NORPAC – A Nordic Project on PM Measurements and Modelling – Overview and First Results

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Introduction

The project "*Validated models describing Nordic urban and regional concentrations of particles and organic/ elemental carbon* (NORPAC)" aims at enhancing and co-ordinating the Nordic research on measurements and modelling of ultrafine particles (UFP) and particles mass (PM). NORPAC connects 10 research groups from Denmark, Finland, Norway and Sweden.

Activities during the first phase (2004-2005):

1) Compilation, evaluation and synthesis of existing particle data and ongoing measurements in the Nordic urban and suburban areas, 2) Intercomparison of SMPS instruments and 3) Comparison and improvement of Nordic dispersion models for particles, including re-suspension of road dust.

The emphasis lies here on **urban sources and models** to get a good understanding on emission factors and processes on short time scale to provide a good description of concentration fields in the urban areas. The emission factors will be based on kerbside measurements and the urban background station will be used for validating the urban models.

The second phase (2005-2006) will focus on the further development of the **EMEP 3D Unified Eulerian model** by implementing a better description of Elemental Carbon (EC) and Organic Carbon (OC), improving its capability to address sources, concentrations in the atmosphere, transformation and deposition.

The assessment of sources for local and regional PM levels has high priority in the political and scientific discussions due to stringent EU limit values that have to be met and the relation of PM to health effects and climate effects.

Methods

At the activities in NORPAC are divided in 7 working groups:

Activity	Participants
DMPS inter-calibration	**LU**, DMU, KU, ITM, NILU, UH, GU
Soot photometer	**ITM**, DMU, UH, NILU, GU
Emission factors UFP, PM (incl. resuspension)	**DMU**, SMHI, NILU, FMI
Local modelling exercise (Case 1: Hornsgatan)	**SMHI**, DMU, NILU
Aerosol dynamics modelling exercise	**DMU**, SMHI, FMI, UH
OC/EC parameterisation	**METNO**, ITM, UH, GU
Implementation in EMEP model	**METNO**

For the SMPS intercomparison exercise an aerosol generator is under construction and will be calibrated by Lund University and circulated among the measuring groups. At the moment Stockholm University builds 6 soot photometer instruments that will be installed in Stockholm and Copenhagen covering kerbside, urban background and rural locations.

The NORDIC database

For our data exchange and analysis we use the web based databank "NORDIC" (www.luftkvalitet.se) developed by Swedish Meteorological and Hydrological Institute (SMHI) and Slb (Environmental and Health Administration of Stockholm), see Fig.1.

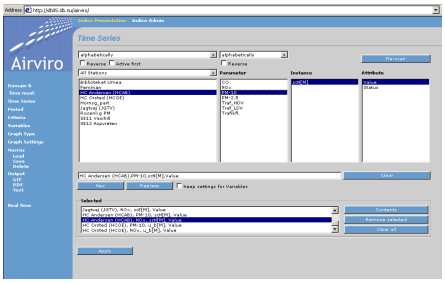

Fig. 1 Up to 15 measured variables in the NORDIC database can be used as a base for up to 4 plotted variables/mathematical expressions. Output may be directed as a GIF image or as a text file (time series download).

Results

Particle mass (PM) emissions from traffic can be divided into three main groups: A) Direct exhaust emissions that are predominantly found in the fine fraction (PM2.5), B) Emissions from brakes wear that are to about equal amount present in the fine and coarse (PM10-PM2.5) fraction and C) emissions from road abrasion, tyre wear and road dust re-suspension. This PM source is influenced by 'external factors' as road condition (wetness, salting, sanding, road material, dust) and use of studded tyres. A comparative analysis of PM measurements in Sweden and Denmark reveal a fair agreement for the average urban concentration ratios PM10/NOx (Fig. 2). For these cases a harmonised emission methodology seems to be possible. Under winter/early spring conditions the use of studded tyres and salting leads to a dramatic increase of coarse emissions, that are very depending on the local conditions at the measuring site and are more difficult to predict (Fig. 3).

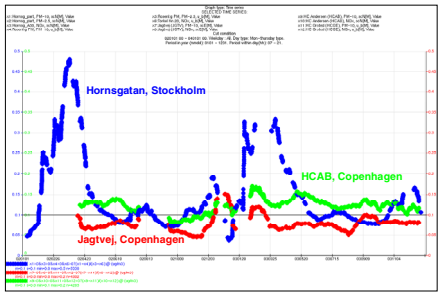

Fig. 2 Running monthly averages (2002-2003) of locally generated PM10/NOx ratios. Criteria: Only weekdays 07-21 hours. Summertime ratios are rather similar, with a tendency for a higher ratio at HCAB. The springtime peak is a characteristic feature at Hornsgatan which in Denmark is absent or at least much less pronounced.

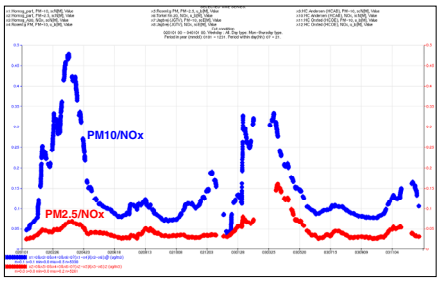

Fig. 3 Running monthly averages (2002-2003) of locally generated PM.../NOx ratios at Hornsgatan. Criteria: Only weekdays 07-21 hours. Most of the PM generated during the springtime peak is in the coarse mode, but PM2.5 is also affected.

Emissions of **particle number** from traffic are totally dominated by tail-pipe emissions in the ultrafine size range. Fig. 4 shows a comparison between emission factors (number of particles · vehicle^{-1} · km^{-1}) from a tunnel study in Stockholm and kerbside measurements on Jagtvej and H.C. Andersens Boulevard (HCAB) in Copenhagen. For all measurements the particle number size distributions peak at ~15-20 nm in diameter, with an additional mode centred around ~75-80 nm. Total particle emission factors for an average car fleet (5% heavy-duty diesel vehicles, HDV) are typically ~3·10^{14} km^{-1} and ~4·10^{14} km^{-1} on Jagtvej and HCAB (speed limit 50 km·h^{-1}).

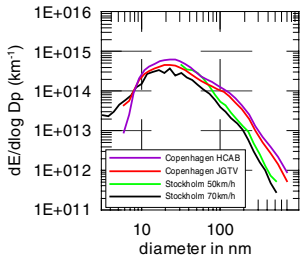

Fig. 4: Comparison of the average fleet emission factor size distribution from a tunnel in Stockholm with the size distribution measured at two streets in Copenhagen. For the speed 50 km h^{-1} and particle sizes below 30 nm, the emission factor could not be estimated due to particle losses in the tunnel.

Acknowledgements

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References

NORPAC-project: http://norpac.dmu.dk