News from Lohmeyer

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Dear Readers

As another interesting and eventful year draws to a close, two important developments lie just ahead:

Firstly, on January 1, 2020, our office will be converted from a GmbH & Co. KG (a limited partnership in which a limited liability company serves as the sole general partner) to a GmbH (a private limited company). As the principal partner in the GmbH, I will receive the majority of the partnership shares as part of this reorganization. From an ownership perspective, this step paves the way for the next generation to assume leadership of the company.

Secondly, our goal moving forward is to continue to serve as an innovative, reliable and economically strong partner, ideally in your area. That's why we are pleased to announce that starting January 1, 2020, we will be integrating the simuPlan company into Lohmeyer Consulting Engineers. This means that in the future, we will also have a branch office in North Rhine-Westphalia (Dorsten). We look forward to solid and successful collaboration with Mr. Ludes and his team.

Now, I hope you enjoy the technical content of our newsletter. The first article focuses on our participation in a now completed research report for the German Federal Highway Research Institute on environmentally sensitive traffic management. The second article addresses a research project commissioned by the German Environment Agency on dispersion modeling of ultrafine particles at the Frankfurt Airport for which we were the main contractor. The final article reports on a feasibility study for modeling the deposition of traffic-induced pollutants such as arsenic, mercury or road salt in surface waters under the Water Framework Directive.

I wish you all a blessed and peaceful Christmas season and a happy new year.

Yours sincerely
H. Lorentz

BRIEF SUMMARY OF CURRENT NEWS

- Since 2017, our office has been leading an advisory assistance project commissioned by the German Environmental Agency entitled "Further development of air quality control planning and air quality monitoring in Ulaanbaatar (Mongolia)". The project concluded with a workshop on October 16 and 17, 2019, in Ulaanbaatar. Further information and the final brochure are available in English and Mongolian in the "News" section of our website.

- September 2019 saw the publication of HBEFA 4.1, an updated version of the Handbook Emission Factors for Road Transport (https://hbefa.net/e/index.html). In addition to updating the base emission factors and the correction factors for taking the impact of temperature into account when calculating nitrogen oxide emissions, major content developments included the expansion of the vehicle fleet to include alternative drivetrains (including the consideration of upstream emissions that have an impact on climate), the expansion of the traffic situation matrix to include speed limits of 30 km/h on urban main roads and the introduction of an additional level of service for traffic situations ("Heavy stop&go"). HBEFA 4.1 also includes emission factors for non-exhaust particulate matter for the first time. The HBEFA 4.1 data have already been implemented in our internal emissions model, which means that all future air pollutant assessments will be based on these data.

CONTENT

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ENVIRONMENTALLY SENSITIVE TRAFFIC MANAGEMENT – CONCLUSIONS FROM THE GERMAN FEDERAL HIGHWAY RESEARCH INSTITUTE (BAST) R&D PROJECT + CURRENT DEVELOPMENTS

Mobility is a key prerequisite for economic growth, employment and participation in social life. But increasing traffic volumes place additional stress on the environment in the form of noise and air pollution. Clean air plans have been drafted and mitigation measures put in place to comply with limits placed on air pollutants, and this work will continue into the future. On account of the high proportion of polluters in this area, measures taken to counteract the effects of car traffic are of particular importance.

In recent years, there has been an increased focus on using environmentally sensitive traffic management as a dynamic approach that limits traffic flow intervention to only those strategies that are particularly effective in keeping air quality below statutory limit values. Such measures include:

- driving bans for specific vehicle classes,
- lowered speed limits,
- optimization of traffic lights to stabilize traffic flow,
- ramp metering at traffic lights to temporarily reduce traffic volumes and
- dynamic route guidance in conjunction with the adjustment of traffic lights to control traffic.

Fig. 1 shows a functional diagram of traffic management using integrated environmentally sensitive traffic control.

