Supporting Information for "**Filtration Efficiency of Air Conditioner Filters and Face Masks to Limit Exposure to Aerosolized Algal Toxins**"

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This Supporting Information (SI) contains 10 pages, 2 tables, and 6 figures.

1. Additional Details of the Experimental Set Up and Toxin Analysis

Table S1. Description of Air Conditioning (AC) filters and face masks used for experimentation.

Filter identifier	Rating listed	Filter brand & model/name	Filter description
AF1	(not rated)	A/C Safe AC-302	Spun polyester air filter
AF2	HEPA-type	Honeywell HRF201B	Pleated fiber HEPA filter with carbon pre-filter
AF3	FPR4	WEB Eco Filter Plus	Reusable washable multi-layer air filter
AF4	FPR10	Honeywell Elite Allergen	Pleated fiber with wire mesh
AF5	FPR4	Rheem High Peformance	Pleated fiber with wire mesh
AF6	FPR5	WEB Absorber	Disposable carbon filter
FM1	N95	3M 8210	Face mask; polyester & polypropylene
FM2	ASTM F2299	Tiger Medical Products Ltd	Disposable medical mask; 3-layer polypropylene
FM3	R95	3M 8247	Face mask; polyester, polypropylene, & activated carbon

2. Corrections to the Particle Size Distribution

In order to combine the measurements made by the Scanning Mobility Particle Sizer (SMPS) and Aerodynamic Particle Sizer (APS), the electrical mobility diameter (d_m) measured by the SMPS and the aerodynamic diameter (d_a) measured by the APS were both converted to the physical diameter (d_p) using the following equations:[2]

$$d_p = d_m \tag{S1}$$

$$d_p = \frac{d_a}{\sqrt{\frac{\rho_{eff}}{\rho_o}}} \tag{S2}$$

where d_p, d_m, and d_a are the physical, mobility, and aerodynamic diameters, respectively; ρ_{Peff} is the effective particle density, and ρ_o is unit density (1 g cm^{-3}). We used an effective density of 1.8 g cm^{-3} for seawater[3] and an effective density of 1.5 g cm^{-3} for aerosols generated from *M. aeruginosa*—a value found to be appropriate for lake spray aerosol.[4] Because the SMPS tends to undercount particles in the upper size bins due to the impactor while the APS tends to undercount particles in the lower size bins due to poor scattering efficiency, the highest SMPS size bins and lowest APS size bins in the overlapping regions were discarded to combine data from the two sizing instruments.[2,3,5]

3. Details of the Proof-of-Concept Experiments Using Filtered Seawater

Aerosols were generated by bubbling filtered seawater collected from the RSMAS dock. The bubbler apparatus is shown in Figure 1 and described in the main text. For the seawater experiments, we used a bubbler flow of 1.5 lpm and a dilution flow of 15.5 lpm. Flows were verified using a Sensidyne Gilibrator bubble flow calibrator. The bubbler and dilution flow were then mixed and passed through the filter cassette containing a 47 mm cutout of a face mask or AC filter. We also ran a control without a filter in this filter cassette. The flow that passes across the face mask or AC filter piece is then split using a four-way aerosol flow splitter (Brechtel Manufacturing Inc) to a filter cassette holding a 47 mm pre-combusted glass fiber filter (EPM2000), which was used to collect generated aerosols, a scanning mobility particle sizer (SMPS, model 3082, TSI Inc), and an aerodynamic particle sizer (APS, model 3221, TSI, Inc). For the seawater experiments, silica gel dryers were used upstream of the SMPS and APS and the relative humidity (RH) for the experiment was controlled to 60%, above the efflorescence RH of sea salts.[6] The fourth split was capped for this experiment.

