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Influence of tube length on mass concentration of fine particles with and without air flow around the probe

VIAQ-28-06

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ARIAMIS
ENERGETIC SYSTEMS

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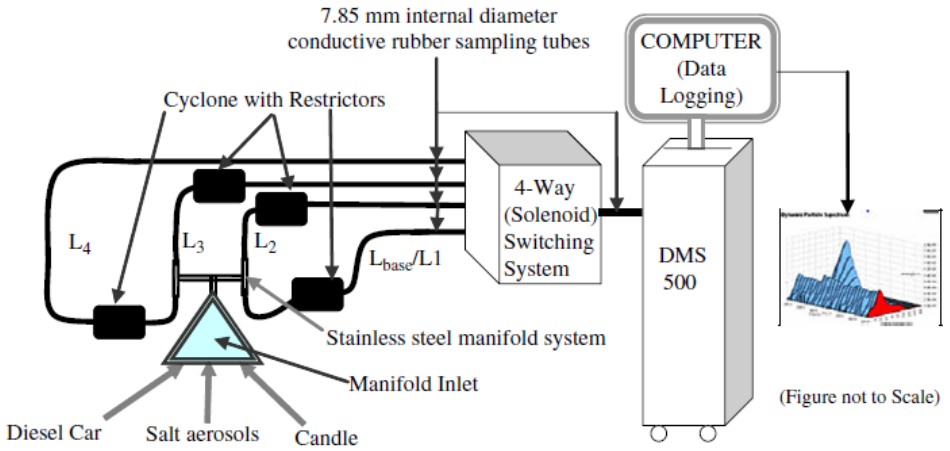
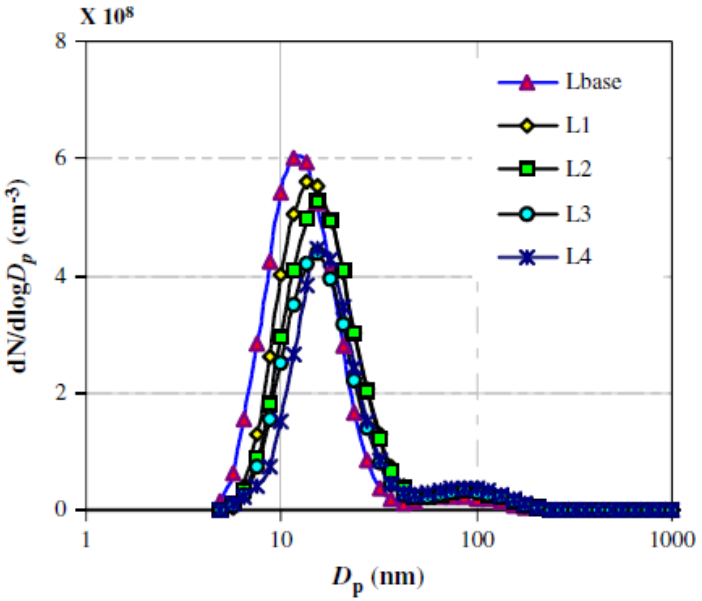
SUMMARY

OBJECTIVE OF THE PRESENT STUDY

Previous study of:
Prashant Kumar, Paul Fennell, Jonathan Symonds, Rex Britter
Treatment of losses of ultrafine aerosol particles in long sampling tubes during ambient measurements
Atmospheric Environment, Vol. 42 (2008)

4 tubes of 7.85mm internal diameter. and various lengths, L_{base} (1.00 m), L_1 (5.47 m), L_2 (5.55 m), L_3 (8.90 m) and L_4 (13.40 m), were used to analyse the particle losses inside the electrically conductive sampling tubes (silicone rubber)





OBJECTIVE OF THE PRESENT STUDY

- The objective of the present study:

→ Assessment of the impact of tube length on fine and ultrafine particle concentration measurements

