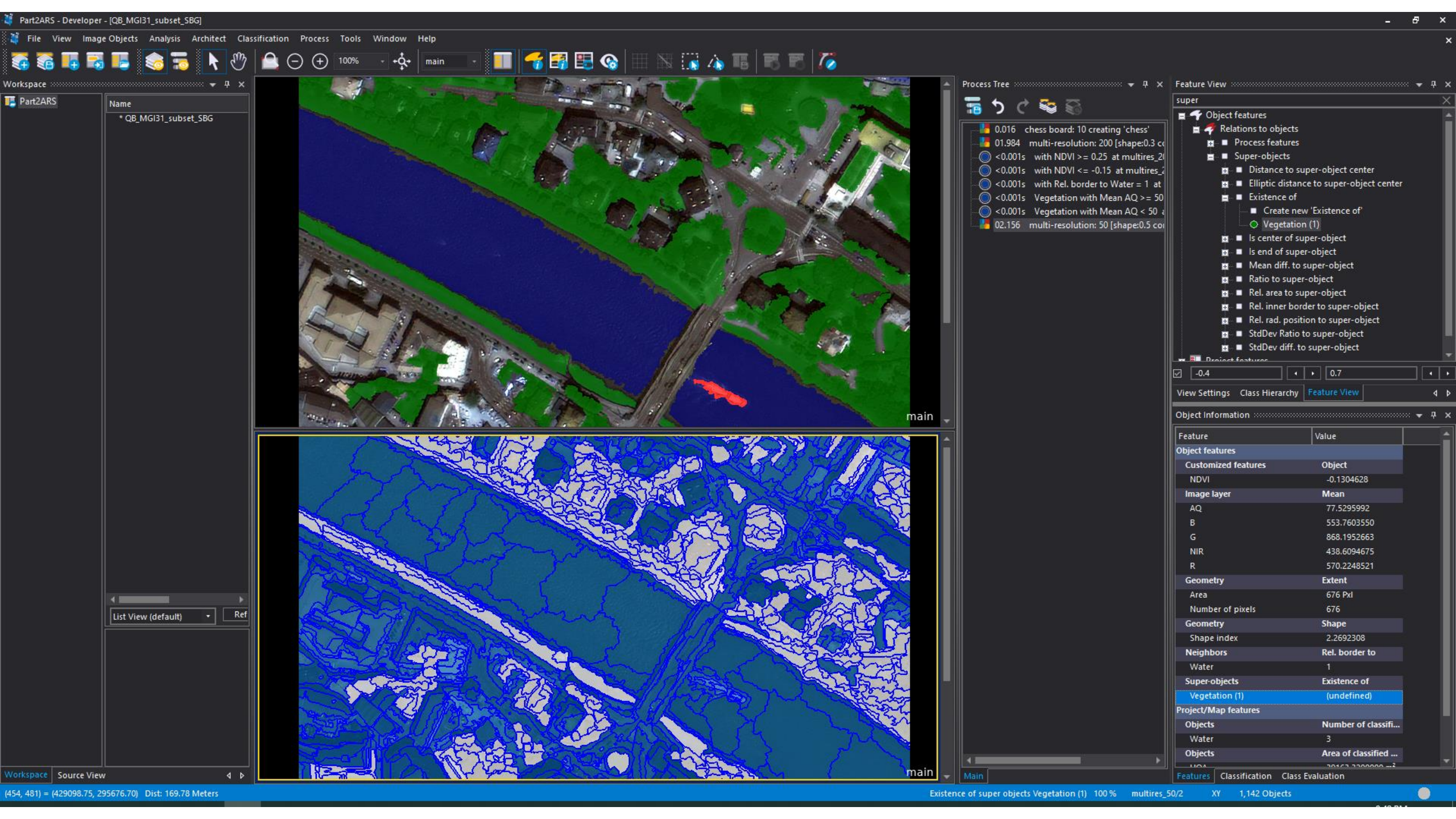
How many objects were classified as „water“?

- There were **3** objects classified as water

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)?

- Yes. If only the vegetation class is selected, its subclasses (High and Low Quality vegetation) will be summarized.