The nine filter cut outs used were comprised of six commercially available air conditioner (AC) panel filters (labeled AF) and three types of personal face masks (labeled FM). Two modes of sampling were used: 1) without a mask or AC filter upstream, and 2) with a mask or AC filter upstream. The system was run without a mask or AC filter upstream (e.g., Mode 1) to collect the background sea spray aerosol particle size distribution for 30 minutes. Air filters were then placed in the experimental filter holder sequentially to measure the particle size distribution passing through the filter (Mode 2). Particle size data was continuously collected for at least 20 minutes for each experimental AC filter, and 60 minutes for each personal face mask. Fig S1 shows the size distributions of the average control run and the average run with each in-line filter. Table S2 shows the average composite particle filtration efficiency across all size bins for each filter cut-out tested. Each particle size distribution is shown as a contour plot as a function of size and sample number for SMPS data in Fig S2 and for APS data in Fig S3.

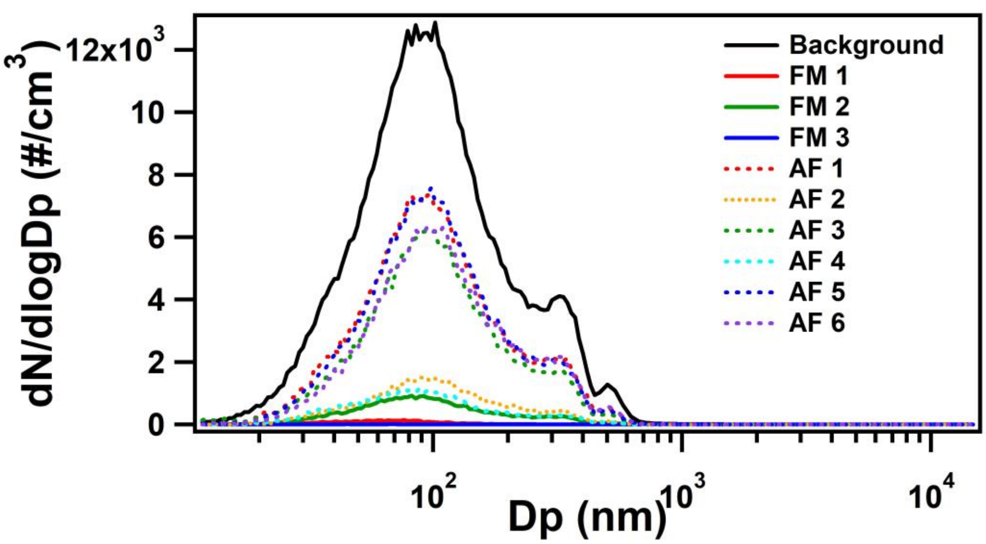


Fig. S1: Average particle size distributions for proof-of-concept air filter efficiency tests using sea spray aerosol with air conditioner panel filters (AF; dashed lines) and face mask filters (FM;

colored solid lines) in-line. The black solid line is the average sea spray aerosol size distribution without a filter in-line.

Table S2: Average particle filtration efficiencies for each filter material tested using aerosols generated from filtered seawater during proof-of-concept experiments. Uncertainties represent 95% confidence intervals.

Filter Materials Tested		Seawater Filtration Efficiency Data
Filter Type	**Filter Description**	**Average Filtration Efficiency**
AF1	Unrated A/C Safe air filter	53±4
AF2	Honeywell HEPA air filter	91±1
AF3	WEB Eco FPR4 air filter	65±3
AF4	Honeywell FPR10 air filter	92±1
AF5	Rheem FPR4 air filter	56±5
AF6	WEB Absorber FPR 5 air filter	62±4
FM1	N95 face mask	99±0.1
FM2	Disposable medical face mask	95±0.1
FM3	R95 face mask	99±0.01

