

Innovation for Climate Resilience to Heat at Rural and Urban Scale

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Cross-Chapter Paper on Mediterranean Types of Climate

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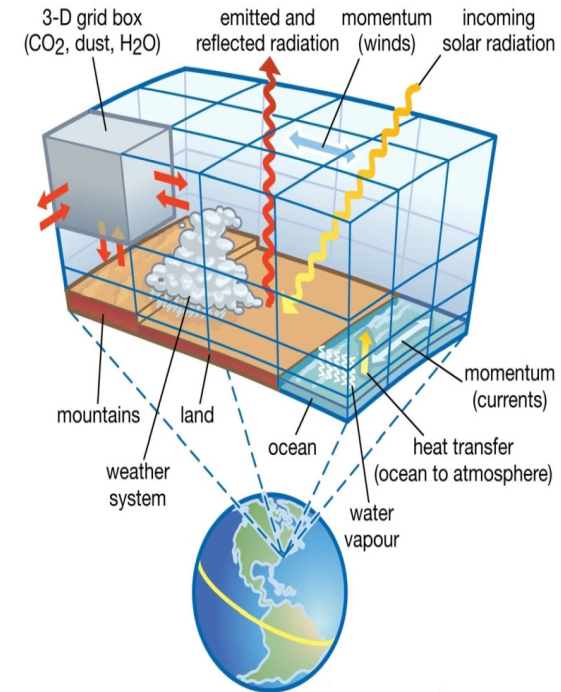


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Global scale

(e.g., CMIP5 or CMIP6 climate model simulations ≈ 100 Km)

Dynamical (e.g., WRF model) ↓ *Statistical Downscaling* (e.g., Artificial Neural Networks)

Regional scale

(e.g., EUROCORDEX ≈ 12 Km)

Dynamical (e.g., WRF model) ↓ *Statistical Downscaling* (e.g., Artificial Neural Networks)

Local scale

(≈ 1 Km or 500m)

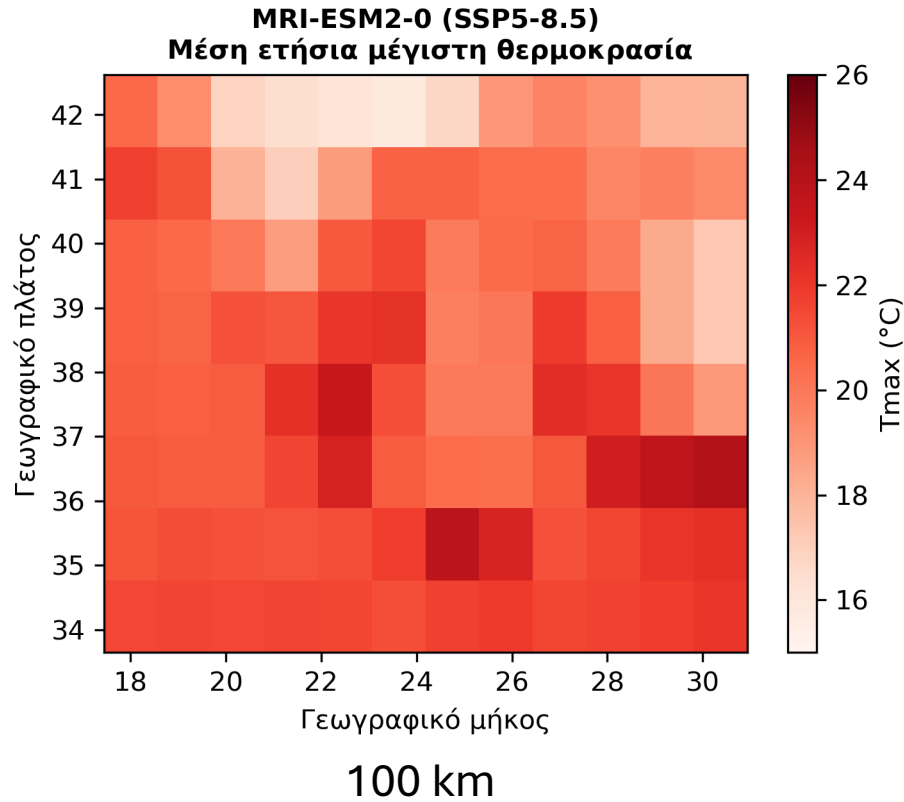
Microscale model ↓ (e.g., ENVI-met)

