

Calibration workshop on Cloud Condensation Nucleus Counters

<i>Project No.:</i>	CCNC-2020-1-4
<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 1006-36
<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

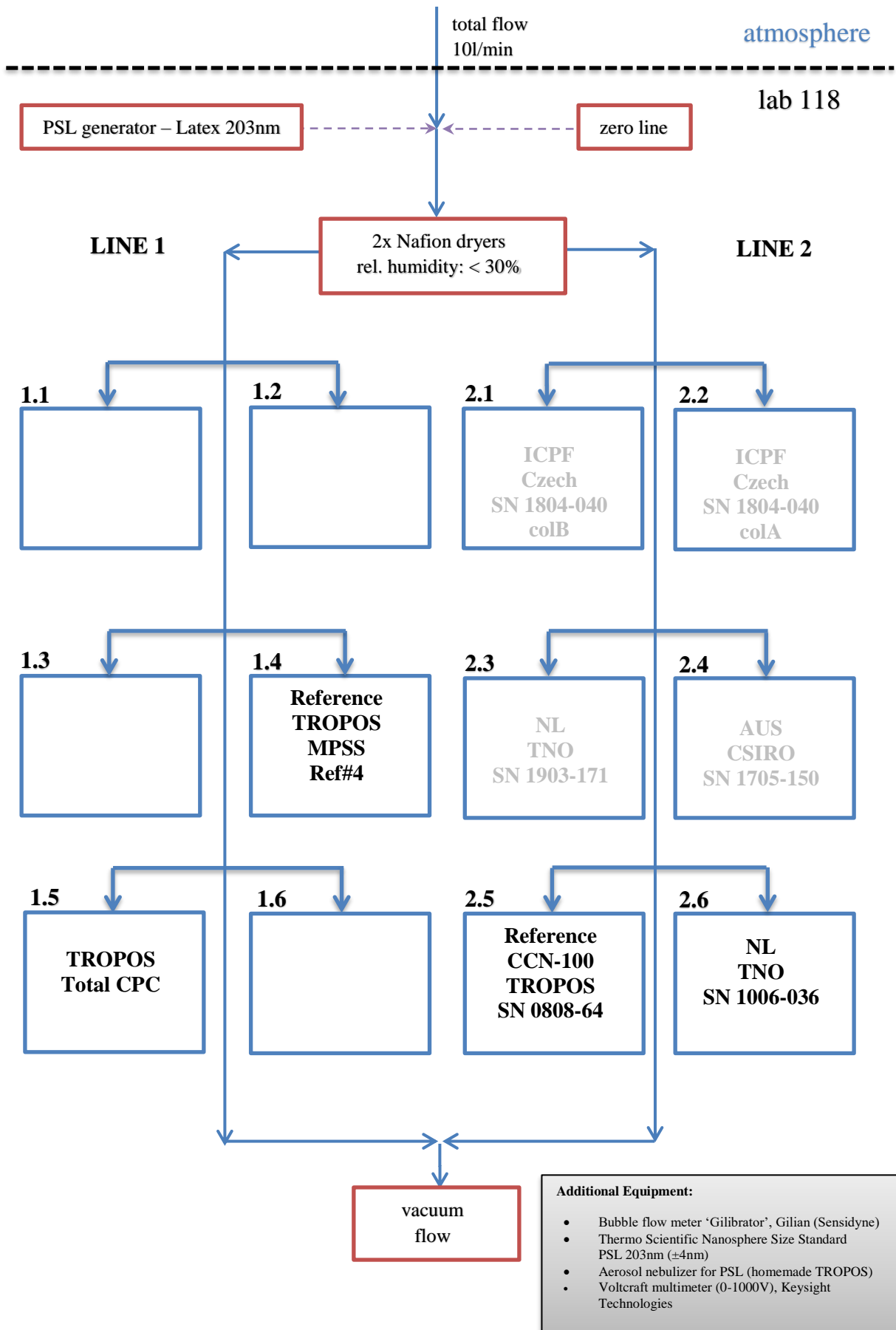
Pre-Status:

