ARSINOE

CLIMATE-RESILIENT REGIONS THROUGH SYSTEMIC SOLUTIONS AND INNOVATIONS

The ARSINOE project: Addressing extreme heatwaves in Athens

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Open Training Session #6

Heat and Health: Building Resilience for a Hotter Future

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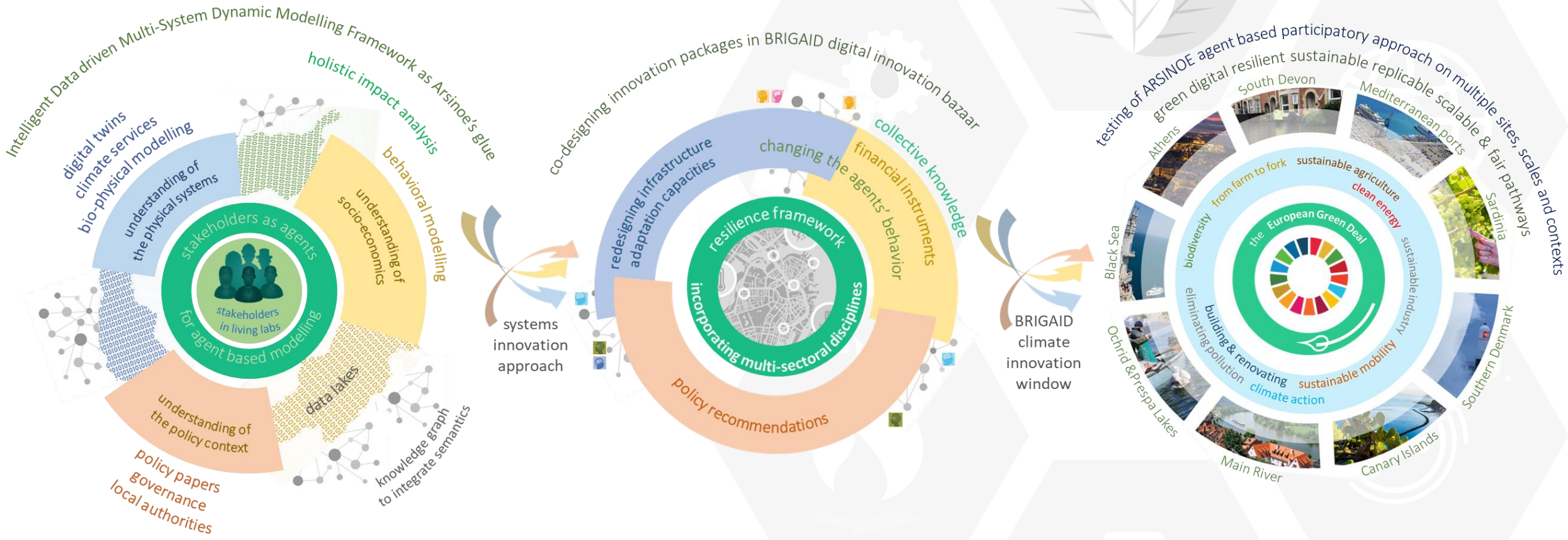
ARSINOE methodological framework in a glimpse

