Deliverable D3.7: Implementation of closure studies for total particle number concentration

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Comments	This deliverable describes the actual status of the preparation in terms of CPC on-site intercomparison as part of the MPSS quality assurance program.

Introduction

Presently, the quality assurance (QA) of in-situ aerosol instrumentation cannot be performed yearly due capacity or funding limitations, although some instrument types, such as mobility particle size spectrometers (MPSS), should undergo more frequent QA exercises. These spectrometers are relative complex instruments consisting of several independent parts such as the bipolar diffusion charger, the differential mobility analyzer (DMA) and a condensation particle counter (CPC). For the user, it is sometimes difficult to observe if one part of the whole system does not perform well anymore. An alternative way to detect instrument malfunctions would be the operation of different instruments in parallel, providing the same physical aerosol parameter. This is called a closure study. In the case of MPSS, one can perform a closure studies for total particle number concentration by operation a second CPC parallel to the MPSS. The integral over the particle number size distribution of the MPSS should be comparable within 10% against the directly measured particle number concentration of the second CPC.

Within WP3 of ACTRIS2, it is planned to employ five travelling CPCs for such on-site closures studies. In the beginning, all CPCs are calibrated at the ECAC-WCCAP calibration facility in Leipzig, and the lower detection efficiency diameter limit is adjusted to 10 nm. Each CPC will then travel from station to station (see Table 1). At the station, the CPC should be operated at least two weeks in parallel to the MPSS before it will be sent to the next station. At the end of the round robin tour, the CPC will be quality-assured again at the calibration center WCCAP. Then, the round robin tour will the repeated. Since the number of stations is different for each CPC and shipping time is an unknown factor, each round robin tour may take six month or longer. However, the plan is the have a QA of the MPSS against a CPC at least once per year for each participating station.

Preparation

CPCs (TSI model 3772) of five different institutions (TROPOS, PSI, UHEL, NILU, CNRS) will be sent for the round robin tour.

The CPCs
1. underwent performance calibration
2. have been cleaned (if necessary)
3. have been adjusted to a lower particle detection efficiency diameter of 10 nm
4. have been calibrated for their counting efficiency curve

The calibration curves of the entrance and adjustment calibrations are shown below:
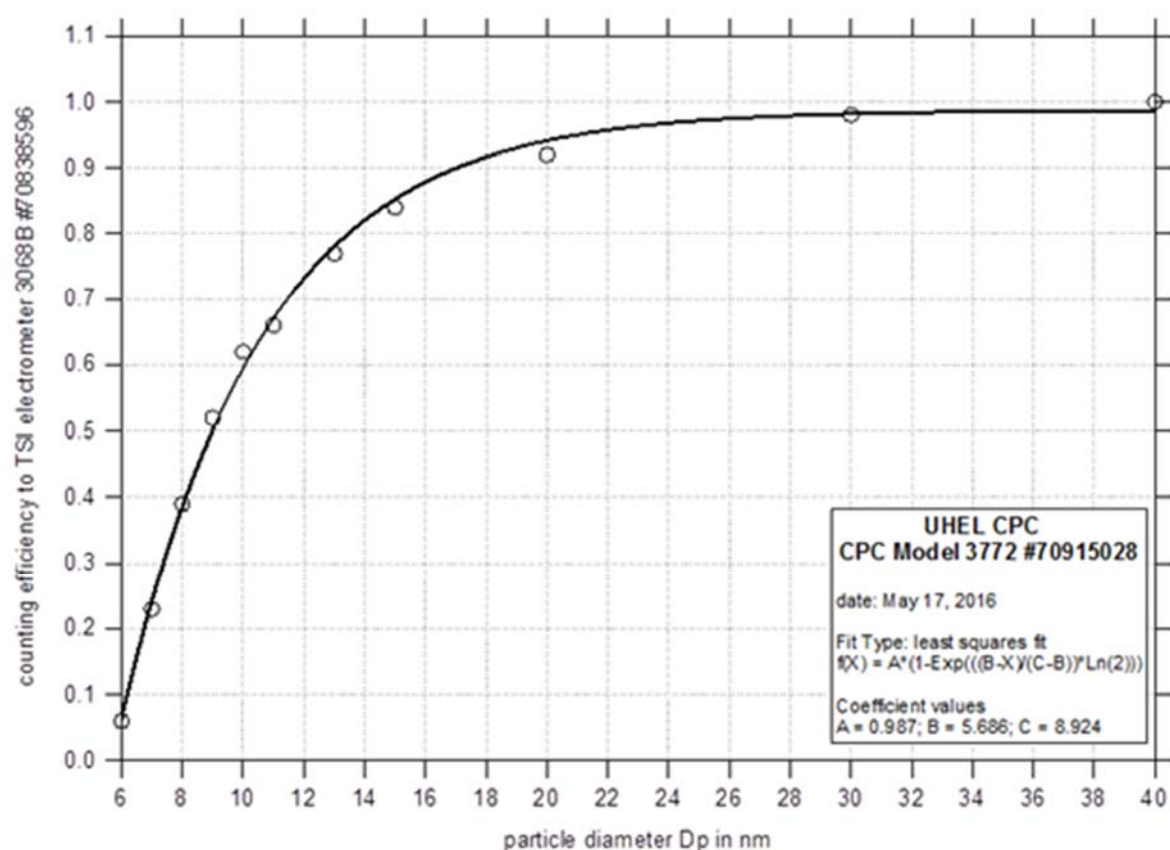
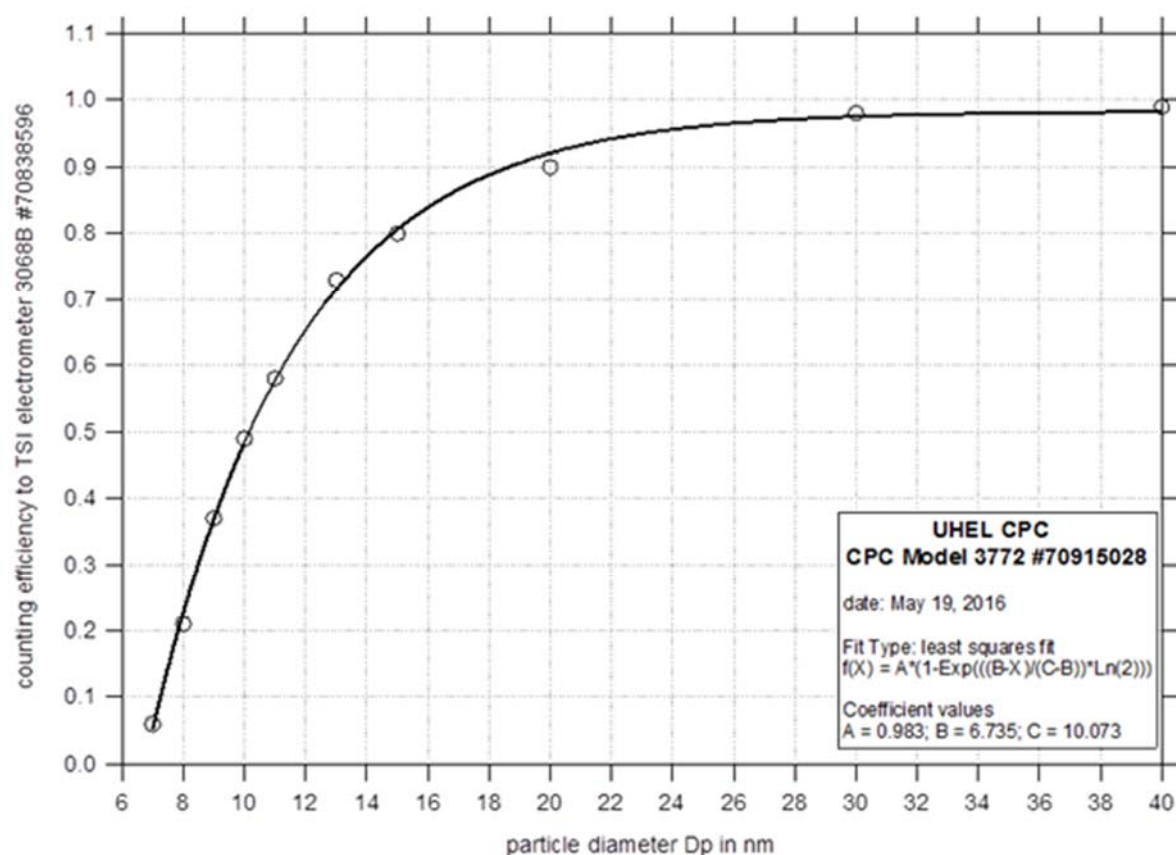Figure 1: Entrance calibration of the UHEL CPC

