European Network on New Sensing Technologies for Air Pollution Control and Environmental Sustainability - *EuNetAir*

COST Action TD1105

WGs and MC Meeting at ISTANBUL, 3-5 December 2014

Action Start date: 01/07/2012 - Action End date: 30/06/2016

Year 3: 1 July 2014 - 30 June 2015 (*Ongoing Action*)

PARTICLE POLLUTION IN DANISH DOMESTIC HOMES: IMPACT OF OUTDOOR SOURCES FOR INDOOR EXPOSUREPRESENTATION

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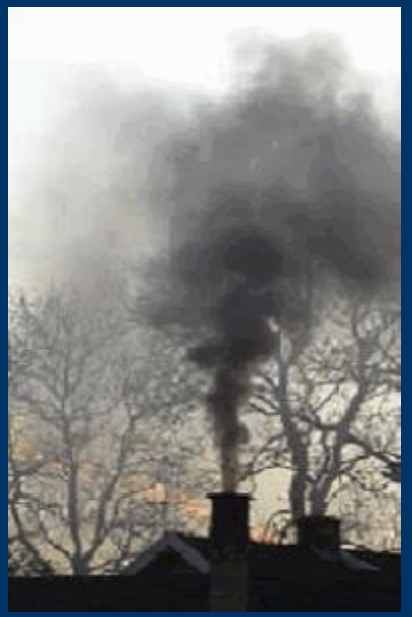
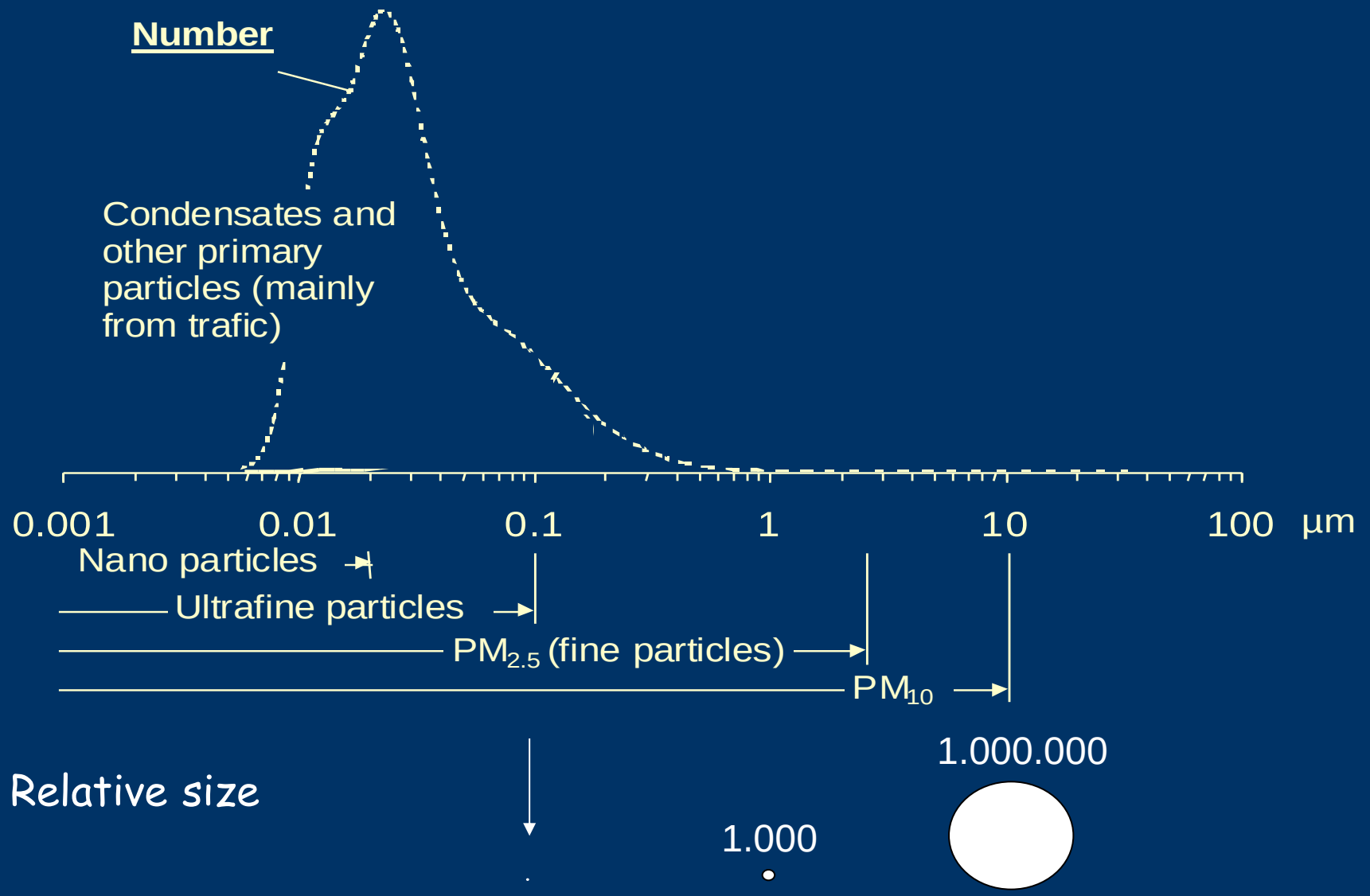
COST is supported by the EU Framework Programme

ESF provides the COST Office through a European Commission contract

Assessment of health effects:

