Intercomparison of Mobility Particle Size Spectrometers

Project No.:	*MPSS-2018-3-1*
Principal Investigator:	Markus Wallasch
Home Institution:	*Umweltbundesamt*
Participant:	
Candidate:	**Waldhof**
Made by:	**TROPOS**
Counter (SN):	**TSI 3772 SN: 3772164503**
Software:	**TROPOS Software V6.68**
Location of the quality assurance:	TROPOS Leipzig, lab 118
Comparison period:	April 23, 2018 – April 27, 2018
Last Intercomparison (with Project No.):	

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Summary of Intercomparison:

Pre-Status:
The instrument arrived with participant. The instrument was running with the TROPOS Software Version 6.68. During the Pre-Status, the candidate showed a concentration of 7% below the TROPOS Reference MPSS No.6. The PSL check showed a peak at 202.76 nm. The high voltage power supply showed 50 volt offset. It was necessary to check the whole electronic including DMA, sensors and connections. It was necessary to change the high voltage power supply and NI-card, because of instability.

Final-Status:
During the Final-Status, the performance of the system showed a concentration 2% below the TROPOS Reference Instrument No.1. The candidate passed the quality standards of ACTRIS and GAW.

Information about the instruments:

Date of check: April 20, 2018

List of Components	TROPOS Reference MPSS No.6	TROPOS Reference MPSS No.5	Candidate
Position	Line 2.5	Line 1.5	Line 2.4
Company	TROPOS	TROPOS	TROPOS
Software	TROPOS V6.68	TROPOS V6.68	TROPOS V6.68
CPC-MPSS	TSI CPC, Model 3772	TSI CPC, Model 3010	TSI CPC, Model 3772
CPC-total	TSI CPC, Model 3010	TSI CPC, Model 3772	-
flow ratio	1.0 : 5.0	1.0 : 5.0	1.0 : 5.0
source	Ni.63	Kr.85	Kr.85
HV power supply	Positive	Positive	Positive
DMA	Hauke medium	Hauke medium	Hauke medium
aerosol dryer	✓	✓	✓
aerosol RH- sensor	✓	✓	✓
aerosol T-sensor	✓	✓	✓
sheath RH-sensor	✓	✓	✓
sheath T-sensor	✓	✓	✓
Sheath dryer	✓	✓	✓
pressure sensor	✓	✓	✓
info			

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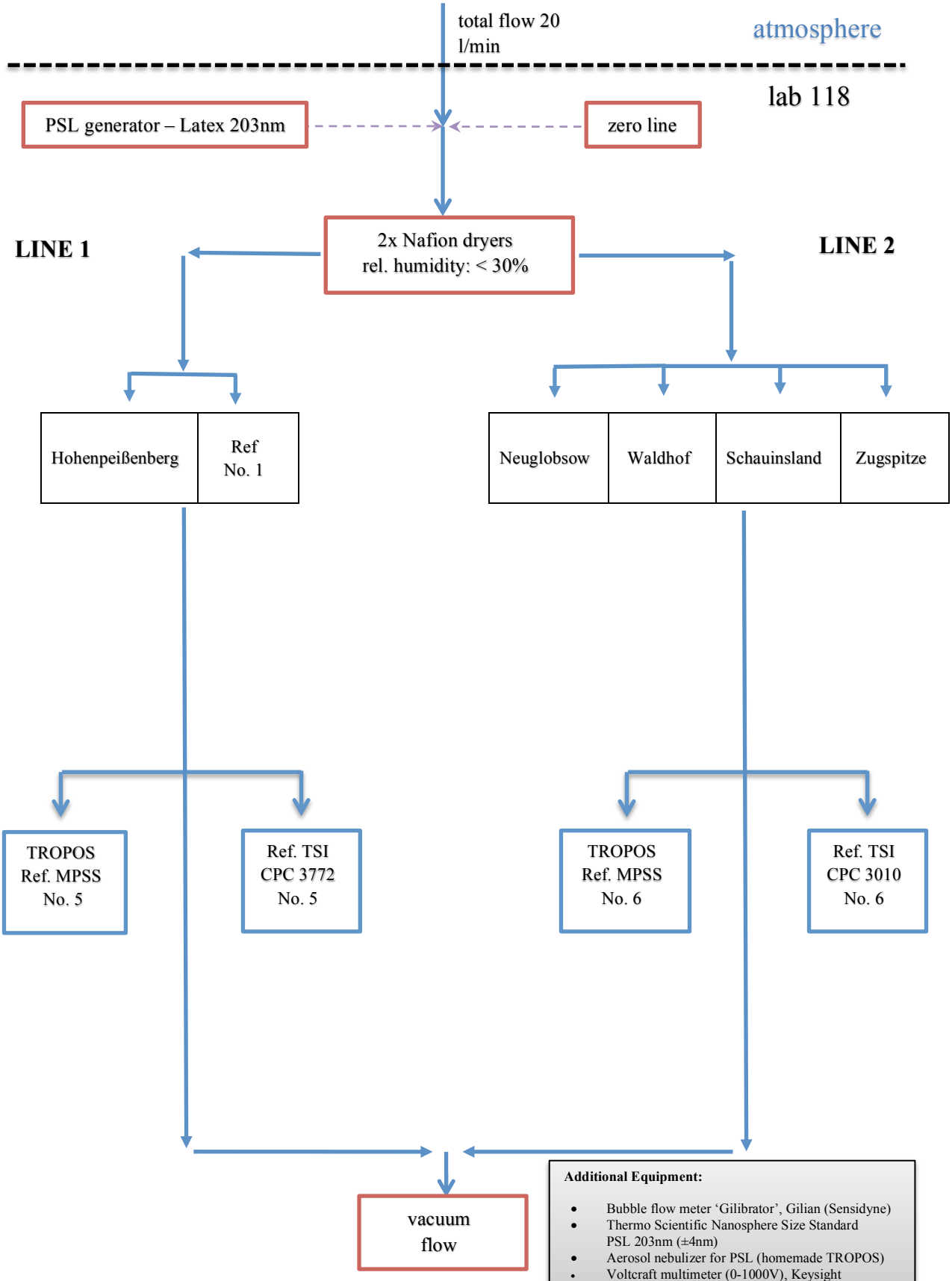
Laboratory setup:



Additional Equipment:

- Bubble flow meter 'Gilibrator', Gilian (Sensidyne)
- Thermo Scientific Nanosphere Size Standard PSL 203nm (±4nm)
- Aerosol nebulizer for PSL (homemade TROPOS)
- Voltcraft multimeter (0-1000V), Keysight Technologies

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Status of the instruments:

Date of system checks:

date	20.04.2018	09.05.2018	unit
total CPC flow	-	-	l/min
aerosol flow (DMA)	0.946	0.986	l/min
aerosol flow (UDMA)	-	-	l/min
aerosol flow (total)	0.946	0.986	l/min
Zero MPSS	0	0	#/cm³
Zero total CPC	-	-	#/cm³
PSL 203 nm	202.76	204.58	nm

date	*HV check*	
	DMA HV in mV	***Voltmeter Reading in V***
20.04.2018	0	0.1
	4	5.1
	200	250.0
	800	1000.0
09.05.2018	0	0.1
	4	4.9
	200	249.7
	800	1000.0

