

Intercomparison of Mobility Particle Size Spectrometers

Project No.: MPSS-2017-2-3

Principal Investigator: Karine Sellegri

Home Institution: CNRS-LaMP

Participant: Jean-Marc Metzger

Candidate: **FR-CNRS-LaMP**

Made by: custom-made DMPS SN:SMPS02

Counter (SN): TSI CPC Model 3010, SN: 2348

Software: home-made

Location of the quality assurance: TROPOS Leipzig, lab 118

Comparison period: March 13, 2017 – March 17, 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 7% lower than the TROPOS Reference Instrument No.4. The PSL check showed a correct peak at 203.48 nm. The system is running normally on the station with a Ni63 source. The flow ratio is 1:5 l/min. The system was in a good visual condition, but it was necessary to clean the whole instrument (inlet, capillary and DMA), because of the underestimation in the smaller size range. During the Pre-status the candidate was operated at

station conditions (Ni63 source and TSI CPC model 3010), which also includes the settings for the scan time and channels. During the final run, we improved these settings regarding ambient conditions.

The candidate did not pass the quality standards of ACTRIS and GAW.

Final-Status:

During the Final-Status, the performance of the system showed a concentration 1% lower than the TROPOS Reference Instrument No.4. The candidate used the recalibrated TSI CPC model 3010 and their own Ni63 source. The data evaluation was done by CNRS-LaMP and TROPOS inversion. Both of them agree very well at 100 nm. For smaller particles, there are differences in the output, which can be explained with the diffusion loss correction. The TROPOS inversion used the effective lengths measured directly from the instrument. Assuming that the home made DMA (design is similar to TSI-DMA) has an effective lengths of 7.1 m.

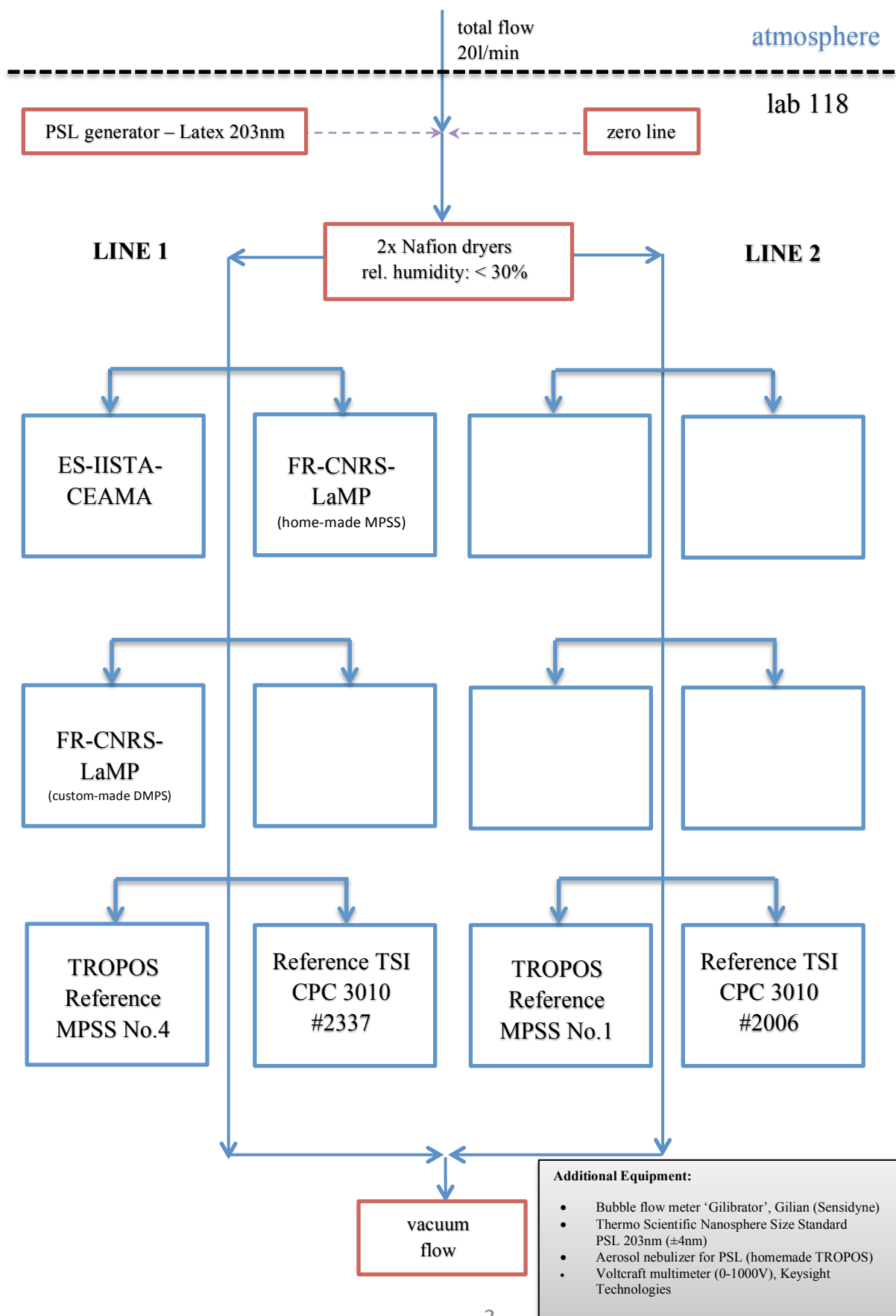
The candidate passed the quality standards of ACTRIS and GAW.

