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Washington River Protection Solutions, LLC
P.O. Box 850
Richland, WA 99352

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Prepared by:

TerraGraphics Environmental Engineering, Inc.
2926 E. Ainsworth
Pasco, WA 99301

TerraGraphics

www.terragraphics.com

Approval Form

Prepared by:

________________________________ Date: 09/25/2019
Tyler Williams

Reviewed by:

________________________________ Date: 09/25/2019
Matt Erickson, Ph.D.

Approved by:

________________________________ Date: 09/25/2019
Rich Westberg

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Acronyms

COPC	Chemical of Potential Concern
CSO	Central Shift Office
ML	Mobile Laboratory
NDEA	N-nitrosodiethylamine
NDMA	N-nitrosodimethylamine
NEMA	N-nitrosomethylethylamine
NMOR	N-nitrosomorpholine
OEL	Occupational Exposure Limit
PST	Pacific Standard Time
PTR-MS	Proton Transfer Reaction – Mass Spectrometer
PTR-TOF	Proton Transfer Reaction – Time of Flight
QA	Quality Assurance
QC	Quality Control

1.0 AUGUST 6, 2018 – SOURCE CHARACTERIZATON AND AREA MONITORING

1.1 Quality Assessment

Data from August 6, 2018, were assessed using Procedure 17124-DOE-HS-102, "Mobile Laboratory Data Processing – Analysis." A Data Exchange Checklist was completed. The data were accepted by TerraGraphics with the following comments. Report No. 66409-RPT-004, *Mobile Laboratory Operational Procedure*, was adequately documented and all checks passed the acceptance limits.

1.2 Summary

All times reported in this document are recorded in Pacific Standard Time (PST).

On August 6, 2018, the Mobile Laboratory (ML) performed area monitoring near the intersection of 4th and Buffalo on the Hanford Site.

The ML arrived at the location at 05:30. A quality assurance/quality control (QA/QC) zero-air/sensitivity check was performed on the LI-COR®[1] CO_2 monitor prior to arrival at 05:21. At 07:56, the ML began mobile monitoring of A Farms. The ML staff concluded their mobile monitoring at 4th and Buffalo at 12:10. At approximately 13:10, ML staff began monitoring septic tanks with Steve Wolfe east of the 242-A Evaporator.

The ML staff departed the monitoring site and returned to TerraGraphics at 15:41. The QA/QC zero-air/sensitivity checks on the Proton Transfer Reaction – Mass Spectrometer (PTR-MS) and Picarro Ammonia Analyzer began at 15:53.

Table 1-1. Mobile Laboratory Sampling Mode Throughout the Monitoring Period.

Time	Location	Sampling Mode
07:30 - 07:56	A Farms	Mobile sampling
07:56 - 12:10	A Farms-near AP stack, AN/AZ Farms	Mobile Area sampling
12:10 - 13:10	A Farms-4th and Buffalo	Mobile sampling (mast)
13:10 - 14:0	A Farms- Septic tanks	Mobile sampling (mast)

[1] LI-COR is a registered trademark of LI-COR, Inc., Lincoln, Nebraska.

Figure 1-1. Mobile Laboratory Route for the Duration of the Mobile Monitoring Period.
Blue location marker indicates site of septic tank monitoring.

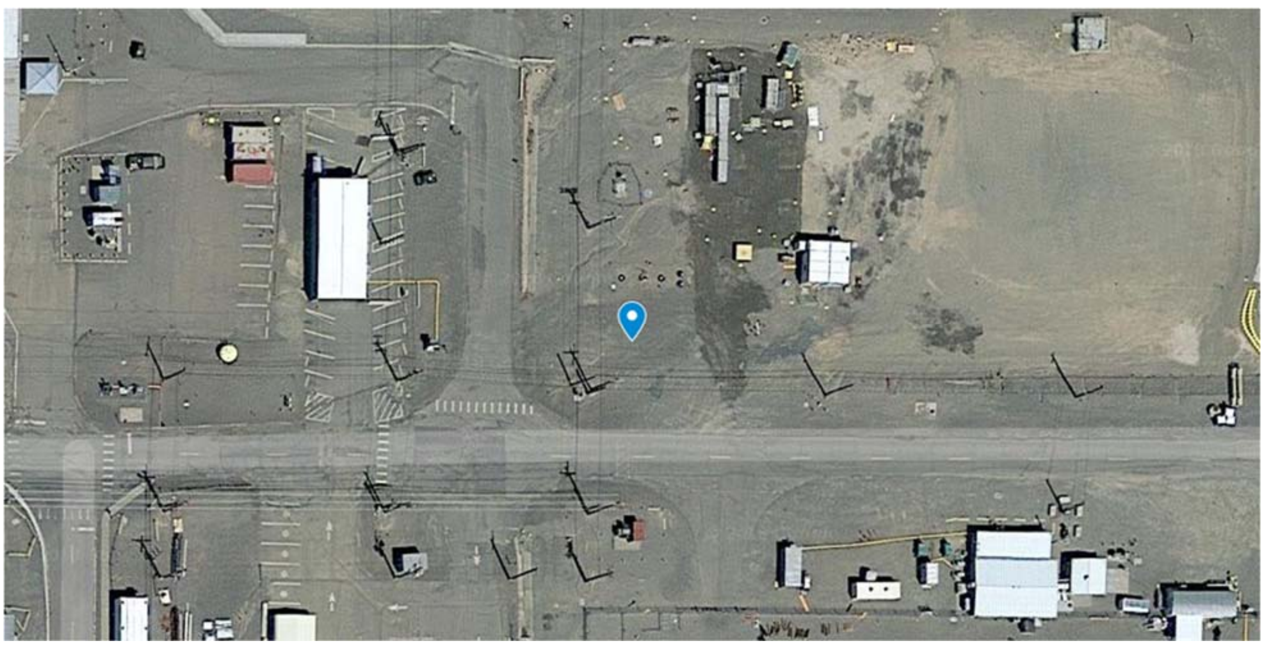

Figure 1-2. (Inset) Mobile Laboratory Location for the Duration of the Septic Tank Monitoring Period.

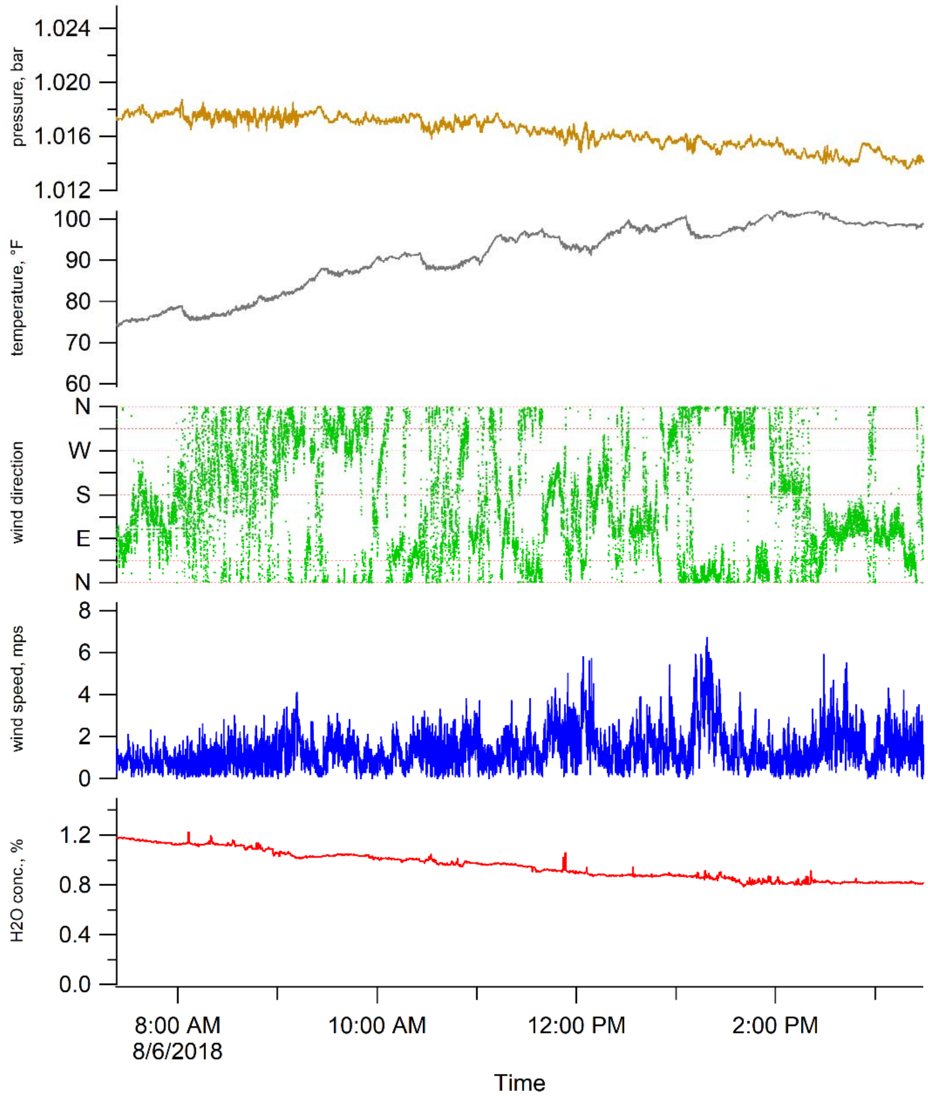

Figure 1-3. Weather Data for the Duration of the Monitoring Period.

1.3 Samples Collected

Continuous air monitoring was performed using the following instrumentation:

- PTR-TOF 6000 X2,
- LI-COR CO_2 Monitor,
- Picarro Ammonia Monitor, and
- Weather Station.

Confirmatory air samples were not collected during this period.

1.4 Mobile Monitoring

Table 1-2. Chemical of Potential Concern Statistical Information for the Monitoring Period of August 6, 2018. (2 Sheets)

COPC #	COPC Name	OEL (ppb)	Ave. (ppb)	St. Dev. (ppb)	Rel St. Dev. (%)	Max (ppb)	Median (ppb)
1	ammonia	25000	16.342	8.931	54.651	48.090	12.402
2	formaldehyde	300	1.277	0.198	15.479	3.808	1.259
3	methanol	200000	13.980	4.990	35.695	143.286	12.253
4	acetonitrile	20000	0.348	0.051	14.687	0.644	0.346
5	acetaldehyde	25000	3.911	1.358	34.735	11.542	3.403
6	ethylamine	5000	0.052	0.022	43.013	0.175	0.048
7	1,3-butadiene	1000	0.227	0.130	57.234	1.515	0.212
8	propanenitrile	6000	0.090	0.028	30.602	0.250	0.089
9	2-propenal	100	0.396	0.120	30.401	1.713	0.370
10	1-butanol + butenes	20000	0.404	0.143	35.286	4.180	0.372
11	methyl isocyanate	20	0.054	0.025	45.800	0.195	0.052
12	methyl nitrite	100	0.206	0.063	30.435	0.635	0.194
13	furan	1	0.061	0.022	35.938	0.188	0.059
14	butanenitrile	8000	0.035	0.018	52.581	0.132	0.033
15	but-3-en-2-one + 2,3-dihydrofuran + 2,5-dihydrofuran	100, 1, 1	0.087	0.042	47.895	**N/A***	**N/A***
16	butanal	25000	0.225	0.088	39.085	1.136	0.198
17	NDMA	0.3	0.034	0.043	127.507	0.308	0.015
18	benzene	500	0.207	0.071	34.306	4.412	0.197
19	2,4-pentadienenitrile + pyridine	300, 1000	0.051	0.018	35.346	0.325	0.049
20	2-methylene butanenitrile	30	0.022	0.011	51.084	0.084	0.021
21	2-methylfuran	1	0.071	0.027	38.646	0.257	0.068
22	pentanenitrile	6000	0.025	0.014	55.863	0.109	0.024
23	3-methyl-3-buten-2-one + 2-methyl-2-butenal	20, 30	0.071	0.031	44.444	0.254	0.066
24	NEMA	0.3	0.028	0.034	124.120	0.269	0.014
25	2,5-dimethylfuran	1	0.044	0.022	50.256	0.181	0.042
26	hexanenitrile	6000	0.017	0.011	64.004	0.079	0.016
27	2-hexanone (MBK)	5000	0.040	0.023	56.096	0.252	0.037
28	NDEA	0.1	0.037	0.033	90.118	0.197	0.032
29	butyl nitrite + 2-nitro-2-methylpropane	100, 30	0.177	0.030	16.984	0.304	0.176
30	2,4-dimethylpyridine	500	0.052	0.019	37.503	0.218	0.050

Table 1-2. Chemical of Potential Concern Statistical Information for the Monitoring Period of August 6, 2018. (2 Sheets)

COPC #	COPC Name	OEL (ppb)	Ave. (ppb)	St. Dev. (ppb)	Rel St. Dev. (%)	Max (ppb)	Median (ppb)
31	2-propylfuran + 2-ethyl-5-methylfuran	1	0.040	0.021	53.994	0.136	0.038
32	heptanenitrile	6000	0.043	0.017	39.370	0.168	0.042
33	4-methyl-2-hexanone	500	0.079	0.027	34.790	0.281	0.076
34	NMOR	0.6	0.013	0.020	158.961	0.137	0.000
35	butyl nitrate	2500	0.022	0.015	68.751	0.099	0.021
36	2-ethyl-2-hexenal + 4-(1-methylpropyl)-2,3-dihydrofuran+ 3-(1,1-dimethylethyl)-2,3-dihydrofuran	100, 1, 1	0.054	0.022	40.917	0.216	0.052
37	6-methyl-2-heptanone	8000	0.054	0.019	34.125	0.143	0.053
38	2-pentylfuran	1	0.045	0.020	44.571	0.233	0.044
39	biphenyl	200	0.038	0.024	62.586	0.143	0.038
40	2-heptylfuran	1	0.134	0.023	17.543	0.280	0.133
41	1,4-butanediol dinitrate	50	0.074	0.022	29.296	0.185	0.073
42	2-octylfuran	1	0.008	0.016	187.493	0.114	0.000
43	1,2,3-propanetriol 1,3-dinitrate	50	0.010	0.020	209.632	0.143	0.000
44	PCB	1000	0.108	0.024	22.373	0.215	0.107
45	6-(2-furanyl)-6-methyl-2-heptanone	1	0.016	0.012	75.838	0.077	0.015
46	furfural acetophenone	1	0.130	0.038	29.200	0.451	0.124

* The maximum peak value for but-3-en-2-one + 2,3 dihydrofuran + 2,5 dihydrofuran was 0.425ppb and the median value was 0.075 ppb. The PTR-MS results for but-3-en-2-one + 2,3 dihydrofuran + 2,5 dihydrofuran are not compared to OEL concentrations because: 1) the result is suspect due to a known biogenic interferant (methacrolein) that is expected to be in concentrations that occasionally exceed the dihydrofuran OEL, and 2) this combination of COPCs have OEL concentrations that differ by a factor of 100, which provide widely variant bases for these numbers.

**Nitrosamine results are also suspect due to interferants identified during the background study.

The following figures display a selection of chemical of potential concern (COPC) signals, overlaid with the same signal smoothed using a one-minute moving average, and CO_2, for the monitoring period of August 6, 2018.

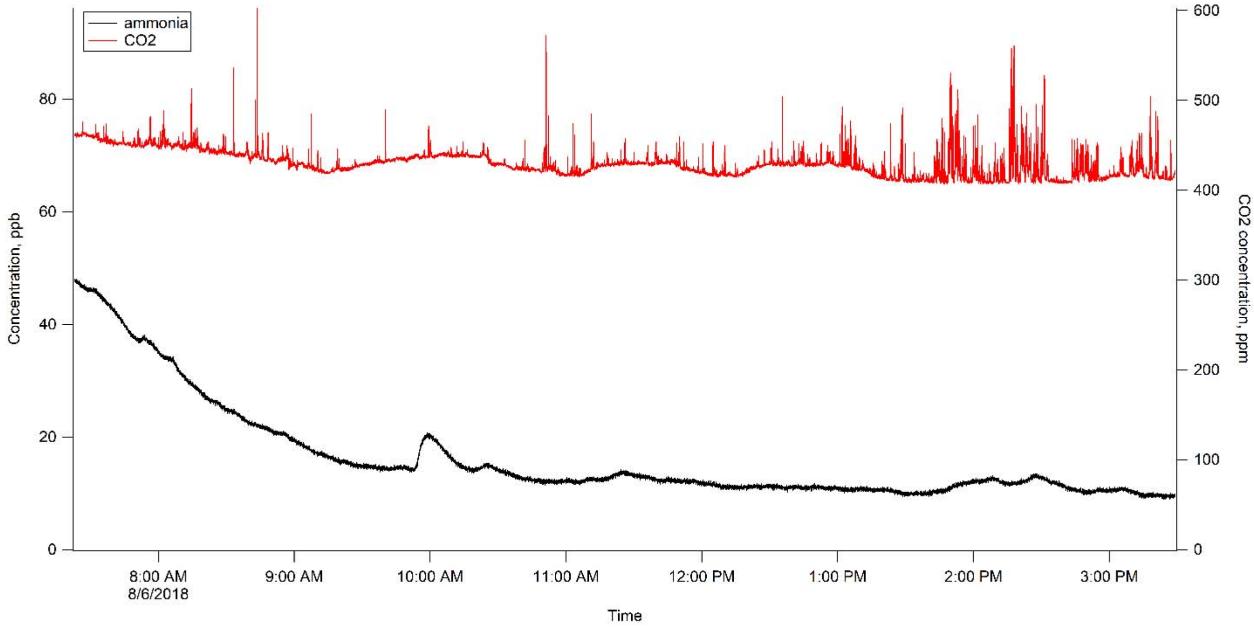

Figure 1-4. Ammonia.

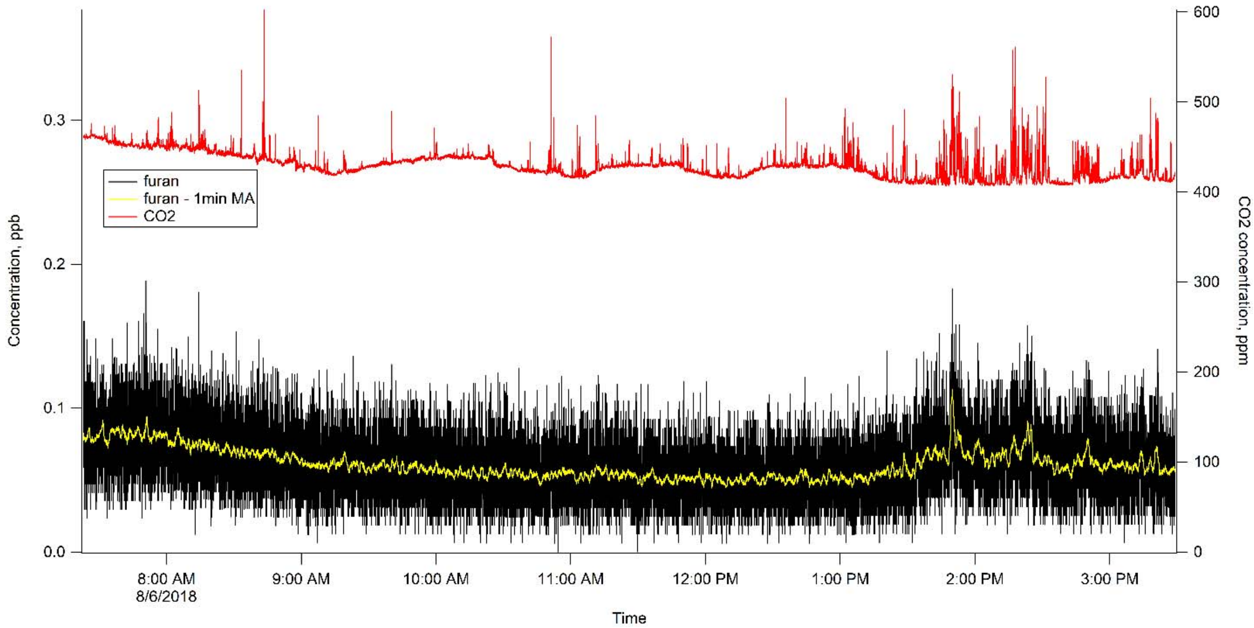

Figure 1-5. Furan.

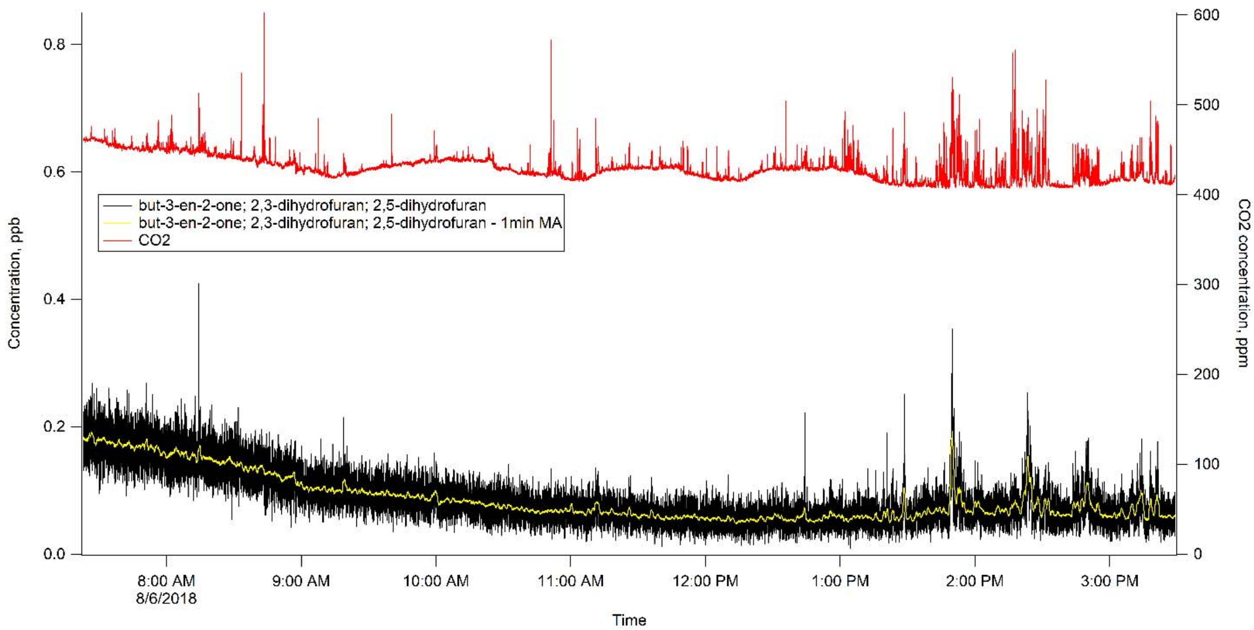

Figure 1-6. But-3-en-2-one; 2,3-dihydrofuran; 2,5-dihydrofuran.

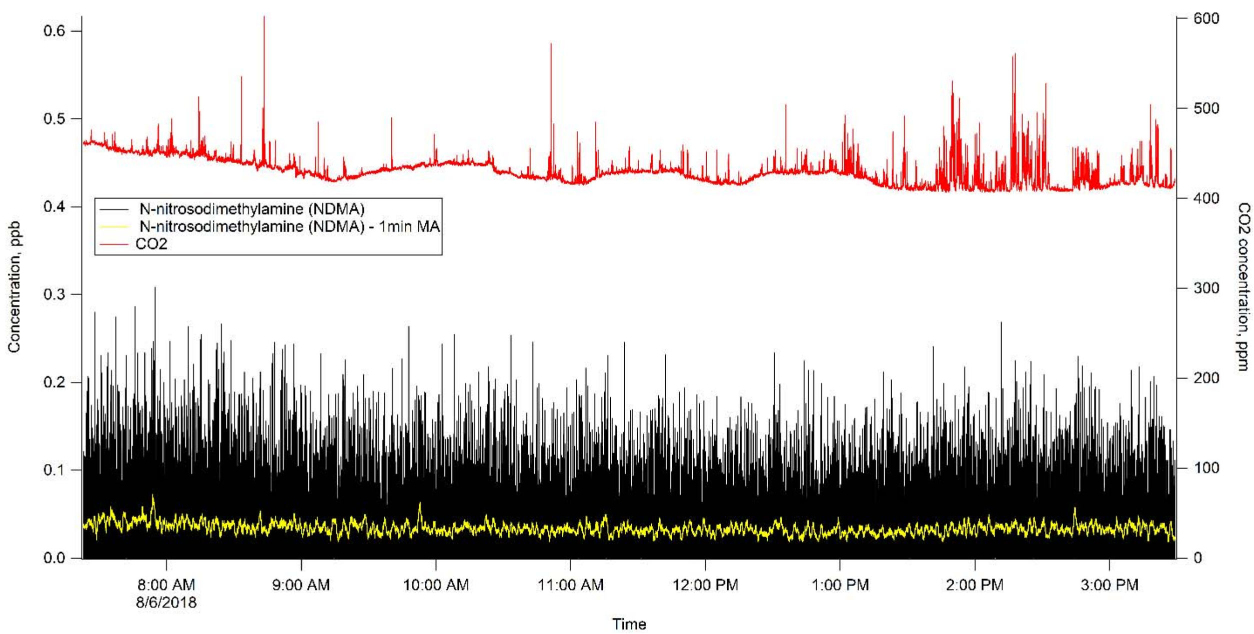

Figure 1-7. N-nitrosodimethylamine (NDMA).

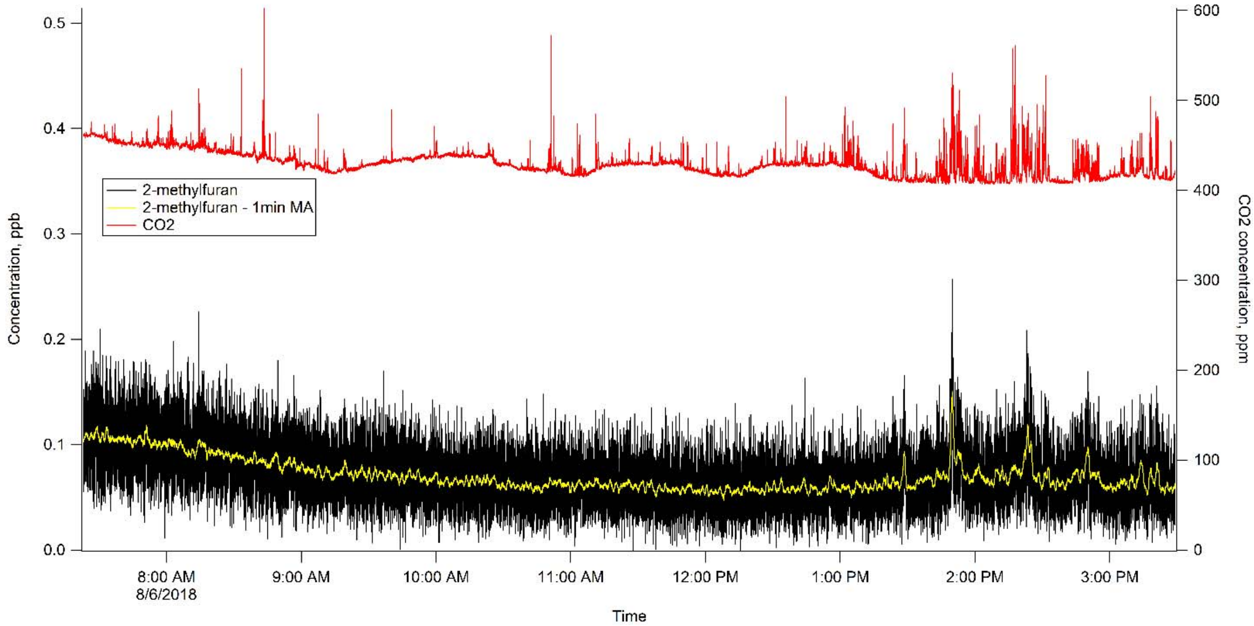

Figure 1-8. 2-methylfuran.

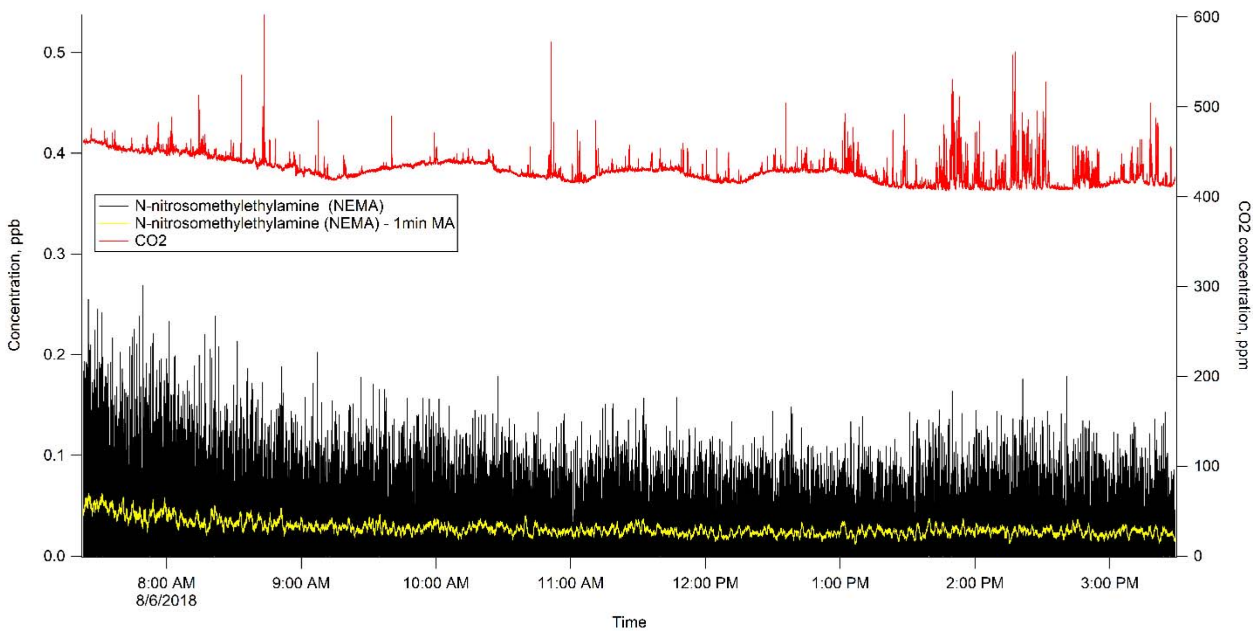

Figure 1-9. N-nitrosomethylethylamine (NEMA).

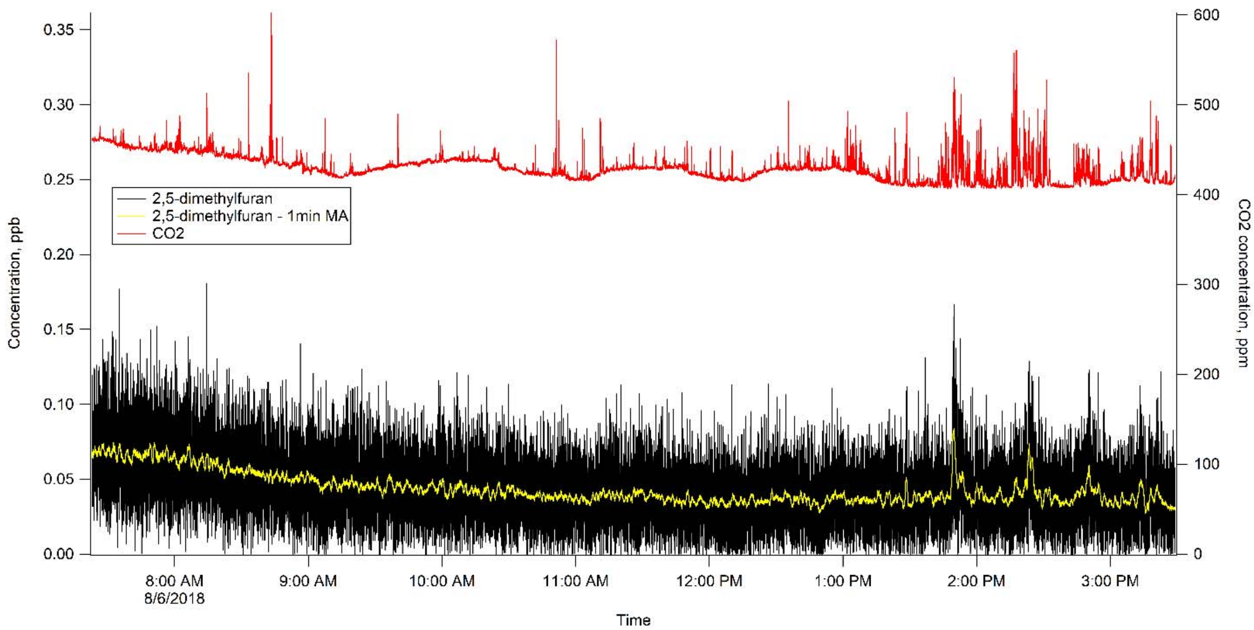

Figure 1-10. 2, 5-dimethylfuran.

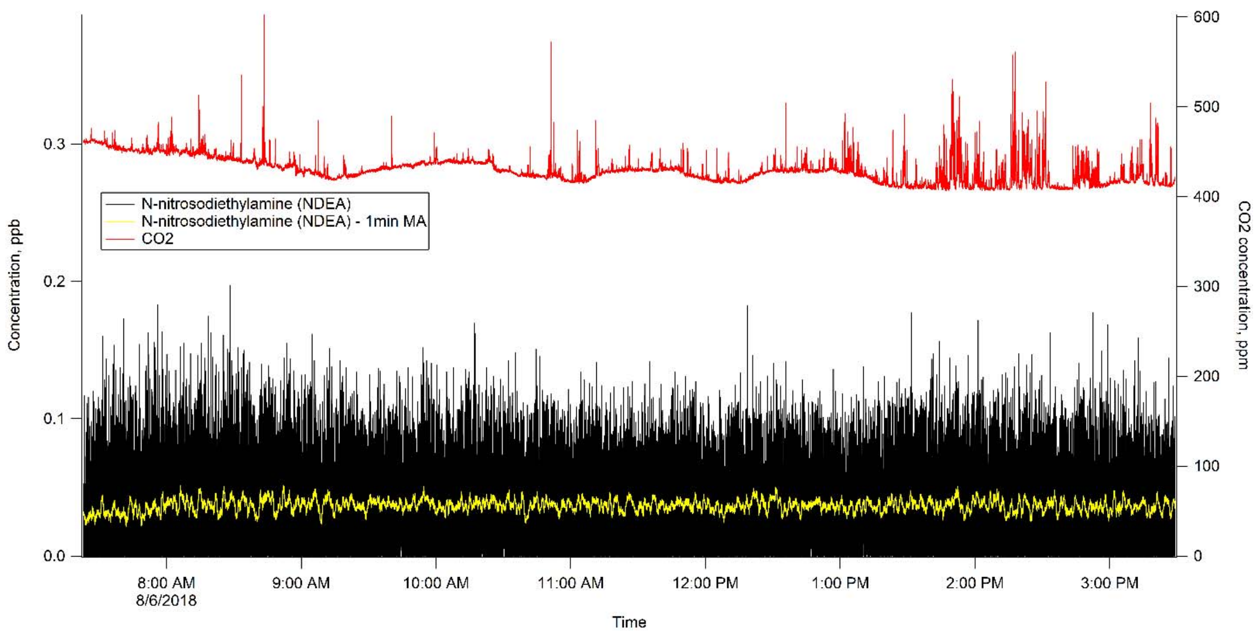

Figure 1-11. N-nitrosodiethylamine (NDEA).

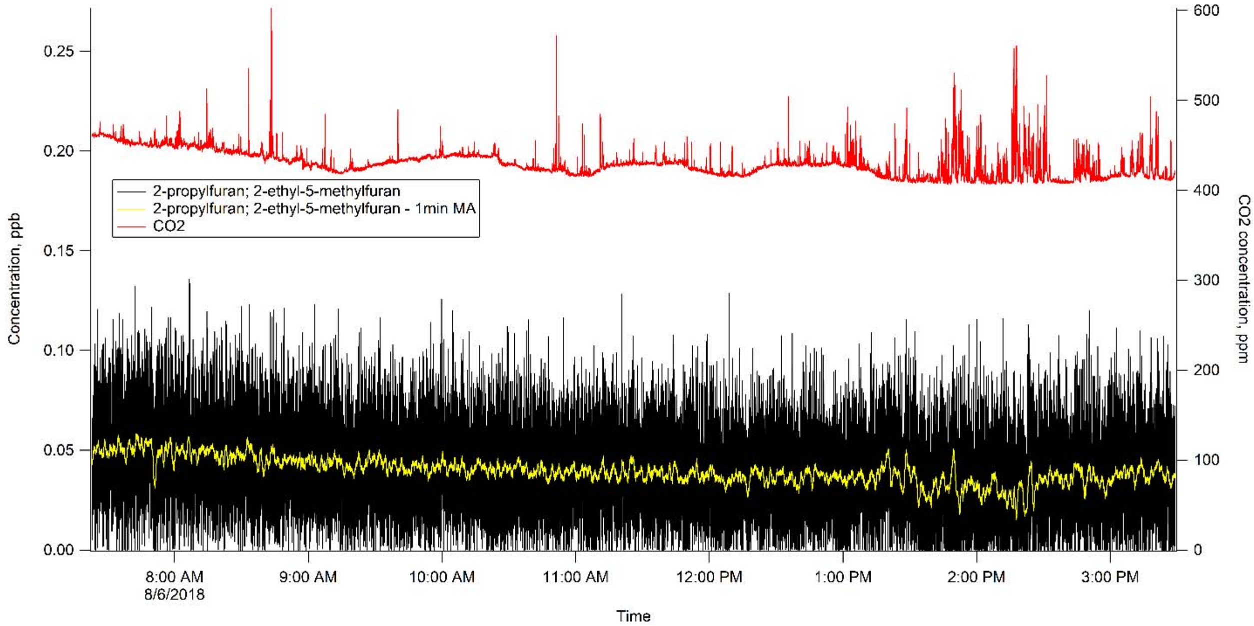

Figure 1-12. 2-propylfuran; 2-ethyl-5-methylfuran.

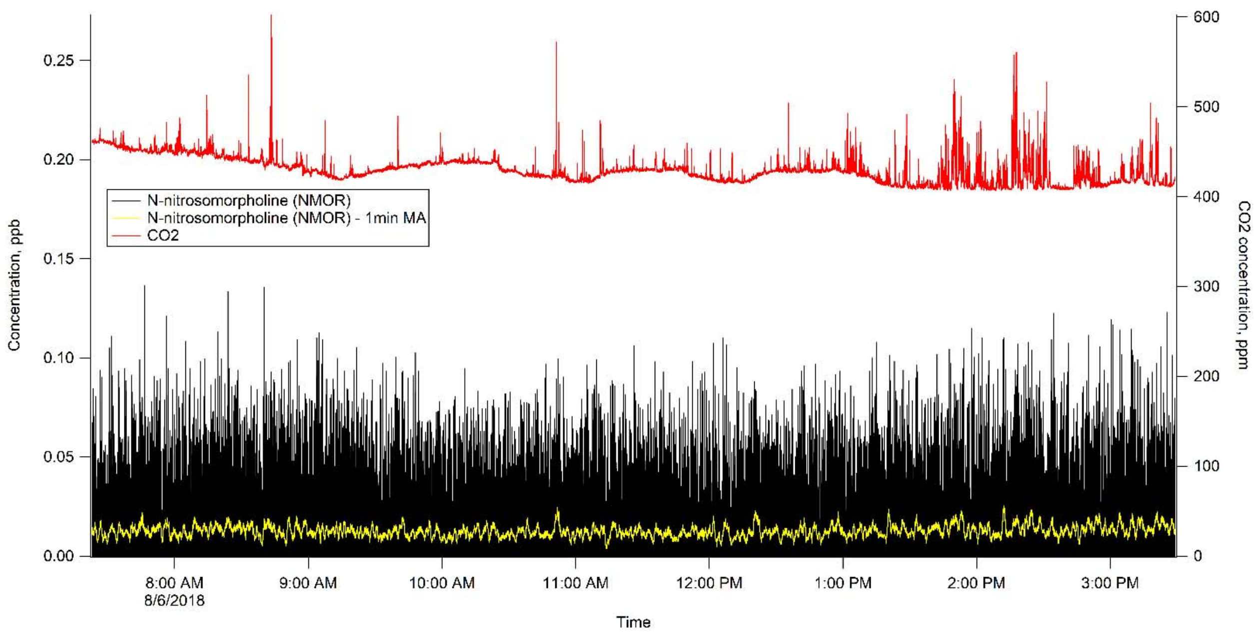

Figure 1-13. N-nitrosomorpholine (NMOR).

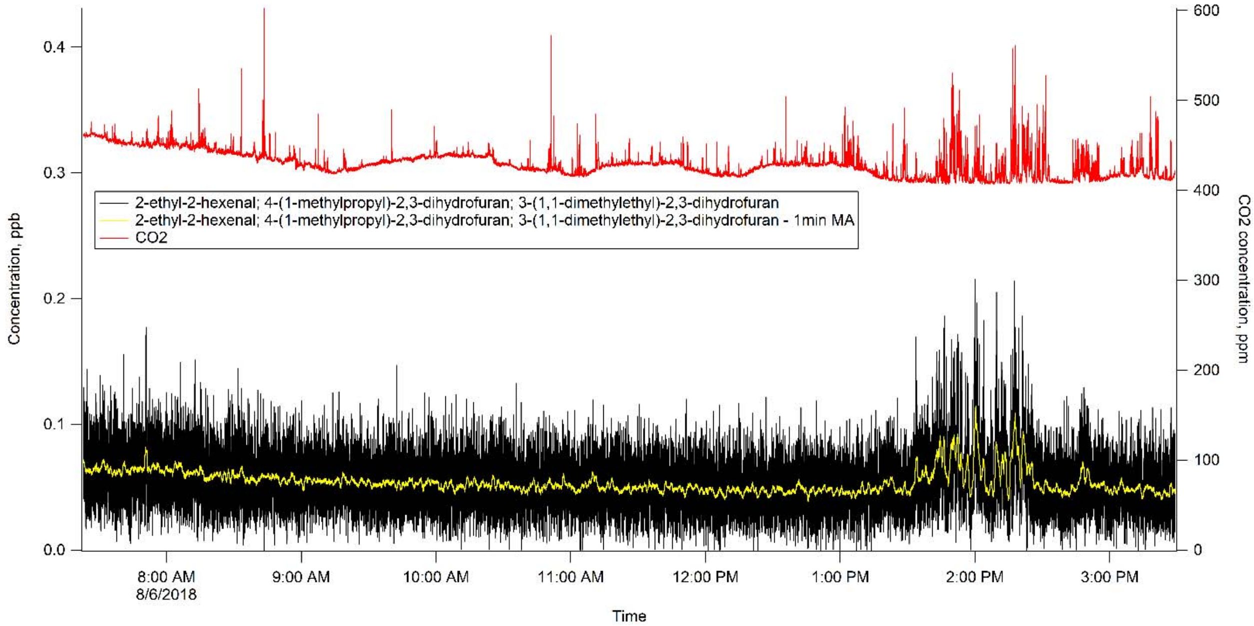

Figure 1-14. 2-ethyl-2-hexenal; 4-(1-methylpropyl)-2,3-dihydrofuran; 3-(1,1-dimethylethyl)-2,3-dihydrofuran.

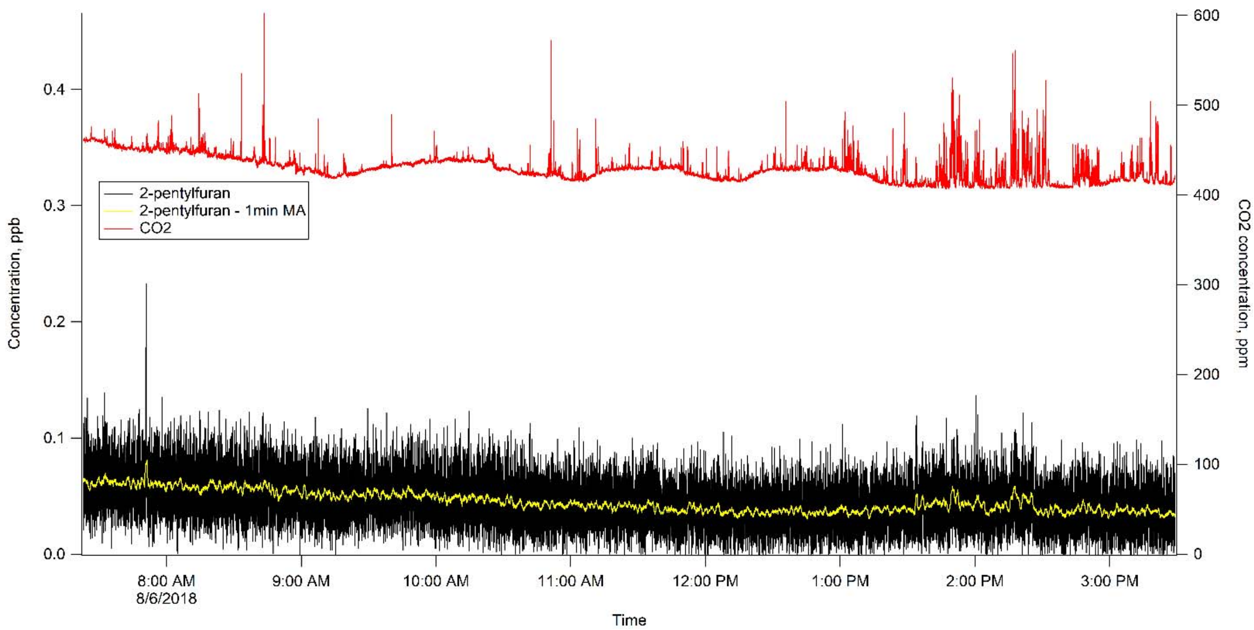

Figure 1-15. 2-pentylfuran.

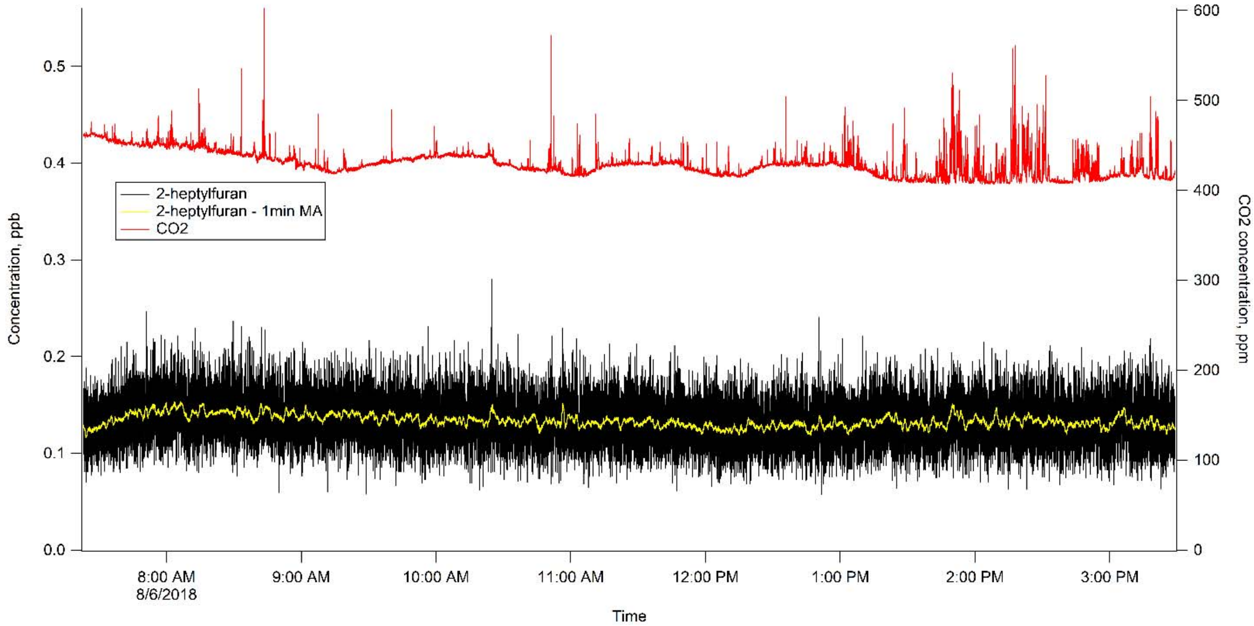

Figure 1-16. 2-heptylfuran.

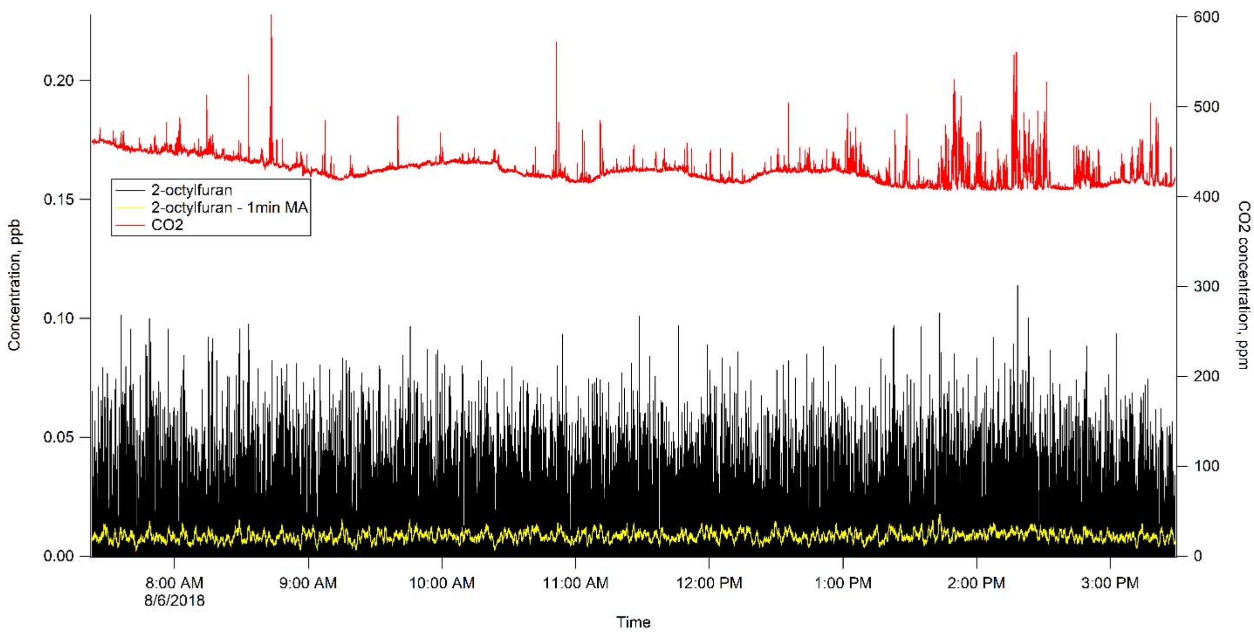

Figure 1-17. 2-octylfuran.

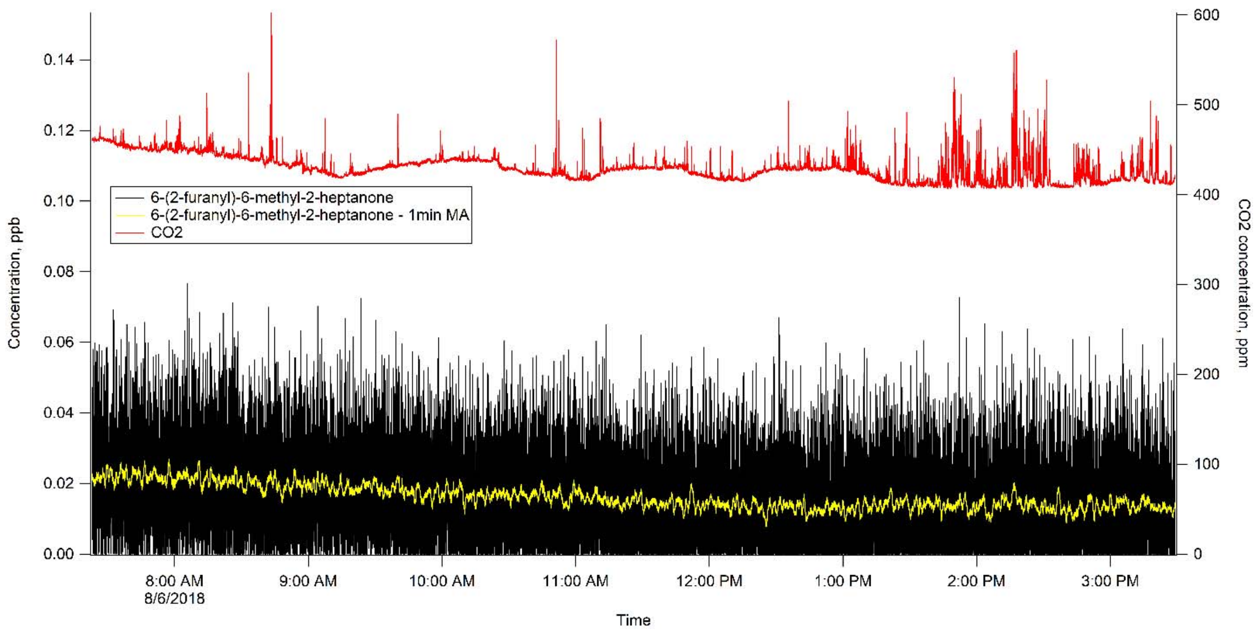

Figure 1-18. 6-(2-furanyl)-6-methyl-2-heptanone.

b

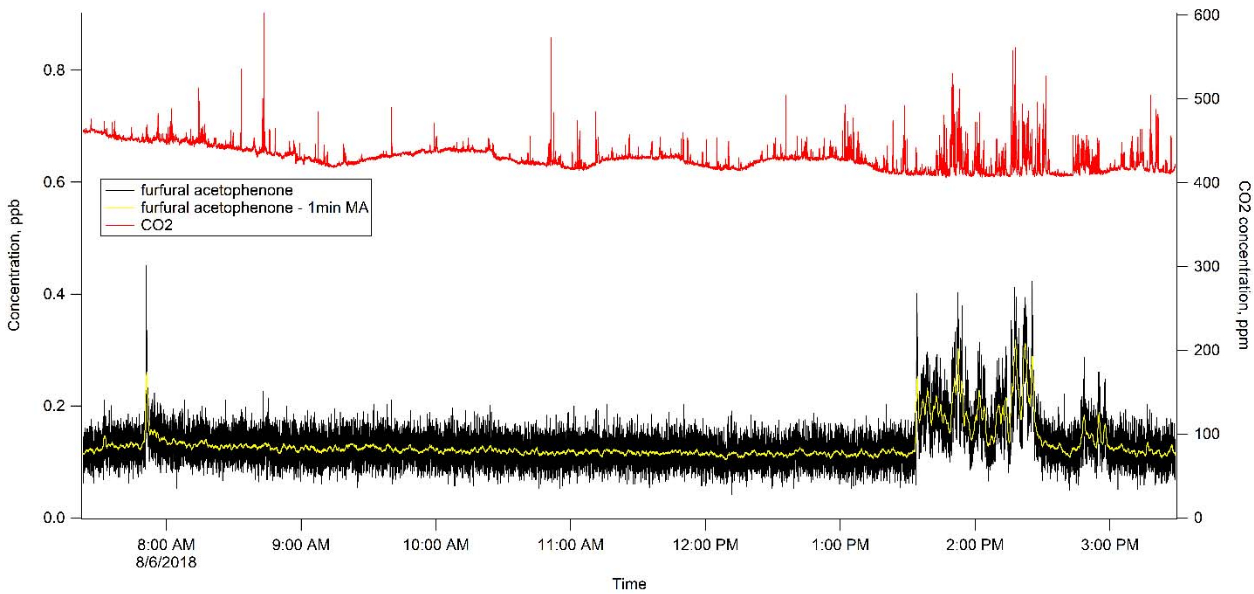

Figure 1-19. Furfural Acetophenone.

