Intercomparison of Mobility Particle Size Spectrometers

Project No.:	*MPSS-2017-5-4*
Principal Investigator:	Noemi Perez
Home Institution:	*IDAEA-CSIC* *Jordi Girona 18-26* *08034 Barcelona* *Spain*
Participant:	Noemí Perez
Candidate:	**ES-IDAEA-CSIC**
Made by:	**TROPOS Home-Made**
Counter (SN):	TSI CPC Model 3772, SN: 3772140203
Software:	TROPOS
Location of the quality assurance:	TROPOS Leipzig, lab 118
Comparison period:	October 09, 2017 – October 13, 2017
Last Intercomparison (with Project No.):	

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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 11% lower than the TROPOS Reference Instrument No.4. The PSL check showed a correct peak at 204.99 nm. The TROPOS software version should be updated to the latest version 6.66; therefore, the whole PC with Windows XP has to be changed. In 2018, ES-IDAEA-CSIC will get an offer from TROPOS to update the hardware and a possibility to change the instrument to an electronic box with USB-NI connection. The pressure drop sensor in the aerosol inlet is shifting.

Final-Status:
During the Final-Status, the performance of the system showed a concentration 1% higher than the TROPOS Reference Instrument No.4. The candidate was operating with a cleaned DMA and settings were updated in the TROPOS evaluation program. During the whole workshop, ES-IDAEA-CSIC used a Kr.85 source from TROPOS. The candidate passed the quality standards of ACTRIS and GAW.

Information about the instruments:
Date of check: October 09, 2017

List of Components	TROPOS Reference MPSS No.1	TROPOS Reference MPSS No.4	Candidate
Position	Line 1	Line 2	Line 2
Company	TROPOS	TROPOS	TROPOS
Software	TROPOS	TROPOS	TROPOS V4.7.2 (win xp)
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	Ni63	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			Offer for update MPSS

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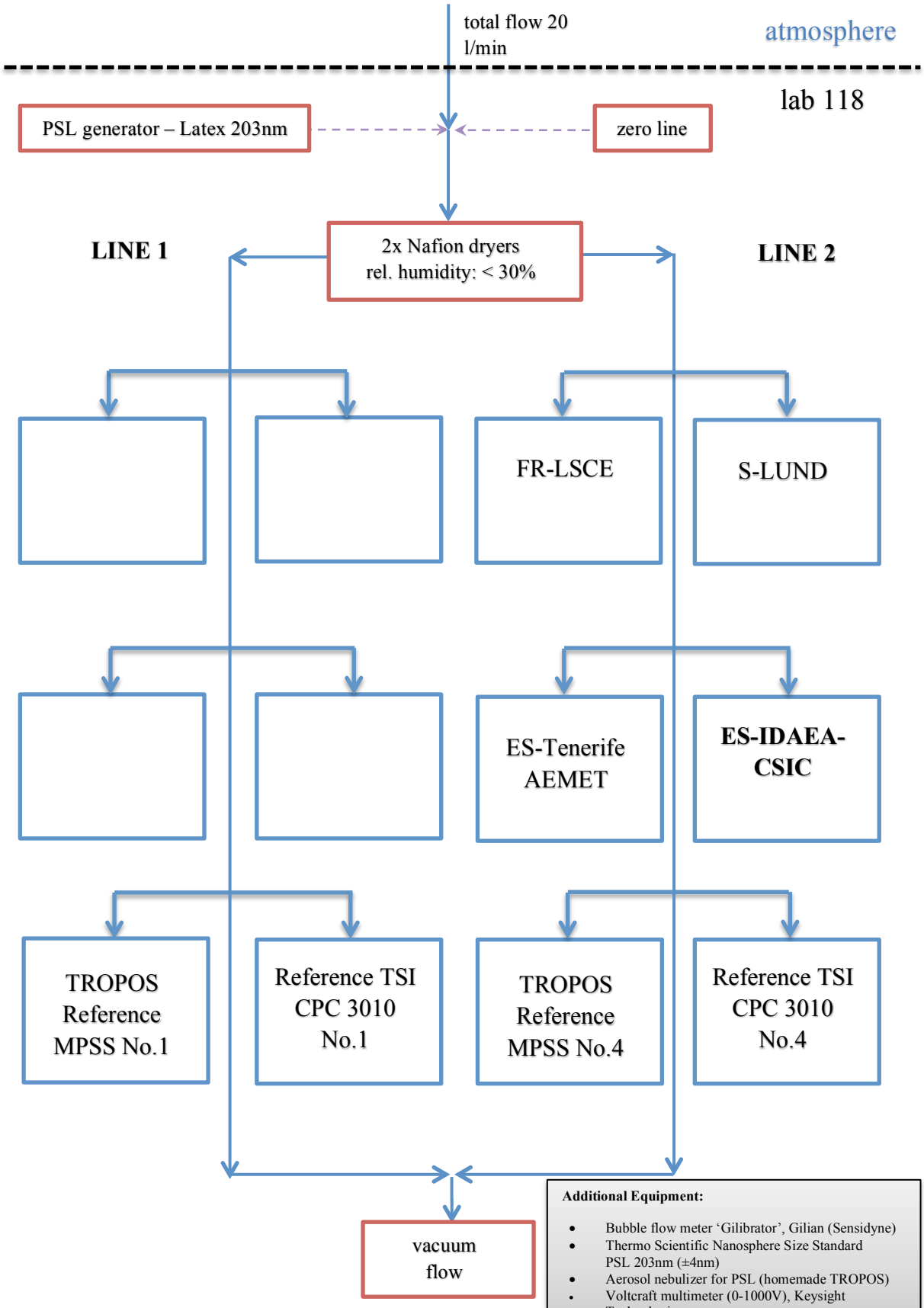
Laboratory setup:



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): October 09, 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	32.4	°C	-	°C
ambient pressure	99.3	kPa	-	kPa
orifice pressure	80.8	kPa	-	kPa
nozzle pressure	2.6	kPa	-	kPa
laser current	39	mA	-	mA
liquid level	full	-	-	-

Date of check (Final-Status): October 12, 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	34.4	°C	-	°C
ambient pressure	99.7	kPa	-	kPa
orifice pressure	82.7	kPa	-	kPa
nozzle pressure	2.7	kPa	-	kPa
laser current	40	mA	-	mA
liquid level	full	-	-	-

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Date of system checks:

date	09.10.2017	10.10.2017	11.10.2017	13.10.2017	unit
total CPC flow	-	-	-	-	l/min
aerosol flow (DMA)	-	-	-	-	l/min
aerosol flow (UDMA)	-	-	-	-	l/min
aerosol flow (total)	0.985	-	1.006	1.008	l/min
Zero MPSS	0	-	0	0	#/cm³
Zero total CPC	-	-	-	-	#/cm³
PSL 203 nm	204	-	204	201	nm
HV – 0 V	0.2	-	0.3	-	V
HV – 5 V	5.1	-	5.4	-	V
HV – 100 V	99.7	-	99.8	-	V
HV – 1000 V	999.8	-	1000.7	-	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	-	-	replace capillary
change aerosol Nafion dryer	Yes	MT052913-05-3	MT112916-01-12	to old
change sheath Nafion dryer	Yes	ND0.7-05a	ND0.7-26e	to old
check source	Yes	-	-	TROPOS source
change HV power supply	No	-	-	-
clean/change DMA	Yes	-	-	Cleaned; DMA okay
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	No	-	-	-

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

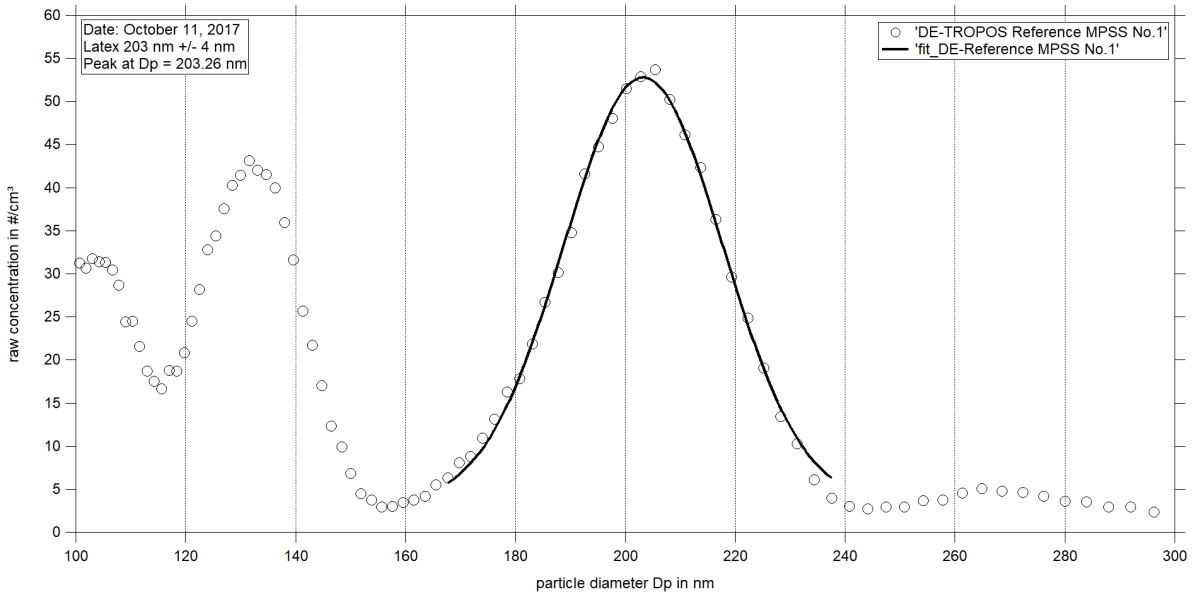

Figure 01: Measurement of latex 203 nm: Particle size distribution (raw concentration) for latex 203 nm on October 11rd, 2017.

