13 December, 2022
Athens

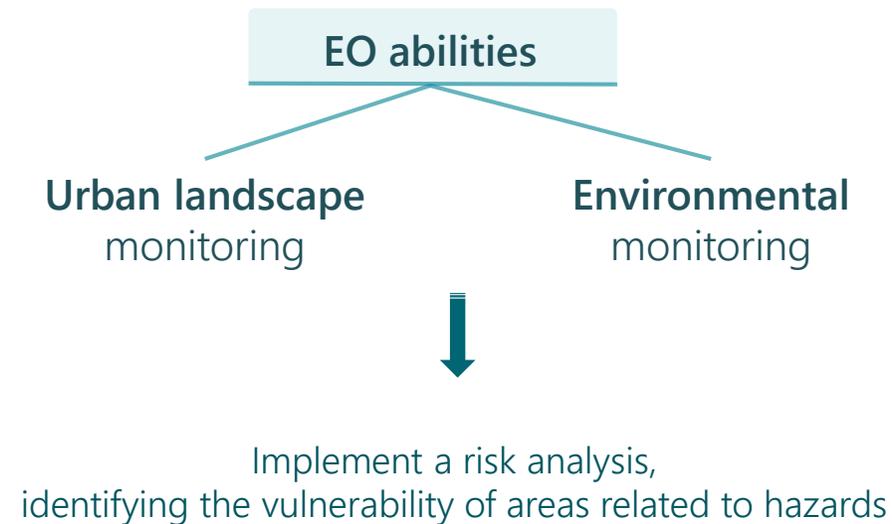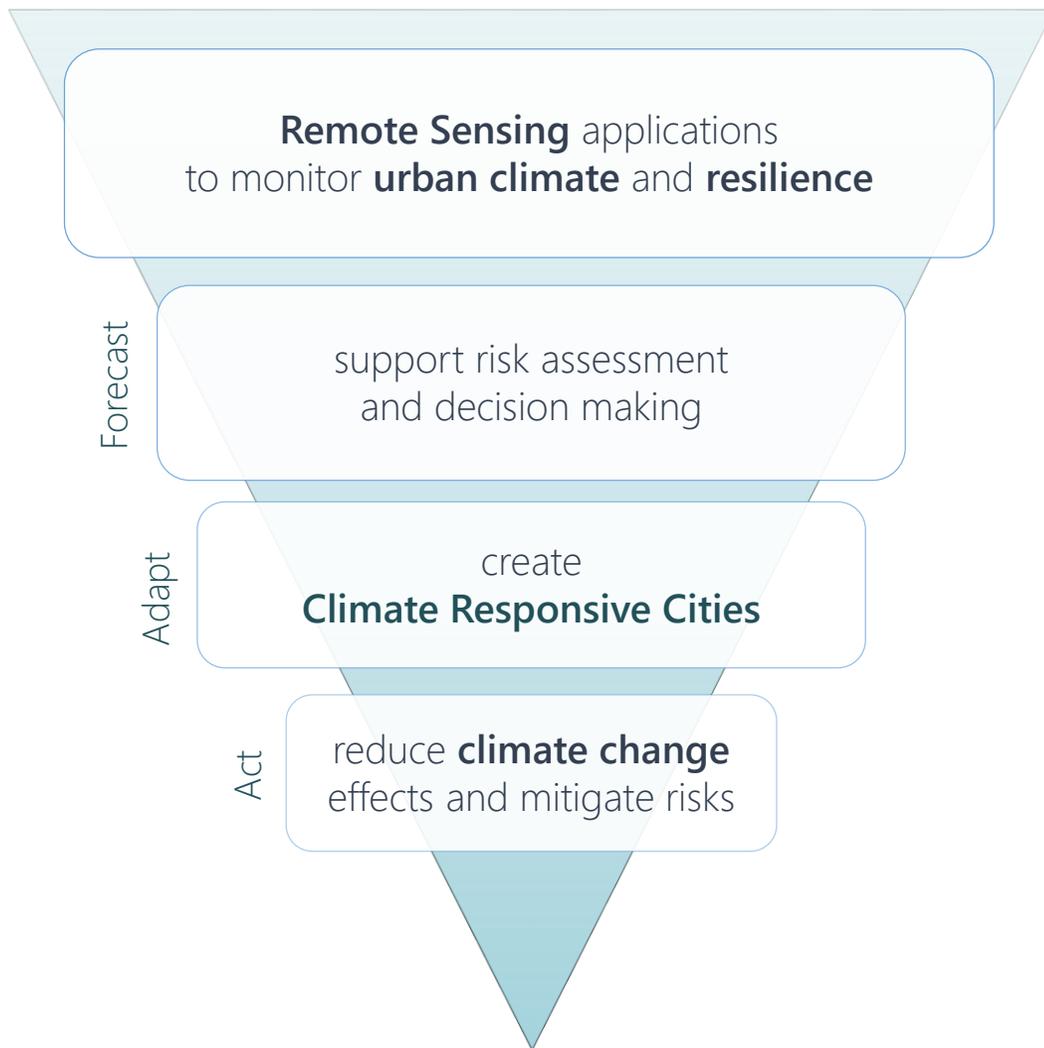# Workshop Joint FIG
Commission 3 and 8

Remote Sensing Project Examples
in Urban Environment –
the Greek Examples

Presenter: Katerina Fotiou

GEOSYSTEMS HELLAS

Remote Sensing applications
to monitor **urban climate** and **resilience**

Forecast

support risk assessment
and decision making

Adapt

create
Climate Responsive Cities

Act

reduce **climate change**
effects and mitigate risks

EO abilities

Urban landscape
monitoring

Environmental
monitoring

Implement a risk analysis,
identifying the vulnerability of areas related to hazards

In line with policies

- Paris Agreement on CC
- European Green Deal
- NBS initiative
- European green deal targets

