TROPOS
Leibniz Institute for Tropospheric Research

ACTRIS

Intercomparison of Mobility Particle Size Spectrometers

Project No.: MPSS-2016-1-6

Basic information:

Location of the quality assurance: TROPOS, lab: 118

Delivery date: January 25, 2016

Setup in the laboratory: January 25, 2016

Comparison period: January 25, 2016 – January 29, 2016

Principal Investigator	Home Institution	Participant	Instrument
Andreas Massling	Aarhus University, Department of Environmental Science	Andreas Massling	Homemade MPSS TSI CPC Model 3010 #2405

Summary of Intercomparison:

Pre-status:
The Homemade MPSS ENVS was in a good condition but 10% lower than the TROPOS Reference MPSS No.1.

Final status:
The Homemade MPSS ENVS passed the quality standards of ACTRIS and GAW. The system is within the 10% range of the TROPOS Reference MPSS No.1. During this week there are a

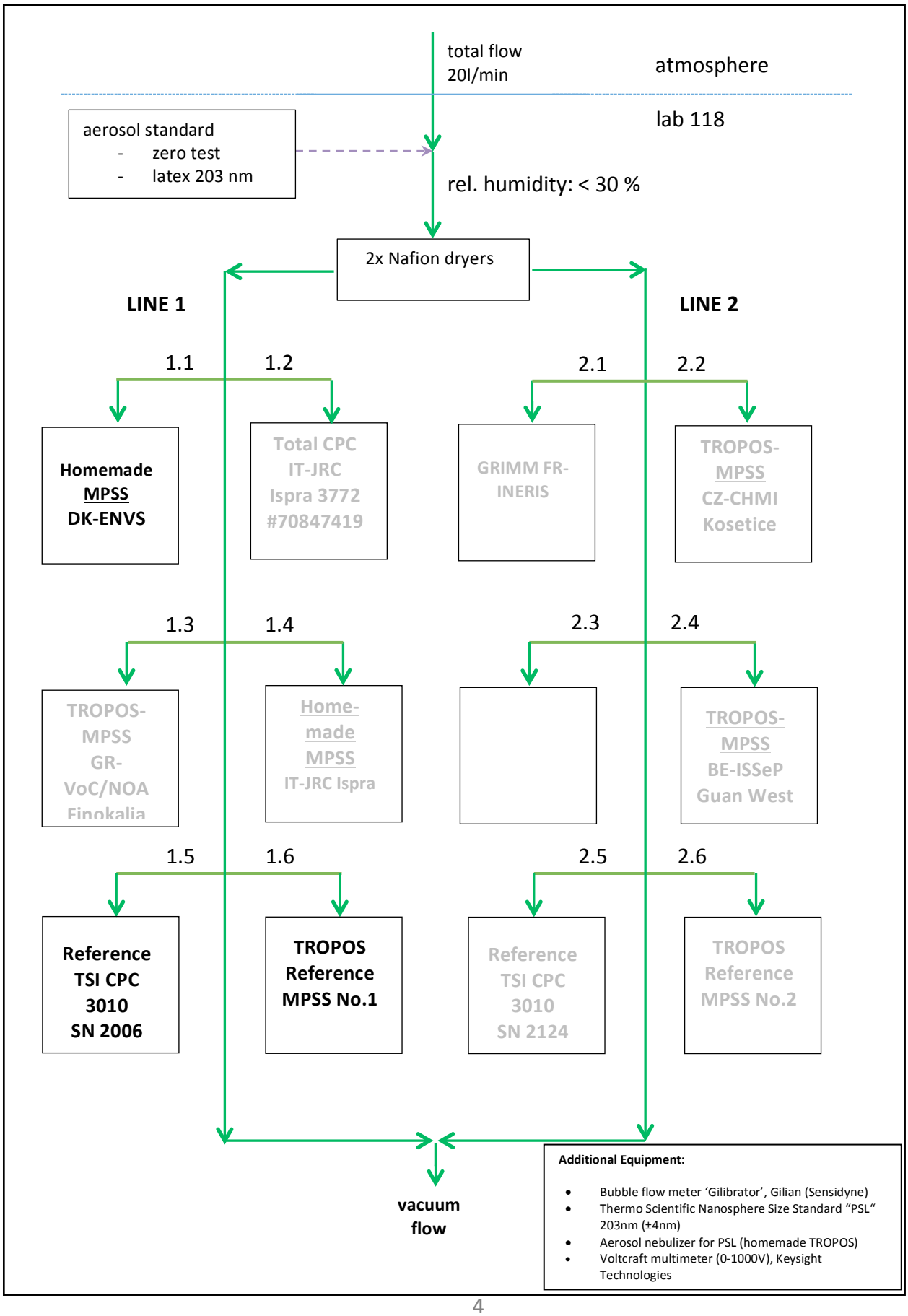
lot of ultrafine particles that is the reason why the correlation to the TROPOS total CPC 3010 is sometimes out of the 10% range.