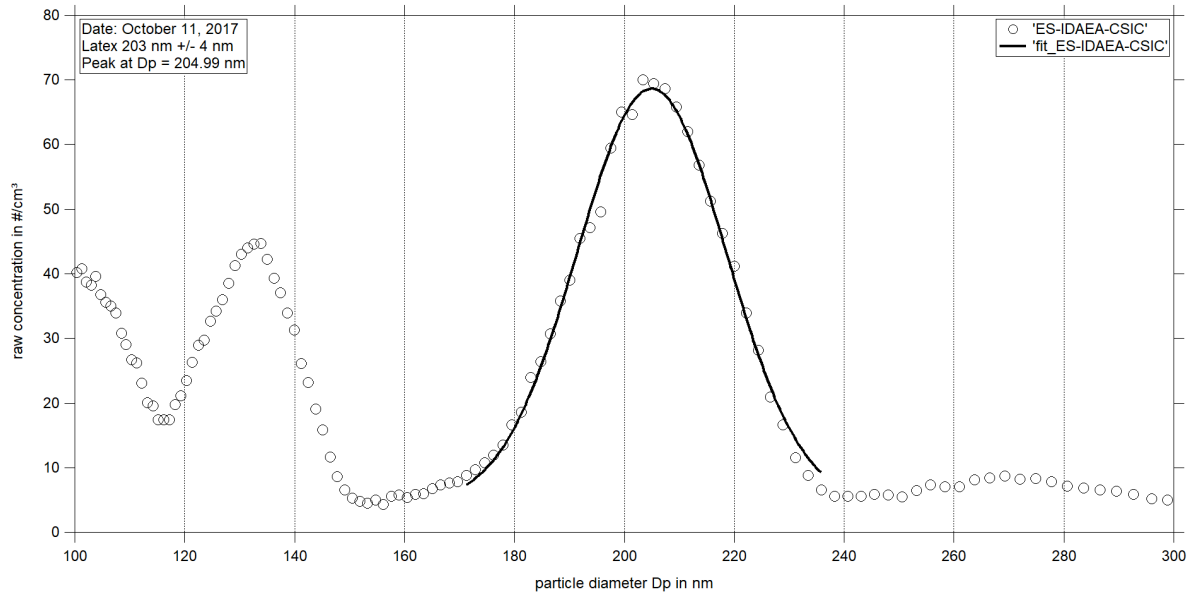

Figure 02: Measurement of latex 203 nm: Particle size distribution (raw concentration) for latex 203 nm on October 11rd, 2017.

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Status of the TROPOS Reference Instruments: Particle Number Size Distribution

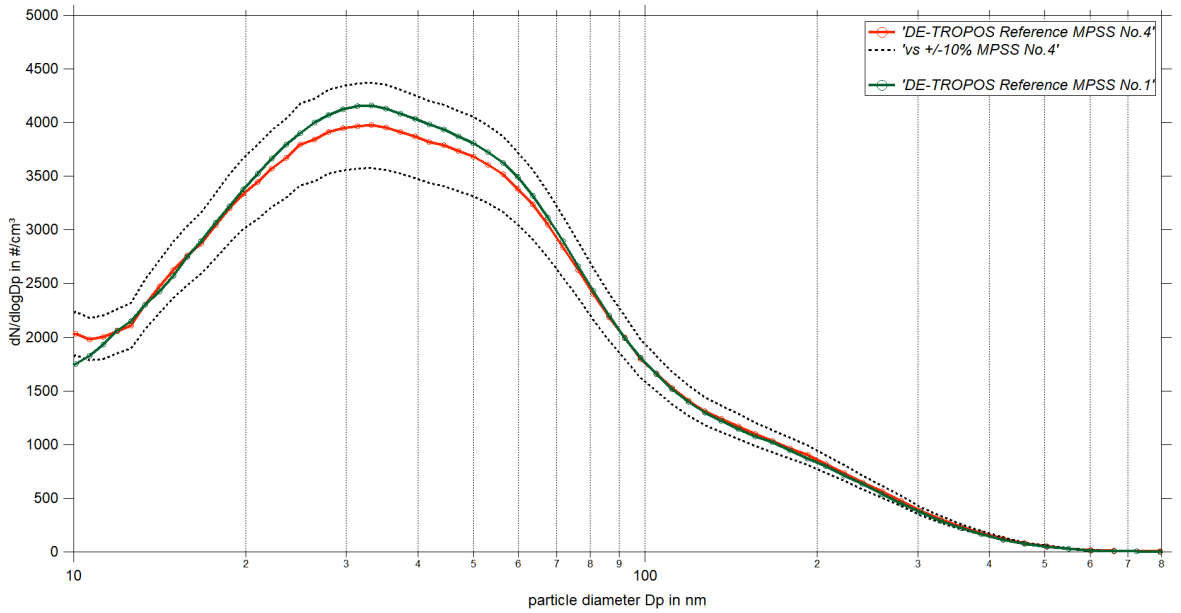

Figure 03: Comparison of mean particle number size distribution of TROPOS Reference MPSS No.1 against TROPOS Reference MPSS No.4 from October 09, 2017 08:00 PM – October 10, 2017 06:00 AM. Multiple charge correction, internal diffusion losses and CPC efficiency are included.

