APPENDIX A. SHELF-SURVEY

A shelf survey of consumer products was conducted in August 2002. The survey was conducted in the East Bay of the San Francisco Bay Area. Researchers visited five outlets of large chain-store retailers (Safeway, Longs Drugs, Smart & Final, Wal-Mart, Home Depot). The objective was to identify the cleaning products and air fresheners that were widely available for sale to California consumers.

A single surveyor visited each of the outlets and recorded the product manufacturer, the brand name, and the physical form of all liquid and aerosol form cleaning products and all air fresheners that were present on the shelves at the times of the visits. Lower-volume specialty products were included as well as broadly recognized name-brand products. Subsequent to the physical survey, the recorded information was checked to the extent possible by referring to manufacturer, distributor, and retailer websites.

The individual consumer products identified in this survey are listed by brand name in this appendix. The products are organized into groups, classified according to consumer product category as defined by the ARB (see Table 3.3). In some cases, products in related categories are combined and listed in a single appendix table.

In each table in this appendix, the products are first ordered alphabetically (ascending) by manufacturer name, and then by brand name. A brief description of the product obtained from the product label and, in some cases, from online information is provided for each entry. If a product was present in more than one form, there are multiple entries with the exception of refill bottles for products also present in trigger spray form. Products available in the same form but with different scents are listed separately as they were presumed to have a different chemical composition. The retail outlets in which each of the products was found are indicated by check marks. The detailed information contained in these appendix tables is summarized in the body of the report.

In total, 291 distinct products were found in the survey. Table A.1 lists 21 disinfectant products. Table A.2 lists 16 general-purpose degreasers and multipurpose solvents. Table A.3 lists 72 general-purpose cleaners. Table A.4 lists 21 glass cleaners. Table A.5 lists 26 dusting aids, furniture maintenance products, and wood cleaners. Table A.6 lists 24 carpet and upholstery cleaners and spot removers. Table A.7 lists eight floor polishes or waxes and floor wax strippers. Table A.8 lists 14 specialty cleaners including bathroom and tile cleaners, metal polish/cleaners, and oven cleaners. Table A.9 lists 89 air fresheners.

Table A.1. Results of consumer product shelf survey for disinfectants. [a]

No.	Brand	Description	Manufacturer	Form	Safe-way	Longs Drugs	Smart & Final	Wal-Mart	Home Depot
1	Great Value	Spray disinfectant antibacterial (fresh linen)	Great Value	Aerosol spray				✓	
2	Lysol	Disinfectant spray & air freshener (crisp linen)	Reckitt Benckiser	Aerosol spray	✓	✓		✓	
3	Lysol	Disinfectant spray & air freshener (original scent)	Reckitt Benckiser	Aerosol spray		✓		✓	
4	Lysol	Disinfectant spray & air freshener (pine breeze)	Reckitt Benckiser	Aerosol spray				✓	
5	Lysol	Disinfectant spray & air freshener (unrecorded scent)	Reckitt Benckiser	Aerosol spray	✓	✓		✓	
6	Lysol	Disinfectant spray (country scent)	Reckitt Benckiser	Aerosol spray	✓	✓		✓	
7	Lysol	Disinfectant spray (spring waterfall)	Reckitt Benckiser	Aerosol spray				✓	
8	Lysol	Professional disinfectant spray (country scent)	Reckitt Benckiser	Aerosol spray					✓
9	Lysol	Professional disinfectant spray (crisp linen)	Reckitt Benckiser	Aerosol spray			✓		✓
10	Lysol	Professional disinfectant spray (fresh scent)	Reckitt Benckiser	Aerosol spray			✓		
11	Lysol	Professional disinfectant spray (original scent)	Reckitt Benckiser	Aerosol spray			✓		✓
12	Lysol	Professional no rinse sanitizer	Reckitt Benckiser	Liquid			✓		
13	Bar Rinse	Disinfectant sanitizer	Smart & Final	Liquid			✓		
14	Lemon Clean	Disinfectant & virucidal cleaner	Smart & Final	Liquid			✓		
15	Sani-Mint	Disinfectant & virucidal cleaner	Smart & Final	Liquid			✓		
16	Sani-Pine Plus	Germicidal disinfectant	Smart & Final	Liquid			✓		
17	Clorox	Disinfecting spray (floral scent)	The Clorox Company	Aerosol spray			✓		
18	Clorox	Disinfecting spray (fresh scent)	The Clorox Company	Aerosol spray			✓		
19	Clorox	Disinfecting spray (sunshine breeze)	The Clorox Company	Aerosol spray			✓		
20	Formula 409	Commercial Solutions heavy-duty degreaser disinfectant	The Clorox Company	Trigger spray			✓		
21	Ozium	Glycolized air sanitizer (reduced airborne bacteria)	Waterbury Cos., Inc.	Aerosol spray			✓		

[a] "✓" indicates that product was found at indicated retail outlet.

Table A.2. Results of consumer product shelf survey for general-purpose degreasers and multipurpose solvents. [a]

No.	Brand	Description	Manufacturer	Form	Safe-way	Longs Drugs	Smart & Final	Wal-Mart	Home Depot
1	Nature's Orange	Cleaner/degreaser	Carroll Company	Liquid					✓
	Nature's Orange	Cleaner/degreaser	Carroll Company	Trigger spray					✓
2	The Big Orange	Cleaner/degreaser/deodorizer	Carroll Company	Liquid			✓		
3	The Big Orange	Cleaner/degreaser/deodorizer	Carroll Company	Trigger spray			✓		
4	Castrol	Super clean tough task cleaner/degreaser	Castrol	Trigger spray			✓		
5	Spray Power	All purpose multi-surface cleaner	Crown Marketing	Trigger spray & liquid				✓	
6	Goo Gone	Degreaser (citrus power)	Magic American Products	Liquid				✓	
7	Orange Clean	Degreasing foam	Orange Glo Intern'l	Aerosol spray			✓	✓	
8	Orange Clean	Multi-purpose cleaner (tough acting degreaser)	Orange Glo Intern'l	Liquid				✓	
9	Orange Clean	Multi-purpose cleaner (tough acting degreaser)	Orange Glo Intern'l	Trigger spray			✓	✓	
10	De-Solv-It	Degreaser (citrus solution)	Orange-Sol Group	Liquid				✓	
11	De-Solv-It	Degreaser (citrus solution)	Orange-Sol Group	Trigger spray			✓		
12	Easy Off	Professional heavy-duty cleaner/degreaser	Reckitt Benckiser	Conc. liquid			✓		
13	Smart & Final	Professional heavy-duty cleaner degreaser	Smart & Final	Conc. liquid			✓		
14	Smart & Final	Professional heavy-duty cleaner degreaser	Smart & Final	Trigger spray			✓		
15	Formula 409	Cleaner/degreaser	The Clorox Company	Liquid			✓		
16	Formula 409	Cleaner/degreaser	The Clorox Company	Trigger spray			✓		

[a] "✓" indicates that product was found at indicated retail outlet.

Table A.3. Results of consumer product shelf survey for general-purpose cleaners. [a]

No.	Brand	Description	Manufacturer	Form	Safe-way	Longs Drugs	Smart & Final	Wal-Mart	Home Depot
1	Zep	All-purpose cleaner & degreaser	Acuity Specialty Products Grp.	Trigger spray					✓
2	Zep	Antibacterial disinfectant & cleaner (with lemon)	Acuity Specialty Products Grp.	Liquid					✓
3	Zep	Antibacterial disinfectant & cleaner (with lemon)	Acuity Specialty Products Grp.	Trigger spray					✓
4	Zep	Citrus cleaner/degreaser	Acuity Specialty Products Grp.	Trigger spray					✓
5	Zep	Formula 505 cleaner & degreaser	Acuity Specialty Products Grp.	Liquid					✓
6	Zep	Formula 505 cleaner & degreaser	Acuity Specialty Products Grp.	Trigger spray					✓
7	Zep	Industrial purple cleaner & degreaser	Acuity Specialty Products Grp.	Liquid					✓
8	Zep	Kitchen foaming cleaner	Acuity Specialty Products Grp.	Aerosol spray					✓
9	Zep	No-wax floor cleaner	Acuity Specialty Products Grp.	Conc. liquid					✓
10	Zep	Pine disinfectant & cleaner	Acuity Specialty Products Grp.	Liquid					✓
11	Zep	Stainless steel cleaner	Acuity Specialty Products Grp.	Aerosol spray					✓
12	Armstrong	Floor cleaner for no-wax & ceramic tile floors	Armstrong Holdings, Inc.	Conc. liquid				✓	
13	Brite	Floor shine cleaner	Brite	Conc. liquid	✓	✓		✓	
14	Ajax QSR	Multi-surface cleaner	Colgate-Palmolive	Conc. liquid			✓		
15	Fabuloso	All purpose cleaner (lavender scent)	Colgate-Palmolive	Liquid			✓		
16	Fabuloso	Floor cleaner (lavender)	Colgate-Palmolive	Liquid			✓	✓	
17	Fabuloso	Floor cleaner (ocean cool)	Colgate-Palmolive	Liquid			✓		
18	Murphy Oil Soap	Multi-purpose cleaner (original)	Colgate-Plamolive	Liquid	✓		✓	✓	
19	Murphy Oil Soap	Multi-use cleaner (spray formula)	Colgate-Plamolive	Trigger spray	✓	✓			
20	Breeze	Odor eliminator	Mission Laboratories	Trigger spray			✓		
21	Practico!	Multi-purpose cleaner/degreaser	Mission Laboratories	Liquid			✓		
22	Pure Citrus	All purpose cleaner	North American Oil Co.	Trigger spray			✓		
23	Orange Glo	Floor polish & cleaner	Orange Glo International	Liquid				✓	
24	Orange Glo	Floor polish & cleaner	Orange Glo International	Trigger spray				✓	
25	T-TreClean	All purpose cleaner with tree oil	Orange-Mate, Inc.	Trigger spray			✓		
26	Mr. Clean	Multi-purpose cleaner (invigorating breeze)	Procter & Gamble	Liquid	✓			✓	

Table A.3 (continued). Results of consumer product shelf survey for general-purpose cleaners

No.	Brand	Description	Manufacturer	Form	Safe-way	Longs Drugs	Smart & Final	Wal-Mart	Home Depot
27	Mr. Clean	Multi-purpose cleaner (summer citrus)	Procter & Gamble	Liquid	✓			✓	
28	Mr. Clean	Season's freshness antibacterial multi-purpose cleaner	Procter & Gamble	Liquid		✓			
29	Spic & Span	Multi-purpose cleaner	Procter & Gamble	Liquid	✓	✓		✓	
30	Mr. Clean	Institutional finished floor cleaner	Proctor & Gamble	Conc. liquid			✓		
31	Lysol	All purpose cleaner (fresh orange breeze)	Reckitt Benckiser	Trigger spray	✓				
32	Lysol	All purpose cleaner (lemon breeze)	Reckitt Benckiser	Liquid				✓	
33	Lysol	All purpose cleaner (lemon scent)	Reckitt Benckiser	Trigger spray	✓	✓			
34	Lysol	All purpose cleaner (summer breeze)	Reckitt Benckiser	Trigger spray	✓			✓	
35	Lysol	All purpose cleaner (summer fresh scent)	Reckitt Benckiser	Trigger spray	✓				
36	Lysol	Concentrate deodorizer/cleaner (fresh orange breeze)	Reckitt Benckiser	Liquid				✓	
37	Lysol	Disinfectant all purpose cleaner (island breeze)	Reckitt Benckiser	Liquid		✓			
38	Lysol	Kitchen cleaner disinfectant antibacterial	Reckitt Benckiser	Trigger spray	✓	✓		✓	
39	Lysol	Multi-surface foam cleaner	Reckitt Benckiser	Aerosol spray			✓		
40	Lysol	Professional all purpose cleaner (lemon scent)	Reckitt Benckiser	Trigger spray			✓		
41	Lysol	Professional deodorizing cleaner	Reckitt Benckiser	Liquid			✓		
42	Masterpiece	Floor cleaner (neutral)	Reckitt Benckiser	Conc. liquid			✓		
43	Mop & Glo	Floor shine cleaner	Reckitt Benckiser	Conc. liquid	✓		✓	✓	
44	Resolve	High-traffic floor cleaner	Reckitt Benckiser	Liquid	✓		✓	✓	
45	Fantastik	All purpose cleaner (antibacterial)	SC Johnson	Liquid			✓		
46	Fantastik	All purpose cleaner (antibacterial)	SC Johnson	Trigger spray			✓		
47	Fantastik	All purpose cleaner (herbal mist scent)	SC Johnson	Trigger spray	✓				
48	Fantastik	All purpose cleaner (lemon power, antibacterial)	SC Johnson	Trigger spray				✓	
49	Fantastik	All purpose cleaner (orange action)	SC Johnson	Trigger spray	✓	✓		✓	

Table A.3 (continued). Results of consumer product shelf survey for general-purpose cleaners.

No.	Brand	Description	Manufacturer	Form	Safe-Way	Longs Drugs	Smart & Final	Wal-Mart	Home Depot
50	Sani-Pine	Cleaner/deodorizer	Smart & Final	Liquid			✓		
51	Smart & Final	Floor cleaner & conditioner	Smart & Final	Conc. liquid			✓		
52	Smart & Final	Pink cleaner concentrate	Smart & Final	Conc. liquid			✓		
53	Simple Green	All purpose cleaner	Sunshine Makers, Inc.	Liqiud			✓		✓
54	Simple Green	All purpose cleaner	Sunshine Makers, Inc.	Trigger spray	✓	✓	✓	✓	✓
55	Simple Green	All purpose cleaner (lemon scent)	Sunshine Makers, Inc.	Trigger spray			✓		
56	Formula 409	All purpose cleaner	The Clorox Company	Liquid	✓	✓			
57	Formula 409	All purpose cleaner	The Clorox Company	Trigger spray	✓	✓			
58	Formula 409	All purpose cleaner (lemon scent)	The Clorox Company	Trigger spray		✓		✓	
59	Formula 409	All purpose cleaner (misty breeze)	The Clorox Company	Trigger spray	✓				
60	Formula 409	All purpose cleaner (orange power)	The Clorox Company	Trigger spray			✓	✓	
61	Pine-Sol	All purpose cleaner (lemon fresh)	The Clorox Company	Liquid	✓	✓	✓	✓	
62	Pine-Sol	All purpose cleaner (meadow fresh)	The Clorox Company	Liquid	✓			✓	
63	Pine-Sol	All purpose cleaner (original)	The Clorox Company	Liquid	✓	✓	✓	✓	✓
64	Pine-Sol	All purpose cleaner (rain clean)	The Clorox Company	Liquid				✓	
65	Pine-Sol	All purpose spray (cleaner & antibacterial, lemon scent)	The Clorox Company	Trigger spray		✓	✓		
66	Pine-Sol	Mop floor cleaner & spray	The Clorox Company	Trigger spray	✓				
67	Ready Mop Cleaner	Floor cleaner	The Clorox Company	Conc. liquid					✓
68	Spic-n-Span	Liquid cleaner	The Spic and Span Co.	Conc. liquid					
69	Xtra-Lemon	Antibacterial cleaner	White Cap, Inc.	Trigger spray			✓		
70	Xtra-Lemon	Antibacterial cleaner/disinfectant/ deodorizer	White Cap, Inc.	Conc. liquid			✓	✓	
71	Xtra-Orange	All purpose cleaner	White Cap, Inc.	Conc. liquid			✓		
72	Xtra-Pine	All-purpose cleaner (clean/shine/deodorizer)	White Cap, Inc.	Conc. liquid			✓	✓	

[a] "✓" indicates that product was found at indicated retail outlet.

Table A.4. Results of consumer product shelf survey for glass cleaners. [a]

No.	Brand	Description	Manufacturer	Form	Safe-way	Longs Drugs	Smart & Final	Wal-Mart	Home Depot
1	Zep	Glass & all surface heavy-duty foaming cleaner	Acuity Specialty Products Grp.	Aerosol spray					✓
2	Zep	Glass cleaner	Acuity Specialty Products Grp.	Liquid					✓
3	Zep	Glass cleaner	Acuity Specialty Products Grp.	Trigger spray					✓
4	Ajax QSR	Glass cleaner	Colgate-Palmolive	Conc. liquid			✓		
5	Great Value	Glass cleaner	Great Value	Trigger spray				✓	
6	Glass Plus	Glass & surface cleaner	SC Johnson	Liquid			✓		
7	Glass Plus	Glass & surface cleaner	SC Johnson	Trigger spray	✓		✓	✓	
8	Windex	Glass cleaner (anti-bacterial)	SC Johnson	Trigger spray	✓	✓	✓	✓	
9	Windex	Glass cleaner (mountain berry)	SC Johnson	Trigger spray				✓	
10	Windex	Glass cleaner (multi-surface with vinegar)	SC Johnson	Trigger spray	✓			✓	
11	Windex	Glass cleaner (no drip)	SC Johnson	Trigger spray	✓	✓			
12	Windex	Glass cleaner (original)	SC Johnson	Trigger spray		✓		✓	✓
13	Windex	Glass cleaner (professional/industrial)	SC Johnson	Liquid			✓		
14	Windex	Glass cleaner (professional/industrial)	SC Johnson	Trigger spray			✓		
15	Windex	Glass cleaner (streak free)	SC Johnson	Trigger spray	✓	✓			
16	Windex	Outdoor & window surface cleaner	SC Johnson	Trigger spray	✓	✓		✓	✓
17	Windex	Powerized foaming glass & multi-surface cleaner	SC Johnson	Aerosol spray			✓	✓	
18	Smart & Final	Glass & hard surface cleaner	Smart & Final	Liquid			✓		
19	Sprayway	Glass cleaner	Sprayway, Inc.	Aerosol spray			✓		
20	Formula 409	Glass & surface cleaner	The Clorox Company	Liquid			✓		
21	Formula 409	Glass & surface cleaner	The Clorox Company	Trigger spray		✓	✓	✓	

[a] "✓" indicates that product was found at indicated retail outlet.

Table A.5. Results of consumer product shelf survey for dusting aids, furniture maintenance products, and wood cleaners. [a]

No.	Brand	Description	Manufacturer	Form	Safe-way	Longs Drugs	Smart & Final	Wal-Mart	Home Depot
1	Zep	Furniture polish & cleaner (lemon)	Acuity Specialty Products Grp.	Aerosol spray					✓
2	Zep	Hardwood & laminate floor cleaner	Acuity Specialty Products Grp.	Trigger spray					✓
3	Lemon Drop	Furniture polish	Carroll Company	Liquid			✓		
4	Behold [b]	Furniture Polish lemon	JohnsonDiversey	Aerosol spray					
5	Endust	Dust spray (fresh scent)	JohnsonDiversey	Aerosol spray	✓				
6	Endust	Dust spray (fresh scent, pro formula)	JohnsonDiversey	Aerosol spray			✓		
7	Endust	Dust spray (lemon scent)	JohnsonDiversey	Aerosol spray	✓			✓	
8	Orange Glo	Wood cleaner & restorer	Orange Glo International	Aerosol spray				✓	
9	Orange Glo	Wood cleaner and polish	Orange Glo International	Trigger spray	✓		✓	✓	
10	Old English	Furniture polish	Reckitt Benckiser	Aerosol spray	✓				
11	Old English	Furniture polish	Reckitt Benckiser	Liquid	✓	✓		✓	✓
12	Old English	Scratch cover for dark wood	Reckitt Benckiser	Liquid	✓	✓		✓	✓
13	Favor	Furniture polish	SC Johnson	Aerosol spray				✓	
14	Pledge	Furniture polish (country garden)	SC Johnson	Aerosol spray			✓	✓	
15	Pledge	Furniture polish (instit./commercial)	SC Johnson	Aerosol spray			✓		
16	Pledge	Furniture polish (lemon scented)	SC Johnson	Aerosol spray	✓	✓	✓	✓	✓
17	Pledge	Furniture polish (orange fresh)	SC Johnson	Aerosol spray	✓		✓	✓	
18	Pledge	Furniture polish (orange oil trigger)	SC Johnson	Trigger spray	✓				
19	Pledge	Furniture polish clean & dust	SC Johnson	Aerosol spray	✓			✓	
20	Pledge	Furniture polish extra moisturizing with lemon oil	SC Johnson	Aerosol spray	✓			✓	
21	Pledge	Furniture polish with cleansing conditioners	SC Johnson	Trigger spray	✓				
22	Pledge	Furniture polish with Glade Rainshower	SC Johnson	Aerosol spray	✓				
23	Pledge	Wood cleaner/conditioner	SC Johnson	Trigger spray			✓		
24	Pledge	Wood floor cleaner	SC Johnson	Liquid	✓			✓	
25	Scott's liquid gold	Wood cleaner & preservative	Scott's Liquid Gold, Inc.	Aerosol spray			✓	✓	
26	Scott's liquid gold	Wood cleaner & preservative	Scott's Liquid Gold, Inc.	Liquid	✓				

[a] "✓" indicates that product was found at indicated retail outlet.
[b] This item appears in database without indication of store(s) where it was found on the shelf.

Table A.6. Results of consumer product shelf survey for carpet and upholstery cleaners and spot removers. [a]

No.	Brand	Description	Manufacturer	Form	Safe-way	Longs Drugs	Smart & Final	Wal-Mart	Home Depot
1	Zep	Carpet cleaner	Acuity Specialty Products Grp.	Conc. liquid					✓
2	Zep	High traffic carpet cleaner	Acuity Specialty Products Grp.	Aerosol spray					✓
3	Zep	High traffic carpet cleaner	Acuity Specialty Products Grp.	Trigger spray					✓
4	Bissell	Pet stain & odor removal	Bissell, Inc.	Trigger spray			✓		
5	Folex	Instant carpet spot remover	Folex Company	Liquid			✓		
6	Folex	Instant carpet spot remover	Folex Company	Trigger spray	✓		✓	✓	
7	SteamVac	Carpet/upholstery cleaner	Maytag Corp.	Conc. liquid			✓		
8	Resolve	Carpet cleaner for steam machine	Reckitt Benckiser	Liquid	✓				
9	Resolve	Dual action foam carpet cleaner	Reckitt Benckiser	Aerosol spray				✓	
10	Resolve	Foam carpet cleaner	Reckitt Benckiser	Aerosol spray	✓	✓			
11	Resolve	Spot & stain carpet cleaner	Reckitt Benckiser	Trigger spray	✓	✓	✓	✓	✓
12	Resolve	Spot magic (spot carpet cleaner)	Reckitt Benckiser	Liquid				✓	
13	Woolite	Carpet pet stain cleaner	Reckitt Benckiser	Trigger spray	✓				
14	Woolite	Foam carpet cleaner heavy traffic	Reckitt Benckiser	Aerosol spray	✓	✓		✓	
15	Woolite Power Shot	Carpet stain remover	Reckitt Benckiser	Aerosol spray	✓	✓			
16	Smart & Final	Carpet spotter	Smart & Final	Trigger spray			✓		
17	Smart & Final	Dry foam rug shampoo	Smart & Final	Conc. liquid			✓		
18	Smart & Final	Extraction carpet cleaner	Smart & Final	Conc. liquid			✓		
19	Smart & Final	Extraction defoamer	Smart & Final	Conc. liquid			✓		
20	Krud Kutter	Cleaner/degreaser	Supreme Chem. of Georgia, Inc.	Trigger spray			✓		
21	Formula 409	Carpet cleaner	The Clorox Company	Aerosol spray	✓				
22	Formula 409	Carpet cleaner large area foam cleaner	The Clorox Company	Trigger spray	✓				
23	Formula 409	Carpet spot cleaner	The Clorox Company	Aerosol spray			✓		
24	Spot shot	Carpet stain remover	WD-40 Company	Aerosol spray	✓		✓	✓	

[a] "✓" indicates that product was found at indicated retail outlet.

Table A.7. Results of consumer product shelf survey for floor polishes or waxes and floor wax strippers. [a]

No.	Brand	Description	Manufacturer	Form	Safe-way	Longs Drugs	Smart & Final	Wal-Mart	Home Depot
1	Future	Floor finish	Future	Liquid	✓			✓	
2	Medalist	Floor finish	Reckitt Benckiser	Liquid			✓		
3	Medalist	Floor sealer	Reckitt Benckiser	Liquid			✓		
4	Medalist	Wax stripper	Reckitt Benckiser	Liquid			✓		
5	Smart & Final	Mop-off floor stripper	Smart & Final	Conc. liquid			✓		
6	Smart & Final	Ply buff floor finish	Smart & Final	Liquid			✓		
7	Smart & Final	Professional ultra high solids floor finish	Smart & Final	Liquid			✓		
8	Smart & Final	Spray Buff	Smart & Final	Liquid			✓		

[a] "✓" indicates that product was found at indicated retail outlet.

Table A.8. Results of consumer product shelf survey for specialty cleaners including bathroom and tile cleaners, metal polish/cleaners, and oven cleaners. [a]

No.	Brand	Description	Manufacturer	Form	Safe-way	Longs Drugs	Smart & Final	Wal-Mart	Home Depot
1	Trewax	Stainless steel cleaner/polish/protectant	Carroll Company	Trigger spray			✓		
2	Trewax Brite Boy	Tarnish remover/metal polish	Carroll Company	Trigger spray			✓		
3	Carbon Off	Heavy-duty grease remover	Discovery Products Corp.	Aerosol spray			✓		
4	CLR	Household deposit remover	Jelmar	Liquid	✓	✓		✓	✓
5	Tarn-X	Tarnish remover	Jelmar	Liquid				✓	
6	Sheila Shine	Stainless steel cleaner/shine	Meyer Laboratory, Inc.	Liquid			✓		
7	Brasso	Multi-purpose metal polish	Reckitt Benckiser	Liquid			✓	✓	✓
8	Easy Off	Fume free max oven cleaner (lemon scent)	Reckitt Benckiser	Aerosol spray			✓		
9	Easy Off	Professional heavy-duty oven/grill cleaner	Reckitt Benckiser	Aerosol spray			✓		
10	Easy Off	Professional heavy-duty oven/grill cleaner	Reckitt Benckiser	Liquid			✓		
11	Lime A Way	Stain remover	Reckitt Benckiser	Liquid	✓	✓	✓	✓	
12	Smart & Final	Professional oven & grill cleaner	Smart & Final	Aerosol spray			✓		
13	Smart & Final	Professional oven & grill cleaner	Smart & Final	Liquid			✓		
14	Smart & Final	Stainless steel cleaner/shine	Smart & Final	Aerosol spray			✓		

[a] "✓" indicates that product was found at indicated retail outlet.

