Final presentation

Most common surface materials on Campus Golm

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Our research question

Identify and quantify the three most common artificial surface materials in Campus Golm. How much area do they cover?

Artificial surface materials definition

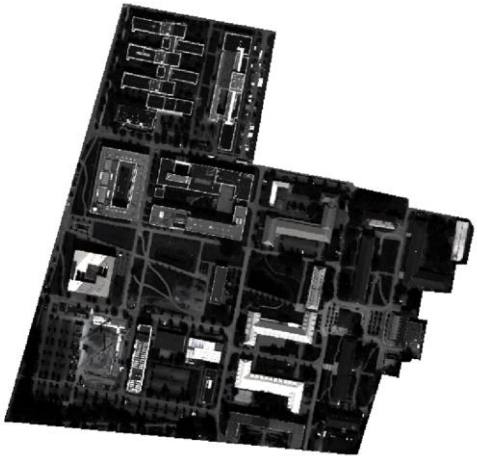
Materials, that are located on the surface and are either:

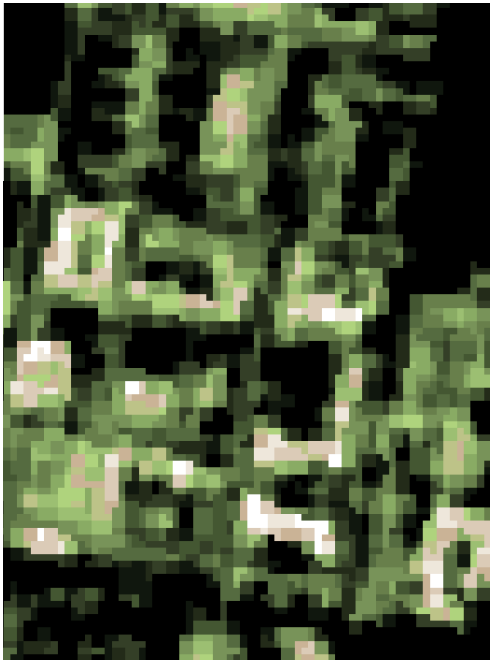
- Man-made (concrete, asphalt)
- Deliberately placed there by humans (stone paths)

Process

1. Find good Hyperspectral (or Multispectral) image of Golm
   > alternative: data on Moodle
1. Optional: try to separate artificial from natural surfaces
   > try NDVI or "artificial surface Index"
1. Classify the image
   > hyperspectral library (Ilehag et al., 2019)
   > alternative: by hand
1. QGIS Accuracy Assessment on the classified image
2. Create "handmade" image (select the pixels by hand) and compare it to first classified image
3. Calculate the surface areas of each Class in the images

1. Find good Hyperspectral (or Multispectral) image of Golm





Data Used

Hyperspectral Image (1m)

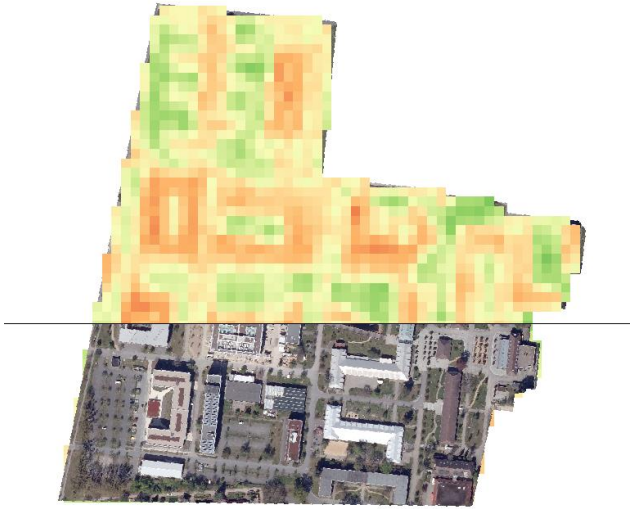
Study Area

2. Optional: try to separate artificial from natural surfaces

NDVI calculation

- Used a Sentinel-2 image, spatial resolution - 10 m.

- Generally, the result is good, but due to the low spatial resolution, it is not suitable for our task, since we cannot define many small objects from it.



2. Optional: try to separate artificial from natural surfaces

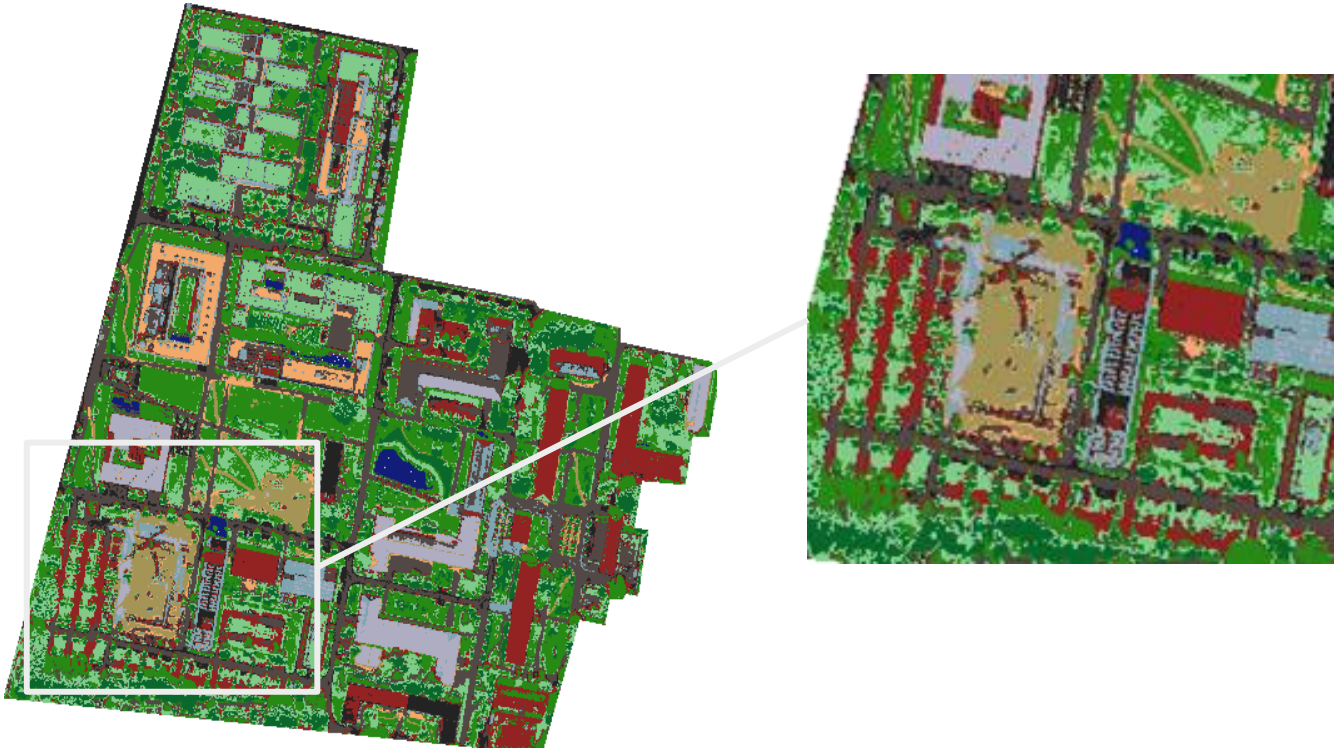
Artificial Surface Index calculation

- Used a Landsat-8 image, spatial resolution - 30 m.
- The same as with NDVI – the result is good, but is not suitable for our task due to the low spatial resolution.

