REGREEN
NATURE-BASED SOLUTIONS

High resolution land cover
Multiple use cases, different data sets, comparable results
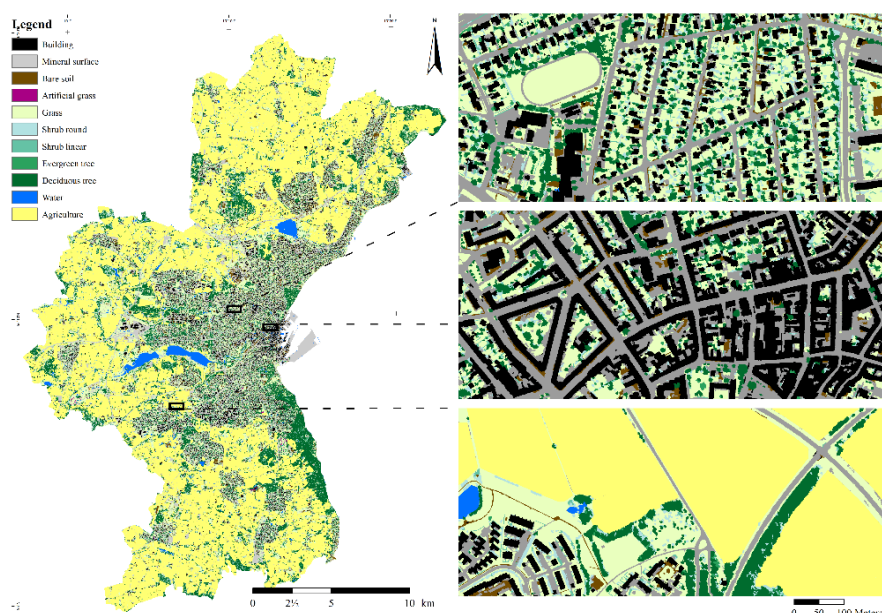
Recommendations for mapping

- High resolution layers provide insights into understanding residential structures; structural urban biodiversity; and the distribution of smaller green elements both on private and public grounds.

- High resolution land cover analysis offers multiple usages and serves to localise NbS, assess status quo, and provides basic information for ecosystem service modelling.

- Make use of available city data.

- Applicable to many urban areas.

- Spatial resolution can be resized dependent on pinpointed research, needs at the planning level, and visualisation demands.

