

## Intercomparison of Mobility Particle Size Spectrometers

*Project No.:* MPSS-2019-3-6

*Principal Investigator:* Stephan Weber

*Home Institution:* Technische Universität Braunschweig

*Participant:*

*Candidate:* TSI MPSS TU-Braunschweig

*Made by:* TSI

*Counter (SN):* TSI CPC 3787 SN3787111801

*Location of the quality assurance:* TROPOS Leipzig, lab 118

*Comparison period:* June 03, 2019 – June 07, 2019

*Last Intercomparison (with Project No.):*

## Summary of Intercomparison:

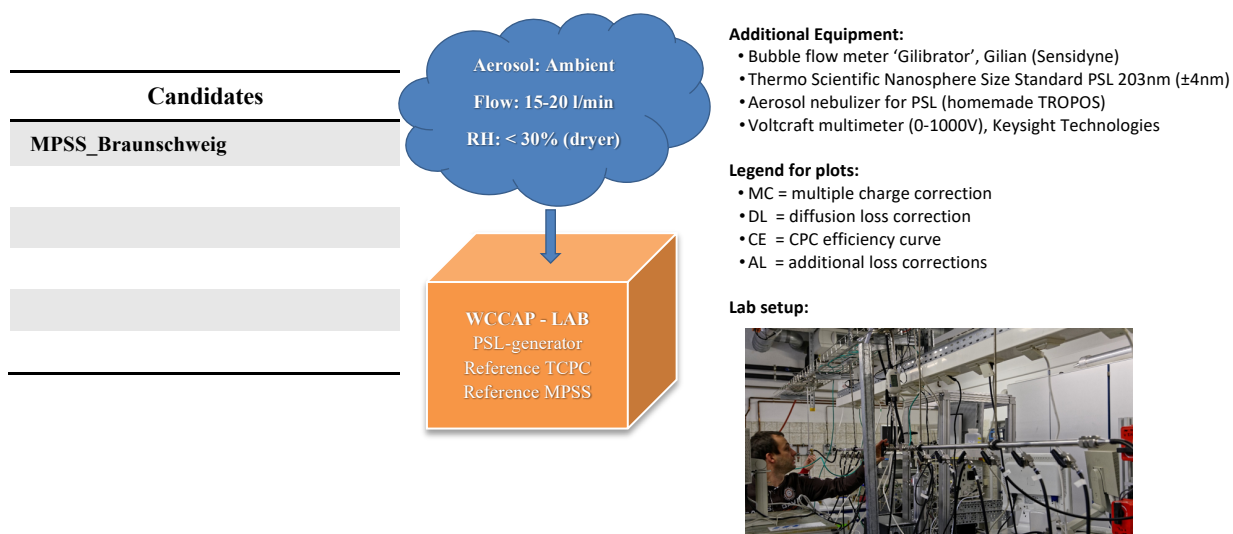
### Pre-Status:

The candidate from TU-Braunschweig MPSS participated in the ACTRIS workshop from June 03, 2018 to June 07, 2019 with the participant. The setup of the candidate was done on Monday, June 03<sup>rd</sup>, 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 53% lower than the TROPOS Reference Instrument No.1. The candidate used a bypass between DMA and counter, what is typical for TSI MPSS systems. TROPOS recommend to not use this bypass anymore. On Tuesday, June 04<sup>th</sup>, 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 3787 did not pass 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:

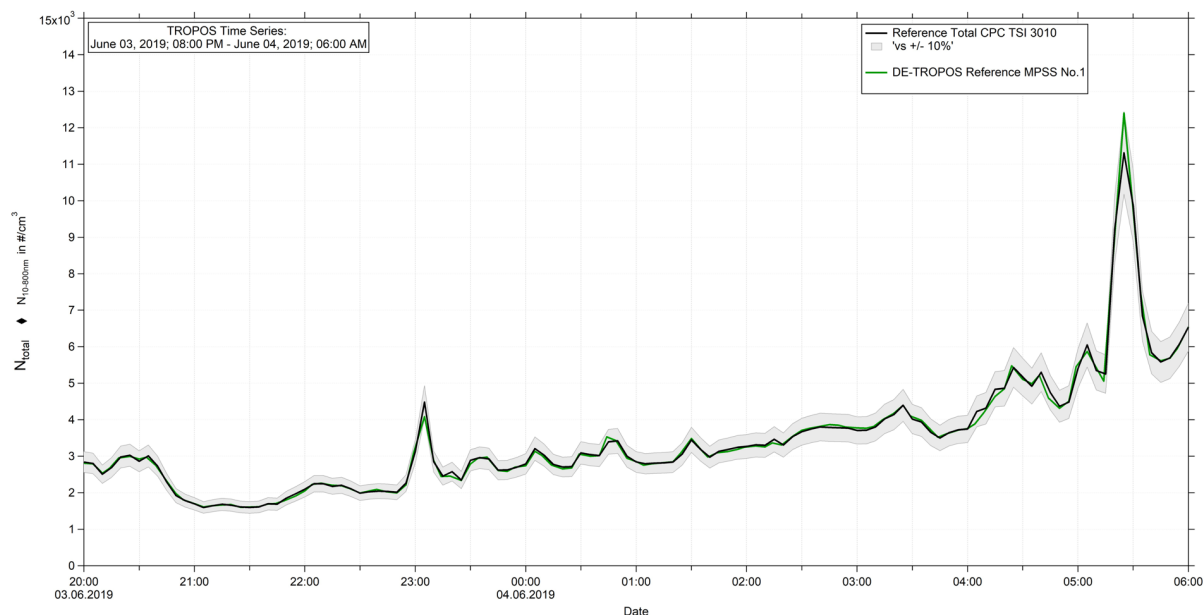
The final run took place from June 04 to June 05, 2019 Running the candidate using the original source Kr.85 and a TROPOS TSI CPC 3772 SN3772142501 and the TROPOS Reference CPC No.1 the performance showed a concentration 4% lower than the TROPOS Reference Instrument No.1. The original CPC from TU-Braunschweig MPSS had technical problems they can't solve. TROPOS recommend TU to send the TSI CPC 3787 back to TSI for maintenance, TROPOS also recommends TU to send the MPSS back to TROPOS once the CPC is performing properly or with a different CPC. The candidate did not pass the standards of ACTRIS and GAW under the conditions, using the TROPOS Reference CPC No.1.

