



## Pathways to sustainable development through use cases in the Athens metropolis

Co-chairs:

Athanasia Tsertou (ICCS/CIBOS)

Evangelos Gerasopoulos (IERSD/NOA)

Learn more here:



#EGW2022

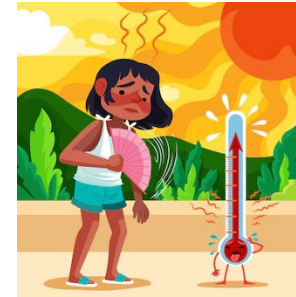
ATHENS 7-9 DECEMBER 2022





## Session Objective:

Discuss shortcuts & rocky roads towards urban sustainable development, well-being & inclusive growth through knowledge synthesis using selected project pilots in Athens.



**Room Alkioni**  
**14:15-15:45**



## Part 1: Lightning talks

**Room Alkioni**  
**14:15-15:15**

**ATHENS 7-9 DECEMBER 2022**

# EUROGEO WORKSHOP 2022



The HARMONIA contribution to GEOSS platform for coastal cities, the example of Piraeus

Nerantzia Tzortzi  
POLIMI & Betty  
Charalampopoulou  
GSH



Urban ReLeaf:  
Citizen-powered data  
ecosystems for  
inclusive and green  
urban transitions

Gerid Hager  
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Establishing a resilience  
framework for co-creating  
adaptation solutions: the  
case of extreme heat in  
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The e-Shape Health  
Surveillance Air Quality  
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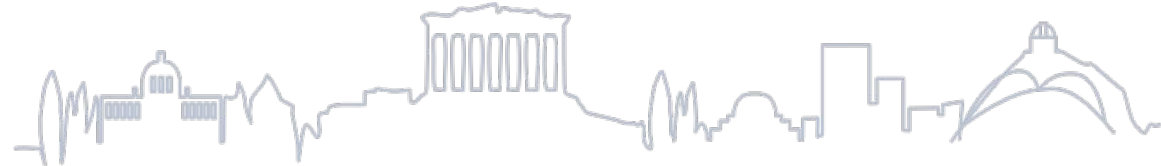
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EUROGEO WORKSHOP

# Citizen-powered data ecosystems for inclusive and green urban transitions

**Gerid Hager & Inian Moorthy**

*International Institute for Applied Systems Analysis (IIASA)*

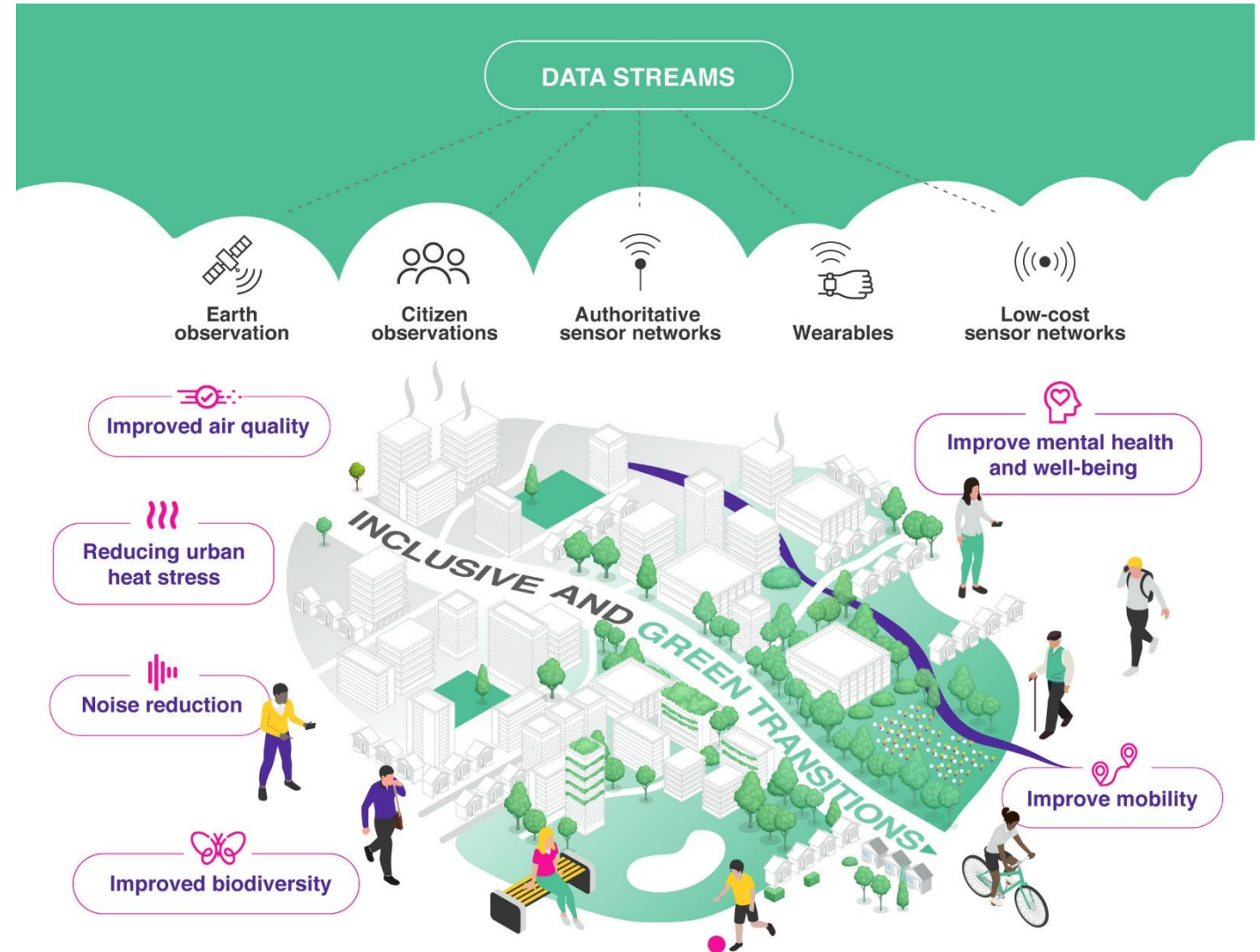


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- January 1, 2023
- 4-year project
- 15 partners from 9 countries
  - 8 R&D entities
  - 7 city/province entities
  - 4 for-profit entities
- Uptake & validation of citizen observations to complement authoritative measurement in the urban environment & boost citizen engagement



The expansion of urban greenspace and planting of trees are critical for climate change adaptation, health and well-being. They provide cooling effects, decrease air pollution, and improve mental health, among other ecosystem services and health-related benefits.

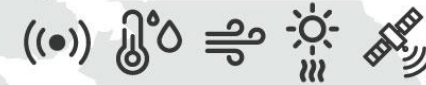
-  **Participatory tree registry**
-  **Low-cost sensors**
-  **Temperature & humidity**
-  **Air quality**
-  **Bioclimatic comfort**
-  **Earth observation**

### Dundee, Scotland



Citizen engagement for resilient Blue Green Infrastructures transitions

### Riga, Latvia



Adaptive community-based urban environment planning for the wellbeing of citizens

### Utrecht, Netherlands



Mitigating heat stress through private greening and active community management

### Cascais, Portugal



Bioclimatic comfort analysis and resilience with nature-based solutions

### Mannheim, Germany



Citizen engagement for building a tree registry and mitigating heat stress

### Athens, Greece

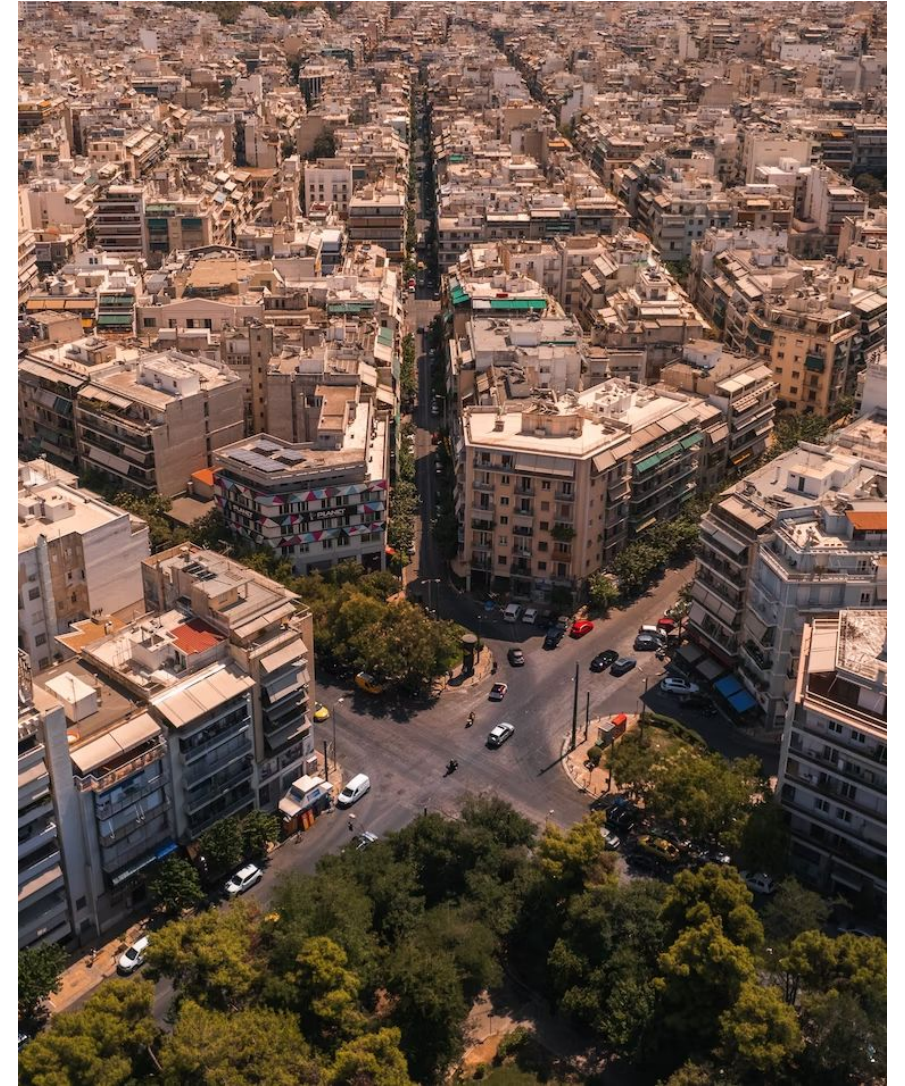


Participatory tree registry and air quality monitoring



# CHALLENGE

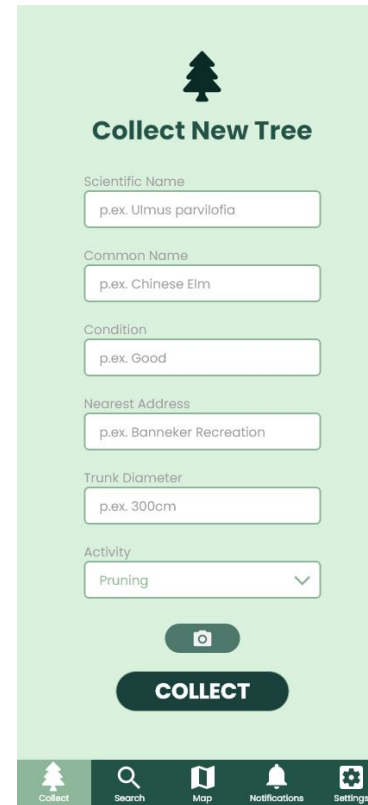
- Increasing **frequency/intensity of heatwaves** and Athens is the first European city to appoint a Chief Heat Officer
- **Air pollution** issues especially for ambient particles that reach episodic levels due to residential biomass burning in winter or wildfires in summer
- At the same time, the city suffers from **sub-optimal green infrastructure** data and planning
- Increasing recognition of the need for an up-to-date, accurate, inclusive, sustainable, and transparent **tree inventory** targeted at the city and its citizens to better monitor and manage urban green spaces.



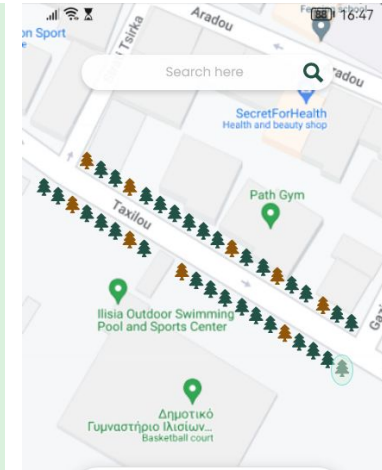
# OBJECTIVES

## PARTICIPATORY TREE REGISTRY

- Comprehensive data platform of all street-level trees for local authorities, including a tool to register/monitor tree-related tasks to improve transparency/capacity building for urban green space activities.

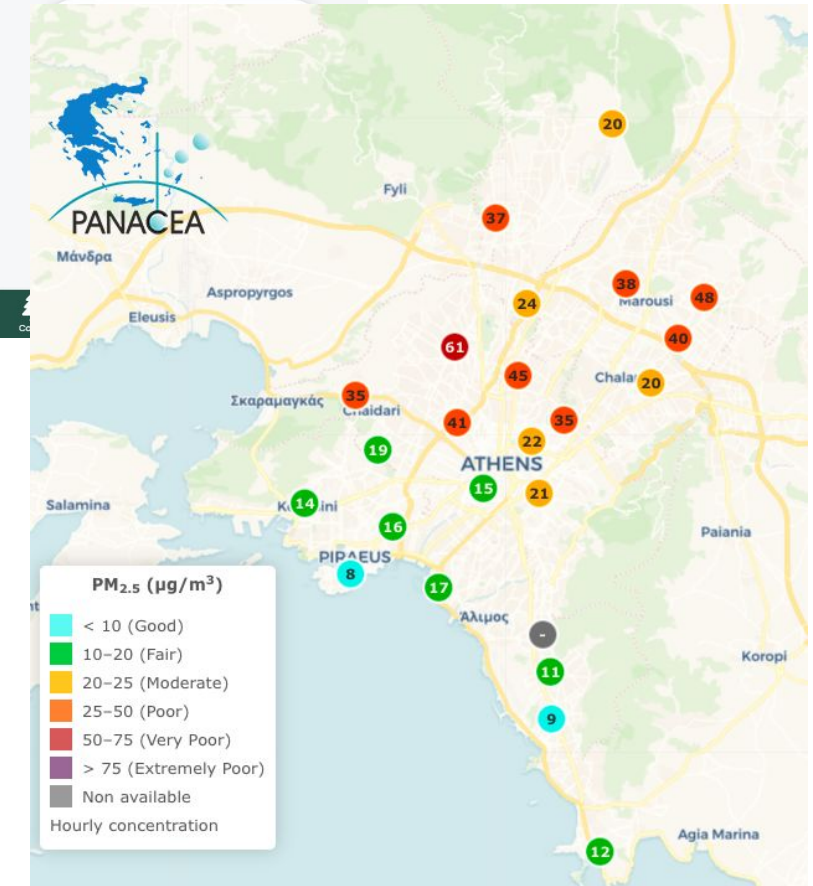


The screenshot shows a mobile app interface for collecting tree data. At the top is a green header with a tree icon and the title 'Collect New Tree'. Below the title are several input fields: 'Scientific Name' (with 'p.ex. Ulmus parvifolia' as a placeholder), 'Common Name' (with 'p.ex. Chinese Elm'), 'Condition' (with 'p.ex. Good'), 'Nearest Address' (with 'p.ex. Bancker Recreation'), 'Trunk Diameter' (with 'p.ex. 300cm'), and 'Activity' (a dropdown menu with 'Pruning' selected). A camera icon is positioned above a large black 'COLLECT' button. At the bottom is a dark navigation bar with icons for 'Collect', 'Search', 'Map', 'Notifications', and 'Settings'.



## LOW-COST, LOW-FOOTPRINT AIR QUALITY MONITORING

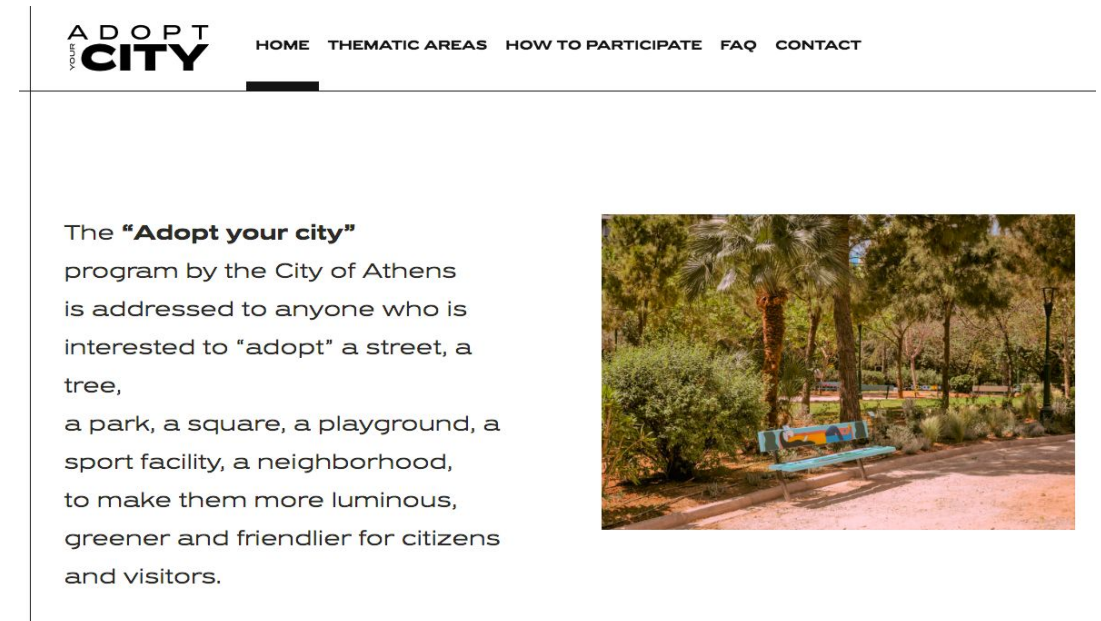
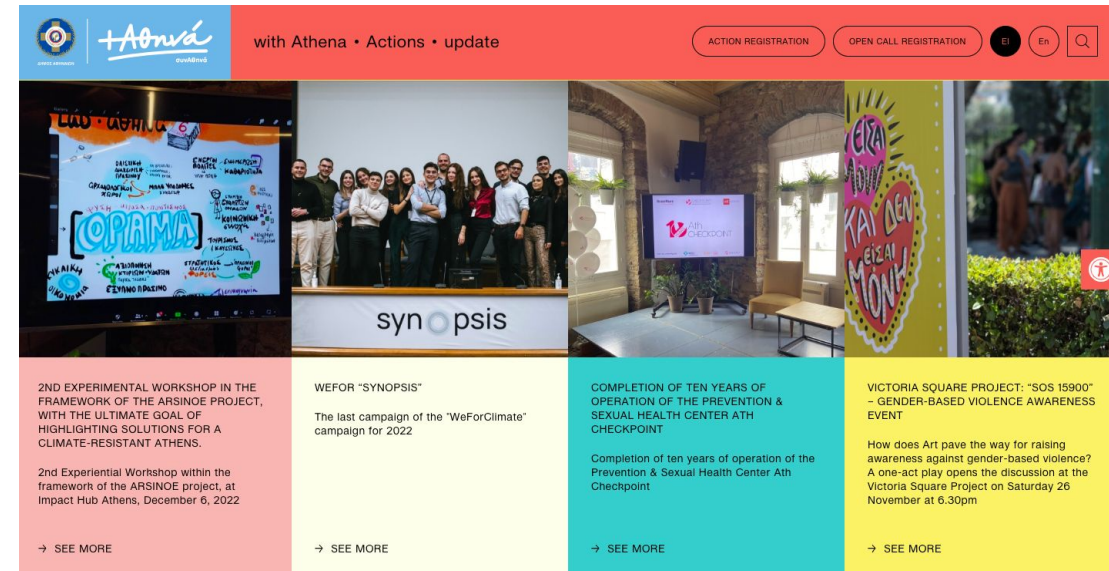
- Enhance the PANACEA network. increase spatiotemporal resolution and improve mapping of citizen's exposure to air pollution (PM<sub>2.5</sub>).





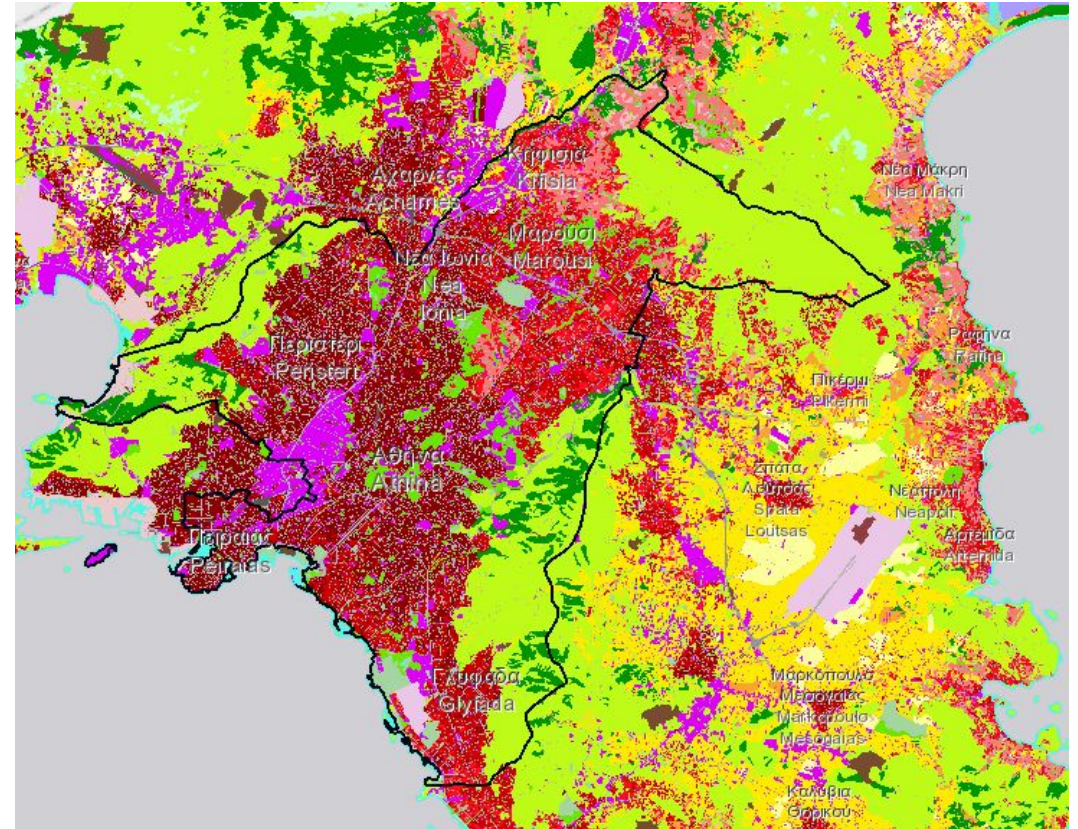
# SYNERGIES

- Existing citizen science initiatives from H2020 Scent and SMURBS/ERA-PLANET projects (i.e. HRTA volunteers that support civil protection activities from climate related disruptions in the Attica region)
- SynAthina: grassroots organisation initiated by the City of Athens to support citizen 4K+ citizen actions supported, 450+ community groups
- Adopt-A-Tree initiative in Athens
- Digital Twin of Athens via the H2020 DUET project: to access tree, terrain and green space data
- Sustainable City Network



# EXPECTED OUTPUTS

- Urban **tree inventory dataset** co-created with citizens for the city (1000+ citizens)
- Dynamic platform to **visualize tree inventory** that integrates multiple data streams including EO
- Expanded **air-quality sensor network** across city with better spatiotemporal resolution
  - **120 wearable low-cost sensors** measuring temperature and humidity and 30 AQ fixed-site sensors
  - **2 black carbon and 2 ultra-fine particle sensors** deployed
  - **100K+ observations** collected from citizens regarding temperature, humidity, or air quality

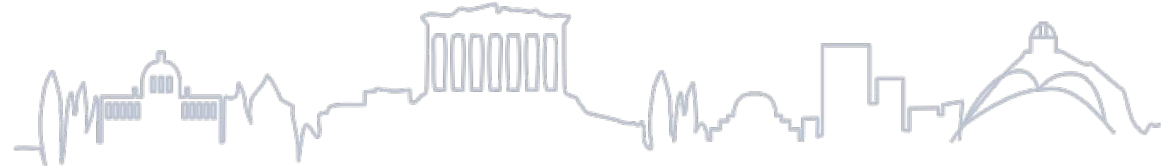


*Copernicus Urban Atlas (Athens, 2018)*



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EUROGEO WORKSHOP

# Thank you!

[hager@iiasa.ac.at](mailto:hager@iiasa.ac.at)  
[moorthy@iiasa.ac.at](mailto:moorthy@iiasa.ac.at)

**Gerid Hager & Inian Moorthy**

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ATHENS 7-9 DECEMBER 2022

Towards an integrated and convergent EuroGEO, 7 to 9 December 2022



Establishing a resilience framework for co-creating adaptation solutions:  
the case of extreme heat in the Athens Metropolitan Area

Professor Chrysi Laspidou - University of Thessaly  
Vice President of Research & Technology - Water Europe



This project has received funding from the European Union's Horizon H2020 innovation action programme under grant agreement 101036683.