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Special Information regarding the Candidate:

Was it necessary to:	yes/no (date)	old part (ID/SN)	new part (ID/SN)	information
clean the aerosol inlet	Yes	-	-	checked
change aerosol Nafion dryer	Yes	MT010214-07-16	MT072717-17-09	checked Leak Test ✓ RH Test ×
change sheath Nafion dryer	Yes	ND0.7-206	ND0.7-187e	checked Leak Test ✓ RH Test ×
check source	Yes	-	-	checked 52nsV/h
change HV power supply	Yes	-	-	50V offset and instability
clean/change DMA	Yes	-	-	checked and cleaned
change aerosol RH/T-sensor	No	-	-	checked
change sheath RH/T-sensor	No	-	-	checked
change pressure sensor	No	-	-	checked
change inlet Nafion dryer (500)	No	-	-	-
Change Total filter	-	-	-	-
NI-card	Yes			checked

PSL Scan and calibration: Latex 203 nm +/- 4 nm

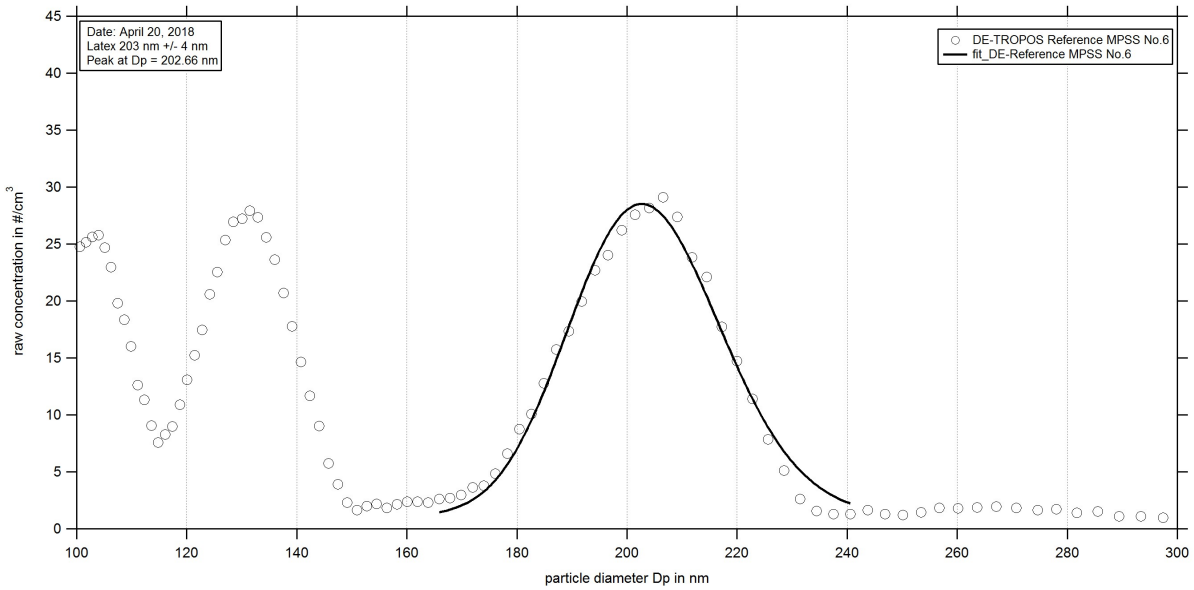

Figure 01: Measurement of latex 203 nm: Particle size distribution (raw concentration) for latex 203 nm on April 20th, 2018.

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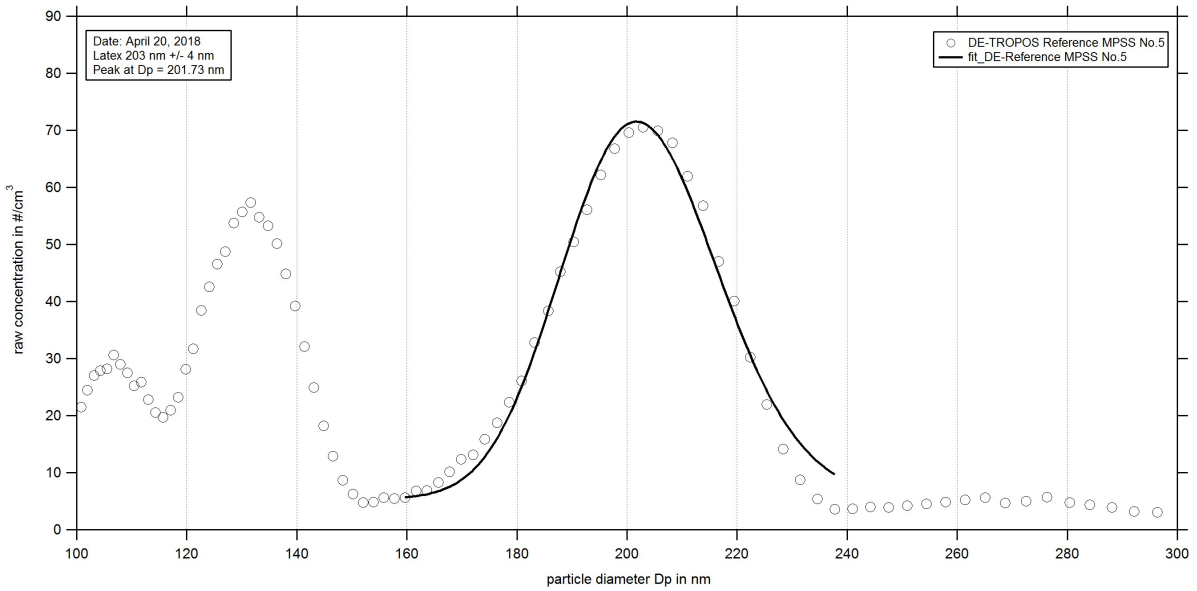

Figure 02: Measurement of latex 203 nm: Particle size distribution (raw concentration) for latex 203 nm on April 20th, 2018.