This brief provides information about the outcome of high-resolution mapping of land cover at all the three European urban living labs in the REGREEN project.
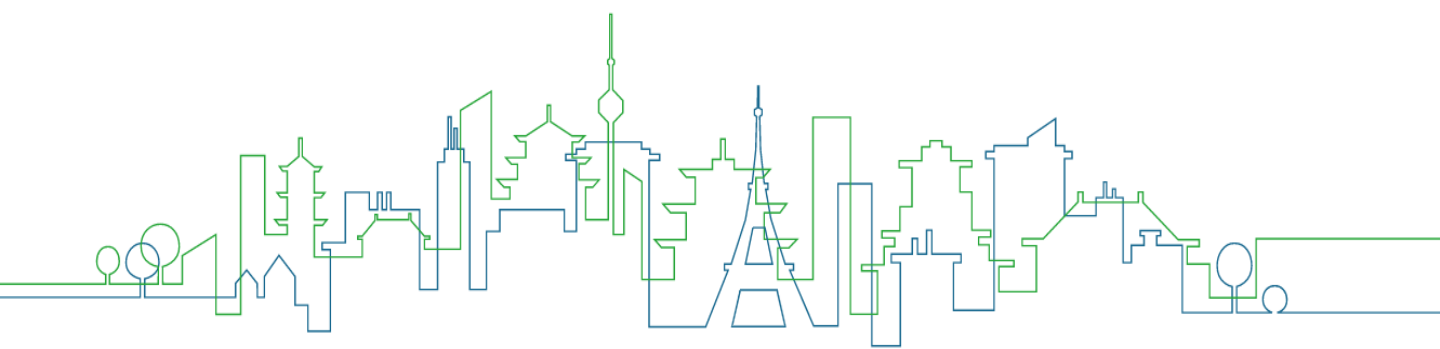
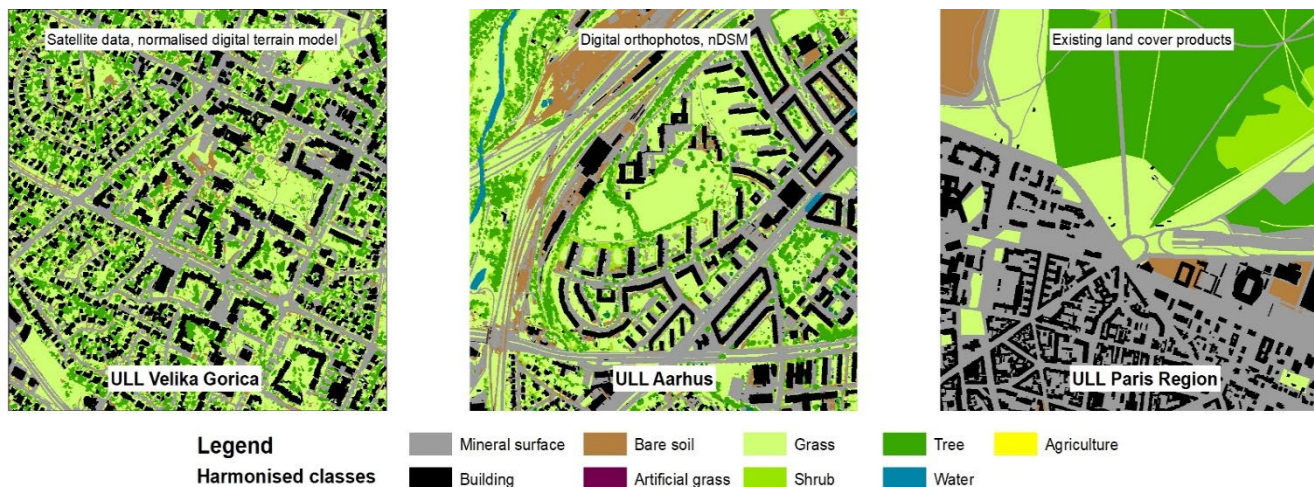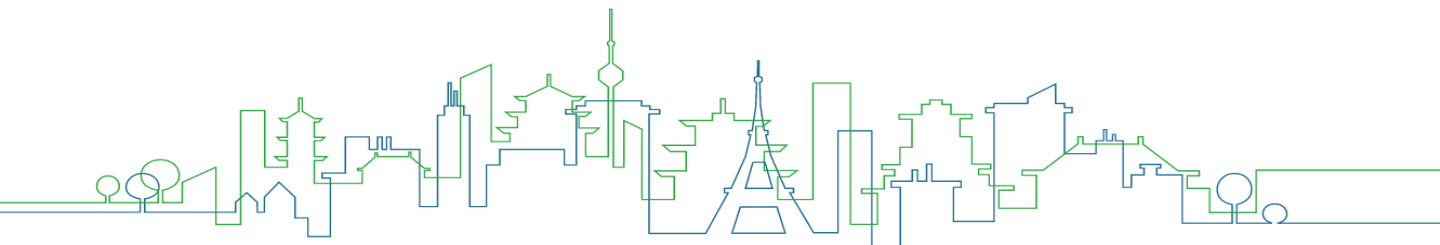## Why high resolution land cover (HRLC)?

Very high resolution dataset of the urban structure, including different "land-cover" and "land-use" classes down to functional urban area types and single elements such as trees and buildings. The mapping is supposed to

- Deepen the understanding of the residential structures in urban areas

- Facilitate the comparisons between the different cities

- Serve as an input for models (e.g. noise)

- Be used to link other data in the same spatial dimension, such as information gathered from questionnaires and simple point data like biodiversity and prevailing species and types

- Enhance knowledge on social demographic and social economic implications of residents for various pressures at allocated hotspots

Legend
- Building
- Mineral surface
- Bare soil
- Artificial grass
- Grass
- Shrub round
- Shrub linear
- Evergreen tree
- Deciduous tree
- Water
- Agriculture

High-resoultion land-cover for Aarhus municipality

Legend
Harmonised classes

- Mineral surface
- Bare soil
- Grass
- Tree
- Agriculture
- Building
- Artificial grass
- Shrub
- Water

Comparing different land-cover products

Background

The high-resolution land-cover (HRLC) map is supposed to bridge gaps in the existing datasets. It aims to provide the highest possible resolution of land cover for a given urban area. The mapping approach is object-based, using remotely sensed datasets to derive objects that closely resemble real-world objects, such as roads and buildings. The input data was provided by the European Space Agency, national orthophotos and various existing land cover and land use products. Mapping relied heavily on test sites and ground truthing by local partners, with a strong emphasis on providing detailed information on land cover for the entire urban area regardless of property status.

