MODELLING TO SUPPORT THE AIR QUALITY PLANS

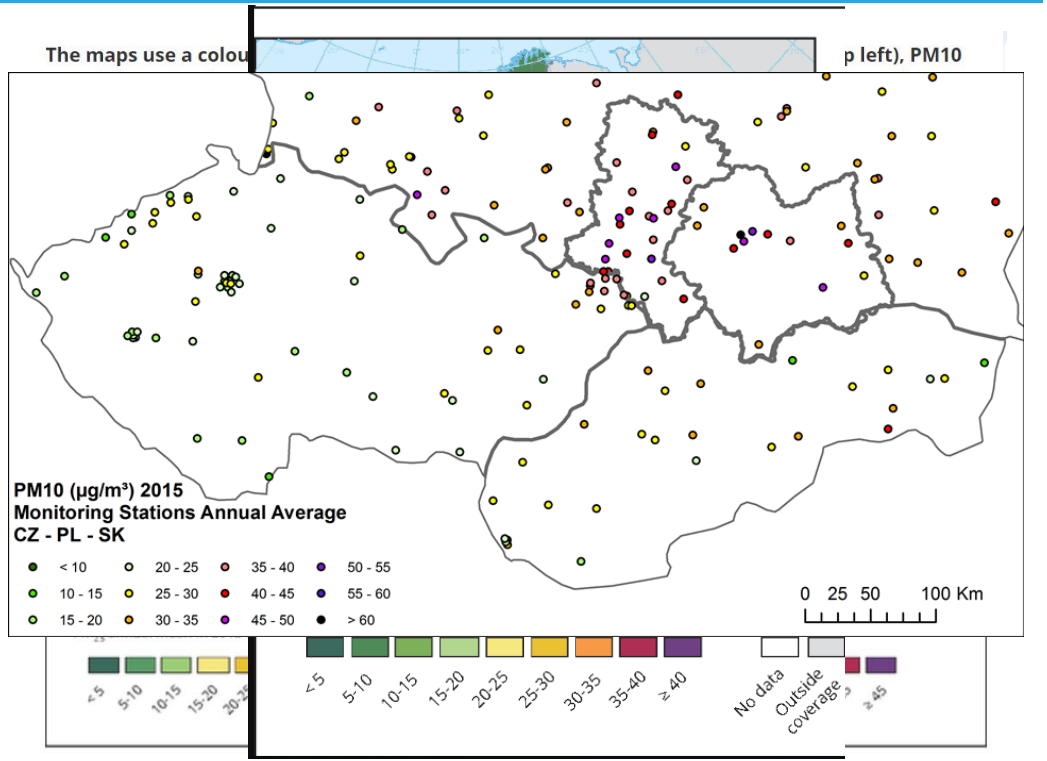
Role of VITO, CHMI & SHMU

TRANSBOUNDARY REGION – SITUATION 2013/2014

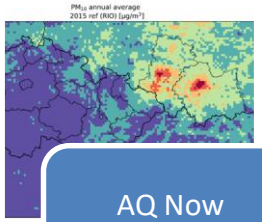
PL Regions: Malopolska, Silesia
Czech Republic
Slovakia

1. **PM_{10} / $PM_{2.5}$ /Benzo(a)pyrene**

2. **NO_2 Hotspot (Krakow..)**



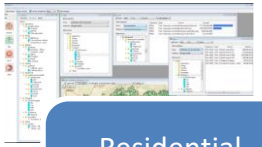
TRANSBOUNDARY REGIONAL MODELLING ACTION



AQ Now

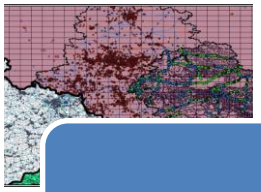
Reference Case 2015

(RIO)

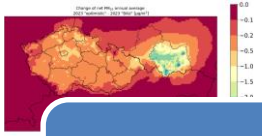


Residential Emissions 2015

(Bottom-up harmonized high resolution)



Transboundary emission database



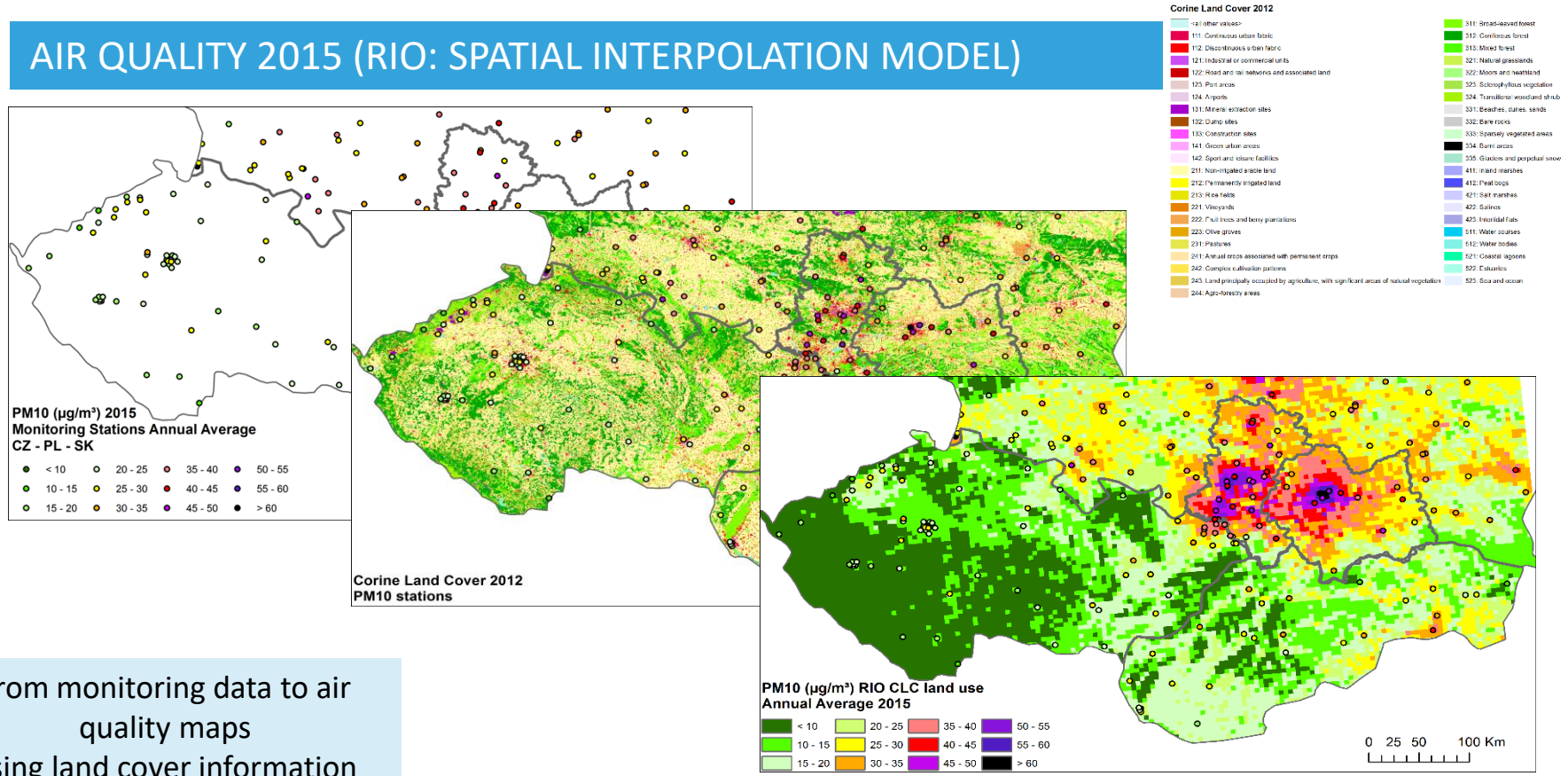
Impact of Emission Reduction Scenarios 2023

