eurac research

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Smart and Sustainable Planning for Cities and Regions 2025

9-12 December, Bolzano/Bozen

TRACK 4 | The Just City: New Transformative Pathways on Governance and Practices
Special session | Intersecting the Multiple Scales of Climate Justice: Mapping Inclusive Adaptation and Just Fossil Fuel Transitions

Equitable urban climate action through microclimatic simulations: a case study from Padua (Italy)

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GIScience

ICEA

Università degli Studi di Padova

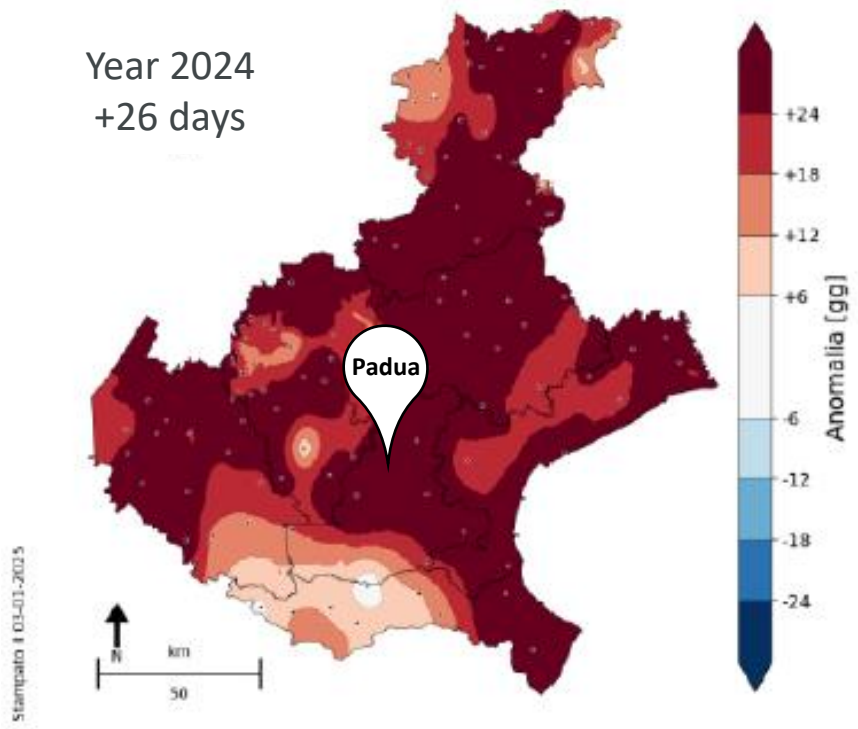
European Commission

Why HW and UHI matter

- + 30% heat-related morbidity in EU in last decades (Copernicus CC Service, 2023)
- Cities are responsible for 70% of global emissions (World Bank, 2024)
- By 2050 the 70% of the population will live in urban areas (World Urbanization Prospects, 2019)

2024 in Veneto (ARPAV, 2024)