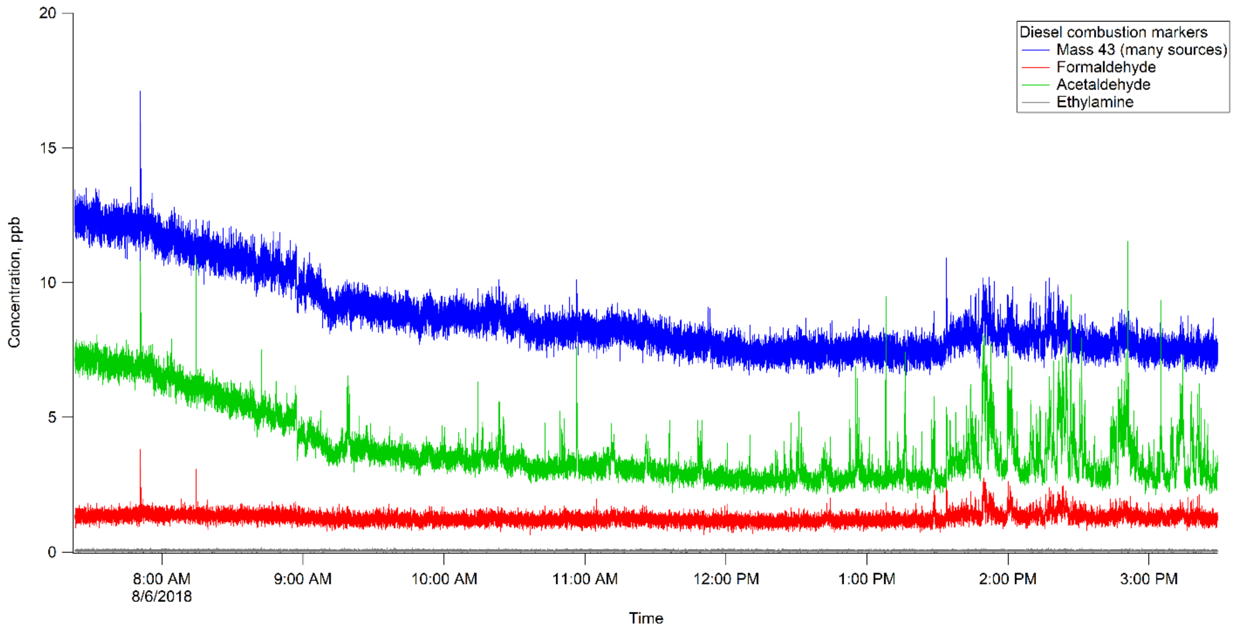

Figure 1-20. Diesel Combustion Markers.

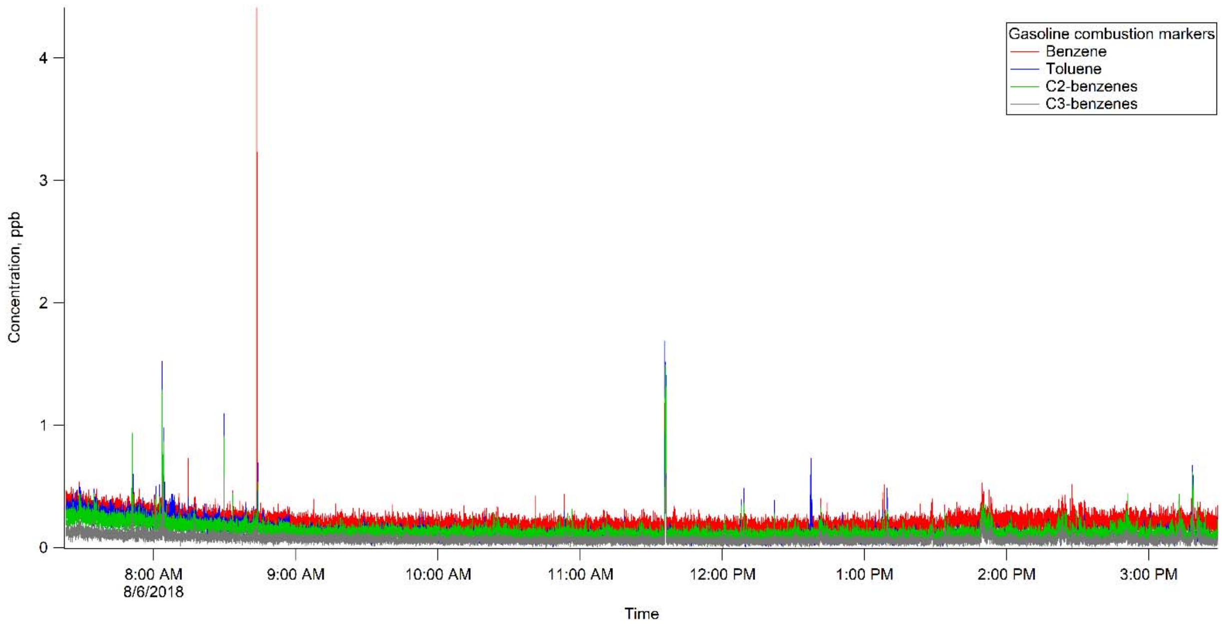

Figure 1-21. Gasoline Combustion Markers.

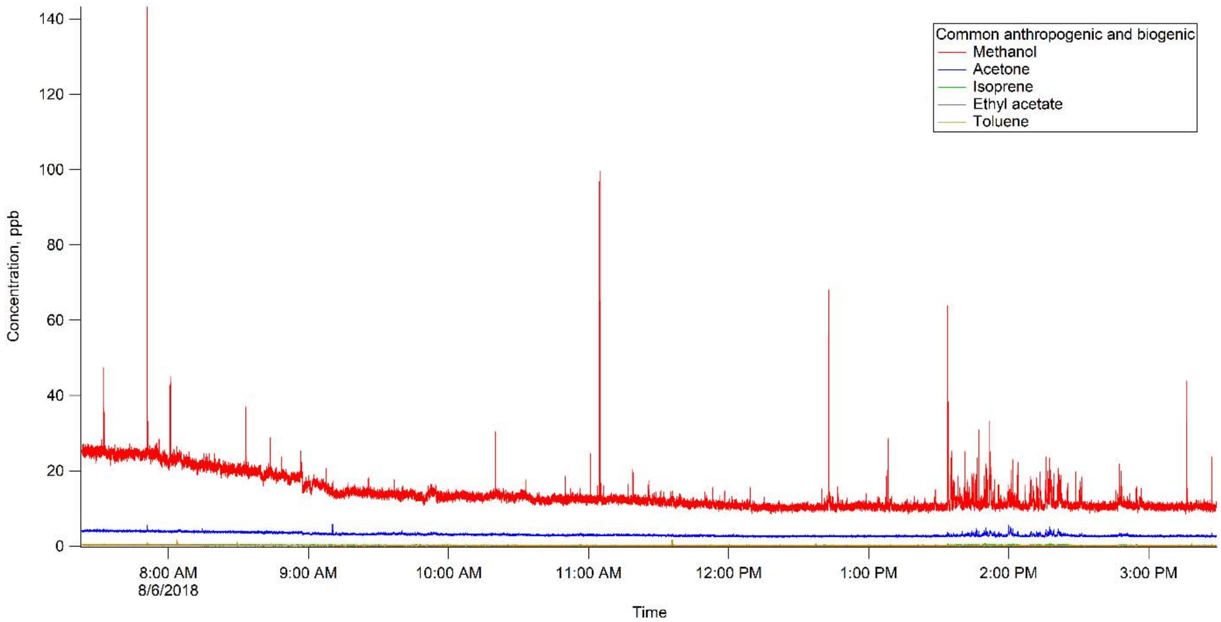

Figure 1-22. Plant and Human Markers.

1.5 Source Characterization – Septic Tanks

From approximately 13:10 to 14:40, ML staff monitored septic tanks with Mr. Steve Wolfe east of the 242-A Evaporator. The goal of this monitoring activity was to characterize the constituents of this source in an effort to identify it while area monitoring. The table and plots below show data from only this time period, with a focus on only odor-causing compounds.

Table 1-3. Odor Statistical Information for the Monitoring Period of August 6, 2018.

Odor #	Odor Compound Name	Ave. (ppb)	St. Dev. (ppb)	Rel St. Dev. (%)	Max (ppb)	Median (ppb)
1	methyl mercaptan	0.116	0.035	54.651	0.561	0.114
2	dimethylsulfide + ethanethiol	0.136	0.032	15.479	0.263	0.135
3	allyl mercaptan	0.010	0.015	35.695	0.102	0.000
4	1-propanethiol + isopropyl mercaptan	0.010	0.017	14.687	0.130	0.000
5	2-butene-1-thiol	0.013	0.020	34.735	0.132	0.000
6	diethyl sulfide + 2-methylpropane-2-thiol	0.179	0.043	43.013	0.397	0.175
7	thiopropanal sulfuroxide	0.046	0.028	57.234	0.175	0.043
8	dimethyl disulfide	0.010	0.022	30.602	0.224	0.000
9	1-pentanethiol + 2,2-dimethylpropane-1-thiol	0.058	0.056	30.401	0.301	0.060
10	benzenethiol	0.017	0.023	35.286	0.152	0.005
11	diallyl sulfide	0.019	0.026	45.800	0.188	0.004
12	methyl propyl disulfide	0.014	0.026	30.435	0.176	0.000
13	methylbenzenethiol	0.026	0.026	35.938	0.155	0.020
14	dimethyl trisulfide	0.019	0.018	52.581	0.101	0.016
15	(1-oxoethyl) thiophene	0.068	0.058	47.895	0.320	0.061
16	(1-oxopropyl) thiophene	0.045	0.029	39.085	0.165	0.044
17	dipropyl disulfide	0.026	0.016	127.507	0.098	0.025
18	methyl propyl trisulfide	0.017	0.026	34.306	0.138	0.000
19	dimethyl tetrasulfide	0.021	0.012	35.346	0.072	0.020
20	dipropyl trisulfide	0.011	0.022	51.084	0.129	0.000
21	diphenyl sulfide	0.016	0.020	38.646	0.103	0.008

The following figures display potential odor-causing chemical signal, overlaid with the same signal smoothed using a one-minute moving average, and CO_2, for the monitoring period of August 6, 2018.

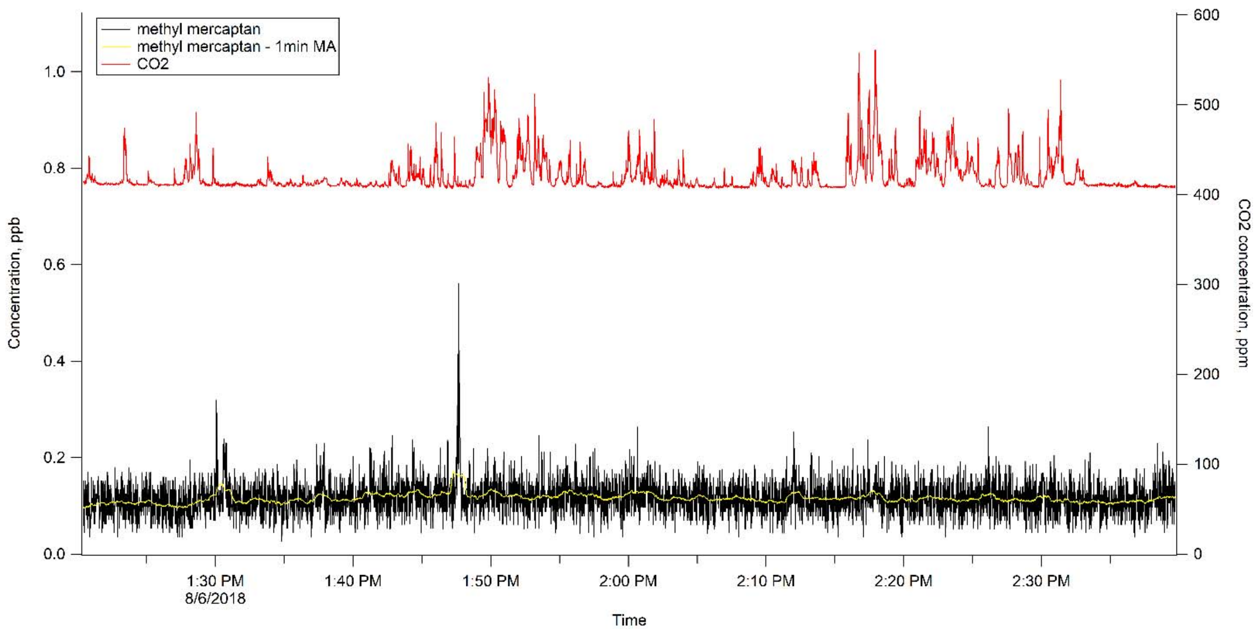

Figure 1-23. Methyl Mercaptan.

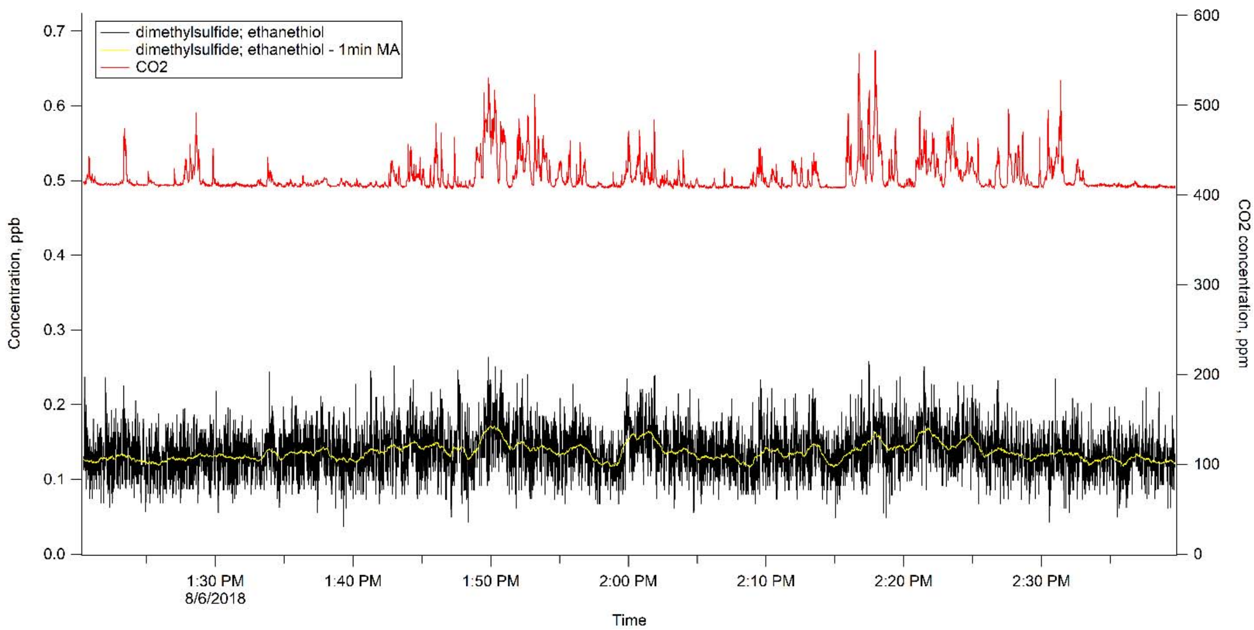

Figure 1-24. Dimethyl Sulfide; Ethanethiol.

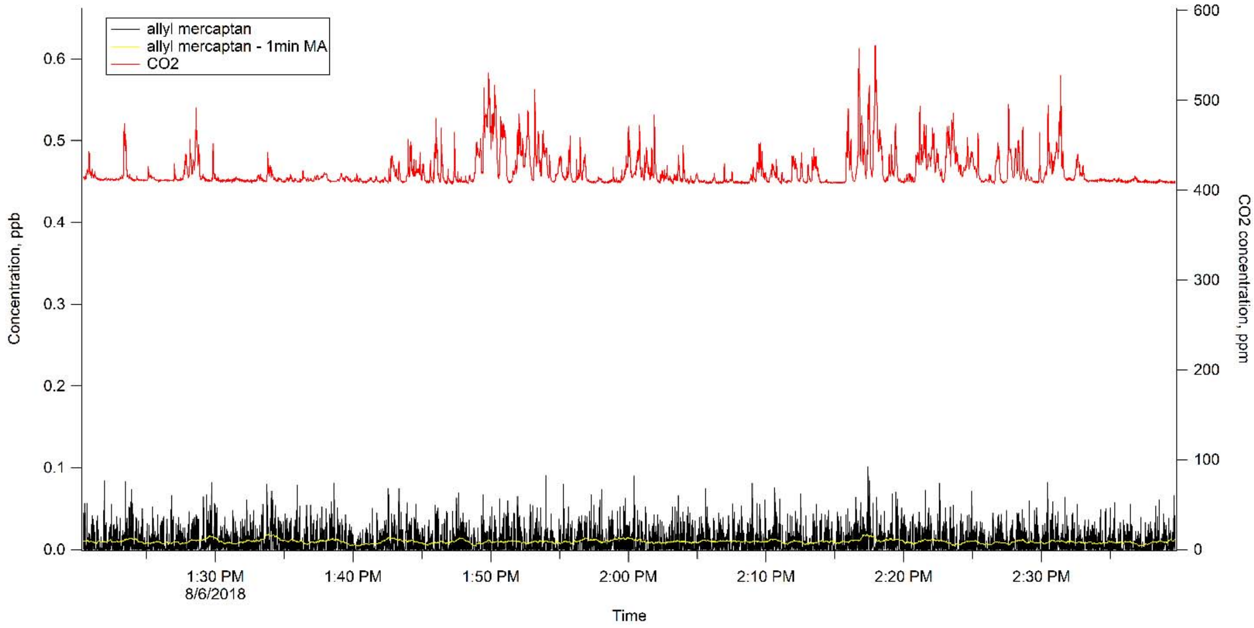

Figure 1-25. Allyl Mercaptan.

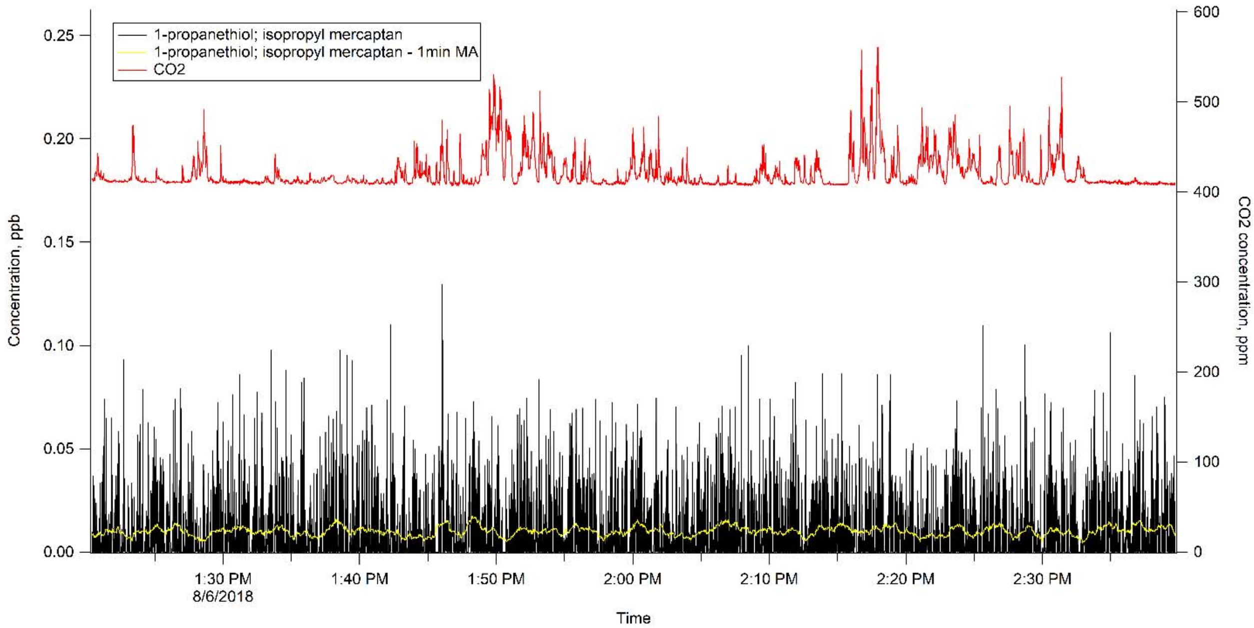

Figure 1-26. 1-propanethiol; Isopropyl Mercaptan.

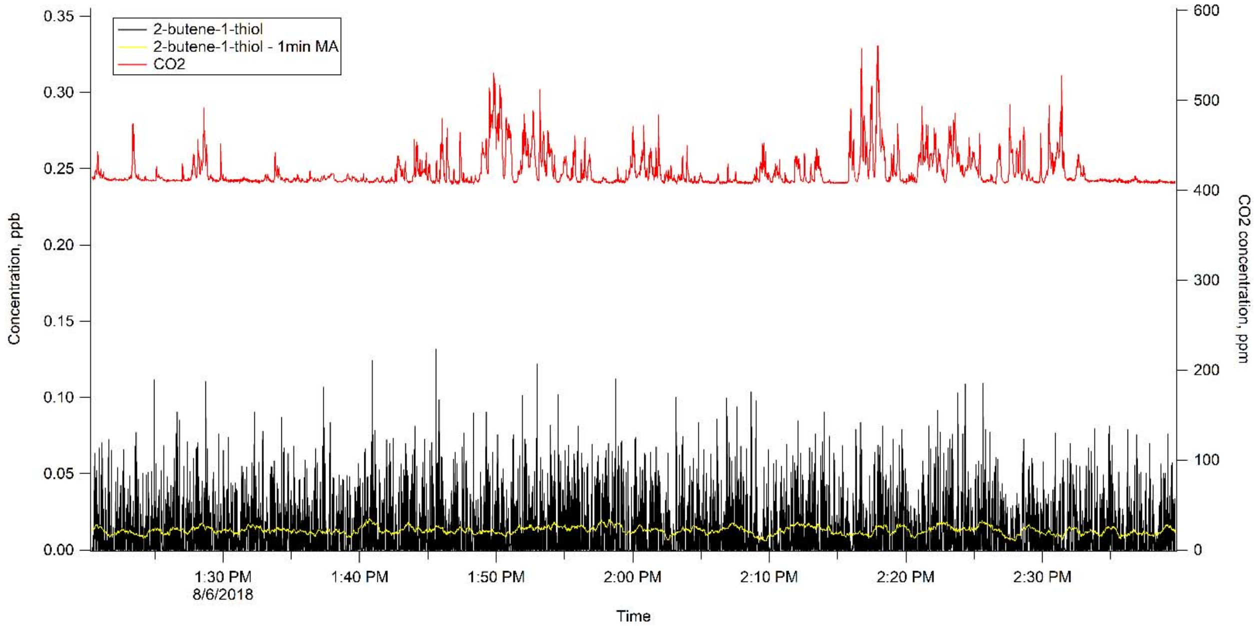

Figure 1-27. 2-butene-1-thiol.

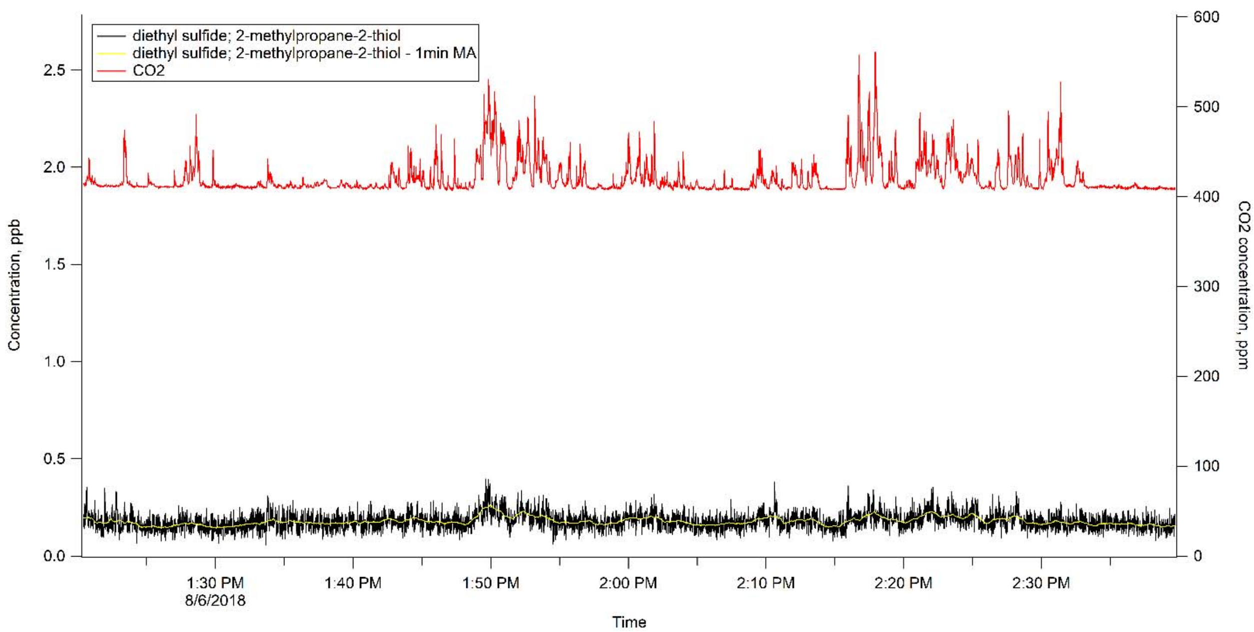

Figure 1-28. Diethyl Sulfide; 2-methylpropane-2-thiol.

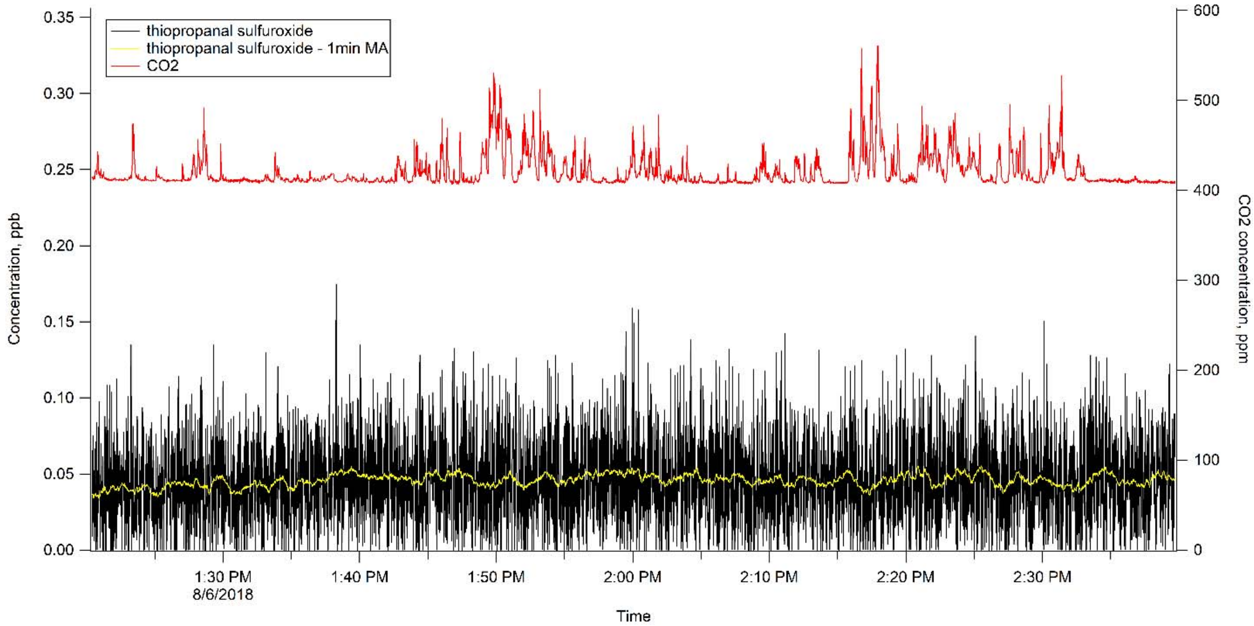

Figure 1-29. Thiopropanal Sulfuroxide.

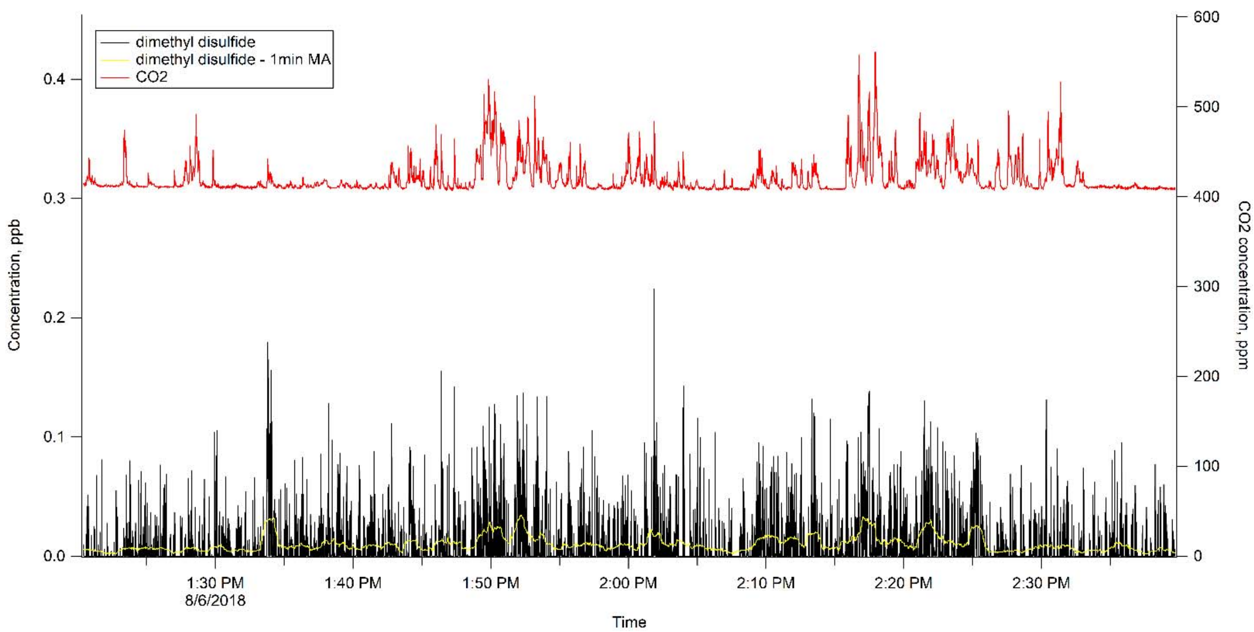

Figure 1-30. Dimethyl Disulfide.

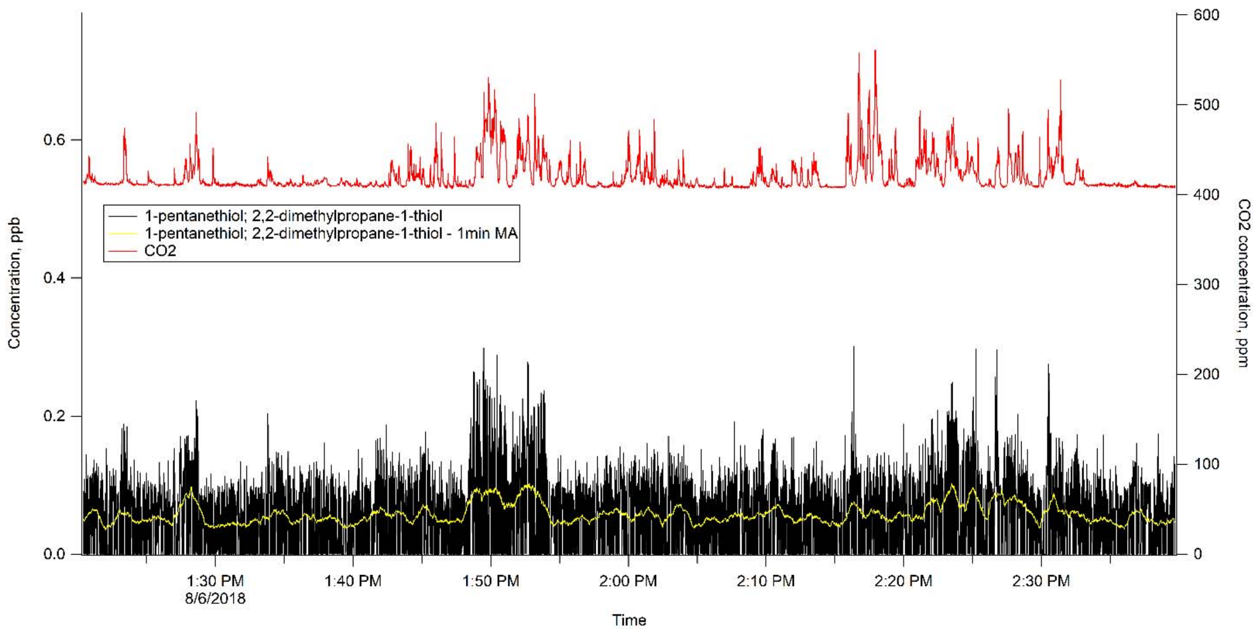

Figure 1-31. 1-pentanethiol; 2,2-dimethylpropane-1-thiol.

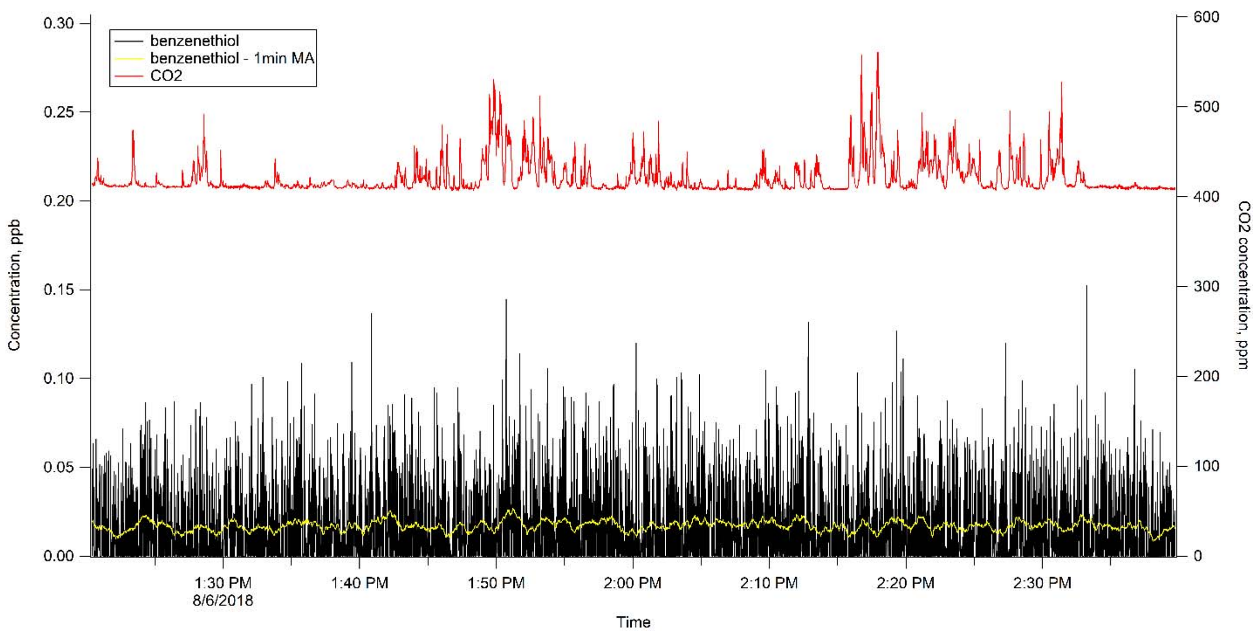

Figure 1-32. Benzenethiol.

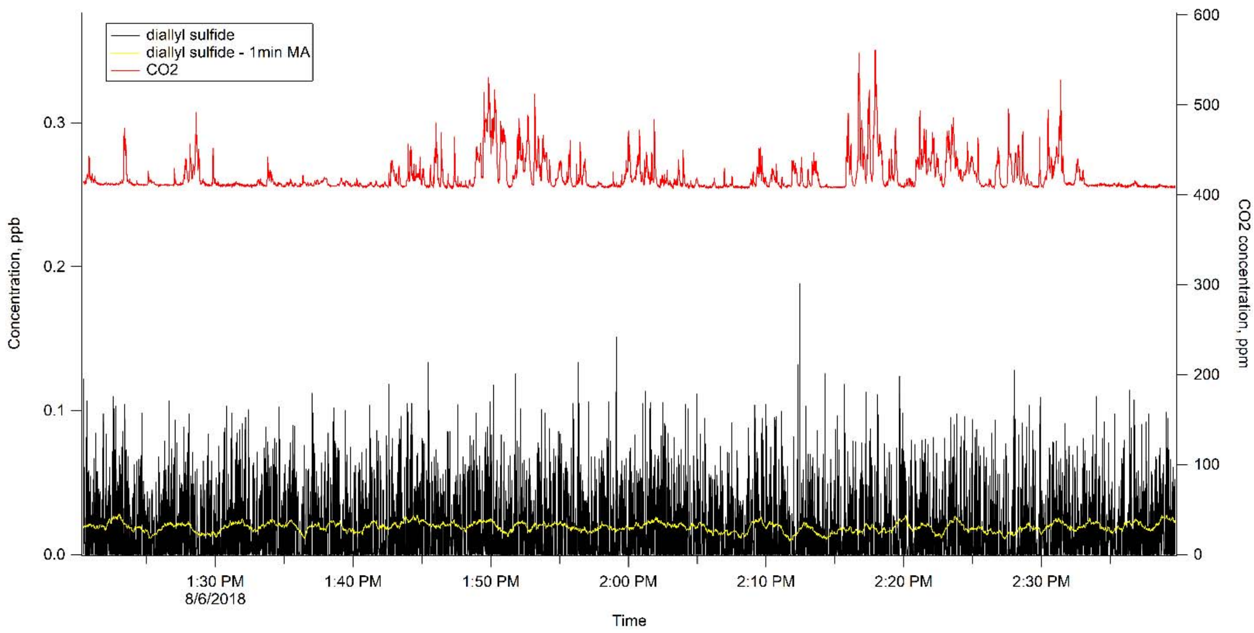

Figure 1-33. Diallyl Sulfide.

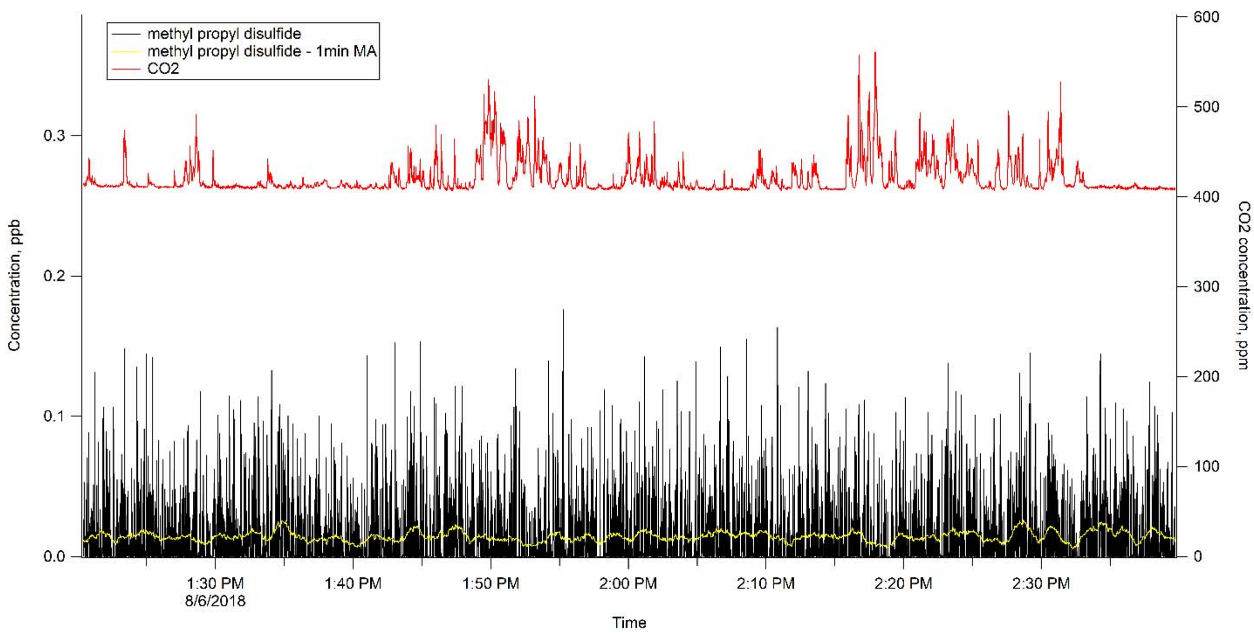

Figure 1-34. Methyl Propyl Disulfide.

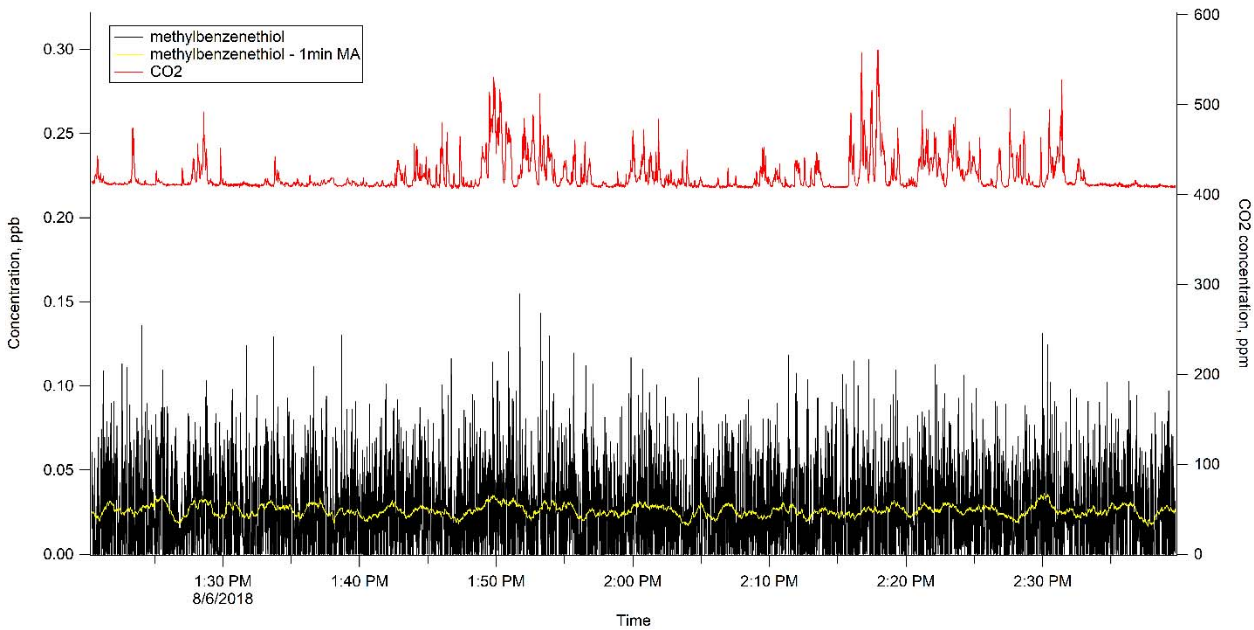

Figure 1-35. Methylbenzenethiol

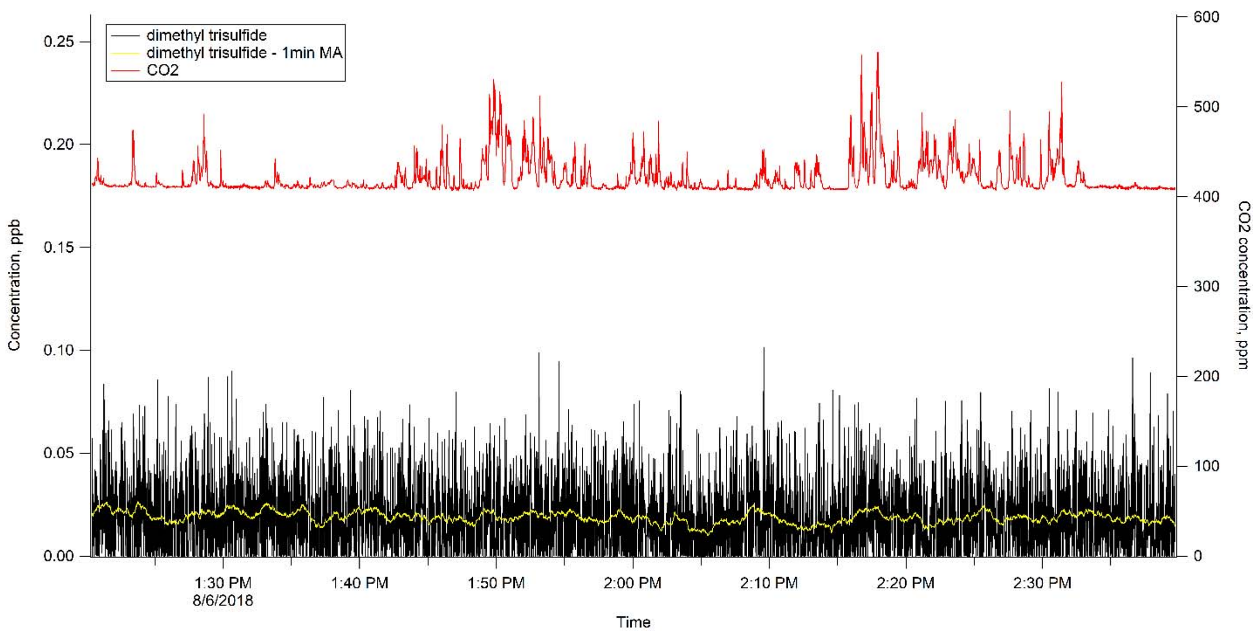

Figure 1-36. Dimethyl Trisulfide.

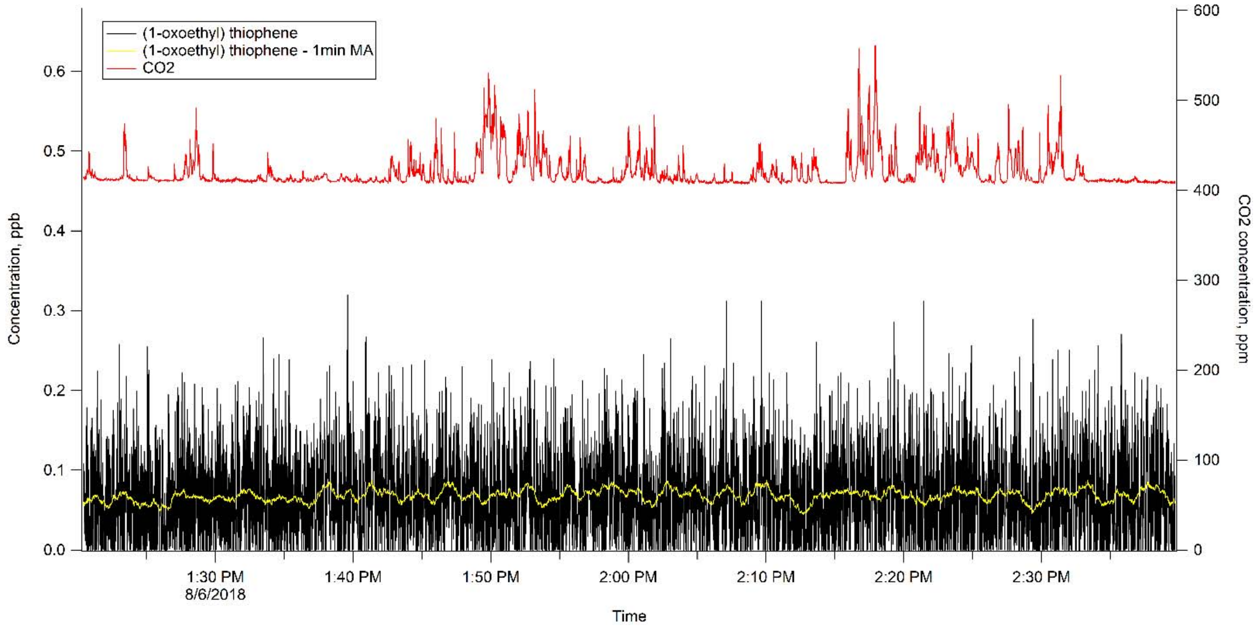

Figure 1-37. (1-oxoethyl) Thiophene.

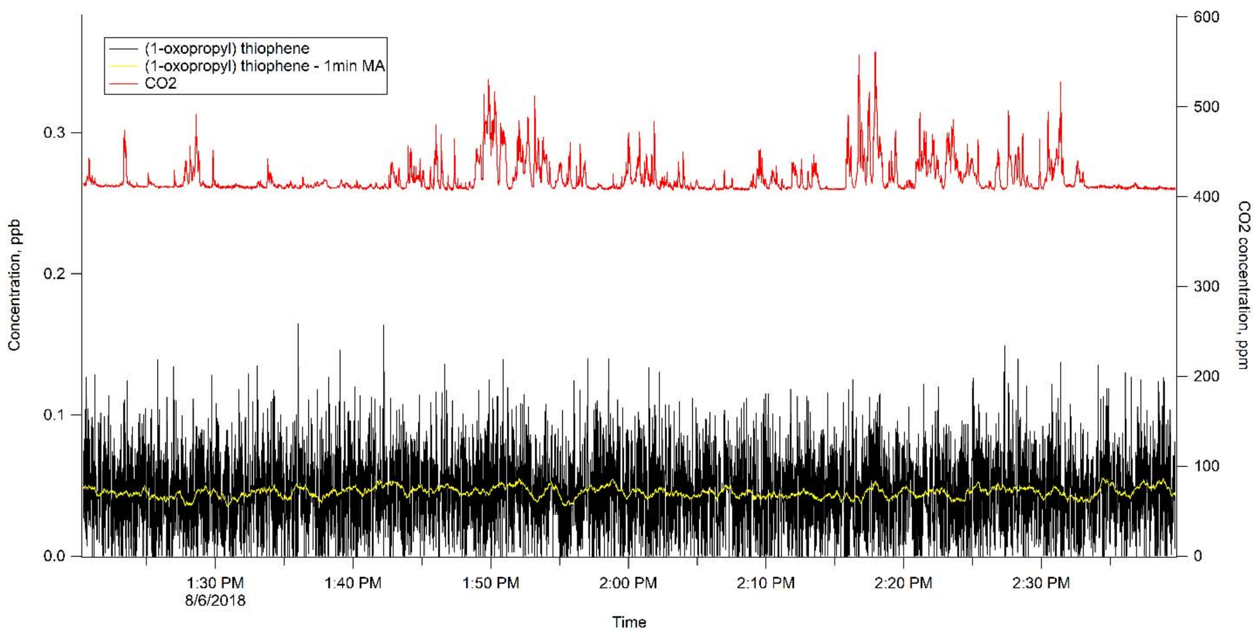

Figure 1-38. (1-oxopropyl) Thiophene.

