



IOŚ-PIB

Institute of Environmental Protection
National Research Institute

Spatial and temporal variability of BaP over Poland based on national high-resolution air quality modelling and observations

Joanna Struzewska, Jacek W. Kaminski,
Grzegorz Jeleniewicz, Aleksander Norowski,
Marcin Kawka, Wojciech Baginski,
Aneta Gienibor, Paulina Jagiełło

Department of Atmospheric and Climate Modelling
Institute of Environmental Protection – National Research Institute

Warsaw, 04.05.2022





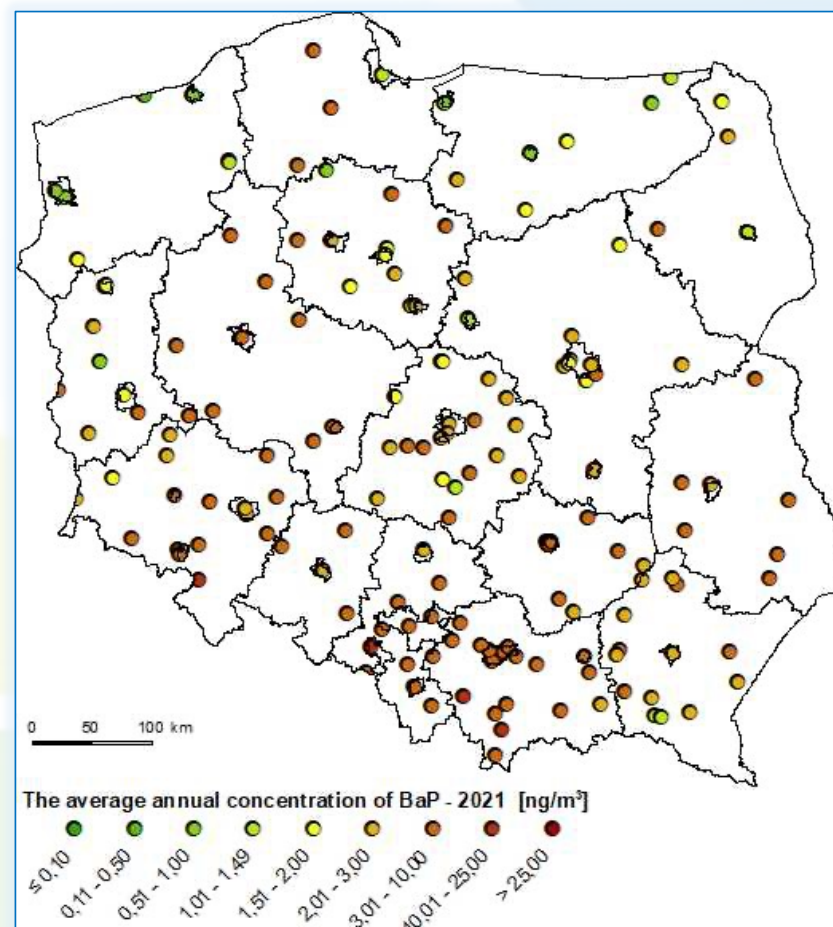
Outline

- BaP in Poland → national activities
- Monitoring network and observed variability
- Bottom-up emission inventory
- AQ assessment
- How to reduce impact (based on modelling):
 - Estimated impact of the national „Clean air Programme”
 - Joint effectiveness of the regional Air Quality Plans
- Lessons learned from the Covid19 lockdown period (based on measurements)
- Station representativeness (modelling + measurements)
- Missing sources – domestic wastes burning
- Summary