Status of the TROPOS Reference Instruments: Time Series

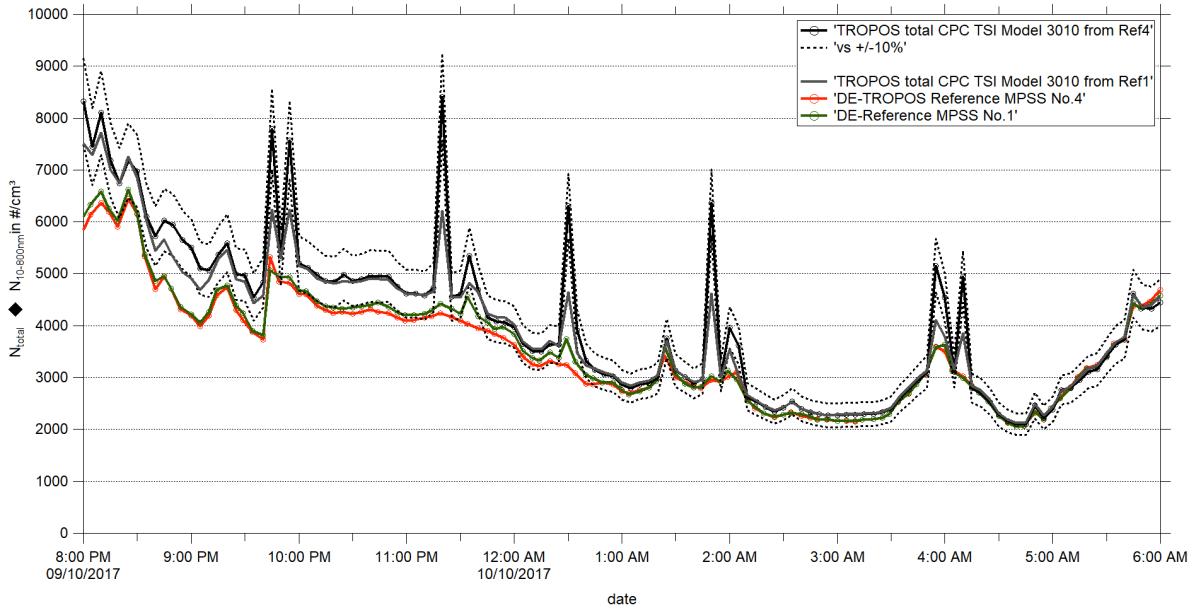

Figure 04: Time series (October 09, 2017 08:00 PM – October 10, 2017 06:00 AM) of the integrated particle number concentration ($N_{10\text{-}800nm}$) of the MPSS and total number concentration (N_{total}) of the Reference TSI-CPC Model 3010. Multiple charge correction, internal diffusion losses and CPC flow corrections are included.

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Status of the TROPOS Reference Instruments Correlation

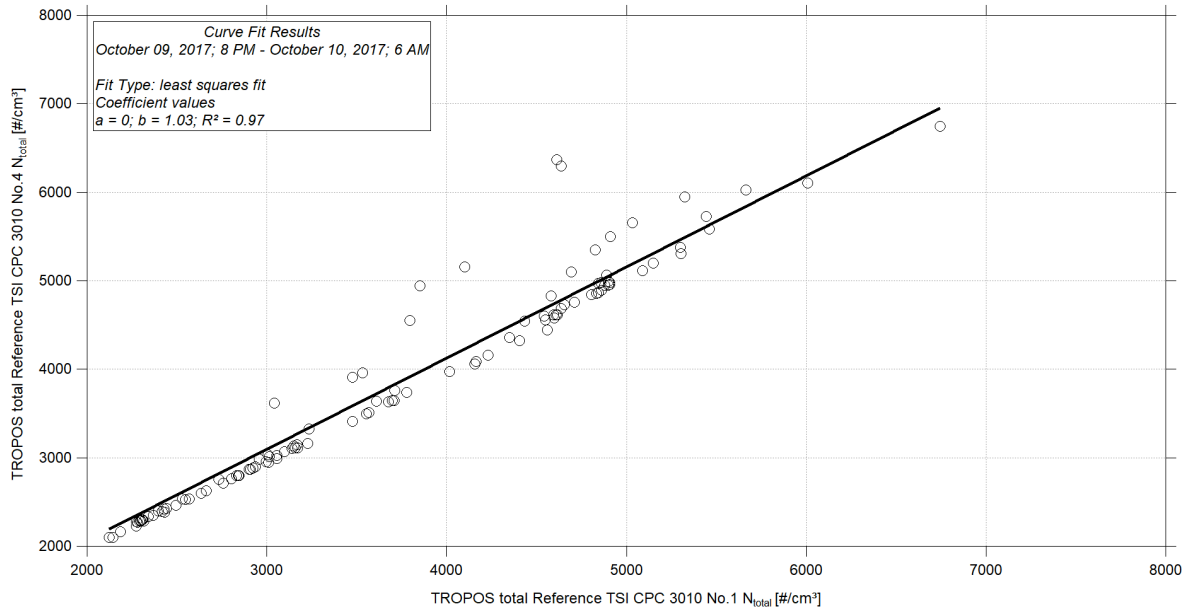

Figure 05: Linear regression between the number concentrations of the TROPOS total Reference TSI CPC Model 3010 No.1 and TROPOS total Reference TSI CPC Model 3010 No.4. Coincidence corrections and CPC flow corrections are included.

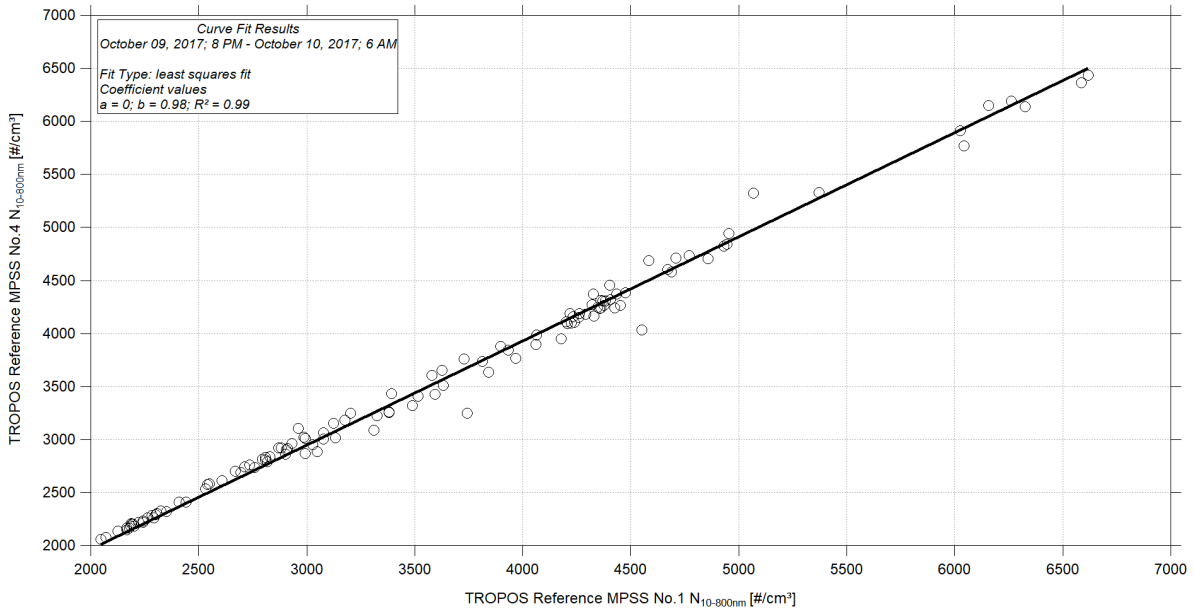

Figure 06: Linear regression between the number concentrations of the TROPOS Reference MPSS No.1 and TROPOS Reference MPSS No.4. Multiple charge correction, internal diffusion losses and CPC flow corrections are included.

