Intercomparison of Mobility Particle Size Spectrometers

Project No.:   *MPSS-2018-1-1*

Principal Investigator: Jianzhong Xu

Home Institution: Chinese Academy of Sciences

Participant: Jianzhong Xu

    Candidate: **China-CAREERI**
    Made by: **TROPOS**
    Counter (SN):   TSI CPC Model 3772, SN: 3772122202
    Software: TROPOS Software V6.68

Location of the quality assurance: TROPOS Leipzig, lab 118

Comparison period: February 19, 2017 – February 23, 2018

Last Intercomparison (with Project No.)*:*

Summary of Intercomparison:

Pre-Status:

The instrument arrived with participant. The instrument was running with the TROPOS Software Version 4.8. The NI-card from Labview was broken. TROPOS placed a new one inside and updated the driver software. During the Pre-Status, the candidate showed a concentration 14% lower than the TROPOS Reference MPSS No.6. The DMA was in a bad condition, therefore TROPOS decided to change it to a new one. The PSL check showed a peak at 204.45 nm.
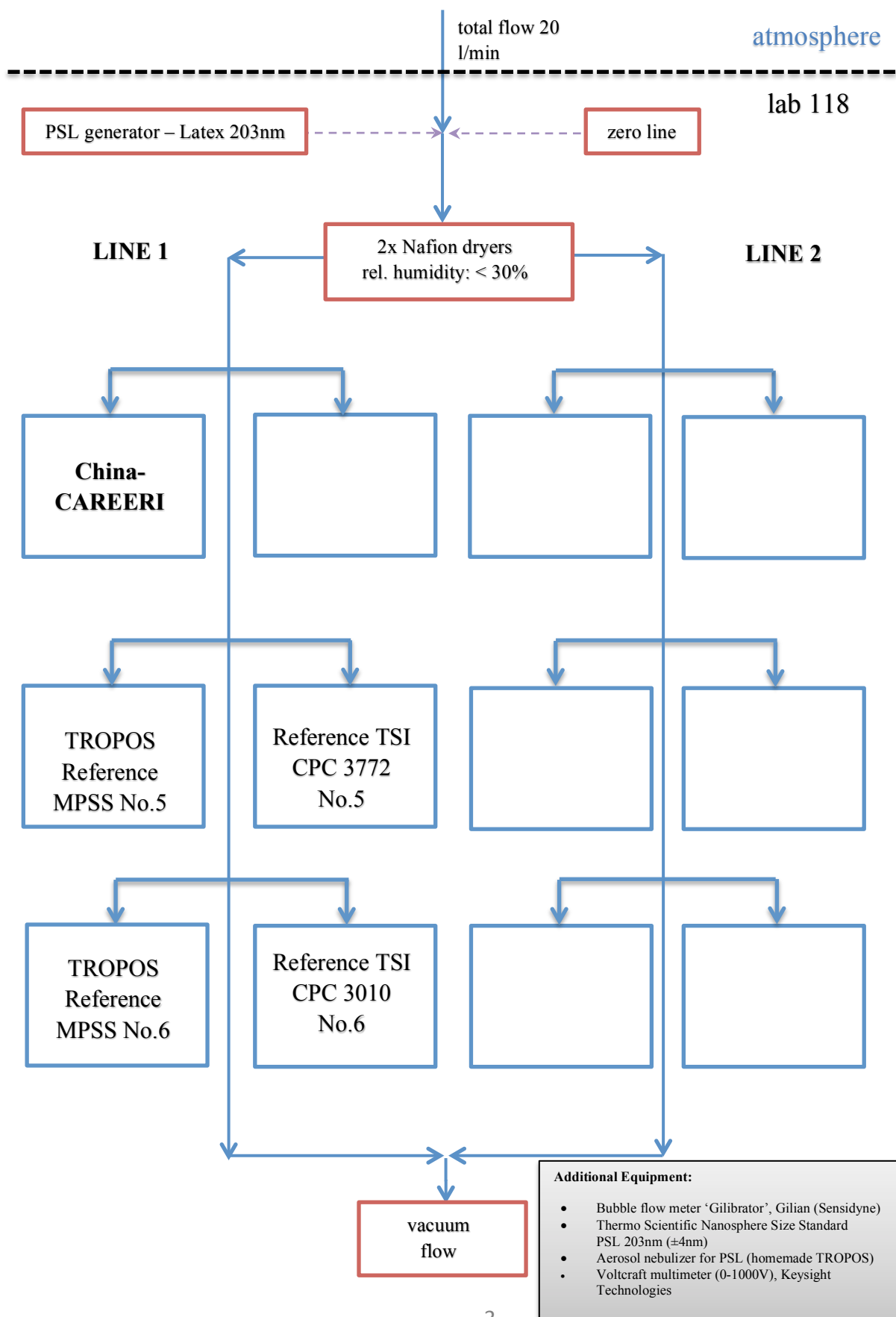
Final-Status:

During the Final-Status, the performance of the system showed the same concentration like the TROPOS Reference Instrument No.6. We updated Windows and installed the newest TROPOS Software V6.68 in the MPSS. The candidate used the recalibrated TSI CPC model 3772 and a Kr.85 source from TROPOS. The candidate passed the quality standards of ACTRIS and GAW.

Information about the instruments:
Date of check: February 19, 2018

List of Components	TROPOS Reference MPSS No.6	TROPOS Reference MPSS No.5	Candidate
Position	Line 1	Line 1	Line 1
Company	TROPOS	TROPOS	TROPOS
Software	TROPOS	TROPOS	TROPOS V6.68
CPC-MPSS	TSI CPC, Model 3772	TSI CPC, Model 3772	TSI CPC, Model 3772
CPC-total	TSI CPC, Model 3010	TSI CPC, Model 3772	-
flow ratio	1.0 : 5.0	1.0 : 5.0	1.0 : 5.0
source	Ni.63	Kr.85	Kr85 (from TROPOS)
HV power supply	Positive	Positive	Positive
DMA	Hauke medium	Hauke medium	Hauke medium
aerosol dryer	✓	✓	✓
aerosol RH- sensor	✓	✓	✓
aerosol T-sensor	✓	✓	✓
sheath RH-sensor	✓	✓	✓
sheath T-sensor	✓	✓	✓
Sheath dryer	✓	✓	✓
pressure sensor	✓	✓	✓
info			

Laboratory setup:

total flow 20 l/min

atmosphere

lab 118

PSL generator – Latex 203nm	zero line

LINE 1

2x Nafion dryers
rel. humidity: < 30%

LINE 2

China-CAREERI

TROPOS Reference MPSS No.5

Reference TSI CPC 3772 No.5

TROPOS Reference MPSS No.6

Reference TSI CPC 3010 No.6

Additional Equipment:

- Bubble flow meter 'Gilibrator', Gilian (Sensidyne)
- Thermo Scientific Nanosphere Size Standard PSL 203nm (±4nm)
- Aerosol nebulizer for PSL (homemade TROPOS)
- Voltcraft multimeter (0-1000V), Keysight Technologies

vacuum flow

Status of the instruments:

Date of system checks:

date	19.02.2018	20.02.2018	21.02.2018	22.02.2018	unit
total CPC flow	-	-	-	-	l/min
aerosol flow (DMA)	-	-	-	-	l/min
aerosol flow (UDMA)	-	-	-	-	l/min
aerosol flow (total)	1.009	1.007	1.001	-	l/min
Zero MPSS	0	0	0	-	#/cm³
Zero total CPC	-	-	-	-	#/cm³
PSL 203 nm	204.45	-	203.61		nm
HV check	okay	-	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	YES	MT 3310910-5	MT 112916-01-18	05.09.2011
change sheath Nafion dryer	YES	ND 0.7-103	ND 0.7-123a	06.09.2011
check source	No	-	-	TROPOS
change HV power supply	No	-	-	-
clean/change DMA	Yes	-	-	Not okay -> change DMA
change aerosol RH/T-sensor	No	-	-	-
change sheath RH/T-sensor	No	-	-	-
change pressure sensor	No	-	-	-
change inlet Nafion dryer (500)	No	-	-	-
Change Total filter	YES	-	-	old
NI-card	YES			defect -> change

PSL Scan and calibration: Latex 203 nm +/- 4 nm
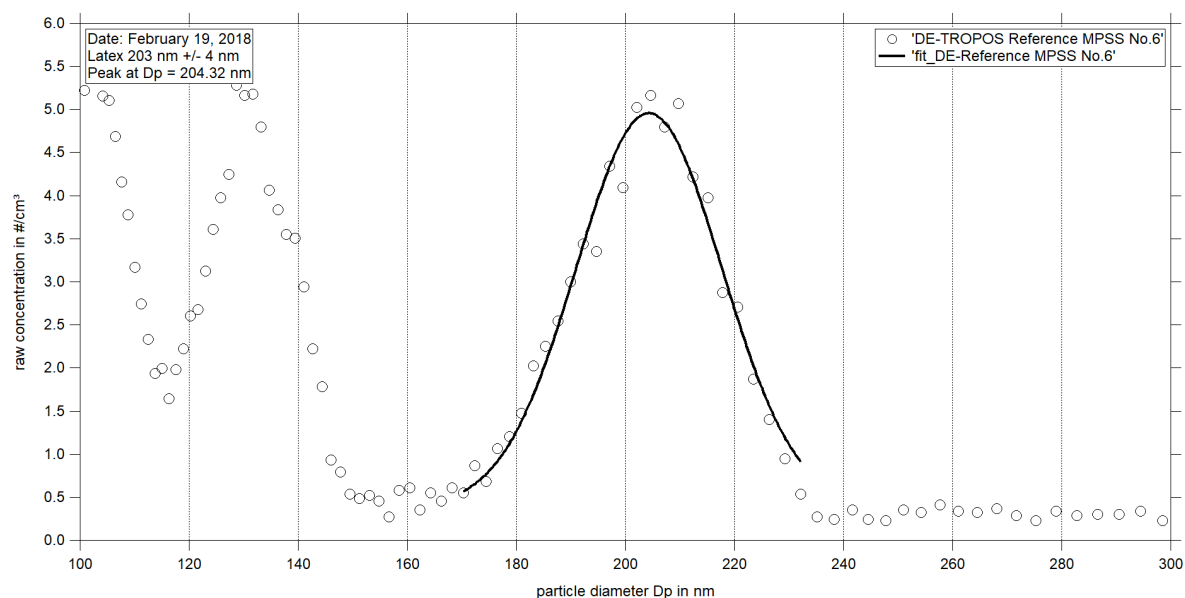
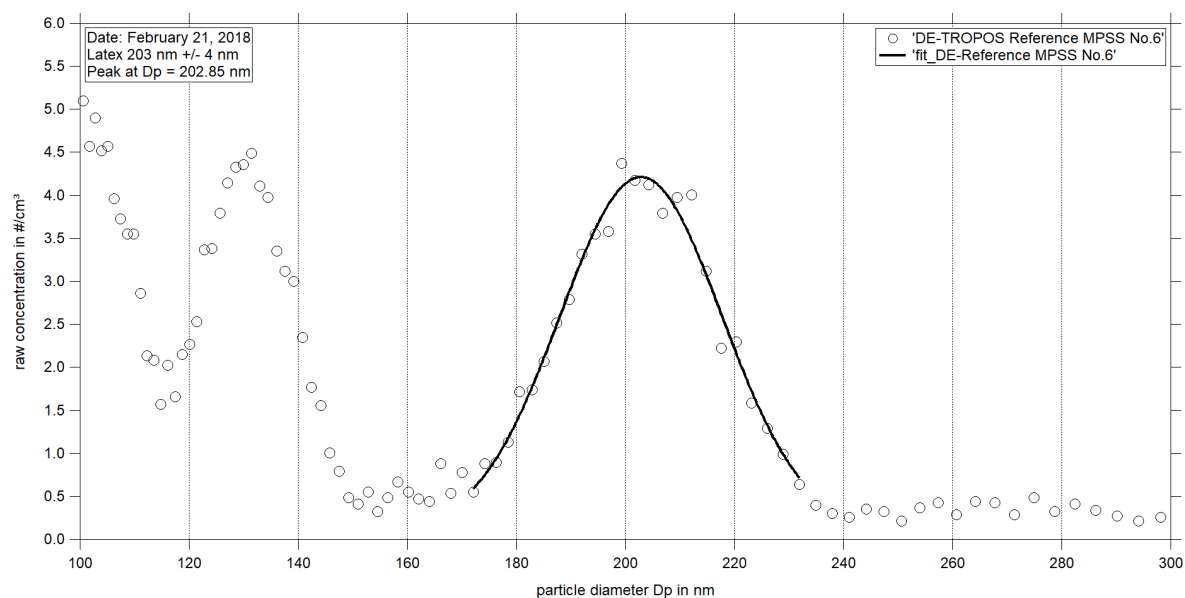**Figure 01:** Measurement of latex 203 nm: Particle size distribution (raw concentration) for latex 203 nm on Feb 19rd, 2018.

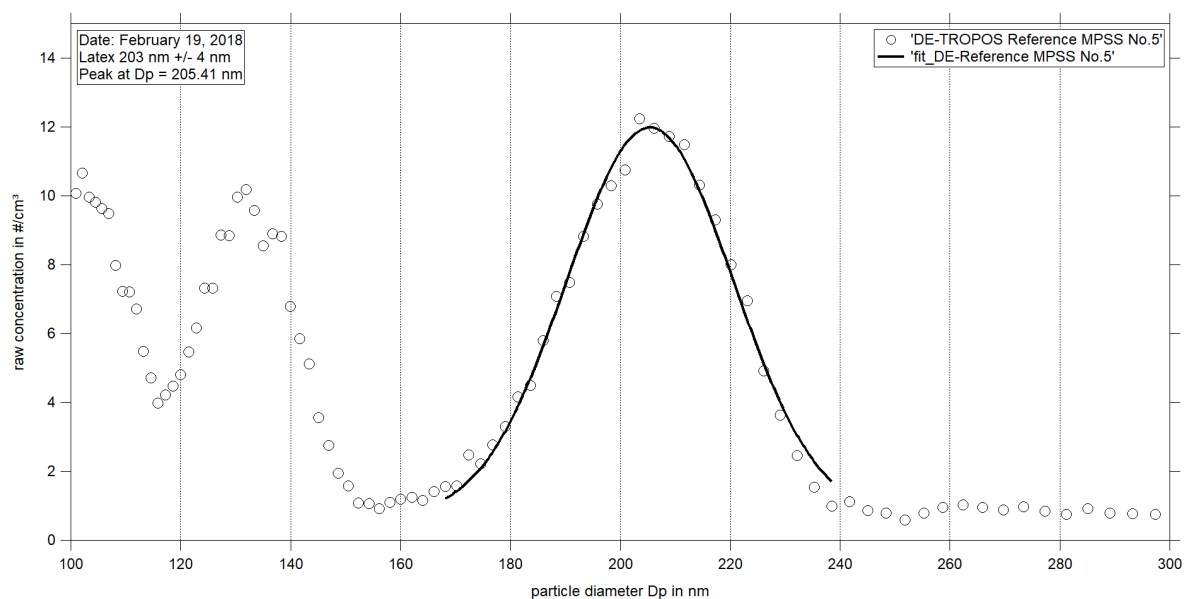**Figure 02:** Measurement of latex 203 nm: Particle size distribution (raw concentration) for latex 203 nm on Feb 21rd, 2018.

