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VALIDATION OF NEWEST DEVELOPMENTS WITHIN OSPM

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Abstract: The Operational Street Pollution Model (OSPM®) has been widely applied in the air pollution community for more than two decades. In the presented work some of the parameterisations used by OSPM have been revised and tested against several street datasets. We present an air pollution "screening" calculation in which OSPM, in combination with the urban background model UBM, was applied for all address locations in Denmark along major roads and results (annual means for NO_2, PM_{10} and $PM_{2.5}$) are presented on an interactive map on the internet.

Key words: *OSPM, street scale modelling, exposure assessment, interactive webpage, GIS*

INTRODUCTION

The Operational Street Pollution Model (OSPM®) is a semi-empirical parameterised model (Berkowicz, 2000a or: www.au.dk/OSPM) and frequently used for local- or street-scale assessment of air pollution. OSPM is a present state of the art operational model and has undergone a large evaluation (Kakosimos et al. 2010). As one of the most often used street pollution models, OSPM is part of many air pollution forecast systems (e.g. Danish THOR, Swedish SIMAIR, Norwegian VLUFT) and single air pollution models (e.g. UK-ADMS, Belgian IFDM model), as well as it is part of the Danish air pollution exposure assessment system AirGIS (Jensen et al. 2001). An on-going comprehensive review of OSPM (Ottosen et al. 2013) is addressing some shortcomings of the current parameterisations and providing further developments that will be extending the applicability of the model. In the current presentation the latest improvements in OSPM will be presented together with new validations and a new application of OSPM within an interactive webpage.

CHANGES IN OSPM, MODEL SET-UP AND VALIDATION

The model formulations within OSPM have been widely applied in the air pollution community for more than two decades. In the presented work some of the parameterisations used by OSPM have been revised and tested against datasets for several streets. One of the parameters is related to special cases with variable height of the buildings along the street including streets with only buildings on one side as often observed in practical applications. The definition of the so-called "general building height" has previously led to incorrect and somewhat arbitrary model results (Ketzel et al. 2012). This height is now estimated by the program using a simple automatic routine, while it was previously a parameter defined by the user and, although it could have substantial impact on the results, with little guidance on how this should be determined. The influence of the improved parameterisation was successful tested for several Danish validation datasets. Another change in the OSPM parameterisations that will be presented, concerns the calculation of the recirculation component for wide street canyons where the recirculation zone is not covering the full canyon.

Since OSPM only calculates the additional contribution from the specific street to the total air pollution level in that street, information about the background air pollution is necessary. For a large number of locations such background levels can only be provided by models. In our model-setup (Brandt et al. 2001) the Urban Background Model (UBM) (Berkowicz 2000b) is used in combination with the Danish Eulerian Hemispheric Model (DEHM) (Christensen, 1997, Brandt et al. 2012).

This model combination has been evaluated with measurements from the Danish Air Quality Monitoring Programme (Ellermann et al. 2013). For the 5 available street concentrations the complete model system (DEHM/UBM/OSPM) was able to reproduce the annual average of NO_2 within a range of -5% to 22%, for the urban background concentrations the agreement was in the range -23% to 5% and for the regional concentrations between 7% and 38%.

NEW WEBGIS APPLICATION FOR WHOLE DENMARK

As parameterised model, OSPM has the advantage to have very short calculation times and is therefore used as part of the Danish AirGIS system to calculate exposure at address level for virtually all addresses in Denmark. AirGIS is a human exposure modelling system for traffic air pollution (Jensen et al. 2001 or http://envs.au.dk/en/knowledge/air/models/airgis/) based on national GIS data sets on traffic and buildings. AirGIS has been applied in a variety of Danish health assessment studies in the past (Hertel et al., 2013)

In a recent project, funded by DCE - Danish Centre for Environment and Energy, Aarhus University, Denmark, AirGIS and the improved OSPM have been coupled with a substantially further developed method for estimating the background concentration. The model UBM has been further developed and is now used for the whole of Denmark and includes emissions from all emission sectors in a resolution of 1 km x 1 km based on the GIS based emission model SPREAD (Plejdrup et al. 2011).
OSPM is applied for all addresses (about 200.000) near the major roads in Denmark. The traffic data is obtained from the Danish Traffic Model developed by DTU Transport for the Danish Ministry of Transport ("Landstrafikmodellen"- LTM, e.g. www.trm.dk). Some test indicated that a "near" road definition as 34 m distance from the centre of the road captures well the relevant addresses for OSPM in the first building block along the roads. For addresses that are further away than 34 meter from these major roads (about 2.2 Mio) the results from UBM are used as estimates of air pollution at those locations.

