



Intercomparison of Mobility Particle Size Spectrometers

Project No.: *MPSS-2019-5-1*

Principal Investigator: Jean-François Doussin

Home Institution: *UCC*

Participant: Niall O’Sullivan and Hayley Furnell

Candidate: MPSS UCC
Made by: **TSI MPSS 3082 SN: 3082001803002**
Counter (SN): **TSI CPC 3750 SN: 3750180301**

Location of the quality assurance: TROPOS Leipzig, lab 118

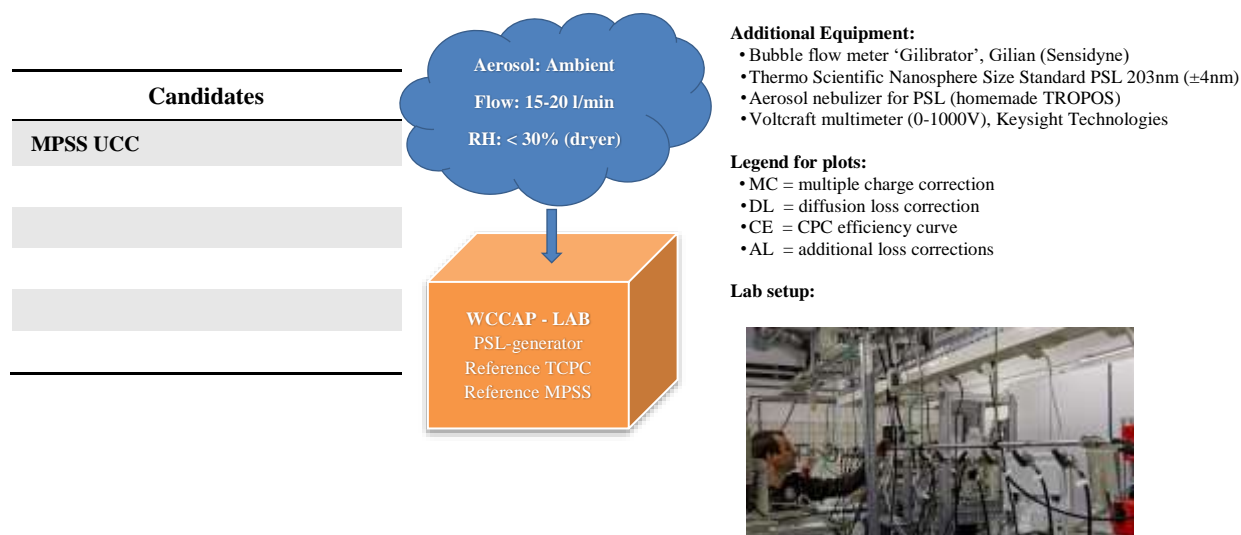
Comparison period: October 07, 2019 – October 11, 2019

Last Intercomparison (with Project No.):

Summary of Intercomparison:

The TSI MPSS from UCC Ireland participated in the WCCAP Workshop in October. The instrument arrived with all necessary parts in good condition to perform the intercomparison. There were no visible damages. The pre-status was performed in the same setup like on the station with a flow of 1.0 l/min (aerosol) and 5.0 l/min (sheath air). The candidate used a TSI 3750 counter with a flow rate of 1 l/min and butanol-based. The radioactive source was provided by TROPOS, because of transport issues. The candidate showed a PSL peak at 209.14 nm and the integrated particle number concentration over the size range 10-520 nm is 7% lower than the Reference Instrument No.1. Looking at the size distribution the candidate overestimates the accumulation mode and underestimates the Aitken mode. There are problems in selecting particles over the DMA and undefined losses in the instrument. It is necessary to check and clean the whole instrument and run one experiment without the impactor, using a dummy. The instrument was cleaned and checked. Results are shown in the different night runs below. The final run was performed from 10.-11.10.2019 using the TSI AMI software V10. The candidate showed, with the TSI AIM software, a slightly higher concentration against the Reference Instrument No.1. The candidate passed the standards of ACTRIS and GAW under the conditions: using the TROPOS Reference CPC No.1 as a counter and a radioactive source from TROPOS.

Laboratory Setup and Legend



PSL Scan: Latex 203 nm +/- 4 nm

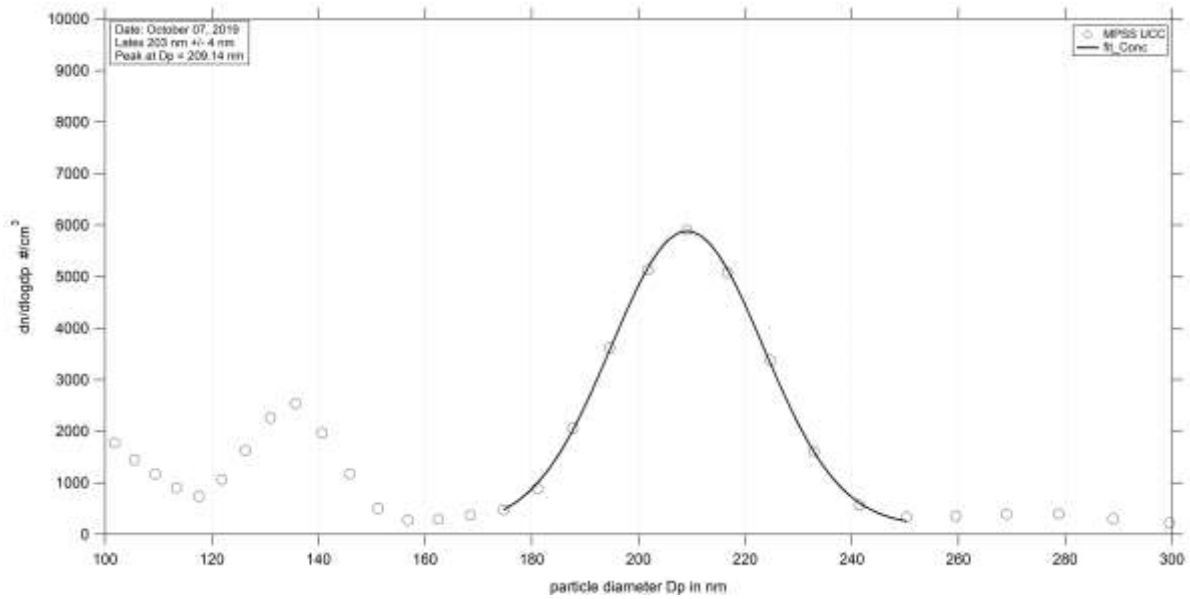


Figure 01: Measurement of latex 203 nm – MPSS UCC: Particle size distribution of latex 203 nm on Oct. 7th 2019. The peak is at 209.14nm.

