NEW EVALUATION TOOLS FOR MEETING THE EU DIRECTIVE ON AIR POLLUTION LIMITS

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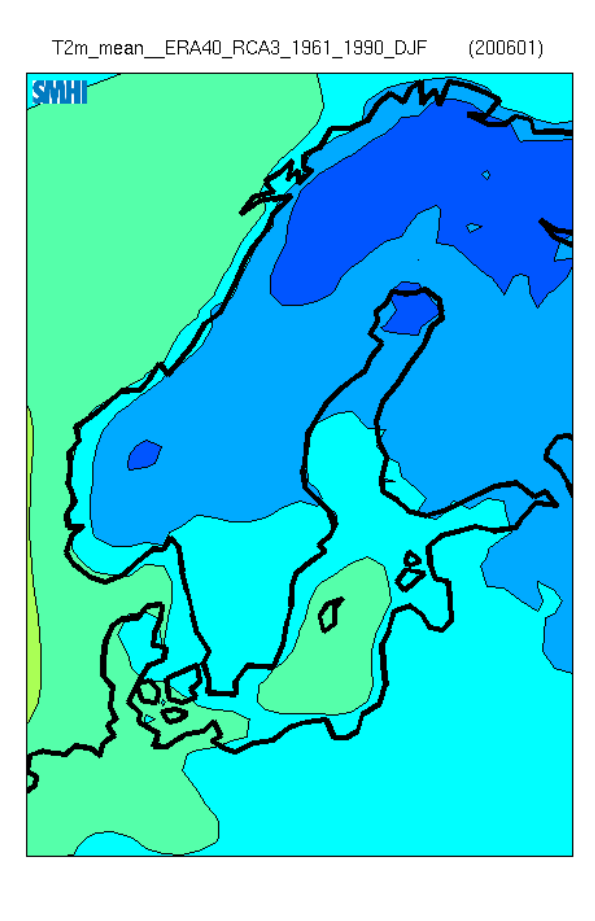

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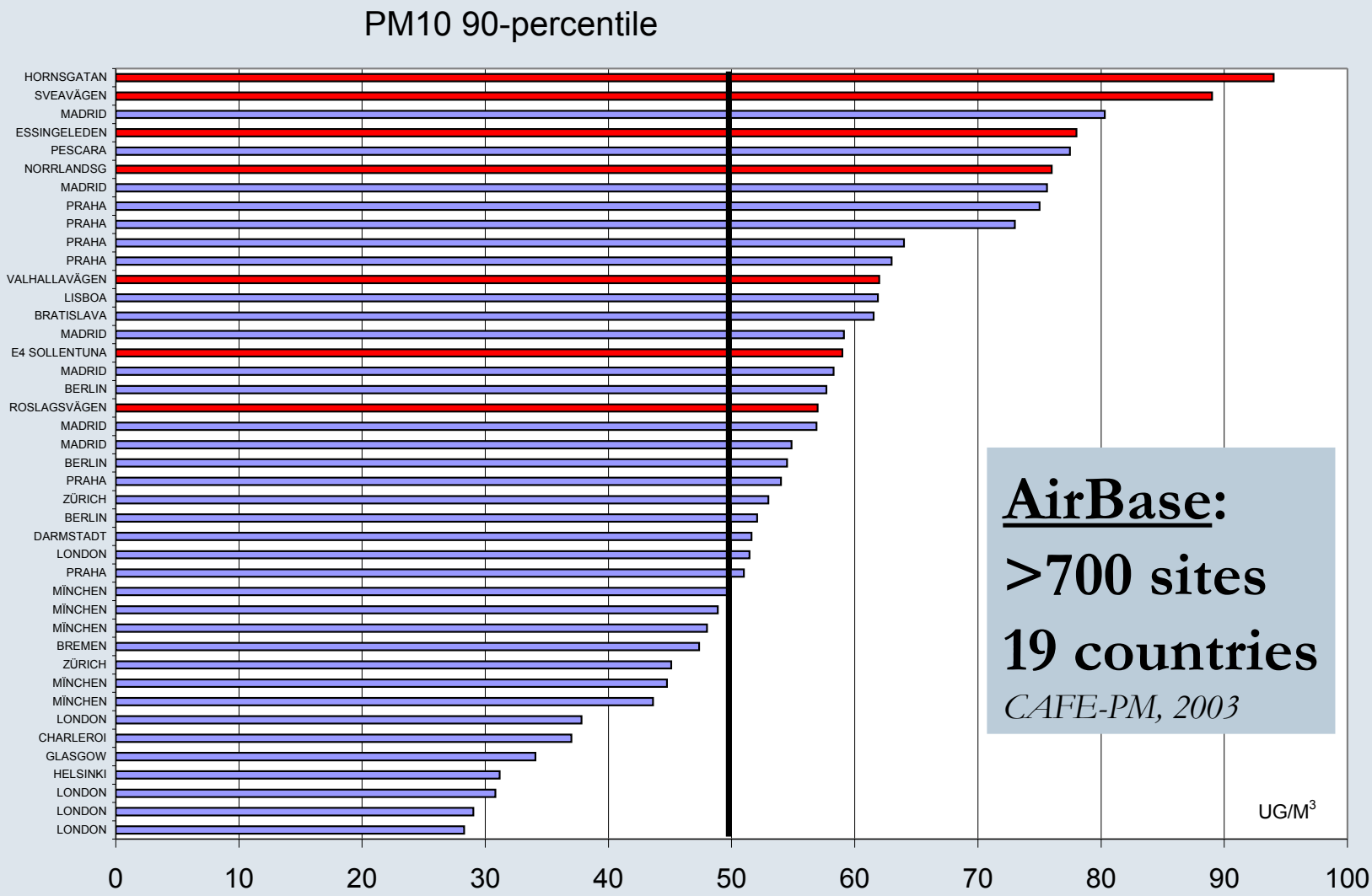
- Motivation
- Models and databases used
- Model validation
- Final remarks