## Key facts



### Climate-resilient regions through systemic solutions and innovations

41

Partners  
coordinated by the  
University of  
Thessaly

15

European  
countries

9

Case studies in  
Europe

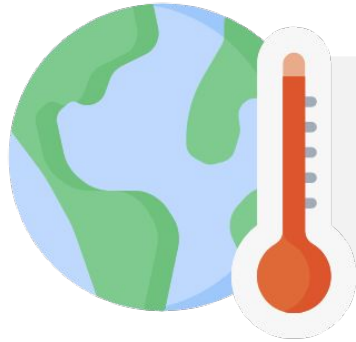
15

Million Euros

48

Months  
(October 2021 –  
September 2025)

## Challenges & approach



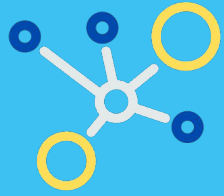
Climate change is complex and interconnected with other global challenges such as food security, water scarcity, biodiversity depletion and environmental degradation.

Adaptation refers to all approaches taken to adjust, prepare for, and accommodate new conditions that are created by changing climates.



ARSINOE will apply a 3-tier approach to address the growing complexity, interdependencies and interconnectedness of modern societies and economies and propose climate change adaptation solutions.

### 3 Tier Approach



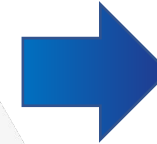
#### SYSTEMS INNOVATION APPROACH

The Systems Innovation Approach addresses the growing complexity, interdependencies and interconnectedness of modern societies and economies. It focuses on the functions of the cross-sectoral system “as a whole” and on the variety of actors.



#### CLIMATE INNOVATION WINDOW

The Climate Innovation Window is the EU reference innovations marketplace for climate adaptation technologies. It facilitates the market exploitation of validated tools and technologies by interested parties.



#### CLIMATE CHANGE ADAPTATION SOLUTIONS IN THE INNOVATION PACKAGES:

Pathways to solutions are co-created and co-designed by stakeholders to form an innovation package for resilience to climate change.

## 9 Case studies in Europe



**CS#1: Greening the Athens metropolitan area**



**CS#2: Mediterranean Ports**



**CS#3: Main River**



**CS#4: Ohrid/Prespa lakes**



**CS#5: Canary Islands**



**CS#6: Black Sea**



**CS#7: Southern Denmark**



**CS#8: Torbay and Devon county**



**CS#9: Sardinia**





## The Athens Metropolitan area

one of ARSINOE's nine CSs  
the frontrunner



main topic: building resilience against extreme heat events

through a

- human centered
  - participatory
  - bottom-up
  - inclusive
- integrated
  - holistic
  - informed
  - dynamic
- market linked

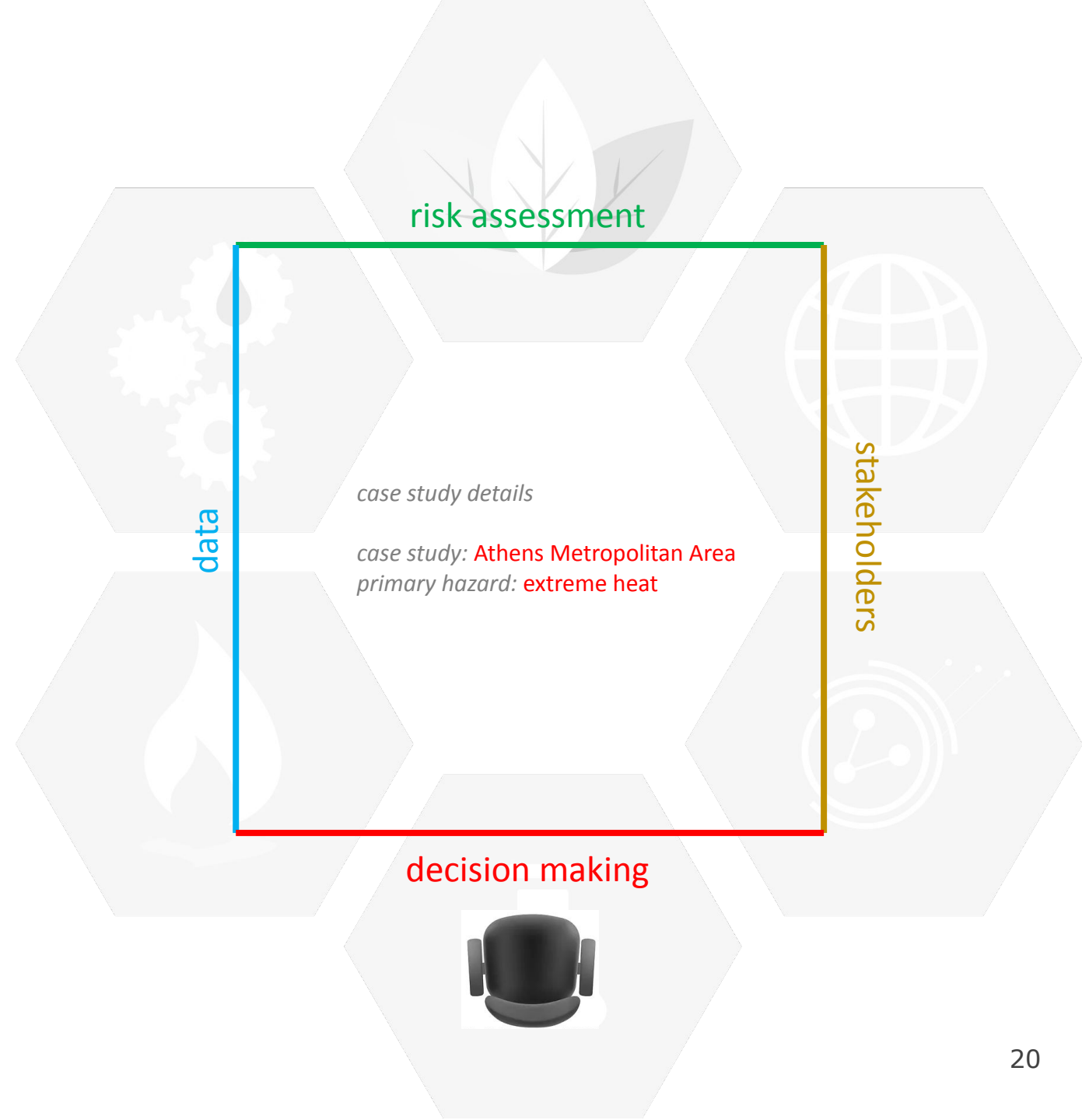
resilience framework



## The 4 pillars of Arsinoe's resilience framework

one of ARSINOE's nine CSs

the frontrunner



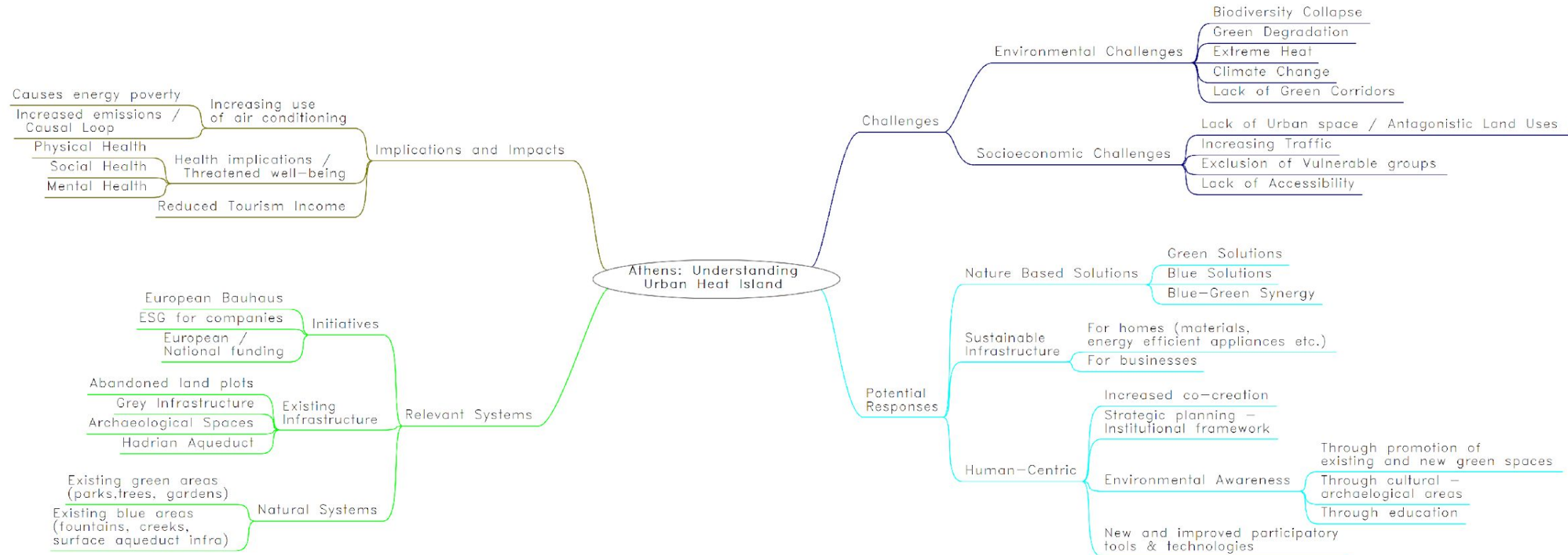
inclusiveness, bottom-up, and participatory features are accomplished through **Systems Innovation Approach**

establishing a living lab  
of regular workshops

engaging with a 4-helix  
network of stakeholders

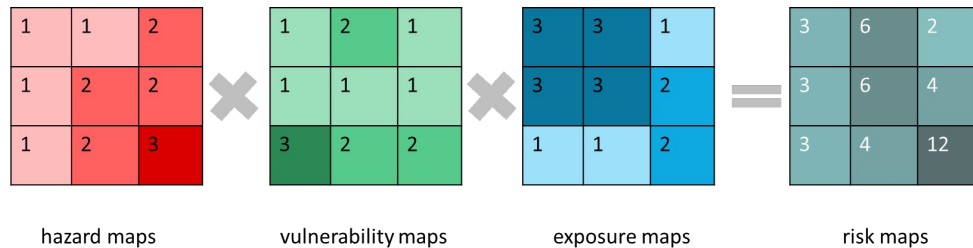
co-creation approach for participatory  
modeling and co-design of solutions

stakeholders

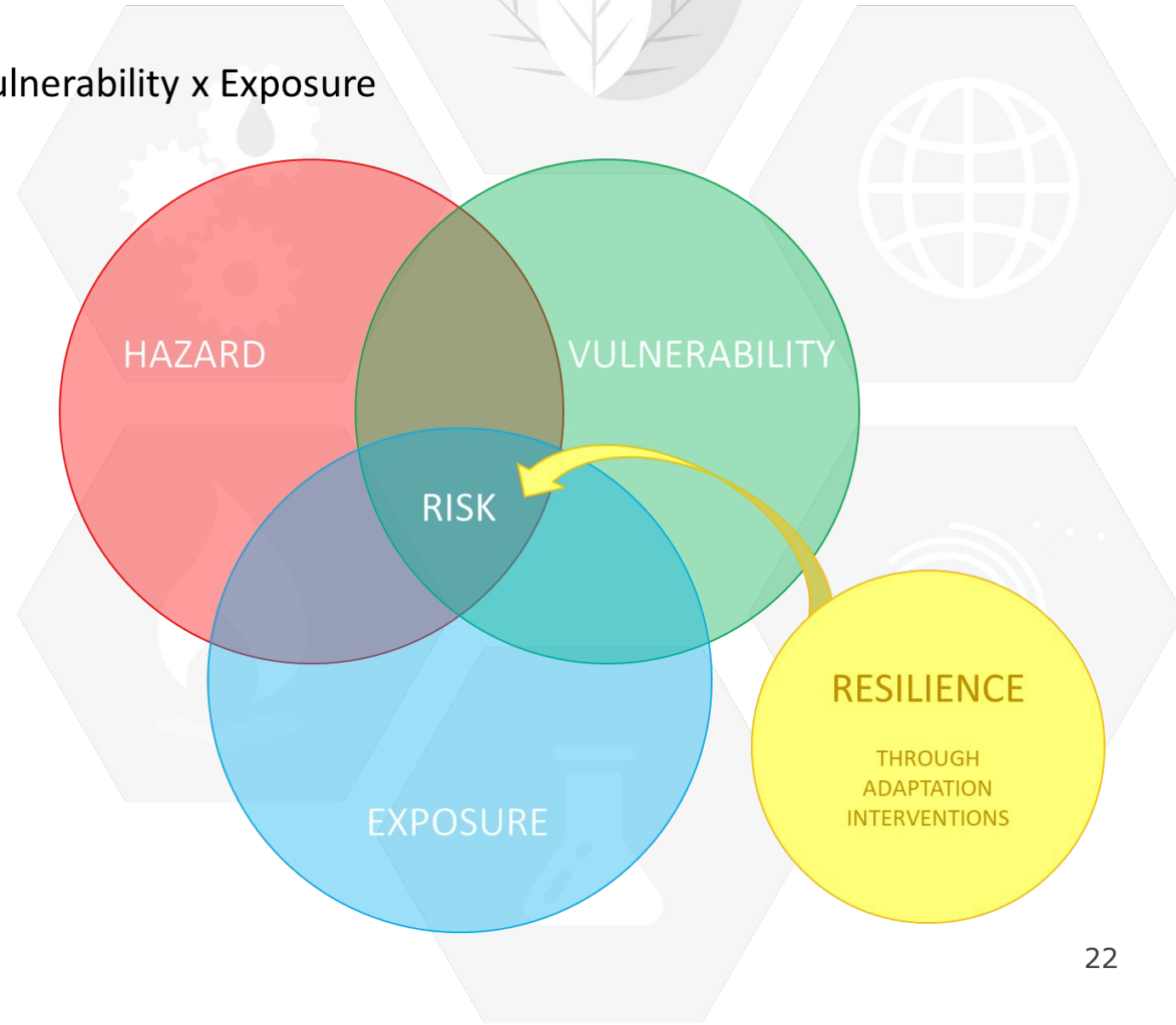
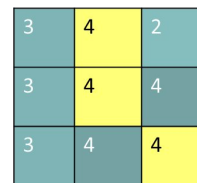


$$\text{Risk} = \text{Hazard} \times \text{Vulnerability} \times \text{Exposure}$$

producing risk maps for a series of risks related to heat in Athens to identify the hotspots for interventions that will increase resilience



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



extreme heat  
related  
risk hotspots  
for Athens  
as identified  
in the LL

Risk = Hazard x Vulnerability x Exposure

hazard

extreme heat  
air pollution  
noise  
GHG emissions  
discontinuity leading to biodiversity loss  
access to green/blue space for recreation and culture  
low aesthetic/recreational value

vulnerability

mortality and morbidity  
biodiversity loss  
vulnerability in infrastructure  
tourism decline  
cultural  
violence  
lack of social justice and cohesion

exposure

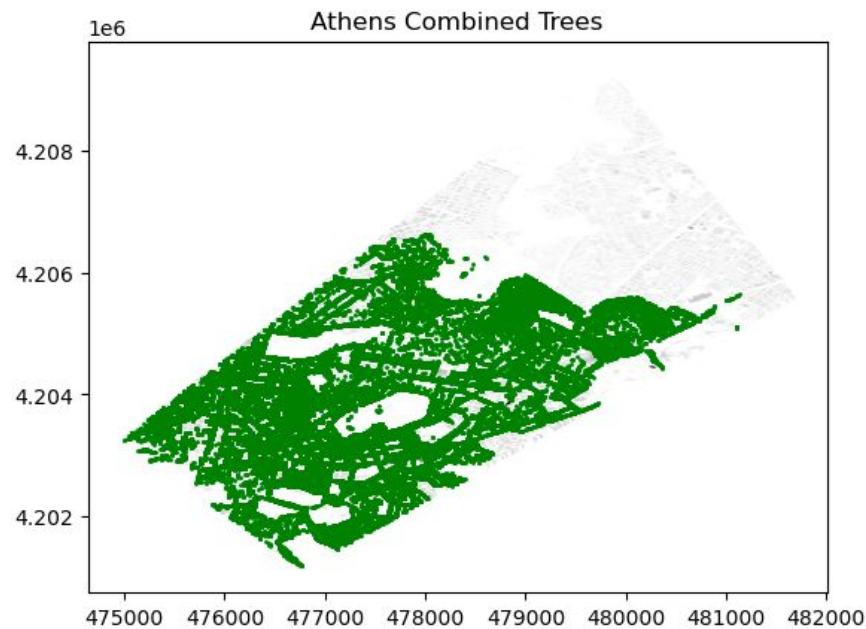
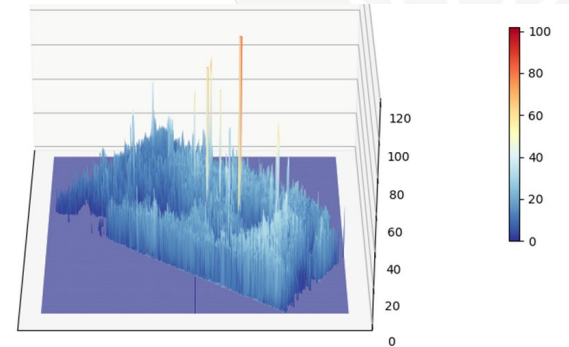
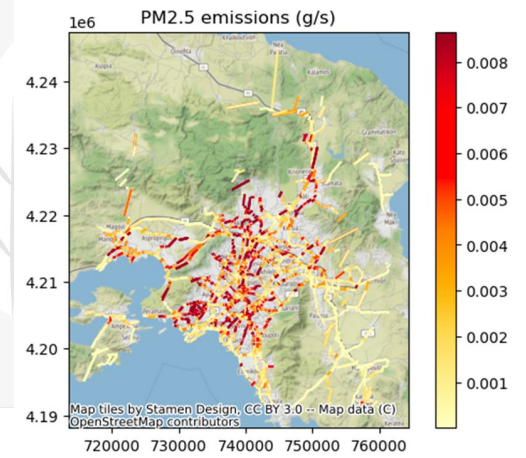
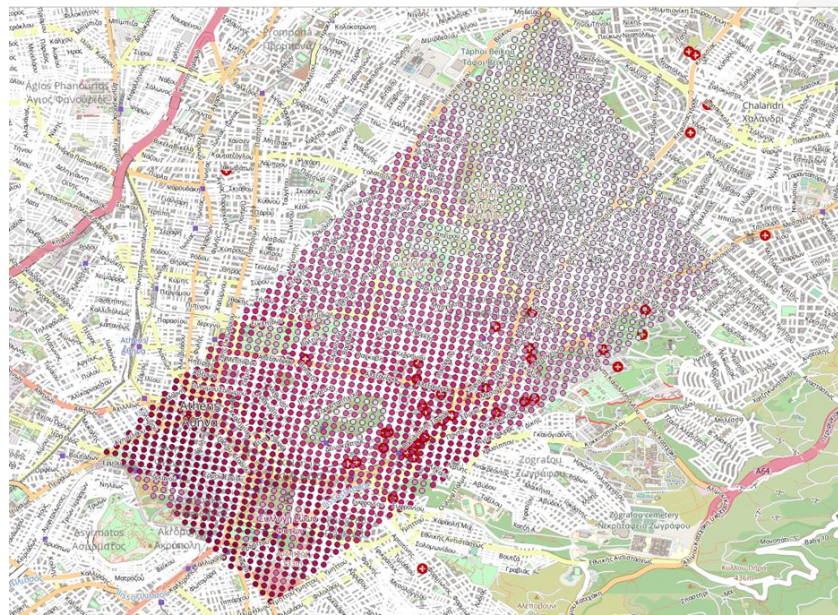
vulnerable population  
infrastructure  
number of hotels or tourist establishments  
workers exposed



the simulation of

- hazards
- vulnerabilities
- exposure
- and eventually risks

will be implemented with  
**System Dynamics Modeling**  
supported by  
ARSINOE'S **data hub**  
exploiting multiple data sources  
including  
**citizen science**





ARSINOE will also simulate a series of interventions that will be an outcome of co-creation.