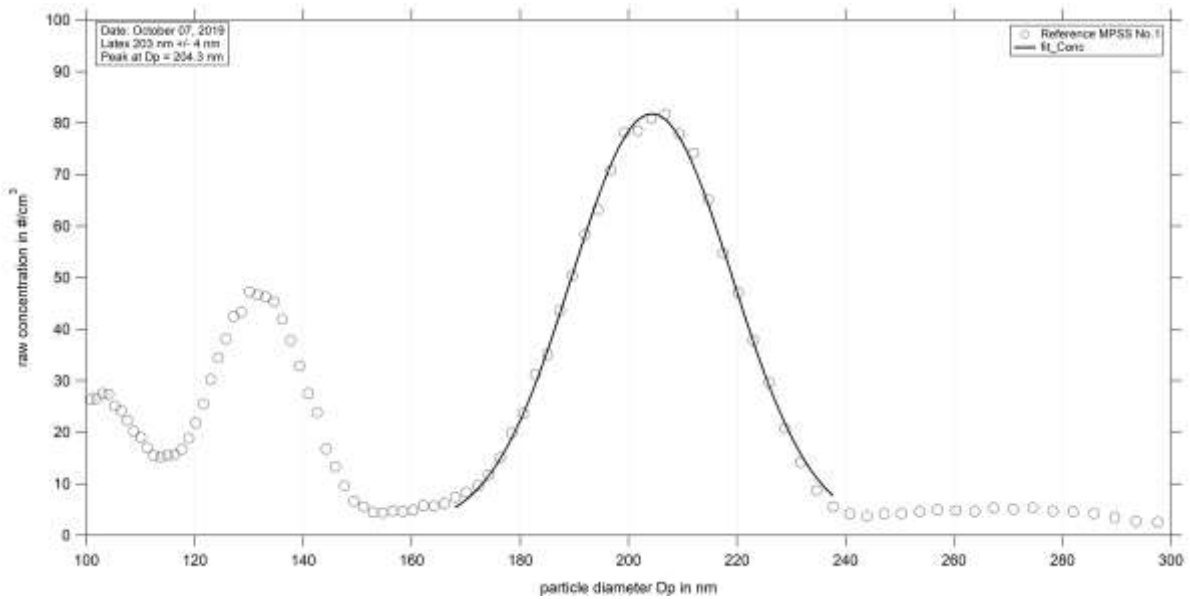


Figure 02: Measurement of latex 203 nm – TROPOS Reference Instrument No.1: Particle size distribution of latex 203 nm on Oct. 7th 2019. The peak is at 204.3nm.

Status October. 07 – 08, 2019

Instrument Settings, Time Series, Particle Number Size Distribution and Correlation

Table No. 1:

Institute: UCC							
Station: Ireland							
Date of checking list: 07.10.2019							
Instrument/ Components	info	SN	Date/Code	CPC-Status		HV-Status	
MPSS/Classifier:	TSI 3082	3082001803002	Jan 2018	<i>ST</i>	39.0	<i>OFF</i>	-
Firmware Classifier:	-		-	<i>CT</i>	18.0	<i>4mv</i>	-
Firmware Software:	TSI AIM		9.0	<i>OT</i>	40.0	<i>800mv</i>	-
DMA type:	TSI 3081A00	3081A1802004	Jan. 2018	<i>CabT</i>	24.2	<i>200mv</i>	-
CPC model:	TSI CPC 3750	3750180301	Jan. 2018	<i>AP</i>	100.5	<i>0</i>	-
Firmware CPC:	-		-	<i>OP</i>	76-4		
radioactive source:	TSI	-	Kr.85	<i>NP</i>	2.5		
Flow CPC (l/min):	0.979			<i>LC</i>	53		
Flow Inlet (l/min):	0.953						
Sheath air flow (l/min):	5.0						
Zero (#/cm ³):	check						
<i>Maintenance</i>							
Aerosol inlet:							
Aerosol Nafion dryer:	No dryer						
Sheath Nafion dryer:	No dryer						
Source:							
HV power supply:							
DMA:							
Aerosol/sheath RH/T- sensor:							
Pressure sensor:							
Filter:							
NI-card:							
CPC:							
Impactor:	Yes: Nozzle size 0.071 cm						
Setup settings over night:	Using the station conditions						

Institute: TROPOS							
Station: Reference Instrument No.1							
Date of checking list: October. 07, 2019							
Instrument/ Components	info	Serial Number	Date/Code	CPC-Status		HV-Status	
MPSS/Classifier:	TROPOS	No.1		<i>ST</i>	39.0	<i>0 V</i>	0
Firmware Classifier:				<i>CT</i>	22.0	<i>5 mV</i>	4.98
Firmware Software:	TROPOS 6.68			<i>OT</i>	40.0	<i>800 mV</i>	999.8
DMA type:	Hauke medium		142	<i>CabT</i>	28	<i>200 mV</i>	250.0
CPC model:	TSI 3772	3772141701		<i>AP</i>	100.1	<i>0 V</i>	0
Firmware CPC:	2.15			<i>OP</i>	78.0		
Radioactive source:	Kr.85	NER 8275	002/13	<i>NP</i>	2.8		
Flow Inlet (l/min):	1.007			<i>LC</i>	50		
Zero (#/cm ³):	0						

Institute: TROPOS							
Station: Reference Total CPC							
Date of checking list: October. 07, 2019							
Instrument/ Components	info	Serial Number	Cut off	CPC-Status			
CPC model:	TSI 3010	2410	D_{p50} 10 nm	<i>ST</i>			
Firmware CPC:				<i>CT</i>			
Flow Inlet (l/min):	1.011			<i>OT</i>			
Zero (#/cm ³):	0			<i>CabT</i>			
				<i>AP</i>			
				<i>OP</i>			