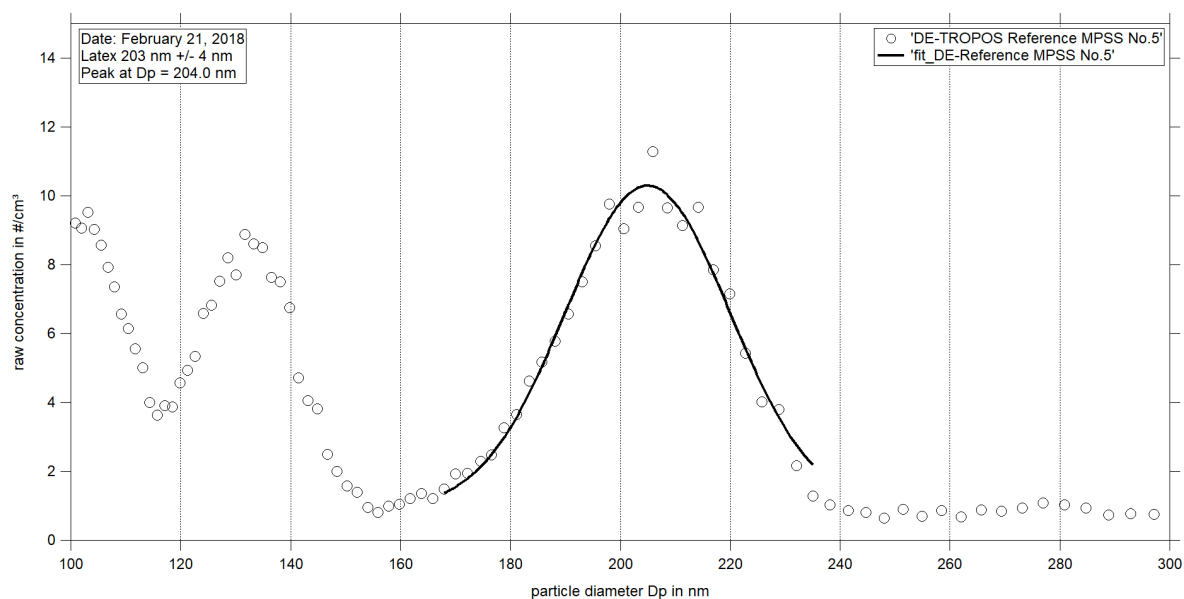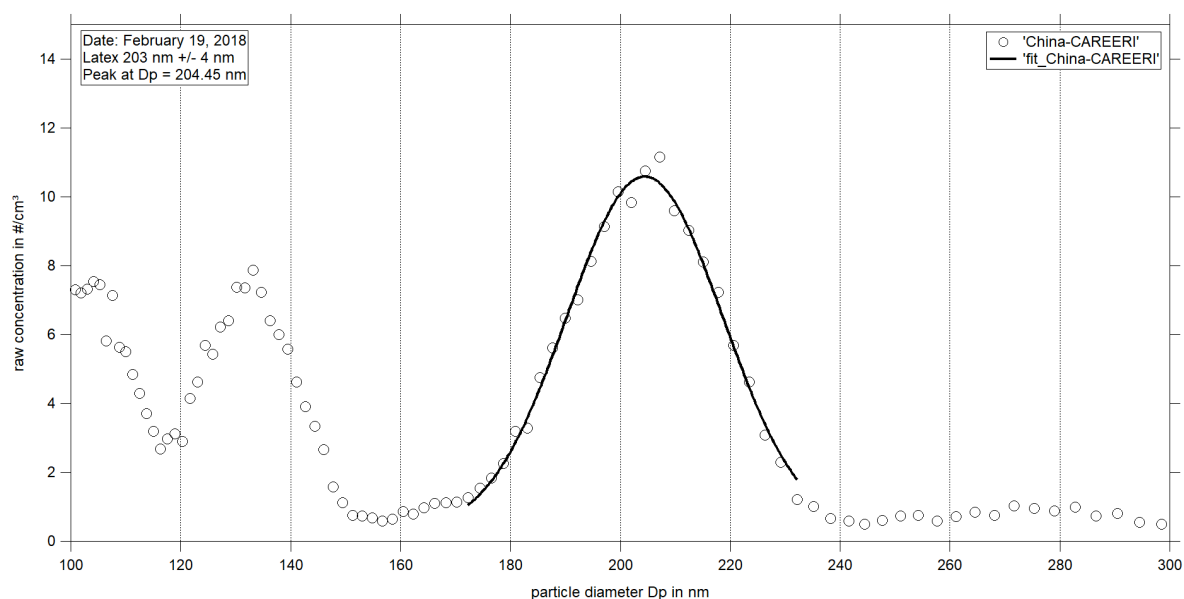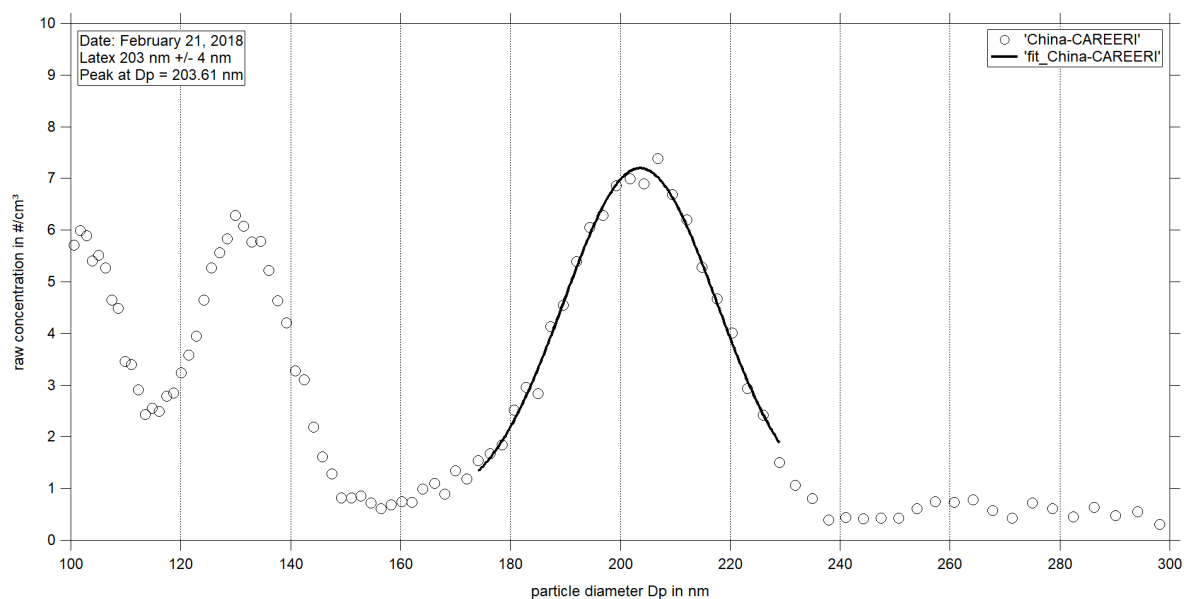**Figure 03:** Measurement of latex 203 nm: Particle size distribution (raw concentration) for latex 203 nm on Feb 19rd, 2018.

