# UDENE
## from Vision to Action

Successful Proposals
from the UDENE
Open Calls

UDENE

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# **U**rban **D**evelopment **E**xplorations using **N**atural **E**xperiments

UDENE is a Research and Innovation project funded under the Copernicus International Partners Call, sponsored by EUSPA within the Horizon Europe 2023 Work Programme. The project supports evidence-based urban development by leveraging large volumes of Earth Observation (EO) data from the Copernicus programme, complemented by local data sources.

At its core, UDENE provides a virtual laboratory for urban development, enabling planners, decision-makers, and innovators to test and compare development ideas using natural experiments—real-world examples of similar urban interventions across different locations and time periods. Through advanced causal analysis and accessible EO data in Data Cube format, UDENE helps users better understand potential impacts and supports more informed, sustainable urban planning decisions.
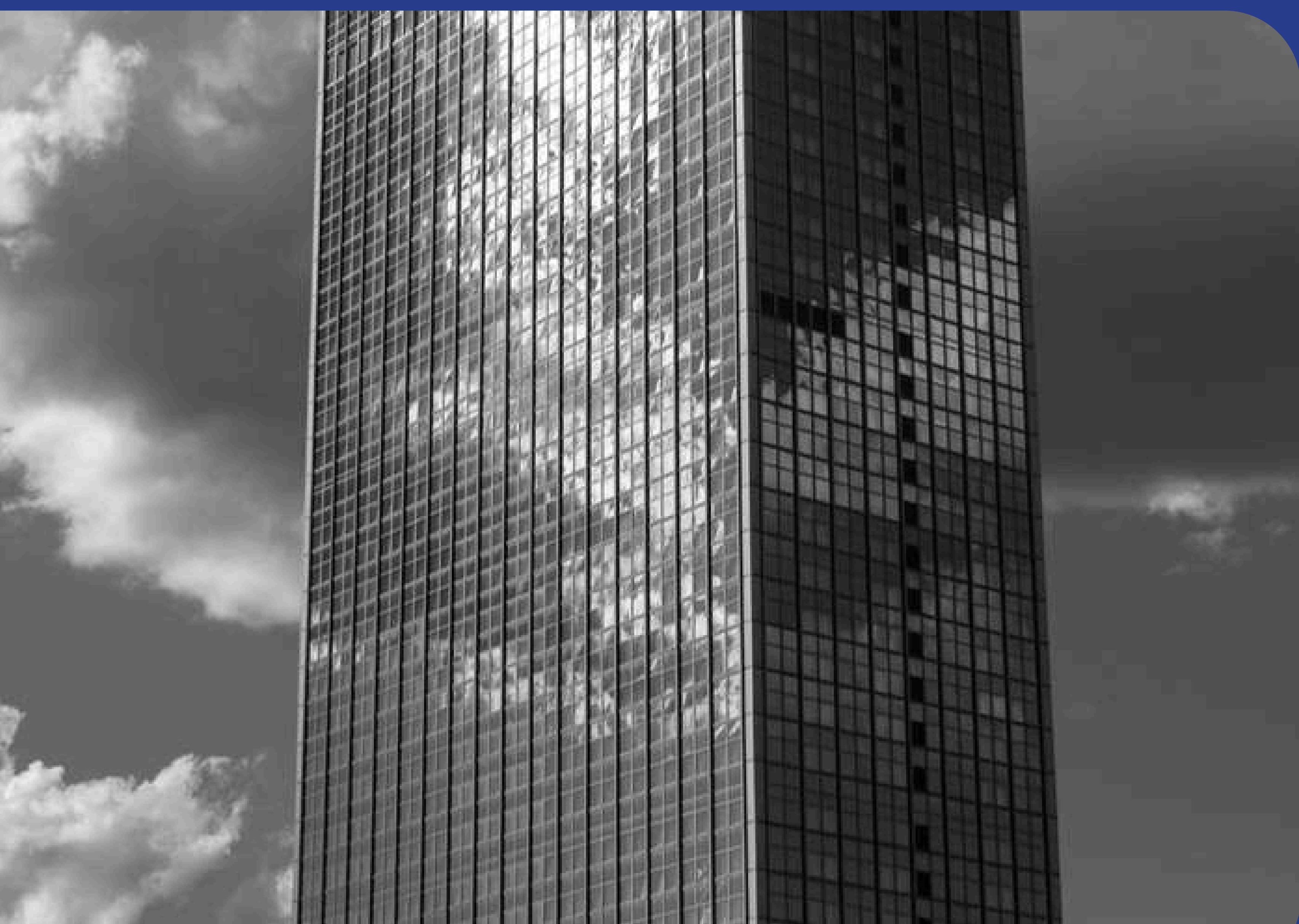
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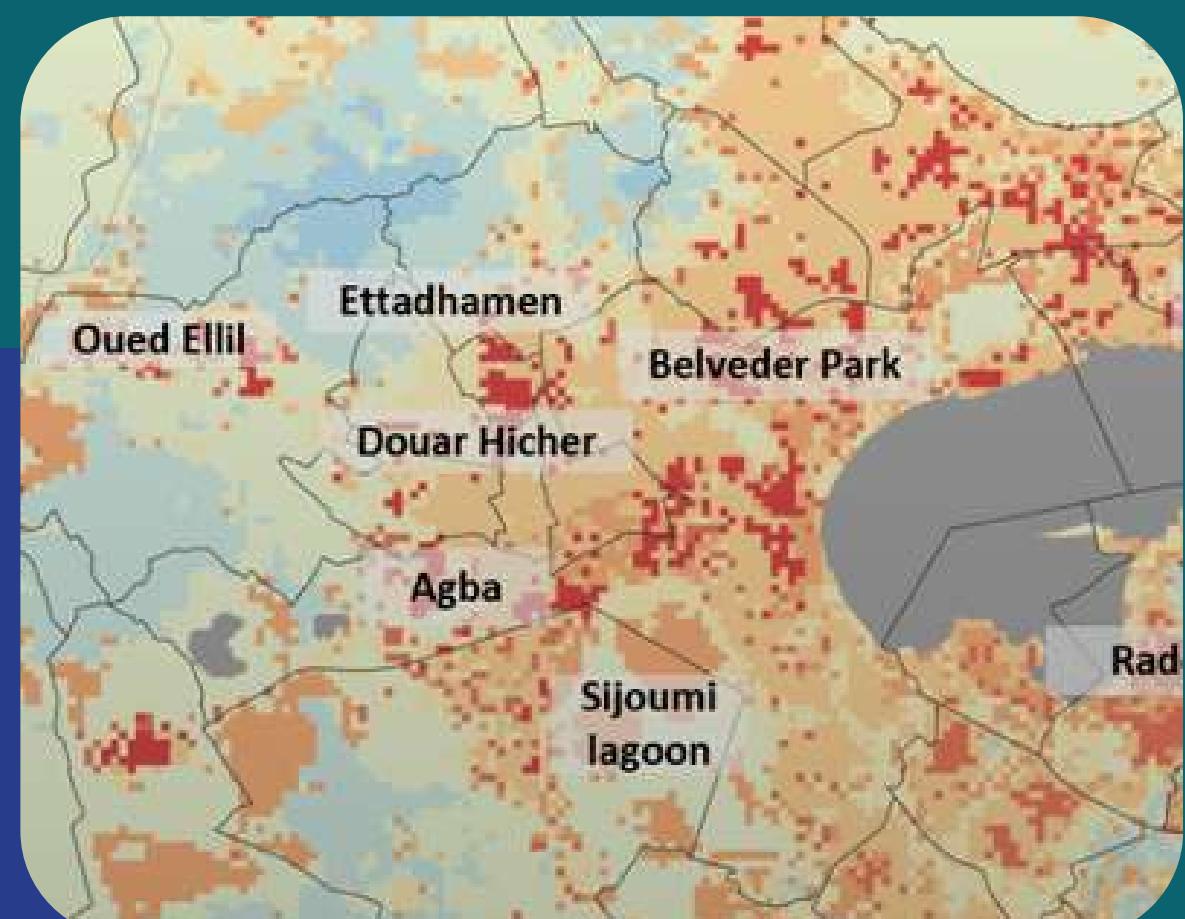
## Effect of a linked park system on heat load
Tunis, Tunisia