- Hottest year recorded since 1955
- Highest number of HW



HW days compared to 1991-2020 time reference series

Extreme heat is not only a climate issue, is a social justice issue

The impacts are not distributed equally across the territory

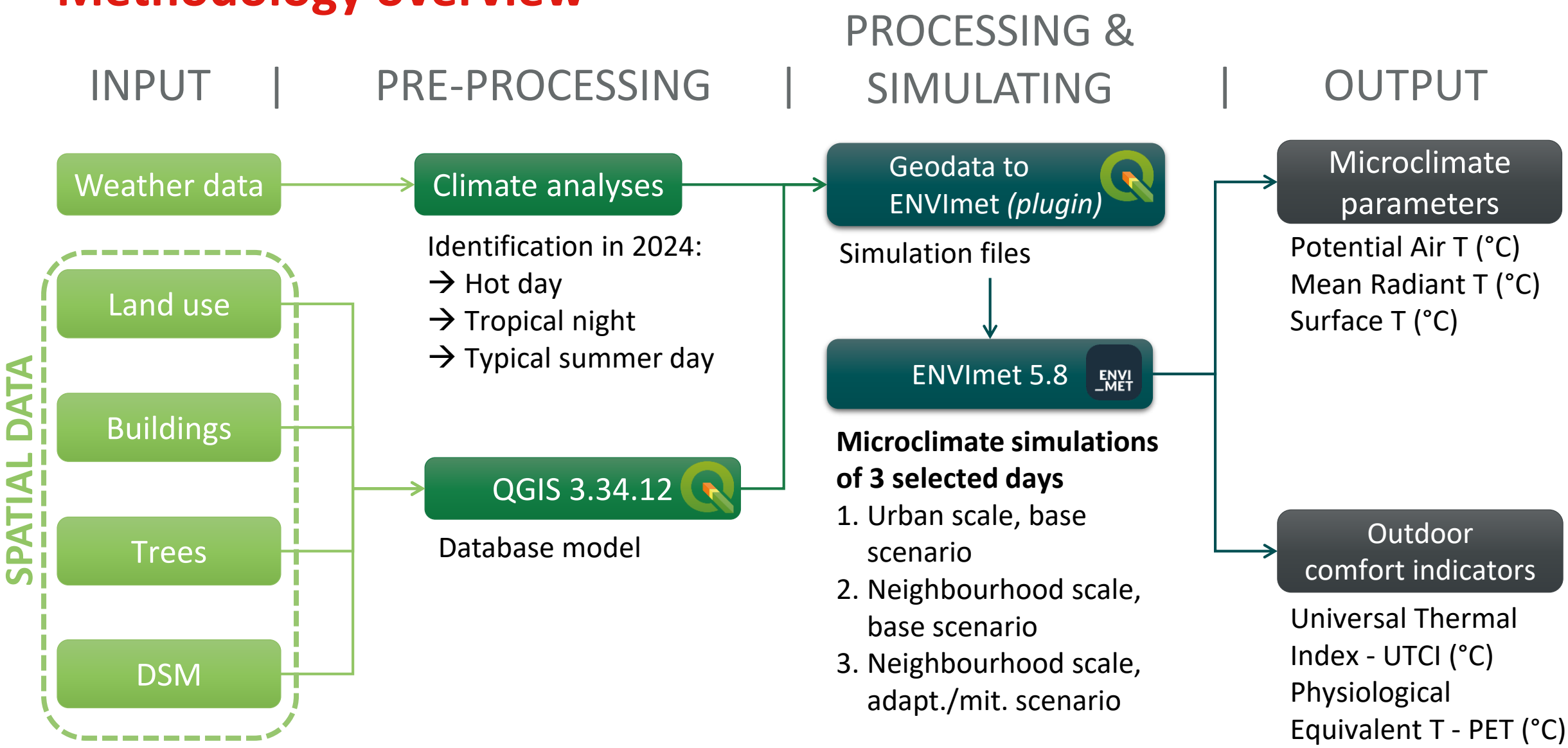
Vulnerable populations are systematically more exposed

How can microclimate simulations support targeted actions in socio-economically vulnerable area in Padua?

- Identifying and mapping **hotspot** (urban scale)
- Planning and measuring the effects of **adaptation and mitigation solutions** for a climate and social-economically vulnerable area (neighborhood scale)
- Analyze social dimension of phenomena through **comfort thermal indicators** (neighborhood scale)

LST, summer 2023, Padua.(*Pappalardo et. al, 2023)* and identification of AOI (1- urban scale; 2- neighborhood scale)