(CAMx/CMAQ)

Exchange best practices & tools (emissions, modelling..)

1. Air quality 2015
2. Bottom-up residential emissions → transboundary emissions
3. Urban AQ modelling for Krakow - Impact of transport scenarios

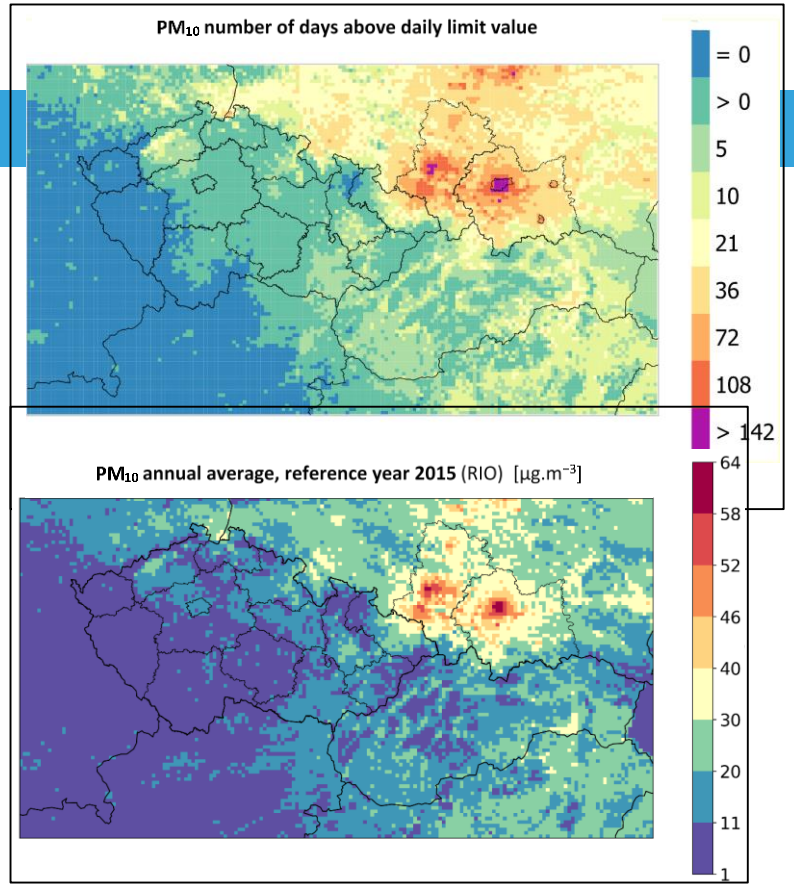
AIR QUALITY 2015 (RIO: SPATIAL INTERPOLATION MODEL)



From monitoring data to air quality maps
using land cover information and population density

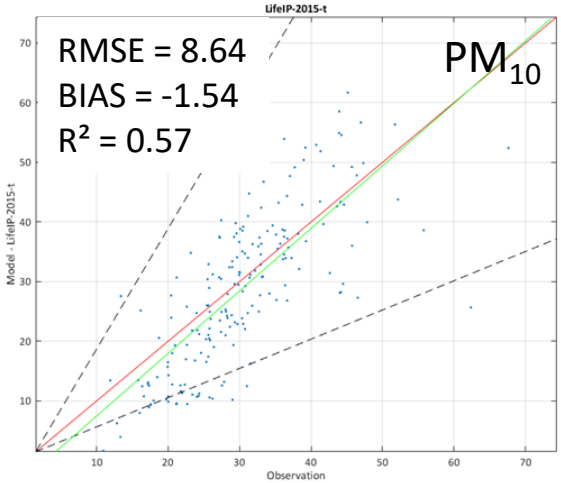
AIR QUALITY 2015

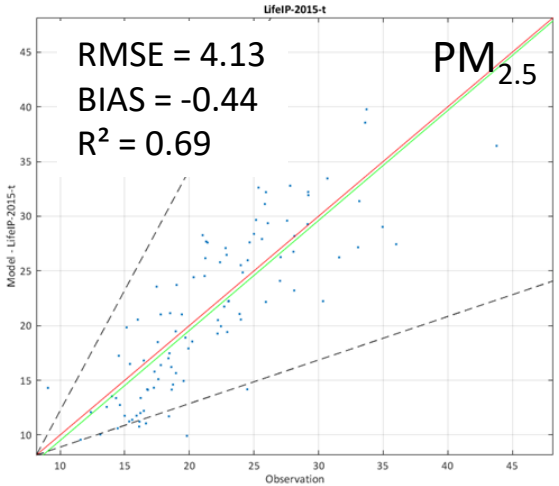
- PM10: no. of days above daily limit value 50 µgm−3 (18–105) (median 59).
- Highest concentrations in the Kraków agglomeration.
- Annual limit value and daily limit value are exceeded
  - in 20 % and 80 % of the territory of Małopolska respectively.
  - in 28 % and 85 % of the territory of Silesia respectively.
  - in 0.14 % and 1.54 % of the territory of the Czech Rep. respectively
  - (daily) in 1.1 % of the territory of Slovakia.