	NP		
	LC		

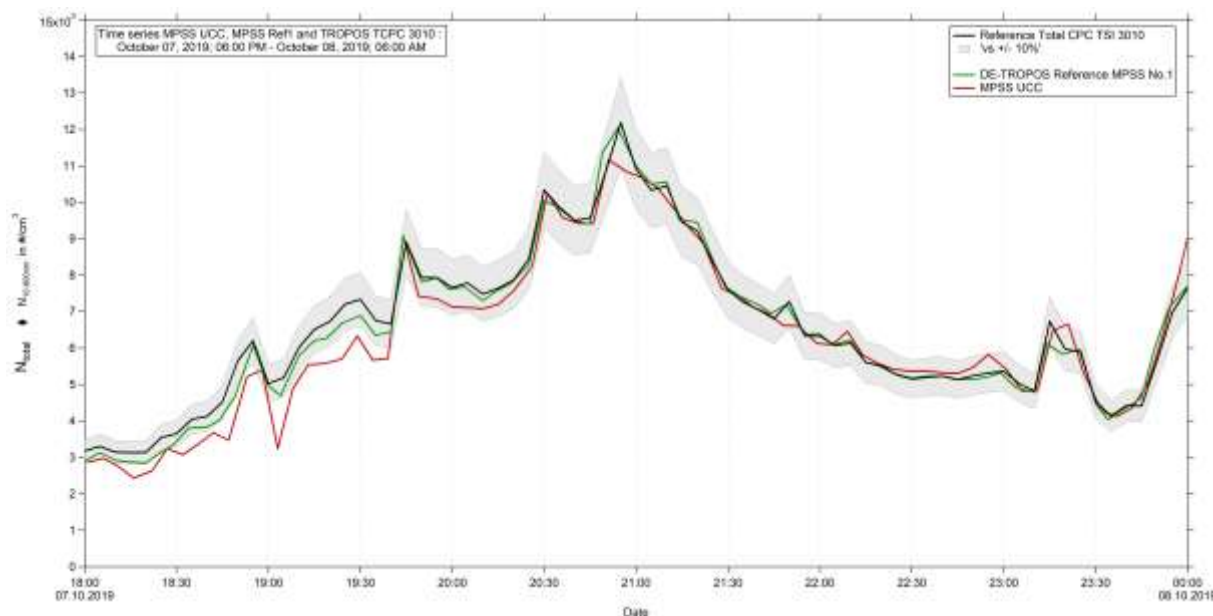


Figure 03: Time series (October, 07, 2019 6 PM – Oct. 08, 2019 6 AM) of the integrated particle number concentration ($N_{10-800nm}$) of the MPSS and total number concentration (N_{total}) of the Reference TSI-CPC Model 3010. Multiple charge correction, internal diffusion losses and CPC flow corrections are included. The candidate is running with the TSI Kr.85 source.

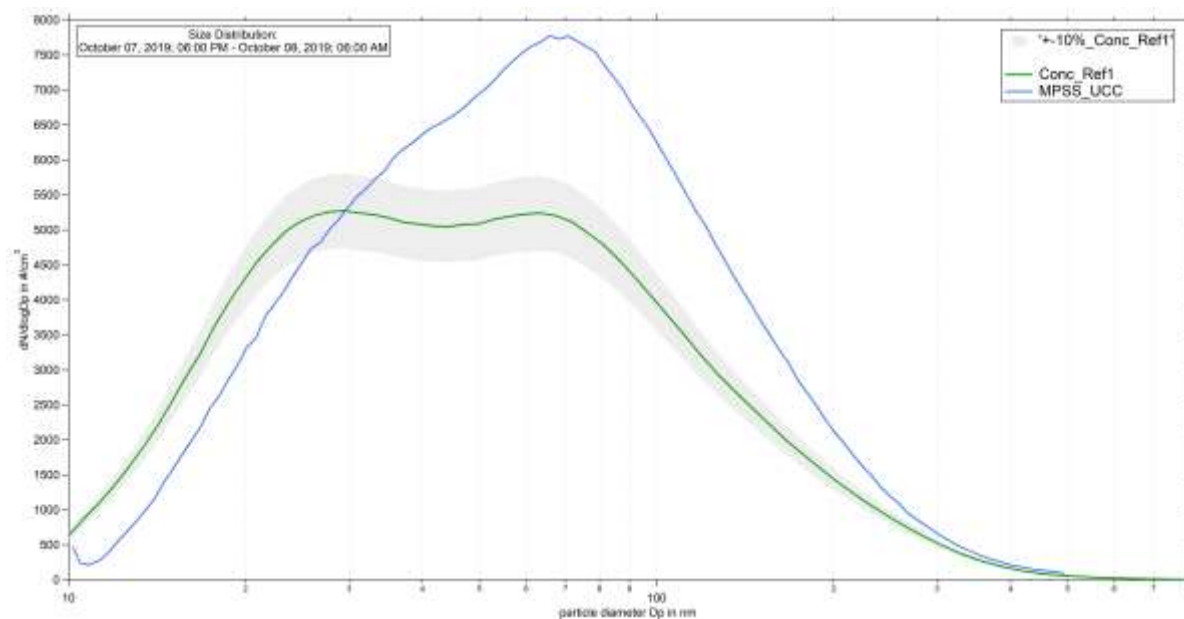


Figure 04: Comparison of mean particle number size distribution of TROPOS Reference MPSS No.1 against MPSS UCC from Oct. 07, 2019 6 PM – Oct. 08, 2019 6 AM.

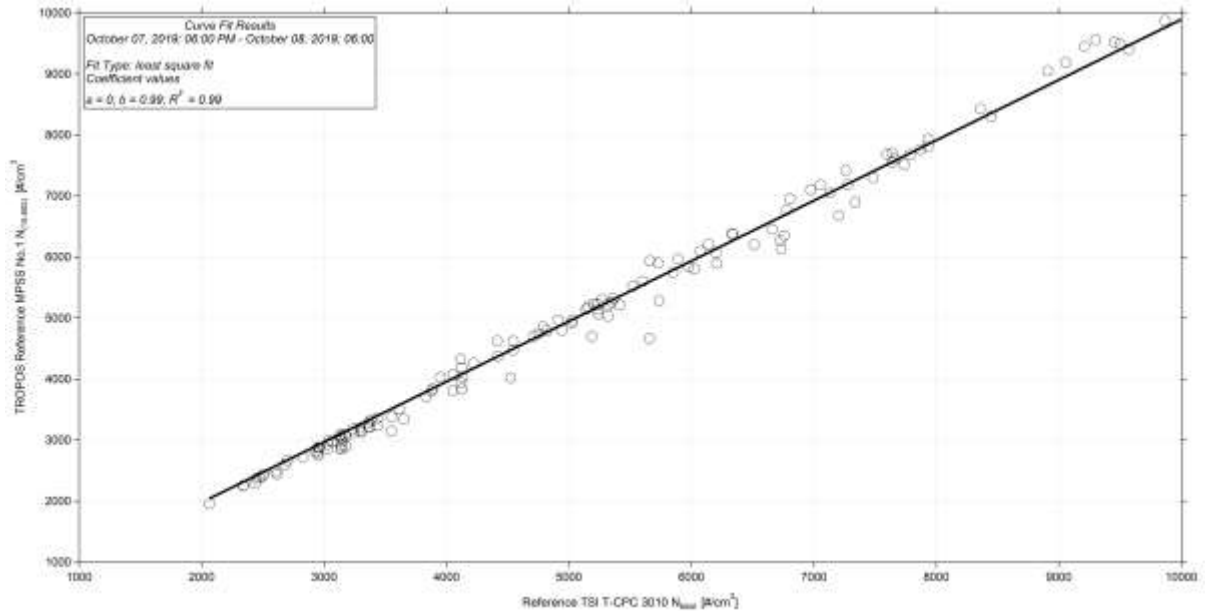


Figure 05: Linear regression between the number concentration of the TROPOS Reference TSI T-CPC Model 3010 and TROPOS Reference MPSS No.1.