- 25.01.2016: setup Homemade MPSS ENVS in the lab 118 -> pre-status overnight run
- 26.01.2016: CPC Workshop in lab 130.
- 26.01.2016: Check and cleaning of the MPSS -> it was necessary to bring the DMA (slit 0.6 mm) to the mechanical workshop. The Kr85 source was checked by Andrea Haudek.
- 26.01.2016: Overnight run with new CPC 3010 (SN: 2316)
- 27.01.2016: DMA back in the MPSS after cleaning.
- 28.-29.01.2016: final status overnight run with ambient, original DMA and CPC 3010 (SN 2314)

List of Components

	Specification	Reference MPSS No.1	Homemade DK-ENVS
Position (Line)		1.6	1.1
Company		TROPOS	Homemade
Software		TROPOS 5.7	Homemade
CPC		Model 3772 SN: 3772141701	Model 3010 SN : 2405
Flow ratio		1.0 : 5.0	1.0 : 6.7
Source		Kr85	Kr85
HV cassette		positive	positive
DMA		Hauke medium	Homemade
Flow meas.	Aerosol	✓	✓
Dryer		✓	
RH sensor	Inlet	✓	
T sensor		✓	
RH sensor	Sheath air	✓	
T sensor		✓	
Dryer		✓	✓
p sensor		✓	

Laboratory Setup



TROPOS Reference Systems during the pre-status night measurement

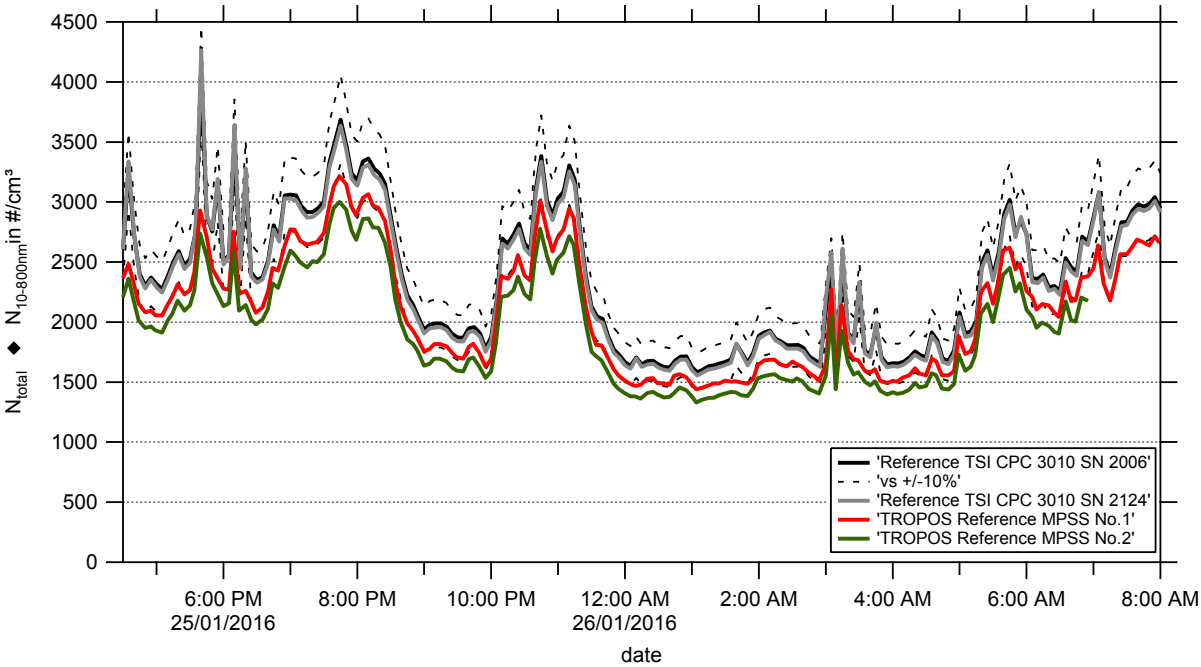


Figure 01: Time series (January 25, 2016 6:00 pm – January 26, 2016 8:00 am) of the integrated particle number concentration ($N_{10\text{-}800nm}$) of the two TROPOS Reference MPSS systems and total number concentration (N_{total}) of the two reference TSI-CPCs Model 3010. The inversion was performed using TROPOS software. Multiple charge correction, internal diffusion losses and CPC flow corrections are included.

Pre- Status of the Candidate (January 25th)

Components and zero check

Institute	System	Components	CPC Model + Serial No.	Line	Flow		Zero	
TROPOS	Ref1	MPSS	3772 SN 3772141701	1.6	**1.026**	l/min	1	# cm^{-3}
TROPOS		Total CPC	3010 SN 2006	1.5	**1.025**	l/min	0	# cm^{-3}
ENVS	HOMEMADE MPSS	Homemade DMPS	3010 SN 2405	1.1	**1.018**	l/min	0	# cm^{-3}

Latex 203nm ±4nm (pressure 1009 hPa, 23.0°C)

Institute	System		Latex 203 [nm]	slope
TROPOS	Reference MPSS No.1	Pre-status	201	-
		final	**202.8**	**4.9**
ENVS	HOMEMADE MPSS	Pre-status	-	-
		final	**209.2**	**-**

