

Intercomparison of Mobility Particle Size Spectrometers

<i>Project No.:</i>	<i>OSIA-2019-1-4</i>
<i>Principal Investigator:</i>	<i>UBA</i>
<i>Home Institution:</i>	<i>UBA</i>
<i>Participant:</i>	<i>Frank Meinhardt</i>
<i>Candidate:</i>	DE-UBA-Schauinsland
<i>Made by:</i>	TROPOS
<i>Counter (SN):</i>	TSI CPC Model 3772, SN: 3772164005 (Sept 2016)
<i>Software:</i>	TROPOS 6.68
<i>Total CPC:</i>	-
<i>Location of the quality assurance:</i>	Station Schauinsland
<i>Comparison period:</i>	February 18, 2020 – February 27, 2020

Summary of Intercomparison

Status des MPSS Schauinsland vor Vergleichsmessung:

Das MPSS lief nicht korrekt. Folgende Fehler mussten festgestellt werden

- *Aerosolfluss lag bei 0.6 l/min. Nach Prüfung der Vakuumpumpe konnte festgestellt werden, dass diese nicht mehr die volle Leistung liefert. Pumpe musste getauscht werden*
- *zwei Vakuumleitungen waren offen*
- *die Aerosolzuleitung der Ambient- und Thermodenuder-Strecken waren in der falschen Ventilstellung. Daher hat das System nicht über die normalerweise vorgesehene Ambientline gezogen, sondern über die Thermodenuderlinie. Diese Leitung war zum Laborraum offen, dass der daran befestigte Heizofen ebenfalls defekt ist. Das System hat somit Laborluft und nicht Außenluft gezogen. Den Zeitpunkt und somit den Zeitraum der Fehlmessungen konnte noch nicht bestimmt werden.*
- *Splitter: Am Aerosol-Splitter war ein offener Schlauch zum Labor. Der daran angeschlossene T-CPC muss zur Reparatur.*

Status des MPSS Schauinsland nach Vergleichsmessung:

Das MPSS wurde vom TROPOS komplett neu kalibriert und sämtliche Fehler wurden an der Station behoben. Der MPSS Aerosoleinlass sowie der APS-Einlass wurden optimiert und vermessen. Das MPSS zeigt nach einer Woche Vergleichsmessung zum TROPOS Reference MPSS einen Minderbefund von 12%. Dabei ist zu erwähnen, dass die Verluste auf die ultrafeinen Partikel kleiner 40 nm zurückzuführen sind. TROPOS hat das System und alle Leitungen überprüft, konnte aber an der Station keine weiteren Maßnahmen durchführen. Im April wird der nächste MPSS Workshop am TROPOS in Leipzig stattfinden, dort wird das System einer weiteren intensiven Qualitätskontrolle unterzogen.

Datenverfügbarkeit:

Auf Grund der festgestellten Probleme mit dem MPSS an der Station Schauinsland sind die gewonnen Datensätze in 2020 und die 2019 teilweise nicht verwendbar. Dazu muss sich der Datensatz nochmal angesehen werden. Eintragungen im Stations-Logbuch sind nicht vorhanden.

Information about the instruments:

Date of check: 18.02.2020

<i>List of Components</i>	TROPOS Reference MPSS No.4	Candidate
<i>Position</i>	-	-
<i>Company</i>	TROPOS	TROPOS
<i>Software</i>	TROPOS	TROPOS
<i>CPC-MPSS</i>	TSI CPC, Model 3772	TSI CPC, Model 3772
<i>CPC-total</i>	TSI CPC, Model 3772	-
<i>flow ratio</i>	1.0 : 5.0	1.0 : 5.0
<i>source</i>	Kr.85	Kr.85
<i>HV power supply</i>	Positive	Positive
<i>DMA</i>	Hauke medium	Hauke medium
<i>aerosol dryer</i>	✓	✓
<i>aerosol RH- sensor</i>	✓	✓
<i>aerosol T-sensor</i>	✓	✓
<i>sheath RH-sensor</i>	✓	✓
<i>sheath T-sensor</i>	✓	✓
<i>Sheath dryer</i>	✓	✓
<i>pressure sensor</i>	✓	✓

