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Laboratory

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School of Engineering
Aristotle University of Thessaloniki

HEALTH IMPACT ASSESMENT OF URBAN BACKGROUND PARTICLE NUMBER CONCENTRATION

Dimosthenis A. Sarigiannis[1,2], Spyros P. Karakitsios[1,2], Marianthi V. Kermenidou[1]

[1] Environmental Engineering Laboratory
Department of Chemical Engineering,
Aristotle University of Thessaloniki
GR-54124, Thessaloniki, Greece

[2] Chair of Environmental Health Engineering,
Institute of Advanced Study, Pavia 27100, Italy

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PM study design

– integrating detailed environmental information into enhanced health and socioeconomic impact assessment

Meteorological parameters prediction

Temperature
Humidity
Wind speed
Wind direction
Precipitation

Region specific oxidative potential index

Lung cancer risk

PM
PM day before

ANN

Forecasted
Ambient air PM
Measured

INTERA comp. platform
+
HRT deposition

Ambient air PM monitoring network

Database

- Anthropometric data
- Time activity data
- Housing data

Training loop

Chemical analysis

- Source apportionment
(e.g. Levoglucosan, BC, metals)
- Refined risk assessment
(e.g. PAHs analysis, redox activity)

Indoor concentrations

Dynamics in time

Population exposure

Health impact

Monetary impact

Measurements

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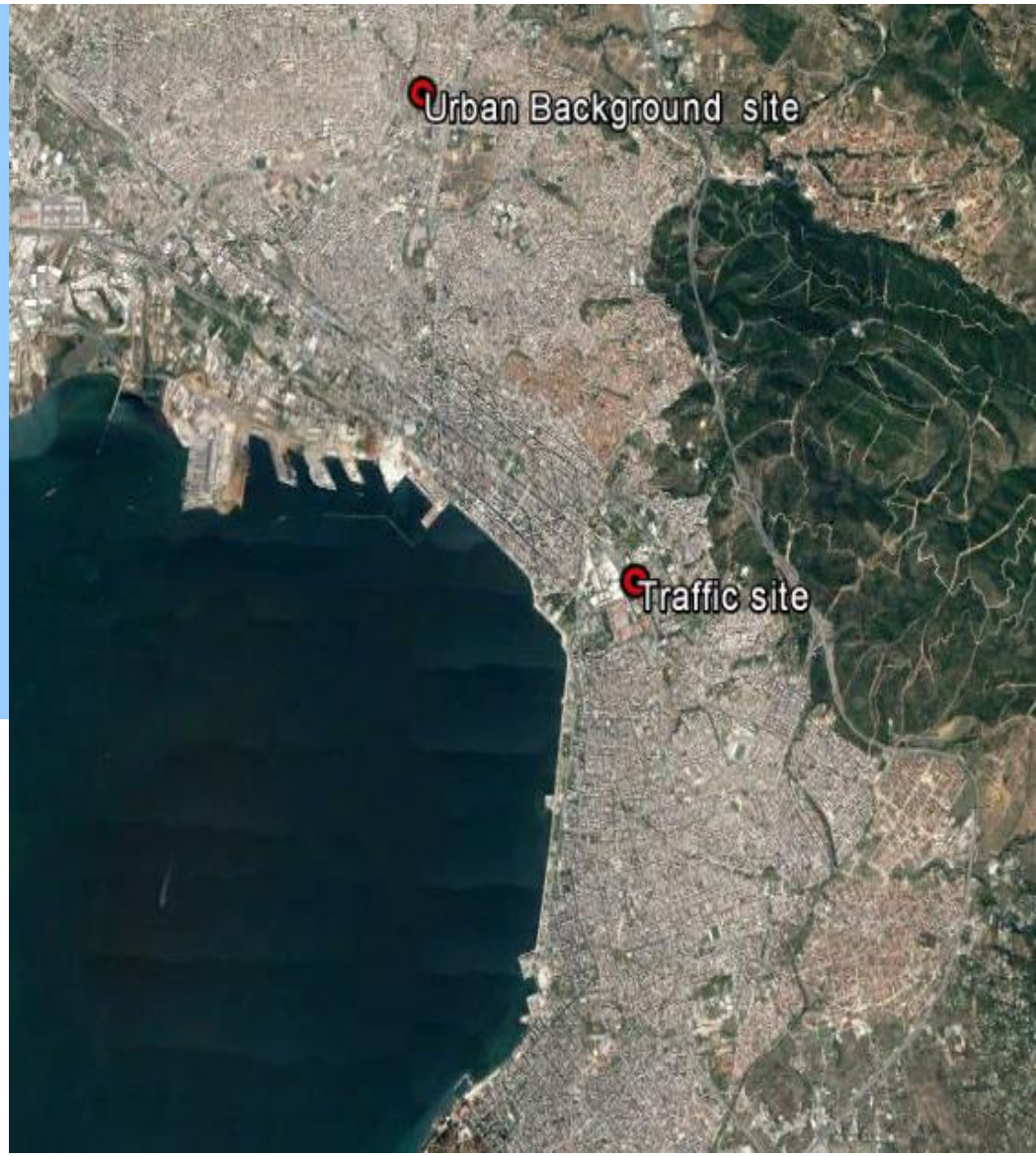
Sampling

- **Urban Background** and **Traffic** station
- TSI NanoScan SMPS
  - ➢ 11 channels from 10 nm to 250 nm
- A grimm, series 11-R aerosol spectrometer
  - ➢ 12 channels (0.25um to 1um)
- **Two sampling periods** (from January to February and June to August)