Table A.9. Results of consumer product shelf survey for air fresheners. [a]

No.	Brand	Description	Manufacturer	Form	Safe-way	Longs Drugs	Smart & Final	Wal-Mart	Home Depot
1	Zep	Mint fresh room deodorizer	Acuity Specialty Prod. Grp.	Aerosol spray					✓
2	Zep	Odor control concentrate	Acuity Specialty Prod. Grp.	Trigger spray					✓
3	Zep	Smoke eliminator	Acuity Specialty Prod. Grp.	Aerosol spray					✓
4	Fruit Basket	Air freshener	Belae Brands, Inc.	Aerosol spray				✓	
5	Big D	Conc. room deodorant (country berry)	Big D Industries, Inc.	Aerosol spray			✓		
6	Big D	Conc. room deodorant (mango bay)	Big D Industries, Inc.	Aerosol spray			✓		
7	Big D	Conc. room deodorant (mountain air)	Big D Industries, Inc.	Aerosol spray			✓		
8	Big D	Conc. room deodorant (potpourri)	Big D Industries, Inc.	Aerosol spray			✓		
9	Big D	Conc. room deodorant (sun burst)	Big D Industries, Inc.	Aerosol spray			✓		
10	Arm & Hammer	Carpet & room deodorizer (citrus fresh)	Church & Dwight Co., Inc.	Aerosol spray	✓			✓	
11	Arm & Hammer	Carpet & room deod. (English meadows)	Church & Dwight Co., Inc.	Aerosol spray	✓			✓	
12	Arm & Hammer	Carpet & room deodorizer (pet fresh)	Church & Dwight Co., Inc.	Aerosol spray	✓			✓	
13	Arm & Hammer	Carpet & room deodorizer (vacuum free)	Church & Dwight Co., Inc.	Aerosol spray	✓				
14	BioOdor Control	Odor digester	Clean Control Corp.	Liquid			✓		
15	Renuzit	Air freshener scented oil (after the rain)	Dial Corp.	Liquid	✓			✓	
16	Renuzit	Air freshener scented oil (hazelnut vanilla)	Dial Corp.	Liquid	✓				
17	Renuzit	Fresh essentials (crisp cotton)	Dial Corp.	Aerosol spray				✓	
18	Renuzit	Fresh essentials (sense of spring)	Dial Corp.	Aerosol spray				✓	
19	Renuzit	Home fragrance spray (apple-cinnamon)	Dial Corp.	Aerosol spray				✓	
20	Renuzit	Home fragrance spray (citrus sunburst)	Dial Corp.	Aerosol spray				✓	
21	Renuzit	Home fragrance spray (tropical melon)	Dial Corp.	Aerosol spray				✓	
22	Pure Citrus	Air freshener (citrus blends)	North American Oil Co.	Aerosol spray			✓	✓	
23	Pure Citrus	Air freshener (lemon)	North American Oil Co.	Aerosol spray			✓		
24	Pure Citrus	Air freshener (orange)	North American Oil Co.	Aerosol spray			✓	✓	
25	Wizard	Air freshener (lavender)	Reckitt Benckiser	Aerosol spray	✓	✓			
26	Wizard	Air freshener (neutra air)	Reckitt Benckiser	Aerosol spray	✓				
27	Wizard	Air freshener (peach sensation)	Reckitt Benckiser	Aerosol spray	✓	✓		✓	
28	Wizard	Air freshener (rain garden)	Reckitt Benckiser	Aerosol spray	✓				
29	Wizard	Air freshener (vanilla essential)	Reckitt Benckiser	Aerosol spray				✓	
30	Wizard	Air freshener (white bouquet)	Reckitt Benckiser	Aerosol spray		✓			
31	Wizard	Air freshener scented oil (country berry)	Reckitt Benckiser	Liquid		✓		✓	

Table A.9 (continued). Results of consumer product shelf survey for air fresheners [a]

No.	Brand	Description	Manufacturer	Form	Safe-way	Longs Drugs	Smart & Final	Wal-Mart	Home Depot
32	Wizard	Air freshener scented oil (crisp breeze)	Reckitt Benckiser	Liquid		✓		✓	
33	Wizard	Air freshener scented oil (harvest spice)	Reckitt Benckiser	Liquid				✓	
34	Wizard	Air freshener scented oil (lavender field)	Reckitt Benckiser	Liquid				✓	
35	Wizard	Air freshener scented oil (white bouquet)	Reckitt Benckiser	Liquid				✓	
36	Wizard	Tobacco odor neutralizer	Reckitt Benckiser	Aerosol spray	✓	✓		✓	
37	Wizard AirWick	Odor neutral. (green apple & honeysuckle)	Reckitt Benckiser	Aerosol spray				✓	
38	Wizard AirWick	Odor neutralizer (lavender field)	Reckitt Benckiser	Aerosol spray				✓	
39	Wizard AirWick	Odor neutralizer (neutra air)	Reckitt Benckiser	Aerosol spray				✓	
40	Wizard AirWick	Odor neutralizer (rain garden)	Reckitt Benckiser	Aerosol spray				✓	
41	Wizard AirWick	Odor neutralizer (sparkling citrus)	Reckitt Benckiser	Aerosol spray				✓	
42	Wizard AirWick	Scented oil (sparkling citrus)	Reckitt Benckiser	Aerosol spray				✓	
43	Ambi Pur	Home fragrance (crystal ocean)	Sara Lee Corp	Liquid	✓			✓	
44	Ambi Pur	Home fragrance (delicate blossoms)	Sara Lee Corp	Liquid	✓			✓	
45	Ambi Pur	Home fragrance (sun ripened oranges)	Sara Lee Corp	Liquid	✓			✓	
46	Glade	Air freshener (French vanilla)	SC Johnson	Aerosol spray				✓	
47	Glade	Air freshener (cinnamon sticks)	SC Johnson	Aerosol spray	✓	✓		✓	
48	Glade	Air freshener (citrus aroma)	SC Johnson	Aerosol spray	✓			✓	
49	Glade	Air freshener (country garden)	SC Johnson	Aerosol spray	✓			✓	
50	Glade	Air freshener (lilac springs)	SC Johnson	Aerosol spray	✓				
51	Glade	Air freshener (mango splash)	SC Johnson	Aerosol spray	✓			✓	
52	Glade	Air freshener (melon burst)	SC Johnson	Aerosol spray	✓				
53	Glade	Air freshener (mountain berry)	SC Johnson	Aerosol spray				✓	
54	Glade	Air freshener (mountain snow)	SC Johnson	Aerosol spray	✓			✓	
55	Glade	Air freshener (powder fresh)	SC Johnson	Aerosol spray				✓	
56	Glade	Air freshener (rain shower)	SC Johnson	Aerosol spray				✓	
57	Glade	Air freshener (sunny days)	SC Johnson	Aerosol spray	✓			✓	
58	Glade	Air freshener (tangerine ginger)	SC Johnson	Aerosol spray	✓	✓			
59	Glade	Air freshener and deodorizer (duet)	SC Johnson	Aerosol spray	✓				
60	Glade	Air freshener and deodorizer (duet)	SC Johnson	Gel	✓				
61	Glade	Air freshener and deodorizer (potpourri)	SC Johnson	Aerosol spray	✓	✓			
62	Glade	Classic Plug-in	SC Johnson	Gel	✓			✓	

Table A.9 (continued). Results of consumer product shelf survey for air fresheners [a]

No.	Brand	Description	Manufacturer	Form	Safe-way	Longs Drugs	Smart & Final	Wal-Mart	Home Depot
63	Glade	Glade aerosol (powder fresh)	SC Johnson	Aerosol spray	✓				
64	Glade	Institutional air freshener (country garden)	SC Johnson	Aerosol spray			✓		
65	Glade	Institutional air freshener (potpourri)	SC Johnson	Aerosol spray			✓		
66	Glade	Institut. air freshener (smoke odor elimin.)	SC Johnson	Aerosol spray			✓		
67	Glade	Institutional air freshener (super fresh)	SC Johnson	Aerosol spray			✓		
68	Glade	Plug-in (botanical garden)	SC Johnson	Gel				✓	
69	Glade	Plug-in (country garden)	SC Johnson	Gel	✓	✓		✓	
70	Glade	Plug-in (French vanilla)	SC Johnson	Gel	✓				
71	Glade	Plug-in (Hawaiian breeze)	SC Johnson	Gel	✓				
72	Glade	Plug-in (lilac springs)	SC Johnson	Gel	✓				
73	Glade	Plug-in (mountain berry)	SC Johnson	Gel	✓				
74	Glade	Plug-in (rain shower)	SC Johnson	Gel	✓	✓			
75	Glade	Plug-in (tropical mist)	SC Johnson	Gel	✓	✓			
76	Glade	Plug-in scented oil (Hawaiian breeze)	SC Johnson	Liquid				✓	
77	Glade	Plug-in scented oil (meadow breeze)	SC Johnson	Liquid	✓			✓	
78	Glade	Plug-in scented oil (mystical garden)	SC Johnson	Liquid	✓			✓	
79	Glade	Plug-in scented oil (neutralizer)	SC Johnson	Liquid	✓			✓	
80	Glade	Plug-in scented oil (sky breeze)	SC Johnson	Liquid	✓			✓	
81	Glade	Plug-in scented oil (summer berries)	SC Johnson	Liquid				✓	
82	Glade	Plug-in scented oil (sunny days)	SC Johnson	Liquid				✓	
83	Glade	Plug-in scented oil (vanilla breeze)	SC Johnson	Liquid	✓			✓	
84	Glade	Plug-in, double strength	SC Johnson	Gel	✓				
85	Touch of Scent Elite	Air freshener (cinnamon stick)	Scott's Liquid Gold, Inc.	Aerosol spray				✓	
86	Touch of Scent Elite	Air freshener (floral)	Scott's Liquid Gold, Inc.	Aerosol spray				✓	
87	Touch of Scent Elite	Air freshener (vanilla)	Scott's Liquid Gold, Inc.	Aerosol spray				✓	
88	Carpet Fresh	Foam carpet refresher (apple cinnamon)	WD 40 Company	Aerosol spray				✓	
89	OdorCide	Air/fabric freshener and odor eliminator	Winston Company, Inc.	Liquid				✓	

[a] "✓" indicates that product was found at indicated retail outlet.

APPENDIX B. COMPOSITION SCREENING EXPERIMENTS

Twenty-one widely available cleaning products and air fresheners were selected for laboratory determination of their composition related to the VOCs of interest to the study. The objective was to obtain information on the vapor-phase compositions likely to result from the use of these products focusing on ethylene-based glycol ethers, unsaturated terpenoid compounds, and other unsaturated compounds potentially reactive with ozone. A gas sampling bag method was developed and utilized for this purpose. In this method, small quantities of the products were volatilized and then sampled for chemical analysis. Concentrations of 24 target VOCs in the 21 products were determined as mass fractions in percent (see equation 3-1).

This appendix presents the results for each sample collected from each individual bag that was prepared from one or more product containers. The upper section of each data table lists the sample preparation information. The lower section of each table gives the mass fractions. The individual compounds are listed in order of decreasing volatility within three categories: terpene hydrocarbons, unsaturated oxygenated compounds including terpenoid compounds, and ethylene-based glycol ethers.

The products are identified using an alphanumeric coding system that retains the consumer product category information (see Table 3.3). For some products, multiple containers were obtained and analyzed. Product containers are identified by the alpha portion (A, B, and C) of the "Bag ID" number. In most cases, multiple bags were prepared from a single container. The bags are indicated by means of the numeric portion (1-4) of the "Bag ID" number. Sample preparation information consists of the volume of nitrogen contained in the bag at standard room conditions, the amount of product added to the bag in either volume units or mass units if weighed, the volume of gas removed from the bag for analysis, and the GC/MS sample file name.

Mass fractions less than 0.1% are not recorded in the tables. In a few cases, there was an apparent contamination of samples likely due to carryover in the transfer syringe or in the analytical system between analyses of samples. In all such cases, which are footnoted in the tables, the suspected contamination was confirmed by subsequent qualitative analysis of freshly prepared bags.

The 21 products are grouped in Tables B.1-B.7 primarily by similarities in their VOC compositions as determined by the bag method. Table B.1 presents data for the four consumer products with >3% d-limonene. These products also contained other terpene hydrocarbons and one contained 2-butoxyethanol. Table B.2 presents data for three general-purpose cleaners with pine oil constituents. The next two tables present data for five products that contain >2% (Table B.3) or >1% (Table B.4) 2-butoxyethanol. (One product appearing in Table B.4, GPC-4, contained d-limonene and is also listed in Table B.1.) Table B.5 presents data for multiple analyses of glass cleaner, GLC-1. Table B.6 presents mass fraction data for five products with <0.2% of each target VOC. The sampling of one product, FMP-2, did not produce any target VOCs above the quantification limits. Mass fraction data for the four air fresheners are presented in Table B.7.

Table B.1. Mass fractions of target VOCs determined by bag method analysis of individual samples of four products with >3% d-limonene.

	General Information for Product Sample										
Product ID	GPD-1	GPD-1	GPD-1	GPC-4	GPC-4	GPC-4	FMP-1	FMP-1	MPS-1	MPS-1	MPS-1
Bag ID	A1	A2	A2	A1	A2	A3	A1	A2	A1	A1	A2
Bag volume (L)	49.9	50.0	50.0	3.01	3.00	3.00	2.98	2.99	3.00	3.00	3.00
Product vol. (µL)				5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Product mass (g)	1.4	1.4	1.1								
Sample vol. (µL)	1 [a]	1 [a]	5 [a]	2000	500	500	500	500	500	300	300
Sample file name	21209-03	21209-07	21210-01	21121-07	21122-04	21126-05	21108-05	21113-02	21114-06	21114-09	21114-10
Compound	**Mass Fraction of Compound in Product (%)**										
α-Pinene			0.20	0.04	0.03	0.03	0.05	0.05	0.10	0.10	0.12
Camphene											
β-Pinene				0.02	0.02	0.02	0.03	0.03	0.07	0.06	0.08
β-Myrcene			0.43	0.08	0.06	0.06	0.08	0.11	0.21	0.19	0.24
3-Carene											
α-Phellandrene											
α-Terpinene											
d-Limonene	26.99	23.49	23.80	3.61	4.08	3.87	5.41	5.32	9.07	9.40	11.19
γ-Terpinene											
Terpinolene											
Dihydromyrcenol											
Linalool											
1-Terpineol											
β-Terpineol											
4-Terpineol											
Terpineol isomer											
α-Terpineol											
γ-Terpineol											
Linalyl acetate											
β-Citronellol											
cis-Citral											
trans-Citral											
2-Butoxyethanol				2.08	1.70	1.26					
2-Hexyloxyethanol											

[a] Equivalent sample volume after 1:1000 gas-phase dilution

Table B.2. Mass fractions of target VOCs determined by bag method analysis of individual samples of three products with pine oil constituents.

	General Information for Product Sample										
Product ID	GPC-1	GPC-1	GPC-1	GPC-1	GPC-1	GPC-1	GPC-6	GPC-6	GPC-6	GPC-7	GPC-7
Bag ID	A1	A2	B2	C1	C2	C2	A1	A2	A2	A1	A2
Bag volume (L)	3.00	3.00	3.00	3.16	3.09	3.12	3.00	3.04	3.04	3.00	3.00
Product vol. (μL)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Sample vol. (μL)	500	500	500	500	500	500	5000	10000	10000	2000	2000
Sample file name	21108-03	21108-04	30122-03	30122-07	30123-04	30124-02	21113-04	21113-06	21114-04	21115-06	21121-04
Compound	**Mass Fraction of Compound in Product (%)**										
α-Pinene	0.18	0.17	0.33	0.19	0.21	0.24	0.05	0.05	0.05	0.10	0.09
Camphene	0.10	0.10	0.12	0.09	0.10	0.12	0.01	0.01	0.01	0.03	0.03
β-Pinene	0.03	0.03	0.07		0.05	0.06	0.01	0.01	0.01	0.02	0.02
β-Myrcene											
3-Carene											
α-Phellandrene	0.04	0.03	0.03	0.04	0.03	0.03				0.01	0.01
α-Terpinene	0.17	0.16	0.12	0.15	0.10	0.09	0.01	0.01	0.01	0.08	0.08
d-Limonene	1.14	1.12	1.07	1.10	0.97	1.14	0.22	0.21	0.20	0.38	0.38
γ-Terpinene	0.14	0.14	0.12	0.17	0.14	0.15	0.01	0.01	0.01	0.06	0.06
Terpinolene	1.66	1.62	1.73	1.89	1.28	1.20	0.04	0.03	0.03	0.41	0.43
Dihydromyrcenol											
Linalool											
1-Terpineol	0.42	0.36	0.36	0.42	0.41	0.50	0.01	0.01	0.01	0.12	0.13
β-Terpineol	0.17	0.15	0.15	0.15	0.15	0.20				0.06	0.07
4-Terpineol	0.08	0.08	0.07	0.10	0.07	0.11				0.13	0.13
Terpineol isomer	0.06	0.09	0.05	0.05	0.05	0.07				0.09	0.08
α-Terpineol	2.85	3.37	2.85	3.22	2.68	2.93	0.01	0.01	0.01	0.71	0.67
γ-Terpineol	0.45	0.56	0.43	0.50	0.38	0.47				0.10	0.09
Linalyl acetate											
β-Citronellol											
cis-Citral											
trans-Citral											
2-Butoxyethanol									0.14 [a]		
2-Hexyloxyethanol									0.01 [a]		

[a] Not present in product; analytical contamination (transfer syringe or analytical system) confirmed by qualitative analysis of subsequent samples

Table B.3. Mass fractions of target VOCs determined by bag method analysis of individual samples of two products with >2% 2-butoxyethanol.

	General Information for Product Sample							
Product ID	DIS-1	DIS-1	DIS-1	GPC-2	GPC-2	GPC-2	GPC-2	GPC-2
Bag ID	A1	A1	A2	A1	A1	A2	A2	A2
Bag volume (L)	3.20	3.20	3.00	3.00	3.00	3.03	3.03	3.03
Product vol. (µL)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Sample vol. (µL)	500	1000	500	1000	1000	1000	1000	1000
Sample file name	21208-05	21210-07	21210-03	31002-07	31013-07	31014-04	31015-06	31015-07
Compound	**Mass Fraction of Compound in Product (%)**							
α-Pinene								
Camphene								
β-Pinene								
β-Myrcene								
3-Carene								
α-Phellandrene								
α-Terpinene								
d-Limonene			0.02 [a]					
γ-Terpinene								
Terpinolene								
Dihydromyrcenol								
Linalool								
1-Terpineol								
β-Terpineol								
4-Terpineol								
Terpineol isomer								
α-Terpineol								
γ-Terpineol								
Linalyl acetate								
β-Citronellol								
cis-Citral								
trans-Citral								
2-Butoxyethanol	7.90	5.01	2.93	2.62	2.56	2.60	2.58	2.51
2-Hexyloxyethanol								

[a] Not present in product; analytical contamination (transfer syringe or analytical system) confirmed by qualitative analysis of subsequent samples

Table B.4. Mass fractions of target VOCs determined by bag method analysis of individual samples of three products with >1% 2-butoxyethanol

	General Information for Product Sample							
Product ID	GPC-3	GPC-3	GPC-3	GPC-4	GPC-4	GPC-4	SRM-1	SRM-1
Bag ID	A1	A2	A2	A1	A2	A3	A3	A4
Bag volume (L)	3.00	3.13	3.13	3.01	3.00	3.00	50.1	59.7
Product vol. (µL)	5.0	5.0	5.0	5.0	5.0	5.0		
Product mass (g)							1.16	1.10
Sample vol. (µL)	1000	1000	1000	2000	500	500	20 [a]	20 [a]
Sample file name	21113-05	31016-03	31017-01	21121-07	21122-04	21126-05	21210-09	21219-03
Compound	**Mass Fraction of Compound in Product (%)**							
α-Pinene				0.04	0.03	0.03		
Camphene								
β-Pinene				0.02	0.02	0.02		
β-Myrcene				0.08	0.06	0.06		
3-Carene								
α-Phellandrene								
α-Terpinene								
d-Limonene	0.02 [b]			3.61	4.08	3.87	0.07 [b]	
γ-Terpinene								
Terpinolene								
Dihydromyrcenol								
Linalool								
1-Terpineol								
β-Terpineol								
4-Terpineol								
Terpineol isomer								
α-Terpineol								
γ-Terpineol								
Linalyl acetate								
β-Citronellol								
cis-Citral								
trans-Citral								
2-Butoxyethanol	4.12	4.34	4.40	2.08	1.70	1.26	6.91	12.23
2-Hexyloxyethanol								

[a] Equivalent sample volume after 1:1000 gas-phase dilution
[b] Not present in product; contamination (transfer syringe or analytical system) confirmed by qualitative analysis of subsequent samples

Table B.5 Mass fractions of target VOCs determined by bag method analysis of individual samples of glass cleaner GLC-1.

	General Information for Product Sample							
Product ID	GLC-1	GLC-1	GLC-1	GLC-1	GLC-1	GLC-1	GLC-1	GLC-1
Bag ID	A1	A1	A2	A2	B1	B2	C1	C2
Bag volume (L)	3.00	3.00	3.00	3.00	3.03	3.00	3.00	3.18
Product vol. (µL)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Sample vol. (µL)	5000	10000	5000	10000	5000	5000	5000	5000
Sample file name	21113-07	21114-05	21114-07	21114-11	30121-06	30122-01	30123-02	30123-01
Compound	**Mass Fraction of Compound in Product (%)**							
α-Pinene								
Camphene								
β-Pinene								
β-Myrcene								
3-Carene								
α-Phellandrene								
α-Terpinene								
d-Limonene					0.01 [a]			
γ-Terpinene								
Terpinolene								
Dihydromyrcenol								
Linalool								
1-Terpineol								
β-Terpineol								
4-Terpineol								
Terpineol isomer								
α-Terpineol								
γ-Terpineol								
Linalyl acetate								
β-Citronellol								
cis-Citral								
trans-Citral								
2-Butoxyethanol	0.56	0.63	0.61	0.58	0.56	0.57	0.61	0.61
2-Hexyloxyethanol	0.20	0.19	0.24	0.25	0.25	0.25	0.27	0.25

[a] Not present in product; contamination (transfer syringe or analytical system) confirmed by qualitative analysis of subsequent samples

Table B.6. Mass fractions of target VOCs determined by bag method analysis of individual samples of products with <0.2% of target analytes.

	General Information for Product Sample										
Product ID	GPC-5	GPC-5	GPC-5	WDC-1	WDC-1	FMP-2	FMP-2	FMP-3	FMP-3	FMP-4	FMP-4
Bag ID	A1	A1	A2	A1	A2	A1	A2	A1	A2	A1	A2
Bag volume (L)	3.00	3.00	3.05	2.99	3	49.8	50.0	50.0	50.2	50.0	50.0
Product vol. (µL)	5.0	5.0	5.0	5.0	5.0	1.1	0.6				
Product mass (g)								3.0	1.5	4.28	1.25
Sample vol. (µL)	5000	10000	5000	5000	5000	500	500	500	1000	500	1500
Sample file name	21115-04	21115-07	21122-03	21122-05	21210-02	21209-04	21219-02	21208-02	21209-02	21126-06	21208-04
Compound	**Mass Fraction of Compound in Product (%)**										
α-Pinene								0.01	0.01	+ [b]	0.01
Camphene											
β-Pinene								0.04	0.03	0.03	0.03
β-Myrcene											
3-Carene											
α-Phellandrene											
α-Terpinene											
d-Limonene				+ [b]	0.01			0.19	0.18	0.11	0.17
γ-Terpinene								0.01	0.01	0.01	0.01
Terpinolene											
Dihydromyrcenol	0.01	0.01	0.01								
Linalool											
1-Terpineol											
β-Terpineol											
4-Terpineol											
Terpineol isomer											
α-Terpineol											
γ-Terpineol											
Linalyl acetate											
β-Citronellol											
cis-Citral								0.01	0.01	0.01	0.01
trans-Citral								0.02	0.02	0.02	0.02
2-Butoxyethanol								0.04 [a]	0.01 [a]		0.07 [a]
2-Hexyloxyethanol											
Xylenes						0.07	0.08				

[a] Not present in product; contamination (transfer syringe or analytical system) confirmed by qualitative analysis of subsequent samples
[b] Present in sample, but at a level of <0.01% of product

Table B.7. Mass fractions of target VOCs determined by bag method analysis of individual samples of air fresheners.

	General Information for Product Sample									
Product ID	AFR-1	AFR-1	AFR-2	AFR-2	AFR-3	AFR-3	AFR-3	AFR-3	AFR-4	AFR-4
Bag ID	A1	A2	A1	A2	A1	A1	A2	A2	A1	A2
Bag volume (L)	3.01	3.01	3.01	3.00	50.1	50.1	65.1	65.1	50.0	50.0
Product vol. (µL)	2.0	2.0	2.0	2.0						
Product mass (g)					0.0006	0.0006	0.041	0.041	0.69	2.84
Sample vol. (µL)	1000	1000	1000	1000	5000	30000	500	1000	20000	5000
Sample file name	21121-09	21220-01	21121-08	21126-03	21209-06	21210-04	21209-08	21210-05	21207-04	21208-03
Compound	**Mass Fraction of Compound in Product (%)**									
α-Pinene			0.11	0.13						
Camphene	0.04									
β-Pinene	0.13	0.11	0.13	0.15						
β-Myrcene	0.10		0.07	0.08						
3-Carene				0.03						
α-Phellandrene										
α-Terpinene										
d-Limonene	1.36	1.15	1.12	1.24	1.84	0.68	0.58	0.64	0.02	0.02
γ-Terpinene			0.12	0.12						
Terpinolene			0.03	0.03						
Dihydromyrcenol	5.52	4.49			4.64	4.82	2.33	2.11		
Linalool	4.36	3.55	8.64	9.00	6.61	6.56	2.98	3.22	0.01	0.01
1-Terpineol										
β-Terpineol			0.09	0.08						
4-Terpineol										
Terpineol isomer										
α-Terpineol			0.32	0.35						
γ-Terpineol			0.12	0.12						
Linalyl acetate	2.53	1.98	2.87	2.97						
β-Citronellol	0.69	0.60								
cis-Citral									0.01	0.01
trans-Citral									0.01	0.01
2-Butoxyethanol									0.01 [a]	
2-Hexyloxyethanol										

[a] Not present in product; contamination (transfer syringe or analytical system) confirmed by qualitative analysis of subsequent samples

APPENDIX C. EMISSIONS AND CONCENTRATIONS FROM SIMULATED-USE EXPERIMENTS

This appendix presents supplemental and detailed material supporting the text and display items in Section 3.4.

Six products were studied to quantify emissions and resulting gas-phase concentrations of specific VOCs of interest when the products were used in a realistic manner. VOCs of interest included (a) ethylene-based glycol ethers (2-butoxyethanol and 2-hexyloxyethanol) and (b) unsaturated terpenes and related compounds (potentially reactive with ozone).

Product applications included cleaning a table top with concentrated product, mopping a floor with a dilute aqueous solution, and continuous use of a plug-in air freshener. Product composition was measured by means of GC-MS analysis of methanol dilutions of the products. Emissions were quantified relative to the amount of each VOC contained in a product. The six products included 4 general-purpose cleaners (GPC-1 through GPC-4), one glass cleaner (GLC-1) and one air freshener (AFR-1). Experimental protocols and results are described in §3.4 of the report. The following paragraphs provide a brief guide to the tables and figures included in this appendix.

Tables C.1-C.2 provide information about the product specimens that were purchased and analyzed using three experimental approaches: (1) the Tedlar bag-based screening method ("Ba") described in §3.3, (2) direct solvent dilution ("Di") in which the product was diluted in methanol and the resulting solution was analyzed directly by GC-MS, and (3) emissions experiments ("Em") in the LBNL room-sized environmental chamber. These tables identify the specific specimens used in each set of experiments.

The next set of tables provides detailed information and results for each sample that was prepared and analyzed in the direct solvent dilution analysis. Each table includes results for the VOCs that are relevant to a single product. The GC file number comprises the date (YMMDD) and run number, and is included here to allow for easy reference to the original GC-MS output file (ion chromatogram). Tables C.3-C.6 list samples and results for the products containing only one or two active ingredients. Table C.7 provides information about the identified VOC constituents of GPC-1 and Table C.8 lists the concentrations of each constituent measured in each dilution sample. Table C.9 shows the amount of each VOC constituent in each dilution sample of AFR-1. For Tables C.8 and C.9, the compounds are grouped into ozone-reactive and other VOCs, and ordered by GC retention time within each group.

Tables C.10 through C.14 provide information about the amount of product used in each experiment. Tables C.10 and C.11 pertain to surveys conducted with LBNL employees to determine reasonable amounts of product use for the large chamber experiments. Table C.10 lists information for each participant in a study of trigger-spray product use. Table C.11 provides analogous information for a survey of disinfectant use (based on GPC-1 and DIS-1). The distributions of measured use rates are plotted in Figures C.1 (GPC-3, trigger spray) and C.2 (GPC-1, liquid disinfectant). These figures show that the data in each case are well fitted by lognormal distributions. Table C.12 provides details about the amount of solution and product used during each state of the mopping experiments. Table C.13 provides similarly detailed information for counter-cleaning with full-strength solution. In these experiments a wetted and wrung sponge was used to scrub the counter after the product was applied; the sponge was then dipped and wrung several times in a bucket of water then wetted again and used to "rinse" the counter.

Tables C.14 through C.31 provide information about each air sample that was collected and analyzed during the large-chamber, simulated product use experiments. (Experiments 1A-1R, see Table 3.26 for a summary.) Background samples are labeled starting with a “bk.” Other samples are identified numerically. For the vast majority of sampling periods, two side-by-side samples (“a” and “b”) were collected. In selected cases – generally for at least one sampling period per experiment – both samples were analyzed. In most but not all cases, when a single sample was analyzed, it was the “a” sample.

Table C.1. Product containers used for solvent dilution, bag screening and large chamber emissions experiments.

Product	Container	Methods [a]	Purchase date	Retailer	Location	Lot number
GLC-1	A	Ba, Di	9/26/2002	Safeway	N. Shattuck Ave, Berkeley	W217R
GLC-1	B	Ba, Di	1/21/2003	Andronico's	Telegraph Ave, Berkeley	W230P
GLC-1	C	Ba	1/21/2003	Ace	Downtown Berkeley	W181T
GLC-1	D	Em	7/22/2003	Safeway	N. Shattuck Ave, Berkeley	X160
GPC-1	A	Ba, Di	9/26/2002	Safeway	N. Shattuck Ave, Berkeley	D622271026
GPC-1	B	Ba	1/21/2003	Andronico's	Telegraph Ave, Berkeley	D622961054
GPC-1	C	Ba	1/21/2003	Ace	Downtown Berkeley	D622671354
GPC-1	D	Em	7/22/2003	Safeway	N. Shattuck Ave, Berkeley	D630231300
GPC-2	A	Ba, Di, Em	9/17/2003	Walgreens	S. Shattuck Ave, Berkeley	AB3227
GPC-3	A	Ba, Di	9/26/2002	Safeway	N. Shattuck Ave, Berkeley	PG2220203
GPC-3	B	Em	7/22/2003	Safeway	N. Shattuck Ave, Berkeley	PG3181\38
GPC-4	A	Ba, Di, Em	11/17/2002	Home Depot	Emeryville	E22521
GPC-4	B	Em	7/21/2003	Home Depot	Emeryville	E3064A1
AFR-1	A	Ba	11/20/2002	Safeway	College Ave, Oakland	453206
AFR-1	B	Di, Em	9/11/2003	Walgreens	S. Shattuck Ave, Berkeley	X085LMG

[a] Experimental methods for which individual product container was used: Ba = (Tedlar) bag-based screening method, Di = direct solvent dilution method, Em = emissions experiments in room-sized test chamber.

Table C.2. Product containers used for each experimental approach.

Product	Containers	Test	Details
GLC-1	A-B	direct	*n* = 1 in 1/2003; *n* = 3 in 3/2005
GLC-1	A-C	bag	*n* = 6 bags in 1/2003 [a]
GLC-1	D	emissions	*n* = 2 expts in fall 2003
GPC-1	A	direct	*n* = 1 in 1/2003
GPC-1	D	direct	*n* = 2 in 10/2003
GPC-1	A-C	bag	*n* = 5 in 1/2003 [b]
GPC-1	D	emissions	experiments 1B, 1E, 1N
GPC-2	A	direct	*n* = 1 in 11/2004; *n* = 4 in 3/2005
GPC-2	A	bag	*n* = 2 in 10/2003 [c]
GPC-2	A	emissions	experiment 1M
GPC-3	A	direct	*n* = 1 in 1/2003; *n* = 3 in 3/2005
GPC-3	B	direct	*n* = 3 in 3/2005
GPC-3	A	bag	*n* = 1 in 1/2003
GPC-3	B	bag	*n* = 1 in 10/2003
GPC-3	B	emissions	experiments 1C, 1F-1H, 1O
GPC-4	A	direct	*n* = 1 in 1/2003, *n* = 3 in 12/2003 [d]
GPC-4	A	bag	*n* = 2 in 1/2003, *n* = 1 in 10/2003
GPC-4	B	emissions	experiments 1D, 1I, 1P, 1Q
GPC-4	A	emissions	experiments 1J, 1K
AFR-1	B	direct	*n* = 2 in 12/2003
AFR-1	A	bag	*n* = 2 in 1/2003
AFR-1	B	emissions	experiment 1R

[a] 2 bags each from 3 product containers, all purchased in 1/2003.
[b] 1-2 bags from each of 3 product containers, all purchased in 1/2003.
[c] 5 total sample injections from 2 bags.
[d] 4 total sample injections from 3 dilution mixtures.

Table C.3. Samples analyzed in solvent dilution determination of GLC-1 composition.

Mixture ID	Injection	GC file	2-BE mass fraction	2-HE mass fraction
30123-1	1	30123_05	0.68%	0.41%
50316C	1	50316_05	0.52%	0.22%
50316E	1	50316_07	0.78%	0.61%
50316F	1	50316_08	0.48%	0.30%
50316E	2	50316_10	0.70%	0.49%

Table C.4. Samples analyzed in solvent dilution determination of GPC-2 composition.

Mixture ID	Injection	GC file	2-BE mass fraction
50317D	1	50317_04	2.91%
50317E	1	50317_05	1.89%
50317F	1	50317_06	2.99%
50321B	1	50321_02	2.59%
31124A	2	31124_04	2.53%

Table C.5. Samples analyzed in solvent dilution determination of GPC-3 composition.

Container ID	Mixture ID	Injection	GC file	2-BE mass fraction
A (9/2002)	30123-1	1	30123_06	4.29%
A (9/2002)	50318A	1	50318_04	7.41%
A (9/2002)	50318B	1	50318_05	6.53%
A (9/2002)	50321A	1	50321_01	5.97%
B (7/2003)	50316G	2	50316_09	6.92%
B (7/2003)	50317A	2	50317_01	5.83%
B (7/2003)	50317B	2	50317_02	6.57%

Table C.6. Samples analyzed in solvent dilution determination of GPC-4 composition.

