Intercomparison of Mobility Particle Size Spectrometers

Project No.:	MPSS-2018-6-9
Principal Investigator:	Dipl.-Ing. Heinz Kaminski
Home Institution:	IUTA – Mülheim-Styrum
Participant:	Dipl.-Ing. Heinz Kaminski
Candidate:	DE-IUTA Mülheim-Styrum
Made by:	TSI
Counter (SN):	CPC 3772 SN3772174001
Location of the quality assurance:	TROPOS Leipzig, lab 118
Comparison period:	October 15, 2018 – October 19, 2018
Last Intercomparison (with Project No.):	

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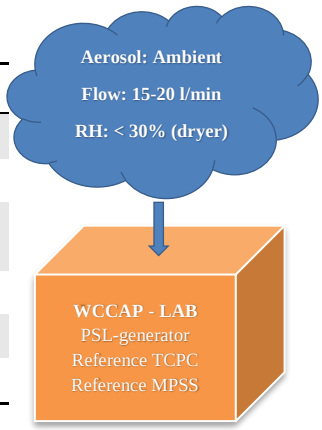
Summary of Intercomparison:

Pre-Status:
The candidate from DE-IUTA Mülheim-Styrum participated in the ACTRIS workshop from October 15, 2018 to October 19, 2018 with the participant. On Tuesday, October 16th, after the CPC-Workshop the setup was done in the TROPOS Lab 118. 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 3% higher than the TROPOS Reference Instrument No.1. The TSI CPC 3772 passed the CPC Workshop. For more information, please look at the CPC-workshop report. During the workshop week the whole candidate was checked and cleaned. The participant was instructed and trained how to optimize his instrument. Farther we talked about the station setup and quality assurance.

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% higher than the TROPOS Reference Instrument No.1. The candidate passed the standards of ACTRIS and GAW.

Laboratory Setup and Legend

Candidates
DE-HLNUG Schwanheim MPSS 001
DE-HLNUG Raunheim MPSS 002
DE-HLNUG mobile Messstation MPSS 003
DE-HLNUG Labor UNH MPSS 004
DE-HLNUG Labor MPSS 005
DE-IUTA Mülheim-Styrum



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

Legend for plots:
- MC = multiple charge correction
- DL = diffusion loss correction
- CE = CPC efficiency curve
- AL = additional loss corrections

Lab setup:

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TROPOS Reference Instruments No. 1 and No. 6

October 15 – October 16, 2018: Time Series, Particle Number Size Distribution and Correlation

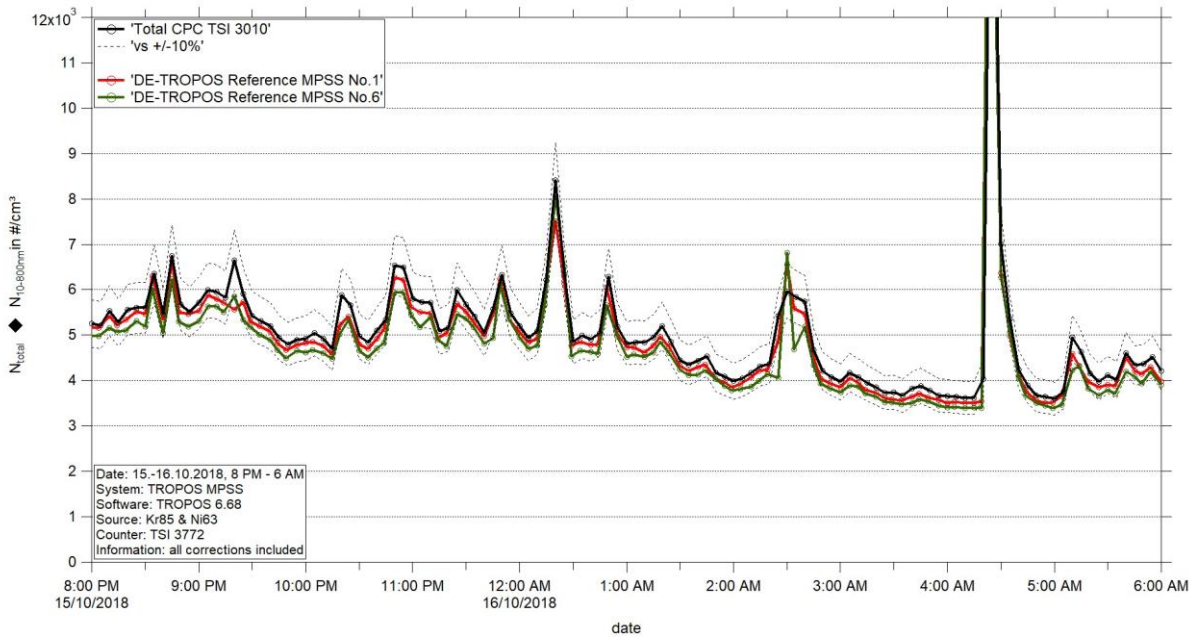

Figure 01: Time series (October 15, 2018 8 PM – October 16, 2018 6 AM) of the integrated particle number concentration ($N_{10\text{-}800nm}$) of the TROPOS Reference MPSS and total number concentration (N_{total}) of the Reference TSI-CPC Model 3010. Multiple charge correction, internal diffusion losses and CPC flow corrections are included.

