PTR-MS MOBILE LABORATORY VAPOR MONITORING BACKGROUND STUDY (3/18/2018 – 4/20/2018)

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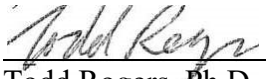
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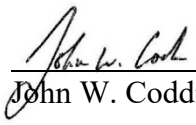
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Acronyms and Abbreviations

ANOVA	Analysis of Variance
ASTM	American Society for Testing and Materials
CAPA	Corrective Action and Preventative Action
CBAL	Columbia Basis Analytical Laboratories
COPC	Chemical of Potential Concern
CV	Calibration Verification
EPA	U.S. Environmental Protection Agency
FY	Fiscal Year
GC/MS	Gas Chromatograph – Mass Spectrometer or Spectrometry
GC/TEA	Gas Chromatograph – Thermal Energy Analyzer
GPS	Global Positioning System
LIMS	Laboratory Information Management System
MDL	Method Detection Limit
ML	Mobile Laboratory
NDEA	N-nitrosodiethylamine
NDMA	N-nitrosodimethylamine
NIOSH	National Institute for Occupational Safety and Health
NIST	National Institute of Standards and Technology
NMEA	N-nitrosomethylethylamine
NMOR	N-nitosomorpholine
OEL	Occupational Exposure Limit
PFA	Perfluoroalkoxy alkane
ppb	Part(s) per billion
ppbv	Part(s) per billion by volume
ppm	Part(s) per million
ppt	Part(s) per trillion
PTR-MS	Proton Transfer Reaction – Mass Spectrometry or Spectrometer
QA	Quality Assurance
QC	Quality Control
RJLG	RJ Lee Group, Inc.

RL	Reporting Limit
RMS	Root mean square
SOP	Standard Operating Procedure
TIC	Tentatively Identified Compound
TOF	Time of Flight
Torr	Unit of Pressure
UPS	Uninterruptable Power Supply
VOC	Volatile Organic Compound
WRPS	Washington River Protection Solutions, LLC

EXECUTIVE SUMMARY

The Mobile Organic Monitoring Laboratory (ML) developed by RJ Lee Group, Inc (RJLG) was used for the measurement of Volatile Organic Compounds (VOCs) during a field campaign spanning 24 days of sampling during an extended background sampling study focusing on nineteen compounds, including nitrosamines, furans, and ammonia. All of these compounds were chosen because of their low Occupational Exposure Limits (OELs) and difficulty of analysis by traditional methods.

The background study occurred from March 18, 2018 – April 20, 2018. It included six sites with four repeated visits to each site, on a rotating basis. The technical basis for this study is the same as the FY17 Summer Background Study. Five sampling locations were chosen within the secured Hanford area and one site within the City of Kennewick, representative of a site of heavy traffic and mixed commercial use.

The Proton Transfer Reaction – Mass Spectrometer (PTR-MS) is only sensitive to molecular mass. Many compounds have the same mass and cannot be speciated by the PTR-MS alone. To resolve isobaric interferences, alternative sampling and analysis methods were used, consisting of NIOSH 2522, and EPA TO-17 methods. While these methods do not provide the same temporal resolution as PTR-MS, they do provide speciation and corroboration of PTR-MS results. Section 5.3.1 describes and evaluates the comparison between alternative sampling and analysis methods and PTR-MS results. In general, where results between alternative methods and PTR-MS were able to be compared, the magnitude of the values were very close to, or below the lower levels of quantitation for all the methods employed. Results for benzene showed good correlation between PTR-MS and EPA TO-17. Although PTR-MS detected compounds at mass numbers indicating very low levels of nitrosamines, well below OELs, the measurements were not confirmed by NIOSH 2522. This supports the likelihood that isobaric interfering compounds were present and measured by the PTR-MS.

A detailed statistical analysis evaluating background concentrations, variability between sites, and diurnal effects was performed and is described in Section 5.3.4. All observed levels of ammonia, furans, and nitrosamines were well below levels of operational concern. Furan and nitrosamine levels for the off-site locations were equal to, or greater than those on site. Little to no smoke was observed in the Spring background study described in this report and no correlation between furan and smoke is observed at this level. Lastly, little diurnal variation was observed with furan concentration, and thus there is no increase in vapor hazards between day and night given the trace concentrations observed in this study.

1.0 DESCRIPTION OF TESTS CONDUCTED

The Mobile Organic Monitoring Laboratory (ML) operated by RJ Lee Group, Inc. (RJLG) was used for the measurement of Volatile Organic Compounds (VOCs) during a field campaign between March 18, 2018, and April 20, 2018. The field campaign, referred to as the Spring Background Study, included 24 days of sampling at six pre-determined sampling sites four days each on a revolving schedule. This study is meant to be a continuation of Fiscal Year (FY)17 sampling activities where samples were taken over a six-week period encompassing ten sites of interest with repeat visits to each location throughout the test period. The goal of the background study is to determine and compare typical ambient concentrations of target Chemicals of Potential Concern (COPCs) in air masses upwind and downwind of tank farms, and at an urban center at various times of the year. The 2017 study is described in detail in *Fiscal Year 2017 Mobile Laboratory Vapor Monitoring at the Hanford Site: Monitoring During Waste Disturbing Activities and Background Study*, September 2017. This, and other background studies, form the basis for interpreting data from targeted studies of vapor sources by providing a clear picture of background or ambient concentrations of the analytes of interest.

The sampling locations chosen for this study were the following:

Site 1: Hanford Central Plateau northwest of the 200W Tank Farm, chosen as an upwind location from the central Hanford Plateau. This site was previously designated as "Site 1B" in the FY17 Summer Background Study.

Site 2: Northern end of the 200W Tank Farms, near S and SY Farms. This site was previously designated as "Site 2A" in the FY17 Summer Background Study.

Site 3: Near the Corner of 4th and Buffalo. This site is historically known for the occurrence of several AOP-15 Events. This site was previously designated as "Site 3A" in the FY17 Summer Background Study.

Site 4: Downwind of the AN Tank Farm.

Site 5: Southwest of the Waste Treatment Facility.

Site 6: Near the intersection of US-395 and Clearwater Avenue in Kennewick, WA. This site represents heavy traffic and mixed commercial activity. This site was previously designated as "Site 5B" in the FY17 Summer Background Study.

The background study focused on nineteen compounds from the Hanford COPC list; four nitrosamines, fourteen furans, and ammonia. Except ammonia, these compounds have occupational exposure limits less than or equal to 1 part per billion by volume (ppbv) and cannot be measured with adequate temporal resolution using conventional analytical methods. The Proton Transfer Reaction – Mass Spectrometer (PTR-MS) provides the required temporal resolution. The list of COPCs for this study are as shown below in Table 1-1.

Table 1-1. List of Applicable COPCs.

COPC	OEL (ppb)
Ammonia	25000
Furan	1
(Set A) But-3-en-2-one + 2,3-dihydrofuran + 2,5-dihydrofuran	100, 1, 1
NDMA	0.3
2-methylefuran	1
NMEA	0.3
2,5-dimethylfuran	1
NDEA	0.1
(Set B) 2-propylfuran + 2-ethyl-5-methylfuran	1
NMOR	0.6
(Set C) 2-ethyl-2-hexenal + 4-(1-methylpropyl)-2,3-dihydrofuran + 3-(1,1-dimethylethyl)-2,3-dihydrofuran	100, 1, 1
2-pentylfuran	1
2-heptylfuran	1
2-octylfuran	1
6-(2-furanyl)-6-methyl-2-heptanone	1
furfural acetophenone	1

There are three sets of compounds that produce a signal at the same nominal mass and cannot be resolved by the PTR-MS. These sets of compounds are referred to as Set A, Set B, and Set C in Table 1-1. These sets are reported as a composite concentration throughout this report. In cases where only one OEL is shown for a given set of compounds (Set B), the unresolvable compounds in question share the same OEL. In cases where more than one OEL is reported for a set of compounds (Set A and Set C), the average of the sum of all compounds seen at that signal is shown in this report to fall well below the lowest OEL listed. The continued reporting of combined mass signals in the case of the compounds reported in the Background Study is driven in part by the desire to remain consistent between multiple studies in the data being reported, and in part by the requirements of the Test Plan.

The results of the average nitrosamine signals shown in this report are believed to be influenced by as-yet unknown interferents, which could cause the average signal seen to be biased higher than actual nitrosamine concentrations.

Data presented in this report summarize all of the COPCs that are measurable using PTR-MS; however, the compound list above is of particular importance due to the low occupational exposure limits (OELs) and difficulty measuring with standard analytical methods. Since a time-of-flight (TOF) PTR-MS system was used for all measurements, the data for all other masses and compounds have been collected and will be available for data mining at a later date.

2.0 MEASUREMENT SYSTEM DESIGN

This section describes the details of the sampling methods used during this study. Details regarding instrumentation, calibration, and confirmatory measurements are described.

2.1 Sampling Methods

2.1.1 Design of Sampling System

All data collected during the background study were sampled through the mast located above the wind shear zone of the RJLG ML. The air sample was pulled into the mast and through a 3/8" perfluoroalkoxy alkane (PFA) main sample line by an oil-free diaphragm pump located under the van. All instrumentation onboard the ML subsampled from the main sample stream. Exhaust from all instruments were recombined with unused sample exiting the diaphragm pump and routed out the side of the van opposite the sampling mast. The gas sampling system in the ML consisted entirely of PFA Teflon[TM1] to minimize surface effects. The pumping of the main air sample stream was controlled by a needle valve and digital flow meter located after the analytical instruments collect their subsamples. The main sample stream was generally pumped at a volumetric flow rate of approximately 20-25 standard liters per minute which corresponded to a linear velocity of approximately 5 meters per second. The RJLG ML sampling system plumbing is shown in Figure 2-1.

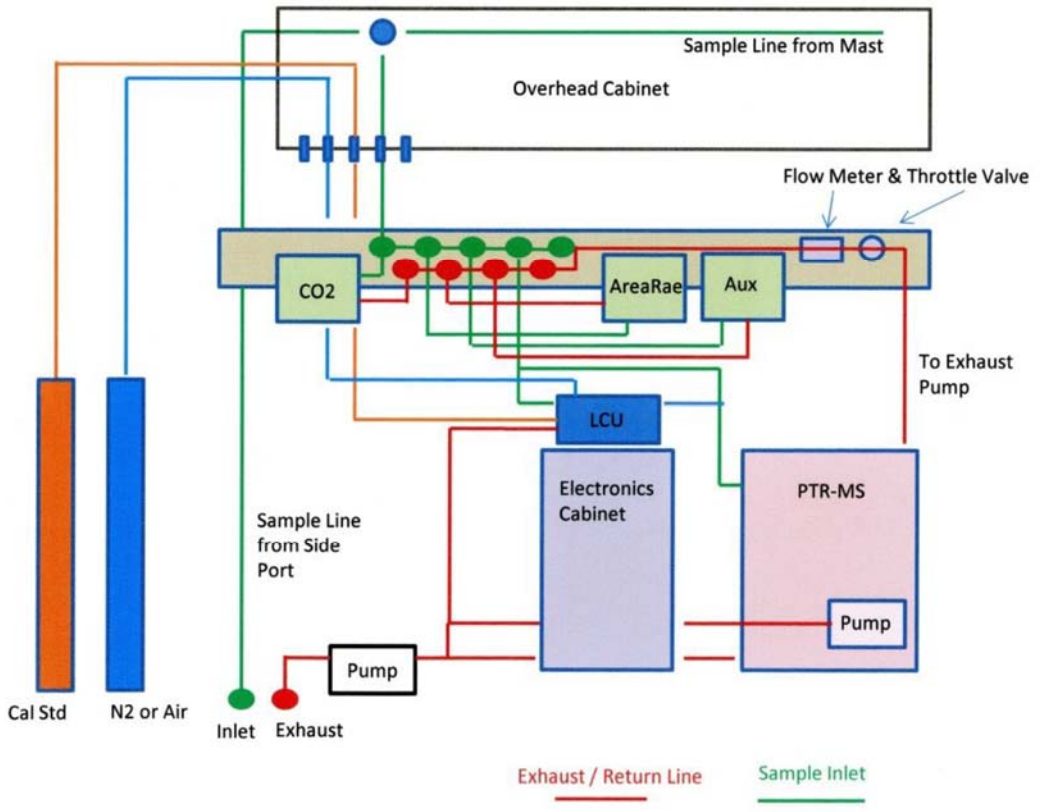


Figure 2-1. The RJLG Mobile Laboratory Gas Sampling System Plumbing.

[1] Teflon is a trademark of The Chemours Company FC, LLC, Wilmington, Delaware.

2.2 Instrumentation and Methods Used

2.2.1 Proton Transfer Reaction Mass Spectrometer

Measurements performed by the ML during FY18 utilized the same IONICON®[2] PTR-TOF 4000 system deployed in FY17. The mass resolution of the PTR-TOF 4000 is sufficient to resolve some COPCs with high confidence (i.e., furan from isoprene) while other compounds have interferences which can potentially compromise their reliable detection and quantification. A full discussion of the reliability of COPC detection and quantification can be found in *Fiscal Year 2017 Mobile Laboratory Vapor Monitoring at the Hanford Site: Monitoring During Waste Disturbing Activities and Background Study*, September 2017. A brief summary of the instrument and its underlying chemistry that leads to the sensitive detection of vapor components will be provided herein. The general layout of the instrument is shown in Figure 2-2.

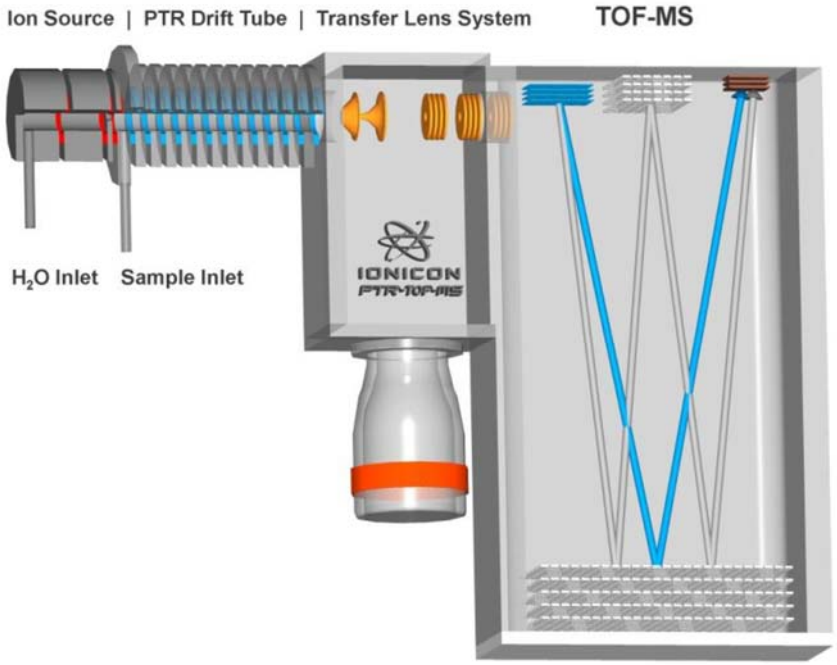


Figure 2-2. The General Configuration of an IONICON PTR-TOF Instrument.

The VOCs are measured by chemical ionization, where the reagent ion H_3O^+ ionizes organics via a fast proton transfer reaction (R1).

$$R + H_3O^+ \rightarrow RH^+ + H_2O \qquad (R1)$$

These reactions are normally non-dissociative, although there are some compounds that fragment to smaller ions upon protonation. The reaction takes place in a drift tube where the sample air stream reacts with H_3O^+ ions produced by a hollow cathode ion source. The number of ions

[2] IONICON is a registered trademark of Ionicon Analytik Gesellschaft m.b.H., Innsbruck, Austria.

counted per second for the reagent ion and protonated sample ion are monitored and used for the determination of estimated concentrations according to Equation 1.

$$[R] = \frac{1}{kt}\left(\frac{I_{RH+}}{I_{H3O+}}\right)\frac{\varepsilon_{RH+}}{\varepsilon_{H3O+}} \quad (1)$$

where *k* is the ion–molecule rate constant (molecules cm^{-3} s^{-1}), *t* is the reaction time (~ 100 microseconds), I_{RH+} and I_{H3O+} are the respective ion count rates, and ε_{RH+} and ε_{H3O+} are the ion transmission efficiencies through the TOF. It is important to note that estimated concentrations of compounds can be determined directly from Equation 1 (the "kinetic approach" to quantification). There is no need for the analysis of authentic standards and the generation of calibration curves. The system is essentially self-correcting as all measurements are made with respect to the ion count rate of the reagent ion.

The mixing ratio *X* of the organic R in the sample air is then determined by:

$$X_R\ (ppbV) = \frac{[R]}{[AIR]_{drift}} \times 1 \times 10^9 \quad (2)$$

where *[AIR]* is the number density of air (molecules/cm^3) in the drift tube given the drift tube pressure (typically ~ 2.4 mbar) and temperature (typically ~ 50°C).

The PTR-MS technology has been used in numerous applications around the world with hundreds of peer review publications appearing in the literature over the past 20 years. Even though the technology is widely used in the research arena and has proven to be indispensable for many applications, there is no standard method among the United States regulatory agencies such as the U.S. Environmental Protection Agency (EPA), ASTM®[3], and NIOSH®[4]. The end user of the technology is expected to provide the "best practice" in its use by adhering to established operational parameters governed by the scope of the project and the nature of the sample(s) to be measured.

The kinetic approach provides quantitative estimates based on the use of relative ion signals of target compounds versus that of the reagent ion with an applied reaction rate constant found in the literature. RJ Lee Group, Inc. chose this approach over the use of calibration standards due to the challenges associated with obtaining stable calibration mixtures for the Hanford COPC list. All quantification performed in this background study was accomplished by the kinetic approach.

2.2.2 Carbon Dioxide Monitor

Carbon dioxide is not a COPC; however, monitoring CO_2 is necessary for correlation of vapor signals to combustion processes or other sources. There are numerous combustion sources near the sampling sites of the background study including diesel and gas generators, all-terrain vehicles with no catalytic converters, and diesel and gasoline vehicles. These contribute VOCs

[3] ASTM is a registered trademark of American Society for Testing and Materials, West Conshohocken, Pennsylvania.
[4] NIOSH is a registered trademark of U.S. Department of Health and Human Services, Bethesda, Maryland.

to the vapor burden and are readily observed by the PTR-MS. It is necessary to distinguish these VOCs from tank farm related emissions resulting from normal work-related activities.

The CO_2 monitor used in the RJLG ML was the LI-COR®[5] Model 840A. The Li-840A is an absolute, non-dispersive infrared gas analyzer based upon a single path, dual wavelength infrared detection system. It is a low-maintenance, high performance monitoring solution that gives accurate, stable readings over a wide range of environmental conditions. It has a range of 0-20,000 ppm (0-2%), low power consumption (4W after power-up), and 1-second signal averaging to allow for real-time source apportionment (i.e., monitoring vehicle exhaust or other combustion sources on-the-fly). The instrument operates on a gas flow of less than 1 liter per minute.

It is interfaced to the laboratory's internal gas manifold just upstream of the PTR-MS sampling port to ensure that both instruments are simultaneously measuring the same source. The data from the CO_2 monitor are used to predict when VOC measurements from the PTR-MS are from combustion sources.

The CO_2 monitor used during the background study was operated using a factory calibration. Periodic checks of the unit were made with zero air and ambient background air (ambient atmospheric CO_2 levels are approximately 375-390 ppm), and a certified reference standard to ensure continued system operation. The system has a continuous direct readout which can be displayed on the server monitor in real time to aid in real-time decision making by the field analysts.

2.2.3 Ammonia Monitor

Ammonia is a compound on the COPC list of particular importance. It is believed to be associated with all high-level waste storage tanks on the Hanford Site. The global average background for ammonia is between 5-7 ppbv. Previous studies of ammonia levels on the Hanford Site indicate the expected measurement range should be in the low ppbv range. Although relatively easy to measure at the parts per million by volume (ppmv) level, its measurement at the low ppbv level with high temporal resolution is not trivial. The purpose of measuring trace levels of NH_3 is the correlation of vapor data from the PTR-MS to actual tank emissions. A measured vapor plume containing elevated COPCs with the same time correlation as an ammonia plume is reasonable evidence of a tank emission.

The ammonia monitor used was a Picarro model G2103 that is capable of measuring NH_3 with parts per trillion (ppt) sensitivity. It is a sophisticated time-based measurement system that uses a laser to quantify spectral features of gas phase molecules in an optical cavity. It is based on cavity ring down spectroscopy with an effective optical path length of up to 20 kilometers. Gas phase spectroscopy measurements are subject to temperature and pressure fluctuations. The Picarro system features a ± 0.005ºC temperature stability and ± 0.0002 atm pressure stability to ensure low noise and high accuracy measurements. Sample flow rate to the instrument was provided by an external pump at 0.8 liters per minute at 760 Torr.

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

The analyzer is interfaced to the ML main sample stream to ensure the instrument measured the same gas sample as the PTR-MS and CO_2 monitor. The system outputs real-time data to a monitor, records data to its internal computer, and uses the ML Wi-Fi connection to automatically synchronize to a clock service. Daily data sets are retrieved and backed up similar to the other data collection instruments.

2.2.4 Weather Station

The weather station used in the ML is an AIRMAR®[6] 150WX with a control unit mounted in the server cabinet and the transducer mounted on the sampling mast located above the roof of the van. Real-time display of the output is visible on the monitor connected to the ML server to aid field analysts in making sampling decisions in the field. The weather station is a stand-alone system that received its power from the uninterruptable power supply (UPS) via a 24VDC transformer. The output data are fed to the server with a clock time-stamp that is synchronized to the other monitoring systems in the laboratory. The functions and outputs of the station include:

- Apparent wind speed and angle,
- True wind speed and angle,
- Air temperature,
- Apparent wind chill temperature,
- True wind chill temperature,
- Barometric pressure,
- 2D Magnetic compass heading,
- Heading relative to true north, and
- Global positioning system (GPS).

The weather station collected data continuously at 1-second intervals. Data were stored in 12-hour increments for long duration monitoring.

2.3 Confirmatory Measurements

Although PTR-MS has exceptional response time, sensitivity, and is an excellent instrument for quantification, it suffers from the inability to make qualitative determinations of complex samples. Alternate analytical methods can provide important supporting evidence of the qualitative assignments made while interpreting the PTR-MS data as well as quantification validation of some COPCs. The Gas Chromatograph – Mass Spectrometer (GC/MS) and GC methods used to support and confirm PTR-MS were performed using well-established

[6] AIRMAR is a registered trademark of AIRMAR Technology Corporation, Milford, New Hampshire.

methodology by accredited laboratories. Within the context of this study, the two confirmatory methods that were utilized were NIOSH Method 2522, "Nitrosamines," modified and EPA TO-17, "Volatile Organic Compounds," modified.

2.3.1 Determination of Nitrosamines by NIOSH Method 2522 Modified

The samples were collected on Thermosorb®[7]-N media by following the approved method and laboratory standard operating procedure and returned to RJLG's Columbia Basin Analytical Laboratories (CBAL) facility where they were held for analysis. Specific details of the analytical method can be found in the CBAL SOP LAP-021.11, "Analysis of Nitrosamines by Gas Chromatography - NIOSH Method 2522."

These confirmatory samples were collected to support the interpretation of collocated PTR-MS data. These samples were collected on a twice-daily basis at the discretion of the RJLG field analysts and were not collected for the use of routine industrial hygiene or environmental monitoring.

2.3.2 Determination of VOCs by EPA Method TO-17 Modified

The samples were collected on CarboTrap®[8]-300 media by following the approved method and laboratory standard operating procedure and returned to RJLG's CBAL facility then shipped to Eurofins Air Toxics Laboratory at 180 Blue Ravine Road, Suite B, in Folsom, CA, where they were analyzed according to procedure.

These confirmatory samples were collected to support the interpretation of collocated PTR-MS data. These samples were collected on a twice-daily basis at the discretion of the RJLG field analysts and were not collected for the use of routine industrial hygiene or environmental monitoring.

3.0 CALIBRATION METHODS AND CALIBRATION GASES USED

3.1.1 Proton Transfer Reaction – Mass Spectrometer

Compound "quantification," particularly in the absence of an authentic gas phase standard, is conveniently performed by using kinetic reaction rate coefficients to provide estimated concentrations. The majority of gas phase ion/molecule reaction rate coefficients range from 1 x 10^{-9} molecule^{-1} cm^3 s^{-1} to 4 x 10^{-9} molecule^{-1} cm^3 s^{-1}. In PTR-MS, the use of kinetic data to estimate concentration generally results in absolute compound concentrations within ±30% of the true value. For many measurements, such as those encountered in this project, this range of precision is adequate in comparison to the problems associated with COPC standard acquisition and reliable storage. RJ Lee Group, Inc. determined that traditional calibration is not an option for this work; however, a standard containing a number of compounds would be analyzed daily to verify the accuracy of the kinetic method (RJLG's "sensitivity verification").

[7] Thermosorb is a registered trademark of Ellutia Limited Company, Cambridgeshire, United Kingdom.
[8] CarboTrap is a registered trademark of Sigma-Aldrich Co., LLC, St. Louis, Missouri.

During the background study, the sensitivity verification was performed twice daily. It was performed by running the calibration verification standard (50 ppbv) and zero air checks. The number of corrected ion counts per part per billion (ppb) of the compound of interest (RJLG chose benzene) can be calculated in the field and tracked as a quality control measure. The administrative limit of sensitivity accuracy determined on a daily basis used ± 30% of the vendor's accepted specification (e.g., 100 cps per ppbv benzene). The following steps were used to determine the sensitivity of the instrument to a specific compound:

1. Tune the instrument and align reaction energies to data collected in FY17,

2. Analyze a zero-air sample followed by the calibration standard (50 ppbv),

3. Subtract the blank corrected ion counts for an ion signal of interest from that observed for the same ion signal in the calibration standard, and

4. Divide the resulting corrected ion counts by the concentration of the measured compound.

This provides a relative sensitivity in ion counts per ppbv for the analyte under the given operating conditions. This sensitivity should be relatively stable over long periods of time and serves as an indication that the instrument is performing well.

3.1.2 Supplementary Analytical Methods; GC/MS, and GC/TEA

The field samples will be returned to CBAL where they will be logged into the Laboratory Information Management System (LIMS). The GC/MS samples to be analyzed by EPA TO-17 were sent to an accredited laboratory following appropriate quality control practices. Gas Chromatograph – Thermal Energy Analyzer (GC/TEA) with a modified NIOSH Method 2522 was used according to existing SOP LAP-021.11 for the analysis of nitrosamines. Results for calibrated compounds are based on multi-point calibration curves with NIST®[9] traceable standards. Guidance on laboratory control limits and quality control (QC) criteria may be found in the relevant laboratory Standard Operating Procedures (SOPs). For Method EPA TO-17, the comparison of confirmatory sample results to Hanford COPCs (except Benzene, which was part of the calibration list for the method) was based on tentatively identified compounds (TICs). The TICs are determined by comparing any peak greater than 10% of the nearest internal standard with a standard NIST mass spectral database to determine approximate concentrations and tentative identifications. Identified compounds based on TICs are to be considered qualitative and only tentative in their certainty for identification.

3.1.3 Carbon Dioxide Monitor

It is important to have the ability to measure absolute CO_2 concentrations over time. Specifications of the instrument from the vendor are relied upon as the source of data qualification, both absolute and long term. To ensure that the instrument was performing within

[9] NIST is a registered trademark of National Institute of Standards and Technology Agency, Gaithersburg, Maryland.

acceptable limits, daily calibration verification and zero checks were performed. A zero-air sample was introduced to the instrument to verify the zero-point setting of the instrument. Since CO_2 is reported as an absolute value, CBAL incorporated an additional QC measure of performing daily verifications of the LI-COR CO_2 monitor by analyzing a certified reference standard [a calibration verification (CV)]. These QC measurements were recorded on the CO_2 Monitor Quality Control Data Sheet located in the ML. The administratively established acceptance criteria of the CV were ± 15% of the accepted value. The CO_2 monitor is calibrated on an annual basis.

The instrument vendor quotes an accuracy of 1.5% of the true measured value with a root mean square (RMS) noise at 370 ppm with 1-second filtering at less than 1 ppm. The calibration drift is specified as the following; zero drift < 0.15 ppm/°C and span drift < 0.03%/°C. The vendor instrument certification form can be found on file at CBAL.

3.1.4 Ammonia Monitor

Since ammonia is a COPC, any device used for the quantitative measurement must be periodically qualified to ensure reliable operation. Specifications from Picarro are relied upon as the source of data qualification, both absolute and long term. To ensure the instrument is performing within acceptable limits, zero air samples were monitored twice per day to track the instruments zero level performance. A standard with a known ammonia concentration was used as an instrument performance verification and was analyzed twice daily. The administratively established acceptance criterion of the verification test is ± 15% of the accepted value. The ammonia monitor is calibrated on a yearly basis.

4.0 MEASUREMENT UNCERTAINTY AND KNOWN SOURCES OF ERROR

4.1.1 Proton Transfer Reaction Mass Spectrometer

Discussion of error associated with the deployment of an IONICON PTR-TOF 4000 for the detection of Hanford COPCs in ambient air has been discussed in detail in *Fiscal Year 2017 Mobile Laboratory Vapor Monitoring at the Hanford Site: Monitoring During Waste Disturbing Activities and Background Study*, September 2017. The same instrument was used in the FY18 background study and operated under similar specifications. Reliability of the instrument to resolve COPCs from potential interferences in ambient air is similar in this study. All standards/zeroes performed by the field team to verify the accuracy of the instrument fell within acceptable administrative limits as described in the field sampling procedure LAP-WRPS173.00, "Air Measurements for the WRPS Background Study."

4.1.2 Carbon Dioxide Monitor

The LI-COR CO_2 Analyzer had no specific errors associated with the FY18 Background Study. All standards/zeroes performed by the field team and reported in this summary to verify the accuracy of the instrument fell within acceptable administrative limits (± 15%). The measurement accuracy of a properly calibrated instrument is listed in the LI-COR factory specifications is ±3% of reading.

4.1.3 Ammonia Monitor

The Picarro G2103 Ammonia Monitor had no specific errors associated with the FY18 Background Study. Further detail regarding the errors associated with measuring ammonia using a Picarro instrument is discussed in *Fiscal Year 2017 Mobile Laboratory Vapor Monitoring at the Hanford Site: Monitoring During Waste Disturbing Activities and Background Study*, September 2017. All standards/zeroes associated with data reported in this summary performed by the field team to verify the accuracy of the instrument fell within acceptable administrative limits (± 15%). The measurement accuracy of a calibrated instrument listed in the Picarro factory specifications is ±5% of reading.

4.1.4 Weather Station

The AIRMAR 150WX Weather Station encountered several errors throughout the course of the study that had no immediate impact on data quality but did affect the ability to correlate chemical monitoring data with weather data in some cases. On March 18, 2018; March 22, 2018; and April 18, 2018, the Weather Station unexpectedly shut down for unknown reasons. During these times (prior to discovery and correction by the field team), no ambient weather data were being collected; therefore, no inferences could be made by the Data Analysis team about concurrent ambient conditions to supplement other data being collected. Refer to Section 6.0, Quality Assessment, for further detail. The AIRMAR 150 WX Weather Station is factory calibrated and is not user calibrated. The manual does not recommend periodic calibration. This is described in the FY18 Test Plan.

4.1.5 Method Detection Limits

Method Detection Limits (MDLs) were calculated by compiling zero-air data collected from January 6, 2017, through February 13, 2017. These numbers were used as the MDLs for the 46 ion signals measured by PTR-MS in the FY17 Background Study. Due to the operational parameters of the PTR-MS instrument remaining unchanged from the previous Background Study, these values were taken to be valid for the purposes of this study as well. Reporting Limits (RLs) were taken to be a factor of 3 above the MDLs. Table 4-1 summarizes the MDLs and RLs determined for each COPC as detected by PTR-MS. The reported MDLs are sufficiently low to ensure detection of the COPCs relative to their OEL concentrations. The method used for determining MDLs in the FY17 Background Study is explained in further detail in *Fiscal Year 2017 Mobile Laboratory Vapor Monitoring at the Hanford Site: Monitoring During Waste Disturbing Activities and Background Study*, September 2017. Note: 2-propenal was added to the list of COPCs detected by PTR-MS in the FY18 Background Study. Its MDL was taken to be the value calculated for the ion signal detected at mass 57 (not associated with 1-butanol and the butenes) in the original MDL study minus the contribution associated with the hydronium hydrate isotope also seen at mass 57.

Table 4-1. MDLs and RLs for Each COPC as Detected by PTR-MS. (2 Sheets)

COPC Name	MDL (ppbv)	RL (ppbv)
formaldehyde	1.658	4.975
methanol	1.676	5.028
acetonitrile	0.027	0.081
acetaldehyde	1.721	5.164
ethylamine	0.030	0.089
1,3-butadiene	1.538	4.615
propanenitrile	0.058	0.175
2-propenal	0.183	0.548
1-butanol + butenes	0.106	0.319
methyl isocyanate	0.051	0.153
methyl nitrite	0.066	0.197
furan	0.030	0.091
butanenitrile	0.009	0.028
but-3-en-2-one + 2,3-dihydrofuran + 2,5-dihydrofuran	0.073	0.219
butanal	0.057	0.172
NDMA	0.020	0.059
benzene	0.023	0.068
2,4-pentadienenitrile + pyridine	0.004	0.013
2-methylene butanenitrile	0.007	0.022
2-methylfuran	0.018	0.054
pentanenitrile	0.007	0.022
3-methyl-3-buten-2-one + 2-methyl-2-butenal	0.071	0.212
NMEA	0.006	0.017
2,5-dimethylfuran	0.015	0.045
hexanenitrile	0.006	0.018
2-hexanone (MBK)	0.030	0.090
NDEA	0.003	0.009
butyl nitrite + 2-nitro-2-methylpropane	0.004	0.013
2,4-dimethylpyridine	0.004	0.011
2-propylfuran + 2-ethyl-5-methylfuran	0.006	0.018
heptanenitrile	0.003	0.009
4-methyl-2-hexanone	0.131	0.394
NMOR	0.015	0.046
butyl nitrate	0.001	0.003
2-ethyl-2-hexenal + 4-(1-methylpropyl)-2,3-dihydrofuran + 3-(1,1-dimethylethyl)-2,3-dihydrofuran	0.014	0.042
6-methyl-2-heptanone	0.015	0.045
2-pentylfuran	0.014	0.042
biphenyl	0.015	0.046

Table 4-1. MDLs and RLs for Each COPC as Detected by PTR-MS. (2 Sheets)

COPC Name	MDL (ppbv)	RL (ppbv)
2-heptylfuran	0.008	0.025
1,4-butanediol dinitrate	0.001	0.004
2-octylfuran	0.001	0.004
1,2,3-propanetriol 1,3-dinitrate	0.022	0.065
PCB	0.001	0.004
6-(2-furanyl)-6-methyl-2-heptanone	0.003	0.010
furfural acetophenone	0.022	0.065
PCB2	0.001	0.004

5.0 TEST RESULTS

The schedule of the background study is shown in Table 5-1 below. The following sections summarize results from the background study and offer some comparisons to the background study completed in FY17.

Table 5-1. Schedule Overview. (2 Sheets)

Start Date	Start Time	Stop Date	Stop Time	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6
18-Mar	14:01	19-Mar			X				
19-Mar	13:09	20-Mar				X			
20-Mar	13:55	21-Mar					X		
21-Mar	13:52	22-Mar						X	
22-Mar	13:44	23-Mar							X
23-Mar	14:10	24-Mar		X					
24-Mar	13:09	25-Mar			X				
25-Mar	13:43	26-Mar				X			
26-Mar	14:01	27-Mar					X		
27-Mar	13:06	28-Mar						X	
28-Mar	13:20	7-Apr							X
7-Apr	13:49	8-Apr		X					
8-Apr	13:12	9-Apr			X				
9-Apr	13:30	10-Apr				X			
11-Apr	13:33	12-Apr						X	
12-Apr	14:10	13-Apr							X
13-Apr	13:43	14-Apr		X					
14-Apr	12:36	15-Apr			X				
15-Apr		16-Apr				X			
16-Apr		17-Apr					X		
17-Apr		18-Apr						X	

Table 5-1. Schedule Overview. (2 Sheets)

Start Date	Start Time	Stop Date	Stop Time	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6
18-Apr		19-Apr							X
19-Apr		20-Apr					X		
20-Apr		21-Apr		X					
Number of Days				4	4	4	4	4	4

5.1 Summary of Results

The following sections show the total average concentrations of COPCs at each site over the course of the background study. The results are broken down into High, Moderate, and Low confidence COPCs, as determined by the FY17 background study. These confidence determinations are a reflection of the ability of the PTR-TOF 4000 to reliably detect and quantify these compounds in the ambient air matrices encountered around the Tri-Cities area. Classifying quantification confidence is discussed in detail in *Fiscal Year 2017 Mobile Laboratory Vapor Monitoring at the Hanford Site: Monitoring During Waste Disturbing Activities and Background Study*, September 2017. The values shown in the site summary tables below are based on the aggregate of all measurements taken at each individual study site across four separate monitoring days. The total number of measurements taken at a study site is shown at the top of the tables.

5.1.1 Summary of Site #1

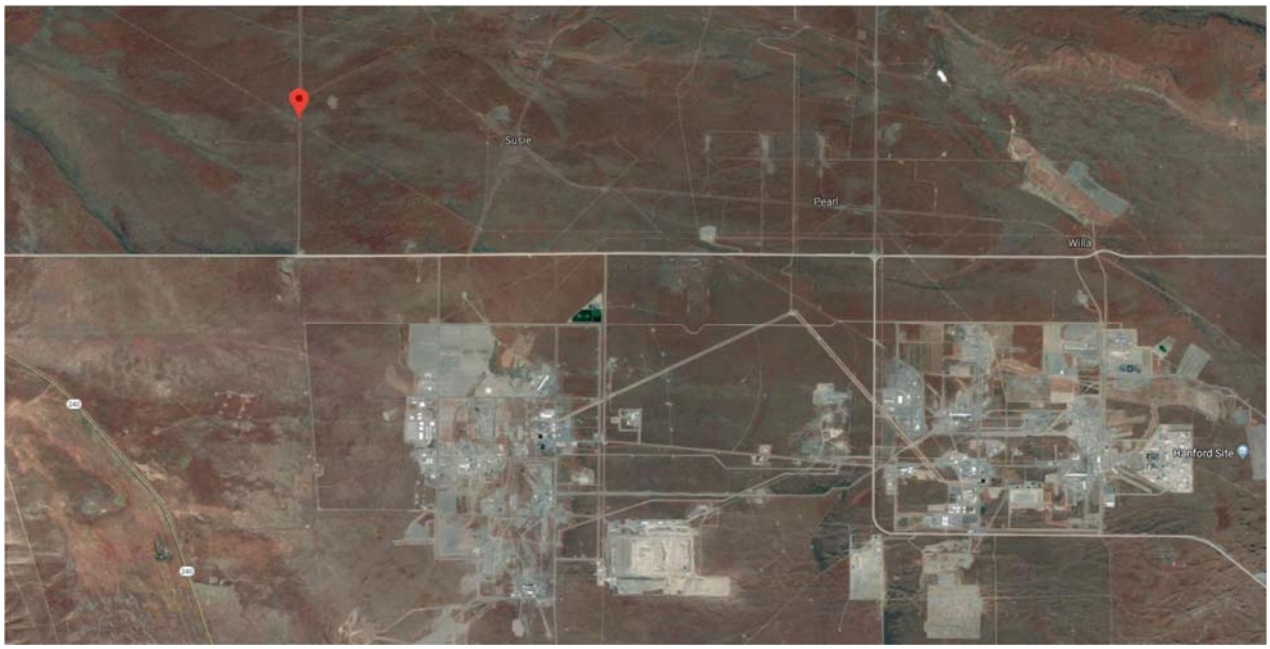


Figure 5-1. Mobile Laboratory Site #1 for the Duration of the Monitoring Period.

Table 5-2. Summary of Site #1 PTR-MS Observations for High Confidence COPCs.

Total # of Measurements		151,531	
COPC	**OEL**	**Avg.**	**Max**
	ppbv	Ppbv	ppbv
Ammonia	25000	5.481	18.900
Methanol	200000	3.709	23.223
acetonitrile	20000	0.065	0.234
acetaldehyde	25000	0.376	6.115
ethylamine	5000	0.032	0.135
propanenitrile	6000	0.062	0.231
methyl isocyanate	20	0.035	0.247
methyl nitrite	100	0.052	1.359
furan	1	0.045	0.299
benzene	500	0.073	1.461
2,4-pentadienenitrile + pyridine	300	0.018	0.145
2-methylene butanenitrile	300	0.012	0.070
2-methylfuran	1	0.026	0.346
pentanenitrile	6000	0.009	0.106
3-methyl-3-buten-2-one + 2-methyl-2-butenal	20	0.021	0.445
2,5-dimethylfuran	1	0.025	0.260
hexanenitrile	6000	0.007	0.094
2,4-dimethylpyridine	500	0.008	0.173
2-propylfuran + 2-ethyl-5-methylfuran	1	0.011	0.107
heptanenitrile	6000	0.003	0.076
4-methyl-2-hexanone	500	0.047	0.167
2-ethyl-2-hexenal + 4-(1-methylpropyl)-2,3-dihydrofuran + 3-(1,1-dimethylethyl)-2,3-dihydrofuran	1	0.021	0.112

Table 5-3. Summary of Site #1 PTR-MS Observations for Moderate Confidence COPCs.

Total # of Measurements		151,531	
COPC	**OEL**	**Avg.**	**Max**
	ppbv	Ppbv	ppbv
1,3-butadiene	1000	0.617	2.707
butanal	25000	0.082	0.490
NDMA	0.3	0.034	0.240
NMEA	0.3	0.013	0.111
2-hexanone (MBK)	5000	0.016	0.157
NDEA	0.1	0.007	0.060
butyl nitrite + 2-nitro-2-methylpropane	30	0.009	0.040
NMOR	0.6	0.025	0.095
butyl nitrate	2500	0.001	0.028
6-methyl-2-heptanone	8000	0.007	0.058
2-pentylfuran	1	0.021	0.141
1,2,3-propanetriol 1,3-dinitrate	50	0.008	0.058
PCB	1000	0.001	0.015
furfural acetophenone	1	0.035	0.047
PCB2	1000	0.001	0.019

Table 5-4. Summary of Site #1 PTR-MS Observations for Low Confidence COPCs.

Total # of Measurements		151,531	
COPC	**OEL**	**Avg.**	**Max**
	ppbv	Ppbv	ppbv
formaldehyde	300	0.580	6.049
1-butanol + butenes	20000	0.117	2.447
butanenitrile	8000	0.014	0.136
but-3-en-2-one + 2,3-dihydrofuran + 2,5-dihydrofuran	1	0.110	0.902
biphenyl	200	0.011	0.084
2-heptylfuran	1	0.010	0.051
1,4-butanediol dinitrate	50	0.002	0.019
2-octylfuran	1	0.005	0.025
6-(2-furanyl)-6-methyl-2-heptanone	1	0.005	0.024

5.1.2 Summary of Site #2



Figure 5-2. Mobile Laboratory Site #2 for the Duration of the Monitoring Period.

Table 5-5. Summary of Site #2 PTR-MS Observations of High Confidence COPCs.

Total # of Measurements		152,973	
COPC	**OEL**	**Avg.**	**Max**
	ppbv	ppbv	ppbv
ammonia	25000	5.923	35.548
methanol	200000	3.854	13.701
acetonitrile	20000	0.058	0.226
acetaldehyde	25000	0.316	8.890
ethylamine	5000	0.035	0.167
propanenitrile	6000	0.058	0.316
methyl isocyanate	20	0.035	0.469
methyl nitrite	100	0.057	2.750
furan	1	0.045	0.460
benzene	500	0.080	1.462
2,4-pentadienenitrile + pyridine	300	0.019	0.153
2-methylene butanenitrile	300	0.012	0.123
2-methylfuran	1	0.026	0.552
pentanenitrile	6000	0.009	0.132
3-methyl-3-buten-2-one + 2-methyl-2-butenal	20	0.020	0.703
2,5-dimethylfuran	1	0.026	0.438
hexanenitrile	6000	0.007	0.173
2,4-dimethylpyridine	500	0.009	0.224
2-propylfuran + 2-ethyl-5-methylfuran	1	0.011	0.192
heptanenitrile	6000	0.003	0.060
4-methyl-2-hexanone	500	0.039	0.149
2-ethyl-2-hexenal + 4-(1-methylpropyl)-2,3-dihydrofuran + 3-(1,1-dimethylethyl)-2,3-dihydrofuran	1	0.020	0.385

Table 5-6. Summary of Site #2 PTR-MS Observations of Moderate Confidence COPCs.

Total # of Measurements		152,973	
COPC	**OEL**	**Avg.**	**Max**
	ppbv	Ppbv	ppbv
1,3-butadiene	1000	0.512	3.445
butanal	25000	0.078	0.479
NDMA	0.3	0.033	0.163
NMEA	0.3	0.013	0.381
2-hexanone (MBK)	5000	0.015	0.127
NDEA	0.1	0.006	0.051
butyl nitrite + 2-nitro-2-methylpropane	30	0.008	0.037
NMOR	0.6	0.025	0.081
butyl nitrate	2500	0.001	0.040
6-methyl-2-heptanone	8000	0.006	0.062
2-pentylfuran	1	0.020	0.144
1,2,3-propanetriol 1,3-dinitrate	50	0.007	0.056
PCB	1000	0.001	0.015
furfural acetophenone	1	0.035	0.028
PCB2	1000	0.002	0.020

Table 5-7. Summary of Site #2 PTR-MS Observations for Low Confidence COPCs.

Total # of Measurements		152,973	
COPC	**OEL**	**Avg.**	**Max**
	ppbv	Ppbv	ppbv
formaldehyde	300	0.667	16.108
1-butanol + butenes	20000	0.126	8.817
butanenitrile	8000	0.014	0.199
but-3-en-2-one + 2,3-dihydrofuran + 2,5-dihydrofuran	1	0.112	1.749
biphenyl	200	0.009	0.069
2-heptylfuran	1	0.010	0.085
1,4-butanediol dinitrate	50	0.001	0.016
2-octylfuran	1	0.005	0.031
6-(2-furanyl)-6-methyl-2-heptanone	1	0.005	0.021

5.1.3 Summary of Site #3



Figure 5-3. Mobile Laboratory Site #3 for the Duration of the Monitoring Period.

Table 5-8. Summary of Site #3 PTR-MS Observations of High Confidence COPCs.

Total # of Measurements		154,050	
COPC	**OEL**	**Avg.**	**Max**
	ppbv	ppbv	ppbv
ammonia	25000	5.166	22.794
methanol	200000	4.114	26.379
acetonitrile	20000	0.064	0.270
acetaldehyde	25000	0.486	16.462
ethylamine	5000	0.033	0.135
propanenitrile	6000	0.064	0.450
methyl isocyanate	20	0.038	0.571
methyl nitrite	100	0.079	3.567
furan	1	0.046	0.573
benzene	500	0.099	3.015
2,4-pentadienenitrile + pyridine	300	0.021	0.226
2-methylene butanenitrile	300	0.014	1.562
2-methylfuran	1	0.030	0.786
pentanenitrile	6000	0.010	0.168
3-methyl-3-buten-2-one + 2-methyl-2-butenal	20	0.027	0.798
2,5-dimethylfuran	1	0.028	0.554
hexanenitrile	6000	0.009	0.198
2,4-dimethylpyridine	500	0.011	0.437
2-propylfuran + 2-ethyl-5-methylfuran	1	0.012	0.237
heptanenitrile	6000	0.004	0.095
4-methyl-2-hexanone	500	0.045	0.169
2-ethyl-2-hexenal + 4-(1-methylpropyl)-2,3-dihydrofuran + 3-(1,1-dimethylethyl)-2,3-dihydrofuran	1	0.021	1.034

Table 5-9. Summary of Site #3 PTR-MS Observations for Moderate Confidence COPCs.

Total # of Measurements		154,050	
COPC	**OEL**	**Avg.**	**Max**
	ppbv	ppbv	ppbv
1,3-butadiene	1000	0.667	5.881
butanal	25000	0.109	34.817
NDMA	0.3	0.034	0.290
NMEA	0.3	0.013	0.113
2-hexanone (MBK)	5000	0.019	0.188
NDEA	0.1	0.006	0.056
butyl nitrite + 2-nitro-2-methylpropane	30	0.009	0.045
NMOR	0.6	0.025	0.120
butyl nitrate	2500	0.002	0.035
6-methyl-2-heptanone	8000	0.008	0.102
2-pentylfuran	1	0.022	0.254
1,2,3-propanetriol 1,3-dinitrate	50	0.011	0.118
PCB	1000	0.001	0.016
furfural acetophenone	1	0.035	0.044
PCB2	1000	0.001	0.018

Table 5-10. Summary of Site #3 PTR-MS Observations for Low Confidence COPCs.

Total # of Measurements		154,050	
COPC	**OEL**	**Avg.**	**Max**
	ppbv	Ppbv	ppbv
formaldehyde	300	0.719	17.141
1-butanol + butenes	20000	0.186	4.806
butanenitrile	8000	0.016	0.229
but-3-en-2-one + 2,3-dihydrofuran + 2,5-dihydrofuran	1	0.114	2.205
biphenyl	200	0.013	0.124
2-heptylfuran	1	0.011	0.127
1,4-butanediol dinitrate	50	0.002	0.018
2-octylfuran	1	0.005	0.044
6-(2-furanyl)-6-methyl-2-heptanone	1	0.005	0.027

5.1.4 Summary of Site #4

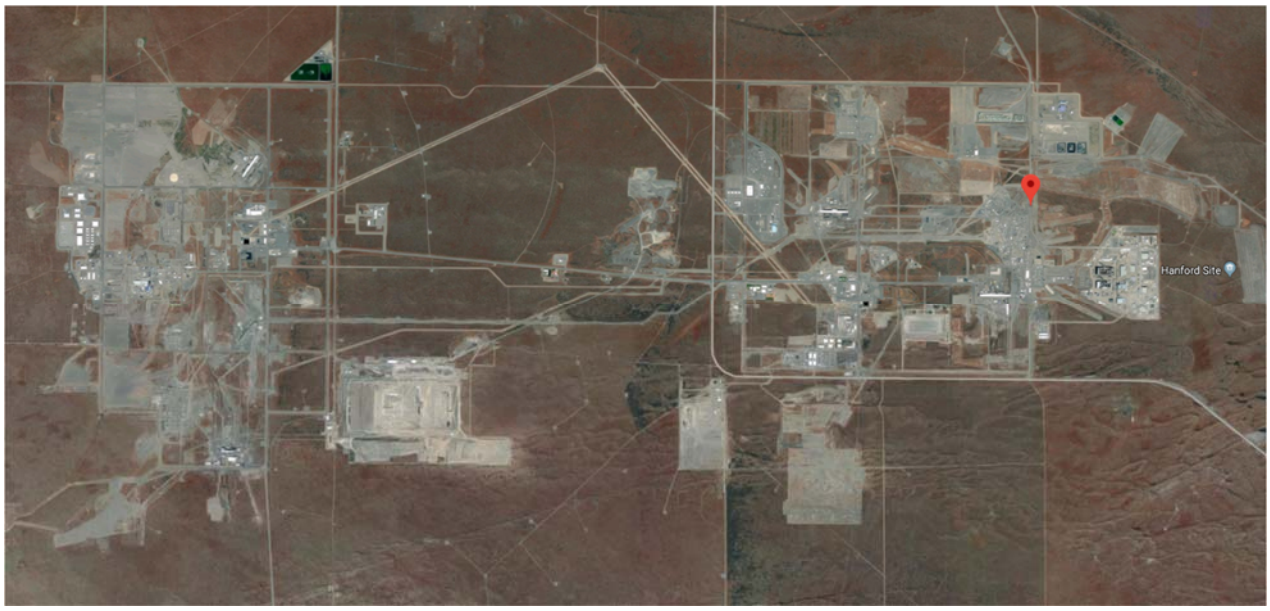


Figure 5-4. Mobile Laboratory Site #4 for the Duration of the Monitoring Period.

Table 5-11. Summary of Site #4 PTR-MS Observations of High Confidence COPCs.

Total # of Measurements		147,334	
COPC	**OEL**	**Avg.**	**Max**
	ppbv	Ppbv	ppbv
ammonia	25000	6.654	25.381
methanol	200000	4.122	141.819
acetonitrile	20000	0.059	0.223
acetaldehyde	25000	0.376	9.024
ethylamine	5000	0.033	0.139
propanenitrile	6000	0.057	0.283
methyl isocyanate	20	0.034	0.431
methyl nitrite	100	0.054	3.014
furan	1	0.048	0.490
benzene	500	0.083	4.579
2,4-pentadienenitrile + pyridine	300	0.019	0.340
2-methylene butanenitrile	300	0.012	1.700
2-methylfuran	1	0.026	0.504
pentanenitrile	6000	0.008	0.101
3-methyl-3-buten-2-one + 2-methyl-2-butenal	20	0.020	0.794
2,5-dimethylfuran	1	0.026	0.421
hexanenitrile	6000	0.007	0.130
2,4-dimethylpyridine	500	0.009	0.534
2-propylfuran + 2-ethyl-5-methylfuran	1	0.011	0.181
heptanenitrile	6000	0.003	0.048
4-methyl-2-hexanone	500	0.038	0.147
2-ethyl-2-hexenal + 4-(1-methylpropyl)-2,3-dihydrofuran + 3-(1,1-dimethylethyl)-2,3-dihydrofuran	1	0.020	0.162

Table 5-12. Summary of Site #4 PTR-MS Observations for Moderate Confidence COPCs.