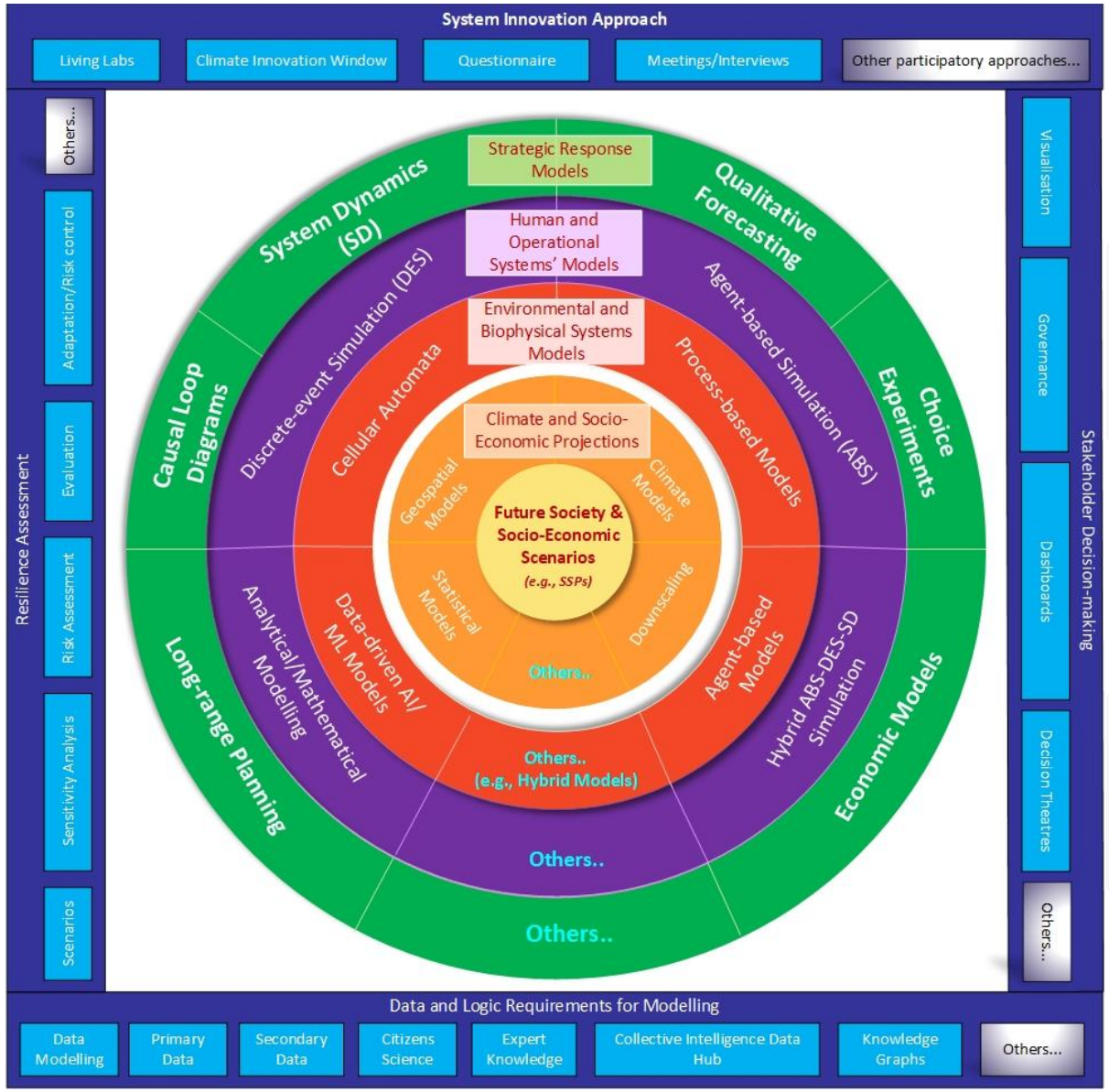


understanding the system vision | restructuring the system | offering an innovative solution

Main challenge identified in the Athens Living Lab

"Athens is becoming increasingly hot with significant impacts on health, society and the local economy. What is our vision for dealing, together, with this imminent and invisible threat?"

The Resilience Wheel of ARSINOE for the Athens case study



tier 1	SSP1-2.6 and SSP3–7.0
tier 2	climatic parameters statistical downscaling
tier 3	Urban Heat Island biodiversity landscape fragmentation noise population density air quality socio-economic vulnerability
tier 4	heatwave crisis response tool
tier 5	blue & green infrastructure tool assessment of willingness to pay

