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IFDM-TRAFFIC, AN OPERATIONAL MODELLING SYSTEM FOR HARMONIZED LOCAL AIR QUALITY PLANS: LOOKING BACK AT 5 YEARS OPERATIONAL SERVICE AND OUTLOOK TO THE FUTURE

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Abstract: To allow for uniform and harmonized air quality modelling in all traffic related environmental impact assessments in Flanders, the Flemish Government asked VITO to develop a centralized web service, called IFDM-Traffic. The system was developed for use by Flemish air quality experts and consultants carrying out air quality impact studies that have limited knowledge and experience in using the underlying model components. The IFDM-Traffic web application offers a standard set of pre-processed input data (meteorology, background concentrations, fleet composition, road network, baseline traffic intensities…) and allows non-modelling experts to define scenarios and setup model parameters. IFDM-Traffic calculates the air quality along roads for the years 2015, 2020, 2025 and 2030 for the relevant pollutants under the Air Quality Directive NO_2, $PM_{2.5}$ and PM_{10} as well as elemental carbon. A first version was launched by the end of 2011. Since then until the present day the system has been used in almost all traffic-related environmental impact assessments in Flanders. With this paper, we look back at 5 years of operational service, highlighting the strengths and weaknesses of such a centralized and harmonized modelling system. We discuss the system from a scientific perspective but also present the views of the Flemish Government who ordered the system and the consultants who use the online platform in their daily work. At present the IFDM-Traffic system is being upgraded into the ATMOSYS-Planning tool which is also able to deal with point and surface sources. The new system is currently being setup in Krakow, Poland and Bratislava, Slovakia with the objective to serve similar needs as identified in Flanders 5 years ago.

Key words: *air quality plan, environmental impact assessment, web service*

INTRODUCTION

The Flemish Government was very much concerned about the quality of the environmental impact assessments they received and which they had to formally evaluate. Although some concrete guidelines existed, consultants used different models, different input data sets and different assessment methodologies to evaluate the impact on air quality of new (industrial) activities or urban development plans. This concern was the trigger for the development of a centralised web based platform that harmonizes air quality modelling activities in the framework of official and legally binding impact assessments.

METHODOLOGY

IFDM-Traffic

In environmental impact assessments air quality models are used in an operational policy context. In Flanders, Belgium, the IFDM-model is the preferred modelling system. IFDM is a bi-Gaussian plume model (Lefebvre et al., 2011) which is extensively validated (Lefebvre et al., 2013). IFDM-Traffic is an on-line web based version of the model designed to assess the impact of road traffic scenarios. The tool is accessible via https://ifdmtraffic.marvin.vito.be (in Dutch only).

As input, the IFDM-Traffic tool requires:

- A reference road database containing information about traffic volumes
- A scenario road database (including new tunnels and/or bridges)

In addition to this case specific input, which has to be uploaded by the user, a number of predefined data sets have to be selected:

- Fleet composition for a particular year
- Background concentrations for a particular year
- Meteo dataset

Finally, the user is requested to specify the grid on which the model simulations have to be performed (note that IFDM is a source-receptor model):

- Regular grid (specify location and distance between grid points)
- Irregular grid (specify distances from roads etc.)
- Additional points of interest (e.g. monitoring stations to be used for validation)

A screen shot of the input screen (in Dutch) is given in Figure 1. The fleet composition and the background concentrations are related to the reference year or a future year for the scenario under investigation.