Total # of Measurements		154,050	
COPC	**OEL**	**Avg.**	**Max**
	ppbv	Ppbv	ppbv
1,3-butadiene	1000	0.549	3.427
butanal	25000	0.102	1.413
NDMA	0.3	0.033	0.202
NMEA	0.3	0.013	0.119
2-hexanone (MBK)	5000	0.016	0.108
NDEA	0.1	0.006	0.076
butyl nitrite + 2-nitro-2-methylpropane	30	0.009	0.053
NMOR	0.6	0.025	0.074
butyl nitrate	2500	0.001	0.025
6-methyl-2-heptanone	8000	0.006	0.076
2-pentylfuran	1	0.020	0.237
1,2,3-propanetriol 1,3-dinitrate	50	0.006	0.051
PCB	1000	0.001	0.016
furfural acetophenone	1	0.035	0.037
PCB2	1000	0.001	0.019

Table 5-13. Summary of Site #4 PTR-MS Observations for Low Confidence COPCs.

Total # of Measurements		147,334	
COPC	**OEL**	**Avg.**	**Max**
	ppbv	Ppbv	ppbv
formaldehyde	300	0.634	12.037
1-butanol + butenes	20000	0.128	3.918
butanenitrile	8000	0.014	0.142
but-3-en-2-one + 2,3-dihydrofuran + 2,5-dihydrofuran	1	0.110	1.639
biphenyl	200	0.008	0.065
2-heptylfuran	1	0.010	0.057
1,4-butanediol dinitrate	50	0.001	0.016
2-octylfuran	1	0.005	0.027
6-(2-furanyl)-6-methyl-2-heptanone	1	0.005	0.017

5.1.5 Summary of Site #5



Figure 5-5. Mobile Laboratory Site #5 for the Duration of the Monitoring Period.

Table 5-14. Summary of Site #5 PTR-MS Observations of High Confidence COPCs.

Total # of Measurements		146,594	
COPC	**OEL**	**Avg.**	**Max**
	ppbv	ppbv	ppbv
ammonia	25000	9.198	146.368
methanol	200000	4.628	817.378
acetonitrile	20000	0.066	0.831
acetaldehyde	25000	0.398	12.636
ethylamine	5000	0.033	0.152
propanenitrile	6000	0.067	1.409
methyl isocyanate	20	0.037	0.639
methyl nitrite	100	0.060	3.803
furan	1	0.045	0.558
benzene	500	0.084	6.179
2,4-pentadienenitrile + pyridine	300	0.020	0.427
2-methylene butanenitrile	300	0.013	0.137
2-methylfuran	1	0.026	0.609
pentanenitrile	6000	0.010	0.217
3-methyl-3-buten-2-one + 2-methyl-2-butenal	20	0.022	0.692
2,5-dimethylfuran	1	0.026	0.373
hexanenitrile	6000	0.008	0.153
2,4-dimethylpyridine	500	0.011	1.682
2-propylfuran + 2-ethyl-5-methylfuran	1	0.012	0.237
heptanenitrile	6000	0.003	0.072
4-methyl-2-hexanone	500	0.043	0.299
2-ethyl-2-hexenal + 4-(1-methylpropyl)-2,3-dihydrofuran + 3-(1,1-dimethylethyl)-2,3-dihydrofuran	1	0.020	0.145

Table 5-15. Summary of Site #5 PTR-MS Observations for Moderate Confidence COPCs.

Total # of Measurements		146,594	
COPC	**OEL**	**Avg.**	**Max**
	ppbv	Ppbv	ppbv
1,3-butadiene	1000	0.704	4.045
butanal	25000	0.105	16.426
NDMA	0.3	0.033	0.200
NMEA	0.3	0.014	0.111
2-hexanone (MBK)	5000	0.018	1.577
NDEA	0.1	0.007	0.061
butyl nitrite + 2-nitro-2-methylpropane	30	0.009	0.211
NMOR	0.6	0.025	0.294
butyl nitrate	2500	0.002	0.050
6-methyl-2-heptanone	8000	0.008	0.093
2-pentylfuran	1	0.021	0.180
1,2,3-propanetriol 1,3-dinitrate	50	0.010	0.143
PCB	1000	0.001	0.015
furfural acetophenone	1	0.035	0.034
PCB2	1000	0.001	0.018

Table 5-16. Summary of Site #5 PTR-MS Observations for Low Confidence COPCs.

Total # of Measurements		146,594	
COPC	**OEL**	**Avg.**	**Max**
	ppbv	ppbv	ppbv
formaldehyde	300	0.612	16.216
1-butanol + butenes	20000	0.148	23.531
butanenitrile	8000	0.015	0.607
but-3-en-2-one + 2,3-dihydrofuran + 2,5-dihydrofuran	1	0.111	1.988
biphenyl	200	0.011	0.098
2-heptylfuran	1	0.012	0.081
1,4-butanediol dinitrate	50	0.001	0.018
2-octylfuran	1	0.005	0.034
6-(2-furanyl)-6-methyl-2-heptanone	1	0.005	0.022

5.1.6 Summary of Site #6

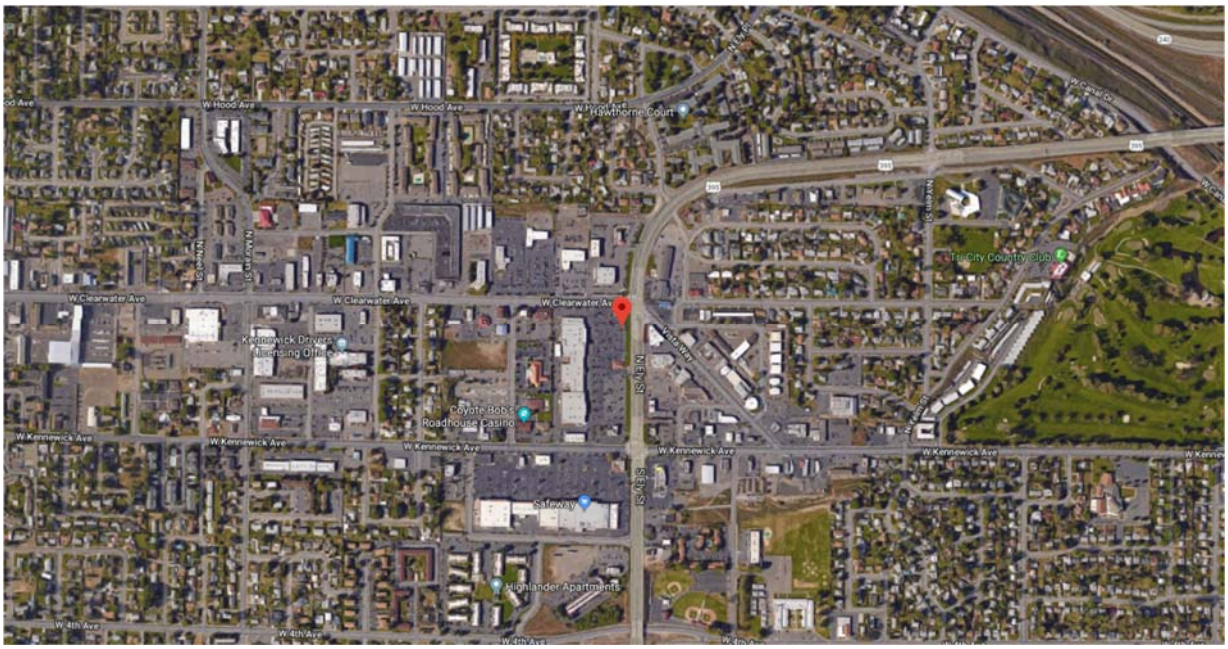


Figure 5-6. Mobile Laboratory Site #6 for the Duration of the Monitoring Period.

Table 5-17. Summary of Site #6 PTR-MS Observations of High Confidence COPCs.

Total # of Measurements		146,870	
COPC	**OEL**	**Avg.**	**Max**
	ppbv	Ppbv	ppbv
ammonia	25000	8.283	57.254
methanol	200000	5.104	582.916
acetonitrile	20000	0.069	2.776
acetaldehyde	25000	0.652	55.219
ethylamine	5000	0.035	0.269
propanenitrile	6000	0.069	4.315
methyl isocyanate	20	0.036	0.509
methyl nitrite	100	0.067	3.151
furan	1	0.045	0.399
benzene	500	0.180	47.621
2,4-pentadienenitrile + pyridine	300	0.027	3.390
2-methylene butanenitrile	300	0.014	0.285
2-methylfuran	1	0.028	0.624
pentanenitrile	6000	0.011	0.720
3-methyl-3-buten-2-one + 2-methyl-2-butenal	20	0.023	0.819
2,5-dimethylfuran	1	0.026	0.411
hexanenitrile	6000	0.009	0.520
2,4-dimethylpyridine	500	0.025	10.715
2-propylfuran + 2-ethyl-5-methylfuran	1	0.012	0.194
heptanenitrile	6000	0.004	0.220
4-methyl-2-hexanone	500	0.042	0.192
2-ethyl-2-hexenal + 4-(1-methylpropyl)-2,3-dihydrofuran + 3-(1,1-dimethylethyl)-2,3-dihydrofuran	1	0.020	0.196

Table 5-18. Summary of Site #6 PTR-MS Observations for Moderate Confidence COPCs.

Total # of Measurements		146,870	
COPC	**OEL**	**Avg.**	**Max**
	ppbv	Ppbv	ppbv
1,3-butadiene	1000	0.576	10.803
butanal	25000	0.091	1.430
NDMA	0.3	0.035	0.374
NMEA	0.3	0.015	0.796
2-hexanone (MBK)	5000	0.021	0.195
NDEA	0.1	0.007	0.062
butyl nitrite + 2-nitro-2-methylpropane	30	0.010	0.142
NMOR	0.6	0.025	0.725
butyl nitrate	2500	0.002	0.308
6-methyl-2-heptanone	8000	0.007	0.096
2-pentylfuran	1	0.021	0.305
1,2,3-propanetriol 1,3-dinitrate	50	0.007	0.045
PCB	1000	0.001	0.020
furfural acetophenone	1	0.035	0.044
PCB2	1000	0.001	0.017

Table 5-19. Summary of Site #6 PTR-MS Observations for Low Confidence COPCs.

Total # of Measurements		146,870	
COPC	**OEL**	**Avg.**	**Max**
	ppbv	ppbv	ppbv
formaldehyde	300	0.734	12.836
1-butanol + butenes	20000	0.334	120.737
butanenitrile	8000	0.020	1.757
but-3-en-2-one + 2,3-dihydrofuran + 2,5-dihydrofuran	1	0.111	4.279
biphenyl	200	0.011	0.255
2-heptylfuran	1	0.010	0.063
1,4-butanediol dinitrate	50	0.001	0.021
2-octylfuran	1	0.005	0.028
6-(2-furanyl)-6-methyl-2-heptanone	1	0.005	0.022

5.2 Identification of Vapor Sources and Quantitative Analysis of Vapor Composition

The background study is primarily focused on a broad determination of typical concentrations observed for COPCs at various locations for general comparisons made between these locations. While high-time resolution is not critical to provide useful insight on daily average concentrations, the high-time resolution of the instruments onboard the RJLG ML do observe

short-lived transient plumes that are likely the result of nearby point sources. While it is not the focus of this study, these short-lived transients should be better understood in case they threaten the quality of the data collected or provide other valuable insight on COPC sources and distribution. This section will present a way of profiling some known VOC sources and using these known profiles for comparison to the most interesting transient plumes observed during the background study.

5.2.1 RJLG ML Generator Exhaust at Site 1

One of the more challenging aspects of the background study was to prevent sampling contamination from the onboard generator of the RJLG ML. The RJLG technicians attached a 30-foot exhaust hose downwind of the ML and often repositioned the van when wind direction changed. Despite these efforts, most data sets show many observations of diesel exhaust signatures. The ML is most susceptible to sampling its own generator exhaust under calm or stagnant wind conditions. On March 18, 2018, any instances that showed a sharp response in exhaust tracers (benzene, toluene, formaldehyde, acetaldehyde, CO_2) accompanied by calm/stagnant winds were categorized as exhaust plumes from the RJLG generator. Five of the instances were selected to create a profile of the exhaust which can be used when analyzing plumes from unknown sources to predict their source. The five green hatched times in Figure 5-7 show the instances of generator exhaust sampling at Site 2 on March 19, 2018. In this analysis, a "plume" is defined as a response above the normal ambient background concentrations; therefore, it is important to also quantify the ambient background. The gray hatched area in Figure 5-7 represents the background concentrations in the ambient air for this day. To get the plume response, each species was averaged within the green hatched areas and the background concentrations were subtracted.

While the absolute value of species within the plume is important, it is difficult to use them to create a signature for the source due to variable dilution prior to sampling. A simple method to create a source signature is to normalize all the values to a common reference, therefore eliminating extent of dilution as a variable. Benzene was chosen as the reference species due to its importance as a COPC, general abundance in a wide range of sources, and the strong confidence of measurement by the PTR-MS. The plume response of each species is divided by the plume response of benzene to result in a plume ratio. Comparing the ratios within different plumes gives us a metric to determine whether the sources are unique to one another. Table 5-20 shows the plume ratios within five selected exhaust plumes. It is important to note that the emission profile of diesel exhaust from the same source is likely to change somewhat over time due to factors such as varying load, fuel composition, combustion temperature, air mixing ratios and more. The average benzene normalized concentration observed during these transient plumes are shown in the final column of the table and will serve as the RJLG ML generator exhaust profile.

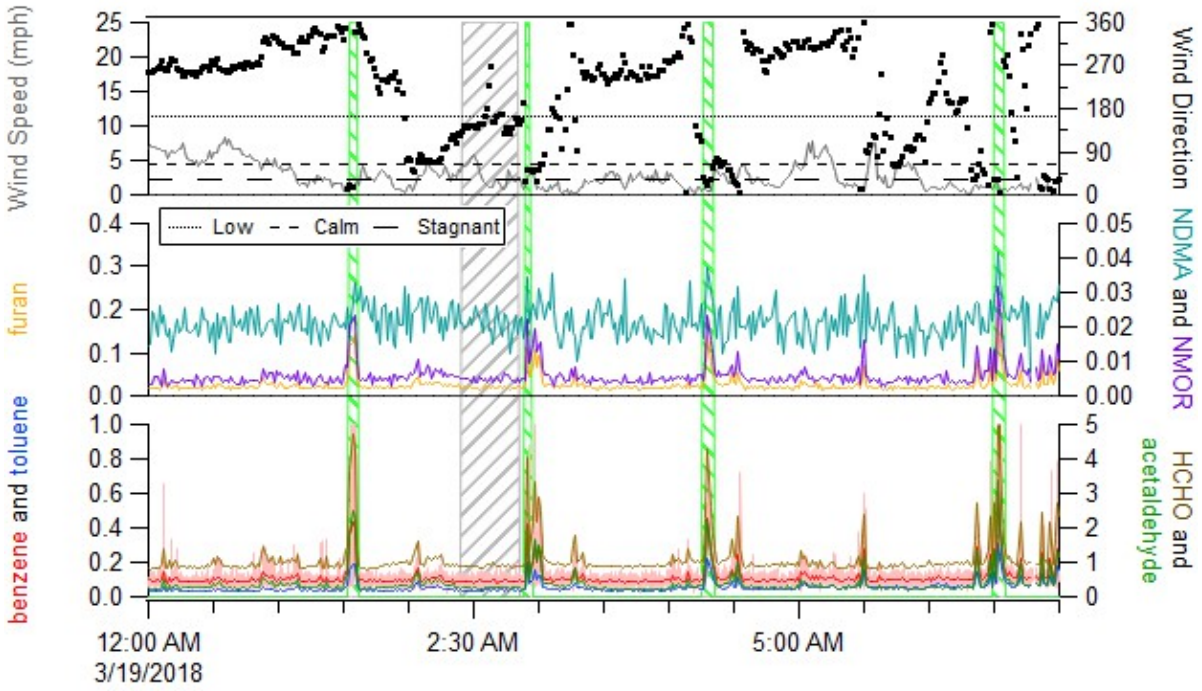


Figure 5-7. Wind Speed, Wind Direction, Select Tracers of Diesel Exhaust Emissions, and Two Nitrosamines on March 19, 2018, at Site #2, Plotted as 1-minute Averages with the Exception of Benzene Plotted at 2-second Time Resolution.

The gray hatched area was used to calculate the average ambient background concentrations. The green hatched areas represent the RJLG generator exhaust plumes.

Table 5-20. RJLG Exhaust Plume Ratios of Select Species with Respect to Benzene on March 19, 2018 at Site #2.

	Plume 1	Plume 2	Plume 3	Plume 4	Plume 5	Average
Start Time of Plume	01:33	01:34	02:55	04:17	06:31	
benzene	1.00	1.00	1.00	1.00	1.00	1.00
toluene	0.42	0.47	0.48	0.52	0.53	0.48
formaldehyde	10.53	11.17	9.33	9.28	9.99	10.06
acetaldehyde	5.84	6.62	5.07	5.32	5.61	5.69
ammonia	No Response	No Response	No Response	No Response	No Response	No Response
furan	0.35	0.35	0.28	0.32	0.30	0.32
but-3-en-2-one + 2,3-dihydrofuran + 2,5-dihydrofuran	1.08	1.26	0.97	0.98	1.07	1.07
NDMA	No Response	0.03	0.04	0.05	0.03	0.04
2-methylfuran	0.40	0.55	0.44	0.43	0.49	0.46
NMEA	No Response	No Response	No Response	No Response	No Response	No Response
2,5-dimethylfuran	0.30	0.42	0.32	0.31	0.38	0.35
NDEA	<MDL*	<MDL*	<MDL*	<MDL*	<MDL*	<MDL*
2-propylfuran + 2-ethyl-5-methylfuran	0.09	0.13	0.10	0.11	0.14	0.11
NMOR	0.05	0.06	0.05	0.05	0.06	0.05
2-ethyl-2-hexenal + 4-(1-methylpropyl)-2,3-dihydrofuran + 3-(1,1-dimethylethyl)-2,3-dihydrofuran	0.06	0.11	0.08	0.09	0.11	0.09
2-pentylfuran	0.07	0.13	0.09	0.11	0.14	0.11
2-heptylfuran	0.03	0.05	0.05	0.05	0.07	0.05
2-octylfuran	<MDL*	<MDL*	<MDL*	<MDL*	<MDL*	<MDL*
6-(2-furanyl)-6-methyl-2-heptanone	<MDL*	<MDL*	<MDL*	<MDL*	<MDL*	<MDL*
furfural acetophenone	<MDL*	<MDL*	<MDL*	<MDL*	<MDL*	<MDL*

*"<MDL" signifies that the signal never exceeded the minimum detection limit. "No Response" signifies that there was a signal at or above the MDL before, during, and after the plume, but no response could be attributed to the plume itself.

5.2.2 Other Known Source Profiles

This section will summarize benzene normalized concentrations characteristic of other known sources observed with the RJLG ML over the past year. Similar to the RJLG ML generator exhaust profile in the previous section, these profiles will be valuable while determining the source of transient plumes observed throughout the background study or in future studies. Table 5-21 shows benzene normalized concentrations above ambient for three additional sources characterized in FY17; the Wallula Paper Mill, Tyson®[10] cattle feed lot, and an urban signature in downtown Pasco. The data workup for each of these sources was performed as described in Section 5.2.1 but only the final results are shown in this report.

[10] Tyson is a registered trademark of Tyson Foods, Inc., Springdale, Arkansas.

The Wallula Paper Mill profile is dominated by the small aldehydes, which are well-known characteristics of paper mill emissions. The Tyson feed lot is dominated by ammonia, which is also a well-known characteristic near cattle or other animal facilities. The Pasco urban profile differs from the Kennewick urban air mass observed during FY18. On this day, Pasco shows elevated toluene and depressed small aldehydes compared to Kennewick. It is difficult to say if these results are the product of activities occurring nearby on these few days or an actual difference in the typical background air observed in these city centers. Toluene, in particular, is likely to vary dramatically day to day in any urban setting since it is an anthropogenic source and a common solvent.

Table 5-21. Ratios of Select Species with Respect to Benzene for a Variety of Different Air Masses Observed on March 22, 2017.

Species	RJLG	Wallula	Tyson	Pasco
benzene	1.00	1.00	1.00	1.00
toluene	0.48	4.28	4.77	2.74
formaldehyde	10.06	34.37	No Response	0.98
acetaldehyde	5.69	14.77	No Response	1.06
ammonia	No Response	No Response	247	No Response
furan	0.32	<MDL	No Response	<MDL
but-3-en-2-one + 2,3-dihydrofuran + 2,5-dihydrofuran	1.07	1.91	No Response	0.10
NDMA	0.04	No Response	0.07	No Response
2-methylfuran	0.46	0.51	No Response	0.03
NMEA	No Response	No Response	No Response	0.00
2,5-dimethylfuran	0.35	0.99	0.14	0.03
NDEA	<MDL	<MDL	No Response	<MDL
2-propylfuran + 2-ethyl-5-methylfuran	0.11	3.75	No Response	0.00
NMOR	0.05	<MDL	0.01	<MDL
2-ethyl-2-hexenal + 4-(1-methylpropyl)-2,3-dihydrofuran + 3-(1,1-dimethylethyl)-2,3-dihydrofuran	0.09	1.46	0.88	0.02
2-pentylfuran	0.11	2.72	2.10	0.01
2-heptylfuran	0.05	0.16	1.00	0.00
2-octylfuran	<MDL	0.03	No Response	0.00
6-(2-furanyl)-6-methyl-2-heptanone	<MDL	<MDL	<MDL	<MDL
furfural acetophenone	<MDL	<MDL	<MDL	<MDL

*"<MDL" signifies that the signal never exceeded the minimum detection limit. "No Response" signifies that there was a signal at or above the MDL before, during, and after the plume, but no response could be attributed to the plume itself.

Although the focus of the study is to estimate the background concentration of chemical compounds on the Hanford site, it is important to characterize potential sources outside the study area. The four locations chosen for this purpose are the Wallula Pulp and Paper Mill (Wallula), the Tyson Feed Lot (Tyson), and downtown Pasco (Pasco). These locations are known for having a recognizable chemical signature that are of use when characterizing transient plumes traversing the study area. The RJLG generator exhaust (RJLG) is included for comparison.

5.2.3 Transient Plumes of Interest

Abnormal plumes, whether short lived or hours in duration, are difficult to assign to a particular source with confidence when analyzing ambient air. Determining characteristic chemical profiles for known VOC sources is a useful way to help determine the source of elevated VOCs located in air masses monitored but it is important to note a few limitations of this approach. Ambient air is a complex mixture of sources that are constantly blending. There is also complex chemistry taking place among these VOCs, especially in the presence of sunlight or reactive species such as ozone. These factors are most complex at sampling locations such as Site 3 (4th and Buffalo in 200E) and Site 6 (downtown Kennewick) where human activity is high and the number of potential VOC point sources are many. In this section, the characteristic chemical profiles of several abnormal plumes observed during the background study will be compared with those of known origin from Sections 5.2.1 and 5.2.2 and the source of these emissions will be theorized.

5.2.3.1 Site 6, Complex Urban Plume

Background study Site 6 is a very complex air mass with major contributions from gasoline vehicle exhaust, diesel exhaust, nearby restaurants, and other urban activities. Table 5-22 shows the average benzene normalized concentrations observed at Site 6 covering all four days of sampling at this location. The complexity of Site 6 makes drawing confident conclusions difficult, but the profile of Site 6 differs from the RJLG ML generator exhaust profile. This both suggests that there are significant sources of VOC near Site 6 other than the onboard generator of the RJLG ML and that they are likely not dominated by diesel exhaust sources. Gasoline exhaust traditionally produces much higher concentrations of VOCs than diesel due to lower combustion temperatures and the occasional automobile without an operational catalytic converter.

Table 5-22. Average Benzene Normalized Concentrations of Select Compounds Observed in Abnormal Transient Plumes at Multiple Locations.

	RJLG Exhaust	Site #6	March 20, 2018 Site #4	April 19, 2018 Site #4	April 20, 2018 Site #1
Date and Time Start			3/20/18 23:15	4/19/18 06:45	4/20/18 18:32
Date and Time Stop			3/21/18 00:44	4/19/18 10:39	4/20/18 20:50
benzene	1.00	1.00	1.00	1.00	1.00
toluene	0.48	1.68	0.86	0.84	0.94
formaldehyde	10.06	1.44	2.48	7.71	13.68
acetaldehyde	5.69	3.04	3.15	11.09	28.62
ammonia	No Response	29.71	41.53	No Response	No Response
furan	0.32	0.08	1.37	<MDL	1.11
but-3-en-2-one + 2,3-dihydrofuran + 2,5-dihydrofuran	1.07	0.13	0.45	<MDL	3.22
NDMA	0.04	0.04	<MDL	0.25	1.21
2-methylfuran	0.46	0.08	0.51	0.50	0.99
NMEA	No Response	0.03	0.01	0.13	No Response
2,5-dimethylfuran	0.35	0.06	0.51	0.41	0.78
NDEA	<MDL	<MDL	<MDL	No Response	<MDL
2-propylfuran + 2-ethyl-5-methylfuran	0.11	0.03	0.09	0.17	0.35
NMOR	0.05	0.02	<MDL	<MDL	<MDL
2-ethyl-2-hexenal + 4-(1-methylpropyl)-2,3-dihydrofuran + 3-(1,1-dimethylethyl)-2,3-dihydrofuran	0.09	0.03	<MDL	0.41	0.52
2-pentylfuran	0.11	0.05	0.08	0.41	0.49
2-heptylfuran	0.05	0.02	<MDL	No Response	<MDL
2-octylfuran	<MDL	<MDL	<MDL	<MDL	<MDL
6-(2-furanyl)-6-methyl-2-heptanone	<MDL	<MDL	<MDL	<MDL	<MDL
furfural acetophenone	<MDL	<MDL	<MDL	<MDL	<MDL

*"<MDL" signifies that the signal never exceeded the minimum detection limit. "No Response" signifies that there was a signal at or above the MDL before, during, and after the plume, but no response could be attributed to the plume itself.

The Site #6 ratios were determined by averaging the identified urban plumes on March 23, 2018, from 05:41 to 09:38; March 28, 2018, from 21:38 to 22:39; April 13, 2018, from 06:45 to 10:45; and April 18, 2018, from 17:26 to 23:32. The ratios for March 20, 2018; April 19, 2018; and April 20, 2018, are based on identification of unique plumes. The RJLG generator exhaust (RJLG) is included for comparison.

5.2.3.2 March 20, 2018, Plume, Site 4

Near midnight on March 20, 2018, an abnormal plume was observed at Site 4 for approximately 90 minutes. Table 5-22 shows the average benzene normalized concentrations observed in this plume. The profile features very high ammonia concentration and elevated small aldehydes. Not shown in the table is the fact that there was no elevated CO_2 associated with this plume;

therefore, it is likely not a combustion source. Winds were from the south prior to observing this plume but became stagnant with unstable direction for the duration of the plume. Ammonia may be an indicator of tank vapor, but the plume is lacking the majority of the COPCs expected to be seen in tank vapor. It is possible that this plume is a mixture of animal-based agricultural operations and Wallula paper mill emissions (elevated aldehydes) but the wind data do not support this. It may be from an unidentified source closer to the Hanford Site. It has unique composition that is not seen on other days of the background study.

5.2.3.3 April 19, 2018, Plume, Site 4

April 19, 2018, featured a four-hour plume with elevated aldehydes at Site 4 during the morning hours. Table 5-22 shows the average benzene normalized concentrations observed in this plume. Elevated CO_2 was observed with this plume and the wind was light from the north or stagnant. The chemical profile aligns somewhat with Wallula paper mill emission but the wind does not suggest this is the source. A local source of aldehydes near Site 4 that is not yet identified may be the source.

5.2.3.4 April 20, 2018, Plume, Site 1

April 20, 2018, featured a two-hour plume with elevated aldehydes, potentially N-nitrosodimethylamine (NDMA) and the sum of but-3-en-2-one + 2,3-dihydrofuran + 2,5-dihydrofuran at the relatively remote Site 1. Table 5-22 shows the average benzene normalized concentrations observed in this plume. Elevated CO_2 was observed throughout the plume but did not coincide with the elevated VOCs, suggesting multiple sources mixing. Winds were light but consistent from the south and southeast (from 200W). The profile suggests an unknown somewhat consistent with tank vapor overlaid with an occasional combustion source but is still lacking a number of COPCs one would expect to observe. This sampling event occurred in the evening hours when there were no RJLG field staff on site to document any abnormal work activity in the area.

5.3 Detailed Analysis of Test Data

The data collected during the FY18 background study were used to draw comparisons between the following:

- FY18 Background Study Data and co-collected confirmatory samples on alternative media,
- Data collected at differing sites, and
- FY18 Background Study Data and FY17 Background Study Data.

5.3.1 Comparison of PTR-MS to Confirmatory Samples

Confirmatory air samples were taken at each study site on two different types of sampling media. Once analyzed, these samples were compared, where possible, to the average PTR-MS signal observed over the same time period the samples were collected. CarboTrab-300 thermal

desorption tubes were used to collect VOC samples twice daily for analysis by EPA TO-17 modified. Thermosorb/N cartridges were used to collect nitrosamine samples twice daily for analysis by NIOSH 2522 modified.

Air sample collection on the alternative media occurred at two different times during the day. One data set encompassed the early morning air mass that exists prior to the typical boundary layer breakup and the other occurred during the afternoon hours after the atmospheric chemistry had time to stabilize from the solar radiation. Samples were collected using standard industrial hygiene air pumps whose flows were verified prior to and at the end of each sampling event with a certified digital flow meter. CarboTrap-300 samples were generally collected over the course of 70 minutes, while Thermosorb/N cartridges were generally collected over the course of 180 minutes.

Half of all samples collected were immediately found to be incomparable to PTR-MS data due to their collection period coinciding with instrument startup, zero air, and sensitivity check procedures. There was not a comparable data set collected by PTR-MS that could be taken as the average ambient concentration during the time that these alternative media samples were collected. All afternoon alternative media samples collected during this campaign were found to have this issue.

Table 5-23. Schedule of Confirmatory Samples.

Sample Type	Analysis Method	AM Sample Time (approx.)	PM Sample Time (approx.)	Total Sample Time (approx.) (min)	Min. Sample Volume (L)
CarboTrap-300	EPA TO-17	7:00	13:00	70	10
Thermosorb/N	NIOSH 2522	7:00	13:00	180	300

5.3.1.1 Comparison to CarboTrap-300 TO-17 Results

When comparing the list of calibrated compounds in the EPA TO-17 modified method to the Hanford COPC list, it is important to point out that benzene is the only compound that overlaps the two lists. Any other detected VOC compounds would be reported as TICs. Reporting TICs is standard analytical practice in GC/MS full scan methods. However, it should be noted that any compounds identified are very dependent on both the analyst experience, column conditions, potential interferences, or amenability of expected compounds to the GC analysis conditions. Some value can be drawn from TIC detects, but one should be cautious to draw any conclusions about non-detected chemical compounds when relying on TIC-only data. In addition, any TIC detects should be considered qualitative only and looked upon with suspicion unless one is sure of the quality of the statistical match of the detected TIC with the available NIST mass spectral database.

As stated in the previous section, only half of the samples were collected during a time at which there is any temporally comparable PTR-MS data. Of the comparable samples, the majority of the analyses detected no VOCs beyond a few low-confidence, non-COPC TICs, which were only partially matched to compounds found in the NIST library of chemicals. These results are only

qualitative at best and were not used for the purposes of comparing to PTR-MS data. Of the positively identified compounds in Air Toxics' list, only benzene aligned with the list of COPCs detected by PTR-MS. These results and their comparison to the PTR-MS results are shown in Tables 5-24 and 5-25 below.

Table 5-24. Summary of CarboTrap-300 Samples (2 Sheets).

Date	Site	ID#	Start	Stop	Sample Time (min)
18-Mar	1	A021990	10:05	11:15	70
18-Mar	2	A046065	13:12	14:24	71
19-Mar	2	A045488	7:05	8:22	75
19-Mar	3	A020954	12:18	13:28	70
20-Mar	3	A046036	7:02	8:15	73
20-Mar	4	A048101	12:56	14:27	74
21-Mar	4	A048084	6:50	8:03	72
21-Mar	5	A020883	12:59	14:13	73
22-Mar	5	A021986	6:43	7:57	74
22-Mar	6	A021312	12:47	13:58	70
23-Mar	6	A021996	6:35	7:47	71
23-Mar	1	A021304	13:30	14:41	70
24-Mar	1	A025998	7:08	8:25	76
24-Mar	2	A022003	12:17	13:32	75
25-Mar	2	A021985	6:58	8:08	70
25-Mar	3	A046070	12:08	13:18	70
26-Mar	3	A046075	6:43	7:53	70
26-Mar	4	A048103	12:33	13:46	72
27-Mar	4	A046031	7:05	8:18	73
27-Mar	5	A048082	12:23	13:35	71
28-Mar	5	A045496	6:55	8:06	71
28-Mar	6	A021301	12:40	13:51	71
29-Mar	6	A048105	6:25	7:37	71
7-Apr	1	A046038	12:59	14:12	72
8-Apr	1	A048159	7:05	8:16	70
8-Apr	2	A007213	12:28	13:38	70
9-Apr	2	A020988	7:07	8:17	70
9-Apr	3	A048104	12:38	13:50	71
10-Apr	3	A001331	6:50	8:05	75
11-Apr	5	A046028	12:50	14:01	71
12-Apr	5	A0221875	6:58	8:12	72
12-Apr	6	A022023	13:04	14:15	70
13-Apr	6	A020890	6:33	7:46	71
13-Apr	1	Y51109	13:01	14:11	71

Table 5-24. Summary of CarboTrap-300 Samples (2 Sheets).

Date	Site	ID#	Start	Stop	Sample Time (min)
14-Apr	1	A020973	6:55	8:06	71
14-Apr	2	A022018	12:03	13:13	70
15-Apr	2	A007574	7:05	8:15	70
15-Apr	3	A020872	12:02	13:12	70
16-Apr	3	A045499	6:41	7:51	70
16-Apr	4	A020844	13:28	14:40	72
17-Apr	4	A007101	6:42	7:55	70
17-Apr	5	A045494	13:24	14:54	90
18-Apr	5	A007514	6:49	8:10	80
18-Apr	6	A048154	12:42	13:55	73
19-Apr	6	A046030	6:10	7:20	70
19-Apr	4	A022007	13:50	15:00	70
20-Apr	4	A048371	6:48	7:58	70
20-Apr	1	A048112	12:32	13:43	71
21-Apr	1	A021978	6:56	8:37	99

Table 5-25. Comparison of TO-17 Results to PTR-MS.

Sample Date	ID#	Compound	TO-17 Results (ppbv)	PTR-MS Avg. (ppbv)	Difference (%)
22-Mar	A021986	Benzene	0.244	0.149	39.0
23-Mar	A021996	Benzene	0.501	0.525	4.9
13-Apr	A020890	Benzene	0.219	0.221	1.0
21-Apr	A021978	Benzene	0.150	0.058	61.6

For the samples collected on March 23, 2018, and April 13, 2018, the results from the TO-17 analysis and PTR-MS averaging differ by less than 5%. For the samples collected on March 22, 2018, and April 21, 2018, the two results differ to a higher degree. Air Toxics' reporting limits for these two results were 0.185 ppbv and 0.128 ppbv, respectively. The reported results are only marginally above the detection limits as calculated by the laboratory, and the PTR-MS results from the same time period show values below the laboratory's detection limits. The data for benzene demonstrate good agreement between PTR-MS and TO-17 results, even considering a rather conservative estimate of 30% accuracy for TO-17 and 30% accuracy for PTR-MS. The accuracy of an analytical measurement that is close to, or below the instrument detection limits is much higher than for measurements that are well above the detection limits.

5.3.1.2 Comparison to Thermosorb/N Results

The Thermosorb/N cartridges were analyzed by RJLG at their CBAL laboratory using the NIOSH 2522 method. None of the samples collected by the ML returned any positive results for nitrosamines. The reporting limits for these analyses were examined against the average

PTR-MS data collected during the sampling period. Sampling times and locations for all Thermosorb/N cartridges are summarized below.

Table 5-26. Summary of Thermosorb/N Samples. (2 Sheets)

Date	Site	ID#	Start	Stop	Sample Time (min)
18-Mar	1	EL22209	7:08	10:10	182
18-Mar	2	EL22207	13:07	16:07	180
19-Mar	2	EL22213	6:57	9:59	180
19-Mar	3	EL22210	12:14	15:17	180
20-Mar	3	EL22212	6:55	9:56	180
20-Mar	4	EL22201	12:51	15:54	182
21-Mar	4	EL22215	6:46	9:56	188
21-Mar	5	EL22206	12:54	16:03	188
22-Mar	5	EL22218	6:43	9:43	183
22-Mar	6	EL22205	12:42	15:44	183
23-Mar	6	EL22219	6:29	9:36	186
23-Mar	1	EL22217	13:27	16:27	180
24-Mar	1	EL22216	7:02	10:03	180
24-Mar	2	EL22204	12:15	15:18	182
25-Mar	2	EL22202	6:52	9:52	180
25-Mar	3	EL22200	12:05	15:05	180
26-Mar	3	EL22214	6:40	9:39	180
26-Mar	4	EL22211	12:30	15:30	180
27-Mar	4	EL22193	7:02	10:04	182
27-Mar	5	EL22192	12:21	15:27	186
28-Mar	5	EL22199	6:51	9:52	180
28-Mar	6	EL22198	12:37	15:38	181
29-Mar	6	EL22182	6:22	9:23	180
7-Apr	1	EL22184	12:46	15:46	180
8-Apr	1	EL22189	6:55	10:10	194
8-Apr	2	EL22188	12:20	15:20	180
9-Apr	2	EL22197	6:58	10:00	181
9-Apr	3	EL22196	12:28	15:30	181
10-Apr	3	EL22195	6:42	9:44	181
11-Apr	5	EL22190	12:43	15:43	180
12-Apr	5	EL22191	6:50	9:53	181
12-Apr	6	EL22194	12:57	15:47	177
13-Apr	6	EL22180	6:30	9:30	180
13-Apr	1	EL22183	12:52	15:50	177
14-Apr	1	EL22181	6:49	9:49	180
14-Apr	2	EL22185	11:55	14:55	180

Table 5-26. Summary of Thermosorb/N Samples. (2 Sheets)

Date	Site	ID#	Start	Stop	Sample Time (min)
15-Apr	2	EL22238	7:01	10:01	180
15-Apr	3	EL22226	11:59	15:01	181
16-Apr	3	EL22230	6:38	9:38	180
16-Apr	4	EL22225	13:26	16:16	170
17-Apr	4	EL22233	6:40	9:41	182
17-Apr	5	EL22227	11:43	14:58	194
18-Apr	5	EL22224	6:46	9:47	180
18-Apr	6	EL22237	12:40	15:39	180
19-Apr	6	EL22223	6:07	9:07	180
19-Apr	4	EL22220	13:46	16:47	180
20-Apr	4	EL22228	6:45	9:46	180
20-Apr	1	EL22229	11:38	14:40	180
21-Apr	1	EL22222	6:50	9:54	182

The results of a comparison between the ppbv equivalent of the RJLG NIOSH 2522 method reporting limits and the PTR-MS ion signal measured during the same time period for NDMA and N-nitrosomethylethylamine (NMEA) are summarized below.

Table 5-27. Comparison of NIOSH 2522 Results to PTR-MS.

			NIOSH 2522 (ppbv)		PTR-MS (ppbv)	
Site	Date	ID	NDMA RL	NMEA RL	NDMA	NMEA
4	21-Mar	EL22215	0.015	0.013	<MDL	0.012
5	22-Mar	EL22218	0.015	0.012	<MDL	0.010
6	23-Mar	EL22219	0.015	0.013	0.035	0.019
3	10-Apr	EL22195	0.010	0.008	0.027	0.011
1	14-Apr	EL22181	0.010	0.008	<MDL	0.010
5	18-Apr	EL22224	0.010	0.009	<MDL	0.010
6	19-Apr	EL22223	0.010	0.008	0.026	0.011
4	20-Apr	EL22228	0.010	0.008	0.036	0.012

Only NDMA and NMEA were measured above PTR-MS MDLs during the times that Thermosorb/N samples were being collected. The rows above highlighted in green show results where PTR-MS detected NMEA below the detection limit reported by RJLG. The rows highlighted in orange show results where PTR-MS detected NDMA or NMEA at a level above the given reporting limits. Each of the nitrosamines are classified as having moderate confidence when quantified by a PTR-TOF 4000 instrument due to the close proximity of potentially interfering compounds. It is likely that some of the elevated PTR-MS results are due to an interfering compound that is only occasionally observed. Limited conclusions can be drawn from the discrepancies given that the results are so close to the lower limit of detection for both

methods. The PTR-MS results in Table 5-27 are all between the MDL and the RL for the method, thus having significantly reduced quantitative confidence (from the benchmark of ± 30%). Although the potential exists for bias in any analytical measurement, the results presented here are too close to the MDL to make any such conclusion, and the results of the NIOSH 2522 method and the PTR-MS method may be statistically identical within any reasonable estimation of uncertainty. It is important to note that none of these averages approach the OEL levels of the nitrosamines, in most cases being less than 10% of the OEL values.

5.3.2 Site Comparisons

In order to obtain an estimate of the true background concentration of COPCs at each study site, each data set was visually scanned for the longest continuous period of time with few or no signal spikes above the noise. An average was taken for this time period, which varied depending on monitoring location and other environmental factors, for each day of the background study. These averages were then sorted by study site (four data points per site) and averaged again to produce a single average and standard deviation value for each study site, per COPC.

The purpose of using this method was to attempt to disregard all short-duration local sources that could skew the estimate of the background concentration. This ensures that the comparison between site averages is truly a meaningful like-for-like comparison of bulk background concentrations that is not heavily biased towards local emissions, which, in many cases, are likely to be vehicle exhaust.

These averages are shown below in the form of bar plots with error bars showing the relative standard deviation for each of the 16 COPCs of interest for the Background Study. The bar plots for the remaining COPCs detected by PTR-MS are located in Appendix B.

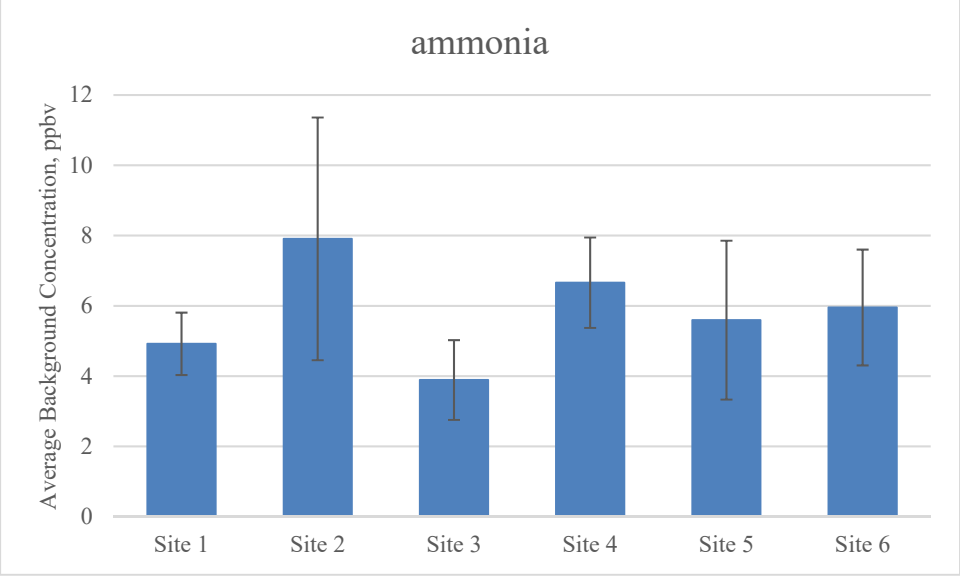


Figure 5-8. Average Background Concentration of Ammonia, by Study Site.

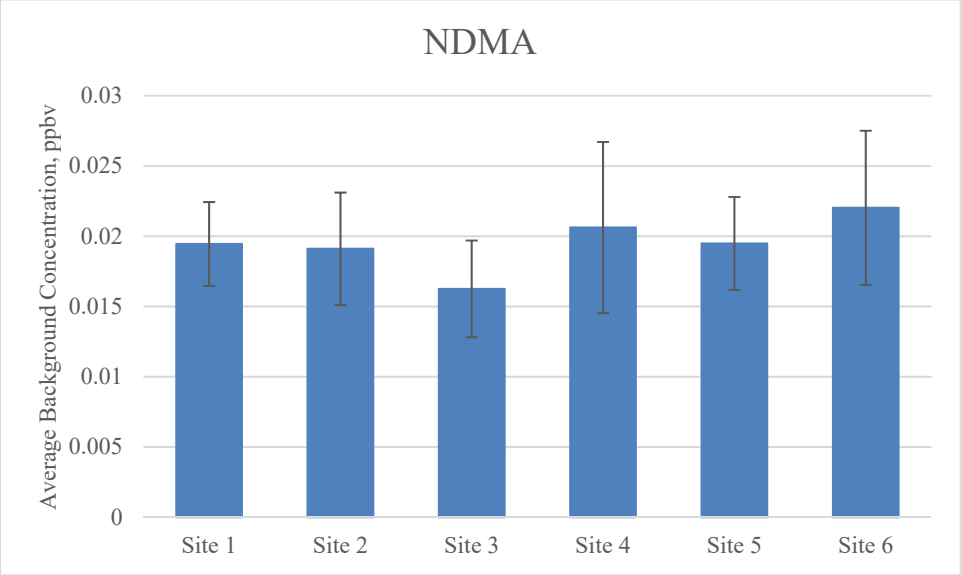


Figure 5-9. Average Background Concentration of NDMA, by Study Site.

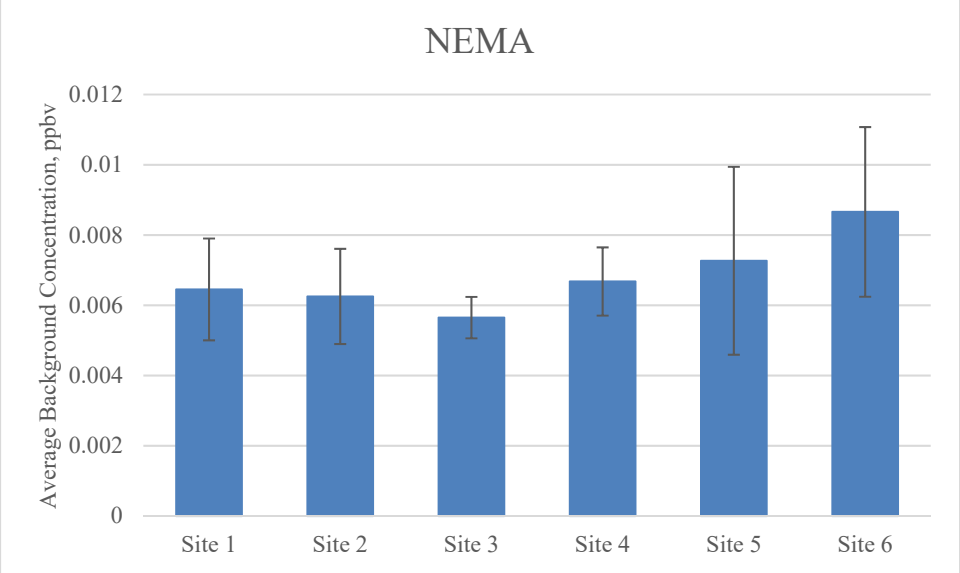


Figure 5-10. Average Background Concentration of NMEA, by Study Site.

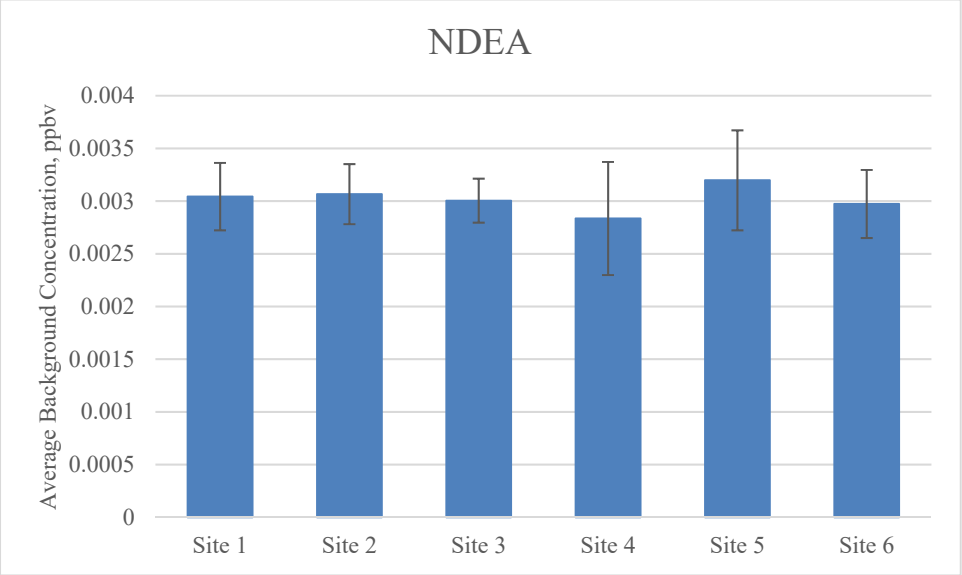


Figure 5-11. Average Background Concentration of NDEA, by Study Site.

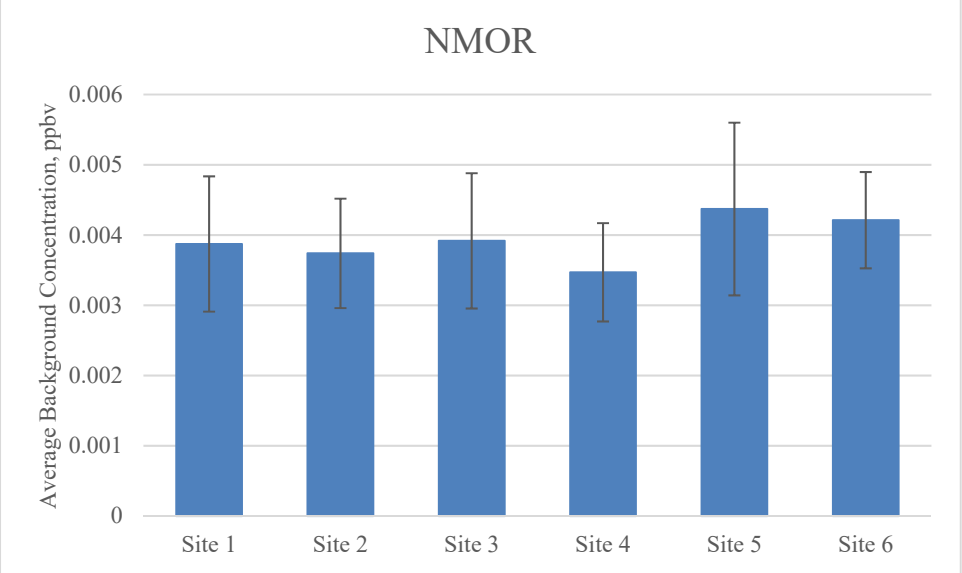


Figure 5-12. Average Background Concentration of NMOR, by Study Site.

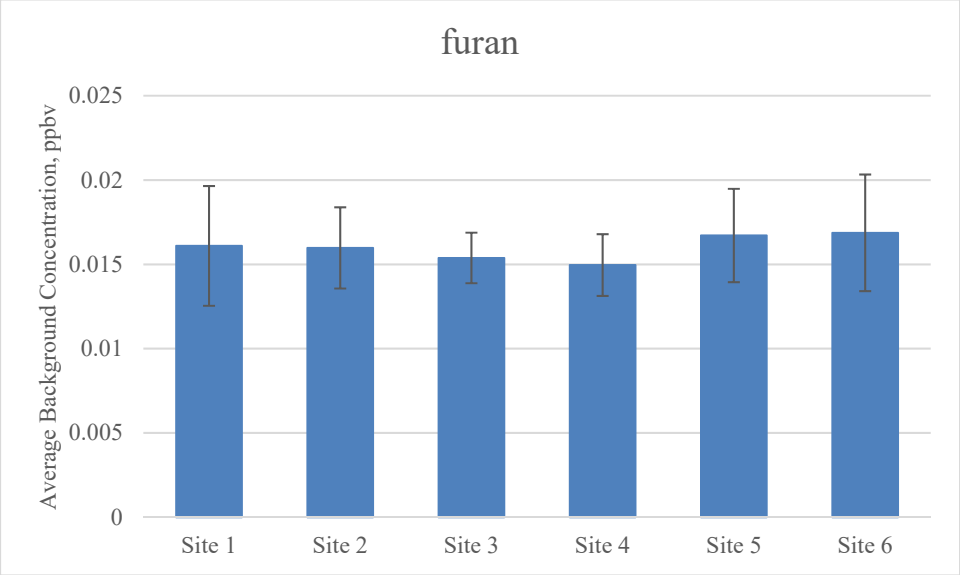


Figure 5-13. Average Background Concentration of Furan, by Study Site.

