Christof Asbach, Michael Spreitzer, Ana Maria Todea

First experiences with a low-cost Sharp dust sensor

Institut für Energie- und Umwelttechnik e.V.

Air Quality & Filtration

Workshop on

Status of Air Quality Sensors and their use in (official) monitoring strategies

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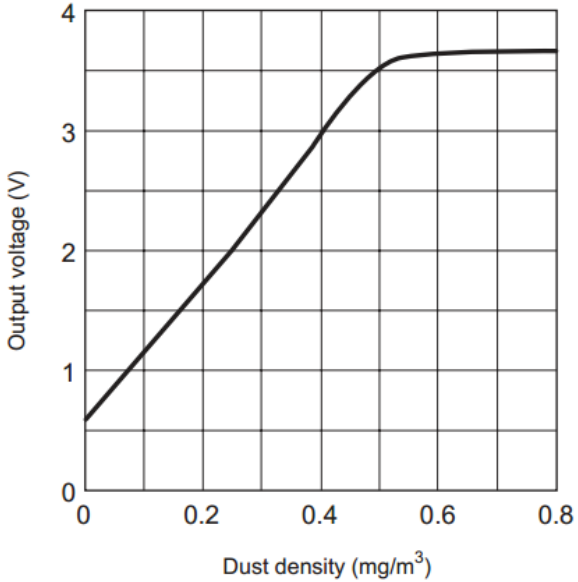
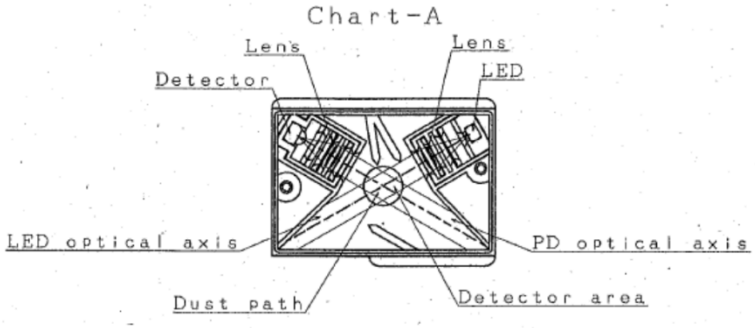
Offen im Denken

Sharp Dust Sensor

- Sharp dust sensor GP2Y1010AU0F
- Based on IR LED ($\lambda \approx 900$ nm)
- Specified measurement range: 25-500 µg/m³
- No active suction
- Operation requires micro-controller (in our case: Arduino Uno)





Planned application at IUTA: compressed air filter

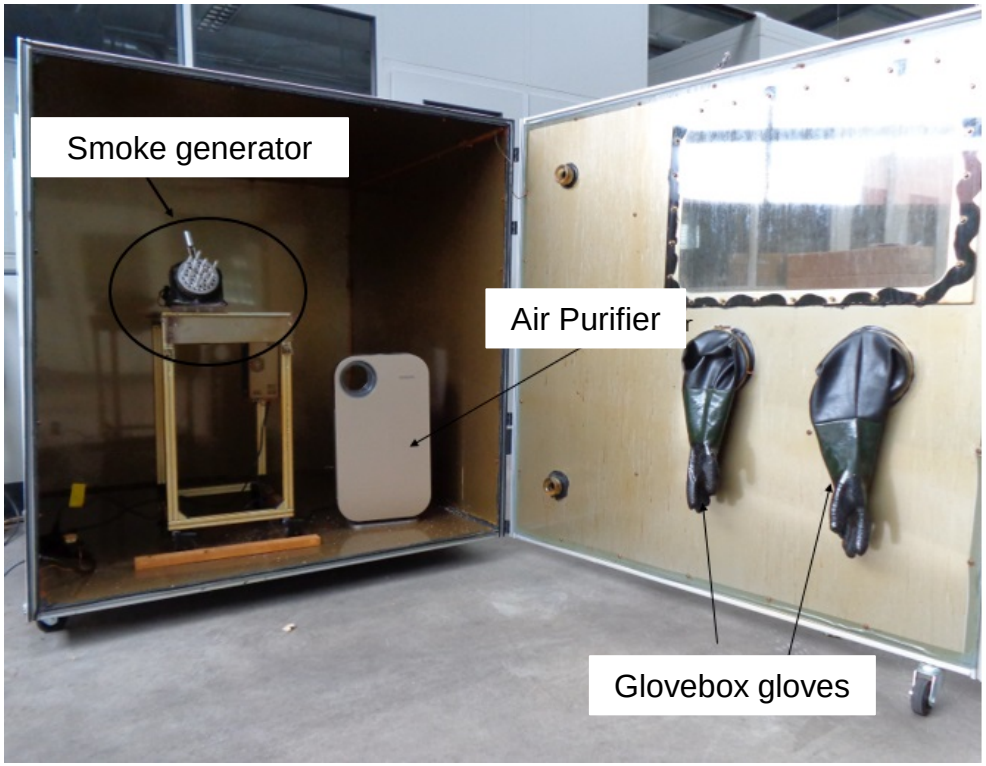
- Test of compressed air filters
- Use of compressor oil (Corena 46) to saturate filters
- Saturation typically lasts between 2 h and 2 days
- Measurement of upstream size distribution before and after saturation with pressure-proof Welas (Palas GmbH)
- During saturation, only measurement of downstream size distribution

