Intercomparison of Mobility Particle Size Spectrometers

Project No.:	*MPSS-2017-2-1*
Principal Investigator:	Lucas Alados Arboledas
Home Institution:	*IISTA-CEAMA, University of Granada*
Participant:	Juan Andrés Casquero
Candidate:	**ES-IISTA-CEAMA**
Made by:	SMPS 3082 TSI, SN: 3082001541003
Counter (SN):	TSI CPC Model 3772, SN: 3772154302
Software:	TSI
Location of the quality assurance:	TROPOS Leipzig, lab 118
Comparison period:	March 13, 2017 – March 17, 2017
Last Intercomparison (with Project No.):	

Leibniz-Institut für Troposphärenforschung e.V.
Telefon: +49 341 2717-7060
Telefax: +49 341 2717-99-7060
info@tropos.de
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Summary of Intercomparison:

Pre-Status:
The instrument arrived with participant. During the Pre-Status, the performance of the system showed a concentration 4% lower than the TROPOS Reference Instrument No.4. The PSL check showed a correct peak at 202.75 nm. The system is running normally on the station with a cyclone in the inlet and an x-ray source from TSI. The impactor from TSI is not used. There is no flow split between the DMA and CPC. The flow ratio is 1:5 l/min. The system was in a good visual condition. During the Pre-status the candidate was operated at station conditions (cyclone, x-ray source from TSI and TSI CPC model 3772). The CPC 3772 showed flow problems indicated by a lower concentration, which was seen also during the CPC workshop March 14, 2017. For more information look at the CPC workshop report.

Final-Status:
During the Final-Status, the performance of the system showed a concentration 3% higher than the TROPOS Reference Instrument No.4. The candidate used the recalibrated TSI CPC model 3772 and their own TSI x-ray source. The candidate passed the quality standards of ACTRIS and GAW.

Information about the instruments:
Date of check: March 13, 2017

List of Components	TROPOS Reference MPSS No.1	TROPOS Reference MPSS No.4	Candidate
Position	Line 2	Line 1	Line 1
Company	TROPOS	TROPOS	TSI
Software	TROPOS	TROPOS	TSI
CPC-MPSS	TSI CPC, Model 3772	TSI CPC, Model 3772	TSI CPC, Model 3772
CPC-total	TSI CPC, Model 3010	TSI CPC, Model 3010	-
flow ratio	1.0 : 5.0	1.0 : 5.0	1.0 : 5.0
source	Kr85	Kr85	x-ray
HV power supply	positive	positive	positive
DMA	Hauke medium	Hauke medium	TSI SN: 3081A1542001
aerosol dryer	✓	✓	-
aerosol RH- sensor	✓	✓	-
aerosol T-sensor	✓	✓	-
sheath RH-sensor	✓	✓	-
sheath T-sensor	✓	✓	-
Sheath dryer	✓	✓	-
pressure sensor	✓	✓	-
info			inlet with cyclone

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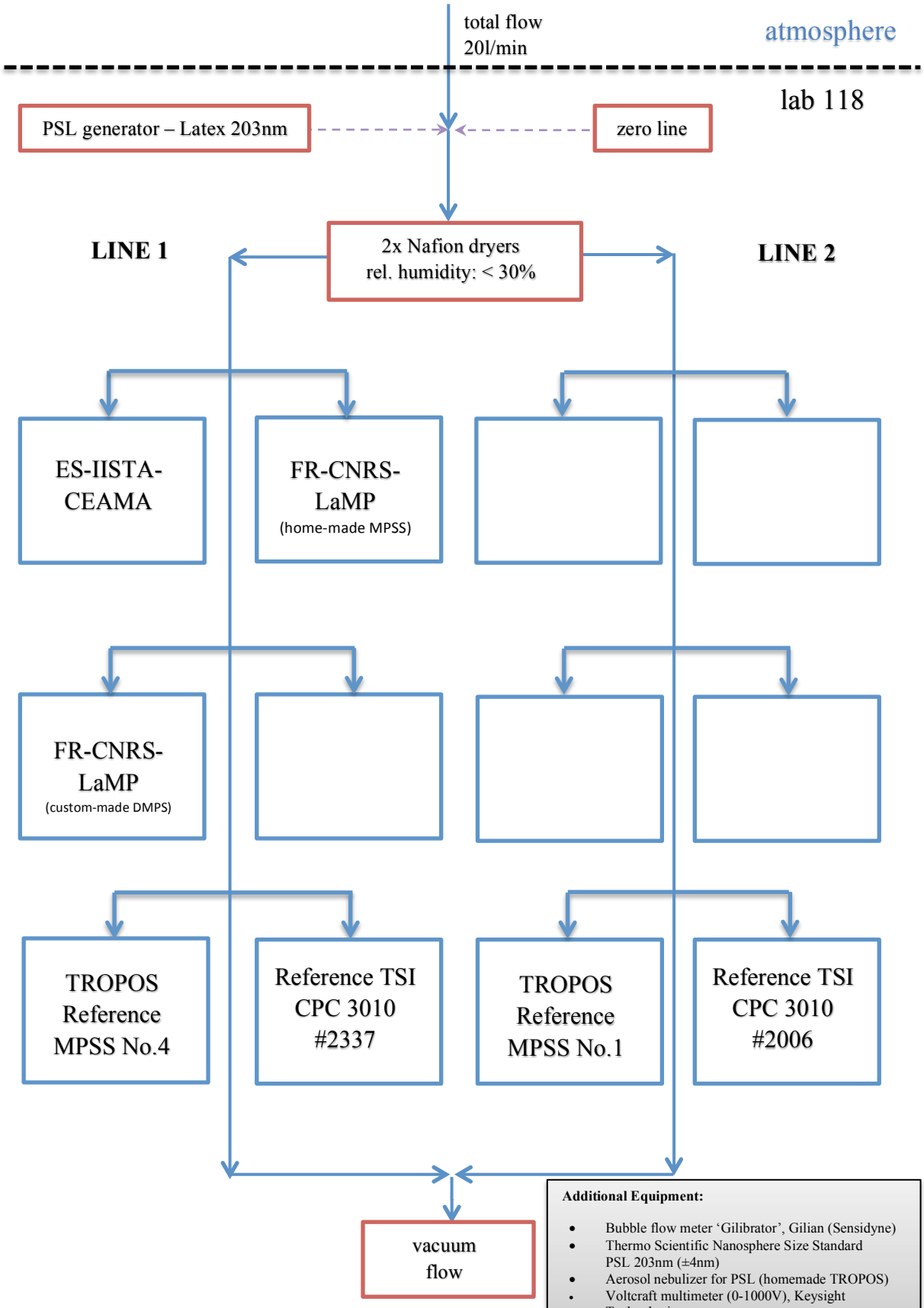
Laboratory setup:



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

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Status of the instruments:

Date of check (Pre-Status): 13.03.2017

CPC status	MPSS		Total CPC	
power/status	LED green	-	-	-
saturator temp	39.0	°C	-	°C
condenser temp	22.0	°C	-	°C
optics temp	40.0	°C	-	°C
cabinet temp	34.3	°C	-	°C
ambient pressure	100.6	kPa	-	kPa
orifice pressure	78.4	kPa	-	kPa
nozzle pressure	3.2	kPa	-	kPa
laser current	38	mA	-	mA
liquid level	full	-	-	-

Date of check (Final-Status): 16.03.2017

CPC status	MPSS		Total CPC	
power/status	LED green	-	-	-
saturator temp	39	°C	-	°C
condenser temp	21.9	°C	-	°C
optics temp	40	°C	-	°C
cabinet temp	35.1	°C	-	°C
ambient pressure	100.2	kPa	-	kPa
orifice pressure	76	kPa	-	kPa
nozzle pressure	2.9	kPa	-	kPa
laser current	37	mA	-	mA
liquid level	full	-	-	-

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Date of system checks:

date	13.03.2017	14.03.2017	15.03.2017	16.03.2017	unit
total CPC flow					l/min
aerosol flow (DMA)					l/min
aerosol flow (UDMA)					l/min
aerosol flow (total)	1035		1037		l/min
Zero MPSS	0		0		#/cm³
Zero total CPC					#/cm³
PSL 203 nm			202.75		nm
HV – 0 V	0		0		V
HV – 5 V	5		5		V
HV – 100 V	100		100		V
HV – 1000 V	1000		1000		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	no			
change aerosol Nafion dryer	no			
change sheath Nafion dryer	no			
check source	no			
change HV power supply	no			
clean/change DMA	no			was cleaned before
change aerosol RH/T-sensor	no			
change sheath RH/T-sensor	no			
change pressure sensor	no			

Instrument lengths: 15 cm cyclone, 15 cm, 15 cm, 1 m, 15 cm, 52 cm, 7.1 m DMA, 30 cm

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

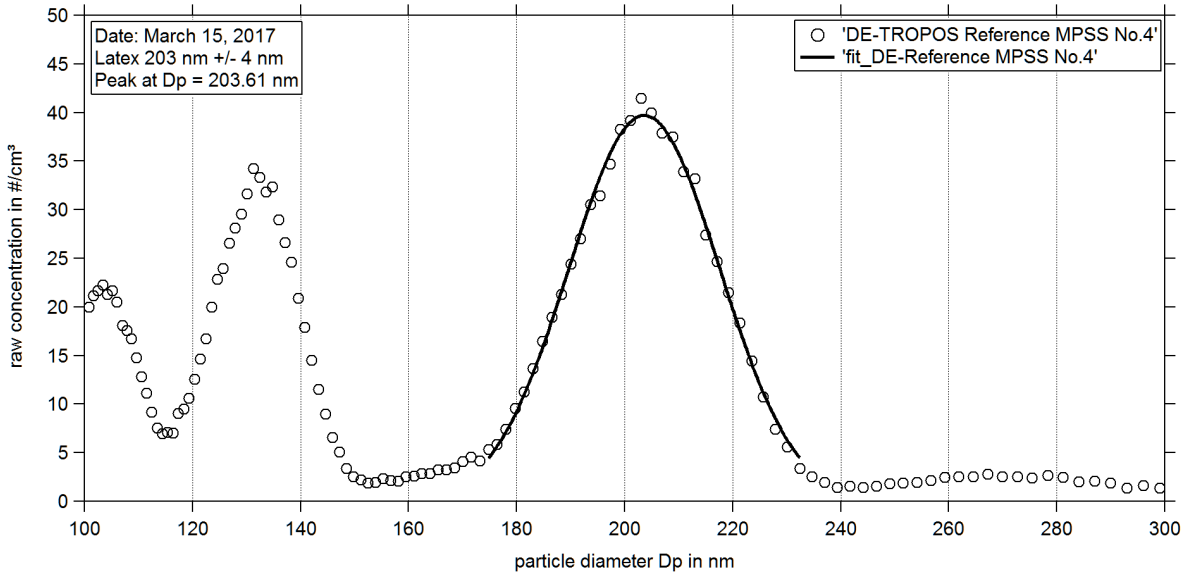

Figure 01: Measurement of latex 203 nm: Particle size distribution (raw concentration) for latex 203 nm on March 15rd, 2017.