Methodology overview



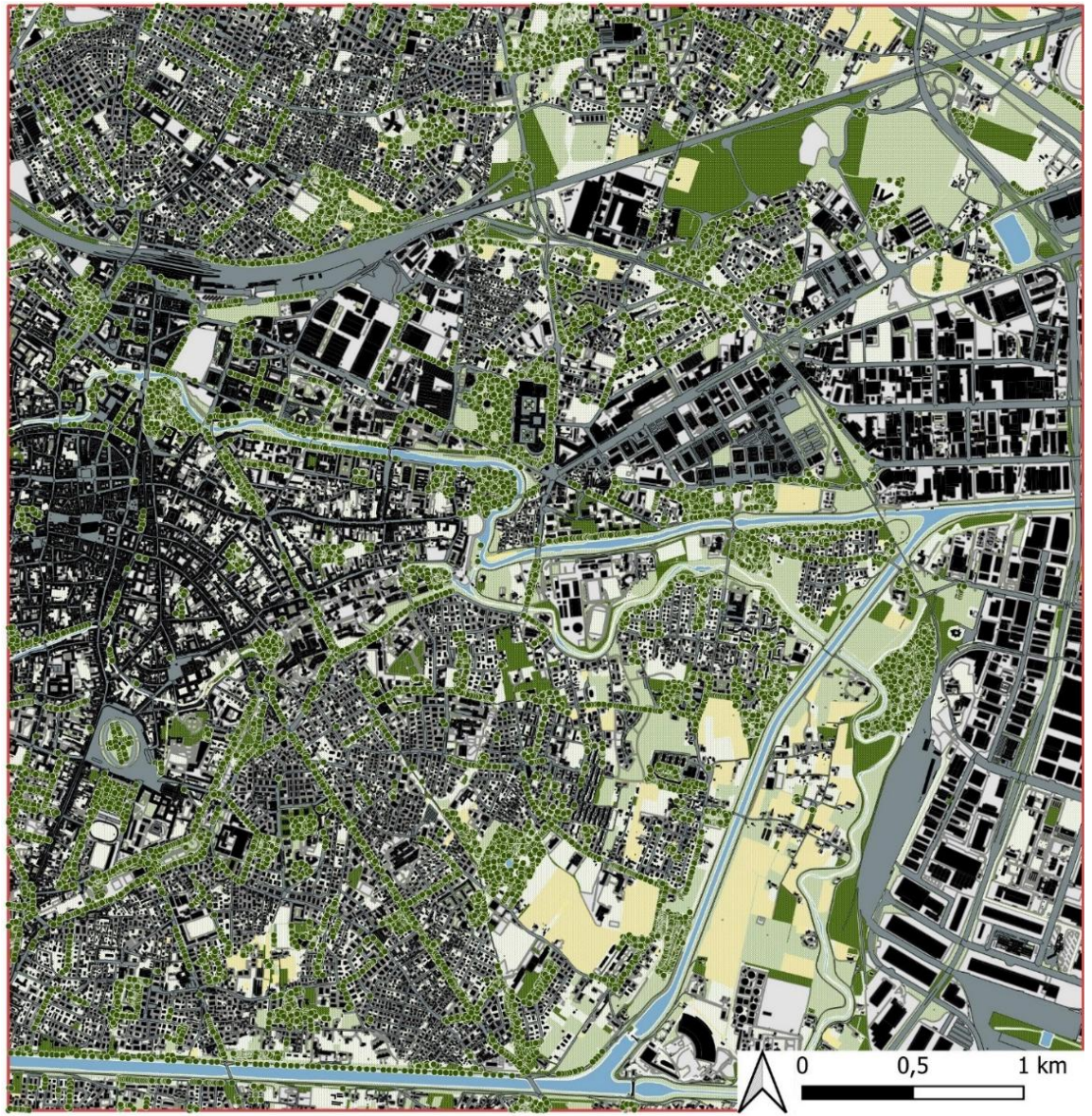
Methodology overview. **Input weather data and selection of the hotday**

Weather station	Source	Time period
Portello	Meteonetwork	1/06/2024 – 31/08/2024
Legnaro	ARPAV	1/06/1990 – 31/10/2020

Hotday (10 July 2024) in a 12-days long heat wave

Methodology overview. **Input spatial data and creation of database model**

Input dataset	Source	Layer
Land use (2023)	Meteonetwork	DBTR class (vectorial, polygonal)
Buildings (2023)		
Trees (2023)	Municipality of Padua	Trees census (vectorial, polygonal)
DSM (2023)	Regional Geoportal	Raster (0.5m resolution)

