News from Lohmeyer

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Dear Readers

In this year's holiday edition of our newsletter, we would once again like to share selected topics from our work.

Immissions experts are routinely faced with the question of whether a prognostic or diagnostic wind field model is appropriate, particularly when it comes to steep terrain. We tackle this issue in our first article, which compares the results of prognostic and diagnostic wind field modelling. Our second article focuses on using the latest version (3.3) of the Handbook Emission Factors for Road Transport (HBEFA) to calculate motor vehicle emissions. It features a discussion of the increased requirements prompted by the recent introduction of temperature dependence for emission factors and additionally highlights the influence of temperature dependence. In our final article, we report on a consulting project that we conducted on behalf of the German Federal Environmental Agency, which involved advising the Bulgarian Ministry of the Environment on the subject of air quality planning. We supported the Ministry's employees in assessing the quality of air quality plans for approximately 40 municipalities.

I am also pleased to report that we began offering a PC program for the implementation of the new standard VDI 3781 Part 4 "Discharge conditions for exhaust gases – Small and medium combustion systems and other installations" in November of this year.

I hope you find these topics interesting and I wish you all a joyful and peaceful Christmas season and a happy new year.

Yours sincerely

H. Lorentz

WE WOULD LIKE TO THANK YOU FOR INTERESTING PROJECTS, INSPIRING DISCUSSIONS AND OUTSTANDING TRUST AND COOPERATION!

MERRY CHRISTMAS AND A HAPPY NEW YEAR!

BRIEF SUMMARY OF CURRENT NEWS

- The symposium "Clean air planning – Measures against particulate matter and nitrogen oxide", was held on November 8, 2017. It was organized and conducted by the Bavarian State Office of the Environment and focused primarily on the advancement of clean air planning and approaches to handling recent court judgements. Additional topics included road vehicle emissions under real-life operating conditions and the potential for reducing nitrogen oxide emissions in diesel light duty vehicles. Our office participated in the symposium with a presentation on environmentally sensitive traffic management. The symposium proceedings are available in the publication area of the Bavarian State Government (https://www.bestellen.bayern.de/).
- The PC program WinSTACC is now available. Further information can be found on the last page of this newsletter or at www.lohmeyer.de/WinSTACC. WinSTACC is a software solution for implementing the standard VDI 3781 Part 4 "Discharge conditions for exhaust gases – Small and medium combustion systems and other installations". The standard is used to determine the minimum height needed for exhaust gas systems to fulfill immission control requirements for the undisturbed removal of exhaust gases with free air flow as well as the adequate dilution of exhaust gases.

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Lohmeyer Consulting Engineers
Aerodynamics, climate, immission control and environmental software
www.lohmeyer.de

Karlsruhe Office:
An der Rossweid 3, 76229 Karlsruhe
Tel.: 0721 / 625 10 0
Fax: 0721 / 625 10 30
Email: info.ka@lohmeyer.de

Dresden Office:
Mohrenstraße 14, 01445 Radebeul
Tel.: 0351 / 839 14 0
Fax: 0351 / 839 14 59
Email: info.dd@lohmeyer.de

FORECASTING IMMISSIONS OVER STEEP TERRAIN: A COMPARISON OF DIAGNOSTIC AND PROGNOSTIC WIND FIELD MODELLING

Forecasting immissions of pollutants or odors generally requires dispersion calculations. If slopes with gradients exceeding 1:5 are widespread in the area to be assessed or if slopes with gradients exceeding 1:5 have a significant influence on the immission forecast at the assessment points (referred to in the following as "steep terrain"), standard VDI 3783 Part 16 (2015) describes a method for properly accounting for this when making dispersion calculations in accordance with the German Technical Instructions on Air Quality Control (TA Luft; 2002) and the German Odor Immissions Guideline (GIRL; 2008). This method is based on wind field calculations with mesoscale prognostic non-hydrostatic models pursuant to standard VDI 3783 Part 7 (2017). It replaces a method based on the diagnostic mesoscale flow model TALdia, which is an integrated standard component of AUSTAL2000 and, according to TA Luft, Annex 3, may be used for "moderately structured" terrain, i.e. slopes with gradients of less than 1:5. As diagnostic wind field modelling relies on simplified physics, it cannot be used for steep terrain, because, for example, it does not reproduce the flow separation at the edges of the terrain. Immission distribution for steep terrain calculated with AUSTAL2000 on the basis of the diagnostic flow model TALdia is considered "generally conservative", for example in the TA Luft Guidelines for Baden-Württemberg (2013).

