Intercomparison of Mobility Particle Size Spectrometers

Project No.: MPSS-2016-4-5

Basic information:

Principal Investigator:	Alfred Wiedensohler
Home Institution:	Leibniz-Institut für Troposphärenforschung Permoserstraße 15 04318 Leipzig
Participant:	-
Instrument No.1:	TROPOS Reference MPSS No.1 TSI CPC Model 3772, SN: 3772141701
Instrument No.2:	TROPOS Reference MPSS No.4 TSI CPC Model 3772, SN: 71011009
Instrument No.3:	TROPOS Reference MPSS No.5 TSI CPC Model 3772, SN: 71011008
Location of the quality assurance:	TROPOS Leipzig, lab 118
Comparison period:	May 30, 2016 – June 03, 2016
Last Intercomparison (with Project No.):	Ref.1: Apr. 2016 – MPSS-2016-3-5

Summary of Intercomparison:

Pre-Status:
The TROPOS Reference MPSS was in good condition.

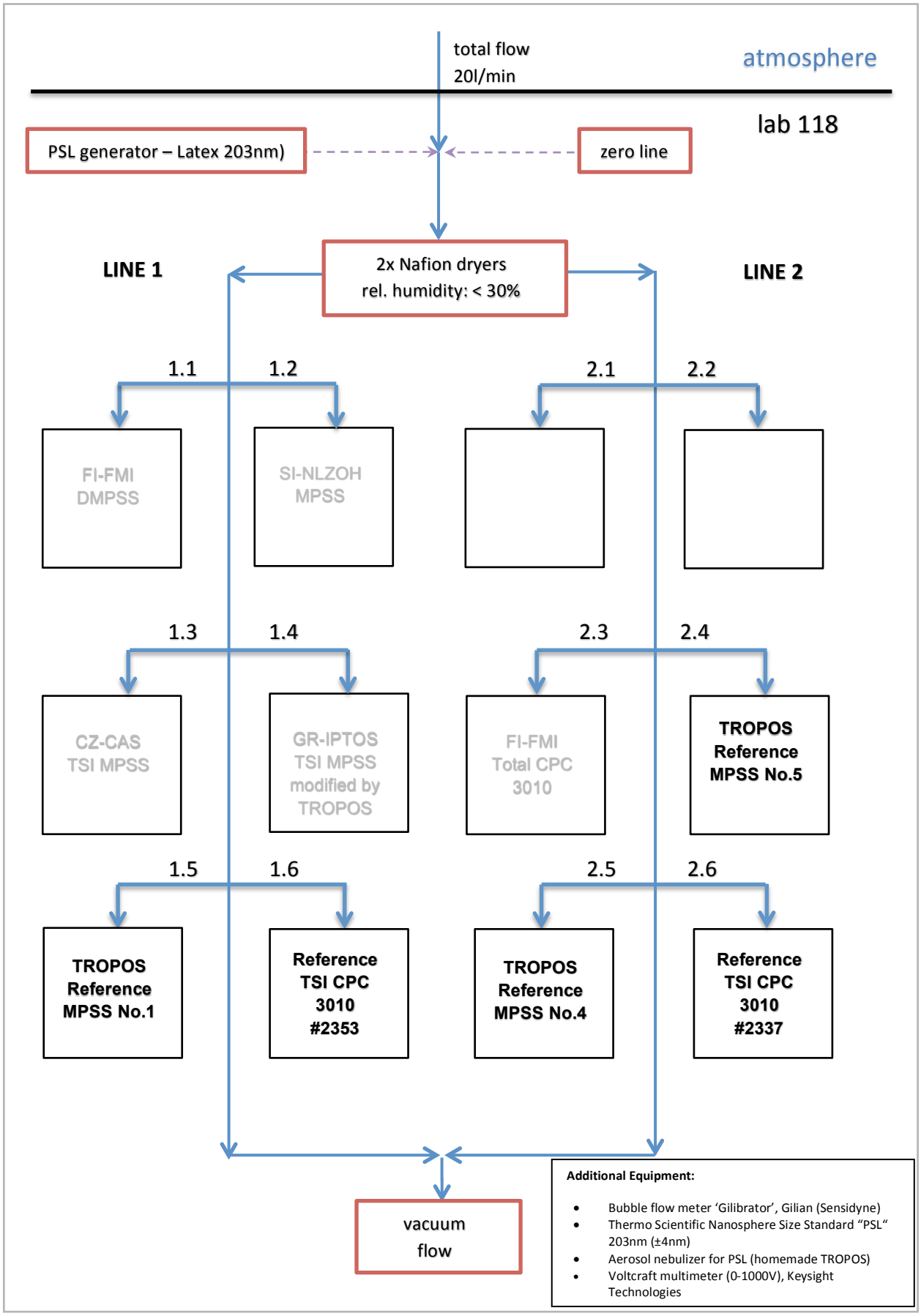
Final Status:

The TROPOS Reference MPSS passed the quality standards of ACTRIS and GAW.

List of Components:

	Specification	Reference MPSS No.1	Reference MPSS No.4	Reference MPSS No.5
Position (Line)		1.5	2.5	2.4
Company		TROPOS	TROPOS	TROPOS
Software		TROPOS 6.1	TROPOS 6.1	TROPOS 6.1
CPC		TSI CPC, Model 3772	TSI CPC, Model 3772	TSI CPC, Model 3772
Flow ratio		1.0 : 5.0	1.0 : 5.0	1.0 : 5.0
Source		Kr85	Kr85	Kr85
HV cassette		positive	positive	positive
DMA		Hauke medium	Hauke medium	Hauke medium
Flow meas.	aerosol	✓	✓	✓
Dryer		✓	✓	✓
RH sensor		✓	✓	✓
T sensor		✓	✓	✓
RH sensor	Sheath air	✓	✓	✓
T sensor		✓	✓	✓
Dryer		✓	✓	✓
p sensor		✓	✓	✓