Mixture ID	Injection	GC file	2-BE mass fraction	Limonene mass fraction
30124-1	1	30124_01	2.37%	3.98%
31124A	1	31124_01	3.75%	5.04%
31125A	1	31125_01	3.35%	4.51%
31215-1	1	31215_05	3.28%	4.22%
31215-1	2	31216_03	2.89%	4.20%

Table C.7. Quantified constituents of GPC-1

Compound [a]	CAS #	RT (min)	Class [b]
Ozone-Reactive Terpenoids			
α-Pinene	80-56-8	22.36	T-HC
Camphene	79-92-5	23.31	T-HC
β-Pinene	127-91-3	24.48	T-HC
α-Terpinene	99-86-5	26.10	T-HC
d-Limonene	5989-27-5	26.43	T-HC
γ-Terpinene	99-85-4	27.54	T-HC
Terpinolene	586-62-9	28.48	T-HC
α-Terpineol	98-55-5	34.57	T-AlcOH
γ-Terpineol	586-81-2	34.66	T-AlcOH
α-Phellandrene	*99-83-2*	*25.6*	*T-HC*
Terpene @ 26.3	*(tentative)*	*26.3*	T-HC(?)
Terpene @ 28.2	*(tentative)*	*28.2*	T-HC(?)
Terpene @ 29.4	*(tentative)*	*29.4*	T-HC(?)
1-Terpineol	*586-82-3*	*32.34*	*T-AlcOH*
β-Terpineol	*138-87-4*	*33.19*	*T-AlcOH*
4-Terpineol	*562-74-3*	*33.59*	*T-AlcOH*
Other VOCs			
p-Cymene	99-87-6	27.05	sHC
Eucalyptol	470-82-6	27.18	AlcOH
Camphor	76-22-2	33.56	AlcOH
Isoborneol	124-76-5	33.83	AlcOH
Borneol	507-70-0	34.33	AlcOH

[a] Compounds in italics quantified using total ion current (TIC), calibrated to TIC response of limonene.
[b] T-HC = terpene hydrocarbon; T-AlcOH = terpene alcohol; sHC = saturated hydrocarbon, AlcOH = saturated alcohol.

Table C.8. Samples analyzed in solvent dilution determination of GPC-1 composition.

Mix ID	a1	31215a	31216a
Bottle	A	D	D
GC file	30122_05	31215_02	31216_01

Ozone-Reactive Terpenoids			
Compound [a]	Mass fraction	Mass fraction	Mass fraction
α-Pinene	0.17%	0.07%	0.08%
Camphene	0.11%	0.13%	0.13%
β-Pinene	nd	0.01%	0.01%
α-Terpinene	0.18%	0.31%	0.26%
d-Limonene	1.30%	1.51%	1.61%
γ-Terpinene	0.16%	0.19%	0.18%
Terpinolene	1.93%	2.35%	2.53%
α-Terpineol	5.58%	6.71%	7.84%
γ-Terpineol	1.10%	1.07%	1.20%
α-Phellandrene	*0.03%*	*0.05%*	*0.05%*
Terpene @ 26.3	*0.02%*	*0.05%*	*0.04%*
Terpene @ 28.2	*0.05%*	*0.09%*	*0.06%*
Terpene @ 29.4	*0.05%*	*0.07%*	*0.06%*
1-Terpineol	*0.71%*	*0.84%*	*0.94%*
β-Terpineol	*0.38%*	*0.47%*	*0.52%*
4-Terpineol	*0.29%*	*0.26%*	*0.34%*
Other VOCs			
Compound [a]	Mass fraction	Mass fraction	Mass fraction
p-Cymene	0.11%	0.23%	0.24%
Eucalyptol	0.40%	0.41%	0.43%
Camphor	0.10%	0.08%	0.08%
Isoborneol	0.14%	0.25%	0.26%
Borneol	0.32%	0.35%	0.31%

[a] Compounds in italics quantified using total ion current (TIC), calibrated to TIC response of limonene.

Table C.9. Samples analyzed in solvent dilution determination of AFR-1 composition (Bottle B).

		GC file	
		31215_03	31216_02
Ozone-Reactive Terpenoids			
Compound [a]	CAS #	Mass fraction	Mass fraction
β-Pinene	127-91-3	0.13%	nq [b]
d-Limonene	5989-27-5	1.57%	1.84%
Dihydromyrcenol	18479-58-8	6.38%	7.76%
Linalool	78-70-6	6.03%	6.89%
Linanyl acetate	*115-95-7*	*2.30%*	*2.69%*
β-Citronellol	7540-51-4	2.29%	2.25%
trans-Citral	141-27-5	0.64%	0.61%
Other VOCs			
Compound [a]	CAS #	Mass fraction	Mass fraction
3,7-Dimethyl-3-octanol	*78-69-3*	*3.73%*	*4.35%*
Isononyl acetate	*40379-24-6*	*4.18%*	*4.97%*
Phenylethyl alchohol	60-12-8	3.75%	8.64%
Benzyl acetate	140-11-4	11.75%	15.44%
Bornyl acetate	76-49-3	4.33%	5.09%

[a] Compounds in italics quantified using total ion current (TIC), calibrated to TIC response of limonene.
[b] Not quantifiable

Table C.10. Results of product application rate survey, with cleaner GPC-3 in trigger spray bottle.

Subject	Subject cleans regularly?	No. TPs [a]	TP completeness [a]	Product use rate (g m^{-2})
1	yes	12	~ full	11.4
2	yes	12	1/2-3/4	11.5
3	yes	9	< 1/2	3.9
4	yes	4	~ 3/4	3.6
5	sometimes	8	nr [b]	6.2
6	sometimes	12	> 1/2	11.7
7	nr [b]	13	~ 3/4	11.7
8	yes	3	full	2.9
9	yes	4	< 1/2	1.2
10	yes	6	nr [b]	5.3
11	yes	4	> 1/2	2.2
12	yes	5	< 1/2	2.3
13	yes	9.5	~ 1/2	5.5
14	yes	28	~ 1/2	15.7
15	yes	16	~ 1/2	10.8
16	yes	15	> 1/2	7.3
17	yes	6	~ 1/2	3.3
18	yes	13	< 1/4	5.4
19	sometimes	8	nr [b]	5.6
20	yes	13	~ 1/2	7.2
21	sometimes	18	~ 1/2	10.7
22	yes	10	> 1/2	8.0
23	yes	16	~ 3/4	10.9
24	yes	4	~ 1/2	5.0
25	yes	19	~ 1/2	10.1

[a] TP = trigger pulls
[b] nr = not recorded.

Table C.11. Results of product application rate survey for disinfection.

Subject	Product	Product use rate (g m^{-2})
1	GPC-1	3
2	GPC-1	23
3	GPC-1	4
4	GPC-1	45
5	GPC-1	8
6	GPC-1	7
7	GPC-1	5
8	GPC-1	2
9	GPC-1	5
10	GPC-1	3
11	GPC-1	11
1	DIS-1	47
2	DIS-1	18
3	DIS-1	15
4	DIS-1	86
5	DIS-1	36
6	DIS-1	10
7	DIS-1	6
8	DIS-1	19
9	DIS-1	46
10	DIS-1	35
11	DIS-1	17

Table C.12. Measured masses (g) of solutions and cleaning equipment during mopping experiments. [a]

	Trial 1	Trial 2	Trial 3	Exp 1N	Exp 1O	Exp 1P	Exp 1Q
Bucket	nr	nr	nr	450	449	450	450
Bucket + solution, initial	3656	3506	3649	3874	4291	4277	4214
Bucket + solution, after wet mop	3316	3193	3288	3596	4025	3918	3920
Bucket + solution after dry mop	3553	3439	3581	3780	4203	4159	4106
Mop, initial	nr	nr	nr	949	952	957	938
Mop, after wet mop	nr	nr	nr	936	939	947	932
Mop, after dry mop	nr	nr	nr	937	940	944	937
Solution applied during wet mop phase	340	313	361	278	266	359	293
Net solution on floor, after dry mop phase	103	67	68	94	88	118	108
Fraction of solution applied, wet mop	9%	9%	10%	8%	7%	9%	8%
Fraction remaining on floor after dry mop	3%	2%	2%	3%	2%	3%	3%
Product container initial				847	1095	760	885
Product container final				797	1043	657	732
Net product used				50	53	103	153

[a] nr = not recorded.

Table C.13. Measured masses (grams) of cleaning products and equipment for full strength, counter-cleaning experiments.

Experiment [a]	**1A**	**1B**	**1D**	**1E**	**1F**	**1G**	**1H**	**1I**	**1J**	**1K**	**1L**	**1M**
Product	GLC-1	GPC-3	GPC-4	GPC-1	GPC-3	GPC-3	GPC-3	GPC-4	GPC-4	GPC-4	GLC-1	GPC-2
Product initial	1026.6	778.6	1122.3	858.1	772.3	766.1	655.3	1102	618.6	612	1010.2	1002.7
Product final	1020.2	772.6	1115.7	847.7	766.3	760.1	649.4	1095.4	612.4	606.3	1003.7	996.4
Pipette initial				30.1								
Pipette final				30.6								
Trigger pulls	7	6	5		6	6	6	5	5	5	7	~3.5
Product used	**6.4**	**6.0**	**6.6**	**9.9**	**6.0**	**6.0**	**5.9**	**6.6**	**6.2**	**5.7**	**6.5**	**6.3**
Scrub Towels												
Initial				7.8	7.9	7.9	7.8	7.8	7.9	7.9	7.9	7.8
After wiping				18.1	15.1	14.8	17.0	16.0	19.7	19.9	12.5	nr [b]
After 24 h				10.1	8.3	9.5	8.3	12.0	9.1	11.0	8.2	8.1
Uptake (scrub)				**10.3**	**7.2**	**6.9**	**9.2**	**8.2**	**11.8**	**12**	**4.6**	**nr**
Net on towels				**2.3**	**0.4**	**1.6**	**0.5**	**4.2**	**1.2**	**3.1**	**0.3**	**0.3**
Rinse Towels												
Initial				10.2	10.2	10.2	10.2	10.3	10.3	10.2		
After wiping				20.6	15.6	15.5	19.6	14.5	18	17.3		
After 24 h				10.6	10.5	10.7	10.3	10.7	11.1	11.3		
Uptake (rinse)				**10.4**	**5.4**	**5.3**	**9.4**	**4.2**	**7.7**	**7.1**		
Net on towels				**0.4**	**0.3**	**0.5**	**0.1**	**0.4**	**0.8**	**1.1**		
Scrub sponge												
Initial				54.3	57.2	55	56.1	53.8	57.7	57.4		
After use				50.5	53	50.9	49.6	49.4	47.8	47.2		
Net H_2O to table				**3.8**	**4.2**	**4.1**	**6.5**	**4.4**	**9.9**	**10.2**		
Rinse sponge												
Initial				71.9	54.8	58.4	62.2	57.6	58.6	61.5		
After use				58.5	48.7	52	50.8	51.9	49.1	52.7		
Net H_2O to table				**13.4**	**6.1**	**6.4**	**11.4**	**5.7**	**9.5**	**8.8**		

[a] For experiment 1C, the only recorded information was the amount of product dispensed.
[b] "nr" = Not recorded

Table C.14. Airborne concentrations of glycol ethers for experiment 1A (GLC-1, counter).

Sample ID	GC file	Start (min) [a]	End (min) [a]	2-BE (μg m^{-3})	2-HE (μg m^{-3})
bk1	30803_02	-50	-30	3	0
1b	30730_04	0	10	347	263
2a	30730_03	10	30	304	198
3b	30731_01	30	60	218	121
4b	30801_01	60	120	132	67
5a	30801_06	120	240	67	35
6a	30803_03	240	1446	9	8
6b	30806_02	240	1446	9	10

[a] Times are referenced to the beginning of the simulated-use activity.

Table C.15. Airborne constituent concentrations (μg m^{-3}) for experiment 1B (GPC-1, counter).

Sample ID	1b	2a	3b	4a	5a	6a	6b
GC file	30825_10	30825_11	30826_02	30825_06	30825_09	30826_04	30826_08
Start (min)	0	11	31	61	121	240	240
End time (min)	10	31	61	121	240	1438	1438
α-Pinene	65	64	52	41	17	1	1
Camphene	98	98	77	60	25	2	2
β-Pinene	12	13	11	9	3	0	0
α-Terpinene	100	82	93	55	15	0	0
d-Limonene	1052	1040	884	651	263	21	22
p-Cymene	147	150	135	92	39	4	4
Eucalyptol	278	284	226	177	71	5	5
γ-Terpinene	106	102	87	61	24	2	2
Terpinolene	1042	887	846	633	193	9	8
Camphor	0	15	12	11	5	1	1
Isoborneol	39	33	28	19	9	2	2
Borneol	38	26	20	16	6	2	nd
α-Terpineol	366	291	209	127	69	25	26
γ-Terpineol	44	35	24	16	7	2	2
α-Phellandrene	26	25	21	16	5	0	nd
Terpene@26.3	31	30	28	20	8	1	nd
Terpene@28.2	48	21	21	15	9	0	nd
Terpene@29.4	4	89	28	2	9	0	nd
1-Terpineol	44	68	54	40	25	5	nd
β-Terpineol	73	37	29	24	10	3	nd
4-Terpineol	80	47	30	21	10	2	nd

Table C.16. Airborne concentrations of 2-butoxyethanol for experiment 1C (GPC-3, counter).

Sample ID	GC file	Start (min) [a]	End (min) [a]	2-BE (μg m^{-3})
bk1	30731_03	-68	-48	2
1a	30731_02	0	10	2684
1b	30821_08	0	10	2690
2a	30731_04	10	30	2497
2b	30821_10	10	30	2318
3a	30731_07	30	60	2055
3b	30731_05	30	60	2149
4b	30731_09	60	120	1197
5a	30731_08	134	240	571
6a	30801_05	240	1440	63
6b	30804_03	240	1440	65

[a] Times are referenced to the start of the simulated-use activity.

Table C.17. Airborne concentrations of 2-butoxyethanol and d-limonene for experiment 1D (GPC-4, counter).

Sample ID	GC file	Start (min) [a]	End (min) [a]	2-BE (μg m^{-3})	Limonene (μg m^{-3})
bk1	30807_13	-71	-31	8	0
1a	30804_02	0	10	1058	2684
2a	30806_07	10	30	727	2358
2b	30807_01	10	30	796	2417
3a	30806_09	30	60	598	1855
4a	30807_03	60	120	399	1236
5a	30806_01	120	240	211	592
6b	30805_05	240	1440	26	46

[a] Times are referenced to the start of the simulated-use activity.

Table C.18. Airborne constituent concentrations (μg m^{-3}) for experiment 1E (GPC-1, counter).

Sample ID	b02	1a	1b	2a	3a	4a	4b
GC run no.	30829_02	30828_01	30829_03	30828_02	30828_04	30828_06	30828_03
Start (min) [a]	-55	0	0	10	30	60	60
End time (min) [a]	-35	10	10	30	60	120	120
α-Pinene	0.2	65	72	84	69	50	50
Camphene	0.0	99	109	124	102	73	74
β-Pinene	1.0	13	15	17	14	10	11
α-Terpinene	0.0	93	107	180	72	73	85
d-Limonene	0.6	998	1098	1246	1014	783	752
p-Cymene	0.2	155	169	190	163	121	119
Eucalyptol	0.0	256	285	329	281	216	216
γ-Terpinene	0.0	100	111	129	102	80	81
Terpinolene	0.5	887	1072	1520	733	743	798
Camphor	0.0	15	16	18	14	11	11
Isoborneol	0.2	36	33	40	38	28	25
Borneol	0.3	24	27	29	19	16	15
α-Terpineol	4.9	342	385	404	292	193	194
γ-Terpineol	0.3	40	47	53	33	16	25
α-Phellandrene	0.0	26	30	39	23	20	22
Terpene@26.3	0.1	34	34	40	33	26	27
Terpene@28.2	0.1	24	28	38	20	19	19
Terpene@29.4	0.0	33	28	34	35	24	23
1-Terpineol	0.1	67	78	84	69	51	52
β-Terpineol	0.4	44	46	47	37	27	24
4-Terpineol	0.6	56	54	55	42	30	31

[a] Times are referenced to the start of the simulated-use activity.

Table C.18 (continued). Airborne constituent concentrations (μg m^{-3}) for experiment 1E (GPC-1, counter).

Sample ID	5a	5b	6a	6b
GC run number	30829_01	30828_05	30829_05	30829_06
Start time (min)	120	120	240	240
End time (min)	240	240	1445	1445
α-Pinene	25	27	2	2
Camphene	37	40	3	3
β-Pinene	6	6	0	0
α-Terpinene	56	61	1	1
d-Limonene	484	480	49	49
p-Cymene	74	73	9	9
Eucalyptol	128	138	17	17
γ-Terpinene	53	54	7	6
Terpinolene	636	655	40	37
Camphor	9	8	3	3
Isoborneol	19	18	9	10
Borneol	13	12	7	7
α-Terpineol	182	170	99	100
γ-Terpineol	25	23	10	9
α-Phellandrene	13	14	1	1
Terpene@26.3	16	17	2	2
Terpene@28.2	14	15	1	1
Terpene@29.4	18	13	4	4
1-Terpineol	44	44	22	23
β-Terpineol	19	19	11	11
4-Terpineol	25	24	11	11

Table C.19. Airborne concentrations of 2-butoxyethanol for experiment 1F (GPC-3, counter).

Sample ID	GC file	Start (min) [a]	End (min) [a]	2-BE (μg m^{-3})
bk2	30905_07	-46	-26	3
1c	30904_05	0	10	1708
2b	30904_01	10	30	1705
3b	30905_04	30	60	1366
4b	30905_03	60	90	1141
5b	30904_02	90	120	947
6a	30905_05	120	150	830
6b	30904_09	120	150	706
7a	30905_06	150	195	680
7b	30904_03	150	195	693
8b	30904_04	195	240	610
9a	30904_07	240	420	423
10a	30904_08	420	630	295
11a	30919_04	630	900	201
11b	30905_02	630	900	191
12a	30905_01	900	1440	106

[a] Times are referenced to the start of the simulated-use activity.

Table C.20. Airborne concentrations of 2-butoxyethanol for experiment 1G (GPC-3, counter).

Sample ID	GC file	Start (min) [a]	End (min) [a]	2-BE (μg m^{-3})
bk1	30911_01	-27	-7	2
1a	30910_08	0	10	1984
2a	30910_07	10	30	1887
3b	30910_03	30	60	1467
4a	30919_07	60	120	995
4b	30910_04	60	120	1014
5b	30910_05	120	191	718
6b	30910_06	191	240	555
7b	30910_09	240	422	384
8a	30911_04	422	722	225
8b	30910_12	422	722	245
9a	30911_02	722	1426	122
9b	30911_03	722	1426	131

[a] Times are referenced to the start of the simulated-use activity.

Table C.21. Airborne concentrations of 2-butoxyethanol for experiment 1H (GPC-3, counter).

Sample ID	GC file	Start (min) [a]	End (min) [a]	2-BE (μg m^{-3})
bk1	31001_12	-50	-30	20
1b	30930_07	0	10	2856
2b	30930_06	10	30	1544
3a	31001_08	30	60	1235
4a	30930_04	60	120	905
4b	31014_03	60	120	913
5b	30930_05	120	240	698
6a	30930_08	240	430	497
7b	31001_09	430	735	393
8a	31001_10	735	1440	65

[a] Times are referenced to the start of the simulated-use activity.

Table C.22. Airborne concentrations of 2-butoxyethanol and d-limonene for experiment 1I (GPC-4, counter).

Sample ID	GC file	Start (min) [a]	End (min) [a]	2-BE (μg m^{-3})	Limonene (μg m^{-3})
bk2	30922_02	-34	-14	3	0
1b	30909_05	0	10	888	2435
2a	30909_01	10	30	776	2359
2b	30909_08	10	30	780	2553
3a	30909_02	30	60	618	1958
4b	30909_03	60	120	424	1271
5b	30909_06	120	180	319	778
6a	30909_04	180	240	267	485
7a	30919_06	240	450	153	180
7b	30909_07	240	450	163	189
8b	30909_07	450	810	114	40
9a	30910_10	810	1440	73	8
9b	30910_02	810	1440	80	8

[a] Times are referenced to the start of the simulated-use activity.

Table C.23. Airborne concentrations of 2-butoxyethanol and d-limonene for experiment 1J (GPC-4, counter).

Sample ID	GC file	Start (min) [a]	End (min) [a]	2-BE (μg m^{-3})	Limonene (μg m^{-3})
bk1	31223_01	-23	-2	3.5	0
1b	31223_02	0	10	912	2740
2a	31222_01	10	30	766	2702
3a	31222_04	30	60	588	2050
4a	31222_02	60	120	430	1406
5a	31222_03	120	240	330	656

[a] Times are referenced to the start of the simulated-use activity.

Table C.24. Airborne concentrations of 2-butoxyethanol and d-limonene for experiment 1K (GPC-4, counter)

Sample ID	GC file	Start (min) [a]	End (min) [a]	2-BE (μg m^{-3})	Limonene (μg m^{-3})
bk1	31225_01	-30	-10	18	3
1a	31224_01	0	10	879	2910
2a	31224_05	10	30	714	2766
3a	31223_04	30	60	512	2243
4b	31224_04	60	120	369	1378
5a	31224_03	120	240	252	644
6a	31224_02	240	570	163	148
7a	31224_06	570	1440	99	17

[a] Times are referenced to the start of the simulated-use activity.

Table C.25. Airborne concentrations of glycol ethers for experiment 1L (GLC-1, counter).

Sample ID	GC file	Start (min) [a]	End (min) [a]	2-BE (μg m^{-3})	2-HE (μg m^{-3})
bk1	30902_06	-61	-41	4	6
1a	30902_01	0	10	324	249
1b	30902_08	0	10	304	241
2a	30903_02	10	30	332	199
2b	30902_05	10	30	342	212
3a	30902_02	30	60	337	174
4c	30902_03	64	120	340	169
5a	30902_04	121	240	263	124
6a	30902_09	240	540	116	68
6b	30902_07	240	540	122	71
7a	30903_03	540	1440	19	25
7c	30903_01	540	1431	20	25

[a] Times are referenced to the start of the simulated-use activity.

Table C.26. Airborne concentrations of 2-butoxyethanol for experiment 1M (GPC-2, counter).

Sample ID	GC file	Start (min) [a]	End (min) [a]	2-BE (μg m^{-3})
bk1	30926_08	-88	-68	7
1b	30926_05	0	10	1479
2a	30926_02	10	30	1434
3a	30926_01	30	60	1379
4b	30925_07	60	120	1197
5b	30925_06	120	240	859
6b	30925_08	240	420	484
7a	30926_07	420	695	206
7b	30926_03	420	695	192
8a	30926_06	695	1457	54
8b	30926_04	695	1457	52

[a] Times are referenced to the start of the simulated-use activity.

Table C.27. Airborne constituent concentrations (μg m^{-3}) for experiment 1N (GPC-1, mopping).

Sample ID	bk1	1a	2a	2b	3a	4a
GC run number	30919_05	30918_05	30918_01	30918_07	30918_02	30918_03
Start time (min) [a]	-52	0	10	10	30	60
End time (min) [a]	-32	10	30	30	60	120
α-Pinene	0.3	56	76	80	63	42
Camphene		88	123	125	98	66
β-Pinene	0.9	11	15	17	13	9
α-Terpinene		50	211	148	112	69
d-Limonene	6.8	968	1340	1353	1045	706
p-Cymene		158	196	206	162	107
Eucalyptol		300	382	396	304	202
γ-Terpinene		95	144	149	110	75
Terpinolene		640	2008	1557	1138	758
Camphor		18	24	26	20	14
Isoborneol		62	71	90	64	42
Borneol	0.2	45	59	62	51	38
α-Terpineol	0.6	432	807	828	722	575
γ-Terpineol	0.3	24	122	109	102	75
α-Phellandrene	0.1	17	40	37	27	17
Terpene@26.3		27	40	42	32	22
Terpene@28.2	0.1	16	45	37	27	19
Terpene@29.4	0.1	6	30	36	64	17
1-Terpineol		109	208	204	153	116
β-Terpineol	0.1	72	79	87	71	52
4-Terpineol	0.6	67	93	88	67	47

[a] Times are referenced to the start of the simulated-use activity.

Table C.27 (continued). Airborne constituent concentrations (μg m^{-3}) for experiment 1N (GPC-1, mopping).

Sample ID	5b	6a	6b	7a	7b
GC Run #	30918_04	30923_01	30918_08	30919_02	30922_08
Start time (min)	120	240	240	540	540
End time (min)	240	540	540	1440	1440

α-Pinene	21	5	5	1	1
Camphene	32	8	8	1	1
β-Pinene	4	1	1	0	0
α-Terpinene	43	6	9	0	0
d-Limonene	348	101	97	15	14
p-Cymene	52	16	15	2	2
Eucalyptol	95	25	23	3	2
γ-Terpinene	38	10	10	1	1
Terpinolene	434	82	106	6	5
Camphor	8	3	3	1	1
Isoborneol	26	12	13	3	3
Borneol	24	13	12	4	4
α-Terpineol	396	230	227	86	84
γ-Terpineol	54	21	27	7	6
α-Phellandrene	10	2	2	0	0
Terpene@26.3	11	3	3	0	0
Terpene@28.2	11	2	3	0	0
Terpene@29.4	9	4	3	1	1
1-Terpineol	81	34	35	8	8
β-Terpineol	33	18	17	6	6
4-Terpineol	27	13	15	4	4

Table C.28. Airborne concentrations of 2-butoxyethanol for experiment 1O (GPC-3, mopping).

Sample ID	GC file	Start (min) [a]	End (min) [a]	2-BE (μg m^{-3})
bk1	30917_01	-119	-99	14
1c	30917_02	0	10	805
2b	30917_03	10	30	1428
3a	30917_05	30	60	1396
4b	30917_04	60	120	958
5a	30919_03	120	240	632
5b	30917_06	120	240	596
6b	30917_11	240	530	262
7a	30918_06	530	1440	57

[a] Times are referenced to the start of the simulated-use activity.

Table C.29. Airborne concentrations of 2-butoxyethanol and d-limonene for experiment 1N (GPC-1, mopping).

Sample ID	GC file	Start (min) [a]	End (min) [a]	2-BE (μg m^{-3})	Limonene (μg m^{-3})
bk2	30917_09	-41	-21	19	33
1c	30916_04	0	10	266	2287
2a	30916_01	10	30	483	3403
3a	30916_02	30	60	389	2737
4a	30916_08	60	120	264	1679
4b	30916_03	60	120	274	1757
5b	30916_07	120	240	168	816
6b	30916_09	240	540	90	239
7a	30917_06	540	1440	24	35

[a] Times are referenced to the start of the simulated-use activity.

Table C.30. Airborne concentrations of 2-butoxyethanol and d-limonene for experiment 1O (GPC-3, mopping).

Sample ID	GC file	Start (min) [a]	End (min) [a]	2-BE (μg m^{-3})	Limonene (μg m^{-3})
bk2	31002_04	-30	-10	8	1
1a	30929_10	0	10	897	5527
2a	30929_01	10	20	1201	7127
3a	30929_09	20	30	1183	6641
4a	30929_02	30	40	1269	6402
5b	31002_02	40	50	1228	5860
6a	31002_05	50	60	1169	5367
6b	31001_13	50	60	1184	5553
7a	30929_13	60	80	798	3803
8b	30930_01	80	100	706	3286
9b	31002_01	100	120	700	2826
10a	30929_11	120	160	515	2176
11a	30929_08	160	200	426	1554
12b	30929_06	200	240	368	1196
13a	30929_07	240	390	226	603
14b	30929_12	390	591	126	219
15b	30930_03	591	910	58	75
16a	31001_11	910	1440	29	29

[a] Times are referenced to the start of the simulated-use activity.

Table C.31. Airborne constituent concentrations (μg m^{-3}) for experiment 1R (AFR-1).

Sample ID	1a	2a	3b	4a	5a	5b	6a	6b
GC Run #	30911_06	30911_08	30912_02	30915_02	30915_01	30913_01	30914_02	30914_01
Start time (min)	238	480	1219	1713	3064	3064	4362	4362
End time (min)	243	482	1221	1715	3066	3069	4364	4367
β-Pinene	4	3	3	3	3	2	2	2
d-Limonene	49	41	40	40	34	31	23	24
Dihydromyrcenol	160	161	183	187	165	149	114	113
Linalool	121	124	148	156	139	131	94	96
Linalyl acetate	56	39	50	75	57	63	50	48
β-Citronellol	15	17	31	38	38	38	29	29
trans-Citral	5	4	9	9	9	12	7	7
3,7-Dimethyl-3-octanol	90	89	101	101	89	82	61	62
Isononyl acetate	111	108	119	119	102	93	71	72
Phenyl ethyl alcohol	33	77	115	65	67	69	113	56
Benzyl acetate	194	216	296	333	322	293	242	237
Bornyl acetate	319	355	473	500	435	403	307	306
a-a-DM-benzeneethanol	78	95	168	198	199	184	149	147

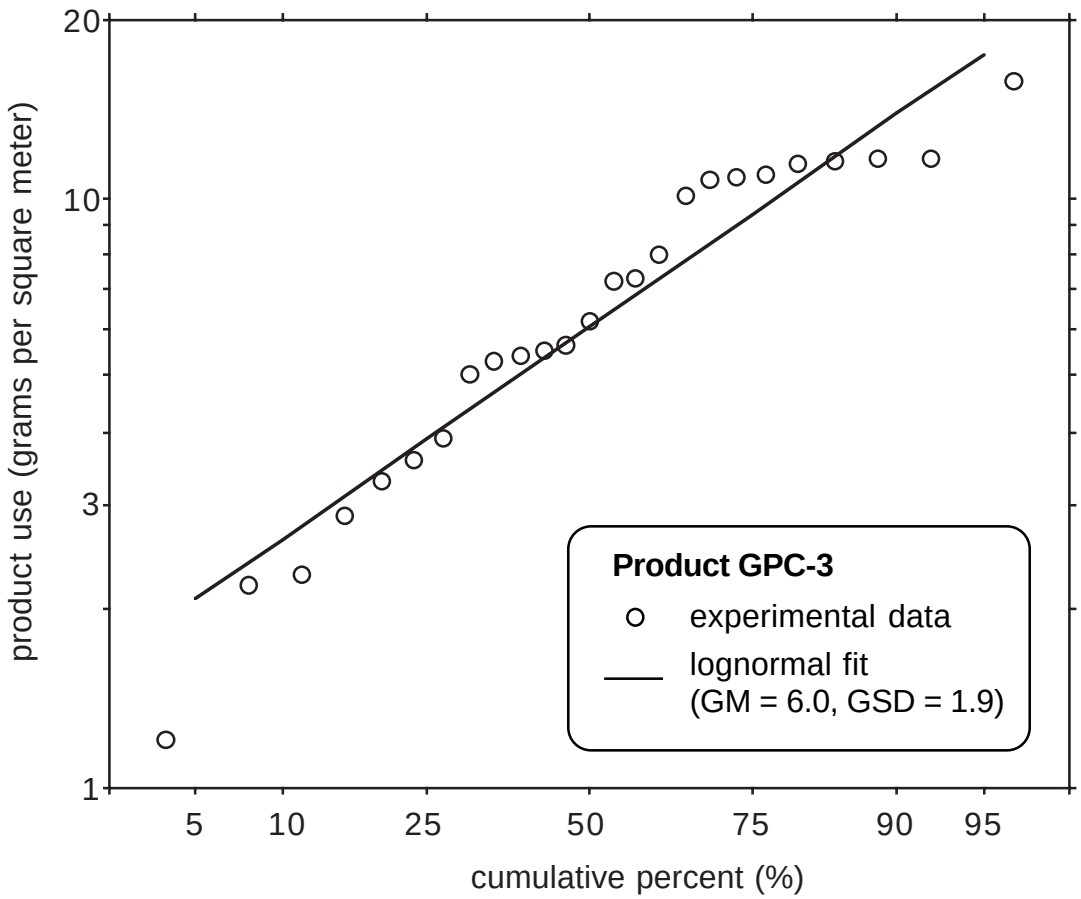


Figure C.1. Cumulative probability distribution for product application rates among 25 subjects instructed to use a trigger-spray product (GPC-3) to clean a 0.93-m^2 section of laminate tabletop.