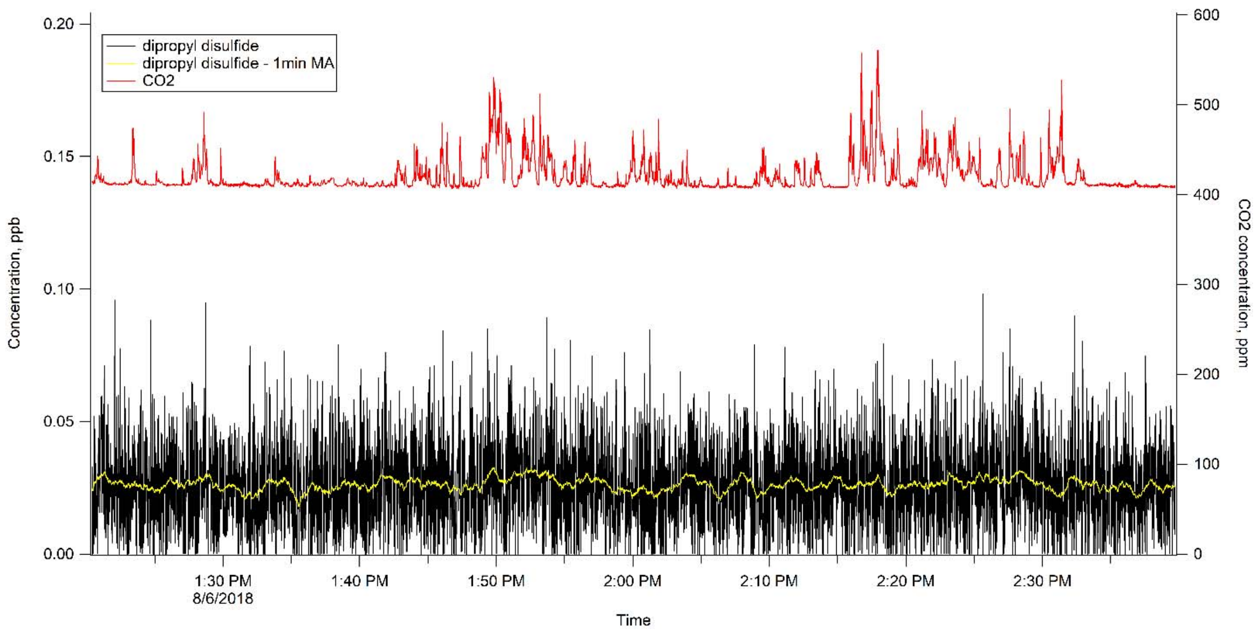

Figure 1-39. Dipropyl Disulfide.

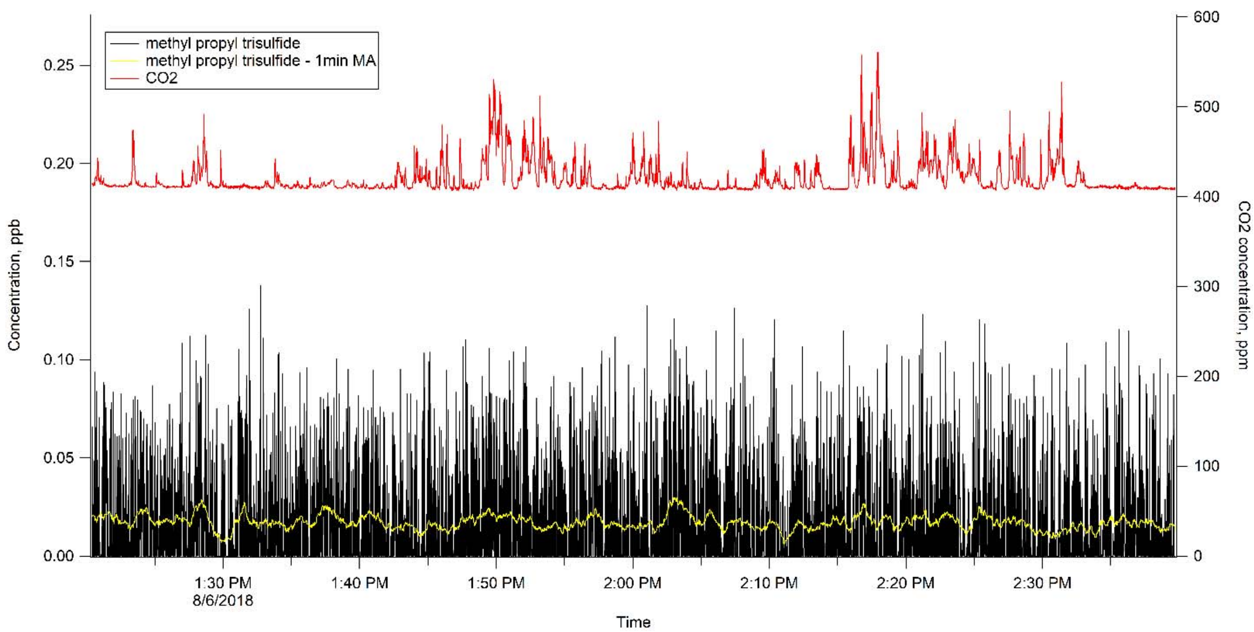

Figure 1-40. Methyl propyl Trisulfide.

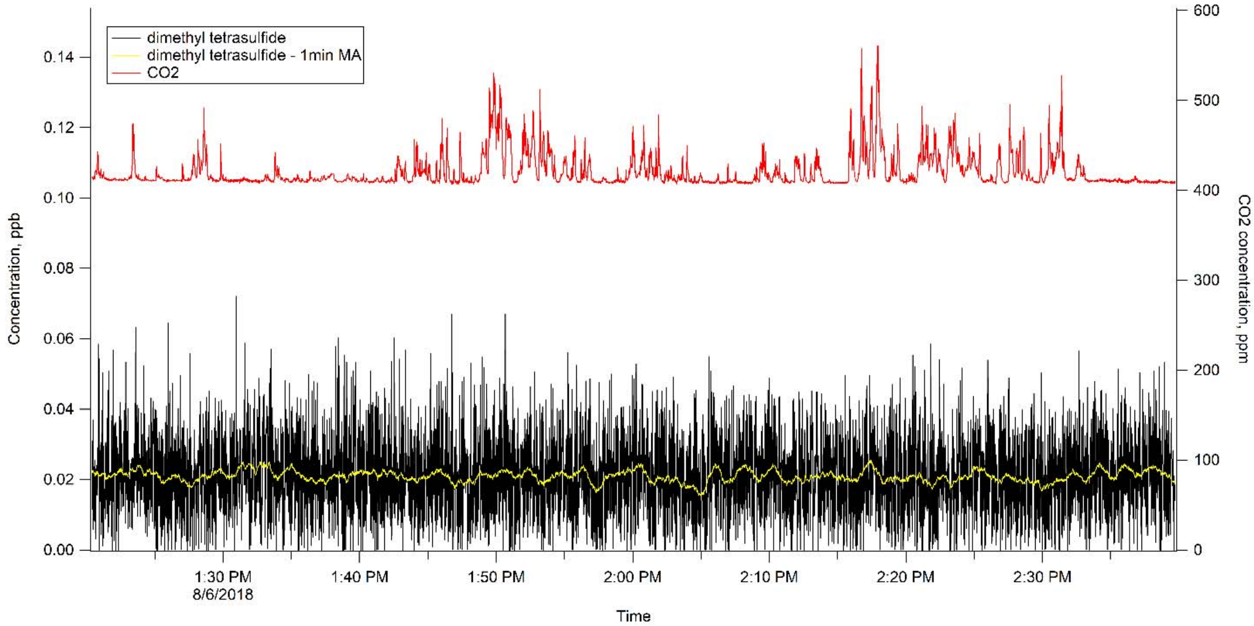

Figure 1-41. Dimethyl Tetrasulfide.

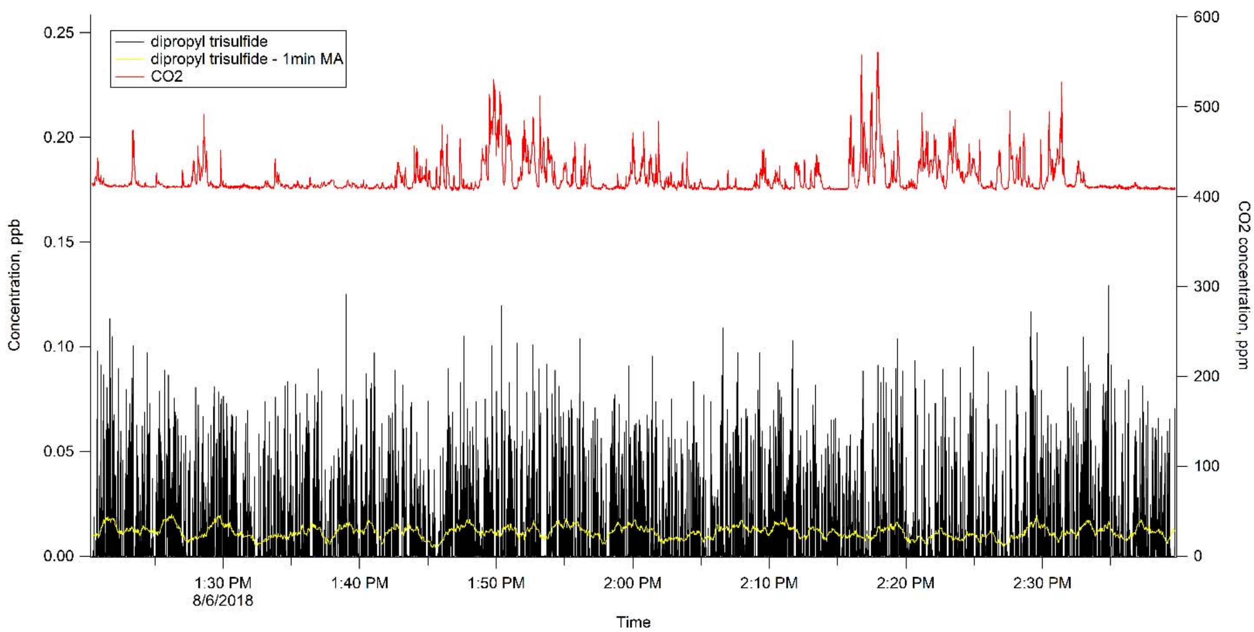

Figure 1-42. Dipropyl Trisulfide.

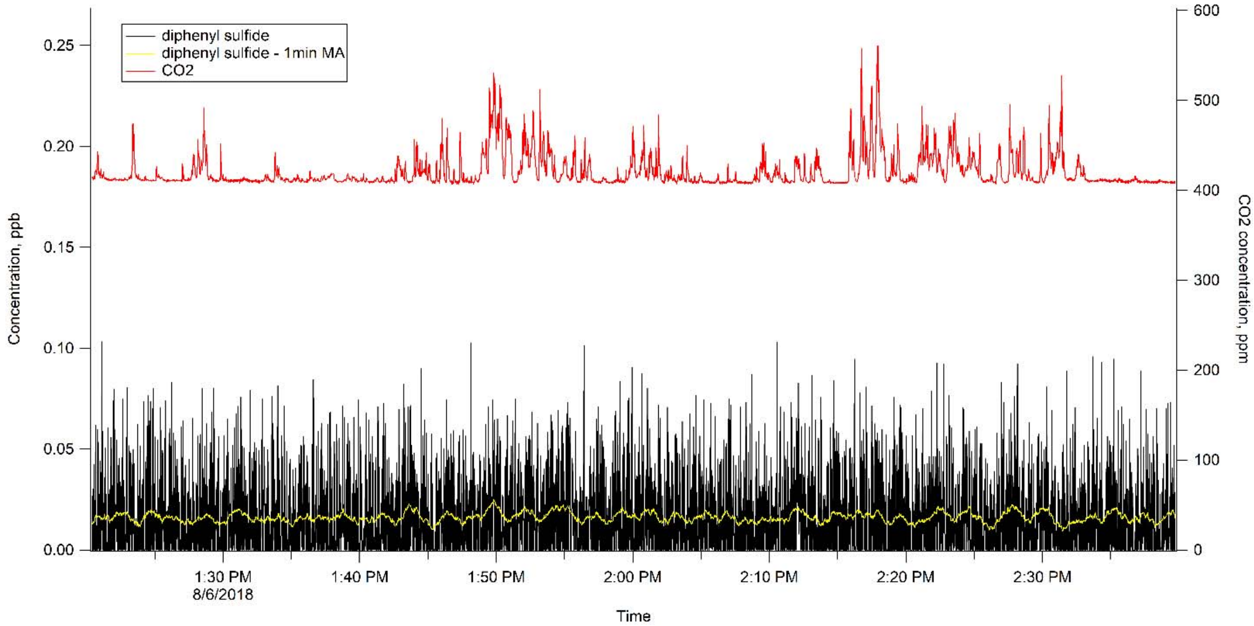

Figure 1-43. Diphenyl Sulfide.

2.0 AUGUST 7, 2018 – SOURCE CHARACTERIZATION AND AREA MONITORING

2.1 Quality Assessment

Data from August 7, 2018, were assessed using Procedure 17124-DOE-HS-102. A Data Exchange Checklist was completed. The data were accepted by TerraGraphics with the following comments. Report No. 66409-RPT-004 was adequately documented and all checks passed the acceptance limits.

2.2 Summary

On August 7, 2018, the ML performed general area monitoring and source characterization of emissions on the Hanford Site.

The ML arrived at the Central Shift Office (CSO) at 06:17 on August 7, 2018. A QA/QC zero-air/sensitivity check began at 05:16 on the CO_2 monitor prior to arrival. The ML staff began monitoring at 4th and Buffalo at 06:23 and remained there for approximately 30 minutes before transitioning to septic tank monitoring east of the 242-A Evaporator. During septic monitoring, both mast and side port configurations were utilized. Upon leaving the septic tanks, the ML performed mobile monitoring of the A Farms at approximately 13:15.

The ML checked out at the CSO at approximately 13:30 and began the return trip to TerraGraphics during which QA/QC zero-air/sensitivity checks of the Picarro, Li-Cor, and PTR-MS were performed at 13:46.

Table 2-1. Mobile Laboratory Sampling Mode Throughout the Monitoring Period.

Time	Location	Sampling Mode
06:23 - 07:06	A Farms-4th and Buffalo	Stationary sampling (mast)
07:06 - 07:52	A Farms-septic tanks	Stationary sampling (mast)
07:52 - 08:32	A Farms-septic tanks	Side Port sampling
08:32 - 09:25	A Farms-moved side port to septic tanks closest to evaporator	Side Port sampling
09:25 - 09:44	A Farms-septic tanks	Stationary sampling (mast)
09:44 - 10:16	A Farms	Mobile Area sampling
10:16 - 11:36	A Farms-West of 241-A tank farm	Stationary sampling (mast)
11:36 - 12:02	A Farms	Mobile Area sampling
12:02 - 13:15	A Farms-west of septic tanks	Stationary sampling
13:15 - 13:30	A Farms	Mobile Area sampling

Figure 2-1. Mobile Laboratory Location for the Duration of the Monitoring Period. ***Blue location marker indicates site of septic tank monitoring.***

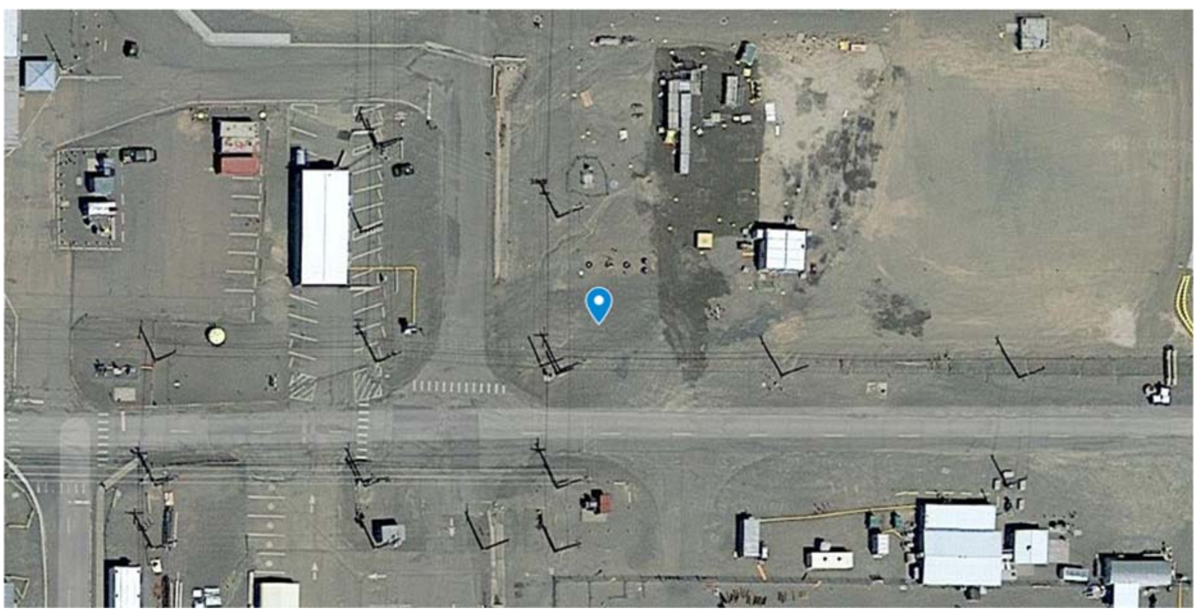

Figure 2-2. (Inset) Mobile Laboratory Location for the Duration of the Septic Tank Monitoring Period.

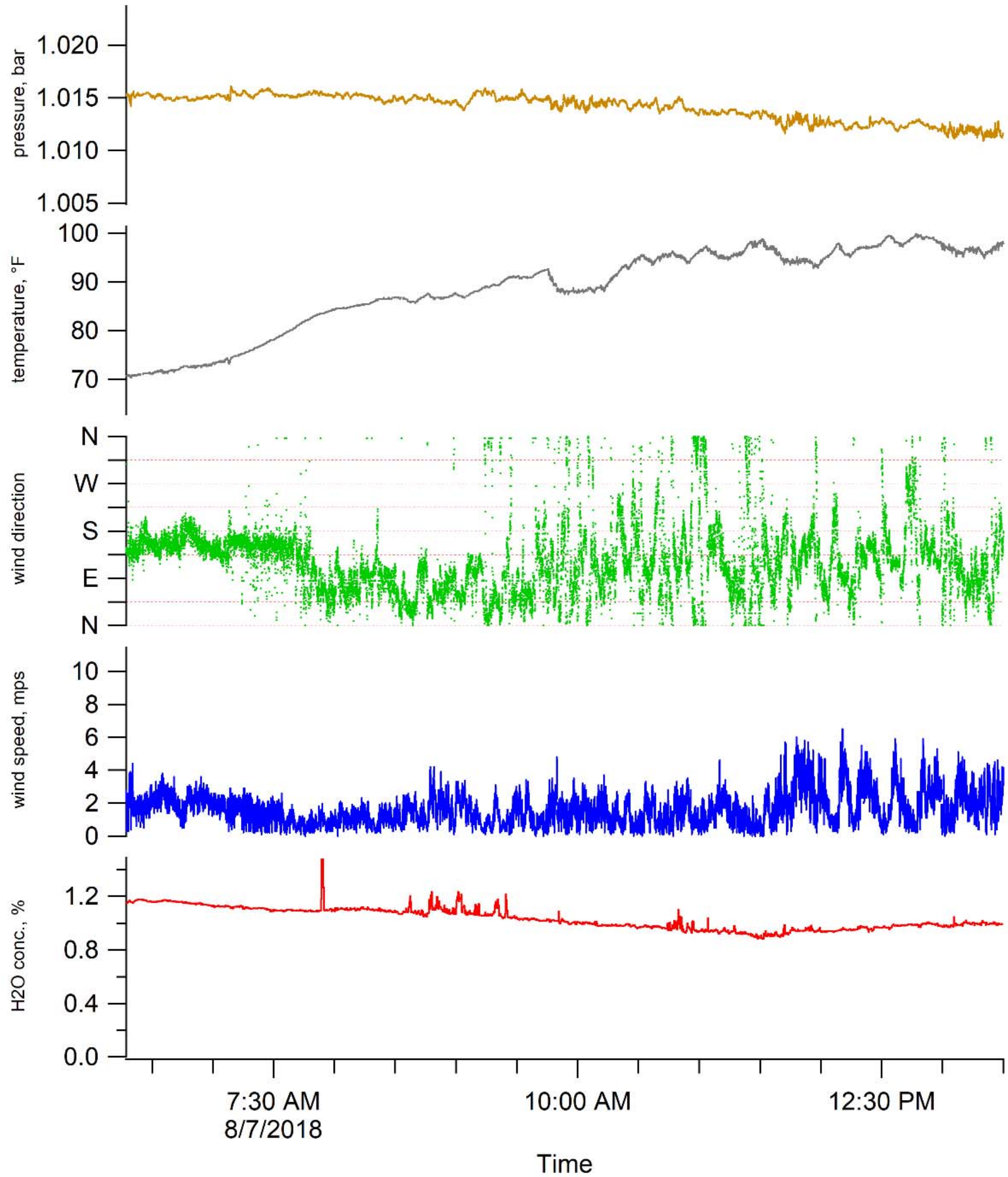

Figure 2-3. Weather Data for the Duration of the Monitoring Period.

2.3 Samples Collected

Continuous air monitoring was performed using the following instrumentation:

- PTR-TOF 6000 X2,
- LI-COR CO_2 Monitor,
- Picarro Ammonia Monitor, and
- Weather Station.

Confirmatory air samples were not collected during this period.

2.4 Source Characterization – Septic Tanks

Figure 2-4. Septic Tank Monitoring.

From approximately 07:52 to 09:25, ML staff monitored septic tanks east of the 242-A Evaporator. The goal of this monitoring activity was to characterize the constituents of this source in an effort to identify it while area monitoring. The table and plots below show data from only this time period, with a focus on only odor-causing compounds.

Table 2-2. Odor Statistical Information for the Monitoring Period of August 7, 2018.

Odor #	Odor Compound Name	Ave. (ppb)	St. Dev (ppb)	Rel St. Dev. (ppb)	Max (ppb)	Median (ppb)
1	methyl mercaptan	2.050	4.121	49.403	38.257	0.323
2	dimethylsulfide + ethanethiol	0.870	1.295	16.142	11.494	0.343
3	allyl mercaptan	0.010	0.015	38.047	0.086	0.001
4	1-propanethiol + isopropyl mercaptan	0.022	0.020	14.373	0.117	0.018
5	2-butene-1-thiol	0.024	0.029	34.679	0.230	0.014
6	diethyl sulfide + 2-methylpropane-2-thiol	0.134	0.039	56.543	0.378	0.128
7	thiopropanal sulfuroxide	0.020	0.014	56.346	0.083	0.019
8	dimethyl disulfide	0.058	0.114	32.768	1.088	0.013
9	1-pentanethiol + 2,2-dimethylpropane-1-thiol	0.021	0.032	34.142	0.242	0.000
10	benzenethiol	0.010	0.014	43.670	0.091	0.002
11	diallyl sulfide	0.021	0.026	46.918	0.150	0.009
12	methyl propyl disulfide	0.010	0.015	33.662	0.100	0.000
13	methylbenzenethiol	0.025	0.017	37.349	0.105	0.023
14	dimethyl trisulfide	0.023	0.017	76.647	0.144	0.020
15	(1-oxoethyl) thiophene	0.022	0.023	53.674	0.130	0.016
16	(1-oxopropyl) thiophene	0.023	0.017	37.497	0.098	0.020
17	dipropyl disulfide	0.013	0.011	114.852	0.070	0.011
18	methyl propyl trisulfide	0.006	0.010	35.095	0.058	0.000
19	dimethyl tetrasulfide	0.009	0.007	40.080	0.045	0.007
20	dipropyl trisulfide	0.005	0.010	75.737	0.067	0.000
21	diphenyl sulfide	0.011	0.013	42.141	0.074	0.007

The following figures display potential odor-causing signals, overlaid with the same signal smoothed using a one-minute moving average, and CO_2, for the monitoring period of August 7, 2018.

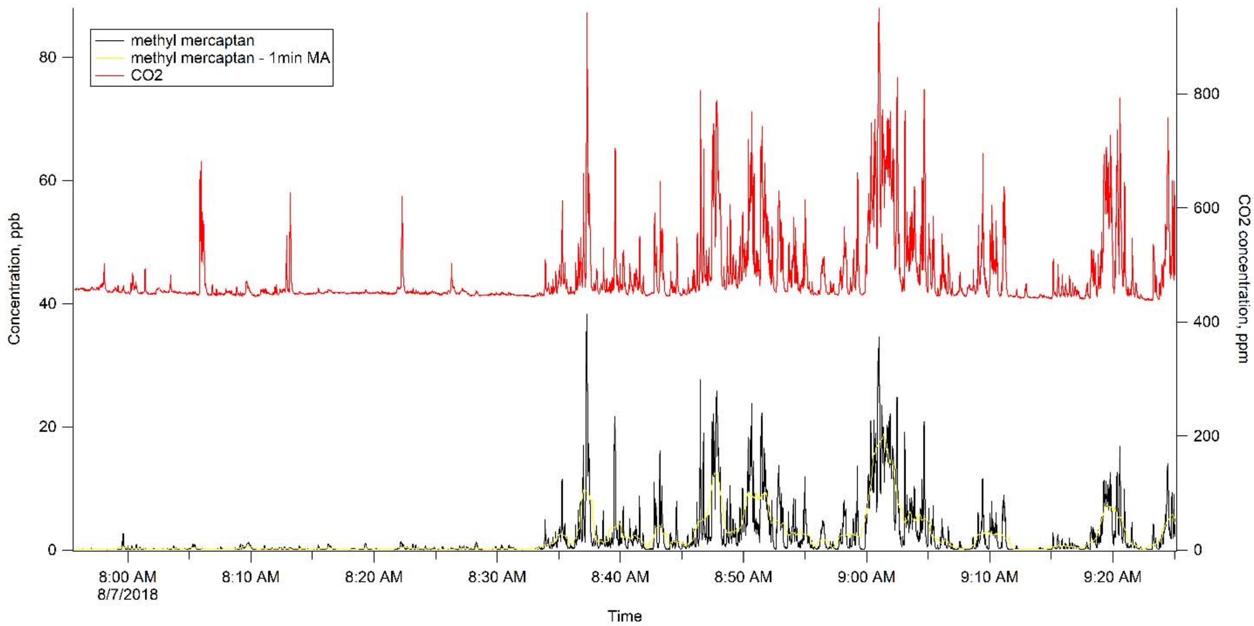

Figure 2-5. Methyl Mercaptan.

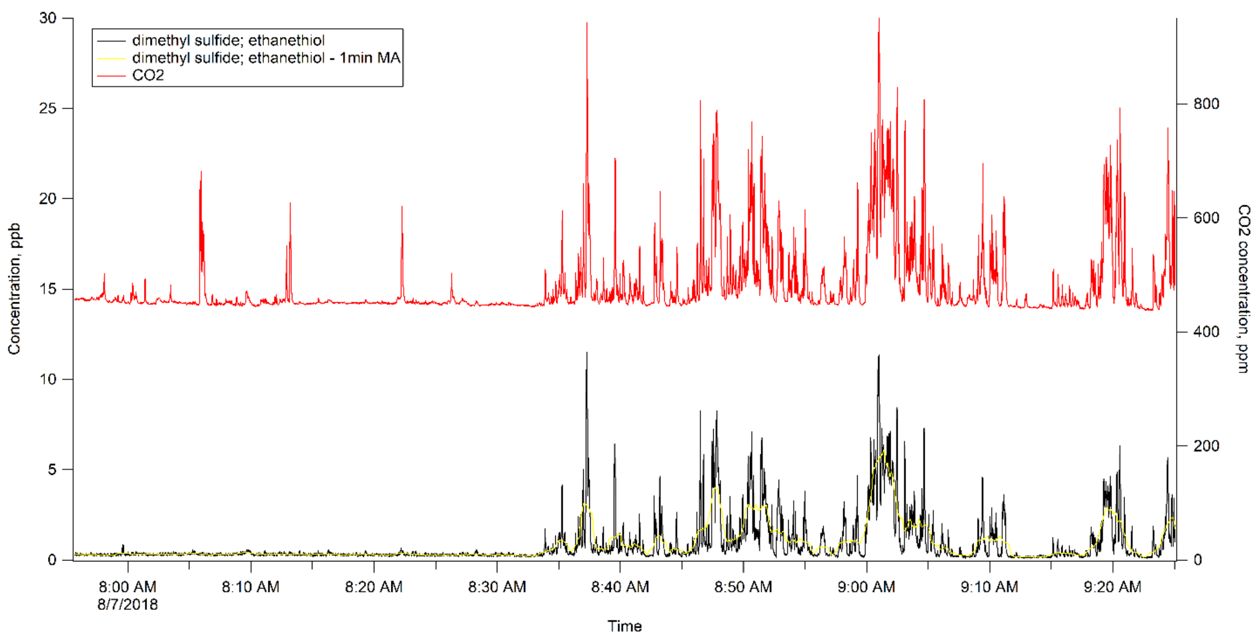

Figure 2-6. Dimethyl Sulfide; Ethanethiol.

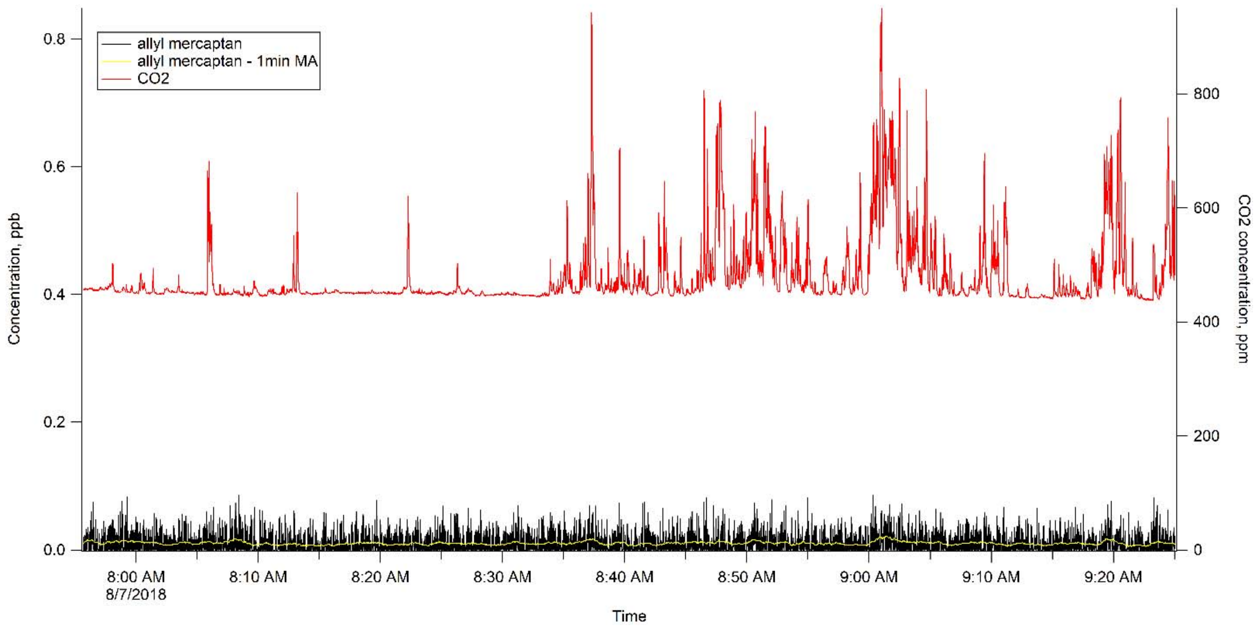

Figure 2-7. Allyl Mercaptan.

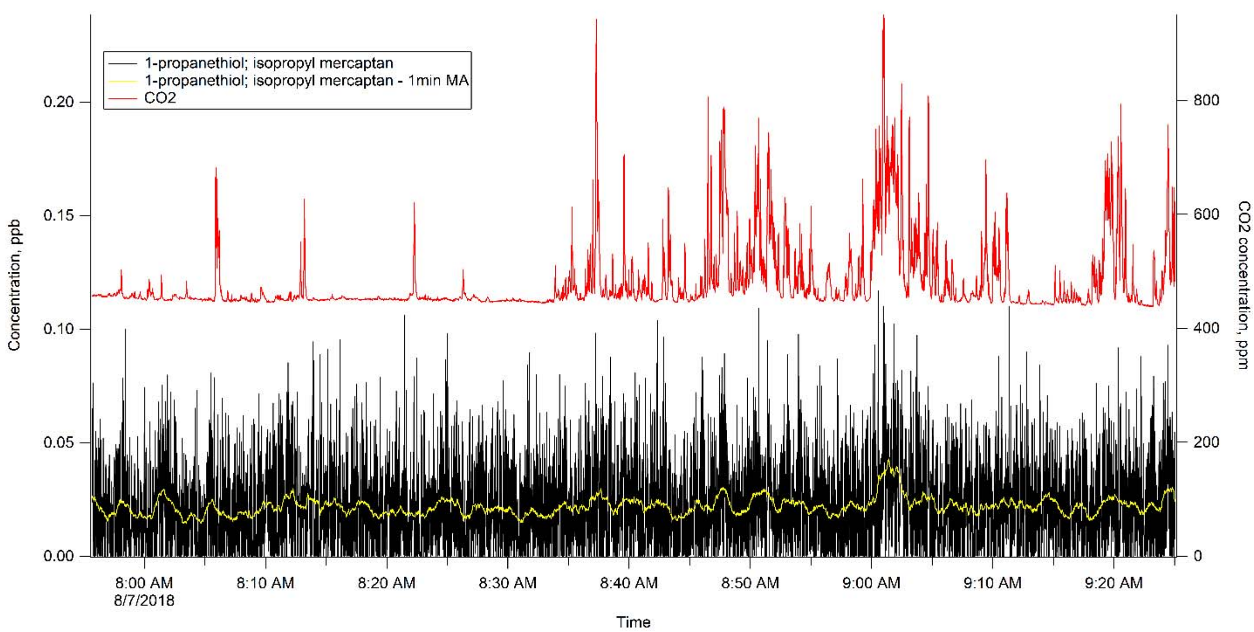

Figure 2-8. 1-propanethiol; Isopropyl Mercaptan.

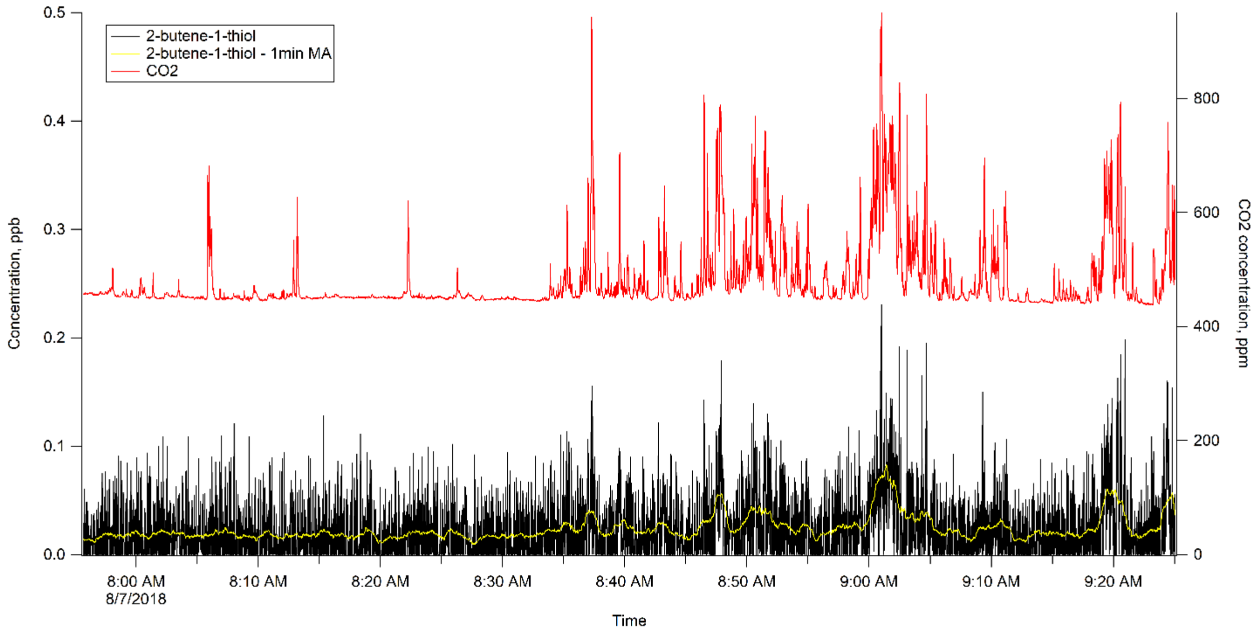

Figure 2-9. 2-butene-1-thiol.

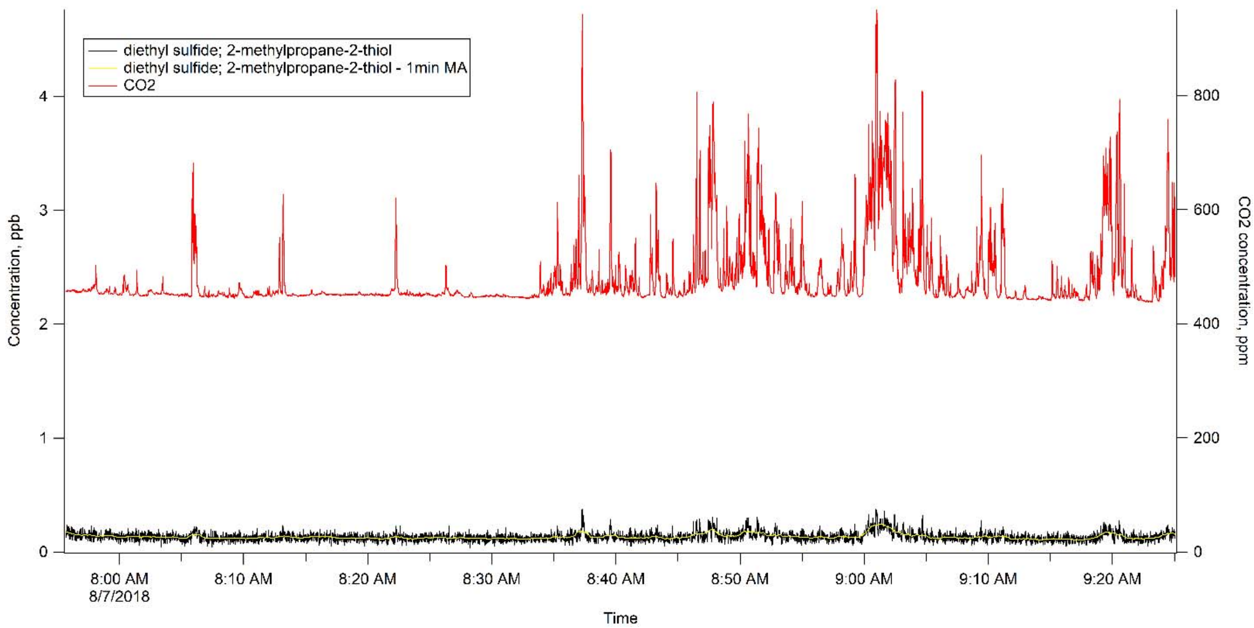

Figure 2-10. Diethyl Sulfide; 2-methylpropane-2-thiol.

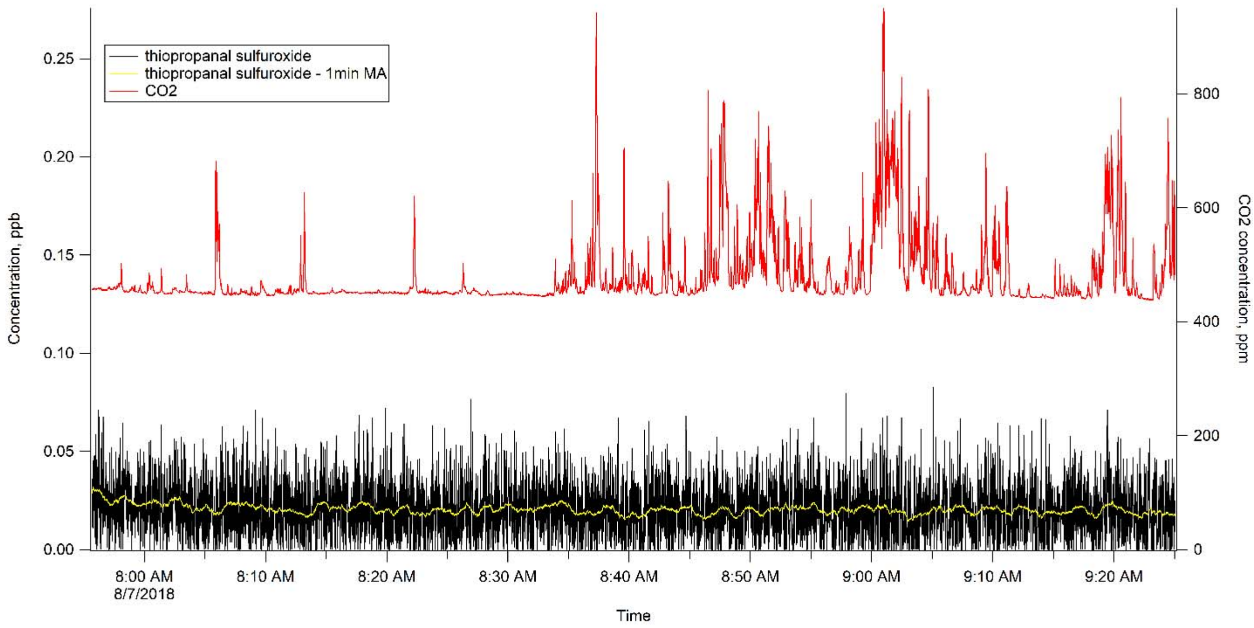

Figure 2-11. Thiopropanal Sulfuroxide.

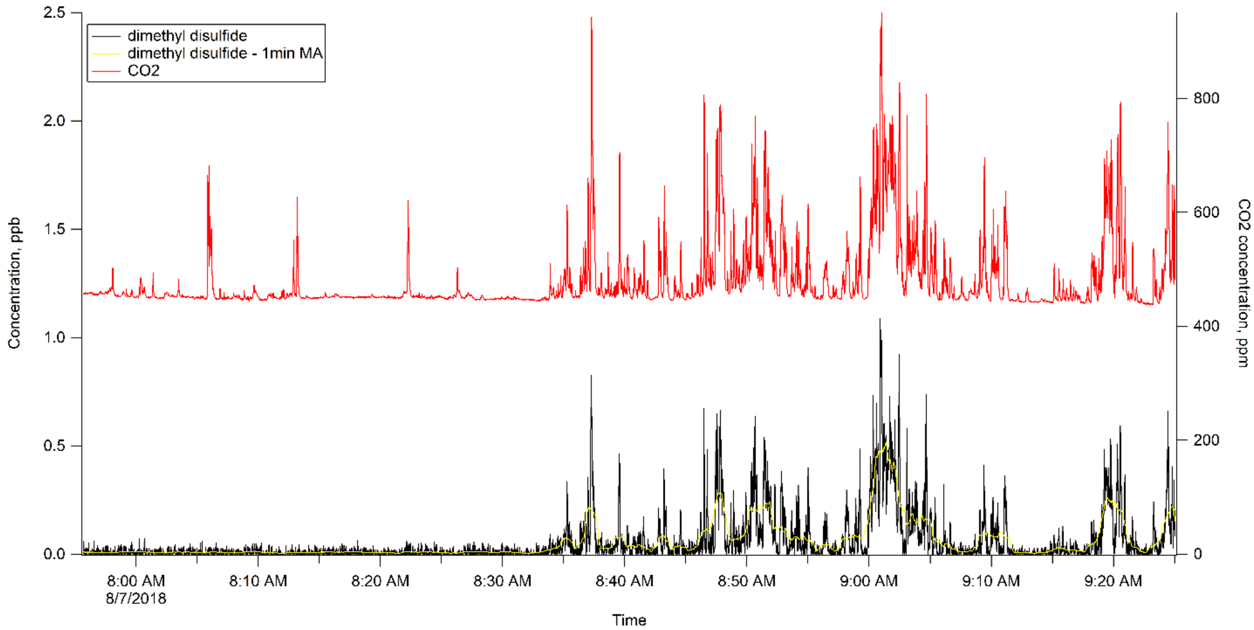

Figure 2-12. Dimethyl Disulfide.

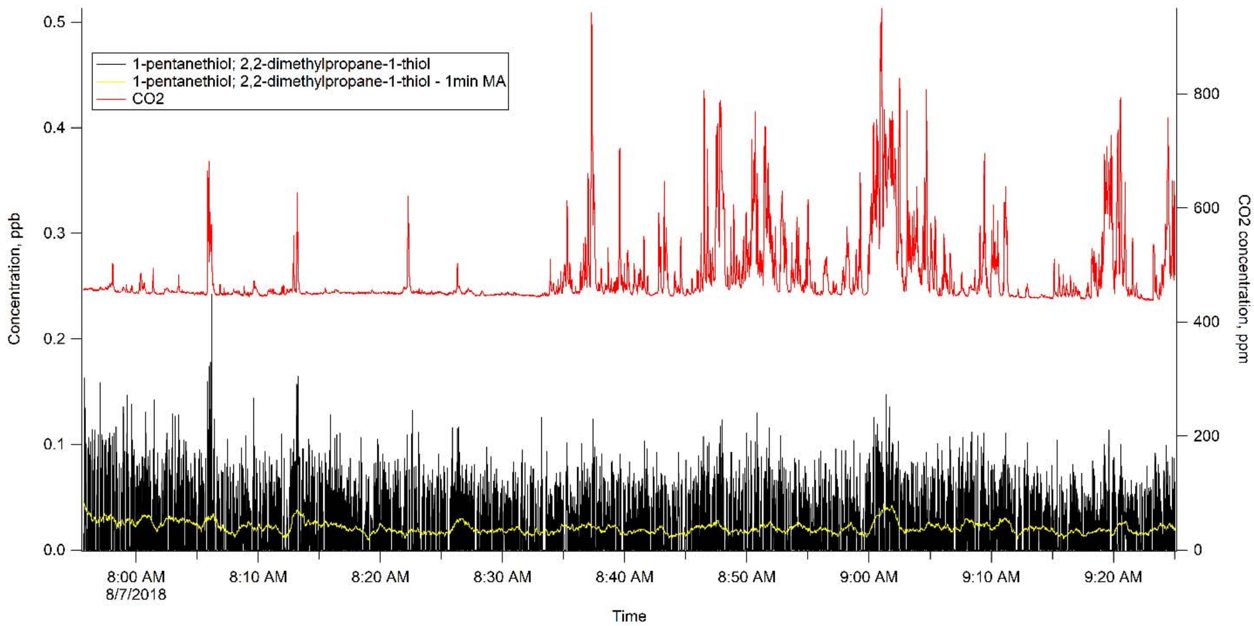

Figure 2-13. 1-pentanethiol; 2,2-dimethylpropane-1-thiol.

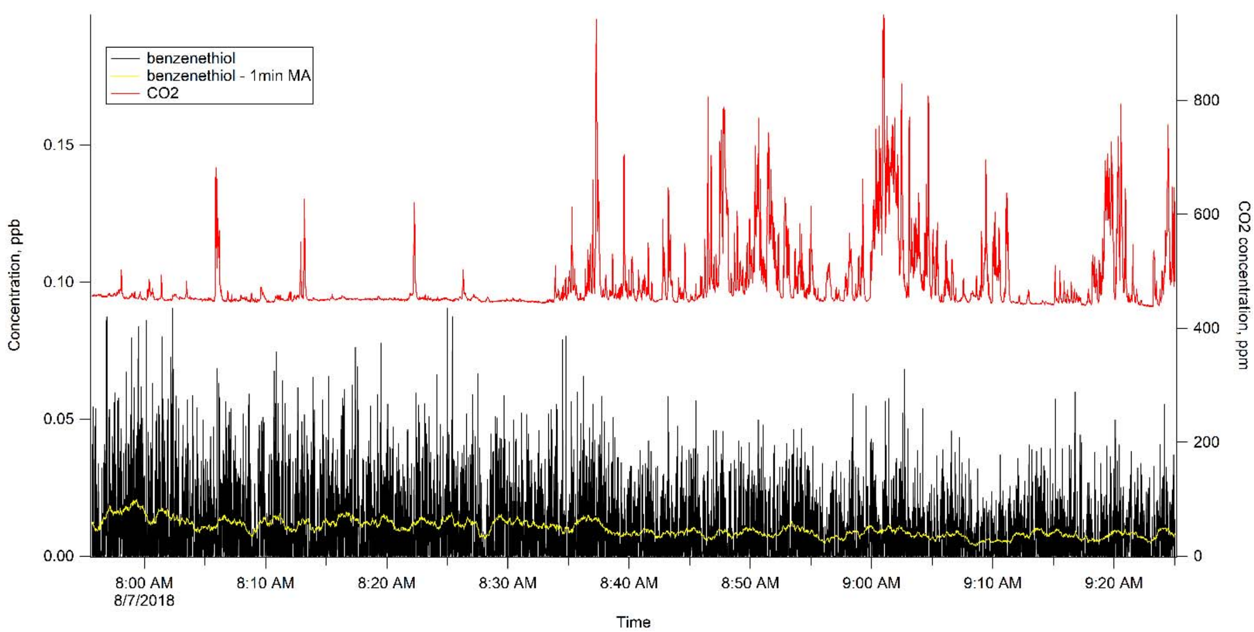

Figure 2-14. Benzenethiol.

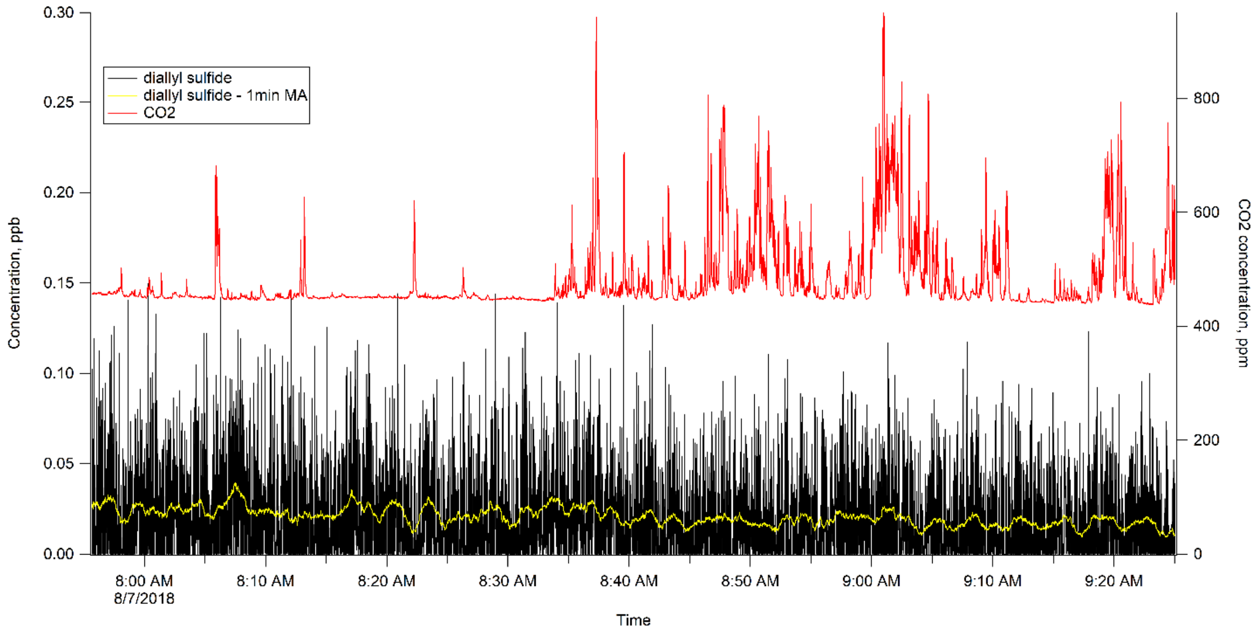

Figure 2-15. Diallyl Sulfide.

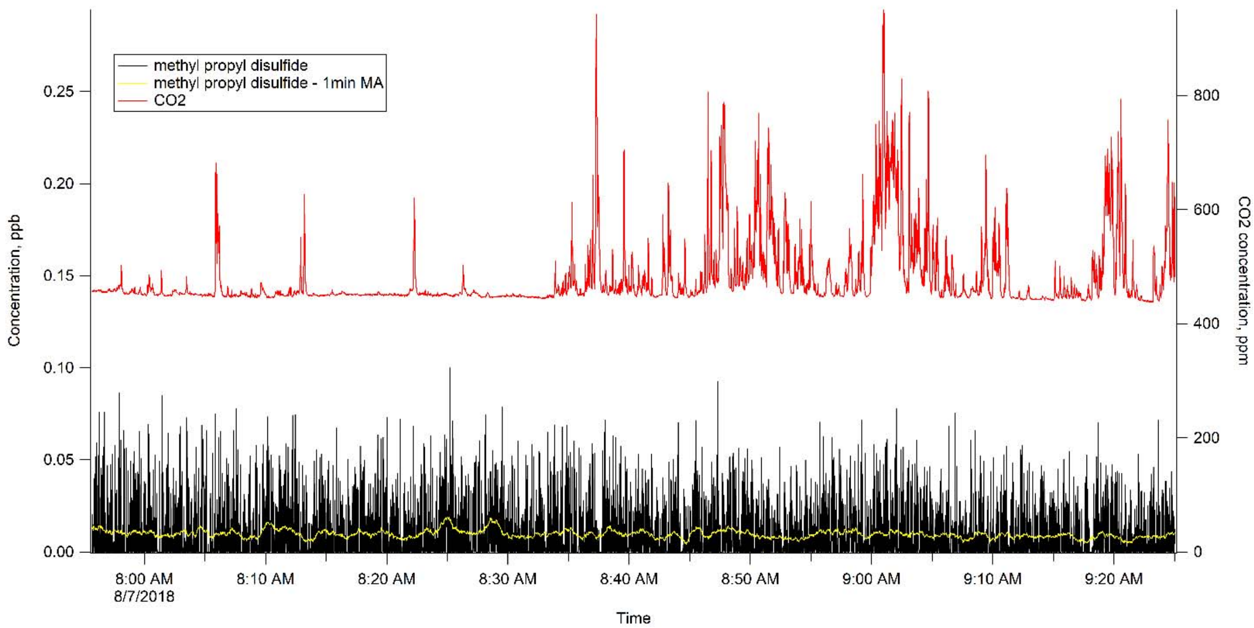

Figure 2-16. Methyl Propyl Disulfide.