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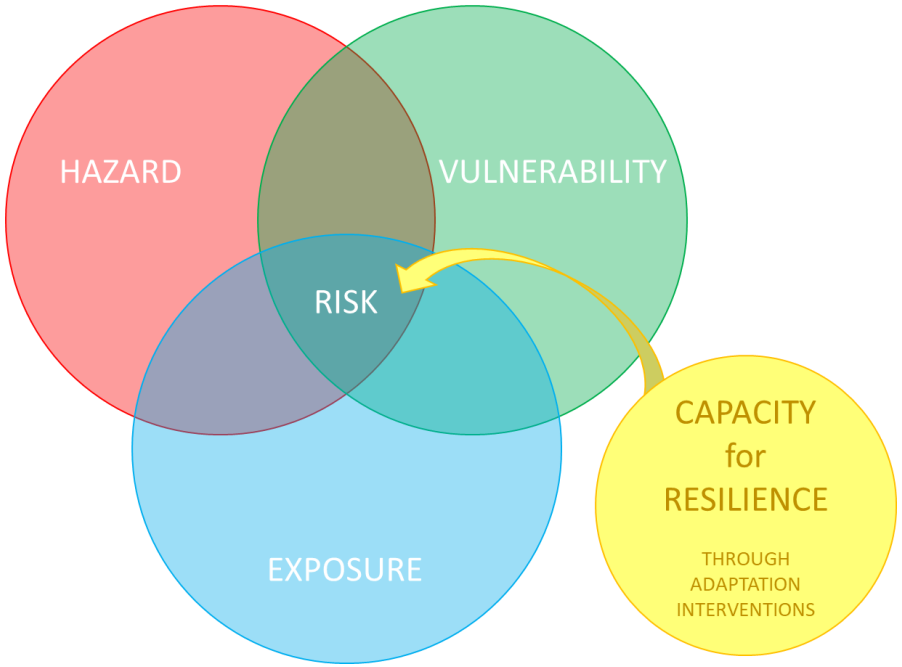
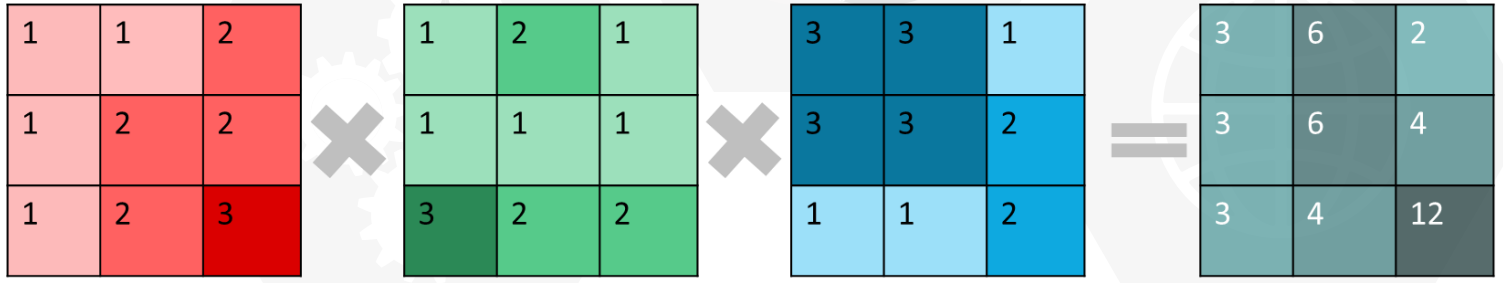
Resilience as a continuous risk mitigation exercise

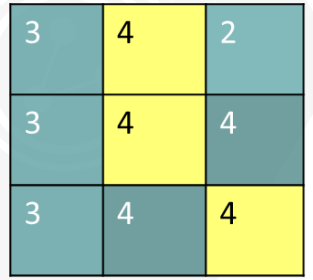
Hazard x Vulnerability x Exposure





hazard maps | vulnerability maps | exposure maps | risk maps

applying interventions to decrease risk and increase resilience to the identified hotspots



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the long-term risk system for urban planning horizon interventions

Risk = Hazard x Vulnerability x Exposure

interventions for resilience

green & blue infrastructure for UHI mitigation

response resources at heatwave crisis

primary hazards	vulnerabilities	exposures
heatwave UHI by CNA average surface temperature calibrated against Copernicus	morbidity & mortality	animal plant species
air pollution NO2, NO, CO, O3, SO2, PM2.5, PM10, VOCs	impact on well-being	residents
noise	tourism decrease	workers
cascading hazards		
biodiversity loss	energy consumption increase	businesses
violence	water consumption increase	tourists

risk

identification of risk hotspots that need interventions for increasing resilience

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different risk systems at different time scales

