

BRINGING THE URBAN AIR QUALITY INDICATOR 11.6.2 INTO POLICY ACTION VIA EARTH OBSERVATION POWERED LOCALISATION

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The UN frame to address the public health threat posed by air pollution



Indicator 11.6.2: Annual mean levels of fine particulate matter (e.g., PM2.5 and PM10) in cities (population weighted)

WHO serves as the custodian agency of the indicator, and they gather data from reporting entities (ministries of environment, environmental agencies, and national monitoring networks) every 2 yrs

Countries with monitoring networks provide annual mean concentrations and inhabitants to derive the national Indicator

Additional data (e.g., satellite retrievals) can be used in the data integration model for air quality (DIMAQ), which delivers yearly AQ profiles for individual countries

SDG frame lacking Earth observation, which is required to support the movement towards localisation

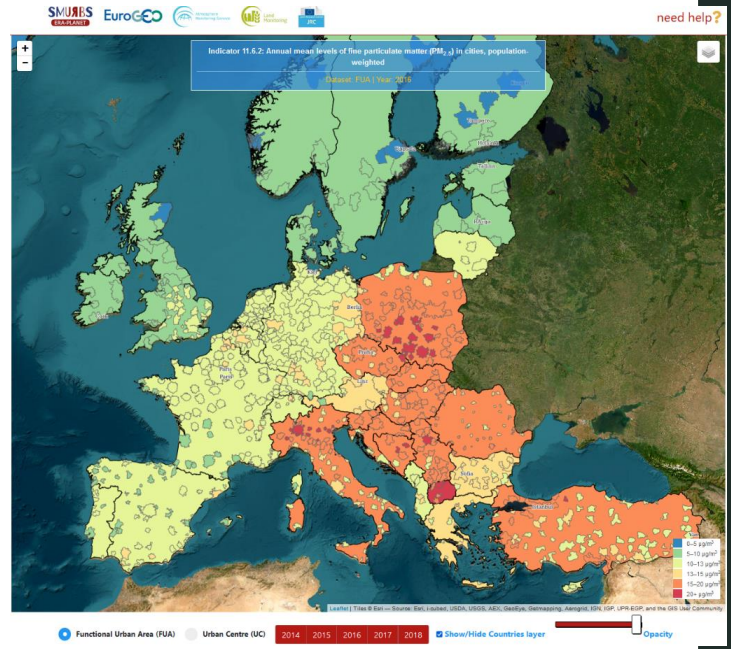
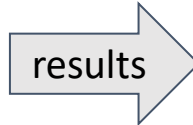
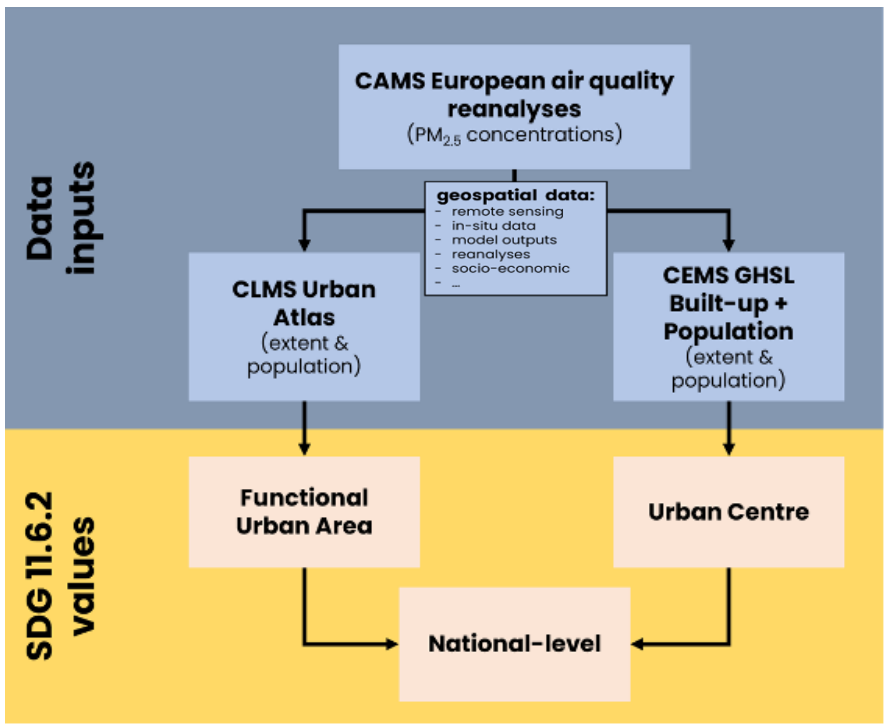
“Our Struggle for Global Sustainability Will Be Won or Lost in Cities”