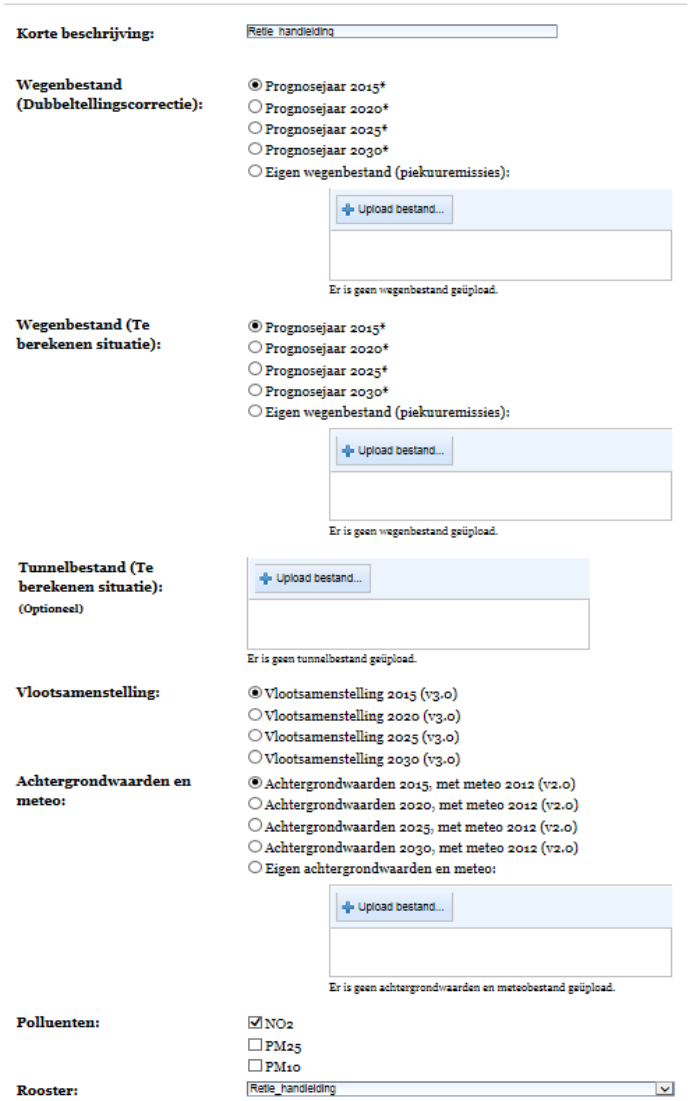

Figure 1 : Input screen for IFDM-traffic. A reference road database and a scenario road database have to be uploaded. The fleet composition and background concentrations that will be used have to be chosen. The pollutants have to be selected.

Upon submission of a run, a job is scheduled by the application backend to run on the VITO high performance computer (HPC) cluster. This job request initiates the FASTRACE traffic emission model run, to calculate the emissions on the line segments taking into account the traffic counts and fleet composition as specified by the user. Next, the IFDM dispersion model is run. When the job is finished, an email is send to the user with a link to the output files. These consist of text files with:

- Concentration and percentiles at all grid points
- Number of exceedances of AQD limit values at all grid points
- Time series at selected grid points
- Emissions per road segment
- Total emissions
- Log files and metadata

The output can be easily visualized offline in order to provide concentration maps as in Figure 2.

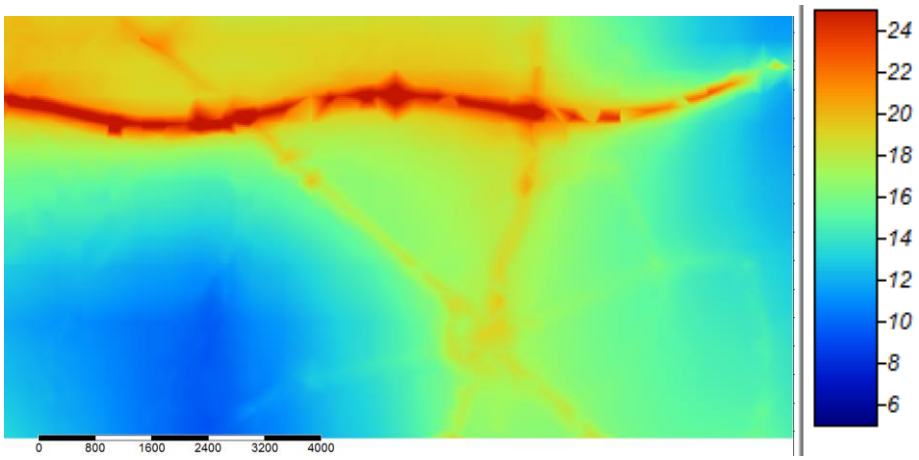

Figure 2 : Example of treated output (in this case annual mean NO_2 concentrations).

The development and introduction of IFDM-Traffic had a clear impact in the way consultants deal with air pollution issues in environmental impact assessment studies. By making use of the centralised tool, they were guaranteed access to a state-of-the-art modelling system, certified by the Flemish government. The hassle of preparing up-to-date transport emission factors, background concentration fields and/or meteo records is gone as this data are now predefined in the system. In addition, the civil servants in charge of the evaluation of the impact assessments, were reassured that the model simulation are produced by a known system and by simply evaluation the log files of the specific runs, they have all relevant information of the used input data at hand.

It is obvious that an operational service such as IFDM-Traffic comes with some maintenance and an operational costs. Both the HPC cluster in the backend as well as the IFDM-Traffic front end require monitoring. In addition, regular upgrades are required to make sure that the system is working with most up-to-date input data sets such as emission factors or background concentrations. This predefined input data is generated by the VITO experts and uploaded in the system.

The first version of IFDM-Traffic was launched in 2011. Since then, almost all environmental impact assessment studies in which road traffic was an issue made use of the web tool. At present the tool is still on-line and (financially) supported by the Flemish government.

ATMOSYS-Planning

IFDM-traffic has been specifically tailored to the requirements of the Flemish government. Consequently the pre-defined standard set of pre-processed input data (meteo, background concentrations, fleet composition, road network, baseline traffic intensities…) is available as proposed by the Flemish

government. However, this tailor made tool for the Flemish situation is not directly deployable in other regions of Europe and abroad. Therefore VITO has started the development of the ATMOSYS Planning, a local scale planning application using IFDM-traffic as a starting platform. ATMOSYS Planning is a more robust, scalable and universal web-based service that can be applied to any city in the EU and abroad. The application also allows scenarios based on non-traffic related sources such as industry since the line source based IFDM-Traffic is being extended with point and area sources. It also automatically handles the double counting of background vs. local emission contributions.