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 an overestimation of N_{CCN} over the whole supersaturation range with relative differences of +13% to +32% 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 -38% (@0.1% ss) to 11% 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”)

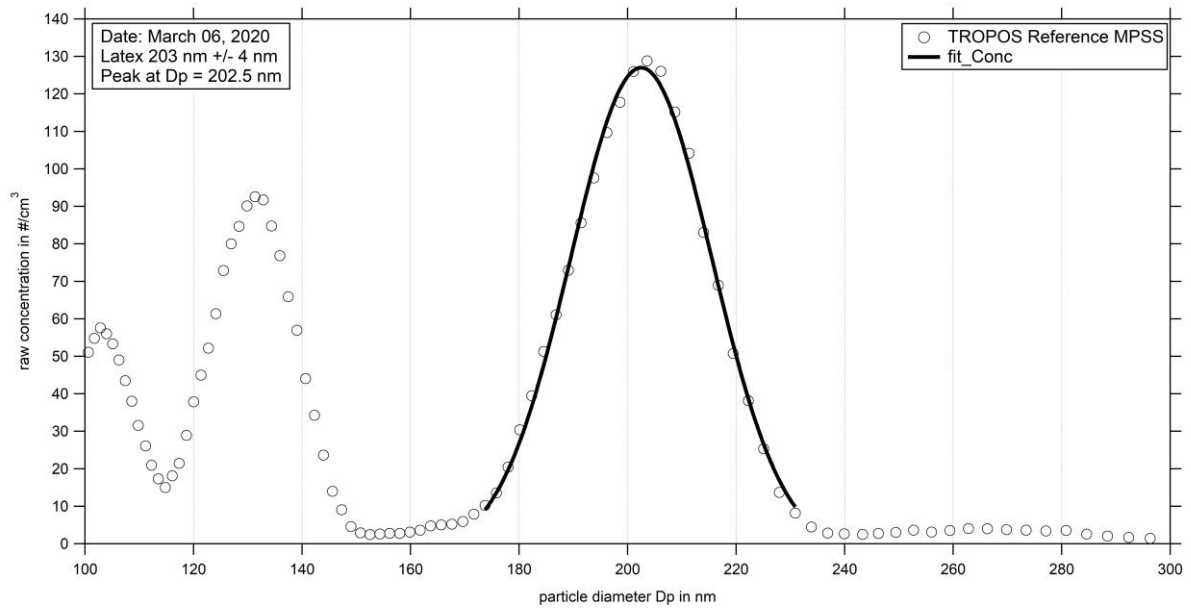


Figure 01: Measurement of latex 203 nm: Particle size distribution (raw concentration) for latex 203 nm on March 6, 2020

Pre-status settings:

Date of check: 10.03.2020

<i>Calibration tab settings</i>	TNO 1006-036 DMT-CCN-100
<i>Sample slope</i>	62.07
<i>Sample y-intercept</i>	-140.83
<i>Sheath slope</i>	750.22
<i>Sheath y-intercept</i>	-1679.55
<i>Temp gradient slope</i>	15.62
<i>Temp gradient intercept</i>	1.48

