TROPOS
Leibniz Institute for Tropospheric Research

ACTRIS

Intercomparison of Mobility Particle Size Spectrometers

Project No.: MPSS-2016-3-3

Basic information:

Location of the quality assurance: TROPOS, lab: 118

Delivery date: April 25, 2016

Setup in the laboratory: April 25, 2016

Comparison period: April 25, 2016 – April 29, 2016

Principal Investigator	Home Institution	Participant	Instrument
Markus Wallasch	UBA Wörlitzer Platz1 06844 Dessau-Roßlau GERMANY	-	DE-UBA Zugspitze TSI MPSS modified by TROPOS TSI CPC Model 3772 SN : 70640111

Summary of Intercomparison:

Pre-status:
The DE-UBA Zugspitze TSI MPSS modified by TROPOS was in good condition, but not in the range of +/-10% of the total reference TSI-CPC Model 3010 from TROPOS.

Final status:
The DE-UBA Zugspitze TSI MPSS modified by TROPOS passed the quality standards of ACTRIS and GAW. The system showed problems for particle smaller than 60 nm and in the

accumulation mode. After several problems over 2 years, TROPOS advises UBA to invest in a new system.

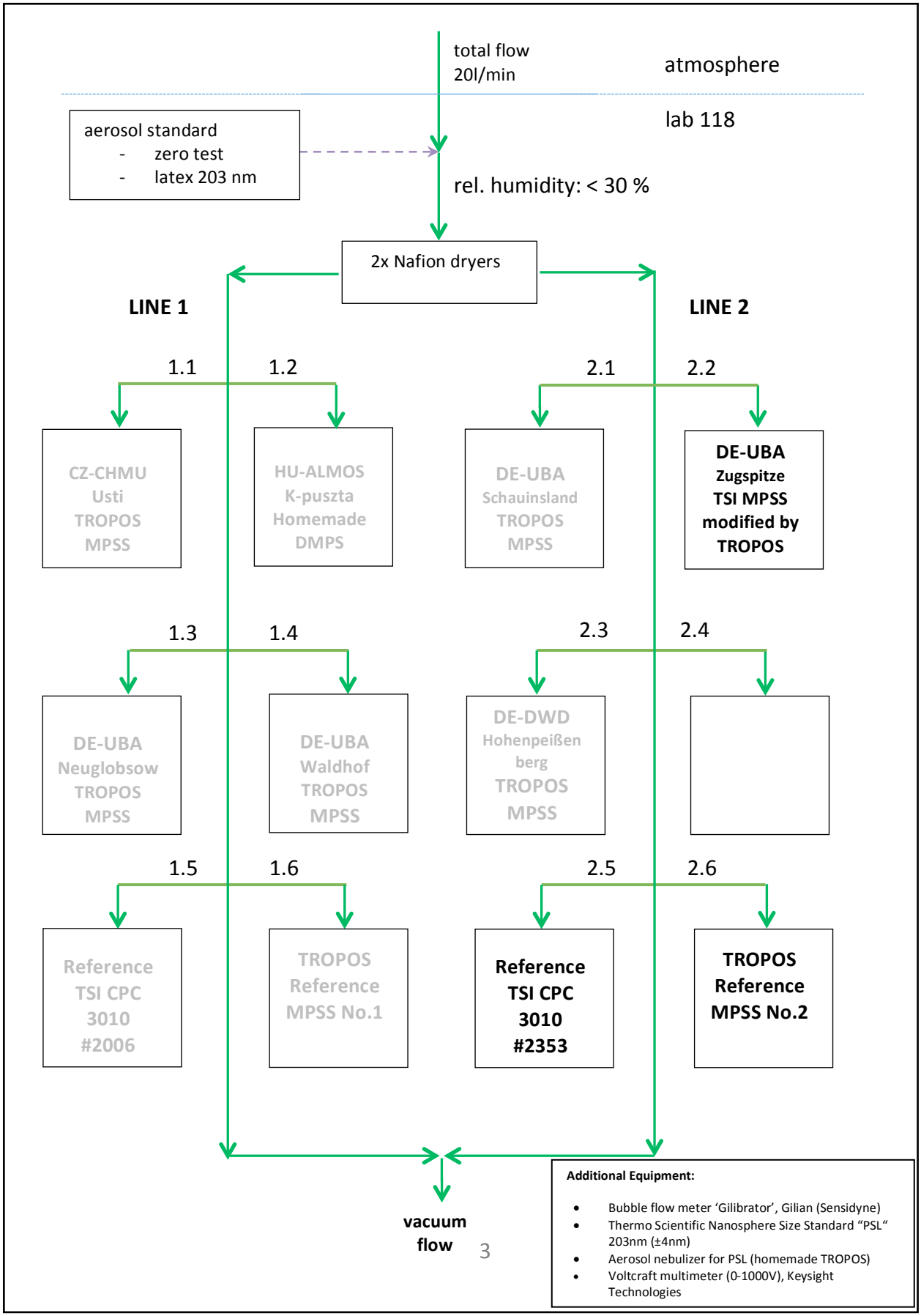
- 25.04.2016: setup and first checks of the system
- 25.04.2016: High voltage check out of the range: Pre-values = (0,0) (5,0) (10,0) (80,78.3) (200,187.8) (800,789.3)
- 25.04.2016, 13:14: Zero & Latex check
- 25.04.2016, 14:23: The CPC within the SMPS system is measuring particles even though connected to zero air
- 25.04.2016, 15:25: Latex 203 nm
- 25.04.2016, 15:32: start ambient overnight -> 26.04.2016, 08:00
- 26.04.2016: Back from CPC workshop, another PSL & zero test. It was necessary to clean the CPC.
- 26.04.2016: 15:56 Zero test
- 26.04.2016, 16:21: Flow measurement: 1.035 l/min
- 26.04.2016, 16:25 – 16:48: Latex 203 nm (peak yesterday was a little too high, now we adjust)
- 26.04.2016, 16:51 start ambient overnight
- 27.04.2016: overnight run 27.-28.2016 18:00
- 28.04.2016: overnight run 28.-29.2016 10:00

