Calibration workshop on Cloud Condensation Nucleus Counters

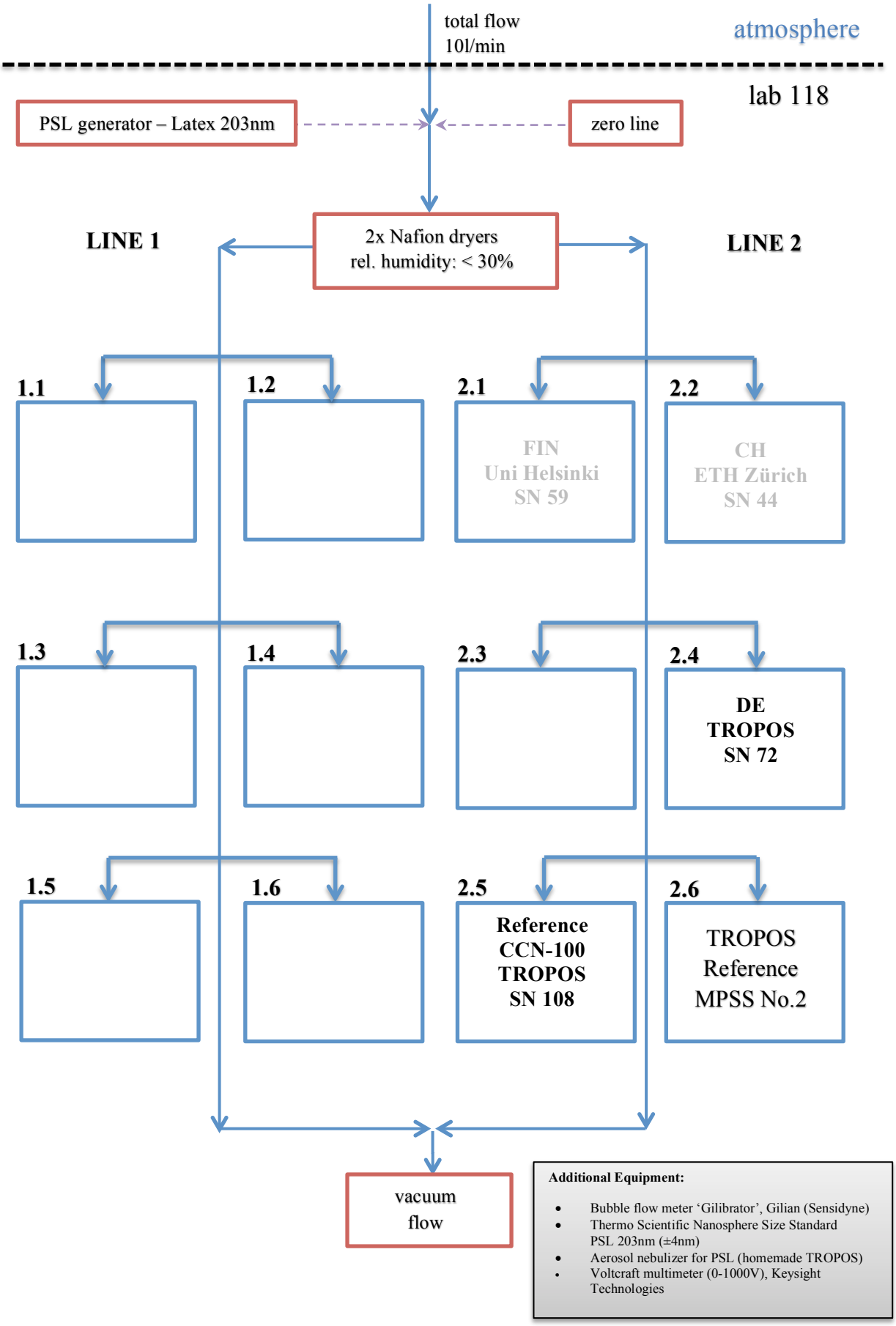
Project No.:	***CCNC-2016-1-3***
Principal Investigator:	Silvia Henning
Home Institution:	*Germany, TROPOS*
Participant:	Silvia Henning, Oliver Welz
Candidate:	**CCN-100**
Made by:	DMT
Counter (SN):	CCN-100, SN 0609-72
Software:	DMT 4.0.4
Location of the quality assurance:	TROPOS Leipzig, lab 118
Comparison 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 -4.8% to +58.4% 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 +0.2% to +14.4% 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)

