Intercomparison of Mobility Particle Size Spectrometers

Project No.:	*MPSS-2018-6-6*
Principal Investigator:	*Kim Jeongeun*
Home Institution:	*South Korea - National Institute of Meteorological Science*
Participant:	*online*
Candidate:	**NIMS_Korea**
Made by:	**Grimm**
Counter (SN):	**Grimm 5.416**
Software:	**GRIMM Software**
Location of the quality assurance:	TROPOS Leipzig, lab 118
Comparison period:	September 17, 2018 – September 21, 2018
Last Intercomparison (with Project No.):	

Summary of Intercomparison:

Pre-Status:
The candidate from South Korea – NIMS participated in the ACTRIS workshop from September 17, 2018 to September 21, 2018 with the participant. On Monday, Sep. 17th, the setup was done in the TROPOS Lab 118, but it was not possible to run the candidate overnight because the GRIMM software had problems to connect to the instrument and crashed suddenly. After the CPC-Workshop, which took place on Sep. 18, 2018, we were able to do the pre-status from Sep. 18 to Sep. 19, 2018. The candidate was running under the same settings like in South Korea. It was not possible to ship their own radioactive source (Am-241) from South Korea, therefore, we ordered a spare directly from GRIMM. The performance of the system showed a concentration 10% lower than the TROPOS Reference Instrument No.1. The PSL check showed a peak at 206.67 nm. The following night we used

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a Kr.85 source for the candidate from TROPOS. From previous intercomparison we know that the Am-241 underestimated the concentration, because of the lower radioactivity. The performance of the system showed a concentration of 2% below the TROPOS Reference Instrument No.1.

Final-Status:
The final run took place from Sep. 20 to Sep. 21, 2018. Running the candidate using the original source yielded to a concentration 12% lower than the TROPOS Reference Instrument No.1. However, using a Kr.85 radioactive source yielded a concentration well within the standards. Therefore, without considering the radioactive source, the candidate passed the standards of ACTRIS and GAW. Nonetheless, TROPOS highly recommends the candidate to change the radioactive source to a Kr.85.

Information about the instruments:

Date of check: September 17, 2018

List of Components		TROPOS Reference MPSS No.1	Candidate
Position		Line 1.2	Line 1.4
Company		TROPOS	GRIMM
Software		TROPOS V6.68	GRIMM
CPC-MPSS		TSI CPC, Model 3772	Grimm 5.416
CPC-total		TSI CPC, Model 3010	-
flow ratio		1.0 : 5.0	0.3 : 3.0
source		Kr.85	Am-241
HV power supply		Positive	Positive
DMA		Hauke medium	GRIMM
aerosol dryer		✓	
aerosol RH- sensor		✓	
aerosol T-sensor		✓	
sheath RH-sensor		✓	
sheath T-sensor		✓	
Sheath dryer		✓	
pressure sensor		✓	
info			GRIMM Setup was used

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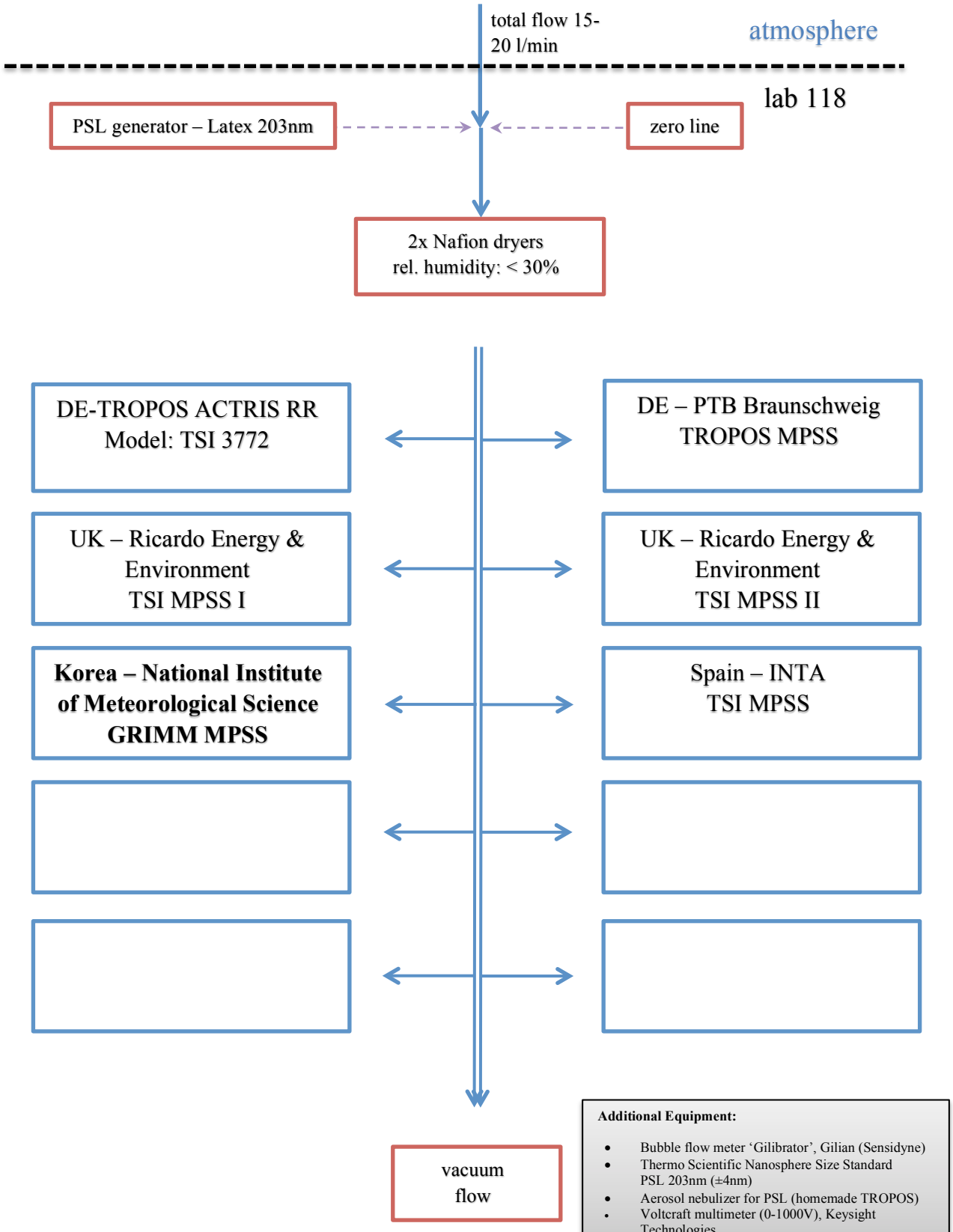
Laboratory setup:



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 system checks:

date	17.09.2018	18.09.2018	unit
total CPC flow	-	-	l/min
aerosol flow (total)	0.3	0.302	l/min
Zero MPSS	0	0	#/cm³
Zero total CPC	-	-	#/cm³
PSL 203 nm	206.67	-	nm

HV check	17.09.2018	18.09.2018	unit
10	-		V
20	-		V
30	-		V
40	-		V
50	-		
70	-		
500	-		
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	-	-	checked
change aerosol Nafion dryer	no	-	-	-
change sheath Nafion dryer	no	-	-	-
check source	no	-	-	Checked and used different source
change HV power supply	no	-	-	-
clean/change DMA	no	-	-	checked
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	-	-	-	-
NI-card	no	-	-	-

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

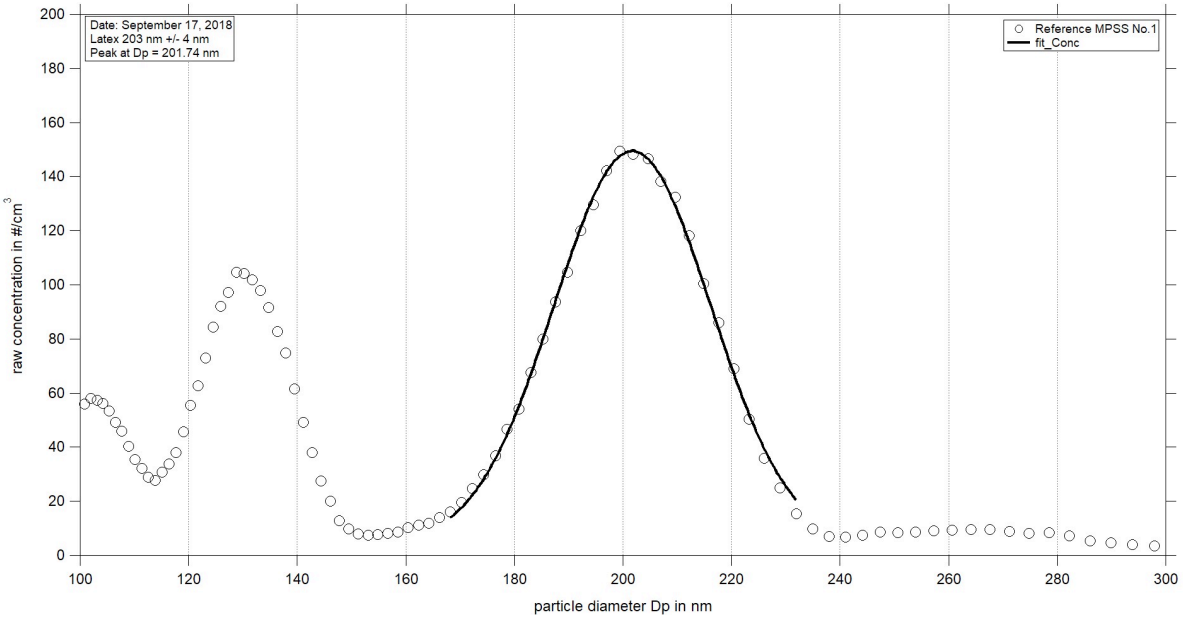

Figure 01: Measurement of latex 203 nm - Reference MPSS No.1: Particle size distribution (raw concentration) for latex 203 nm on September 17th 2018.

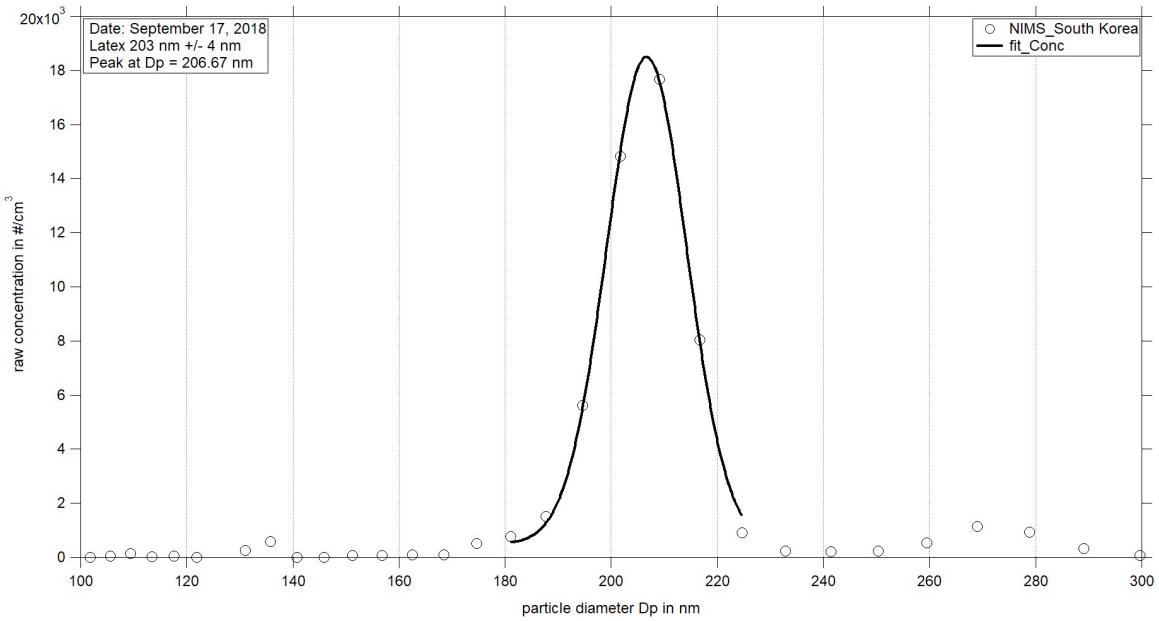

Figure 02: Measurement of latex 203 nm – South Korea NIMS: Particle size distribution for latex 203 nm on September 17th 2018.

