METHOD, EQUIPMENT AND EXEMPLARY RESULTS FOR HARMONIZED UFP NUMBER AND SIZE DISTRIBUTION MEASUREMENTS FOLLOWING CEN/TS 16976 AND CEN/TS 17434

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Motivation

TSI's Goal:

Supporting the community with state-of-the-art instruments, ranging from individual components to complete solutions

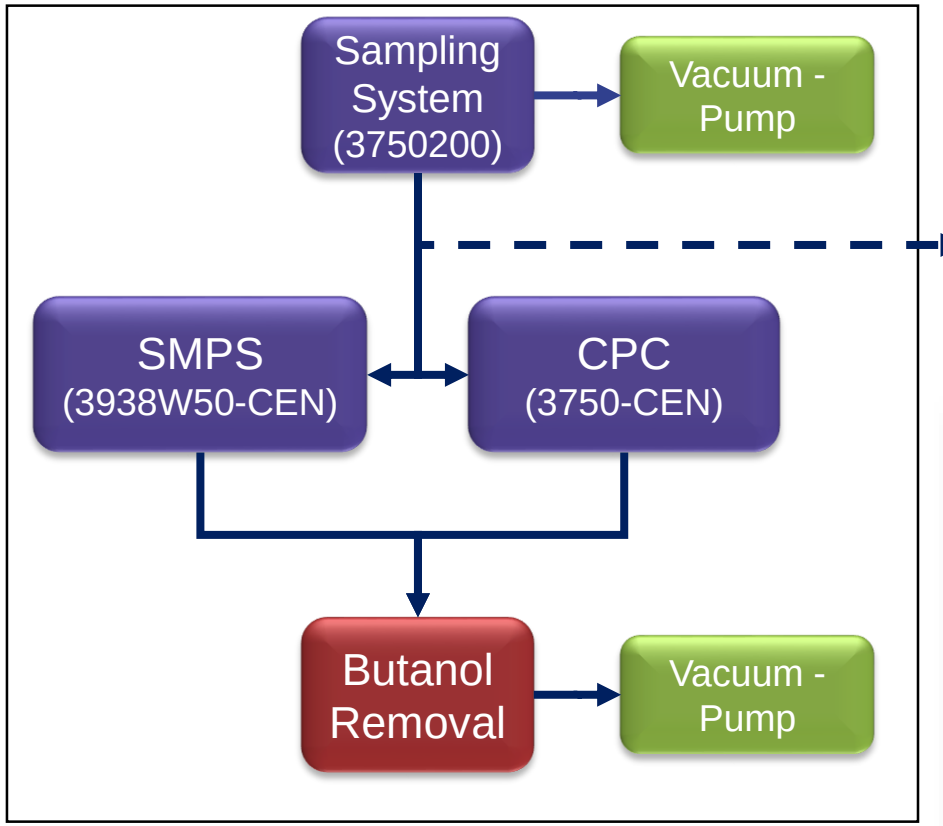
Harmonization of **aerosol in-situ PN** and **PSD** measurement techniques

- Instrument specification
- Setup and sampling specification
- Measurement procedure
- Data processing and reporting
- Quality control and assurance

- Particle number concentration (PN) according to CEN/TS 16976
- Particle size distribution (PSD) according to CEN/TS 17434
- Network recommendations (ACTRIS, GAW, ...)

Particle Monitoring Solution from TSI

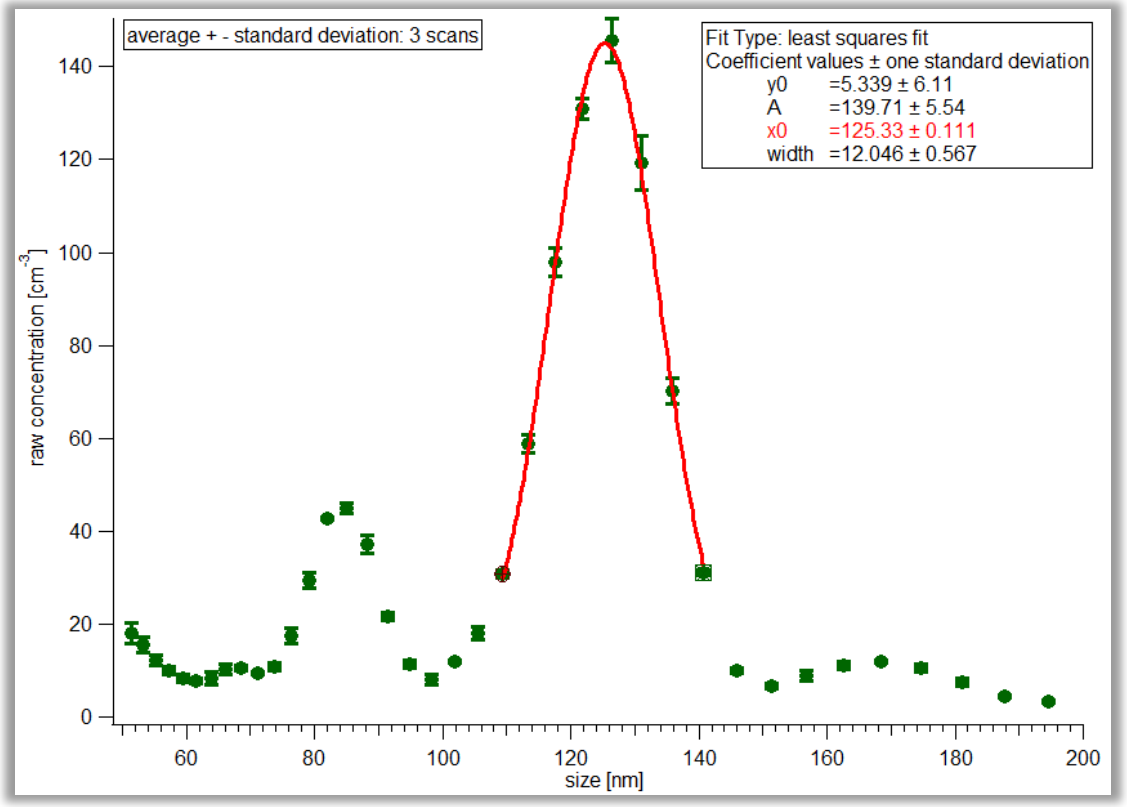
KEY SPECS:
- CEN/TS 16976
- CEN/TS 17434
- 10-800nm
- Vienna type DMA (Winklmayr et al. 1991) based on TROPOS
- RH control for aerosol and sheath air
- full system auto recovery
- auto data export