Ban Ki-moon, former UN Secretary-General





EO for SDG 11.6.2: Country- and City-Level Approach



<http://apcg.meteo.noa.gr/sdg1162/>

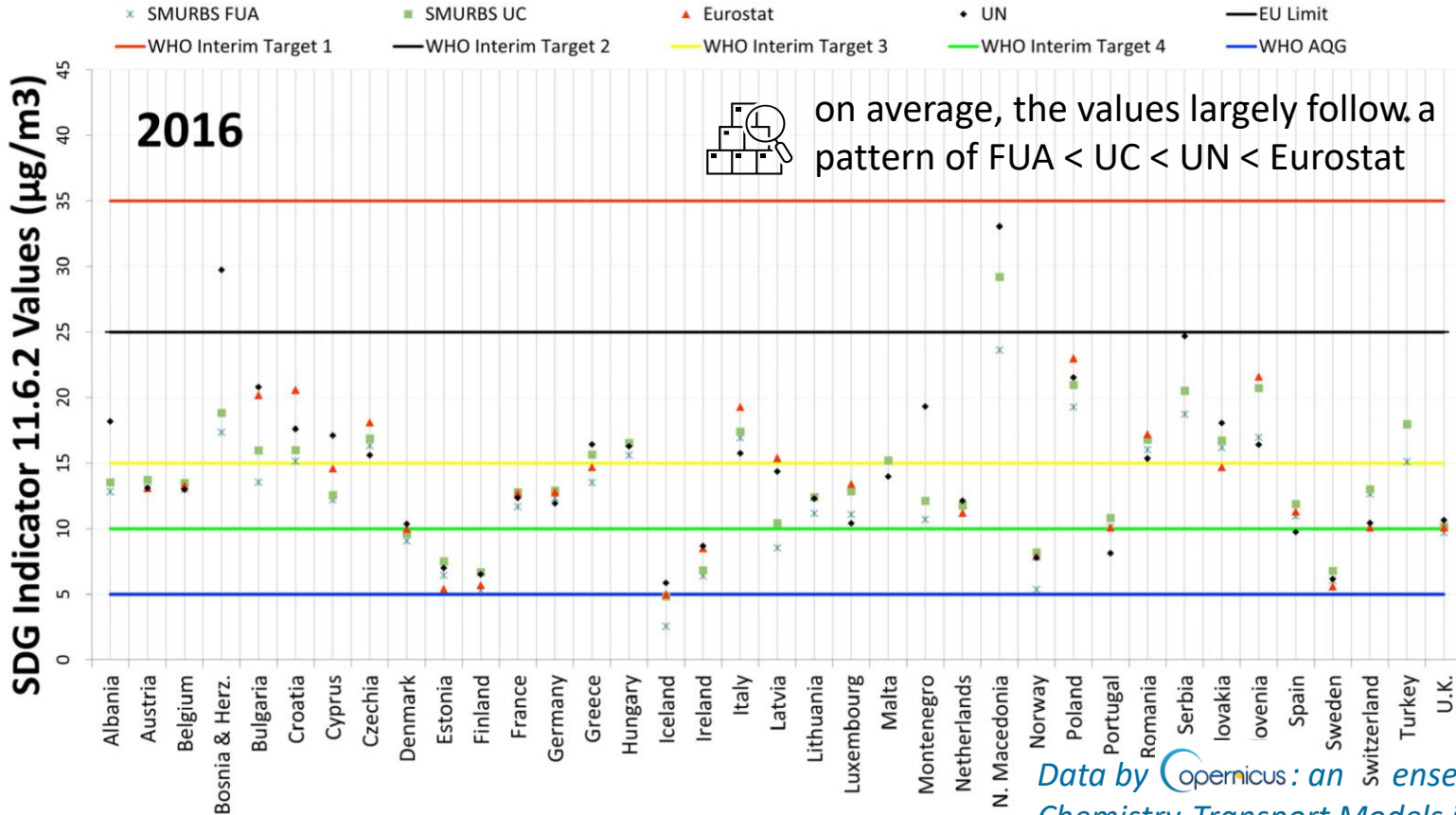
Data by Copernicus: an ensemble of Chemistry-Transport Models integrated with in situ and/ or satellite information.

