European Cities addressing climate change and building urban resilience through Project Harmonia

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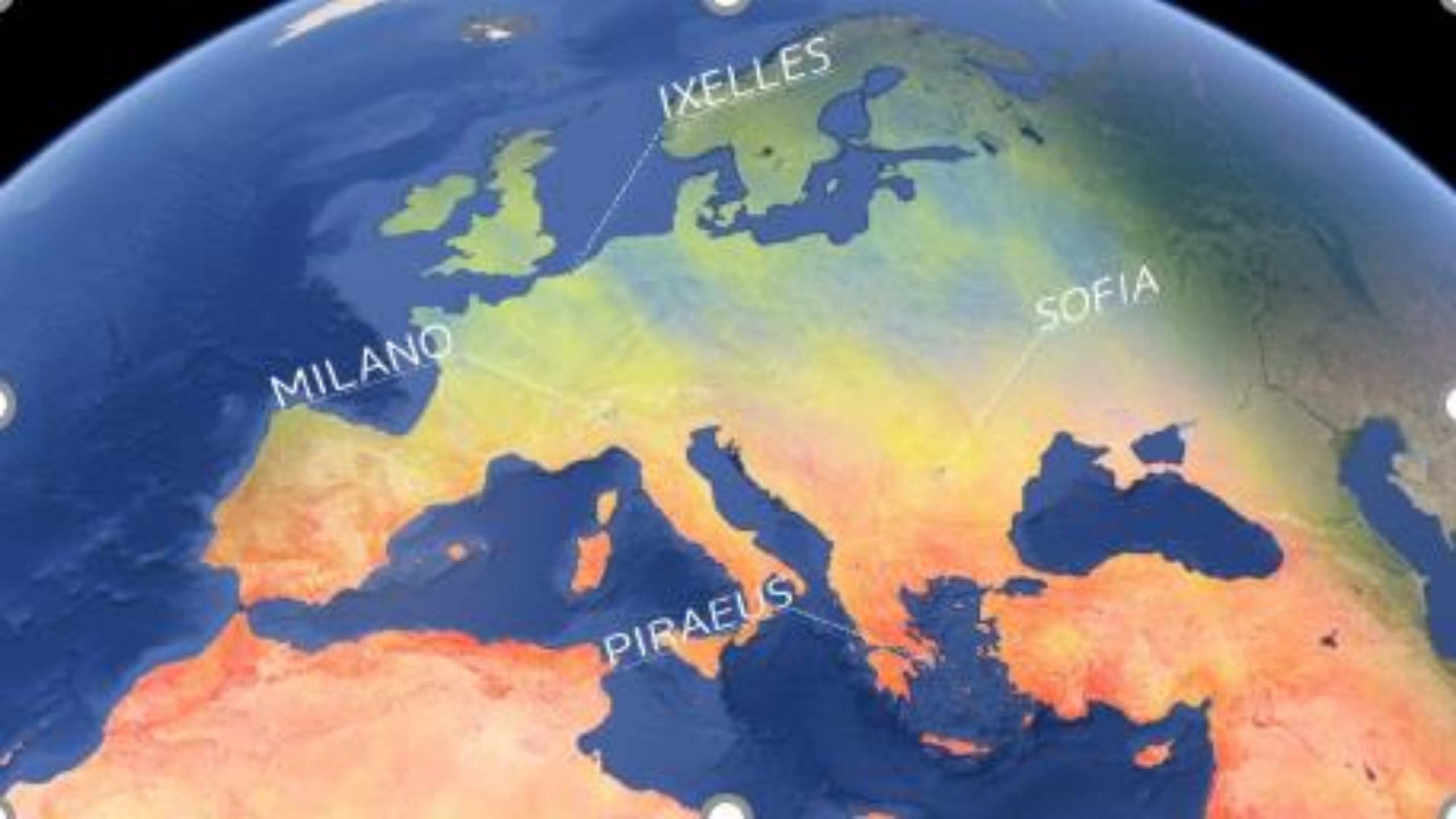
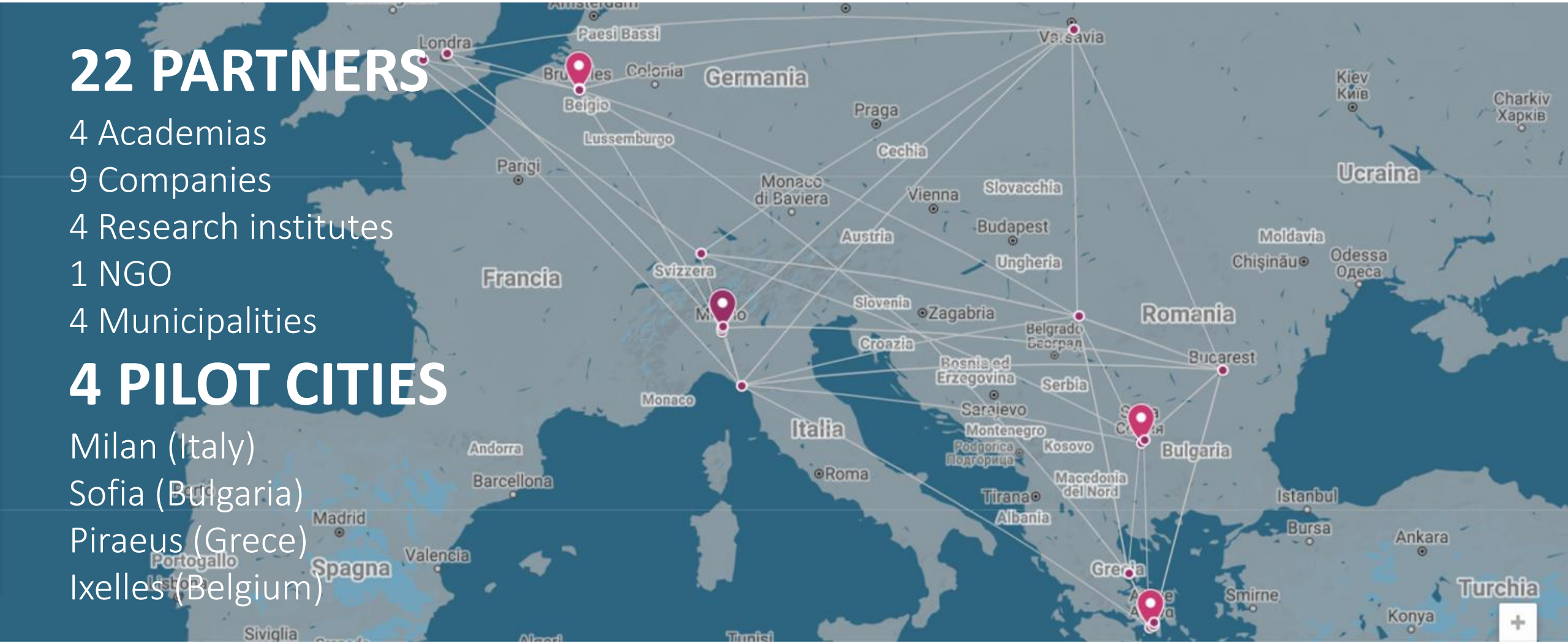
The HARMONIA project has received funding from the EU Horizon 2020 research and innovation programme under agreement No. 101003517.