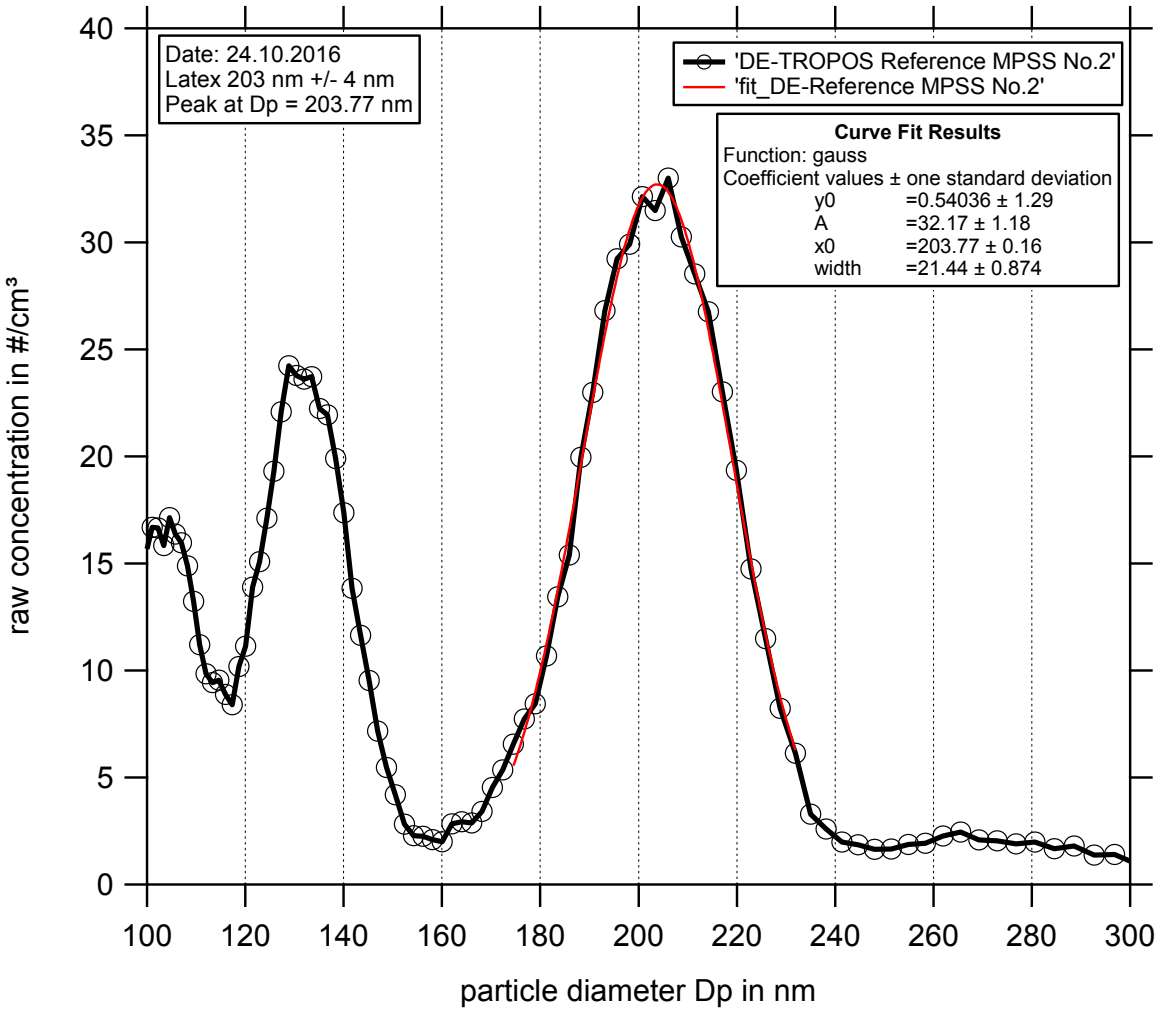


Figure 01: Measurement of latex 203 nm: Particle size distribution (raw concentration) for latex 203 nm on October 24rd, 2016.

Pre-status settings:

Date of check: 24.10.2016

Calibration tab settings	TROPOS 72 DMT-CCN-100
Sample slope	64.2874
Sample y-intercept	-140.147
Sheath slope	1265.82