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

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

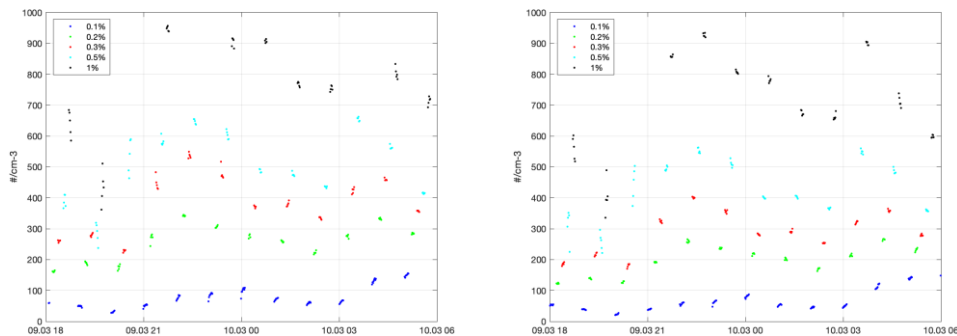


Figure 02: Time series (March 9, 2020 06:00 pm – March 10, 2020 06:00 am) of the candidate (left) vs. Ref. CCN-100 SN 0808-64 (right).

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

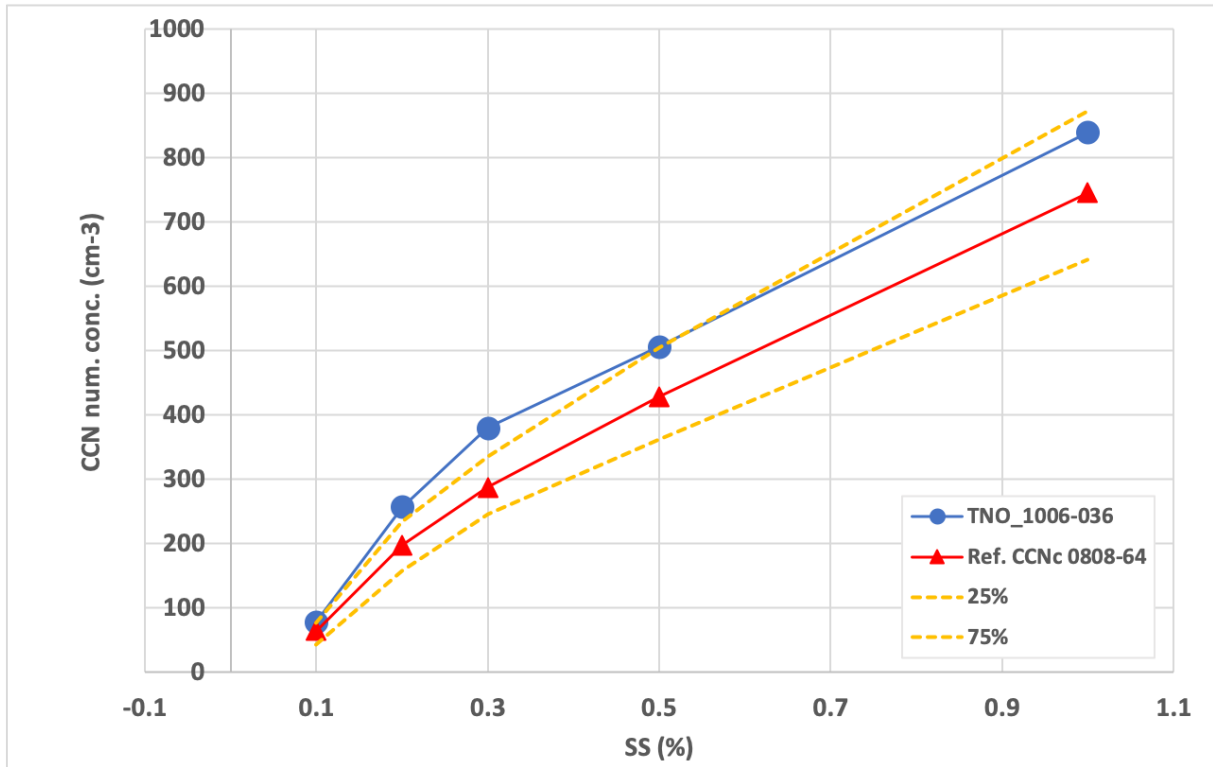


Figure 03: Average (March 9, 2020 06:00 pm – March 10, 2020 06:00 am) of the candidate vs. Ref. CCN-100 SN-0808-64.