Information about the instruments:

Date of check: March 13, 2017

<i>List of Components</i>	TROPOS Reference MPSS No.1	TROPOS Reference MPSS No.4	Candidate
<i>Position</i>	Line 2	Line 1	Line 1
<i>Company</i>	TROPOS	TROPOS	Home made
<i>Software</i>	TROPOS	TROPOS	Home made
<i>CPC-MPSS</i>	TSI CPC, Model 3772	TSI CPC, Model 3772	TSI CPC, Model 3010
<i>CPC-total</i>	TSI CPC, Model 3010	TSI CPC, Model 3010	-
<i>flow ratio</i>	1.0 : 5.0	1.0 : 5.0	1.0 : 5.0
<i>source</i>	Kr85	Kr85	Ni63
<i>HV power supply</i>	positive	positive	positive
<i>DMA</i>	Hauke medium	Hauke medium	TSI
<i>aerosol dryer</i>	✓	✓	
<i>aerosol RH- sensor</i>	✓	✓	✓
<i>aerosol T-sensor</i>	✓	✓	✓
<i>sheath RH-sensor</i>	✓	✓	
<i>sheath T-sensor</i>	✓	✓	
<i>Sheath dryer</i>	✓	✓	
<i>pressure sensor</i>	✓	✓	
<i>info</i>			

Laboratory setup:



Status of the instruments:

Date of check (Pre-Status): 13.03.2017

<i>CPC status</i>	MPSS		Total CPC	
<i>power/status</i>	LED green	-	-	-
<i>saturator temp</i>	-	°C	-	°C
<i>condenser temp</i>	-	°C	-	°C
<i>optics temp</i>	-	°C	-	°C
<i>cabinet temp</i>	-	°C	-	°C
<i>ambient pressure</i>	-	kPa	-	kPa
<i>orifice pressure</i>	-	kPa	-	kPa
<i>nozzle pressure</i>	-	kPa	-	kPa
<i>laser current</i>	-	mA	-	mA
<i>liquid level</i>	full	-	-	-

Date of check (Final-Status): 16.03.2017

<i>CPC status</i>	MPSS		Total CPC	
<i>power/status</i>	LED green	-	-	-
<i>saturator temp</i>	-	°C	-	°C
<i>condenser temp</i>	-	°C	-	°C
<i>optics temp</i>	-	°C	-	°C
<i>cabinet temp</i>	-	°C	-	°C
<i>ambient pressure</i>	-	kPa	-	kPa
<i>orifice pressure</i>	-	kPa	-	kPa
<i>nozzle pressure</i>	-	kPa	-	kPa
<i>laser current</i>	-	mA	-	mA
<i>liquid level</i>	full	-	-	-

Date of system checks:

<i>date</i>	13.03.2017	14.03.2017	15.03.2017	16.03.2017	unit
<i>total CPC flow</i>	-	-	-	-	l/min
<i>aerosol flow (DMA)</i>	-	-	-	-	l/min
<i>aerosol flow (UDMA)</i>	-	-	-	-	l/min
<i>aerosol flow (total)</i>	1033	-	1036	-	l/min
<i>Zero MPSS</i>	0	-	0	-	#/cm ³
<i>Zero total CPC</i>	-	-	-	-	#/cm ³
<i>PSL 203 nm</i>		-	203.48	-	nm
<i>HV – 0 V</i>	-	-	checked	-	V
<i>HV – 5 V</i>	-	-	checked	-	V
<i>HV – 100 V</i>	-	-	checked	-	V
<i>HV – 1000 V</i>	-	-	checked	-	V

Special Information regarding the Candidate:

<i>Was it necessary to:</i>	yes/no (date)	old part (ID/SN)	new part (ID/SN)	information
<i>clean the aerosol inlet</i>	yes			
<i>change aerosol Nafion dryer</i>	no			
<i>change sheath Nafion dryer</i>	no			
<i>check source</i>	yes			Ni63 is working. We used Kr85 from TROPOS.
<i>change HV power supply</i>	no			
<i>clean/change DMA</i>	yes			Cleaning was necessary
<i>change aerosol RH/T-sensor</i>	no			
<i>change sheath RH/T-sensor</i>	no			
<i>change pressure sensor</i>	no			

Instrument lengths: 45 cm, 1 m with radioactive source, 30 cm, 10 cm, 15 cm 90°, 26 cm, 27 cm, 7.1 m DMA, 25 cm, 15 cm, 50 cm