List of Components

	Specification	Reference MPSS No.2	DE-UBA Zugspitze TSI
Position (Line)		2.6	2.2
Company		TROPOS	DE-UBA Zugspitze
Software		TROPOS 6.1	TROPOS
CPC		Model 3772 SN: 70835059	Model 3772 SN : 70640111
Flow ratio		1.0 : 5.0	1.0 : 5.0
Source		Kr85	Kr.85
HV cassette		positive	positive 10.0kV
DMA		Hauke medium	TSI
Flow meas.	Aerosol	✓	
Dryer		✓	
RH sensor	Inlet	✓	✓
T sensor		✓	✓
RH sensor	Sheath air	✓	✓
T sensor		✓	✓
Dryer		✓	✓

p sensor		✓	

Laboratory setup



CPC Status total CPC SN: 2353

Institute	CPC	Variable	Status	Comments
TROPOS	**Total CPC 3010, #2353**	Power	good	
		Laser	good	
		Flow	good	
		Liquid level	full	

CPC Status Reference Instrument No.2

Institute	CPC	Variable	Status	Comments
TROPOS	**Reference Instrument No.2, 3772 #70835059**	Saturator Temp	39.1°C	
		Condenser Temp	22.0°C	
		Optics Temp	40.0°C	
		Cabinet Temp	32.0°C	
		Ambient Pressure	99.4 kPa	
		Orifice Pressure	77.2 kPa	
		Nozzle Pressure	2.7 kPa	
		Laser Current	47 mA	

CPC Status DE-UBA Zugspitze TSI 3772

Institute	CPC	Variable	Status	Comments
DE-UBA Zugspitze	**TSI 3772 #70640111**	Saturator Temp	39.0°C	
		Condenser Temp	22.0°C	
		Optics Temp	40.0°C	
		Cabinet Temp	30.1°C	
		Ambient Pressure	98.2 kPa	
		Orifice Pressure	80.4 kPa	
		Nozzle Pressure	2.6 kPa	
		Laser Current	37 mA	

TROPOS Reference Systems during the pre-status night measurement

Time Series

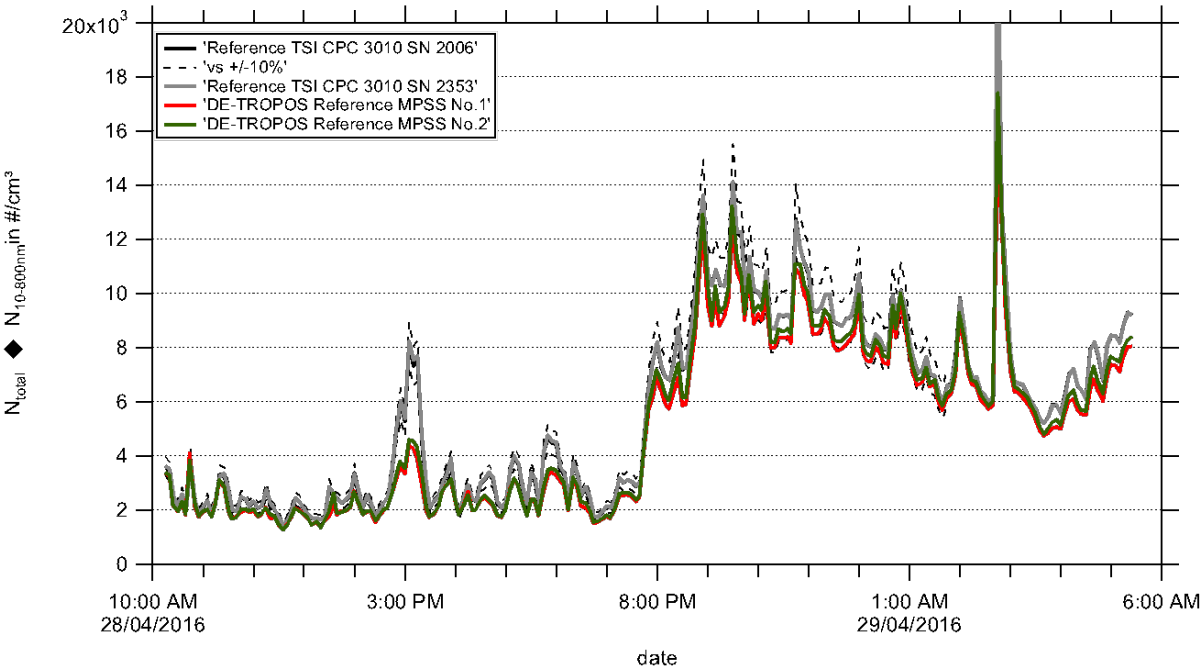


Figure 01: Time series (April 28, 2016 10:00 am – April 29, 2016 06:00 am) of the integrated particle number concentration ($N_{10\text{-}800nm}$) of the TROPOS Reference MPSS and total number concentration (N_{total}) of the Reference TSI CPC 3010. The inversion was performed using TROPOS software. Multiple charge correction, internal diffusion losses and CPC flow corrections are included.

Pre- Status of the Candidate (April 25-26th)

Components and zero check

Institute	System	Line	Flow		Zero	
TROPOS	Ref2	2.6	**1.013**	l/min	0	# cm^{-3}
TROPOS	Total CPC	2.5	**1.012**	l/min	0	# cm^{-3}
DE-UBA Zugspitze	Total CPC	2.4	**1.054**	l/min		# cm^{-3}
DE-UBA Zugspitze	TSI MPSS	2.2	**1.016**	l/min	0	# cm^{-3}

High voltage calibration

Institute	System	[V]	0 V	4 mV	80 mV	800 mV
TROPOS	Reference MPSS No.2	**final**	**0.1**	**5.1**	**99.9**	**999.5**
		[V]	**0 V**	**5 mV**	**200 mV**	**800 mV**
DE-UBA Zugspitze	TSI MPSS	**final**	**0.8**	**7.8**	**198.2**	**799.9**

Latex 203nm ±4nm (pressure 991 hPa, 23.0°C)

Institute	System		Latex 203 [nm]	slope
TROPOS	Reference MPSS No.2	**final**	**205.71**	**4.9**
DE-UBA Zugspitze	TSI MPSS	**final**	**199.5**	**4.5**

