

1 Supplemental Information for:

2 Systematic Characterization and Fluorescence Threshold Strategies for the Wideband Integrated
3 Bioaerosol Sensor (WIBS) Using Size-Resolved Biological and Interfering Particles

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11 Table S1. Material types analyzed, including biological and non-biological. Table includes
 12 threshold values for FT + 3σ and FT +9σ.

Materials		Provider	Part Number	Aerosolization Method	3σ FL1	3σ FL2	3σ FL3	9σ FL1	9σ FL2	9σ FL3
BIOLOGICAL MATERIALS										
Pollen										
1	<i>Urtica dioica</i> (Stinging Nettle)	BONAPOL	-	Powder (P1)	49.0	24.3	44.4	96.5	45.6	73.5
2	<i>Artemisia vulgaris</i> (Common Mugwort)	BONAPOL	-	Powder (P1)	49.0	24.3	44.4	96.5	45.6	73.5
3	<i>Castanea sativa</i> (European Chestnut)	BONAPOL	-	Powder (P1)	48.2	24.1	46.1	95.2	45.2	77.6
4	<i>Corylus avellana</i> (Hazel)	BONAPOL	-	Powder (P1)	48.2	24.1	46.1	95.2	45.2	77.6
5	<i>Taxus baccata</i> (Common Yew)	BONAPOL	-	Powder (P1)	48.2	24.1	46.1	95.2	45.2	77.6
6	<i>Rumex acetosella</i> (Sheep Sorrel)	BONAPOL	-	Powder (P1)	48.2	24.1	46.1	95.2	45.2	77.6
7	<i>Olea europaea</i> (European Olive Tree)	BONAPOL	-	Powder (P1)	48.2	24.1	46.1	95.2	45.2	77.6
8	<i>Alnus glutinosa</i> (Black Alder)	BONAPOL	-	Powder (P1)	50.5	24.9	48.8	101.2	46.3	80.9
9	<i>Phleum pratense</i> (Timothy Grass)	BONAPOL	-	Powder (P1)	50.5	24.9	48.8	101.2	46.3	80.9
10	<i>Populus alba</i> (White Poplar)	BONAPOL	-	Powder (P1)	47.7	23.9	46.2	95.6	44.8	77.8
11	<i>Taraxacum officinale</i> (Common Dandelion)	BONAPOL	-	Powder (P1)	47.7	23.9	46.2	95.6	44.8	77.8
12	<i>Amaranthus retroflexus</i> (Redroot Amaranth)	BONAPOL	-	Powder (P1)	45.6	24.4	46.6	89.5	45.7	78.9
13	<i>Aesculus hippocastanum</i> (Horse-chestnut)	BONAPOL	-	Powder (P1)	45.6	24.4	46.6	89.5	45.7	78.9
14	<i>Lycopodium</i> (Clubmoss)	Polysci., Inc.	16867	Powder (P1)	85.1	52.3	46.1	162.5	85.2	79.2
Fungal spores										
1	<i>Aspergillus brasiliensis</i>	ATCC*	-	Fungal	50.3	24.7	48.5	99.5	45.9	82.4
2	<i>Aspergillus niger</i> ; WB 326	ATCC	16888	Fungal	50.3	24.7	48.5	99.5	45.9	82.4
3	<i>Rhizopus stolonifera</i> (Black Bread Mold); UNB-1	ATCC	14037	Fungal	50.3	24.7	48.5	99.5	45.9	82.4
4	<i>Saccharomyces cerevisiae</i> (Brewer's Yeast)	ATCC	-	Fungal	49.0	24.3	44.5	96.5	45.6	73.5
5	<i>Aspergillus versicolor</i> ; NRRL 238	ATCC	10106	Fungal	49.0	24.3	44.5	96.5	45.6	73.5

Bacteria										
1	<i>Bacillus atrophaeus</i>	ATCC	49337	Bacterial	34.1	18.1	65.8	70.8	38.1	103.0
2	<i>Escherichia coli</i>	ATCC	15597	Bacterial	34.1	18.1	65.8	70.8	38.1	103.0
3	<i>Pseudomonas stutzeri</i>	ATCC	13525	Bacterial	34.1	18.1	65.8	70.8	38.1	103.0
Biofluorophores										
1	Riboflavin	Sigma	R7649	Powder (P1)	87.3	56.2	49.1	166.8	92.4	84.3
2	Chitin	Sigma	C9752	Powder (P1)	87.3	56.2	49.1	166.8	92.4	84.3
3	NAD	Sigma	N8129	Powder (P1)	87.3	56.2	49.1	166.8	92.4	84.3
4	Folic Acid	Sigma	F7876	Powder (P1)	87.3	56.2	49.1	166.8	92.4	84.3
5	Cellulose, fibrous medium	Sigma	4352396	Powder (P1)	85.3	54.5	48.5	159.7	88.6	82.1
6	Ergosterol	Sigma	45480	Powder (P1)	92.8	48.0	40.5	176.1	79.7	68.8
7	Pyridoxine	Sigma	P5669	Powder (P1)	96.7	46.1	40.6	186.5	77.7	69.0
8	Pyridoxamine	Sigma	P9380	Powder (P1)	92.8	48.0	40.5	176.1	79.7	68.8
9	Tyrosine	Sigma	855456	Powder (P1)	87.1	52.3	44.8	166.4	86.8	75.8
10	Phenylalanine	Sigma	78019	Powder (P1)	85.3	54.5	48.5	159.7	88.6	82.1
11	Tryptophan	Sigma	93659	Powder (P1)	85.3	54.5	48.5	159.7	88.6	82.1
12	Histidine	Sigma	H8000	Powder (P1)	90.9	45.2	39.3	173.0	76.8	66.3
NON-BIOLOGICAL MATERIALS										
Dust										
1	Arabic Sand	UM-SEES **	-	Powder (P3)	85.1	52.3	46.1	162.5	85.2	79.2
2	California Sand	UM-SEES	-	Powder (P2)	85.1	52.3	46.1	162.5	85.2	79.2
3	Africa Sand	UM-SEES	-	Powder (P2)	87.9	45.7	39.4	166.4	77.8	66.8
4	Murkee-Murkee Australian Sand	UM-SEES	-	Powder (P2)	87.9	45.7	39.4	166.4	77.8	66.8
5	Manua Key Summit Hawaii Sand	UM-SEES	-	Powder (P2)	87.9	45.7	39.4	166.4	77.8	66.8
6	Quartz	UM-SEES	-	Powder (P2)	87.9	45.7	39.4	166.4	77.8	66.8
7	Kakadu Dust	UM-SEES	-	Powder (P2)	87.9	45.7	39.4	166.4	77.8	66.8

8	Feldspar	UM-SEES	-	Powder (P2)	87.9	45.7	39.4	166.4	77.8	66.8
9	Hematite	UM-SEES	-	Powder (P2)	87.9	45.7	39.4	166.4	77.8	66.8
10	Gypsum	UM-SEES	-	Powder (P2)	90.9	45.2	39.3	173.0	76.8	66.3
11	Bani AMMA	UM-SEES	-	Powder (P2)	90.9	45.2	39.3	173.0	76.8	66.3
12	Arizona Test Dest	UM-SEES	-	Powder (P2)	90.9	45.2	39.3	173.0	76.8	66.3
13	Kaolinite	Sigma		Powder (P2)	90.9	45.2	39.3	173.0	76.8	66.3

HULIS

1	Waskish Peat Humic Acid Reference	IHSS***	1R107H	Powder (P1)	90.9	45.2	39.3	173.0	76.8	66.3
2	Suwannee River Humic Acid Standard II	IHSS	2S101H	Powder (P2)	90.9	45.2	39.3	173.0	76.8	66.3
3	Suwannee River Fulvic Acid Standard I	IHSS	1S101F	Powder (P2)	90.9	45.2	39.3	173.0	76.8	66.3
4	Elliott Soil Humic Acid Standard	IHSS	1S102H	Powder (P1)	90.9	45.2	39.3	173.0	76.8	66.3
5	Pony Lake (Antarctica) Fulvic Acid Reference	IHSS	1R109F	Powder (P2)	90.9	45.2	39.3	173.0	76.8	66.3
6	Nordic Aquatic Fulvic Acid Reference	IHSS	1R105F	Powder (P2)	90.9	45.2	39.3	173.0	76.8	66.3

Polycyclic Hydrocarbons

1	Pyrene	Sigma	82648	Powder (P1)	92.8	48.0	40.5	176.1	79.7	68.8
2	Phenanthrene	Sigma	695114	Powder (P1)	92.8	48.0	40.5	176.1	79.7	68.8
3	Naphthalene	Sigma	84679	Powder (P1)	92.8	48.0	40.5	176.1	79.7	68.8

Combustion Soot and Smoke

1	Aquadag	Synthesized in lab	-	Liquid	45.6	24.4	46.6	89.5	45.7	78.9
2	Ash	MPIC	-	Powder (P1)	96.7	46.1	40.6	186.5	77.7	69.0
3	Fullerene Soot	Alfa Aesar	40971	Powder (P2)	92.8	48.0	40.5	176.1	79.7	68.8
4	Diesel Soot	NIST	2975	Powder (P1)	92.8	48.0	40.5	176.1	79.7	68.8
5	Cigarette Smoke	Marlboro 83s	-	Smoke	50.5	24.9	48.8	101.2	46.3	80.9
6	Wood Smoke (<i>Pinus Nigra</i> , <i>Black Pine</i>)	Local Sample	-	Smoke	50.5	24.9	48.8	101.2	46.3	80.9