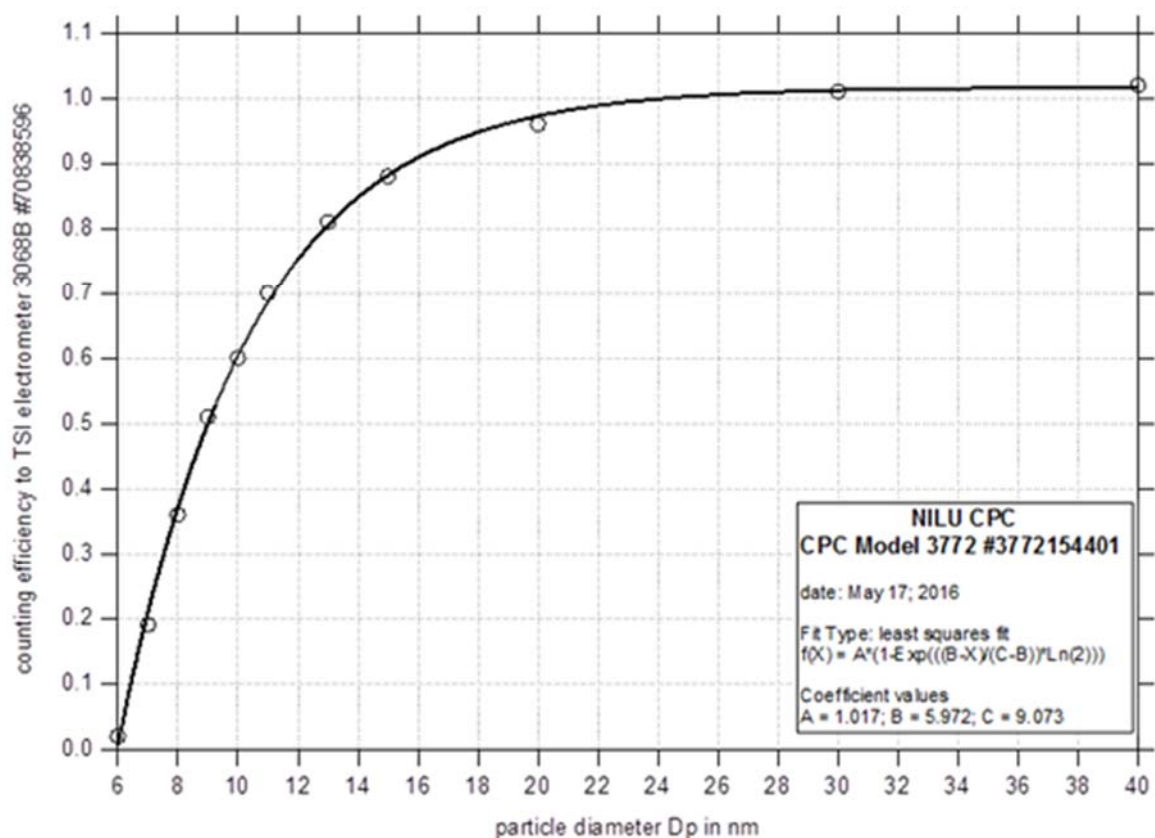Figure 2: Adjustment calibration of the UHEL CPC

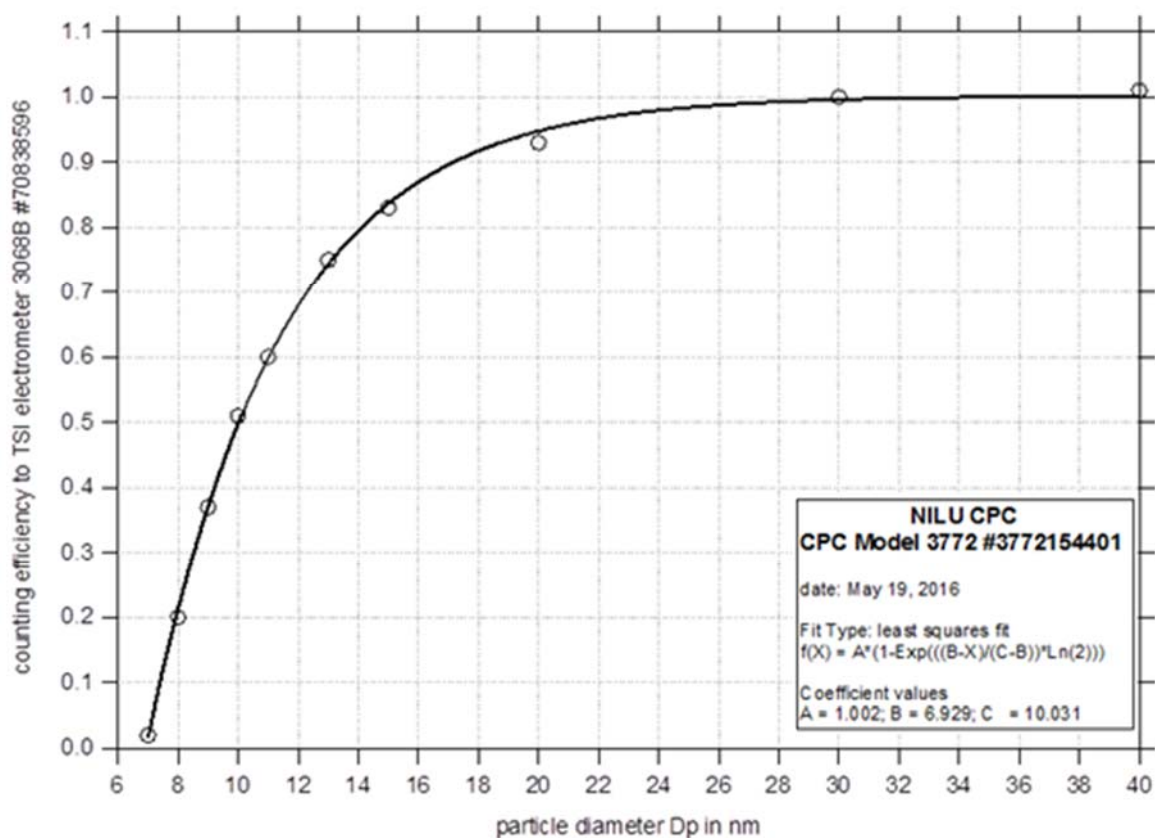Figure 3: Entrance calibration of the NILU CPC