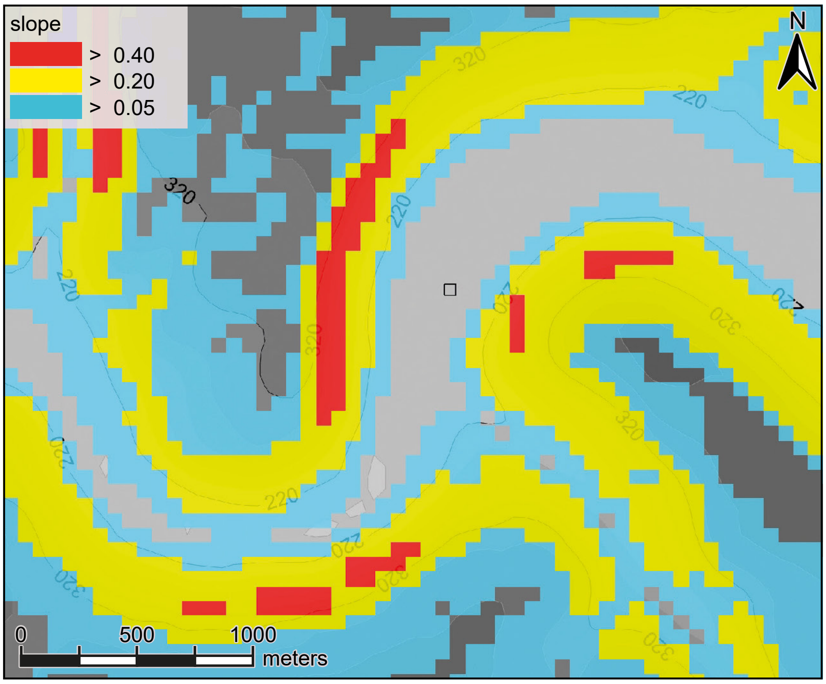

Fig. 1: Slopes in the investigation area

As part of a project in southern Germany, a prognostic mesoscale wind field library was generated for a deep, meandering valley using the prognostic mesoscale model ProWiMo in accordance with standard VDI 3783 Part 7. The slopes in the investigation area are shown in **Fig. 1**. Slopes greater than 0.05, 0.2 and 0.4 have been depicted. The maximum slope in the coarsest computational mesh (horizontal mesh size: 64 m) is 0.55. A fictitious source location (ground level, quadratic plane source with a horizontal extension of 50 m) including an odor source with a emission rate of 2000 OU/s was specified. Two dispersion calculations were performed with AUSTAL2000, one using the prognostic wind field library and another for comparison which used TALdia, the mesoscale diagnostic flow model integrated into AUSTAL2000. Both dispersion calculations used the same airspeed meter position. This

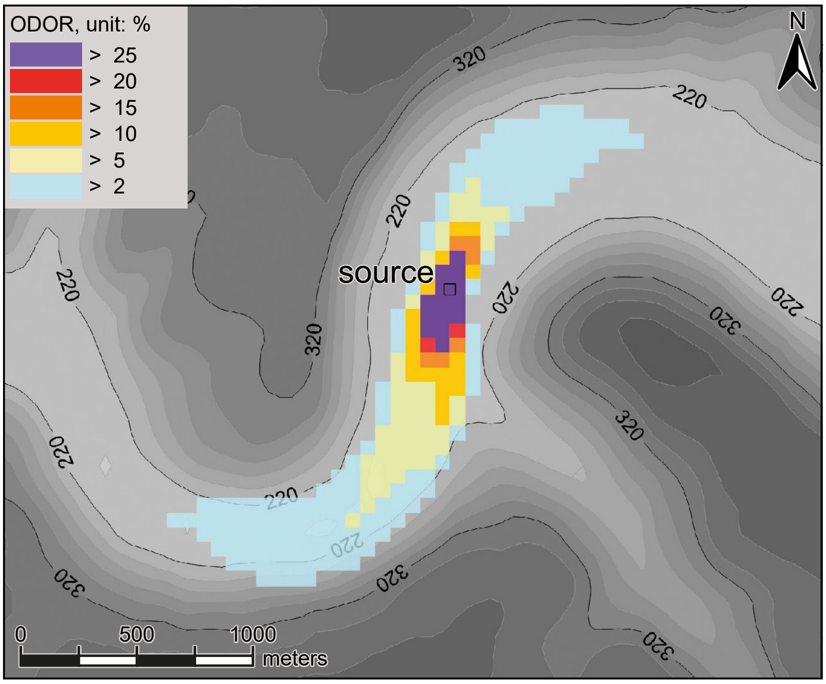

Fig. 2: Immission distribution calculated with AUSTAL2000 and prognostic wind field modelling