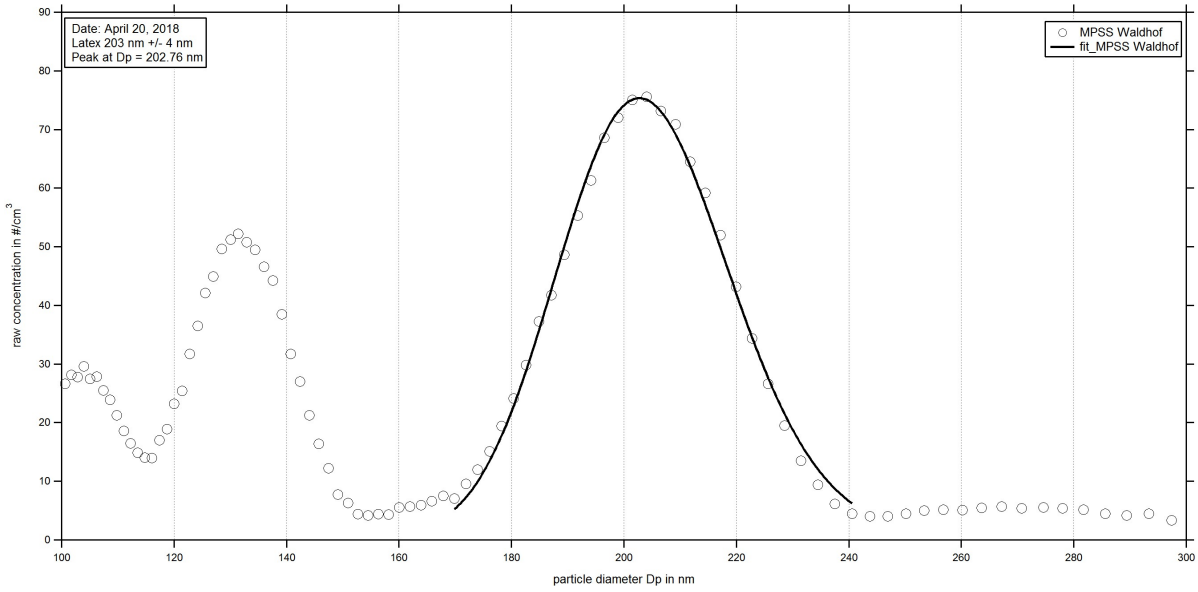

Figure 03: Measurement of latex 203 nm: Particle size distribution (raw concentration) for latex 203 nm on April 20th, 2018.

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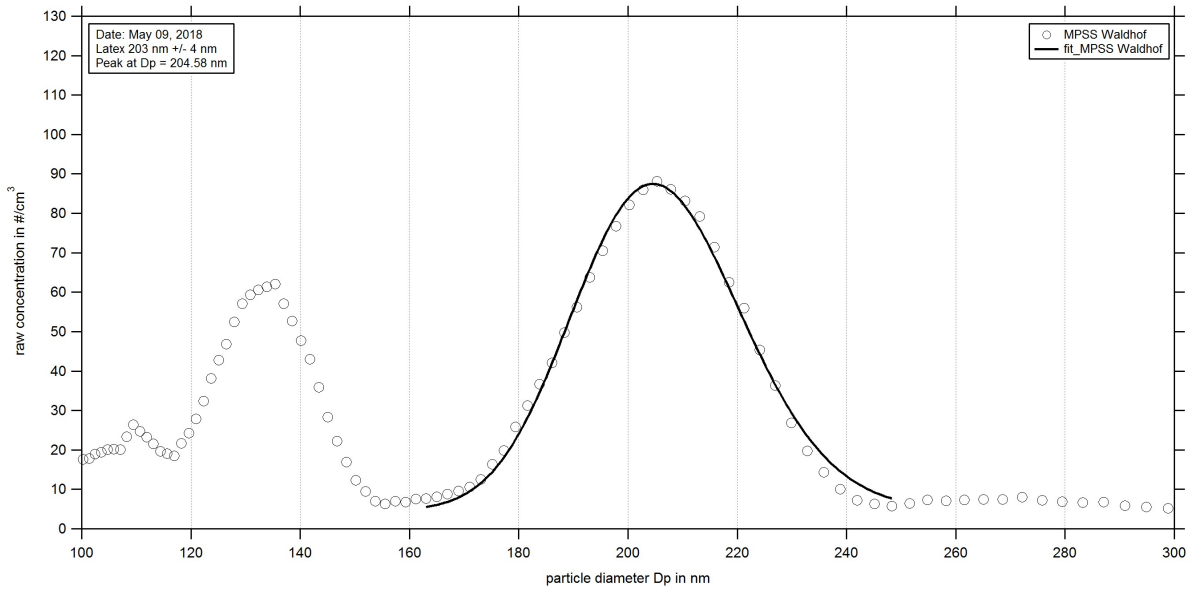

Figure 04: Measurement of latex 203 nm: Particle size distribution (raw concentration) for latex 203 nm on May 09th, 2018.

TROPOS Reference Instruments: Time Series, Correlation and Particle Number Size Distribution

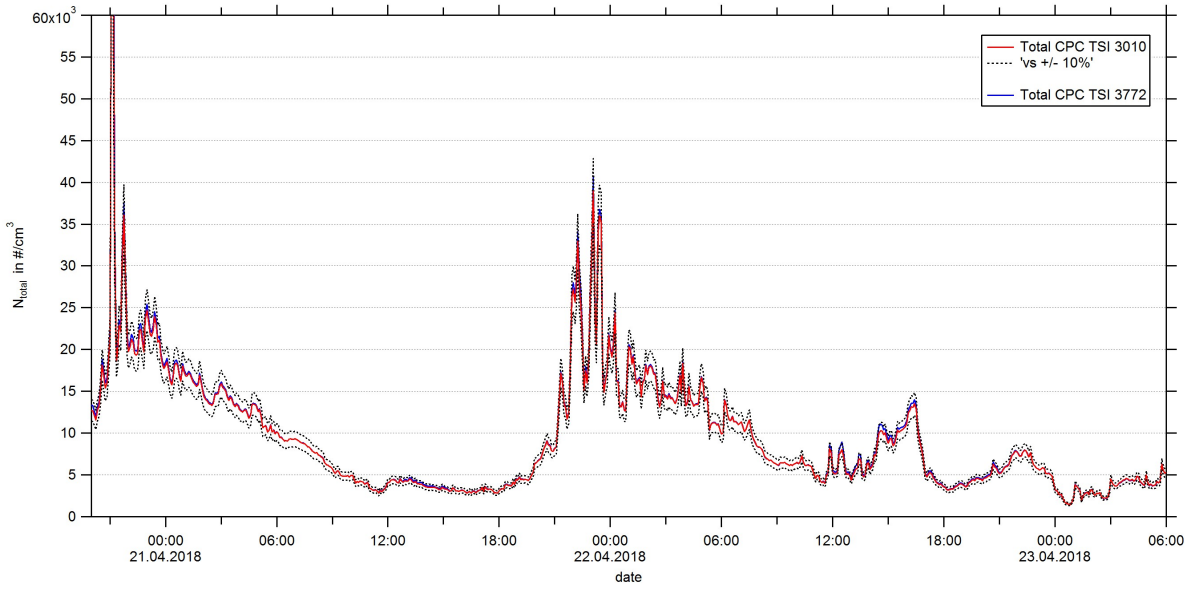

Figure 05: Time series (April 20, 2018 20:00 – April 23, 2018 06:00) of the total number concentration (N_{total}) of the Reference TSI-CPC Model 3010 and TSI-CPC Model 3772. Multiple charge correction, internal diffusion losses and CPC flow corrections are included.