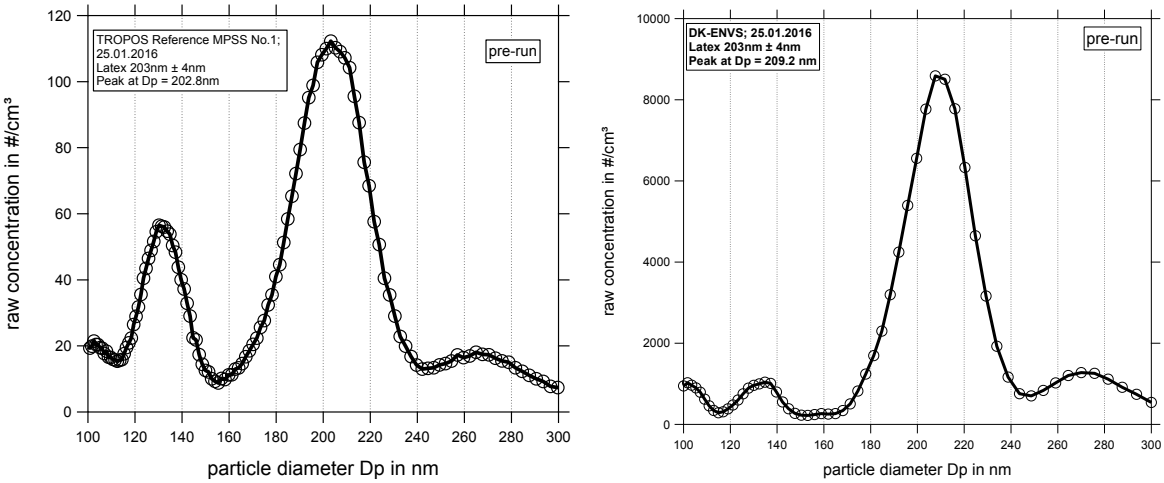


Figure 02: Measurement of latex 203 nm: Particle size distribution (raw concentration) for TROPOS Reference MPSS No. 1 (left) and the Homemade MPSS DK-ENVS, using latex 203 nm on January 25th, 2016.

Time Series

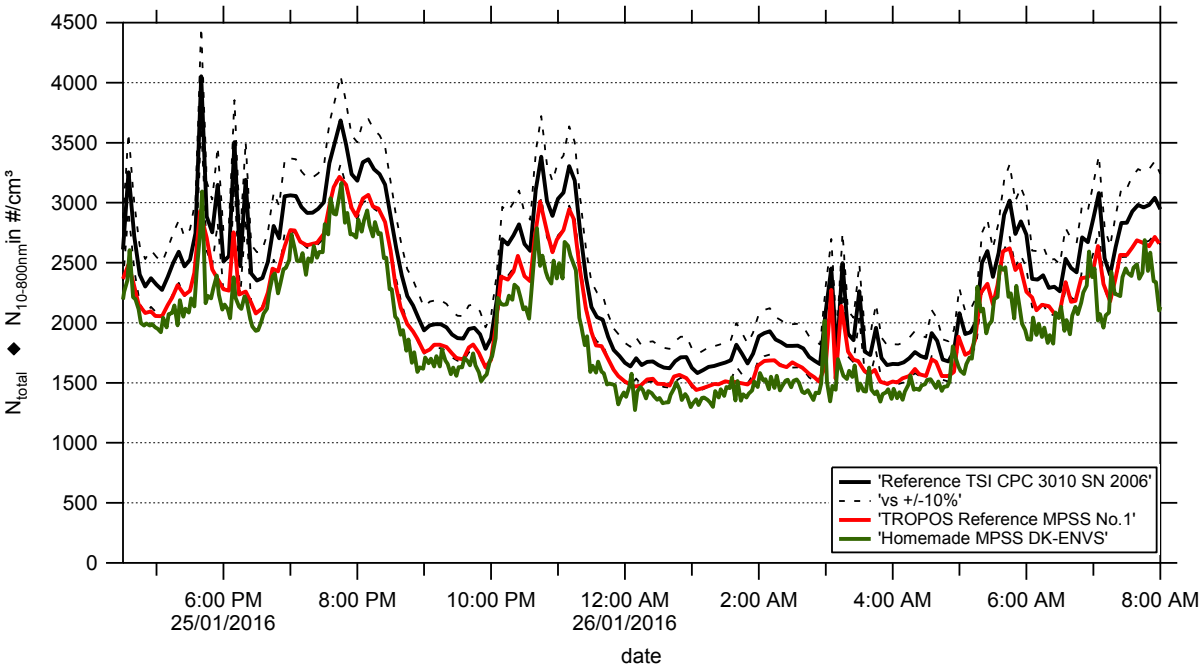


Figure 03: Time series (January 25, 2016 6:00 pm – January 26, 2016 8:00 am) of the integrated particle number concentration ($N_{10\text{-}800nm}$) of the MPSS and total number concentration (N_{total}) of the reference TSI-CPC Model 3010. The inversion was performed using TROPOS software. Multiple charge correction, internal diffusion losses and CPC flow corrections are included.