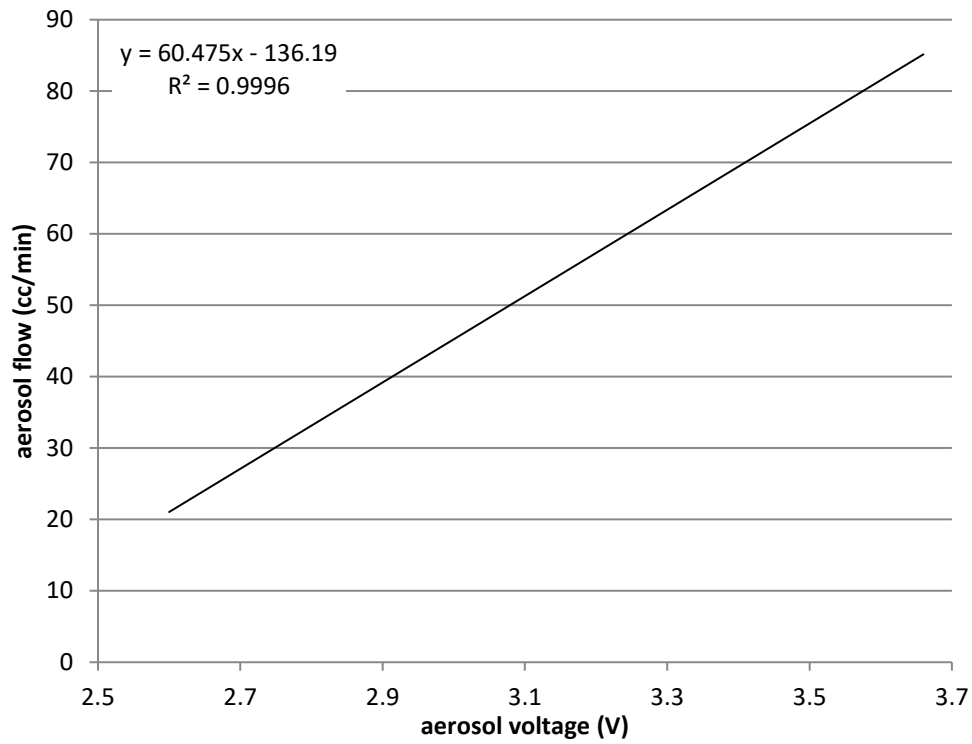
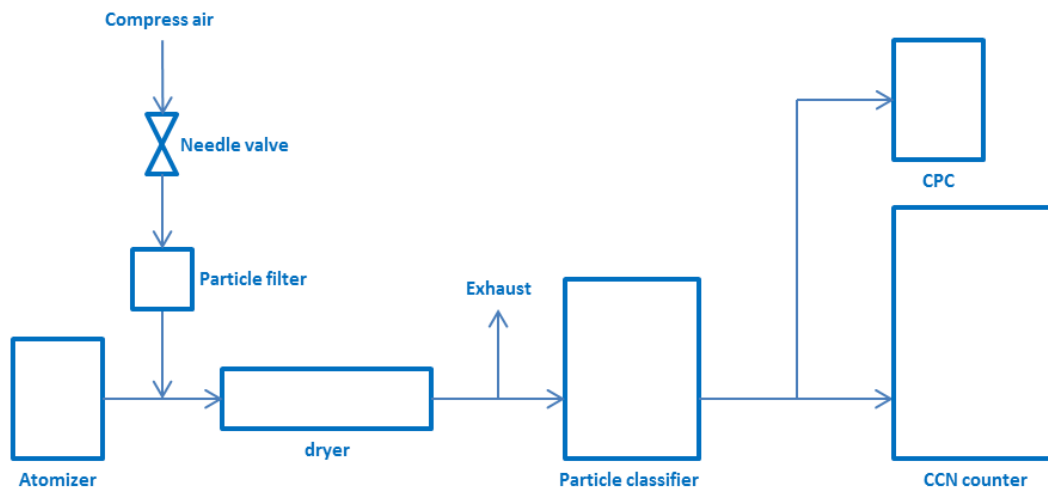


Figure 05: Aerosol flow calibration.

