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

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Abstract: According to the Ambient Air Quality Directive, zones must be created where the concentrations have exceeded the limit values of the regulated pollutants. In these zones air quality plans must be introduced, with the implementation of which it is possible to ensure that air quality improves in the shortest time possible.An eco-manager network is constructed within the framework of the LIFE IP HungAIRy (LIFE17 IPE/HU/000017) project in Hungary. The task of the eco-managers is the preparation of air quality plans and the ATMO-Plan software developed by VITO has been adapted to Hungary to help their work.

Key words: *air quality plan, air quality directive, policy support, ATMO-Plan*

INTRODUCTION

The world's population is growing, along with this, the number of residents in urban areas is also increasing. Individuals who reside in urban areas are more likely to be exposed to air pollution (Liang and Gong, 2020). At least 238,000 people died in the EU from $PM_{2.5}$ pollution in 2020 (EEA, 2022). The biggest environmental problem in Hungary is PM_{10} particulate matter pollution, the main source of which is transportation and residential heating. The Ambient Air Quality Directive regulates the concentrations of air pollutants such as $PM_{2.5}$, PM_{10}, NO_2 and O_3, by setting limit and target values for the protection of human health (Directive 2008/50/EC). Where the concentrations have exceeded the limit values of pollutants, air quality zones must be created. In these zones air quality plans must be introduced, with the implementation of which it is possible to ensure that air quality improves in the shortest time possible. We must take steps to comply with air quality limits in Hungary too.

The most suitable help for this is an application optimized for Hungary, which focuses on current local problems and provides the appropriate background data. An eco-manager network is constructed within the framework of the LIFE IP HungAIRy (LIFE17 IPE/HU/000017) project in Hungary. The task of the eco-managers is the preparation of air quality plans and the ATMO-Plan software developed by VITO has been adapted to Hungary to help their work. The HungaroMet Hungarian Meteorological Service (HungaroMet) is responsible for the operation and update of the Hungarian version of ATMO-Plan.

THE ATMO-PLAN AIR QUALITY PLANNING APPLICATION

The ATMO-Plan application is developed by VITO (Flemish Institute for Technological Research) and is part of a larger system called ATMOSYS. Within the ATMOSYS system, we can find models for making air quality forecasts, assessments and plans. ATMO-Plan is an urban-scale air quality planning application. It is a user-friendly and web-based tool. It can be used to assess the impact of air quality scenarios on the concentration of pollutants. ATMO-Plan can be customized for a specific country and installed at a specific user location. Since this model works with a very fine spatial resolution, it is worth using it with your country-specific data to get more reliable results.

It was originally designed to examine the impact of urban mobility scenarios on the air quality. But it also includes point sources thus we can simulate measures aimed at modifying their emissions. The recently added capability of the model is to assess the impact of residential heating related measures too. As a result, ATMO-Plan calculates changes in NO_2, PM_{10} and $PM_{2.5}$ concentrations over a selected urban area with high horizontal resolution.

The Hungarian version of ATMO-Plan

The Hungarian version of the ATMO-Plan tool works with data from 2018. The model needs information on air quality, meteorology and emissions to calculate the effects of different measures on the air quality of a specific region. The concentration data for the calculation comes from the RIO interpolation model, which requires as input spatially representative concentration measurements and geospatial data. The traffic module of the application uses road network data (several road segments with a specific road type with traffic counts and the average speed) and fleet data (number of vehicles per vehicle type with the annual mileage per vehicle type). Both dataset types are of national or municipal origin. In the case of the residential module, the emissions of different types of heating appliances used for residential heating are included in the model with a resolution of 1 km x 1 km. This emission data is prepared by the Unit of Air Quality Modelling and Emissions of HungaroMet.

WHAT TYPE OF MEASURES CAN BE EXAMINED WITH ATMO-PLAN?

The ATMO-Plan application first calculates the base case using the original input datasets. After that, we can create different scenarios in which we modify the mobility data, the point source emissions or the emissions coming from residential heating. Within ATMO-Plan, the FASTRACE model calculates the traffic emissions of the base case and the traffic scenarios on the basis of the given mobility data. On the other hand, the model does not calculate emissions from domestic heating, but only scales the ratio of emissions from different heating appliances.

Mobility measures

There are four main types of mobility measures that the model can handle: setting up a Low Emission Zone, modifying the number of cars passing a given road, decreasing or increasing the speed limit of a road, and adding or removing road segments from the network. In Figure 1, we see the changes in the yearly mean NO_2 concentrations over Kecskemét due to a traffic measure calculated with ATMO-Plan.