Laboratory setup:



TROPOS Total CPC Status

Instrument	Variable	Status
TROPOS Total CPC 3010, #2337	Power	good
	Laser	good
	Flow	good
	Liquid level	full

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

TROPOS Reference Instrument Status

Instrument	Variable	Status
TROPOS Reference Instrument No.1, TSI CPC 3772 #3772141701	Saturator Temp	39.0°C
	Condenser Temp	22.0°C
	Optics Temp	40.0°C
	Cabinet Temp	32.8°C
	Ambient Pressure	98.7 kPa
	Orifice Pressure	69.8 kPa
	Nozzle Pressure	2.8 kPa
	Laser Current	50 mA

Instrument	Variable	Status
TROPOS Reference Instrument No.5, TSI CPC 3772 #71011008	Saturator Temp	38.9°C
	Condenser Temp	22.0°C
	Optics Temp	40.0°C
	Cabinet Temp	38.3°C
	Ambient Pressure	99.0 kPa
	Orifice Pressure	73.6 kPa
	Nozzle Pressure	2.5 kPa
	Laser Current	52 mA

Instrument	Variable	Status
TROPOS Reference Instrument No.4, TSI CPC 3772 #71011009	Saturator Temp	39.0°C
	Condenser Temp	22.0°C
	Optics Temp	39.9°C
	Cabinet Temp	33.3°C
	Ambient Pressure	99.2 kPa
	Orifice Pressure	78.7 kPa
	Nozzle Pressure	2.8 kPa
	Laser Current	46 mA

TROPOS Reference Systems during the pre-status May 30-31st

Components and zero check

Instrument	Line	Flow		Zero	
TROPOS Reference MPSS No.1	1.5	1.026	l/min	0	# cm^{-3}
TROPOS Total CPC 3010, #2337	1.6	1.015	l/min	0	# cm^{-3}
TROPOS Reference MPSS No.5	2.4	1.000	l/min	0	# cm^{-3}
TROPOS Total CPC 3010, #2353	2.6	1.018	l/min	0	# cm^{-3}
TROPOS Reference MPSS No.4	2.5	1.016	l/ min	0	# cm^{-3}

High voltage calibration

Instrument	[V]	0 V	4 mV	80 mV	800 mV
TROPOS Reference MPSS No.1	final	0.0	4.9	99.5	999.1
TROPOS Reference MPSS No.4	final	0.0	5.0	99.8	1000.2
TROPOS Reference MPSS No.5	final	0.1	5.1	99.9	1000.6

Latex 203nm ±4nm (pressure 988 hPa, 23.0°C)

Instrument	Latex 203 [nm]	slope
TROPOS Reference MPSS No.1	201.01	5.27
TROPOS Reference MPSS No.4	201.23	1.0
TROPOS Reference MPSS No.5	202.21	2.6

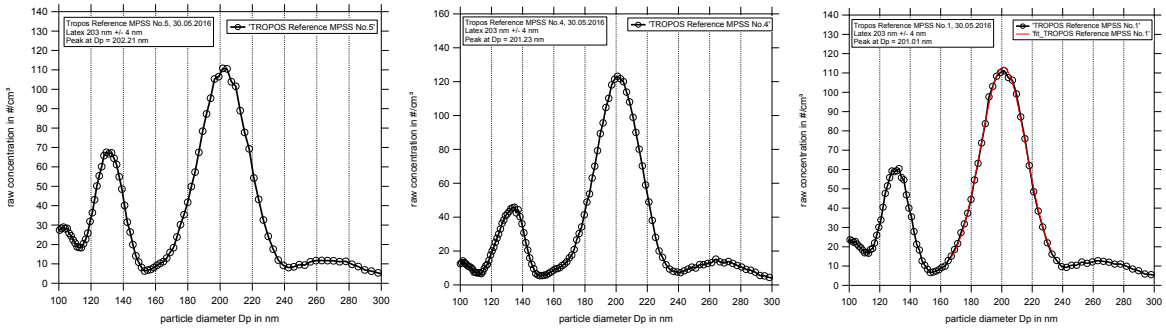


Figure 01: Measurement of latex 203 nm: Particle size distribution (raw concentration) for latex 203 nm on May 30th, 2016.

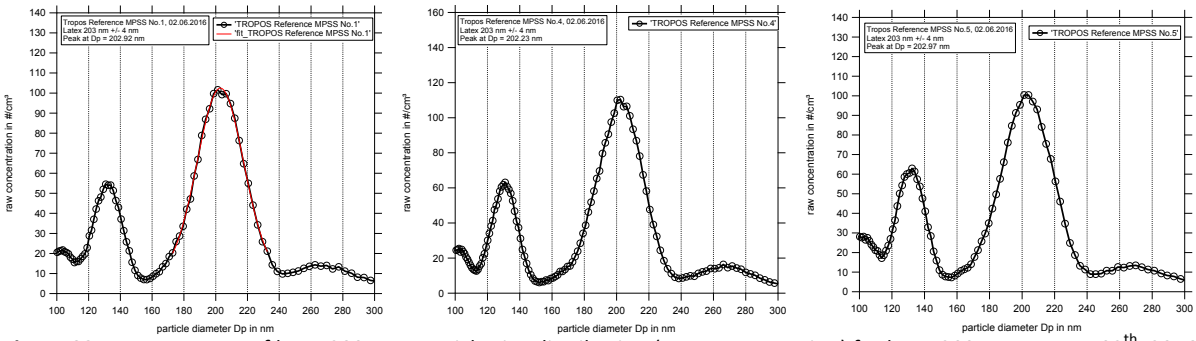


Figure 02: Measurement of latex 203 nm: Particle size distribution (raw concentration) for latex 203 nm on June 02th, 2016.