- Goals SDG11, SDG13
  (UN 2030 Agenda for Sustainable Development)

SUSTAINABLE
DEVELOPMENT
GOALS

11 SUSTAINABLE CITIES
AND COMMUNITIES

13 CLIMATE
ACTION

Land & sea topography

→ Sea level rise
→ Ocean acidification
→ Floods
→ Coastal erosion
→ Soil erosion

Air quality, temperature, humidity

→ Heatwaves
→ Sea surface temperature

Snow & ice coverage

→ Mass balance
→ Surface changes

Copernicus
Europe's eyes on Earth

Climate Change Service
open access to climate data and tools

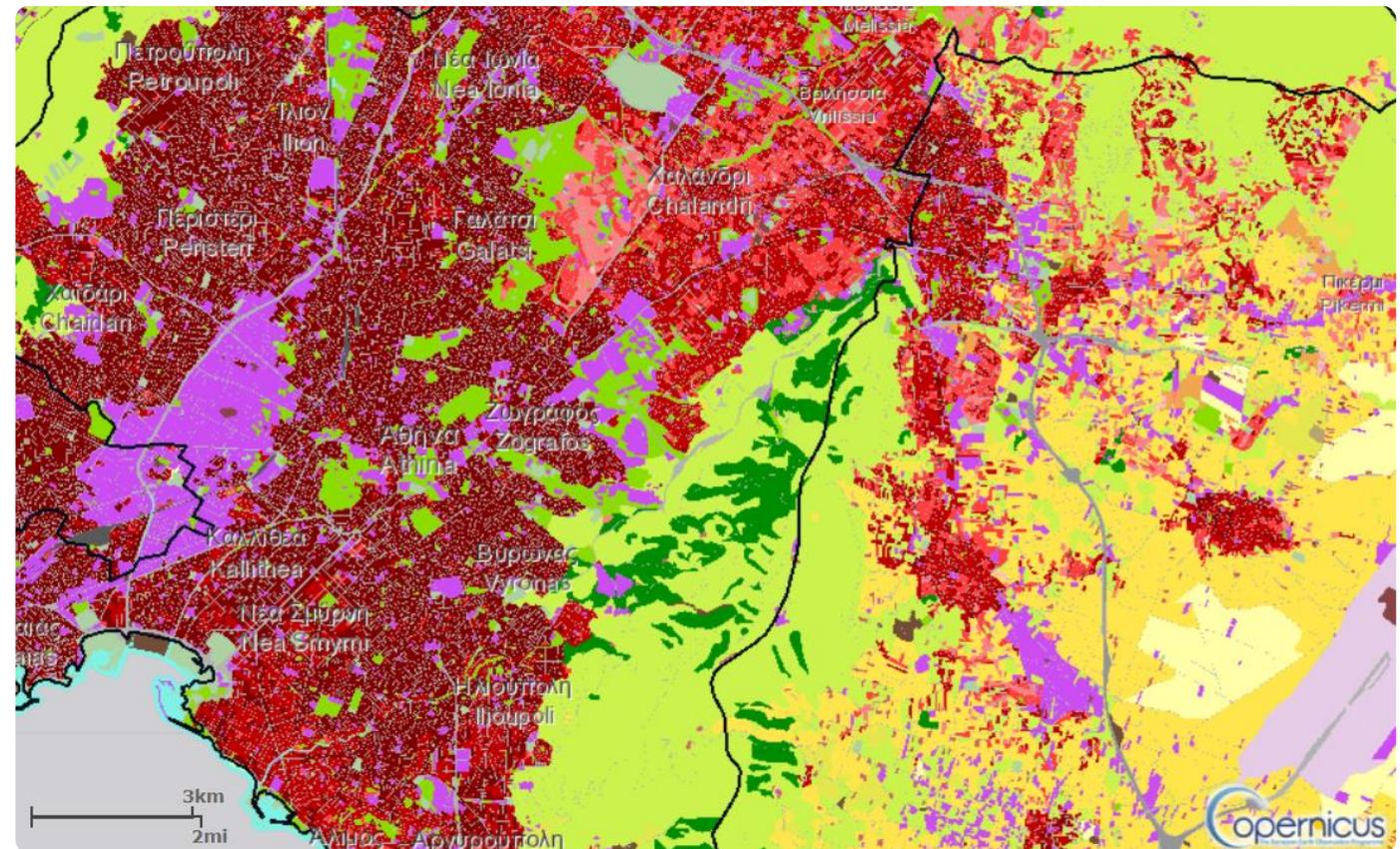Atmosphere Monitoring

Land Monitoring

Urban surface **modelling**

Urban surface **Land cover**

Land Use/Cover

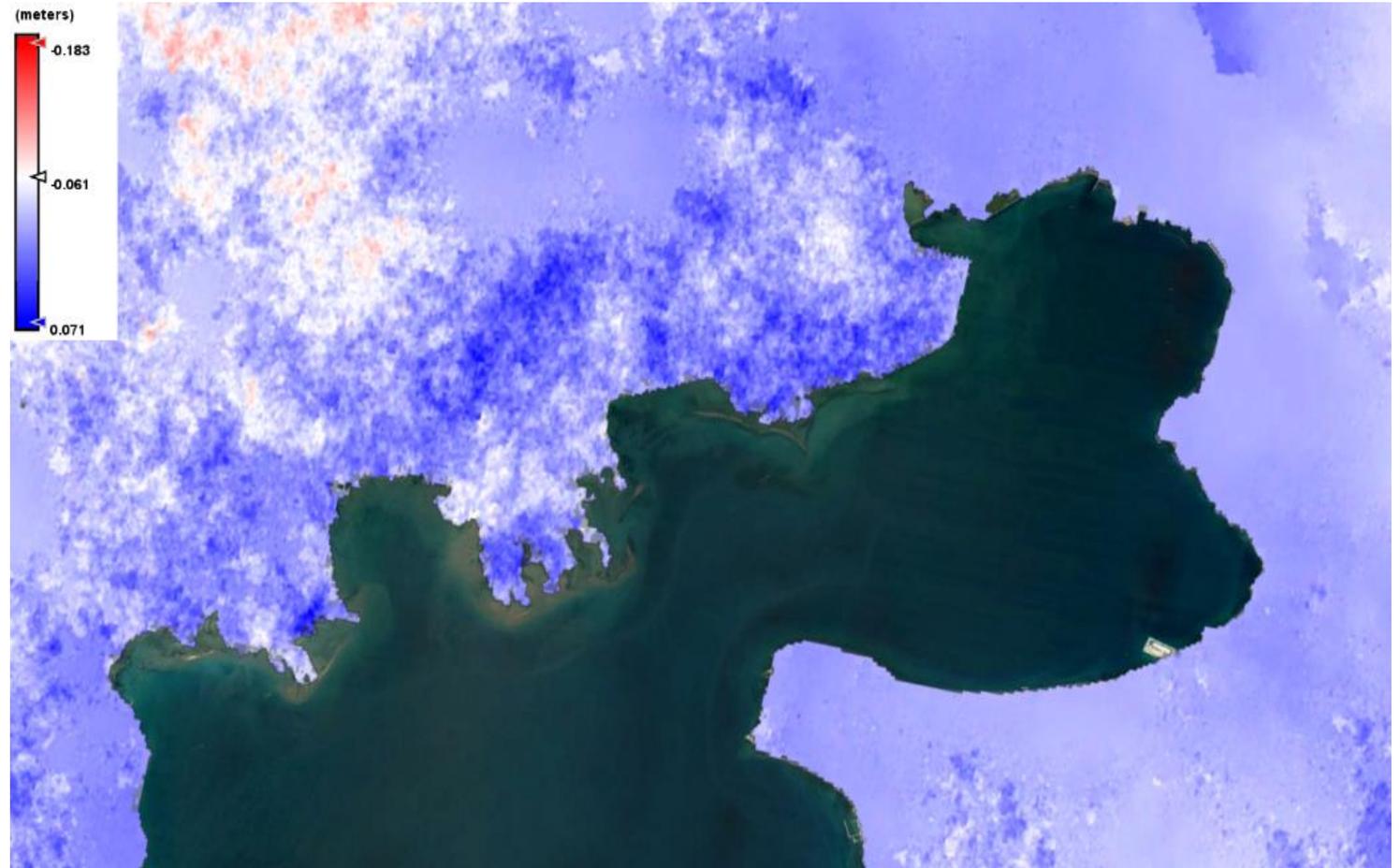Deforestation quantification

UA 2018 Function Urban Areas

Land Deformation

Synthetic Aperture Radar (SAR) data
coupled with ground truth data

Urban subsidence, movements and deformation risk assessment
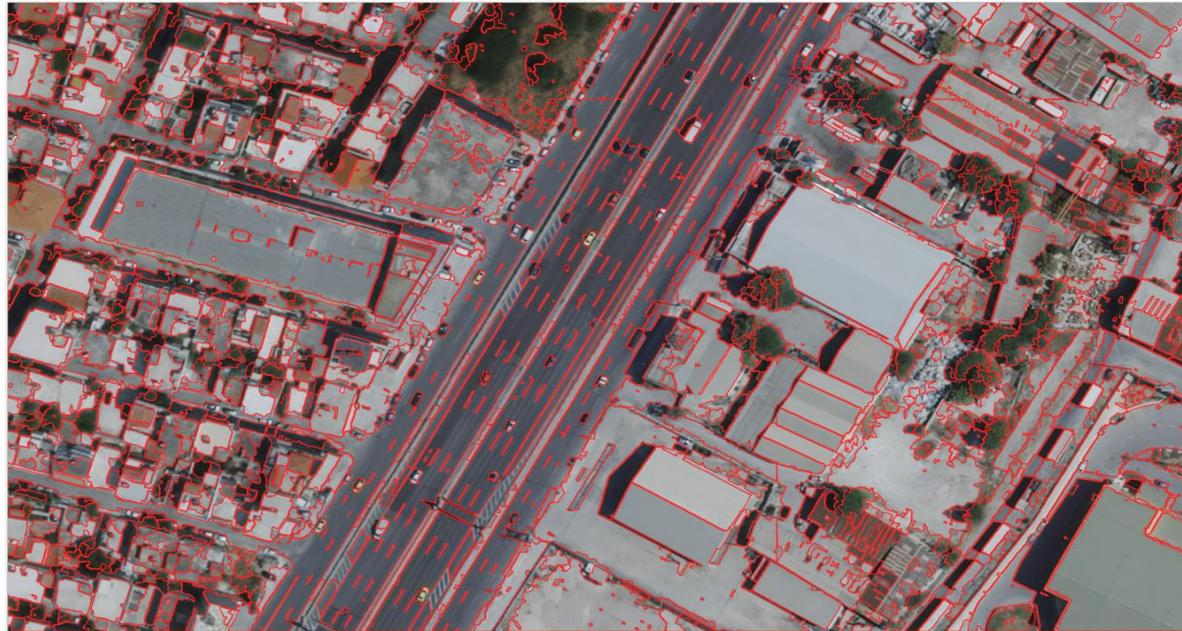

Land subsidence velocity map (2014 – 2016), from Sentinel-1 (InSAR)