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).

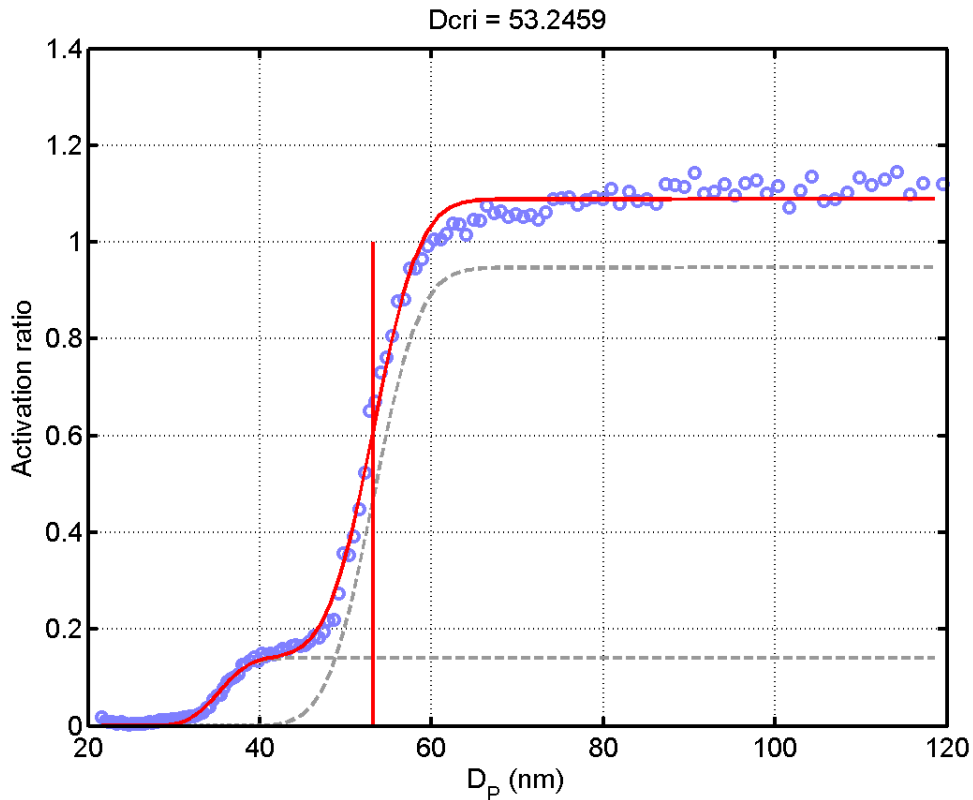


Figure 06: Example for activation curve of ammonium sulfate. Size selection was done with MPSS "Wolken" of WCCAP. The red line gives the sum of two sigmoid fits which are fitted to the measurements data. The grey lines give the fraction of doubly charged particles and the fit corrected for the doubly 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
3.042	0.124	111.586	25.168
3.042	0.121	113.023	25.166
4.604	0.272	67.057	25.569
4.604	0.271	67.201	25.567
4.604	0.270	67.333	25.569
6.166	0.384	53.246	27.011
6.166	0.387	52.989	27.010
9.290	0.602	39.807	27.788
9.290	0.601	39.869	27.788
17.100	1.194	25.527	29.747
17.100	1.192	25.553	29.748
12.414	0.831	32.228	29.029
12.414	0.839	32.042	29.029
NaN	NaN	NaN	NaN
12.414	0.839	32.026	29.029