An interactive webpage has been created where the air pollution levels over Denmark are presented in high spatial resolution, at address level within cities and near major roads and at 1km x 1km resolution away from roads. A few examples of the various plots and results are given in the figures below.

Figure 1 shows the annual average of NO_2 at the addresses away from the major roads, i.e. only urban background levels calculated with UBM are shown. The major Danish cities and a few large point sources are clearly visible with elevated pollution levels.

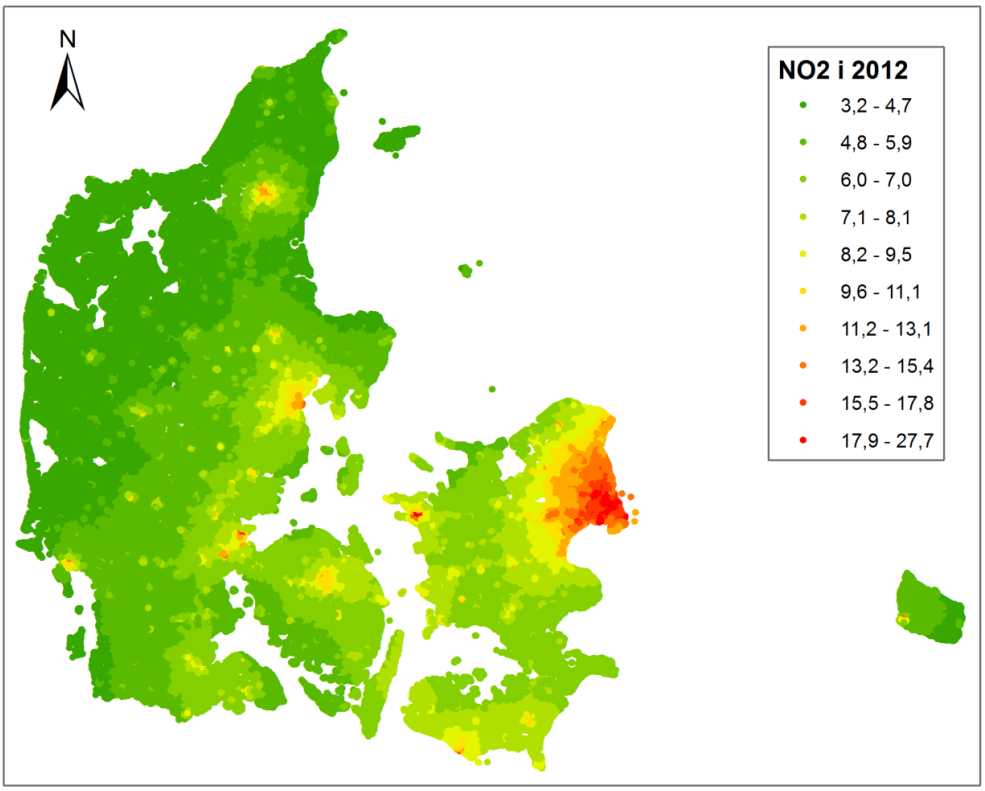

Figure 1. NO_2 annual average in 2012 in the "urban background" no street concentration added yet

Figure 2 shows the annual mean $PM_{2.5}$ at all addresses near the major roads where OSPM has been applied. Besides the larger Danish cities also a general South-North gradient with higher PM concentrations in the South due to long range transport from central Europe is visible.

Finally, in Figure 3 a combination of both types of addresses is shown for the city of Roskilde, displaying the annual average for NO_2 in the city enter.