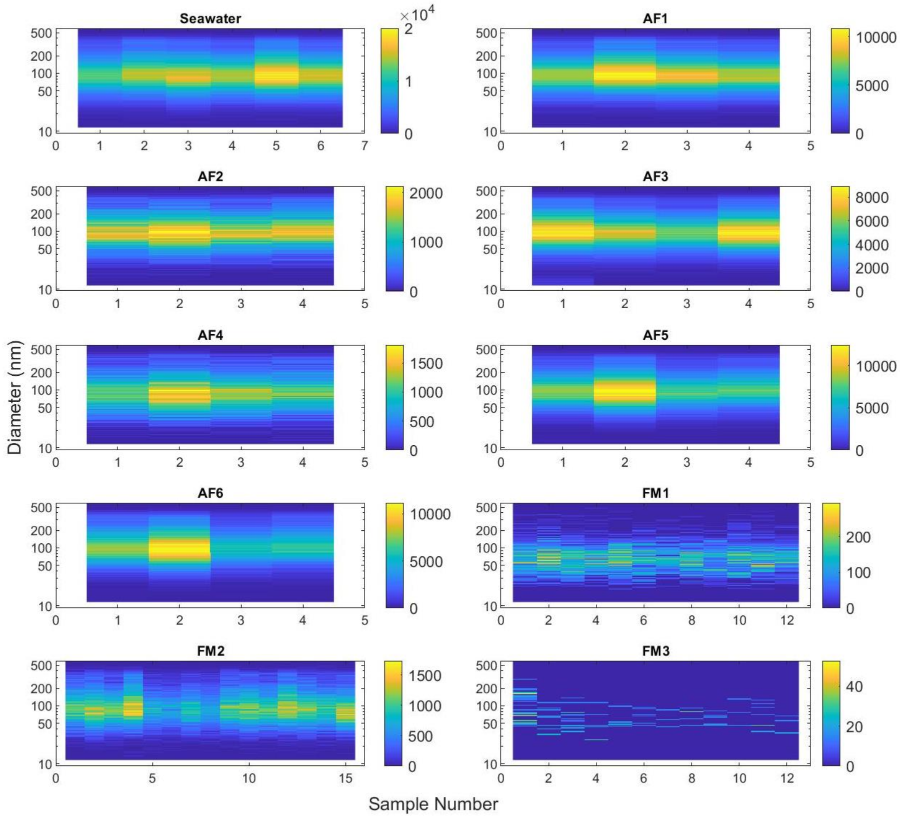


Fig. S2: Contour plots showing the particle number concentrations as a function of size and time (e.g., sample number) for each proof-of-concept experiment conducted with seawater collected with the SMPS.

