Temporal and spatial variability of sub-µm aerosol concentrations in the urban atmosphere of Leipzig

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PURAT Project (2004-2006)

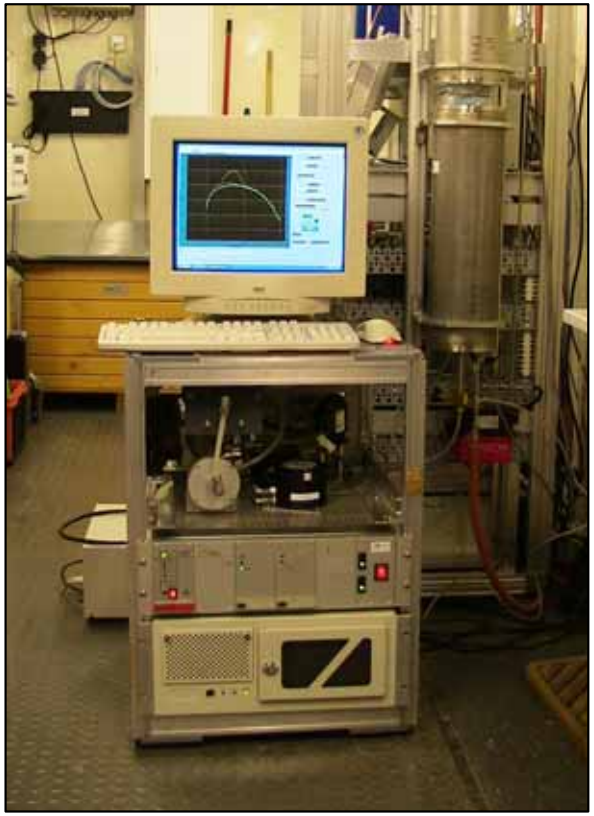
- Title "*Concentration of ultrafine particles (Dp<100 nm) in urban atmospheres: validation of measurement techniques, experimental determination of their tempo-spatial variation, and microscale transport and transformation modelling*"
- Explore spatial variation of nanoparticle concentrations within one city
- How many measurement points are needed to characterise population exposure?

PURAT Project (2004-2006)
Experimental set-up

Experiment	Period	Location	Length scale	No. of sites
Long-term	2 years	Leipzig	**1.5 km**	2
PURAT 1	2 months	Berlin	**100 m - 10 km**	7+1
PURAT 2	2 months	Leipzig	**10 m - 1 km**	3+1
PURAT 3	6 months	Leipzig	**1 m - 100 m**	4
PURAT 4	3 months	Leipzig	**1 m - 100 m**	3+1

Particle size spectrometers (IfT Leipzig)

Simple DMPS
1 DMA; Size range 10-900 nm



Twin-DMPS
2 DMAs; Size range 3-900 nm

Long-term measurements in a street canyon in Leipzig (Eisenbahnstrasse)

