

Intercomparison of Mobility Particle Size Spectrometers

Project No.: MPSS-2018-7-2

Principal Investigator: Dr. Diana Rose

Home Institution: Hessisches Landesamt für Naturschutz, Umwelt und Geologie
Dezernat I2 Luftreinhaltung: Immissionen

Participant: Dr. Diana Rose

Candidate: DE-HLNUG MPSS 002 - Raunheim
Made by: TSI – EC 3082
Counter (SN): CPC 3772 SN3772163701

Location of the quality assurance: TROPOS Leipzig, lab 118

Comparison period: October 15, 2018 – October 19, 2018

Last Intercomparison (with Project No.):

Summary of Intercomparison:

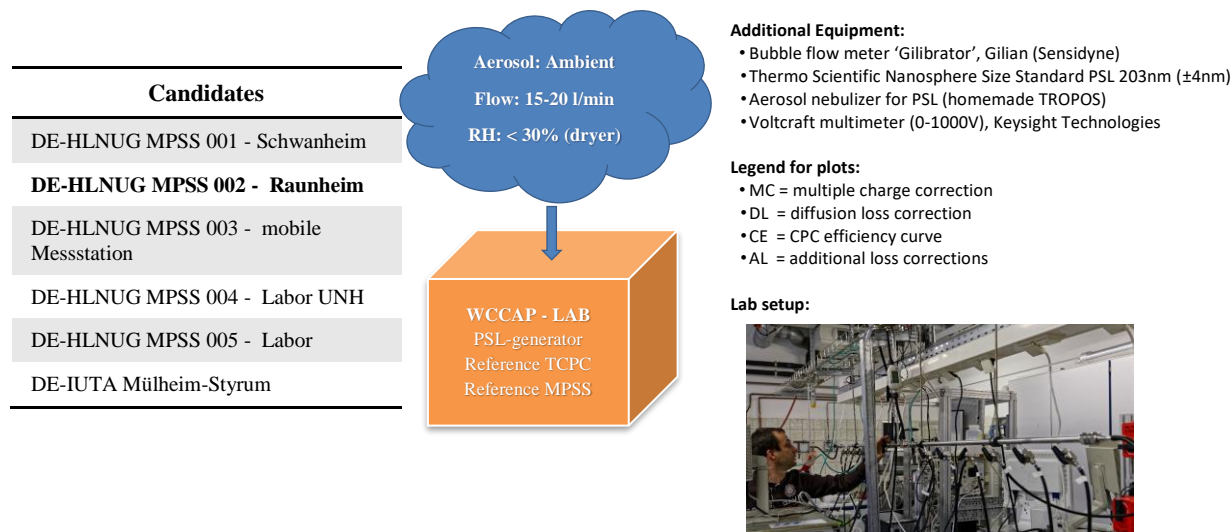
Pre-Status:

The candidate from DE-HLNUG MPSS_002 Raunheim participated in the ACTRIS workshop from October 15, 2018 to October 19, 2018 with the participant. The setup of the candidate was done on Monday, October 15th, afternoon. During the Pre-Status the candidate was running under the same settings, with their own TSI Kr.85 source, like on the Institute. The performance of the candidate showed a concentration in the same level than the TROPOS Reference Instrument No.1. On Tuesday, October 16th, after the CPC-Workshop the MPSS was checked and the first part of maintenance was done. The performance of the CPC is shown in the Report of the CPC-Workshop. The TSI CPC 3772 passed the CPC Workshop after maintenance. For more information, please look at the CPC-workshop report. During the workshop week, the whole candidate was checked and cleaned. More details are in the Tables for each night run. The participant was instructed and trained how to optimize his instrument. In addition, the station setup and quality assurance procedures were discussed.

Final-Status:

The final run took place from October 18 to October 19, 2018. Running the candidate using the original source Kr.85 the performance showed a concentration 1% lower than the TROPOS Reference Instrument No.1.. The candidate passed the standards of ACTRIS and GAW.

Laboratory Setup and Legend



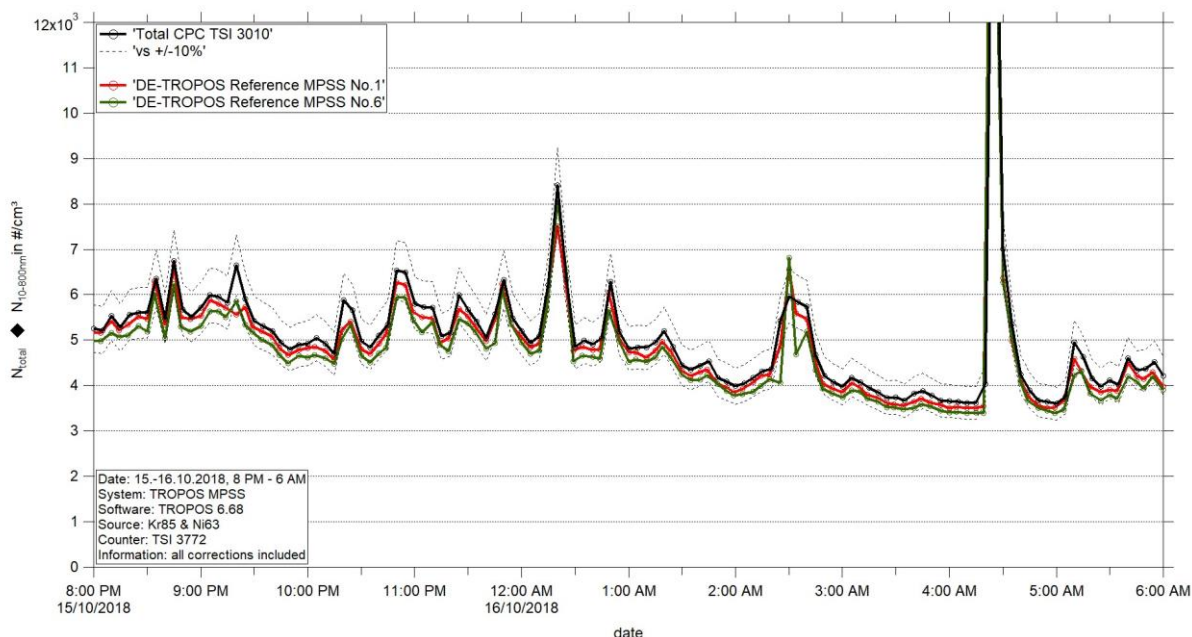
TROPOS Reference Instruments No. 1 and No. 6**October 15 – October 16, 2018: Time Series, Particle Number Size Distribution and Correlation**

Figure 01: Time series (October 15, 2018 8 PM – October 16, 2018 6 AM) of the integrated particle number concentration ($N_{10-800nm}$) of the TROPOS Reference 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.

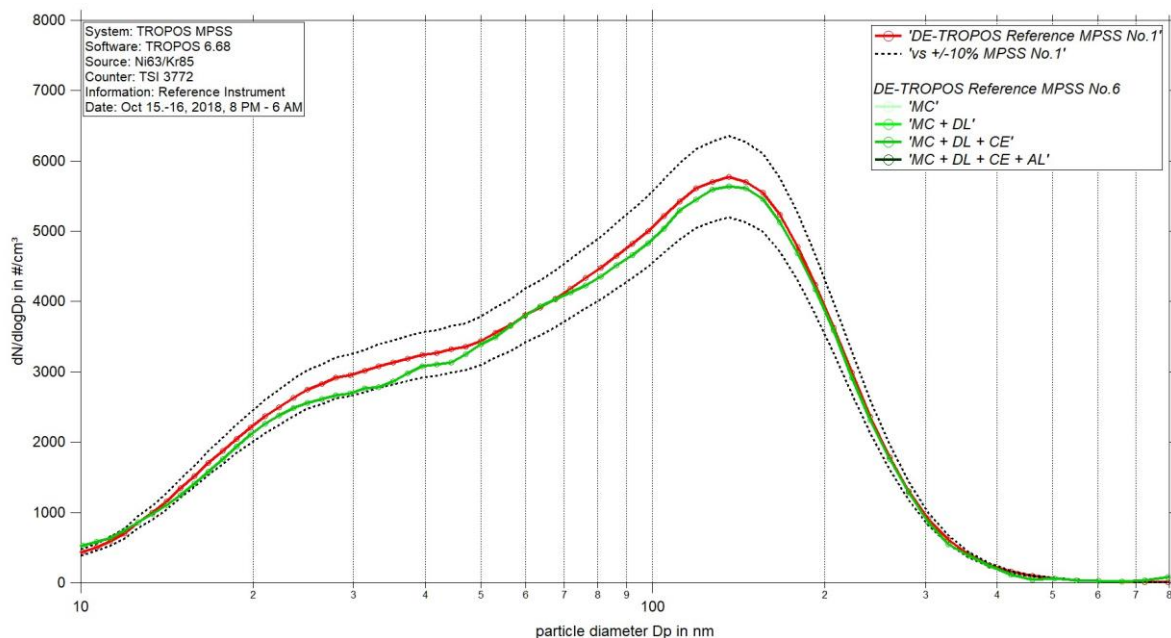


Figure 02: Comparison of mean particle number size distribution of TROPOS Reference MPSS No.1 against TROPOS Reference MPSS No.6 from October 15, 2018 8 PM – October 16, 2018 6 AM. Multiple charge correction, internal diffusion losses and CPC efficiency are included in different steps.

