Intercomparison of Mobility Particle Size Spectrometers

Project No.:	*MPSS-2017-3-1*
Principal Investigator:	Martin Gysel
Home Institution:	*Paul Scherrer Institute, Schweiz*
Participant:	Günther Wehrle
Candidate:	**CH-PSI**
Made by:	
Counter (SN):	TSI CPC Model 3775, SN: 3775141002
Software:	TSI
Location of the quality assurance:	TROPOS Leipzig, lab 118
Comparison period:	May 16, 2017 – May 19, 2017
Last Intercomparison (with Project No.):	

Summary of Intercomparison:

Pre-Status:
The instrument arrived with participant. During the Pre-Status, the performance of the system showed a concentration 21% higher than the TROPOS Reference Instrument No.1. The PSL check showed a correct peak at 201.86 nm. The CH-PSI is a homemade instrument with their own software for data processing. The flow ratio between aerosol flow and sheath air is 0.3 : 3.0 l/min. The instrument used a radioactive source Kr.85 from TROPOS. It was necessary to clean the instrument and measure the effective lengths to get the correct diffusion losses of all aerosol parts according the ACTRIS standards. TROPOS together with Günther Wehrle analyzed the instrument itself and the data processing in detail and talked about possibilities to increase the performance in the future.
Due to these technical and data processing issues, the candidate did not pass the quality standards of ACTRIS and GAW.

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Final-Status:
As already mentioned, the evaluation of the data including the internal diffusion losses showed differences to the TROPOS method. CH-PSI recalculated all their data for the final run patterned to TROPOS methods. Due to these changes, the performance of the system showed a concentration 9% higher than the TROPOS Reference Instrument No.1. During the workshop week, we also talked about rebuilding the system. TROPOS recommends to change the flow ratio to 1.0 : 5.0. If there are any future questions, please contact us. The candidate passed the quality standards of ACTRIS and GAW.

Information about the instruments:

Date of check: May 15, 2017

List of Components	TROPOS Reference MPSS No.1	TROPOS Reference MPSS No.	Candidate
Position	Line 1	-	Line 1
Company	TROPOS	-	PSI
Software	TROPOS	-	Homemade
CPC-MPSS	TSI CPC, Model 3772	-	TSI CPC, Model 3775
CPC-total	TSI CPC, Model 3010	-	-
flow ratio	1.0 : 5.0	-	0.3 : 3.0
source	Kr85	-	TROPOS Kr.85
HV power supply	positive	-	negative
DMA	Hauke medium	-	Homemade
aerosol dryer	✓	-	-
aerosol RH- sensor	✓	-	-
aerosol T-sensor	✓	-	✓
sheath RH-sensor	✓	-	✓
sheath T-sensor	✓	-	✓
Sheath dryer	✓	-	✓
pressure sensor	✓	-	✓
info			

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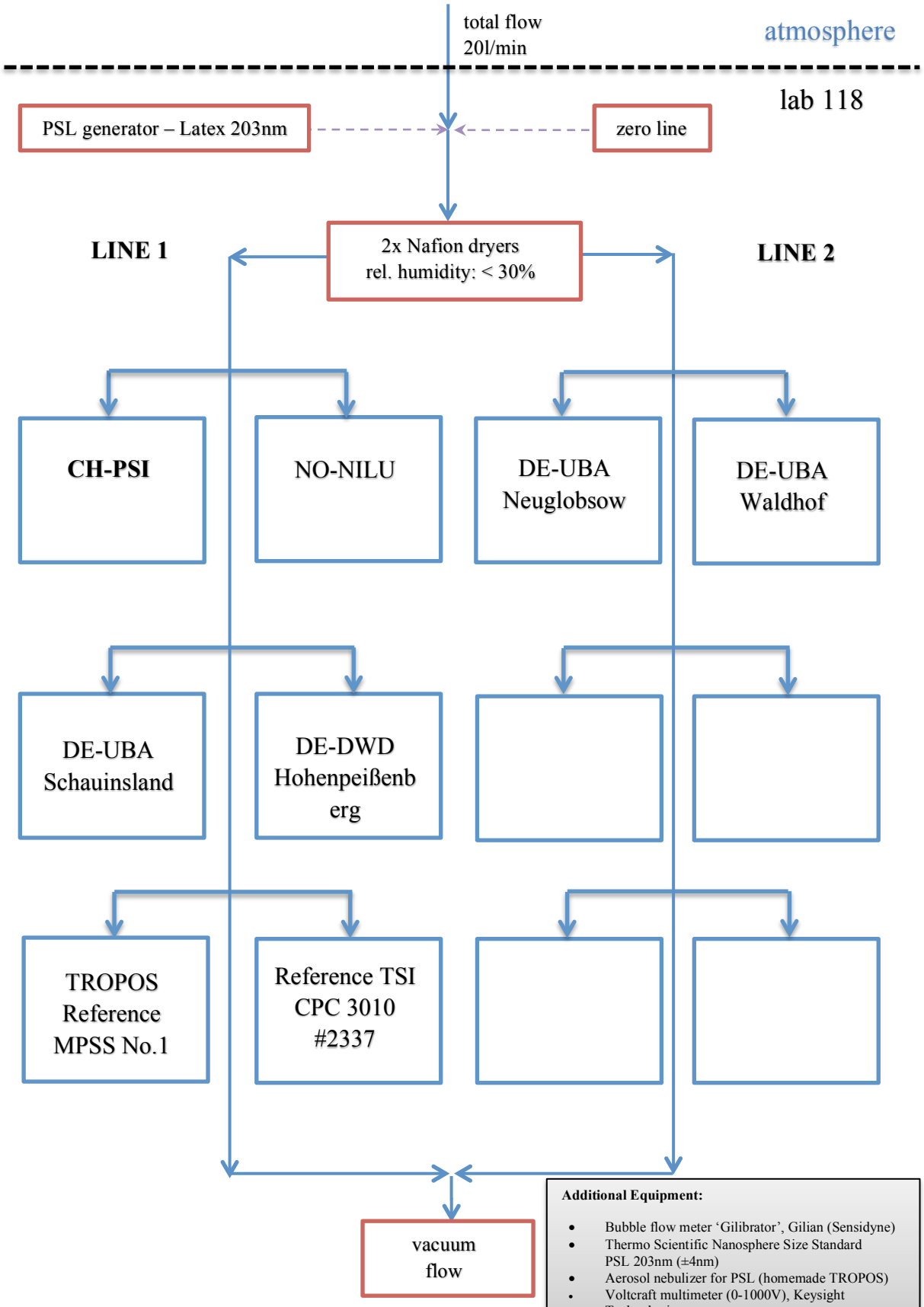
Laboratory setup:



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Status of the instruments:

Date of check (Pre-Status): May 15, 2017

CPC status	MPSS		Total CPC	
power/status	LED green	-	-	-
saturator temp	39.0	°C	-	°C
condenser temp	14.0	°C	-	°C
optics temp	40.0	°C	-	°C
cabinet temp	35.6	°C	-	°C
ambient pressure	101.0	kPa	-	kPa
orifice pressure	45.0	kPa	-	kPa
nozzle pressure	0.07	kPa	-	kPa
laser current	29.0	mA	-	mA
liquid level	full	-	-	-

Date of check (Final-Status): May 18, 2017

CPC status	MPSS		Total CPC	
power/status	LED green	-	-	-
saturator temp	39.0	°C	-	°C
condenser temp	14.0	°C	-	°C
optics temp	40.0	°C	-	°C
cabinet temp	35.5	°C	-	°C
ambient pressure	101.1	kPa	-	kPa
orifice pressure	45.0	kPa	-	kPa
nozzle pressure	0.07	kPa	-	kPa
laser current	29.0	mA	-	mA
liquid level	full	-	-	-

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Date of system checks:

date	15.05.2017	16.05.2017	17.05.2017		unit
total CPC flow	-	-	-		l/min
aerosol flow (DMA)	-	-	-		l/min
aerosol flow (UDMA)	-	-	-		l/min
aerosol flow (total)	0.295	0.298	0.299		l/min
Zero MPSS	okay	okay	okay		#/cm³
Zero total CPC	-	-	-		#/cm³
PSL 203 nm	201.86	-	-		nm
HV – 0 V	okay				V
HV – 5 V	okay				V
HV – 100 V	okay				V
HV – 1000 V	okay				V

Special Information regarding the Candidate:

Was it necessary to:	yes/no (date)	old part (ID/SN)	new part (ID/SN)	information
clean the aerosol inlet	yes			
change aerosol Nafion dryer	no			
change sheath Nafion dryer	no			
check source	no			CH-PSI used TROPOS Kr.85
change HV power supply	no			
clean/change DMA	yes			Clean DMA
change aerosol RH/T-sensor	no			
change sheath RH/T-sensor	no			
change pressure sensor	no			