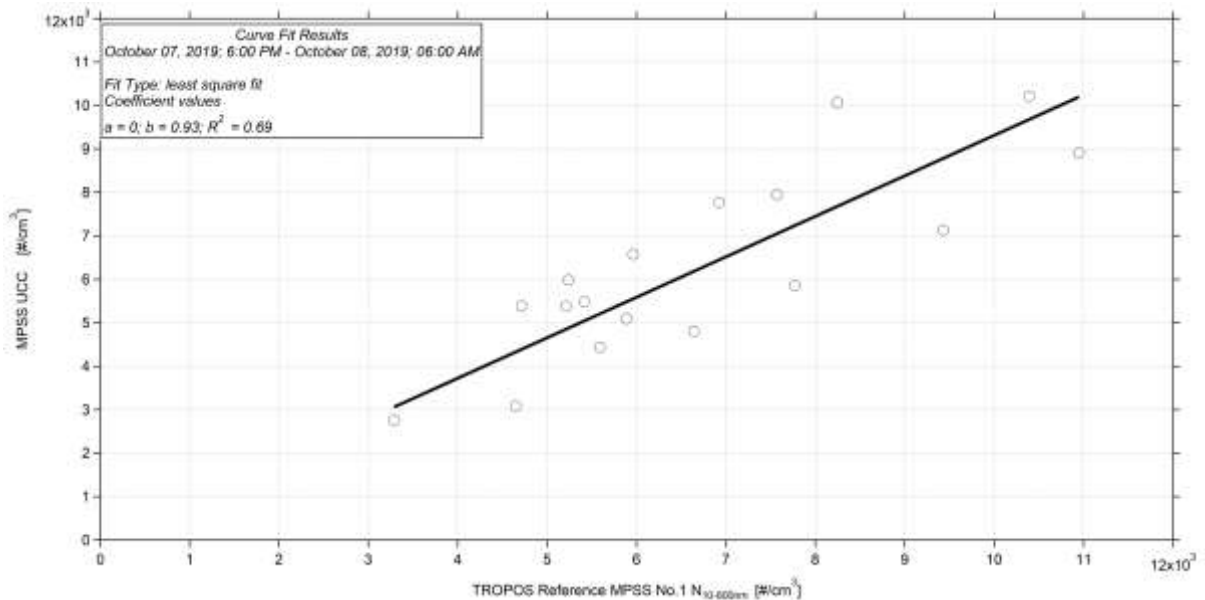


Figure 06: Linear regression between the number concentration of the MPSS UCC-Ireland and TROPOS Reference MPSS No.1.

Status Oct. 08 – 09, 2019

Table No. 2:

<i>Institute: UCC</i>							
<i>Station: Ireland</i>							
<i>Date of checking list: 08.10.2019</i>							
<i>Instrument/ Components</i>	<i>info</i>	<i>SN</i>	<i>Date/Code</i>	<i>CPC-Status</i>		<i>HV-Status</i>	
<i>MPSS/Classifier:</i>	TSI 3082	3082001803002	Jan 2018	<i>ST</i>	39.0	<i>OFF</i>	-
<i>Firmware Classifier:</i>	-		-	<i>CT</i>	22.0	<i>4mv</i>	-
<i>Firmware Software:</i>	TSI AIM		9.0	<i>OT</i>	40.0	<i>800mv</i>	-
<i>DMA type:</i>	TSI 3081A00	3081A1802004	Jan. 2018	<i>CabT</i>	35.4	<i>200mv</i>	-
<i>CPC model:</i>	TSI CPC 3750	3750180301	Jan. 2018	<i>AP</i>	99.7	<i>0</i>	-
<i>Firmware CPC:</i>	-		-	<i>OP</i>	83.1		
<i>radioactive source:</i>	TSI	-	Kr.85	<i>NP</i>	2.7		
<i>Flow CPC (l/min):</i>	0.979			<i>LC</i>	43		
<i>Flow Inlet (l/min):</i>	0.953						
<i>Sheath air flow (l/min):</i>	5.0						
<i>Zero (#/cm³):</i>	check						
<i>Maintenance</i>							
<i>Aerosol inlet:</i>							-
<i>Aerosol Nafion dryer:</i>							-
<i>Sheath Nafion dryer:</i>							-
<i>Source:</i>							-
<i>HV power supply:</i>							-
<i>DMA:</i>							-
<i>Aerosol/sheath RH/T- sensor:</i>							-
<i>Pressure sensor:</i>							-
<i>Filter:</i>							-
<i>NI-card:</i>							-
<i>CPC:</i>							-
<i>Impactor:</i>							Dummy
<i>Setup settings over night:</i>							-
<i>Institute: TROPOS</i>							
<i>Station: Reference Instrument No.1</i>							
<i>Date of checking list: Oct. 08, 2019</i>							
<i>Instrument/ Components</i>	<i>info</i>	<i>Serial Number</i>	<i>Date/Code</i>	<i>CPC-Status</i>		<i>HV-Status</i>	
<i>MPSS/Classifier:</i>	TROPOS	No.1		<i>ST</i>	39.0	<i>0 V</i>	0
<i>Firmware Classifier:</i>				<i>CT</i>	22.0	<i>5 mV</i>	4.98
<i>Firmware Software:</i>	TROPOS 6.68			<i>OT</i>	40.0	<i>800 mV</i>	999.8
<i>DMA type:</i>	Hauke medium		142	<i>CabT</i>	27.3	<i>200 mV</i>	250.0
<i>CPC model:</i>	TSI 3772	3772141701		<i>AP</i>	98.5	<i>0 V</i>	0
<i>Firmware CPC:</i>	2.15			<i>OP</i>	72.1		
<i>Radioactive source:</i>	Kr.85	NER 8275	002/13	<i>NP</i>	2.8		
<i>Flow Inlet (l/min):</i>	1.017			<i>LC</i>	50		
<i>Zero (#/cm³):</i>	0						

Instrument Settings, Time Series, Particle Number Size Distribution.