$$\text{Annual mean level} = \frac{(C_{U1}P_{U1} + C_{U2}P_{U2} + \dots + C_{Un}P_{Un})}{P_{total}}$$

CU: PM2.5 concentration of an urban area; PU: population of the urban area;
 n: total number of urban areas in a country; Ptotal: total population of all cities in a country



EO for SDG 11.6.2: Country-Level Comparisons



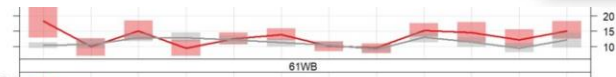
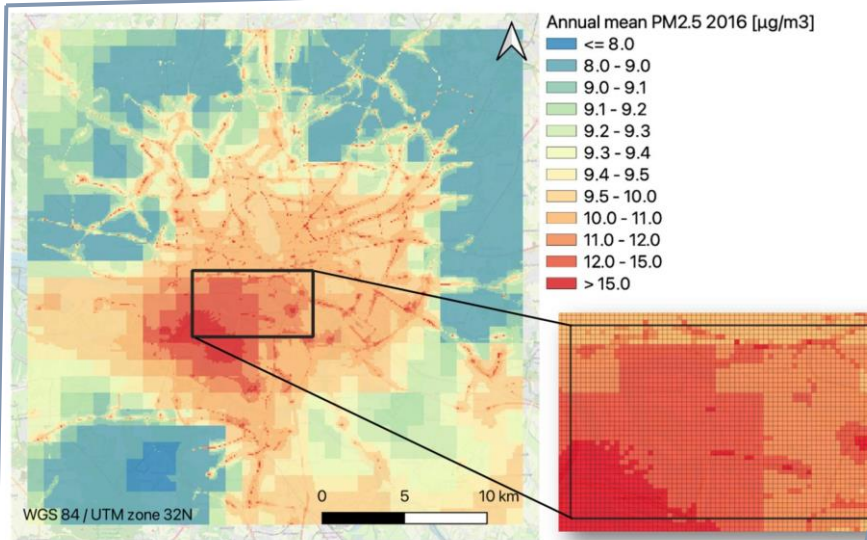
Sources:
<http://apcg.meteo.noa.gr/sdg1162/>
 And Remote Sens. **2023**, 15, 1082 :
<https://doi.org/10.3390/rs15041082>

Data by Copernicus: an ensemble of Chemistry-Transport Models integrated with in situ and/or satellite information.

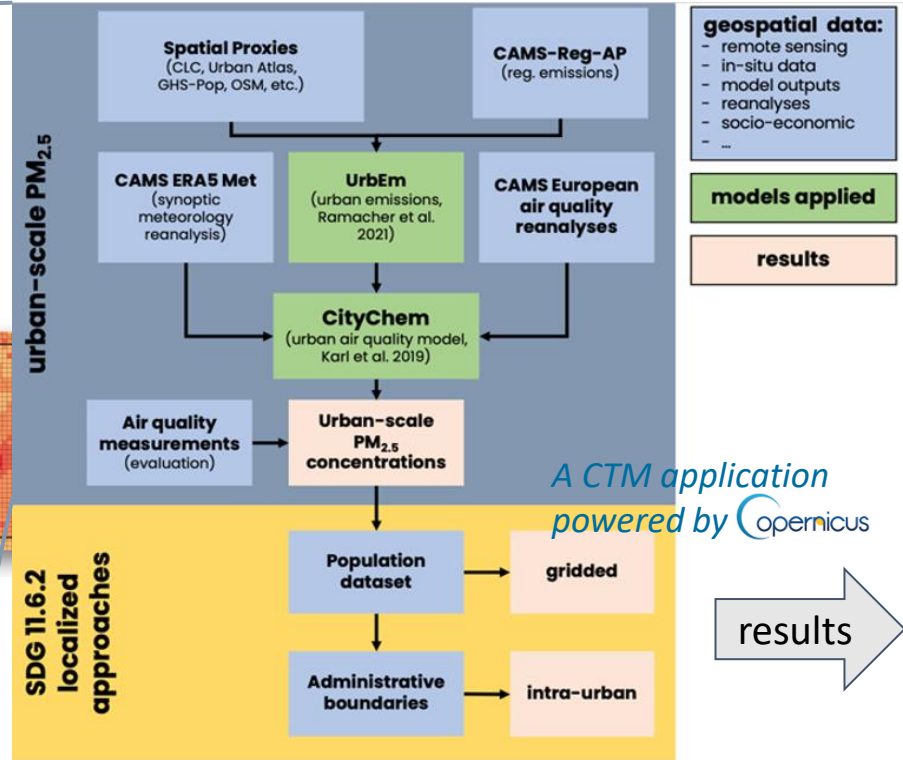


Localized approach for SDG 11.6.2

Pilot city: Hamburg (DE)