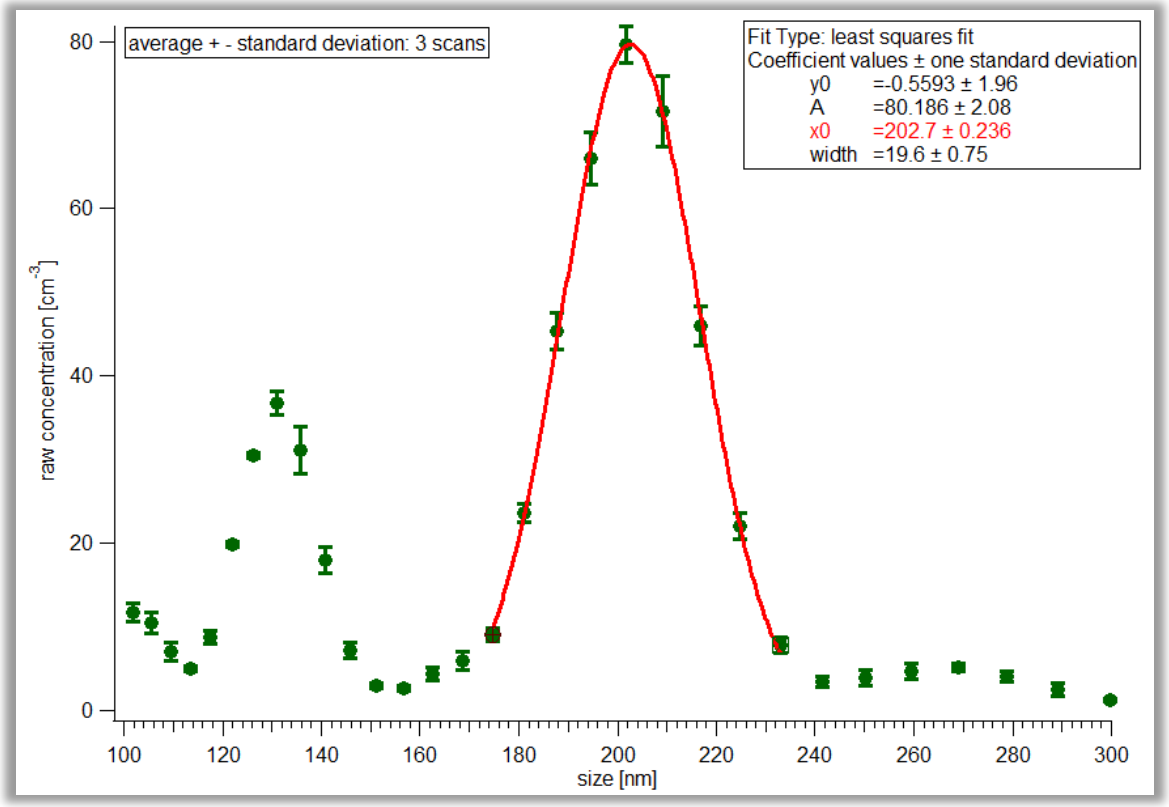
New wide-range SMPS from TSI

Sizing Accuracy for PSL Reference Particles

125 nm certified

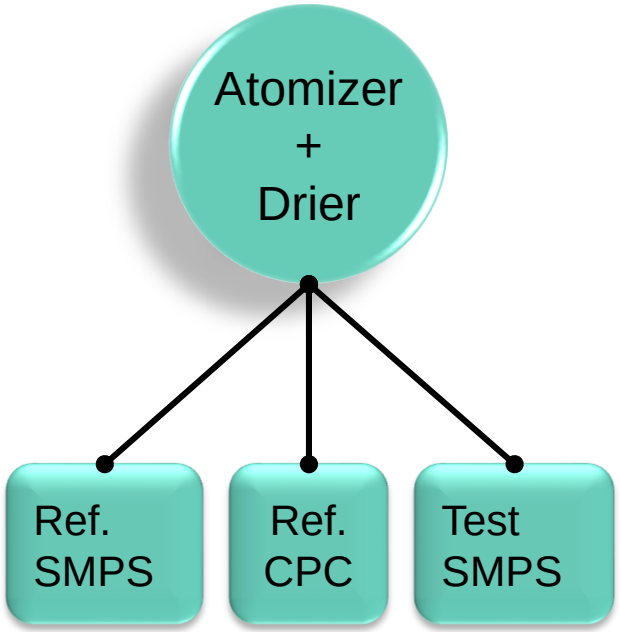


203 nm certified

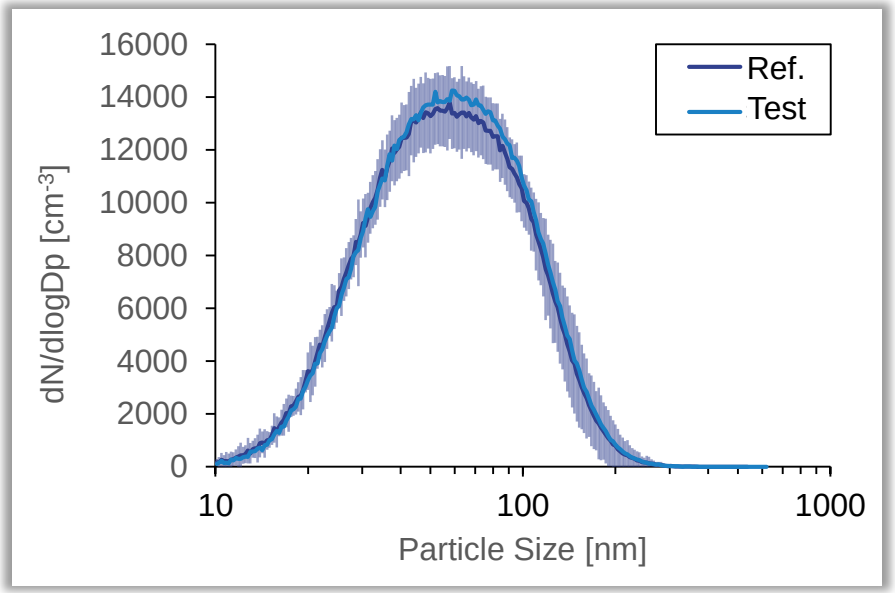


Polydisperse Lab Aerosol

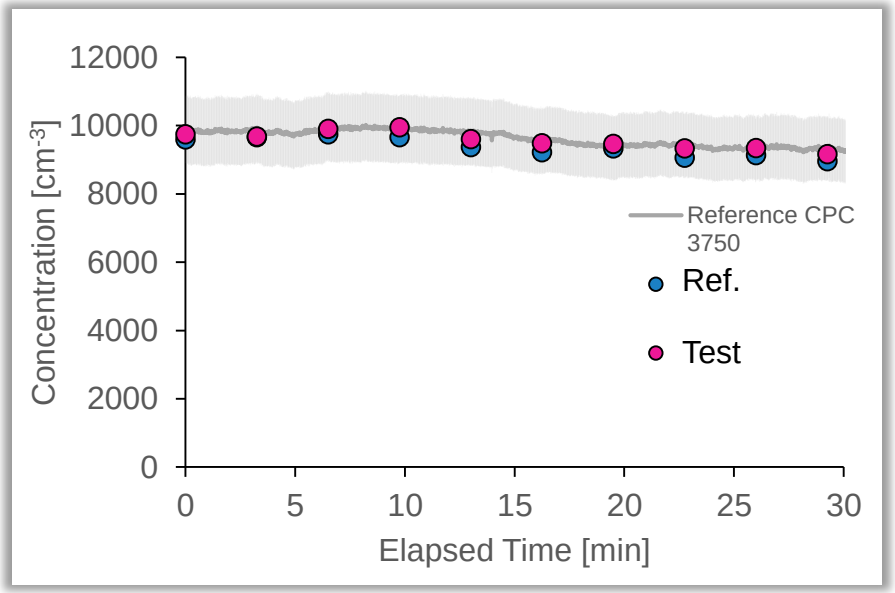
Atomized sucrose 0.1%



Ref. SMPS with 3081 DMA and 3750 CPC
Test SMPS with **novel 3083 DMA** (under test) and 3750 CPC
Stand-alone **CPC 3750** as concentration reference

