

Intercomparison of Mobility Particle Size Spectrometers

Project No.: MPSS-2017-6-3

Principal Investigator: Paul Quincey

Home Institution: National Physical Laboratory

Participant: Jordan Tompkins

Candidate: **UK-NPL**

Made by: **TSI**

Counter (SN): TSI CPC Model 3775, SN: 3775121303

Software: TSI Software V9.0

Location of the quality assurance: TROPOS Leipzig, lab 118

Comparison period: November 13, 2017 – November 17, 2017

Last Intercomparison (with Project No.):

Summary of Intercomparison:*Pre-Status:*

The instrument arrived with participant. The instrument was running with the TSI Software Version 8.1 on the classifier and the TSI Version 9.0 for data evaluation. During the Pre-Status, we found different results by using different TSI software versions. Therefore, we used also the TROPOS evaluation software to apply each correction e.g. flow, diffusion losses, CPC efficiency, and DMA. The PSL check showed a peak at 206.1 nm. Please note that it was not possible nor necessary to change the sheath air settings. More details are shown in the plots below.

Final-Status:

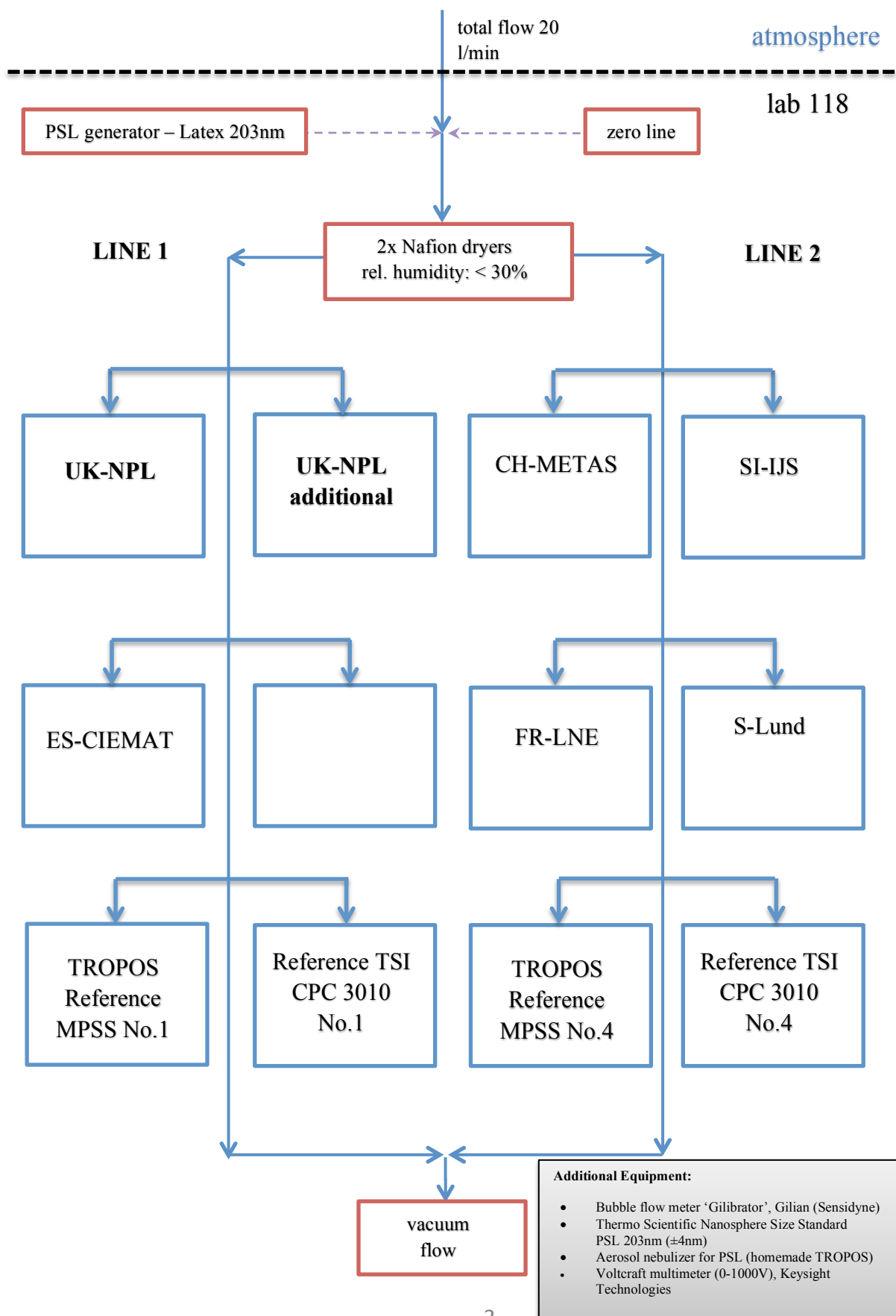
During the Final-Status, the performance of the system showed a concentration 4% lower than the TROPOS Reference Instrument No.4 when using the TROPOS evaluation software with ADL of 4 m and 11% lower when using the TSI evaluation software. The instrument was running with the TSI Software Version 9.0 on the classifier and the TSI Version 9.0/10.1 for data evaluation. The candidate used the recalibrated TSI CPC model 3775. The candidate passed the quality standards of ACTRIS and GAW.

Information about the instruments:

Date of check: November 13, 2017

<i>List of Components</i>	TROPOS Reference MPSS No.1	TROPOS Reference MPSS No.4	Candidate
<i>Position</i>	Line 1	Line 2	Line 1
<i>Company</i>	TROPOS	TROPOS	TSI 3080; SN:70907186
<i>Software</i>	TROPOS	TROPOS	TSI V9.0
<i>CPC-MPSS</i>	TSI CPC, Model 3772	TSI CPC, Model 3772	TSI CPC, Model 3775
<i>CPC-total</i>	TSI CPC, Model 3010	TSI CPC, Model 3010	-
<i>flow ratio</i>	1.0 : 5.0	1.0 : 5.0	0.3 : 3.0
<i>source</i>	Kr.85	Ni.63	Kr85
<i>HV power supply</i>	Positive	Positive	negative
<i>DMA</i>	Hauke medium	Hauke medium	TSI 3081
<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 system checks:

<i>date</i>	13.11.2017	14.11.2017	15.11.2017	16.11.2017	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>	0.295	-	0.298	0.296	l/min
<i>Zero MPSS</i>	0	-	0	0	#/cm ³
<i>Zero total CPC</i>	-	-	-	-	#/cm ³
<i>PSL 203 nm</i>	208.85	-			nm
<i>HV check</i>	okay	-	okay	-	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>	No	-	-	-
<i>change aerosol Nafion dryer</i>	No	-	-	-
<i>change sheath Nafion dryer</i>	No	-	-	-
<i>check source</i>	No	-	-	-
<i>change HV power supply</i>	No	-	-	-
<i>clean/change DMA</i>	Yes	-	-	Check okay
<i>change aerosol RH/T-sensor</i>	No	-	-	-
<i>change sheath RH/T-sensor</i>	No	-	-	-
<i>change pressure sensor</i>	No	-	-	-
<i>change inlet Nafion dryer (500)</i>	No	-	-	-
<i>Change Total filter</i>	No	-	-	-

PSL Scan and calibration: Latex 203 nm \pm 4 nm

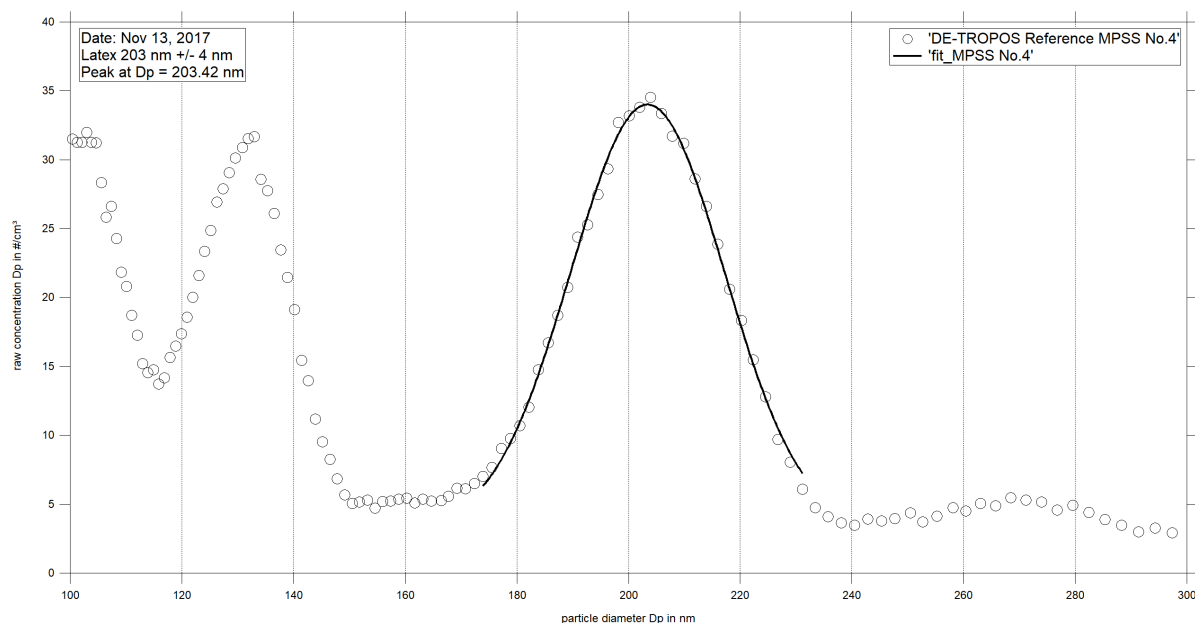


Figure 01: Measurement of latex 203 nm: Particle size distribution (raw concentration) for latex 203 nm on Nov 13rd, 2017.

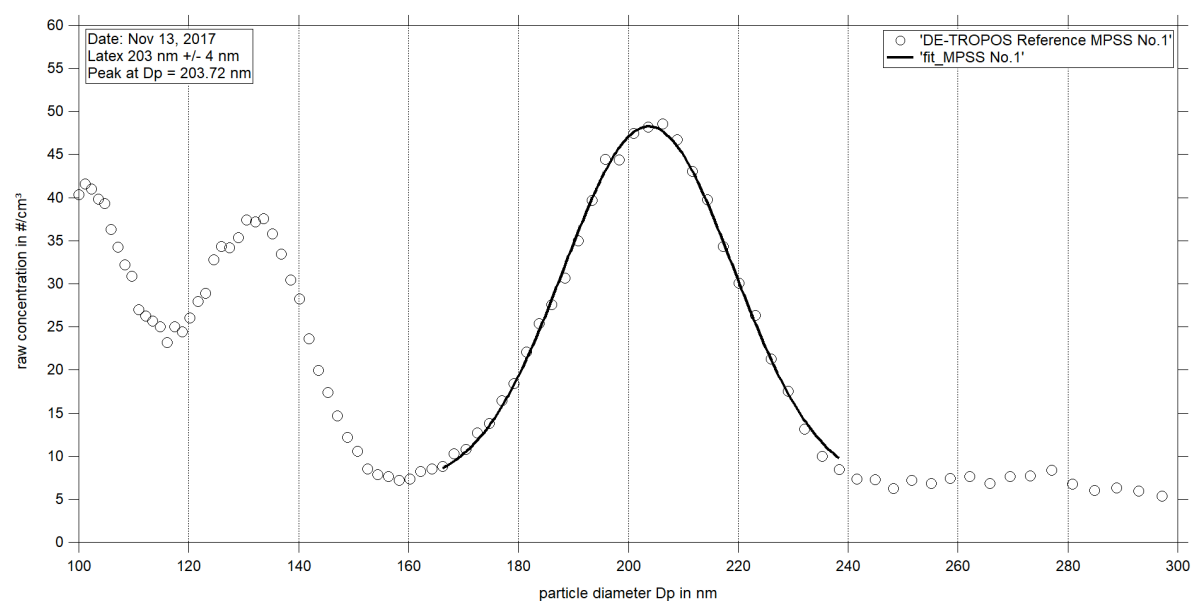


Figure 02: Measurement of latex 203 nm: Particle size distribution (raw concentration) for latex 203 nm on Nov 13rd, 2017.