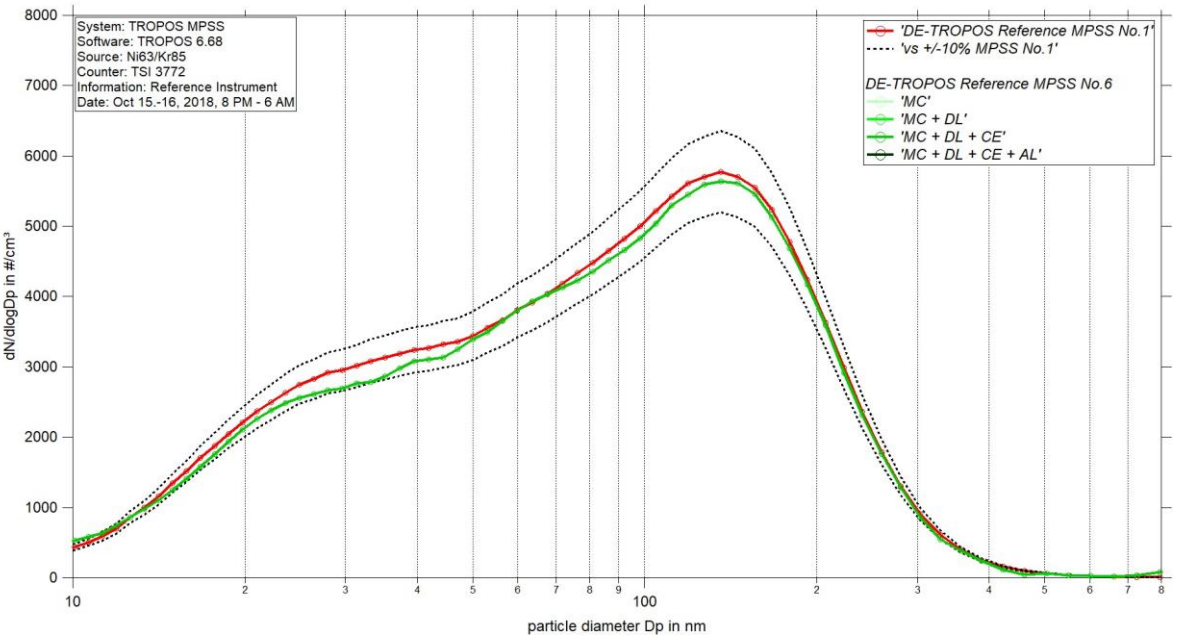

Figure 02: Comparison of mean particle number size distribution of TROPOS Reference MPSS No.1 against TROPOS Reference MPSS No.6 from October 15, 2018 8 PM – October 16, 2018 6 AM. Multiple charge correction, internal diffusion losses and CPC efficiency are included in different steps.

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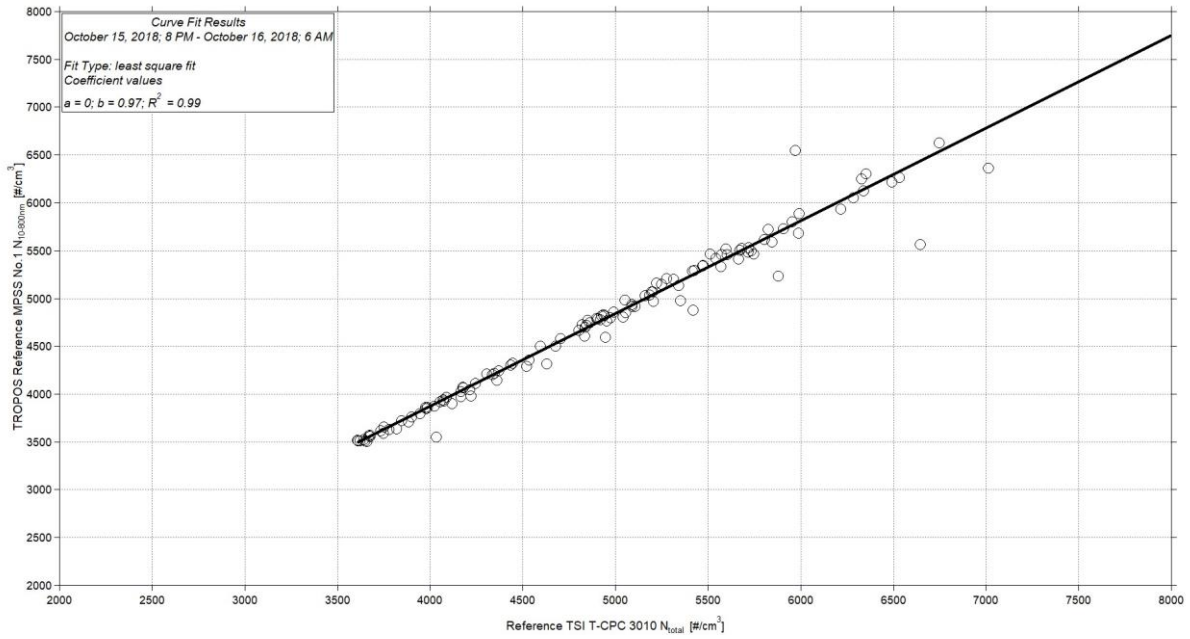

Figure 03: Linear regression between the number concentrations of the TROPOS Reference TSI T-CPC Model 3010 and TROPOS Reference MPSS No.1. Multiple charge correction, internal diffusion losses and CPC efficiency are included.

