UFIPOLNET
ultrafine particle size distributions in air pollution monitoring networks

Human exposure against particles

Cardiovascular Emergency Calls Associated to Urban Submicron Aerosol Fractions, the Indoor-Outdoor Problem and Traffic

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- Hypotheses and main questions
- Particle associated cardiovascular health effects
- Indoor vs. outdoor
- Effects of traffic reduction

hypothesis

airborne particles are associated with health effects

main questions

what kind of particles (ultrafine, fine, PM2.5 or PM10) cause these health effects

linked with this question

- problem of exposure pattern and/or exposure scenarios
- contribution to the doses coming from outdoor respectively indoor exposure
- influence of traffic on outdoor and indoor concentrations, since traffic is the main source for ultrafine particles in urban areas

Within epidemiological studies the exposure situation is usually characterized using outdoor particle concentrations,
yet knowing that people spend most of their time indoors

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why do epidemiological studies consider particles < 10 µm

- very large particles not inhalable and respirable → no internal burden
- particles < 10 µm
  - inhalable
  - deposited in the upper airways and the lungs

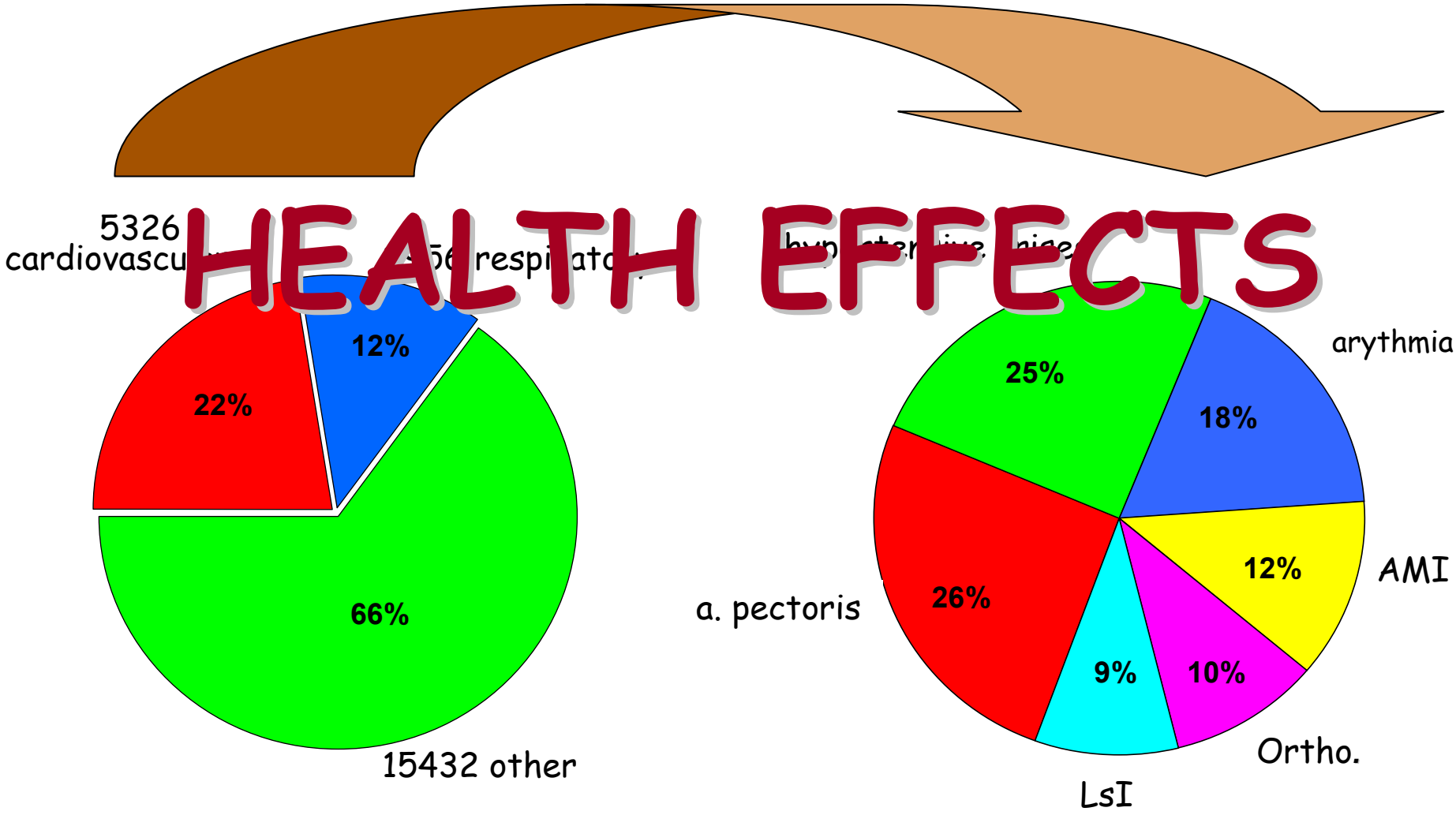
some findings suggest

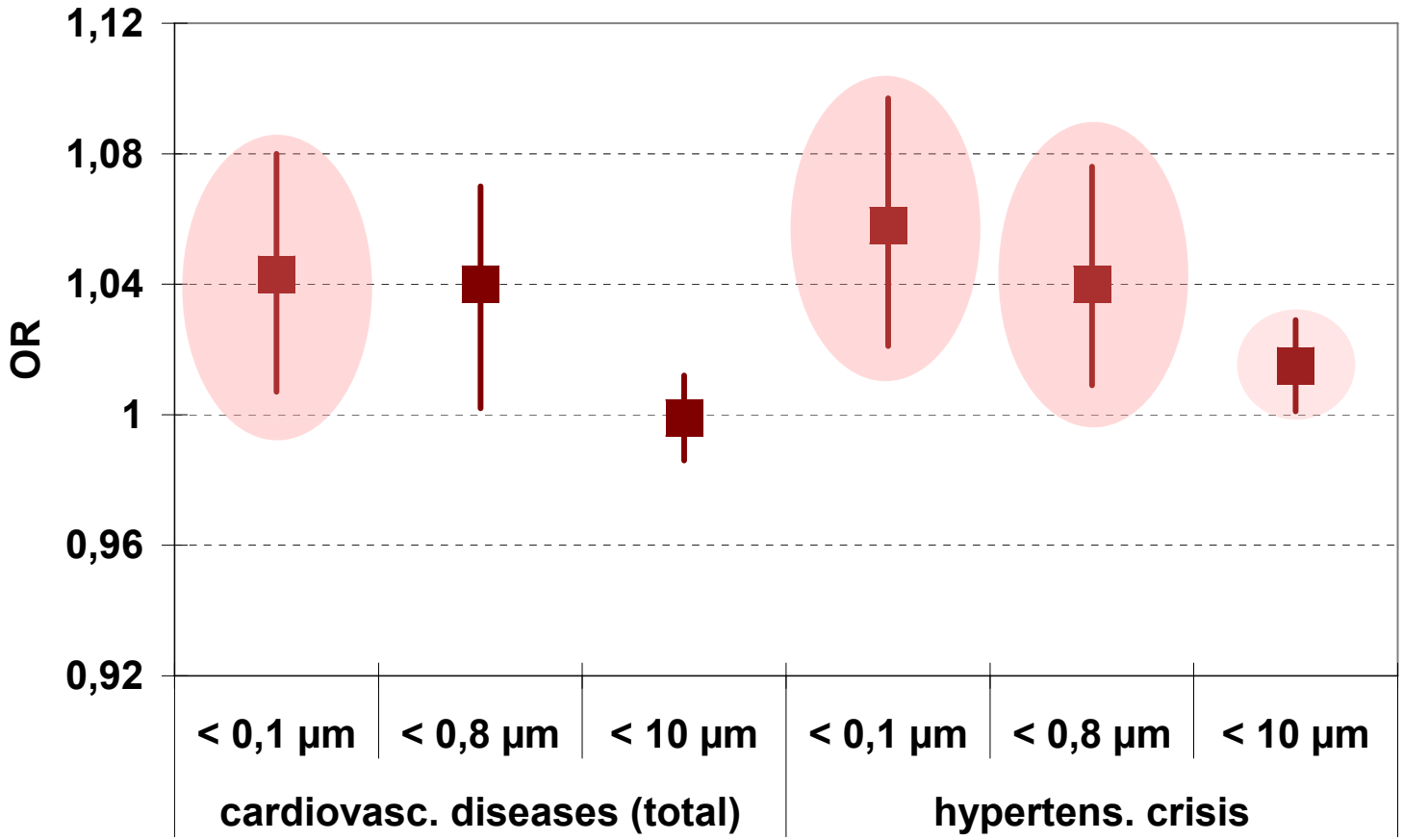
- particle < PM2.5 of great importance for adverse effects

special attention to particles < 1 µm and to ultrafine particles (UF):