The urban development idea revolves around the creation and enhancement of a linked park system within the city to mitigate urban heat islands (UHI). This idea would involve the strategic design and expansion of green spaces, parks, and urban forests to counteract the negative impacts of increased temperatures and create a more comfortable and sustainable urban environment. The idea is to create not just a series of green spaces, but a cohesive system that benefits the environment, the climate, and the community.
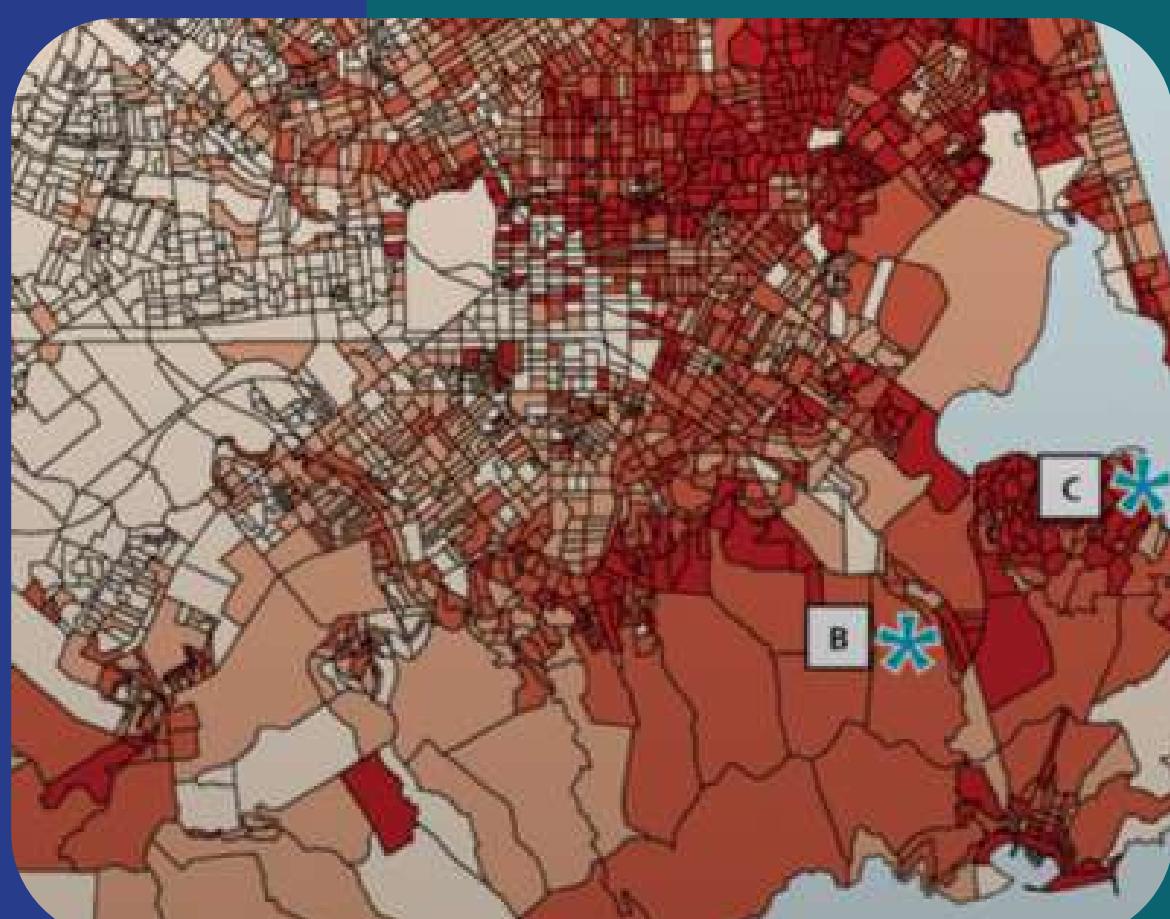