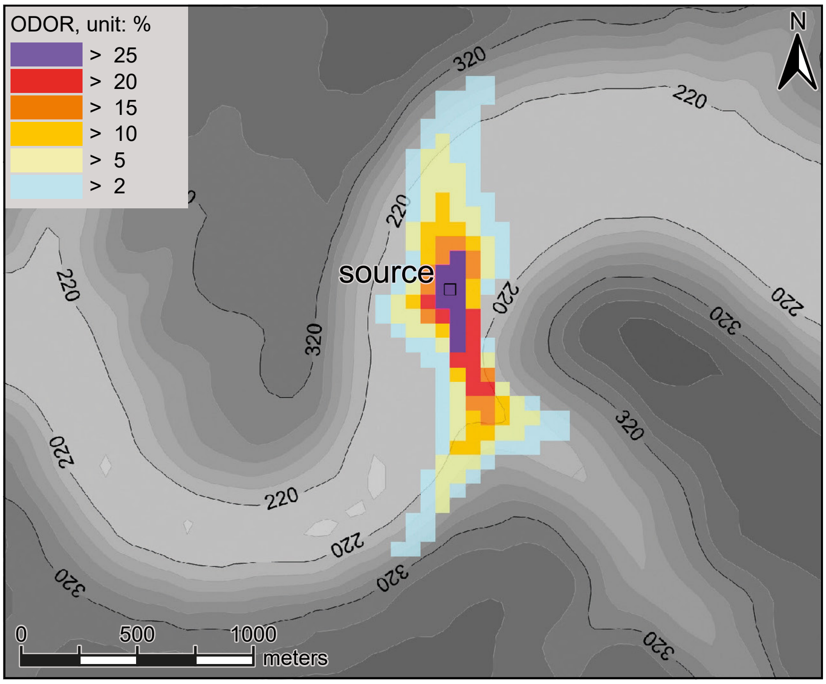

Fig. 3: Immission distribution calculated with AUSTAL2000 and the diagnostic wind field model integrated into AUSTAL2000

position was determined on the basis of recommendations contained in standard VDI 3783 Part 16, i.e. a location outside of the valley where the local terrain structure has as little influence as possible.

The distribution of odor hour frequency in both cases is shown in **Fig. 2** and **Fig. 3**. The distribution calculated using the prognostic wind field library takes the expected course along the valley, while in the distribution based on the diagnostic wind field library, the tail ends of the plume stay close to opposite sides of the valley. In the diagnostic model, part of the plume also extends into the side valley that branches off to the southeast.

There are no measurement results available, e.g. from field inspections of the plume, for assessing the calculation results. Moreover, this case does not fall within the valid scope of applicability for the diagnostic wind field model.

As a result, the only conclusion that may be drawn from this comparison is that for the case presented here with steep terrain, the odor hour frequency calculated using the prognostic wind field library appears more plausible and corresponds more closely to expectations than the odor hour frequency calculated using the diagnostic wind field library. The conservatism of the results of diagnostic wind field modelling is reflected at many assessment points in this specific case (e.g. in the side valley that branches off to the southeast); however, there are also a number of assessment points where the results of the diagnostic wind field model are not conservative and could lead to the false assessment of the immission conditions to be expected. Of particular importance is the fact that it is a priori unclear where the results of the diagnostic wind field model are or are not conservative.

From the perspective of the immissions expert, the prognostic flow model should take precedence in cases of doubt or for controversial projects, as this will also help ensure that objections or questions regarding the plausibility and conservatism of the results of the model used will not result in delays to the project schedule.

INCREASED REQUIREMENTS FOR DETERMINING TRAFFIC-RELATED EMISSIONS

An updated emissions database for car traffic (HBEFA 3.3, official data base of Austria, France, Germany, Norway, Sweden and Switzerland, http://www.hbefa.net) was published in May 2017. On the basis of extensive measurement data for new diesel passenger cars, the diesel Euro 6 emission factors for nitrogen oxide have been updated and the impact of air temperature has been taken into account in organizing the exhaust gas aftertreatment system for Euro 4, Euro 5 and Euro 6 diesel passenger cars. The HBEFA makes it possible to incorporate the average German conditions using daily temperature variations coupled with predefined standardized daily traffic load curves for an annual average air temperature of 9 °C as well as for typical days for each of the four seasons. No new emissions measurement data were incorporated for light commercial vehicles, even though a similar need for adjustments could be expected in light of comparable diesel engine concepts.

