Calibration workshop on Cloud Condensation Nucleus Counters

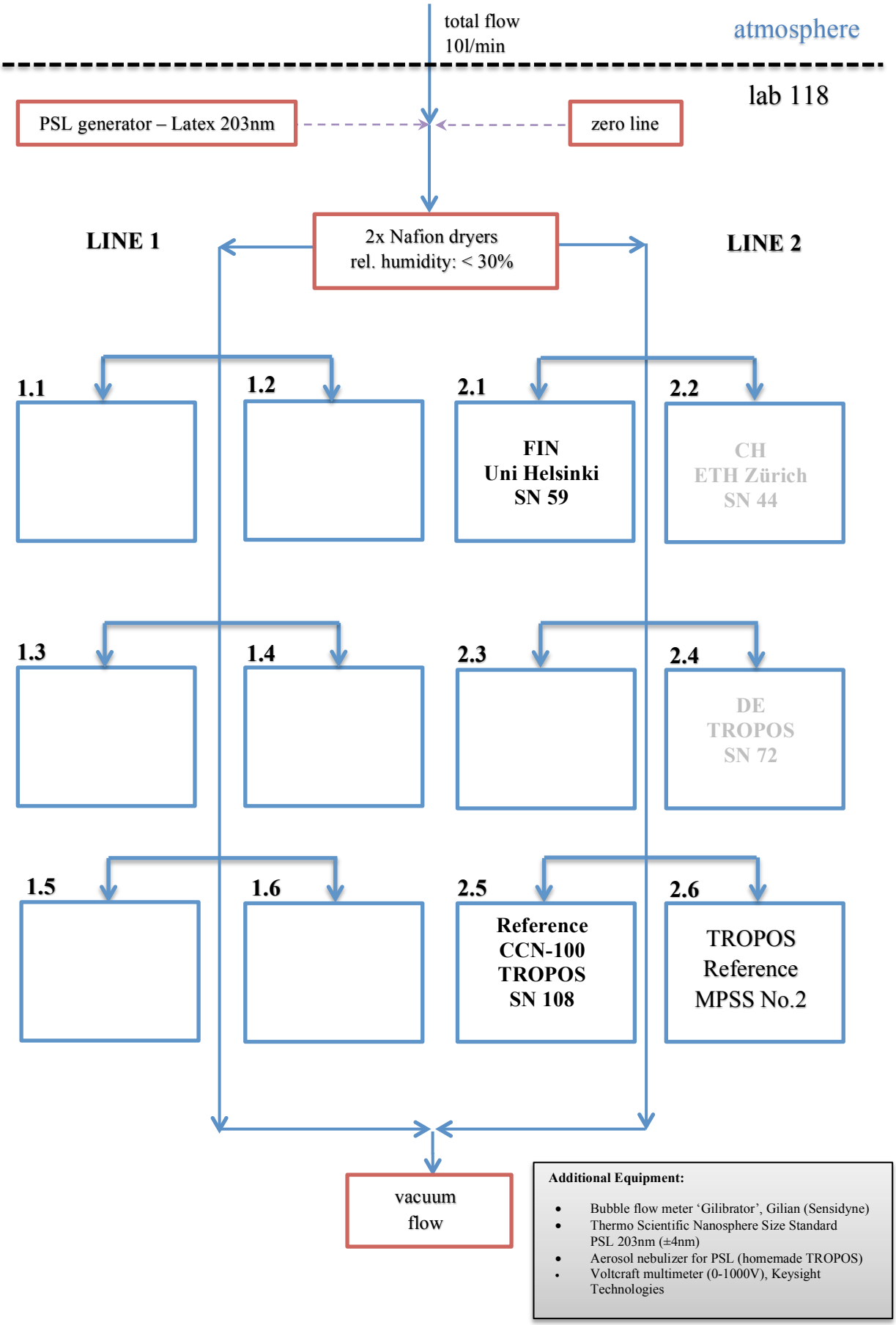
Project No.:	***CCNC-2016-1-2***
Principal Investigator:	
Home Institution:	*Finland, Uni Helsinki*
Participant:	
Candidate:	**CCN-100**
Made by:	DMT
Counter (SN):	CCN-100, SN 0508-59
Software:	DMT 4.0.4
Location of the quality assurance:	TROPOS Leipzig, lab 118
Comparison period:	October 24, 2016 – October 28, 2016
Last Intercomparison (with Project No.):	