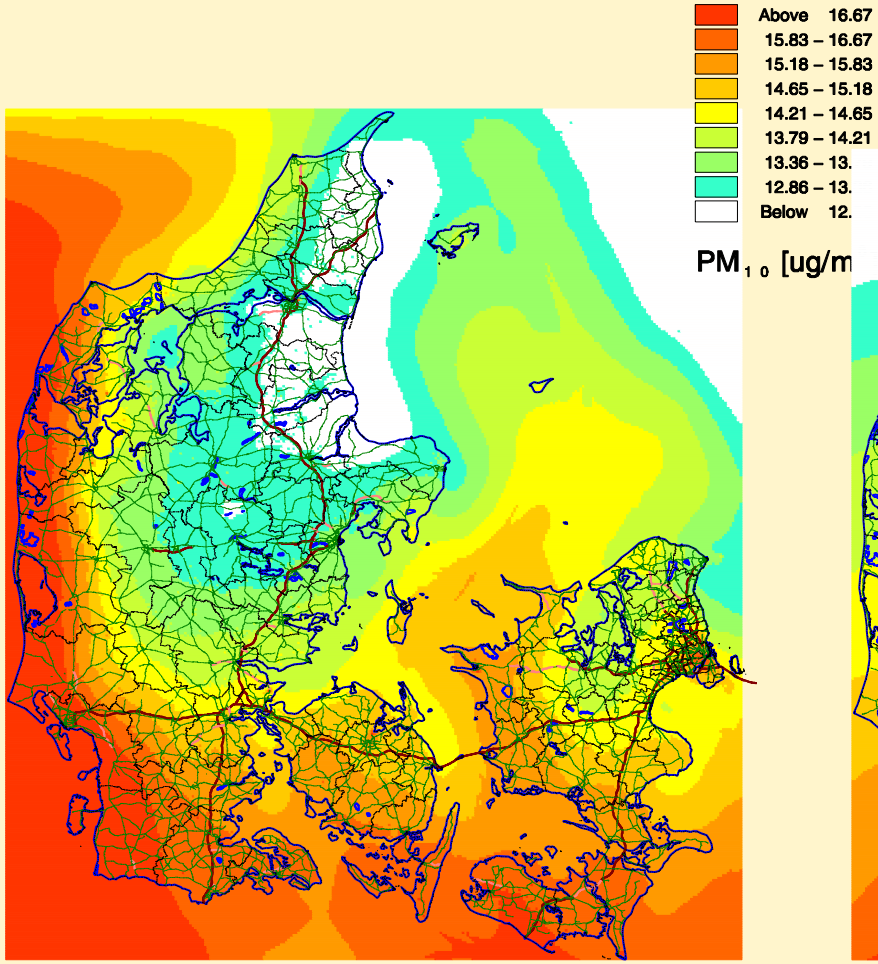
- Address AP used for personal exposure
- People spend typically 90% indoors
- Indoor-outdoor ration thus crucial
- Particles most hazardous
- Penetration to indoor depend on size etc.
- What is the role of different sources

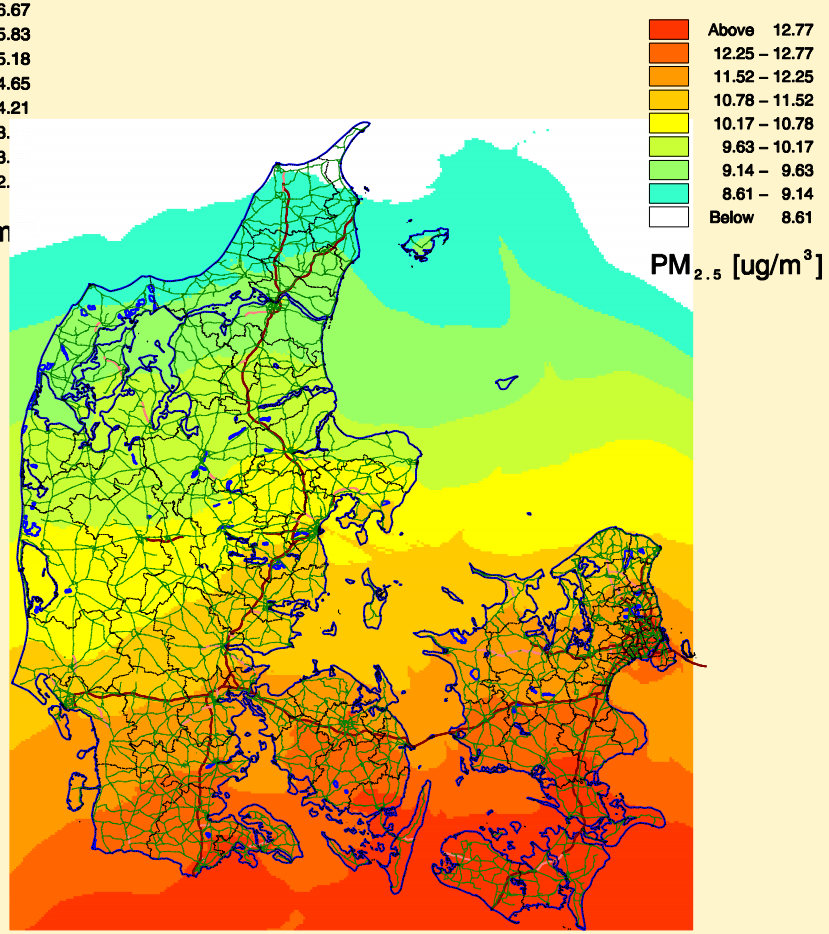



Number
Condensates and other primary particles (mainly from trafic)
0.001
0.01
0.1
1
10
100
µm
Nano particles
Ultrafine particles
PM2.5 (fine particles)
PM10
Relative size
1.000.000
1.000