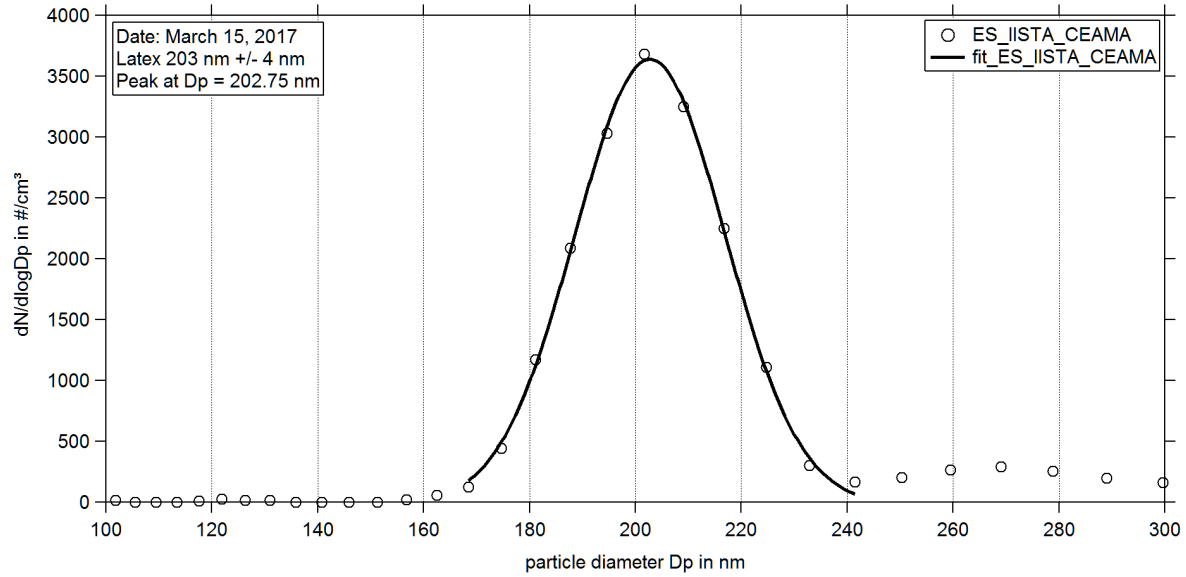

Figure 02: Measurement of latex 203 nm: Particle size distribution (raw concentration) for latex 203 nm on March 15rd, 2017.

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Status of the TROPOS Reference MPSS: Time Series

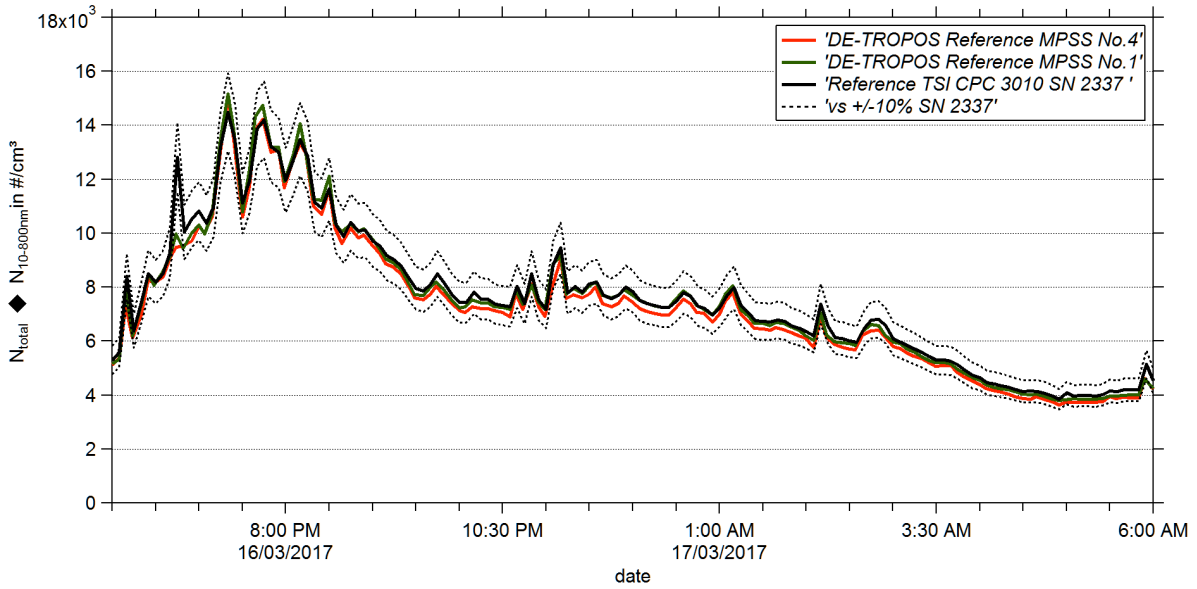

Figure 03: Time series (March 16, 2017 06:00 PM – March 17, 2017 06:00 AM) of the integrated particle number concentration ($N_{10\text{-}800nm}$) of the TROPOS Reference MPSS and total number concentration (N_{total}) of the Reference TSI CPC 3010. The inversion was performed using TROPOS software. Multiple charge correction, internal diffusion losses and CPC flow corrections are included.