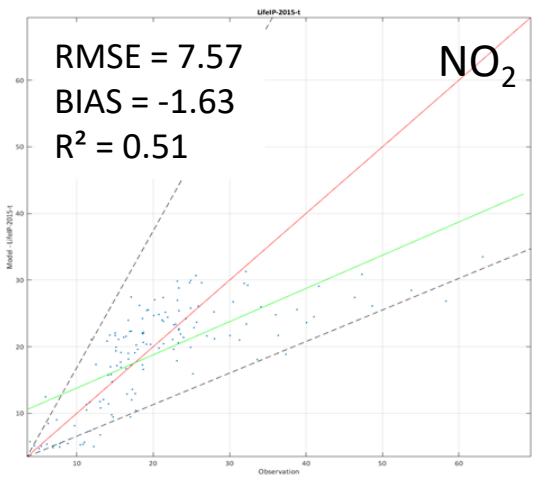


Leaving-one-out validation

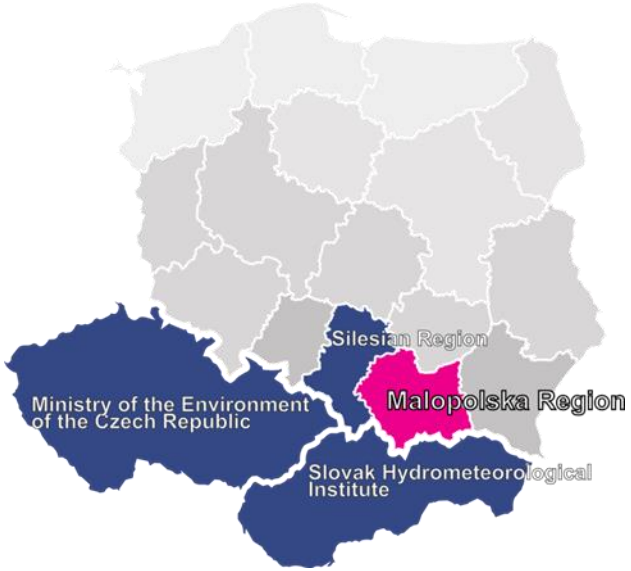
AIR QUALITY – 2015 - VALIDATION







- Spatial resolution: 4.7 x 4.7 km² grid
- Temporal resolution: hourly data



HARMONIZED (BOTTOM-UP) HIGH RESOLUTION RESIDENTIAL EMISSIONS

CONSISTENT INVENTORY FOR MODEL INPUT

PHASE 1: RESIDENTIAL EMISSIONS METHODOLOGY

Emissions (E) = Energy (heat)/Fuel consumption (‘per fuel/house’) * emission factor (EF)

- Methodology (per region): goes hand in hand with data availability & historic methods
- Harmonization of general parameters
  - Substances
  - Sectors and subsectors
  - Fuel types (e.g. detail in coal subtypes)
- Harmonization of methodologies over all sub-regions not straightforward
- Too challenging → pairwise harmonization
  - Małopolska and Silesia Region
  - Slovakia and the Czech Republic

HARMONISATION OF RESIDENTIAL EMISSION INVENTORIES

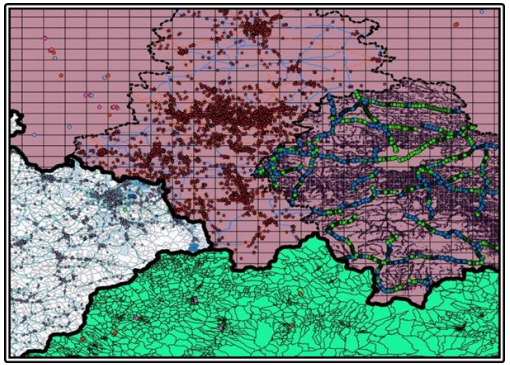
Findings: **lot of similarities (common approach), yet crucial differences exist:**

- activity data, based on
  - fuel consumption vs. heat consumption (Malopolska)
  - statistical data vs. based on surveys
- varying emission factors (EFs) taken from several sources: EMEP/EEA guidebook, literature, (local) studies, …
- different
  - level of detail (e.g. coal subtypes)
  - different approaches wrt the methodology of emissions
    availability e.g. wood consumption (SK vs CZ)

Combustion Efficiences				
Fuel type	Fuel subtype	Fuel subsubtype	CZ	SK
Solid fuels	Coal	Hard/Black Coal	0,605	0,72
		Brown coal	0,605	0,72
		Coke	0,75	0,72
		Briquettess	-	0,72
Gaseous fuels	Natural gas	-	0,942	Not provided
	LPG	-	0,884	Not provided
Liquid fuels	Fuel Oil	-	0,884	Not provided
Renewable fuels	Wood	-	0,603	0,72

OVERVIEW OF TRANSBOUNDARY EMISSIONS FOR MODELLING

- 2015 Transboundary emissions dataset
  - **New bottom-up 'harmonized' residential emissions per region (2015)**
  - Rest PL: GIOS and KOBiZE
  - CZ: national inventory REZZO
  - Rest EU: CAMS anthropogenic emissions v1.1
  - Benzo(a)pyrene emissions: Johannes Bieser Hamburg University



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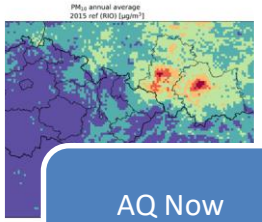

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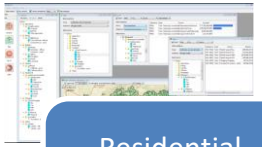

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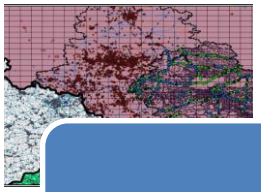

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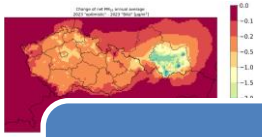

Impact of Emission Reduction Scenarios 2023

(CAMx/CMAQ)