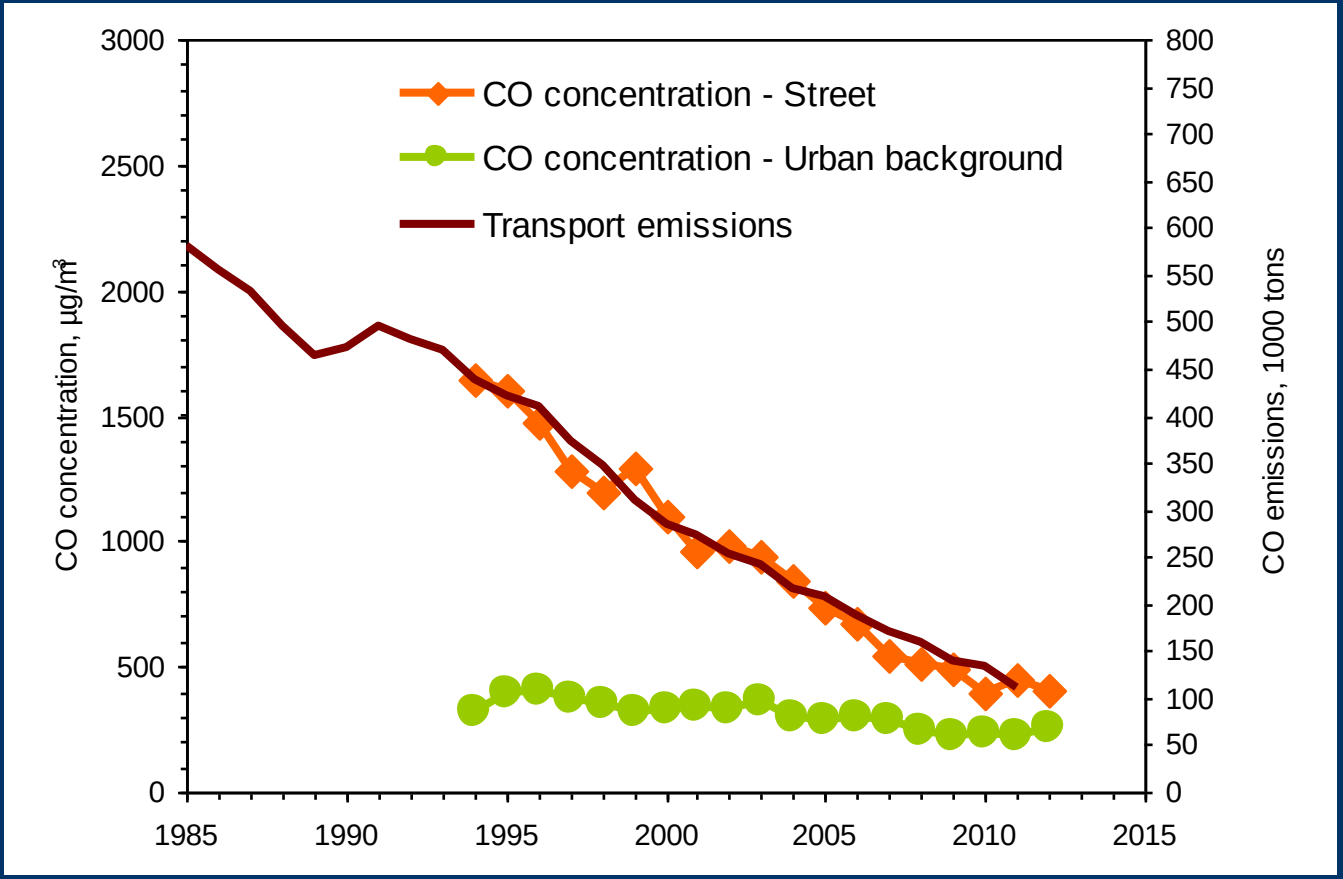

Concentration
Regional
Distance
City area

Modelled PM10 and PM2.5 using UBM model





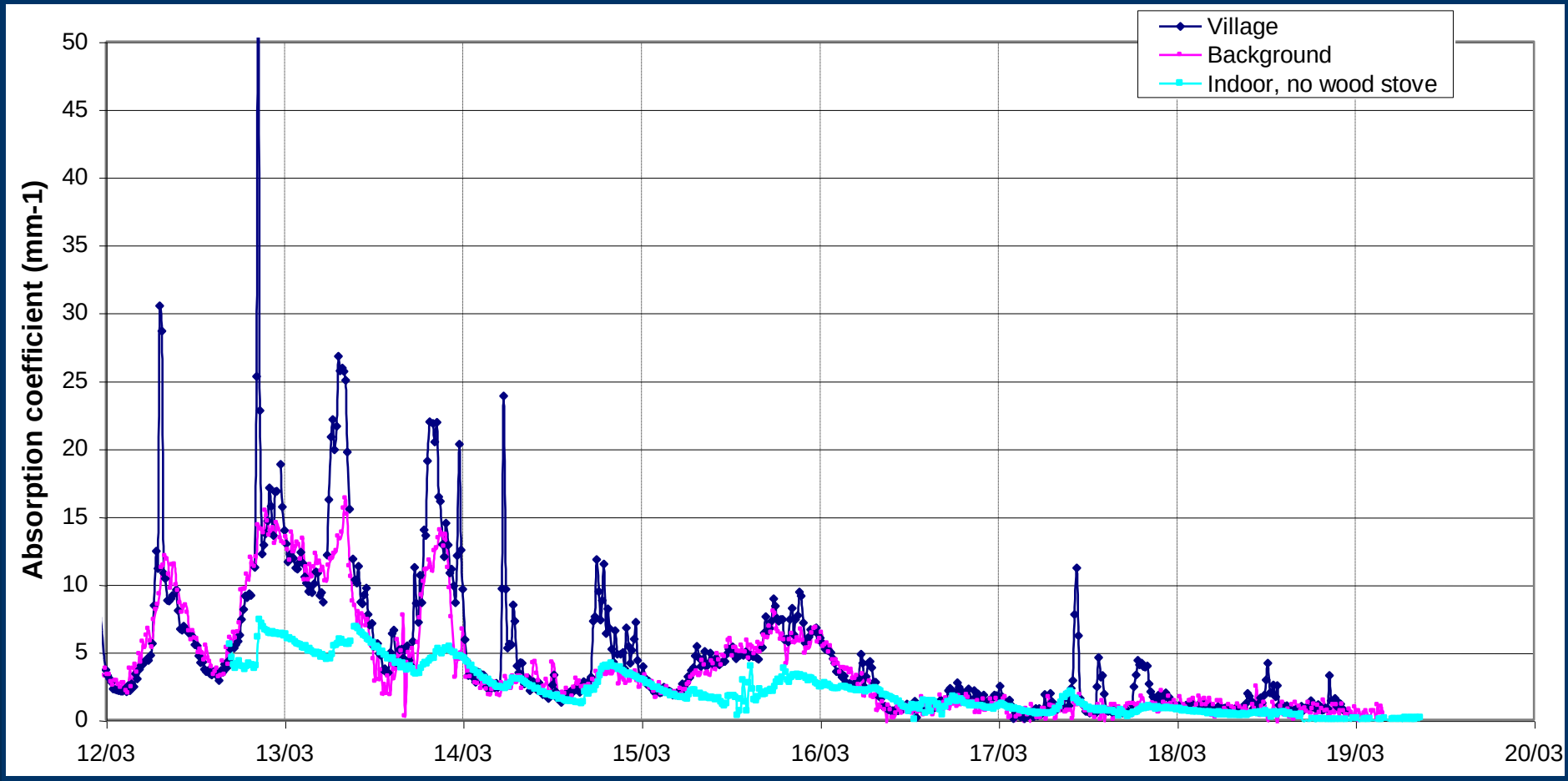
Ratio between street level & urban background



