EIFFEL project: exploring urban GHG mitigation and health co-benefits in buildings, solar energy and mobility

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Learn more here:

HELLENIC REPUBLIC
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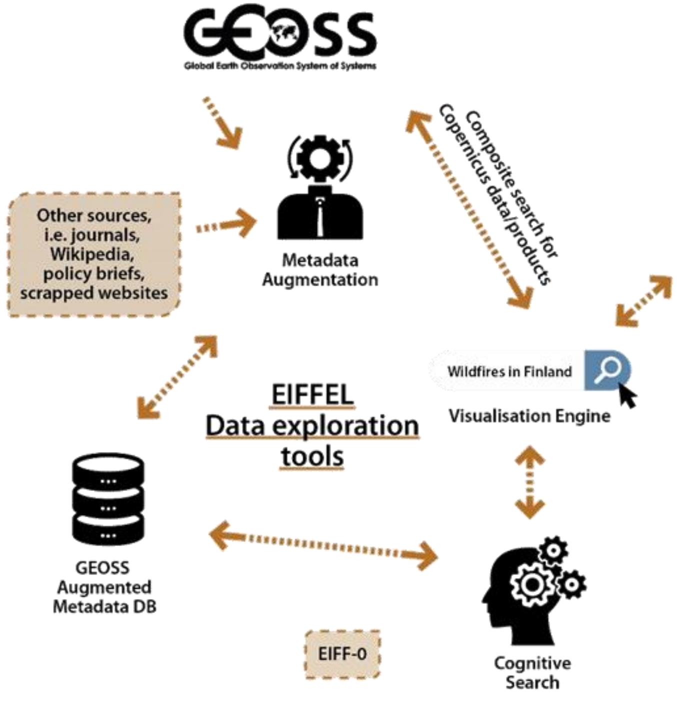
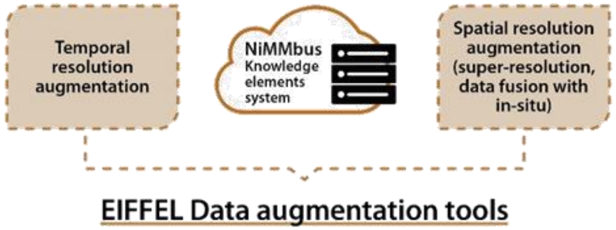
Eiffel

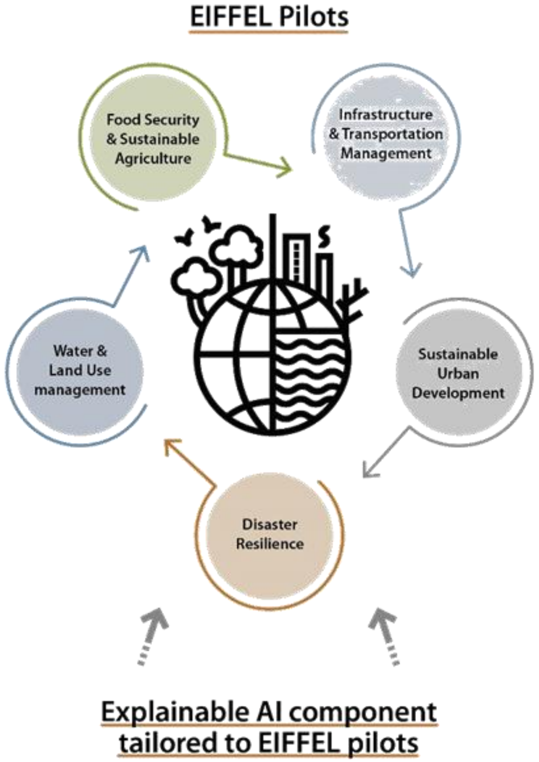
GEOSS APPLICATIONS FOR CLIMATE CHANGE





Co-design approach

Decision makers & stakeholders monitoring & implementing P.A. in local, regional, national, pan-European scales; Leading 5 EIFFEL pilots



EUROGEO WORKSHOP 2022

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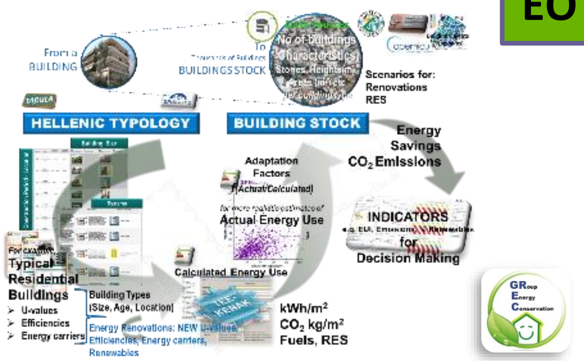
Athens, the Greek capital, hosts a population of ~4 million and ~40% GDP