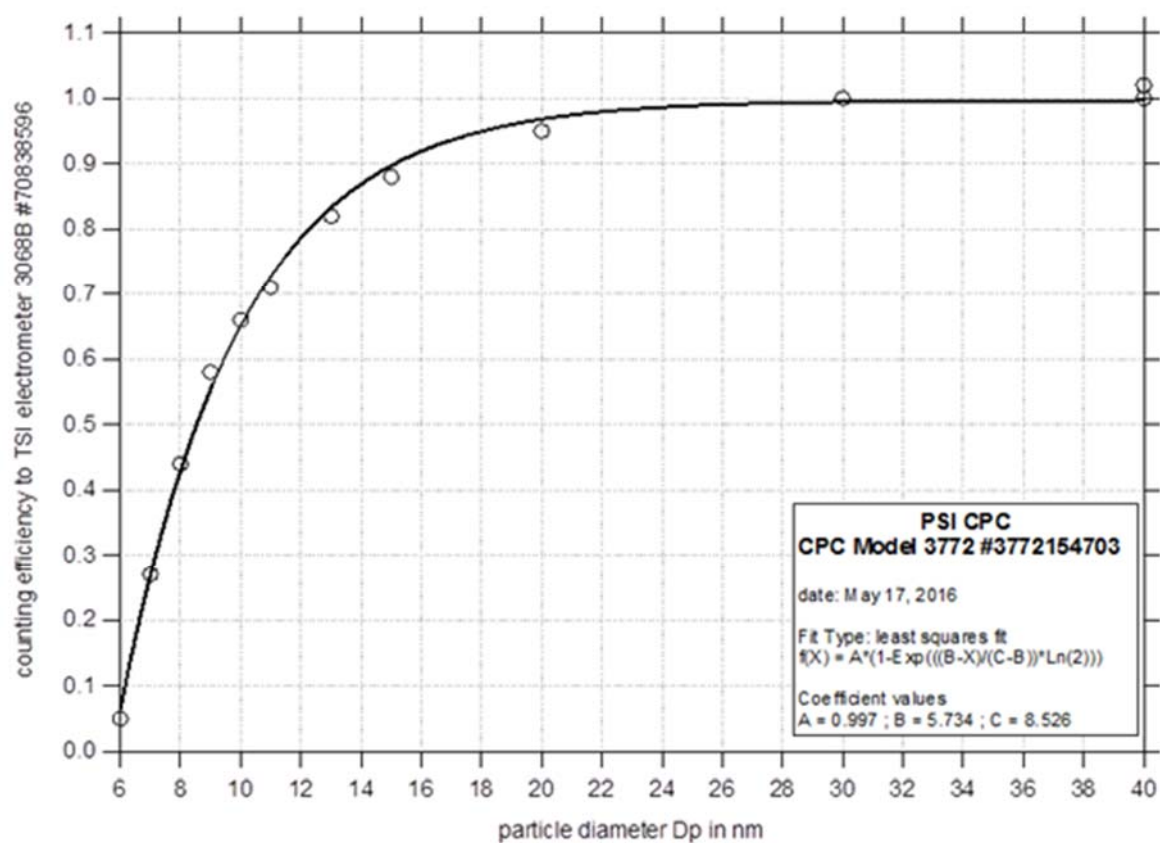Figure 4: Adjustment calibration of the NILU CPC

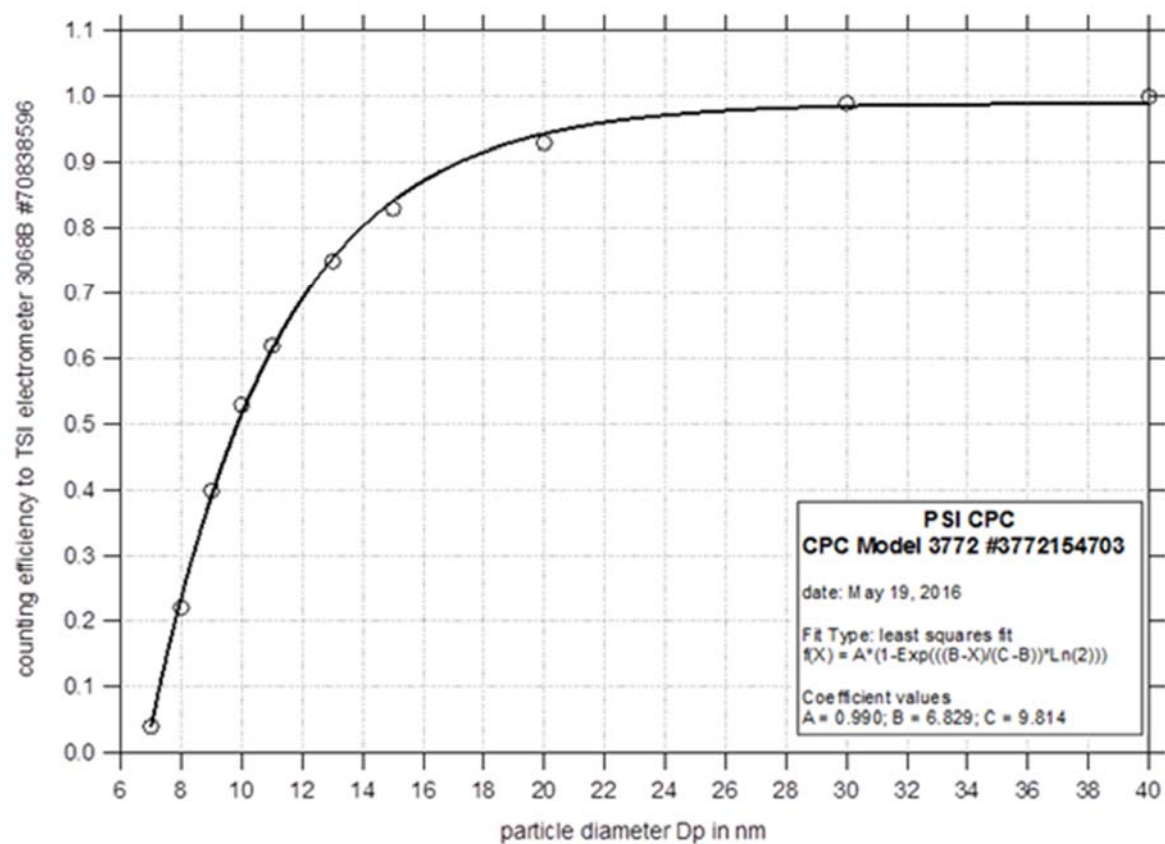Figure 5: Entrance calibration of the PSI CPC