Campaign in woodstove area

- Village with intense use of woodstove
- Measurements and modelling
- Emission inventories

Woodstove measurement campaign



Week without woodstove – mean values of soot measurements

Measurement site in village (Anemonevej)	4.7 Mm^{-1}
Background (Schellerupgård)	3.6 Mm^{-1}
Indoor (house without woodstove)	2.1 Mm^{-1} (about 45 % of outdoor level)

Vascular and lung function related to ultrafine and fine particles exposure assessed by personal and indoor monitoring

60 houses in West of Copenhagen, 70% of time participants spent at home

Aerasense NanoTracer (Philips) PNC, d_a=10÷300nm

$PM_{2.5}$ sampler

Tab. Correlations between exposure variables

		Personal monitoring - PNC			Stationary indoor monitoring (home)	
		Total period ($10^3/cm^3$)	When at home ($10^3/cm^3$)	When away from home ($10^3/cm^3$)	PNC ($10^3/cm^3$)	$PM_{2.5}$ ($\mu g/m^3$)
N		59	59	59	60	60
Median (5^{th}, 95^{th} percentile)		9.3 (4.5, 36.5)	8.8 (3.4, 36.7)	8.9 (2.8, 55.5)	8.5 (3.7, 24.1)	12.3 (7.7, 23.2)
Personal monitoring - PNC	Total ($10^3/cm^3$)	1.000				
	When at home ($10^3/cm^3$)	0.45* (0.00)	1.000			
	When away from home ($10^3/cm^3$)	0.93* (0.00)	0.10 (0.43)	1.000		
Stationary indoor monitoring	PNC ($10^3/cm^3$)	0.15 (0.24)	0.41* (0.00)	0.01 (0.94)	1.000	
	$PM_{2.5}$ ($\mu g/m^3$)	0.22 (0.12)	0.44* (0.00)	0.03 (0.84)	0.49* (0.0000)	1.000

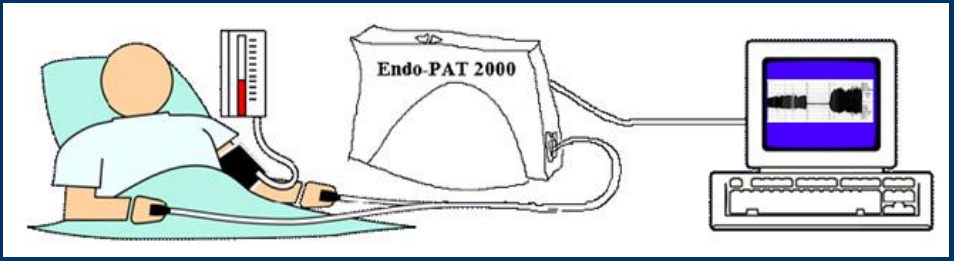
Values are medians (5^{th}, 95^{th} percentiles);
Pearson product moment coefficients (p-values)

➔ Personal PNC integrated for time at home
➔ Personal PNC integrated for time away from home

Results highlights the importance of exposure away from home

PNC exposure while away from home significantly associated with:

- **Reduction in microvascular function**



EndoPat 2000

- **Inflammatory response (leukocyte &neutrophil counts)**

Where do the particles deposit in the respiratory system ?

Particle deposition Mechanisms

- Impaction
- Sedimentation
- Diffusion
- Interception
- Electrostatic precepitation

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Factors determining respiratory tract deposition

- exposure concentration
- exposure duration
- respiratory tract anatomy
- ventilation parameters
- particle properties:size, hygroscopicity