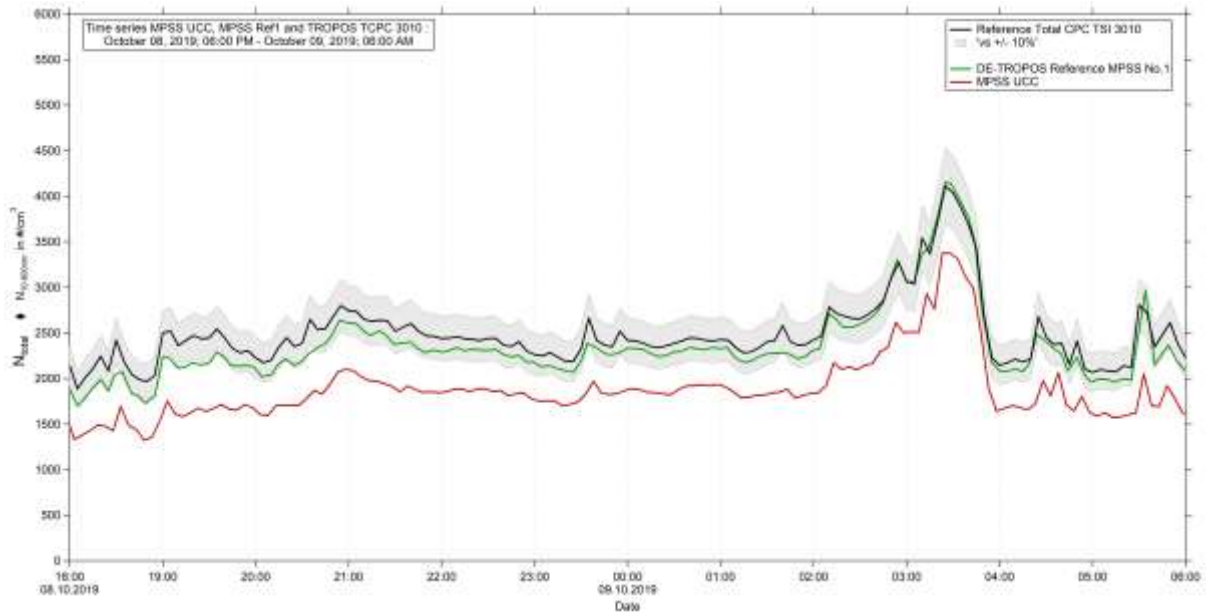


Figure 07: Time series between MPSS Ref1, MPSS UCC and TCPC (Oct. 08, 2019 6 PM – Oct. 09, 2019 6 AM) of the integrated particle number concentration (N10-800nm) of the MPSS and total number concentration of the Reference TSI-CPC Model 3010. Multiple charge correction, internal diffusion losses and CPC flow corrections are included. The candidate is running with the TSI Kr.85 source.

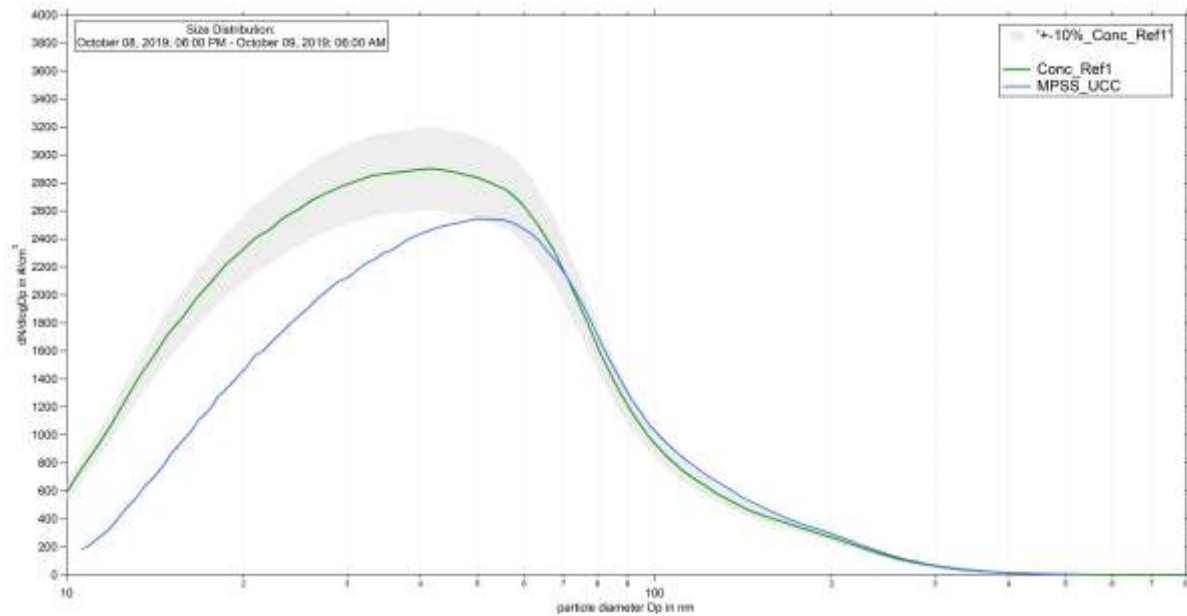


Figure 08: Comparison of mean particle number size distribution of TROPOS Reference MPSS No.1 against MPSS UCC from Oct. 08, 2019 6 PM – Oct. 09, 2019 6 AM.

Status Oct. 09 – 10, 2019

Table No. 3:

Institute: UCC							
Station: Ireland							
Date of checking list: 09.10.2019							
Instrument/ Components	info	SN	Date/Code	CPC-Status		HV-Status	
MPSS/Classifier:	TSI 3082	3082001803002	Jan 2018	ST	39.0	OFF	-
Firmware Classifier:	-		-	CT	22.0	4mv	-
Firmware Software:	TSI AIM		9.0	OT	40.0	800mv	-
DMA type:	TSI 3081A00	3081A1802004	Jan. 2018	CabT	35.4	200mv	-
CPC model:	TSI CPC 3750	3750180301	Jan. 2018	AP	99.7	0	-
Firmware CPC:	-		-	OP	83.1		
radioactive source:	TSI	-	Kr.85	NP	2.7		
Flow CPC (l/min):	1.09			LC	43		
Flow Inlet (l/min):	0.99						
Sheath air flow (l/min):	5.0						
Zero (#/cm ³):	check						
Maintenance							
Aerosol inlet:						-	
Aerosol Nafion dryer:						-	
Sheath Nafion dryer:						-	
Source:						-	
HV power supply:						-	
DMA:						-	
Aerosol/sheath RH/T- sensor:						-	
Pressure sensor:						-	
Filter:						-	
NI-card:						-	
CPC:						-	
Impactor:						Dummy	
Setup settings over night:						-	

Institute: TROPOS							
Station: Reference Instrument No.1							
Date of checking list: 09. 10, 2019							
Instrument/ Components	info	Serial Number	Date/Code	CPC-Status		HV-Status	
MPSS/Classifier:	TROPOS	No.1		ST	39.0	0 V	0
Firmware Classifier:				CT	22.0	5 mV	4.98
Firmware Software:	TROPOS 6.68			OT	40.0	800 mV	999.8
DMA type:	Hauke medium		142	CabT	27.3	200 mV	250.0
CPC model:	TSI 3772	3772141701		AP	98.5	0 V	0
Firmware CPC:	2.15			OP	72.1		
Radioactive source:	Kr.85	NER 8275	002/13	NP	2.8		
Flow Inlet (l/min):	1.017			LC	50		
Zero (#/cm ³):	0						

Institute: TROPOS							
Station: Reference Total CPC							
Date of checking list: 09. 10, 2019							
Instrument/ Components	info	Serial Number	Cut off	CPC-Status			
CPC model:	TSI 3010	2410	D_{p50} 10 nm	ST			
Firmware CPC:				CT			
Flow Inlet (l/min):	1.008			OT			
Zero (#/cm ³):	0			CabT			
				AP			
				OP			
				NP			
				LC			