Site	n	FAC2	MB	NMB	RMSE	r	IOA
13ST (urban)	352	0.81	-3.03	-0.23	8.39	0.51	0.60
20VE (urban background)	364	0.81	-1.62	-0.12	7.67	0.48	0.61
61WB (urban background)	364	0.78	-1.18	-0.09	9.26	0.29	0.53
64KS (road site)	347	0.82	-2.49	-0.17	7.91	0.51	0.60
68HB (road site)	363	0.88	-2.27	-0.14	8.29	0.52	0.62



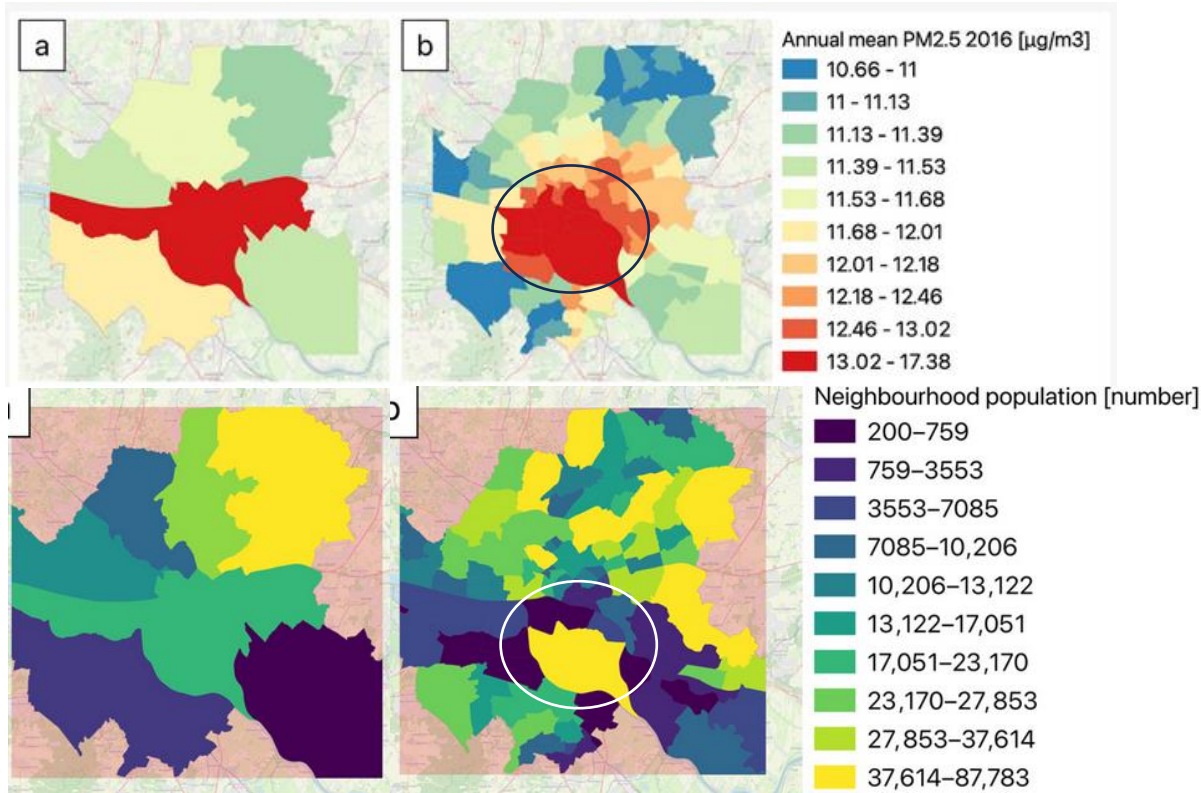
$$\text{Annual mean level} = \frac{(C_{U1}P_{U1} + C_{U2}P_{U2} + \dots + C_{Un}P_{Un})}{P_{total}}$$