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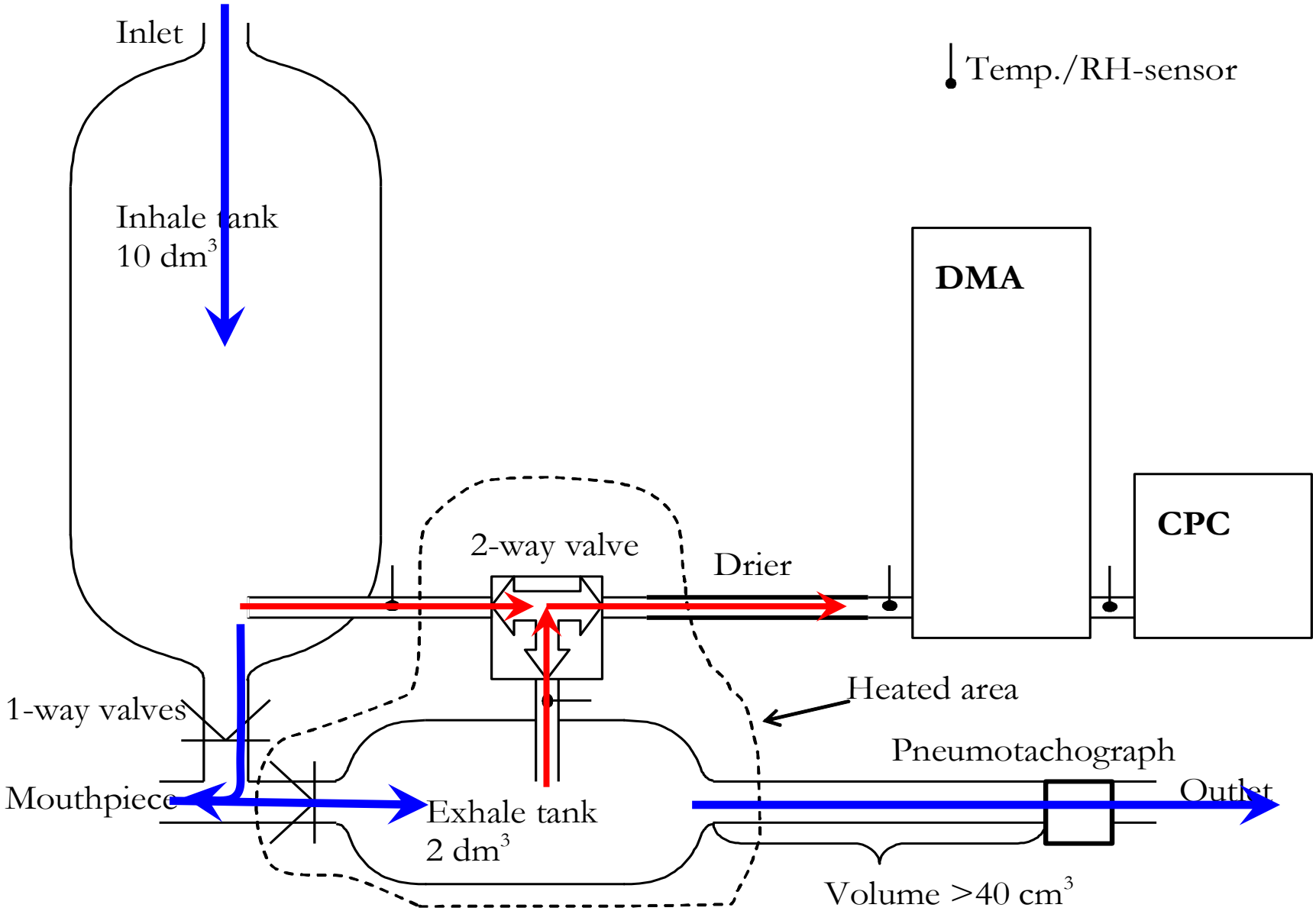
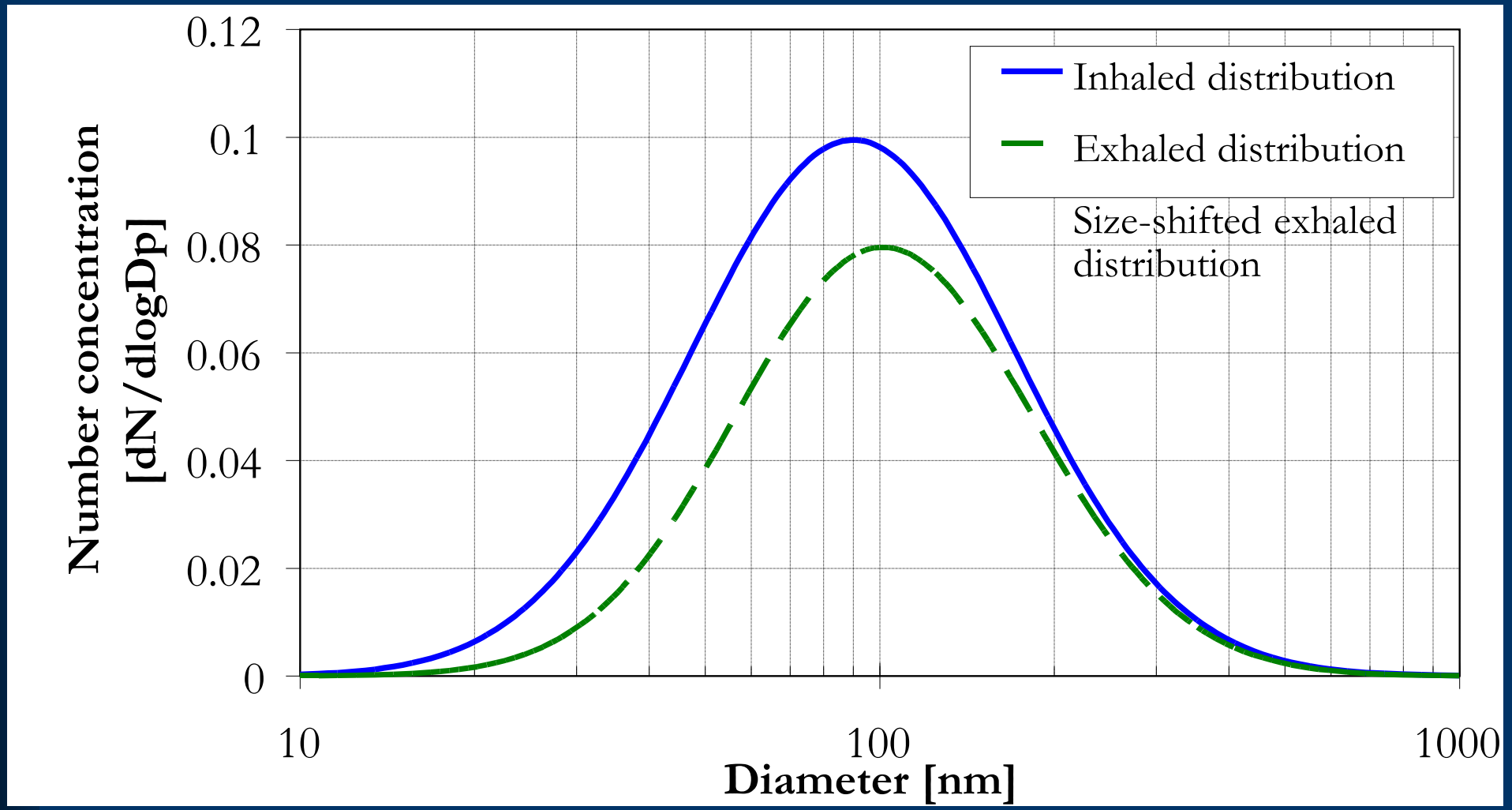
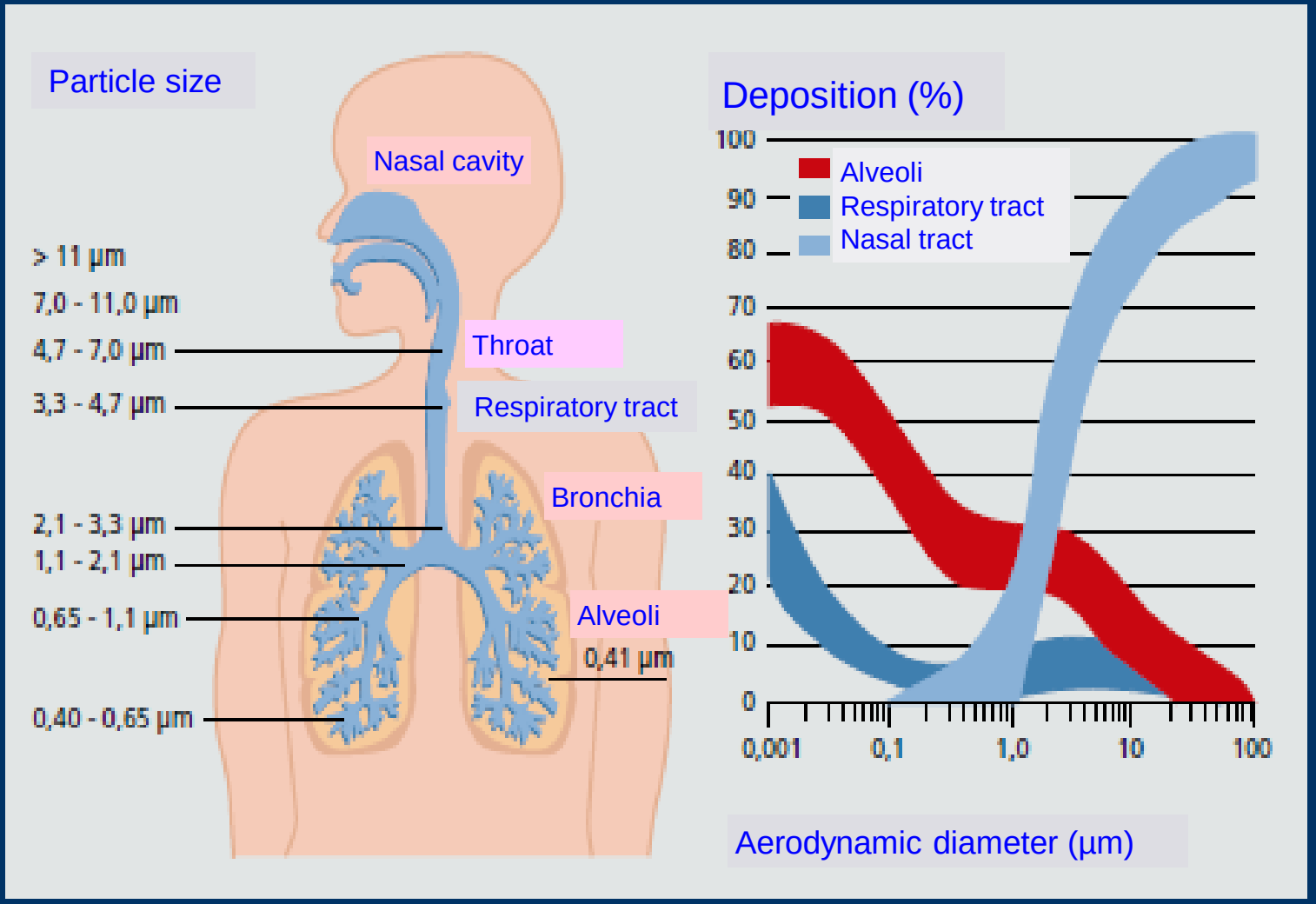

