THE ADAPTATION OF THE ATMO-PLAN AIR QUALITY PLANNING APPLICATION IN HUNGARY

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HungaroMet Hungarian Meteorological Service
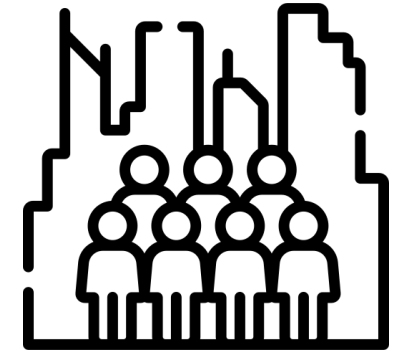Unit of Air Quality Modelling and Emission

HARMO22

Introduction

- Number of residents in urban areas is increasing
  → exposed to air pollution

- The biggest environmental problem in Hungary is:

  PM_{10}

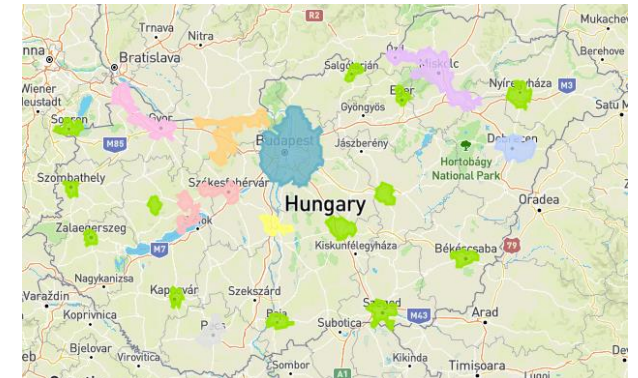 *Transportation*   *Residential heating*

  - The Ambient Air Quality Directive (2008/50/EC) sets limit and target values to regulate $PM_{2.5}$, PM_{10}, NO_2 and O_3 concentrations
    → Too high levels: air quality zones with air quality plans

Air quality zones and agglomerations in Hungary (legszennyezettseg.met.hu)

- How to plan the air quality?
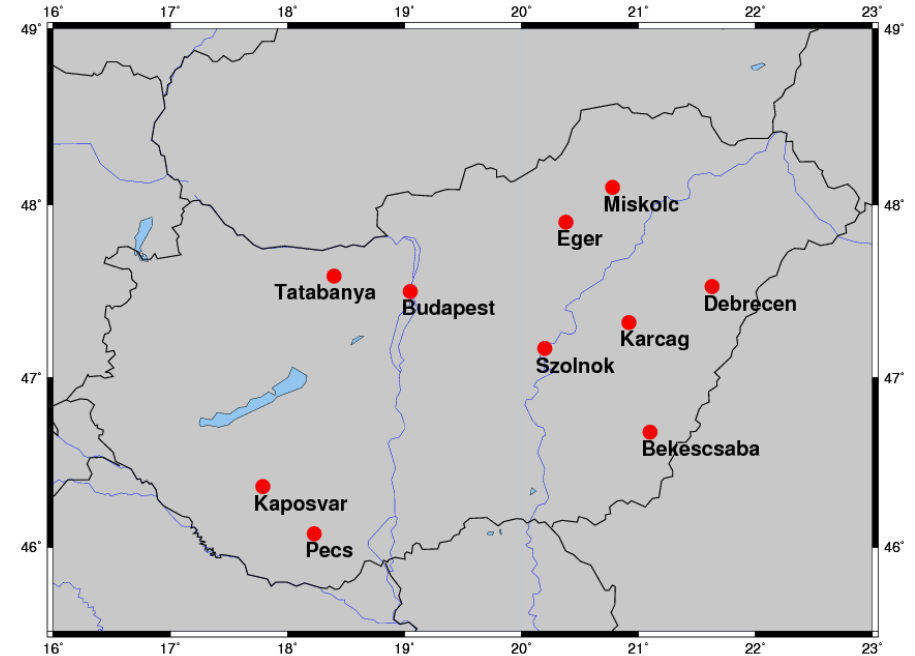 → Air quality planning application, modelling

The HungAIRy project

- Improving air quality in 8 regions by encouraging the implementation of air quality plans
- Project duration: 1/1/2019–31/12/2026
- 10 Hungarian cities involved