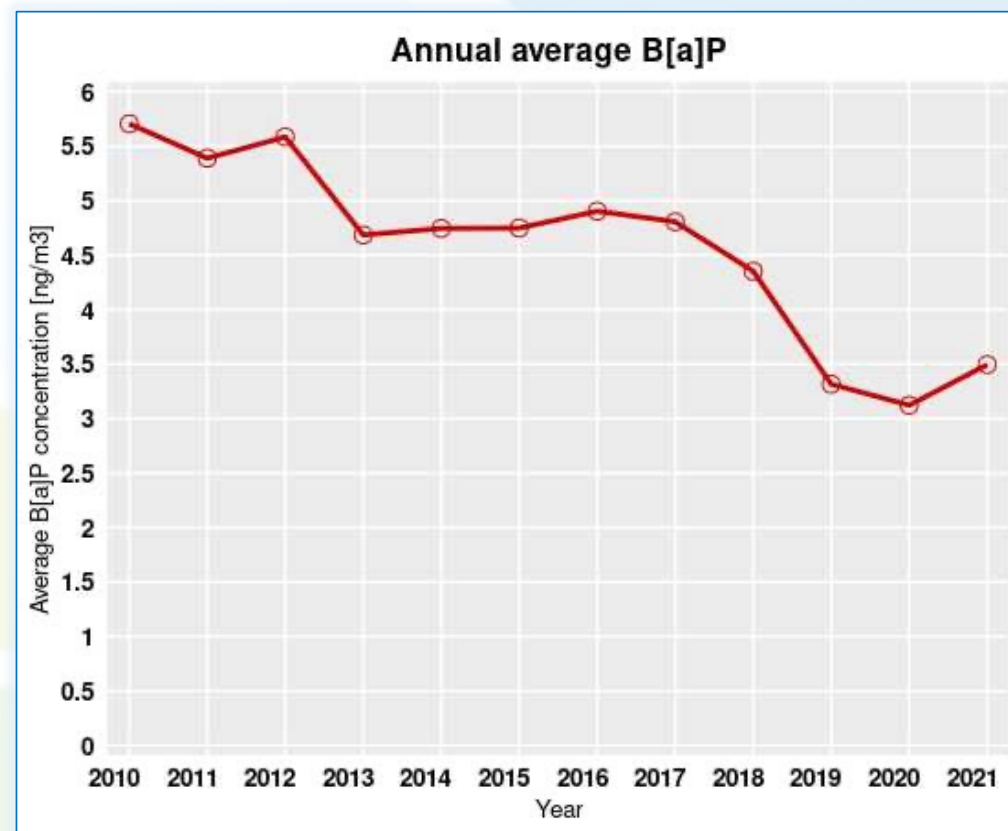
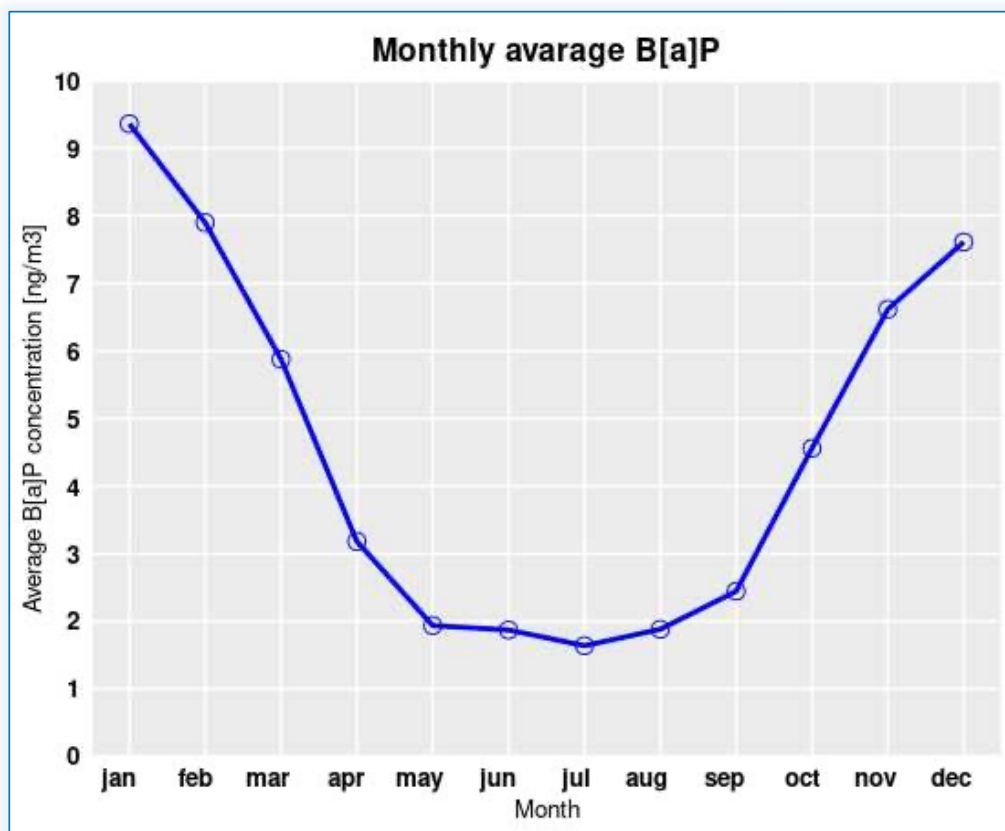
B[a]P observational network in Poland

BaP monitoring sites	
Type	Number
urban	141
suburban	14
rural	9





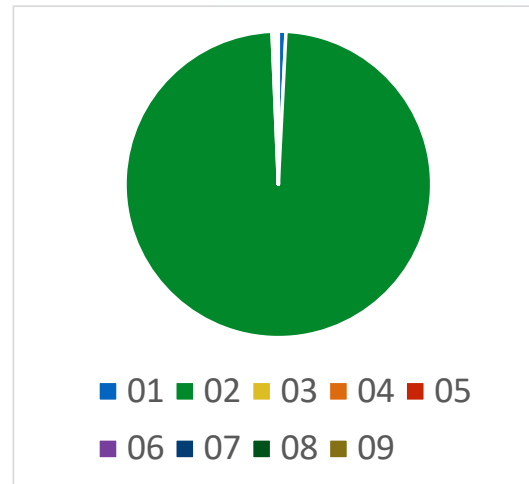
B[a]P observational variability in Poland