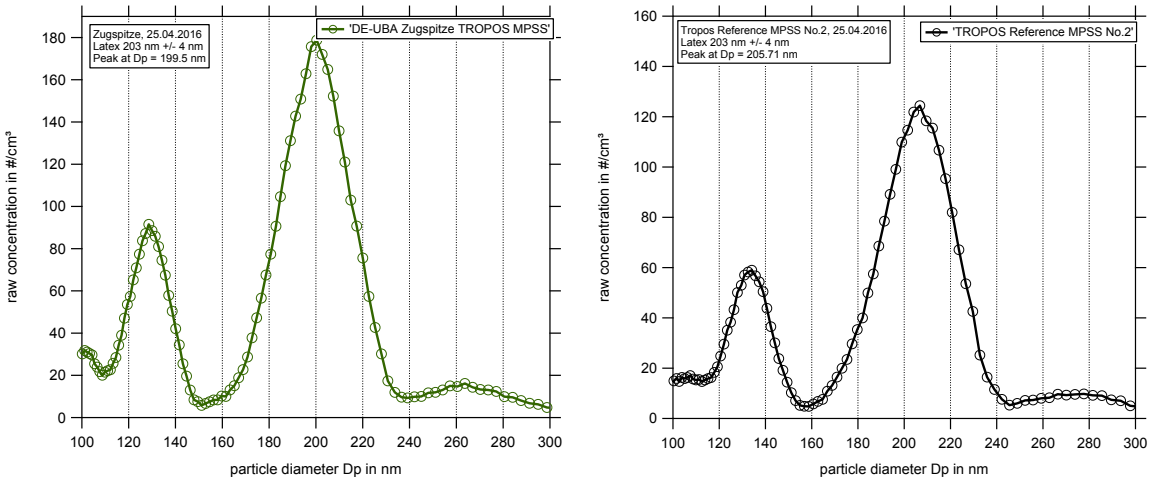


Figure 02: Measurement of latex 203 nm: Particle size distribution (raw concentration) for latex 203 nm on April 25th, 2016.

Time Series

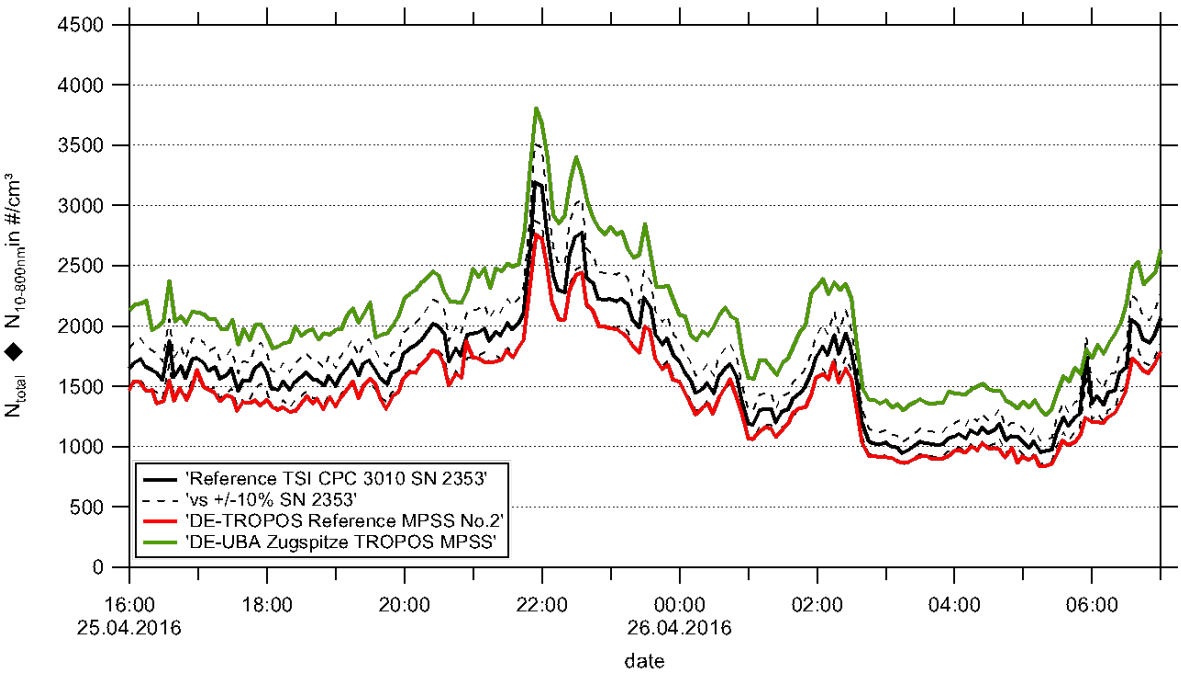


Figure 03: Time series (April 25, 2016 04:00 pm – April 26, 2016 08:00 am) of the integrated particle number concentration ($N_{10\text{-}800nm}$) of the MPSS and total number concentration (N_{total}) of the reference TSI-CPC Model 3010. The inversion was performed using TROPOS software. Multiple charge correction, internal diffusion losses and CPC flow corrections are included.