7	Fire Ash	UM-SEES	-	Powder (P1)	85.1	52.3	46.1	162.5	85.2	79.2
Brown Carbon										
1	Methylglyoxal + Glycine	Synthesized in lab	-	Liquid	30.9	16.8	60.8	63.8	35.1	101.2
2	Glycolaldehyde + Methylamine	Synthesized	-	Liquid	33.5	17.6	64.0	69.4	36.1	108.5
3	Glyoxal + Ammonium Sulfate	Synthesized	-	Liquid	31.5	17.2	64.9	65.2	34.7	111.7
Miscellaneous non-biological										
1	Laboratory wipes	Kimberly Clark	-		46.4	23.7	43.9	92.7	44.5	73.9
2	Cotton t-shirt (white)	Hanes	-		46.4	23.7	43.9	92.7	44.5	73.9
3	Cotton t-shirt (black)	Hanes	-		46.4	23.7	43.9	92.7	44.5	73.9
4	2 µm Green	Thermo-Sci.	G0200	Liquid	-	-	-	-	-	-
5	2 µm Red	Thermo-Sci.	R0200	Liquid	-	-	-	-	-	-
6	2.1 µm Blue	Thermo-Sci.	B0200	Liquid	-	-	-	-	-	-

13 *ATCC: American Type Culture Collection

14 ** University of Manchester – School of Earth and Environmental Sciences

15 *** International Humic Substance Society

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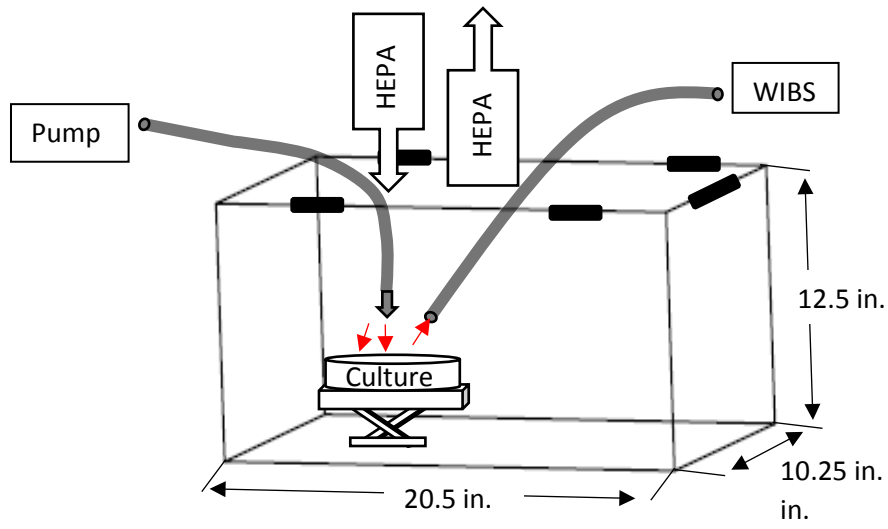
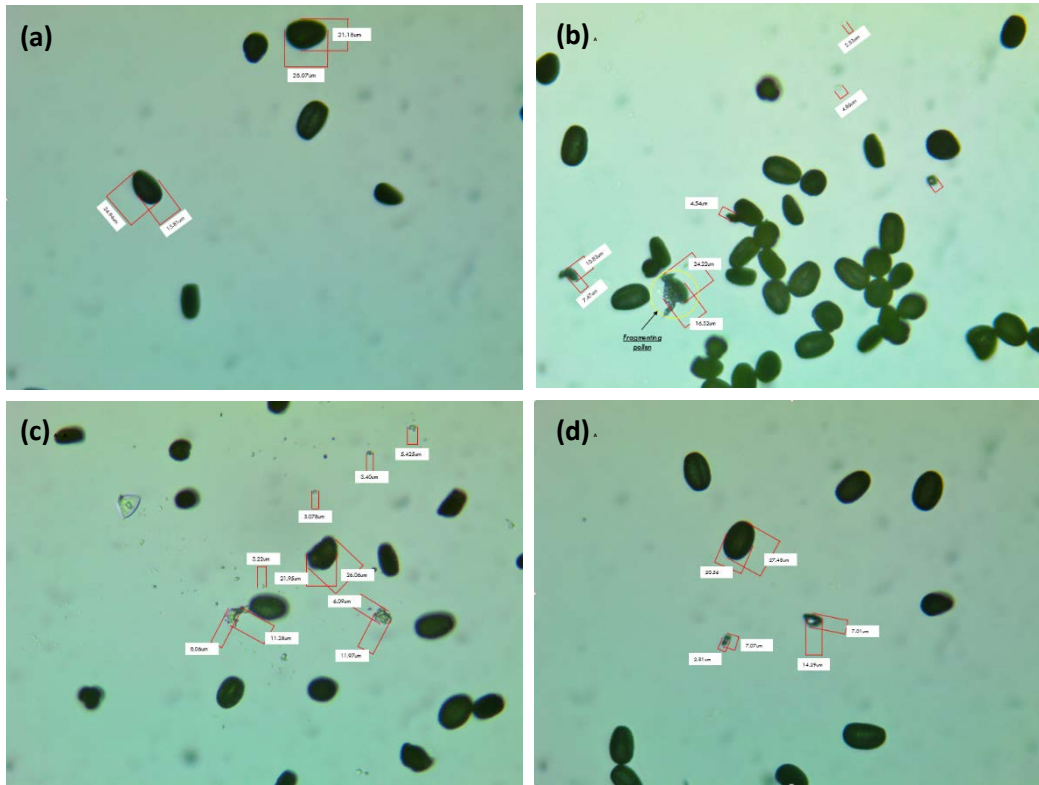
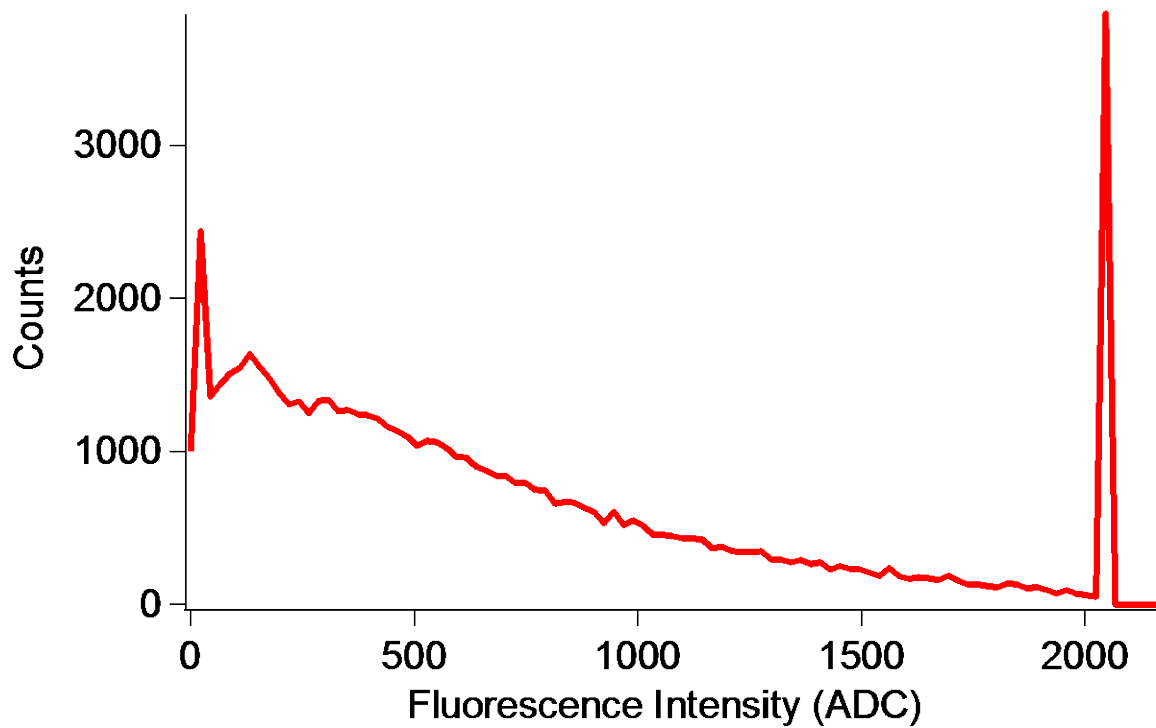


Figure S1. Schematic diagram of home-built chamber for the aerosolization of fungal spores.

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43 Figure S2. Impacted pollen (*Olea europaea*) images collected with an AmScope camera
44 (MU800, AmScope) with an objective lens with 40x magnification. (a) Not stirred (b-d) Stirred.



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46 Figure S3. Fluorescence intensity histogram of FL1 for *Aspergillus niger* (Fungi 2). One broad
47 mode extending from 0-2000 analog-to-digital counts (ADC) and a second mode showing
48 detector saturation at ~2047 ADC.