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

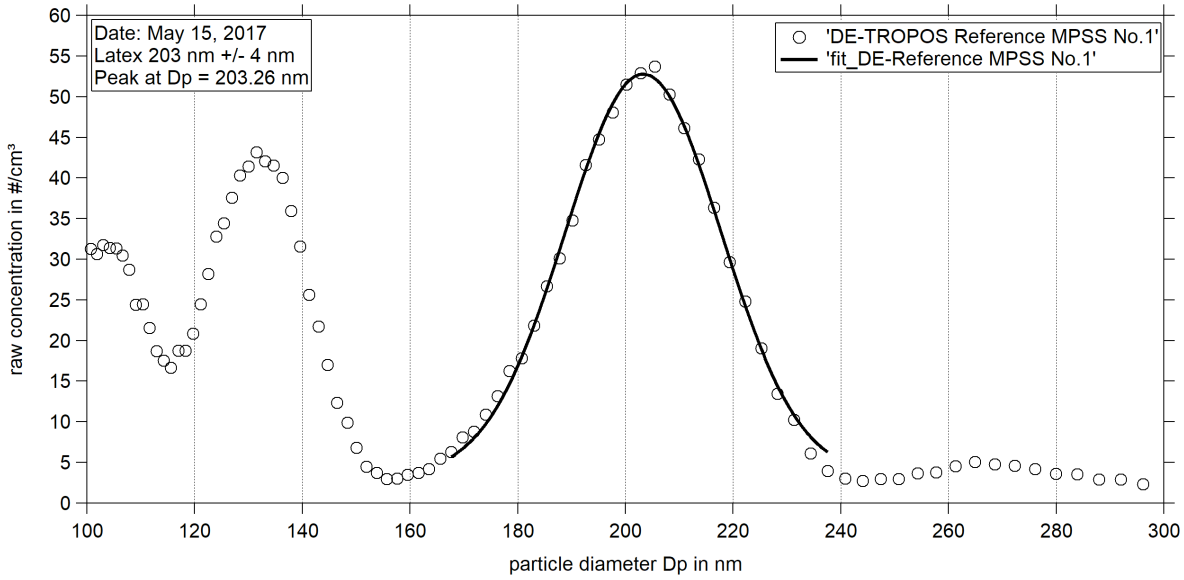

Figure 01: Measurement of latex 203 nm: Particle size distribution (raw concentration) for latex 203 nm on May 15rd, 2017.

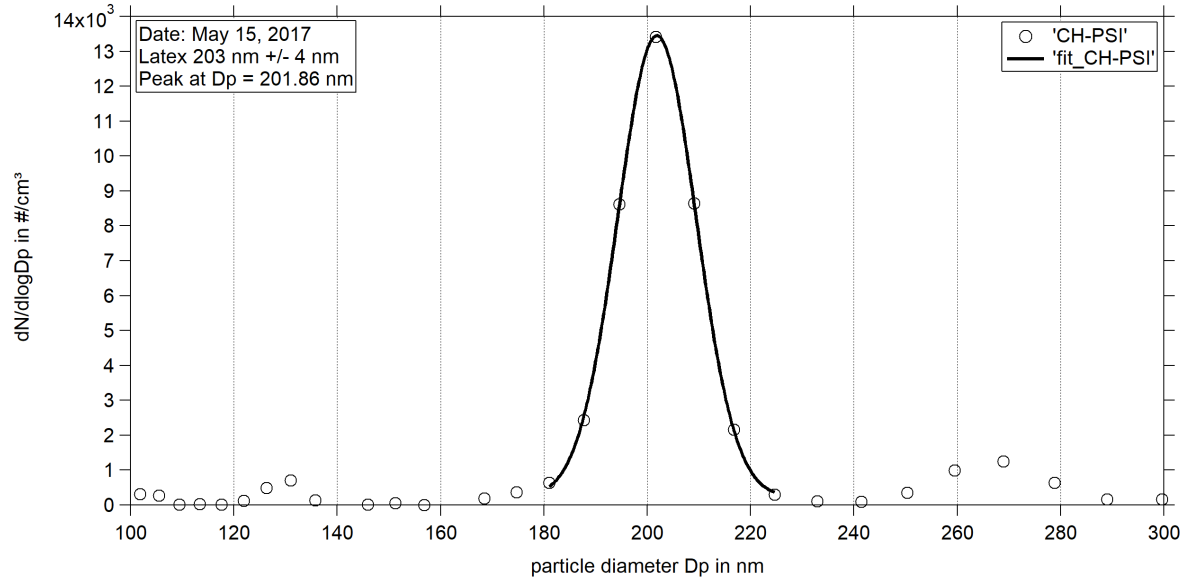

Figure 02: Measurement of latex 203 nm: Particle size distribution (raw concentration) for latex 203 nm on May 15rd, 2017.

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Pre-Status of the Candidate: Particle Number Size Distribution