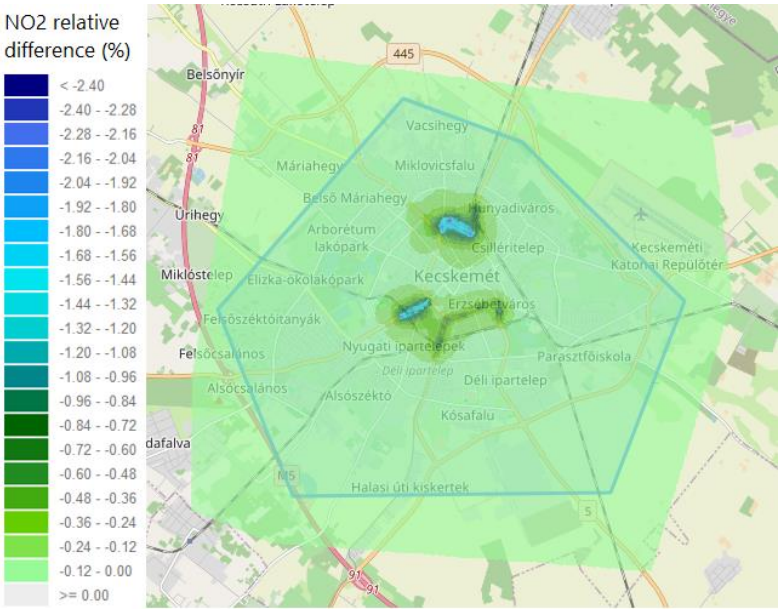

Figure 1. The change in the yearly mean NO_2 concentrations over Kecskemét due to a traffic measure expressed as percentage values. The measure was to create a Low Emission Zone in a large area of the city centre with a ban on diesel buses and heavy duty trucks.

We created a Low Emission Zone within the city and banned the diesel buses and heavy duty trucks from entering this zone. We can identify two areas in the result map where the NO_2 concentration decreases by more than 1.5%.

Domestic heating-related measures

Within ATMO-Plan, there are three types of measures related to domestic heating: energy efficiency improvements in buildings, modernisation of heating equipment and replacement of heating equipment or fuel. In Figure 2, we see the changes in the yearly mean PM_{10} concentrations over Kecskemét due to a domestic heating-related measure calculated with ATMO-Plan. We defined a zone in the city where we replaced 75% of biomass stoves and boilers with gas and 5% with non-combustible appliances. The replacement of fuel resulted in maximum 15% reduction in the PM_{10} concentration over the area with high emission coming from biomass burning. We can also see that a larger part of the city is benefiting from this measure as well.

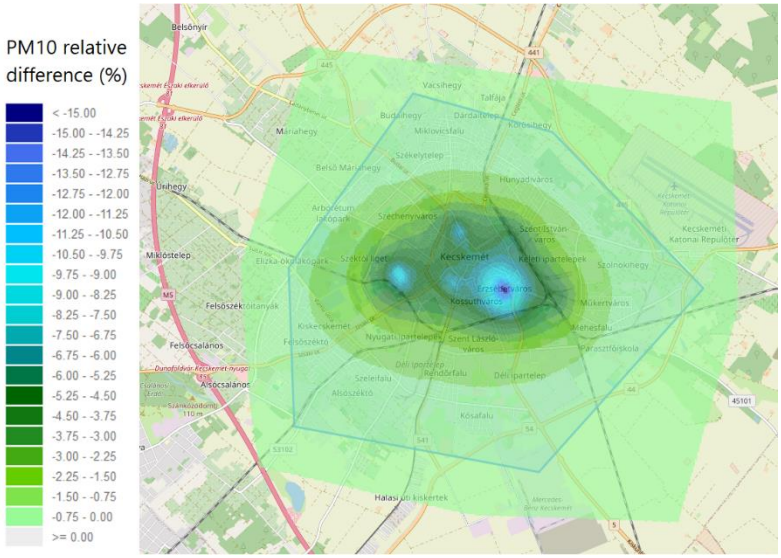

Figure 2. The change in the yearly mean PM_{10} concentrations over Kecskemét due to a domestic heating-measure expressed as percentage values. The measure involved replacing 75% of biomass stoves and boilers with gas and 5% with non-combustible appliances in a central area of the city.

CONCLUSIONS

The implementation of the ATMO-Plan application greatly advanced the air quality management in Hungary. The primary user of the model is the eco-manager network. Both traffic and residential heating-related measures can be evaluated using ATMO-Plan. The eco-managers exchange their experiences with the model among themselves, and their feedback is crucial for us to upgrade the application. In the future, we would like to change the base year for the calculations and supplement the model with additional mobility data.

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