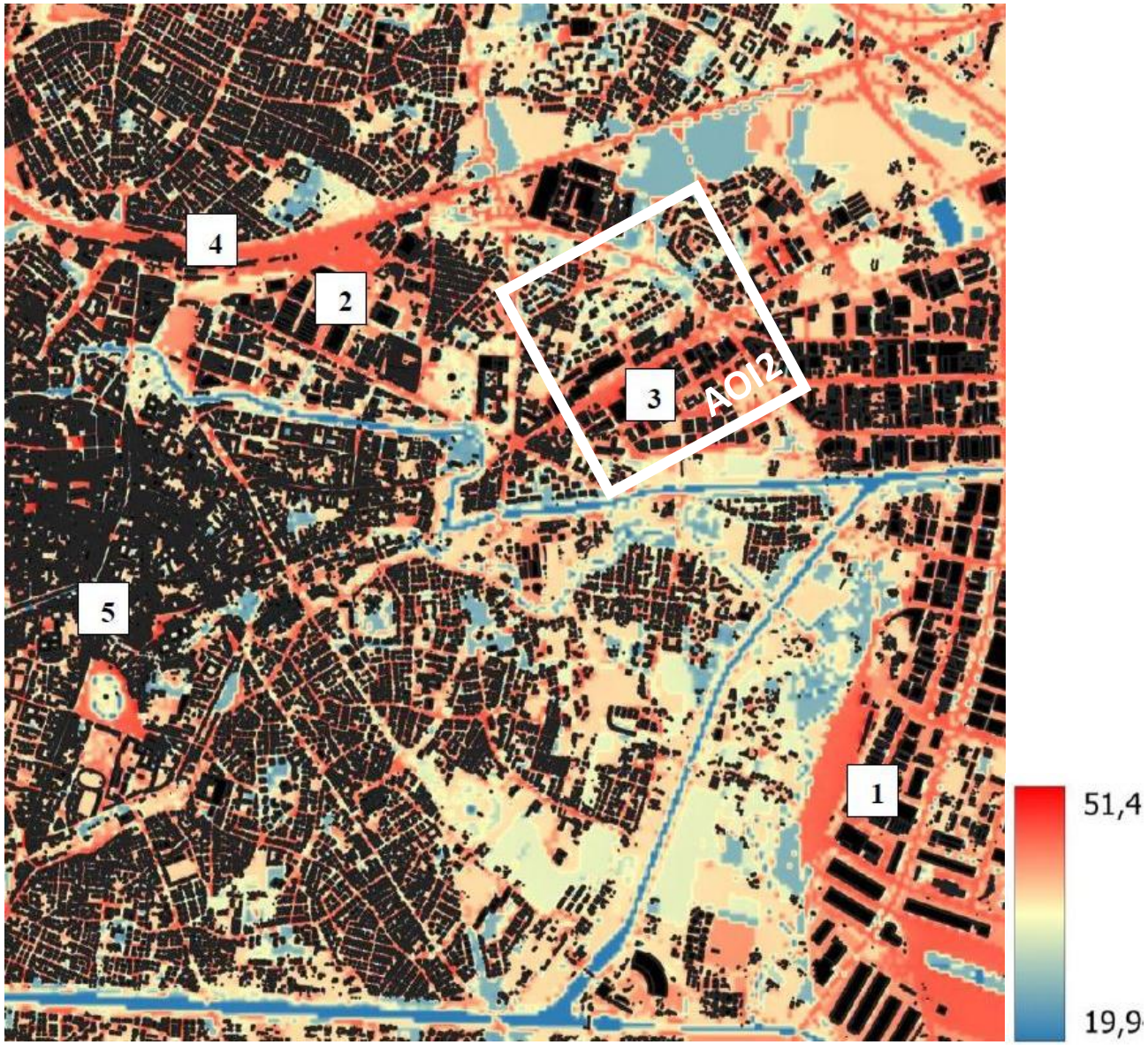


Database model (AOI1 – urban scale, baseline scenario)

Identification of critical neighborhood (AOI2). **High heat exposure**

Hotspot (AOI1)