Time Series

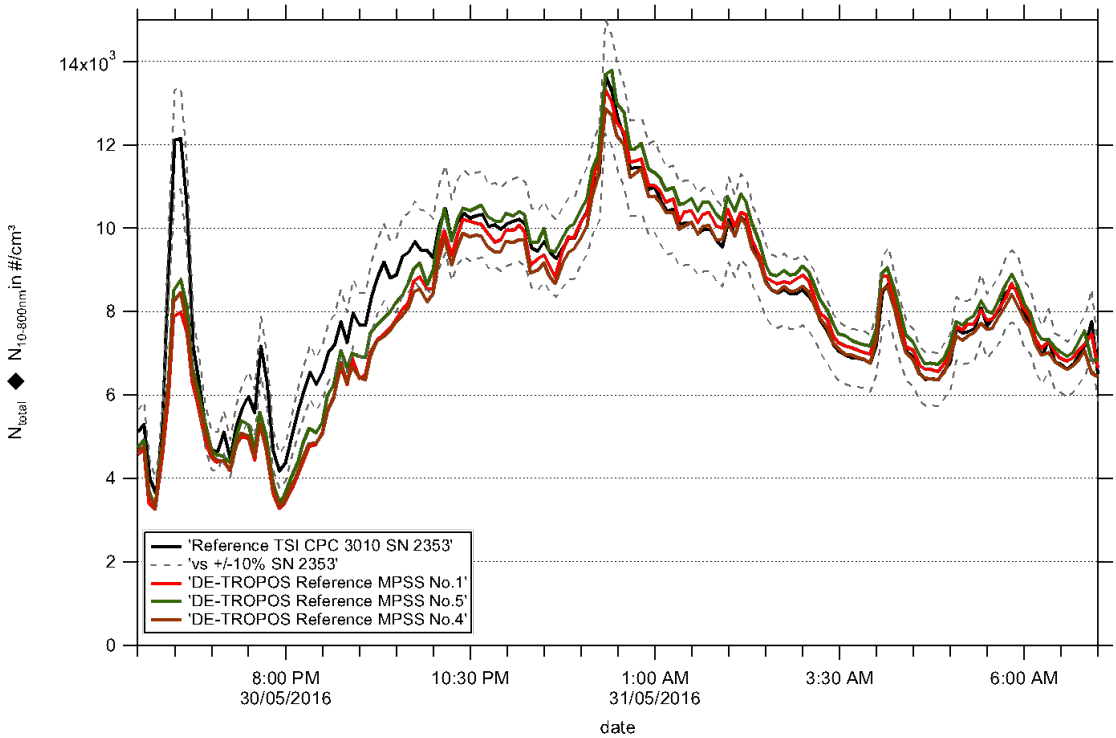


Figure 03: Time series (May 30, 2016 06:00 pm – May 31, 2016 08:00 am) of the integrated particle number concentration ($N_{10\text{-}800nm}$) of the TROPOS Reference MPSS and total number concentration (N_{total}) of the Reference TSI CPC 3010. The inversion was performed using TROPOS software. Multiple charge correction, internal diffusion losses and CPC flow corrections are included.

Particle Number Size Distribution

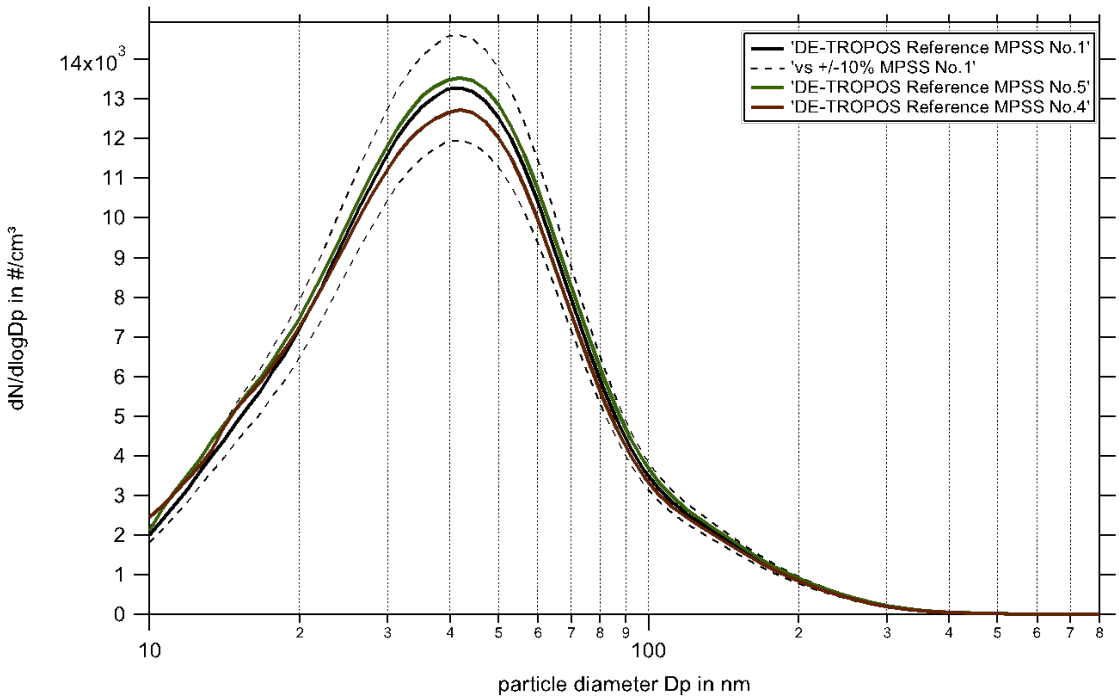


Figure 04: Comparison of mean particle number size distribution of TROPOS Reference MPSS No.1, No.4 and No.5 from May 30, 2016 08:00 pm until May 31, 201605:00 am. Multiple charge correction, internal diffusion losses and CPC efficiency are included for both of the TROPOS Reference MPSS.

