



Calibration workshop on Cloud Condensation Nucleus Counters

<i>Project No.:</i>	CCNC-2020-1-3
<i>Principal Investigator:</i>	Arnoud Frumau
<i>Home Institution:</i>	Netherlands, TNO
<i>Participant:</i>	Marcus J. Blom
<i>Candidate:</i>	CCN-100
<i>Made by:</i>	DMT
<i>Counter (SN):</i>	CCN-100, SN 1903-171
<i>Software:</i>	DMT 5.0.6
<i>Location of the quality assurance:</i>	TROPOS Leipzig, lab 118
<i>Comparison period:</i>	March 9, 2020 – March 12, 2019
<i>Last Intercomparison (with Project No.):</i>	

Summary of Intercomparison

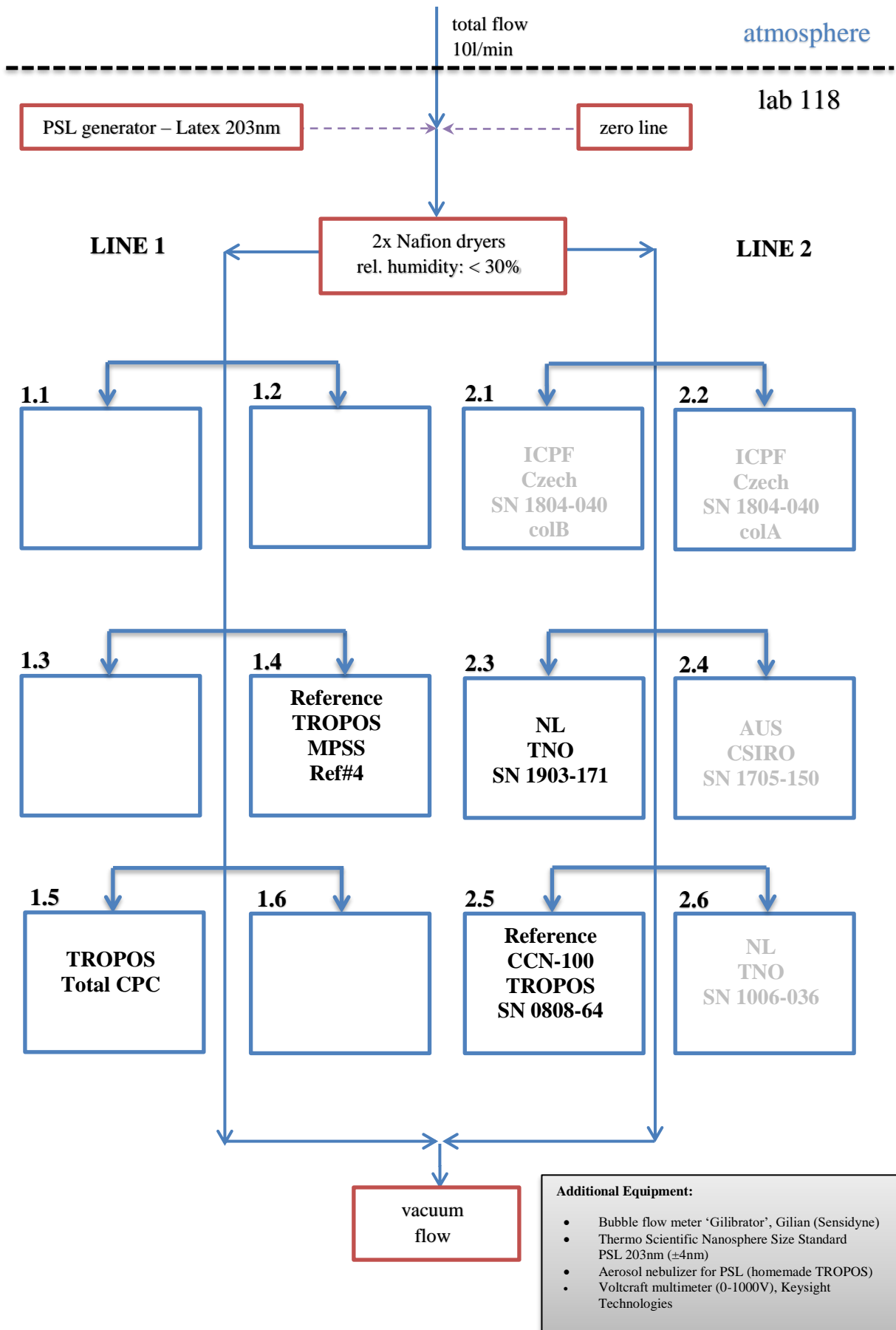
Pre-Status:

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 -2% to +85% compared with the TROPOS Reference Instrument SN 0808-0064 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 -16% (@0.1% ss) to 4.5% compared with the TROPOS Reference Instrument SN 0808-64 for supersaturation between 0.1% and 1.0%. The candidate passed the quality standards of ACTRIS and GAW.

Laboratory setup:



Supersaturation calibration protocol (Ammonium Sulfate Particle, size selected by TROPOS Reference MPSS “Wolken”)

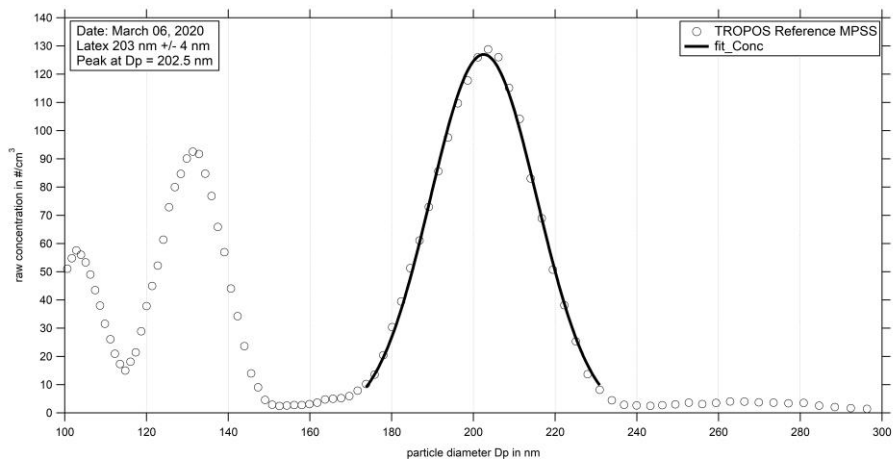


Figure 01: Measurement of latex 203 nm: Particle size distribution (raw concentration) for latex 203 nm on March 6, 2020

Pre-status settings:

Date of check: 10.03.2020

<i>Calibration tab settings</i>	TNO 1903-171 DMT-CCN-100
<i>Sample slope</i>	68.0434
<i>Sample y-intercept</i>	-153.596
<i>Sheath slope</i>	924.399
<i>Sheath y-intercept</i>	-2091.12
<i>Temp gradient slope</i>	13.88
<i>Temp gradient intercept</i>	1.82

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

Candidate against Ref. CCN-100 SN 0808-64 during the pre-status: Time Series

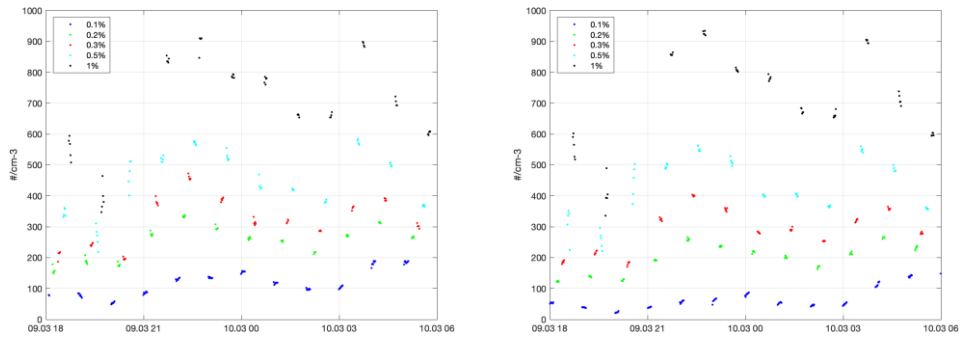


Figure 02: Time series (March 9, 2020 06:00 pm – March 10, 2020 06:00 am) of the candidate (left) vs. Ref. CCN-100 SN 0808-64 (right).