Pre-Status Sept. 18 – 19, 2018 with Am241: Time Series, Particle Number Size Distribution and Correlation

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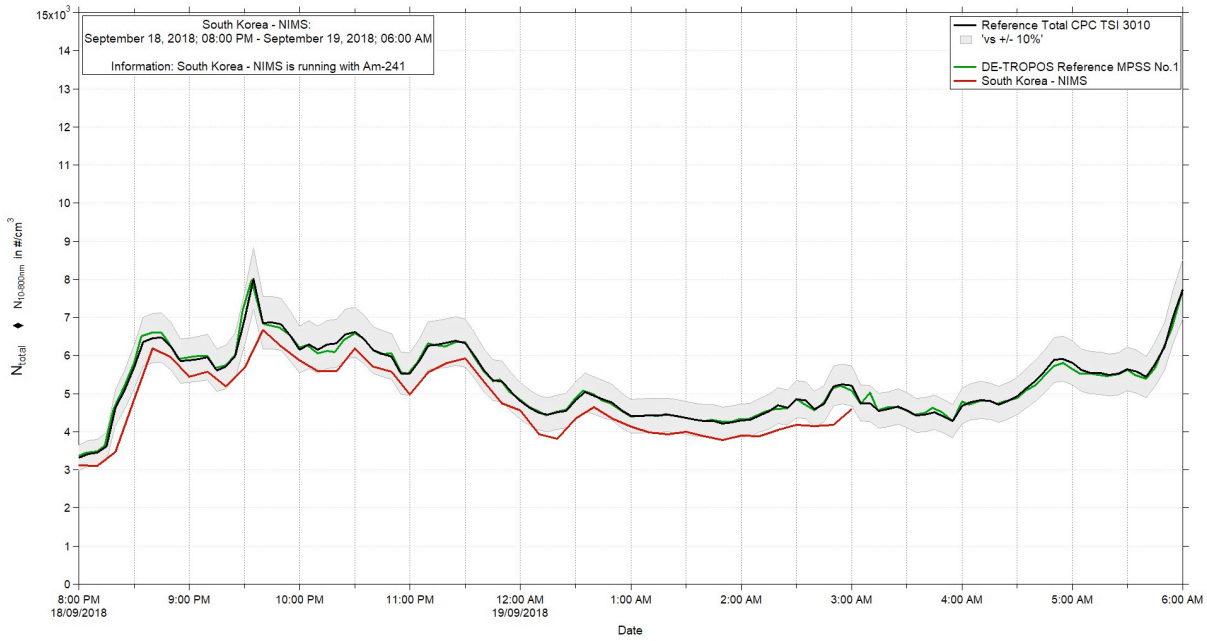

Figure 03: Time series (September 18, 2018 8 PM – September 19, 2018 6 AM) of the integrated particle number concentration ($N_{10\text{-}800nm}$) of the MPSS and total number concentration (N_{total}) of the Reference TSI-CPC Model 3010. The candidate South Korea – NIMS had problems over night and stopped recording the data. Therefore we have only data until 3 AM on September 19th. Multiple charge correction, internal diffusion losses and CPC flow corrections are included. The candidate is running with the Am241 source.

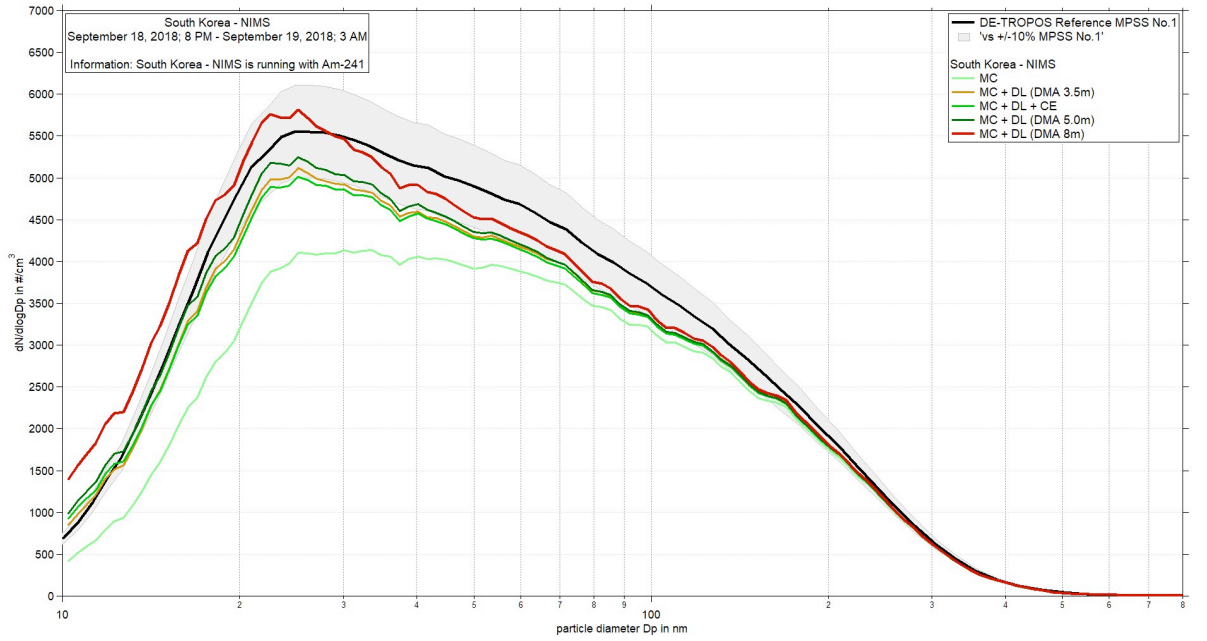

Figure 04: Comparison of mean particle number size distribution of TROPOS Reference MPSS No.1 against South Korea - NIMS from September 18, 2018 8 PM – September 19, 2018 3 AM. Multiple charge correction, internal diffusion losses and CPC efficiency are included in different steps.

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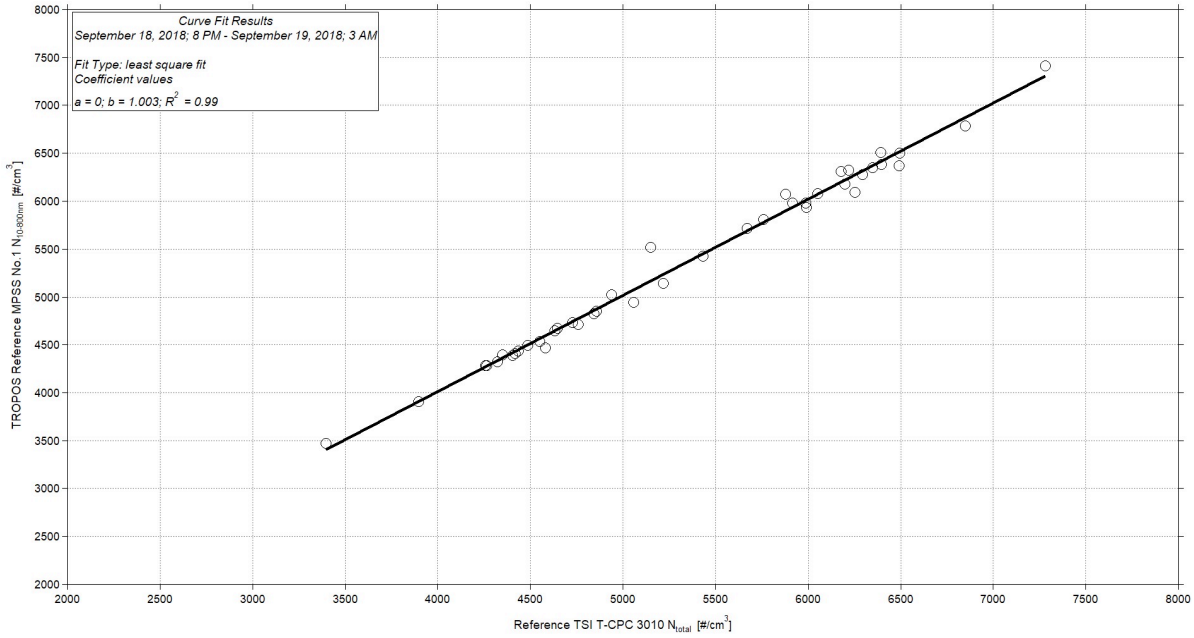

Figure 05: Linear regression between the number concentrations of the TROPOS Reference TSI T-CPC Model 3010 and TROPOS Reference MPSS No.1. Multiple charge correction, internal diffusion losses and CPC efficiency are included.