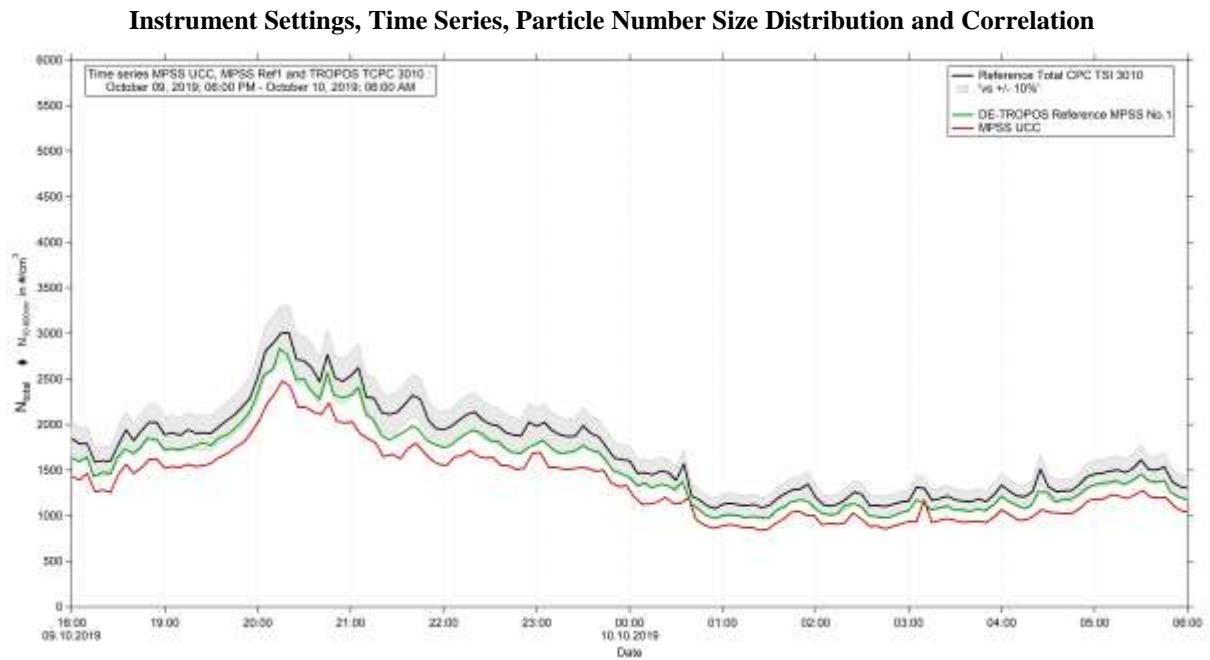


Figure 09: Time series between MPSS Ref1, MPSS UCC and TCPC (Oct. 09, 2019 6 PM – Oct. 10, 2019 6 AM) of the integrated particle number concentration (N10-800nm) of the MPSS and total number concentration of the Reference TSI-CPC Model 3010.

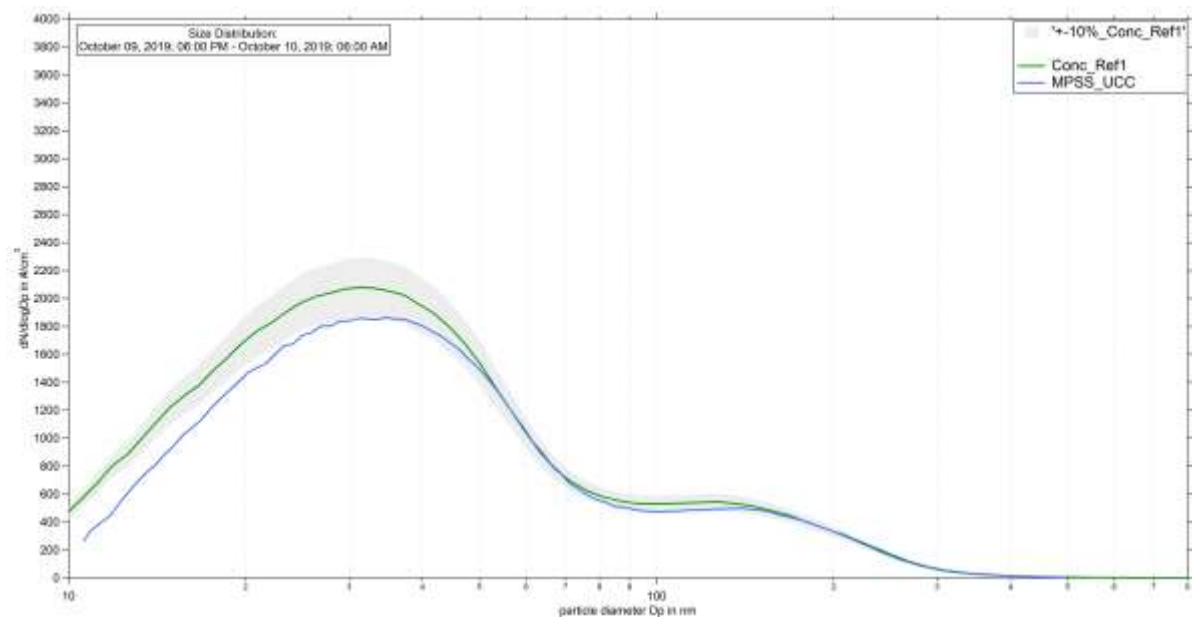


Figure 10: Comparison of mean particle number size distribution of TROPOS Reference MPSS No.1 against MPSS UCC from Oct. 09, 2019 6 PM – Oct. 10, 2019 6 AM.

Final-Status Oct. 10 - 11, 2019

Table No. 4:

Institute: UCC							
Station: Ireland							
Date of checking list: 10.10.2019							
Instrument/ Components	info	SN	Date/Code	CPC-Status		HV-Status	
MPSS/Classifier:	TSI 3082	3082001803002	Jan 2018	ST	39.0	OFF	-
Firmware Classifier:	-		-	CT	22.0	4mv	-
Firmware Software:	TSI AIM		9.0	OT	40.0	800mv	-
DMA type:	TSI 3081A00	3081A1802004	Jan. 2018	CabT	35.4	200mv	-
CPC model:	TSI CPC 3750	3750180301	Jan. 2018	AP	99.7	0	-
Firmware CPC:	-		-	OP	83.1		
radioactive source:	TSI	-	Kr.85	NP	2.7		
Flow CPC (l/min):	0.979			LC	43		
Flow Inlet (l/min):	0.953						
Sheath air flow (l/min):	5.0						
Zero (#/cm ³):	check						
Maintenance							
Aerosol inlet:	checked and cleaned						
Aerosol Nafion dryer:	-						
Sheath Nafion dryer:	-						
Source:	-						
HV power supply:	-						
DMA:	cleaned						
Aerosol/sheath RH/T- sensor:	-						
Pressure sensor:	-						
Filter:	-						
NI-card:	-						
CPC:	Checked and cleaned						
Impactor:	Yes: Nozzle size 0.071 cm						
Setup settings over night:							

Institute: TROPOS							
Station: Reference Instrument No.1							
Date of checking list: 10. 10, 2019							
Instrument/ Components	info	Serial Number	Date/Code	CPC-Status		HV-Status	
MPSS/Classifier:	TROPOS	No.1		ST	39.0	0 V	0
Firmware Classifier:				CT	22.0	5 mV	4.98
Firmware Software:	TROPOS 6.68			OT	40.0	800 mV	999.8
DMA type:	Hauke medium		142	CabT	27.3	200 mV	250.0
CPC model:	TSI 3772	3772141701		AP	98.5	0 V	0
Firmware CPC:	2.15			OP	72.1		
Radioactive source:	Kr.85	NER 8275	002/13	NP	2.8		
Flow Inlet (l/min):	1.017			LC	50		
Zero (#/cm ³):	0						