- both may reach the **deepest regions** of the human respiratory system
- **clearance mechanisms** do not work effectively for UF
- compared with mass the **number concentration** is very high
- **chemical composition** of submicron and ultrafine particles may differ from larger ones because these particles originate from different sources
- **urban traffic** is a main source of these particles and urban traffic volume is **increasing**

Emergency case numbers





increase of cases using emergency units

per 1000 particles / cm³; per 1 µg /m³

02/2002 – 01/2003; N = 5326 (cardiovascular diseases); n = 1513 (hypertensive crisis)

Odeh SF. PhD Thesis 2006

Herbarth O, Odeh SF, Franck U, et al.2007 in prep.

cardiovascular disease (total) vs. different fraction of fine dust

	day after exposure	0	1	2	3	4	5	6	7
number-conc. < 100 nm	Odds Ratio	0.999	1.012	1.033	1.018	0.989	1.023	1.043	1.043
	p	0.938	0.480	0.063	0.299	0.511	0.190	0.017	0.371
PM 10	Odds Ratio	1.001	1.001	1.004	1.006	1.007	0.998	0.999	1.000
	p	0.837	0.862	0.539	0.379	0.304	0.805	0.851	0.940

hypertensive crisis vs. different fraction of fine dust

number-conc. < 100 nm	Odds Ratio	0.989	1.006	1.058	1.052	1.035	1.044	1.049	1.052
	p	0.532	0.711	0.001	0.003	0.048	0.014	0.006	0.004
PM 10	Odds Ratio	0.997	0.995	0.996	1.003	1.015	1.015	1.015	1.012
	p	0.681	0.403	0.571	0.669	0.031	0.001	0.027	0.071

increase of cases using emergency units per 1000 UF particles / cm³, per 1 µg PM10 / m³

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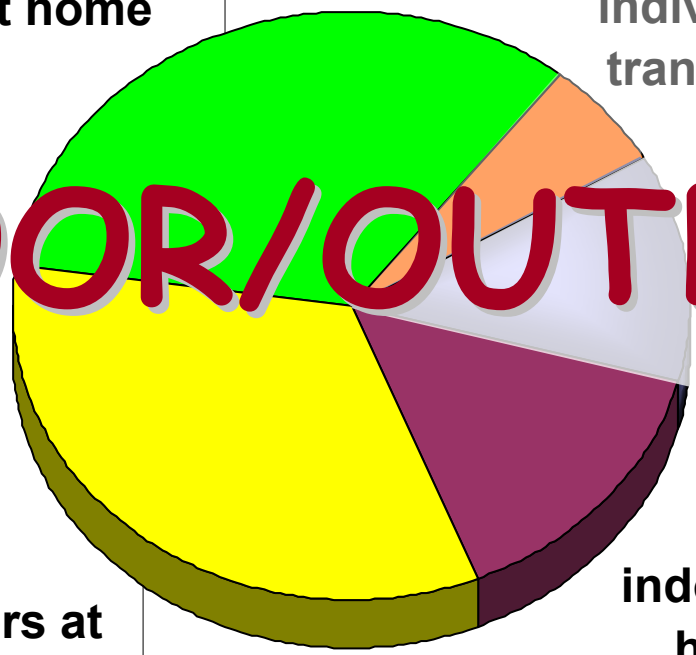
CONCLUSIONS

There is a time lag between exposure and effect.