## Laboratory Setup and Legend

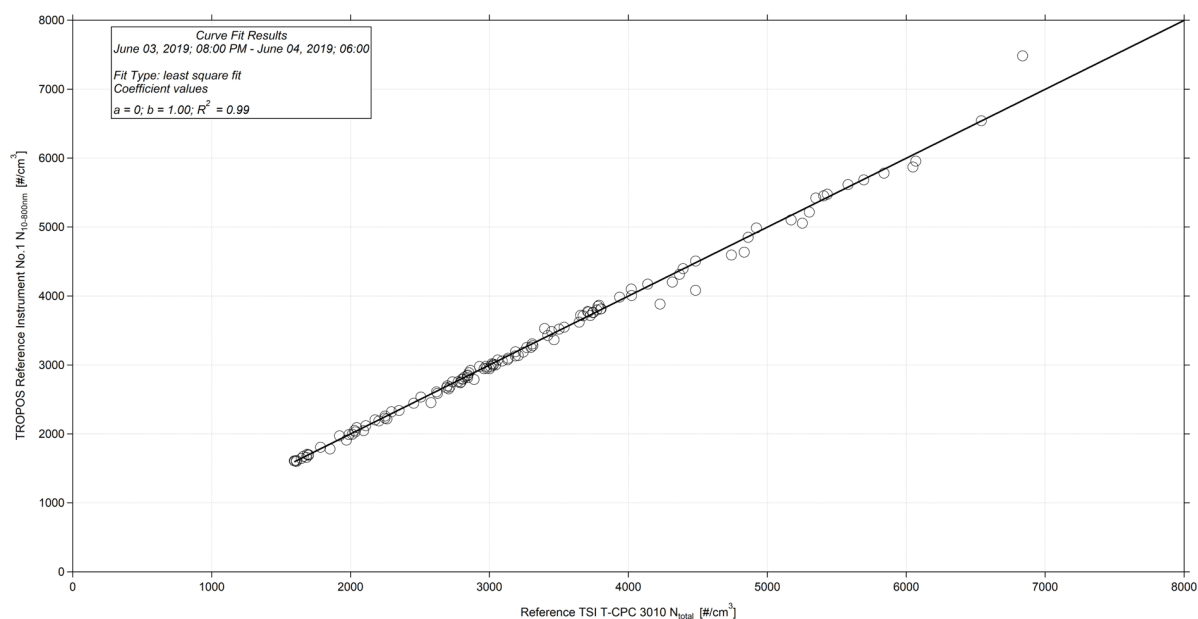


## **TROPOS Reference Instruments No. 1 and TROPOS Reference T-CPC 3010**

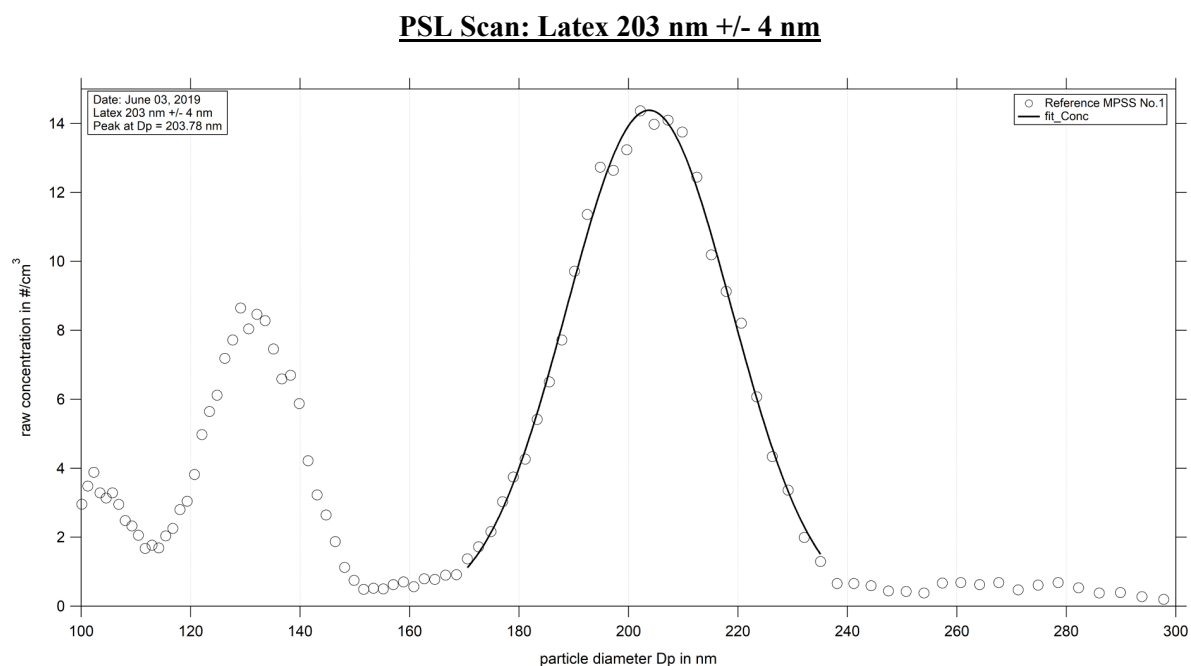
### **June 03 – June 04, 2019: Time Series, Particle Number Size Distribution and Correlation**