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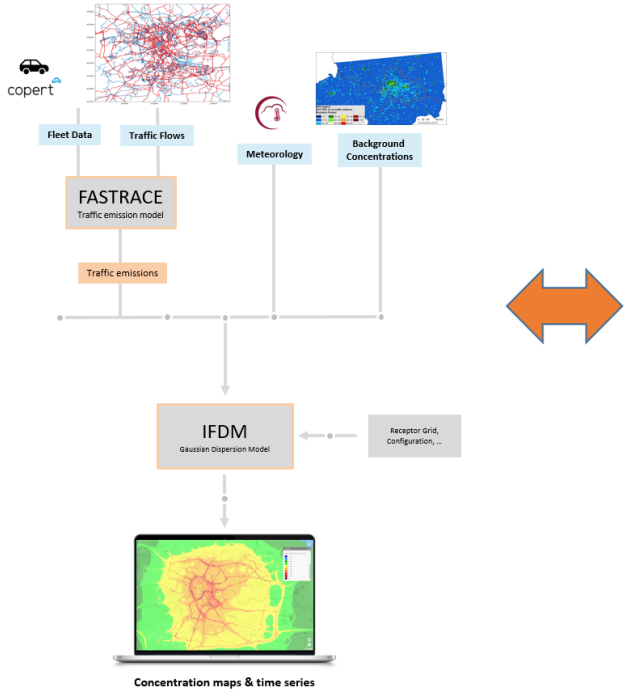
URBAN AQ MODELLING IMPACT OF TRANSPORT SCENARIOS

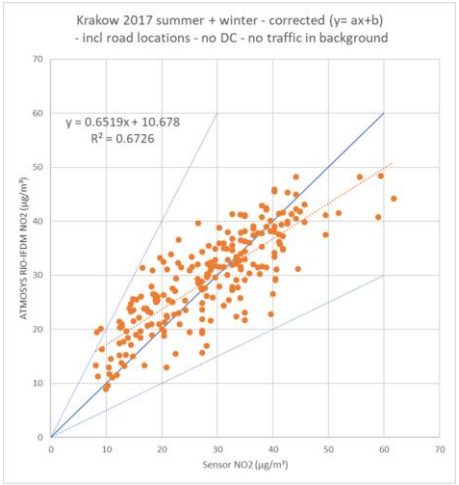
KRAKOW - NO2

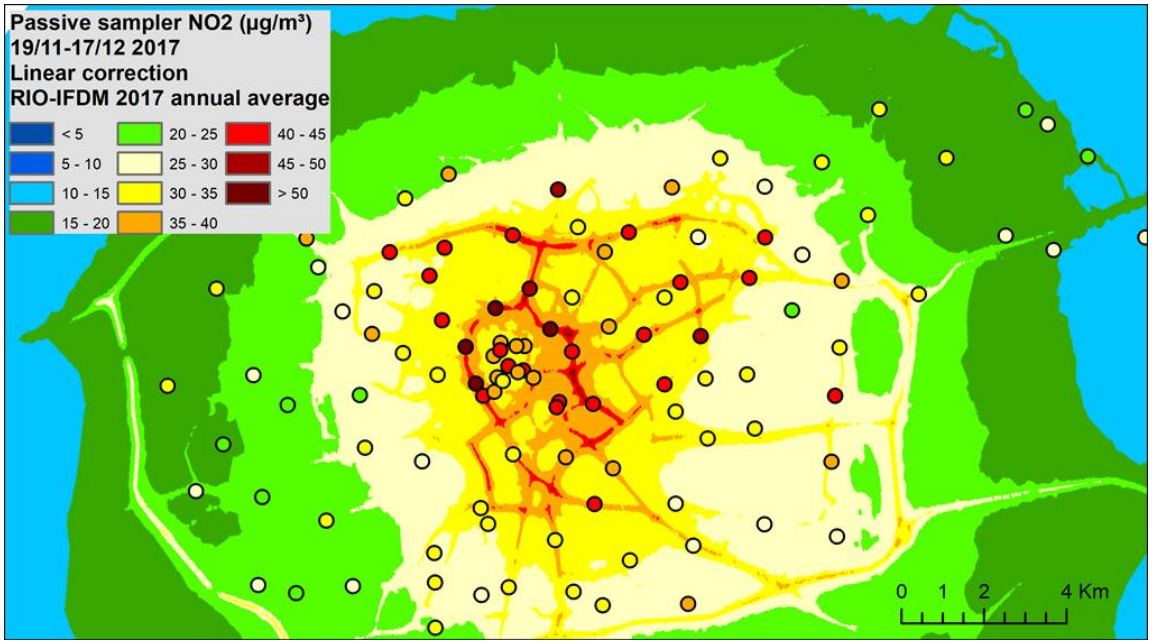
AIR QUALITY 2015 & 2017 (2019)



VALIDATION: NO2 PASSIVE SAMPLER DATA – SUMMER/WINTER 2017

High Spatial & Temporal Variation!





ASSESSING MOBILITY SCENARIOS (2015) – NEW ROAD & SHIFT IN TRAFFIC

Scenario 2015 - 1: Additional road - in the east, leading to shifts in traffic volumes.