The planner will be offered a tool to experience through VR the effect of different interventions

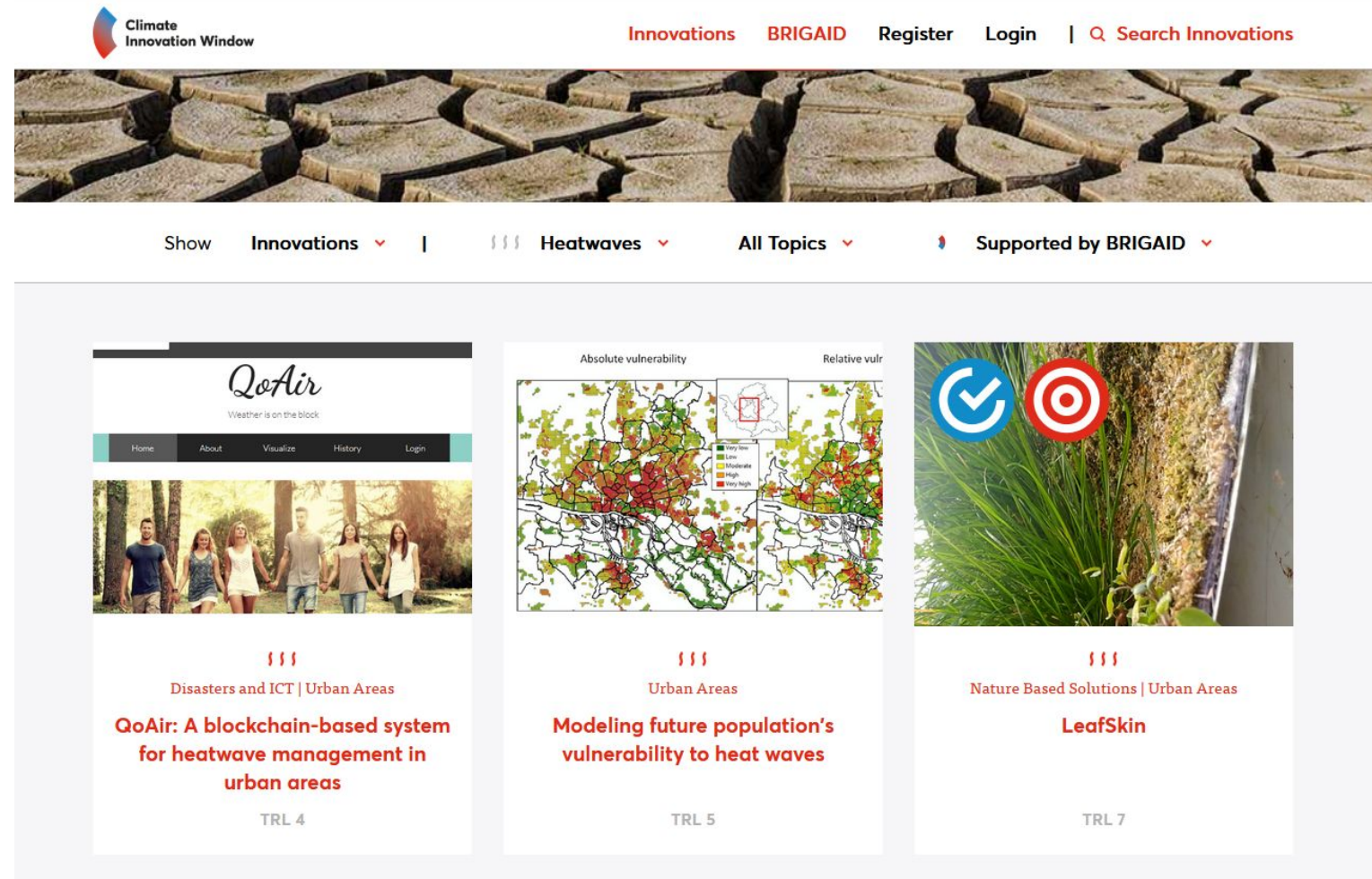
The solutions will be evaluated through a series of SDG KPIs and resilience metrics

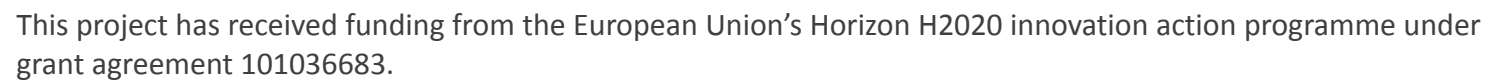
## interventions

- green infrastructure
- blue infrastructure
- grey infrastructure
- green-grey infrastructure
- other



Finally, ARSINOE will provide a link of the tested solutions to the market through its open tender calls and by integrating BRIGAIID'S **Climate Innovation Window**







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We e-shape EuroGEO

7-9 Dec.2022 | Athens



EuroGEO  
Showcases:  
Applications  
Powered  
by Europe

“  
Blazing new trails  
for EO markets  
”

EuroGEO  
Workshop  
2022

- www.e-shape.eu
- Horizon2020-e-shape
- @eshape\_eu
- e-shape project

## The e-Shape Health Surveillance Air Quality Pilot – merging EO for health benefits

Athanasopoulou Eleni  
National Observatory of Athens (NOA)



Learn more here:



EuroGEO



GROUP ON  
EARTH OBSERVATIONS



The e-shape project has received funding from the  
European Union's Horizon 2020 research and  
innovation programme under grant agreement 820852

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## HSAQ pilot overview – Main objectives:

### **Pilot 2.3 | EO-based pollution-health risks profiling in the urban environment**



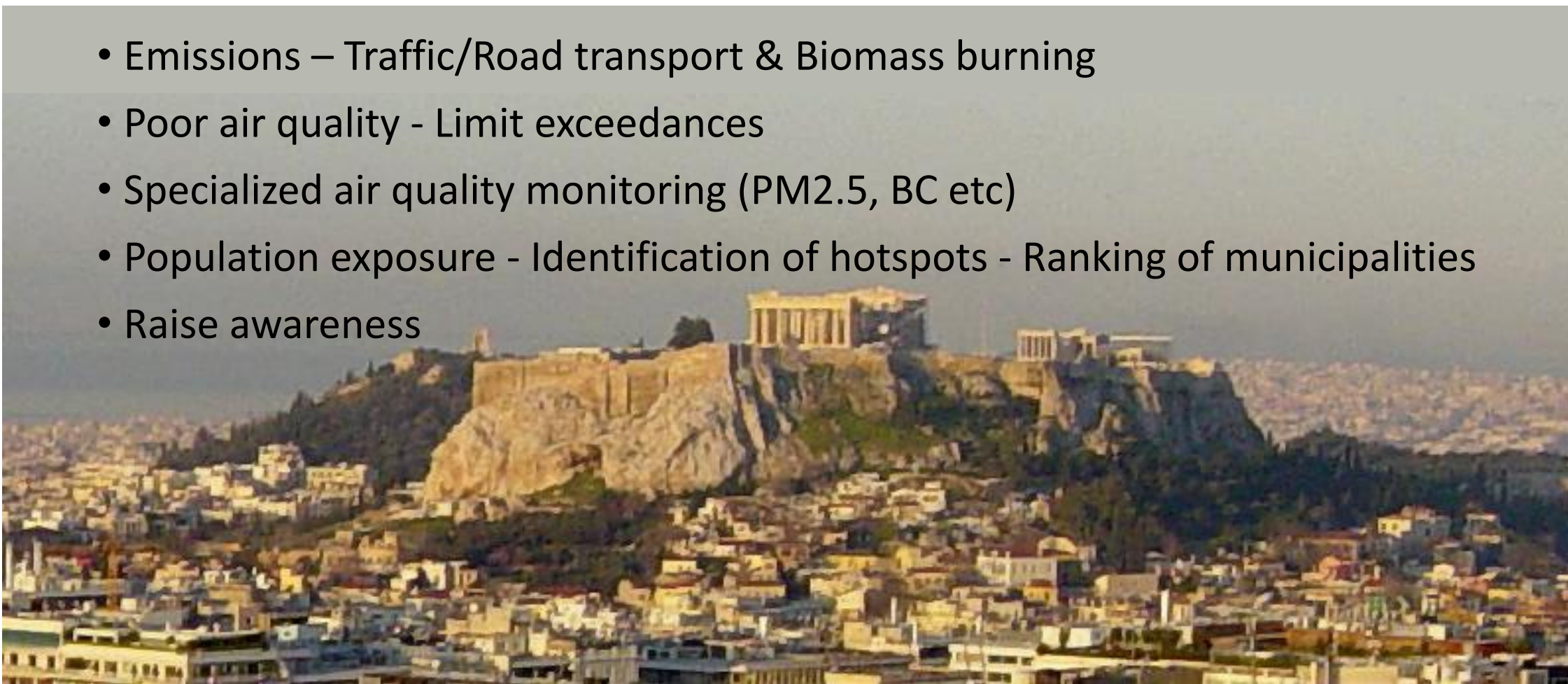
- To improve AQ-health information, from air pollution data and land use/health/socio-economic features of cities, for use in public health assessment and urban planning.
- To evaluate and exploit citizen science data towards their integration with the official measurements.
- To strengthen decision making by allowing for pollution mitigation scenarios and provision of alerts.
- To raise awareness on AQ implications on public health, enhancing the citizen participation.





## HSAQ Sub-pilot Athens – Problems / Challenges:

- Emissions – Traffic/Road transport & Biomass burning
- Poor air quality - Limit exceedances
- Specialized air quality monitoring (PM2.5, BC etc)
- Population exposure - Identification of hotspots - Ranking of municipalities
- Raise awareness

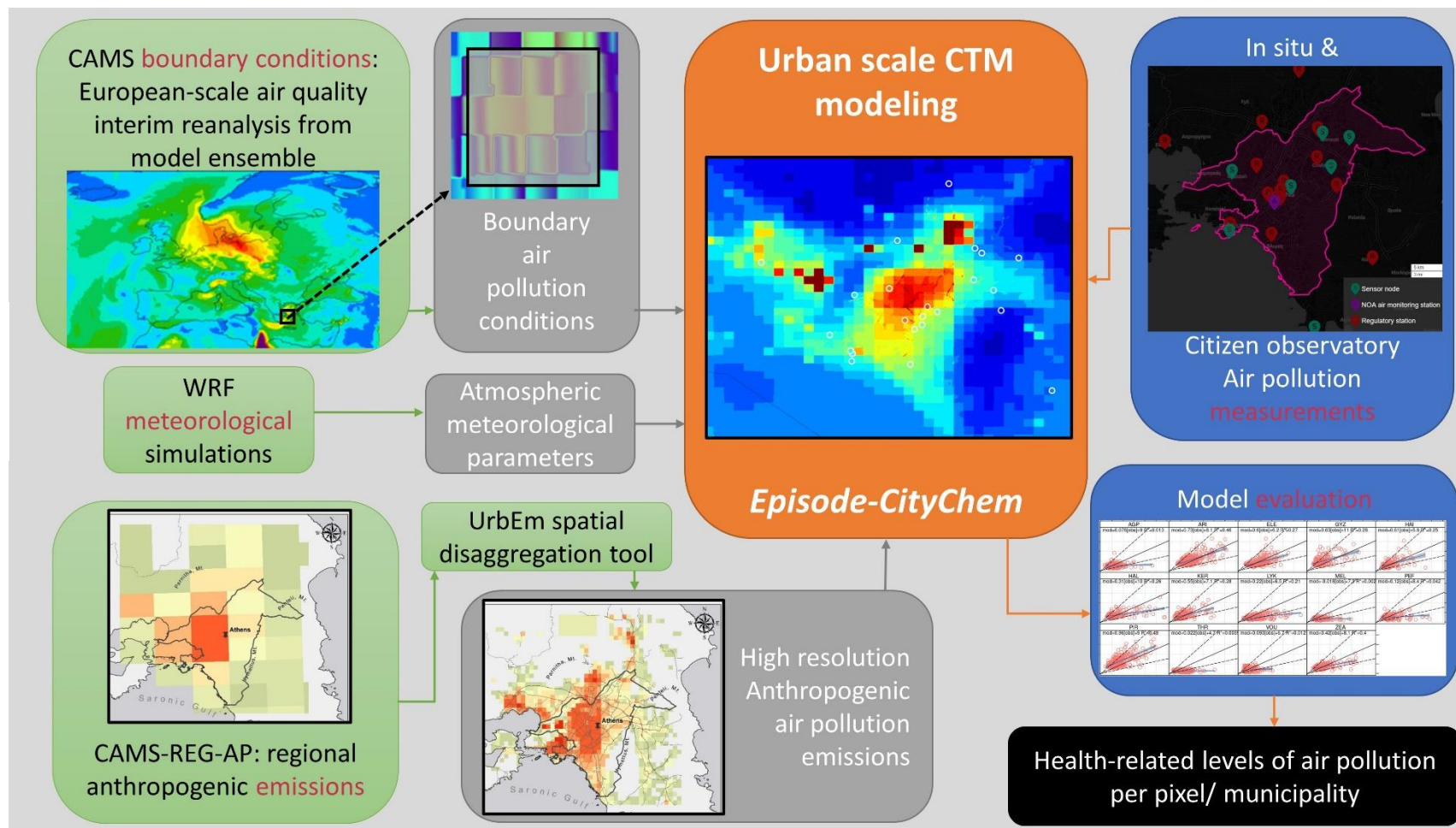
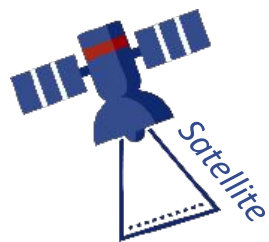




## EO platforms/ data streams exploited:



Numerical modeling



citizens



e-shape



EuroGEO



GROUP ON EARTH OBSERVATIONS



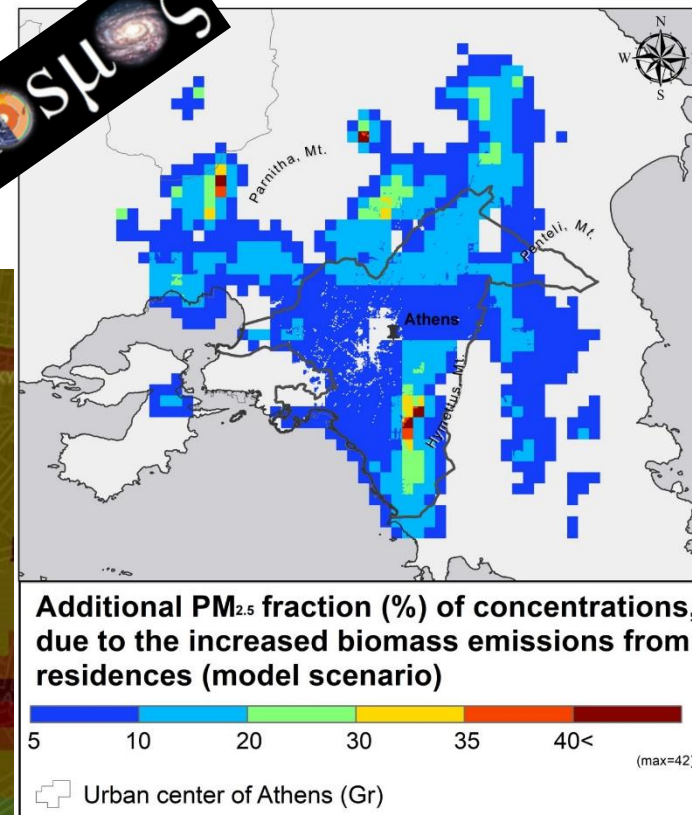
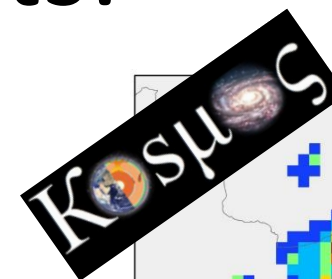
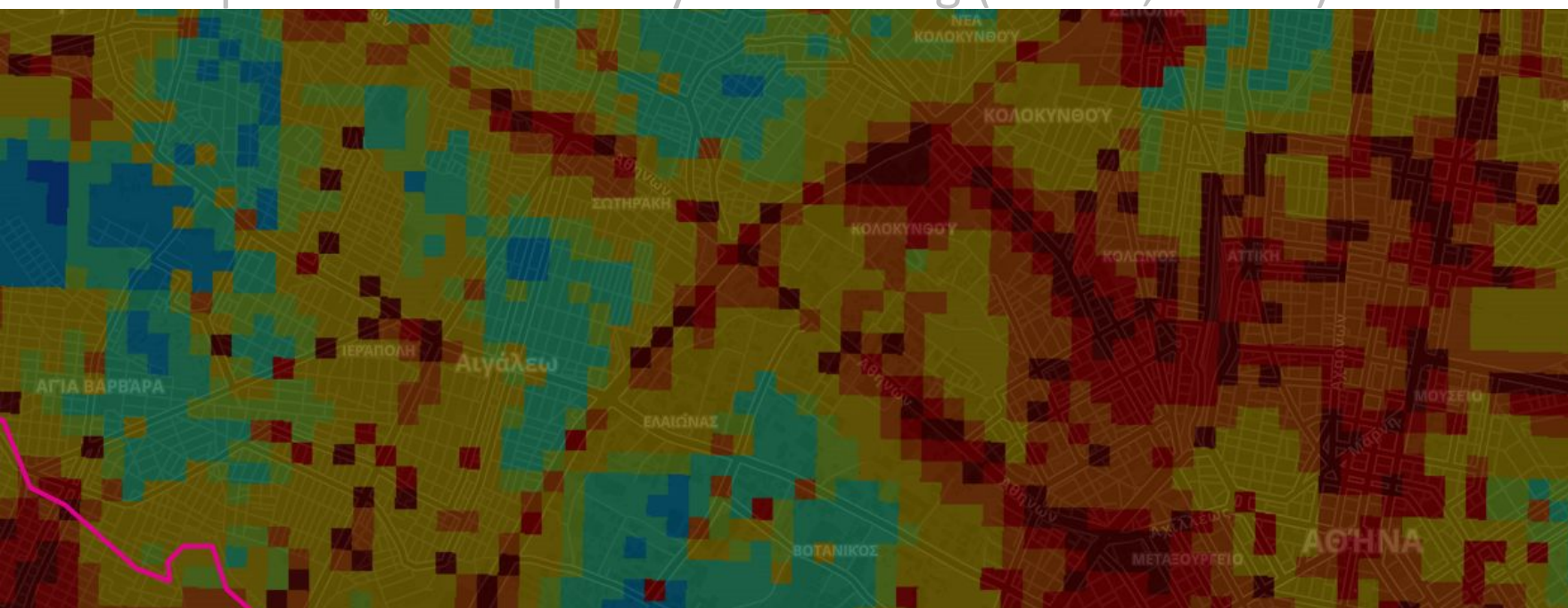
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## HSAQ Sub-pilot Athens – Results:

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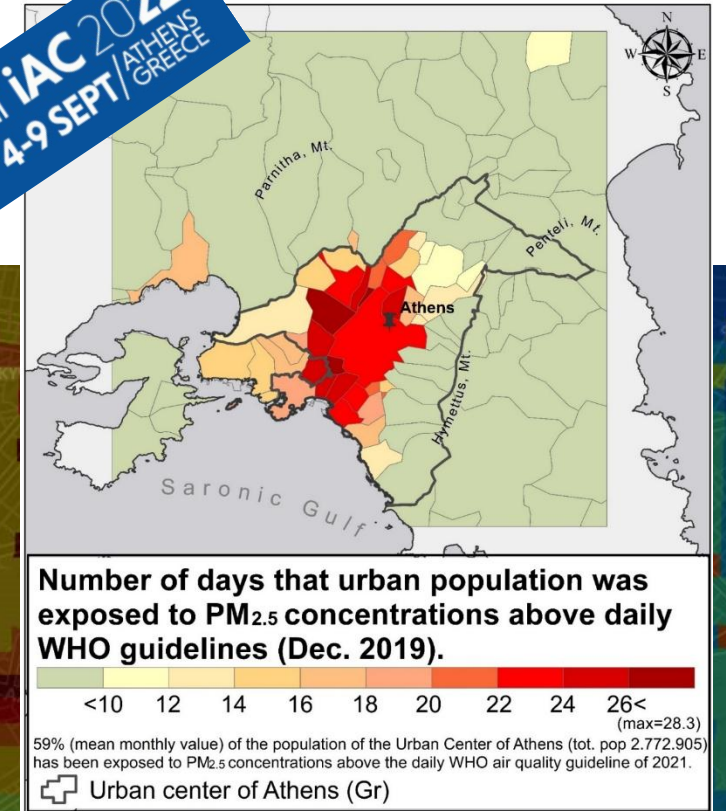




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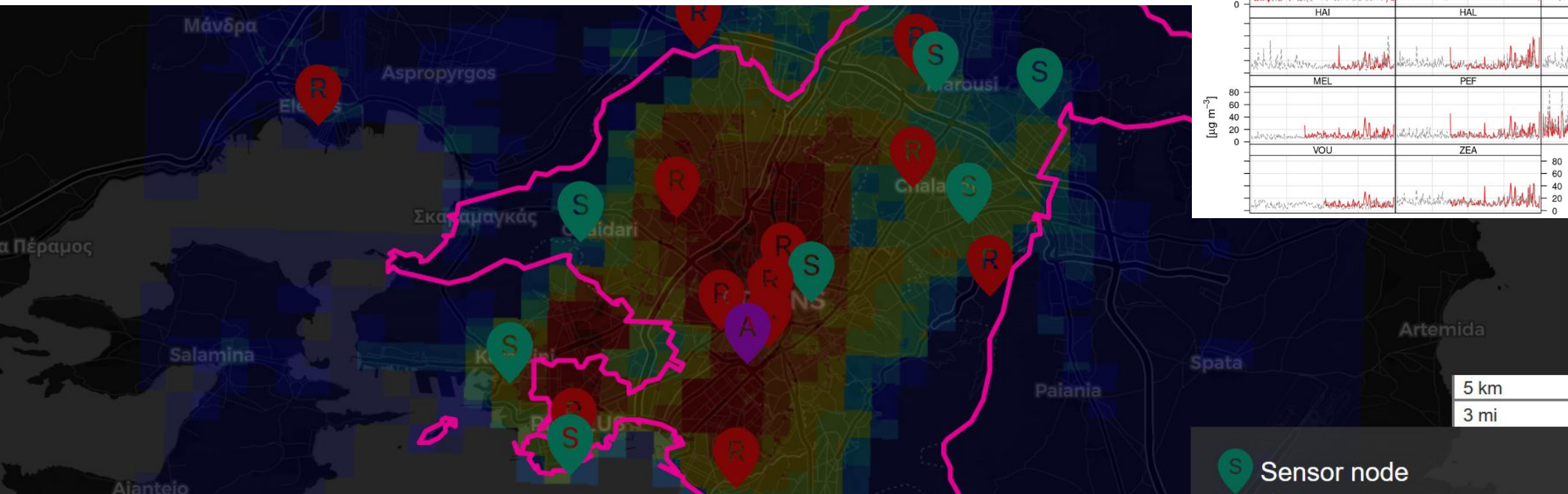
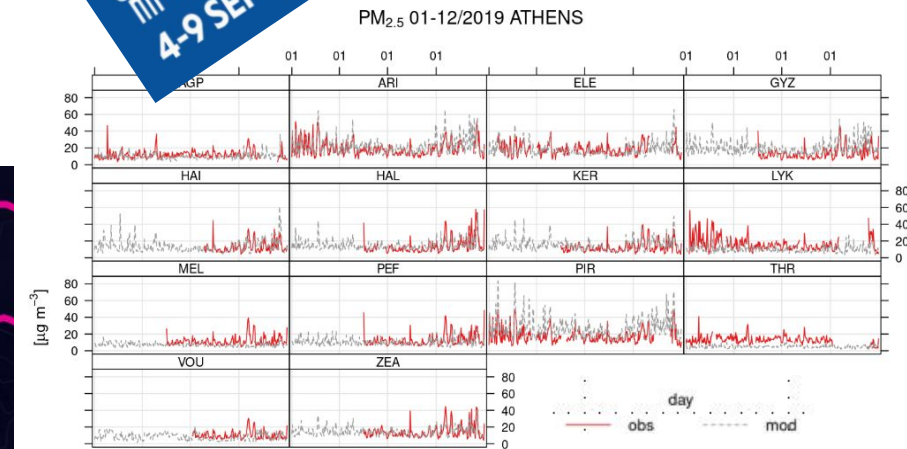
**iAC 2022**  
4-9 SEPT / ATHENS GREECE





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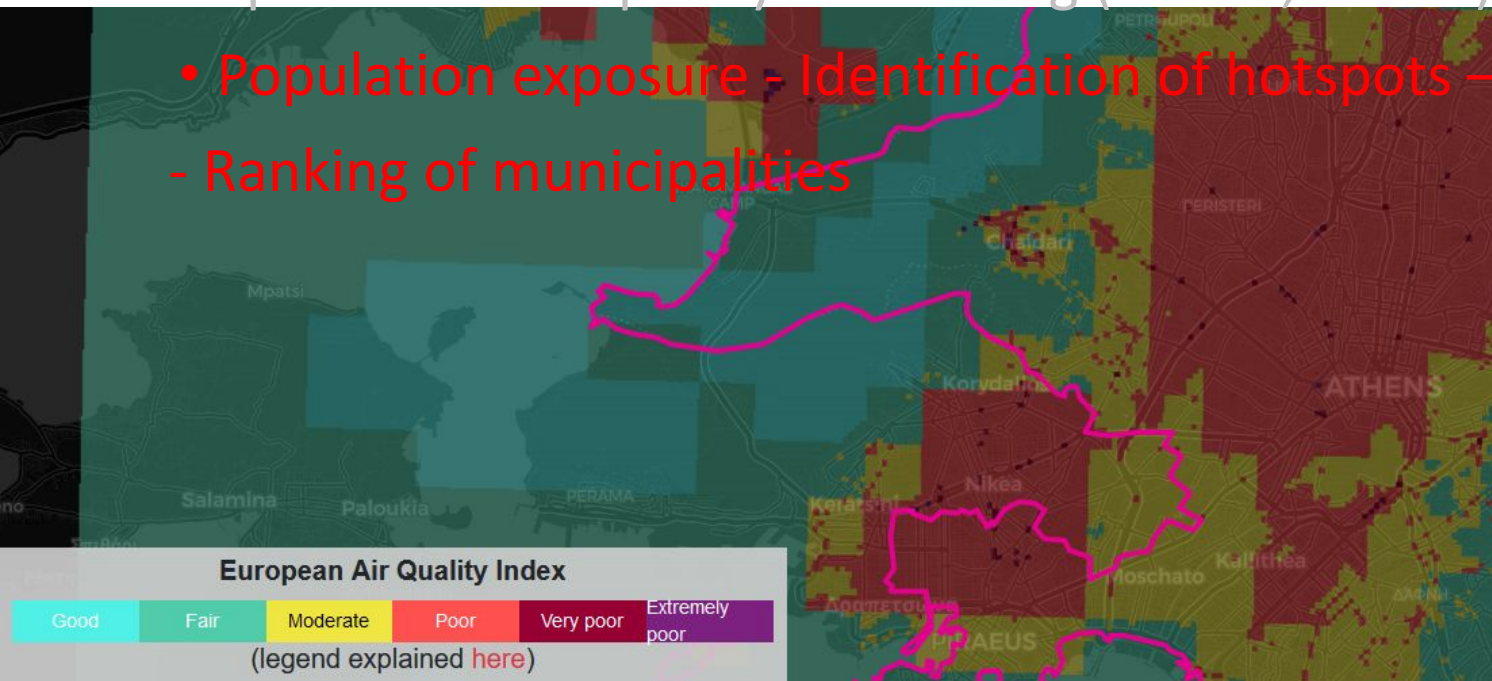




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- Population exposure - Identification of hotspots –
- Ranking of municipalities



### 2019 municipality ranking Athens, Greece

Average annual PM<sub>2.5</sub> concentration (µg/m<sup>3</sup>)  
for municipalities in descending order