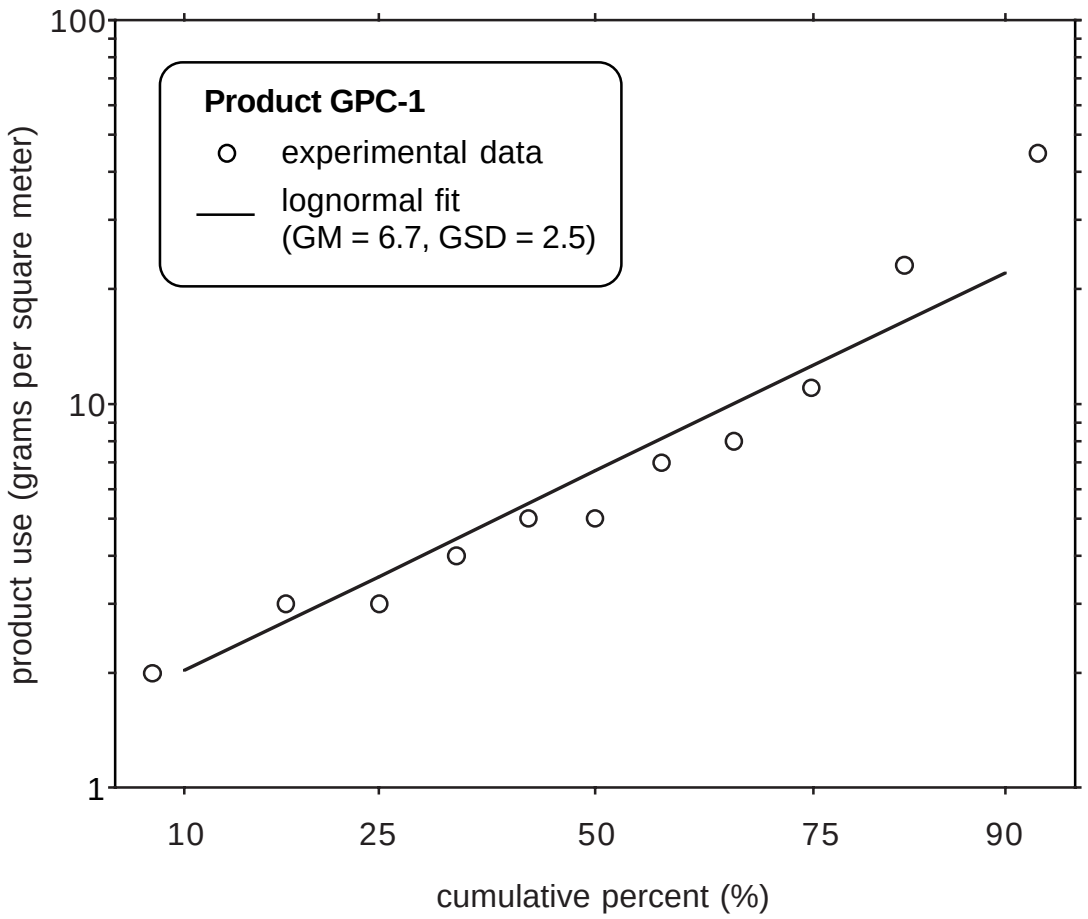


Figure C.2. Cumulative probability distribution for product application rate for 11 subjects instructed to use a trigger-spray product (GPC-1) to disinfect a clean 1.16-m^2 laminate tabletop.

APPENDIX D. REACTIVE CHEMISTRY BENCH-SCALE EXPERIMENTS

This appendix presents results corresponding to three household products (GPC-1, GPD-1 and AFR-1) tested for ozone reactive chemistry in bench-scale experiments following a matrix of 15 different experiments. Experimental conditions explored low (~30 ppb), moderate (~60 ppb), high (~130 ppb) and very high (~250 ppb) ozone supply levels, as well as two different air exchange rates (1 and 3 h^{-1}). We also tested for ozone reactivity of dry residue remaining on surfaces exposed to the three products, and for the effect of the presence of NO_2 in one experimental condition. The experimental matrix is summarized in Table 4.1.

Sample IDs starting in "1" correspond to VOC or oxidation products collected in the absence of ozone; those starting in "2" correspond to samples collected at steady-state ozone levels. Replicate samples for each condition are indicated with a letter following the number, in alphabetical order. For experiments with the products GPC-1 and GPD-1, an additional VOC "bag" sample is reported, corresponding to a direct measurement of the Tedlar bag concentrations of VOCs before being introduced (and diluted) in the reaction chamber. Chamber ozone concentrations were measured directly in the reaction chamber; supply ozone concentrations were determined before and after each experiment at the output of the ozone source. These measured data were adjusted by calculation to account for dilution of ozone into the total rate of air supply to the chamber.

Airborne concentrations of primary VOCs and of oxidation products corresponding to each experimental condition are presented in Tables D.1-D.31. Table D.32 presents a summary of ozone concentration data from experiments performed in the bench-scale chamber. Scanning mobility particle sizer (SMPS) plots and optical particle counter (OPC) data recorded during the experiments are presented in Figures D.1-D.23. Figures D.24-D.37 present data corresponding to the response of the ozone analyzer in each experiment. Figure D.38 illustrates the response of the ozone analyzer and the NO/NO_2 monitor during experiment 2O.

Table D.1. Airborne concentrations of primary VOCs (mg m^{-3}) measured in experiment 2A (GPC-1)

	sample ID									
species	Bag	1a	1b	1c	1d	1e	2a	2b	2c	2d
α-Terpinene	11.96	0.12	0.13	0.08	0.12	0.07	0.00	0.00	0.00	0.00
d-Limonene	153.66	1.09	1.14	1.18	1.12	1.14	0.85	0.88	0.85	0.89
p-Cymene	36.22	0.21	0.22	0.23	0.21	0.22	0.22	0.23	0.22	0.24
Eucalyptol	45.52	0.32	0.34	0.35	0.33	0.34	0.34	0.35	0.34	0.37
Terpinolene	88.34	1.31	1.39	1.03	1.32	0.92	0.47	0.50	0.40	0.48
α-Terpineol	109.64	0.74	0.92	0.94	0.89	0.92	0.69	0.73	0.71	0.74
γ-Terpineol	11.60	0.10	0.13	0.11	0.12	0.10	0.04	0.04	0.04	0.04

Table D.2. Airborne oxidation product concentrations (mg m^{-3}) measured in experiment 2A (GPC-1)

	sample ID						
species	1a	1b	2a	2b	1c	2c	2d
Formaldehyde	0.001	0.001	0.071	0.075			
Acetaldehyde	0.002	0.003	0.009	0.012			
Acetone	0.028	0.030	0.311	0.328			
Glycolaldehyde	nd	nd	0.037	0.043			
Formic acid					0.020	0.083	0.106
Acetic acid					0.016	0.135	0.165

Table D.3. Airborne concentrations of primary VOCs (mg m^{-3}) measured in experiment 2B-I (GPC-1).

	sample ID							
species	Bag	1a	1b	1c	2a	2b	2c	2d
α-Terpinene	20.84	0.12	0.13	0.09	0.01	0.01	0.01	0.01
d-Limonene	201.30	1.23	1.38	1.29	1.07	1.08	1.14	1.21
p-Cymene	42.00	0.26	0.29	0.27	0.26	0.26	0.28	0.29
Eucalyptol	64.78	0.39	0.44	0.41	0.39	0.39	0.41	0.44
Terpinolene	187.54	1.14	1.26	0.94	0.64	0.73	0.72	0.82
α-Terpineol	122.98	0.72	0.81	0.83	0.73	0.74	0.79	0.83
γ-Terpineol	14.36	0.08	0.09	0.08	0.05	0.05	0.06	0.05

Table D.4. Airborne oxidation product concentrations (mg m^{-3}) measured in experiment 2B-I (GPC-1).

	sample ID							
species	1a	1b	2a	2b	1c	1d	2c	2d
Formaldehyde	0.001	<0.001	0.029	0.030				
Acetaldehyde	0.001	0.002	0.003	0.005				
Acetone	0.058	0.071	0.166	0.187				
Glycolaldehyde	nd	nd	0.021	0.022				
Formic acid					0.036	0.039	0.063	0.143
Acetic acid					0.072	0.109	0.105	0.290

Table D.5. Airborne concentrations of primary VOCs (mg m^{-3}) measured in experiment 2B-II (GPC-1).

	sample ID									
species	Bag	1a	1b	1c	1d	2a	2b	2c	2d	2e
α-Terpinene	23.96	0.15	0.14	0.11	0.11	0.01	0.01	0.01	0.01	0.01
d-Limonene	194	1.28	1.27	0.96	1.27	1.09	1.05	1.06	1.04	1.03
p-Cymene	34.86	0.23	0.23	0.17	0.23	0.23	0.22	0.23	0.22	0.24
Eucalyptol	58.26	0.38	0.37	0.28	0.38	0.37	0.35	0.33	0.35	0.21
Terpinolene	212.1	1.52	1.42	1.14	1.23	0.90	0.81	0.71	0.58	0.69
α-Terpineol	153.1	0.78	0.77	0.60	0.80	0.74	0.73	0.77	0.75	0.65
γ-Terpineol	19.66	0.09	0.09	0.07	0.09	0.06	0.05	0.05	0.05	0.04

Table D.6. Airborne oxidation product concentrations (mg m^{-3}) measured in experiment 2B-II (GPC-1)

	sample ID							
species	1a	1b	2a	2b	1c	1d	2c	2d
Formaldehyde	0.001	0.002	0.038	0.041				
Acetaldehyde	0.003	0.009	0.006	0.014				
Acetone	0.024	0.035	0.179	0.197				
Glycolaldehyde	nd	nd	0.024	0.026				
Formic acid					0.016	0.044	0.043	0.058
Acetic acid					0.035	0.111	0.090	0.115

Table D.7. Airborne concentrations of primary VOCs (mg m^{-3}) measured in experiment 2B-III (GPC-1)

	sample ID							
species	Bag	1a	1b	1c	1d	2a	2b	2c
α-Terpinene	13.62	0.15	0.13	0.14	0.13	0.01	0.01	0.01
d-Limonene	181.06	1.23	1.22	1.21	1.22	1.02	1.00	1.01
p-Cymene	34.46	0.23	0.23	0.22	0.23	0.22	0.22	0.23
Eucalyptol	56.08	0.36	0.37	0.36	0.36	0.35	0.35	0.35
Terpinolene	139.36	1.54	1.47	1.52	1.39	0.85	0.83	0.87
α-Terpineol	60.9	0.91	0.93	0.97	0.94	0.83	0.80	0.80
γ-Terpineol	6.58	0.11	0.11	0.12	0.11	0.06	0.06	0.06

Table D.8. Airborne oxidation product concentrations (mg m^{-3}) measured in experiment 2B-III (GPC-1)

	sample ID							
species	1a	1b	2a	2b	1c	1d	2c	2d
Formaldehyde	0.001	0.003	0.043	0.045				
Acetaldehyde	0.002	0.002	0.006	0.009				
Acetone	0.022	0.005	0.198	0.212				
Glycolaldehyde	nd	nd	0.028	0.034				
Formic acid					0.013	0.014	0.052	0.074
Acetic acid					0.021	0.027	0.095	0.140

Table D.9. Airborne concentrations of primary VOCs (mg m^{-3}) measured in experiment 2C (GPC-1)

	sample ID							
species	Bag	1a	1b	1c	1d	2a	2b	2c
α-Terpinene	23	0.15	0.15	0.13	0.13	0.02	0.02	0.02
d-Limonene	192	1.24	1.32	1.28	1.27	1.09	1.07	1.12
p-Cymene	34	0.22	0.24	0.23	0.23	0.23	0.22	0.23
Eucalyptol	57	0.37	0.39	0.38	0.38	0.37	0.36	0.38
Terpinolene	221	1.54	1.56	1.40	1.42	1.03	0.95	0.99
α-Terpineol	95	0.63	0.67	0.66	0.66	0.78	0.74	0.76
γ-Terpineol	12	0.08	0.08	0.08	0.08	0.07	0.06	0.06

Table D.10. Airborne oxidation product concentrations (mg m^{-3}) measured in experiment 2C (GPC-1)

	sample ID							
species	1a	1b	2a	2b	1c	1d	2c	2d
Formaldehyde	0.001	0.001	0.044	0.045				
Acetaldehyde	0.002	0.007	0.008	0.009				
Acetone	0.012	0.020	0.206	0.218				
Glycolaldehyde	nd	nd	0.029	0.027				
Formic acid					0.017	0.040	0.048	0.054
Acetic acid					0.033	0.096	0.109	0.129

Table D.11. Airborne concentrations of primary VOCs concentrations (mg m^{-3}) measured in experiment 2D (GPC-1)

	sample ID								
species	Bag	1a	1b	1c	1d	2a	2b	2c	2d
α-Terpinene	20.15	0.14	0.12	0.14	0.12	0.04	0.04	0.04	0.03
d-Limonene	155.68	1.11	1.15	1.16	1.17	1.13	1.12	1.21	1.07
p-Cymene	26.33	0.19	0.20	0.21	0.21	0.21	0.21	0.22	0.20
Eucalyptol	47.63	0.33	0.25	0.24	0.35	0.33	0.35	0.38	0.34
Terpinolene	180.60	1.07	1.33	1.50	1.34	1.25	1.17	1.39	1.03
α-Terpineol	61.23	0.82	0.85	1.10	1.10	1.00	0.98	1.06	0.93
γ-Terpineol	7.55	0.11	0.10	0.14	0.14	0.11	0.10	0.11	0.09

Table D.12. Airborne oxidation product concentrations (mg m^{-3}) measured in experiment 2D (GPC-1)

	sample ID							
species	1a	1b	2a	2b	1c	1d	2c	2d
Formaldehyde	0.001	nd	0.016	0.017				
Acetaldehyde	0.002	nd	0.002	0.006				
Acetone	0.014	0.016	0.081	0.087				
Glycolaldehyde	nd	nd	0.012	0.013				
Formic acid					0.009	0.041	0.020	0.066
Acetic acid					0.022	0.114	0.045	0.107

Table D.13. Airborne concentrations of primary VOCs (mg m^{-3}) measured in experiment 2E (GPC-1)

	sample ID						
species	Bag	1a	1b	1c	2a	2b	2c
α-Terpinene	11.96	0.09	0.09	0.08	0.03	0.03	0.03
d-Limonene	153.66	1.11	1.14	1.14	1.07	1.09	1.09
p-Cymene	36.22	0.27	0.27	0.28	0.27	0.27	0.28
Eucalyptol	45.52	0.33	0.34	0.34	0.33	0.33	0.34
Terpinolene	88.34	0.71	0.74	0.72	0.63	0.65	0.64
α-Terpineol	109.64	0.52	0.72	0.72	0.72	0.82	0.80
γ-Terpineol	11.60	0.05	0.07	0.07	0.06	0.08	0.07

Table D.14. Airborne oxidation product concentrations (mg m^{-3}) measured in experiment 2E (GPC-1)

	sample ID							
species	1a	1b	2a	2b	1c	1d	2c	2d
Formaldehyde	0.001	0.003	0.007	0.007				
Acetaldehyde	0.002	0.007	0.002	0.004				
Acetone	0.039	0.060	0.062	0.073				
Glycolaldehyde	nd	nd	0.008	0.008				
Formic acid					0.008	0.026	0.035	0.012
Acetic acid					0.018	0.044	0.025	0.029

Table D.15. Airborne d-limonene concentrations (mg m^{-3}) measured in experiment 2F (GPD-1).

sample ID	d-Limonene
Bag	951.90
1a	3.71
1b	3.60
1c	3.56
1d	3.43
2a	2.84
2b	2.84
2c	2.88
2d	2.95

Table D.16. Airborne oxidation product concentrations (mg m^{-3}) measured in experiment 2F (GPD-1)

	sample ID							
species	1a	1b	2a	2b	1c	1d	2c	2d
Formaldehyde	0.001	0.001	0.041	0.040				
Acetaldehyde	0.002	0.004	0.002	0.004				
Acetone	0.003	0.007	0.009	0.014				
Glycolaldehyde	nd	nd	0.005	0.008				
Formic acid					0.013	0.024	0.039	0.053
Acetic acid					0.028	0.055	0.070	0.113

Table D.17. Airborne d-limonene concentrations (mg m^{-3}) measured in experiment 2G (GPD-1).

sample ID	d-Limonene
Bag	371.40
1a	4.09
1b	4.01
1c	4.19
1d	4.14
2a	3.49
2b	3.35
2c	3.08
2d	3.33
2e	3.12

Table D.18. Airborne oxidation product concentrations (mg m^{-3}) measured in experiment 2G (GPD-1)

	sample ID							
species	1a	1b	2a	2b	1c	1d	2c	2d
Formaldehyde	<0.001	0.003	0.045	0.047				
Acetaldehyde	0.002	0.008	0.007	0.009				
Acetone	0.005	0.017	0.016	0.019				
Glycolaldehyde	nd	nd	0.008	0.010				
Formic acid					0.014	0.043	0.047	0.082
Acetic acid					0.039	0.101	0.099	0.195

Table D.19. Airborne d-limonene concentrations (mg m^{-3}) measured in experiment 2H (GPD-1).

sample ID	d-Limonene
Bag	585.6
1a	3.23
1b	3.26
1c	3.27
2a	2.99
2b	2.96
2c	2.92
2d	2.87

Table D.20. Airborne oxidation product concentrations (mg m^{-3}) measured in experiment 2H (GPD-1)

	sample ID							
species	1a	1b	2a	2b	1c	1d	2c	2d
Formaldehyde	<0.001	0.001	0.016	0.017				
Acetaldehyde	0.003	0.012	0.002	0.005				
Acetone	0.006	0.016	0.007	0.016				
Glycolaldehyde	nd	nd	0.003	0.005				
Formic acid					0.012	0.037	0.023	0.039
Acetic acid					0.032	0.090	0.039	0.122

Table D.21. Airborne concentrations of primary VOCs (mg m^{-3}) measured in experiment 2I (AFR-1)

	sample ID							
species	1a	1b	1c	2a	2b	2c	2d	2e
d-Limonene	0.57	0.57	0.56	0.45	0.49	0.48	0.50	0.48
Linalool	0.94	0.94	0.92	0.66	0.72	0.71	0.74	0.71
Linalyl acetate	0.35	0.46	0.51	0.38	0.39	0.42	0.40	0.47
Dihydromyrcenol	1.30	1.30	1.28	1.39	1.49	1.47	1.52	1.49
Phenylethyl alcohol	0.66	0.68	0.67	0.76	0.83	0.82	0.83	0.82
Benzyl acetate	1.54	1.54	1.52	1.71	1.83	1.80	1.86	1.81
β-citronellol	0.10	0.11	0.10	0.07	0.07	0.08	0.08	0.07

Table D.22. Airborne oxidation product concentrations (mg m^{-3}) measured in experiment 2I (AFR-1)

	sample ID							
species	1a	1b	2a	2b	1c	1d	2c	2d
Formaldehyde	0.001	nd	0.051	0.052				
Acetaldehyde	0.012	0.019	0.014	0.017				
Acetone	0.010	0.014	0.134	0.087				
Glycolaldehyde	nd	nd	0.031	0.033				
Formic acid					0.013	0.041	0.070	0.076
Acetic acid					0.358	0.446	0.454	0.529

Table D.23. Airborne concentrations if primary VOCs (mg m^{-3}) measured in experiment 2J (AFR-1)

	sample ID								
species	1a	1b	1c	2a	2b	2c	2d	2e	2f
d-Limonene	0.63	0.63	0.62	0.74	0.67	0.79	0.79	0.42	0.51
Linalool	1.06	1.08	1.05	1.03	0.94	1.07	1.11	0.63	0.72
Linalyl acetate	0.43	0.51	0.51	0.51	0.43	0.64	0.80	0.32	0.49
Dihydromyrcenol	1.46	1.48	1.45	2.29	2.07	2.41	2.48	1.33	1.58
Phenylethyl alcohol	0.73	0.73	0.71	1.18	1.05	1.27	1.31	0.66	0.83
Benzyl acetate	1.74	1.76	1.73	2.91	2.66	3.06	3.17	1.70	2.02
β-citronellol	0.10	0.11	0.10	0.10	0.09	0.10	0.11	0.06	0.08

Table D.24. Airborne oxidation product concentrations (mg m^{-3}) measured in experiment 2J (AFR-1)

	sample ID					
species	1a	1b	2a	2b	1c	2c
Formaldehyde	0.002	0.005	0.142	0.138		
Acetaldehyde	0.009	0.012	0.034	0.034		
Acetone	0.026	0.032	0.255	0.252		
Glycolaldehyde	nd	nd	0.078	0.080		
Formic acid					0.032	0.159
Acetic acid					0.407	0.613

Table D.25. Airborne concentrations of primary VOCs (mg m^{-3}) measured in experiment 2K (AFR-1)

	sample ID									
species	1a	1b	1c	1d	1e	2a	2b	2c	2d	2e
d-Limonene	0.52	0.51	0.53	0.51	0.53	0.45	0.42	0.52	0.47	0.47
Linalool	0.93	0.93	0.95	0.91	0.94	0.82	0.78	0.96	0.84	0.87
Linalyl acetate	0.36	0.46	0.40	0.36	0.41	0.43	nd	0.53	0.42	0.49
Dihydromyrcenol	1.34	1.33	1.38	1.32	1.37	1.40	1.32	1.61	1.45	1.48
Phenylethyl alcohol	0.66	0.66	0.66	0.65	0.67	0.74	0.67	0.86	0.76	0.78
Benzyl acetate	1.47	1.48	1.52	1.46	1.52	1.64	1.64	1.87	1.69	1.74
β-citronellol	0.11	0.11	0.10	0.10	0.10	0.09	0.07	0.10	0.09	0.09

Table D.26. Airborne oxidation product concentrations (mg m^{-3}) measured in experiment 2K (AFR-1)

	sample ID							
species	1a	1b	2a	2b	1c	1d	2c	2d
Formaldehyde	<0.001	0.001	0.025	0.016				
Acetaldehyde	0.014	0.015	0.011	0.012				
Acetone	0.010	0.015	0.046	0.045				
Glycolaldehyde	nd	nd	0.016	0.018				
Formic acid					0.015	0.038	0.046	0.059
Acetic acid					0.322	0.504	0.295	0.501

Table D.27. Airborne concentrations of primary VOCs (mg m^{-3}) measured in experiment 2L (GPC-1)

	sample ID (time)					
species	1a (0.2 h)	1b (1.6 h)	1c (3 h)	1d (20 h)	1e (24 h)	1f (25 h)
α-Terpinene	nd	nd	nd	nd	nd	nd
d-Limonene	nd	nd	nd	nd	nd	nd
p-Cymene	nd	nd	nd	nd	nd	nd
Eucalyptol	nd	nd	nd	nd	nd	nd
Terpinolene	nd	nd	nd	nd	nd	nd
α-Terpineol	5.8	6.9	2.2	< 0.01	< 0.01	< 0.01
γ-Terpineol	0.55	0.69	0.09	n.d.	nd	nd

Table D.28. Oxidation product concentrations (μg m^{-3}) measured in experiment 2L (GPC-1)

	sample ID (time)	
species	1a (0-3 h)	1b (0-3 h)
Formaldehyde	5.27	6.11
Acetaldehyde	1.03	2.12
Acetone	22.7	24.4
Glycolaldehyde	3.18	3.78

Table D.29. Airborne oxidation product concentrations (μg m^{-3}) measured in experiment 2N (GPD-1)

	sample ID (time)
species	1a (0-4 h)
Formaldehyde	4.03
Acetaldehyde	5.12
Acetone	26.1
Glycolaldehyde	nd

Table D.30. Airborne concentrations of primary VOCs (mg m^{-3}) measured in experiment 2O (GPC-1).

	sample ID									
species	Bag	1a	1b	1c	1d	2a	2b	2c	2d	2e
α-Terpinene	11.96	0.14	0.12	0.12	0.11	0.01	0.01	0.01	0.01	0.01
d-Limonene	153.66	1.27	1.32	1.27	1.28	1.02	1.03	1.03	1.06	1.13
p-Cymene	36.22	0.26	0.27	0.25	0.26	0.24	0.24	0.24	0.25	0.26
Eucalyptol	45.52	0.38	0.40	0.38	0.38	0.35	0.36	0.36	0.37	0.38
Terpinolene	88.34	1.54	1.40	1.40	1.33	0.87	0.88	0.84	0.72	0.92
α-Terpineol	109.64	1.08	1.11	1.09	1.11	1.03	1.02	1.00	1.02	1.09
γ-Terpineol	11.6	0.13	0.13	0.13	0.13	0.08	0.08	0.08	0.08	0.09

Table D.31. Airborne oxidation product concentrations (mg m^{-3}) measured in experiment 2O (GPC-1)

	sample ID							
species	1a	1b	2a	2b	1c	1d	2c	2d
Formaldehyde	0.001	0.001	0.037	0.036				
Acetaldehyde	0.001	0.001	0.027	0.028				
Acetone	0.035	0.023	0.196	0.194				
Glycolaldehyde	0.006	nd	0.031	0.035				
Formic acid					0.005	0.028	0.043	0.037
Acetic acid					0.004	0.000	0.085	0.110

Table D.32. Summary of ozone concentration data from experiments in bench-scale chamber.

Experiment	Product	Ozone concentration (ppb)	
		Supply	Chamber
2A	GPC-1	253 ± 4	24 ± 5
2B	GPC-1	131 ± 4	12 ± 3
2C	GPC-1	130 ± 13	8 ± 3
2D	GPC-1	65 ± 2	2 ± 1
2E	GPC-1	29 ± 1	0 ± 2
2F	GPD-1	137 ± 9	18 ± 4
2G	GPD-1	136 ± 7	4 ± 3
2H	GPD-1	61 ± 2	9 ± 2
2I	AFR-1	126 ± 6	15 ± 5
2J	AFR-1	127 ± 5	2 ± 2
2K	AFR-1	63 ± 0.5	5 ± 4
2L	GPC-1	118 ± 2	[a]
2M	AFR-1	114 ± 2	[a]
2N	GPD-1	122 ± 2	[a]
2O	GPC-1	139 ± 2	8 ± 3

[a] Chamber concentrations decreased initially as a consequence of the introduction of the dry residue applied on a surface, and subsequently increased to approach inlet values.

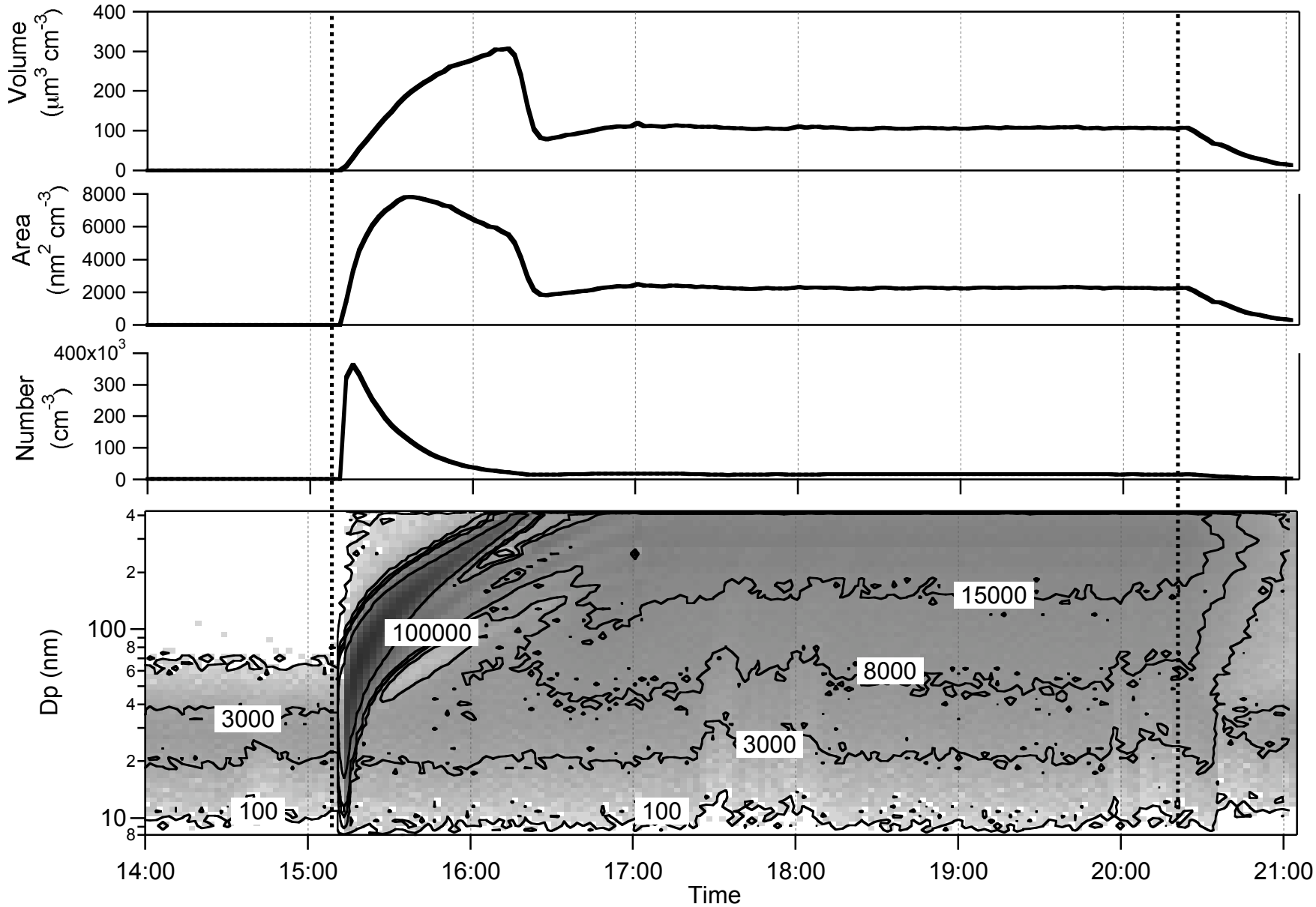
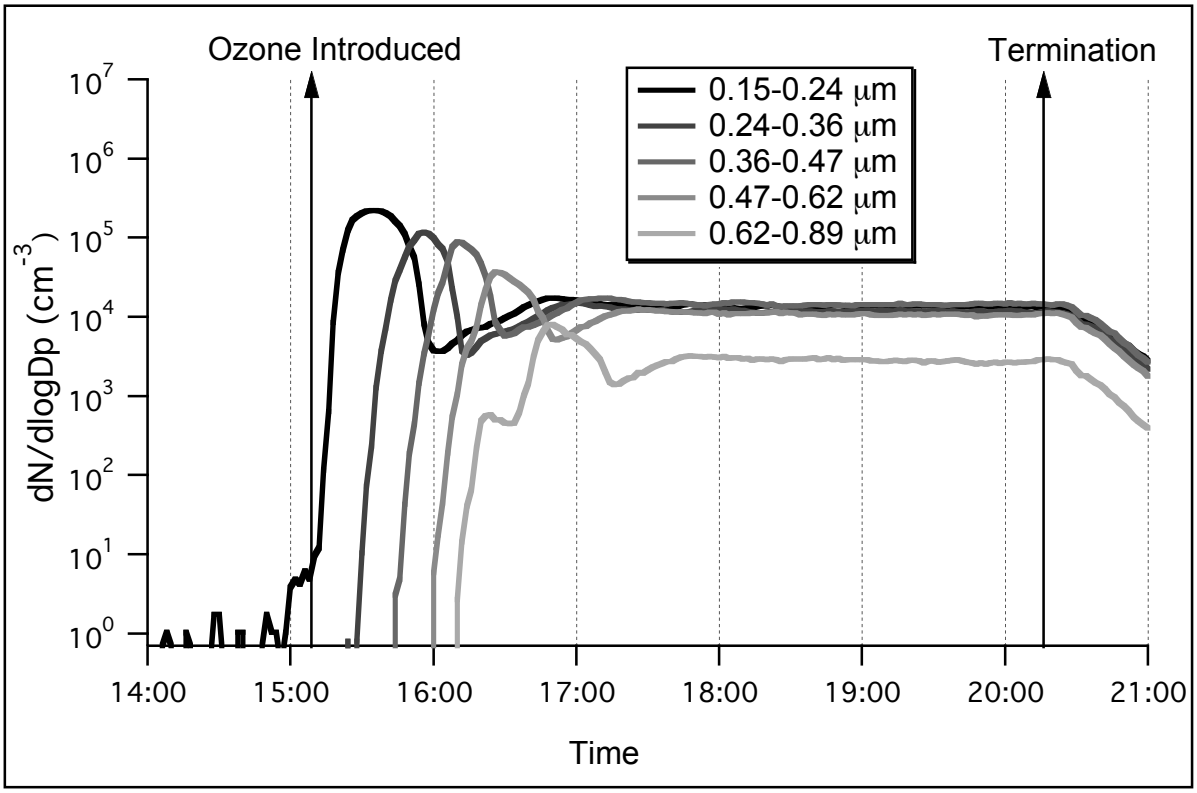


Figure D.1. SMPS measurements of secondary organic aerosol particles generated in the reaction of GPC-1 with very high ozone levels (253 ppb in supply air) at 3 ach (Expt 2A).