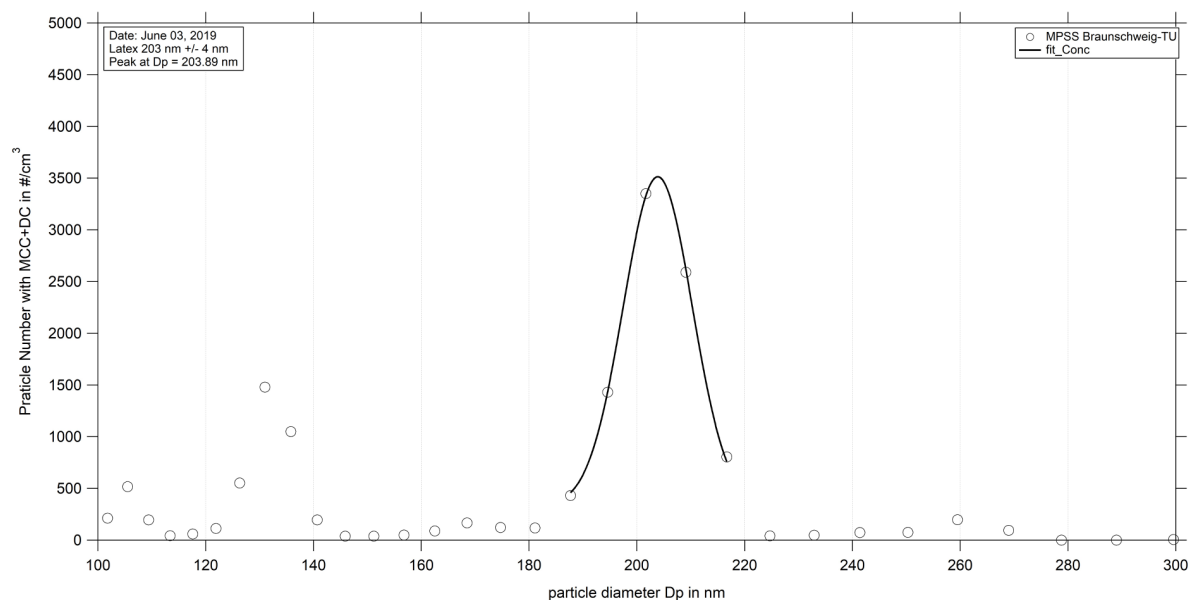
**Figure 01:** Time series (June 03, 2019 8 PM – June 04, 2019 6 AM) of the integrated particle number concentration ( $N_{10-800nm}$ ) of the TROPOS Reference MPSS and total number concentration ( $N_{total}$ ) of the Reference TSI-CPC Model 3010. Multiple charge correction, internal diffusion losses and CPC flow corrections are included.



**Figure 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 05:** Measurement of latex 203 nm - Reference MPSS No.1: Particle size distribution (raw concentration) for latex 203 nm on June 03<sup>rd</sup> 2018.



**Figure 06:** Measurement of latex 203 nm for the candidate TU-Braunschweig MPSS: Particle size distribution for latex 203 nm on June 03<sup>rd</sup> 2019 with a peak at 203.89 nm.