## High-rise district effect on earthquake preparedness
Istanbul, Türkiye

To ensure earthquake-resistant urbanization, realization of evidence-based land use planning to test the earthquake preparedness of high-rise buildings is an important concern. Sustainable Development Goal 11 (SDG11) titled "Sustainable cities and communities" is constituting specific reference for such an achievement in resilient urbanization.
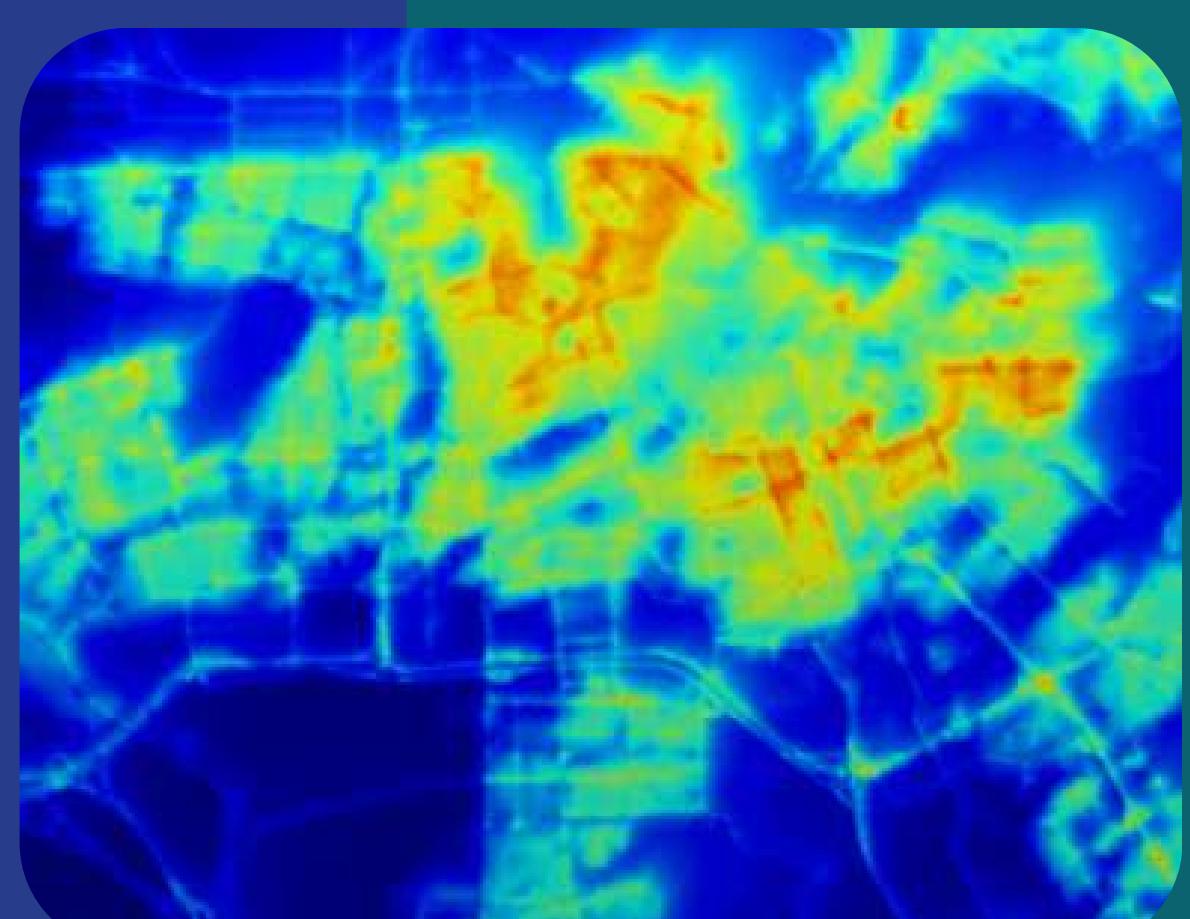


## Effect of a new ring road on air quality
Novi Sad, Serbia

The purpose and final aim of this use case is to estimate the change of pollutant emissions caused by significant transport infrastructure changes, such as building a city bypass and retouring the heavy traffic, or creation of new pedestrian and semi-pedestrian areas.

# The Open Calls

## Mission

This year, the UDENE Project successfully concluded two cascade funding opportunities to promote the integration of Earth Observation (EO) tools in education and business environments across Serbia, Tunisia, and Türkiye. Each call provided €10,000 in funding per successful proposal to foster sustainable urban development, support EO knowledge transfer, and accelerate the uptake of Copernicus–based solutions in partner countries.

## Open Call #1

Open Call #1: *UDENE Tools Integration in Geodata Science Education* aimed to empower educators, trainers, and institutions to integrate UDENE's EO–based tools into geodata science and vocational training programmes.

## Open Call #2

Open Call #2: *UDENE Tools for Global Business Solutions that Accelerate Copernicus Adoption* targeted SMEs and EO providers, supporting the development of scalable, market–ready solutions using UDENE tools and promoting international collaboration for global EO adoption.

# UDENE Tools in Geodata Science Education – Awarded Proposals

# Air Quality and Carbon Footprint Modelling with Copernicus & UDENE Tools

**Yildiz Technical University, Department of Environmental Engineering**

## CONCEPT

This course module will introduce a practice-oriented geodata science curriculum focused on urban air quality and carbon footprint modelling using Copernicus and UDENE tools. Developed by Yildiz Technical University, the module will combine Earth Observation (EO), environmental engineering, and urban sustainability to enable data-driven analysis of air pollution and greenhouse gas emissions in cities. The course will reflect a shift from theory-based teaching towards hands-on, real-world learning, aligned with European climate and sustainability priorities.

## INTENDED PARTICIPANTS

The course will target Master's level students in environmental engineering, urban studies, and related geospatial disciplines who are interested in applying Earth Observation data to urban sustainability challenges.