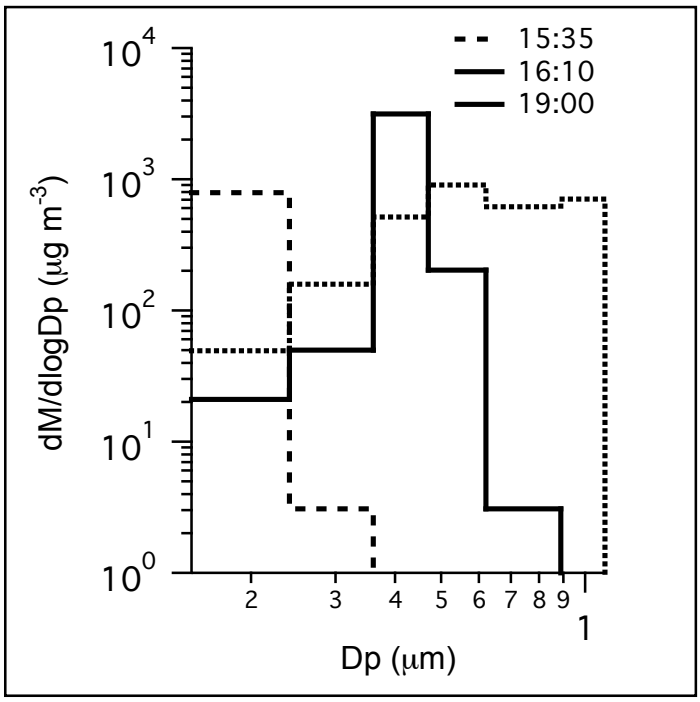


Figure D.2. OPC measurements of secondary organic aerosol particles generated in the reaction of GPC-1 with very high ozone levels (253 ppb in supply air) at 3 ach (Expt 2A).

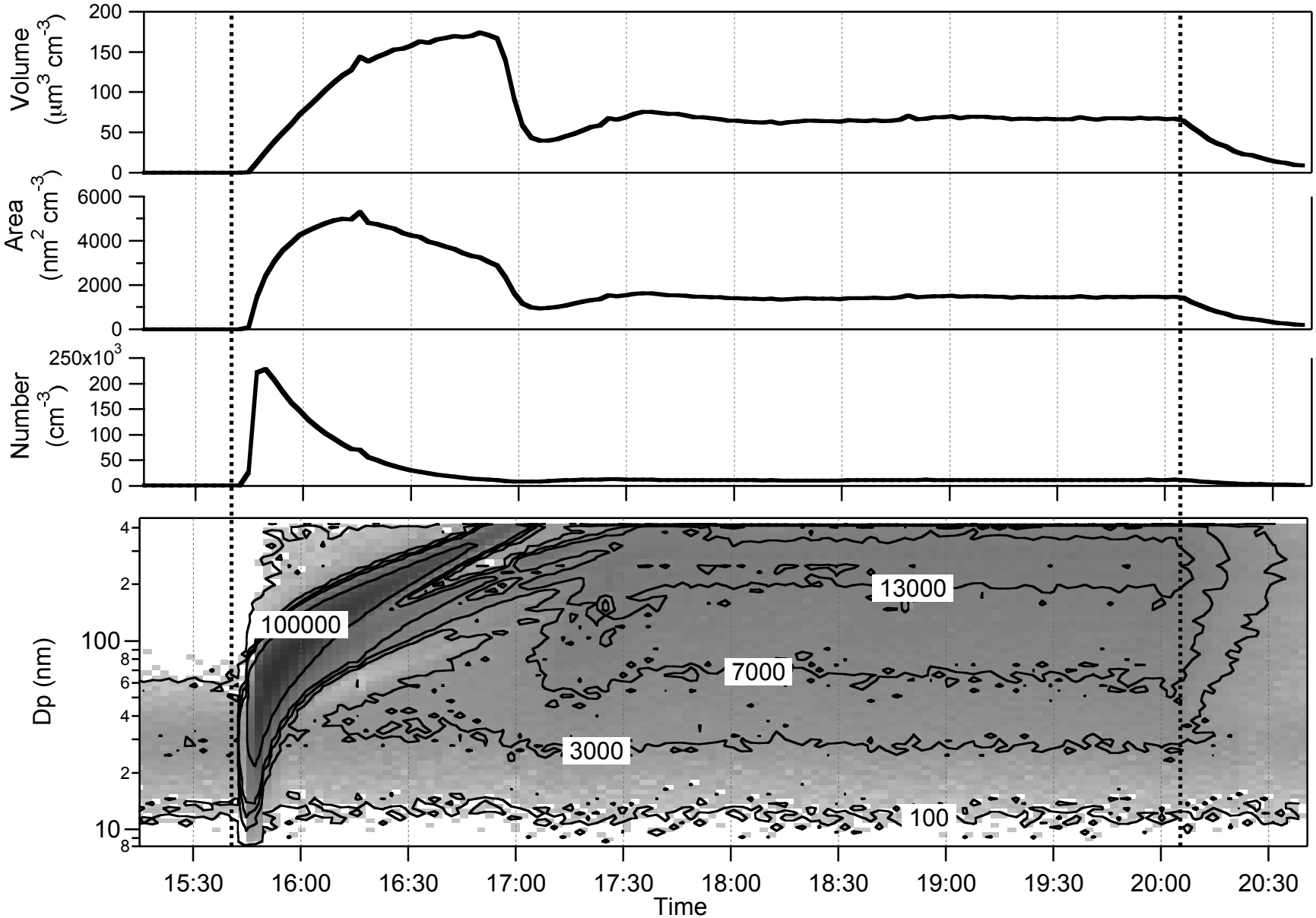
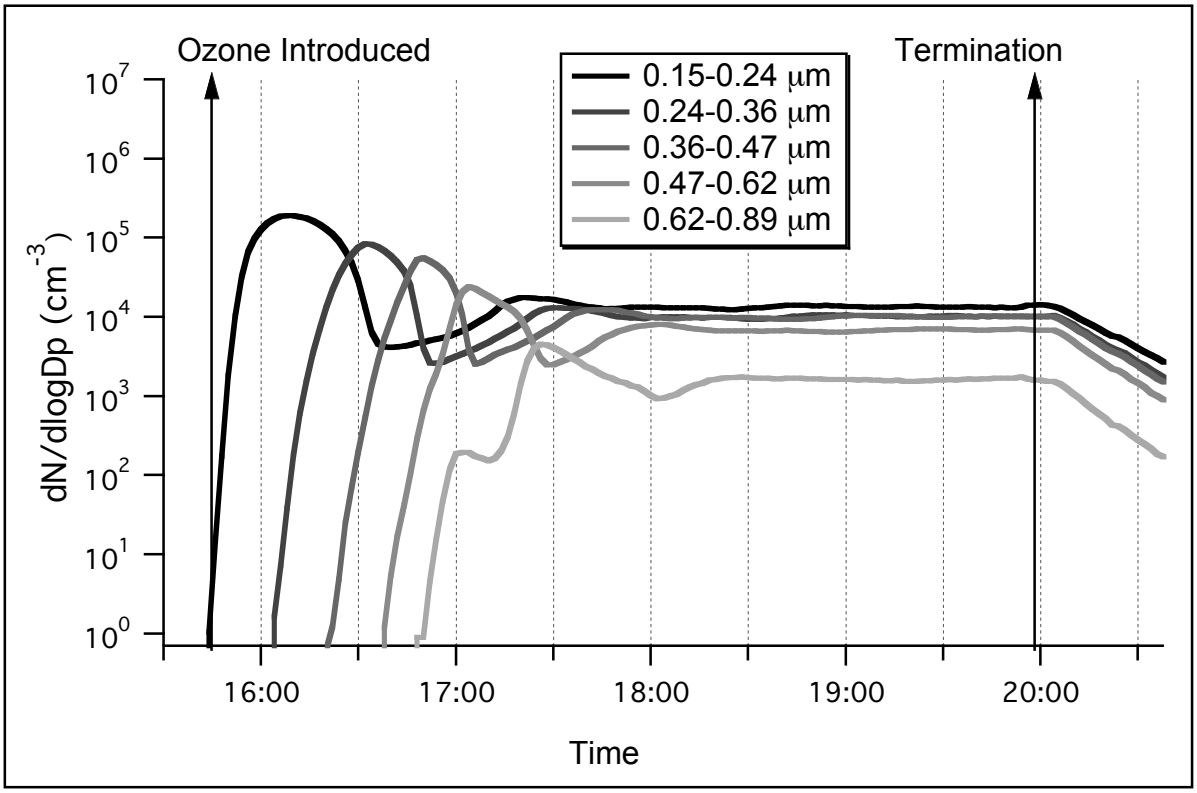


Figure D.3. SMPS measurements of secondary organic aerosol particles generated in the reaction of GPC-1 with high ozone levels (131 ppb in supply air) at 3 ach (Expt 2B).



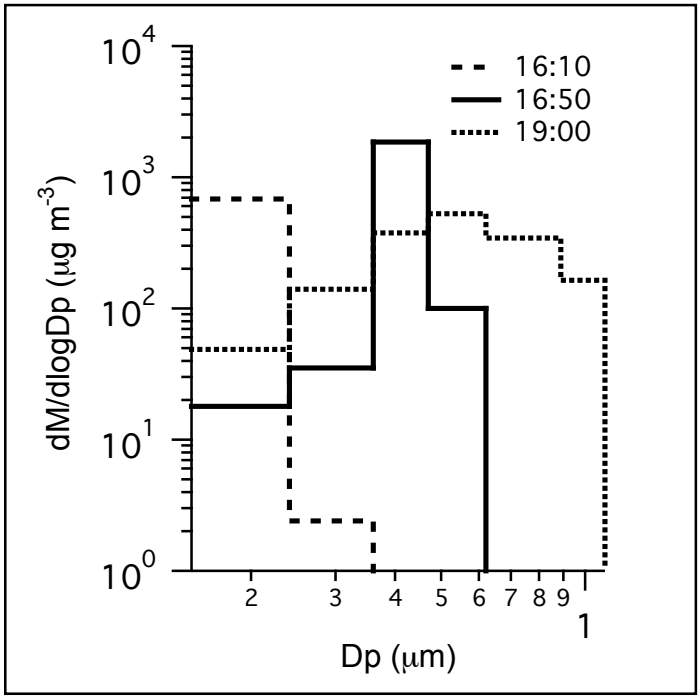


Figure D.4. OPC measurements of secondary organic aerosol particles generated in the reaction of GPC-1 with high ozone levels (131 ppb in supply air) at 3 ach (Expt 2B).

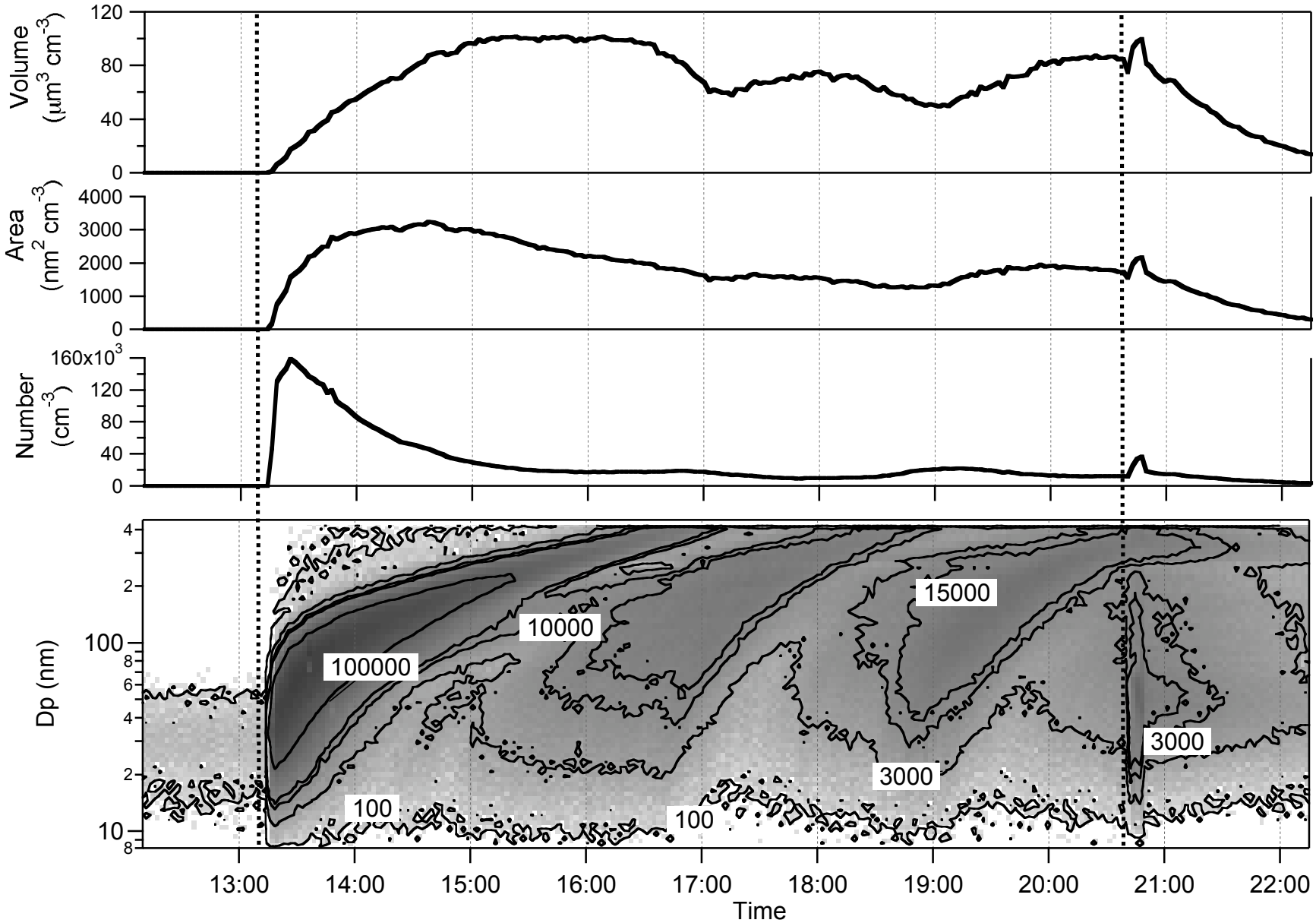


Figure D.5. SMPS measurements of secondary organic aerosol particles generated in the reaction of GPC-1 with high ozone levels (130 ppb in supply air) at 1 ach (Expt 2C).

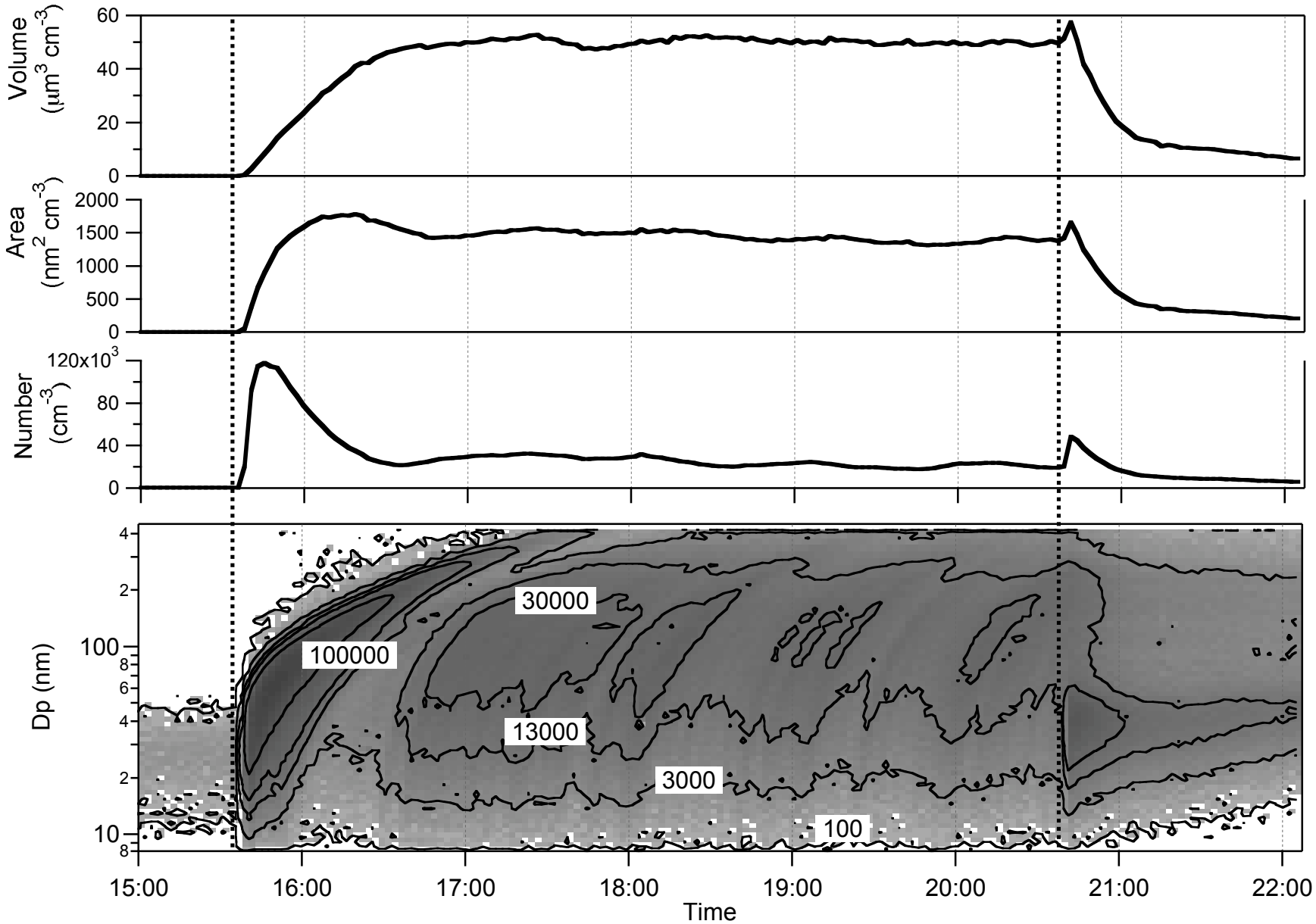


Figure D.6. SMPS measurements of secondary organic aerosol particles generated in the reaction of GPC-1 with moderate ozone levels (65 ppb in supply air) at 3 ach (Expt 2D).

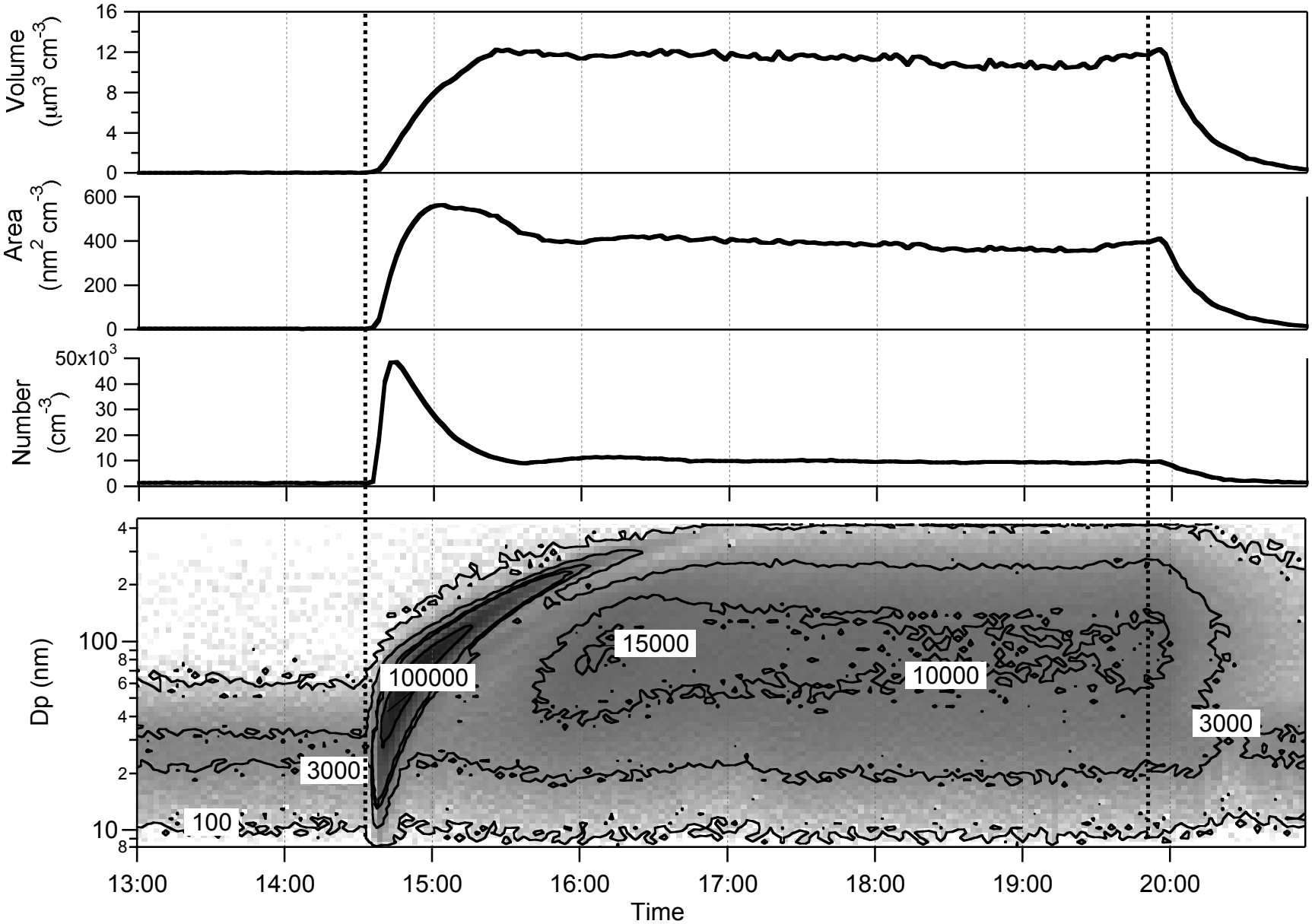
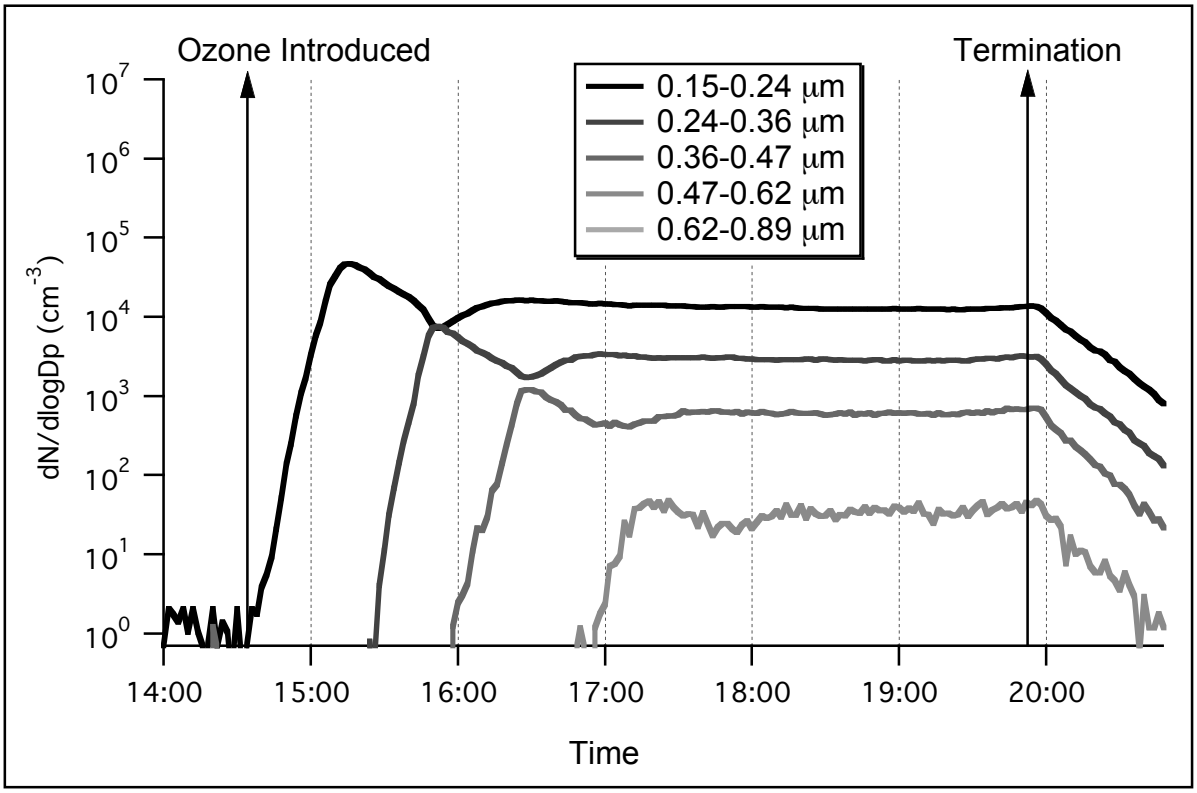


Figure D.7. SMPS measurements of secondary organic aerosol particles generated in the reaction of GPC-1 with low ozone levels (29 ppb in supply air) at 3 ach (Expt 2E).



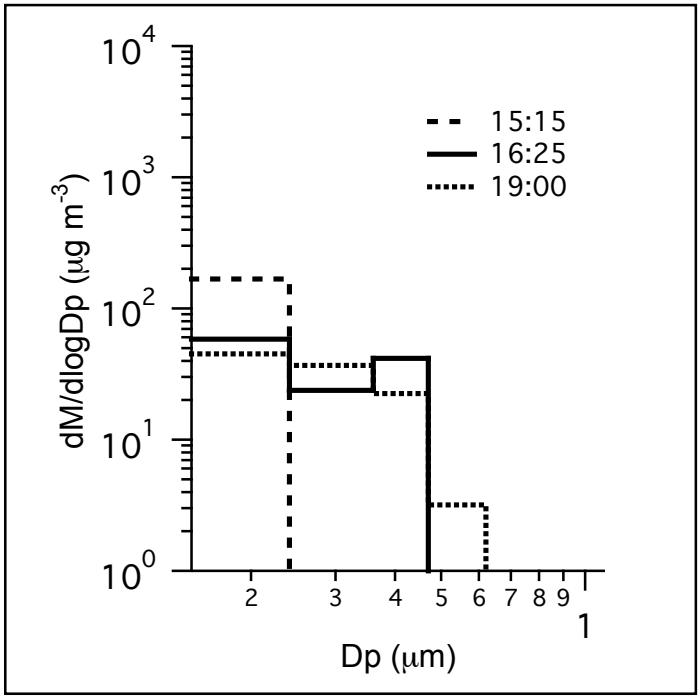


Figure D.8. OPC measurements of secondary organic aerosol particles generated in the reaction of GPC-1 with low ozone levels (29 ppb in supply air) at 3 ach (Expt 2E).

