



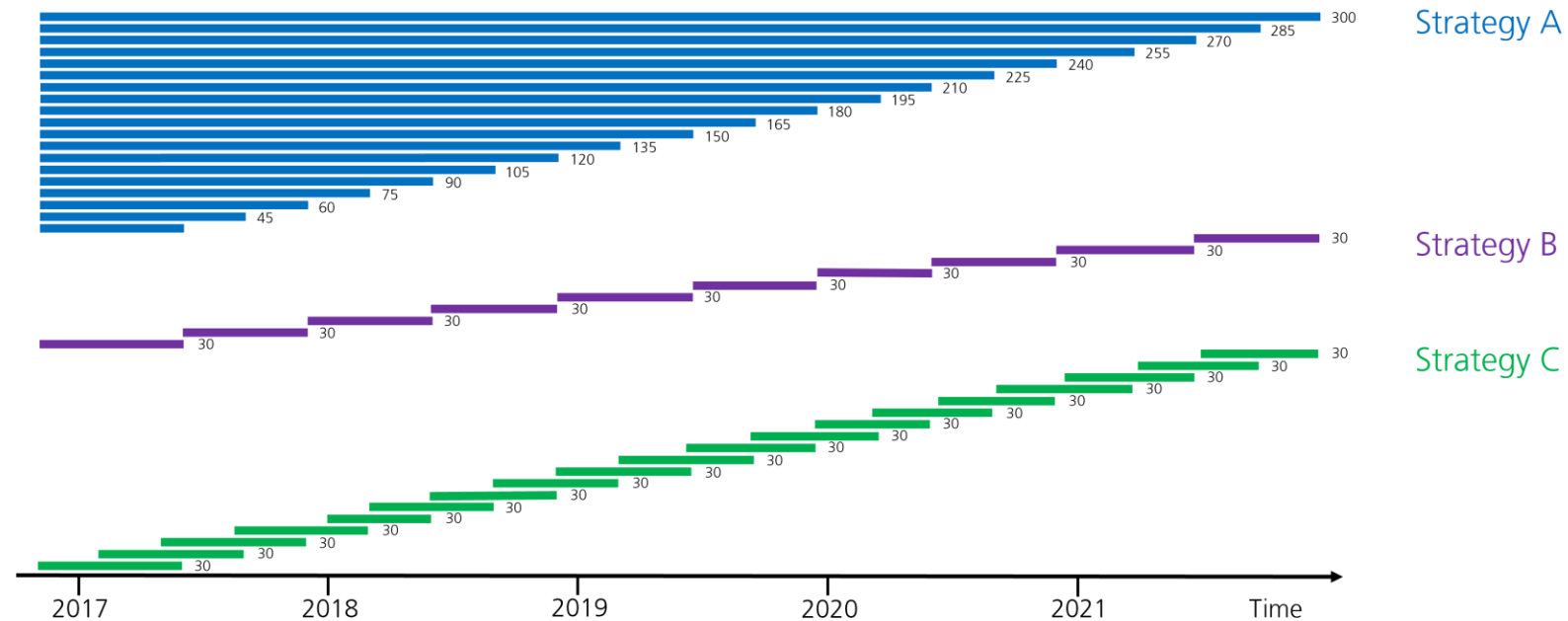
Valentine Schnell, Madeline Evers, Antje Thiele

Seasonal Variations in Persistent Scatterer Density Associated with Different Land-Cover

ESA FRINGE 2026, Krakow, 17.06.2026

Motivation

- Nowadays, the available consistent SAR image data stream (e.g., Sentinel-1 (S1)) enables long-term continuous monitoring tasks
- Processing very long time series raises questions concerning:
 - The achievability of a sufficient persistent scatterer (PS) coverage
 - Update frequency
 - Processing efficiency
- Earlier tests:
 - Three processing strategies were tested
 - Test data set consisted of 300 S1 images divided into temporal subsets



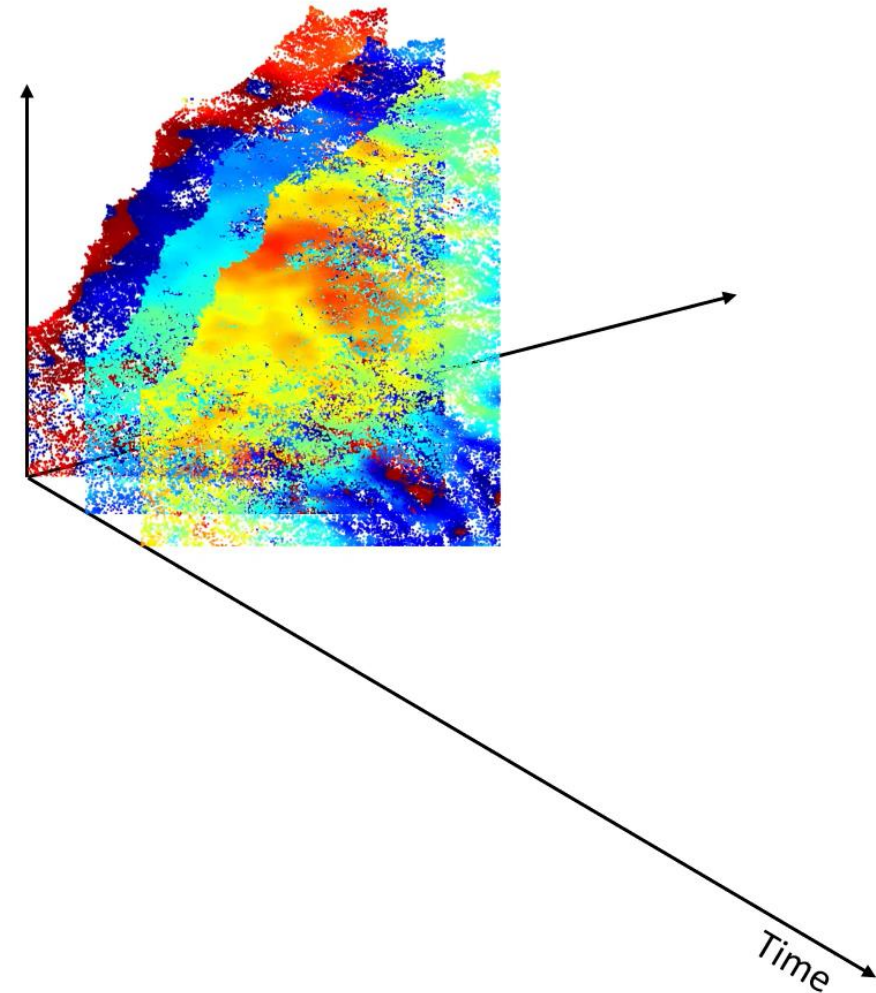
Strategy A: Growing Data Set

Advantages:

- Timely reprocessing possible
- The reference image does not need to be updated for every reprocessing.
- Continuous evaluation of results is possible.

