Lobelia.

URBIS24 | URBan Insights from Space

16–18 September 2024 | ESA-ESRIN | Frascati (Rome), Italy

esa

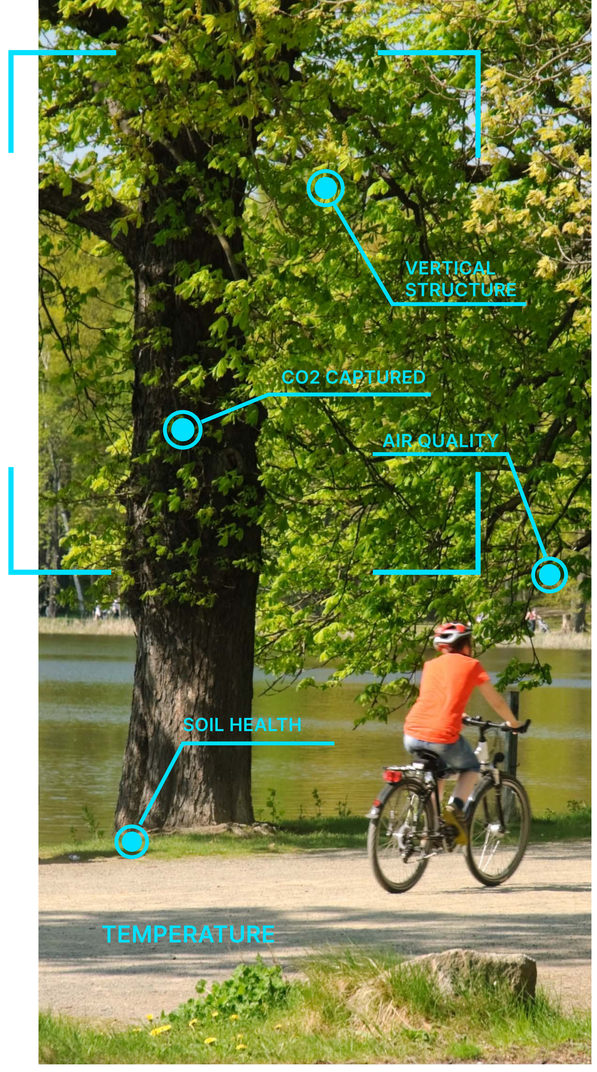
Assessing Urban Biodiversity: A multidisciplinary approach

Martí Perpinyà-Vallès[1], Claudia Huertas[1], Thaís Fontenelle[1]

[1]Lobelia Earth; Doctor Trueta Street, 113, 1st Floor, 08005 Barcelona.

In urban environments, nature-based solutions and the integration of natural capital into planning are crucial to creating **climate resilient cities**. These strategies act as carbon sinks, improve biodiversity and overall well-being, providing cleaner air, reducing heat and mitigating flood risk. Incorporating these elements into urban planning ensures sustainable development and climate resilience, highlighting the importance of **enhancing and protecting our urban ecosystems and forests**. Lobelia Earth responds to these environmental challenges with an innovative platform that leverages web technology, **satellite data from various sources** (optical, radar and LiDAR) and climate science.

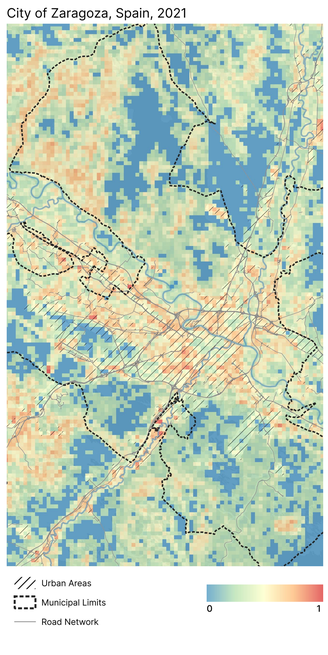
Through big data analysis methods and the application of artificial intelligence and landscape ecology analysis methods, we measure **key indicators such as aboveground biomass (AGB), soil moisture, phenology, fragmentation and connectivity**. This multifaceted approach permits an accurate assessment of urban biodiversity and natural capital, facilitating informed decision making for sustainable management and climate change mitigation in urban and peri-urban forests. These efforts are essential to address environmental degradation and promote sustainable growth that respects the limits of our natural resources.



Habitat Fragmentation

Landscape Fragmentation Index (LFI)

City of Zaragoza, Spain, 2021



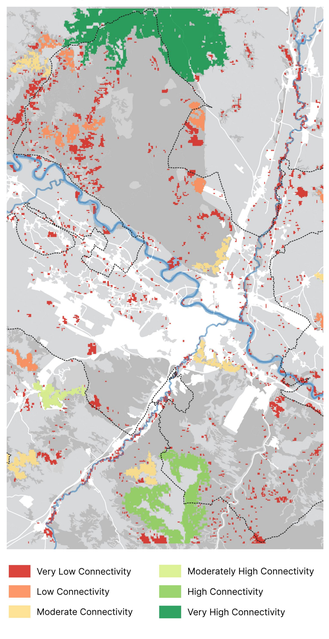
LFI indicates habitat fragmentation, reducing connectivity and increasing the vulnerability of species to extinction.