Sustainable Urban Development Pilot: Development of a Decision Support Application (DSA) to enable inspection of **GHG mitigation scenarios**, in three urban-critical sectors: **Building energy efficiency, photovoltaic penetration in urban environments, vehicle fleet emissions + intra-urban Air Quality**

EUROGEO WORKSHOP 2022

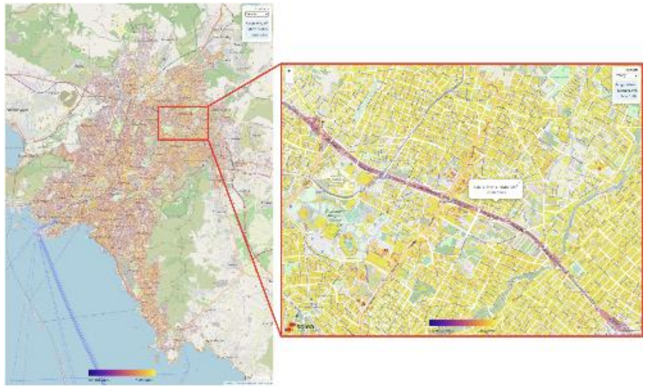
Building emissions account for 28% of global carbon emissions. EU buildings use ~42% of the total energy and they are responsible for ~30% of the total CO_2 emissions. ***National Plan for Energy and Climate* targets by 2030**: improve energy efficiency of buildings by 38%

EO, GEOSS and socio-economic data will enable a novel workflow for a creation of an ***enhanced* Building Stock Model (BSM). A semi-automatic service** to facilitate the process of preparing the necessary input data for a BSM by utilizing EO and socio-economic data



Solar energy is the most abundant renewable source especially in Greece. The revised renewable energy directive 2018/2001/EU establishes a new target for 2030 of 32%, with a clause for a possible upwards revision by 2023. ***National Plan for Energy and Climate* targets by 2030**: increase in renewables penetration to >35% by 2030 (now 18%)

Apart from advancing the **estimation of solar irradiance**, new socio-economic data, building data and, new ray-tracing techniques will be utilized to ultimately deliver **a more realistic estimation of photovoltaic potential at building level**. This will enable the estimation of GHG abatement equivalent.



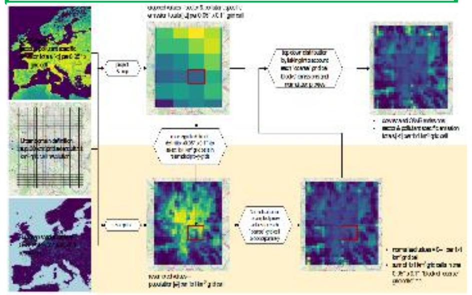
Urban transport causes 23% of CO2 emissions from transport. The Whitepaper on Transport calls for halving ‘conventionally fueled’ cars by 2030. ***National Plan for Energy and Climate* targets by 2030**: transition of fleets to electric cars 30% share

COPERT is the EU standard vehicle emissions calculator. Realistic scenarios will be studied to support policy decisions for achieving the desirable fleet transition and the consequent GHG emission reduction.

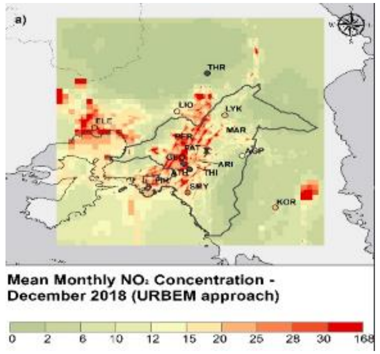
copert

EO in support of policy mandates

The sectorial scenarios of the CC applications will alter urban emissions.



URBEM methodology for creating high resolution emission inventories.



City scale AQ model (EPISODE-Citychem) to study the effects of the scenarios on the intra-urban concentration fields of basic air pollutants and population exposure.

