



Supplement of

Developing A Custom-Built Metal Aerosol Processing Chamber: Analysis of Aerosol Coagulation at Low Humidities

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The following provides additional information about the initial experiments conducted in the LANL Cloud Chamber. Table S1 shows the number of experiments used for each aerosol type, the statistical values and spreads for wall-loss and coagulation correction factor, specifically the mean and median categorized for specific hours throughout the experiment.

Example experimental data is shown in Figures S1 through S9. Figure S1 shows the 2D particle distribution of the raw data from the SMPS for the soot experiment presented in the manuscript. Figures S2-S4 show particle distribution data, for each aerosol, from the SMPS fitted to a probability mass function (PMF) along with stacked plots for each particle loss rate. Figures S5-S7 show the distribution fitting and Pearson R-squared of the distribution fitting. Figure S8 shows the volume conservation analysis. Figure S9 shows example number concentrations vs experiment time.

Table S1. Summary of experimental statistical results for wall-eddy diffusivity and coagulation corrections, fitted for specific time intervals.

	Sodium chloride	Sucrose	Smoke
# of experiments	8	4	6
Mean wall-eddy diffusivity (1 hour)	0.152 ± 0.187	0.279 ± 0.422	1.12 ± 1.55
Median wall-eddy diffusivity (1 hour)	0.0999	0.0631	0.343
Mean wall-eddy diffusivity (1-6 hours)	0.562 ± 0.975	0.233 ± 0.286	0.201 ± 0.267
Median wall-eddy diffusivity (1-6 hours)	0.220	0.109	0.0953
Mean coagulation factor (<2 hours)	0.969 ± 0.524	1.16 ± 1.38	1.23 ± 0.312
Median coagulation factor (<2 hours)	0.889	0.852	1.24
Mean coagulation factor (2-6 hours)	0.811 ± 0.352	0.911 ± 0.382	0.941 ± 0.307
Median coagulation factor (2-6 hours)	0.774	0.931	0.973

2 Example Experiments

2.1 Raw SMPS measurements

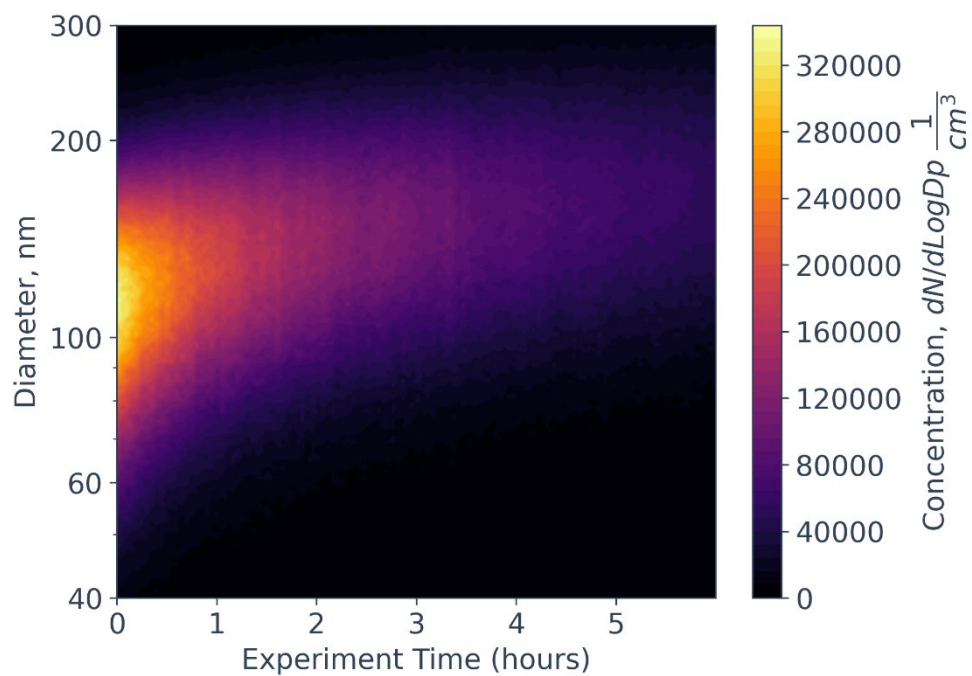


Figure S1. A 2D particle distribution plot for the raw SMPS data of the smoke experiment presented in the manuscript.