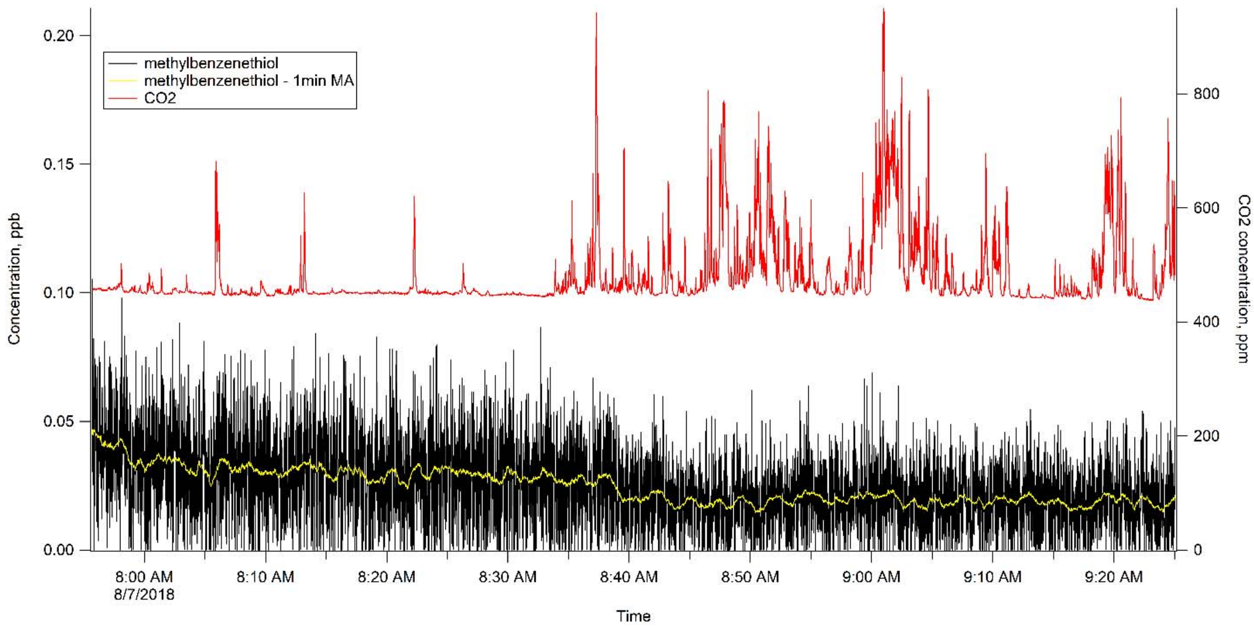

Figure 2-17. Methylbenzenethiol.

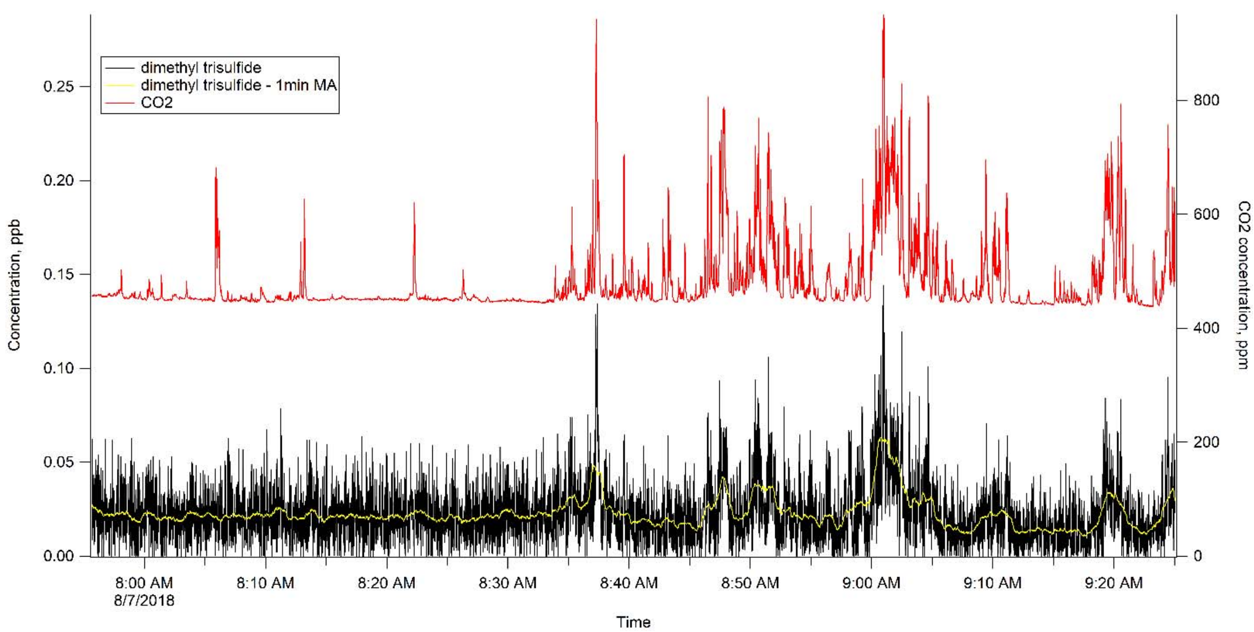

Figure 2-18. Dimethyl Trisulfide.

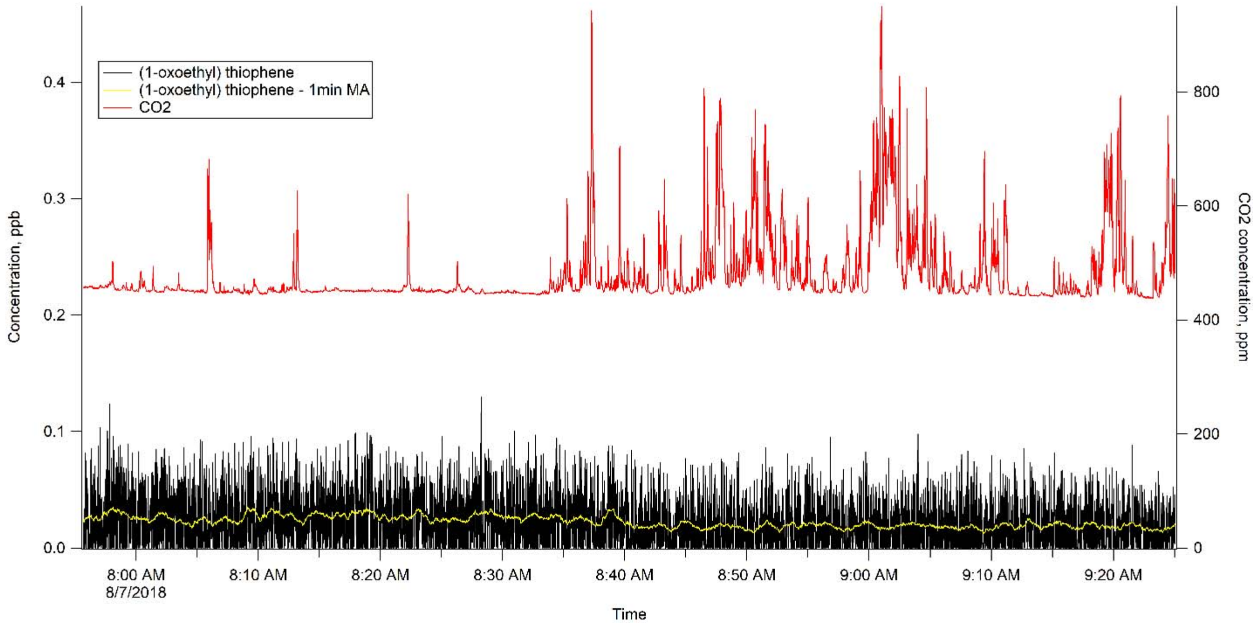

Figure 2-19. (1-oxoethyl) Thiophene.

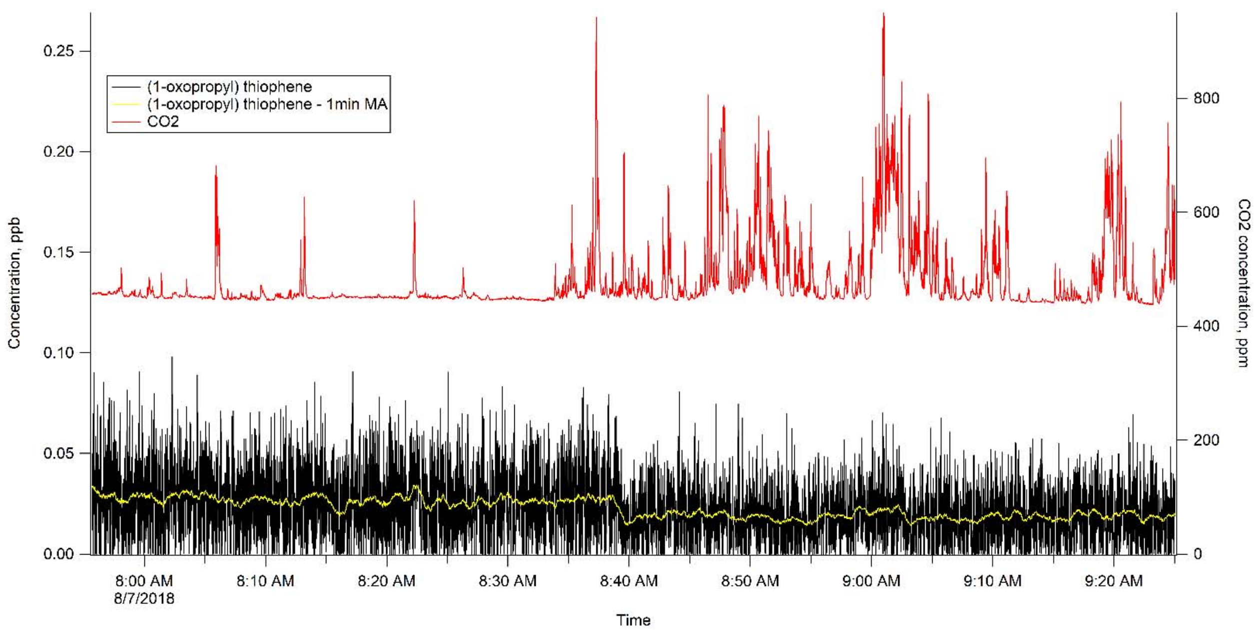

Figure 2-20. (1-oxopropyl) Thiophene.

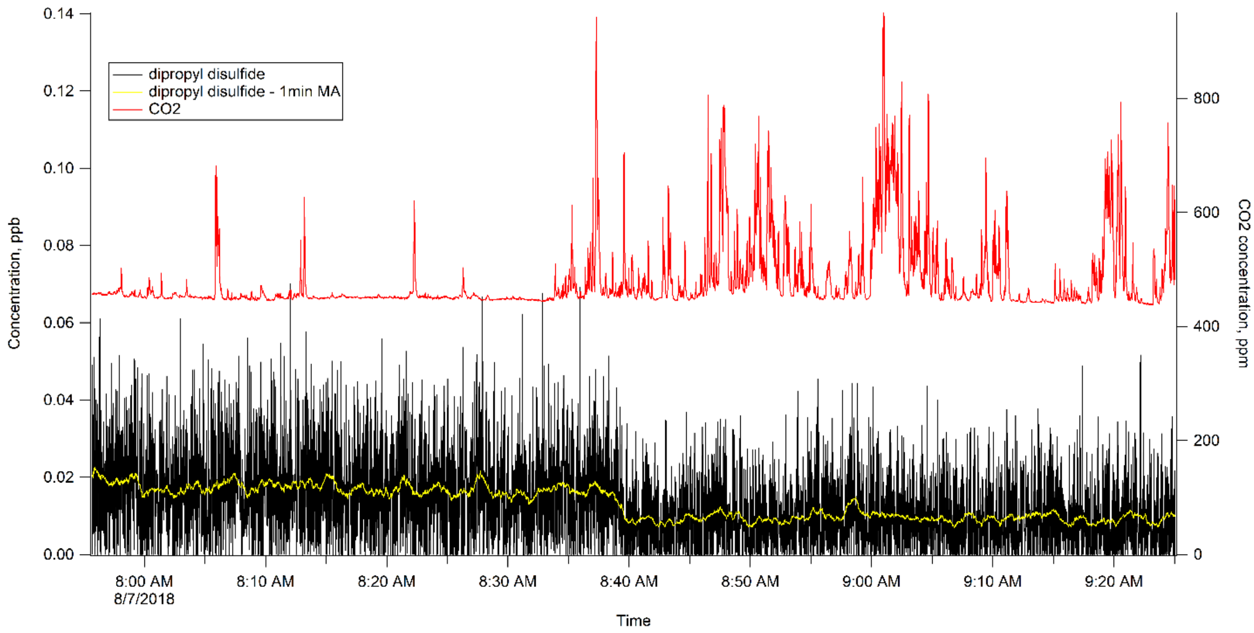

Figure 2-21. Dipropyl Disulfide.

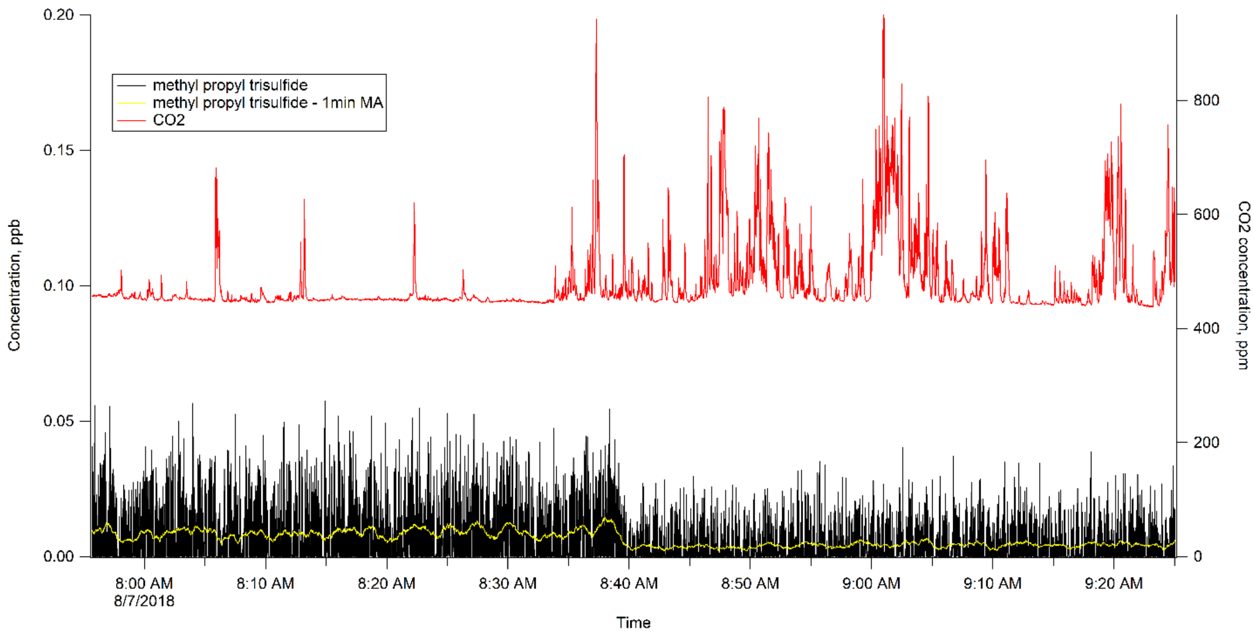

Figure 2-22. Methyl Propyl Trisulfide.

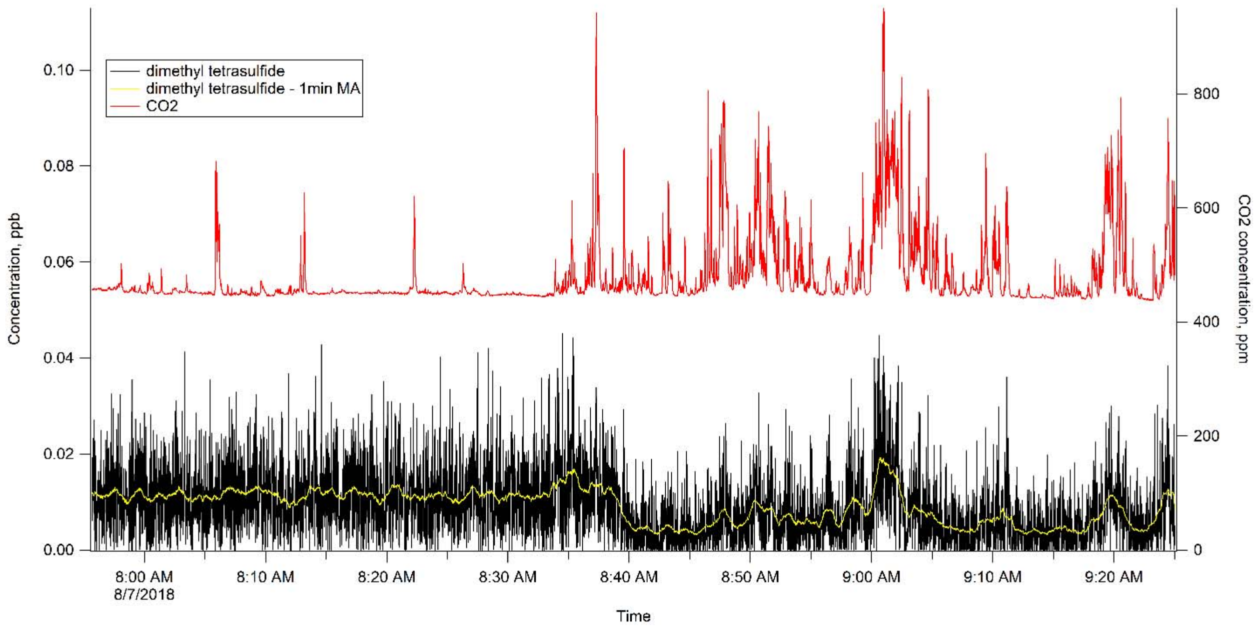

Figure 2-23. Dimethyl Tetrasulfide.

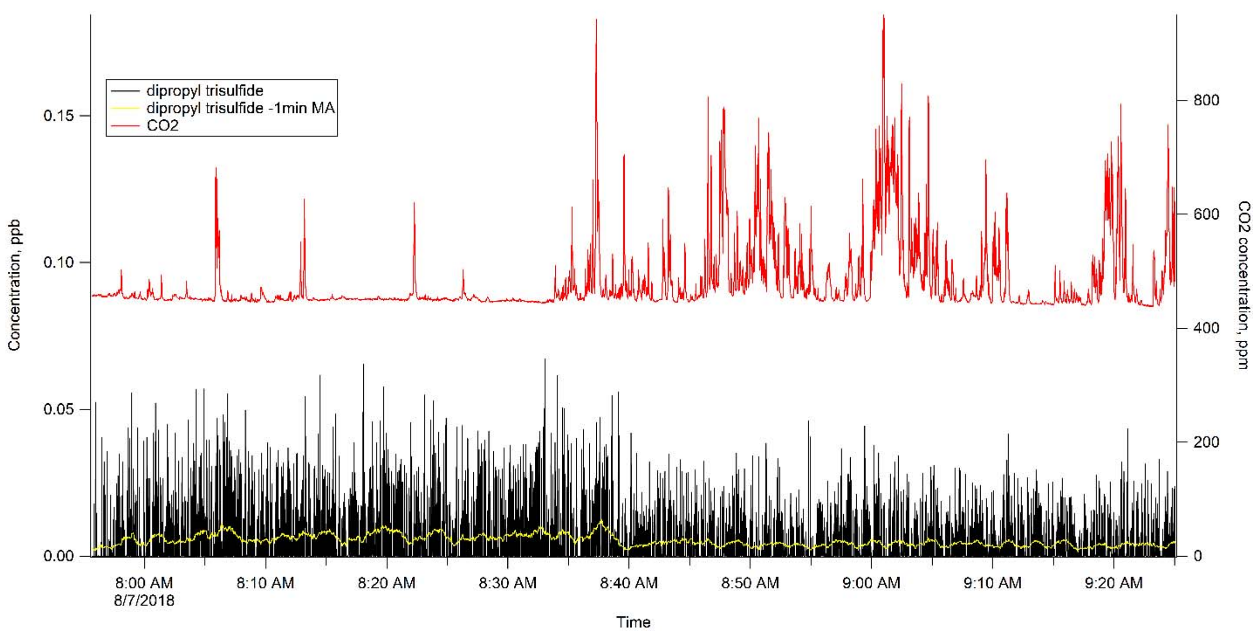

Figure 2-24. Dipropyl Trisulfide.

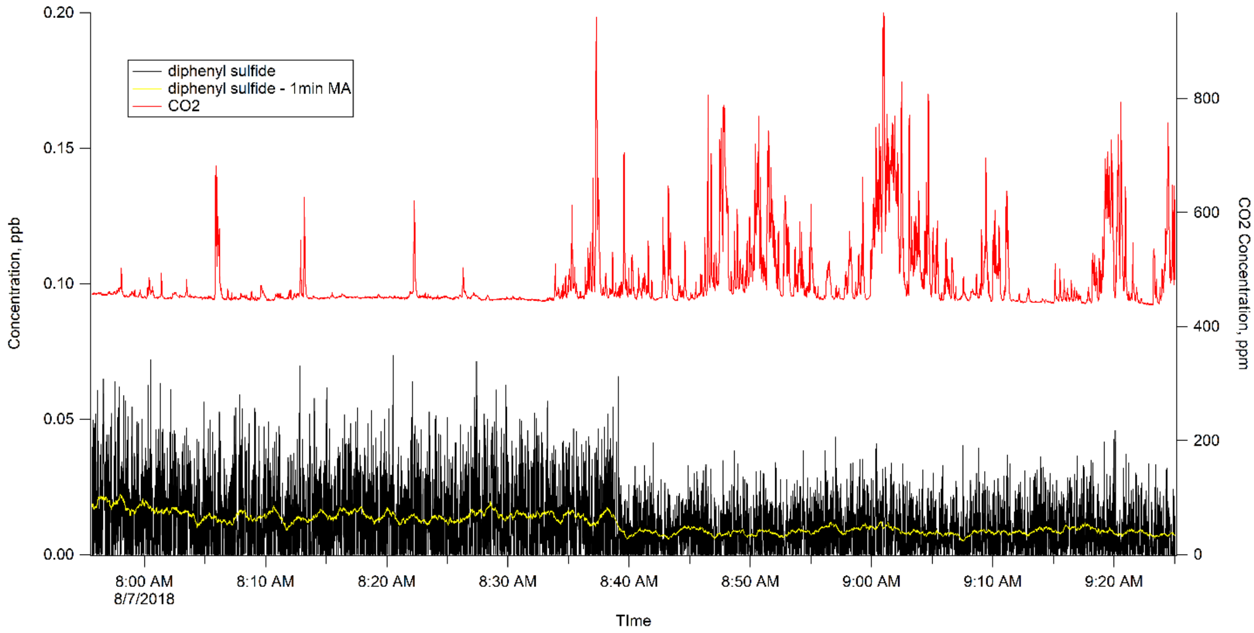

Figure 2-25. Diphenyl Sulfide.

2.5 Area Monitoring

Table 2-2 displays the COPC statistical information for the monitoring period of August 7, 2018.

Table 2-3. Chemical of Potential Concern Statistical Information for the Monitoring Period of August 7, 2018. (2 Sheets)

COPC #	COPC Name	OEL (ppb)	Ave. (ppb)	St Dev. (ppb)	Rel St. Dev. (%)	Max (ppb)	Median (ppb)
1	ammonia	25000	15.331	7.574	49.403	48.634	13.099
2	formaldehyde	300	1.265	0.204	16.142	5.381	1.253
3	methanol	200000	16.587	6.311	38.047	258.176	14.235
4	acetonitrile	20000	0.300	0.043	14.373	0.755	0.298
5	acetaldehyde	25000	4.385	1.521	34.679	12.740	3.944
6	ethylamine	5000	0.027	0.015	56.543	0.099	0.025
7	1,3-butadiene	1000	0.265	0.149	56.346	1.456	0.249
8	propanenitrile	6000	0.068	0.022	32.768	0.270	0.065
9	2-propenal	100	0.408	0.139	34.142	3.091	0.380
10	1-butanol + butenes	20000	0.320	0.140	43.670	3.479	0.281
11	methyl isocyanate	20	0.047	0.022	46.918	0.202	0.044
12	methyl nitrite	100	0.209	0.070	33.662	1.719	0.199
13	furan	1	0.055	0.020	37.349	0.265	0.052
14	butanenitrile	8000	0.032	0.024	76.647	0.252	0.026
15	but-3-en-2-one + 2,3-dihydrofuran + 2,5-dihydrofuran	100, 1, 1	0.106	0.057	53.674	0.664	0.086
16	butanal	25000	0.272	0.102	37.497	1.029	0.252
17	NDMA	0.3	0.042	0.048	114.852	0.329	0.027
18	benzene	500	0.198	0.070	35.095	4.442	0.192
19	2,4-pentadienenitrile + pyridine	300, 1000	0.041	0.016	40.080	0.291	0.039
20	2-methylene butanenitrile	30	0.017	0.013	75.737	0.190	0.014
21	2-methylfuran	1	0.066	0.028	42.141	0.319	0.062
22	pentanenitrile	6000	0.020	0.012	63.571	0.103	0.017
23	3-methyl-3-buten-2-one + 2-methyl-2-butenal	20, 30	0.073	0.035	47.378	0.416	0.067
24	NEMA	0.3	0.023	0.032	138.466	0.261	0.007
25	2,5-dimethylfuran	1	0.038	0.023	60.815	0.226	0.034
26	hexanenitrile	6000	0.009	0.008	86.781	0.077	0.007
27	2-hexanone (MBK)	5000	0.037	0.024	65.010	0.169	0.032
28	NDEA	0.1	0.010	0.016	159.013	0.138	0.000
29	butyl nitrite + 2-nitro-2-methylpropane	100, 30	0.046	0.015	32.280	0.140	0.044
30	2,4-dimethylpyridine	500	0.024	0.018	76.317	1.340	0.022
31	2-propylfuran + 2-ethyl-5-methylfuran	1	0.032	0.023	72.229	0.221	0.028

Table 2-3. Chemical of Potential Concern Statistical Information for the Monitoring Period of August 7, 2018. (2 Sheets)

COPC #	COPC Name	OEL (ppb)	Ave. (ppb)	St Dev. (ppb)	Rel St. Dev. (%)	Max (ppb)	Median (ppb)
32	heptanenitrile	6000	0.018	0.012	65.979	0.121	0.016
33	4-methyl-2-hexanone	500	0.044	0.022	50.212	0.225	0.041
34	NMOR	0.6	0.013	0.020	155.006	0.177	0.000
35	butyl nitrate	2500	0.010	0.010	94.920	0.067	0.008
36	2-ethyl-2-hexenal + 4-(1-methylpropyl)-2,3-dihydrofuran + 3-(1,1-dimethylethyl)-2,3-dihydrofuran	100, 1, 1	0.044	0.031	69.988	0.272	0.036
37	6-methyl-2-heptanone	8000	0.043	0.031	71.256	0.225	0.034
38	2-pentylfuran	1	0.033	0.018	54.766	0.132	0.030
39	biphenyl	200	0.026	0.023	90.530	0.219	0.021
40	2-heptylfuran	1	0.067	0.024	35.750	0.290	0.067
41	1,4-butanediol dinitrate	50	0.033	0.017	51.049	0.108	0.032
42	2-octylfuran	1	0.005	0.010	182.345	0.080	0.000
43	1,2,3-propanetriol 1,3-dinitrate	50	0.004	0.011	236.811	0.093	0.000
44	PCB	1000	0.051	0.021	40.823	0.136	0.051
45	6-(2-furanyl)-6-methyl-2-heptanone	1	0.008	0.008	100.405	0.058	0.006
46	furfural acetophenone	1	0.059	0.024	41.527	0.384	0.059

* The maximum peak value for but-3-en-2-one + 2,3 dihydrofuran + 2,5 dihydrofuran was 0.664 ppb and the median value was 0.864 ppb. The PTR-MS results for but-3-en-2-one + 2,3 dihydrofuran + 2,5 dihydrofuran are not compared to OEL concentrations because: 1) the result is suspect due to a known biogenic interferant (methacrolein) that is expected to be in concentrations that occasionally exceed the dihydrofuran OEL, and 2) this combination of COPCs have OEL concentrations that differ by a factor of 100, which provide widely variant bases for these numbers.
**Nitrosamine results are also suspect due to interferants identified during the background study.

The following figures display a series of COPC signals, overlaid with the same signal smoothed using a one-minute moving average, and CO_2, for the monitoring period of August 7, 2018.

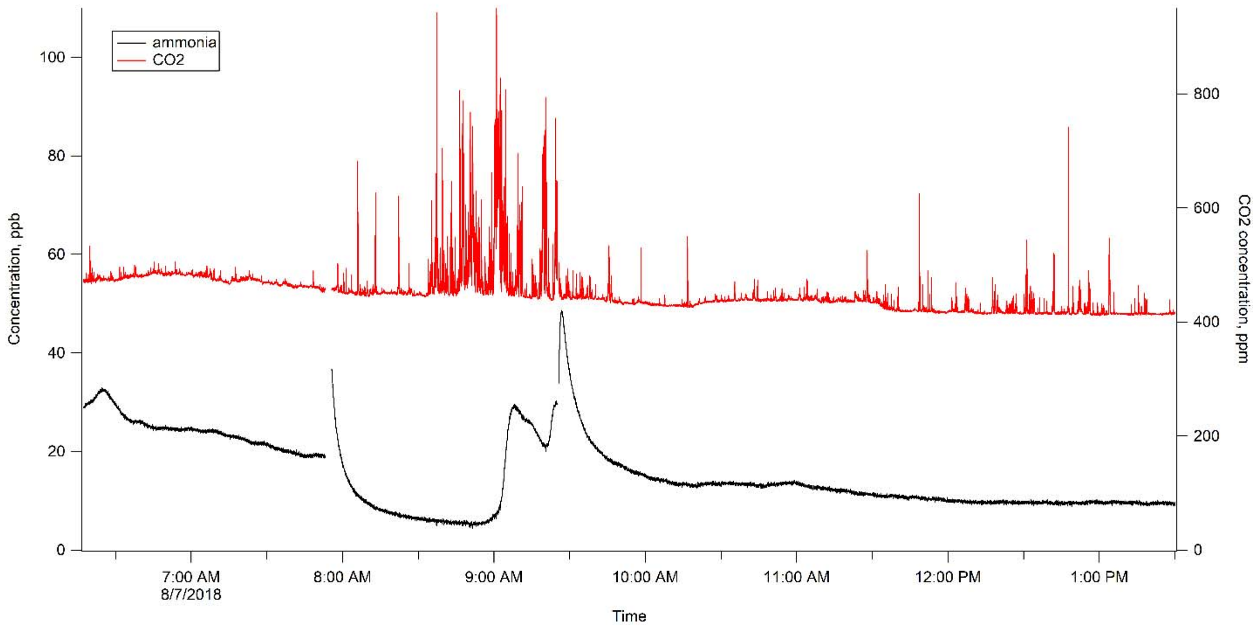

Figure 2-26. Ammonia.

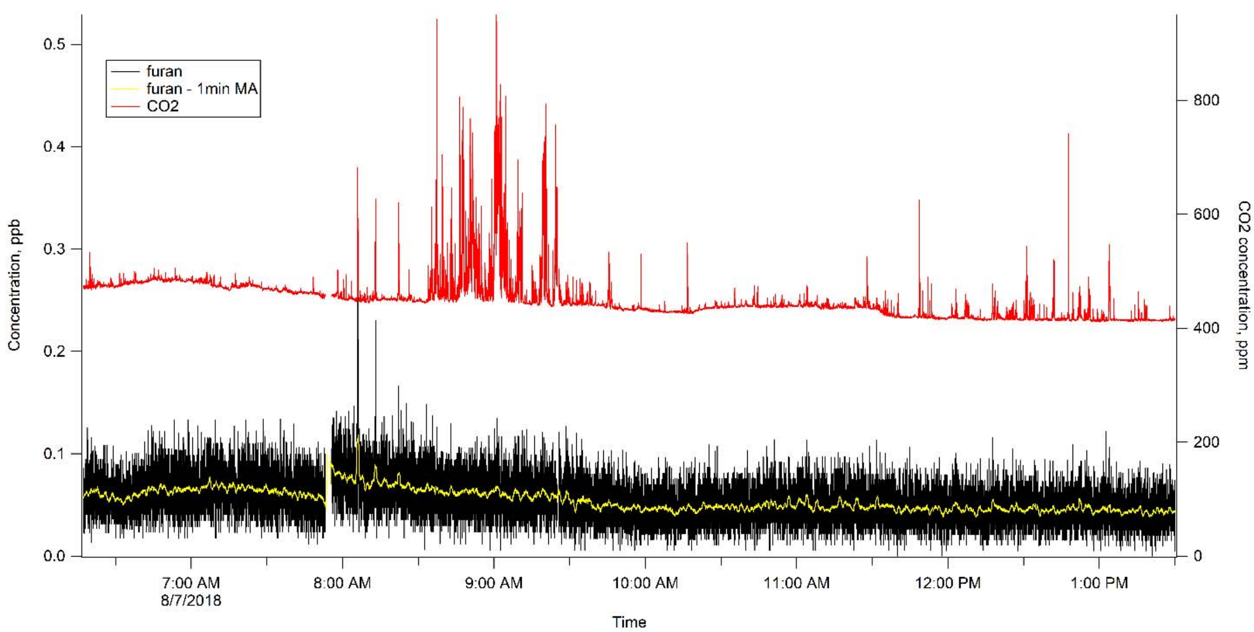

Figure 2-27. Furan.

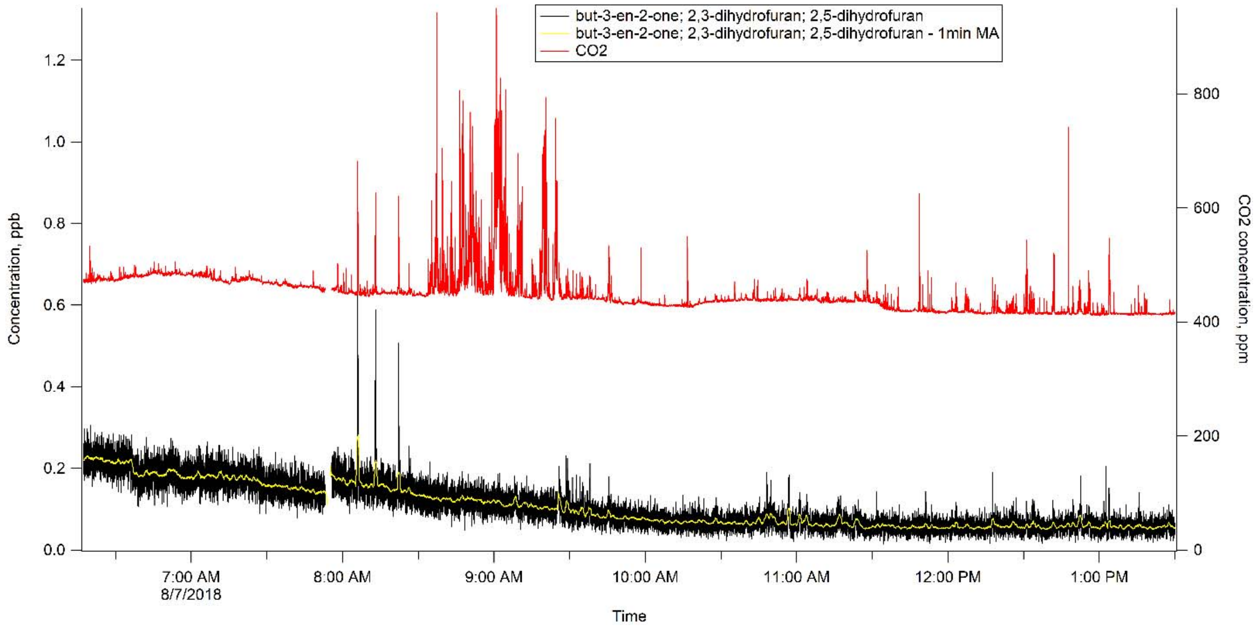

Figure 2-28. But-3-en-2-one; 2,3-dihydrofuran; 2,5-dihydrofuran.

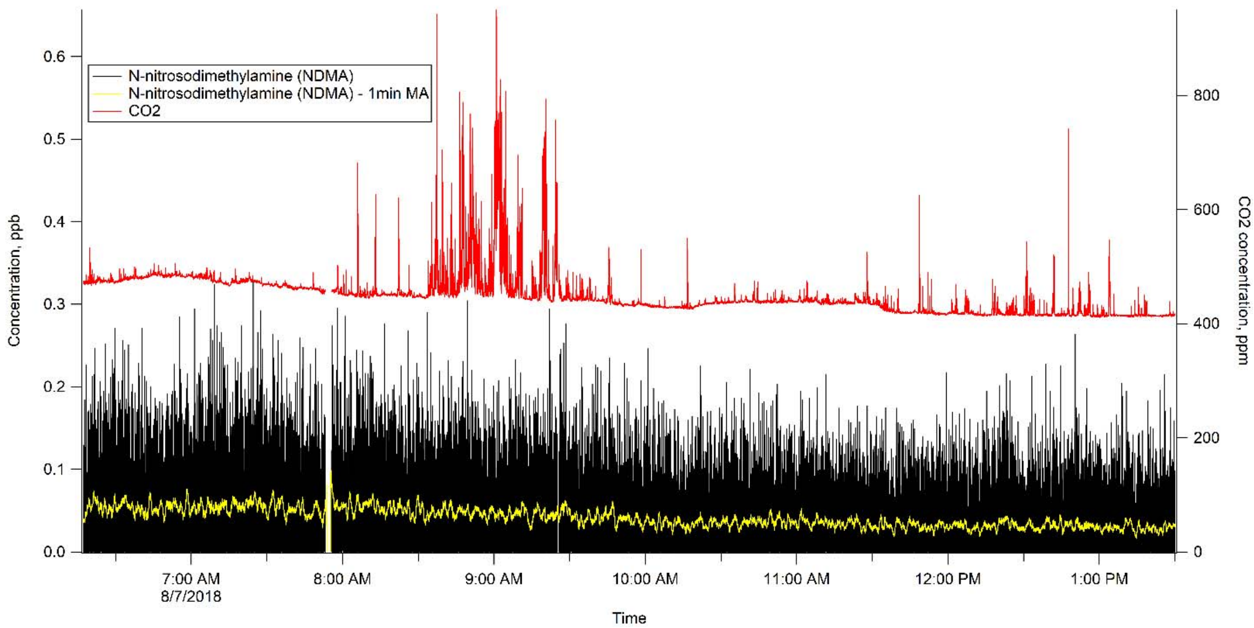

Figure 2-29. N-nitrosodimethylamine (NDMA).

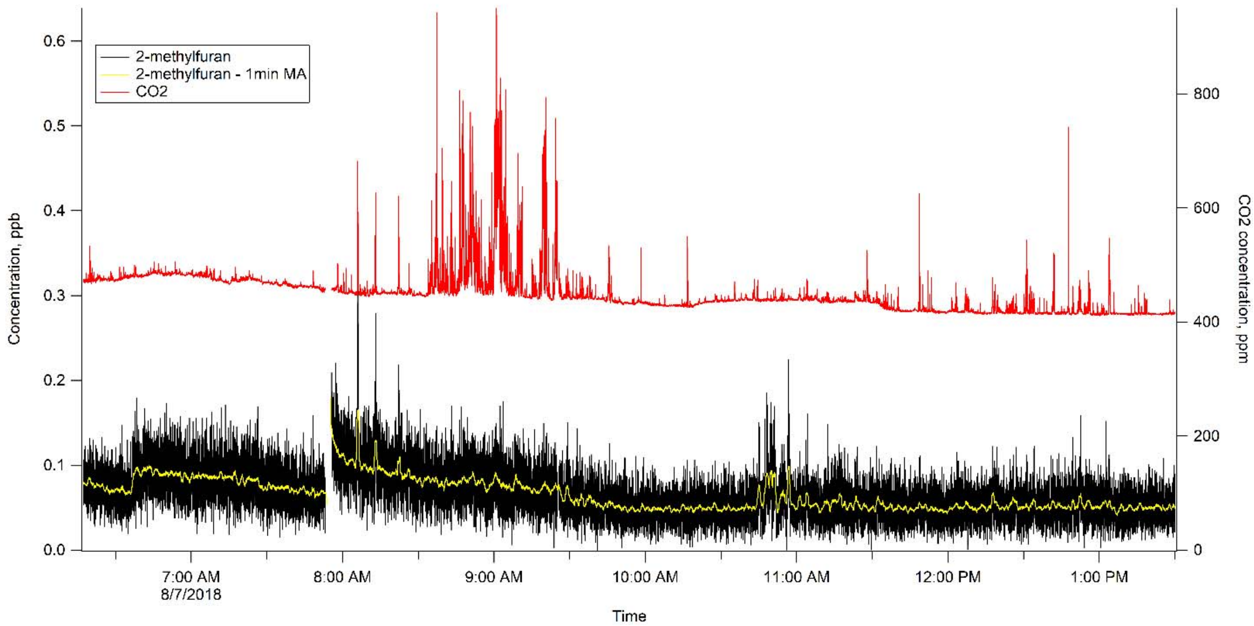

Figure 2-30. 2-methylfuran.

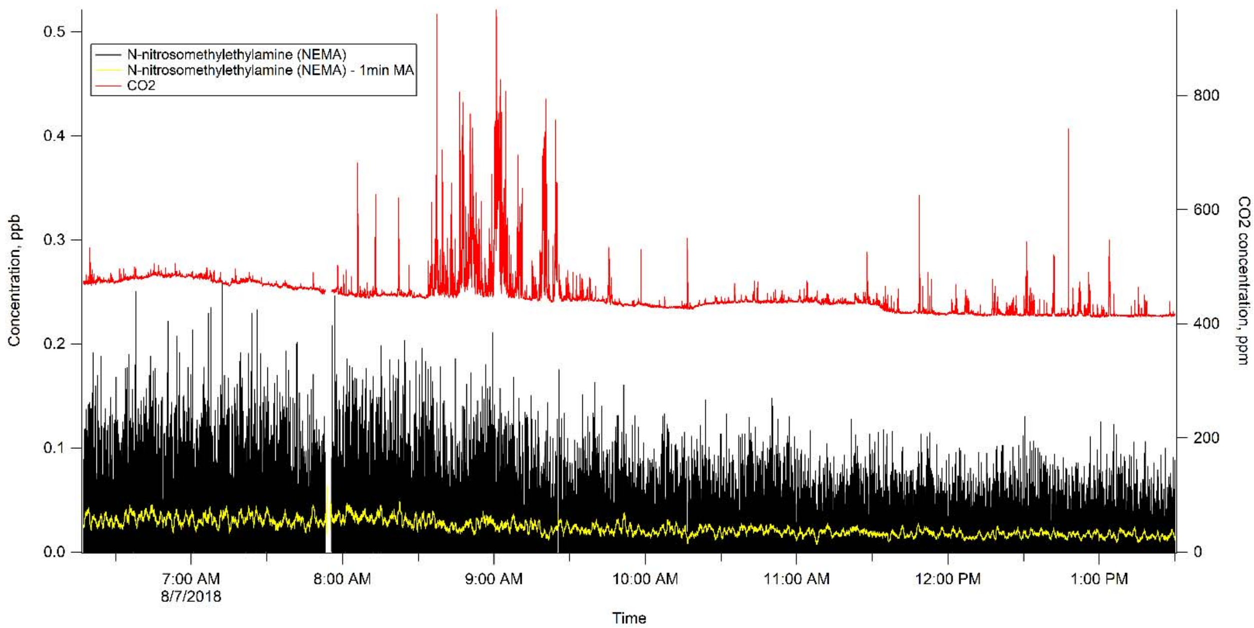

Figure 2-31. N-nitrosomethylethylamine (NEMA).

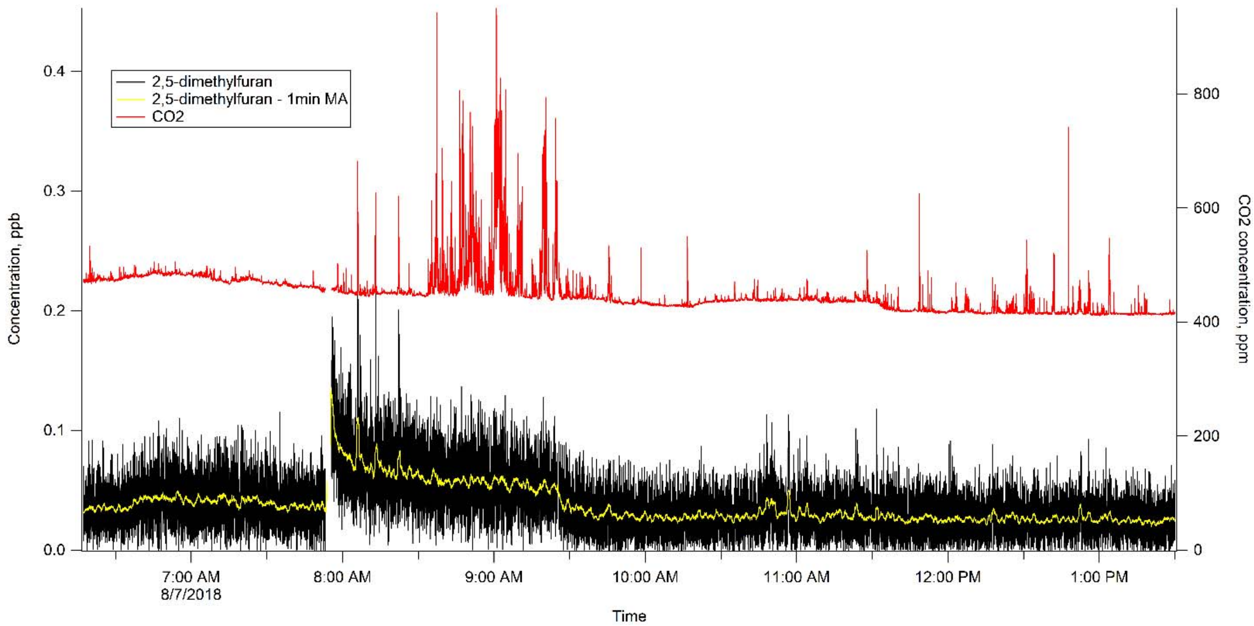

Figure 2-32. 2, 5-dimethylfuran.

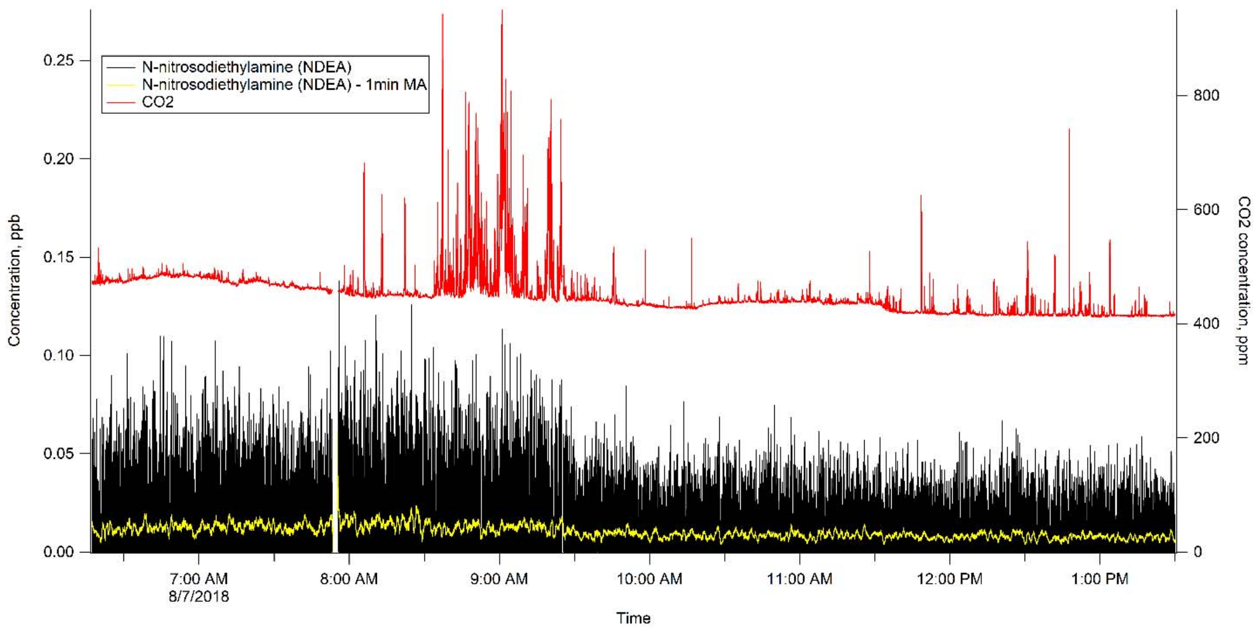

Figure 2-33. N-nitrosodiethylamine (NDEA).

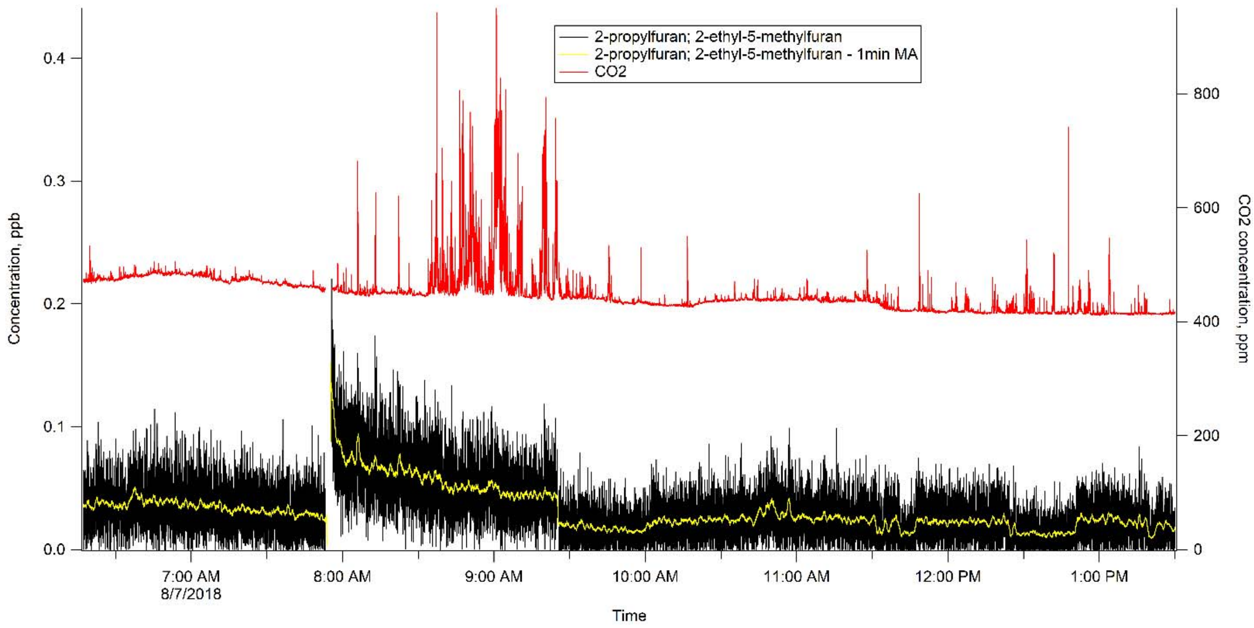

Figure 2-34. 2-propylfuran; 2-ethyl-5-methylfuran.