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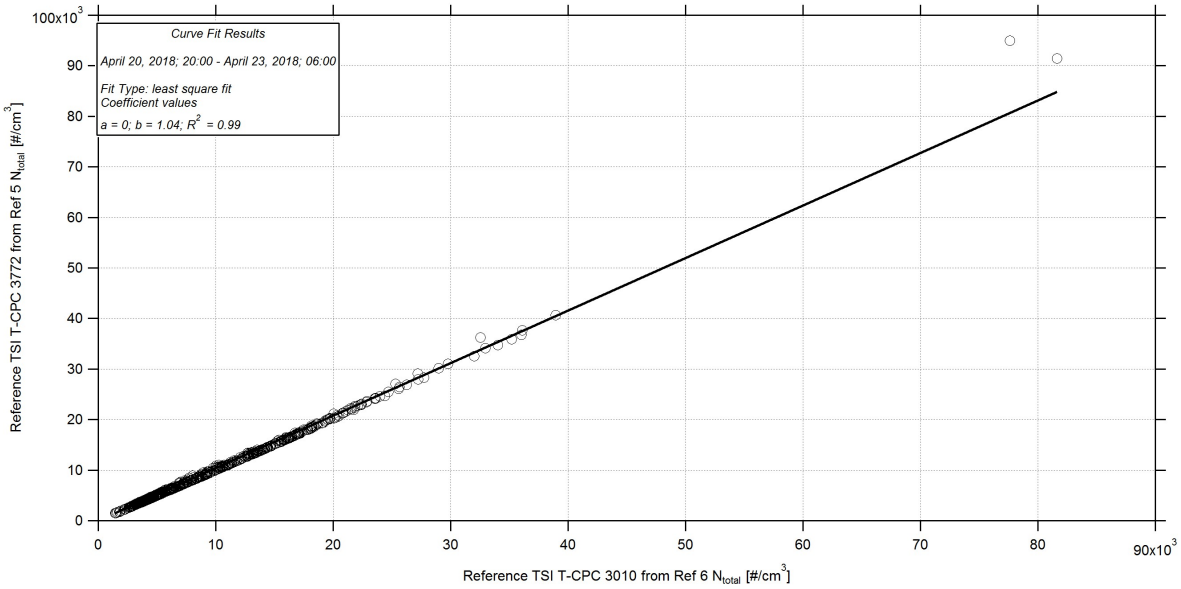

Figure 06: Linear regression between the number concentrations of the TROPOS Reference TSI CPC Model 3010 Ref 6 and TROPOS Reference TSI CPC Model 3772 Ref 5. Multiple charge correction, internal diffusion losses and CPC efficiency are included.

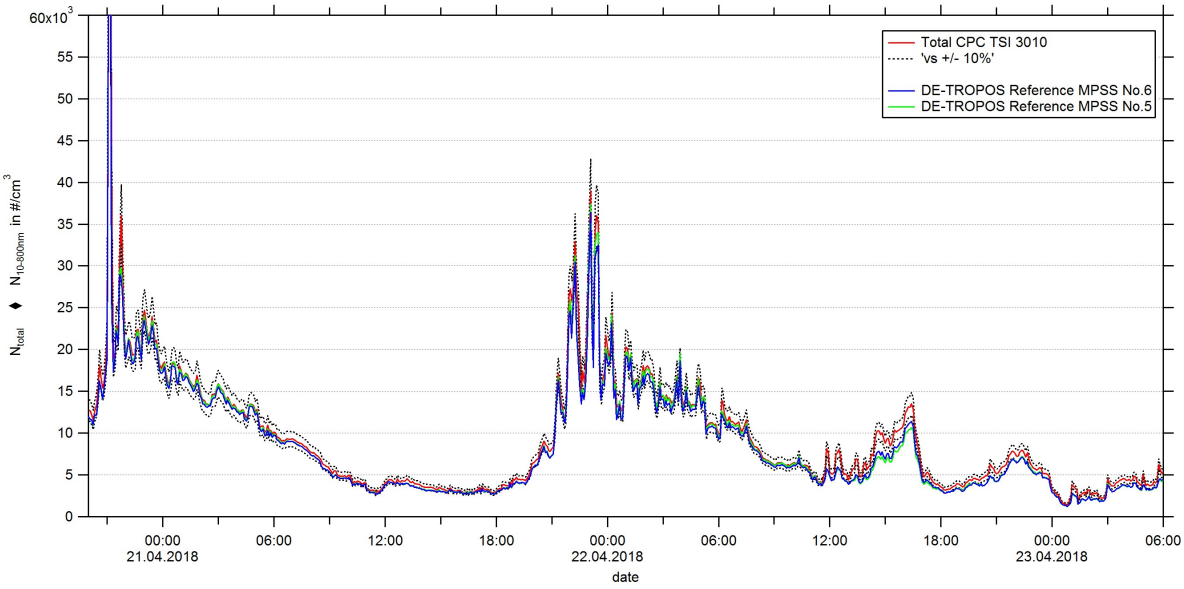

Figure 07: Time series (April 20, 2018 20:00 – April 23, 2018 06:00) of the integrated particle number concentration ($N_{10\text{-}800nm}$) of the MPSS and total number concentration (N_{total}) of the Reference TSI-CPC Model 3010. Multiple charge correction, internal diffusion losses and CPC flow corrections are included.

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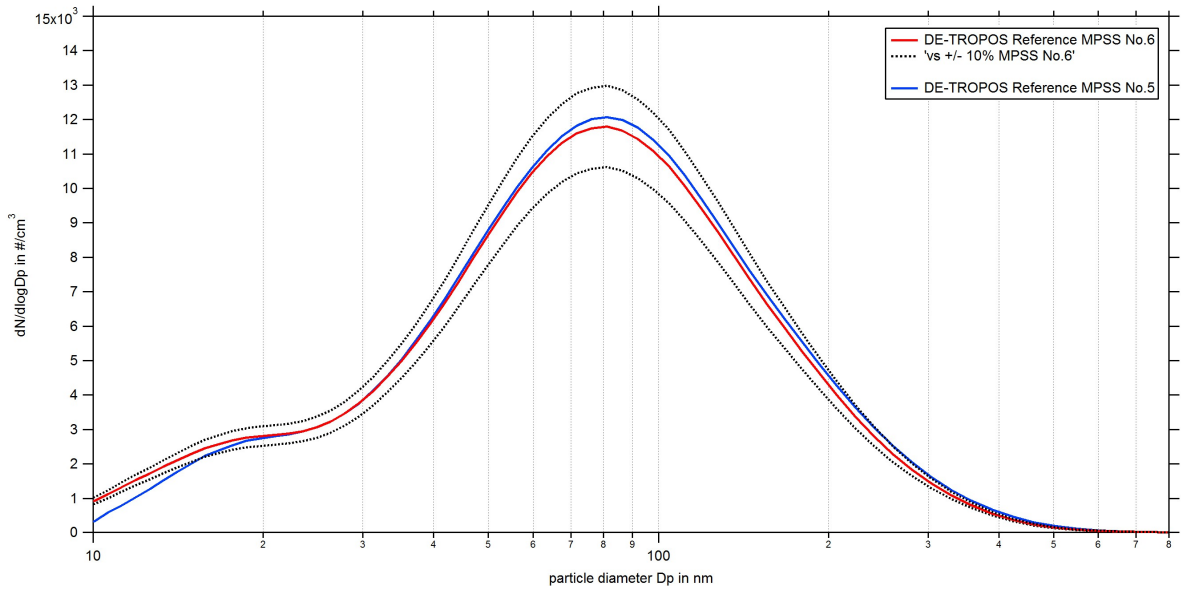

Figure 08: Comparison of mean particle number size distribution of TROPOS Reference MPSS No.6 against TROPOS Reference MPSS No.5 from April 20, 2018 20:00 – April 23, 2018 06:00. Multiple charge correction, internal diffusion losses and CPC efficiency are included.