2021 World Air Quality Report visualization framework

Annual PM<sub>2.5</sub> breakpoints based on 2021 WHO guideline and interim targets

	PM <sub>2.5</sub> (µg/m <sup>3</sup> )	Color code	WHO levels
Meets WHO PM <sub>2.5</sub> guideline	0 – 5	Blue	Air Quality guideline
Exceeds WHO PM <sub>2.5</sub> guideline by 1 to 2 times	5.1 – 10	Green	Interim target 4
Exceeds WHO PM <sub>2.5</sub> guideline by 7 to 8 times	10.1 – 15	Yellow	Interim target 3
Exceeds WHO PM <sub>2.5</sub> guideline by 3 to 5 times	15.1 – 25	Orange	Interim target 2

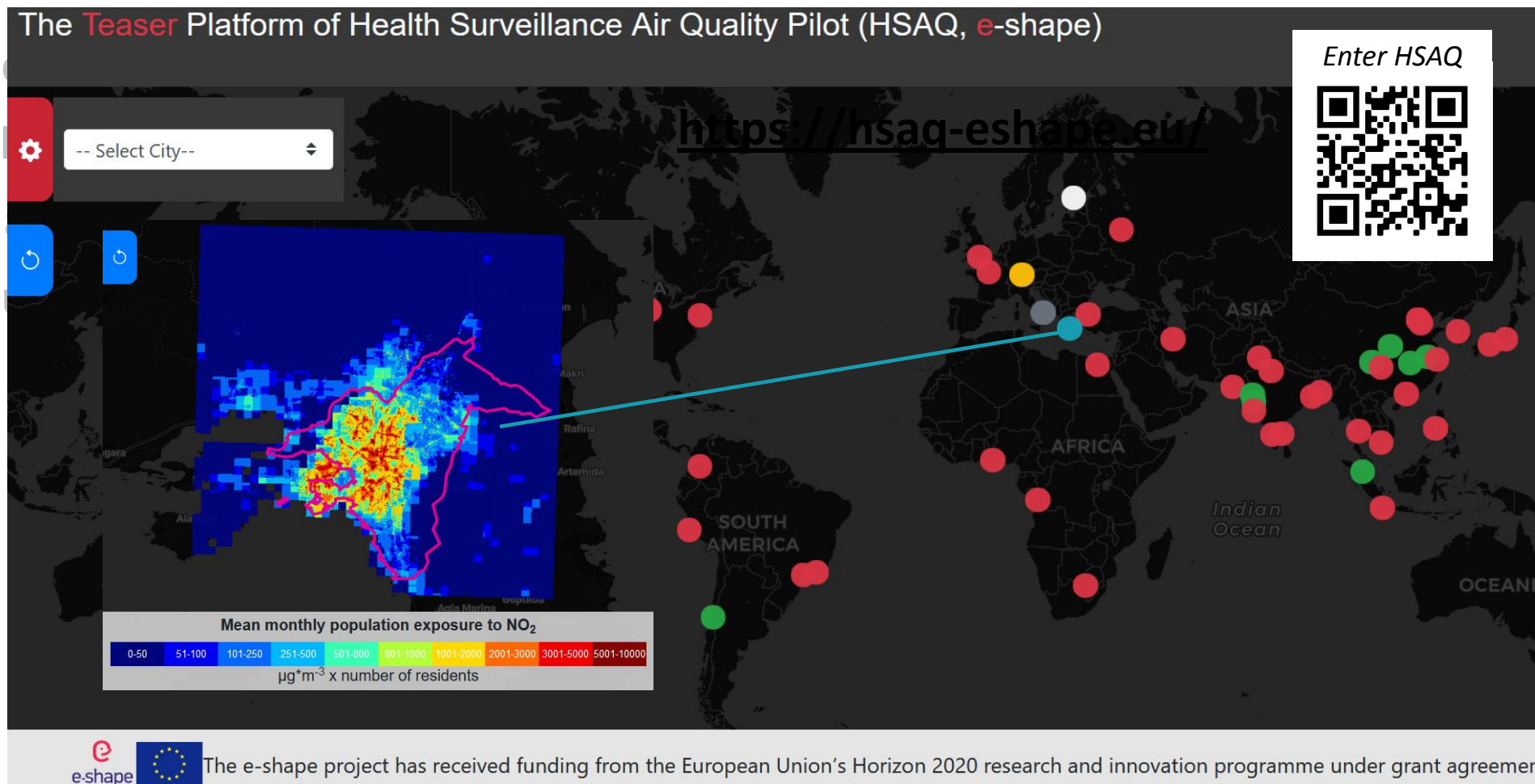
22	Peristeri	25.9	21 (36%)
26	Ilion	23.5	
4	Galatsi	23.2	
17	Nea Ionio	21.9	
2	Athens (ARI & GYZ)	21.4 (16.2)	
25	Aigaleo	21.3	
9	Filadelfeia-Chalkidona	21.2	
29	Kallithea	20.1	
24	Agioi Anargyroi-Kamatero	19.8	
34	Moschato-Tavros	19.3	
16	Metamorfosi	19.3	
35	Nea Smyrni	18.2	
37	Acharnes (THR)	17.5 (13.1)	
54	Piraeus (PIR & ZEA)	17.4 (16.0)	
36	Palaio Faliro	17.3	
27	Petroupoli	17.3	
57	Nikaia-Agios Ioannis Rentis	16.7	
50	Aspropyrgos	16.5	
49	Elefsina (ELE)	16.3 (18.5)	17 (29%)
28	Haidari (HAL)	15.7 (12.7)	
23	Agia Varvara	15.5	
13	Irakleio	15.4	
56	Korydallos	15.0	
30	Agios Dimitrios	14.9	
31	Alimos	14.5	
55	Keratsini-Drapetsona (KER)	14.5 (12.6)	
51	Mandra-Eidyllia	14.3	
58	Perama	13.9	
20	Filotheli-Psychiko	13.4	
10	Marousi	12.9	
5	Dafni-Ymittos	12.8	
21	Chalandri (HAL)	12.6 (14.0)	





## HSAQ Sub-pilot Athens – Results:

- Emissions – Traffic
- Poor air quality -
- Specialized air qu
- Population expos
- Raise awareness





We e-shape EuroGEO

7-9 Dec.2022 | Athens



EuroGEO  
Showcases:  
Applications  
Powered  
by Europe

“  
Blazing new trails  
for EO markets  
”

EuroGEO  
Workshop  
2022

- www.e-shape.eu
- Horizon2020-e-shape
- @eshape\_eu
- e-shape project

## The e-Shape Health Surveillance Air Quality Pilot

### THANK YOU !!!

Athanasopoulou Eleni

[eathana@noa.gr](mailto:eathana@noa.gr)

National Observatory of Athens (NOA)

Learn more here:



EuroGEO



GROUP ON  
EARTH OBSERVATIONS



The e-shape project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement 820852

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The HARMONIA contribution to GEOSS platform for coastal cities, the example of Piraeus

Nerantzia Tzortzi  
POLIMI & Betty  
Charalampopoulou  
GSH



Urban ReLeaf:  
Citizen-powered data  
ecosystems for  
inclusive and green  
urban transitions

Gerid Hager  
& Inian Moorthy  
IIASA



Establishing a resilience  
framework for co-creating  
adaptation solutions: the  
case of extreme heat in  
Athens Metropolitan Area  
(ARSINOE)

Chrysi Laspidou,  
University of Thessaly



The e-Shape Health  
Surveillance Air Quality  
Pilot –  
merging EO for health  
benefits

Eleni  
Athanasopoulou,  
NOA



Raising citizen awareness  
and engagement towards  
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assisted monitoring  
platform for the water we  
drink in Athens

Ioannis Manakos,  
CERTH



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## Raising citizen awareness and engagement towards greener daily mobility habits – The SOCIO-BEE use case at Maroussi

Kotzagianni Maria, PhD

Roussos Anargyros

Municipality of Amaroussion



Learn more here:



This project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under Grant Agreement n° 101037648 – SOCIO-BEE

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## The Socio-Bee project and its main objectives

Wearables and droneS fOr City Socio-environmental Observations and BEhavioral change (GA:101037648)

18 partners from 7 EU countries: 3 RTI, 6 UNI,  
3 SMEs, 3 Municipalities & 3 End Users



SOCIO-BEE ambitions to:

- raise awareness on importance of atmospheric pollution and climate change and
- foster communities to adopt more sustainable behaviors towards air pollution reduction through:
  - community engagement strategies and social innovation methods combined with
  - citizen science (CS) and
  - emerging technologies via a playful interaction platform.



Socio-Bee's is committed to:

- support commission's EU action plan towards a zero pollution for air, water and soil &
- aid in fulfilling the four main objectives of Ambient Air Quality Directive i.e. universal monitoring process, harmonized standards, general public awareness and maintenance and improvement of air quality.

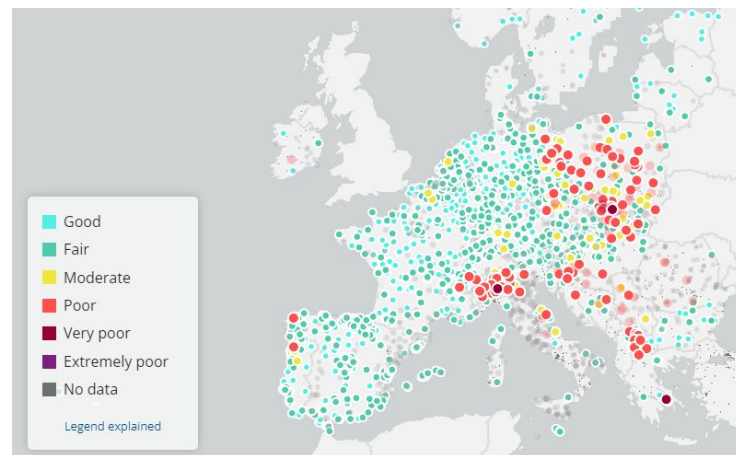


## Atmospheric pollution in EU

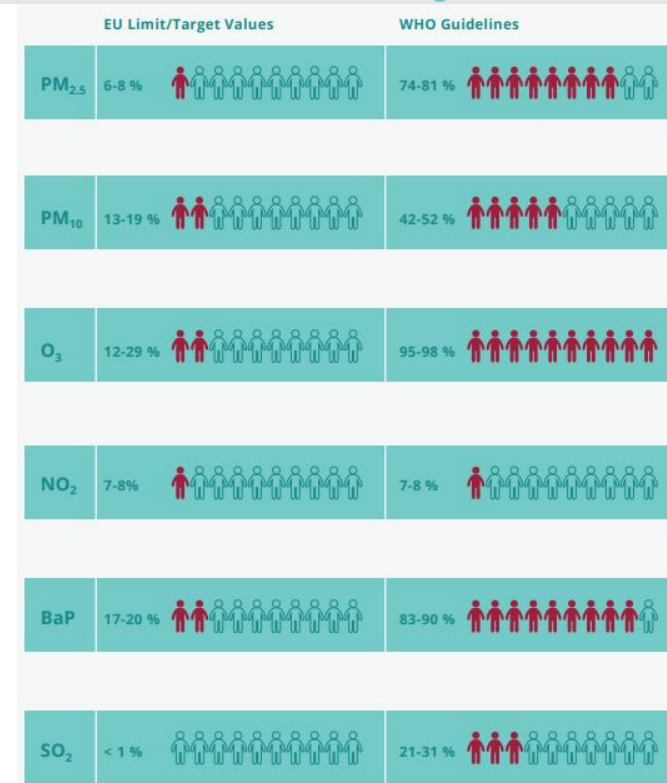
Air pollution (AP) problem and its consequences:

- affects 75% of EU total population (≈330M) in urban areas
- key threat to human health and the environment
- ≈ 350K premature deaths attributed to air pollution

Air quality across EU



Percentage of the EU urban population exposed to air pollution concentrations above EU & WHO reference values during 2014-17



### Health Impacts

Country	Population (*1000)	Annual mean (PM2.5)	Premature Deaths (PM2.5)	Annual mean (NO2)	Premature Deaths (NO2)	Annual mean (O3)	Premature Deaths (O3)
Greece		14.50	8.843	16.90	1.882	6.165	911
EU27	442.850	11.20	237.810	14.10	48.555	4.182	24.109
Total	530.892	11.40	274.673	15.70	61.312	4.229	28.337

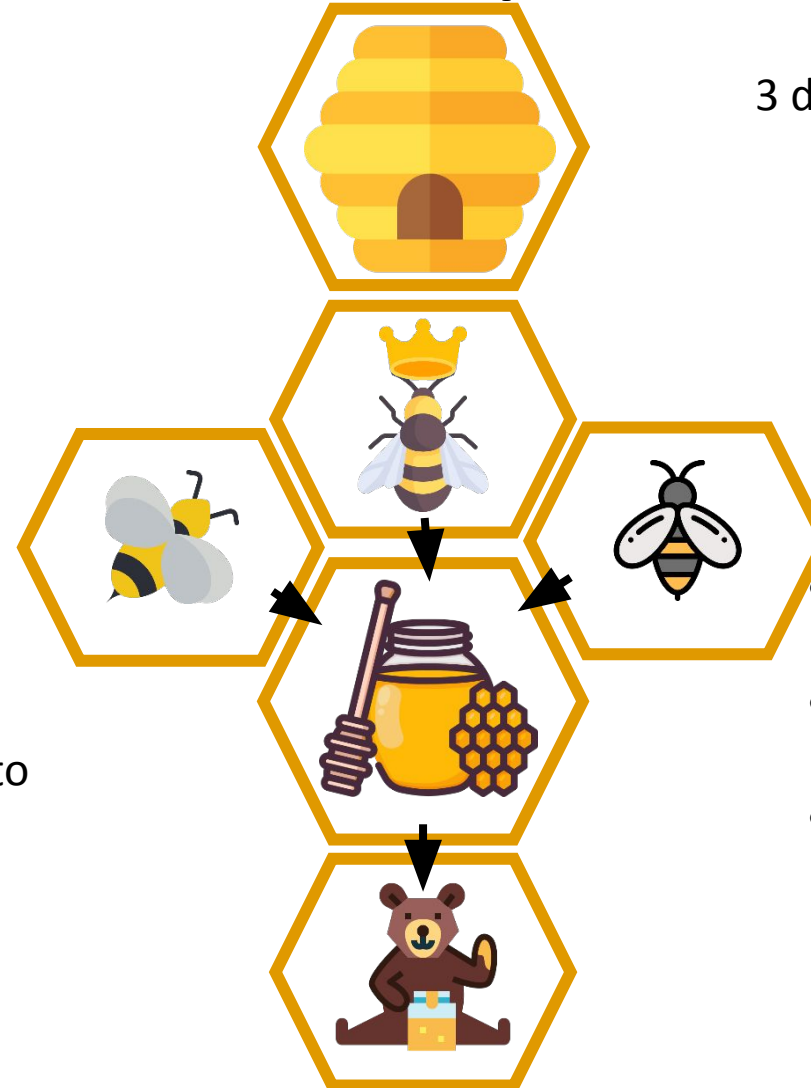


## Socio-Bee Overall Concept

Socio-Bee aims at community engagement and raising citizens' awareness of atmospheric pollution and their own responses to it, through experimentation, better monitoring, and observation of the environment.

The project utilizes the metaphor of **bees' behaviour**.

- **CS hives**, crowdsourcing and collaboration instruments/space for assembling environmental action groups and communities  
SOCIO-BEE hives include citizens appointed as:
- **Queen bees**, to lead the hive
- **Worker bees**, to collect data
- **Drone bees**, to make observations
- **Larvae bees**, to be approached, informed and if possible trained to become future worker bees.
- The data and information collected by the citizens is the **honey**.
- The stakeholders interested in those results are the **Honeybears**.



3 different EU pilot sites:

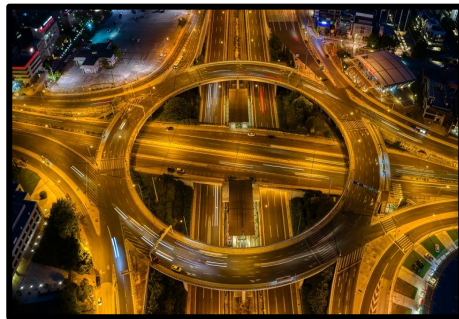


- Zaragoza
  - Young adults
- Ancona
  - Elderly people
- Amaroussion
  - Commuters



## The pilot case of Municipality of Amaroussion

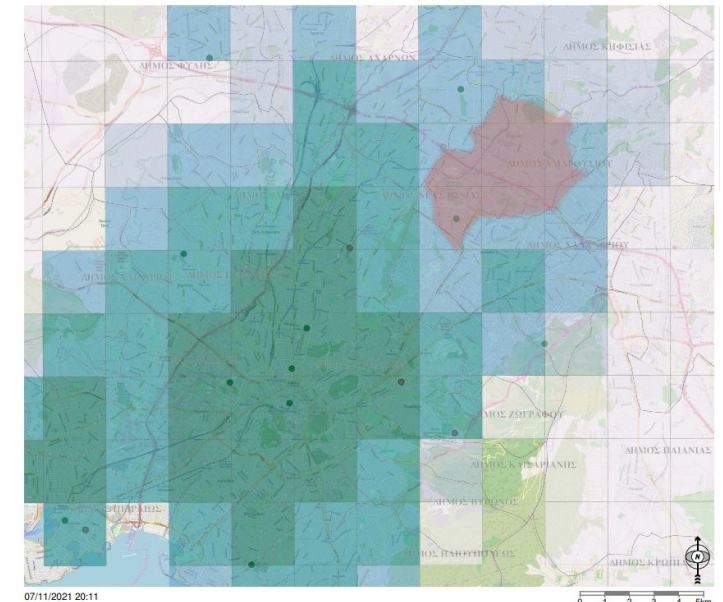
Current Status in Municipality of Amaroussion



	Measurements for 2021		
	Max	Median	Thershold for emergency measures
CO (mg/m <sup>3</sup> )	5	0.4	30
O <sub>3</sub> (µg/m <sup>3</sup> )	247	69	240
PM10 (µg/m <sup>3</sup> )	82	23	51-75 for vulnerable groups 76-100 for general population
NO (µg/m <sup>3</sup> )	384	2	400
NO <sub>2</sub> (µg/m <sup>3</sup> )	111	16	200

- 70,500 permanent residents (2021)
- Business center of northern suburbs with:
  - advanced technology companies
  - major ministries
  - private and public hospitals
- 2 main highways (L. Kifissias & Attiki Odos)
- Affected by economic and energy crisis

- ☐ 1M cars crossing MRSI daily
- ☐ Elevated air pollution particularly during rush hours
- ☐ Pollutants from house heating (less eco-friendly solutions like wood, pellet, etc.)
- ☐ Enhance availability of air quality data





## Socio-Bee Preliminary Results & Next Steps

1 <sup>st</sup> year					2 <sup>nd</sup> year				3 <sup>rd</sup> year							
1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q					
Sept21	Dec21	Mar22	Jun22	Sept22	Dec22	Mar23	Jun23	Sept23	Dec23	Mar24	Jun24					
						1 <sup>st</sup> iteration					2 <sup>nd</sup> iteration					

SOCIO-BEE achievements up to M14:

- Stakeholders role identification and creation of new ones
- Socio-Bee toolkit: Citizen engagement strategies per bee type
- Gamification structure for Socio-Bee app (Web front- and back-end & mobile app) - 1<sup>st</sup> release of Socio-Bee integrated platform
- Miniaturized sensors for pollutants' detection
- Air pollution data visualization and predictive model
- Knowledge Powerhouse for Citizen Science on Law & Ethics
- 1<sup>st</sup> Clustering event (Please contact us for more information)

Socio-Bee Roadmap – Upcoming milestones

- ✓ **12.22:** 1st release of Socio-Bee platform and mobile app
- ✓ **01.23:** 1st batch of air quality sensors (wearables, stationary, and on drones)
- ✓ **03.23-06.23:** 1<sup>st</sup> Pilot iteration
- ✓ **07.23-11.23:** Data processing, evaluation of technical components, and assessment of engagement strategies.
- ✓ **01.24-06.24:** 2<sup>nd</sup> Pilot iteration
- ✓ **07.24-08.23:** Data analysis/evaluation of Socio-Bee concept.
- ✓ **09.23:** End of the project



## Thank you for your attention. Any questions?

Maria Kotzagianni, PhD  
[mkotzagianni@maroussi.gr](mailto:mkotzagianni@maroussi.gr)  
Anargyros Roussos  
[aroussos@maroussi.gr](mailto:aroussos@maroussi.gr)



Care to join us?

[socio-bee.eu/](https://socio-bee.eu/)

 [linkedin.com/company/socio-bee/](https://linkedin.com/company/socio-bee/)

 [facebook.com/sociobee.h2020/](https://facebook.com/sociobee.h2020/)

 [@socio\\_bee?lang=en](https://twitter.com/socio_bee?lang=en)



# EUROGEO WORKSHOP 2022



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Unmanned Vehicles as a  
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WQeMS: a Copernicus  
assisted monitoring  
platform for the water we  
drink in Athens

Ioannis Manakos,  
CERTH



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## Unmanned Vehicles as a complementary tool for water quality of Reservoirs

Georgios Sachinis & Georgios Katsouras

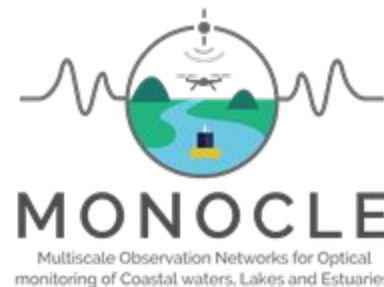
Athens Water and Sewerage Company S.A

Learn more here:

INTCATCH



2020



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## Combined use of INTCATCH-Unmanned Surface Vehicle (USV) and MONOCLE-Unmanned Aerial Vehicle (UAV)

### Project overview and main objectives

- *Importance of an integrated innovative water quality monitoring strategy*
- *Prediction of water quality in a large area of a catchment with higher frequency than traditional sampling methods*
- *Communicate and disseminate innovative technologies and services to the Greek Stakeholder Network during a demo-campaign in **Lake Marathon***
- *Integrated Management of Water Resources aiming at cleaner water for the needs of society and citizens*





## Problem/challenge and use case in the Athens metropolitan region

- Problem:
- *Not Real time monitoring*
  - *Data management focuses on small parts of rivers and lakes*
  - *Inadequate water quality data*

### Challenge:

- *Improved management on catchment scale*
- *Fast & flexible data collection*
- *Scanning of larger areas*
- *High level of customization*
- *Low lab equipment management*

Lake Marathon:





## INTCATCH and MONOCLE Tools and Technologies

**INTCATCH (USV) service:**



- ***Autonomous boats with sensors***
- ***Novel sensors and sampling systems***
- ***Data visualization***
- ***Genomics laboratory***
- ***Decision Support System***

**MONOCLE (UAV) service:**



- ***Drones with multispectral cameras***
- ***One flight/ thousands of square meters***
- ***Chl-a, Turbidity, TSS from the colour of the water***
- ***Pilot app from mobile device***
- ***Online platform to turn data into valuable products***



## INTCATCH - Unmanned Surface Vehicle with sensors

### *Basic set of sensors*

- Chlorophyll -a
- Conductivity
- Dissolved Oxygen
- pH



### *Innovative sensors and systems*

- Hydrocarbons and Refined-oils
- On-board sampler (4\*500ml)
- On-site systems for the determination of E. Coli / DNA-analysis