Micro-scale

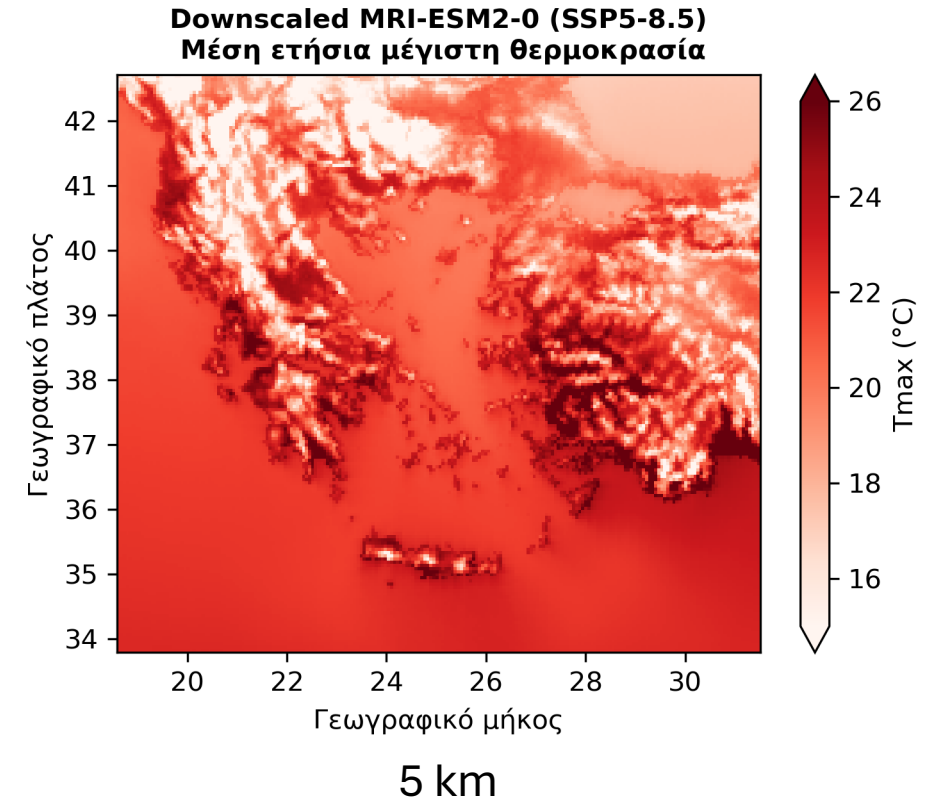
($\approx < 5$ m)

- The integration of microclimatic processes due to the three-dimensional building morphology
- Evaluation of potential interventions/adaptation measures (e.g., increasing green spaces, applying cool materials)
- Can be applied in the current and future climatic conditions under different scenarios