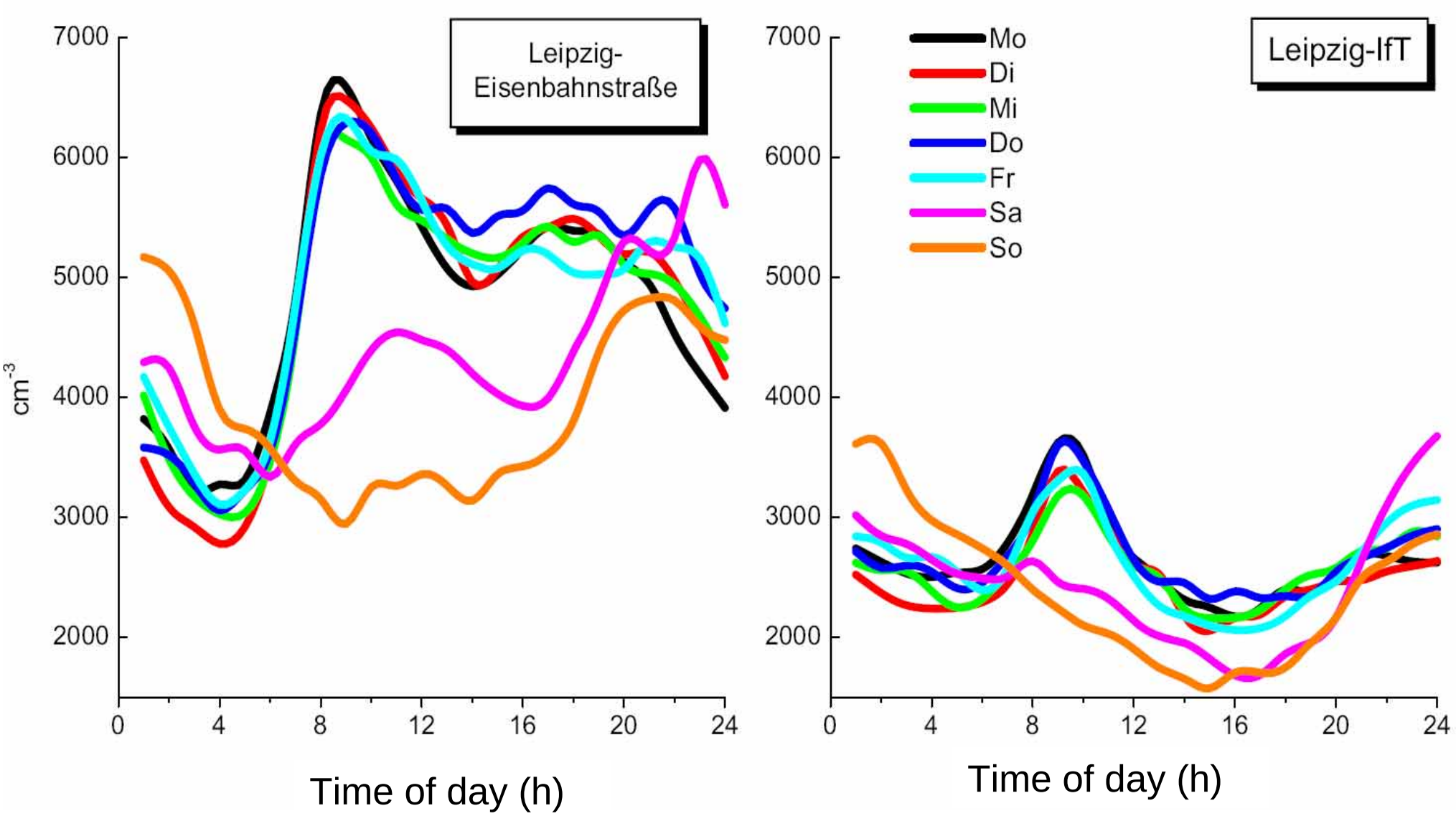
Narrow canyon

25000 veh / day

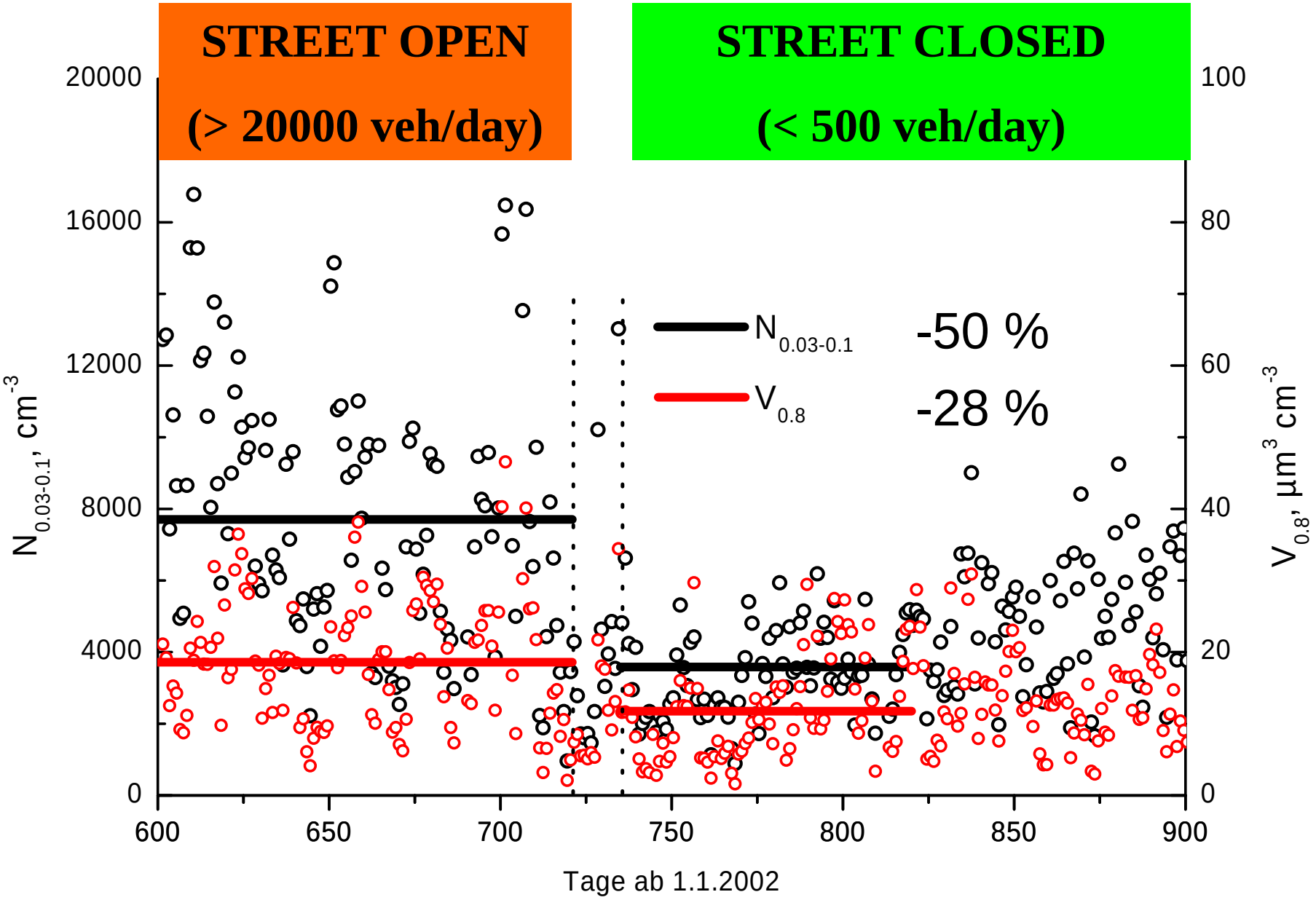
~ 4 % Heavy-Duty Lorries

Almost complete closure to traffic during 6 months

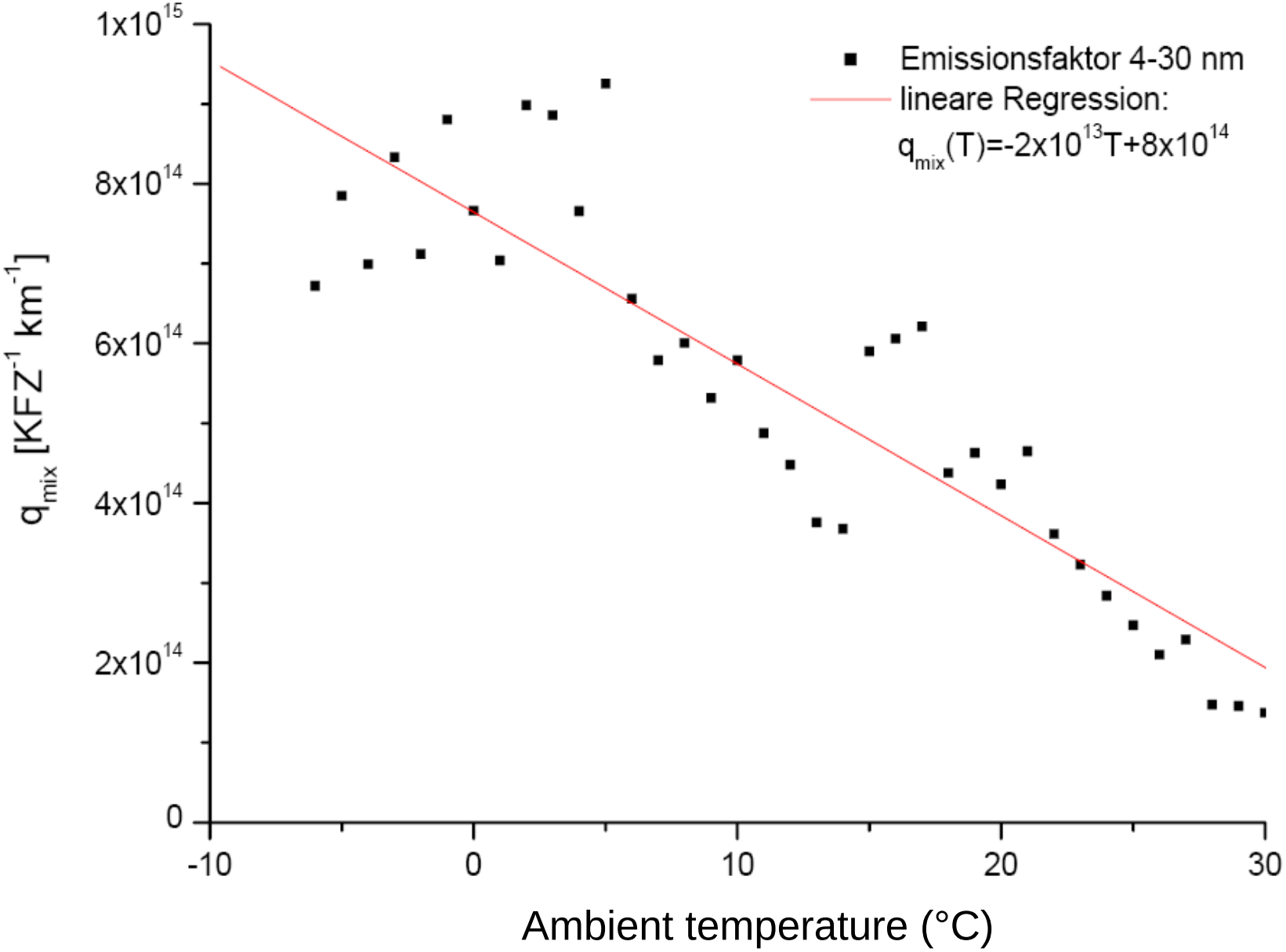
Diurnal & weekly cycles of particle number (40-120 nm)

