POLITECNICO
MILANO 1863

18th of June 2024

Earth Observation – Mod a

Vegetative cycles in different land cover conditions

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1. Introduction

Scope

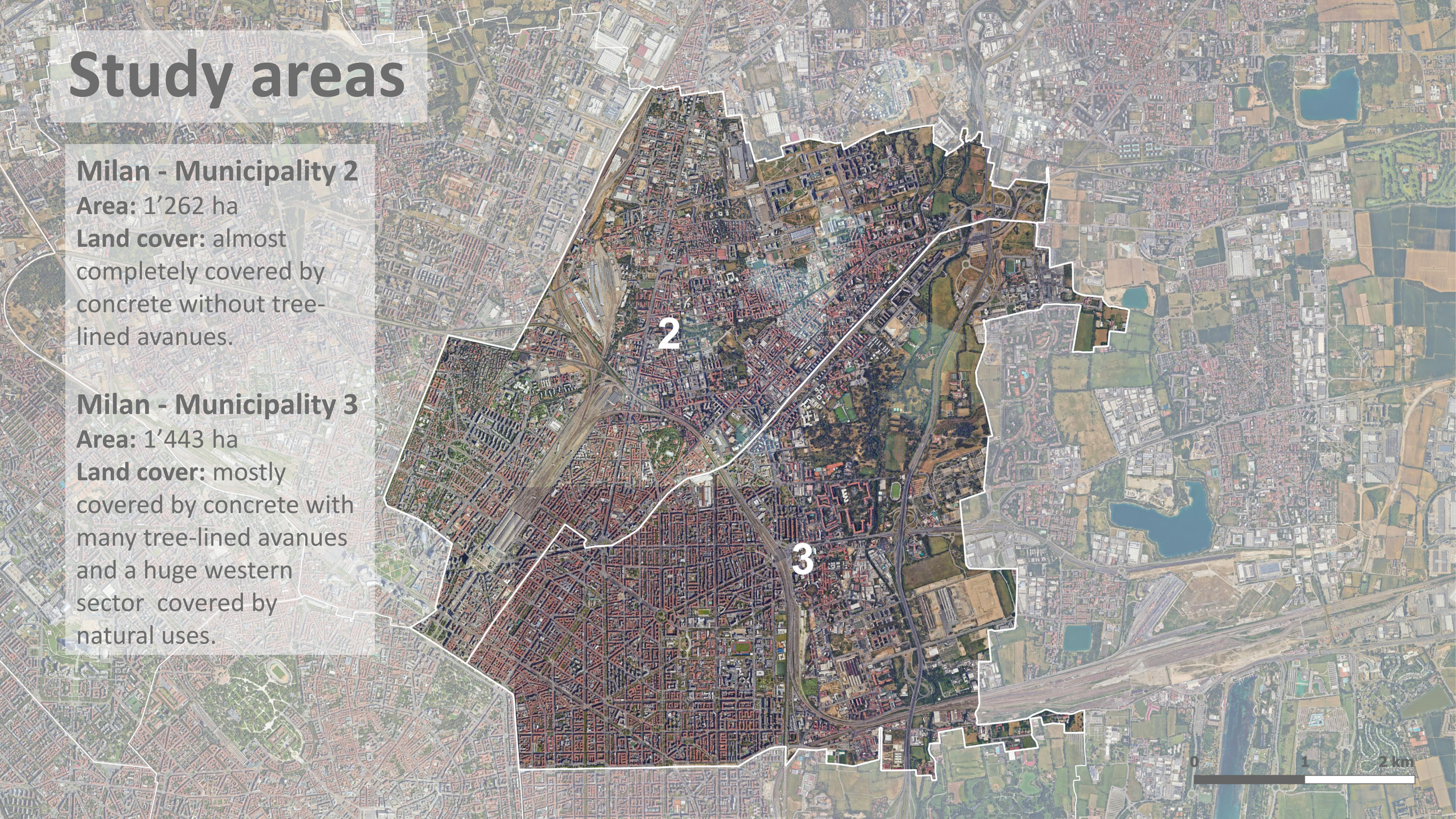
Understand if we are able to detect the seasonal vegetative changes (winter – summer) of two study areas using remote sensing techniques.

Understand if this seasonal behaviour is influenced by the specific land cover of each of the two areas in a different way.

Study areas

Milan - Municipality 2
Area: 1’262 ha
Land cover: almost completely covered by concrete without tree-lined avanues.

Milan - Municipality 3
Area: 1’443 ha
Land cover: mostly covered by concrete with many tree-lined avanues and a huge western sector covered by natural uses.



Expected output

Notice a sensible change in the in the two observation periods (winter – summer) due to the vegetative growth of the natural elements.

Observing a more substantial change in the area with a higher presence of natural elements.