Disadvantages:

- PS density decreases
- Processing time increases



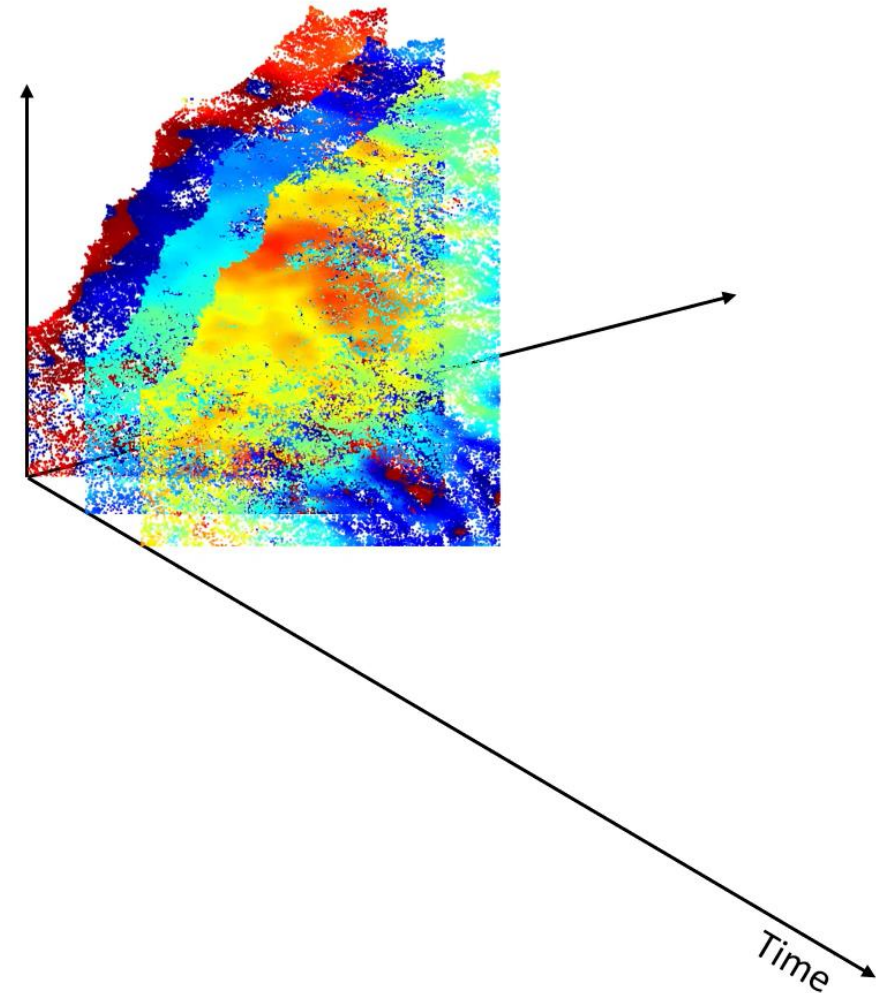
Strategy B: Non-Overlapping Data Subsets

Advantages:

- PS density remains relatively constant
- Processing time remains relatively constant

Disadvantages:

- Long waiting time before reprocessing is possible.
- The reference image must be changed for each reprocessing.
- Continuous evaluation of results is hindered.

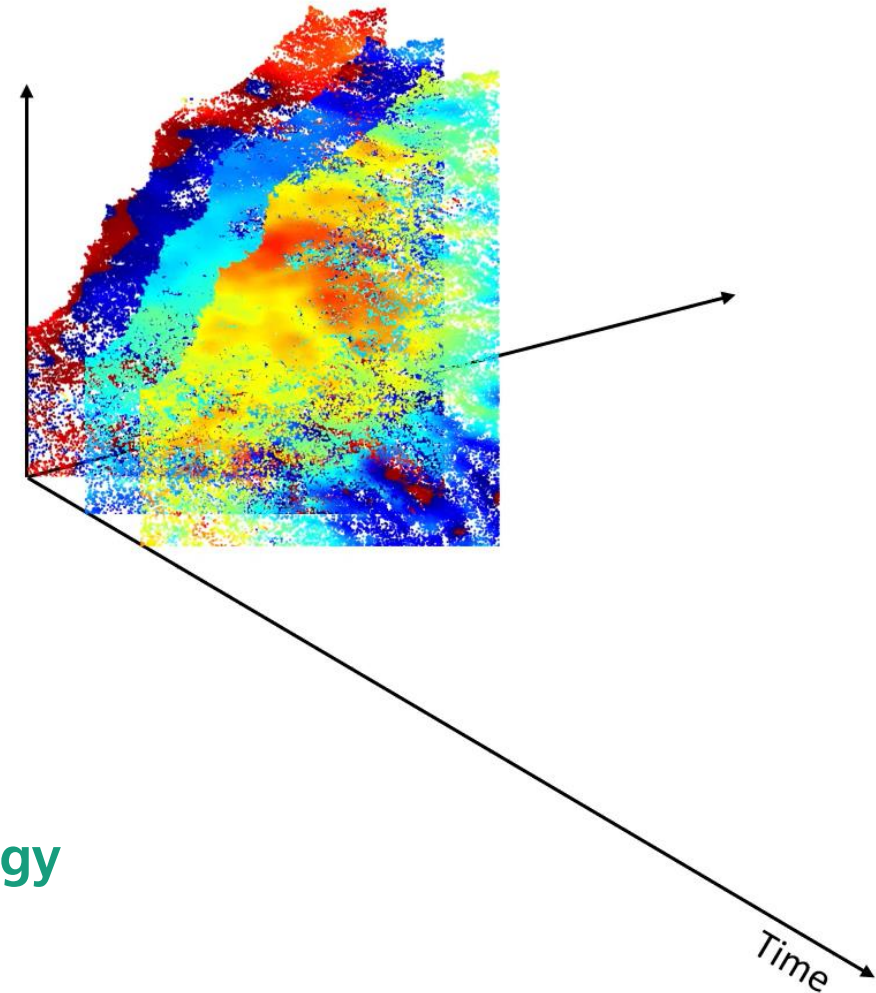


Strategy C: Overlapping Data Subsets

Advantages:

- PS density remains relatively constant
- Processing time remains relatively constant
- Timely reprocessing is possible.
- Reference image does not need to be changed.
- Results can be evaluated continuously.
- Intermediate results can be reused.