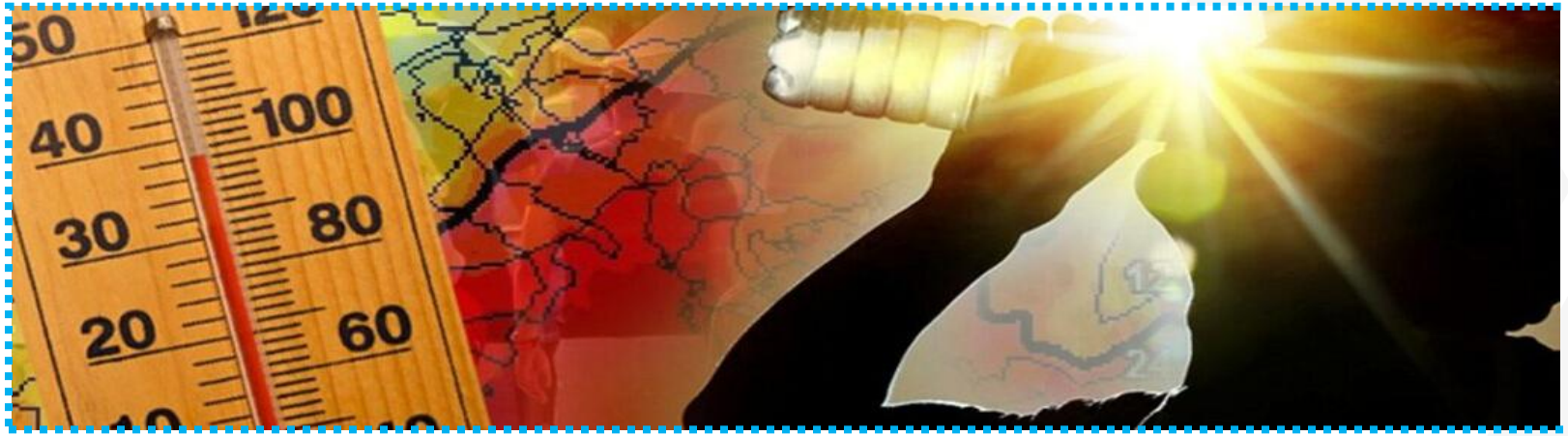
long-term: **urban planning horizon**

how can we reduce the Urban Heat Island?

heatwave + air pollution

+biodiversity loss + noise

impact on health, well-being, tourism, economy



short-term: immediate response horizon

how can we respond during the heatwave crisis?

heatwave + air pollution

direct impact on human health

and quality of life

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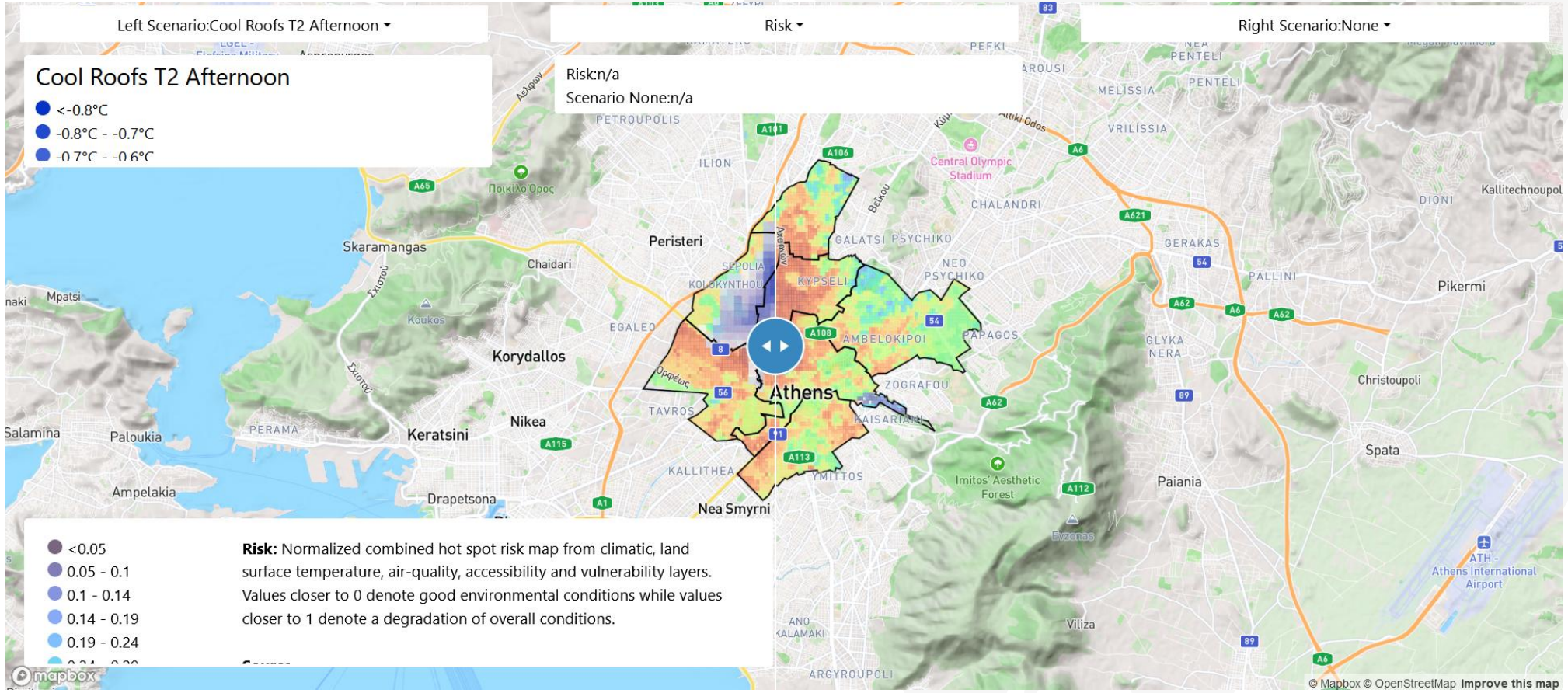
urban planning horizon

a supportive tool that

- integrates and visualizes all risk parameters
- prioritizes adaptation for Athens neighborhoods based on long-term risk
- assesses the relief achieved through a list of selected interventions