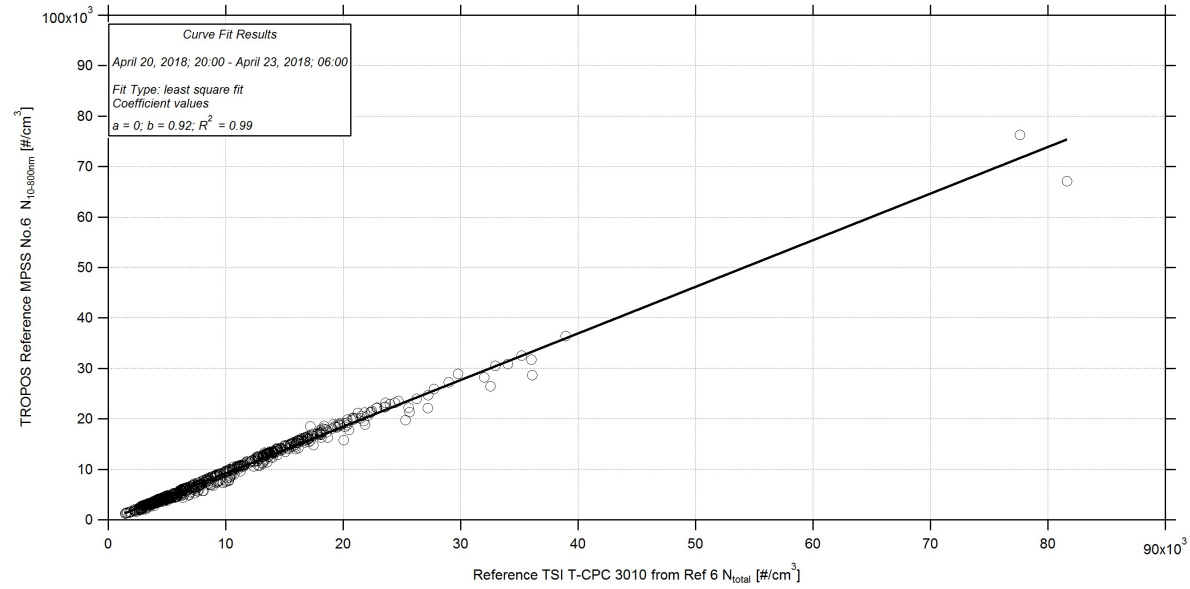

Figure 09: Linear regression between the number concentrations of the TROPOS Reference TSI CPC Model 3010 Ref 6 and TROPOS Reference MPSS No.6. Multiple charge correction, internal diffusion losses and CPC efficiency are included.

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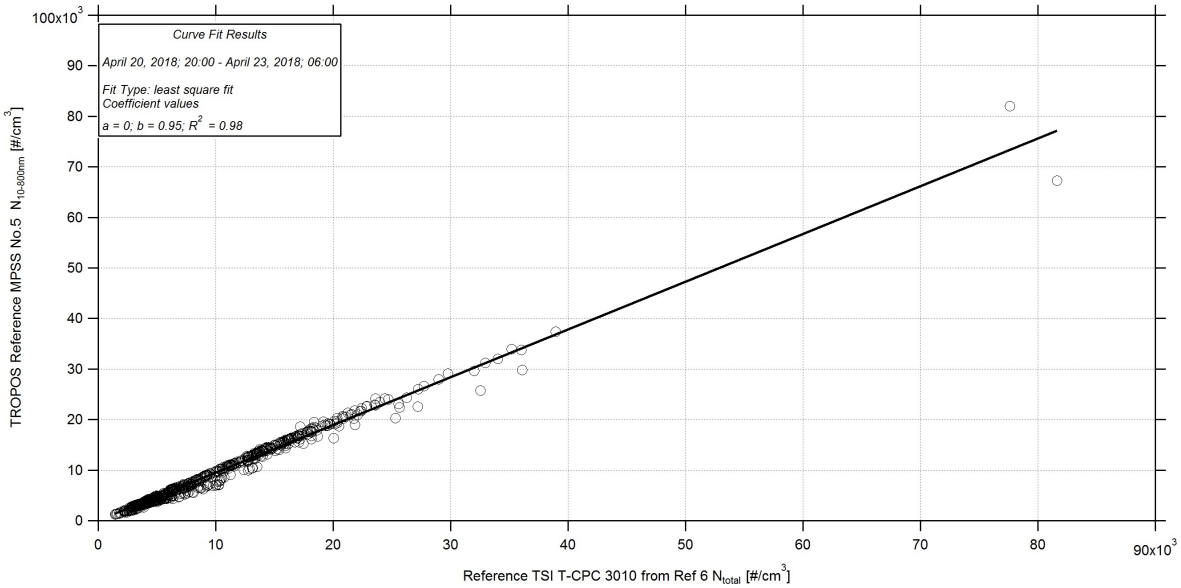

Figure 10: Linear regression between the number concentrations of the TROPOS Reference TSI CPC Model 3010 Ref 6 and TROPOS Reference MPSS No.5. Multiple charge correction, internal diffusion losses and CPC efficiency are included.

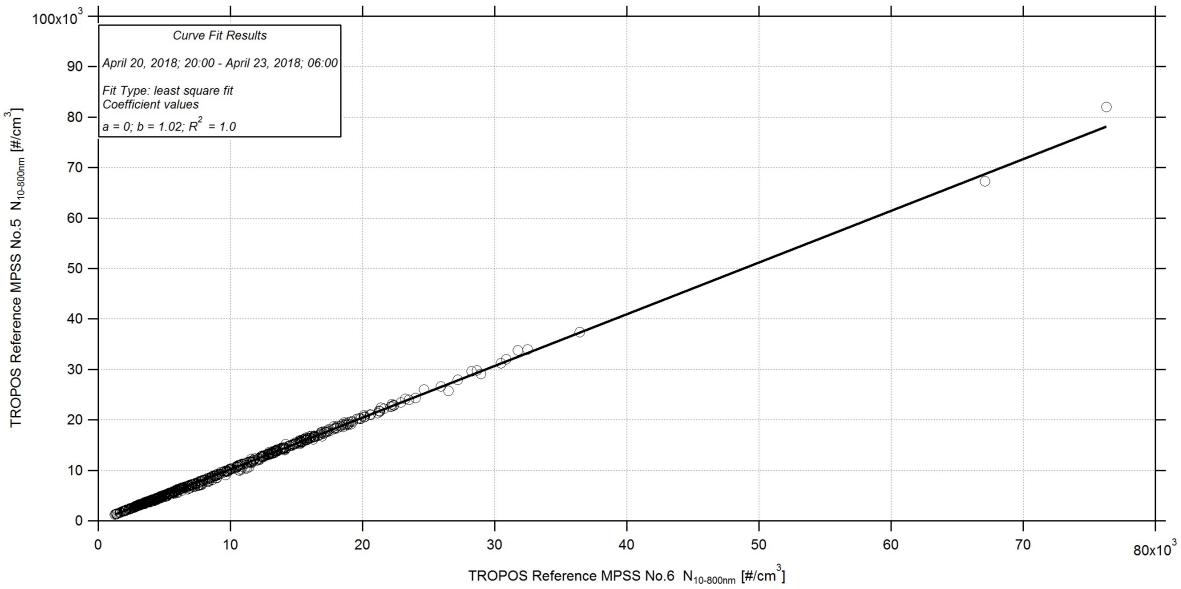

Figure 11: Linear regression between the number concentrations of the TROPOS Reference MPSS No.6 and TROPOS Reference MPSS No.5. Multiple charge correction, internal diffusion losses and CPC efficiency are included.