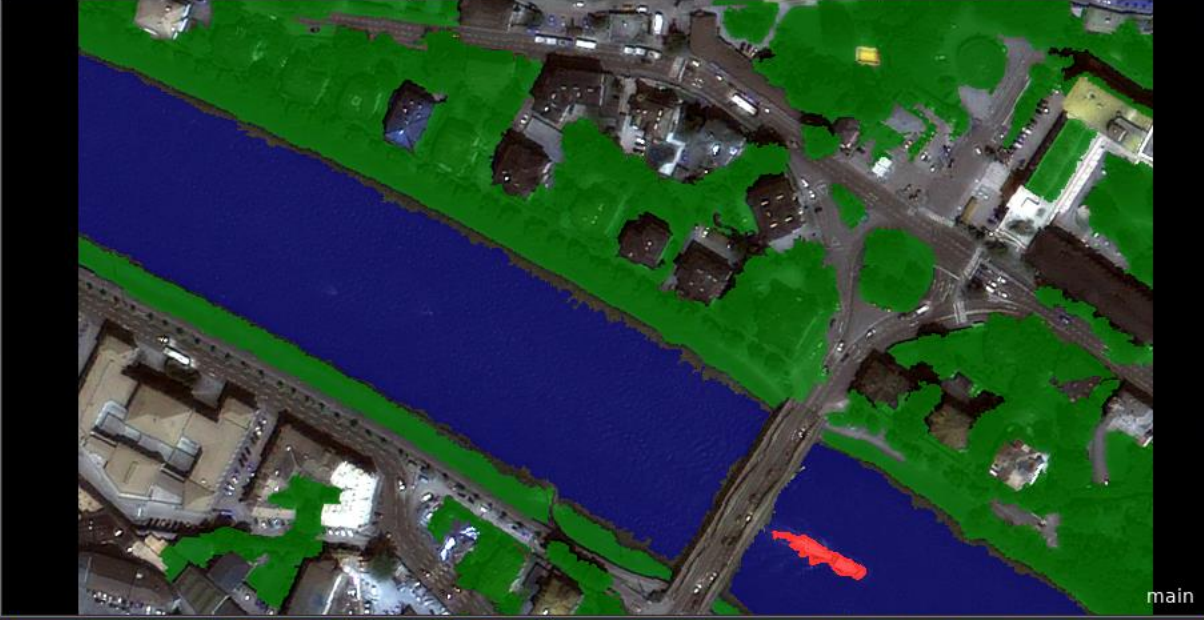


Workspace

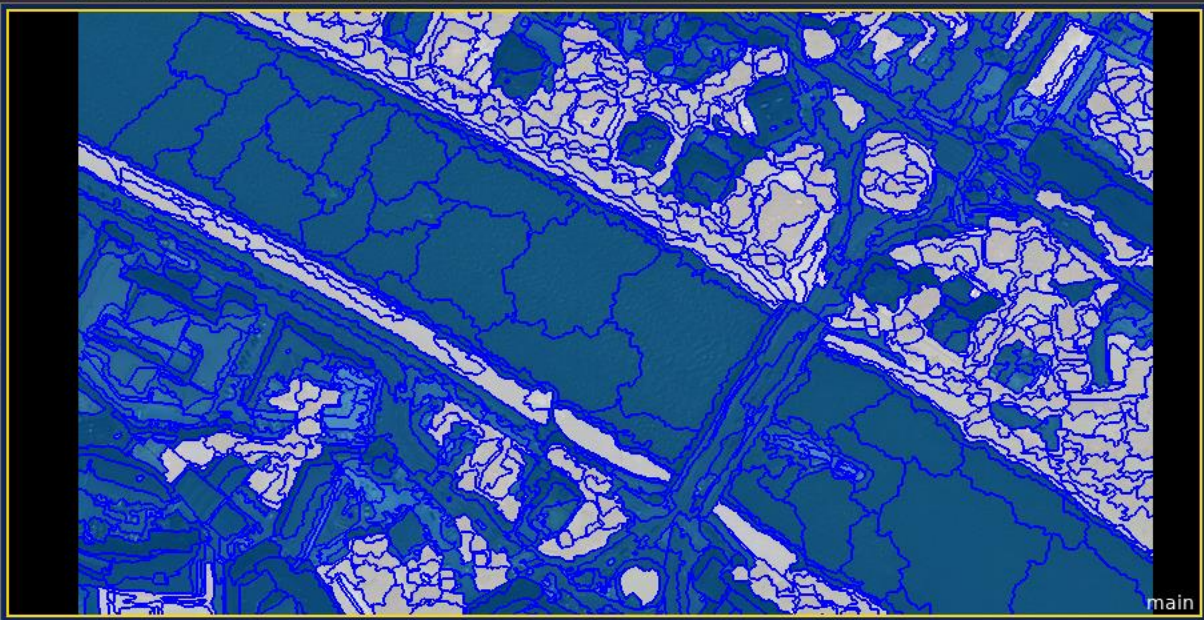
Part2ARS

Name

*QB_MGI31_subset_SBG



main



main

Process Tree

- 0.016 chess board: 10 creating 'chess'
- 01.984 multi-resolution: 200 [shape:0.3 co
- <0.001s with NDVI >= 0.25 at multires_2
- <0.001s with NDVI <= -0.15 at multires_2
- <0.001s with Rel. border to Water = 1 at
- <0.001s Vegetation with Mean AQ >= 50
- <0.001s Vegetation with Mean AQ < 50 a
- 02.156 multi-resolution: 50 [shape:0.5 coi