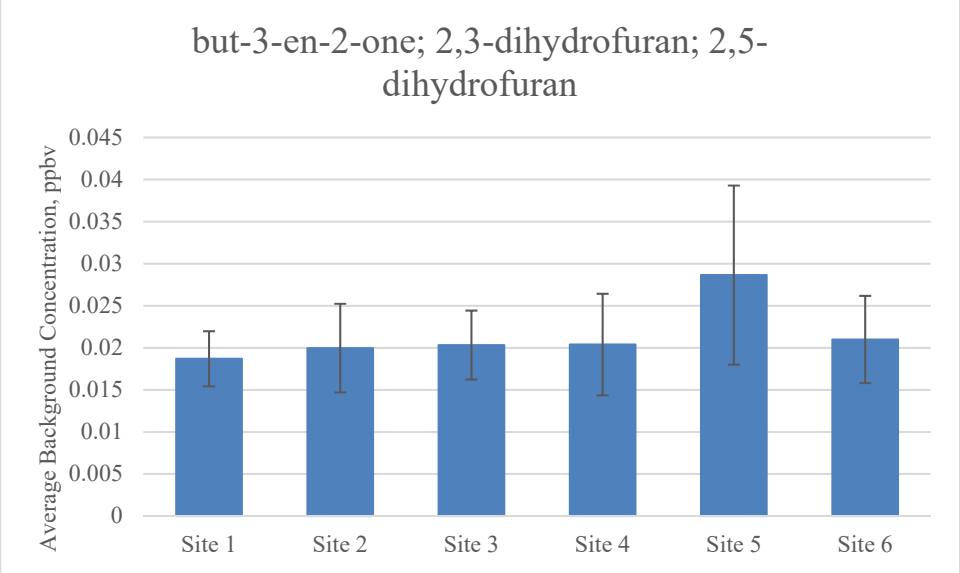


Figure 5-14. Average Background Concentration of but-3-en-2-one, 2,3-dihydrofuran, and 2,5-dihydrofuran, by Study Site.

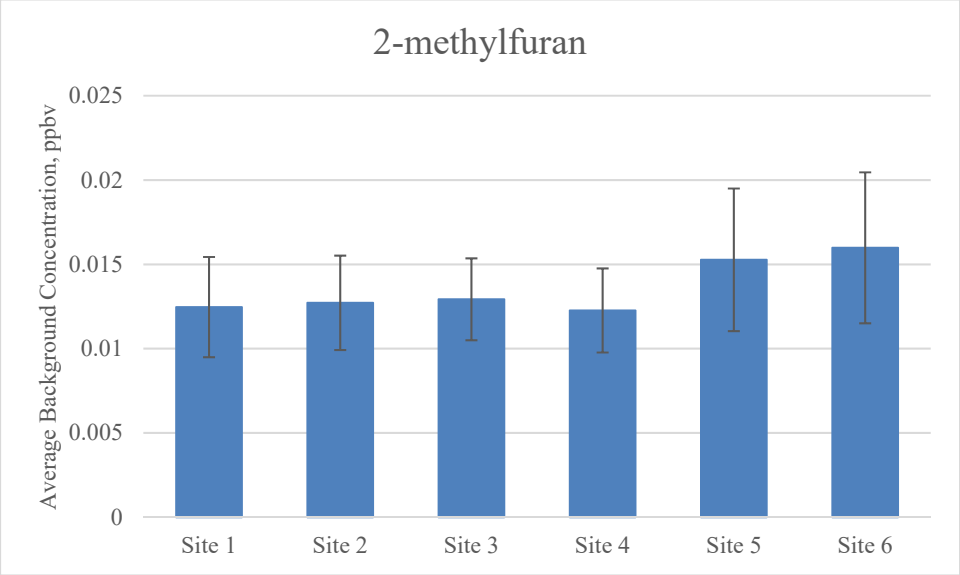


Figure 5-15. Average Background Concentration of 2-methyluran, by Study Site.

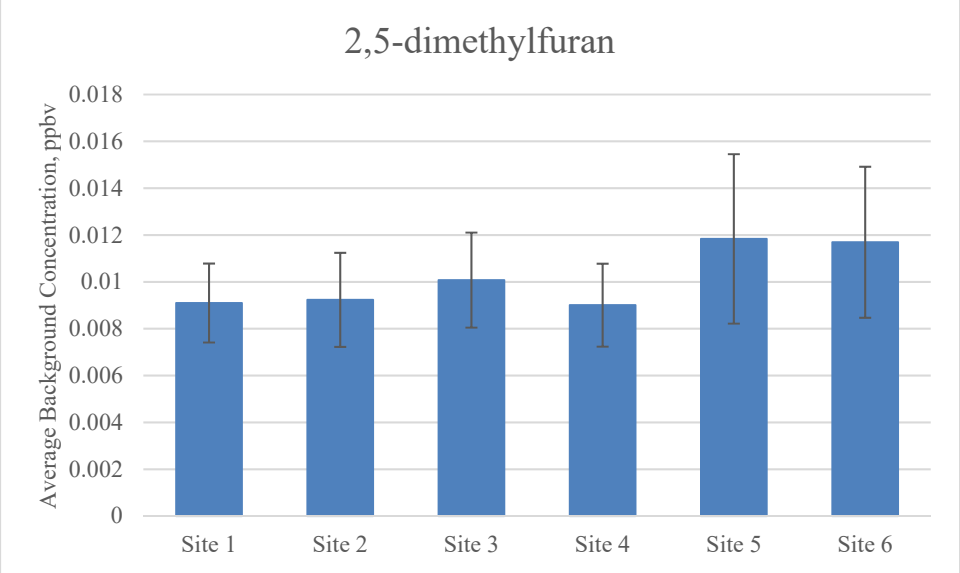


Figure 5-16. Average Background Concentration of 2,5-dimethylfuran, by Study Site.

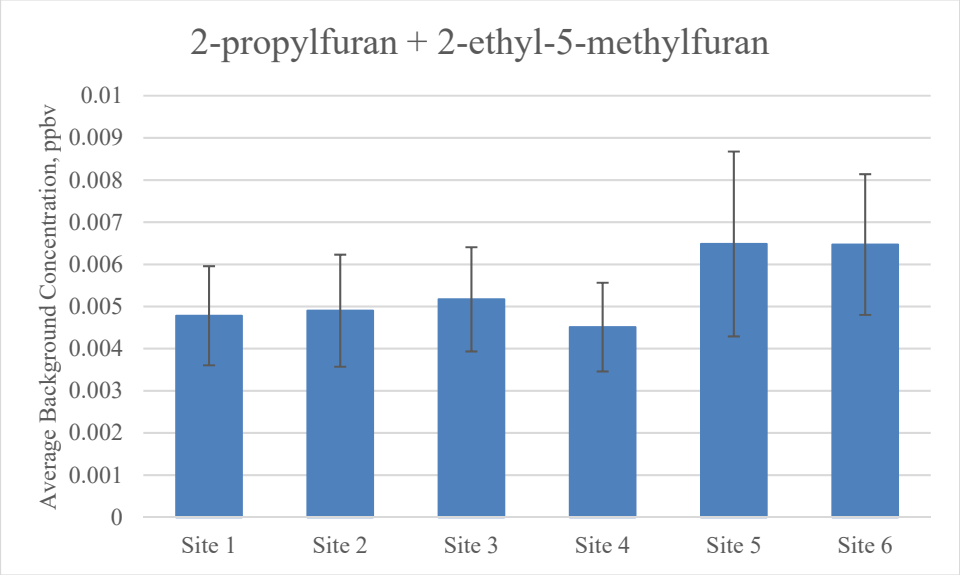


Figure 5-17. Average Background Concentration of 2-propylfuran and 2-ethyl-5-methylfuran, by Study Site.

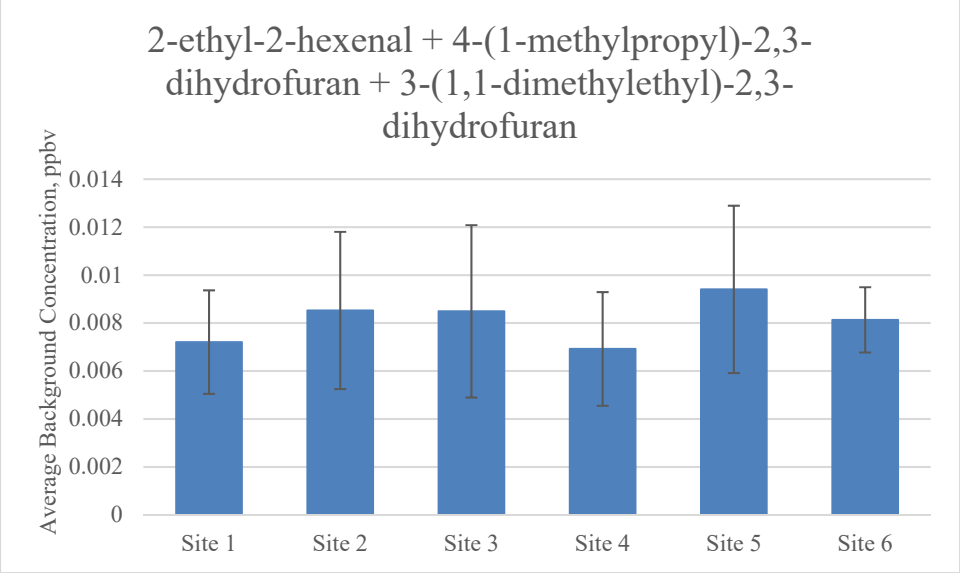


Figure 5-18. Average Background Concentration of 2-ethyl-2-hexenal, 4-(1-methylpropyl)-2,3-dihydrofuran, and 3-(1,1-dimethylethyl)-2,3-dihydrofuran, by Study Site.

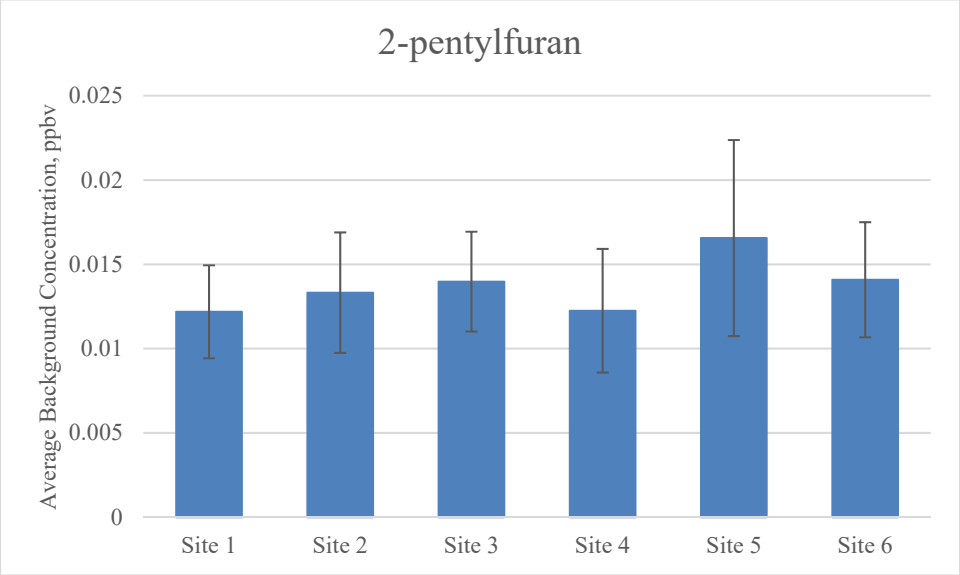


Figure 5-19. Average Background Concentration of 2-pentyluran, by Study Site.

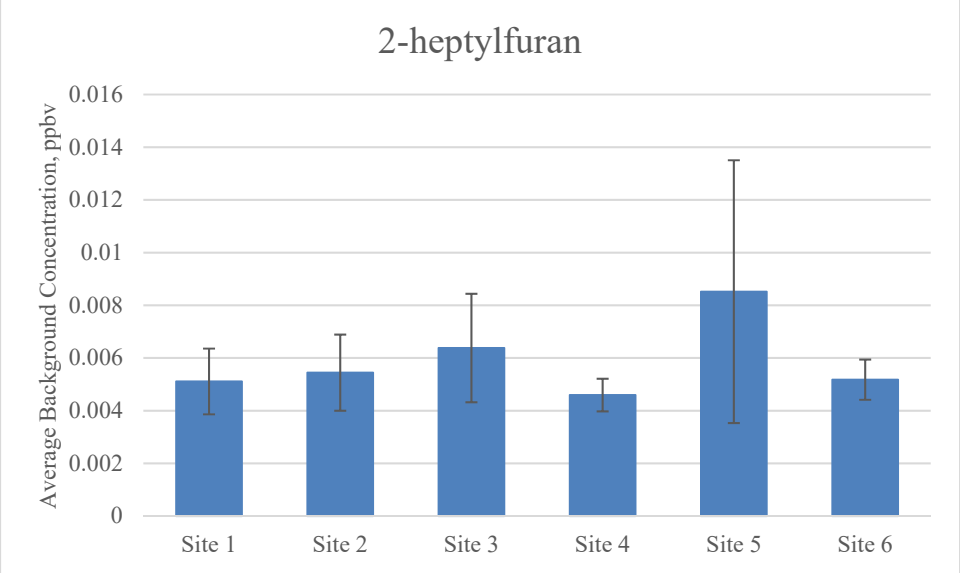


Figure 5-20. Average Background Concentration of 2-heptyluran, by Study Site.

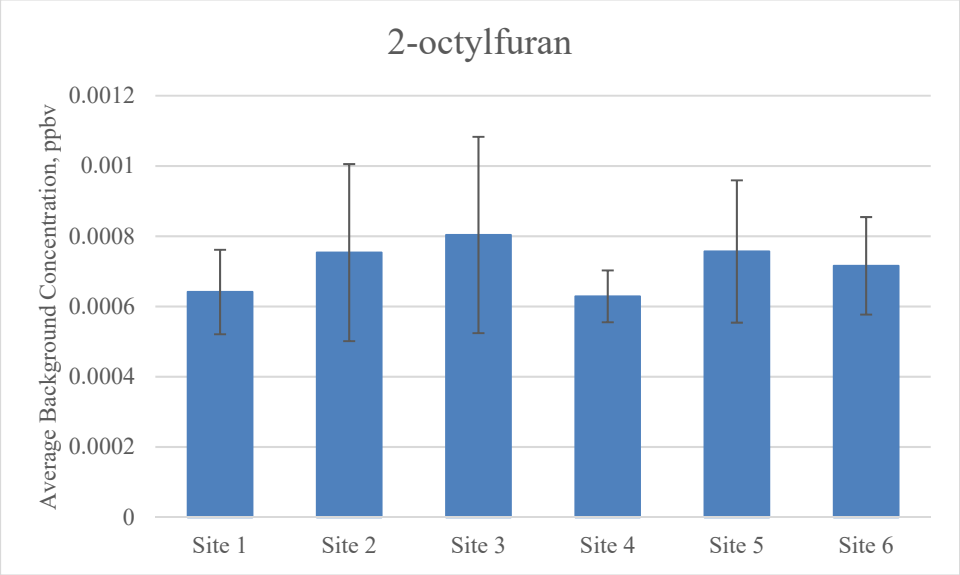


Figure 5-21. Average Background Concentration of 2-octyluran, by Study Site.

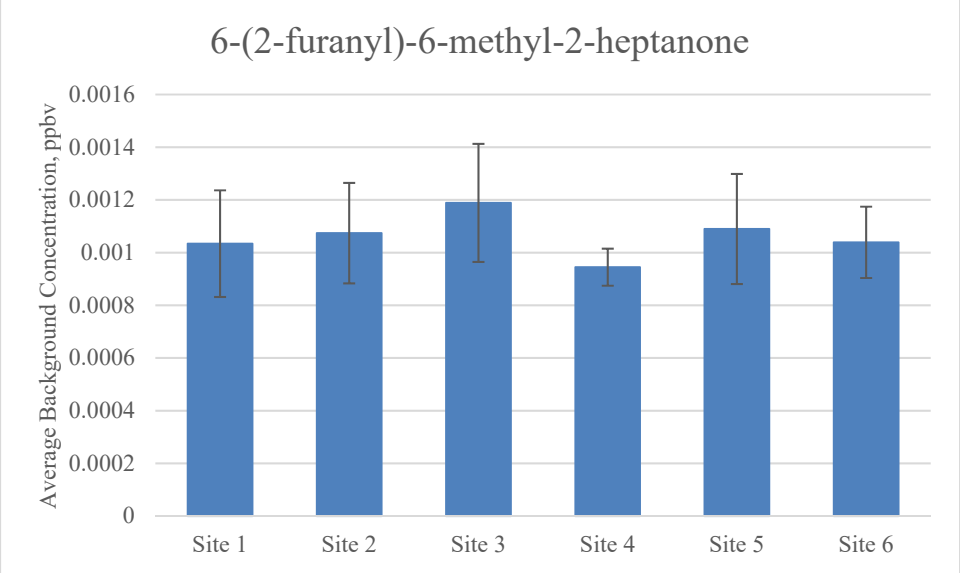


Figure 5-22. Average Background Concentration of 6-(2-furanyl)-6-methyl-2-heptanone, by Study Site.

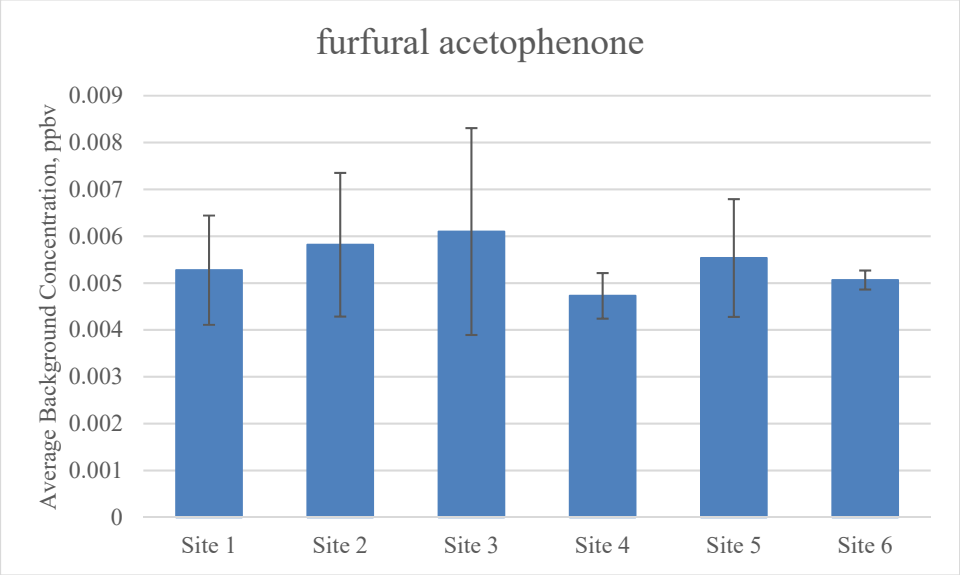


Figure 5-23. Average Background Concentration of Furfural acetophenone, by Study Site.

5.3.3 Comparison to FY17 Study

The average background concentrations calculated in Section 5.3.2 were compared to legacy FY17 data where those comparisons were valid. Specifically, Study Sites 1, 2, 3, and 6 coincide with study sites 1B, 2A, 3A, and 5B from the FY17 Background Study. For these study sites in FY17, the same averaging was performed for the longest continuous stretch of data with little or no signal spikes. These averages were then sorted by study site (four data points per site) and averaged again to produce a single average and standard deviation value for each study site, per COPC in the FY17 Background Study campaign.

The FY17 and FY18 averages are compared below in the form of bar plots with error bars showing the relative standard deviation for each of the 16 COPCs of interest for the Background Study. There are significant differences in the regional tropospheric background concentrations, but this is to be expected not only due to sampling at different times of the year but the FY17 study occurred during a significant forest fire smoke season across the Pacific Northwest. N-nitrosodiethylamine (NDEA) showed elevated concentrations in the current background study, although these concentrations are extremely low. All comparisons will be more useful after completing additional background studies at different times of the year. The bar plots for the remaining COPCs detected by PTR-MS are located in Appendix C.

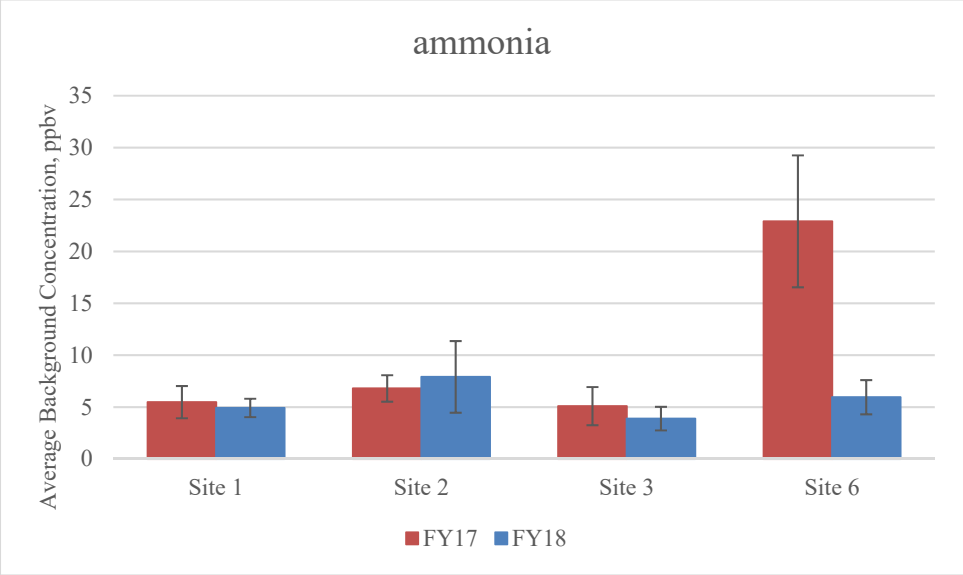


Figure 5-24. Comparison Between FY17 and FY18, Ammonia.

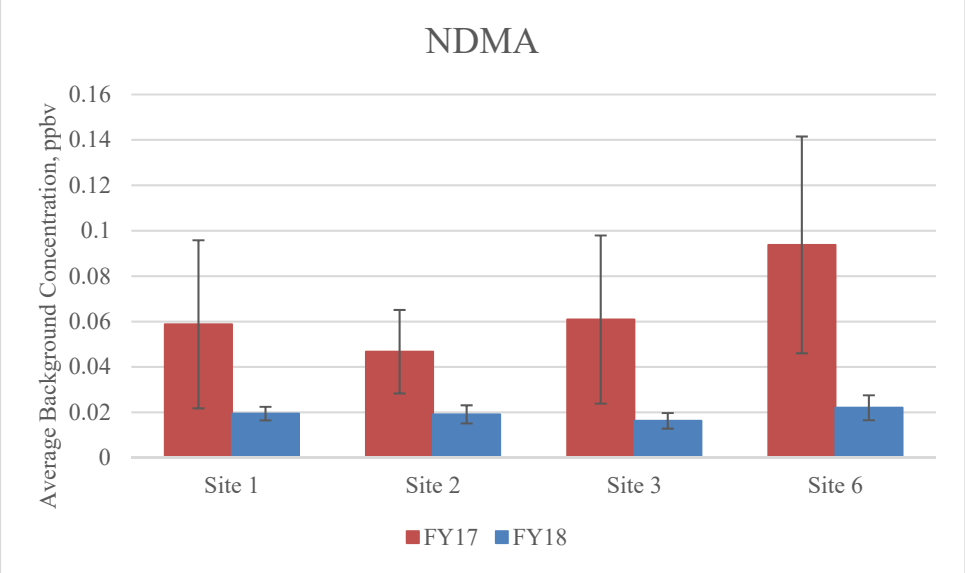


Figure 5-25. Comparison Between FY17 and FY18, NDMA.

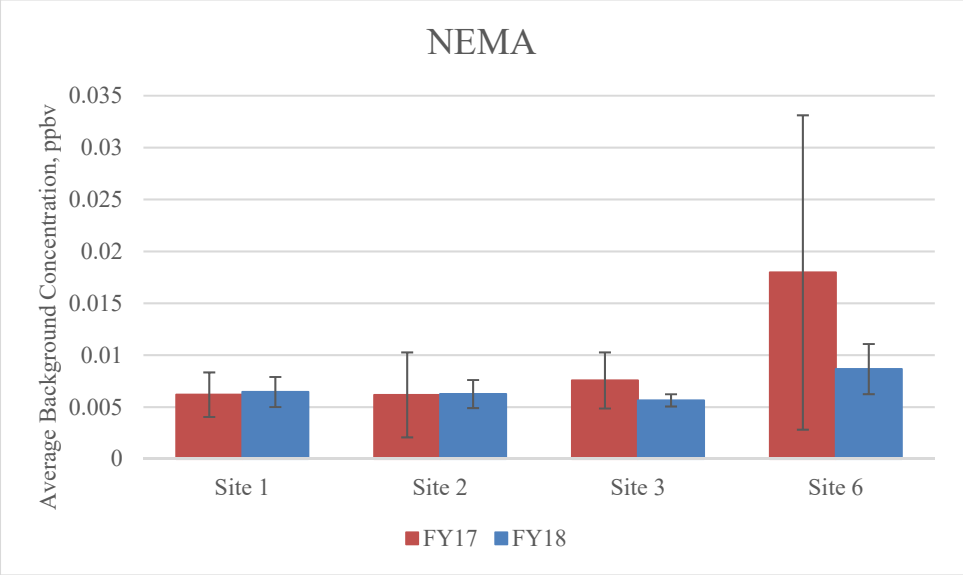


Figure 5-26. Comparison Between FY17 and FY18, NMEA.

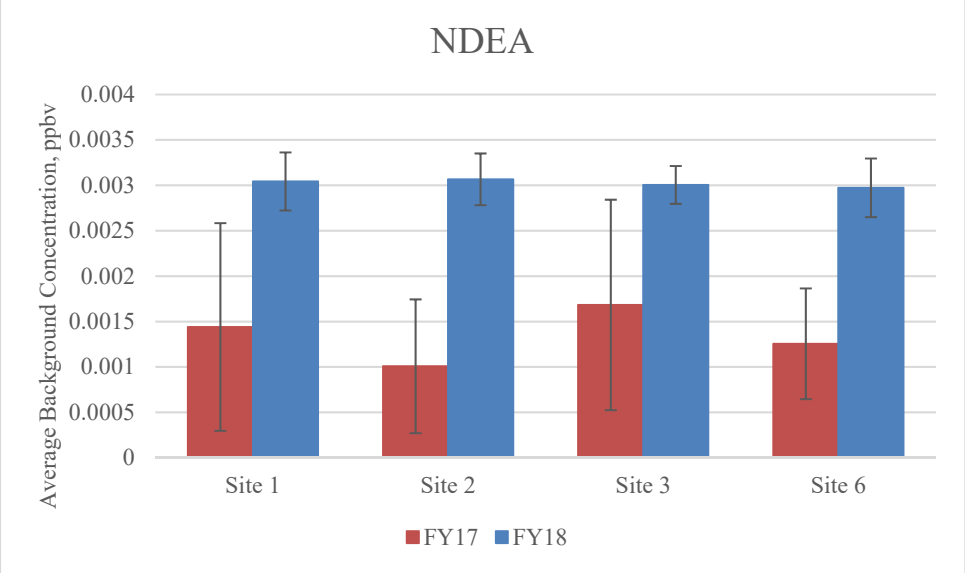


Figure 5-27. Comparison Between FY17 and FY18, NDEA.

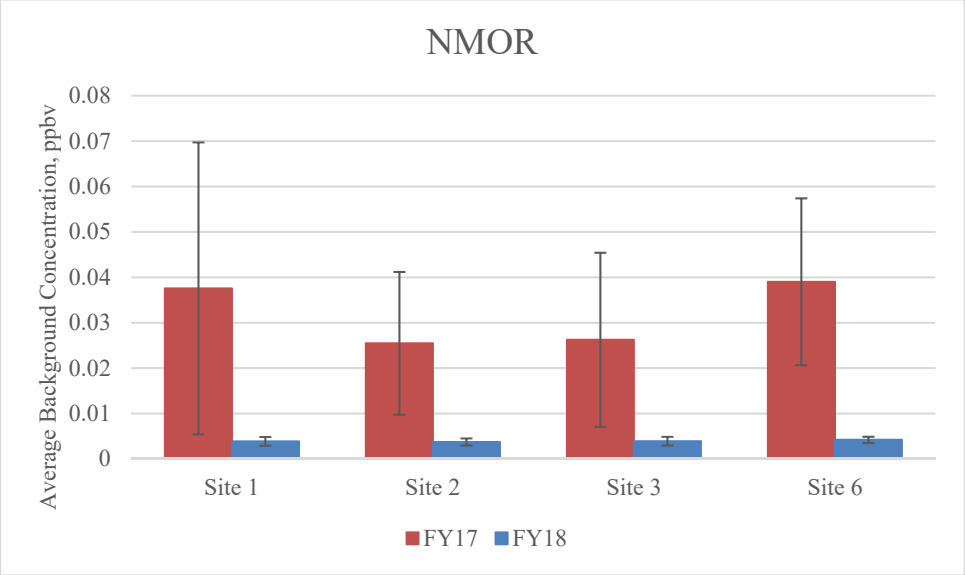


Figure 5-28. Comparison Between FY17 and FY18, NMOR.

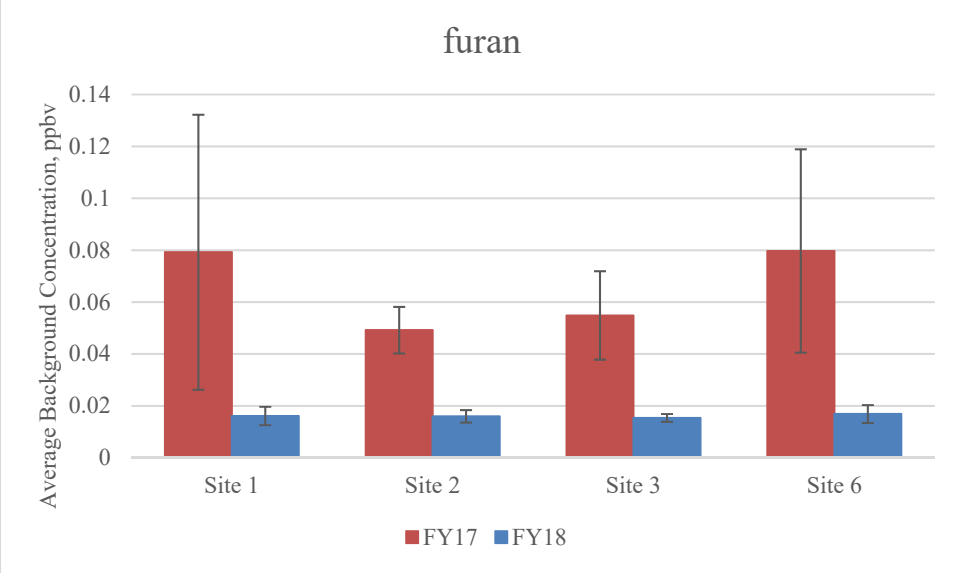


Figure 5-29. Comparison Between FY17 and FY18, Furan.

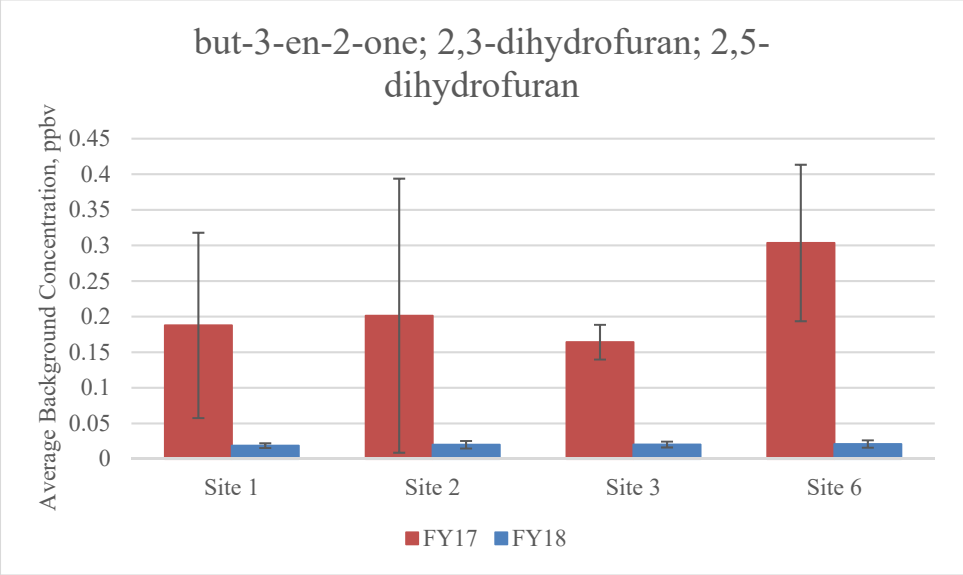


Figure 5-30. Comparison Between FY17 and FY18, but-3-en-2-one, 2,3-dihydrofuran, and 2,5-dihydrofuran.

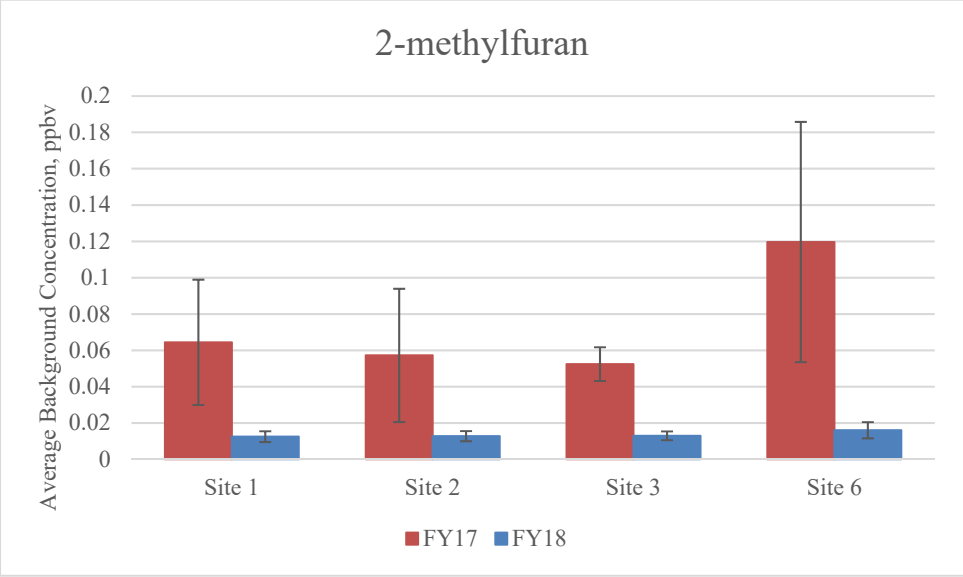


Figure 5-31. Comparison Between FY17 and FY18, 2-methylfuran.

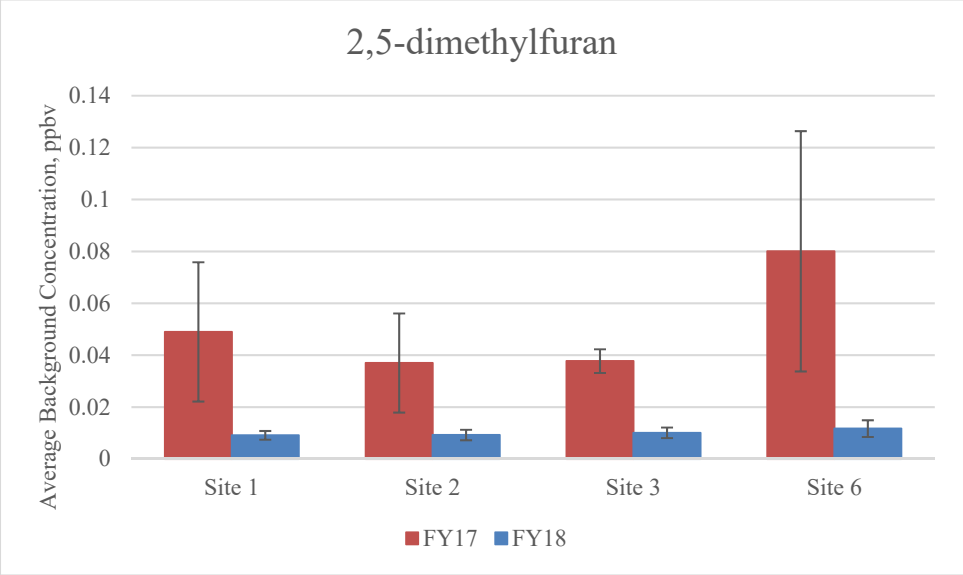


Figure 5-32. Comparison Between FY17 and FY18, 2,5-dimethylfuran.

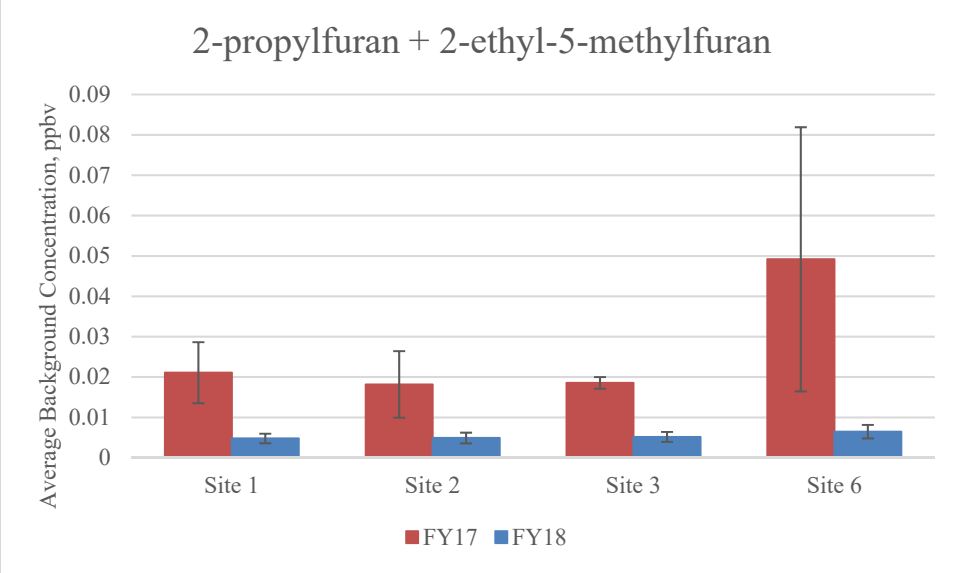


Figure 5-33. Comparison Between FY17 and FY18, 2-propylfuran and 2-ethyl-5-methylfuran.

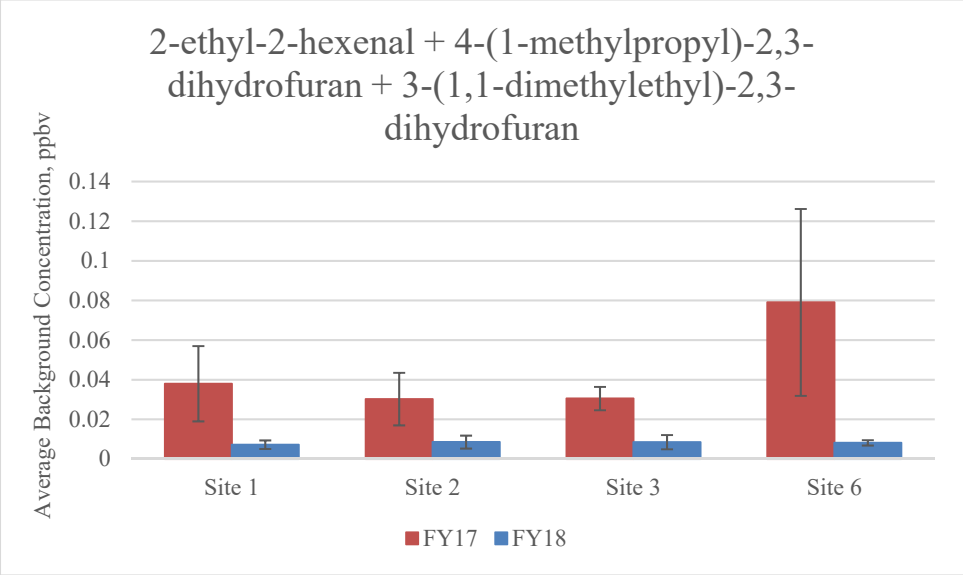


Figure 5-34. Comparison Between FY17 and FY18, 2-ethyl-2-hexenal, 4-(1-methylpropyl)-2,3-dihydrofuran, and 3-(1,1-dimethylethyl)-2,3-dihydrofuran.

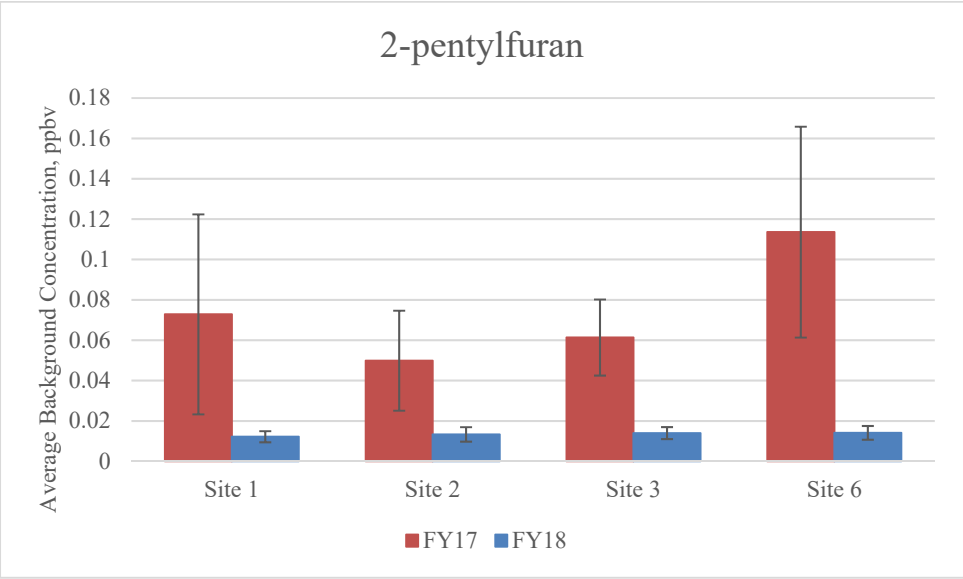


Figure 5-35. Comparison Between FY17 and FY18, 2-pentylfuran.

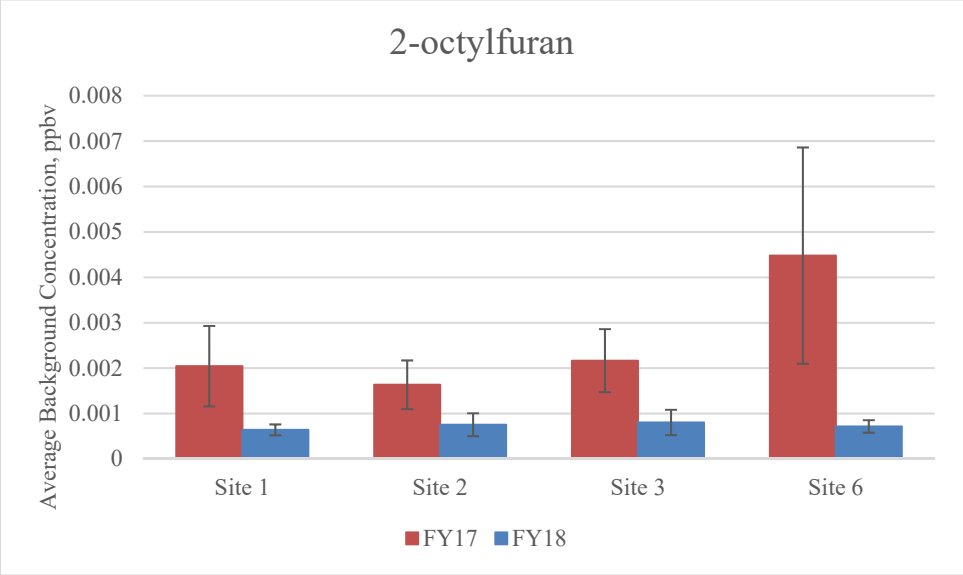


Figure 5-36. Comparison Between FY17 and FY18, 2-octylfuran.

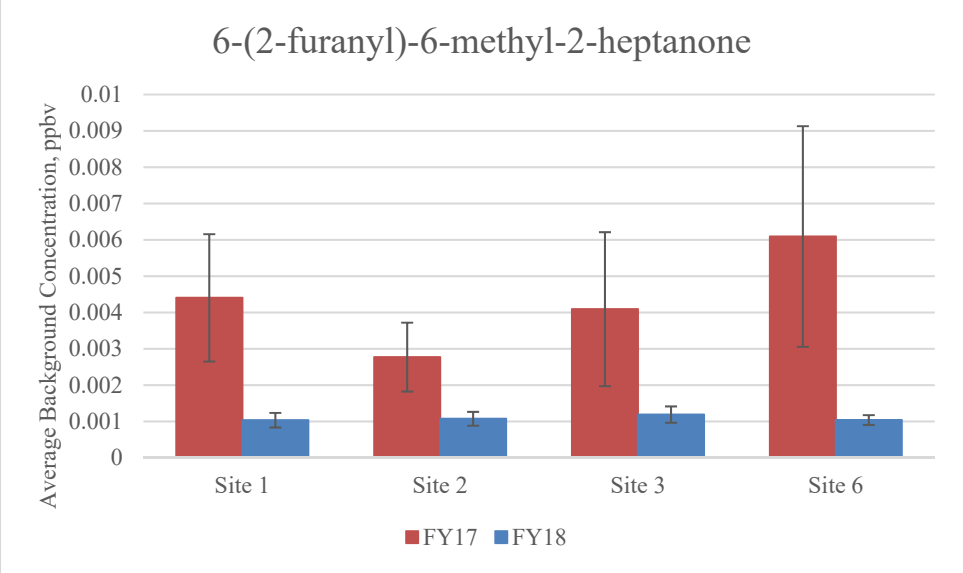


Figure 5-37. Comparison Between FY17 and FY18, 6-(2-furanyl)-6-methyl-2-heptanone.

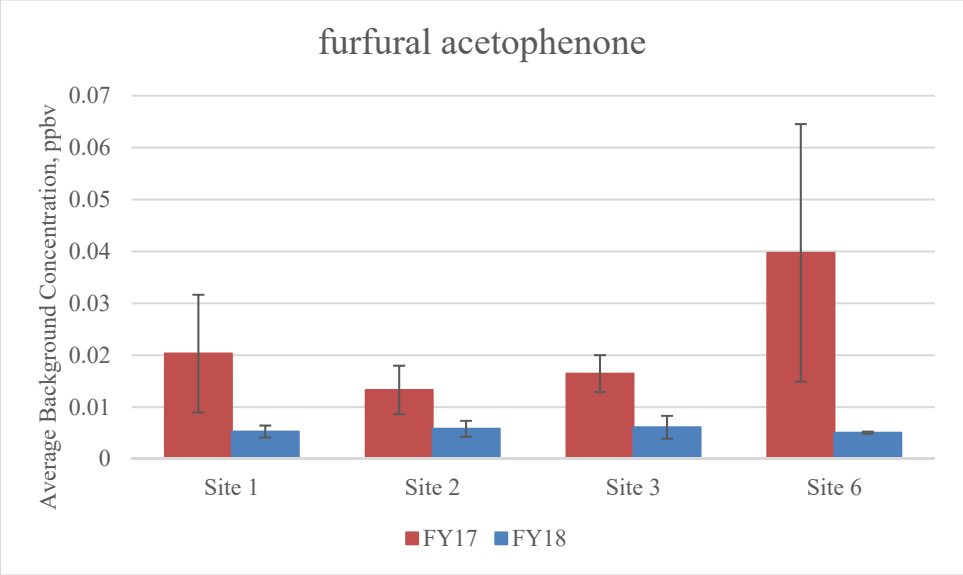


Figure 5-38. Comparison Between FY17 and FY18, furfural acetophenone.

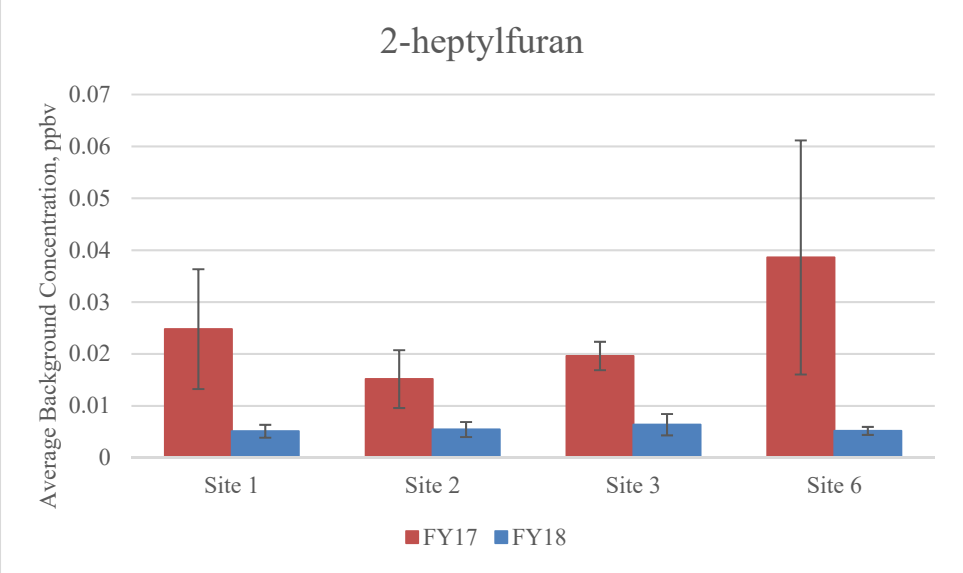


Figure 5-39. Comparison Between FY17 and FY18, 2-heptylfuran.

5.3.4 Background Study Statistical Analysis and Conclusions

To assess differences between sampling locations, an Analysis of Variance (ANOVA) is typically performed. However, for an ANOVA to be valid, the variances in each population must be similar. Figure 5-40 plots the hourly averages and means for furan measured at each of the six sites. As can be clearly seen by this figure, the data variance is quite different at each site. As expected, the Bartlett test indicated a significant difference in these variances; as a result, a regular ANOVA test will be suspect.

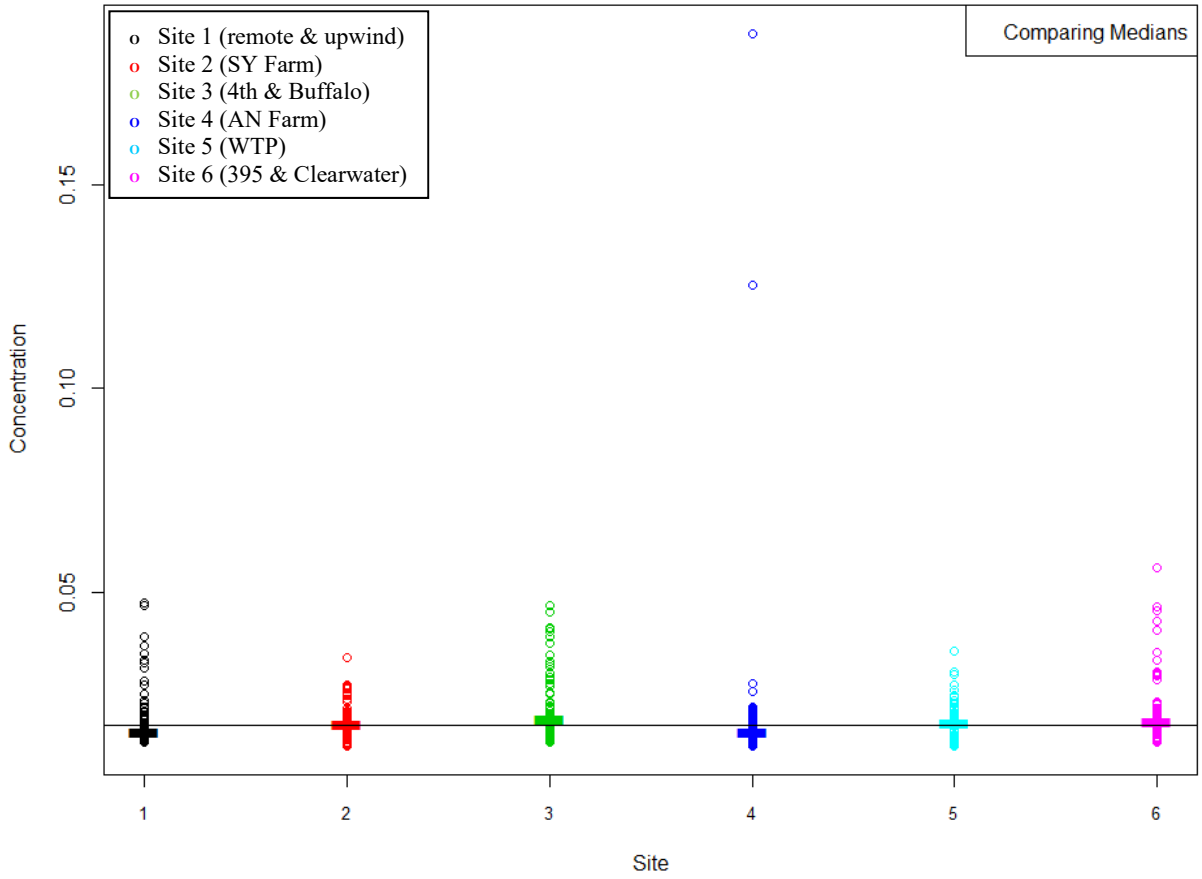


Figure 5-40. Dissimilar Variances in Hourly Average Furan Concentrations (ppb) by Sites.