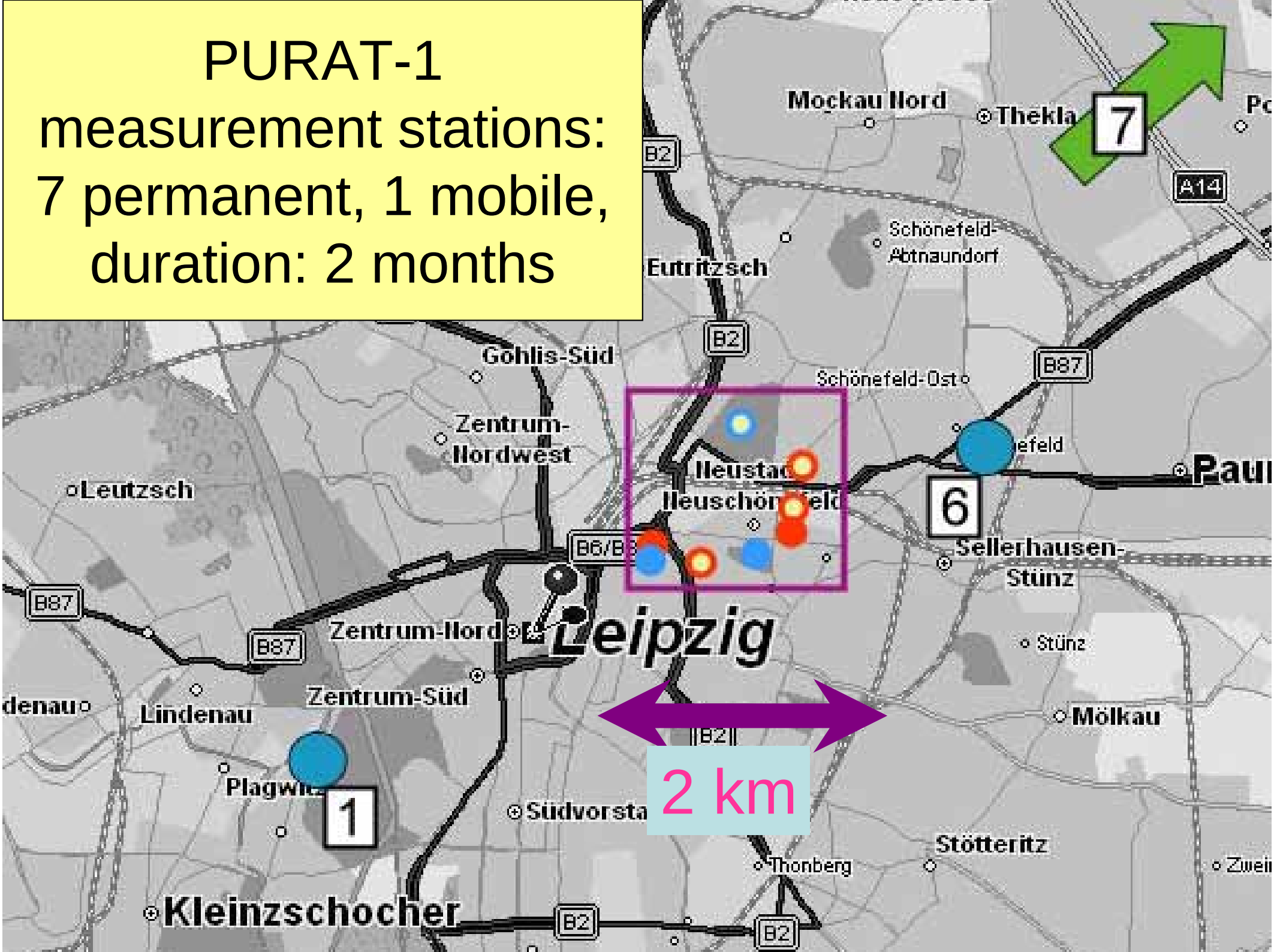


Effect of street closure

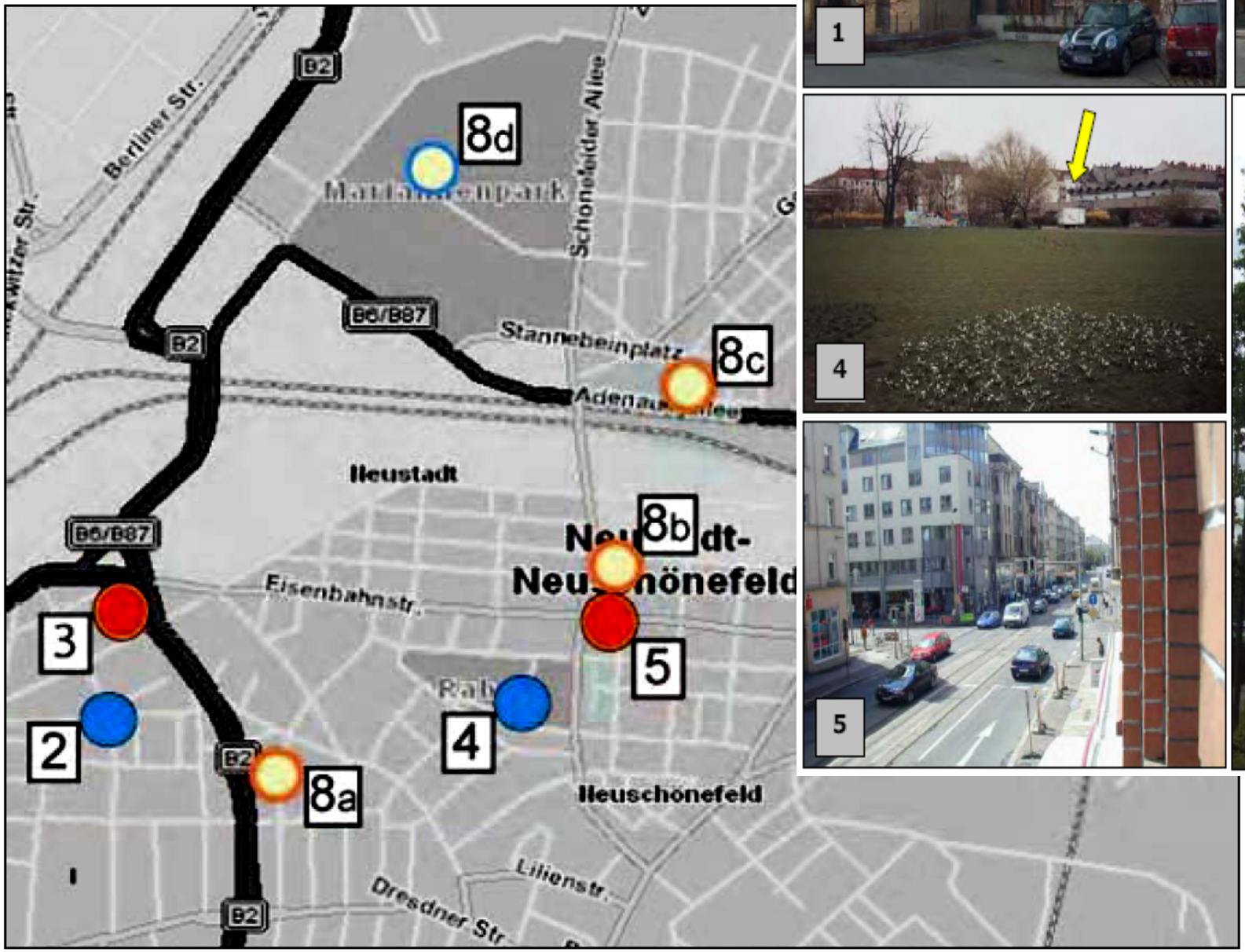


UFP number emission factor also depends on temperature here!