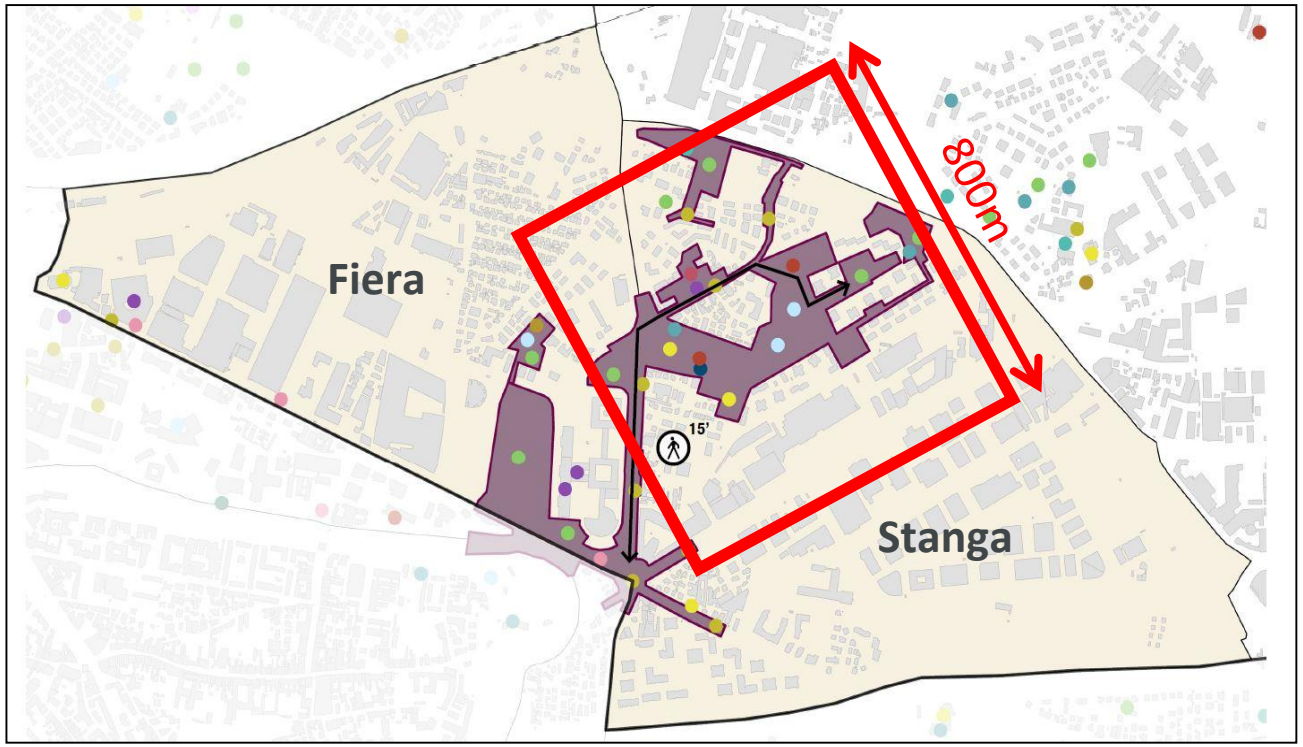
1. ZIP zone
2. Fiera district
3. Stanga commercial area
4. Train station
5. City center



Surface Temperature (°C) AOI1, 10/07/2024, 4 pm, z=0

Identification of critical neighborhood (AOI2). **Socio-economic factors**

- high population density
- socio-economic vulnerabilities
- important social facilities (behavioral exposure) *(Norton et al., 2015)*