Date of check: 18.02.2020

<i>CPC status</i>	TROPOS-MPSS	TROPOS-total	Candidate-MPSS	Candidate-total
<i>power/status</i>	LED green	LED green	LED green	
<i>saturation temp</i>	39 °C	39 °C	39 °C	
<i>condenser temp</i>	22 °C	23.8 °C	23.0 °C	
<i>optics temp</i>	40 °C	40 °C	40 °C	
<i>cabinet temp</i>	29.1 °C	26.3 °C	31.0 °C	
<i>ambient pressure</i>	88.6 kPa	87.0 kPa	88.6 kPa	
<i>orifice pressure</i>	76.8 kPa	78.0 kPa	80.1 kPa	
<i>nozzle pressure</i>	2.4 kPa	2.4 kPa	0.4 kPa	
<i>laser current</i>	59 mA	41 mA	35 mA	
<i>liquid level</i>	full	full	Full	

Date of check: 18.02.2020

<i>date</i>	TROPOS Reference MPSS		Candidate	
	pre-audit status	final-audit status	pre-audit status	final-audit status
<i>total CPC flow</i>	-	1.033 l/min	-	-
<i>aerosol flow (DMA)</i>	-	-	-	-
<i>aerosol flow (UDMA)</i>	-	-	-	-
<i>aerosol flow (total)</i>	-	1.012 l/min	0.96 l/min	-
<i>zero</i>	-			-
<i>PSL 203 nm</i>	-			-
<i>HV – 0 V</i>	-	0 V	0 V	-
<i>HV – 4 mV</i>	-	5.1 V	5.1 V	-
<i>HV – 80 mV</i>	-	99.9 V	99.9 V	-
<i>HV – 800 mV</i>	-	1000.0 V	1000.0 V	-

Date of check: 19.02.2020

<i>date</i>	TROPOS Reference MPSS		Candidate	
	pre-audit status	final-audit status	pre-audit status	final-audit status
<i>total CPC flow</i>	-	1.032 l/min	-	-
<i>aerosol flow (DMA)</i>	-	-	-	-
<i>aerosol flow (UDMA)</i>	-	-	-	-
<i>aerosol flow (total)</i>	-	1.014 l/min	0.96 l/min	-
<i>zero</i>	-	0 #/cm ³	0 #/cm ³	-
<i>PSL 203 nm</i>	-	203.94 nm	203.83 nm	-
<i>HV – 0 V</i>	-	0 V	0 V	-
<i>HV – 4 mV</i>	-	4.95 V	5.11 V	-
<i>HV – 80 mV</i>	-	99.7 V	99.95 V	-
<i>HV – 800 mV</i>	-	1000.0 V	1000.0 V	-

Date of check: 17.02.2020

<i>CPC status</i>	TROPOS-MPSS	TROPOS-total	Candidate-MPSS	Candidate-total
<i>power/status</i>	LED green	LED green	LED green	LED green
<i>saturator temp</i>	39 °C	39 °C	39 °C	39 °C
<i>condenser temp</i>	22 °C	23.5 °C	22.0 °C	23.0 °C
<i>optics temp</i>	40 °C	40 °C	40 °C	40 °C

<i>cabinet temp</i>	35.2 °C	33.0 °C	31.4 °C	31.3°C
<i>ambient pressure</i>	100.7 kPa	99.6 kPa	100.4 kPa	101.0 kPa
<i>orifice pressure</i>	86.0 kPa	86.6 kPa	86.1 kPa	89.0 kPa
<i>nozzle pressure</i>	2.7 kPa	2.8 kPa	2.7 kPa	0.6 kPa
<i>laser current</i>	59 mA	42 mA	52 mA	41 mA
<i>liquid level</i>	full	full	full	full

Date of check: 27.02.2020

<i>Date</i>	TROPOS Reference MPSS		Candidate	
	pre-audit status	final-audit status	pre-audit status	final-audit status
<i>total CPC flow</i>	-	1.035 l/min	-	-
<i>aerosol flow (DMA)</i>	-	-	-	-
<i>aerosol flow (UDMA)</i>	-	-	-	-
<i>aerosol flow (total)</i>	-	1.012 l/min	0.995 l/min	-
<i>zero</i>	-	0 #/cm ³	0 #/cm ³	-
<i>PSL 203 nm</i>	-	-	-	-
<i>HV – 0 V</i>	-	0 V	0.2 V	-
<i>HV – 4 mV</i>	-	5.02 V	5.12 V	-
<i>HV – 80 mV</i>	-	100.1 V	99.9 V	-
<i>HV – 800 mV</i>	-	1001.0 V	1001.0 V	-