2. Methodology

Methodology & steps

1. Data procurement

1.1 **Used data:** Sentinel2 level 1c multispectral data
Provider: Semi-Automatic Classification plugin
Dates: 16th January 2022 & 15th July 2022
Technical details: DOS1 atmospheric correction, cloud coverage (0%)

2. Images preprocessing

2.1 **Process:** Band set
Tool: i.group to create Rgb image
Porpoise: first “human eye” check to understand feasibility of the analysis (i.e. building shadows)

Process: Pansharpening
Tool: GDAL pansharpening
Porpoise: adapt SWIR 1 band (resolution 20m) to NIR 1 band (resolution 10m) in order to compute NDBI index

Methodology & steps

3. Images processing

3.1 **Process:** SAVI (Soil-Adjusted Vegetation Index) index calculation [1]
Tool: Raster calculator
Expression: $(NIR - R)/(NIR + R + L) * (1 + L)$ *L = soil brightness correction factor* [2]
Area of interest & Time frame: wider area encompassing both the municipalities. Activity performed for both of the period singularly

3.2 **Process:** NDBI (Normalized Difference Built-up) index calculation [3]
Tool: Raster calculator
Expression: $((SWIR1 - NIR)/(SWIR1 + NIR))$
Area of interest & Time frame: wider area encompassing both the municipalities. Activity performed for January only

[1]- Ismayilova I., Timpf S.,: *Classifying Urban Green Spaces using a combined Sentinel-2 and Random Forest approach.* Institute of Geography, University of Augsburg, Augsburg, Germany, 2022
[2]- https://custom-scripts.sentinel-hub.com/custom-scripts/sentinel-2/savi/
[3]- Tsion A. K., Binyan T. H., Karuturi V. S., *Evaluation of spectral built-up indices for impervious surface extraction using Sentinel-2A MSI imageries: A case of Addis Ababa city, Ethiopia,* Elsevier, 2022

Methodology & steps

3.3 **Process:** Raster mask
Targets: 2 NDBI layers, 4 SAVI layers
Tool: clip raster with mask
Area of interest & Time frame: masked each time frame and each municipality