Summary of Intercomparison

Pre-Status:
The instrument arrived with participant. The column was wetted and a pre-status measurement was done on ambient aerosol. During the Pre-Status, the performance of the system showed relative differences of -15.2% to +15.8% compared with the TROPOS Reference Instrument SN108 for supersaturation between 0.1% and 1.0%. The system was operated with a flow of 500ml.

Final Status:
The new parameters for flow and supersaturation calibration were set. During the Final Status the performance of the system showed relative differences of -7.2% to +2.7% compared with the TROPOS Reference Instrument SN108 for supersaturation between 0.1% and 1.0%. The candidate passed the quality standards of ACTRIS and GAW.

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

Supersaturation calibration protocol (Ammonium Sulfate Particle, size selected by TROPOS Reference MPSS No.2)

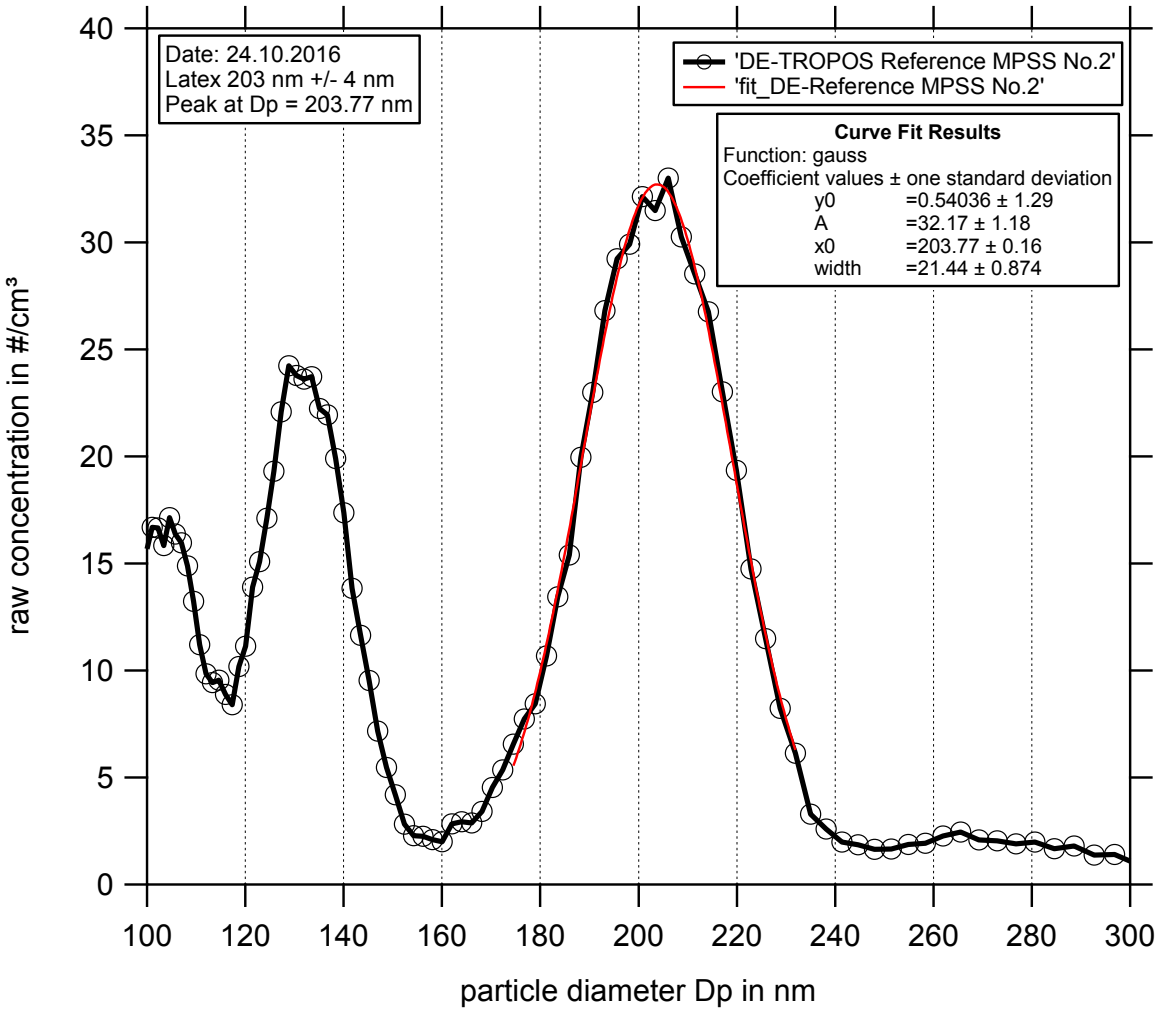


Figure 01: Measurement of latex 203 nm: Particle size distribution (raw concentration) for latex 203 nm on October 24rd, 2016.

Pre-status settings:

Date of check: 24.10.2016

Calibration tab settings	ETH DMT-CCN-100
Sample slope	64.251
Sample y-intercept	-146.36
Sheath slope	1091.6
Sheath y-intercept	-2486.2
Temp gradiet slope	17.553
Temp gradient intercept	1.0247

Zero-test with filter: passed (< 0.01 particles cm-3)

Candidate against TROPOS CCN-100 SN 108 during the pre-status: Time Series

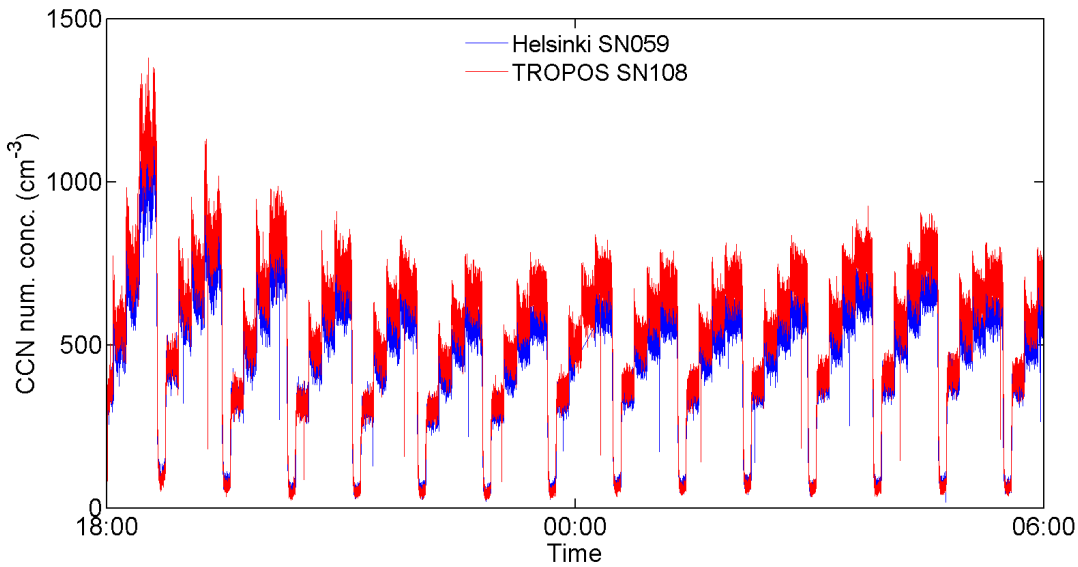


Figure 02: Time series (Oct 24, 2016 06:00 pm – Oct 25, 2016 06:00 am) of the Candidate vs. TROPOS CCN-100 SN-108.