Installation of new air pollution monitoring stations

Reducing emissions from households

Promoting environmentally friendly modes of transport

Use of environmentally friendly farming techniques

Raising awareness and shaping attitudes

Establishing a network of eco-managers

Development of an air quality modelling tool to support decision making
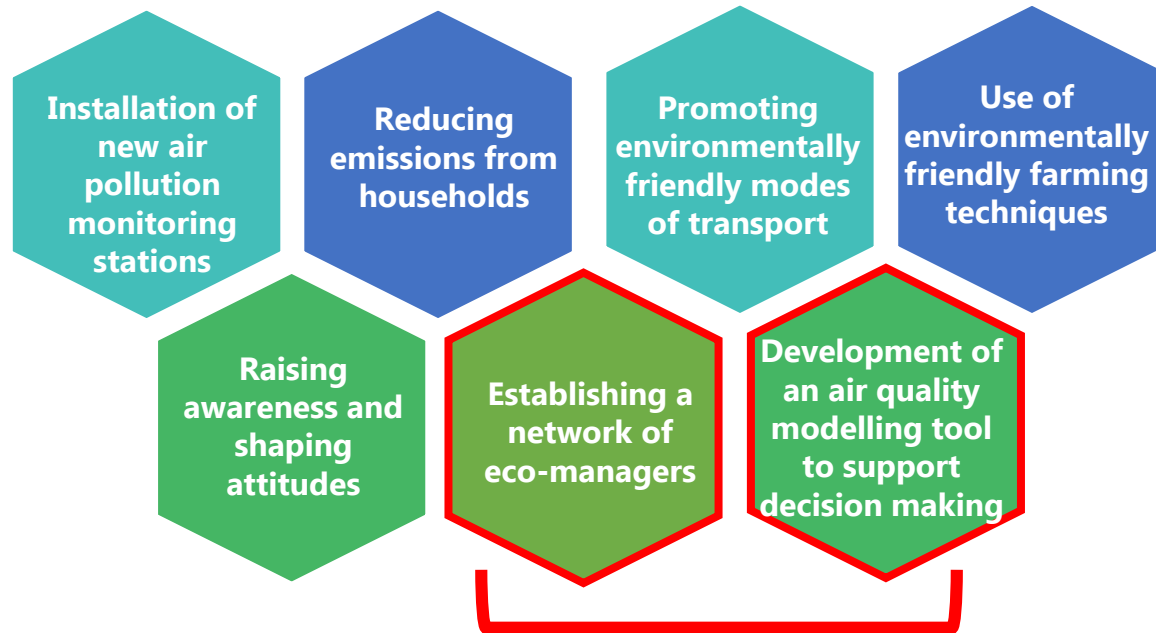
the ATMO-Plan software has been adapted to Hungary

- Role of HungaroMet:
  - project coordination
  - operation and
  - update of ATMO-Plan
  - support the eco-managers

The ATMO-Plan application
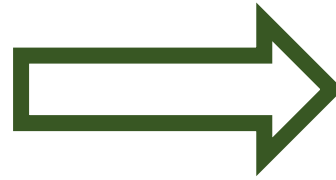
- developed by VITO (Flemish Institute for Technological Research)
- urban-scale air quality planning application
- user friendly, web-based tool

Assess the impact of air quality scenarios on the concentration of pollutants

- urban mobility scenarios
- point sources
- residential heating related measures

Calculates changes in NO_2, PM_{10} and $PM_{2.5}$ concentrations over a selected urban area with high horizontal resolution

The models behind ATMO-Plan
FASTRACE
- calculates hourly traffic emission on road segments
COPERT
- gives traffic-related emission factors
IFDM
- calculates the dispersion of pollutants
RIO
- calculates fine resolution concentration data for the whole country

ATMO-Plan can be customized for a specific country and installed at a specific user location