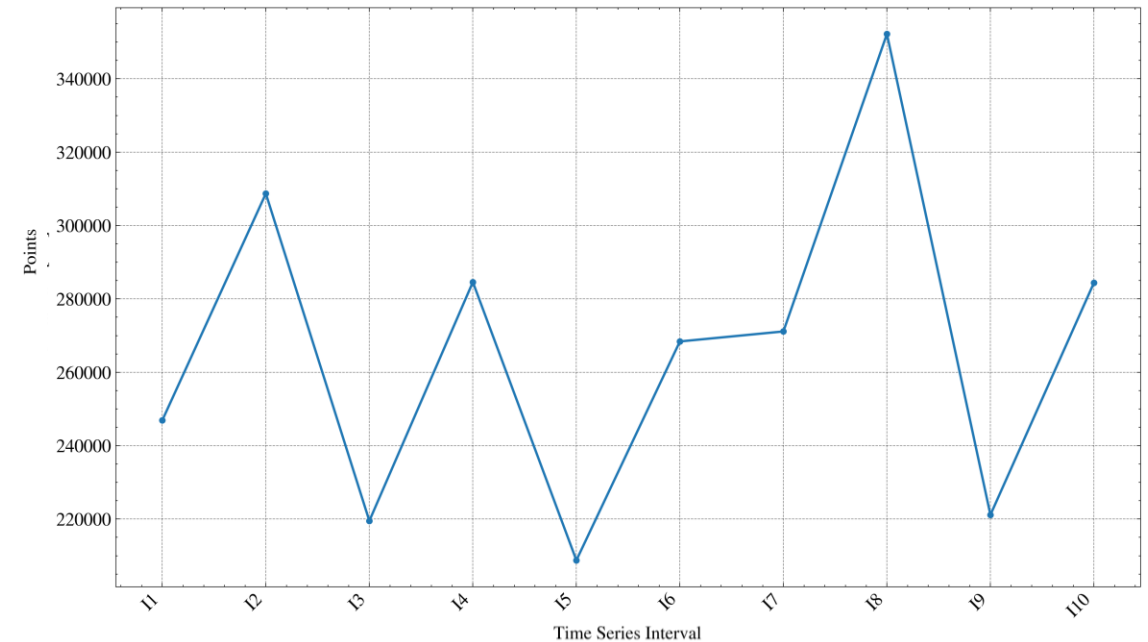
 **Most promising long-term monitoring strategy**



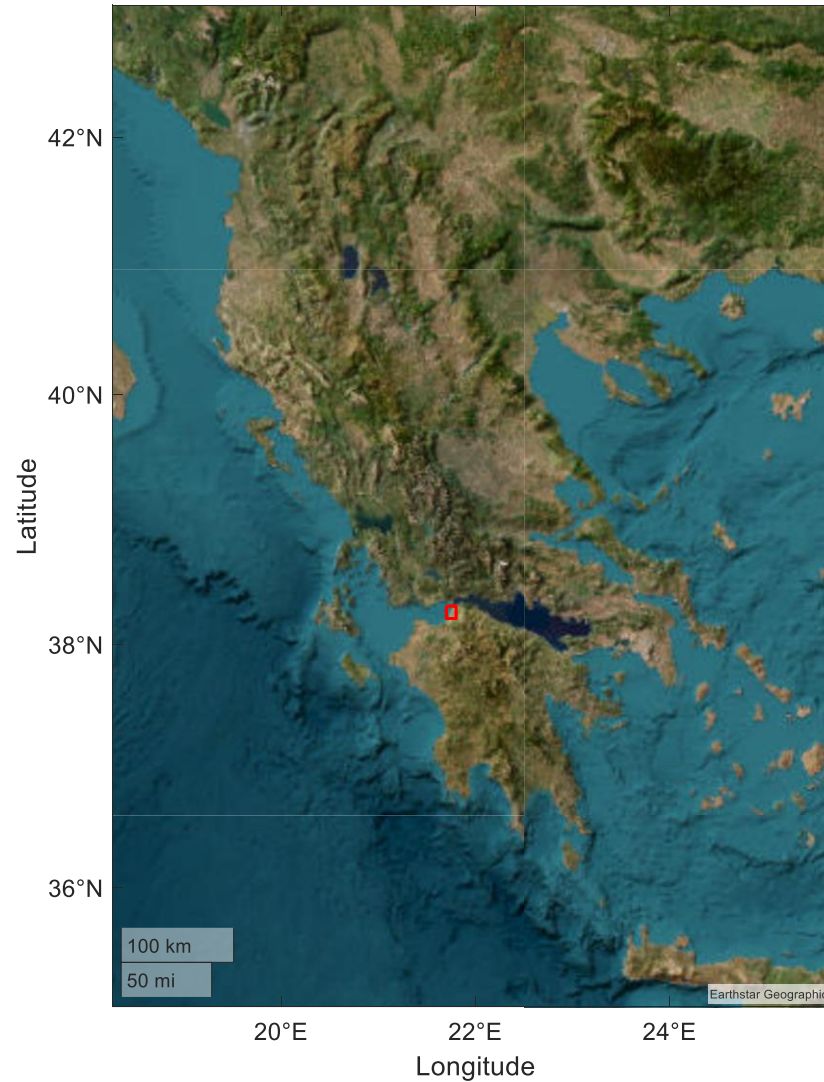
POSTER SESSION I: The PSISlider Processing Chain - A Sliding-Window Approach for Persistent Scatterer Interferometry
Madeline Evers, Erich Cadario, Horst Hammer, Antje Thiele

Notable Observation Concerning PS Number for Approach B

- Approach B uses non-overlapping subsets:
 - Always cover six months (30 SAR images)
 - Cover either the winter (November – April) or summer (May – October) half of the year
- Variations in PS-density can be observed
 - The summer half has more PS than the winter half of the year.
 - Outliers can be observed for subsets I7 and I8.