2.2 Experiment and Rates Analysis

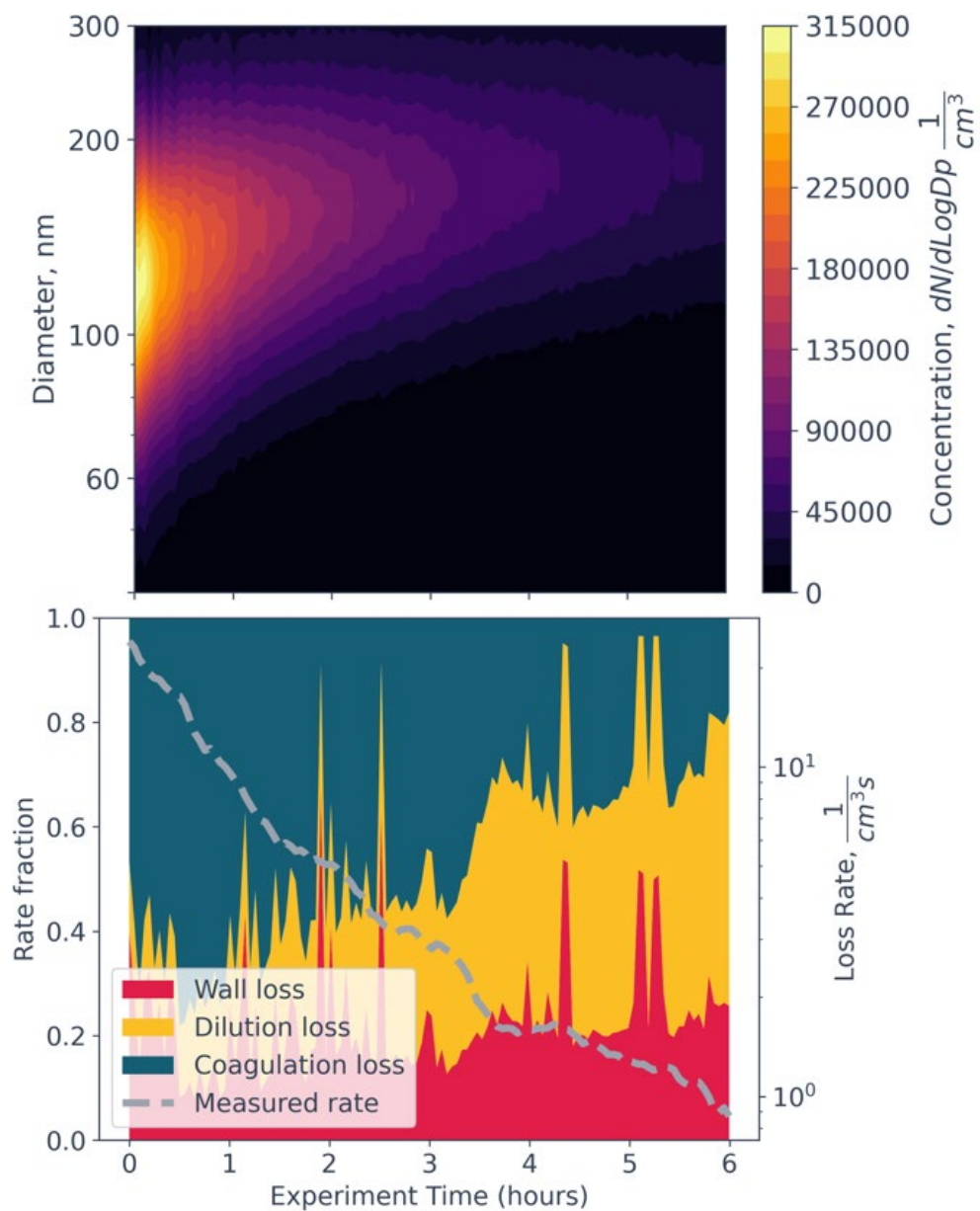


Figure S2. A 2D, two-mode, log-normal distribution plot fitted for a probability mass function representing one of the smoke experiments. A stacked plot shows the particle loss rates for each process, while the dashed line shows the experimental loss rate for the particles lost.