Adapted from (inter)national scale: Pu & Cu = Concentration and population in urban area i; can be district, postal code, statistical unit, house, grid cell



Localized approach for SDG 11.6.2: intra-urban scale

Pilot city: Hamburg (DE)



Concentration

Population

District

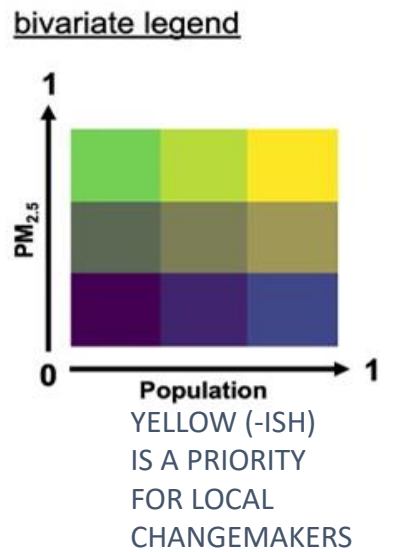
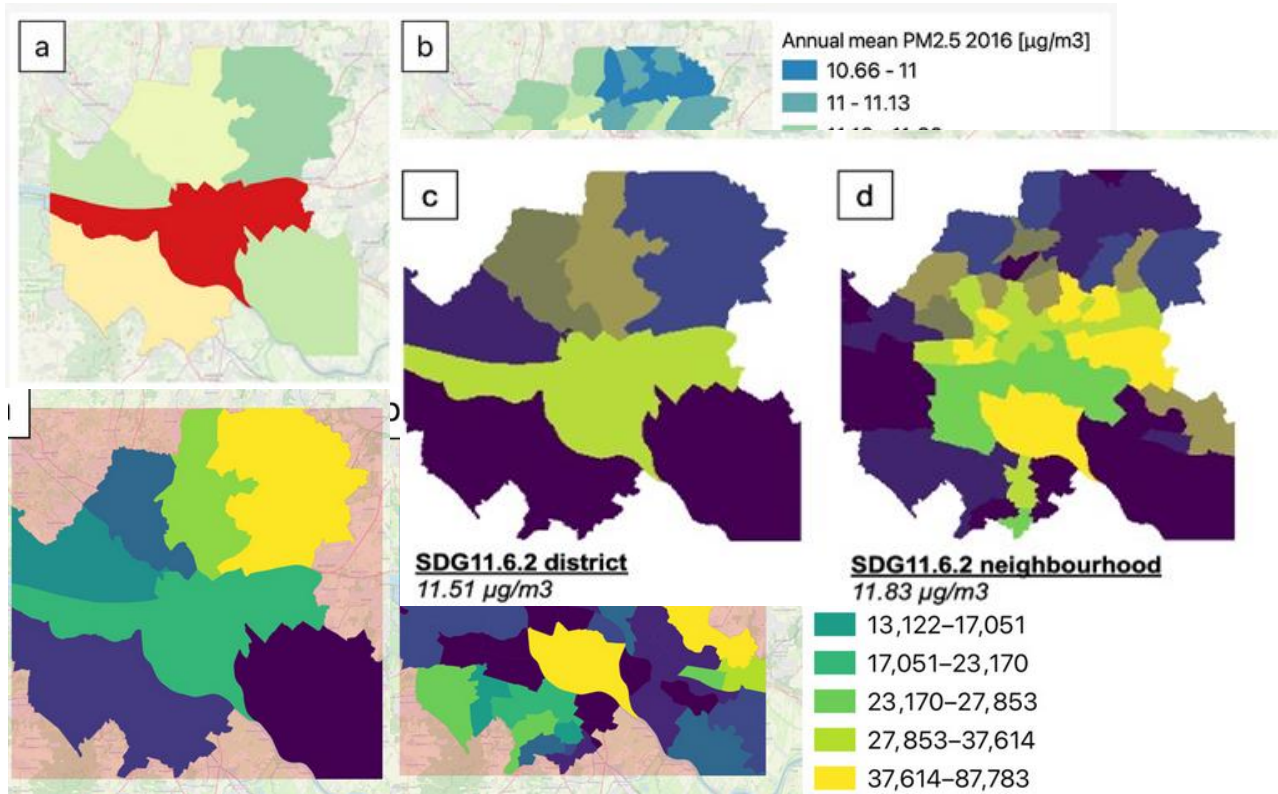
Neighbourhood