## COURSE OVERVIEW

The module will be delivered over six weeks (3 ECTS / 90 hours) and will follow the UDENE virtual laboratory approach: define, acquire, process, design, test, and evaluate. Students will work with open-access EO datasets and tools, including the UDENE EO Exploration Tool, Copernicus Atmosphere Monitoring Service (CAMS), Sentinel-5P, and Google Earth Engine.

Through a combination of lectures, data labs, and applied case studies, participants will analyse urban air pollutants (such as $NO_2$ and $PM_{10}$), estimate carbon emissions, validate EO data with local sources, and explore mitigation scenarios for major cities. The course will emphasise practical interpretation of results and comparison of urban environments using real-world examples.

## IMPACT

The course will strengthen students' skills in using Earth Observation data for urban environmental analysis, improving their employability in sustainability, planning, and climate-focused roles. By generating reusable learning materials and practical case studies, it will support more evidence-based approaches to sustainable urban development beyond the classroom.

# Geodata Science for Multi-Sectoral Resilience

**Özyeğin University**

## CONCEPT

This course will integrate UDENE's Earth Observation tools, including the Exploration and Matchmaking Tools, into an interdisciplinary geodata science curriculum focused on multi-sectoral resilience. Embedded in Özyeğin University's Sectoral Solutions programme, the course will combine EO data analysis with social and spatial perspectives to support evidence-based decision-making in areas such as climate adaptation, food systems, and public health.

## INTENDED PARTICIPANTS

The course will target undergraduate and graduate students from diverse backgrounds, including public policy, data science, environmental engineering, and urban studies, as well as selected public sector and local governance professionals.

## COURSE OVERVIEW

Delivered as a 3 ECTS module (75–90 hours), the course will be structured into four modules covering EO fundamentals, Copernicus data and UDENE tool use, applied urban case studies, and project development. Participants will work with open EO datasets and UDENE tools to analyse real-world challenges such as urban heat, food resilience, and access to health services, while developing interdisciplinary solutions through team-based projects and scenario analysis.

## IMPACT

The course will strengthen participants' capacity to use EO data for resilience-oriented planning and policy design, supporting more inclusive and evidence-based approaches to urban and regional challenges. By producing transferable learning materials and fostering cross-sectoral skills, the module will contribute to wider uptake of Copernicus-based solutions and support sustainable development beyond the academic setting.
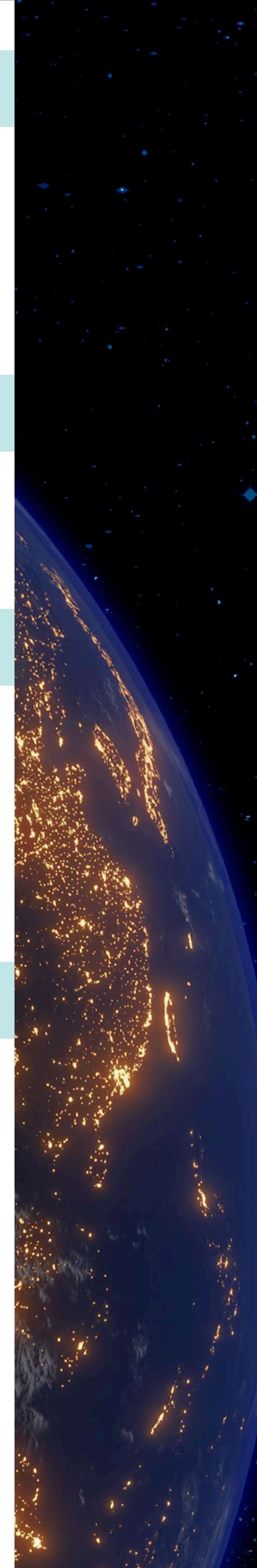
# EO Data Management and Applications in Sustainable Urban Development
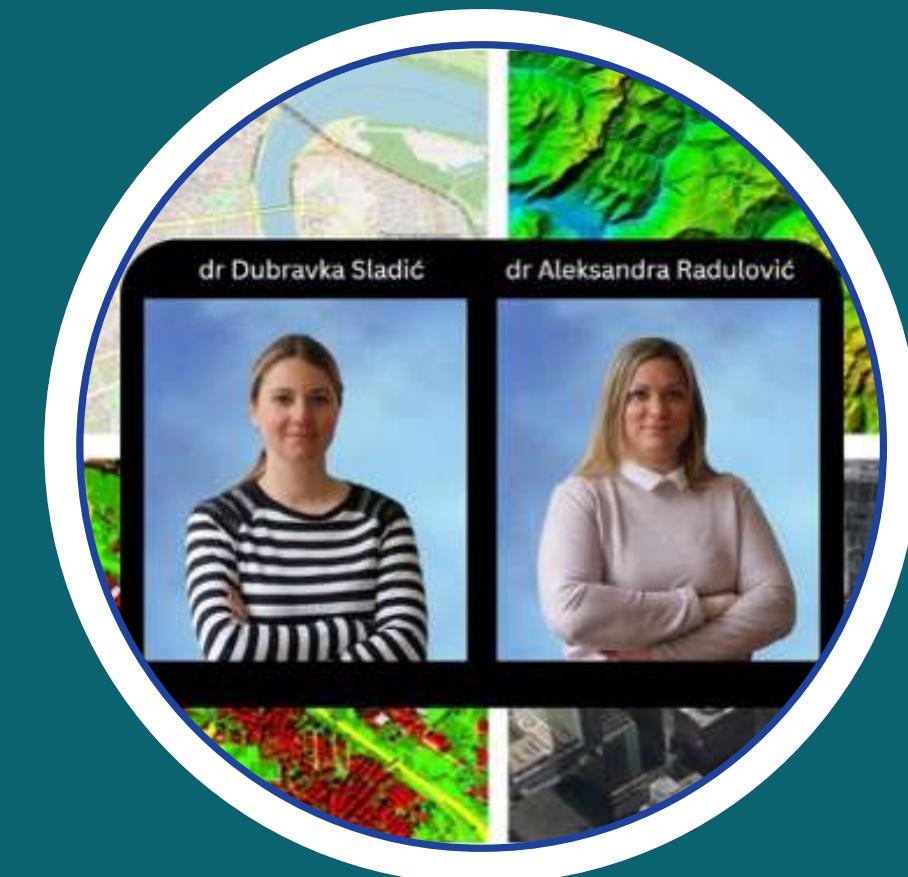
**University of Novi Sad – NSGeoLab**

## CONCEPT

The course will provide a progressive, feasible, and vocationally aligned curriculum, combining theoretical foundations, tool-based practice, and real-world case studies. It will integrate Copernicus EO data and UDENE tools to equip learners with geospatial skills applicable to urban development challenges. By offering low-threshold access to EO tools and open data, the course will promote inclusivity while setting performance expectations that demand active learner engagement and ensure professionally applicable competencies.