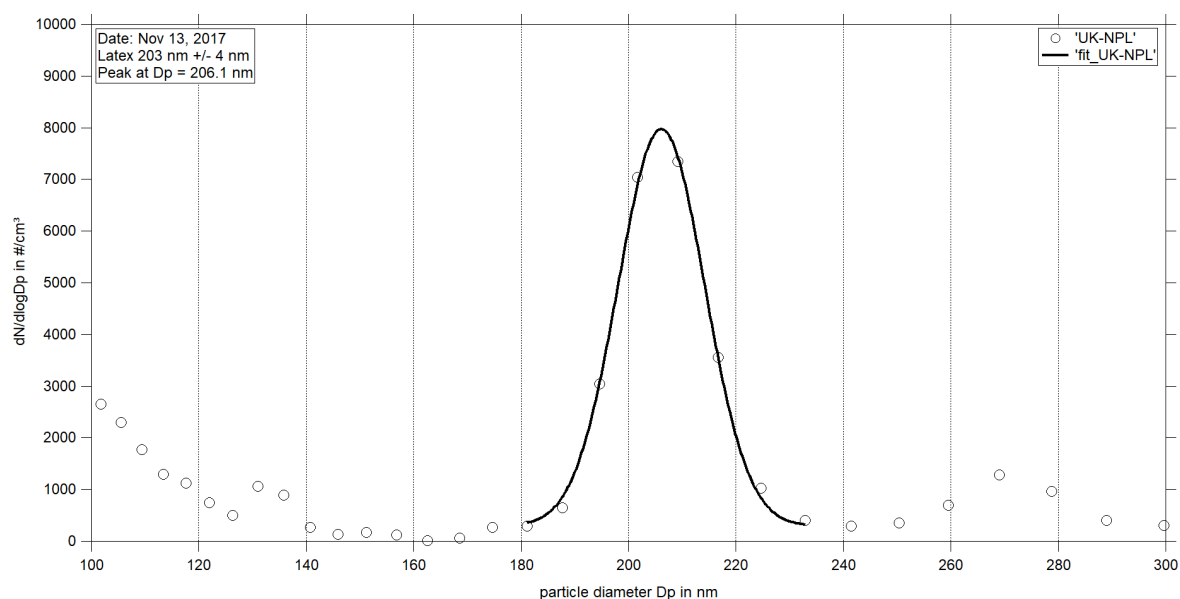


Figure 03: Measurement of latex 203 nm: Particle size distribution for latex 203 nm on November 13th, 2017.

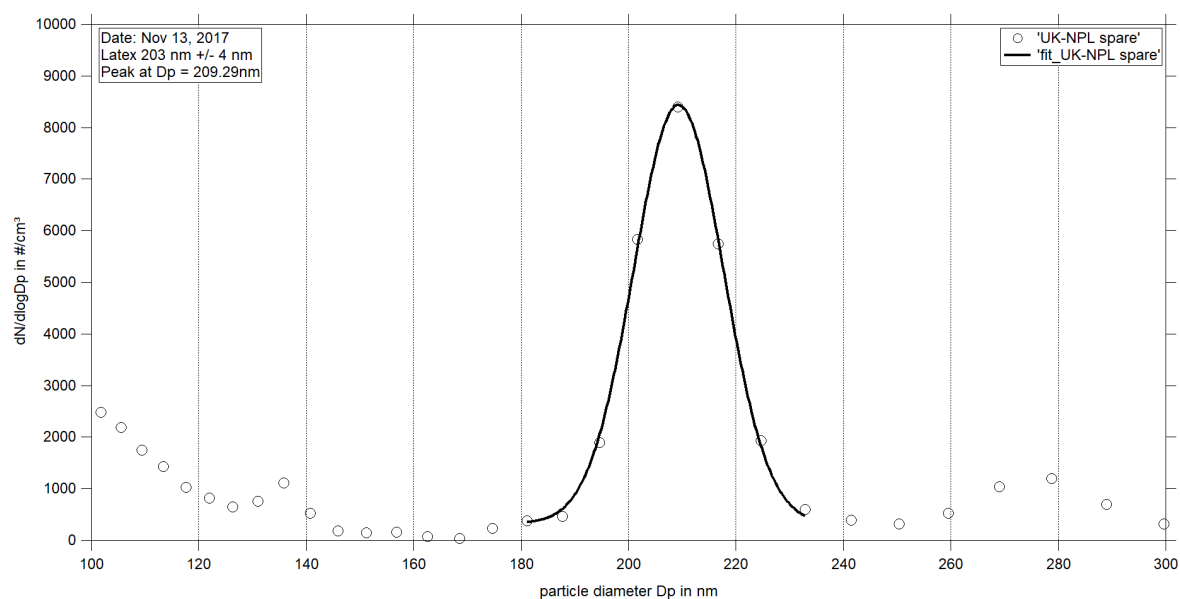


Figure 04: Measurement of latex 203 nm: Particle size distribution for latex 203 nm on November 13th, 2017.

Pre-Status of the TROPOS Reference Instruments: Particle Number Size Distribution

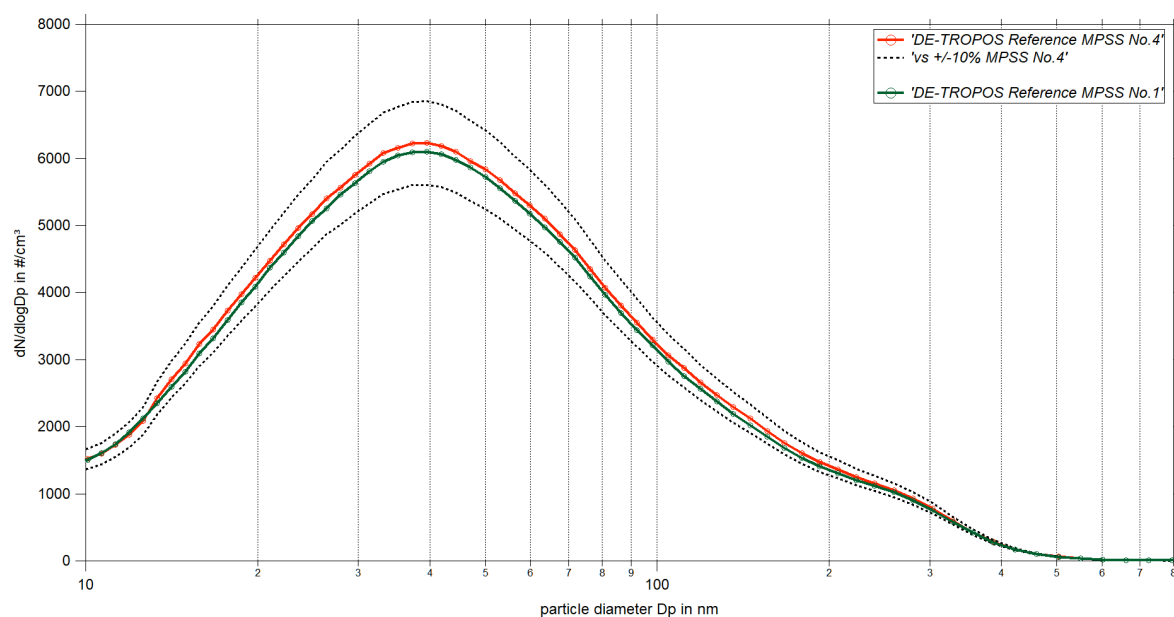


Figure 05: Comparison of mean particle number size distribution of TROPOS Reference MPSS No.4 against TROPOS Reference MPSS No.1 from November 13, 2017 08:00 PM – November 14, 2017 06:00 AM. Multiple charge correction, internal diffusion losses and CPC efficiency are included.

Pre-Status of the TROPOS Reference Instruments: Time Series

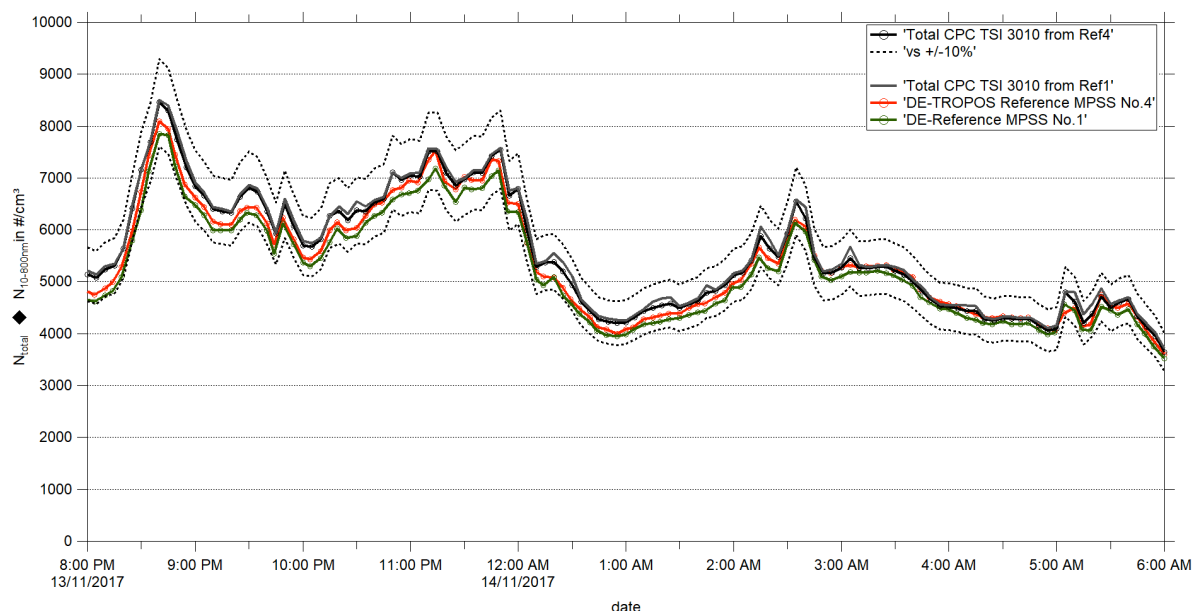


Figure 06: Time series (November 13, 2017 08:00 PM – November 14, 2017 06:00 AM) of the integrated particle number concentration ($N_{10-800nm}$) of the MPSS and total number concentration (N_{total}) of the Reference TSI-CPC Model 3010. The inversion for the candidate was performed using TSI software.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