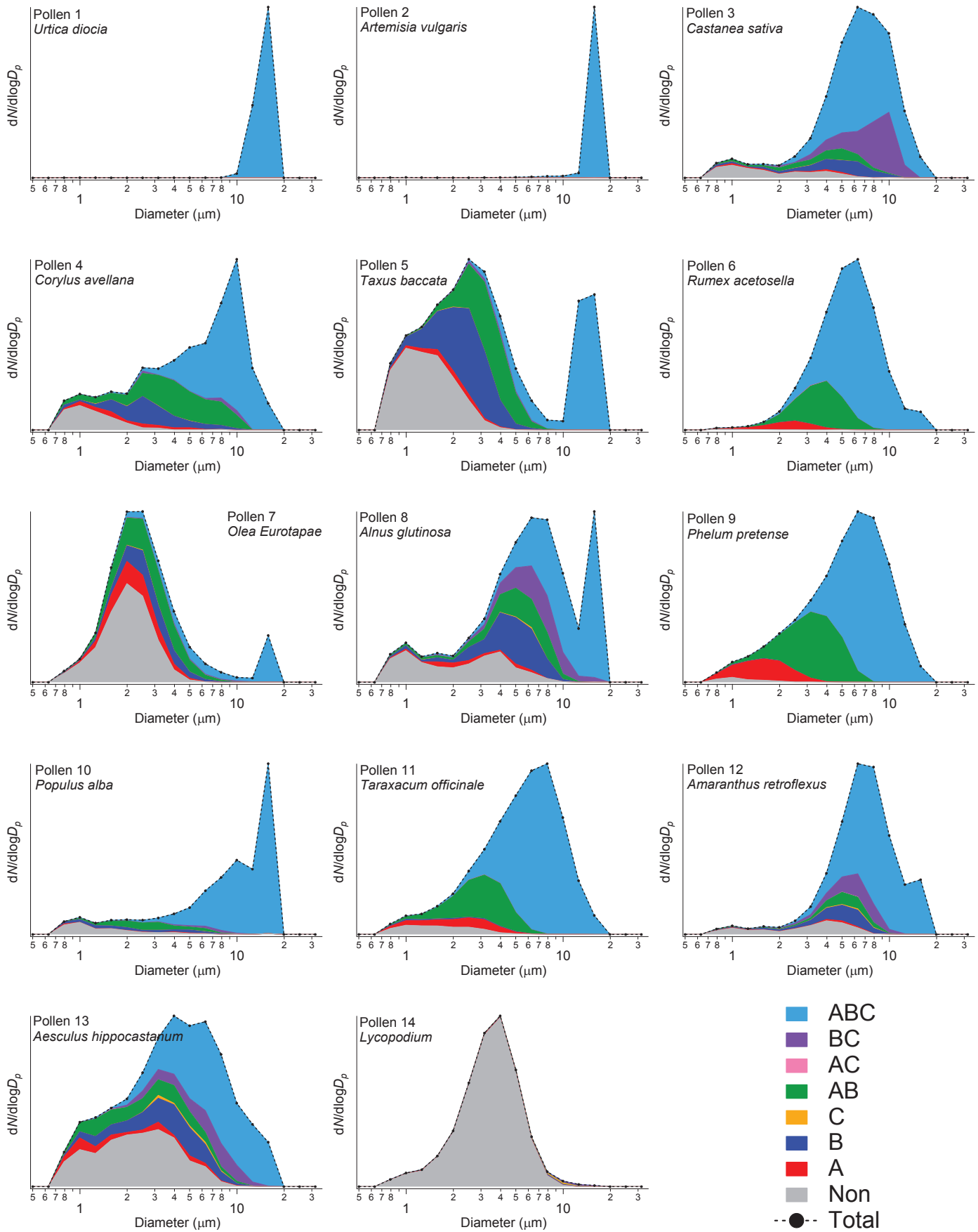


Figure S4A. Stacked particle type size distributions of pollen using FT + 3σ threshold

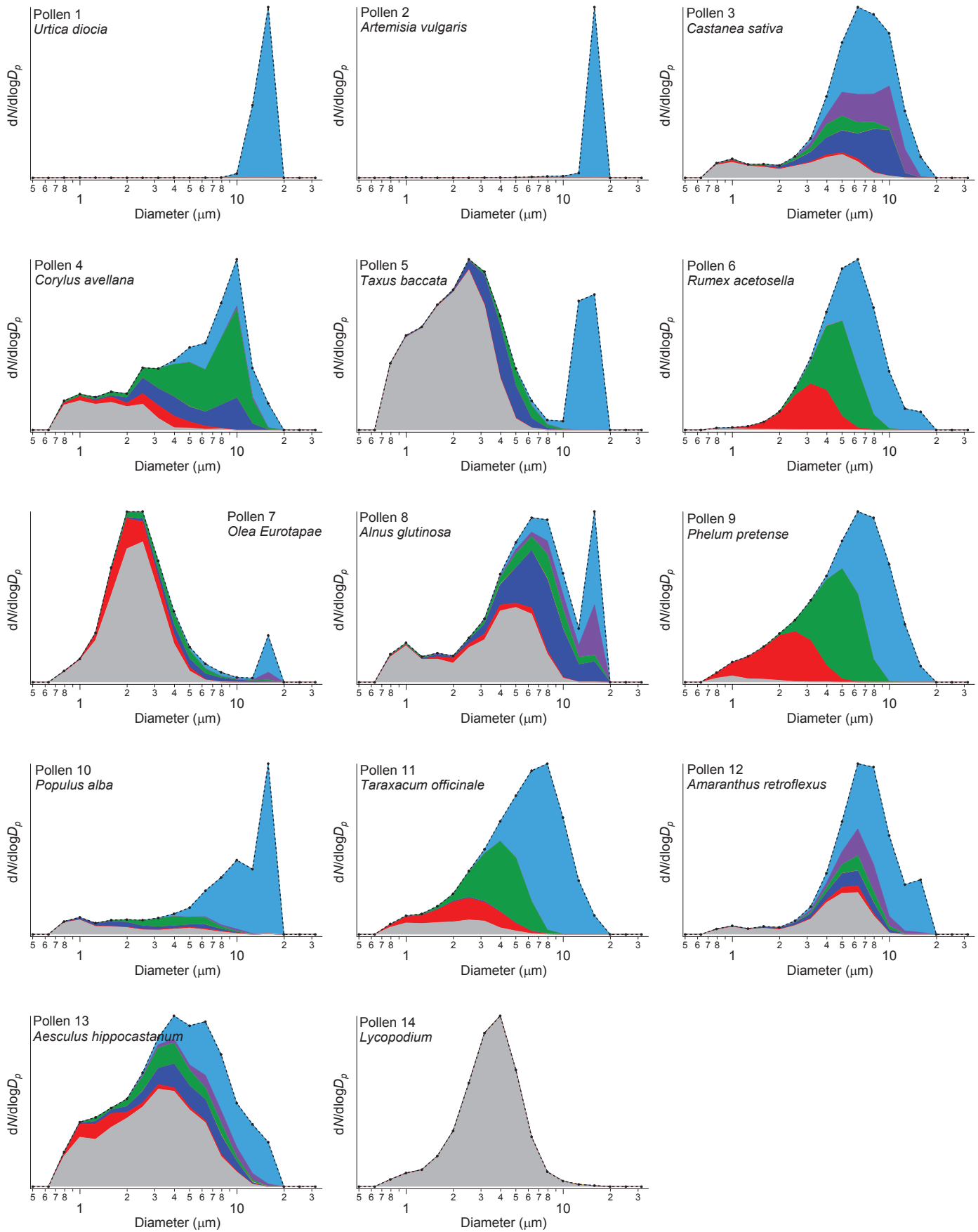


Figure S4B. Stacked particle type size distributions of pollen using FT + 9σ threshold

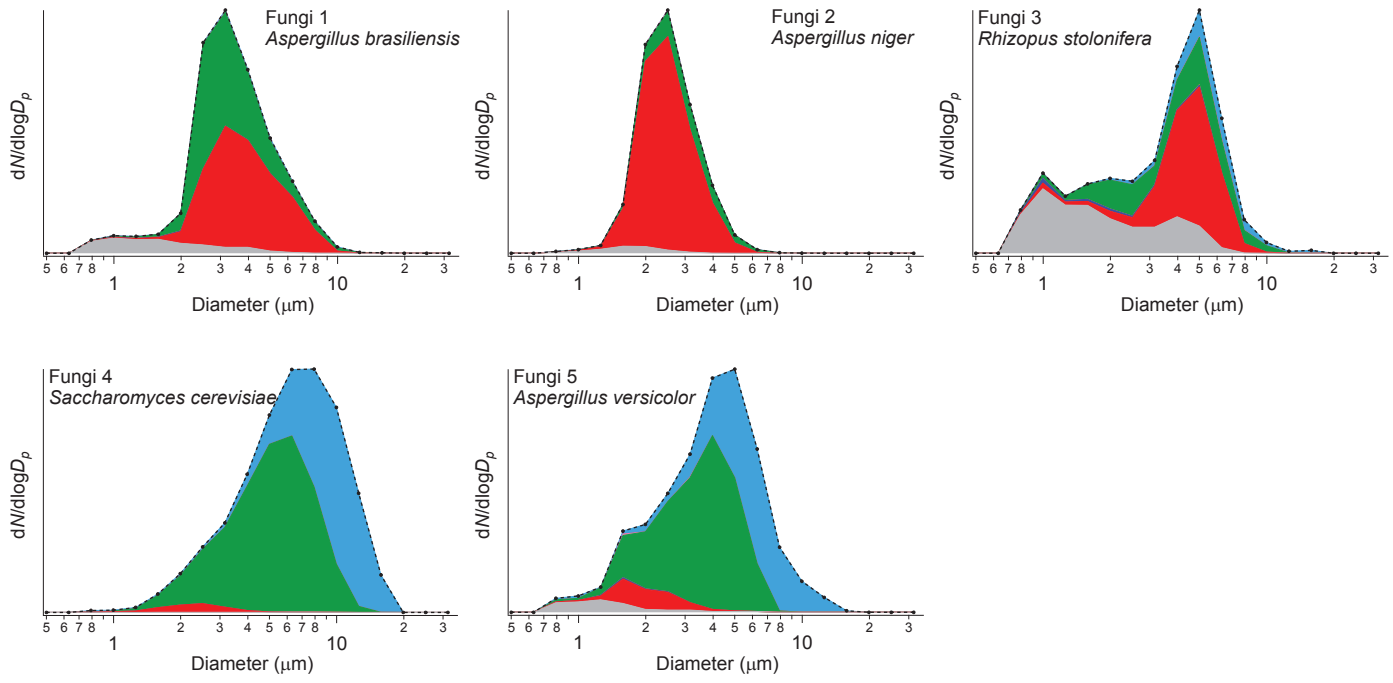


Figure S4C. Stacked particle type size distributions of fungal spores using $FT + 3\sigma$ threshold