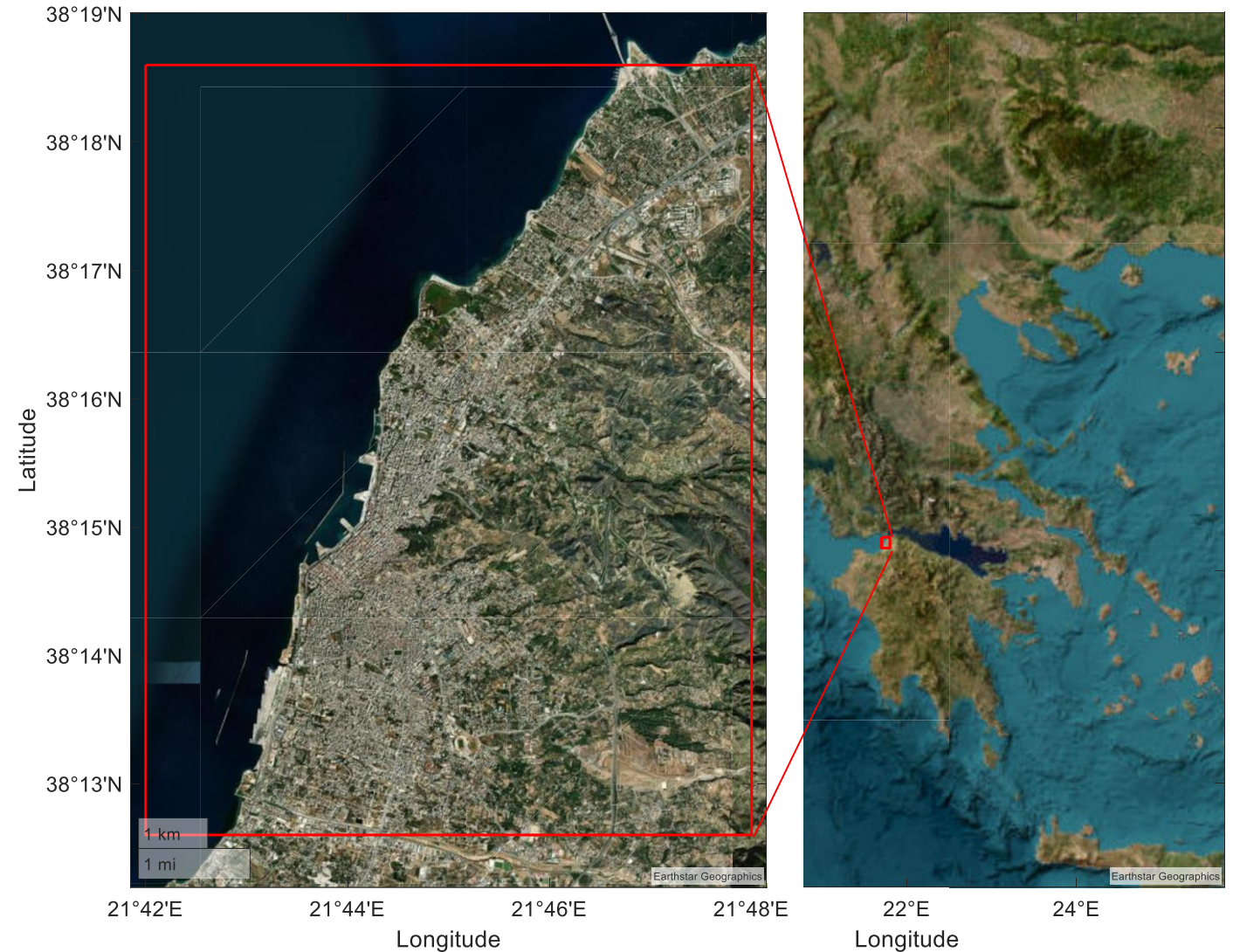


Study Area: Patras City and Surrounding Area



Study Area: Patras City and Surrounding Area

- Location: Peloponnese Peninsula
South Greece
- Area: 14,543.616 ha
- Climate type: Mediterranean, hot-summer
 - Hot, dry summers
 - Mild, wetter winters
 - Strong seasonality in precipitation
- Topography:
 - Coastal plains
 - Steep foothills
 - High mountains nearby



GIS Data Coverage

OpenStreetMap & CORINE Land Cover

OpenStreetMap (OSM):

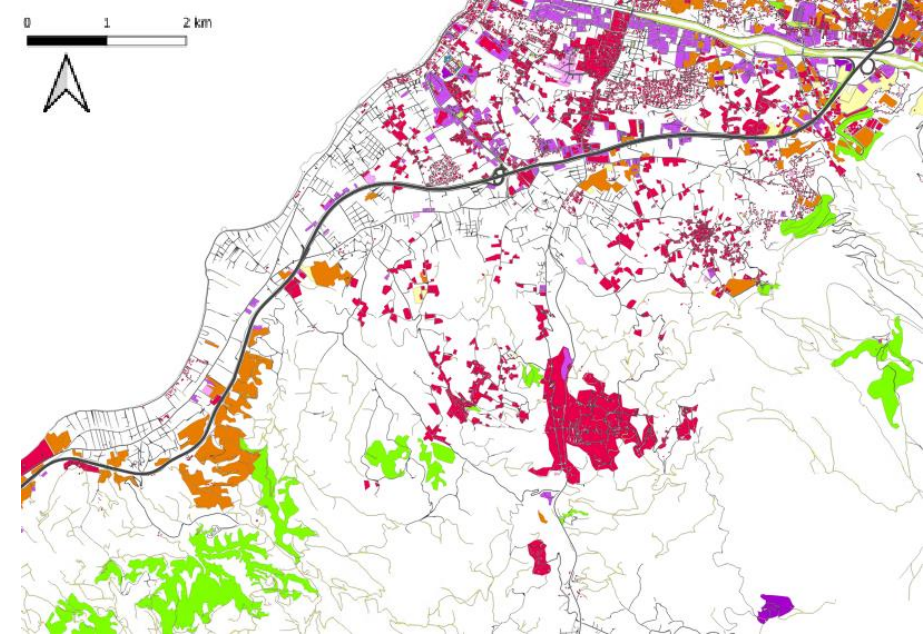
- High spatial resolution
- Constantly updated
- Poor coverage in rural areas

CORINE Land Cover:

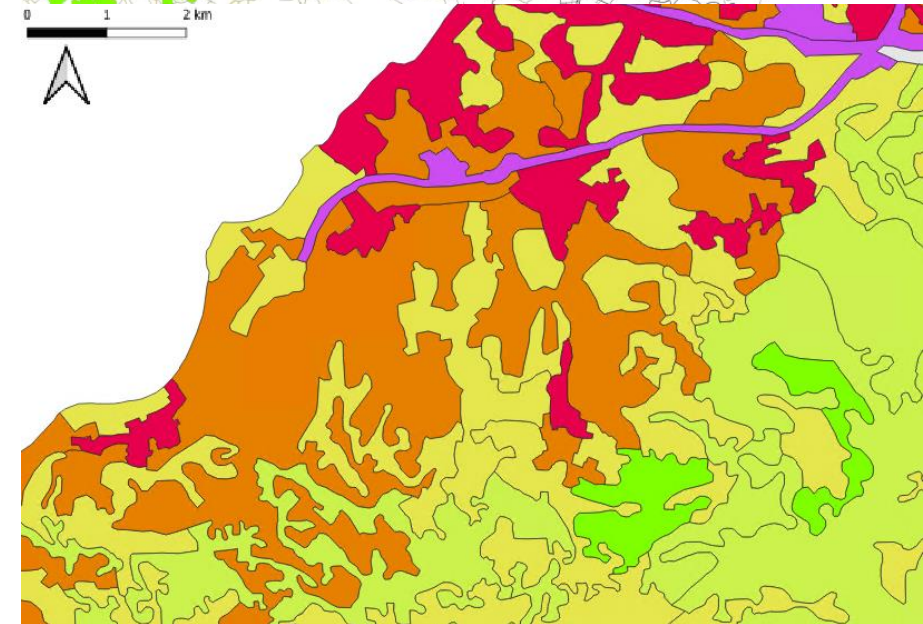
- Based on Sentinel-2 and Landsat-8 data
- Covers the time between 2017 and 2018
- Low spatial resolution
- Good coverage in rural areas

Both data sets need to be incorporated to achieve full coverage.