This indicator is calculated from metrics such as edge density and mean patch size, used to assess ecological integrity.

Species Connectivity

Integral Index of Connectivity (IIC)

City of Zaragoza, Spain, 2021

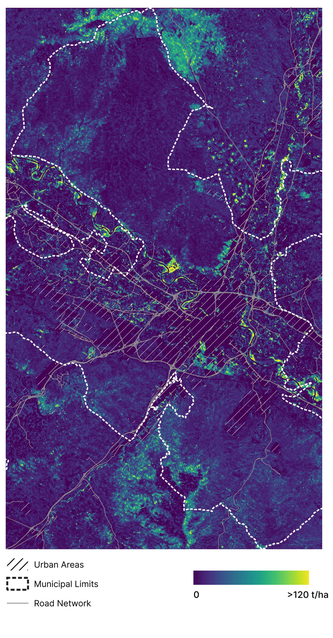


Functional connectivity is crucial for species dispersal and survival, permitting genetic flow and adaptation to environmental change. This indicator measures the ability of species to move and disperse across the landscape, assessed using models of passage resistance and potential routes of movement.

Vegetation Biomass

Above Ground Biomass (AGB)

City of Zaragoza, Spain, 2020



AGB reflects the productivity of an ecosystem, directly related to the capacity to support a high diversity of species.

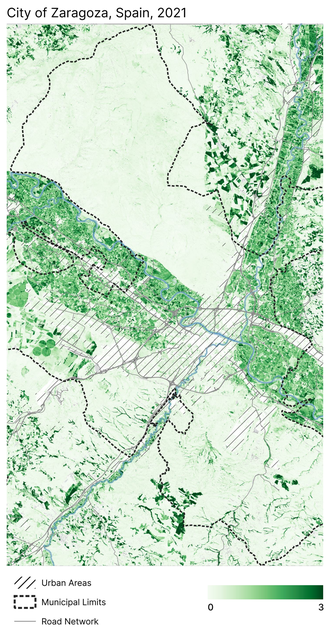
It can directly be translated into the above ground carbon stocks of an area.

It estimates of the total above ground biomass density in an area, used to assess carbon stocks and productivity of forest ecosystems.

Vegetation Phenology

Seasonal Amplitude

City of Zaragoza, Spain, 2021

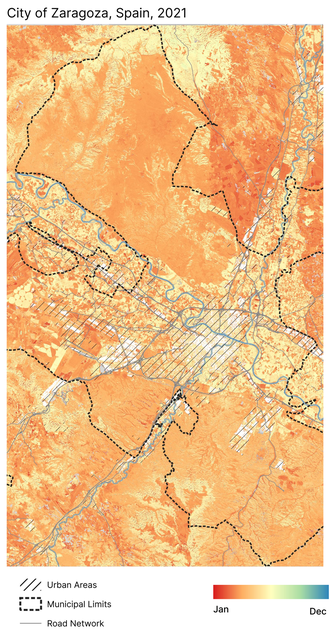


Phenology is an indicator that measures seasonal changes in vegetation, such as sprouting, growth, maturation and senescence, using satellite data. Changes in phenology can affect the availability of resources for wildlife, the timing of biological events and the structure of ecosystems.

Vegetation Phenology

End of season

City of Zaragoza, Spain, 2021

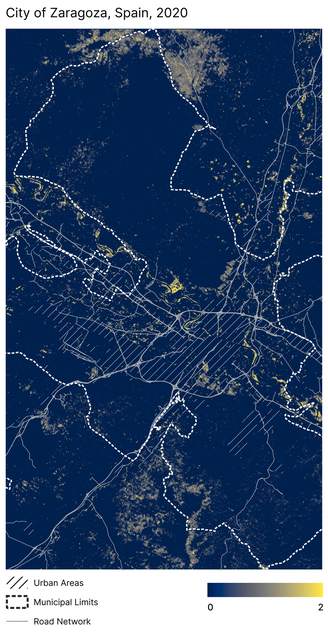


Senescence monitoring is crucial to assess vegetation cycle closure and to understand how climatic changes can alter phenological cycles and affect biodiversity, as well as to detect vegetation degradation or mortality.

Vegetation Structure

Foliage Height Diversity (FHD)

City of Zaragoza, Spain, 2020



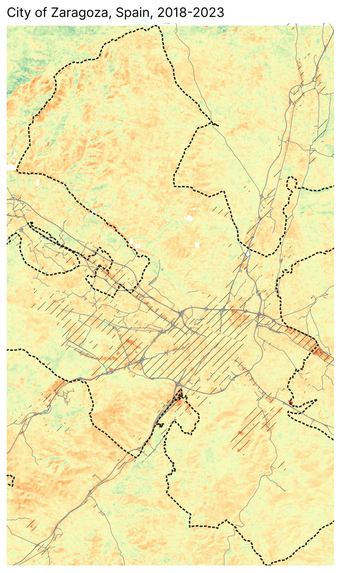
FHD represents the diversity in the vertical structure of tree-covered areas.