Inlet
Temp./RH-sensor
Inhale tank
10 dm3
DMA
CPC
2-way valve
Drier
Heated area
1-way valves
Pneumotachograph
Mouthpiece
Exhale tank
2 dm3
Outlet
Volume >40 cm3

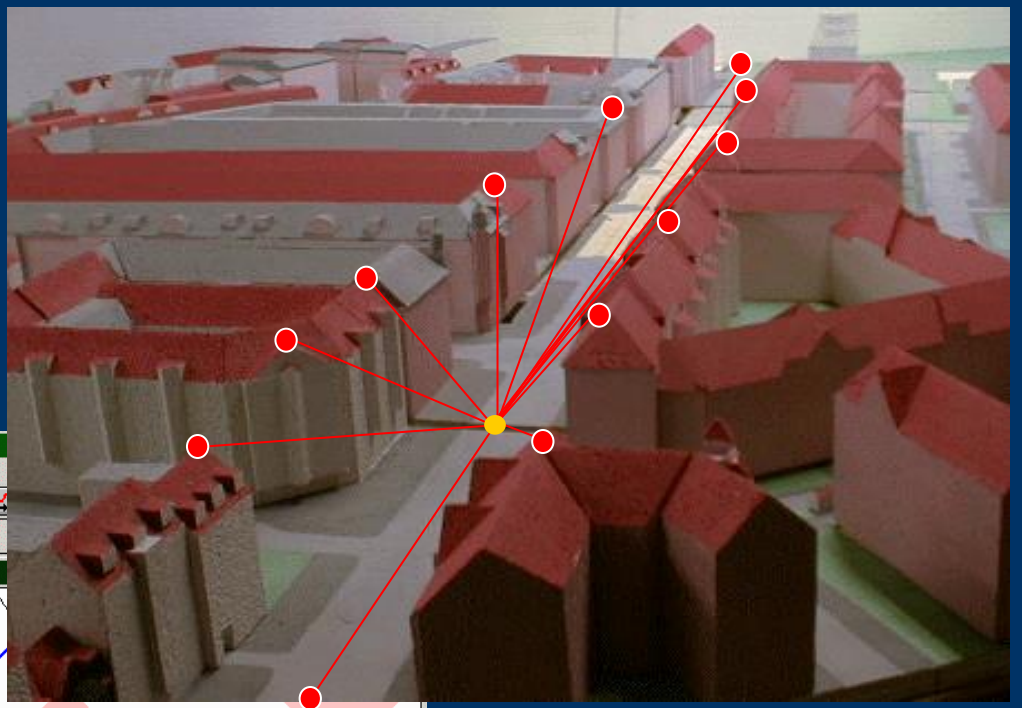

0.12
0.1
0.08
0.06
0.04
0.02
0
Number concentration [dN/dlogDp]
10
100
1000
Diameter [nm]
Inhaled distribution
Exhaled distribution
Size-shifted exhaled distribution