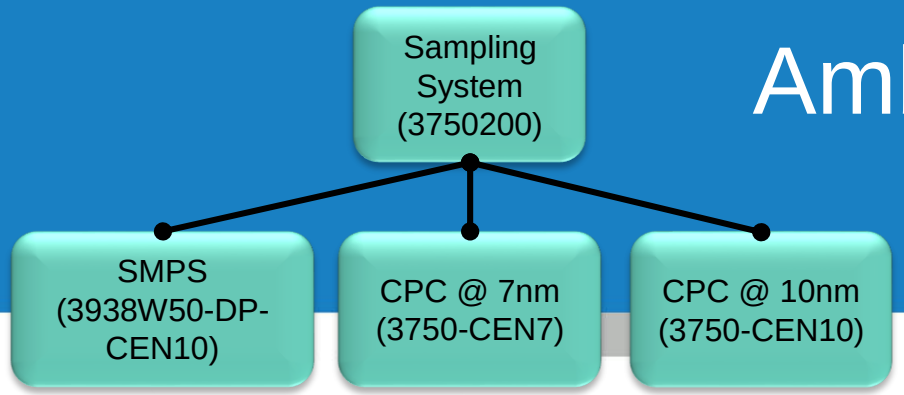


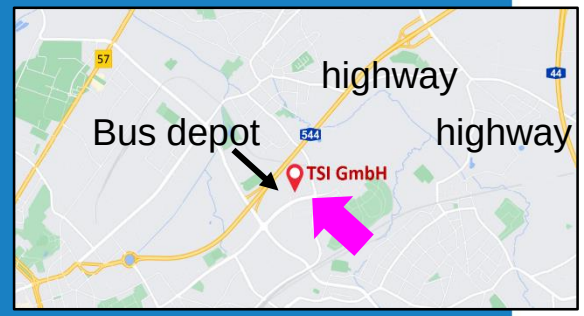
average of 10 scans
reference SMPS+-10%

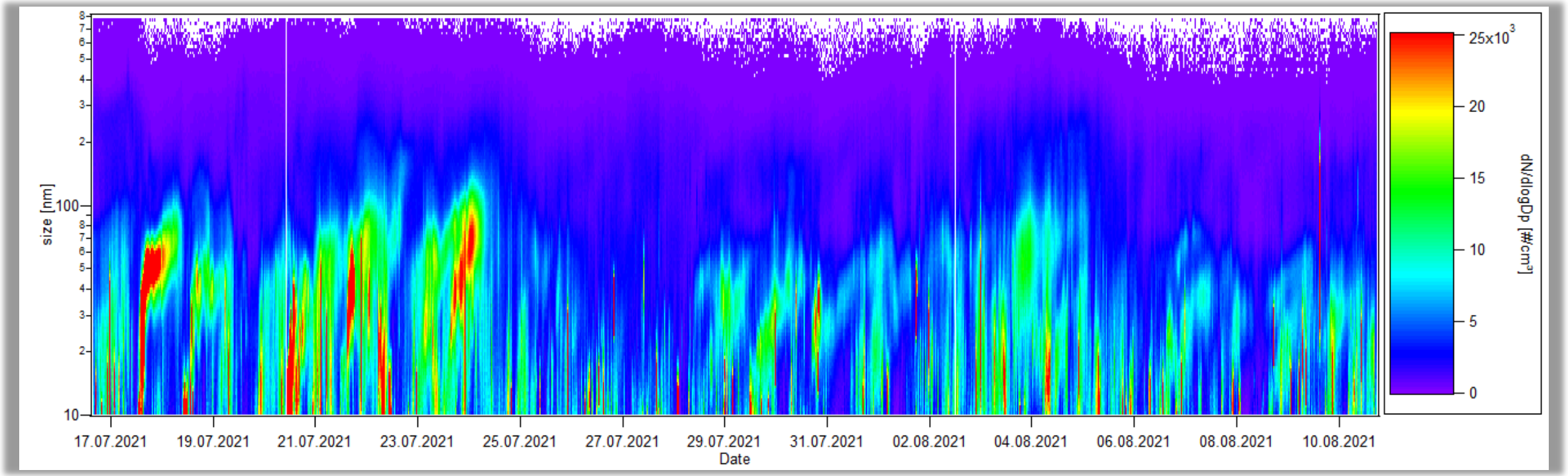


Number concentration intercomparison
reference CPC+-10%

Ambient Aerosol PSD



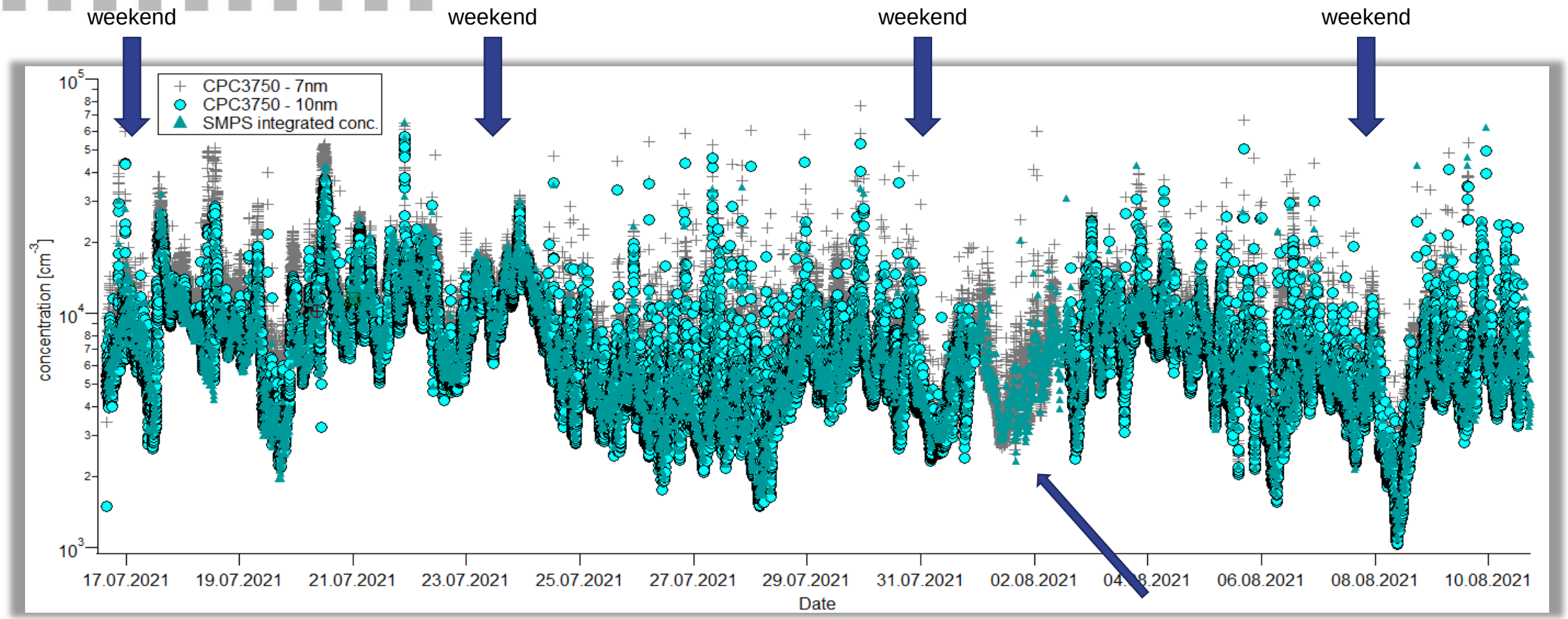




24 days @ 5min time resolution
Urban/industrial close to UFP sources