Urban **feature extraction**

Material-level analysis

VHR data + semantic segmentation
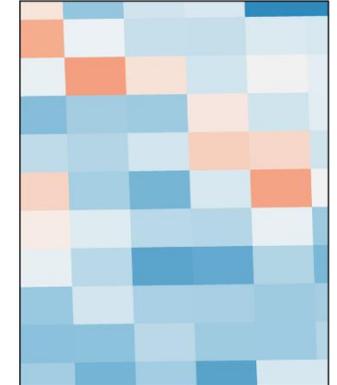
Urban surface **Indices**

Surface temperature

Landsat, ASTER (NASA), Sentinel-3 (ESA)
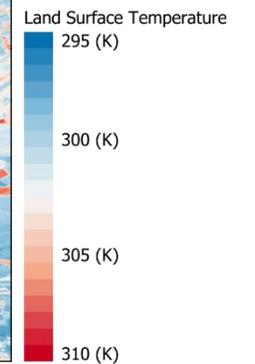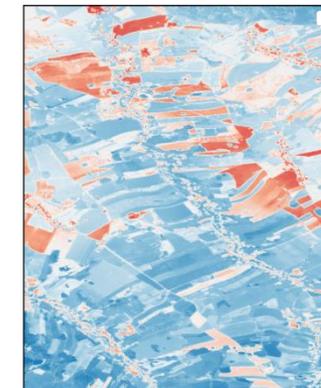
- Local surface temperature dynamics
- Urban heat emissions monitoring
- Urban thermal comfort & UHI assessment

Digital Twin Earth Models

Digital representation of a city

Variety of data inputs enable:

Better urban planning through model simulation & testing

Kaunas digital twin created by KTU

HORIZON 2020 | Grant agreement ID: 101003517

Greek case study: Piraeus

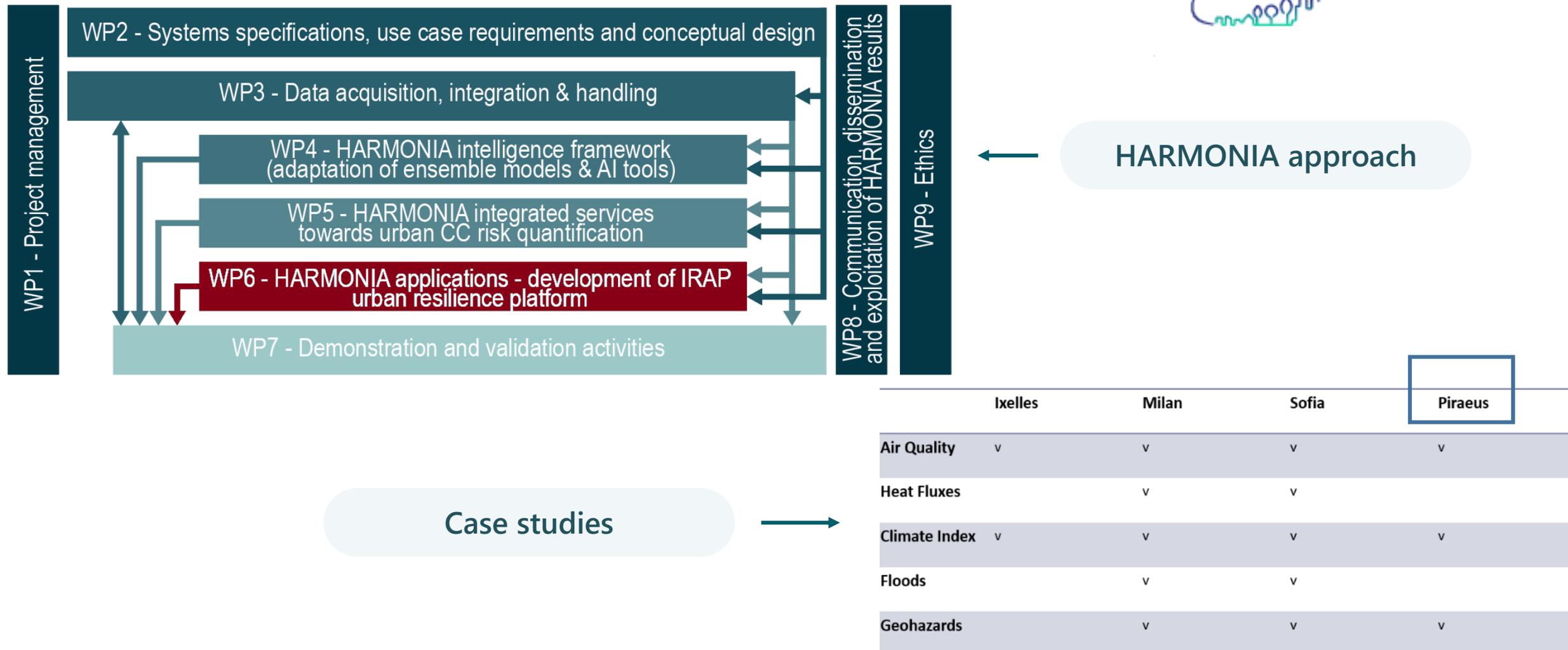| WP2 - Systems specifications, use case requirements and conceptual design |
| WP3 - Data acquisition, integration & handling |
| WP4 - HARMONIA intelligence framework (adaptation of ensemble models & AI tools) |
| WP5 - HARMONIA integrated services towards urban CC risk quantification |
| WP6 - HARMONIA applications - development of IRAP urban resilience platform |
| WP7 - Demonstration and validation activities |

WP1 - Project management

WP8 - Communication, dissemination and exploitation of HARMONIA results

WP9 - Ethics

HARMONIA approach

Case studies

	Ixelles	Milan	Sofia	Piraeus
Air Quality	v	v	v	v
Heat Fluxes		v	v	
Climate Index	v	v	v	v
Floods		v	v	
Geohazards		v	v	v

Urban Exposure index – Piraeus example

Imperviousness

- 0
- 10
- 20
- 30
- 40
- 50
- 60
- 70
- 80
- 90
- 100
- Water bodies
- Street tree level
- Municipality of Piraeus

0   0.5   1 km

Imperviousness Density (IMD) 2018

Source: Copernicus

Sp. Resolution: 10m

The Imperviousness degree is a thematic product showing the sealing density in the range from 0-100% for the period 2018 (including data from 2017-2019) for the EEA-39 area.