Pre-Status of the TROPOS Reference Instruments: Correlation

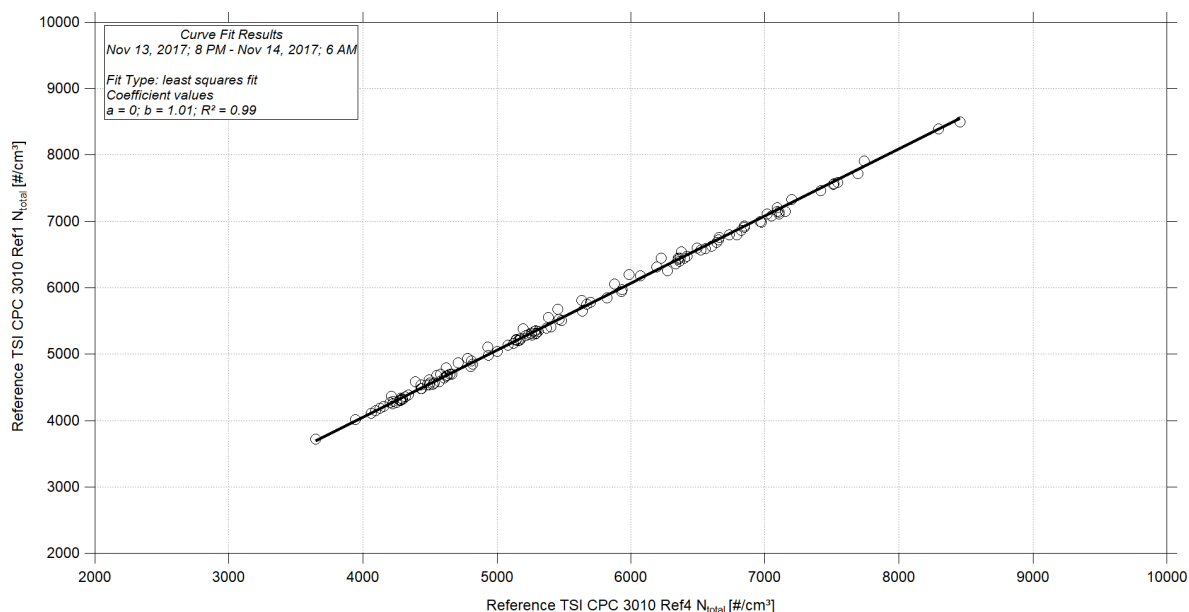


Figure 07: Linear regression between the number concentrations of the TROPOS Reference TSI CPC Model 3010 Ref4 and TROPOS Reference TSI CPC Model 3010 Ref1. CPC flow and coincidence corrections are included.

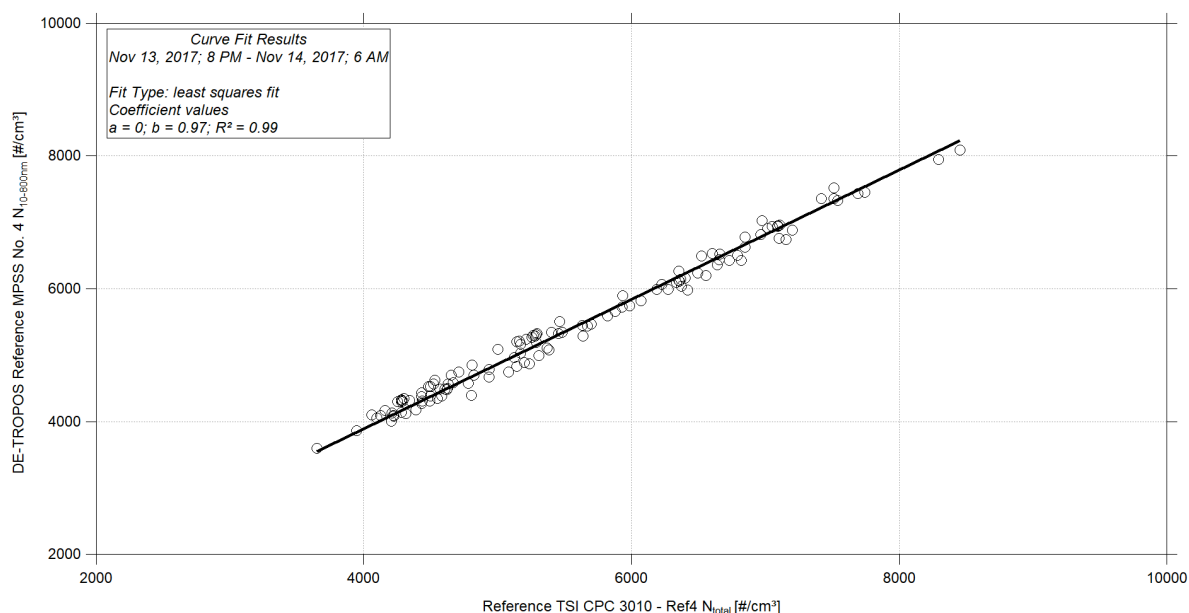


Figure 08: Linear regression between the number concentrations of the TROPOS Reference TSI CPC Model 3010 Ref4 and TROPOS Reference MPSS No.4. Multiple charge correction, internal diffusion losses and CPC flow corrections are included.

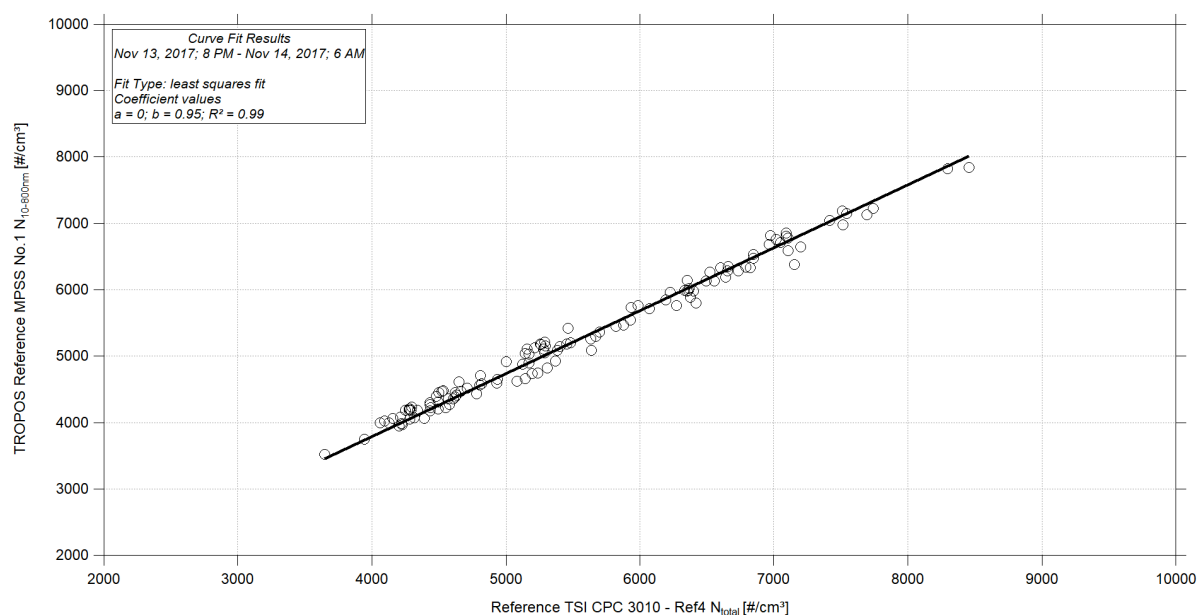


Figure 09: Linear regression between the number concentrations of the TROPOS Reference TSI CPC Model 3010 Ref4 and TROPOS Reference MPSS No.1. Multiple charge correction, internal diffusion losses and CPC flow corrections are included.

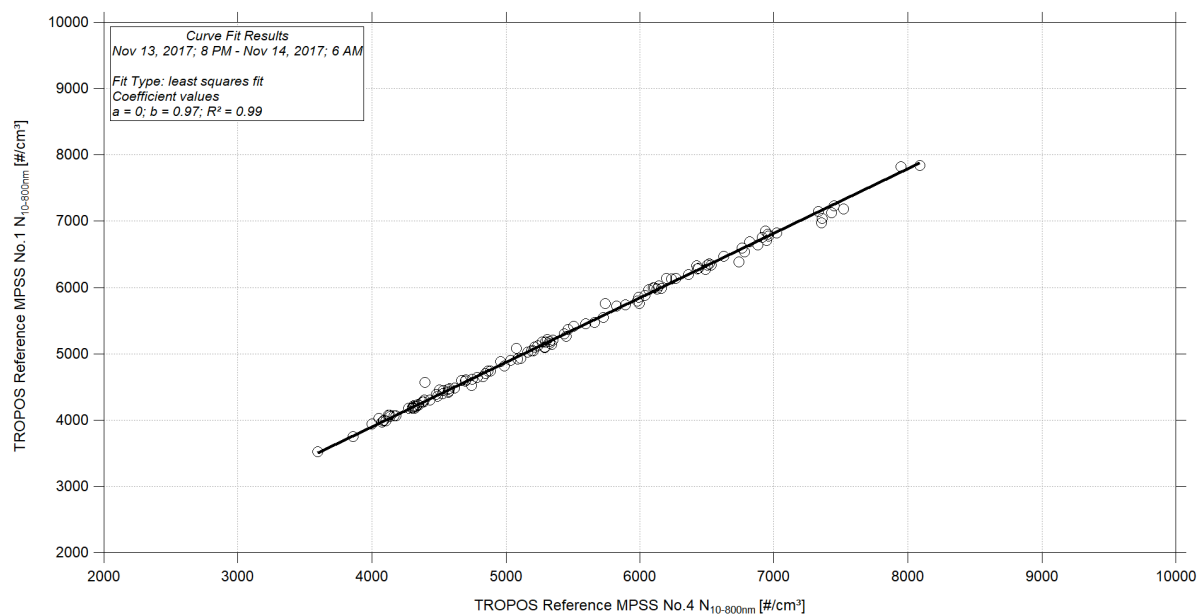


Figure 10: Linear regression between the number concentrations of the TROPOS Reference MPSS No.4 and TROPOS Reference MPSS No.1. Multiple charge correction, internal diffusion losses and CPC flow corrections are included.