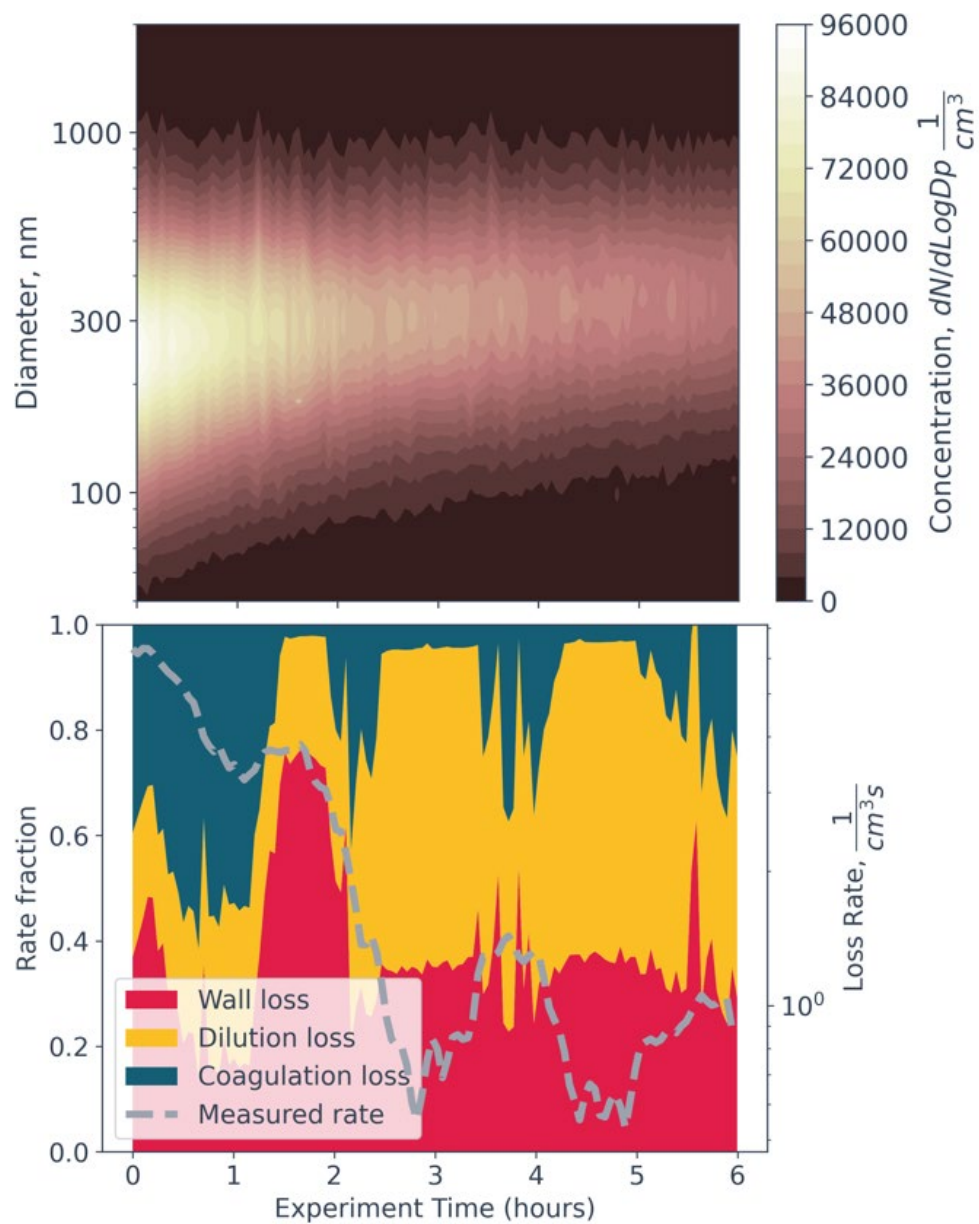


Figure S3: A 2D, two-mode, log-normal distribution plot fitted for a probability mass function representing one of the sodium chloride experiments. A stacked plot shows the particle loss rates for each process, while the dashed line shows the experimental loss rate for the particles lost.