Correlation

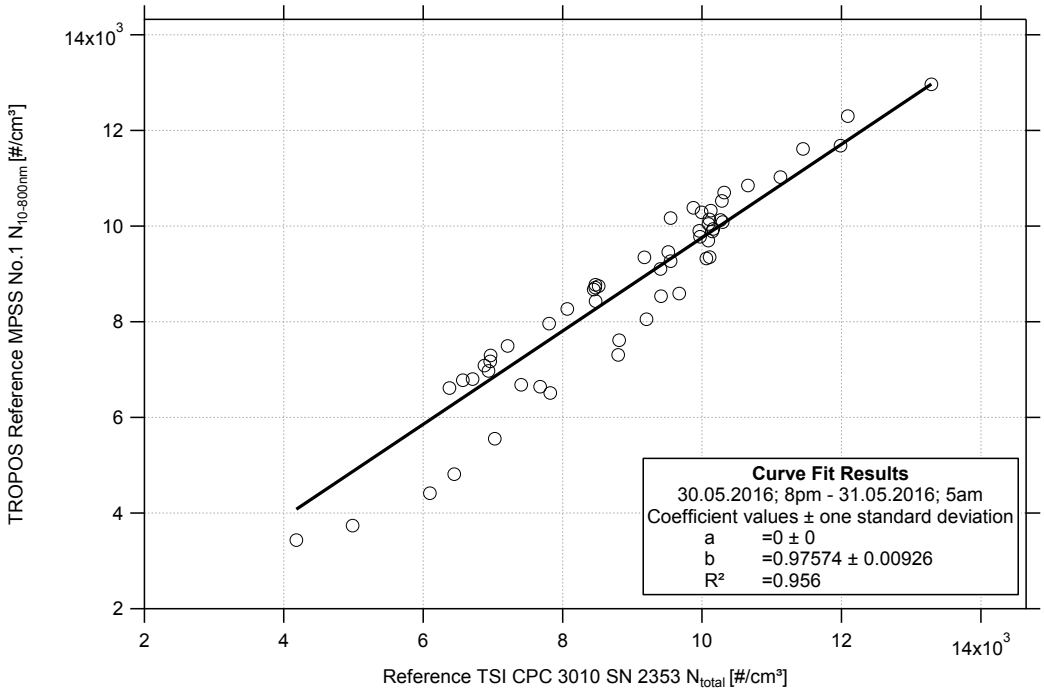


Figure 05: Linear regression between the number concentrations of the TROPOS Reference TSI CPC Model 3010 SN: 2353 and TROPOS Reference MPSS No.1. Multiple charge correction, internal diffusion losses and CPC flow corrections are included.

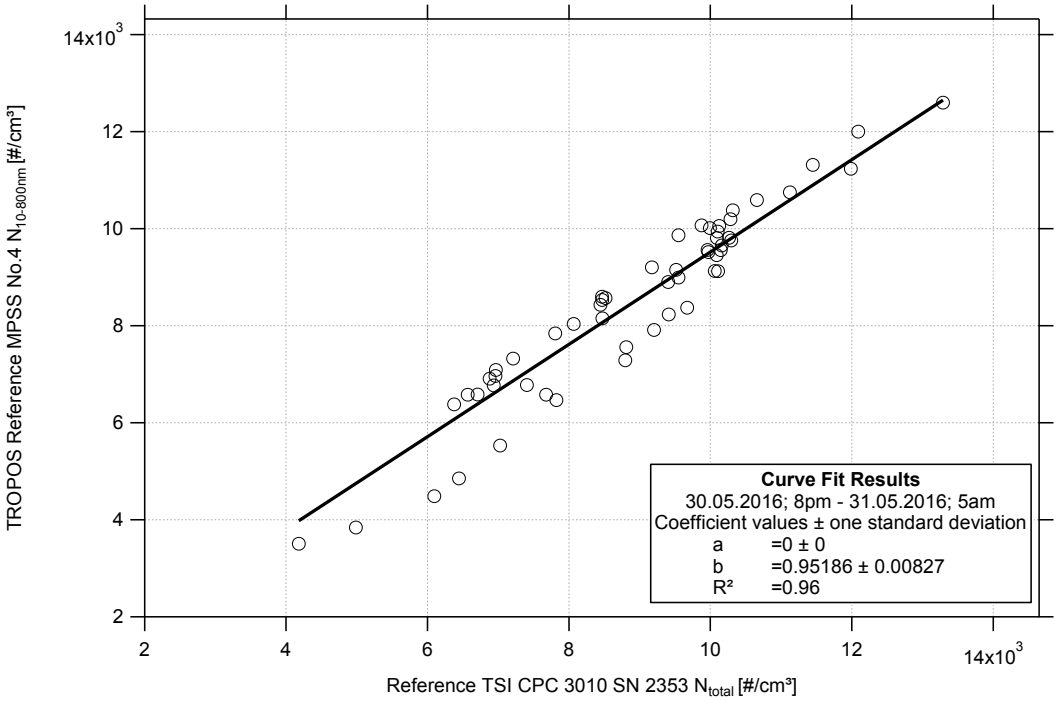


Figure 06: Linear regression between the number concentrations of the TROPOS Reference TSI CPC Model 3010 SN: 2353 and TROPOS Reference MPSS No.4. Multiple charge correction, internal diffusion losses and CPC flow corrections are included.