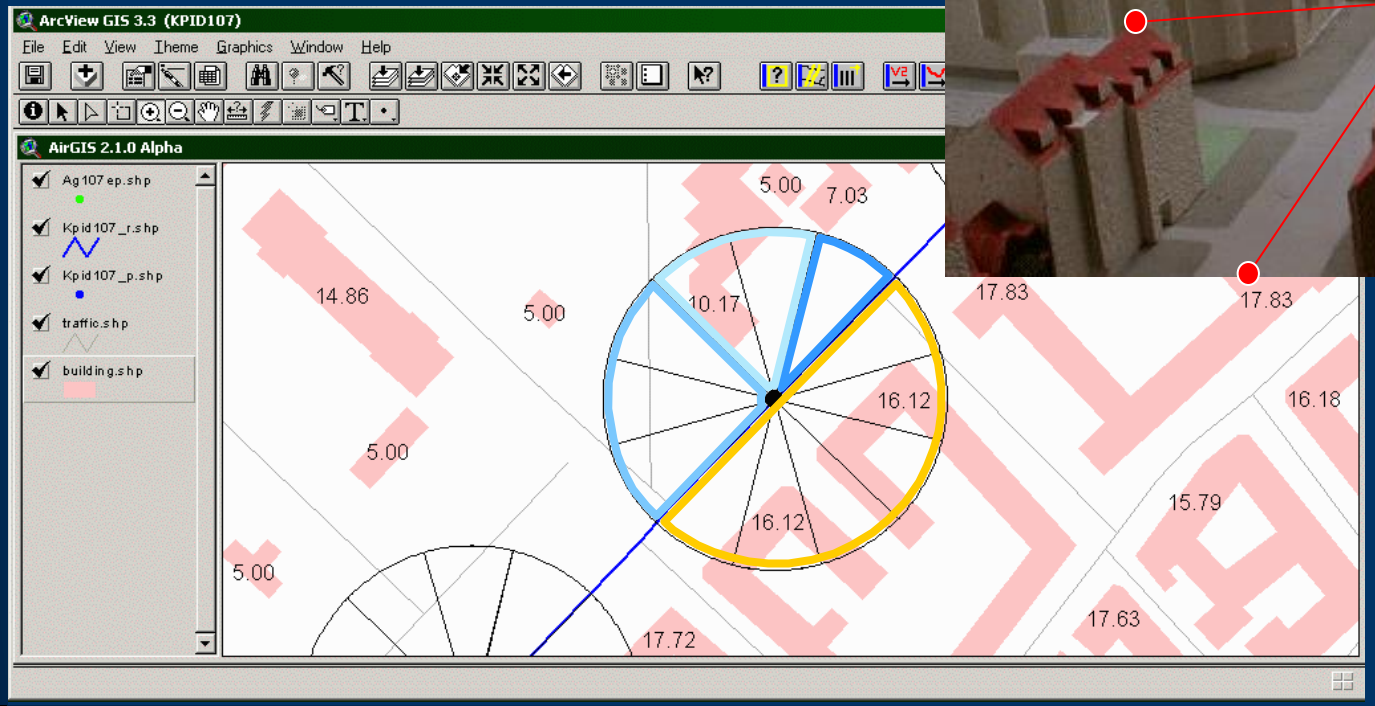
Particle deposit in respiratory system



AirGIS automatic generation street configuration

Calculations for the nutrition, cancer, health cohort of 50.000 people & 200.000 addresses
Currently mapping all Danish addresses