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

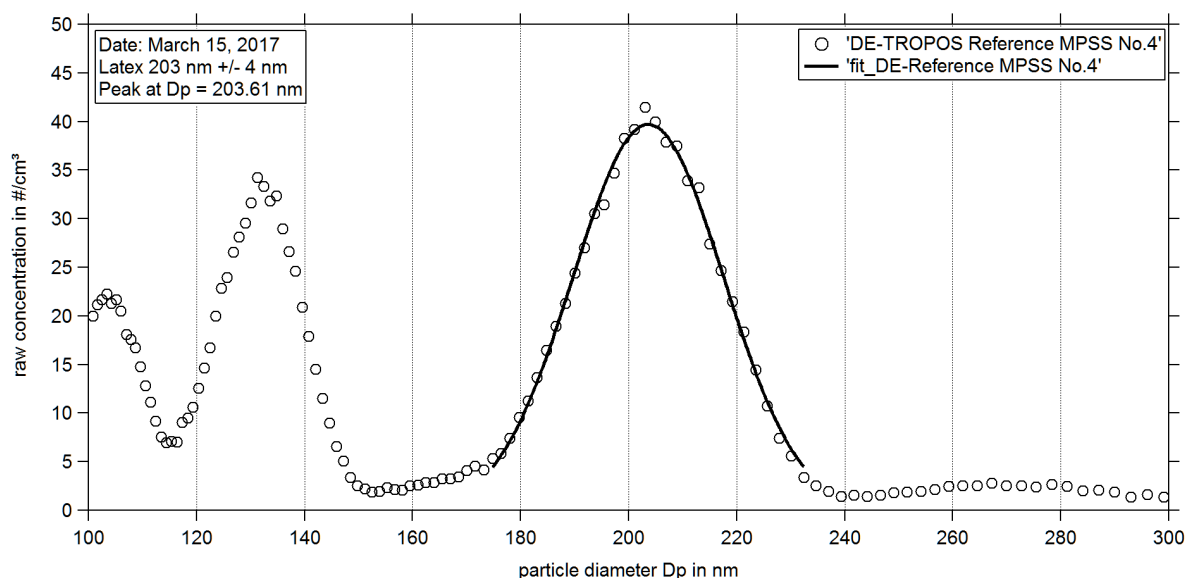


Figure 01: Measurement of latex 203 nm: Particle size distribution (raw concentration) for latex 203 nm on March 15th, 2017.

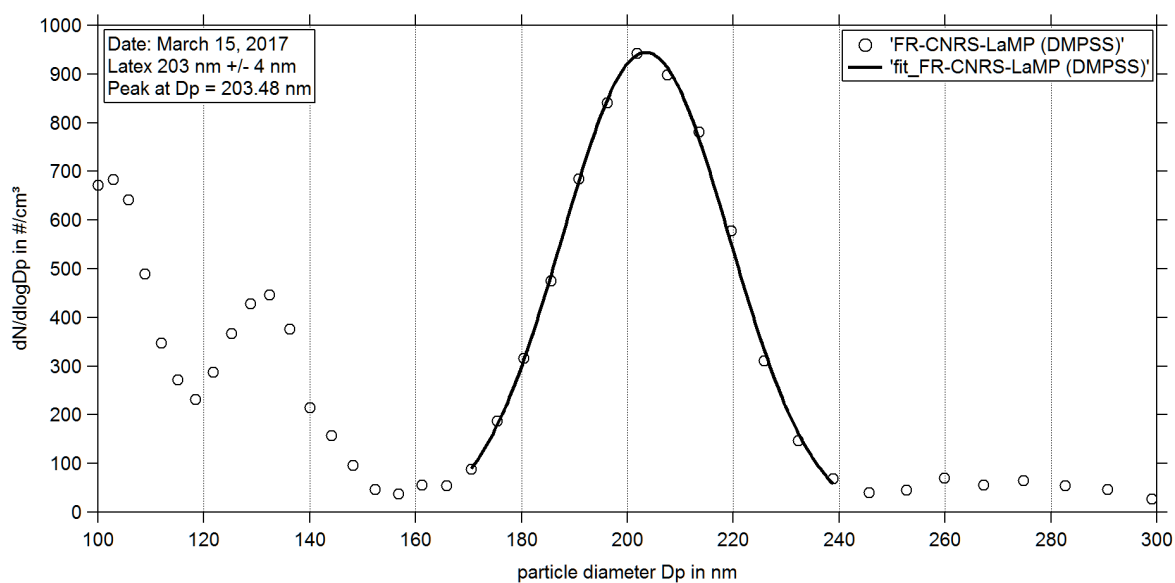


Figure 02: Measurement of latex 203 nm: Particle size distribution (raw concentration) for latex 203 nm on March 15th, 2017.