The health risk depends on the medical endpoint.

Health effects of airborne particles depend sophisticated on size fractions.

INDOOR/OUTDOOR



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localities

urban background site

- different buildings / rooms in different floors on the institute campus

representative for traffic pollution in a city centre

- second floor of an apartment house in an unoccupied apartment

Instruments

- two different differential/scanning mobility particle sizer systems
  ~15 nm and ~800 nm indoors & outdoors simultaneously
- conventional PM 2.5 and PM 10 measurement instruments

comparability of both systems was verified by parallel outdoor measurements

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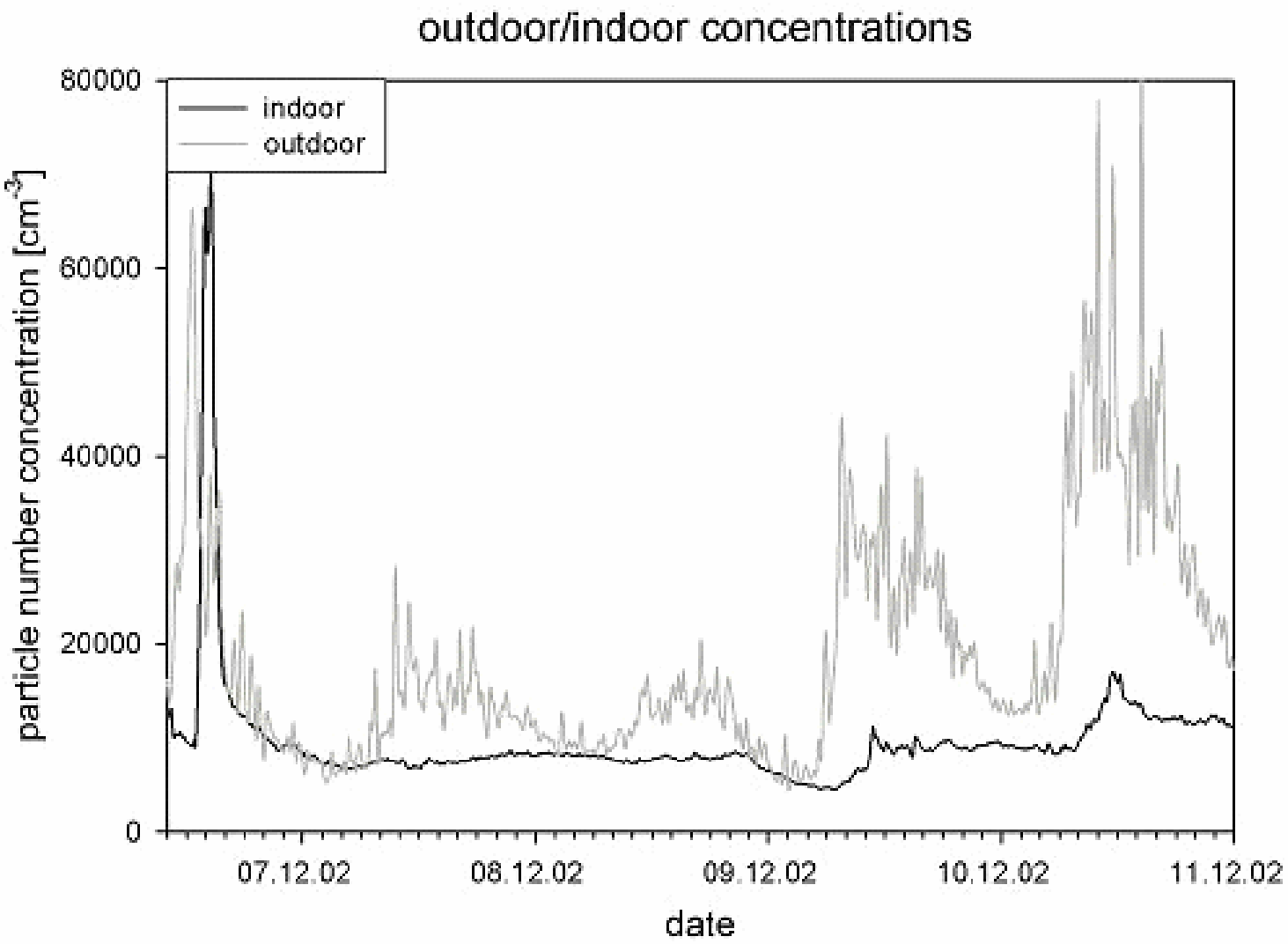