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Pre-Status of the Candidate: Particle Number Size Distribution

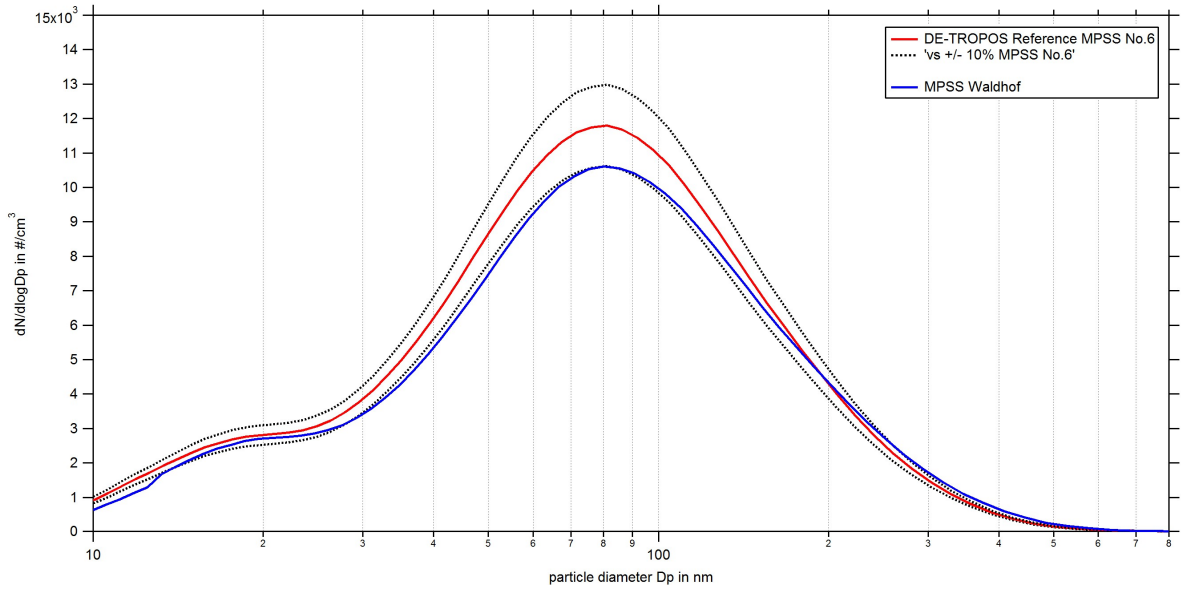

Figure 12: Comparison of mean particle number size distribution of TROPOS Reference MPSS No.6 against MPSS Waldhof from April 20, 2018 20:00 – April 23, 2018 06:00. Multiple charge correction, internal diffusion losses and CPC efficiency are included.

Pre-Status of the Candidate: Time Series and Correlation

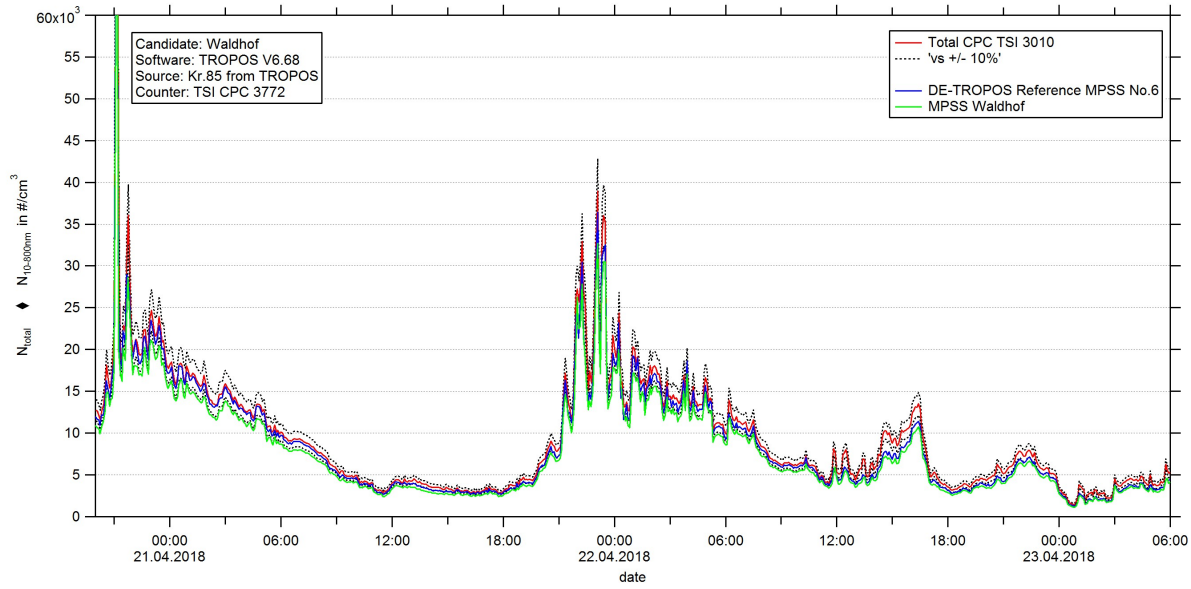

Figure 13: Time series (April 20, 2018 20:00 – April 23, 2018 06:00) of the integrated particle number concentration ($N_{10\text{-}800nm}$) of the MPSS and total number concentration (N_{total}) of the Reference TSI-CPC Model 3010. The inversion and corrections for the candidate were performed using TROPOS software. Multiple charge correction, internal diffusion losses and CPC flow corrections are included.

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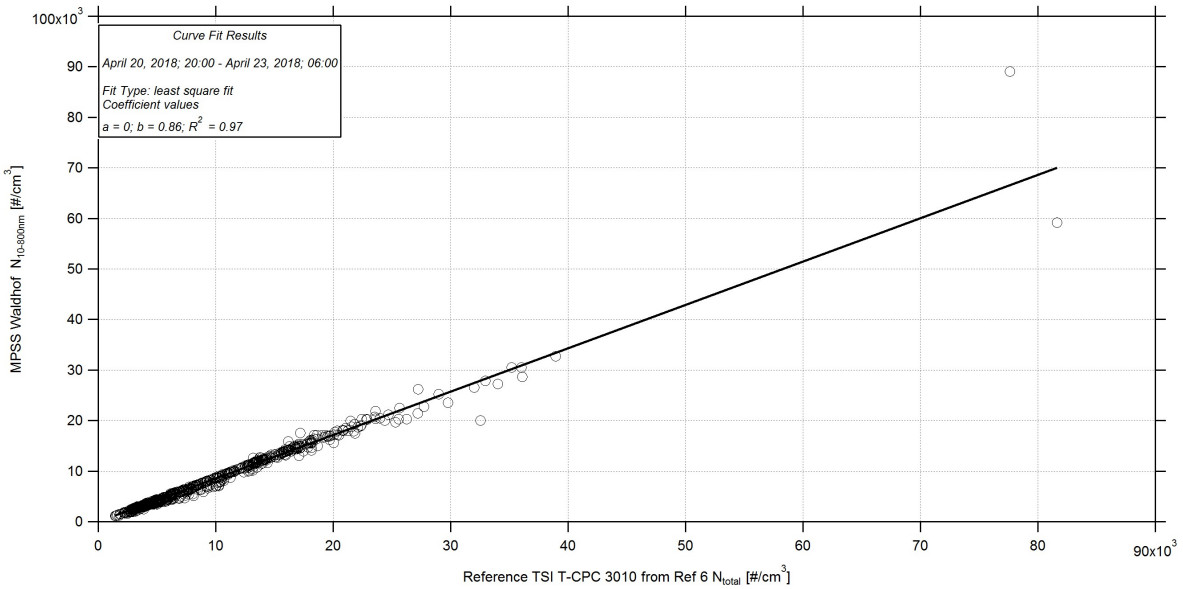