Institute: TROPOS							
Station: Reference Total CPC							
Date of checking list: 10. 10, 2019							
Instrument/ Components	info	Serial Number	Cut off	CPC-Status			
CPC model:	TSI 3010	2410	D_{p50} 10 nm	ST			
Firmware CPC:				CT			
Flow Inlet (l/min):	1.008			OT			
Zero (#/cm ³):	0			CabT			
				AP			
				OP			
				NP			
				LC			

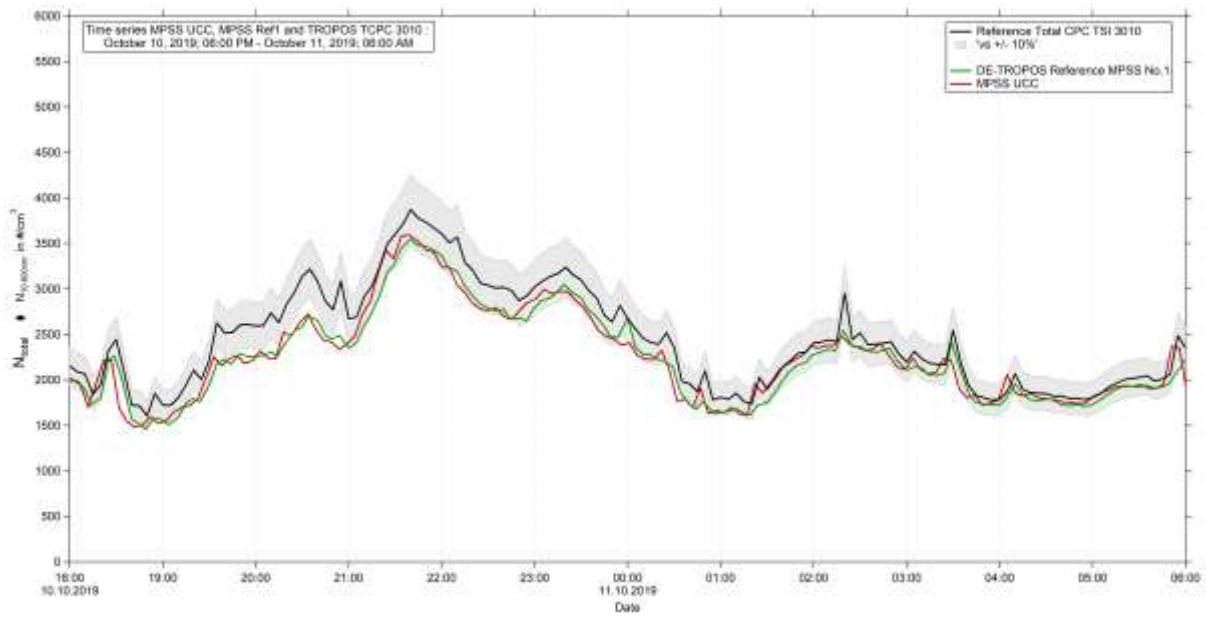


Figure 11: Time series between MPSS Ref1, MPSS UCC and TCPC (Oct. 10, 2019 6 PM – Oct. 11, 2019 6 AM) of the integrated particle number concentration ($N_{10-800nm}$) of the MPSS and total number concentration of the Reference TSI-CPC Model 3010.

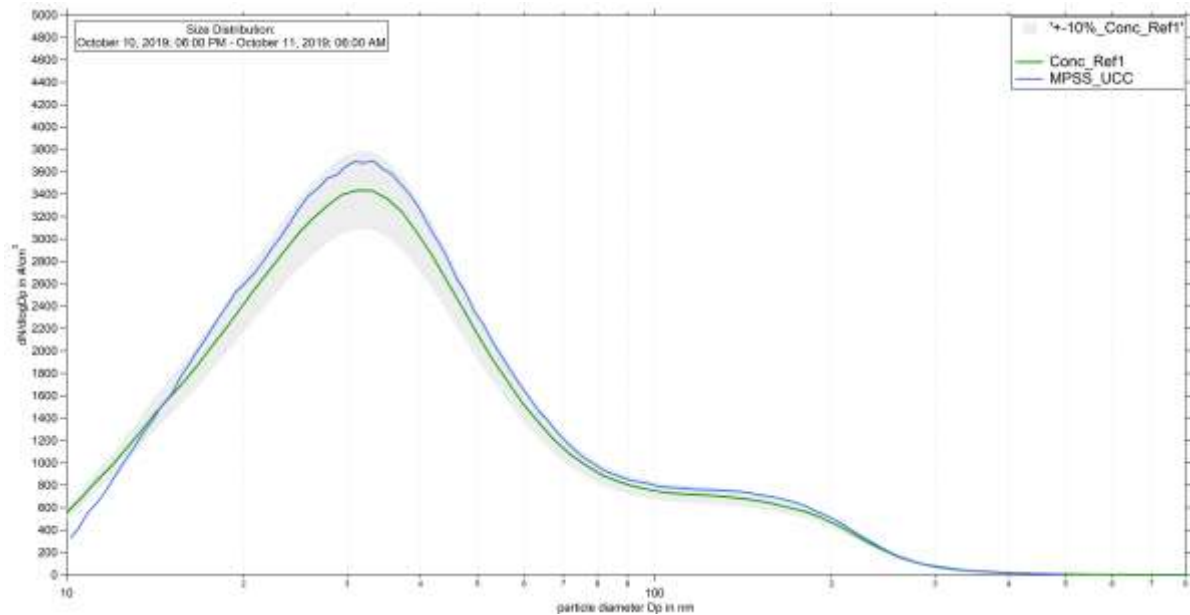


Figure 12: Comparison of mean particle number size distribution of TROPOS Reference MPSS No.1 against MPSS UCC from Oct. 10, 2019 6 PM – Oct. 11, 2019 6 AM.