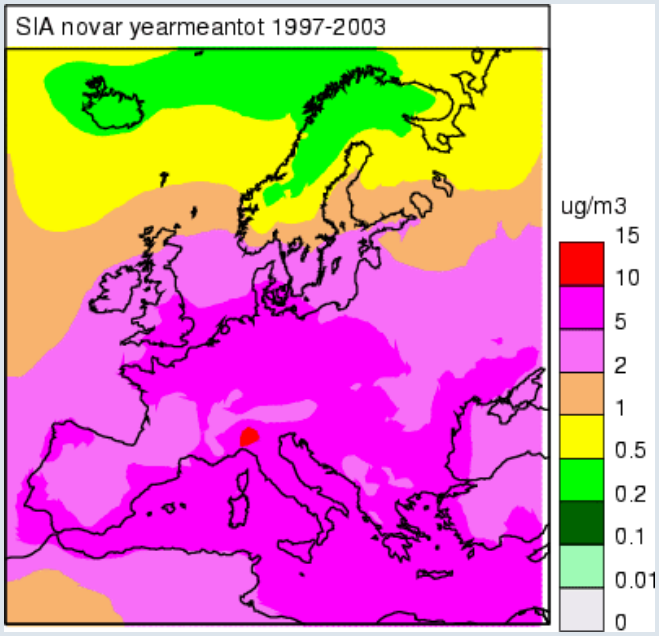
Mean temperature [C] in Dec-Feb for the years 1961-1990

EU directive has far reaching consequences for Swedish municipalities



Three main sources of particles in Sweden

1. Long-range transport of air pollutants



2. Road traffic emissions

Mainly due to the use of studded tyres (and sand as antiskid treatment)

3. Residential wood combustion

Mainly due to old wood boilers

Estimated increased mortality:

Long-range transport about 3500 deaths per year

Local sources about 1800 death per year
(residential wood combustion about 90-330 death per year)

Forsberg et al., 2005. Ambio Vol 34, No 1, 11-19

The SIMAIR system

Two new web-based tools have been developed that can be used by all Swedish municipalities to assess air pollution levels and how they compare to the EU directive

SIMAIRroad **a model tool for the assessment of air pollution levels close to roads**

SIMAIRrwc **a model tool for the assessment of air pollution levels in areas with residential wood combustion**

Basic principles:

- **Coupled model system using different models on local, urban and regional scale**
- **Best available emission data**
- **Best available meteorological data**
- **Simple to use: all data stored on an server together with pre-calculated concentrations from time consuming models of larger scale. Model calculations are only made by computer fast local models. Automatic generation of reports.**

