Intercomparison of Mobility Particle Size Spectrometers

Project No.: MPSS-2022-WCCAP-111

Principal Investigator: Adam Kristensson

Home Institution: Lund University

Participant: -

Candidate:

Made by:	TROPOS
Counter (SN):	TSI CPC Model 3772, SN: 3772160801 (2016) TSI CPC Model 3756, SN: 3756214301 (2021)
Software:	TROPOS TSMPS 8.0 Total
CPC:	-

Location of the quality assurance: TROPOS Leipzig, lab 118

Comparison period: February 08, 2022 – February 16, 2022

Last Intercomparison (with Project No.): -

Summary of Intercomparison

Status:
The candidate passed the quality standards of ACTRIS and GAW during the intercomparison. The system is within the range of +/-10% of the TROPOS Reference MPSS.

The candidate was in a good status. This instrument is new. It was not necessary to change or repair parts of the inlet, instrument or counter. The zero, high voltage and PSL checks are in the correct range of tolerance.

Information about the instruments:

Date of check: 08.02.2022

List of Components	TROPOS Reference MPSS No.1	Lund Dual-MPSS
Position	-	-
Company	TROPOS	TROPOS
Software	TROPOS	TROPOS
CPC-MPSS	TSI CPC, Model 3750	TSI CPC, Model 3772 TSI CPC Model 3756
CPC-total	TSI CPC, Model 3750	-
flow ratio	1.0 : 5.0	1.0 : 5.0 15:1.5
source	Ni-63	Kr85
HV power supply	positive	Positive
DMA	Hauke medium	Hauke medium Hauke short
aerosol dryer	√	√
aerosol RH- sensor	√	√
aerosol T-sensor	√	√
sheath RH-sensor	√	√
sheath T-sensor	√	√
Sheath dryer	√	√
pressure sensor	√	√

Date of check: 08.02.2022

CPC status	TROPOS-MPSS	TROPOS-total CPC	Lund-UCPC	Lund-CPC
power/status	LED green	LED green	LED blue	LED green
saturator temp	39 °C	39 °C	39.0	39 °C
condenser temp	24.1 °C	23.6 °C	10.0	22.0 °C
optics temp	40 °C	40 °C	40.0	40.0 °C
cabinet temp	24.3 °C	22.7 °C	27.3	35.1 °C
ambient pressure	101.7 kPa	101.9 kPa	102.5 kPa	102.5 kPa
orifice pressure	78.0 kPa	78.3 kPa	54.8 kPa	71.6 kPa
nozzle pressure	2.37 kPa	2.54 kPa	-0.3 kPa	Sensor defect
laser current	39 mA	42 mA	44 mA	39 mA
liquid level	full	full	full	full

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Date of check: 08.02.2022

	TROPOS Reference MPSS		**Lund MPSS**	
date	**pre- status**	**final- status**	**pre- status**	**final- status**
aerosol flow (total)	-	0.98 l/min	-	0.97 l/min
zero	-	0 #/cm³	-	0 #/cm³
HV – 0 V	-	0 V	-	0 V
HV – 4 mV	-	4.91 V	-	5.1 V
HV – 80 mV	-	99.9 V	-	99.7 V
HV – 800 mV	-	999.9 V	-	1000.1 V
	Lund nano MPSS			
date	**pre- status**	**final- status**		
aerosol flow (total)	-	1.514 l/min		
zero	-	0 #/cm³		
HV – 0 V	-	5.3 V		
HV – 15 mV	-	17.5 V		
HV – 50 mV	-	99.7 V		
HV – 100 mV	-	35.1 V		
HV – 1000 mV	-	350.3 V		

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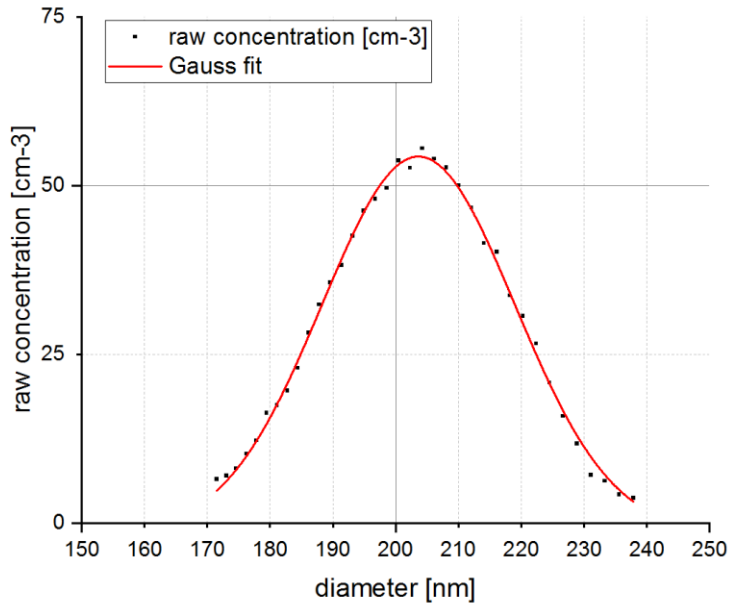