Results

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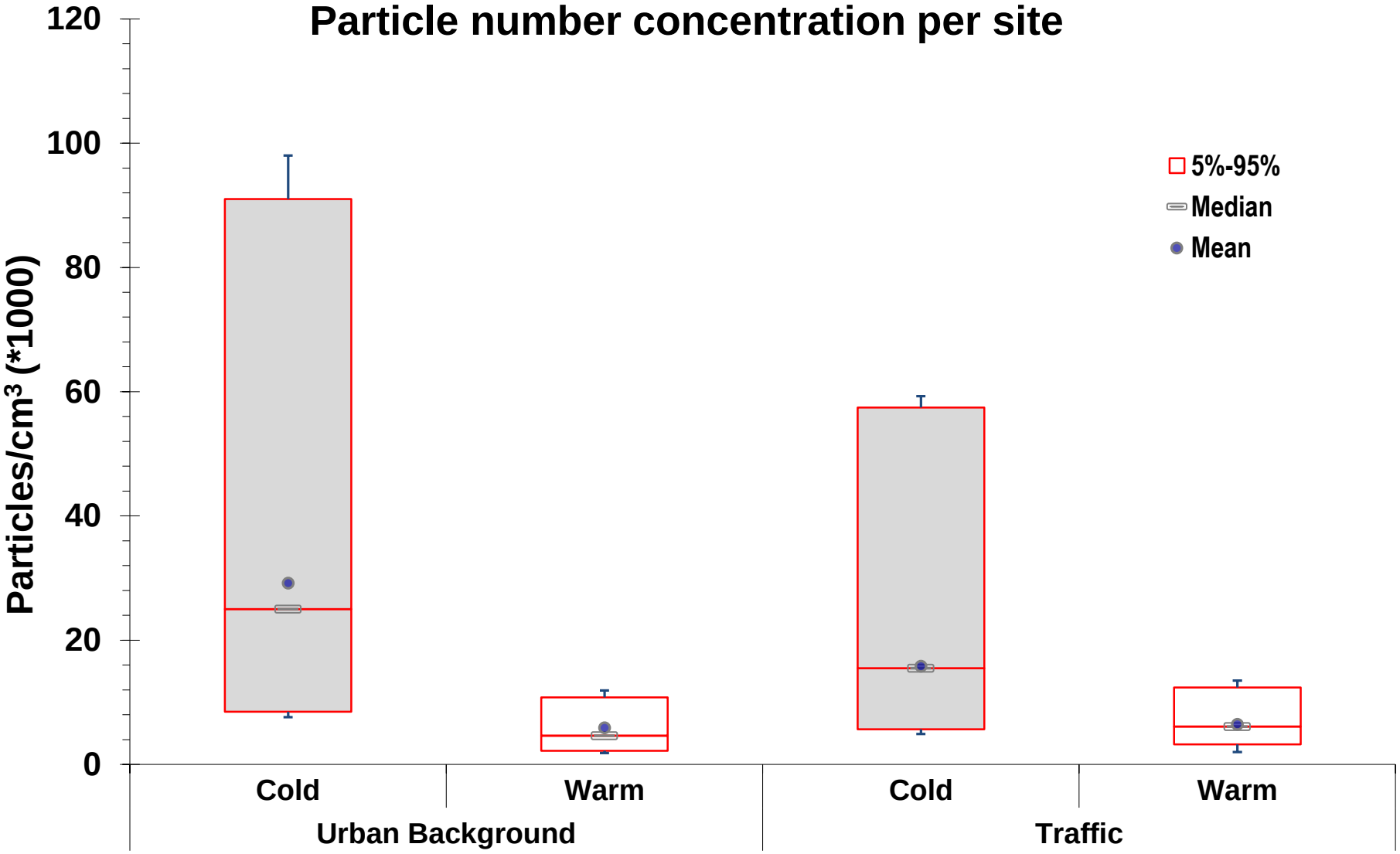

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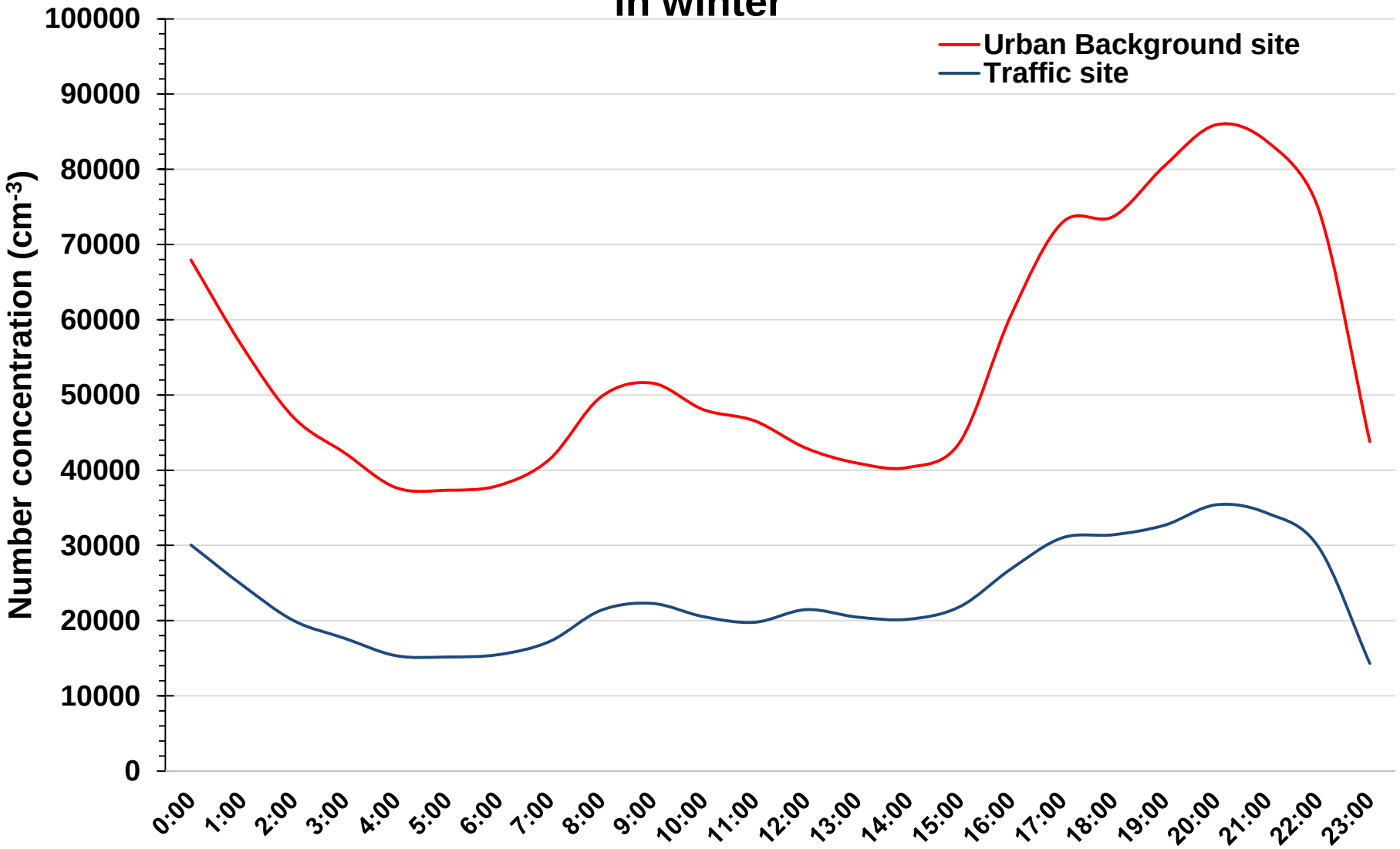
Changes in the total average particle number 1-hour per site in winter