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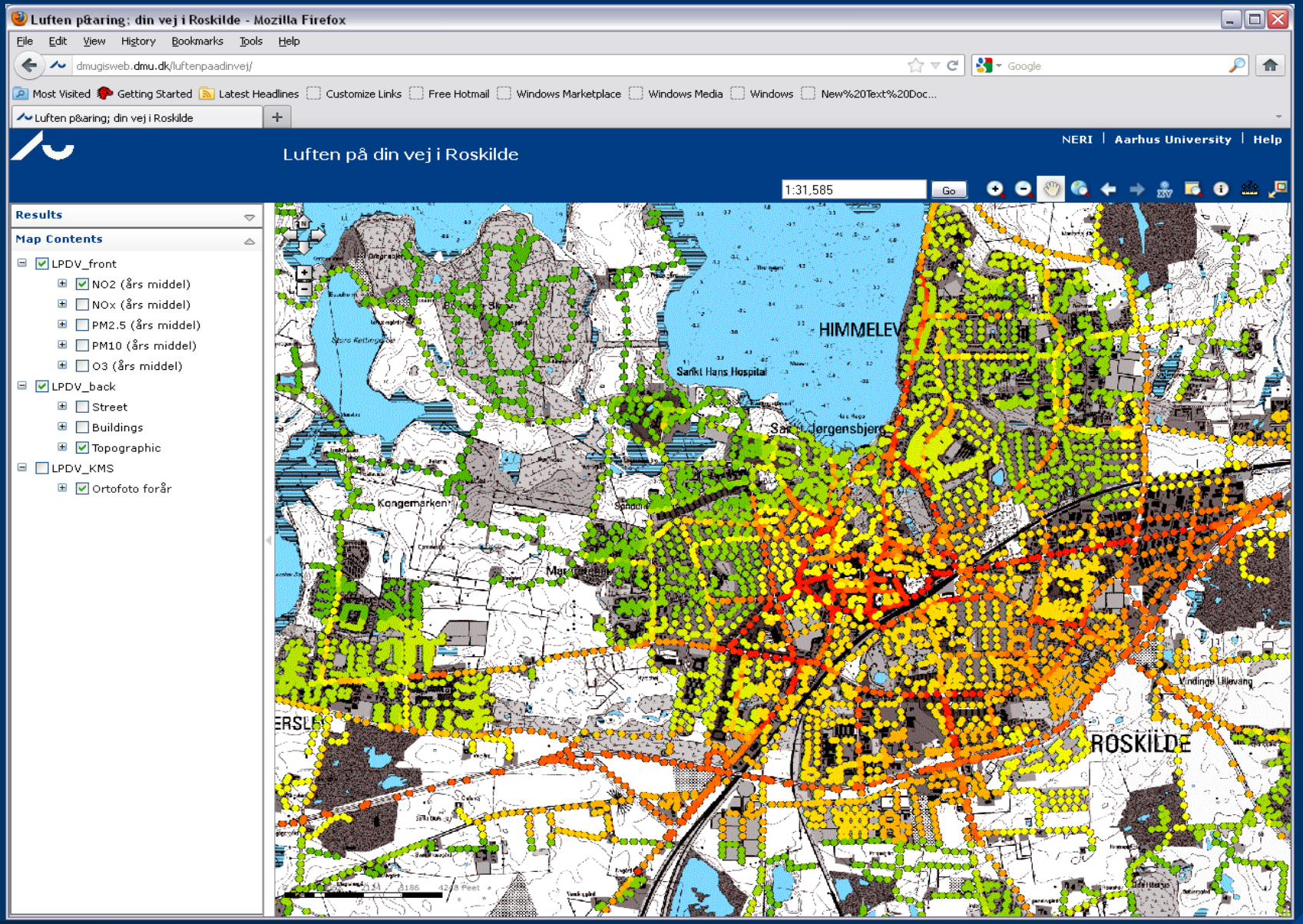
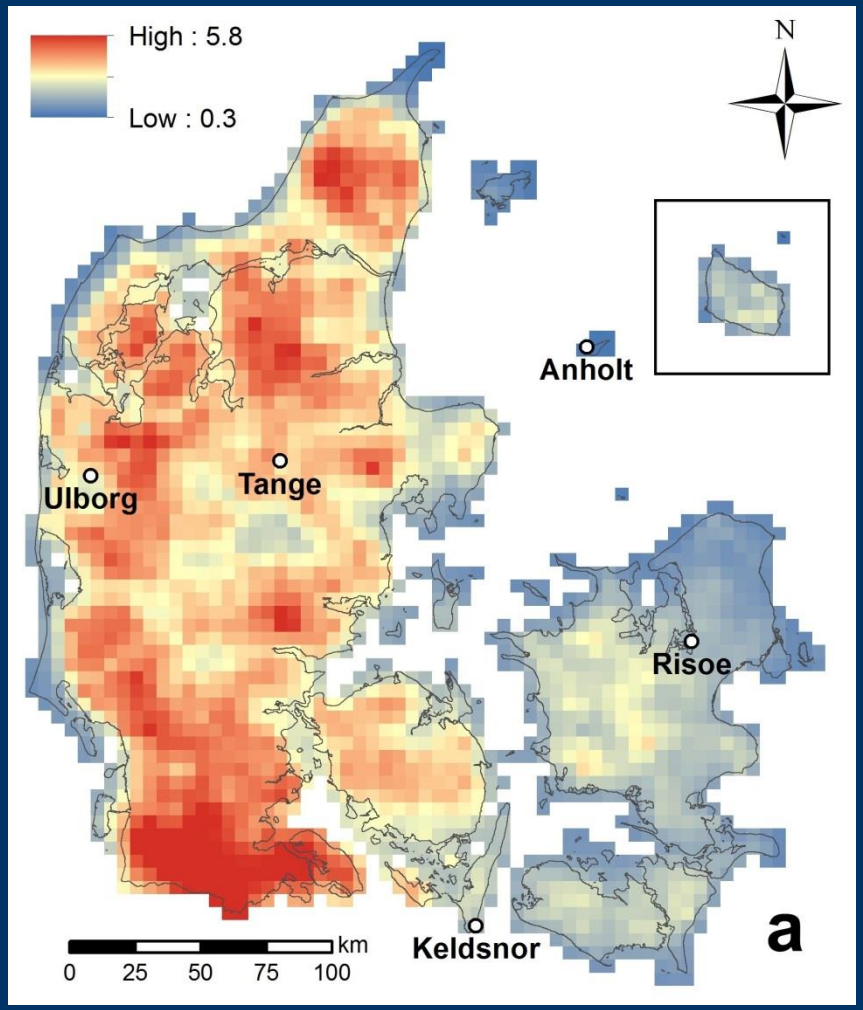
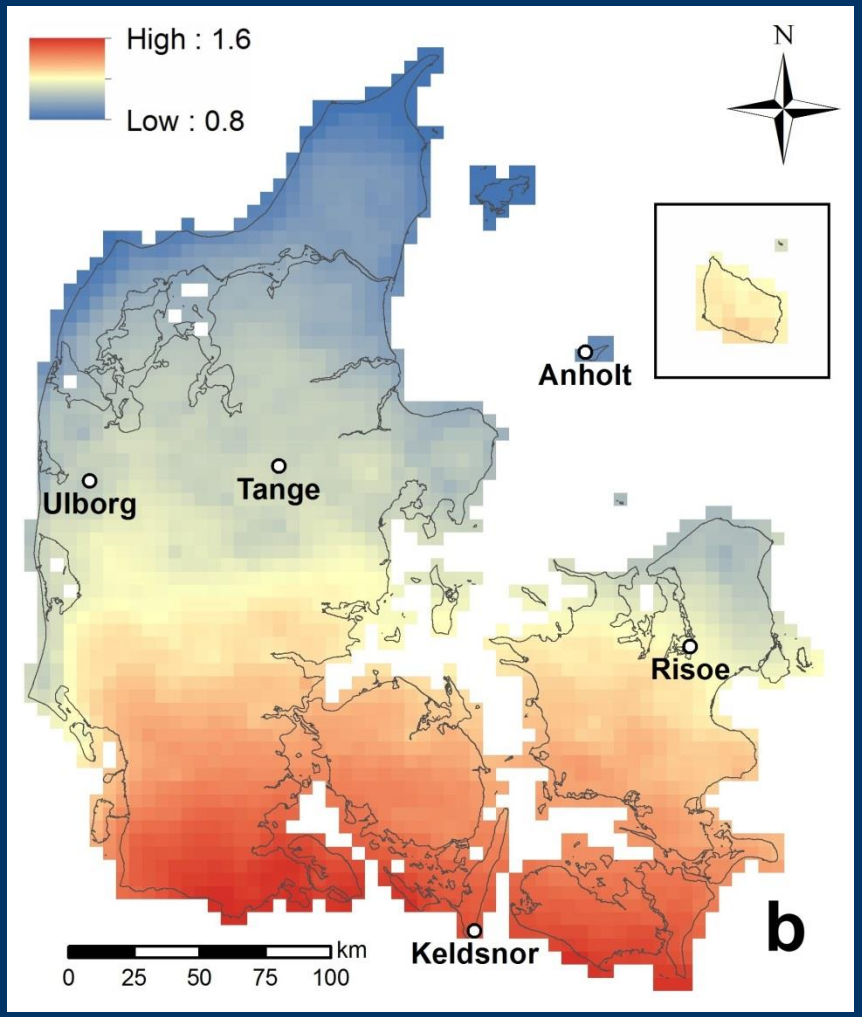
Mapping address level exposure in Danish city



NH3 concentration NH4+ concentration





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Need for inexpensive devices for:

- Studying indoor-outdoor relation
- Personal exposure monitoring
- Geographic distribution in levels