BUILDSPACE

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GREEK PILOT

Urban Heat Analysis and Resilience for the Municipality of Piraeus, Greece

BUILDSPACE brought its innovative digital services into practice through four pilot sites across Europe. Each pilot addressed a different local challenge. The pilots demonstrate how BUILDSPACE solutions can support smarter construction, sustainable energy planning, and better protection of cities against heat and flooding.

CONTEXT & OBJECTIVES

Pilot Overview

Location: Piraeus, Attica, Greece

Piraeus, a major Greek urban center and one of Europe's most important ports, faces significant challenges related to urban heat and climate change resilience. The city has a high population density and some of the lowest levels of green space per capita in the EU—just 1.56 m² per resident. Its urban fabric is further characterized by extensive areas of abandoned industrial buildings.

Strategic Importance

1. Protects public health by reducing risks from heatwaves and urban heat islands.

2. Enables evidence-based urban planning through high-resolution data and heat maps.

3. Can provide support to efficiency and building resilience, reducing cooling demand and energy poverty.

4. Builds local capacity via training and knowledge transfer for sustainable decision-making.

Pilot Objectives

DIGITAL TWIN GENERATION

1. **Generate a high-fidelity Digital Twin (DT) of the building using multi-source spatial data, including photogrammetry, point clouds, and Building Information Modeling (BIM), and to explore how users can interact with it through mixed reality environments.**
2. **Enrich this Digital Twin with thermal performance data by combining drone thermography with advanced image analysis algorithms, enabling the identification of structural inefficiencies like thermal bridges and moisture zones.**

This pilot aims to demonstrate how advanced digital tools can support energy efficiency, preventive maintenance, and informed decision-making in public infrastructure, while engaging users in an intuitive, interactive manner.

URBAN HEAT ANALYSIS AND RESILIENCE

The main objective of this pilot is to apply a data-driven approach to assess urban heat risks, identify high-risk areas (hotspots), and enhance urban climate resilience through advanced analysis and visualization tools.

The pilot also included capacity building activities, such as training sessions and seminars for local stakeholders, to ensure practical knowledge transfer and promote sustainable use of the service.

IMPLEMENTATION & LESSONS LEARNT

DIGITAL TWIN GENERATION

Phase 1: Preparation & Deployment plan

In the initial phase of the pilot, the Municipality of Piraeus worked in close collaboration with the BUILDSPACE service providers to define the scope and local implementation plan for the services which focused on Digital Twin Generation and Enrichment. As the pilot city, Piraeus did not engage in technical development but played a central role in facilitating and enabling the deployment of the services on-site.

A key early task for the Municipality was identifying a suitable public building for the pilot. The 21st Elementary School of Piraeus was selected based on its accessibility, age, and significance to the city. Once the site was confirmed, Piraeus provided all necessary data, and logistical support to the technical teams from the University of Madrid and the University of Cambridge. These contributions were essential to tailoring the deployment of the services to a real-world municipal setting.

The Municipality also helped coordinate local permissions for drone flights, which were scheduled for summer 2024 to ensure optimal daylight and thermal conditions.