Sheath y-intercept	-2789.95
Temp gradiet slope	15.875
Temp gradient intercept	1.1621

Zero-test with filter: passed (< 1 particles cm-3)

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

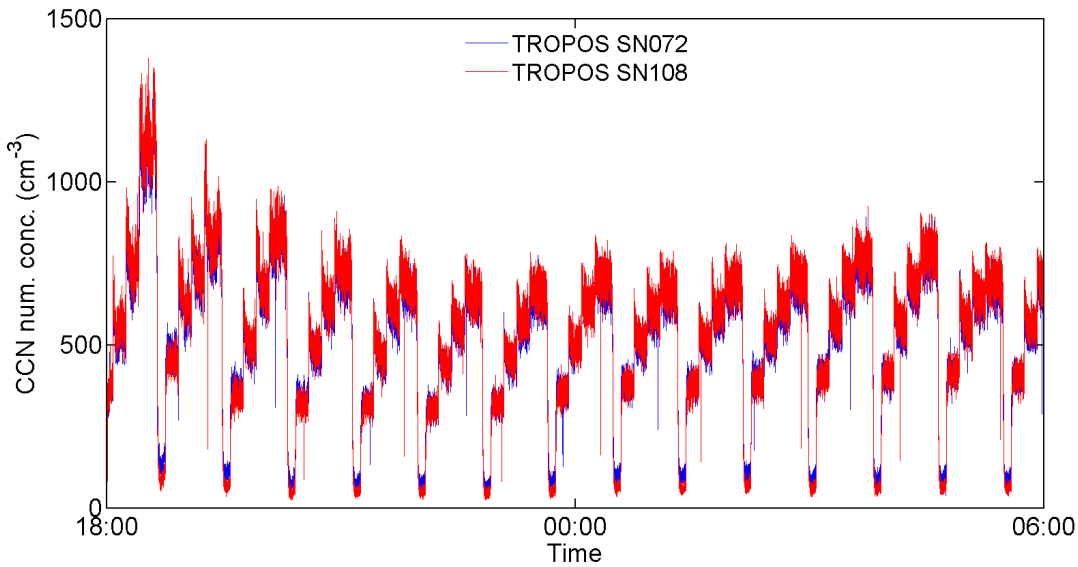


Figure 02: Time series (Oct 24, 2016 06:00 pm – Oct 25, 2016 06:00 am) of the Candidate vs. TROPOS CCN-100 SN-108.