The Hungarian version of ATMO-Plan

The Hungarian version of the ATMO-Plan tool works with data from 2018

MEASUREMENTS

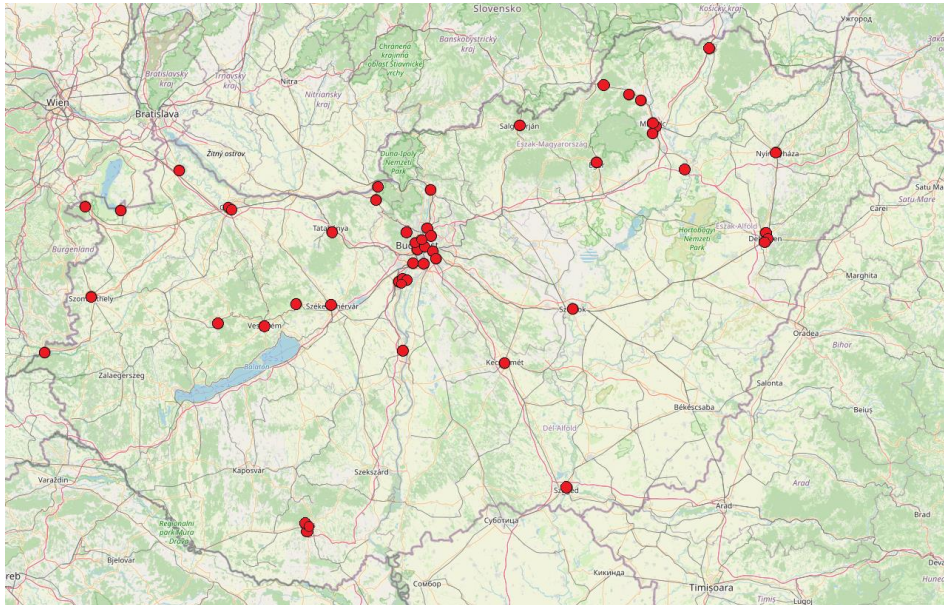- Data from Hungarian NO_2, PM_{10} and $PM_{2.5}$ monitoring stations to feed RIO

MOBILITY DATA
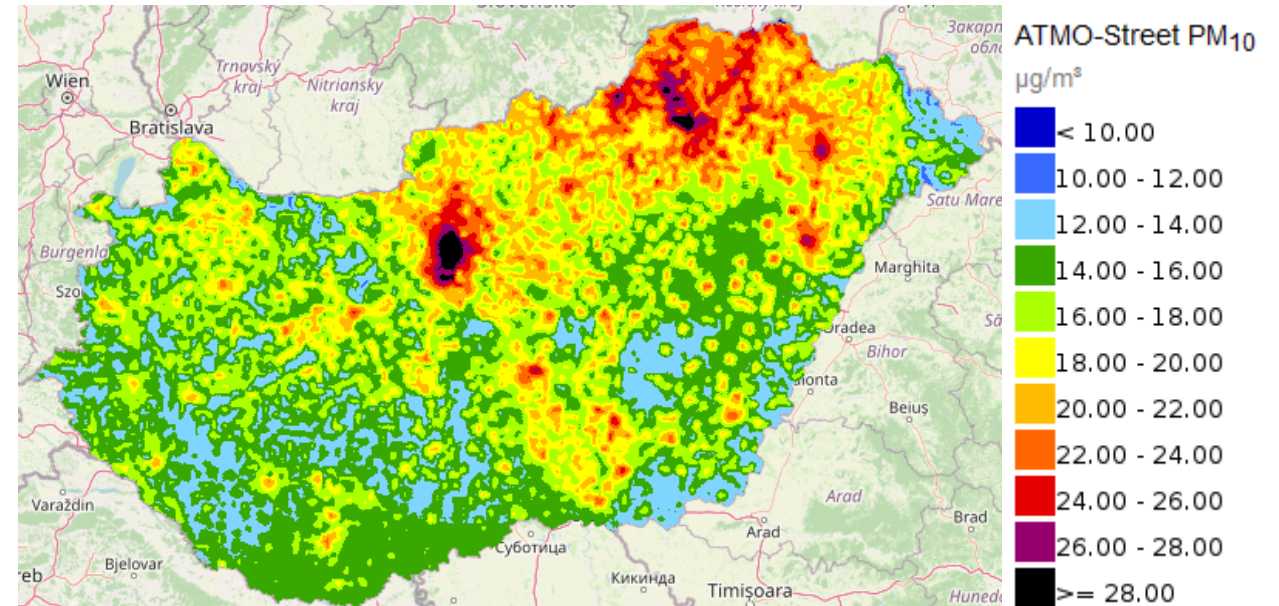
- Road network and fleet from national and municipial databases