### *Visualisation of data in different formats*

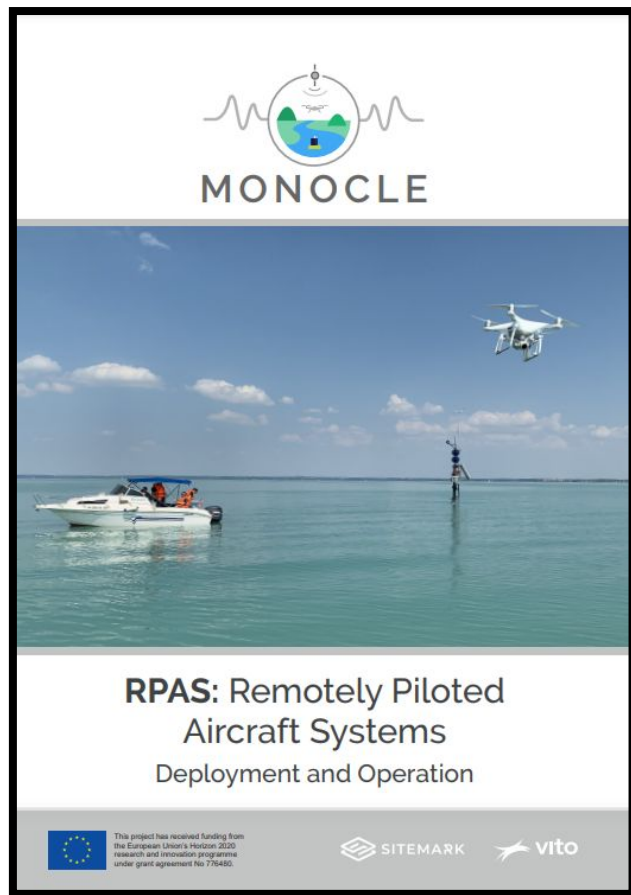






## MONOCLE - Unmanned Aerial Vehicle with cameras

### *Flight plan*

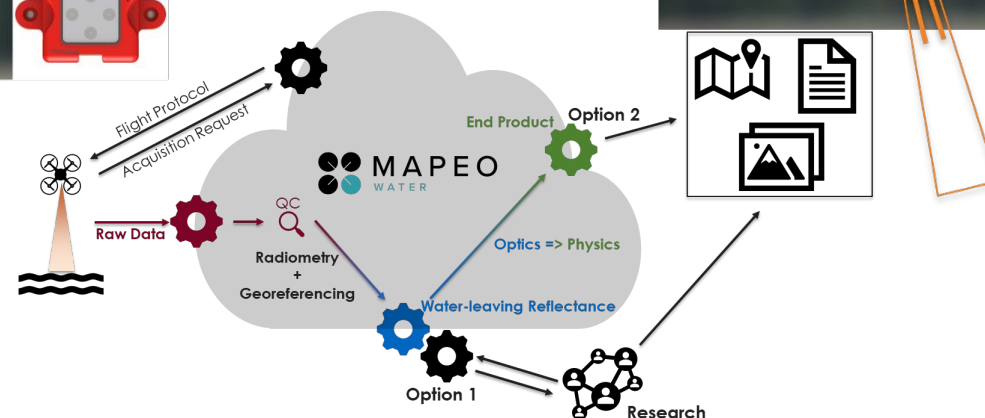


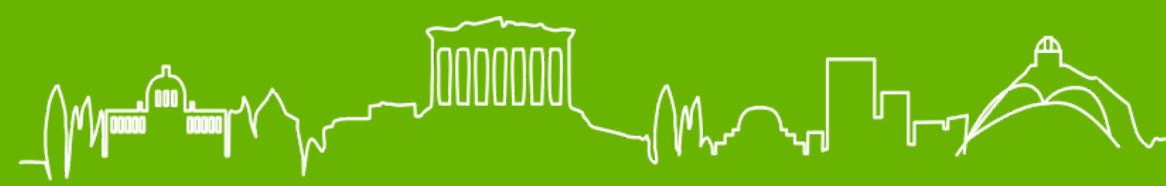
### *Measuring Water-leaving Reflectance*

Light Sensor: Input<sub>sun light</sub>



Camera: Output<sub>water column</sub>



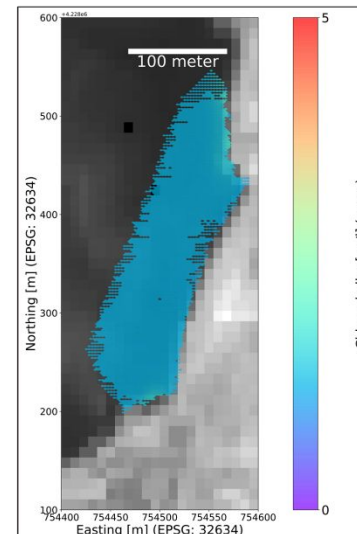


## Results of INTCATCH (USV) – MONOCLE (UAV) campaign in Lake Marathon, 15th June 2022

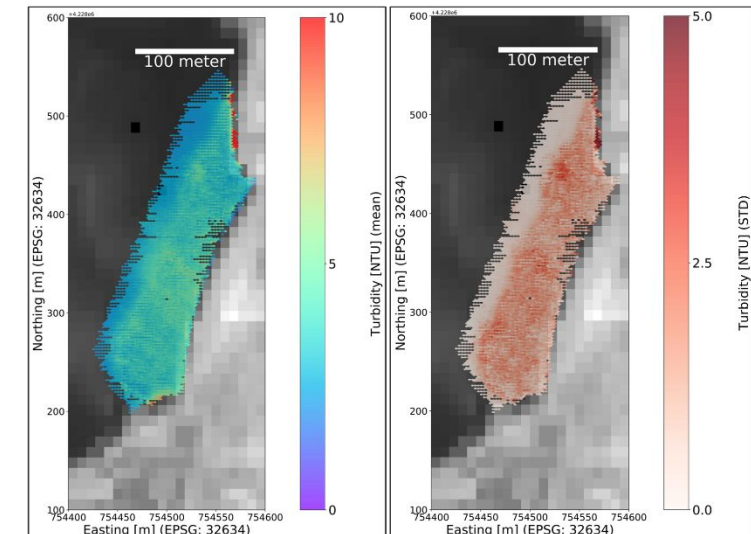
- *USV collected more than 10.000 measurements of physicochemical parameters (chlorophyll-a, conductivity, pH, dissolved oxygen) from the surface of Lake Marathon*
- *UAV, equipped with MicaSense Dual camera (RGB), recorded thousands of images for the calculation of chlorophyll-a and water turbidity*



Chlorophyll-a (in situ: 2,5 µg/l)



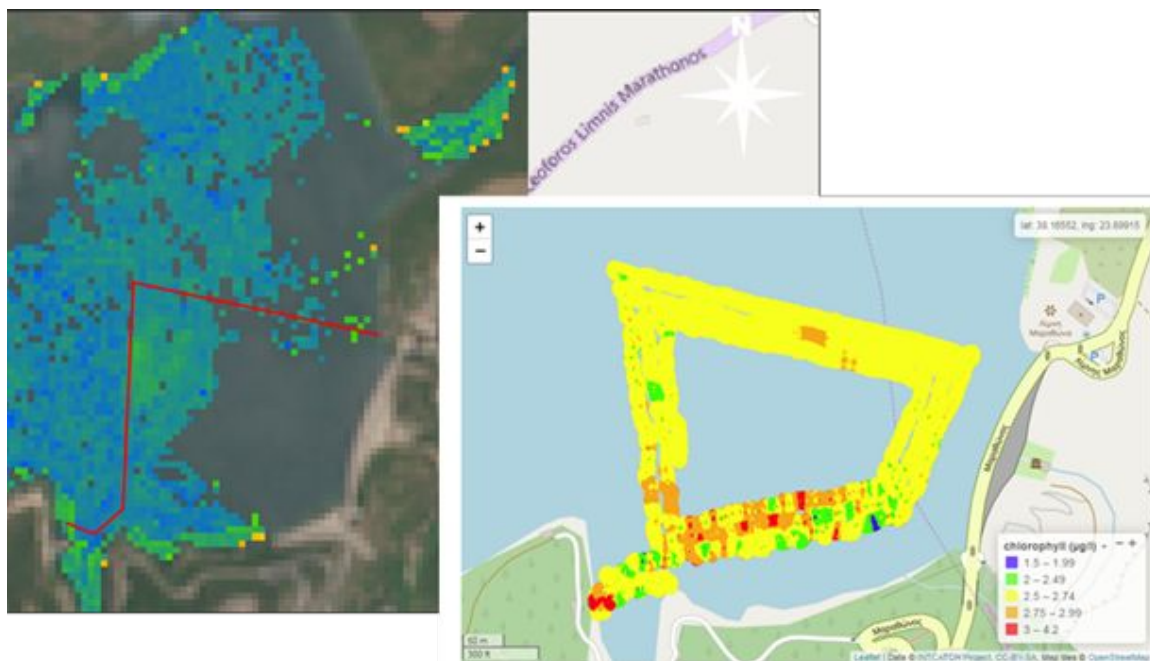
Turbidity (in situ: 3,7 NTU)





## INTCATCH and MONOCLE synergies

- **WQeMS H2020 project**



Mean value of chl-a along the drawn red line (2.66  $\mu\text{g/l}$ ) from Sentinel-2 capture is equivalent to the yellow line (2.50-2.74  $\mu\text{g/l}$ ) in capture provided by EYDAP's USV.

- **BIGDATA4RIVERS Interreg choose INTCATCH as Good practice**

The screenshot shows the Interreg Europe website interface. At the top, there's a navigation bar with 'Interreg Europe' logo, 'Co-funded by the European Union' logo, and search, help, and account links. Below the navigation bar, there's a section for 'WATER QUALITY MONITORING WITH THE USE OF ROBOTIC BOATS'. The main content area features a large image of a robotic boat on a river, with text describing the project and its benefits. A sidebar on the right lists 'What INTCATCH offers for you...' and includes a list of features. At the bottom, there's a section for 'About this good practice' and a 'Sign up to contact' button.





## INTCATCH and MONOCLE next steps/sustainability of solutions

- It achieves a more thorough monitoring campaign *both in space and time* and provides *significantly **higher amount of water quality data*** without requiring labour-intensive and costly monitoring schemes.
- It allows *monitoring of ecological status* more accurately with ***emphasis on phytoplankton growth***.
- It allows the collection of many discrete ***samples and pictures*** and provides with a ***representative coverage of the whole catchment*** (rivers & lakes) required for chemical classification of a water body.
- Especially for lakes *could obtain variations due anthropogenic* (urban, agricultural, industrial etc.) or *natural pressures*.



<https://www.monocle-h2020.eu/>  
[www.intcatch.eu](http://www.intcatch.eu)  
[www.eydap.gr](http://www.eydap.gr)



## ***Thank you!***

***And see you on board and on flight mode  
for a real time demonstration...***

# EUROGEO WORKSHOP 2022



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WQeMS: a Copernicus  
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Ioannis Manakos,  
CERTH



ATHENS 7-9 DECEMBER 2022





## Q&A [10 min]



## Part 2: Interactive Discussion

**Room Alkioni**  
**15:15-15:45**

**ATHENS 7-9 DECEMBER 2022**

# EUROGEO WORKSHOP 2022



Syner  
gies

Partnerships

Replication

Upsca  
ling

Room Alkioni  
15:15-15:45

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## WQeMS: a Copernicus assisted monitoring platform for the water we drink in Athens

The platform:



Ioannis Manakos



**CERTH**  
CENTRE FOR  
RESEARCH & TECHNOLOGY  
HELLAS

The site:



<https://wqems.eu/>

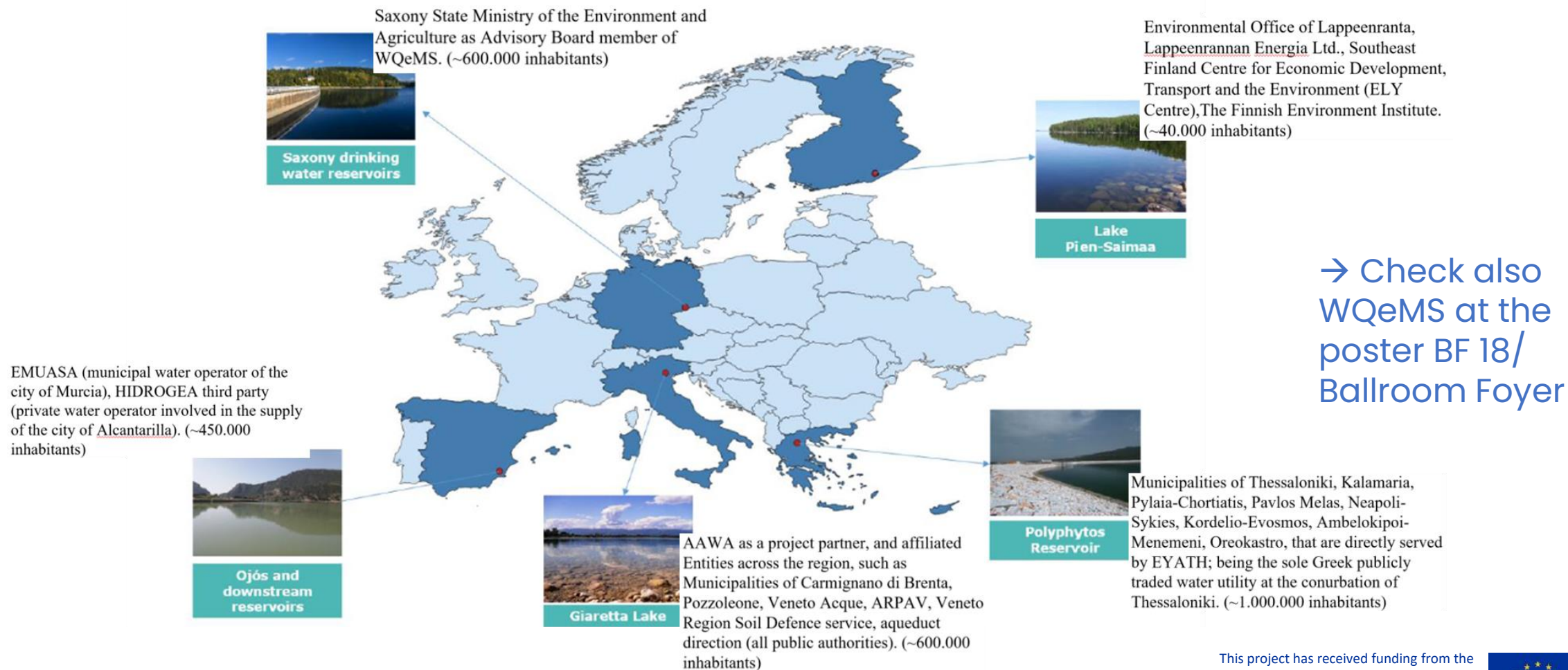
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## Project/initiative overview and main objectives I



Water we drink...





## Project/initiative overview and main objectives II



Water we drink...



1- **provide** an open surface Water Quality Emergency Monitoring Service (WQeMS) to the water utilities' industry leveraging on the Copernicus products and services

2- **optimize** the use of resources by gaining access to frequently acquired, wide covering and locally accurate water-status information

3- **citizens** will gain a deeper insight and confidence for selected key quality elements of the 'water we drink', while enjoying a friendlier environmental footprint from a more intelligent production process.





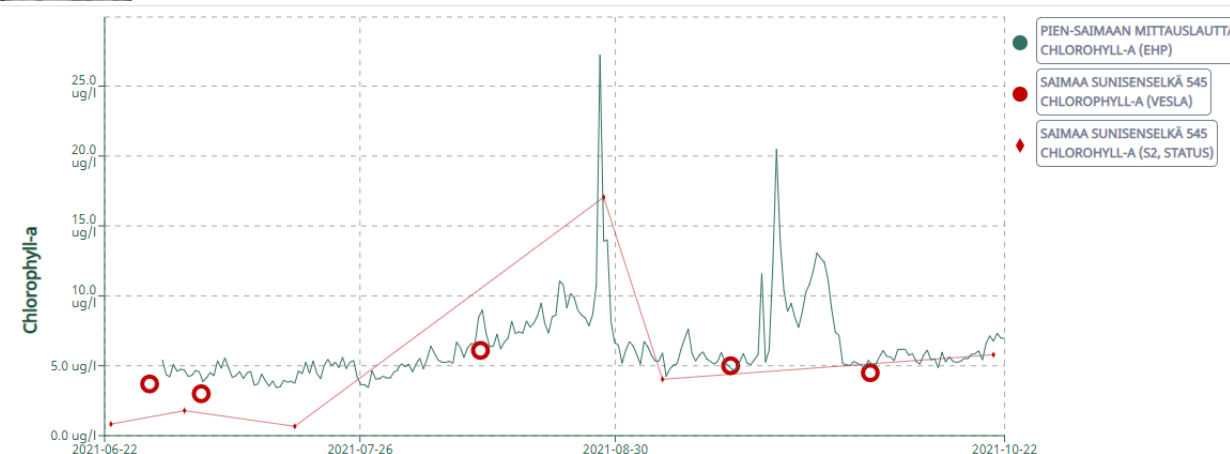
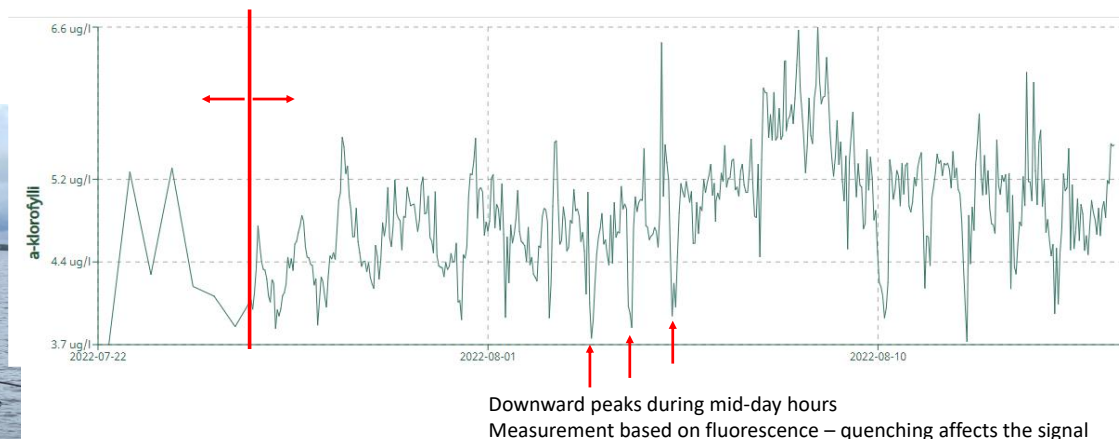


## Challenge

(example case from Finland)



- Automated stations are great for providing continuous stationary or transect observations
- Useful for cal/val of satellite observations
- However:
  - Do not measure the same water volume as satellites
  - Quality control very important and not always easy



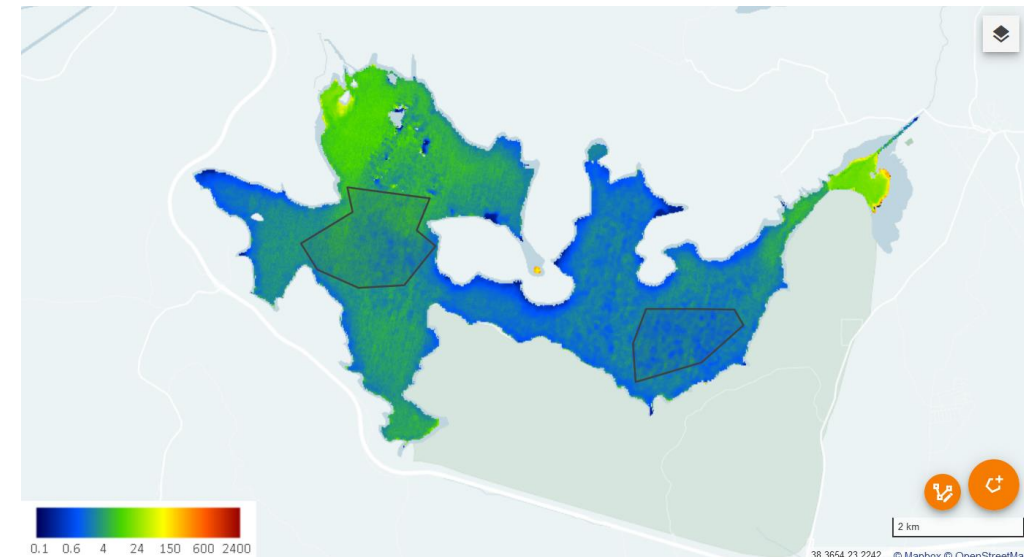
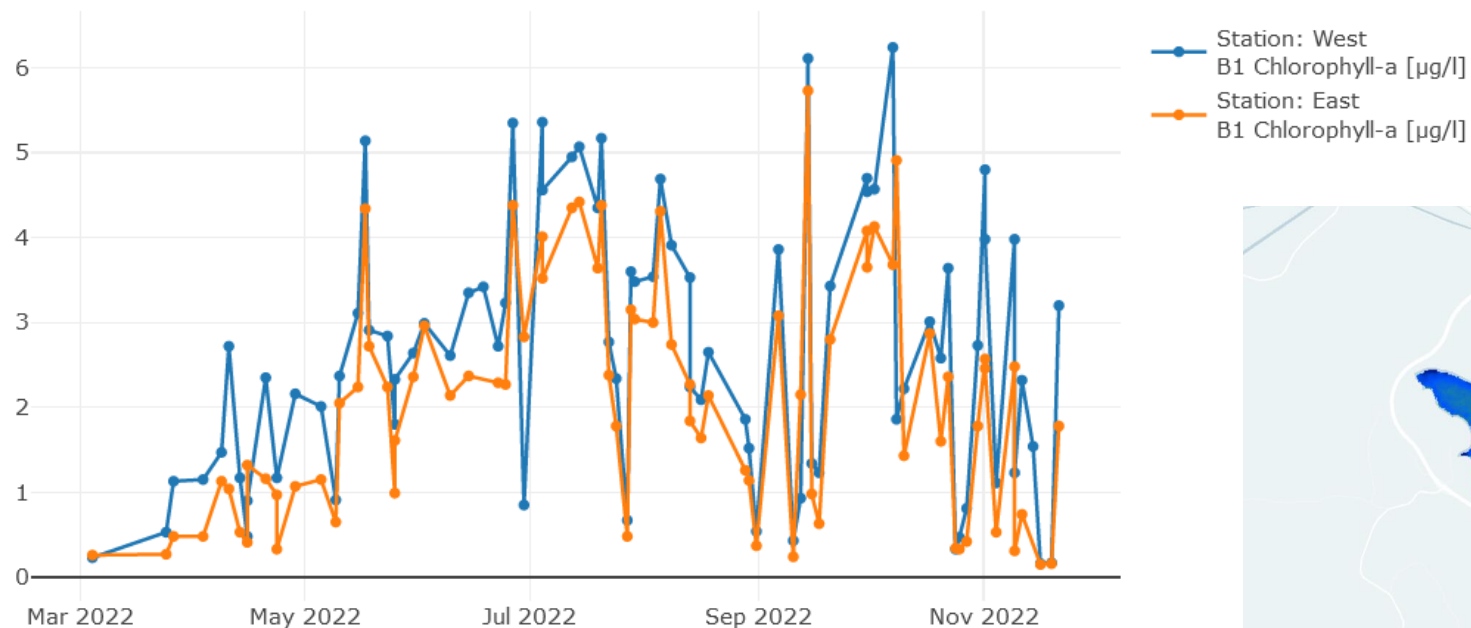
Credits: City of Lappeenranta (owner of the platform), company EHP who has built the automated platform and handles the data collections, storage and interfaces. Their website: <https://www.ehpenvironment.com/en/>, and →





## Use case in the Athens metropolitan region Ia

Chlorophyll-a content for Iliki lake over the period from beginning of March until end of November 2022



Water we drink...