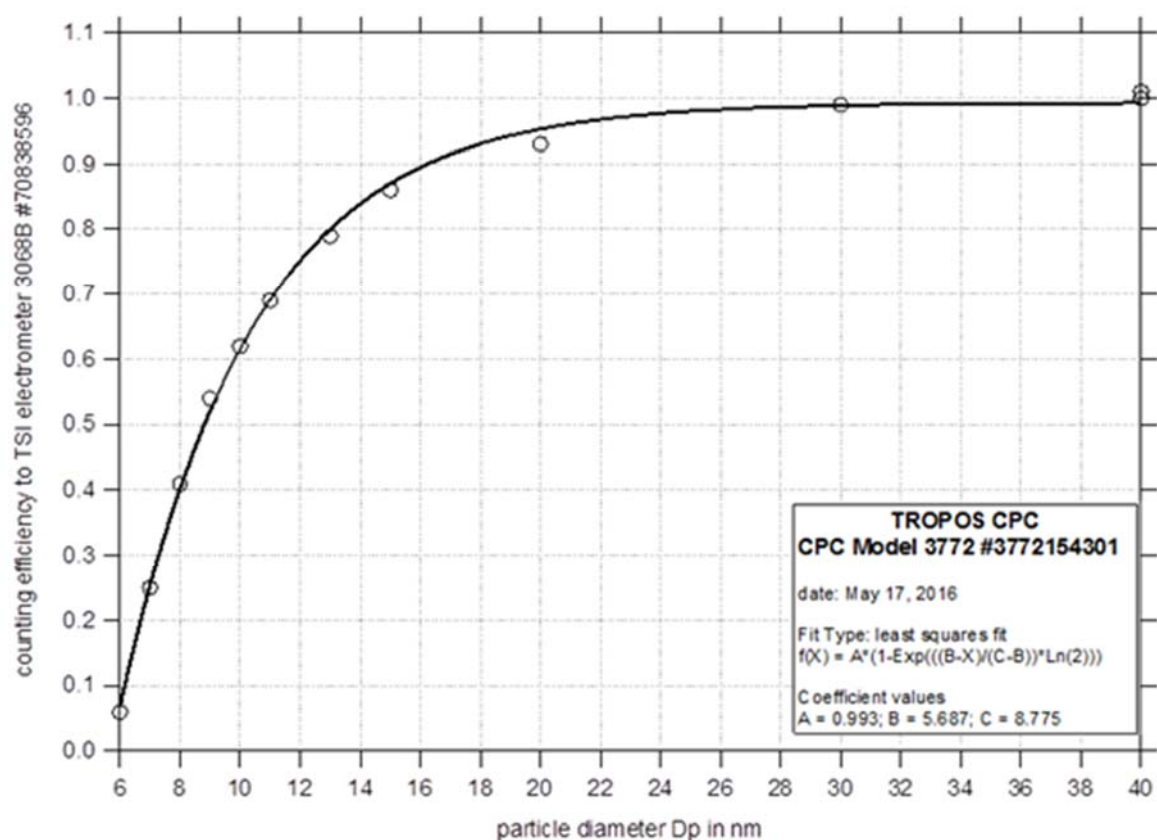Figure 6: Adjustment calibration of the PSI CPC

Figure 7: Entrance Calibration of the TROPOS CPC

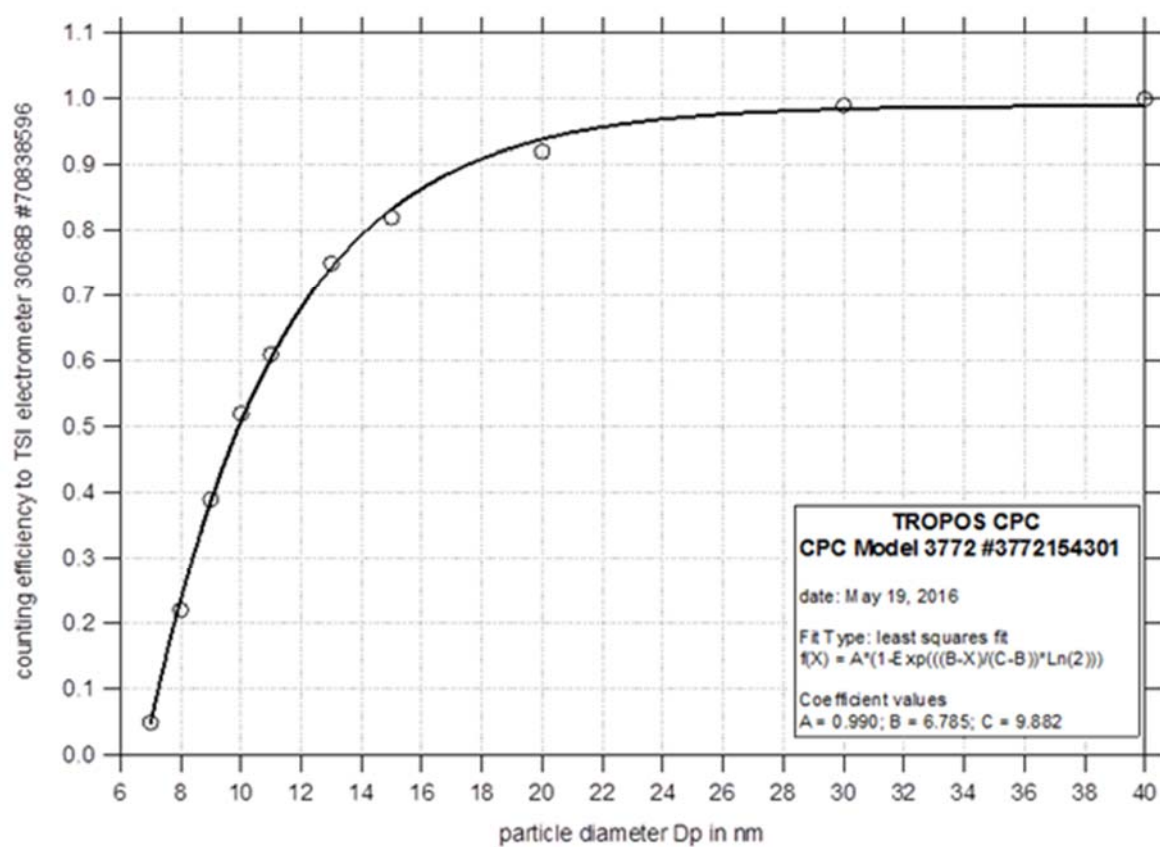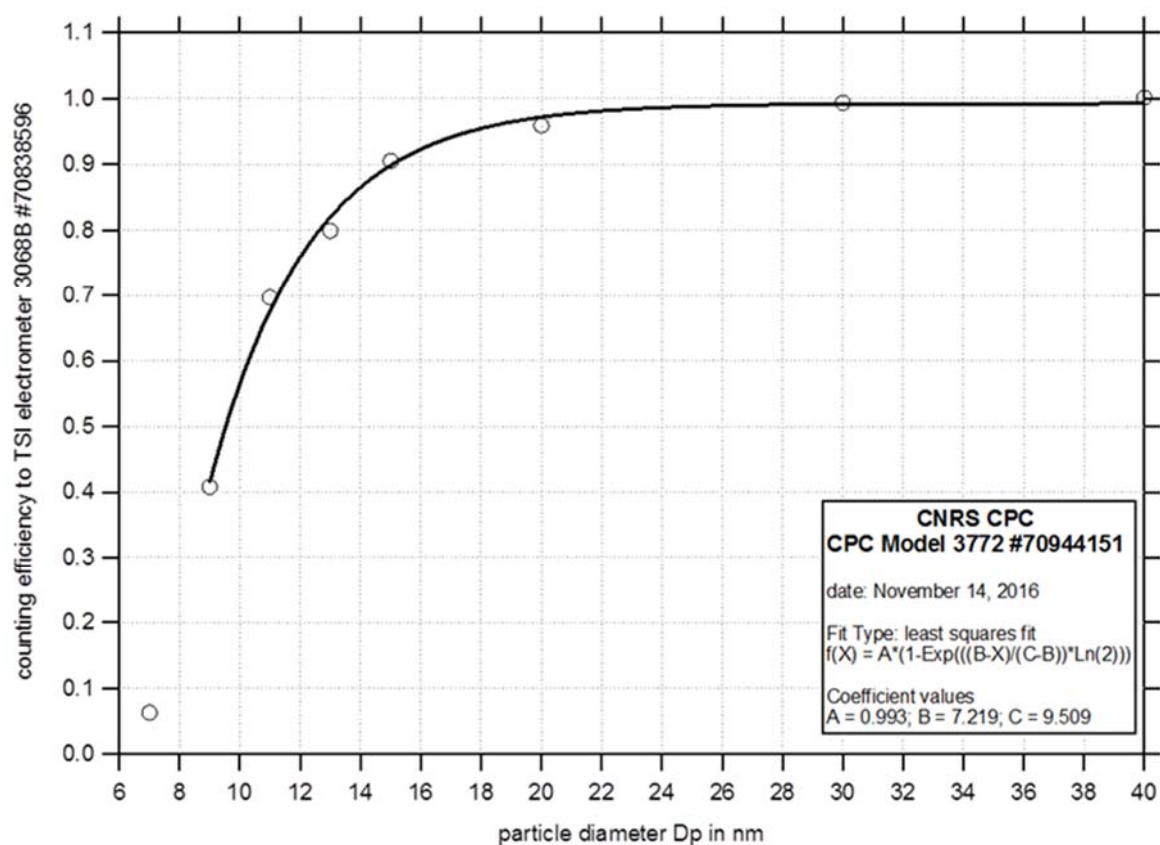
Figure 8: Adjustment calibration of the TROPOS CPC
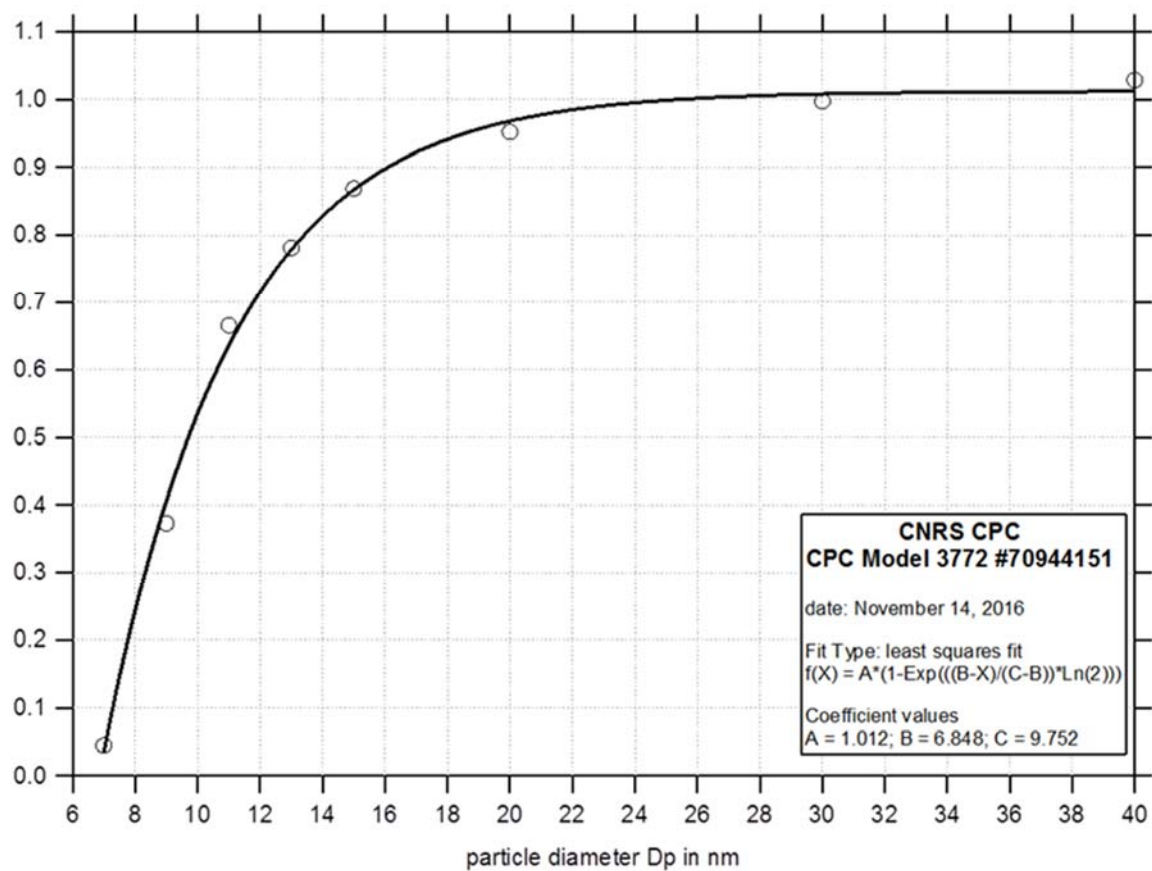
Figure 9: Entrance Calibration of the CNRS CPC