Source: Bailey, J. et al. Remote Sens. 2023, 15, 1082. <https://doi.org/10.3390/rs15041082>



Localized approach for SDG 11.6.2: intra-urban scale

Pilot city: Hamburg (DE)



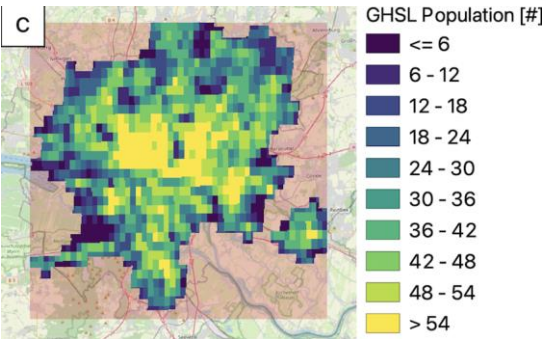
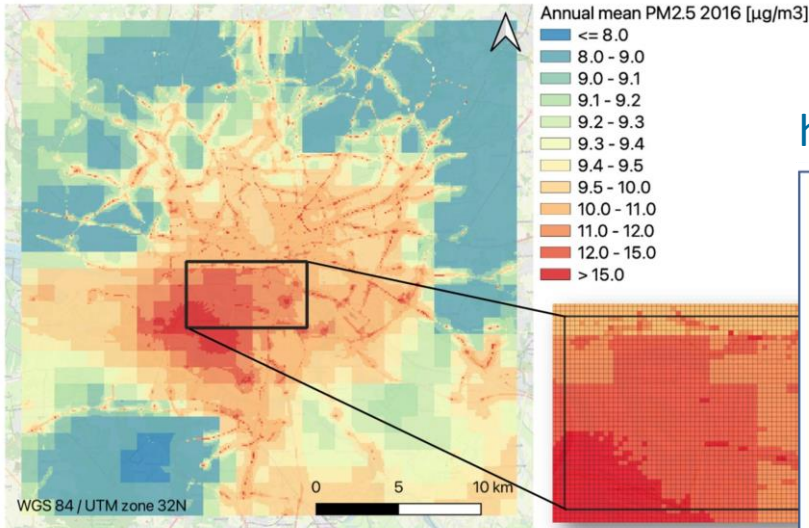
More urban units = better identification of hotspots for SDG11.6.2





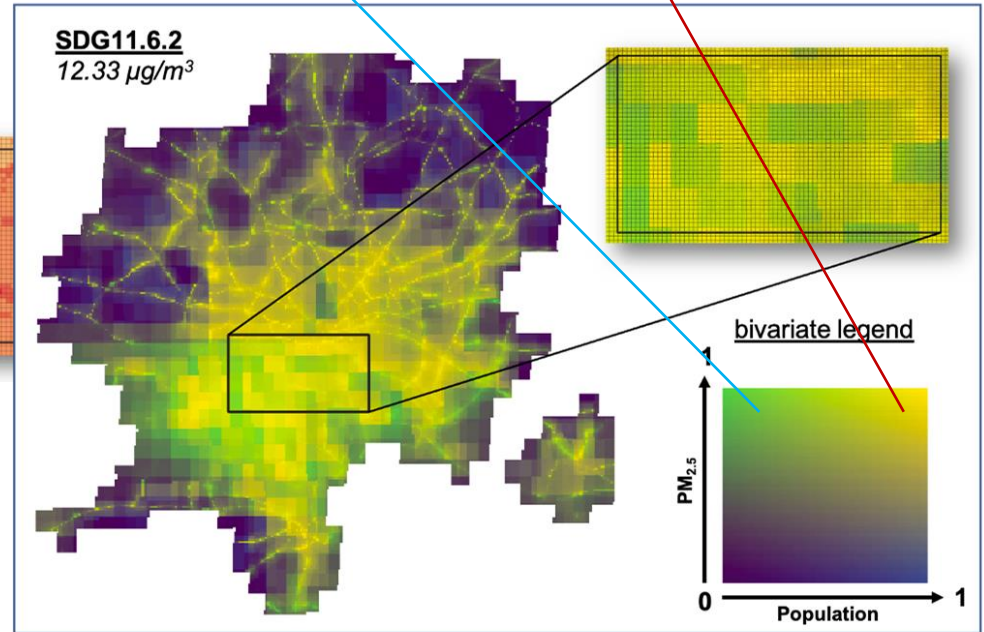
Localized approach for SDG 11.6.2: gridded approach