## INTENDED PARTICIPANTS

The course will target future urban planners, decision-makers, geospatial professionals, and other stakeholders involved in sustainable urban development. It will also welcome learners with diverse skill levels, including non-technical users, fostering accessibility and broad participation across sectors.

## COURSE OVERVIEW

The course will be modular, combining lectures with practical lab sessions:
- Module 1: EO foundations, Copernicus services, and UDENE framework.
- Module 2: EO data management and applications in sustainable urban development.
- Module 3: UDENE tools for visualization, simulation, and scenario-building.
- Module 4: Case studies (≥50% of course), including urban heat mitigation, building energy efficiency, and mobility analysis in Novi Sad.
- Module 5: Individual assignments assessing problem-solving, EO tool use, and scenario-based recommendations.

Learners will preprocess EO datasets, apply UDENE tools to real-world challenges, and deliver technically robust, contextually relevant solutions.

## IMPACT

The course will strengthen urban planners' and geospatial professionals' capacity to address urban challenges, supporting sustainable infrastructure, improved mobility, green spaces, and better air quality. It will align with EU priorities, foster cross-border knowledge transfer, and ensure inclusivity through open data and low-threshold tools. Skills acquired will be applicable across sectors and transferable to other European regions.

# Advanced Environmental and Urban Analyses Using Copernicus

**Dr. Miljan Šunjević - University of Novi Sad**

## CONCEPT

The course will provide a specialized, hands-on training program fully focused on the UDENE Exploration Tool. It will enable participants to perform advanced environmental and urban analyses using Copernicus Earth Observation datasets. By concentrating on a single sophisticated platform, the course will teach learners not only how to navigate its interface but also how to design, execute, and interpret experiments with real-world relevance. Participants will gain deep technical mastery, progressing from basic dataset navigation to complex multi-parameter analysis of urban and environmental scenarios.

## INTENDED PARTICIPANTS

The course will be suitable for professionals, researchers, and students working in urban planning, environmental management, climate resilience, or related fields. It will accommodate learners with varying levels of prior technical expertise, ensuring that both beginners and experienced users of Earth Observation data can develop strong analytical skills.

## COURSE OVERVIEW

The course will carry 3 ECTS (75–90 hours) and will include four modules: fundamentals of EO and the Exploration Tool, environmental indicators, scenario design, and an independent analysis project. Participants will progress from basic tool navigation to designing and interpreting complex environmental analyses, using step-by-step exercises and clear visual guides.

## IMPACT

The course will provide in-demand skills for environmental management, urban planning, and climate resilience. Graduates will be able to monitor air quality, heat stress, flooding risks, and vegetation loss, informing policy and urban design.

It will support the European Green Deal and Copernicus uptake strategy, reinforcing Europe's EO expertise. Openly licensed materials will allow replication and long-term knowledge dissemination across sectors and borders.
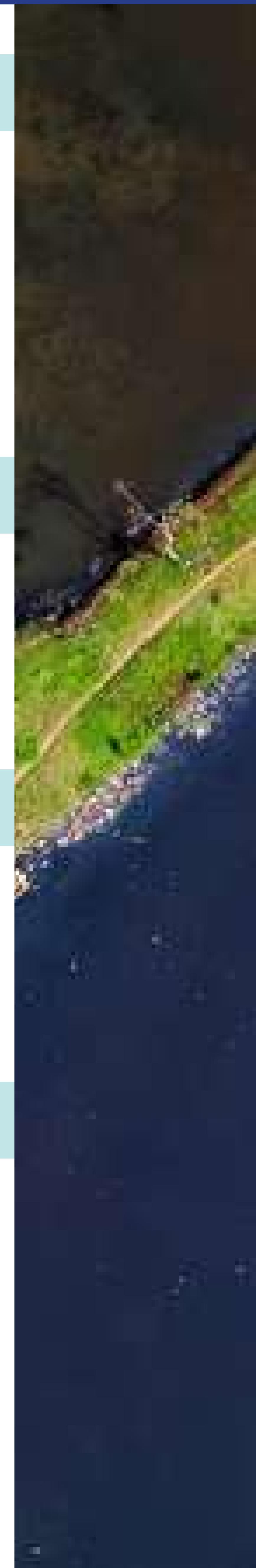
# Vertical Urban Farming Enhanced by EO & AI

**FeedIN GREEN (Startup – Tunisia)**

## CONCEPT

The course will introduce participants to the latest innovations in vertical urban farming enhanced by Artificial Intelligence. It will combine theoretical knowledge with practical applications, guiding learners from foundational concepts in controlled-environment agriculture, hydroponics, and sensor-based monitoring to advanced AI-driven decision support, automation, and sustainability metrics. Through hands-on prototypes developed by FeedIN GREEN, learners will connect abstract knowledge with real-world applications and develop the skills needed to implement smart, sustainable urban farming solutions.

## INTENDED PARTICIPANTS

The course will target motivated learners from diverse educational and socio-economic backgrounds, including those with limited prior experience in agritech. Special attention will be given to urban communities, women, and underrepresented groups interested in agriculture, technology, and sustainability.