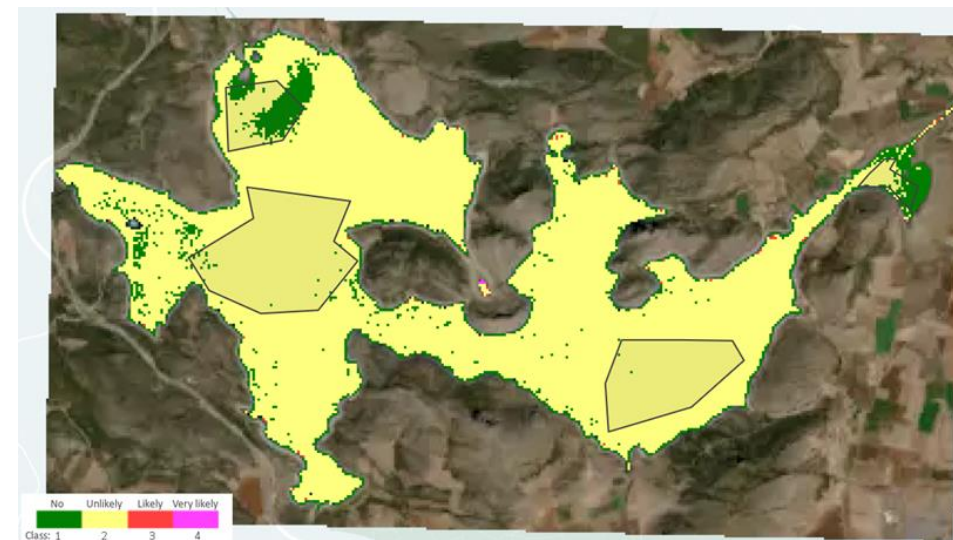
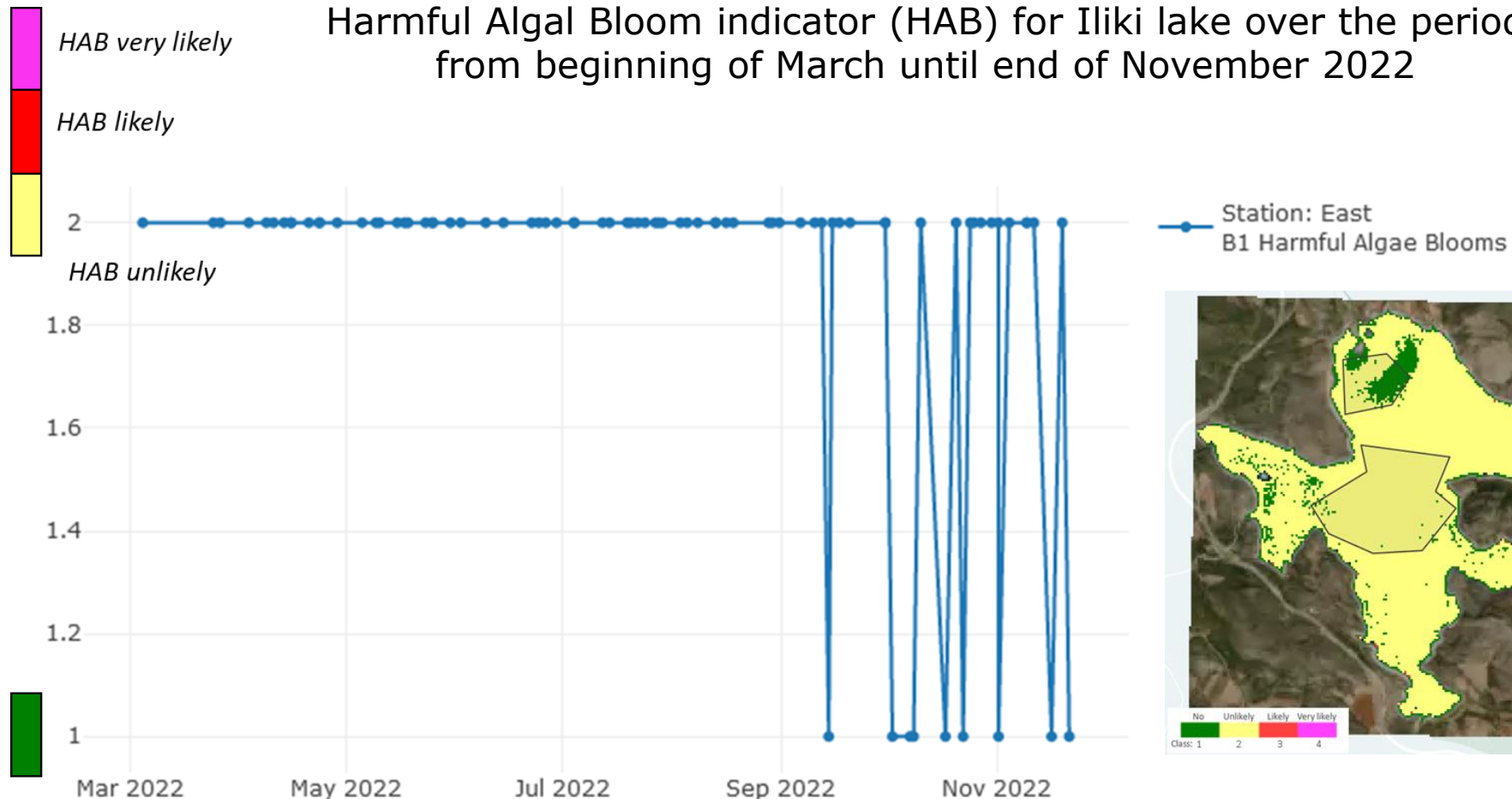




## Use case in the Athens metropolitan region Ib



Harmful Algal Bloom indicator (HAB) for Iliki lake over the period from beginning of March until end of November 2022



Water we drink...

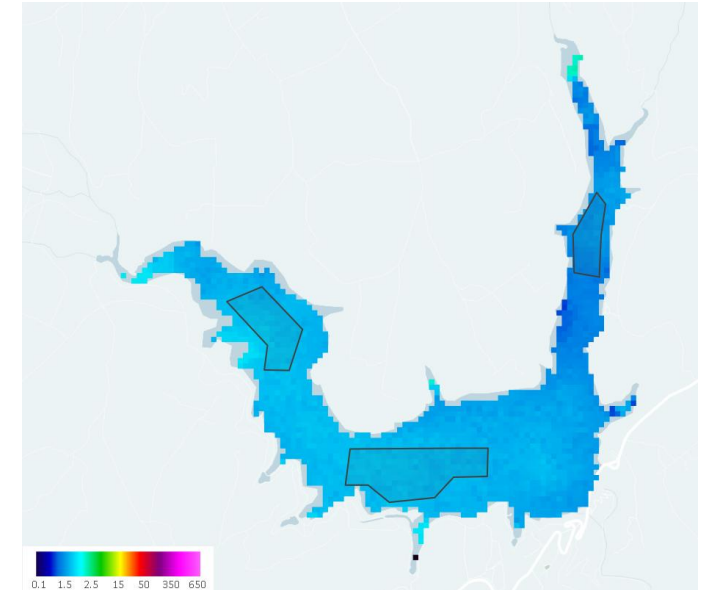
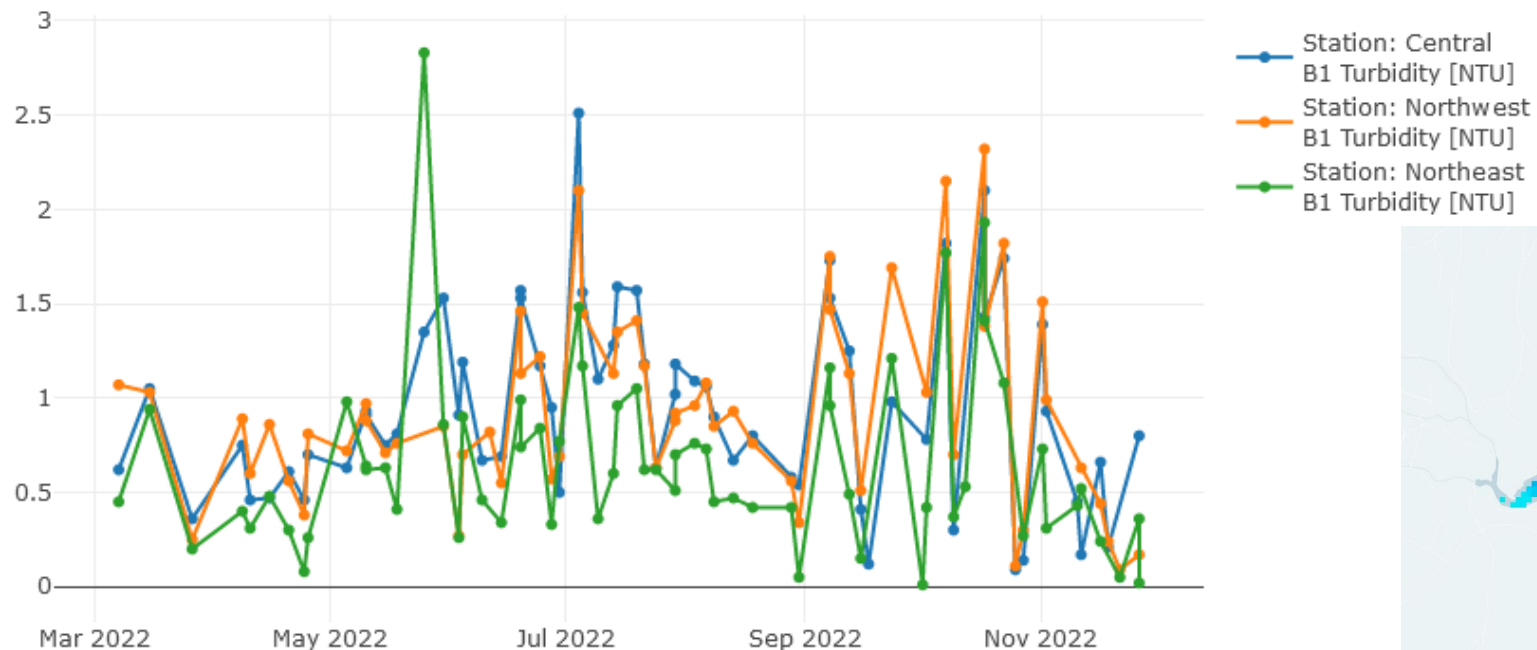






## Use case in the Athens metropolitan region IIa

Turbidity levels for Marathon lake over the period from beginning of March until end of November 2022



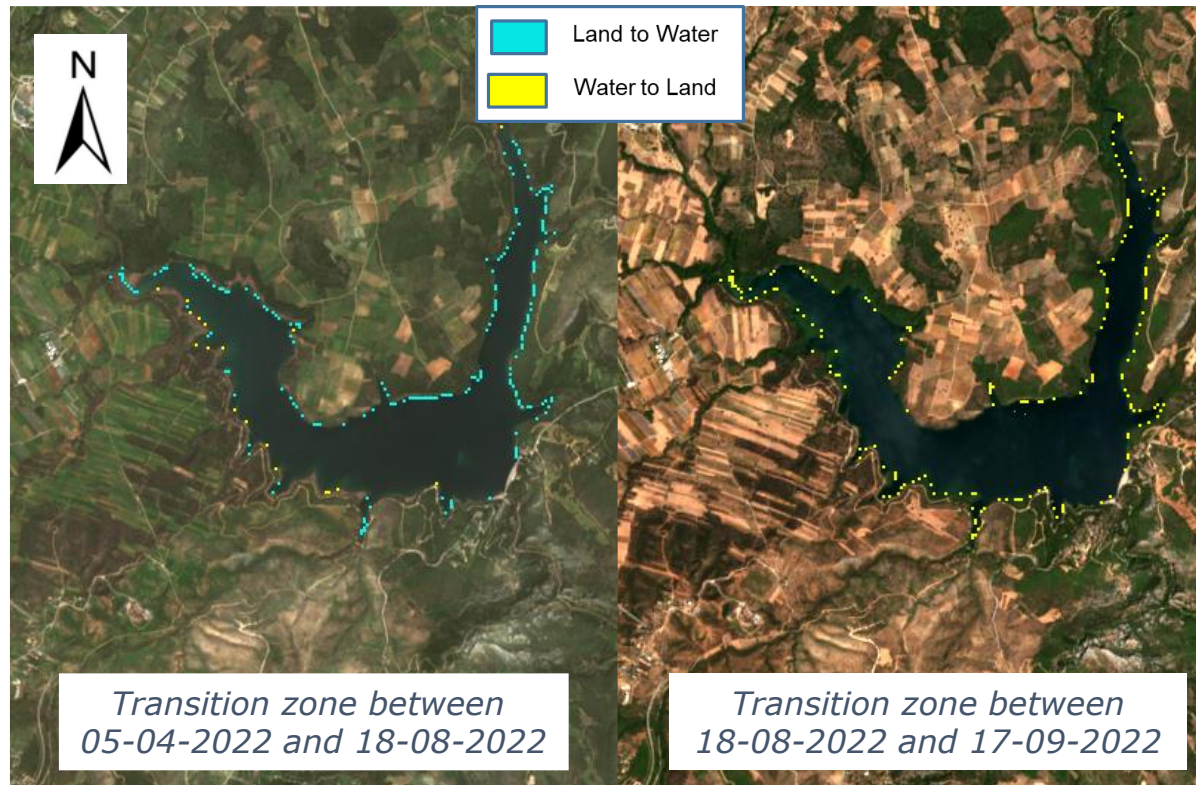
Water we drink...





## Use case in the Athens metropolitan region IIb

Land water transition zone change for Marathon lake over the period from beginning of March until end of November 2022



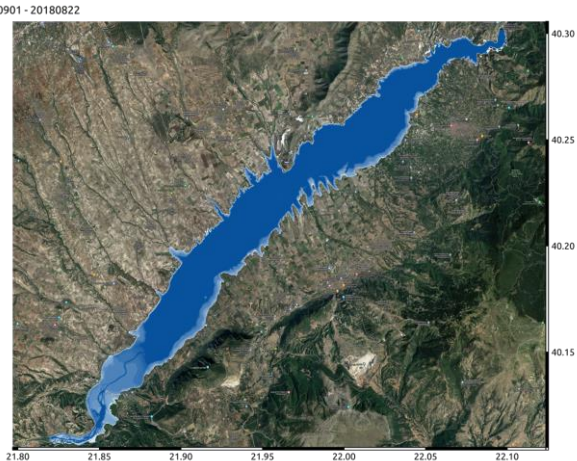
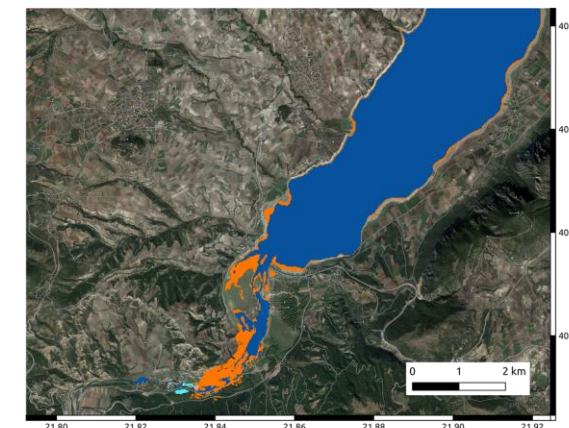
Example for mapping  
the hydroperiod →

and changes between  
two instances in time  
at the lake Polyphytos



Land Water Transition Zone Change Detection between two dates: 20210806 - 20210816

Water  
Water to Land  
Land to Water



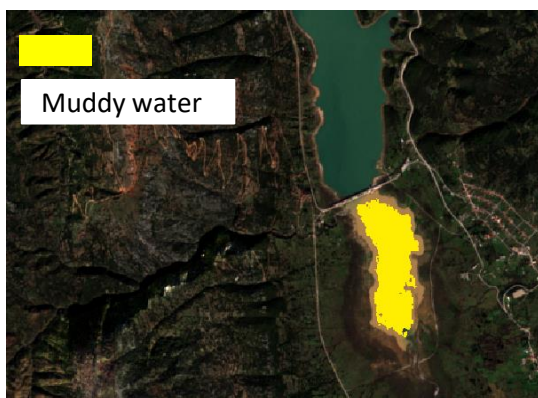
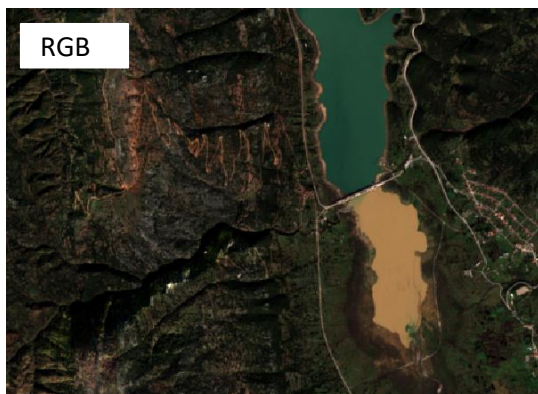




## Use case in the Athens metropolitan region III

Muddy water mapping for Mornos reservoir, transferable workflow from experimenting in Polyphytos lake

Mornos (14/12/2021)



Polyphytos lake (19/12/2021)



- Extreme event potential impact on water quality of drinking water reservoirs
- Extreme floods, muddy water/debris, unspecified formations on water surface
- Sentinel-2 images
- Trained Machine Learning model at Polyphytos
- 10m spatial resolution, 1 product per 5 days (cloudless)
- Applied on various muddy water cases
- Being enhanced to include additional muddy water spectral characteristics



Water we drink...







## Tools and technologies used to address the problem I



- ◆ Exploitation of available sources of information (Copernicus, in situ, social media – **use of multi-sensor-fusion technologies** )
- ◆ Built on existing knowledge and algorithms from successful research lines & projects and **improve the spatial and temporal resolution, and the product consistency** (e.g. comparison of in situ data/modelling/EO data for enhanced water quality products from previous projects (GlaSS, INFORM, SPACE-O, ECOPOTENTIAL, E-SHAPE))
- ◆ Minimization and **documentation of uncertainty** on water quality indicators through provenance documentation (ISO19115-1/ISO19115-2) of datasets following the FAIR principles and according to quality ISO19157 and QualityML vocabulary



Water we drink...





## Tools and technologies used to address the problem II



- ◆ Establishment of **ontology and semantics of water quality supporting regulations** (WFD)
- ◆ Development of **metadata tool documenting** quality metadata
- ◆ Utilization of **cloud based micro-services**, assuring easy deployment of the novel services, as it facilitates fast prototyping, continuous deployment and integration, resilience to failure and service availability
- ◆ Linkage and assimilation of services and products to **existing Decision Support Systems**



Water we drink...



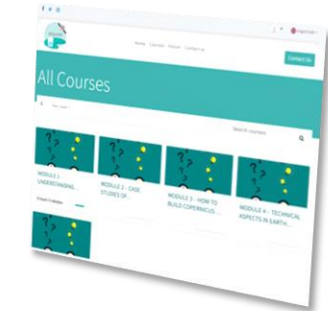
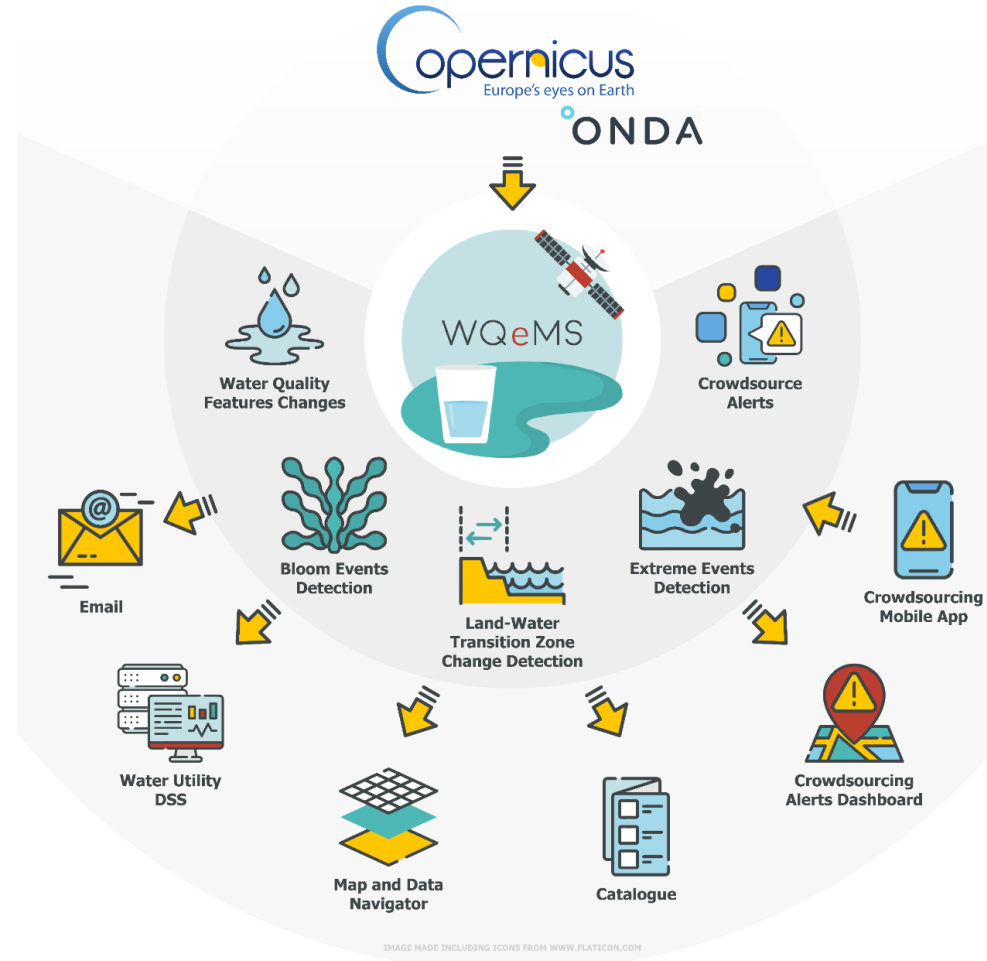


## Results and ongoing activities I



Water we drink...

The platform:



+ User Training

EYATH (partner) &  
EYDAP (Third Party  
cooperation)



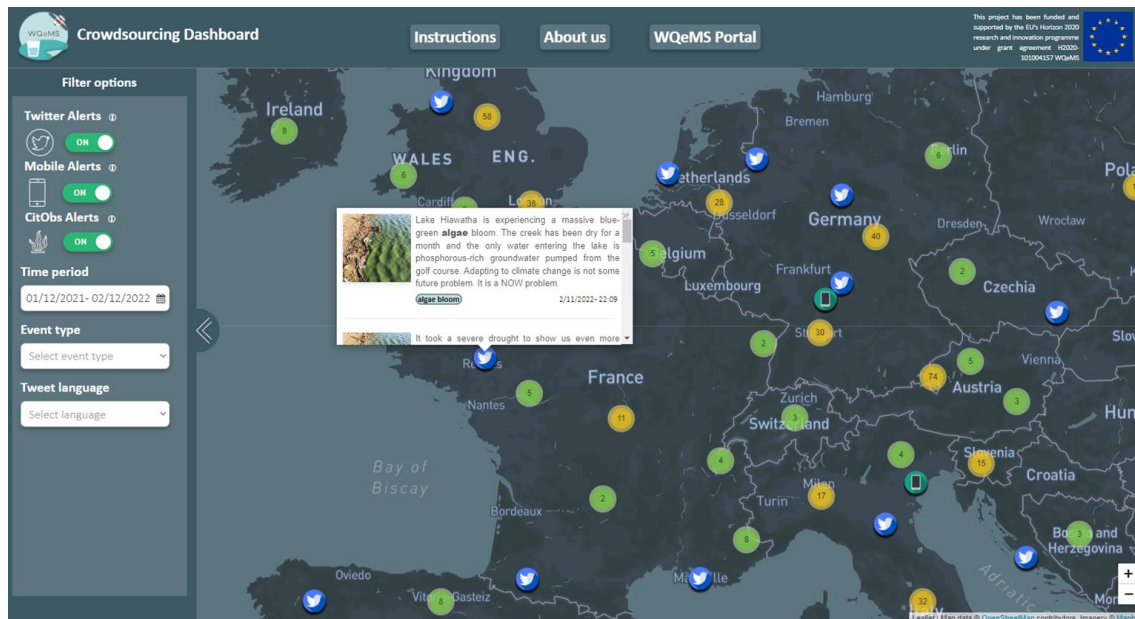




## Results and ongoing activities II

- Collection of water quality related crowdsourcing information
- Generation of alerts for water quality incidents by analyzing the collected data
- Visualization of the alerts

Visualization of alerts in Crowdsourcing Dashboard



Number of documents collected and alerts generated

Source	Social Documents	Alerts
CitObs	34,408	10,433
Twitter	1,770,322	2,694
Mobile App	52	52

Mobile Reporting Form & Submission Overview

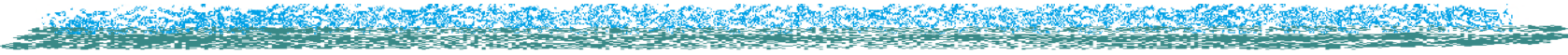
The 'Submit an issue' screen shows fields for Category (Water quality), Subcategory (Strange taste), Description (The water coming from the tap is dirty today!), Location (Odos xoris onomasia, Lagkadas 570 02, Greece), and Date & Time (24-10-22 11:53). The 'Complaint details' screen shows the same information with a 'Thank you for submitting your complaint.' message and an image of the water sample.

The App:





## Synergies are being established

- 
- ◆ With ongoing European projects (clustering)
  - ◆ With International actors
  - ◆ With Water Utilities and SMEs across Europe
  - ◆ With Governmental actors
  - ◆ Especially in Greece: with the Power Supply Company; Water Utilities and governmental actors in Thessaloniki, Athens, Patras; regional Offices of the General Organization of Land Improvements; the National Wetland and Biotope Centre, to name but a few
  - ◆ *Open to new ones!*



Water we drink...