Figure 10: Adjustment calibration of the CNRS CPC

Round Robin Tour

Presently, the following round robin tours are planned. The list could however be extended or shortened as necessary.

ACTRIS CPC Round Robin Tour			
Country	**Station name**	**Responsible person**	**Email**
BOX1 NILU CPC			
CZ	Kosetice	Vladimir Zdimal	Zdimal@icpf.cas.cz
CZ	Prague	Vladimir Zdimal	Zdimal@icpf.cas.cz
B	Vielsalm	Benjamin Bergmans	b.bergmans@issep.be
NL	Cabauw	Bas Henzing	bas.henzing@tno.nl
NO	Zeppelin*	Chris Lunder	chris.lunder@nilu.no
NO	Birkenes*	Chris Lunder	chris.lunder@nilu.no
BOX2 - UHEL CPC			
FI	Hyytiälä	Pasi Aaalto	pasi.p.aalto@helsinki.fi
FI	Pallas	Asmi Eija	eija.asmi@fmi.fi
S	Vavihill/Hyltemossa	Adam Kristenson	adam.kristensson@nuclear.lu.se
S	Aspvreten/Norunda	Radovan Krejci	Radovan.Krejci@aces.su.se
D	Hohenpeissenberg	Harald Flentje	flentje@dwd.de
D	Melpitz	Kay Weinhold	weinhold@tropos.de
BOX3 - CNRS CPC			
CY	Agia Marina Xyliatou	Jean Sciare	j.sciare@cyi.ac.cy
GR	Finokalia	Nikolaos Mihalopoulos	mihalo@uoc.gr
GR	DEM Athens	Konstantinos Eleftheriadis	elefther@ipta.demokritos.gr
BG	BEO Moussala	Ivo Kalapov	ivokalapov@gmail.com
F	SIRTA/Gif	Valérie Gros	valerie.gros@lsce.ipsl.fr
F	Pic du Midi	Véronique Pont	veronique.pont@aero.obs-mip.fr
F	La Réunion *	Pierre Tulet	pierre.tulet@univ-reunion.fr
F	Puy de Dome	Karine Sellegri	K.Sellegri@opgc.univ-bpclermont.fr
BOX4 - TROPOS CPC			
E	Granada	Juan Andrés Casquero	casquero@ugr.es
E	Arenosillo	Mar Sorribas Panero	sorribas@inta.es
E	Montseny	Noemi Perez	n.perezlozano@gmail.com
E	Madrid	Francisco J Gomez	fj.gomez@ciemat.es
E	Izana*	Sergio Rodriguez	srodriguezg@aemet.es
BOX5 - PSI CPC			
HU	K-Pustza	András Hoffer	hofferandras@gmail.com
M	Giordon Lighthouse	David Munao	david.munao@um.edu.mt
I	Lecce	Daniele Contini	d.contini@isac.cnr.it
I	Lamezia Terme	Claudia Calidonna	cr.calidonna@isac.cnr.it
I	Monte Curcio	Francesca Sprovieri	sprovieri@iia.cnr.it
I	JRC Ispra	JP Putaud	jean.putaud@jrc.ec.europa.eu
CH	Jungfraujoch*	Martin Gysel	martin.gysel@psi.ch
*carnet is needed			
German TROPOS stations (Leipzig-TROPOS , -Mitte & -EiBa) are quality-assured once per year			
German UBA stations (Zugspitze, Schauinsland, Waldhof & Neuglobsow) are quaility assure twice per year			
The Czech station Usti is presently quality-assured few times per year, in the frame of a regional EU-project			

Table 1: Round robin tour list

Each CPC will be safely packed in an aluminum box in which detailed instructions are given in a folder. The instruments will come with a butanol bottle (butanol has to be provided by the station), an SD card for logging the CPC time series as well as other small useful parts.