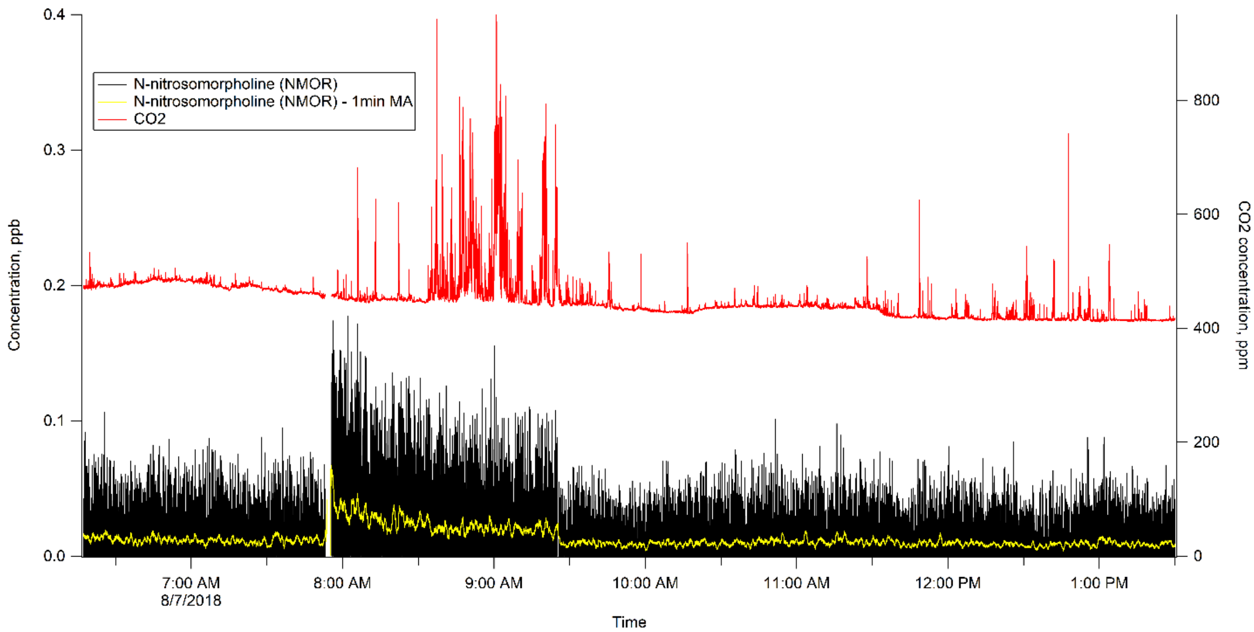

Figure 2-35. N-nitrosomorpholine (NMOR).

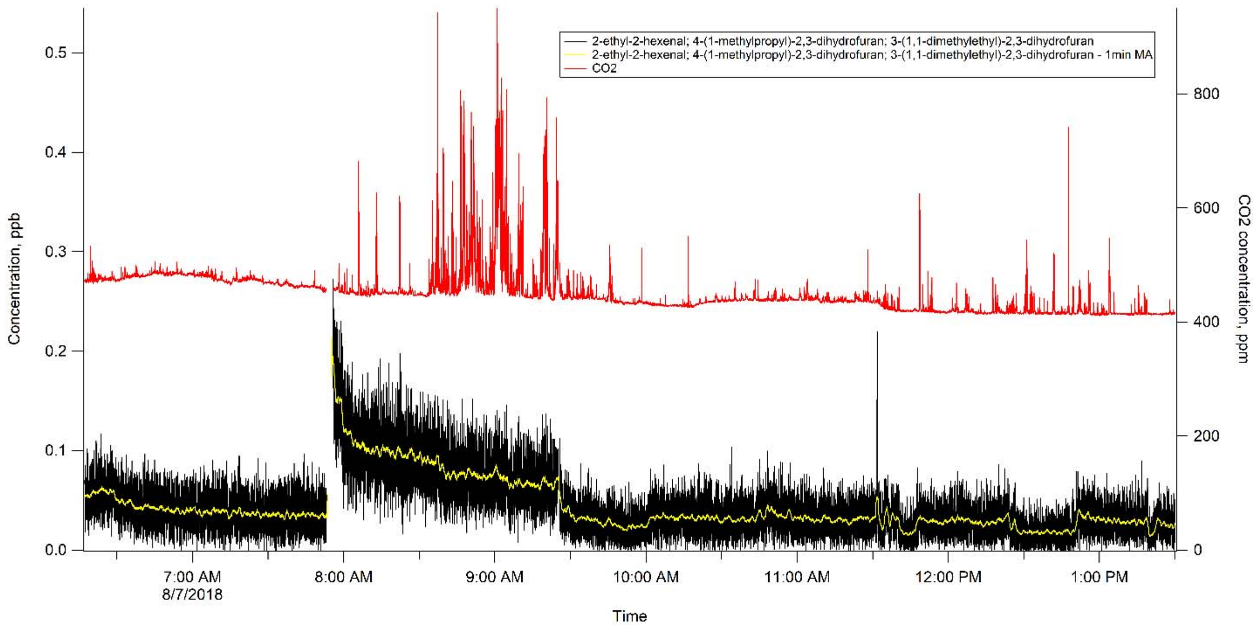

Figure 2-36. 2-ethyl-2-hexenal; 4-(1-methylpropyl)-2,3-dihydrofuran; 3-(1,1-dimethylethyl)-2,3-dihydrofuran.

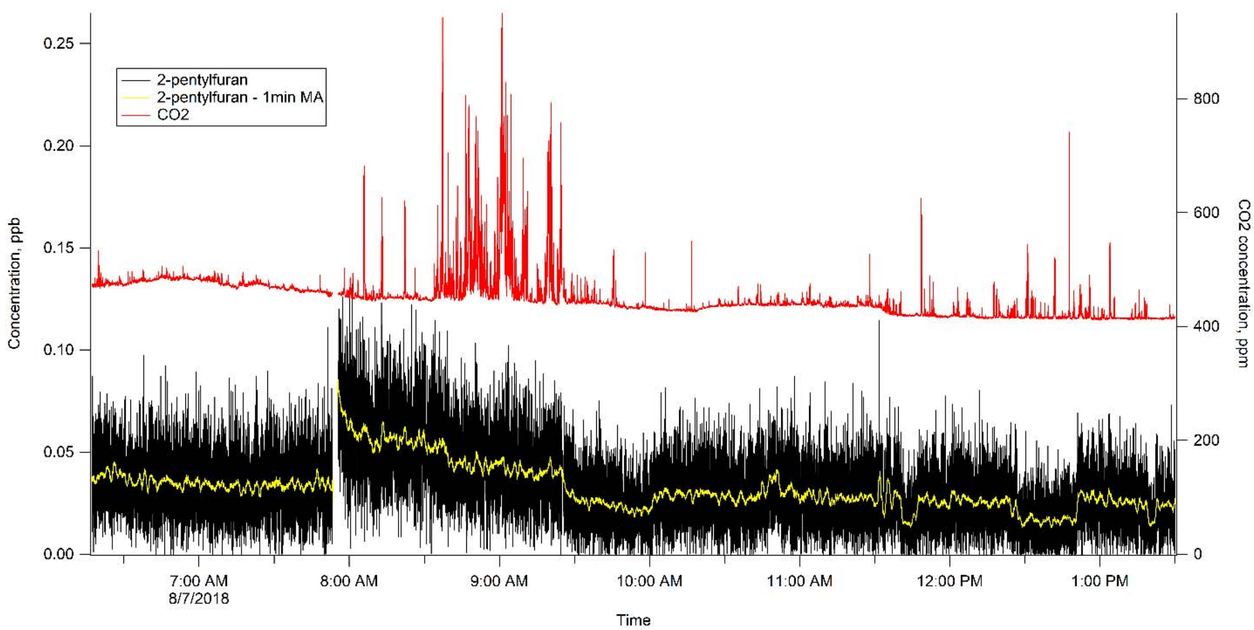

Figure 2-37. 2-pentylfuran.

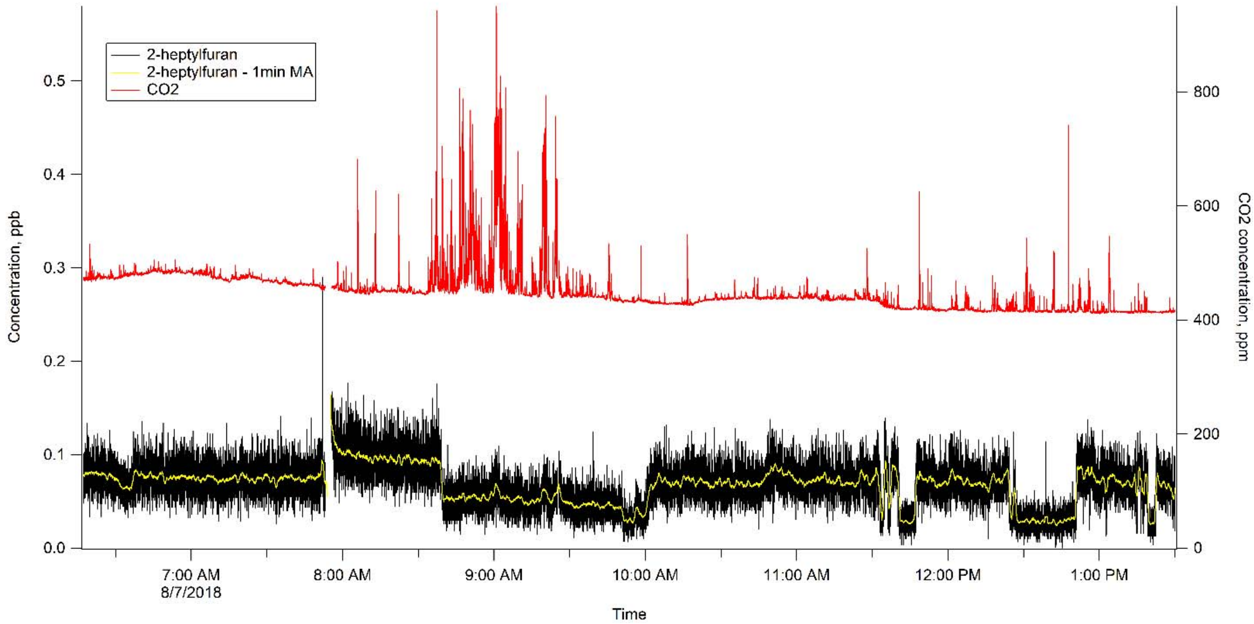

Figure 2-38. 2-heptylfuran.

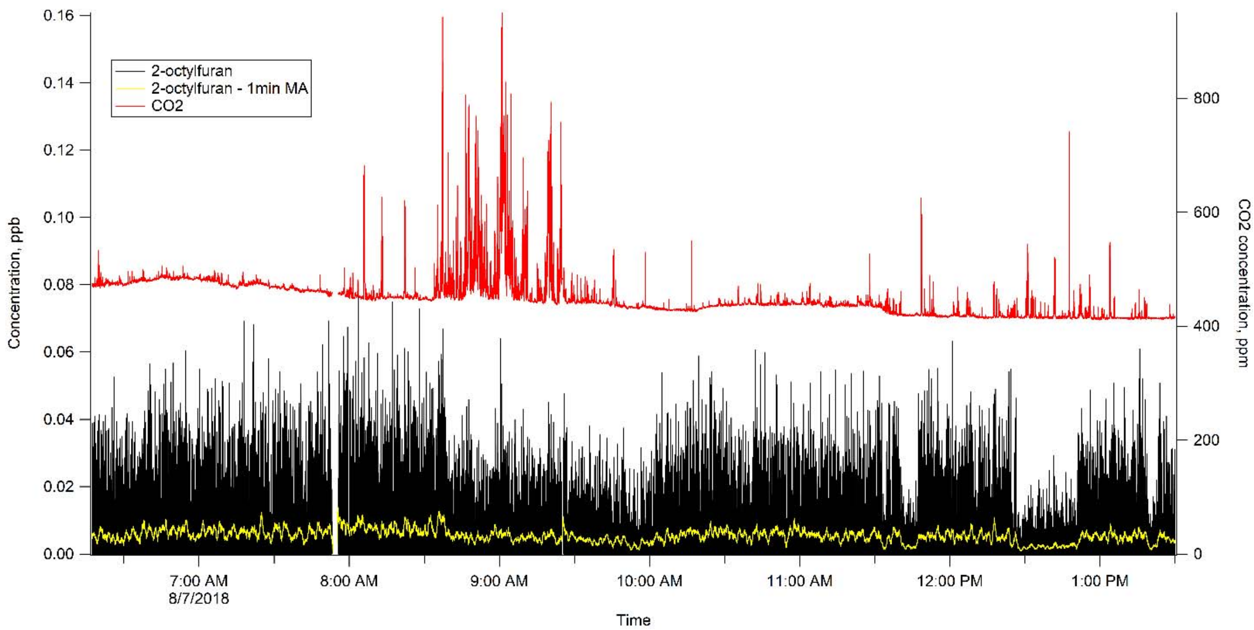

Figure 2-39. 2-octylfuran.

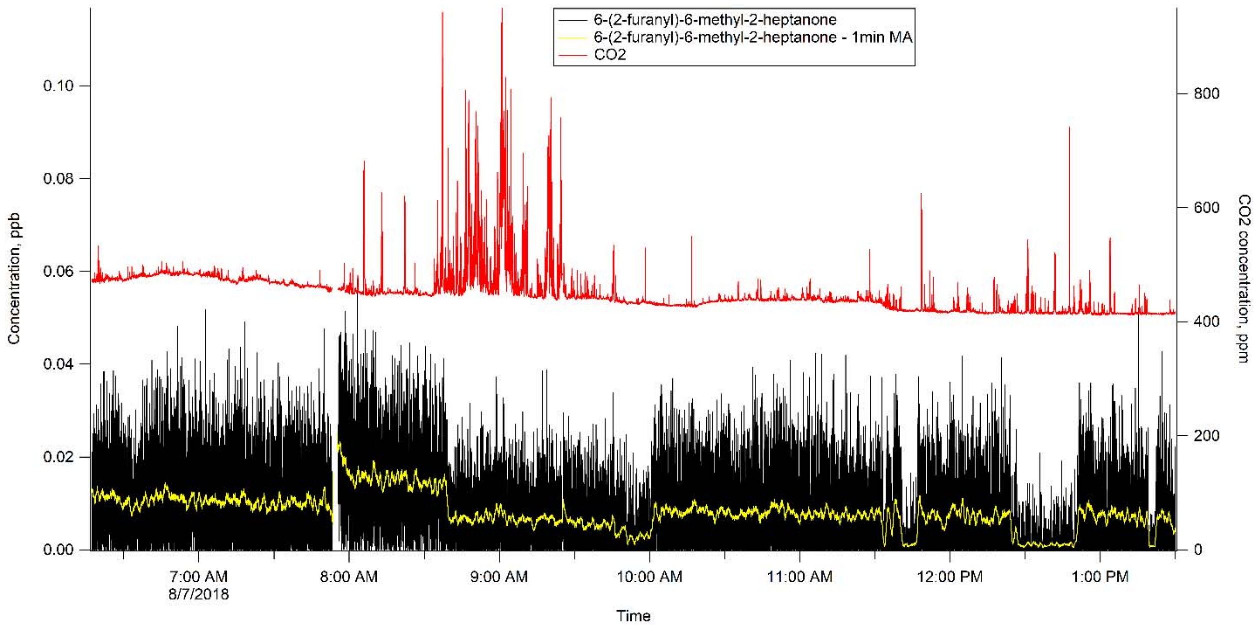

Figure 2-40. 6-(2-furanyl)-6-methyl-2-heptanone.

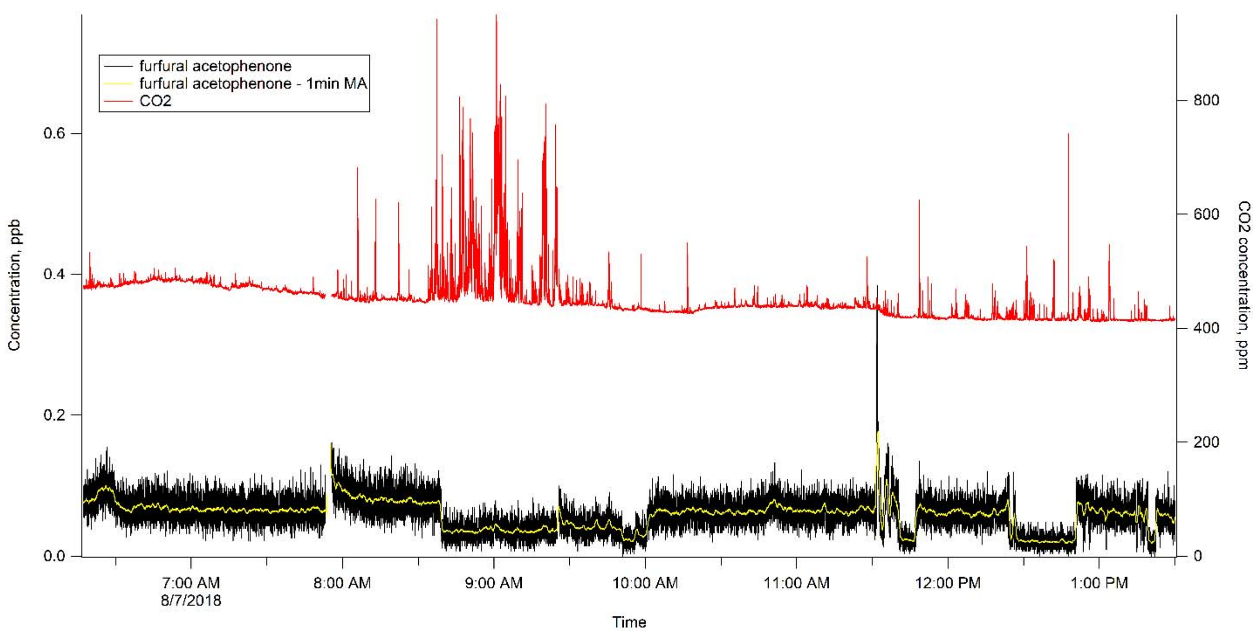

Figure 2-41. Furfural Acetophenone.

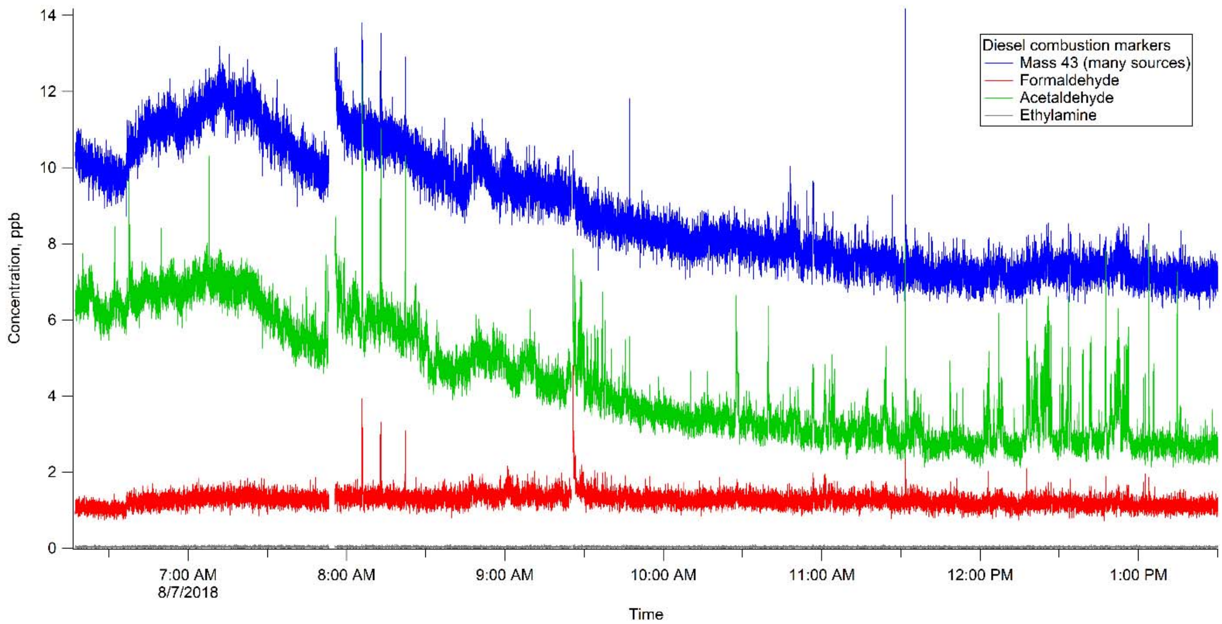

Figure 2-42. Diesel Combustion Markers.

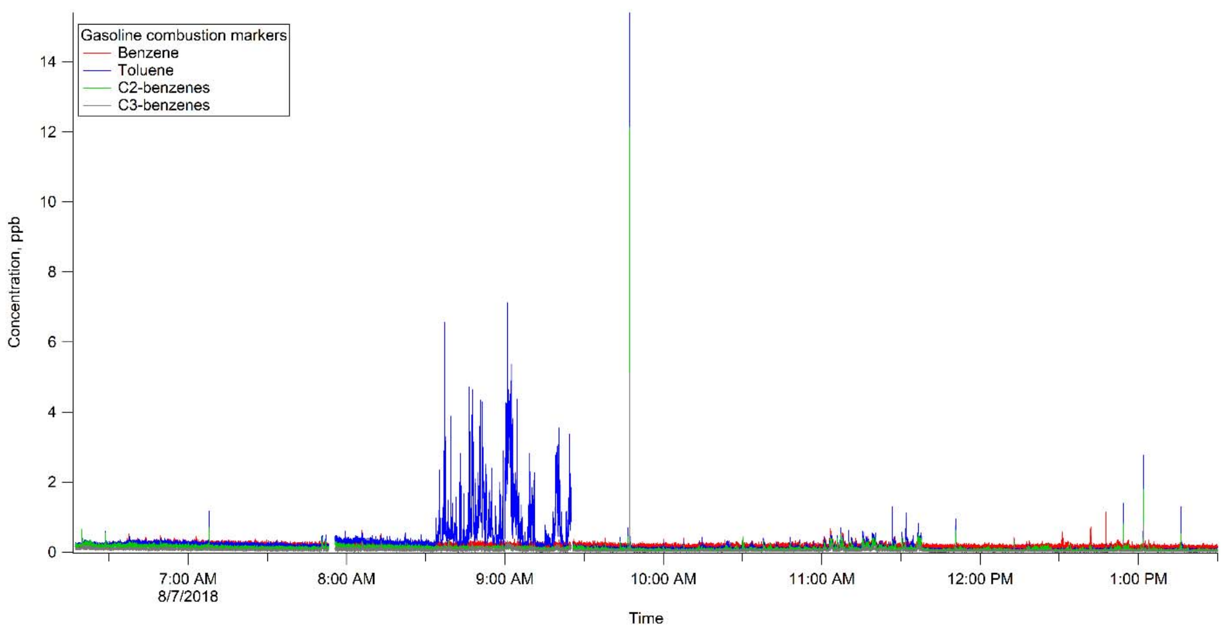

Figure 2-43. Gasoline Combustion Markers.

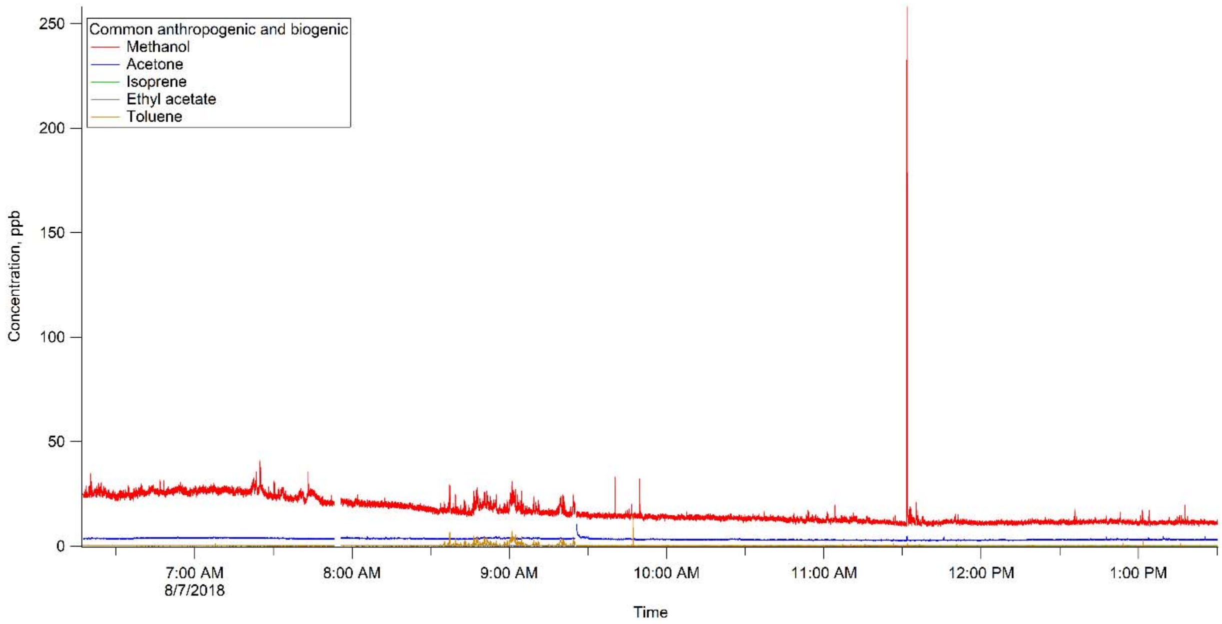

Figure 2-44. Plant and Human Markers.

3.0 AUGUST 8, 2018 – SOURCE CHARACTERIZATION

3.1 Quality Assessment

Data from August 8, 2018, were assessed using Procedure 17124-DOE-HS-102. A Data Exchange Checklist was completed. The data were accepted by TerraGraphics with the following comments. Report No. 66409-RPT-004 was adequately documented and all checks passed the acceptance limits.

3.2 Summary

On August 8, 2018, the ML performed source characterization monitoring at Weston Mountain Onions located at 2926 Kingsgate Way in Richland.

The ML arrived at the 3110 Port of Benton Blvd Building at 06:35 for a status meeting with Mr. George Weeks, Mr. Clark Carlson, and Mr. Wolfe. The ML relocated to Weston Mountain Onions to monitor biodegrading onions at 07:10. The ML performed mobile monitoring of the onions for 30-minute intervals in numerous locations around the site. From 09:37 to 10:07, the side port was utilized to monitor a disposal truck filled with onions. The ML departed from Weston Mountain Onions at around 10:15.

At 10:57, the ML arrived at TerraGraphics and shortly after began the QA/QC zero-air/ sensitivity checks on the CO_2 monitor, Ammonia Analyzer, and PTR-MS.

The ML deployed to the Hanford Site, checked in with the CSO at 13:50, and spent the afternoon at S Farms confirming ML parking locations for the SX Paving Project with Mr. Weeks. The ML returned to TerraGraphics at 16:14 and performed closeout procedures.

Table 3-1. Mobile Laboratory Sampling Mode Throughout the Monitoring Period.

Time	Location	Sampling Mode
07:10 - 08:25	Weston Mountain Onions - downwind from bins of biodegrading onions	Mobile sampling
08:25 - 08:31	Weston Mountain Onions -moved 50-60 yards downwind from onion bins	Mobile sampling
08:31 - 08:47	Weston Mountain Onions - moved 30-40 yards downwind of onions	Mobile sampling
09:37 - 10:07	Weston Mountain Onions	Side port sampling
10:07	Weston Mountain Onions	Mobile sampling (mast)

Figure 3-1. Mobile Laboratory Location for the Duration of the Monitoring Period at Weston Mountain Onions.

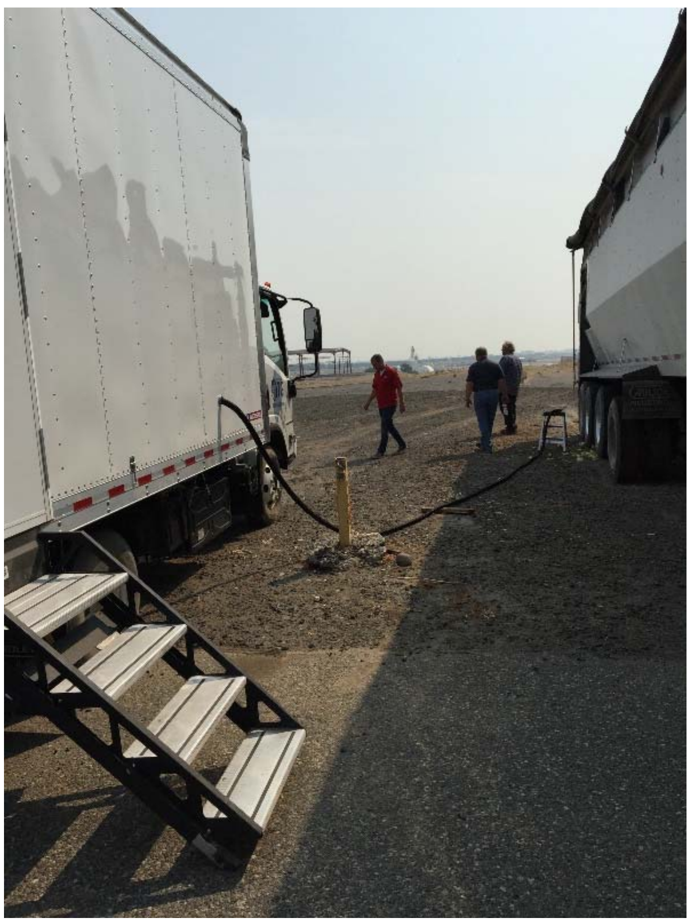

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Figure 3-2. Side Port Monitoring of Onion Disposal Truck.

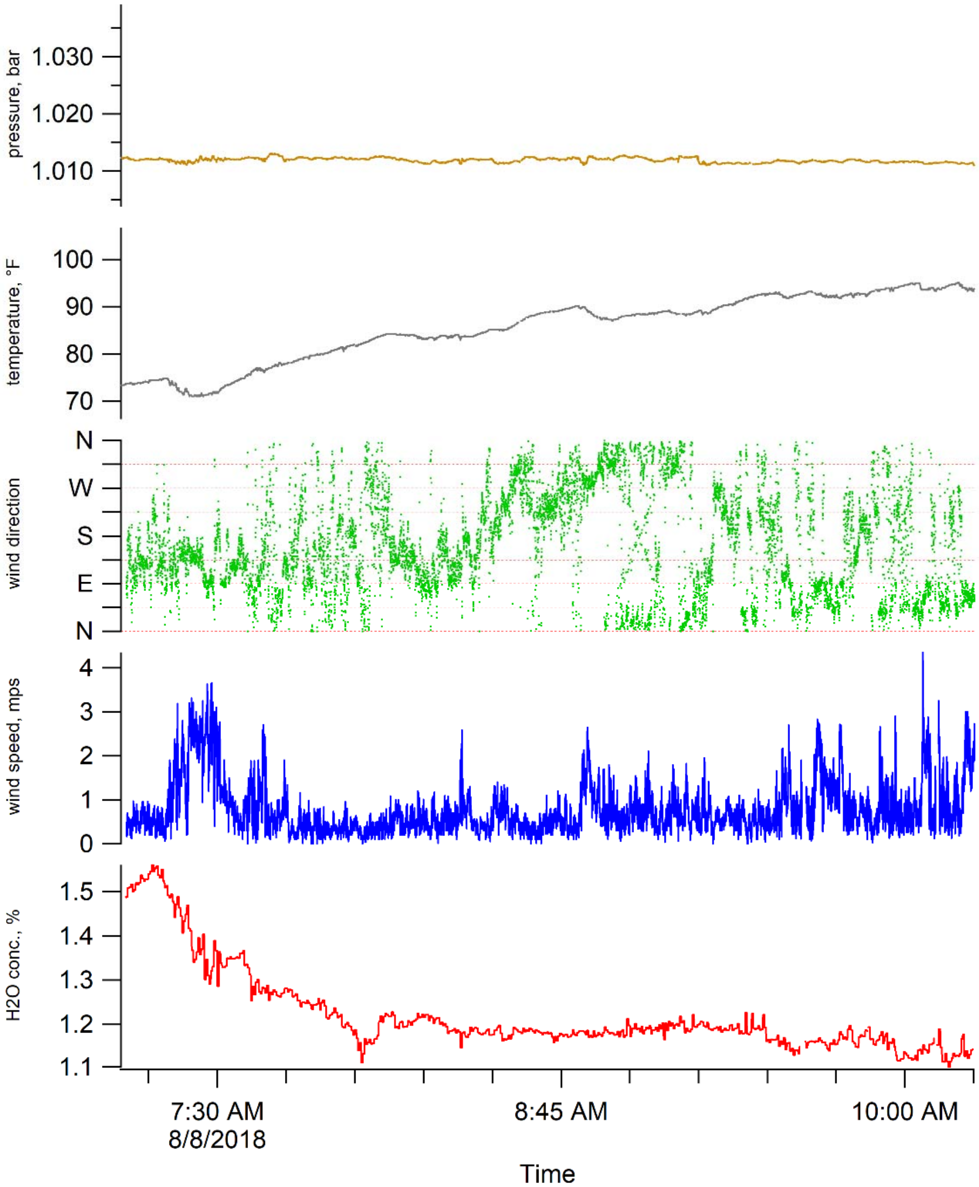

Figure 3-3. Weather Data for the Duration of the Monitoring Period.

3.3 Samples Collected

Continuous air monitoring was performed using the following instrumentation:

- PTR-TOF 6000 X2,
- LI-COR CO_2 Monitor,
- Picarro Ammonia Monitor, and
- Weather Station.

Confirmatory air samples were not collected during this period.

Table 3-1 displays the odor compound statistical information for the monitoring period of August 8, 2018.

Table 3-2. Odor Statistical Information for the Monitoring Period of August 8, 2018.

Odor #	Odor Compound Name	Ave. (ppb)	St. Dev. (ppb)	Rel St. Dev. (%)	Max (ppb)	Median (ppb)
1	methyl mercaptan	0.106	0.092	20.969	1.334	0.083
2	dimethylsulfide + ethanethiol	0.232	0.089	64.733	1.124	0.209
3	allyl mercaptan	0.009	0.015	112.098	0.14	0
4	1-propanethiol + isopropyl mercaptan	0.027	0.032	12.693	0.303	0.018
5	2-butene-1-thiol	0.016	0.024	112.057	0.42	0.002
6	diethyl sulfide + 2-methylpropane-2-thiol	0.133	0.031	61.514	0.289	0.131
7	thiopropanal sulfuroxide	0.035	0.021	100.996	0.134	0.032
8	dimethyl disulfide	0.008	0.013	36.029	0.109	0
9	1-pentanethiol + 2,2-dimethylpropane-1-thiol	0.021	0.031	25.867	0.207	0
10	benzenethiol	0.01	0.013	47.623	0.086	0.002
11	diallyl sulfide	0.018	0.023	40.804	0.168	0.007
12	methyl propyl disulfide	0.013	0.019	73.312	0.149	0
13	methylbenzenethiol	0.02	0.017	34.436	0.089	0.018
14	dimethyl trisulfide	0.019	0.013	45.787	0.076	0.017
15	(1-oxoethyl) thiophene	0.037	0.035	48.245	0.203	0.03
16	(1-oxopropyl) thiophene	0.022	0.018	79.636	0.104	0.02
17	dipropyl disulfide	0.031	0.047	161.024	0.467	0.017
18	methyl propyl trisulfide	0.009	0.013	25.625	0.103	0
19	dimethyl tetrasulfide	0.009	0.007	32.724	0.042	0.008
20	dipropyl trisulfide	0.006	0.012	53.929	0.075	0
21	diphenyl sulfide	0.01	0.013	34.322	0.072	0.005

The following figures display potential odor-causing signals, overlaid with the same signal smoothed using a one-minute moving average, and CO_2, for the monitoring period of August 8, 2018.

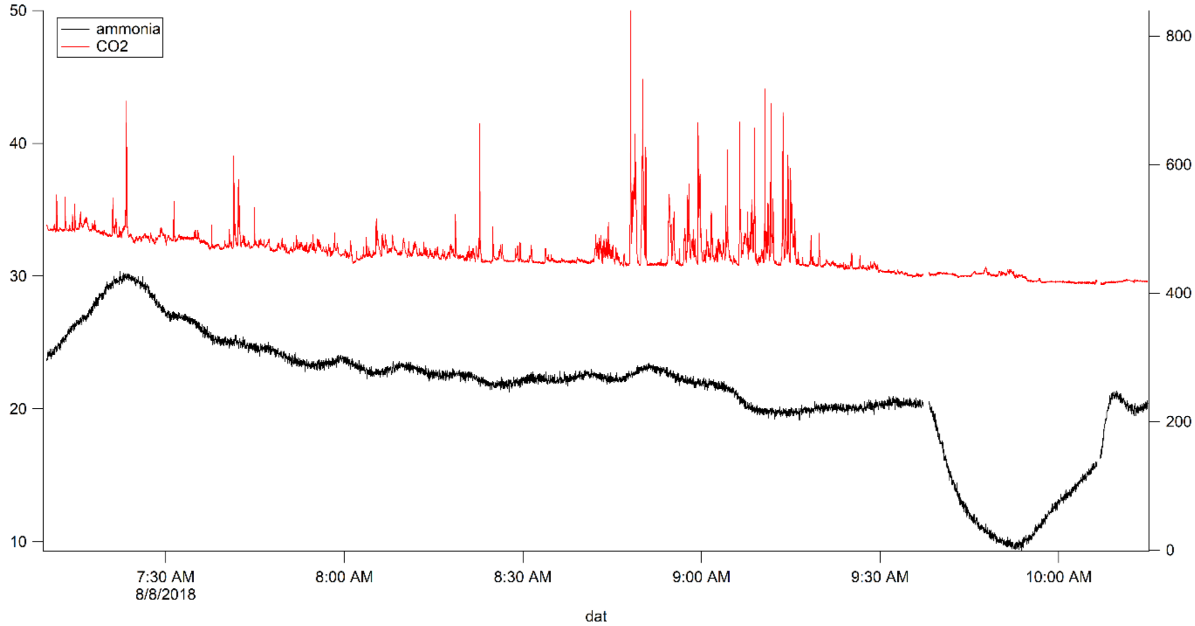

Figure 3-4. Ammonia.

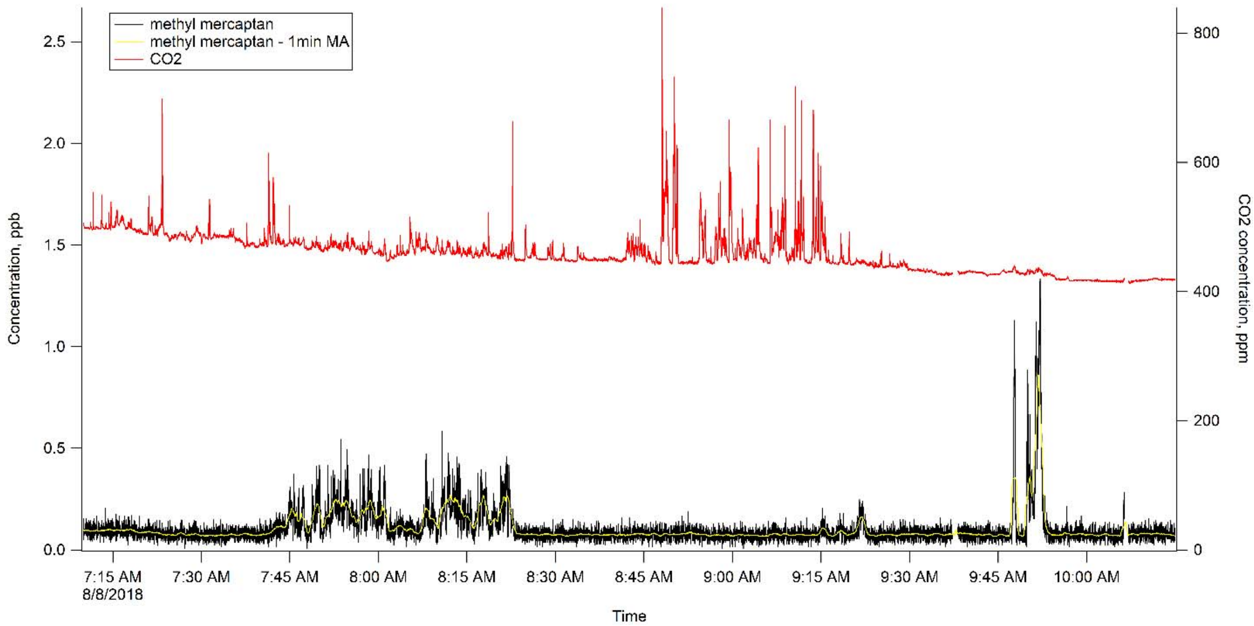

Figure 3-5. Methyl Mercaptan.

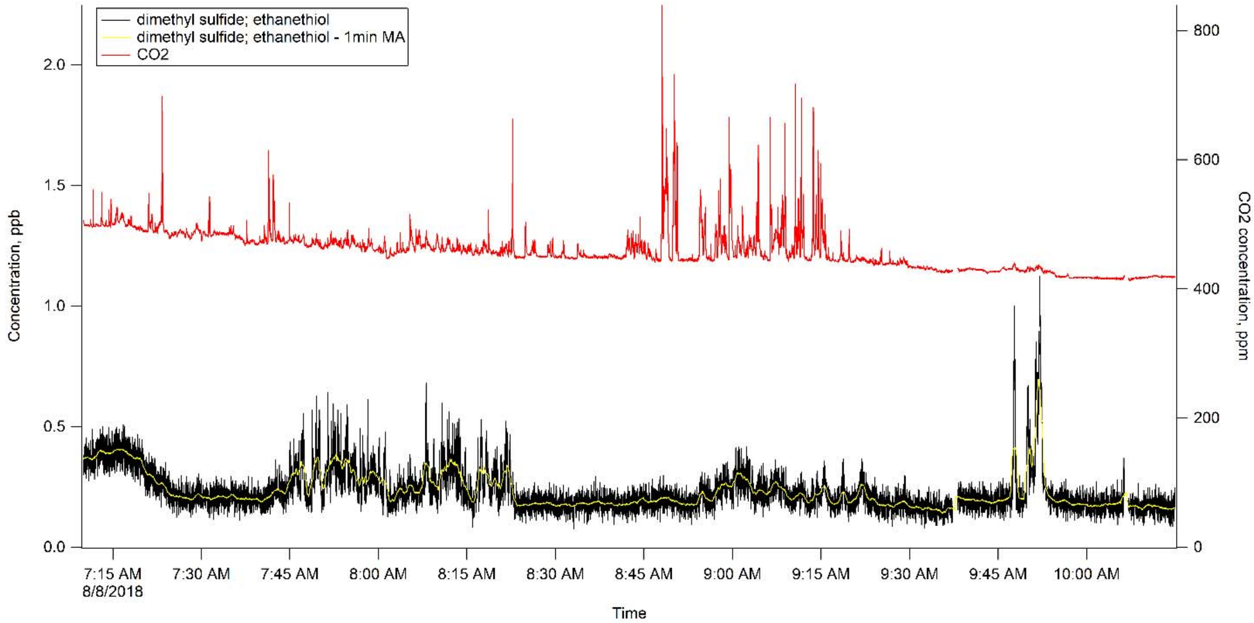

Figure 3-6. Dimethyl Sulfide; Ethanethiol.

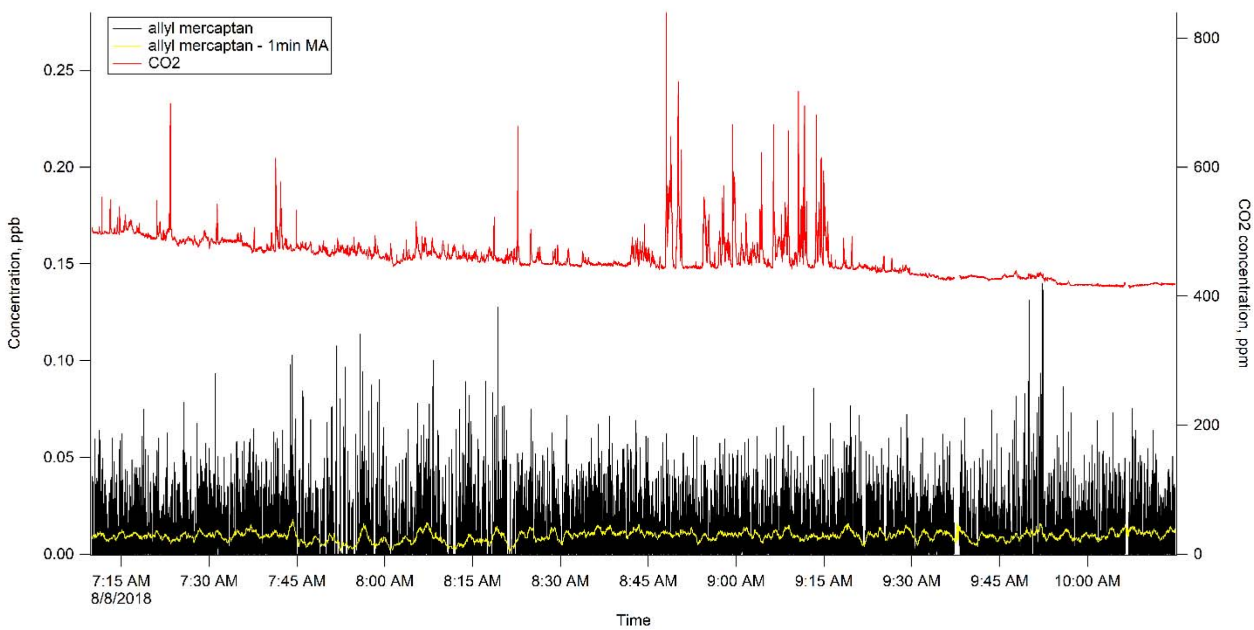

Figure 3-7. Allyl Mercaptan.

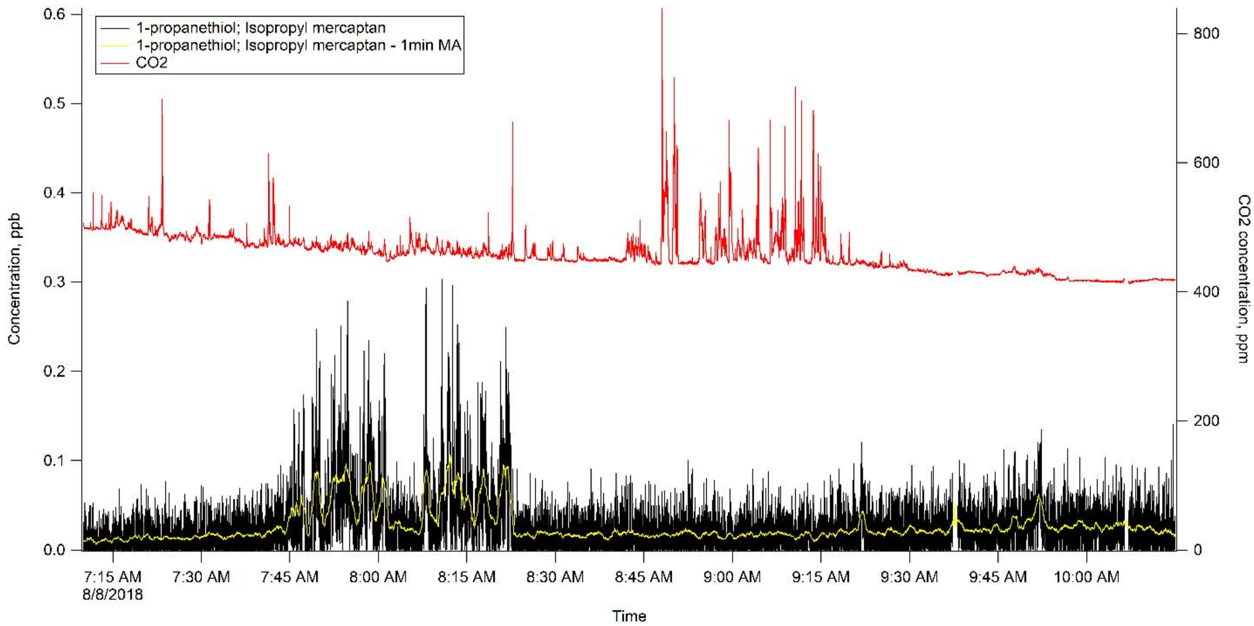

Figure 3-8. 1-propanethiol; Isopropyl Mercaptan.

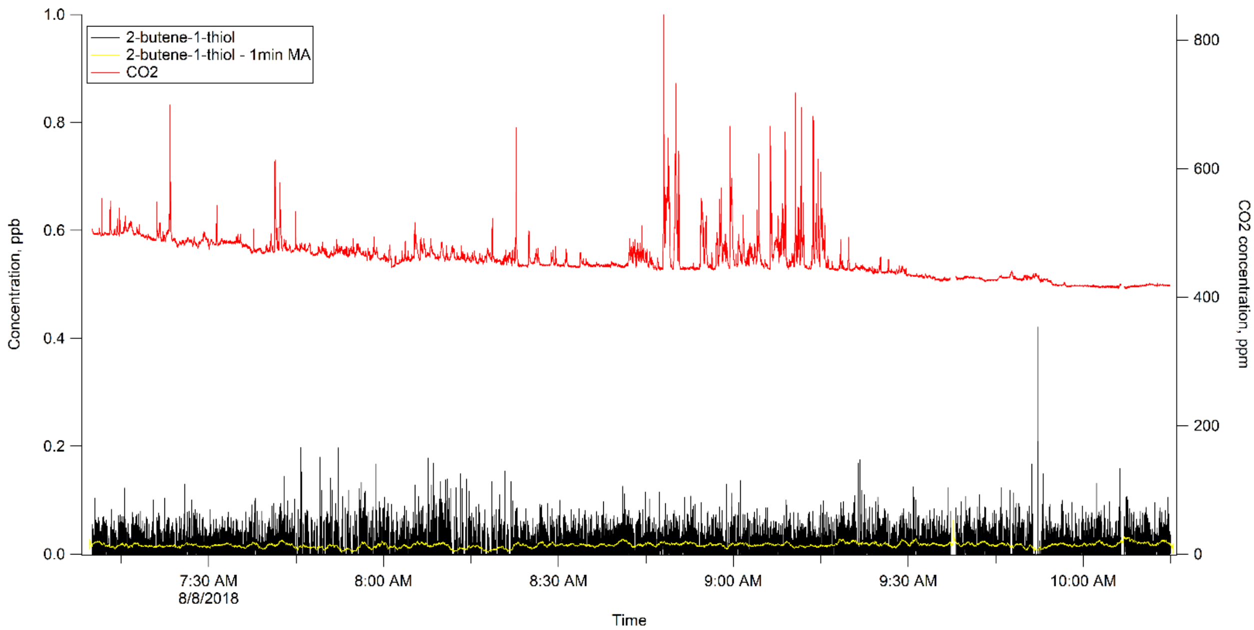

Figure 3-9. 2-butene-1-thiol.

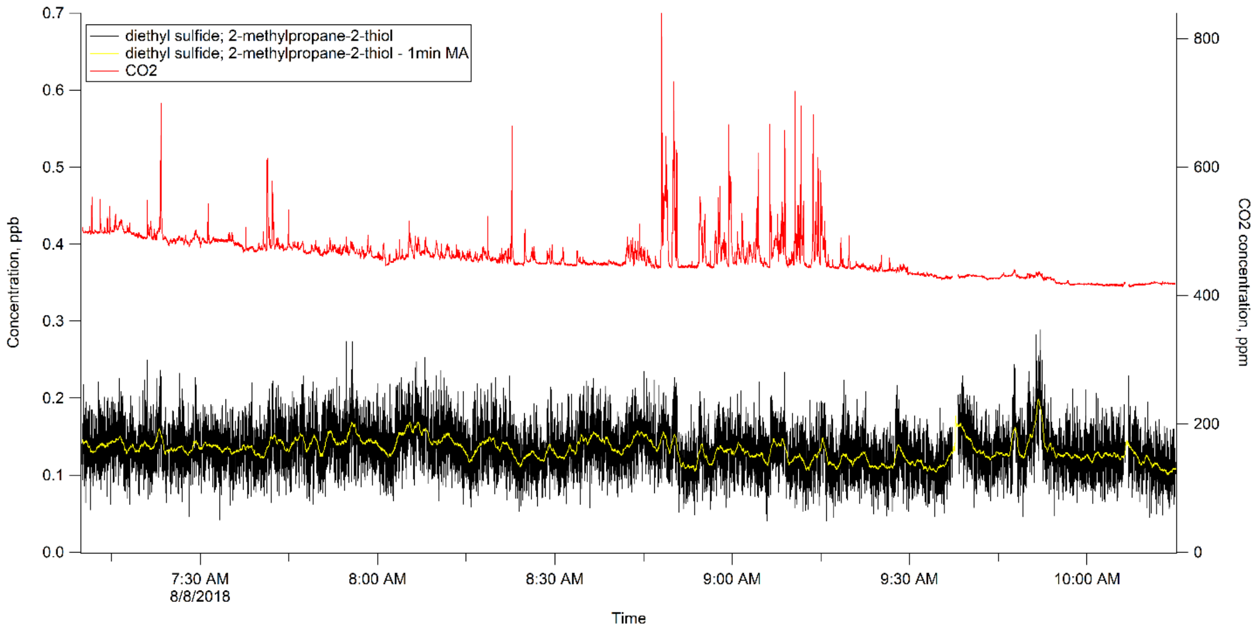

Figure 3-10. Diethyl Sulfide; 2-methylpropane-2-thiol.