Pre-Status of the Candidate: Particle Number Size Distribution

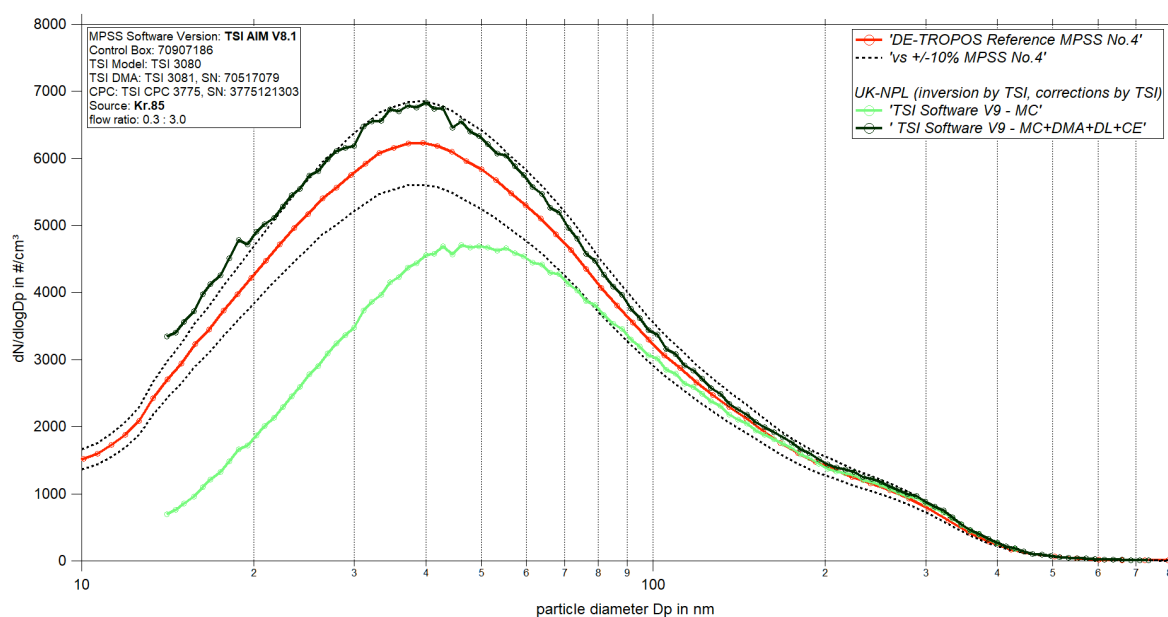


Figure 11: Comparison of mean particle number size distribution of TROPOS Reference MPSS No.4 against UK-NPL from November 13, 2017 08:00 PM – November 14, 2017 06:00 AM. Multiple charge correction, internal diffusion losses and CPC efficiency are included. Evaluation TSI Software V9 includes all corrections from TSI.

Pre-Status of the Candidate: Time Series and Correlation

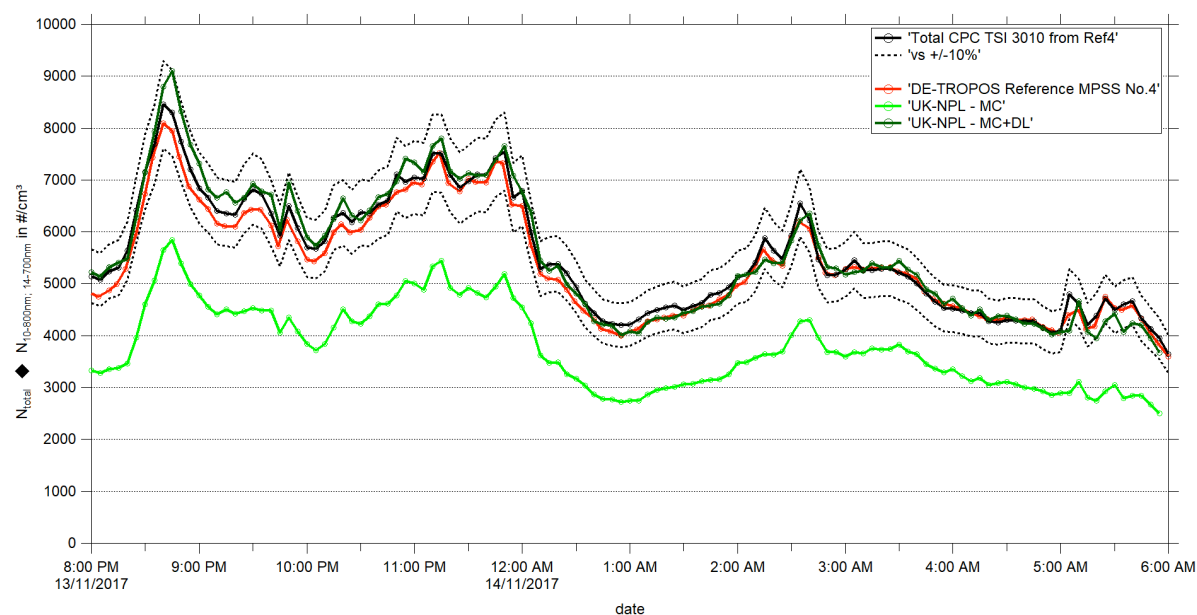


Figure 12: Time series (November 13, 2017 08:00 PM – November 14, 2017 06:00 AM) of the integrated particle number concentration ($N_{10-800nm}$; $N_{14-700nm}$) of the MPSS and total number concentration (N_{total}) of the Reference TSI-CPC Model 3010. The inversion and corrections for the candidate was performed using TSI software. Multiple charge correction, internal diffusion losses and CPC flow corrections are included.

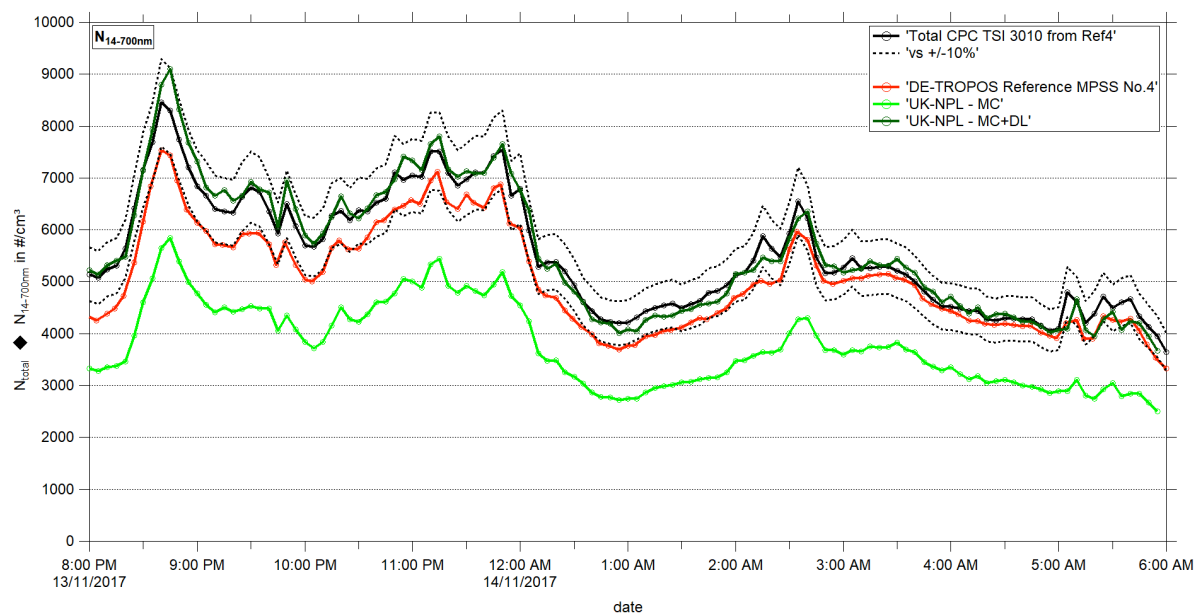


Figure 13: Time series (November 13, 2017 08:00 PM – November 14, 2017 06:00 AM) of the integrated particle number concentration ($N_{14-700\text{nm}}$) of the MPSS and total number concentration (N_{total}) of the Reference TSI-CPC Model 3010. The inversion and corrections for the candidate was performed using TSI software. Multiple charge correction, internal diffusion losses and CPC flow corrections are included.

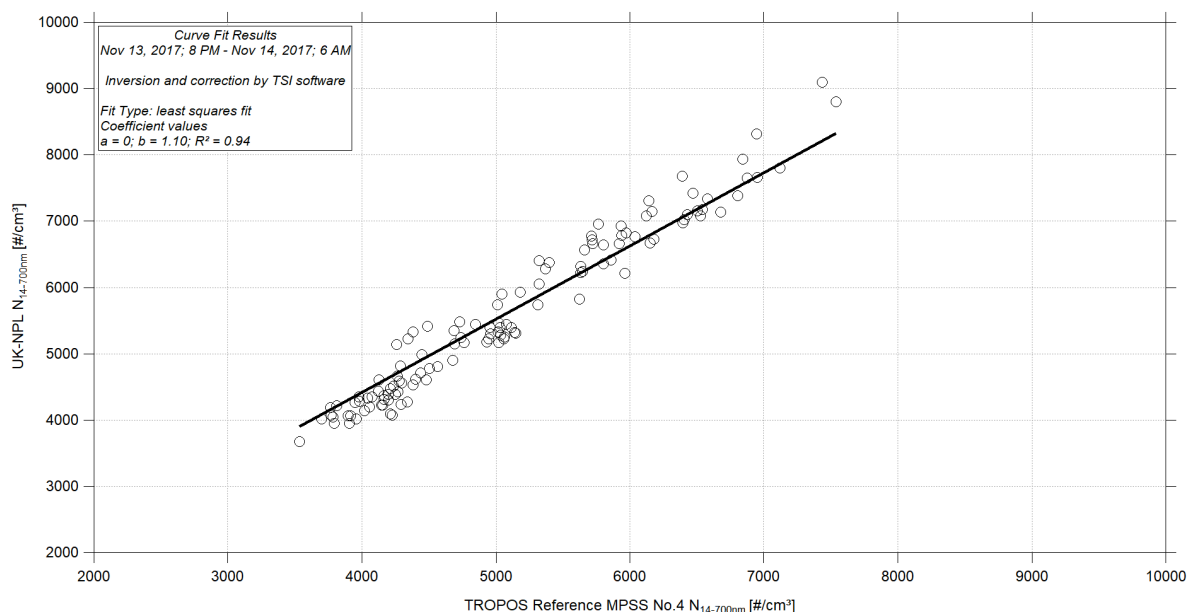


Figure 14: Linear regression between the number concentrations of the TROPOS Reference MPSS No. 4 and UK-NPL. The inversion and corrections for the candidate was performed using TSI software. Multiple charge correction, internal diffusion losses and CPC flow corrections are included.

