IOŚ-PIB
Instytut Ochrony Środowiska
Państwowy Instytut Badawczy

Impact of traffic emissions on air quality in Warsaw

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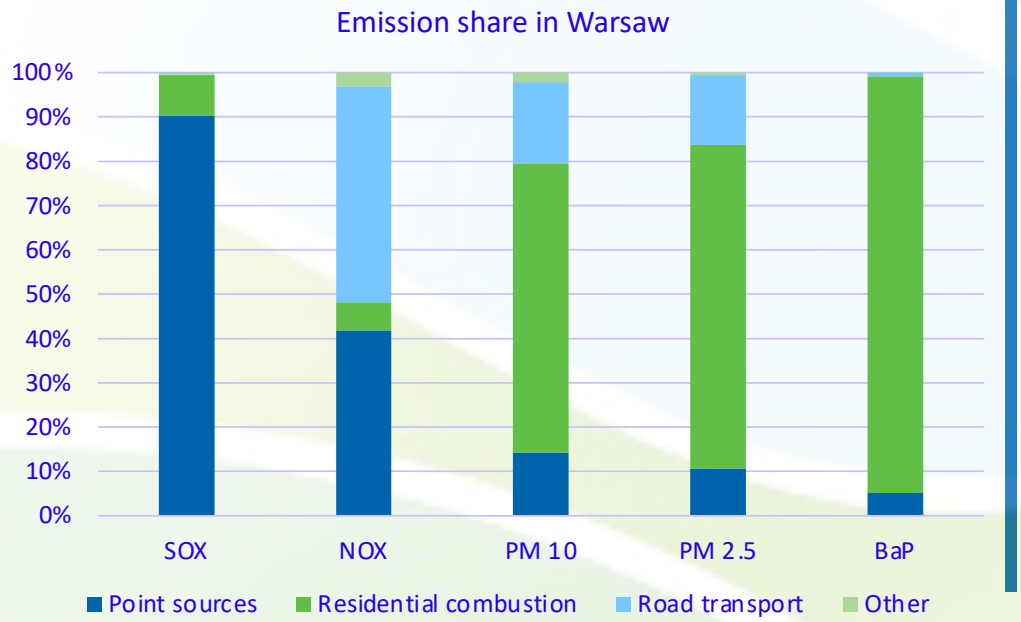
Motivation

- To consolidate the research potential and ongoing work at IEP-NRI related to traffic sector
  - Traffic emission estimations
  - Analysis of AQ observations
  - AQ modelling
  - Health effects
- To establish the cooperation with related projects
  - CoMobility Project
  - VITO (ATMO-street model setup/testing for Warsaw)
- To provide a scientifically sound results to the City of Warsaw