3. Classify the image

- technical problems using hyperspectral library (Ilehag et al., 2019)
- chose samples by hand
- used QGIS EnMap box classification workflow
- 11 classes, 130 samples

class	material	number samples	colour
1	asphalt	10	
2	stones	16	
3	gravel	10	
4	facade rendering	15	
5	ceramic roof	12	
6	metal roof	12	
7	concrete roof	11	
8	grass roof	12	
9	tree	11	
10	grass	17	
11	water	4	



4. QGIS Accuracy Assessment on the classified image

class	material
1	asphalt
2	stones
3	gravel
4	facade rendering
5	ceramic roof
6	metal roof
7	concrete roof
8	grass roof
9	tree
10	grass
11	water

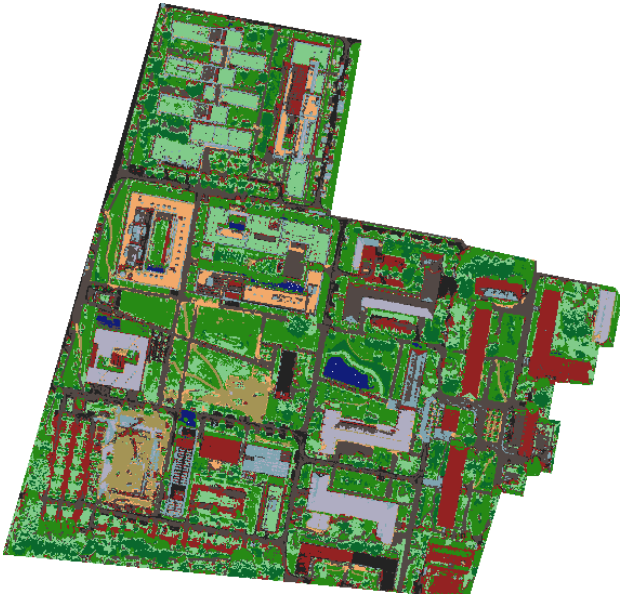
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
1 (1)	10	5	0	0	0	0	0	0	0	0	0
2 (2)	0	7	0	1	1	1	0	0	0	0	0
3 (3)	0	0	7	0	2	0	1	0	0	1	0
4 (4)	0	0	1	14	0	3	0	0	0	0	0
5 (5)	0	1	0	0	8	0	0	1	0	2	0
6 (6)	0	0	0	0	0	7	0	0	0	0	0
7 (7)	0	2	2	0	0	1	10	0	0	0	0
8 (8)	0	0	0	0	1	0	0	11	0	0	0
9 (9)	0	0	0	0	0	0	0	0	9	1	0
10 (10)	0	0	0	0	0	0	0	0	2	8	0
11 (11)	0	1	0	0	0	0	0	0	0	5	4

Adjusted confusion matrix counts:
predicted (rows) vs. observed (columns)