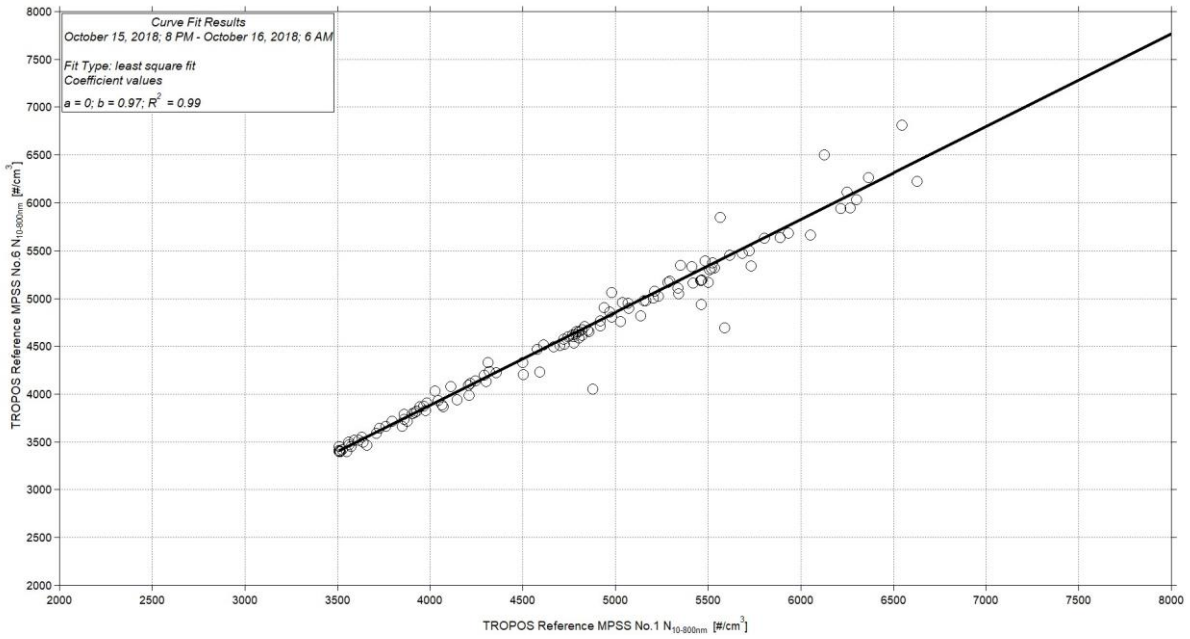

Figure 04: Linear regression between the number concentrations of the TROPOS Reference MPSS No.1 and TROPOS Reference MPSS No.6. Multiple charge correction, internal diffusion losses and CPC efficiency are included.

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PSL Scan: Latex 203 nm +/- 4 nm

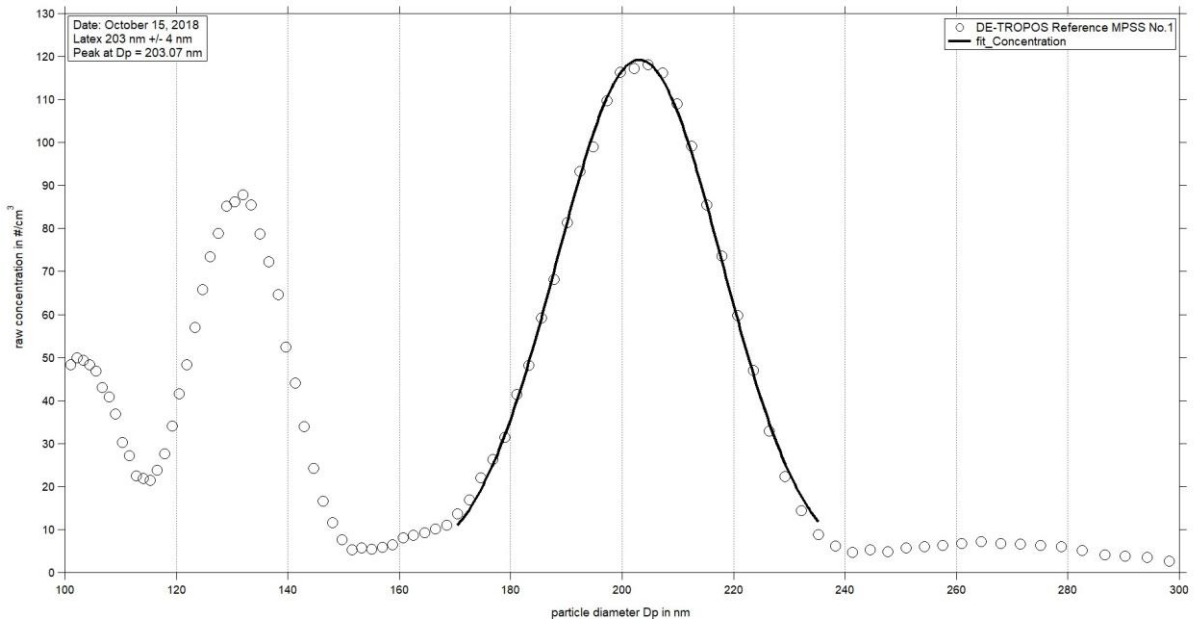

Figure 05: Measurement of latex 203 nm - Reference MPSS No.1: Particle size distribution (raw concentration) for latex 203 nm on October 15th 2018.

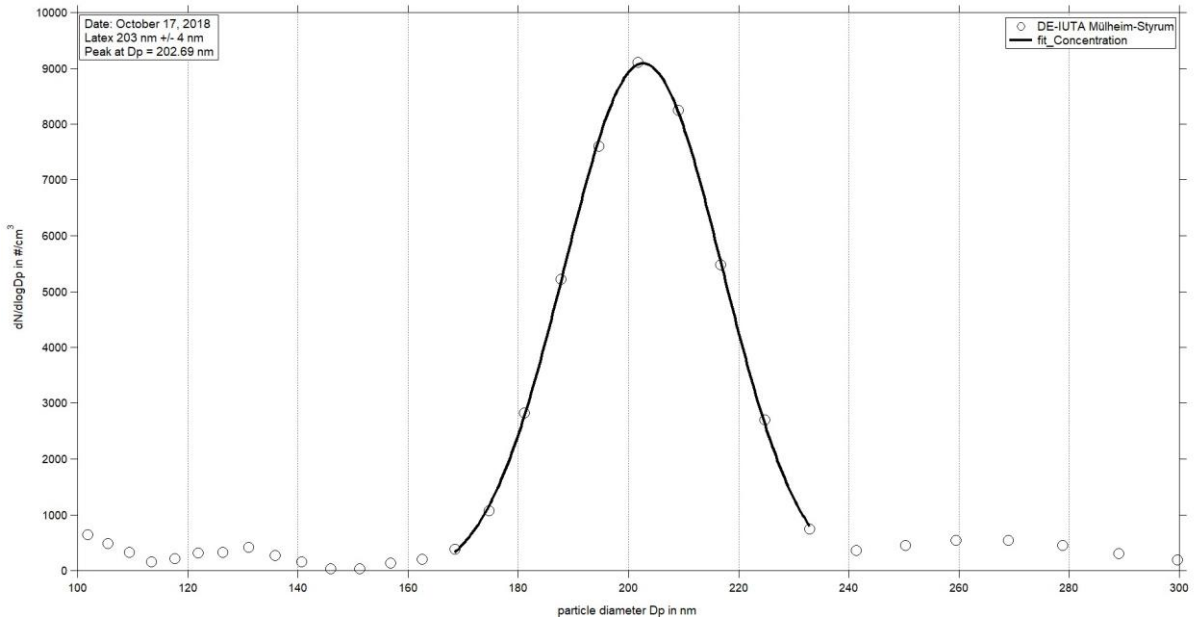

Figure 06: Measurement of latex 203 nm – DE-IUTA Mülheim-Styrum: Particle size distribution for latex 203 nm on October 17th 2018.