This dataset includes validation of the new 3750-CEN10 CPC with Dp50=10nm

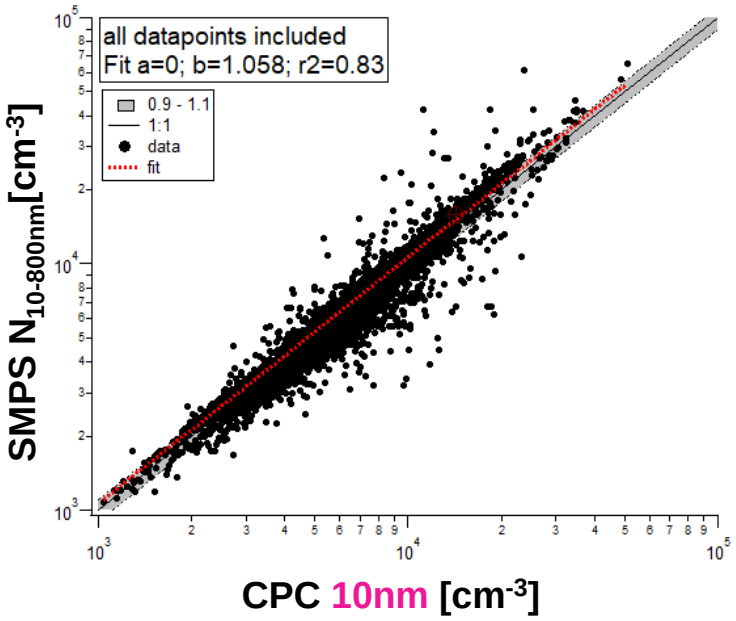
Ambient Aerosol – PN SMPS vs CPC



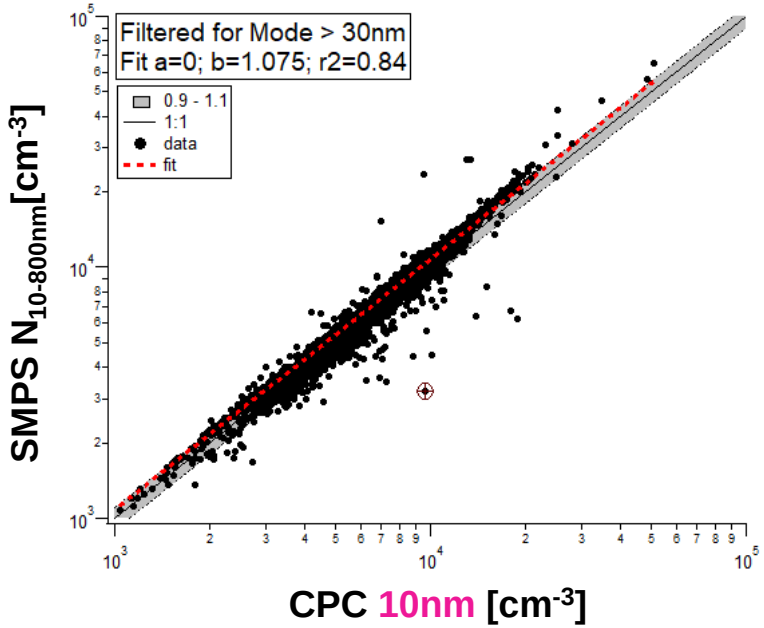
24 days @ 5min time resolution Urban/industrial close to UFP sources

Missing CPC – 10nm data due to computer issues

Ambient Aerosol – Total PN SMPS vs CPC