➔ Use Sharp dust monitor to monitor the stability of the challenge aerosol

Planned application at IUTA: aging of air purifier filters

- Most indoor air purifiers use electret filters with decreasing efficiency over time
- According to GB/T 18801:2015 reproducible accelerated aging of the filters with 50 cigarettes simultaneously in 3 m³ chamber
- Termination of aging step, when mass concentration in chamber ≤ 35 µg/m³

➔ Use Sharp dust sensor to monitor mass concentration inside chamber

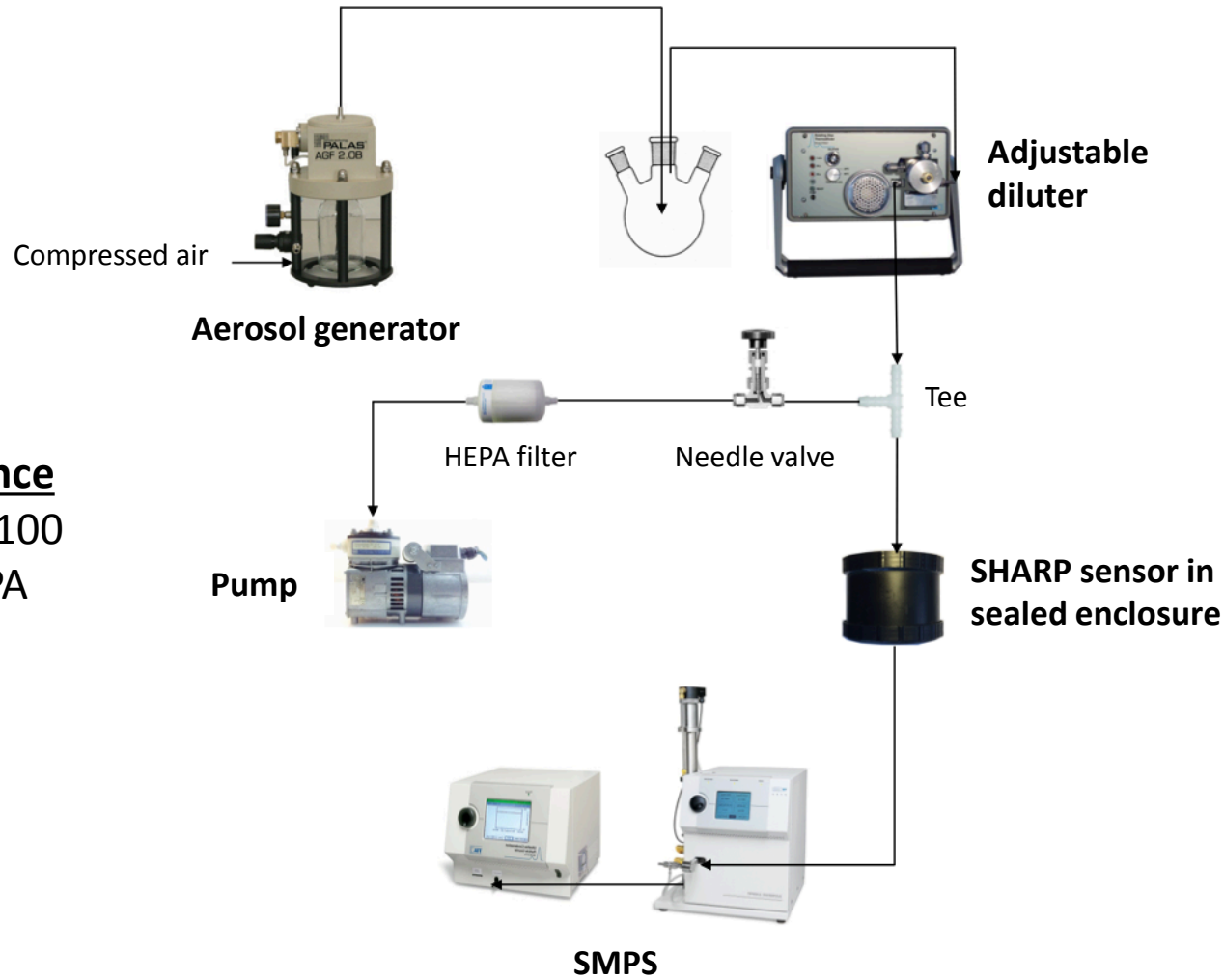


Future applications at IUTA

- Workplace exposure monitoring
  - Project funded by BAuA to evaluate optical aerosol measurement techniques for use in workplaces

- Ambient air pollution monitoring
  - M.Sc. Thesis (starting April 2017), among others, comparing data from the dust sensors with data from established instruments (SMPS, NSAM, TEOM, OPS, filter samplers) in Mülheim Styrum monitoring station