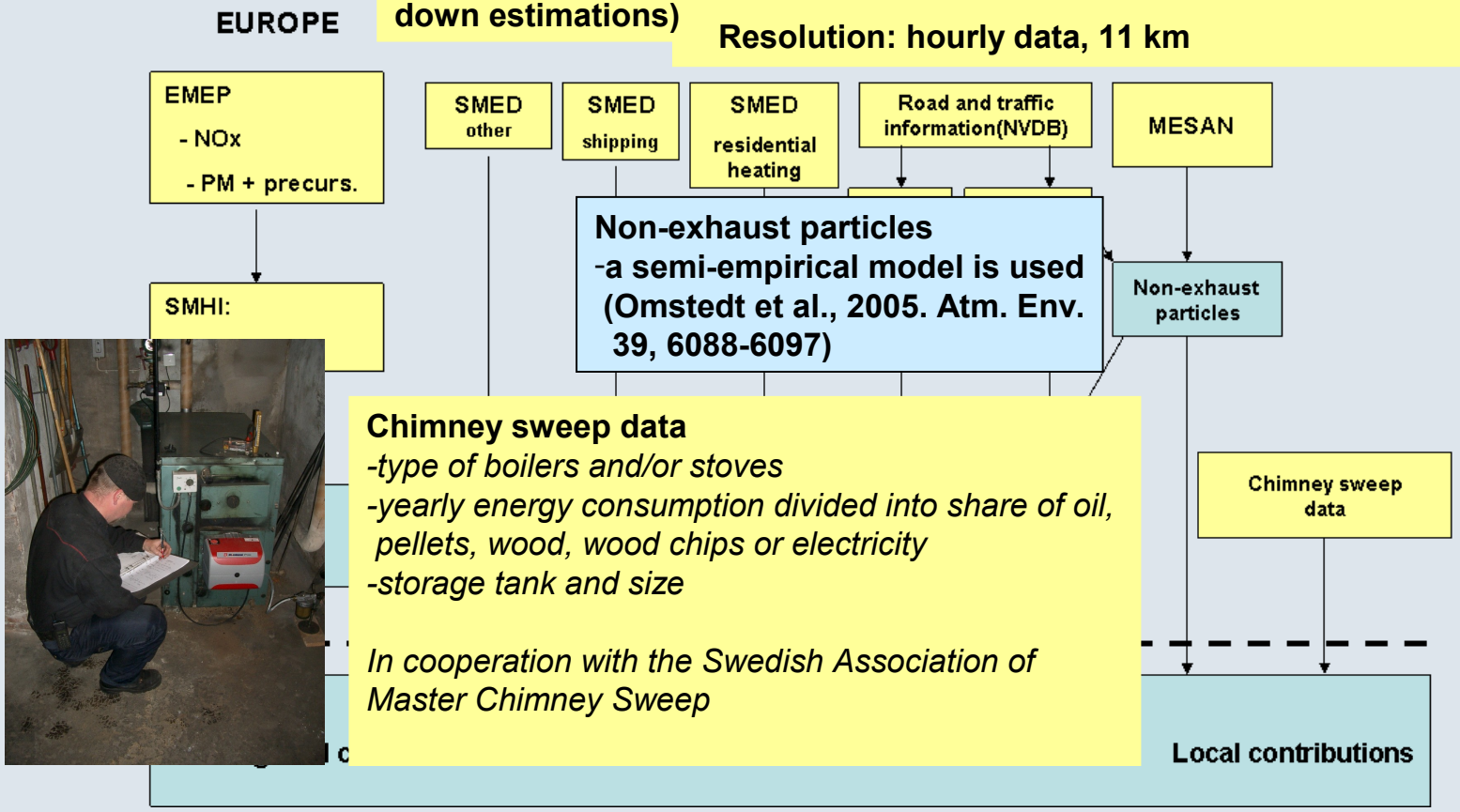
Databases and models used by the SIMAIR system

Meteorological data:

Routine operating meteorological system (MESAN) based on optimal interpolation technique.
-background field from the HIRLAM model
-measurements from synoptic and automatic stations, radar, satellites

Resolution: hourly data, 11 km

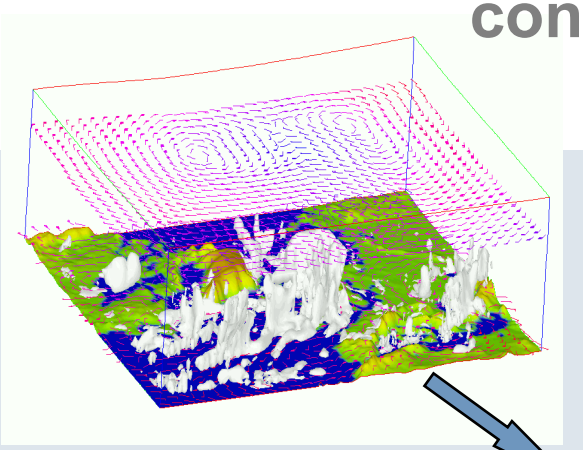
SMED:
The Swedish Databa
Emissions to the En
(report to CLRTAP b
down estimations)