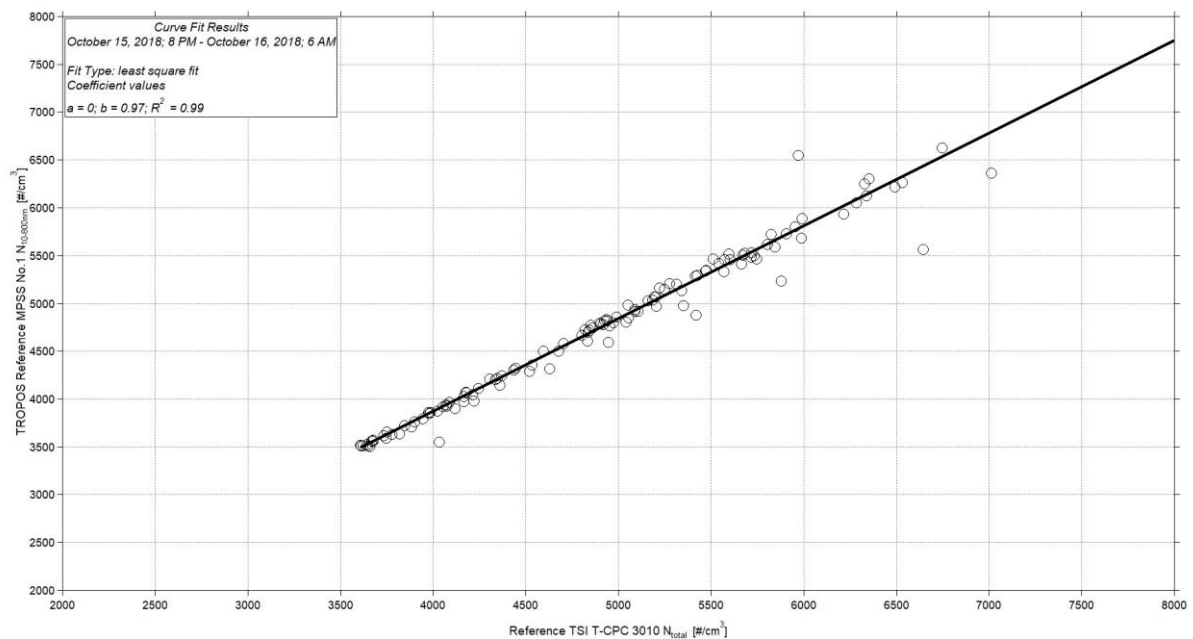


Figure 03: Linear regression between the number concentrations of the TROPOS Reference TSI T-CPC Model 3010 and TROPOS Reference MPSS No.1. Multiple charge correction, internal diffusion losses and CPC efficiency are included.

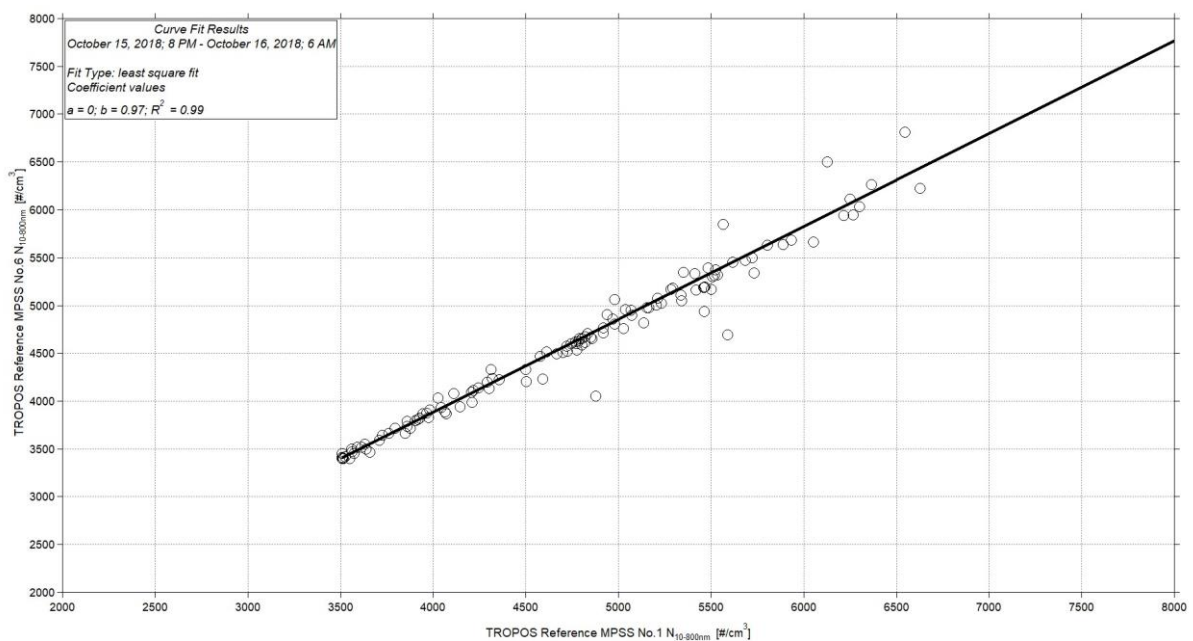


Figure 04: Linear regression between the number concentrations of the TROPOS Reference MPSS No.1 and TROPOS Reference MPSS No.6. Multiple charge correction, internal diffusion losses and CPC efficiency are included.

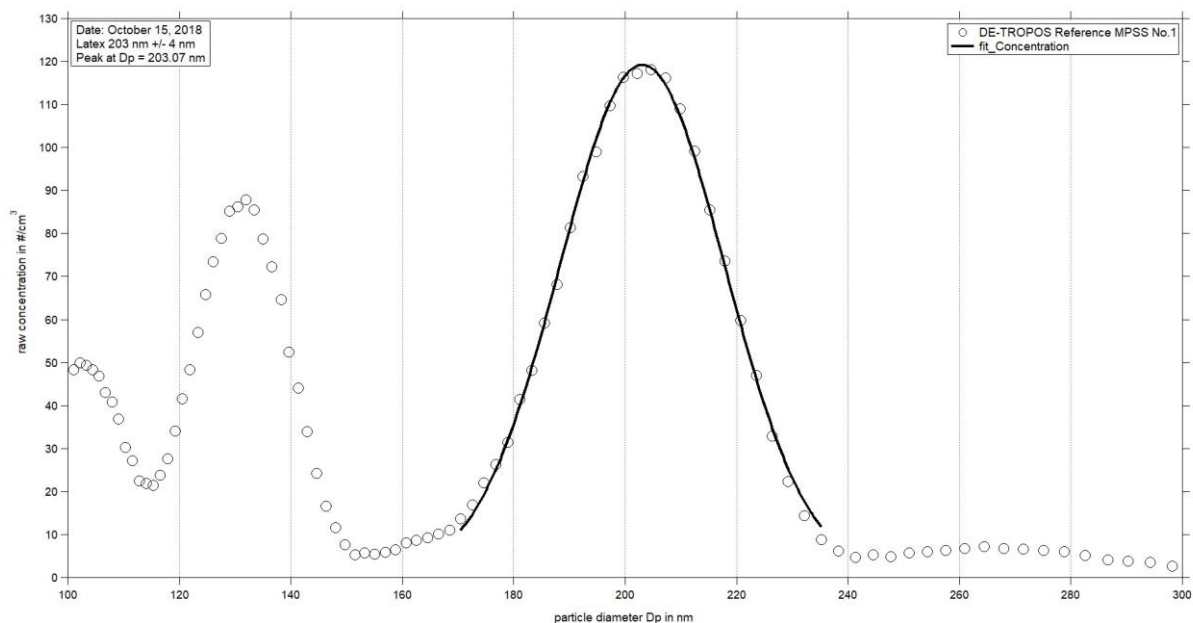
PSL Scan: Latex 203 nm +/- 4 nm

Figure 05: Measurement of latex 203 nm - Reference MPSS No.1: Particle size distribution (raw concentration) for latex 203 nm on October 15th 2018.

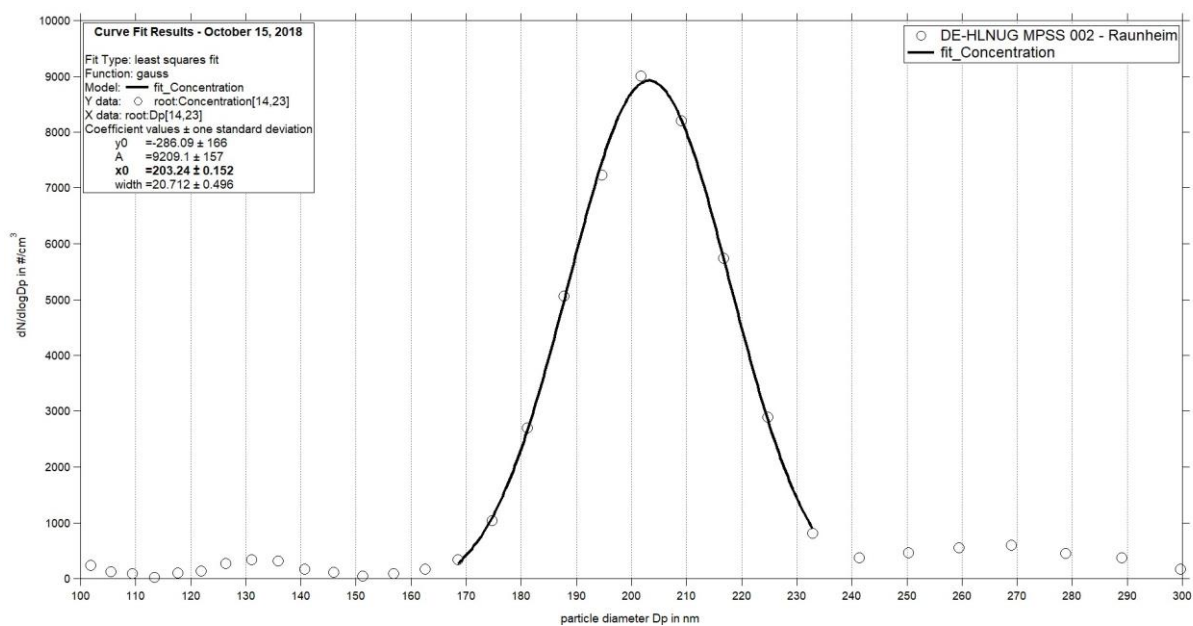


Figure 06: Measurement of latex 203 nm for the candidate DE-HLNUG MPSS 002 - Raunheim: Particle size distribution for latex 203 nm on October 15th 2018 with a peak at 203.24 nm.