Figure 11: Aluminum box for the round robin CPCs

Appendix:

Manual inside of the transport box

<u>Cover letter:</u>

Dear User,
In this box, you receive a reference condensation particle counter (CPC), which should be used in the ACTRIS on-site intercomparison exercise as part of the quality assurance program for your mobility particle size spectrometer (MPSS). The CPC should be operated parallel to the MPSS at your station to be able to compare the MPSS integral particle number concentration to the CPC.

Please read this manual carefully and fill out all necessary parts to make this "ACTRIS Round-Robin Tour" successful. You will find the manual together with the CPC in a folder labelled "Manual – ACTRIS Round-Robin Tour". This manual is divided into several chapters. The structure will lead you to the "step by step" instructions how to the CPC setup, the data handling and data submission. Furthermore, the tables in this manual will help us acquire all the necessary CPC-related information during the intercomparison. So, please fill out all this tables.

Due to a TSI-CPC software problem, it is necessary to restart the data logging twice per week, e.g. Monday and Friday. Laboratory tests showed a maximum logging time with the SD memory cards of five days.

The MPSS-CPC intercomparison should last for about 2 full weeks of valid data. After the intercomparison, please make a copy of the data from the SD-card and send them via e-mail together with your Level-1 MPSS-data to TROPOS, including loss correction for the size spectrometer only. Place the manual back in the box and ship it together with the instrument to the next institute.

If there are any questions, problems, or missing spare parts, you may contact:

Kay Weinhold
  e-mail: weinhold@tropos.de
  mobile phone: +49 (0) 174-3033239

Checklist:

Table A1. Checklist of the contents of the box. To be checked upon arrival.

Item	Available	Operating condition	Sample image
1x manual from TROPOS			
1x TSI CPC Model 3772 SN: 3772154301			
1x CPC power cable			
1x SD card 2GB from "ScanDisk" with adaptor			
1x SD card reader from "LogiLink"			
1x y-splitter			
3x black tubes (40cm)			
1x zero filter			
2x bottles (1 Fill bottle and 1 Drain bottle)			
1x vacuum connection ¾ or ¼ inch			

Setup instructions:

The installation of the TROPOS CPC, TSI Model 3772, (from this point denoted as "Ref CPC") should be close to the MPSS. We would like to avoid long tubes with additional particle losses by diffusion. For transparent documentation, the whole setup should be documented with photos. The internal time of the Ref CPC has to be set to the same time as the MPSS.

Place the CPC on a safe and stable surface (e.g. on top of the MPSS), preferably as close as possible to the MPSS inlet, like shown in the following picture.

Figure A1:

Remove both black dirt caps that cover the inlet (front) and the vacuum line socket (back).
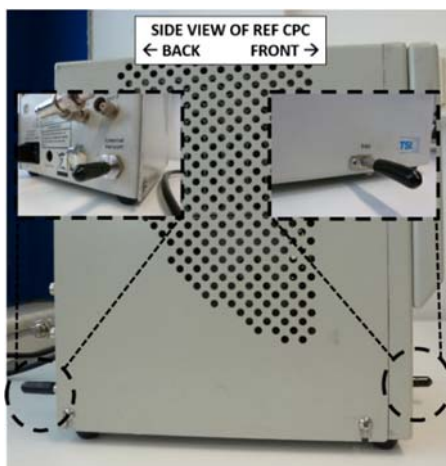

Figure A2:

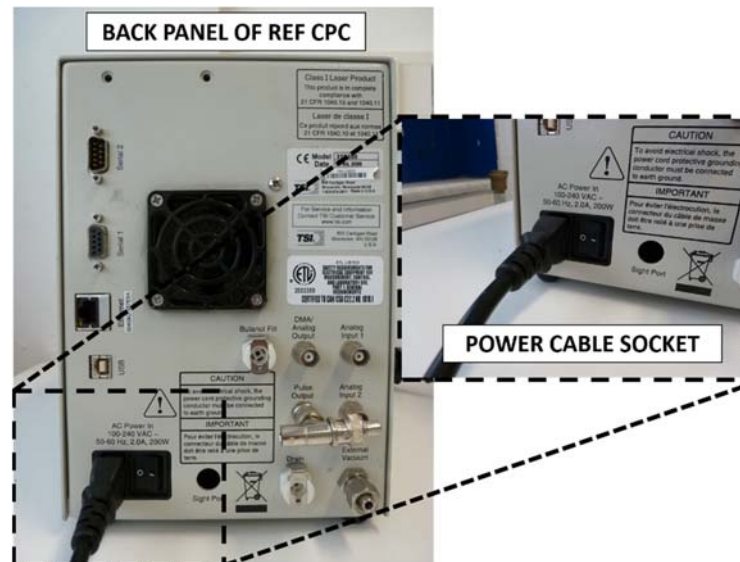Connect the power cable to the back panel of the Ref CPC.

Figure A3:

Connect the Ref CPC to a vacuum pump using the white tube. You may use the same vacuum pump that is connected to the MPSS.
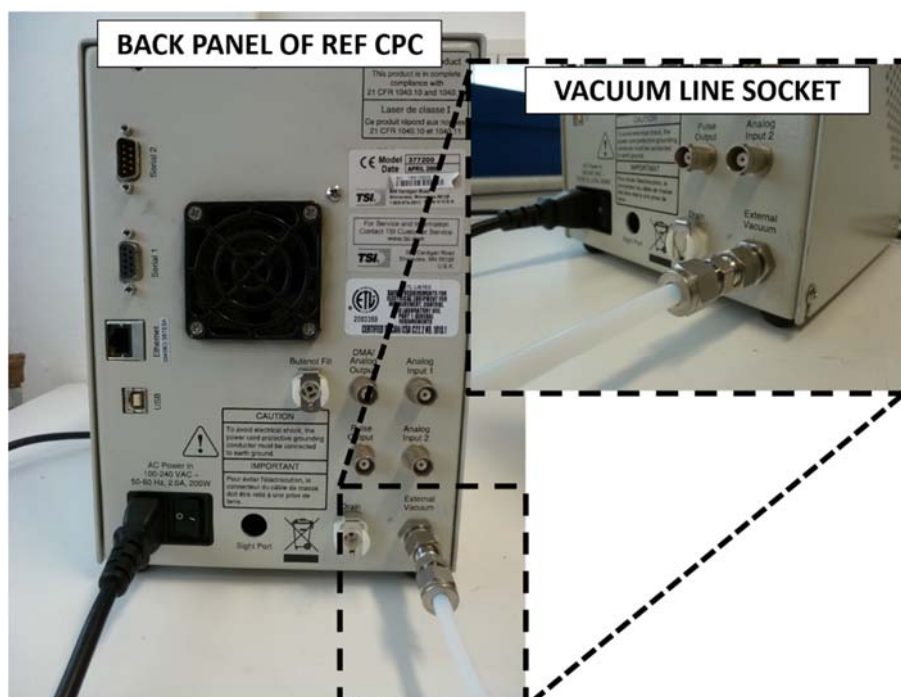