Since the variances are statistically different, a Kruskal-Wallis test is a more reliable way to determine whether a significant difference exists between background concentrations at the different test sites. A pair-wise Dunn's test was also performed to assess statistical differences between pairs of sites for each chemical compound. The results of the Kruskal-Wallis and Dunn's pair-wise comparison tests are presented in this section for the combined furans.

Combined furans were selected for statistical analysis instead of individual furans to streamline reporting and summarize the combined effects of furan exposure. Only furans that are confidently measured by the PTR-MS were included in the combined furan analysis as follows:

- furan,
- 2-methylfuran,
- 2,5-dimethylfuran,
- 2-propylfuran, and
- 2-ethyl-5-methylfuran.

4-(1-methylpropyl)-2,3-dihydrofuran and 3-(1,1-dimethylethyl)-2,3-dihydrofuran were not included in the combined furan analysis since they are not separable from 2-ethyl-2-hexenal by the PTR-MS. Including this combined PTR-MS result would trigger reporting higher than actual combined furan results. Since 2-ethyl-2-hexanal has an OEL which is 100 times greater than the furans, including this compound in the combined furan results would not allow comparison to the furan OEL. 2-pentylfuran, 3-(2-furanyl)-1-pheynyl-2-propen-1-one, 2-heptylfuran, 2-octylfuran, and 6-(2-furanyl)-6-methyl-2-heptanone were not included in the combined furan analysis since they could not be separated from one or more non-COPC interfering compounds by the PTR-MS. The TOF-4000 used in Spring of FY18 did not have sufficient mass resolution to resolve these peaks, which results in reported concentrations that represent the summation of the two compounds and consistently overestimating the furan concentration.

In addition to the Kruskal-Wallis and Dunn's tests, an additional statistical analysis was performed to assess potential linear correlations between combined furan concentrations and smoke. A statistical analysis was not performed for diurnal effects, but the data are plotted for visualization.

5.3.4.1 Site Comparisons

The p-value is defined as the probability of obtaining a result equal to or "more extreme" than what was actually observed, when the null hypothesis is true. In this case, the null hypothesis is that "there is no difference between the vapor concentrations at each of the sites." If a 95% confidence limit is established, the null hypothesis must be rejected when the p-value is less than 0.05. The Kruskal-Wallis test produced a p-value of 1.428×10^{-9}, which clearly indicates that there are significant differences in concentrations between the different sites as shown below.

non-parametric tests

```
        Kruskal-Wallis rank sum test

data:  Combined Furans by Site
Kruskal-Wallis chi-squared = 49.936, df = 5, p-value =
1.428e-09
```

By visual inspection, Figure 5-41 shows that the sites with the highest furan concentration are associated with the sites with the highest ammonia concentration [Site 5 (WTP) and Site 6 (395 and Clearwater)] and highest CO_2 locations [Site 3 (4^{th} and Buffalo) and Site 6). Site 4 (AN Farm) is interestingly the lowest furan concentration site, yet relatively close to Sites 3 and 5. Site 4 is somewhat unique in that the ML was located at an elevation about 20' below the adjacent tank farm (AN), which may lead to tank and equipment vapors traveling over the sampling location. Site 4 also recorded the two highest hourly average combined furan concentrations, which were measured on the same day. At this point, these are unexplained outlier data points compared to the remainder of the Site 4 data.

The most notable observation from the data is that all sites had extremely low furan concentrations. All hourly averaged furan concentrations at all sites were less than 20% of the OEL, and the median hourly average furan concentration for each site was less than 7% of the OEL (see Figure 5-40). Similarly, all hourly averaged combined furan concentrations at all sites were less than 40% of the OEL (see Figure 5-41).

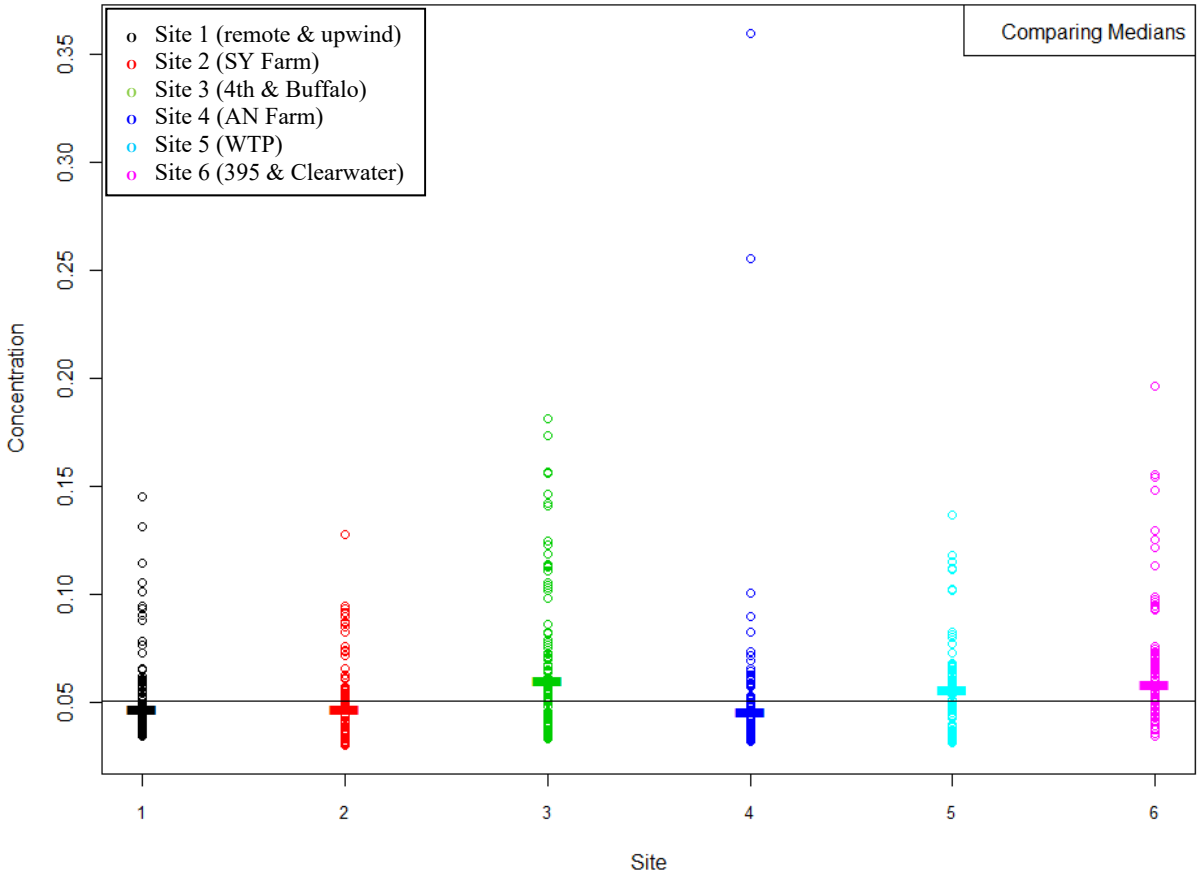


Figure 5-41. Medians of Hourly Averages of Combined Furan Concentrations (ppb) by Site.

The pairwise Dunn's Test results for the combined furan signals measured during the background study are shown below in Table 5-28. This test was run for each pair of study sites to test the null hypothesis that there is no significant difference between them. For each intersection of study site columns and rows, a calculated p-value is shown. P-values highlighted in yellow denote pairs of study sites where the null hypothesis was rejected; i.e. with 95% confidence there is a significant difference between the sites (p-values <0.05). The significance of site comparisons become more apparent when assessing the Dunn's pairwise comparison results, as follows:

- The two most commercially active locations [Site 3 (4th and Buffalo) and Site 6 (395 and Clearwater)] are statistically different than the less active sites [Site 1 (remote and upwind) and Site 2 (SY Farm)];
- The less active sites (1 and 2) and the depressed elevation site (Site 4 – AN Farm) are not statistically different;
- The three most commercially active sites (3, 5 - WTP and 6) are not statistically different from each other; and
- The sampling location upwind of tank farms (Site 1) is not statistically different than the downwind location (Site 5).

It should be noted that these values may be statistically interesting in postulating the source of the ultra-trace furans, but they are not significant from an Industrial Health or Operations perspective.

Table 5-28. Comparison of Combined Furans by Site (Holm-Šidák).

	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6
Site 1 (Remote & Upwind)						
Site 2 (SY Farm)	0.4828					
Site 3 (4th & Buffalo)	0.0003	0.0003				
Site 4 (AN Farm)	0.4551	0.3842	0.0000			
Site 5 (WTP)	0.1646	0.1741	0.1041	0.0180		
Site 6 (395 & Clearwater)	0.0001	0.0001	0.6297	0.0000	0.0632	
P-values highlighted in yellow denote pairs of study sites where the null hypothesis was rejected, i.e., with 95% confidence there is a significant difference between the sites (p-values <0.05).						

5.3.4.2 Ammonia as an Indicator of Tank Vapors

Trace quantities of ammonia are a potential indicator of tank vapors in the surrounding atmosphere. Ammonia is a major constituent of the headspace vapors in all Hanford waste storage tanks. A positive correlation of a VOC profile to an ammonia profile may provide a link to a waste tank emission. Additionally, elevated ammonia levels around the tank farms may be an indication of tank vapor emissions. Figure 5-42 provides a summary of hourly average ammonia concentrations by site, with the median value for each site shown as a black solid line. First it should be noted that the ammonia concentrations for all sites are extremely low and are three orders of magnitude below its OEL and well below what might be considered a leading indicator action level. Ammonia concentrations for three of the six sites were consistent with global atmospheric averages (0.3 – 6 ppbv, https://www.atsdr.cdc.gov/toxprofiles/tp126-c2.pdf). Three sites [(Site 4 (AN Farm), Site 5 (WTP), and Site 6 (395 and Clearwater)] have higher ammonia concentrations than the global atmospheric average. Again, it should be noted that these values may be statistically interesting in postulating the source of the ammonia, but they are not significant from an Industrial Health or Operations perspective.

Table 5-29 indicates that Sites 4, 5 and 6 are statistically similar to each other and statistically different than the rest [Site 1 (remote and upwind, Site 2 (SY Farm), and Site 3 (4th and Buffalo)]. Site 6 is off-site and logically not due to tank waste vapors. Sites 4 and 5 are downwind of the A-Tank Farm complex. If the ammonia from Site 5 was from the tank waste, it should be accompanied by elevated furan levels. As can be seen in Table 5-28, the furan level at Site 5 is not statistically different from the upwind remote site (Site 1). This indicates that the elevated ammonia at Site 5 is due to something other than tank waste. The low ammonia concentrations for all tank farm sites (2, 3, and 4) support the conclusion that the observed furan concentrations around the tank farms are not due to the tank waste but rather to vehicle traffic, diesel generators and fugitive emissions. Further, the furan and ammonia levels at the tank farm and remote downwind monitoring locations indicate that current vapor control strategies are working (i.e., vapor control zones, stacks and stack extensions).

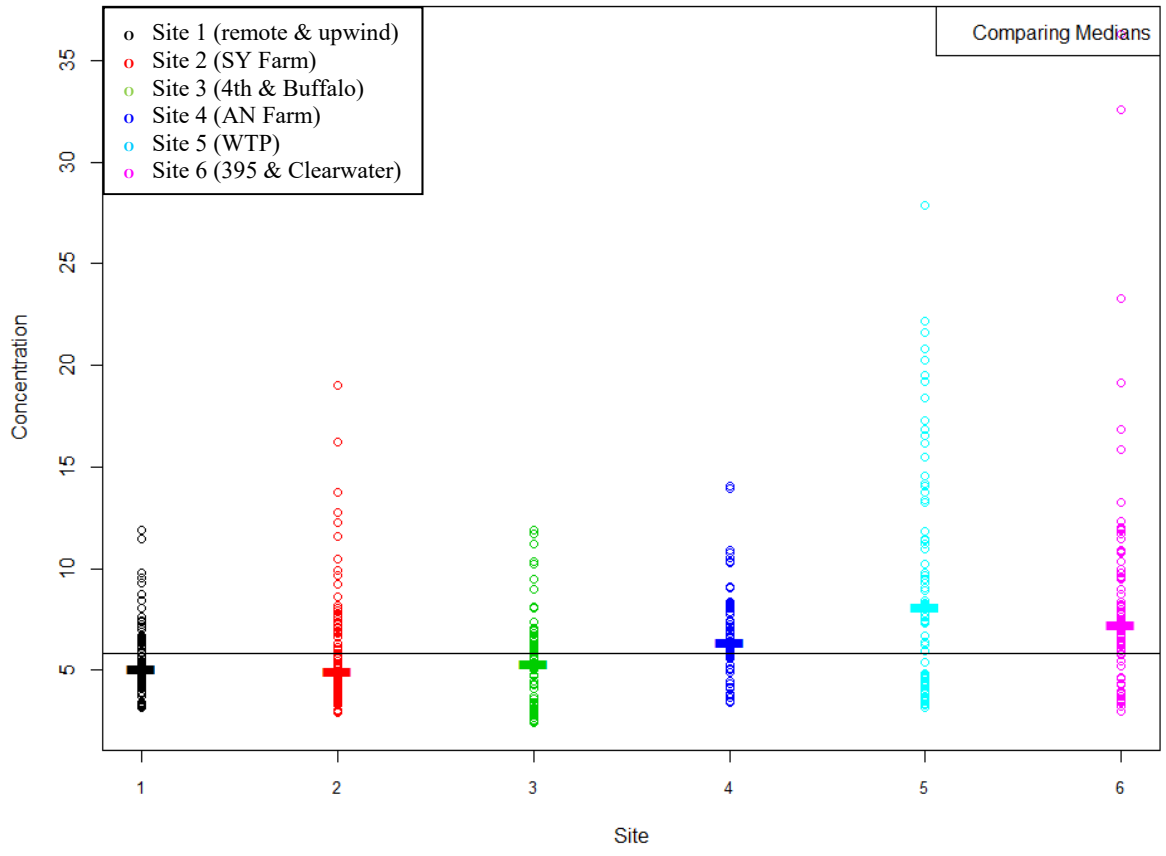


Figure 5-42. Hourly Average Ammonia Concentrations (ppb) by Site.

Table 5-29. Comparison of Ammonia by Site (Holm-Šidák).

	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6
Site 1 (remote & upwind)						
Site 2 (SY Farm)	0.7004					
Site 3 (4th & Buffalo)	0.4362	0.4164				
Site 4 (AN Farm)	0.0012	0.0015	0.0000			
Site 5 (WTP)	0.0000	0.0000	0.0000	0.4432		
Site 6 (395 & Clearwater)	0.0000	0.0000	0.0000	0.4799	0.4574	
P-values highlighted in yellow denote pairs of study sites where the null hypothesis was rejected; i.e., with 95% confidence there is a significant difference between the sites (p-values <0.05).						

5.3.4.3 Correlation with Smoke

In order to assess the correlation between smoke and furan concentrations, particulate matter data of less than 2.5 microns was obtained from a public sampling location in Kennewick (on the roof of Tri-Tech) managed by Washington State Ecology. Particulate matter of less than 2.5 microns is typical of smoke found a long distance from its source. Very little evidence of smoke was observed during the study, particularly since the ML was involved in a stop work during the minor excursion shown in Figure 5-43.

Figure 5-43 shows a time series plot of combined furan concentration on the left axis and particulate matter concentrations less than 2.5 microns on the right axis. The black lines represent combined furan concentrations and the red line represents the level of small particulate in the air (smoke). The linear correlation coefficient was calculated to be 0.2763 indicating there is essentially no correlation between combined furan signal and smoke. This is not surprising, since there were zero smoke days during the FY18 background study as defined in the FY17 background study (> 15 µg/m^3).

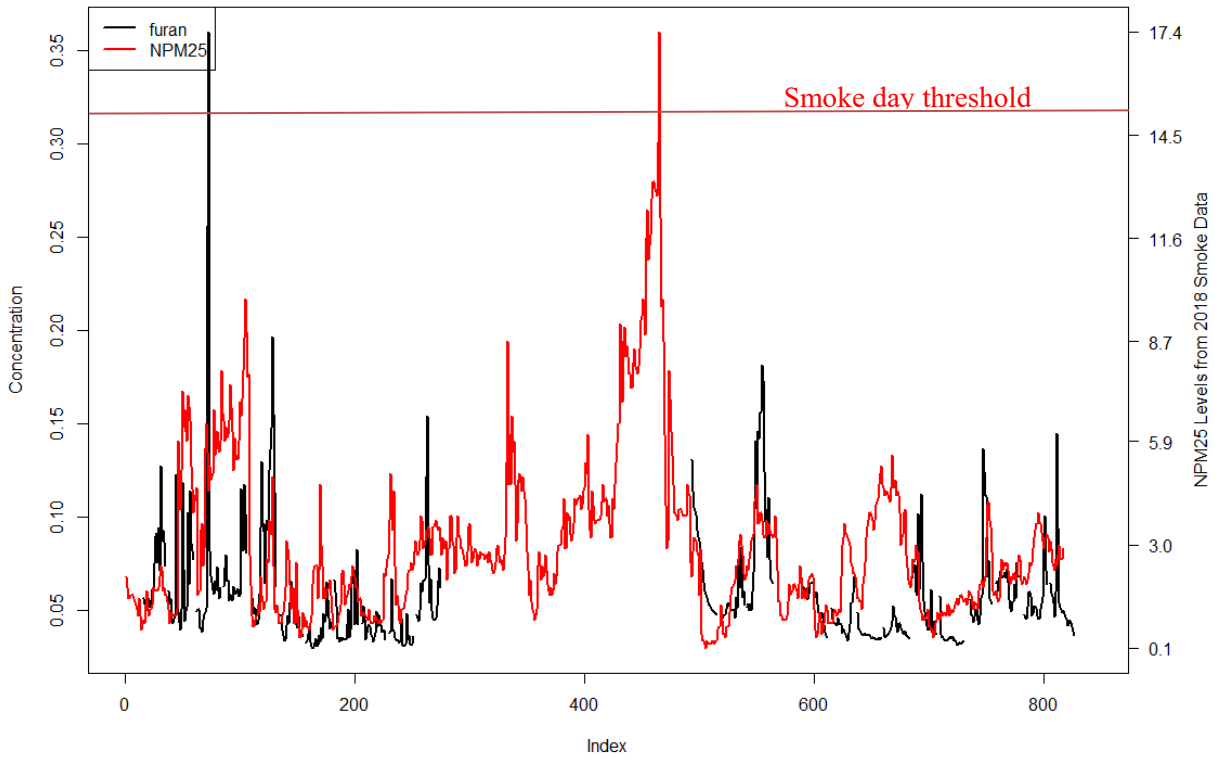


Figure 5-43. Time Series Plot of Combined Furan Concentrations (ppb) for All Sites Versus Smoke (µg/m^3).

5.3.4.4 Diurnal Variations

Figure 5-44 is a plot of the combined furan signal broken into one-hour averages for the entire background study. The dots represent each average taken at a a given hour, the thick colored bars represent the median of each of those sets of averages, and the black line represents the overall median for combined furans throughout the entire data set. This plot shows very little diurnal variation in the combined furan concentrations, with potentially minor reductions in the early evening and early morning hours. The median hourly averages were well below 10% of the OEL. From an operational perspective, there is no significant increase in vapor hazard between day vs. night given the trace concentrations.

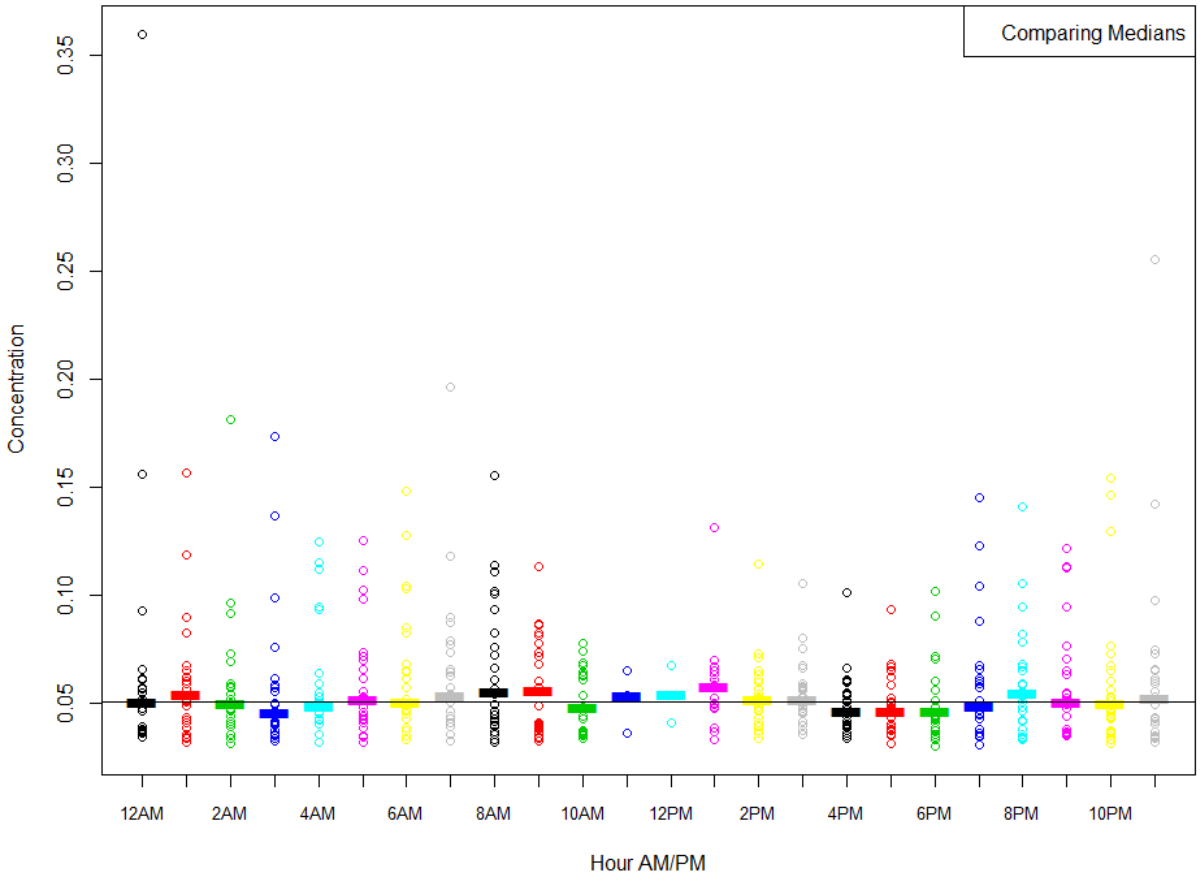


Figure 5-44. Diurnal Effects for Combined Furans (ppb).

Figure 5-45 is a plot of the carbon dioxide signal broken into one-hour averages for the entire background study. The dots represent each average taken at a a given hour, the thick colored bars represent the median of each of those sets of averages, and the black line represents the overall median for carbon dioxide throughout the entire data set. This plot shows a maximum CO_2 concentration around 7-8 AM decreasing during the day to a minimum at aound 6 PM. The cause of the variation is not known, but may be partially due to the accumulation of CO_2 during formation of the boundary layer and release of the CO_2 as the boundary layer breaks up in the morning hours.

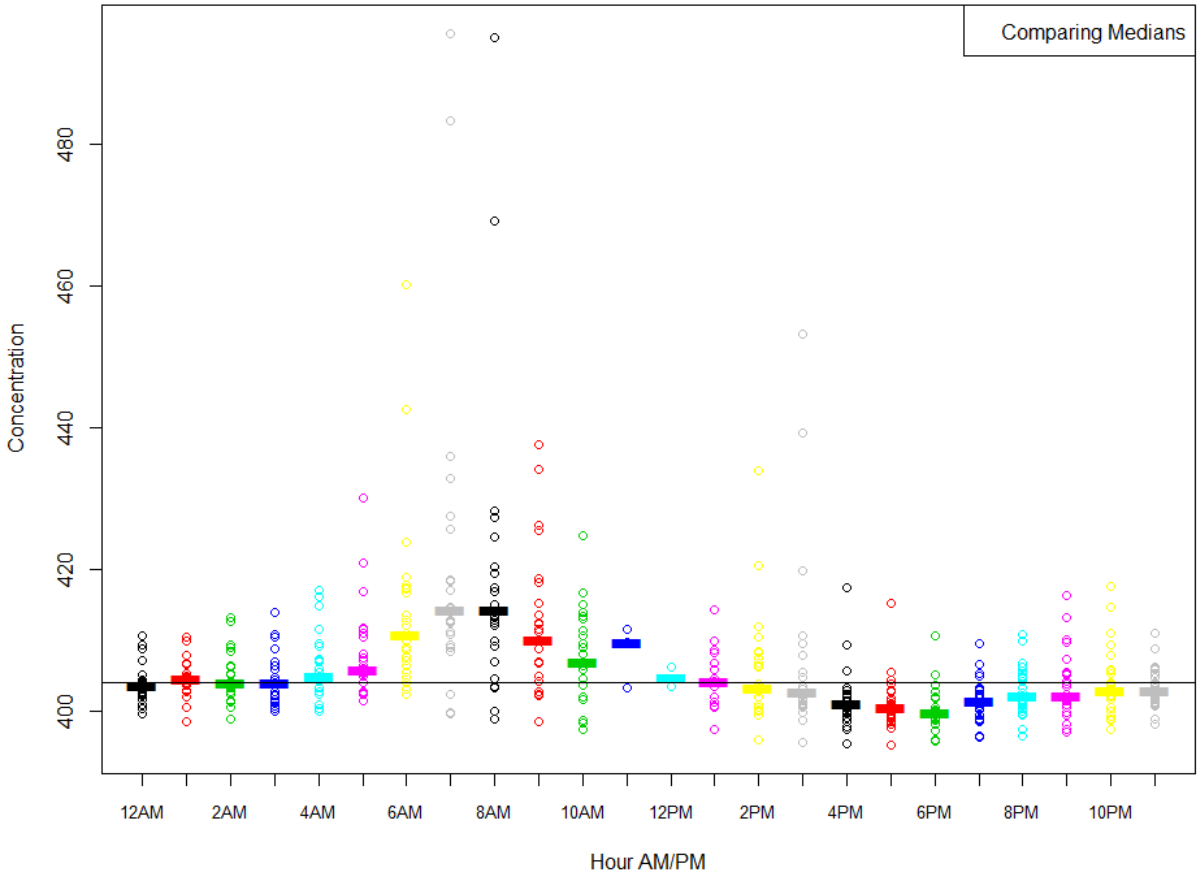


Figure 5-45. Diurnal Variations for CO_2 (ppm).

Figure 5-46 is a plot of the ammonia signal broken into one-hour averages for the entire background study. The dots represent each average taken at a a given hour, the thick colored bars represent the median of each of those sets of averages, and the black line represents the overall median for ammonia throughout the entire data set. This plot shows an increase in ammonia at noon, decaying to a baseline level over the next ten hours. This diurnal variation is likely due to analytical system procedures and configuration and less likely due to environmental variation. The ML procedures required calibration checks whenever the ML was moved, which occurred around noon each day during the background study. The relatively high concentration of ammonia used in the calibration check is adsorbed on the walls of the sampling system and is retained for a period of time. The severly affected data (about 15 minutes following each calibration check) was removed from the data set before analysis, but the ammonia contamination in the system continued to decay over time.

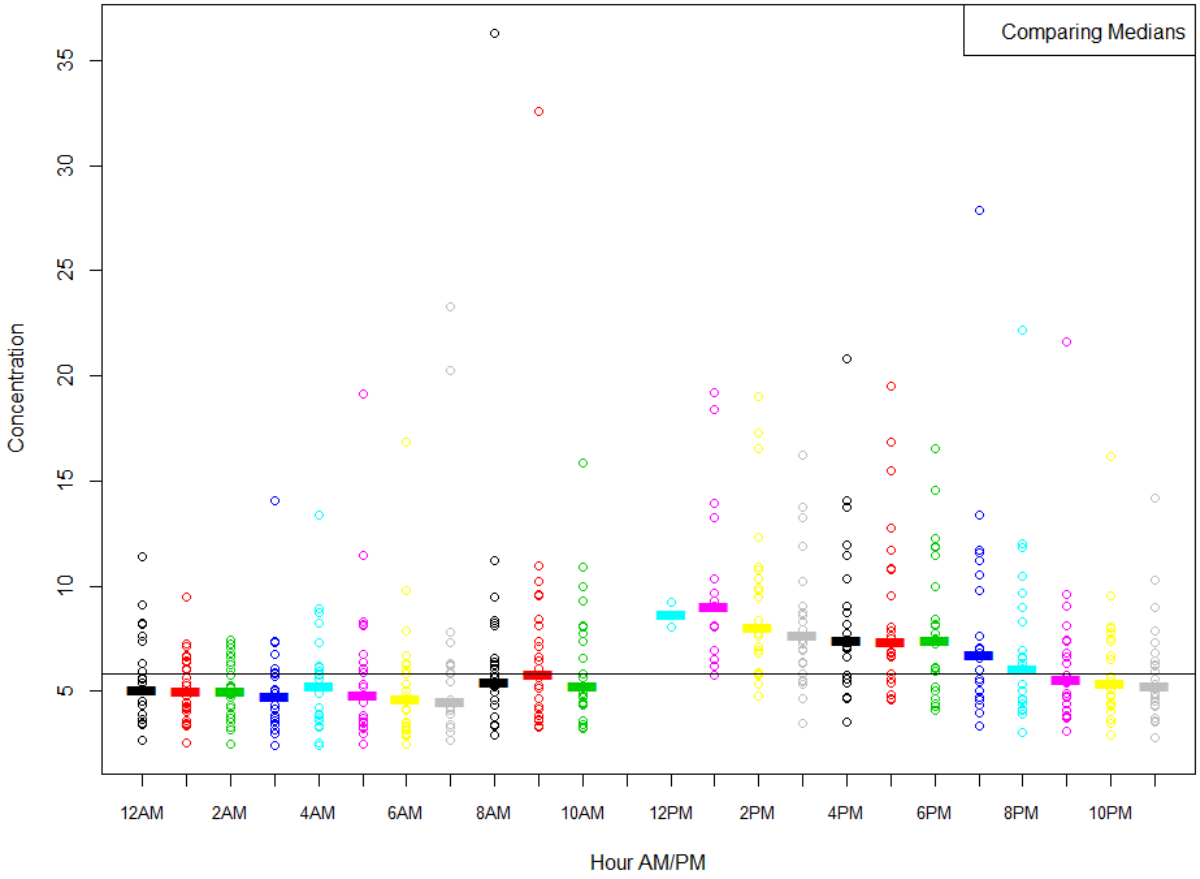


Figure 5-46. Diurnal Variation for Ammonia (ppb).

5.3.4.5 Combustion Markers

Several PTR-MS analytes are generated as a result of combustion and can be used to help identify the source of other trace analytes (e.g., furans) also generated during combustion. Ethylamine is a good indicator of diesel combustion, while benzene and toluene are good indicators of gasoline combustion. Carbon dioxide is a good indictor for all combustion sources.

Figure 5-47 provides a summary of hourly average CO_2 concentrations by site, with the median value for each site shown as a solid colored line. The dots represent each average taken at a given hour, the thick colored bars represent the median of each of those sets of averages, and the black line represents the overall median for CO_2 throughout the entire data set. This plot shows two sites with above average concentrations [Site 3 (4^{th} and Buffallo) and Site 6 (395 and Clearwater)]. These sites are also the sites with the most vehicle traffic and diesel generator use. Site 1 (remote and upwind) has the lowest CO_2 concentrations, which is consistent with it being the most remote site and having the least amount of vehicle traffic.

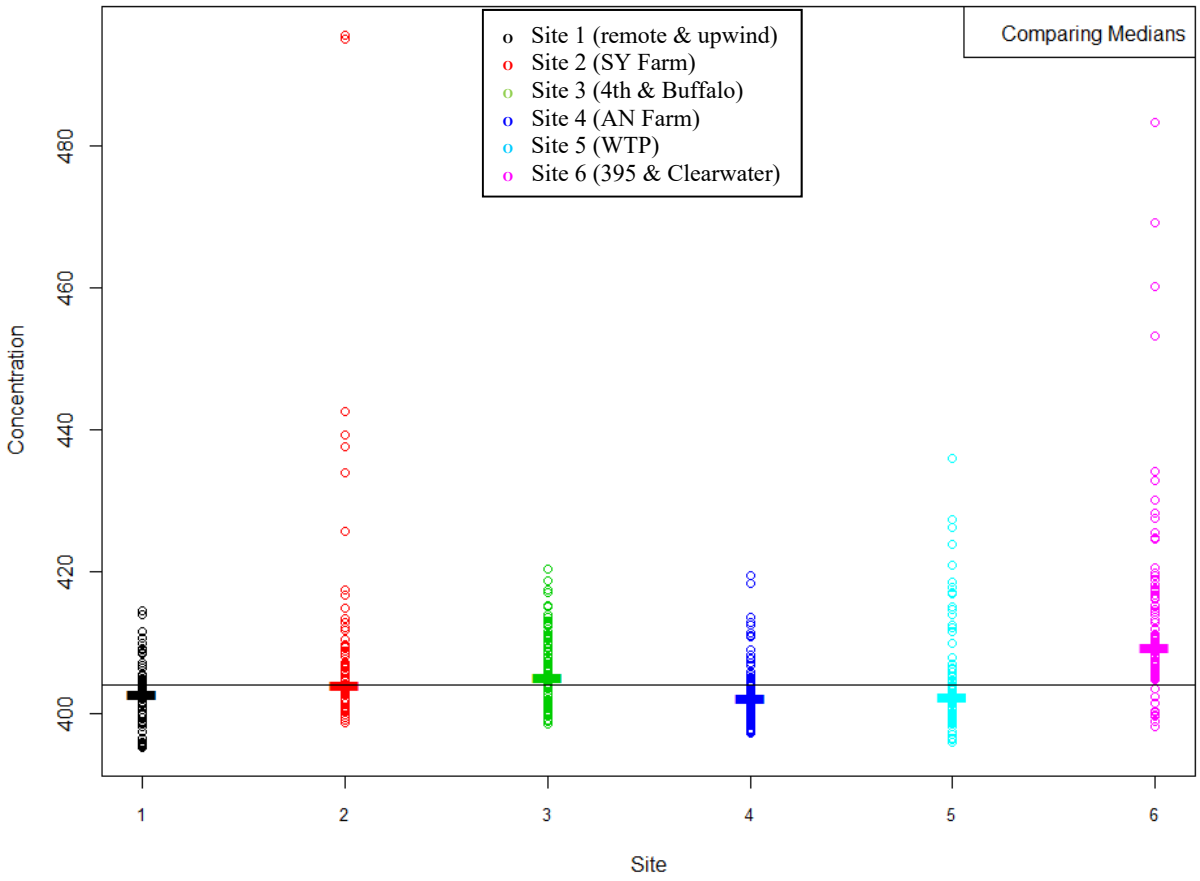


Figure 5-47. Carbon Dioxide Concentrations (ppm) as a Function of Site.

6.0 QUALITY ASSESSMENT

During this background monitoring campaign, quality control procedures were followed by both the data collection contractor, RJLG, and the data processing contractor, TerraGraphics Environmental Engineering, Inc. All data were processed and reported according to the 17124-DOE-HS-101, "Mobile Laboratory Data Analysis Quality Assurance Project Plan." Data were collected and quality assurance documents according to established procedure LAP-WRPS173.00. When data were transferred from WRPS to the data processing group, checks were performed and documented according to 17124-DOE-HS-102, "Mobile Laboratory Data Processing – Analysis." All exceptions have been noted and any potentially quality-affecting issues were resolved prior to report or are noted in this report. All potentially quality-affecting deviations have been captured by Corrective Action and Preventative Action (CAPA) reports and are summarized below with some interpretation.

During the background study there were seventeen (17) CAPA reports that are captured in Table 6-1. RJ Lee Group's Quality Assurance (QA) Program initiated the CAPAs to investigate and determine preventative measures to avoid future issues of the same type with the ML.

Table 6-1. RJ Lee Group's Corrective Action/Preventative Action.

ID	CAPA	Inception	Closed	CAPA Description
1810	Corrective	03/26/2018	04/25/2018	Mobile Laboratory CO_2 pump failure.
1811	Corrective	04/04/2018	05/04/2018	Weather Station data missing week one.
1812	Corrective	04/04/2018	05/04/2018	Logbook photos not legible.
1813	Corrective	04/04/2018	05/04/2018	Weather station data missing 03/22/2018.
1814	Corrective	04/04/2018	05/04/2018	NH_3 Raw data missing.
1815	Corrective	04/04/2018	05/04/2018	Zero air check for 03/19/2018 not provided.
1816	Corrective	04/04/2018	05/04/2018	TeamViewer notification.
1817	Corrective	04/06/2018	05/06/2018	Benzene write-ins on LAP-WRPS150A.
1818	Corrective	04/06/2018	06/08/2018	Determination of human inferences (open door, leak, etc.).
1819	Corrective	04/06/2018	05/06/2018	Clock Sync issues with PTR-MS and LI-COR
1820	Corrective	04/06/2018	05/06/2018	Identity of replacement ammonia standards.
1821	Corrective	04/09/2018	04/09/2018	Generator exhaust line blew off the ML 04/08/2018.
1822	Corrective	04/09/2018	04/11/2018	TeamViewer®[11] software was not operating correctly and a verbal validation had to be performed.
1823	Corrective	04/11/2018	04/11/2018	PTR-MS and CO_2 stopped acquiring data at 17:31 on 04/10/2018.
1825	Corrective	04/16/2018	04/17/2018	Mobile Laboratory could not move from Site 3 to Site 4 at scheduled time.
1826	Corrective	04/18/2018	04/19/2017	Weather station data not collected for 35 minutes on 04/18/2018 at Site 6.
1827	Corrective	04/19/2018	04/19/2018	PTR-MS was not updating with live data on the morning of 04/19/2018 at Site 6.

6.1 Lessons Learned – Case Study for CAPA 1823

On April 10, 2018, the PTR-MS and the CO_2 both stopped acquiring data at 17:31. A corrective action, CAPA 1823, was initiated. RJ Lee Group's investigation led to an automatic Microsoft®[12] software update that caused the computer to not recognize the PTR-MS software, which resulted in the PTR-MS and CO_2 ceasing to acquire data.

The CAPA 1823 investigation assessed that two (2) updates (Windows Security and a cumulative update for Windows 10) occurred on April 10, 2018. During the investigation, it was verified that the ML computer had been placed in disabled mode. The ML personnel powered down the PTR-MS to reestablish the internal communication with the computer. Upon the rebooting, the PTR-MS and CO_2 programs were communicating effectively with the computer software. It was noted by Quality Assurance that the Windows updates were once again in "disabled" mode.

6.2 Lessons Learned – Confirmatory Sampling

Upon examination of the TO-17 and SM 2522m results, it was discovered that half of all samples collected were incomparable to PTR-MS data due to their collection period coinciding with instrument startup, zero air, and sensitivity check procedures. There was not a comparable data

[11] TeamViewer is a registered trademark of TeamViewer GmbH gesellschaft, Goeppiningen, Germany.
[12] Microsoft is a registered trademark of Microsoft Corporation in the United States and other countries.

set collected by PTR-MS that could be taken as the average ambient concentration during the time that these alternative media samples were collected. All afternoon alternative media samples collected during this campaign were found to have this issue.

6.3 CAPA Trends

As part of a general examination of quality, the CAPAs that were generated have been grouped into categories to provide some trend analysis of issues that occurred during the background study deployment. The summary is presented below in Table 6-2.

Table 6-2. CAPA Classifications and Effects on Data Quality.

CAPAs	Classification	Effect on Data Quality
1810, 1811, 1816, 1821, 1825, 1826	Natural phenomenon	The root cause for these CAPAs was determined to be isolated phenomena regarding operation of the ML. While this prevented continuous data collection, there was no impact on data quality.
1819, 1823, 1827	Signal loss	These were isolated signal losses to data collecting instrumentation.
1812, 1813, 1814, 1820, 1822	Human Error	These were caused by isolated human error, despite following proper procedure. The deficiencies were corrected.
1815, 1817, 1818	Process improvements	The root cause for these was determined to be the result of potential process improvements for the ML operation. The process improvements did not affect data quality but rather provided an increasingly accurate picture of ML operation and potential areas for procedural improvement.

6.4 Overall Assessment of Data Quality and QA Recommendations

All operational anomalies and exceptions of potential negative impact on data quality were documented, addressed, and corrected using root cause analysis. Data presented in this report have passed acceptance criteria in the referenced QA project plans, Test Plans, and procedures and have been found to be the result of compliance to documented procedure.

The CAPAs that have been documented, while in some cases resulted in a small amount of lost data or schedule delay, did not negatively impact data that were collected and presented in this report. By nature of the background study continuous monitoring, sufficient data were collected of acceptable quality to provide reasonable conclusions addressing the objectives of this study. It should be noted that similar operational issues occurring for studies of shorter duration or limited sampling opportunity could potentially result in lost data collection opportunities or lost data of an irreplaceable nature.

Since a number of the CAPAs were isolated phenomena of natural causes or simple mechanical breakdown, it is critical to set aside enough project time and schedule sampling to accommodate for the inevitable unknowns associated with field sampling using complex instrument systems. Furthermore, planning for “set-aside” time for routine preventative maintenance and testing on

instrumentation may help reduce some system malfunctions as well as reviewing overall instrument systems for potential improvements.

Confirmatory samples, such as NIOSH 2522 and TO-17 must be taken at the same time as the PTR-MS and other associated analytical instrumentation are collecting data in order for the result to be directly comparable. It is required that procedural documents are revised or written to ensure that confirmatory samples are taken after the other ML instrumentation is in data collection mode.

7.0 CONCLUSION AND RECOMMENDATIONS

7.1 Conclusion

The RJLG ML operated for 24 days between March 18, 2018, and April 20, 2018, across six study sites ranging from remote, to onsite, to urban influences. During this time, the ML was monitoring 54 COPCs with a focus on a subset of 19 compounds. This subset is of interest due to low OELs and a historical difficulty with using traditional methods to monitor on the Hanford Site. Through the course of the study, the site averages for all COPCs never exceeded their respective OELs.

Over the course of the Background Study, multiple transient plumes of unknown origins were observed. To assist in identification, emissions from known sources (Generator exhaust, Wallula paper mill, Tyson, and downtown Pasco) were characterized using concentrations observed during short-duration events to generate unique relative abundances. Despite initial assumptions, the relative abundances of key species found in urban plumes observed at Site 6 differed from that of the ML generator's exhaust. On March 20, 2018, at Site 4, a unique plume consisting of ammonia but no COPCs was hypothesized to be a mixture of emissions from animal-based agriculture and the Wallula paper mill, but wind data suggests an unidentified source near the Hanford Site. Another unique plume that resembled Wallula emissions was detected by the ML at Site 4 on April 19, 2018, but again meteorological data points towards a nearby unidentified source of aldehydes. A potential tank vapor signature caused by elevated aldehydes, potentially NDMA and the sum of but-3-en-2-one + 2,3-dihydrofuran + 2,5-dihydrofuran was observed on April 20, 2018, at Site 1 but the absence of key COPCs reduces confidence in this assessment.

To shed light on isobaric interferences, alternative sampling and analysis methods were used, consisting of NIOSH 2522 and EPA TO-17 methods. While these methods do not provide the same temporal resolution as PTR-MS, they do provide speciation and corroboration of PTR-MS results. In general, where results between alternative methods and PTR-MS were able to be compared, the magnitude of the values were very close to, or below the lower levels of quantitation for all the methods employed. Results for benzene showed good correlation between PTR-MS and EPA TO-17. Although PTR-MS detected compounds at mass numbers indicating very low levels of nitrosamines well below OELs, the measurements were not confirmed by NIOSH 2522. This supports the likelihood that isobaric interfering compounds were present and measured by the PTR-MS.

When looking at the absolute backgrounds at each Study Site, there is no broad discernible pattern for any of the 19 COPCs of interest to the Background Study. The absolute background of urban Site 6 does not appear to be any different than remote Site 1 for most species. Notable exceptions include ammonia, NEMA, 2-methylfuran, 2,5-dimethylfuran, and the sum of the signal of 2-propylfuran and 2-ethyl-5-methylfuran. There was a noticeable increase in absolute background at Site 5 for the sum of the signal for but-3-en-2-one, 2,3-dihydrofuran, and 2,5-dihydrofuran, 2-methylfuran, 2,5-dimethylfuran, the sum of the signal for 2-propylfuran and 2-ethyl-5-methylfuran, 2-pentylfuran, and 2-heptylfuran.

When comparing absolute backgrounds measured between the Summer 2017 and Spring 2018 Background Studies, there is a clear pattern of elevated absolute background concentrations observed during the Summer study. This is attributed to the high abundance of compounds related to smoke caused by the abnormally extreme wildfire season in 2017. The exception to this trend was the comparison for NDEA. Absolute background averages were found to be higher for NDEA in Spring 2018 than Summer 2017. Some species observed at Site 6 during the FY17 Summer Background Study showed a discernable increase compared to other sites. This pattern was not observed in the FY18 Spring Study (Site 6 looks like the others). Additional studies during different conditions and seasons will help to make this analysis even more beneficial in the years to come.

A summary of the observations and conclusions from the statistical analysis of the Spring background data are as follows:

- All observed levels of ammonia and furan are well below levels of operational concern.
    - All sites had hourly average ammonia concentrations less than 0.15% of the OEL.
    - All sites had hourly average furan concentrations well below the OEL (< 20% of OEL for furan and < 40% of OEL for combined furans).
- Three sites had statistically higher furan concentrations than the other sites as follows:
    - Site 3 (4th and Buffalo) also had low ammonia concentrations and elevated CO2 concentrations suggesting that the elevated furans were not from tank waste.
    - Site 5 (Waste Treatment Plant) also had elevated ammonia concentrations and low CO2 concentrations, which could be consistent with tank vapors. However, Site 5 furan concentrations were not statistically different from the upwind, remote location (Site 1) indicating that the elevated ammonia concentrations may be coming from the WTP site.
    - Site 6 (395 and Clearwater) had elevated CO2 and ammonia concentrations consistent with high vehicle traffic. These set of conditions could also be consistent with tank waste vapors, but the site is much too far away from the tank farms to be the case.
- Furan levels in the off-site location (Site 6) are equal to or higher than all on-site locations.

- Little to no smoke was present during the Spring background study and no correlation was observed between furan concentrations and smoke at this level.

- Little diurnal variation was observed with furan concentrations. From an operational perspective, there is no significant increase in vapor hazard between day vs. night given the trace concentrations.

7.2 Recommendations

The following recommendations are offered for consideration prior to future work:

- Consider an ML deployment in the vicinity of Site 4 to look for local point sources of the small aldehydes observed in the transient plumes in Section 5.2.3.
- Consider an ML deployment in the vicinity of Site 5 to identify point sources of ammonia to ensure that they are not tank waste related.
- Consider deploying a PTR-TOF 6000, which has improved mass resolution and sensitivity, to improve reliability of nitrosamine detection. The improved mass resolution decreases the likelihood of interference from nearby ion signals and the improved sensitivity aids the peak separation when a nearby interferent has a significantly higher concentration.
- Sampling improvements:
    - Generator exhaust is often observed in data sets, primarily in unstable or stagnant wind conditions. Improvements were made to reduce this in the FY18 study, but additional measures should be considered to minimize this further. Sample location, exhaust placement, and alternate power sources are a few options that could be considered.
    - Move the sampling location away from the door entering the ML. The field workers observed contamination moving from inside the van to the sample inlet when the van door was opened.
    - Alternate media should be sampled concurrently with the PTR-TOF analyzing the same air sample. Half of the samples from FY18 were not sampled concurrently.
    - Sample a greater volume on alternate media to produce results above the reporting limits or improve sensitivity of alternate methods.
    - Request field workers collect grab samples or additional alternate media samples when abnormal transient plumes are observed. This will aid with source identification for transient plumes and understanding the underlying sources that impact each site. Ammonia, formaldehyde, and acetaldehyde are the most commonly observed priority compounds in transient plumes from unknown sources.

8.0 REFERENCES

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APPENDIX A

BACKGROUND STUDY WEEKLY REPORTS

WEEKLY REPORT FOR WEEK 1 (MARCH 11 – MARCH 17)

Report No. 53005-81-RPT-001
Revision 0

April 2018

Prepared for:

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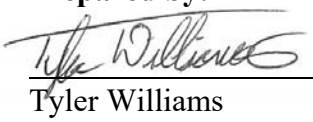
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Approval Form

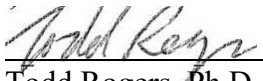
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Date: 4/5/2018

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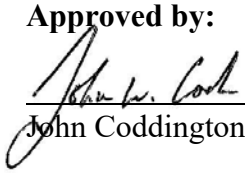
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Date: 4/5/2018

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Approved by:



Date: 4/5/2018

John Coddington, Ph.D.

Record of Revision

Revision	Date	Pages/Sections Changed	Brief Description
0	04/2018	All	Initial Release.

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Acronyms

CAPA	Corrective and Preventative Action
COPC	Chemical of Potential Concern
FTP	File Transfer Protocol
PTR-MS	Proton Transfer Reaction – Mass Spectrometer
QA	Quality Assurance
QC	Quality Control
RJLG	RJ Lee Group, Inc.
WRPS	Washington River Protection Solutions, LLC

1.0 (MARCH 17 – MARCH 18) – STUDY LOCATION #1

1.1 Quality Assessment

Data from March 17, 2018, were transferred to TerraGraphics via the Washington River Protection Solutions, LLC (WRPS) File Transfer Protocol (FTP) site on March 20, 2018. Data were assessed using Procedure 17124-DOE-HS-102, "Mobile Laboratory Data Processing – Analysis." A completed Data Exchange Checklist was sent to WRPS on March 21, 2018. The data were accepted by TerraGraphics with the following comments. All startup, shutdown, and calibration procedures were adequately documented and all other checks passed the acceptance limits. No other exceptions besides those below were noted.

Weather station data were missing from 18:00 on March 17, 2018, to 06:43 on March 18, 2018. A Corrective and Preventative Action (CAPA) is pending from RJ Lee Group, Inc. (RJLG) to address this issue. When the field team arrived at the Site, they discovered that the pump on the CO_2 analyzer was not operational. The CO_2 pump system was fixed and data collection for CO_2 was begun at 15:27. The CAPA was completed by RJLG (CAPA-1810).

On March 21, 2018, WRPS informed TerraGraphics via telephone conversation that there may be incidents of sampling the Mobile Lab's own diesel exhaust. A review of the data by TerraGraphics showed that diesel exhaust plumes can be confidently flagged out of the data set with a loss of approximately 1.1% of the data for this period. This report does not reflect the removal of any diesel exhaust plumes since a decision from WRPS on this action is pending.

During data processing, it was discovered that the raw proton transfer reaction – mass spectrometer (PTR-MS) data were offset from the CO_2 data by approximately 40 seconds. Diesel combustion markers formaldehyde and acetaldehyde were examined, and the CO_2 and the raw data were adjusted so that the CO_2 data aligned properly with the PTR-MS data stream. It is typical that there is a 1-2 second data offset, which is easily corrected, but a time discrepancy of this magnitude is unusual. TerraGraphics has instituted a deficiency report (DI18-003) to alter the data processing procedure to check for this discrepancy earlier in the data analysis process. On March 26, 2018, WRPS was notified of this issue so investigation may be performed to identify the cause.

1.2 Summary

Krystin Riha, Joe Sears, and Adrielle Olson performed background sampling using the Mobile Lab from March 17, 2018, to March 18, 2018, at Study Site 1. Site 1 is located on the plateau northwest of the 200W Tank Farm operations. This site was chosen as an upwind site from the central Hanford Plateau. Since shore power is not available at this location, the Mobile Lab relies on its generator for continuous operation. Exhaust from the generator is routed down-wind by a 40' line and thus interference from the Mobile Lab exhaust is expected to be minimal. The orientation of the diesel generator exhaust line was such that it was roughly 15' downwind of the sampling mast.

The Mobile Lab arrived at Location 1 at 12:20 on March 17, 2018. The initial quality assurance/quality control (QA/QC) zero air/sensitivity checks were performed on the CO_2 monitor, NH_3 monitor, and the PTR-MS beginning at 12:50. At 13:15, it was discovered that the CO_2 monitor pump had failed. At this time, Mobile Lab staff notified WRPS management of the problem and were instructed to leave the site for repairs, then return and resume data collection. By 15:30, Mobile Lab staff had returned to the Study Location and had resumed running a new zero air/sensitivity check on the CO_2 monitor. Routine data collection resumed by 16:00. At 16:20, the Mobile Lab staff reported that the Mobile Lab had no Wi-Fi connectivity, and verbally confirmed the instrument operational statuses telephonically to RJLG QA staff. The Mobile Lab staff departed the monitoring site after performing the final PTR-MS zero air check for the evening at 16:48.