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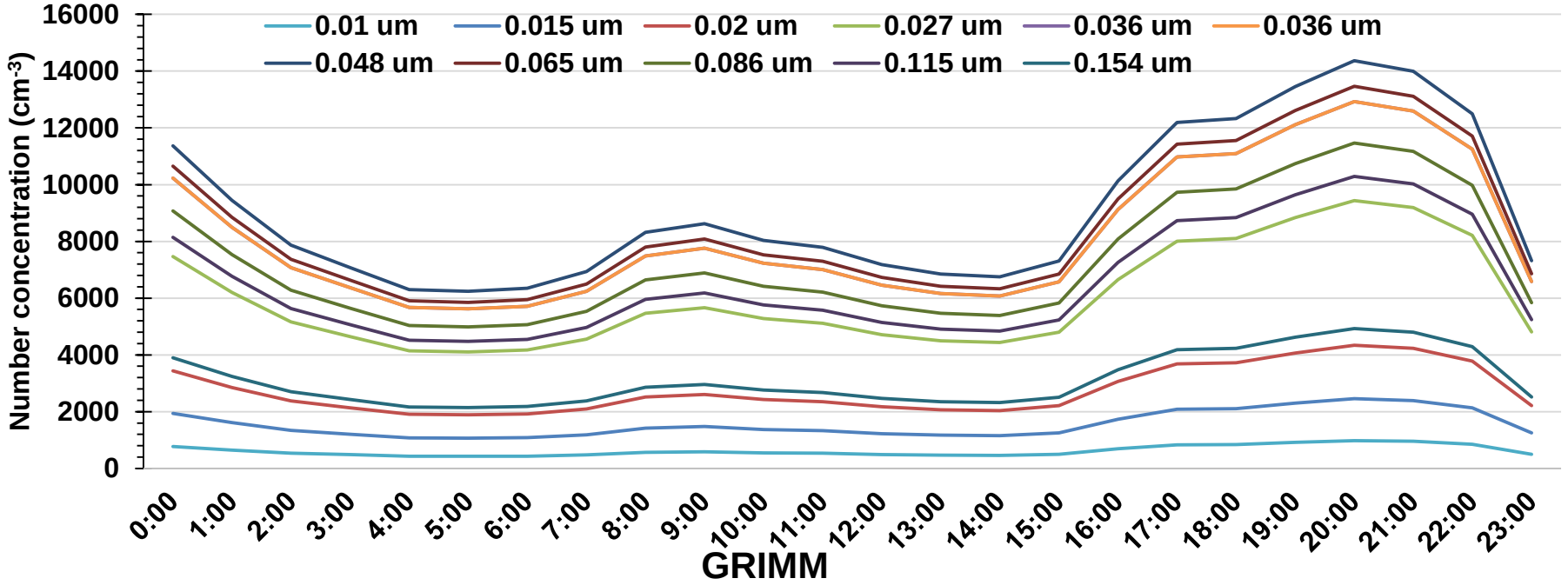
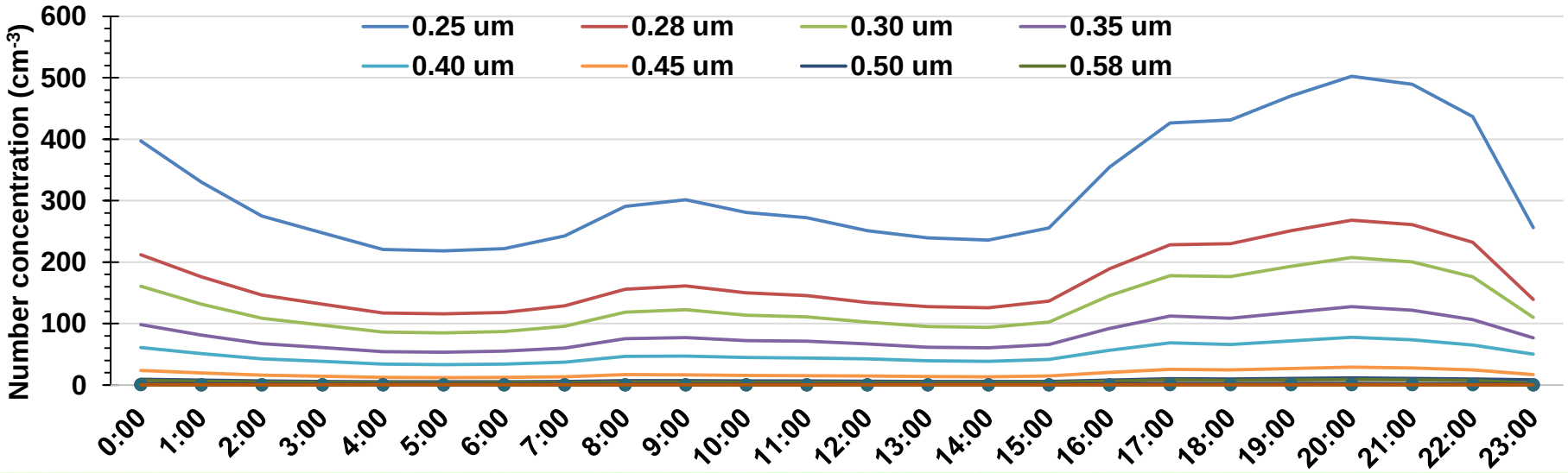
Urban Background site in winter