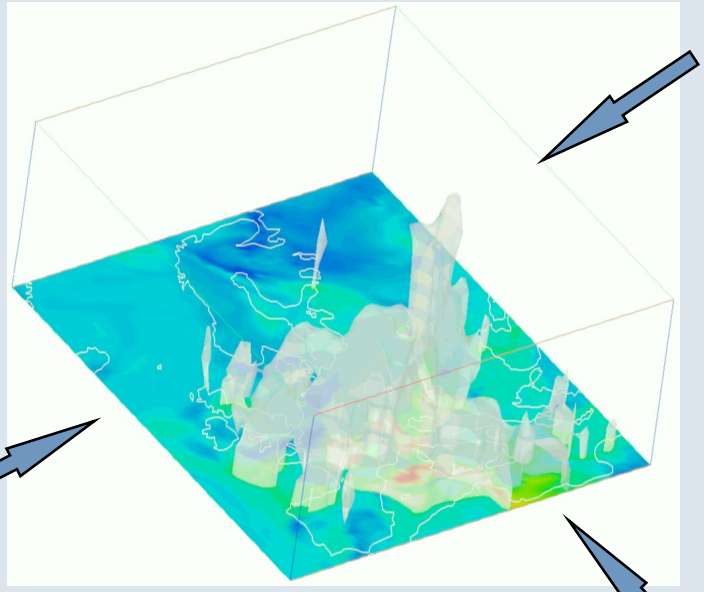
Chimney sweep data
-type of boilers and/or stoves
-yearly energy consumption divided into share of oil, pellets, wood, wood chips or electricity
-storage tank and size