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

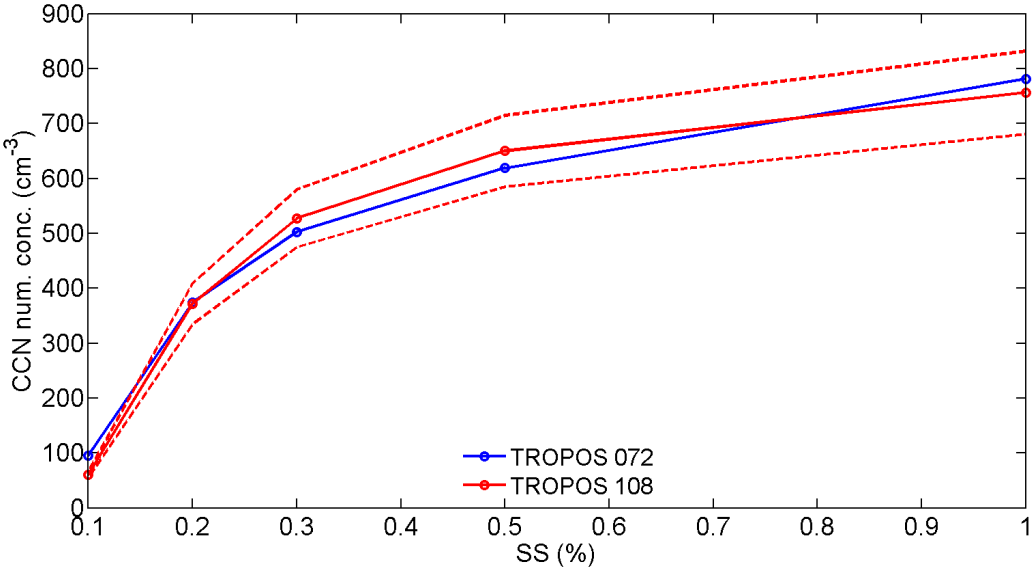


Figure 03: Average (Oct 24, 2016 06:00 pm – Oct 25, 2016 06:00 am) of the Candidate vs. TROPOS CCN-100 SN-108.

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

	Old	New		Old	New
Sample Slope	64.2874	61.7171	Sheath Slope	1265.82	1199.102
Sample intercept	-140.147	-134.0235	Sheath intercept	-2789.95	-2622.7647

Sample Calibration Without Sheath

Valve Set (V)	Sample Volt (V)	Sheath Volt (V)	Measured Total Flow (mlpm)	
1	2.62		27.37	29.08
1.2	3.2		66.42	69.08
1.3	3.67		92.16	83.93
1.1	2.82		39.05	50.76
0.9	2.46		17.83	19.77
1.25	3.47		78.75	85.28

Sheath Calibration

Valve Set (V)	Sample Volt (V)	Sheath Volt (V)	Measured Total Flow (mlpm)	Sample Calcu (mlpm)	Sheath Flow (mlpm)
2.5	3.75	3.02	1085	97.415625	987.584375
2	2.86	2.6	542.1	42.487406	499.612594
2.2	3.15	2.74	731.7	60.385365	671.314635
2.3	3.32	2.82	833.4	70.877272	762.522728
1.6	2.48	2.4	262	19.034908	242.965092
2.1	3.01	2.68	647.1	51.744971	595.355029
1.9	2.75	2.55	469.9	35.698525	434.201475
1.8	2.63	2.48	381.5	28.292473	353.207527

	Sheath Cal.	Valve Set (V)	Measured Sheath Flow (mlpm)
total vorher	504.3	2	516.6
total nachher	500.3		