IXELLES
SOFIA
MILANO
PIRAEUS

PARTNERS



22 PARTNERS

4 Academias
9 Companies
4 Research institutes
1 NGO
4 Municipalities

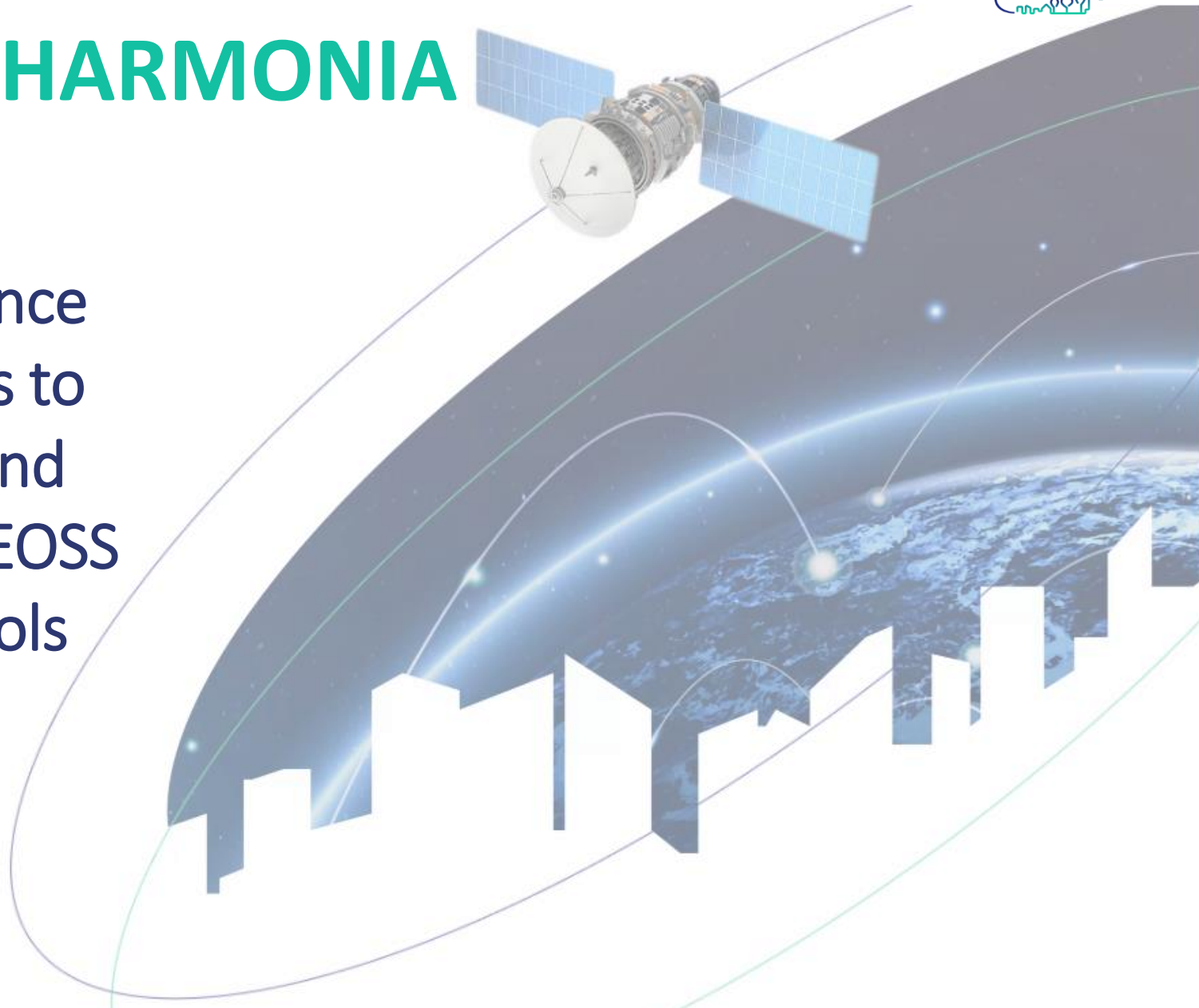
4 PILOT CITIES

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

HARMONIA

Development of a Support System for Improved Resilience and Sustainable Urban areas to cope with Climate Change and Extreme Events based on GEOSS and Advanced Modelling Tools

LC-CLA-19-2020: Integrated GEOSS climate applications to support adaptation and mitigation measures of the Paris Agreement



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 AGREEMENT

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

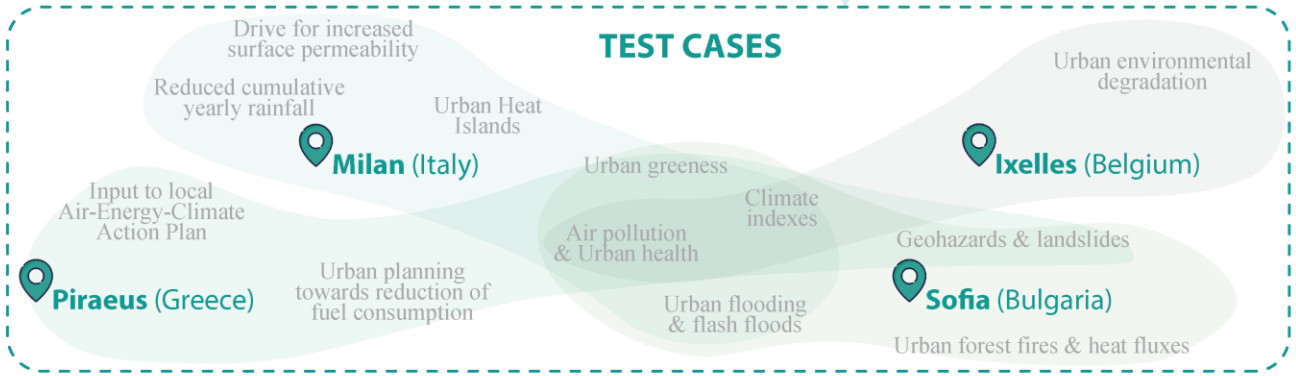
CC Mitigation

- 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



HARMONIA

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 SBEfin 2022 Conference - Emerging Concepts for Sustainable Built Environment

MILAN

Focus:

- Air pollution
- Urban heat island
- Urban flooding – flash flooding
- Ground deformation / motion
- Urban greenness

SOFIA

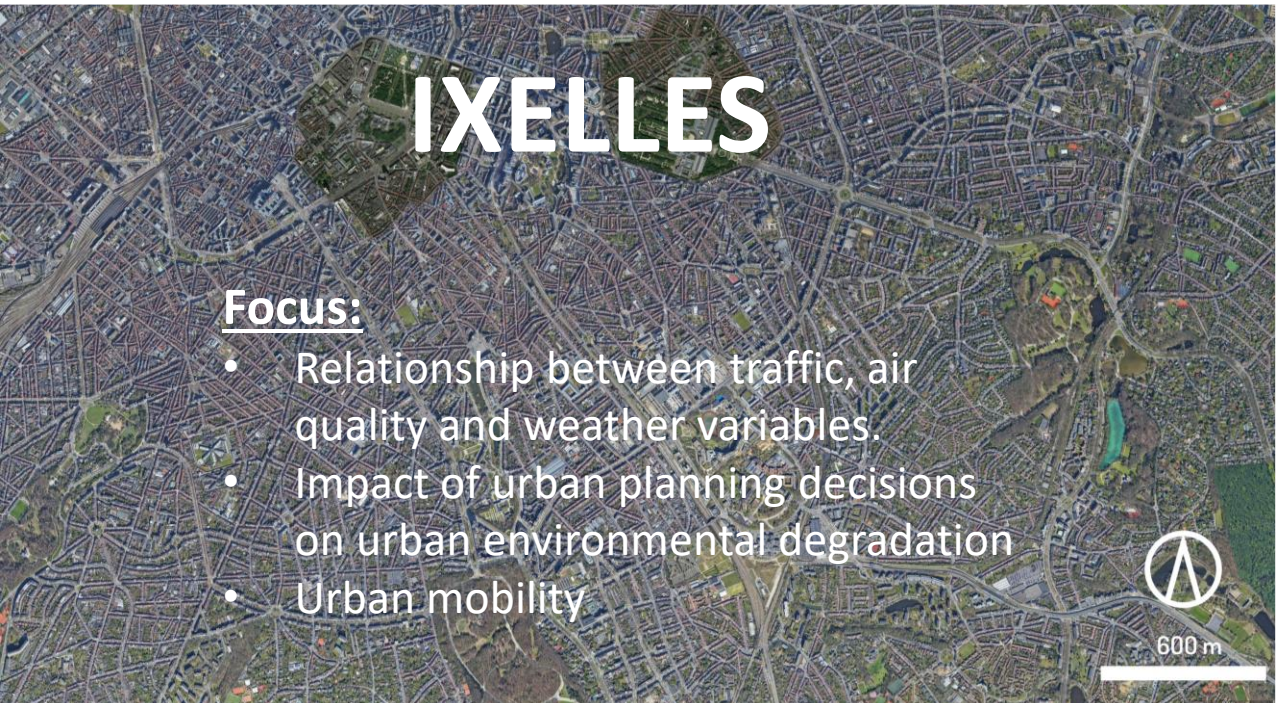
Focus:.