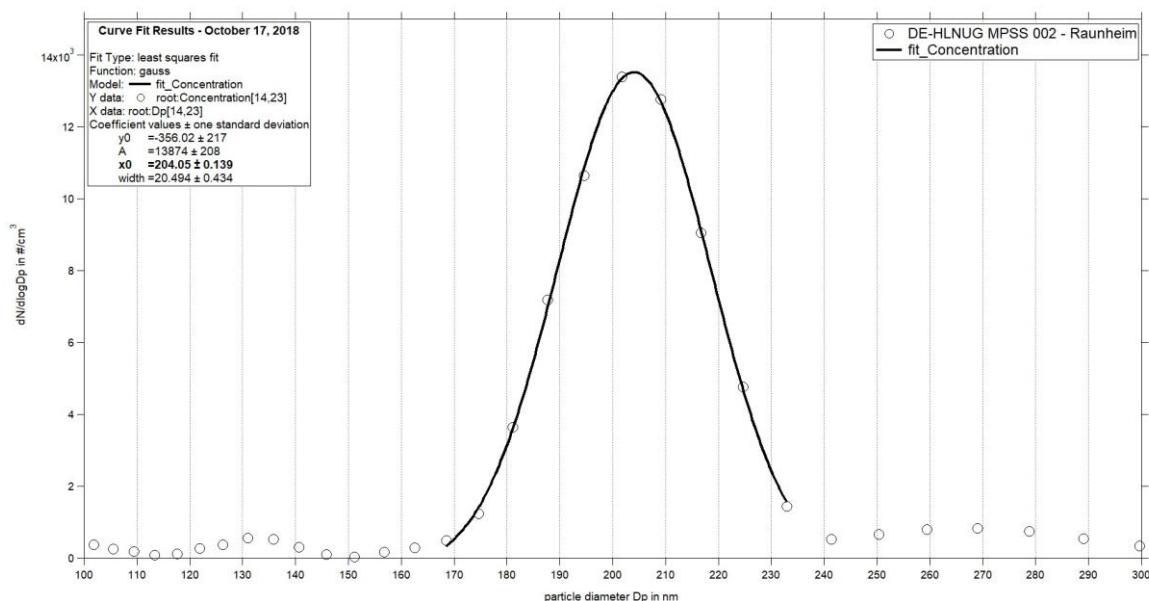


Figure 07: Measurement of latex 203 nm for the candidate DE-HLNUG MPSS 002 – Raunheim: Particle size distribution for latex 203 nm on October 17th 2018 with a peak at 204.05 nm.

Pre-Status October 15 – 16, 2018

Instrument Settings, Time Series, Particle Number Size Distribution and Correlation

Table No. 1:

Institute: HLNUG							
Station: MPSS 002 – Raunheim							
Date of checking list: October 15, 2019							
Instrument/ Components	info	SN	Date/Code	CPC-Status		HV-Status	
MPSS/Classifier:	TSI 3082	3082001637001		ST	39.0	OFF	0.3
Firmware Classifier:	2.1		14.09.2016	CT	22.0	5 V	5.3
Firmware Software:	AIM 10			OT	40.0	10 V	10.3
DMA type:	TSI 3081A	3081A1635005		CabT	32.2	1000 V	999.1
CPC model:	TSI 3772	3772163701		AP	99.8	250 V	250.2
Firmware CPC:	2.16			OP	72.6	5 V	5.3
radioactive source:	Kr.85	77A-0699	Oct 2016	NP	2.9	OFF	0.3
Flow CPC (l/min):	1.023			LC	40.0	400 V	
Flow Inlet (l/min):	0.998					800 V	
Flow Display (l/min):	1.07					700 V	
Zero (#/cm³):	0					650 V	
Maintenance							
Aerosol inlet:							
Aerosol Nafion dryer:							
Sheath Nafion dryer:							
Source:							
HV power supply:							
DMA:							
Aerosol/sheath RH/T- sensor:							
Pressure sensor:							
Filter:							
NI-card:							
CPC:							
Impactor:							
Setup settings over night:	settings like on the station						

Institute: TROPOS							
Station: Reference Instrument No.1							
Date of checking list: October 15, 2019							
Instrument/ Components	info	Serial Number	Date/Code	CPC-Status		HV-Status	
MPSS/Classifier:	TROPOS	No.1		ST	39.0	0 V	0
Firmware Classifier:				CT	22.0	5 mV	4.98
Firmware Software:	TROPOS 6.68			OT	40.0	800 mV	999.8
DMA type:	Hauke medium		142	CabT	27.3	200 mV	250.0
CPC model:	TSI 3772	3772141701		AP	98.5	0 V	0
Firmware CPC:	2.15			OP	72.1		
Radioactive source:	Kr.85	NER 8275	002/13	NP	2.8		
Flow Inlet (l/min):	1.031			LC	50		
Zero (#/cm ³):	0						

Institute: TROPOS							
Station: Reference Total CPC							
Date of checking list: October 15, 2019							
Instrument/ Components	info	Serial Number	Cut off	CPC-Status			
CPC model:	TSI 3010	2410	Dp50 10 nm	ST			
Firmware CPC:	2.15			CT			
Flow Inlet (l/min):	1.015			OT			
Zero (#/cm ³):	0			CabT			
				AP			
				OP			
				NP			
				LC			

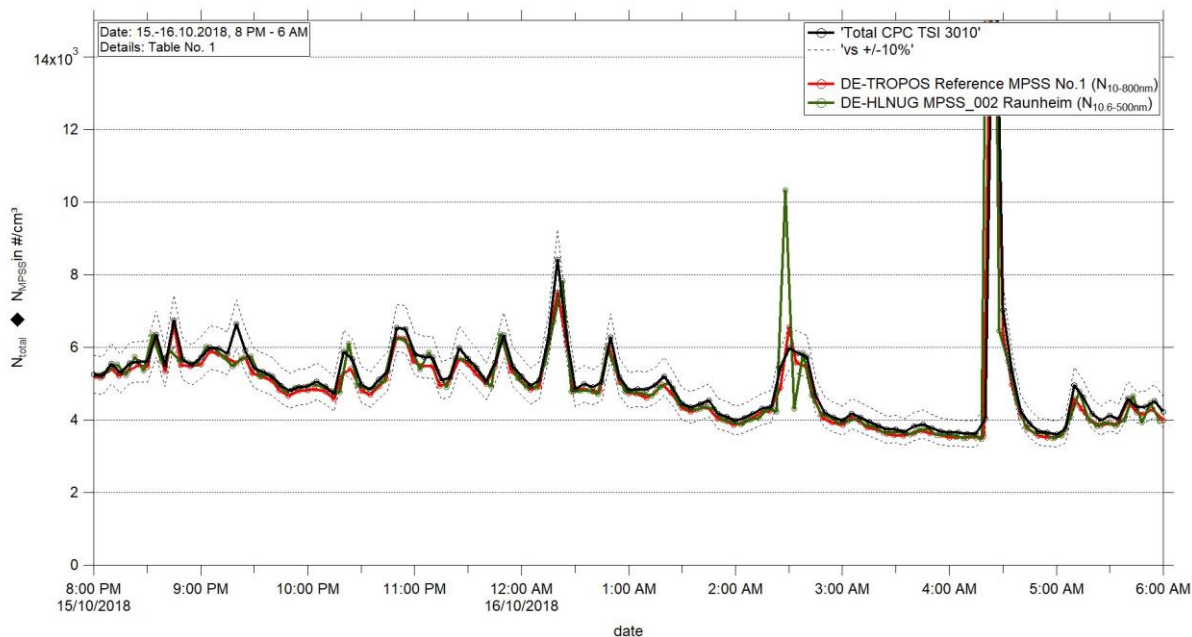


Figure 08: Time series (October 15, 2018 8 PM – October 16, 2018 6 AM) of the integrated particle number concentration ($N_{10-800\text{nm}}$ or $N_{10.6-500\text{nm}}$) of the MPSS and total number concentration (N_{total}) of the Reference TSI-CPC Model 3010. Multiple charge correction, internal diffusion losses and CPC flow corrections are included. The candidate is running with the Kr.85 source.

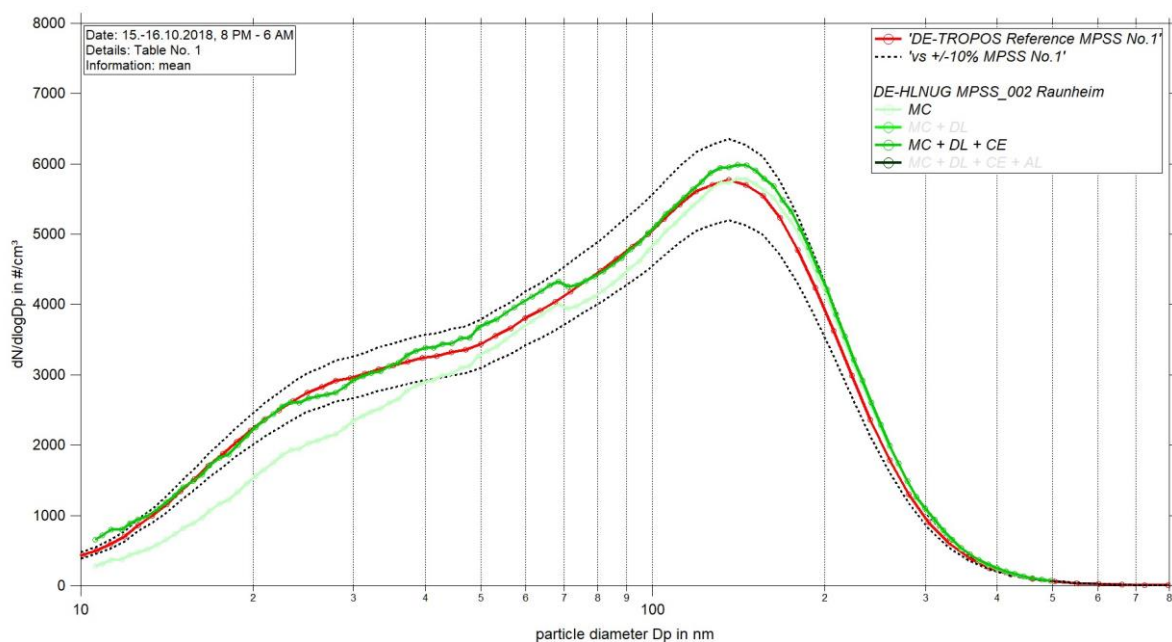


Figure 09: Comparison of mean particle number size distribution of TROPOS Reference MPSS No.1 against DE-HLNUG MPSS_002 Raunheim from October 15, 2018 8 PM – October 16, 2018 06:00 AM. Multiple charge correction, internal diffusion losses and CPC efficiency are included in different steps.