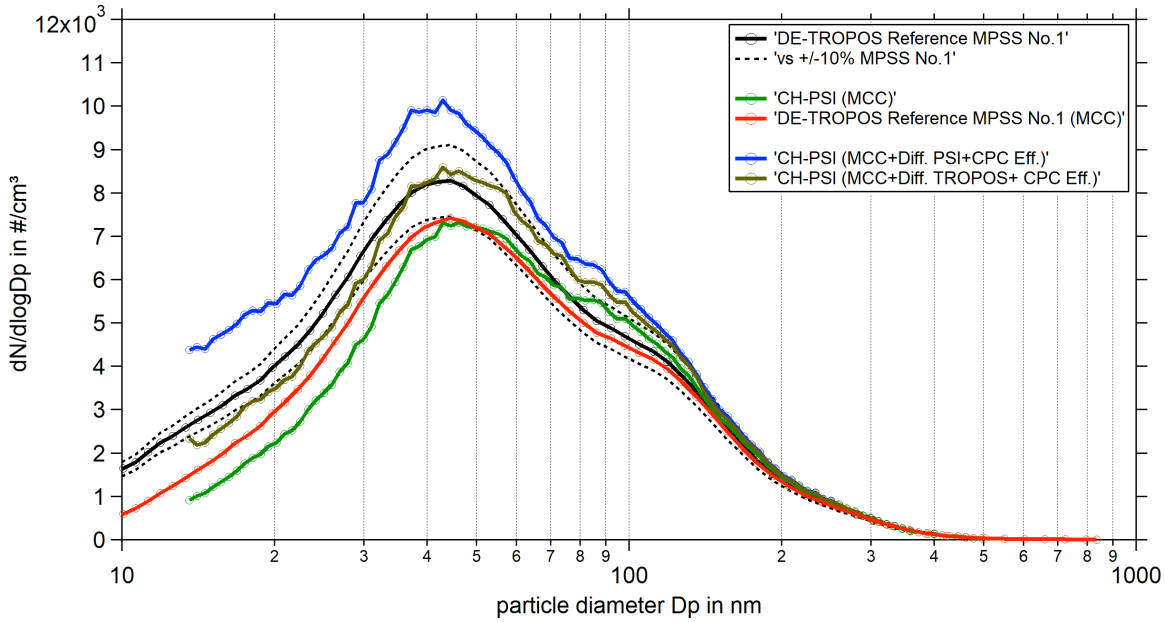

Figure 04: Comparison of mean particle number size distribution of TROPOS Reference MPSS No.1 against CH-PSI from May 15, 2017 08:00 PM – May 15, 2017 11:12 AM. Multiple charge correction, internal diffusion losses and CPC efficiency are in separate steps included. CH-PSI stopped overnight!

Pre-Status of the Candidate: Time Series

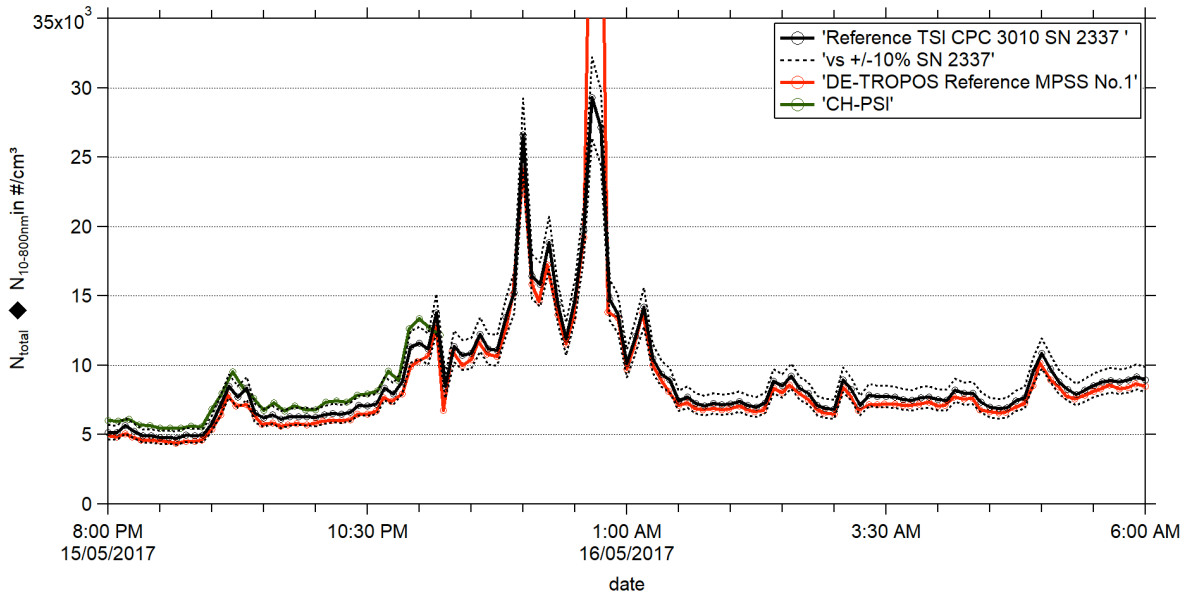

Figure 05: Time series (May 15, 2017 06:00 PM – May 16, 2017 06:00 AM) of the integrated particle number concentration ($N_{10\text{-}800nm}$) of the MPSS and total number concentration (N_{total}) of the Reference TSI-CPC Model 3010. The inversion for the candidate was performed using TSI software. Multiple charge correction, internal diffusion losses and CPC flow corrections are included. Using the inverted and calculated data from PSI.

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Pre-Status of the Candidate: Correlation