## COURSE OVERVIEW

The course will be structured into progressive modules covering three pillars:
1. Sustainable vertical agriculture practices – introducing ecosystems, controlled environment design, and resource-efficient farming.
2. AI and digital tools for monitoring and automation – focusing on sensors, IoT, AI algorithms for crop prediction, and integration of Copernicus datasets through UDENE tools.
3. Entrepreneurship and community impact – addressing business case development, social inclusion, and local food system improvements.

Each module will include hands-on labs, field demonstrations, and collaborative projects, culminating in a capstone feasibility report. Blended learning approaches will be used to ensure accessibility and inclusivity.

## IMPACT

The course will support urban agritech by enabling participants to develop AI-driven vertical farming solutions that optimize yields, reduce resource use, and create green jobs. It will enhance food security, promote healthy diets, and foster sustainable skills, while producing scalable tools and business models applicable across European cities and beyond.

# UDENE Tools for Global Business Solutions that Accelerate Copernicus Adoption – Awarded Proposals

# Urban Heat Island Mitigation and Water-Efficient Agriculture

**EasyFlex (SME – Türkiye)**

## CONCEPT

FlexiUDENE will combine UDENE tools with Easyflex's IoT/edge platform to provide actionable insights for municipalities and farmers. The platform will support Urban Heat Island mitigation and water-efficient agriculture by fusing Sentinel-2 EO data with soil and micro-climate sensors. It will deliver real-time alerts, thematic maps for plant health, water stress, and heat, and collaborative dashboards, all operating even in low-connectivity areas.

## NOVELTY

FlexiUDENE will introduce hybrid data fusion, integrating EO and sensor data in near-real-time, while automated UDENE Matchmaking will ensure reliable EO provider selection. Collaborative workspaces will allow multi-stakeholder analysis, and edge computing will guarantee fast, low-latency alerts. Early validation will target 10–30% water savings, 5–15% yield improvement, and high alert accuracy.

## CHALLENGES ADDRESSED

FlexiUDENE will tackle several key challenges in both agriculture and urban planning. It will overcome data silos by unifying EO and IoT data within a single, standardized schema aligned with UDENE protocols. Rural connectivity limitations will be addressed through an edge-based store-and-forward architecture that will ensure continuous operation in low-internet areas. The cost of scaling precision agriculture and UHI monitoring will be mitigated through selective open-source adoption combined with UDENE-guided EO provider selection. Operational complexity will be reduced via pre-configured templates for drought monitoring and UHI mapping, enabling rapid deployment and immediate value for municipalities and farmer cooperatives.

## IMPACT

FlexiUDENE will reduce costs and boost yields for farmers, enabling up to 90% water savings and an 80% yield increase, while open-source tools and MOOC (Massive Open Online Course) training for farmers will expand accessibility and digital skills. For the agri-tech sector, it will create new revenue streams and jobs, and it will contribute to climate resilience, food security, and rural digitalization. Aligned with EU policies and SDGs, it will be designed for scalable adoption across Türkiye, Europe, and globally.

# Urban Growth Scenarios Anticipating Disaster Resilience

**Anofa (SME – Türkiye)**

## CONCEPT

Anofa will provide advanced geospatial analytics and urban resilience services to municipalities, development agencies, and industry, leveraging its expertise in disaster risk modelling and urban planning. By integrating UDENE's Exploration and Matchmaking tools, Anofa will deliver evidence-based and scalable urban solutions. The project will feature two main cases. First, the Planex platform will serve as the innovation case, modelling scenario-based urban development at the building, household, and individual levels. Planex will forecast future urban growth under multiple planning scenarios, combining EO data with user-led urban or land use plans. Second, in the business case, Anofa will integrate UDENE tools into its multi-hazard risk assessments for industrial organisations under the EU-funded RESMAR project.

## NOVELTY

The innovation of this project will lie in its forward-looking urban modelling approach, as Planex will simulate future urban forms rather than relying solely on historical data. By integrating UDENE's Exploration and Matchmaking tools, the project will provide quantitative evidence of how these tools enhance decision-making in urban planning and industrial risk assessment. Furthermore, the project will combine technical urban simulations and consultancy services, creating scalable solutions that are both scientifically rigorous and commercially viable.

## CHALLENGES ADDRESSED

The project will tackle three primary challenges. First, it will integrate EO data into predictive urban modelling, linking foresight simulations with observational evidence. Second, it will scale access to tools and insights through consultancy, SaaS platforms, and potential API connections, ensuring usability across different sectors. Finally, the project will demonstrate the feasibility of applying these solutions in both technical modelling and consultancy contexts, paving the way for wider adoption.

## IMPACT

The proposed solution will generate economic and societal benefits by aligning urban investments with environmental constraints, lowering disaster and climate adaptation costs, and increasing planning efficiency through faster, data-driven decision-making.
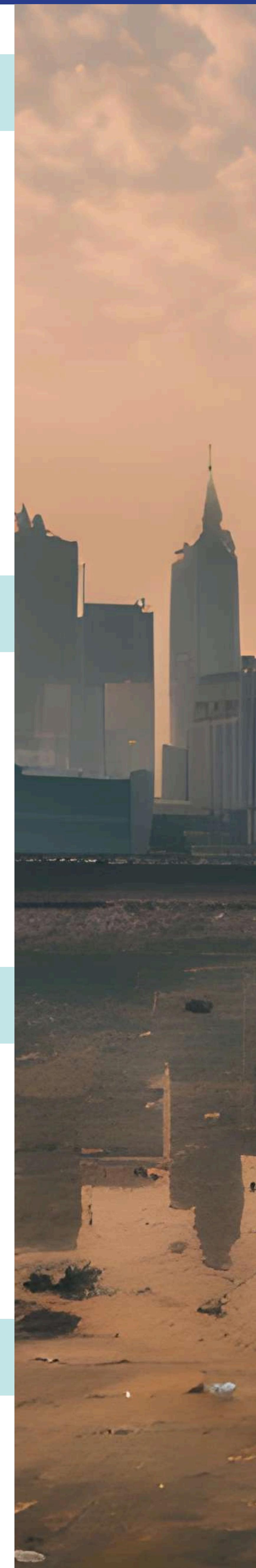
# EO-Driven Urban Heat Intelligence

**GILAB (SME – Serbia)**

## CONCEPT

GILAB will develop UHI-Insight: Belgrade pilot, an EO-driven platform integrating UDENE tools to support data-driven urban planning. The solution will pilot in Belgrade as a feasibility study to demonstrate its technical, operational, and business viability. UHI-Insight will transform Copernicus EO data, DailyMeteo meteorological grids, and OpenStreetMap datasets into street-level heat simulations, allowing planners to test interventions such as increased vegetation, reflective materials, or reduced traffic areas. The platform will combine automated data integration, a spatio-temporal Random Forest model, and an interactive dashboard for dynamic "what-if" scenario testing, providing a scalable and replicable tool for climate-smart urban decision-making.