Particle Number Size Distribution

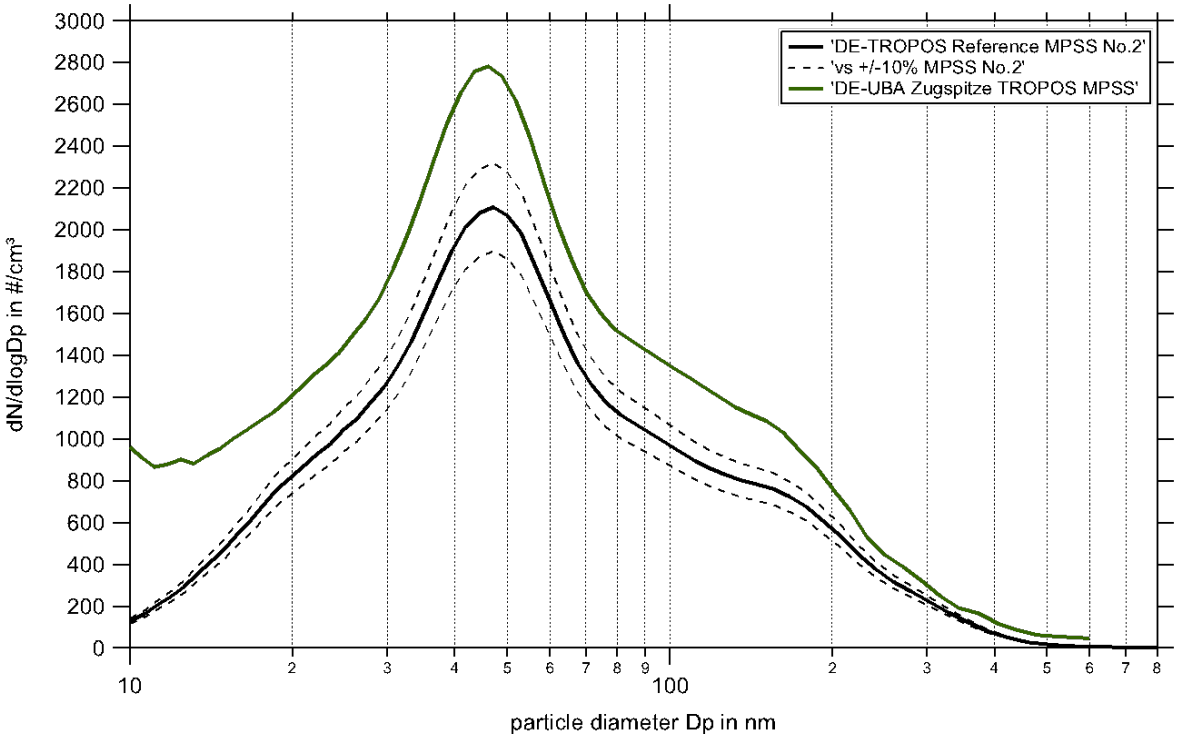


Figure 04: Comparison of mean particle number size distribution of DE-UBA Zugspitze TSI MPSS and TROPOS Reference MPSS No.2 from April 25, 2016 9:00 pm until April 26, 2016 05:00 am. Multiple charge correction, internal diffusion losses and CPC efficiency are included for the TROPOS Reference MPSS No.2.

Correlation

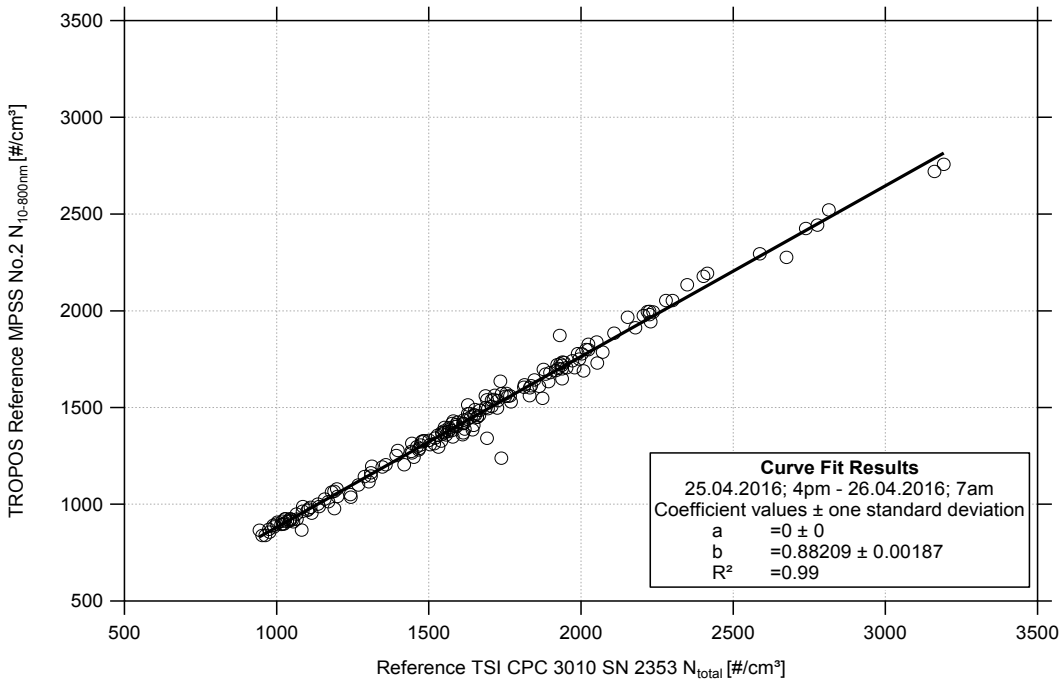


Figure 05: Linear regression between the number concentrations of the TROPOS Reference MPSS No.2 and TROPOS Reference TSI CPC Model 3010 (SN 2353). Multiple charge correction, internal diffusion losses and CPC flow corrections are included.