A now concluded research project by BASt (FE 70.0912/2015 “Dynamisches umweltsensitives Verkehrsmanagement” (Dynamic environmentally sensitive traffic management)) studied the content, framework conditions and the impact and costs of systems that are already in place (drawing on our environment-oriented modules PROKAS^{online} and ProFet, among others) and provides recommendations for planning environmentally sensitive traffic management on the basis of these data.

The survey showed that environmentally sensitive traffic management systems work reliably in real operation, that they are accepted by authorities, industry and commerce and citizens, that they help reduce air pollution and that the implemented measures were commensurate.

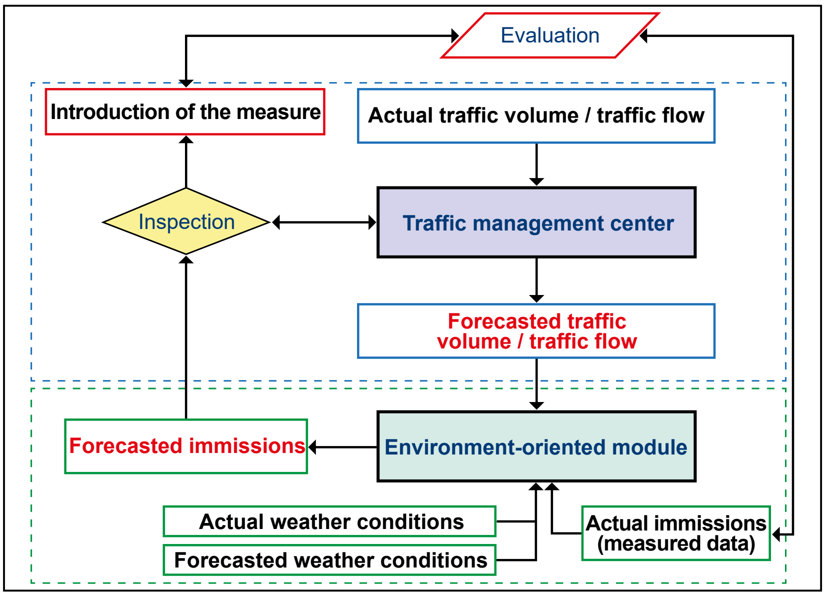

Fig. 1: Functional diagram of traffic management with integrated environmentally sensitive traffic control

Using real-life data, the impact of action taken could be systematically organized and assessed with respect to threshold values, shifting traffic to less busy roads and changes in traffic flow, driving times, emissions, traffic safety and immissions. Evaluations of both predictions and compliance were also conducted.

For hotspots with an annual average value for NO_2 near the limit value, the results of “light” measures such as the improvement of traffic flow and ramp metering lead to reductions of less than ten percent. In regard to PM10, the reported reduction is within the range of only a few days on which the limit was exceeded. Higher reductions can be reached by increasing the threshold value or including “harsher” measures such as traffic limitations or banning certain types of vehicles. For hotspots where the limit value is clearly exceeded, only the “harsher” environmentally sensitive traffic management measures are effective in reaching the goal. Using the environmentally sensitive approach, threshold values and the impact of measures taken can be optimally adjusted to the targets.

The cost-effectiveness analyses show that the environmentally sensitive traffic management either has a positive cost-benefit ratio or at least shows that the temporary measure has clear advantages over a permanent measure.

Additional environmentally sensitive traffic management and environmental monitoring systems are currently being set up in a number of German cities. Drawing on the findings and experiences gained through this project, we are implementing our environment-oriented module PROKAS^{online} in cities such as Erfurt, Jena and Magdeburg. Further information on PROKAS^{online} is available at: http://www.lohmeyer.de/en/content/software-sales-distribution/product-overview/prokas-online. The BASt project reports will be published soon.