- Integration, interrelationships, interactions and mutual influences of ECOZONES.
- Urban flooding – flash flooding
- Landslide and geohazards

IXELLES

Focus:

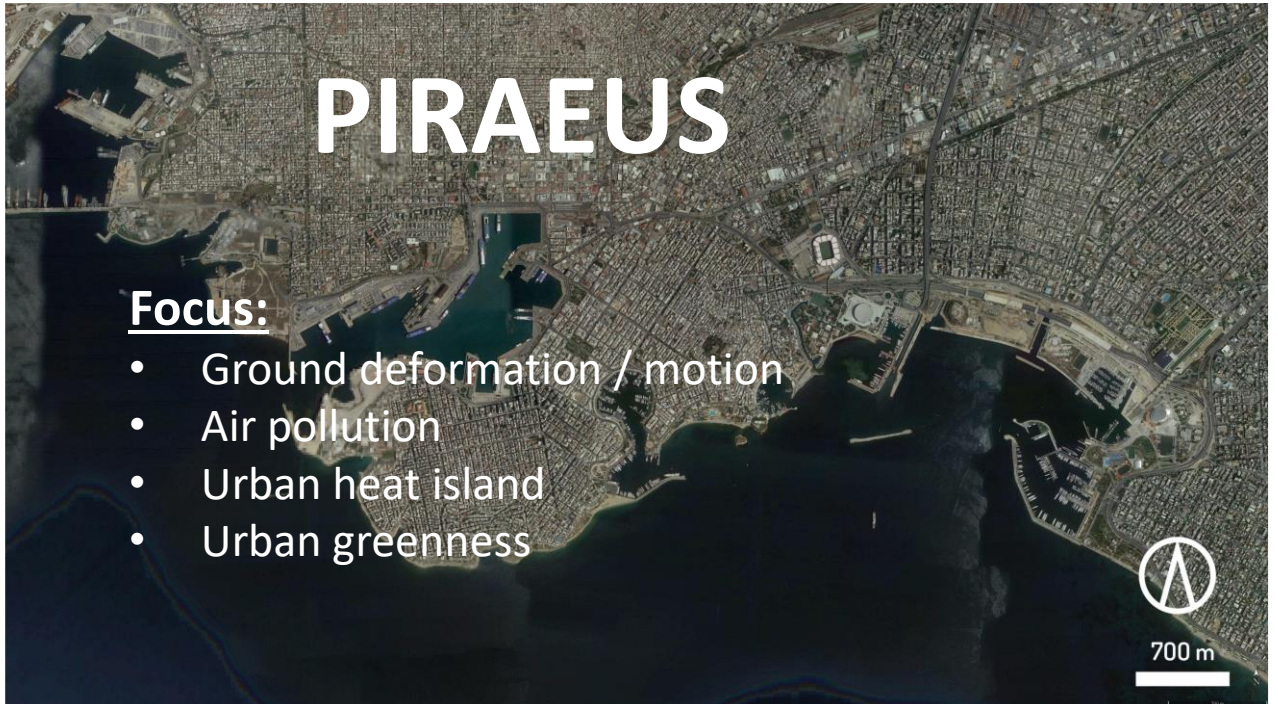
- Relationship between traffic, air quality and weather variables.
- Impact of urban planning decisions on urban environmental degradation
- Urban mobility



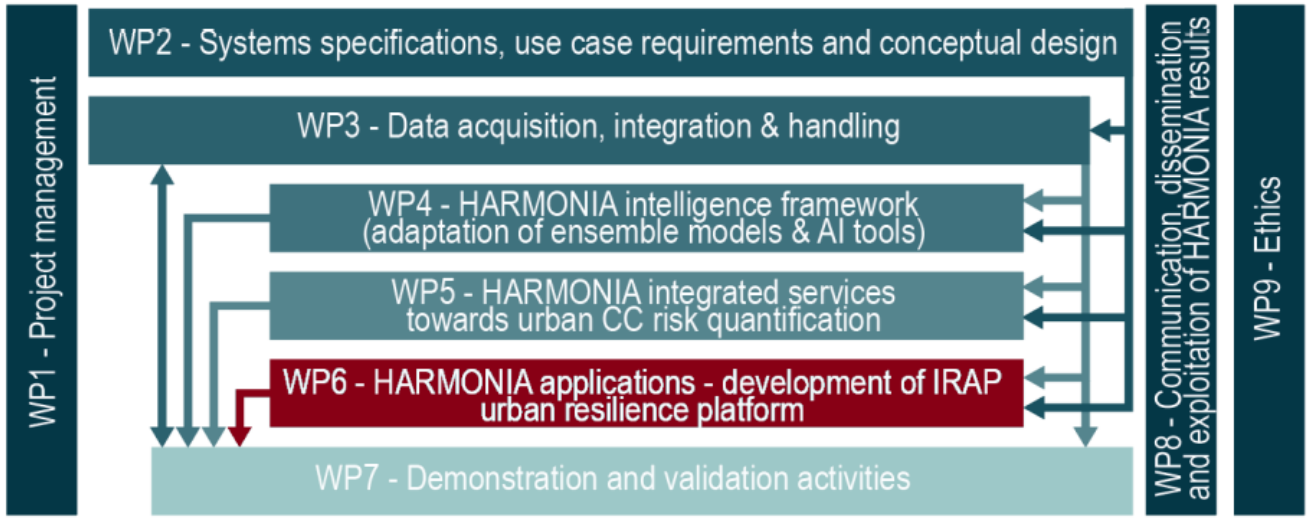
PIRAEUS

Focus:

- Ground deformation / motion
- Air pollution
- Urban heat island
- Urban greenness



Decision Support System



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	

END-USERS

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)

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 heath 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