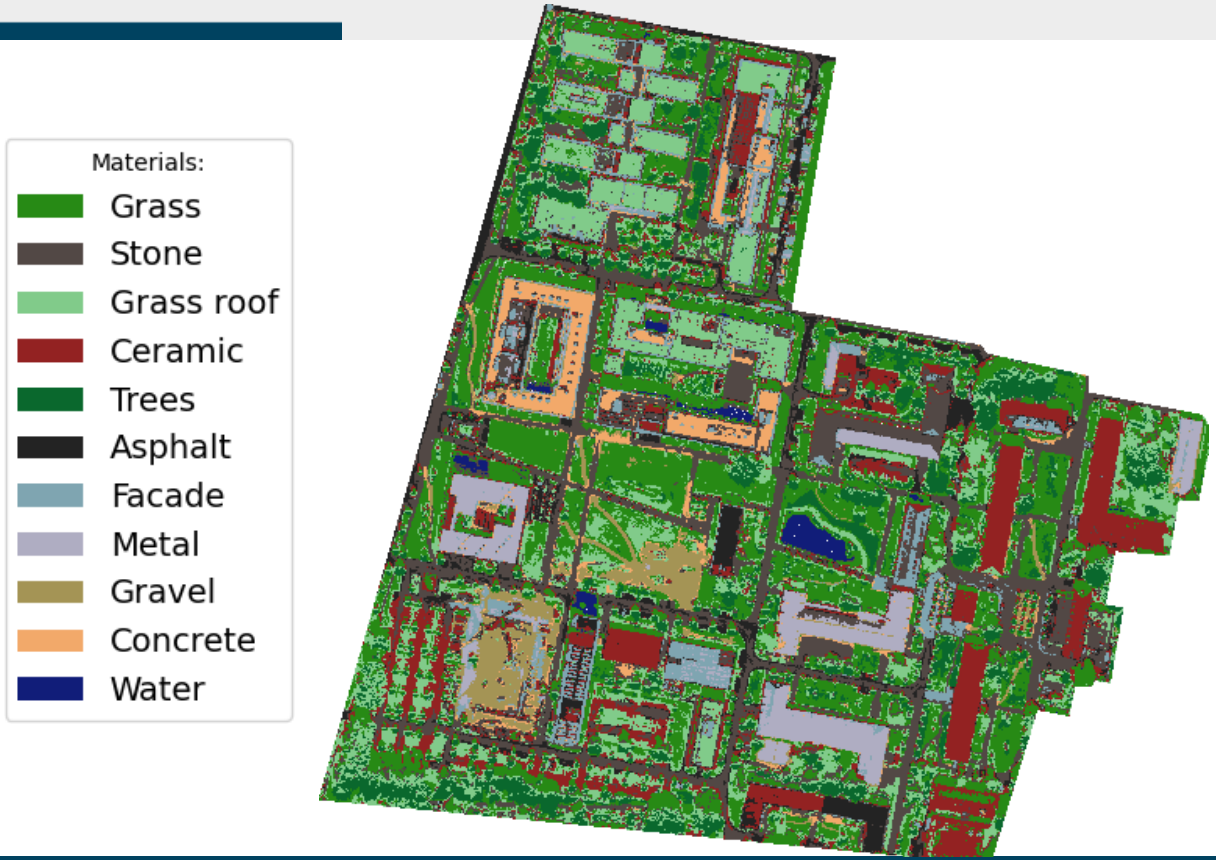
Overall accuracy: 0.7308

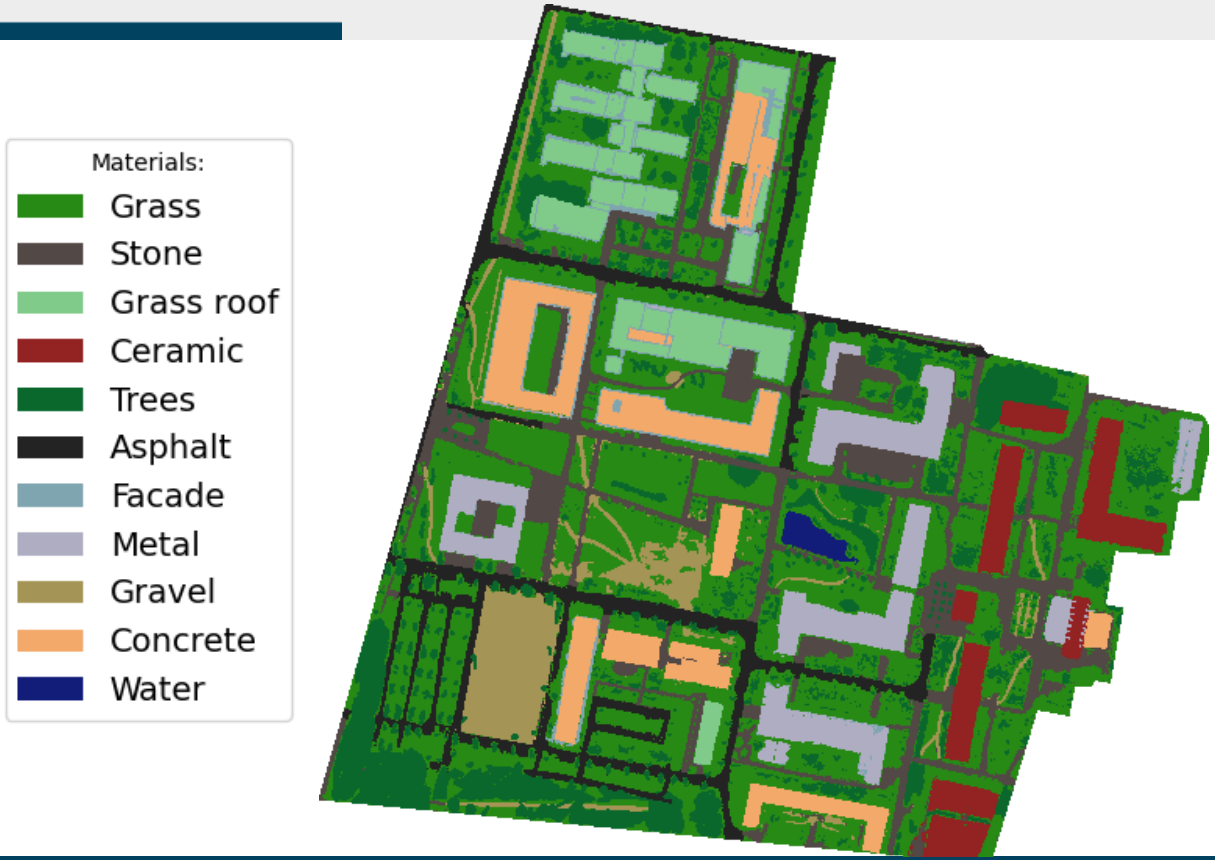
5. Create handmade image and compare it to the classified image

