

M²UHIP - Mapping and Monitoring of Urban Heat Islands in Piedmont

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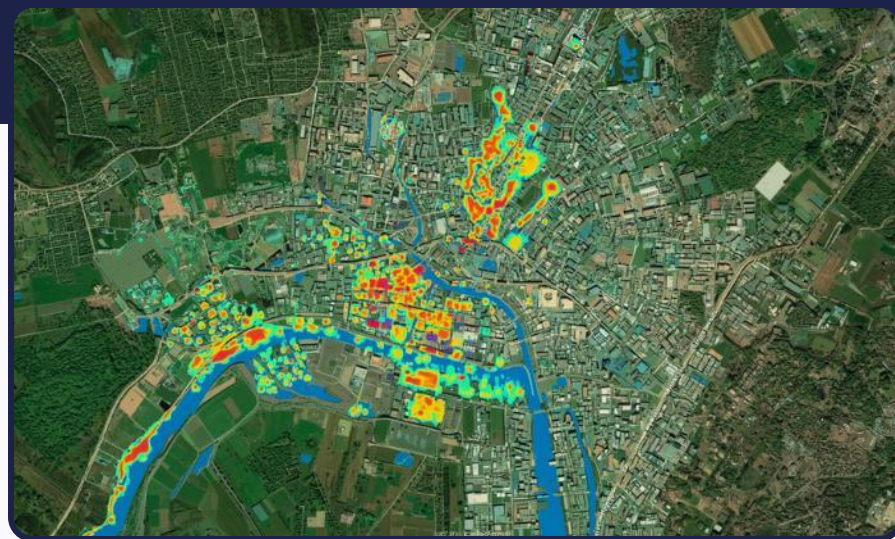
Project Overview

Program: ASI I4DP_PA – "Resilient Cities" Call.

Purpose: To bridge knowledge gaps regarding the UHI (Urban Heat Island) phenomenon and provide operational tools for urban planning and socio-health risk assessment.

Progression Target: TRL 7 to TRL 9 in 24 months.

Accessibility: Results are exposed via standard OGC geoservices (WMS/WFS) on the Piedmont GeoPortal.



Data Sources & Integration Satellite Data:

PRISMA – Hyperspectral, materials

Sentinel-2 – Multispectral

Landsat – LST day & nighttime

ECOSTRESS – LST day & nighttime

On Site:

T_{air} - Rh – ET - Network of fixed and mobile sensors

Base cartographies – Pre-existing cartographies

NWP Model output:

T_{air} - Rh from ICON+TERRA_URB

Socio-Economic Data:

ISTAT – Population censuses

SSR – Health related data

National/regional databases for climate-related services and infrastructure

Processing Technology

Core Approach: Multidisciplinary integration of satellite, ground-based observations, NWP model output, and socio-economic data through advanced machine learning algorithms.

Spatial Resolution: 70m – 100 m.