Statistical Downscaling



DBCCA



Innovative methods

Downscaling

Mean annual maximum temperature

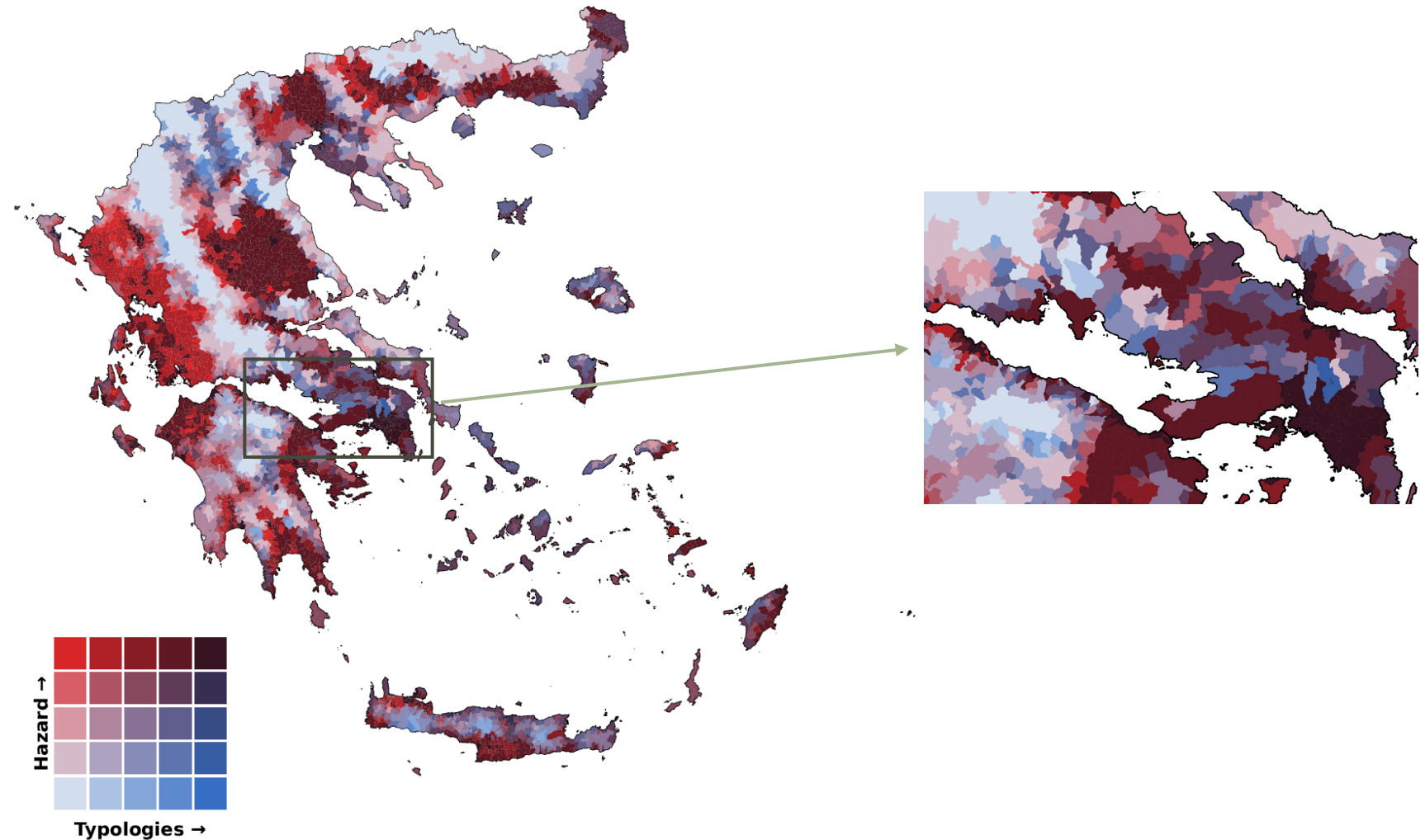
Innovative methods

ML-based bivariate maps

Climate Hazard vs Typologies developed
with climate and non-climate data

Τοπικές Δημοτικές Κοινότητες - Ακραία Υψηλές Θερμοκρασίες

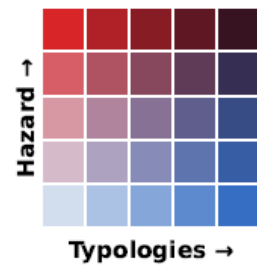
Extreme temperatures



ML-based bivariate maps

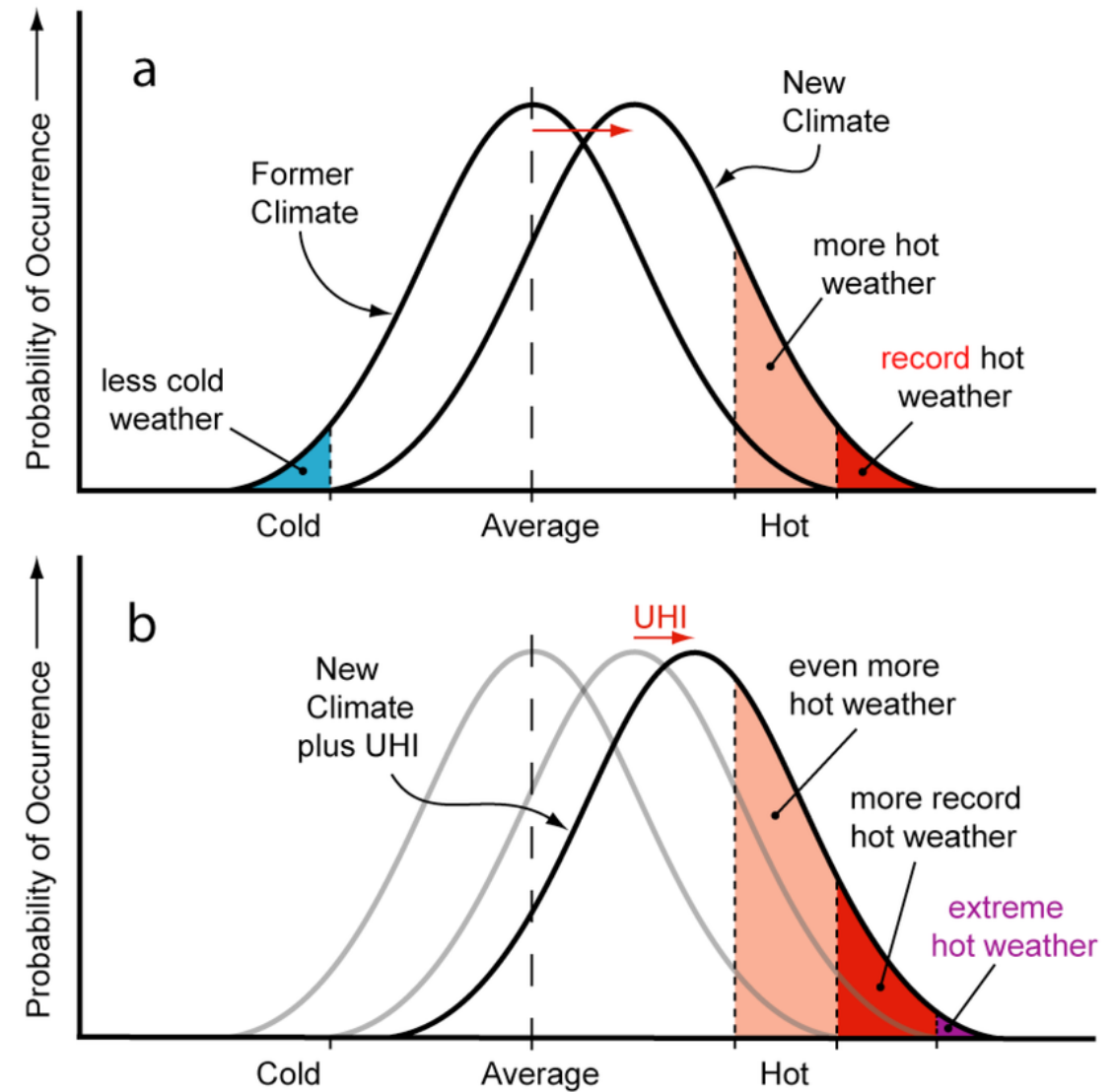