Getting closer – CEN17434:
„Periods where the aerosol shows a nucleation mode shall be excluded. “



For this analysis SMPS size distribution is not corrected for CPC counting efficiency

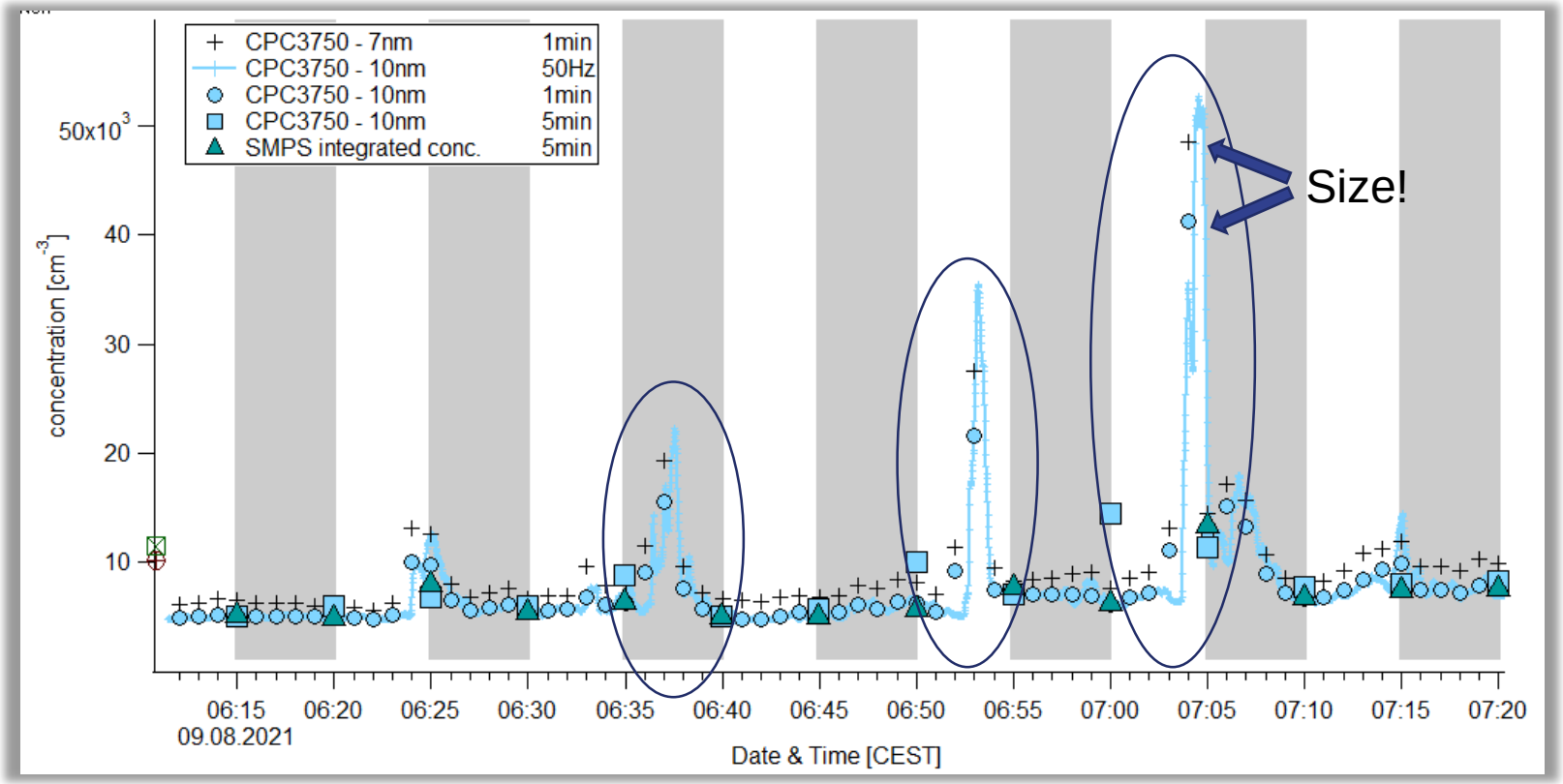
Ambient Aerosol Close to Sources

- All data points at start of interval
- Assumption: Stability of aerosol population during scan:

300 s Interval

260 s Scan | 40s retrace

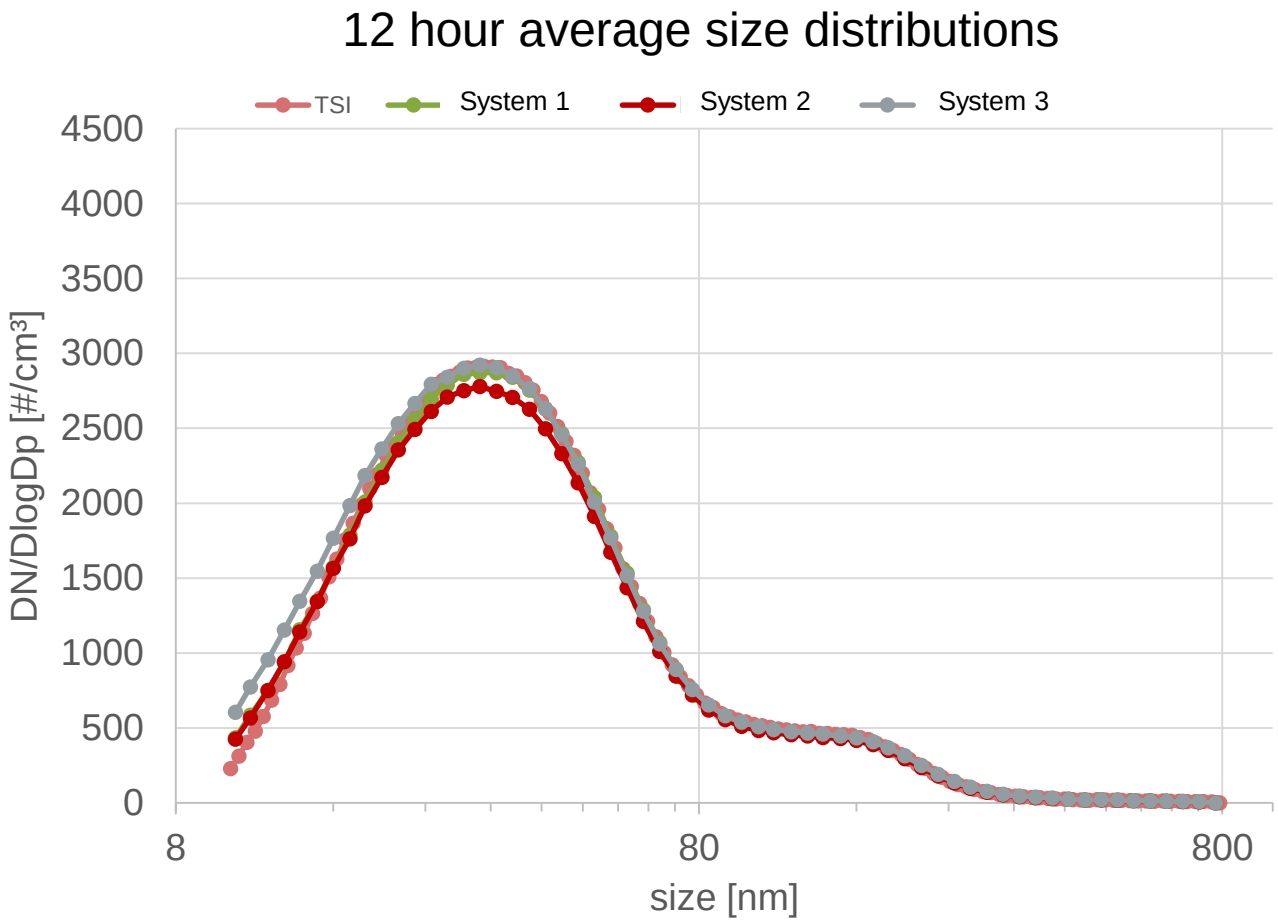
- It matters at which part of the scan a plume occurs
- Averaging multiple Scans does reduce the effect but averages are very sensitive to outliers!



→ Instabilities in the aerosol population can explaind scatter when comparing SMPS and CPC
→ Besides using the CPC only as total number concentration validation it can act as a stability indicator to flag uncertainty of size distributions

Harmonization

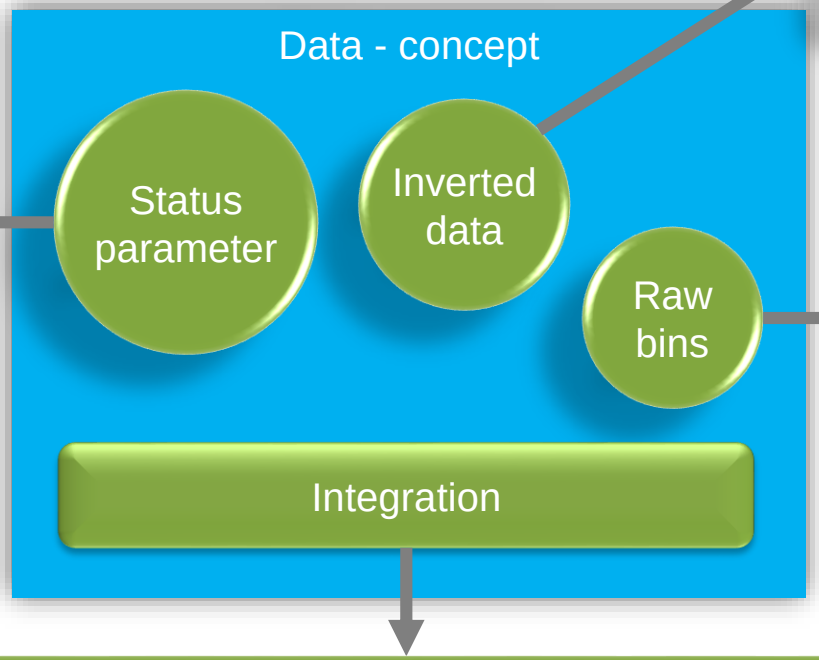
TSI SMPS and CPC are on the ACTRIS white list for instrumentation



Data Handling

- Create your quicklooks
- Get a quick picture of final data

- Check instrument status and act upon warnings before they result in errors
- Quality control / quality assurance for data processing
- Including inlet RH + T