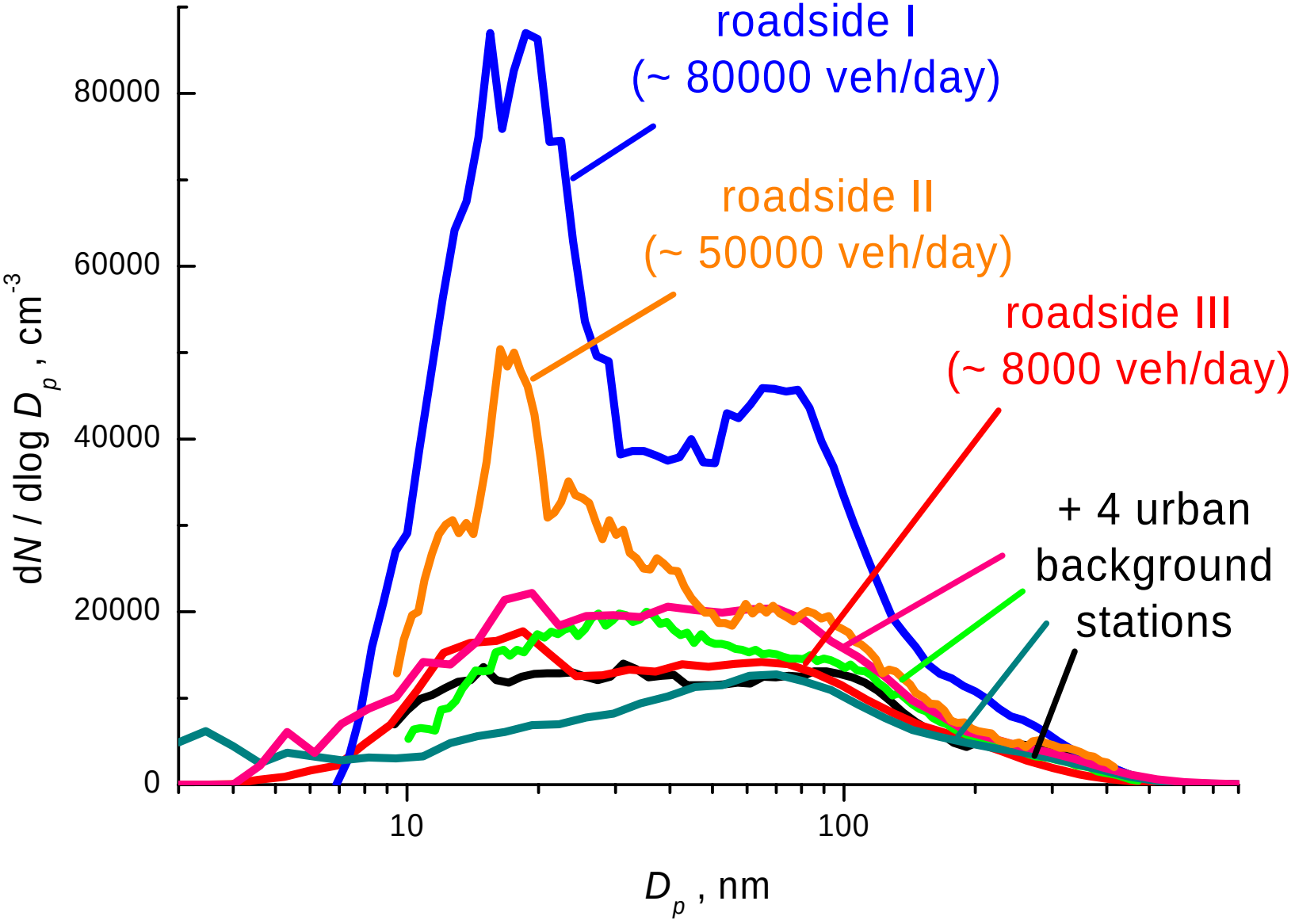



PURAT-1
measurement stations:
7 permanent, 1 mobile,
duration: 2 months
Mockau Nord
Thekla
7
A14
B2
Schönefeld-
Abtnaundorf
Eutritzsch
Gohlis-Süd
B2
B87
Schönefeld-Ost
Zentrum-
Nordwest
Leutzsch
6
Sellerhausen-
Stünz
B6/B
B87
Zentrum-Nord
Leipzig
B87
Stünz
Zentrum-Süd
Lindenau
Mölkau
B2
2 km
1
Südvorsta
Stötteritz
Thonberg
Kleinzschocher
B2
B2