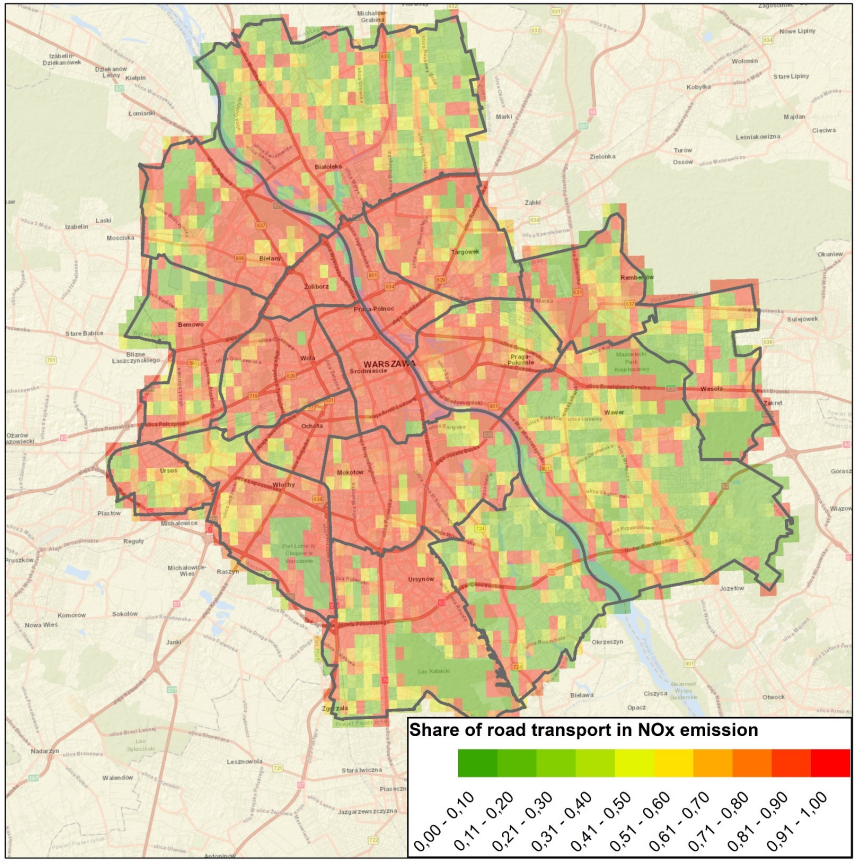
Emission analysis

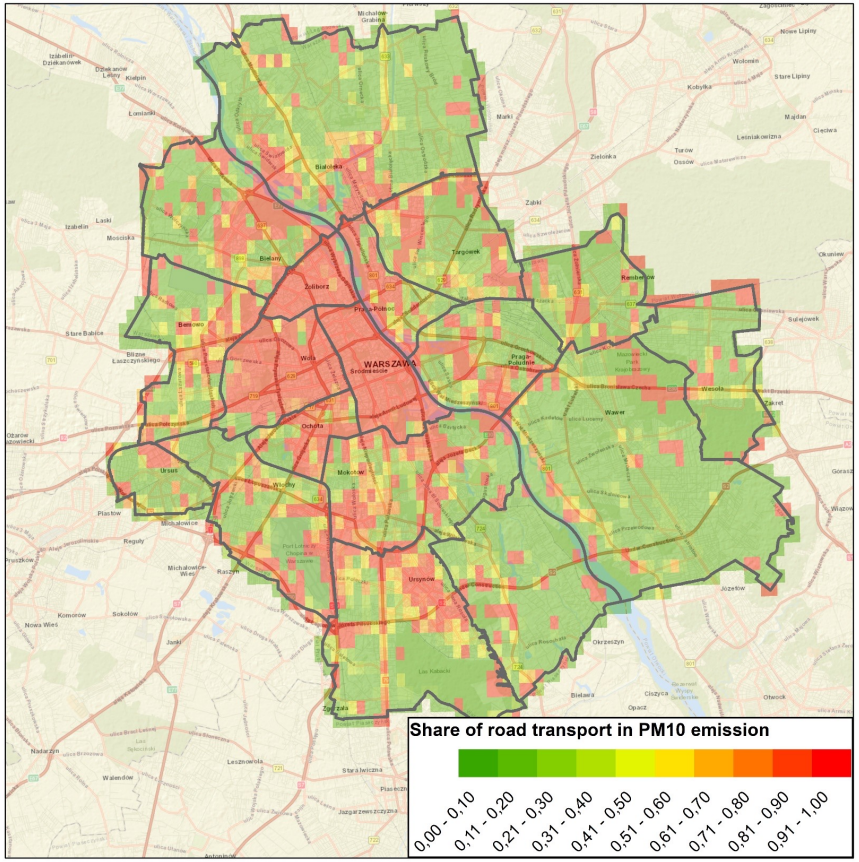
- Emission Department is responsible for the development, maintenance and annual updates of the Central Emission database – the high resolution national emission inventory
- For last 2 years a new approach for traffic emission is being developed (based on mobile application for car drivers - Yanosik)

	Point sources	Residential combustion	Road transport	Other
SOX	90,2%	9,2%	0,2%	0,3%
NOX	41,8%	6,3%	48,8%	3,1%
PM 10	14,3%	65,2%	18,3%	2,2%
PM 2.5	10,7%	73,0%	15,8%	0,6%
BaP	5,2%	94,0%	0,8%	0,0%



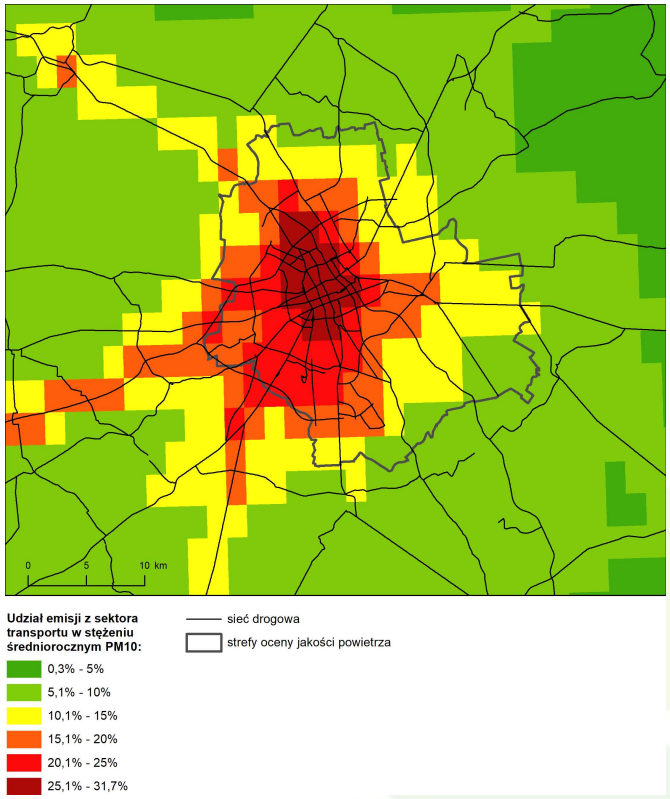
Traffic emissions (% of total emission load)