Figure 01: Measurement of latex 203 nm Lund MPSS: Raw particle number size distribution of latex 203 nm on February 8th 2022. The peak shows at 203.6nm.

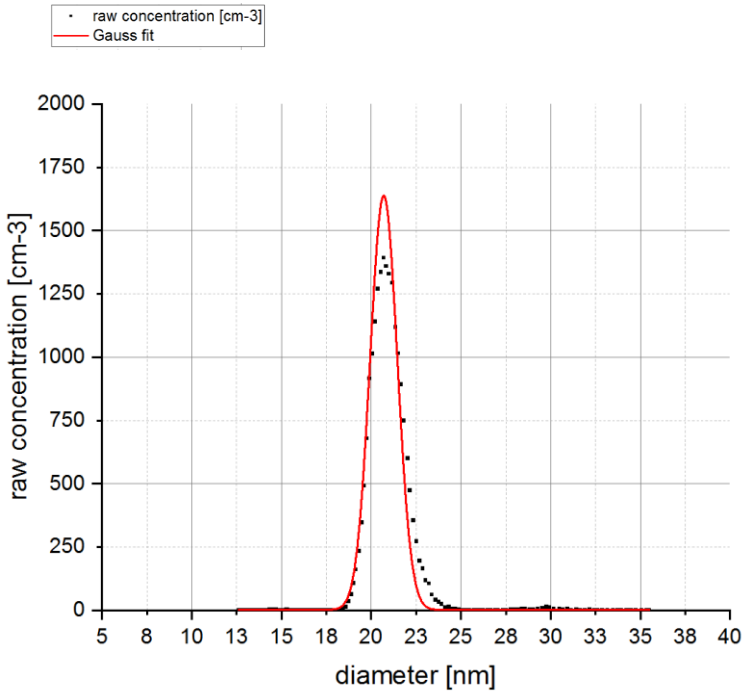

Figure 02: Measurement of 20 nm silver particles with the Lund Nano-MPSS: Particle size distribution on February 8th 2022. The peak shows at 20.7 nm.

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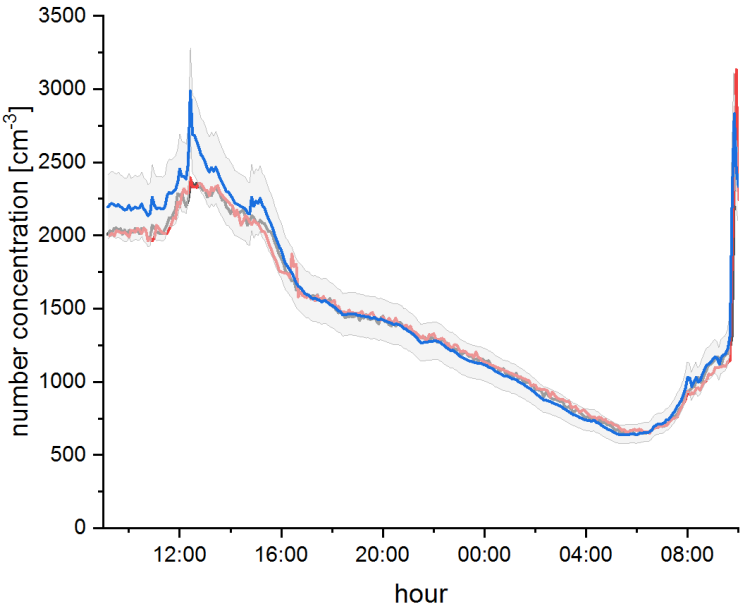

Figure 03: Time series (8.02.2022 09:00 AM – 9.02.2022 09:00 AM) of the integrated particle number concentration ($N_{10\text{-}800}$) of the MPSS of the Lund Dual-MPSS system (red), integral particle number concentration ($N_{10\text{-}800}$) of the Reference MPSS 1 (black) and number concentration measured by the total CPC 3750 SN 3750200901 (blue). The gray shaded area represents +-10 of the number concentration measured by the total CPC. Multiple charge correction, internal diffusion losses, CPC flow corrections.