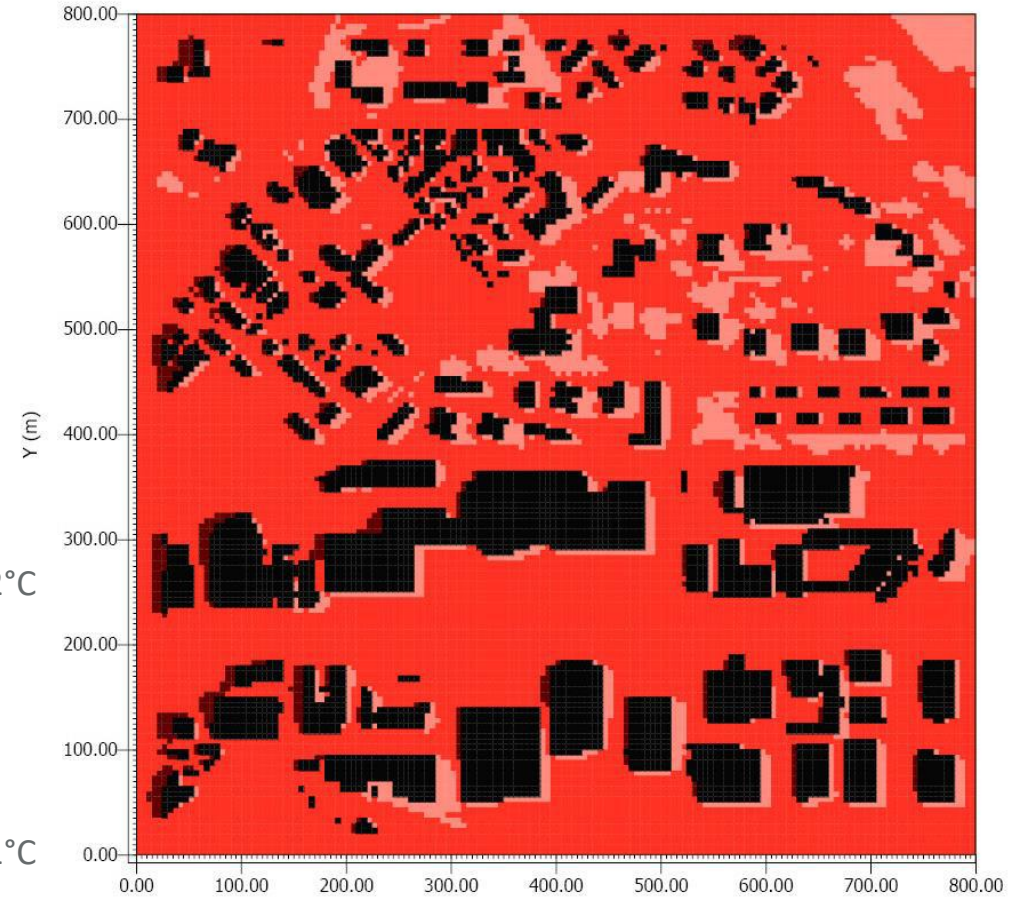
Neighborhood core – Interventions Plan *(Municipality of Padua, 2023)*

Urban Unit Details					Demography					
UU ID	UU N°	UU Name	Surface (km2)	Built-up	Pop	Dens. Pop	% Under 5	% Over 65	% Over 65 Alone	% Strangers
10	5.1	Fiera	1,02	86%	1.981	1.949	4,4	18,7	5,9	30,0
31	25.1	Arcella	2,25	85%	15.971	7.103	4,8	23,4	8,0	32,2
12	6	Stanga	1,40	71%	3.586	2.554	4,4	27,7	9,6	26,7

Results. **AOI2 baseline scenario: output (10/07/2024, 4pm)**

Strong thermal stress (UTCI, PET beyond comfort, Tmrt values up to 78°C).

Mean Radiant Temperature (°C)