ATHENS 7-9 DECEMBER 2022

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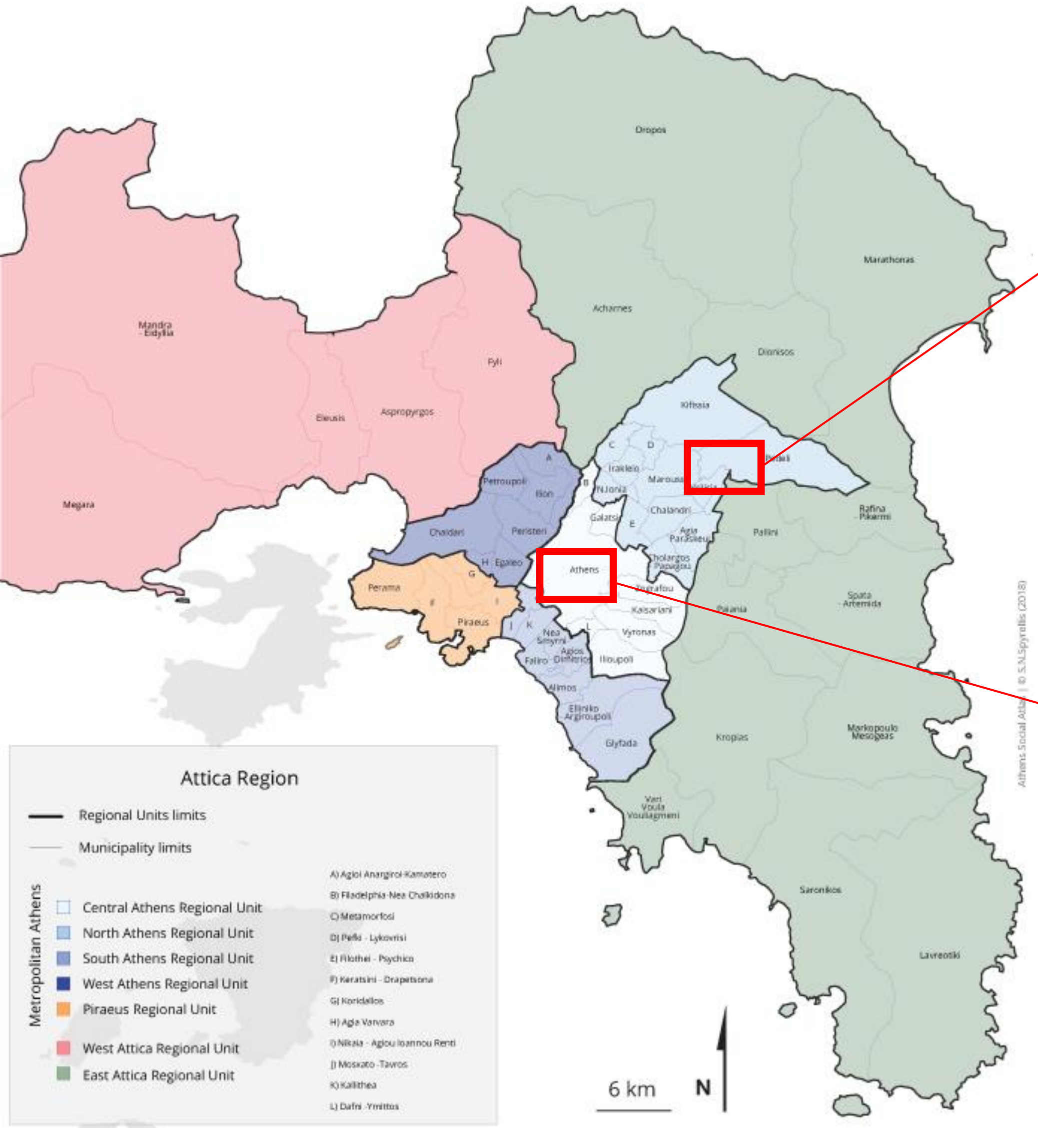
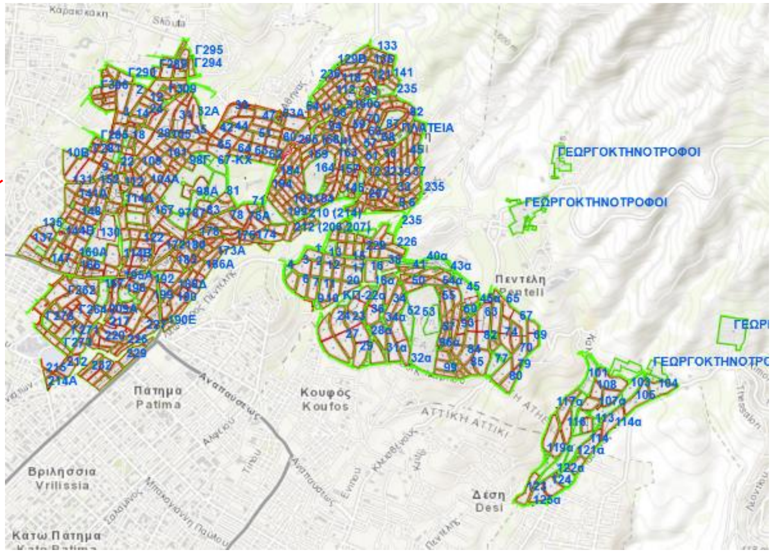




Local to Regional

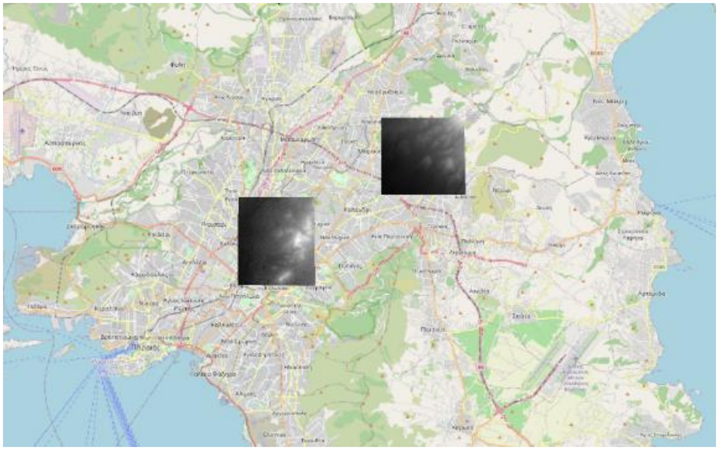
Municipality of Penteli/Athens vs Region of Attica.