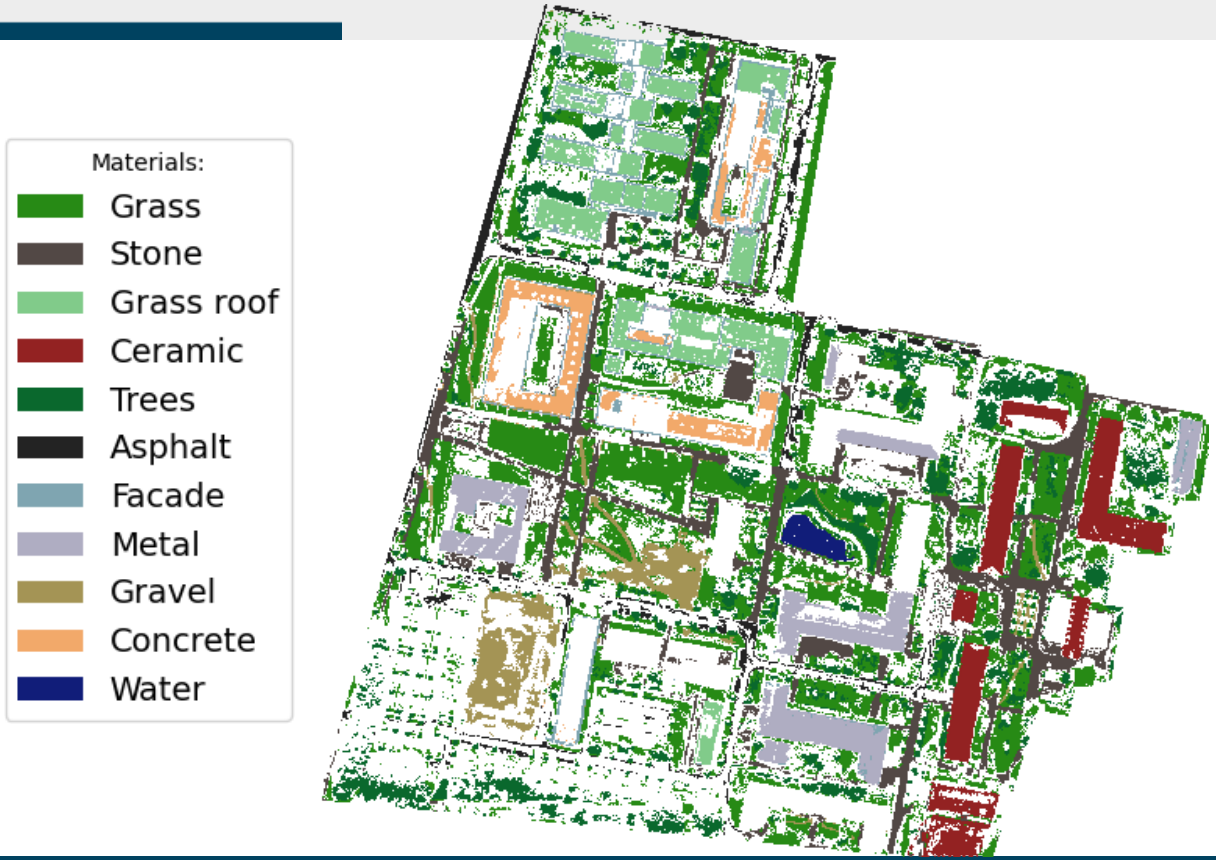
Supervised classification



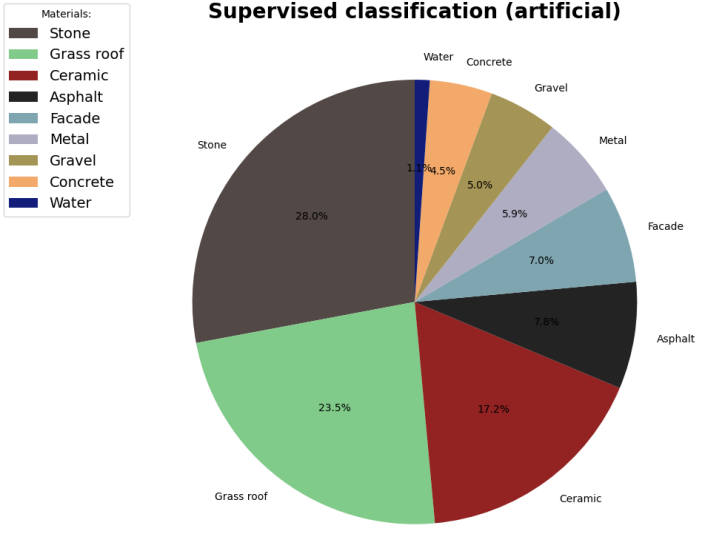
Classification by hand

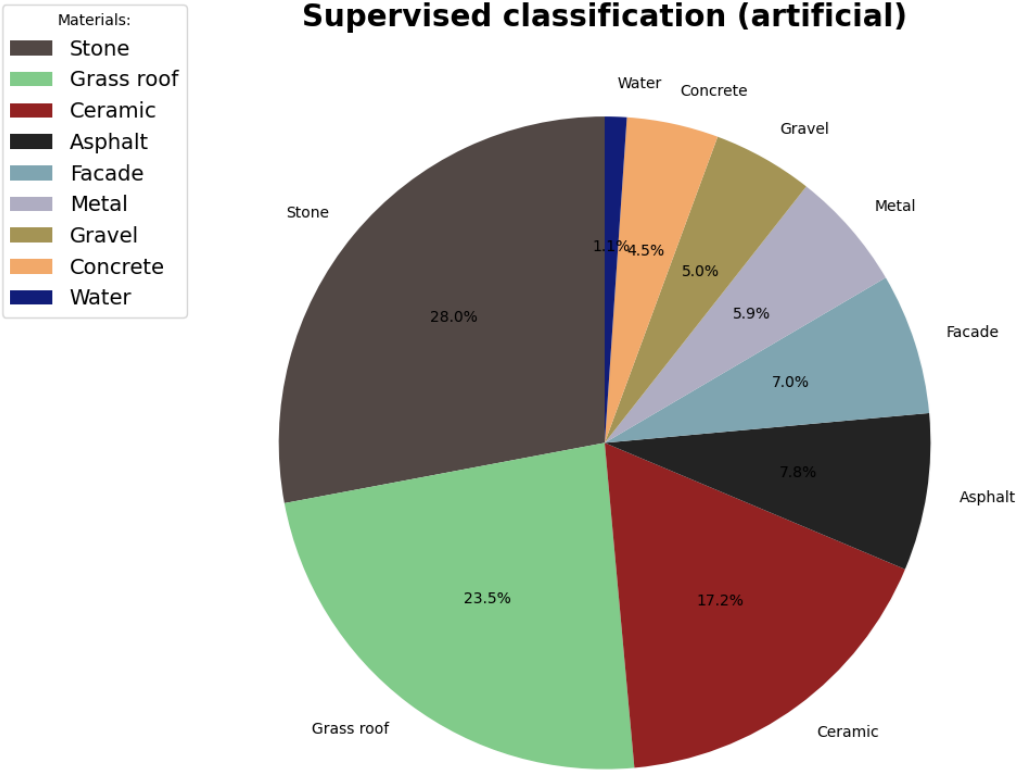

Materials:
Grass
Stone
Grass roof
Ceramic
Trees
Asphalt
Facade
Metal
Gravel
Concrete
Water

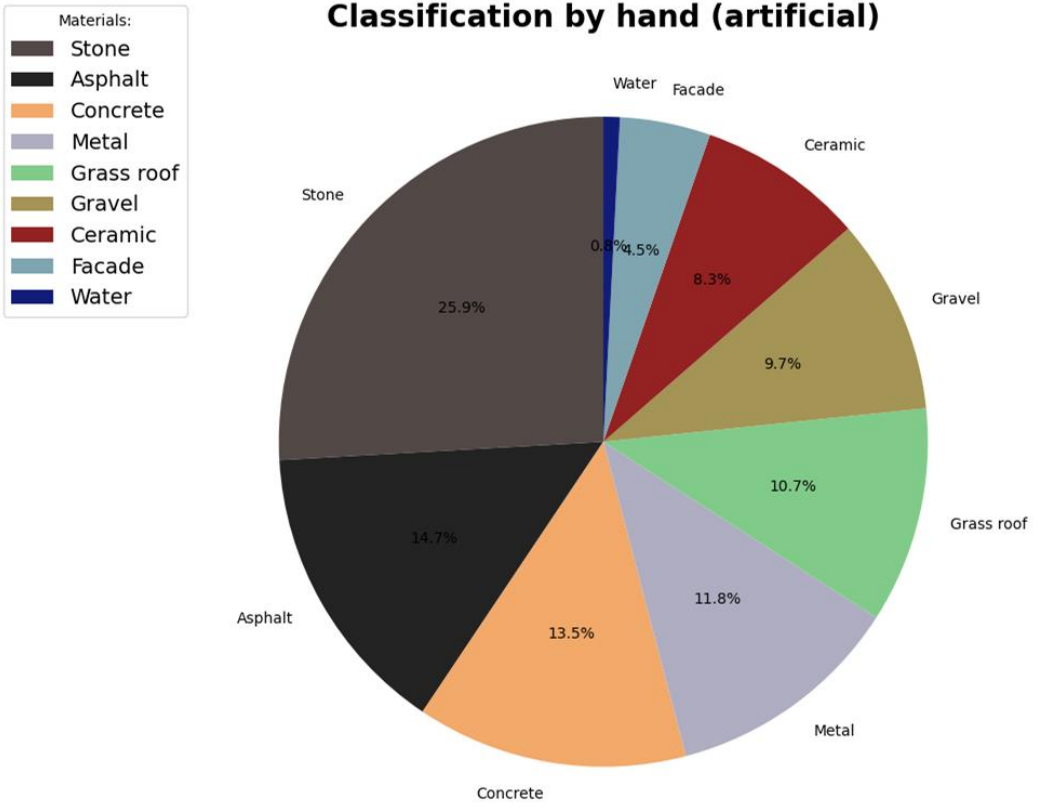

Materials:
Grass
Stone
Grass roof
Ceramic
Trees
Asphalt
Facade
Metal
Gravel
Concrete
Water