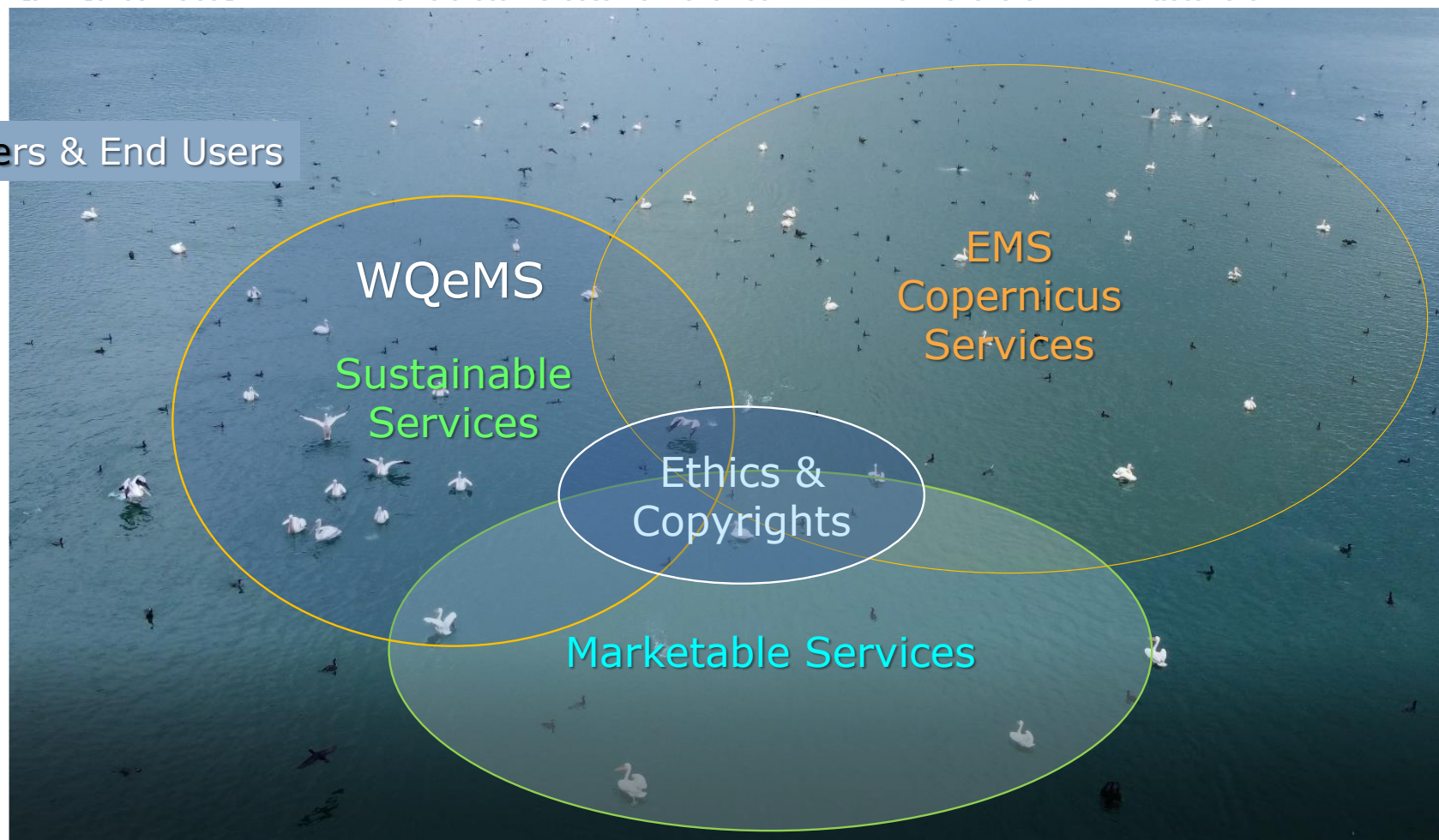


## Roadmap and sustainability, potential for replication and transferability I



**CERTH**  
CENTRE FOR  
RESEARCH & TECHNOLOGY  
HELLAS

Users & End Users



Water we drink...







## Roadmap and sustainability, potential for replication and transferability II



**CERTH**  
CENTRE FOR  
RESEARCH & TECHNOLOGY  
HELLAS

- ◆ The main ambition of WQeMS is to become a candidate service component of the Copernicus Emergency Management Service (CEMS);
- ◆ ultimately, to receive approval by the Member States to be embedded in the existing Copernicus Services portfolio.
- ◆ Activities and results are expected to contribute to Europe's endeavors towards GEO and priorities in the framework of the UN 2030 Agenda for Sustainable Development, the Paris Climate Agreement and the Sendai Framework for Disaster Risk Reduction.



COP21 • CMP11  
**PARIS 2015**  
UN CLIMATE CHANGE CONFERENCE



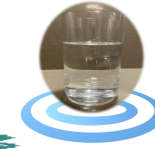
Water we drink...



# EUROGEO WORKSHOP 2022



## With a smile and a vision



**CERTH**  
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RESEARCH & TECHNOLOGY  
HELLAS

Water we drink...



**CERTH**  
CENTRE FOR  
RESEARCH & TECHNOLOGY  
HELLAS



**CREAF**



**CETAQUA**  
WATER TECHNOLOGY CENTER



on behalf of the consortium

<https://wqems.eu/>  
[imanakos@iti.gr](mailto:imanakos@iti.gr)

→ Check also  
WQeMS at the  
poster BF 18/  
Ballroom Foyer

**serco**



**PHOEBE**  
RESEARCH & INNOVATION



**ATHENS 7-9 DECEMBER 2022**

WQeMS: a Copernicus assisted monitoring platform for the water we drink in Athens  
08/12/2022 | imanakos@iti.gr | slide 17 | <http://wqems.eu/>

This project has received funding from the  
European Union's Horizon 2020 Research  
and Innovation Action programme under  
Grant Agreement No 101004157





## The **HARMONIA** contribution to **GEOSS** platform for coastal cities, the example of Piraeus

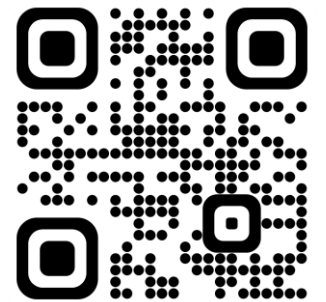
Nerantzia Tzortzi (POLIMI) | Betty Charalampopoulou (GSH)



POLITECNICO  
DI MILANO

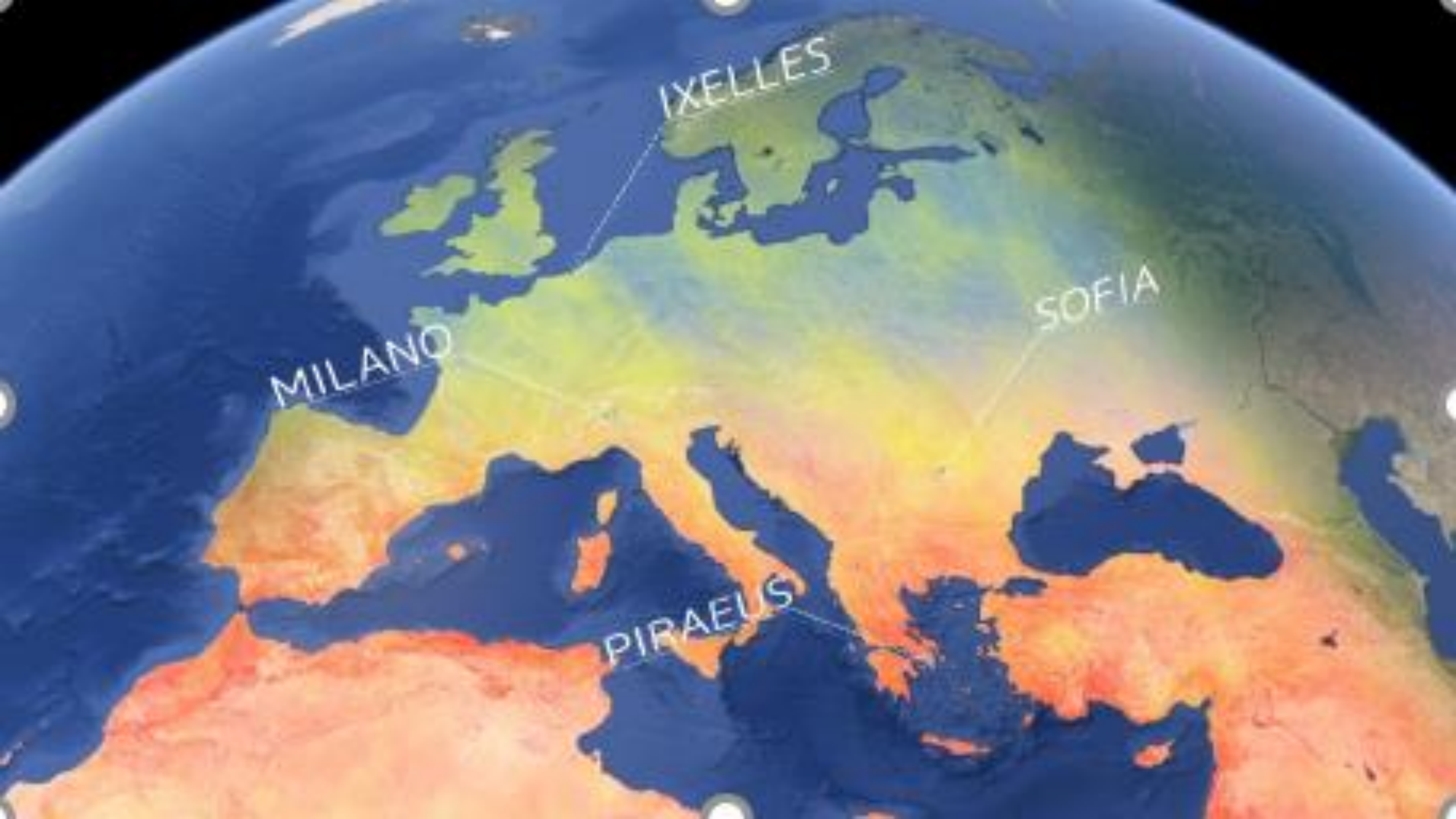


Learn more here:



ATHENS 7-9 DECEMBER 2022





IXELLES

MILANO

SOFIA

PIRAEUS

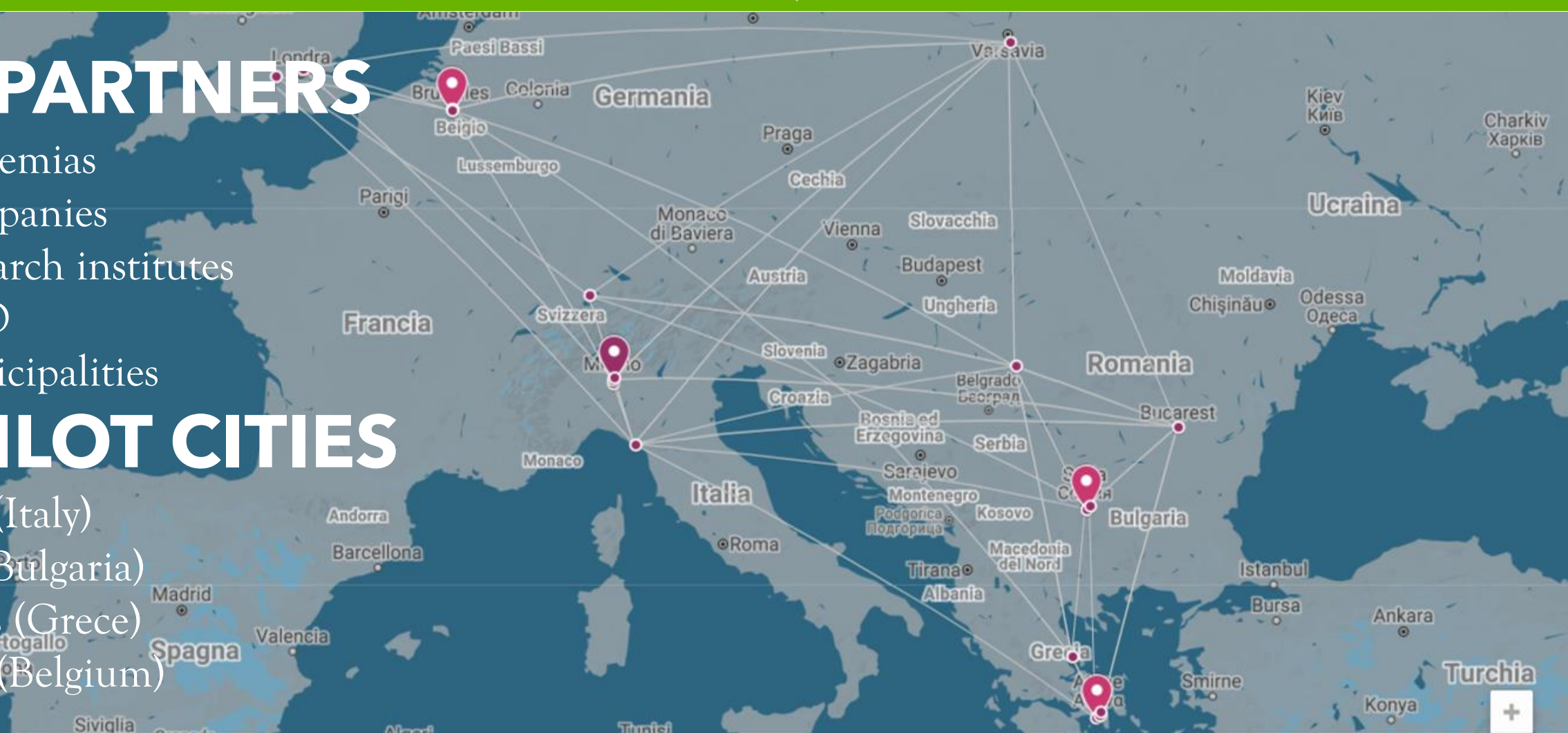


## 22 PARTNERS

4 Academies  
9 Companies  
4 Research institutes  
1 NGO  
4 Municipalities

## 4 PILOT CITIES

Milan (Italy)  
Sofia (Bulgaria)  
Piraeus (Greece)  
Ixelles (Belgium)



**ATHENS 7-9 DECEMBER 2022**



## The HARMONIA Project



Development of a Support System for Improved Resilience and Sustainable Urban areas to cope with Climate Change and Extreme Events



**HARMONIA will focus on two types of Climate Change (CC) effects:**



Natural and man-made hazards intensified by CC, including urban flooding, soil degradation and geohazards (landslides, earthquake, ground deformation)



Man-made hazards, such as heat islands, urban heat fluxes, air quality, gas emissions

**HARMONIA** will systematically study to integrate knowledge from **EO, IoT, engineering, health, physical social** and **biological sciences** with **urban planning** and **ICT**.



# EUROGEO WORKSHOP 2022



## Data input

**Data types** (eg satellite, in-situ, socio-economic, citizen observatories)

**Data sources** (existing open services such as GEOSS, Copernicus services, ESA TEPs; local/regional/national statistical and geospatial data; one-off campaigns, commercial; research)

**Access routes** (eg online open access, proprietary, commercial)

**Licensing issues/constraints**



## Data preparation

Climate indexes, Essential variables, Downscaling, Data integration, Data annotation, Data cubes



## Intelligence framework

- Atmospheric forcing & weather reanalysis
- CC at city level
- Ecological integrity indices
- Geotechnical models & CC
- Air quality & urban health
- Urban mobility & CC
- AI/ML tools for adaptation



## PARIS GREEMENT

**CC Mitigation**  
low carbon economy

**CC Adaptation**  
unavoidable CC—  
increased resilience

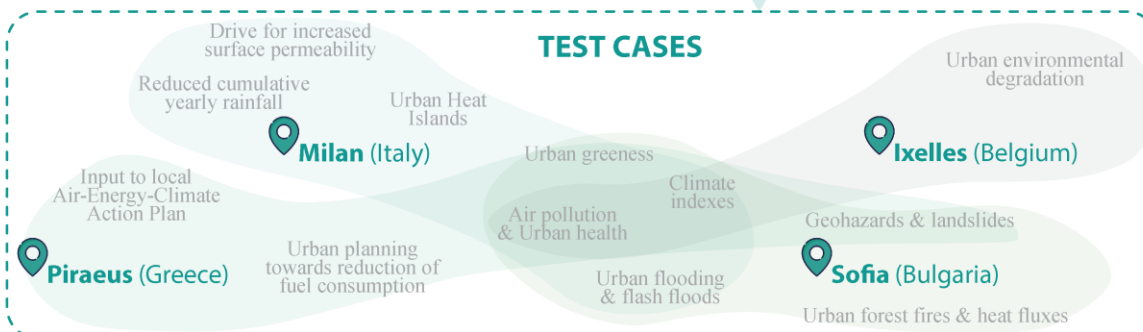
## Integrated Resilience Assessment Platform (IRAP) for Urban environment

- Creating a climate baseline
- Assessing recent change and trends
- Short term future change, impact and preparedness (seasonal)
- Decision support for long term (decadal) planning: Baseline and Worst Case

- CC Mitigation**
- Housing stock and buildings
  - Land use, including green spaces, urban forests
  - Transport infrastructure
  - Community participation and behaviour change

- CC Adaptation**
- Reducing impact of extreme events
  - Preparing for slow onset & unavoidable changes (Sea level rise, Floods, Precipitation, Temperature, Urban heat flux, Drought, Wild fires, Landslides, Atmospheric composition/pollution change)

## TEST CASES



## PROJECT STRUCTURE

HARMONIA IRAP leverages cutting-edge technologies (i.e., Artificial Intelligence, Data Mining, multi-criteria analysis, dynamic programming) and services (ie., Virtual Machines, Containers) in order to provide an **integrated solutions** for mitigation and adaptation to CC, considering the complexity and diversity of earth and non-earth data.

The HARMONIA IRAP design tends to address CC challenges by offering a **dynamic, scalable and robust tools** targeted on the needs of different end-users.

IMAGE CREDITS: J.N. Tzortzi, A. Doulamis, I. Rallis, M.S. Lux, G. Barbotti, I. Tzortzis (2022) "HARMONIA: strategy of an integrated resilience assessment platform (IRAP) with available tools and geospatial services.", in SBfin 2022 Conference - Emerging Concepts for Sustainable Built Environment



## The example of Piraeus



 The biggest and most important industrial and commercial center of Greece

 The biggest passenger port in Europe and 3<sup>rd</sup> biggest in the whole world



Lack of free spaces and parks

High density buildings

Lack of infrastructures

Air pollution (mainly due to the emissions of cruise ships)

Hot semi-arid climate (Köppen climate classification)

Subsidence/local ground deformation effects

Population reduction nearly to 20% since 1990

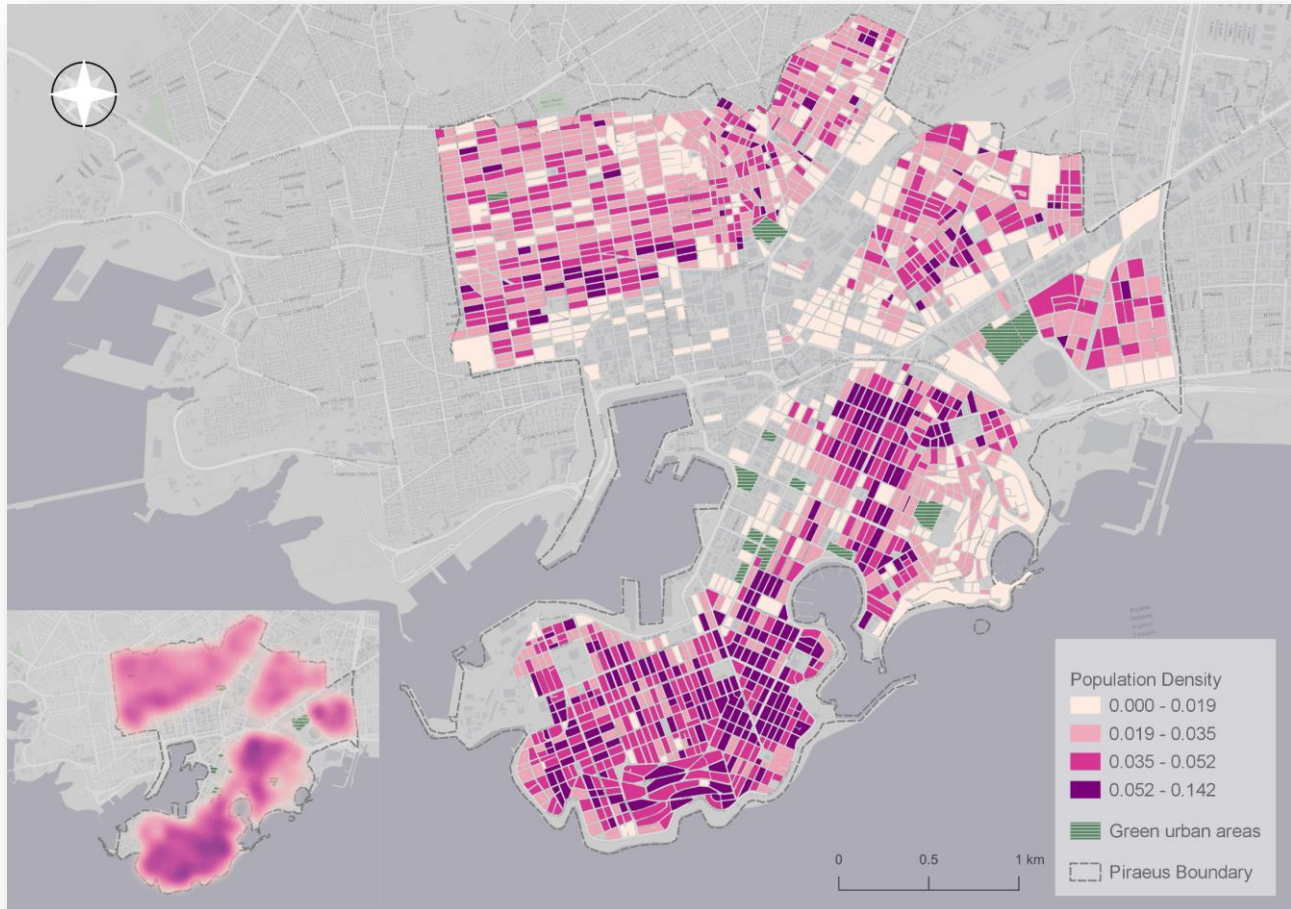
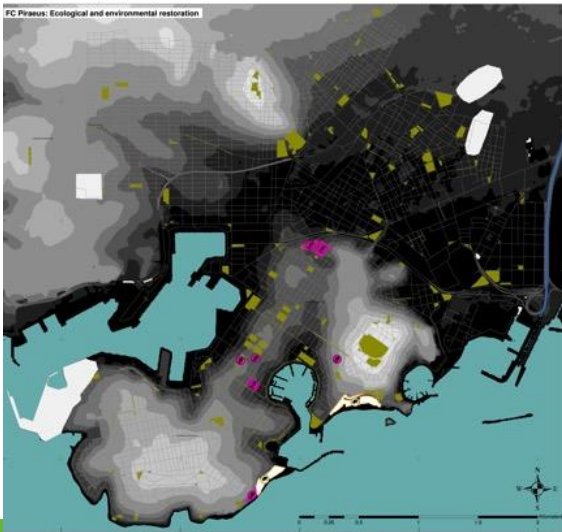