Figure 04: Measurement of latex 203 nm: Particle size distribution (raw concentration) for latex 203 nm on Feb 21rd, 2018.

Figure 05: Measurement of latex 203 nm: Particle size distribution (raw concentration) for latex 203 nm on Feb 19rd, 2018.

Figure 06: Measurement of latex 203 nm: Particle size distribution (raw concentration) for latex 203 nm on Feb 21rd, 2018.

Pre-Status of the TROPOS Reference Instruments: Particle Number Size Distribution
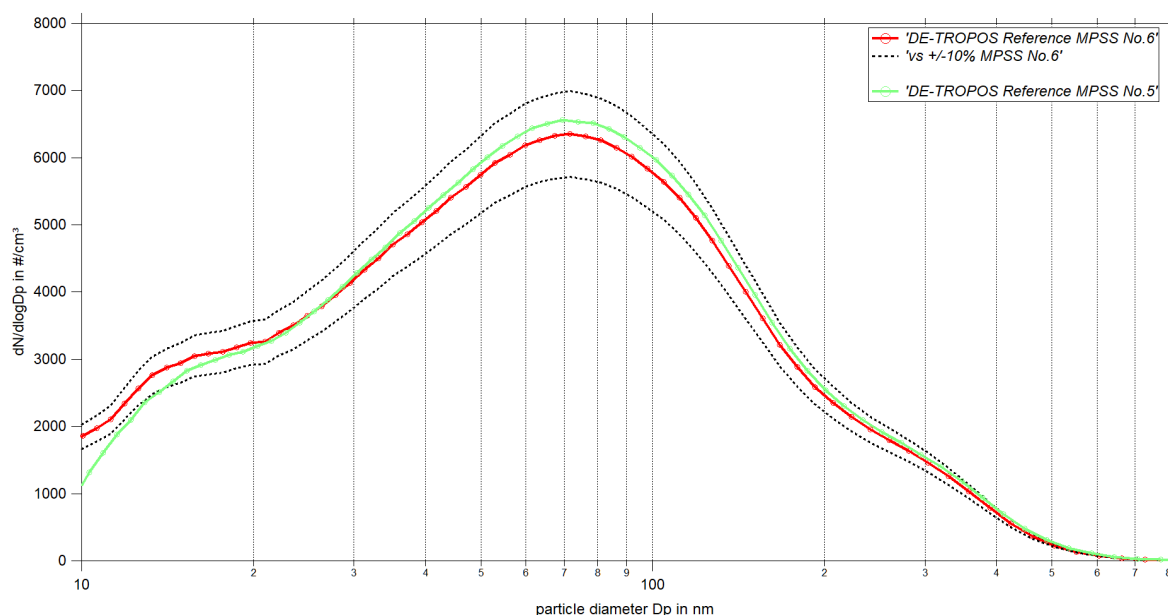
Figure 07: Comparison of mean particle number size distribution of TROPOS Reference MPSS No.6 against TROPOS Reference MPSS No.5 from February 19, 2018 08:00 PM – February 20, 2018 06:00 AM. Multiple charge correction, internal diffusion losses and CPC efficiency are included.

Pre-Status of the TROPOS Reference Instruments: Time Series
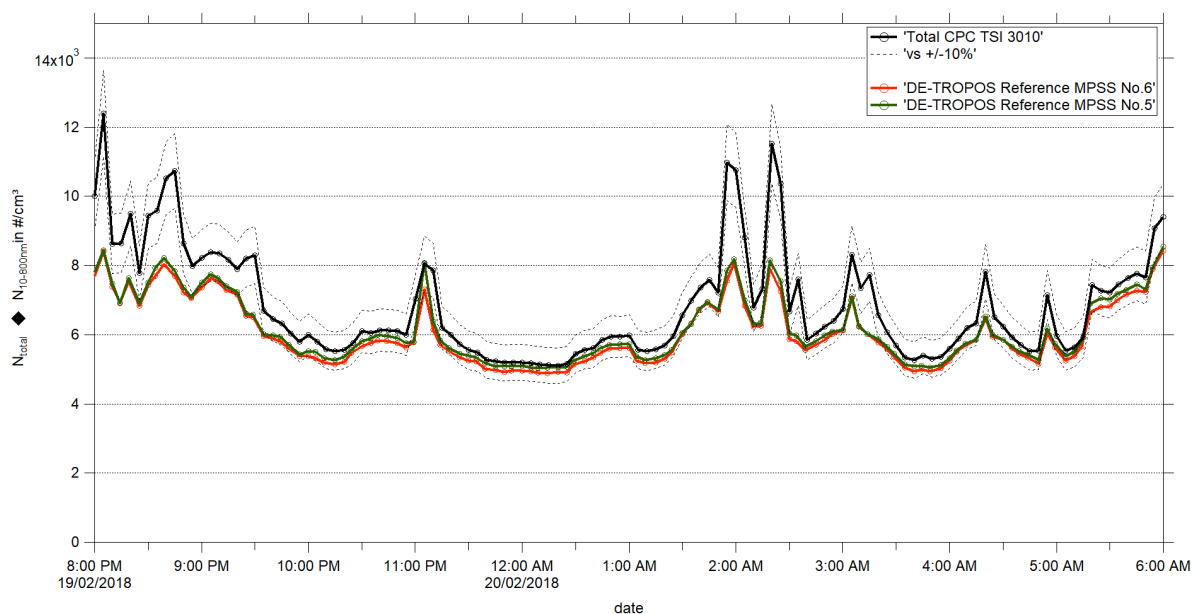
Figure 08: Time series (February 19, 2018 08:00 PM – February 20, 2018 06:00 AM) of the integrated particle number concentration ($N_{10-800nm}$) of the MPSS and total number concentration (N_{total}) of the Reference TSI-CPC Model 3010. The inversion for the candidate was performed using TROPOS software. Multiple charge correction, internal diffusion losses and CPC flow corrections are included.