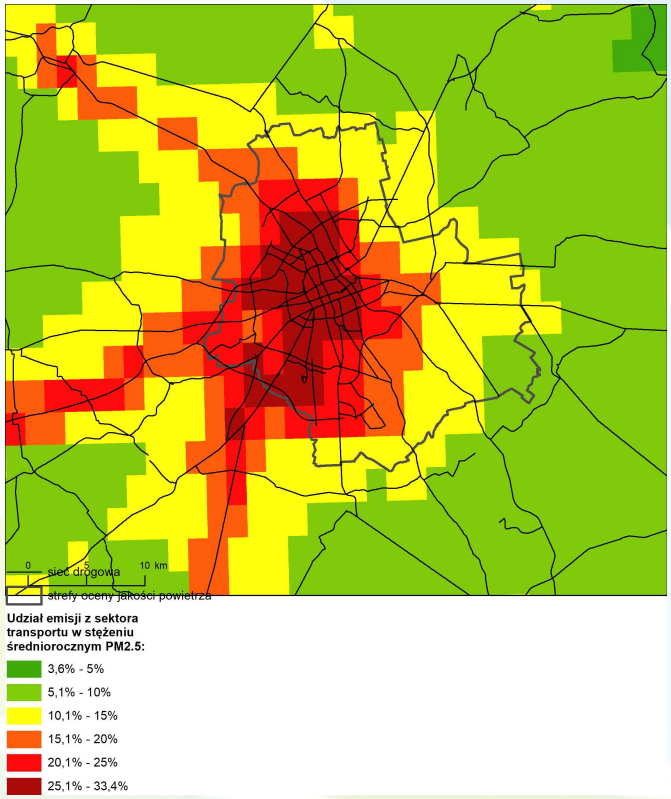


Annual assessment 2021 – source contribution

Year: 2021
Resolution: 2,5km
Species: PM_{10}, $PM_{2.5}$
Method: brute-force



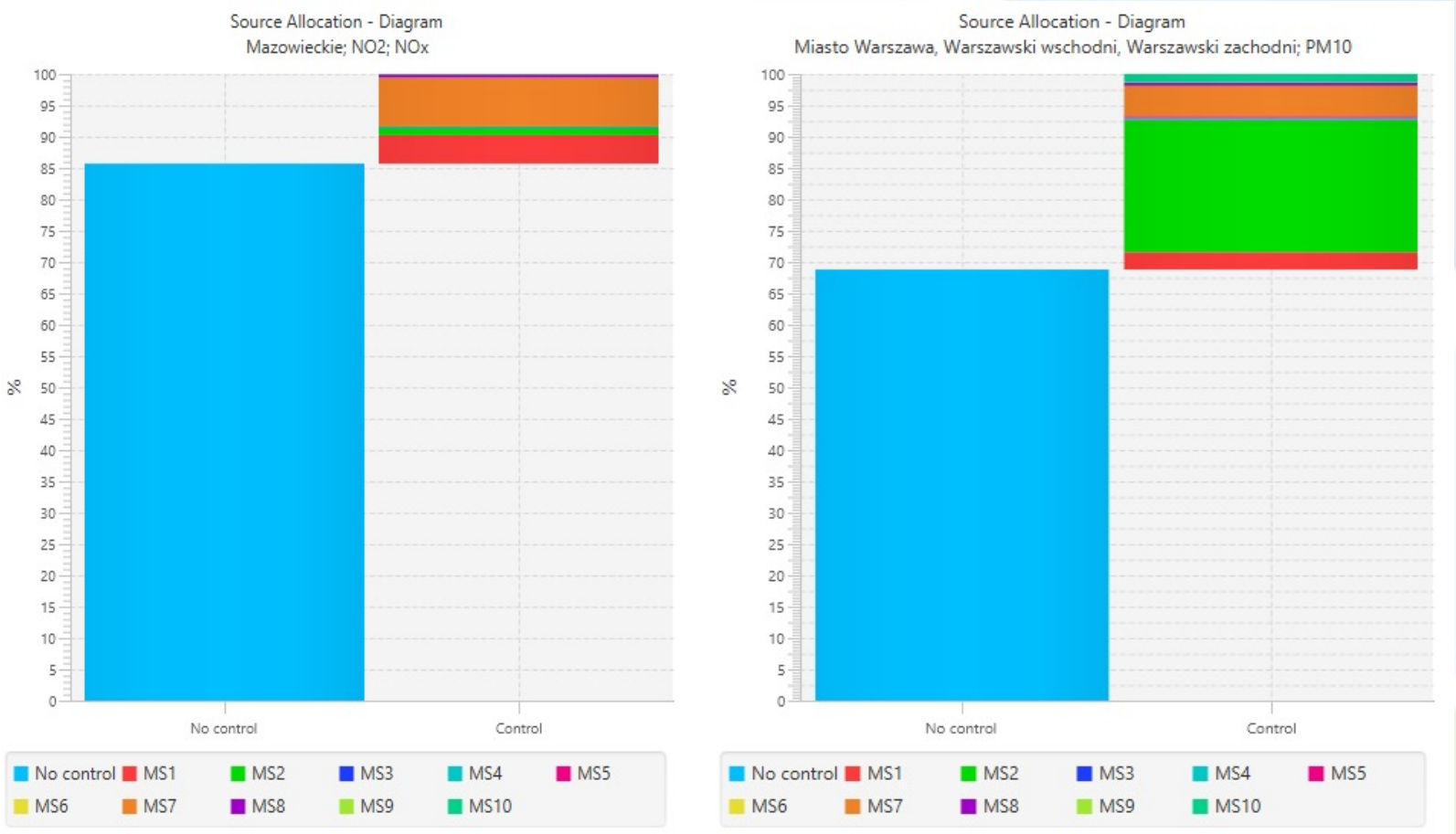
PM_{10}