Particle Number Size Distribution

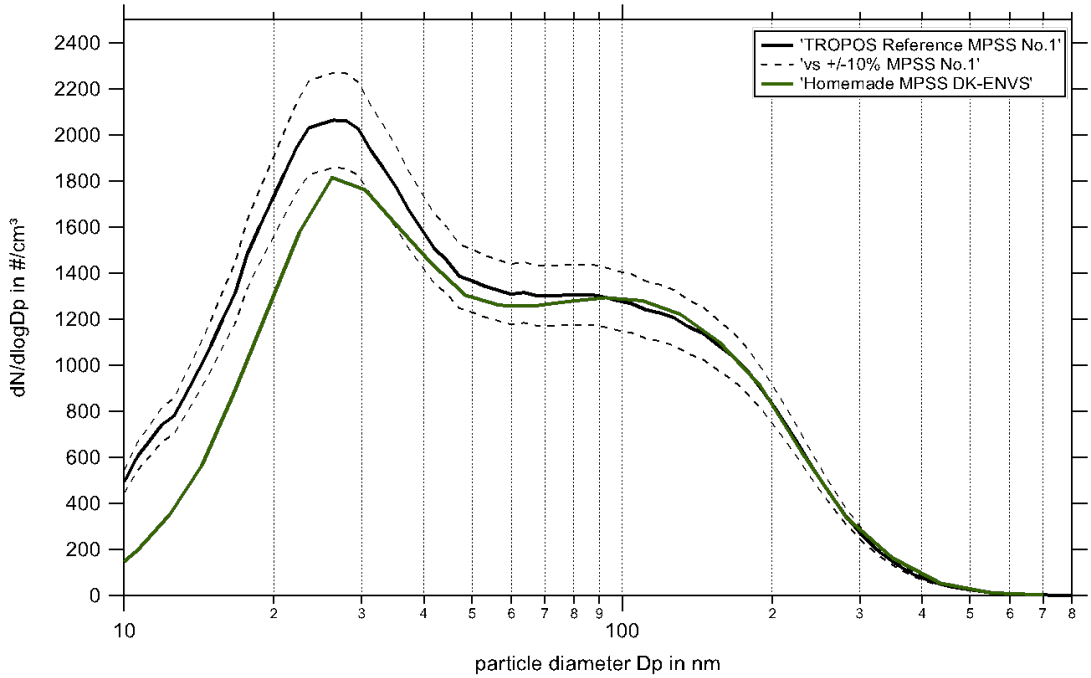


Figure 04: Comparison of mean particle number size distribution of TROPOS-MPSS Alaska and TROPOS Reference MPSS No.1 from January 25, 2016 6:00 pm to January 26, 2016 8:00 am. The inversion was performed using TROPOS software. Multiple charge correction, internal diffusion losses and CPC efficiency are included.

Correlation between the Reference CPCs Model 3010 and TROPOS Reference MPSS No.1

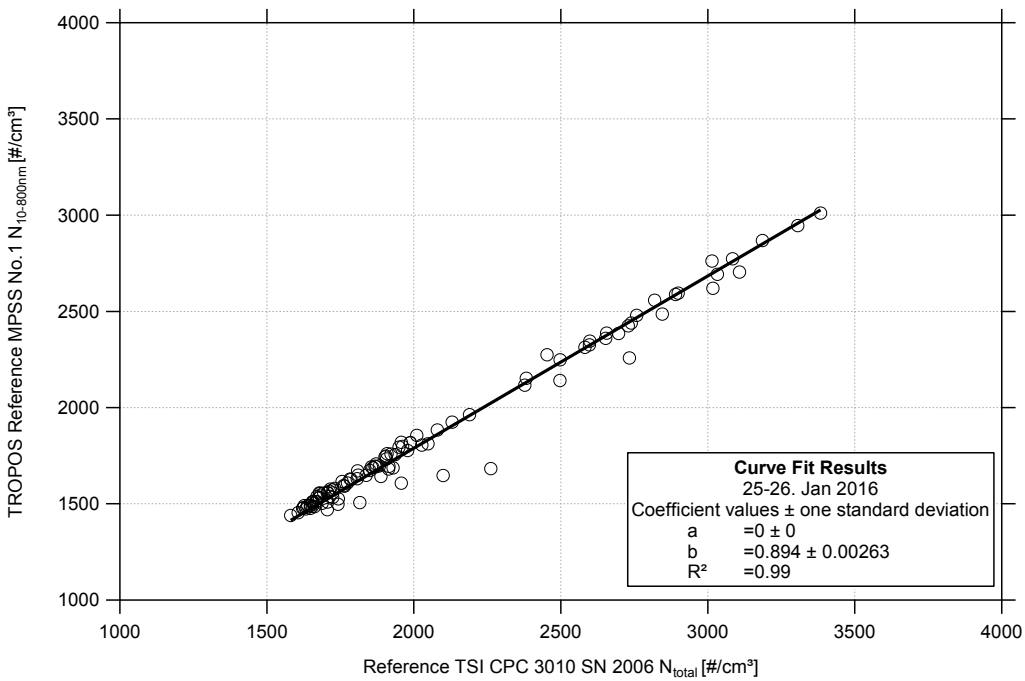


Figure 05: Linear regression between the number concentrations of the TROPOS Reference MPSS No.1 and TROPOS Reference TSI CPC Model 3010 (SN 2006). Multiple charge correction, internal diffusion losses and CPC flow corrections are included.