Feature View

- super
 - Object features
 - Relations to objects
 - Process features
 - Super-objects
 - Distance to super-object center
 - Elliptic distance to super-object center
 - Existence of
 - Create new 'Existence of'
 - Vegetation (1)
 - Is center of super-object
 - Is end of super-object
 - Mean diff. to super-object
 - Ratio to super-object
 - Rel. area to super-object
 - Rel. inner border to super-object
 - Rel. rad. position to super-object
 - StdDev Ratio to super-object
 - StdDev diff. to super-object

View Settings: Class Hierarchy Feature View

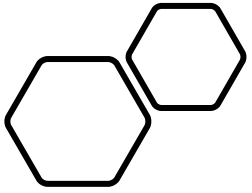
Object Information

Feature	Value
Object features	
Customized features	Object
NDVI	-0.1304628
Image layer	
AQ	77.5295992
B	553.7603550
G	868.1952663
NIR	438.6094675
R	570.2248521
Geometry	
Extent	
Area	676 Pxl
Number of pixels	676
Geometry	
Shape index	2.2692308
Neighbors	Rel. border to
Water	1
Super-objects	
Existence of	
Vegetation (1)	(undefined)
Project/Map features	
Objects	
Number of classifi...	
Water	3
Objects	Area of classified ...

QUESTION 5

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

- The distance value refers to the hierarchical relation between the objects in the finer segmentation (scale 50) and the super objects in the coarser segmentation (scale 200). A distance value of 1 for the vegetation means that if an object from segmentation 50 exists within an object of the segmentation 200, it will be detected and considered as belonging to the same class.