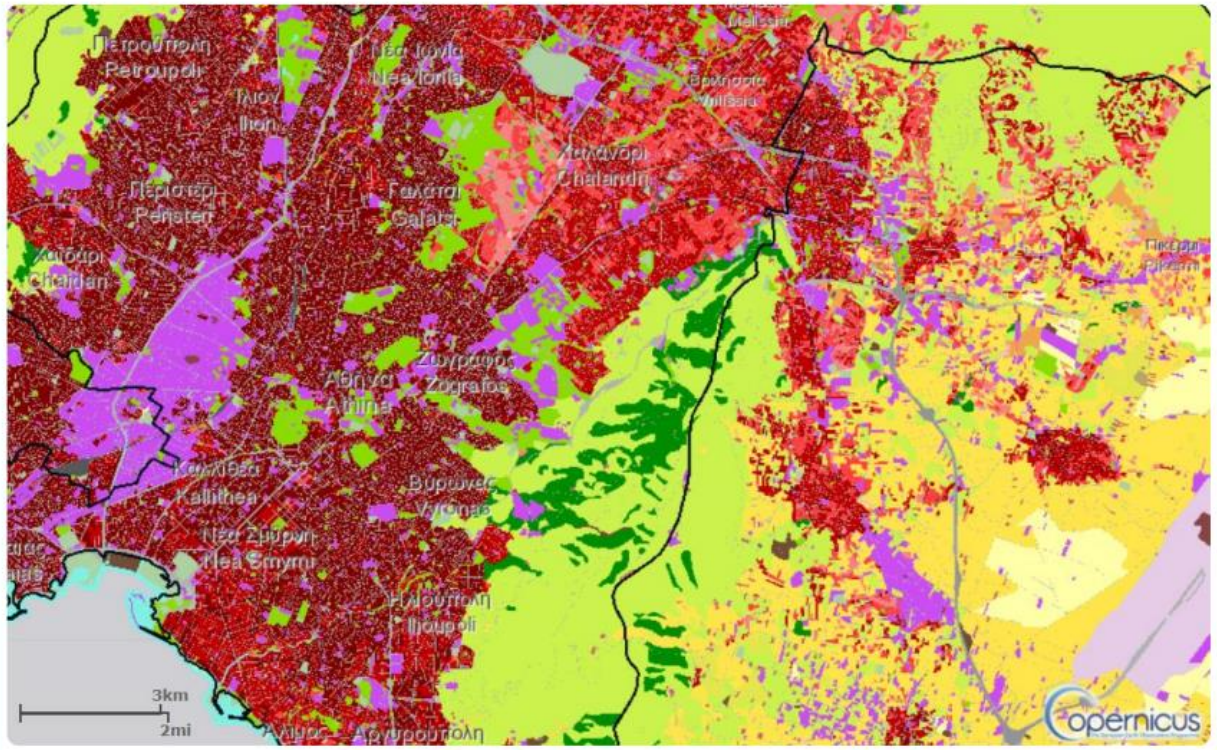
SERVICE PROVIDED: use of the platform for research and training purposes

SMART, CLIMATE RESILIENT CITIES

Urban surface **Land cover**

Land Use/Cover

Deforestation quantification



UA 2018 Function Urban Areas

SMART, CLIMATE RESILIENT CITIES

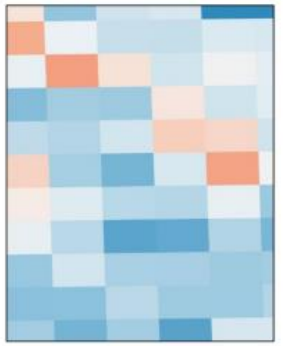
Urban surface **Indices**

Surface temperature

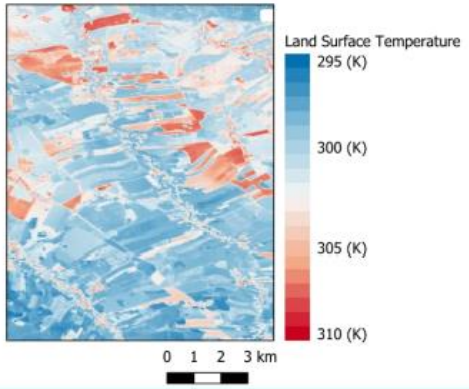
Landsat, ASTER (NASA), Sentinel-3 (ESA)

Sentinel-2
True Colour Composite

Sentinel-3
Land Surface Temperature



Fused Data
Land Surface Temperature

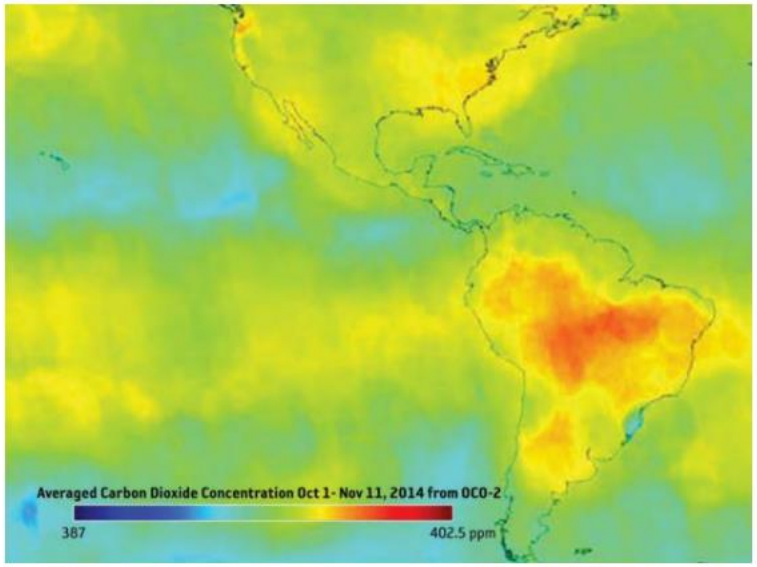


- Local surface temperature dynamics
- Urban heat emissions monitoring
- Urban thermal comfort & UHI assessment