Candidate against TROPOS CCN-100 SN 108 during the pre-status: average over supersaturation

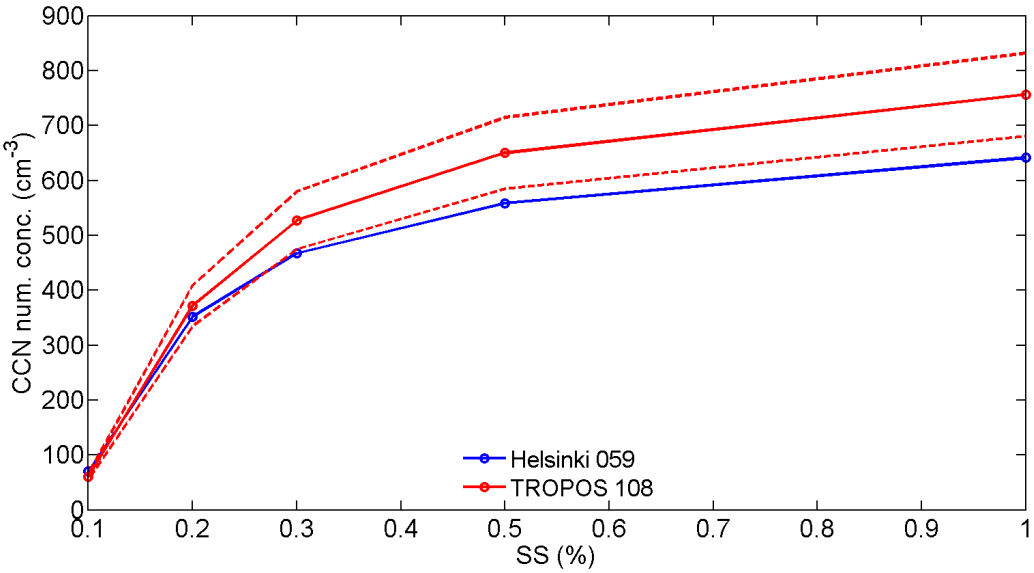


Figure 03: Average (Oct 24, 2016 06:00 pm – Oct 25, 2016 06:00 am) of the Candidate vs. TROPOS CCN-100 SN-108.

Flow calibration protocol (Bubble flow meter 'Gilibrator', Gilian (Sensidyne))

	Old	New		Old	New
Sample Slope	44.7195	64.293	Sheath Slope	1077.4	1083.6
Sample intercept	-98.8517	-145.24	Sheath intercept	-2349	-2365.3

Sample Calibration Without Sheath

Valve Set (V)	Sample Volt (V)	Sheath Volt (V)	Measured Total Flow (mlpm)
1.55	3.11		55.41
1.5	2.78		32.6
1.52	2.96		44.96
1.48	2.62		23.89
1.57	3.33		67.53
1.58	3.44		76.88

Sheath Calibration

Valve Set (V)	Sample Volt (V)	Sheath Volt (V)	Measured Total Flow (ml	Sample Calcu (mlpm)	Sheath Flow (mlpm)
1.58	2.35	2.25	67.82	5.84855	61.97145
2	2.92	2.59	496.2	42.49556	453.70444
2.2	3.39	2.85	781.7	72.71327	708.98673
1.8	2.66	2.44	311.6	25.77938	285.82062
2.1	3.12	2.7	622.4	55.35416	567.04584
1.7	2.53	2.36	208.2	17.42129	190.77871