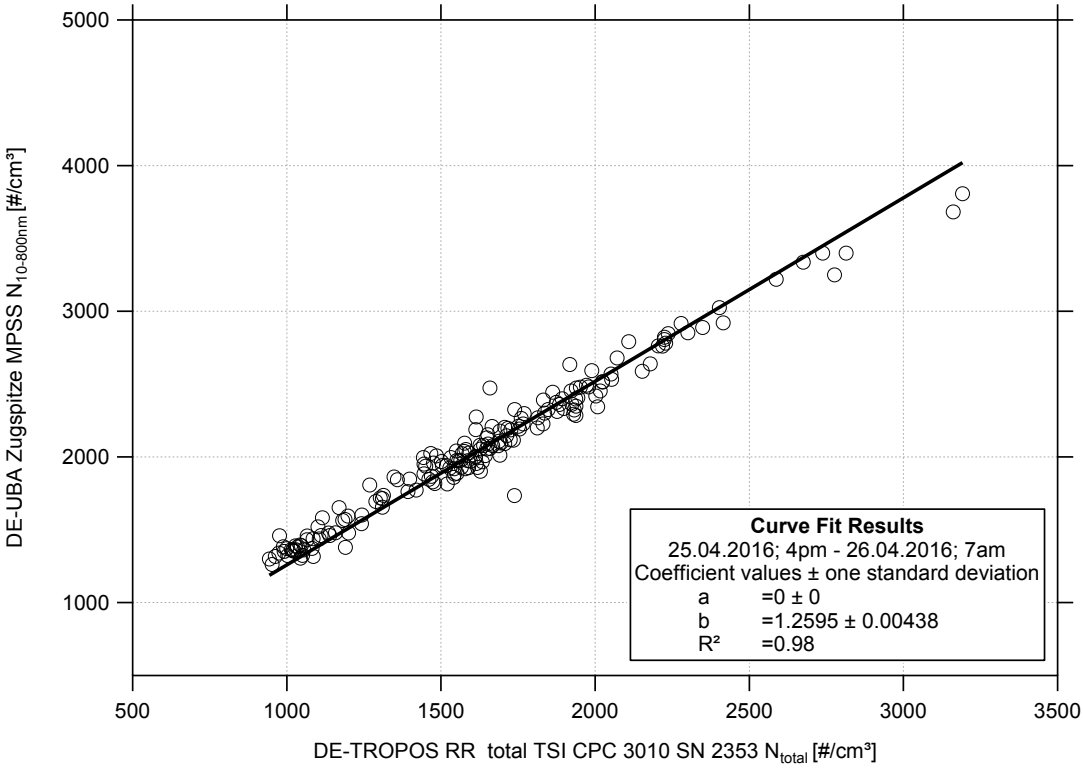


Figure 06: Linear regression between the number concentrations of the DE-UBA Zugspitze TSI MPSS and TROPOS Reference TSI CPC Model 3010 (SN 2353).

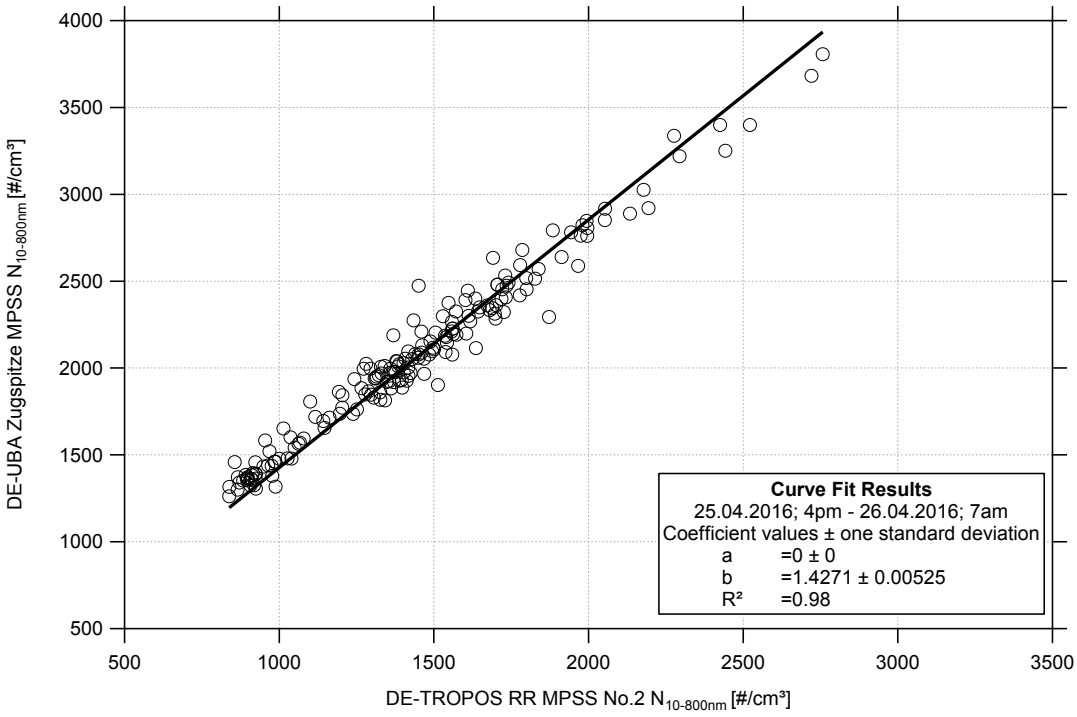


Figure 07: Linear regression between the number concentrations of the DE-UBA Zugspitze TSI MPSS and TROPOS Reference MPSS No.2. Multiple charge correction, internal diffusion losses and CPC flow corrections are included.

Final Status of the Candidate (April 28-29 th)