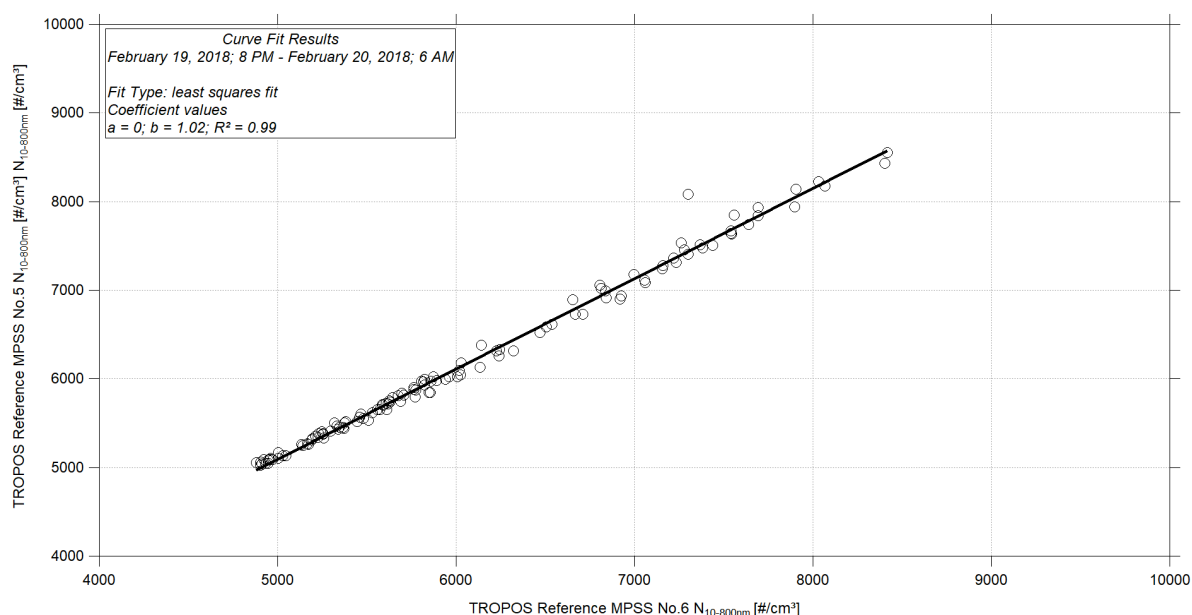## Pre-Status of the TROPOS Reference Instruments: Correlation

Figure 09: Linear regression between the number concentrations of the TROPOS Reference MPSS No.6 and TROPOS Reference MPSS No.5. Multiple charge correction, internal diffusion losses and CPC flow corrections are included.

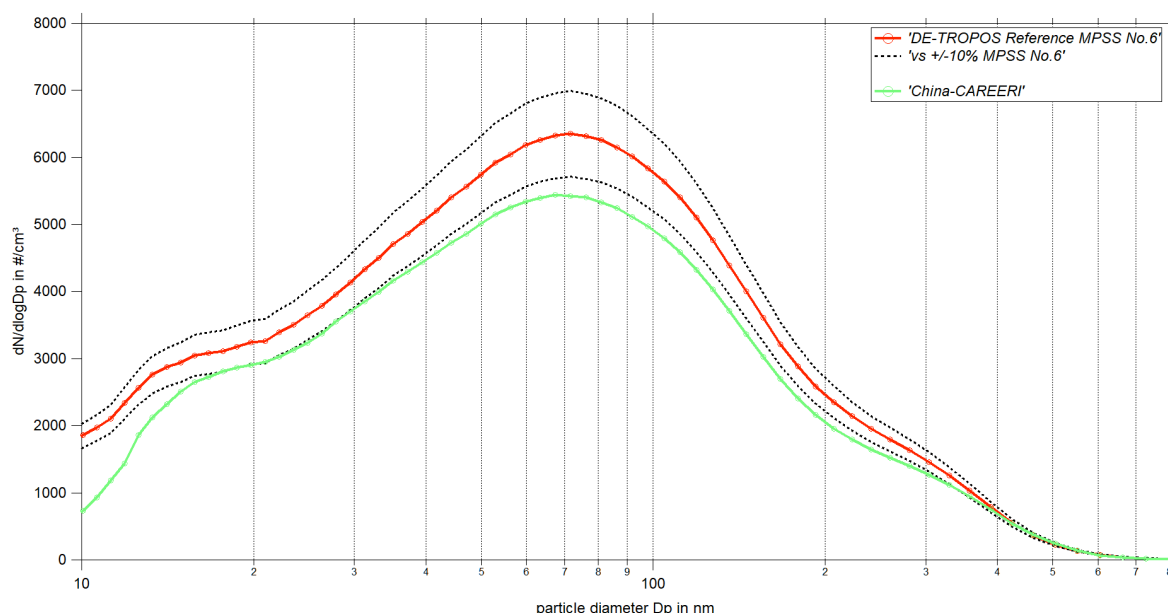## Pre-Status of the Candidate: Particle Number Size Distribution

Figure 10: Comparison of mean particle number size distribution of TROPOS Reference MPSS No.6 against China-CAREERI from February 19, 2018 08:00 PM – February 20, 2018 06:00 AM. Multiple charge correction, internal diffusion losses and CPC efficiency are included.