Status of the TROPOS Reference MPSS: Time Series

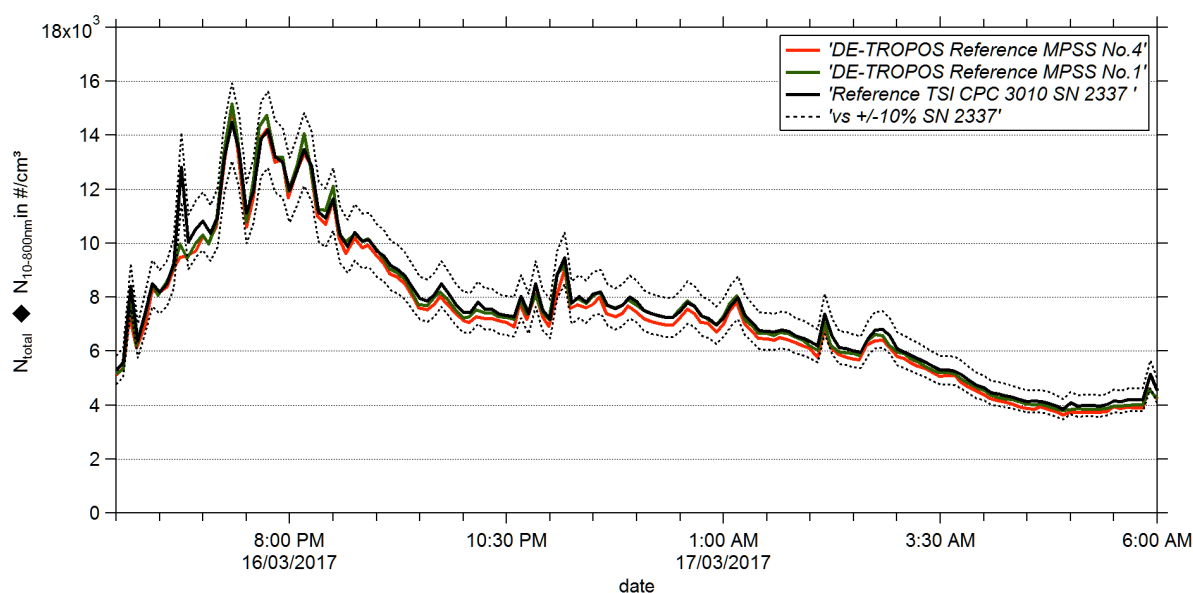


Figure 03: Time series (March 16, 2017 06:00 PM – March 17, 2017 06:00 AM) of the integrated particle number concentration ($N_{10-800\text{nm}}$) of the TROPOS Reference MPSS and total number concentration (N_{total}) of the Reference TSI CPC 3010. The inversion was performed using TROPOS software.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

Pre-Status of the Candidate: Particle Number Size Distribution

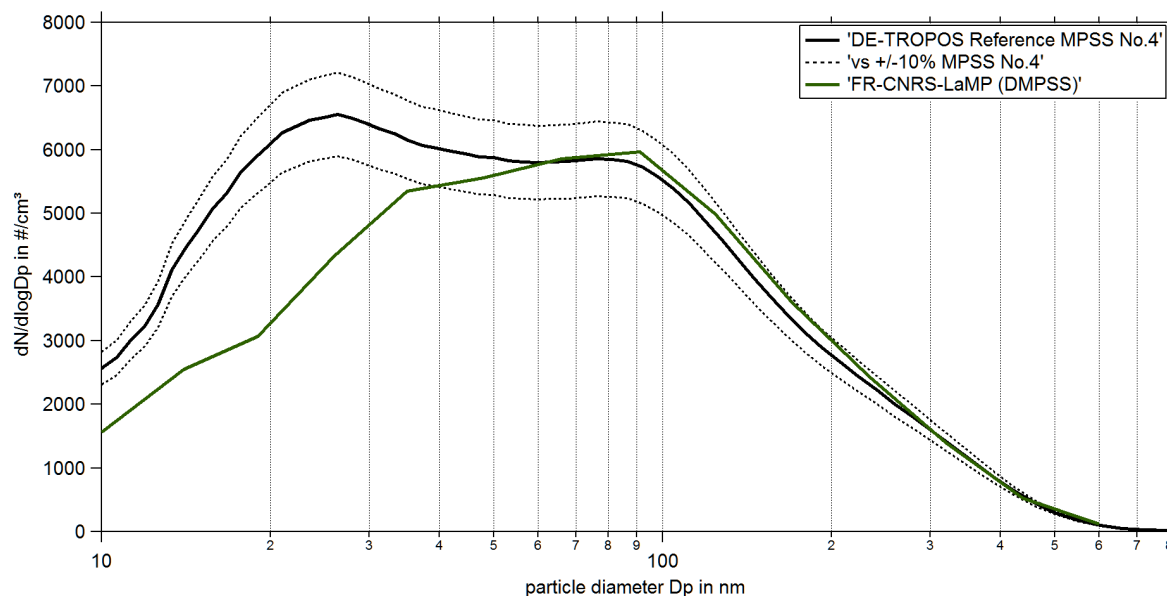


Figure 04: Comparison of mean particle number size distribution of TROPOS Reference MPSS No.4 against FR-CNRS-LaMP from March 13, 2017 08:00 PM – March 14, 2017 06:00 AM. Multiple charge correction, internal diffusion losses and CPC efficiency are included.