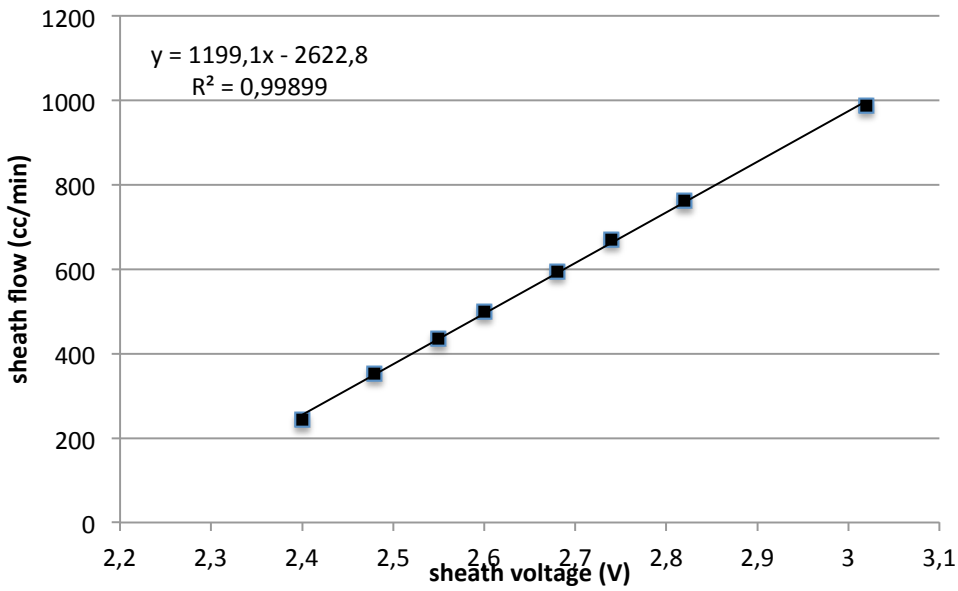


Figure 04: Sheath flow calibration

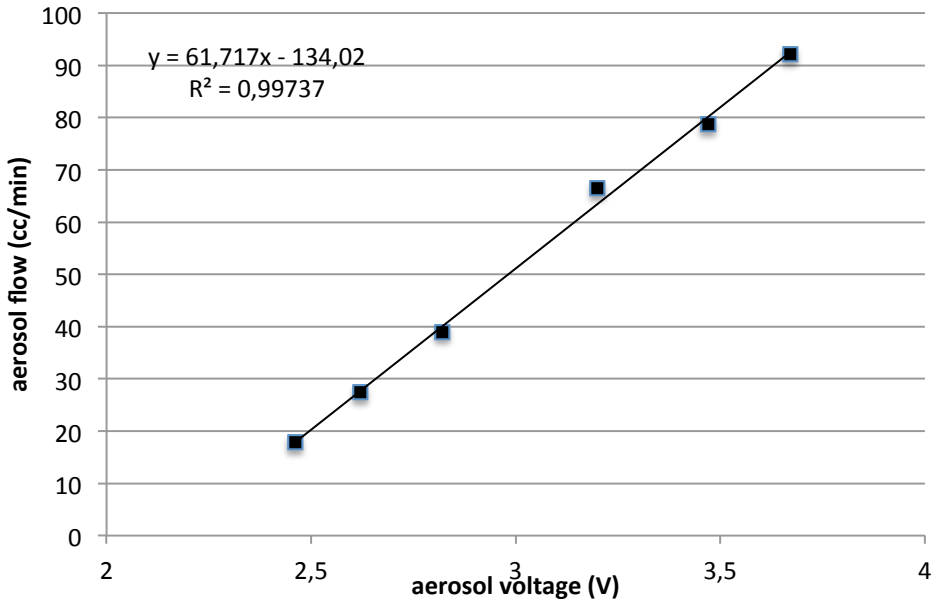
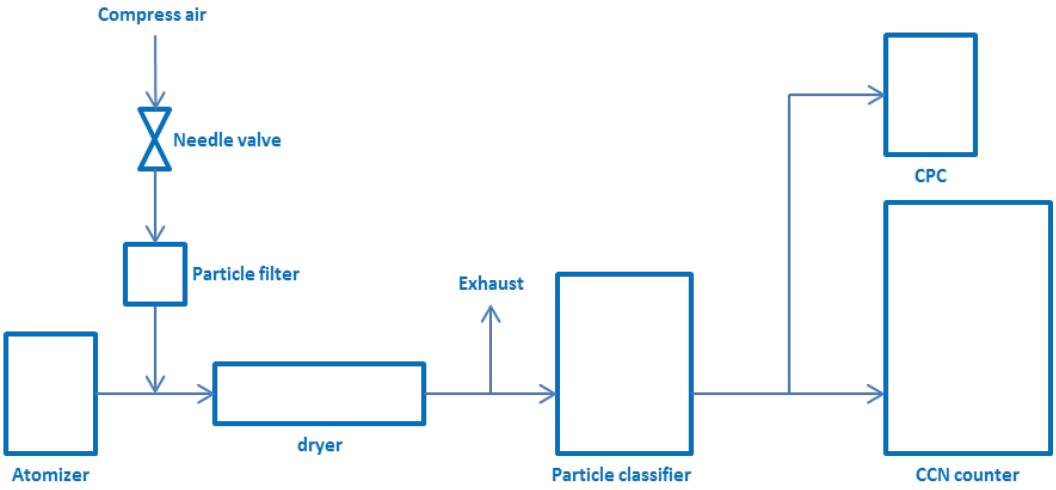