In cooperation with the Swedish Association of Master Chimney Sweep

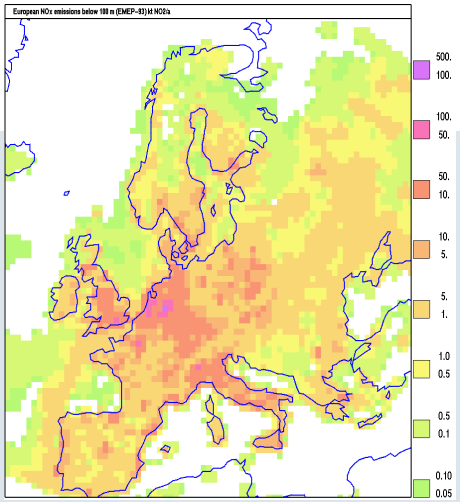
Models: regional contribution



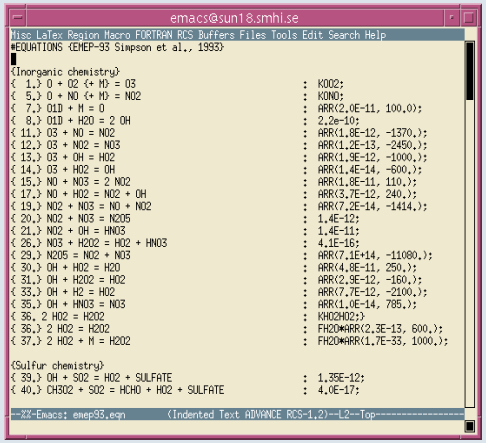
3D meteorological data, HIRLAM



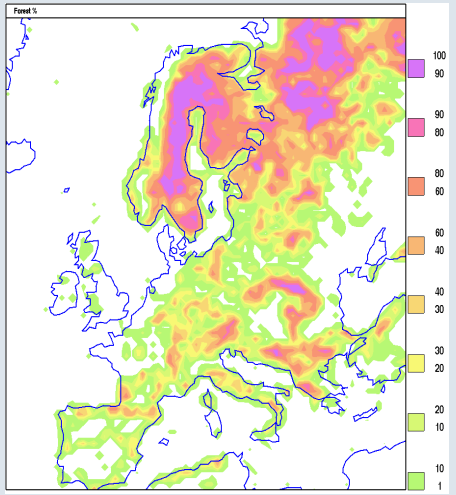
3D transport/chemistry model, MATCH



Emissionsdata, EMEP



Chemical mechanism, KPP syntax



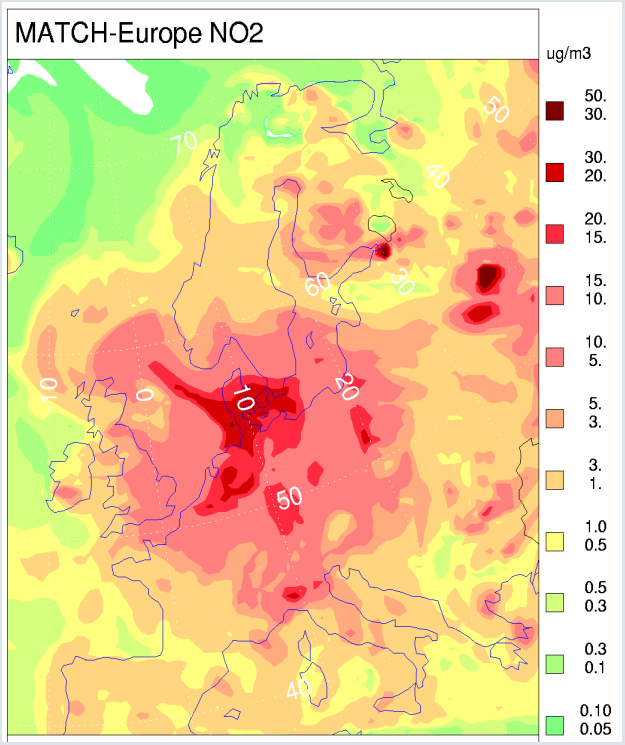
HIRLAM land use data

Robertson, L., Langner, J. and Engardt, M., ١٩٩٩. An Eularian limited-area atmospheric transport model. *Journal of Applied Meteorology* ٣٨, ١٩٠-٢١٠.