Hyperspectral unmixing

Hyperspectral imagery assignment

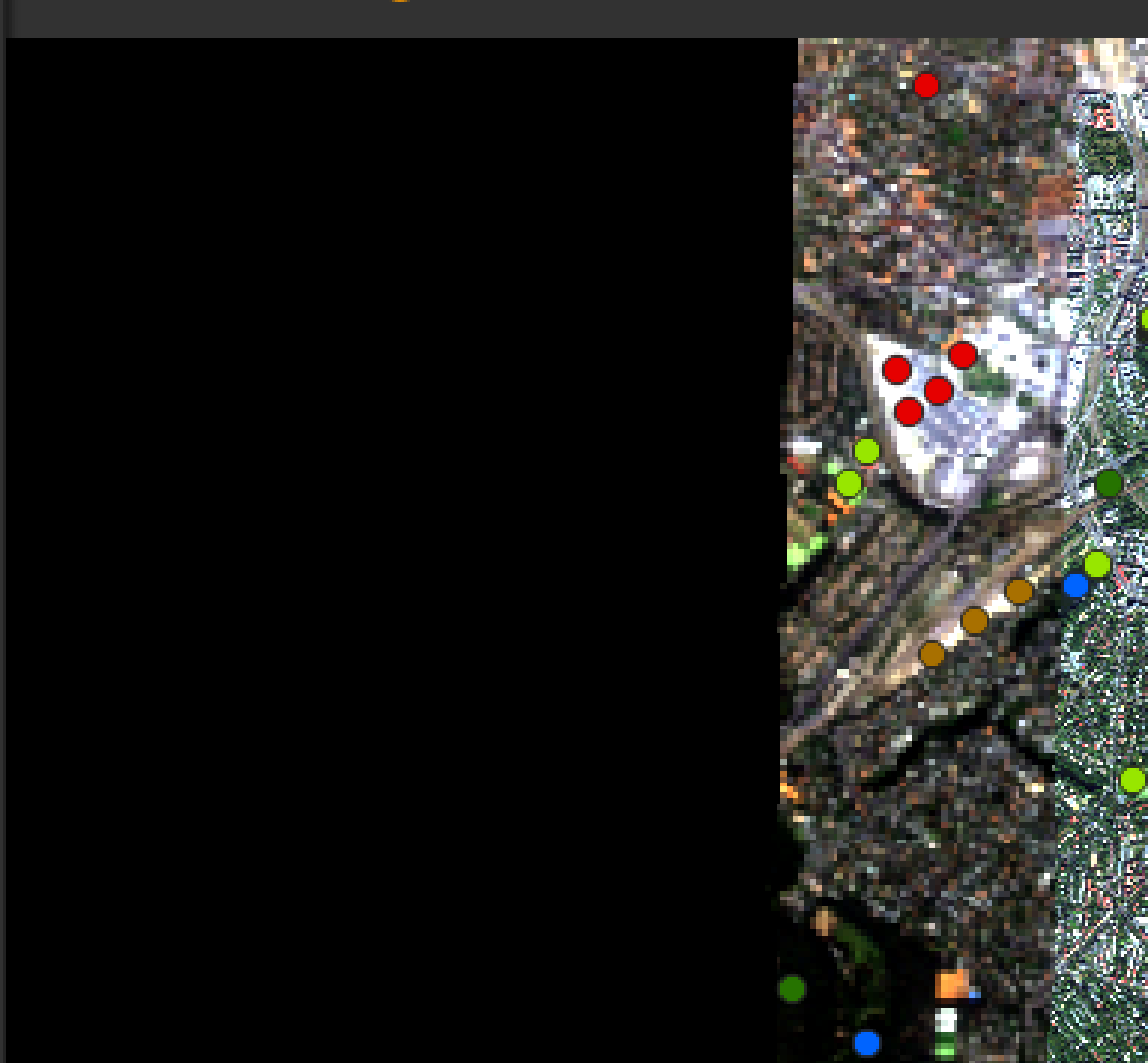
Data Sources

+ ✖ ↕ ↕ 🔍

Filter

Name	Value
Rasters (2)	
enmap_berlin.bs	
hires_berlin.bsq	
Vectors (5)	
enmap_srf_libra	
landcover_berlin	
landcover_berlin	
library_berlin.gp	
veg-cover-fracti	

- Classification workflow
- Classification Workflow (advanced)
- Classification Workflow (deprecated)
- EnPT (EnMAP Processing Tool) ▶
- EO Time Series Viewer
- GFZ EnGeoMAP ▶
- Image Math (deprecated)
- Raster math
- Regression Dataset Manager
- Regression workflow
- Regression Workflow (deprecated)
- Regression-based unmixing**



Data Views

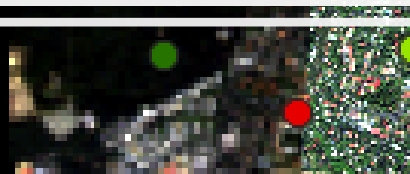
✖ ↕ ↕

Filter

Property

- Soil Applications ▶
- Spectral Index Calculator
- Agricultural Applications ▶

Launching the Unmixing application



Parameters Log

Endmember dataset



Regression-based unmixing

Implementation of the regression-based unmixing approach ["Ensemble"](#)

Raster layer

enmap_berlin.bsq [EPSG:32633]

Regressor

RandomForestRegressor

```
1 from sklearn.ensemble import RandomForestRegressor
2 regressor = RandomForestRegressor(n_estimators=100, oo
```

- Create classification dataset (from categorized vector layer and feature rast
- Create classification dataset (from categorized raster layer and feature rast
- Create classification dataset (from categorized spectral library)
- Create classification dataset (from categorized vector layer with attribute ta
- Create classification dataset (from table with categories and feature fields)
- Create classification dataset (from Python code)
- Create classification dataset (from text files)
- Create classification dataset (from JSON file)

Creating a classification dataset

Scikit-learn python code. See [RandomForestRegressor](#) for information on different parameters.

A raster layer to be unmixed.

Regressor


Scikit-Learn Python code specifying a regressor.

Number of mixtures per class.

Number of mixtures per class.

Proportion of background mixtures (%)

Raster layer with features

 enmap_berlin.bsq [EPSG:32633]

Advanced Parameters

Field with class values [optional]

abc_level_1

Minimum pixel coverage

50

Majority voting

Output dataset

[Save to temporary file]

layer and feature raster)

Create a classification dataset by sampling data for pixels that match the given categories and store the result as a pickle file.

If the layer is not categorized, or the field with class values is selected manually, categories are derived from the sampled target data y . To be more precise: i) category values are derived from unique attribute values (after excluding no data or zero data values), ii) category names are set equal to the category values, and iii) category colors are picked randomly.

Categorized vector layer

Categorized vector layer specifying sample locations and target data y . If required, the layer is reprojected and rasterized internally to match the feature raster grid.

Setting up the classification dataset

Raster layer with features

Raster layer used for sampling feature data X .

Executing the Regression model

Regression-Based Unmixing

Parameters Log

Endmember dataset
/Users/turki/AppData/Local/Temp/processing_j8EyaM/a4eaa7df52234d128b1a0915ce90700c/outputClassificationDataset.pkl

Raster layer
enmap_berlin.bsq [EPSG:32633]

Regressor
LinearRegression

```
1 from sklearn.pipeline import make_pipeline
2 from sklearn.preprocessing import StandardScaler
3 from sklearn.linear_model import LinearRegression
4
5 linearRegression = LinearRegression()
6 regressor = make_pipeline(StandardScaler(), linearRegression)
```

Scikit-learn python code. See [LinearRegression](#) for information on different parameters.

Number of mixtures per class
1000

Proportion of background mixtures (%)
0

Include original endmembers

Mixing complexity probabilities [optional]
0.5, 0.5

Allow within-class mixtures

Class probabilities [optional]

0%

Scikit-learn python code. See [LinearRegression](#) for information on different parameters.