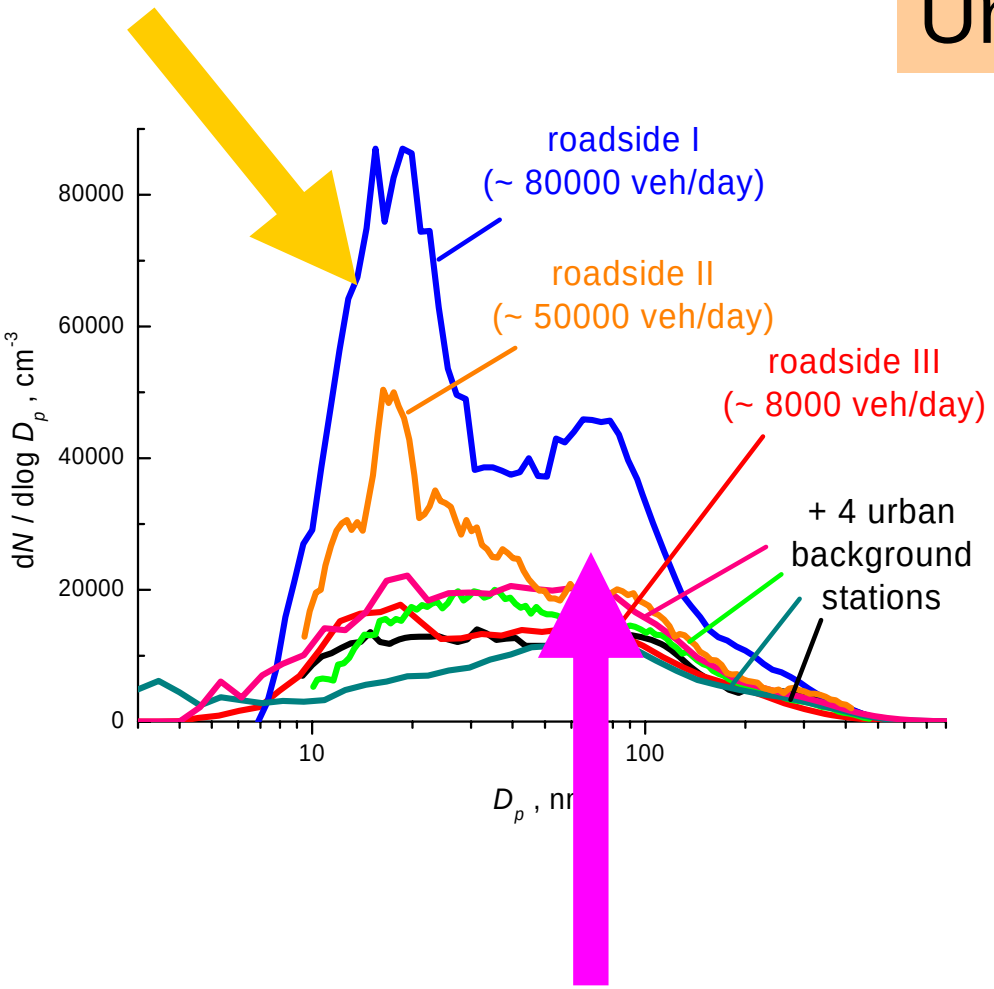
PURAT-1 measurement stations



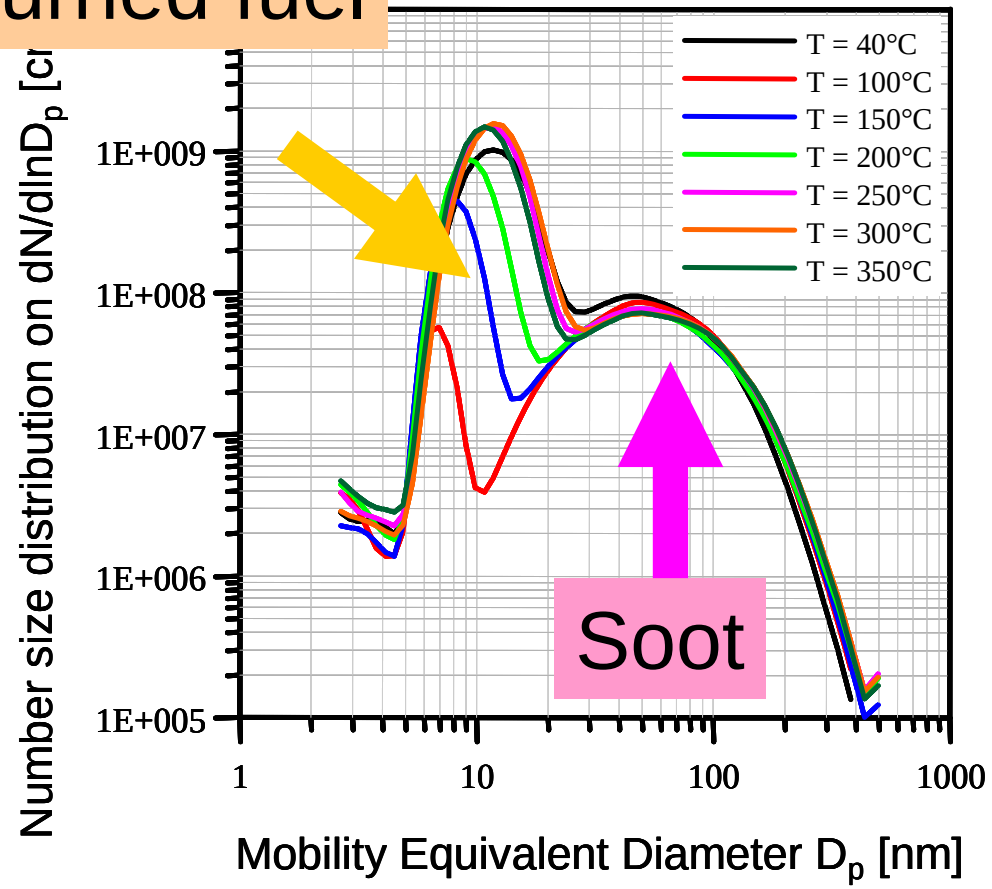
Snapshot: Ambient size distributions at 7 stations during 1 morning rush hour