## HARMONIA Datasets - Contribution to GEOSS platform (1/6)



### Population Density





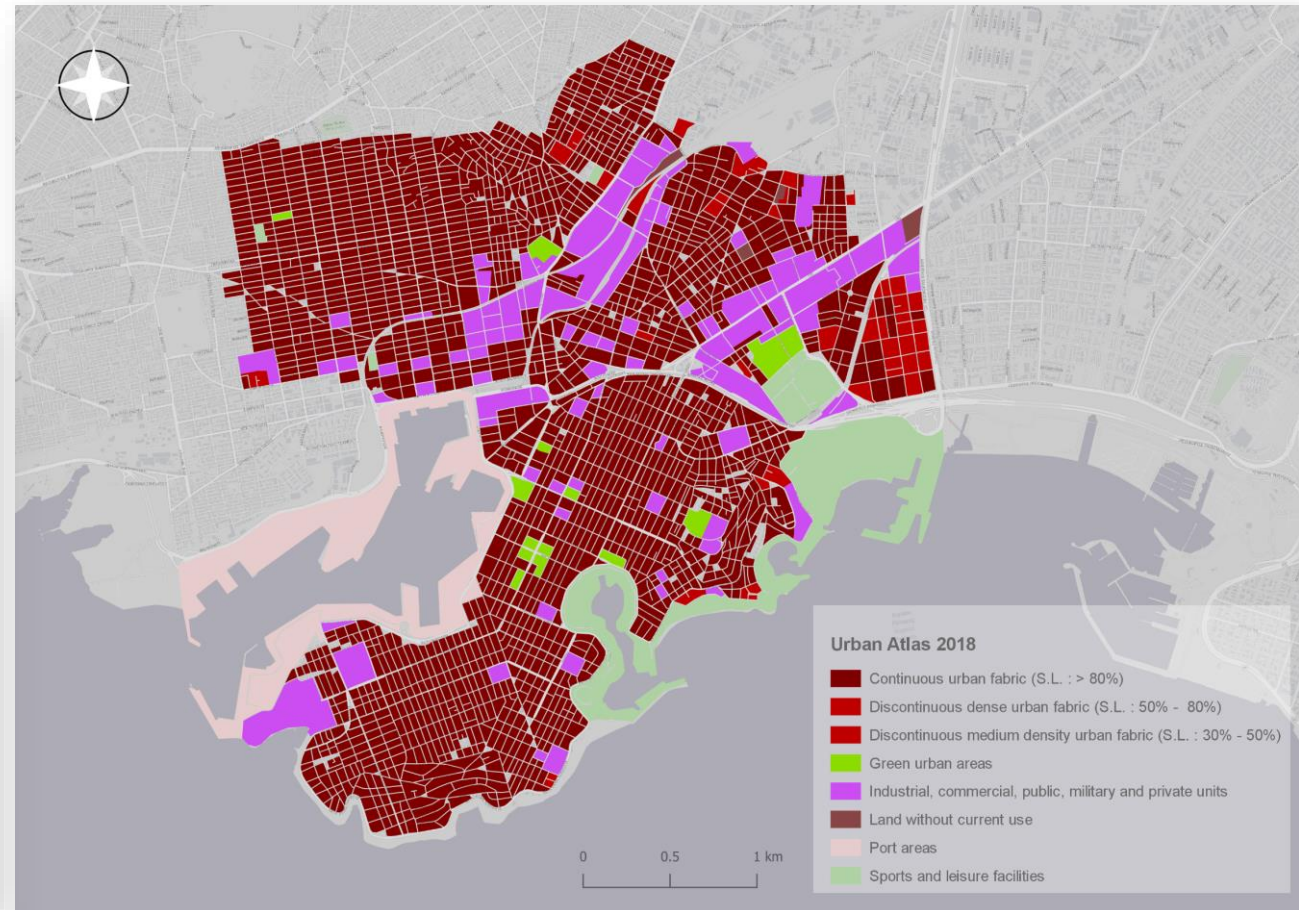
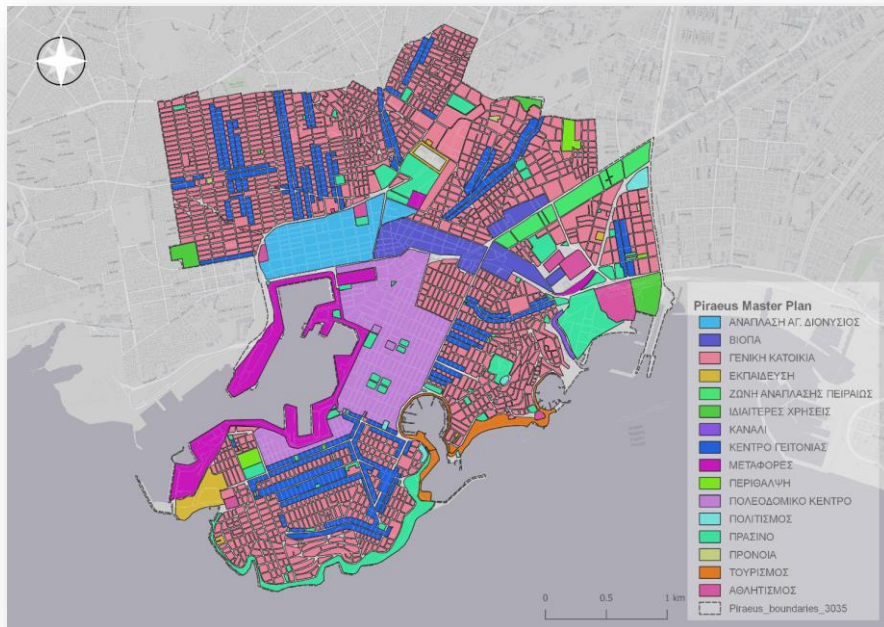


## HARMONIA Datasets - Contribution to GEOSS platform (2/6)



### Land Use & Land Cover

#### Master Plan





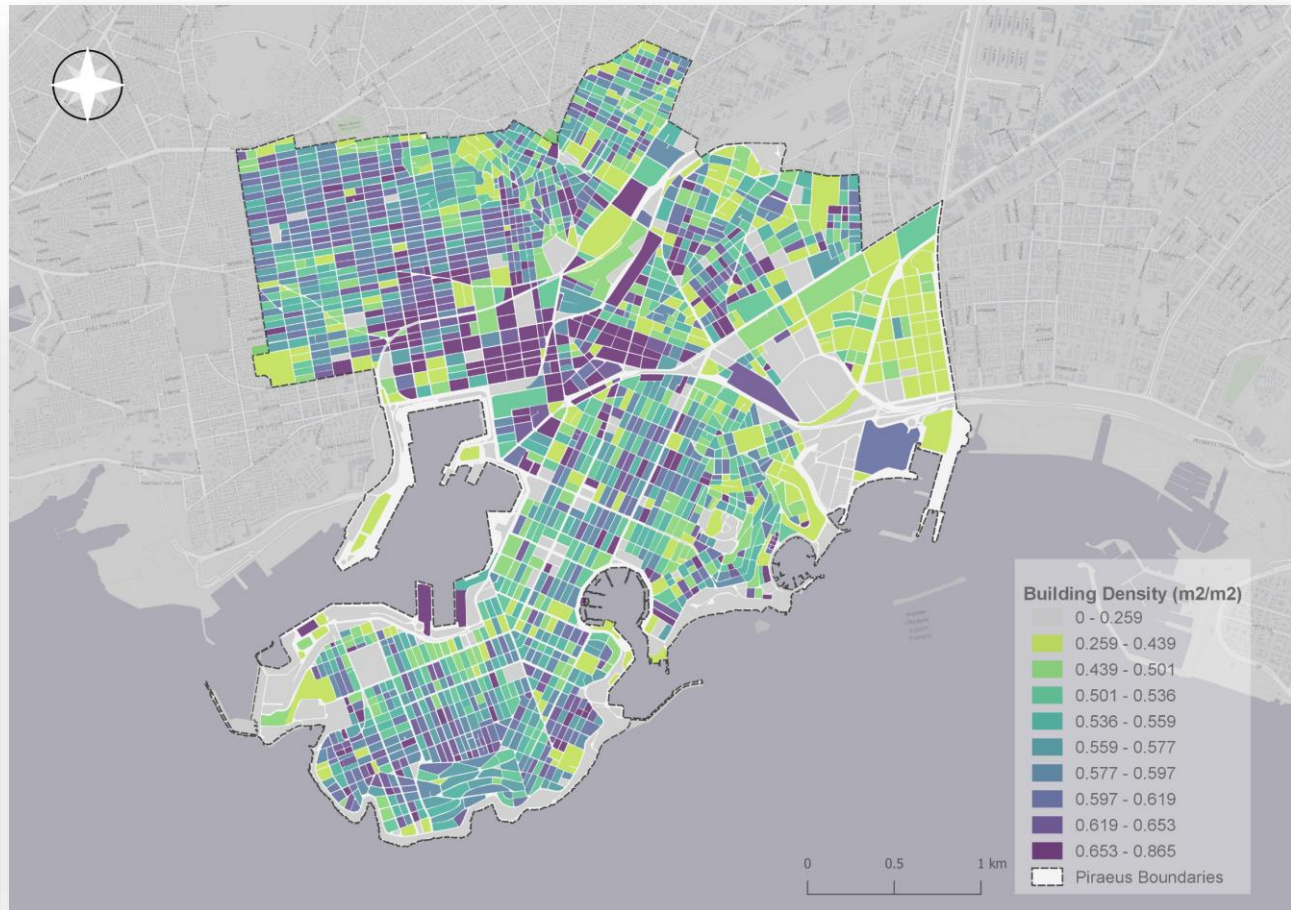
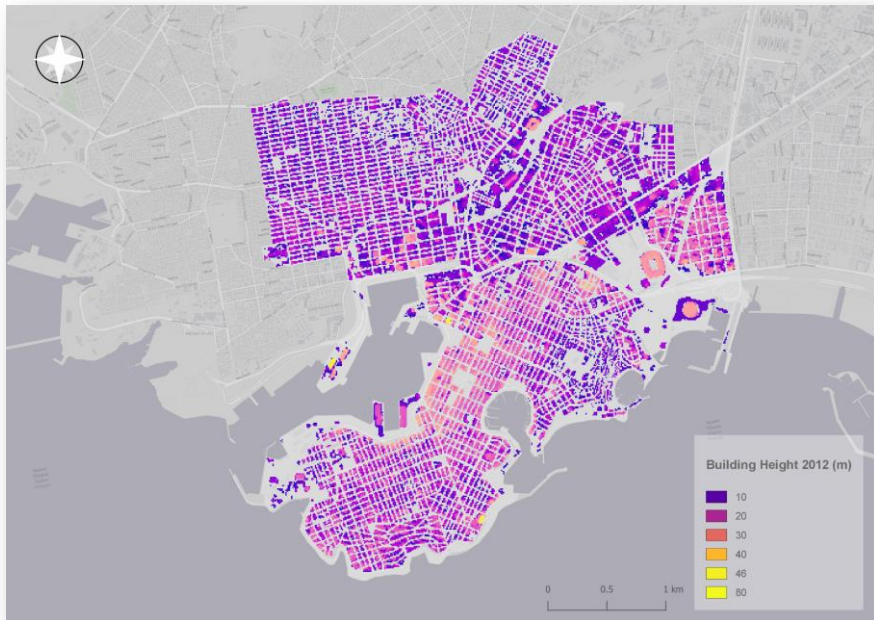


## HARMONIA Datasets - Contribution to GEOSS platform (3/6)



**Building Density ( $\text{m}^2/\text{m}^2$ )**

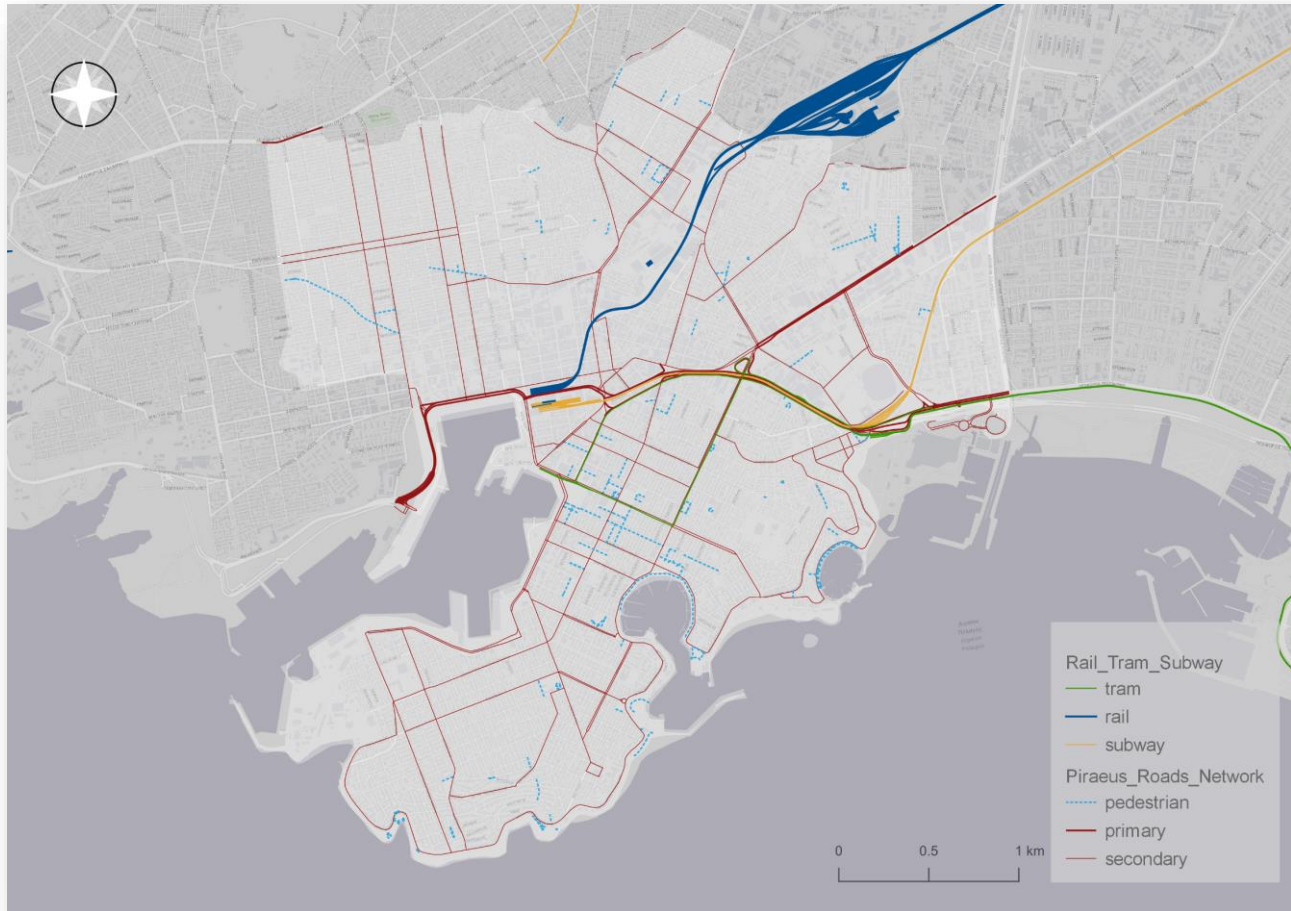
**Building Height (m)**





## HARMONIA Datasets - Contribution to GEOSS platform (4/6)

### Transportation & Road Network



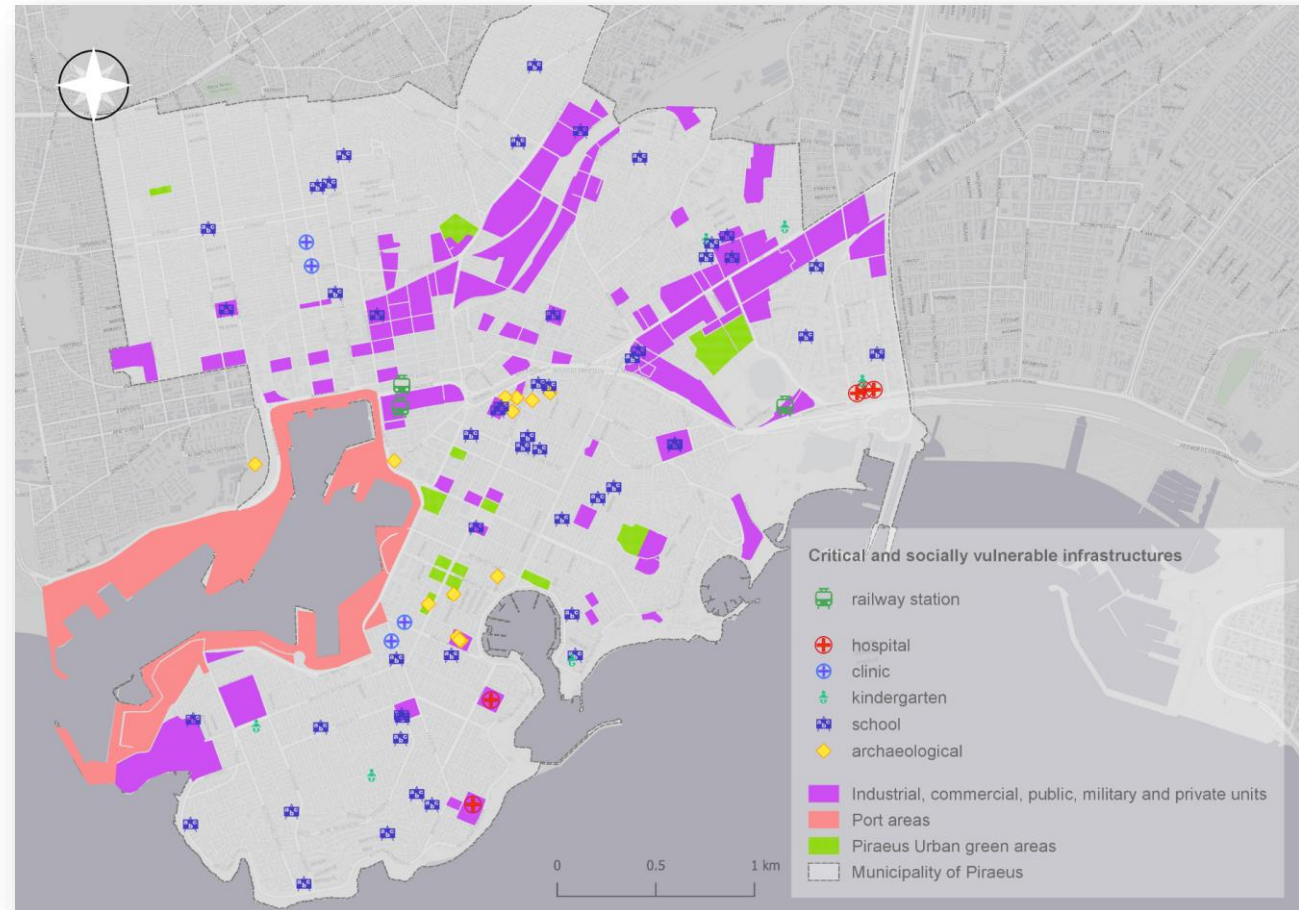




## HARMONIA Datasets - Contribution to GEOSS platform (5/6)



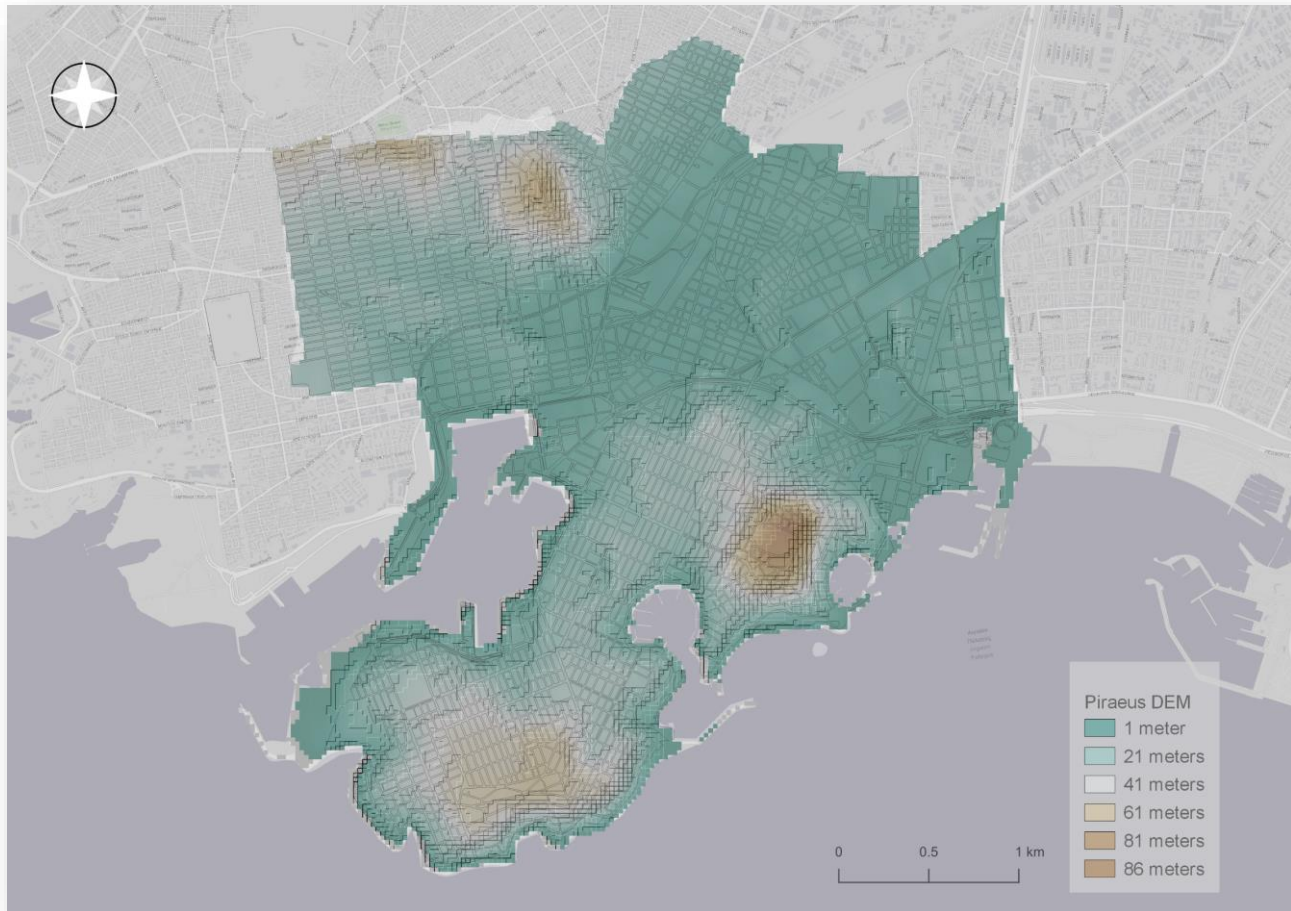
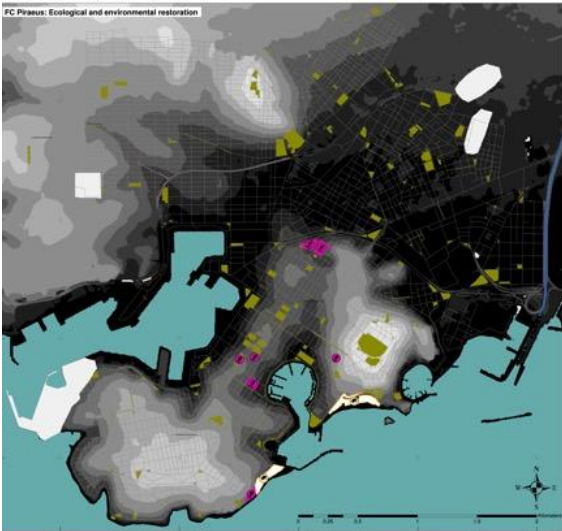
### Critical & Vulnerable infrastructures





## HARMONIA Datasets - Contribution to GEOSS platform (6/6)

### Digital Elevation Model & Slopes Green spaces





## HARMONIA Resilience DSS components

### **Risk and Impact assessment:**

*Mapping of urban risks with synergies from multiple WPs*

**HARMONIA**

### **Vulnerability Assessment and Urban Resilience:**

*Offer scalable, practical, easy-to-implement tools for incident management and resilience investments*

### **Decision Support System:**

*Hazard mitigation & adaptation, Urban planning, Health & well-being*





## HARMONIA Resilience Decision Support System (DSS)





## Municipalities, local administrators, urban planners and decision-makers

**NEEDS:** to receive support for better informed decision processes

**SERVICE PROVIDED:** Decision Support System (DSS) that will provide reliable feedback regarding any spatio-temporal changes and the impact of CC on the environment through a fully interactive Graphical User Interface (GUI)

## END-USERS

**NEEDS:** to be informed on Climate Change hazards; to gain awareness on potential risks

**SERVICE PROVIDED:** basic visualization of information and data + service of early-warnings and recommendations about potential risks such as heat peaks or extreme rainfalls

## Citizens and non-expert users



## Researchers, academia and industries

**NEEDS:** to get raw data from the platform and use it as a tool for training and evaluating new ML models

**SERVICE PROVIDED:** use of the platform for research and training purposes



## Future with Harmonia

Launch of Citizen Observatory in pilot cities to collect citizen-based data

Meet Harmonia for events and workshops

Follow our website and get involved with your community, municipality, organization







## Thank You!