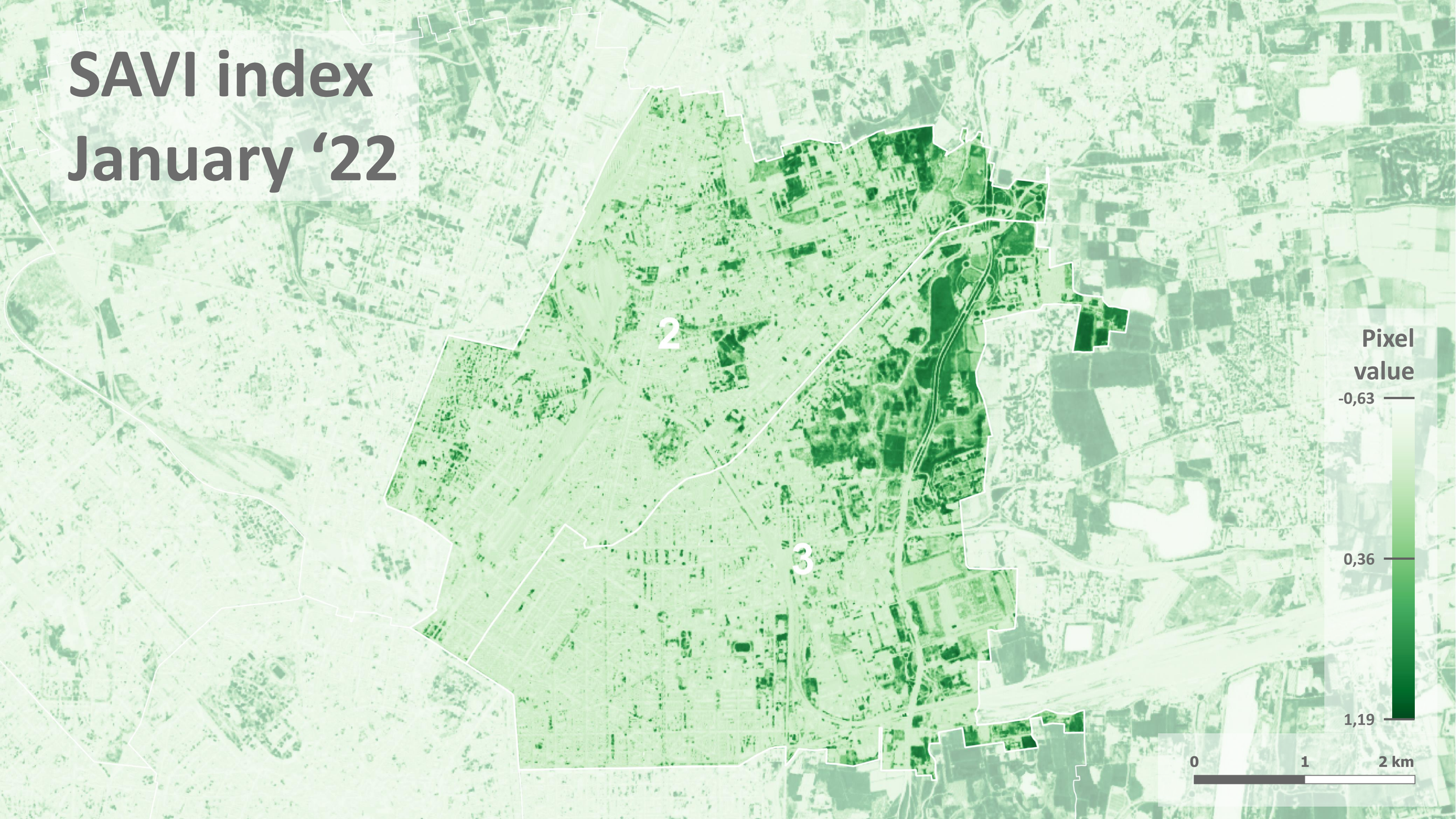
4. Processing result data analysis

4.1 **Process:** Analysis of the frequencies histograms
Targets: 4 SAVI layers [4] ,2 NDBI layers [5]
Tool: Rasterio library

[4]- My code available at the link: https://github.com/fillobissi/EO_2024/blob/240615_Savi_histogram_extractions/240615_Savi_histogram_extractions.ipynb
[5]- My code available at the link: https://github.com/fillobissi/EO_2024/blob/240616_Ndbi_histogram_extractions/240616_Ndbi_histogram_extractions.ipynb

3. Results

SAVI index
January ‘22



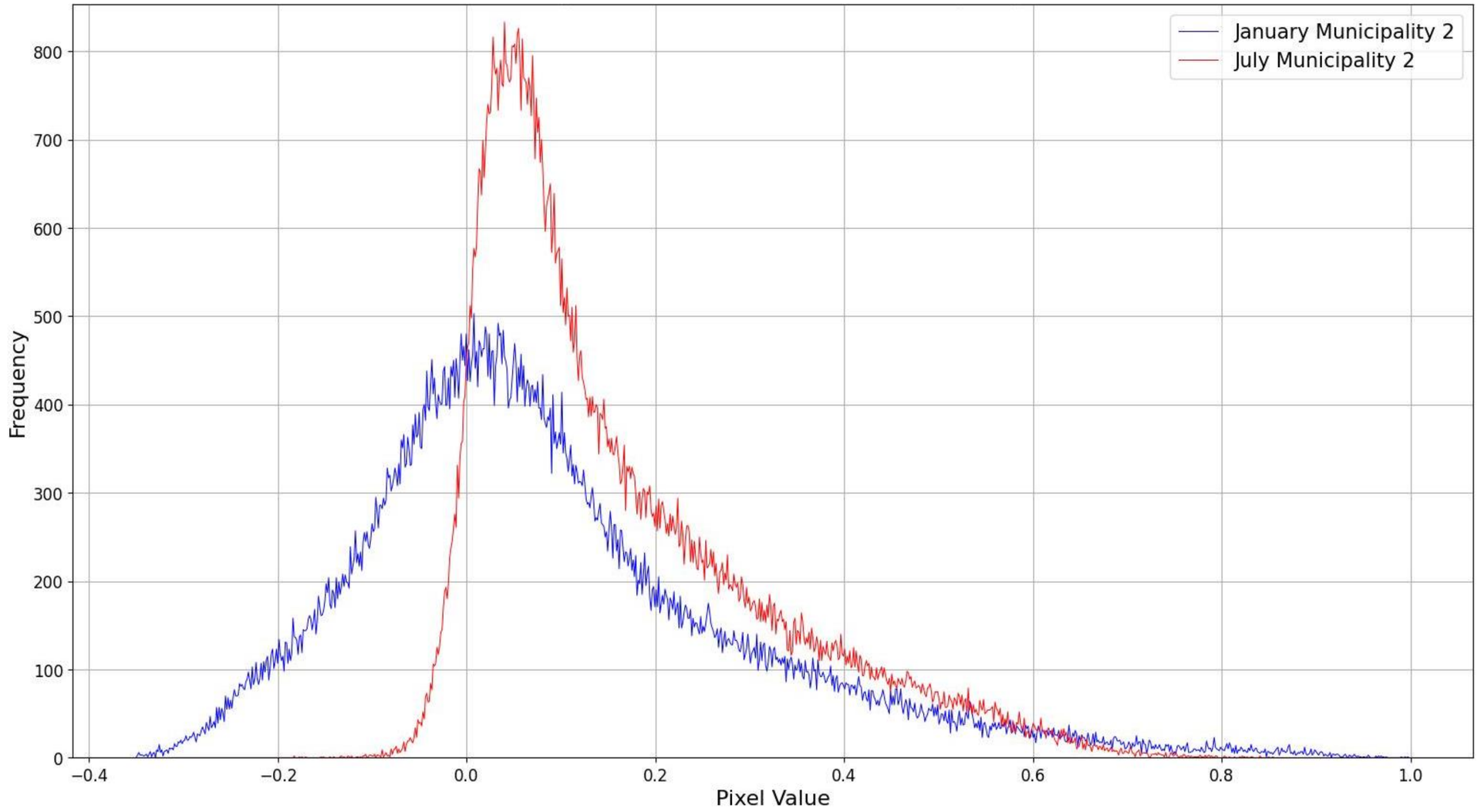
SAVI index
July ‘22


SAVI index
July ‘22
2
3
Tree-lined boulevards now visible
Pixel value
-0,63
0,36
1,19
0
1
2 km