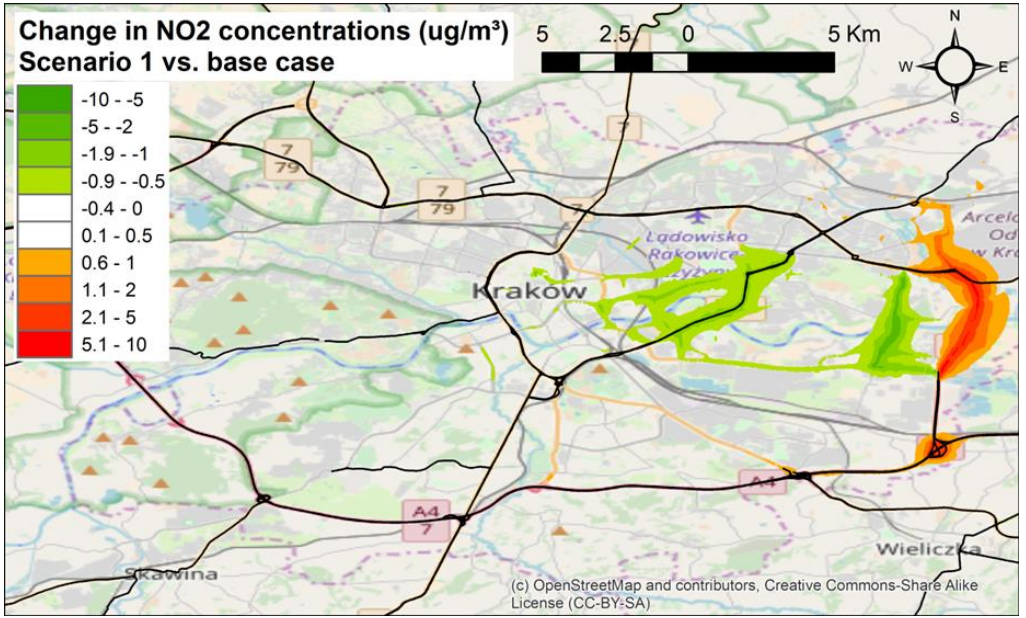


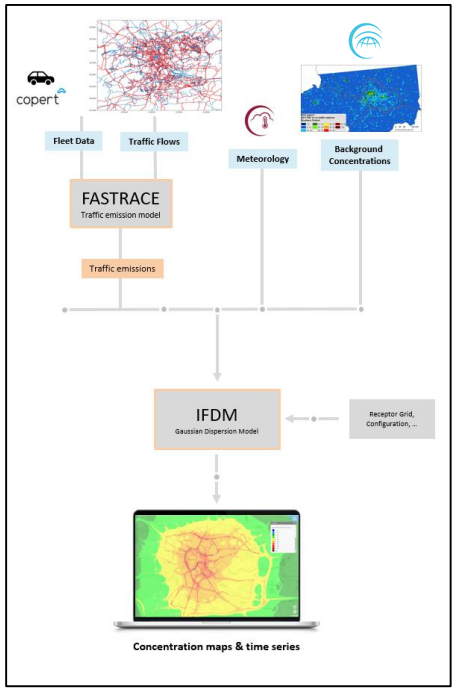
Figure : Concentration difference between the first scenario and the base case (in µg/m³) for NO_2. Negative (red) values indicate an increase in concentration when the scenario is applied. The maps provide a zoom on the Eastern side of Krakow, as all changes occur in this part.

ATMO-PLAN – ASSESSING MOBILITY SCENARIOS (LEZ, MODAL SWITCH…)

Challenge:
Significant resources, and skills needed to test the impact of scenarios.

What if:
Application to simplify the process & provide a first (screening) estimate

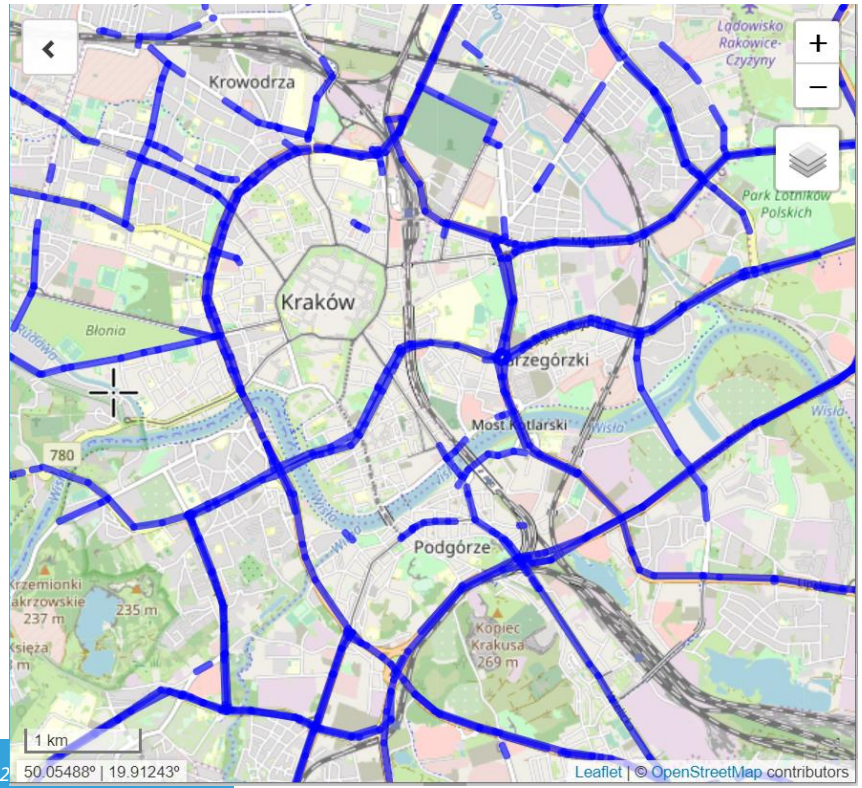
ATMO-PLAN – ASSESSING MOBILITY SCENARIOS (LEZ, MODAL SWITCH…)