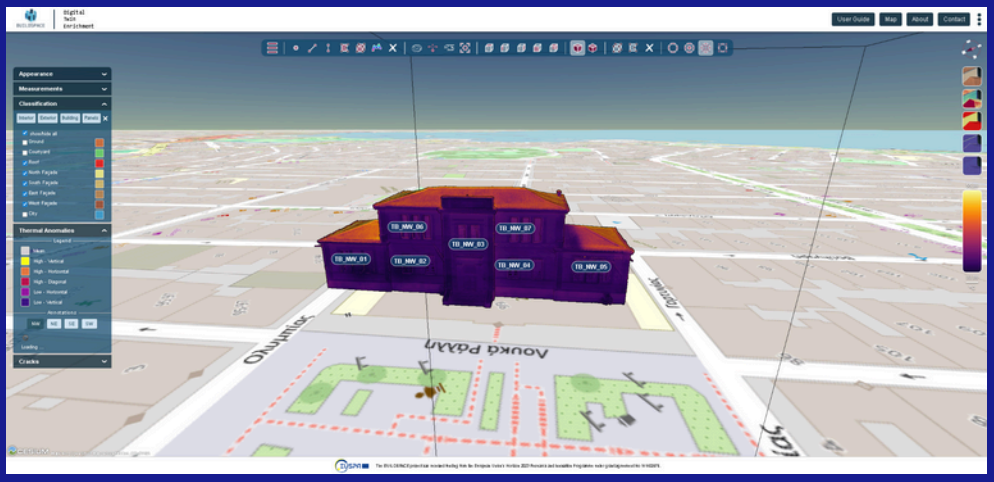
Phase 2: Implementation & Execution

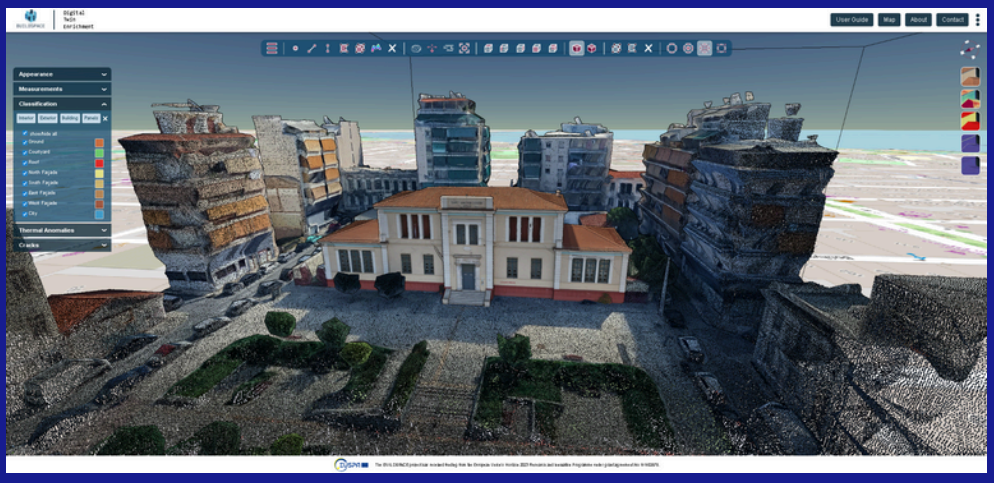
In the second phase, the actual deployment of the services took place, with Piraeus actively supporting the fieldwork and monitoring activities.
The drone flights and on-site data collection were conducted during the summer months, as planned. Municipal staff were present to facilitate access to the school, ensure safety and compliance with local regulations, and provide on-the-ground support to the external drone team. Throughout this process, Piraeus continued to share building-related information to help enrich the generated digital twin with relevant thermal and geometric data.

Phase 3: Completion

In the final phase, the enriched digital twin of the 21st Elementary School was delivered to the Municipality of Piraeus, alongside a preliminary version of a reporting tool designed to interpret the findings. The digital twin included visualizations of the building's structure and thermal performance, revealing potential inefficiencies and areas where heat loss was more prominent.

Municipal stakeholders found the enriched model to be a useful tool for understanding the building's condition in a more comprehensive and accessible way. The ability to visualize structural issues and energy inefficiencies through an interactive platform was especially valuable for municipal staff who do not have a technical background. Additionally, the early version of the reporting tool showed how the service could eventually support decision-making for building maintenance and future renovation planning.