Pre-Status of the Candidate: Time Series

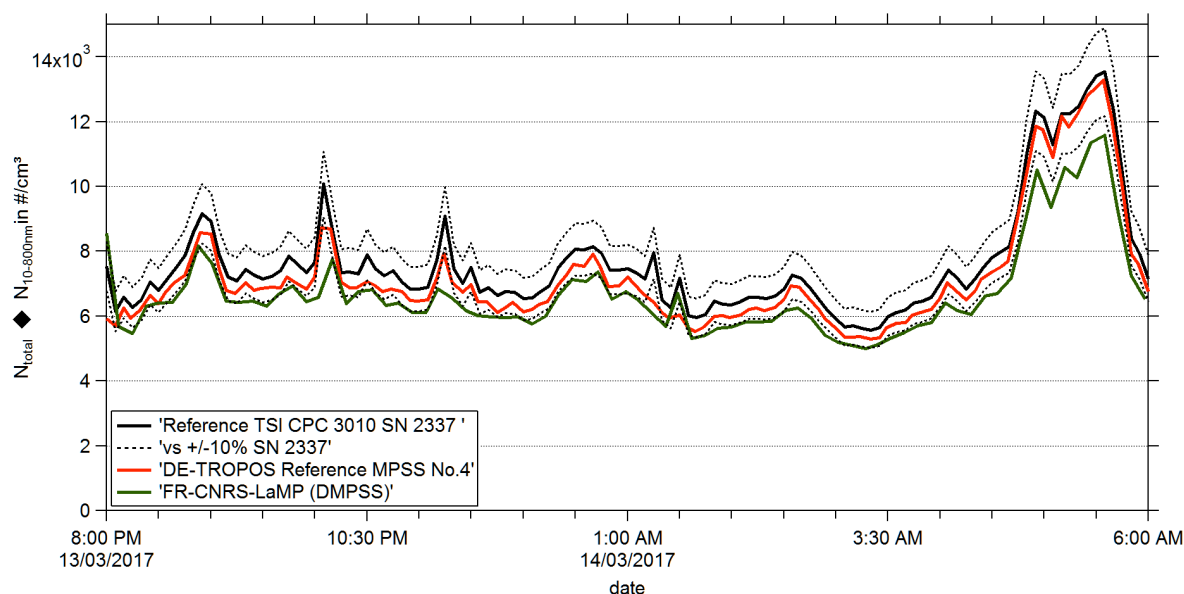


Figure 05: Time series (March 13, 2017 08:00 PM – March 14, 2017 06:00 AM) of the integrated particle number concentration ($N_{10-800nm}$) of the MPSS and total number concentration (N_{total}) of the Reference TSI-CPC Model 3010. The inversion for the candidate was performed using TSI software. Multiple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

Pre-Status of the Candidate: Correlation

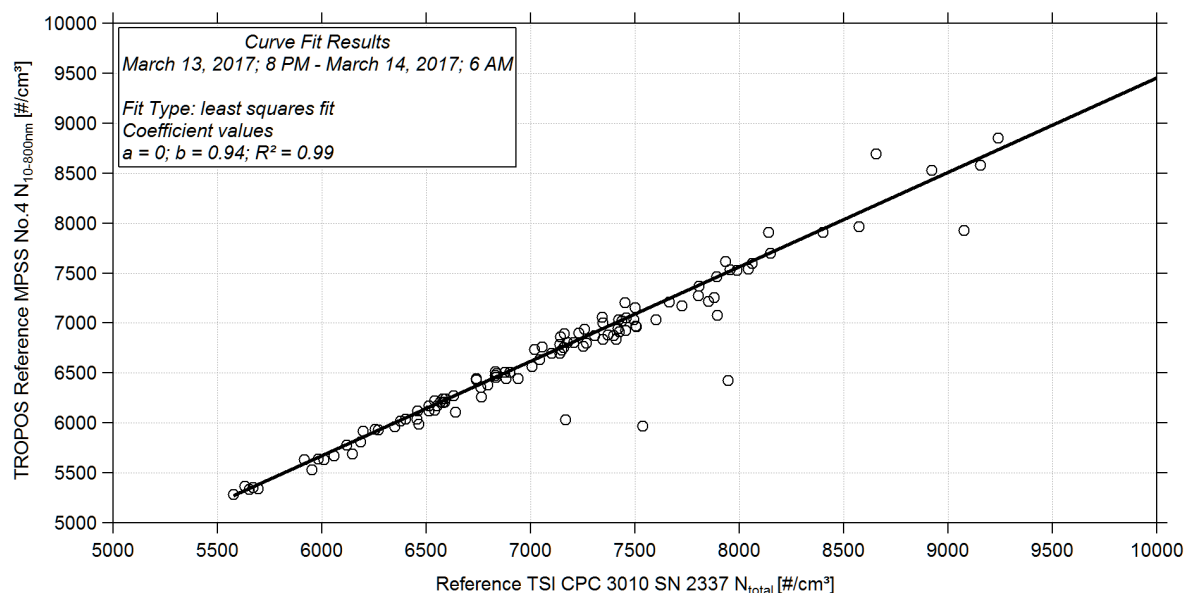


Figure 06: Linear regression between the number concentrations of the TROPOS Reference TSI CPC Model 3010 SN: 2337 and TROPOS Reference MPSS No.4. Multiple charge correction, internal diffusion losses and CPC flow corrections are included.

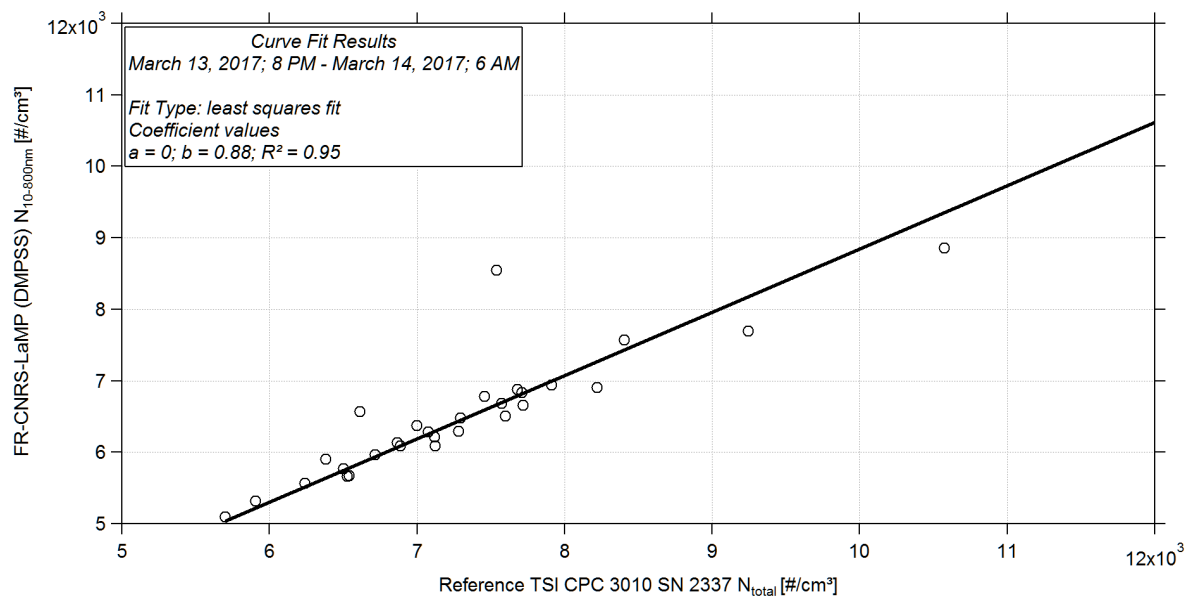


Figure 07: Linear regression between the number concentrations of the TROPOS Reference TSI CPC Model 3010 SN: 2337 and FR-CNRS-LaMP. Multiple charge correction, internal diffusion losses and CPC flow corrections are included.