Pre-Status of the Candidate: Particle Number Size Distribution

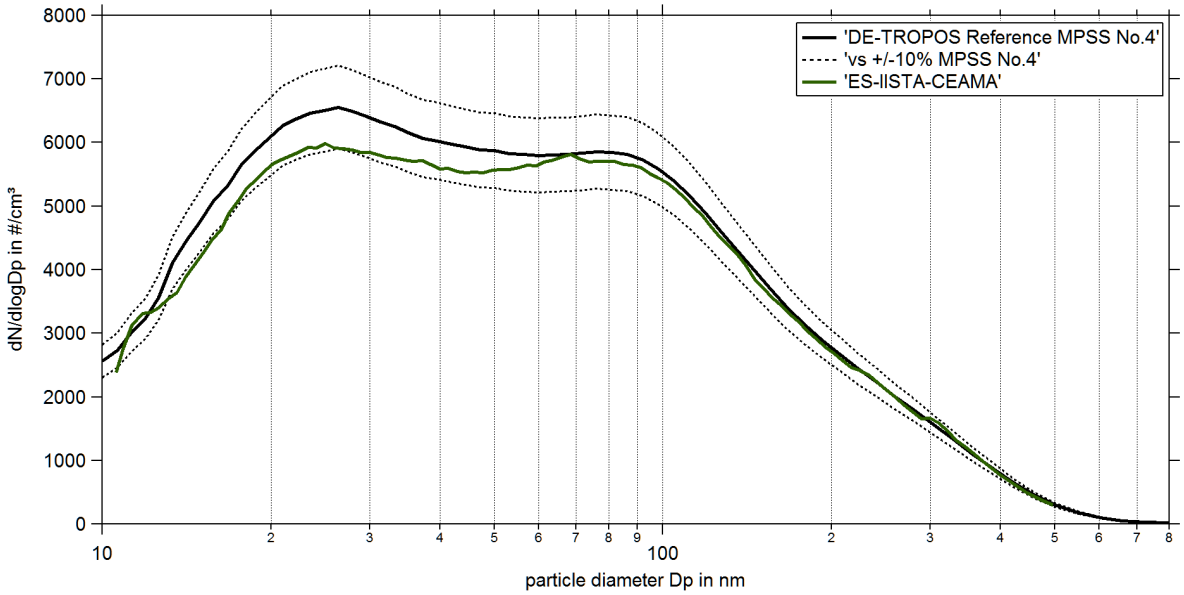

Figure 04: Comparison of mean particle number size distribution of TROPOS Reference MPSS No.4 against ES-IISTA-CEAMA from March 13, 2017 08:00 PM – March 14, 2017 06:00 AM. Multiple charge correction, internal diffusion losses and CPC efficiency are included.

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Pre-Status of the Candidate: Time Series

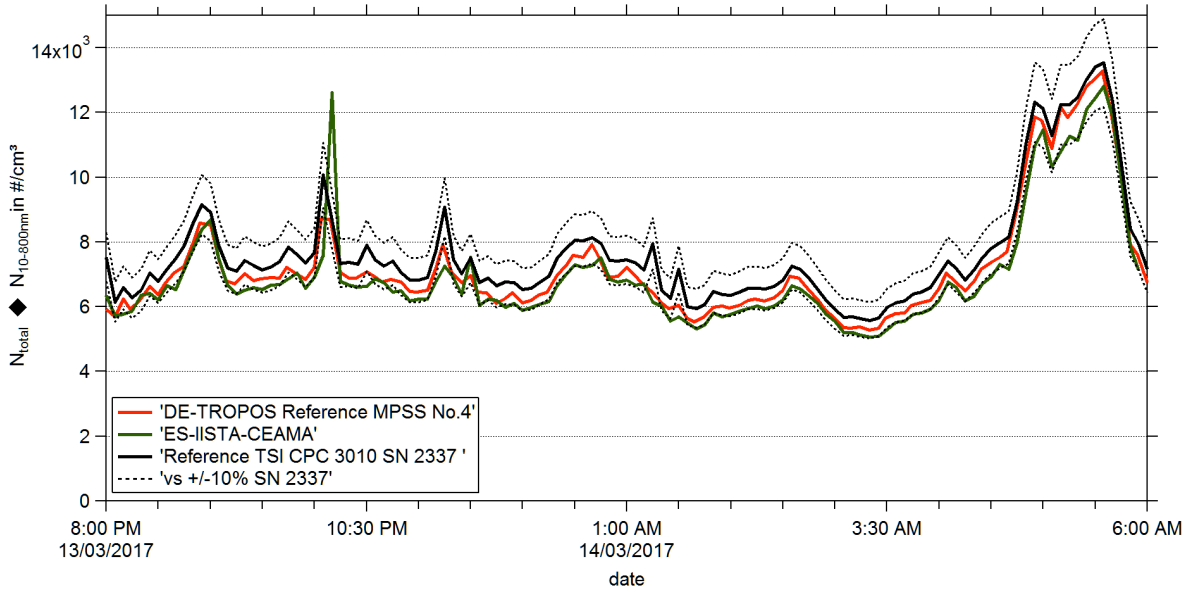

Figure 05: Time series (March 13, 2017 08:00 PM – March 14, 2017 06:00 AM) of the integrated particle number concentration ($N_{10\text{-}800nm}$) of the MPSS and total number concentration (N_{total}) of the Reference TSI-CPC Model 3010. The inversion for the candidate was performed using TSI software. Multiple charge correction, internal diffusion losses and CPC flow corrections are included.