Comparison with dynamometer tests

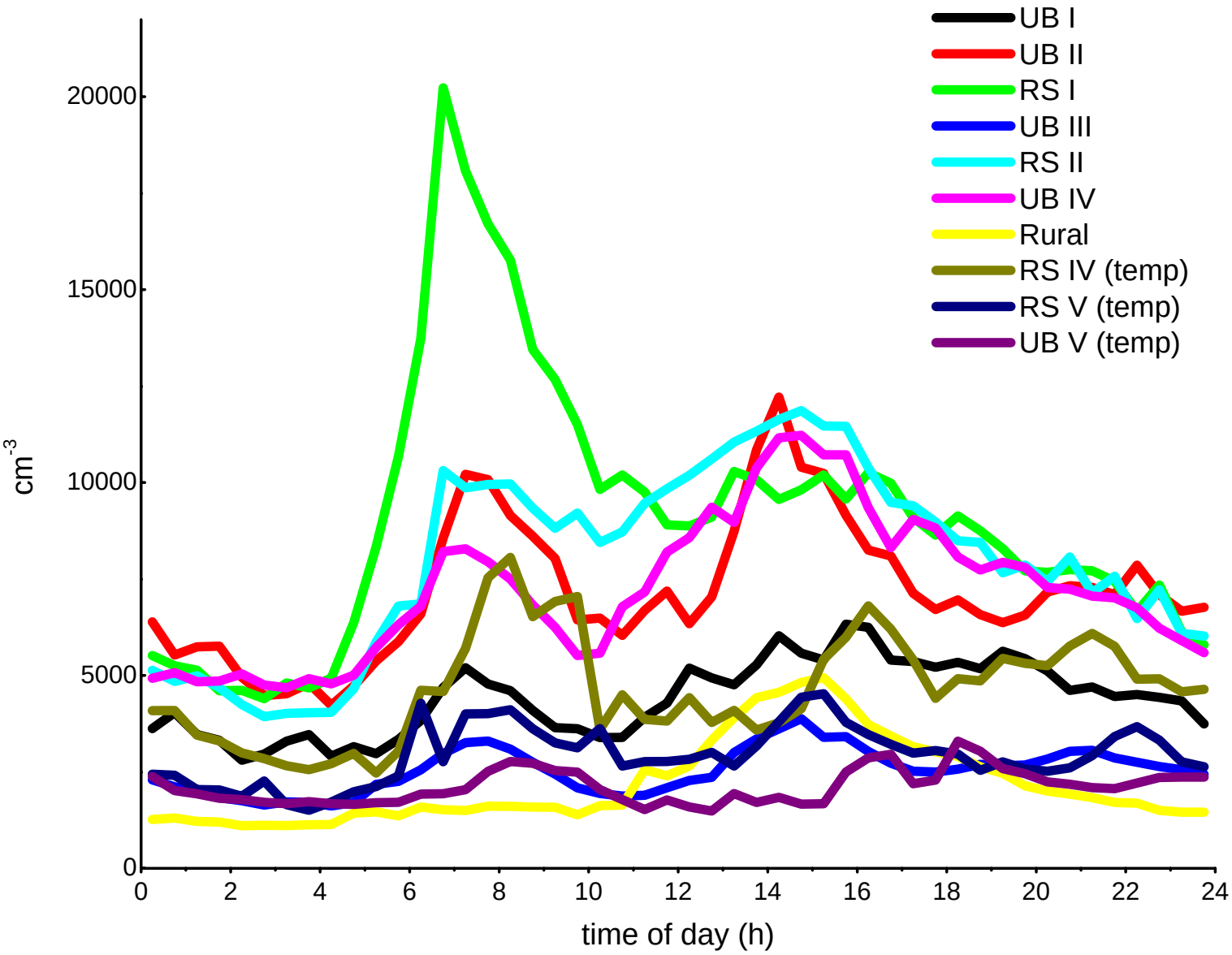


Unburned fuel

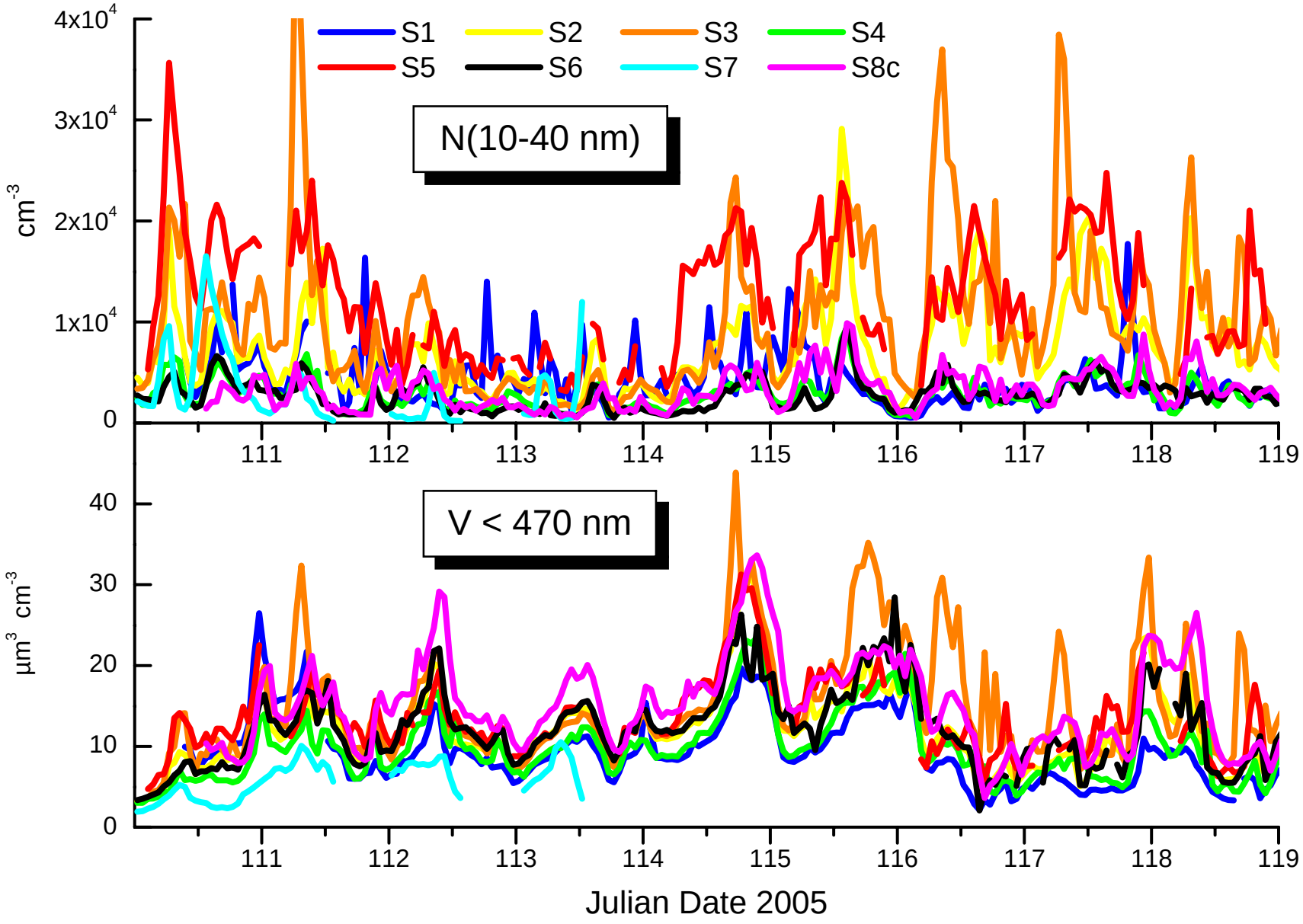


N. METZ, G. RESCH, A. WIEDENSOHLER, H. HERRMANN, TH. M. TUCH, B. WEHNER, D. ROSE, C. ENGLER, T. GNAUK, E. BRÜGGEMANN, U. FRANCK (2004), PHYSICAL AND CHEMICAL CHARACTERISTICS OF AEROSOL PARTICLES FROM DIESEL EXHAUST AND URBAN ENVIRONMENT, J.Aerosol Sci, S 391-392.