Initial total (mlpm)	500.9
New total	507.5

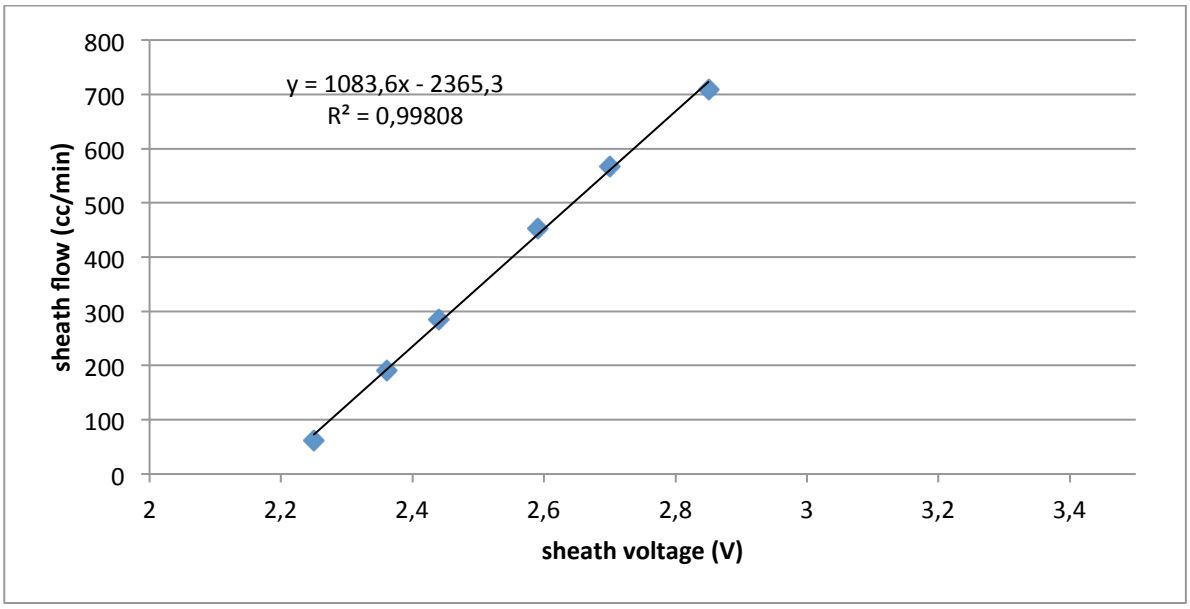


Figure 04: Sheath flow calibration

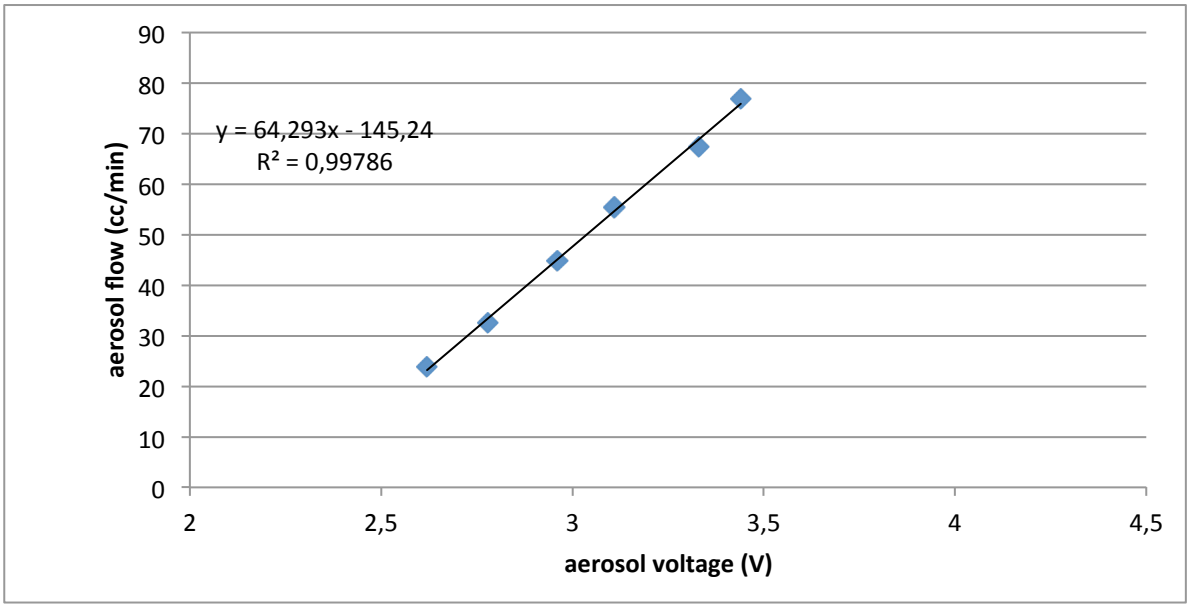
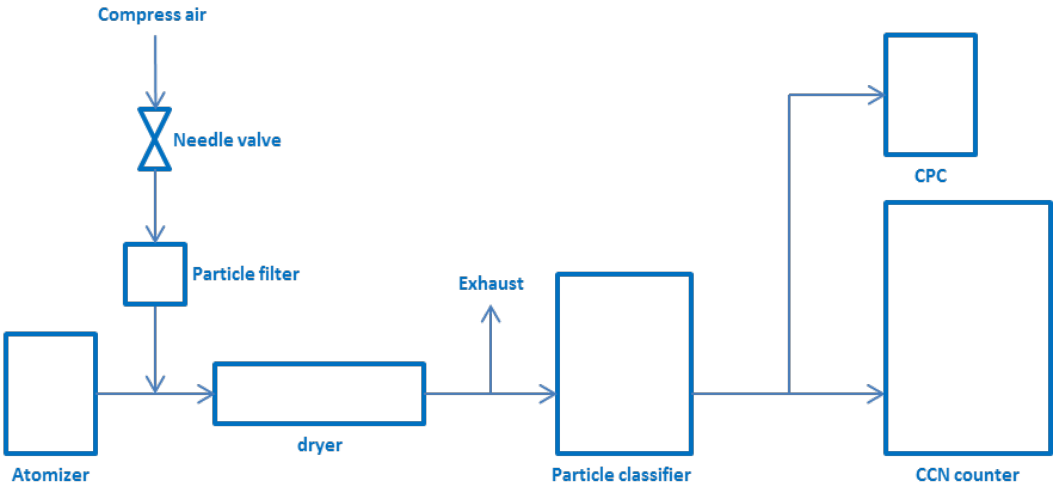