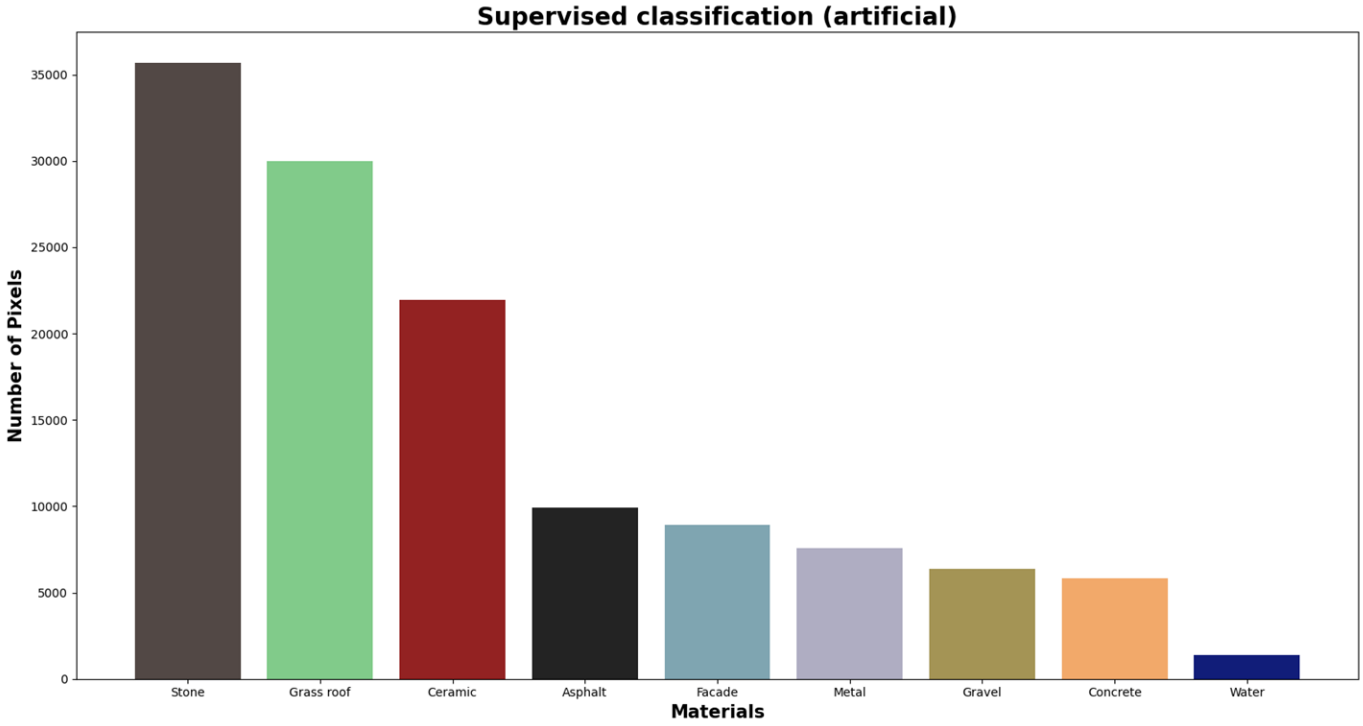

Materials:
Grass
Stone
Grass roof
Ceramic
Trees
Asphalt
Facade
Metal
Gravel
Concrete
Water

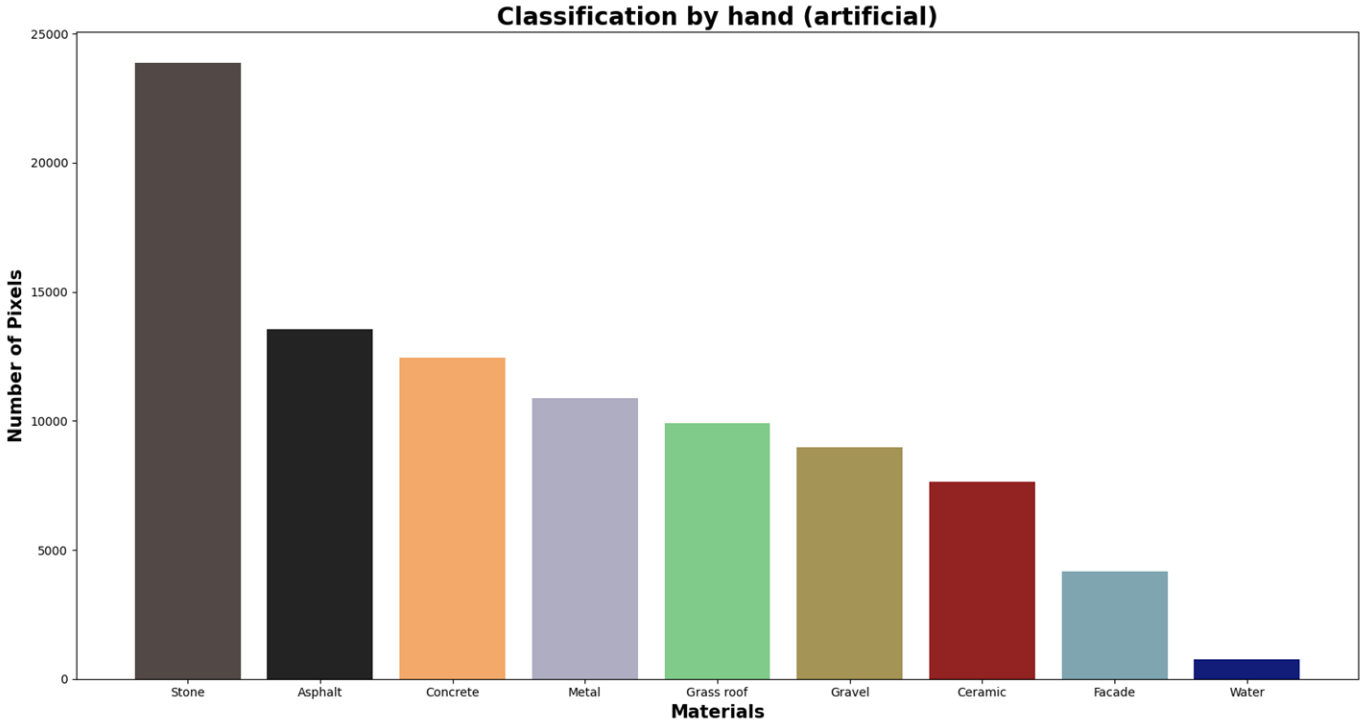
6. Calculate the surface areas of each Class in the images




Supervised classification (artificial)
Materials:
Stone
Grass roof
Ceramic
Asphalt
Facade
Metal
Gravel
Concrete
Water
Water
Concrete
Gravel
Metal
Facade
Asphalt
Ceramic
Grass roof
Stone
1.1%
4.5%
5.0%
5.9%
7.0%
7.8%
17.2%
23.5%
28.0%


Classification by hand (artificial)
Materials:
Stone
Asphalt
Concrete
Metal
Grass roof
Gravel
Ceramic
Facade
Water
Water
Facade
Ceramic
Stone
Gravel
Grass roof
Asphalt
Metal
Concrete
0.8%
4.5%
8.3%
25.9%
9.7%
10.7%
14.7%
11.8%
13.5%


Supervised classification (artificial)
Number of Pixels
0
5000
10000
15000
20000
25000
30000
35000
Stone
Grass roof
Ceramic
Asphalt
Facade
Metal
Gravel
Concrete
Water
Materials


Classification by hand (artificial)
Number of Pixels
25000
20000
15000
10000
5000
0
Stone
Asphalt
Concrete
Metal
Grass roof
Gravel
Ceramic
Facade
Water
Materials

Conclusions

Identify and quantify the three most common artificial surface materials in Campus Golm. How much area do they cover?