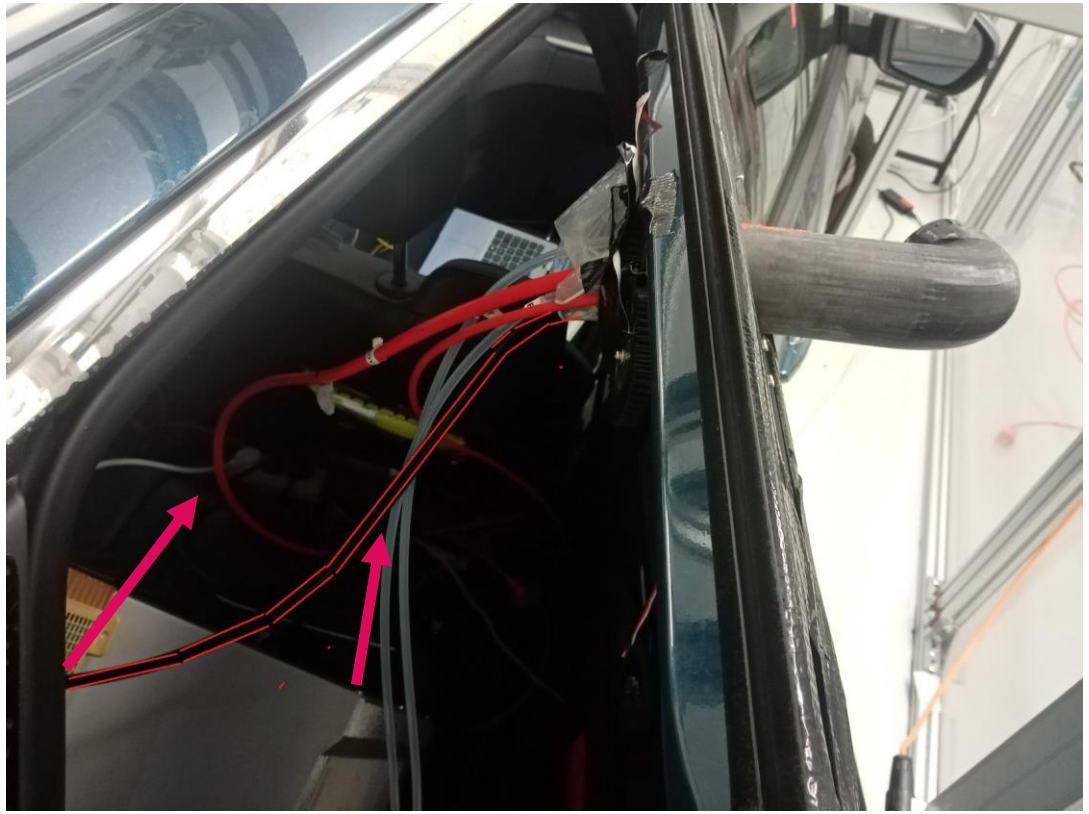


Fig. 1 : Tube influence study using the car's external measurement probe

Test methodology

THE VIAQ MEASUREMENT CHAMBER (THE BUBBLE)

Closed chamber (The bubble)

- Closed enclosure allowing to introduce the vehicle
- Air extractor, fan and power supply.
- Generation of a polluted environment with fine and ultrafine particles

Fig. 2 : The measurement plateforme

PARTICLE INJECTION SYSTEM AND INSTRUMENTATION

- Particles (NaCl ou KCl)
- Particles size : 0.01µm – 10µm
- Injection concentration : 10^7 particles/cm^3.min