TSI NanoScan SMPS



GRIMM



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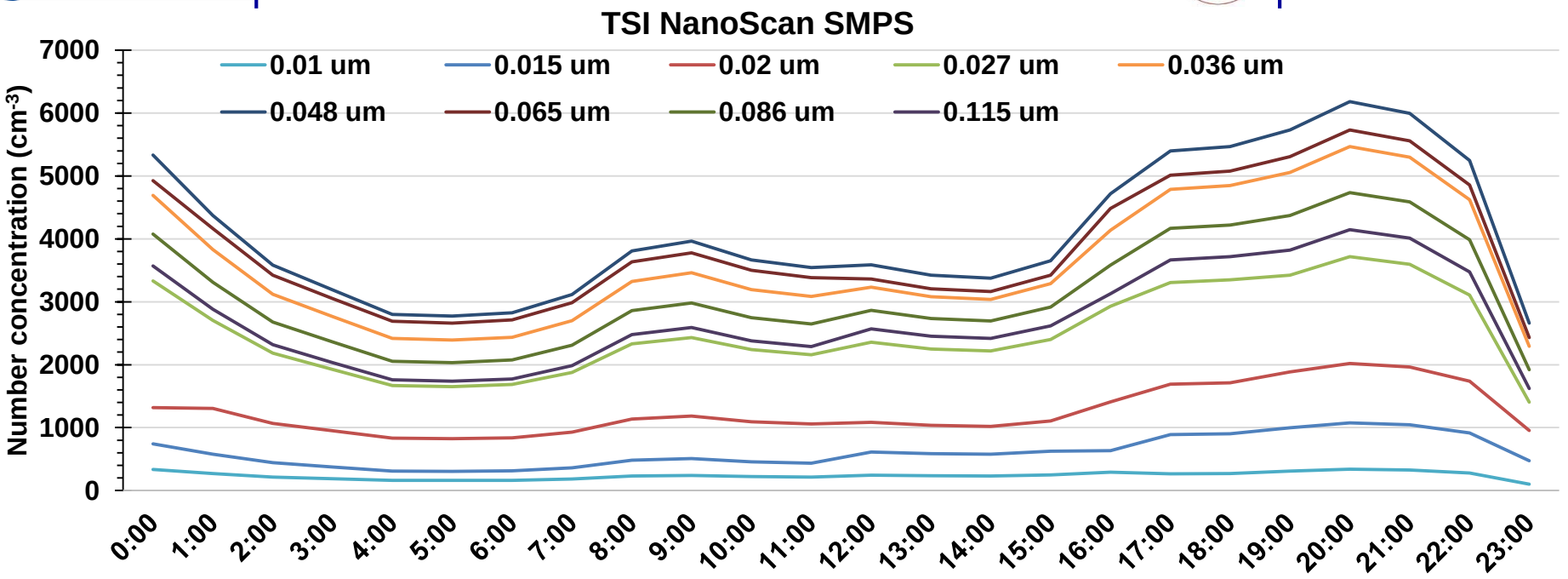
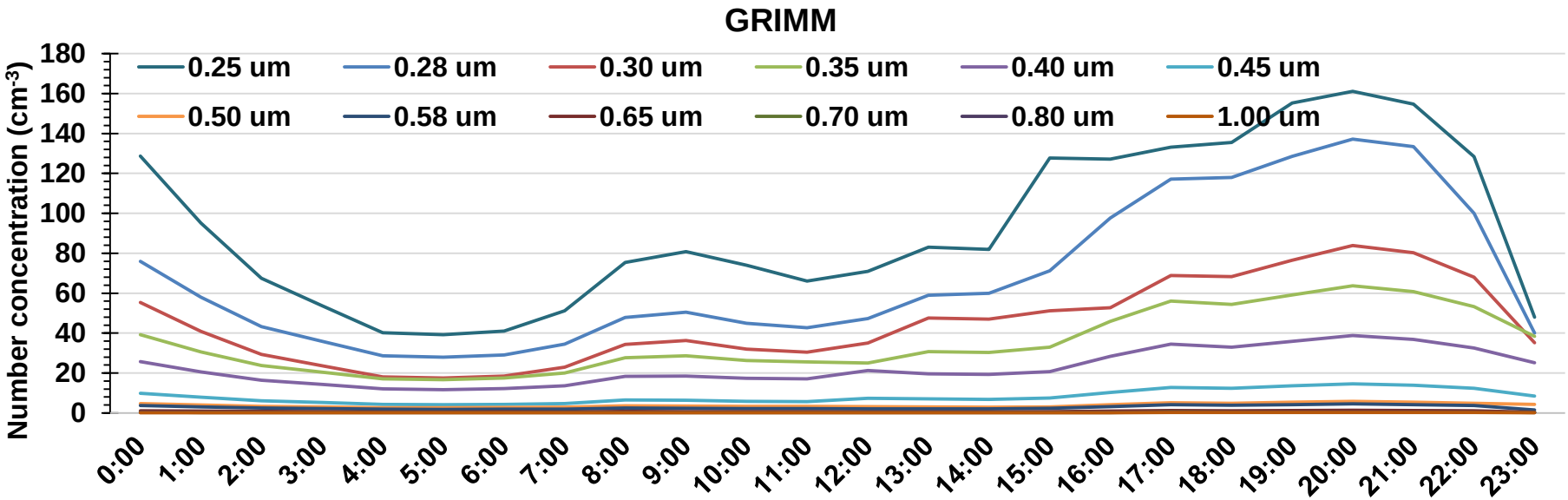
Traffic site in winter