Time Series

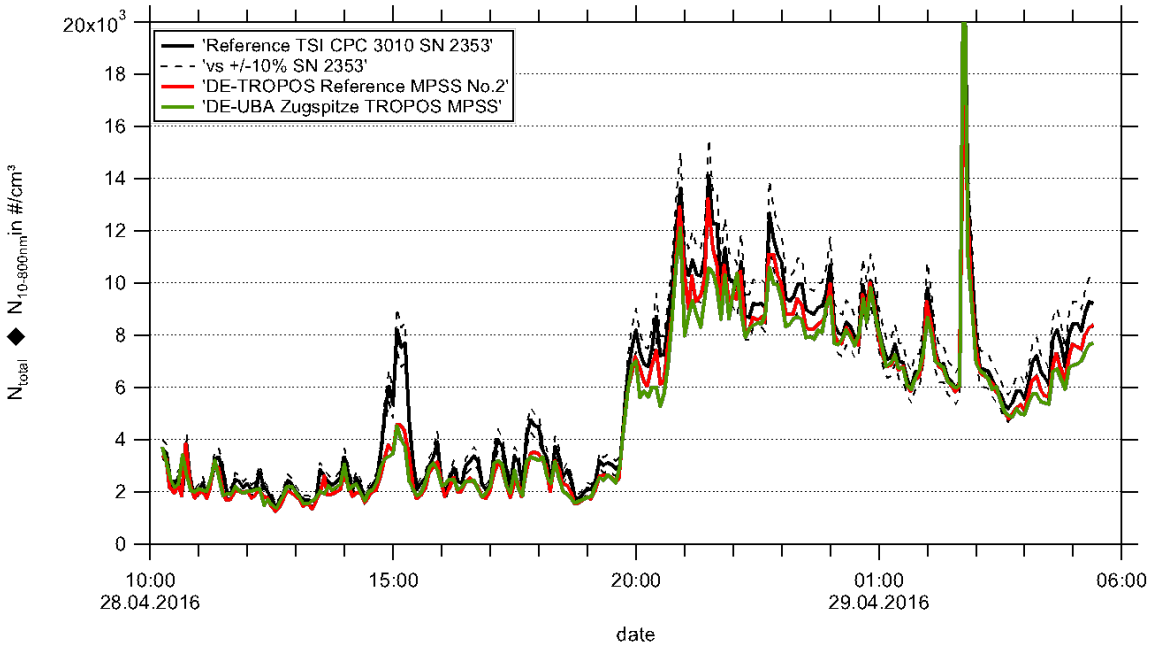


Figure 08: Time series (April 28, 2016 10:00 am – April 29, 2016 06:00 am) of the integrated particle number concentration ($N_{10\text{-}800nm}$) of the MPSS and total number concentration (N_{total}) of the reference TSI-CPC Model 3010. The inversion was performed using TROPOS software. Multiple charge correction, internal diffusion losses and CPC flow corrections are included.

Particle Number Size Distribution

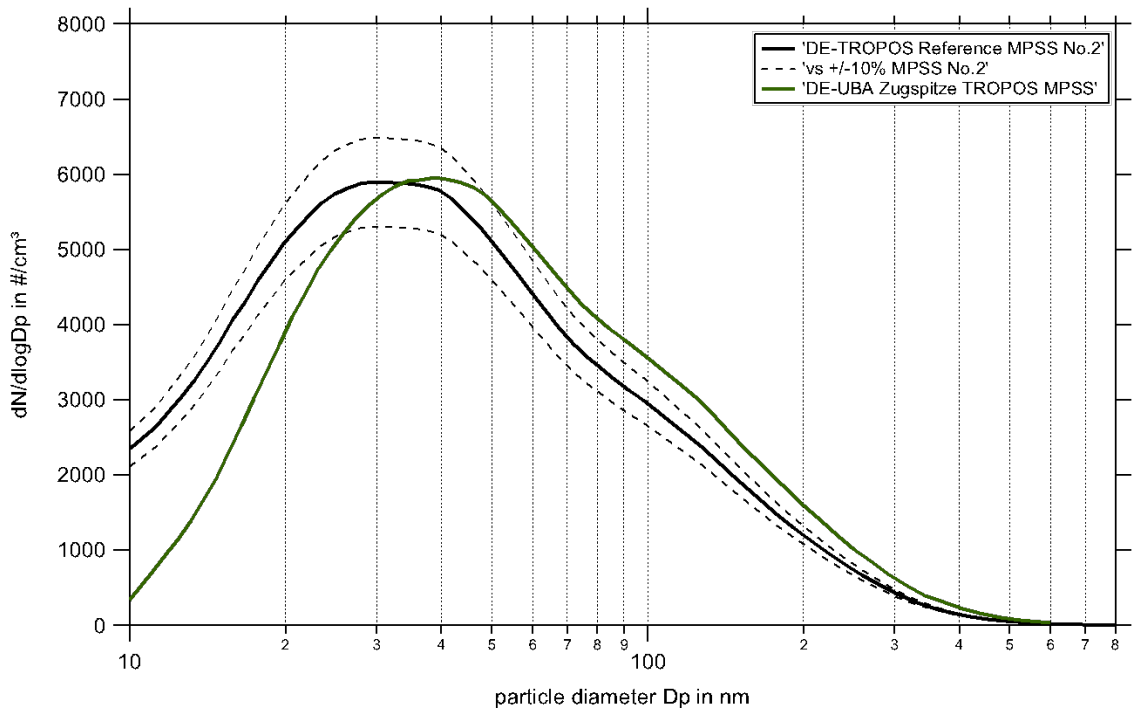
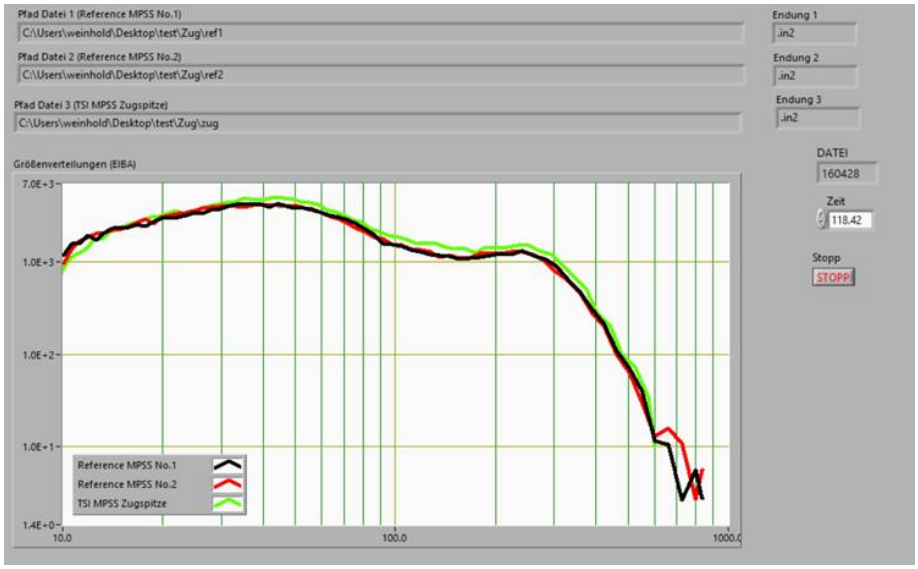
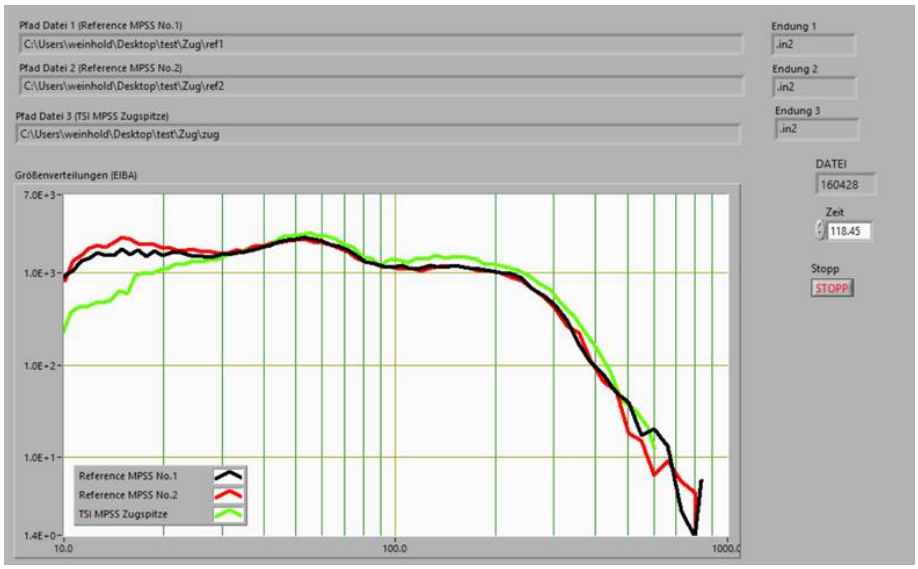
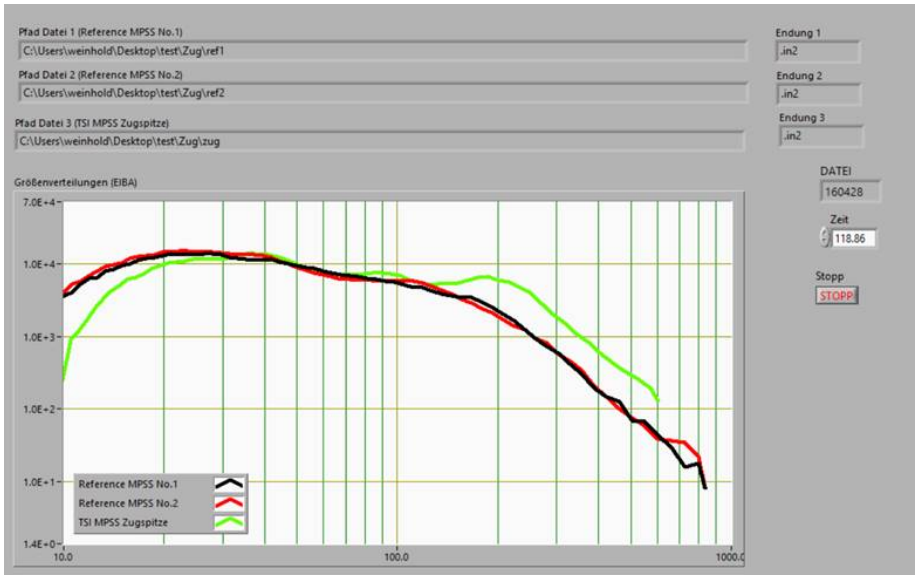