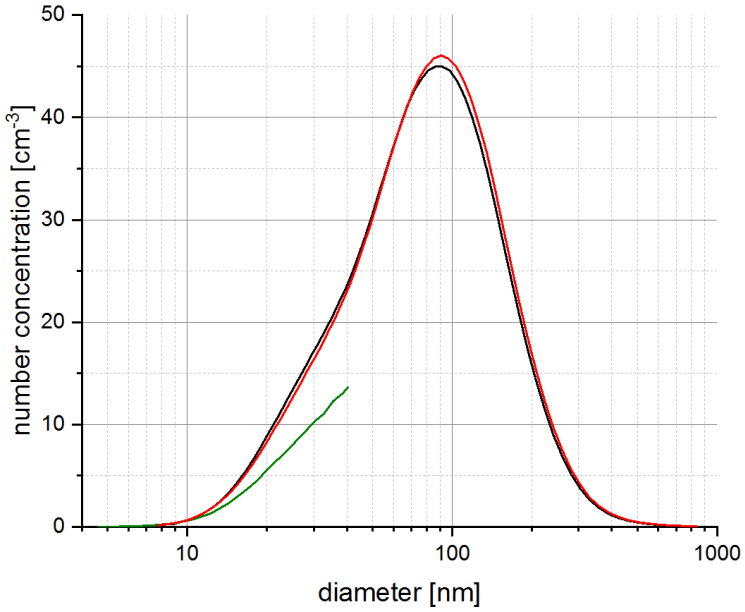

Figure 04: Raw particle number size distribution for TROPOS Reference MPSS No.1 (black) and Lund Dual-MPSS (green: Nano-MPSS; red: MPSS). Raw data from the instruments without any correction applied.

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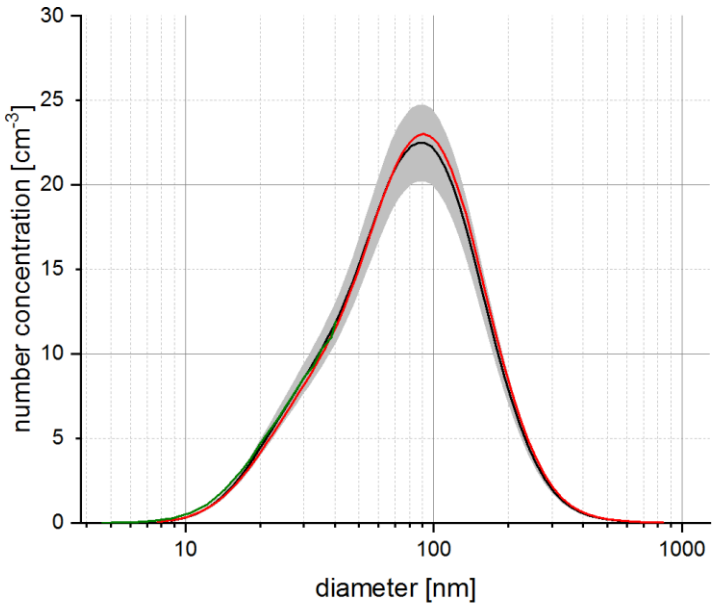

Figure 05: Raw particle number size distribution for TROPOS Reference MPSS No.1 (black) and Lund Dual-MPSS (green: Nano-MPSS; red: MPSS). The shaded area represents the 10% error margin of the TROPOS Reference MPSS No.1. Transfer function correction applied for the different aerosol to sheath air ratios (Nano-MPSS 1.5:15 and MPSS 1:5) resulting in a reduction of the MPSS concentrations by a factor of 2. The raw concentration of the Nano-MPSS has been adjusted to the MPSS at 40 nm. This is necessary due to uncertainty of the nominal flow rate of the UCPC of 50 cc/min (+- 20%).