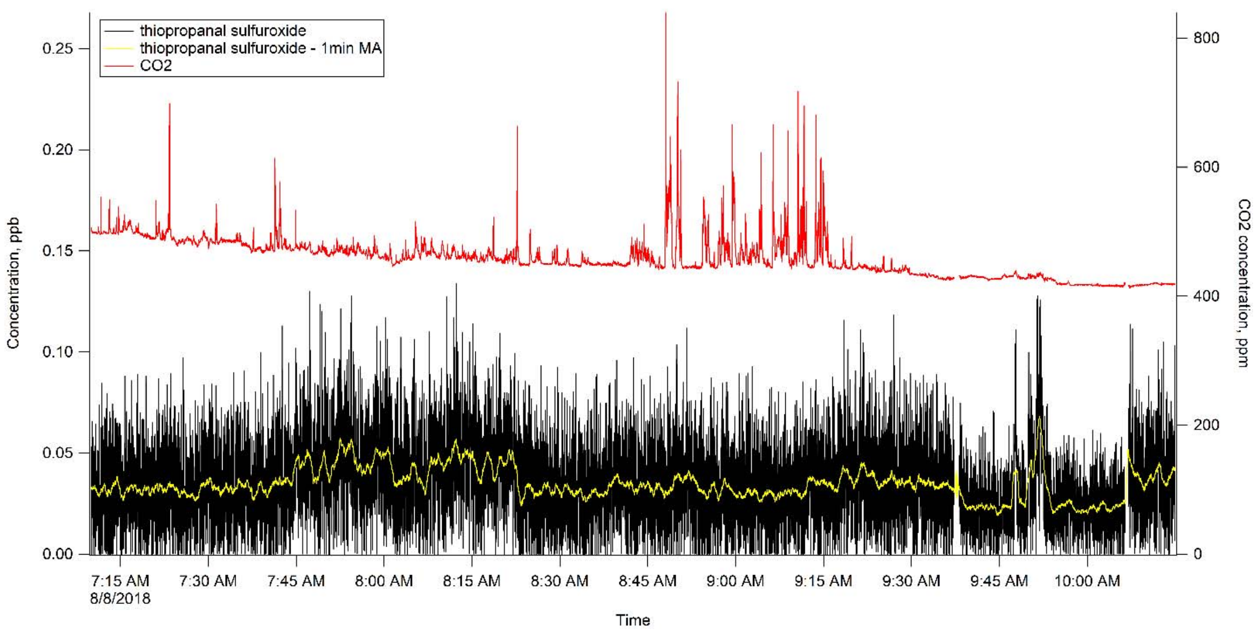

Figure 3-11. Thiopropanal Sulfuroxide.

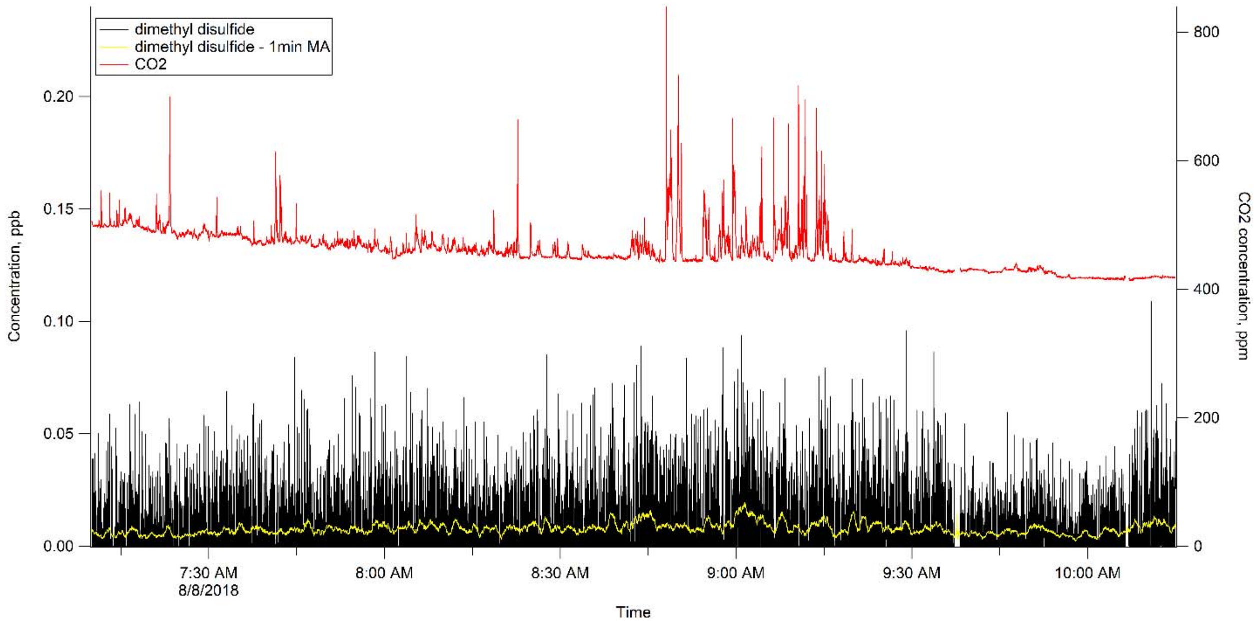

Figure 3-12. Dimethyl Disulfide.

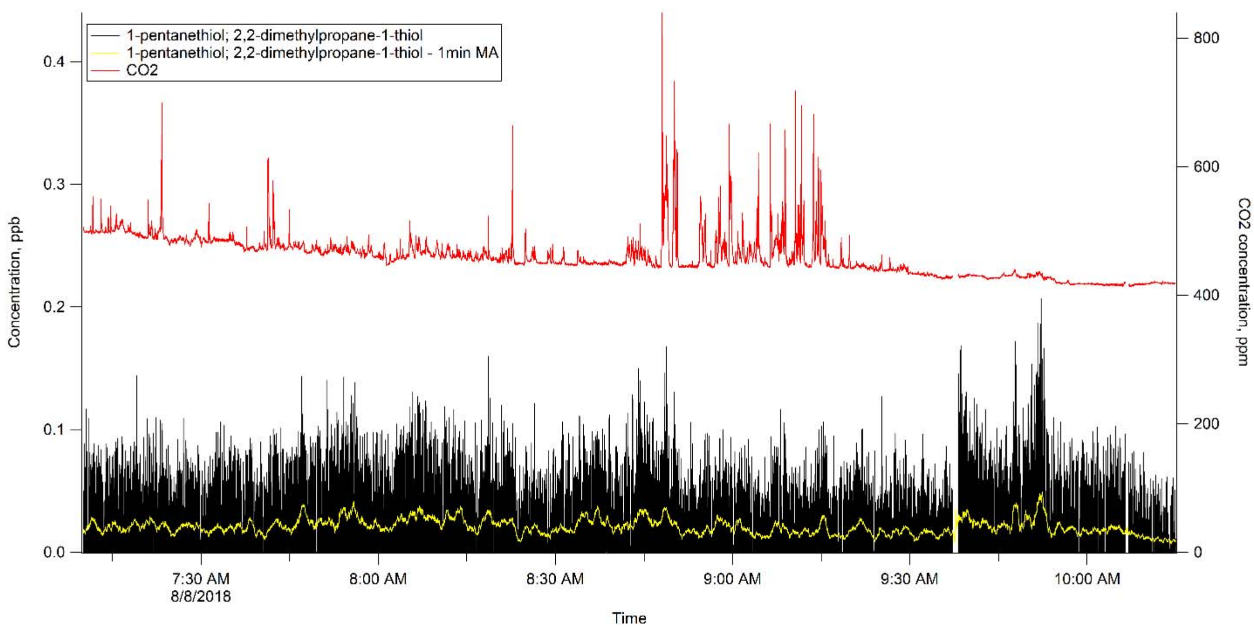

Figure 3-13. 1-pentanethiol; 2,2-dimethylpropane-1-thiol.

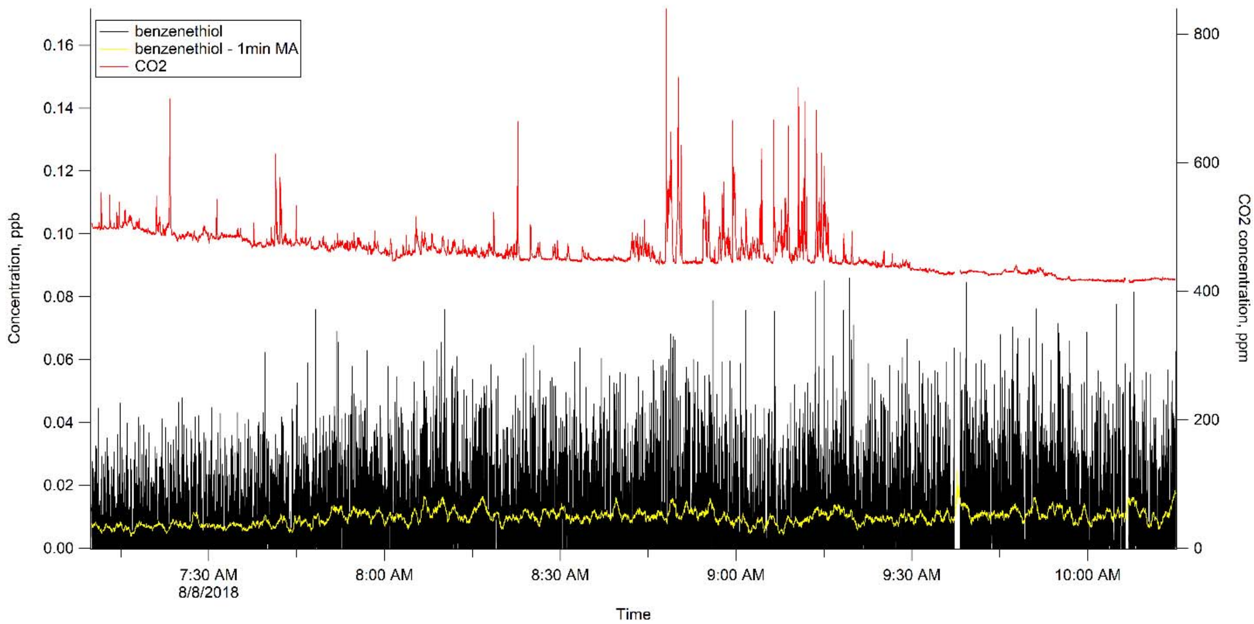

Figure 3-14. Benzenethiol.

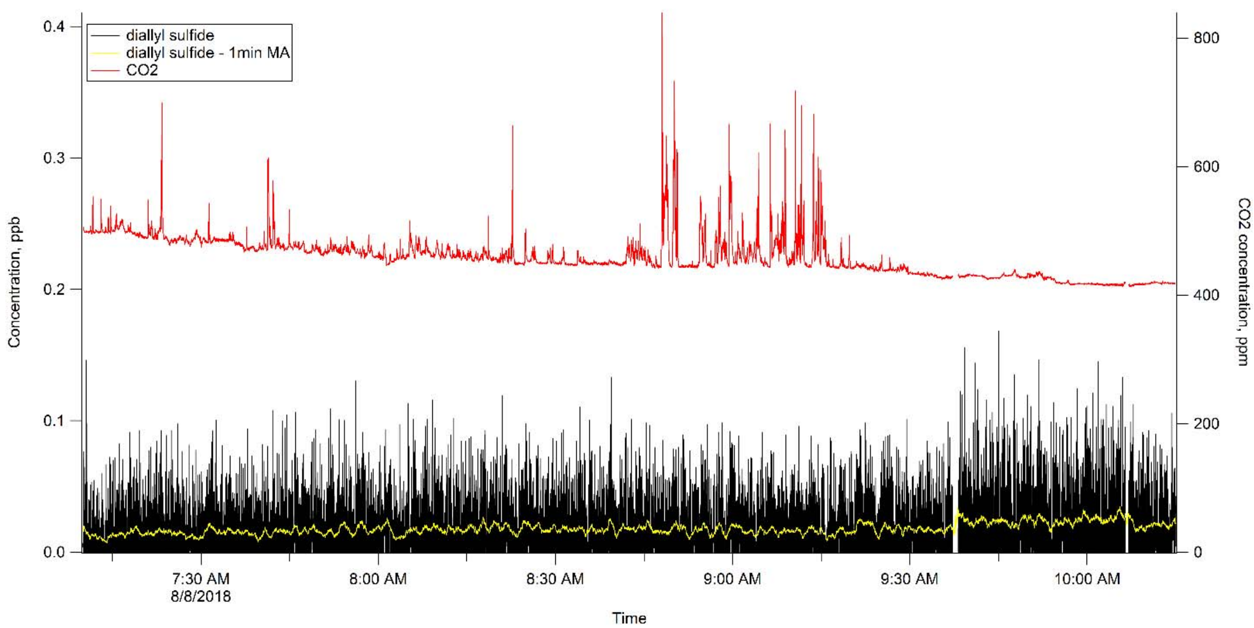

Figure 3-15. Diallyl Sulfide.

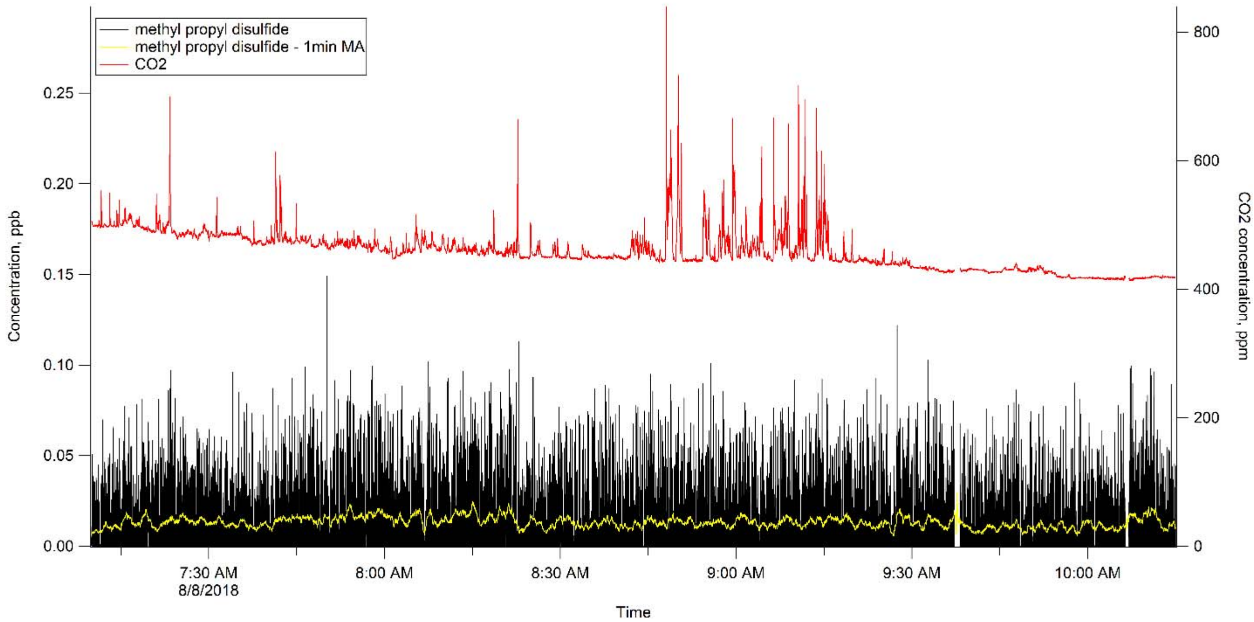

Figure 3-16. Methyl Propyl Disulfide.

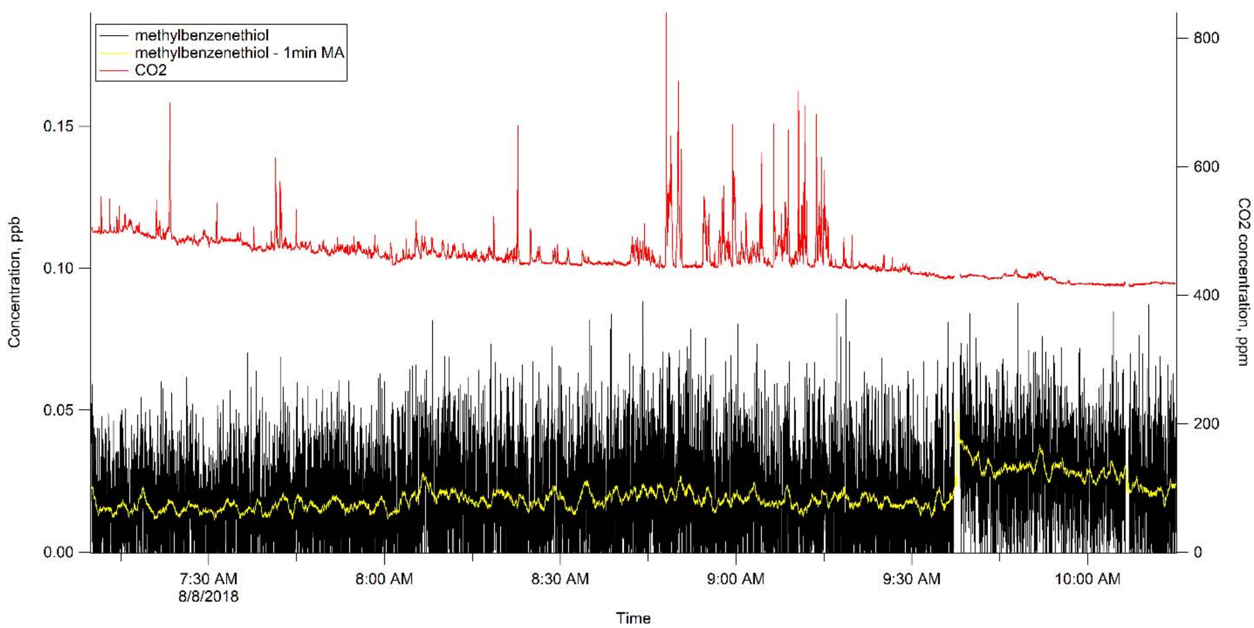

Figure 3-17. Methylbenzenethiol.

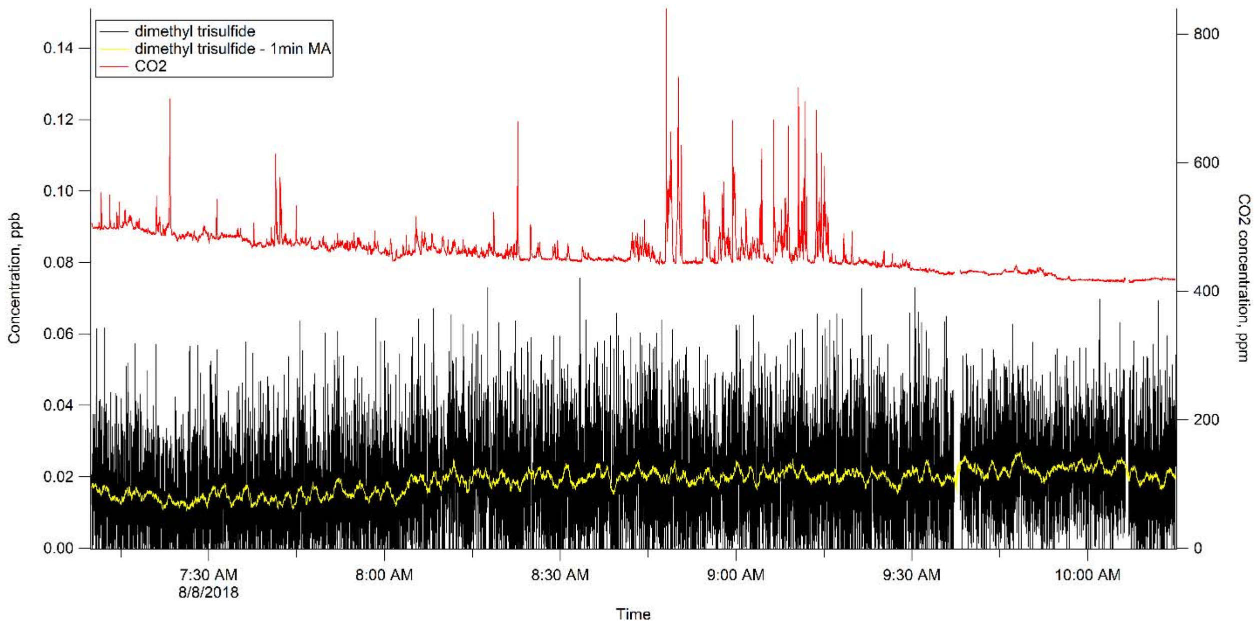

Figure 3-18. Dimethyl Trisulfide.

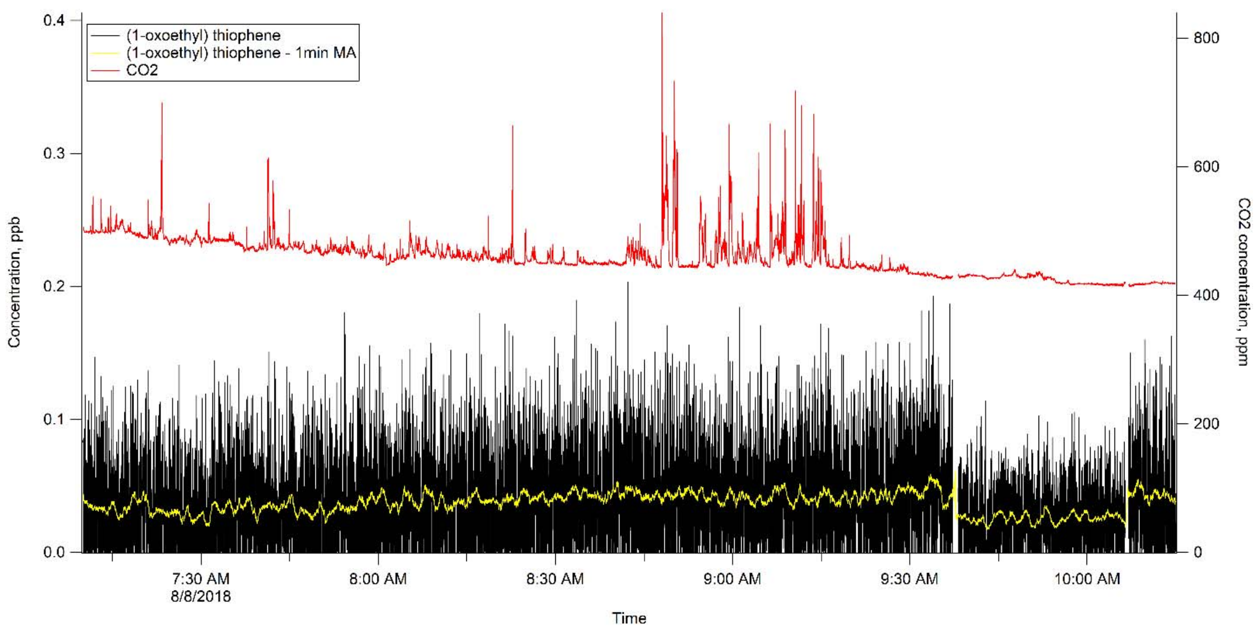

Figure 3-19. (1-oxoethyl) Thiophene.

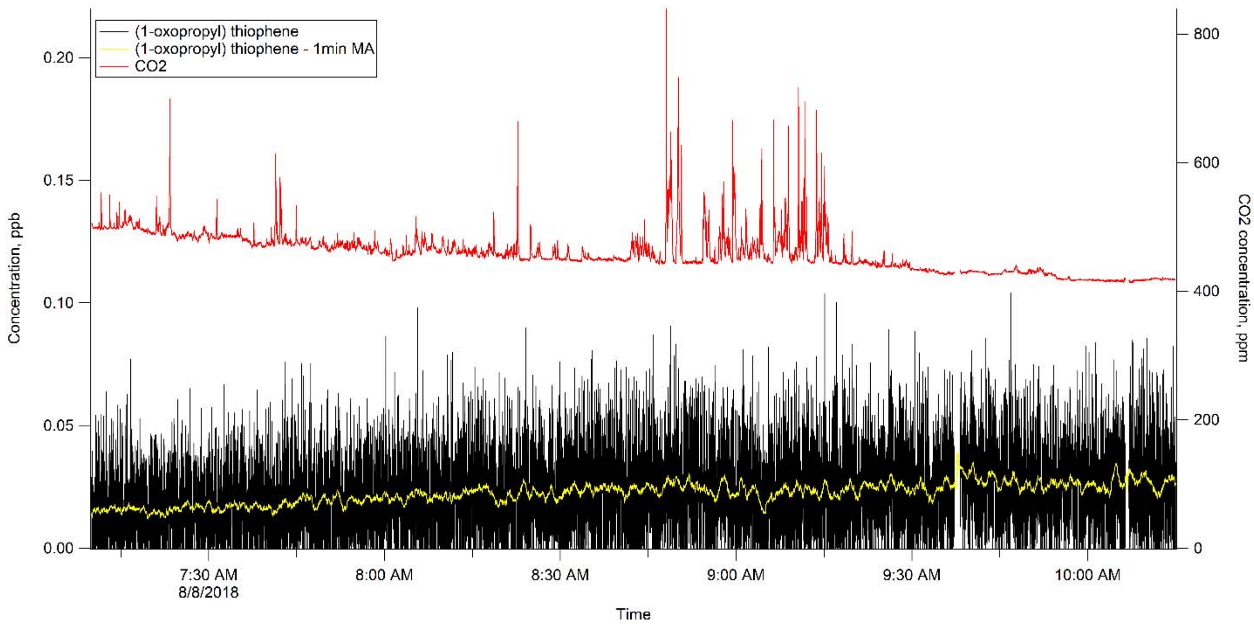

Figure 3-20. (1-oxopropyl) Thiophene.

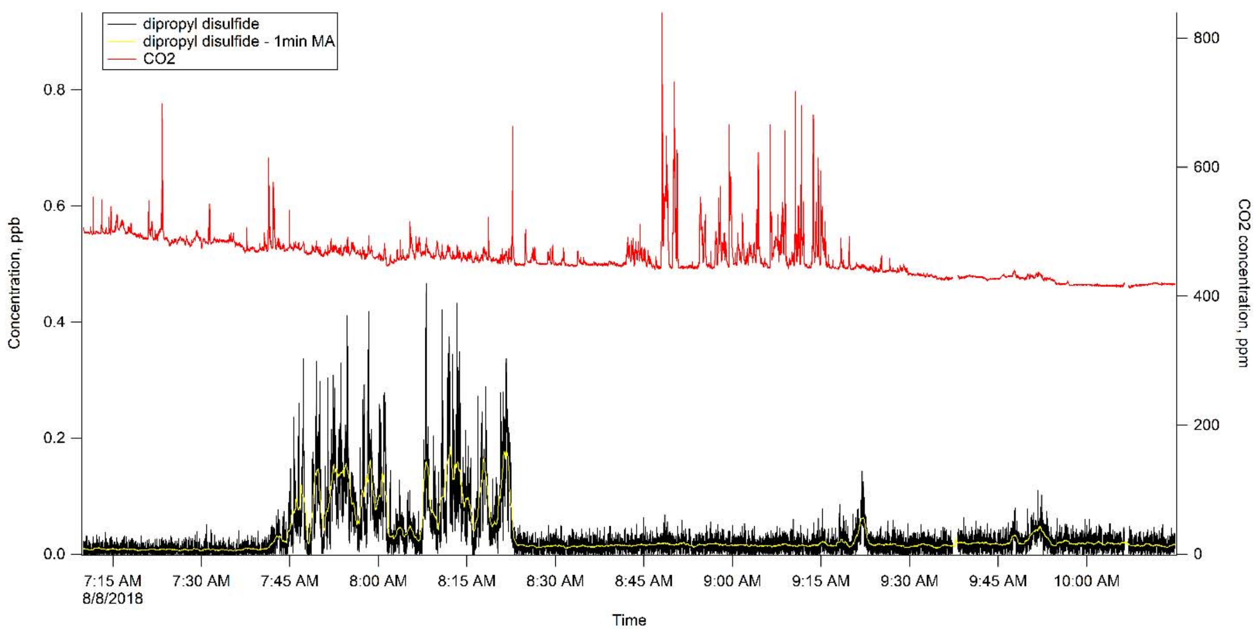

Figure 3-21. Dipropyl Disulfide.

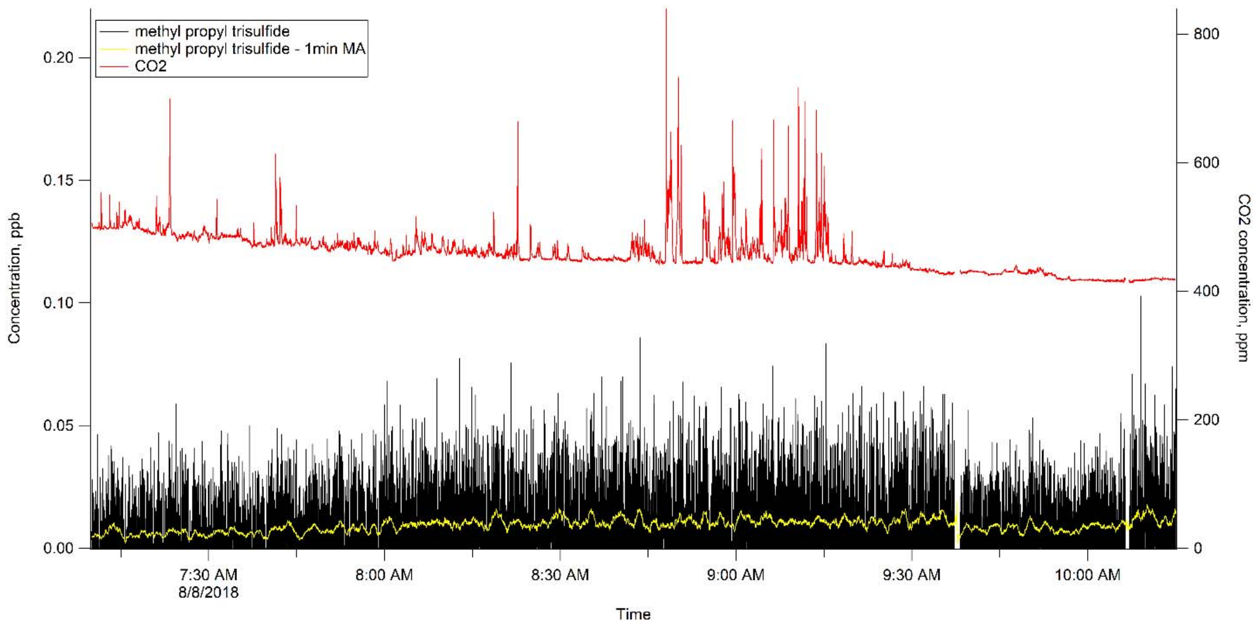

Figure 3-22. Methyl Propyl Trisulfide.

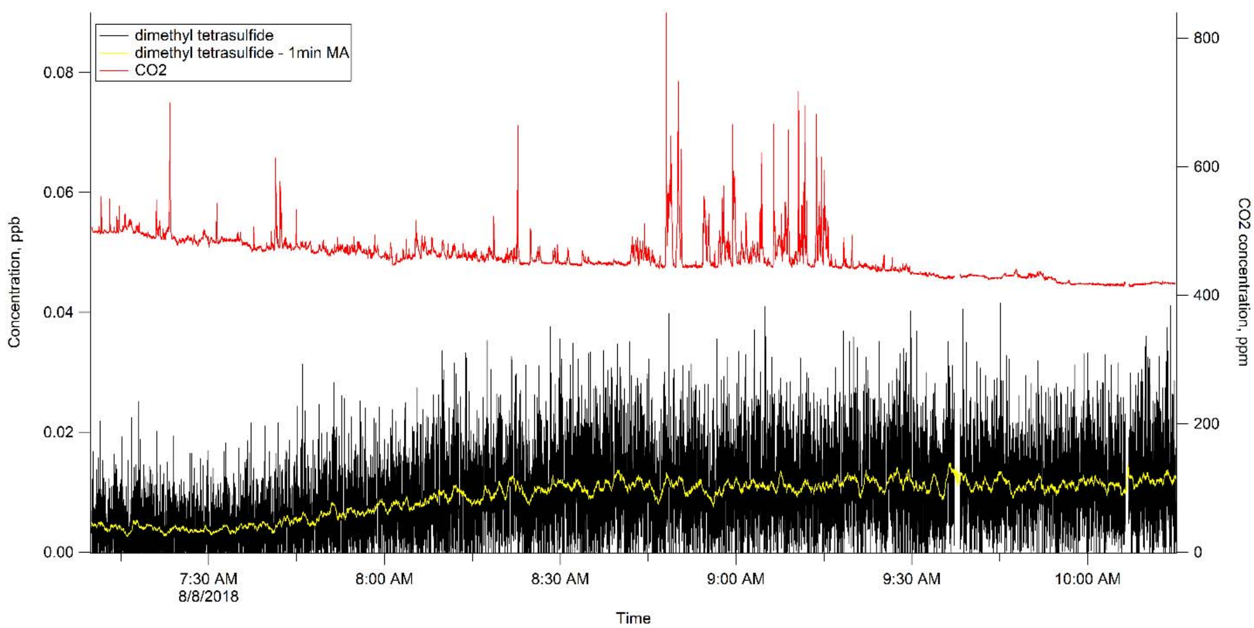

Figure 3-23. Dimethyl Tetrasulfide.

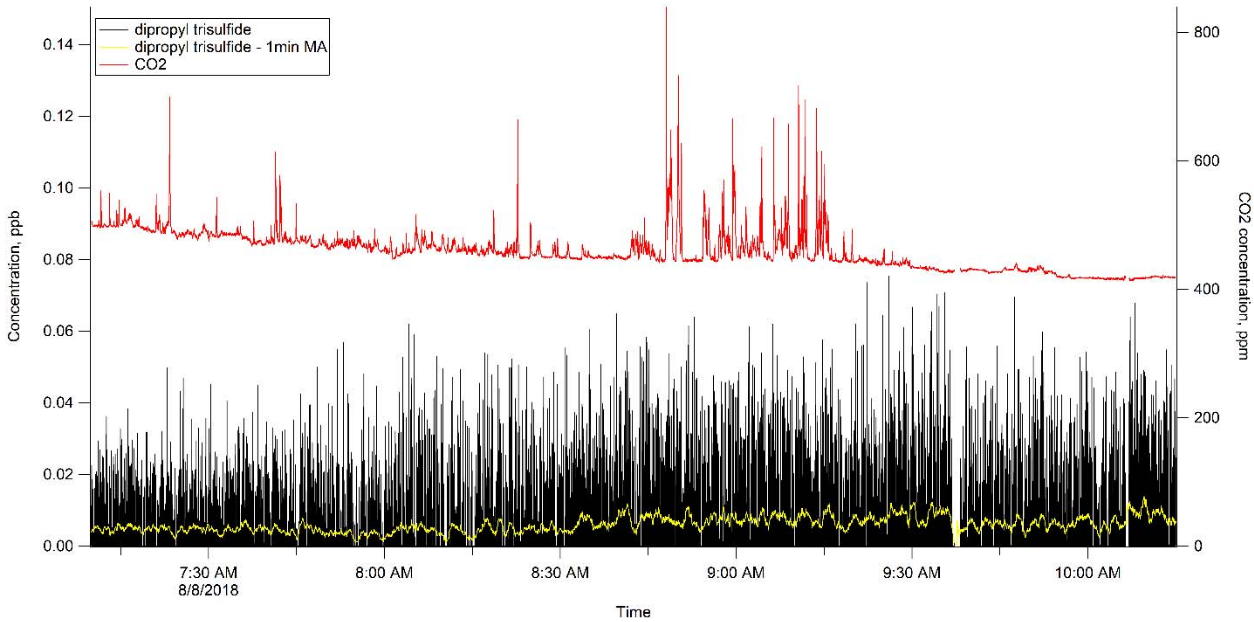

Figure 3-24. Dipropyl Trisulfide.

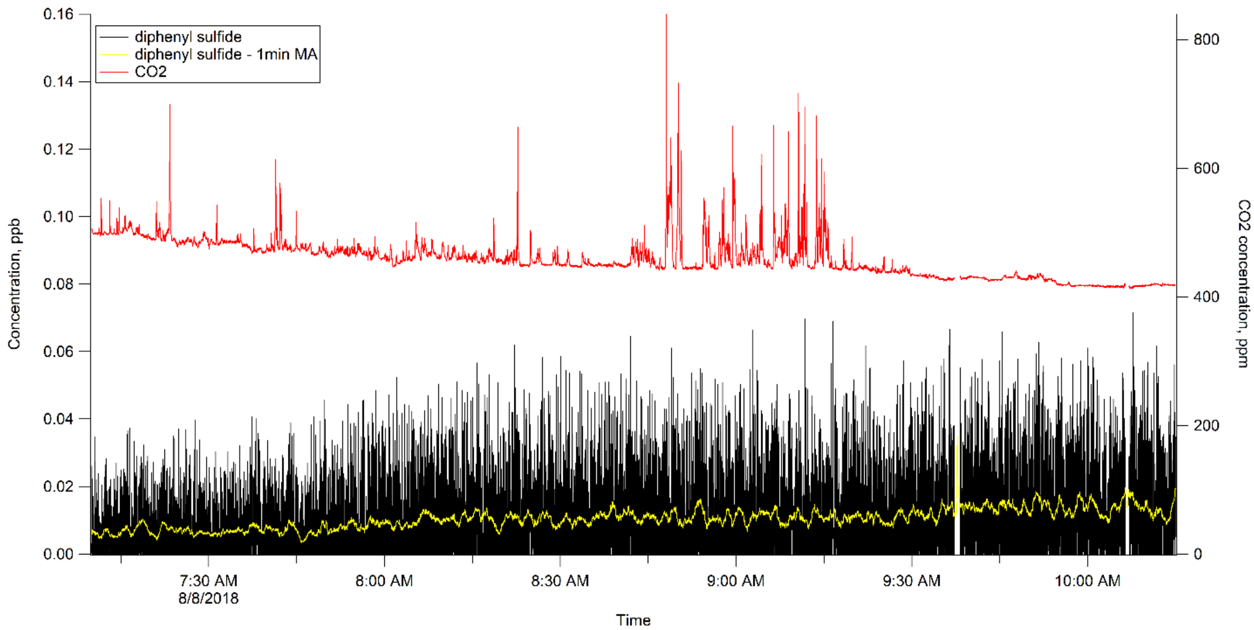

Figure 3-25. Diphenyl Sulfide.

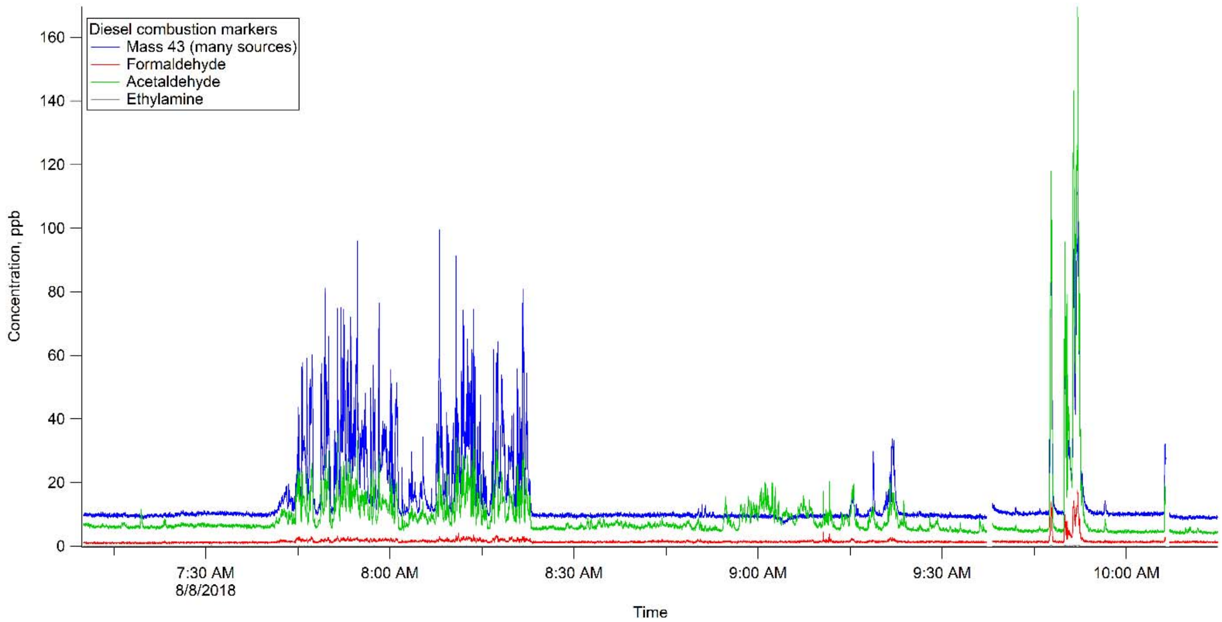

Figure 3-26. Diesel Combustion Markers.

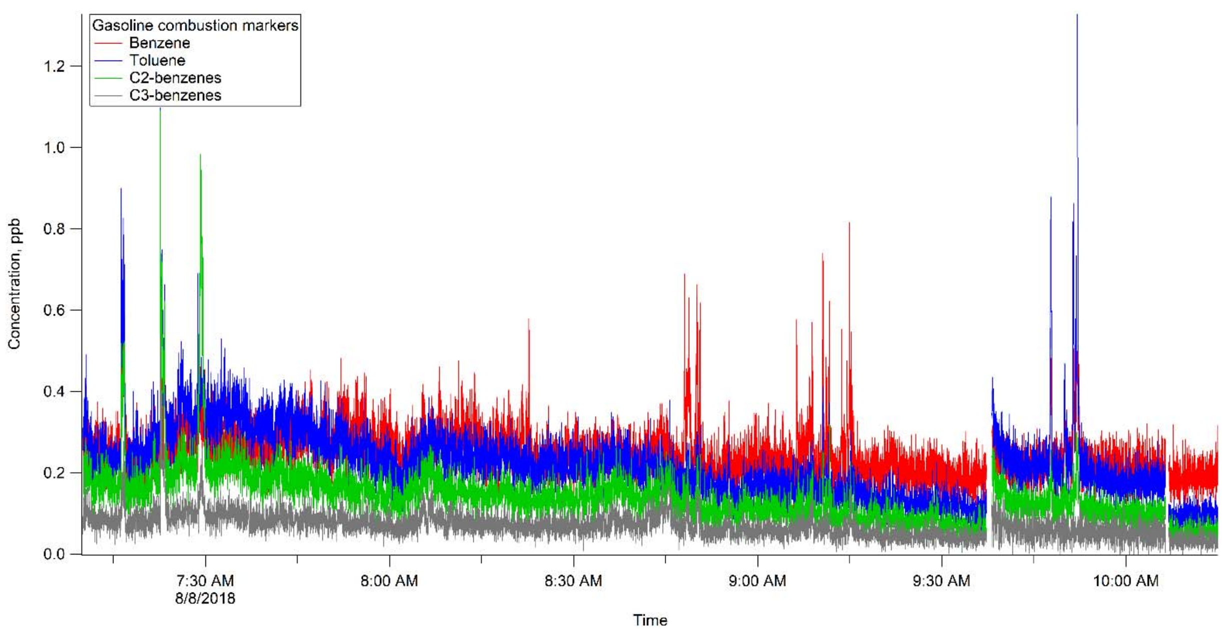

Figure 3-27. Gasoline Combustion Markers.

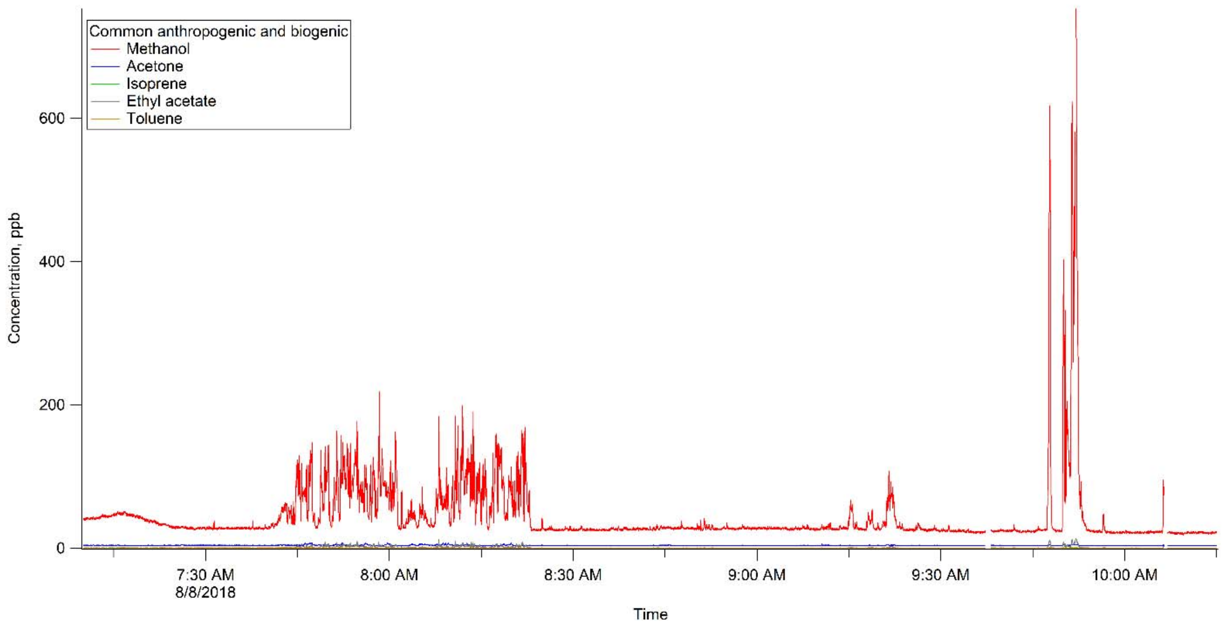

Figure 3-28. Plant and Human Markers.

4.0 AUGUST 9, 2018 – SOURCE CHARACTERIZATION AND AREA MONITORING

4.1 Quality Assessment

Data from August 9, 2018, were assessed using Procedure 17124-DOE-HS-102. A Data Exchange Checklist was completed. The data were accepted by TerraGraphics with the following comments. Report No. 66409-RPT-004 was adequately documented and all checks passed the acceptance limits.

4.2 Summary

On August 9, 2018, the ML performed source characterization and area monitoring at the Hanford Site.

ML staff arrived on site, checked in with the CSO at 06:42, and began mobile monitoring around A Farms. Prior to arrival, a QA/QC zero-air/sensitivity check was performed on the CO_2 monitor. At 07:06, ML staff began sampling at the septic tanks from the side port for about 40 minutes. After relocating downwind of the septic tanks, the ML proceeded to perform mobile monitoring along the A Farms perimeter as previously done that morning. During transit back to TerraGraphics, ML Staff performed a QA/QC zero-air/sensitivity check on the Ammonia Analyzer beginning at 12:11.

The ML returned to TerraGraphics at 12:50 and performed a QA/QC zero-air/sensitivity check on the PTR-MS followed by their closeout and shutdown procedure.

ML staff performed shutdown procedure in order for the ML to be transported to Mustang Signs in Kennewick for completion of vehicle wrap.

Table 4-1. Mobile Laboratory Sampling Mode Throughout the Monitoring Period.

Time	Location	Sampling Mode
06:42 - 7:01	A Farms	Mobile Area sampling
07:01 - 07:06	A Farms-septic tanks	Mobile sampling (mast)
07:06 - 07:49	A Farms-septic tanks	Side Port sampling
07:49 - 08:14	A Farms-downwind of septic tanks	Mobile sampling (mast)
08:14 - 11:42	A Farms	Mobile Area sampling

Figure 4-1. Mobile Laboratory Location for the Duration of the Monitoring Period.

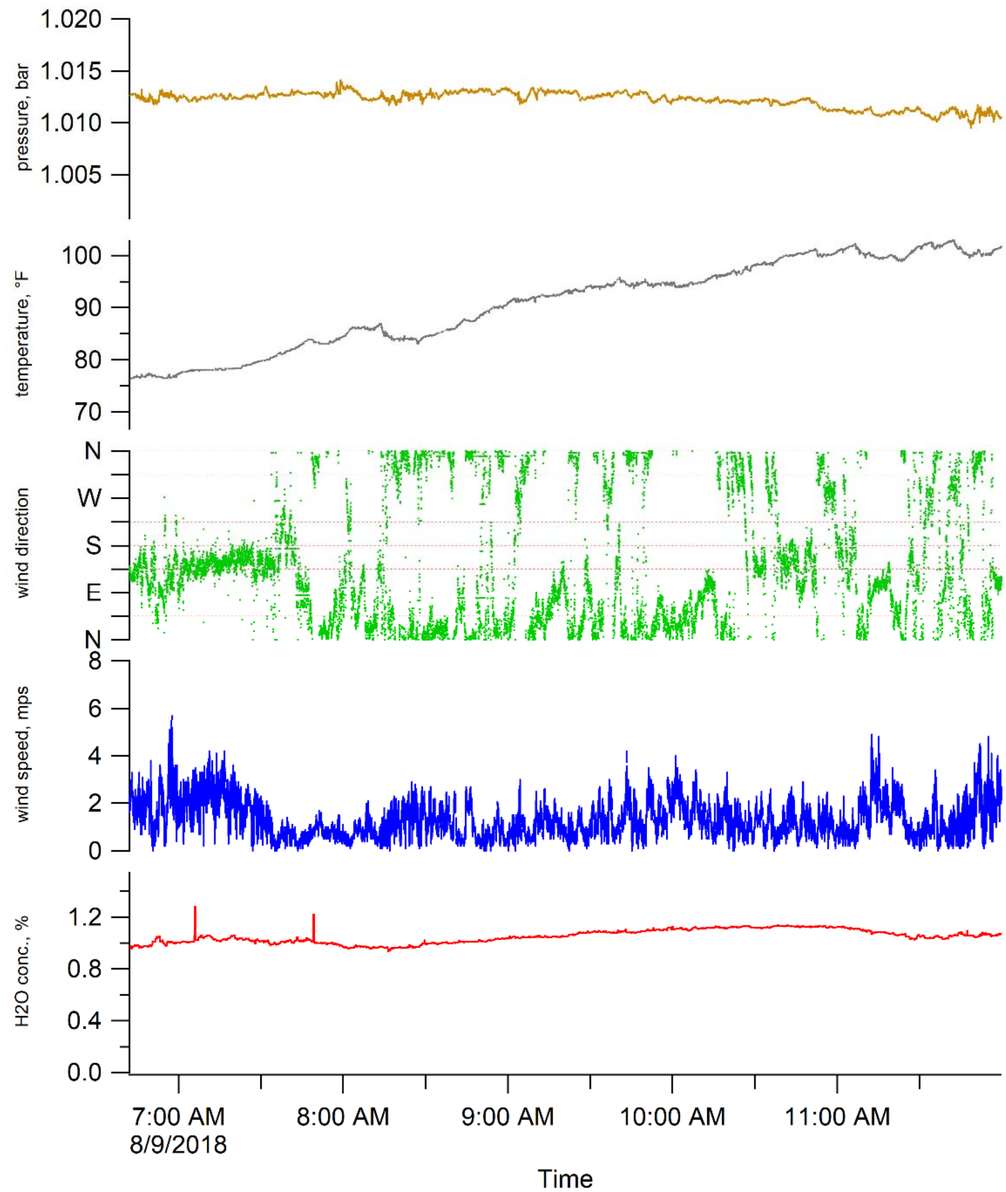

Figure 4-2. Weather Data for the Duration of the Monitoring Period.

4.3 Samples Collected

Continuous air monitoring was performed using the following instrumentation:

- PTR-TOF 6000 X2,
- LI-COR CO_2 Monitor,
- Picarro Ammonia Monitor, and
- Weather Station.

Confirmatory air samples were not collected during this period.

4.4 Area Monitoring

Table 4-1 displays the COPC statistical information for the monitoring period of August 9, 2018.

Table 4-2. Chemical of Potential Concern Statistical Information for the Monitoring Period of August 9, 2018. (2 Sheets)

COPC #	COPC Name	OEL (ppb)	Ave. (ppb)	St. Dev. (ppb)	Rel St. Dev. (%)	Max (ppb)	Median (ppb)
1	ammonia	25000	12.000	2.875	23.963	20.587	11.273
2	formaldehyde	300	1.422	0.174	12.257	3.137	1.412
3	methanol	200000	21.880	3.442	15.733	66.260	21.639
4	acetonitrile	20000	0.350	0.043	12.397	0.961	0.348
5	acetaldehyde	25000	4.873	1.268	26.011	20.089	4.595
6	ethylamine	5000	0.023	0.013	57.139	0.098	0.022
7	1, 3-butadiene	1000	0.216	0.126	58.199	0.987	0.208
8	propanenitrile	6000	0.065	0.021	31.950	0.227	0.061
9	2-propenal	100	0.381	0.088	23.156	1.510	0.371
10	1-butanol + butenes	20000	0.244	0.129	52.769	2.489	0.216
11	methyl isocyanate	20	0.048	0.020	42.384	0.148	0.046
12	methyl nitrite	100	0.262	0.102	38.911	3.693	0.252
13	furan	1	0.051	0.017	33.695	0.167	0.050
14	butanenitrile	8000	0.025	0.014	55.592	0.110	0.023
15	but-3-en-2-one + 2,3-dihydrofuran + 2,5-dihydrofuran	100, 1, 1	0.130	0.031	23.865	0.416	0.126
16	butanal	25000	0.272	0.052	19.087	0.608	0.265
17	NDMA	0.3	0.047	0.051	107.758	0.334	0.033
18	benzene	500	0.212	0.122	57.406	3.423	0.194
19	2, 4-pentadienenitrile + pyridine	300, 1000	0.042	0.015	36.488	0.281	0.039
20	2-methylene butanenitrile	30	0.016	0.009	56.469	0.070	0.016
21	2-methylfuran	1	0.067	0.022	32.579	0.274	0.065
22	pentanenitrile	6000	0.018	0.010	58.303	0.076	0.016
23	3-methyl-3-buten-2-one + 2-methyl-2-butenal	20, 30	0.065	0.023	36.054	0.258	0.062
24	NEMA	0.3	0.023	0.032	135.853	0.230	0.006
25	2, 5-dimethylfuran	1	0.033	0.017	51.430	0.180	0.031
26	hexanenitrile	6000	0.007	0.007	88.909	0.057	0.006
27	2-hexanone (MBK)	5000	0.035	0.026	73.170	0.267	0.029
28	NDEA	0.1	0.010	0.016	153.684	0.103	0.000

Table 4-2. Chemical of Potential Concern Statistical Information for the Monitoring Period of August 9, 2018. (2 Sheets)

COPC #	COPC Name	OEL (ppb)	Ave. (ppb)	St. Dev. (ppb)	Rel St. Dev. (%)	Max (ppb)	Median (ppb)
29	butyl nitrite + 2-nitro-2-methylpropane	100, 30	0.047	0.014	28.904	0.108	0.046
30	2, 4-dimethylpyridine	500	0.021	0.025	119.146	0.587	0.017
31	2-propylfuran + 2-ethyl-5-methylfuran	1	0.032	0.018	54.758	0.169	0.030
32	heptanenitrile	6000	0.026	0.012	44.455	0.082	0.025
33	4-methyl-2-hexanone	500	0.048	0.023	48.531	0.280	0.044
34	NMOR	0.6	0.013	0.019	146.342	0.269	0.000
35	butyl nitrate	2500	0.014	0.011	73.663	0.063	0.013
36	2-ethyl-2-hexenal + 4-(1-methylpropyl)-2, 3-dihydrofuran + 3-(1, 1-dimethylethyl)-2, 3-dihydrofuran	100, 1, 1	0.038	0.018	46.590	0.151	0.035
37	6-methyl-2-heptanone	8000	0.036	0.016	44.661	0.139	0.034
38	2-pentylfuran	1	0.043	0.016	37.851	0.118	0.041
39	biphenyl	200	0.024	0.017	71.418	0.125	0.023
40	2-heptylfuran	1	0.085	0.018	20.781	0.175	0.083
41	1, 4-butanediol dinitrate	50	0.035	0.014	39.964	0.096	0.034
42	2-octylfuran	1	0.006	0.011	191.770	0.085	0.000
43	1, 2, 3-propanetriol 1, 3-dinitrate	50	0.004	0.010	252.886	0.071	0.000
44	PCB	1000	0.052	0.016	31.060	0.132	0.051
45	6-(2-furanyl)-6-methyl-2-heptanone	1	0.012	0.009	70.139	0.055	0.011
46	furfural acetophenone	1	0.076	0.016	21.590	0.165	0.075

* The maximum peak value for but-3-en-2-one + 2,3 dihydrofuran + 2,5 dihydrofuran was 0.416 ppb and the median value was 0.126 ppb. The PTR-MS results for but-3-en-2-one + 2,3 dihydrofuran + 2,5 dihydrofuran are not compared to OEL concentrations because: 1) the result is suspect due to a known biogenic interferant (methacrolein) that is expected to be in concentrations that occasionally exceed the dihydrofuran OEL, and 2) this combination of COPCs have OEL concentrations that differ by a factor of 100, which provide widely variant bases for these numbers.