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Pre-Status October 16 – 17, 2018

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

Institute: **IUTA**							
Station: **Mülheim-Styrum**							
Date of checking list: **October 16, 2019**							
Instrument/ Components	*info*	*SN*	*Date/Code*	*CPC-Status*		*HV-Status*	
MPSS/Classifier:	**TSI 3080**	**70446143**		*ST*	**39.0**	*OFF*	**0.1**
Firmware Classifier:				*CT*	**22.0**	*0 V*	
Firmware Software:	**AIM 10**			*OT*	**40.0**	*10 V*	**9.6**
DMA type:	**TSI 3081**	**70442917**		*CabT*	**31.9**	*1000 V*	**998.8**
CPC model:	**TSI 3772**	**3772174001**		*AP*	**98.6**	*800 V*	**799.0**
Firmware CPC:	**2.16**			*OP*	**72.7**	*600 V*	**599.4**
radioactive source:	**Kr.85**		**2005**	*NP*	**2.5**	*400 V*	**399.5**
Flow CPC (l/min):	**1.03**			*LC*	**39.0**	*250 V*	**249.7**
Flow Inlet (l/min):	**1.02**					*20 V*	**19.8**
Flow Display (l/min):	**1.12**					*10 V*	**9.6**
Zero (#/cm³):	**0**					*OFF*	**0.1**
Maintenance							
Aerosol inlet:							
Aerosol Nafion dryer:							
Sheath Nafion dryer:							
Source:							
HV power supply:							
DMA:							
Aerosol/sheath RH/T- sensor:							
Pressure sensor:							
Filter:							
NI-card:							

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*	**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):	**1.02**			*LC*	**50**		
Zero (#/cm³):	**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 (#/cm³):	**0**			*CabT*			
				AP			
				OP			
				NP			
				LC			

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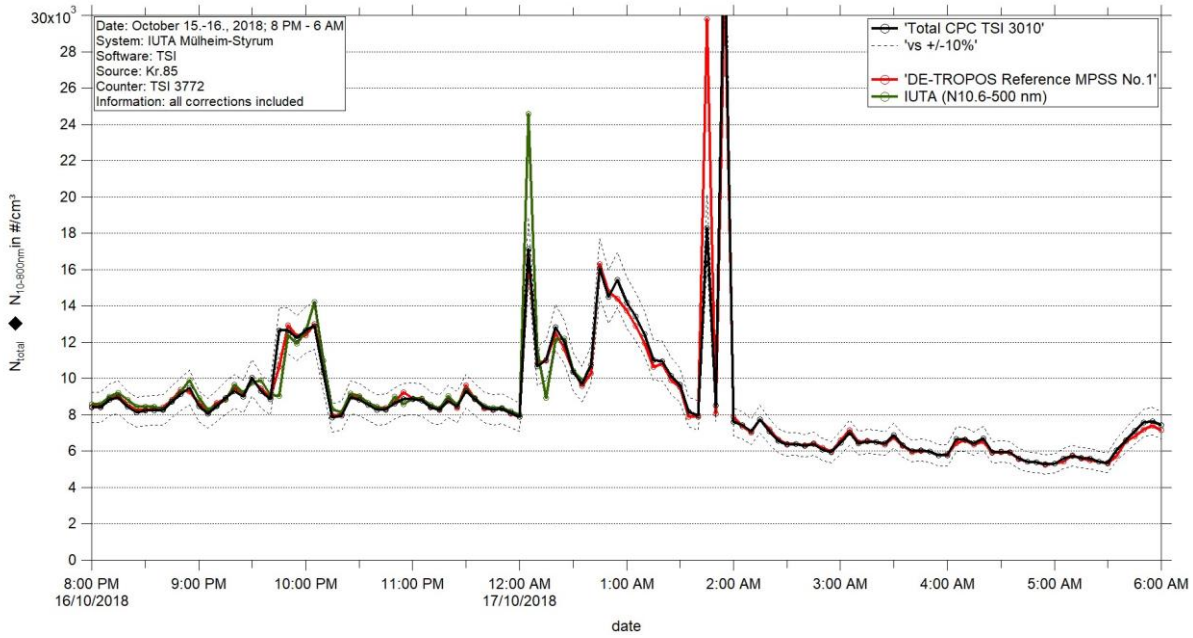

Figure 07: Time series (October 16, 2018 8 PM – October 17, 2018 6 AM) of the integrated particle number concentration ($N_{10\text{-}800nm}/N_{7\text{-}300nm}$) of the MPSS and total number concentration (N_{total}) of the Reference TSI-CPC Model 3010. Multiple charge correction, internal diffusion losses and CPC flow corrections are included. The candidate is running with the TSI X-ray source.