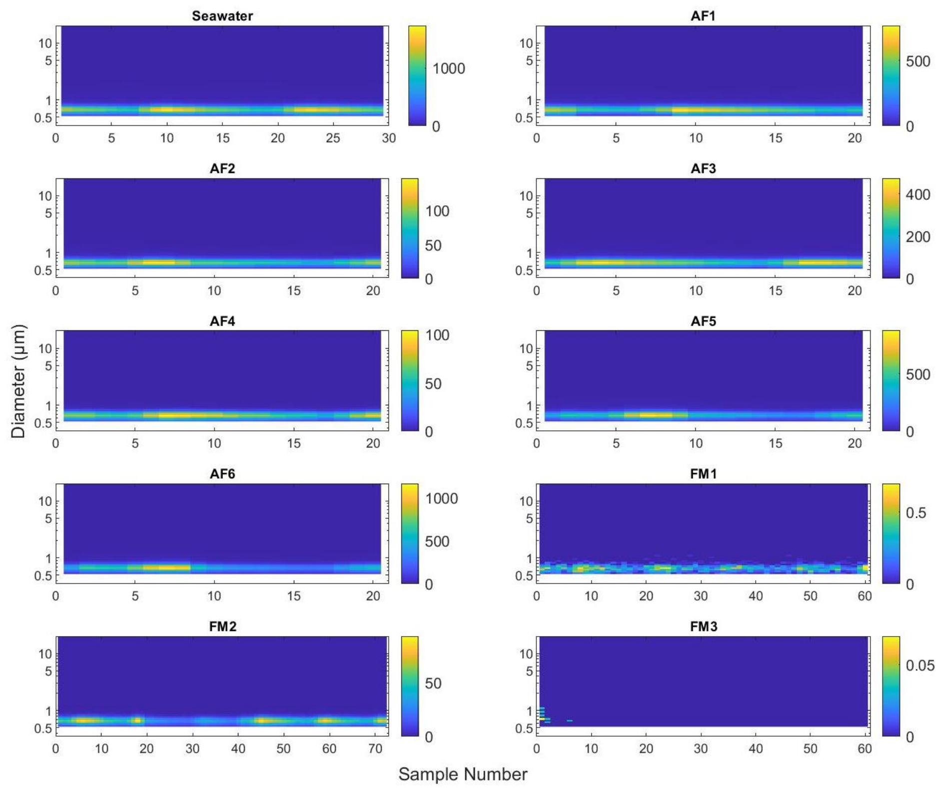
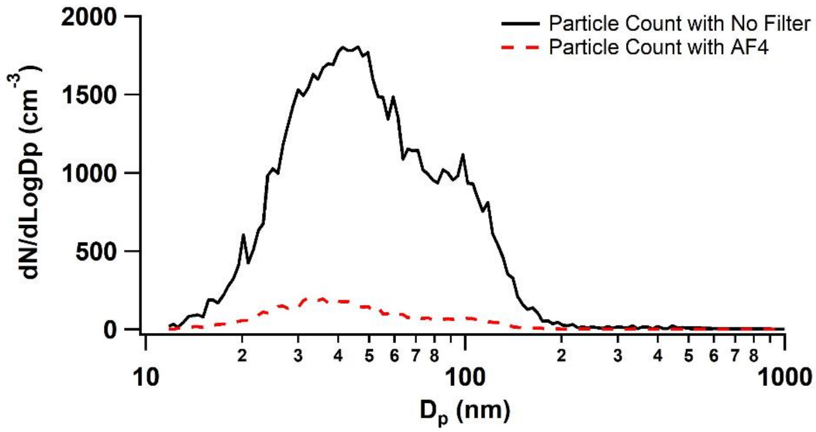
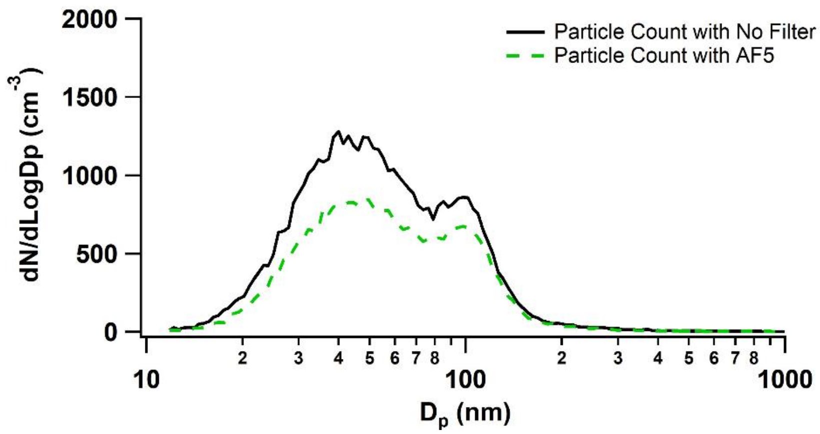


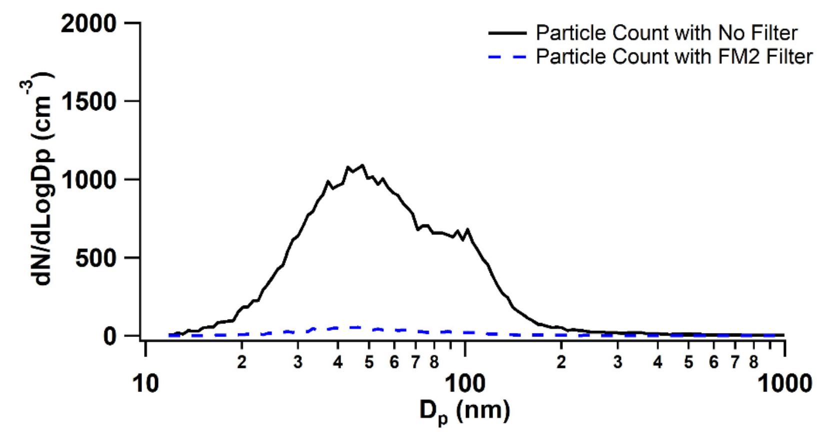
Fig. S3: Contour plots showing the particle number concentrations as a function of size and time (e.g., sample number) for each proof-of-concept experiment conducted with seawater collected with the APS.