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Pre-Status of the Candidate: Particle Number Size Distribution

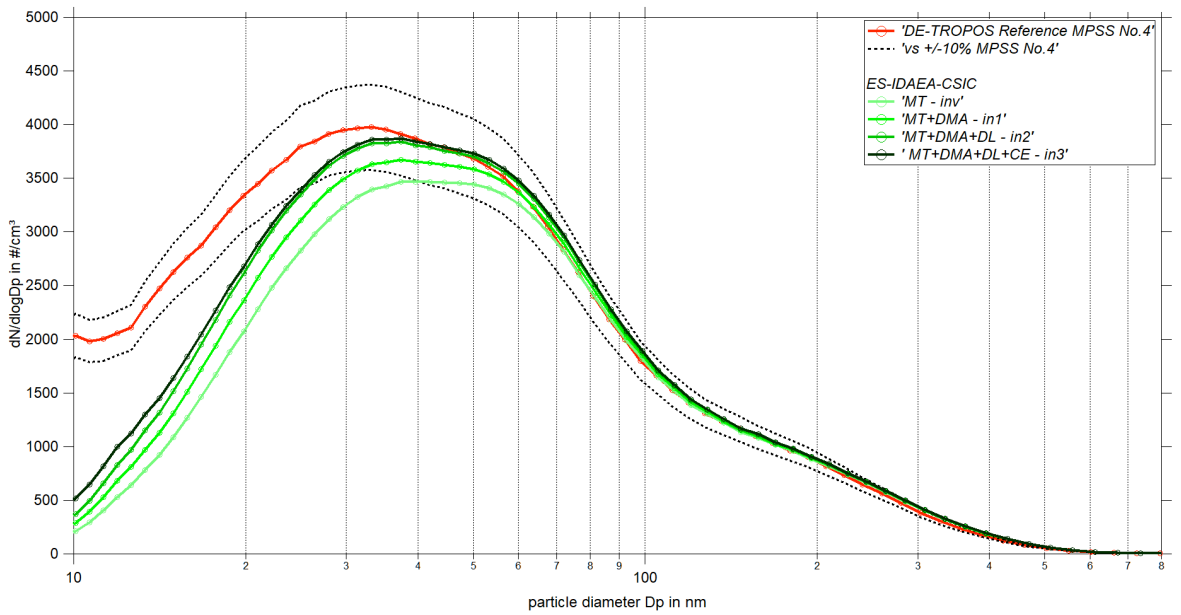

Figure 07: Comparison of mean particle number size distribution of TROPOS Reference MPSS No.4 against ES-IDAEA-CSIC from October 09, 2017 08:00 PM – October 10, 2017 06:00 AM. Multiple charge correction, internal diffusion losses and CPC efficiency are included.

Pre-Status of the Candidate: Time Series

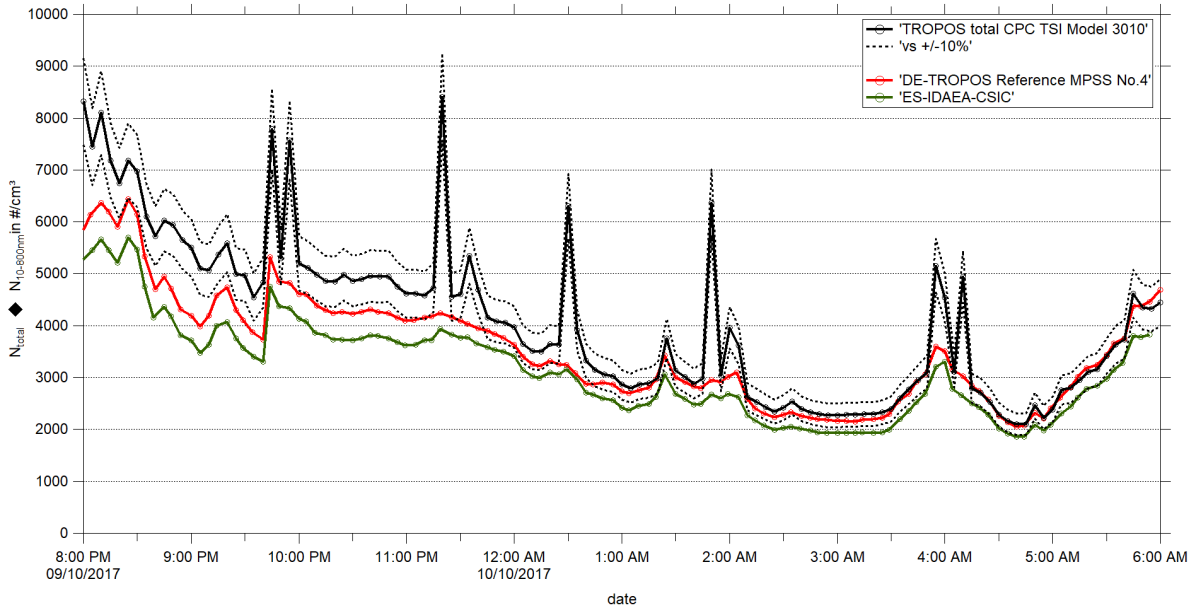

Figure 08: Time series (October 09, 2017 08:00 PM – October 10, 2017 06:00 AM) of the integrated particle number concentration ($N_{10\text{-}800nm}$) of the MPSS and total number concentration (N_{total}) of the Reference TSI-CPC Model 3010. Multiple charge correction, internal diffusion losses and CPC flow corrections are included.