Need

The high-resolution land cover (HRLC) product is essential for local decision-making and enhancing knowledge on socio-demographic and socio-economic implications of residents for various environmental pressures and needs:

- Detailed information on land cover as input for ecosystem service models such as heat, water-related issues and human wellbeing.

- Environmental challenges in urban environments for different societal groups

- Social inequality

- Policymakers can identify areas that require more resources and attention.

- Policymakers can make informed decisions about resource allocation and management.

- HRLC may be overlaid over walkable floor maps for visualising land cover status quo and scenarios.

- Identification of hotspots where urban development is putting pressure on environment and residents,

- Allowing for targeted interventions.

Its advantages

All of the above dimensions are mapped regardless of property status, which distinguishes them from more conventional municipal datasets. Here, green infrastructure on private property is assessed and considered when planning new interventions. Mapping of urban morphology enables to assess potentials for green roofs. Where urban development is putting pressure on the environment of residents, the targeted interventions are spatially allocated.

This provides insights into:

- Parcel based population aggregation
- Access to "UGS" (calculations)
- Structural biodiversity (patch connectivity, metrics)

Additional material

Knopp, J. M. (2021). High-resolution land cover 2015, Aarhus, Denmark.
https://zenodo.org/record/5215792

Knopp, J. M. (2021). High-resolution land cover 2016, Velika Gorica, Croatia.
https://zenodo.org/record/7107514

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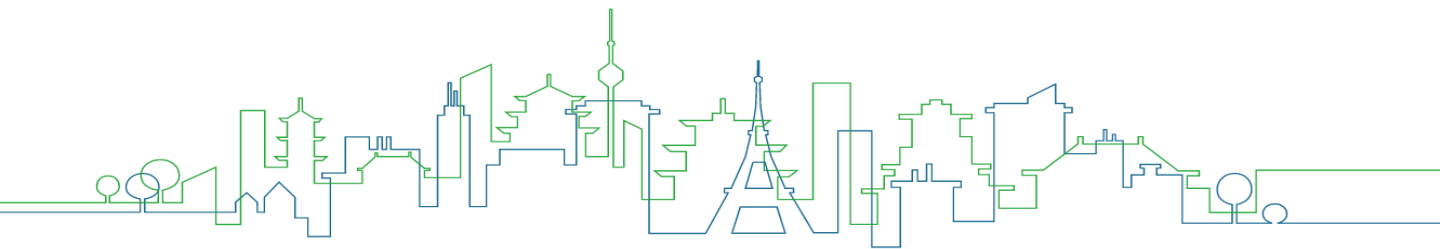
Impact

Overall, the HRLC product has a significant impact on users, providing them with scientifically validated information to make decisions about the urban environment and to quantify land cover. Visualisation also helps to raise awareness towards social inequality in a spatial context. It enables stakeholders to make evidence-based decisions on hotspots that require more resources and attention.
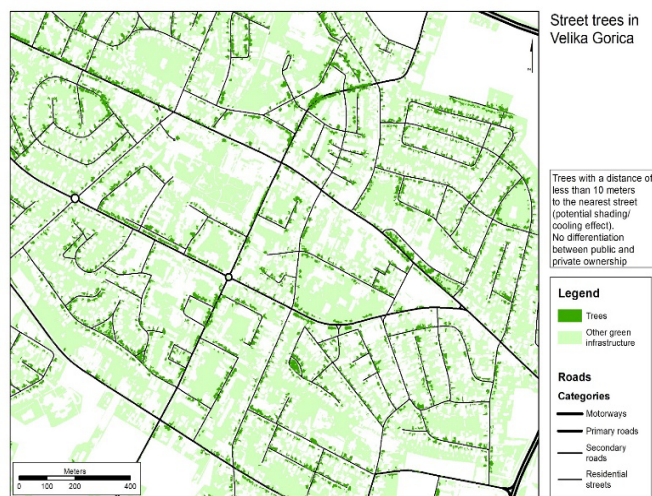
Capturing the canopy area of street trees in Velika Gorica