1. Stone (23875 m^2)
2. Asphalt (13547 m^2)
3. Concrete (12445 m^2)

Literature

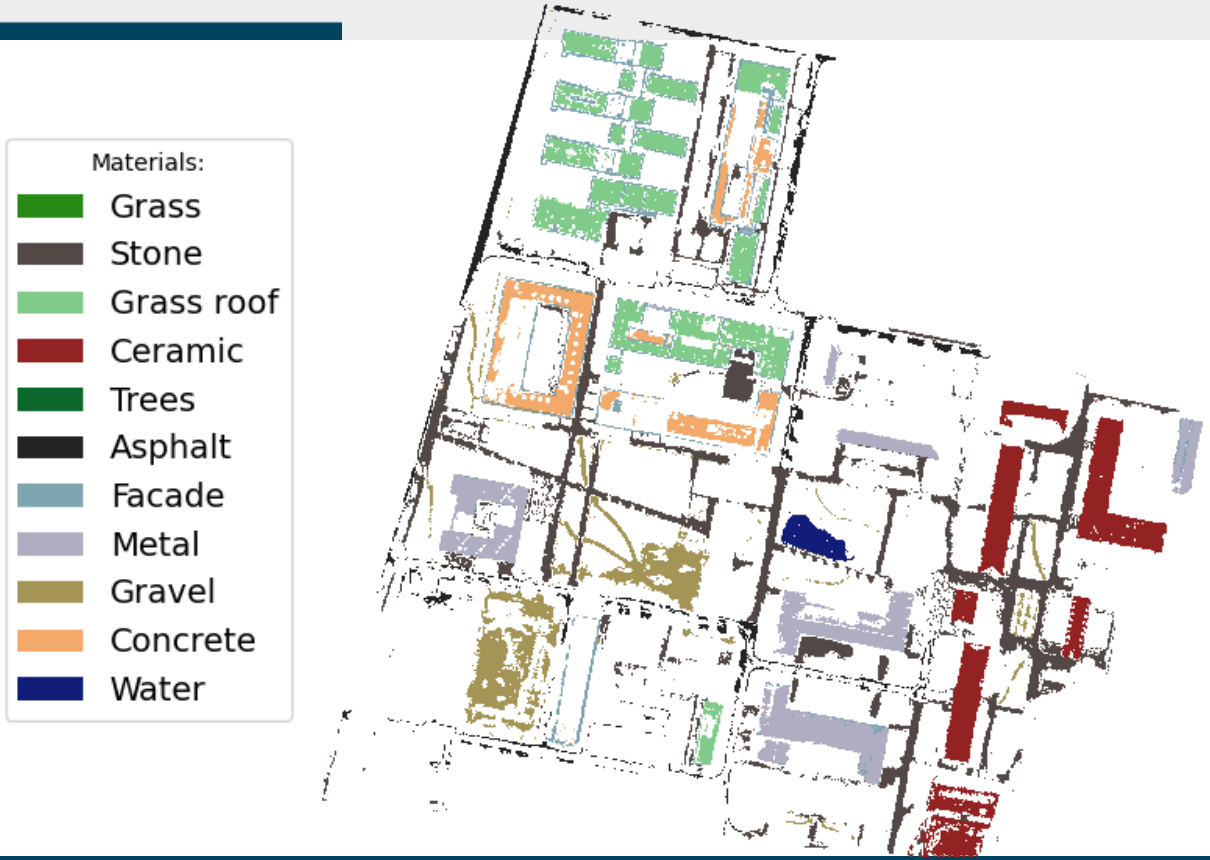
Ilehag, Rebecca, Andreas Schenk, Yilin Huang, and Stefan Hinz. 2019. "KLUM: An Urban VNIR and SWIR Spectral Library Consisting of Building Materials" Remote Sensing 11, no. 18: 2149. https://doi.org/10.3390/rs11182149

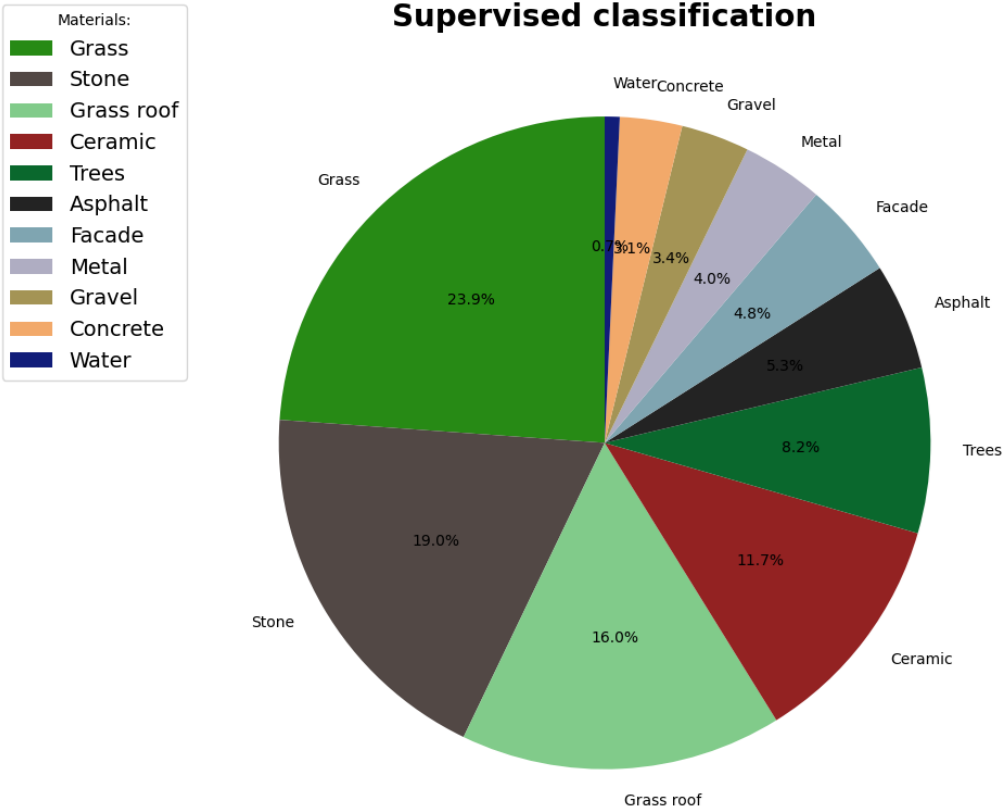
Guanter, L., Kaufmann, H., Segl, K., Foerster, S., Rogass, C., Chabrillat, S., ... & Sang, B. (2015). The EnMAP spaceborne imaging spectroscopy mission for earth observation. *Remote Sensing*, *7*(7), 8830-8857.

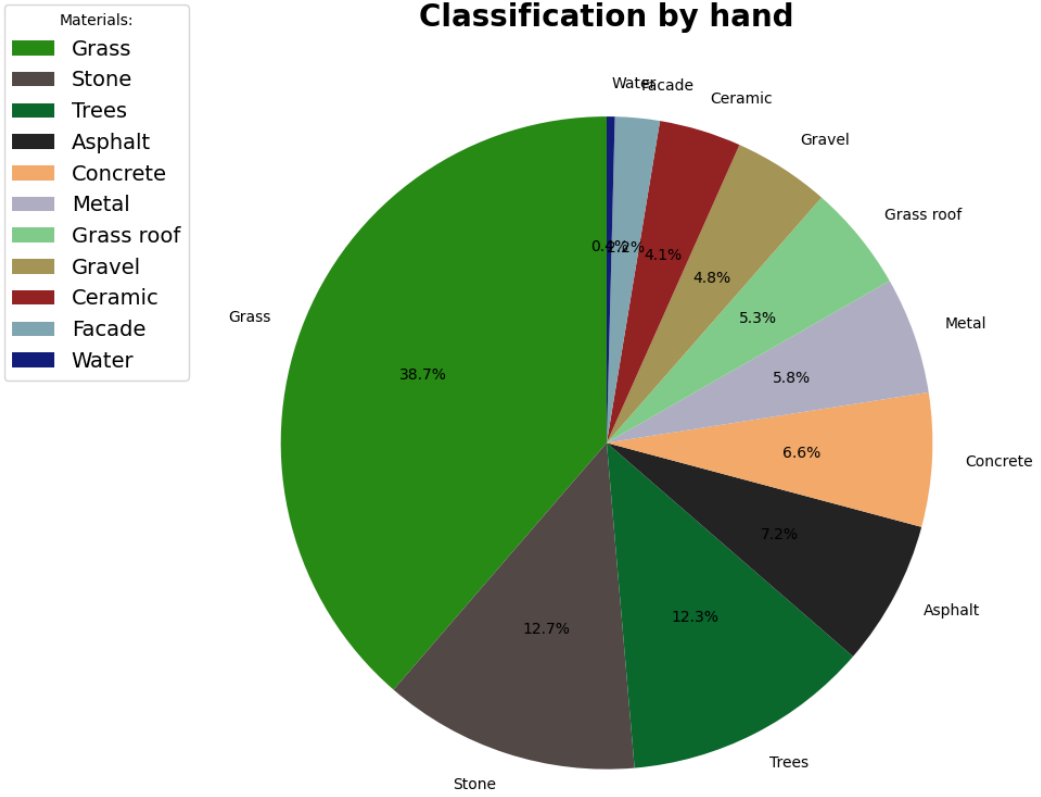
Balsamo, G., Agusti-Parareda, A., Albergel, C., Arduini, G., Beljaars, A., Bidlot, J., ... & Zeng, X. (2018). Satellite and in situ observations for advancing global Earth surface modelling: A review. *Remote Sensing*, *10*(12), 2038.