EMISSIONS

- Gridded PM and NO_2 emissions from different types of heating appliances

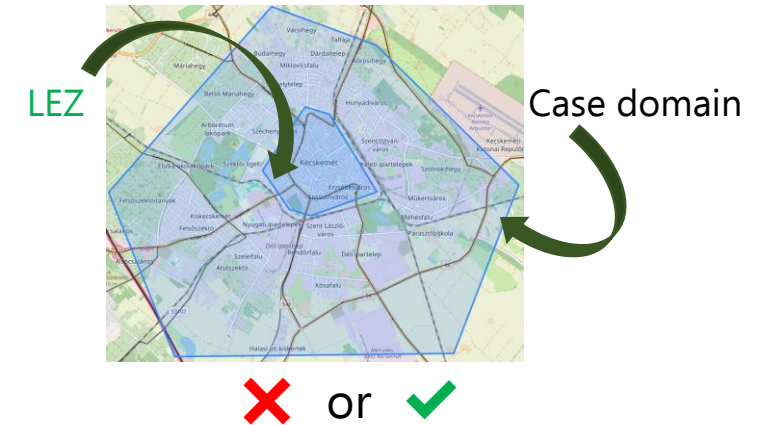Hungarian PM_{10} stations within ATMO-Plan

PM_{10} concentration map made with RIO

The traffic module of ATMO-Plan

Type of measures can be:

- Setting up a Low Emission Zone (LEZ)
- Modifying the number of cars passing a given road
- Decreasing or increasing the speed limit of a road
- Adding or removing road segments from the network

LEZ   Case domain

❌ or ✔

Road segment informations

Traffic count

- Yearly total number of:
  - bus
  - car
  - high duty vehicle
  - low duty vehicle

Segment properties

- speed limit (km/h)
- height (m)
- road type (urban; rural; highway)

Transport emissions are calculated by the FASTRACE model

| LEZ Configuration		
Vehicle type	**Emission**	**Fuel**
Bus	Conventional (pre Euro 1)	Diesel
Heavy Duty Truck	EEV	CNG
L-Category	Euro 1	Petrol
Light Commercial Vehicle	Euro 2	Diesel Hybrid CS
Passanger Car	Euro 3	Petrol Hybrid CS
	Euro 4	Electric
	Euro 5	LPG
	Euro 6	Petrol Hybrid PHEV
	PRE ECE	
	Euro 6D	
	Euro 6DT	

$$Emission(pol, h, d, m) = TF(h, d, m) \times \sum_{vt,sp} \text{EF}(vt, sp, pol) \times \text{kms}(vt, sp)$$

Setting up a Low Emission Zone inside Kecskemét

We created a Low Emission Zone within the city and banned the diesel buses and heavy duty trucks from entering this zone.

LEZ

Case domain

NO2 relative difference (%)