Correlation between the Reference TSI CPC Model 3010 and Homemade MPSS DK-ENVS

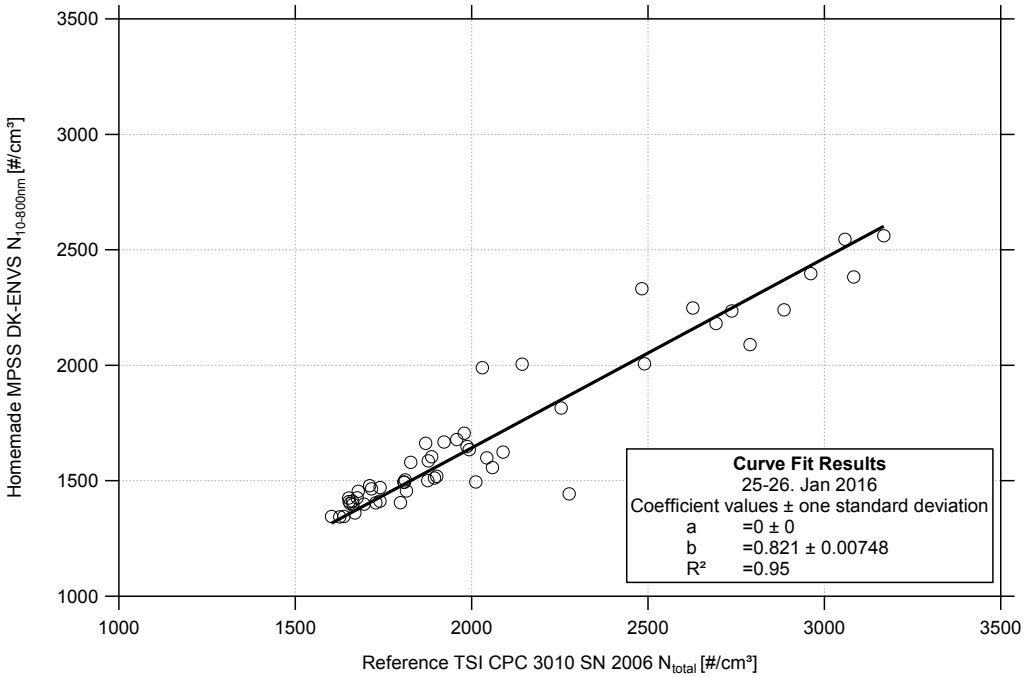


Figure 06: Linear regression between the number concentrations of the Homemade MPSS DK-ENVS and TROPOS Reference TSI CPC Model 3010. Multiple charge correction, internal diffusion losses and CPC flow corrections are included.

Correlation between the TROPOS Reference MPSS No.1 and Homemade MPSS DK-ENVS

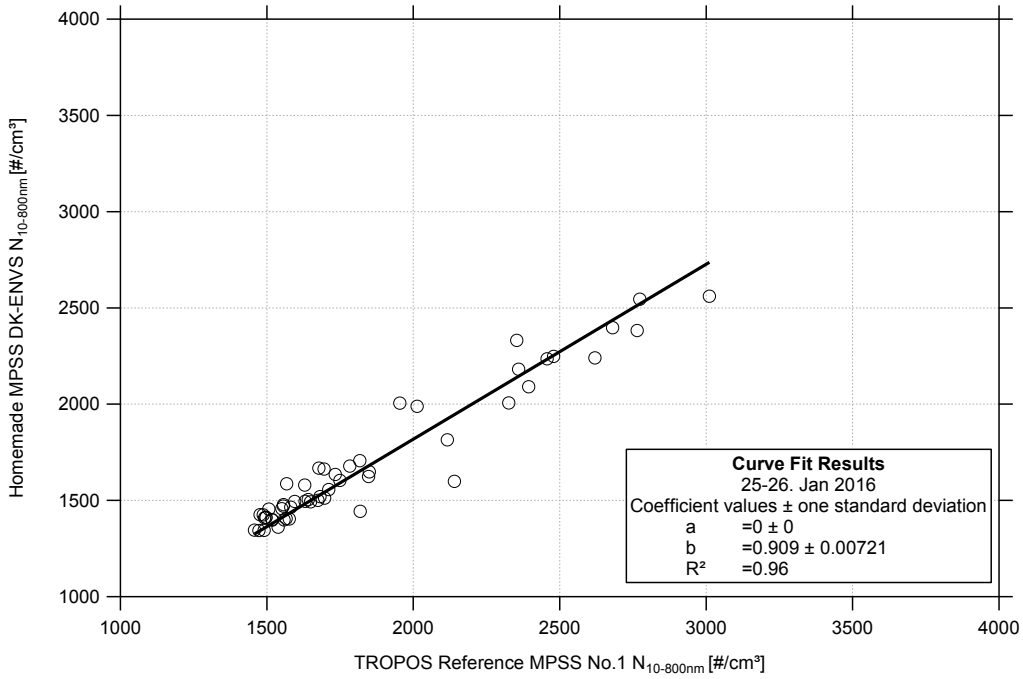


Figure 07: Linear regression between the number concentrations of the Homemade MPSS DK-ENVS and TROPOS Reference MPSS No.1. Multiple charge correction, internal diffusion losses and CPC flow corrections are included.