Water bodies (Water & Wetness 2018)

Source: Copernicus

Sp. Resolution: 10m

The combined Water and Wetness product is a thematic product showing the occurrence of water and wet surfaces over the period from 2012 to 2018.

Street Tree Layer (STL) 2018
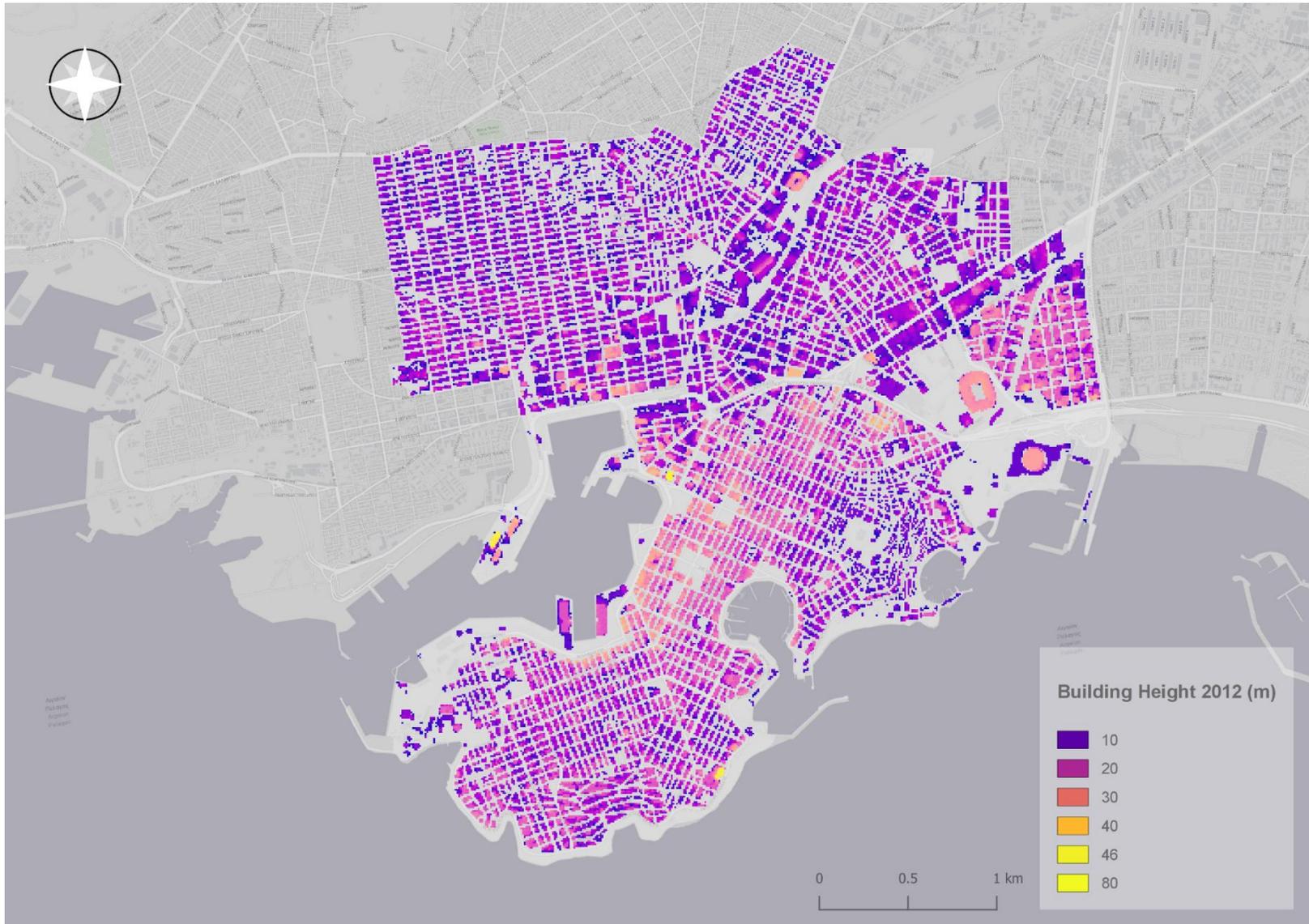
Source: Urban Atlas