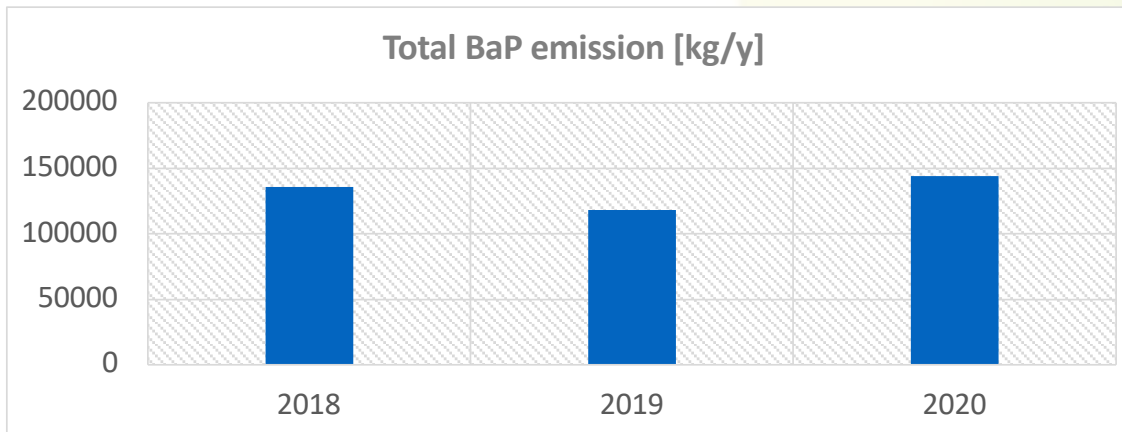
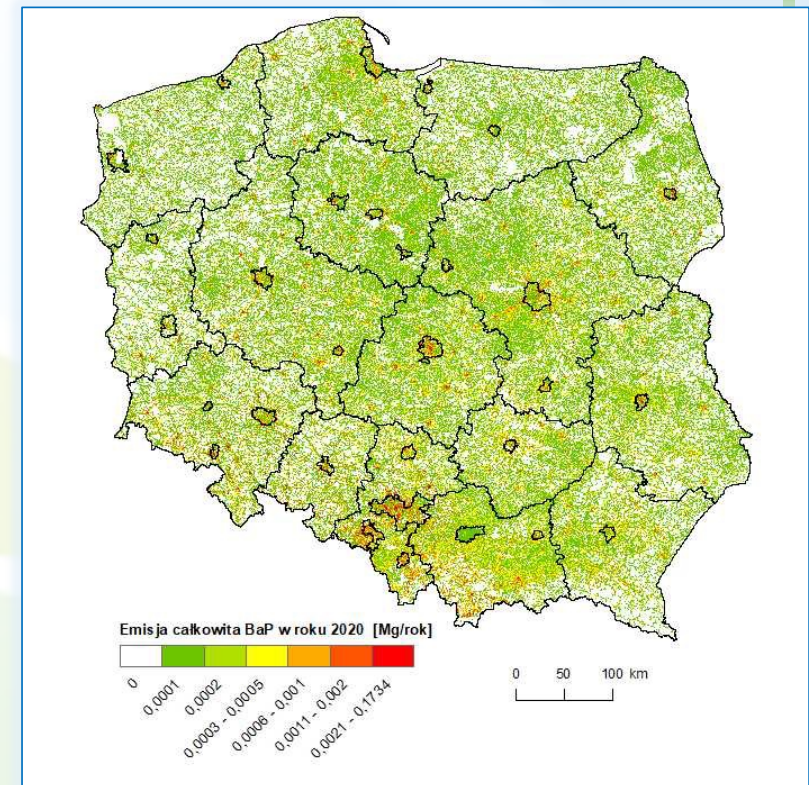


B[a]P emissions used for modelling

Low combustion is the dominant source of B[a]P emission in Poland (~98%)



Central Emission Database 2020
(a high resolution BU inventory for Poland)



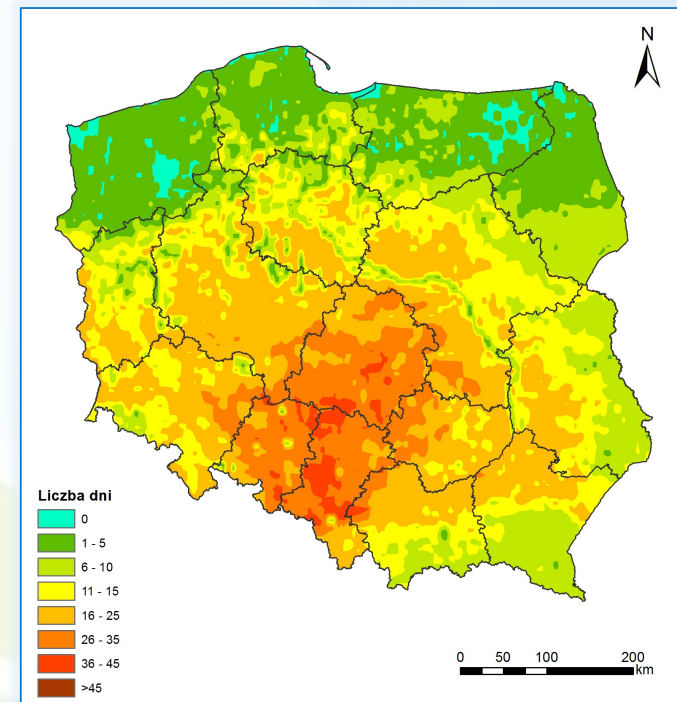


Air Quality Modelling - policy support

Starting in 2018 the **Institute of Environmental Protection, National Research Institute** is responsible for modelling in support of air quality policy for Poland (State Inspectorate of Environmental Protection and Ministry of Climate)

Modelling of B[a]P concentrations is undertaken for the purpose of:

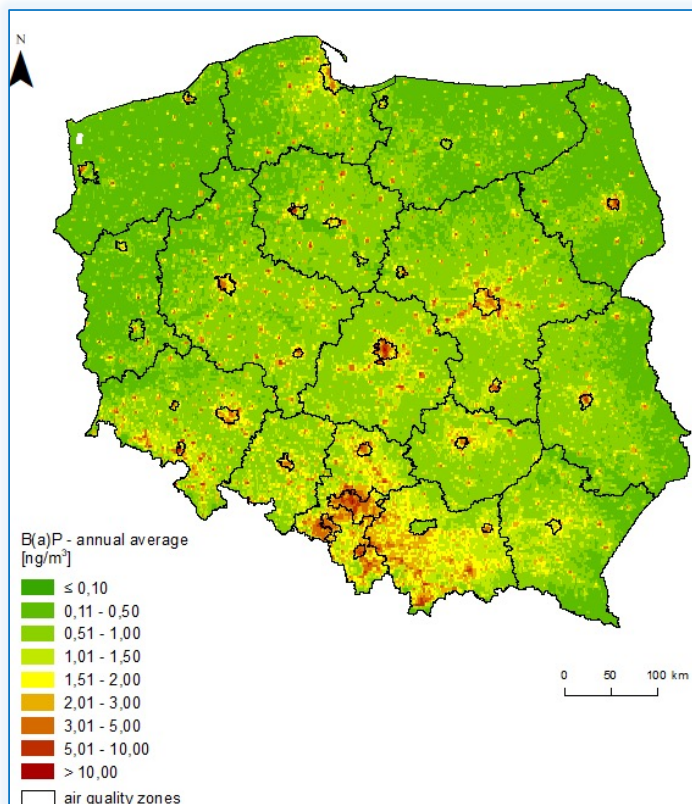
- Annual assessment (46 zones, including 30 urban areas)
- Transboundary transport assessment
- Representativeness of monitoring stations
- 5 year assessment for the zone classifications



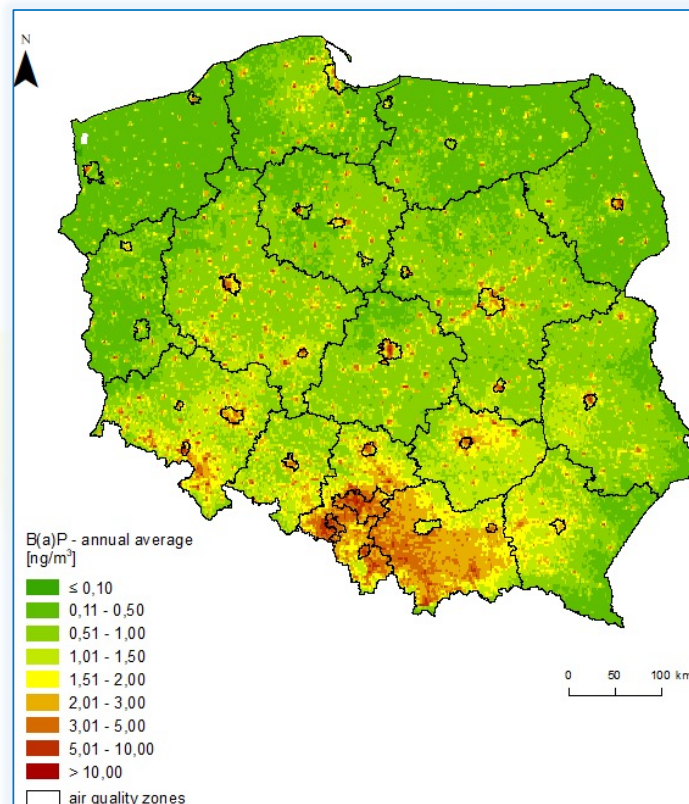


Results from 2021 AQ assessment for PL

RAW MODEL



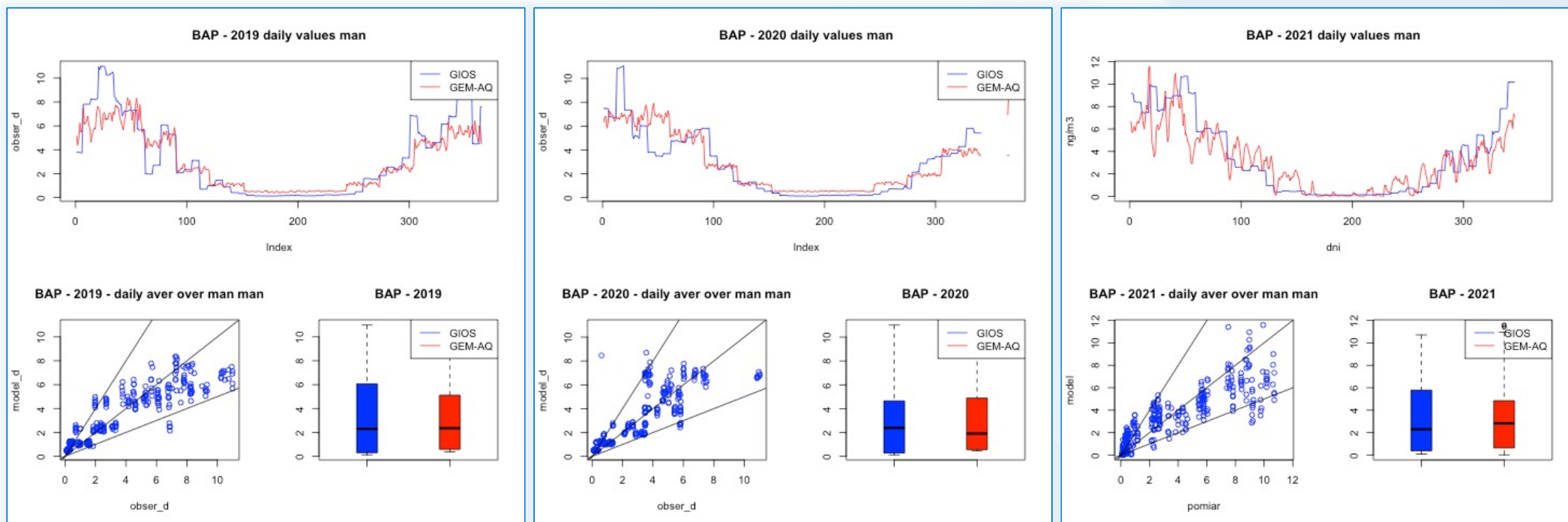
REANALYSIS



- Reanalysis increased BaP background concentration in rural areas
- In some urban areas concentrations decreased after data assimilation
- Significant differences in Malopolska (Southern Poland)



