

The new UFP 330: Comparison with a DMPS for ambient aerosols

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Why ultrafine particles?

Several epidemiological studies have shown a relationship between high number concentrations of ultrafine particles (< 100 nm) and adverse health effects. However, most routine measurements of particulate matter are limited to the mass concentration, e.g. PM10 or PM2.5.

One major reason for this is that commercially available measurement technique is relatively expensive and needs more maintenance than in the routine network operation can be provided.



Location of one measurement site: street canyon Eisenbahnstr., Leipzig

Objectives

- measuring device for ultrafine particles;
- suitable for residential areas in Europe
- affordable and easy to use
- stable delivery of reliable data
- reduced data amount per time
- documentation of measuring activities over several years
- publications for general public and scientific community



UFP 330 at one measurement site.

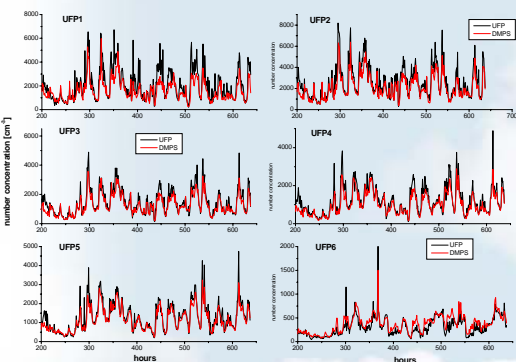
The instrument: UFP 330

The new instrument (Ultrafine Particle Monitor, UFP330) consists of a Corona Charger, a DMA, and an electrometer. The measured current is online transferred to a number size distribution (20 – 500 nm) and locally stored. Within routine networks the number of measured parameters which might be saved continuously is limited. Thus, number size distributions are usually replaced by integral concentrations within certain size classes. For the UFP 330 the size classes have been defined as follows:

name	range
UFP1	20 - 30 nm
UFP2	30 - 50 nm
UFP3	50 - 70 nm
UFP4	70 - 100 nm
UFP5	100 - 200 nm
UFP6	> 200 nm

Size classes of UFP 330

Comparison of UFP 330 and DMPS at Eisenbahnstraße, Leipzig



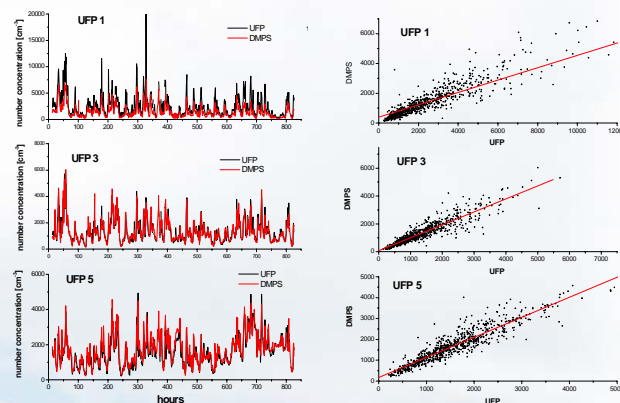
Time series of UFP size channels and those from the DMPS measured from January 11 to February 2, 2007 at Eisenbahnstr., Leipzig.

Measurement Sites in UFIPOLNET



Within the frame of UFIPOLNET 4 prototypes of the instrument have been built and are operated at 4 stations in Europe. To ensure the data quality and comparability the UFPs have been operated in parallel to different DMPS systems of IFT in a street canyon, representing a typical measurement site within an urban network. Number size distributions obtained by DMPS have been converted to size classes according to UFP1 – UFP6.

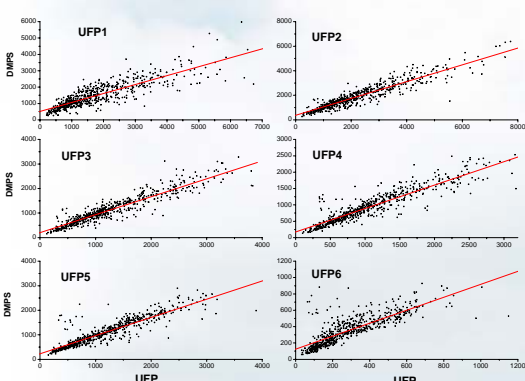
Comparison of UFP 330 and DMPS in Dresden



Time series of three UFP size channels and those from the DMPS (left) measured from January 24 to February 27, 2007 in Dresden Nord and linear regression between number concentrations (right) obtained by DMPS and those from the UFP (same period and location)

Channel	UFP1	UFP2	UFP3	UFP4	UFP5	UFP6
r	0.83	0.88	0.91	0.92	0.92	0.91
a	0.41	0.77	0.93	0.97	0.96	0.93

Correlation coefficients r and slope a of the linear regression (y = ax+b) calculated for the comparison between UFP (#0) and DMPS from Jan. 24 to Feb. 27 in Dresden Nord.

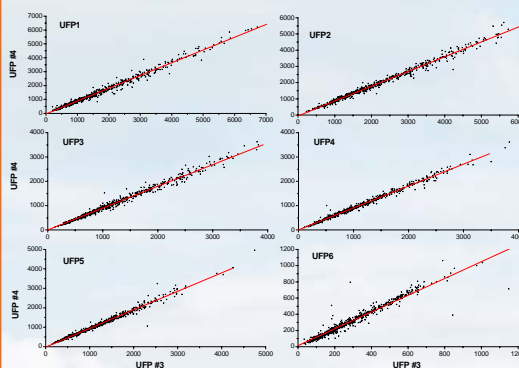


Linear regression between number concentrations obtained by DMPS and those from the UFP, measured between Jan. 11 and Feb. 6, 2007 at Eisenbahnstr.

Channel	UFP1	UFP2	UFP3	UFP4	UFP5	UFP6	
#3	r	0.85	0.93	0.94	0.92	0.91	0.82
	a	0.55	0.68	0.73	0.71	0.74	0.79
#4	r	0.83	0.88	0.91	0.92	0.92	0.91
	a	0.41	0.77	0.93	0.97	0.96	0.93
#1	r	0.83	0.88	0.91	0.92	0.92	0.91
	a	0.41	0.77	0.93	0.97	0.96	0.93

Correlation coefficients r and slope a of the linear regression (y = ax+b) for the comparison between UFP (#3), UFP (#4), UFP (#1) and DMPS from Jan. 11 to Feb. 2 at Eisenbahnstr.

Comparison of two UFP 330 at Eisenbahnstraße, Leipzig



Linear regression between number concentrations obtained by DMPS and those from the UFP, measured between Jan. 11 and Feb. 6, 2007 at Eisenbahnstr.

Channel	UFP1	UFP2	UFP3	UFP4	UFP5	UFP6
r	0.99	0.99	0.99	0.99	0.99	0.97
a	0.92	0.91	0.90	0.90	0.96	1.04

Correlation coefficients r and slope a of the linear regression (y = ax+b) calculated for the comparison between UFP (#3) and UFP (#4) from Jan. 11 to Feb. 6 at Eisenbahnstr.

Conclusions

- A new instrument has been developed to measure size resolved number concentrations of ultrafine particles: UFP 330
- The instrument is easy to handle, needs only little maintenance
- Comparison with the well established DMPS system shows good agreement, highest uncertainties occur below 30 nm and above 200 nm
- After a final comparison (beginning of 2008) the instrument will be commercially available and recommended to be integrated into the European routine network

See also related posters:

T02A048, A. Zschoppe et al., A new conception for environmental measurement of ultrafine particles

T13A162, H. Gerwig et al., UFIPOLNET: Concentration of particle number distributions at 4 stations in Europe

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