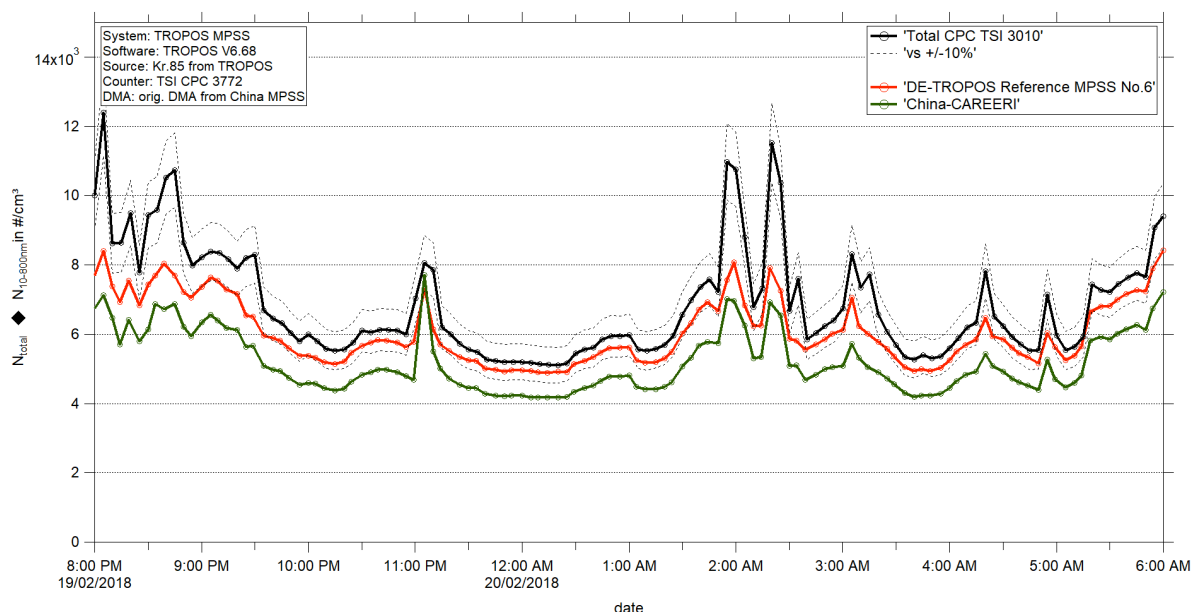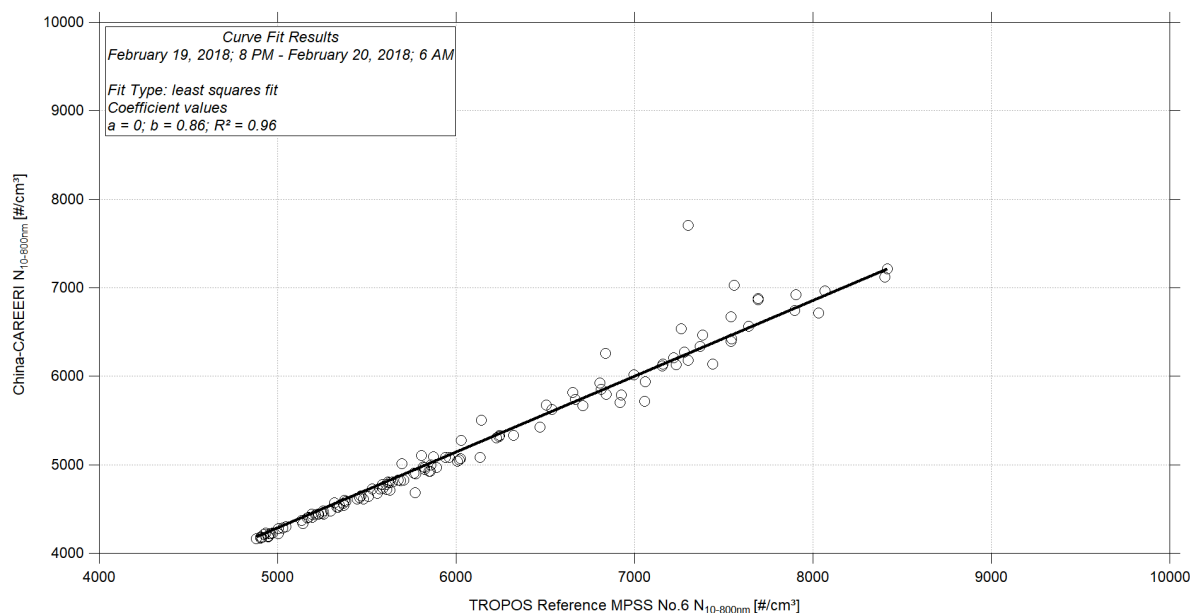## Pre-Status of the Candidate: Time Series and Correlation

Figure 11: Time series (February 19, 2018 08:00 PM – February 20, 2018 06:00 AM) of the integrated particle number concentration ($N_{10-800nm}$) of the MPSS and total number concentration (N_{total}) of the Reference TSI-CPC Model 3010. The inversion and corrections for the candidate was performed using TROPOS software. Multiple charge correction, internal diffusion losses and CPC flow corrections are included.

Figure 12: Linear regression between the number concentrations of the TROPOS Reference MPSS No. 6 and China-CAREERI. The inversion and corrections for the candidate was performed using TROPOS software. Multiple charge correction, internal diffusion losses and CPC flow corrections are included.

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Final-Status of the Candidate: Particle Number Size Distribution
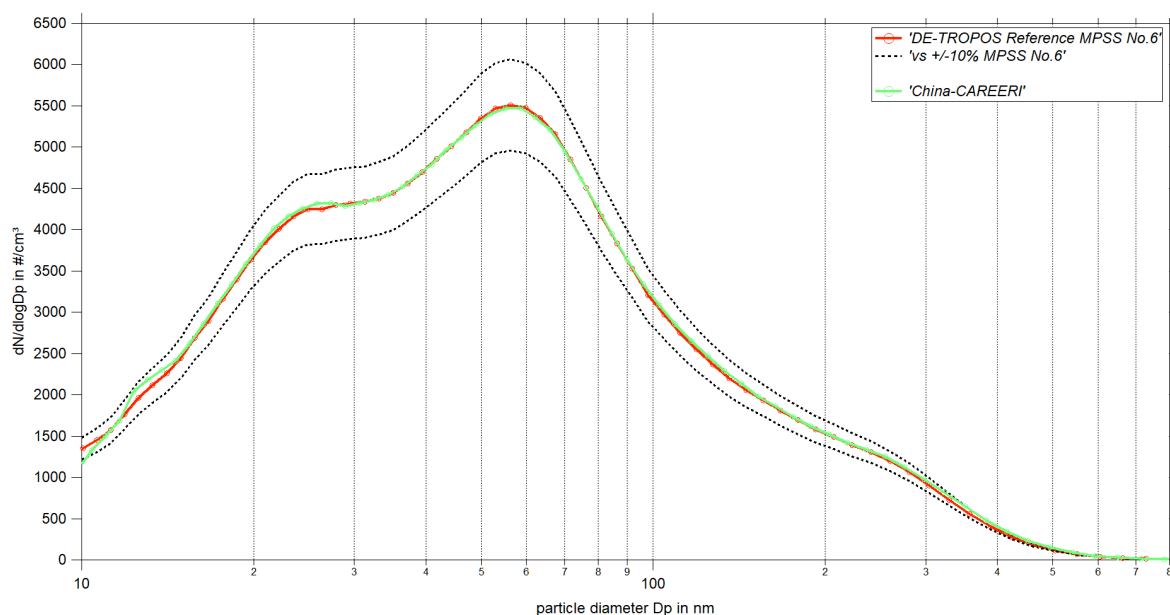

Figure 13: Comparison of mean particle number size distribution of TROPOS Reference MPSS No.6 against China-CAREERI from February 21, 2018 08:00 PM – February 22, 2018 06:00 AM. Multiple charge correction, internal diffusion losses and CPC efficiency are included.

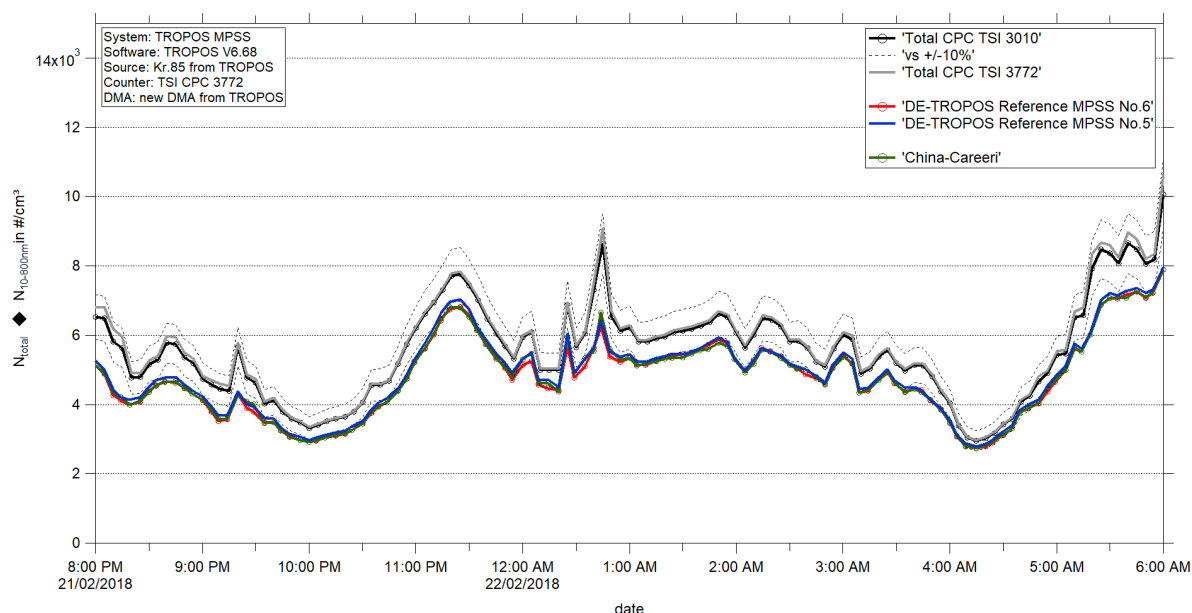## Final-Status of the Candidate: Time Series and Correlation