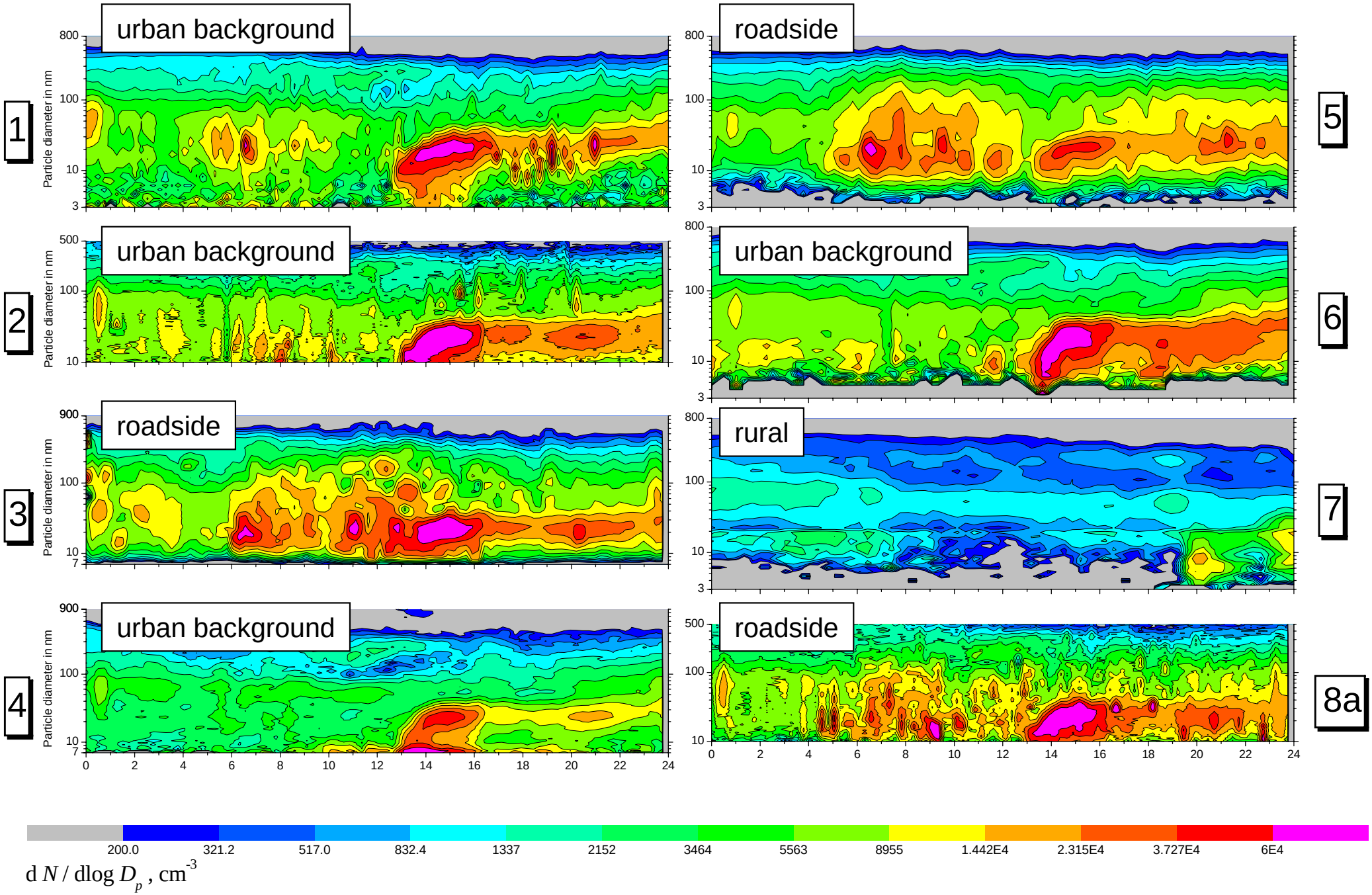
Diurnal average cycles of particle number (40-120 nm) at 10 sites in Leipzig



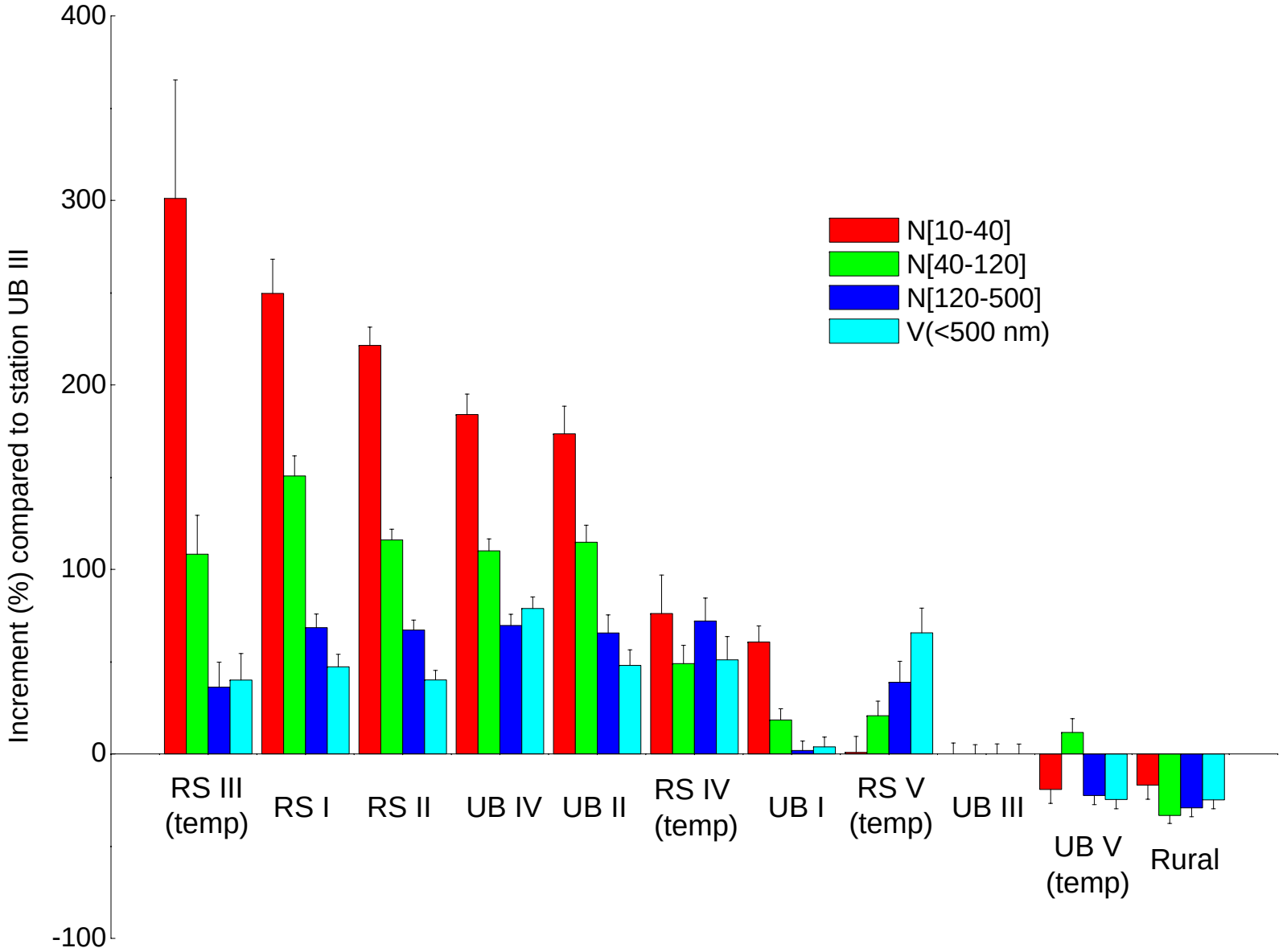
Particle number and volume during PURAT-1