**Nitrosamine results are also suspect due to interferants identified during the background study.

The following figures display a series of COPC signals, overlaid with the same signal smoothed using a one-minute moving average, and CO_2, for the monitoring period of August 9, 2018.

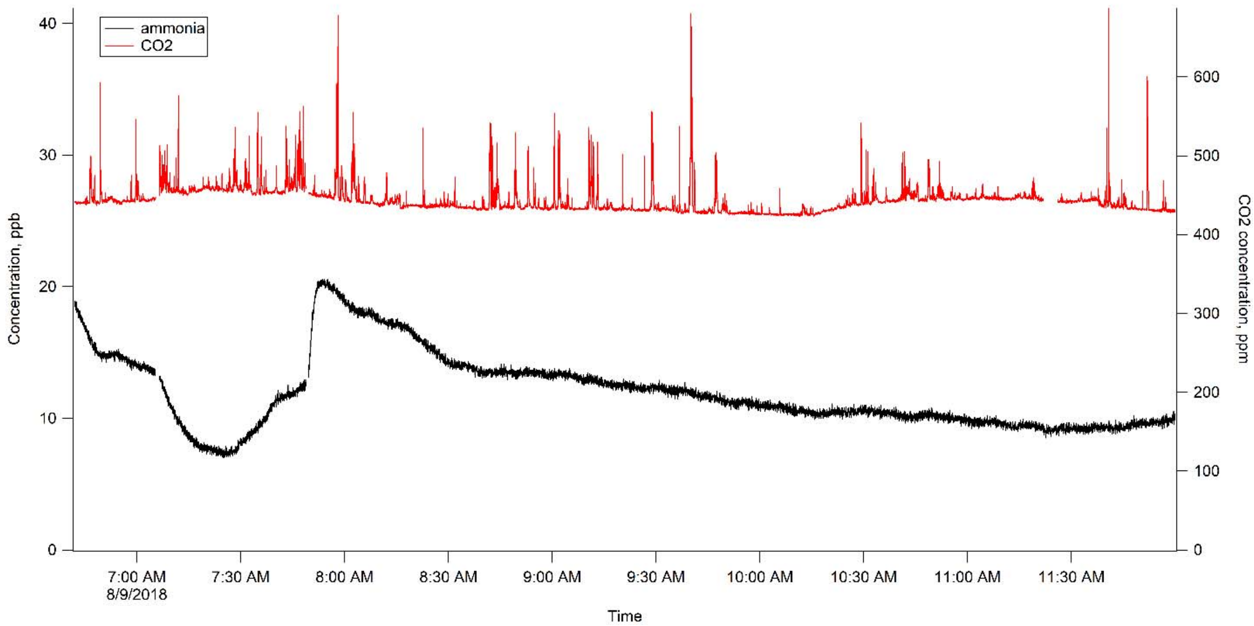

Figure 4-3. Ammonia.

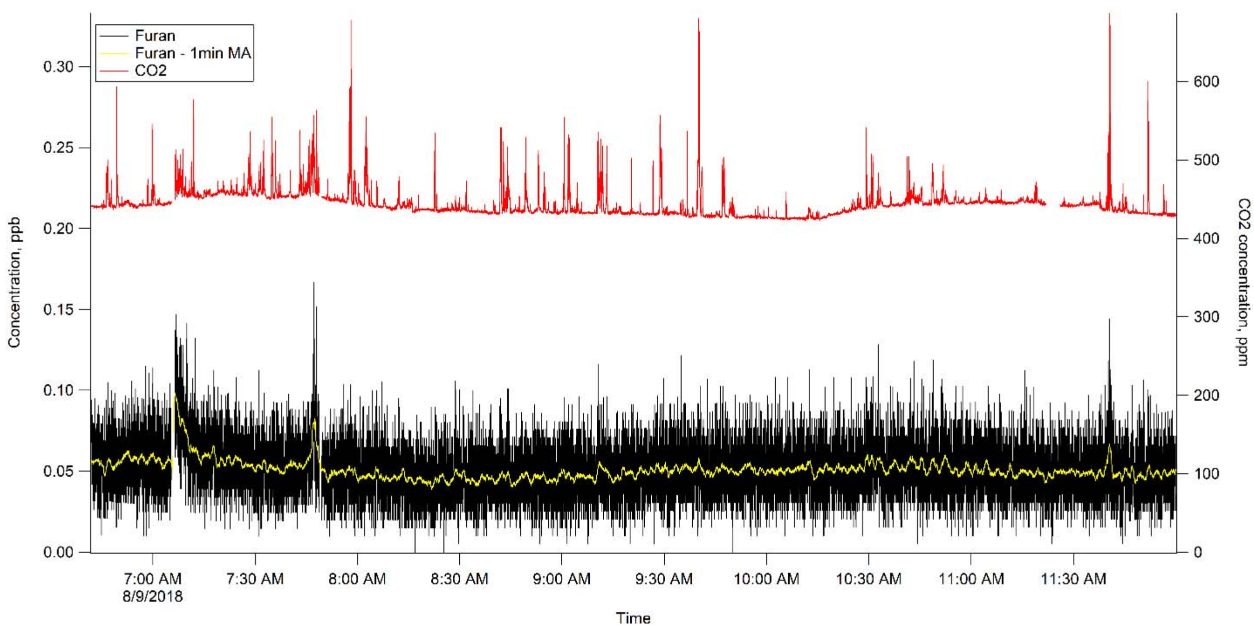

Figure 4-4. Furan.

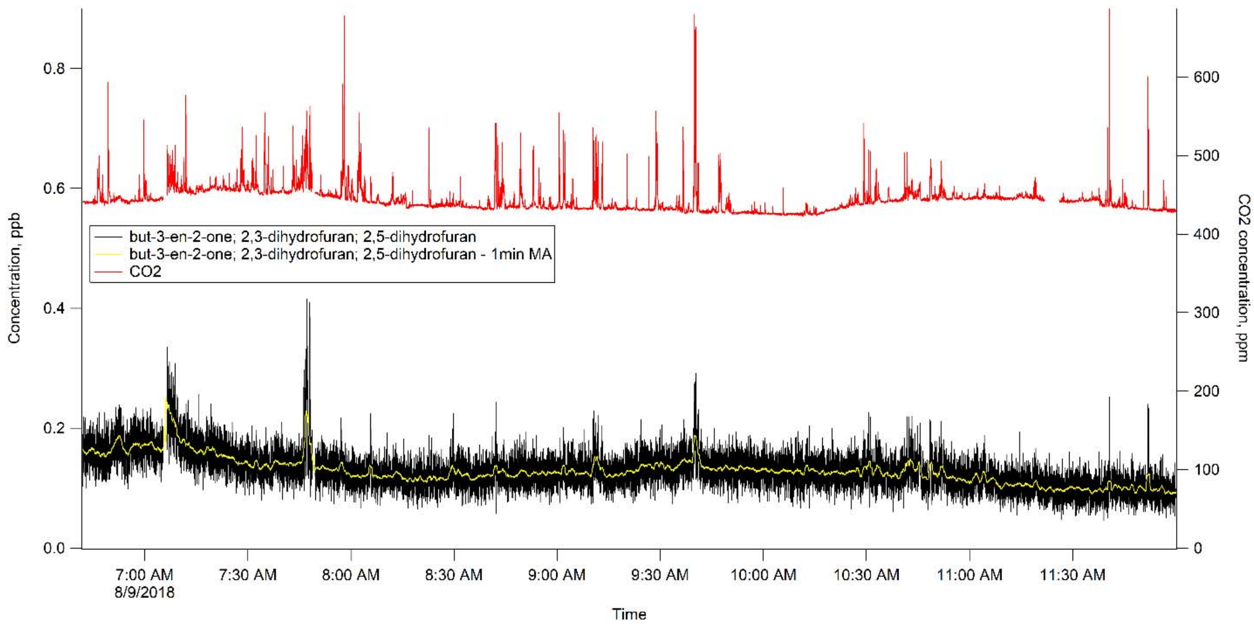

Figure 4-5. But-3-en-2-one; 2,3-dihydrofuran; 2,5-dihydrofuran.

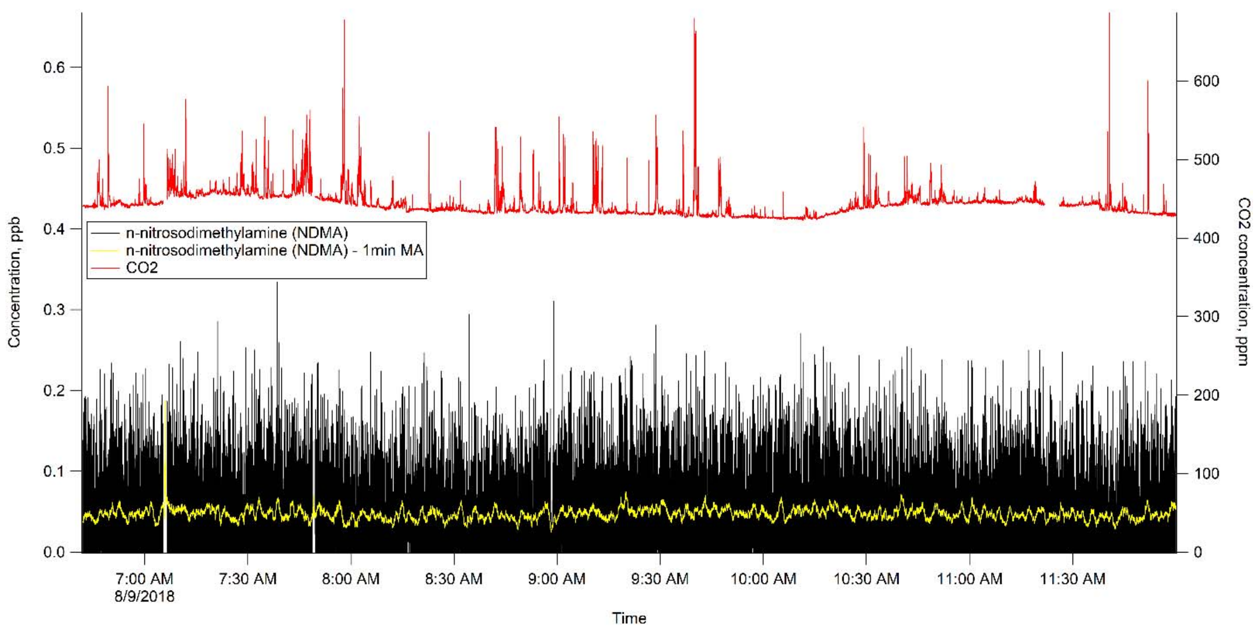

Figure 4-6. N-nitrosodimethylamine (NDMA).

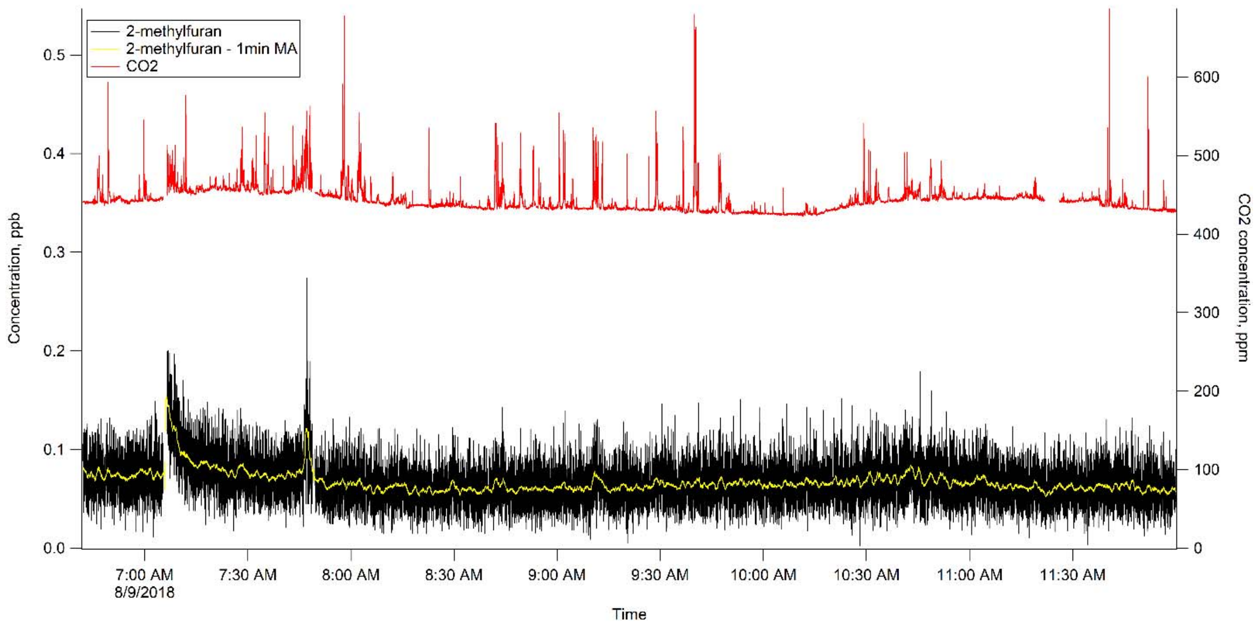

Figure 4-7. 2-methylfuran.

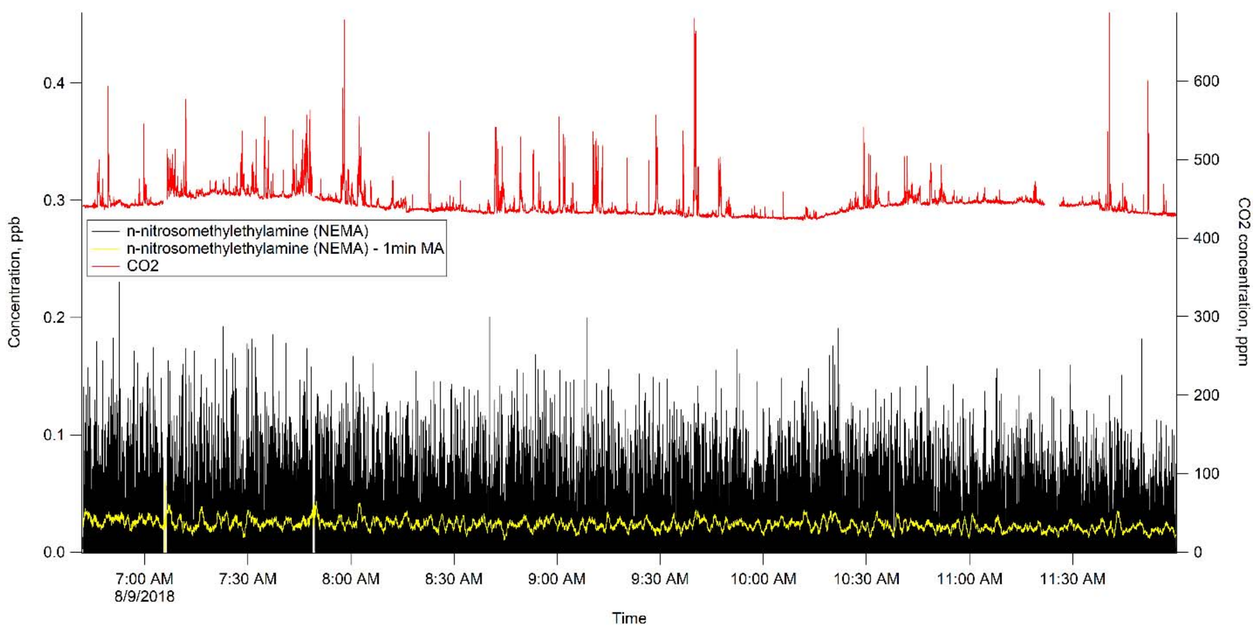

Figure 4-8. N-nitrosomethylethylamine (NEMA).

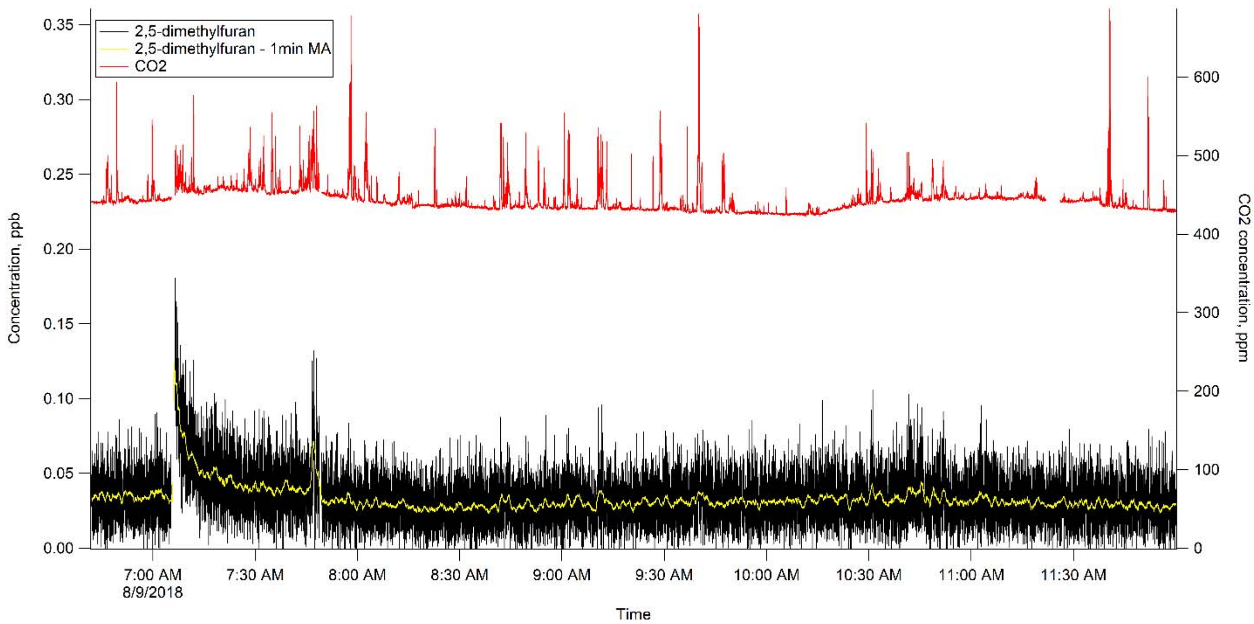

Figure 4-9. 2, 5-dimethylfuran.

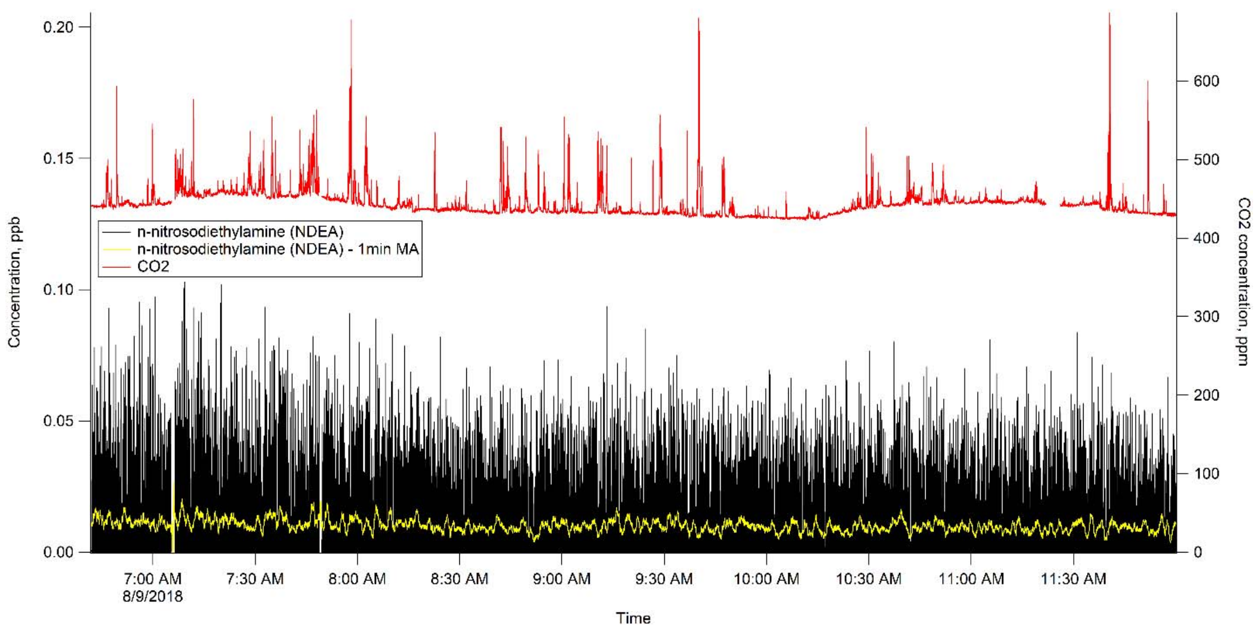

Figure 4-10. N-nitrosodiethylamine (NDEA).

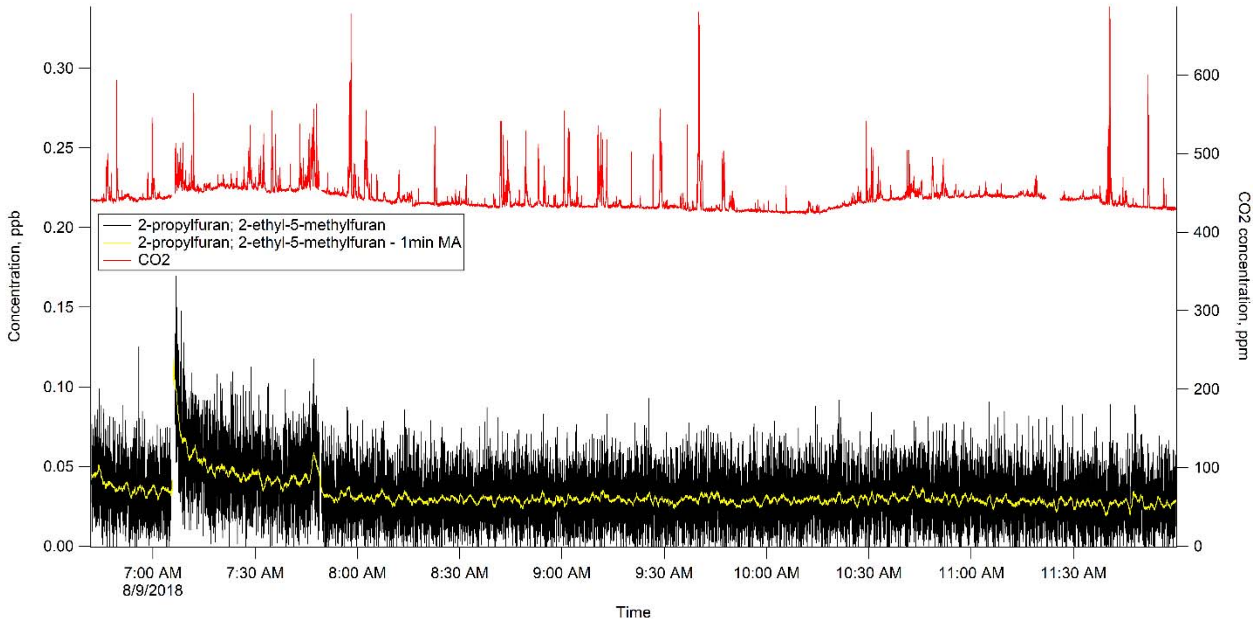

Figure 4-11. 2-propylfuran; 2-ethyl-5-methylfuran.

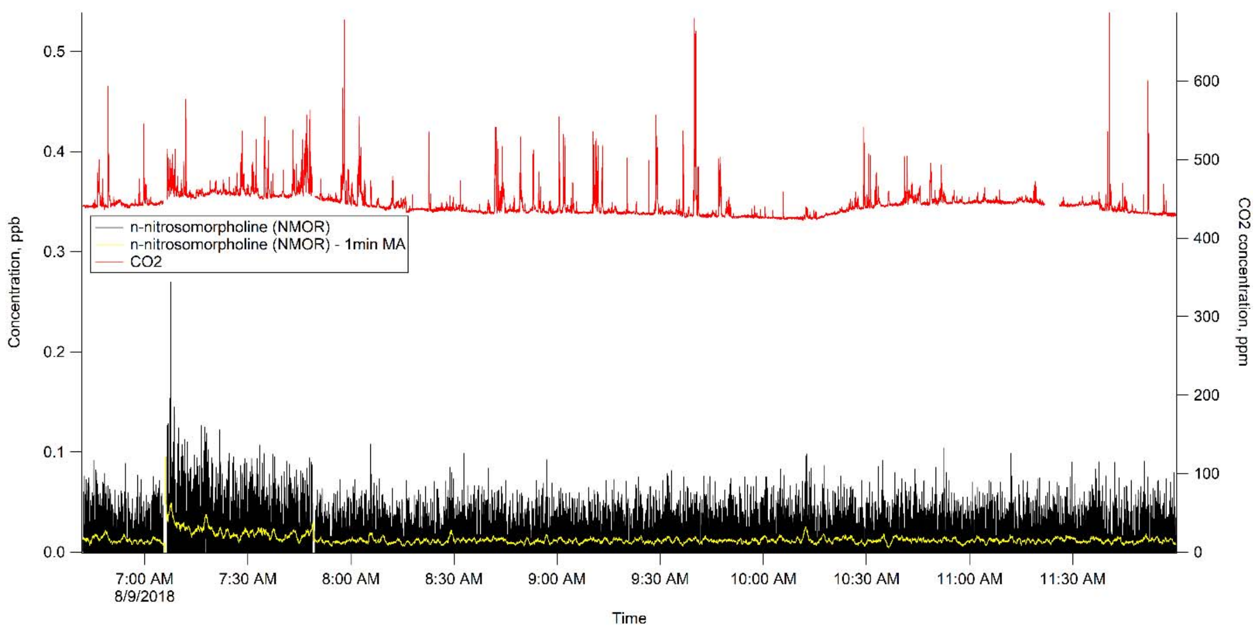

Figure 4-12. N-nitrosomorpholine (NMOR).

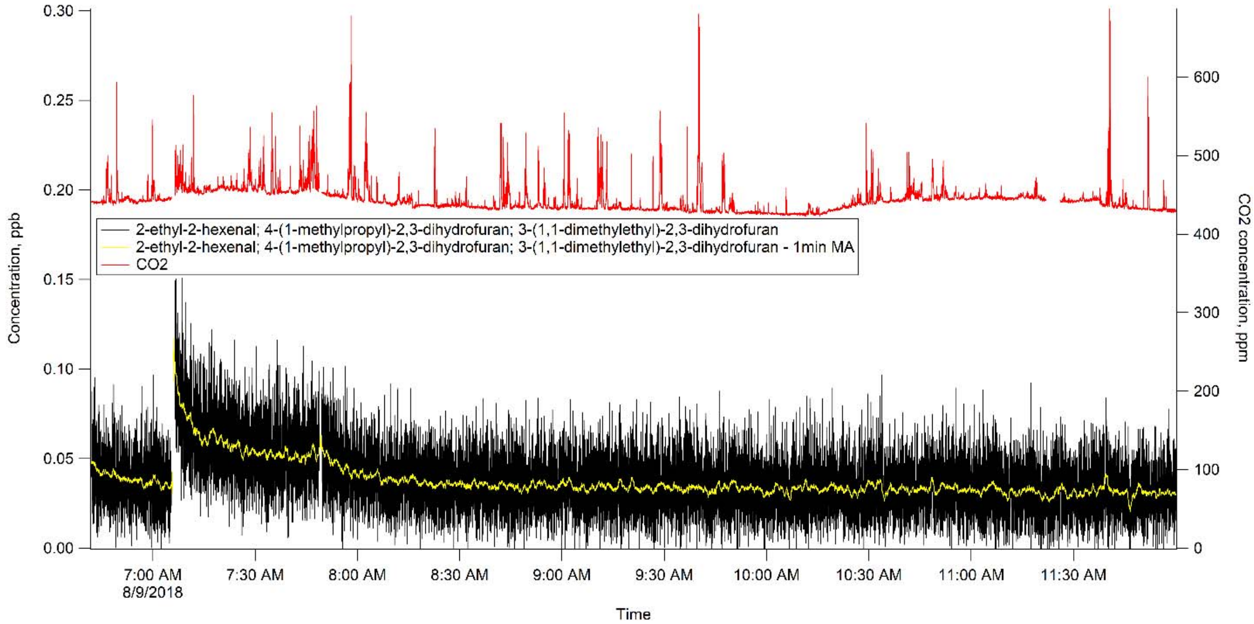

Figure 4-13. 2-ethyl-2-hexenal; 4-(1-methylpropyl)-2,3-dihydrofuran; 3-(1,1-dimethylethyl)-2,3-dihydrofuran.

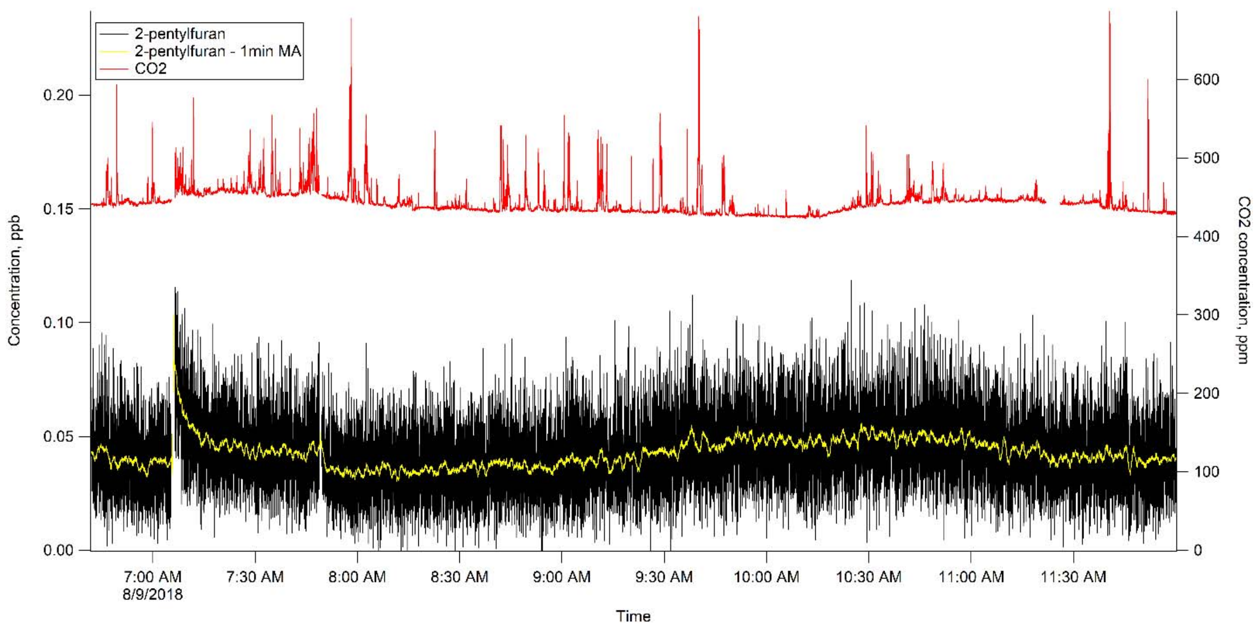

Figure 4-14. 2-pentylfuran.

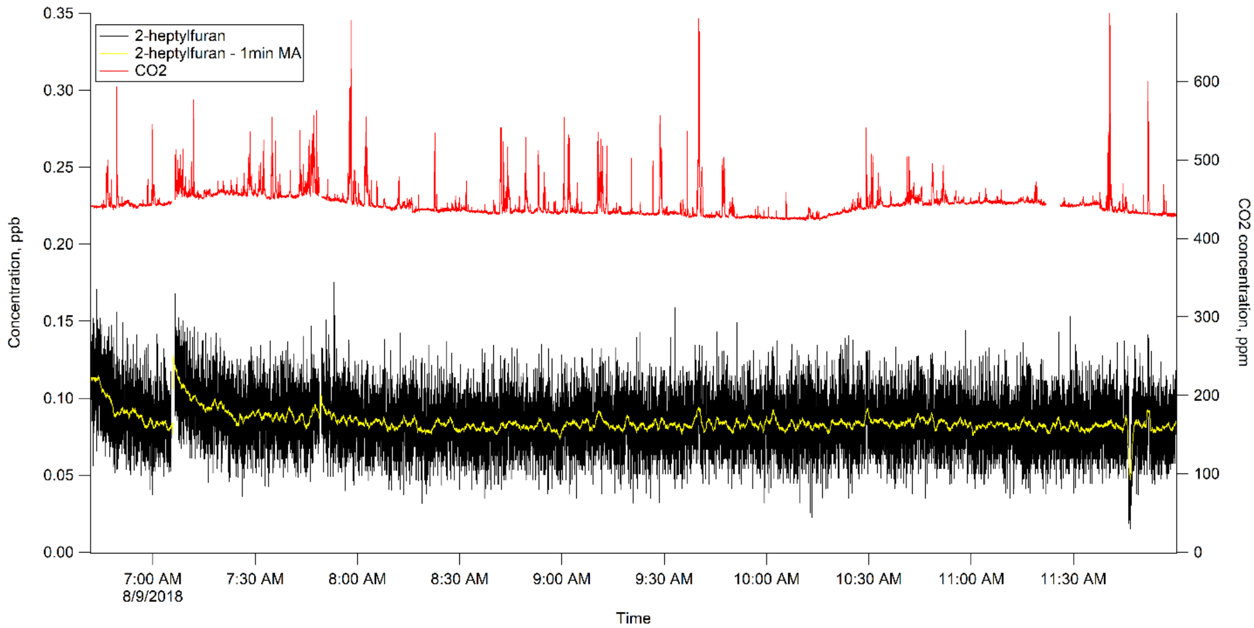

Figure 4-15. 2-heptylfuran.

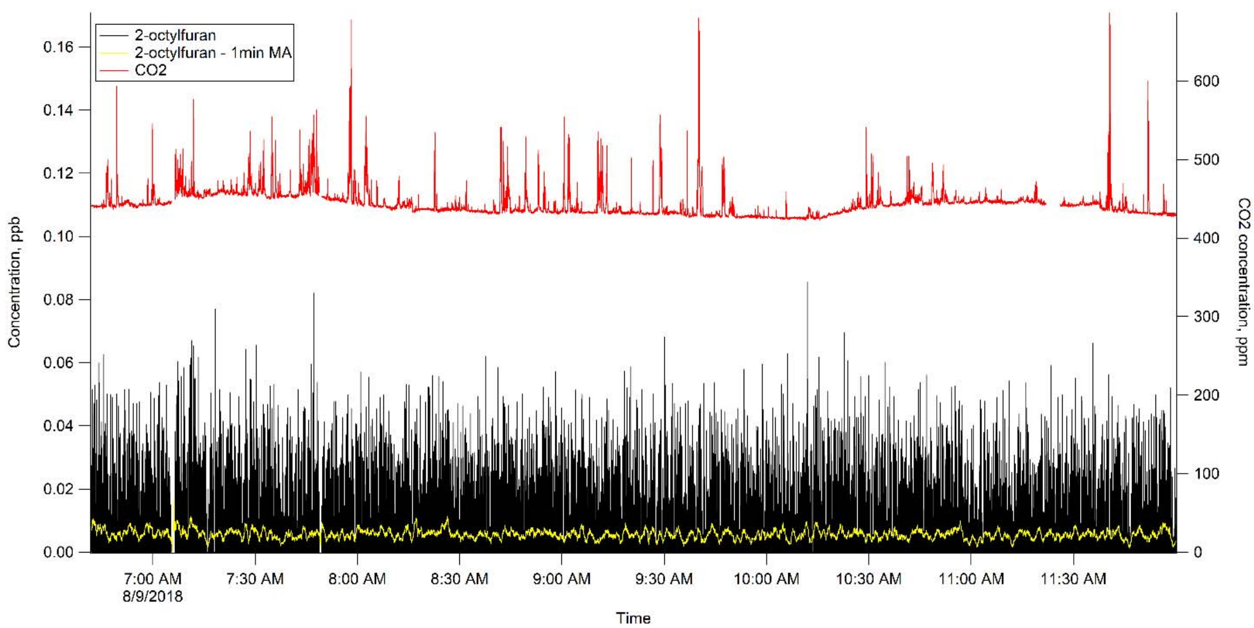

Figure 4-16. 2-octylfuran.

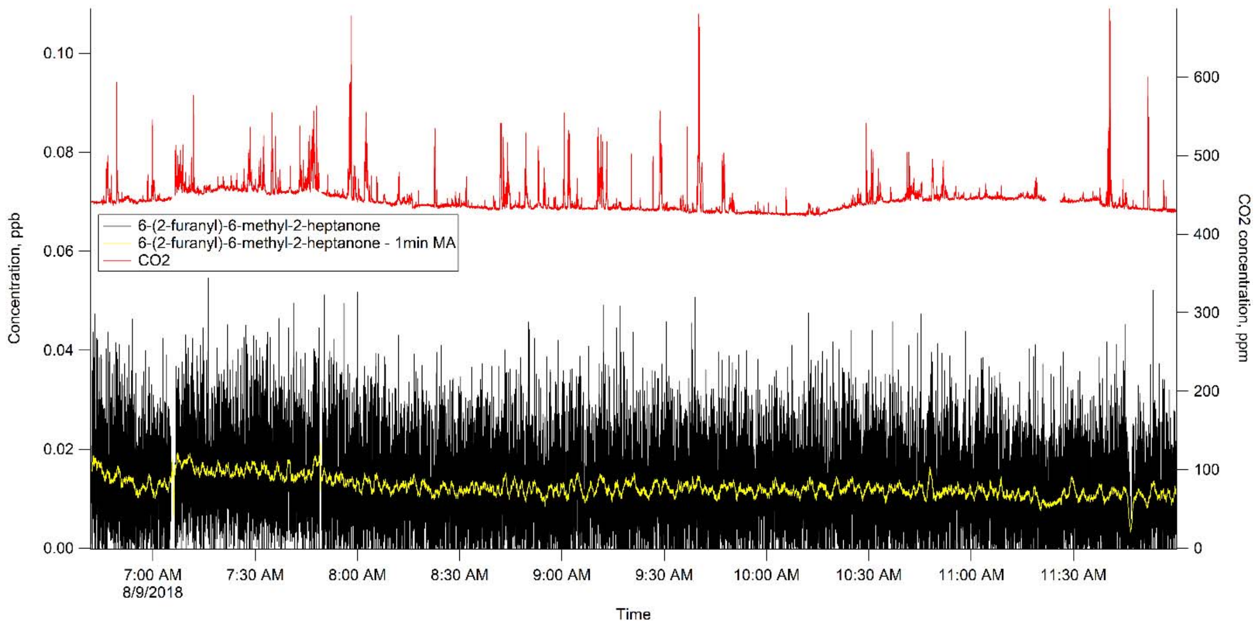

Figure 4-17. 6-(2-furanyl)-6-methyl-2-heptanone.

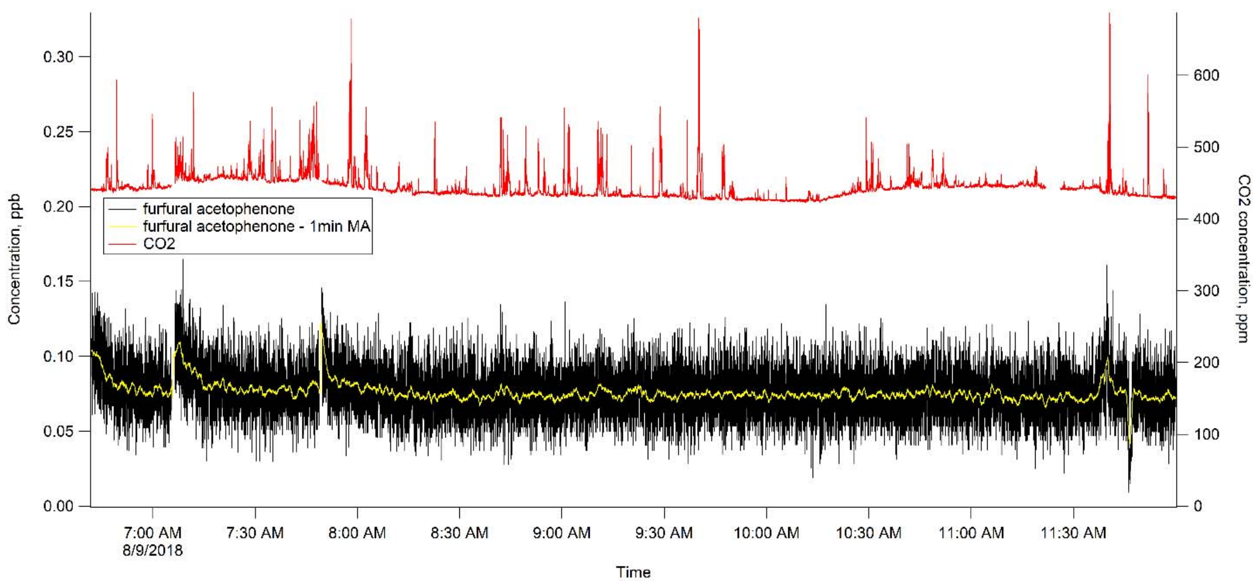

Figure 4-18. Furfural Acetophenone.

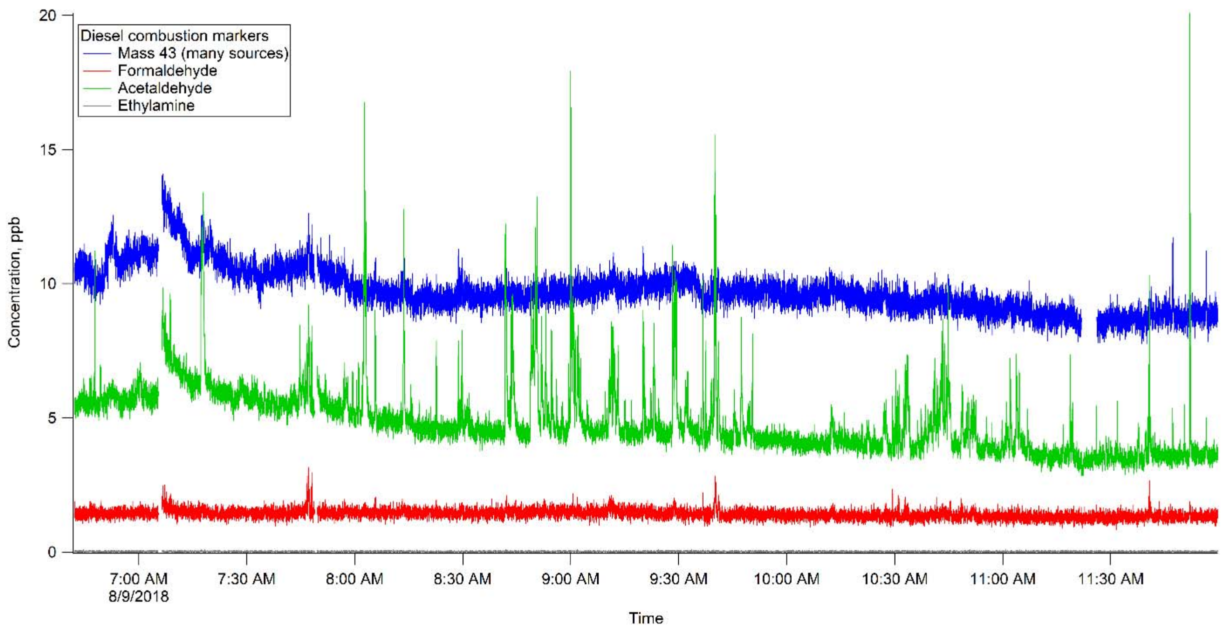

Figure 4-19. Diesel Combustion Markers.

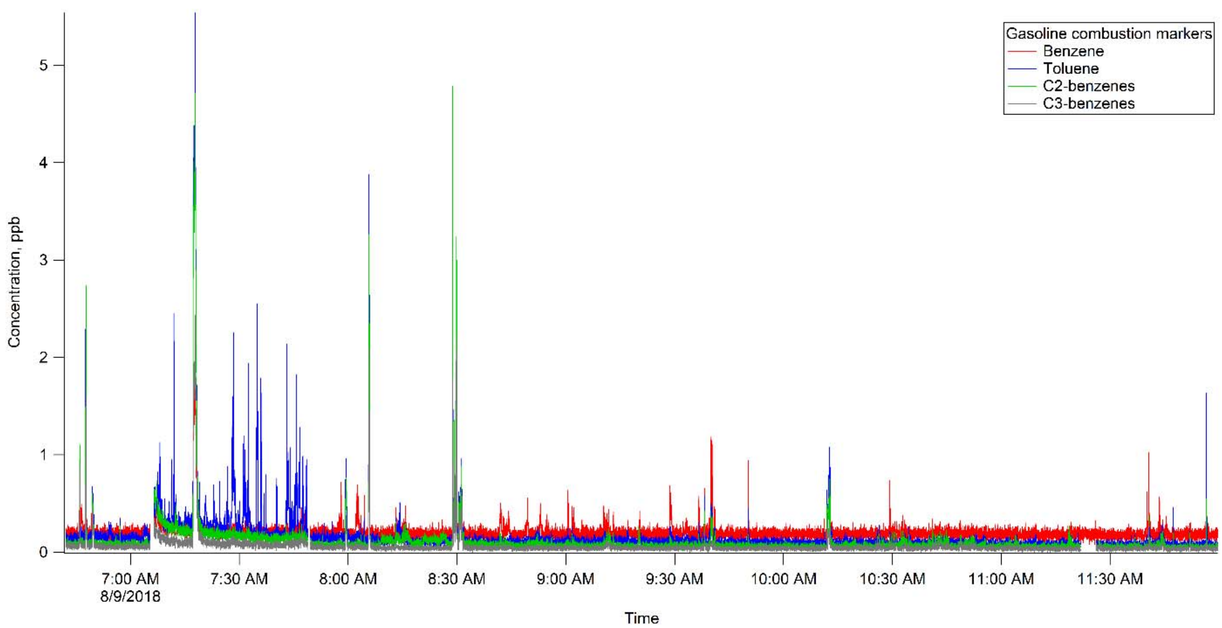

Figure 4-20. Gasoline Combustion Markers.

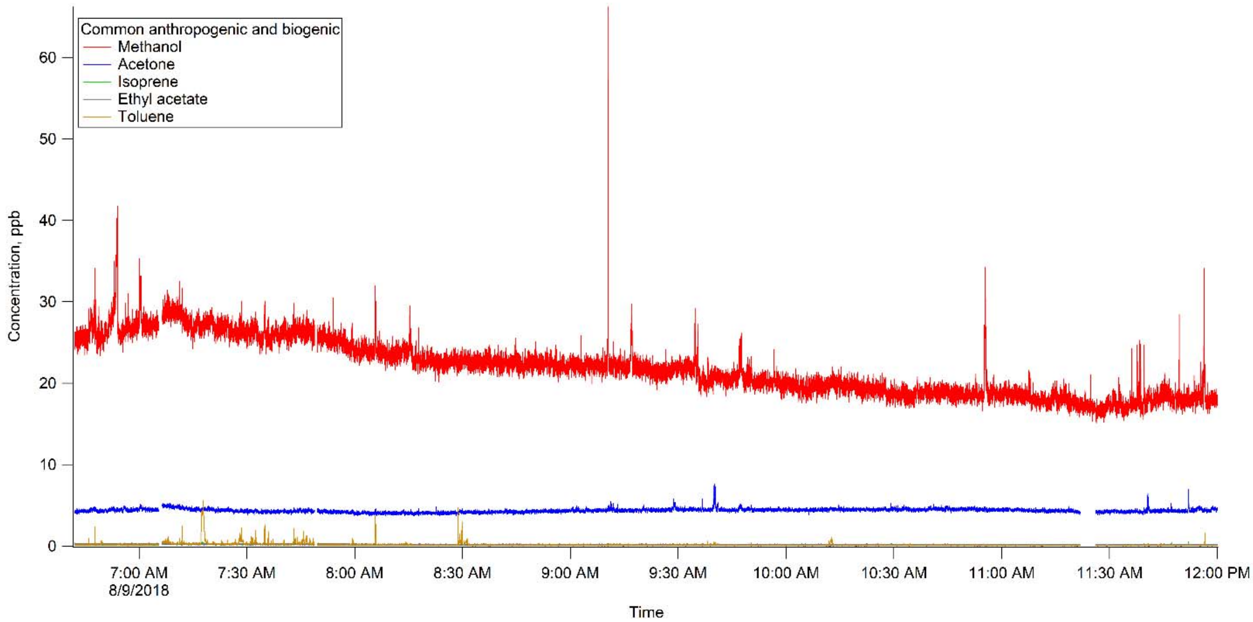

Figure 4-21. Plant and Human Markers.

4.5 Source Characterization – Septic Tanks

Table 4-2 displays the odor compound statistical information for the monitoring period of August 9, 2018.

Table 4-3. Odor Statistical Information for the Monitoring Period of August 9, 2018.

Odor #	Odor Compound Name	Ave. (ppb)	St. Dev. (ppb)	Rel St. Dev. (%)	Max (ppb)	Median (ppb)
1	methyl mercaptan	1.085	2.047	23.963	19.337	0.354
2	dimethylsulfide + ethanethiol	0.414	0.421	12.257	4.357	0.272
3	allyl mercaptan	0.006	0.011	15.733	0.077	0.000
4	1-propanethiol + isopropyl mercaptan	0.019	0.017	12.397	0.102	0.016
5	2-butene-1-thiol	0.014	0.019	26.011	0.113	0.003
6	diethyl sulfide + 2-methylpropane-2-thiol	0.151	0.050	57.139	0.516	0.142
7	thiopropanal sulfuroxide	0.016	0.012	58.199	0.061	0.014
8	dimethyl disulfide	0.019	0.038	31.950	0.370	0.005
9	1-pentanethiol + 2, 2-dimethylpropane-1-thiol	0.030	0.045	23.156	0.337	0.000
10	benzenethiol	0.010	0.014	52.769	0.098	0.002
11	diallyl sulfide	0.019	0.023	42.384	0.114	0.011
12	methyl propyl disulfide	0.008	0.014	38.911	0.092	0.000
13	methylbenzenethiol	0.027	0.016	33.695	0.079	0.026
14	dimethyl trisulfide	0.025	0.013	55.592	0.112	0.024
15	(1-oxoethyl) thiophene	0.028	0.022	23.865	0.102	0.026
16	(1-oxopropyl) thiophene	0.024	0.016	19.087	0.097	0.022
17	dipropyl disulfide	0.017	0.011	107.758	0.069	0.016
18	methyl propyl trisulfide	0.009	0.012	57.406	0.054	0.003
19	dimethyl tetrasulfide	0.013	0.007	36.488	0.039	0.012
20	dipropyl trisulfide	0.007	0.012	56.469	0.076	0.000
21	diphenyl sulfide	0.013	0.013	32.579	0.069	0.009

The following figures display potential odor-causing signals, overlaid with the same signal smoothed using a one-minute moving average, and CO_2, for the monitoring period of August 9, 2018.