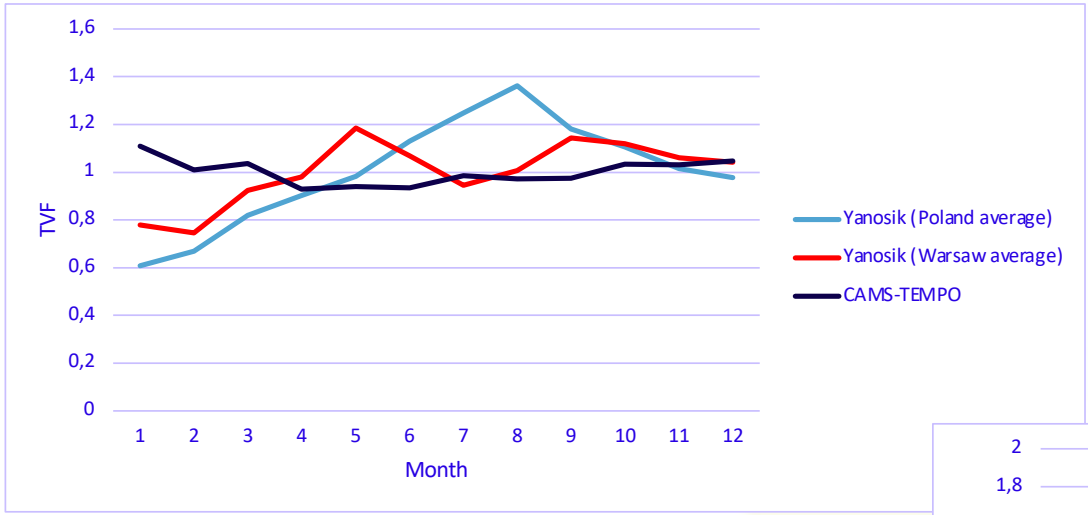
$PM_{2.5}$

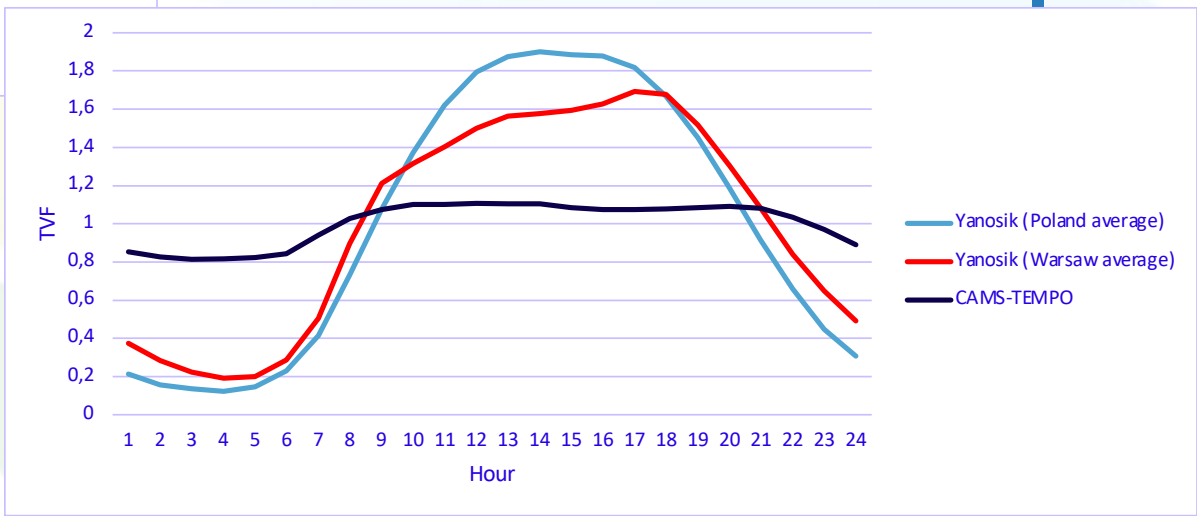
SHERPA bottom-up → Warsaw NO_2, PM_{10}

Year: 2018
Resolution: 2,5km
Species: PM10, NO2
Method: SHERPA

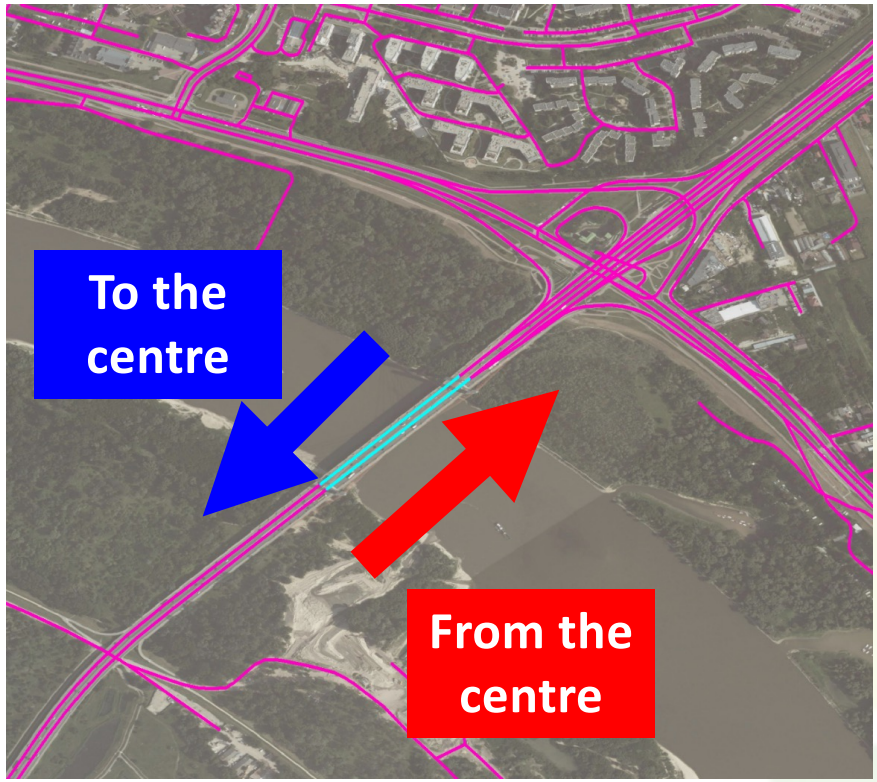