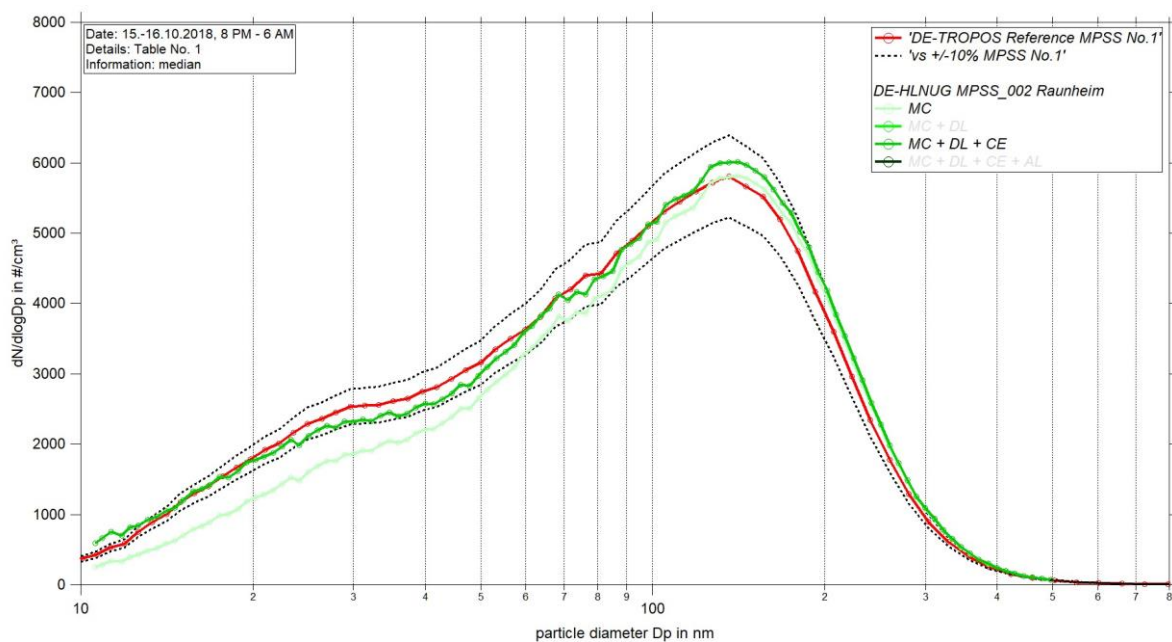


Figure 10: Comparison of median particle number size distribution of TROPOS Reference MPSS No.1 against DE-HLNUG MPSS_002 Raunheim from October 15, 2018 8 PM – October 16, 2018 06:00 AM. Multiple charge correction, internal diffusion losses and CPC efficiency are included in different steps.

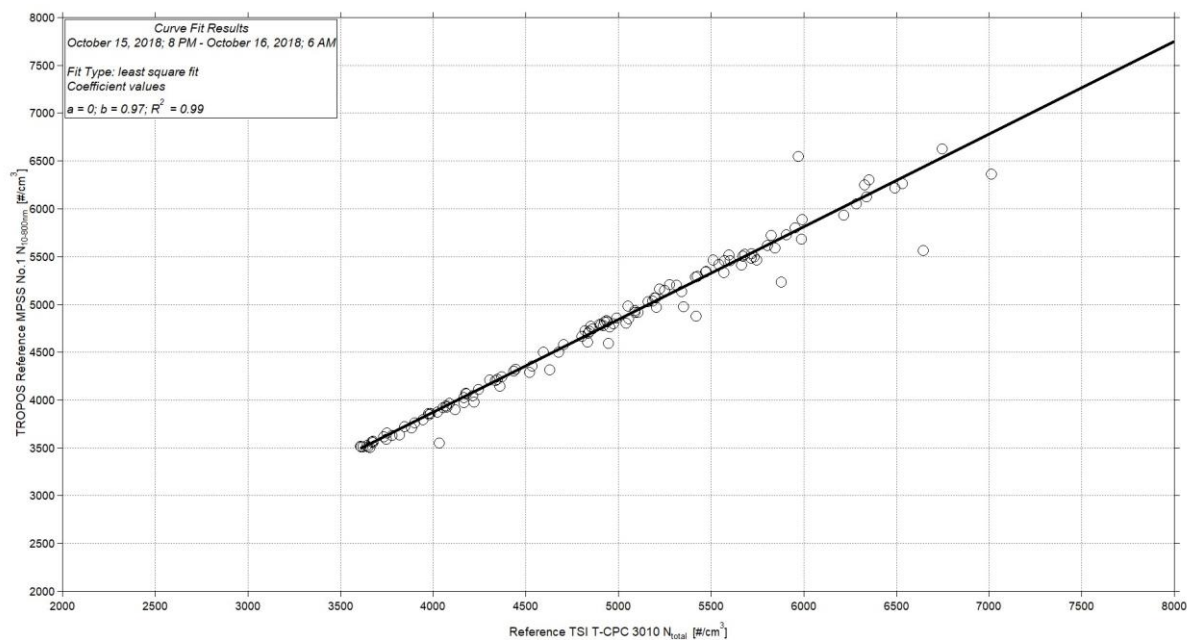


Figure 11: Linear regression between the number concentrations of the TROPOS Reference TSI T-CPC Model 3010 and TROPOS Reference MPSS No.1. Multiple charge correction, internal diffusion losses and CPC efficiency are included.

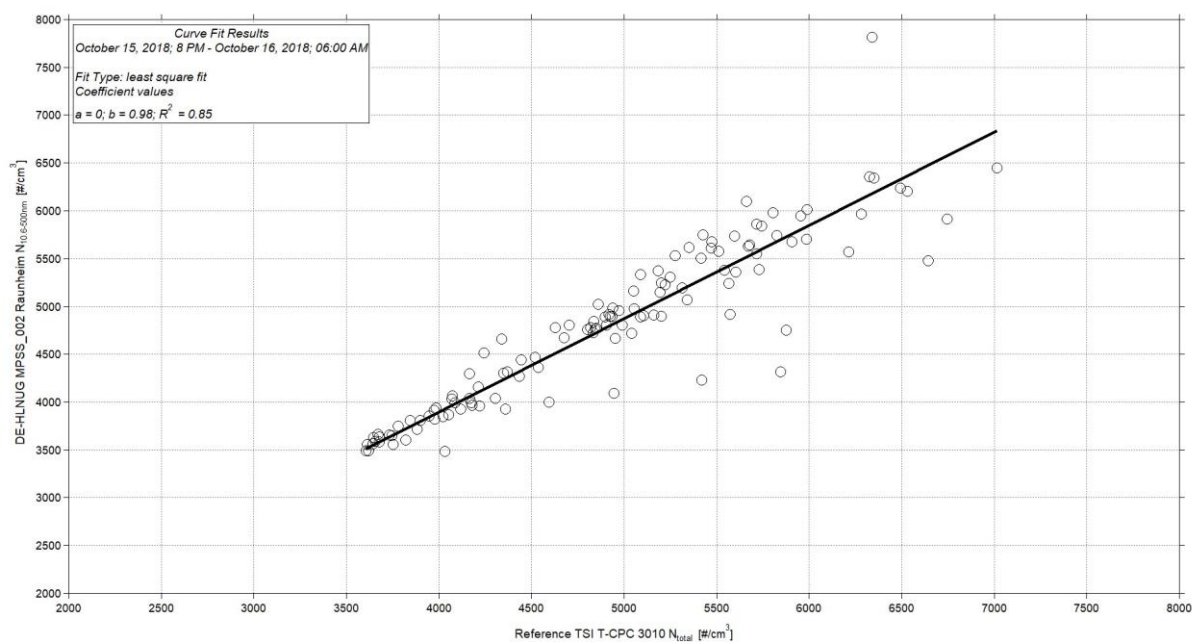


Figure 12: Linear regression between the number concentrations of the TROPOS Reference TSI T-CPC Model 3010 and DE-HLNUG MPSS_002 Raunheim. Multiple charge correction, internal diffusion losses and CPC efficiency are included.

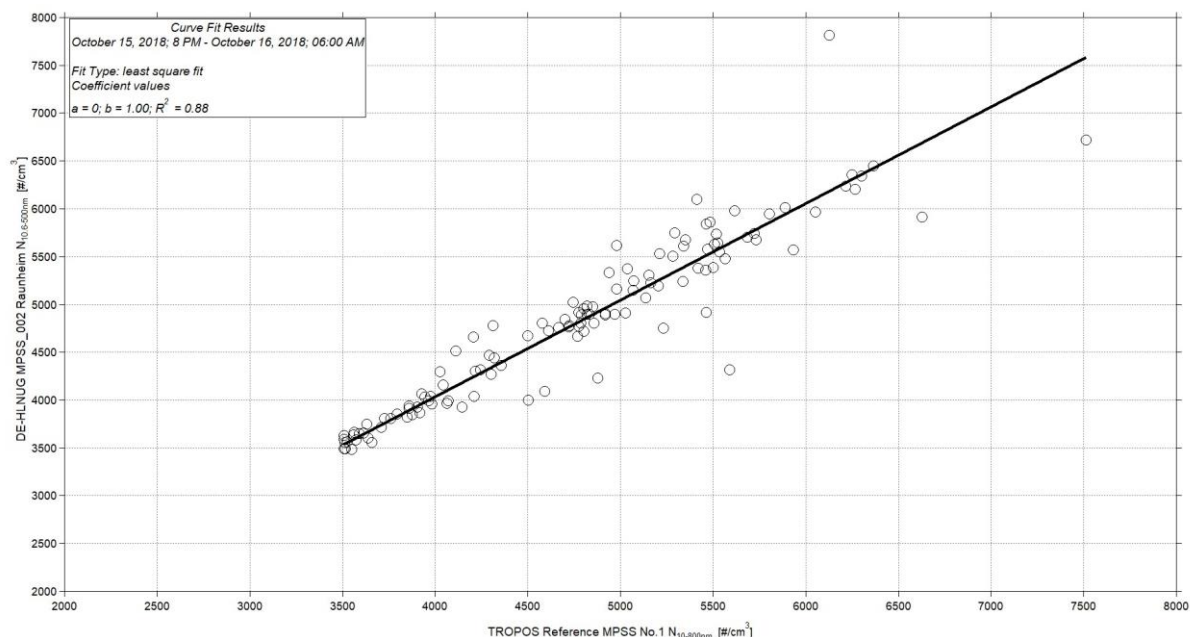


Figure 13: Linear regression between the number concentrations of the TROPOS Reference MPSS No.1 and DE-HLNUG MPSS_002 Raunheim. Multiple charge correction, internal diffusion losses and CPC efficiency are included.