Taking the influence of temperature into account with respect to the fleet of cars on the road in Germany results in as much as a 27 % increase in emissions for light vehicles (passenger cars and light commercial vehicles) in 2017 as compared to emissions under “test stand” conditions or in accordance with previous specifications for emission factors.

In light of this, we followed up on comparisons between location-specific temperature conditions based on the respective 10-year hourly air temperature time series and the average conditions from the HBEFA in completed local analyses. Just as regional car fleets can be taken into account, for example to generate robust basic models based on collected air measurement data as part of air quality planning, regional temperature data can also be incorporated.

For an area of the Upper Rhine Plain in southwestern Germany with an average temperature of approx. 11.3 °C, emissions from light vehicles declined by approx. 5 % for the reference year 2016 as compared to the average temperatures in accordance with the HBEFA; when a regional car fleet was used, emissions dropped by approx. 6 %. On the basis of regional temperature conditions of 11 °C, a reduction in light vehicle emissions of between 4 % and 5 % was calculated for various traffic situations in 2015 for a car fleet in Düsseldorf that was recorded using license plate recognition. In the Black Forest 3 % higher emissions were calculated using an average air temperature of 8 °C as a function of the hourly temperature profile.

Comparisons of emissions calculated for car traffic using regional air temperature time series and the values for average German temperature conditions integrated into the emissions database (HBEFA 3.3) reveal sometimes significant differences which may exceed the effects of popular mitigation measures used in traffic flow, traffic control and parking management. As a result, detailed consideration of the role of air temperature in determining emissions is essential for assessing the validity of statements regarding NO_2 immission loads in sensitive areas of investigation.

AIR QUALITY PLANNING IN BULGARIA

Like every other EU member state, Bulgaria is required to implement the Air Quality Directive (2008/50/EC). Measures to address particulate matter concentrations in ambient air are especially crucial in Bulgaria, as approximately 30 municipalities are currently unable to maintain PM10 values within the limits prescribed for air quality. High PM10 concentrations are observed in the winter months (October-March) in particular. According to Art. 23 of the Air Quality Directive, municipalities that exceed the applicable limit values for air quality are required to create air quality plans, which must include mandatory measures for reducing the concentration of pollutants. Regional Inspectorates of Environment and Water (RIEW) are in place in Bulgaria to approve air quality plans and to monitor and evaluate their implementation in municipalities. These inspectorates are administered by the Bulgarian Ministry of Environment and Water (MOEW). By 2012, 29 municipalities in Bulgaria had created or updated air quality plans and implementation was underway. The MOEW determined that the quality of these air quality plans varied greatly, both in terms of their characterization and assessment of the present situation as well as with respect to the suitability of the mitigation measures selected.

In the context of a 1993 agreement between the German and Bulgarian governments regarding cooperation in the field of environmental protection (“Regierungsabkommen über die Zusammenarbeit auf dem Gebiet des Umweltschutzes”), our office partnered with INNO-CON Ltd. on behalf of the German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU) to advise the MOEW with regard to clean air planning. The Project continues in the context of the Advisory Assistance Programme of the BMU (https://www.umweltbundesamt.de/en/topics/sustainability-strategies-international/cooperation-eeca-centraleastern-european-states/federal-environment-ministrys-advisory-assistance), which also addresses to environmental administration of states of Central and Eastern Europe, the Caucasian countries, Central Asia and North Africa.

A central goal of the project was to train representatives from Bulgarian agencies so that they are capable of creating and evaluating air quality plans themselves and can pass this knowledge on to other agencies in Bulgaria.

The project began with an educational trip to Germany, where MOEW representatives learned the fundamentals of clean air planning. Visits to environmental agencies in Reutlingen and Stuttgart gave participants insight into the way air quality planning is practiced in Germany.

Using the Bulgarian cities of Veliko Tarnovo and Pernik as examples, two on-site workshops focused on the evaluation of existing air quality plans. To promote the continued independent transfer of knowledge within Bulgaria, a comprehensive guideline, including advice on emissions and dispersion modeling as well as on measures for planning and assessment, was prepared. This guideline takes into account the particular circumstances in Bulgaria and is specifically oriented toward the level of knowledge of the MOEW employees. It is available as a PDF on the website of the German Federal Environmental Agency (http://www.umweltbundesamt.de/en/publikationen/guideline-on-air-quality-plans).

WINSTACC

- PC program for implementing the new standard VDI 3781 Part 4 “Discharge conditions for exhaust gases – Small and medium combustion systems and other installations”.
- Determines the minimum height of exhaust gas systems
- Intuitive graphical interface
- More information available at:
  www.lohmeyer.de/WinSTACC