Evaluation against measurements



The model evaluation showed good agreement with observations for all spatial and temporal scales. HDD based variability in residential sector used for the first time in 2021



Scenario analysis





Assessment of “Clean air” programme – scenario assumptions (2019)

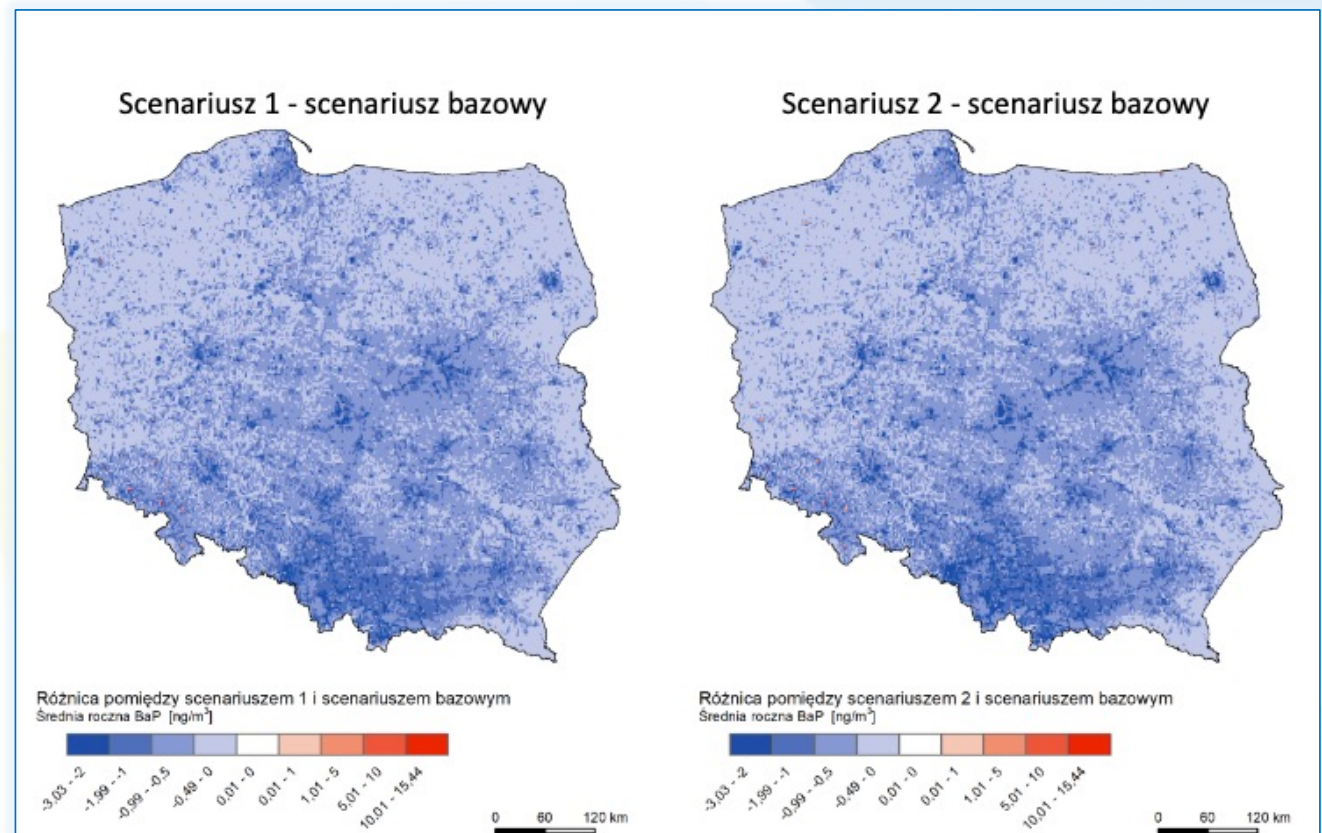
- „Clean Air programme” aims to provide support for heating system modernisation and better insulation for homes. The Clean Air Programme is designed to reach 4.5 million households in Poland over the next ten years.
- Base scenario – emissions reported in 2018, meteorology 2019
- Future scenarios: exchange of furnaces in 2 million households (home insulation not considered)
 - Scenario I – uniform distribution over Poland, proportional in all administrative units (30% households)
 - Scenario II – action focused on administrative units with $PM_{2,5} > 20 \mu g/m^3$ (39% households)



BaP reduction in Poland (Clean air Programme)

- B[a]P concentration changes very similar for both scenarios
- Reduction up to $3\mu\text{g}/\text{m}^3$

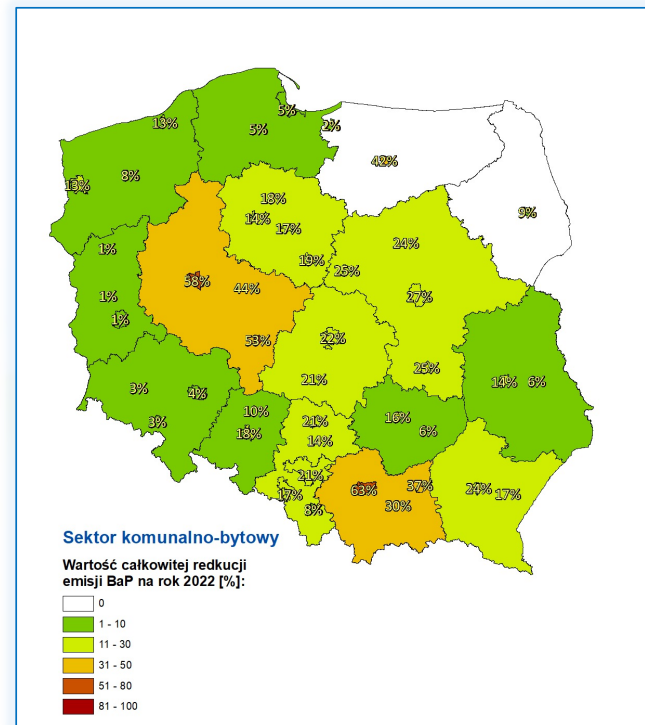
BaP	Base (2019)	Scenario I	Scenario II
Area of exceedances [km ²]	32991	5852	5834
Number of people exposed	19 495 518	7 826 430	7 729 373
Number of zones with exceedances	46	42	42