Full EO (including commercial) and socio-economic data vs GEOSS and EU-wide datasets.

How does it compare?
Is it worth it?

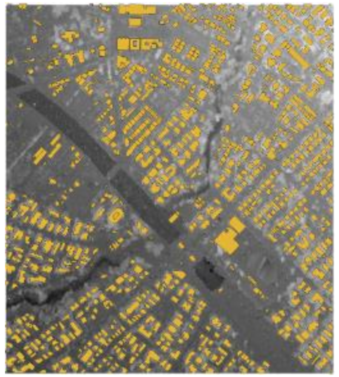
Photovoltaic penetration (PMOD World Radiation Center, Switzerland)

Rooftop based solar model simulation using actual orientation and radiative transfer modeling

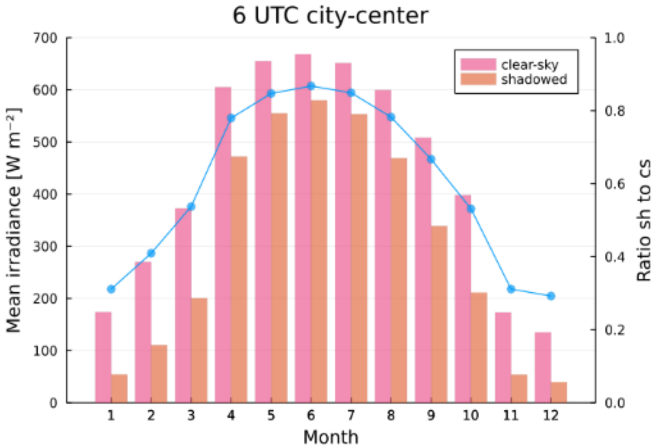


City Center ~3K roofs

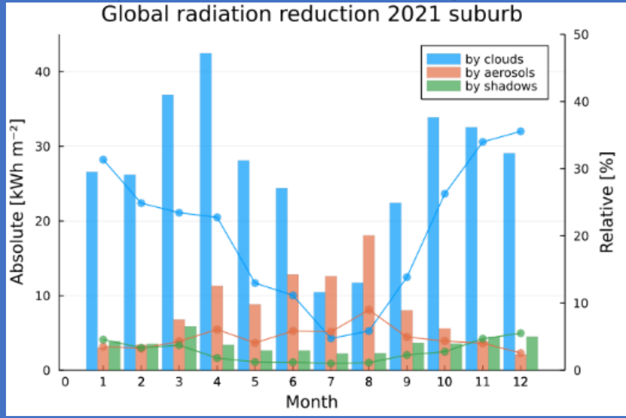
Suburb ~1K roofs



Shadowing portion to clear sky



Atmospheric vs shadowing effects

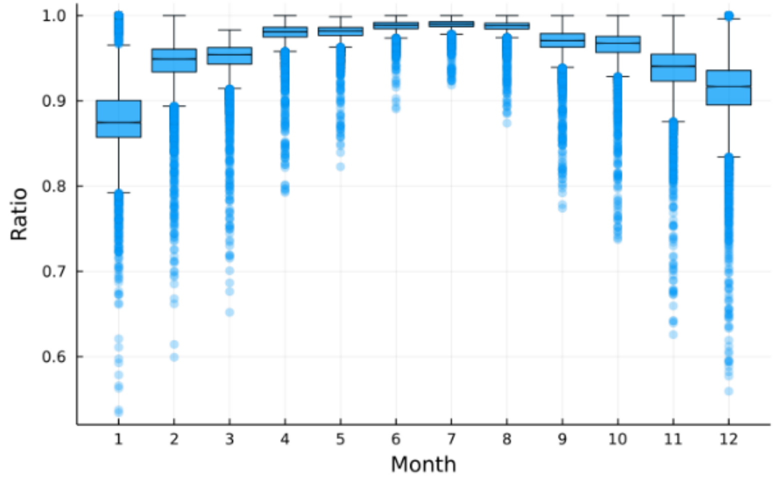


Increasingly realistic estimations

Rooftop shadowing effect calculation in urban areas requires knowledge of:

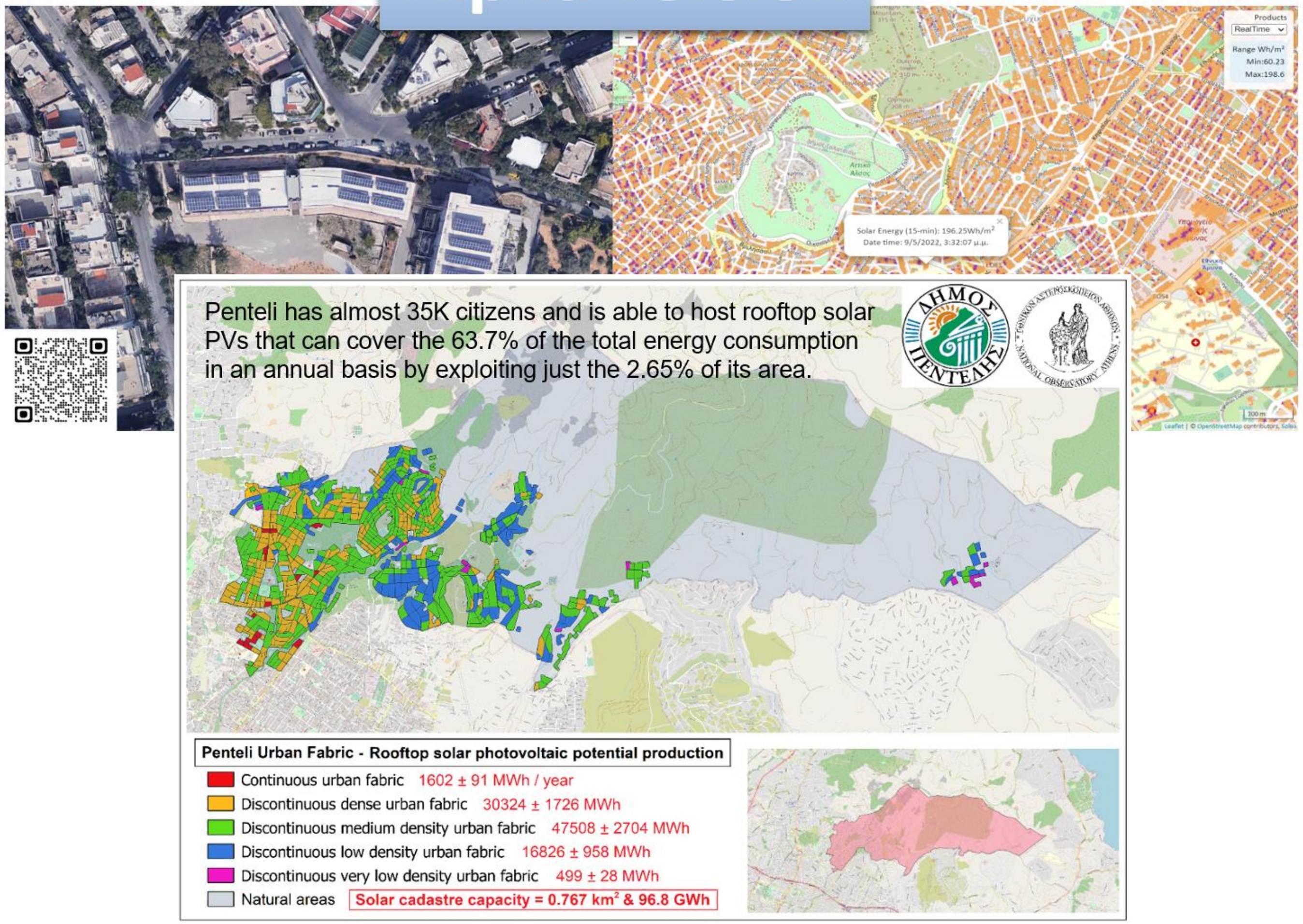
- Actual roof orientation
- Aerosol and cloud properties
- Understanding of fast coding vs accurate coding uncertainties and impact on solar estimation