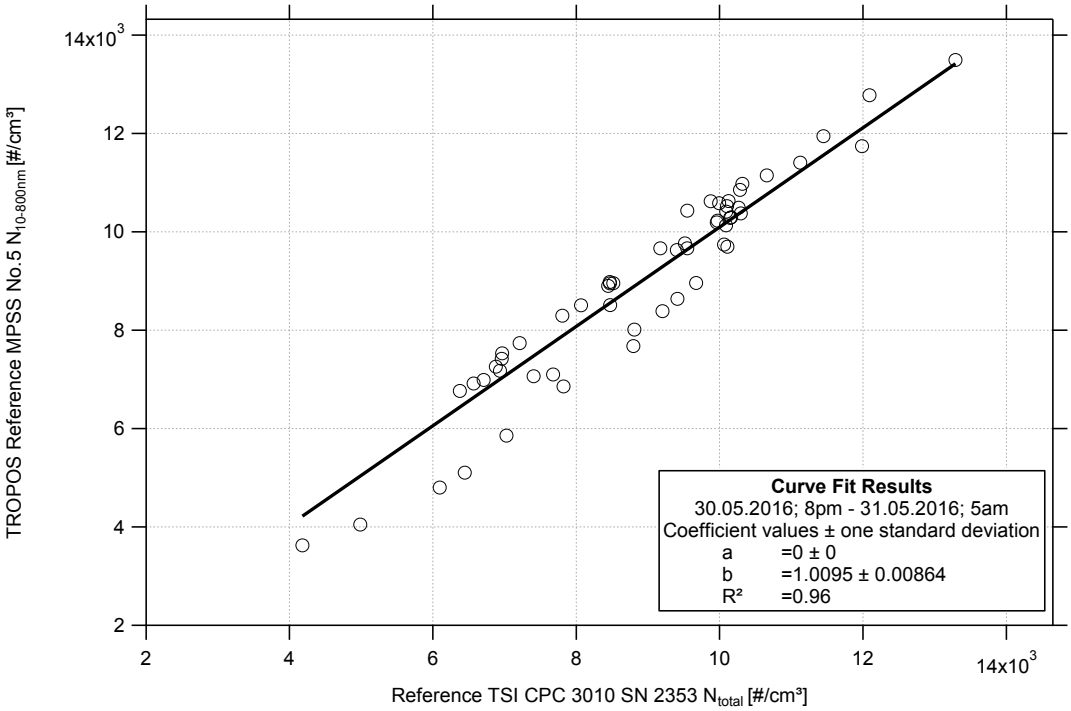


Figure 07: Linear regression between the number concentrations of the TROPOS Reference TSI CPC Model 3010 SN: 2353 and TROPOS Reference MPSS No.5. Multiple charge correction, internal diffusion losses and CPC flow corrections are included.

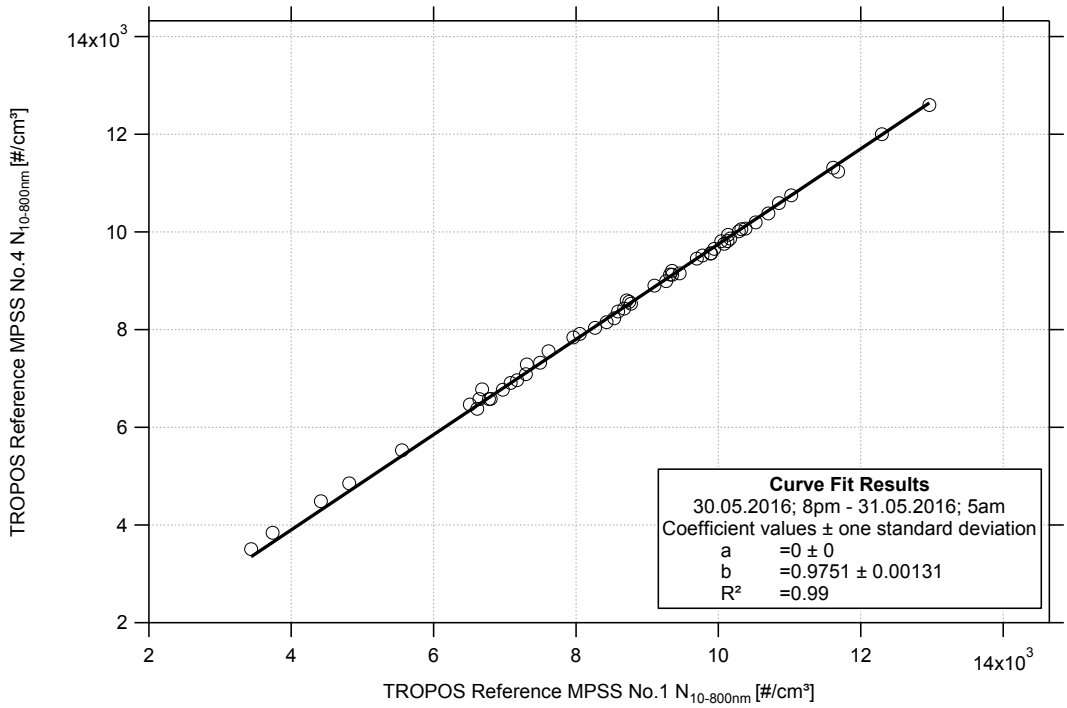


Figure 08: Linear regression between the number concentrations of the TROPOS Reference MPSS No.1 and TROPOS Reference MPSS No.4. Multiple charge correction, internal diffusion losses and CPC flow corrections are included.