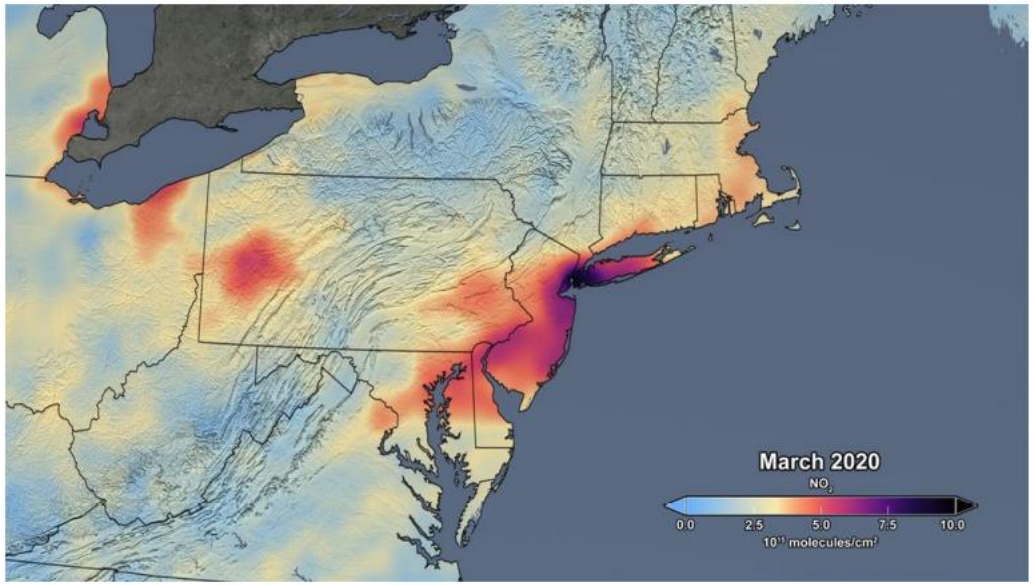
Environmental Monitoring

Atmospheric Chemistry Monitoring

CO2, Methane, PMs, Ozone, Aerosol



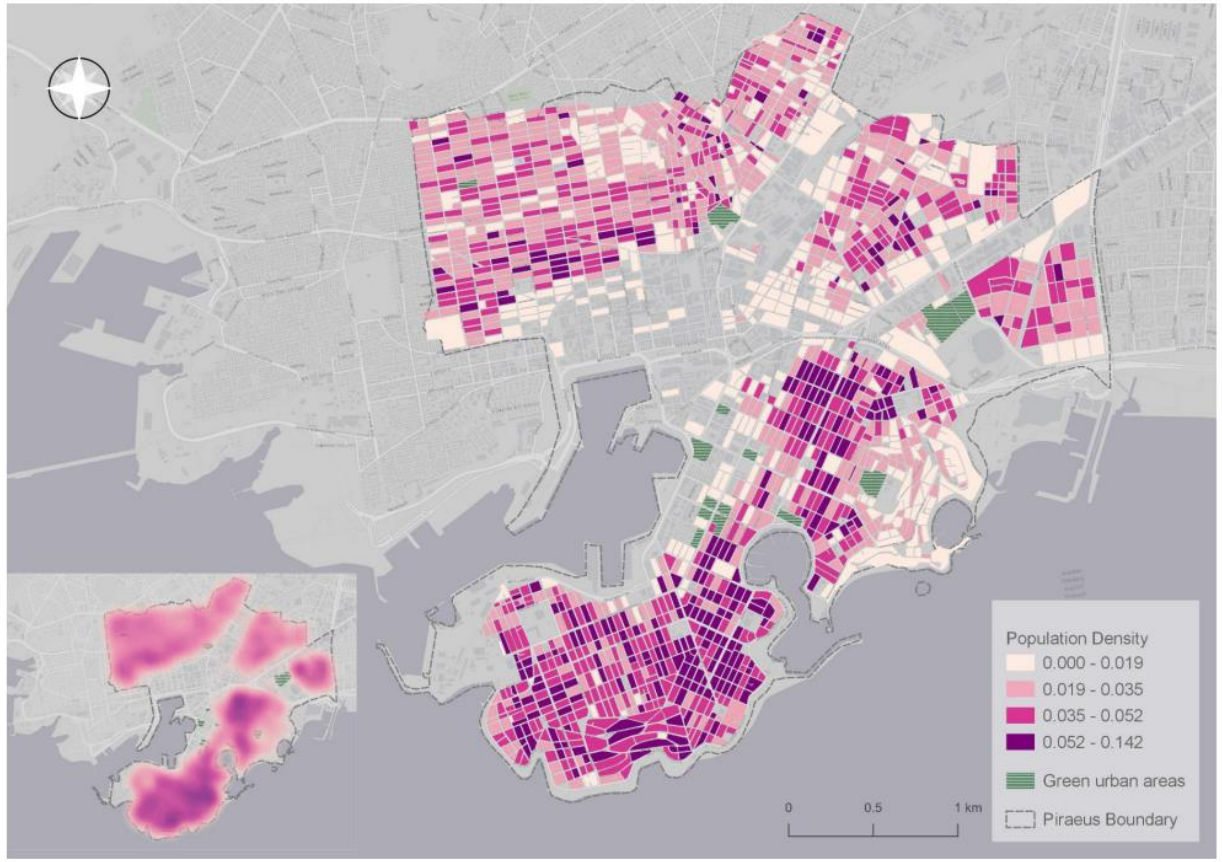
OCO-2, NASA



OMI, NASA

Enhanced urban air quality and weather monitoring facilitate in the improvement of citizens' **quality of life**

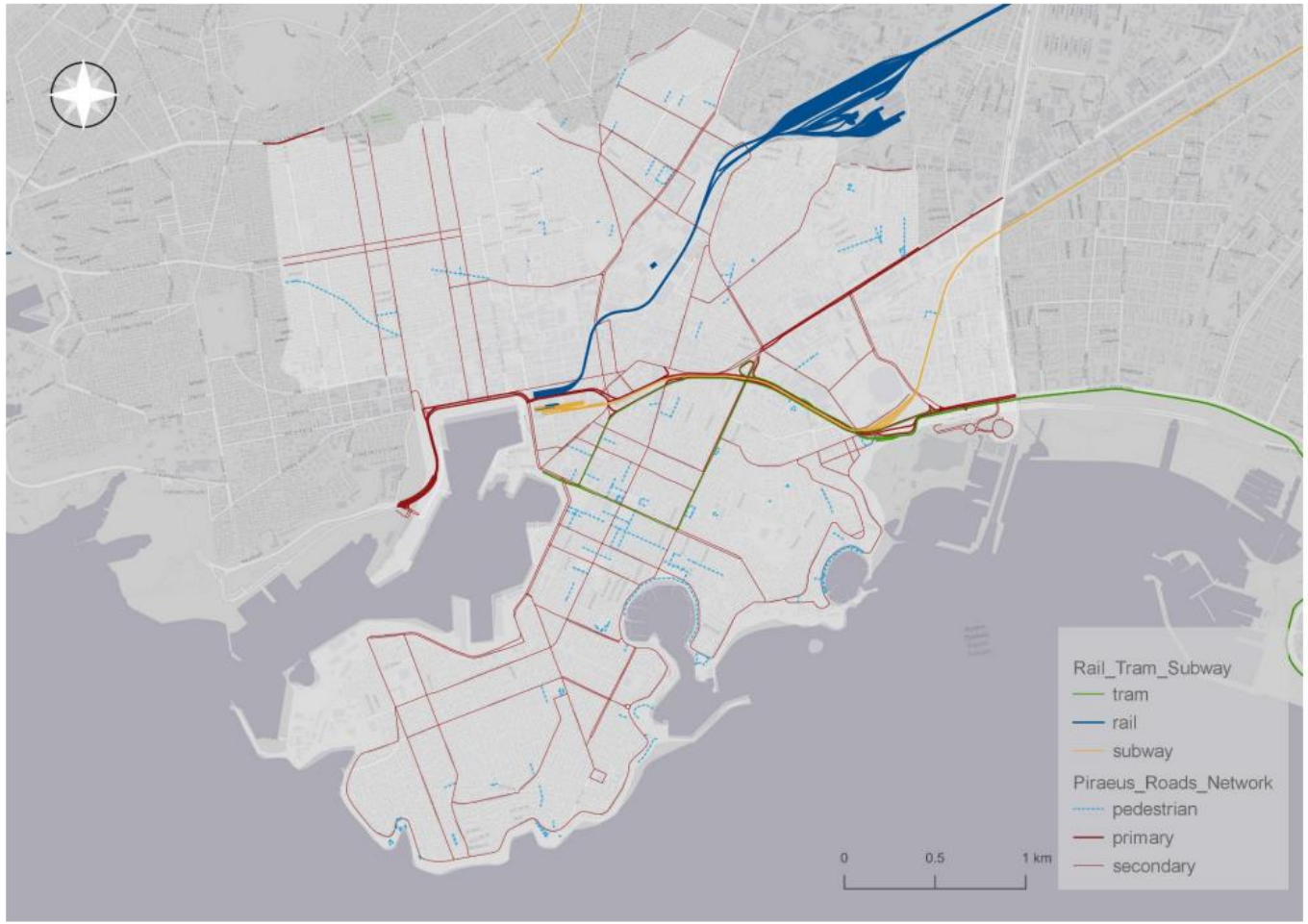
Urban Exposure index-Piraeus example



Population Density (pop / m^2)
- Source:
Hellenic Statistical Authority
(2011 Population-Housing Census)
- Resolution: Building Block