Fig. 3: Palas AGK 2000

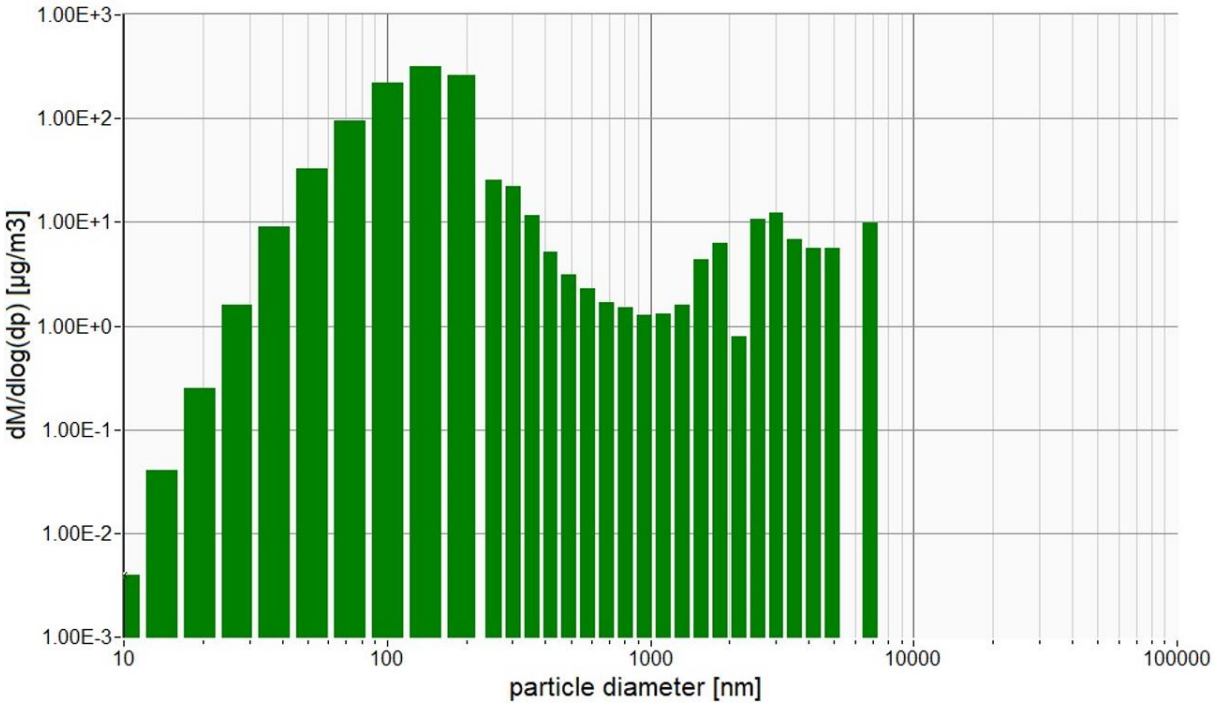


Fig. 4 : Particles distribution (0,1µm<d_p<10µm in the bubble

-Anti-Static tube (internal diameter 4mm, length 1m and 2m)

Mass concentration measurement mg/m3 *(technique optique)*

Particles between (0.1 to 15 µm)

Acquisition frequency (1s)

Fig. 5: TSI DustTrak measurements of particle mass concentration

TEST METHODOLOGY

Mini-wind tunnel for air fflow generation simulating moving vehicle at 13 m/s

The Test Tube

Dusttrack connected to the test tube

Reference Dusttrack (without tube))

Measurements probe

Fig. 6: global test mehodology for tube influence assessment

Results and analysis

INFLUENCE OF TUBE LENGTH

- Influence of the tube length on the measurement of particle mass concentration in a polluted environment with a concentration level of 0.5mg/m^3 at T= 17°±2°, RH=25% ±5%

	Comparison between without tube and with tube of 1m length	Comparison between 1m length tube and 2m length tube
Relative difference of mass concentration	**6%**	**12%**