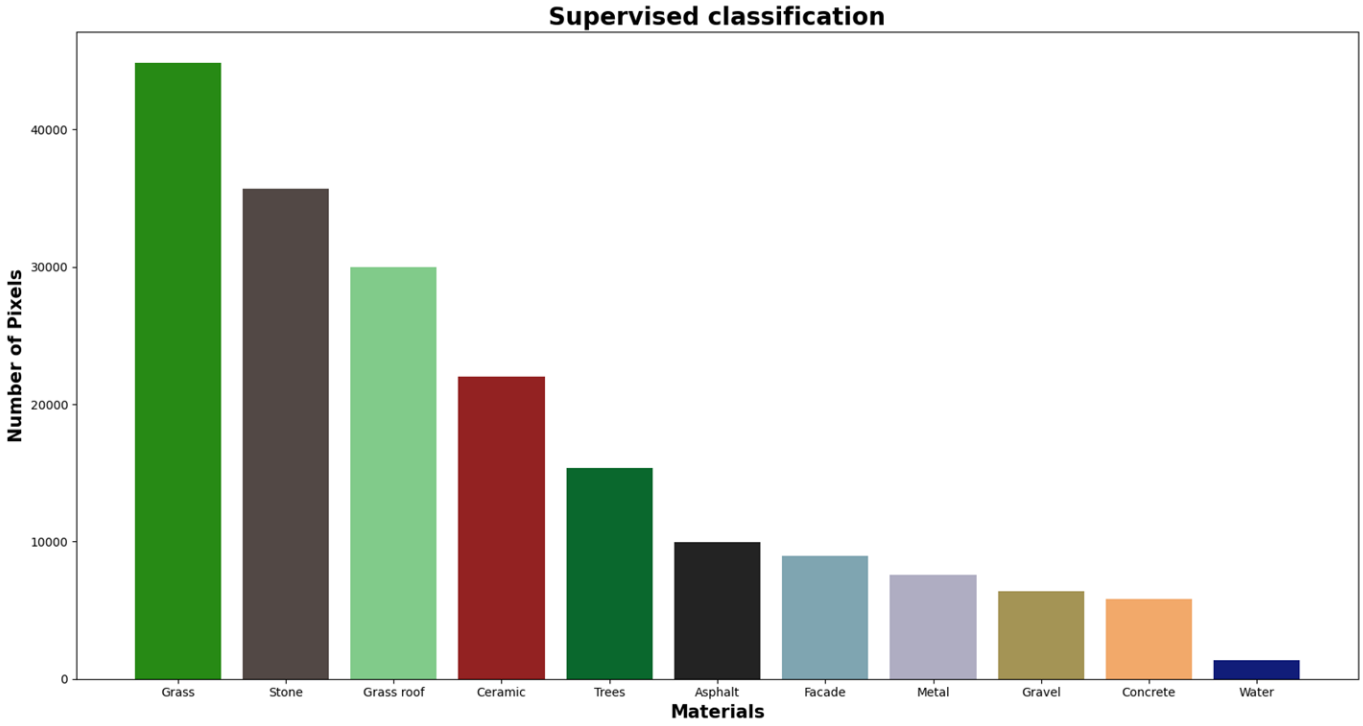
Yongquan Zhao, Zhe Zhu, ASI: An artificial surface Index for Landsat 8 imagery, International Journal of Applied Earth Observation and Geoinformation, Volume 107, 2022, 102703, ISSN 1569-8432, https://doi.org/10.1016/j.jag.2022.102703

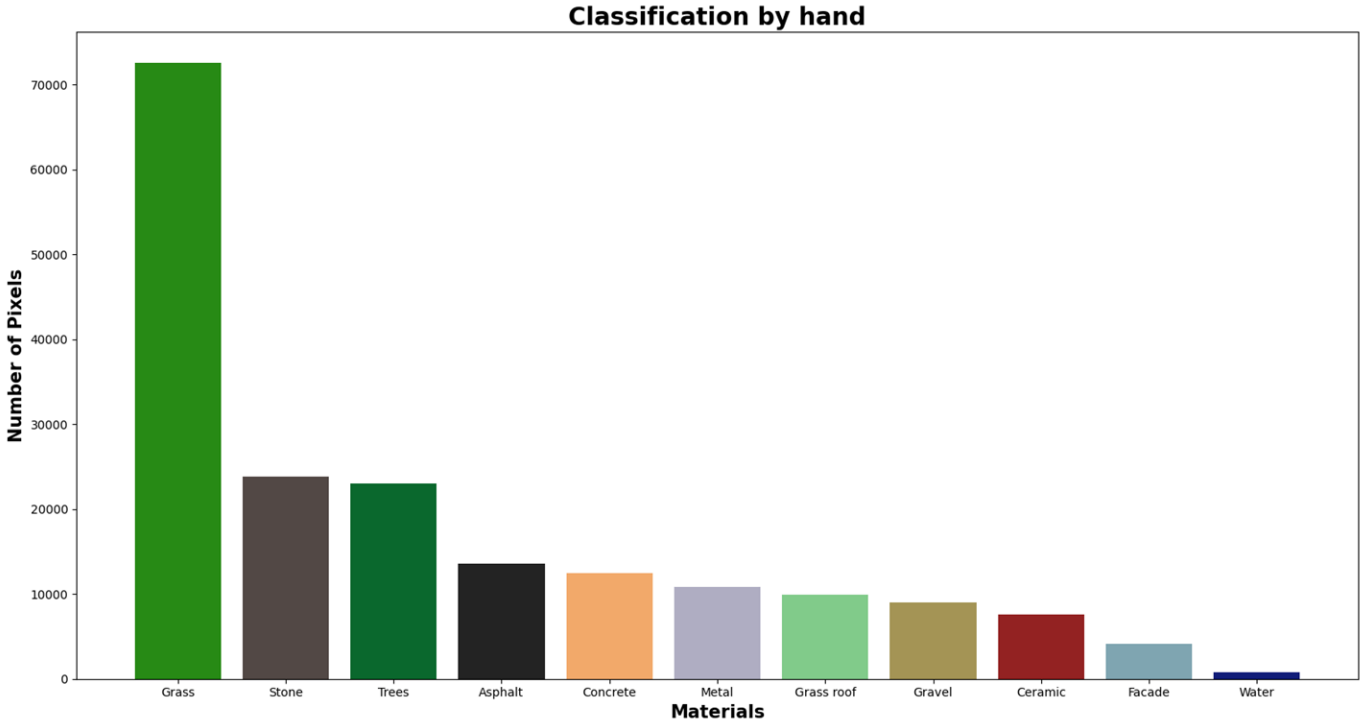
Additional Graphs


Materials:
Grass
Stone
Grass roof
Ceramic
Trees
Asphalt
Facade
Metal
Gravel
Concrete
Water