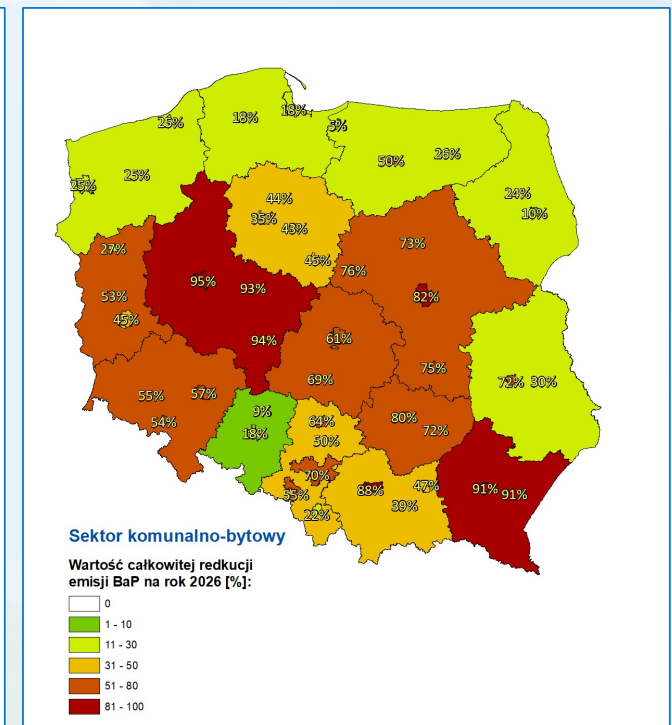


Assessment of regional Air Quality Plans

- All regional Air Quality Plans as accepted in 2020 collected from Marshall Offices
- Emission reduction (percentage) was reported for each activity sector and each pollutant for the full implementation (2026) and partial implementation (2022) od AQP
- Base scenario – emissions reported in 2019, meteorology 2020



2022



2026

BaP reduction in Poland (regional AQP 2020)

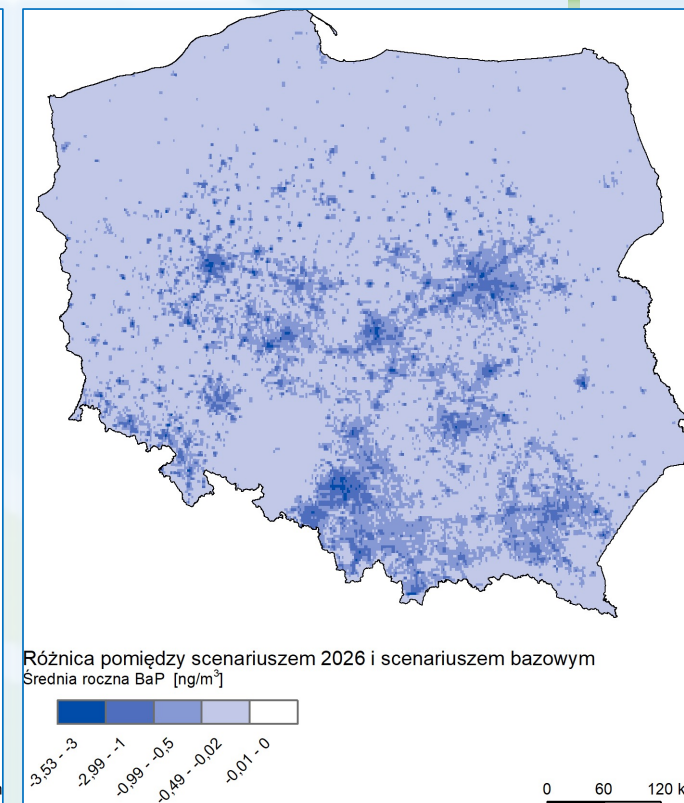
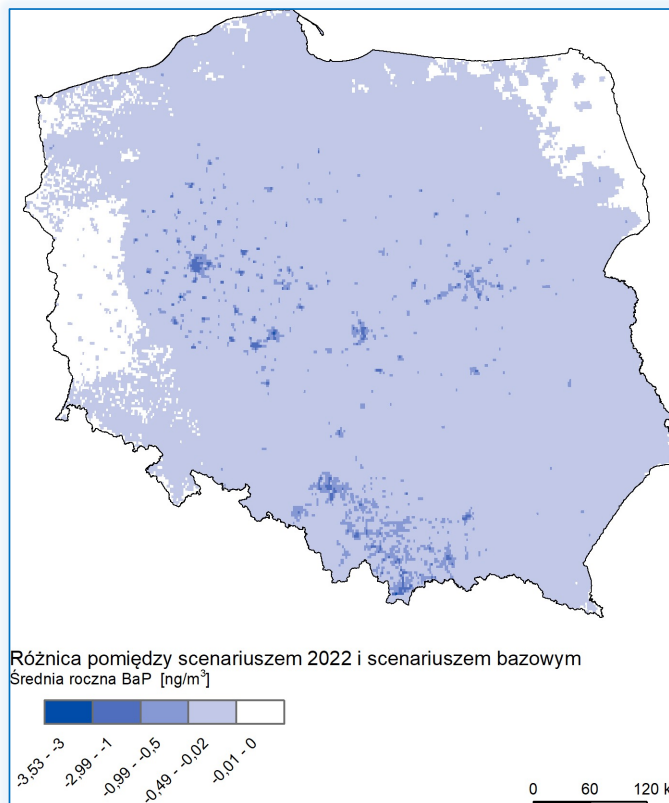