Number of mixtures per class
1000

Proportion of background mixtures (%)
0

Include original endmembers

Mixing complexity probabilities [optional]
0.5, 0.5

Allow within-class mixtures

Class probabilities [optional]

Ensemble size
1

Robust decision fusion [optional]

Output class fraction layer
C:/Users/turki/OneDrive/Assignment/Hyperspectral/RegressionUnmixing/ClassFractionLayer.tif

Open output file after running algorithm

Output classification layer [optional]
C:/Users/turki/OneDrive/Assignment/Hyperspectral/RegressionUnmixing/ClassificationLayer.tif

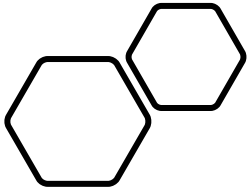
Open output file after running algorithm

Output class fraction variation layer [optional]
[Skip output]

Open output file after running algorithm

0%

Advanced Run as Batch Process...

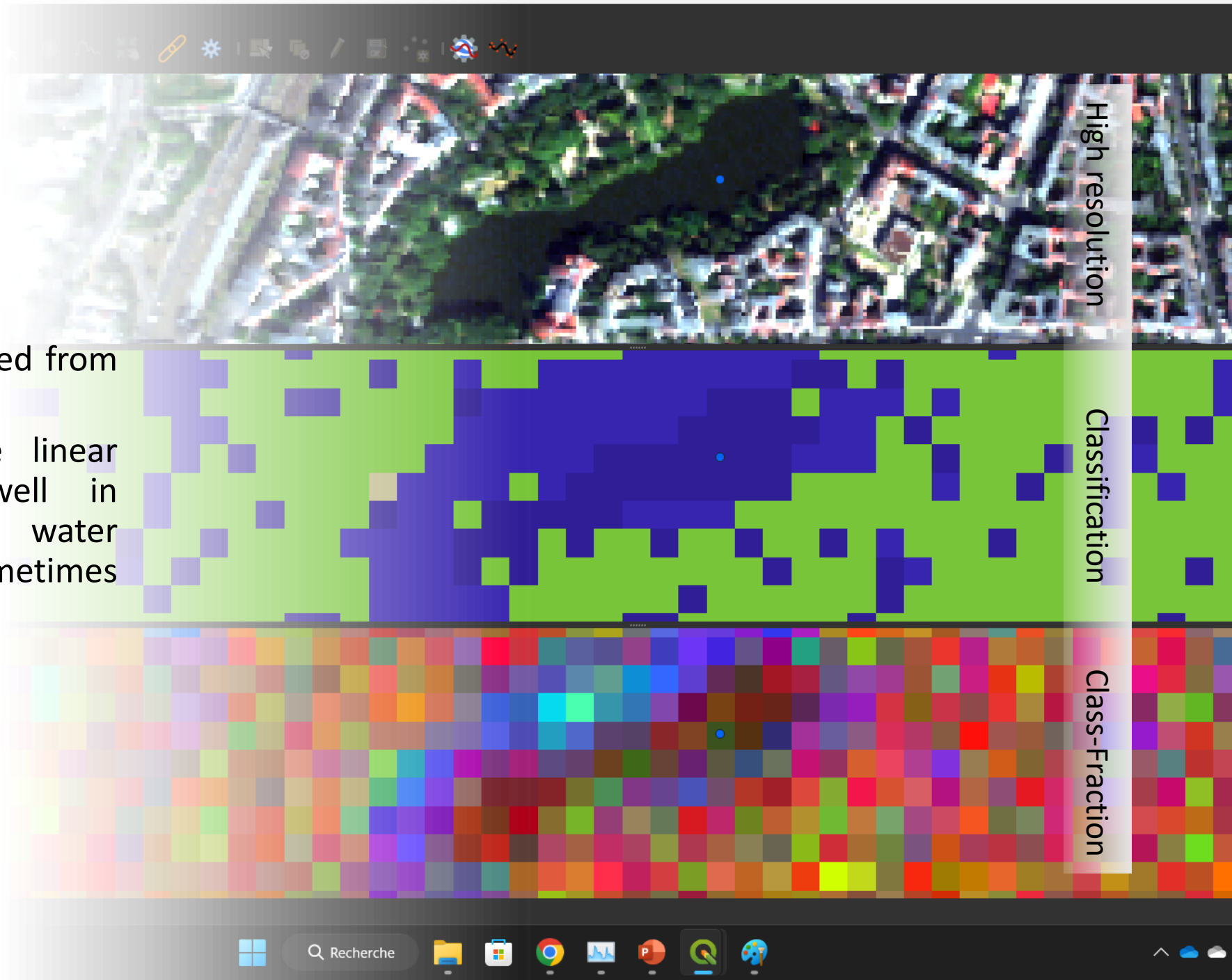


Comparing results



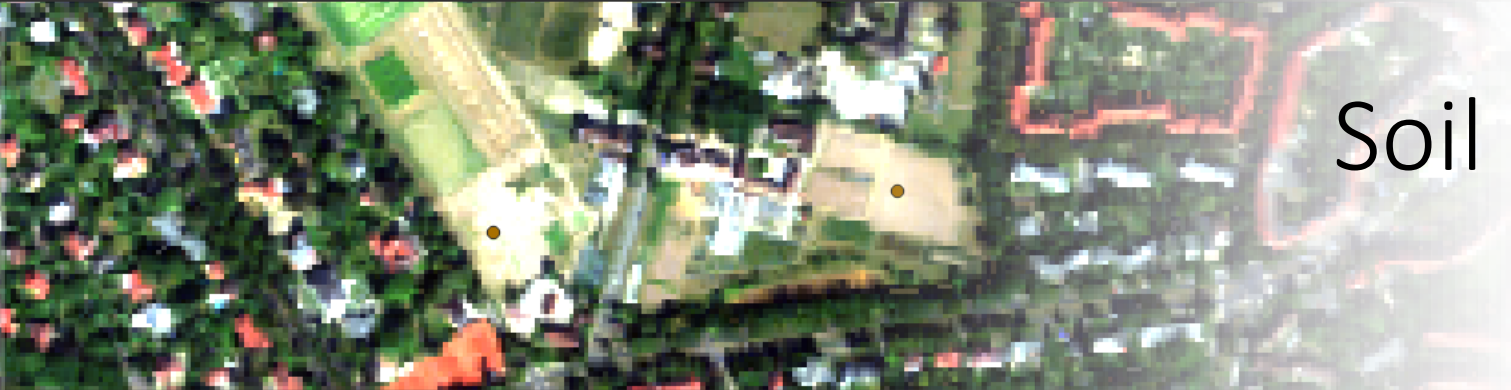
Water

- Water is well distinguished from other endmembers
- We can see that the linear regression performed well in distinguishing water and water fraction, although it is sometimes confused with vegetation