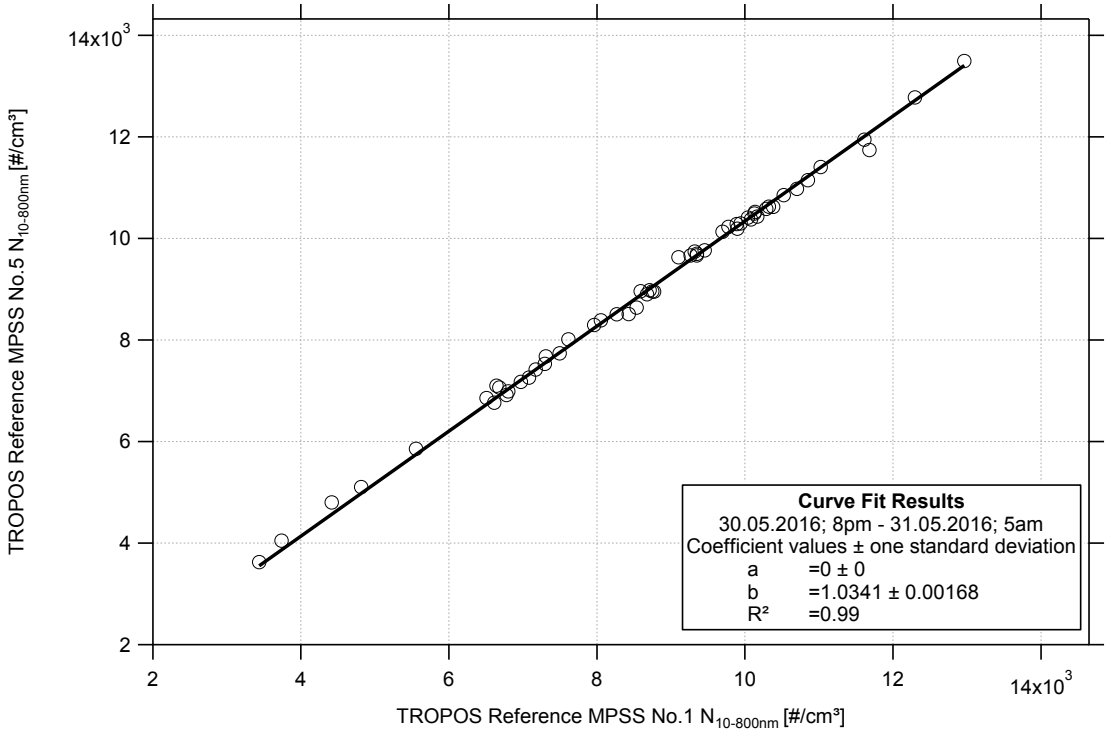


Figure 09: Linear regression between the number concentrations of the TROPOS Reference MPSS No.1 and TROPOS Reference MPSS No.5. Multiple charge correction, internal diffusion losses and CPC flow corrections are included.

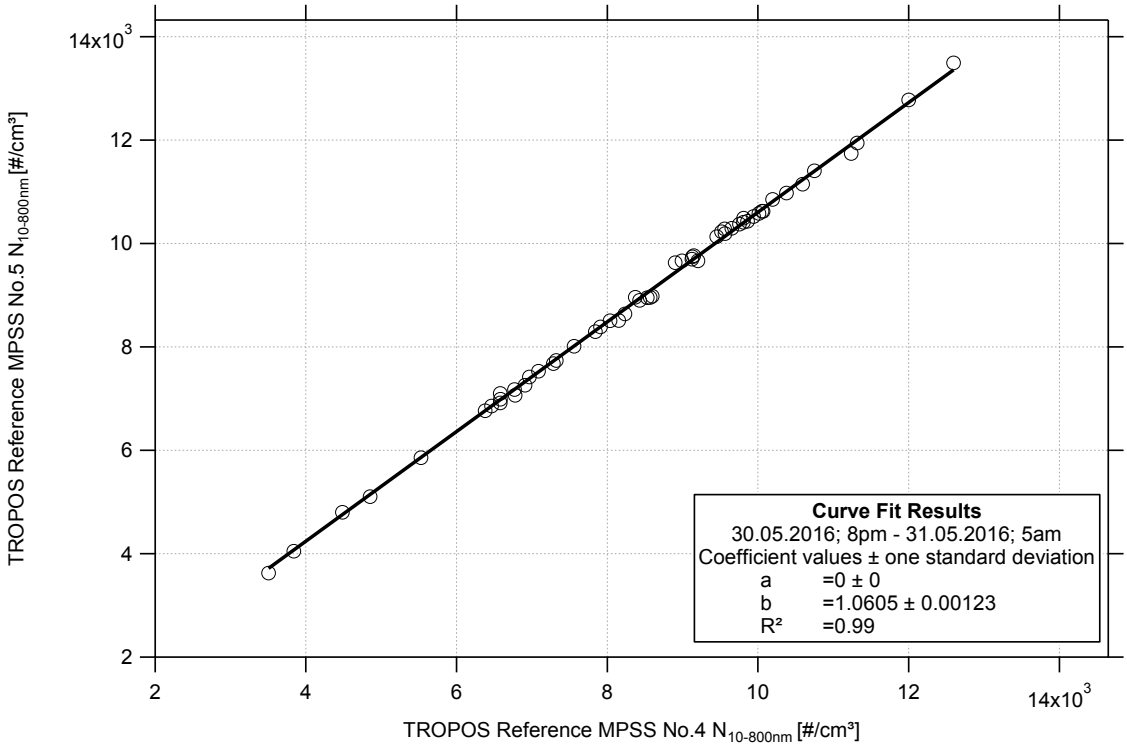


Figure 10: Linear regression between the number concentrations of the TROPOS Reference MPSS No.4 and TROPOS Reference MPSS No.5. Multiple charge correction, internal diffusion losses and CPC flow corrections are included.