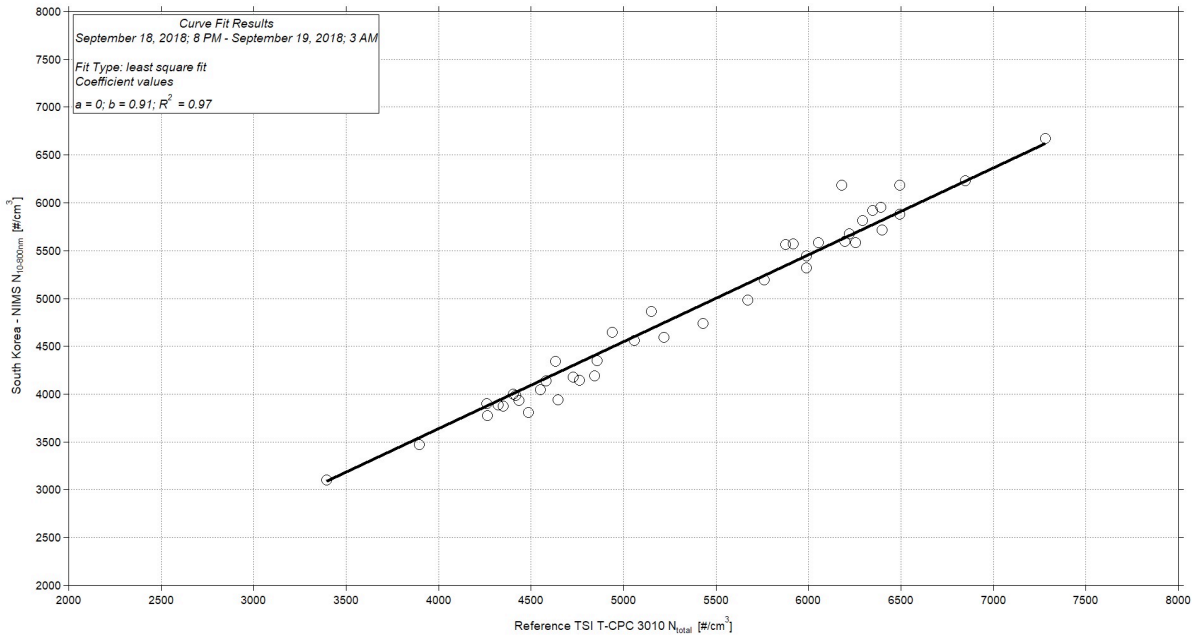

Figure 06: Linear regression between the number concentrations of the TROPOS Reference TSI T-CPC Model 3010 and South Korea. Multiple charge correction, internal diffusion losses and CPC efficiency are included.

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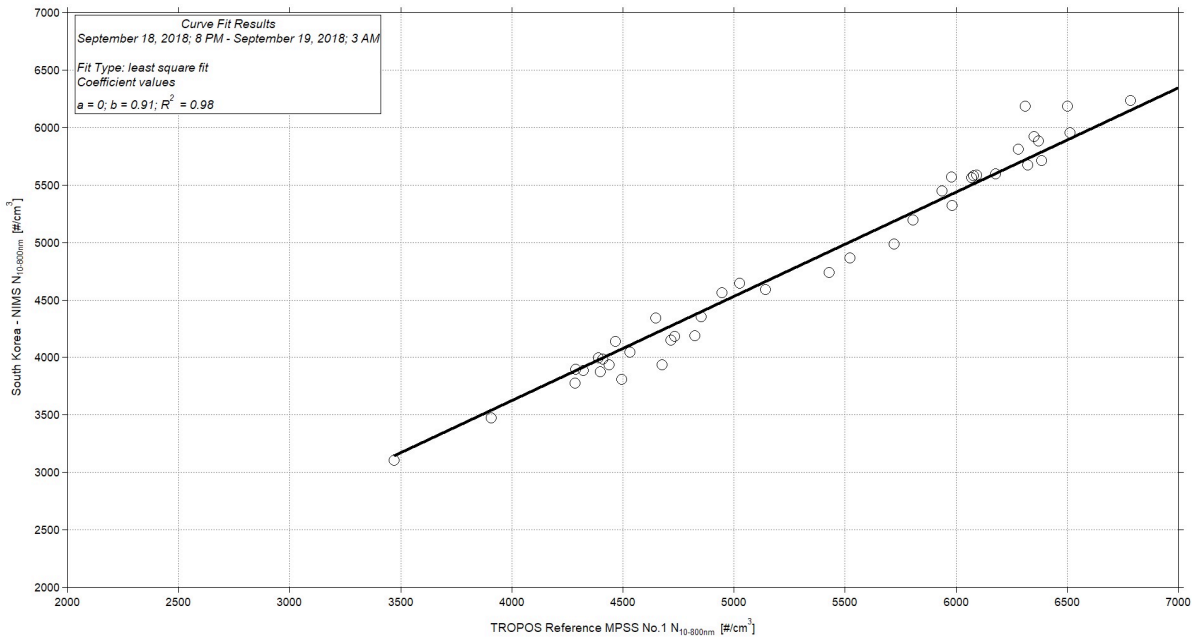

Figure 07: Linear regression between the number concentrations of the TROPOS Reference MPSS No.1 and South Korea - NIMS. Multiple charge correction, internal diffusion losses and CPC efficiency are included.