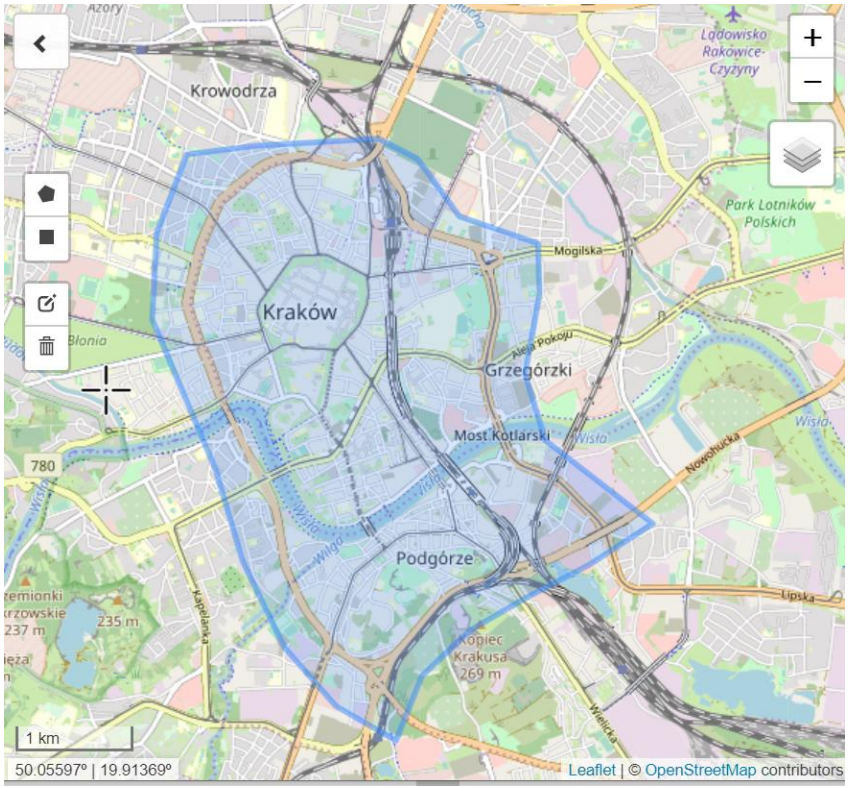
https://krakow.atmo-plan.vito.be/

SCREENING OF LEZ FOR KRAKOW - RESTRICTING PASSENGER VEHICLES TO EURO 6

Traffic network

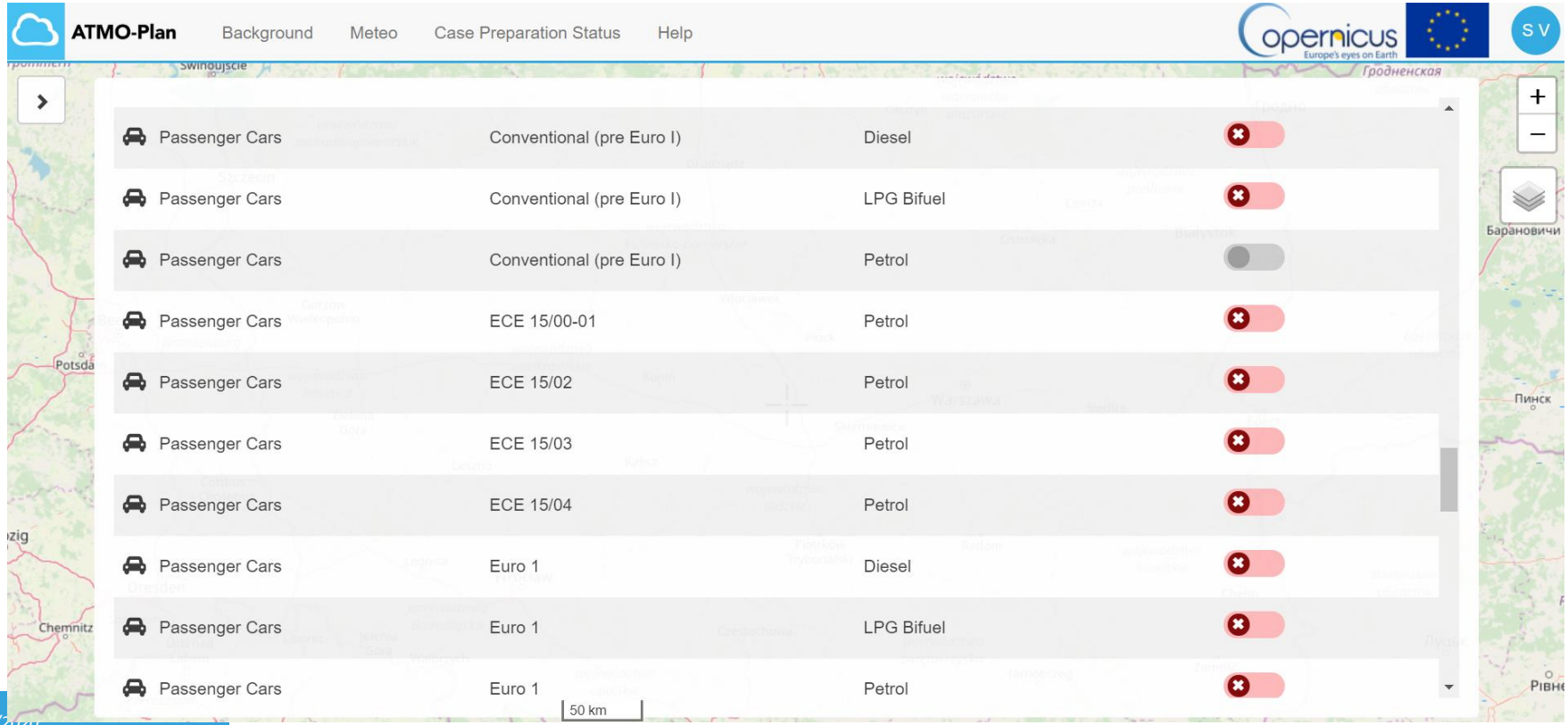


LEZ boundaries



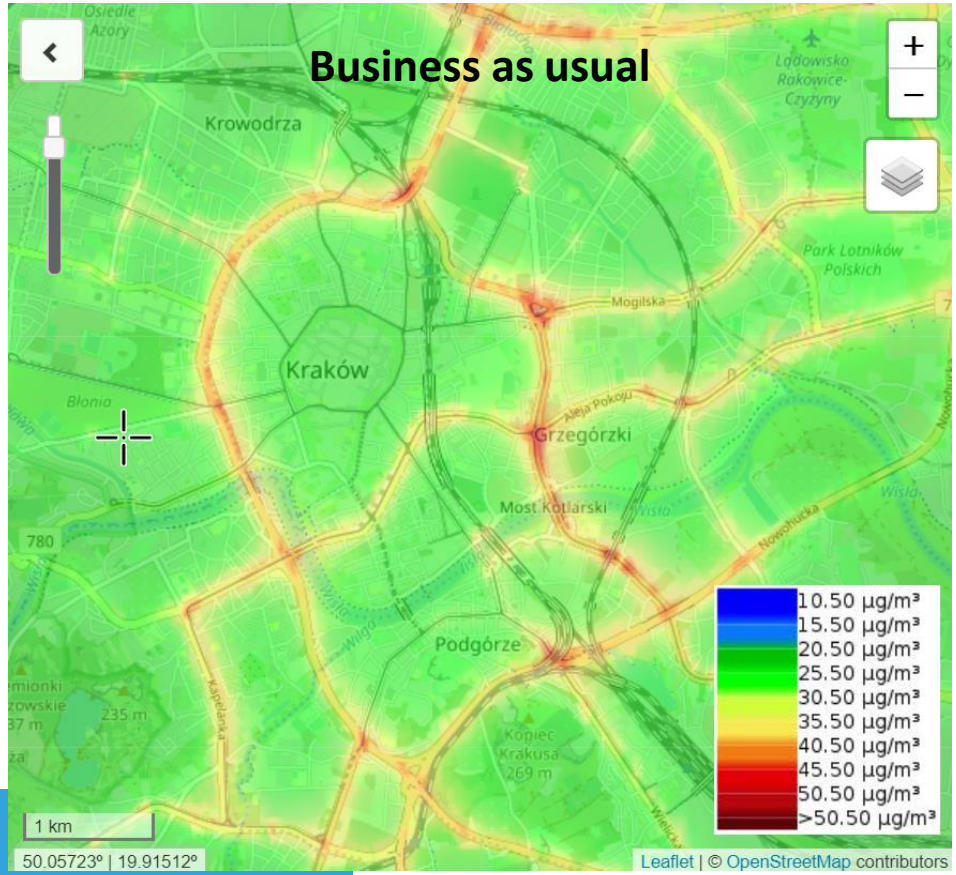
SCREENING OF LEZ FOR KRAKOW

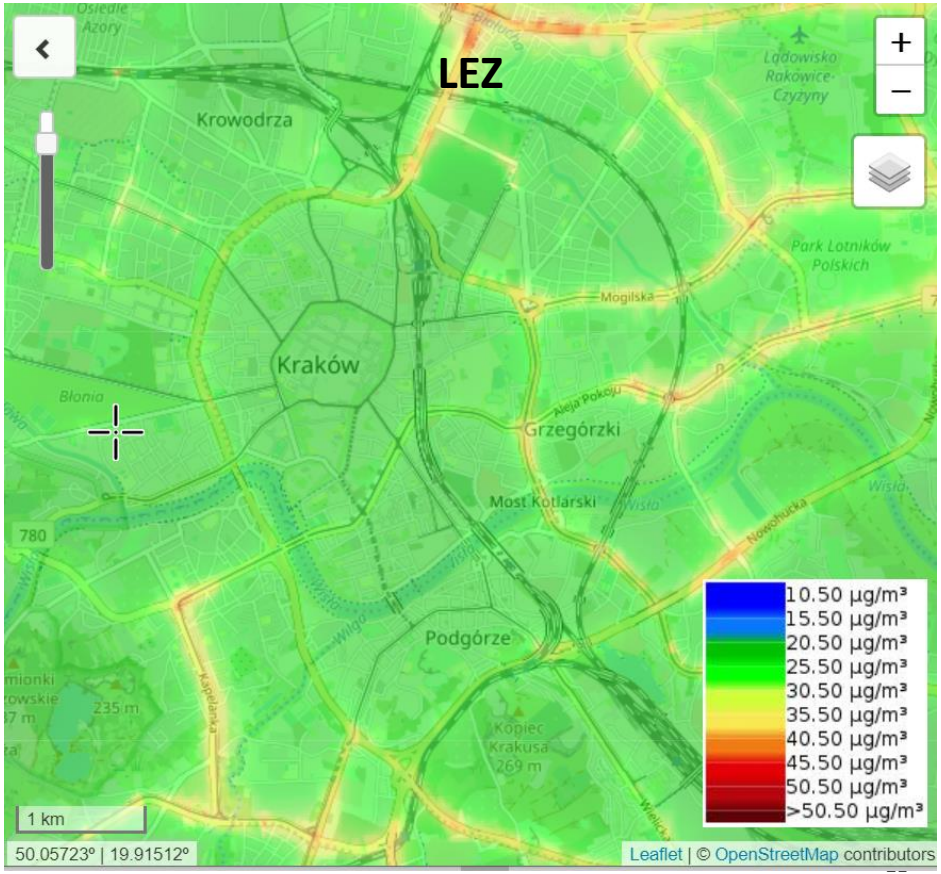