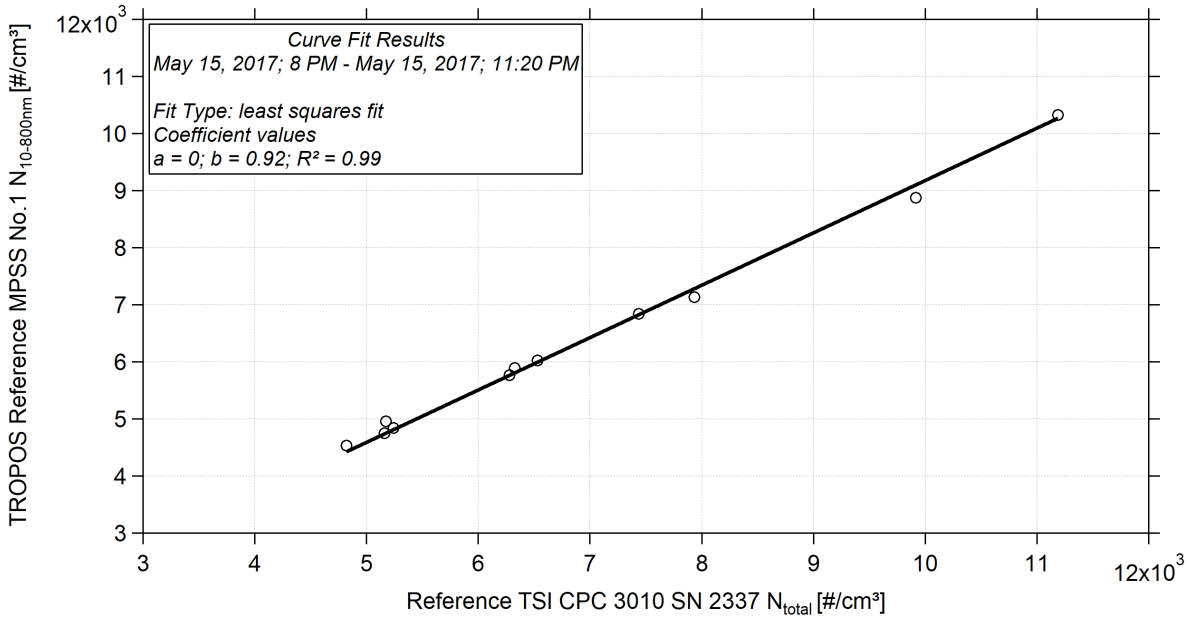

Figure 06: Linear regression between the number concentrations of the TROPOS Reference TSI CPC Model 3010 SN: 2337 and TROPOS Reference MPSS No.1. Multiple charge correction, internal diffusion losses and CPC flow corrections are included.

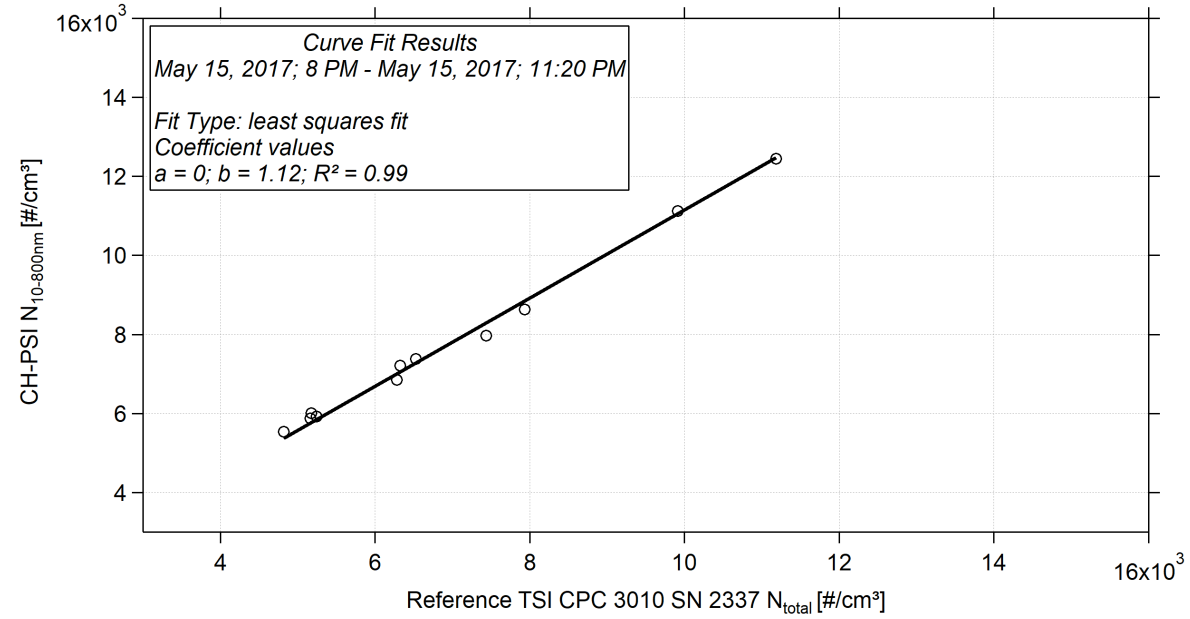

Figure 07: Linear regression between the number concentrations of the TROPOS Reference TSI CPC Model 3010 SN: 2337 and CH-PSI. Multiple charge correction, internal diffusion losses and CPC flow corrections are included. CH-PSI used their own evaluation process.