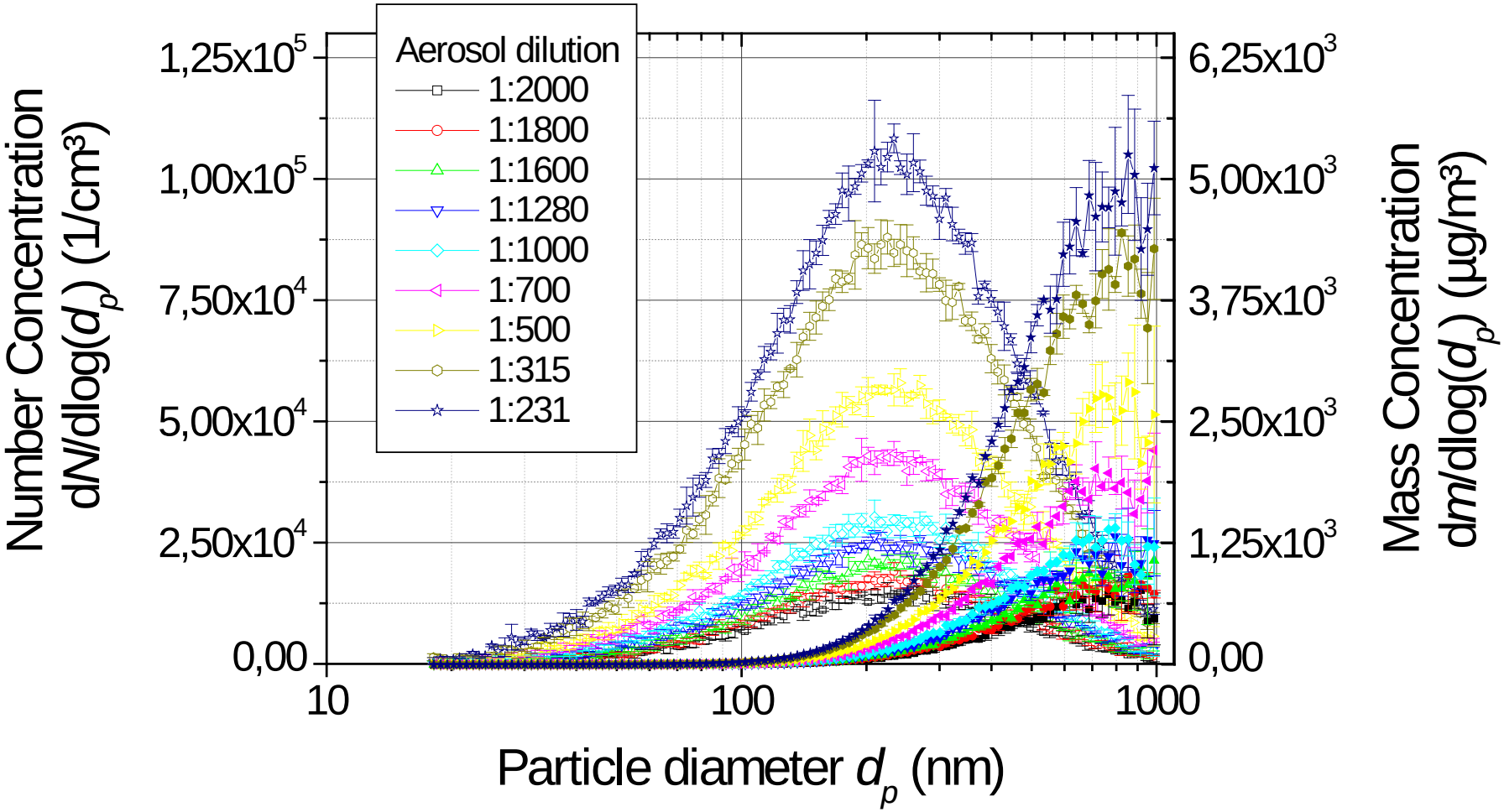
First experiments: DEHS aerosols



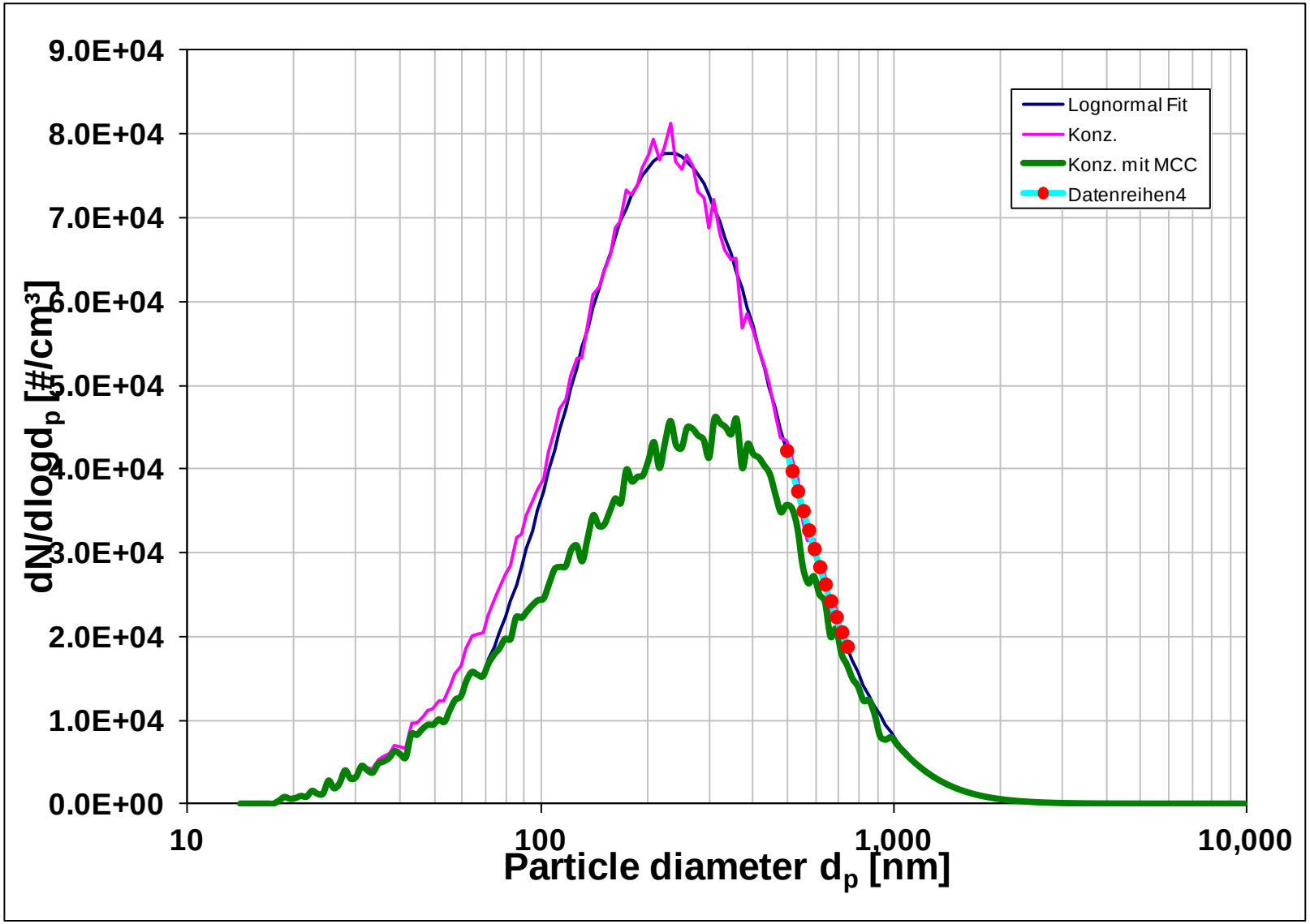