LEZ Assumptions: restricting vehicles to adapt the local fleet → EURO 6 car fleet



SCREENING OF LEZ FOR KRAKOW

Screening ambitious LEZ: impact passenger cars EURO 6 only





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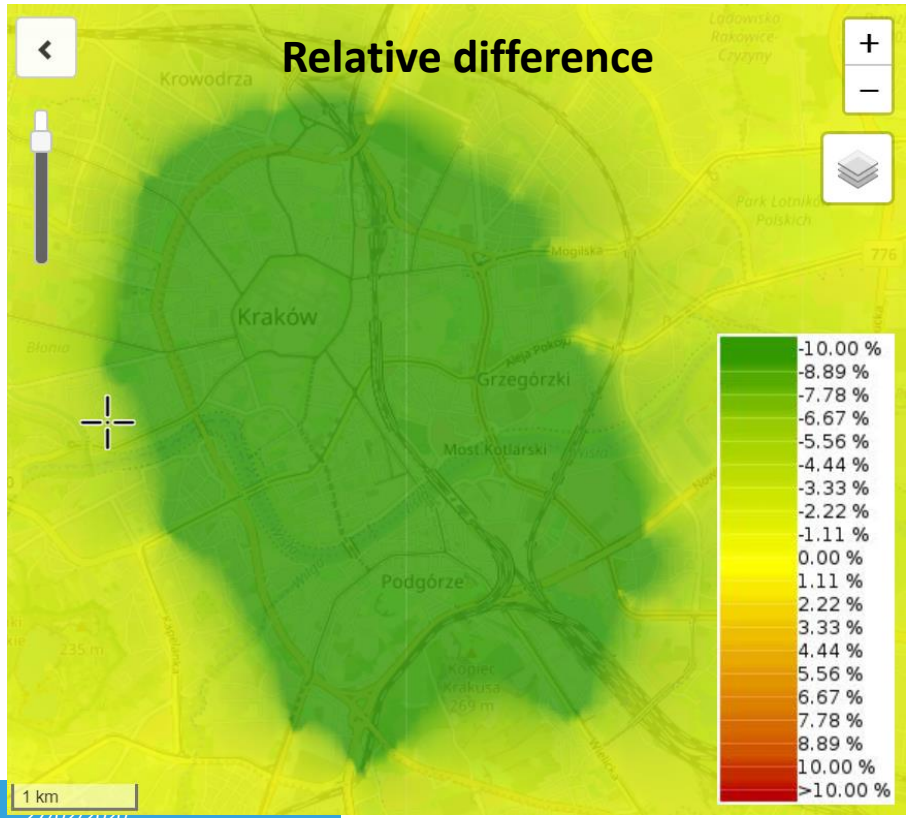
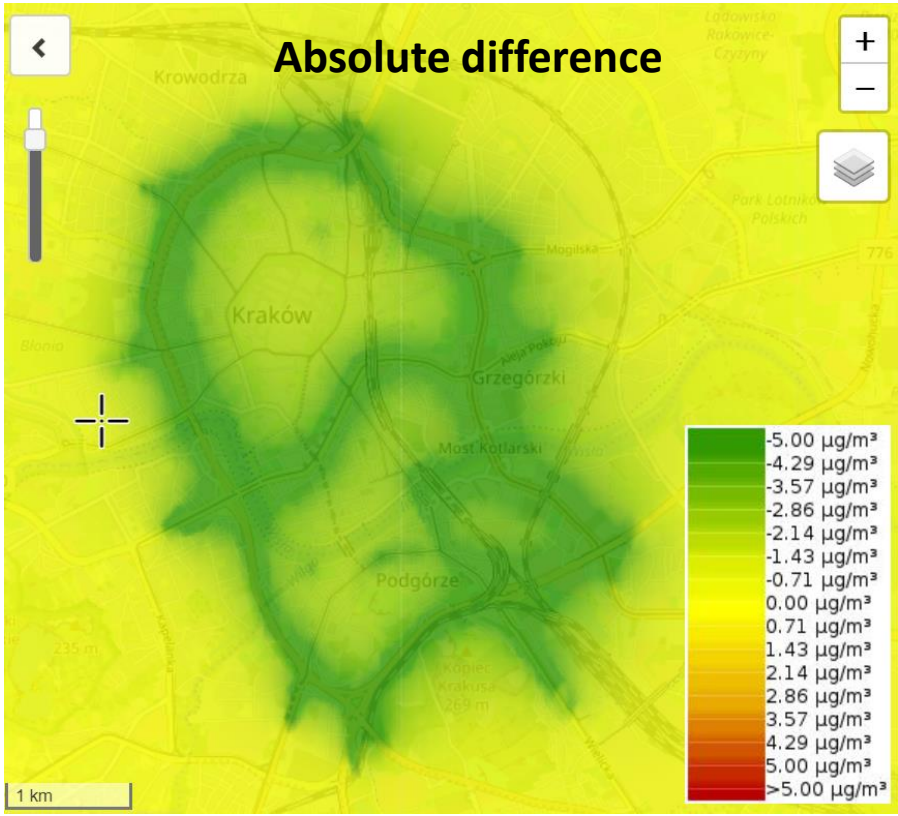
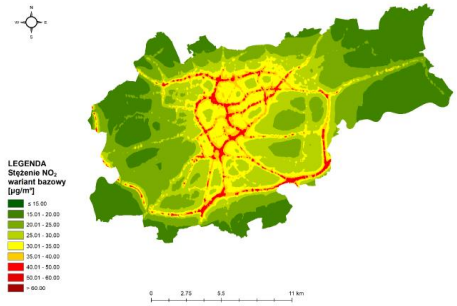