Figure 10: Comparison of mean particle number size distribution of DE-UBA Zugspitze TSI MPSS and TROPOS Reference MPSS No.2 from April 28, 2016 10:00 am until April 29, 2016 05:00 am. Multiple charge correction, internal diffusion losses and CPC efficiency are included for the TROPOS Reference MPSS No.2.

Single scans during the final run:







Correlation

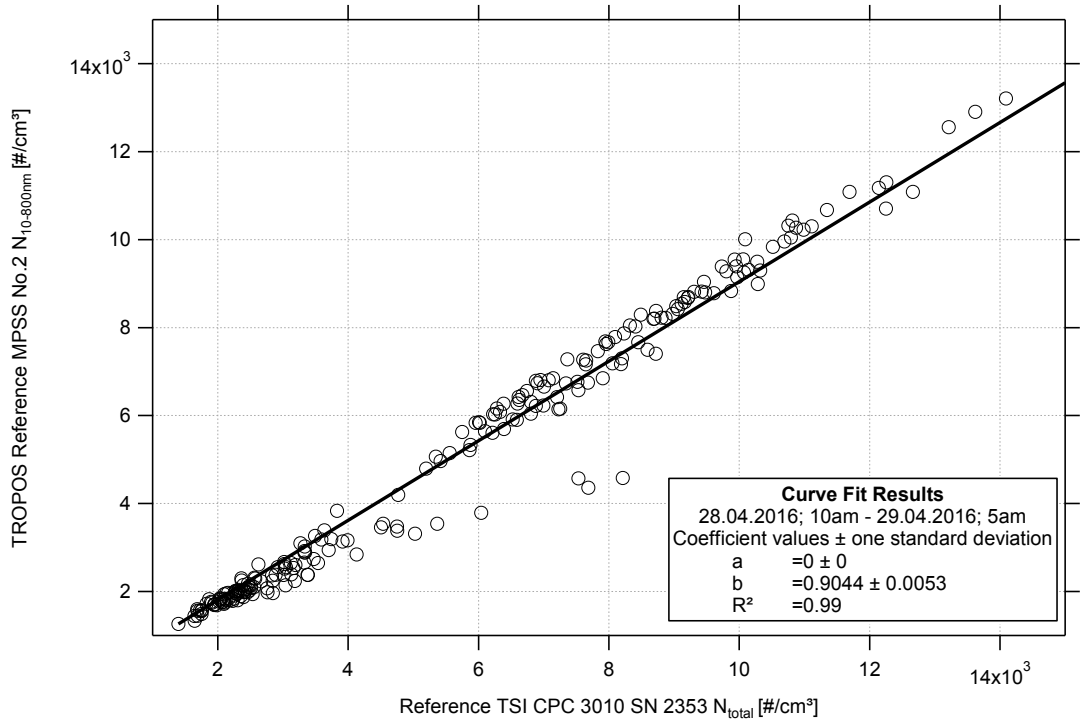


Figure 12: Linear regression between the number concentrations of the TROPOS Reference MPSS No.2 and Reference TSI CPC 3010 SN 2353. Multiple charge correction, internal diffusion losses and CPC flow corrections are included.