<u>Aerosol substance</u>

Pure DEHS or 1:100 diluted with IPA

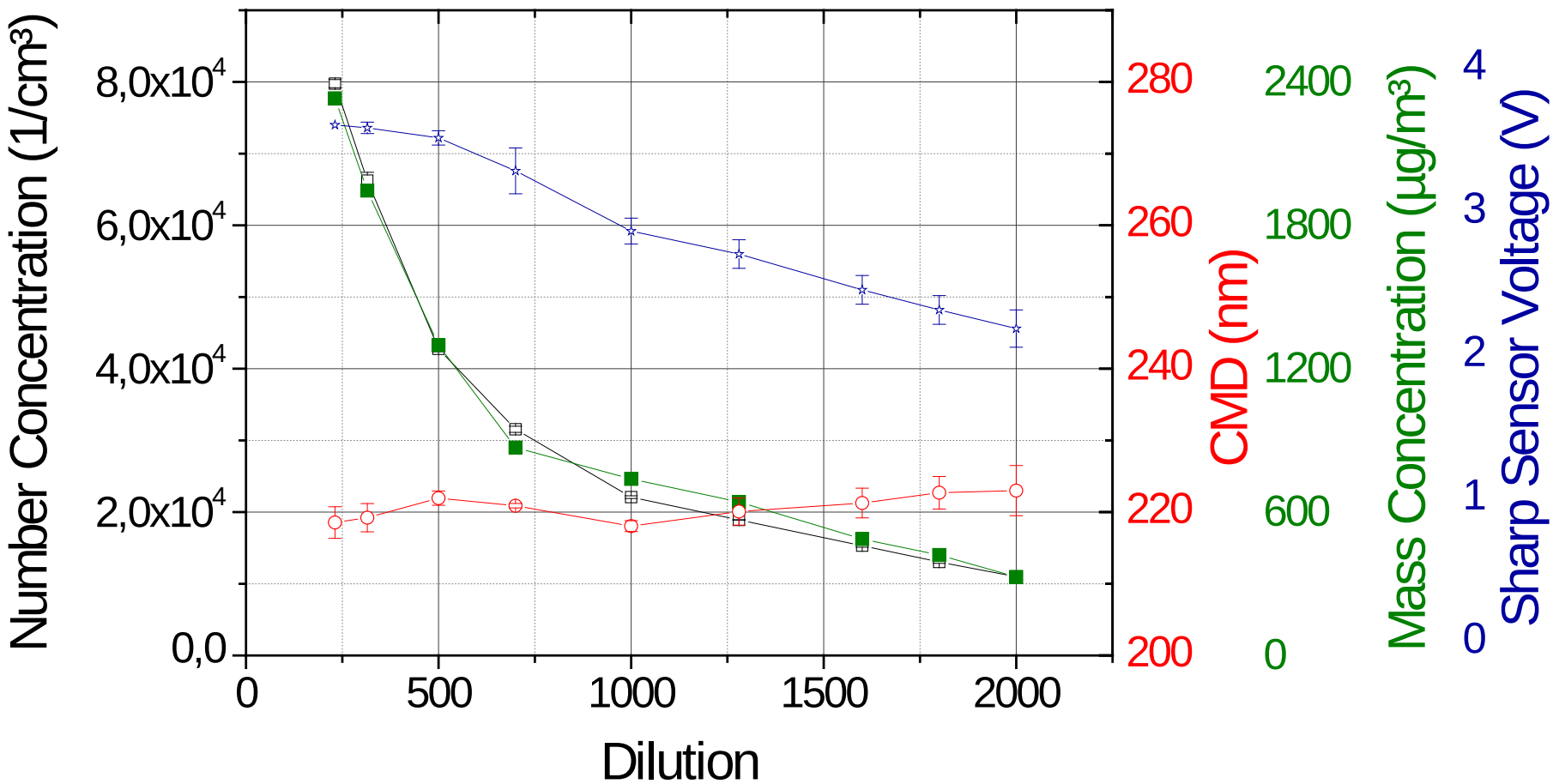