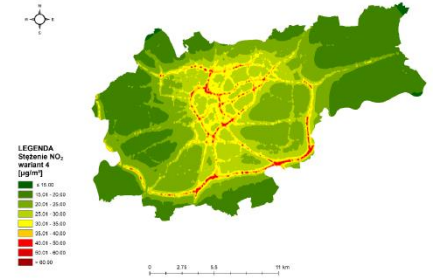


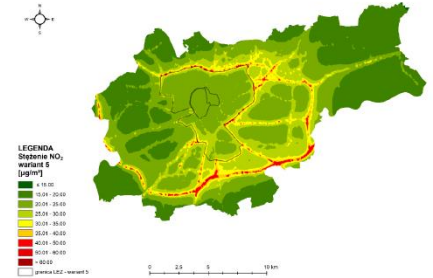
ATMOTERM & KRAKOW TRANSPORT

- Testing several LEZ variants

Variant	Network changes	Capacity changes	Speed changes
	2nd bypass road	baseline values	baseline values
Variant 3	Streets covered by the restricted traffic zone	Section capacity = 70% of baseline values	Section speed = 70% of baseline values
Variant 4	Streets covered by the restricted traffic zone	Restriction on the entry of vehicles of categories of vans, heavy duty trucks and buses in road sections of classes G, L, Z, D	Restriction on the entry of vehicles of categories of vans, heavy duty trucks and buses in road sections of classes G, L, Z, D
Variant 5	Zone A: Streets inside the 1st bypass road	Section capacity = 50 vehicles / hour	Speed = 20 km/h
	Zone A: Streets inside the 2nd bypass road	Section capacity = 36% of baseline values	Section speed = 36% of baseline values
	Zone B: Streets inside the 2nd bypass road	Section capacity = 60% of baseline values	Section speed = 60% of baseline values
	Zone C: streets inside the 3rd bypass	Section capacity = 75% of baseline values	Section speed = 75% of baseline values

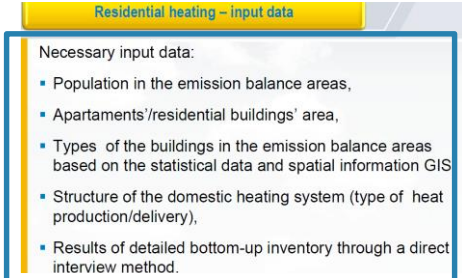






- area of the city where the zone is to be established,
- types of vehicles to be affected by zone restrictions,
- type of vehicle propulsion permitted to travel,
- variant objective

CONCLUSIONS



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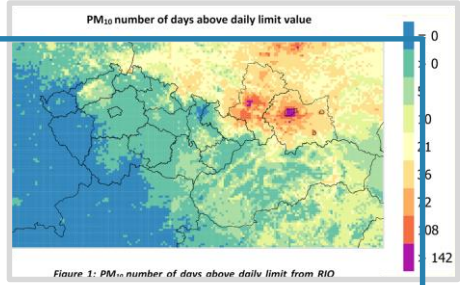
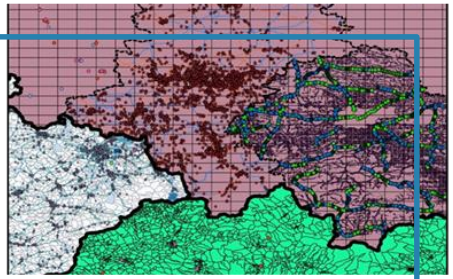
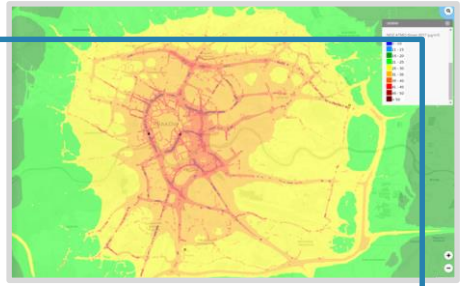


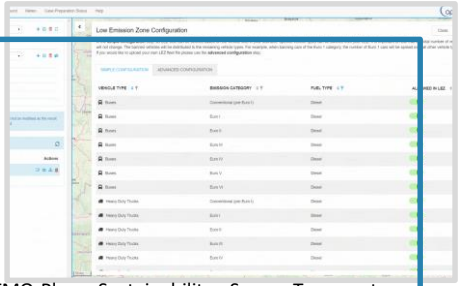
Regional AQ 2015 - PM/B(a)P



Transboundary Emissions for CTMs



Krakow – Street Level Hotspots



ATMO-Plan – Sustainability - Screen Transport Scenarios

- THANK- YOU

- lisa.blyth@vito.be