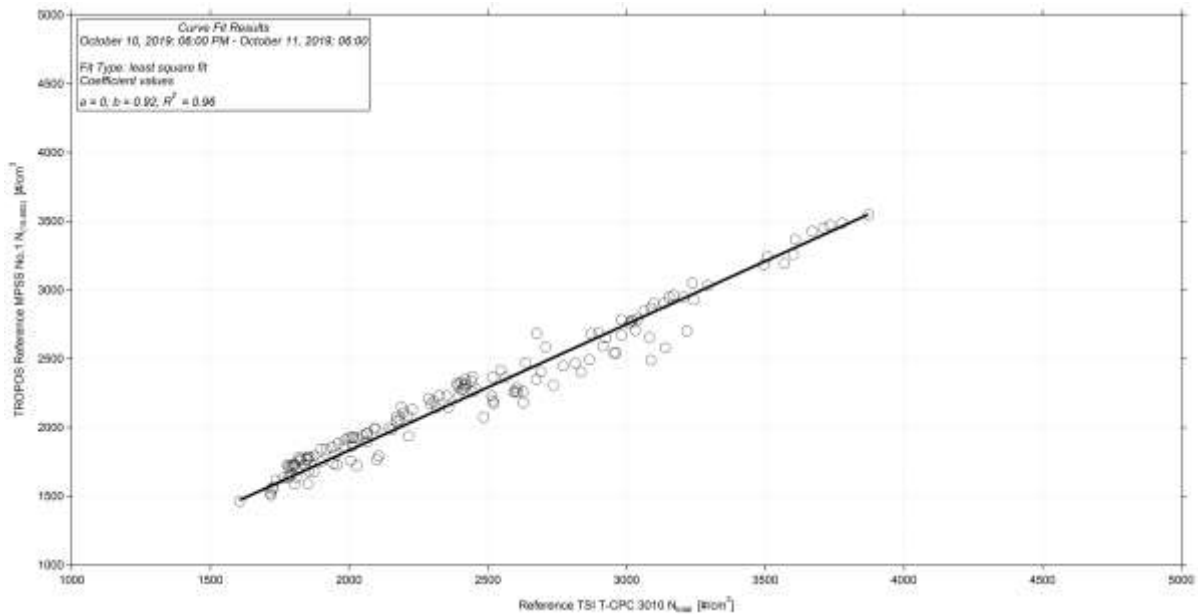


Figure 13: Linear regression between the number concentration of the TROPOS Reference TSI T-CPC Model 3010 and TROPOS Reference MPSS No.1.

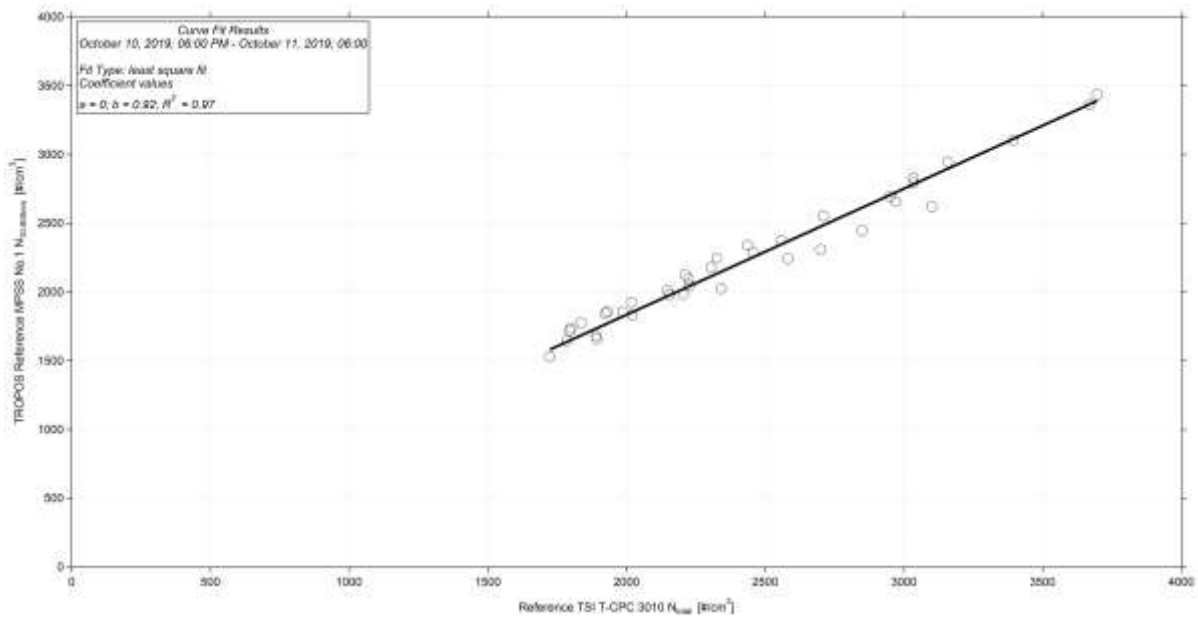


Figure 14: Linear regression between the number concentration of the TROPOS Reference TSI T-CPC Model 3010 and TROPOS Reference MPSS No.1. Data averaged for 20 minutes.

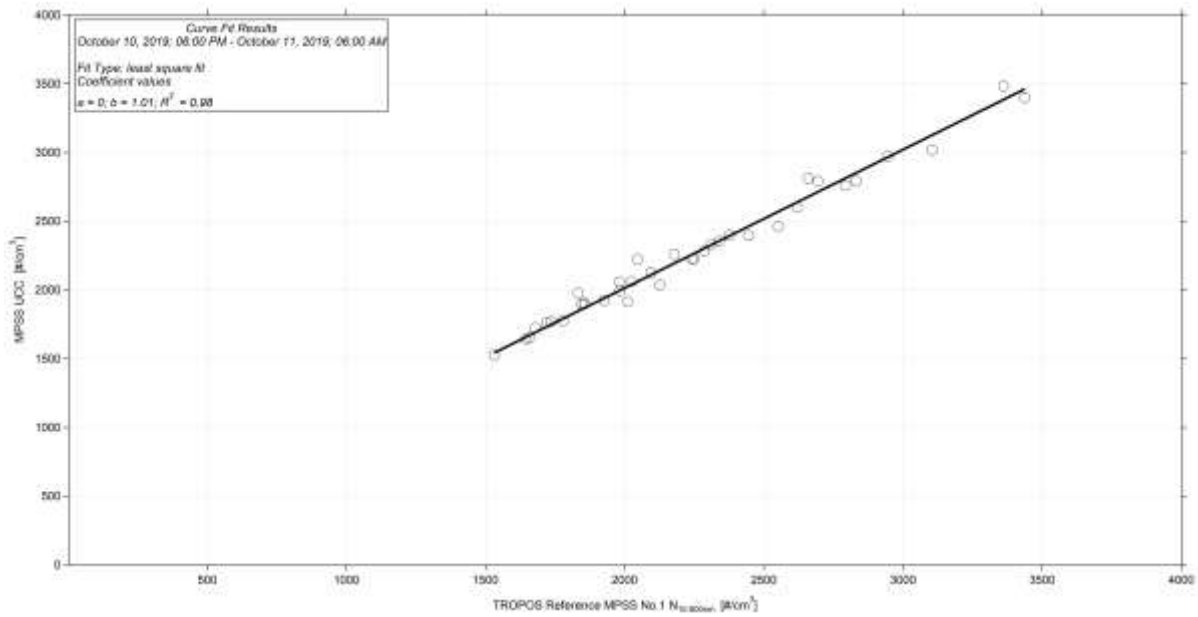


Figure 15: Linear regression between the number concentration of the MPSS UCC-Ireland and TROPOS Reference MPSS No.1. Data averaged for 20 minutes.