Figure 05: Aerosol flow calibration.

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).

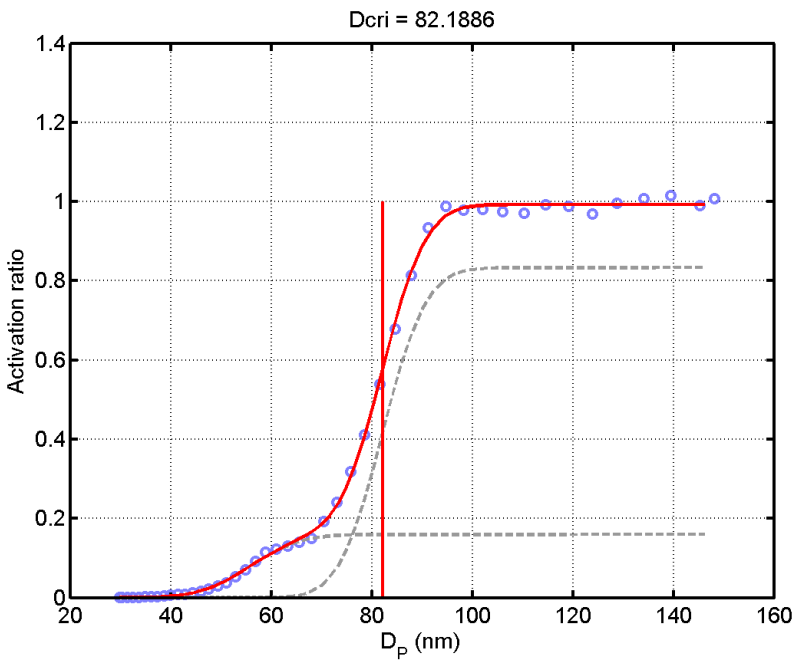


Figure 06: Example for activation curve of ammonium sulfate. Size selection was done with ref2 of WCCAP. The red line gives the sum of two sigmoid fits which are fitted to the measurements data. The grey lines give the fration of doubly charged particles and the fit corrected for the doubly charged particles.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

Table 01: Result of the supersaturation calibration.

deltaT	SS	Dcrit	T
17.04	0.921913372	30.38586793	27.70097191
17.04	0.928634296	30.24804284	27.69575843
17.04	0.916525116	30.49780581	27.696
12.27	0.628131253	38.90898698	27.01529775
12.27	0.624214412	39.06303754	27.0197191
9.1	0.452455421	48.15297975	26.29148315
9.1	0.452279653	48.16437	26.29398876
5.92	0.289379942	64.35293329	25.64211798
5.92	0.285913028	64.85258941	25.64501685
4.34	0.195505256	82.99165739	25.31935955
4.34	0.198473816	82.18864078	25.32011236
2.75	0.086065118	141.6604711	24.81016292
2.75	0.087038094	140.6263057	24.81189888