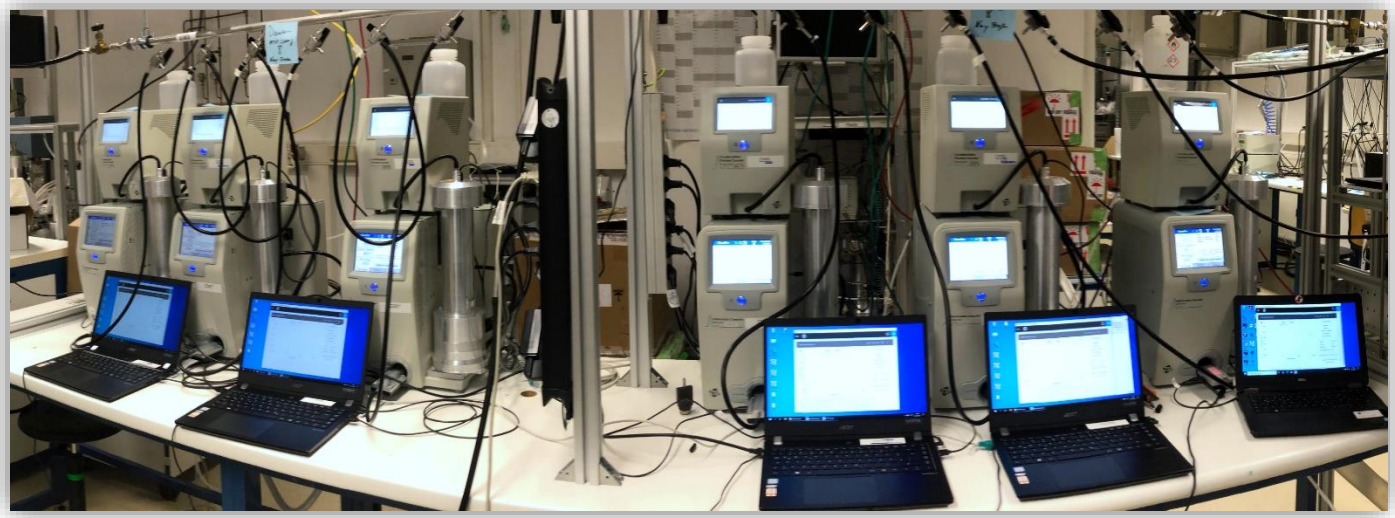
- Deliver your data to EBAS database according to CEN/ACTRIS recommendations
- Allows harmonized post processing

- Is your station following a certain protocol?
- We can make sure TSI data fit into this protocol

Conclusion and Outlook

NOVEL WIDE-RANGE SMPS FROM TSI

- 10-800nm in one single scan
- performance according to CEN/TS 16976:2016 and CEN/TS 17434:2020
- incl. Vienna type DMA based on TROPOS (Winklmayr et al. 1991)
- full RH control for aerosol and sheath air
- Enhanced software version for auto recovery, auto export incl. all status parameters available



THANK YOU

- Customers for valuable feedback and discussions
- Colleagues within TSI who contributed to this project

Let‘s meet today or contact me via

Sebastian.schmitt@tsi.com

→ Happy to meet many GAeF members today

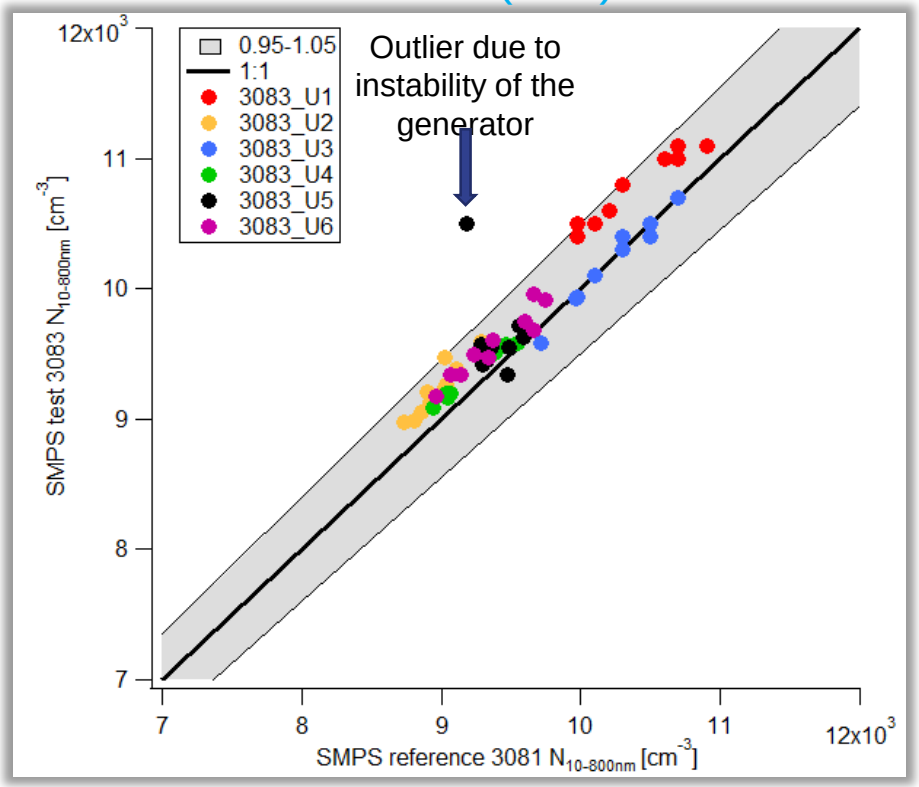
→ No member yet? Don‘t worry just scan QR or visit :