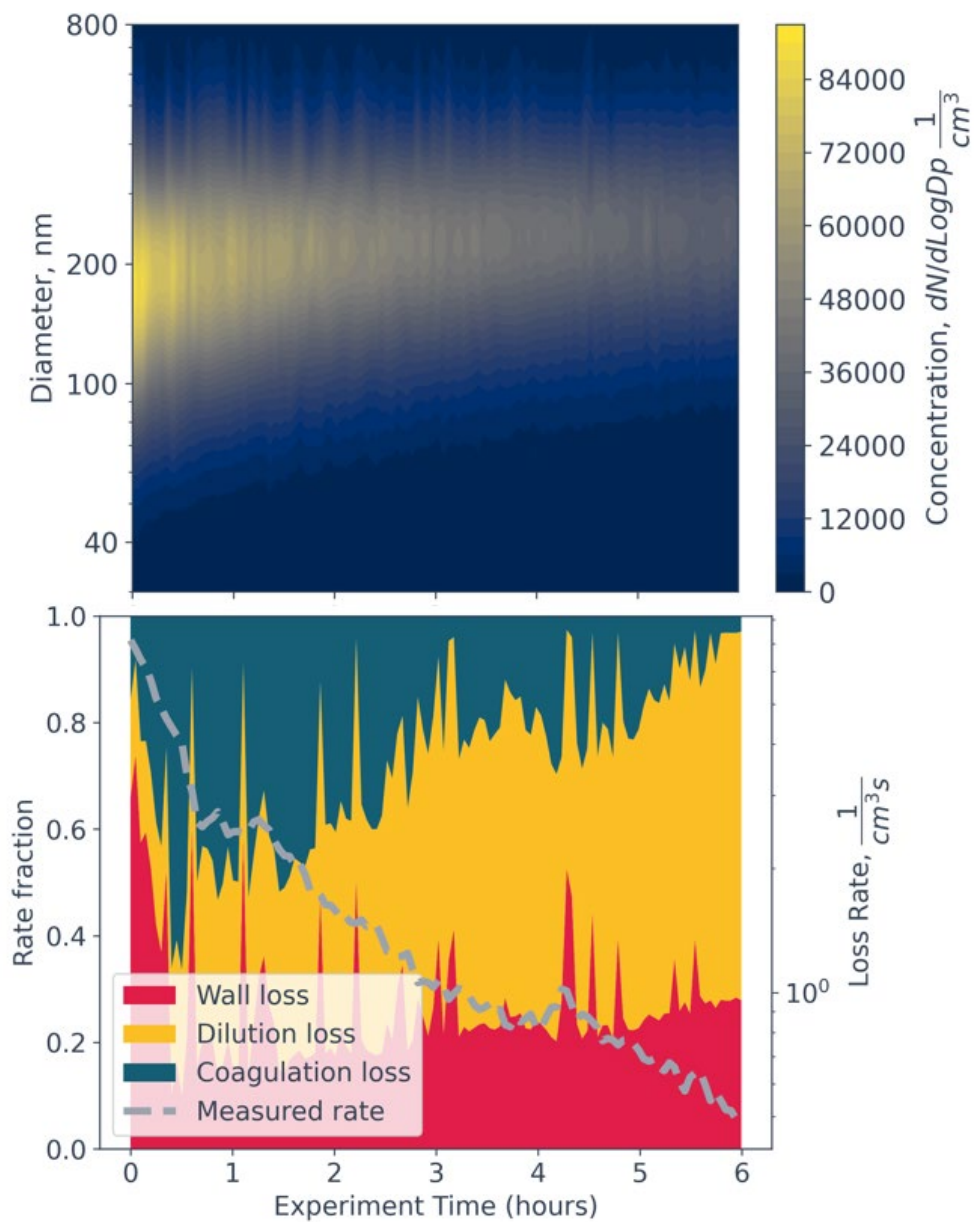


Figure S4: A 2D, two-mode, log-normal distribution plot fitted for a probability mass function representing one of the sucrose experiments. A stacked plot shows the particle loss rates for each process, while the dashed line shows the experimental loss rate for the particles lost.

2.3 Example Distribution fits.