Date of check: 17.02.2020

<i>CPC status</i>	TROPOS-MPSS	TROPOS-total	Candidate-MPSS	Candidate-total
<i>power/status</i>	LED green	LED green	LED green	LED green
<i>saturation temp</i>	39 °C	39 °C	39 °C	39 °C
<i>condenser temp</i>	22 °C	23.5 °C	22.0 °C	23.0 °C
<i>optics temp</i>	40 °C	40 °C	40 °C	40 °C
<i>cabinet temp</i>	35.2 °C	33.0 °C	31.4 °C	31.3°C
<i>ambient pressure</i>	100.7 kPa	99.6 kPa	100.4 kPa	101.0 kPa
<i>orifice pressure</i>	86.0 kPa	86.6 kPa	86.1 kPa	89.0 kPa
<i>nozzle pressure</i>	2.7 kPa	2.8 kPa	2.7 kPa	0.6 kPa
<i>laser current</i>	59 mA	42 mA	52 mA	41 mA
<i>liquid level</i>	full	full	full	full

Special Information regarding to the Candidate:

<i>Was it necessary to:</i>	yes/no	old part (ID/SN)	new part (ID/SN)	information
<i>clean the aerosol inlet</i>	no			
<i>change aerosol Nafion dryer</i>	no			
<i>change sheath Nafion dryer</i>	no			
<i>check source</i>	no			
<i>change HV power supply</i>	no			
<i>clean/change DMA</i>	no			
<i>change aerosol RH/T-sensor</i>	no			
<i>change sheath RH/T-sensor</i>	no			
<i>change pressure sensor</i>	no			
<i>Total CPC</i>	no			

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

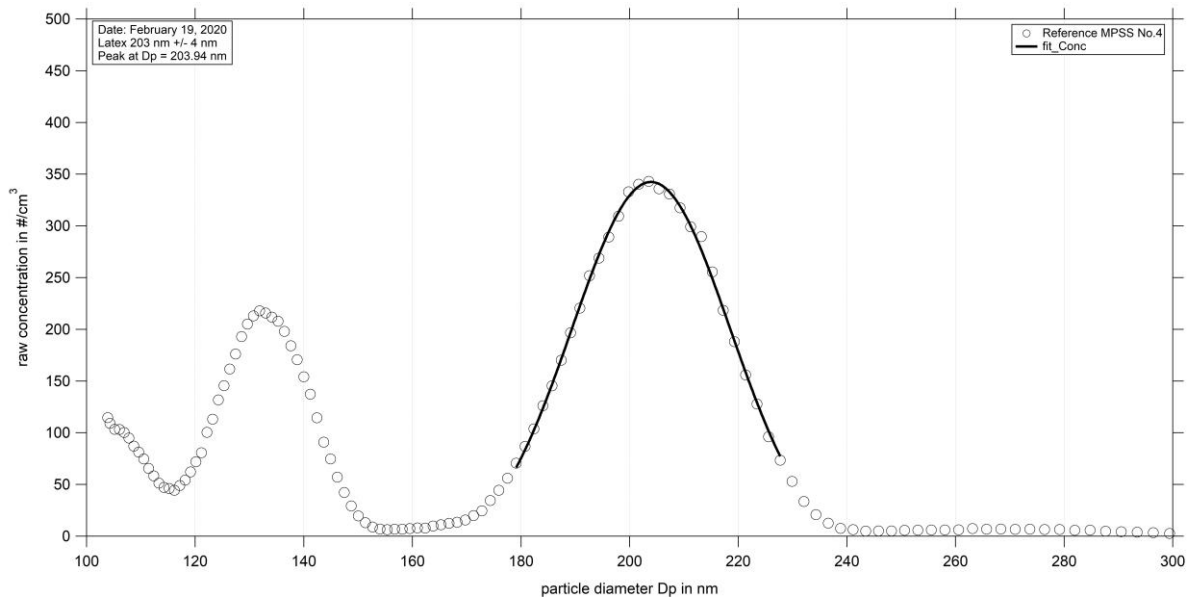


Figure 01: Measurement of latex 203 nm: Particle size distribution (raw concentration) for latex 203 nm on February 19th, 2020.