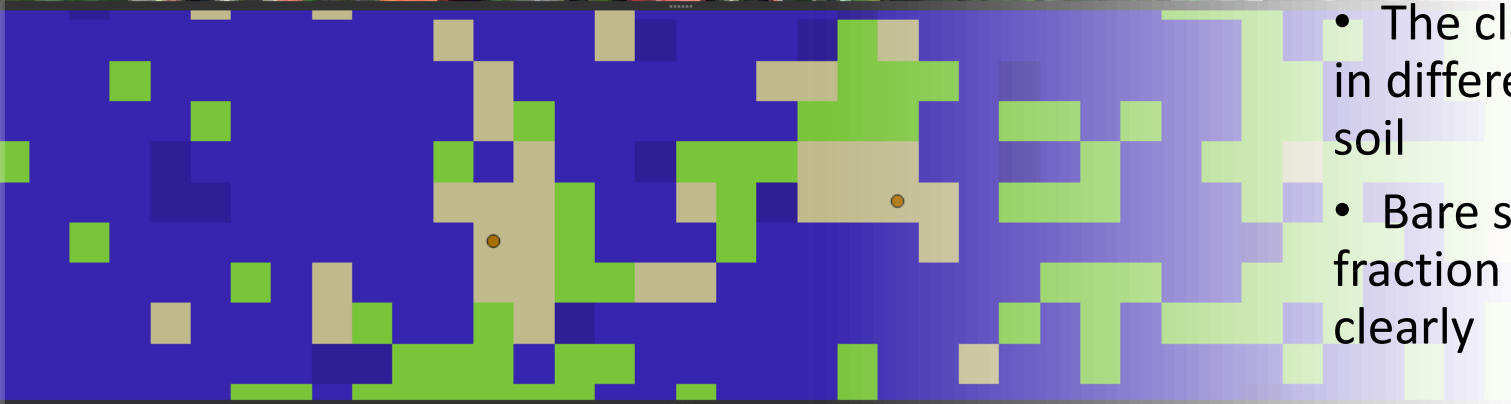


High resolution



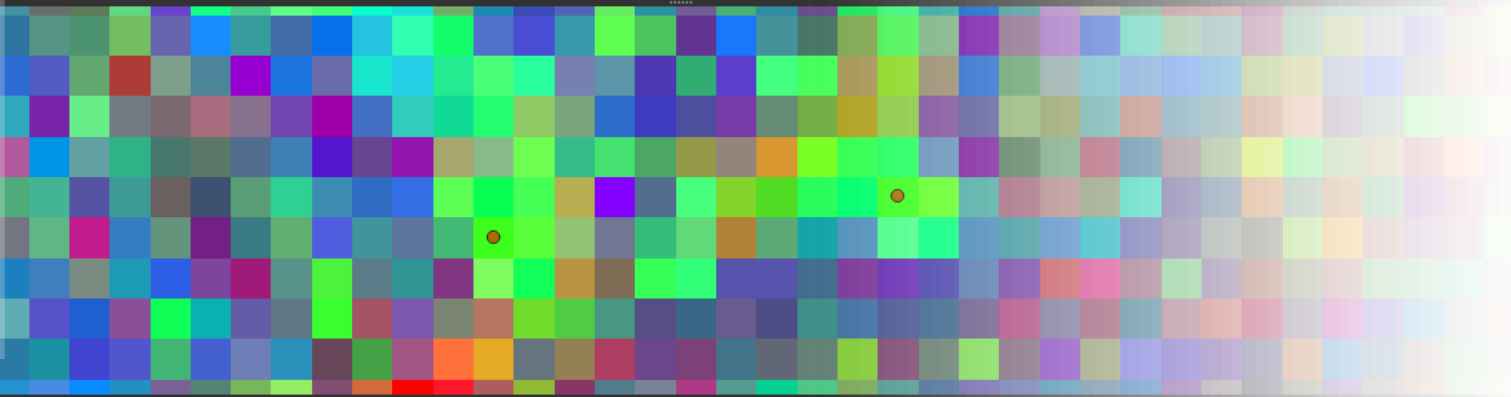
Soil

Classification



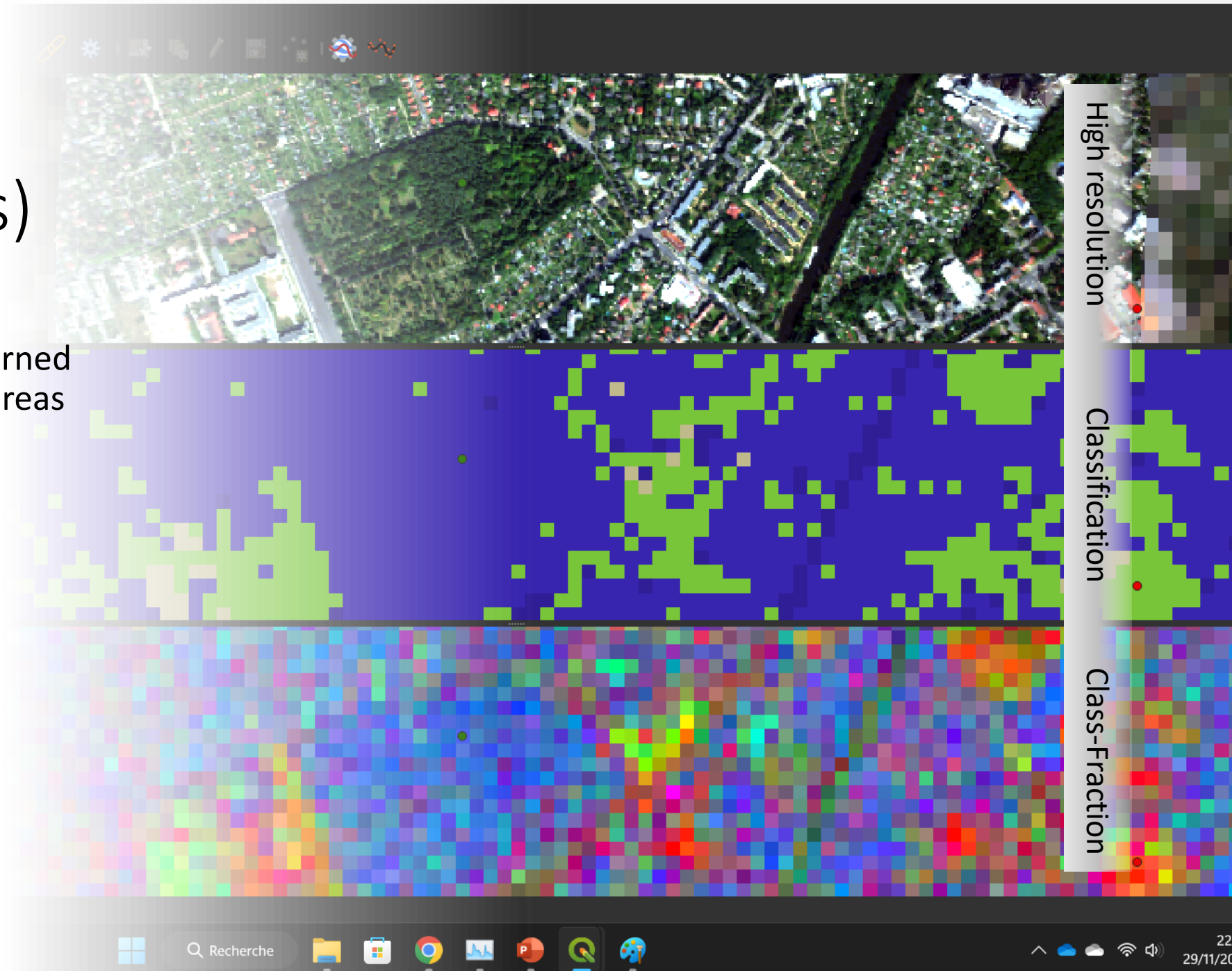
- The classification performs well in differentiating patches of bare soil
- Bare soil has a predominant fraction and can be characterized clearly