TROPOS Reference Systems during the final-status June 02-03st

Components and zero check

Instrument	Line	Flow		Zero	
TROPOS Reference MPSS No.1	1.5	1.027	l/min	0	# cm^{-3}
TROPOS Total CPC 3010, #2337	1.6	1.023	l/min	0	# cm^{-3}
TROPOS Reference MPSS No.5	2.4	1.001	l/min	0	# cm^{-3}
TROPOS Total CPC 3010, #2353	2.6	1.051	l/min	0	# cm^{-3}
TROPOS Reference MPSS No.4	2.5	1.021	l/min	0	# cm^{-3}

Time Series

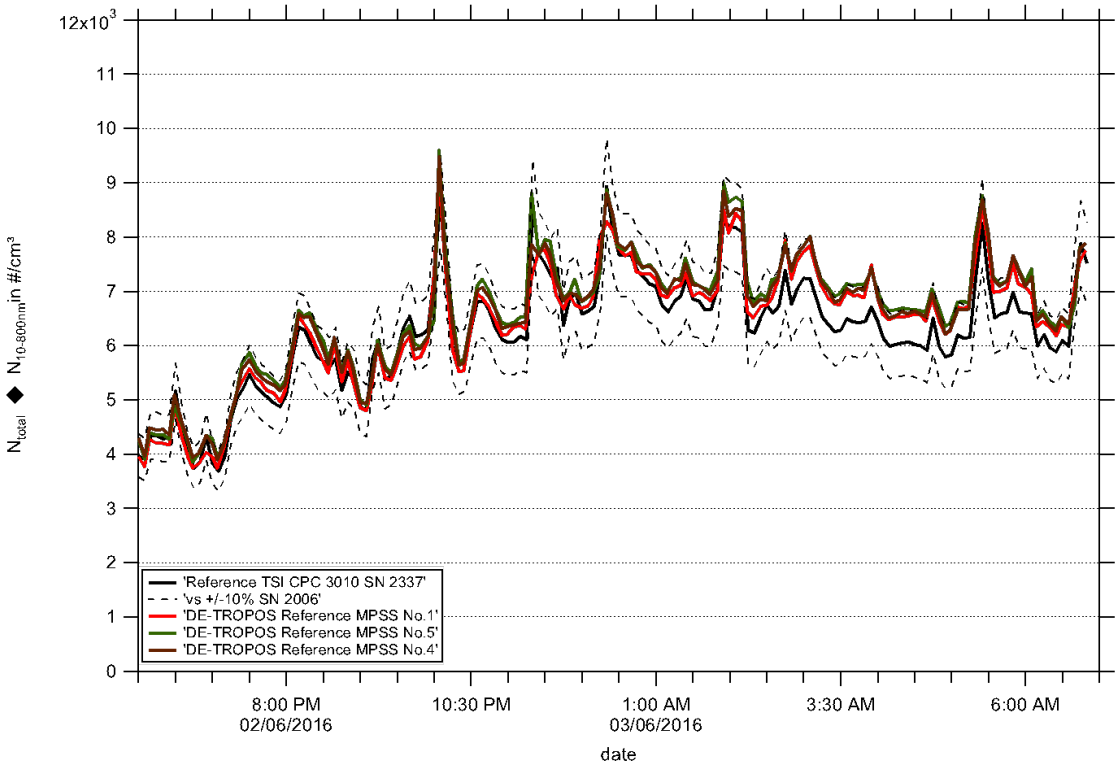


Figure 11: Time series (June 02, 2016 06:00 pm – June 03, 2016 08:00 am) of the integrated particle number concentration ($N_{10\text{-}800nm}$) of the TROPOS Reference MPSS and total number concentration (N_{total}) of the Reference TSI CPC 3010. The inversion was performed using TROPOS software. Multiple charge correction, internal diffusion losses and CPC flow corrections are included.

Correlation

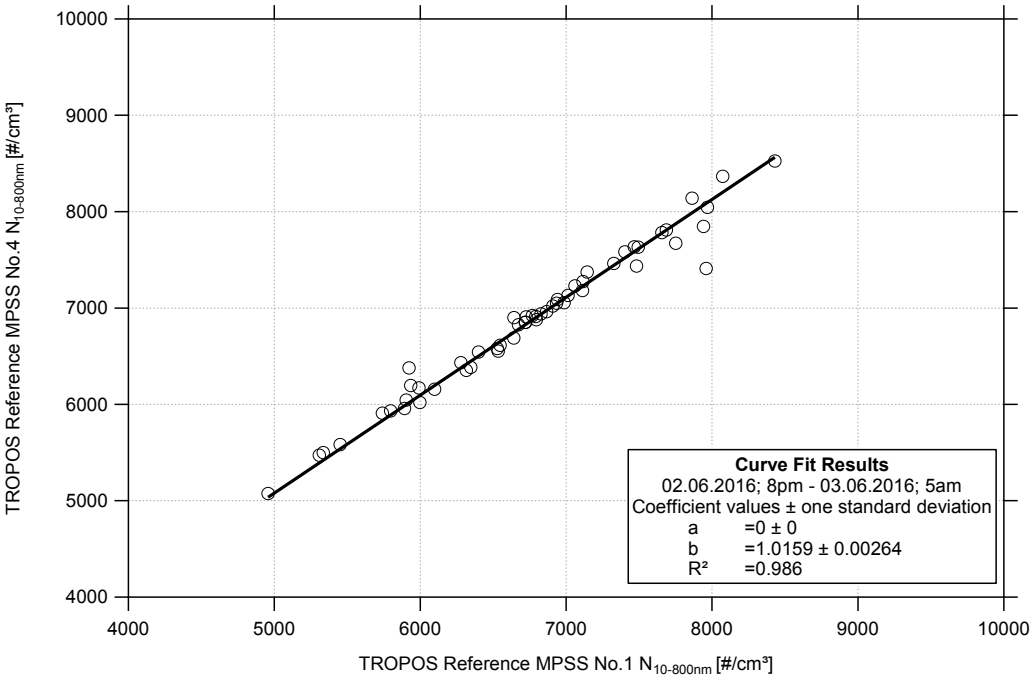


Figure 12: Linear regression between the number concentrations of the TROPOS Reference MPSS No.1 and TROPOS Reference MPSS No.4. Multiple charge correction, internal diffusion losses and CPC flow corrections are included.