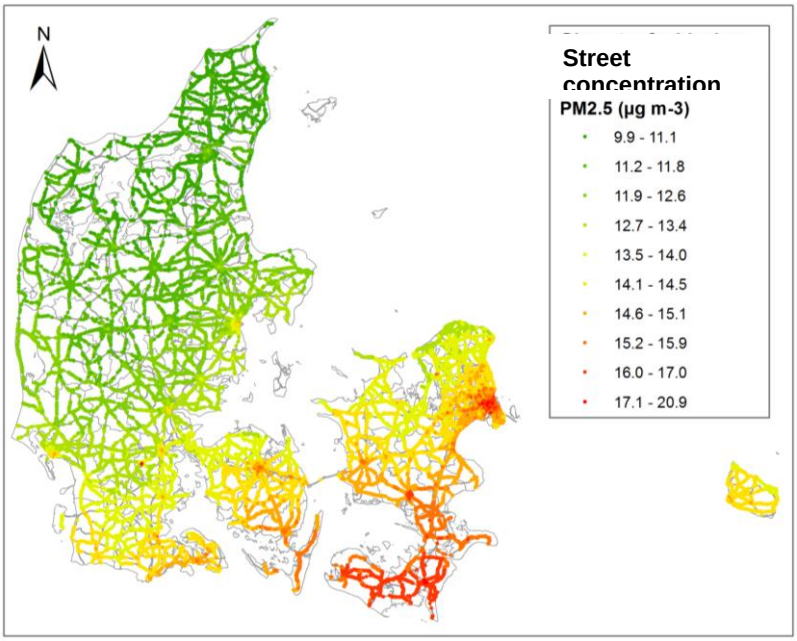

Figure 2. Street concentrations ($PM_{2.5}$ annual average 2012) calculated with OSPM along the roads included in the Danish Traffic Model

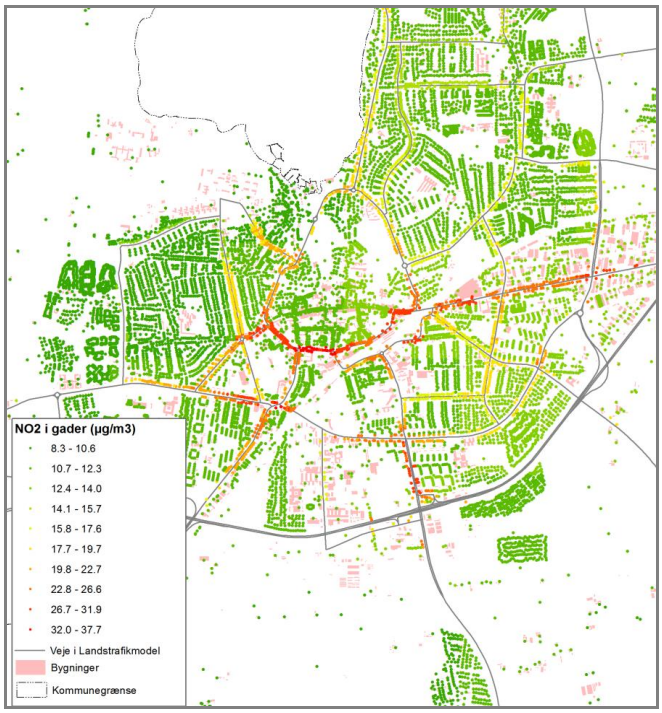

Figure 3. Annual NO_2 concentration for year 2010 for the city of Roskilde combination of background and street receptor points.

CONCLUSIONS

The OSPM model has been further developed and coupled with a revised version of the urban background model. The calculations are showing satisfying performance when evaluated with measurements. An air pollution "screening" calculation is presented in which OSPM, in combination with the urban background model UBM, was applied for all address locations in Denmark along major roads

and results (annual means for NO_2, PM_{10} and $PM_{2.5}$) are presented on interactive maps on the internet. This gives all interested citizens the possibility to get informed about the general outdoor air pollution levels at places where they spend their time.

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