Sp. Resolution: 10m

It includes contiguous rows or a patches of trees covering 500 m² or more and with a minimum width of 10 meter over "Artificial surfaces" (i.e. rows of trees along the road network outside urban areas or forest adjacent to urban areas should not be included)
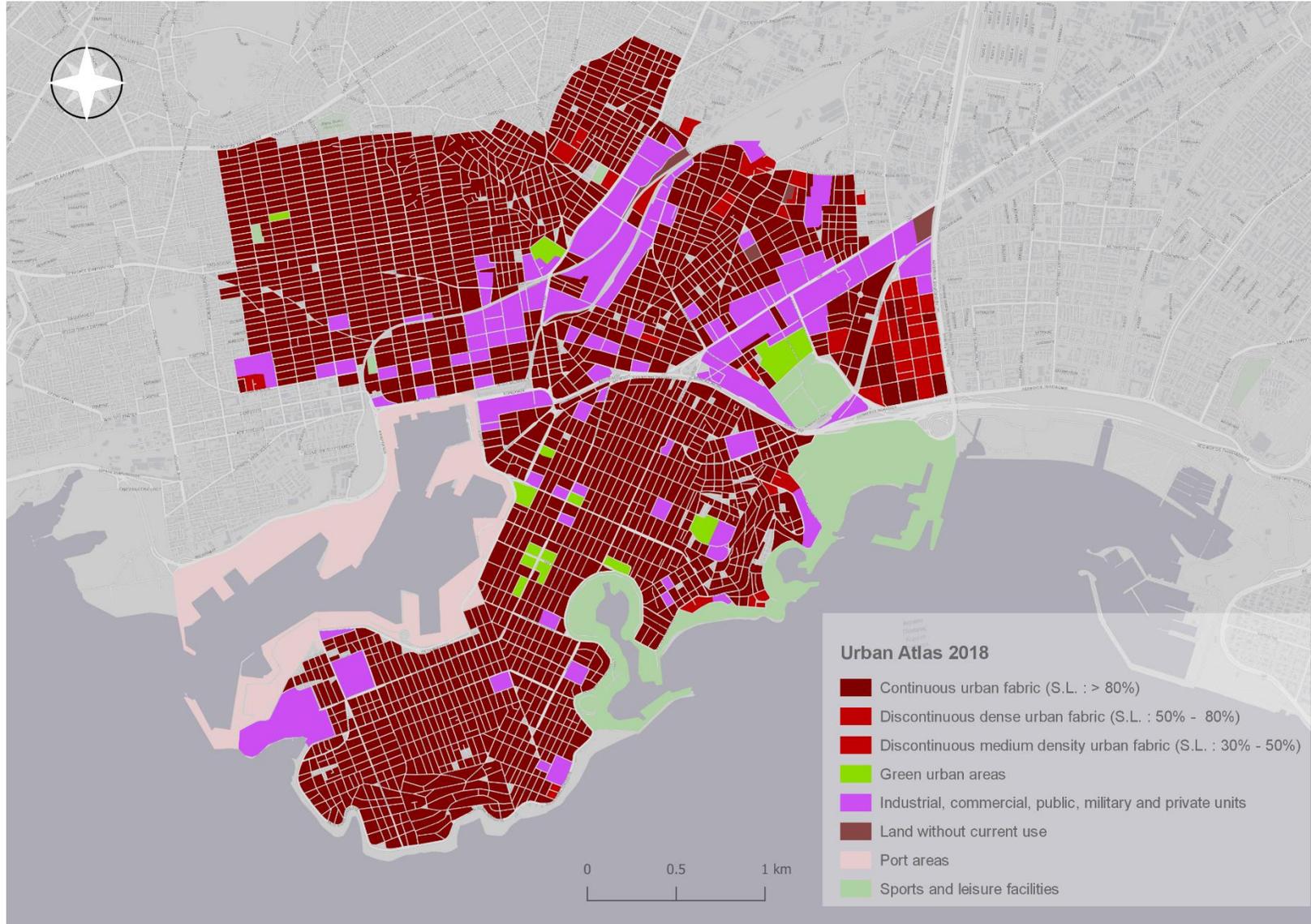
Land Use / Land Cover

Source: Copernicus Urban Atlas 2018

Resolution: Building Block

Urban Atlas 2018 provides reliable, inter-comparable, high-resolution land use and land cover data with integrated population estimates

Urban Atlas 2018

- Continuous urban fabric (S.L. : > 80%)
- Discontinuous dense urban fabric (S.L. : 50% - 80%)
- Discontinuous medium density urban fabric (S.L. : 30% - 50%)
- Green urban areas
- Industrial, commercial, public, military and private units
- Land without current use
- Port areas
- Sports and leisure facilities

0   0.5   1 km

Building Height 2012 (meters)

Source: Urban Atlas
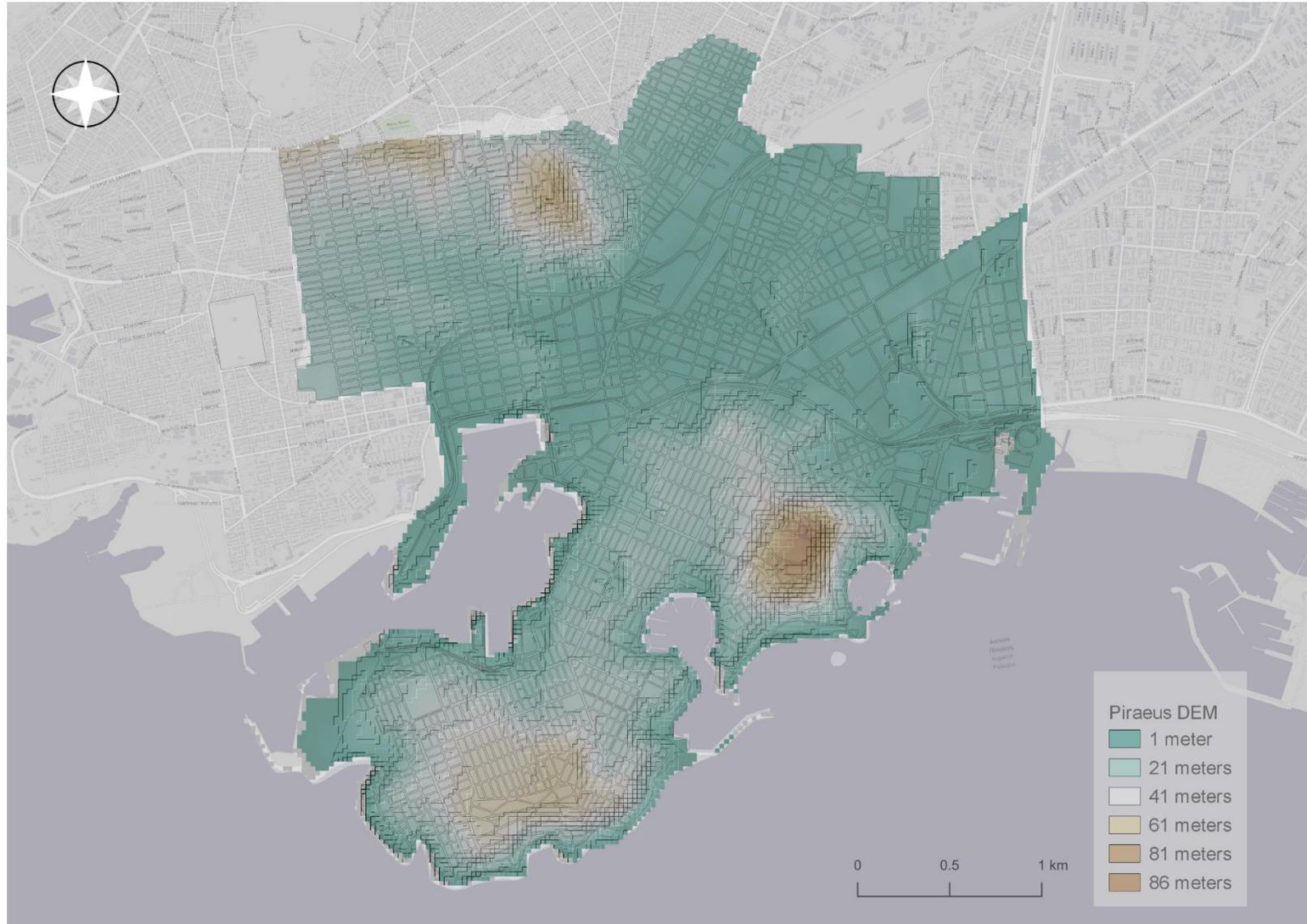
Digital Elevation Model
Source: Eurostat (Copernicus)
Sp. Resolution: 10m
Vertical accuracy of 2.9m