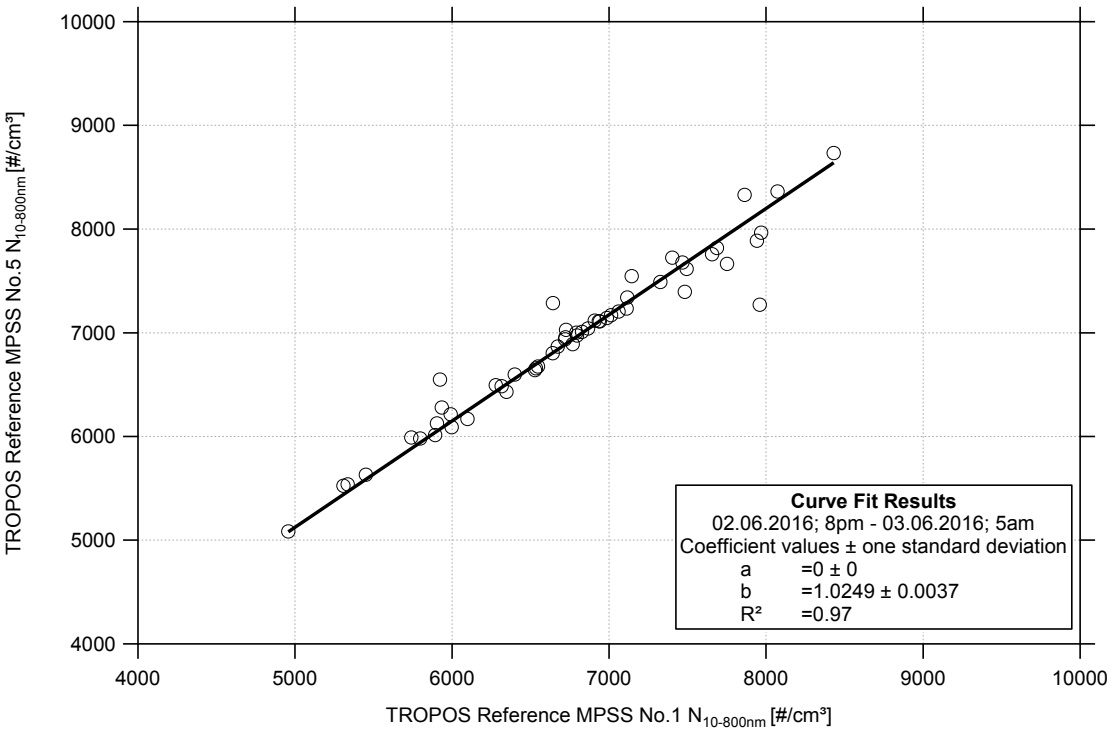


Figure 13: Linear regression between the number concentrations of the TROPOS Reference MPSS No.1 and TROPOS Reference MPSS No.5. Multiple charge correction, internal diffusion losses and CPC flow corrections are included.

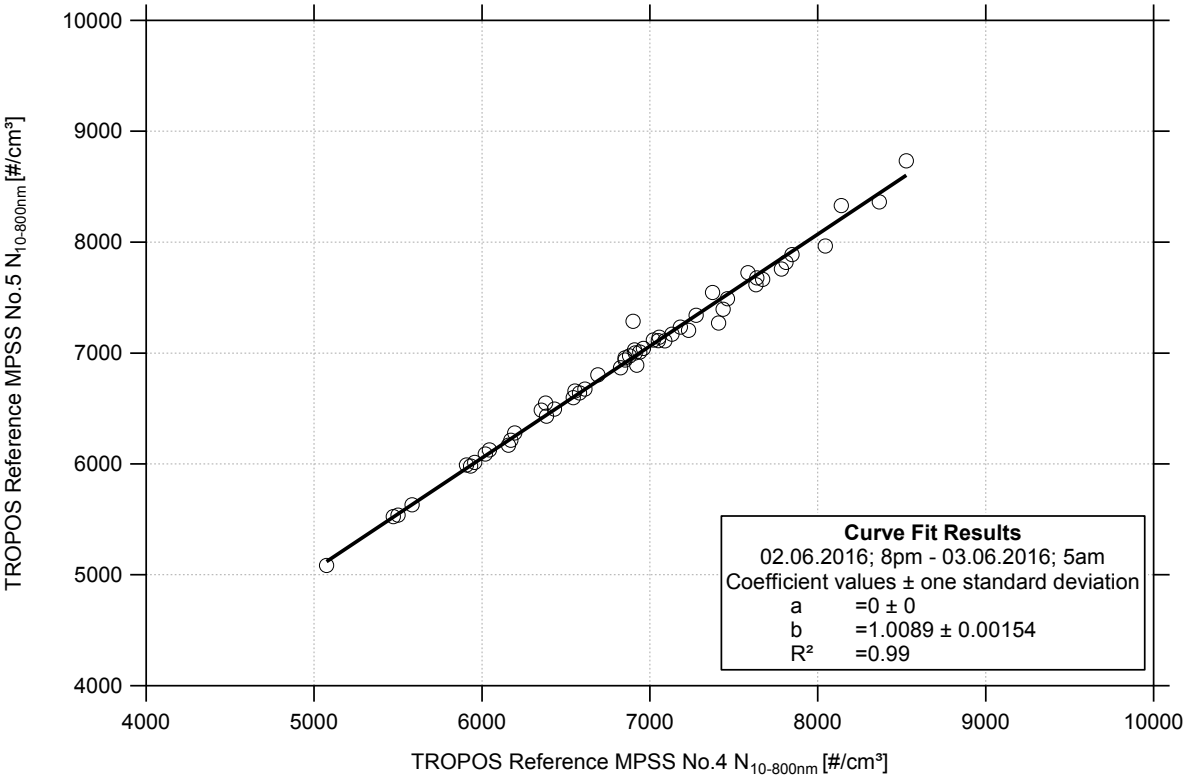


Figure 14: Linear regression between the number concentrations of the TROPOS Reference MPSS No.4 and TROPOS Reference MPSS No.5. Multiple charge correction, internal diffusion losses and CPC flow corrections are included.