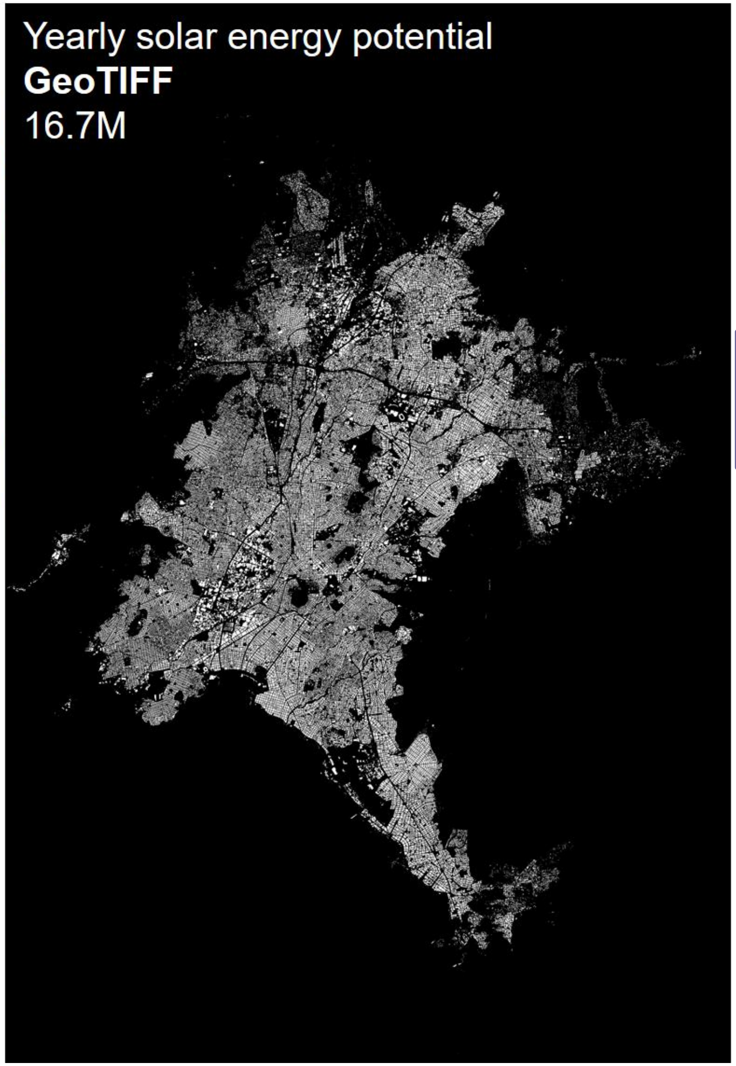
Shadowing effect 2012-2021



Photovoltaic penetration (NOA & PMOD)

Alpha version





Athens Solar Cadastre

Building Energy Efficiency (NOA - GREC)

- **Census data only** (Building Census 2011 and Population - Household Census 2011 from ELSTAT), i.e. highly detailed socio-economic datasets but not accessible to the public. **"Reference" implementation**.
- EO datasets free and open to all (e.g. Copernicus products) as well as EO datasets that are not publicly available (e.g. orthophotomaps and DSM from Hellenic Cadastre). **"Hybrid EO" implementation**.
- Coarser implementation, **only open and publicly available datasets** (e.g. Urban Atlas Building Heights, GHSL time series for construction period, Urban Atlas for land use). **"GEOSS" implementation**.

The requirements for the BSM and EUI: use (commercial/residential), floors, period of construction, surface, type of heating, water heating

Tier 1

- **"Reference" implementation**
- Census Datasets (ELSTAT)

Tier 2

- **"Hybrid EO" implementation**
- EO Datasets

Tier 3

- **"GEOSS" implementation**
- Publicly available EO Datasets

Detailed calculations (Tier 1) will take place in the Municipality of Penteli.
Regional Scale will take place in the whole of Attica region and will encompass both Tier 2 and Tier 3 implementations

Local to Regional

Building Energy Efficiency – Inputs/Outputs

ELSTAT DATA
Building Census 2011 & Population – Household Census 2011

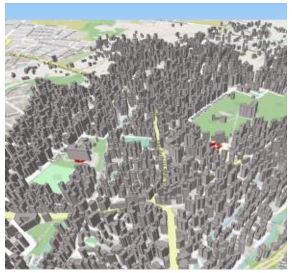
→

ENERGY USE & EMISSION INTENSITIES
Normative calculations for typical buildings

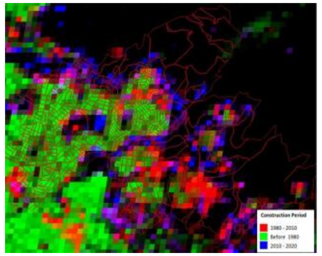
Tier 1

Building Footprints
OpenStreetMap

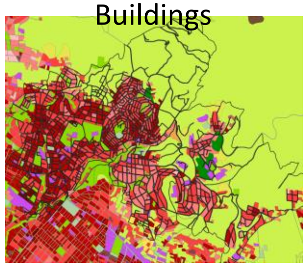
Building Heights (Floors)
VHR DSM & DEM



Construction period
GHSL-S Timeseries



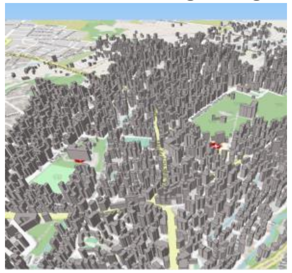
Land use/Cover
Urban Atlas 2012 & Important Buildings