MODELING ULTRAFINE PARTICLES AT AND AROUND FRANKFURT AIRPORT

Deposits from air pollutants pose a significant risk to human health. In addition to the air pollutants already regulated by the Air Quality Directive (EU Directive 2008/50/EC), other airborne trace substances which could be harmful to human health are the focus of scientific discussion. Recent studies have shown airports to be sources of increased UFP concentrations in the air. It is therefore necessary to use measurements and models to better understand how airports contribute to the UFP concentration in ground-level ambient air. In this project, a combination of well-established small-scale (LASAT, LASPORT) and large-scale (EURAD, MADE) air pollutant dispersion models was used to calculate the total UFP number concentration for the region around Frankfurt Airport. The emissions were determined for air traffic, road traffic, airport ground traffic, other airport infrastructure and the regional and mesoscale background based on national and international data sources (HBEFA, ICAO, GRETA) and specific data collected at the airport. The results of the modeling (three-dimensional concentration time series with one-hour resolutions, as a whole and differentiated according to the source groups air traffic and ground handling, vehicular traffic in the surrounding area and background load) were compared with measurements recorded near the airport.

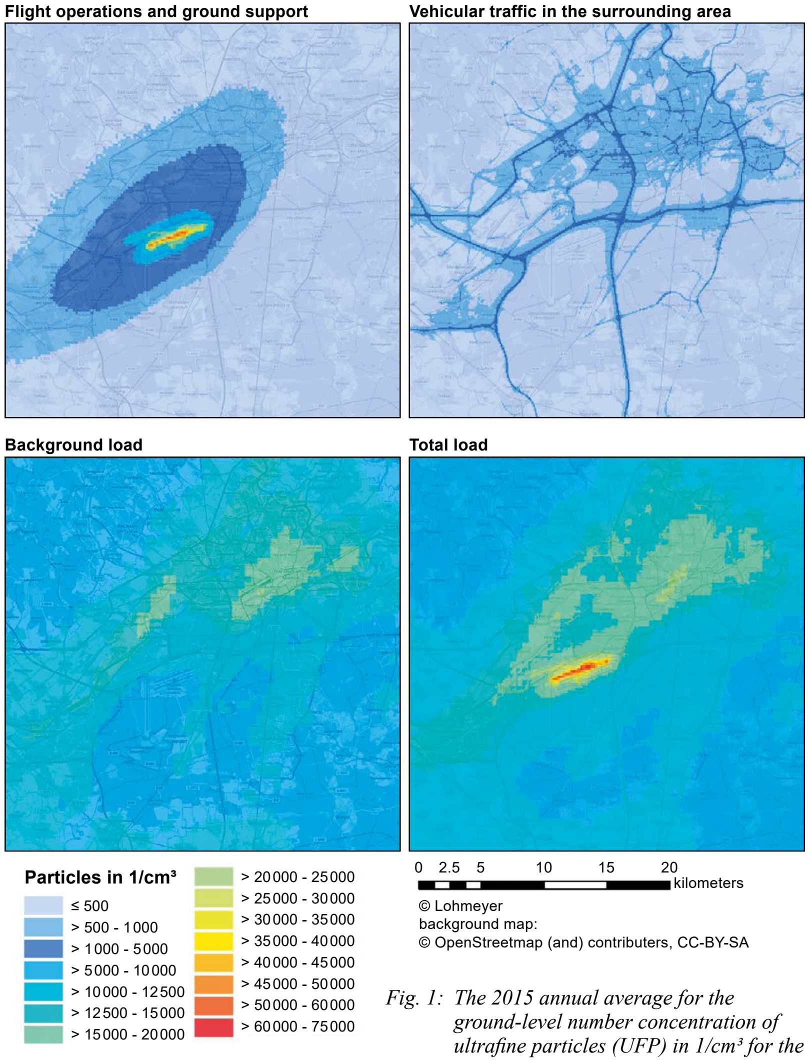

Fig. 1: The 2015 annual average for the ground-level number concentration of ultrafine particles (UFP) in 1/cm³ for the three source groups: flight operations and ground support, vehicular traffic in the surrounding area, and background load, as well as for the resulting total load.

In terms of UFP number emissions, the model results show that the main engines of airplanes are the predominant source of emissions, responsible for more than 90% of the non-volatile UFPs emitted at airports. More than 50% of these engine emissions are particles with diameters of less than 20 nm produced during taxiing.

