

Summer Internship Report -2023

Organisation name: EO Analytics Lab, University of Salzburg

Supervisors: Prof. Dirk Tiede, Dr Martin Sudmanns

Duration: 01 May – 30 August 2023

Area of Research: Exploration of semantic data cubes to monitor real-estate properties

The following tasks were undertaken as part of research that spanned over 4 months:

- A literature review was undertaken to understand ESG indicators for real estate properties.
- Of the ones identified through literature, the ones generally derived from remote sensing data and methods were highlighted. An ESG indicator list, generated with the partners, was evaluated and indicators potentially derived from Sentinel-2/Sen2Cube.at infrastructure were deemed relevant for further exploration in the research scope.
- SenCube.at models were developed for the application of ESG-related indicators for parcels
- Jupyter Notebooks were developed for direct access to Sen2Cube.at for parcel-based analyses. The following analyses were developed into Jupyter Notebook workflows:
 - I proposed a new ‘green score’ monitoring as a measure of the greenness of property parcels – a combination of the proportion of parcel under vegetation and the average greenness observed in the parcel. This combined metric, or ‘green score’ can be monitored over time for a more stable and meaningful view of the changes in the strength of vegetation in the property parcel, as it combines the extent and intensity of vegetation.
 - Generation of ‘semantic parcel history’: A semantic time-series generation to highlight and flag major/significant changes between spectral categories indicating potential land cover changes.
- The above indicators/analyses were tested with SenCube.at models for arbitrarily selected property plots in Vienna from a national cadastral property database, with the only criteria being the observation of the commencement and end of a construction activity resulting in a newly built structure in the parcel.
- The results were validated using high-resolution imagery from Google Earth.
- Green roof change detection in Austria based on Sen2Cube.at derived Greenness
- Documentation of the processes and transfer of knowledge (Jupyter notebooks, documents, presentation files) to the EO Analytics team.

Work samples

Green score profile of parcel A (32 Sentinel-2 pixels)



Figure Temporal high-resolution images for parcel A obtained from Google Earth Imagery

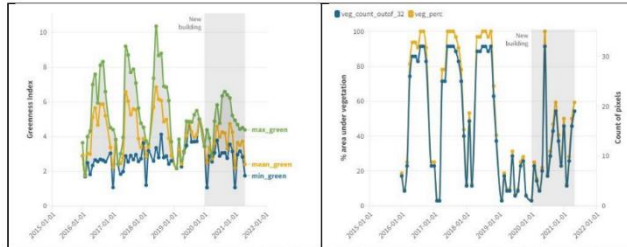


Figure Timeseries curves of greenness-index (left) and % of area under vegetation (right) for parcel A as monthly aggregates (maximum)

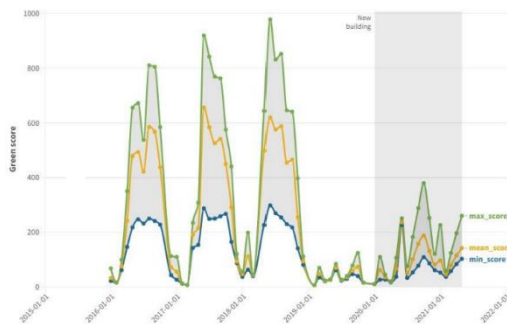


Figure Timeseries curve of the proposed green score for parcel A as a monthly aggregate (maximum)

Figure: Sample work – Green Score Monitoring (Results validated visually from Google Earth Imagery)

- % of total buildings showing a vegetation decrease

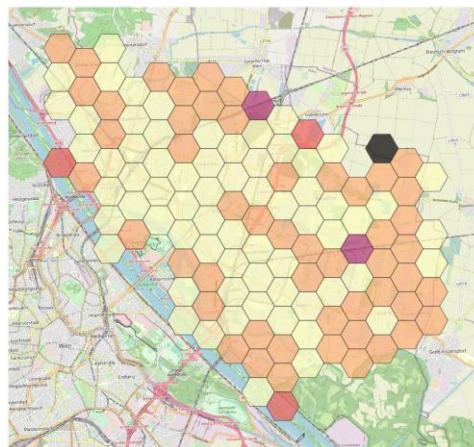
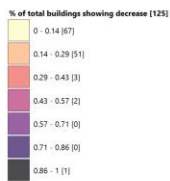


Figure: Sample work – Green Roof Analysis (Results not validated with ground truth)

Personal experience and recommendation for future students

I had a fruitful experience in my internship with EO Analytics Lab, under the guidance of Prof Dirk and Dr Martin. During this internship, I picked up working with data cubes, querying them, building related workflows on Jupyter Notebooks, and working with Xarray-based data structures. I also got a chance to sharpen my application lens by having to distil a feasible set of ESG indicators of high relevance, from a wide range of possibilities. The experience also improved my programming skills. While the learning curve was steep for the first few weeks, the flexibility, patience, and guidance that Prof Dirk and Dr Martin offered was extremely valuable in getting up to speed quickly. I always learnt a thing or two new in all my discussions with Prof Dirk and Dr Martin. I am grateful that they encouraged and entertained all my ideas and provided guidance to move forward with them. I also enjoyed the flexibility to make a changing concoction of hybrid mode of work, it boosted my productivity through all phases of the internship. The internship has been one my best professional experiences, by far.

If you are someone who is self-driven and motivated to work with semantic EO data, or generally interested in working EO data cubes, I would highly recommend reaching out to Prof Dirk and Dr Martin and pitching your ideas to them.