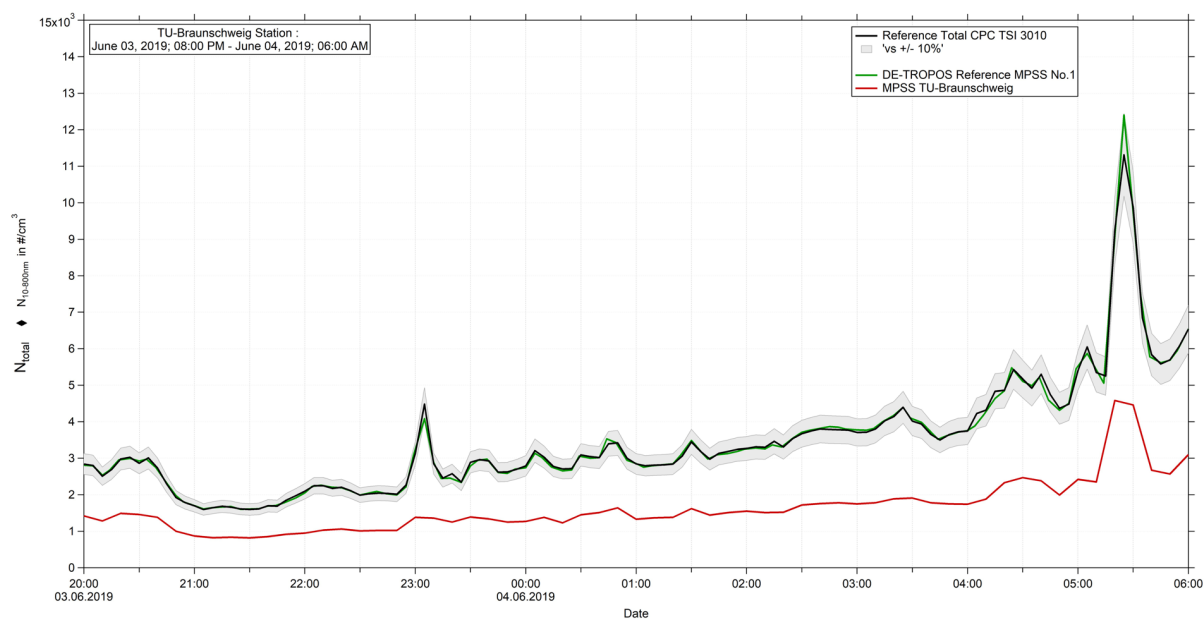
**Pre-Status June 03 – 04, 2019****Instrument Settings, Time Series, Particle Number Size Distribution and Correlation**

Table No. 1:

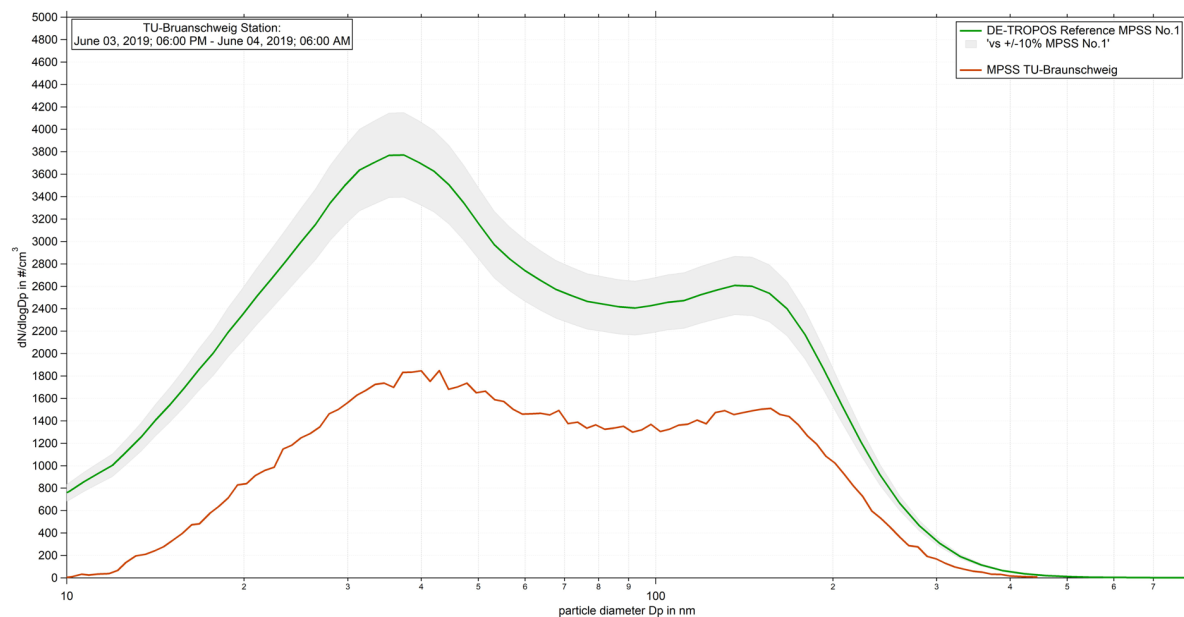
<i>Institute: TSI SMPS TU-Braunschweig</i>							
<i>Station: Braunschweig</i>							
<i>Date of checking list: 03.06.2019</i>							
<i>Instrument/ Components</i>	<i>info</i>	<i>SN</i>	<i>Date/Code</i>	<i>CPC-Status</i>		<i>HV-Status</i>	
<i>MPSS/Classifier:</i>	<b>TSI 308200</b>	<b>3082001407002</b>		<i>ST</i>		<i>OFF</i>	<b>-0.1</b>
<i>Firmware Classifier:</i>				<i>CT</i>		<i>5 V</i>	
<i>Firmware Software:</i>				<i>OT</i>		<i>10 V</i>	
<i>DMA type:</i>	<b>TSI DMA</b>			<i>CabT</i>		<i>1000 V</i>	
<i>CPC model:</i>	<b>TSI CPC 3787</b>	<b>3787111801</b>		<i>AP</i>		<i>250 V</i>	
<i>Firmware CPC:</i>				<i>OP</i>		<i>5 V</i>	
<i>radioactive source:</i>	<b>Kr.85</b>	<b>77-0702</b>		<i>NP</i>		<i>400 V</i>	
<i>Flow CPC (l/min):</i>				<i>LC</i>		<i>600 V</i>	
<i>Flow Inlet (l/min):</i>						<i>800 V</i>	
<i>Flow Display (l/min):</i>						<i>700 V</i>	
<i>Zero (#/cm<sup>3</sup>):</i>						<i>650 V</i>	
<i>Maintenance</i>							
<i>Aerosol inlet:</i>							
<i>Aerosol Nafion dryer:</i>							
<i>Sheath Nafion dryer:</i>							
<i>Source:</i>							
<i>HV power supply:</i>							
<i>DMA:</i>							
<i>Aerosol/sheath RH/T- sensor:</i>							
<i>Pressure sensor:</i>							
<i>Filter:</i>							
<i>NI-card:</i>							
<i>CPC:</i>							
<i>Impactor:</i>	<b>0.0457 CM</b>						
<i>Setup settings over night:</i>	<b>Bypass between DMA and TSI CPC 3787</b>						