4. Size Distributions from Aerosol Generated from *M. aeruginosa*

Aerosols were generated by bubbling cultures of *M. aeruginosa*. We selected three filters representative of high and low filtration efficiencies for experiments with *M. aeruginosa*: AF4 (Honeywell FPR 10), AF5 (Rheem FRP 4), and FM2 (a disposable surgical mask). Two modes of sampling were used: 1) without a mask or AC filter upstream (Mode 1), and 2) with a mask or AC filter upstream (Mode 2). Particle size data was collected for at least 2 hours in each Mode for each experiment with *M. aeruginosa*. Fig. S4 shows a comparison of average size distributions collected in Mode 1 and Mode 2 for each filter tested. Each particle size distributions is shown as a contour plot as a function of size and sample number for data collected in Mode 1 in Fig S5 and for data collected in Mode 2 in Fig S6.


Particle Count with No Filter
Particle Count with AF4
dN/dLogDp (cm-3)
2000
1500
1000
500
0
10
2
3
4
5
6
7
8
100
2
3
4
5
6
7
8
1000
Dp (nm)


Particle Count with No Filter
Particle Count with AF5
dN/dLogDp (cm-3)
2000
1500
1000
500
0
10
2
3
4
5
6
7
8
100
2
3
4
5
6
7
8
1000
Dp (nm)


Particle Count with No Filter
Particle Count with FM2 Filter
dN/dLogDp (cm-3)
2000
1500
1000
500
0
10
2
3
4
5
6
7
8
100
2
3
4
5
6
7
8
1000
Dp (nm)

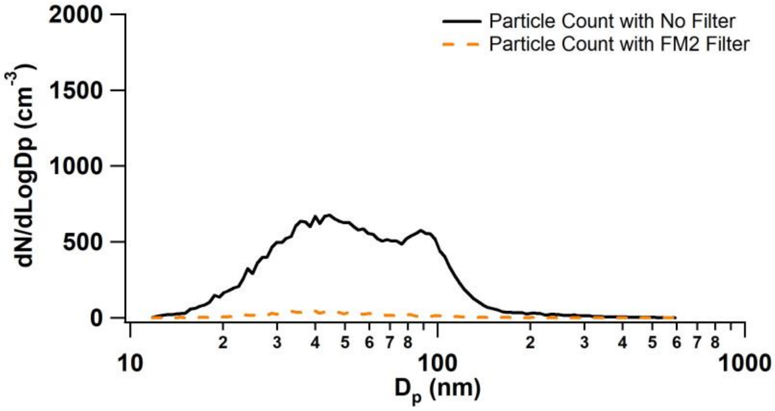


Figure S4: Particle size distributions measured by SMPS and APS for air filter efficiency tests using aerosolized *M. aeruginosa* cultures. The average size distributions for the test using AF4 (top panel), AF5 (second panel), the first run with FM2 (third panel), and the second run with FM2 (bottom panel) are shown.