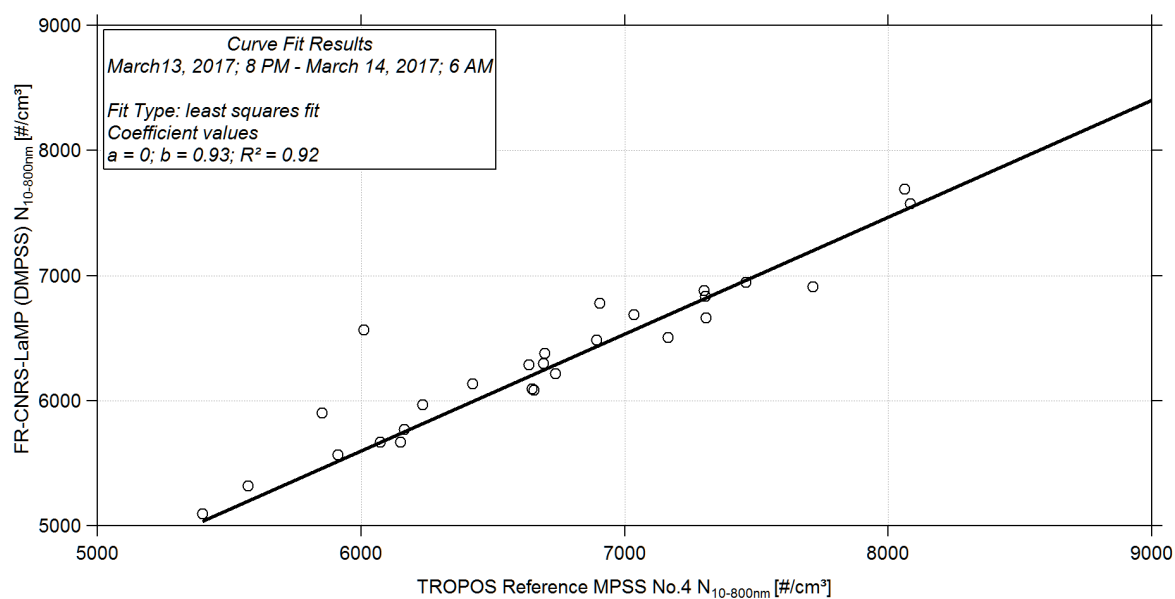


Figure 08: Linear regression between the number concentrations of the TROPOS Reference MPSS No.4 and FR-CNRS-LaMP. Multiple charge correction, internal diffusion losses and CPC flow corrections are included.

Final-Status of the Candidate: Particle Number Size Distribution

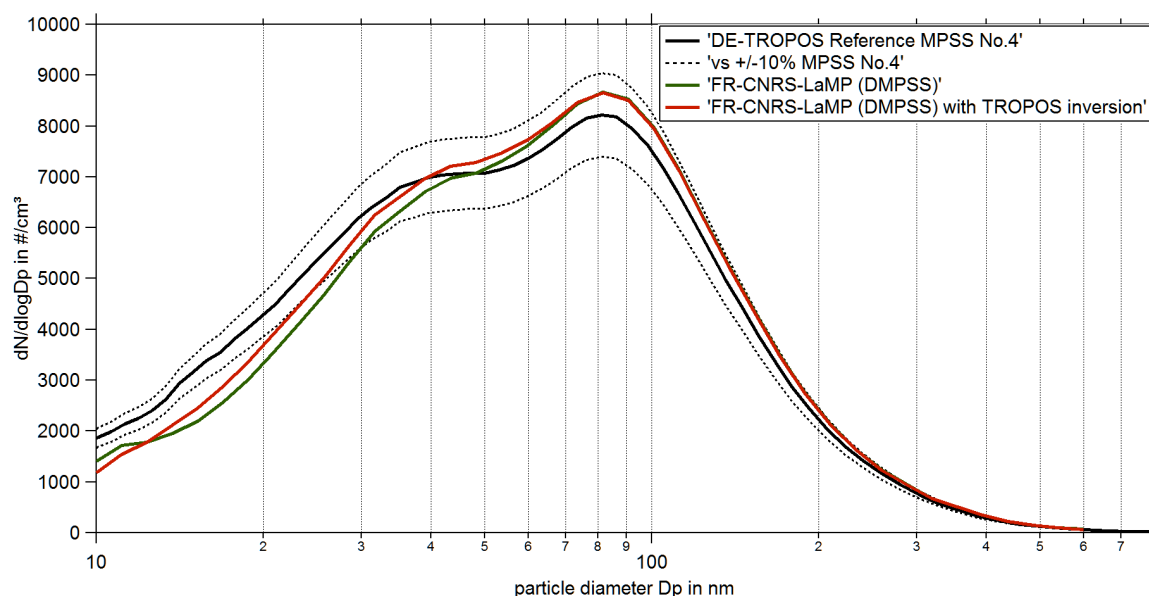


Figure 09: Comparison of mean particle number size distribution of TROPOS Reference MPSS No.4 against FR-CNRS-LaMP from March 16, 2017 06:00 PM – March 17, 2017 06:00 AM. Multiple charge correction, internal diffusion losses and CPC efficiency are included. The green curve shows the inversion done by CNRS-LaMP and the red one with TROPOS inversion.

