Modelling primary PM$_{10}$ concentrations for the city of Graz, Austria

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Motivation

Source: http://www.eea.europa.eu/themes/air/airbase

HARMO 08, Cavtat, Croatia
Dispersion conditions

- What are the main sources for the observed high concentrations Graz?

- How high would the concentrations be, if the dispersion conditions are like that in Vienna?
Model domain

GRAMM:
27 km x 39 km
300 m x 300 m x 10 m
15 vertical levels

GRAL:
10 m x 10 m x 2 m

~350,000 inhabitants
Methodology

• Establishment of meteorological statistics (PGT classes, 5 wind speed classes, 36 wind sectors)
  ~80 % below 1.5 ms$^{-1}$
  ~50 % stable classes

• Computation of quasi-steady state wind fields with GRAMM (Oettl, 2000) and steady-state concentration fields with GRAL (Oettl, 2008: www.umwelt.steiermark.at->Luft>Publikationen) separated by user defined source groups (traffic, heating, etc.) for each classified situation.

• Computation of concentration statistics (annual mean, etc.) by applying different emission modulations (daily, monthly) for each source group.
A few words on non-exhaust emissions from traffic....

Frankfurter Allee, Berlin (Ketzel et al., 2007)

Hornsgatan, Stockholm (Ketzel et al., 2007)

Völkermarkterstr., Klagenfurt (Ketzel et al., 2007)

Frankfurter Allee, Berlin (Ketzel et al., 2007)
Wind field model

Simulated annual mean wind speed with GRAMM
Background concentration

Assumptions:
Long range PM\textsubscript{10}: AQM Masenberg at 1.100m
(16\,µg/m\textsuperscript{3})

Locally generated secondary PM\textsubscript{10}:
Conc. in Graz (AQUELLA, Bauer et al. 2007)
minus conc. at AQM Masenberg (estimated
from Hüglin et al., 2005 – 34 %)
Simulated annual mean PM\textsubscript{10} concentrations
GRAL results

Comparison of observed and modelled annual mean PM$_{10}$ concentrations
GRAL results

Comparison with chem. analysis (Bauer et al., 2007; Jan.-Apr.-Jun.-Oct. 04)
Source apportionment annual mean

- non-exhaust HDV: 10%
- non-exhaust PC: 19%
- exhaust HDV: 4%
- exhaust PC: 7%
- heating PH: 8%
- heating businesses: 4%
- nicht modelliert: 48%
- local secondary PM: 6%
- long-range transport: 35%
- not quantified: 7%

Source apportionment Graz-Don Bosco
annual mean: 48 μg/m³
Source apportionment winter mean

- Heating PH: 14%
- Heating businesses: 9%
- Non-exhaust HDV: 12%
- Non-exhaust PC: 20%
- Exhaust HDV: 4%
- Exhaust PC: 6%
- Nicht modelliert: 35%
- Local secondary PM: 14%
- Long-range transport: 16%
- Not quantified: 5%

Luftgüteüberwachung
Results

Observed and modelled PM10 reductions due to the mild winter 06/07 (less salting; less heating)

![Graph showing PM10 reductions for different locations: Don-Bosco, Graz-Mitte, Graz-Süd, Graz-Nord. Observations and simulations are compared with different percentage reductions.]
Sensitivity analysis

Assumptions:
Flat terrain
Met. Data from Vienna

About a factor of 3-4 lower concentrations (without background)
Conclusions

- Scenarios to meet AQS.....

- Don-Bosco: -100 % traffic & -60 % heating
- Graz-Süd: -100 % traffic & -100 % heating
- Graz-Nord: -35 % traffic & -100 % heating
Wishes towards EU

➢ Financial support from EU for strong measures (railway, tramway, P&R, remote heating, stove replacements, etc.)

➢ To postpone penalties to the EU, due to violating PM10 air quality standards in regions with similar dispersion conditions in Styria (e.g. Carinthia, Slovenia, South Tyrol, Torino, Milano, etc.)
The End....

Thanks for your attention!
Zusammenhang Überschreitungstage – Jahresmittelwert auf Basis steirischer Messwerte
Luftgüteüberwachung

HARMO 08, Cavtat, Croatia
Emissions

Overview:

Traffic
- exhaust: 57 t/a
- non-exhaust: 123 t/a

Heating
- private households: 70 t/a
- businesses and industry: 44 t/a

Missing sources
- fugitive dust (construction, industry)
- Offroad vehicles and equipment
- Agriculture
Emissions

$PM_{10}$ Traffic Emissions for Graz, 2006

NEMO:
Network emission model (Rexeis and Hausberger, 2005)
Emissions

Domestic heating of private households (Oettl, 2008; www.umwelt.steiermark.at->Luft->Publikationen)
Emissions

Heating of businesses and industry (Zelle, 2008)