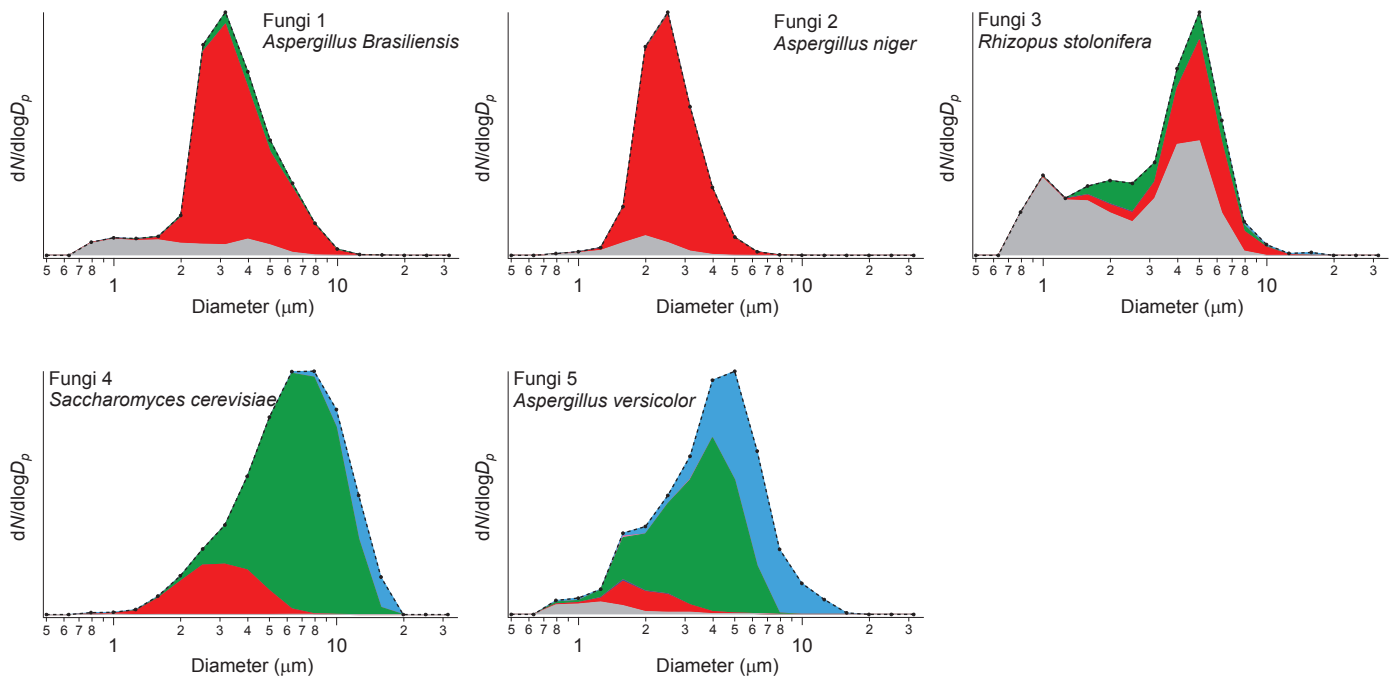


Figure S4D. Stacked particle type size distributions of fungal spores using $FT + 9\sigma$ threshold

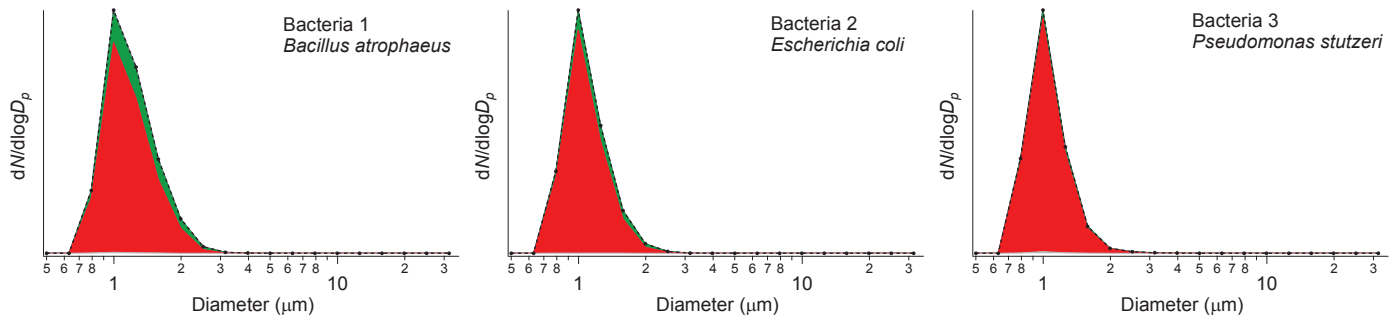


Figure S4E. Stacked particle type size distributions of bacteria using $FT + 3\sigma$ threshold

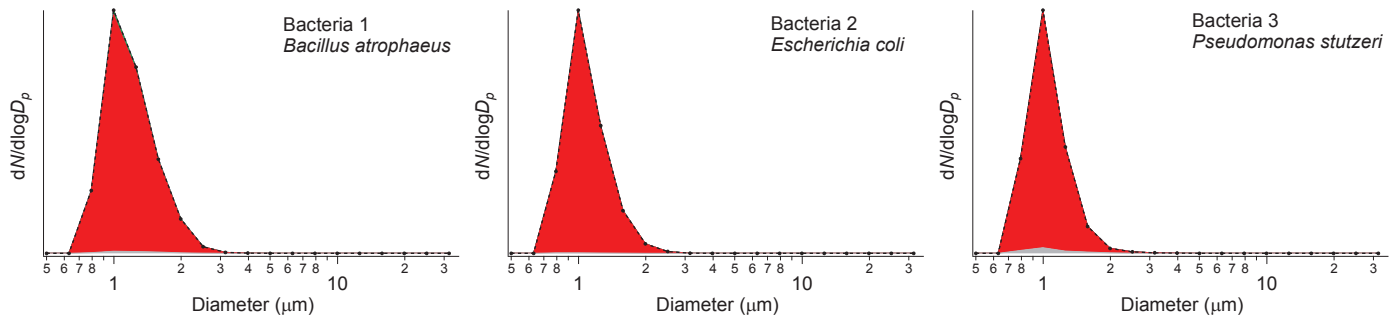


Figure S4F. Stacked particle type size distributions of bacteria using $FT + 9\sigma$ threshold

