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Building Climate Resilience: Utilizing Copernicus Land Monitoring Service (CLMS) High-Resolution-Layer Non-Vegetated Land Cover Characteristics (NVLCC) for Urban Adaptation Strategies

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Responding to global warming and adapting to climate change effects such as heat waves and droughts is a key priority of European and national climate change adaptation strategies. Soil sealing, covering of ground surfaces with impermeable materials or buildings, thereby preventing water infiltration into the soil, has a significant impact on the urban climate, especially in the context of urban-heat-islands (UHI). Administrations at different levels aim at reducing health risks associated with climate change and to improve human well-being through appropriate planning measures like policies, urban planning strategies but also technological solutions. The CLMS supports such activities with dedicated high-quality, pan-European data products. The HRL NVLCC portfolio enhances planning capabilities and support evidence-based adaptation measures to build resilience against climate impacts.

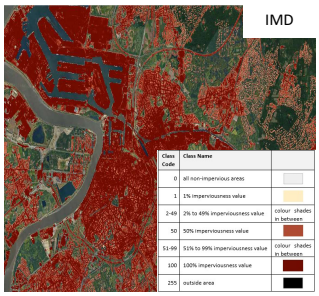
The NVLCC's raster layer focus on impervious areas, at 10m resolution across EEA38-countries aiding frequent land cover updates and serving as an early detection system for environmental changes. Derived from Copernicus Sentinel missions, the product includes components for imperviousness densities and built-up areas, that provide insights into artificial and bare surface cover and building constructions. The NVLCC data, when used alongside with various data sources like meteorological, demographic, and socio-economic data, can provide detailed and up-to-date information on land use and land cover, which is often lacking for effective planning. This information is crucial for assessing the impact of building development on local climate and understanding of heat storages in urban areas.

HRL NVLCC Products

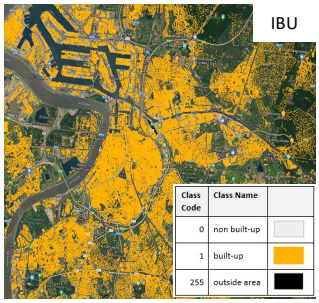
Status (main) products 2021 in 10m

Imperviousness Density (IMD) 10x10m resolution. In 2021 product update a UNET (CNN) model was used (formerly supervised classification). The model was trained on the IMD 2018 dataset by using S2 band metrics and NDVI harmonic coefficients of the year 2018 as input. Then, the model was applied to S2 data of the year 2021 to produce the prediction (transfer learning).

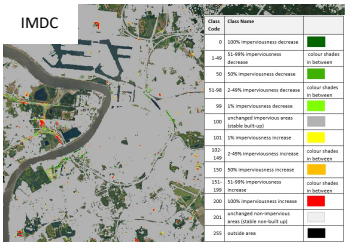
- Highly scalable, fully automatic
- Fully consistent, reproduceable
- Decoupling into different modules

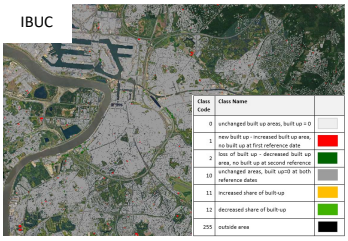


Imperviousness Built-up (IBU) 10x10m for 2021. This binary product shows the built-up areas, i.e. all sealed surfaces with above-ground buildings (fully harmonized with imperviousness component). Built-up areas are mapped with the same UNET classification approach as the impervious areas (with independent training data from OSM, MS and Google buildings). It uses combined prediction approach which assures by design that IBU is only mapped within the sealed surface outline of the IMD.



Change products 2018-2021 in 20m





Imperviousness Density Change (IMDC) - depicts Imperviousness change on a continuous range (decrease: 0-99 correspond to -100% to -1%; increase: 101-200 correspond to 1% to 100%).

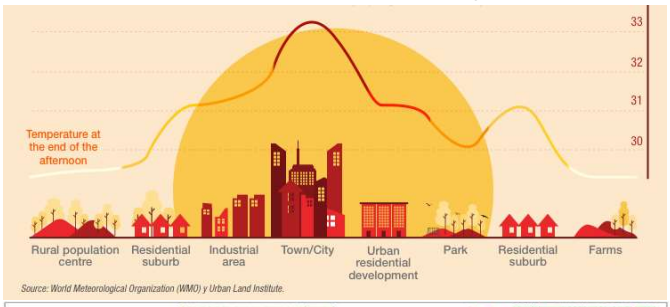
Imperviousness Density Change Classified (IMCC) - depicts thematically classified change (new sealed, loss of sealed, increased imp. density, decreased imp. density, unchanged areas).

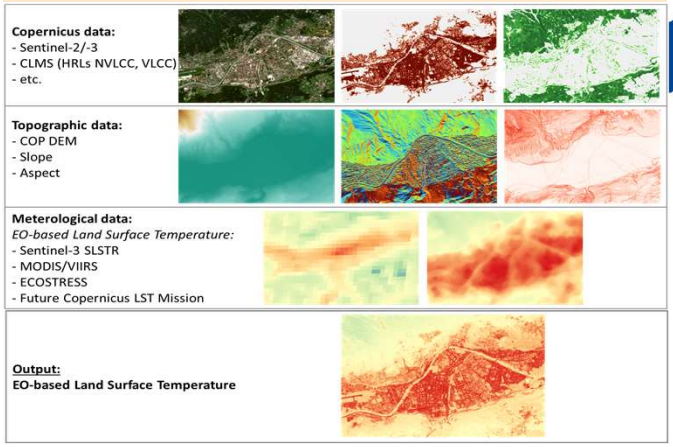
Imperviousness Built-up Change (IBUC) - indicates the changes in increases and decreases of built-up / non-built-up as well as stable (unchanged) built-up and non-built-up areas.

HRL NVLCC Application

Heat Island Monitoring

The heat island effect is characterized as being the cause of higher temperatures in towns and cities than in their surrounding areas.





Schematic of multi-sensor and multi-resolution data fusion process using an ML-based regression modelling approach. The schematic shows that a combination of HRL NVLCC IMD and HRL VLCC TCD, topographic, and EO-based datasets is used to train an AI-based machine learning model to downscale the Land Surface Temperature (LST).

This approach addresses a key limitation in Urban Heat Island (UHI) research - the lack of high-resolution thermal data. By downscaling LST data using high-resolution imperviousness data, researchers can more accurately monitor and analyze UHI effects, leading to better-informed urban planning and mitigation strategies.

Get more information

HRL NVLCC: Imperviousness density (IMD)

HRL NVLCC: Imperviousness Built-up (IBU)

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