Figure 14: Linear regression between the number concentrations of the TROPOS Reference TSI CPC Model 3010 Ref 6 and MPSS Waldhof. The inversion and corrections for the candidate were performed using TROPOS software. Multiple charge correction, internal diffusion losses and CPC flow corrections are included.

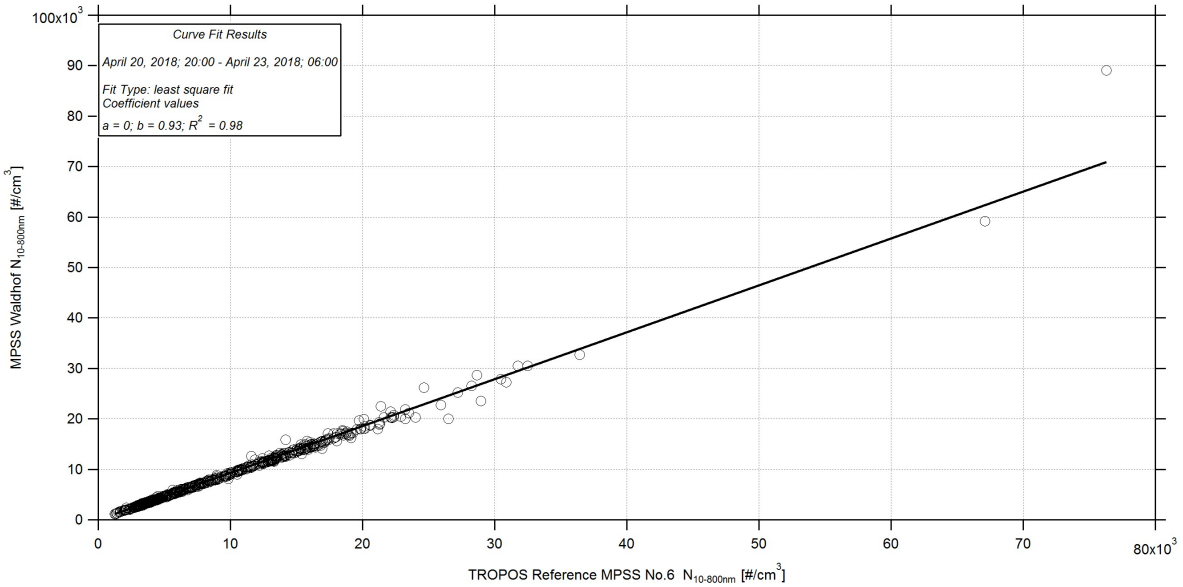

Figure 15: Linear regression between the number concentrations of the TROPOS Reference MPSS No.6 and MPSS Waldhof. The inversion and corrections for the candidate were performed using TROPOS software. Multiple charge correction, internal diffusion losses and CPC flow corrections are included.

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Final-Status of the Candidate: Particle Number Size Distribution

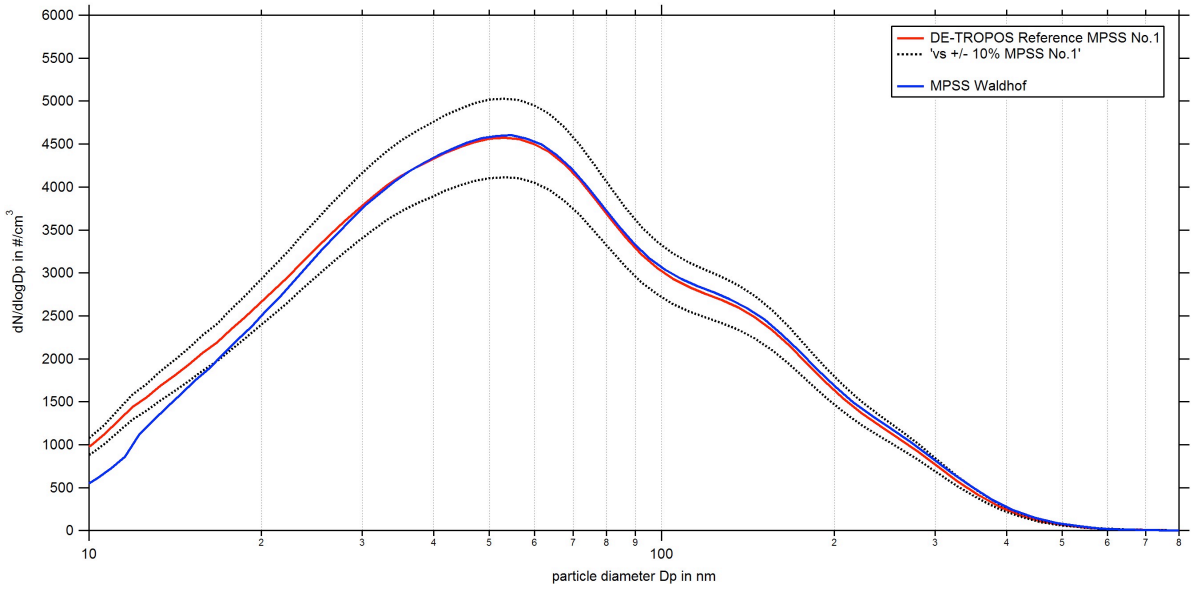

Figure 16: Comparison of mean particle number size distribution of TROPOS Reference MPSS No.1 against MPSS Waldhof from May 11, 2018 20:00 – May 22, 2018 06:00. Multiple charge correction, internal diffusion losses and CPC efficiency are included.