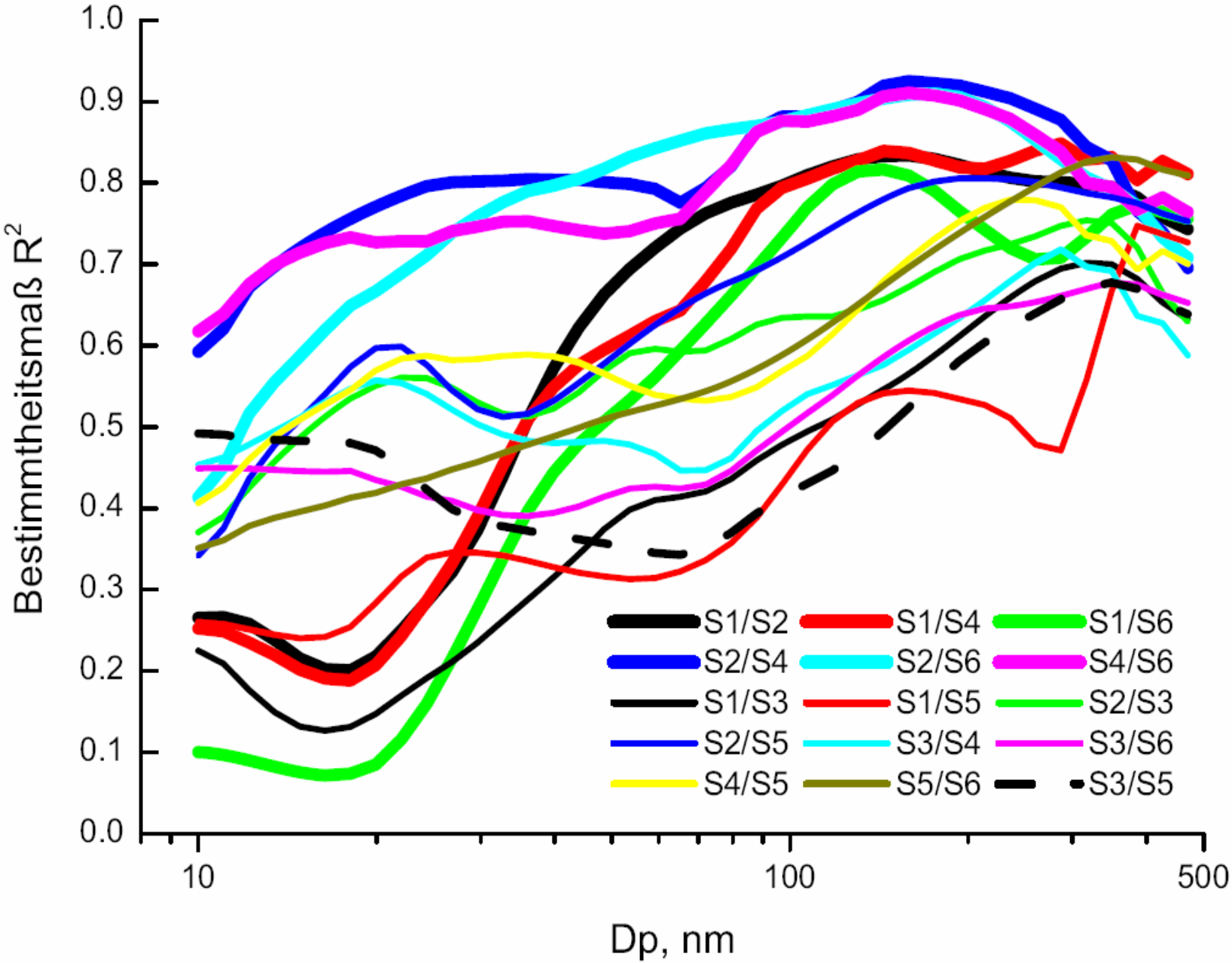
Size distributions on 11/4/2005 (Monday)



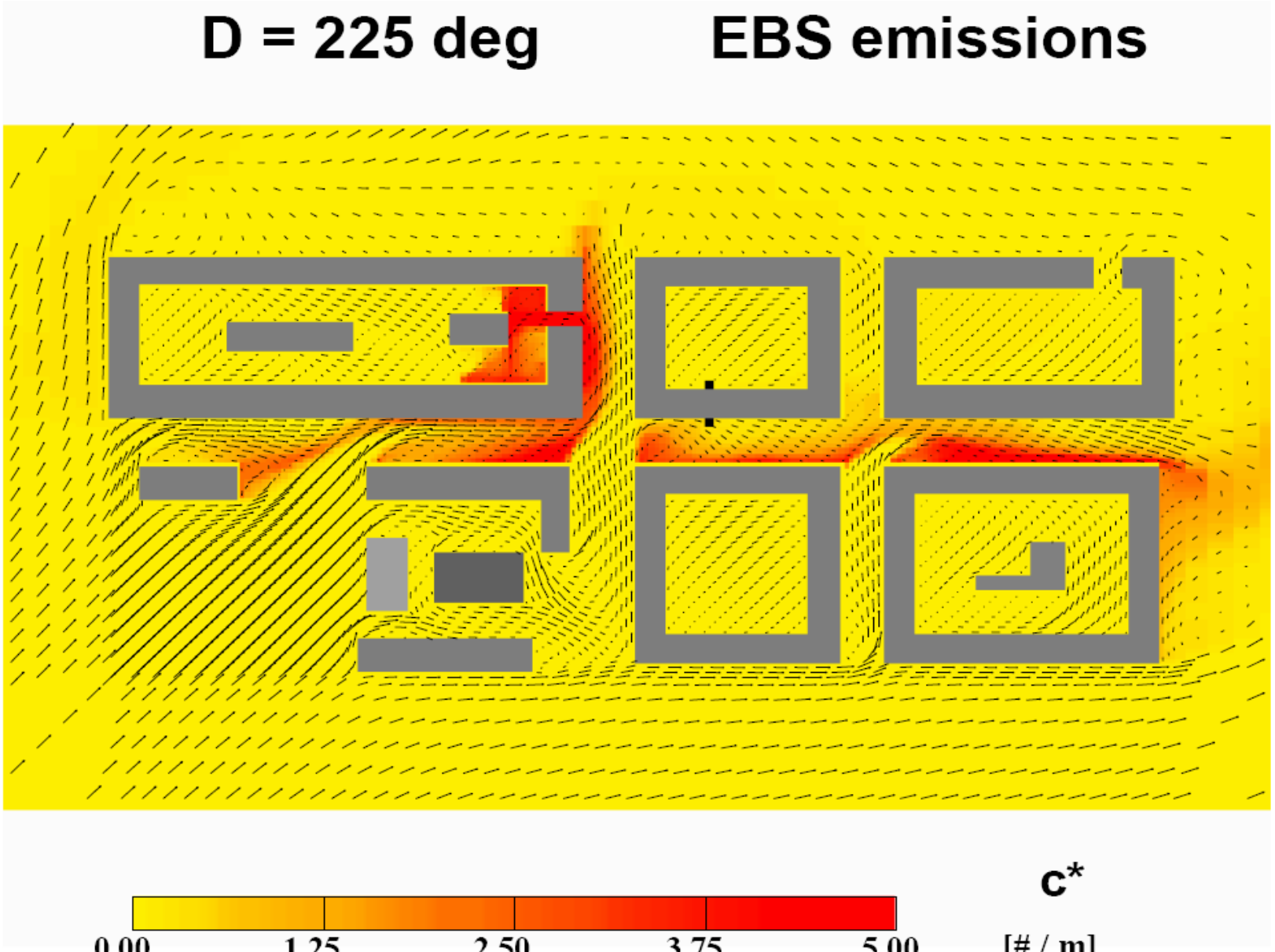
Differences in mean particle concentrations



Inter-site correlations (R^2) during PURAT-1



Dispersion modelling with ASAM



Conclusions

- Intensive field experiments confirmed large variations of UFPs within the same urban atmosphere
- Distance and orientation towards traffic sources were crucial for station mean values
- Topography and meteorology are crucial for ambient concentrations at high time resolution

Report available

Birmili W. et al. Konzentration ultrafeiner luftgetragener Partikel (< 100 nm) in städtischen Atmosphären87 S., Abschlussbericht UFOPLAN-Projekt 20442204/03, Umweltbundesamt, Dessau, 11. April 2007.

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