<i>Institute: TROPOS</i>							
<i>Station: Reference Instrument No.1</i>							
<i>Date of checking list: June 03, 2019</i>							
<i>Instrument/ Components</i>	<i>info</i>	<i>Serial Number</i>	<i>Date/Code</i>	<i>CPC-Status</i>		<i>HV-Status</i>	
<i>MPSS/Classifier:</i>	<b>TROPOS</b>	<b>No.1</b>		<i>ST</i>	<b>39.0</b>	<i>0 V</i>	<b>0</b>
<i>Firmware Classifier:</i>				<i>CT</i>	<b>22.0</b>	<i>5 mV</i>	<b>4.98</b>
<i>Firmware Software:</i>	<b>TROPOS 6.68</b>			<i>OT</i>	<b>40.0</b>	<i>800 mV</i>	<b>999.8</b>
<i>DMA type:</i>	<b>Hauke medium</b>		<b>142</b>	<i>CabT</i>	<b>27.3</b>	<i>200 mV</i>	<b>250.0</b>
<i>CPC model:</i>	<b>TSI 3772</b>	<b>3772141701</b>		<i>AP</i>	<b>98.5</b>	<i>0 V</i>	<b>0</b>
<i>Firmware CPC:</i>	<b>2.15</b>			<i>OP</i>	<b>72.1</b>		
<i>Radioactive source:</i>	<b>Kr.85</b>	<b>NER 8275</b>	<b>002/13</b>	<i>NP</i>	<b>2.8</b>		
<i>Flow Inlet (l/min):</i>	<b>1.031</b>			<i>LC</i>	<b>50</b>		
<i>Zero (#/cm<sup>3</sup>):</i>	<b>0</b>						

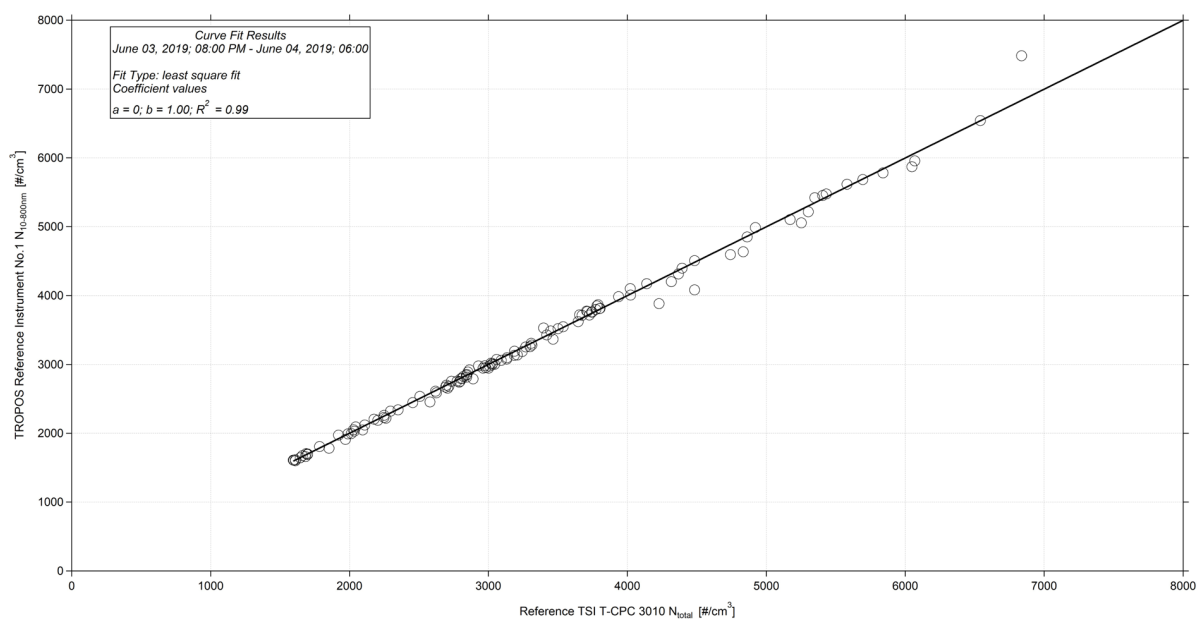
<b>Institute: TROPOS</b>					
<b>Station: Reference Total CPC</b>					
<b>Date of checking list: June 03, 2019</b>					
Instrument/ Components	info	Serial Number	Cut off	CPC-Status	
CPC model:	TSI 3010	2410	D <sub>p50</sub> 10 nm	ST	
Firmware CPC:	2.15			CT	
Flow Inlet (l/min):	1.015			OT	
Zero (#/cm <sup>3</sup> ):	0			CabT	
				AP	
				OP	
				NP	
				LC	