Różnica między rokiem 2022-2020

Różnica między rokiem 2026-2020

BaP	Base (2020)	2022	2026
Area of exceedances [km ²]	24 527	15985	5430
Number people exposed	20 644 815	17 089 934	7 700 833

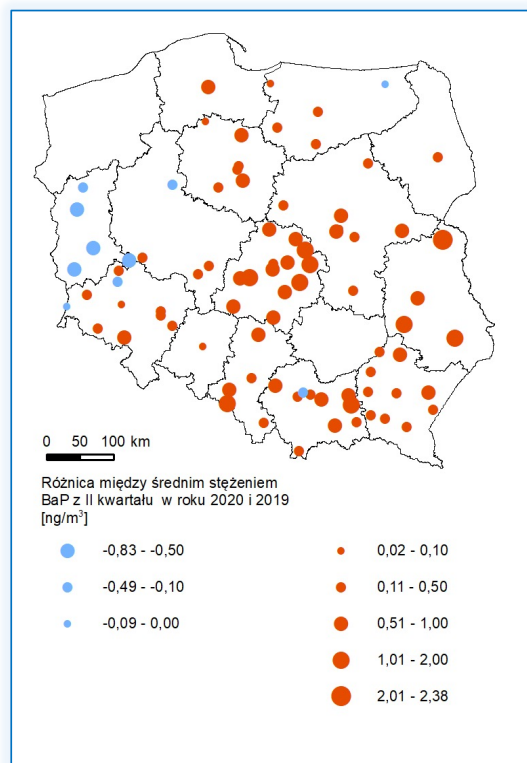
Reduction of the exposure up to 62% in 2026



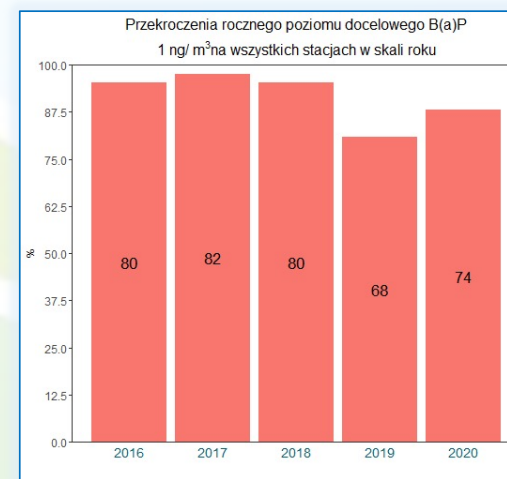
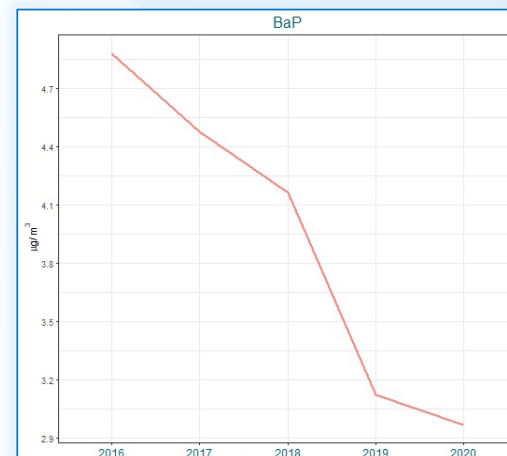
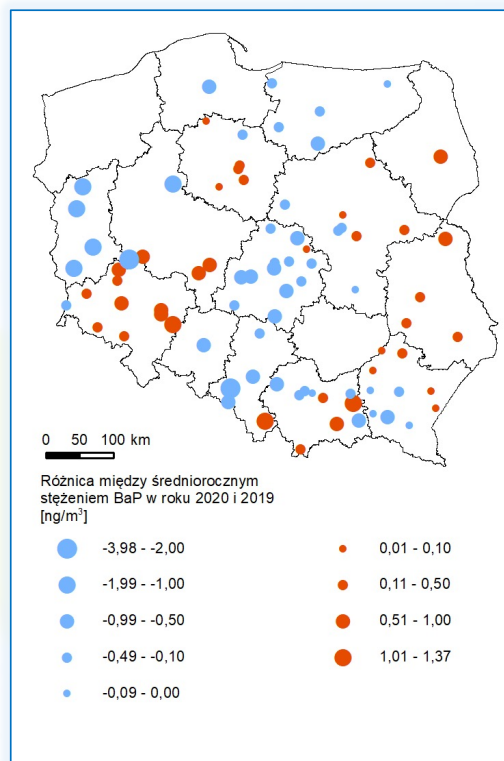


Lessons learned from Covid19 lockdown period

MAM difference (2020-2019)