Figure A4:

Connect the Ref CPC and MPSS to the inlet system using the "Y-splitter" and the black tubes. Take the first black tube and connect one end to the inlet of the Ref CPC. Take the second black tube and connect it to the inlet of the MPSS. Connect the ends of both black tubes to the angled legs of the "Y-splitter". Take the third and last black tube, connect one end to the last open part of the Y-splitter. Then connect the other end of this black tube to the main inlet. Make sure you follow the correct orientation of the Y-splitter as shown in the image below. Note: Use only TROPOS provided materials for this set-up.
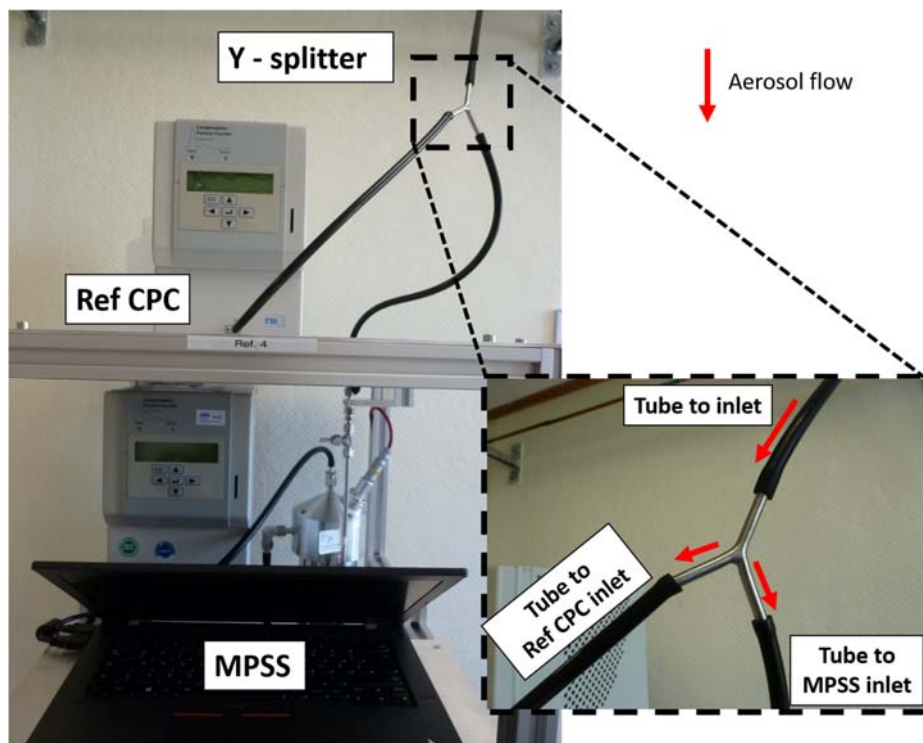
Figure A5:

Connect the butanol bottle with the label "CPC FILL bottle" to the back panel of the Ref CPC to fill it with butanol.
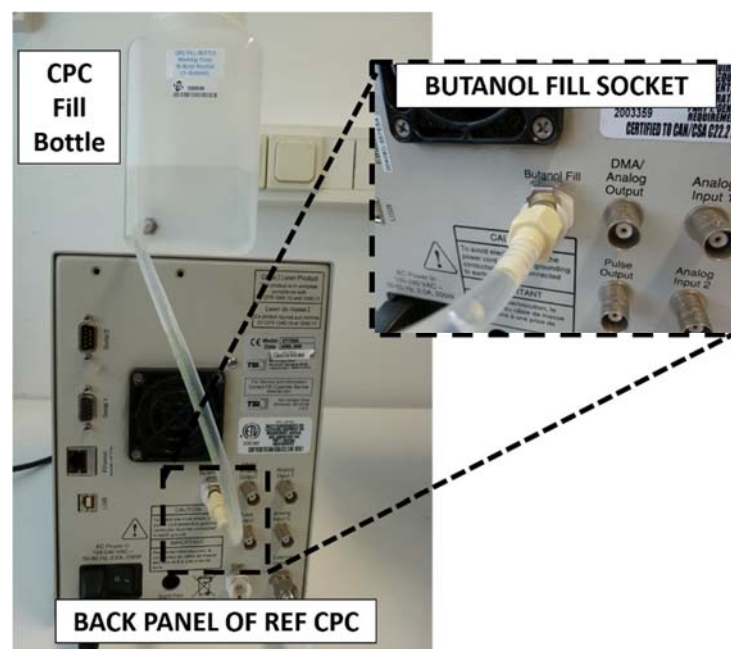

Figure A6:

If there is no aerosol dryer in the main inlet system, you need to activate the "water removal" function which can be found in the "USER SETTINGS". Connect the butanol bottle with the label "DRAIN BOTTLE" to the back panel of the Ref CPC in the port labeled "DRAIN".
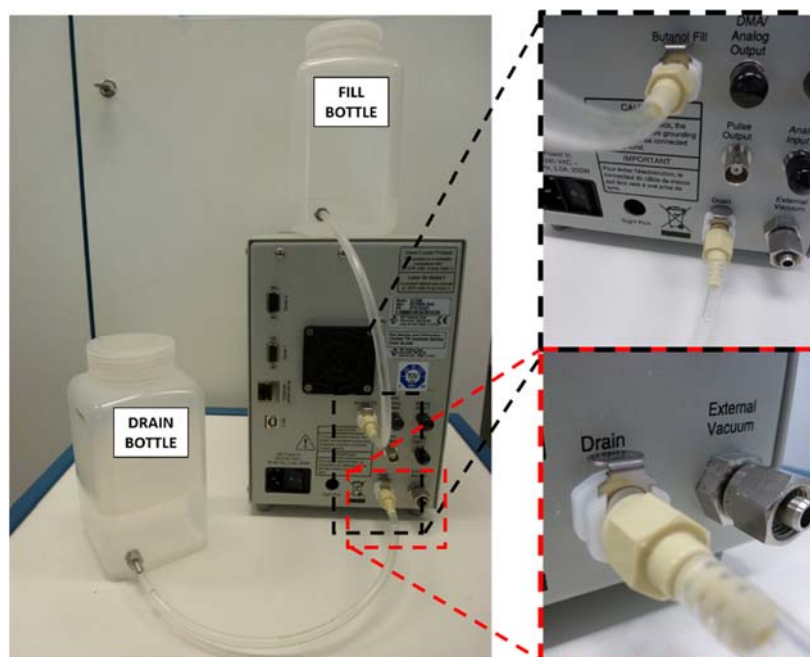
Figure A7:

Switch on the Reference TSI CPC. It takes minimum 10 minutes to warm up. The warm up process is shown on the display of the Ref CPC.
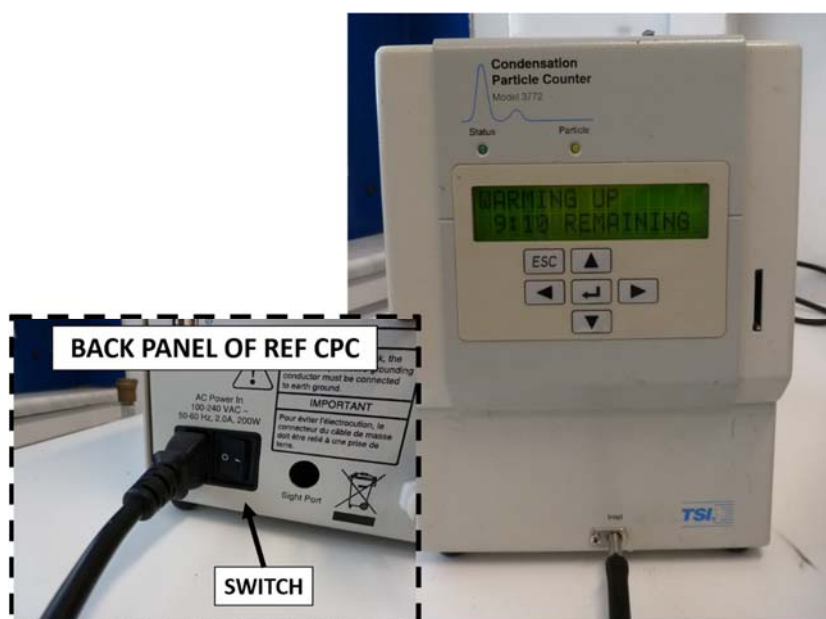

Figure A8:

Place the SD Card in the slot on the front panel of the Ref CPC.

Figure A9:

Change the "Data Averaging" on the CPC to **60 s**. For this you have to go to the "settings mode". Press the "down" button until you see "USER SETTINGS: TO VIEW" on the display. Press the middle button to select. Press the "right" button until the display shows 60 s.
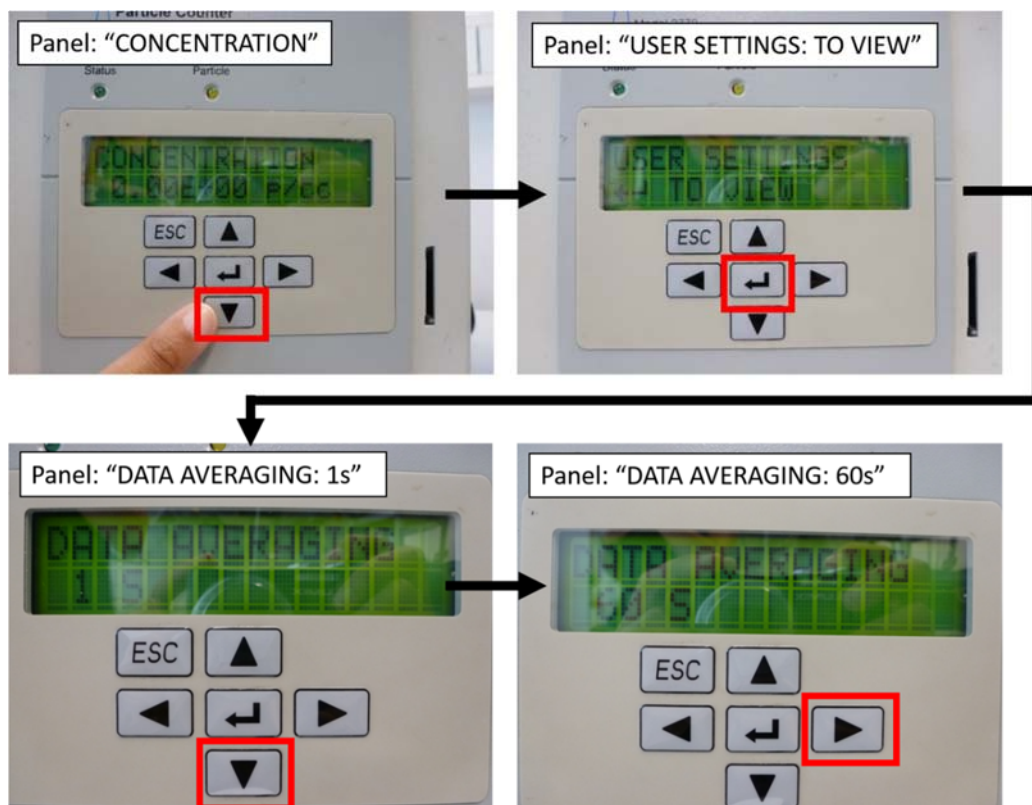

Figure A10:

Start data logging by pressing the "down" button again until "DATA LOGGING: OFF" is displayed. Press the "right" button to turn the data logging ON. Once done, press the ESC button to return to the main display: "CONCENTRATION":
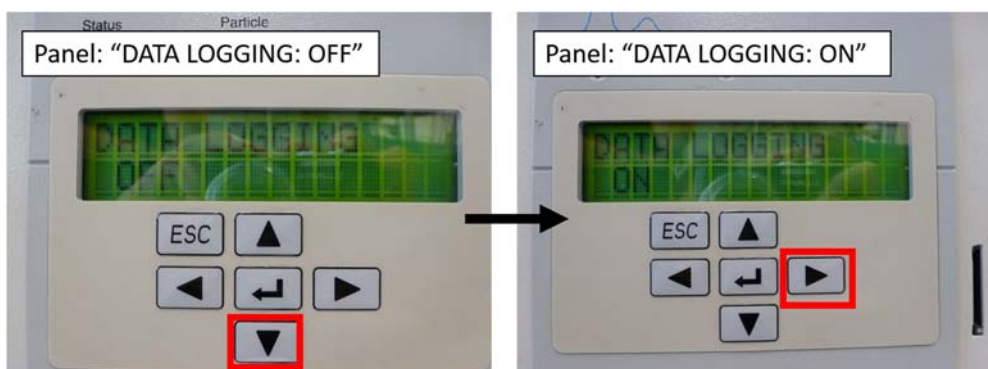
Figure A11:

Check if the "status –LED" on the front panel of the CPC is **green**. If not, check the status points of the CPC or contact TROPOS.

Figure A12:

Zero check. Remove the end of the black tube connected to the main inlet. Use the blue filter or "zero filter" and place it in this open end. Check over 30 minutes that both instruments get a clear zero count.
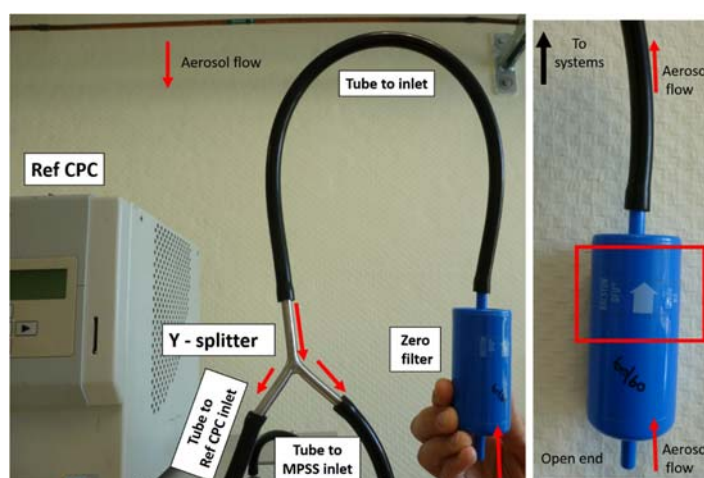

Figure A13:

Flow check. Measure the flow of EACH SYSTEM. For the Ref CPC, the flow should be approximately 1l/min. Take note of the measured flow.