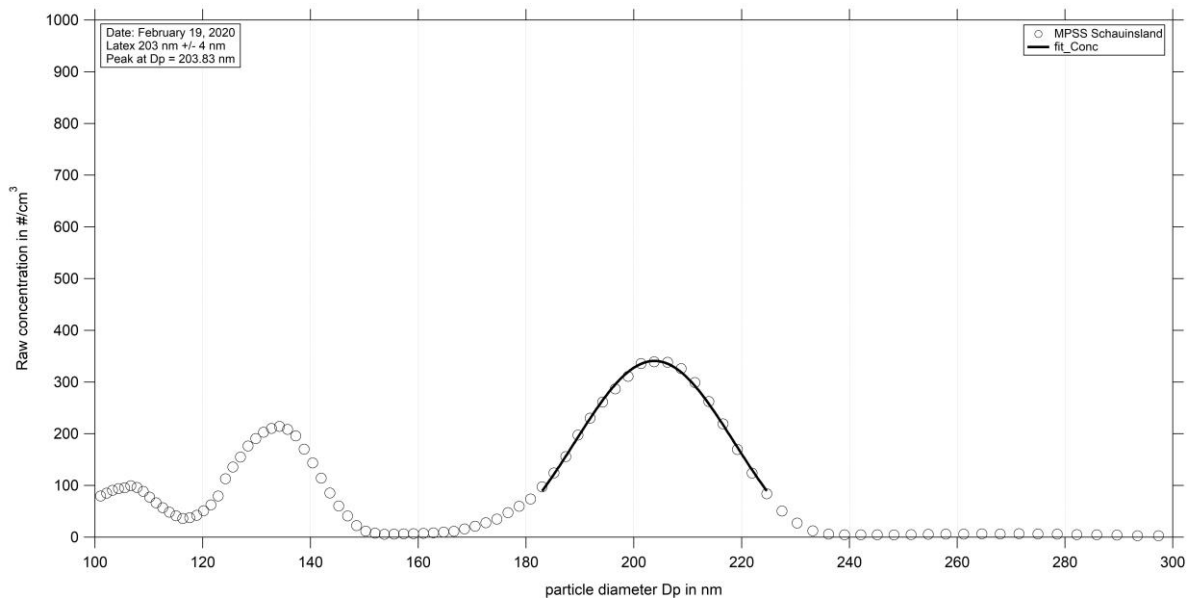


Figure 02: Measurement of latex 203 nm: Particle size distribution (raw concentration) for latex 203 nm on February 27th, 2020.