Candidate against Ref. CCN-100 SN 0808-64 during the pre-status: average over supersaturation

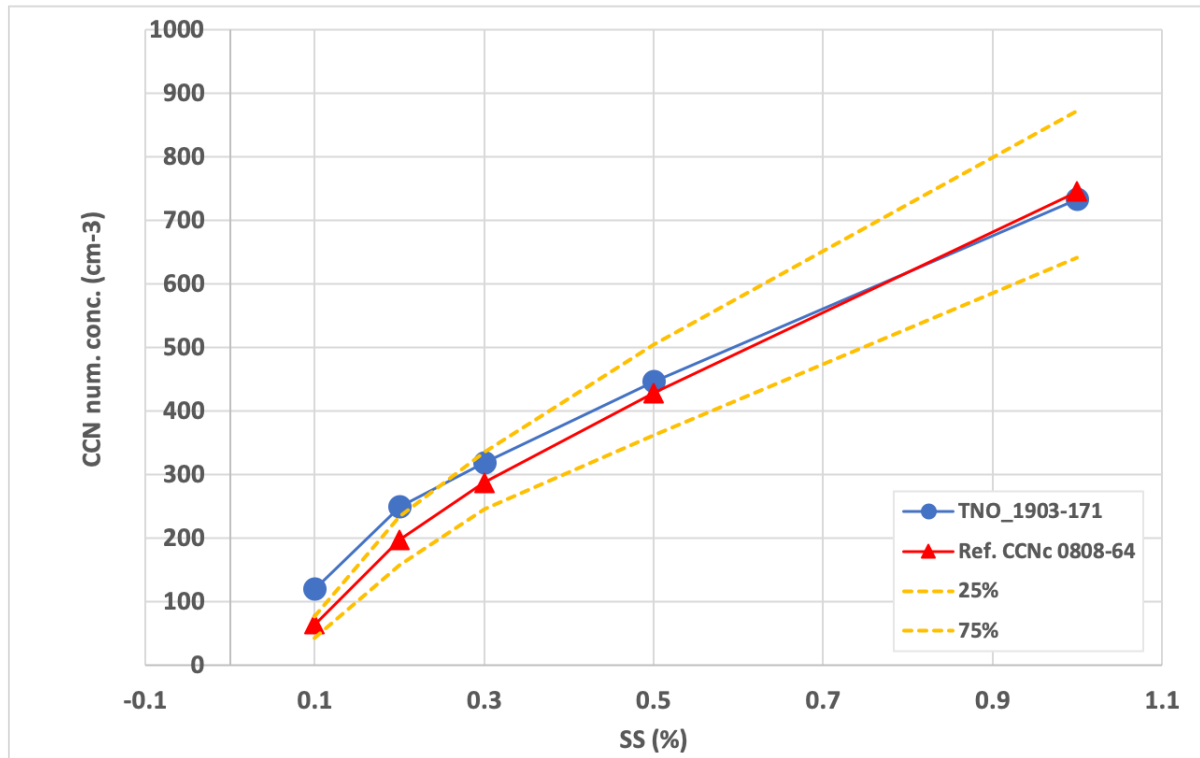


Figure 03: Average (March 9, 2020 06:00 pm – March 10, 2020 06:00 am) of the candidate vs. Ref. CCN-100 SN-0808-64.

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

	Old	New		Old	New
Sample Slope	68.0434	63.687	Sheath Slope	924.399	896.83
Sample intercept	-153.596	-142.02	Sheath intercept	-2091.12	-2036.9
Sample Calibration Without Sheath	(close sheath valve) Gilibrator				
Valve Set M (V)	Sample Volt (Vccm)	Measured Total Flow (mlpm)			
1.55	3.52	81.58			
1.45	3.17	60.46			
1.4	2.93	44.86			
1.33	2.75	33.69			
1.25	2.58	21.43			
Sheath Calibration	(open sheath valve) Gilibrator				
Valve Set M (V)	Sheath Volt (Vccm)	Sample Volt (Vccm)	Measured Total Flow (mlpm)	Sheath Flow (mlpm)	
2.6	3.02	67.8	735.1	667.3	
2.45	2.91	57.3	634.2	576.9	
2.2	2.75	41.5	473.1	431.6	
1.9	2.57	25.2	293	267.8	
1.75	2.48	17.4	202.9	185.5	