OSM



CORINE

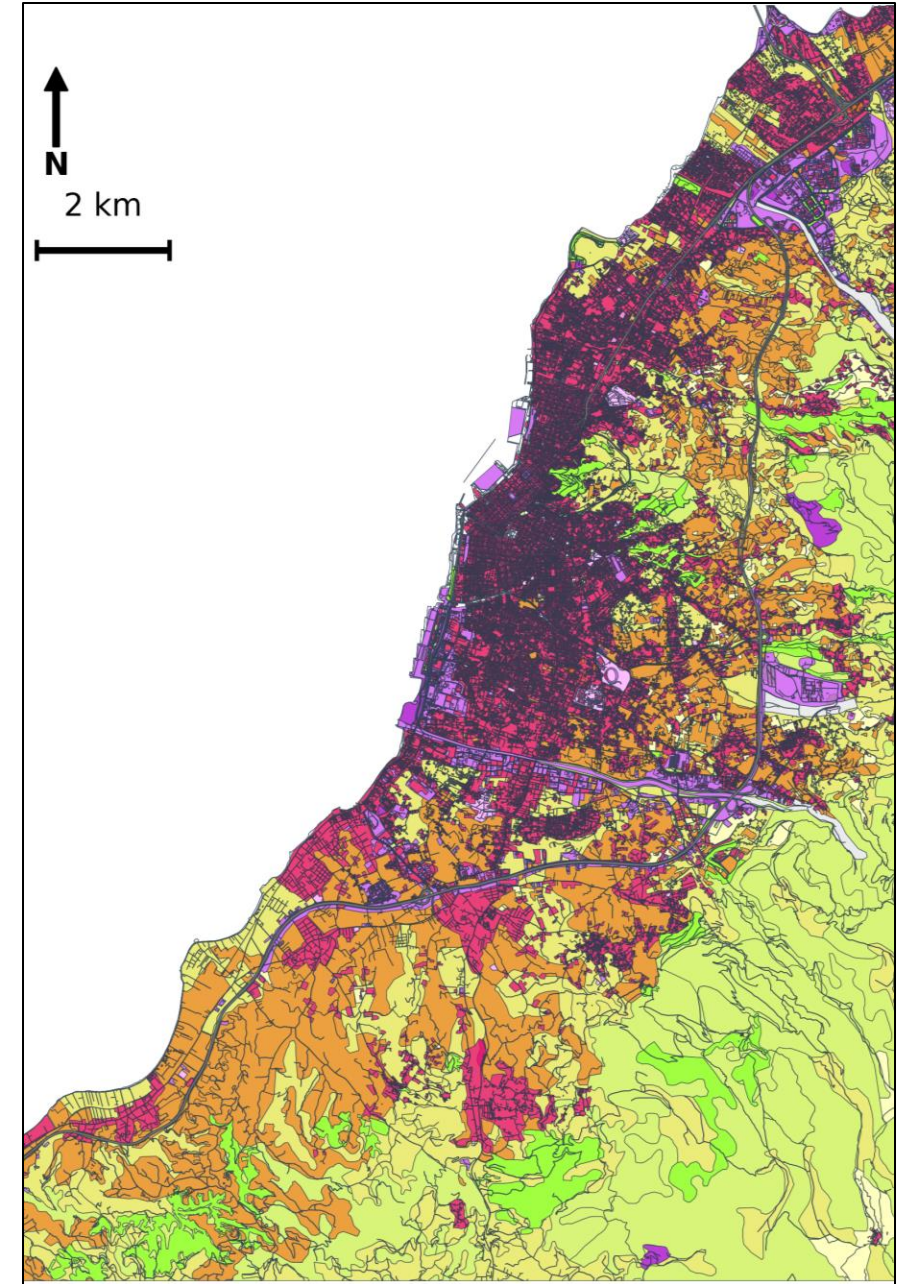


GIS Data Coverage

OpenStreetMap (OSM) & CORINE

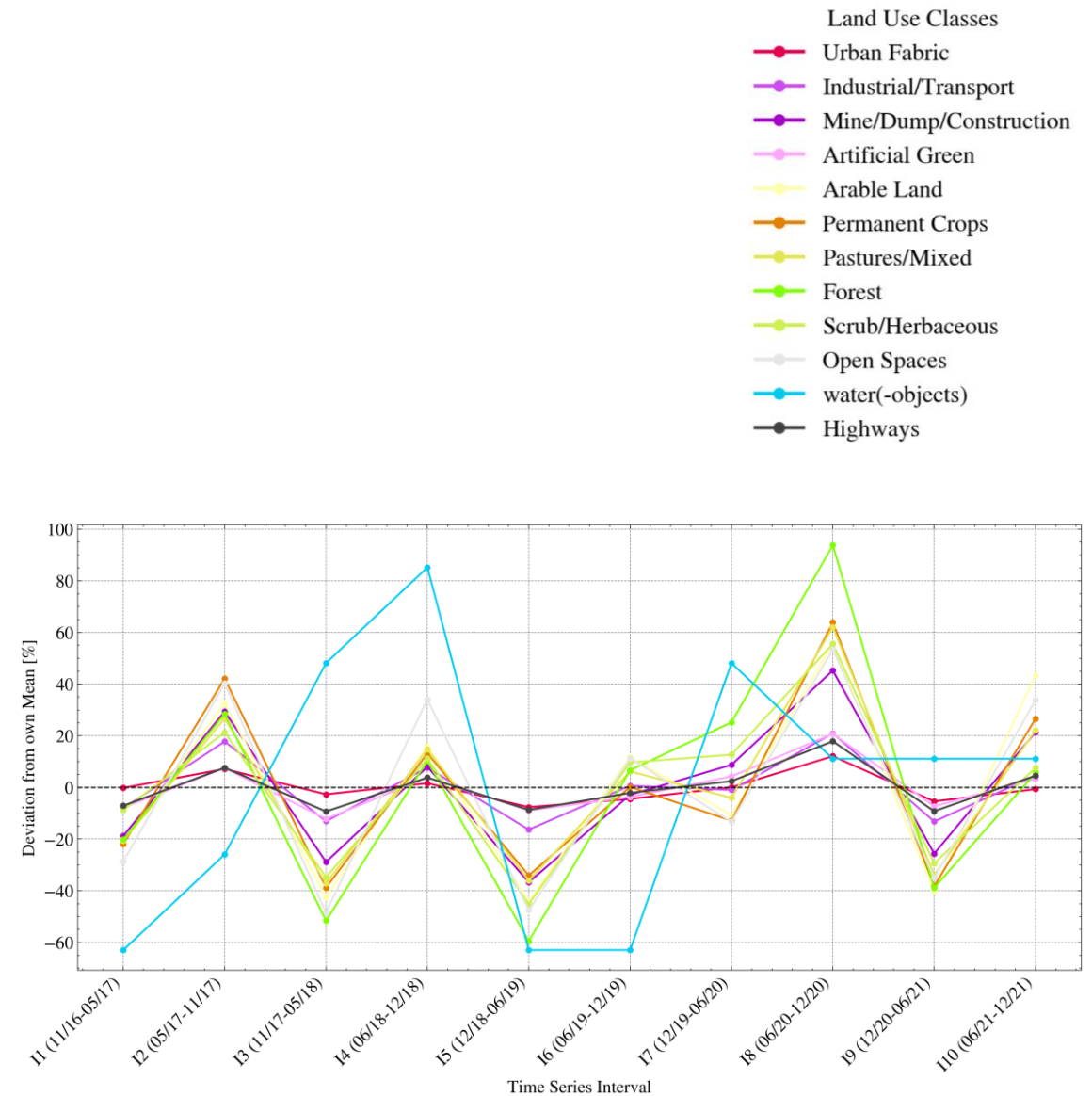
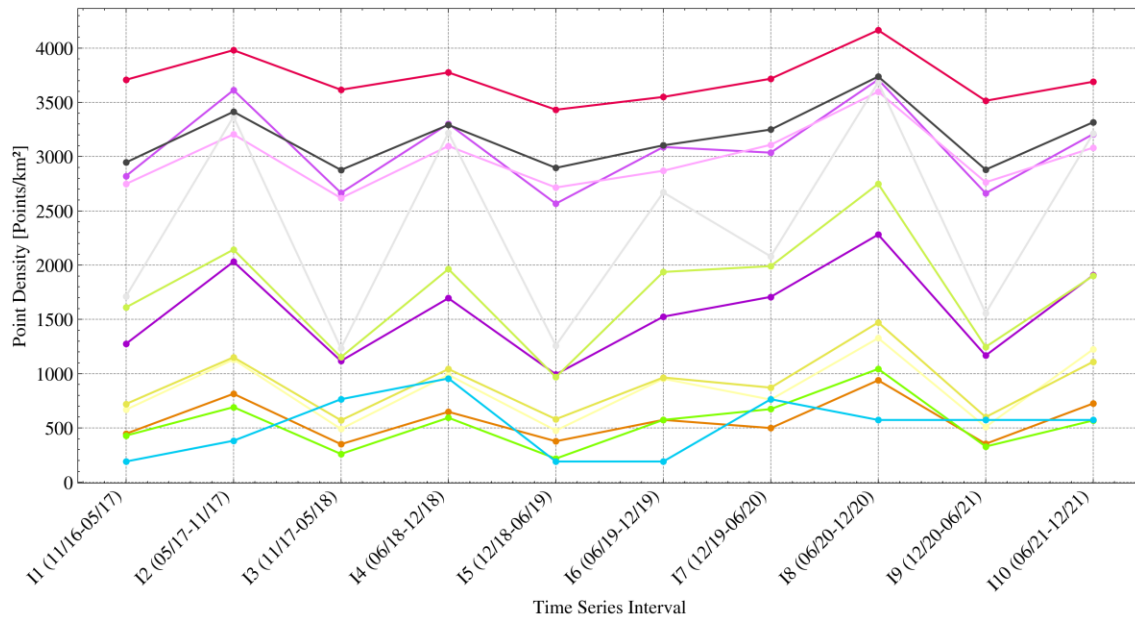
Final set of land cover classes:

- Urban Fabric
- Industrial/Transport
- Mine/Dump/Construction
- Artificial Green
- Arable Land
- Permanent Crops