Location 2
Location 1
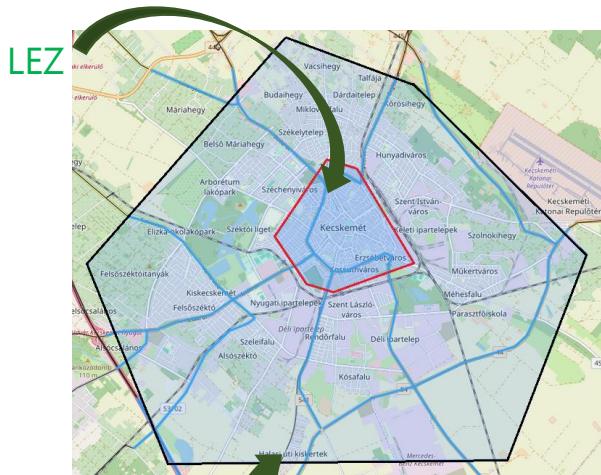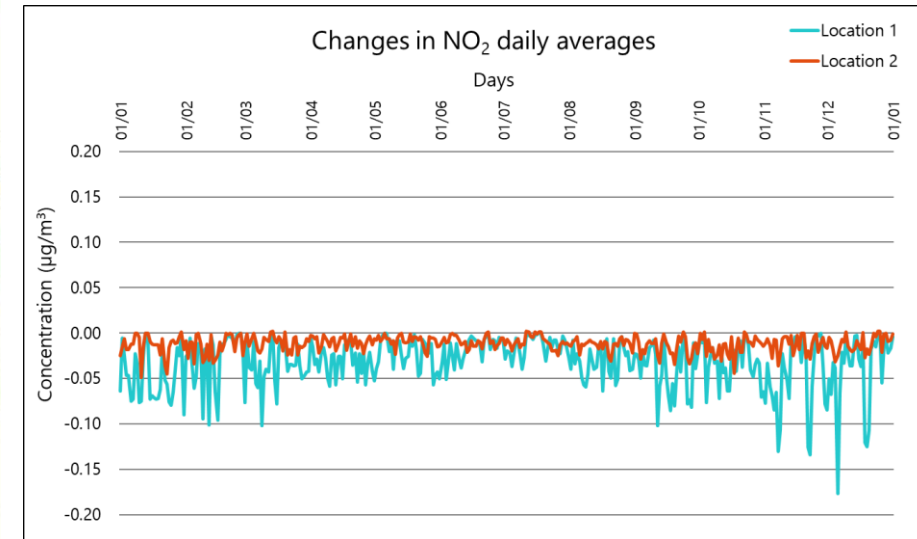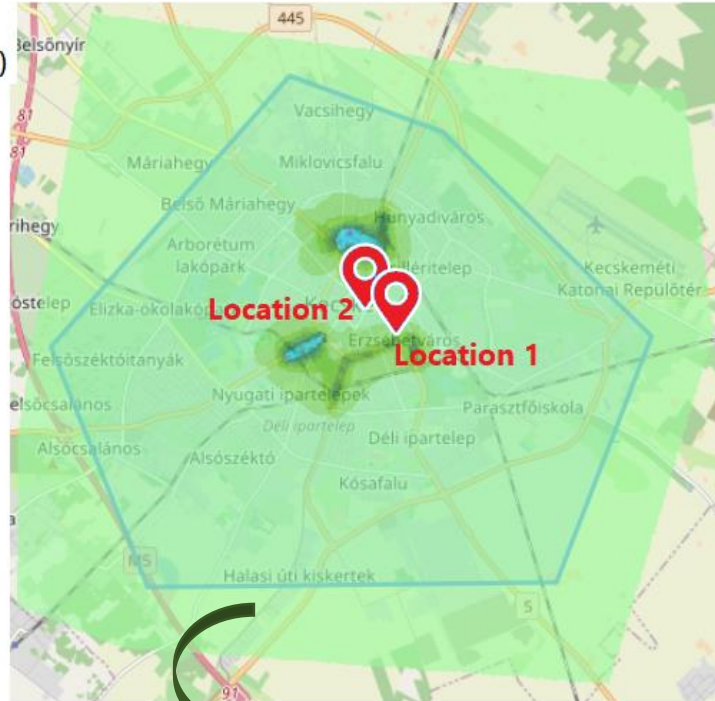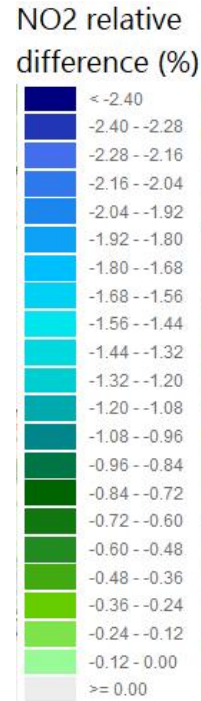
Changes in yearly averages

Very few roads available in the city center

Changes in NO₂ daily averages
Location 1
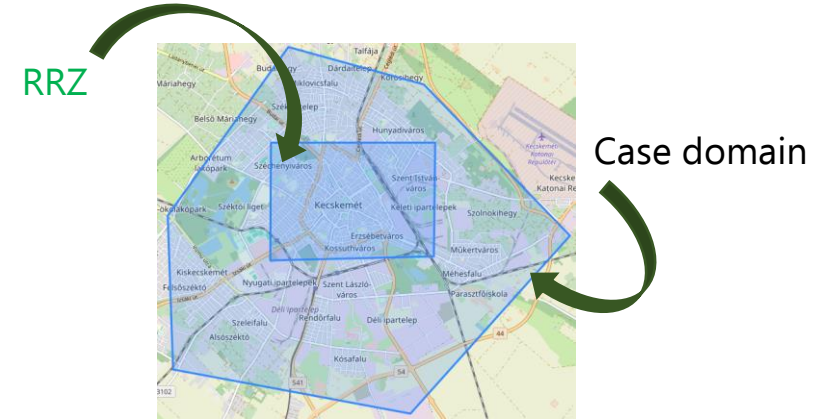Location 2
Days
Concentration (µg/m³)