Examples of smoke, sucrose, and NaCl experiments of a distribution fit at the 2 hour experiment mark, accompanied by the Pearson R-squared fit for the experimental time used in the analysis.

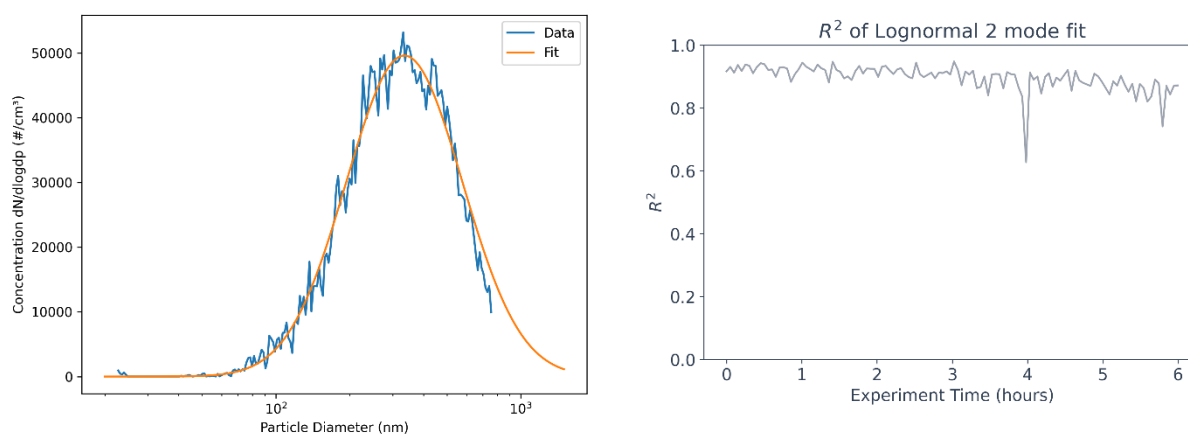


Figure S5: NaCl experiment. Left: fitted and measured size distribution. Right: Pearson R-squared of fit.