Status October 16 – 17, 2018

Instrument Settings, Time Series, Particle Number Size Distribution and Correlation

Table No. 2:

Institute: HLNUG							
Station: MPSS 002 – Raunheim							
Date of checking list: October 16, 2019							
Instrument/ Components	info	SN	Date/Code	CPC-Status		HV-Status	
MPSS/Classifier:	TSI 3082	3082001637001		ST		OFF	
Firmware Classifier:	Update to 2.2		14.09.2016	CT		5 V	
Firmware Software:	AIM 10		OT		10 V		
DMA type:	TSI 3081A	3081A1635005		CabT		1000 V	
CPC model:	TSI 3772	3772163701		AP		250 V	
Firmware CPC:	2.16			OP		5 V	
radioactive source:	Kr.85	77A-0699	Oct 2016	NP		OFF	
Flow CPC (l/min):	1.03			LC		400 V	
Flow Inlet (l/min):	1.00					800 V	
Flow Display (l/min):	1.06					700 V	
Zero (#/cm ³):	0					650 V	
Maintenance							
Aerosol inlet:		Checked and cleaned					
Aerosol Nafion dryer:							
Sheath Nafion dryer:							
Source:							
HV power supply:		Checked					
DMA:		Checked and cleaned					
Aerosol/sheath RH/T- sensor:							
Pressure sensor:							
Filter:							
NI-card:							

CPC:	<ul style="list-style-type: none"> CPC Workshop -> have a look at the CPC-Report CPC was checked and cleaned -> wick changed -> CPC okay
Impactor:	
Setup settings over night:	No changes – settings like on the station

Institute: TROPOS						
Station: Reference Instrument No.1						
Date of checking list: October 16, 2019						
Instrument/ Components	info	Serial Number	Date/Code	CPC-Status		HV-Status
MPSS/Classifier:	TROPOS	No.1		ST		0 V
Firmware Classifier:				CT		5 mV
Firmware Software:	TROPOS 6.68			OT		800 mV
DMA type:	Hauke medium		142	CabT		200 mV
CPC model:	TSI 3772	3772141701		AP		0 V
Firmware CPC:	2.15			OP		
Radioactive source:	Kr.85	NER 8275	002/13	NP		
Flow Inlet (l/min):	1.02			LC		
Zero (#/cm ³):	0					

Institute: TROPOS						
Station: Reference Total CPC						
Date of checking list: October 16, 2019						
Instrument/ Components	info	Serial Number	Cut off	CPC-Status		
CPC model:	TSI 3010	2410	D_{p50} 10 nm	ST		
Firmware CPC:	2.15			CT		
Flow Inlet (l/min):	1.01			OT		
Zero (#/cm ³):	0			CabT		
				AP		
				OP		
				NP		
				LC		

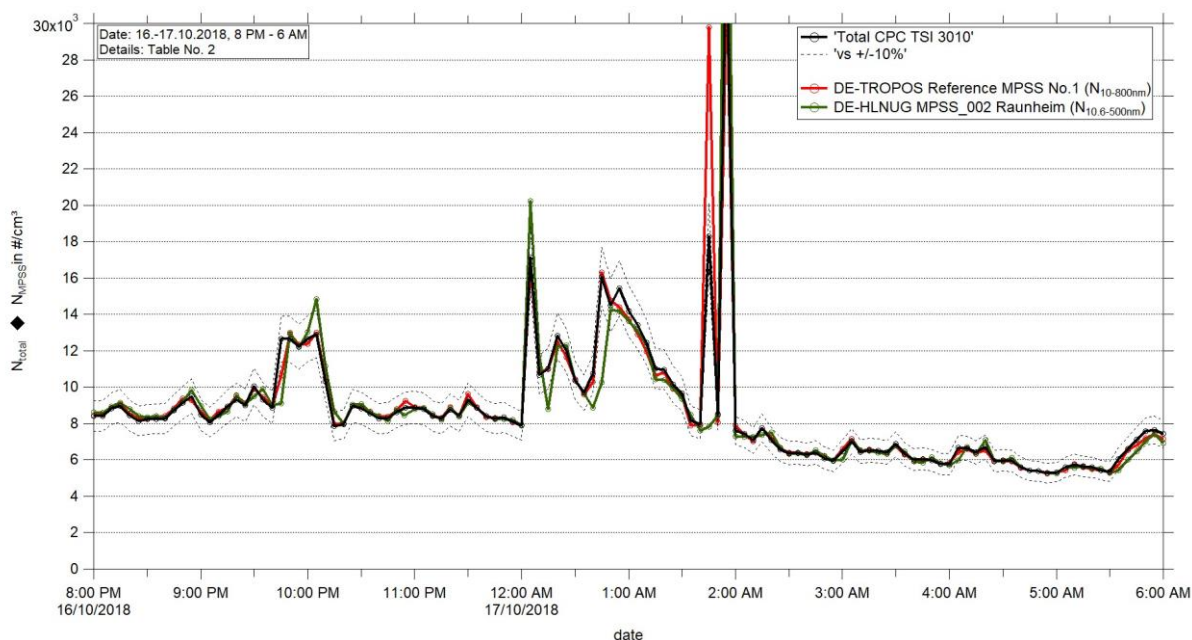


Figure 14: Time series (October 16, 2018 8 PM – October 17, 2018 6 AM) of the integrated particle number concentration ($N_{10-800\text{nm}}$ or $N_{10.6-500\text{nm}}$) of the MPSS and total number concentration (N_{total}) of the Reference TSI-CPC Model 3010. Multiple charge correction, internal diffusion losses and CPC flow corrections are included.

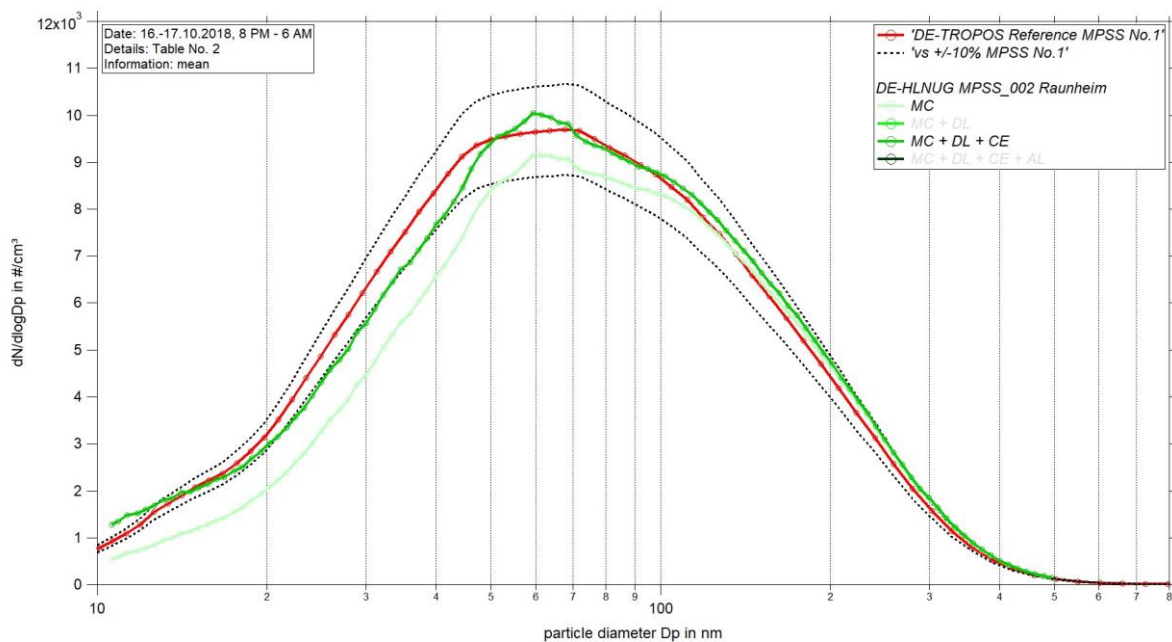


Figure 15: Comparison of mean particle number size distribution of TROPOS Reference MPSS No.1 against DE-HLNUG MPSS_002 Raunheim from October 16, 2018 8 PM – October 17, 2018 6 AM. Multiple charge correction, internal diffusion losses and CPC efficiency are included in different steps.

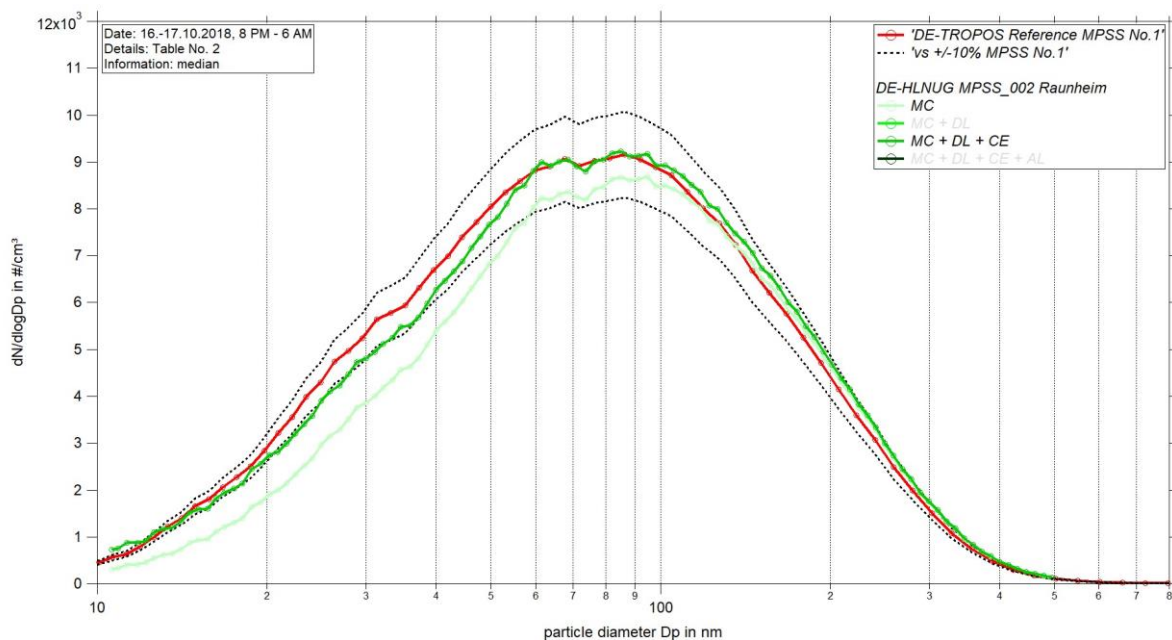


Figure 16: Comparison of median particle number size distribution of TROPOS Reference MPSS No.1 against DE-HLNUG MPSS_002 Raunheim from October 16, 2018 8 PM – October 17, 2018 6 AM. Multiple charge correction, internal diffusion losses and CPC efficiency are included in different steps.