The residential heating module of ATMO-Plan

Type of measures can be:

- Energy efficiency improvements in buildings
- Modernisation of heating equipment
- Replacement of heating equipment or fuel

Definition of a Residential Restriction Zone

RRZ

Case domain

No calculation of emissions from residential heating!

Multiple emission maps inside ATMO-Plan
- 1 map/appliance/fuel/dwelling/pollutant
- sum: total emission/year of a pollutant

Scenario = scaling of total emission map and/or individual maps

Residential Restriction Zone configuration			
Pollutant	**Dwelling**	**Fuel**	**Appliance**
NO_2	Apartment	Biomass	Boiler
PM	Family house	Coal	Stove
		Gas	

$$Scenario\ emission\ map$$
$$=$$
$$(Energy\ efficiency\ measure) \times [map1 \times reduction\ factor1 + map2 \times reduction\ factor2 + \cdots + mapN \times reduction\ factorN]$$
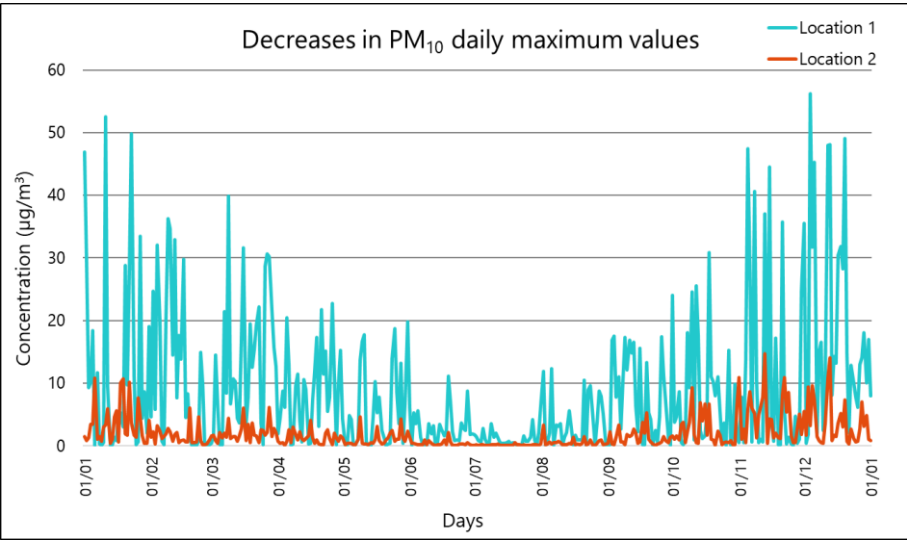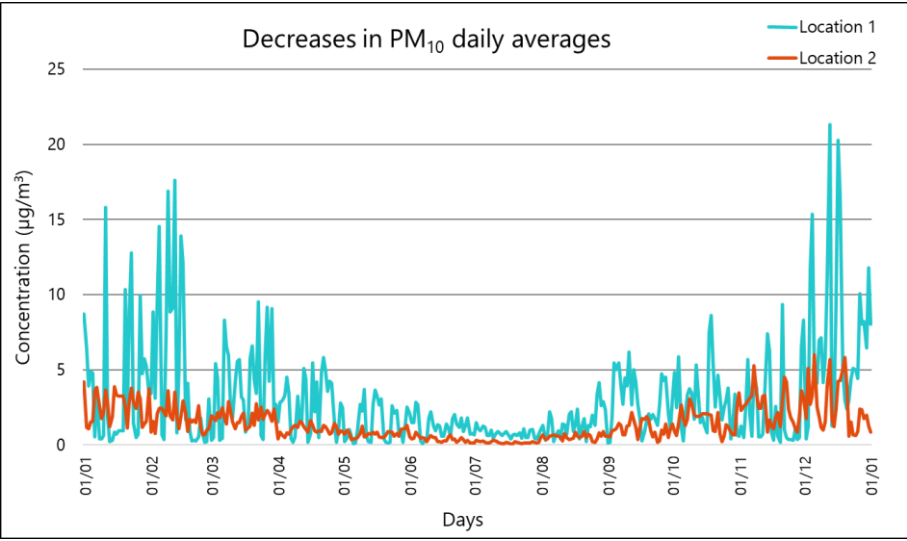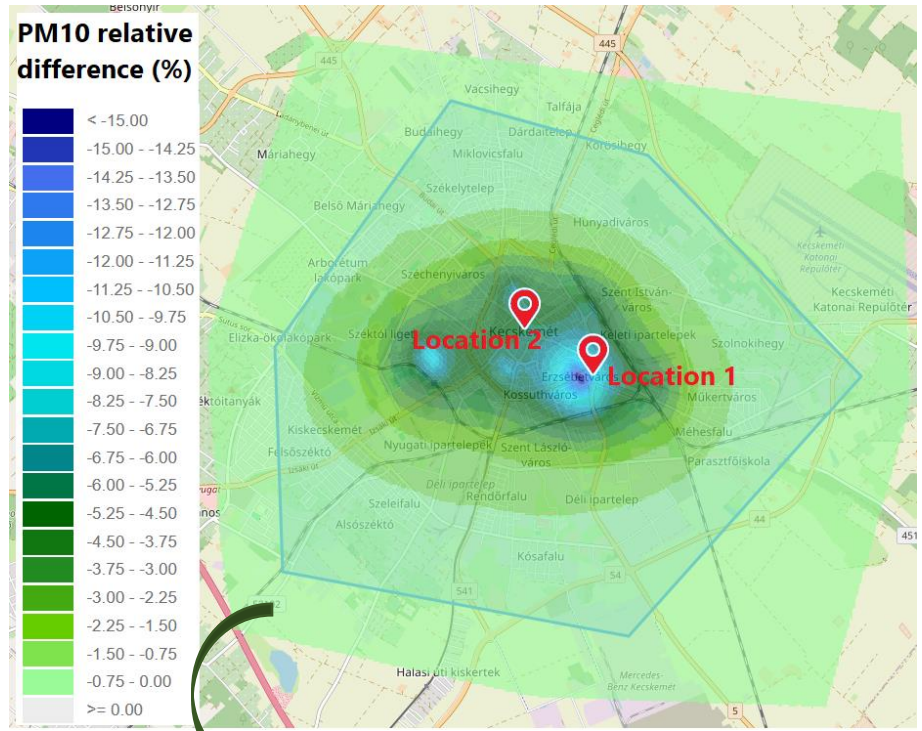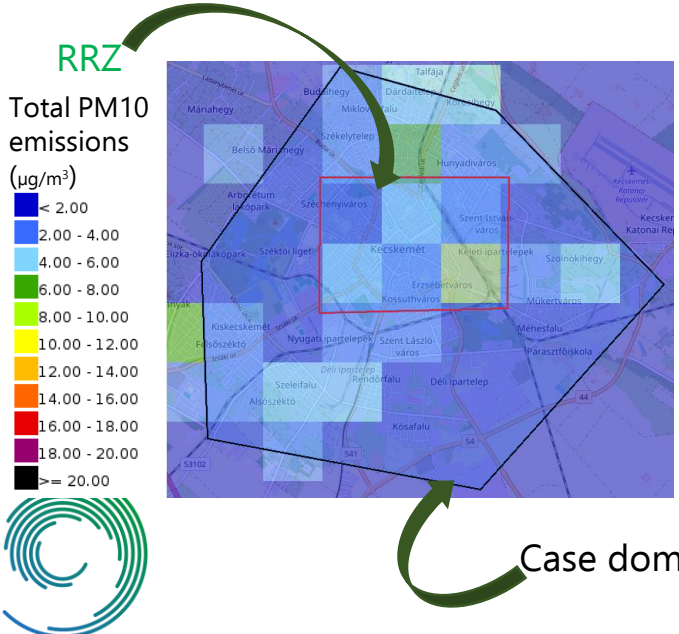
%   %

Setting up a Residential Restriction Zone inside Kecskemét

We defined a zone in the city where we replaced 75% of biomass stoves and boilers with gas and 5% with non-combustible appliances.