Figure 05: Aerosol flow calibration.

Calibration of Supersaturation-ΔT in CCN chamber

Experiment setup:



- Solution: ammonium sulfate 0.05 mol/L.
- Particle classifier was operated in diameter-scanning mode.
- Size-resolved activation ratio of ammonium sulfate particles was measured at 6 ΔT.
- Size-resolved activation ratio curves were fitted with 2 error functions, and critical diameter was taken as the centre diameter of the second error function (Fig. 05).
- Equivalent supersaturation at each pre-selected ΔT was derived from the fitted critical diameter based on a lookup-table according to the Standardized protocol for CCN measurements WP3-NA3 / D3.11.
- Calibration parameters was derived by a linear fit of equivalent supersaturation and ΔT (Fig. 06).

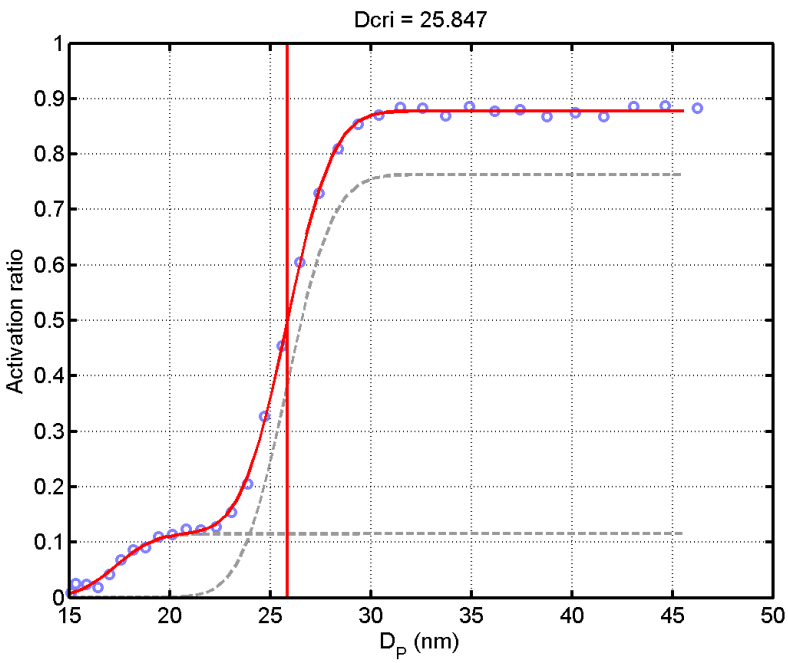


Figure 06: Example for activation curve of ammonium sulfate. Size selection was done with ref2 of WCCAP. The red line gives the sum of two sigmoid fits which are fitted to the measurements data. The grey lines give the fration of doubly charged particles and the fit corrected for the doubly charged particles. The red vertical line gives the position of the determined critical diameter.