Piraeus DEM
- 1 meter
- 21 meters
- 41 meters
- 61 meters
- 81 meters
- 86 meters

0   0.5   1 km

HARMONIA Resilience DSS components

Risk and Impact assessment:

mapping of urban risks with synergies from multiple WPs

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)

Clear and precise Risk Mitigation benefits which facilitate the Decision Makers and relevant stakeholders

*Create **Climate Resilient Cities***

Construct **environmental condition profile** for urban sites by producing recommendations

Urban planning

DSS

Urban health & well-being application

Provide hazard indicators → timely and accurate assessment of short and medium-long term risks to the health of citizens
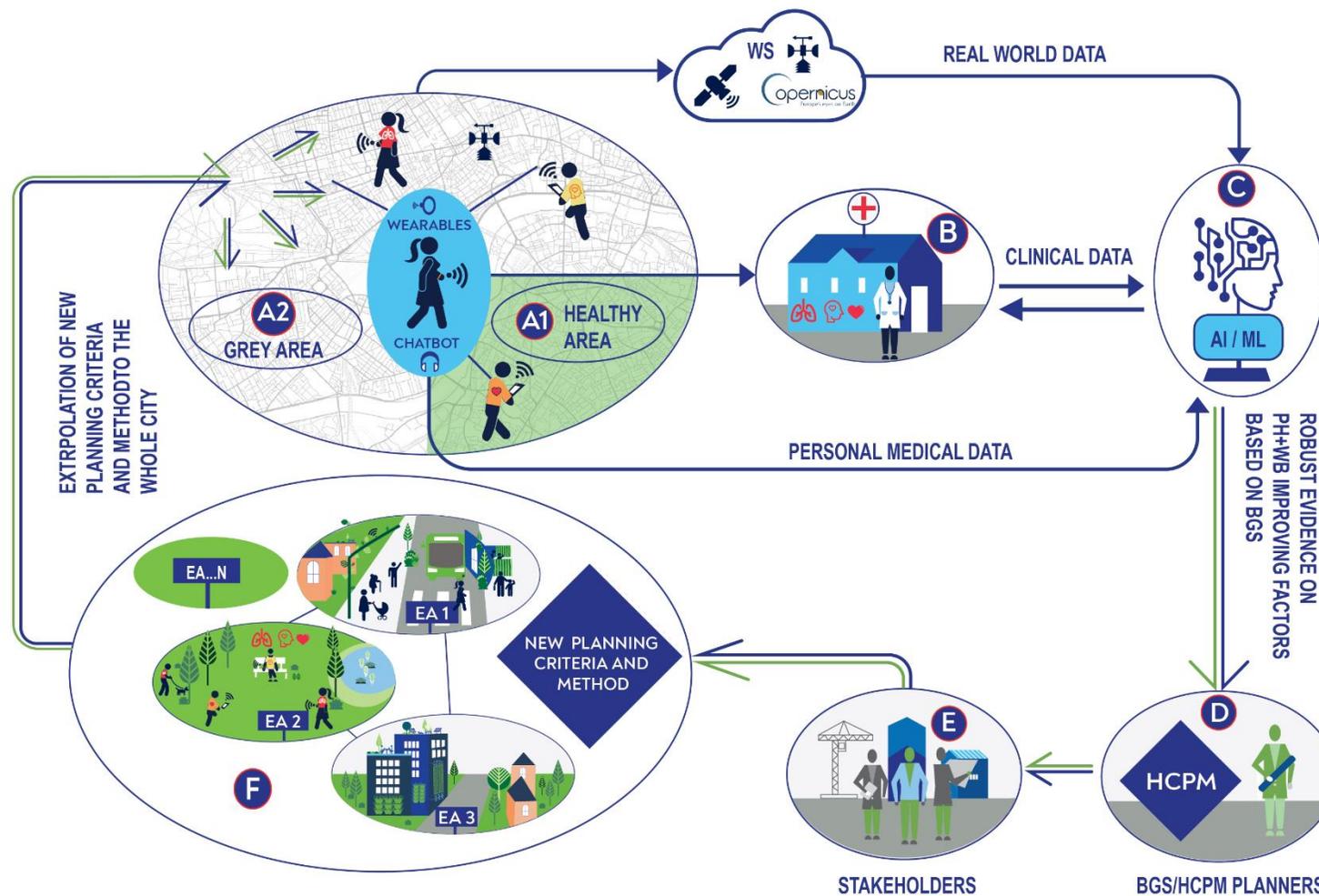
Multi-hazard mitigation & adaptation measures