Final-Status of the Candidate: Particle Number Size Distribution

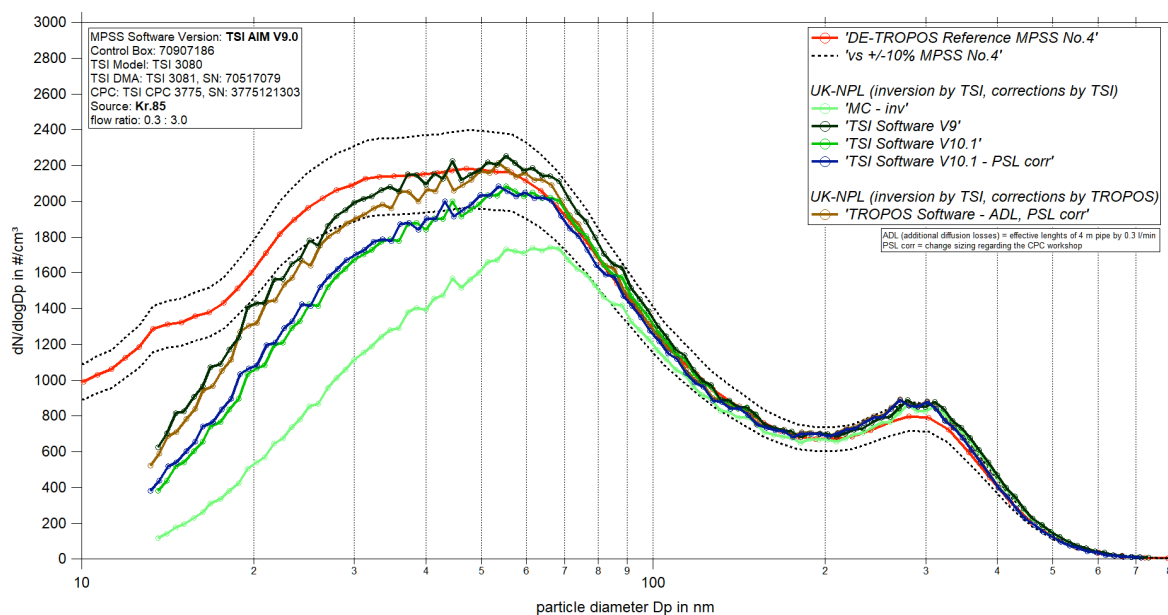


Figure 15: Comparison of mean particle number size distribution of TROPOS Reference MPSS No.4 against UK-NPL from November 16, 2017 08:00 PM – November 17, 2017 06:00 AM. Multiple charge correction, internal diffusion losses and CPC efficiency are included. TSI Software V9 and 10.1 includes all corrections from TSI.

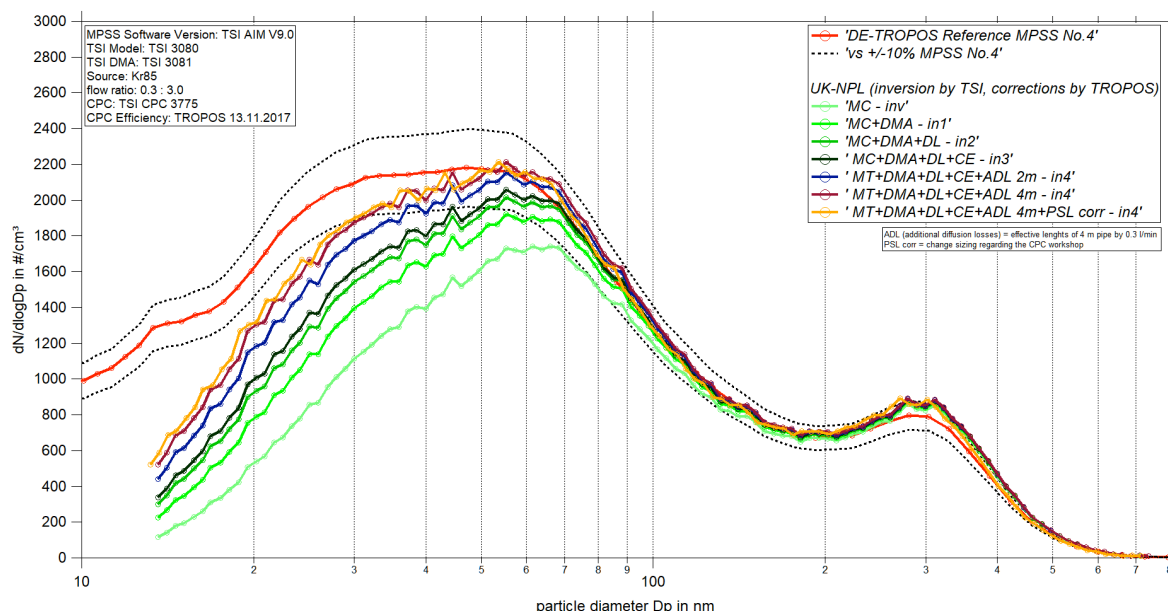


Figure 16: Comparison of mean particle number size distribution of TROPOS Reference MPSS No.4 against UK-NPL from November 16, 2017 08:00 PM – November 17, 2017 06:00 AM. All corrections, excluding the multiple charge correction, which is done by TSI software, are calculated by using the TROPOS software.

Final-Status of the Candidate: Time Series and Correlation

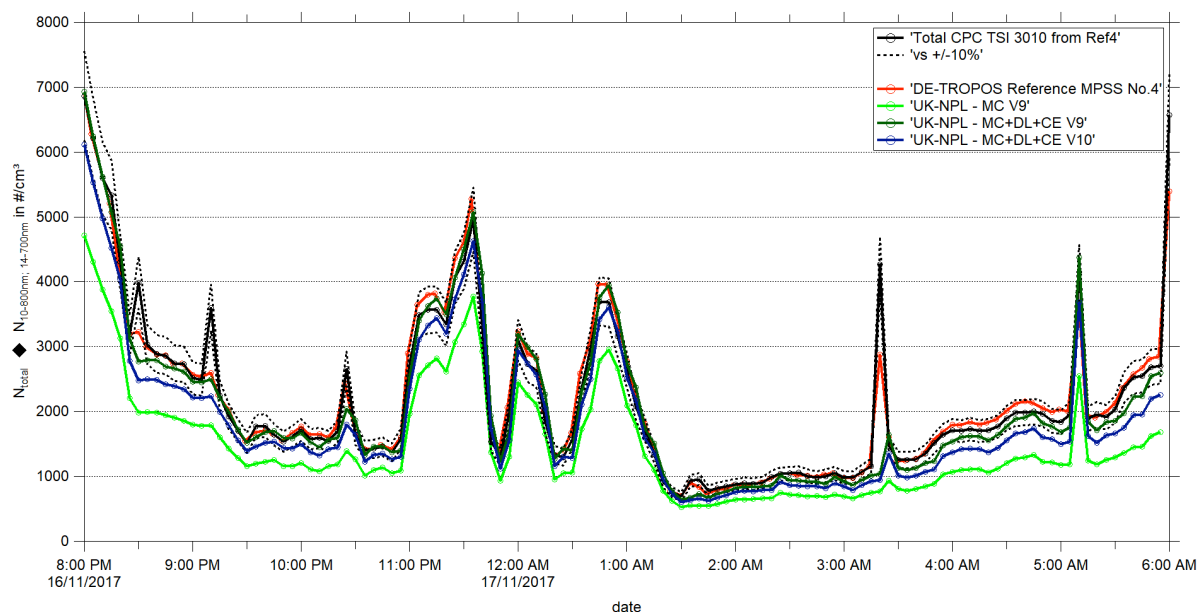


Figure 17: Time series (November 16, 2017 08:00 PM – November 17, 2017 06:00 AM) of the integrated particle number concentration (N_{10-800nm}; N_{14-700nm}) of the MPSS and total number concentration (N_{total}) of the Reference TSI-CPC Model 3010. The inversion and correction for the candidate was performed using TSI software.

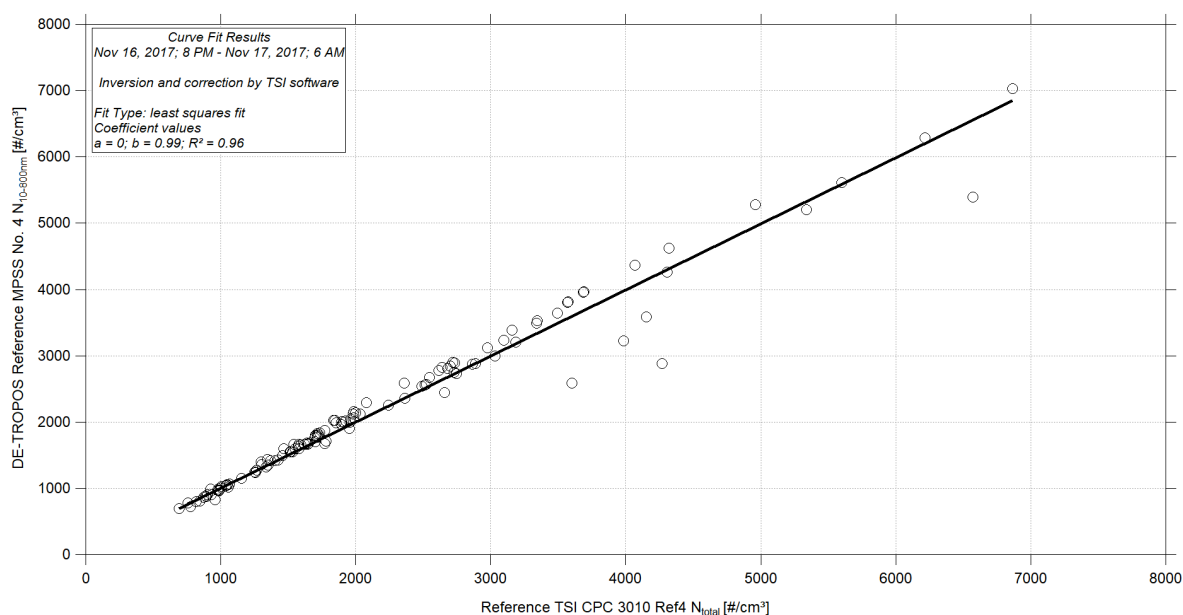


Figure 18: Linear regression between the number concentrations of the TROPOS Reference TSI CPC Model 3010 Ref4 and TROPOS Reference MPSS No.4 (November 16, 2017 08:00 PM – November 17, 2017 06:00 AM). Multiple charge correction, internal diffusion losses and CPC flow corrections are included.