Figure 14: Time series (February 21, 2018 08:00 PM – February 22, 2018 06:00 AM) of the integrated particle number concentration ($N_{10-800nm}$) of the MPSS and total number concentration (N_{total}) of the Reference TSI-CPC Model 3010. The inversion and correction for the candidate was performed using TROPOS software.
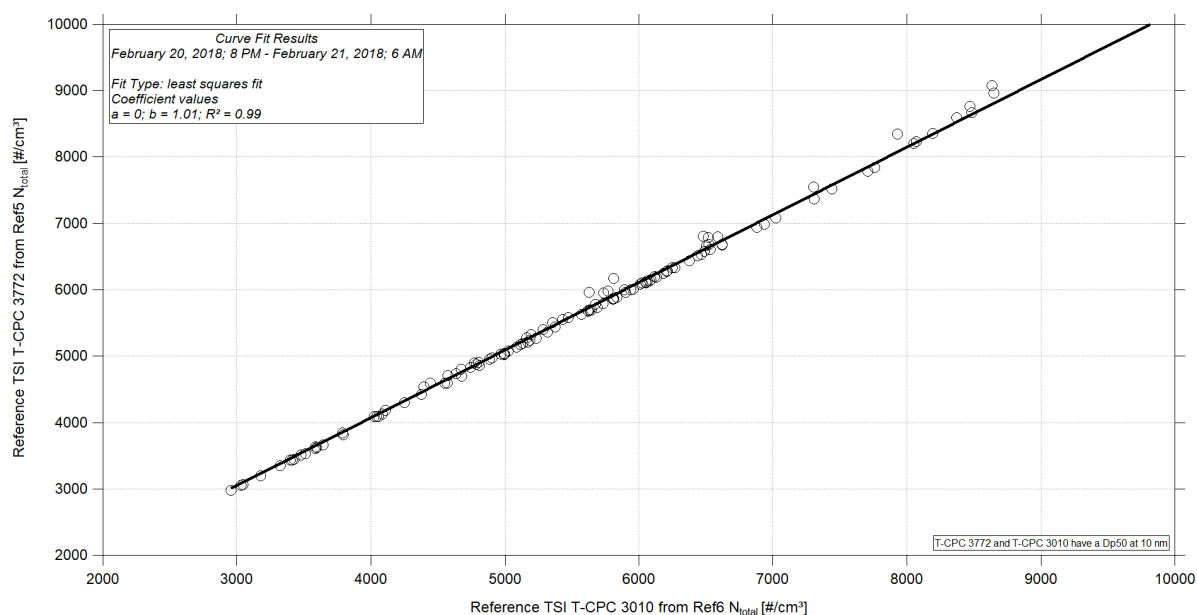
Figure 15: Linear regression between the number concentrations of the TROPOS Reference TSI CPC Model 3010 Ref 6 and TROPOS Reference TSI CPC Model 3772 Ref 5 (February 21, 2018 08:00 PM – February 22, 2018 06:00 AM). All corrections are included.
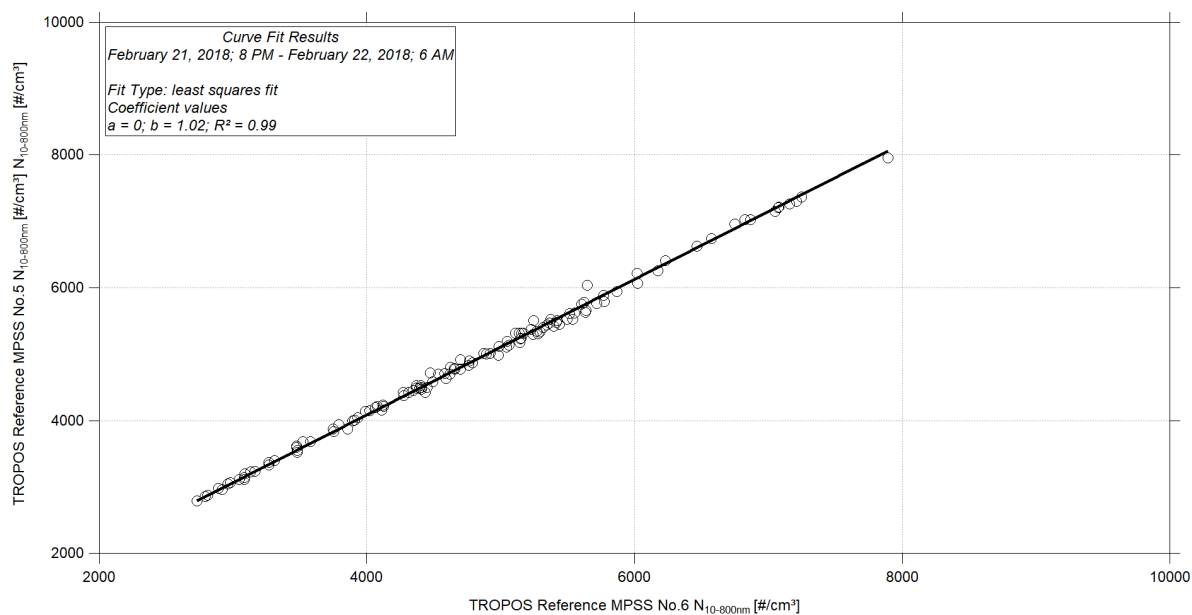