Status Sept. 19 – 20, 2018 with Kr.85 from TROPOS: Time Series, Particle Number Size Distribution and Correlation

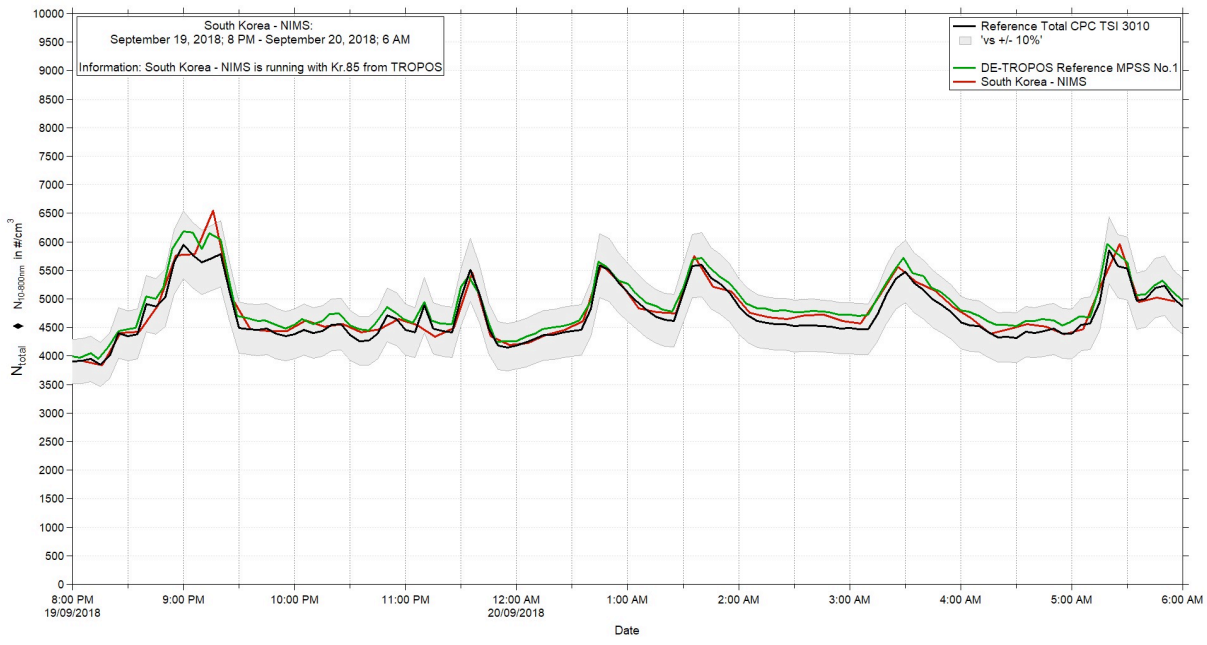

Figure 08: Time series (September 19, 2018 8 PM – September 20, 2018 6 AM) of the integrated particle number concentration ($N_{10\text{-}800nm}$) of the MPSS and total number concentration (N_{total}) of the Reference TSI-CPC Model 3010. Multiple charge correction, internal diffusion losses and CPC flow corrections are included. The candidate is running with the Kr.85 source from TROPOS to see the differences to the Pre-status run.

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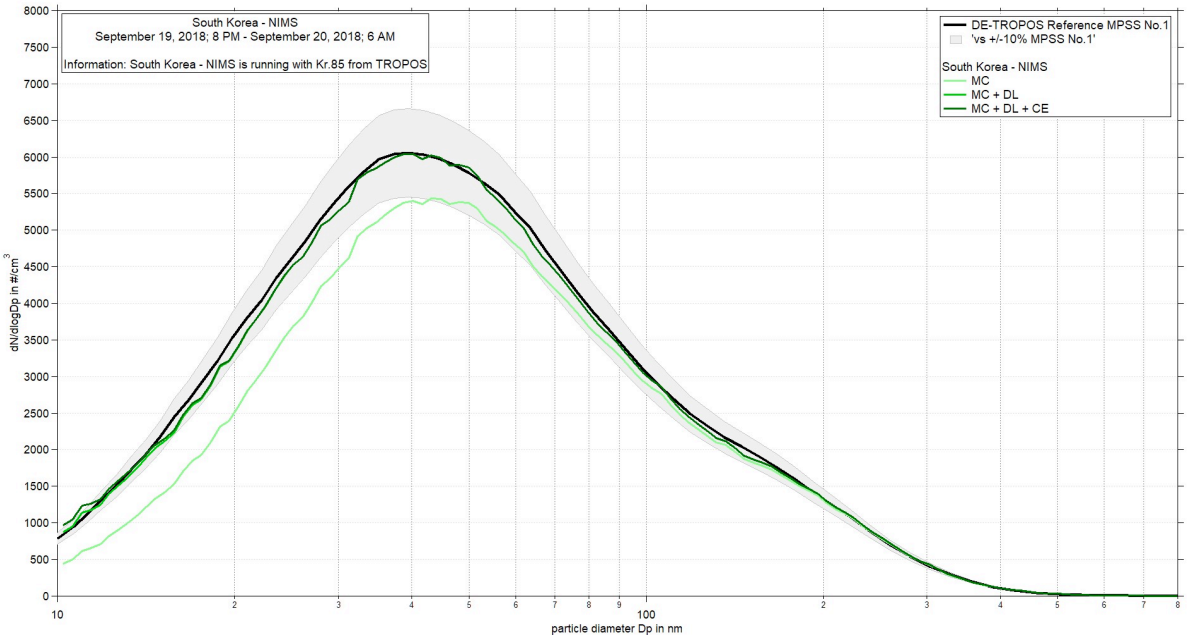

Figure 09: Comparison of mean particle number size distribution of TROPOS Reference MPSS No.1 against South Korea - NIMS from September 19, 2018 8 PM – September 20, 2018 6 AM. Multiple charge correction, internal diffusion losses and CPC efficiency are included.