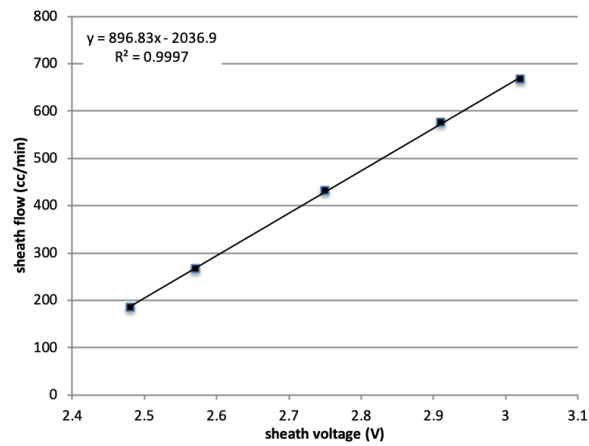


Figure 04: Sheath flow calibration

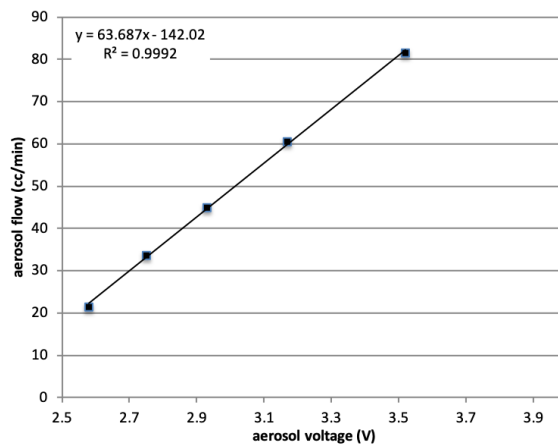
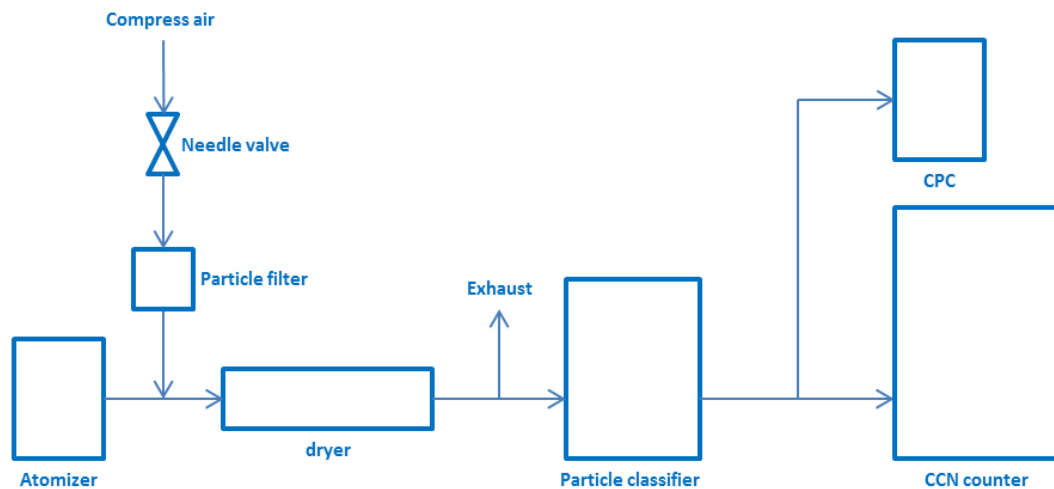


Figure 05: Aerosol flow calibration.

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 center 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).