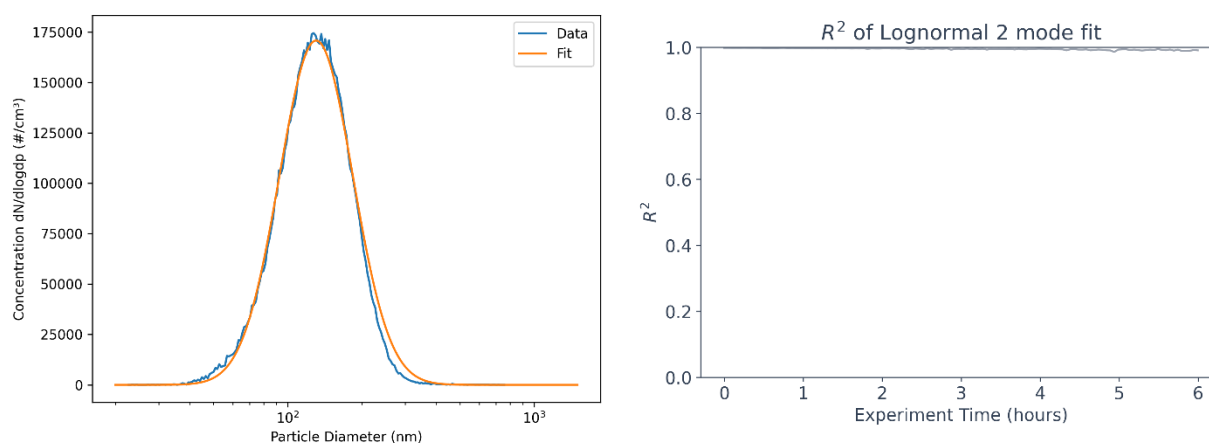


Figure S6: Smoke experiment. Left: fitted and measured size distribution. Right: Pearson R-squared of fit. Note the R-squared line is very close to 1 for most of this experiment.

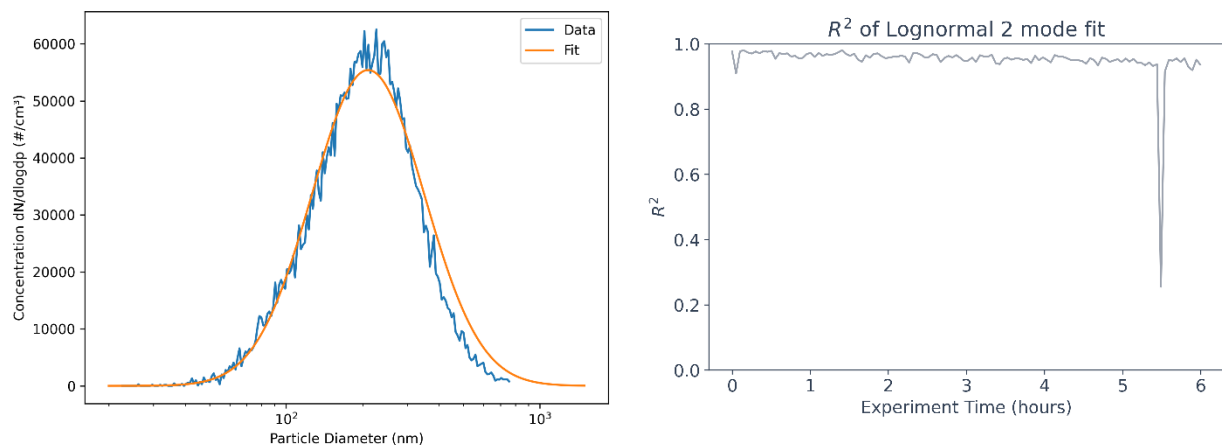


Figure S7: Sucrose experiment. Left: fitted and measured size distribution. Right: Pearson R-squared of fit.

2.4 Example Volume Analysis

Figure S8 shows the time series of aerosol volume concentration for a representative chamber run of smoke, illustrating the effect of successive loss corrections. The raw measurement (grey) steadily declines because particles are removed by deposition to the walls and by the continuous push flow that maintains slight over-pressure in the chamber. Correcting only for wall-losses (red) recovers part of the deficit, while correcting only for the push-flow dilution (gold) yields a different partial restoration. When both terms are applied simultaneously (black) the resulting curve is nearly level after the initial mixing period, indicating that the total suspended particle volume is conserved within the combined measurement uncertainty. The sharp spikes at 3 h and 5.7 h correspond to poor size distribution fits which get excluded in the final analysis. This volume conservation is confirming that no systematic bias is introduced by the procedure.