Supervised classification
Materials:
Grass
Stone
Grass roof
Ceramic
Trees
Asphalt
Facade
Metal
Gravel
Concrete
Water
Water
Concrete
Gravel
Metal
Facade
Asphalt
Trees
Ceramic
Grass roof
Stone
Grass
23.9%
19.0%
16.0%
11.7%
8.2%
5.3%
4.8%
4.0%
3.4%
1%


Classification by hand
Materials:
Grass
Stone
Trees
Asphalt
Concrete
Metal
Grass roof
Gravel
Ceramic
Facade
Water
38.7%
12.7%
12.3%
7.2%
6.6%
5.8%
5.3%
4.8%
4.1%
Grass
Stone
Trees
Asphalt
Concrete
Metal
Grass roof
Gravel
Ceramic
Facade
Water


Supervised classification
Number of Pixels
0
10000
20000
30000
40000
Grass
Stone
Grass roof
Ceramic
Trees
Asphalt
Facade
Metal
Gravel
Concrete
Water
Materials


Classification by hand
Number of Pixels
0
10000
20000
30000
40000
50000
60000
70000
Grass
Stone
Trees
Asphalt
Concrete
Metal
Grass roof
Gravel
Ceramic
Facade
Water
Materials

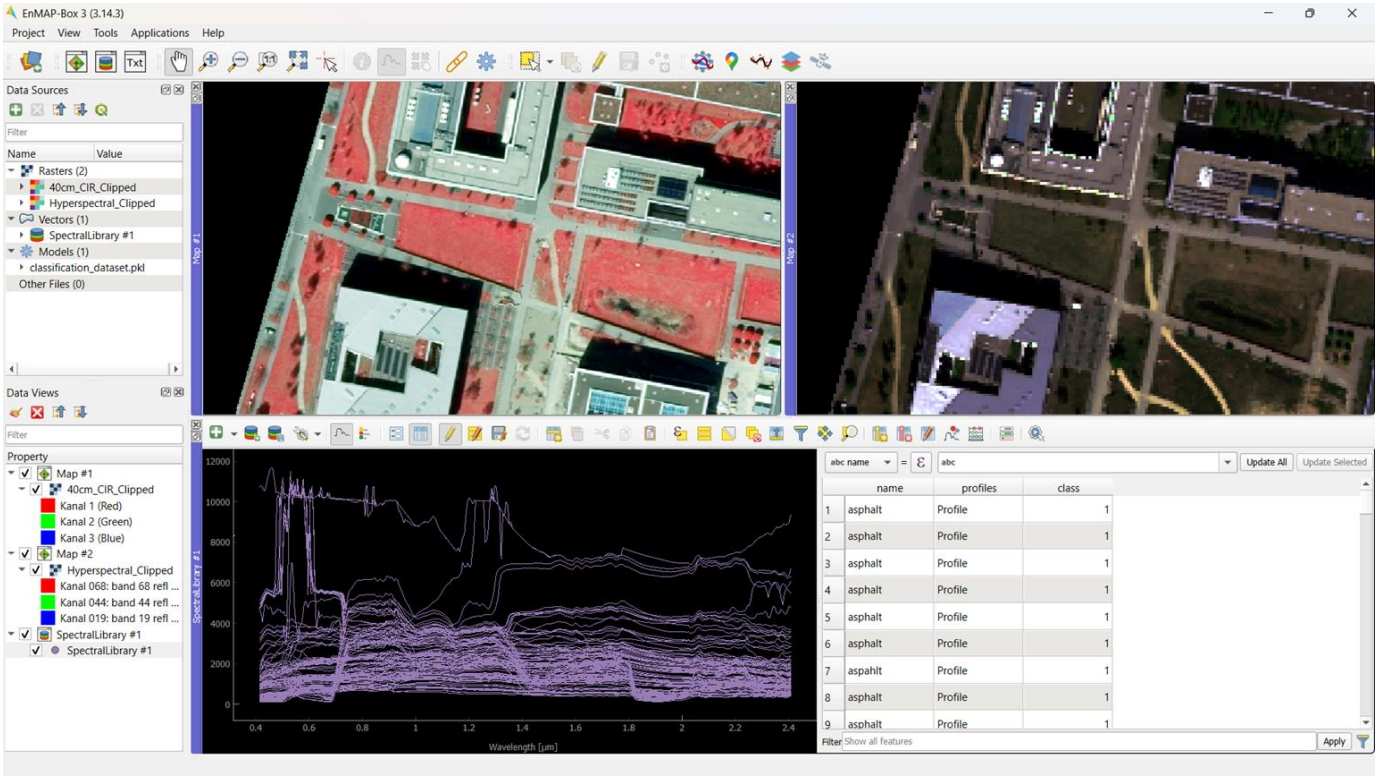
Material	Supervised Classification	Classification by hand
Asphalt	9941 m²	13547 m²
Stone	35696 m²	23875 m²
Gravel	6359 m²	8977 m²
Facade	8930 m²	4159 m²
Ceramic	21978 m²	7637 m²
Metal	7575 m²	10885 m²
Concrete	5808 m²	12445 m²
Grass roof	29993 m²	9905 m²
Tree	15376 m²	23060 m²
Grass	44864 m²	72615 m²
Water	1387 m²	753 m²

5. QGIS Accuracy Assessment on the classified image

class	material
1	asphalt
2	stones
3	gravel
4	facade rendering
5	ceramic roof
6	metal roof
7	concrete roof
8	grass roof
9	tree
10	grass
11	water

	User's accuracy	Producer's accuracy	F1-score
1	0.6667	1	0.8
2	0.7	0.4375	0.5385
3	0.6364	0.7	0.6667
4	0.7778	0.9333	0.8485
5	0.6667	0.6667	0.6667
6	1	0.5833	0.7368
7	0.6667	0.9091	0.7692
8	0.9167	0.9167	0.9167
9	0.9	0.8182	0.8571
10	0.8	0.4706	0.5926
11	0.4	1	0.5714

Class-wise accuracies


EnMAP-Box 3 (3.14.3)
Project View Tools Applications Help
Data Sources
Filter
Name Value
Rasters (2)
40cm_CIR_Clipped
Hyperspectral_Clipped
Vectors (1)
SpectralLibrary #1
Models (1)
classification_dataset.pkl
Other Files (0)
Data Views
Property
Map #1
40cm_CIR_Clipped
Kanal 1 (Red)
Kanal 2 (Green)
Kanal 3 (Blue)
Map #2
Hyperspectral_Clipped
Kanal 068: band 68 refl ...
Kanal 044: band 44 refl ...
Kanal 019: band 19 refl ...
SpectralLibrary #1
SpectralLibrary #1
Map #1
Map #2
Spectral Library #1
12000
10000
8000
6000
4000
2000
0
0.4 0.6 0.8 1 1.2 1.4 1.6 1.8 2 2.2 2.4
Wavelength [µm]
abc name
abc
Update All
Update Selected
name profiles class
1 asphalt Profile 1
2 asphalt Profile 1
3 asphalt Profile 1
4 asphalt Profile 1
5 asphalt Profile 1
6 asphalt Profile 1
7 aspahlt Profile 1
8 asphalt Profile 1
9 asphalt Profile 1
Filter Show all features
Apply