Particle Mobility Size Spectrometers: Harmonization of Technical Standards and Data Structure for High Quality Long-term Observations of Atmospheric Particle Size Distributions

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Motivation

Long-term observations of particle number size distributions of atmospheric aerosols developed to a standard measurements

Especially, mobility size spectrometers such as SMPS or DMPS are used to determine the number size distribution in the ultrafine and fine particle size range

Beside few commercially available mobility size spectrometers, a larger number of custom-designed instruments are used for atmospheric studies, especially in Europe

For comparability reasons, a technical standardization of mobility size spectrometers is essential

Furthermore, the transparency and the traceability of the measurements are important to evaluate the quality of data

We present here the standardization work done in the frame of EUSAAR
Standardizing the mobility size spectrometer set-up
- Building a reference mobility size spectrometer for the network
- Comparing inversion routines for ideal transfer functions
- Conducting calibration workshop for condensation particle counters
- Organizing intercomparison workshops for mobility size spectrometers employed in the network
- Performing site intercomparisons
- Creating a new transparent data structure for the database

Minimum Requirements

The mobility size spectrometer should be always size-calibrated with Latex particles (e.g. 200 nm), and the agreements should be within 3.5% of the nominal PSL sphere size.

The measured number size distribution should agree within 10% against a reference instrument (CPC or reference size spectrometer) in absence of particles smaller than 20 nm.

Aerosol and sheath air flow rates have to be checked frequently by an independent flow meter.

For laboratory measurements, the above listed requirements are sufficient, however, users errors often lead to significant false measurements.

Furthermore, these requirements are not sufficient for stand-alone long-term observation at a field site.

Additional requirements are necessary for these automated number size distribution measurements.
Additional EUSAAR-Requirements

The aerosol and sheath air flows have to be measured, controlled, and stored with the time resolution of the mobility scan.

The relative humidity and temperature in the aerosol and sheath air flow have to be measured and stored with the time resolution of the mobility scan.

The use of correction functions for particle losses and the inversion routine applied for multiple charge correction have to be well documented.

The hardware of the mobility size spectrometer has to fulfill a certain standard as shown in the next slide.

However, not all commercial mobility size spectrometers are set up for long-term environmental measurements.

EUSAAR-Standard SMPS Set-Up
Quality Assurance in EUSAAR

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Comparison of Inversion Routines

Latex Calibration
CPC Calibration

Intercomparison: Number Size Distribution
Traditionally, highly time-resolved data are stored in the EMEP data base as hourly-averages. This data are determined from raw data, corrected for losses etc., and converted to standard temperature and pressure. For the user, however, there was no transparency and traceability. We developed, therefore, a three-level data structure:

- Level-1: mobility distribution and system parameter
- Level-2: Inverted and corrected number size distribution
- Level-3: Final data as hourly averages for STP
Thank you very much!!!