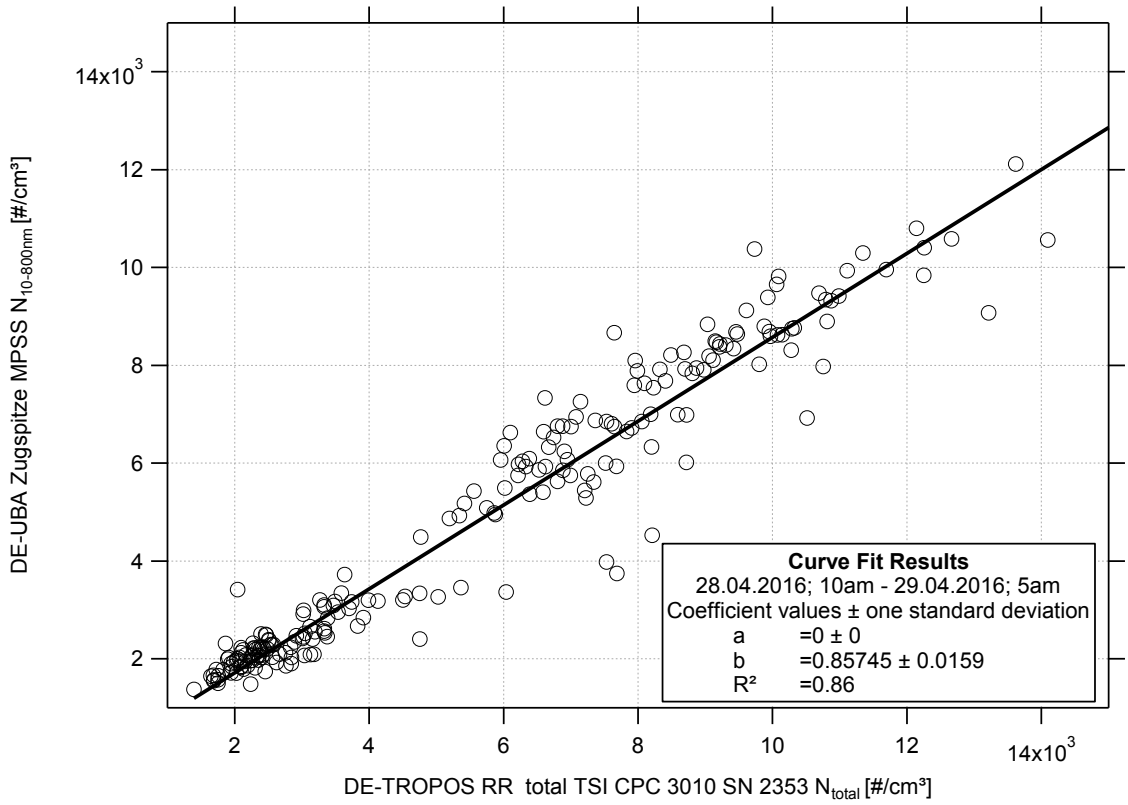


Figure 13: Linear regression between the number concentrations of the DE-UBA Zugspitze TSI MPSS and Reference TSI CPC 3010 SN 2353. Multiple charge correction, internal diffusion losses and CPC flow corrections are included.

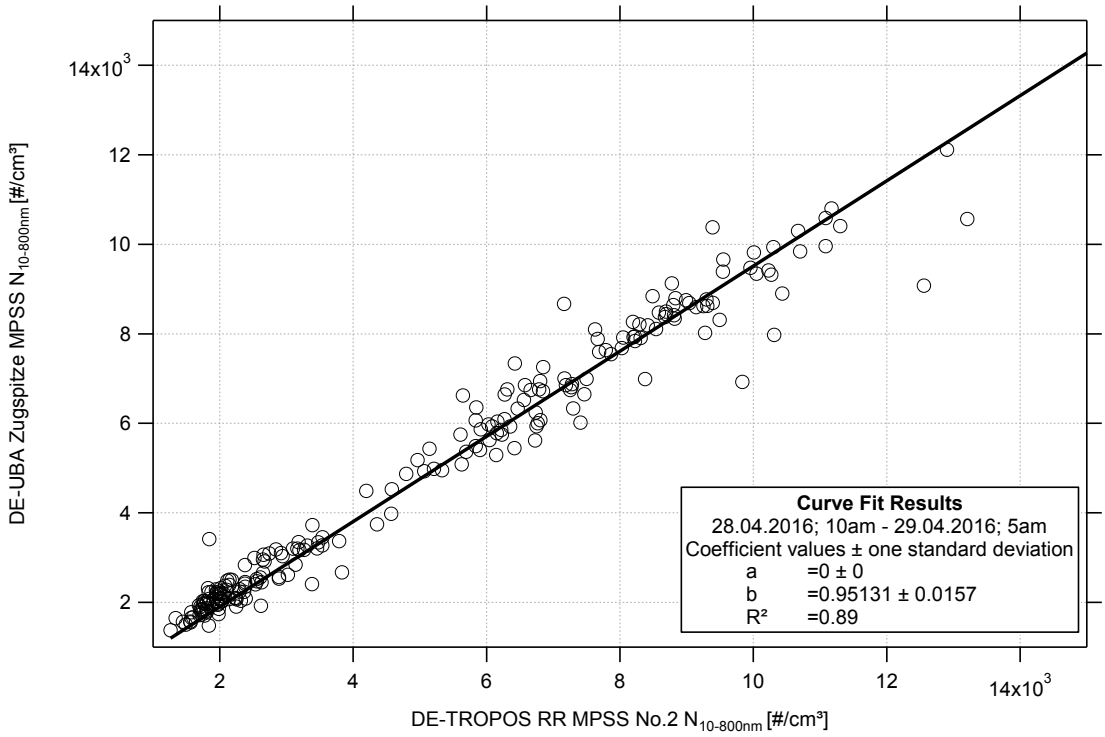


Figure 14: Linear regression between the number concentrations of the DE-UBA Zugspitze TSI MPSS and TROPOS Reference MPSS No.2. Multiple charge correction, internal diffusion losses and CPC flow corrections are included.