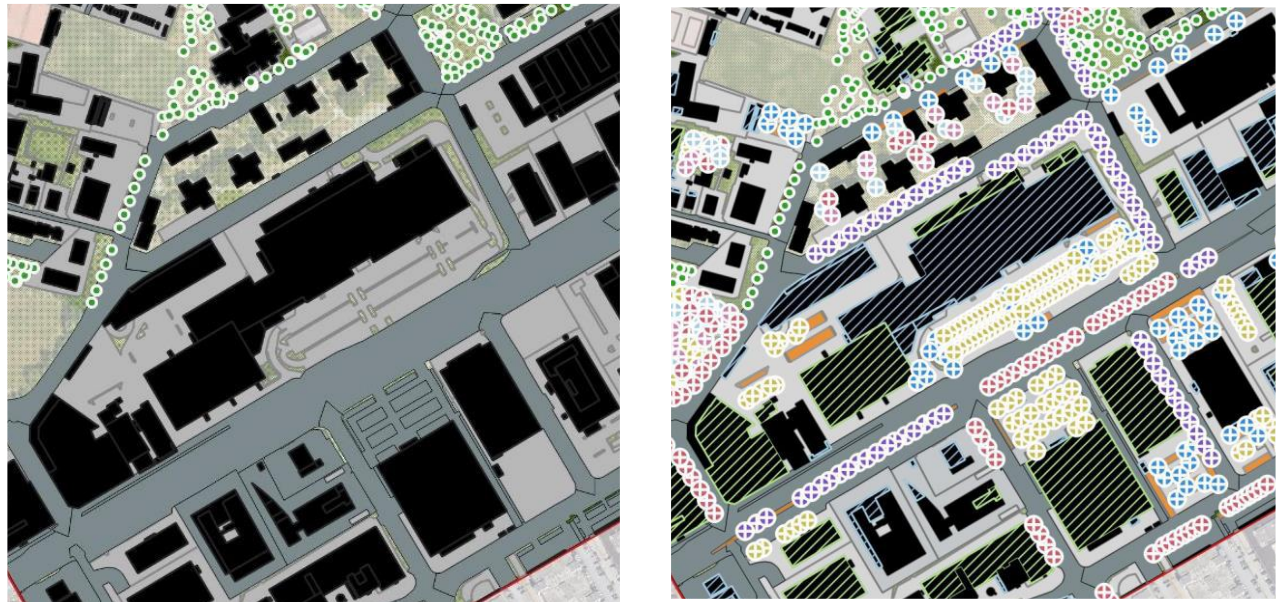
Universal Thermal Index (°C)

Heat stress level
(UTCI thresholds)

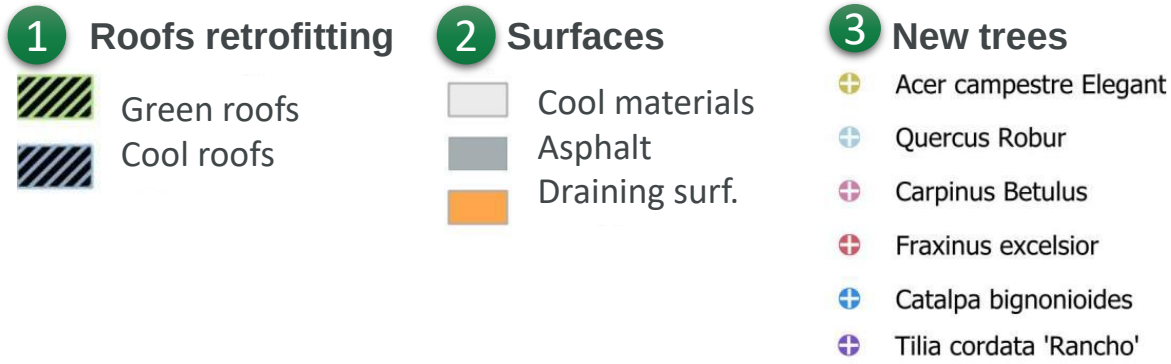
46°C to 70°C (extreme)
38°C to 46°C (very strong)
32°C to 38°C (strong)

Results. **AOI2 mitigation & adaptation scenario: planned solutions**

- **Roofs retrofitting** 1
  green roofs (40%) + cool roofs (16%)
- **Surfaces** 2
  + 140.000 m2 cool materials
  - 21.000 m2 asphalt
  - 149.000 m2 used concrete
- **Greening** 3
  + 840 new trees (in parking areas and wide streets)