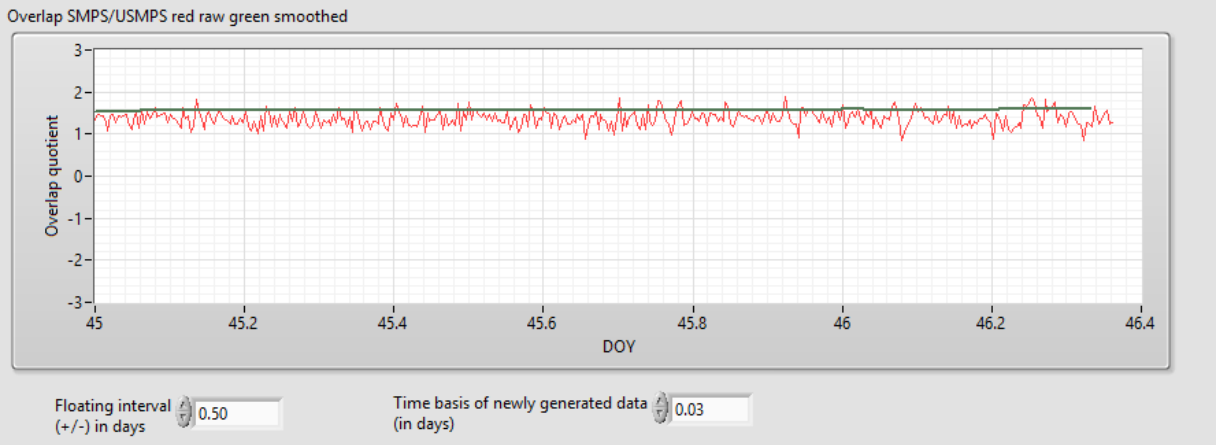

Figure 06: Time series of the overlap correction applied to the UCPC of the Lund Nano-MPSS in figure 5.

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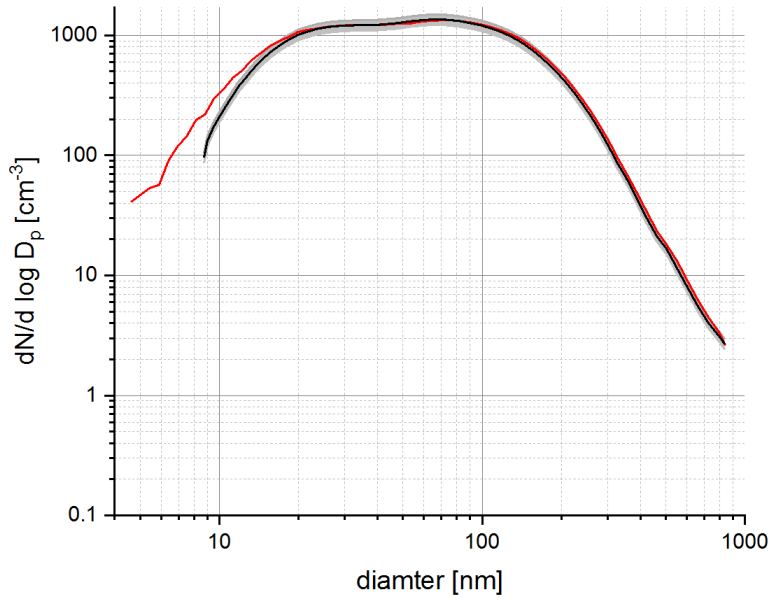

Figure 07: Inverted particle number size distributions (8.2.2022 – 9.2.2022) for the TROPOS reference MPSS 1 (black) and the Lund Dual-MPSS system (red). The shaded area represents the 10% error margin of the TROPOS Reference MPSS No.1. Flow corrections, multiple charge correction and diffusion loss corrections are included.

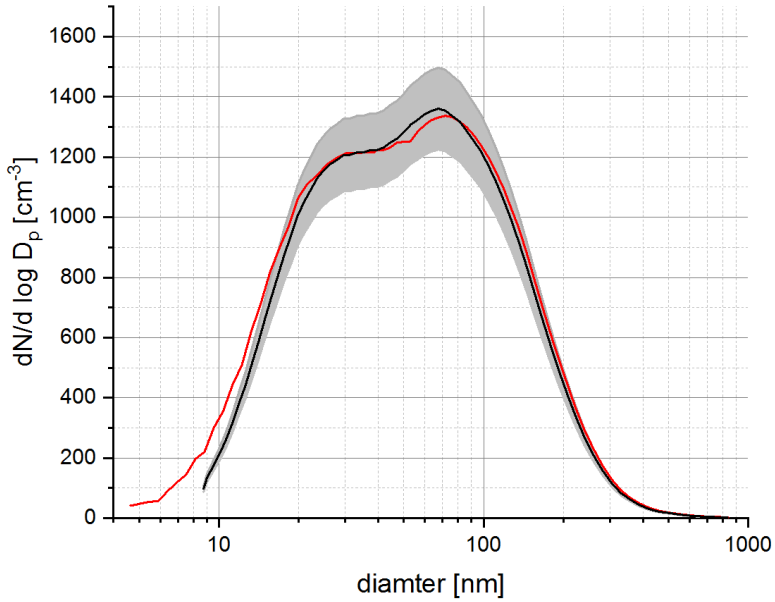

Figure 08: Inverted particle number size distributions (8.2.2022 – 9.2.2022) for the TROPOS reference MPSS 1 (black) and the Lund Dual-MPSS system (red). The shaded area represents the 10% error margin of the TROPOS Reference MPSS No.1. Flow corrections, multiple charge correction and diffusion loss corrections are included. Same as figure 06 with linear y-axis.