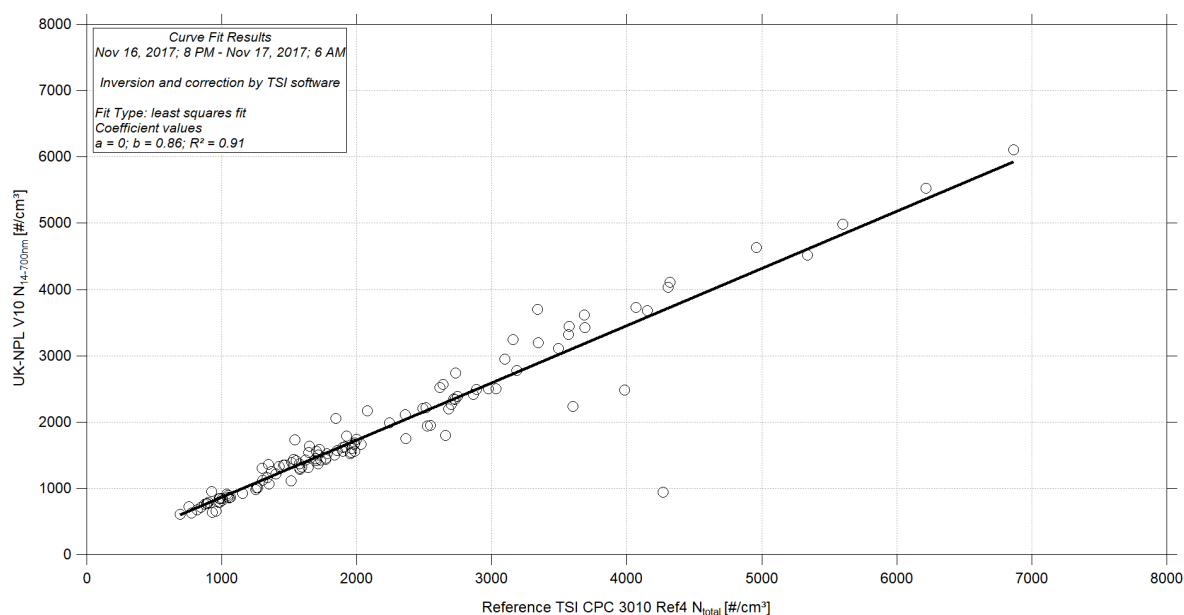


Figure 19: Linear regression between the number concentrations of the TROPOS Reference TSI CPC Model 3010 Ref4 and UK-NPL V10 (November 16, 2017 08:00 PM – November 17, 2017 06:00 AM). The inversion and corrections for the candidate was performed using TSI software.

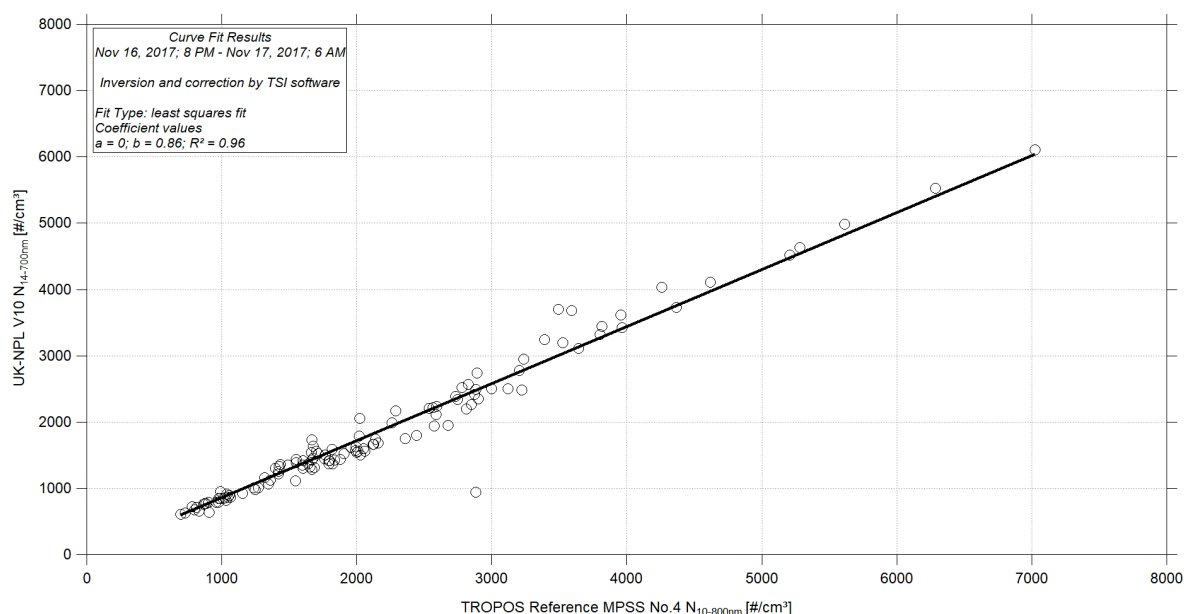


Figure 20: Linear regression between the number concentrations of the TROPOS Reference MPSS No.4 and UK-NPL V10 (November 16, 2017 08:00 PM – November 17, 2017 06:00 AM). The inversion and corrections for the candidate was performed using TSI software.

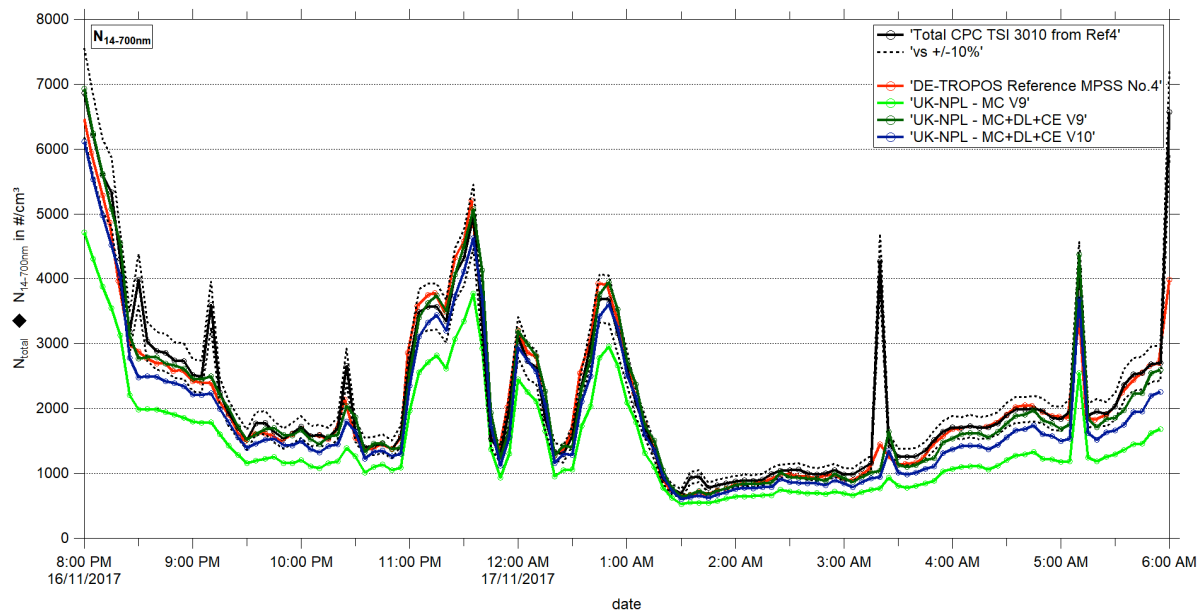


Figure 21: Time series (November 16, 2017 08:00 PM – November 17, 2017 06:00 AM) of the integrated particle number concentration ($N_{14-700nm}$) of the MPSS and total number concentration (N_{total}) of the Reference TSI-CPC Model 3010. The inversion and corrections for the candidate was performed using TSI software. Multiple charge correction, internal diffusion losses and CPC flow corrections are included.

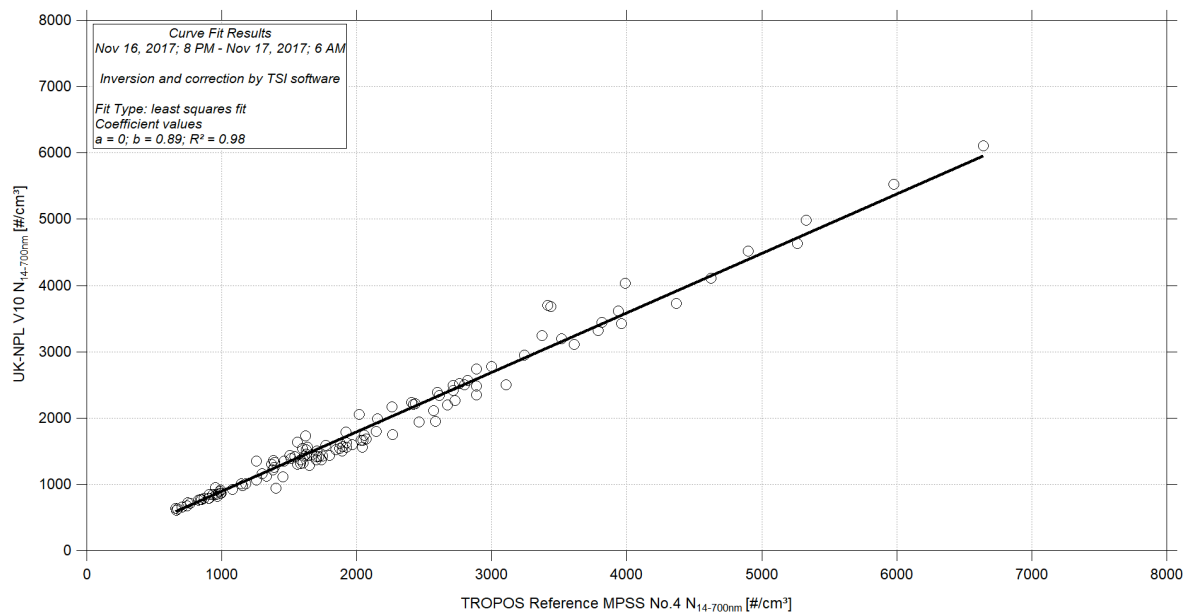


Figure 22: Linear regression between the number concentrations of the TROPOS Reference MPSS No.4 and UK-NPL V10 (November 16, 2017 08:00 PM – November 17, 2017 06:00 AM). The inversion and corrections for the candidate was performed using TSI software.

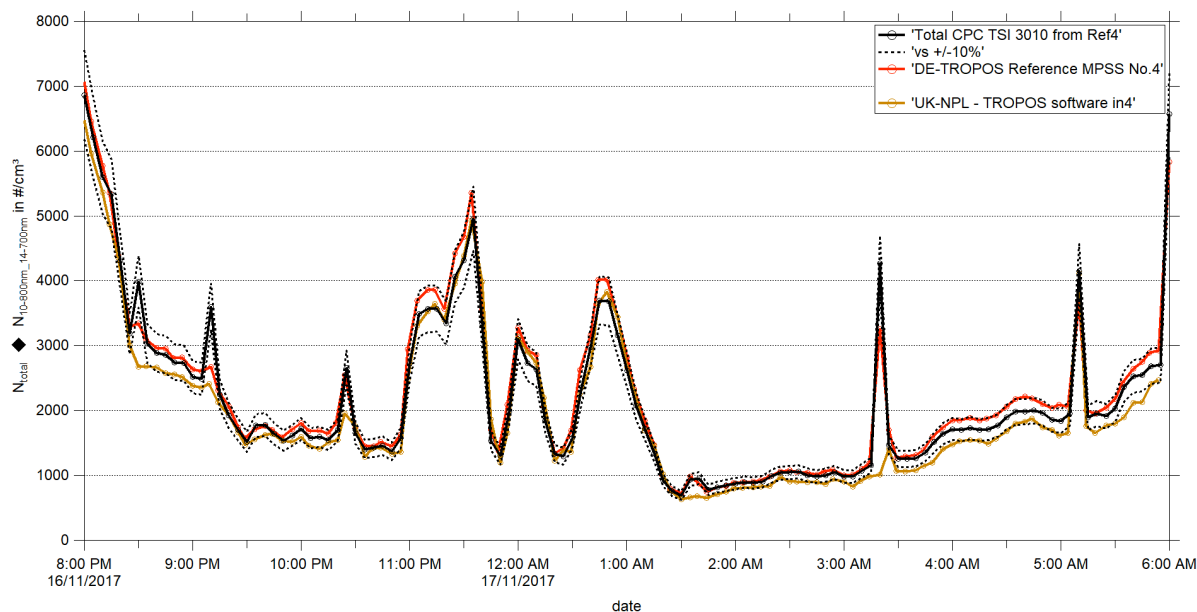


Figure 23: Time series (November 16, 2017 08:00 PM – November 17, 2017 06:00 AM) of the integrated particle number concentration ($N_{10-800nm}$; $N_{14-700nm}$) of the MPSS and total number concentration (N_{total}) of the Reference TSI-CPC Model 3010. The inversion for the candidate was performed using TSI software. Internal diffusion losses, CPC efficiency and CPC flow corrections are included and performed using TROPOS software.