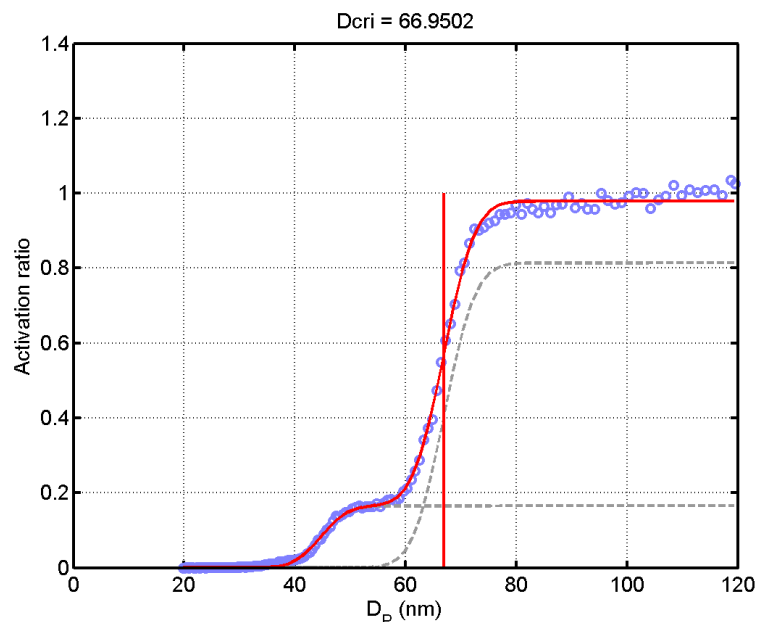


Figure 06: Example for activation curve of ammonium sulfate. Size selection was done with MPSS "Wolken" of WCCAP. The red line gives the sum of two sigmoid fits which are fitted to the measurements data. The grey lines give the fraction of doubly charged particles and the fit corrected for the doubly 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
3.208	0.134	104.510	27.833
3.208	0.133	105.208	27.833
4.596	0.267	66.905	28.186
4.596	0.267	66.950	28.186
5.984	0.366	54.497	28.538
5.984	0.367	54.457	28.542
8.760	0.556	41.838	27.968
8.760	0.552	42.054	27.967
15.700	1.049	27.707	29.701
15.700	1.051	27.671	29.700

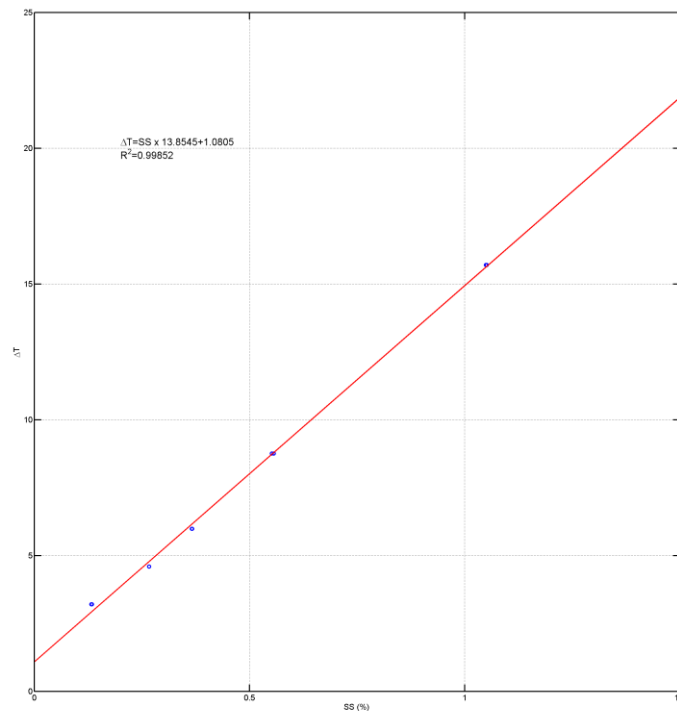


Figure 07: New supersaturation calibration coefficients.