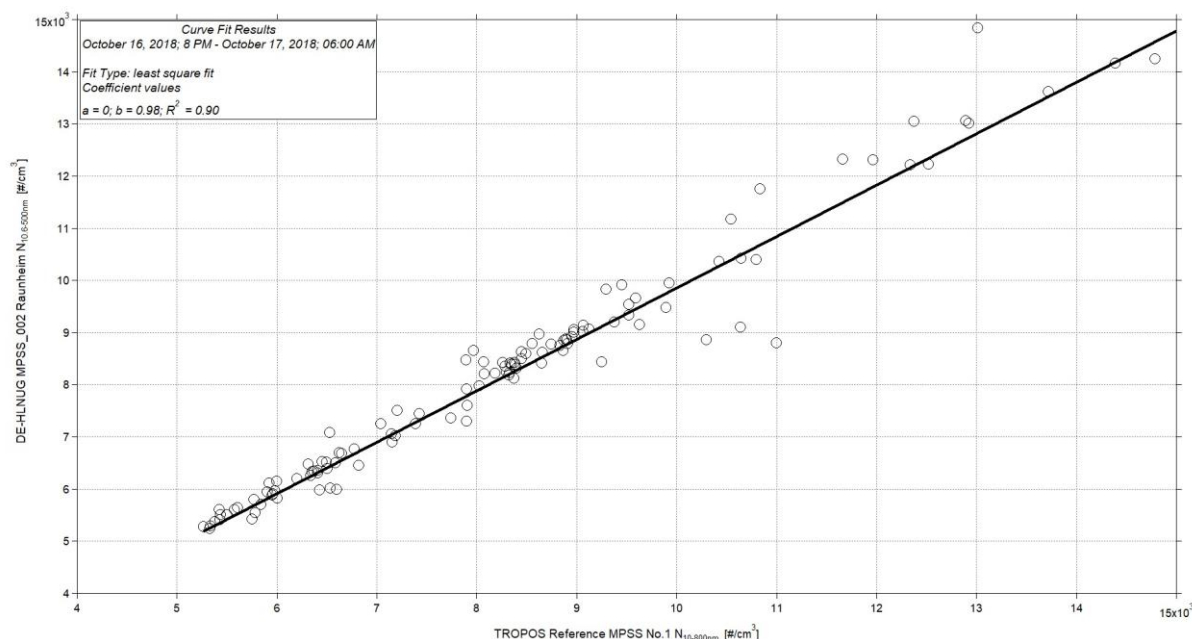


Figure 17: Linear regression between the number concentrations of the TROPOS Reference MPSS No.1 and DE-HLNUG MPSS_002 Raunheim. Multiple charge correction, internal diffusion losses and CPC efficiency are included.

Status October 17 – 18, 2018

Instrument Settings, Time Series, Particle Number Size Distribution and Correlation

Table No. 3:

Institute: HLNUG						
Station: MPSS 002 – Raunheim						
Date of checking list: October 17, 2019						
Instrument/ Components	info	SN	Date/Code	CPC-Status		HV-Status
MPSS/Classifier:	TSI 3082	3082001637001		ST		OFF
Firmware Classifier:	2.2		14.09.2016	CT		5 V
Firmware Software:	AIM 10			OT		10 V
DMA type:	TSI 3081A	3081A1635005		CabT		1000 V
CPC model:	TSI 3772	3772181201		AP		250 V
Firmware CPC:	2.16		March 2018	OP		5 V
radioactive source:	Kr.85	77A-0699	Oct 2016	NP		OFF
Flow CPC (l/min):	1.02			LC		400 V
Flow Inlet (l/min):						800 V
Flow Display (l/min):						700 V
Zero (#/cm ³):	0					650 V
Maintenance						
Aerosol inlet:						
Aerosol Nafion dryer:						
Sheath Nafion dryer:						
Source:						
HV power supply:						
DMA:						
Aerosol/sheath RH/T- sensor:						
Pressure sensor:						
Filter:						
NI-card:						

CPC:	• CPC change: System is running with CPC_004
Impactor:	
Setup settings over night:	No changes – settings like on the station

Institute: TROPOS						
Station: Reference Instrument No.1						
Date of checking list: October 17, 2019						
Instrument/ Components	info	Serial Number	Date/Code	CPC-Status		HV-Status
MPSS/Classifier:	TROPOS	No.1		ST		0 V
Firmware Classifier:				CT		5 mV
Firmware Software:	TROPOS 6.68			OT		800 mV
DMA type:	Hauke medium		142	CabT		200 mV
CPC model:	TSI 3772	3772141701		AP		0 V
Firmware CPC:	2.15			OP		
Radioactive source:	Kr.85	NER 8275	002/13	NP		
Flow Inlet (l/min):	1.02			LC		
Zero (#/cm ³):	0					

Institute: TROPOS						
Station: Reference Total CPC						
Date of checking list: October 17, 2019						
Instrument/ Components	info	Serial Number	Cut off	CPC-Status		
CPC model:	TSI 3010	2410	D _{p50} 10 nm	ST		
Firmware CPC:	2.15			CT		
Flow Inlet (l/min):	1.01			OT		
Zero (#/cm ³):	0			CabT		
				AP		
				OP		
				NP		
				LC		

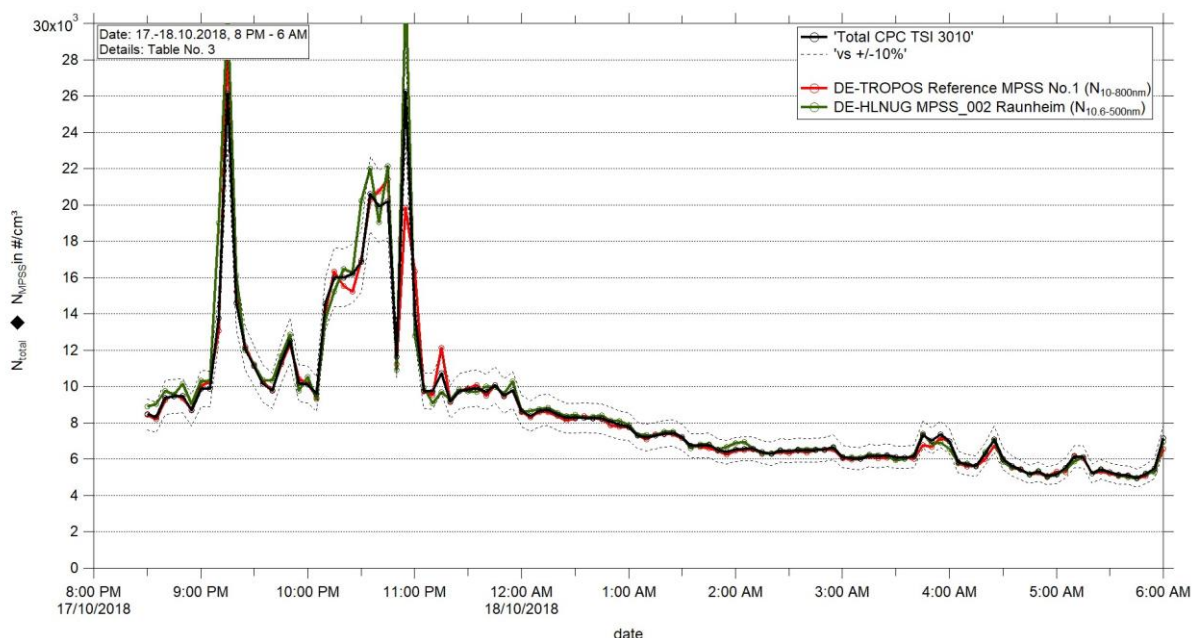


Figure 18: Time series (October 17, 2018 8 PM – October 18, 2018 6 AM) of the integrated particle number concentration ($N_{10-800\text{nm}}$ or $N_{10.6-500\text{nm}}$) of the MPSS and total number concentration (N_{total}) of the Reference TSI-CPC Model 3010. Multiple charge correction, internal diffusion losses and CPC flow corrections are included.

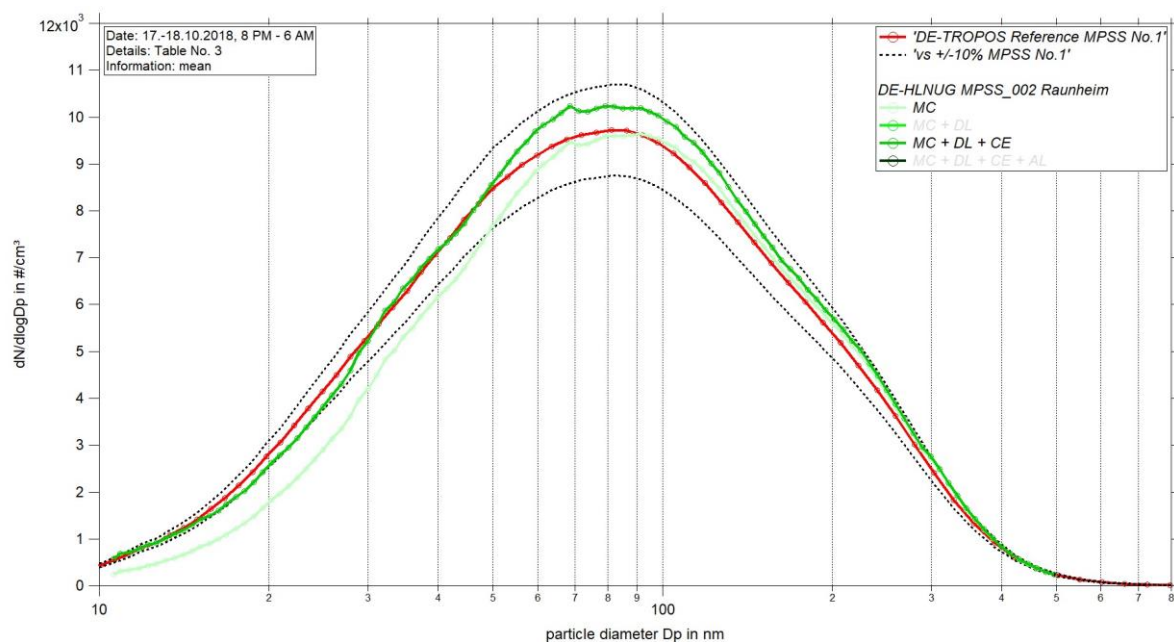


Figure 19: Comparison of mean particle number size distribution of TROPOS Reference MPSS No.1 against DE-HLNUG MPSS_002 Raunheim from October 17, 2018 8 PM – October 18, 2018 6 AM. Multiple charge correction, internal diffusion losses and CPC efficiency are included in different steps.