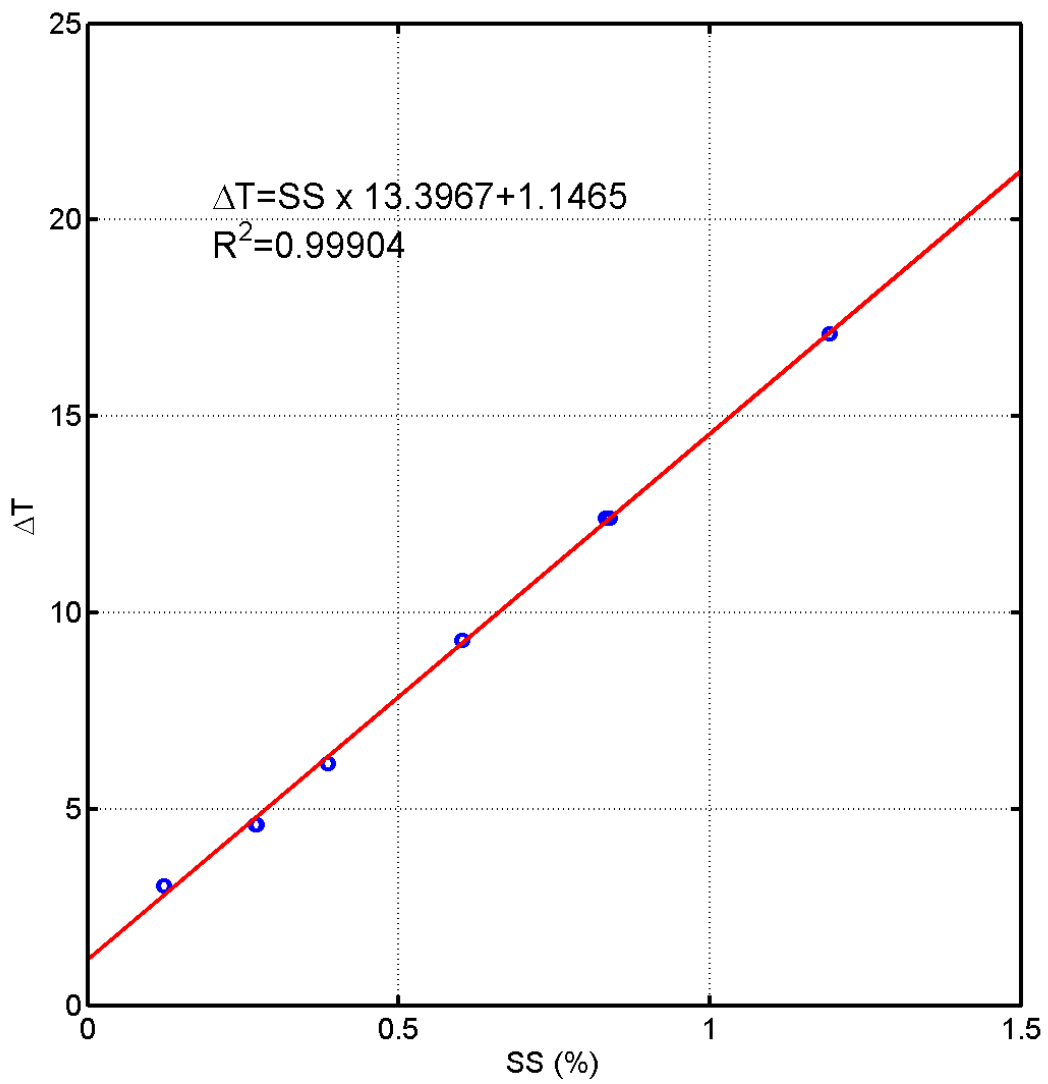


Figure 07: New supersaturation calibration coefficients.