Status of the Candidate: Particle Number Size Distribution

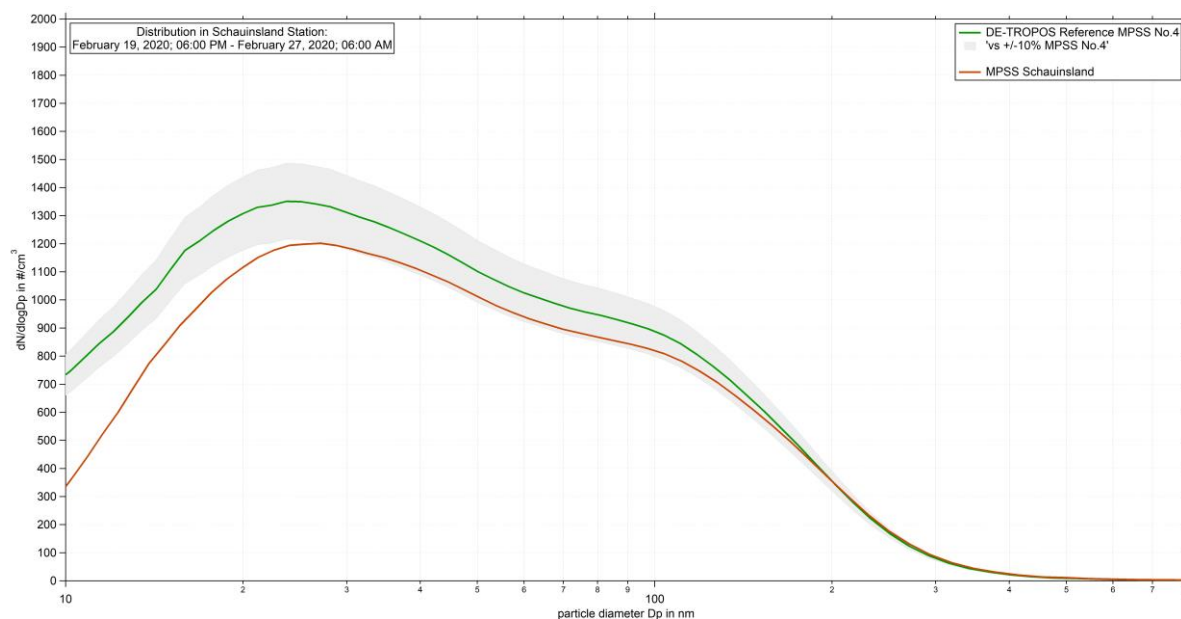


Figure 03: Comparison of mean particle number size distribution of TROPOS Reference MPSS No.4 against DE-UBA-Schauinsland from February 19, 2020 18:00 PM until February 27, 2020 06:00 AM. Multiple charge correction, internal diffusion losses and CPC efficiency are included for both instruments.

Status of the Candidate: Time Series

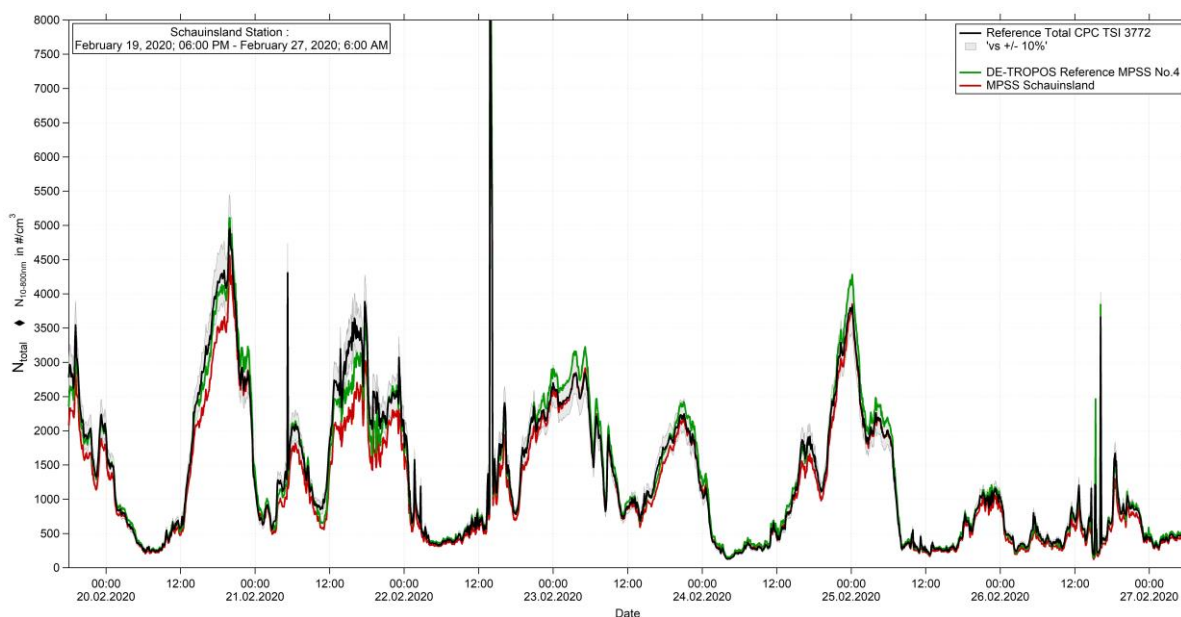


Figure 04: Time series (February 19, 2020 18:00 PM until February 27, 2020 06:00 AM) of the integrated particle number concentration (N10-800nm) of the MPSS and total number concentration (Ntotal) of the reference TSI-CPC Model 3772. The inversion was performed using TROPOS software. Multiple charge correction, internal diffusion losses and CPC flow corrections are included.