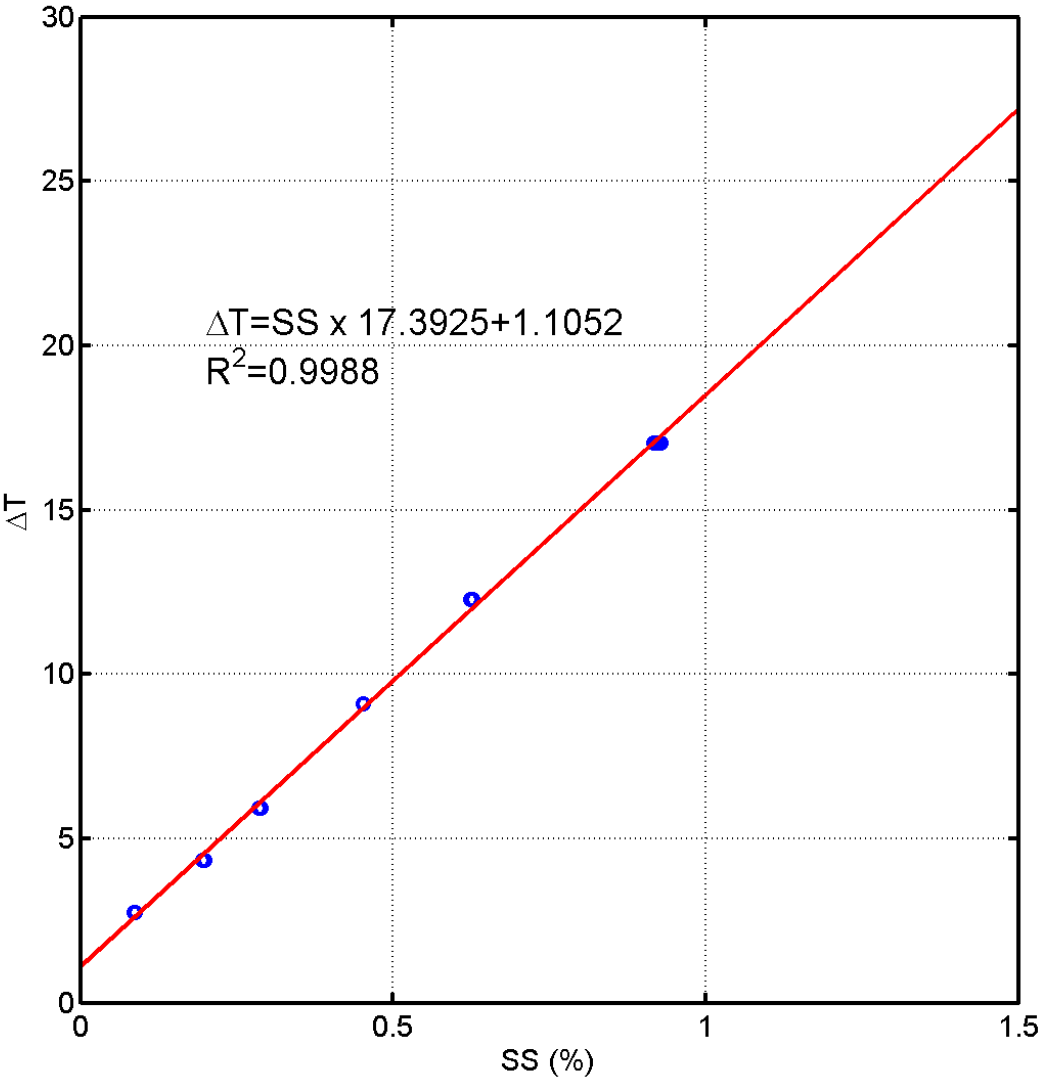


Figure 07: New supersaturation calibration coefficients.