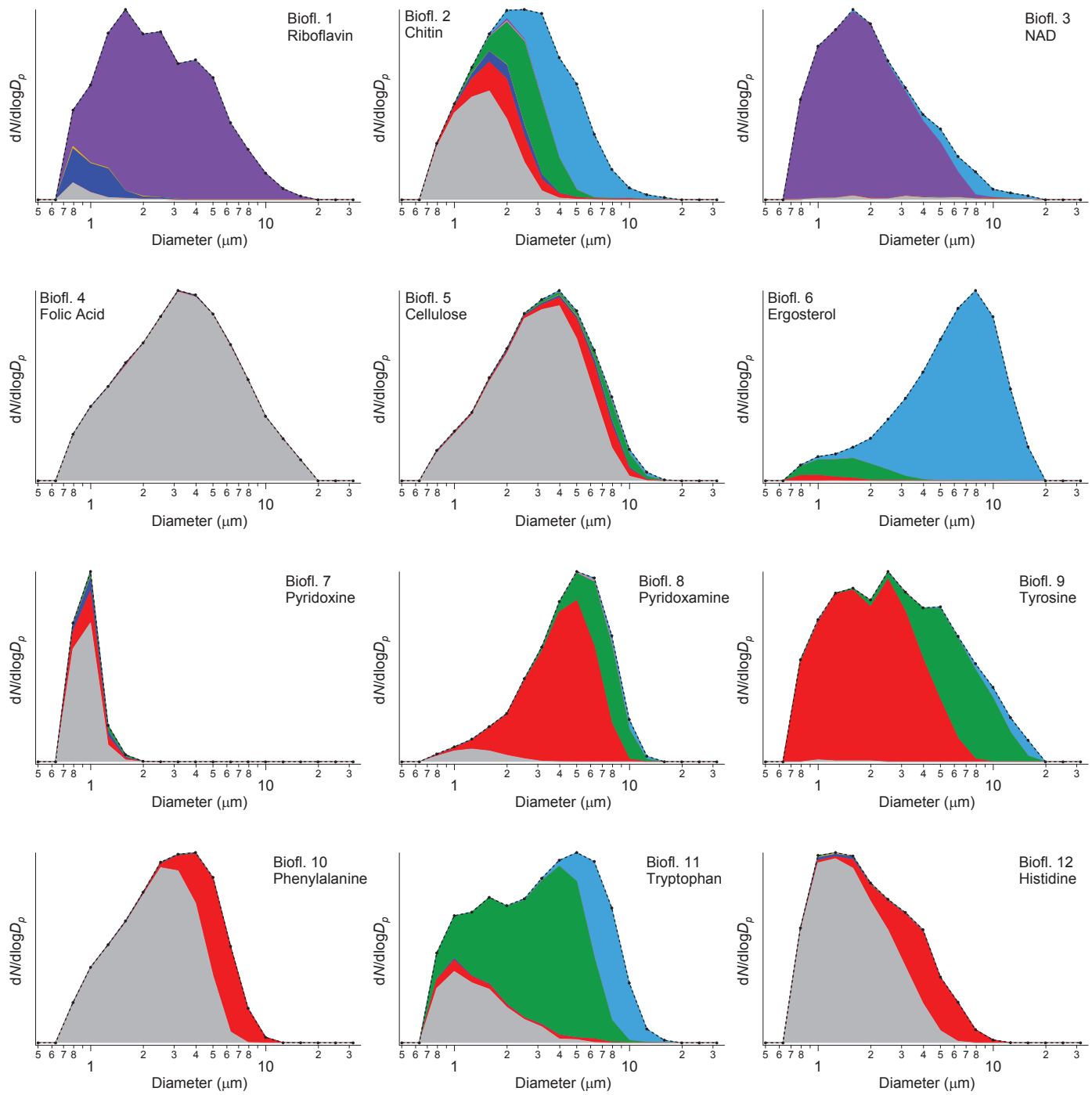


Figure S4G. Stacked particle type size distributions of biofluorophores using FT + 3σ threshold

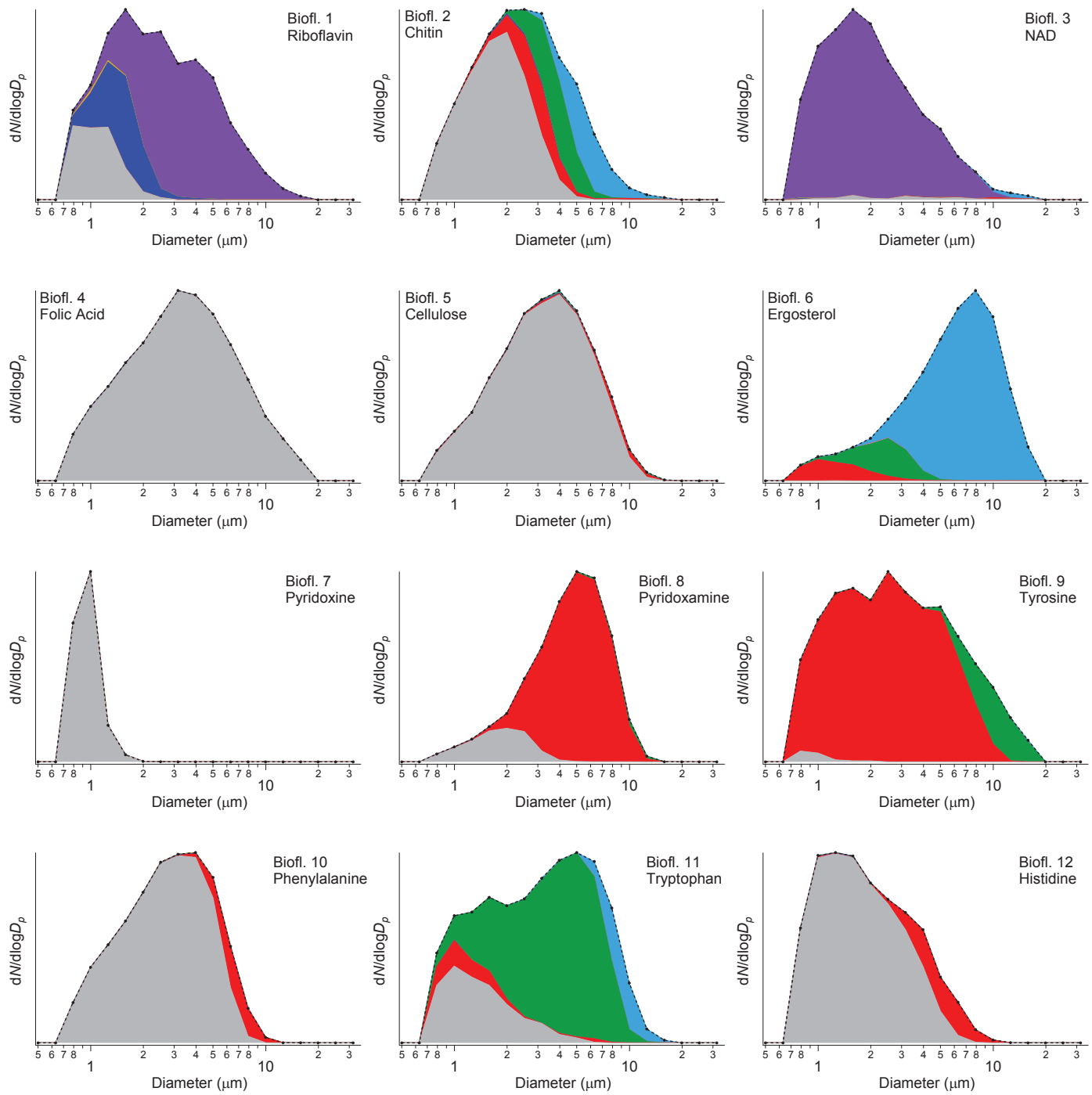


Figure S4H. Stacked particle type size distributions of biofluorophores using FT + 9σ threshold

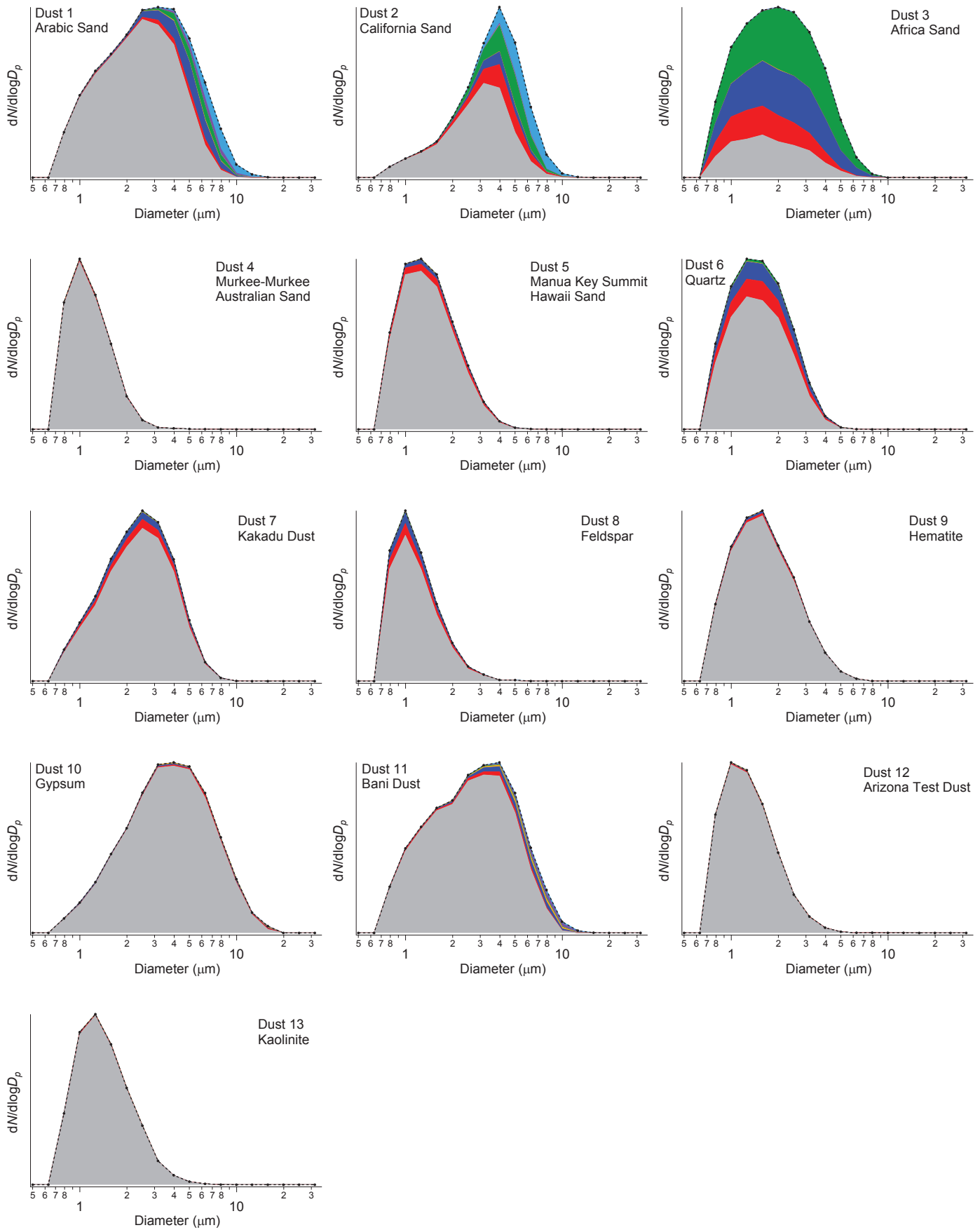


Figure S4I. Stacked particle type size distributions of dust using $FT + 3\sigma$ threshold