The Mobile Lab staff had returned to Location 1 and performed a PTR-MS zero air check by 06:45 on March 18, 2018. Closeout zero air/sensitivity checks were performed at 11:30. The Mobile Lab was then refueled and moved to Location 2 by 12:45.

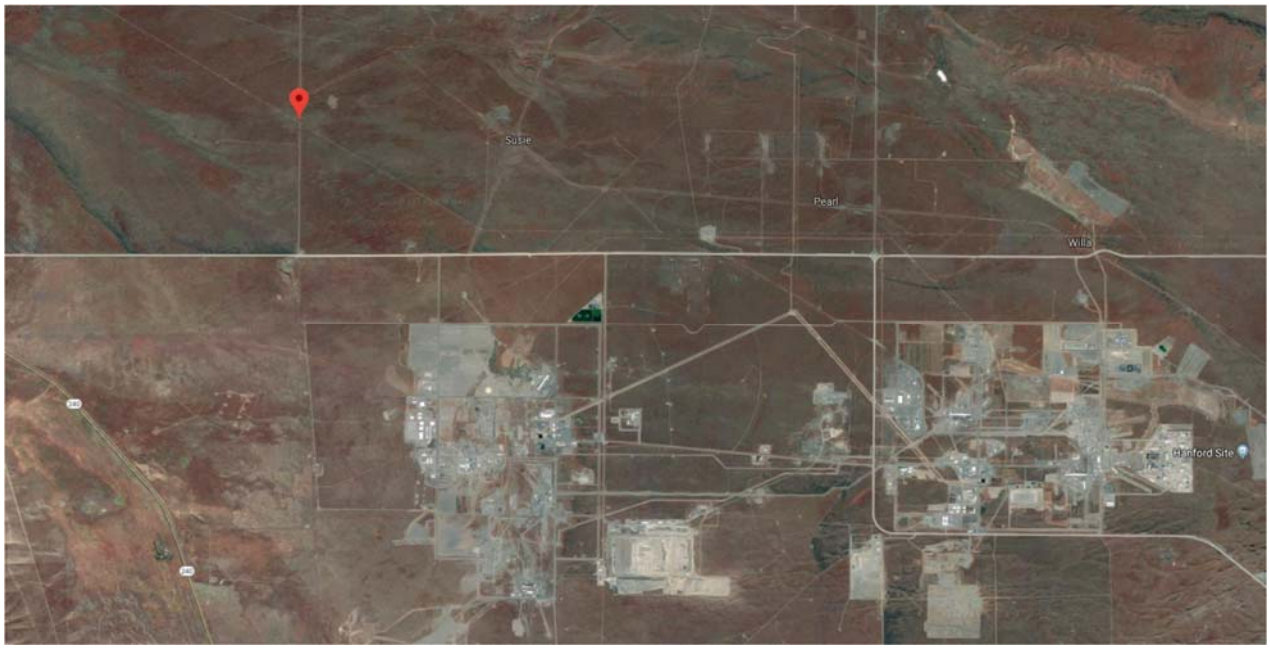


Figure 1-1. Mobile Lab Location for the Duration of the Monitoring Period.

1.3 Samples Collected

Continuous air monitoring was performed using the following instrumentation:

- PTR-MS,
- LI-COR®[1] CO_2 Monitor,

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

- Picarro Ammonia Monitor, and
- Weather Station.

Confirmatory air samples were collected as follows:

Table 1-1. Alternative Media Samples Taken.

Site	Date	Sample Type	ID	Start	Stop	Sample Time (min)
1	17-Mar	Thermosorb/N	EL22203	12:45	16:02	197
1	17-Mar	TDU	A047720	12:46	15:40	174*
1	18-Mar	Thermosorb/N	EL22209	7:08	10:10	182
1	18-Mar	TDU	A021990	10:05	11:15	70

*Note: LAP-WRPS160A.00, 2.1.12 shows a sampling time of 70 minutes for TDU # A047720, but was initialed at 15:40, 174 minutes after the Sampling Start Time listed in 2.1.11.

Table 1-2 displays the statistical information for the monitoring period of March 17, 2018 to March 18, 2018. By definition, the OEL is an 8-hour time weighted average that establishes a limit for personnel exposures to hazardous chemicals. It is the exposure level to which a person may be exposed for 8 hours/day, 40 hours/week for 40 years and have no expectation of adverse health effects. In this study, area vapor concentration measurements were made to better understand the hazardous vapor exposures that workers may receive. These measurements are only compared to OEL concentrations to give them context. It is not accurate nor appropriate to interpret these short duration measurements (2-seconds) as worker exposures levels. Since the OEL is defined as a time weighted average, it is more appropriate to compare them to daily average vapor concentrations. Short duration excursions above the OEL concentration are not significant.

Table 1-2. Statistical Information for the Monitoring Period of (3/17-3/18). (2 Sheets)

COPC #	COPC name	Reporting Limit (PPB)	OEL (ppb)	Ave. (PPB)	St. Dev. (PPB)	Rel. St. Dev. (%)	Max (PPB)	Median (PPB)	Sec. over 50% OEL	Sec. over OEL
1	ammonia	1	25000	4.21	1.498	35.6%	9.92	3.66	0	0
2	furan	0.09	1	0.045	0.013	66.3%	0.191	0.018	0	0
3	but-3-en-2-one + 2,3-dihydrofuran + 2,5-dihydrofuran	0.22	1	0.110	0.018	68.0%	N/A*	N/A*	N/A	N/A
4	NDMA	0.06	0.3	0.032	0.021	117.5%	0.135	0.010	0	0
5	2-methylfuran	0.05	1	0.026	0.012	69.4%	0.258	0.016	0	0
6	NEMA	0.02	0.3	0.012	0.010	187.7%	0.087	0.000	0	0
7	2,5-dimethylfuran	0.05	1	0.025	0.010	79.4%	0.153	0.011	0	0
8	NDEA	0.01	0.1	0.006	0.006	194.1%	0.048	0.000	0	0

Table 1-2. Statistical Information for the Monitoring Period of (3/17-3/18). (2 Sheets)

COPC #	COPC name	Reporting Limit (PPB)	OEL (ppb)	Ave. (PPB)	St. Dev. (PPB)	Rel. St. Dev. (%)	Max (PPB)	Median (PPB)	Sec. over 50% OEL	Sec. over OEL
9	2-propylfuran + 2-ethyl-5-methylfuran	0.02	1	0.011	0.008	114.0%	0.085	0.005	0	0
10	NMOR	0.05	0.6	0.025	0.004	102.9%	0.037	0.003	0	0
11	2-ethyl-2-hexenal + 4-(1-methylpropyl)-2,3-dihydrofuran + 3-(1,1-dimethylethyl)-2,3-dihydrofuran	0.04	1	0.021	0.011	97.4%	0.261	0.009	0	0
12	2-pentylfuran	0.04	1	0.020	0.008	45.3%	0.076	0.016	0	0
13	2-heptylfuran	0.02	1	0.010	0.004	61.6%	0.038	0.006	0	0
14	2-octylfuran	0.01	1	0.005	0.002	209.4%	0.023	0.000	0	0
15	6-(2-furanyl)-6-methyl-2-heptanone	0.01	1	0.005	0.002	161.0%	0.021	0.000	0	0
16	furfural acetophenone	0.07	1	0.035	0.004	60.4%	0.030	0.006	0	0

* The maximum peak value for but-3-en-2-one + 2,3 dihydrofuran + 2,5 dihydrofuran was 0.508 ppb and the median value was 0.023 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 200, 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 each chemical of potential concern (COPC) signal, overlaid with the same signal smoothed using a one-minute moving average, and CO_2, for the monitoring period March 18, 2018 to March 19, 2018.

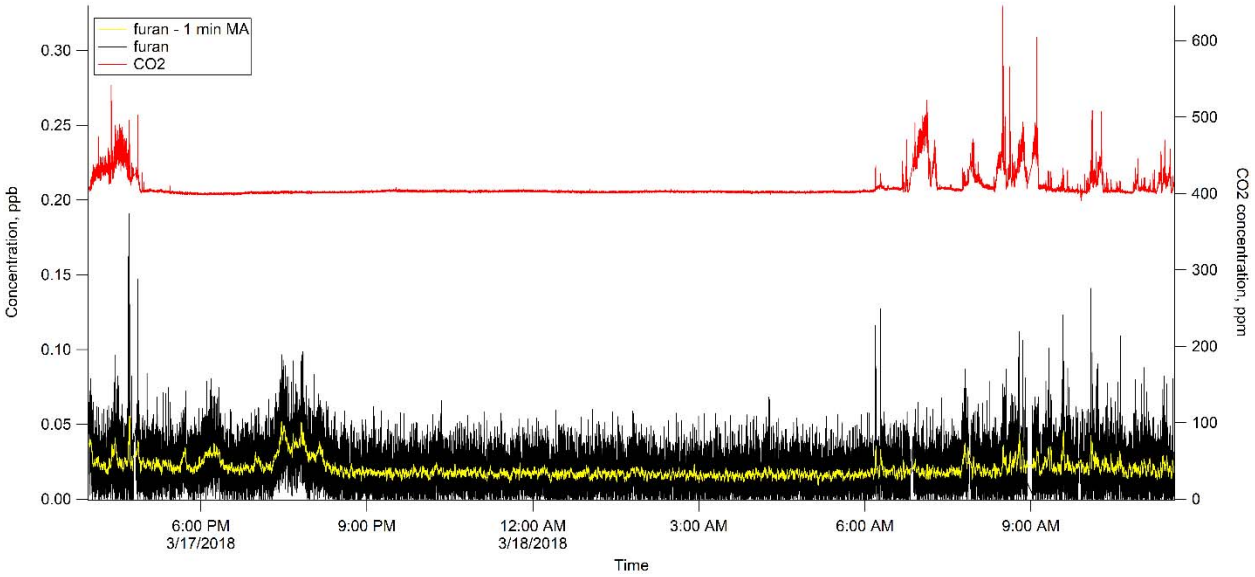


Figure 1-2. Furan.

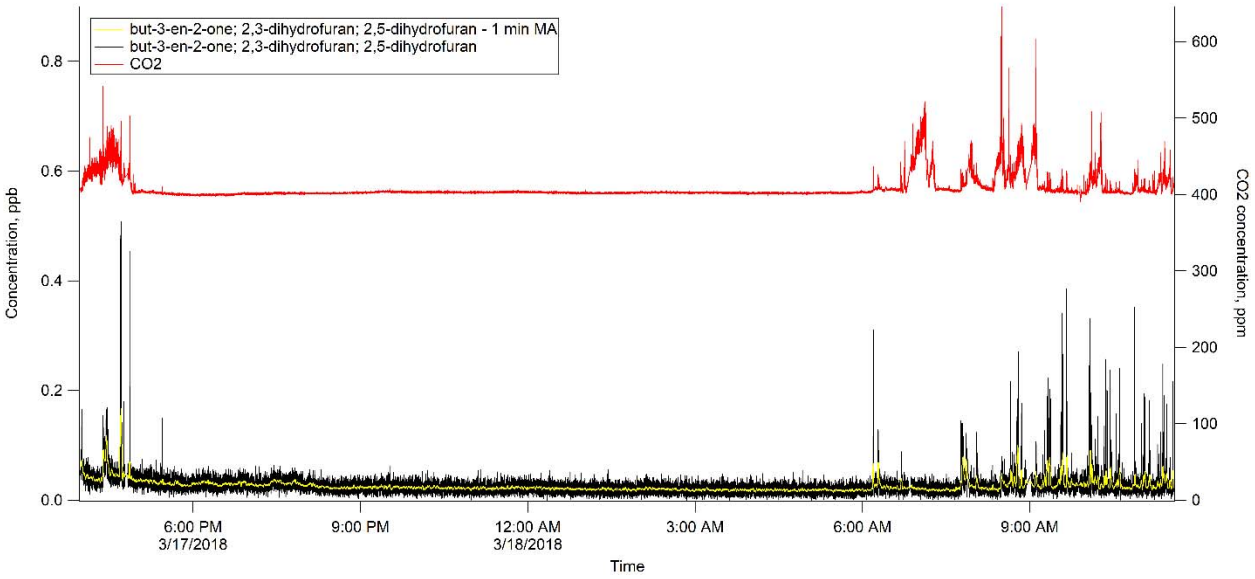


Figure 1-3. -3-en-2-one + 2,3-dihydrofuran + 2,5-dihydrofuran.

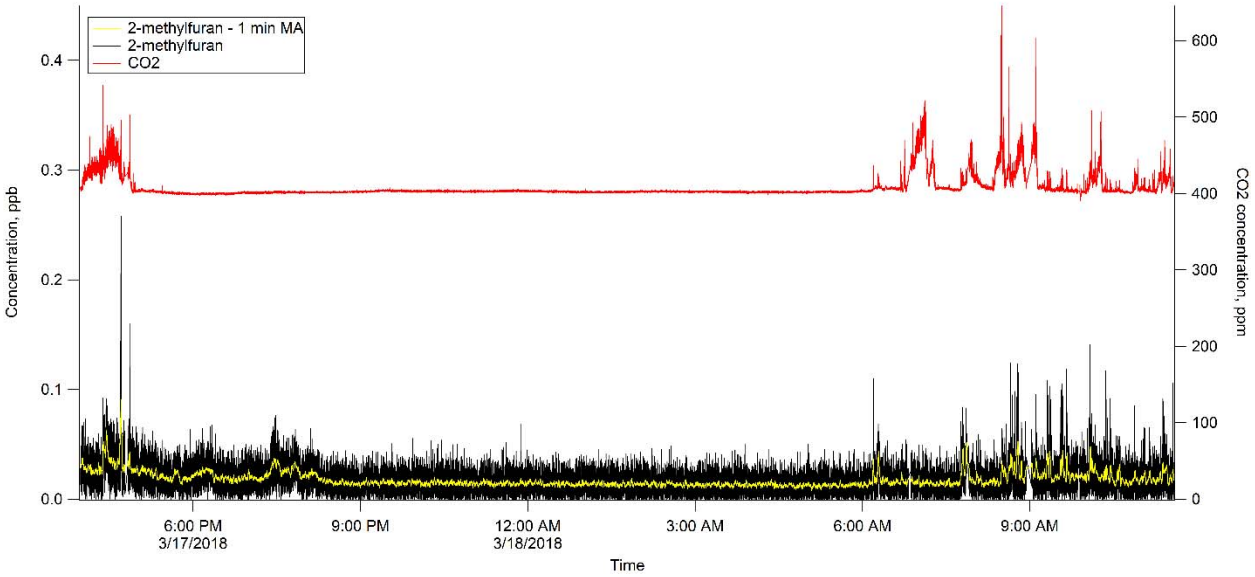


Figure 1-4. 2-methylfuran.

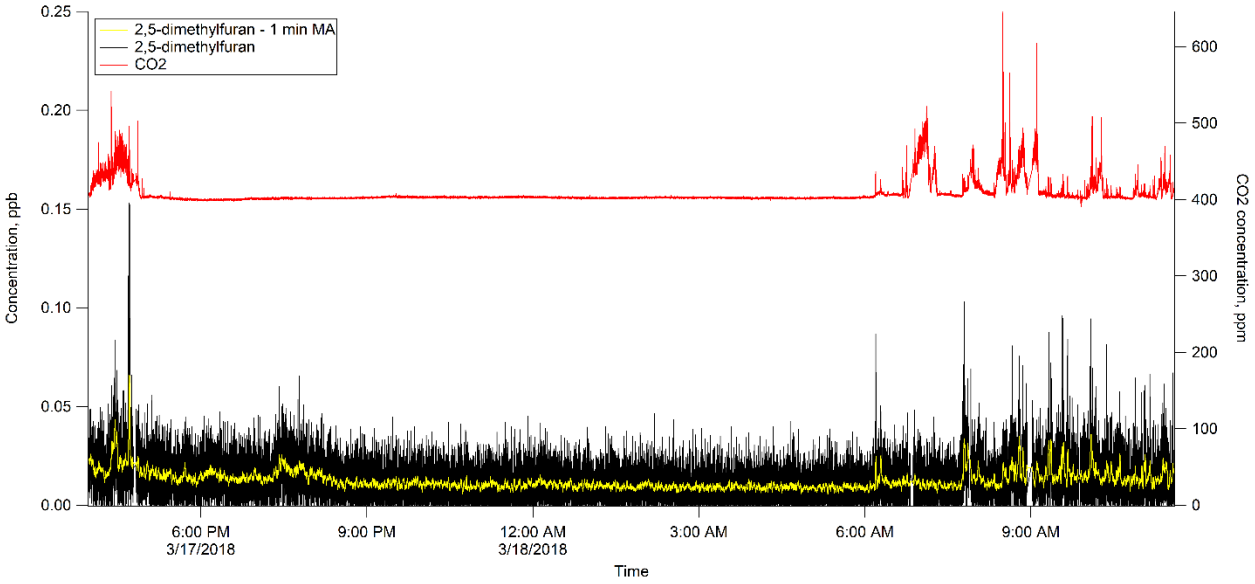


Figure 1-5. 2,5-dimethylfuran.

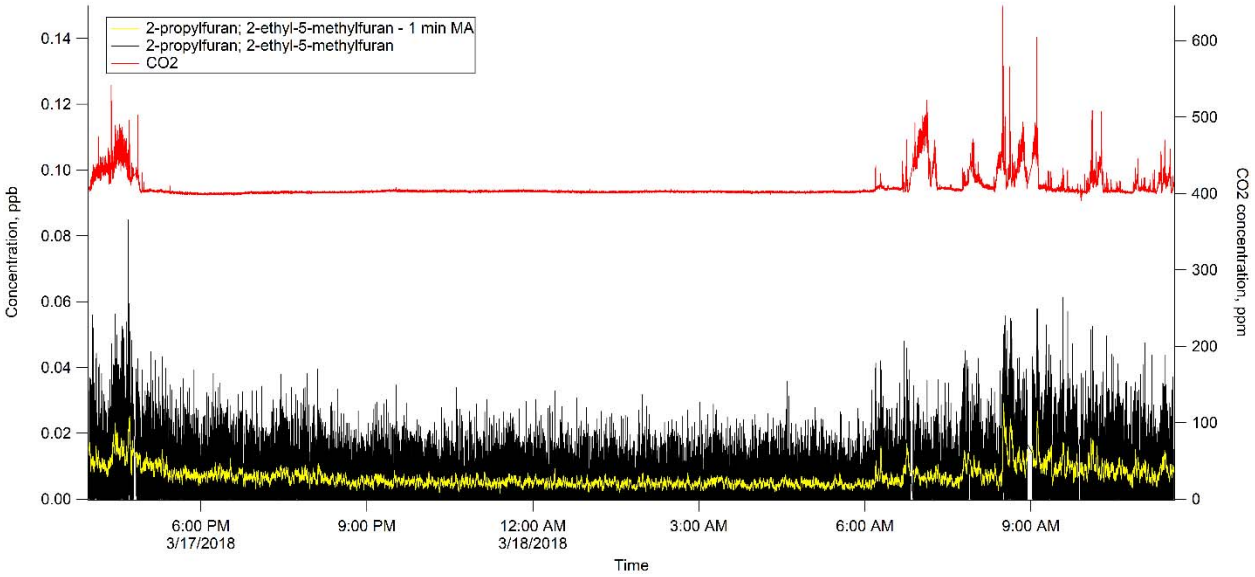


Figure 1-6. 2-propylfuran + 2-ethyl-5-methylfuran.

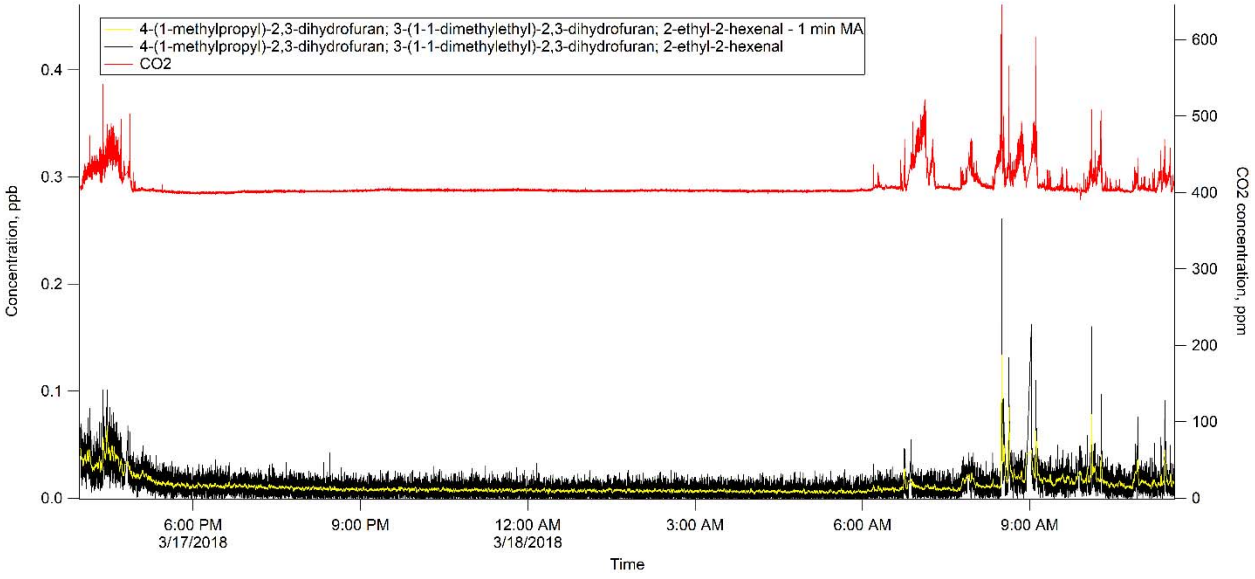


Figure 1-7. 4-(1-methylpropyl)-2,3-dihydrofuran + 3-(1,1-dimethylethyl)-2,3-dihydrofuran + 2-ethyl-2-hexenal.

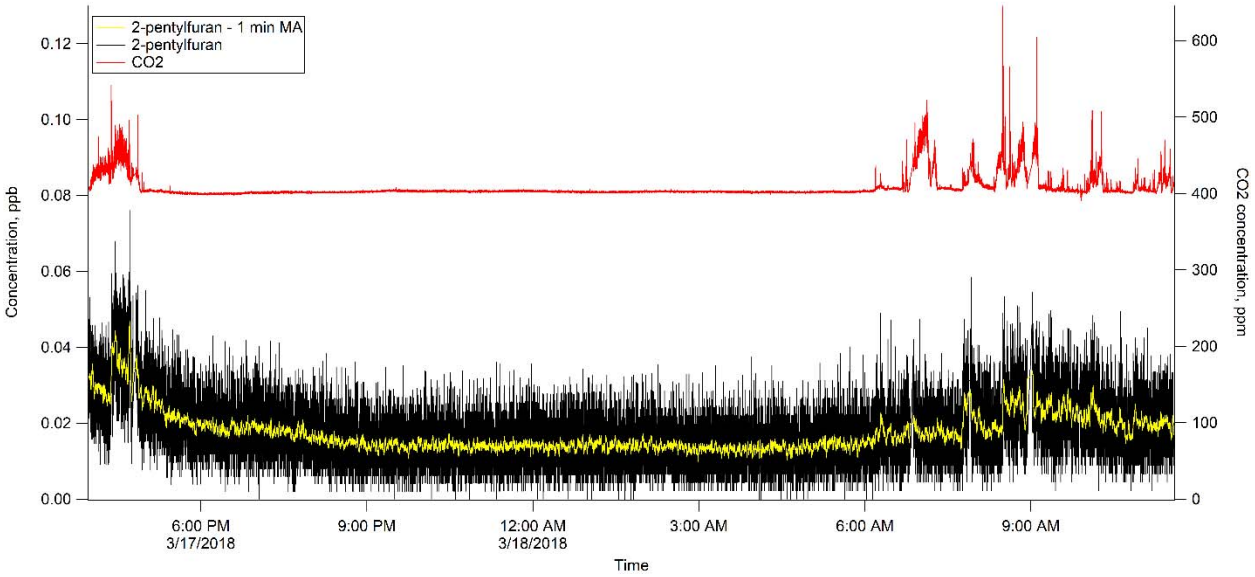


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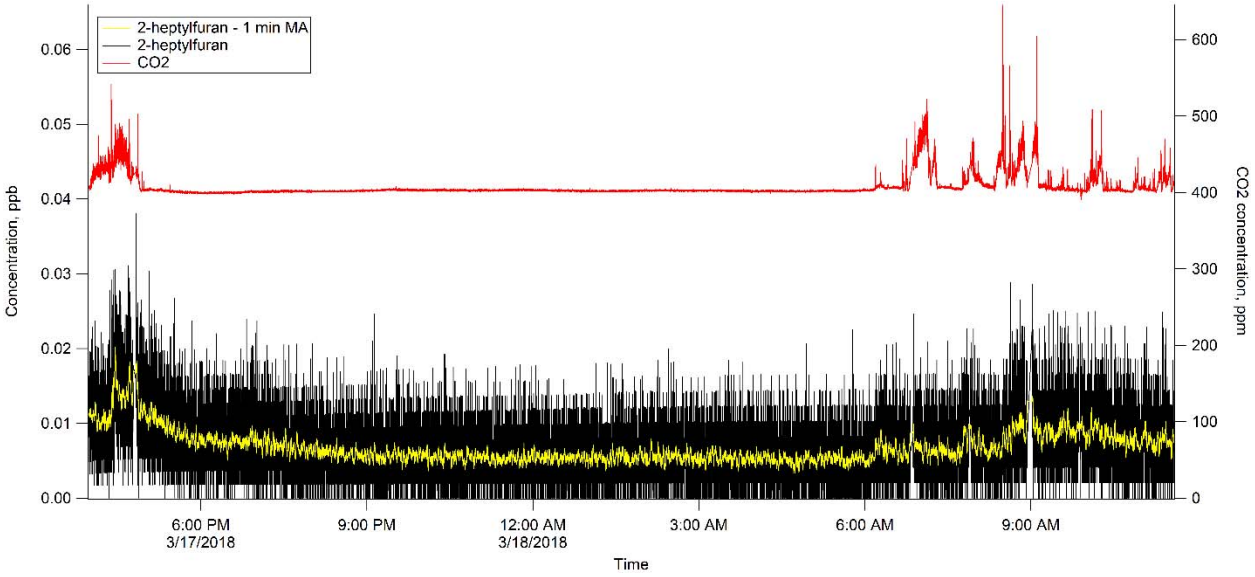


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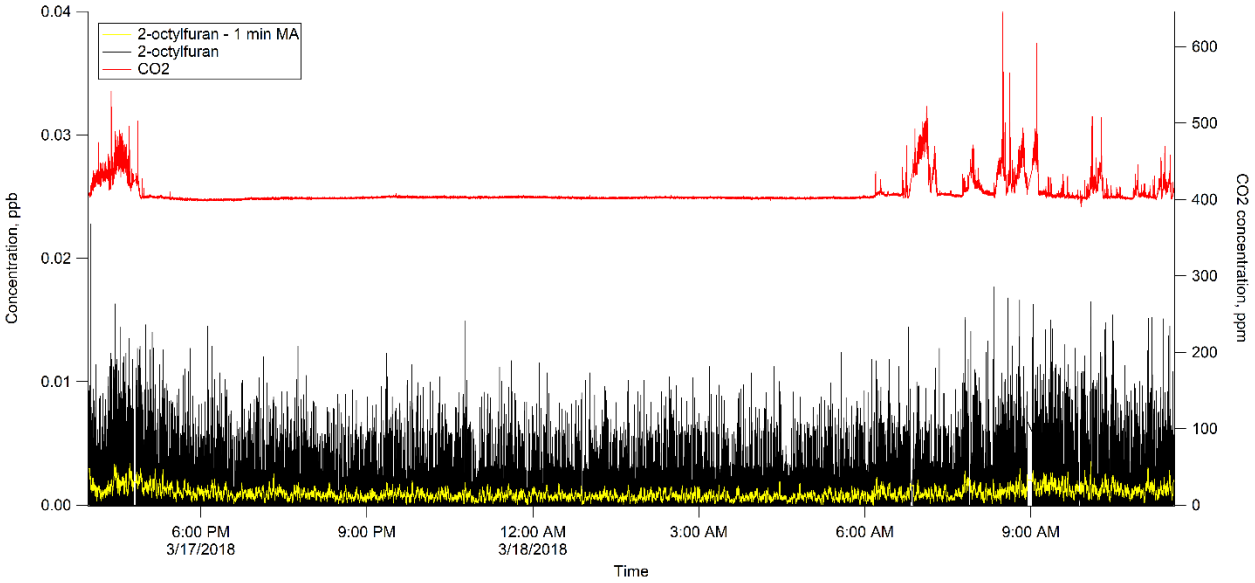


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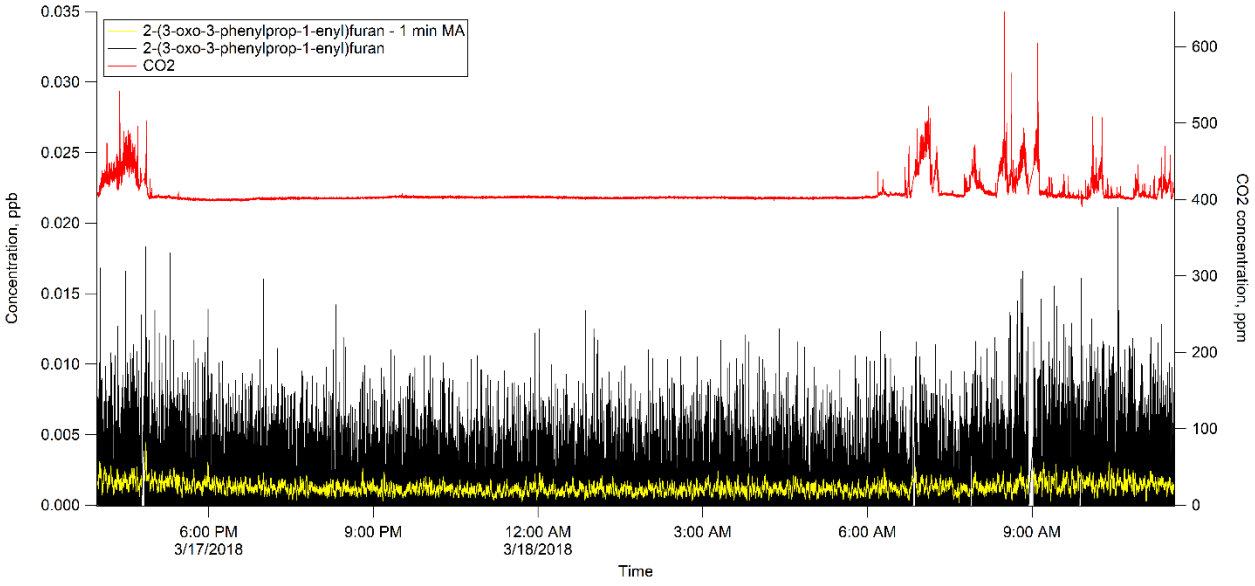


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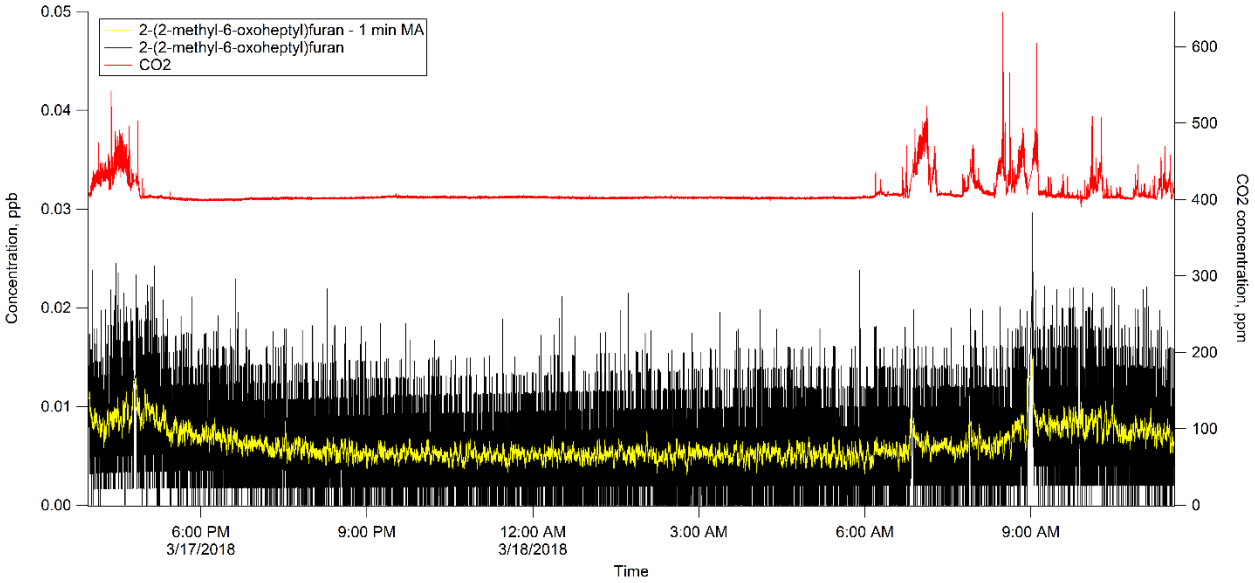


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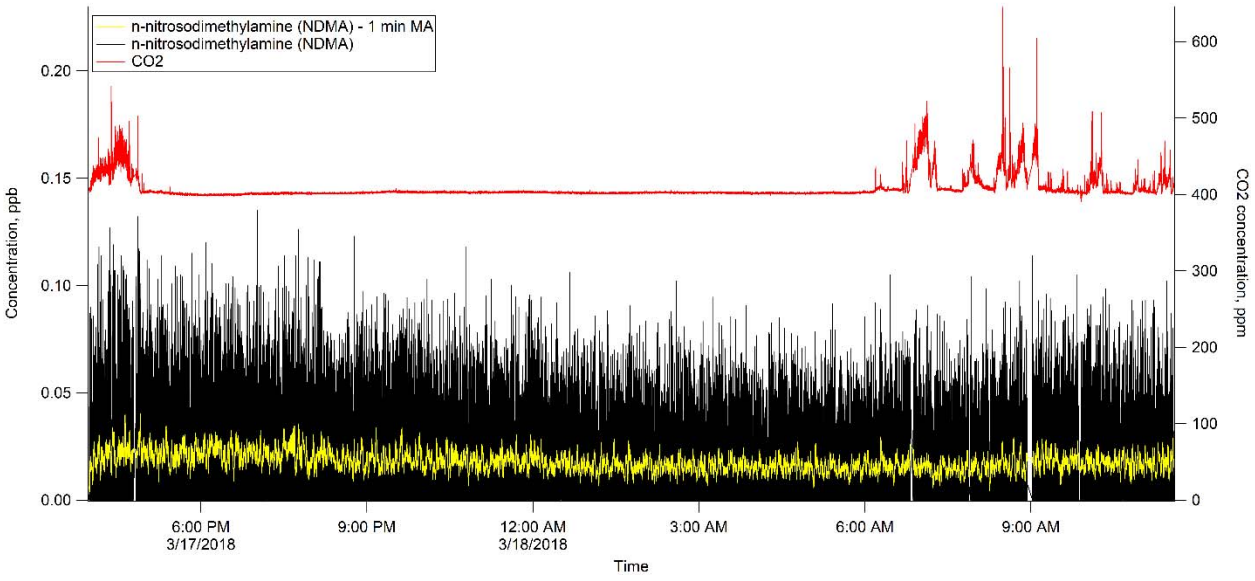


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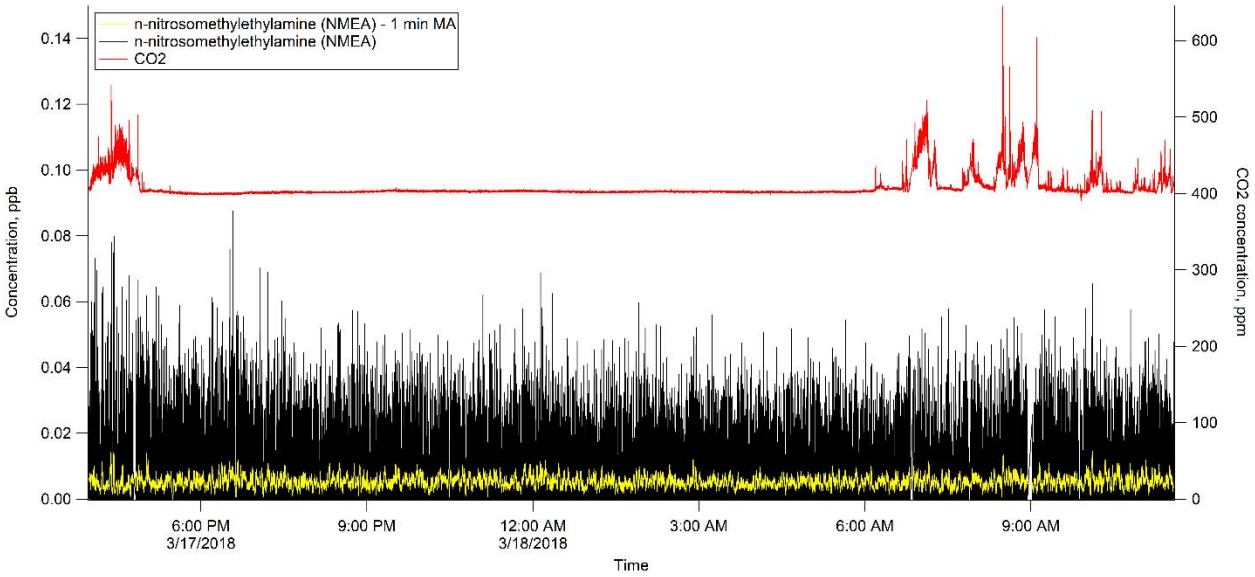


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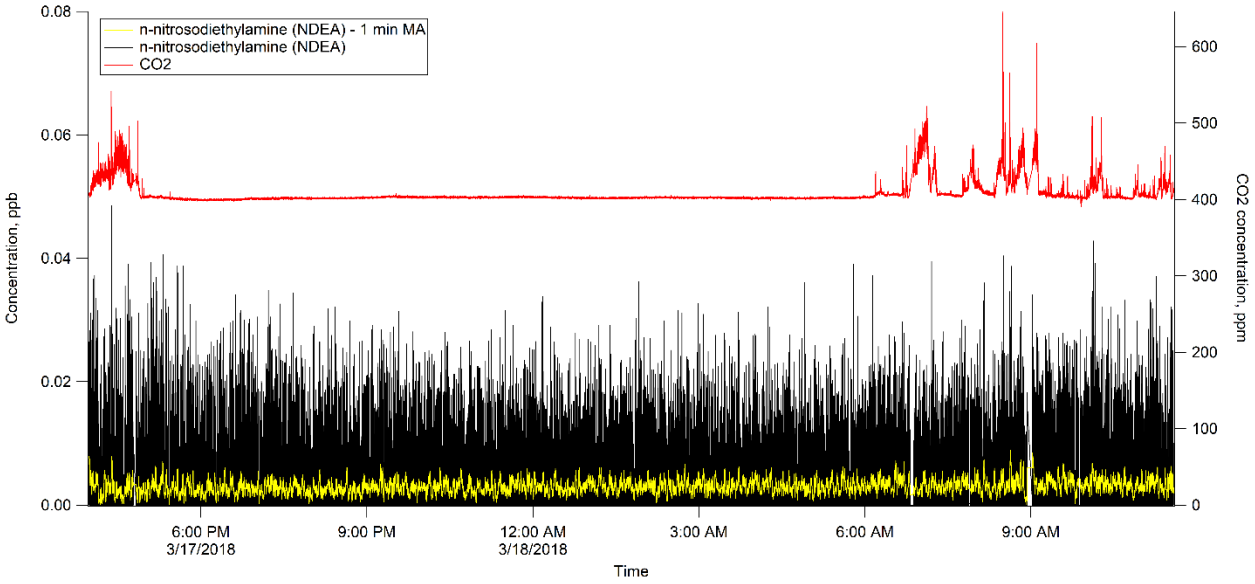


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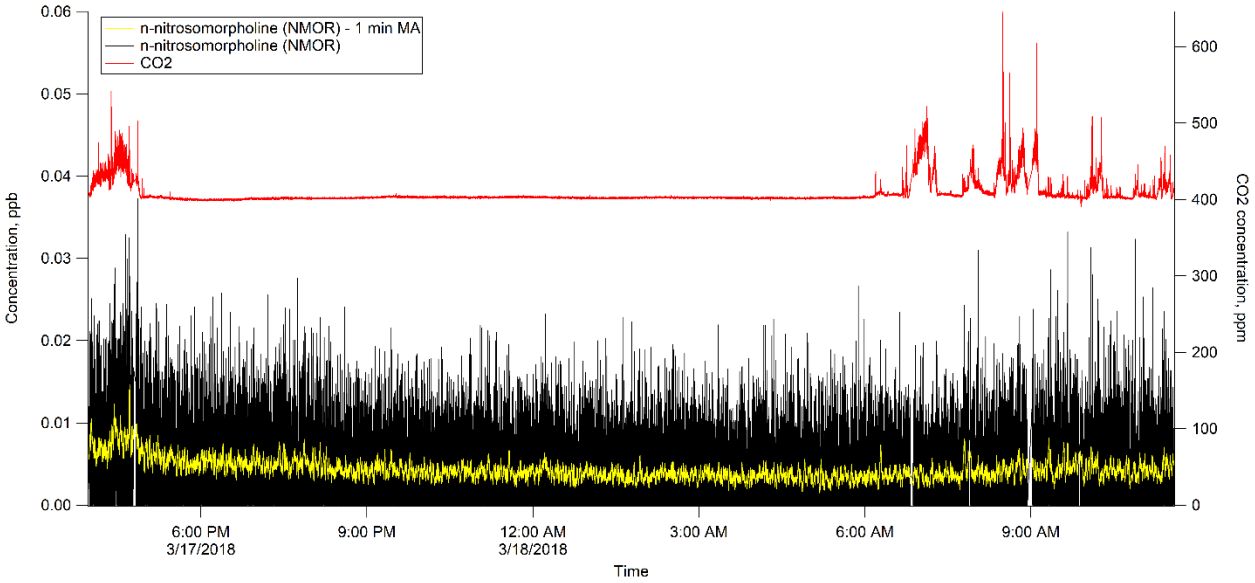


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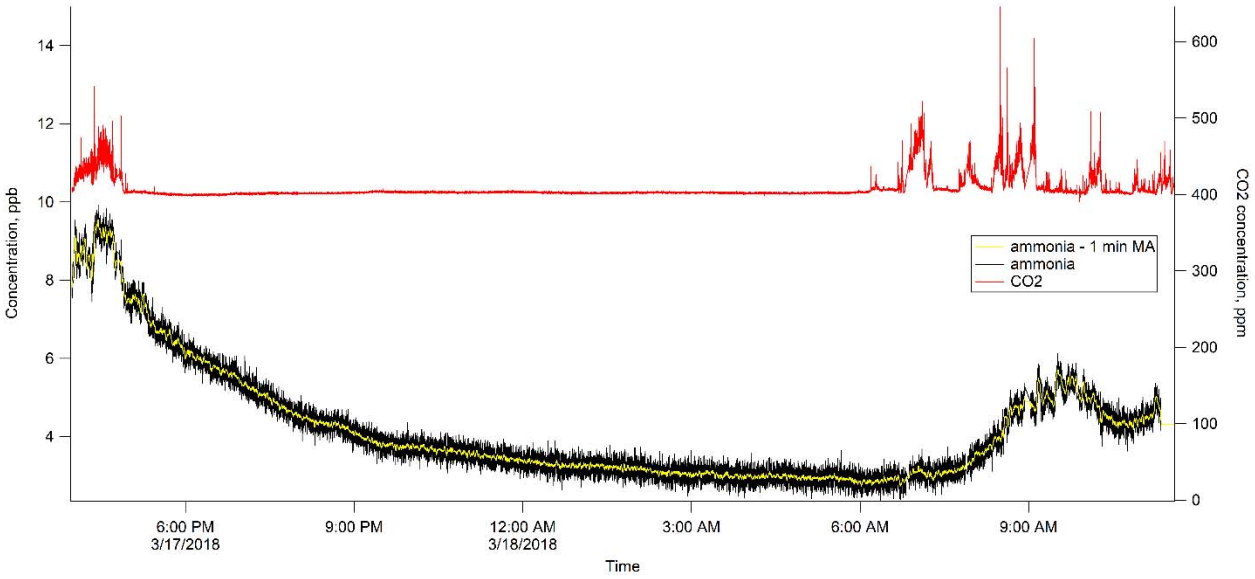


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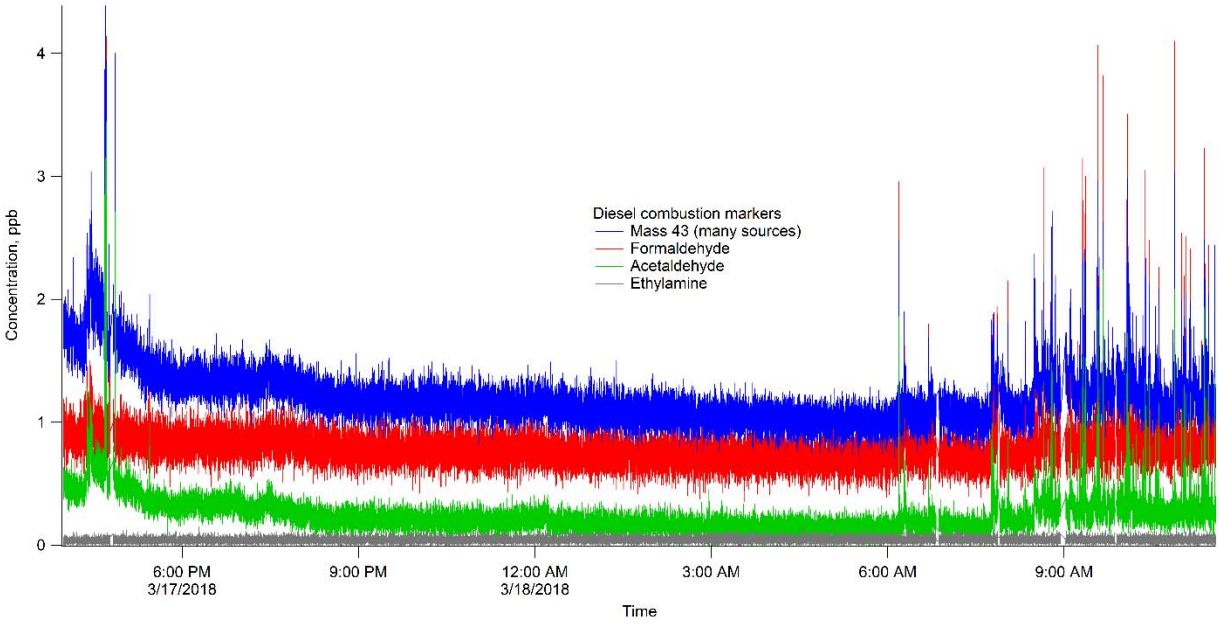


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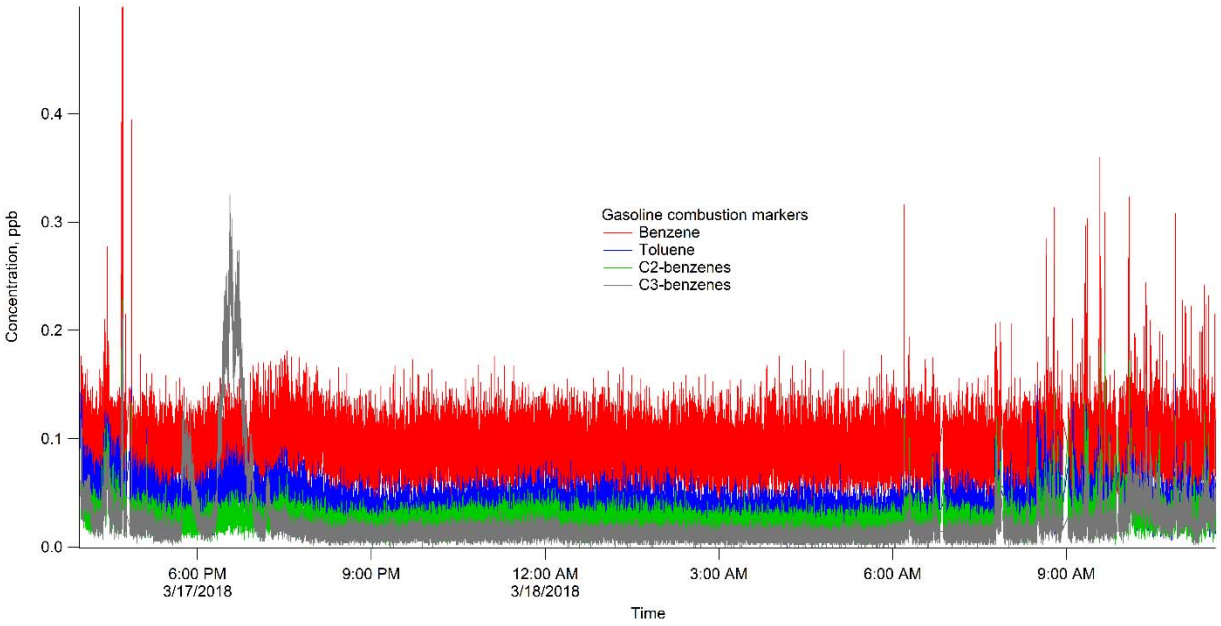


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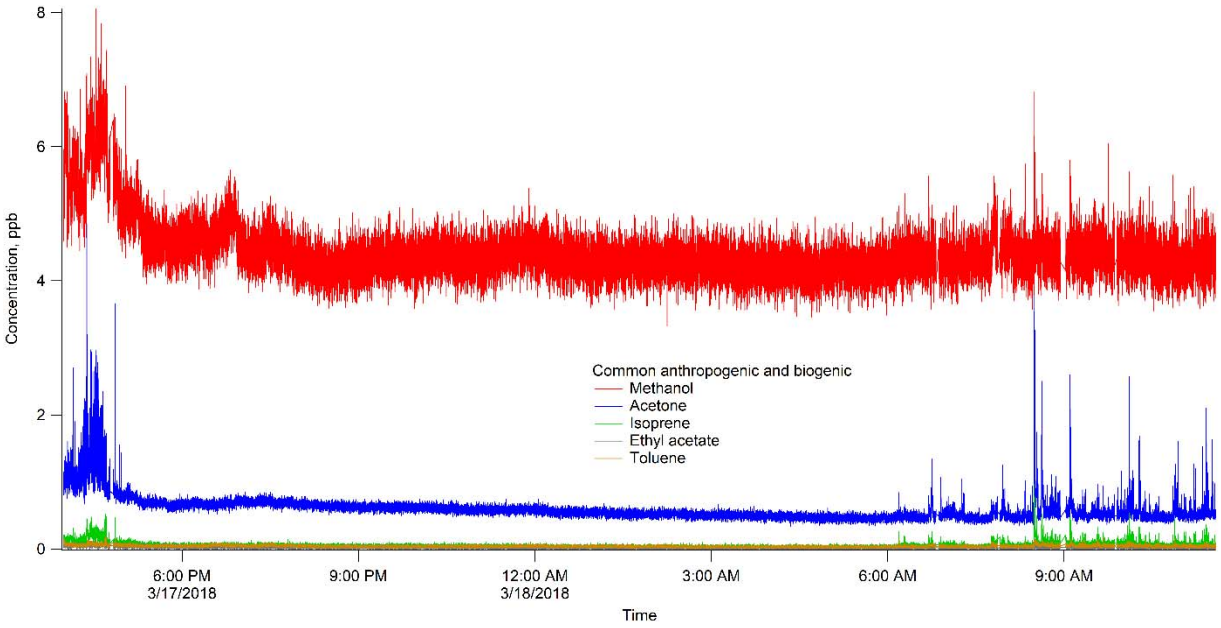


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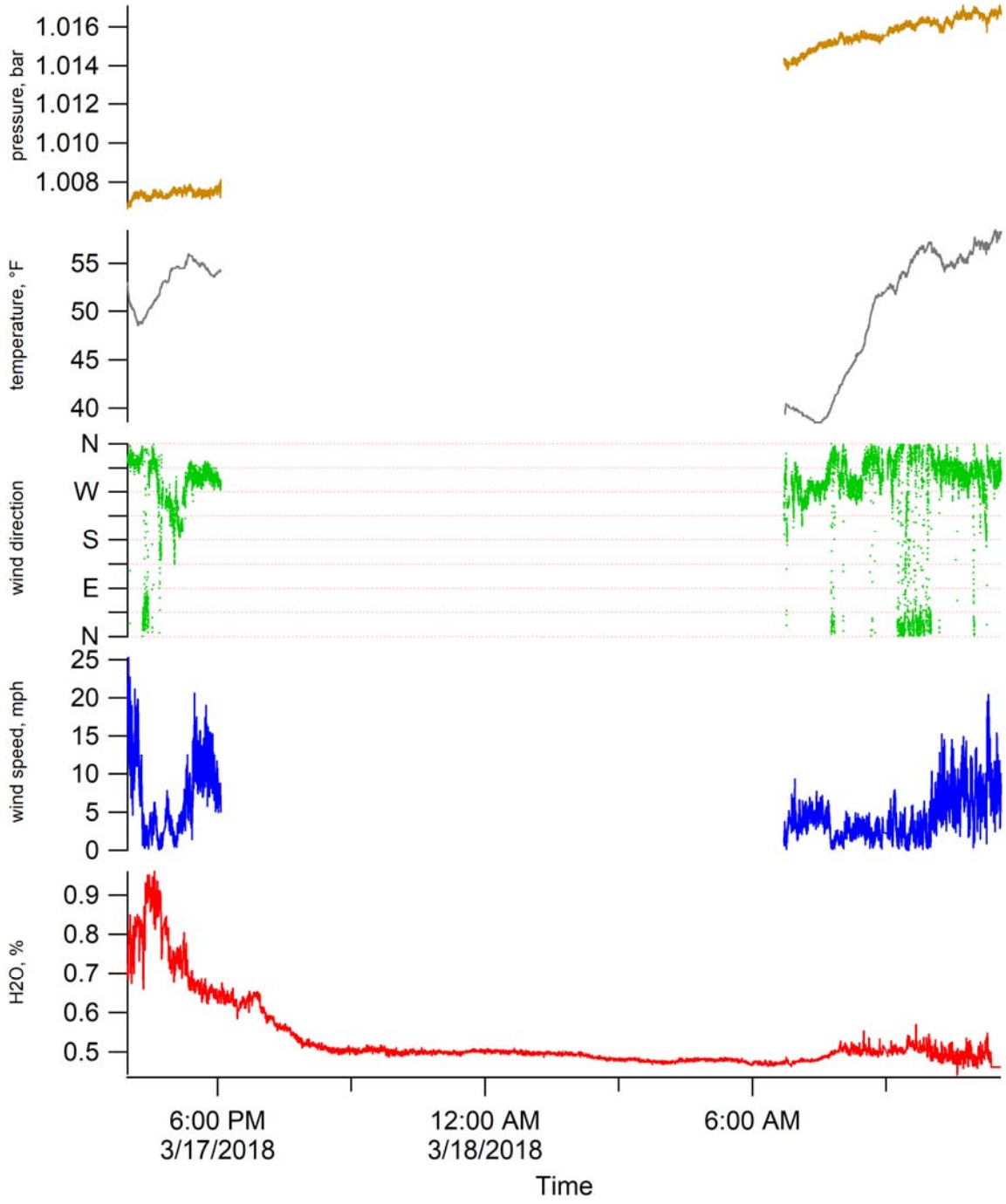


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(MARCH 18, 2018 – MARCH 24, 2018)

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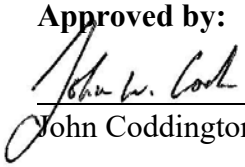
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Acronyms

CAPA	Corrective and Preventative Action
COPC	Chemical of Potential Concern
FTP	File Transfer Protocol
NDMA	N-nitrosodimethylamine
NMEA	N-nitrosomethylethylamine
NMOR	N-nitrosomorpholine
OEL	Occupational Exposure Limit
PTR-MS	Proton Transfer Reaction – Mass Spectrometer
QA	Quality Assurance
QC	Quality Control
RJLG	RJ Lee Group, Inc.
WRPS	Washington River Protection Solutions, LLC

1.0 MARCH 18, 2018 – MARCH 19, 2018 – STUDY SITE #2

1.1 Quality Assessment

Data from March 18, 2018, were transferred to TerraGraphics via the Washington River Protection Solutions, LLC (WRPS) File Transfer Protocol (FTP) site on March 20, 2018. Data were assessed using Procedure 17124-DOE-HS-102, "Mobile Laboratory Data Processing – Analysis." A completed Data Exchange Checklist was sent to WRPS on March 22, 2018. The data were accepted by TerraGraphics with the following comments. All startup, shutdown, and calibration procedures were adequately documented and all other checks passed the acceptance limits. No other exceptions besides those below were noted.