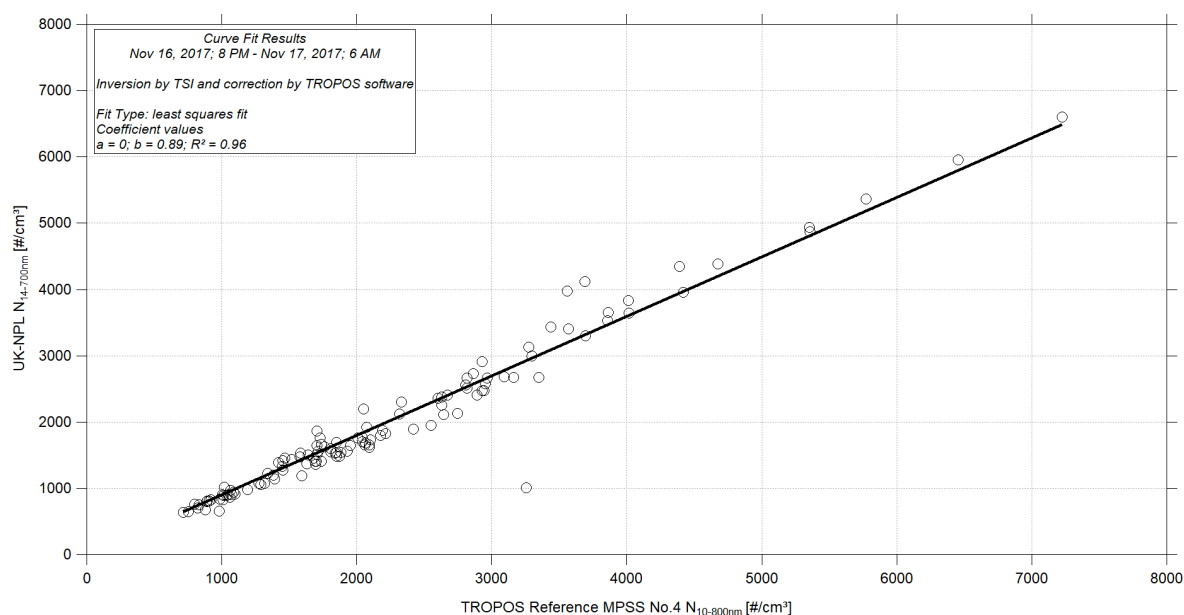


Figure 24: Linear regression between the number concentrations of the TROPOS Reference MPSS No.4 and UK-NPL - TROPOS software in4 (November 16, 2017 08:00 PM – November 17, 2017 06:00 AM). The inversion for the candidate was performed using TSI software. Internal diffusion losses, CPC efficiency and CPC flow corrections are included and performed using TROPOS software.

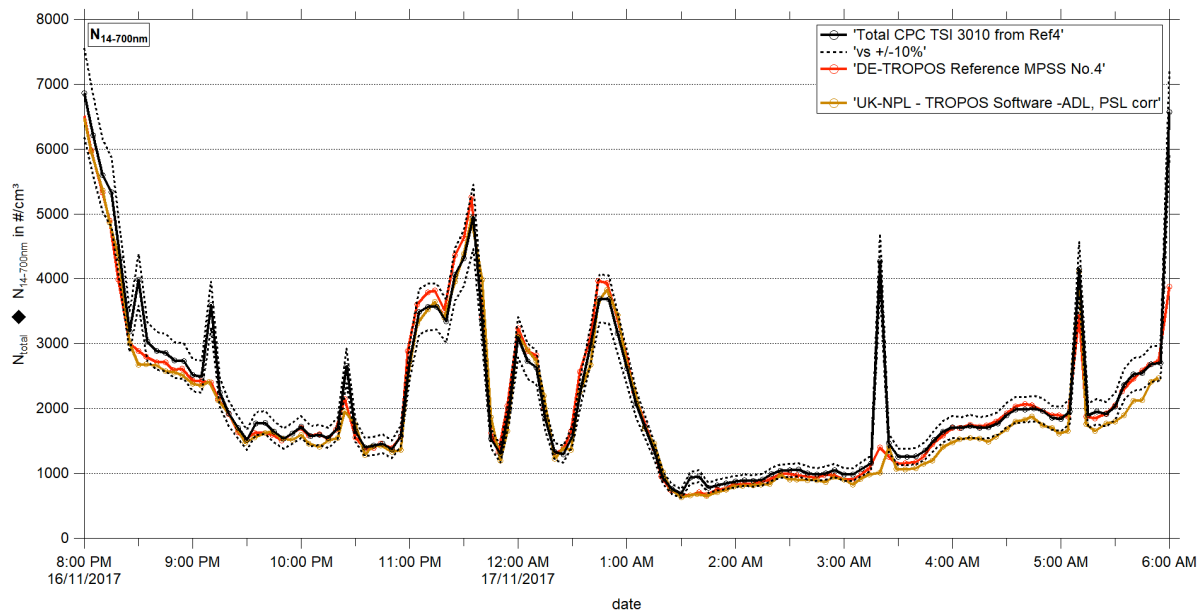


Figure 25: Time series (November 16, 2017 08:00 PM – November 17, 2017 06:00 AM) of the integrated particle number concentration ($N_{14-700nm}$) of the MPSS and total number concentration (N_{total}) of the Reference TSI-CPC Model 3010. The inversion for the candidate was performed using TSI software. Internal diffusion losses, CPC efficiency and CPC flow corrections are included and performed using TROPOS software.

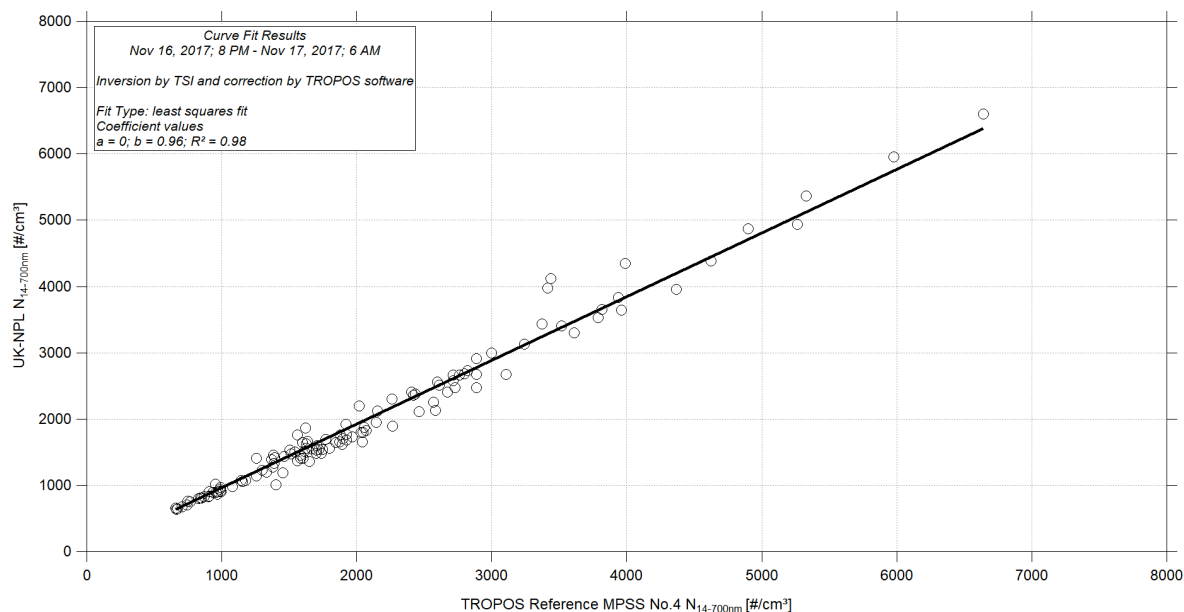


Figure 26: Linear regression between the number concentrations of the TROPOS Reference MPSS No.4 and UK-NPL - TROPOS software in4 (November 16, 2017 08:00 PM – November 17, 2017 06:00 AM). The inversion for the candidate was performed using TSI software. Internal diffusion losses, CPC efficiency and CPC flow corrections are included and performed using TROPOS software.

Tuesday November 14, 2017

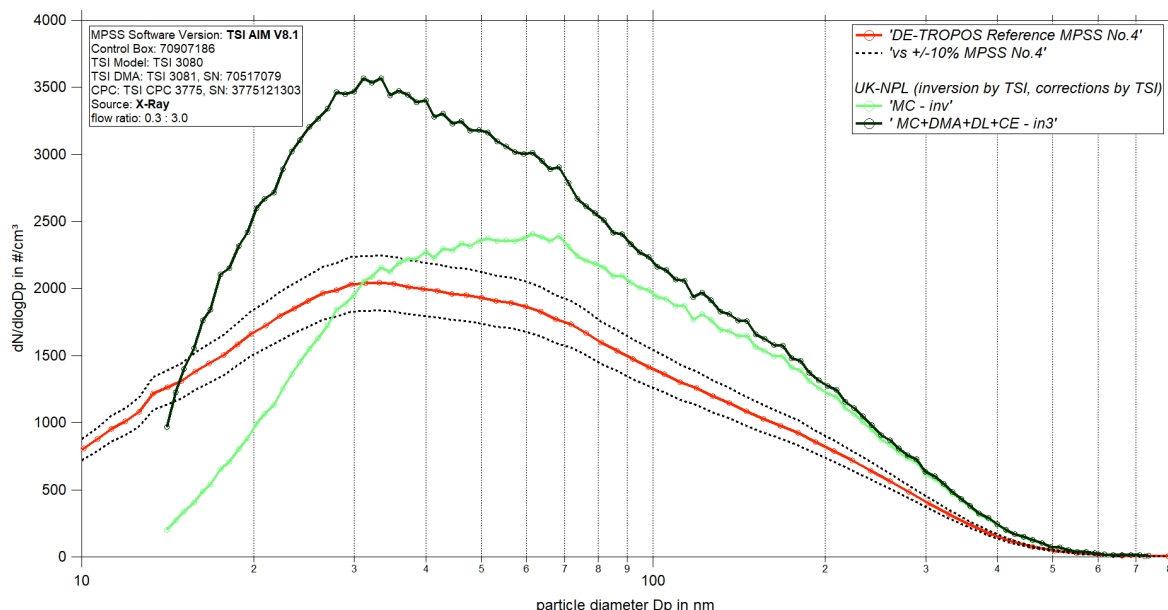


Figure 29: Comparison of mean particle number size distribution of TROPOS Reference MPSS No.4 against UK-NPL from November 14, 2017 08:00 PM – November 15, 2017 06:00 AM. Multiple charge correction, internal diffusion losses and CPC efficiency are included. Evaluation TSI Software V9 includes all corrections from TSI.