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Pre-Status of the Candidate: Correlation

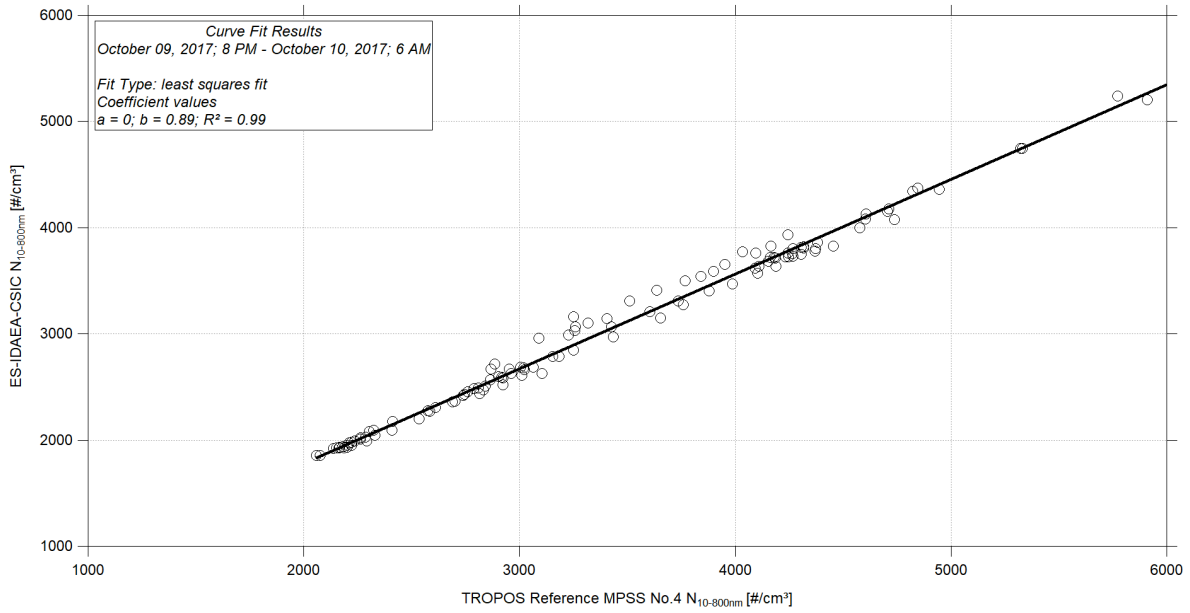

Figure 09: Linear regression between the number concentrations of the TROPOS Reference MPSS No.4 and ES-IDAEA-CSIC. Multiple charge correction, internal diffusion losses and CPC flow corrections are included.

Final-Status of the Candidate: Particle Number Size Distribution

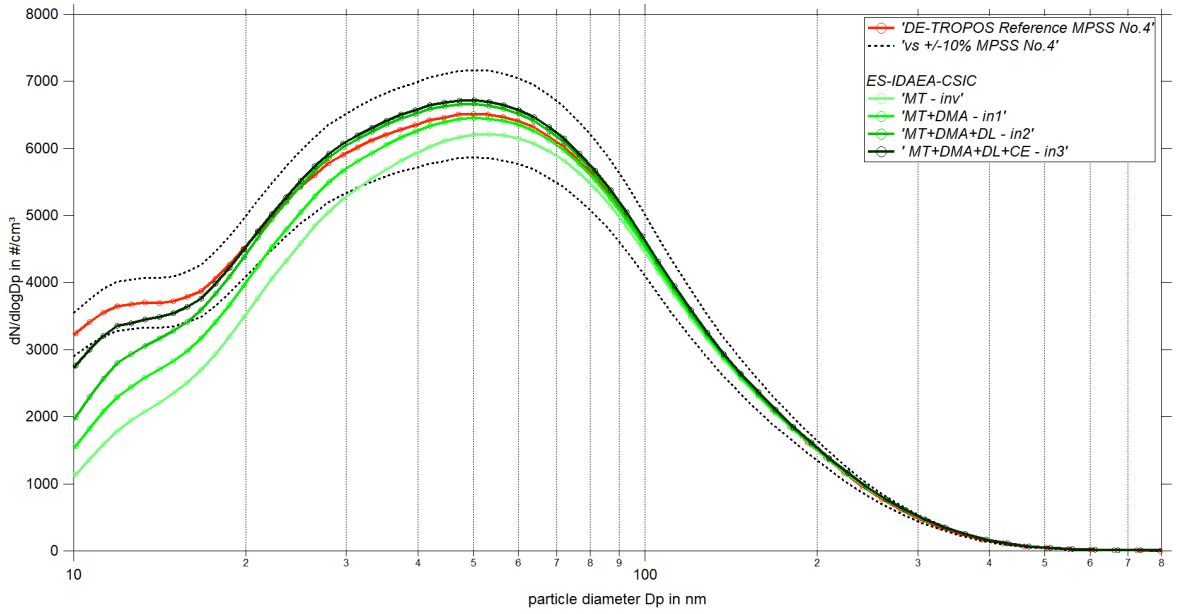

Figure 10: Comparison of mean particle number size distribution of TROPOS Reference MPSS No.4 against ES-IDAEA-CSIC from October 13, 2017 06:00 PM – October 16, 2017 06:00 AM. Multiple charge correction, internal diffusion losses and CPC efficiency are included.