Final Status of the Candidate: time series

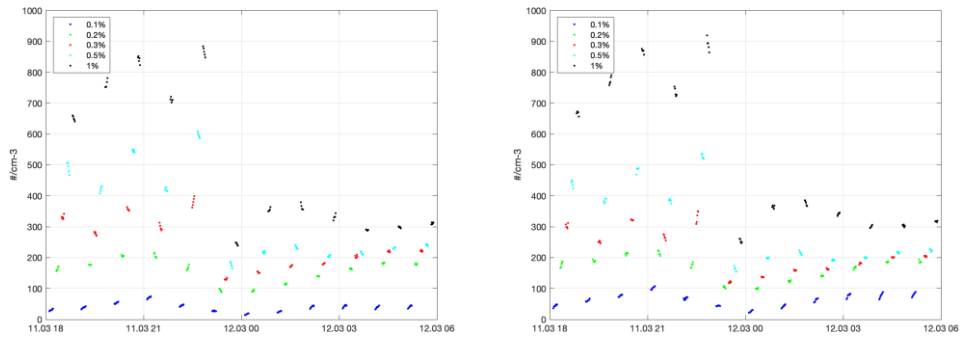


Figure 08: Time series (March 11, 2020 06:00 pm – March 12, 2020 06:00 am) of the Candidate vs. Ref. CCN-100 SN 0808-64.

Final Status of the Candidate: average over supersaturation

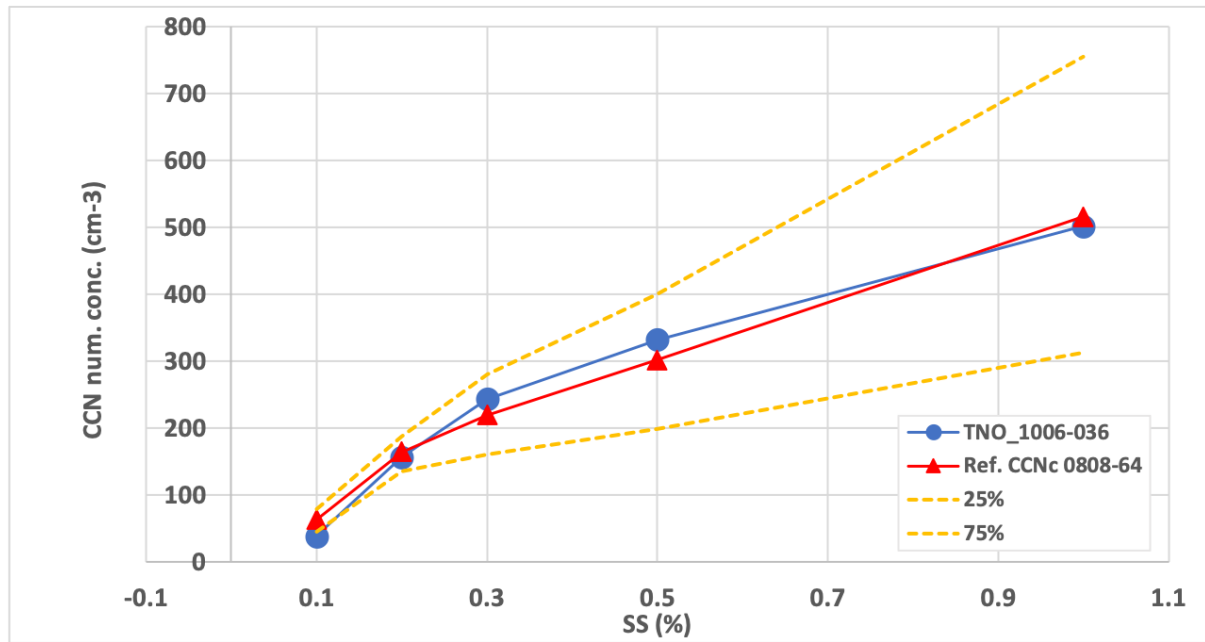


Figure 09: Average of activated particles vs. supersaturation (March 11, 2020 06:00 pm – March 12, 2020 06:00 am) of the Candidate vs. Ref. CCN-100 SN 0808-64.