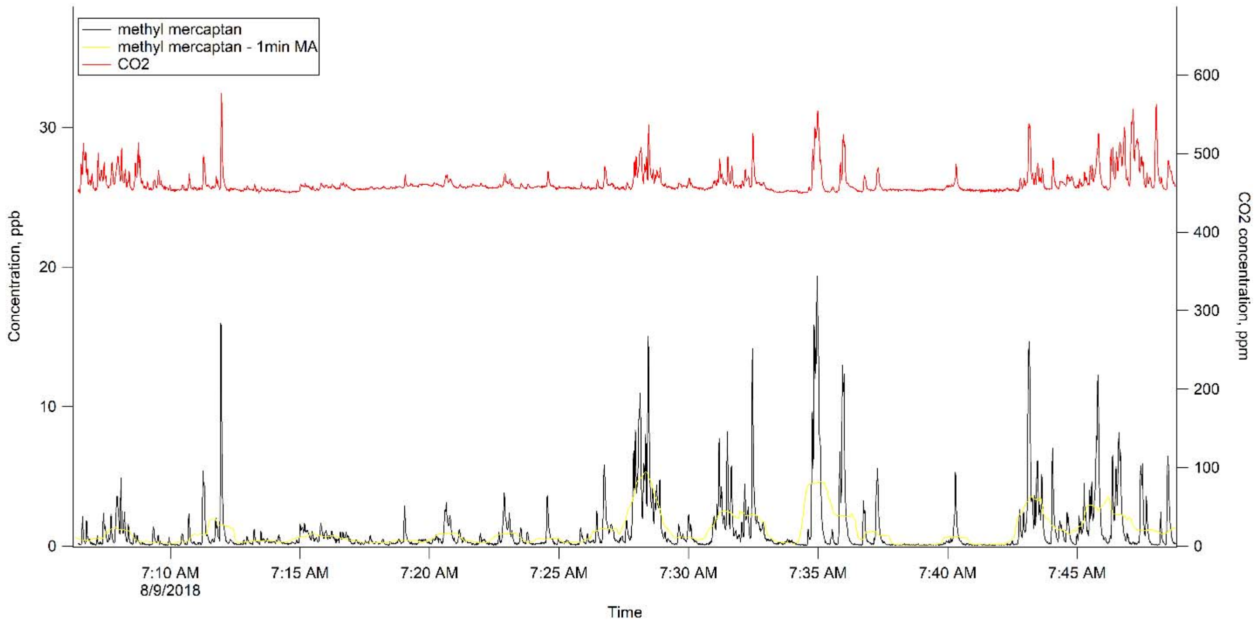

Figure 4-22. Methyl Mercaptan.

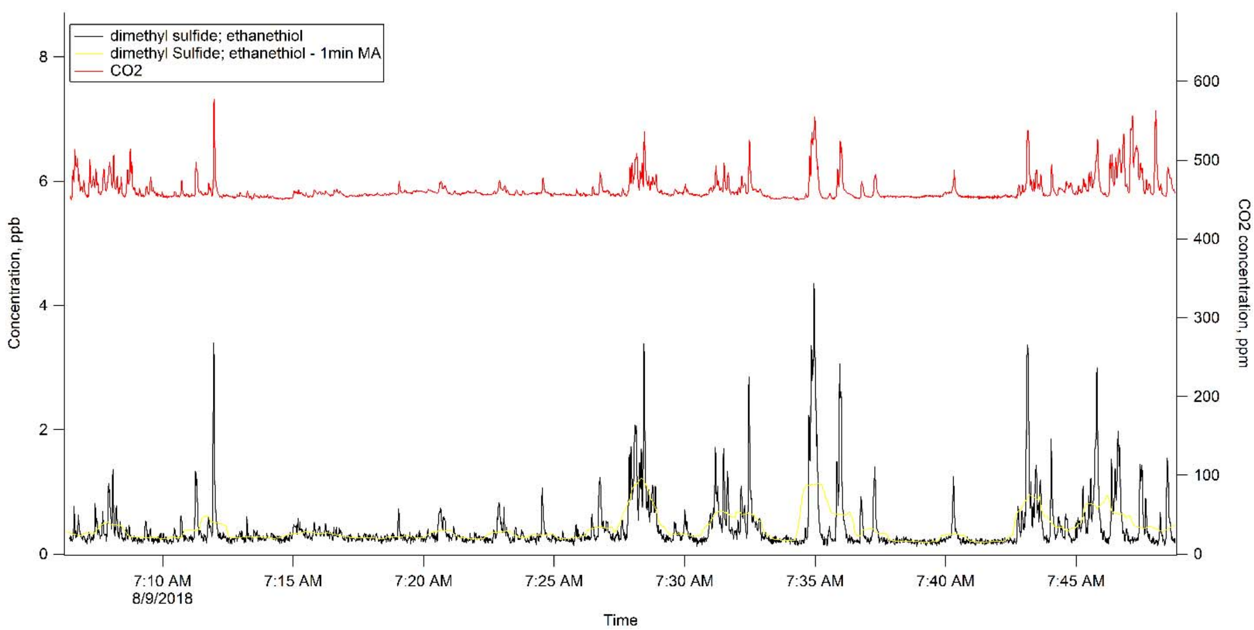

Figure 4-23. Dimethyl Sulfide; Ethanethiol.

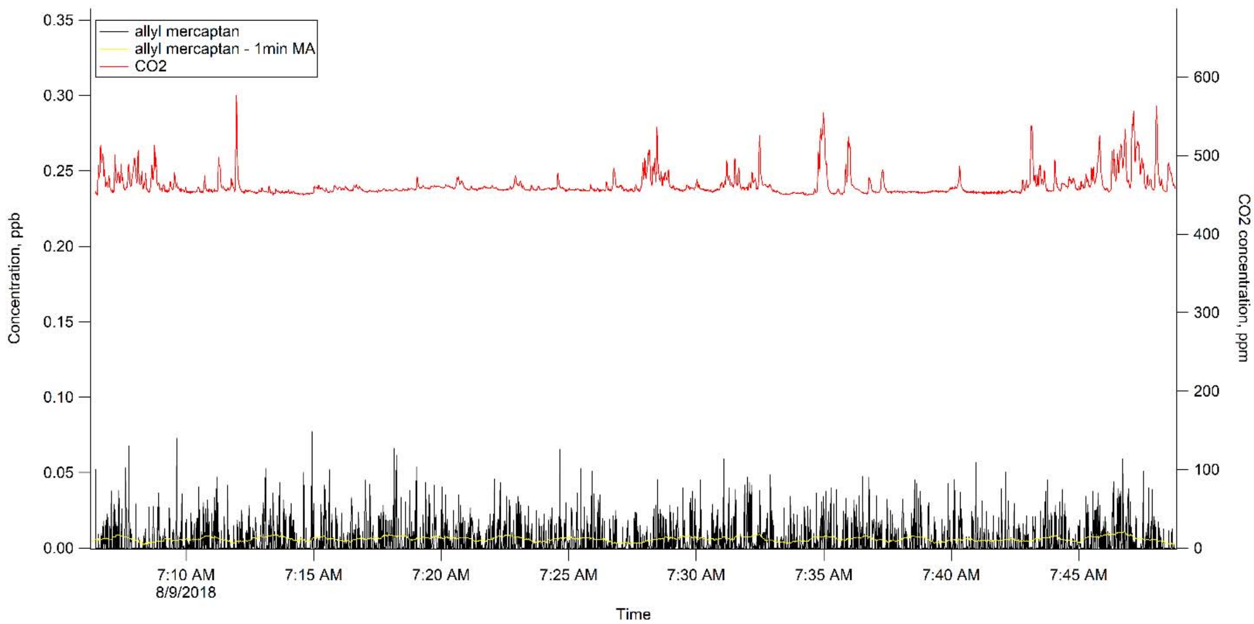

Figure 4-24. Allyl Mercaptan.

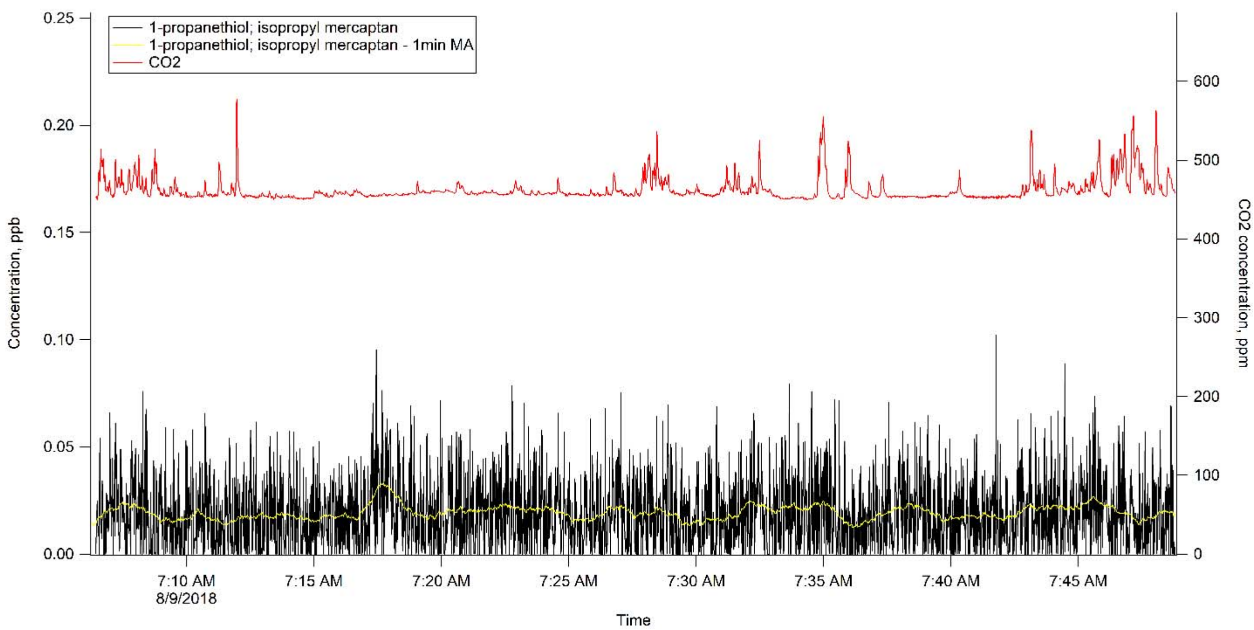

Figure 4-25. 1-propanethiol; Isopropyl Mercaptan.

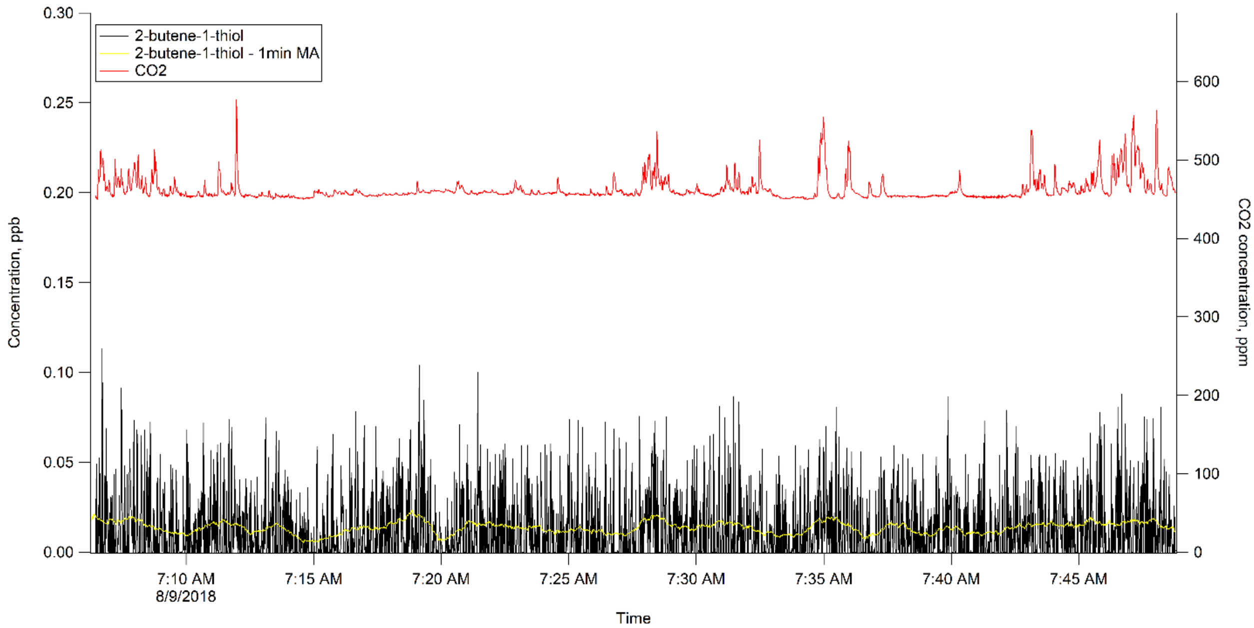

Figure 4-26. 2-butene-1-thiol.

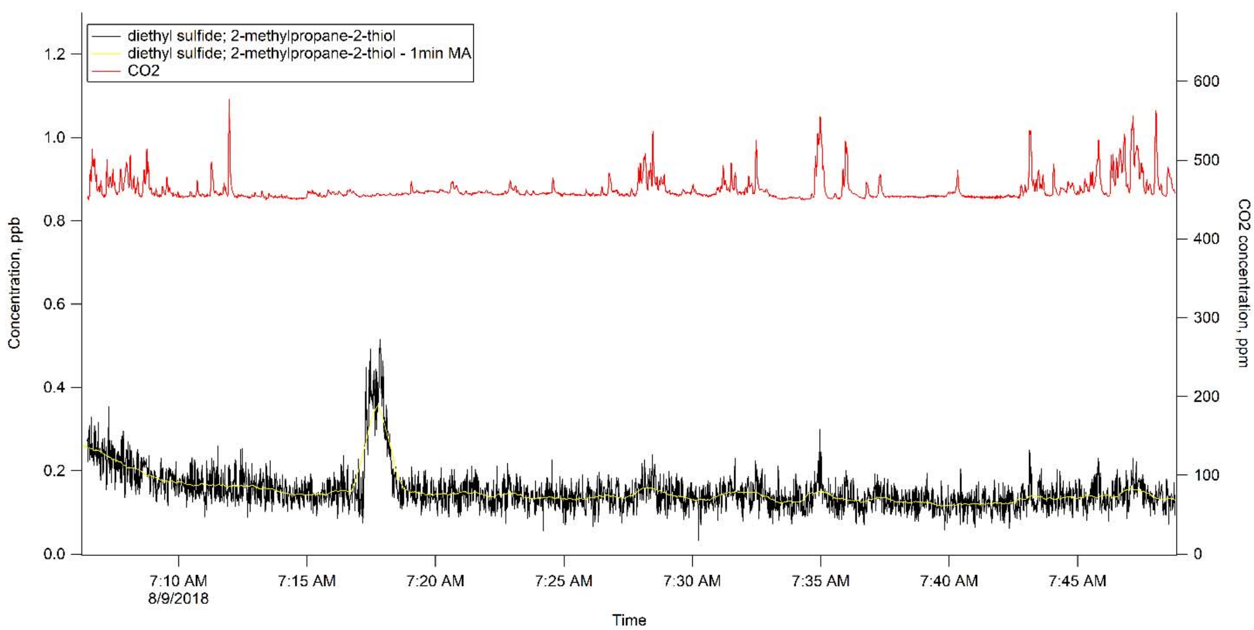

Figure 4-27. Diethyl sulfide; 2-methylpropane-2-thiol.

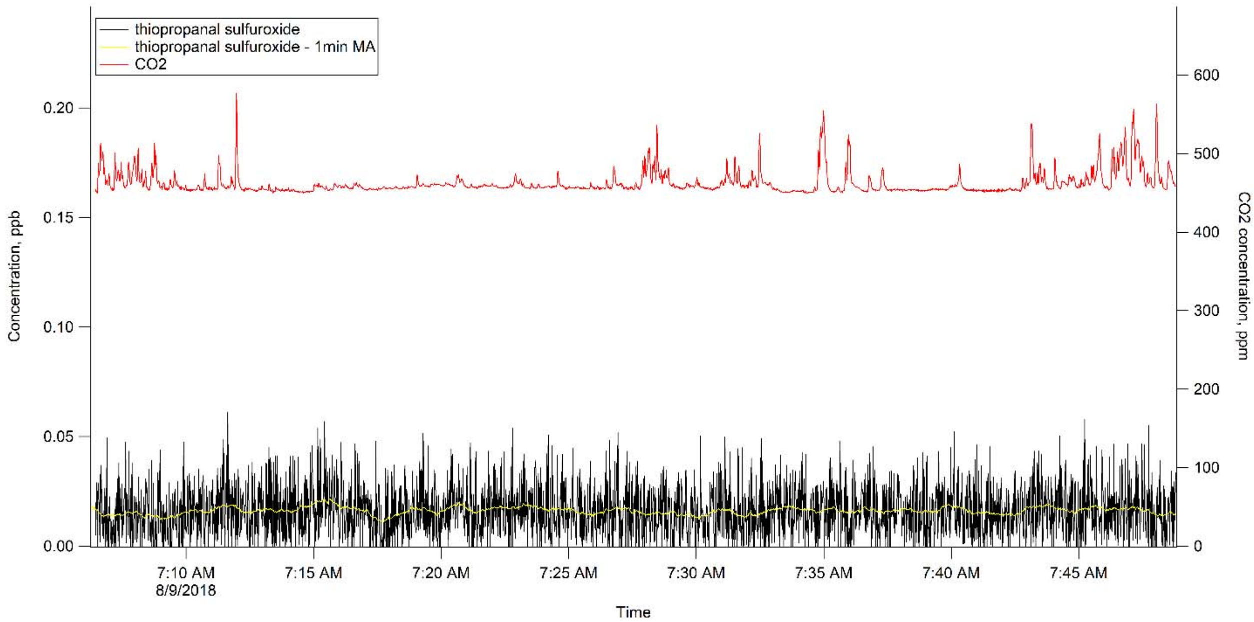

Figure 4-28. Thiopropanal Sulfuroxide.

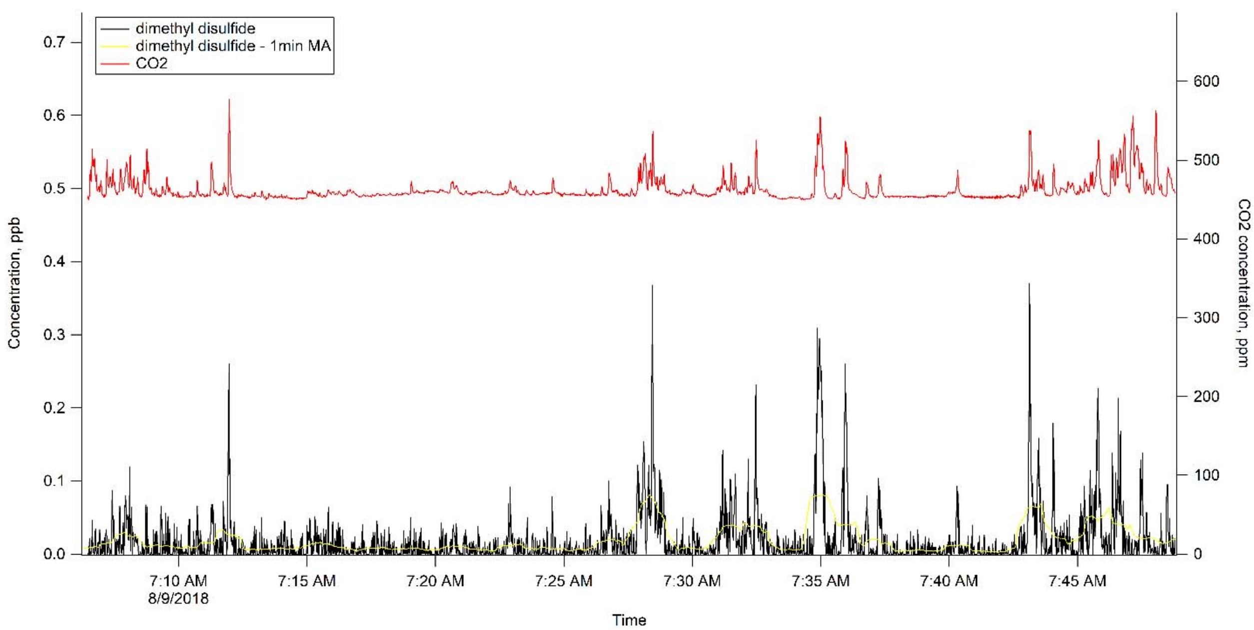

Figure 4-29. Dimethyl Disulfide.

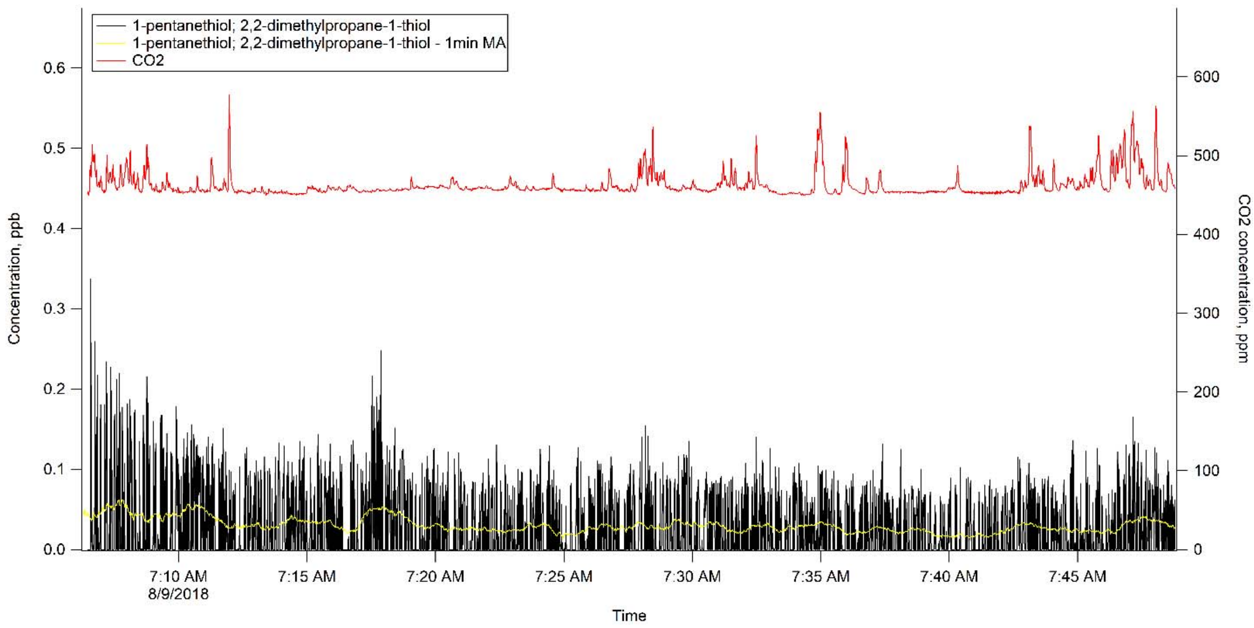

Figure 4-30. 1-pentanethiol; 2,2-dimethylpropane-1-thiol.

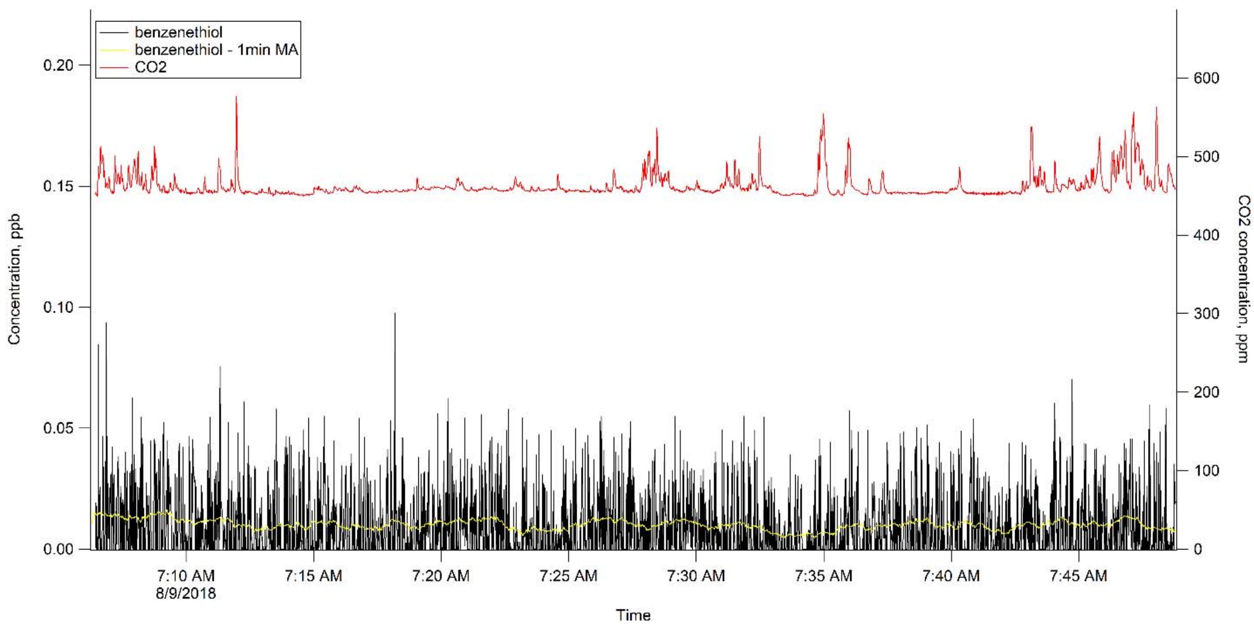

Figure 4-31. Benzenethiol.

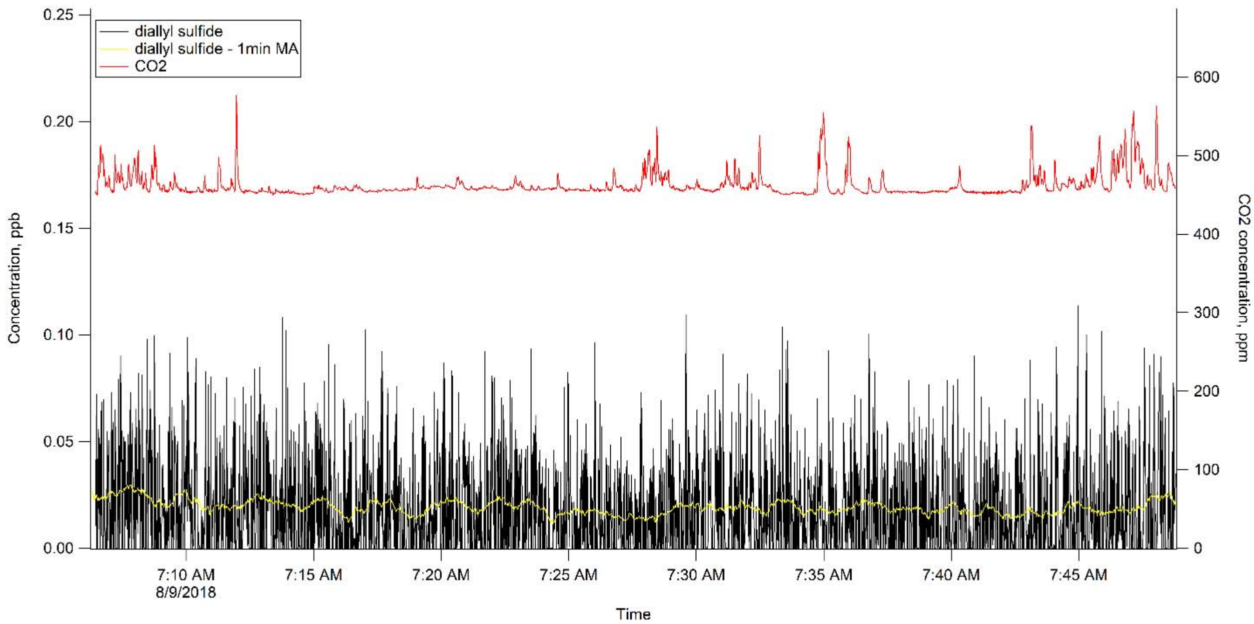

Figure 4-32. Diallyl Sulfide.

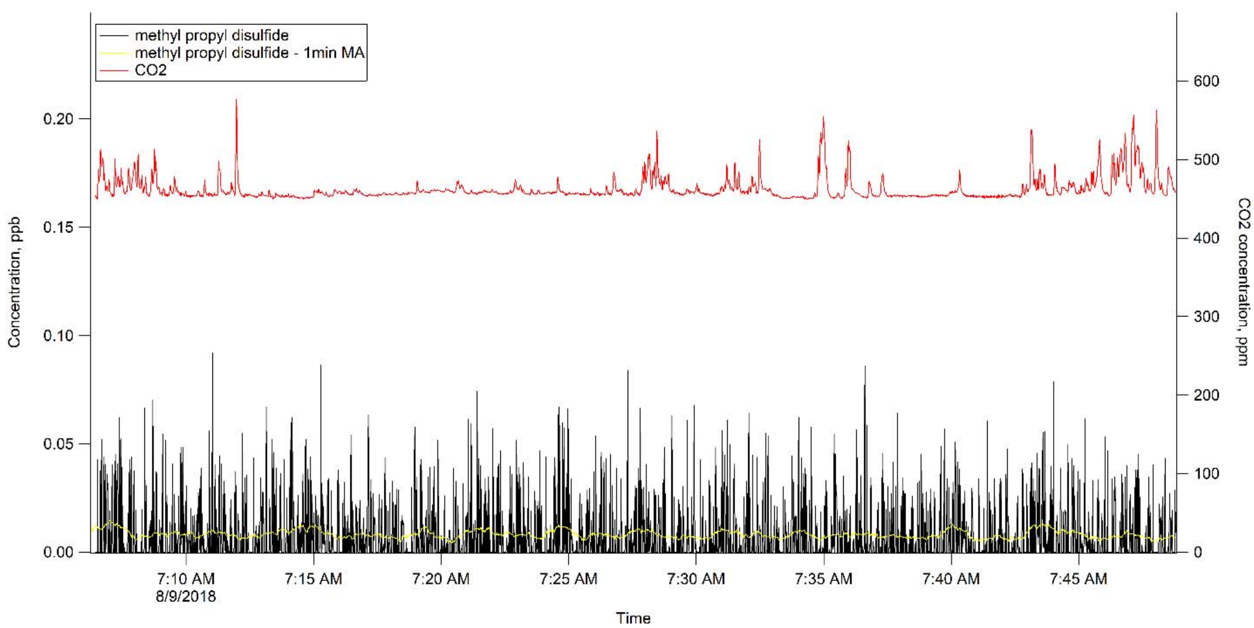

Figure 4-33. Methyl Propyl Disulfide.

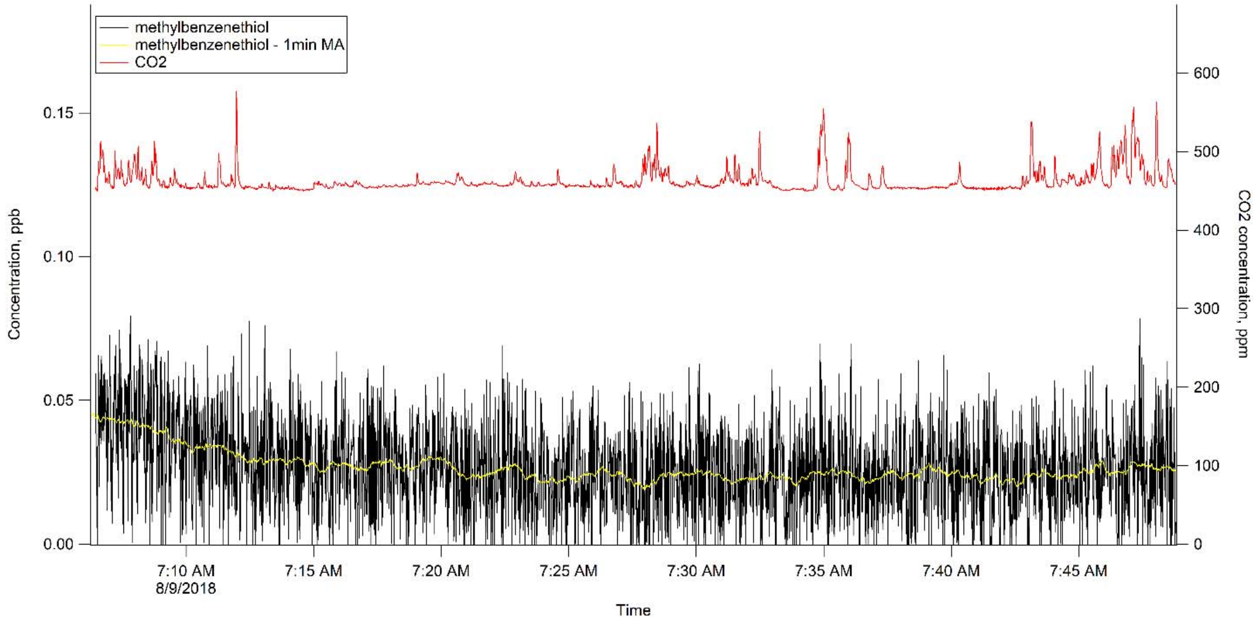

Figure 4-34. Methylbenzenethiol.

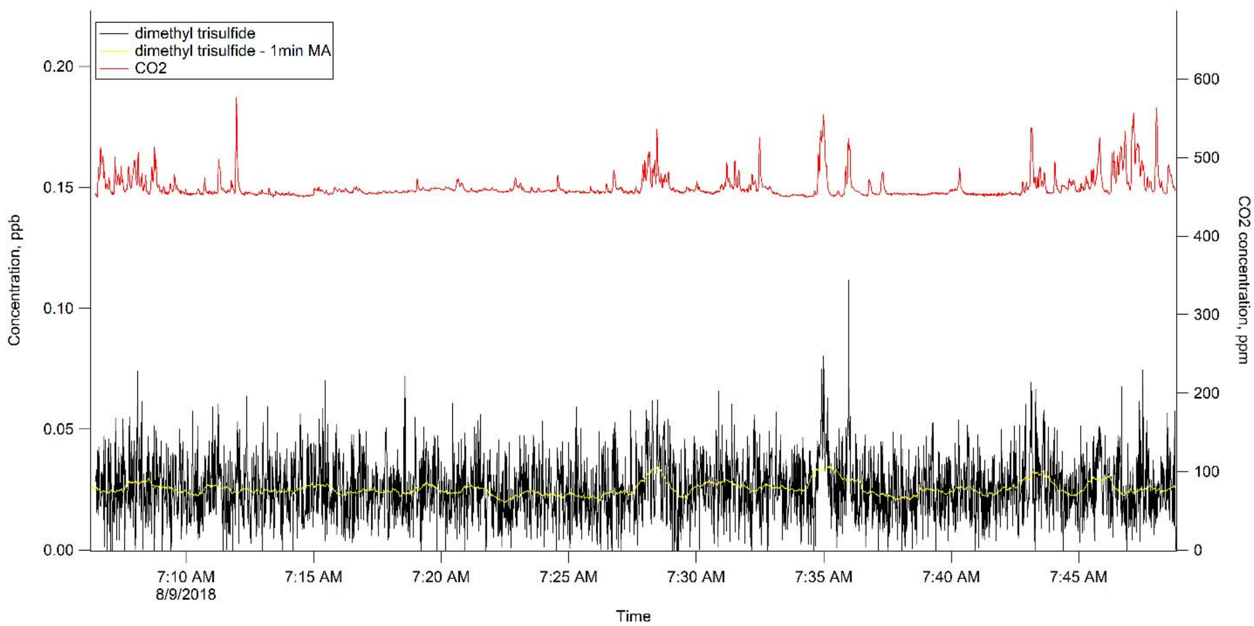

Figure 4-35. Dimethyl Trisulfide.

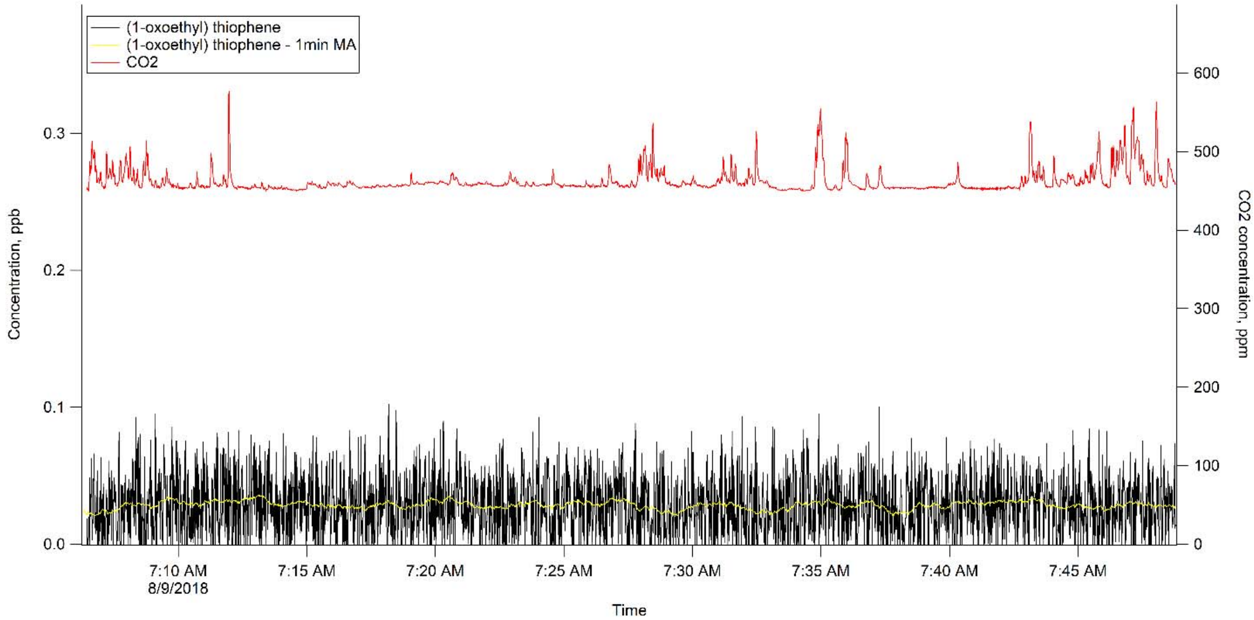

Figure 4-36. (1-oxoethyl) Thiophene.

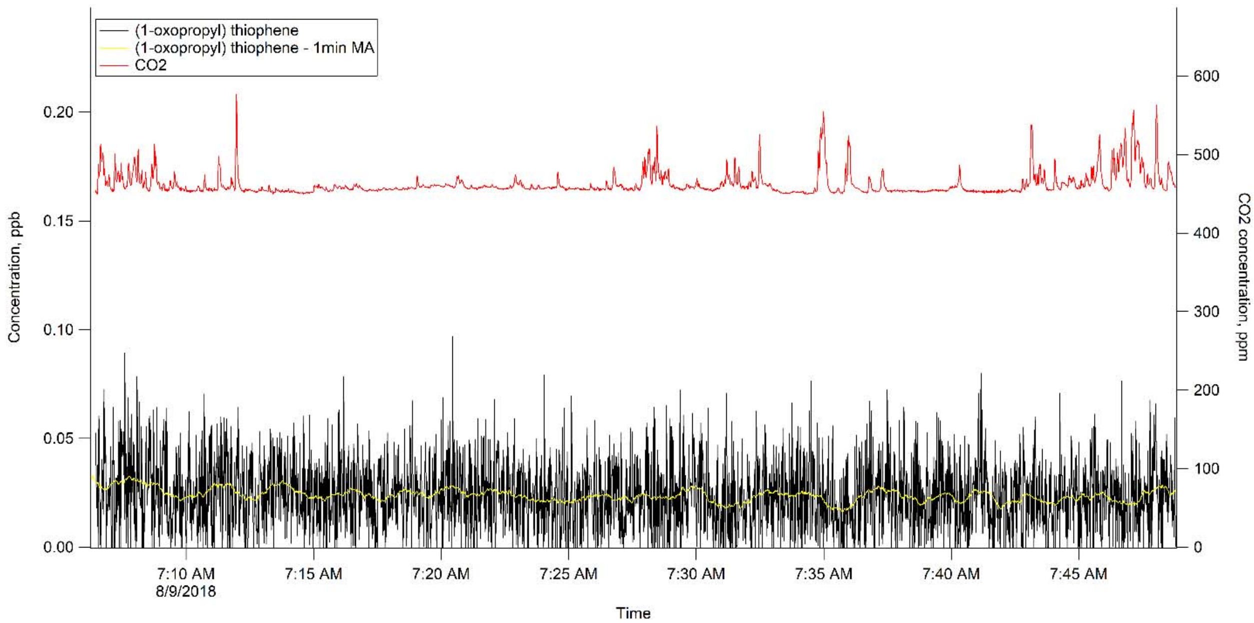

Figure 4-37. (1-oxopropyl) Thiophene.

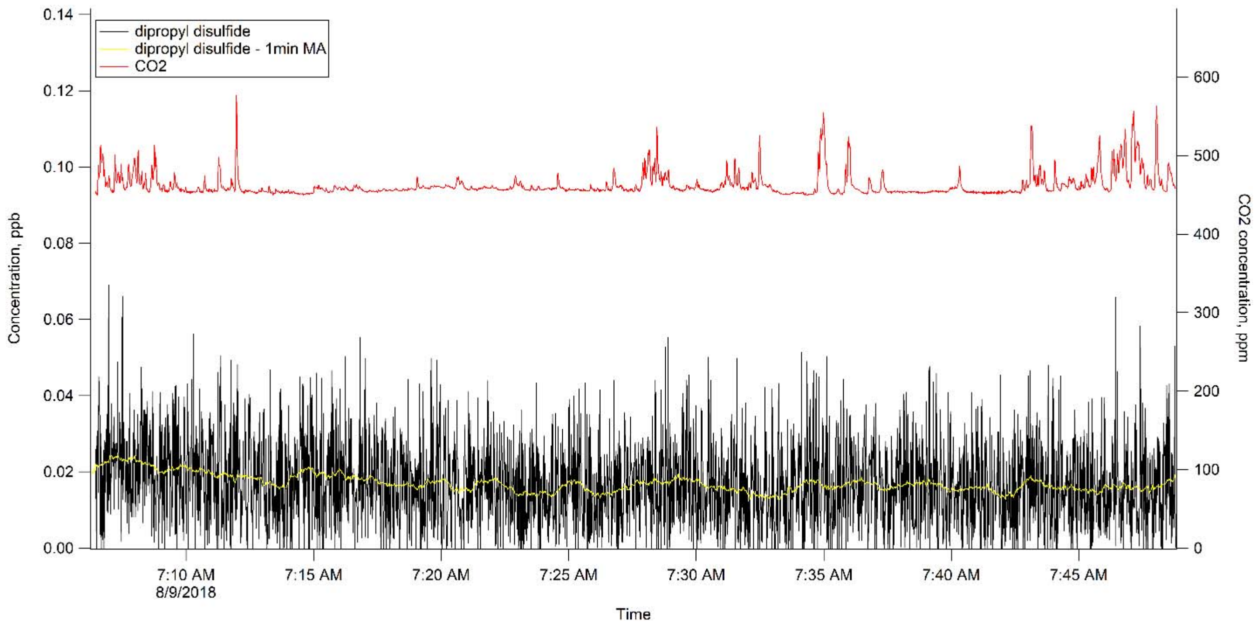

Figure 4-38. Dipropyl Disulfide.

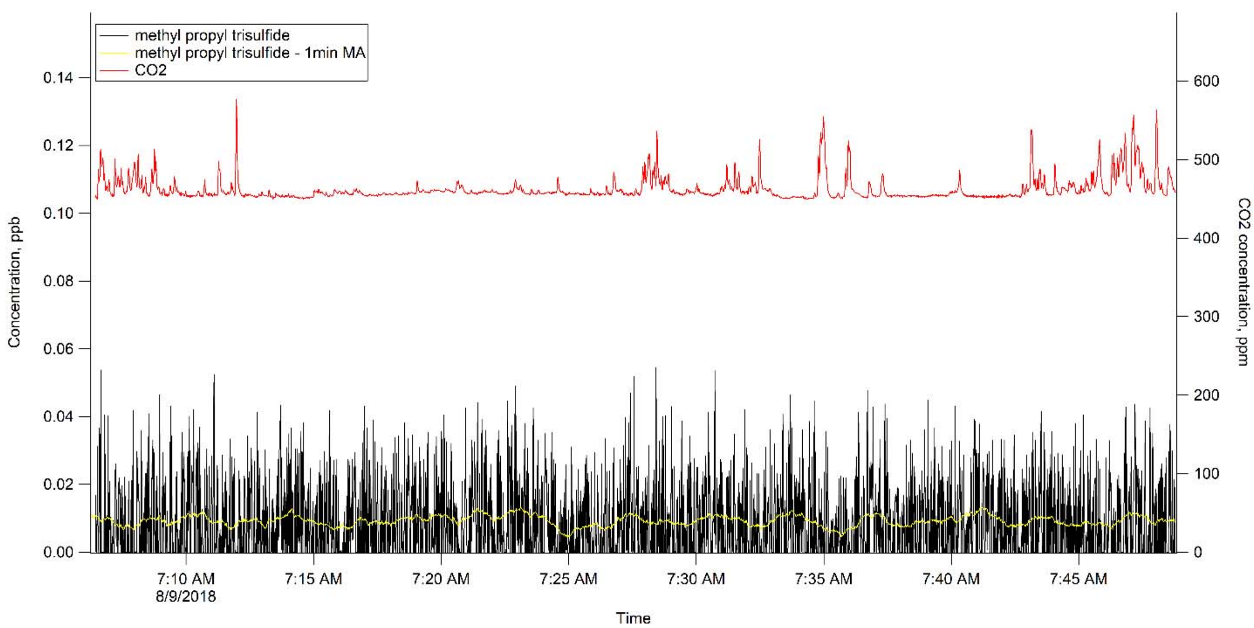

Figure 4-39. Methyl Propyl Trisulfide.

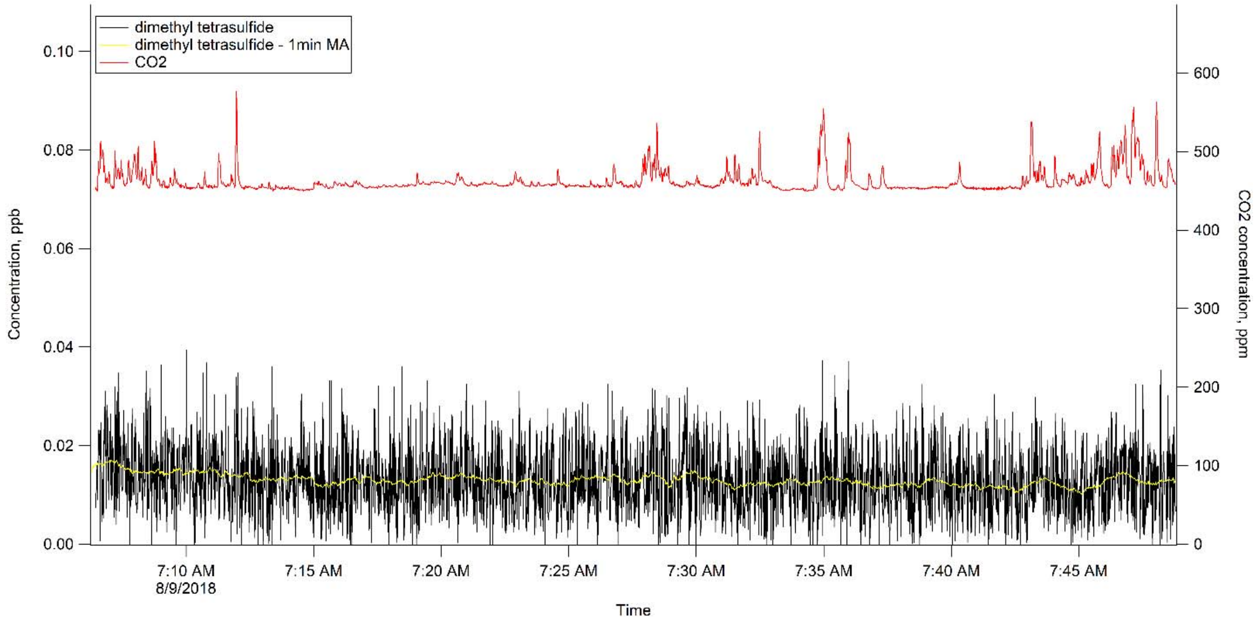

Figure 4-40. Dimethyl Tetrasulfide.

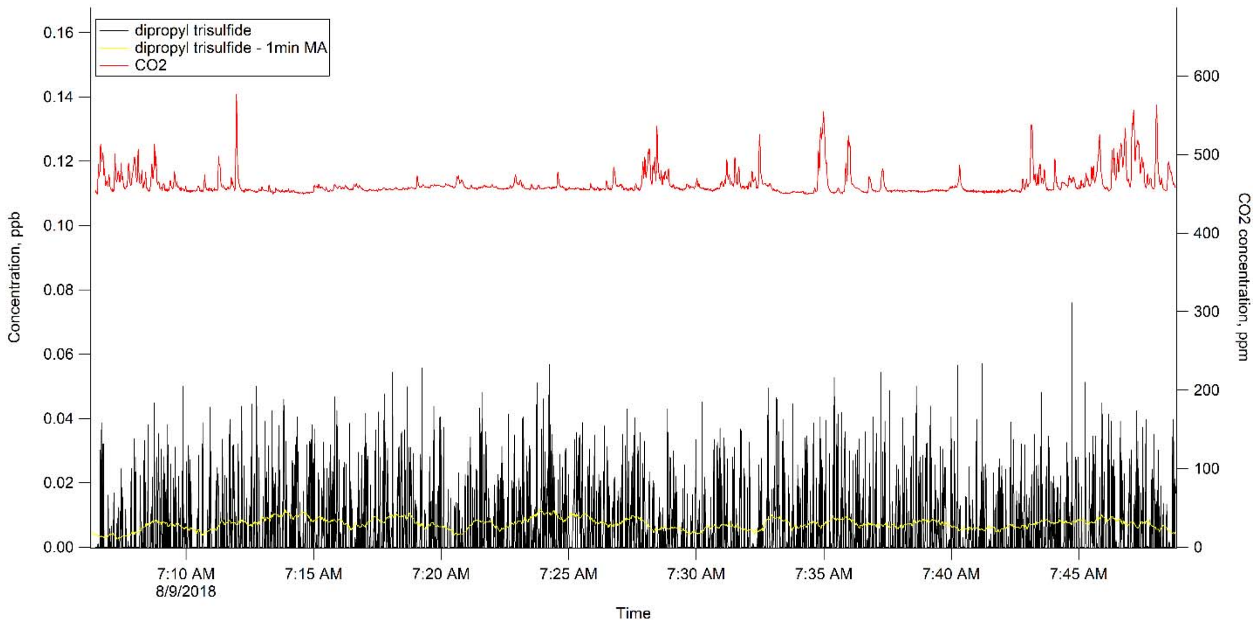

Figure 4-41. Dipropyl Trisulfide.

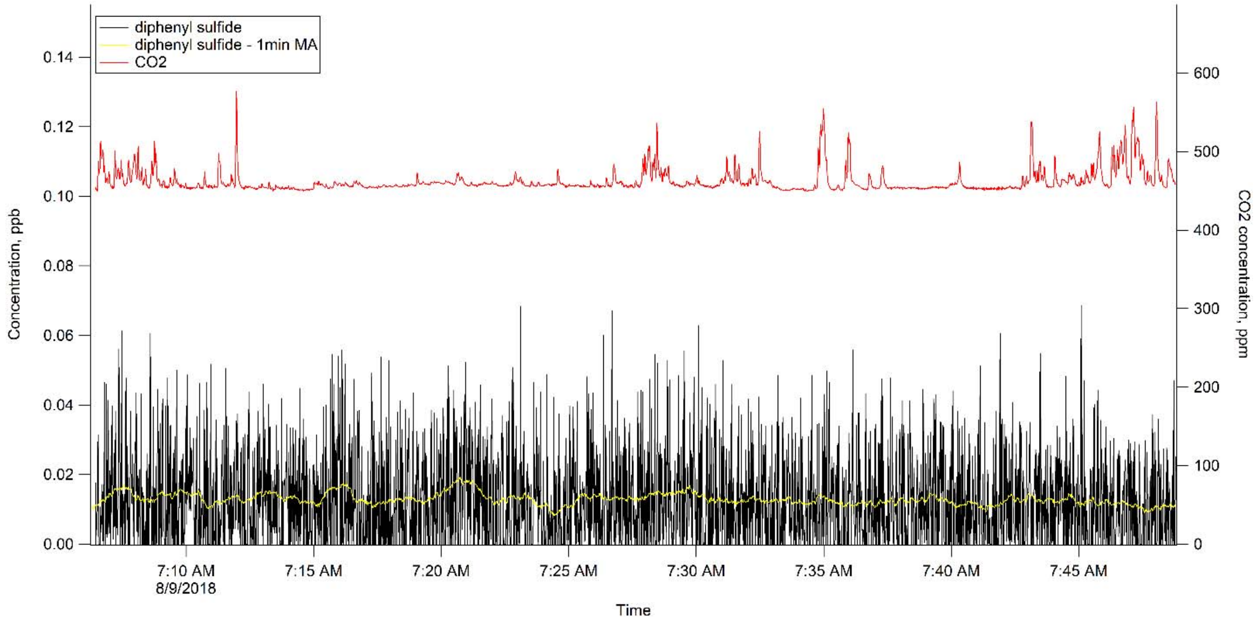

Figure 4-42. Diphenyl Sulfide.

5.0 REFERENCES

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