Final-Status of the Candidate: Time Series

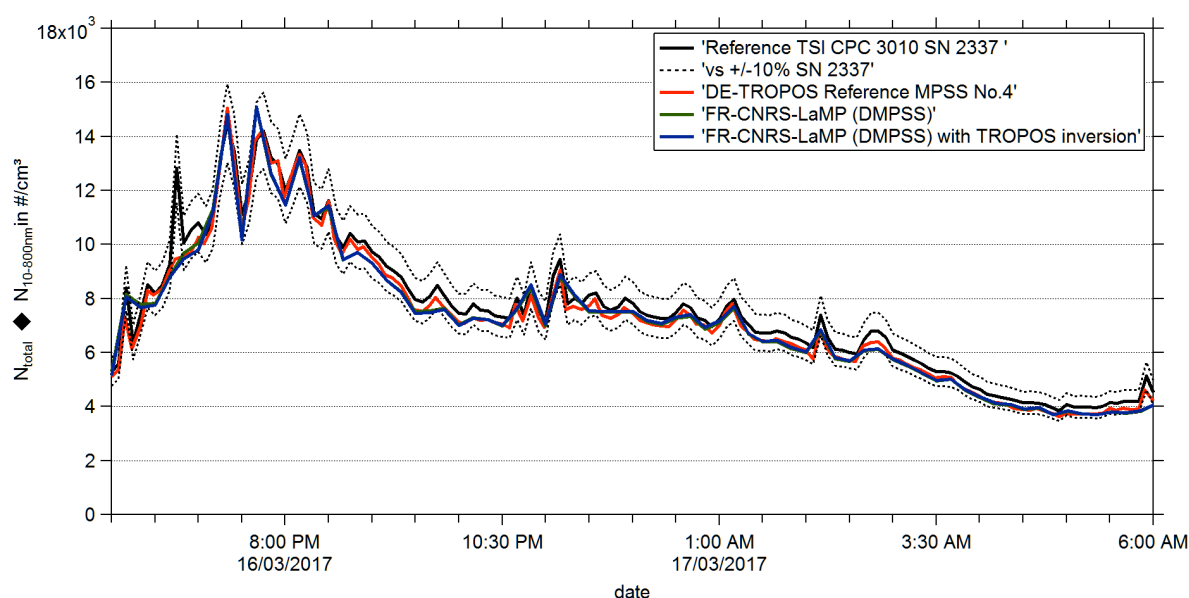


Figure 10: Time series (March 16, 2017 06:00 PM – March 17, 2017 06:00 AM) of the integrated particle number concentration ($N_{10-800nm}$) of the MPSS and total number concentration (N_{total}) of the Reference TSI-CPC Model 3010. The inversion for the candidate was performed using home made and TROPOS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

Final-Status of the Candidate: Correlation

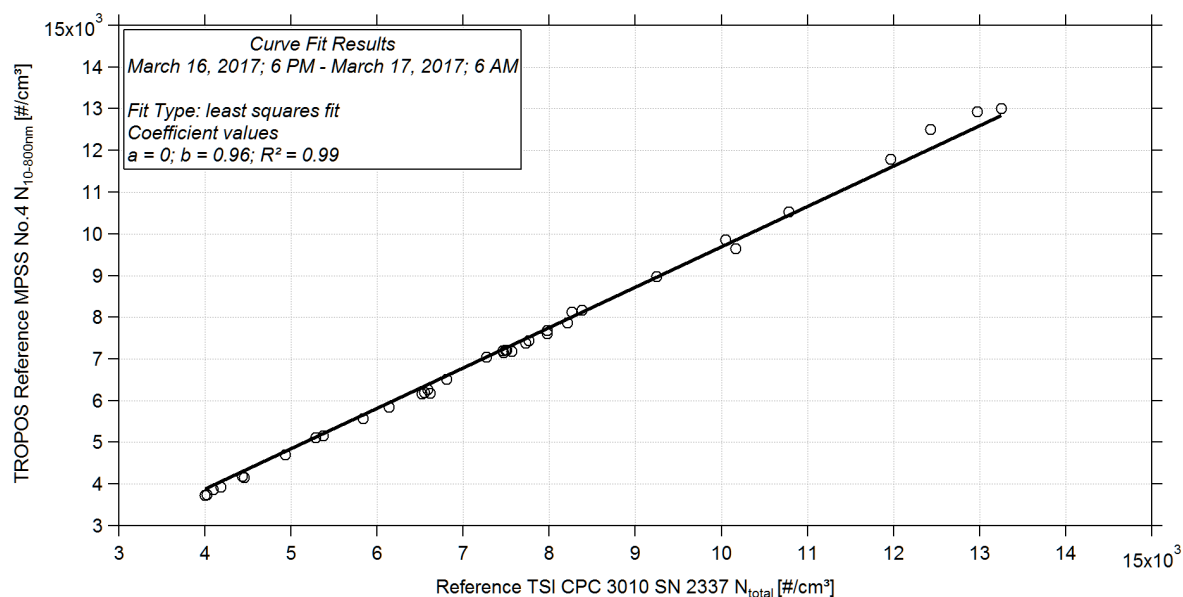


Figure 11: Linear regression between the number concentrations of the TROPOS Reference TSI CPC Model 3010 SN: 2337 and TROPOS Reference MPSS No.4. Multiple charge correction, internal diffusion losses and CPC flow corrections are included.