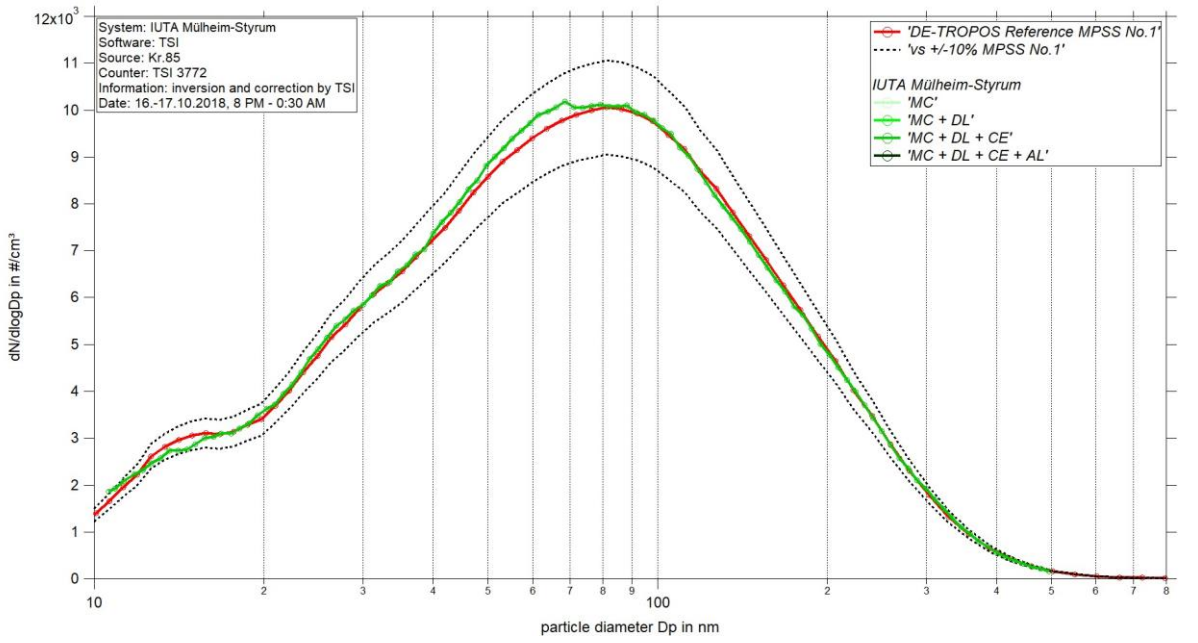

Figure 08: Comparison of mean particle number size distribution of TROPOS Reference MPSS No.1 against DE-IUTA Mülheim-Styrum from October 16, 2018 8 PM – October 17, 2018 00:30 AM. Multiple charge correction, internal diffusion losses and CPC efficiency are included in different steps.

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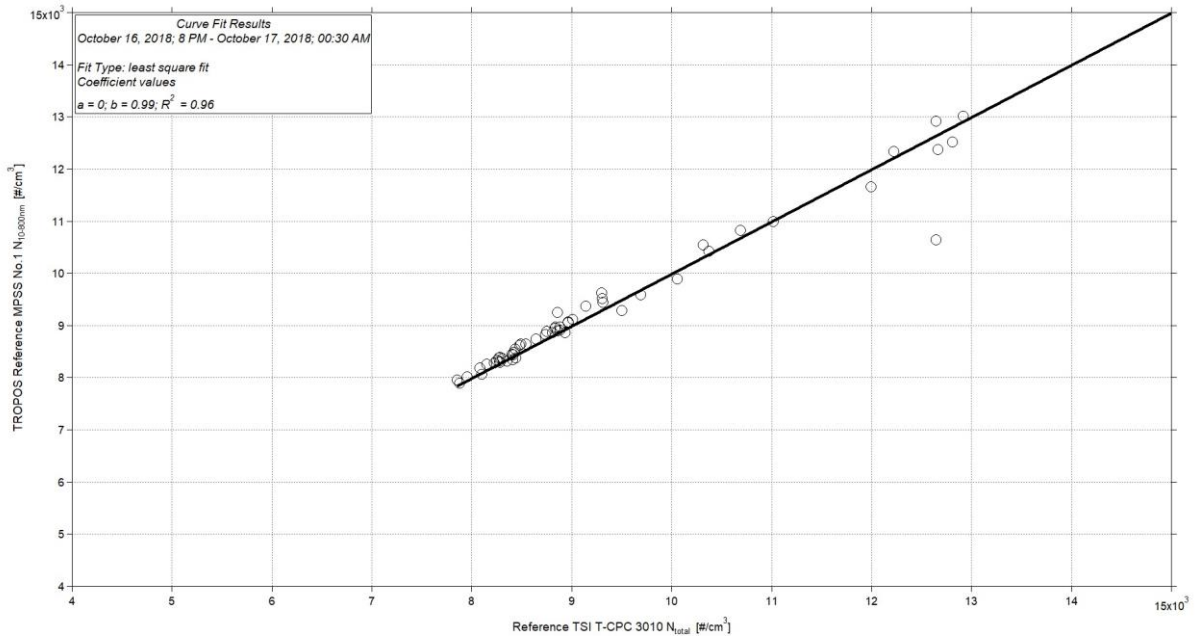

Figure 09: Linear regression between the number concentrations of the TROPOS Reference TSI T-CPC Model 3010 and TROPOS Reference MPSS No.1. Multiple charge correction, internal diffusion losses and CPC efficiency are included.

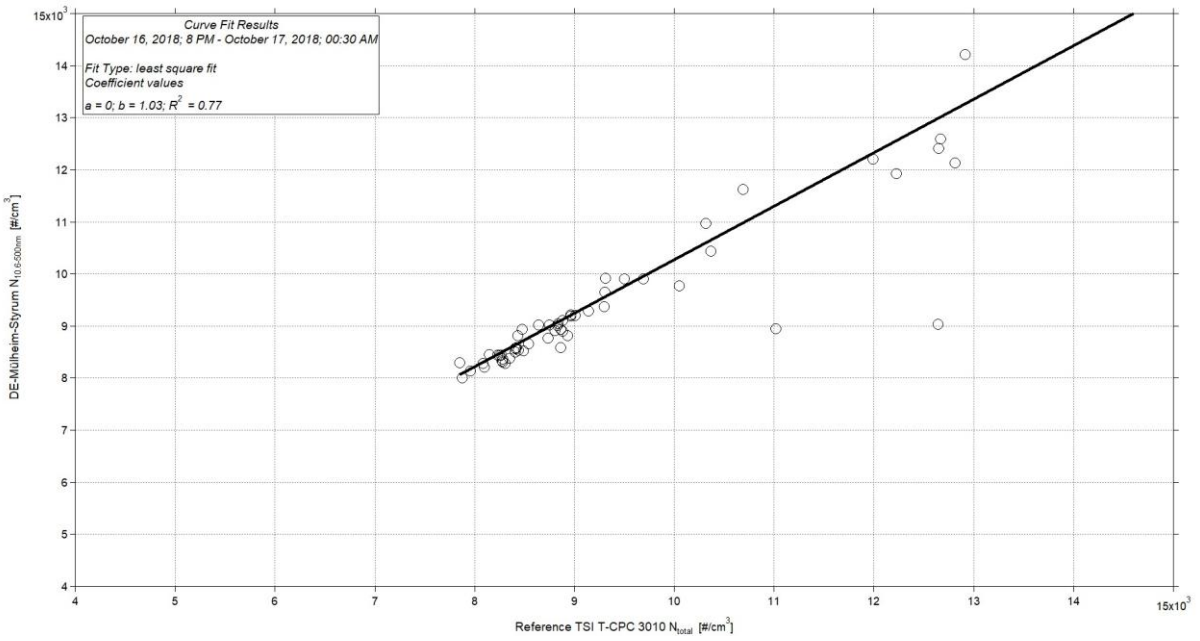

Figure 10: Linear regression between the number concentrations of the TROPOS Reference TSI T-CPC Model 3010 and DE-IUTA Mülheim-Styrum. Multiple charge correction, internal diffusion losses and CPC efficiency are included.