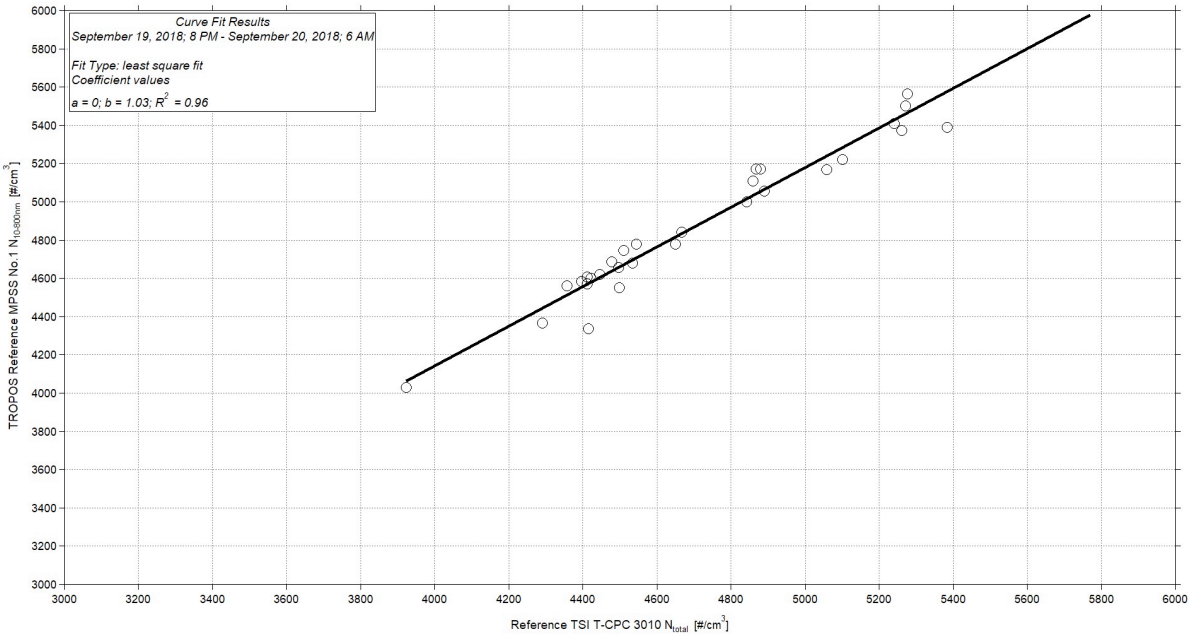

Figure 10: Linear regression between the number concentrations of the TROPOS Reference TSI T-CPC Model 3010 and TROPOS Reference MPSS No.1. Multiple charge correction, internal diffusion losses and CPC efficiency are included.

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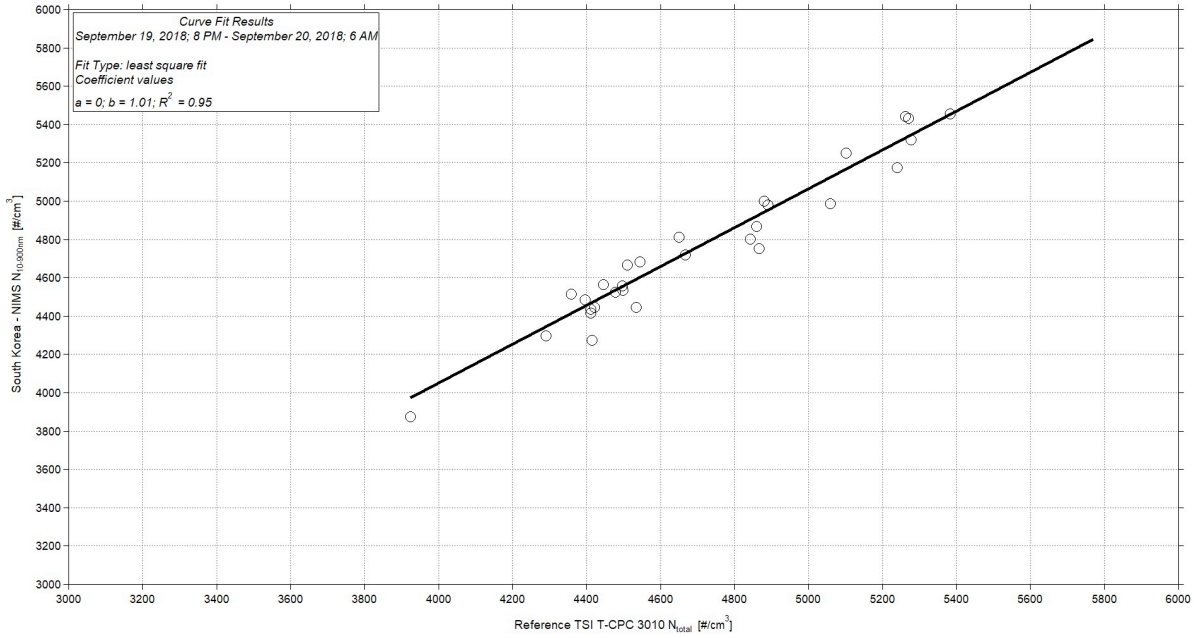

Figure 11: Linear regression between the number concentrations of the TROPOS Reference TSI T-CPC Model 3010 and South Korea - NIMS. Multiple charge correction, internal diffusion losses and CPC efficiency are included.

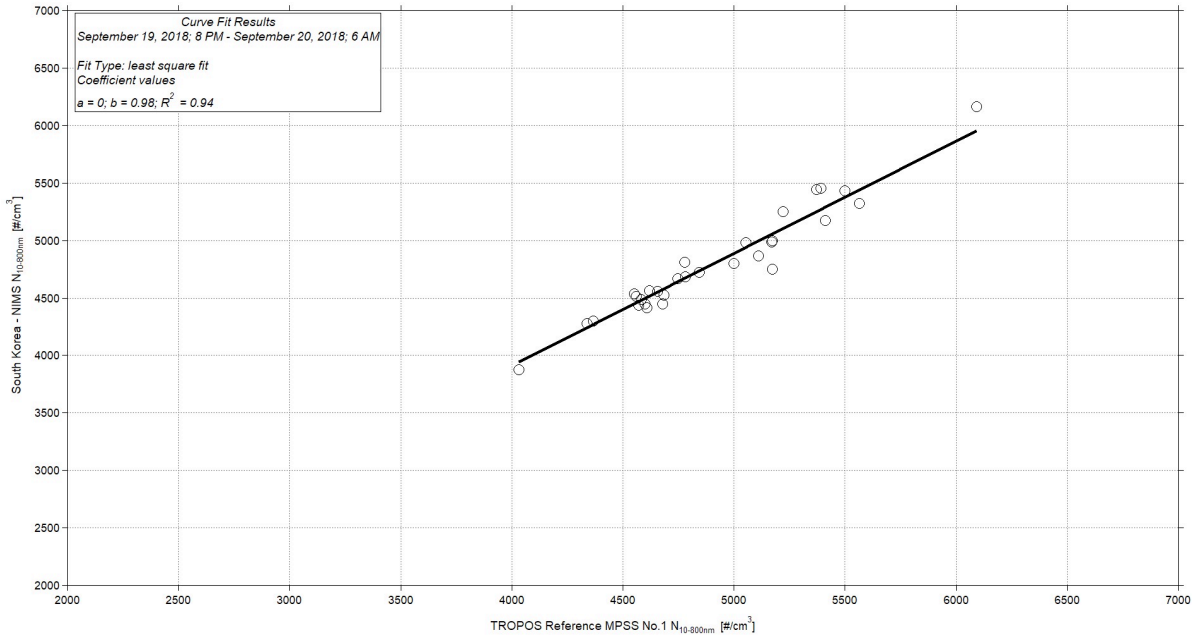

Figure 12: Linear regression between the number concentrations of the TROPOS Reference MPSS No.1 and South Korea - NIMS. Multiple charge correction, internal diffusion losses and CPC efficiency are included.