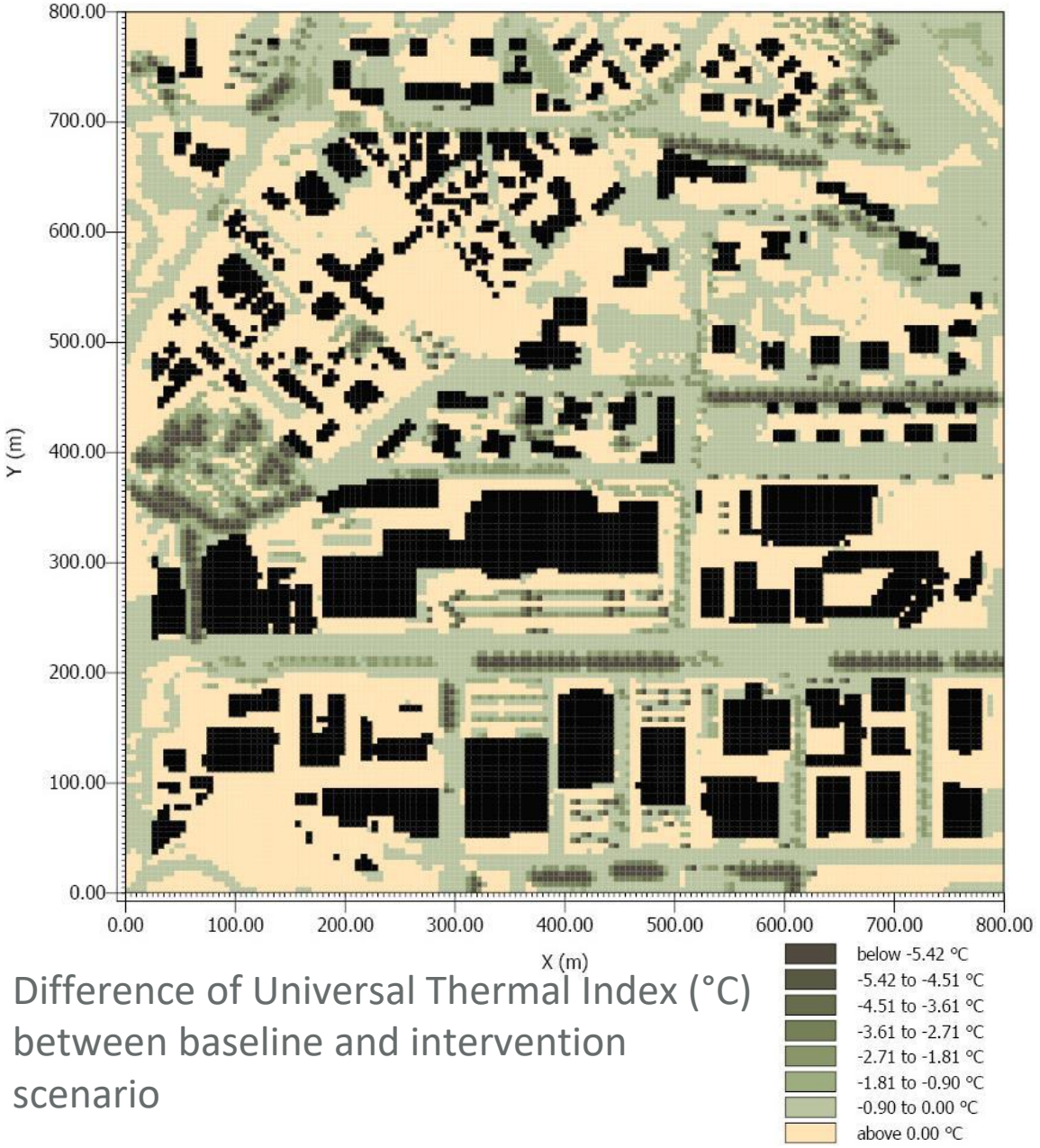


Baseline and interventions scenario (QGIS extraction)



Results. **AOI2 mitigation & adaptation scenario: output (10/07/24, 4 pm)**

- **Greening** has the best improvements (ΔUTCI ≈ - 6°C; ΔTmrt ≈ - 24°C)
- **Cool materials** has mixed result (local warming effect)
- **Green roofs** have limited effects at pedestrian level but co-benefits



Difference of Universal Thermal Index (°C) between baseline and intervention scenario

Main findings and conclusions

- Vulnerability amplifies impacts of extreme heat
  - The spatial mismatch between hotspots and vulnerable areas is the core of climate injustice
  - Targeted mitigation and adaptation strategies improves fairness
- Not all measures perform equally
  - Greening provides the strongest benefits
  - Combined strategies can enhance resilience but must be tailored to local conditions
- Microclimate modelling supports equitable planning
  - ENVImet + GIS tools identify where interventions matter most
  - Enables cities to prioritize investments with the highest impact

Contact

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