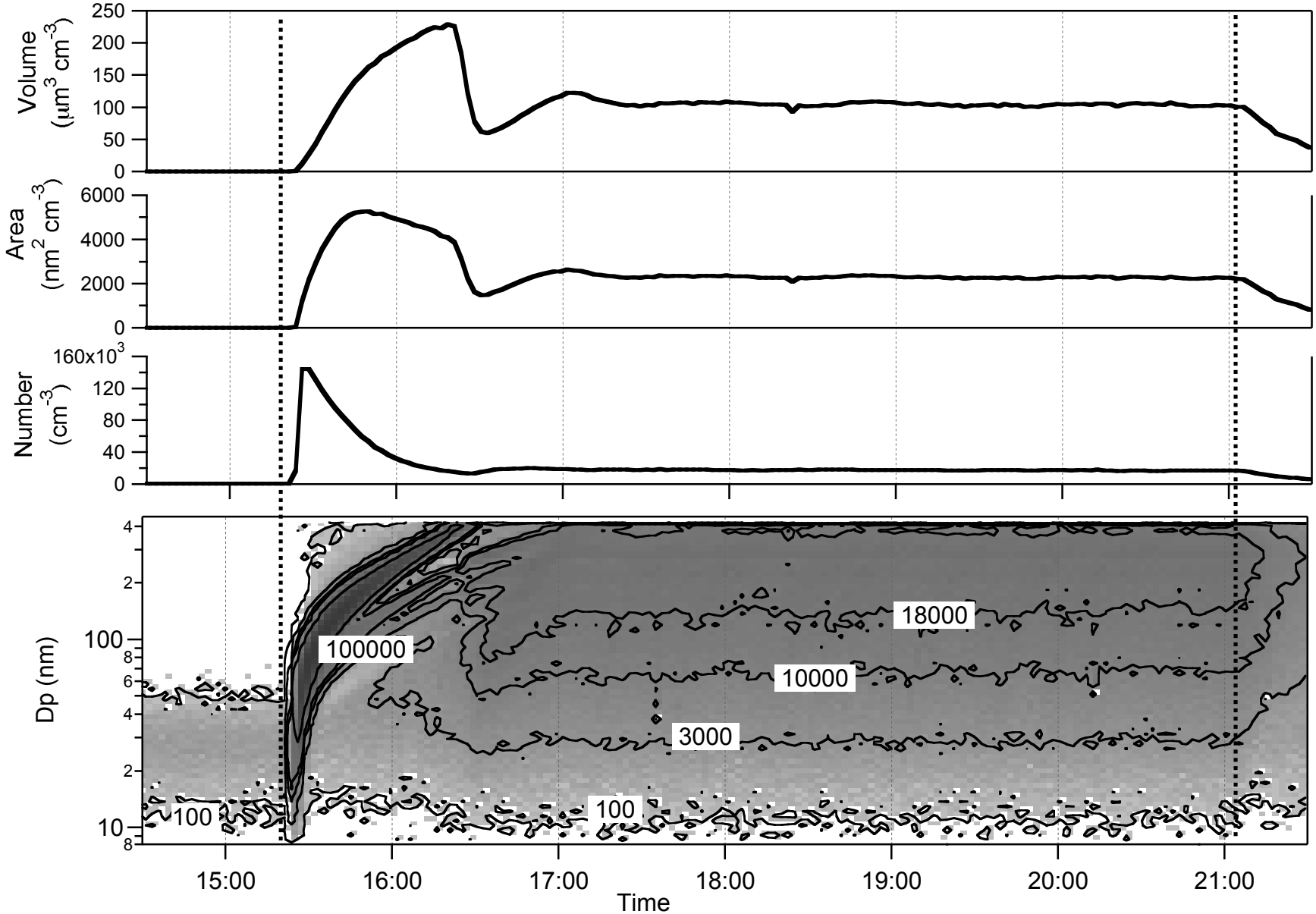


Figure D.9. SMPS measurements of secondary organic aerosol particles generated in the reaction of GPD-1 with high ozone levels (137 ppb in supply air) at 3 ach (Expt 2F).

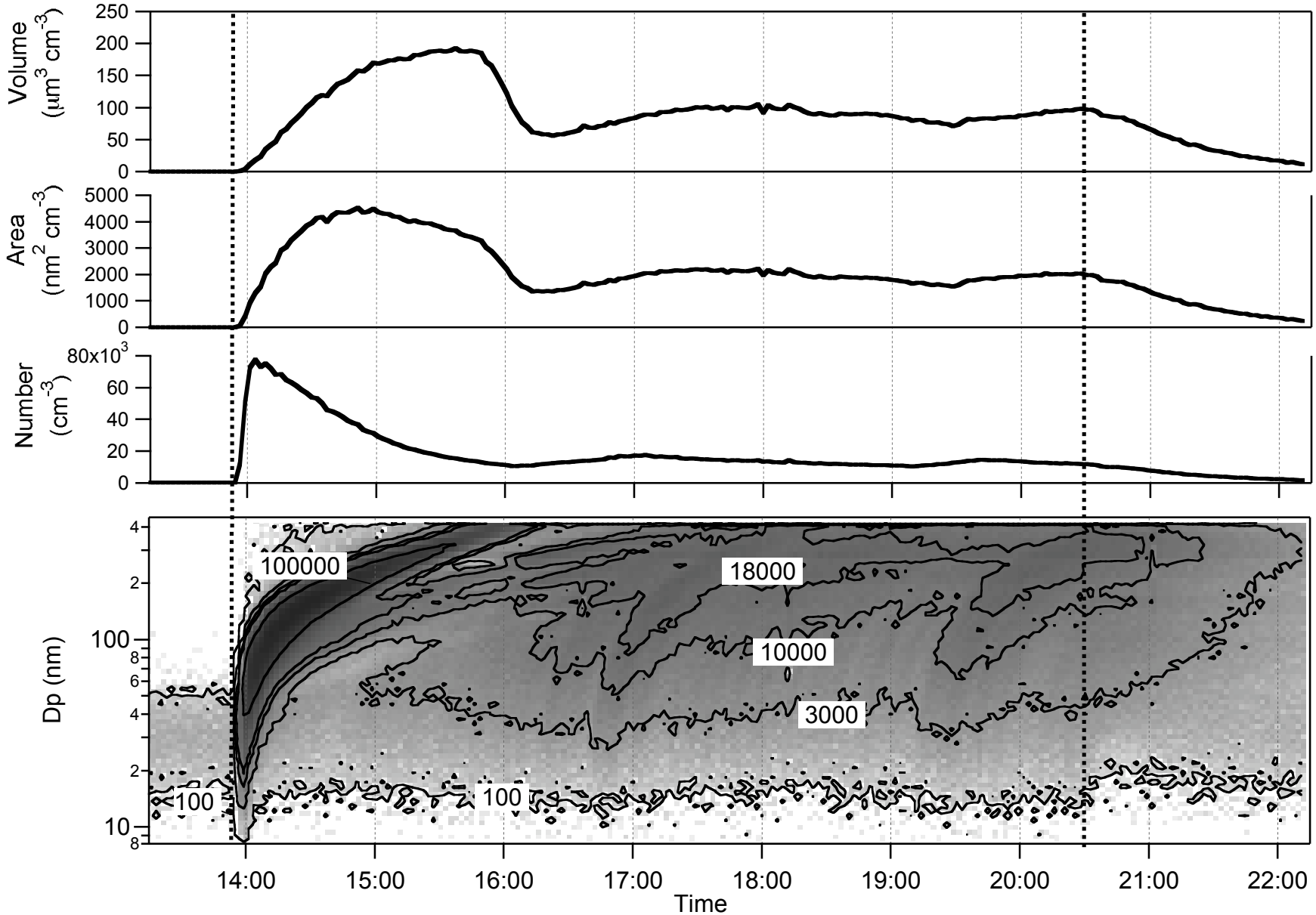


Figure D.10. SMPS measurements of secondary organic aerosol particles generated in the reaction of GPD-1 with high ozone levels (136 ppb in supply air) at 1 ach (Expt 2G).

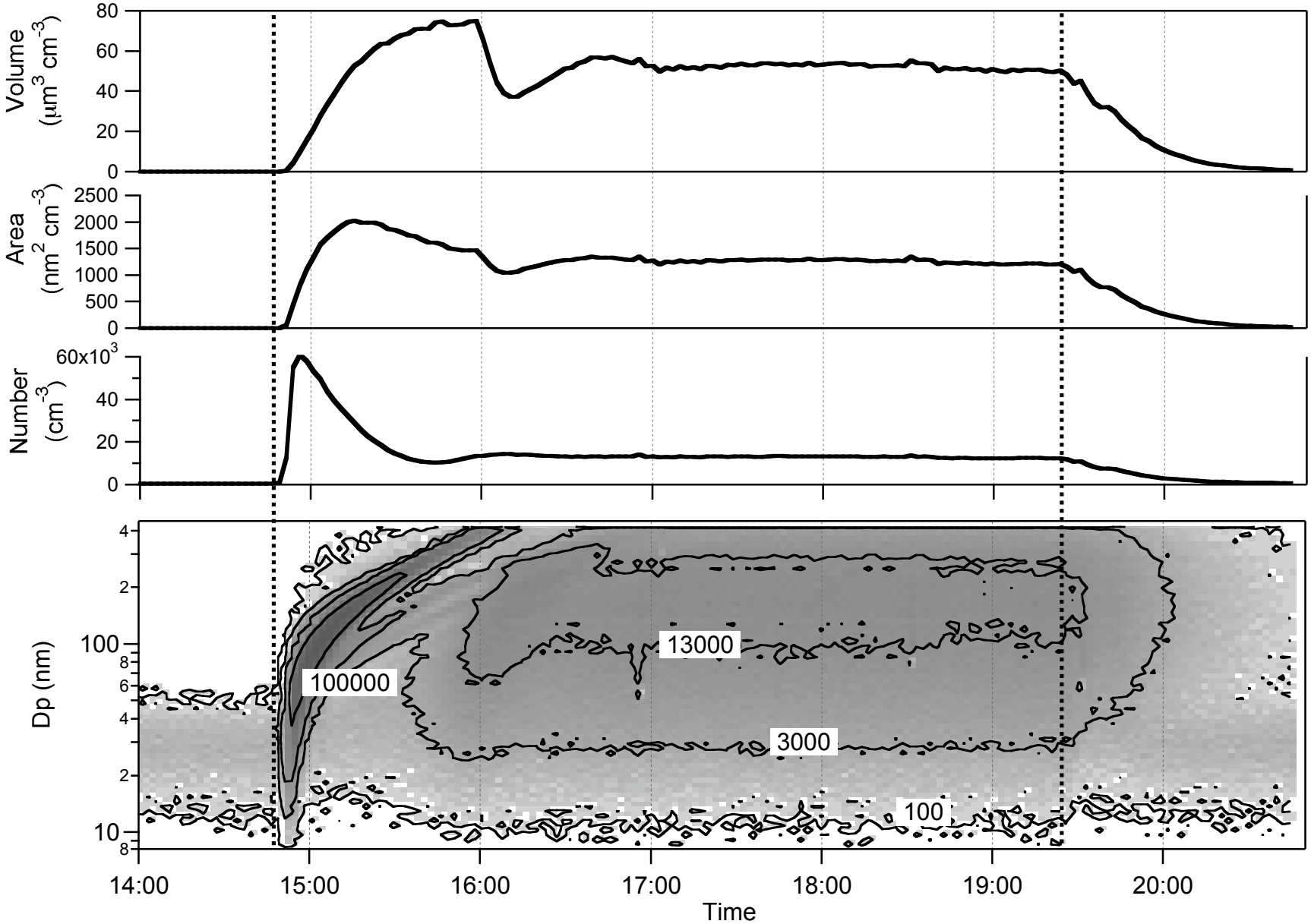


Figure D.11. SMPS measurements of secondary organic aerosol particles generated in the reaction of GPD-1 with moderate ozone levels (63 ppb in supply air) at 3 ach (Expt 2H).

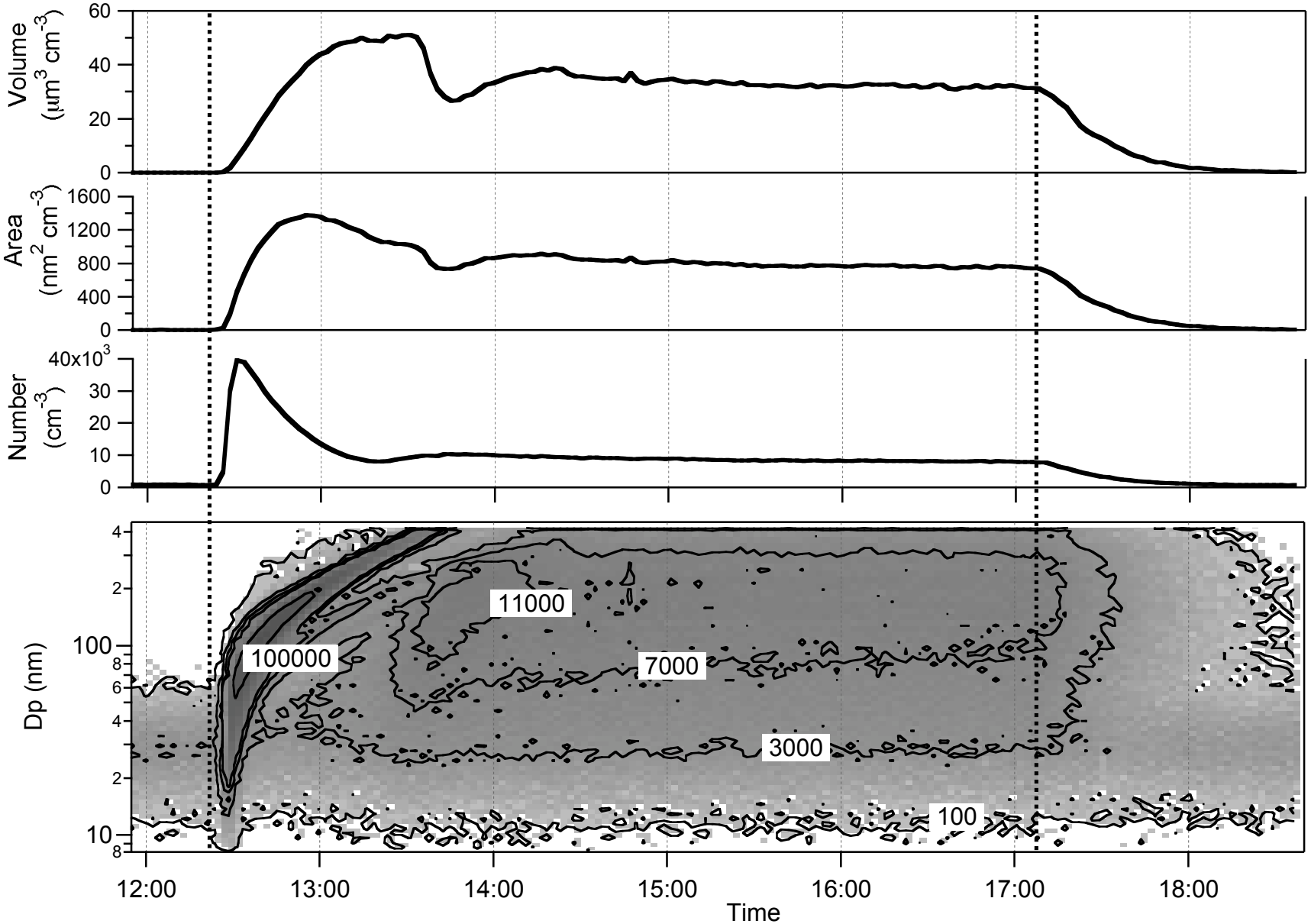
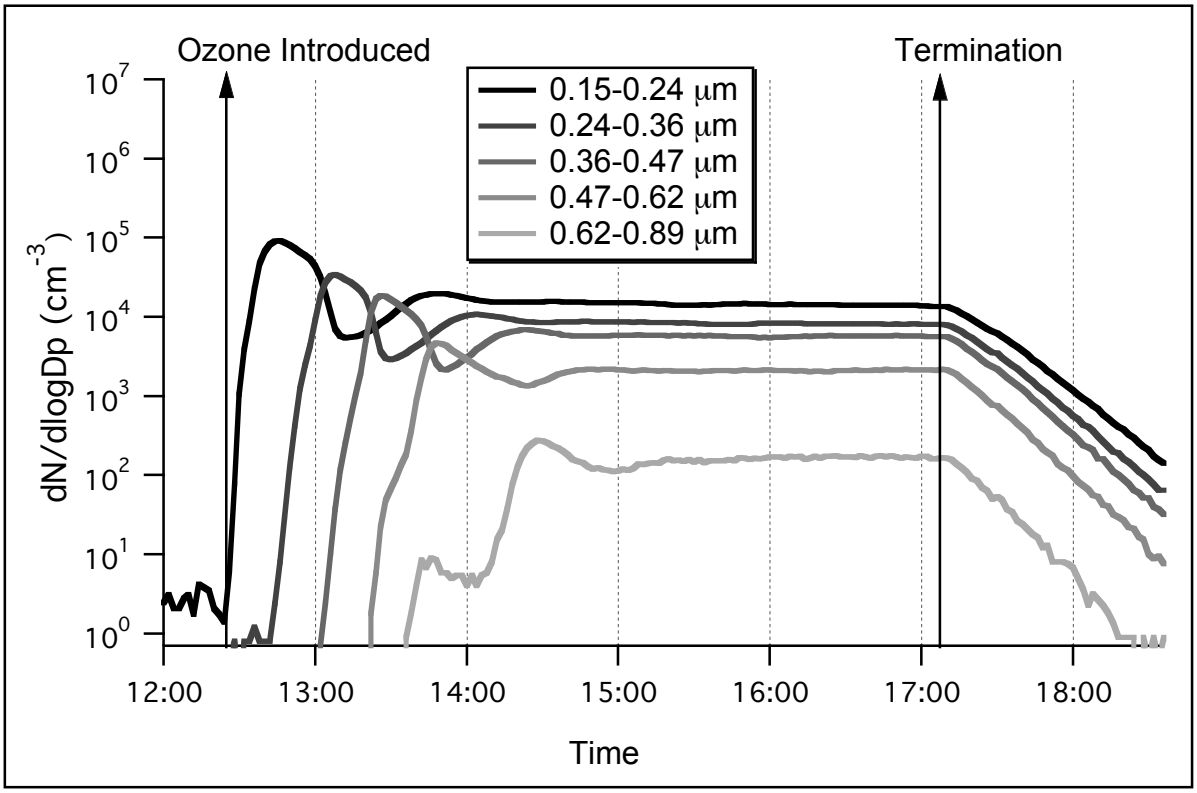


Figure D.12. SMPS measurements of secondary organic aerosol particles generated in the reaction of AFR-1 with high ozone levels (126 ppb in supply air) at 3 ach (Expt 2I).



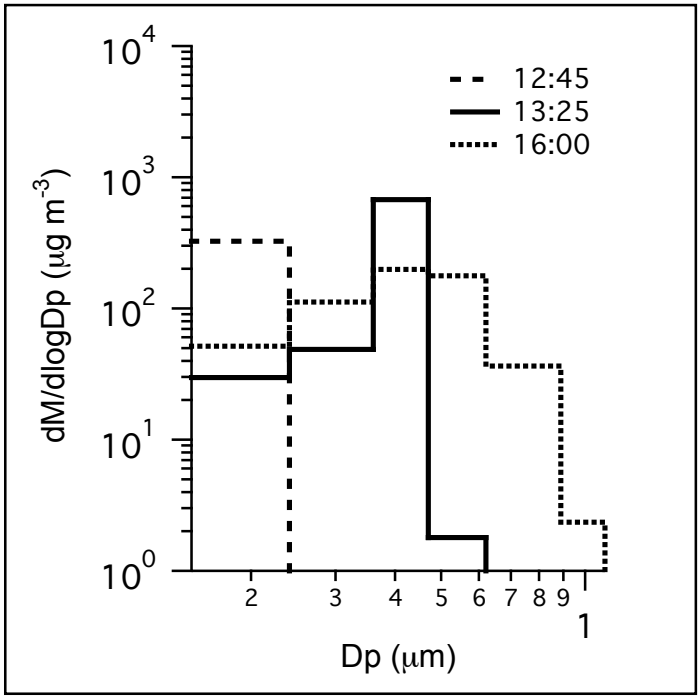


Figure D.13. OPC measurements of secondary organic aerosol particles generated in the reaction of AFR-1 with high ozone levels (126 ppb in supply air) at 3 ach (Expt 2I).

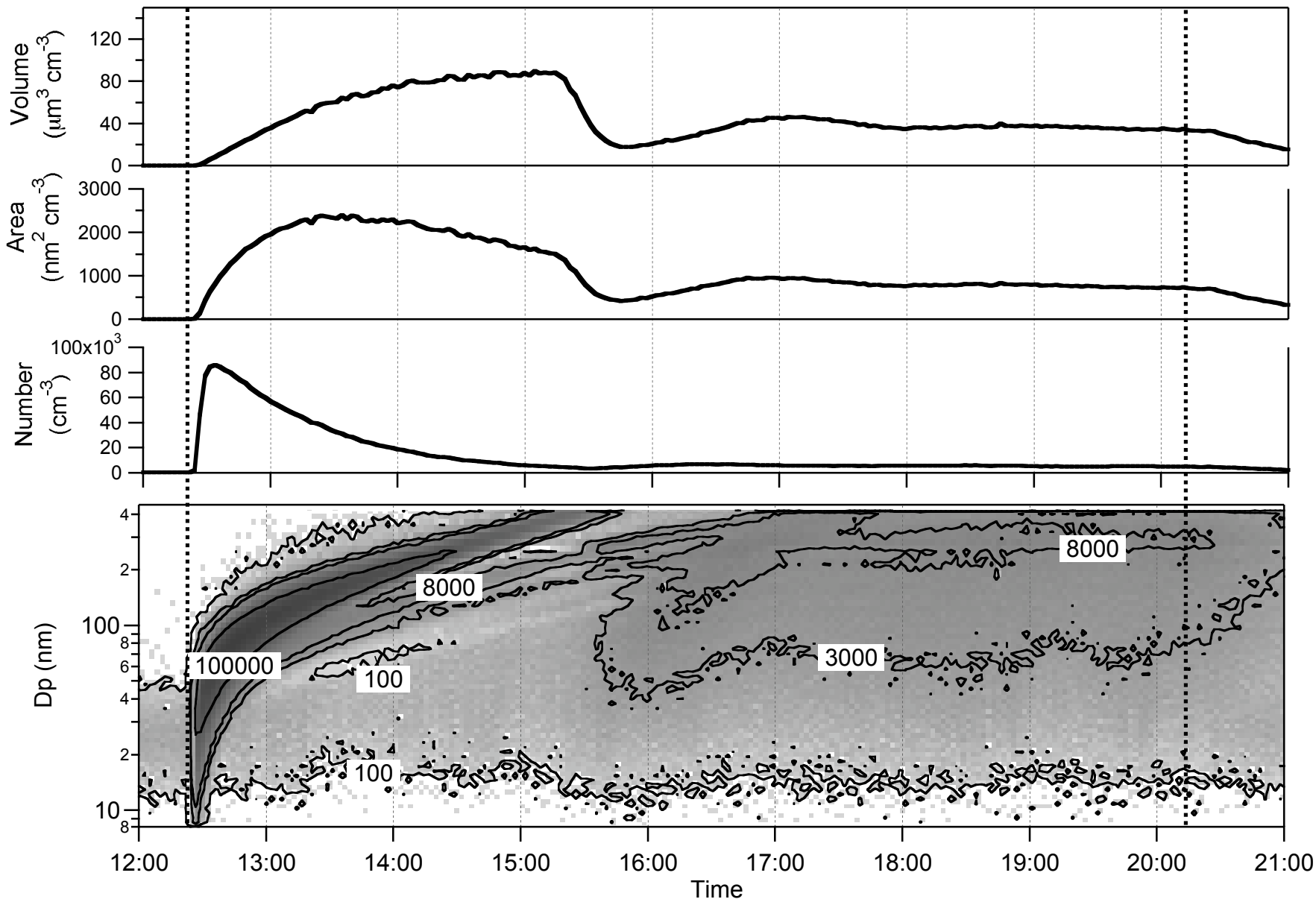
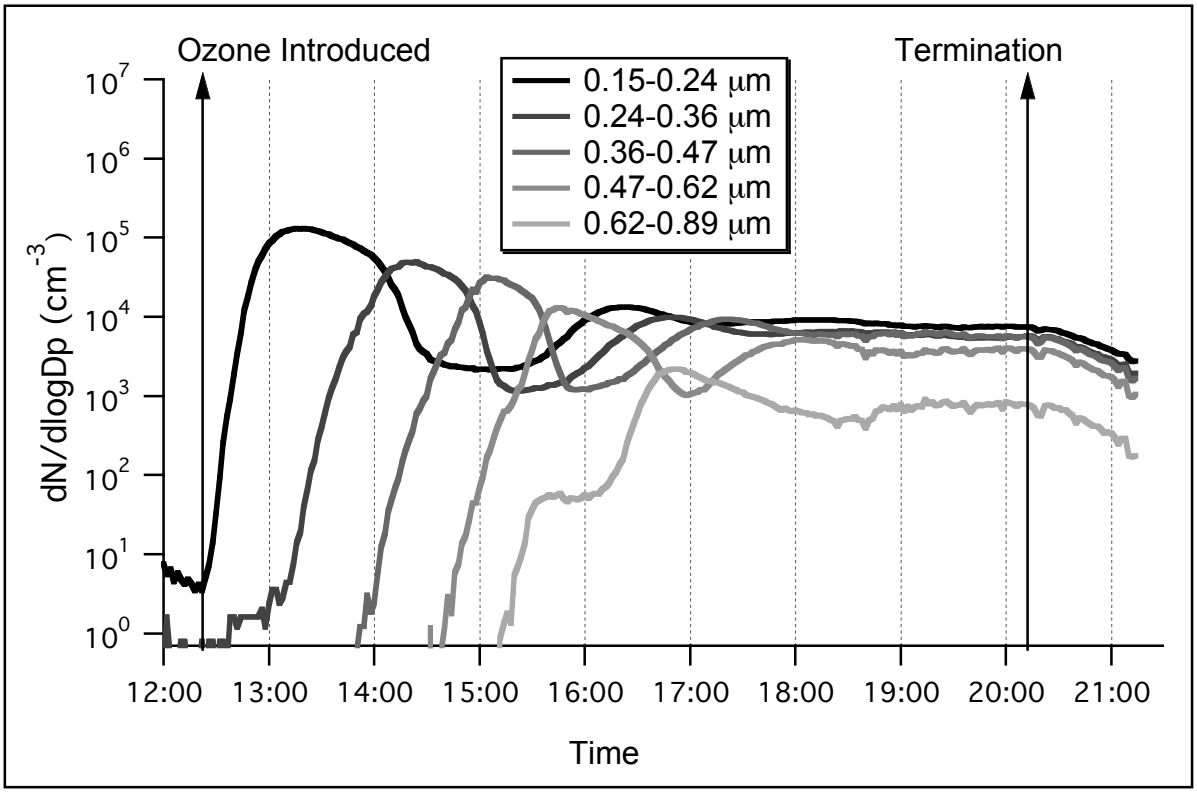


Figure D.14. SMPS measurements of secondary organic aerosol particles generated in the reaction of AFR-1 with high ozone levels (127 ppb in supply air) at 1 ach (Expt 2J).



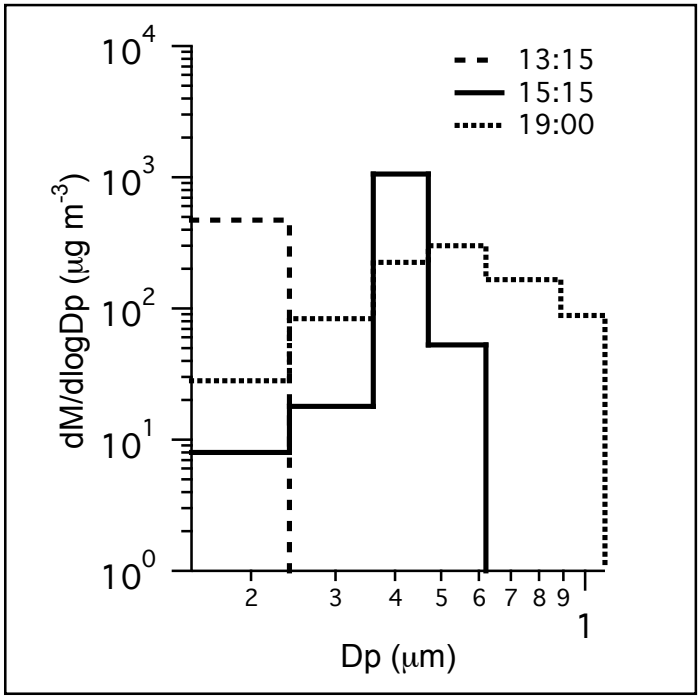


Figure D.15. OPC measurements of secondary organic aerosol particles generated in the reaction of AFR-1 with high ozone levels (127 ppb in supply air) at 1 ach (Expt 2J).

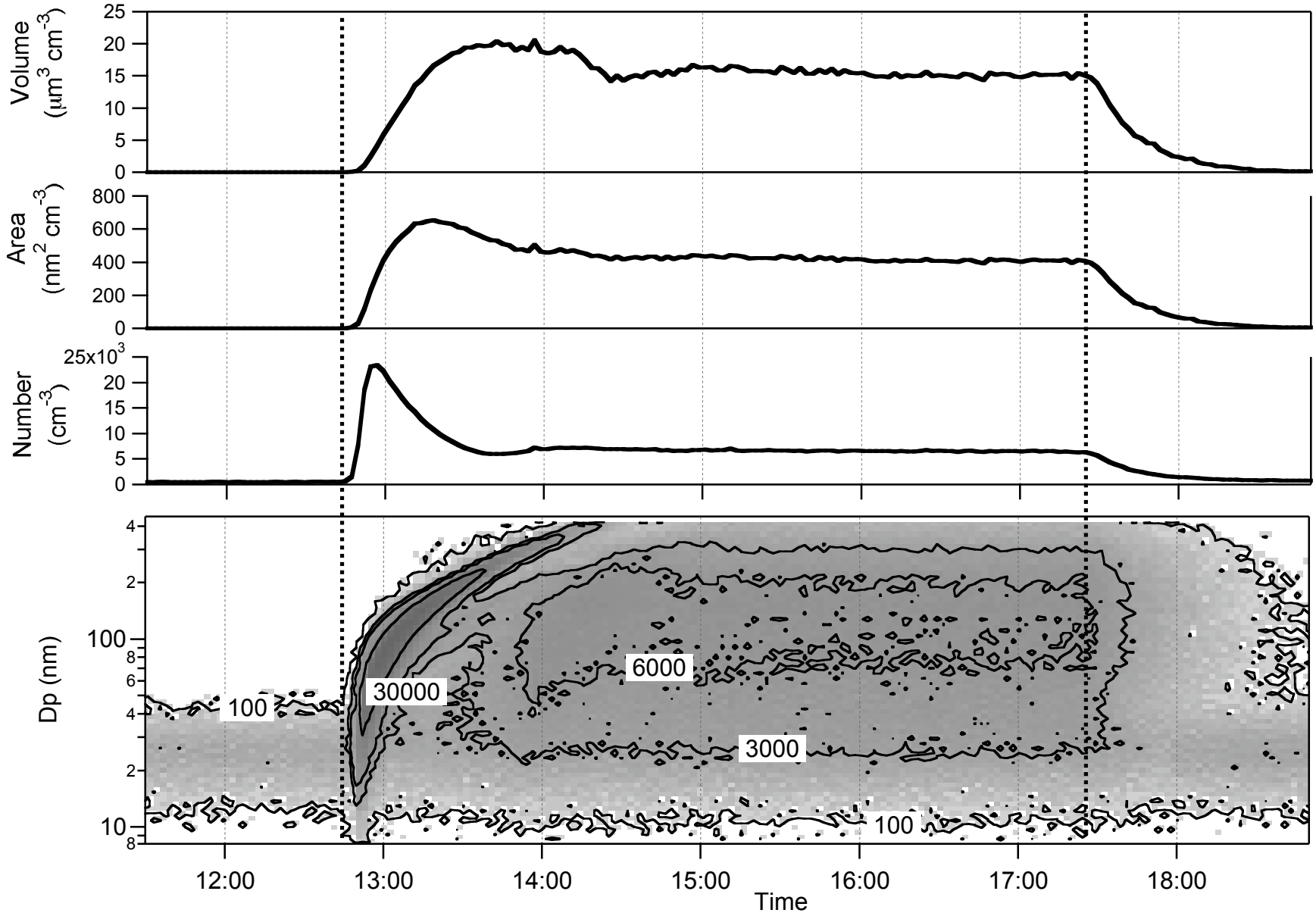


Figure D.16. SMPS measurements of secondary organic aerosol particles generated in the reaction of AFR-1 with moderate ozone levels (63 ppb in supply air) at 3 ach (Expt 2K).