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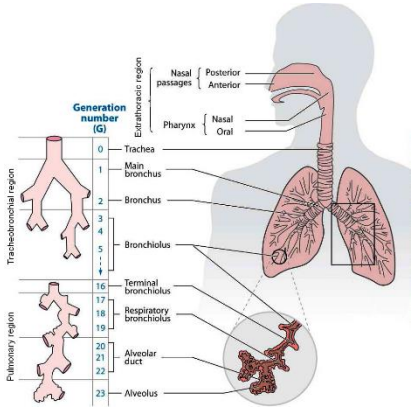
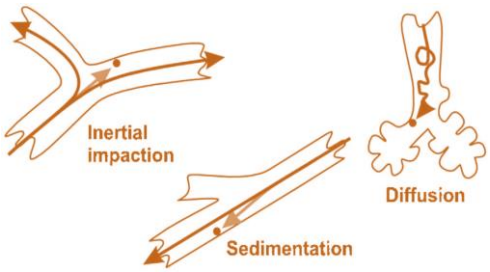
HRT deposition modelling





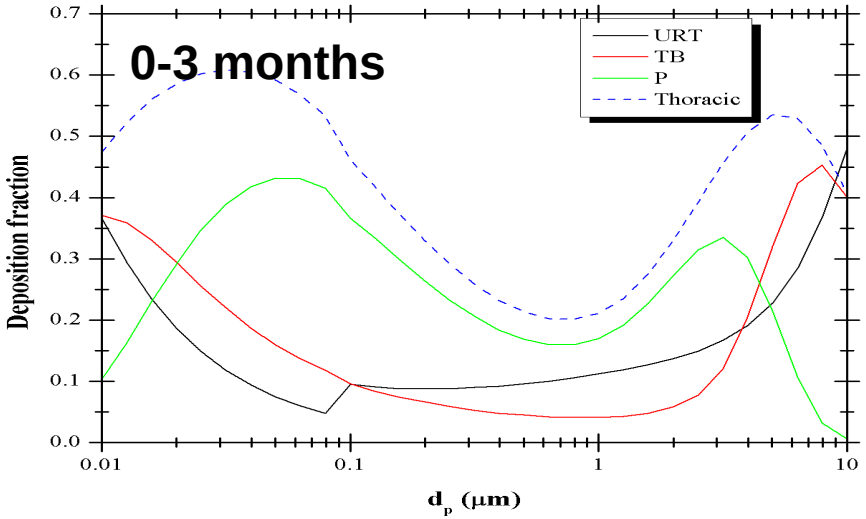
Major:
- Diffusion
- Sedimentation
- Inertial Impaction

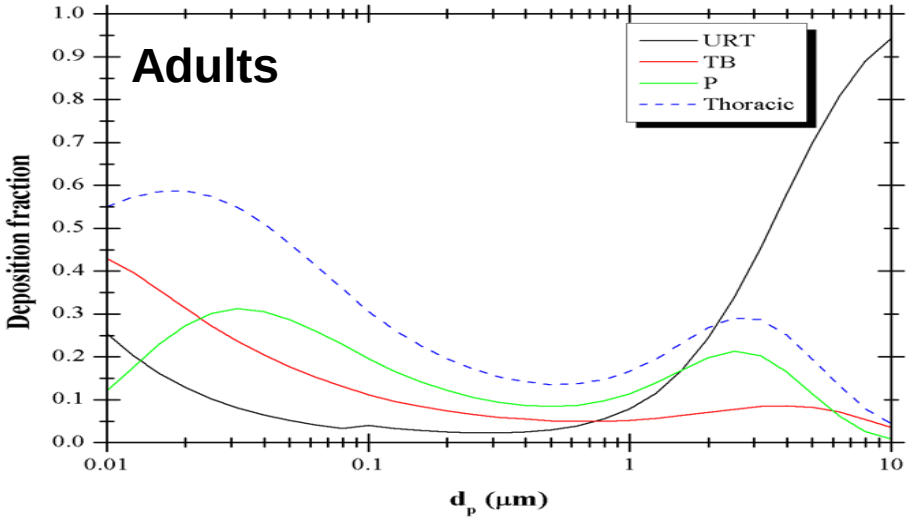
Minor:
- Interception
- Electrostatic

Aerosol property
- Size distribution
- Concentration
- Particle hygroscopicity
- Gas-particle interaction
- Chemical reaction
- Particle surface