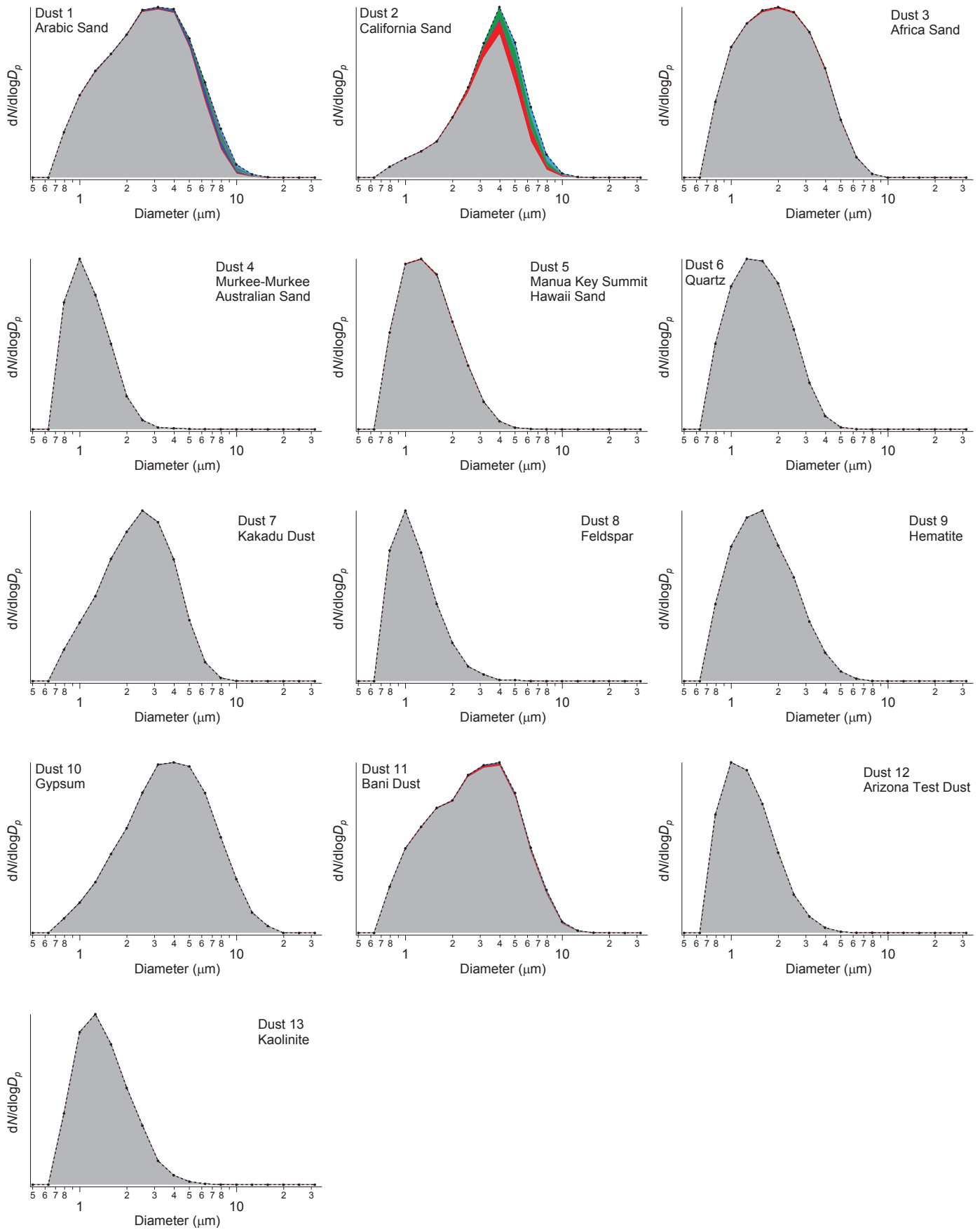


Figure S4J. Stacked particle type size distributions of dust using $FT + 9\sigma$ threshold

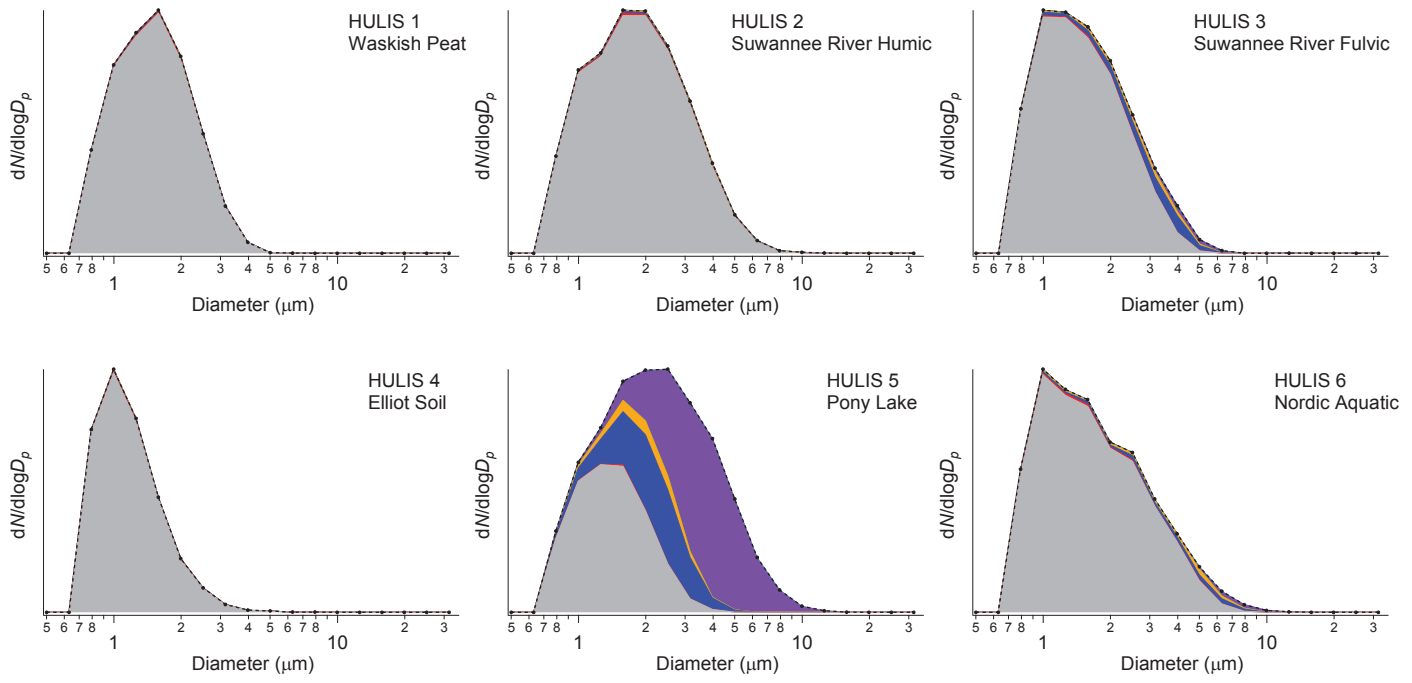


Figure S4K. Stacked particle type size distributions of HULIS using FT + 3 σ threshold

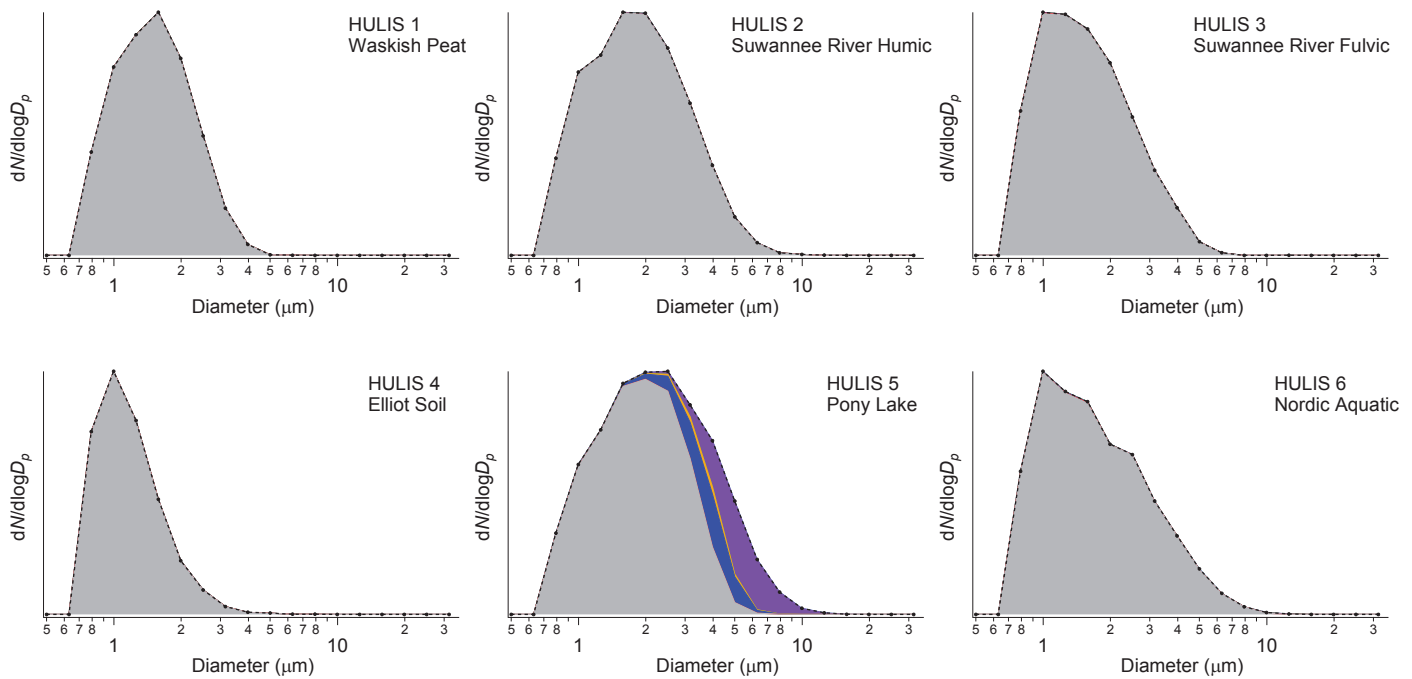


Figure S4L. Stacked particle type size distributions of HULIS using FT + 9 σ threshold