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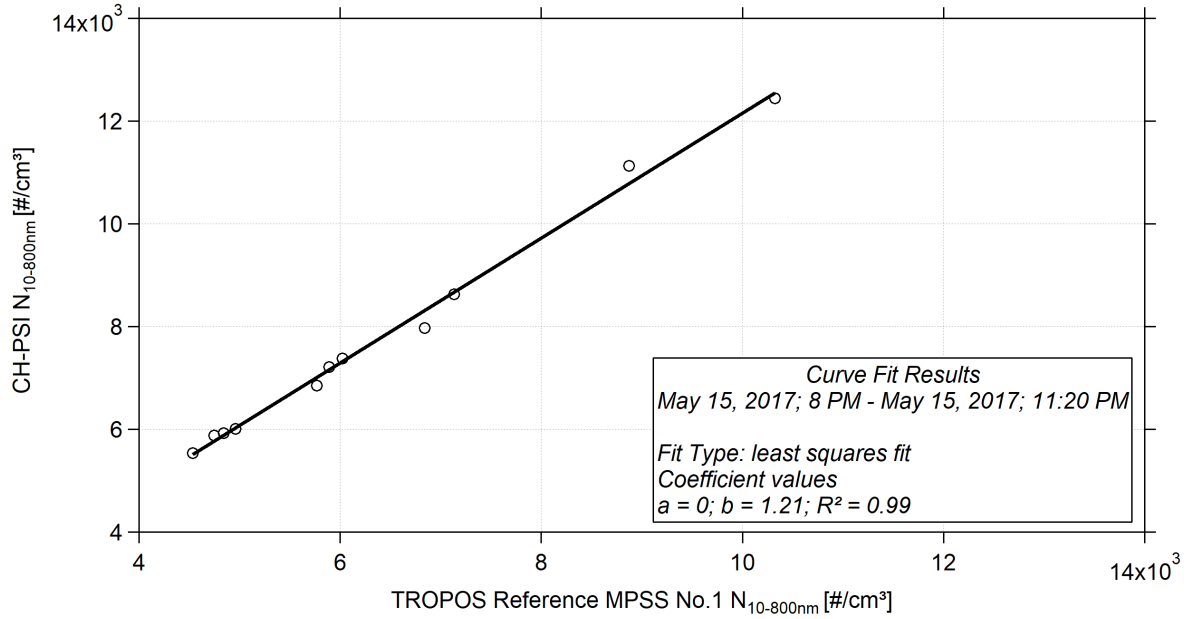

Figure 08: Linear regression between the number concentrations of the TROPOS Reference MPSS No.1 and CH-PSI. Multiple charge correction, internal diffusion losses and CPC flow corrections are included. CH-PSI used their own evaluation process.

Final-Status of the Candidate: Particle Number Size Distribution

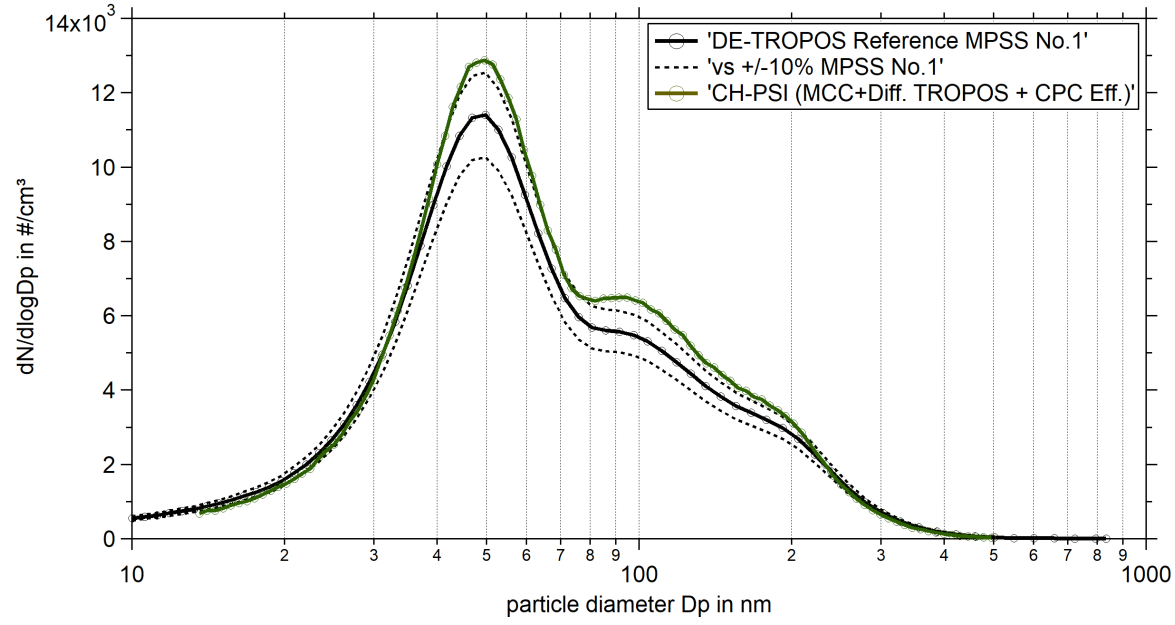

Figure 09: Comparison of mean particle number size distribution of TROPOS Reference MPSS No.1 against CH-PSI from May 17, 2017 06:00 PM – May 18, 2017 06:00 AM. Multiple charge correction, internal diffusion losses from TROPOS and CPC efficiency are included.