Air Flow property
- Lung capacity
- Breathing frequency

Respiratory tract
- Lung structure and morphology





Deposition fraction

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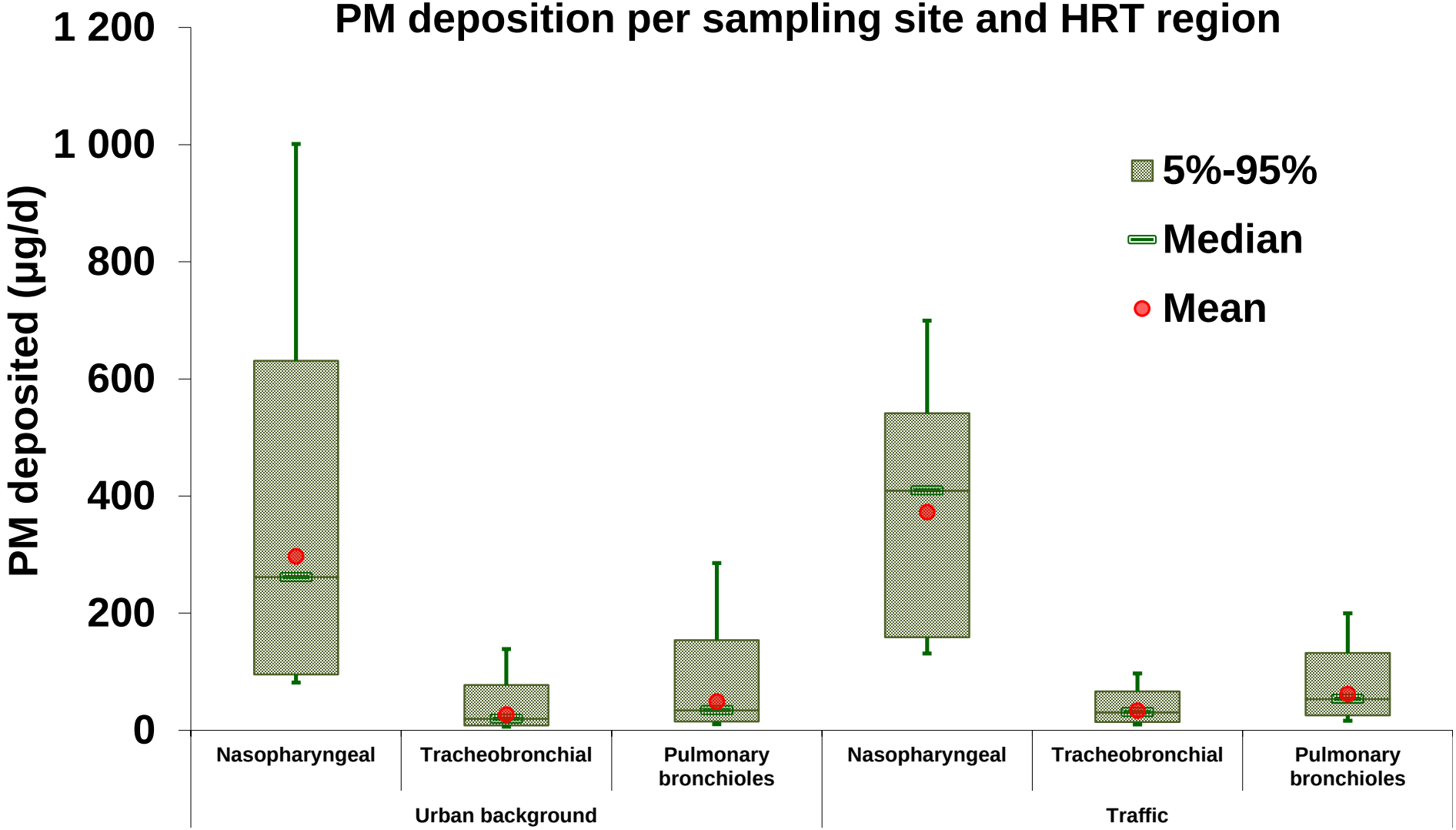

Exposure/response functions

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Health endpoint	CRF (summary estimate)	Reference	CRF (per study)	Study population	
Mortality (all cause)	0.3% (95% CI: 0.1%, 0.4%) change per 1000 p/cm^3	(Wichmann et al., 2000)	0.1% (95% CI: -0.2%,0.5%) change per 1000 p/cm3	Erfurt, Germany 200,000 inhabitants of Erfurt	
		(Stolzel et all., 2007)	0.2% (95% CI: -0.1%, 0.5%) change per 1000 p/cm3	Erfurt, Germany 200,000 inhabitants of Erfurt	
		(Holonen et al., 2001)	0.1% (95% CI: -0.8%, 0.6%) change per 1000 p/cm3	Cardiovascular mortality	Helsinki, Finland ~ 1 million inhabitants of Helsinki (age>=65) Nucleation mode (<0.03 µm)
			0.2% (95% CI: -1.3%, 1.8%) change per 1000 p/cm4	Respiratory mortality	
			0.01% (95% CI: -0.7%, 0.8%) change per 1000 p/cm5	Cardiovascular mortality	Helsinki, Finland ~ 1 million inhabitants of Helsinki (age>=65) Aitken mode (0.03-0.1 µm)
			0.8% (95% CI: --0.9%, 2.5%) change per 1000 p/cm6	Respiratory mortality	

Health endpoint	CRF	Reference	Period	Age group
Cardiovascular hospital admissions	0.1% (95% CI: 0.0%, 0.3%) change per 1000 p/cm^3	(Lanki et al., 2006)	Varied from 1992-2000	>=35
Respiratory hospital admissions	1% (95% CI: 0.0%, 2.2%) change per 1000 p/cm^3	(Andersen et al., 2008)	2001-2004 (NC_{tOt} =6-700nm)	>=65