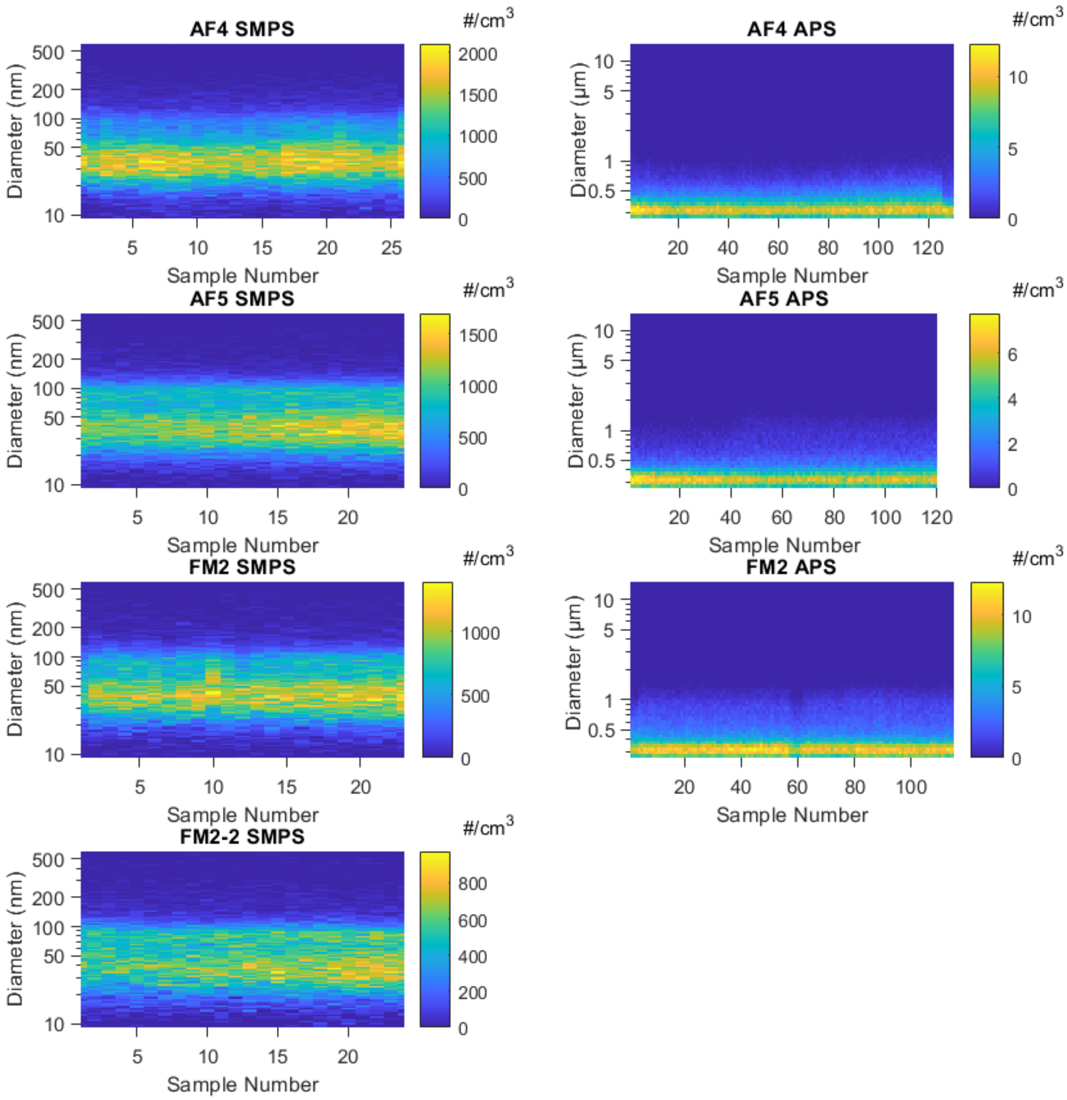


Figure S5: Contour plots showing the particle number concentrations as a function of size and time (e.g., sample number) for each experiment conducted with *M. aeruginosa* without an in-line AC filter or face mask (Mode 1 of aerosol sampling) collected with the SMPS (left-hand side) and APS (right-hand side).