Figure 16: Linear regression between the number concentrations of the TROPOS Reference MPSS Ref 6 and TROPOS Reference MPSS Ref 5 (February 21, 2018 08:00 PM – February 22, 2018 06:00 AM). All corrections are included.
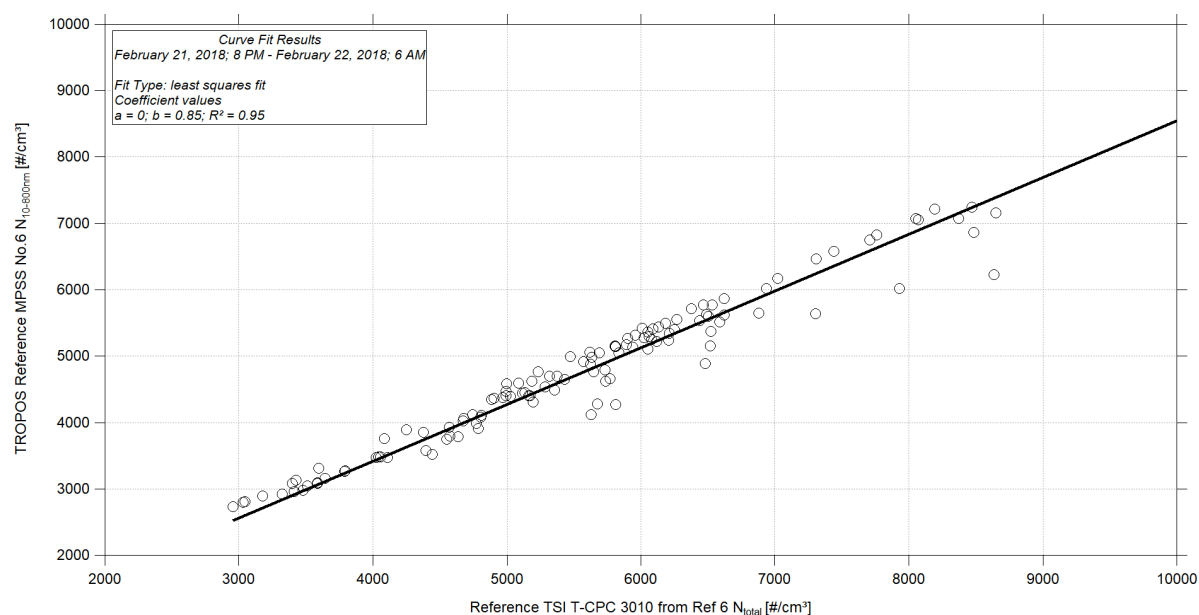
Figure 17: Linear regression between the number concentrations of the TROPOS Reference TSI CPC Model 3010 Ref 6 and TROPOS Reference MPSS Ref 6 (February 21, 2018 08:00 PM – February 22, 2018 06:00 AM). All corrections are included.
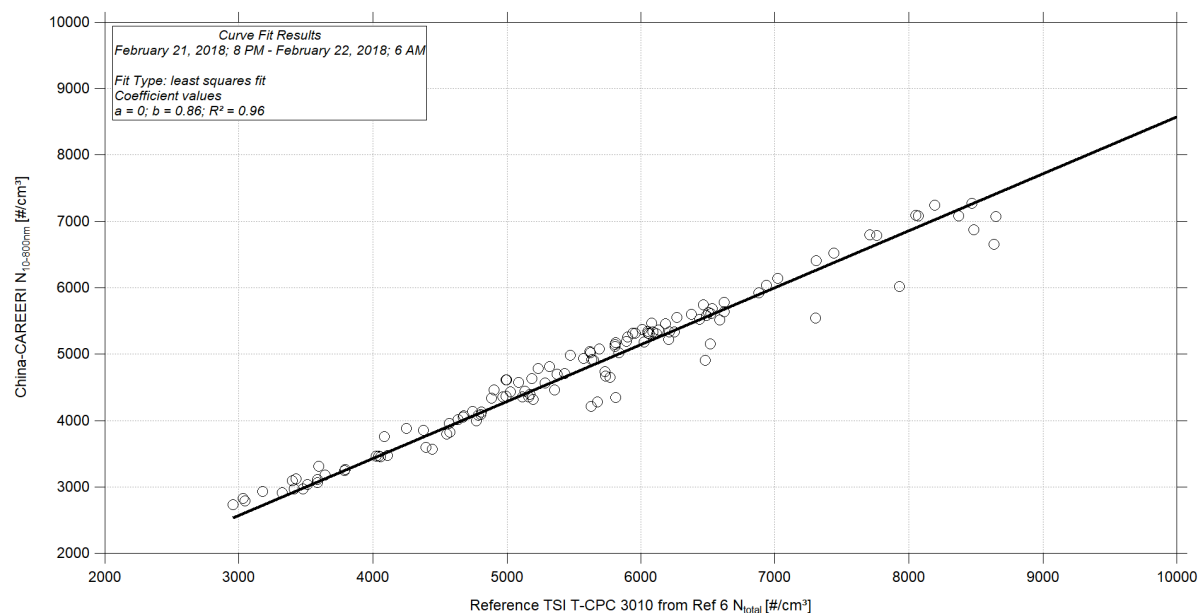

Figure 18: Linear regression between the number concentrations of the TROPOS Reference TSI CPC Model 3010 Ref 6 and China-CAREERI (February 21, 2018 08:00 PM – February 22, 2018 06:00 AM). All corrections are included.
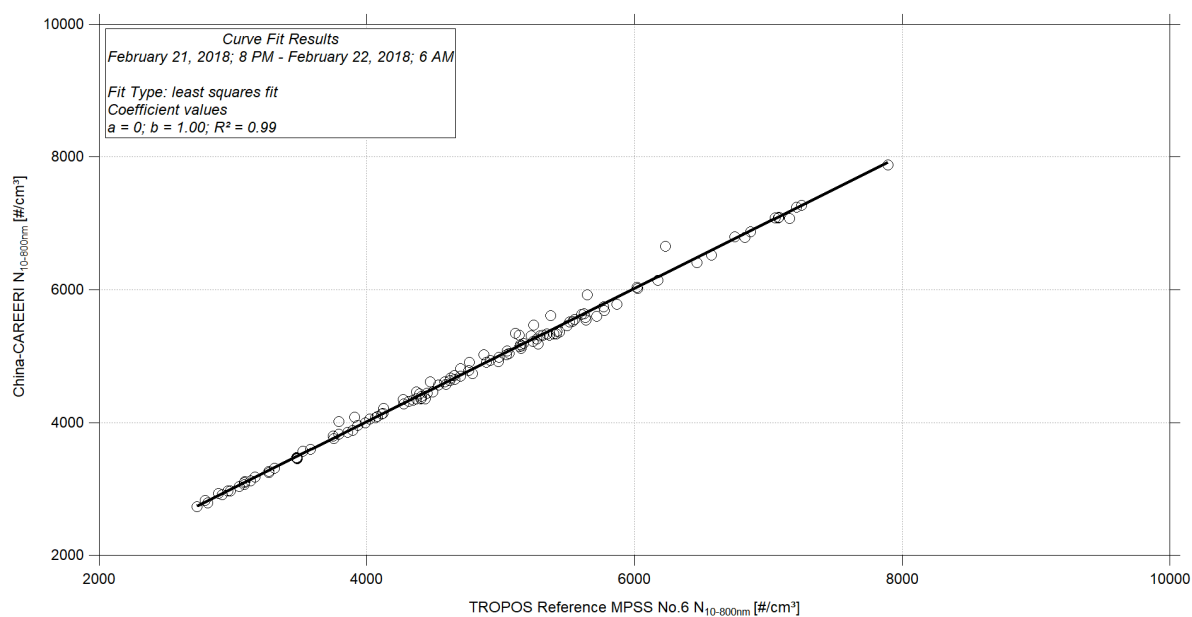
Figure 19: Linear regression between the number concentrations of the TROPOS Reference MPSS Ref 6 and China-CAREERI (February 21, 2018 08:00 PM – February 22, 2018 06:00 AM). All corrections are included.