Ammonia data were cut from 08:06 to 09:15 on March 19, 2018, due to an ammonia leak within the van identified in the RJ Lee Group, Inc. (RJLG) field notes. The van doors were opened to ventilate out the ammonia, which resulted in contamination at the inlet for approximately 70 minutes. Mast maintenance occurred at this time.

The Proton Transfer Reactor – Mass Spectrometer (PTR-MS) data were offset from the CO_2 data by approximately 40 seconds for the duration of this data set. Diesel combustion markers formaldehyde and acetaldehyde from the PTR-MS were correlated to the CO_2 data to determine the offset and modify the CO_2 time basement to align with the PTR-MS data. On March 27, 2018, WRPS was notified of this timing error although data quality is not compromised.

1.2 Summary

Krystin Riha, Joe Sears, and Adrielle Olson performed background sampling using the Mobile Laboratory from March 18, 2018, to March 19, 2018, at Study Site 2. Site 2 is located near the northern end of the 200W tank farms. The Mobile Laboratory arrived at Site 2 at 12:55 on March 18, 2018. The initial quality assurance/quality control (QA/QC) zero air/sensitivity checks were performed on the CO_2 monitor, NH_3 monitor, and the PTR-MS beginning at 13:03. Routine data collection resumed by 14:02. The Mobile Laboratory staff departed the monitoring site after performing the final PTR-MS zero air check for the evening at 15:02.

The Mobile Laboratory staff had returned to Site 2 and performed a PTR-MS zero air check by 06:47 on March 19, 2018. The field notes indicate mast maintenance was performed between 08:09 and 10:10, which caused occasional signal increase on all instruments and a "stove pipe" effect from the Mobile Laboratory to the sample inlet was observed. Data from 08:06 to 09:15 was removed from the data set due to apparent contamination of the sample stream caused by the maintenance. During the maintenance, the CO_2 rain shield was removed to stabilize the signal. Closeout zero air/sensitivity checks were performed at 10:43. The Mobile Laboratory moved to Site 3 by 12:02.



Figure 1-1. Mobile Lab Site #2 for the Duration of the Monitoring Period.

1.3 Samples Collected

Continuous air monitoring was performed using the following instrumentation:

- PTR-MS,
- LI-COR®[1] CO_2 Monitor,
- Picarro Ammonia Monitor, and
- Weather Station.

Confirmatory air samples were collected as follows:

Table 1-1. Alternative Media Samples Taken.

Site	Date	Sample Type	ID	Start	Stop	Sample Time (min)
2	18-Mar	Thermosorb/N	EL22207	13:07	16:07	180
2	18-Mar	CarboTrap-300	A046065	13:12	14:24	71
2	19-Mar	Thermosorb/N	EL22213	06:57	09:59	180
2	19-Mar	CarboTrap-300	A045488	07:05	08:22	75

Table 1-2 displays the statistical information for the monitoring period of March 18, 2018, to March 19, 2018. By definition, the occupational exposure limit (OEL) is an 8-hour, time-weighted average that establishes a limit for personnel exposures to hazardous chemicals. It is the exposure level to which a person may be exposed for 8 hours/day, 40 hours/week for 40 years and have no expectation of adverse health effects. In this study, area vapor concentration measurements were made to better understand the hazardous vapor exposures that workers may receive. These measurements are only compared to OEL concentrations to give them context. It

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

is neither accurate nor appropriate to interpret these short duration measurements (2 seconds) as worker exposure levels. Since the OEL is defined as a time-weighted average, it is more appropriate to compare them to daily average vapor concentrations. Short duration excursions above the OEL concentration are not significant.

Table 1-2. Statistical Information for the Monitoring Period of March 18, 2018 –March 19, 2018.

COPC #	COPC Name	Reporting Limit (PPB)	OEL (ppb)	Ave. (PPB)	St. Dev. (PPB)	Rel. St. Dev. (%)	Max (PPB)	Median (PPB)	Sec. over 50% OEL	Sec. over OEL
1	ammonia	1	25000	7.94	4.74	59.7%	35.55	5.04	0	0
2	furan	0.09	1	0.046	0.020	90.1%	0.460	0.019	0	0
3	but-3-en-2-one + 2,3-dihydrofuran + 2,5-dihydrofuran	0.22	1	0.114	0.055	138.3%	N/A*	N/A*	N/A	N/A
4	NDMA**	0.06	0.3	0.034	0.024	109.5%	0.147	0.015	0	0
5	2-methylfuran	0.05	1	0.028	0.025	109.0%	0.552	0.019	4	0
6	NEMA	0.02	0.3	0.014	0.013	180.6%	0.381	0.000	16	4
7	2,5-dimethylfuran	0.05	1	0.027	0.020	118.3%	0.438	0.013	0	0
8	NDEA	0.01	0.1	0.007	0.006	190.8%	0.051	0.000	2	0
9	2-propylfuran + 2-ethyl-5-methylfuran	0.02	1	0.012	0.010	125.1%	0.192	0.006	0	0
10	NMOR	0.05	0.6	0.025	0.005	110.0%	0.081	0.004	0	0
11	2-ethyl-2-hexenal + 4-(1-methylpropyl)-2,3-dihydrofuran + 3-(1,1-dimethylethyl)-2,3-dihydrofuran	0.04	1	0.021	0.009	68.3%	0.148	0.012	0	0
12	2-pentylfuran	0.04	1	0.021	0.010	50.7%	0.144	0.018	0	0
13	2-heptylfuran	0.02	1	0.010	0.005	66.3%	0.085	0.006	0	0
14	2-octylfuran	0.01	1	0.005	0.002	203.7%	0.031	0.000	0	0
15	6-(2-furanyl)-6-methyl-2-heptanone	0.01	1	0.005	0.002	163.8%	0.021	0.000	0	0
16	furfural acetophenone	0.07	1	0.035	0.004	57.4%	0.028	0.006	0	0

* The maximum peak value for but-3-en-2-one + 2,3 dihydrofuran + 2,5 dihydrofuran was 1.749 ppb and the median value was 0.031 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 200, 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 each chemical of potential concern (COPC) signal, overlaid with the same signal smoothed using a 1-minute moving average, and CO_2, for the monitoring period March 18, 2018 to March 19, 2018.

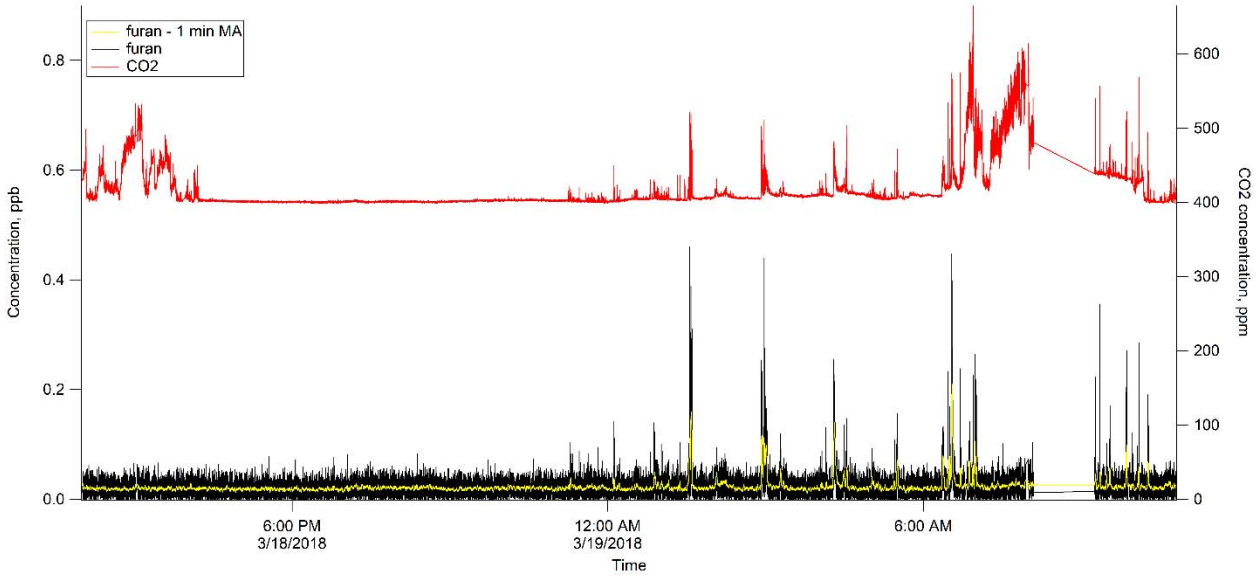


Figure 1-2. Furan.

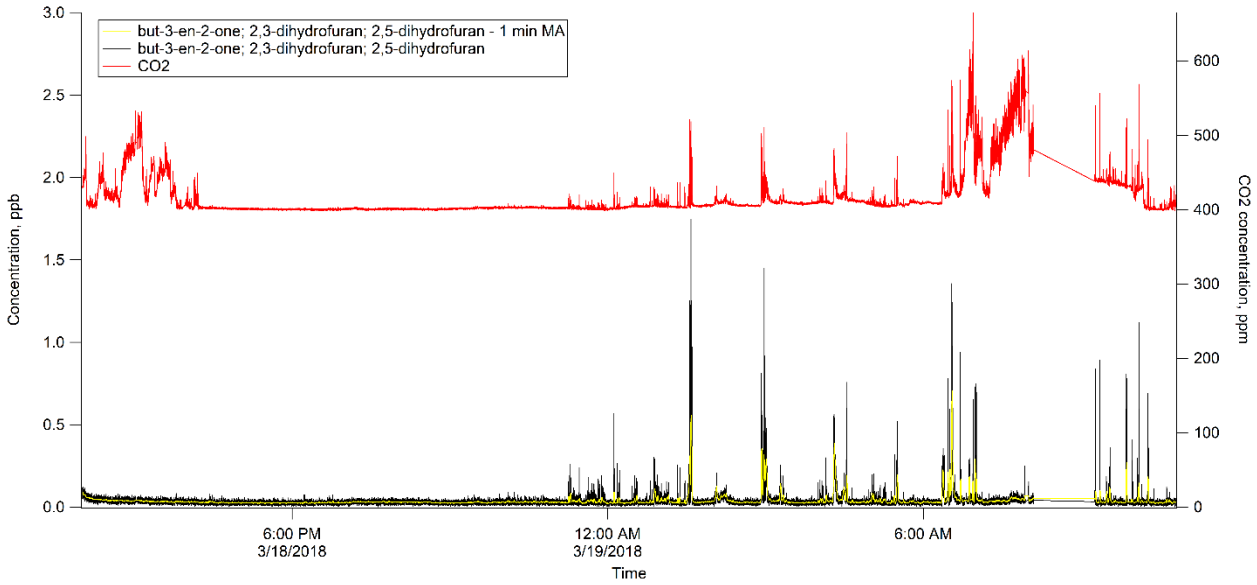


Figure 1-3. -3-en-2-one + 2,3-dihydrofuran + 2,5-dihydrofuran.

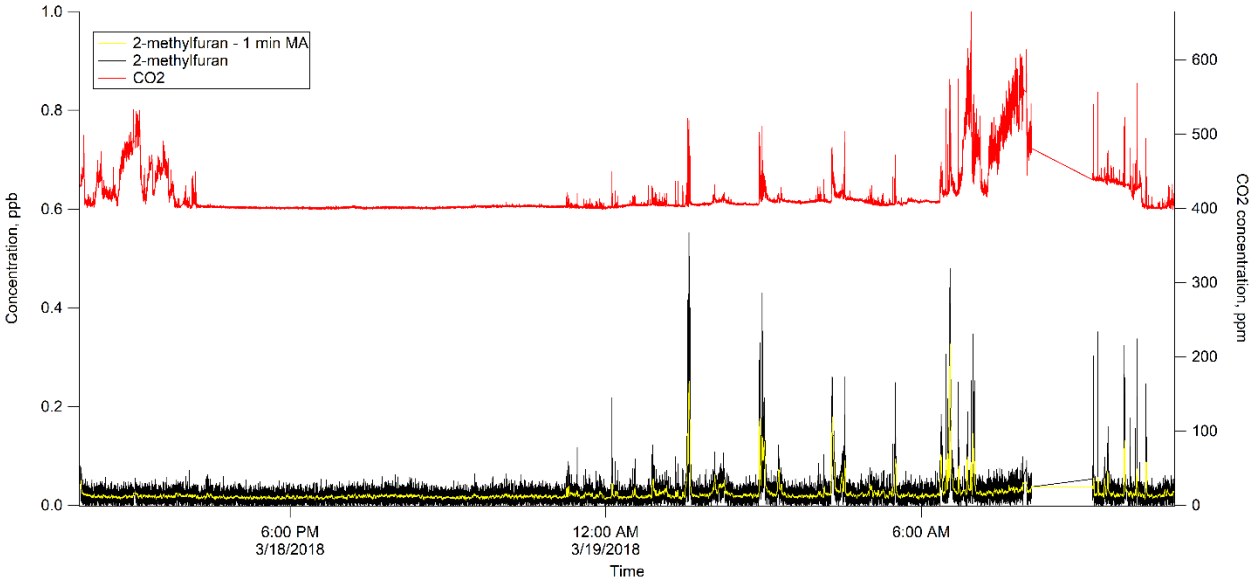


Figure 1-4. 2-methylfuran.

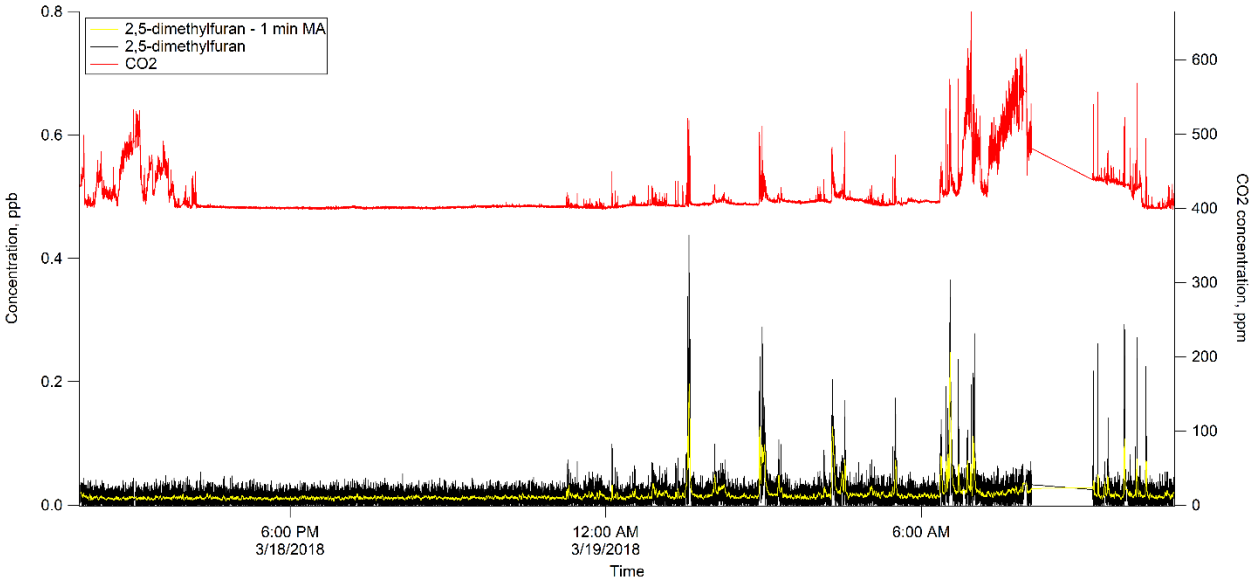


Figure 1-5. 2,5-dimethylfuran.

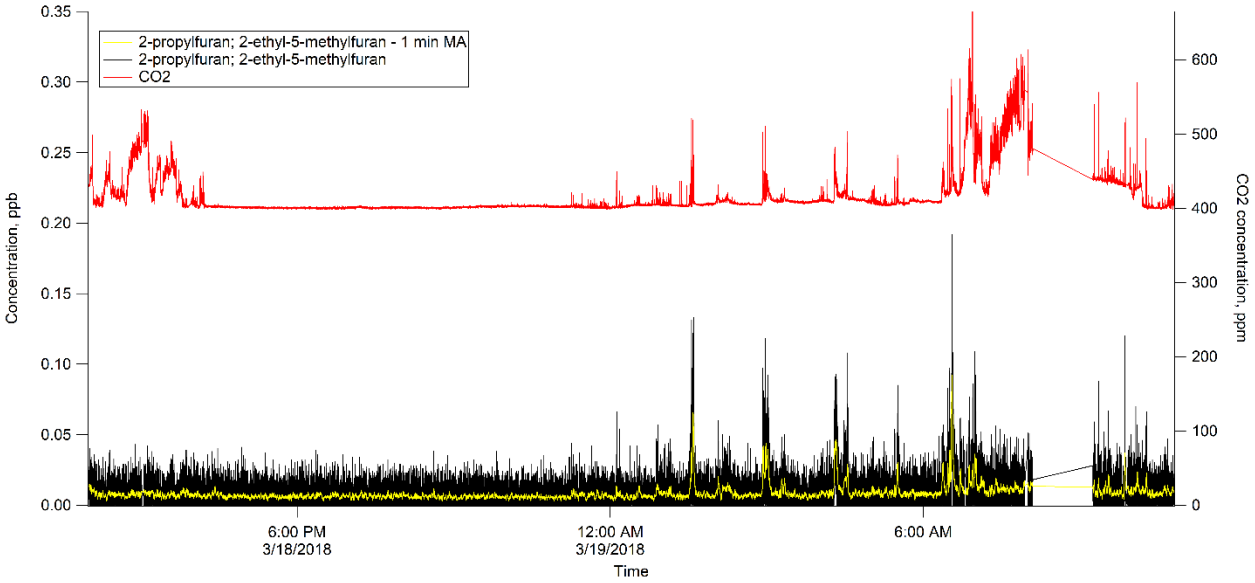


Figure 1-6. 2-propylfuran + 2-ethyl-5-methylfuran.

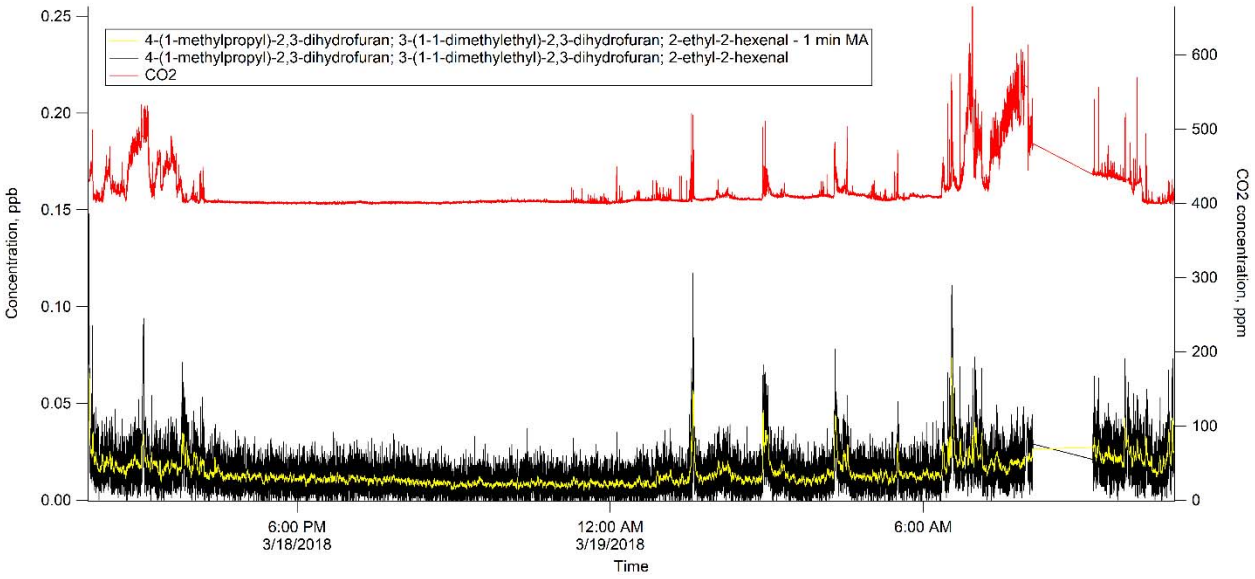


Figure 1-7. 4-(1-methylpropyl)-2,3-dihydrofuran + 3-(1,1-dimethylethyl)-2,3-dihydrofuran + 2-ethyl-2-hexenal.

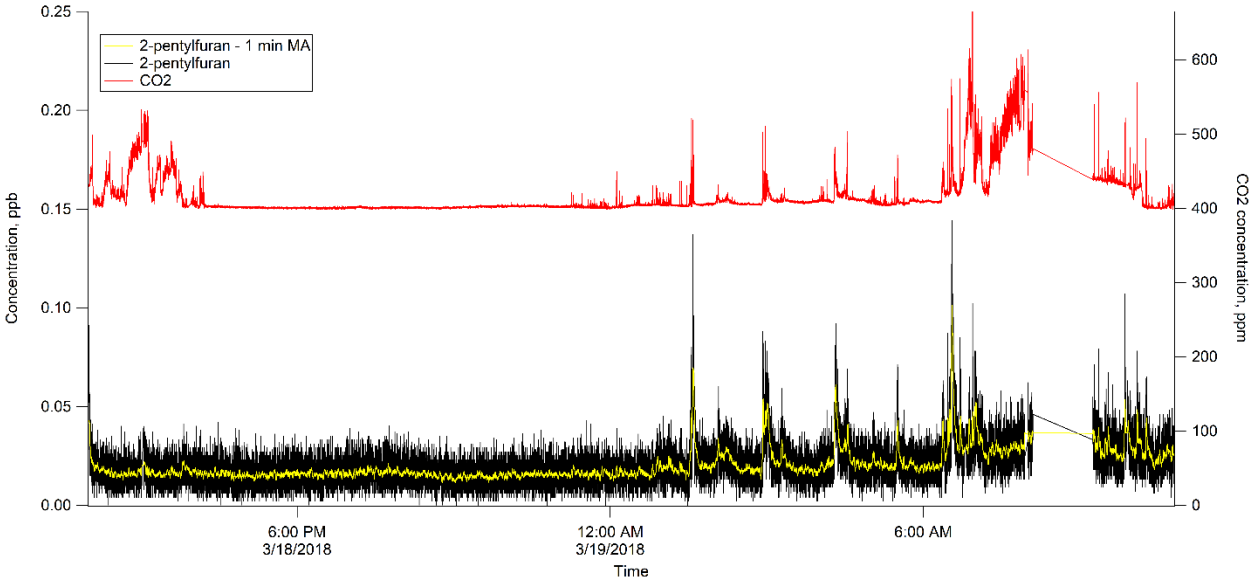


Figure 1-8. 2-pentylfuran.

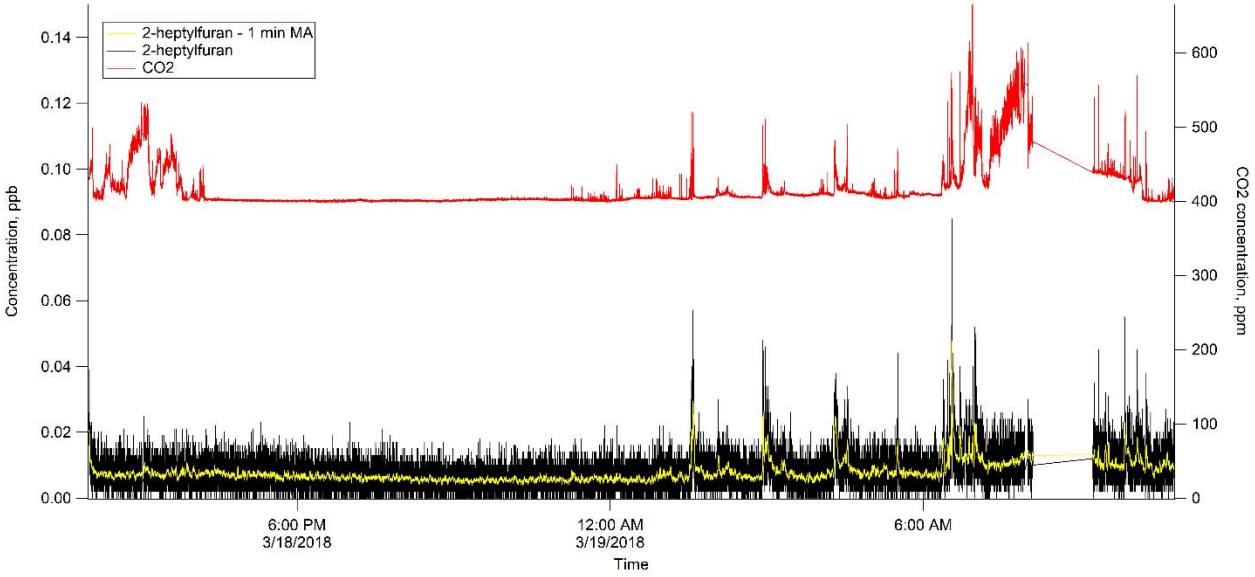


Figure 1-9. 2-heptylfuran.

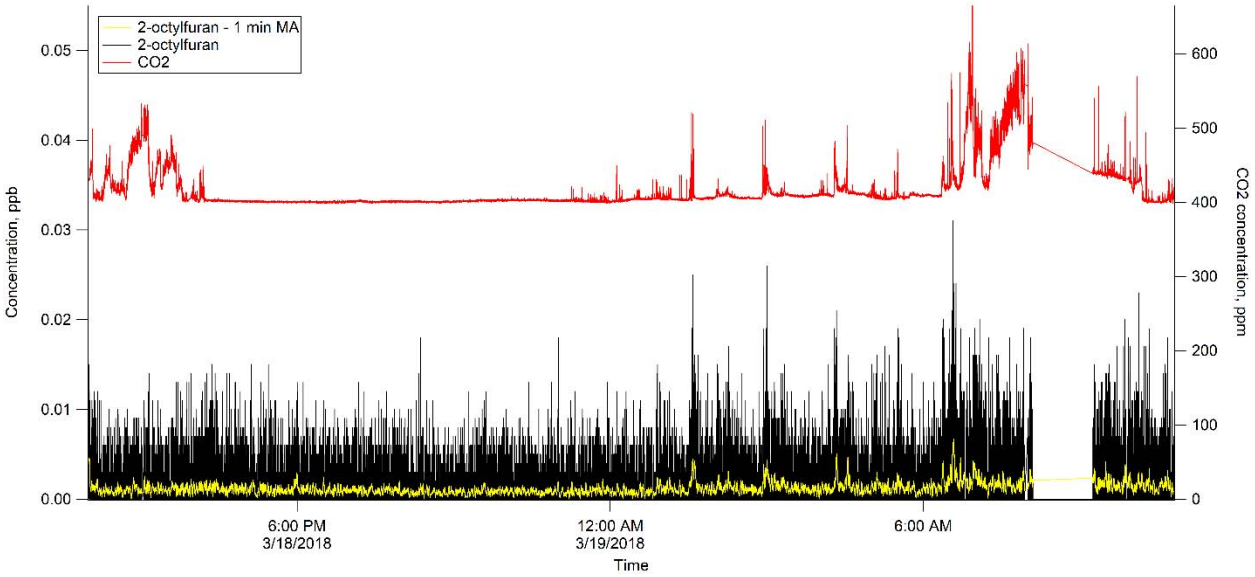


Figure 1-10. 2-octylfuran.

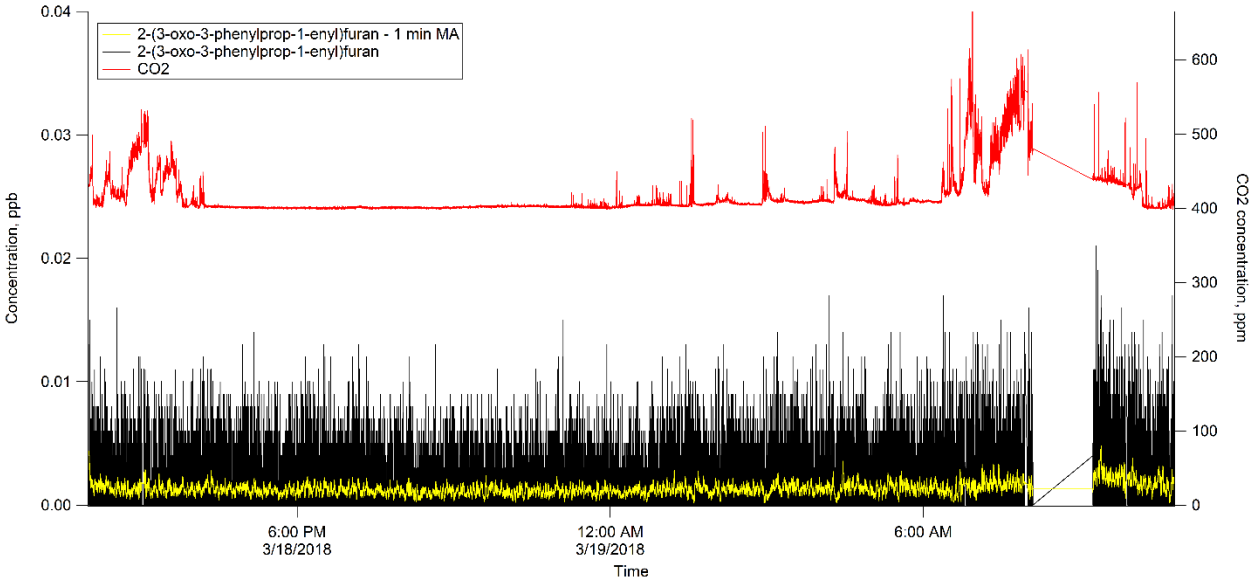


Figure 1-11. 2-(3-oxo-3-phenylprop-1-enyl)furan.

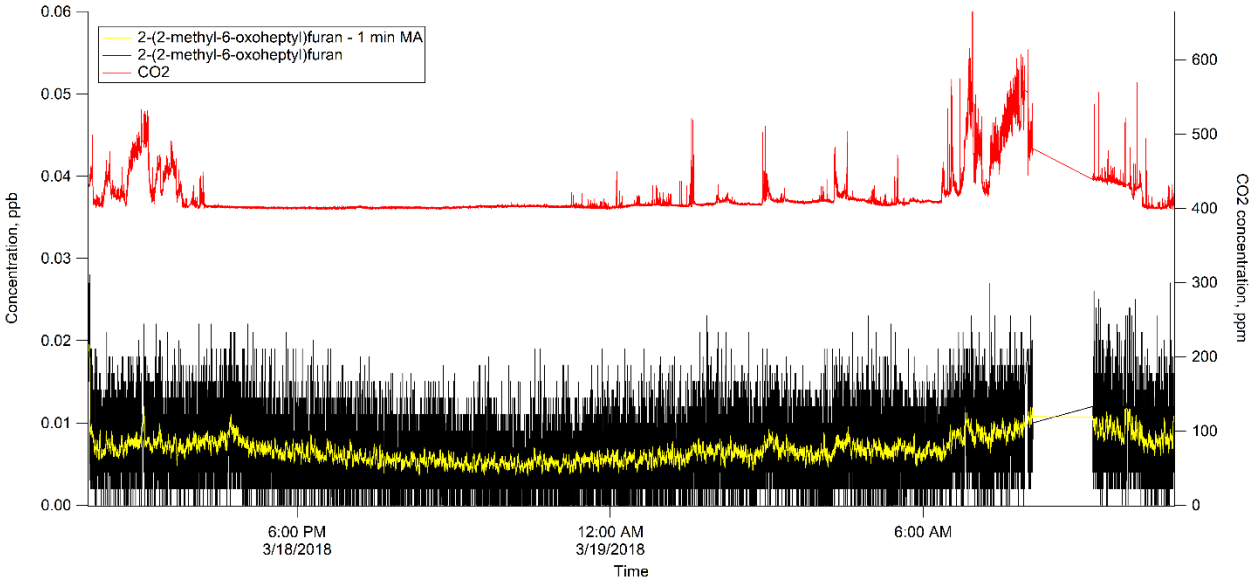


Figure 1-12. 2-(2-methyl-6-oxoheptyl)furan.

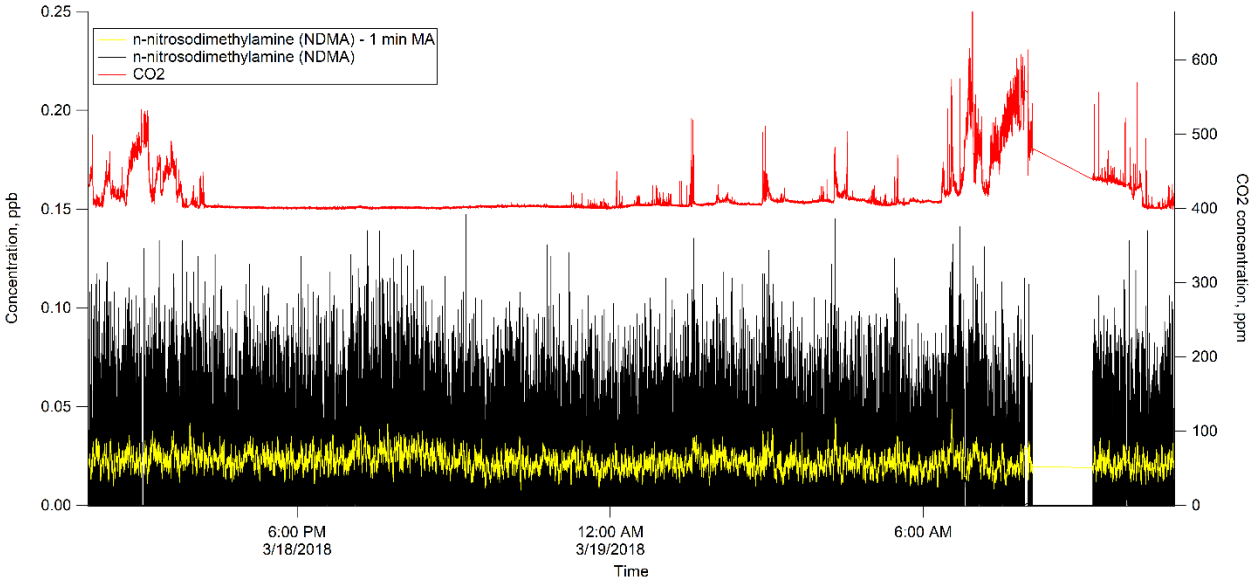


Figure 1-13. N-nitrosodimethylamine (NDMA).

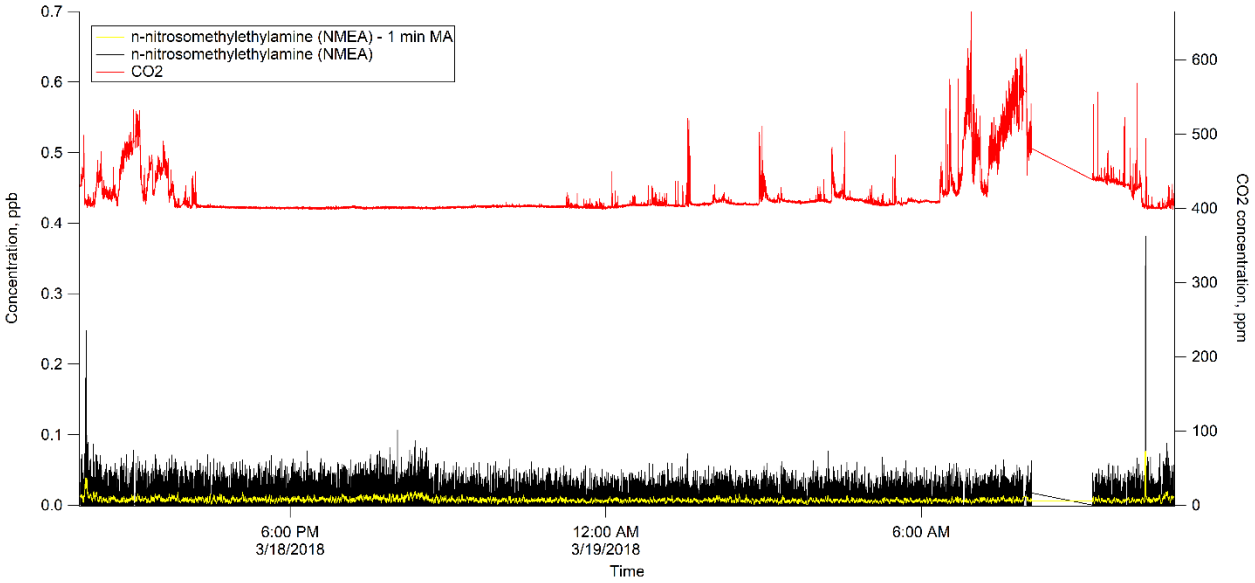


Figure 1-14. N-nitrosomethylethylamine (NMEA).

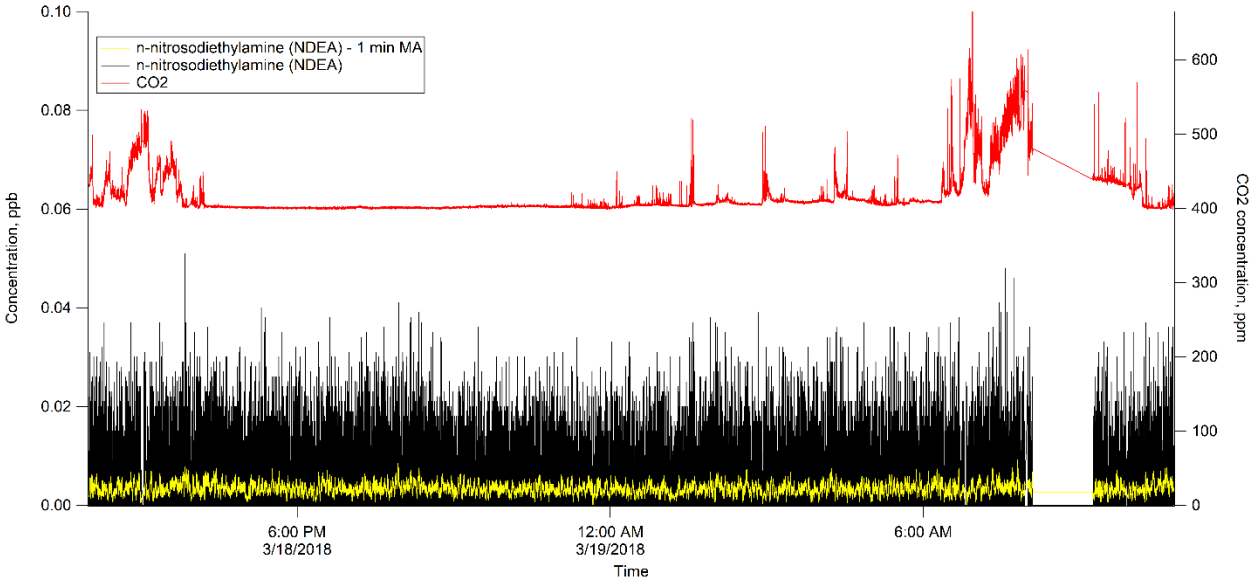


Figure 1-15. N-nitrosodiethylamine (NDEA).

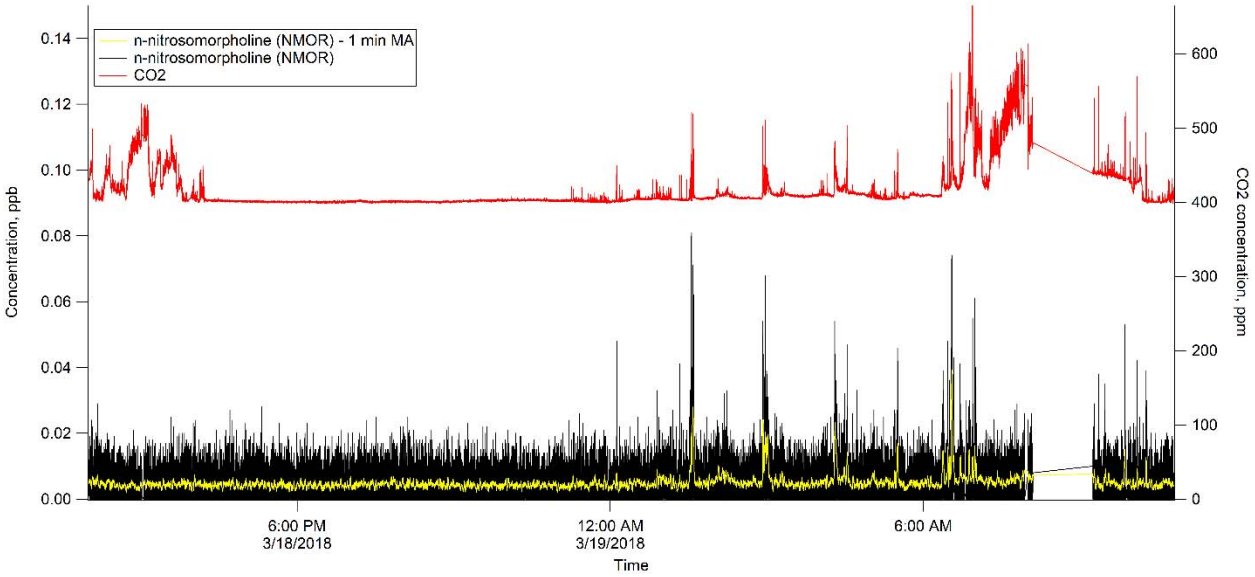


Figure 1-16. N-nitrosomorpholine (NMOR).

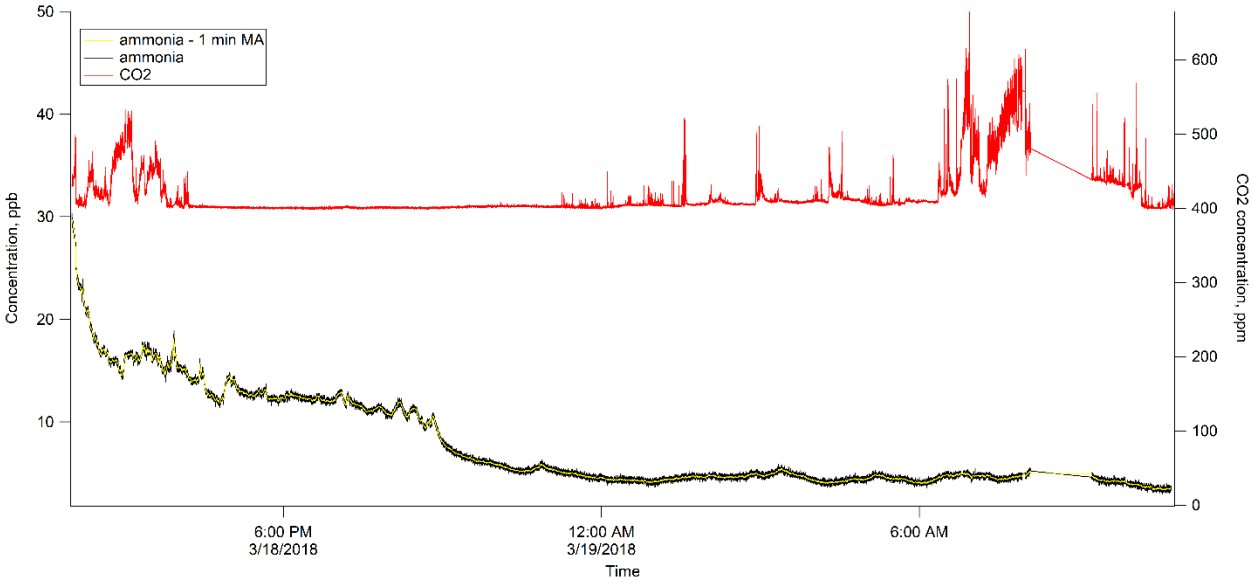


Figure 1-17. Ammonia.

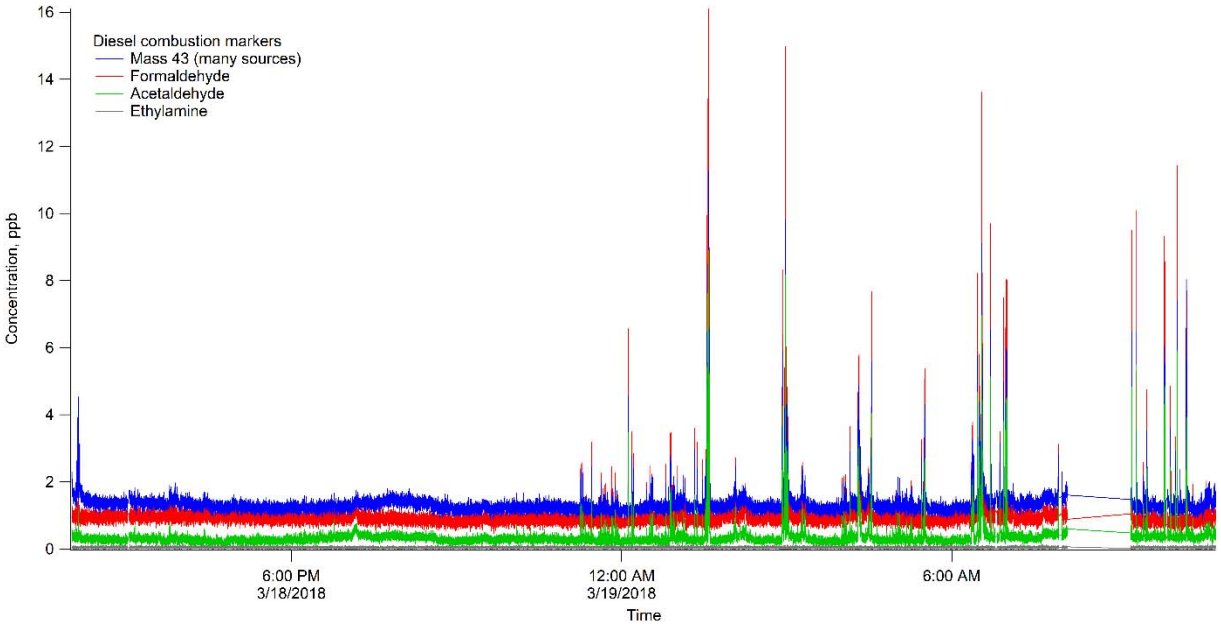


Figure 1-18. Diesel Combustion Markers.

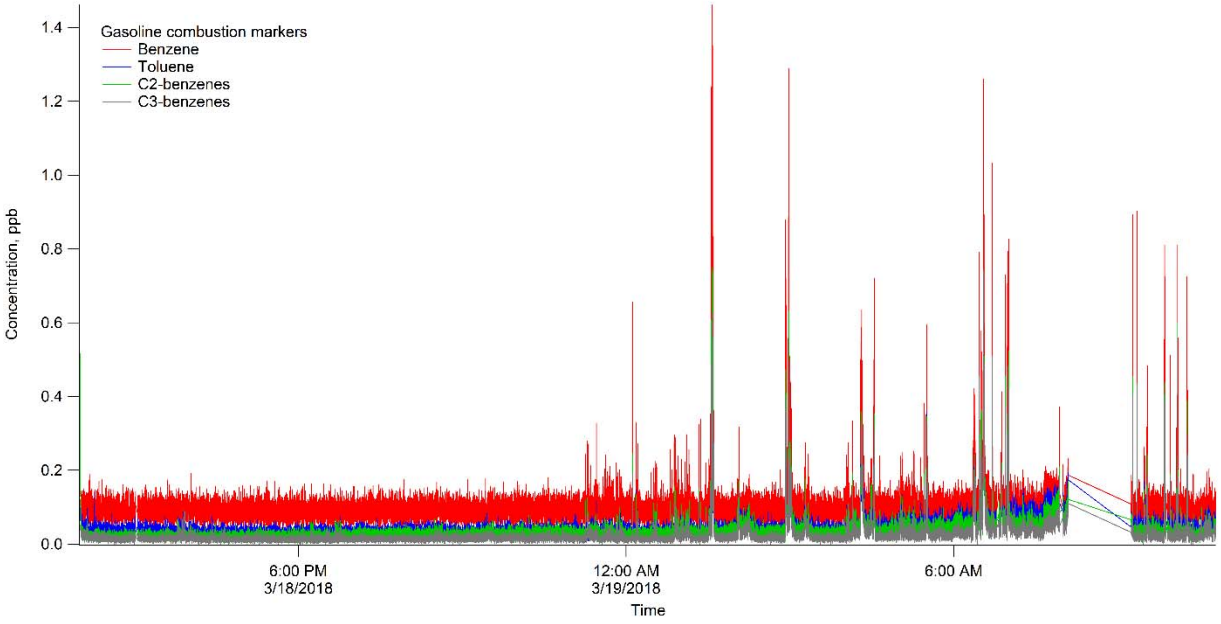


Figure 1-19. Gasoline Combustion Markers.