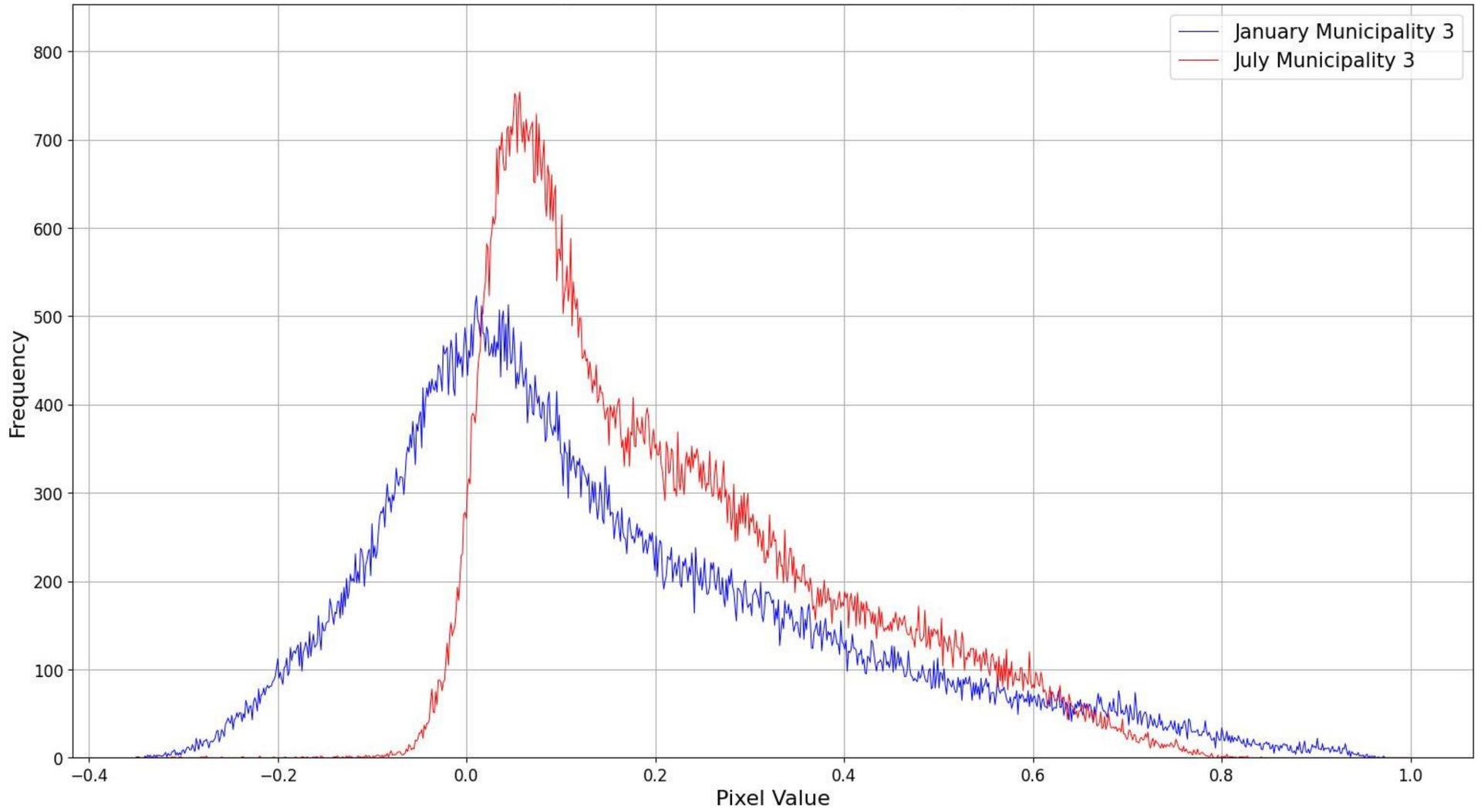
SAVI index
July ‘22

SAVI index
July ‘22

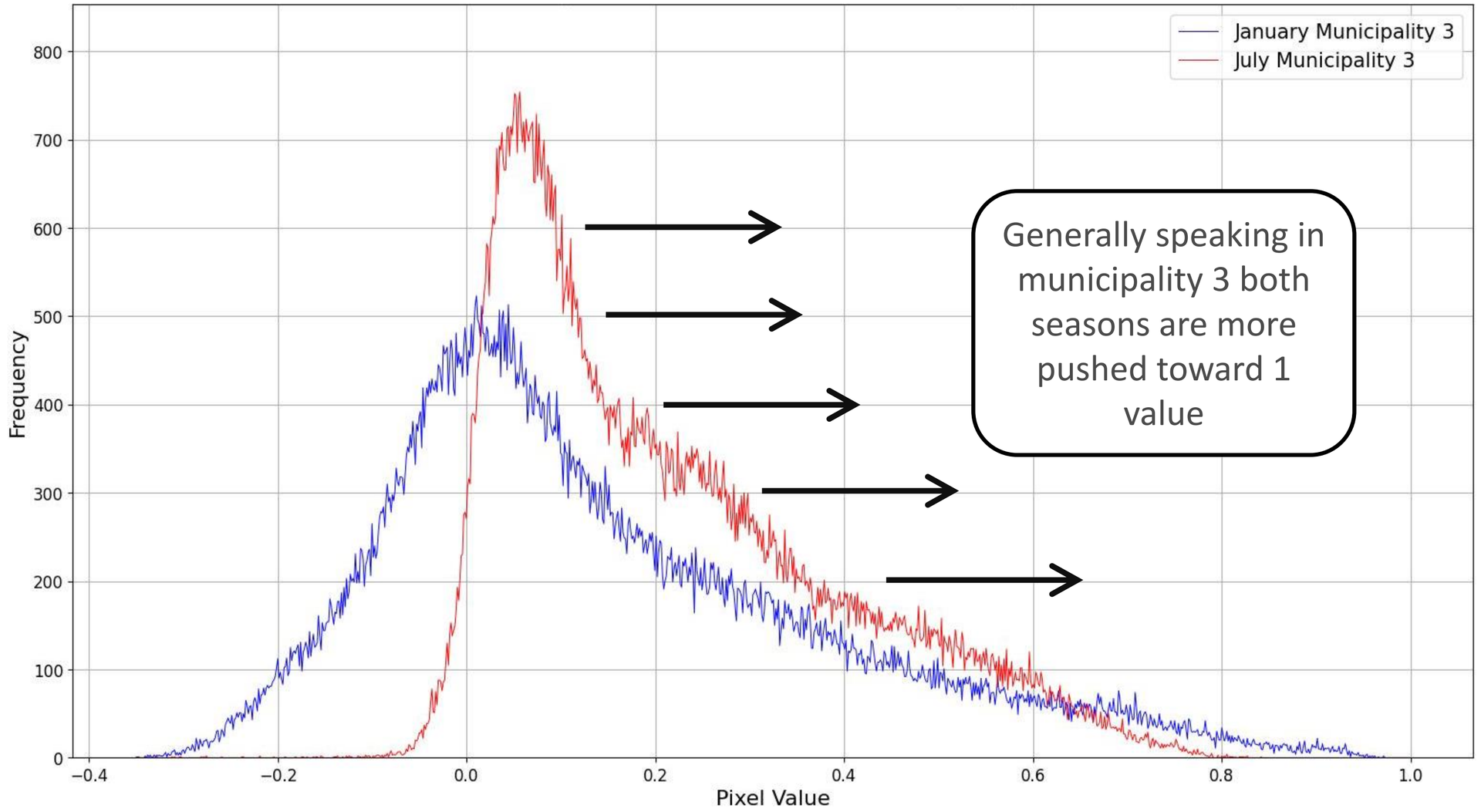
Frequency histogram: municipality 2



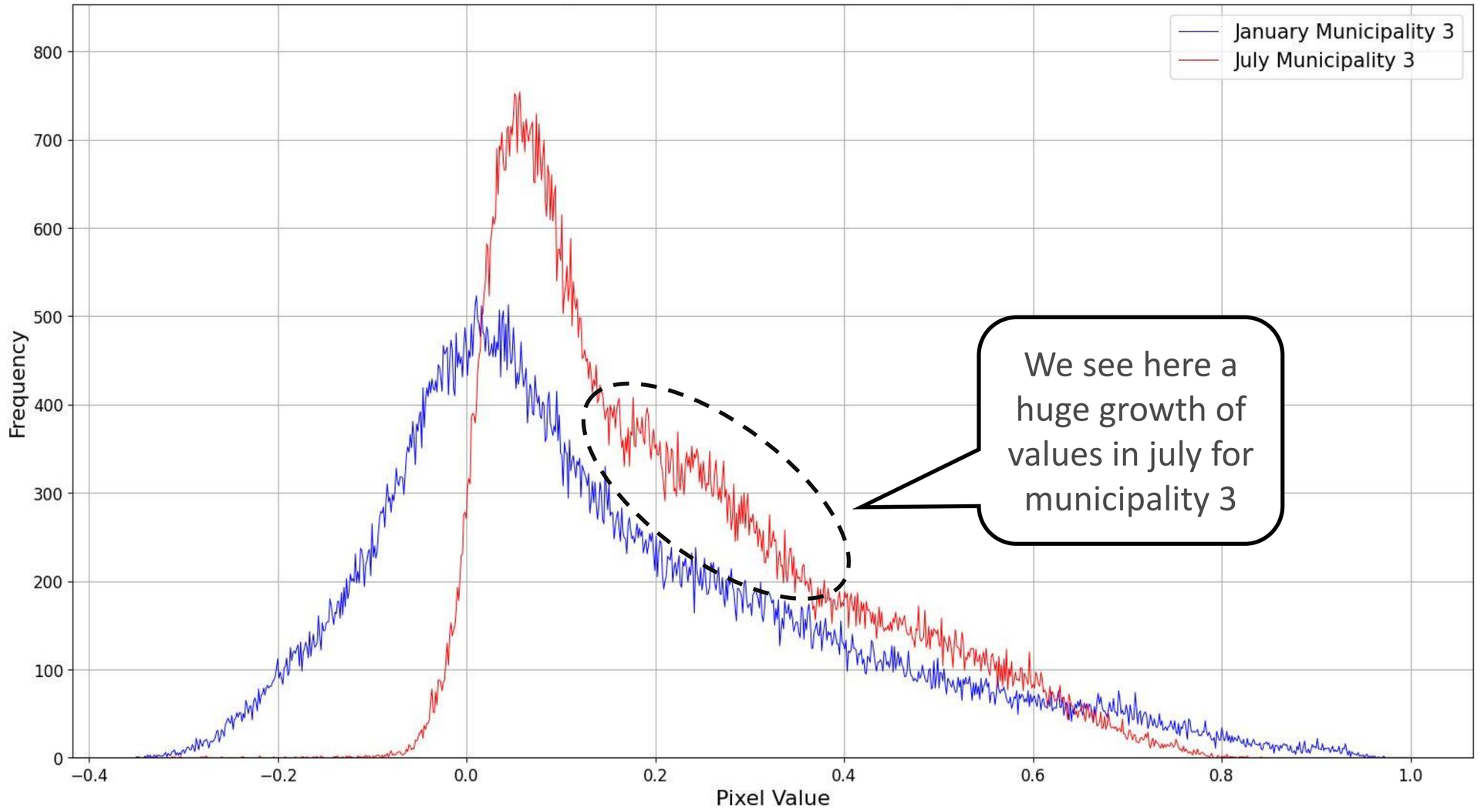
Frequency histogram: municipality 3



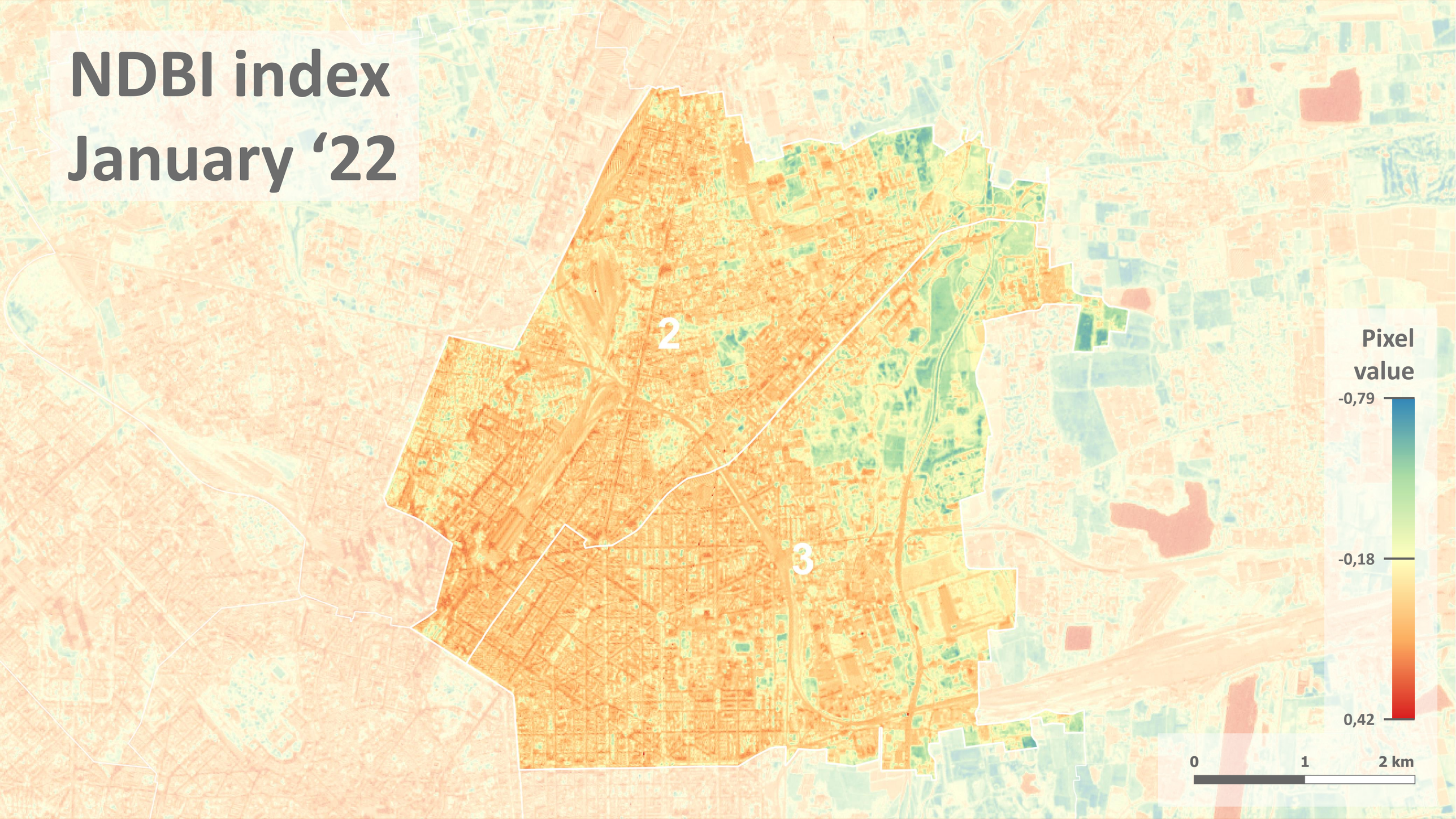
Frequency histogram: municipality 3



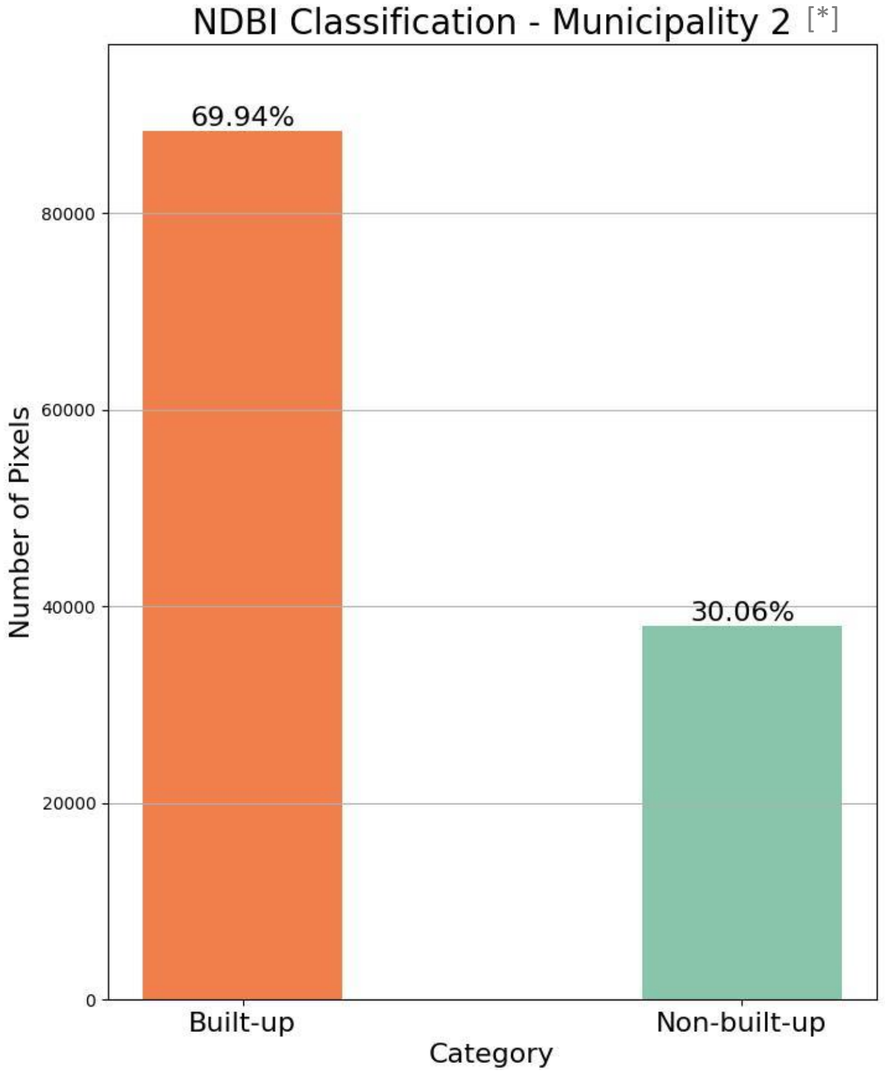
Frequency histogram: municipality 3

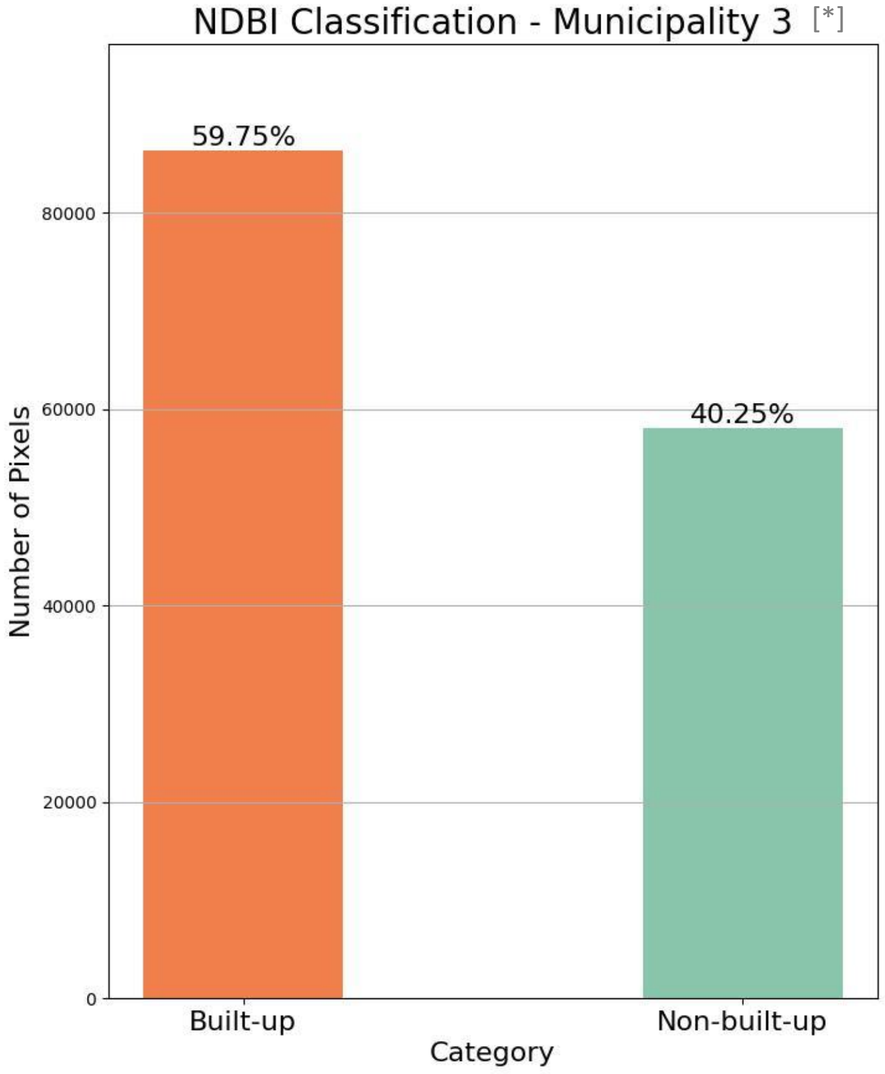


NDBI index
January ‘22