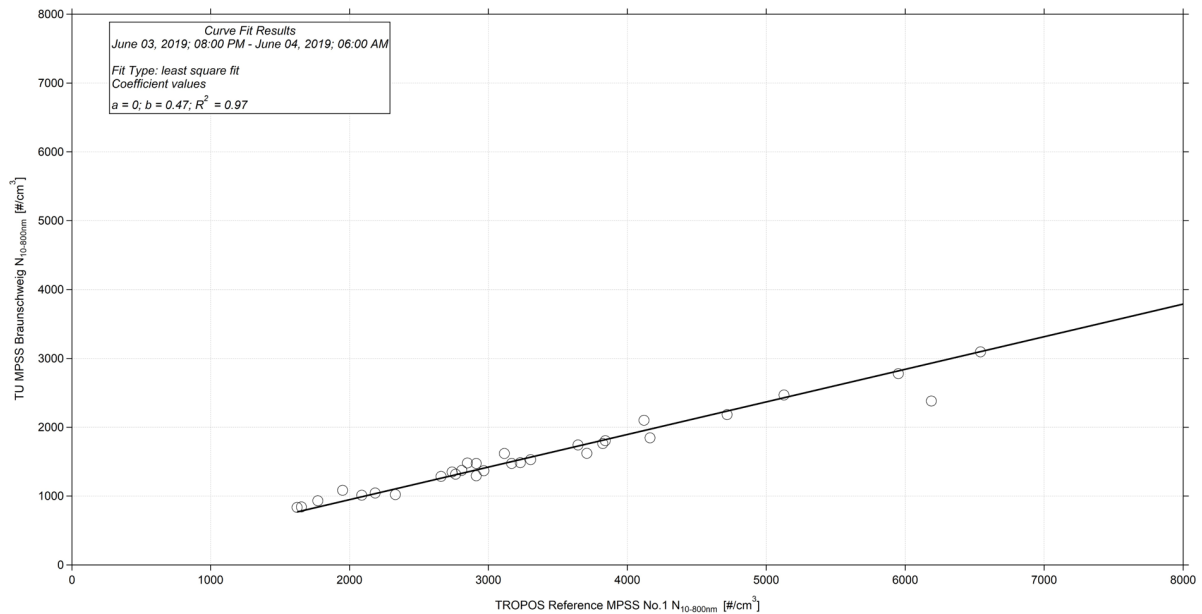
**Figure 08:** Time series (June 03, 2019 8 PM – June 04, 2019 6 AM) of the integrated particle number concentration ( $N_{10-800\text{nm}}$ ) of the MPSS and total number concentration ( $N_{\text{total}}$ ) of the Reference TSI-CPC Model 3010. Multiple charge correction, internal diffusion losses and 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 TU-Braunschweig MPSS from June 03, 2019 8 PM – June 04, 2019 06:00 AM. Multiple charge correction, internal diffusion losses and CPC efficiency are included in different steps.



**Figure 10:** 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 MPSS No.1 and TU-Braunschweig MPSS. Multiple charge correction, internal diffusion losses and CPC efficiency are included.



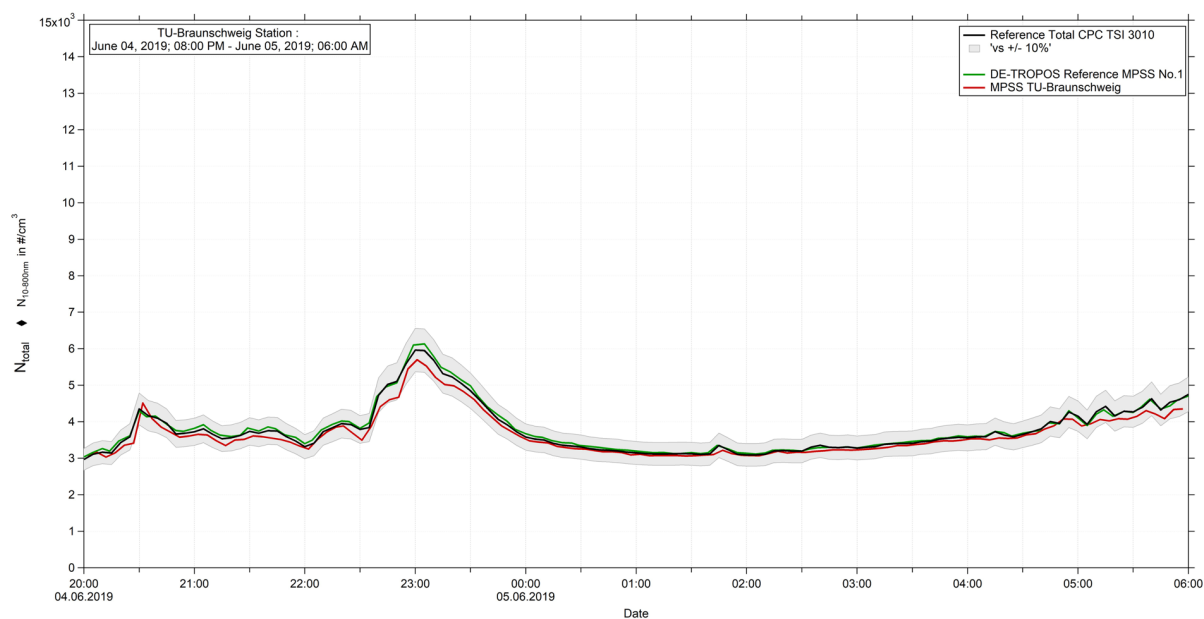
**Status June 04 – 05, 2018****Instrument Settings, Time Series, Particle Number Size Distribution and Correlation**