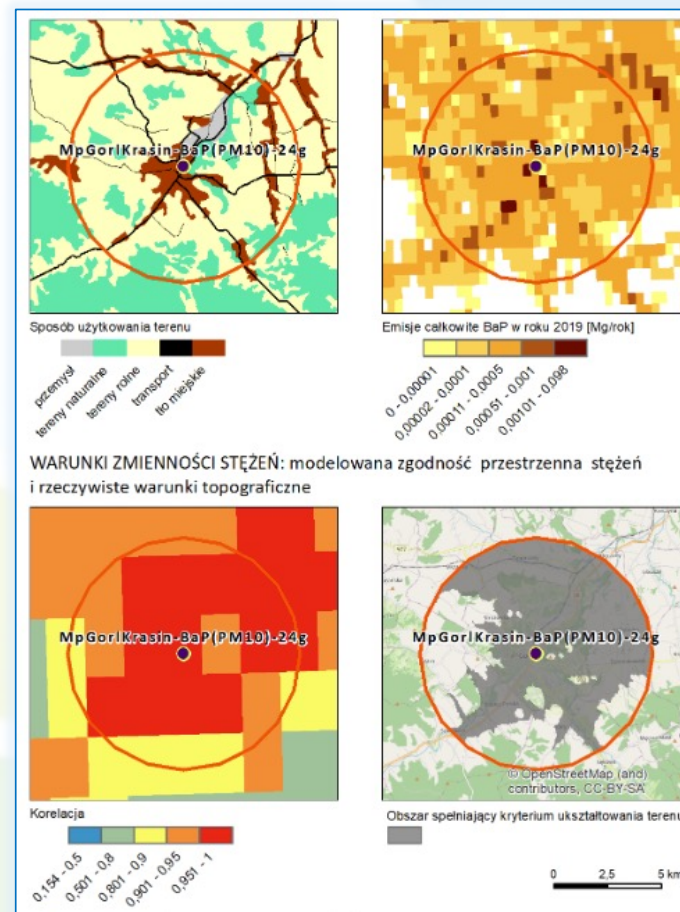
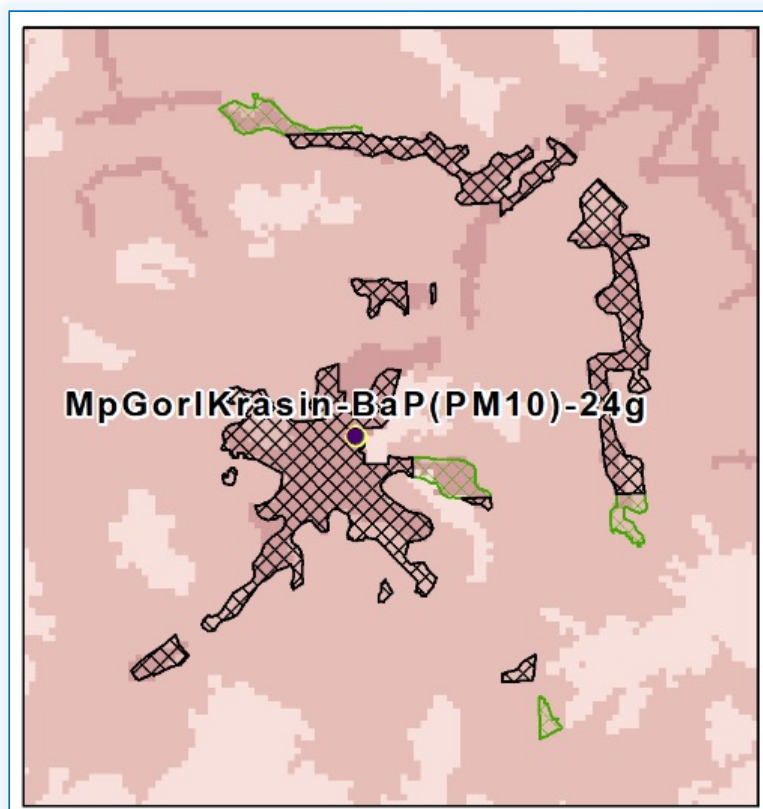
YEAR difference (2020-2019)



Decreasing annual concentrations does not imply the reduction of exceedances



Local vs. non-local impact





Summary 1/2

- B[a]P concentrations show decreasing trend over last decade. However, average concentrations are much higher than the threshold. Moreover, concentrations in 2020 are influenced by anomalous meteorology and Covid19 lockdown.
- Seasonal variation of B[a]P in Poland shows maximum concentrations during wintertime (from October to March) due to household heating. Average temperature during spring months (March, April) very important in terms of exceedances.
- Station located in the hot spots – modelling crucial for reliable assessment and exposure analysis
- Weekly sampling may cut off peaks and make it difficult to analyse temporal variability
- Modelling results show very good spatial and temporal agreement with the observations
- Data assimilation reduced concentrations in some urban regions and slightly increased concentrations in rural regions



Summary 2/2

- Model analysis of reduction scenarios showed that:
 - “Clean air” Program would reduce the exposure but the number of zones with exceedances will be still high (base year 2019)
 - By 2026 Regional Air Quality Plans would reduce the concentrations up to 62% (base year 2020)
- Covid19 lockdown – based on observations the annual average concentrations were lower than in previous years but there were more exceedances
- Modelling based analysis shows local representativeness of the stations
- Future plans:
 - NAQP: Impact of the heat cogeneration scenario (at least 70% heat consumption in the cities) → September 2022
 - NAPCP revision: BaP not included but we may consider scenario for BaP based on PM10 from residential sector → July 2022
 - Collaboration with Czech (exchange of BU emission inventory already initiated)



IOŚ-PIB

Institute of Environmental Protection
National Research Institute

THANK YOU!

joanna.struzewska@ios.edu.pl

