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COPERNICUS4REGIONS 2025

SATELLITE DATA FOR THE CHARACTERIZATION OF URBAN AREAS

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> Use of Sentinel-2 data improved both the quality and processing time of artificial surface identification, providing valuable support for sustainable urban planning
>
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> *Tuscany Region*

False-color hyperspectral image of the Lucca area (Italy) | Copernicus Sentinel 2 L-2A (2024) | Credits: Tuscany Region – Regional Territorial Information Base,

The service utilizes Sentinel-2 satellite data to distinguish between natural and artificial surfaces in Tuscany, providing the basis for identifying anthropic materials with the aim of supporting efficient land management and informed administrative actions in territorial planning.

THE CHALLENGE

The challenge is to identify artificial materials through AI-driven processes. While the final service will use hyperspectral satellite data, Sentinel-2 imagery was initially employed to distinguish between natural and artificial surfaces. Copernicus solutions, particularly Sentinel-2, offer frequent and high-quality updates tailored to specific needs. This application supports urban planning and environmental protection, offering data-driven insights for efficient land management. By addressing challenges such as climate change and urban heat islands, it aligns with European and national sustainability goals, equipping decision-makers with the tools to mitigate environmental impacts.

THE SPACE SOLUTIONS

The solution leverages Earth Observation data, including Sentinel satellites (Sentinel-2 imagery), to provide accurate, reliable, and timely information on land cover. The service, developed within a project co-funded by the Italian Space Agency, is currently offered and operational by the Tuscany Region.

Specific algorithms based on the Random Forest method analyze Sentinel-2 multispectral imagery to distinguish between natural and artificial surfaces in urbanized areas, leveraging regional maps to support the classification of complex features such as roads, whose narrow, elongated shapes often fall below the satellite's spatial resolution and result in mixed pixels that hinder interpretation.

The regional land use and cover map has been updated to include the percentage of natural and artificial surfaces for each urbanized area. Ongoing developments and those projected for 2025 will incorporate hyperspectral satellite data to identify the materials characterizing artificial surfaces, further improving the precision and accuracy of monitoring.



Classification map of the urbanized territory of the city of Lucca (Italy) overlaid on an RGB orthophoto.
The semi-transparent red areas represent the "artificial surfaces" class. Copernicus Sentinel 2 L-2A (2024) | Credits: Tuscany Region – Regional Territorial Information Base, pursuant to Article 55 of Regional Law 65/2014.

THEMATIC AREA

Territorial Management and Urban Planning

REGION OF APPLICATION

Tuscany Region

SENTINEL MISSION USED

S2

COPERNICUS SERVICE USED

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THE BENEFITS AND THE BENEFICIARIES

The primary beneficiaries of this operational service are public administrations, particularly in the Tuscany Region, which use it to enhance their land use and cover maps.

The solution helps improve administrative decision-making by providing up-to-date data on land cover characteristics. This, in turn, supports efficient urban planning and the implementation of sustainable land use policies. Secondary users, such as research institutions, will also benefit from the future development of the service, gaining valuable insights into urban artificial materials and heat islands, which will support studies on climate change and environmental impacts.

By adding data on the percentage of natural and artificial surfaces to existing land use maps, this service enhances the tools available for urban planning with minimal additional costs.

The solution reduces the need for costly and time-consuming field surveys, increasing the efficiency of monitoring practices. Ultimately, this leads to direct benefits for citizens, such as improved quality of life and a more sustainable urban environment. The service also promotes transparency, as all the data is publicly accessible, allowing everyone to contribute to sustainable development.

	TIER 1 SERVICE PROVIDER	TIER 2 PRIMARY USER	TIER 3 SECONDARY USER	TIER 4 END USER BENEFICIARIES
SERVICES AND BENEFITS	Sentinel 2 L-2A	Quantitative information on natural and artificial surfaces	Input data for urban areas characterization, support for environmental research, and insights into heat islands challenges	Improved efficiency of administrative actions in territorial planning, supporting informed decision-making and sustainable urban and environmental management
BENEFICIARIES	Tuscany Region	Tuscany Region and local authorities	Research institutions (e.g., universities) and environmental agencies	Citizens of Tuscany and Italian society at large

EU POLICY / DIRECTIVE

Cohesion Policy

TYPE OF SERVICE PROVIDER

Public Service

TYPE OF FUNDING SOURCE

National Space Programmes

USAGE MATURITY LEVEL

4



A FUTURE WITH COPERNICUS

In the future, Sentinel satellites will be crucial in maintaining the solution, ensuring that the data remains up-to-date and reliable. As the system matures, it will offer increasingly detailed insights, further improving the service's accuracy and effectiveness. Additionally, the service will be enhanced with hyperspectral data from the PRISMA mission of the Italian Space Agency, enabling the identification of different materials in artificial surfaces detected using Sentinel-2 multispectral data. This integration will enhance the accuracy of monitoring and improve the overall effectiveness of the service.



DID YOU KNOW?

This innovative service leverages frequent satellite data to provide insights into urban land cover. By combining Sentinel-2 multispectral imagery with future hyperspectral data from the PRISMA mission, this approach offers a unique way to characterize urban territories. Public administrations and researchers value its efficiency, transparency, and contribution to sustainable urban planning.

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