Green urban areas
Urban Atlas 2018

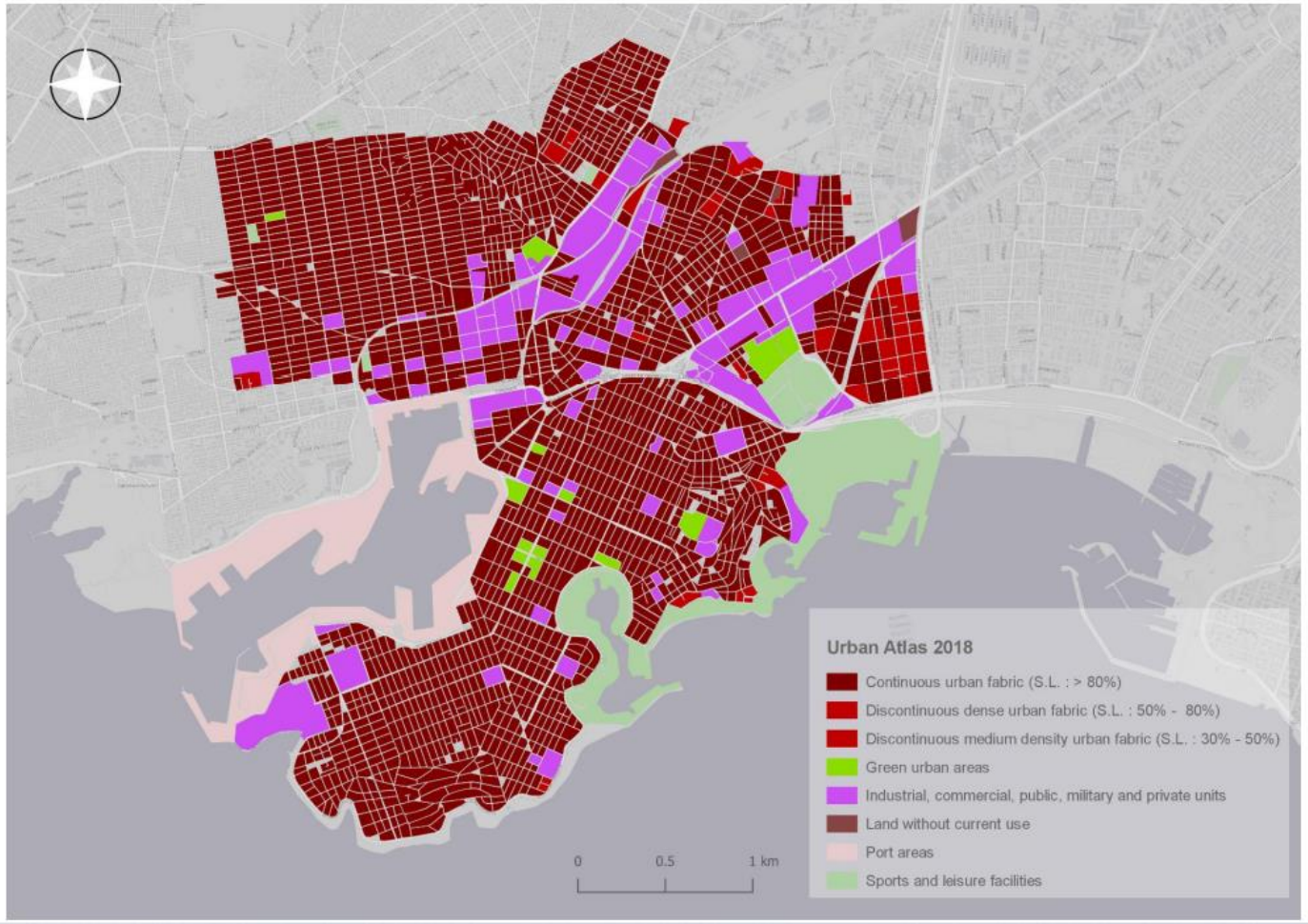
Urban Exposure index-Piraeus example



Transportation & Road Network

Source: OpenStreetMap
Geofabrik (09/22)