Final Status of the Candidate: time series

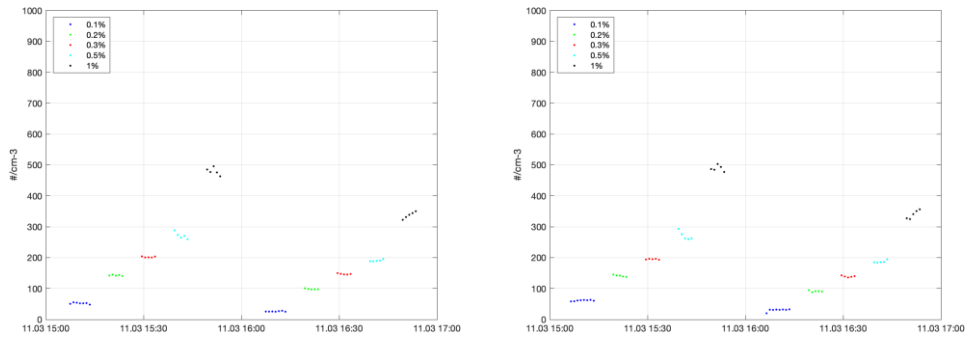


Figure 08: Time series (March 11, 2020 03:00 pm – March 11, 2020 05:00 pm) of the Candidate vs. Ref. CCN-100 SN 0808-64.

Final Status of the Candidate: average over supersaturation

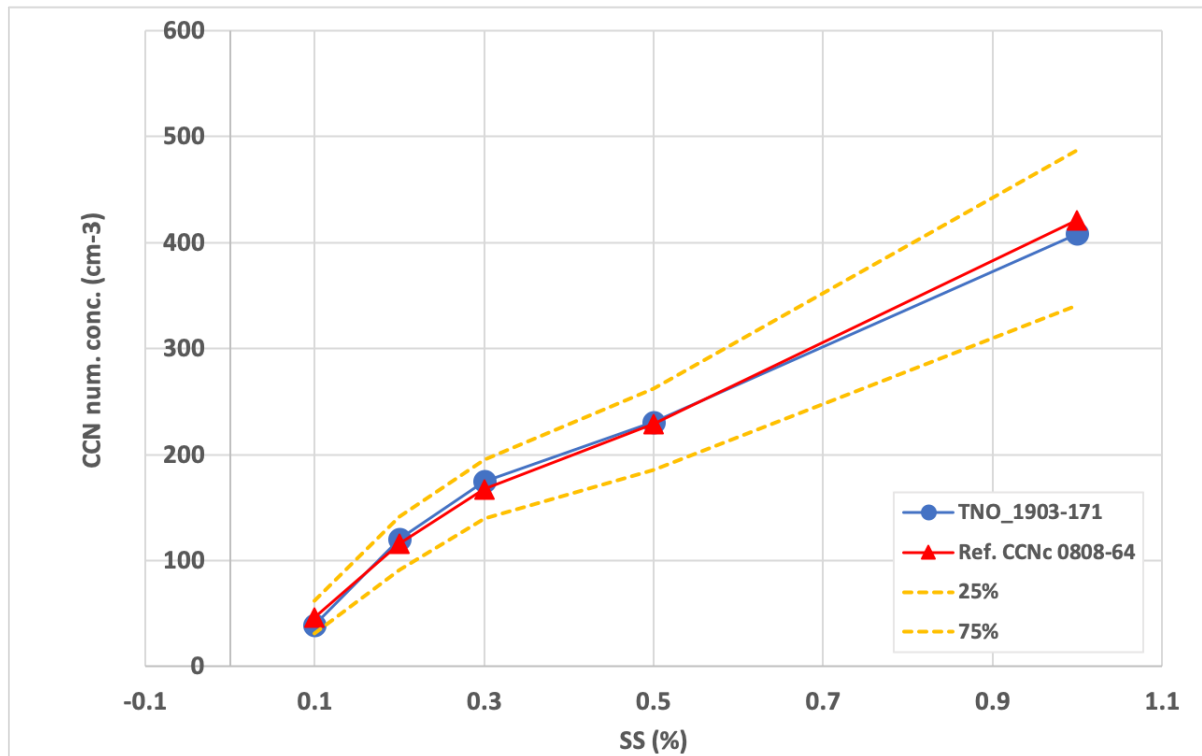


Figure 09: Average of activated particles vs. supersaturation (March 11, 2020 03:00 pm – March 12, 2020 05:00 pm) of the Candidate vs. Ref. CCN-100 SN 0808-64.