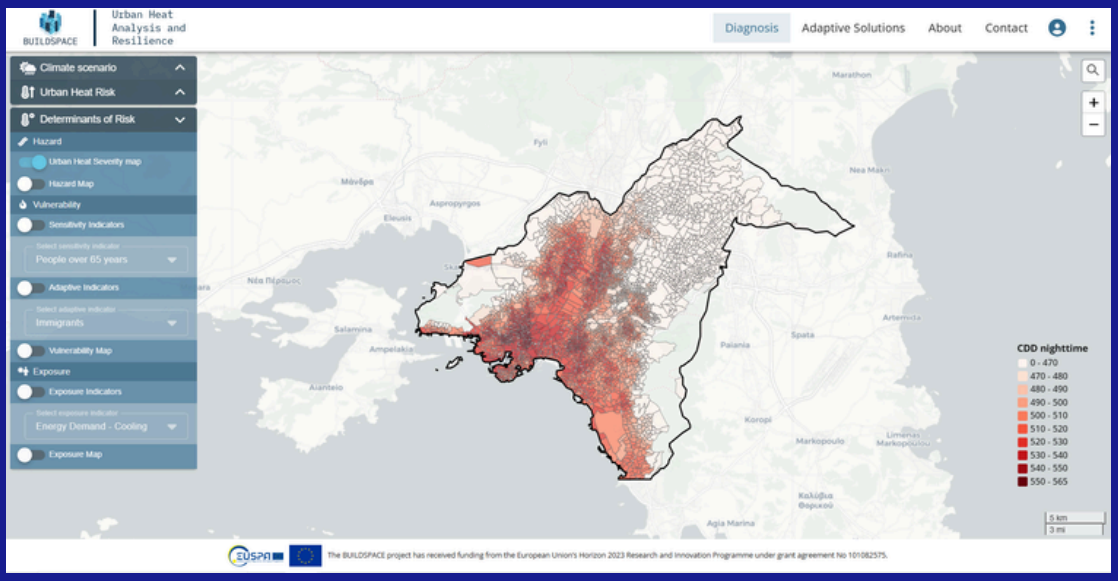
URBAN HEAT ANALYSIS AND RESILIENCE

Phase 1: Preparation & Deployment plan

During this phase, the Municipality of Piraeus collaborated with technical partners and national authorities, such as the Hellenic Statistical Authority, to secure key sociodemographic, spatial, and energy-demand data. It also provided local knowledge to contextualize the analysis and help define areas of interest.

This first phase revealed the importance of strong coordination with technical partners and highlighted the need for local adaptation of scientific methodologies.

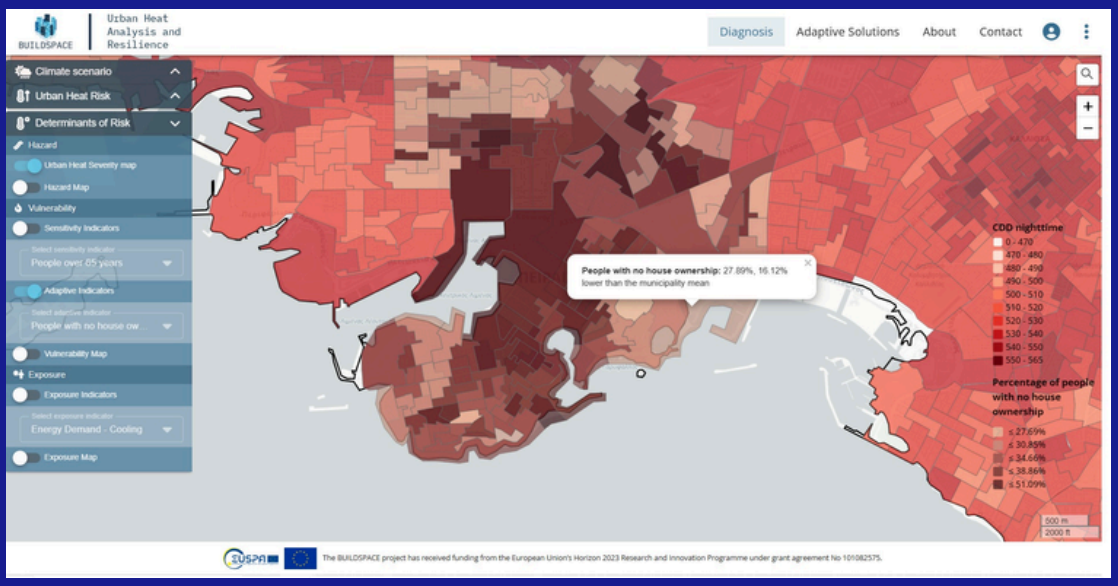
Urban Heat Severity Map:



Phase 2: Implementation & Execution

During the pilot phase, the Municipality of Piraeus actively supported the implementation of the Service by providing local data, reviewing intermediate outputs, and validating results with their knowledge.
Municipal staff collaborated with the service provider and internal departments to refine findings, improve usability, and design training for local personnel. This process demonstrated the practical value of the urban heat maps and energy-demand analysis, showing how scientific tools combined with municipal expertise can inform climate resilience planning.

Urban Heat Analysis and Resilience:



Phase 3: Completion

The pilot concluded with the Municipality of Piraeus receiving comprehensive outputs from Service 4.
This includes:

1. Urban heat risk assessments
2. Building Energy demand estimates
3. High-resolution hotspot maps (shared across departments for staff training and awareness)

A dedicated training session and a public seminar helped municipal staff and local stakeholders understand the findings, explore their application in planning, and provide feedback.