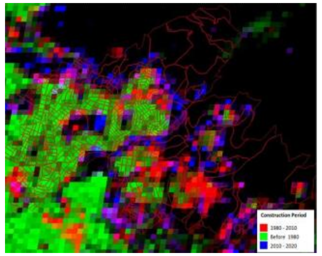
Tier 2

Building Footprints
OpenStreetMap

Building Heights (Floors)
Urban Atlas Building Heights 2012



Construction period
GHSL-S Timeseries



Land use/Cover
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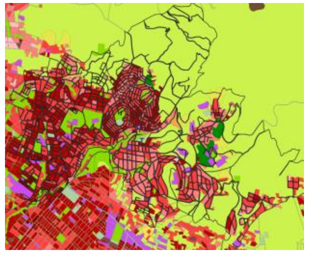


Tier 3

Outputs per Building Block

- Final energy consumption
- Carbon emissions
- Energy performance

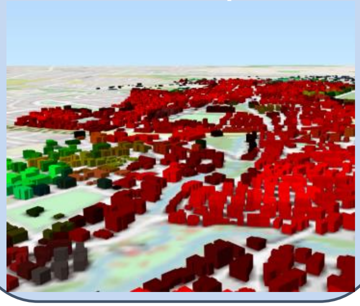
(Existing conditions)

- Envelope improvement
- Fuel change
- Combined scenarios

(GHG mitigation scenarios)

Spatial Data Analysis

Model Inputs



emobility – COPERT (DRAXIS S.A.)

Tier 2 is followed

- Calculations take into account the amount of fleet and the vehicle kilometers.
- **Mandatory input data**:
  - Stock Configuration *(number & types of vehicles)*
  - Stock & Activity Data
- **Additional data:**
  - Environmental data (min / max monthly temperatures)
- **Results**:
  - Total emissions
  - Implied emission factors
  - NMVOC emissions

EU standard vehicle emissions calculator. **Realistic scenarios will be studied in concert with Region** for achieving the desirable fleet transition and the consequent GHG emission reduction.

Initial data acquisition: Country level: Environmental conditions (temperature) → EMISSIA (2019, 2020), Vehicles' stock & mean activity → EMISSIA (2019, 2020)

Regional level: Environmental conditions (temperature & relative humidity) → HNMS (2019), Vehicles' stock → NOA (2019)Mean activity (country level) → EMISSIA (2019)

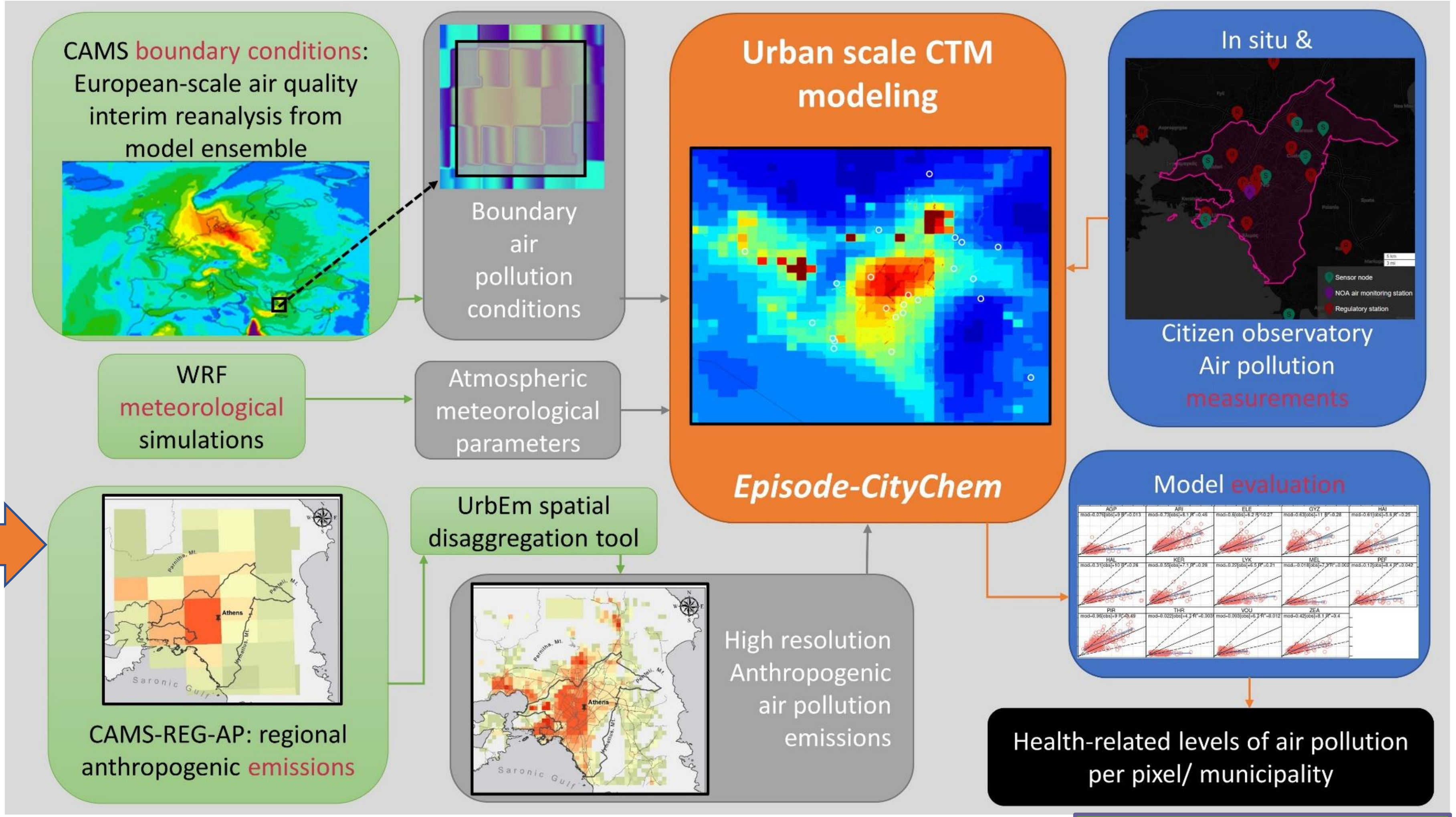
1st run of COPERT → results for Greece (country level) (2019), Results for Greece (country level) (2019, 2020), Results for the Region of Attica (regional level) (2019)