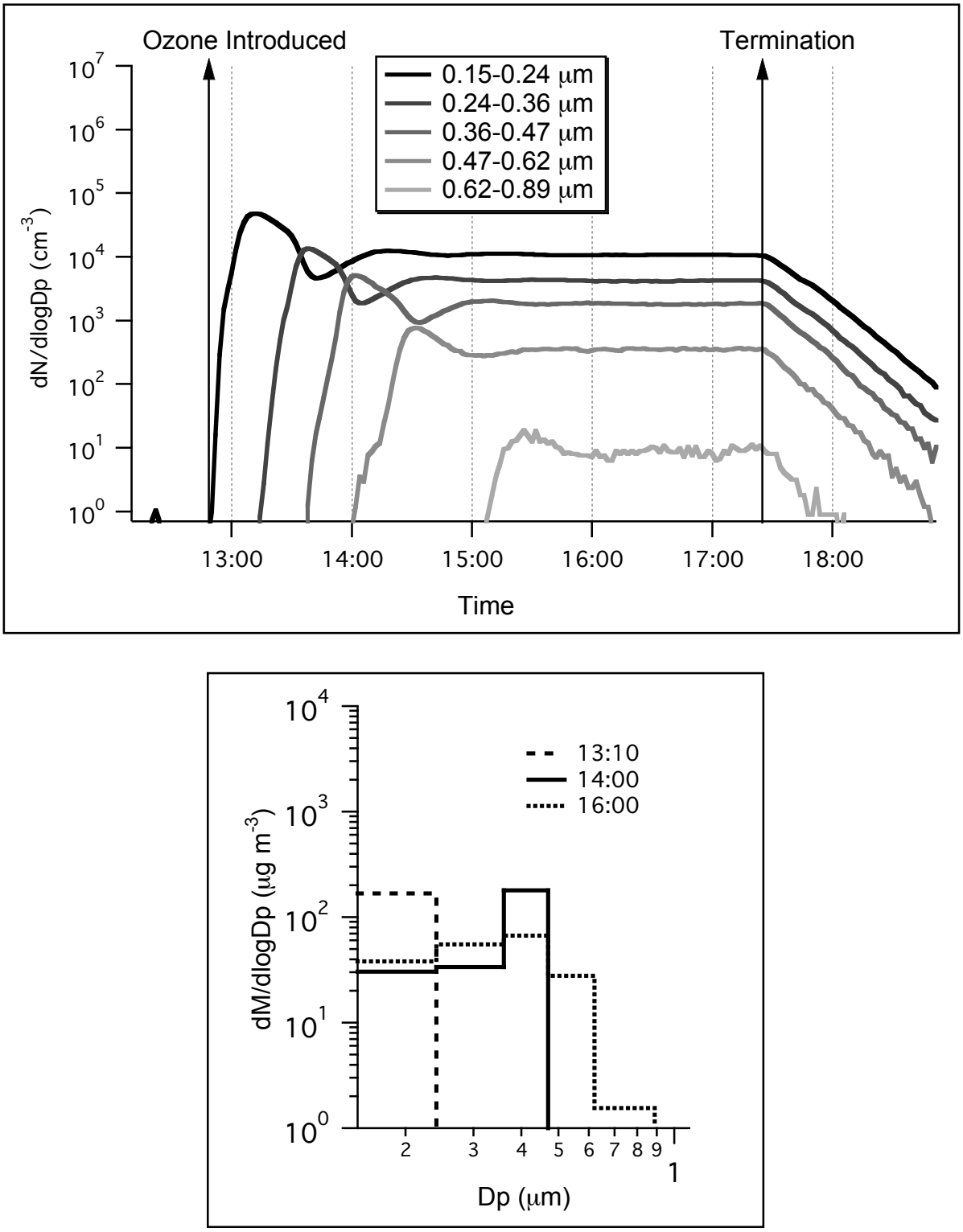


Figure D.17. OPC measurements of secondary organic aerosol particles generated in the reaction of AFR-1 with moderate ozone levels (63 ppb in supply air) at 3 ach (Expt 2K).

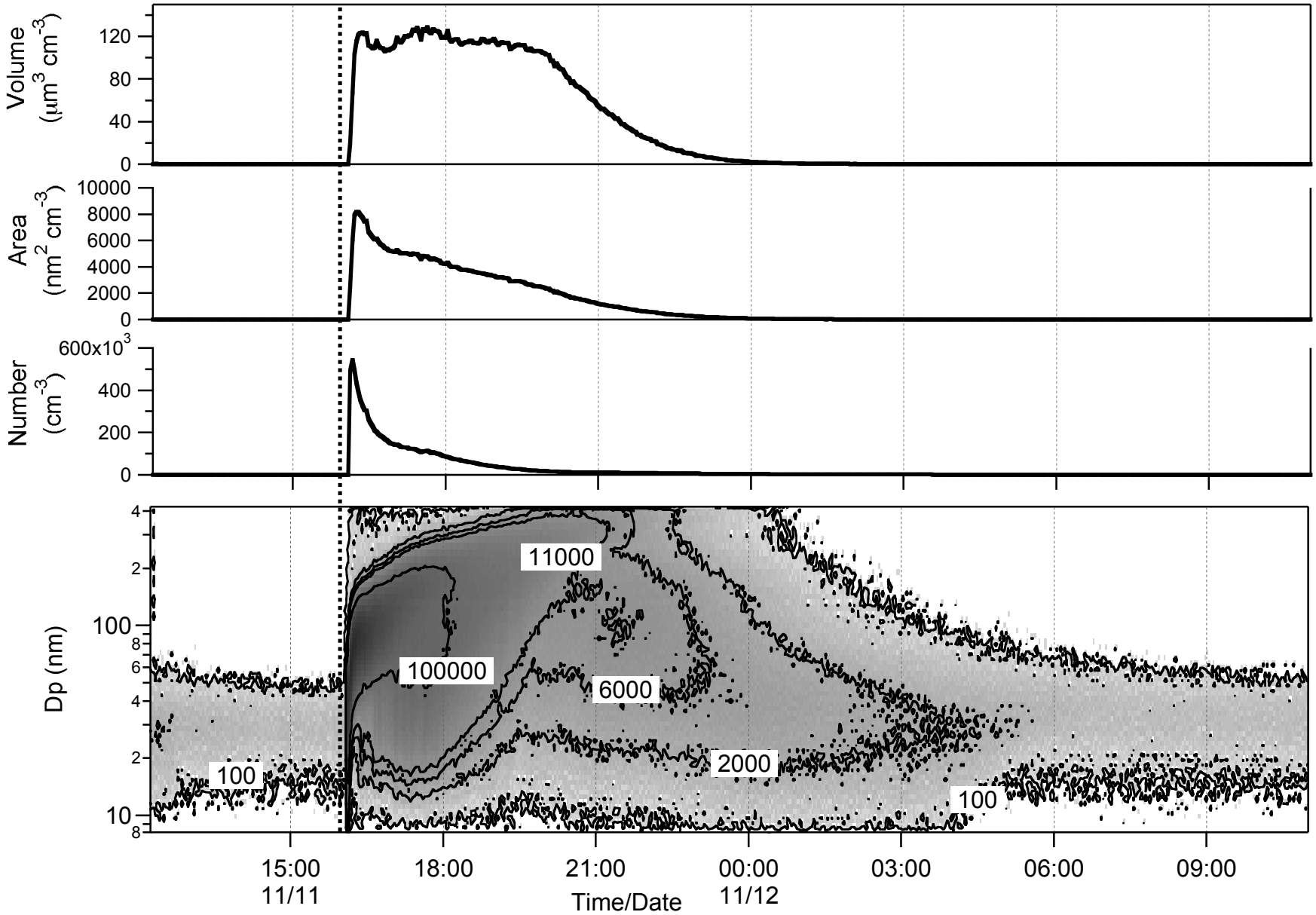
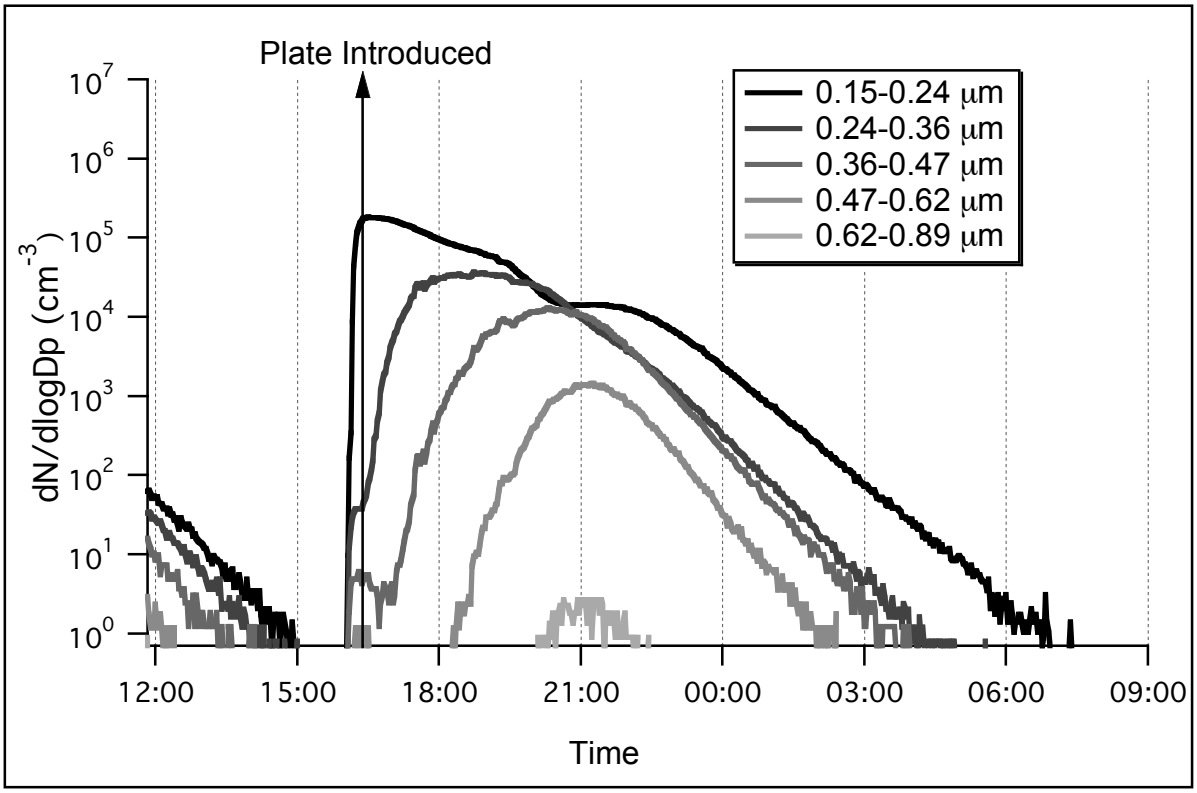


Figure D.18. SMPS measurements of secondary organic aerosol particles generated in the reaction of dried residue of GPC-1 with high ozone levels (118 ppb in supply air) at 1 ach (Expt 2L).



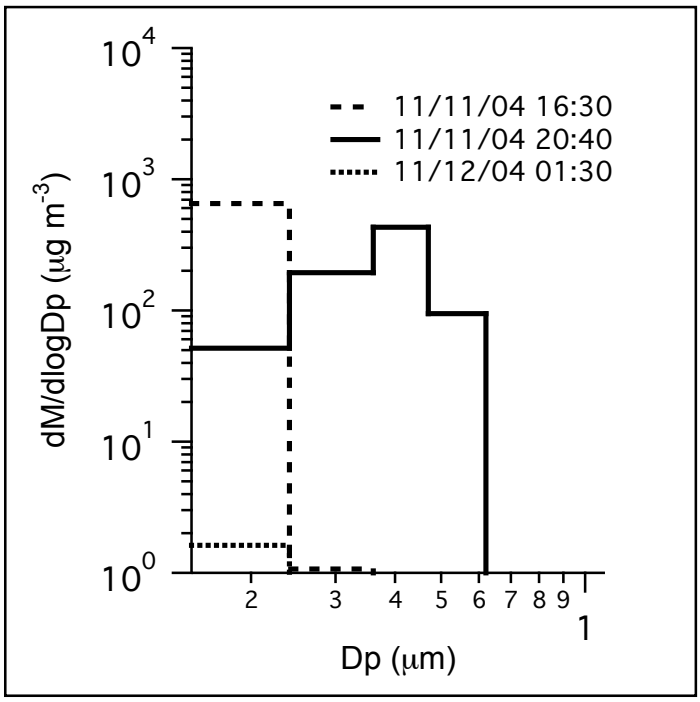


Figure D.19. OPC measurements of secondary organic aerosol particles generated in the reaction of dried residue of GPC-1 with high ozone levels (118 ppb in supply air) at 1 ach (Expt 2L).

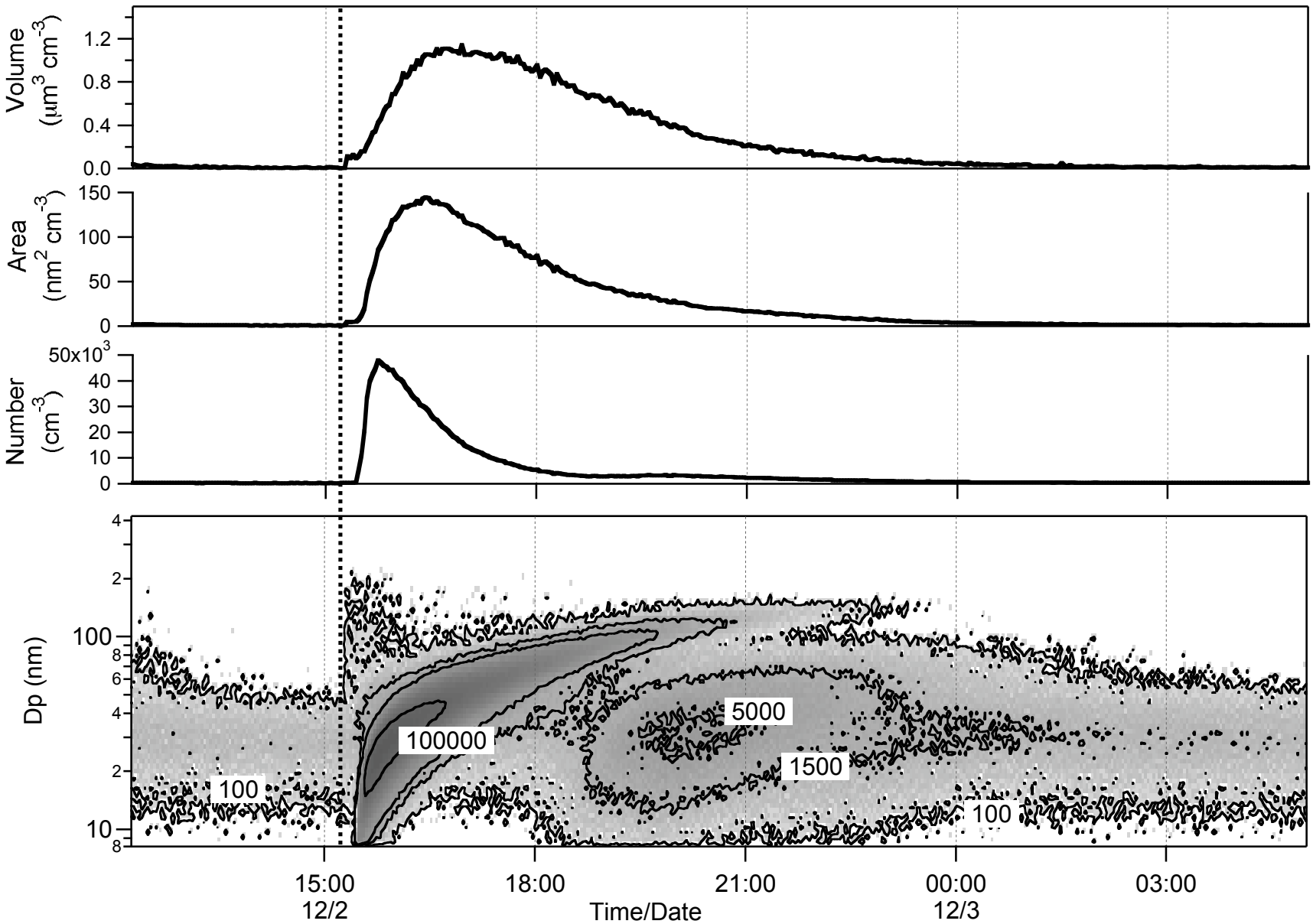


Figure D.20. SMPS measurements of secondary organic aerosol particles generated in the reaction of dried residue of GPD-1 with high ozone levels (114 ppb in supply air) at 1 ach (Expt 2M).

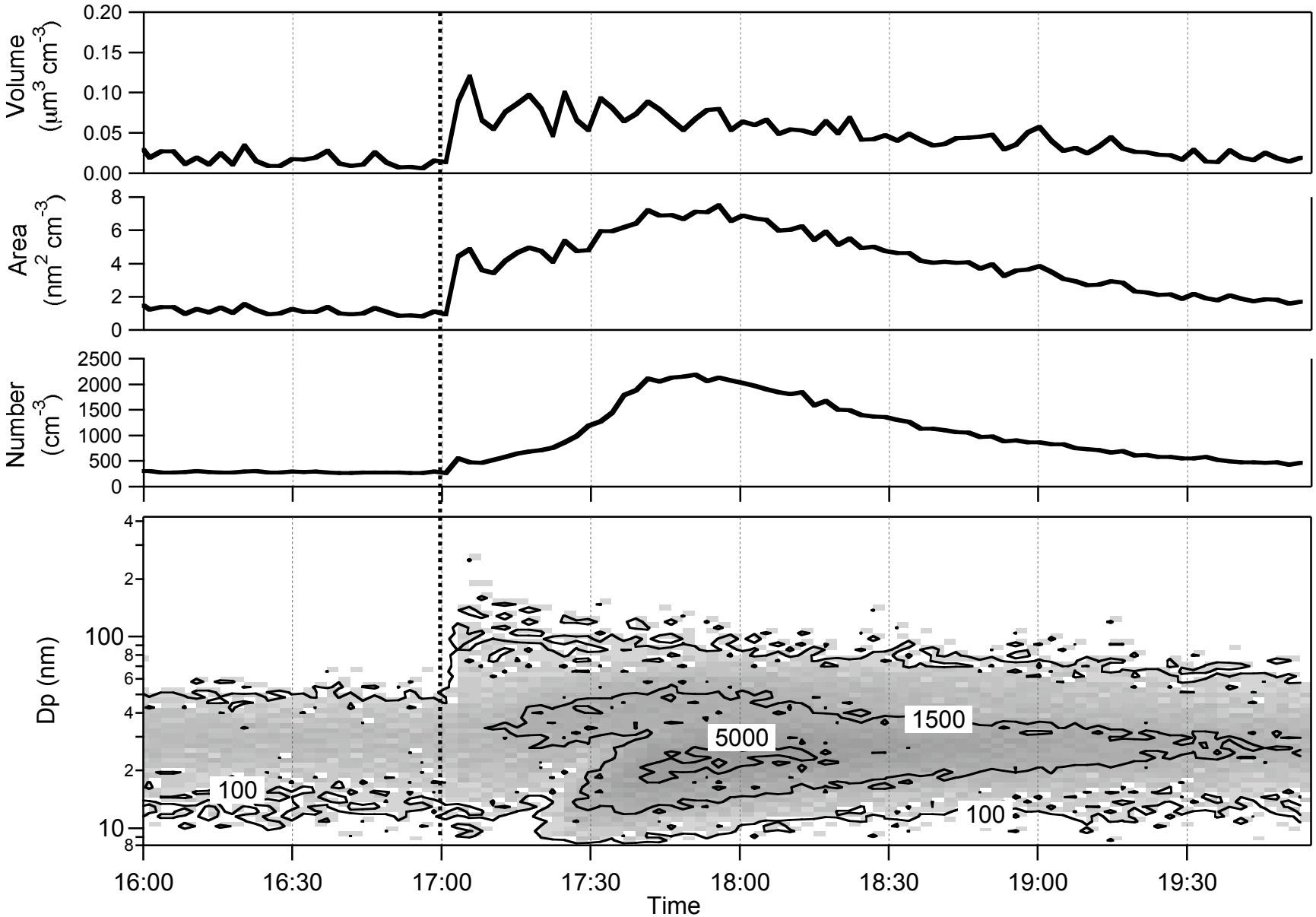


Figure D.21. SMPS measurements of secondary organic aerosol particles generated in the reaction of sorbed residue of AFR-1 with high ozone levels (122 ppb in supply air) at 1 ach (Expt 2N).

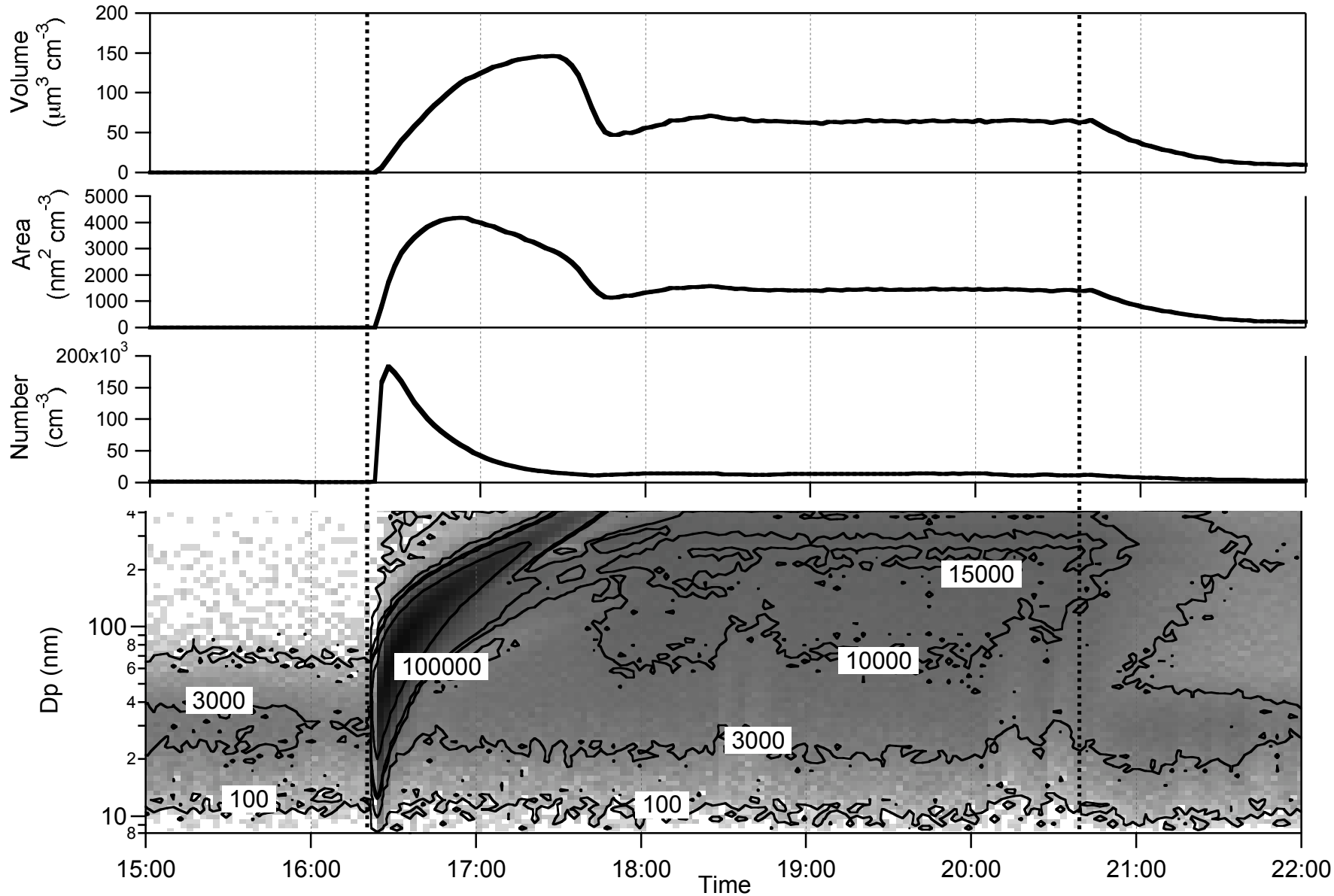
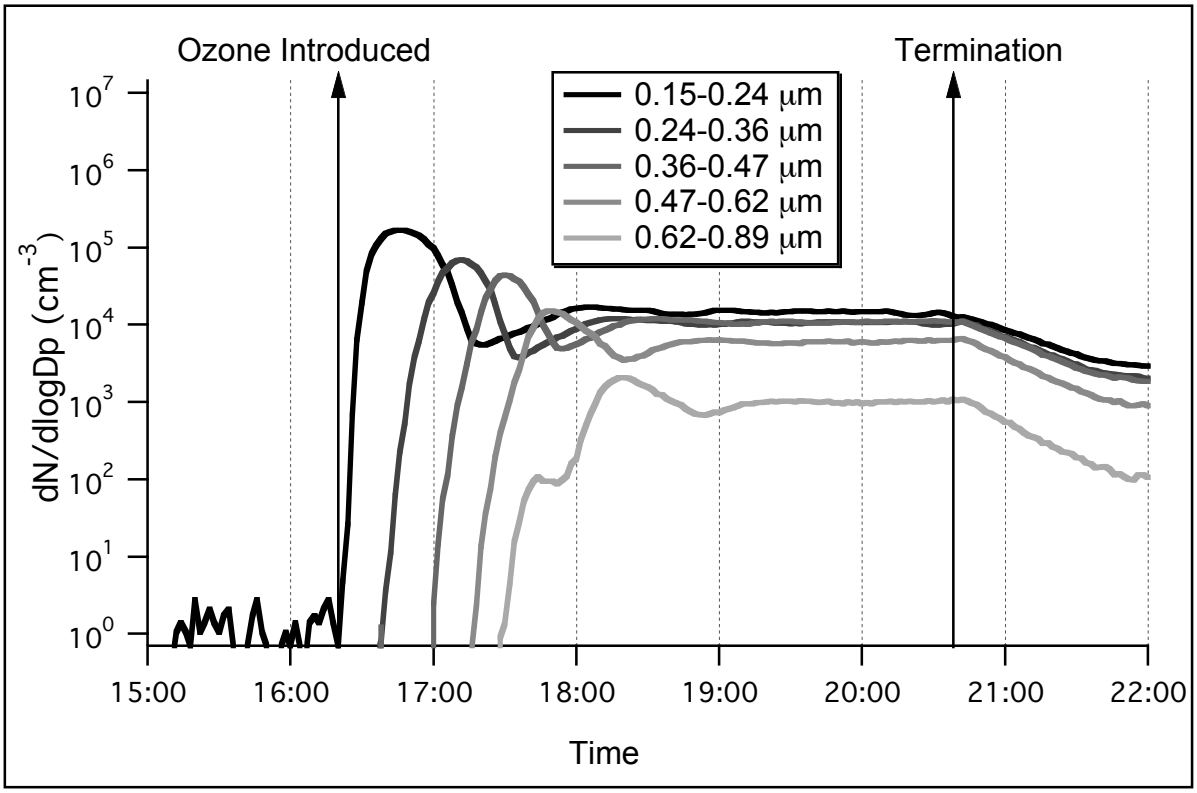


Figure D.22. SMPS measurements of secondary organic aerosol particles generated in the reaction of GPC-1 with high ozone levels (139 ppb in supply air) and NO2 levels (75 ppb in supply air) at 3 ach (Expt 2O).



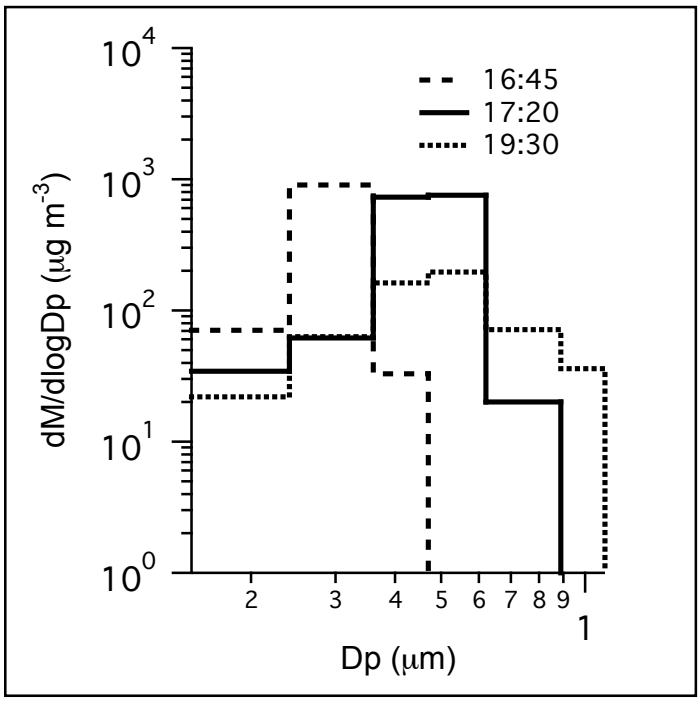


Figure D.23. OPC measurements of secondary organic aerosol particles generated in the reaction of GPC-1 with high ozone levels (139 ppb in supply air) and NO2 levels (75 ppb in supply air) at 3 ach (Expt 2O).