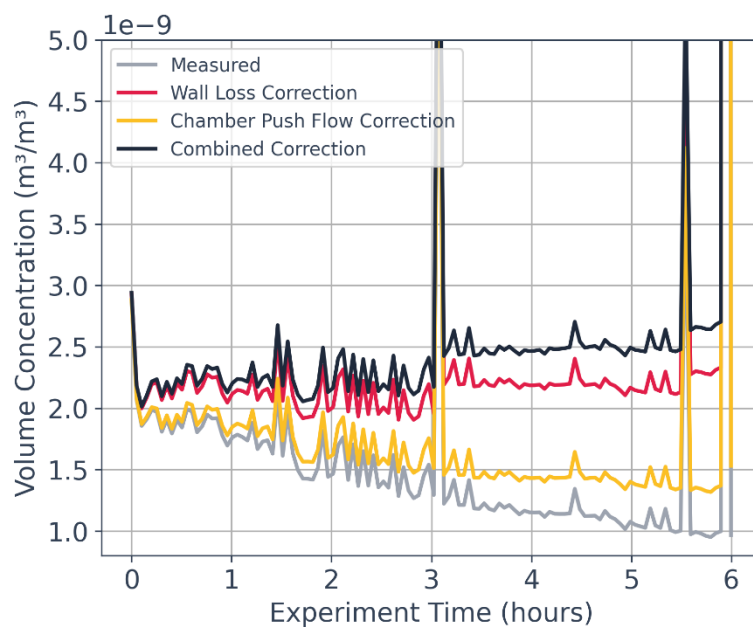


Figure S8: Volume conservation analysis for a smoke experiment.

2.5 Example Number Concentrations

Figure S9 shows the evolution of the typical total particle number concentration during the different species studies. The smoke injection produced the highest initial loading ($>10^6 \text{ cm}^{-3}$) and maintained concentrations above 10^5 cm^{-3} for more than an hour (solid line). The NaCl was consistently the next highest, which was followed by sucrose. All experiments were conducted under identical chamber conditions (25°C , $<10\%$ RH, well-mixed).

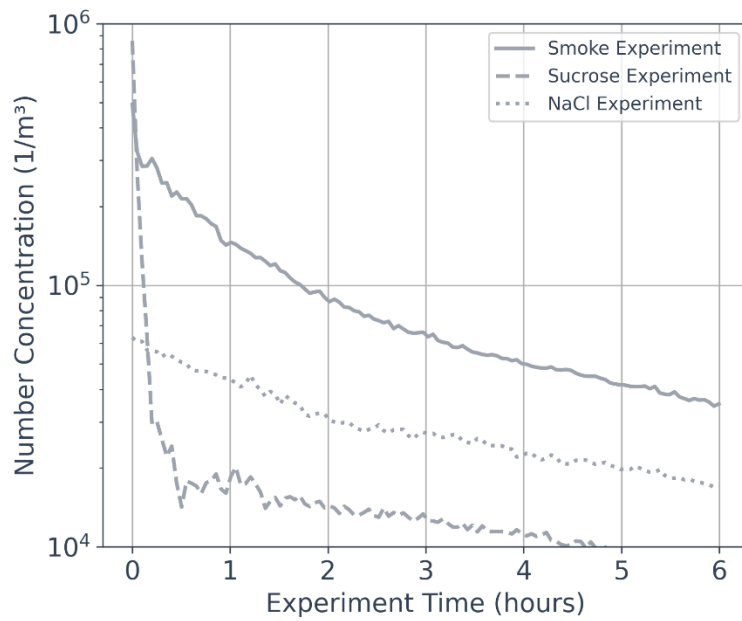


Figure S9: Evolution of the typical total particle number concentration during the three chamber experiment series.