indoor and outdoor total number concentrations

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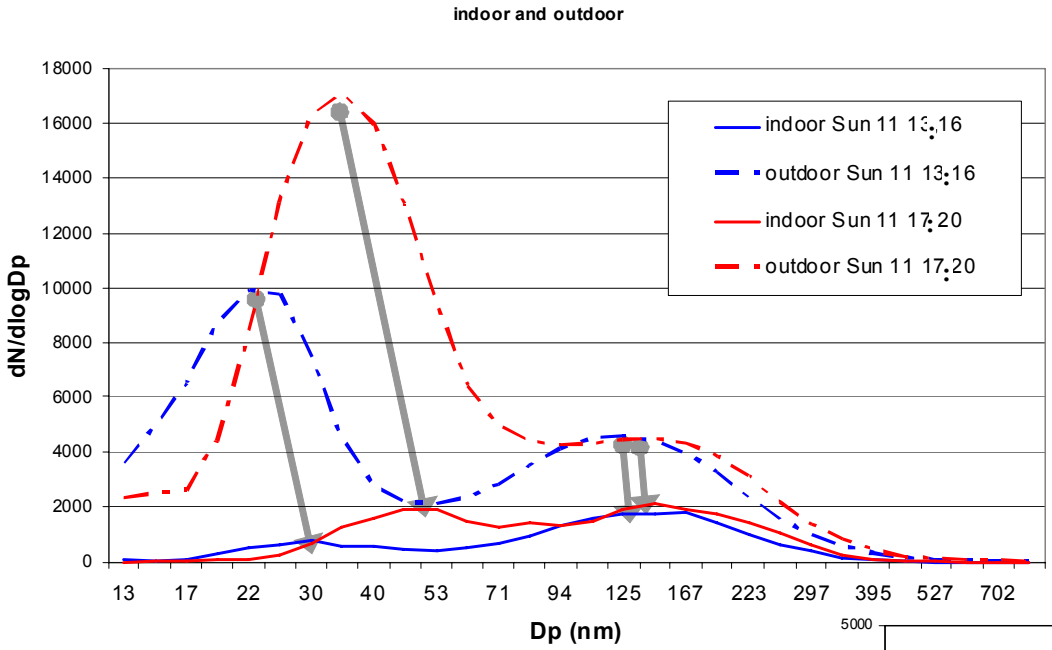
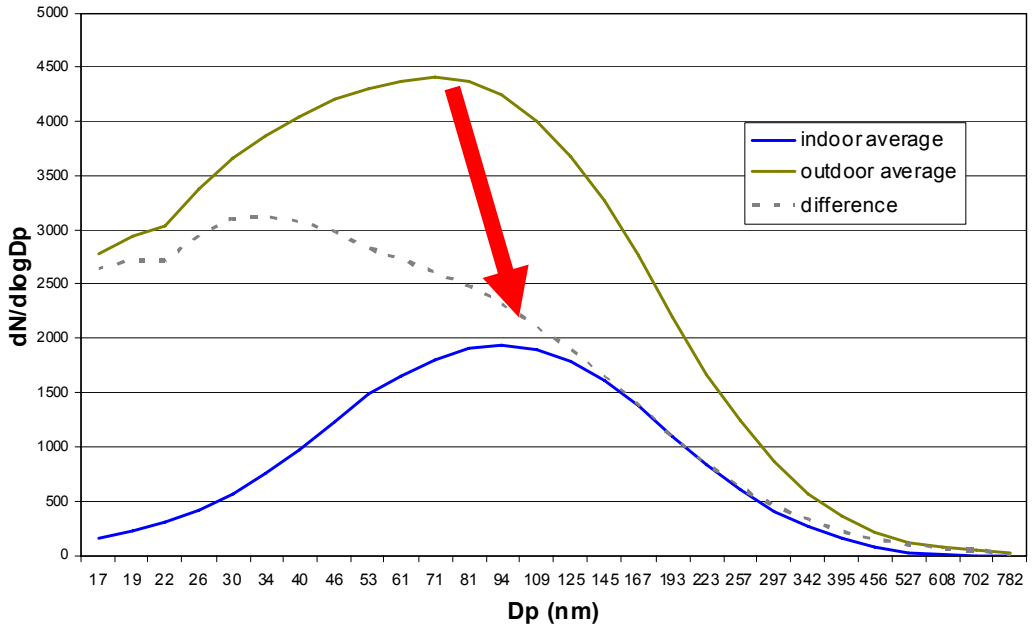
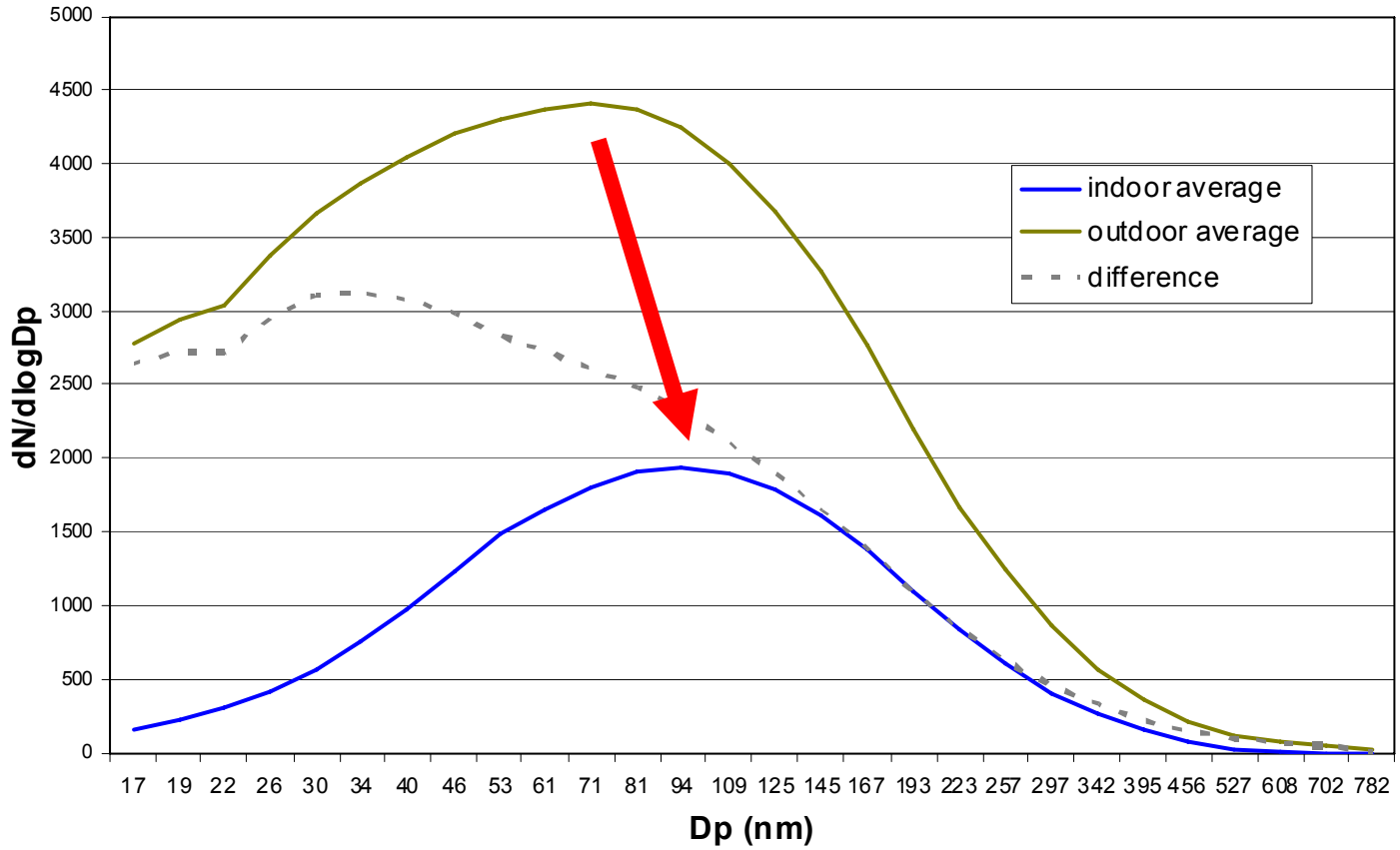