Drought

Hazard ↑



An urban area is affected by heat as a result of climate change in particular the higher temperatures and the increase of the intensity, duration, and frequency of heatwaves.

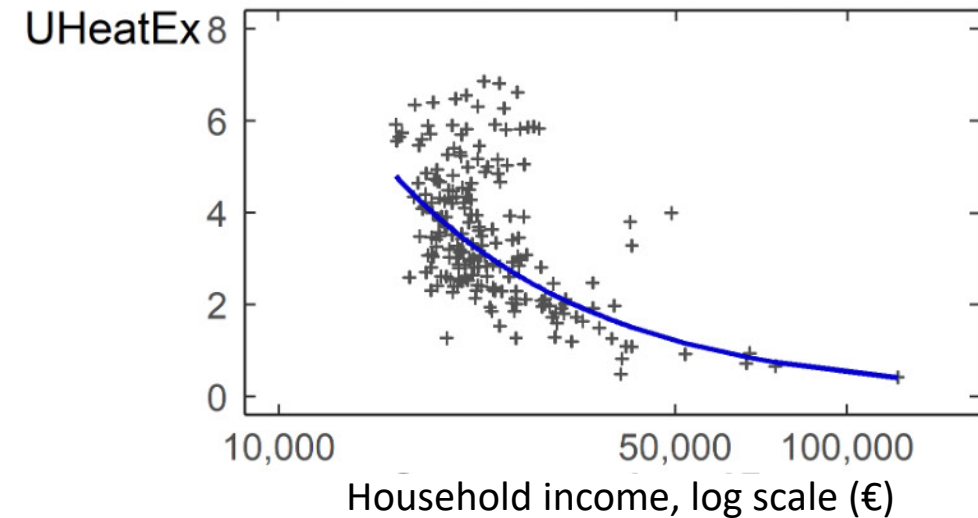
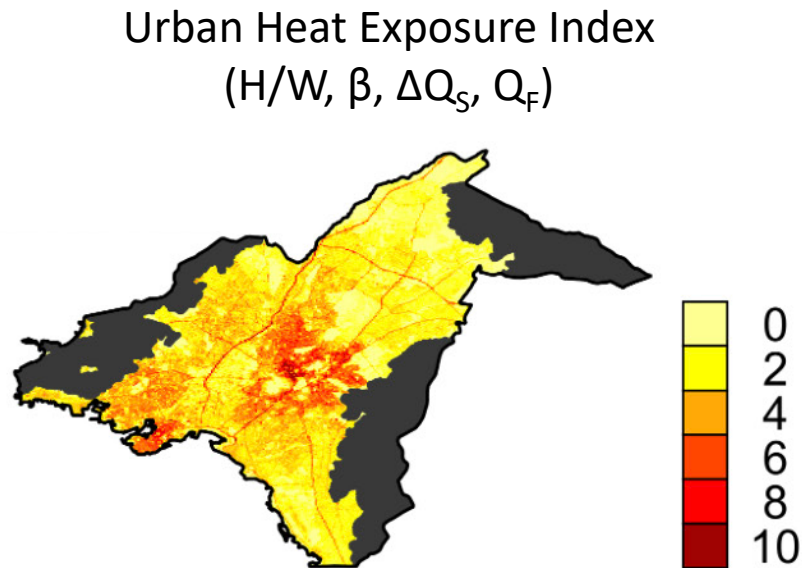
The increase in air temperature because of climate change is added to the Urban Heat Island (UHI) phenomenon (urban influence on local microclimates).