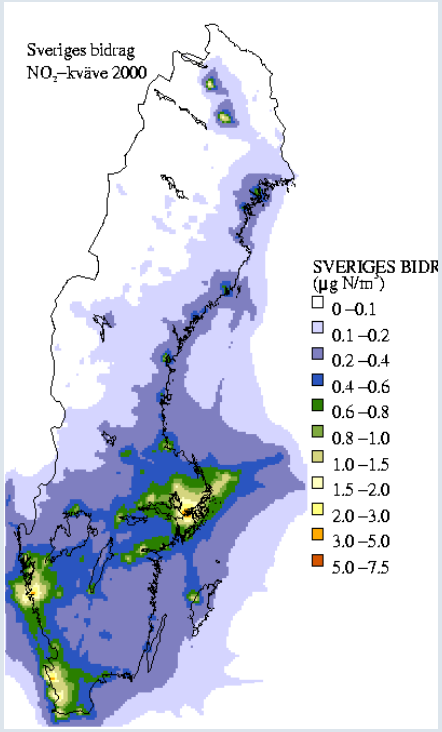
Models: regional contribution

- *from sources outside Sweden*
- *from Swedish sources*

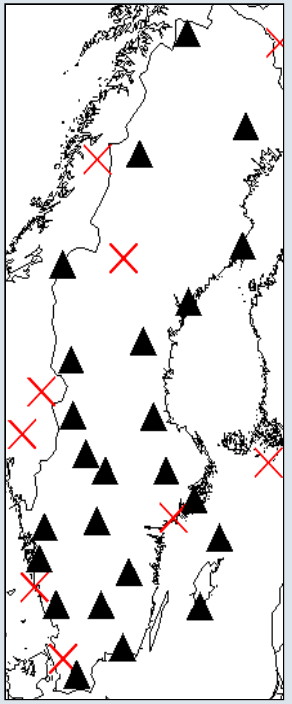
MATCH Europe



MATCH Sweden



National Atmospheric Chemistry Network

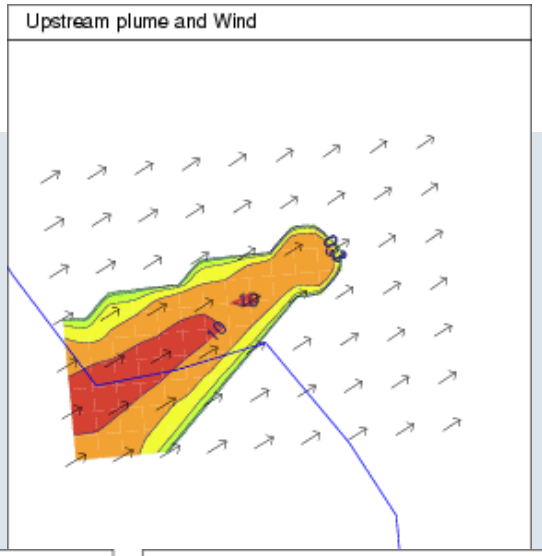


Models: urban contributions

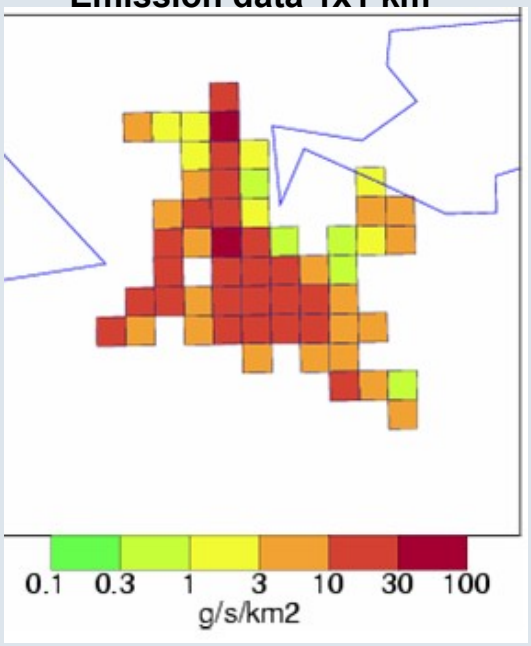
An adjoint model approach similar to the method presented by Berkowicz, 200

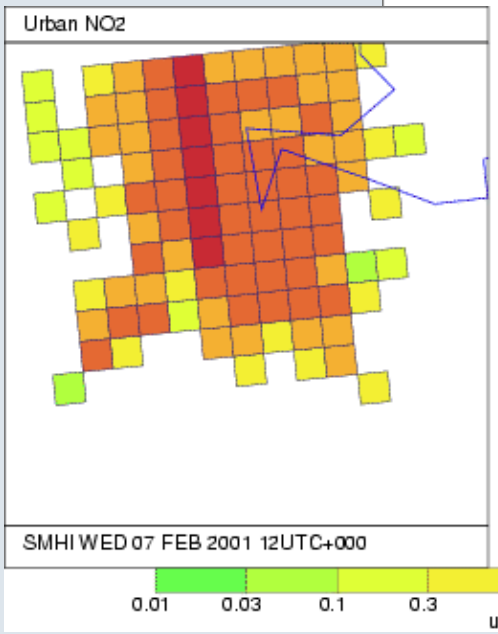
$$C = \frac{1}{2\theta}\int_{-\theta}^{\theta}\int_{0}^{r}\frac{Q}{u\sigma_z(r)}dxd\theta$$

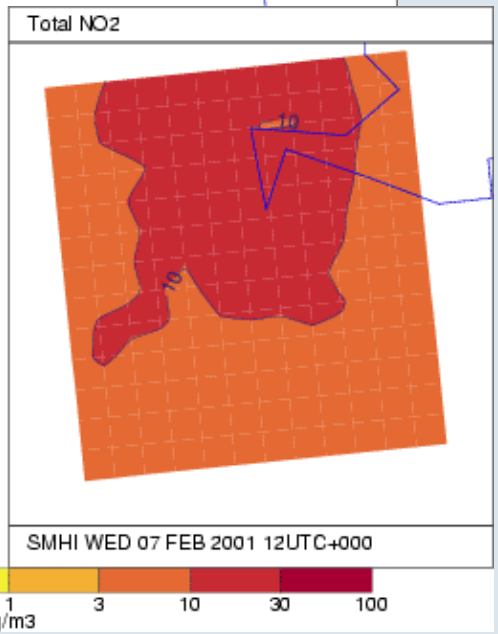
$$\sigma_z(r) = h_o + \sigma_w r/u$$

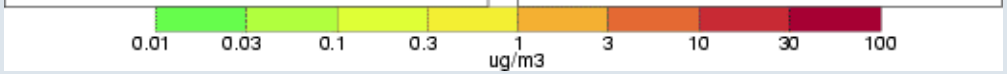


Emission data 1x1 km





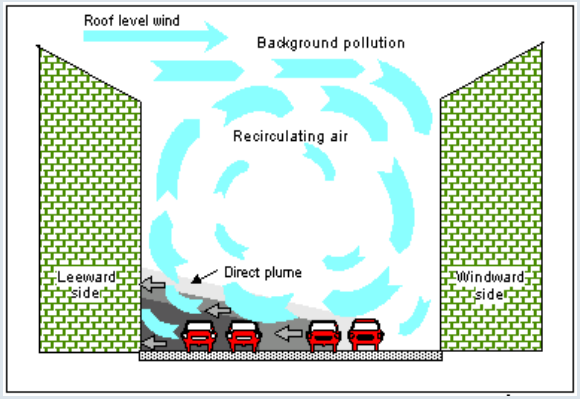




Berkowicz, R., 2000a. A simple model for urban background pollution. *Environment Monitoring and Assessement* **65**, 259-267.

Models: local contribution SIMAIRroad

OSPM



Berkowicz, R.,٢٠٠٠.OSPM-A parameterised street pollution model. Environmental Monitoring and Assessment Vol. ٦٥:٣٢٣-٣٣١.