Frequency, consequences (impact) and magnitude of hazards and their temporal changes → Holistic planning process

HORIZON 2020 | Grant agreement ID: 945105

Greek case study: Pedion Areos

HEART
Healthier Cities
through Blue-Green
Regenerative Technologies

Clinical studies:

patients using wearable devices able to record biosignals and emotions

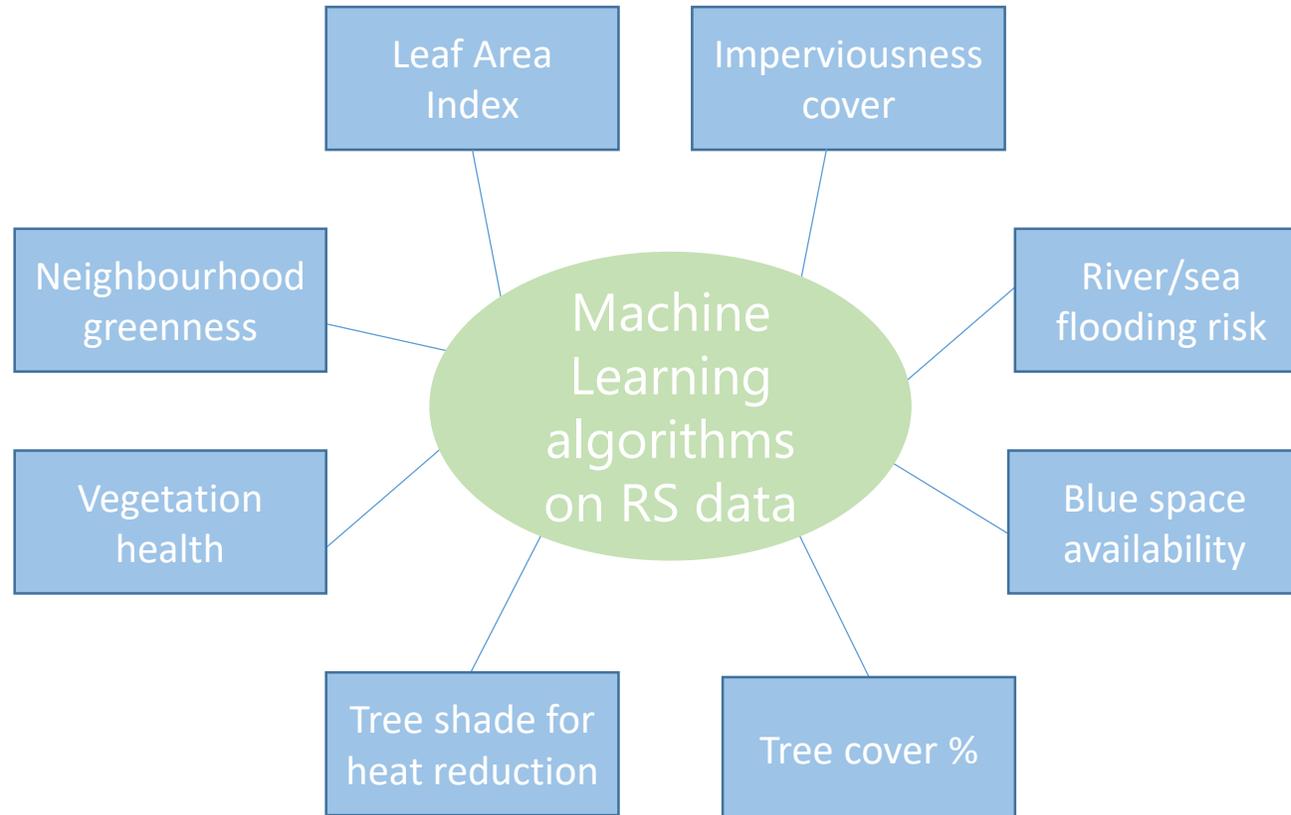**Environmental monitoring:**

in-situ weather & air pollution sensors, Remote Sensing data & methodologies

Geospatial Engine

NBS impact assessment on PH & WB:

Correlation of health and environmental data

HEART – Geospatial Engine

HEART – Geospatial Engine

Preliminary results of urban green detection

REGION OF ATTICA
LOCATION OF AIR POLLUTION
STATIONS COMPARED TO THE
GREEK DEMOSITE

MERCATOR PROJECTION
GGRS87 / Greek Grid - EPSG:2100

SCALE 1:15000

0 100 200 300 400 500 600
Meters

Legend

● Air pollution stations
☐ Pedion of Areos
■ No vegetation
■ Low Vegetation
■ Normal Vegetation
■ High Vegetation

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HEART – Geospatial Engine

Fusion of all levels of information

REGION OF ATTICA
LOCATION OF AIR POLLUTION STATIONS COMPARED TO THE GREEK DEMOSITE

MERCATOR PROJECTION
GGRS87 / Greek Grid - EPSG:2100

SCALE 1:15000

Legend

● Air pollution stations

― Trajectory

▭ Pedion of Areos

Coverage
- No vegetation
- Low Vegetation
- Normal Vegetation
- High Vegetation

O3 [μg/m3]
- 5 - 12
- 13 - 20
- 21 - 28
- 29 - 36
- 37 - 44
- 45 - 52
- 53 - 60

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Thank you