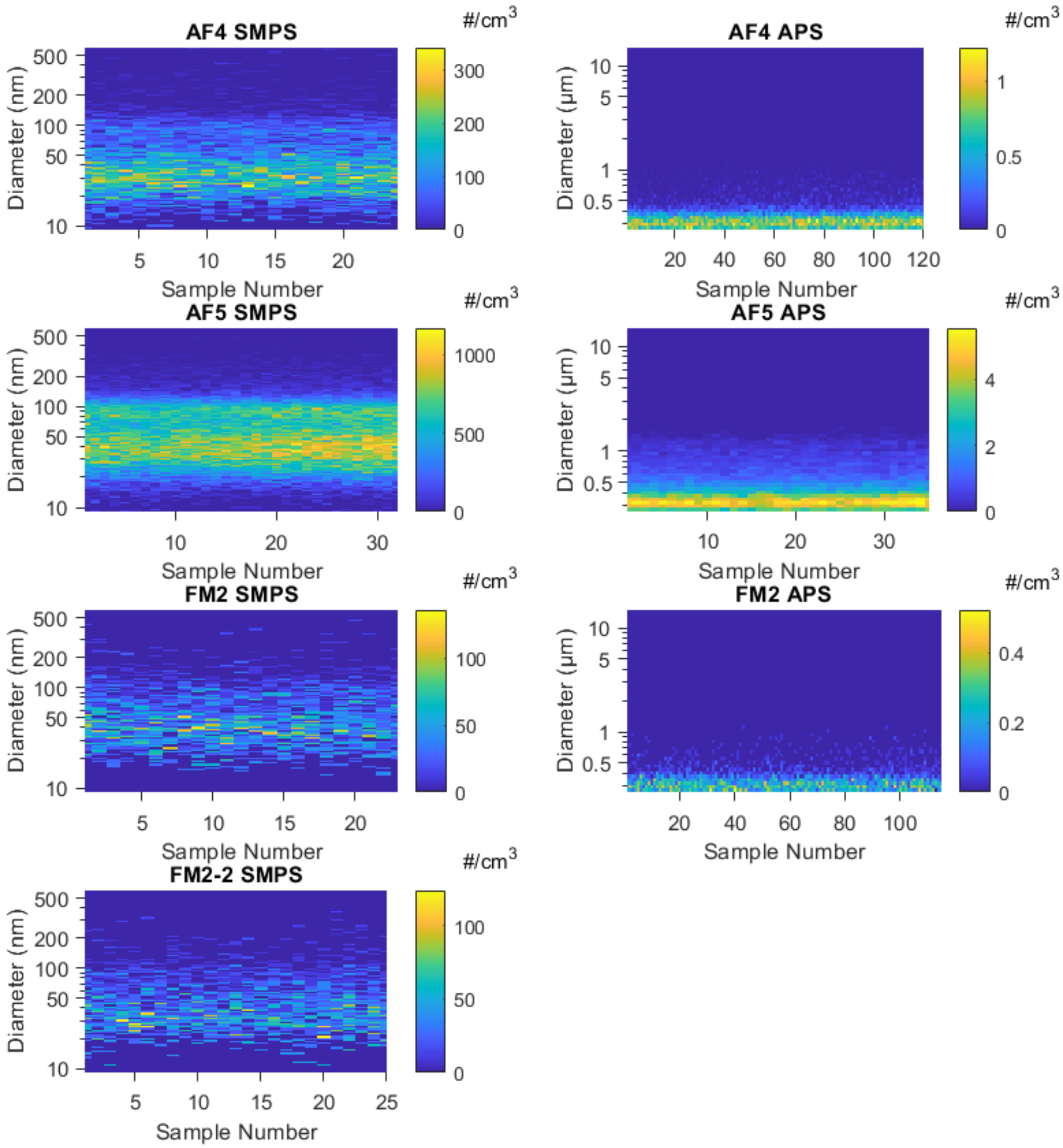


Figure S6: Contour plots showing the particle number concentrations as a function of size and time (e.g., sample number) for each experiment conducted with *M. aeruginosa* with an in-line AC filter or face mask (Mode 2 of aerosol sampling) collected with the SMPS (left-hand side) and APS (right-hand side).

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