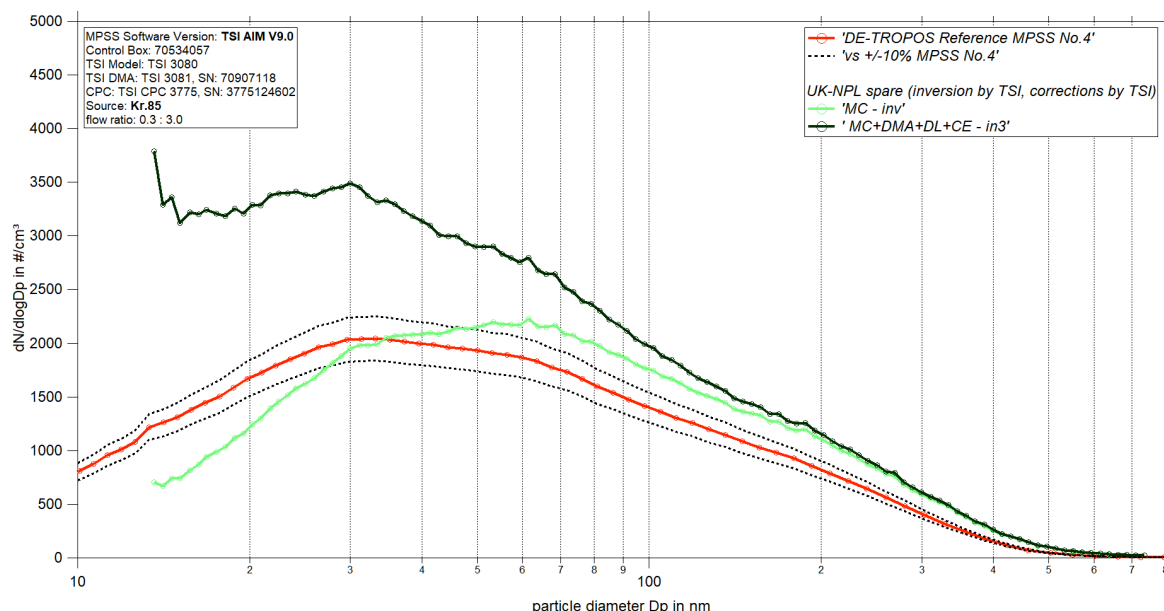


Figure 30: Comparison of mean particle number size distribution of TROPOS Reference MPSS No.4 against UK-NPL spare from November 14, 2017 08:00 PM – November 15, 2017 06:00 AM. Multiple charge correction, internal diffusion losses and CPC efficiency are included. Evaluation TSI Software V9 includes all corrections from TSI.

Wednesday November 15, 2017

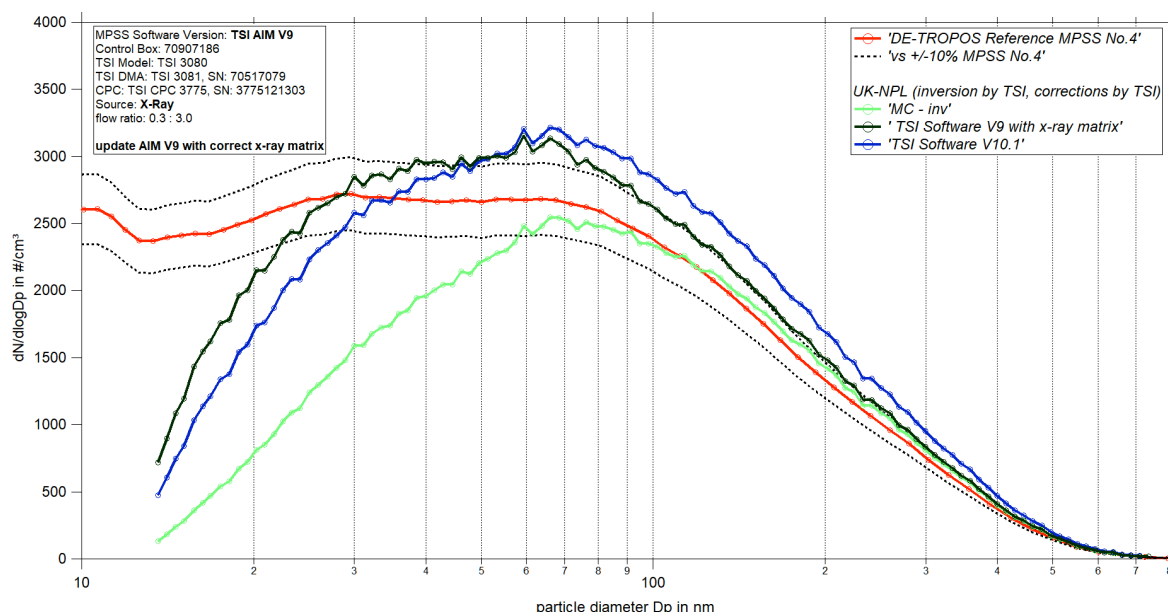


Figure 31: Comparison of mean particle number size distribution of TROPOS Reference MPSS No.4 against UK-NPL from November 15, 2017 08:00 PM – November 16, 2017 06:00 AM. Multiple charge correction, internal diffusion losses and CPC efficiency are included. Evaluation TSI Software V9 (correct x-ray matrix) and V10.1 includes all corrections from TSI.

Thursday November 16, 2017

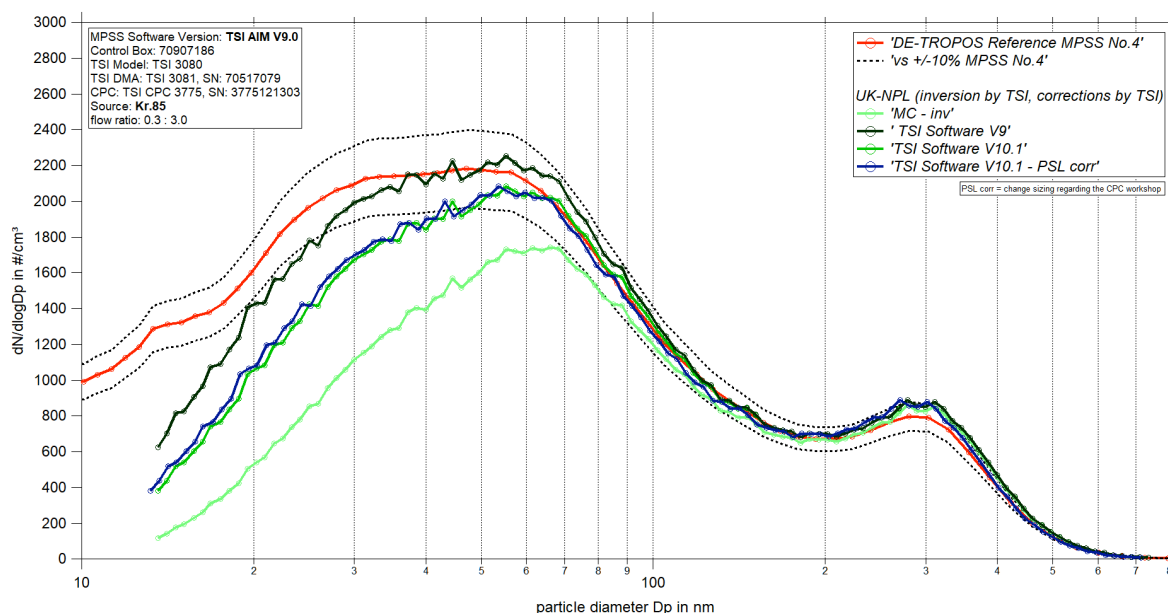


Figure 32: Comparison of mean particle number size distribution of TROPOS Reference MPSS No.4 against UK-NPL from November 16, 2017 08:00 PM – November 17, 2017 06:00 AM. Multiple charge correction, internal diffusion losses and CPC efficiency are included. TSI Software V9 and 10.1 includes all corrections from TSI.

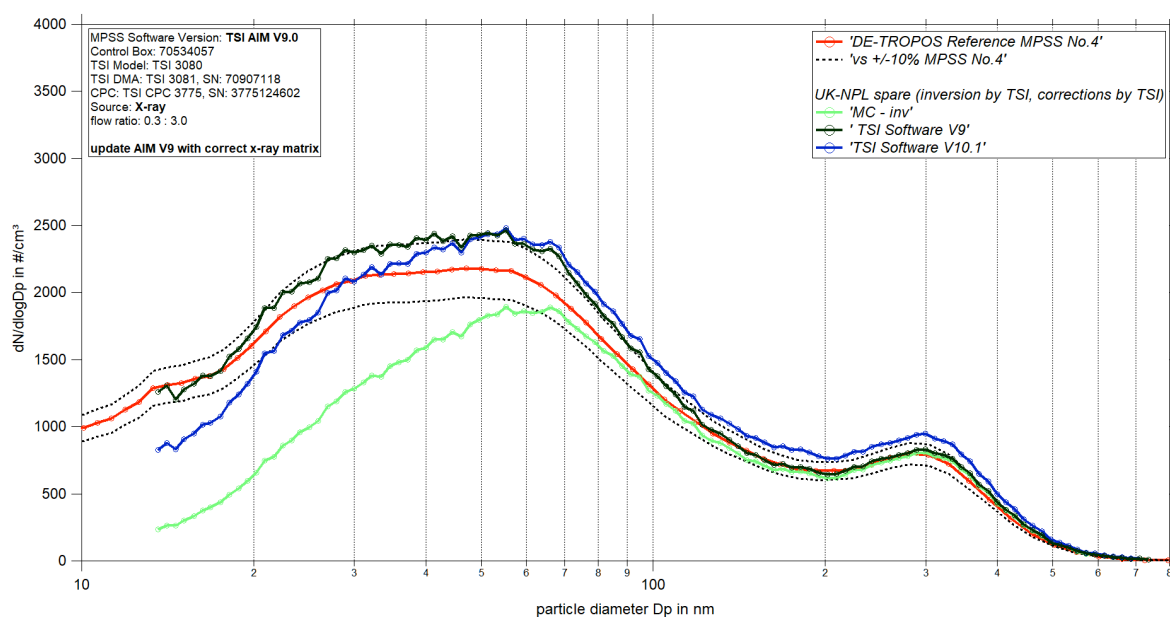


Figure 33: Comparison of mean particle number size distribution of TROPOS Reference MPSS No.4 against UK-NPL spare from November 16, 2017 08:00 PM – November 17, 2017 06:00 AM. Multiple charge correction, internal diffusion losses and CPC efficiency are included. Evaluation TSI Software V9 (correct x-ray matrix) and V10.1 includes all corrections from TSI.