Size distributions with pure DEHS



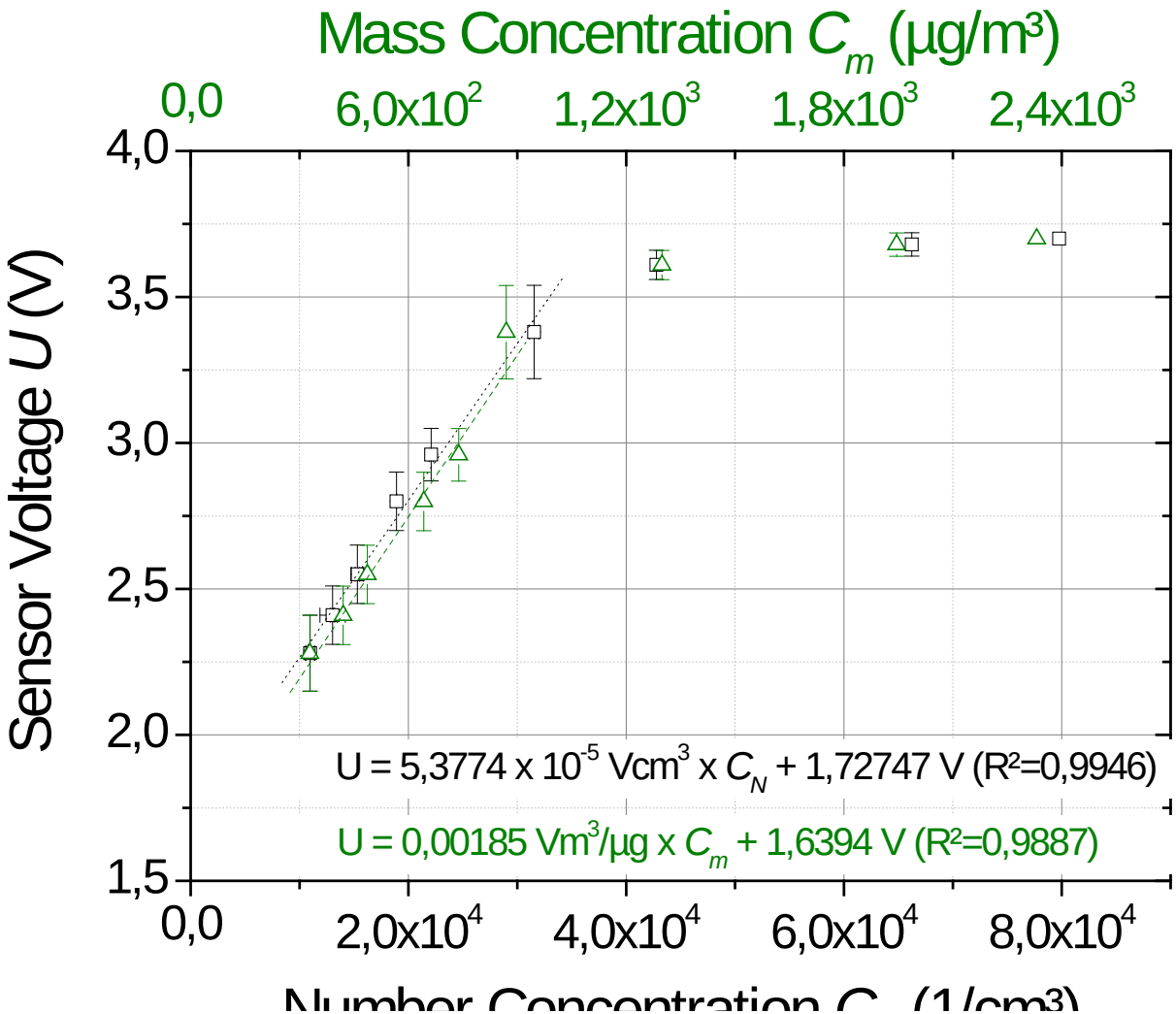
PM 2.5 mass concentration from number size distribution