## NOVELTY

The proposed solution will be innovative in delivering a lightweight, proof-of-concept EO-based service capable of producing street-level heat intelligence. By combining multiple open datasets with advanced machine learning, UHI-Insight will generate predictive thermal maps and actionable insights that urban planners will use to guide interventions. The platform will integrate UDENE tools with heterogeneous EO, meteorological, and urban datasets in a single workflow. Its spatio-temporal Random Forest model will allow users to simulate the impact of potential urban adaptation measures on local temperatures.

## CHALLENGES ADDRESSED

UHI-Insight will overcome technological barriers by integrating UDENE tools with heterogeneous EO, meteorological, and urban datasets, enabling automated extraction of urban heat indicators. The platform will provide a scalable, reproducible workflow that cities can adopt with minimal infrastructure and computational requirements.

## IMPACT

UHI-Insight will deliver economic, societal, and environmental value by enabling data-driven decisions for municipalities, utilities, and A/E/C firms. The Belgrade pilot will map urban heat, simulate cooling interventions, and reduce energy demand and heat risks, while strengthening the local EO sector. The workflow will be replicable in cities like Zagreb, Budapest, Thessaloniki, and Vienna, with its analytical core open-source for transparency and dashboards commercially managed to ensure sustainability and wider European adoption.

# Testing Traffic Network Modifications in Novi Sad

**Lilly021 (Startup – Serbia)**

## CONCEPT

The project will integrate advanced AI-based environmental modeling with an interactive urban planning tool tailored for the City of Novi Sad. The system will allow decision-makers to test modifications to the city's traffic network—such as altering lanes, converting streets to one-way, or adjusting traffic flows—and immediately measure their impact on car exhaust emissions and the environment. By combining scientific simulation with a user-friendly planning interface, the tool will foster data-driven and transparent urban decision-making. It will bridge artificial intelligence, environmental science, and digital governance, supporting sustainable urban development.

## NOVELTY

The proposed solution will be progressive by enabling predictive insights before costly infrastructure measures are implemented. Unlike static analyses, it will allow real-time scenario testing and visual comparisons of environmental outcomes. The project will provide capacity-building for city planners, citizens, researchers, and students, offering hands-on experience with AI, traffic planning, and environmental modeling. A multilingual, accessible interface will ensure usability for diverse stakeholders, enhancing inclusivity and public engagement.

## CHALLENGES ADDRESSED

The tool will manage complex traffic and emissions simulations while integrating diverse municipal data, including sensors and GIS datasets. It will support multiple users simultaneously and help stakeholders balance environmental, mobility, and economic considerations. By combining a mature AI model with modern digital tools, the platform will provide actionable insights for sustainable, data-driven urban planning.

## IMPACT

The tool will reduce the risk of costly urban projects by simulating traffic interventions in advance, helping municipalities optimize resources, lower long-term costs, and improve public health and productivity. Citizens will gain clear insight into how traffic changes affect air quality, fostering civic engagement and sustainable mobility awareness. Aligned with EU climate and mobility goals, and compliant with data standards like INSPIRE and Eurostat, the platform will support cross-border knowledge transfer and adoption in other European cities.
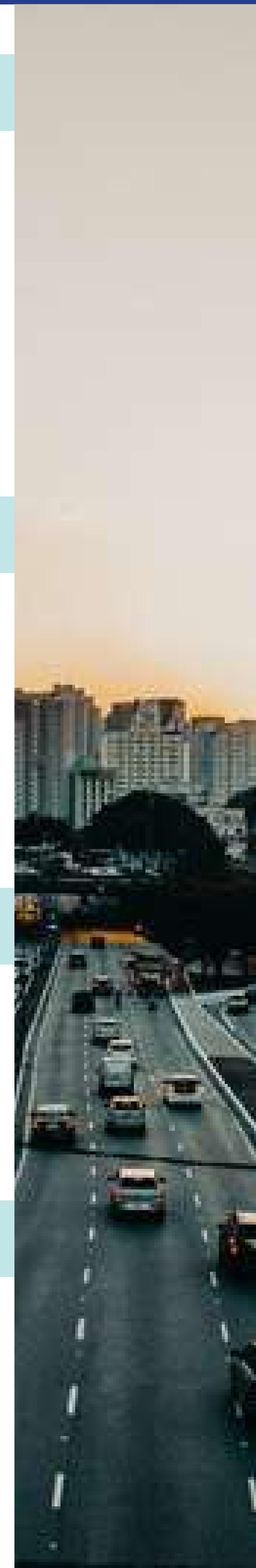
# Urban Forest Corridors for Carbon Sequestration

**DRILLSERV (Startup – Tunisia)**

## CONCEPT

DRILLSERV will analyze the potential impact of Urban Forest Corridors in Sfax, Tunisia, on carbon sequestration from the atmosphere and carbon fixation in soils. Using Earth Observation (EO) data, the project will quantify how creating interconnected green corridors could function as natural carbon sinks, supporting Tunisia's Nationally Determined Contributions (NDCs) and contributing to climate mitigation at the urban scale. The expected output will be a digital carbon map of Sfax, showing spatial variations in carbon storage and the contribution of each corridor to total sequestration potential.