Final Status of the Candidate (January 27-28th)

Components and zero check

Institute	System	Components	CPC Model + Serial No.	Line	Flow		Zero	
TROPOS	Ref1	MPSS	3772 SN 3772141701	1.6	**1.034**	l/min	0	# cm^{-3}
TROPOS		Total CPC	3010 SN 2006	1.5	**1.035**	l/min	0	# cm^{-3}
ENVS	HOMEMADE MPSS	Homemade DMPS	3010 SN 2405	1.1	**1.012**	l/min	0	# cm^{-3}

High voltage calibration

Institute	System	[V]	0 V	4 mV	80 mV	800 mV
TROPOS	Reference MPSS No.1	Pre-status	-	-	-	-
		final		**4.9**		**1000**
ENVS	HOMEMADE MPSS	Pre-status	-	-	-	-
		final				

Latex 203nm ±4nm (pressure 1007 hPa, 23.0°C)

Institute	System		Latex 203 [nm]	Slope
TROPOS	Reference MPSS No.1	Pre-status	-	-
		final	**202.9**	**4.97**
ENVS	HOMEMADE MPSS	Pre-status	-	-
		final	**206.3**	-

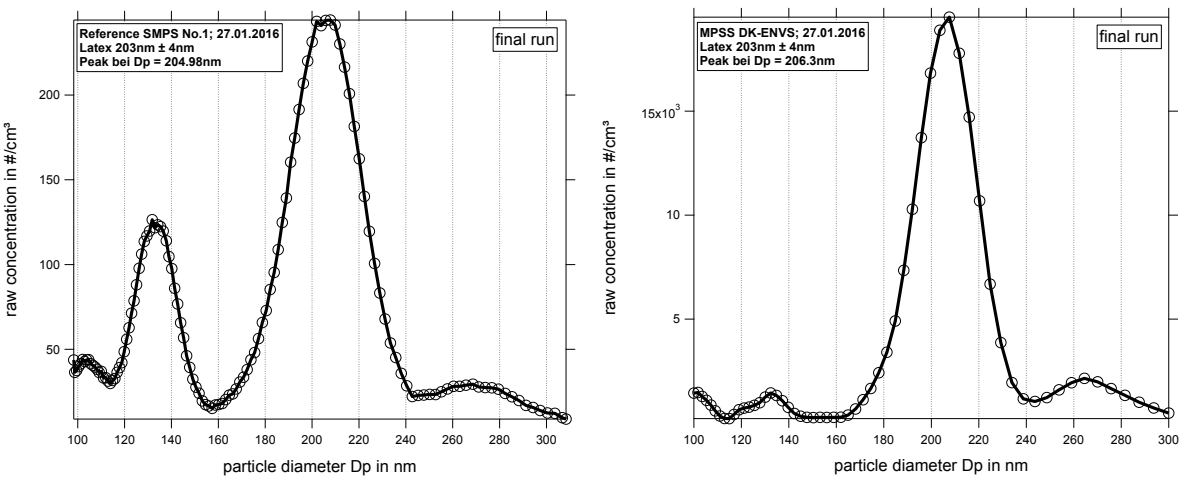


Figure 08: Measurement of latex 203 nm: Particle size distribution (raw concentration) for latex 203 nm on January 27th, 2016.

Time Series

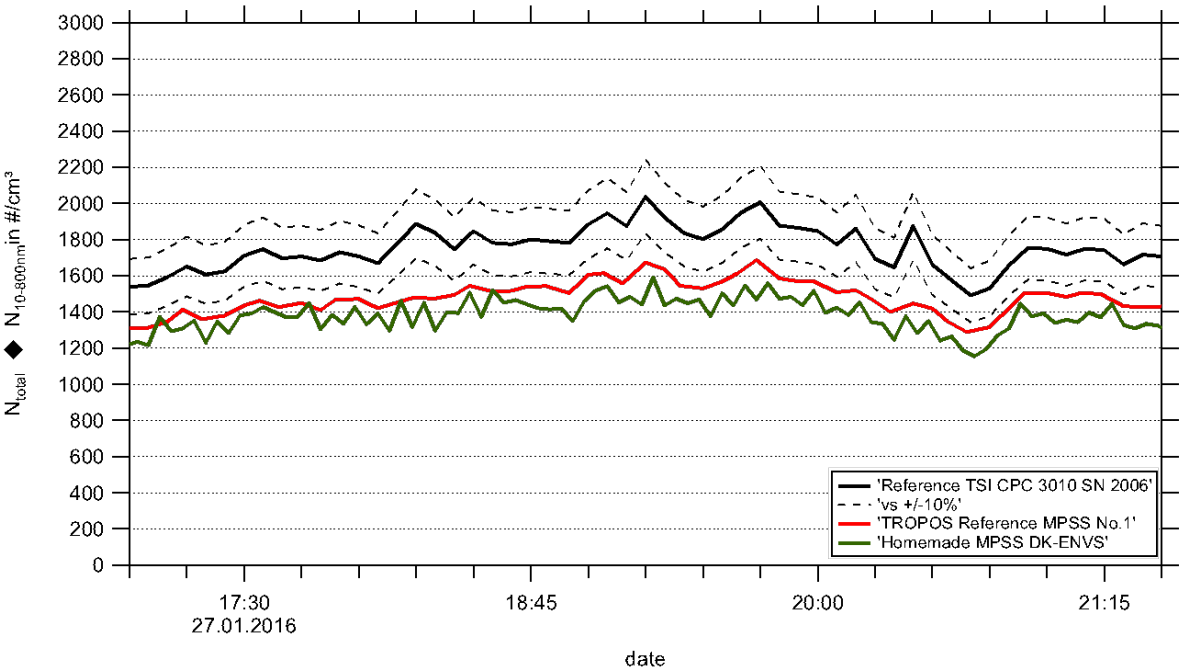


Figure 09: Time series (January 27, 2016 5:00 pm – January 27, 2016 9:30 pm) of the integrated particle number concentration ($N_{10\text{-}800nm}$) of the MPSS and total number concentration (N_{total}) of the reference TSI-CPC Model 3010. The inversion was performed using TROPOS software. Multiple charge correction, internal diffusion losses and CPC flow corrections are included.