The ICT architecture behind the web application has evolved to a modularized system in which the different components interact via modern REST interfaces and in which an Advanced Message Queuing Protocol (AMQP) (https://www.amqp.org/) system handles asynchronous events such as completion of the calculation runs on a HPC cluster.

The following key improvements have been made to offer much more flexibility and user functionality compared to IFDM-traffic:

- A modern user interface has been designed, including an authentication system which allows each user to manage his/her own cases and data files in between sessions.
- The COPERT based road transport emission model (FASTRACE) has been updated.
- The tailor-made data source restrictions imposed in the Flemish version have been removed so that the user has more flexibility in uploading, choosing and adapting the traffic data (fleet composition, traffic intensities).
- The possibly to assess LEZs has been introduced.
- Point source emissions are now included.
- Pollutant concentration maps for the cases being studied can be customised and visualised in the tool itself rather than offline.
- The user also has the flexibility to upload different meteorological data and background concentrations or used predefined sets.

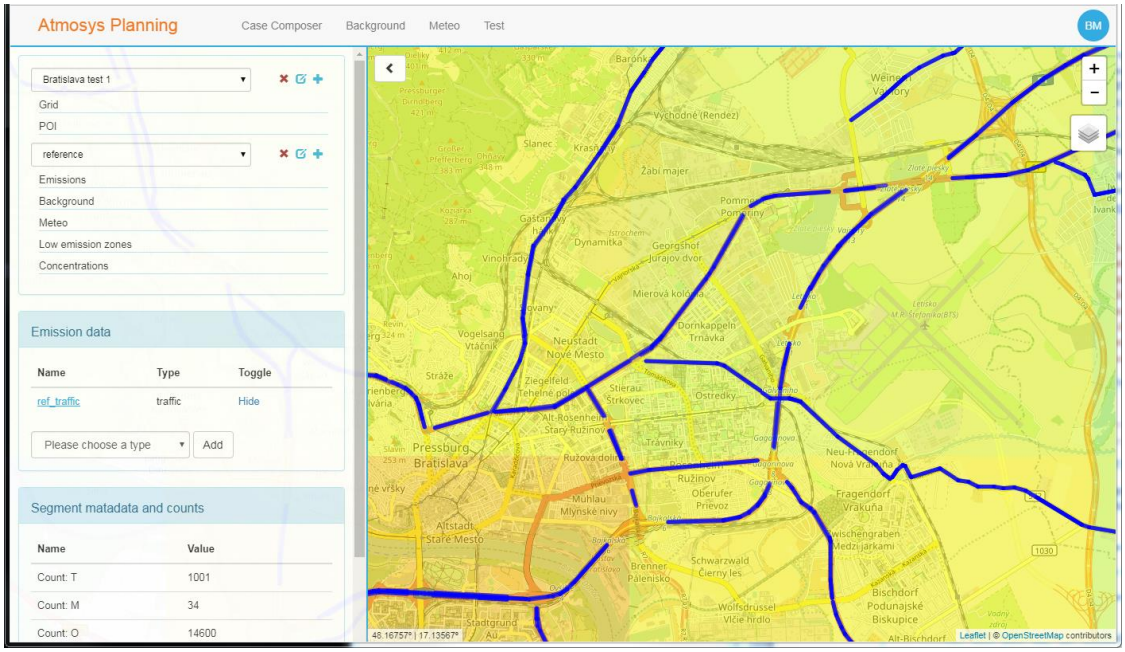

Figure 3 : Screenshot of the newly developed ATMOSYS Planning application. Setup for Bratislava, Sovakia.

Since some potential users across Europe may not have access to reliable estimates of background concentrations, the functionality to easily integrate CAMS air quality data for Europe was developed. This modification was performed within a use case project that is supported by Copernicus (CAMS_95f_VITO). The performance of this data has recently been demonstrated and evaluated for a test case in Bratislava, Slovakia (Figure 2).

Further, the application is currently also being implemented in Krakow, Poland for the city of Krakow under the LIFE14 IPE PL 021 project, "Implementation of Air quality Plan for Małopolska Region – Małopolska in a healthy atmosphere". The ATMOSYS web application is being tailored for Krakow city to their local requirements, using their local data so that they can assess the impact of various traffic management plans on their air quality. Delivery is planned for the end of 2017.

CONCLUSIONS

Over the past 5 years IFDM-Traffic clearly contributed to the harmonisation of modelling practices in Flanders and strongly increased the transparency and confidence in the results established as input for environmental impact assessments.

Recently, the IFDM-Traffic tool was significantly upgraded resulting in ATMOSYS Planning. The technical improvements coupled with a new modernised user friendly front-end web interface have resulted in a decision management tool that can be applied in almost any city in Europe.

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