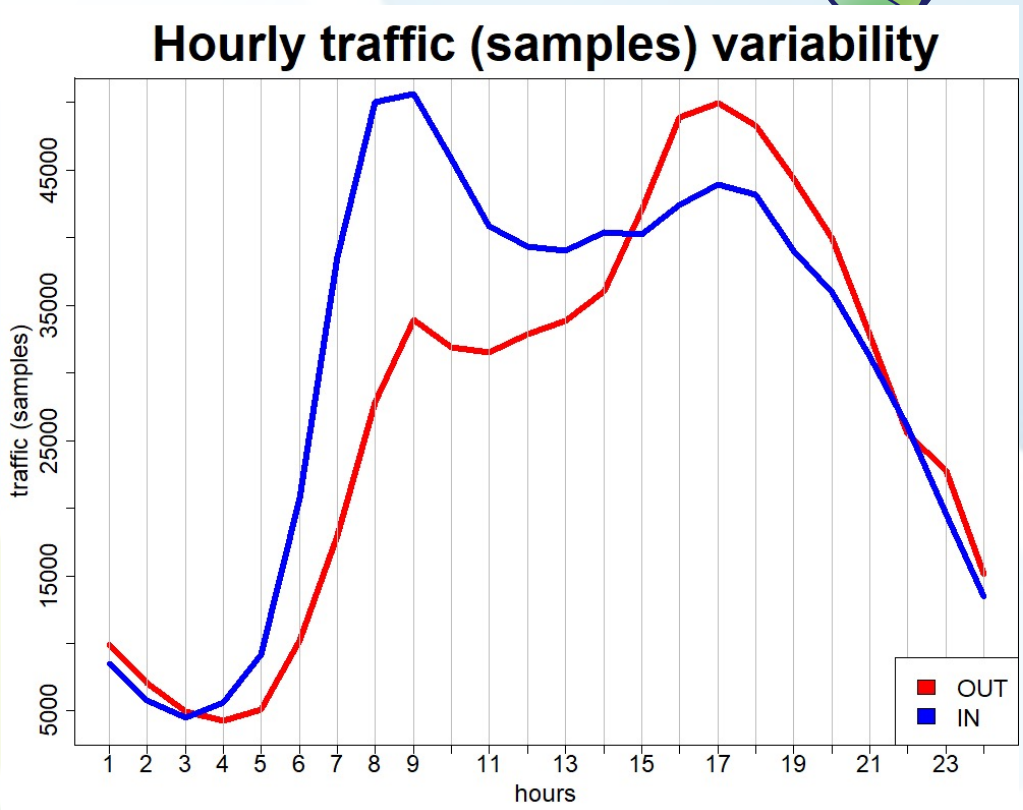
Traffic sector - temporal variability (Yanosik)





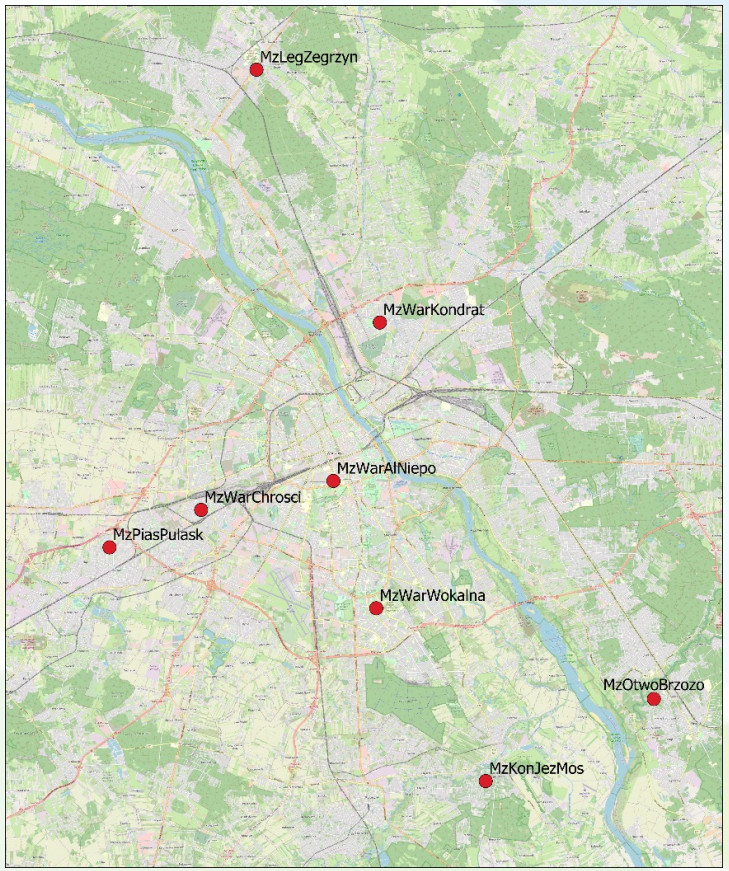
Temporal variability





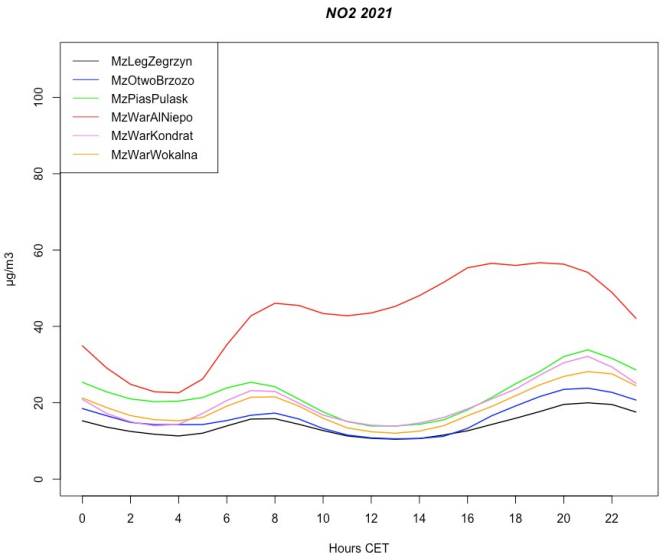
Observations
(traffic stations vs. urban background)