Table 01: Result of the supersaturation calibration.

deltaT	SS	Dcrit	T
17.44	1.142775507	26.0139309	31.42996629
17.44	1.154688843	25.84703367	31.42661798
11.07	0.672740431	36.70456168	29.82473596
11.07	0.676668264	36.56301143	29.84932022
9.48	0.56266621	41.214322	29.42708989
9.48	0.562355627	41.27944635	29.19188202
9.48	0.552277703	42.14515294	27.42429213
6.3	0.339696051	57.7571248	26.62861236
6.3	0.334420782	58.34013677	26.62816854
4.71	0.223817958	74.89195285	28.26588764
4.71	0.221344393	75.54366157	27.97809551
4.71	0.226114359	75.18307654	26.26834831
3.12	0.081893379	143.9705504	27.88342697
3.12	0.078678553	147.7782021	27.88012921

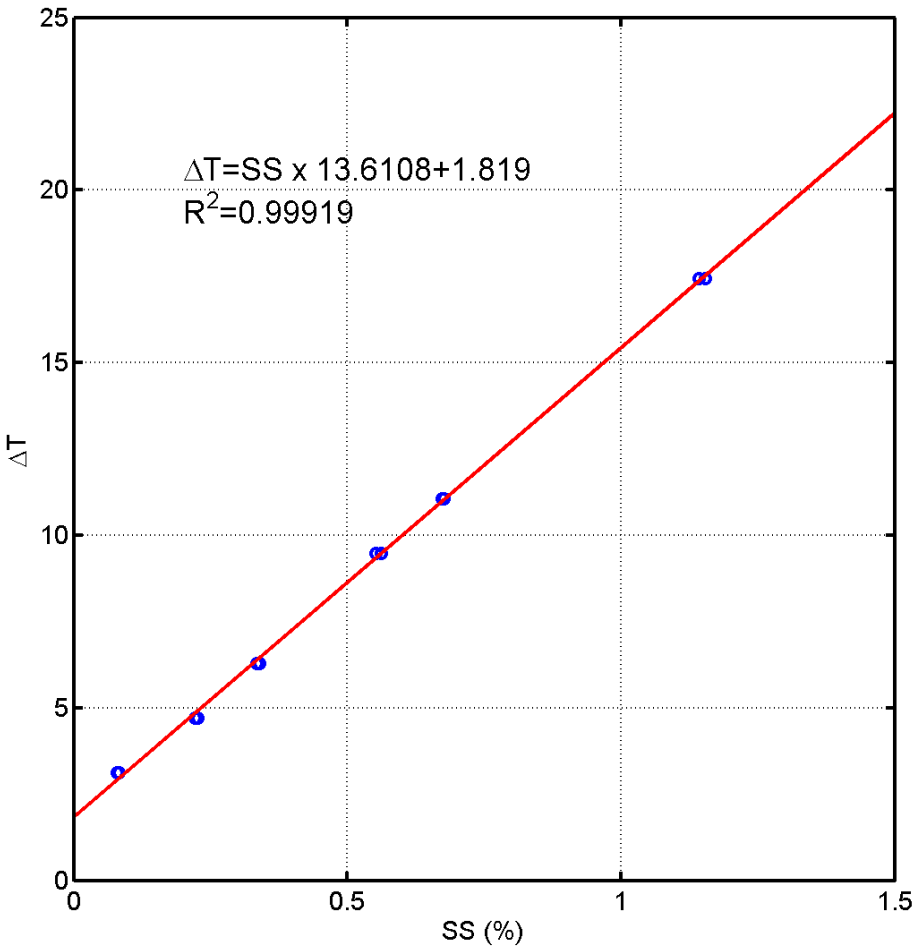


Figure 07: New supersaturation calibration coefficients.