Source: Brown et al., 2018

Climate justice – risk is unevenly distributed

Low-income communities are particularly vulnerable to the impacts of urban heat and climate change due to limited access to resources such as air conditioning and cooling centres, making them more susceptible to heat-related illnesses and mortality.



UHeatEx demonstrates that the urban thermal landscape of Athens is characterized by high spatial variability. This thermal inequity is associated with the socioeconomic status of residents.

Source: Agathangelidis et al., 2019

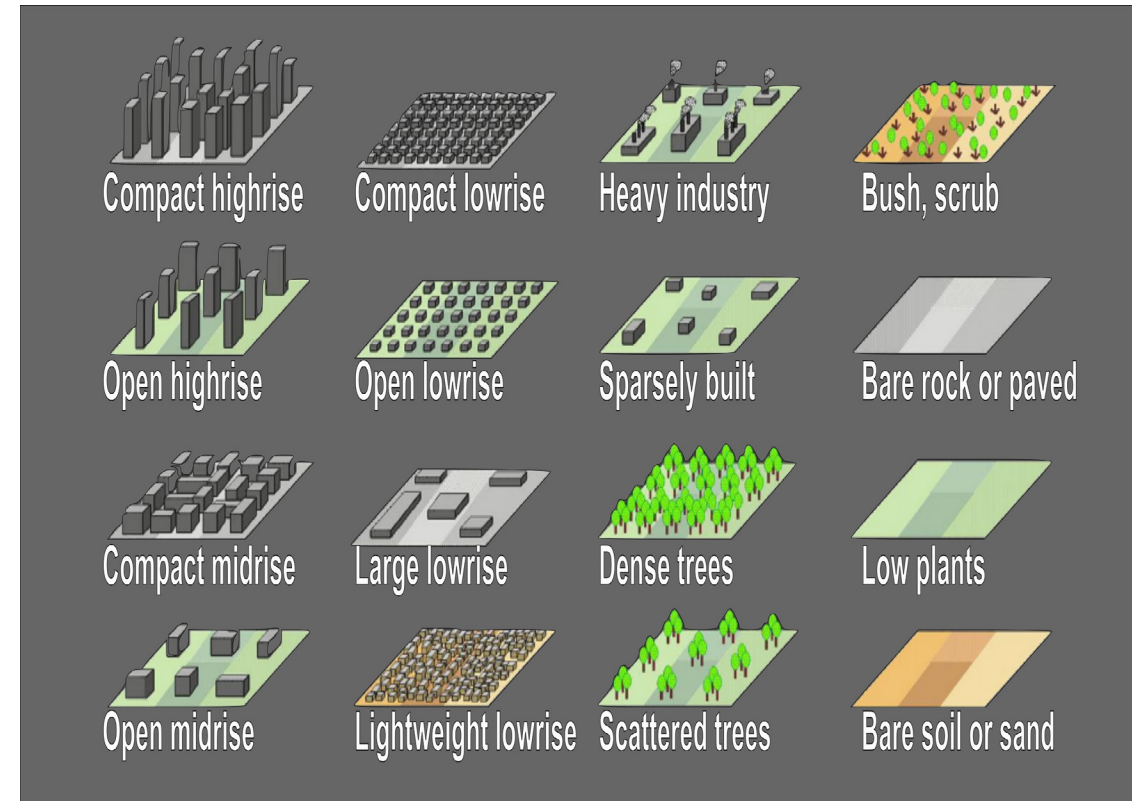
Local Climate Zones

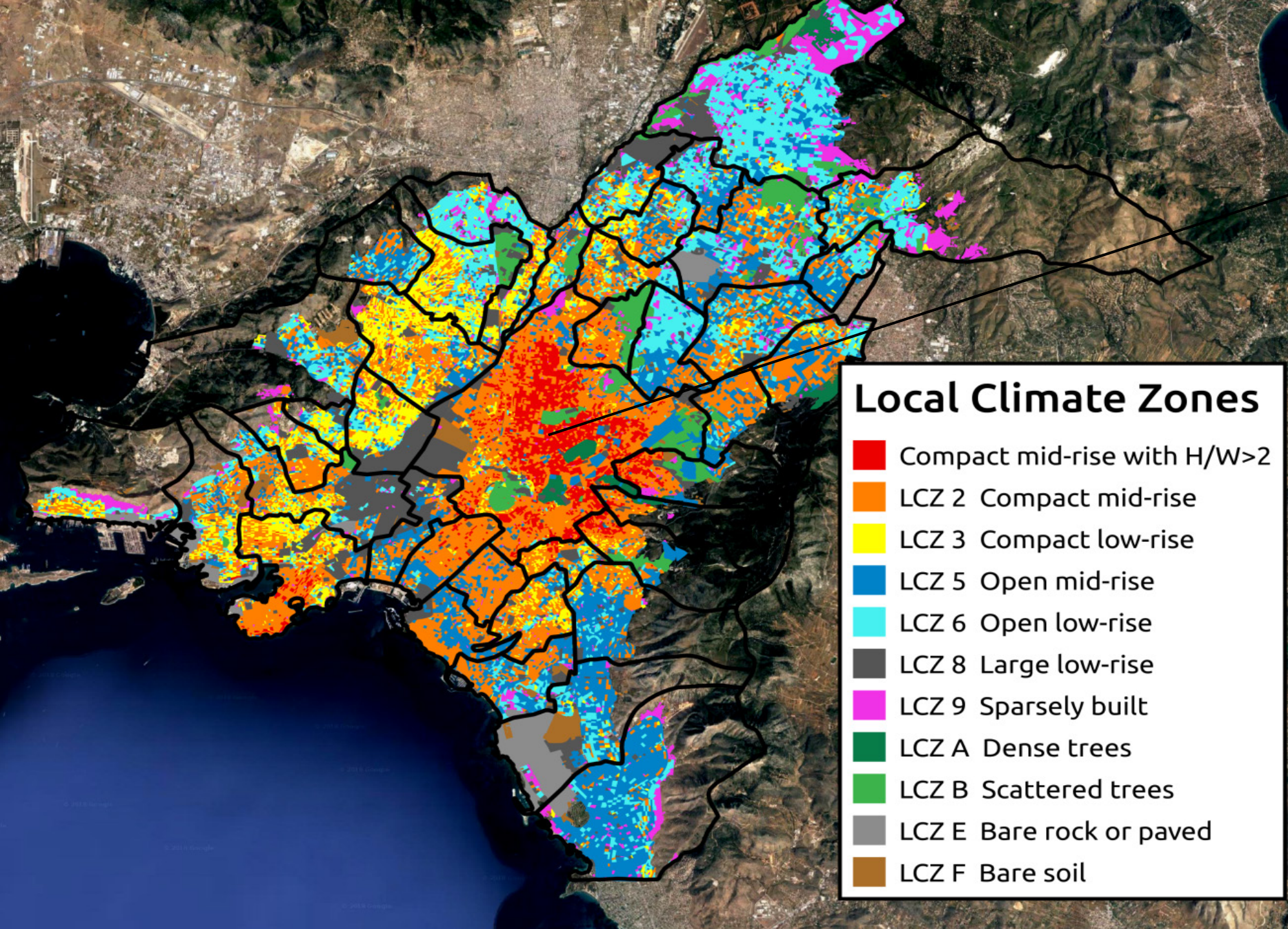


LCZs are defined as regions of uniform surface cover, structure, material, and human activity that span hundreds of meters to several kilometers in horizontal scale.



The physical properties used are: Solar View Factor, aspect ratio, building surface fraction, impervious surface fraction, height of buildings, albedo, anthropogenic heat.





Municipality of Athens

Adaptation plans need to be developed by local climate zone rather than by administrative borders.