Particle Number Size Distribution

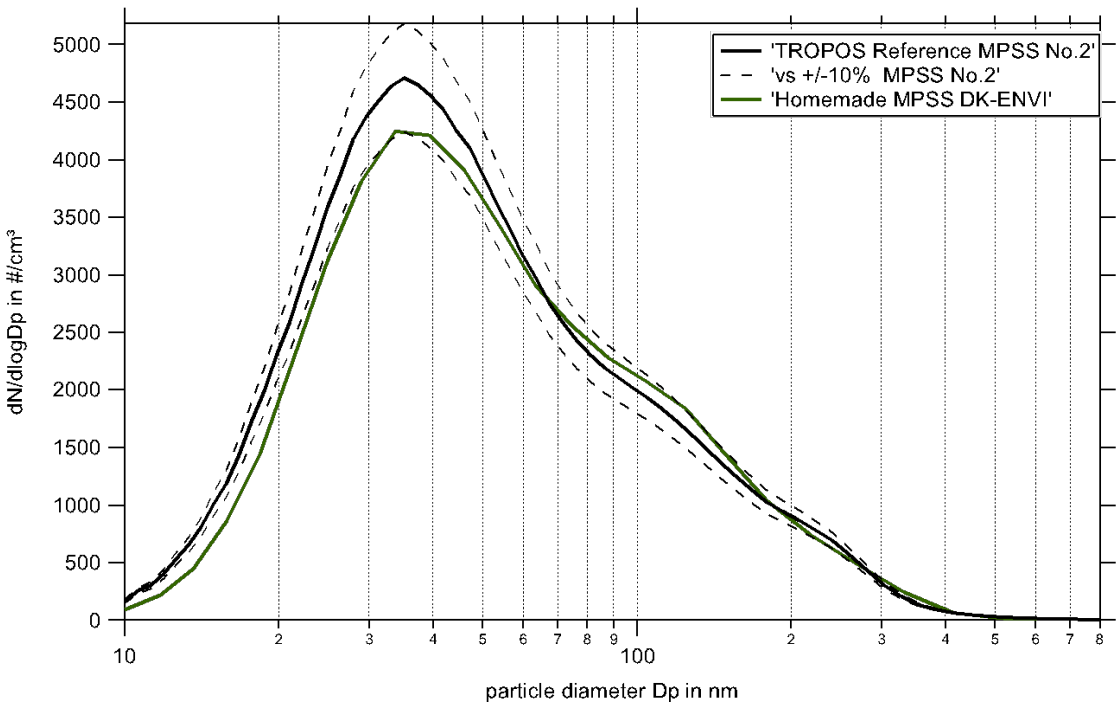


Figure 10: Comparison of mean particle number size distribution of Candidate MPSS and TROPOS reference MPSS No.2 from January 28, 2016 6:00 pm until January 29, 2016 6:00 am. The inversion was performed using TROPOS software. Multiple charge correction, internal diffusion losses and CPC efficiency are included.

Correlation between the Reference CPC Model 3010 and TROPOS Reference MPSS No.1

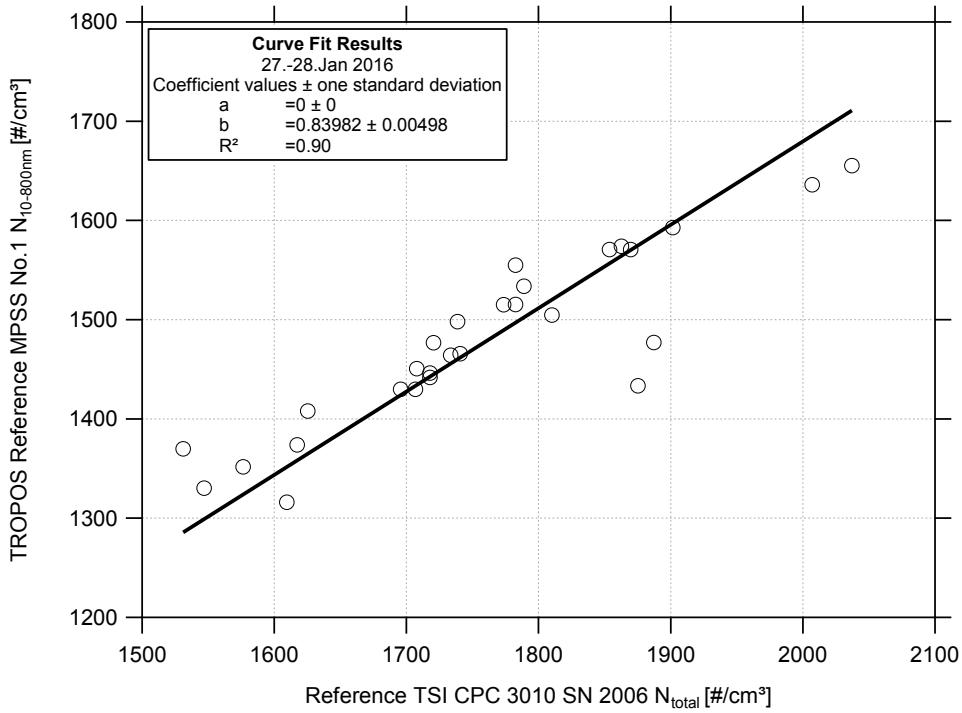


Figure 11: Linear regression between the number concentrations of the TROPOS Reference MPSS No.1 and TROPOS Reference TSI CPC Model 3010. Multiple charge correction, internal diffusion losses and CPC flow corrections are included.