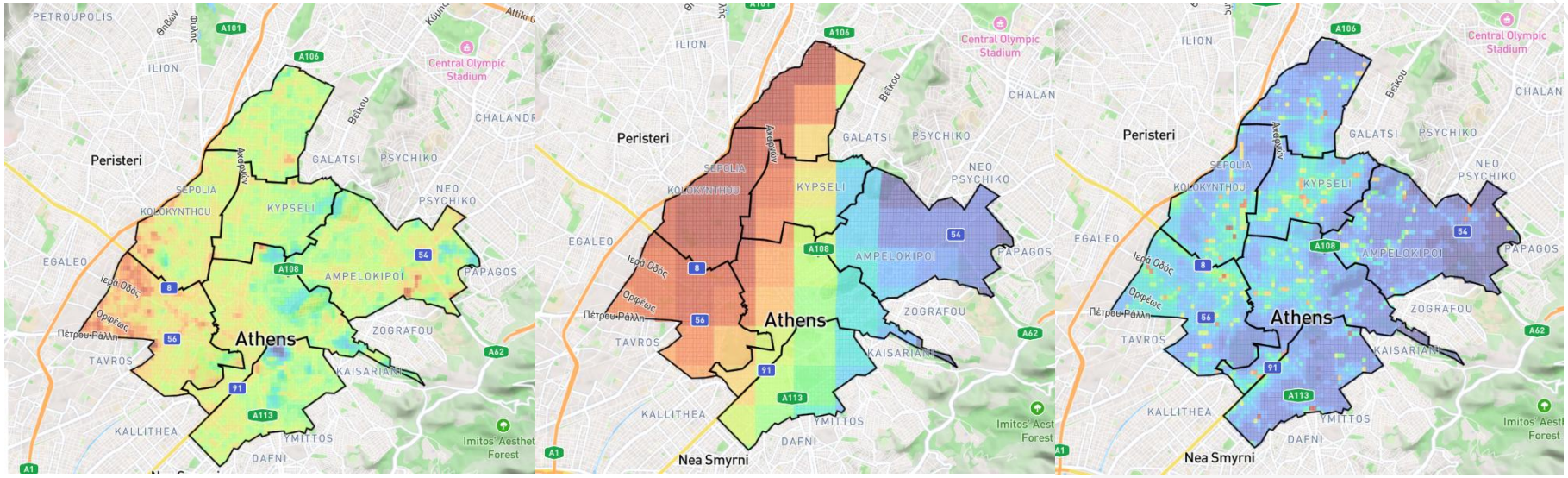
urban planning horizon

integrated models

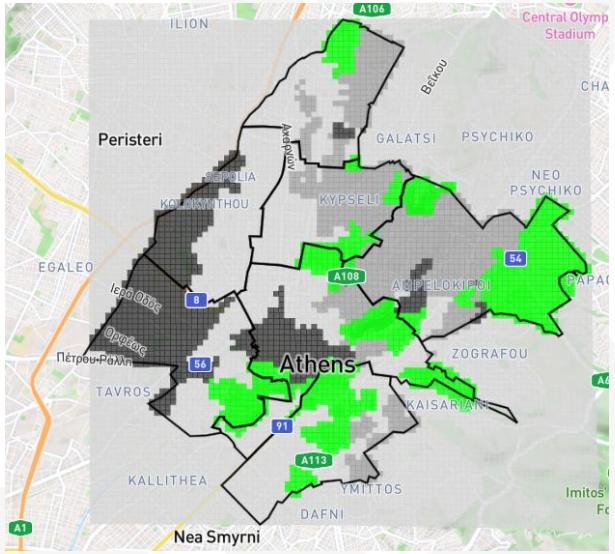
land surface temperature

heat index

air quality



biodiversity clusters



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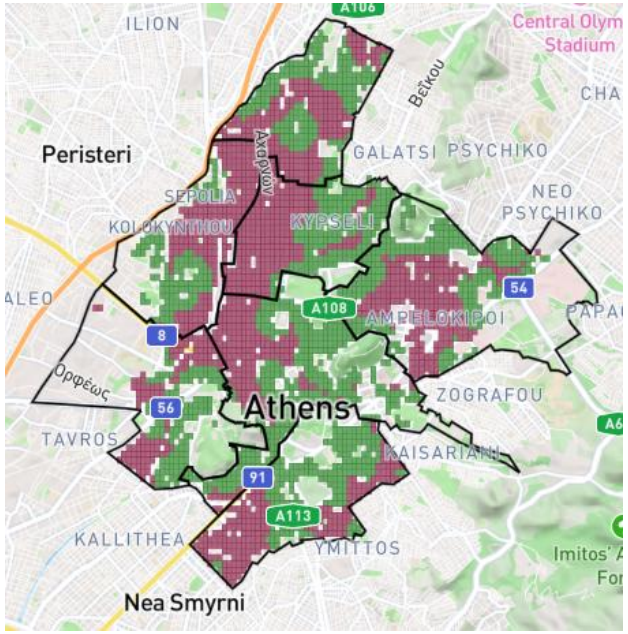
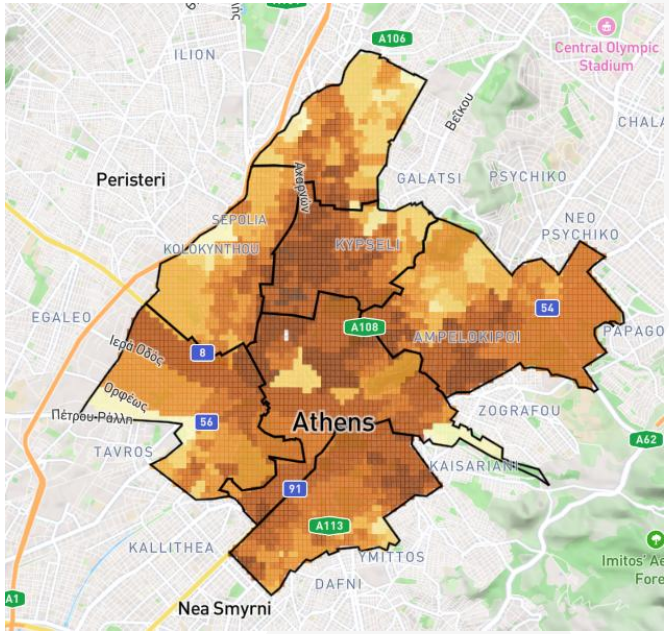
integrated models

urban planning horizon

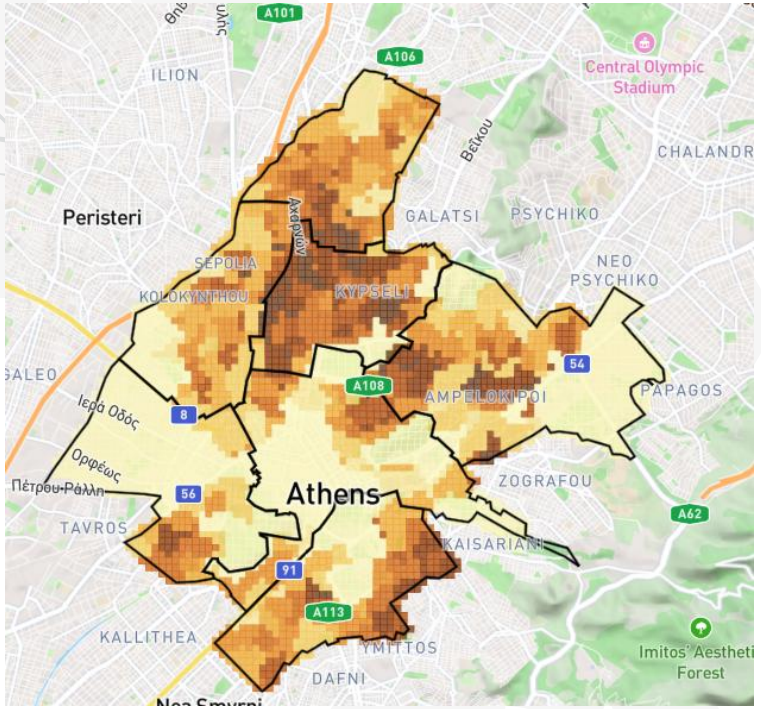


accessibility to green



combined vulnerability

- elderly
- retired
- living in houses built before 1980
- living alone
- renting
- living in houses smaller than 60 sq m
- unemployed
- immigrants from low-income countries



population density

N. Votsi, G. Papangelis, K.V. Varotsos, E. Athanasopoulou, P. Koutsantoni, A. Karali, D. Karagianis, P. Sismanidis, C.T. Kiranoudis, I. Keramitsoglou, C. Giannakopoulos, E. Gerasopoulos, *A multi-faceted, integrated methodological approach to identify hotspots of combined urban environmental pressures in the climate change context ,* Euro-Mediterranean Journal for Environmental Integration (EMJE, © 2025 Springer Nature): Accepted for publishing

Ziliaskopoulos, K., Petropoulos, C., & Laspidou, C. (2024). Quantifying and Mapping Vulnerability to Extreme Heat Using Socio-Economic Factors at the National, Regional and Local Level.