It highlights the vertical diversity in forests, directly linked with habitat provision, generational succession and restoration/ degradation state.

Soil Health / Condition

Soil Moisture (SM) Amplitude

City of Zaragoza, Spain, 2018-2023



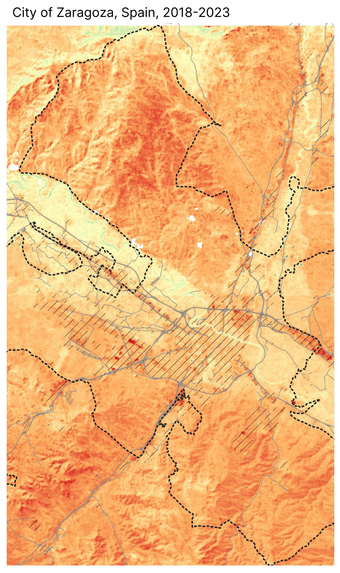
Soil moisture is critical to the health of ecosystems and the diversity of plant and animal species that depend on water resources.

SM Amplitude is extracted from long time-series and highlights areas with great variability of SM over time.

Soil Health / Condition

Soil Moisture (SM) (Mean)

City of Zaragoza, Spain, 2018-2023



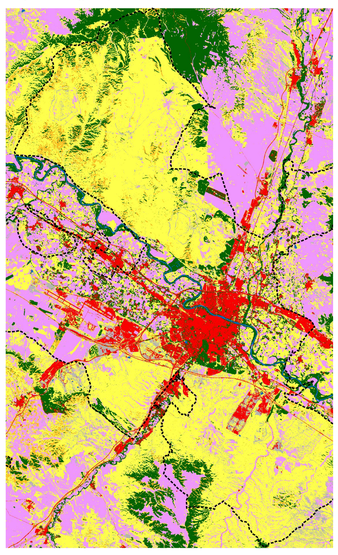
Soil moisture is critical to the health of ecosystems and the diversity of plant and animal species that depend on water resources.

The average value of SM highlights the difference between dry and wet areas, showing a clear distribution of drylands, croplands and tree-covered areas.

Habitat Types

Land Use and Land Cover

City of Zaragoza, Spain, 2020-2021, ESA WorldCover



Land cover and land use affect the availability and quality of habitats, influencing biodiversity in terms of species and ecosystems. This indicator refers to the classification and analysis of land cover and land use, based on satellite data and thematic maps, to study landscape changes and trends.

Methodology

Data sources

Different data layers are used for each product, consisting of satellite data mostly (**Sentinel-1,2,3, MODIS, Landsat 8-9, GEDI, SMAP, SMOS**), but including Digital Elevation Models, Land Cover datasets and biological and climatic variables.

Model variety

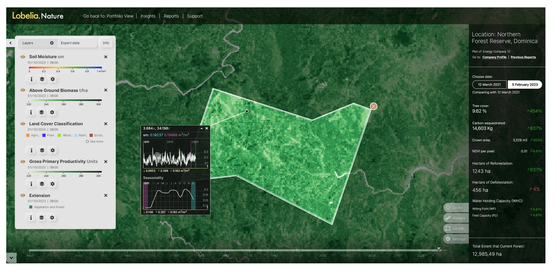
Each variable is obtained through different modeling techniques. **Physics-based models** are used for soil moisture estimation, using Land Surface Temperature and vegetation indices to drive its downscaling as proxies for evapotranspiration. Connectivity is obtained through **ecological modelling** taking into account landscape features and potential species movement. **Deep Learning** for satellite data fusion is used for all the vegetation structural variables such as canopy height, structure and above ground biomass.

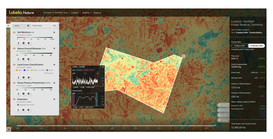
Owing to the complexity to measure the different aspects of biodiversity, this study aims to shed light into the need of multi-indicator measurements at the landscape level. Each indicator highlights a different component of the **Essential Biodiversity Variables** (EBVs).

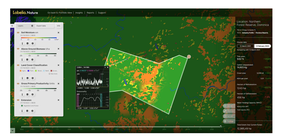
- 10-30 m Resolution
- Model variety: DL, physics-based, ecological
- Daily/monthly/yearly time-series analysis
- Satellite data fusion from different sources
- State-of-the-art validated methods
- Automatic processing of new areas via API

Dashboard

The Lobelia.Nature platform, featuring Lobelia Explore technology, delivers data through a robust and intuitive interface. This platform facilitates viewing time series graphs, performing temporal analyses, and accessing a variety of advanced data exploration features.







Contact: info@lobelia.earth

www.lobelia.earth