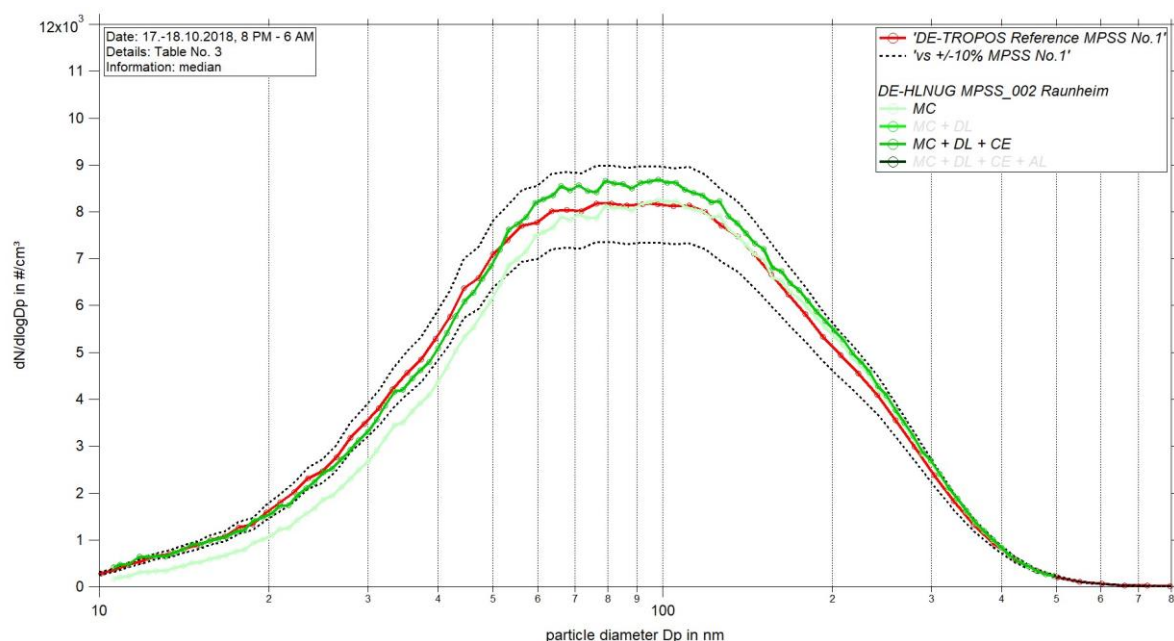


Figure 20: Comparison of median particle number size distribution of TROPOS Reference MPSS No.1 against DE-HLNUG MPSS_002 Raunheim from October 17, 2018 8 PM – October 18, 2018 6 AM. Multiple charge correction, internal diffusion losses and CPC efficiency are included in different steps.

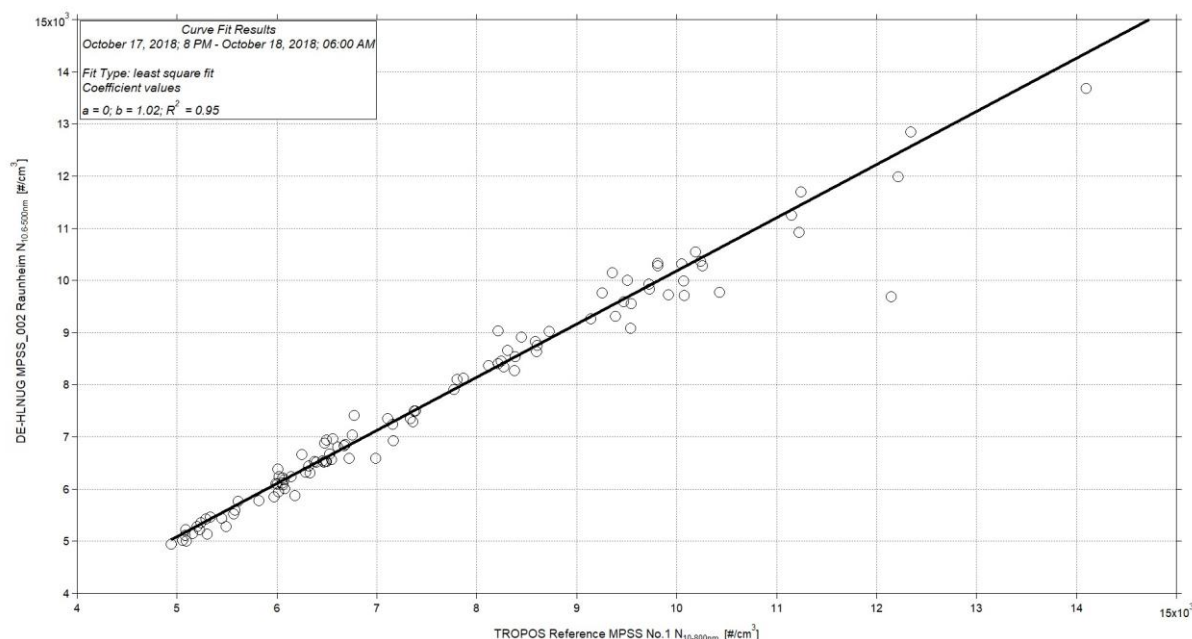


Figure 21: Linear regression between the number concentrations of the TROPOS Reference MPSS No.1 and DE-HLNUG MPSS_002 Raunheim. Multiple charge correction, internal diffusion losses and CPC efficiency are included.

Final-Status October 18 – 19, 2018

Instrument Settings, Time Series, Particle Number Size Distribution and Correlation

Table No. 4:

Institute: HLNUG							
Station: MPSS 002 – Raunheim							
Date of checking list: October 18, 2019							
Instrument/ Components	info	SN	Date/Code	CPC-Status		HV-Status	
MPSS/Classifier:	TSI 3082	3082001637001		ST		OFF	
Firmware Classifier:	2.2		14.09.2016	CT		5 V	
Firmware Software:	AIM 10			OT		10 V	
DMA type:	TSI 3081A	3081A1635005		CabT		1000 V	
CPC model:	TSI 3772	3772163701		AP		250 V	
Firmware CPC:	2.16			OP		5 V	
radioactive source:	Kr.85	77A-0699	Oct 2016	NP		OFF	
Flow CPC (l/min):				LC		400 V	
Flow Inlet (l/min):						800 V	
Flow Display (l/min):						700 V	
Zero (#/cm³):	0					650 V	
Maintenance							
Aerosol inlet:							
Aerosol Nafion dryer:							
Sheath Nafion dryer:							
Source:							
HV power supply:							
DMA:							
Aerosol/sheath RH/T- sensor:							
Pressure sensor:							

Filter:	
NI-card:	
CPC:	original CPC is back in the instrument
Impactor:	
Setup settings over night:	Scan time 120s

Institute: TROPOS							
Station: Reference Instrument No.1							
Date of checking list: October 18, 2019							
Instrument/ Components	info	Serial Number	Date/Code	CPC-Status		HV-Status	
MPSS/Classifier:	TROPOS	No.1		ST		0 V	
Firmware Classifier:				CT		5 mV	
Firmware Software:	TROPOS 6.68			OT		800 mV	
DMA type:	Hauke medium		142	CabT		200 mV	
CPC model:	TSI 3772	3772141701		AP		0 V	
Firmware CPC:	2.15			OP			
Radioactive source:	Kr.85	NER 8275	002/13	NP			
Flow Inlet (l/min):	1.02			LC			
Zero (#/cm ³):	0						

Institute: TROPOS							
Station: Reference Total CPC							
Date of checking list: October 18, 2019							
Instrument/ Components	info	Serial Number	Cut off	CPC-Status			
CPC model:	TSI 3010	2410	D_{p50} 10 nm	ST			
Firmware CPC:	2.15			CT			
Flow Inlet (l/min):	1.01			OT			
Zero (#/cm ³):	0			CabT			
				AP			
				OP			
				NP			
				LC			

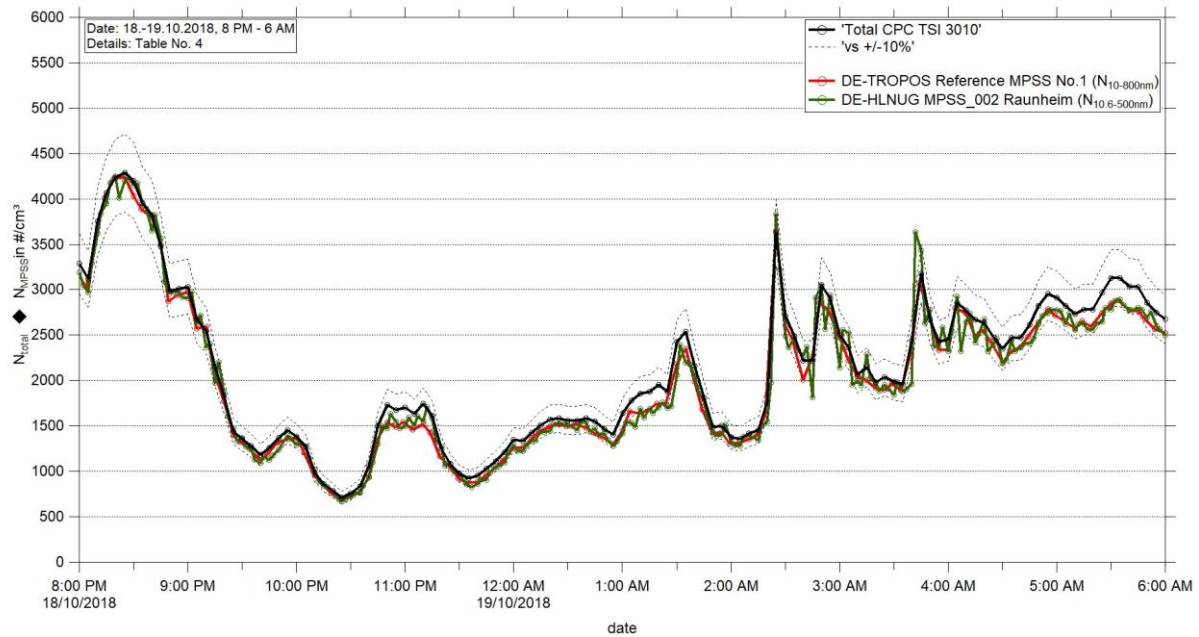


Figure 22: Time series (October 18, 2018 8 PM – October 19, 2018 6 AM) of the integrated particle number concentration ($N_{10-800\text{nm}}$ or $N_{10.6-500\text{nm}}$) of the MPSS and total number concentration (N_{total}) of the Reference TSI-CPC Model 3010. Multiple charge correction, internal diffusion losses and CPC flow corrections are included.