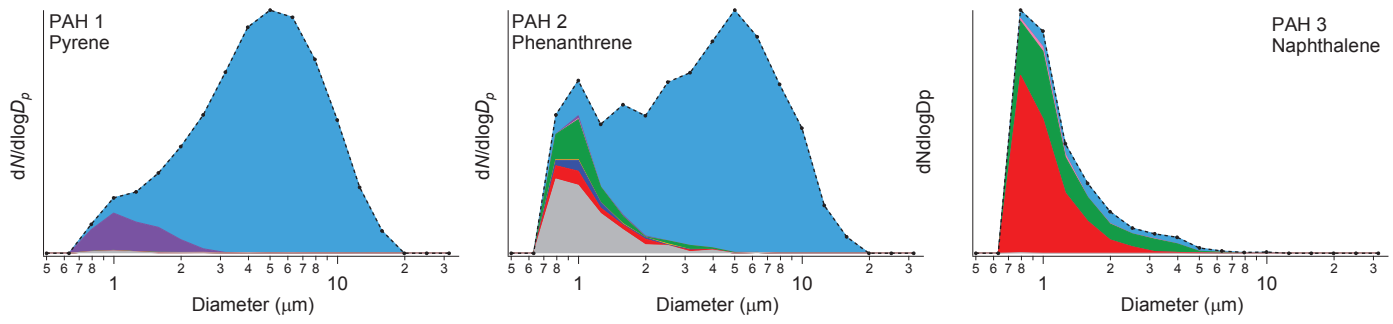


Figure S4M. Stacked particle type size distributions of PAHs using FT + 3σ threshold

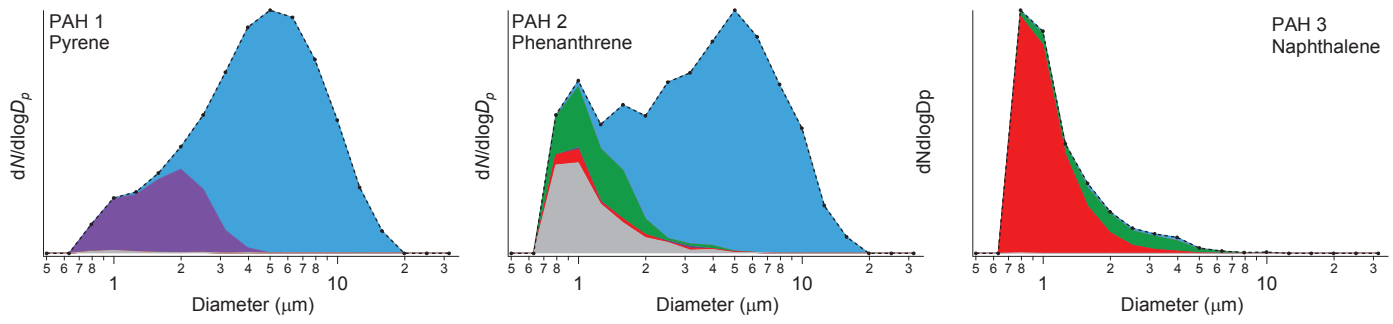


Figure S4N. Stacked particle type size distributions of PAHs using FT + 9σ threshold

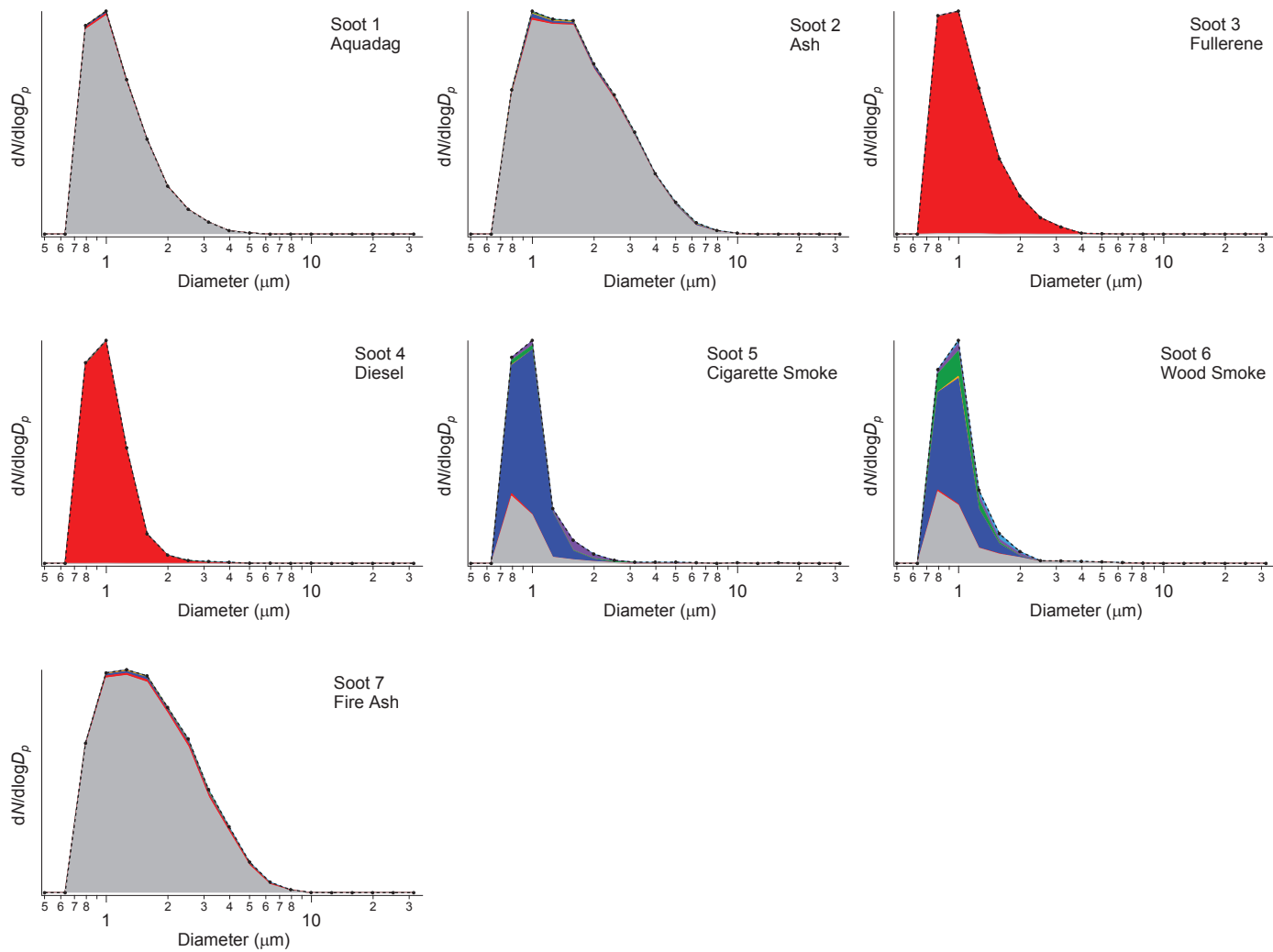


Figure S40. Stacked particle type size distributions of soot and smoke using FT + 3σ threshold