OpenRoad

Dispersion model for ”infinite” line sources

Gidhagen,L., Johansson,C., Omstedt,G., Langner,J. and G Olivares.Model simulations of NOx and ultrafine particles close to a Swedish highway. Environment Science and Technology. ٢٠٠٤

Models: local contribution SIMAIRrwc

Dispersion -Point

Emission model
- *emission types*
- *emission factors*
- *start and running phases*
- *storage tank and size*
- *fuel consumption*

Johansson et al.,2004 Atm. Env. 38

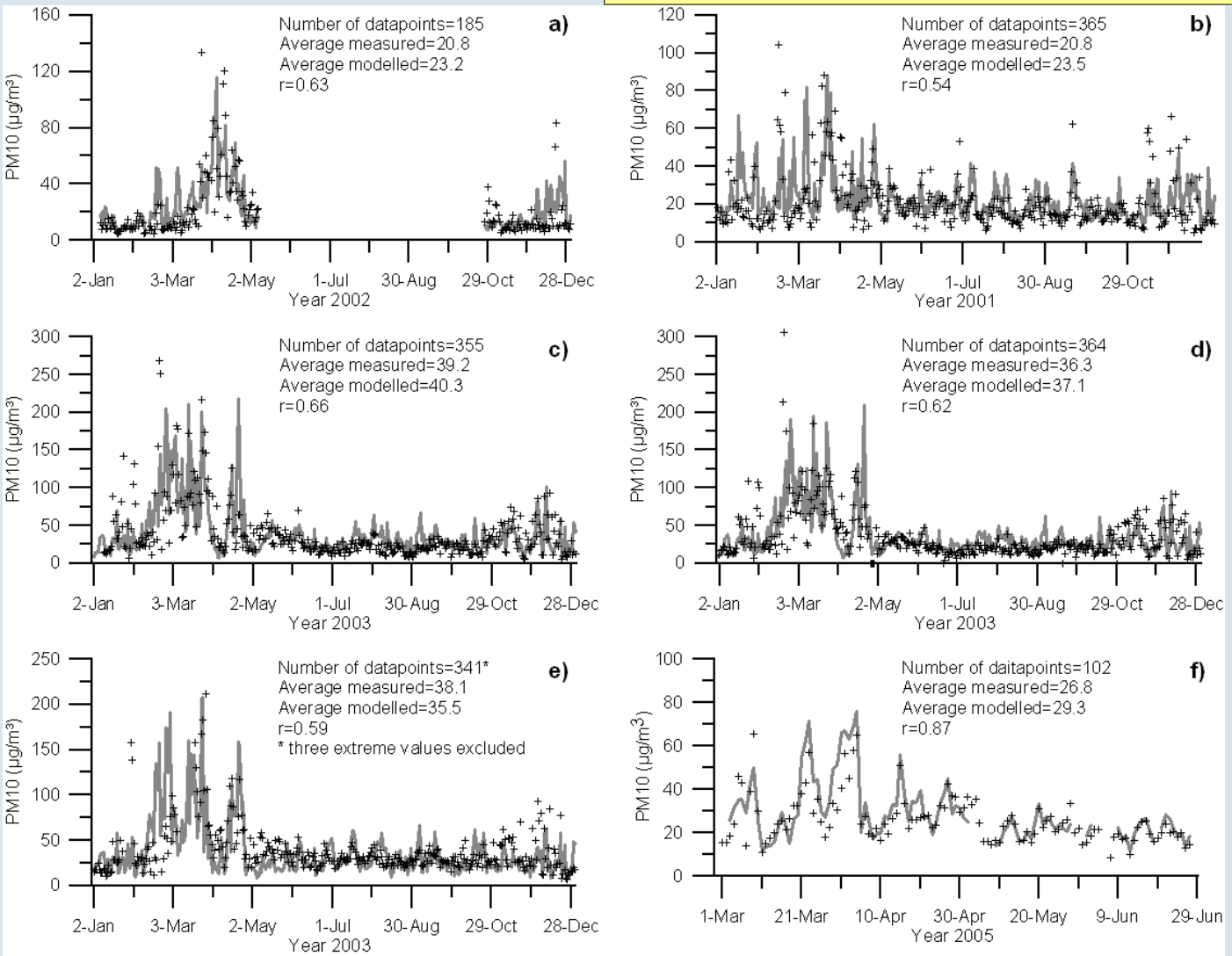
Dispersion model based on the Danish OML model (Berkowicz et. al, 1986, Omstedt,1988).