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Final-Status of the Candidate: Time Series

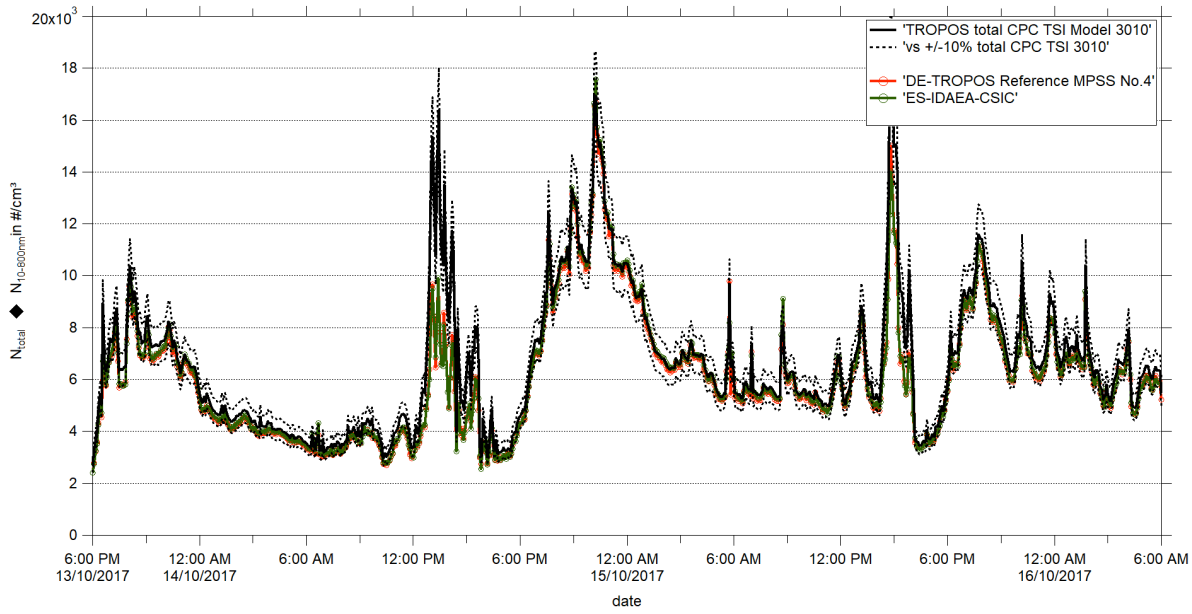

Figure 11: Time series (October 13, 2017 06:00 PM – October 16, 2017 06:00 AM) of the integrated particle number concentration ($N_{10\text{-}800nm}$) of the MPSS and total number concentration (N_{total}) of the Reference TSI-CPC Model 3010. Multiple charge correction, internal diffusion losses and CPC flow corrections are included.

Final-Status of the Candidate: Correlation

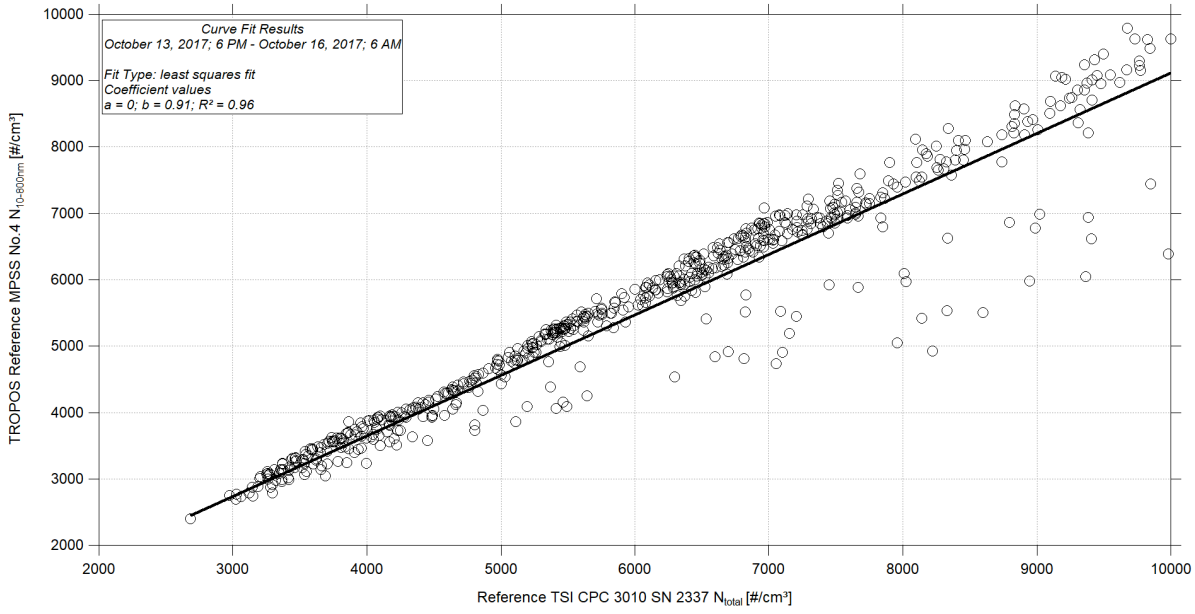

Figure 12: Linear regression between the number concentrations of the TROPOS Reference TSI CPC Model 3010 SN: 2337 and TROPOS Reference MPSS No.4 (October 13, 2017 06:00 PM – October 16, 2017 06:00 AM). Multiple charge correction, internal diffusion losses and CPC flow corrections are included.