Urban Exposure index-Piraeus example



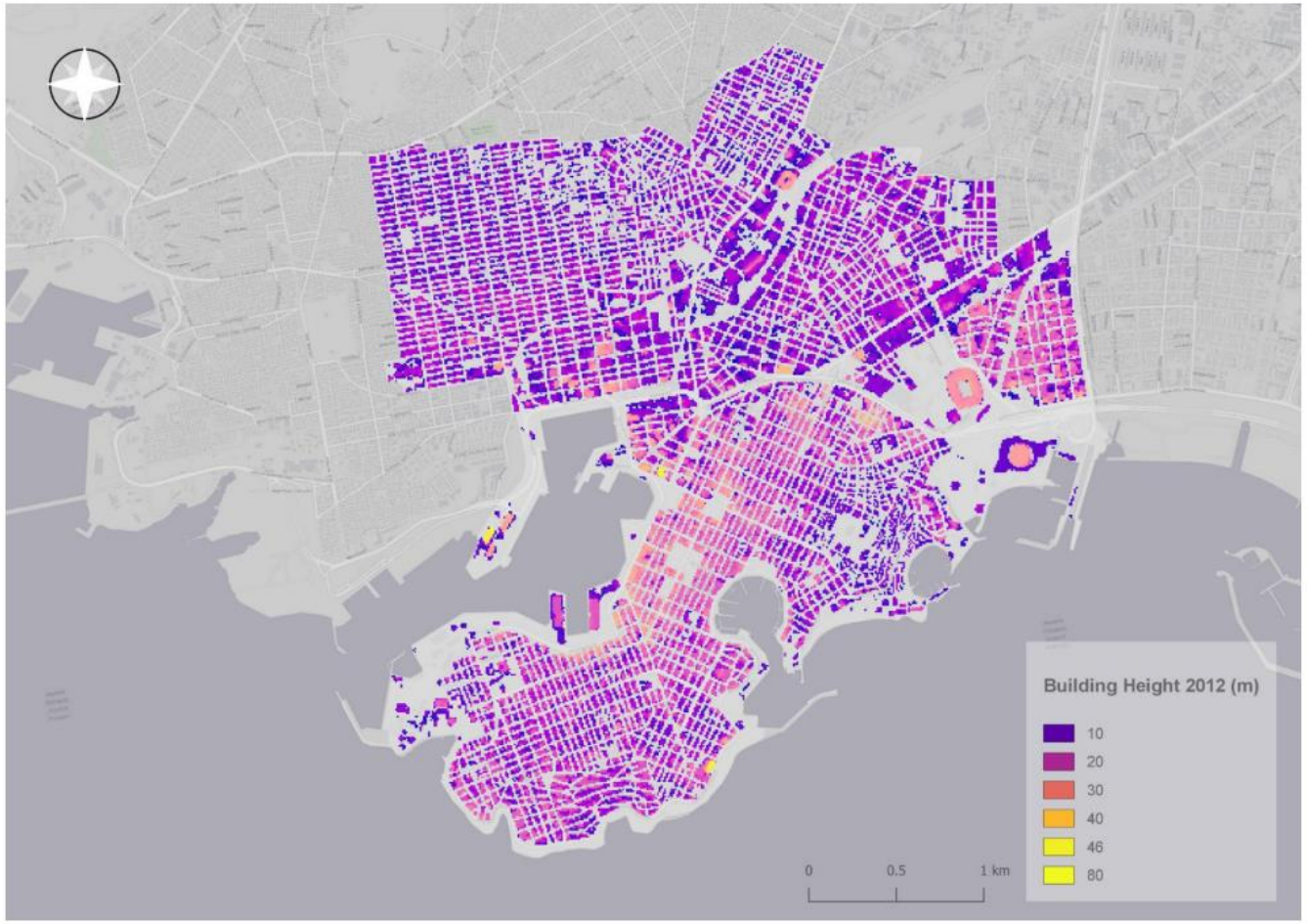
Land Use / Land Cover

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

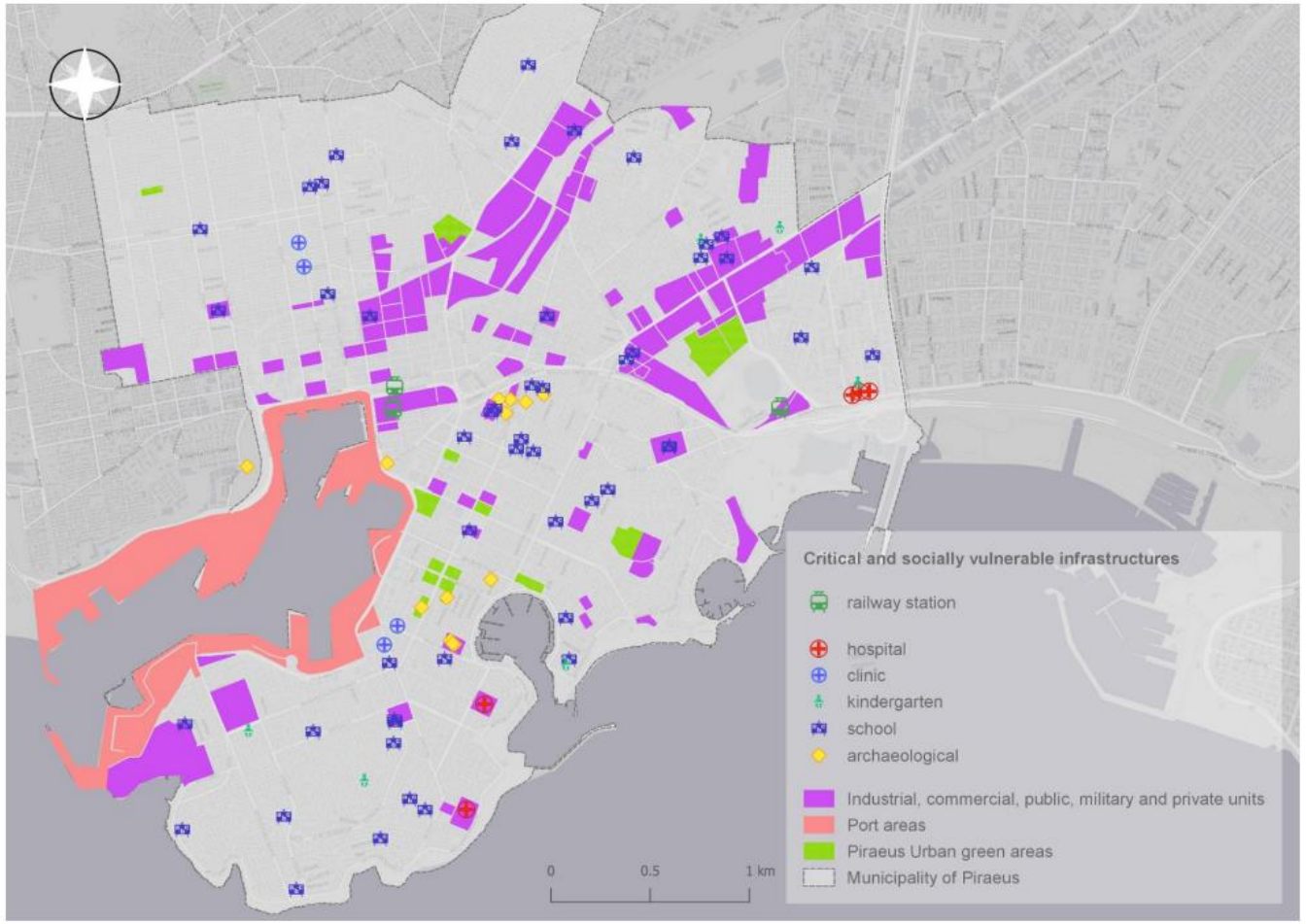
Urban Exposure index-Piraeus example



Building Height 2012 (meters)

Source: Urban Atlas

Urban Exposure index-Piraeus example



Critical & vulnerable infrastructures

Source:

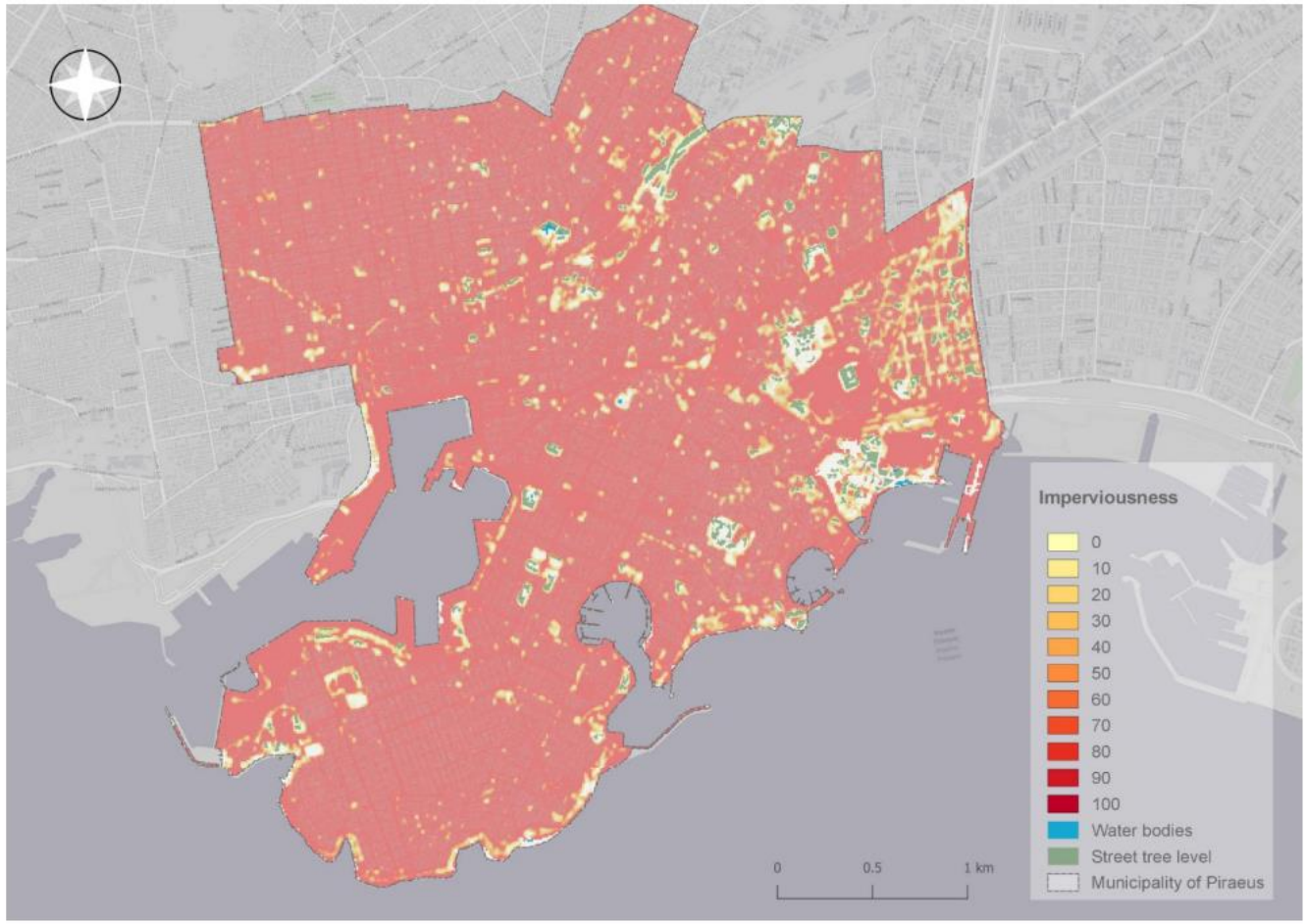
Points

OpenStreetMap - Geofabrik (09/22)