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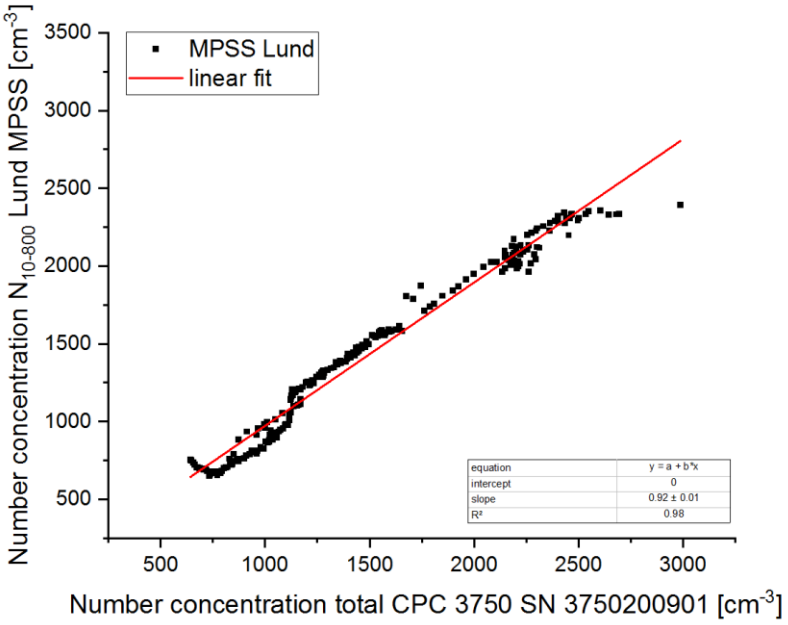

Figure 09: Correlation of the integrated particle number concentration $N_{10\text{-}800}$ of the MPSS of the Lund Dual-MPSS and the number concentration measured by the total CPC 3750 SN 3750200901.

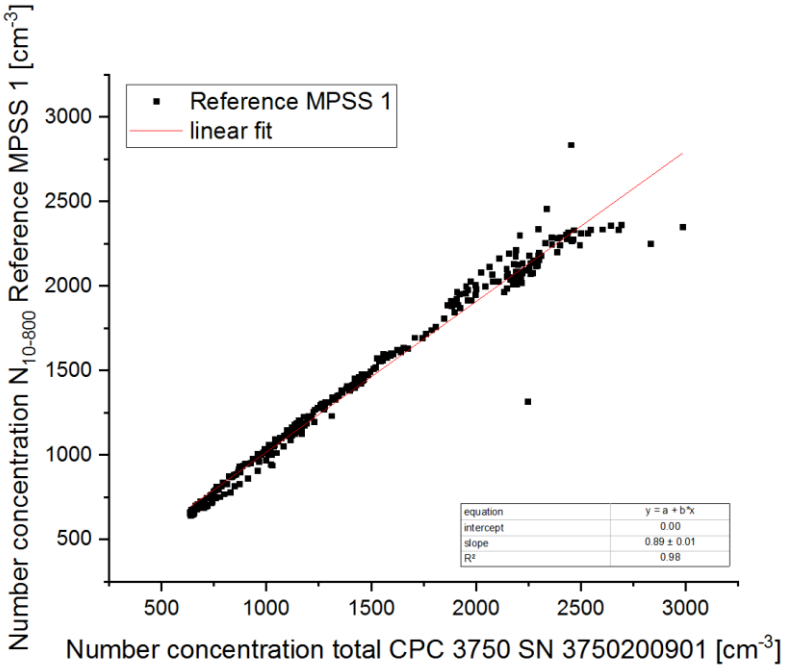

Figure 10: Correlation of the integrated particle number concentration $N_{10\text{-}800}$ of the Reference MPSS 1 and the number concentration measured by the total CPC 3750 SN 3750200901.

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