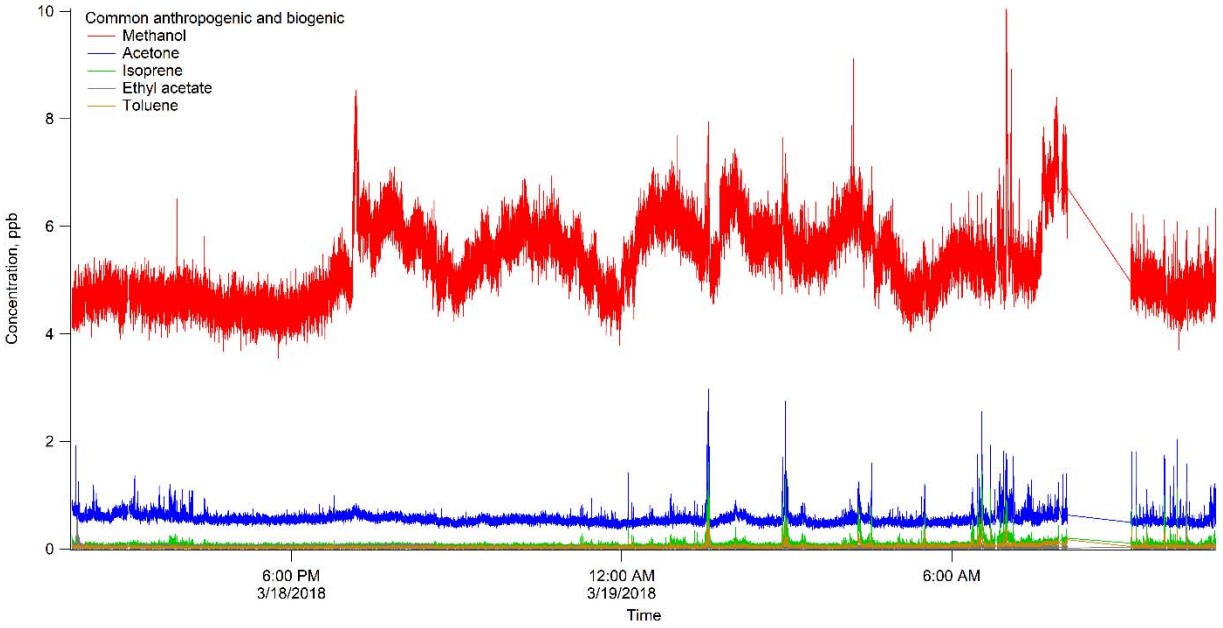


Figure 1-20. Plant and Human Markers.

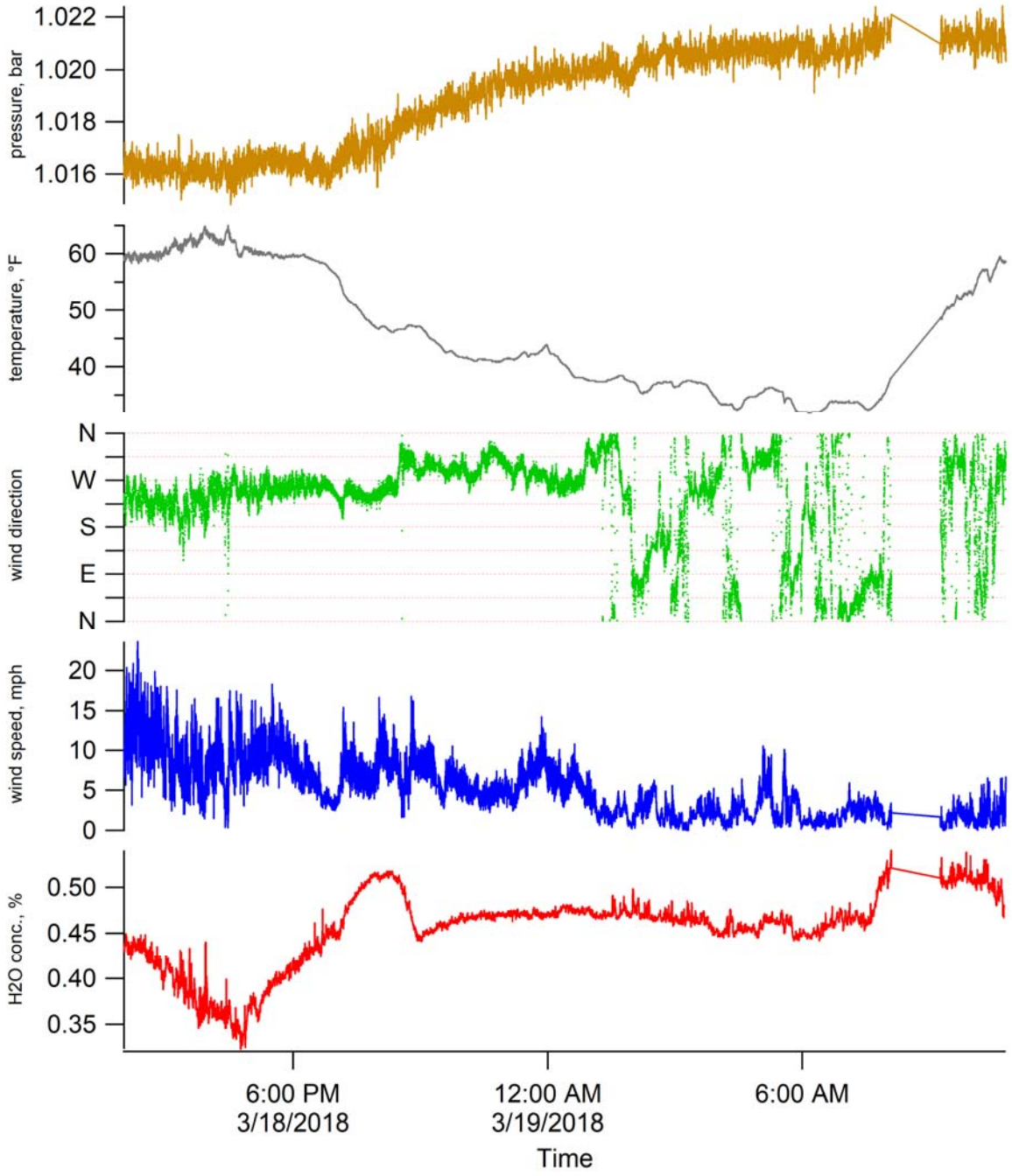


Figure 1-21. Weather Data.

2.0 MARCH 19, 2018 – MARCH 20, 2018 – STUDY SITE #3

2.1 Quality Assessment

Data from March 19, 2018, were transferred to TerraGraphics via the WRPS FTP site on March 26, 2018. Data were assessed using Procedure 17124-DOE-HS-102. A completed Data Exchange Checklist was sent to WRPS on March 28, 2018. The data were accepted by TerraGraphics with the following comments. All startup, shutdown, and calibration procedures were adequately documented and all other checks passed the acceptance limits. No other exceptions besides those below were noted.

Ammonia final check/zero data file stated in the procedure as AEES2077-20180320-174840Z starting at 10:49 on March 20, 2018, is missing from the FTP.

Using diesel combustion markers from the PTR-MS and CO_2 from the LI-COR, there is a 3-second time offset between the CO_2 and PTR-MS data. This was considered a minor error for background study deployment and the data streams were not adjusted. On March 30, 2018, WRPS was notified of this time offset.

2.2 Summary

Joe Sears, Krystin Riha, and Robert White performed background sampling using the Mobile Laboratory from March 19, 2018, to March 20, 2018, at Study Site 3. Site 3 is located near the corner of 4th and Buffalo just to the west of the 242-A Evaporator. This site was chosen as it historically has seen the occurrence of several AOP-15 events. The Mobile Laboratory arrived at Site 3 at 12:02 on March 19, 2018. The initial QA/QC zero air/sensitivity checks were performed on the CO_2 monitor, NH_3 monitor, and the PTR-MS beginning at 12:05. Routine data collection resumed by 13:10. The Mobile Laboratory staff departed the monitoring site after performing the final PTR-MS zero air check for the evening at 15:56.

The Mobile Laboratory staff had returned to Site 3 and performed a PTR-MS zero air check by 06:42 on March 20, 2018. The exhaust location was changed at 09:00. Closeout zero air/sensitivity checks were performed at 10:52. The Mobile Laboratory moved to Site 4 by 12:30.



Figure 2-1. Mobile Laboratory Site #3 for the Duration of the Monitoring Period.

2.3 Samples Collected

Continuous air monitoring was performed using the following instrumentation:

- PTR-MS,
- LI-COR CO_2 Monitor,
- Picarro Ammonia Monitor, and
- Weather Station.

Confirmatory air samples were collected as follows.

Table 2-1. Alternative Media Samples Taken.

Site	Date	Sample Type	ID	Start	Stop	Sample Time (min)
3	19-Mar	Thermosorb/N	EL22210	12:14	15:17	180
3	19-Mar	CarboTrap-300	A020954	12:18	13:28	70
3	20-Mar	Thermosorb/N	EL22212	06:55	09:56	180
3	20-Mar	CarboTrap-300	A046036	07:02	08:15	73

Table 2-2 displays the statistical information for the monitoring period of March 19, 2018, to March 20, 2018. By definition, the OEL is an 8-hour, time-weighted average that establishes a limit for personnel exposures to hazardous chemicals. It is the exposure level to which a person may be exposed for 8 hours/day, 40 hours/week for 40 years and have no expectation of adverse health effects. In this study, area vapor concentration measurements were made to better understand the hazardous vapor exposures that workers may receive. These measurements are only compared to OEL concentrations to give them context. It is neither accurate nor appropriate

to interpret these short duration measurements (2 seconds) as worker exposures levels. Since the OEL is defined as a time-weighted average, it is more appropriate to compare them to daily average vapor concentrations. Short duration excursions above the OEL concentration are not significant.

Table 2-2. Statistical Information for the Monitoring Period of March 19, 2018 – March 20, 2018.

COPC #	COPC Name	Reporting Limit (PPB)	OEL (ppb)	Ave. (PPB)	St. Dev. (PPB)	Rel. St. Dev. (%)	Max (PPB)	Median (PPB)	Sec. over 50% OEL	Sec. over OEL
1	ammonia	1	25000	6.21	3.11	50.0%	13.30	4.92	0	0
2	furan	0.09	1	0.046	0.022	103.8%	0.552	0.018	6	0
3	but-3-en-2-one + 2,3-dihydrofuran + 2,5-dihydrofuran	0.22	1	0.115	0.065	172.0%	N/A*	N/A*	N/A	N/A
4	NDMA**	0.06	0.3	0.033	0.023	123.1%	0.207	0.009	8	0
5	2-methylfuran	0.05	1	0.030	0.028	130.2%	0.786	0.016	34	0
6	NEMA	0.02	0.3	0.013	0.012	172.6%	0.095	0.000	0	0
7	2,5-dimethylfuran	0.05	1	0.028	0.023	132.8%	0.554	0.012	4	0
8	NDEA	0.01	0.1	0.006	0.006	192.9%	0.042	0.000	0	0
9	2-propylfuran + 2-ethyl-5-methylfuran	0.02	1	0.012	0.011	141.2%	0.187	0.004	0	0
10	NMOR	0.05	0.6	0.025	0.006	120.2%	0.117	0.003	0	0
11	2-ethyl-2-hexenal + 4-(1-methylpropyl)-2,3-dihydrofuran + 3-(1,1-dimethylethyl)-2,3-dihydrofuran	0.04	1	0.021	0.013	118.7%	1.034	0.009	8	2
12	2-pentylfuran	0.04	1	0.021	0.012	64.4%	0.184	0.016	0	0
13	2-heptylfuran	0.02	1	0.011	0.006	78.6%	0.096	0.006	0	0
14	2-octylfuran	0.01	1	0.005	0.002	223.3%	0.042	0.000	0	0
15	6-(2-furanyl)-6-methyl-2-heptanone	0.01	1	0.005	0.002	171.1%	0.027	0.000	0	0
16	furfural acetophenone	0.07	1	0.035	0.004	63.1%	0.025	0.006	0	0

* The maximum peak value for but-3-en-2-one + 2,3 dihydrofuran + 2,5 dihydrofuran was 2.205 ppb and the median value was 0.025 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 200, 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 each COPC signal, overlaid with the same signal smoothed using a 1-minute moving average, and CO_2, for the monitoring period March 19, 2018, to March 20, 2018.

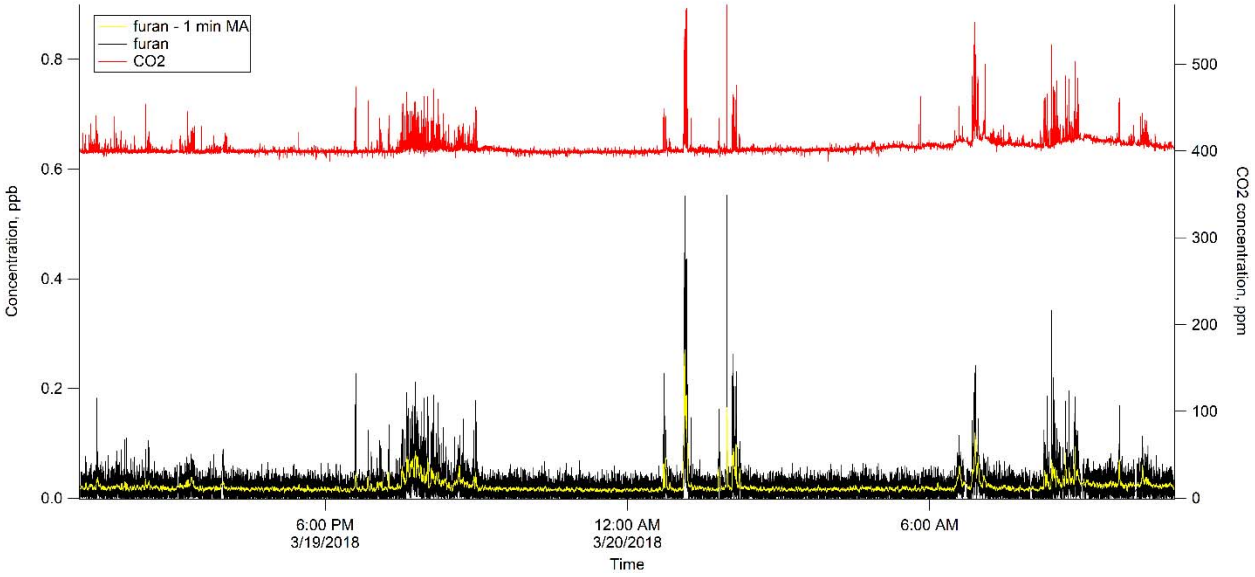


Figure 2-2. Furan.

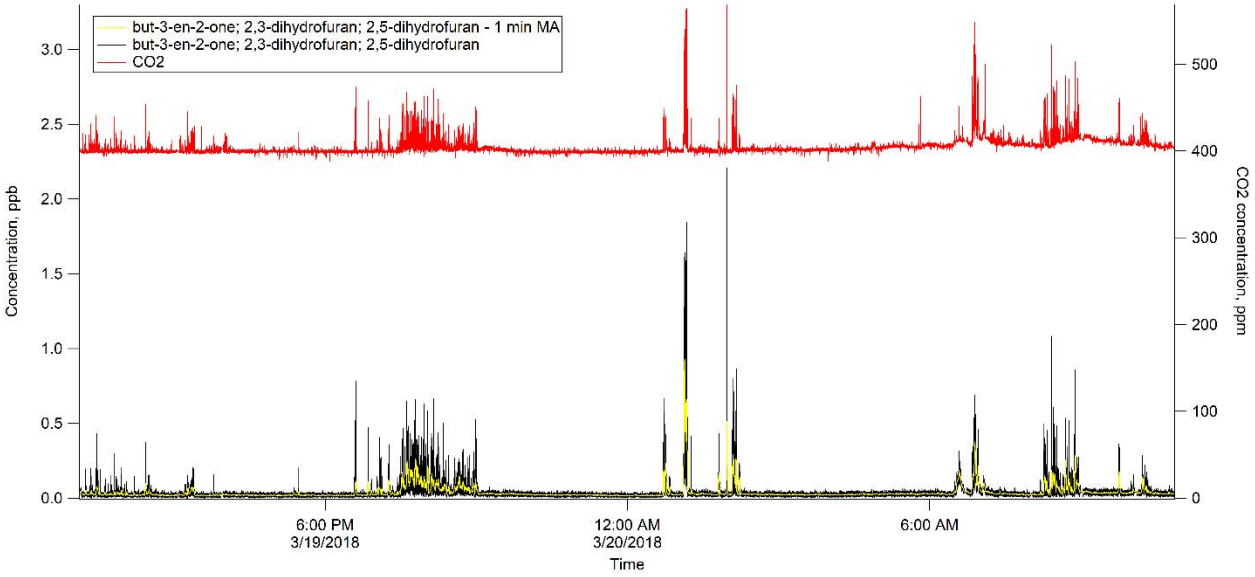


Figure 2-3. -3-en-2-one + 2,3-dihydrofuran + 2,5-dihydrofuran.

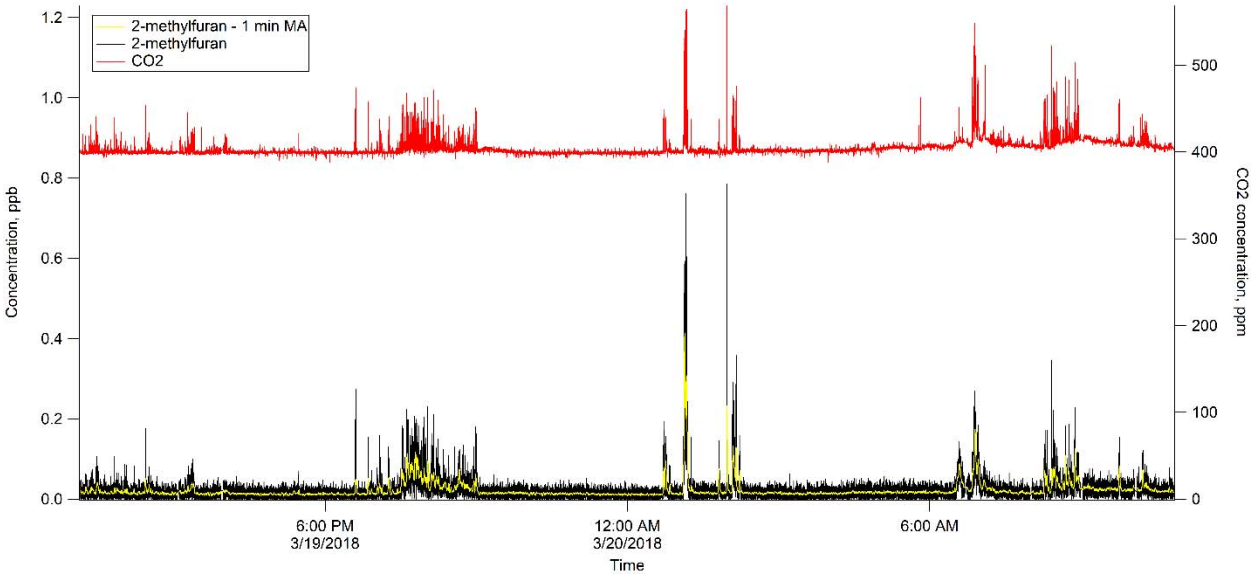


Figure 2-4. 2-methylfuran.

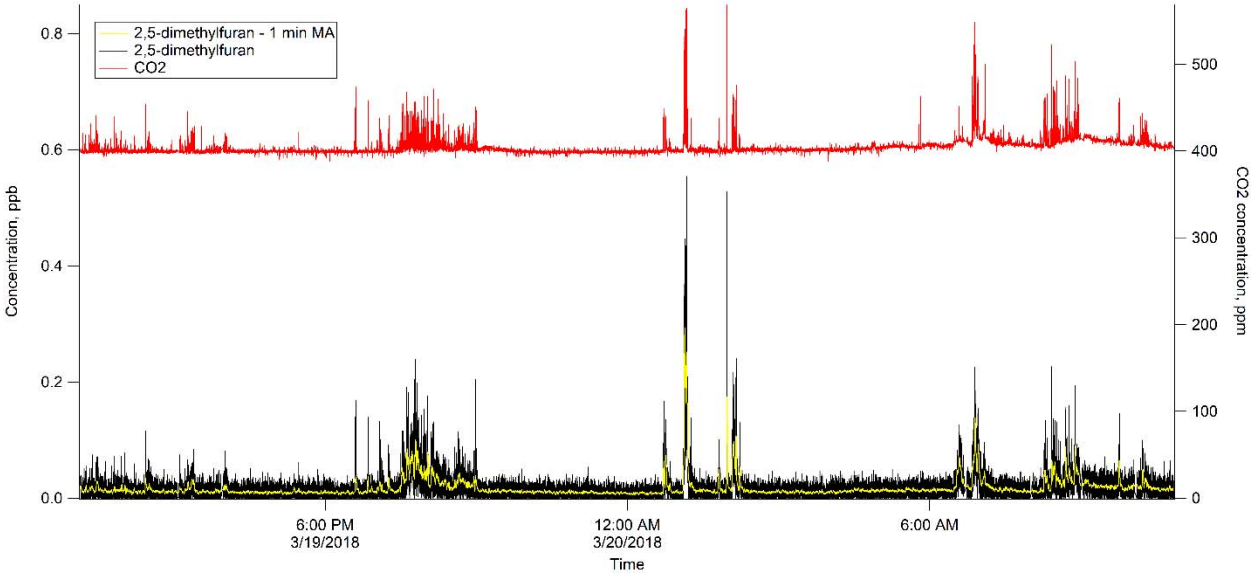


Figure 2-5. 2,5-dimethylfuran.

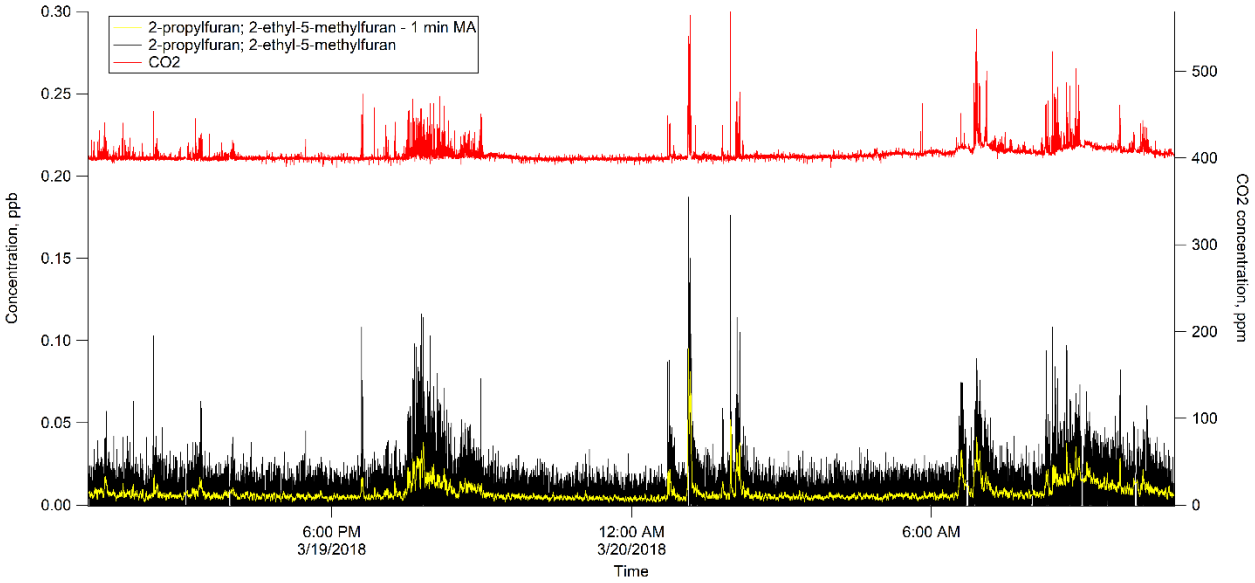


Figure 2-6. 2-propylfuran + 2-ethyl-5-methylfuran.

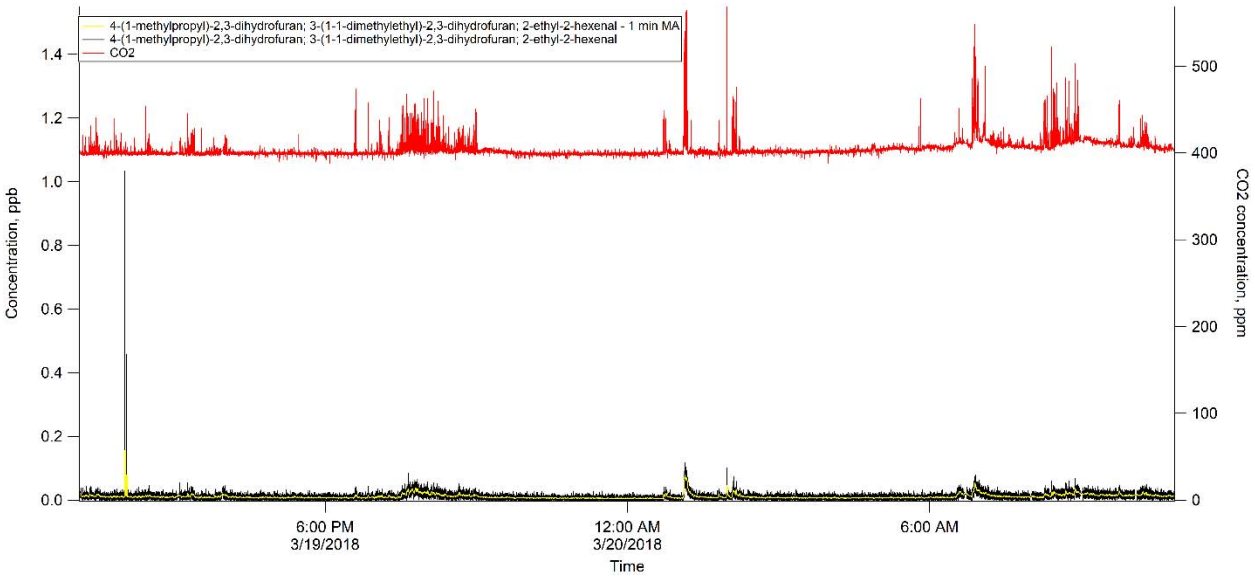


Figure 2-7. 4-(1-methylpropyl)-2,3-dihydrofuran + 3-(1,1-dimethylethyl)-2,3-dihydrofuran + 2-ethyl-2-hexenal.

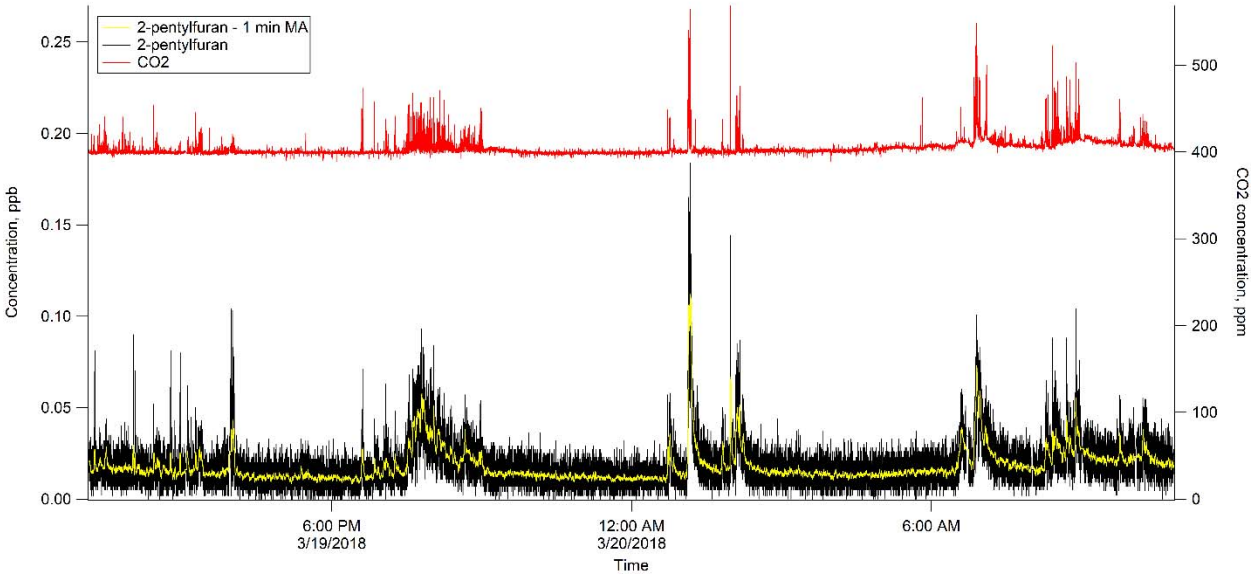


Figure 2-8. 2-pentylfuran.

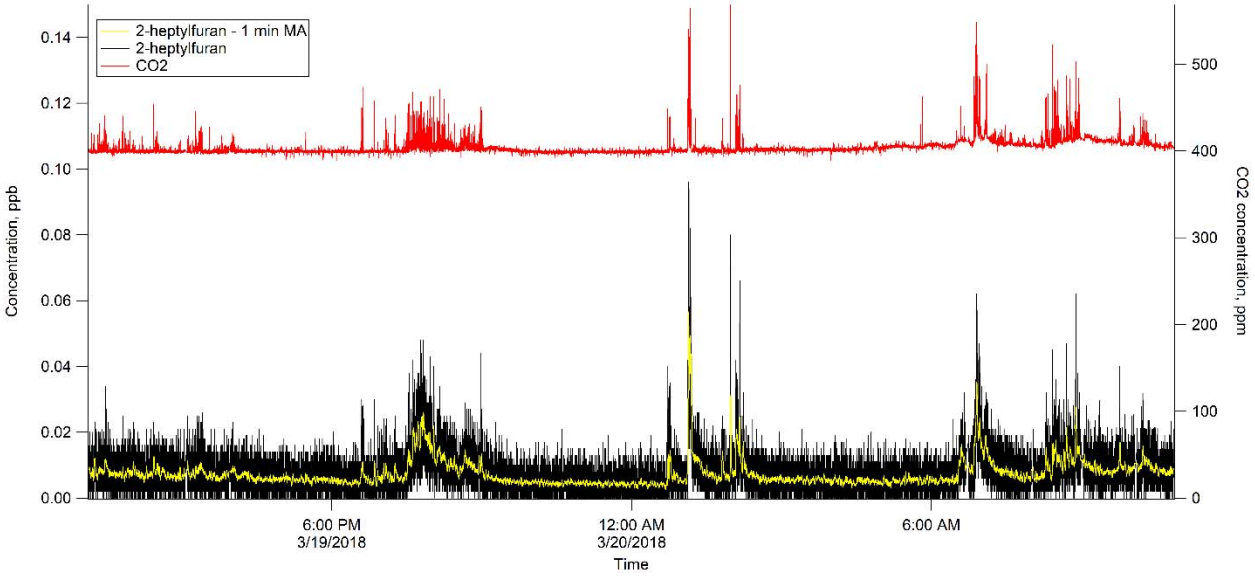


Figure 2-9. 2-heptylfuran.

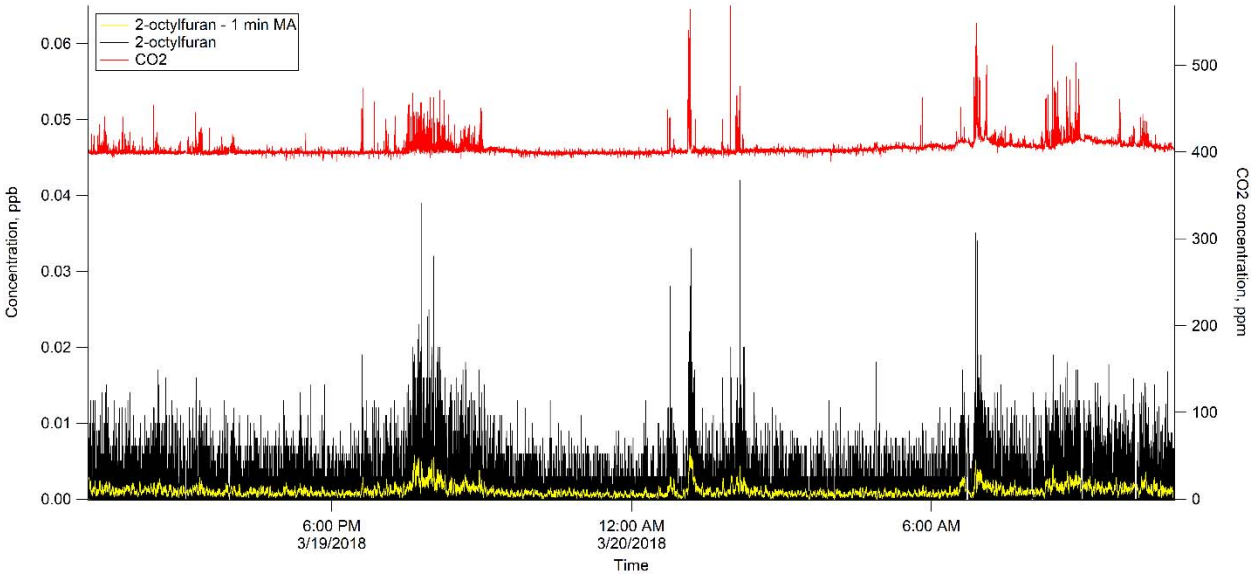


Figure 2-10. 2-octylfuran.

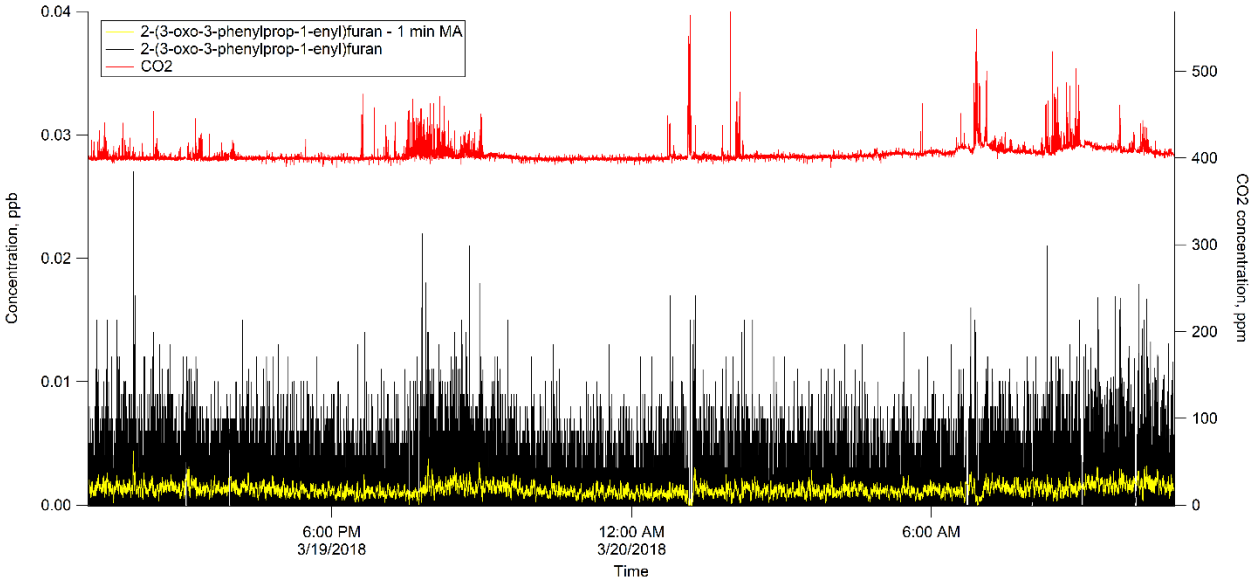


Figure 2-11. 2-(3-oxo-3-phenylprop-1-enyl)furan.

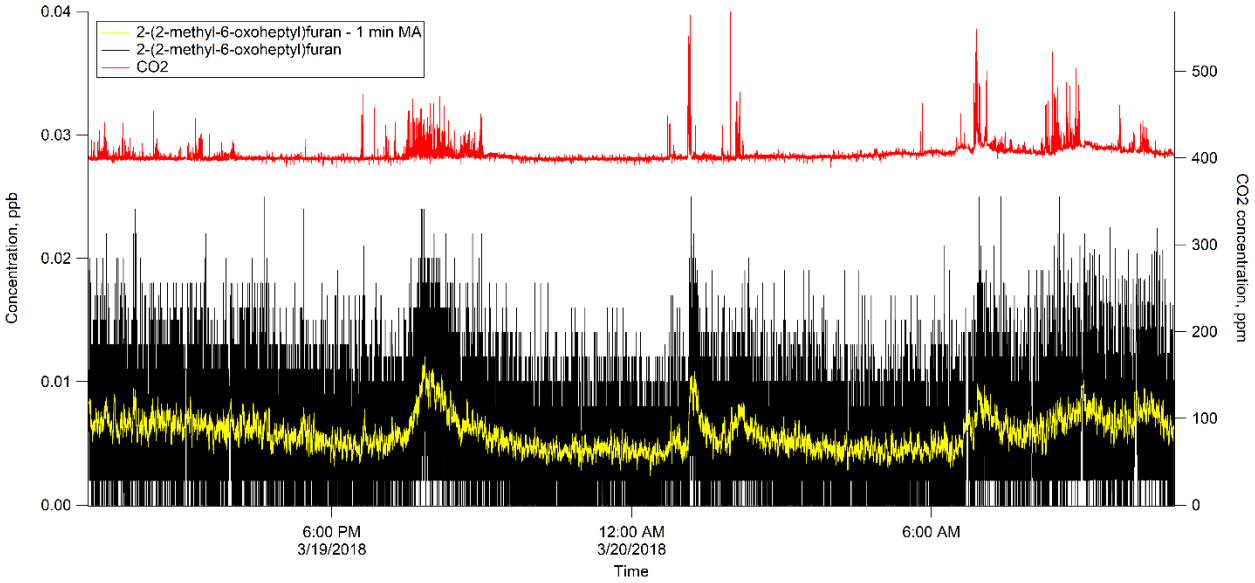


Figure 2-12. 2-(2-methyl-6-oxoheptyl)furan.

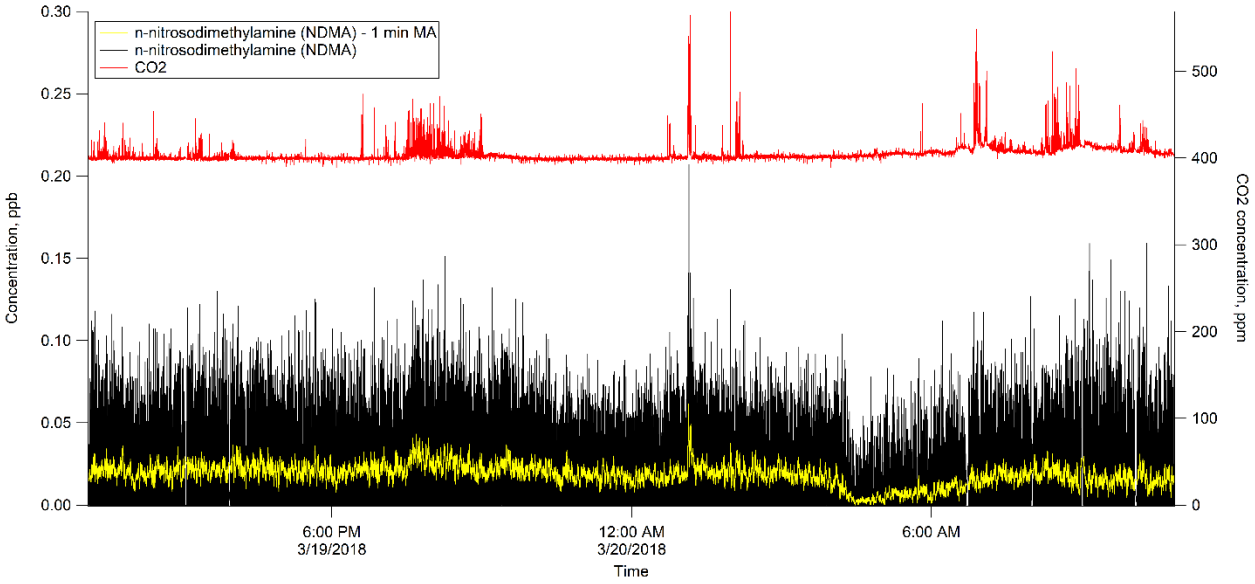


Figure 2-13. N-nitrosodimethylamine (NDMA).

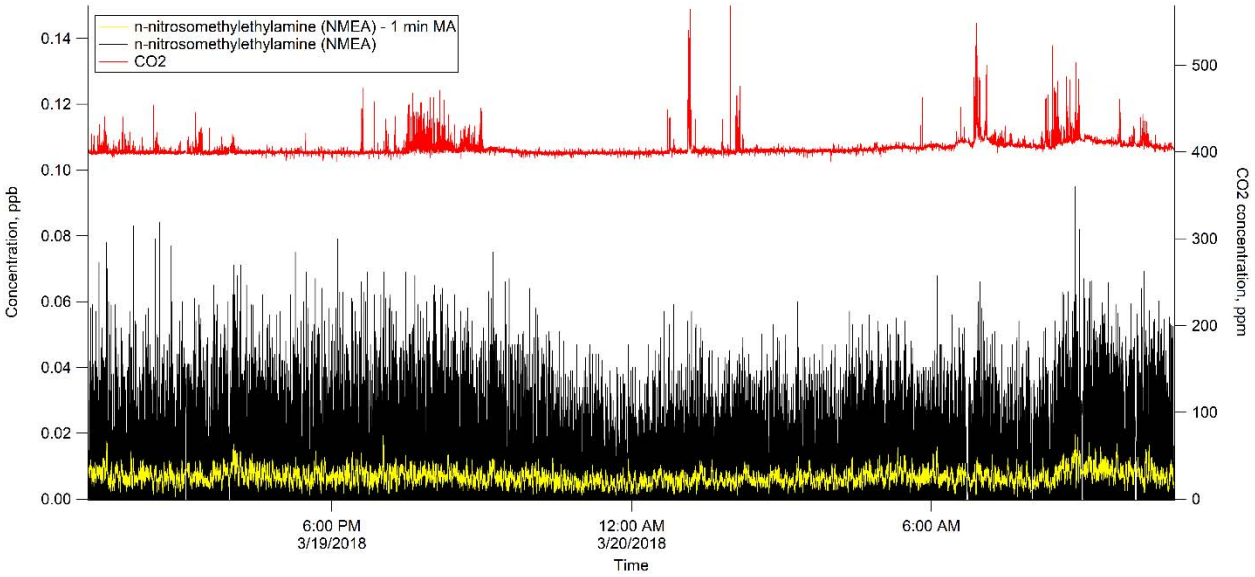


Figure 2-14. N-nitrosomethylethylamine (NMEA).

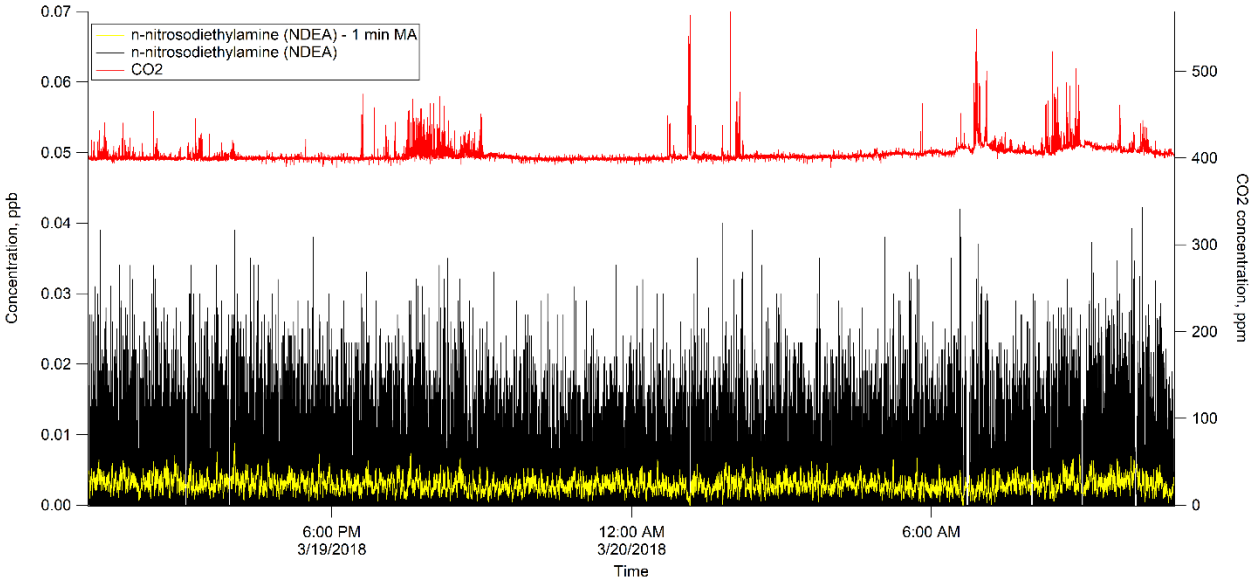


Figure 2-15. N-nitrosodiethylamine (NDEA).

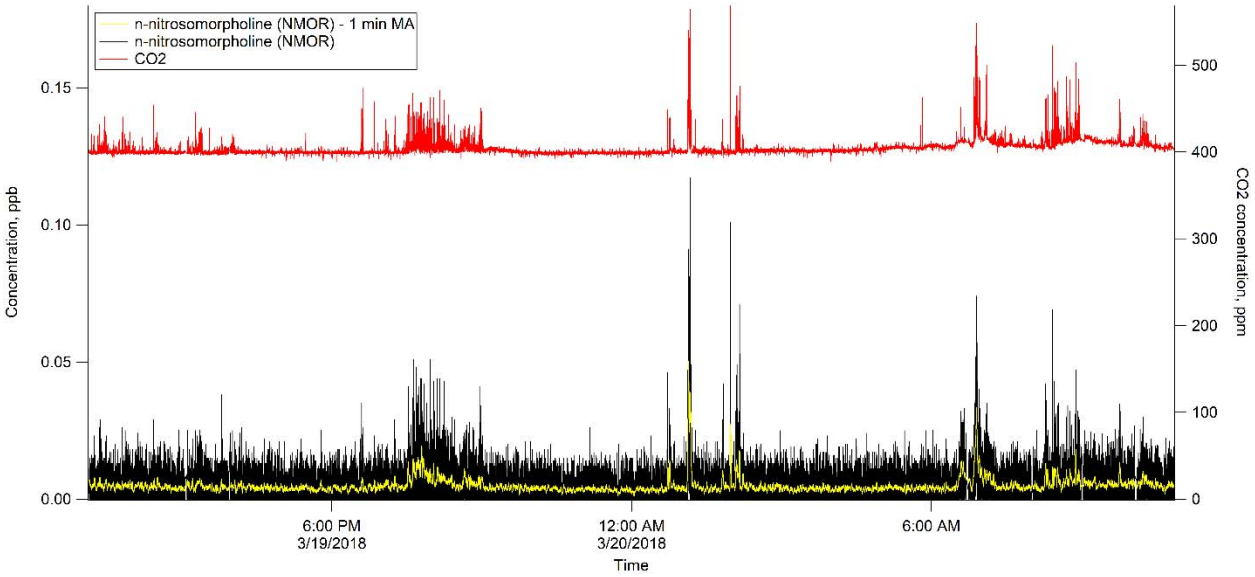


Figure 2-16. N-nitrosomorpholine (NMOR).

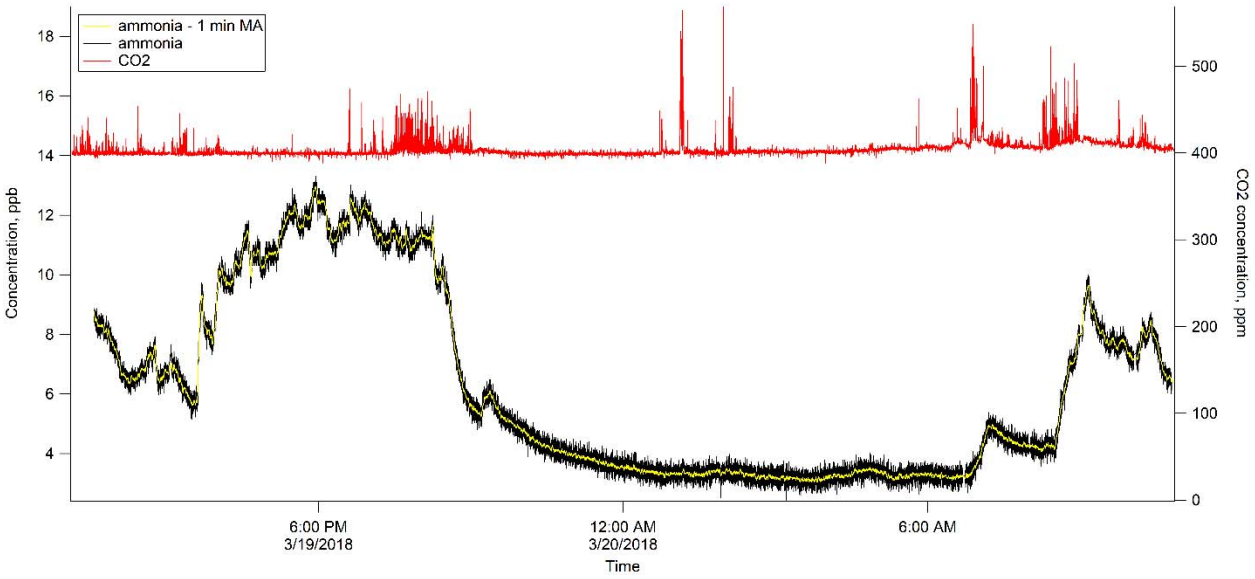


Figure 2-17. Ammonia.

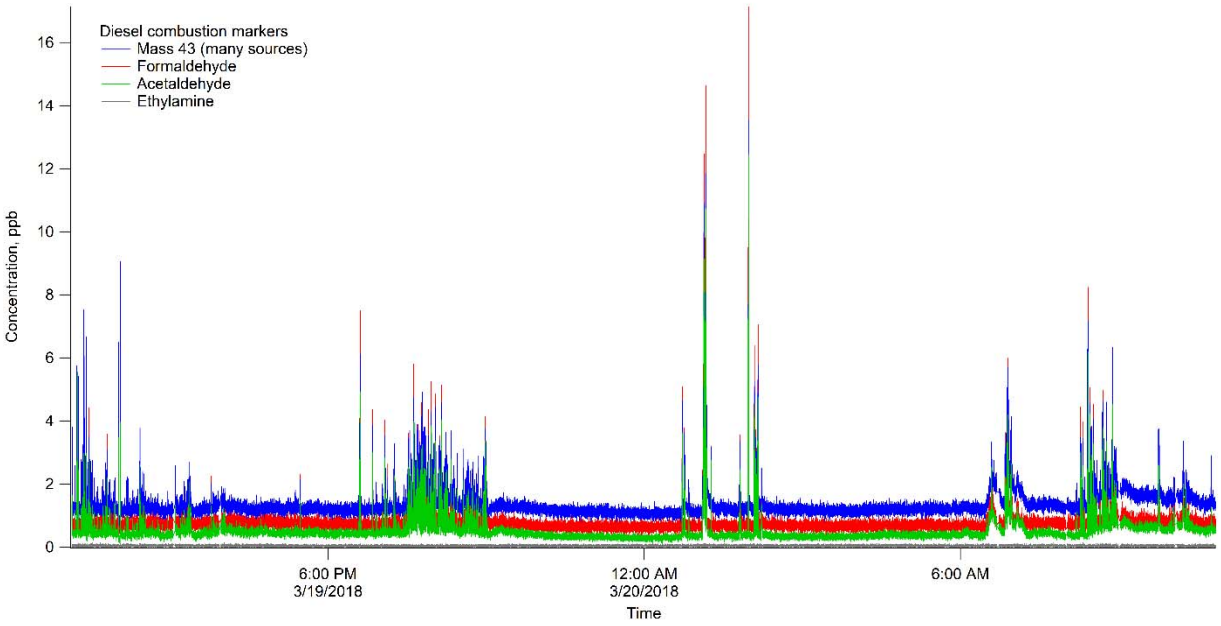


Figure 2-18. Diesel Combustion Markers.

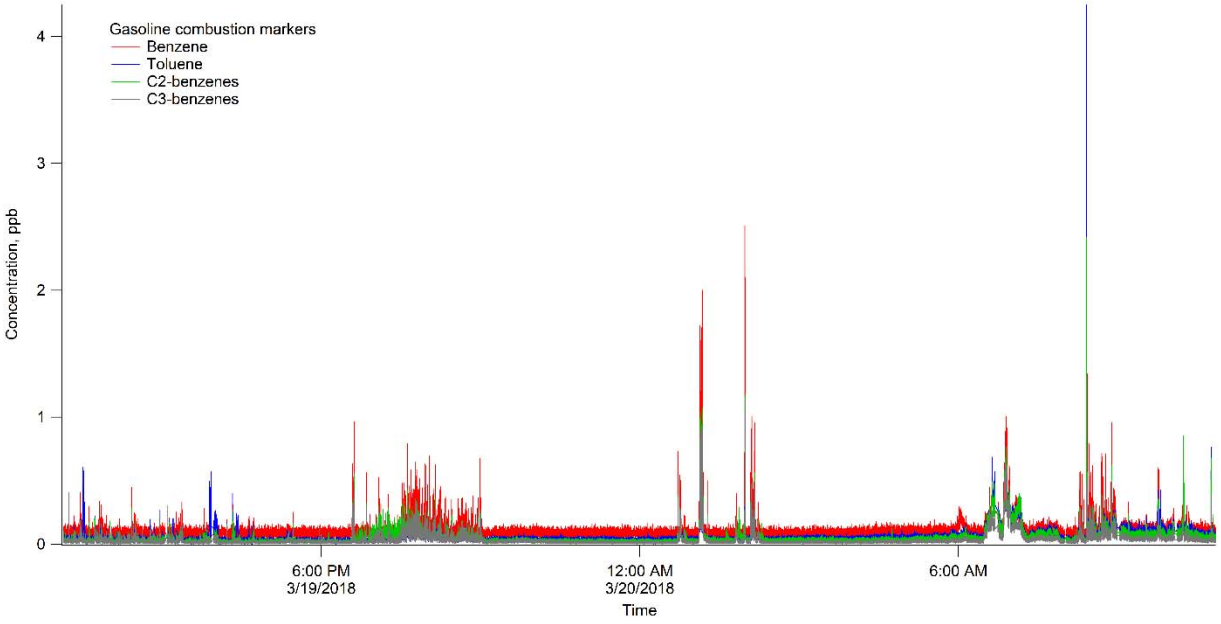


Figure 2-19. Gasoline Combustion Markers.