Pre-Status of the Candidate: Correlation

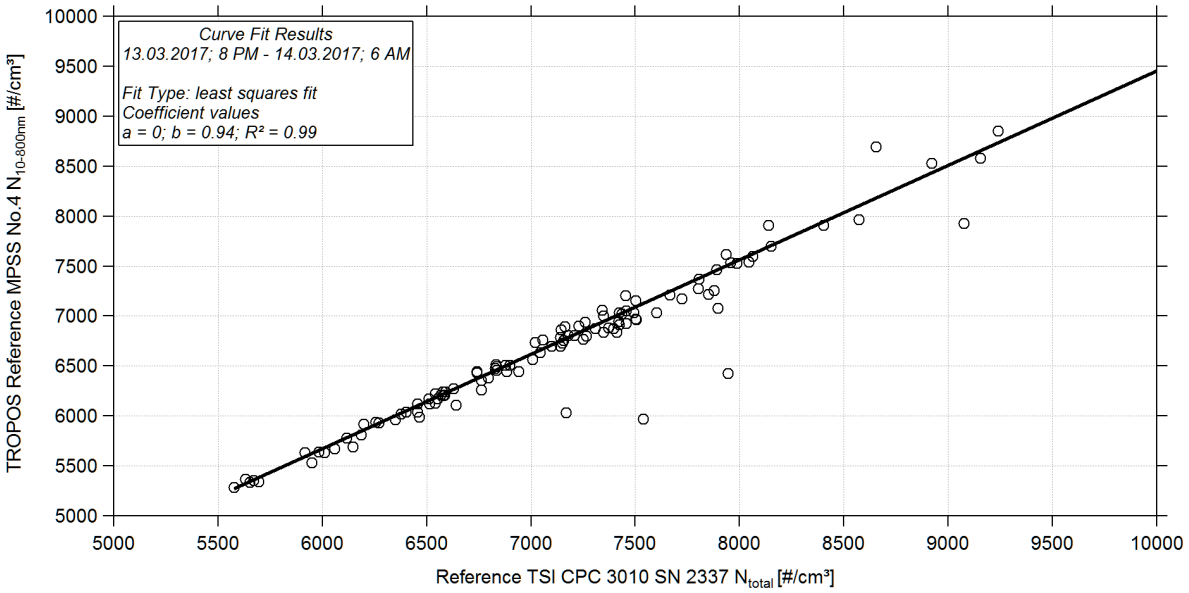

Figure 06: Linear regression between the number concentrations of the TROPOS Reference TSI CPC Model 3010 SN: 2337 and TROPOS Reference MPSS No.4. Multiple charge correction, internal diffusion losses and CPC flow corrections are included.

Leibniz-Institut für Troposphärenforschung e.V.
Telefon: +49 341 2717-7060
Telefax: +49 341 2717-99-7060
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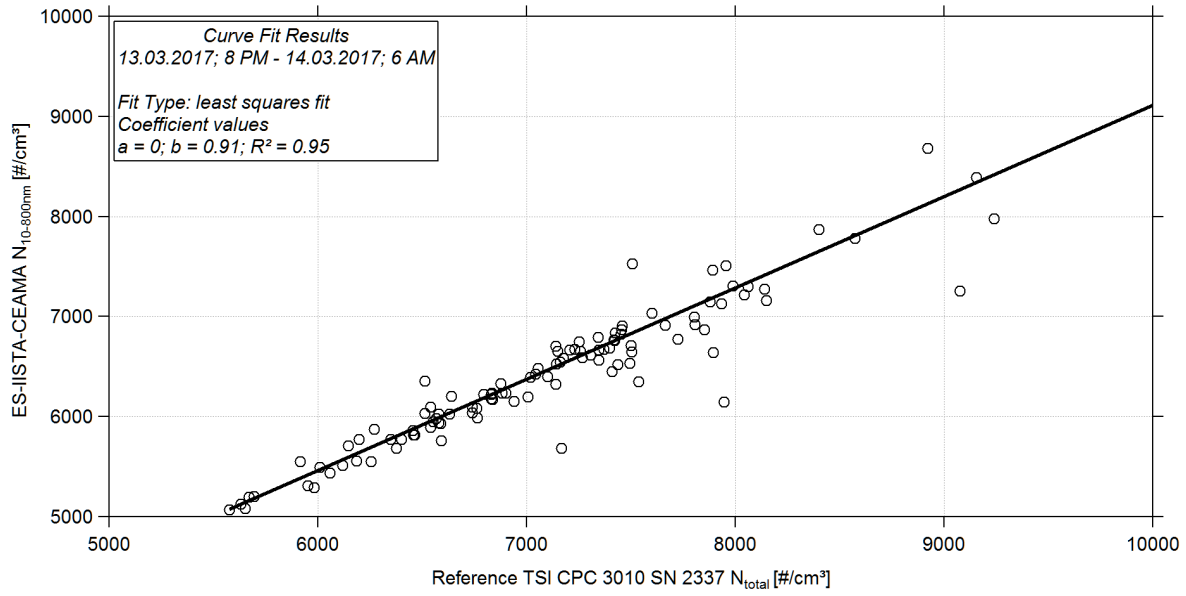

Figure 07: Linear regression between the number concentrations of the TROPOS Reference TSI CPC Model 3010 SN: 2337 and ES-IISTA-CEAMA. Multiple charge correction, internal diffusion losses and CPC flow corrections are included.