- Pastures/Mixed
- Forest
- Scrub/Herbaceous
- Open Spaces
- water(-objects)
- Highways



PS Density: Different Land-Cover Types

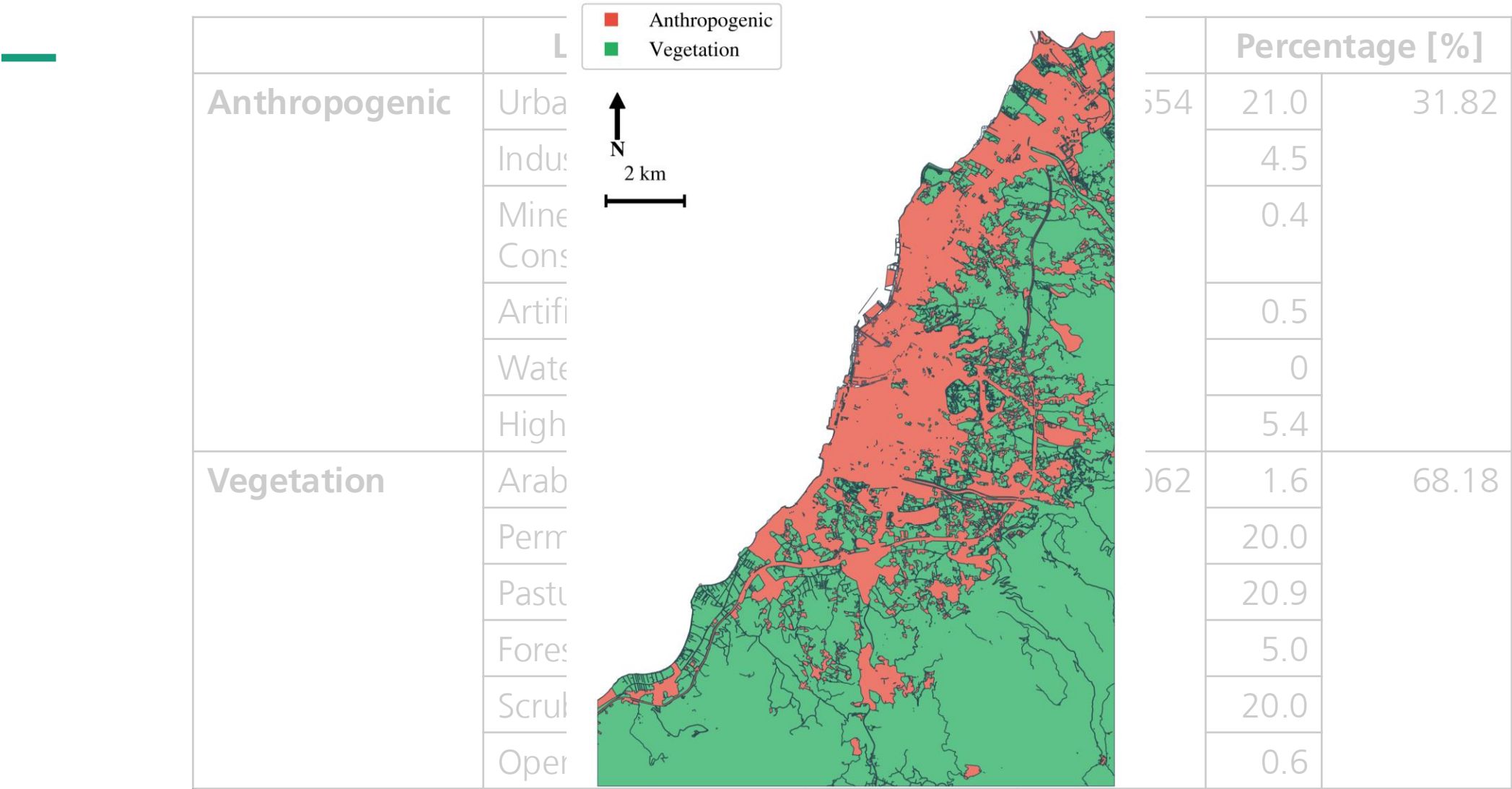
- PS density varies for all land cover classes.
- Magnitude of the variation is larger for the “natural” land cover classes, e.g., permanent crops and scrubs.