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Final-Status of the Candidate: Time Series

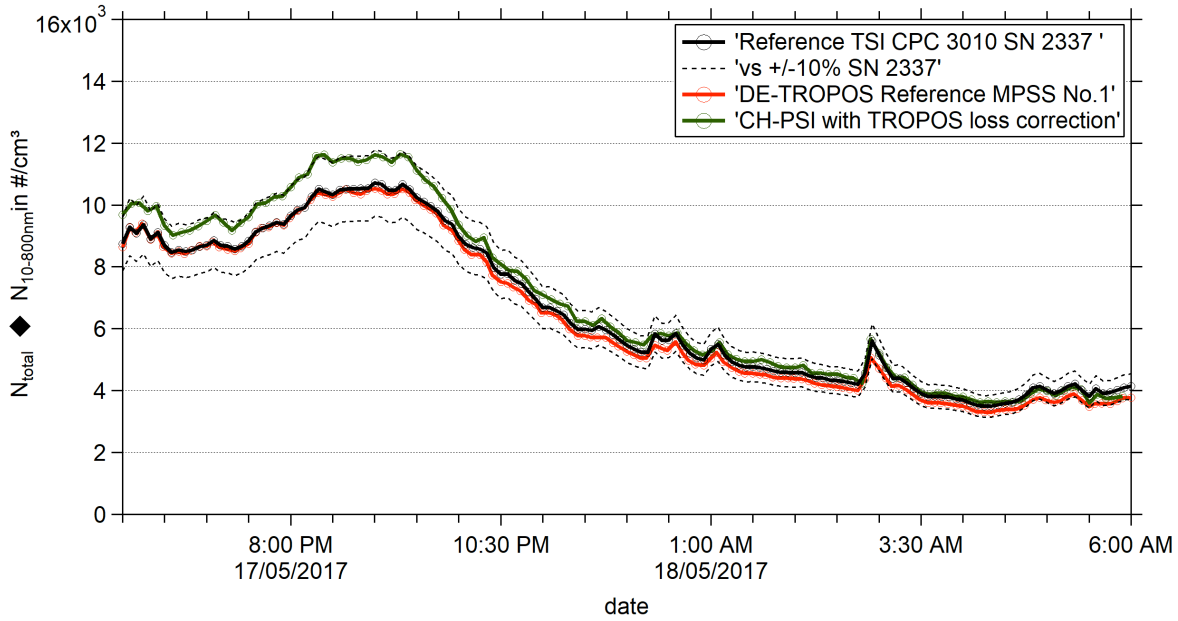

Figure 10: Time series (May 17, 2017 08:00 PM – May 18, 2017 06:00 AM) of the integrated particle number concentration ($N_{10\text{-}800nm}$) of the MPSS and total number concentration (N_{total}) of the Reference TSI-CPC Model 3010. The inversion for the candidate was performed using TSI software. Multiple charge correction, internal diffusion losses from TROPOPS and CPC flow corrections are included.

Final-Status of the Candidate: Correlation

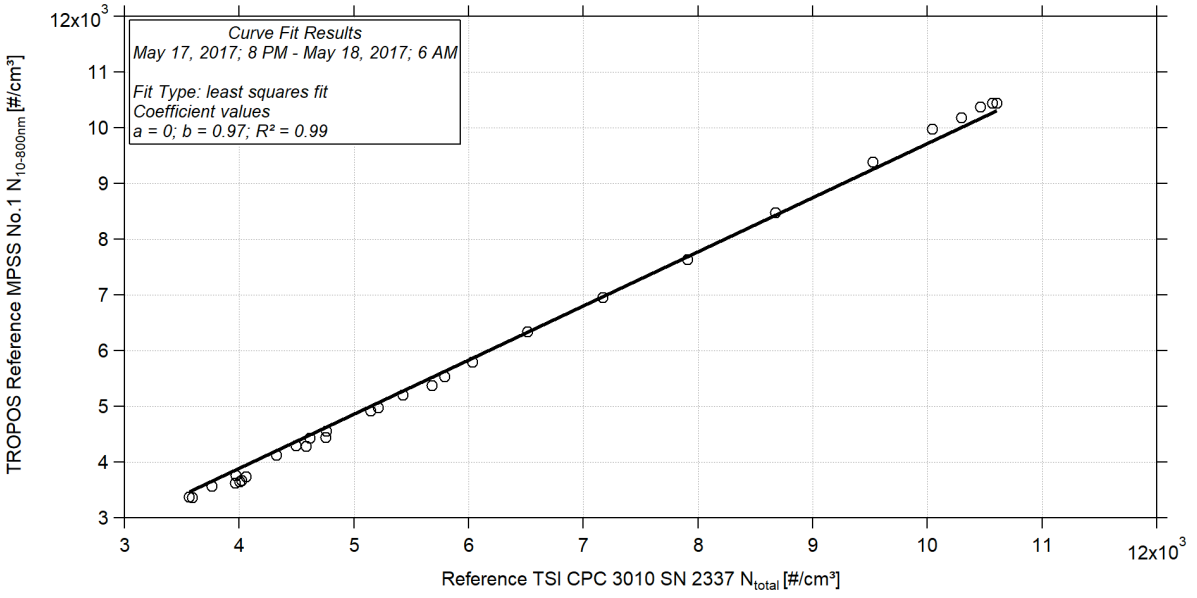

Figure 11: Linear regression between the number concentrations of the TROPOS Reference TSI CPC Model 3010 SN: 2337 and TROPOS Reference MPSS No.1. Multiple charge correction, internal diffusion losses and CPC flow corrections are included.