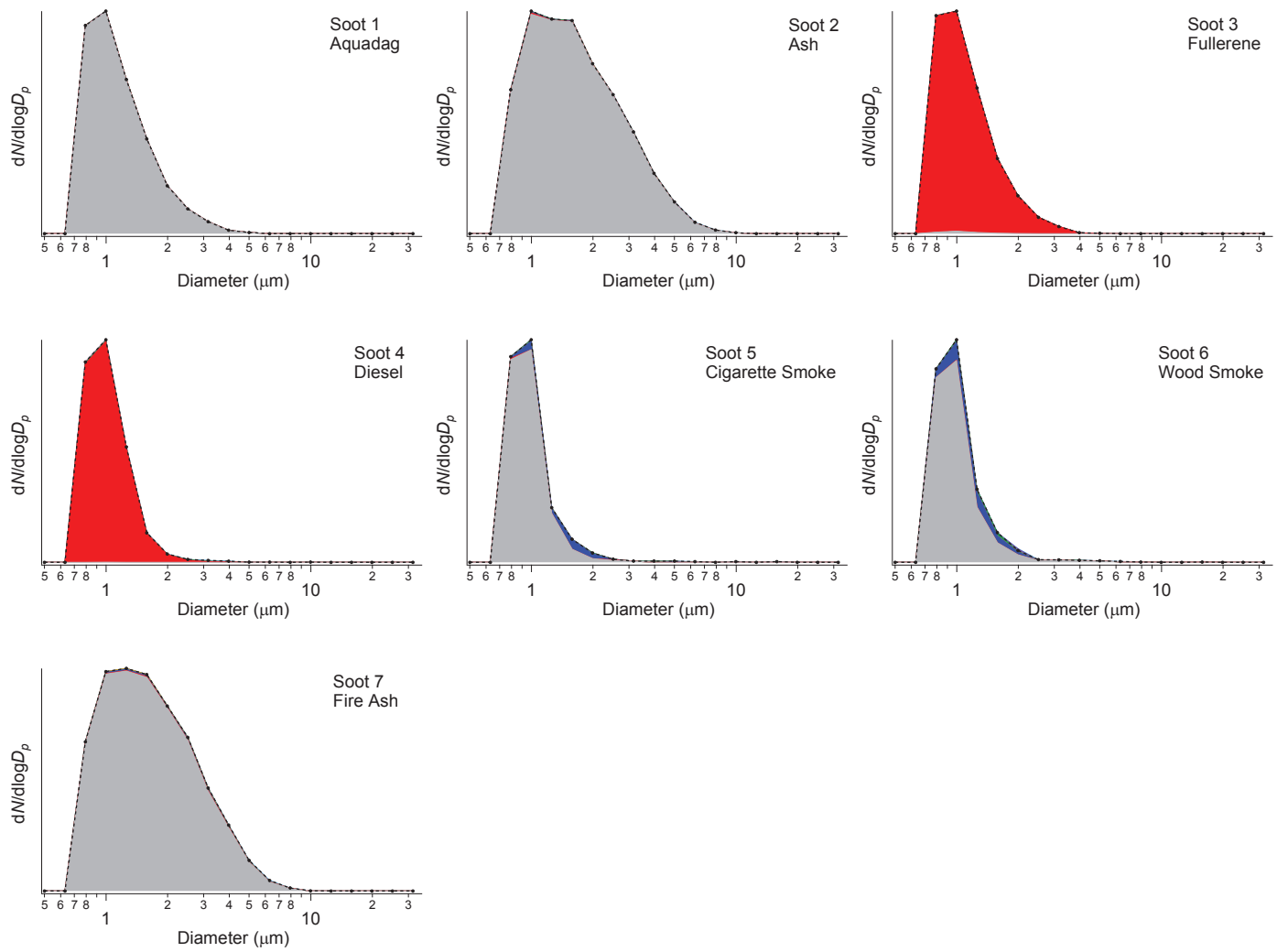


Figure S4P. Stacked particle type size distributions of soot and smoke using FT + 9σ threshold

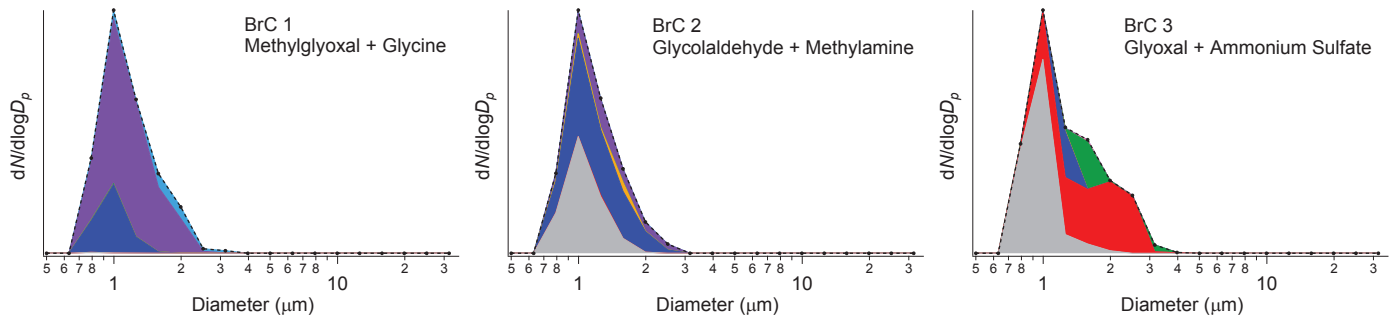


Figure S4Q. Stacked particle type size distributions of brown carbon (BrC) using $FT + 3\sigma$ threshold

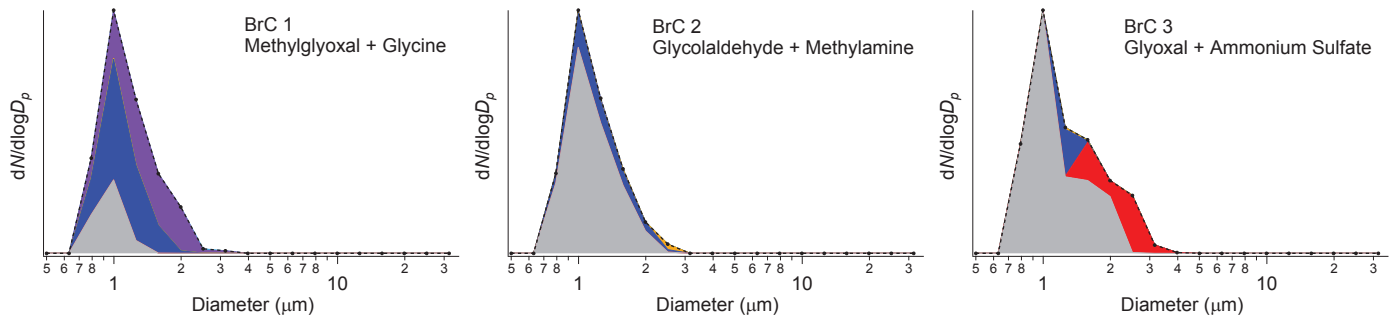


Figure S4R. Stacked particle type size distributions of brown carbon (BrC) using $FT + 9\sigma$ threshold

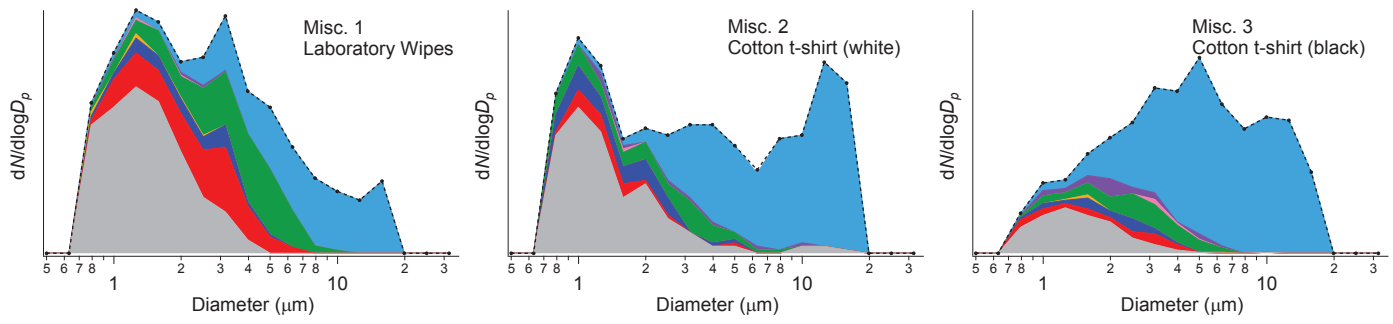


Figure S4S. Stacked particle type size distributions of miscellaneous samples using $FT + 3\sigma$ threshold

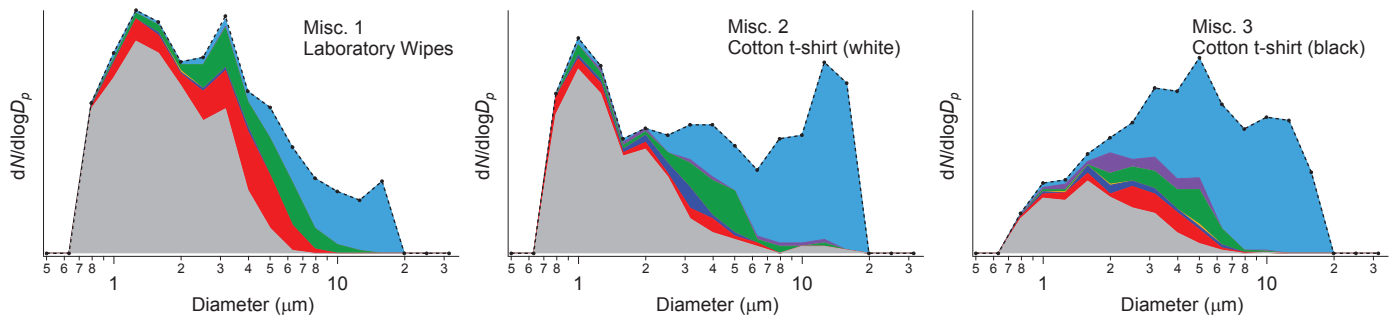


Figure S4T. Stacked particle type size distributions of miscellaneous samples using $FT + 9\sigma$ threshold