- Period 2016-2021
- Only one traffic station
  → Al. Niepodleglosci
- Analysis for NO_2, PM_{10}, $PM_{2.5}$

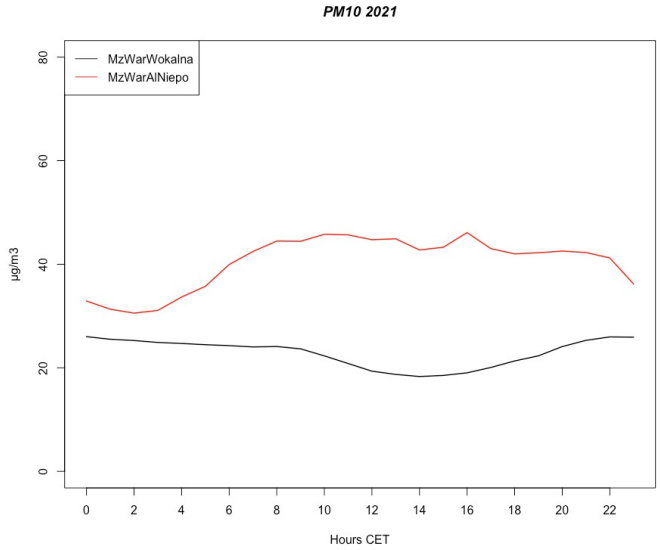


Observations
(traffic station vs. urban background, 2021)