Pilot city: Hamburg (DE)



high conc. & many people

high conc. but no people



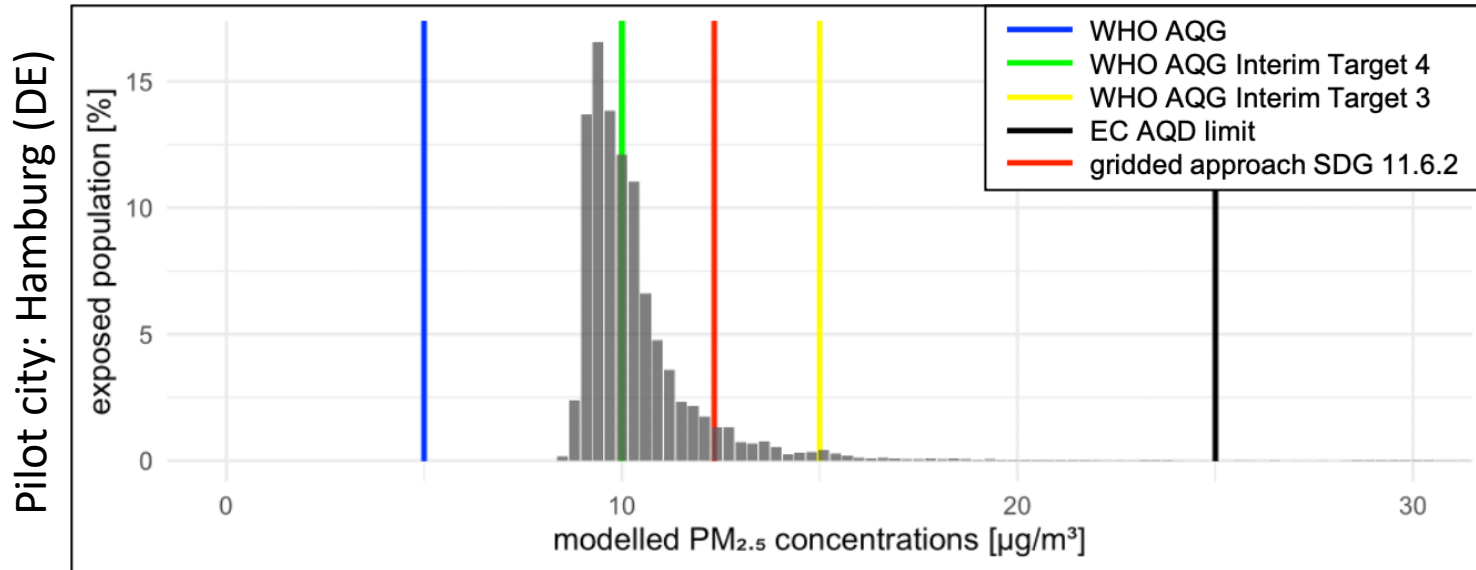
Source: Bailey, J. et al. Remote Sens. 2023, 15, 1082. <https://doi.org/10.3390/rs15041082>





Additional policy support → EC AQD + WHO AQQ

- the distribution of the population exposed to different PM_{2.5} conc.
- % of the population above (interim) AQ targets/ limits
- spatiotemporal information is helpful for epidemiological studies



Source: Bailey, J. et al. *Remote Sens.* **2023**, 15, 1082. <https://doi.org/10.3390/rs15041082>





Summary: Why this approach is important?

- Current official reporting systems (i.e., United Nations, Eurostat), suffer from lack of representativity for the actual diversity of urban conditions: **EO data allow for a holistic & representative approach to tackle air pollution within cities**
- Climate change mitigation efforts can improve AQ and, therefore, health and well-being in cities: **EO-powered numerical atmospheric simulations estimate the AQ co-benefits to climate action** (<http://urban-sustainability.apcg.meteo.noa.gr/> by <https://eiffel-ve.risa.eu/home>)

Earth Observation lead the way towards a bright and shiny future, when consistent, free-of-charge, easy-to-use data are available worldwide and are used to optimize the monitoring of indicators (eg SDG 11.6.2) and ultimately improve the situation in air quality, pushing forward progress on the latest WHO Air Quality Guidelines.