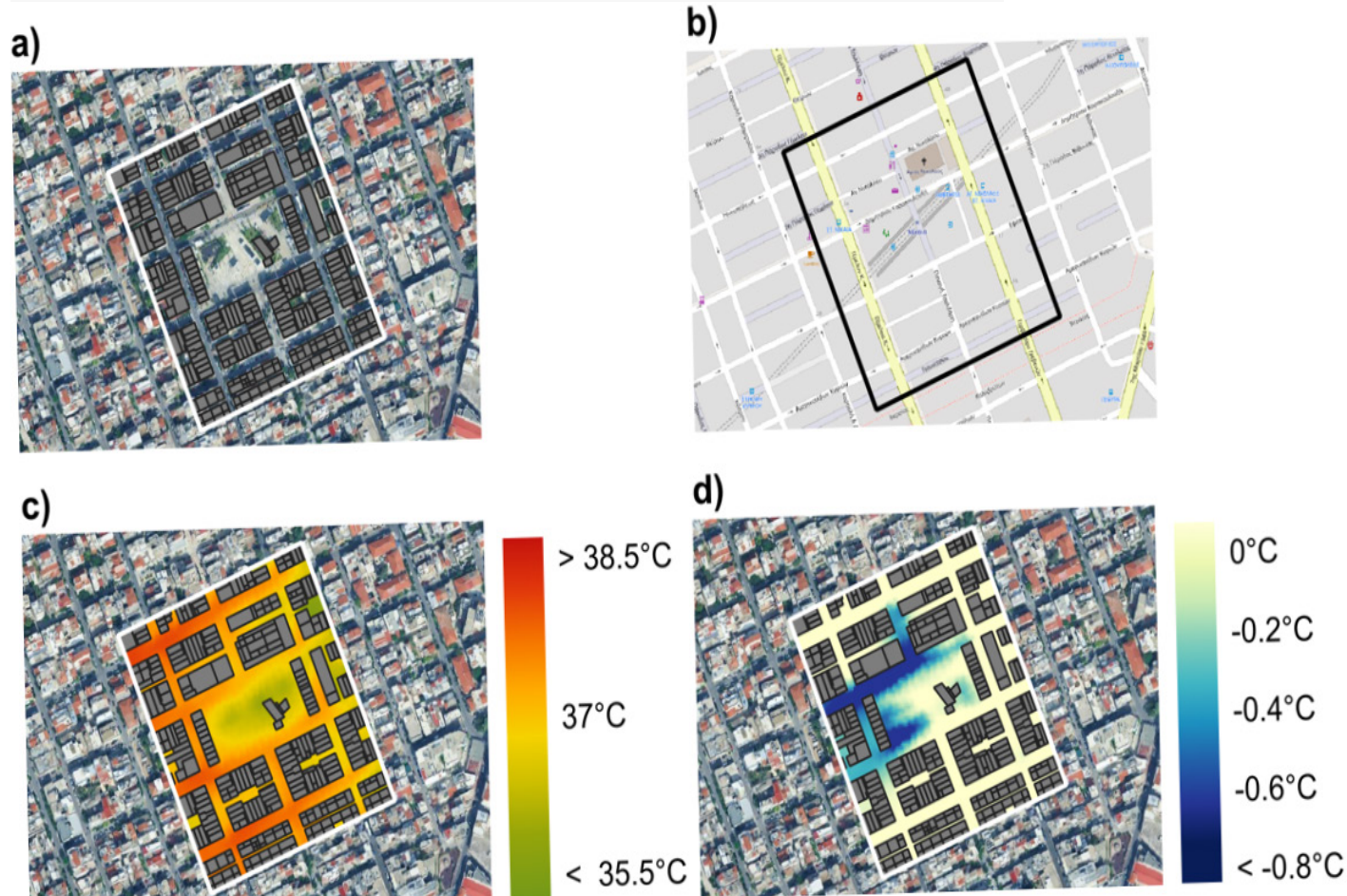
For instance, the area of the Municipality of Athens has 3 local climate zones (red, orange and yellow), thus 3 distinct adaptation plans are needed.

A photograph of a single, full-canopied green tree standing in a vast, flat, green grassy field. In the far distance, a city skyline with various skyscrapers is visible under a clear blue sky. The text "But there are no open spaces for greenery!" is overlaid in white serif font on the right side of the image.

But there are no open spaces for greenery!

Distribution of small and medium-sized parks within the urban fabric

Municipality of Nikaia – Agios Ioannis Rentis
Piraeus regional unit, Attica, Greece

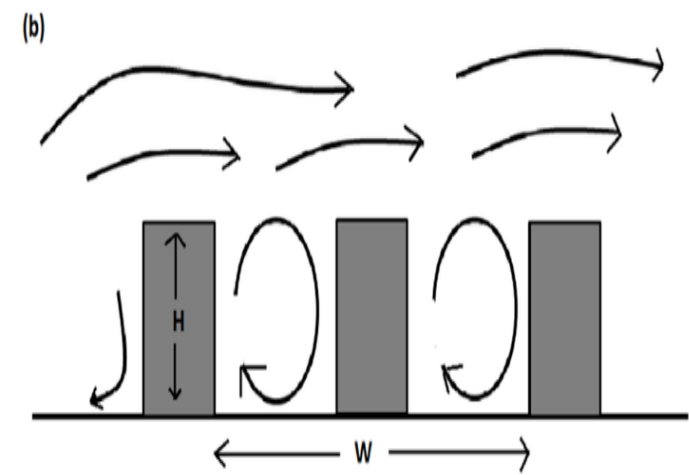
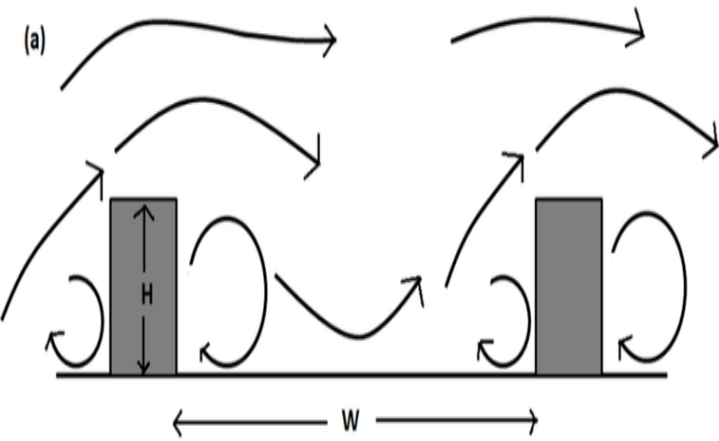