Approach

For Paris Region, the various datasets are combined into a single product. To accomplish this, data types are converted to raster, and merged with rulesets, where priority is given to the highest resolution or thematic content. In addition, overlapping data was combined to represent the 3rd dimension within the datasets. Some datasets are only available for limited areas within the Ile- de- France region. The datasets used in the production of this map were *MosPlus 2017-81*, *Cadastre Verte* (green cadastre), *hauteur vegetation* (vegetation height), *Copernicus* (small and woody features, street tree layer) and the *densibati* dataset (estimation of residents per building).

For Grad Velika Gorica, the input data are acquired from ESA and enable an object-based image analysis (OBIA) based on very high-resolution satellite imageries. OBIA involves aggregating individual pixels in remotely sensed datasets to derive objects that resemble real-world objects. The method was applied to both Aarhus Municipality and Grad Velika Gorica. Currently using commercial software, the approach can also be transferred into open-source software to strengthen the transferability and repeatability of the mapping effort.

For Aarhus Municipality, the approach used for the HRLC product is object-based image analysis (OBIA), which involves aggregating individual pixels in remotely sensed datasets to derive objects that resemble real-world objects. The method was applied to both Aarhus Municipality and Grad Velika Gorica. Currently using commercial software, the approach can also be transferred into open-source software to strengthen the transferability and repeatability of the mapping effort.

Building and land-use type influencing the vegetation distribution on parcels
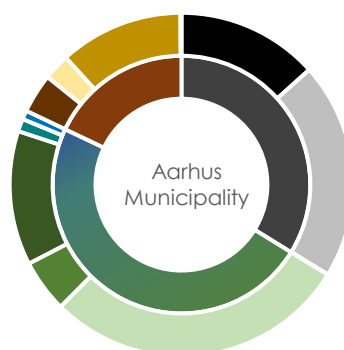
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Results

The HRLC project has so far provided valuable insights into land cover and land use in urban environments. It has identified hotspots where urban development is putting pressure on the environment and residents, allowing for targeted interventions, such as the planning of new green roofs, street trees or urban (pocket) parks.

The project has also provided valuable information on the socio-demographic and socio-economic implications of residents for various pressures, enabling policymakers to address social inequality through e.g., access to urban green spaces. The effort has once more exemplified the importance of detailed land-cover and land-use information in urban planning and management.

As an example, the structural biodiversity on private grounds can be mapped and linked to the estimated number of residents per building. Furthermore, street trees can be extracted from the HRLC to provide insight into canopy cover along streets, proving shade and cooling.

Do you know that...

… the highest spatial resolution achieved was for Aarhus Municipality by using orthophotos?

… private green spaces contribute around 32% of vegetation of Grad Velika Gorica and Aarhus Municipality?

… bi-temporal satellite imagery and aerial photographs were used to delineate evergreen and deciduous trees?

… 2% of the urban footprint of Paris Region are waterbodies and courses, with Aarhus Municipality and Beijing being closer to 1%

… only 7% of Grad Velika Gorica are covered by parks, but 75% of residents have access to one within 300m?

Legend:

■ Building	■ Grass	■ Water			
■ Mineral surface	■ Shrub	■ Bare soil			
■ Artificial grass	■ Deciduous	■ Agriculture extensive			
	■ Evergreen	■ Agriculture temporary			
	■ Tree	■ Agriculture permanent			
■ Built and sealed	■ Green blue infrastructure	■ Agriculture and barren			

Land-use and land-cover, aggregated and disaggregated

Grad Velika Gorica

Aarhus Municipality

Comparing the percentages of land-cover classes between Aarhus Municipality and Grad Velika Gorica

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You want to know more?

REGREEN webpage
www.regreen-project.eu

REGREEN repository zenodo
https://zenodo.org/communities/regreen

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