- Particle deposition

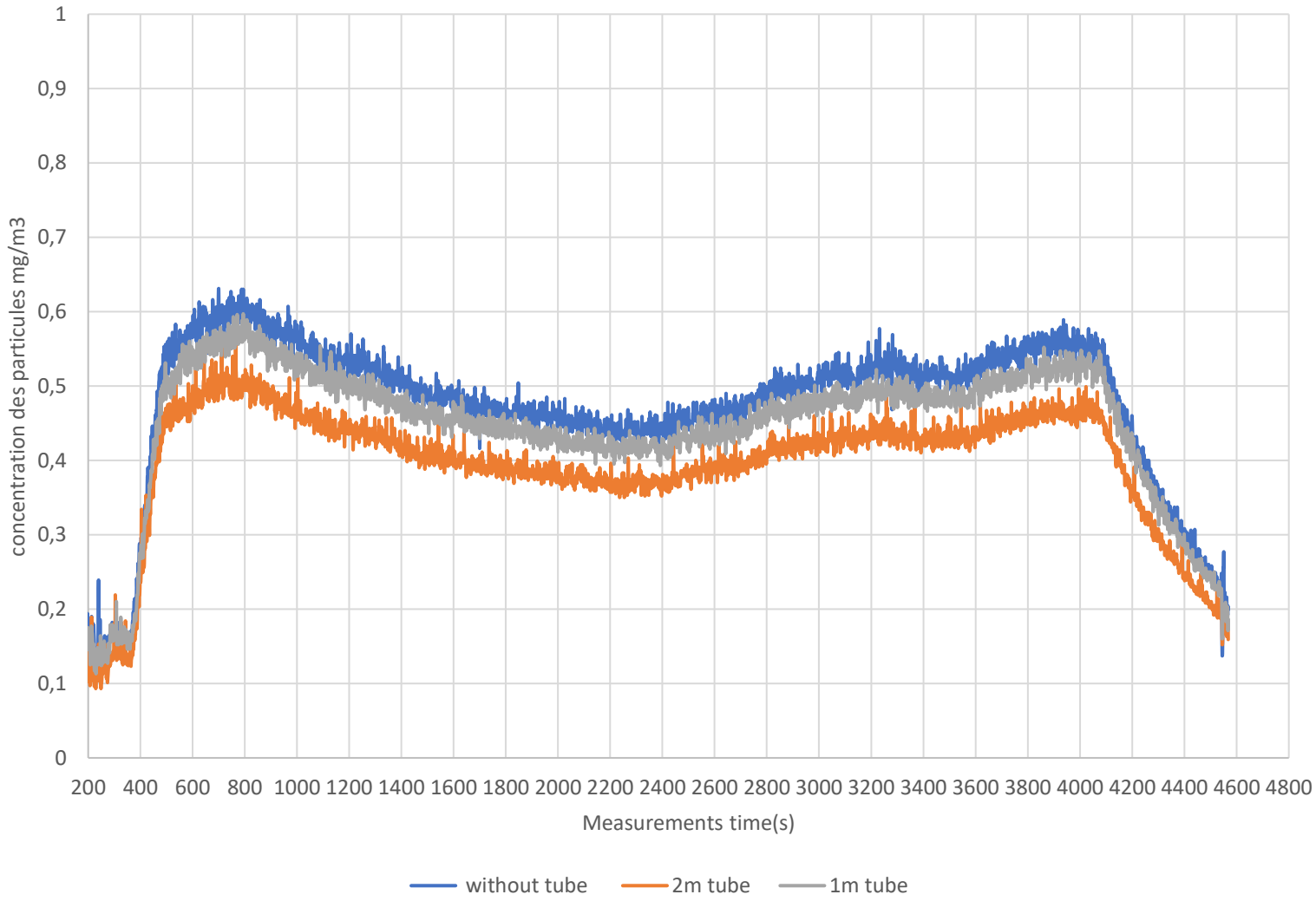
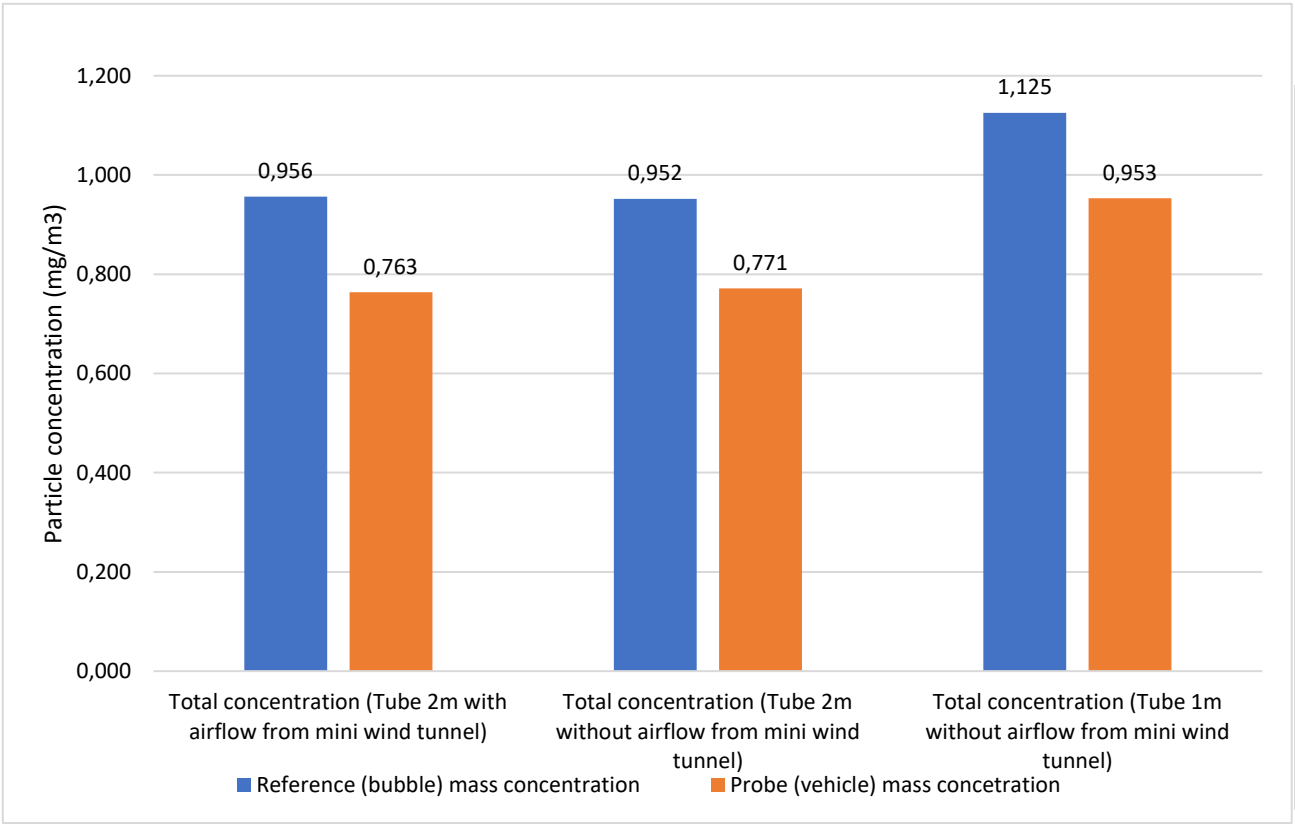