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Final Status Sept. 20 – 21, 2018 with Am241, 3.7MBq: Time Series, Particle Number Size Distribution and Correlation

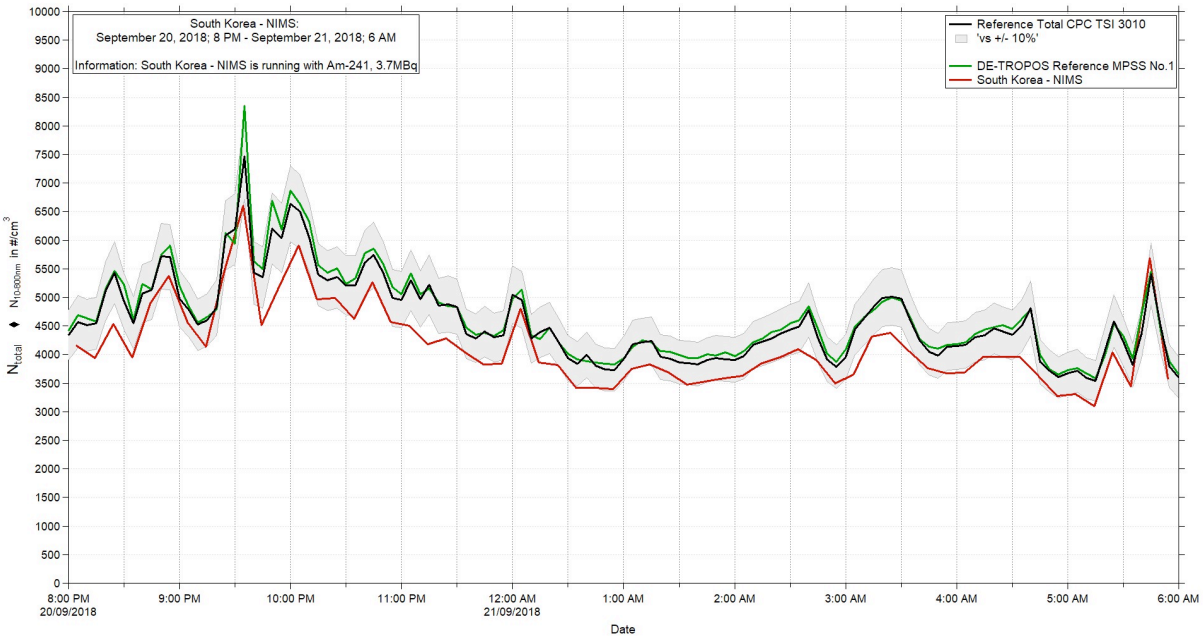

Figure 13: Time series (September 20, 2018 8 PM – September 21, 2018 6 AM) of the integrated particle number concentration ($N_{10\text{-}800nm}$) of the MPSS and total number concentration (N_{total}) of the Reference TSI-CPC Model 3010. Multiple charge correction, internal diffusion losses and CPC flow corrections are included. The candidate is running with the original Am-241 source from GRIMM.

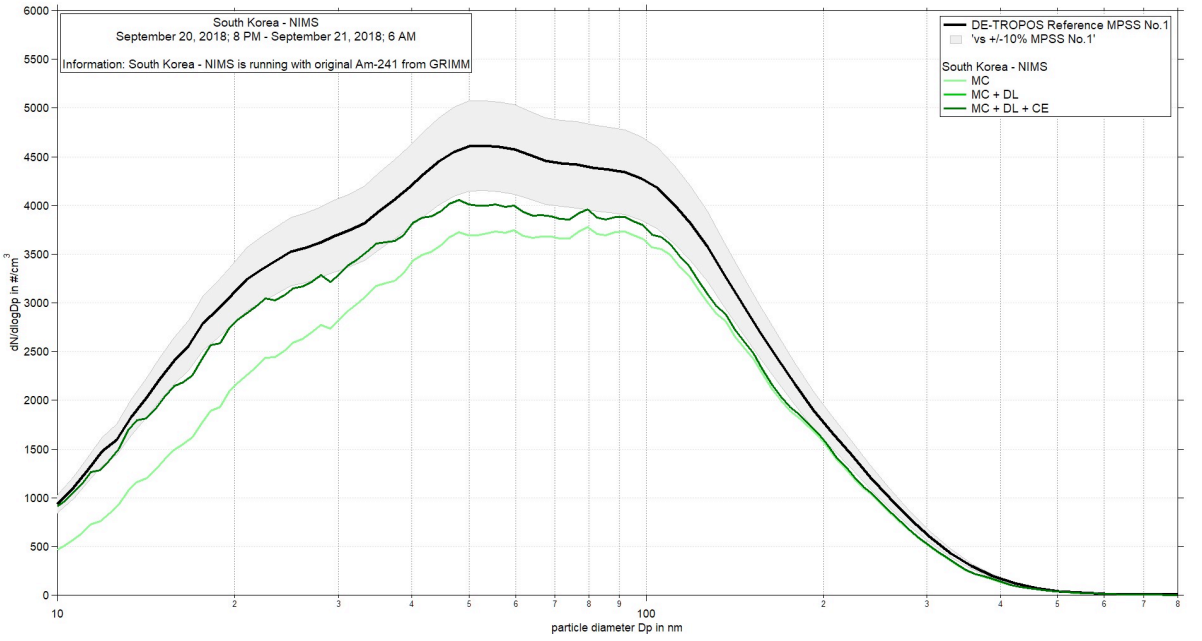

Figure 14: Comparison of mean particle number size distribution of TROPOS Reference MPSS No.1 against South Korea - NIMS from September 20, 2018 8 PM – September 21, 2018 6 AM. Multiple charge correction, internal diffusion losses and CPC efficiency are included.

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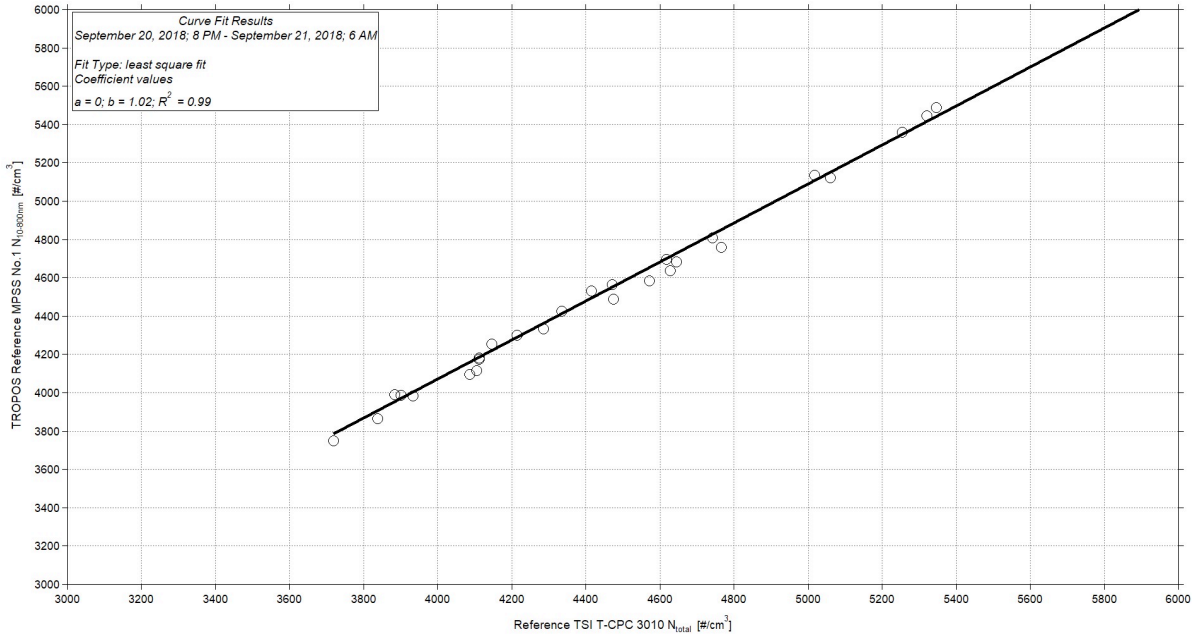