## NOVELTY

The project will integrate Copernicus satellite missions with AI-driven analytics to estimate carbon captured by vegetation and stored in soils. Sentinel-1 SAR data will characterize vegetation structure, canopy density, and soil moisture; Sentinel-2 imagery will monitor vegetation cover, health, and chlorophyll activity; and Sentinel-3 optical and thermal products will provide additional parameters relevant to carbon dynamics. All datasets will be processed within the AI-enabled UDENE platform to generate high-resolution above-ground biomass (AGB) and soil organic carbon (SOC) estimates. This approach represents a novel use of EO data for urban carbon planning, creating a reproducible framework for modeling carbon storage in complex urban environments using only open-access Copernicus data.

## CHALLENGES ADDRESSED

Sfax currently faces a shortage of green spaces, limiting its natural carbon absorption capacity. This project will provide municipalities and environmental agencies with a scientific tool to evaluate the carbon potential of urban green corridors, overcoming challenges in urban carbon accounting, monitoring, and scenario planning. The project will also benchmark Sfax against other cities with similar climates to identify best practices for urban greening and carbon management.

## IMPACT

The project will provide a high-resolution digital carbon map that enables data-driven urban planning, supports climate-smart decision-making, and informs sustainable greening strategies to enhance carbon sequestration, biodiversity, and urban resilience.

# Copernicus-Enabled Service Predicting Photovoltaic Soiling Risk

## Institute of Industrial Management - Sfax

## CONCEPT

The proposal will deliver a Copernicus-enabled service that predicts photovoltaic (PV) soiling risk, forecasts energy losses, and optimizes cleaning schedules. It will fuse CAMS aerosol forecasts, Sentinel-5P AAI, Sentinel-3 SY_2_AOD, and ERA5 hourly rain/wind data with inverter measurements to produce a Soiling Risk Index, expected percentage energy loss over the next 14 days, and ROI-ranked cleaning actions. UDENE tools will support benchmarking across similar cities and connecting EU partners to scale up the solution.

## NOVELTY

This solution will operationalize aerosol intelligence, enabling soiling accumulation and ROI-based cleaning decisions in a single, automated pipeline. Copernicus products will provide continuous, global inputs—including aerosol optical depth, UV-absorbing aerosols, and meteorological data—to support daily PV operations. The service is expected to generate direct commercial impact by reducing unnecessary cleaning operations, recovering a meaningful portion of typical 3–5% annual soiling losses, and improving water and labor efficiency. Early pilots will measure €/kWh recovered and payback per cleaning policy.

## CHALLENGES ADDRESSED

The service will tackle several technological challenges. It will translate column AOD and AAI measurements into surface soiling and optical losses using multi-sensor fusion (CAMS, Sentinel-5P, Sentinel-3) combined with local calibration. Event-aware scheduling will detect dust intrusions and anticipate rain resets to optimize cleaning timing. The system will ensure model robustness by accounting for site-specific, saw-tooth soiling behavior, validated against inverter data and sensitivity tests. Finally, operationalization and quality assurance will harmonize differing data resolutions and latencies, institute quality-control flags, and align with IEA PVPS guidance on soiling measurement and forecasting.

## IMPACT

The service will recover lost PV yield, reduce unnecessary cleaning, and improve revenue while saving water and labor, with aerosol detection and rain-aware scheduling minimizing missed energy and supporting accurate day-ahead bidding. Built on Copernicus data and UDENE tools, it will validate benefits across EU cities, enable cross-border and cross-sector scalability, and combine open-source components for replicability with proprietary tools.
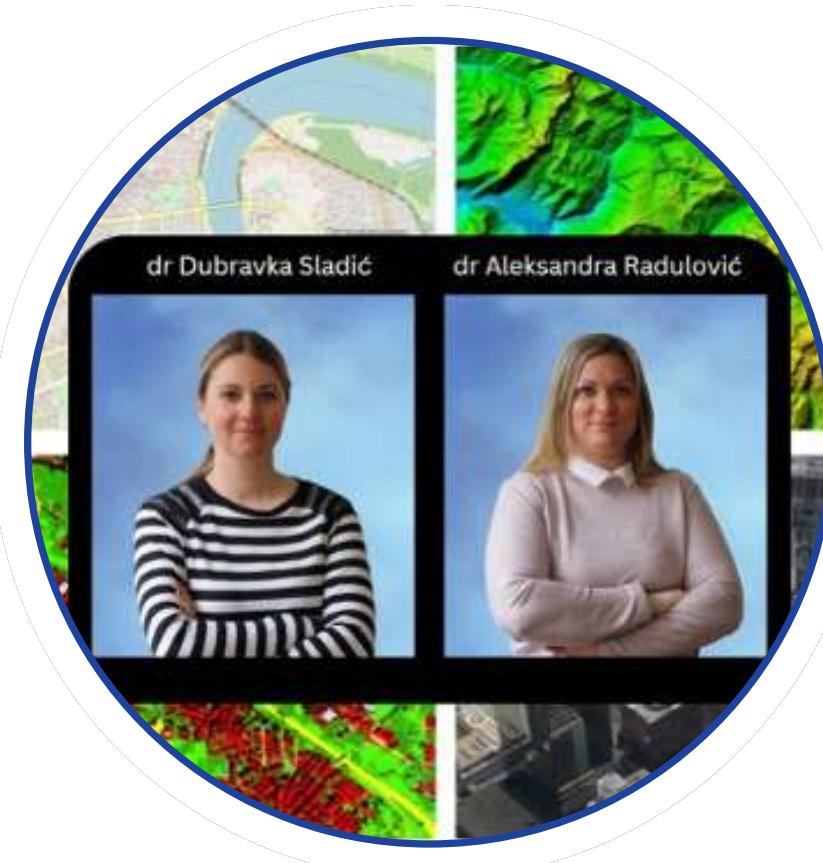
# Connect with our winners!

If you would like to learn more about our Open Call winners or explore collaboration opportunities, do not hesitate to get in touch.

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