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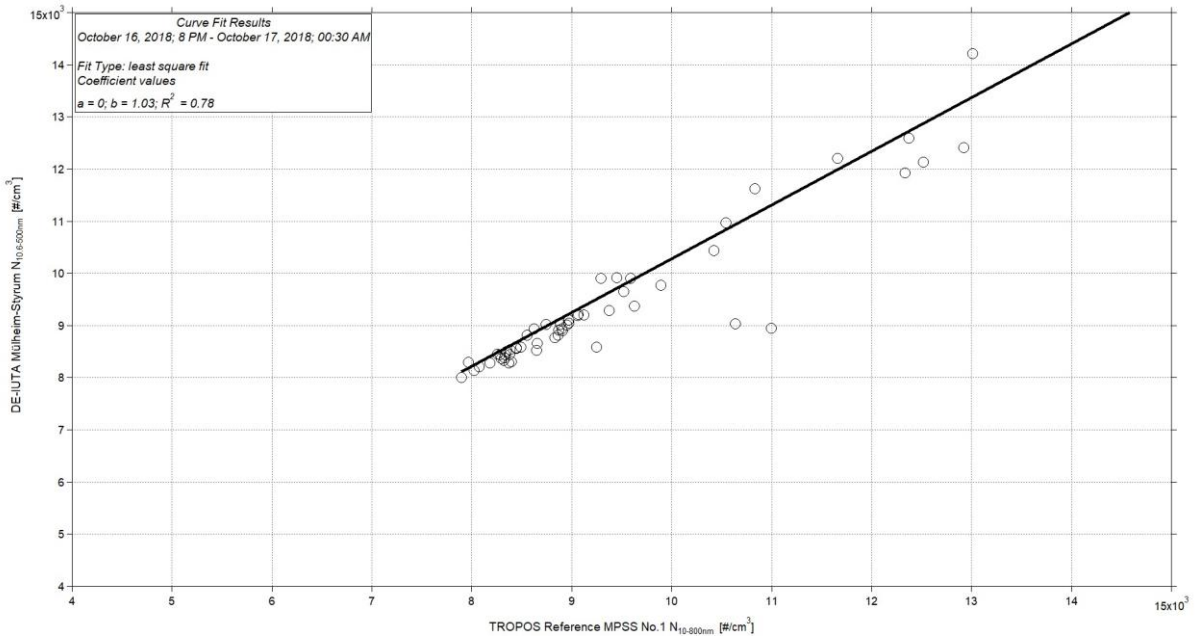

Figure 11: Linear regression between the number concentrations of the TROPOS Reference MPSS No.1 and DE-IUTA Mülheim Styrum. Multiple charge correction, internal diffusion losses and CPC efficiency are included.

Final-Status October 18 – 19, 2018

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

Institute: **IUTA**							
Station: **Mülheim-Styrum**							
Date of checking list: **October 18, 2019**							
Instrument/ Components	*info*	*SN*	*Date/Code*	*CPC-Status*		*HV-Status*	
MPSS/Classifier:	**TSI 3080**	**70446143**		*ST*		*OFF*	
Firmware Classifier:				*CT*		*0 V*	
Firmware Software:	**AIM 10**			*OT*		*10 V*	
DMA type:	**TSI 3081**	**70442917**		*CabT*		*1000 V*	
CPC model:	**TSI 3772**	**3772174001**		*AP*		*800 V*	
Firmware CPC:	**2.16**			*OP*		*600 V*	
radioactive source:	**Kr.85**		**2005**	*NP*		*400 V*	
Flow CPC (l/min):				*LC*		*250 V*	
Flow Inlet (l/min):	**1.013**					*20 V*	
Flow Display (l/min):						*10 V*	
Zero (#/cm³):	**0**					*OFF*	
Maintenance							
Aerosol inlet:		**checked**					
Aerosol Nafion dryer:							
Sheath Nafion dryer:							
Source:		**checked**					
HV power supply:		**checked**					
DMA:		**checked and cleaned**					
Aerosol/sheath RH/T- sensor:							
Pressure sensor:							
Filter:							
NI-card:							

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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):	**1.03**			*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	