Final Status of the Candidate: time series

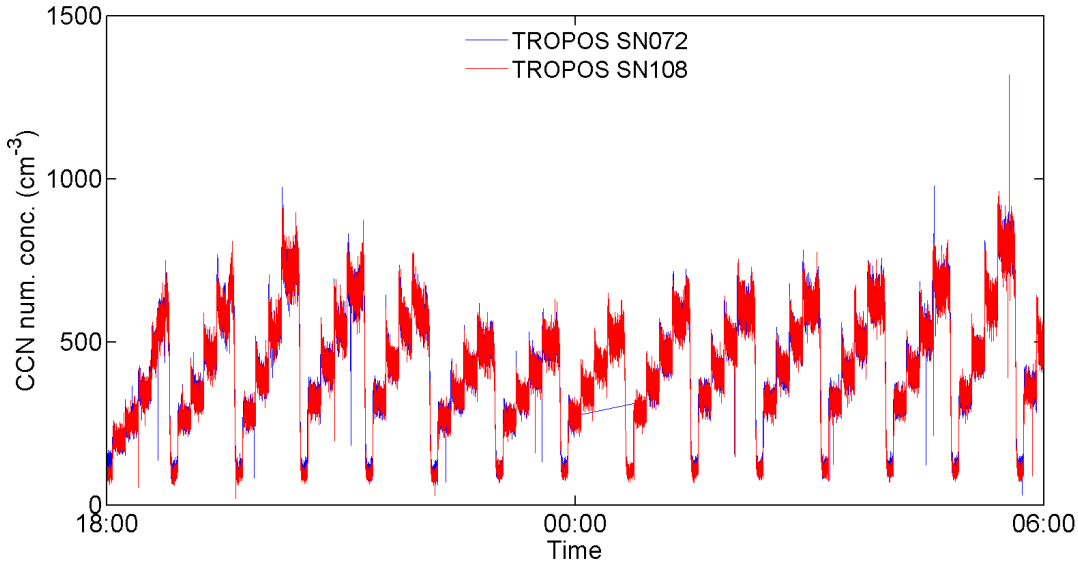


Figure 08: Time series (Oct 26, 2016 06:00 pm – Oct 27, 2016 06:00 am) of the Candidate vs. TROPOS CCN-100 SN-108.

Final Status of the Candidate: average over supersaturation

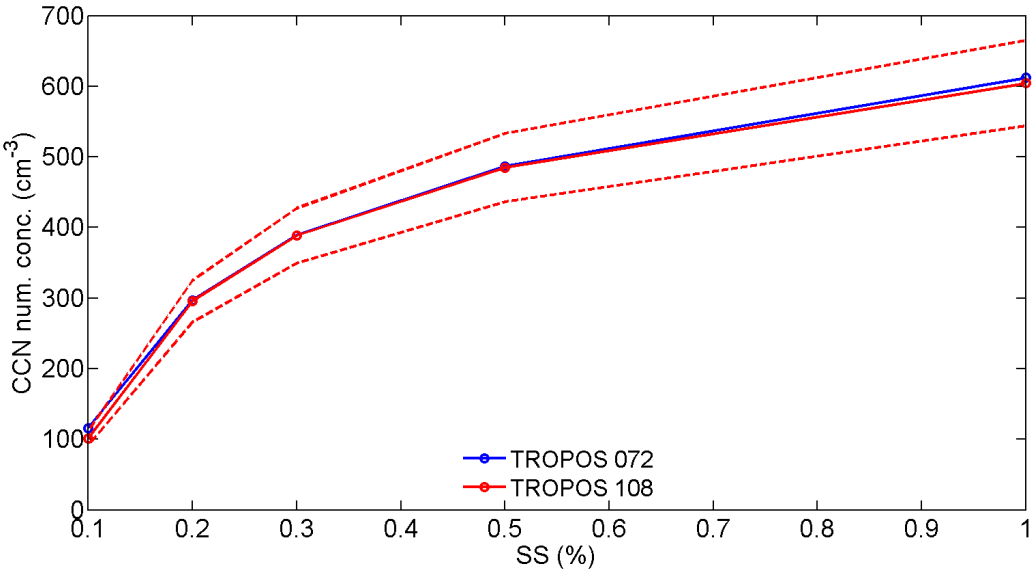


Figure 09: Average of activated particles vs. supersaturation (Oct 26, 2016 06:00 pm – Oct 27, 2016 06:00 am) of the Candidate vs. TROPOS CCN-100 SN-108.