Methodological issues: a) Fleet composition derived from ELSTAT, ACEA and TREMOVE data for Attica for each vehicle category (NOA). Cross-validation with EMISIA data can improve the dataset. b) Mean activity data for Greece not necessarily applicable for Attica.

Pending:

- Further data collection [NOA, DRAXIS]
- More COPERT runs (integration of new data, results for more years, different geographical applications etc.) and creation of baseline

Intra-urban Air Quality (NOA)



GHG emission reduction scenarios per sector/application

Copernicus powered

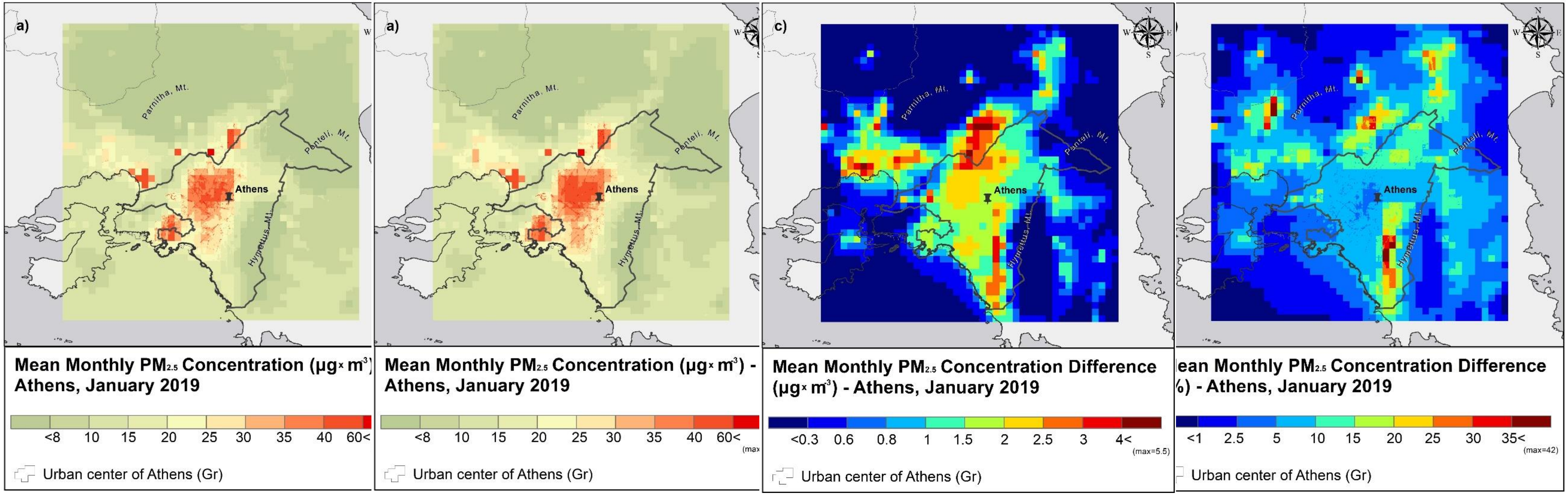
Intra-urban Air Quality

$PM_{2.5}$ from Residential Wood Burning activity from CAMS anthropogenic emissions database

x1 **x2**

$PM_{2.5}$ Concentration differences

Bias **%**



Critical GHG urban sectors

Stakeholder iteration

Integration of socio-economic data

Balance between effort, uncertainty and scalability

Quantification of co-benefits