Figure 15: Linear regression between the number concentrations of the TROPOS Reference TSI T-CPC Model 3010 and TROPOS Reference MPSS No.1. Multiple charge correction, internal diffusion losses and CPC efficiency are included.

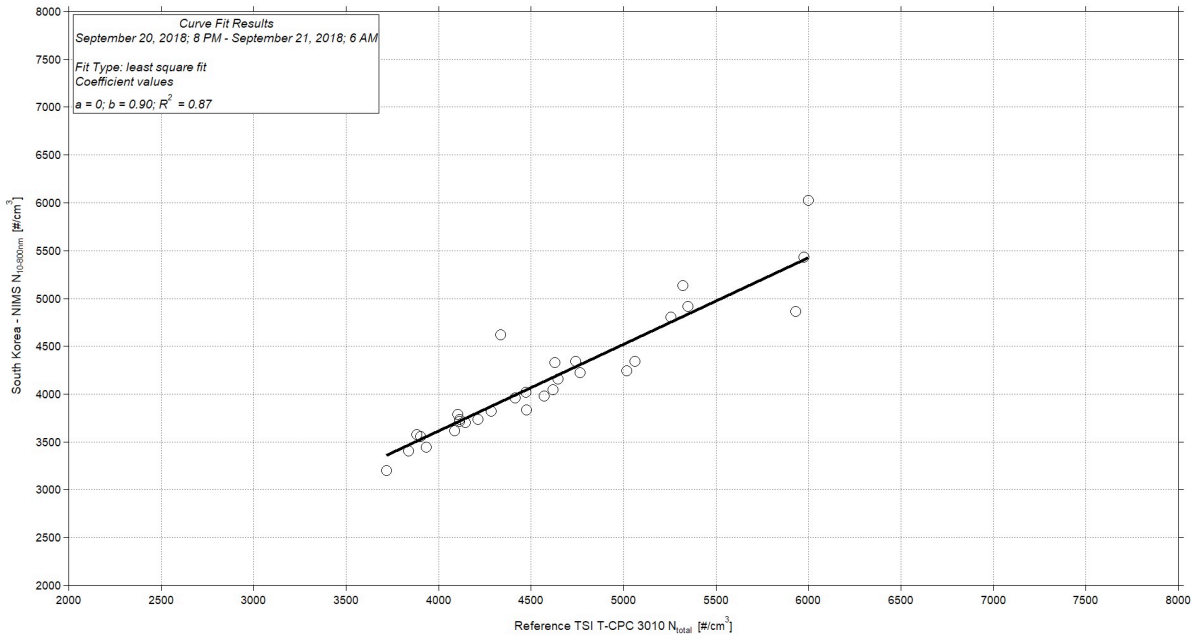

Figure 16: Linear regression between the number concentrations of the TROPOS Reference TSI T-CPC Model 3010 and South Korea - NIMS. Multiple charge correction, internal diffusion losses and CPC efficiency are included.

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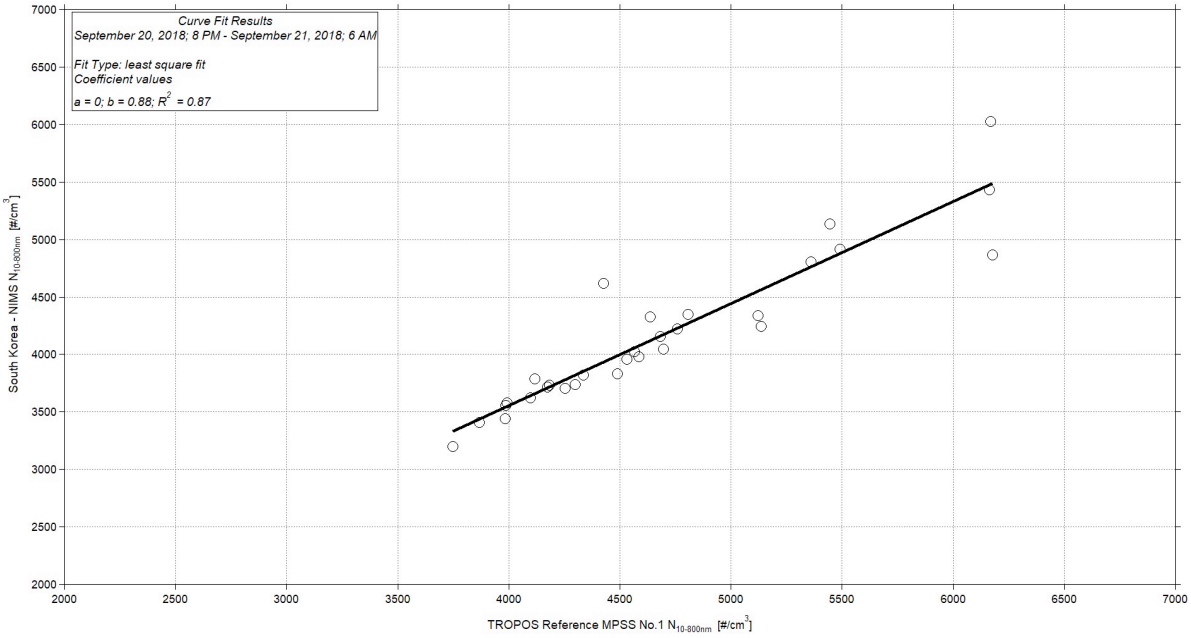

Figure 17: Linear regression between the number concentrations of the TROPOS Reference MPSS No.1 and South Korea - NIMS. Multiple charge correction, internal diffusion losses and CPC efficiency are included.

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