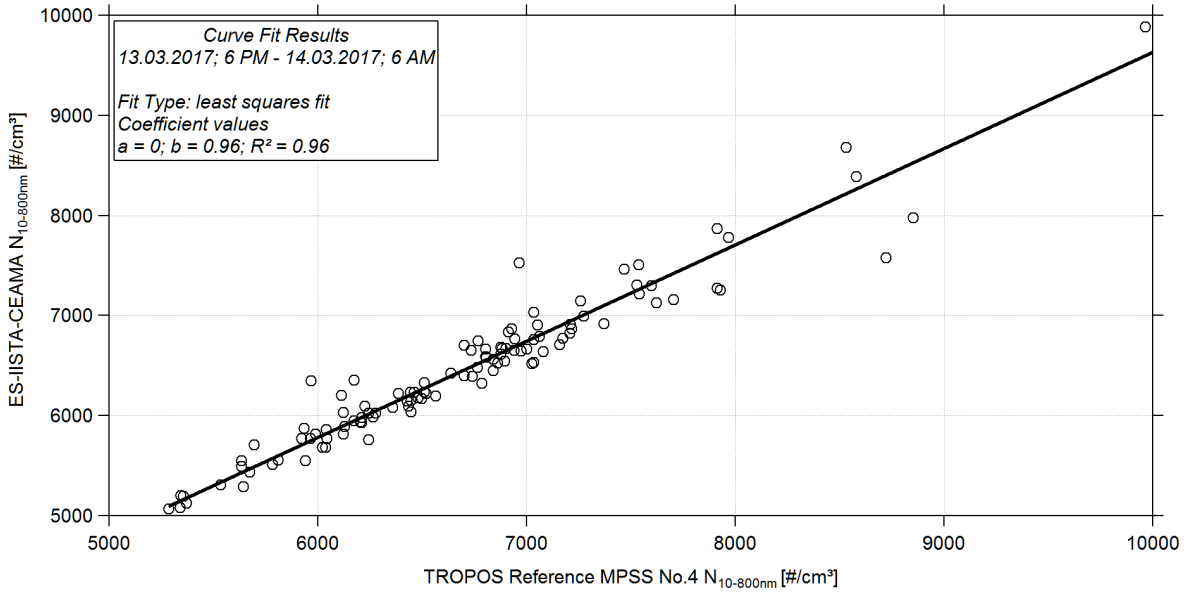

Figure 08: Linear regression between the number concentrations of the TROPOS Reference MPSS No.4 and ES-IISTA-CEAMA. Multiple charge correction, internal diffusion losses and CPC flow corrections are included.

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Telefax: +49 341 2717-99-7060
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Final-Status of the Candidate: Particle Number Size Distribution

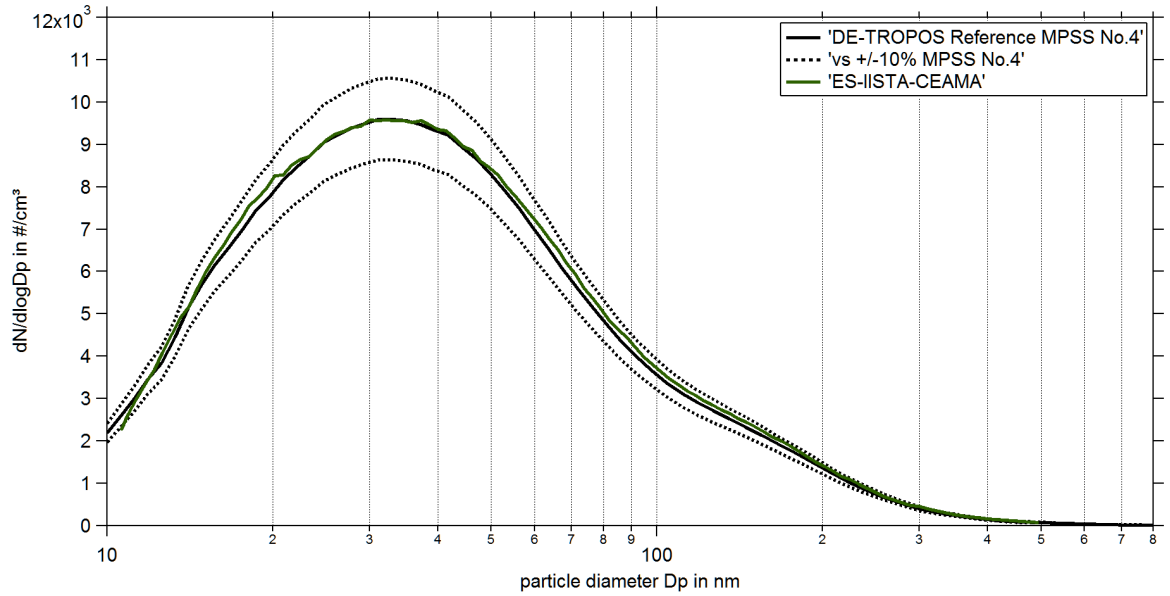

Figure 09: Comparison of mean particle number size distribution of TROPOS Reference MPSS No.4 against ES-IISTA-CEAMA from March 15, 2017 08:00 PM – March 16, 2017 03:00 AM. Multiple charge correction, internal diffusion losses and CPC efficiency are included.