PS Density: Anthropogenic vs. Vegetation

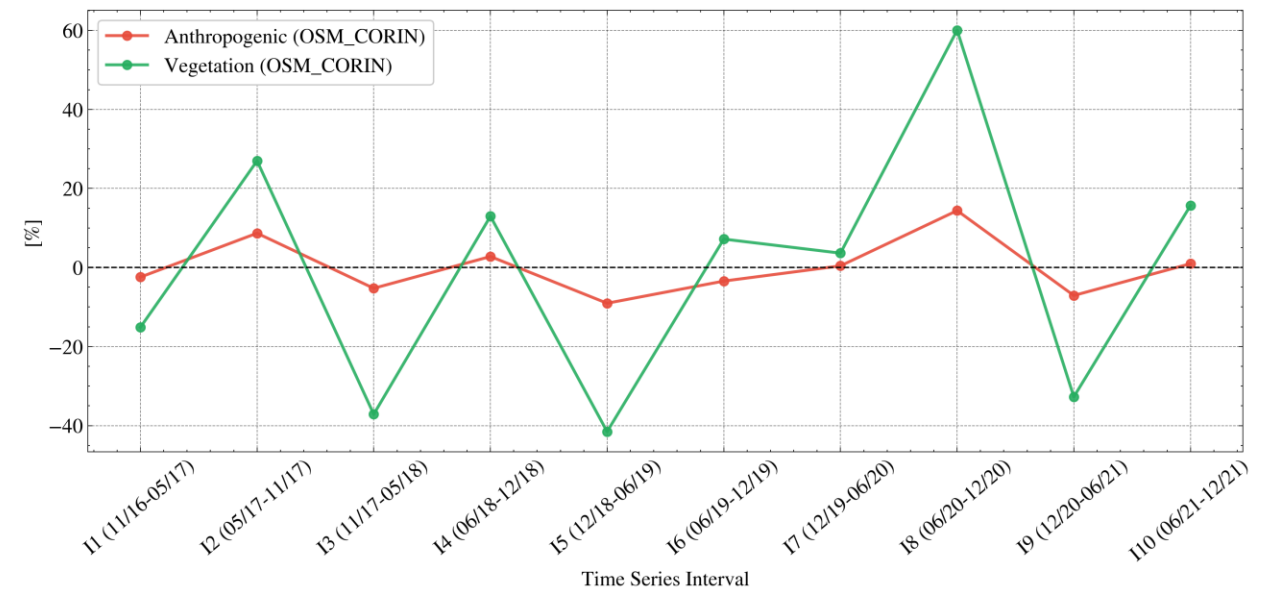
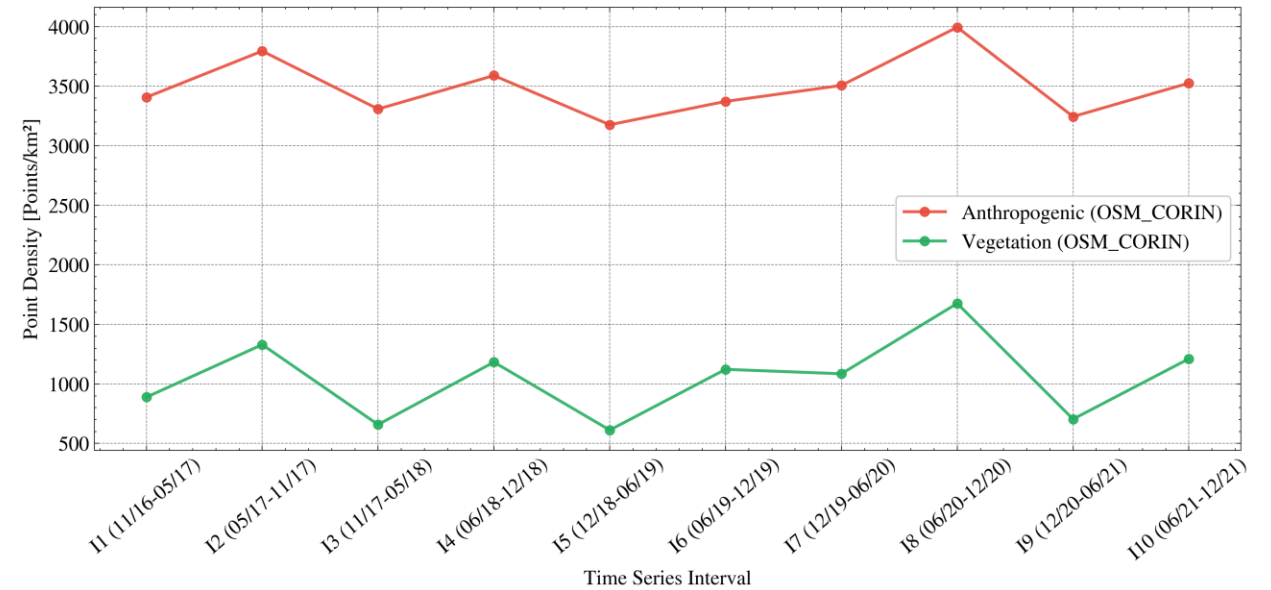
	Land-Cover	Area [ha]		Percentage [%]	
Anthropogenic	Urban fabric	3057.655	4628.554	21.0	31.82
	Industrial/ Transport	653.768		4.5	
	Mine/ Dump/ Construction	59.260		0.4	
	Artificial green	79.031		0.5	
	Water(-objects)	0.523		0	
	Highway	778.317		5.4	
Vegetation	Arable land	232.360	9915.062	1.6	68.18
	Permanent crops	2920.382		20.0	
	Pastures/ Mixed	3031.915		20.9	
	Forests	725.756		5.0	
	Scrub/ Herbaceous	2917.204		20.0	
	Open spaces	87.445		0.6	