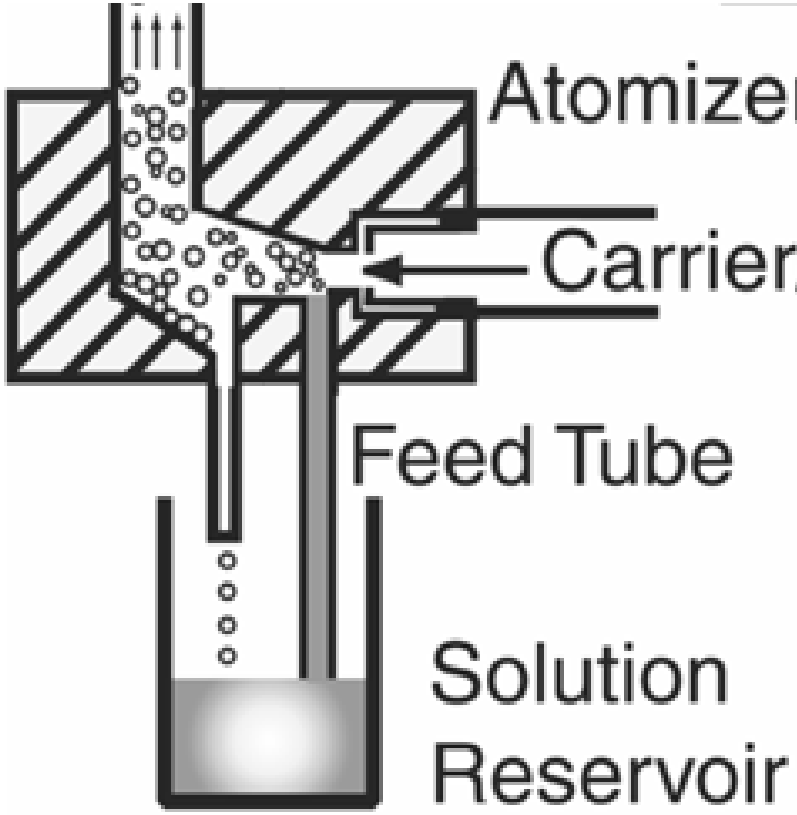
Number + mass concentration, CMD (pure DEHS)



Correlation with number and mass concentration (pure DEHS)