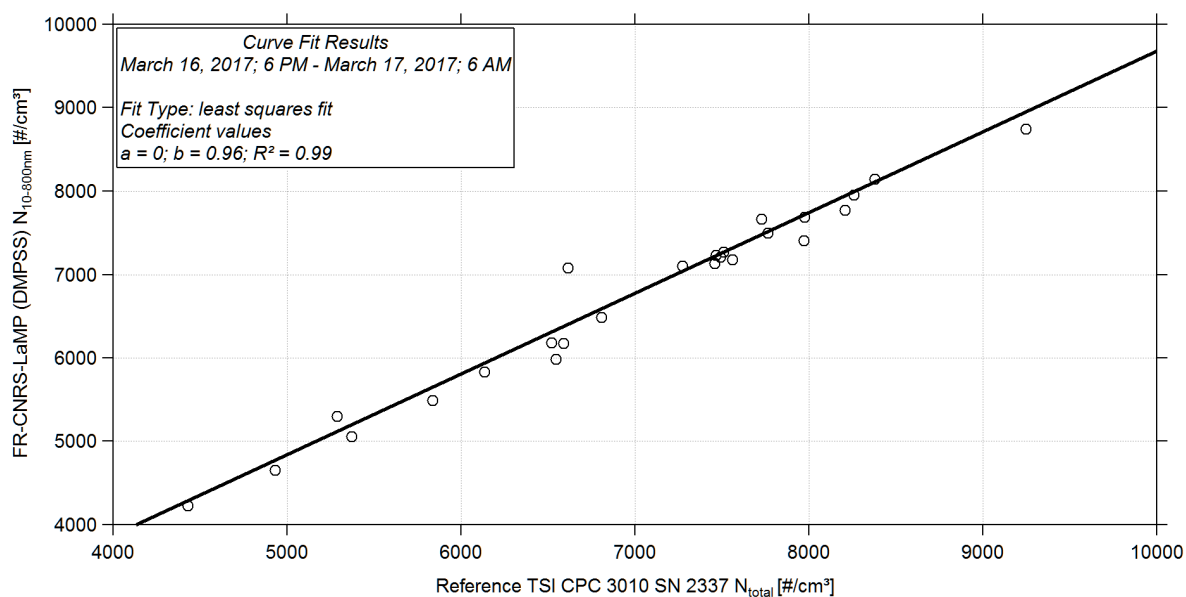


Figure 12: Linear regression between the number concentrations of the TROPOS Reference TSI CPC Model 3010 SN: 2337 and FR-CNRS-LaMP. Multiple charge correction, internal diffusion losses and CPC flow corrections are included.

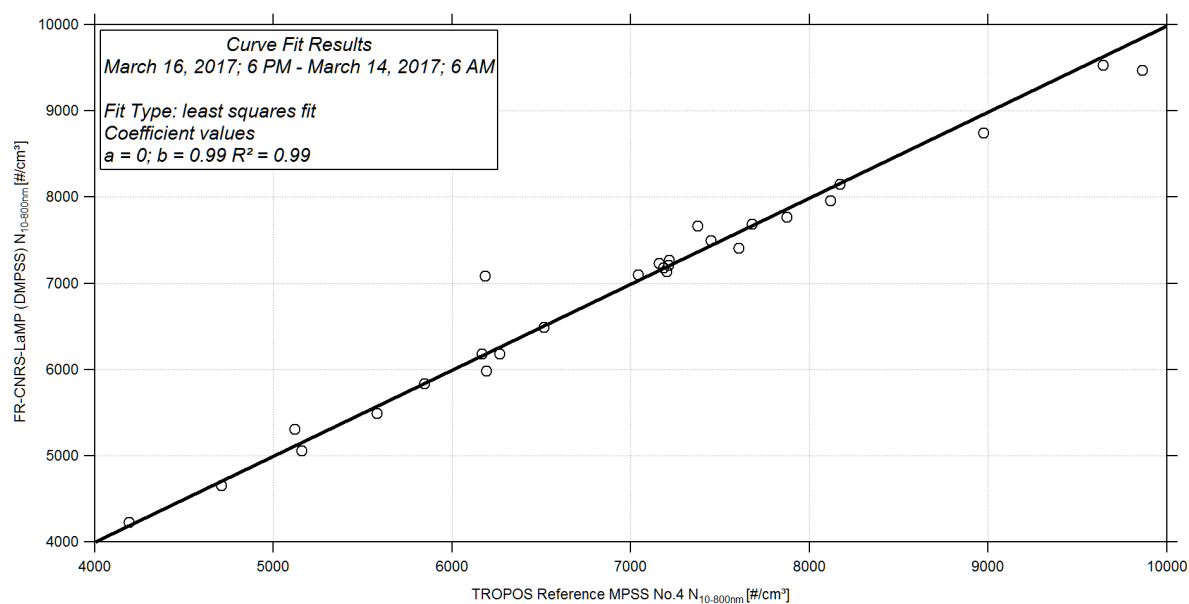


Figure 13: Linear regression between the number concentrations of the TROPOS Reference MPSS No.4 and FR-CNRS-LaMP. Multiple charge correction, internal diffusion losses and CPC flow corrections are included.