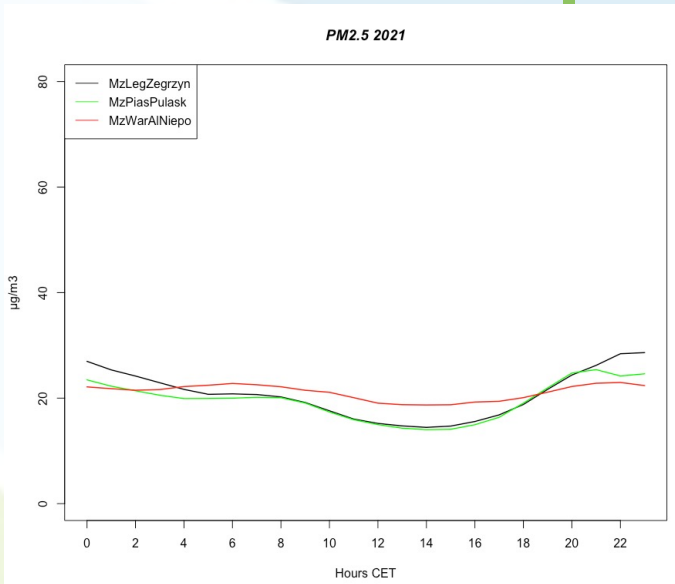
NO_2



PM_{10}

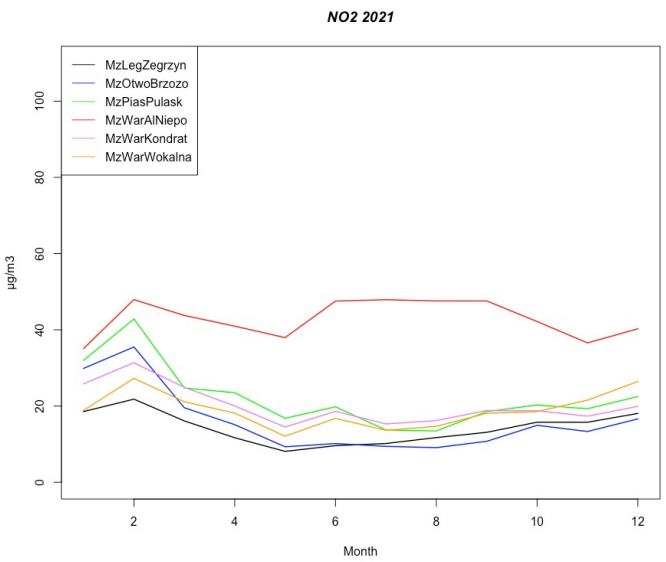


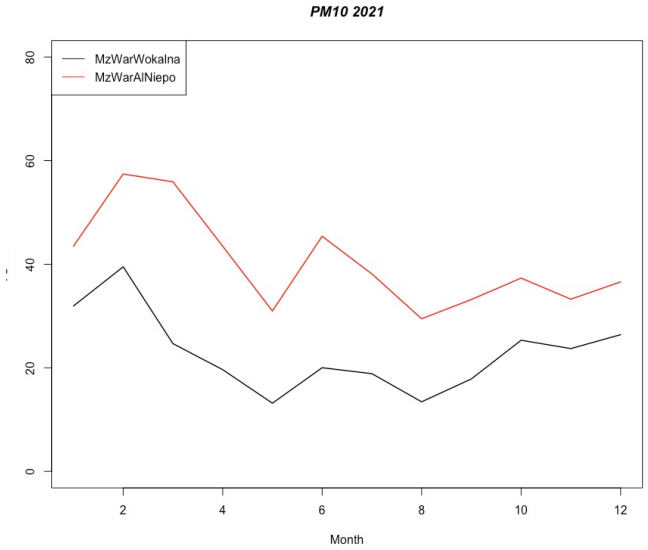
$PM_{2.5}$

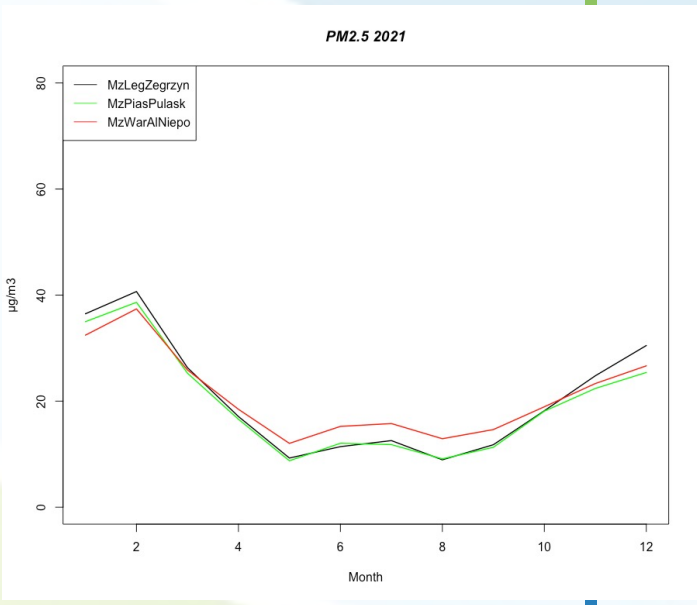


- For PM_{10} and NO_2 observations at traffic site are significantly higher than at urban background stations
- NO_2 variability shows similar pattern related to traffic hours
- PM_{10} concentrations at traffic station increase in the morning and show small variability (resuspension?)
- $PM_{2.5}$ concentrations are similar at traffic and urban background stations

Observations
(traffic stations vs. urban background, 2021)

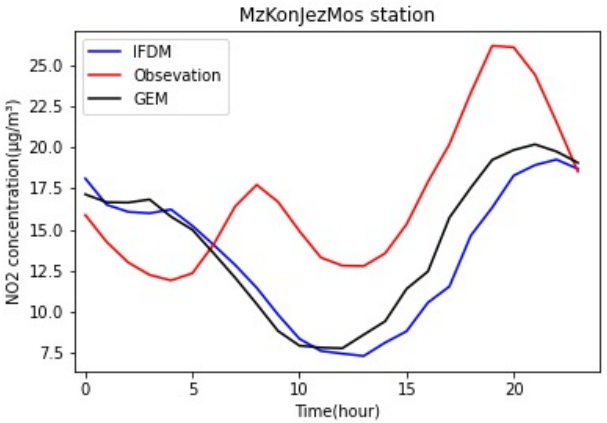


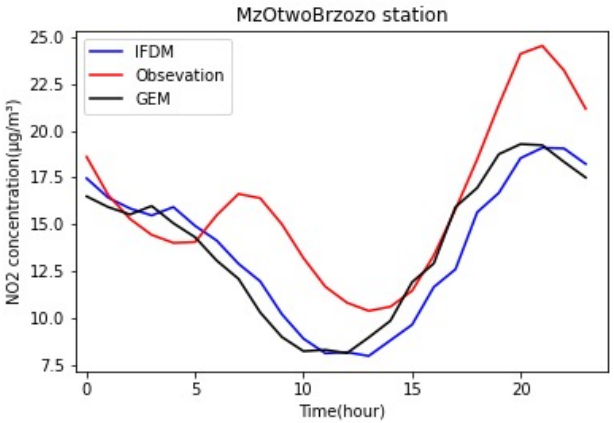


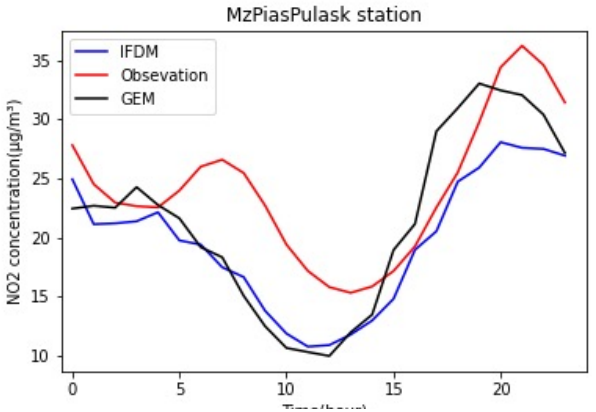


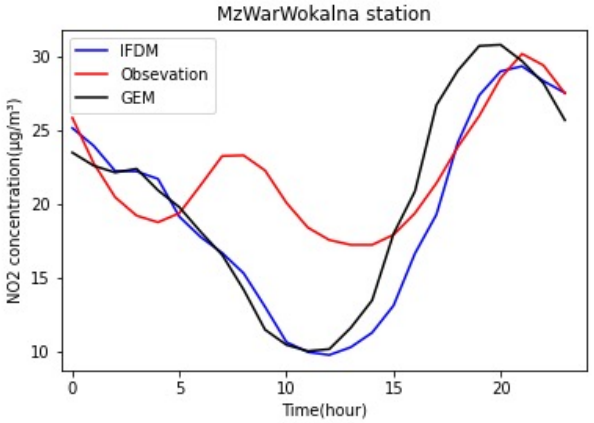
- Monthly pattern follows urban background for PM10 and PM2.5

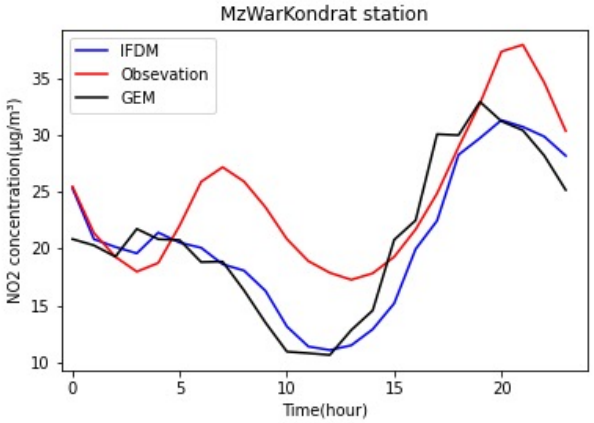
NO2 hourly plots in other stations (2019)