Dispersion -Road

Dispersion model for finite line sources.
(Omstedt and Robertson ,2008 Venkatram and Horst ,2006)

Model validation PM10, 6 streets

Street	Height of buildings (m) side 1/side 2	Width of the street (m)	Traffic intensity (vehicles/day)	Heavy duty vehicles (%)	Antiskid treatment	Share of studded tyres (%)
Sundsvall/Skolhusallen	10/1	20	20000	4	sand	90
Uppsala/Kungsgatan	20/0	18	18000	5	sand	76
Stockholm/Sveavägen	25/25	33	29100	4	salt	75
Stockholm/Norrlandsg	25/25	15	14800	4	salt	75
Stockholm/Hornsgatan	24/24	24	35000	5	salt	75
Malmö/Amiralsgatan	25/25	21	23000	10	salt	30



Model validation

PM10, Lycksele/ Sweden

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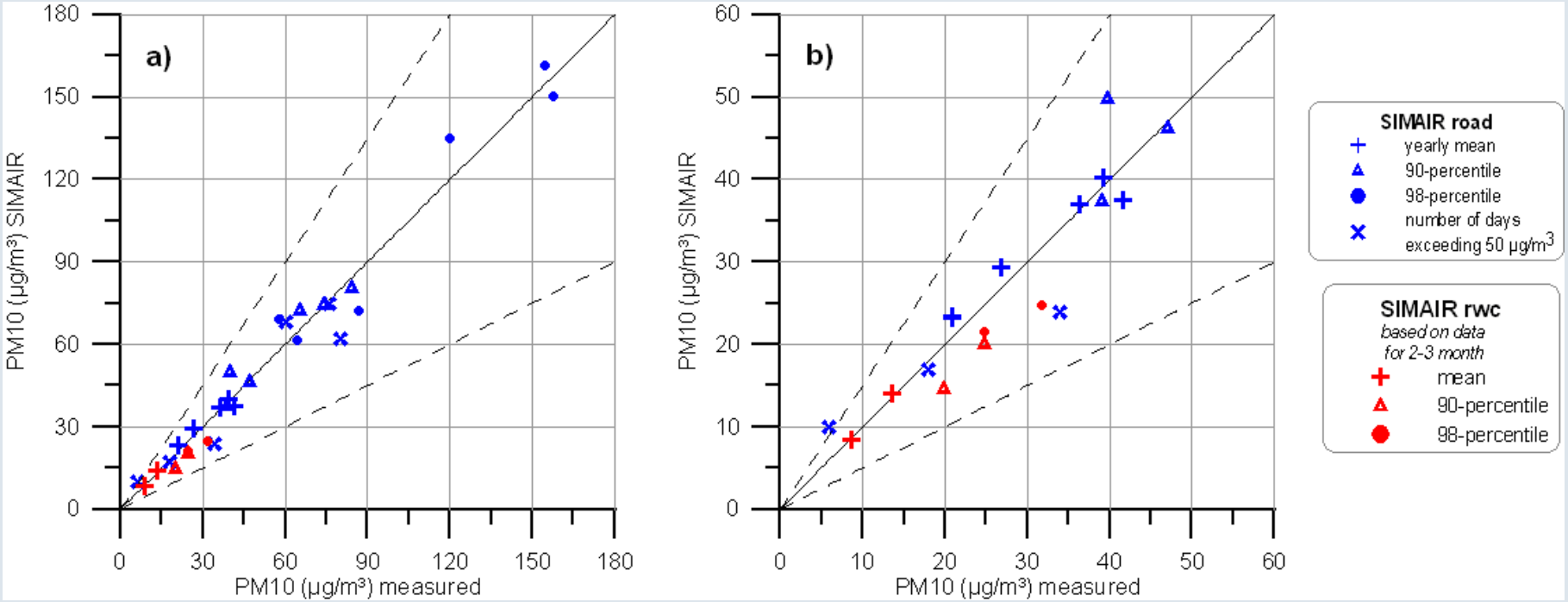
Comparison with EU directive on air quality



Comparison of measured and modelled concentrations of PM١٠ (µg/m٣) expressed in terms of air quality levels defined by the EU directive on air pollution levels for PM١٠. (a) All data, (b) data below ٦٠ µg/m٣.

SMHI

Final remarks

- **Many cities in Sweden have problems meeting the EU directive on air pollution levels, especially the PM10 legislation**
- **Two new web-based tools have been developed that can be used by all Swedish cities to assess air pollution levels and how they compare to the EU directive**
- **Comparing them with measurements show that the models yield results that lead to the same conclusions as measurements, in term of air quality statistics Thus the models can to some extent replace costly measurements**

ACKNOWLEDGEMENTS
The development of SIMAIRroad and SIMAIRrwc has been founded by the Swedish Protection Agency, the Swedish Road Administration and the Swedish Energy Agency.

Thank you for your attention!