- The conversion of part of the square into a small park leads to a temperature reduction of up to 1 °C.
- The wind significantly transfers the park's cooling effect to the adjacent heat-stressed streets.
- Useful in neighbourhoods with limited open space.
- Once developed in a network mode, they form ventilation corridors and result in higher air temperature reductions.

Barcelona

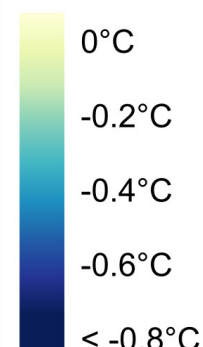
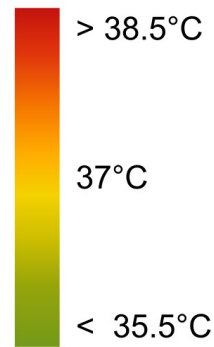
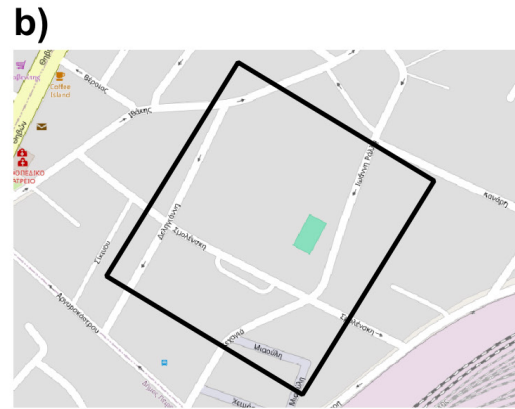
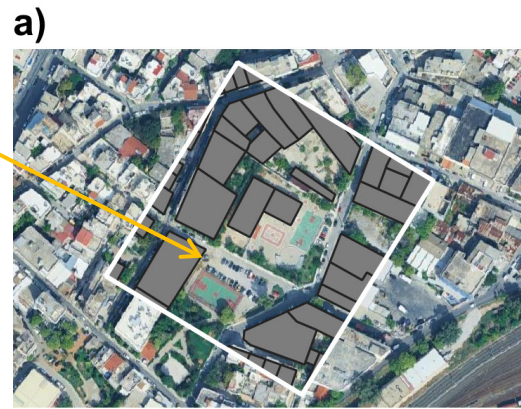
Super Blocks

(conversion of streets'
junctions to open
parks)

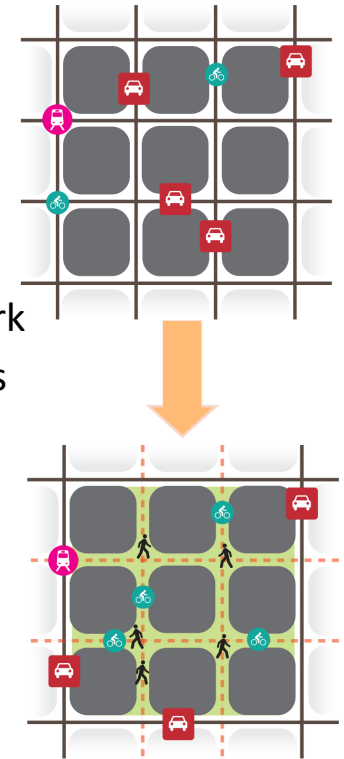


Super blocks

Municipality of Nikaia – Agios Ioannis Rentis
Piraeus regional unit, Attica, Greece



- If open spaces are not available, they should be “discovered”.
- Creation of a network of pedestrian streets and green spaces at street intersections, following the example of Barcelona.



- Each urban area needs its own heat mitigation plan. No urban heat mitigation plan can be indiscreetly applied anywhere.
- Set the institutional framework and ensure the involvement of stakeholders in its shaping.
- Conduct heat risk and vulnerability assessment at a detailed spatial scale to differentiate the urban heat mitigation plan at the neighborhood scale.
- Work out a mix of heat mitigation measures to achieve the best result.
- Engage the local communities in the urban heat mitigation process, raise awareness about climate change and urban heat, and foster local initiatives to enhance just resilience.
- Develop a monitoring and evaluation system for the early assessment of the performance of the heat mitigation measures and
- Take note of the risk of maladaptation, namely when a heat mitigation plan, instead of reducing vulnerability, creates new risks and negative consequences.

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