Correlation between the Reference TSI CPC Model 3010 and Homemade MPSS DK-ENVS

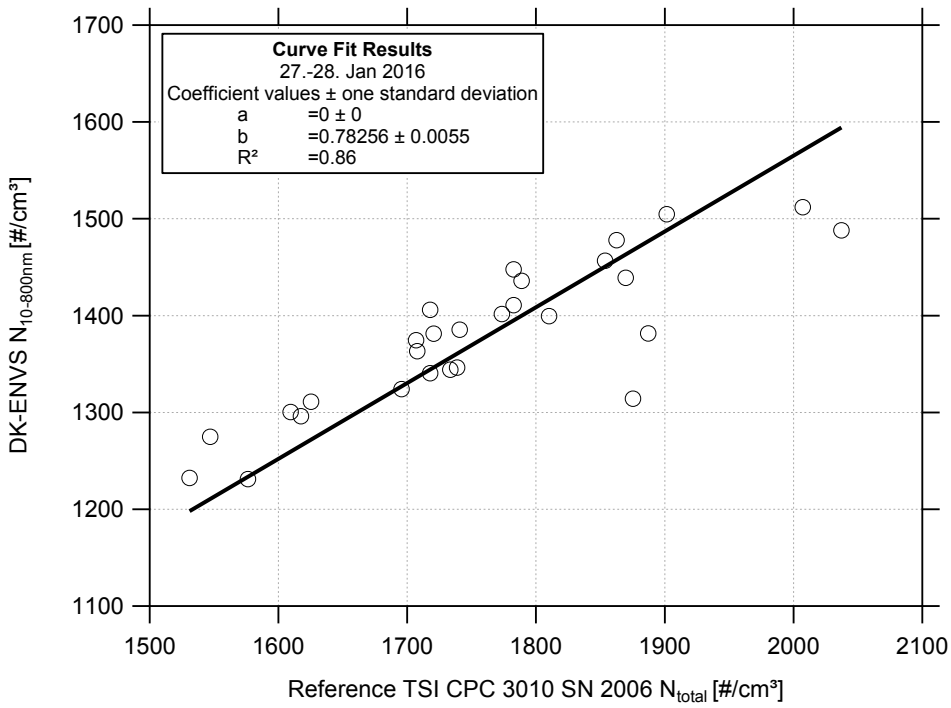


Figure 12: Linear regression between the number concentrations of the Homemade MPSS DK-ENVS and TROPOS Reference TSI CPC Model 3010. Multiple charge correction, internal diffusion losses and CPC flow corrections are included.

Correlation between the TROPOS Reference MPSS No.1 and Homemade MPSS DK-ENVS

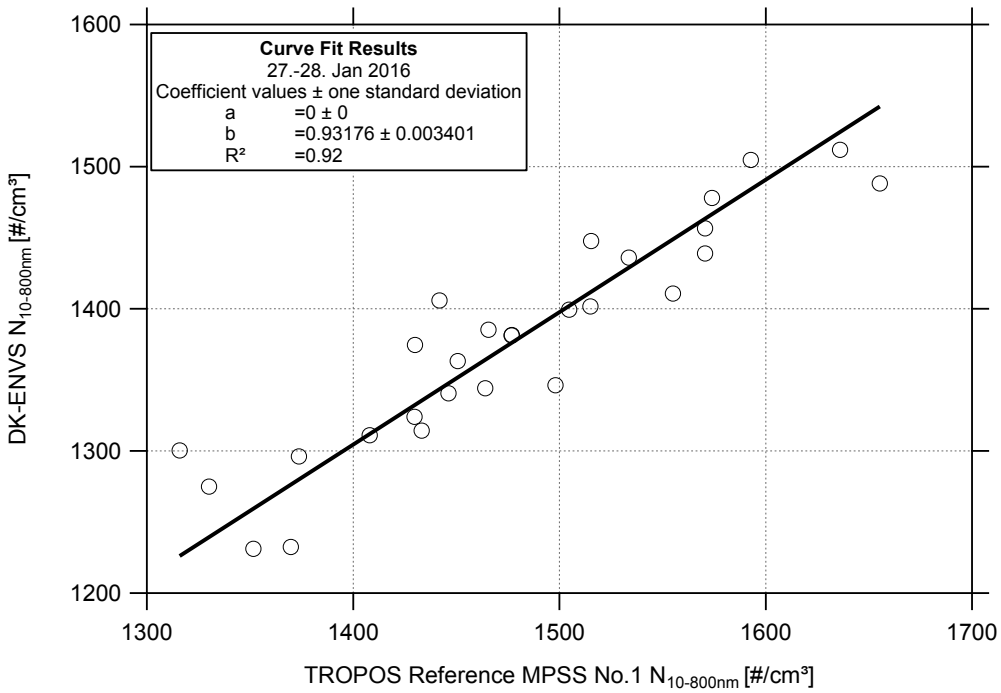


Figure 13: Linear regression between the number concentrations of the Homemade MPSS DK-ENVS and TROPOS Reference MPSS No.1. Multiple charge correction, internal diffusion losses and CPC flow corrections are included.