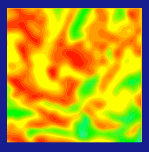
Key Lessons & Recommendations

DIGITAL TWIN GENERATION

- **Data collection should be phased and aligned with optimal weather conditions. The site should be selected based on accessibility, architectural relevance and technical feasibility. Access during daylight for optimal drone mapping is suggested.**
- **Ensure network infrastructure can handle large file transfers.**

- **Drone flights and aerial surveys should be conducted in adherence to national civil aviation regulations**

- **Required tools:** drones (RGB + LiDAR), photogrammetry software, BIM-compatible processing tools and a digital twin platform capable of supporting federated models.



- **Thermal and geometric data must be aligned with BIM standards for future integration.**

- **Respect personal data:** Drone imagery may capture identifiable individuals. Always secure consent before recording or processing such data or apply anonymisation techiques to images.

- **Ensure compliance and training:** If carrying out missions independently, use drones that comply with current regulations and ensure personnel hold the necessary certificates and permissions.

URBAN HEAT ANALYSIS AND RESILIENCE

- **Ensure compliance with the GDPR for any processing of personal or sensitive data.**
- **Assess national and local policies regarding the use and licensing of open datasets, including meteorological, environmental, cadastral, and energy data.**

- **Regulatory support for cross-agency collaboration is essential to ensure smooth data integration.**

- **Collect multi-source data on temperature (e.g., ERA5, CWS), vulnerability (e.g., age, health), and exposure (e.g., land use, energy demand).**

- **Data must be validated, processed (QC/QA), interpolated where necessary, and stored in compatible formats (e.g., CSV, shapefile, GeoJSON).**

- **Use GIS and remote sensing tools to map hazard, vulnerability, and exposure. Urban heat modeling requires GIS software for processing EO data and visualizing outputs in high resolution.**

- **Outsourcing is recommended. If subcontracted, only a coordinator and basic GIS support are needed.**
- **For in-house execution, staff must include a remote sensing expert, urban climate modeler, GIS analyst, Software Engineers and IT/data manager and Public Health Liaison**

Technical requirements for end-user to receive service

In order to use the URBAN HEAT ANALISIS AND RESILIENCE application the only requirements are connection to internet and a browser.
You will be able to download GIS format data. In order to work with GIS data you can download **QGIS**.

QGIS technical requirements:

1. **Processor - CPU:** Core i3 2.7 Ghz (minimum), Core i7 3.5 Ghz (recommended)
2. **Memory RAM:** 2 Gb (minimum), 8 Gb or more (recommended)
3. **Hard Disk:** 500 Gb SATA (minimum), SDD 128 Gb or 500 Gb SATA (recommended)
4. **Graphic card:** 1 Gb RAM (minimum), 2 Gb RAM (NVIDIA GeForce) (recommended)
5. **Operating System:** Windows 7-10, MacOS, Linux, BSD, and (Various Android apps) for mobile and tablets.

Results, Performance & Future Outlook

The pilot met its goals, demonstrating the potential of the city scale services to support informed decision-making and enhance urban resilience.
Through the identification of urban heat hotspots, the visualization of energy demand, and stakeholder training, the pilot demonstrates the value of combining scientific data with local knowledge. It also highlights the importance of clear communication, user-friendly interfaces, and sustained capacity building to support long-term impact.

A few words from the Municipality of Piraeus

Our experience with the BUILDSPACE Urban Heat Analysis and Resilience Service has been **highly positive and transformative**.

By integrating satellite, climate, socioeconomic, and demographic data, **the platform produces high-resolution maps of surface temperature and heat stress across the city**. This powerful decision-support tool helps identify urban heat hotspots, guide green infrastructure projects, improve public spaces, and protect vulnerable citizens during extreme heat events. Its intuitive interface and scenario-simulation features have fostered effective collaboration across municipal departments, from urban planning and IT to public health, enabling them to test targeted mitigation measures.

One of the **most valuable outcomes** has been the **clear visualization of temperature differences between neighbourhoods, directly informing actions such as creating shaded corridors, expanding green areas, and using reflective materials**.

This pilot demonstrates how European innovation can help a dense, port-based city like Piraeus confront climate challenges, strengthen resilience, and engage the community in building a smarter, more sustainable urban future.
We strongly recommend the Urban Heat Analysis and Resilience Service to other cities aiming to enhance their climate adaptation strategies.

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