The long-term average values of the UFP number concentration are dominated by background sources located further from the airport, while the airport's role is more pronounced in the hourly averages. An important aim of the project was to identify the shortcomings of the current state of the art for modeling UFP emissions and concentrations in the context of airports. These shortcomings include emission factors, models and measurements based on inconsistent UFP diameter ranges, as well as differences in the UFP components observed, particularly the distinction between volatile and non-volatile particles.

The results of the modeling show that the airport's impact on the annual average of the total number concentration of ultrafine particles is subject to the main wind direction and decreases considerably as the distance from the airport increases. For example, the modeling indicated that around 1 km north of the airport, approximately 25% of the total average annual load originated from the airport, and this dropped to less than 10% at a distance of 2.5 km from the airport (see **Fig. 1**).

Our office is collaborated on the project commissioned by the German Environment Agency (UBA research and development project 3716 52 200) with Janicke Consulting, MUVEDA and the Rhenish Institute for Environmental Research at the University of Cologne. The final report is scheduled for publication on the German Environmental Agency's website by the end of 2020.

CALCULATING DEPOSITIONS IN LIGHT OF THE EU WATER FRAMEWORK DIRECTIVE (WFD)

Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy (Water Framework Directive, WFD) pursues the central goal of ensuring that as many bodies of water as possible are in good condition. When roads are planned in the vicinity of water, one of the fundamental questions is which traffic-related substances can be expected to be deposited in surface waters as a result.

According to annexes 6, 7 and 8 of the German Ordinance on the Protection of Surface Waters (Oberflächengewässerverordnung, OgewV), assessments should cover a variety of relevant pollutants, including arsenic, chromium, copper, zinc, chloride, sulfate, iron, ammoniacal nitrogen, nitrate-nitrogen, nitrite-nitrogen, benzene, cadmium, mercury and naphthalene.

Against this backdrop, our office was tasked with answering the following questions as part of a feasibility study for the Landesbetrieb Straßenwesen Brandenburg, the road agency for the federal state of Brandenburg:

- Are reliable factors for car-related emissions available for any of these air pollutants and if so, for which?
- Which deposition velocities should be applied?
- Which dispersion models are suitable for this issue?
- Which deposition rates – and thus which substances – can typically be expected, and are these relevant to the issue at hand?
- Are there specific conditions (distribution and composition of traffic, etc.) under which there is a maximum range where these substances are relevant?
- What is the background load of these air pollutants?
- How can results be presented?

We found that for the majority of the substances considered, either emission factors were available in the literature or the car traffic was not a relevant source of emissions. We were further able to determine deposition velocities for the relevant pollutants that apply to water surfaces or were land-use independent and which can be used in calculations accordingly.

Dispersion calculations for a model road with a flat bridge structure with a length of approx. 80 m over water were performed using LASAT. Taking into consideration the range of emission factors and deposition velocities, rates of deposition on water surfaces for the individual substances specified by the WFD were calculated in g/ha/year as a function of the distance from the road.

The following is a selection of the key takeaways from the project:

- As expected, depositions vary in accordance with the emissions from the road and the distance from the emission source. Decay characteristics also depend on local wind conditions and the position and height of the bridge.
- With the exception of chloride, the highest deposition rates (as a function of emission, concentration and deposition velocity) were found for iron and nitrate-nitrogen.
- Mercury was determined to have the lowest deposition rates.
- Depositions of chloride largely resulted from the spraying of de-icing salt to facilitate vehicle traffic. Since depositions are primarily determined by sedimentation processes of large drops of chloride-laden water, the deposition rate drops sharply as the distance from the bridge increases. At a distance of just 20 m, the chloride deposition in the example above dropped to 1/10, at a distance of 50 m to 1/100 and at a distance of 100 m to 1/1000 of the initial value.

The deposition rates calculated for water within the meaning of the WFD must still undergo an expert review.