Status of the Candidate: Correlation

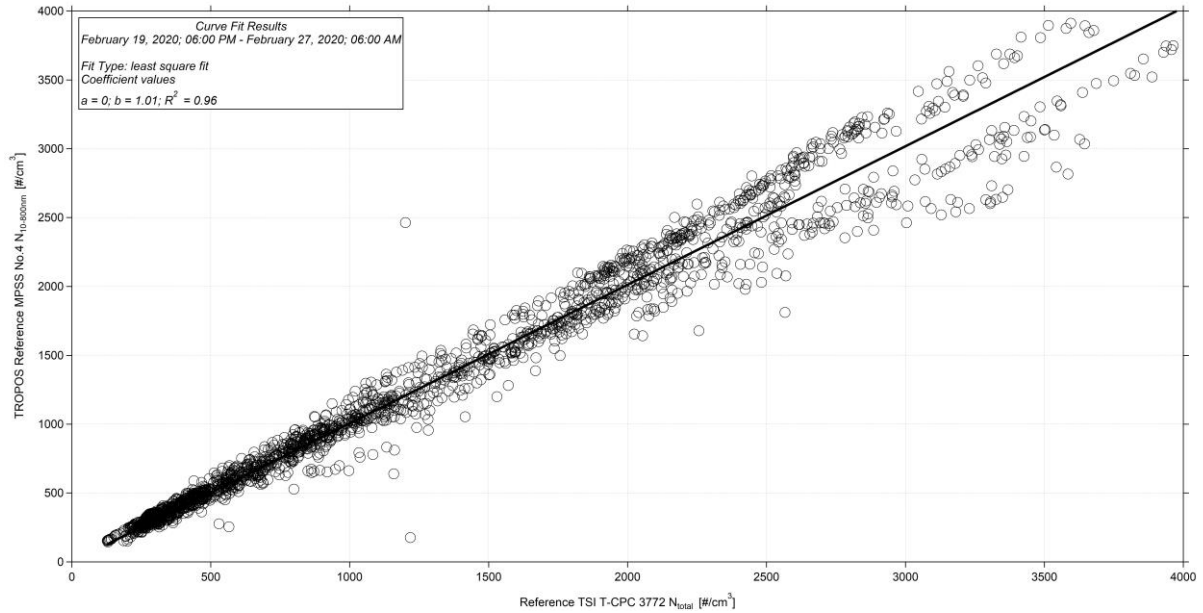


Figure 05: Linear regression between the number concentrations of the TROPOS Reference TSI CPC Model 3772 and TROPOS Reference MPSS No.4. Multiple charge correction, internal diffusion losses and CPC flow corrections are included.