PS Density: Anthropogenic vs. Vegetation



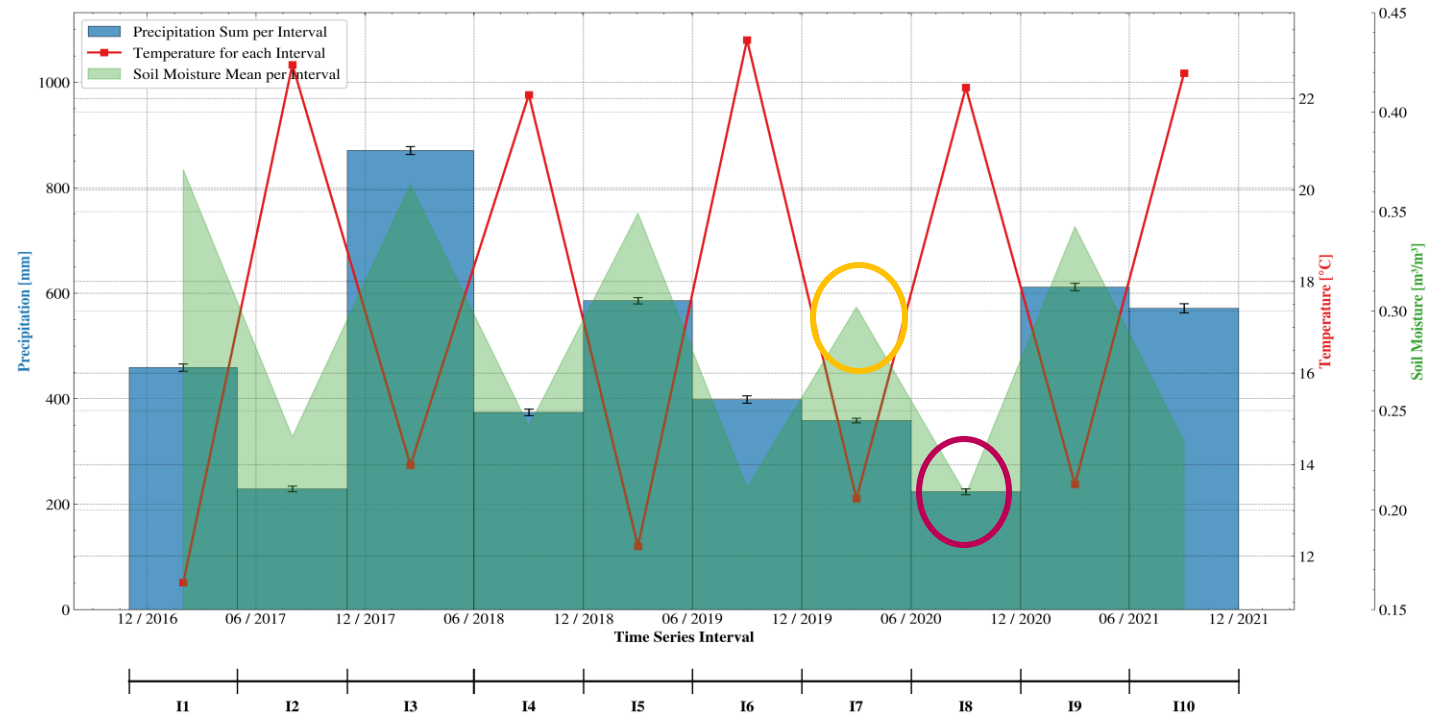
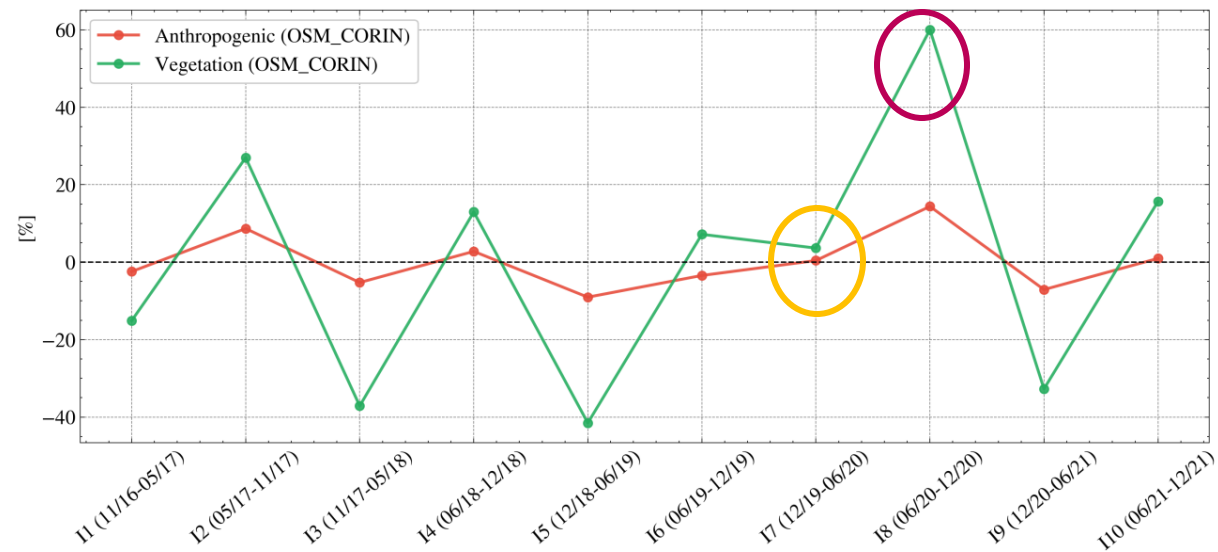
PS Density: Anthropogenic vs. Vegetation

- Magnitude in variation is smaller for anthropogenic land cover classes.
- Outlier: Subset I7 & I8
 - Following a seasonal pattern, PS density in subset I7 should decrease, but it doesn't.
 - PS density for subset I8 is significantly larger.
 - Natural land cover classes are more affected.
 - Hypothesis: Natural effects, e.g., lower coherence due to vegetation cycles and soil moisture variations



PS Density: Anthropogenic vs. Vegetation

- High ambient temperature, low precipitation, and soil moisture affect vegetation cycles.
- Perception and soil moisture are low than PS Density increases.
- Ambient temperature is high than PS density increases.
- The perception and soil moisture are especially low for the time spans of subsets 7 and 8.
- SAR images acquired during vegetation growth periods might need to be excluded from PSI processing.



Summary & Outlook

- Seasonal variations in the number of identified PS were observed in the case of processing a SAR image stream in semiannual slices.
- PS were intersected with data sets concerning different land cover classes.
- Anthropogenic land cover classes (e.g., streets) are less affected than natural land cover classes (e.g., permanent crops).
- Variations coincide with variations in perception, soil moisture, and temperature.
- SAR images recorded during times of vegetation growth periods may need to be excluded from PSI processing to increase PS density.
- The specific time span should be further narrowed down.
- Hypothesis should be validated for other climate zones.



Thank You For Your Attention!

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