Table No. 2:

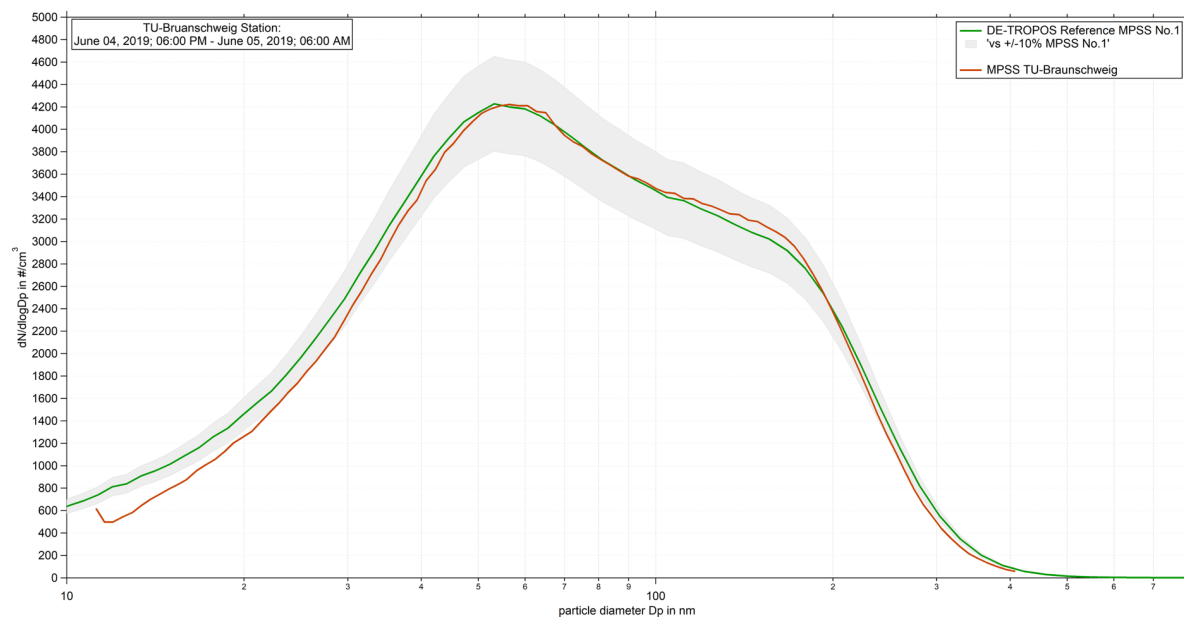
Institute: <b>TU</b>							
Station: <b>Braunschweig</b>							
Date of checking list: <b>04.06.2019</b>							
Instrument/ Components	info	SN	Date/Code	CPC-Status		HV-Status	
MPSS/Classifier:	<b>TSI 308200</b>			ST		OFF	
Firmware Classifier:				CT		5 V	
Firmware Software:				OT		10 V	
DMA type:	<b>TSI DMA</b>			CabT		1000 V	
CPC model:	<b>TSI CPC 3772</b>	<b>3772142501</b>	<b>ERFE</b>	AP		250 V	
Firmware CPC:				OP		5 V	
radioactive source:	<b>Kr.85</b>			NP		400 V	
Flow CPC (l/min):				LC		600 V	
Flow Inlet (l/min):	<b>1.014</b>					800 V	
Flow Display (l/min):						700 V	
Zero (#/cm <sup>3</sup> ):						650 V	
<i>Maintenance</i>							
Aerosol inlet:							
Aerosol Nafion dryer:							
Sheath Nafion dryer:							
Source:							
HV power supply:							
DMA:							
Aerosol/sheath RH/T- sensor:							
Pressure sensor:							
Filter:							
NI-card:							
CPC:	<b>Water cpc changed with Ref4 TSI CPC 3772 SN: 3772142501</b>						
Impactor:	<b>Changed to dummy</b>						
Setup settings over night:	<b>Bypass removed</b>						