Final-Status of the Candidate: Time Series and Correlation

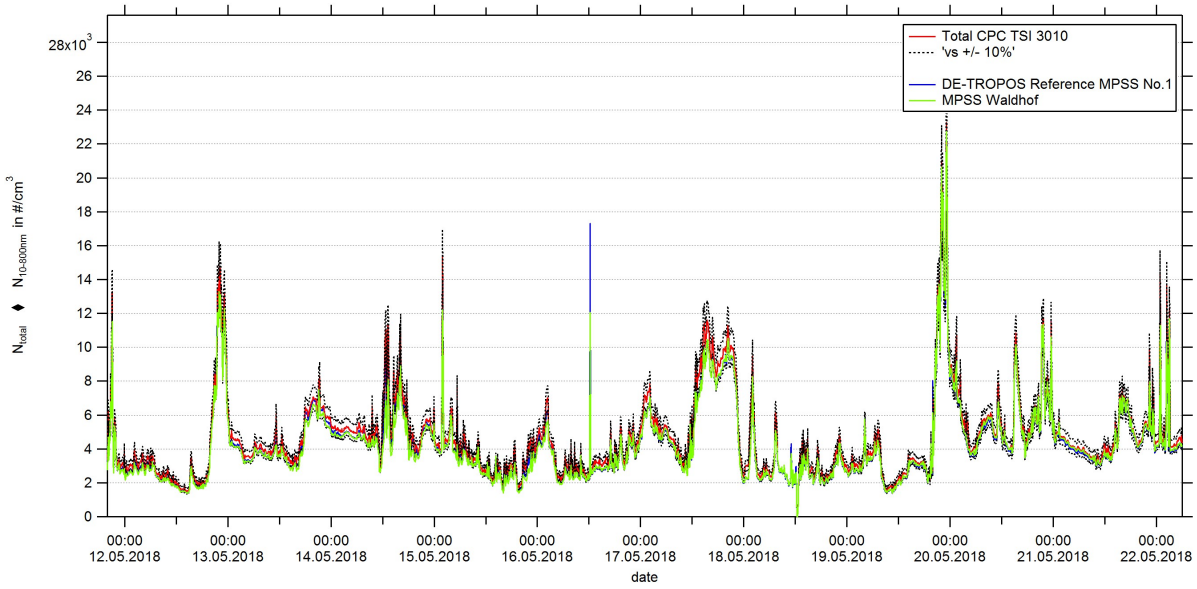

Figure 17: Time series (May 11, 2018 20:00 – May 22, 2018 06:00) of the integrated particle number concentration ($N_{10\text{-}800nm}$) of the MPSS and total number concentration (N_{total}) of the Reference TSI-CPC Model 3010. The inversion and correction for the candidate were performed using TROPOS software. Multiple charge correction, internal diffusion losses and CPC flow corrections are included.

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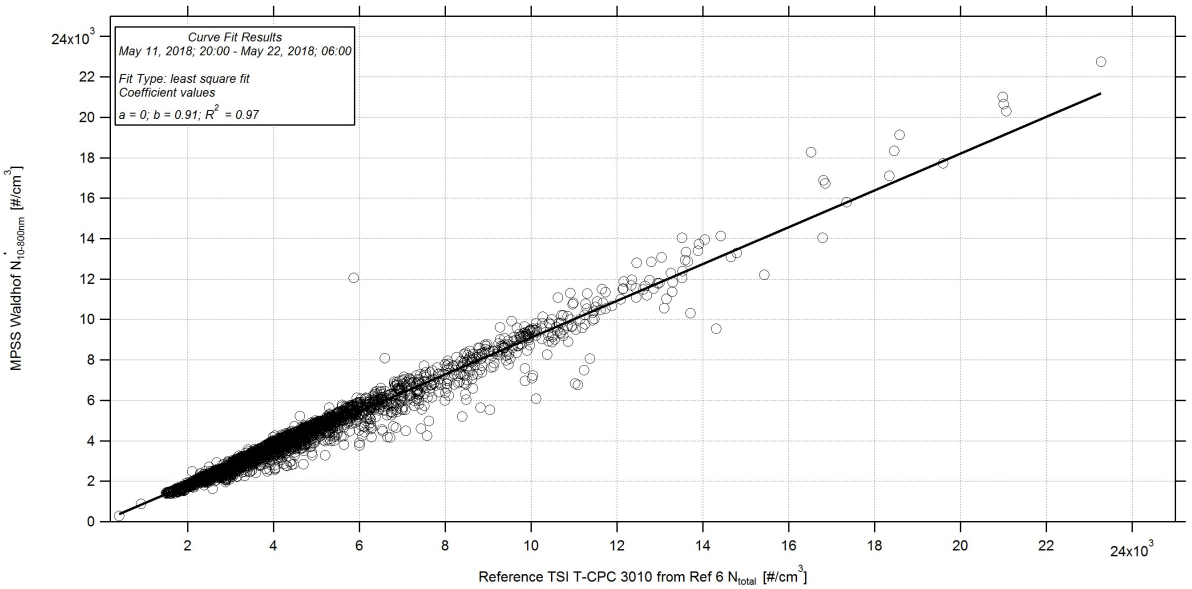

Figure 18: Linear regression between the number concentrations of the TROPOS Reference TSI CPC Model 3010 Ref 6 and MPSS Waldhof (May 11, 2018 20:00 – May 22, 2018 06:00). All corrections are included.

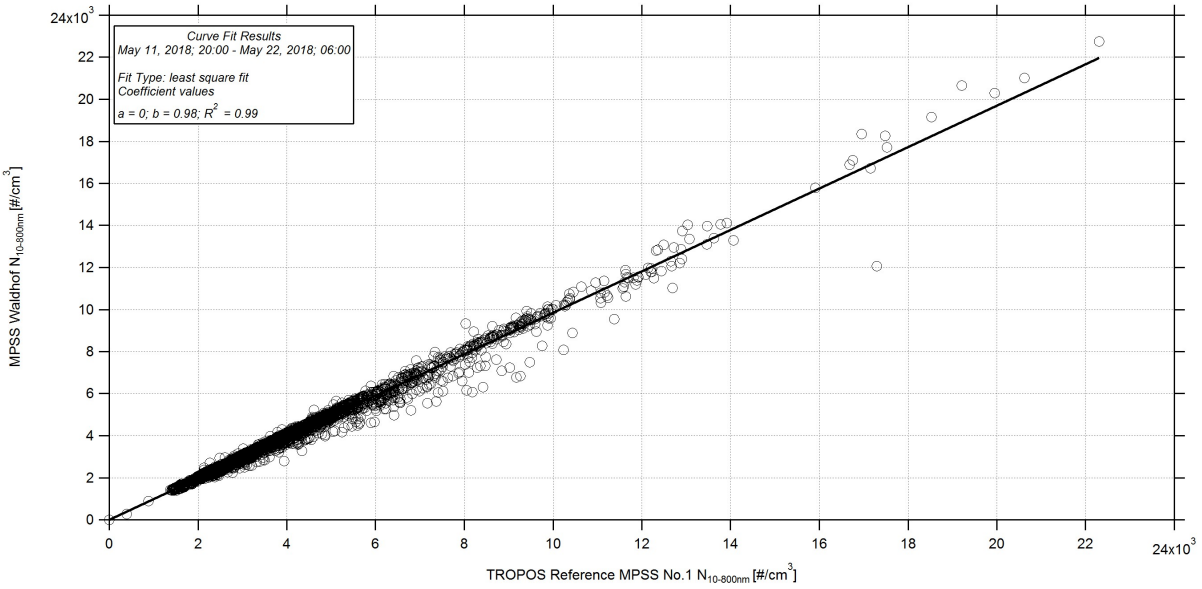

Figure 19: Linear regression between the number concentrations of the TROPOS Reference MPSS No.1 and MPSS Waldhof (May 11, 2018 20:00 – May 22, 2018 06:00). All corrections are included.

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