simultaneously measured
indoor and
outdoor particle size distributions

averaged
indoor and outdoor size distributions
for sub-micrometer particles.
(data from all four seasons)



Franck U, Tuch T, Manjarrez M, Wiedensohler A,
Herbarth O. Environ Toxicol. 2006 Nov 7;21(6):606-613



averaged indoor and outdoor size distributions for sub-micrometer particles.
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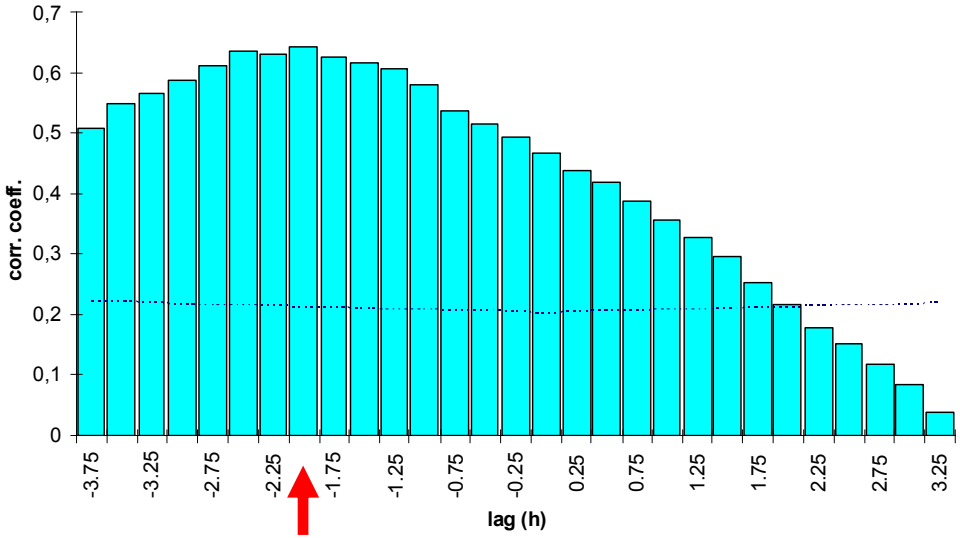
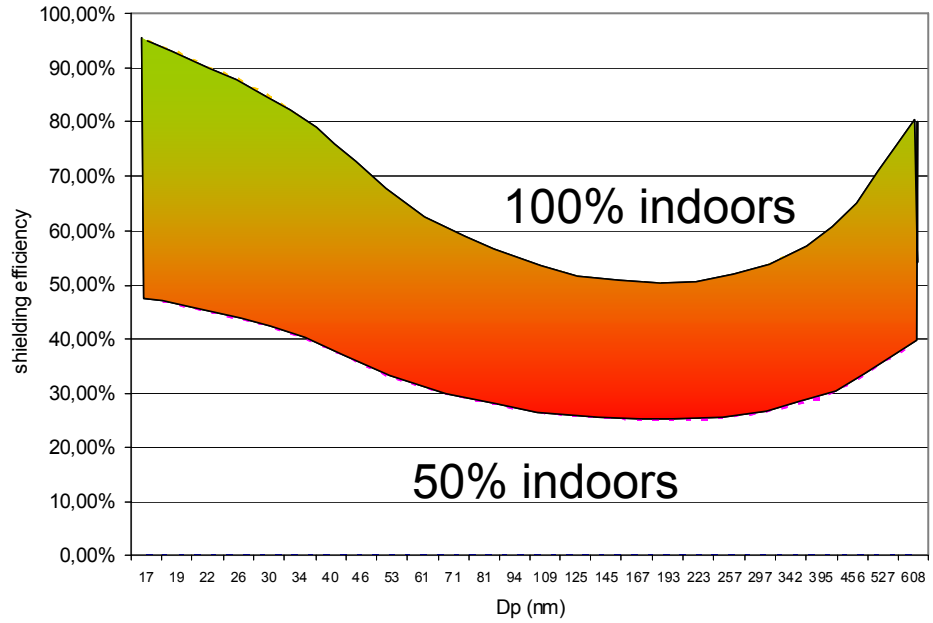


2 h later

correlation coefficients
of outdoor particles (34 nm)
with indoor particles(107.7 nm)

exposure reduction
by indoor shielding



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CONCLUSIONS

Outdoor particles contribute to indoor particle exposure.