Final-Status of the Candidate: Time Series

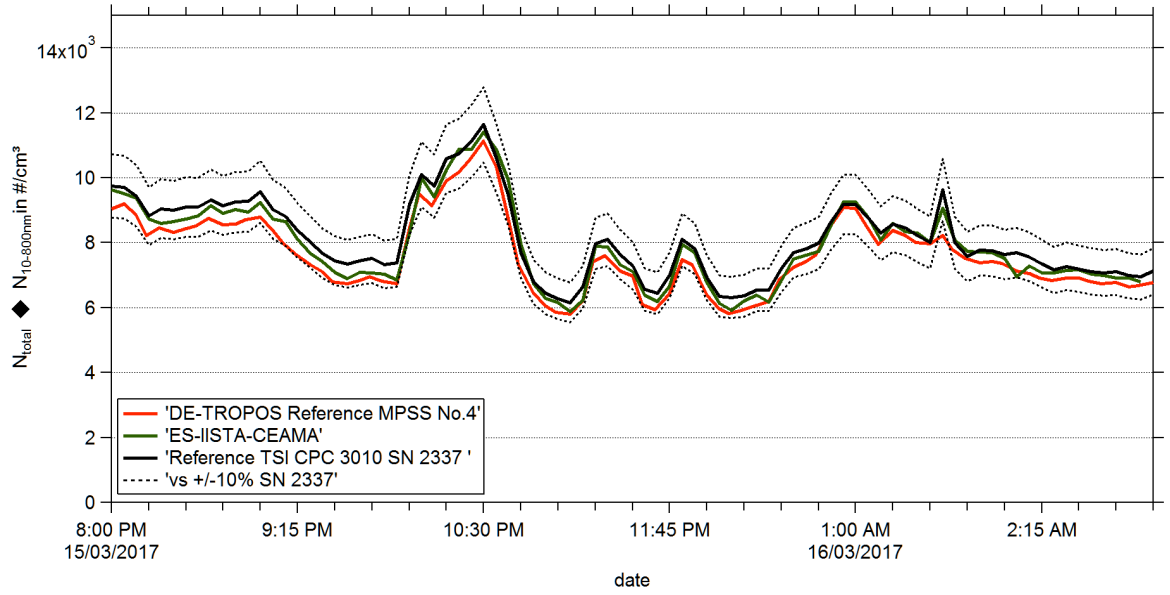

Figure 10: Time series (March 15, 2017 08:00 PM – March 16, 2017 03:00 AM) of the integrated particle number concentration ($N_{10\text{-}800nm}$) of the MPSS and total number concentration (N_{total}) of the Reference TSI-CPC Model 3010. The inversion for the candidate was performed using TSI software. Multiple charge correction, internal diffusion losses and CPC flow corrections are included.

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Telefax: +49 341 2717-99-7060
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Final-Status of the Candidate: Correlation

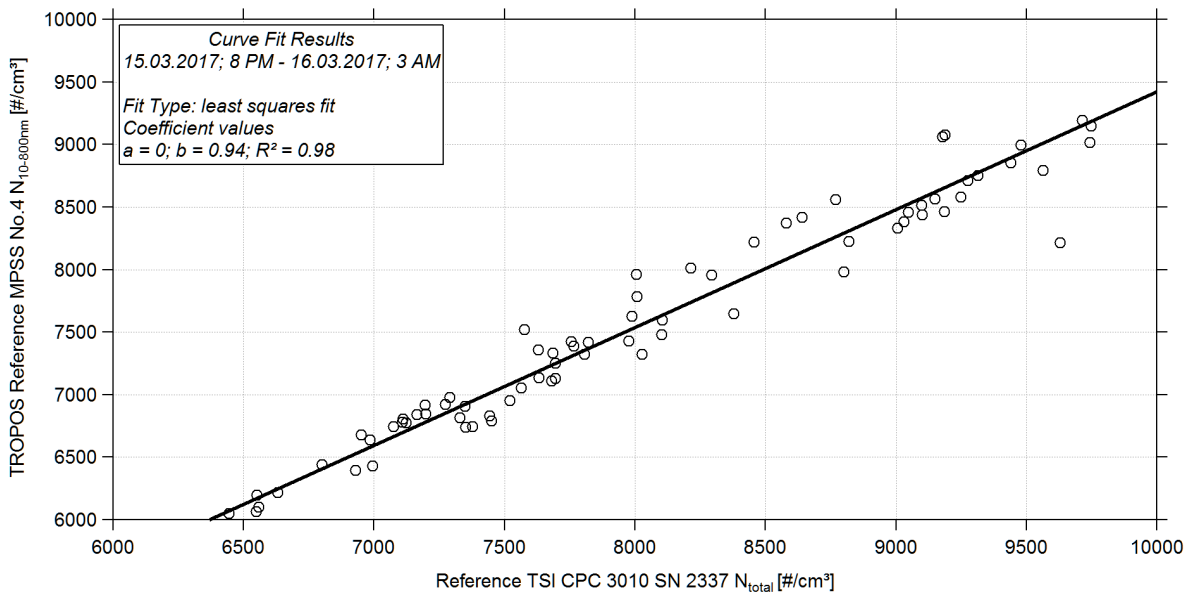

Figure 11: Linear regression between the number concentrations of the TROPOS Reference TSI CPC Model 3010 SN: 2337 and TROPOS Reference MPSS No.4. Multiple charge correction, internal diffusion losses and CPC flow corrections are included.