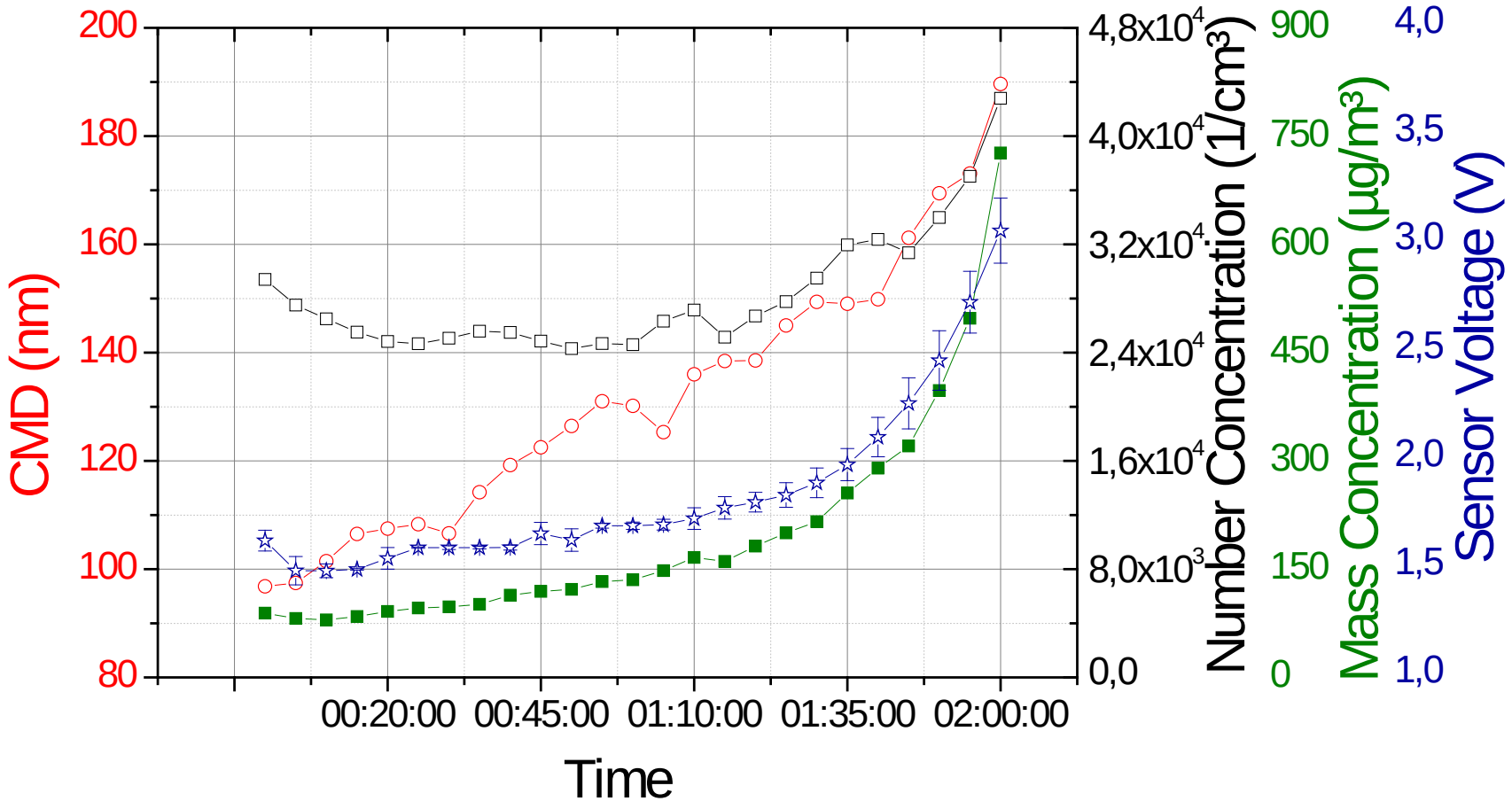


Dilution of DEHS with IPA (1:100)