Class-Fraction



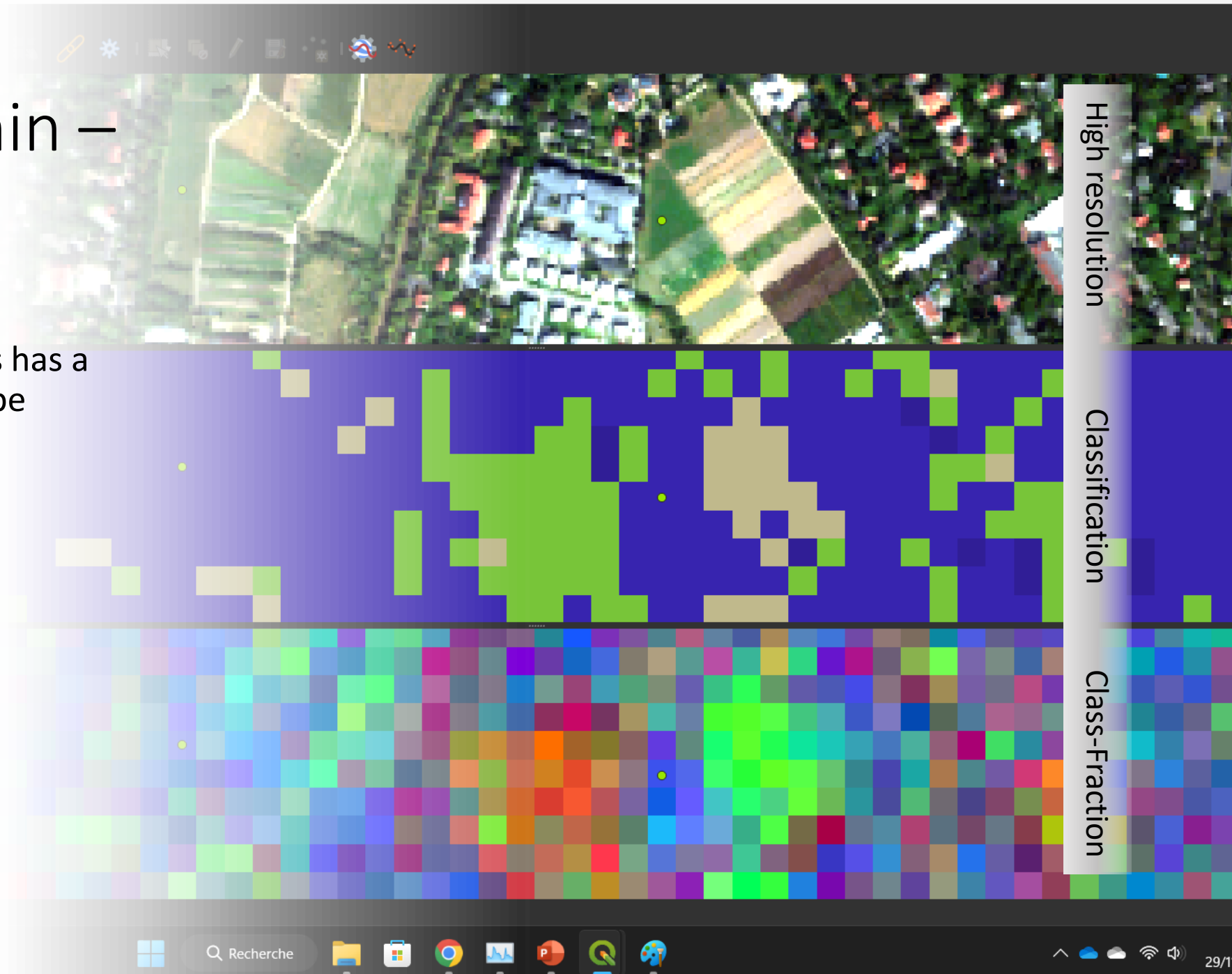
Vegetation (dense – trees)

- Dense vegetation is discerned with fuzzy limits, but with areas with major fraction



Vegetation (thin – grass)

- Thin vegetation and grass has a mixed fraction and cannot be detected simply



Impervious

- Impervious areas have very mixed fractions and cannot be detected clearly