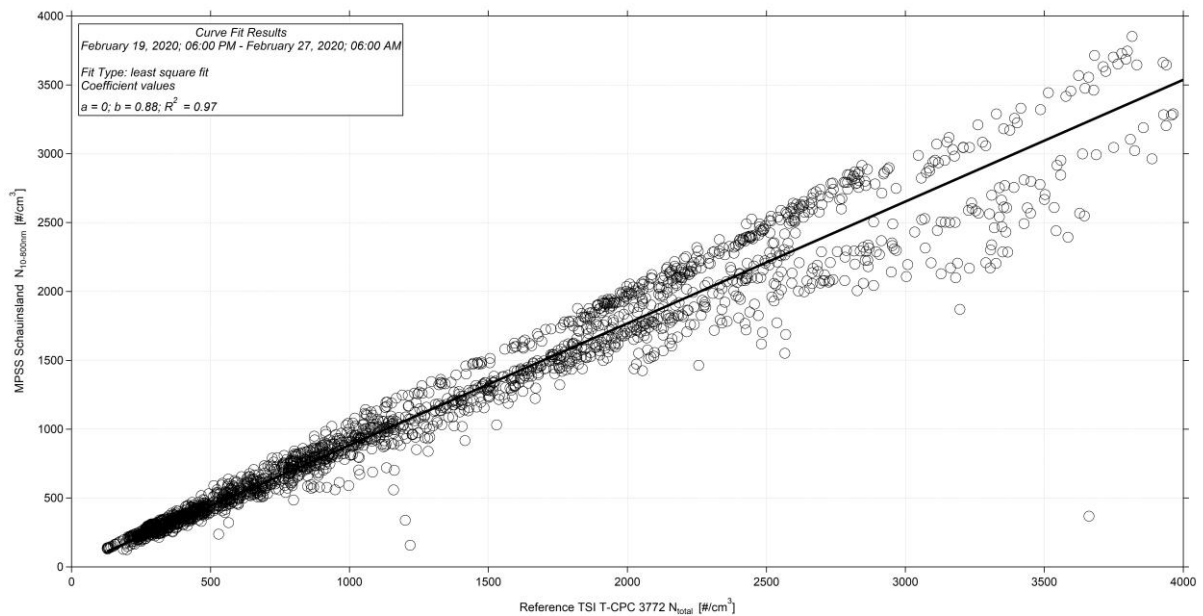


Figure 06: Linear regression between the number concentrations of the TROPOS Reference TSI CPC Model 3772 and DE-UBA-Schauinsland. Multiple charge correction, internal diffusion losses and CPC flow corrections are included.

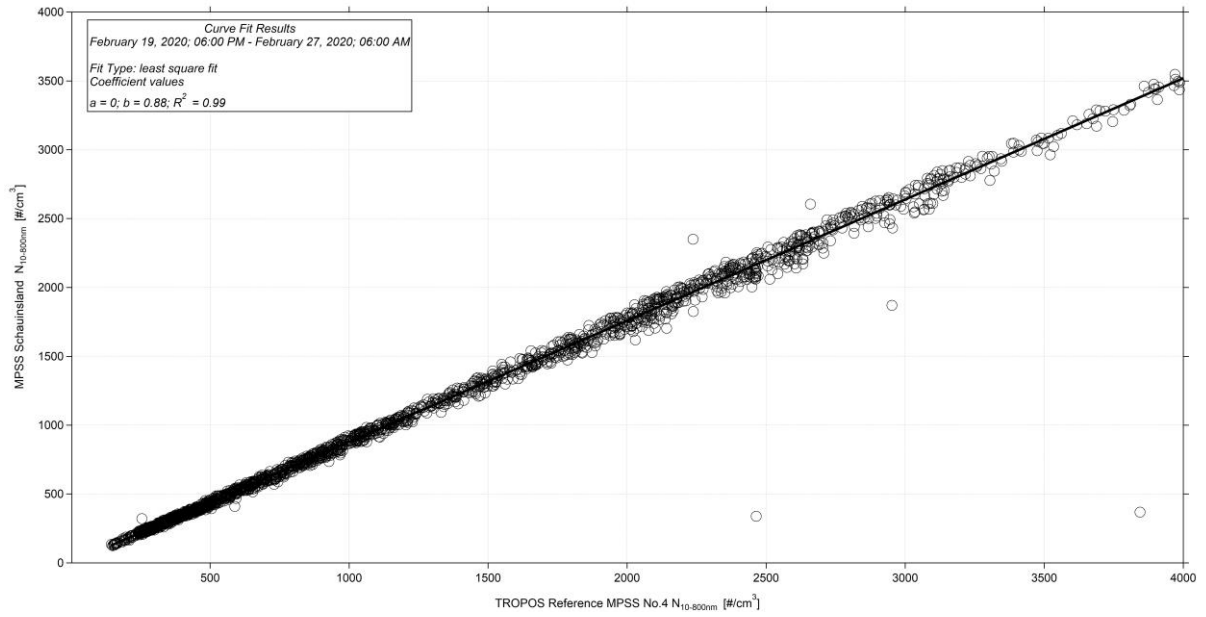


Figure 07: Linear regression between the number concentrations of the TROPOS Reference MPSS No.4 and DE-UBA-Schauinsland. Multiple charge correction, internal diffusion losses and CPC flow corrections are included.