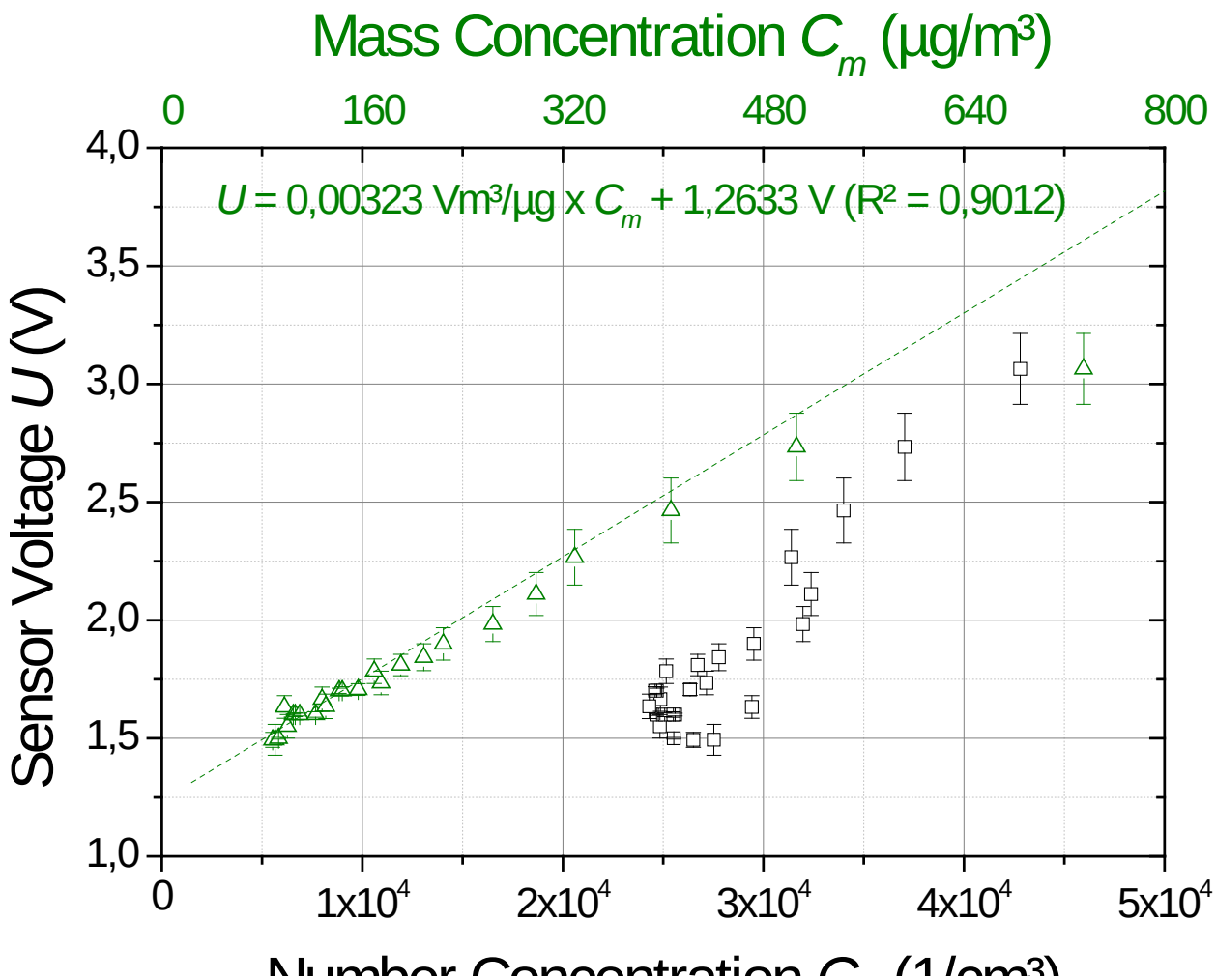


- IPA evaporates over time
- Size and concentration of the droplets change

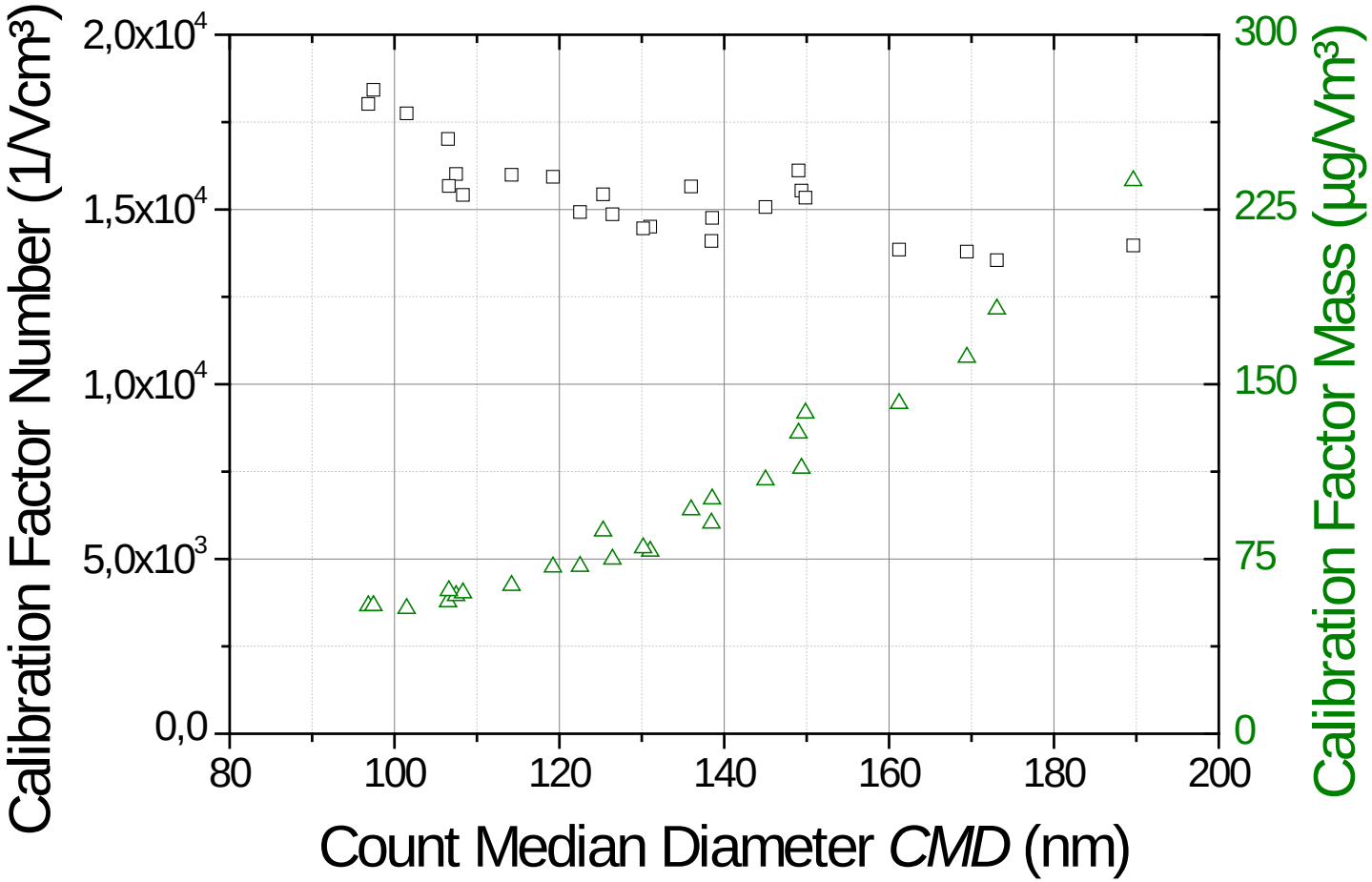
Number + mass concentration, CMD (1:100 diluted DEHS)



Correlation with number and mass concentration (dil. DEHS)



Calibration factors



Conclusions

- Sharp sensors are a good candidate for monitoring stability of test aerosols
- If mean particle size and refractive index are known, the mass and number concentrations can be estimated
- Strong size dependence of calibration factors (seems stronger for mass than for number concentration)

Next steps:

- Use of different aerosols (NaCl and cigarette smoke)

Thank you for your attention