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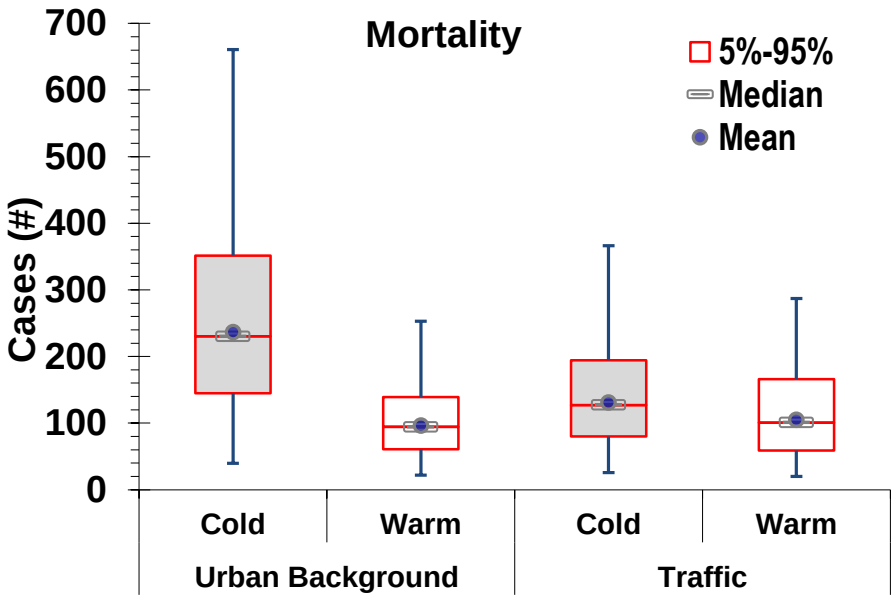
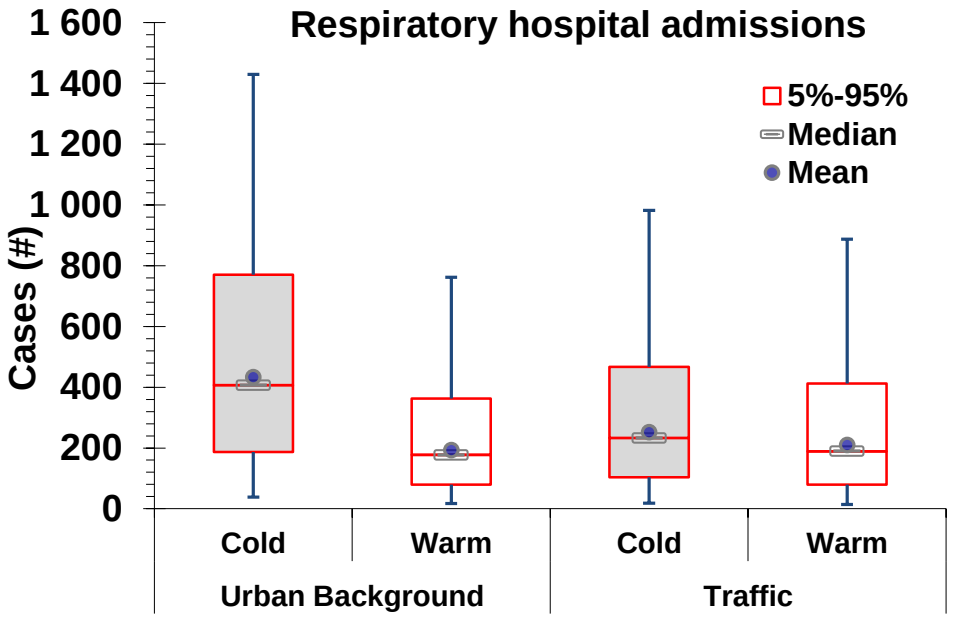
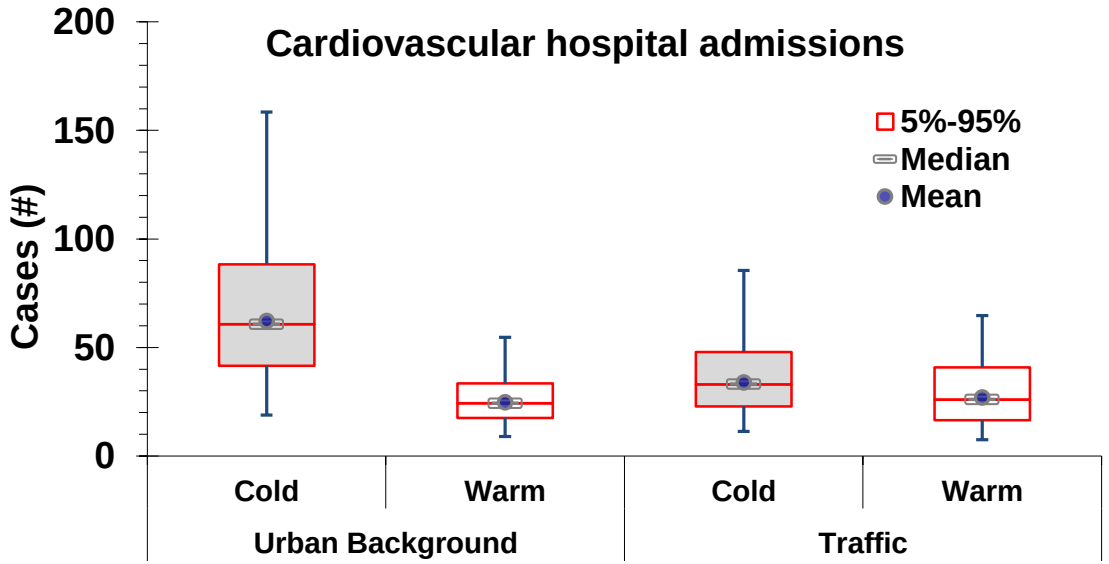
Health impact assessment
Mortality and morbidity