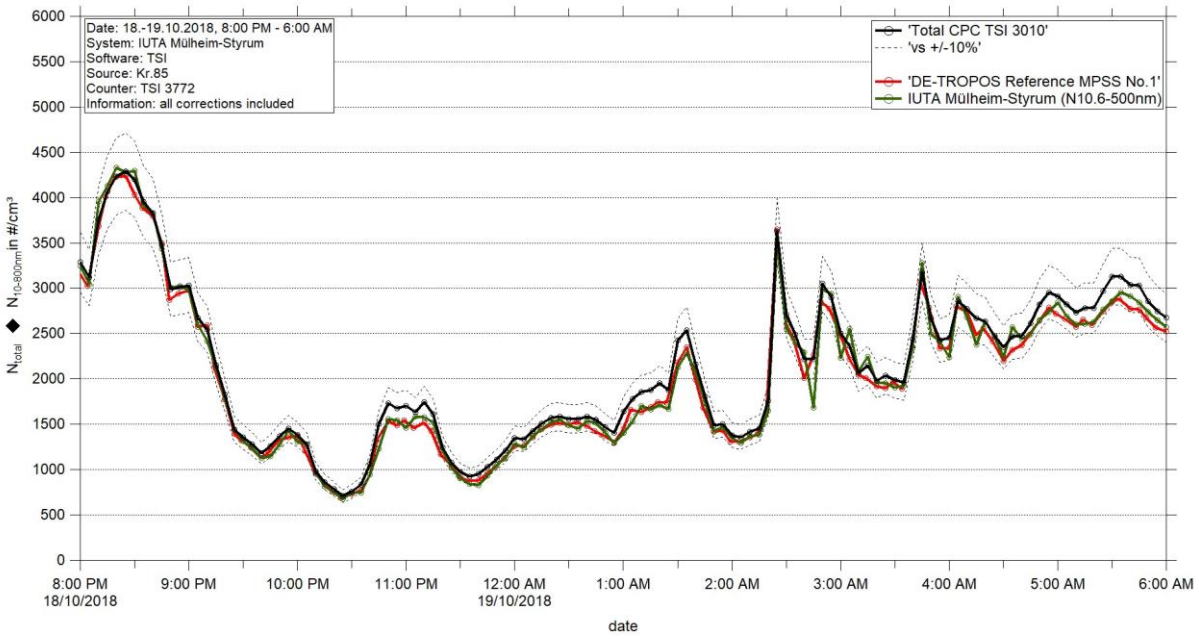

Figure 12: Time series (October 18, 2018 8 PM – October 19, 2018 6 AM) of the integrated particle number concentration ($N_{10\text{-}800nm}/N_{10.6\text{-}500nm}$) of the MPSS and total number concentration (N_{total}) of the Reference TSI-CPC Model 3010. Multiple charge correction, internal diffusion losses and CPC flow corrections are included.

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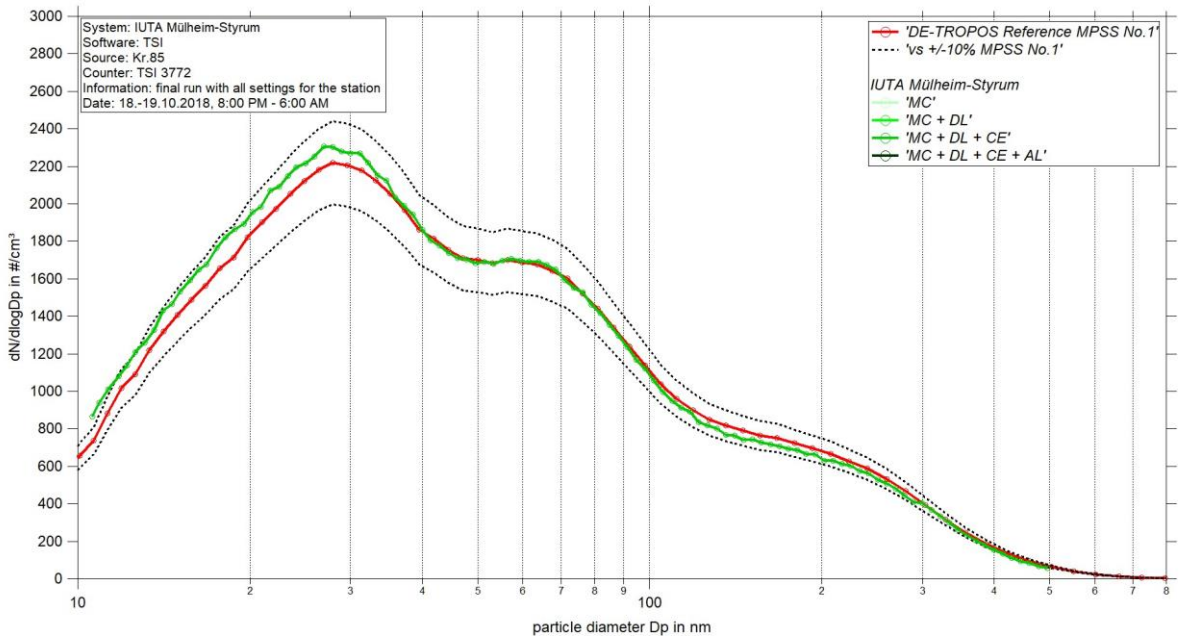

Figure 13: Comparison of mean particle number size distribution of TROPOS Reference MPSS No.1 against DE-IUTA Mülheim-Styrum from October 18, 2018 8 PM – October 19, 2018 6 AM. Multiple charge correction, internal diffusion losses and CPC efficiency are included in different steps.

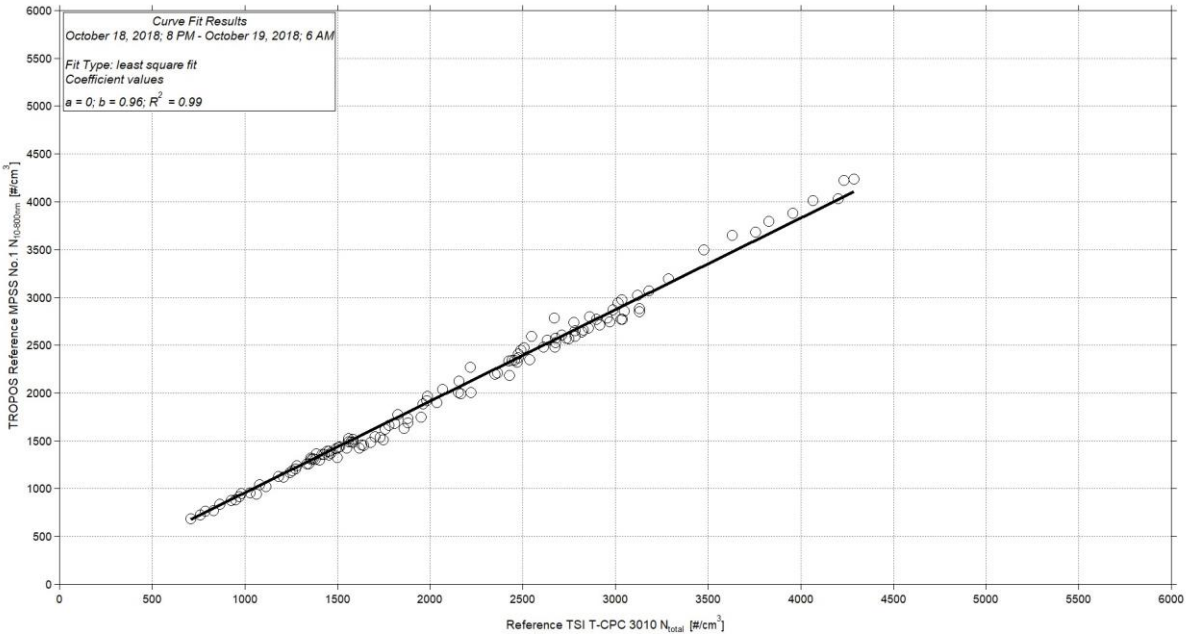

Figure 14: Linear regression between the number concentrations of the TROPOS Reference TSI T-CPC Model 3010 and TROPOS Reference MPSS No.1. Multiple charge correction, internal diffusion losses and CPC efficiency are included.