Land Use

Urban Atlas 2018

Urban Exposure index-Piraeus example

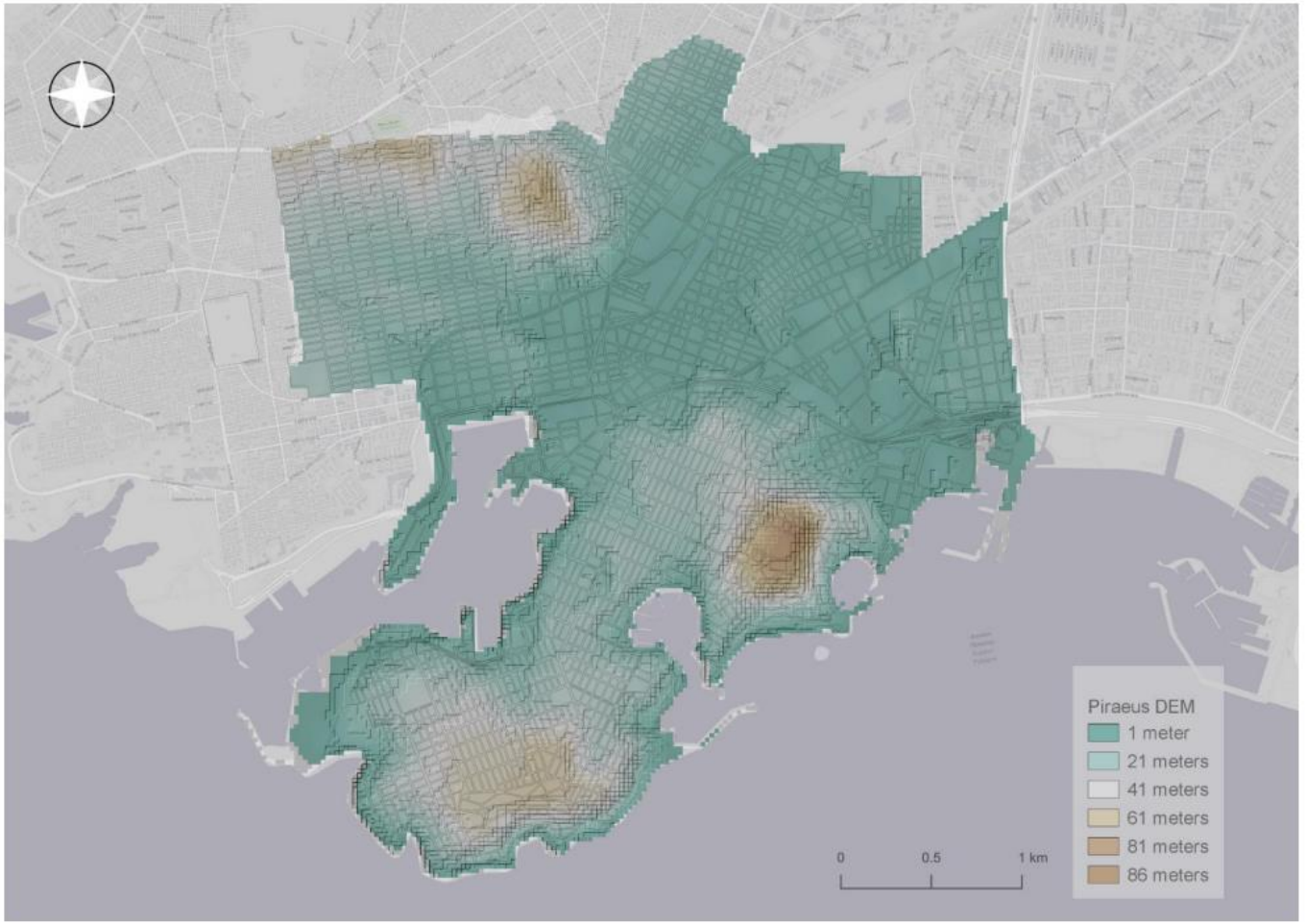


Imperviousness Density (IMD) 2018
Source: Copernicus
Sp. Resolution: 10m
The Imperviousness degree is a thematic product showing the sealing density in the range from 0-100% for the period 2018 (including data from 2017-2019) for the EEA-39 area.

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

Urban Exposure index-Piraeus example



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

HARMONIA Resilience DSS components

Risk and Impact assessment:

mapping of urban risks with synergies from multiple WPs

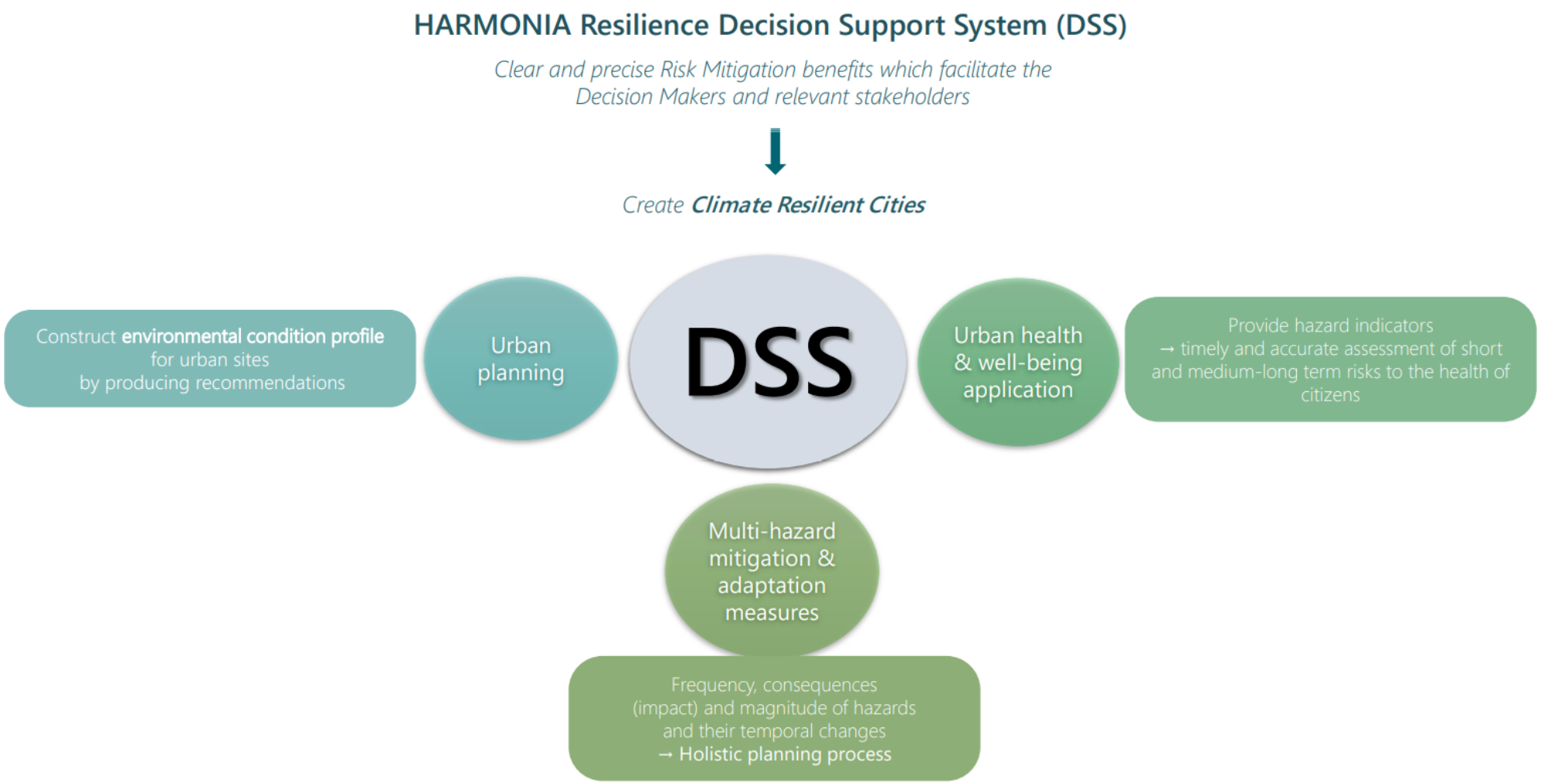
Vulnerability Assessment and Urban Resilience:

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

Decision Support System:

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

Urban Exposure index-Piraeus example



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

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HARMONIA

FINAL OUTCOMES

Harmonia aims to unite all relevant stakeholders around the issue of Climate Change

The **HARMONIA platform** will be user friendly and allow stakeholders to not only understand but also visualize the impact of CC across different environments.

This will **enhance cities' preparedness** to respond to specific predictions, such as floods or dust storms, and protect their residents and assets.

HARMONIA

@ProjectHarmonia

The Harmonia project

@HarmoniaProject2021

https://harmonia-project.eu

Harmonia.h2020

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