Final Status of the Candidate: time series

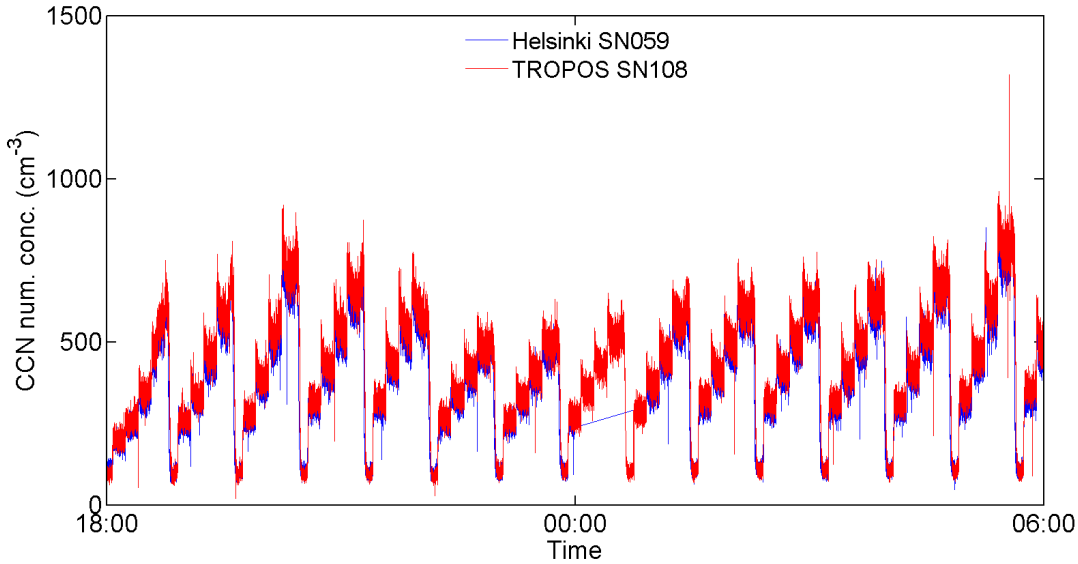


Figure 08: Time series (Oct 26, 2016 06:00 pm – Oct 27, 2016 06:00 am) of the Candidate vs. TROPOS CCN-100 SN-108.

Final Status of the Candidate: average over supersaturation

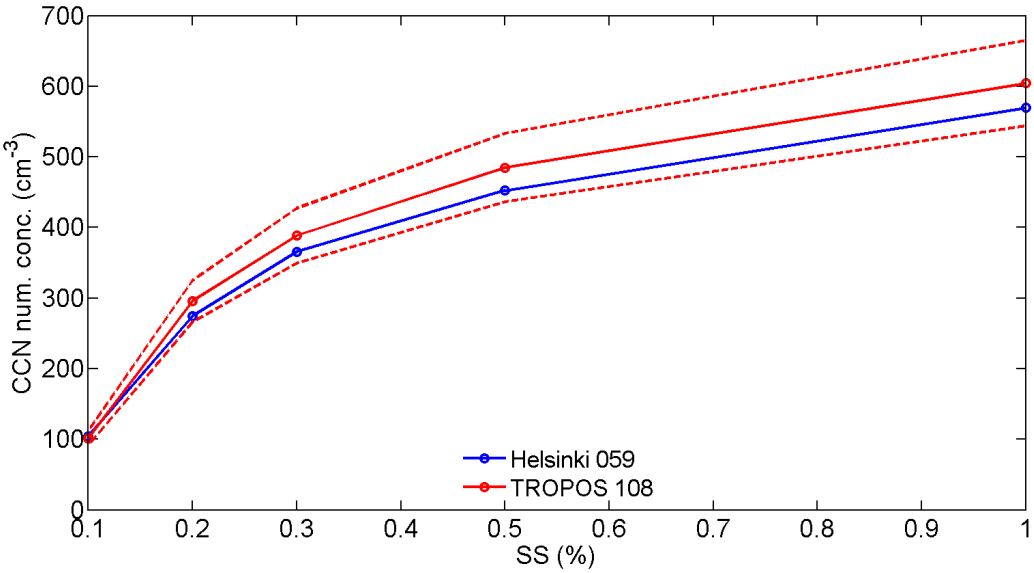


Figure 09: Average of activated particles vs. supersaturation (Oct 26, 2016 06:00 pm – Oct 27, 2016 06:00 am) of the Candidate vs. TROPOS CCN-100 SN-108.