Both indoor size distributions and concentrations are different from those measured outside.

Total exposure including the time budget indoors and outdoors differs from the exposure measured outdoors.

CONCLUSIONS

differences between indoor and outdoor exposure
can be summarized by "**3 indoor L's**":

LESS:

indoor environment is generally shielded against outdoor particulates,
→ lower number concentrations indoors than outdoors,
(if no important indoor sources)

LARGER:

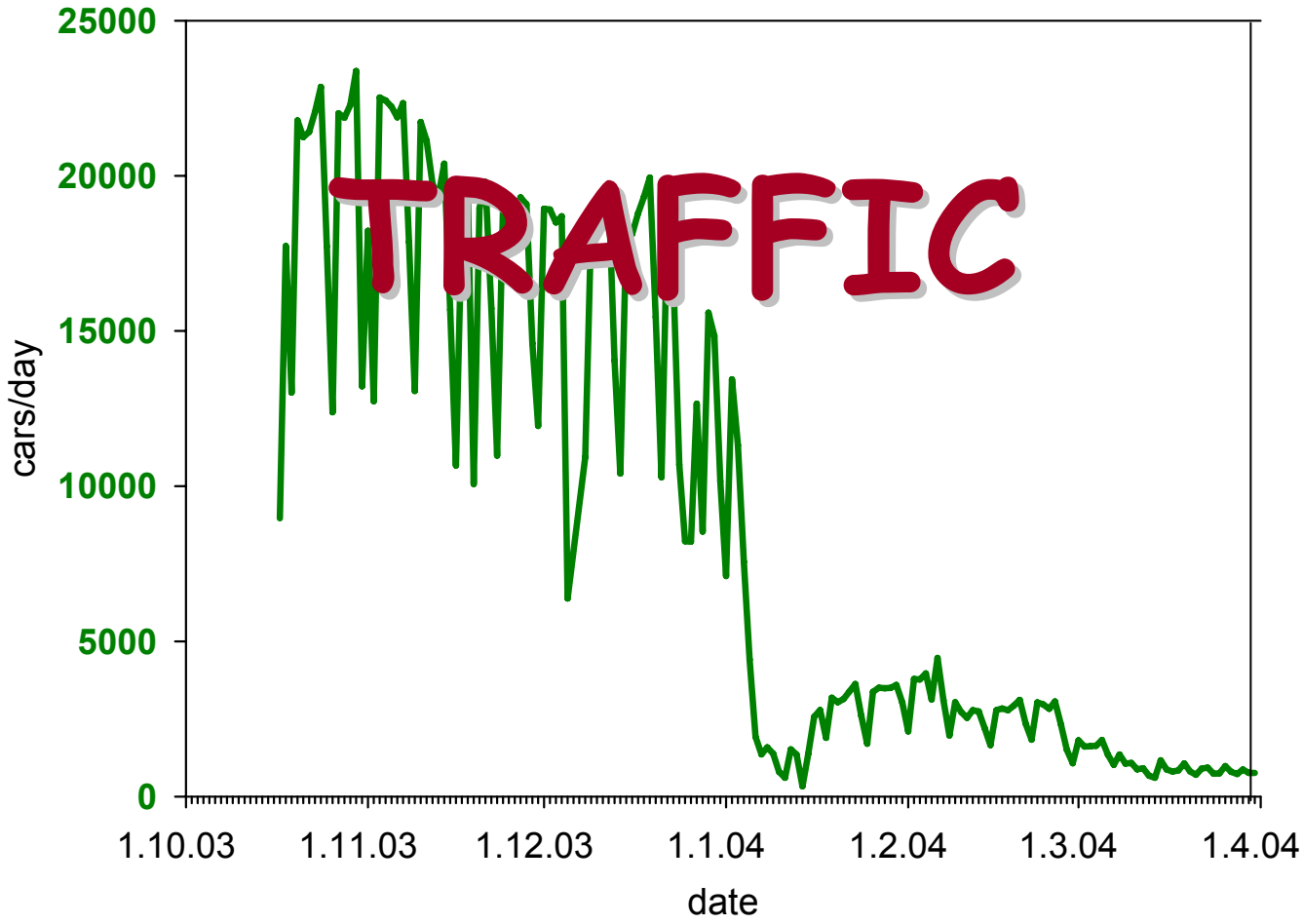
indoor size distributions of particles very different from outdoor one:
→ concentrations of very fine particles are decreased significantly
→ concentration maxima are shifted to larger diameters

LATER:

→ time lag between outdoor and indoor number concentrations

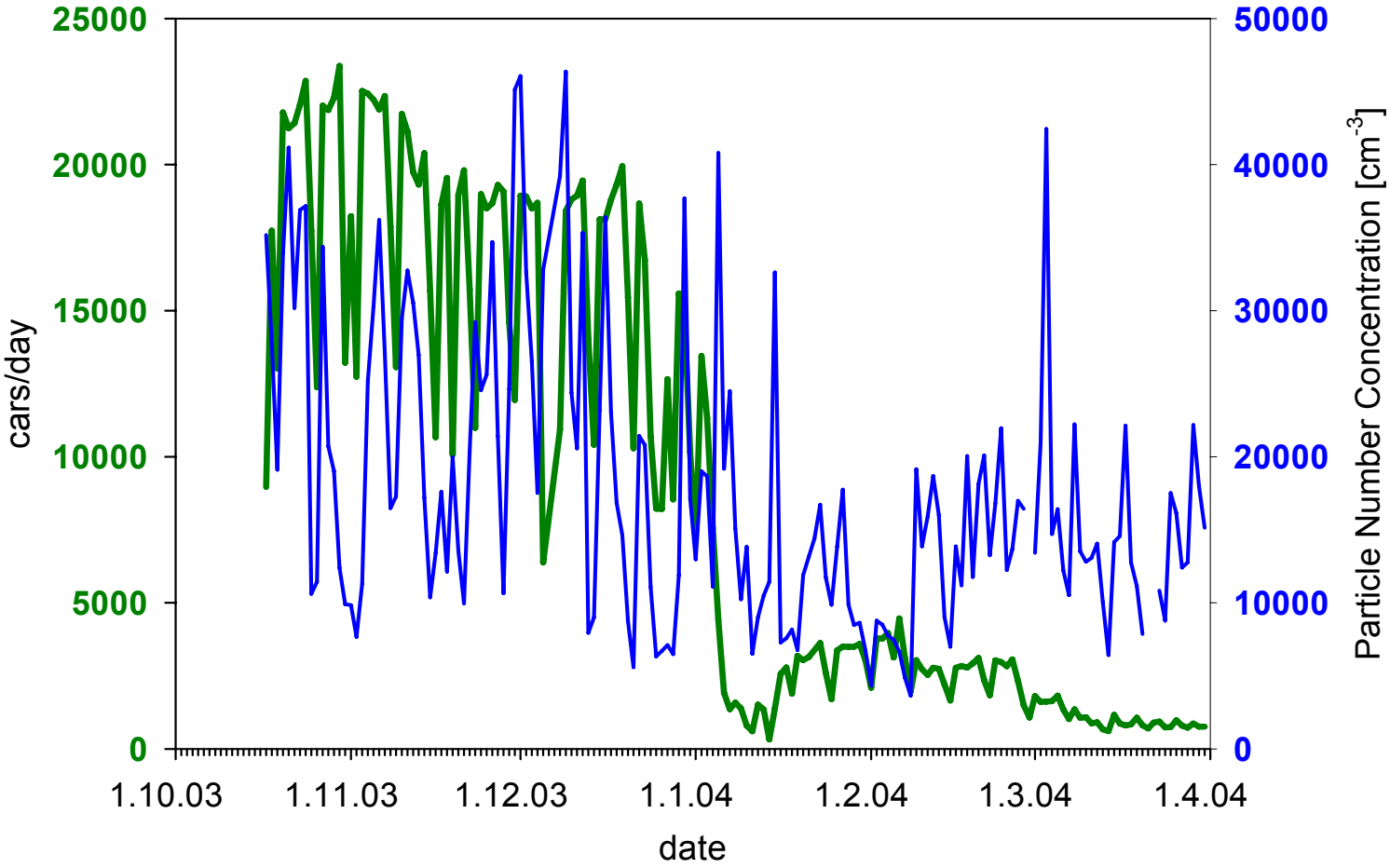
reduction by (total) road blocking

reduction of traffic



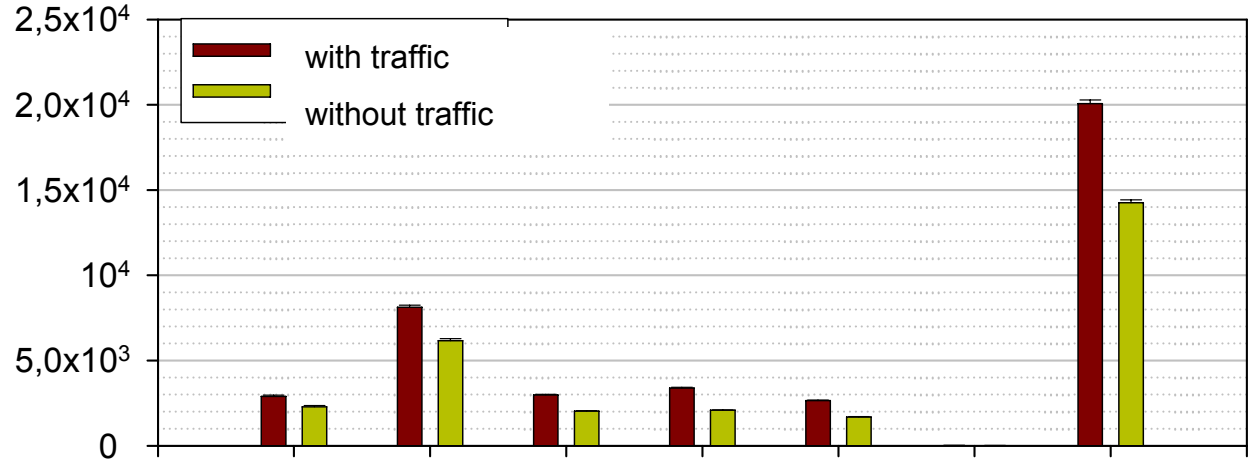
reduction by (total) road blocking

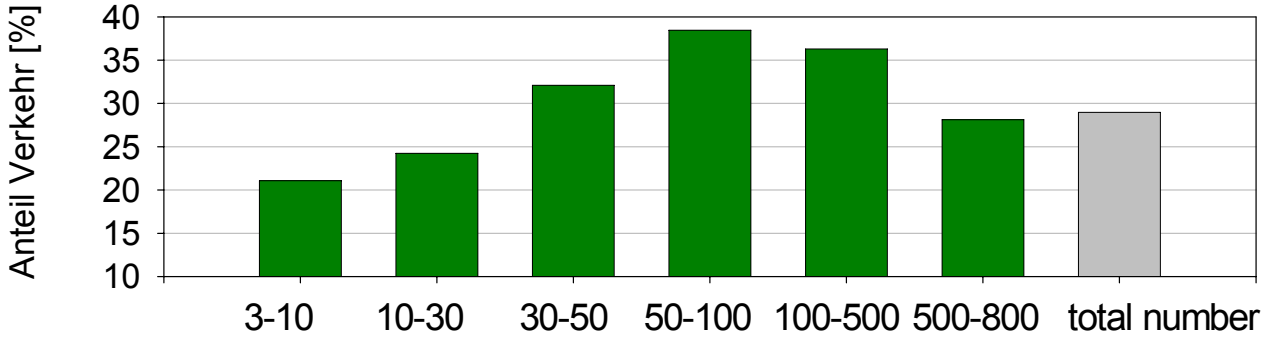
reduction of traffic and number concentration



reduction by (total) road blocking

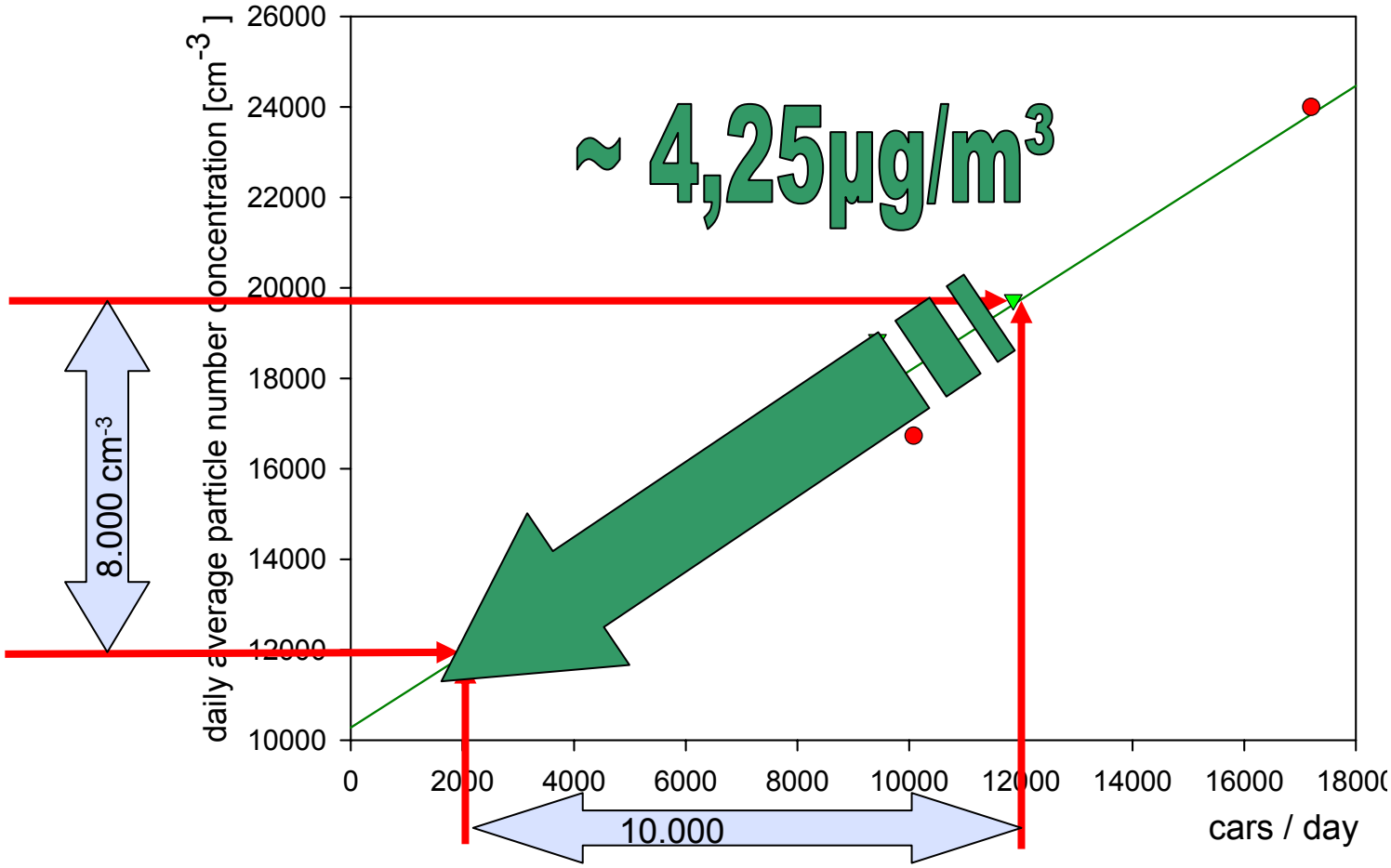
local traffic contribution to local particle exposure





reduction by (total) road blocking

eposure vs. traffic density



CONCLUSIONS

Traffic is significantly contributing to local exposure.

Traffic reduction in a street results in decreased concentration of the concentration of traffic related particle sizes.

Road blocking reduces the particle exposure but not very much.

Acknowledgements

The authors thank
Maik Schilde
for his technical support.

Parts of this paper has been published in
Env Toxicology 21:6 (2006) 606 – 613 .
The authors thank the publisher John Wiley & Sons, Inc. for the possibility to republish parts of this work.

… THANK YOU FOR YOUR ATTENTION

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ULTIMATE SOLUTION

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