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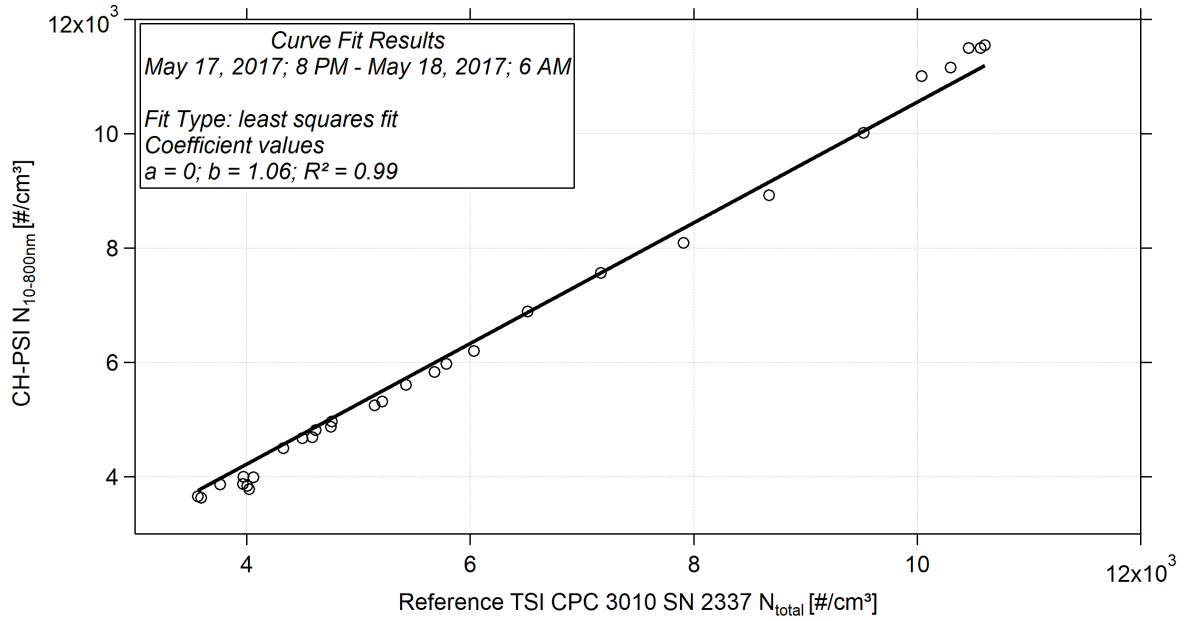

Figure 12: Linear regression between the number concentrations of the TROPOS Reference TSI CPC Model 3010 SN: 2337 and CH-PSI. Multiple charge correction, internal diffusion losses and CPC flow corrections are included.

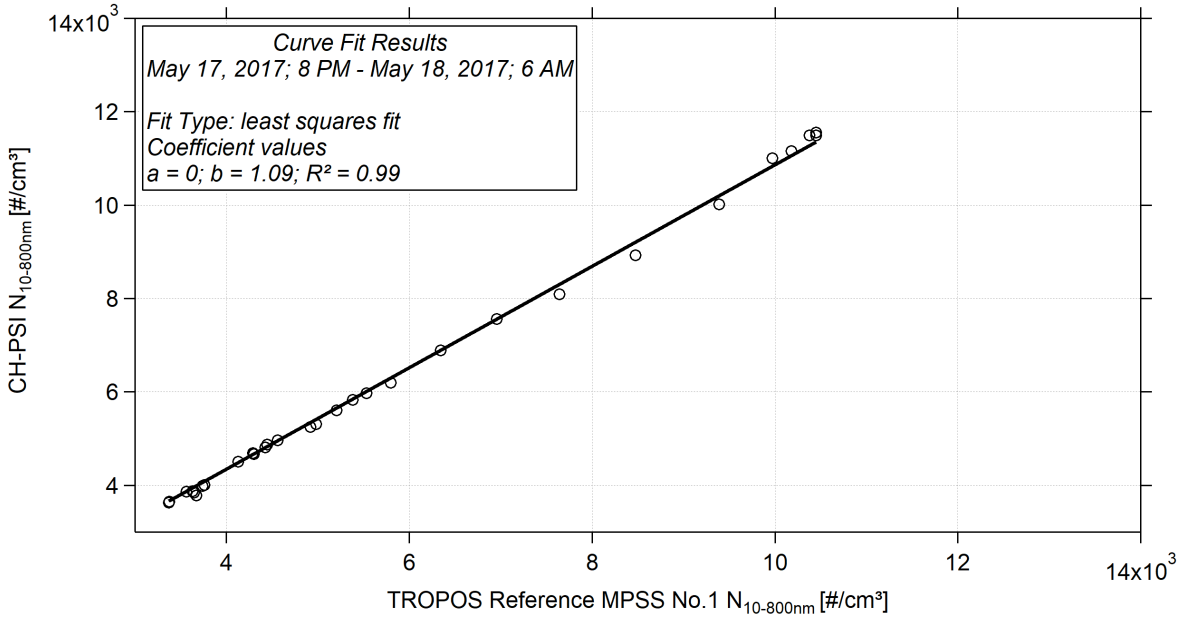

Figure 13: Linear regression between the number concentrations of the TROPOS Reference MPSS No.1 and CH-PSI. Multiple charge correction, internal diffusion losses and CPC flow corrections are included.

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