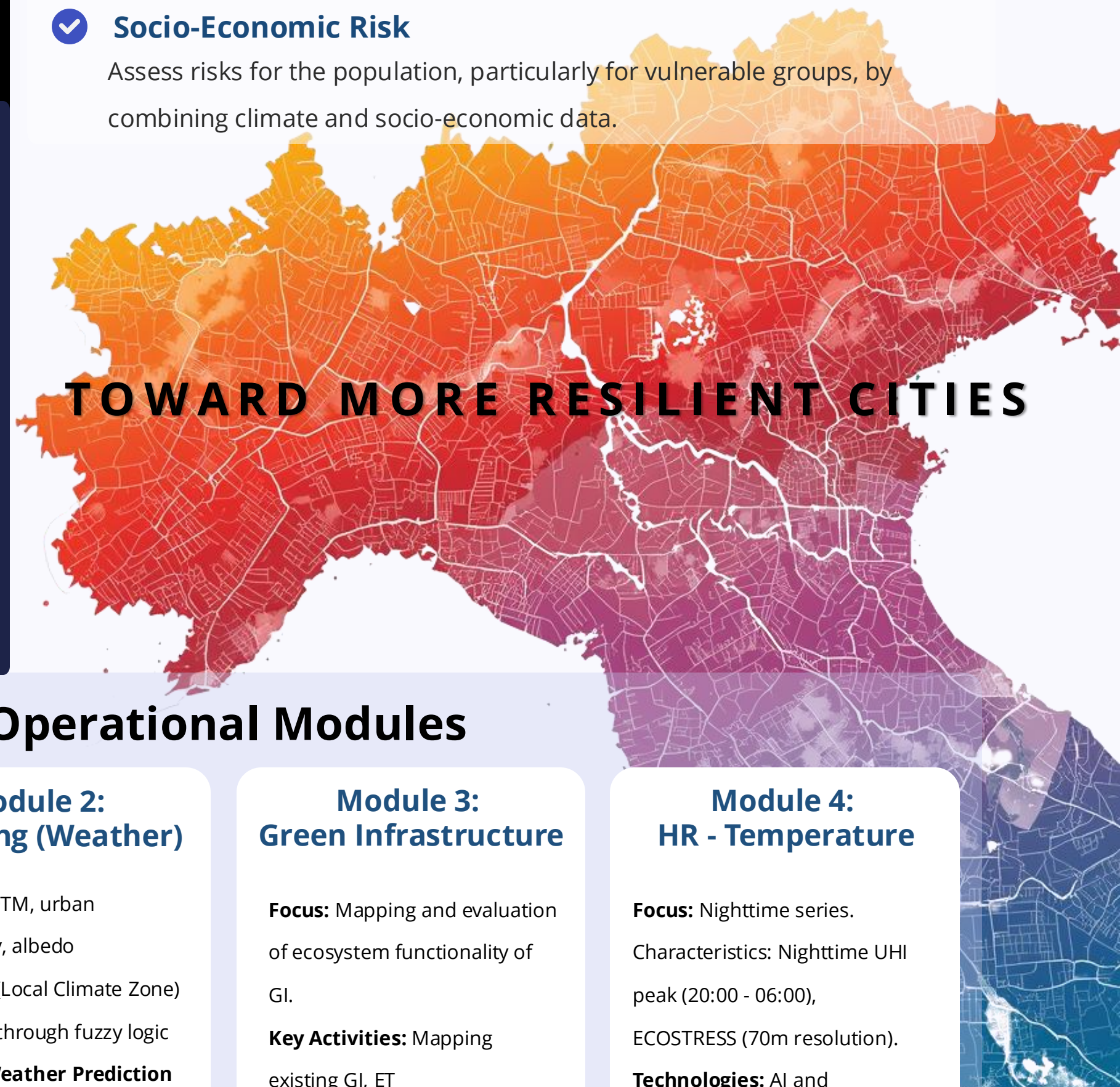
Frequency: Summer nights

Update Cycle: Periodic.

Data Scale: 50+ estimated Petabytes

Project Objectives

- ✓ **Scientific Understanding**
Bridge knowledge gaps in the scientific understanding of the UHI (Urban Heat Island) phenomenon through integrated analysis of satellite, ground data and NWP model output.
- ✓ **Dynamic Cartography**
Develop thematic maps for urban areas in the Piedmont region with periodical updates.
- ✓ **Green Infrastructure (GI)**
Provide tools for planning and designing GIs and monitoring the effectiveness of mitigation interventions.
- ✓ **Socio-Economic Risk**
Assess risks for the population, particularly for vulnerable groups, by combining climate and socio-economic data.



Operational Modules

Module 1: Urban Materials

Instrument: PRISMA (ASI hyperspectral).

Parameters: Surface emissivity, spectral reflectance, thermo-physical properties.

Outputs: Emissivity maps.

Partners: UniTo DISAFA

Module 2: Modeling (Weather)

GIS - Input: DTM, urban morphometry, albedo

Output: LCZ (Local Climate Zone) classification through fuzzy logic

Numerical Weather Prediction

Model: ICON + TERRA_URB

Input: LCZ, ISA, AHF, initial and boundary conditions

Output: temperature maps at 500m

Partner: ARPA Piemonte

Module 3: Green Infrastructure

Focus: Mapping and evaluation of ecosystem functionality of GI.

Key Activities: Mapping existing GI, ET (evapotranspiration) from satellite, cooling capacity, potential interventions.

Technologies: Sentinel-2

Partners: ENEA

Module 4: HR - Temperature

Focus: Nighttime series.

Characteristics: Nighttime UHI peak (20:00 - 06:00), ECOSTRESS (70m resolution).

Technologies: AI and regression, Machine Learning.

Outputs: 70m temperature maps, nighttime UHI intensity.

Partners: CNR IIA – ARPA Piemonte

Module 5: Vulnerability & Risk

Focus: Mapping of the population vulnerable to heat stress.

Key activities: **Identification** of conditions of vulnerability to UHIs and **Mapping** of the urban population according to age (older people, children); socio-economic disadvantage; socio-health status; housing and household conditions; other factors limiting adaptive capacity.

Partners: UniTo Est, CNR IRCrES, ARPA Piemonte

Outcomes and Final Deliverables

Maps

Emissivity surfaces (70m),

Dynamic UHI (nighttime, 70m),

Health Risk (vulnerability),

Green & Blue Infrastructure (cooling efficiency).

Guidelines

Operational document for urban green planning, plant species selection, and climatic baseline for monitoring.

Services

Support for Environmental Impact Assessment (EIA/SEA), Assessment of susceptibility for interventions, Access via Geoportal, API REST, and Mobile App.

References

ASI – AGENZIA SPAZIALE ITALIANA
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UNITO – Enrico Borgogno Mondino
CNR-IIA – Saverio Vicario

Conclusion

- ✓ M2UHIP provides innovative tools to monitor and mitigate urban heat islands in Piedmont
- ✓ Multi-entity collaboration ensures an integrated approach between research and operational application