https://www.info.gaef.de/gaef-membership-application

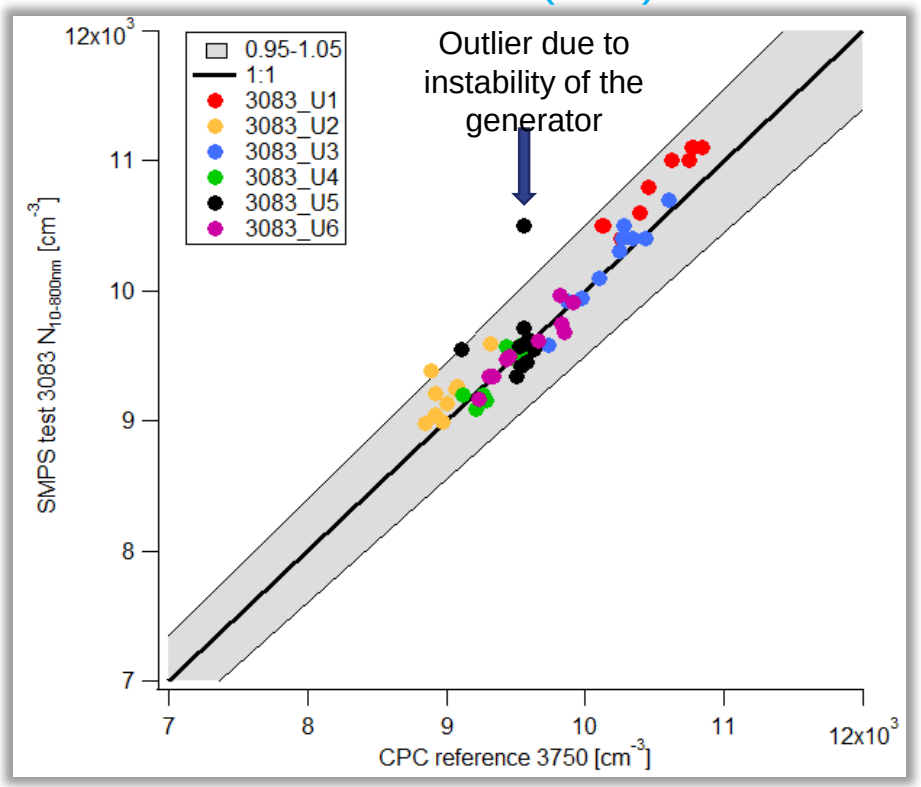
→ Let‘s unite and push all aspects of UFP

Polydisperse Lab Aerosol

Total PN of SMPS (new) vs SMPS



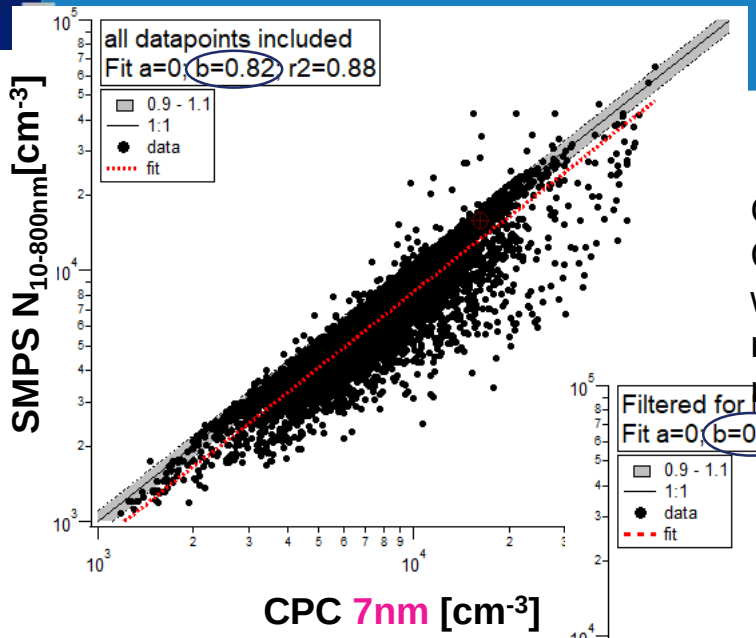
Total PN of SMPS (new) vs CPC



→ Total integrated number concentration **within 5%** of both reference SMPS (incl. 3081) and reference CPC for well-defined lab aerosol!

Ambient Aerosol – Total PN SMPS vs

Skew to CPC>SMPS



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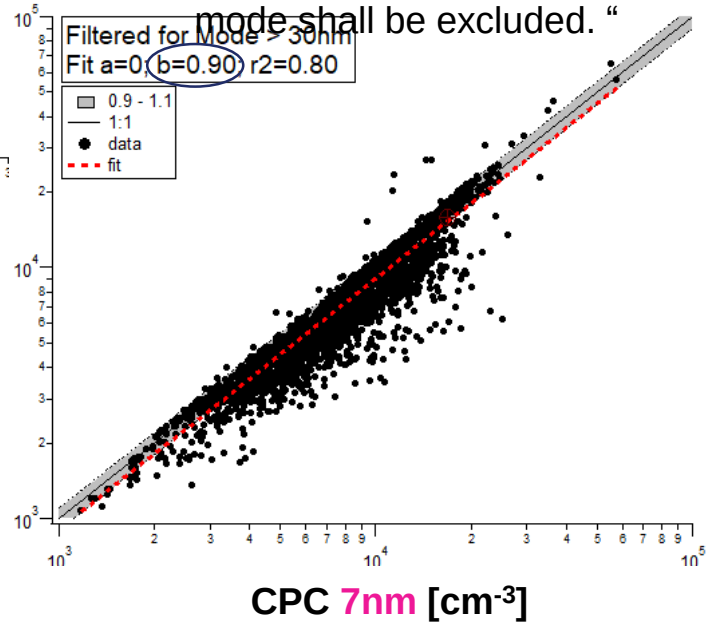
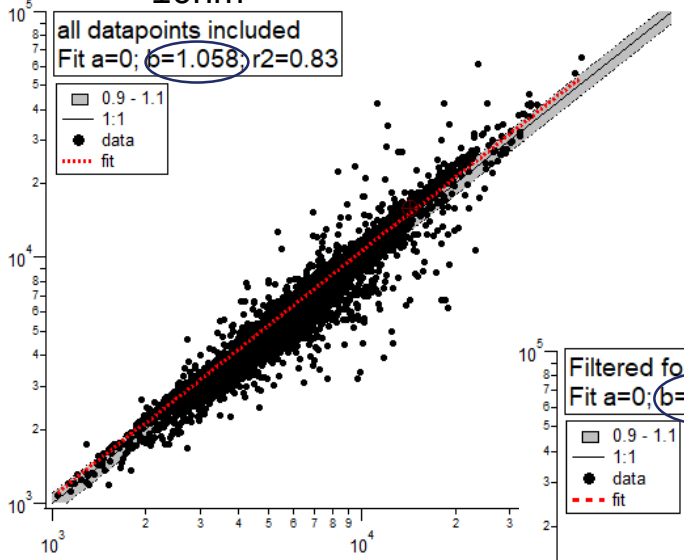


Same size range > 10nm



Outliers due to instability!