PM10 relative difference (%)

	< -15.00
	-15.00 – -14.25
	-14.25 – -13.50
	-13.50 – -12.75
	-12.75 – -12.00
	-12.00 – -11.25
	-11.25 – -10.50
	-10.50 – -9.75
	-9.75 – -9.00
	-9.00 – -8.25
	-8.25 – -7.50
	-7.50 – -6.75
	-6.75 – -6.00
	-6.00 – -5.25
	-5.25 – -4.50
	-4.50 – -3.75
	-3.75 – -3.00
	-3.00 – -2.25
	-2.25 – -1.50
	-1.50 – -0.75
	-0.75 – 0.00
	>= 0.00

Location 2   Location 1

Changes in yearly averages

RRZ

Total PM10 emissions ($\mu g/m^3$)

	< 2.00
	2.00 – 4.00
	4.00 – 6.00
	6.00 – 8.00
	8.00 – 10.00
	10.00 – 12.00
	12.00 – 14.00
	14.00 – 16.00
	16.00 – 18.00
	18.00 – 20.00
	>= 20.00

Case domain

Exceedances of 50 $\mu g/m^3$ limit value of PM_{10}	Location 1	Location 2
Base	38	30
Scenario	28	25

Decreases in PM_{10} daily averages — Location 1, Location 2

Decreases in PM_{10} daily maximum values — Location 1, Location 2

Challanges

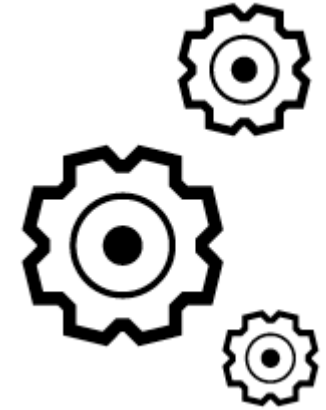- Number of measurement sites with accurate data

- Find best setup within RIO to give the closest approximation to reality

- Lack of mobility data inside some cities

- Translate measures into numerical values

- The calculation is for a whole year; it can't be run over a short period of time

Reliable baseline runs

Using additional information:
- Traffic model
- Source-apportionment

Scaling of residential emissions:
- Excel table to help set the values (takes into account the changes in emission factors)
- maximum allowed 0–200%
  - Above 200%: Further calculation in a GIS software

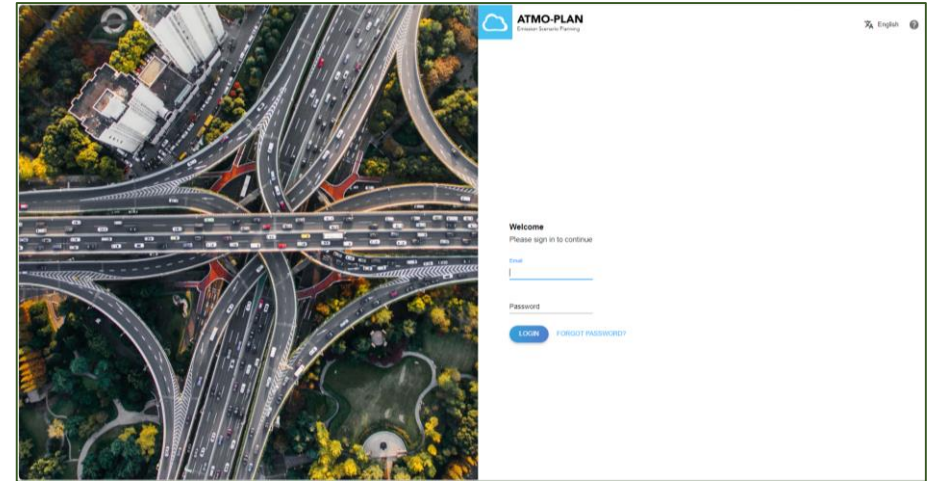Measures during episode situations can't be tested

Conclusions

ATMO-Plan:

- air quality planning application with two main moduls: traffic and residential heating

The implementation of the ATMO-Plan application greatly advanced the air quality management in Hungary

- translation into Hungarian
- continuous training courses
- Hungarian documentation

Eco-managers: share experiences, feedback

In the future, we would like to change the base year for the calculations and supplement the model with additional mobility data.

Thank you for your attention!

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