NDBI Histograms comparisons (January ‘22)





[*]- Threshold for builìt-up NDBI >=-0.1. Chosen Sampling «by hand» the space and comparing to satellite rgb image

4. Conclusions: further refinement

Possible improvements and evolutions

1. **Preliminary change detection to eliminate the shadows of the buildings**
   (in this case the images shoted in january 16 at 10:22 am)

2. **Analyse other sources regarding land cover**
   This could be done:
   - Using available vector data (Osm, Geoportals, etc)
   - Performing a supervised classification of the land covers (Dzetsaka plugin, Random forest)

   Eventually, for both the 2 cases, assessing if there is an actual correlation supported by data between the land cover data of the two areas and the SAVI data.

3. **Calculate a change detection for the two epochs of the SAVI indexes per each area**
   This would help spatializing which areas changed, and again comparing with results of NDBI to understand land cover correlations

Bibliography / sitography

[1]- Ismayilova I., Timpf S.,: *Classifying Urban Green Spaces using a combined Sentinel-2 and Random Forest approach.* Institute of Geography, University of Augsburg, Augsburg, Germany, 2022
[2]- https://custom-scripts.sentinel-hub.com/custom-scripts/sentinel-2/savi/
[3]- Tsion A. K., Binyan T. H., Karuturi V. S., Evaluation of spectral built-up indices for impervious surface extraction using Sentinel-2A MSI imageries: A case of Addis Ababa city, Ethiopia, Elsevier, 2022

Codes

[4]- SAVI histogram analysis:
https://github.com/fillobissi/EO_2024/blob/240615_Savi_histogram_extractions/240615_Savi_histogram_extractions.ipynb
[5]- NDBI histogram analysis:
https://github.com/fillobissi/EO_2024/blob/240616_Ndbi_histogram_extractions/240616_Ndbi_histogram_extractions.ipynb

Sapefiles

[6]-Administrative borders of Milan municipality: https://www.istat.it/it/archivio/222527

Thank you!