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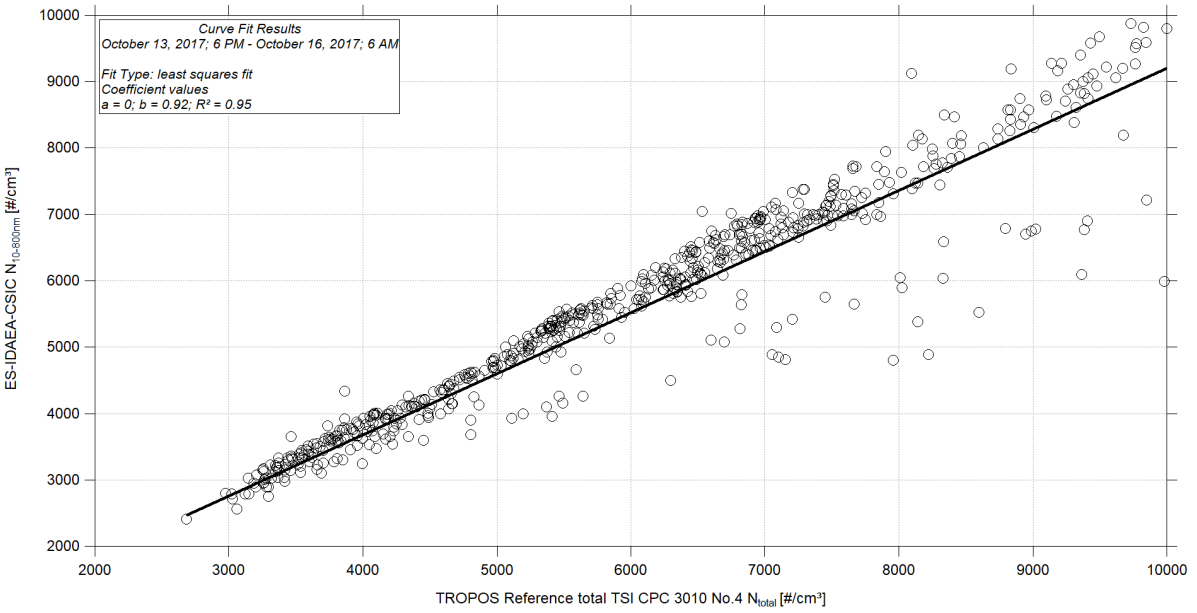

Figure 13: Linear regression between the number concentrations of the TROPOS Reference TSI CPC Model 3010 SN: 2337 and ES-IDAEA-CSIC (October 13, 2017 06:00 PM – October 16, 2017 06:00 AM). Multiple charge correction, internal diffusion losses and CPC flow corrections are included.

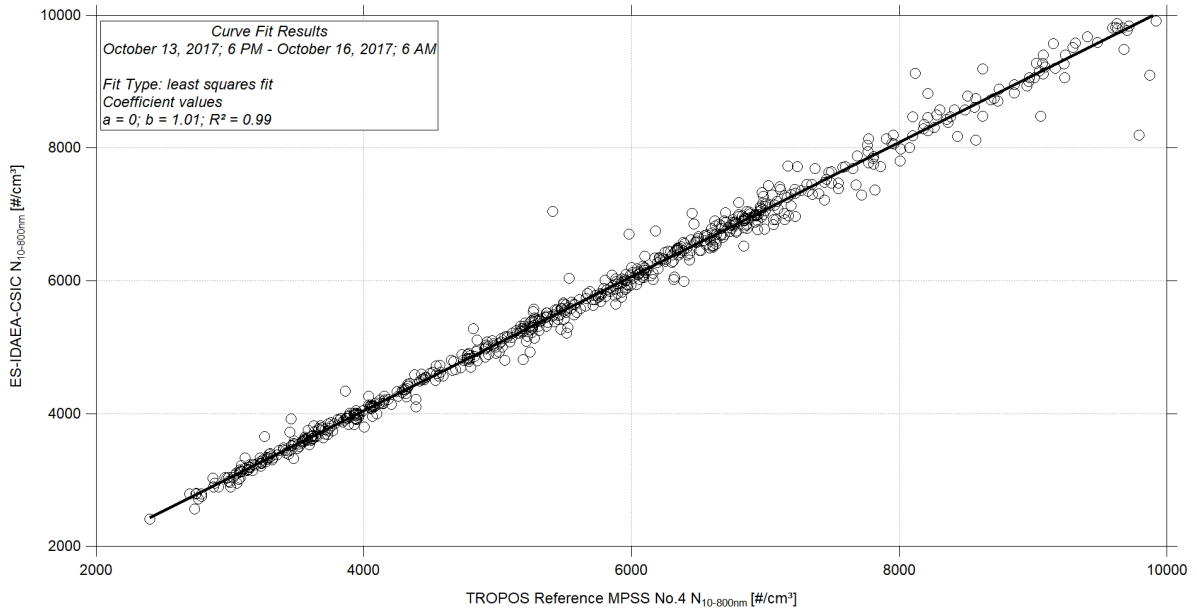

Figure 14: Linear regression between the number concentrations of the TROPOS Reference MPSS No.4 and ES-IDAEA-CSIC (October 13, 2017 06:00 PM – October 16, 2017 06:00 AM). Multiple charge correction, internal diffusion losses and CPC flow corrections are included.

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