*Fig. 7: I*nfluence of the tube length on the measured particle mass concentrations at bubble concentration level of 0.5 mg/m3)

INFLUENCE OF TUBE LENGTH WITH AIR FLOW

- Influence of tube length with and wihout airf low



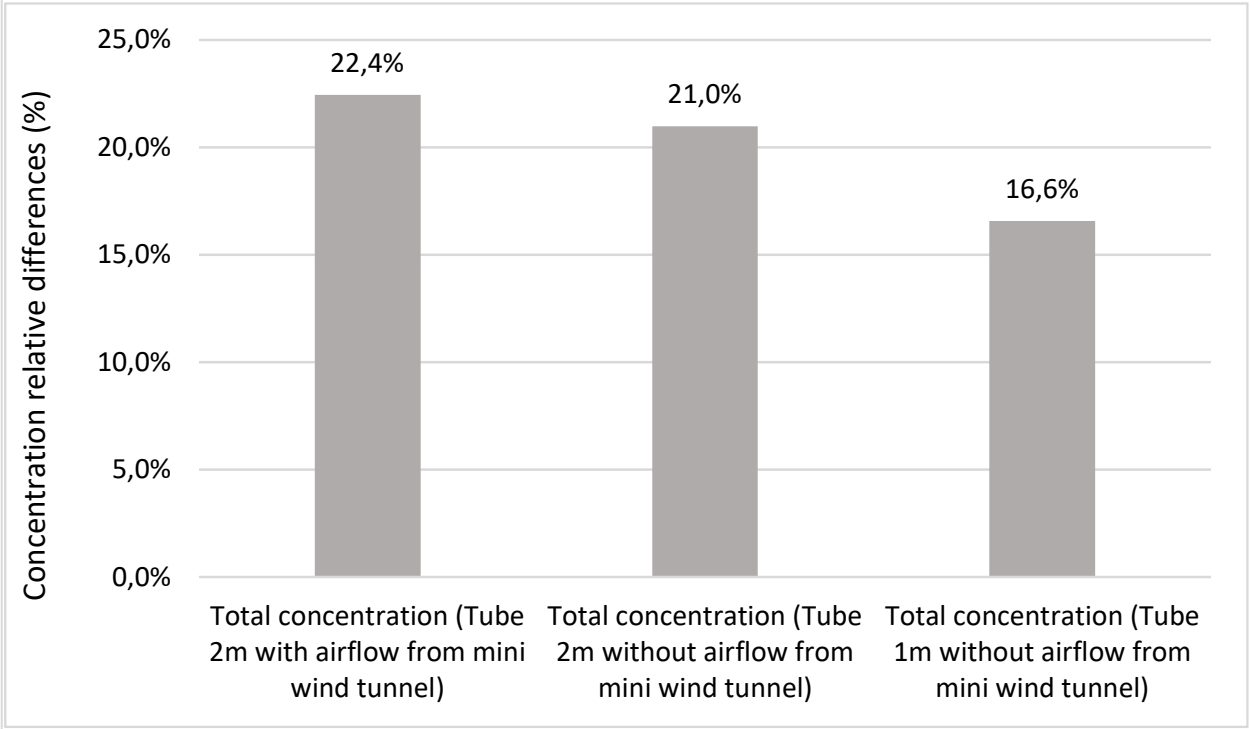


Fig. 8: Comparison of mass concentration obtained from different measurements achieved with 1m or 2m tube and with or without air flow generated with the mini wind tunnel

Fig. 9: Comparison of relative differences in mass concentration obtained from different measurements achieved with 1m or 2m tube and with or without air flow generated with the mini wind tunnel

CONCLUSION

- The tube that connect the probe to the instrument has an influence on particle mass concentration measurement
- The increase in the tube length increases particle deposition in the tube and hance the relative differences between the real (reference) mass concentration and the one measured by the instrument
- The airflow could induce non isokinetic condition at probe inlet during measurement. At the present studied air velocity at probe inlet (13 m/s), this effect is weak on particle mass concentration measured (less than 1% difference) in comparison to the tube length impact.