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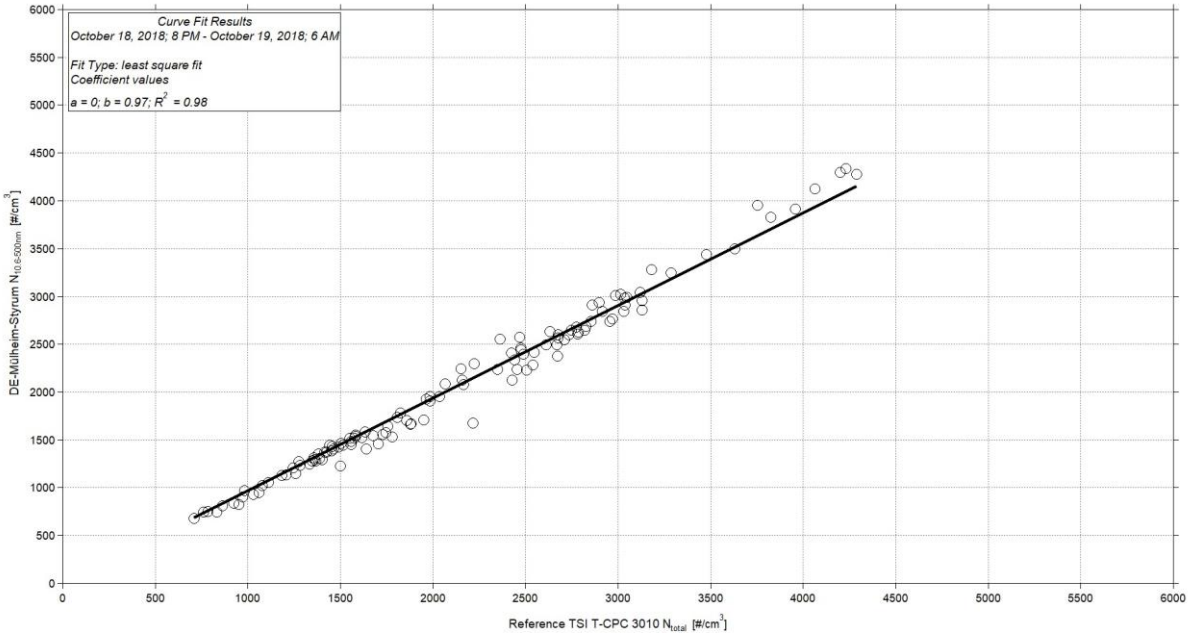

Figure 15: Linear regression between the number concentrations of the TROPOS Reference TSI T-CPC Model 3010 and DE-IUTA Mülheim-Styrum. Multiple charge correction, internal diffusion losses and CPC efficiency are included.

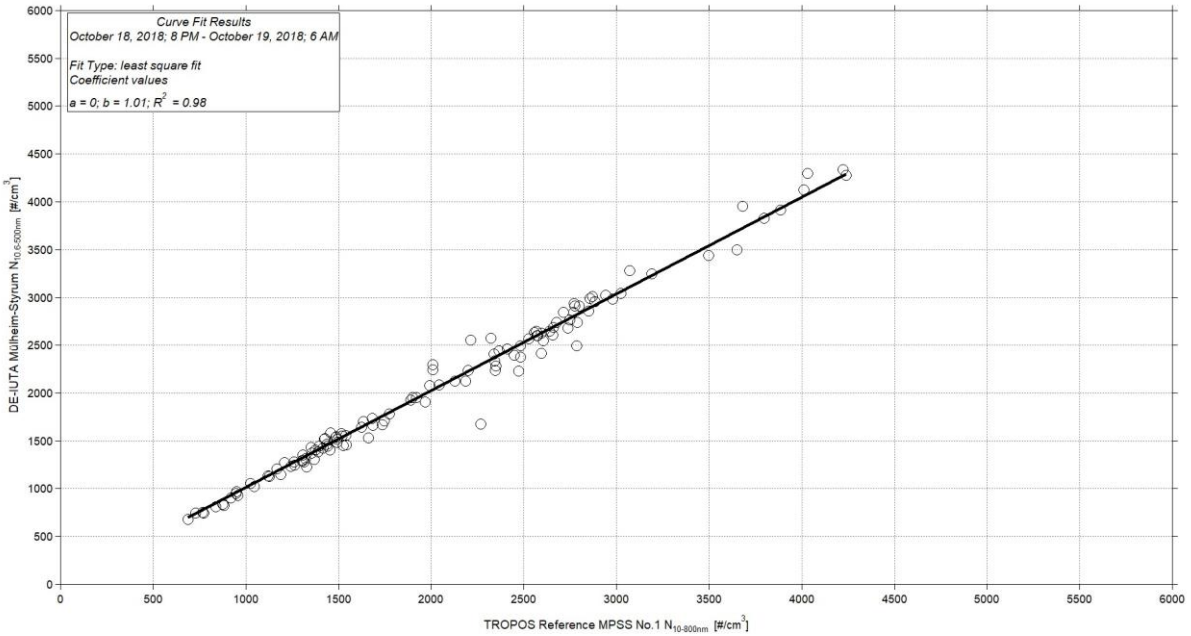

Figure 16: Linear regression between the number concentrations of the TROPOS Reference MPSS No.1 and DE-IUTA Mülheim Styrum. Multiple charge correction, internal diffusion losses and CPC efficiency are included.

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