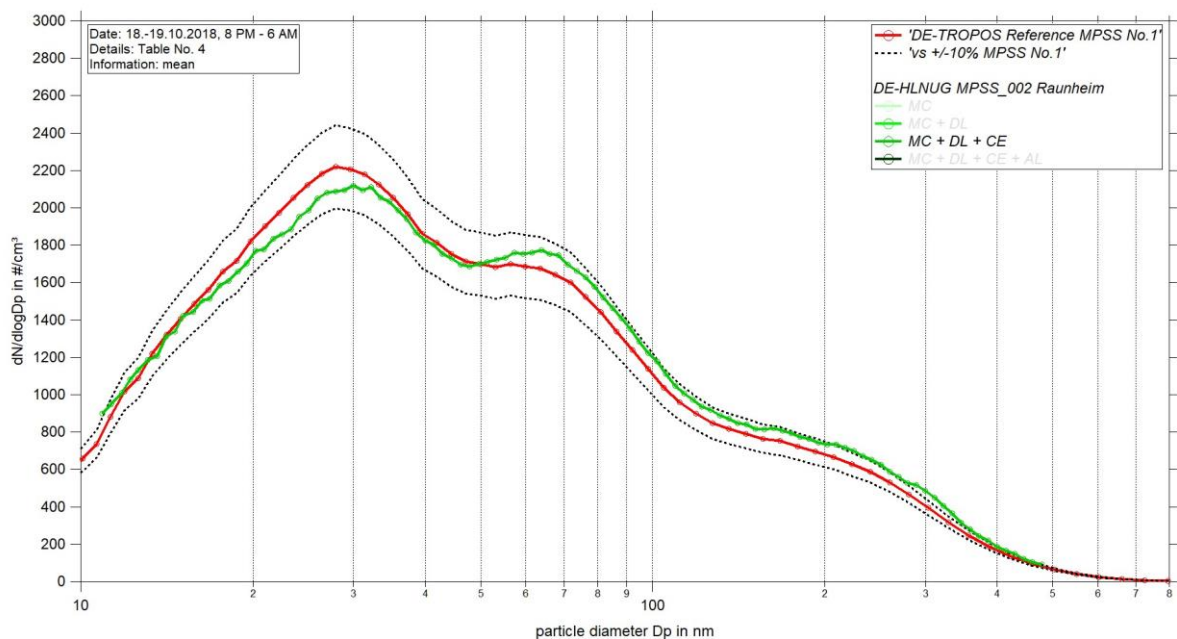


Figure 23: Comparison of mean particle number size distribution of TROPOS Reference MPSS No.1 against DE-HLNUG MPSS_002 Raunheim from October 18, 2018 8 PM – October 19, 2018 6 AM. Multiple charge correction, internal diffusion losses and CPC efficiency are included in different steps.

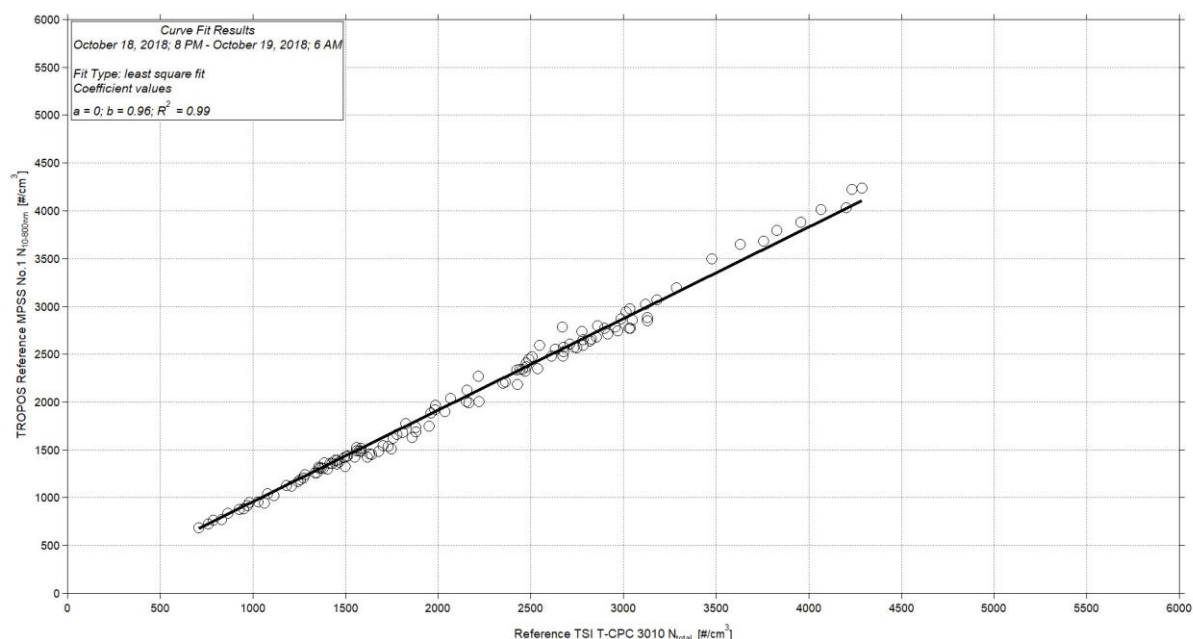


Figure 24 Linear regression between the number concentrations of the TROPOS Reference TSI T-CPC Model 3010 and TROPOS Reference MPSS No.1. Multiple charge correction, internal diffusion losses and CPC efficiency are included.

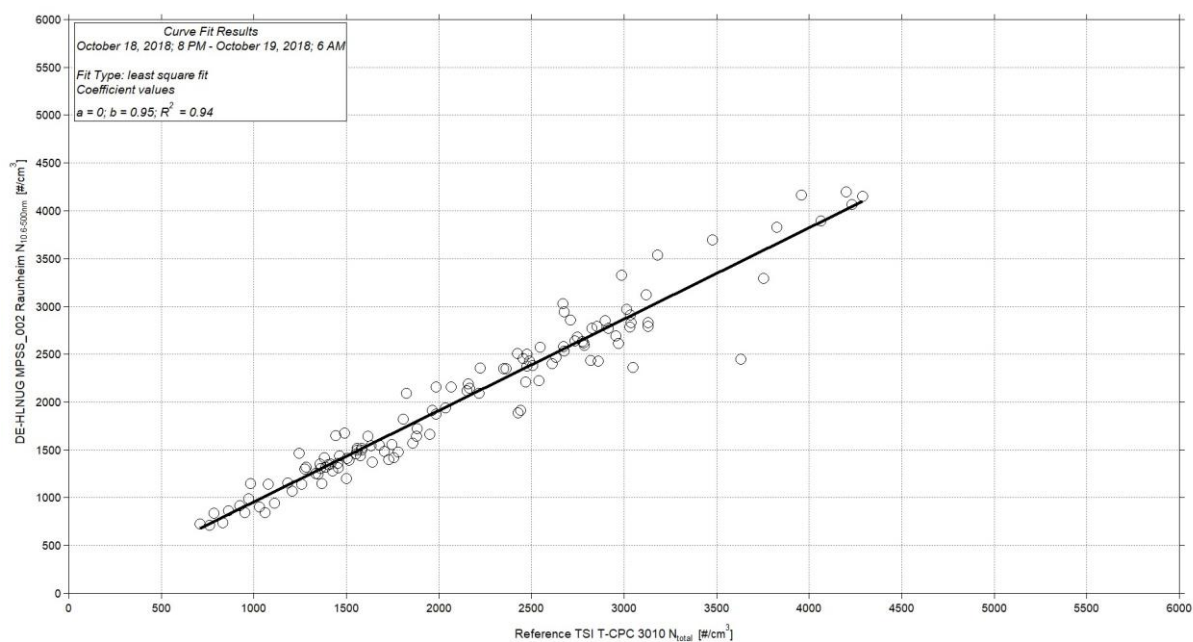


Figure 25: Linear regression between the number concentrations of the TROPOS Reference TSI T-CPC Model 3010 and DE-HLNUG MPSS_002 Raunheim. Multiple charge correction, internal diffusion losses and CPC efficiency are included.

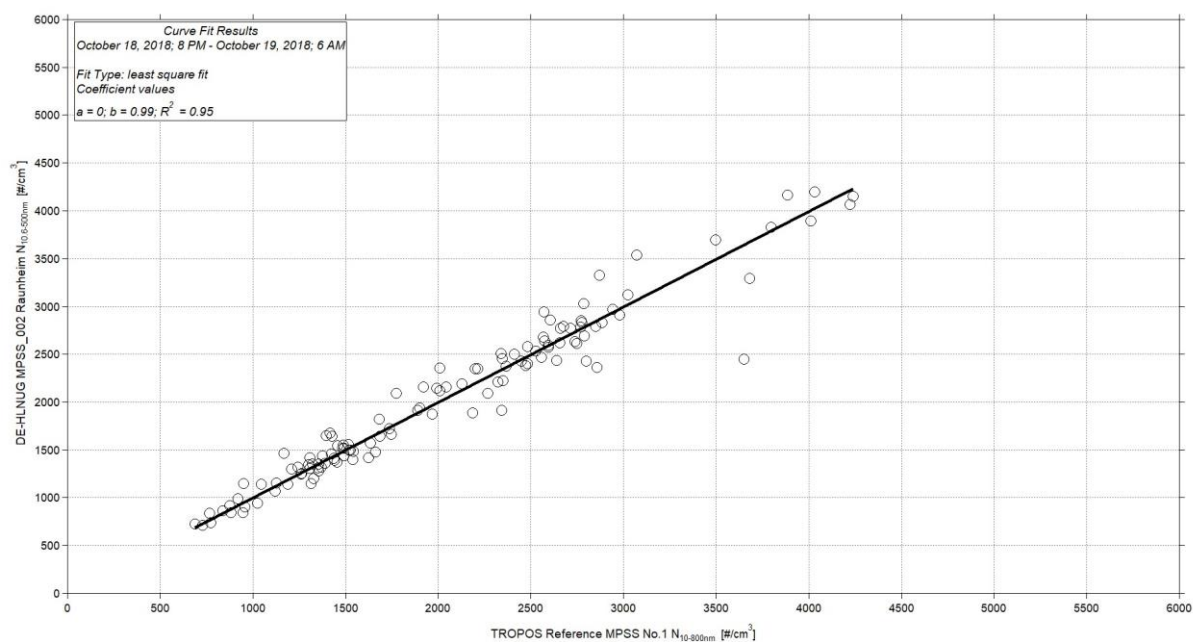


Figure 26: Linear regression between the number concentrations of the TROPOS Reference MPSS No.1 and DE-HLNUG MPSS_002 Raunheim. Multiple charge correction, internal diffusion losses and CPC efficiency are included.