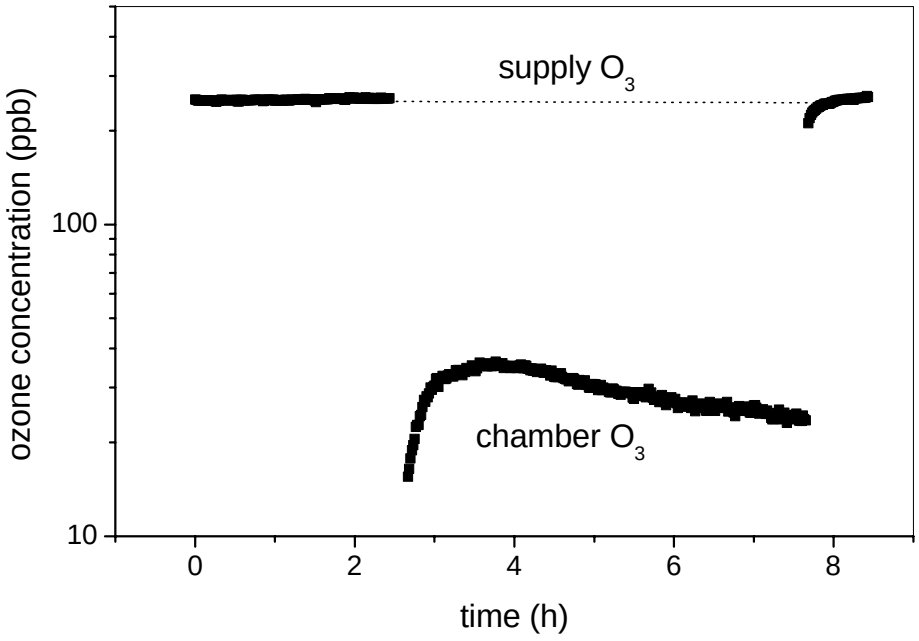


Figure D.24. Response of ozone analyzer in experiment 2A (GPC-1).

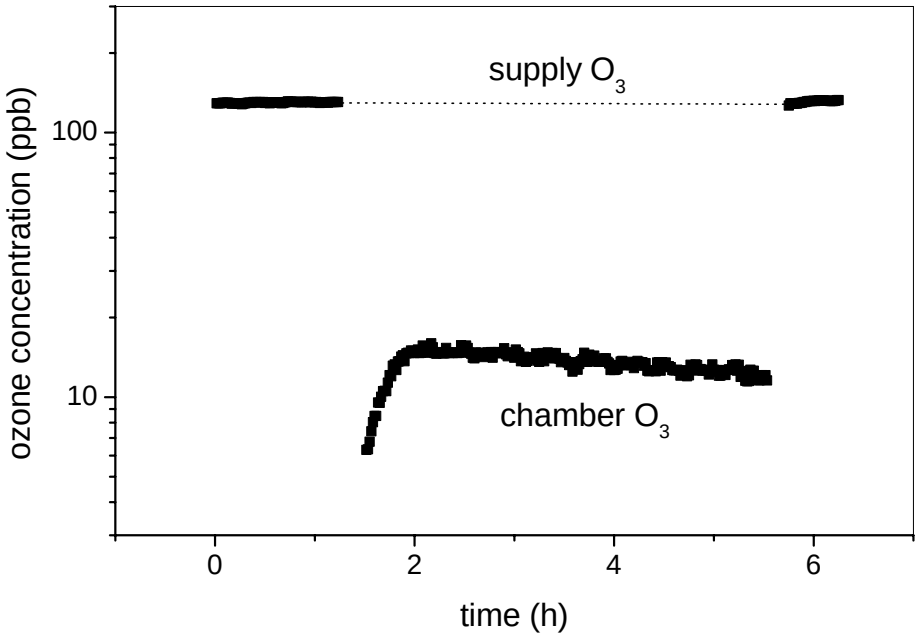


Figure D.25. Response of ozone analyzer in experiment 2B (GPC-1).

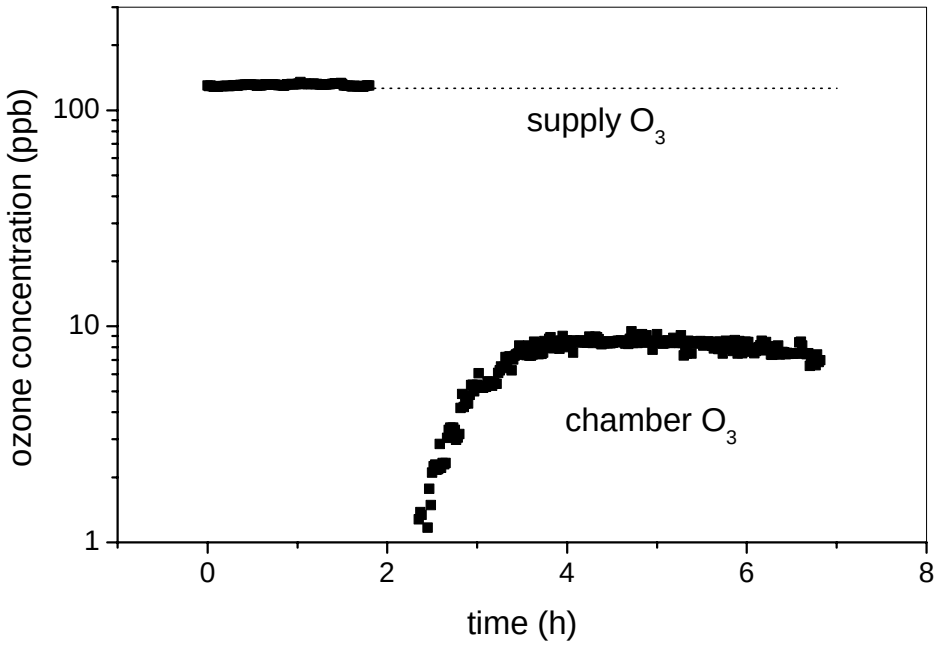


Figure D.26. Response of ozone analyzer in experiment 2C (GPC-1).

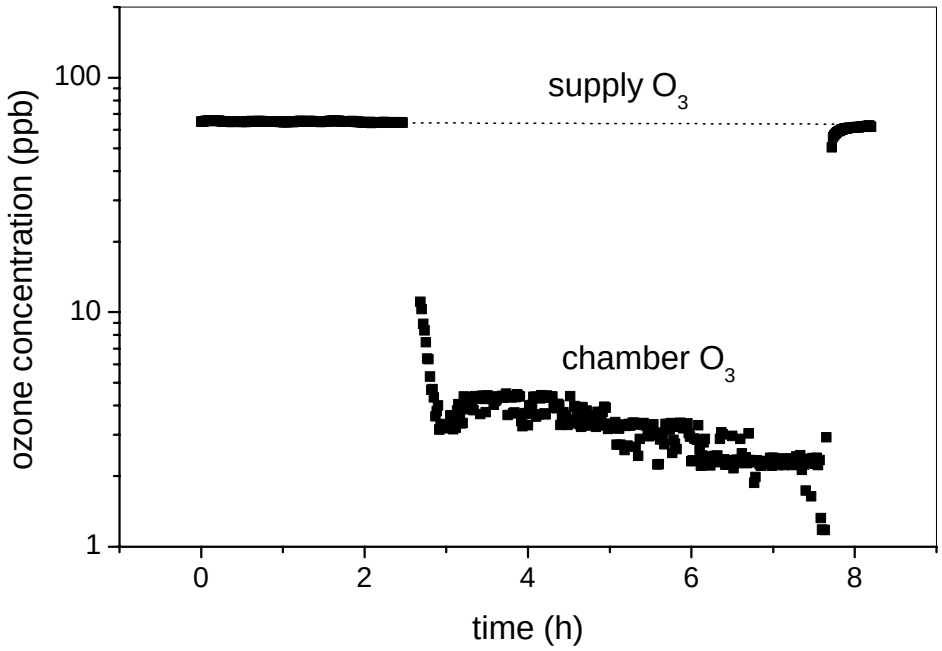


Figure D.27. Response of ozone analyzer in experiment 2D (GPC-1).

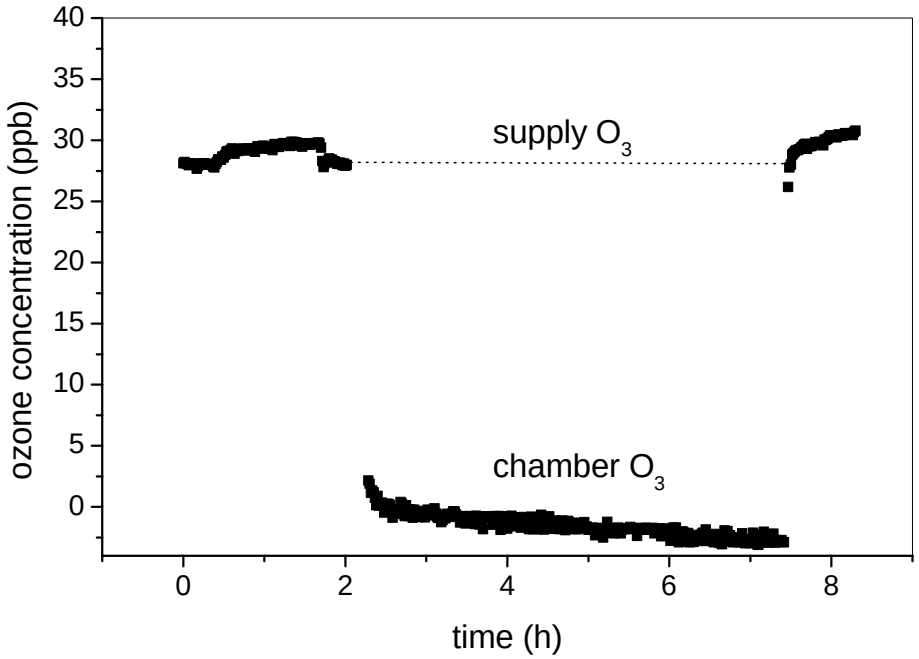


Figure D.28. Response of ozone analyzer in experiment 2E (GPC-1).

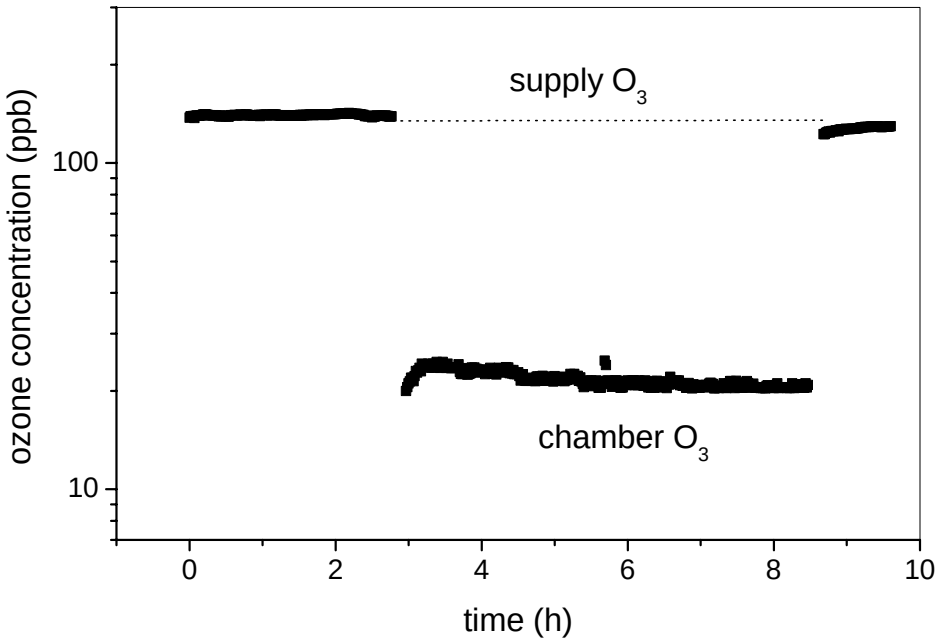


Figure D.29. Response of ozone analyzer in experiment 2F (GPD-1).

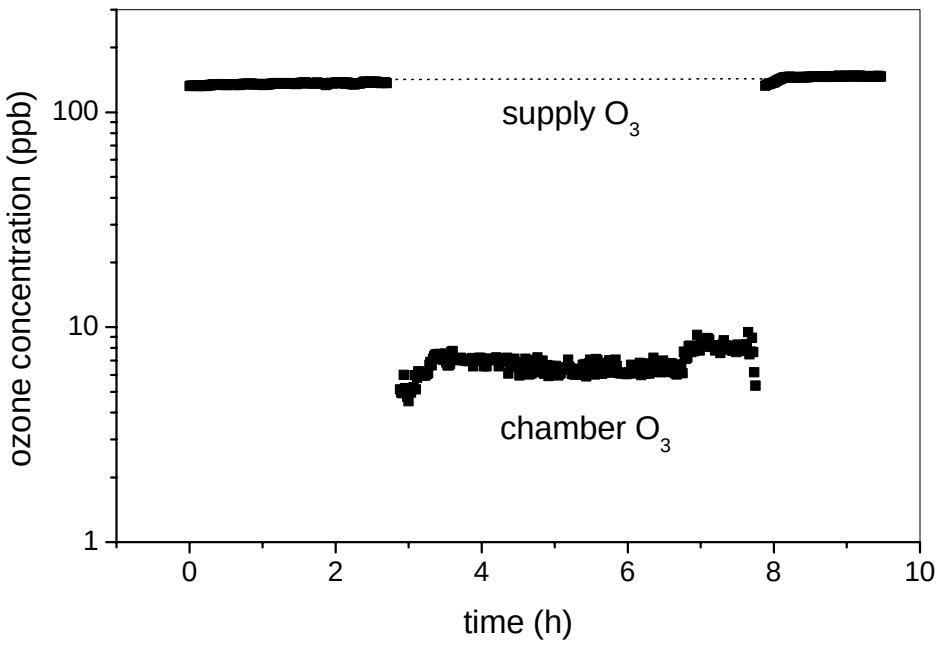


Figure D.30. Response of ozone analyzer in experiment 2G (GPD-1).

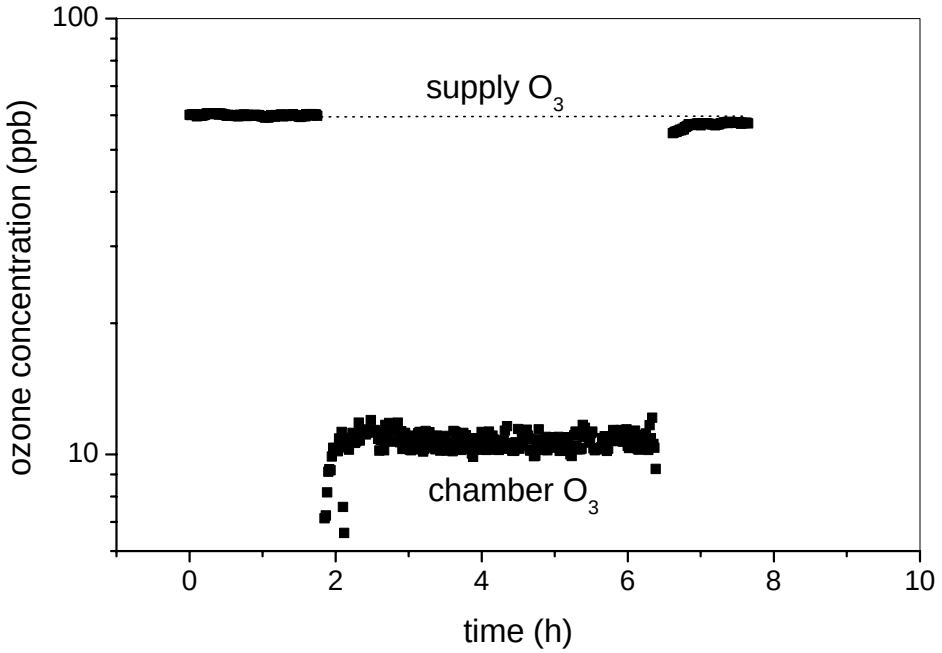


Figure D.31. Response of ozone analyzer in experiment 2H (GPD-1).

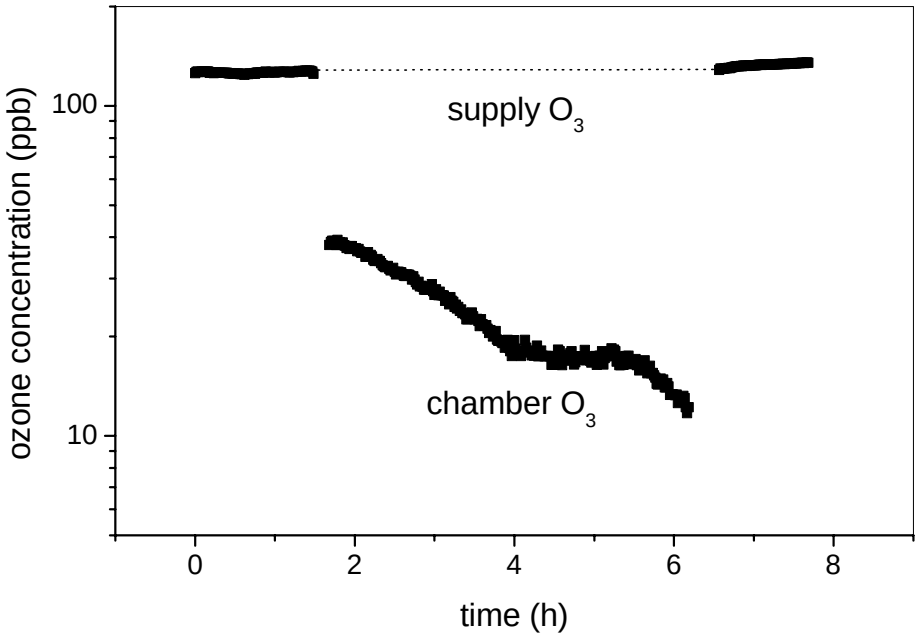


Figure D.32. Response of ozone analyzer in experiment 2I (AFR-1).

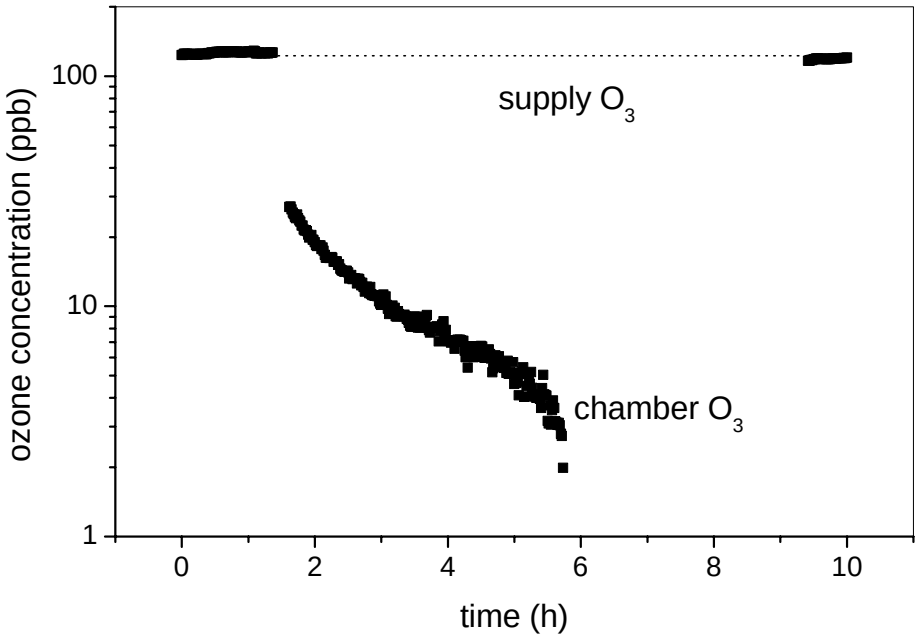


Figure D.33. Response of ozone analyzer in experiment 2J (AFR-1).

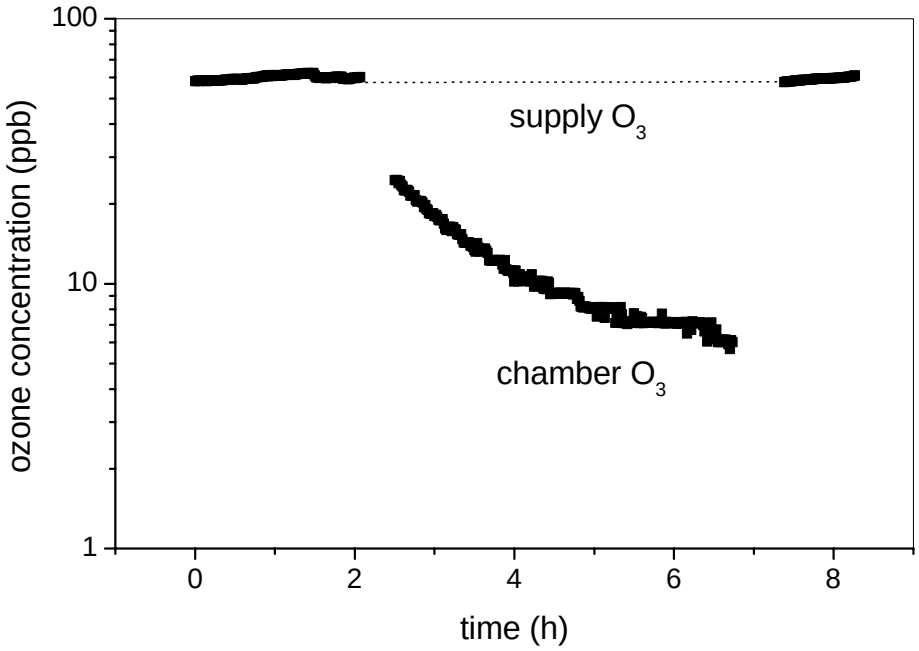


Figure D.34. Response of ozone analyzer in experiment 2K (AFR-1).

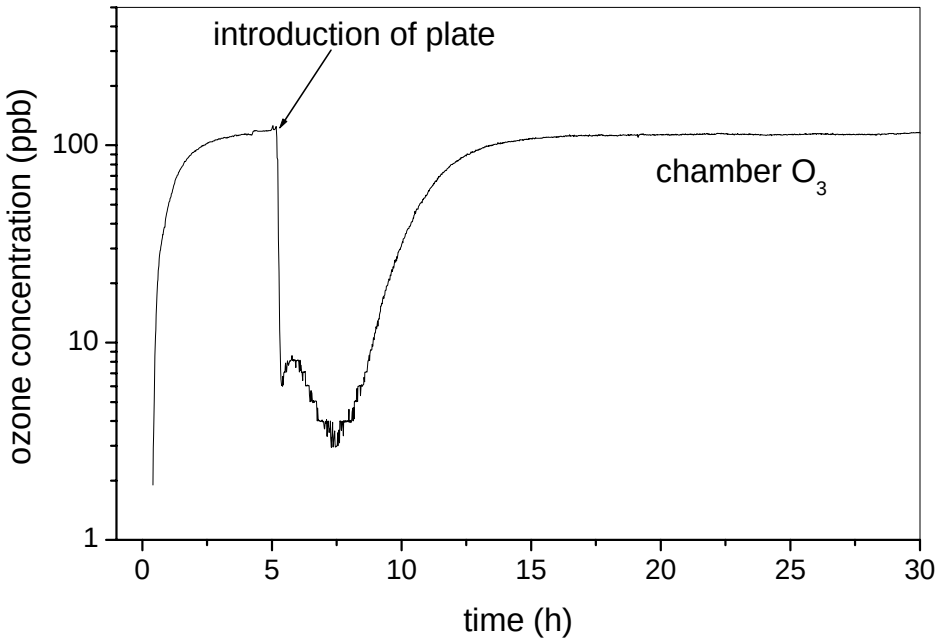


Figure D.35. Response of ozone analyzer in experiment 2L (GPC-1).

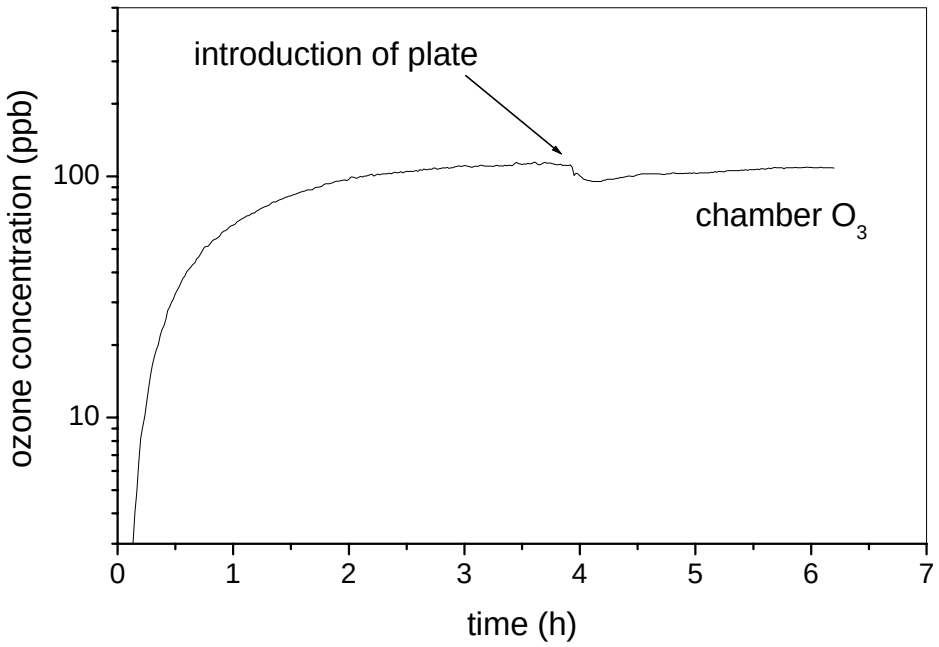


Figure D.36. Response of ozone analyzer in experiment 2M (AFR-1).

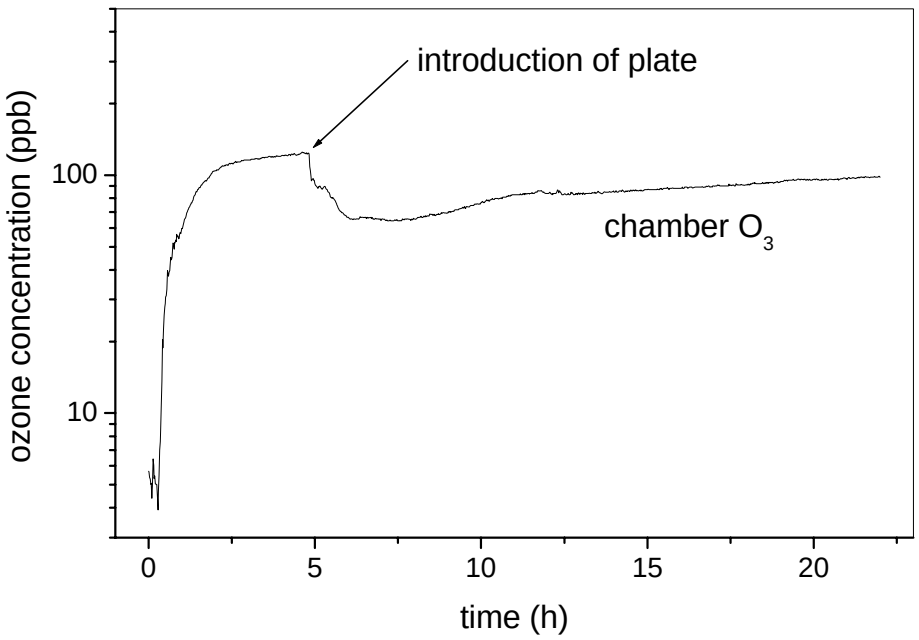


Figure D.37. Response of ozone analyzer in experiment 2N (GPD-1).

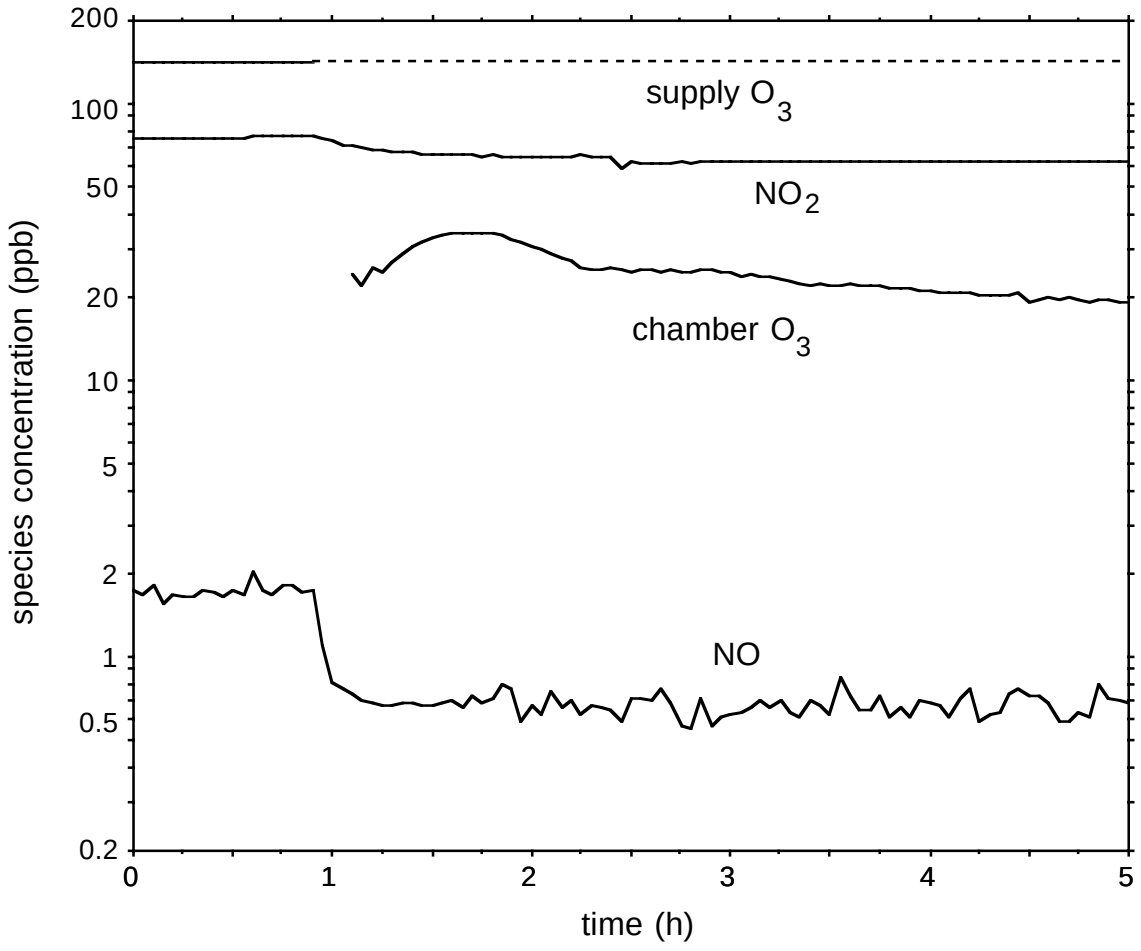


Figure D.38. Time-dependent concentrations of ozone, NO_2, and NO in Expt 2O.