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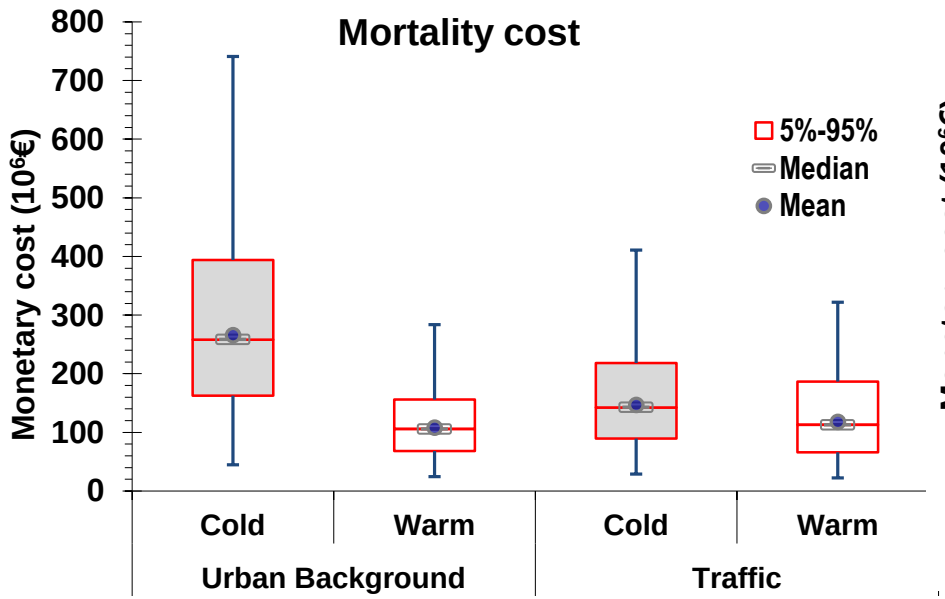
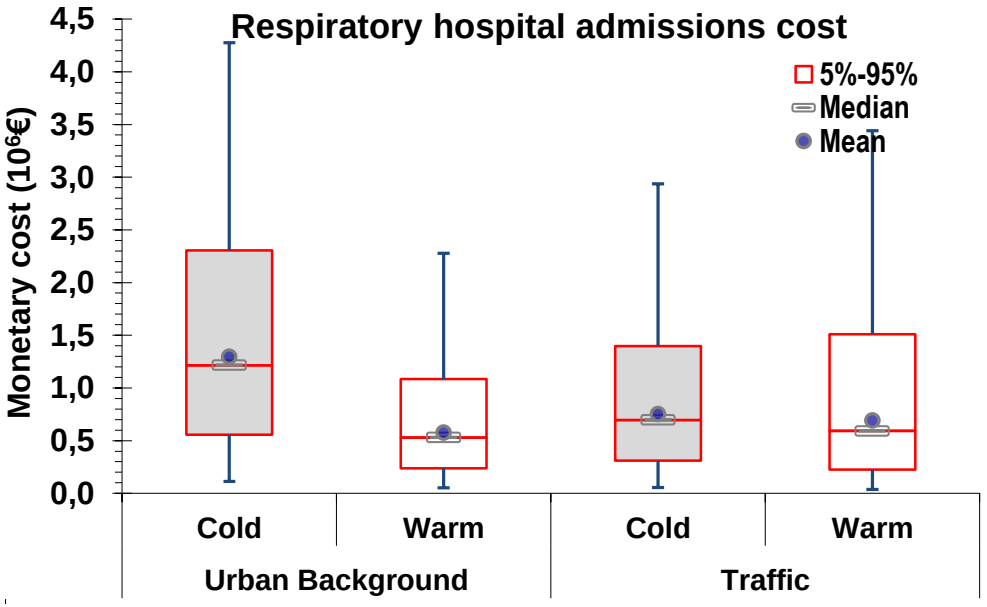
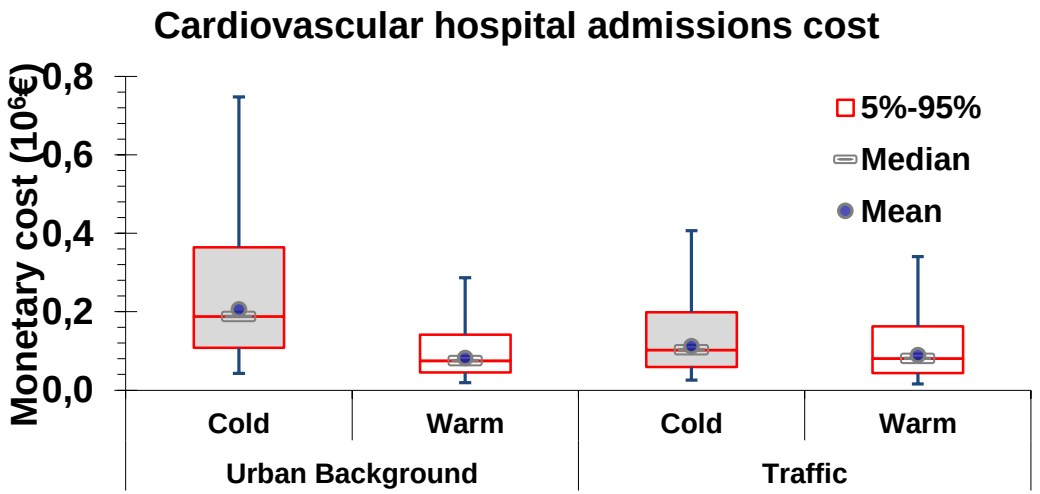
Health impact assessment
Mortality and morbidity







Concluding remarks

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- Particle number concentration at the urban background site were significantly higher than the particle number concentration at the traffic site during the cold period; indicating the strong presence of particles sources other than traffic; this was identified as biomass.

- At the background site the maximum hourly concentrations were observed during the early mornings between **8:00 to 10:00** and in the evenings between **20:00 to 23:00**.

- Wood smoke particles are generally smaller than 1 μm, with *a size distribution that peaks* between **36** and **86** nm.

- The seasonal variations essentially comprised the minimum monthly mean in warm season and the maximum in cold season when the air temperature dropped below zero. As a result, the presence of strong seasonal patterns in aerosol PNC is explained by the ***domestic use of biomass burning*** for residential heating during the winter.

- Ultrafine fraction which are mainly emitted by biomass burning have *higher oxidative potential*, because it has the ability to absorb more chemical substances (higher ratio of surface area - volume).

Concluding remarks

- The higher number of particles during the winter, increases the deposition of particles in the lower part of the respiratory tract; this is clearly reflected in the increased mortality and morbidity of cold period

- Moreover, positive associations between PNCs and daily mortality were found with the latter to increase as particle size decreased.

- Almost 134 additional more deaths are attributed to PNCs during the cold period compared to the warm period at the urban background site and 30 at the traffic site, although this refers to a small period (2 month). Similarly, an additional number of 200 respiratory and 40 cardiovascular hospital admissions is expected during the cold period.

- The associated monetary costs of the observed health effects are dominated by mortality costs, resulting in an increase of ca. €100m in the cold period of the year compared to the warm period. Increase in morbidity costs due to cardiovascular and respiratory hospital admissions are in the range of €500,000 and €100,000 , respectively.

Thank you for your kind attention

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