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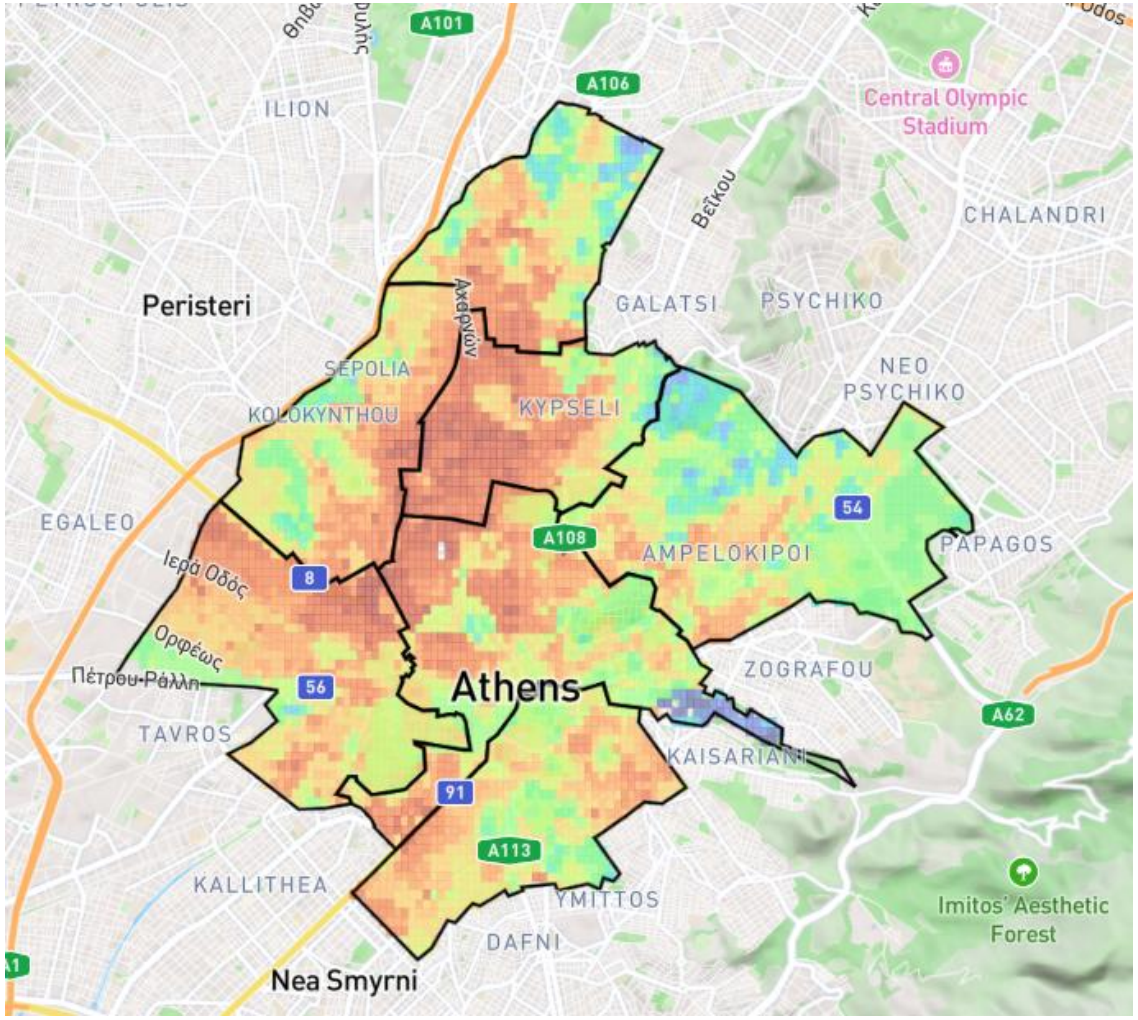
integrated models

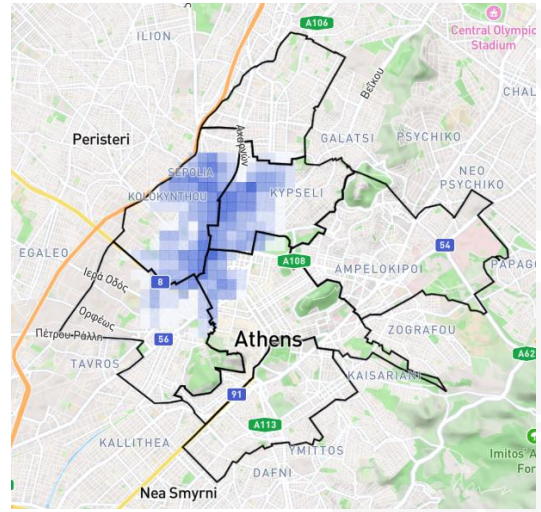
urban planning horizon

heatwave risk



interventions tested:

- cool roofs and cool streets
- green roofs and urban greening
- green roofs and urban trees



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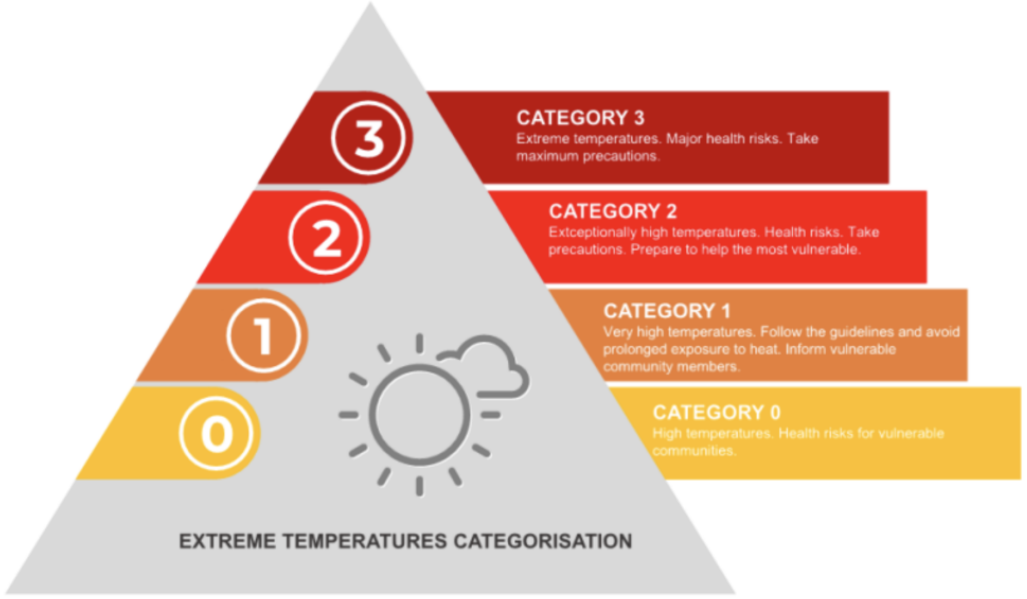
a supportive ABM tool

for immediate response that:

- informs, supports the coordination, consults the involved actors on the high priority intervention spots and the type of support needed
- integrates existing heatwave categorizations
- activates responses gradually as a function of the heatwave category
- distinguishes the heatwaves hazard from the wildfires hazard
- enables a digital twin and early warning tool



resources and corresponding services:

• guidance • shading • cooling • drinking water •

• animal support • first aid • medical care •

Municipality of Athens and other Municipalities

municipal parks, friendship clubs, protection centres for the elderly, municipal health centers, drinking water distribution, helpline, Athens Municipal Homeless Shelter, health workers or volunteers, Extrema Global, Cool of Athens website, free WiFi spots, animal feeders, guidelines in Metro stations

Region of Attica

regional parks, air-conditioned spaces, announcements on electronic boards

Red Cross

first aid trucks, Red Cross centers, shading kiosks, home assistance, water bottle distribution, volunteers' app

Ministry of Civil Protection

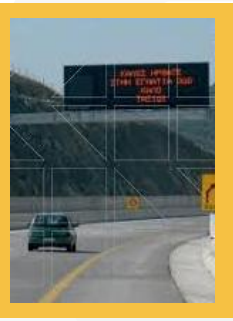
notifications, website with heatwave guidelines

Ministry of Labor and Social Security

instructions for working from home, restriction of outdoor work

Ministry of Health

circular note on extreme heatwaves, primary care structures, hospitals, connection with air pollution



two pilot scale interventions from ARSINOE

Singular Ribbon

lightweight linear structure of channels
for a continuous strip of vegetation through hydroponics

- temperature decrease due to shade & evapotranspiration
- positive impact on biodiversity

Tiny Forest in Athens

fast-growing native woodland, typically made up of 600 trees planted in a tennis-court-sized plot of 200m^2

- connect people with nature
- mitigate impacts of heat stress
- enhance urban biodiversity

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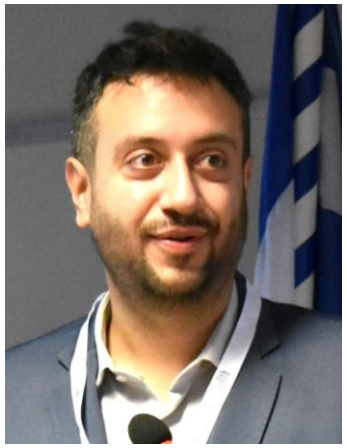
the ARSINOE team for Athens case study supportive tools



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THANK YOU

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