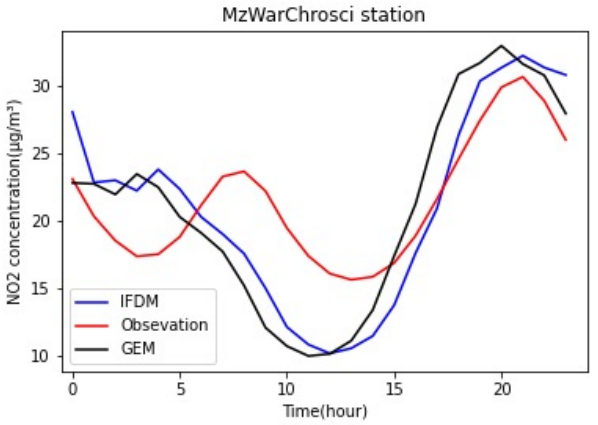




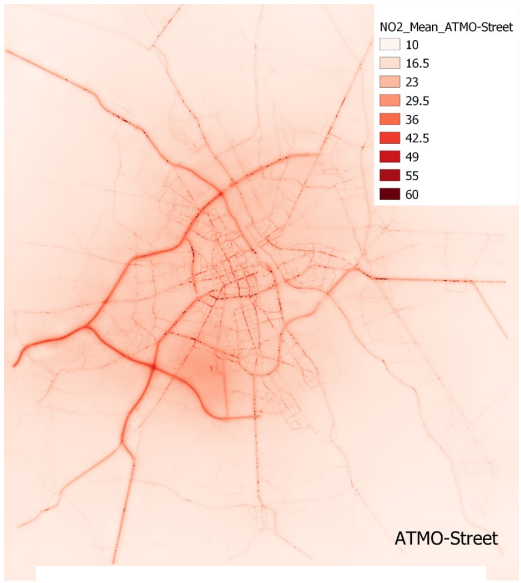


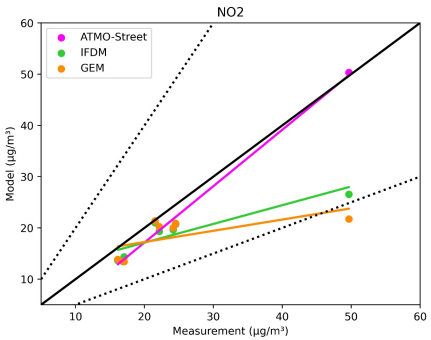


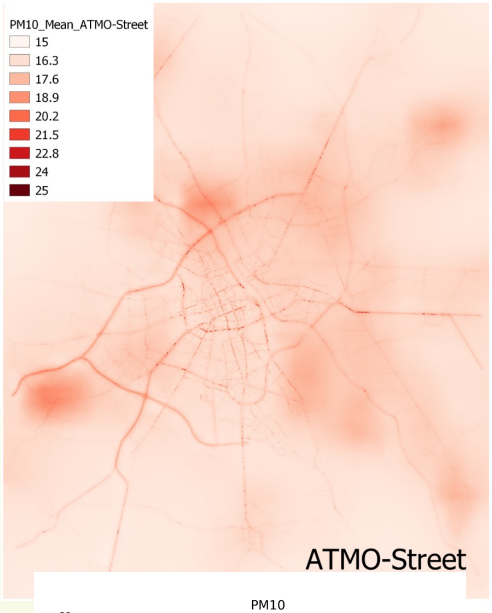


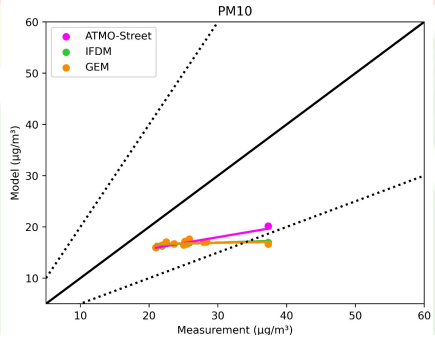


ATMO-Street model (VITO) → NO2









Summary

- YANOSIK data gives an opportunity to analyse traffic intensity and assess time factors. **Estimated emission intensity differs from the profiles used so far in the model simulations.**
- Observational data variability suggests that in the case of NO_2 concentrations follow traffic intensity estimates. In the case of PM_{10} the pattern may suggest that resuspension plays major role. For $PM_{2.5}$ the difference between traffic and urban background stations is relatively small. This may suggest that **emissions from transport sector do not play a major role and the inventory may be overestimated for $PM_{2.5}$**
- Significant differences in „traffic contributions" estimates depending on the approach and emission data applied (e.g. 2018 vs. 2021).
- ATMO-Street model underestimated PM_{10} and $PM_{2.5}$ concentrations at all sites, while NO_2 concentrations are underestimated at the urban background sites

Future work

- Further simulations with ATMO-street (new “2019 background”)
- Planned sensitivity analysis for the temporal profiles
- Simulations for Warsaw using local the model developed at IEP-NRI
- Suggested revision of PM2.5 traffic emissions
- Updated source contribution calculations (comparison 2019-2022)
- Health analysis based on AirQ+

- We will continue the analysis for Warsaw – a measurement campaign focused on PM_{10} is planned during the winter period 2022/2023 (vertical measurements with the aerostat)

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Thank you

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