Institute: <b>TROPOS</b>							
Station: <b>Reference Instrument No.1</b>							
Date of checking list: <b>04.06.2019</b>							
Instrument/ Components	info	Serial Number	Date/Code	CPC-Status		HV-Status	
MPSS/Classifier:	<b>TROPOS</b>	<b>No.1</b>		ST		0 V	
Firmware Classifier:				CT		5 mV	
Firmware Software:	<b>TROPOS 6.68</b>			OT		800 mV	
DMA type:	<b>Hauke medium</b>		<b>142</b>	CabT		200 mV	
CPC model:	<b>TSI 3772</b>	<b>3772141701</b>		AP		0 V	
Firmware CPC:	<b>2.15</b>			OP			
Radioactive source:	<b>Kr.85</b>	<b>NER 8275</b>	<b>002/13</b>	NP			
Flow Inlet (l/min):	<b>1.022</b>			LC			
Zero (#/cm <sup>3</sup> ):	<b>0</b>						

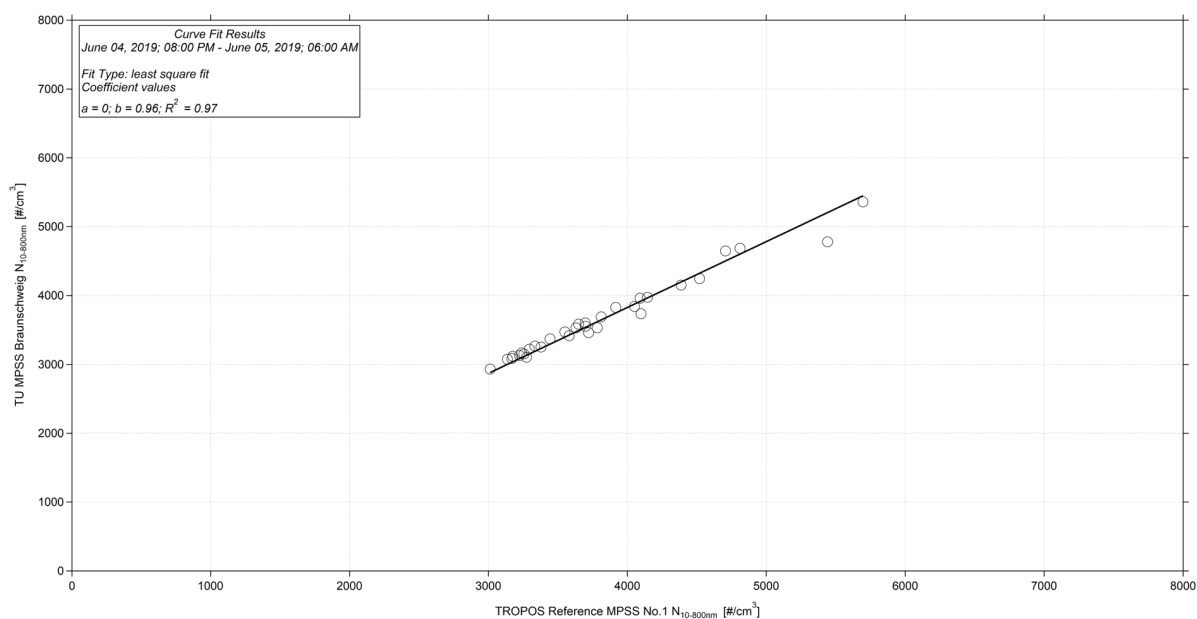
<b>Institute: TROPOS</b>					
<b>Station: Reference Total CPC</b>					
<b>Date of checking list: 04.06.2019</b>					
<i>Instrument/ Components</i>	<i>info</i>	<i>Serial Number</i>	<i>Cut off</i>	<i>CPC-Status</i>	
<i>CPC model:</i>	<b>TSI 3010</b>	<b>2410</b>	<b>D<sub>p50</sub> 10 nm</b>	<i>ST</i>	
<i>Firmware CPC:</i>	<b>2.15</b>			<i>CT</i>	
<i>Flow Inlet (l/min):</i>	<b>1.011</b>			<i>OT</i>	
<i>Zero (#/cm<sup>3</sup>):</i>	<b>0</b>			<i>CabT</i>	
				<i>AP</i>	
				<i>OP</i>	
				<i>NP</i>	
				<i>LC</i>	



**Figure 13:** Time series (June 03, 2019 8 PM – June 04, 2019 6 AM) of the integrated particle number concentration ( $N_{10-800\text{nm}}$ ) of the MPSS and total number concentration ( $N_{\text{total}}$ ) of the Reference TSI-CPC Model 3010. Multiple charge correction, internal diffusion losses and CPC flow corrections are included. The MPSS system is running with TSI CPC 3772 SN3772142501



**Figure 14:** Comparison of median particle number size distribution of TROPOS Reference MPSS No.1 against TU-Braunschweig MPSS from June 04, 2019 8 PM – June 05, 2019 6 AM. Multiple charge correction, internal diffusion losses and CPC efficiency are included in different steps. The MPSS system is running with TSI CPC 3772 SN3772142501



**Figure 15:** Linear regression between the number concentrations of the TROPOS Reference MPSS No.1 and TU-Braunschweig MPSS. Multiple charge correction, internal diffusion losses and CPC efficiency are included.