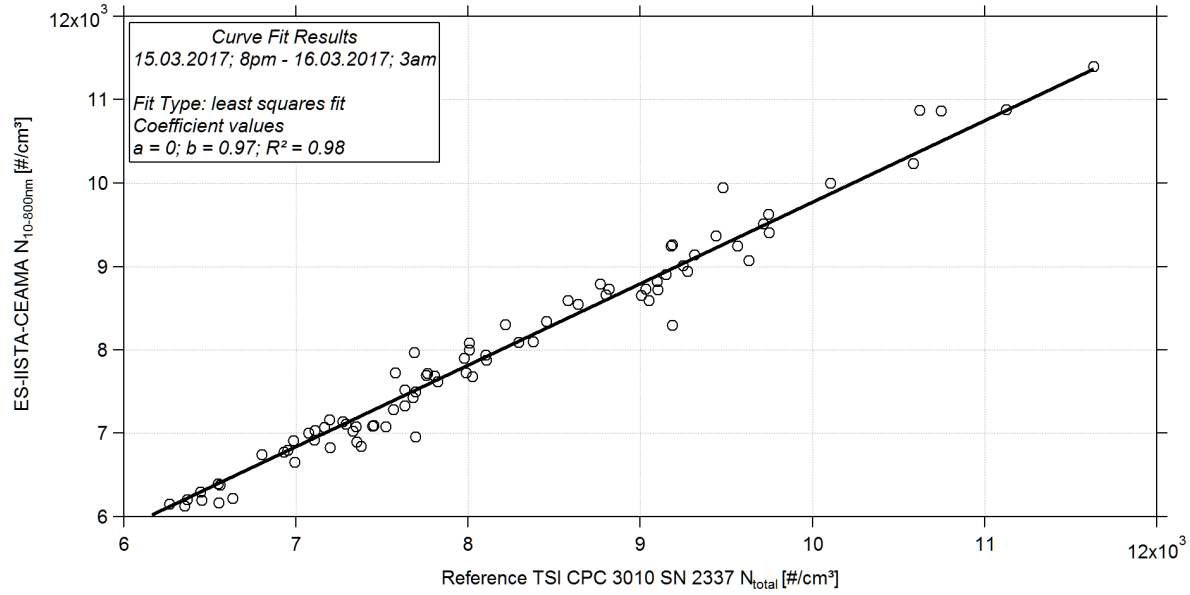

Figure 12: Linear regression between the number concentrations of the TROPOS Reference TSI CPC Model 3010 SN: 2337 and ES-IISTA-CEAMA. Multiple charge correction, internal diffusion losses and CPC flow corrections are included.

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Telefax: +49 341 2717-99-7060
info@tropos.de
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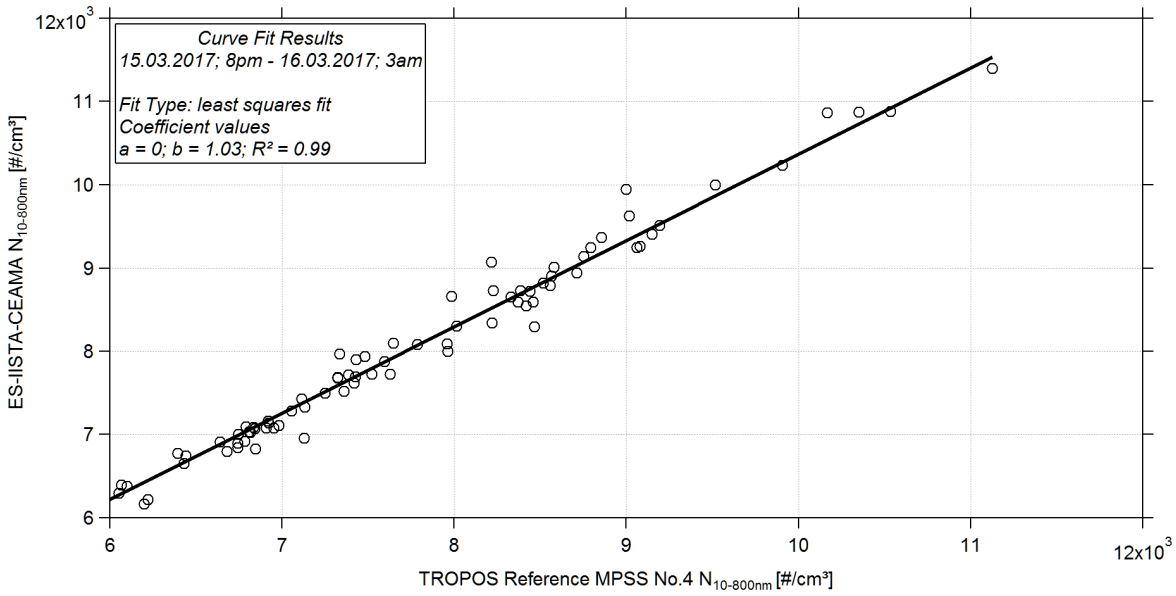

Figure 13: Linear regression between the number concentrations of the TROPOS Reference MPSS No.4 and ES-IISTA-CEAMA. Multiple charge correction, internal diffusion losses and CPC flow corrections are included.

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