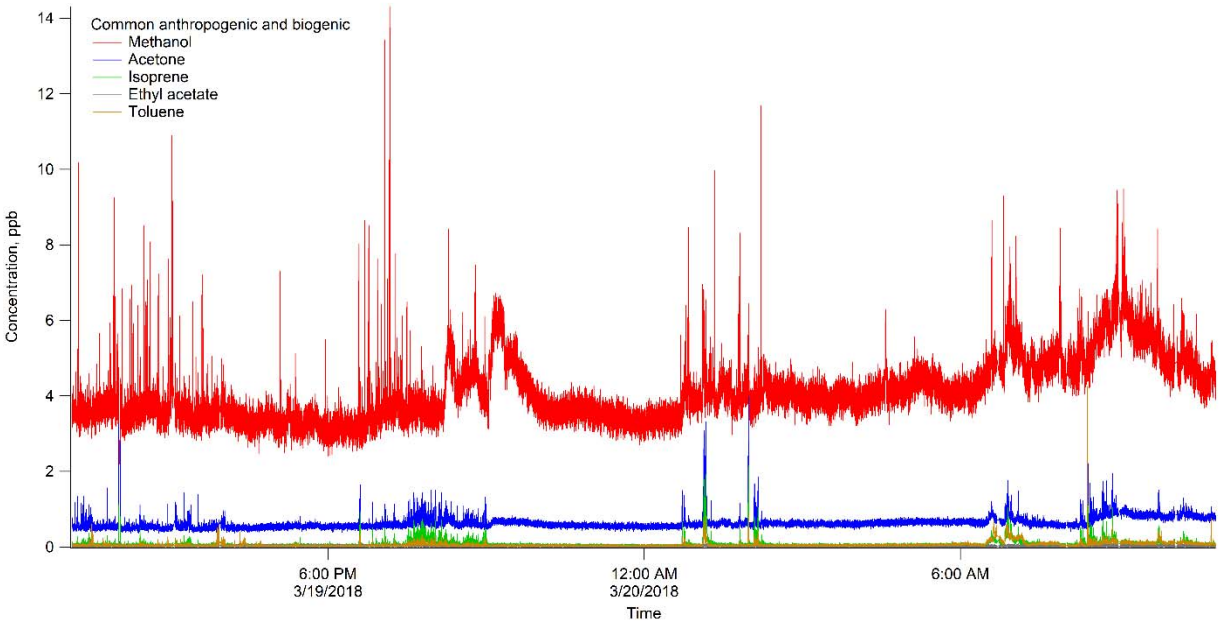


Figure 2-20. Plant and Human Markers.

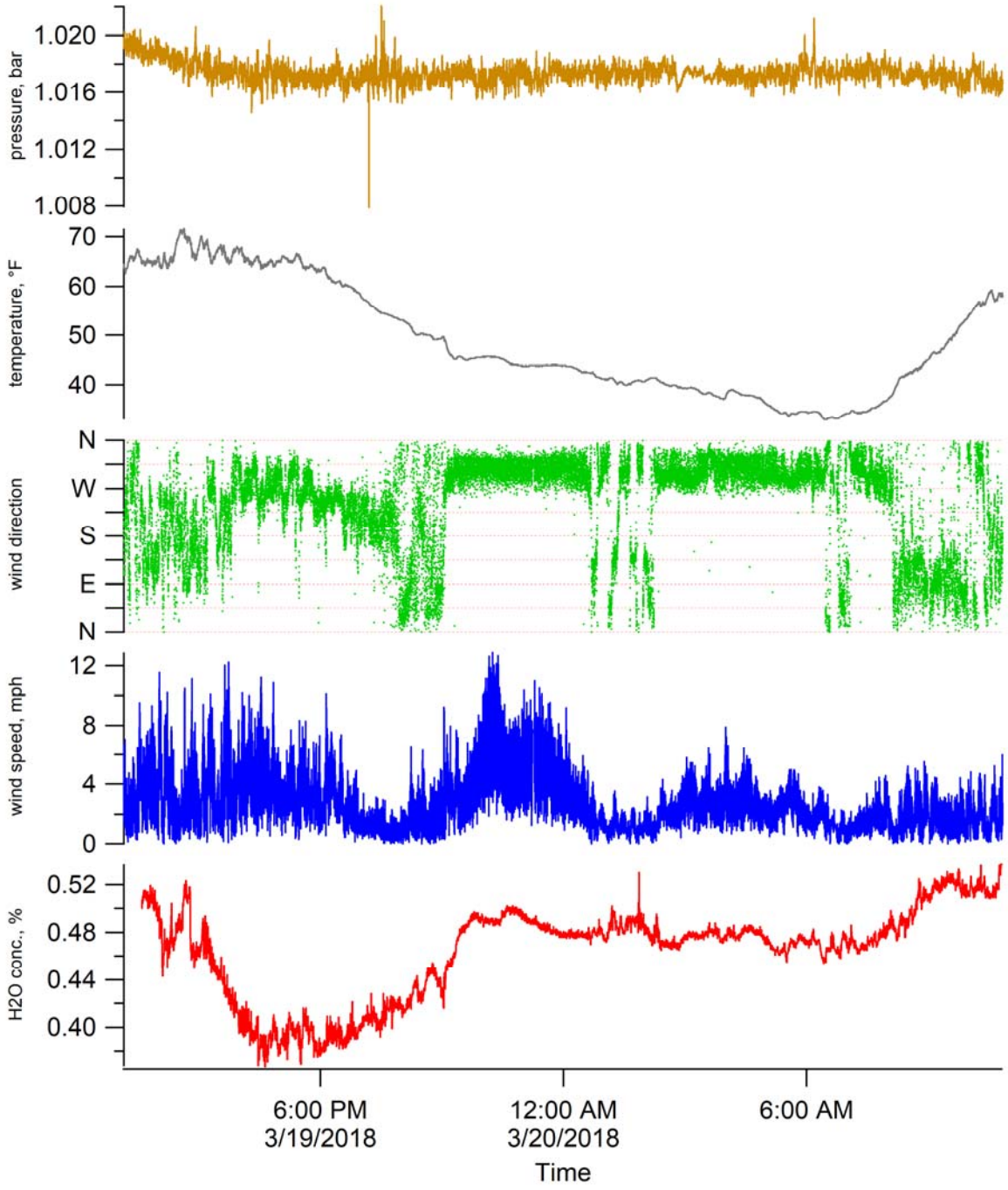


Figure 2-21. Weather Data.

3.0 MARCH 20, 2018 – MARCH 21, 2018 – STUDY SITE #4

3.1 Quality Assessment

Data from March 20, 2018, were transferred to TerraGraphics via the WRPS FTP site on March 26, 2018. Data were assessed using Procedure 17124-DOE-HS-102. A completed Data Exchange Checklist was sent to WRPS on March 28, 2018. The data were accepted by TerraGraphics with the following comments. All startup, shutdown, and calibration procedures were adequately documented and all other checks passed the acceptance limits. No other exceptions besides those below were noted.

Using diesel combustion markers from the PTR-MS and CO_2 from the LI-COR there is a 3-second time offset between the CO_2 and PTR-MS data. This was considered a minor error for background study deployment and the data streams were not adjusted. On March 30, 2018, WRPS was notified of this time offset.

3.2 Summary

Joe Sears, Adrielle Olson, and Robert White performed background sampling using the Mobile Laboratory from March 20, 2018, to March 21, 2018, at Study Site 4. Site 4 is located down wind of the AN Tank Farm. The Mobile Laboratory arrived at Site 4 at 12:30 on March 20, 2018. The initial QA/QC zero air/sensitivity checks were performed on the CO_2 monitor, NH_3 monitor, and the PTR-MS beginning at 12:42. Routine data collection resumed by 13:57. The Mobile Laboratory staff departed the monitoring site after performing the final PTR-MS zero air check for the evening at 16:00.

The Mobile Laboratory staff had returned to Site 4 and performed a PTR-MS zero air check by 06:51 on March 21, 2018. The van orientation was changed at 08:00 to be north facing with exhaust to the south due to observable wind being from the north. Closeout zero air/sensitivity checks were performed at 11:03. The Mobile Laboratory moved to Site 5 by 12:45.

Data processing revealed more instability in the LI-COR CO_2 concentrations than in previous or later data sets. The data collected, such as cell pressure and temperature, did not indicate the source of the increased quantification noise. With the instrument passing QA requirements and maintaining sensitivity to rapid changes in CO_2, all data were accepted. On April 04, 2018, WRPS was notified of the increase in noise on this data set to assist RJLG to investigate further.



Figure 3-1. Mobile Laboratory Site #4 for the Duration of the Monitoring Period.

3.3 Samples Collected

Continuous air monitoring was performed using the following instrumentation:

- PTR-MS,
- LI-COR CO_2 Monitor,
- Picarro Ammonia Monitor, and
- Weather Station.

Confirmatory air samples were collected as follows:

Table 3-1. Alternative Media Samples Taken.

Site	Date	Sample Type	ID	Start	Stop	Sample Time (min)
4	20-Mar	Thermosorb/N	EL22201	12:51	15:54	182
4	20-Mar	CarboTrap-300	A048101	12:56	14:27	74*
4	21-Mar	Thermosorb/N	EL22215	06:46	09:56	188
4	21-Mar	CarboTrap-300	A048084	06:50	08:03	72

*Note: LAP-WRPS160A.01, 2.1.12 shows a sampling time of 74 minutes for TDU # A048101, but was initialed at 14:27, 91 minutes after the Sampling Start Time at 12:56 listed in 2.1.11.

Table 3-2 displays the statistical information for the monitoring period of March 20, 2018, to March 21, 2018. By definition, the OEL is an 8-hour, time-weighted average that establishes a limit for personnel exposures to hazardous chemicals. It is the exposure level to which a person may be exposed for 8 hours/day, 40 hours/week for 40 years and have no expectation of adverse health effects. In this study, area vapor concentration measurements were made to better understand the hazardous vapor exposures that workers may receive. These measurements are only compared to OEL concentrations to give them context. It is neither accurate nor appropriate

to interpret these short duration measurements (2 seconds) as worker exposures levels. Since the OEL is defined as a time-weighted average, it is more appropriate to compare them to daily average vapor concentrations. Short duration excursions above the OEL concentration are not significant.

Table 3-2. Statistical Information for the Monitoring Period of March 20, 2018 – March 21, 2018.

COPC #	COPC Name	Reporting Limit (PPB)	OEL (ppb)	Ave. (PPB)	St. Dev. (PPB)	Rel. St. Dev. (%)	Max (PPB)	Median (PPB)	Sec. over 50% OEL	Sec. over OEL
1	ammonia	1	25000	7.26	2.39	32.9%	20.42	6.37	0	0
2	furan	0.09	1	0.056	0.050	157.5%	0.445	0.019	0	0
3	but-3-en-2-one + 2,3-dihydrofuran + 2,5-dihydrofuran	0.22	1	0.110	0.025	72.5%	N/A*	N/A*	N/A	N/A
4	NDMA**	0.06	0.3	0.033	0.024	135.3%	0.202	0.005	18	0
5	2-methylfuran	0.05	1	0.029	0.022	96.4%	0.454	0.018	0	0
6	NEMA	0.02	0.3	0.015	0.016	162.9%	0.119	0.000	0	0
7	2,5-dimethylfuran	0.05	1	0.029	0.021	115.2%	0.303	0.013	0	0
8	NDEA	0.01	0.1	0.006	0.006	210.8%	0.050	0.000	4	0
9	2-propylfuran + 2-ethyl-5-methylfuran	0.02	1	0.011	0.008	121.3%	0.181	0.004	0	0
10	NMOR	0.05	0.6	0.025	0.005	104.7%	0.072	0.004	0	0
11	2-ethyl-2-hexenal + 4-(1-methylpropyl)-2,3-dihydrofuran + 3-(1,1-dimethylethyl)-2,3-dihydrofuran	0.04	1	0.020	0.007	72.0%	0.106	0.008	0	0
12	2-pentylfuran	0.04	1	0.020	0.008	52.1%	0.173	0.014	0	0
13	2-heptylfuran	0.02	1	0.010	0.004	65.1%	0.053	0.006	0	0
14	2-octylfuran	0.01	1	0.005	0.002	220.4%	0.024	0.000	0	0
15	6-(2-furanyl)-6-methyl-2-heptanone	0.01	1	0.005	0.002	168.6%	0.017	0.000	0	0
16	furfural acetophenone	0.07	1	0.035	0.003	63.4%	0.037	0.004	0	0

* The maximum peak value for but-3-en-2-one + 2,3 dihydrofuran + 2,5 dihydrofuran was 1.314 ppb and the median value was 0.030 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 200, 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 each COPC signal, overlaid with the same signal smoothed using a 1-minute moving average, and CO_2, for the monitoring period March 20, 2018, to March 21, 2018.

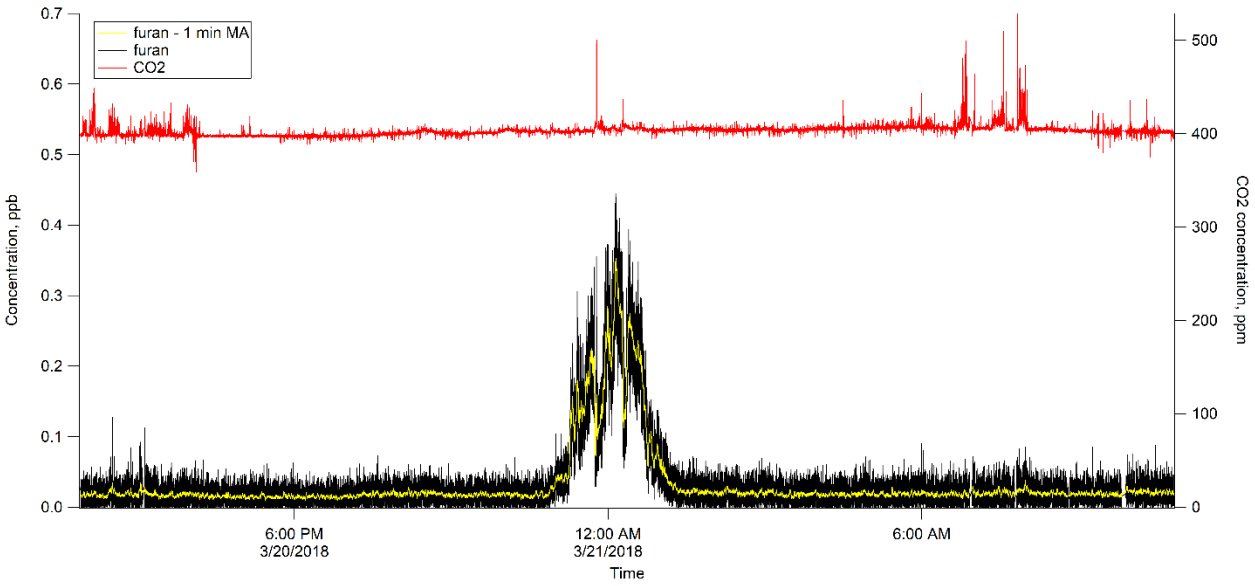


Figure 3-2. Furan.

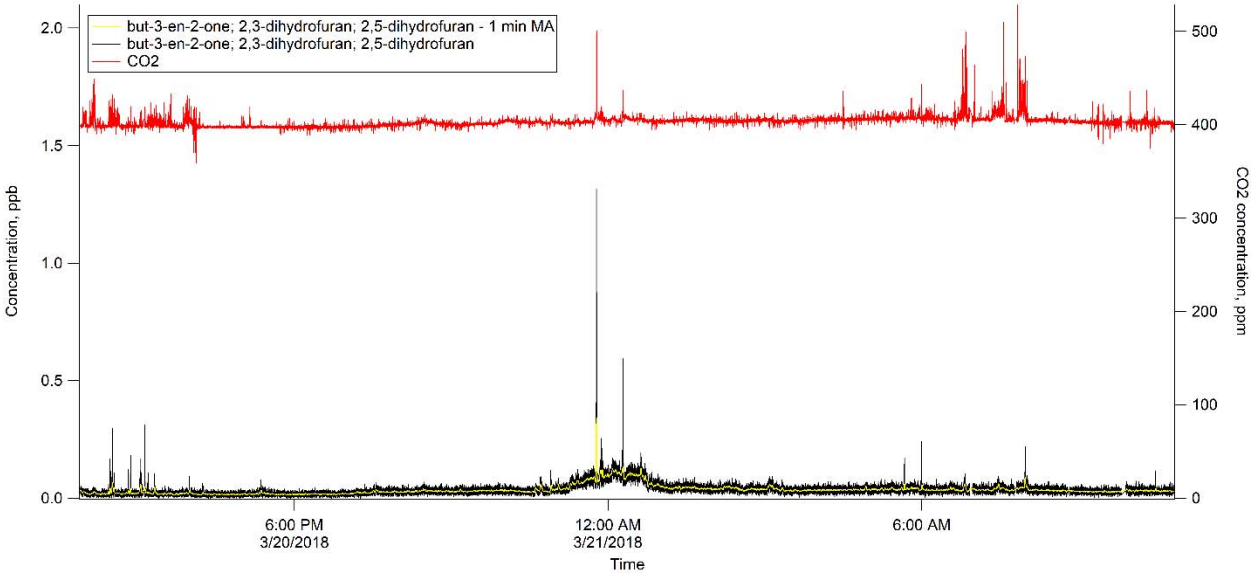


Figure 3-3. -3-en-2-one + 2,3-dihydrofuran + 2,5-dihydrofuran.

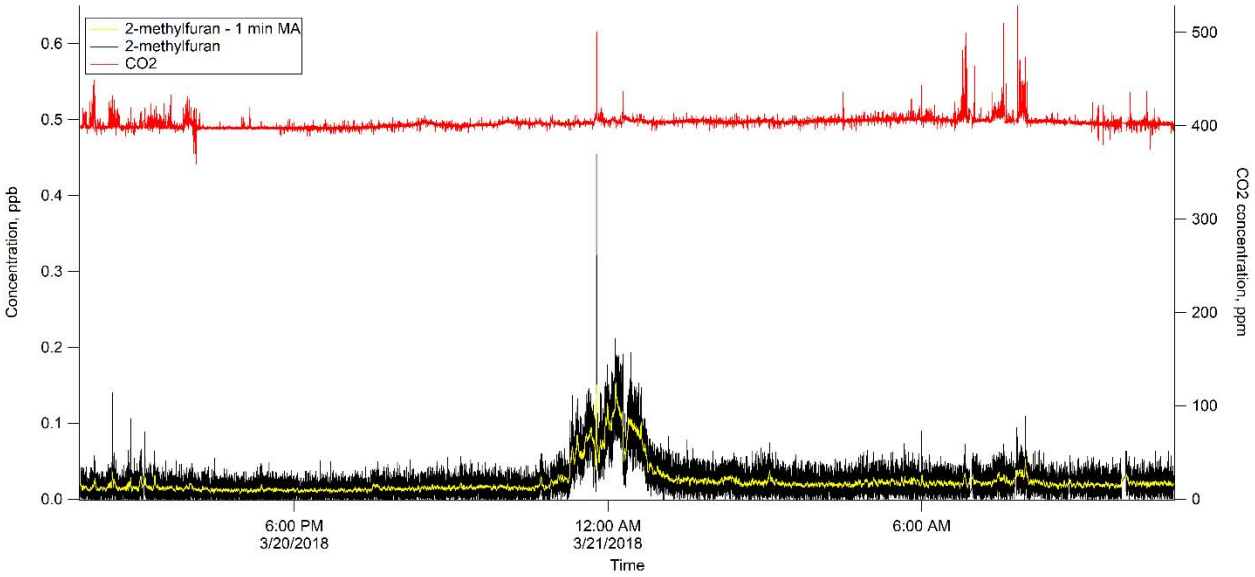


Figure 3-4. 2-methylfuran.

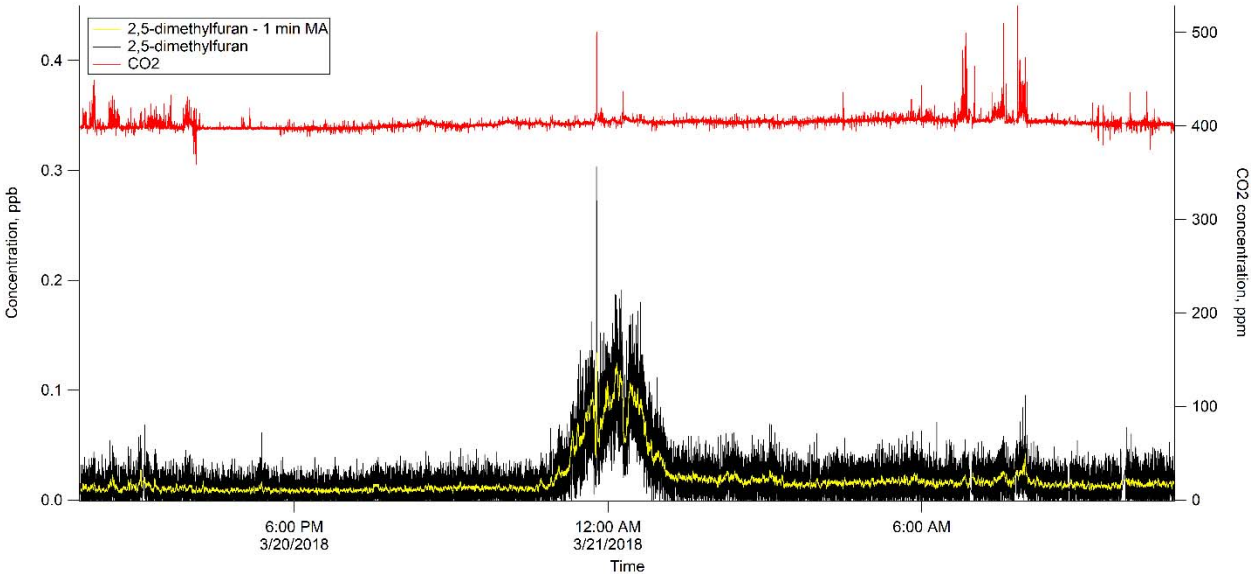


Figure 3-5. 2,5-dimethylfuran.

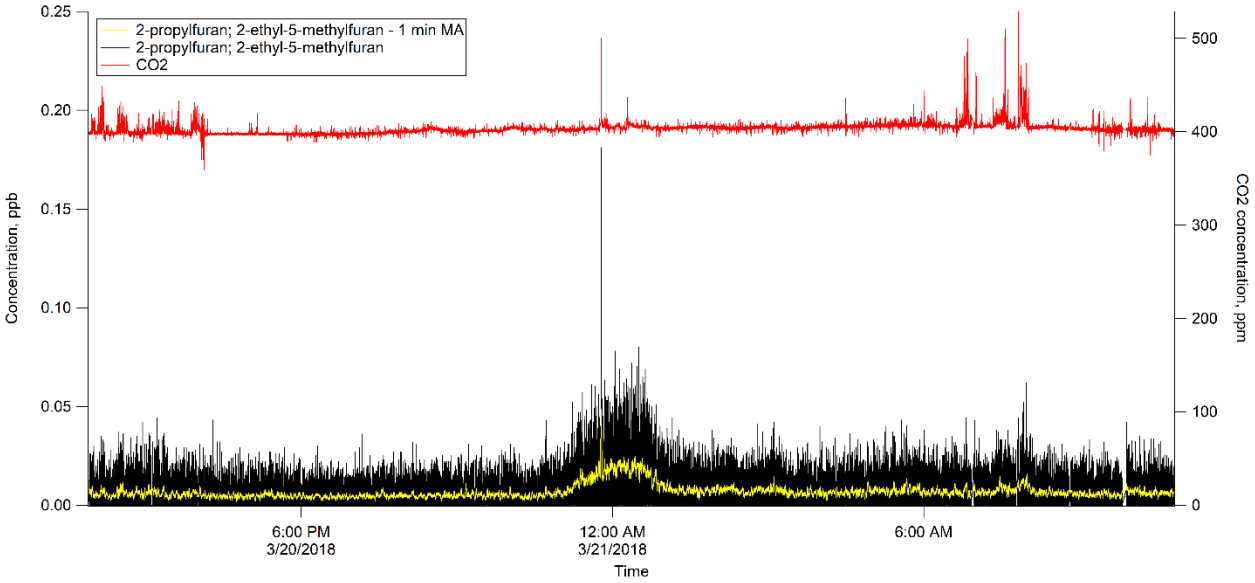


Figure 3-6. 2-propylfuran + 2-ethyl-5-methylfuran.

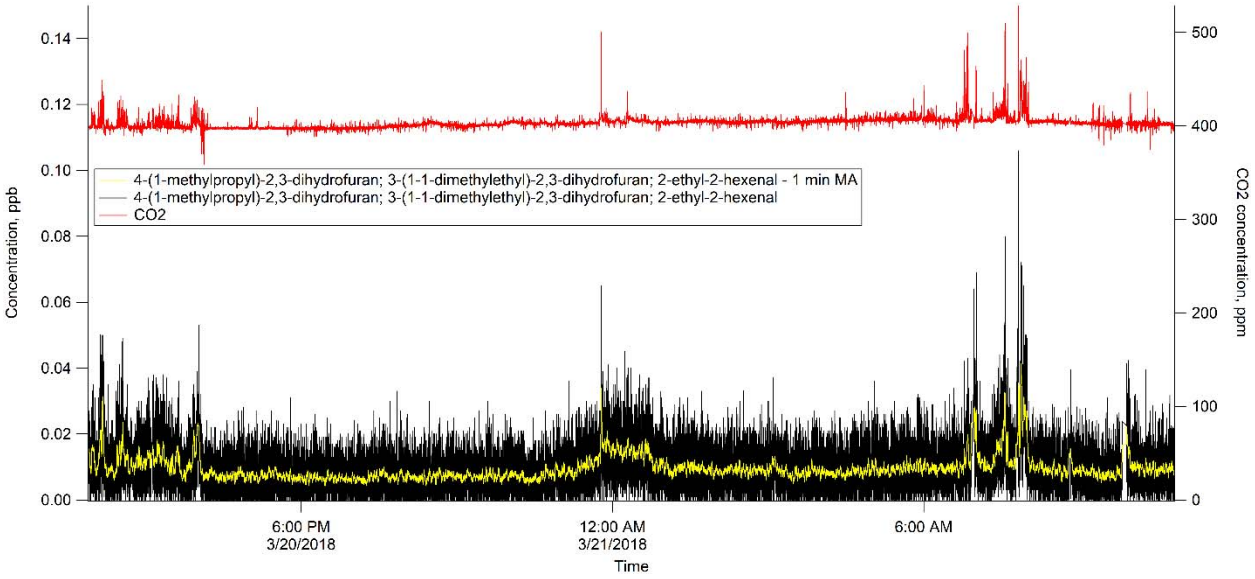


Figure 3-7. 4-(1-methylpropyl)-2,3-dihydrofuran + 3-(1,1-dimethylethyl)-2,3-dihydrofuran + 2-ethyl-2-hexenal.

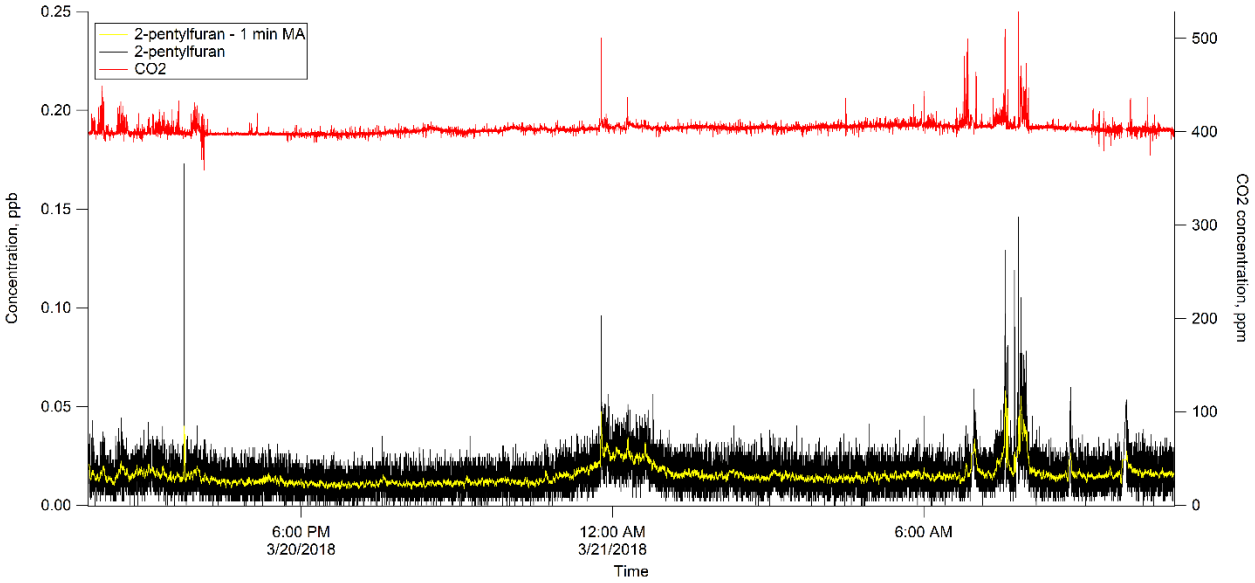


Figure 3-8. 2-pentylfuran.

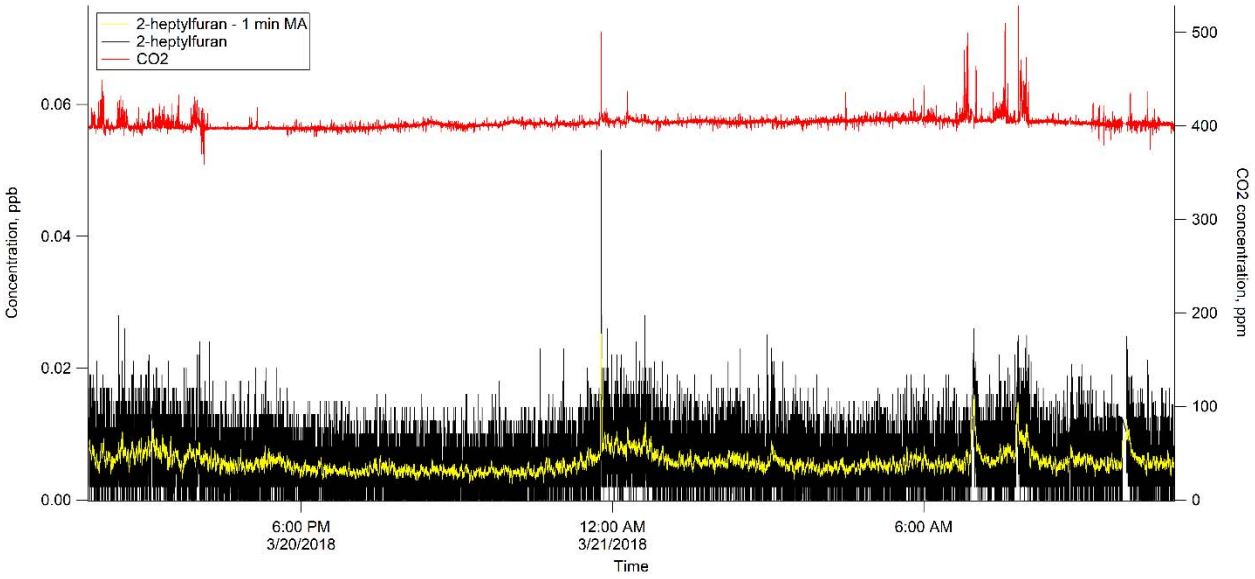


Figure 3-9. 2-heptylfuran.

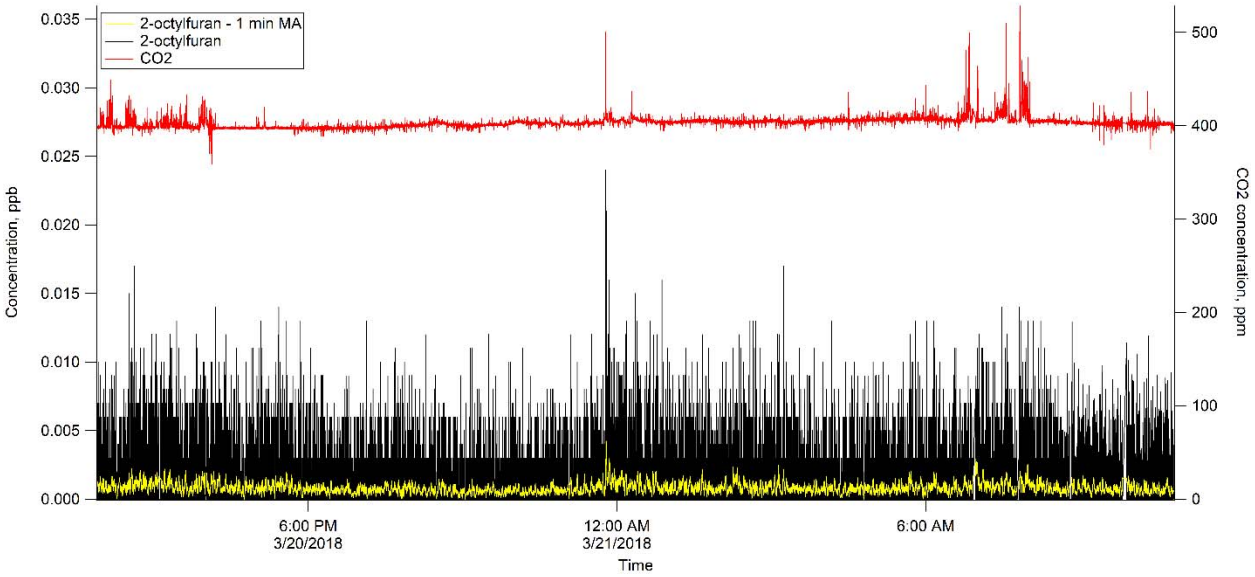


Figure 3-10. 2-octylfuran.

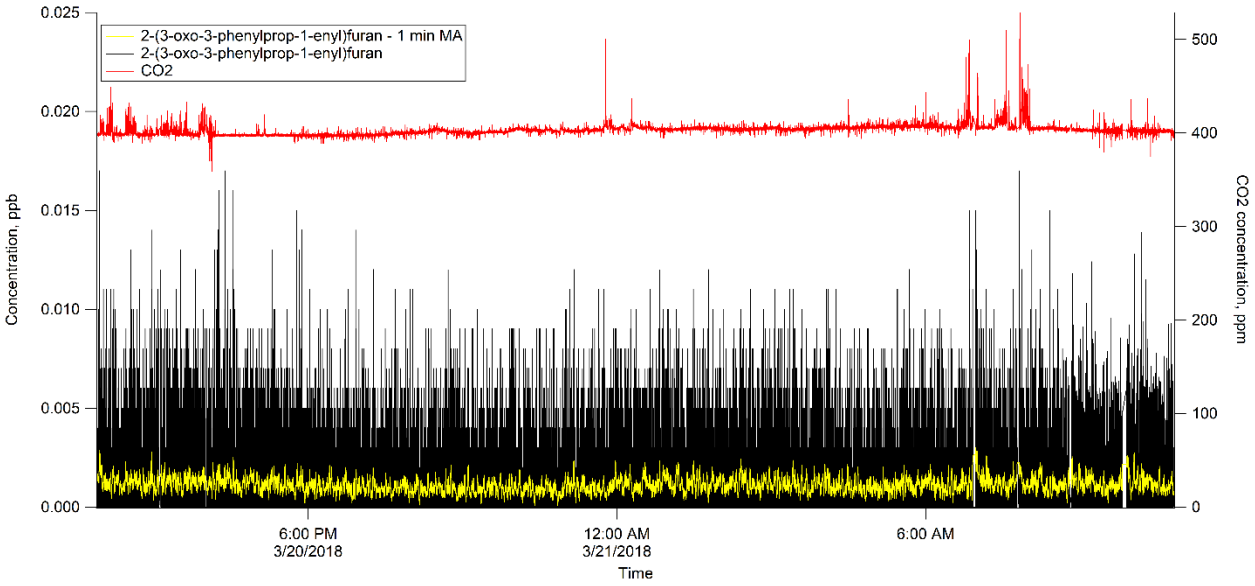


Figure 3-11. 2-(3-oxo-3-phenylprop-1-enyl)furan.

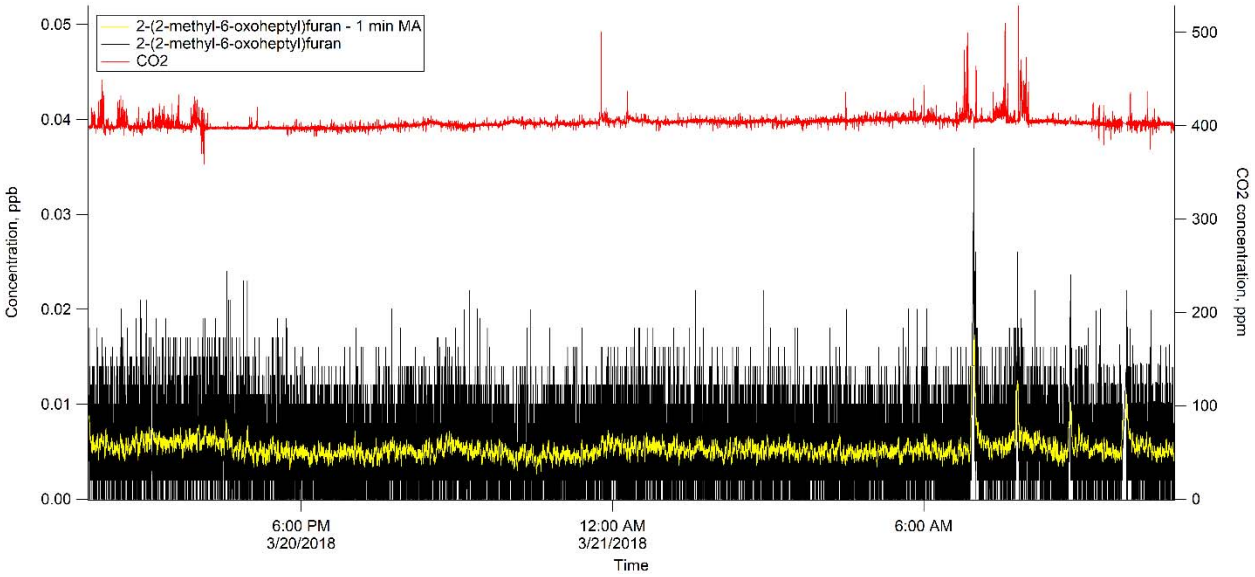


Figure 3-12. 2-(2-methyl-6-oxoheptyl)furan.

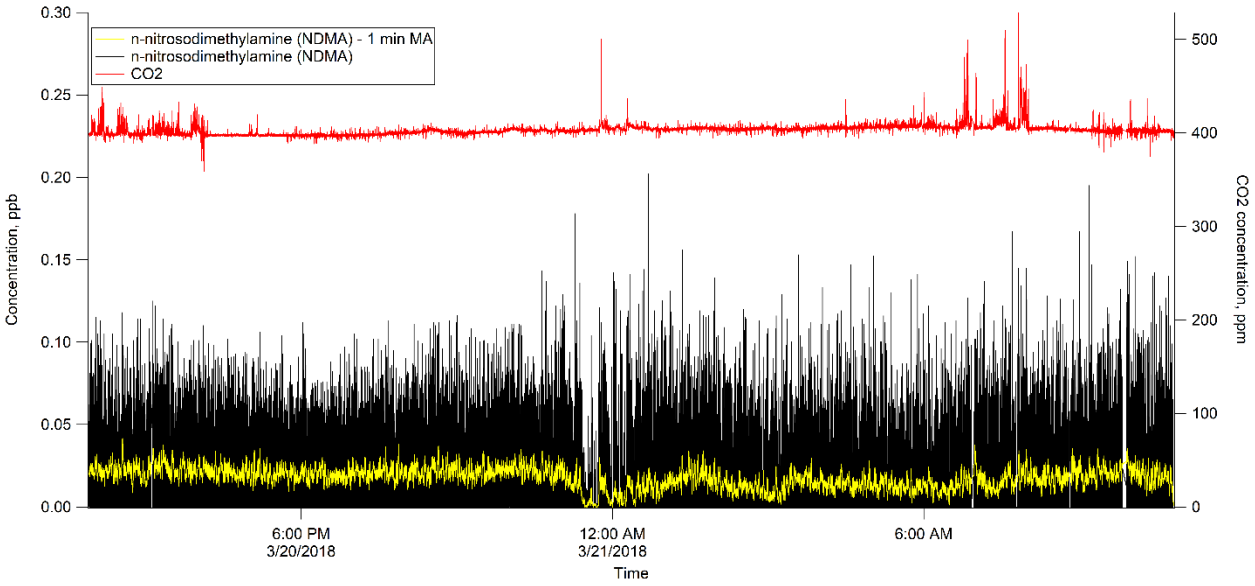


Figure 3-13. N-nitrosodimethylamine (NDMA).

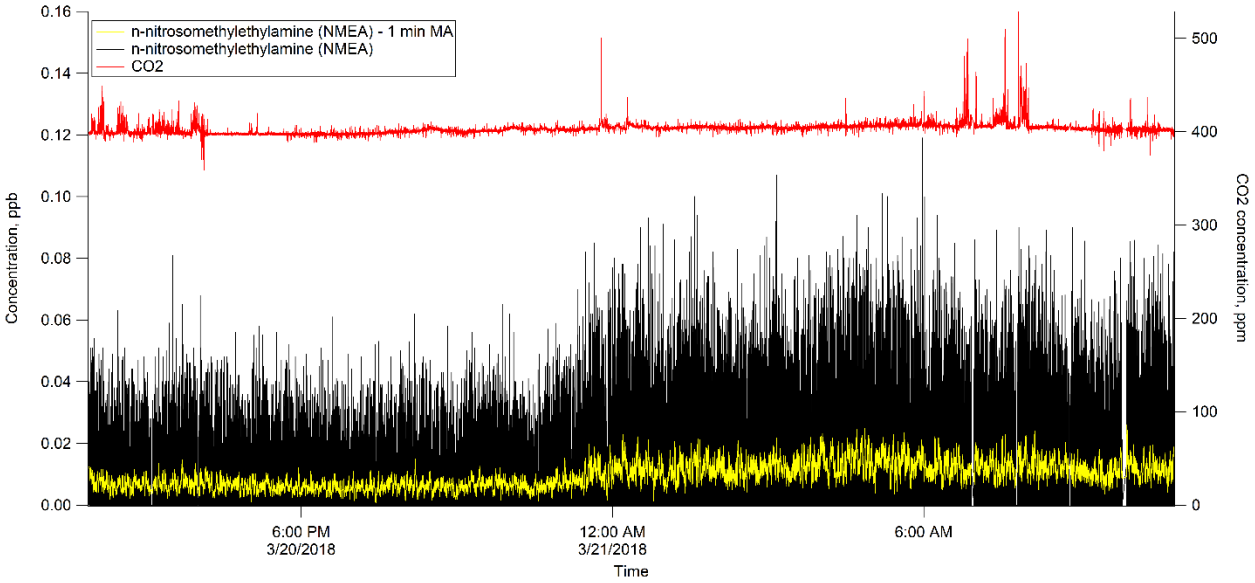


Figure 3-14. N-nitrosomethylethylamine (NMEA).

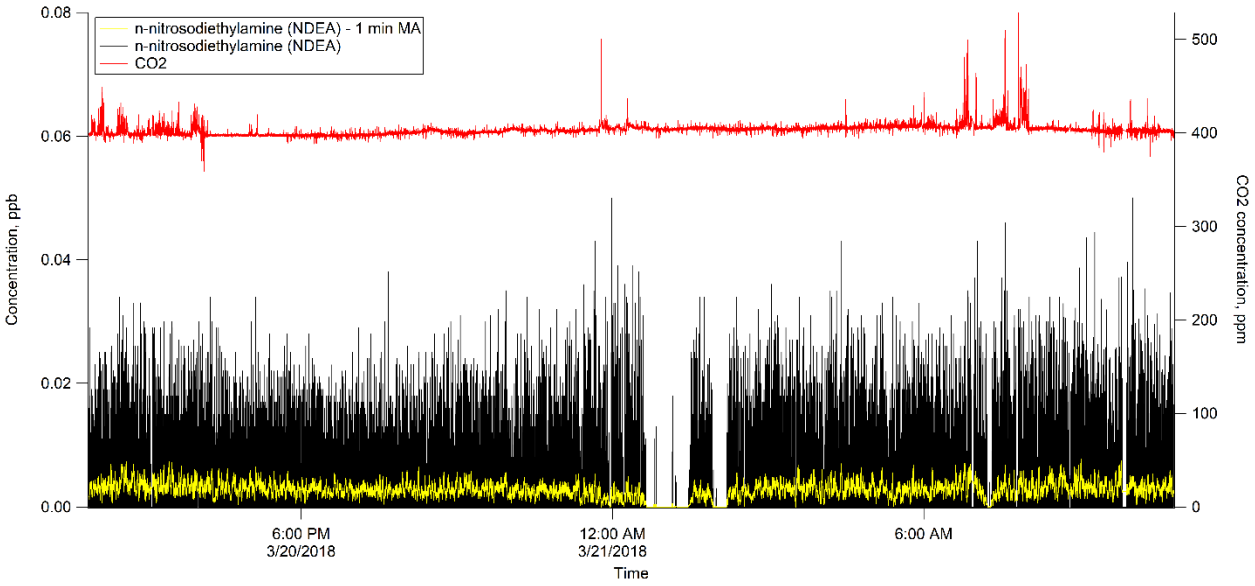


Figure 3-15. N-nitrosodiethylamine (NDEA).

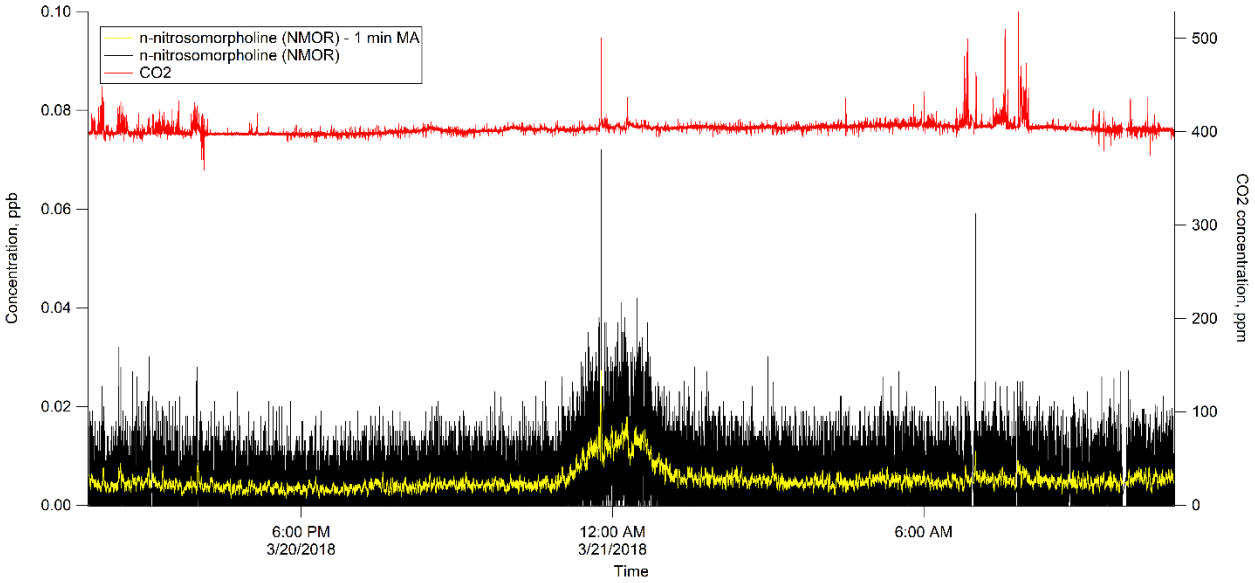


Figure 3-16. N-nitrosomorpholine (NMOR).

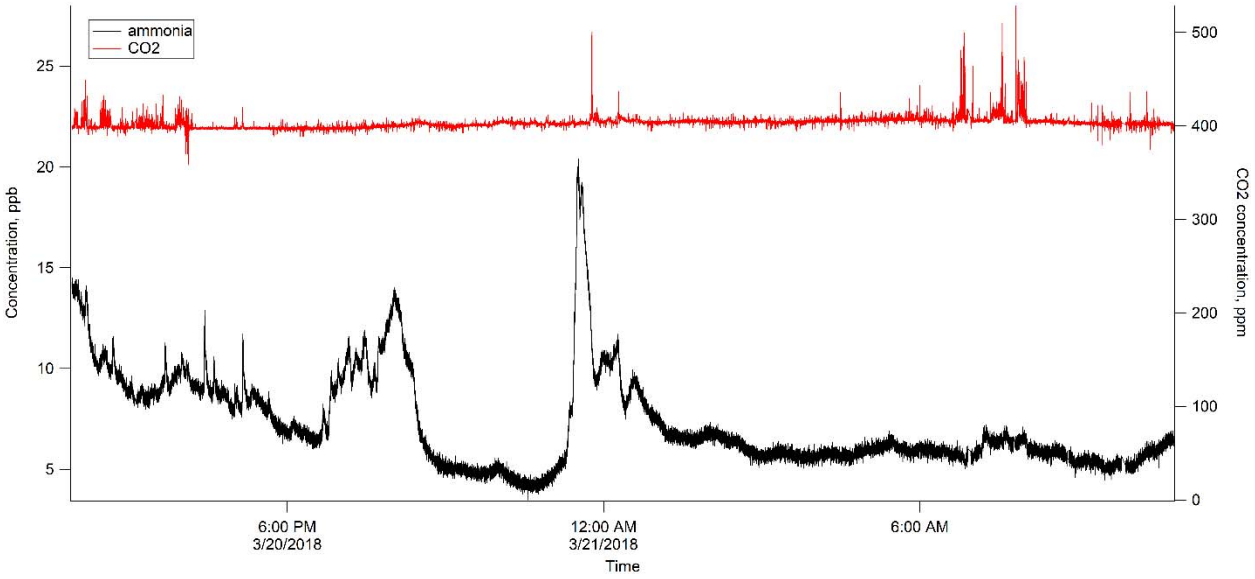


Figure 3-17. Ammonia.

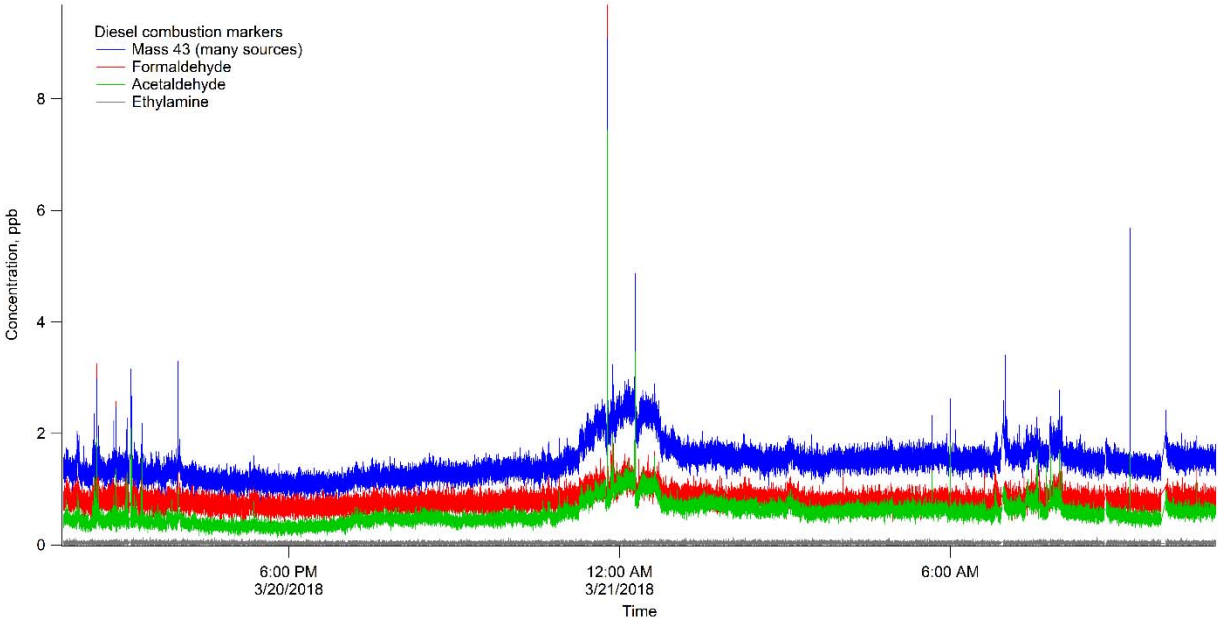


Figure 3-18. Diesel Combustion Markers.

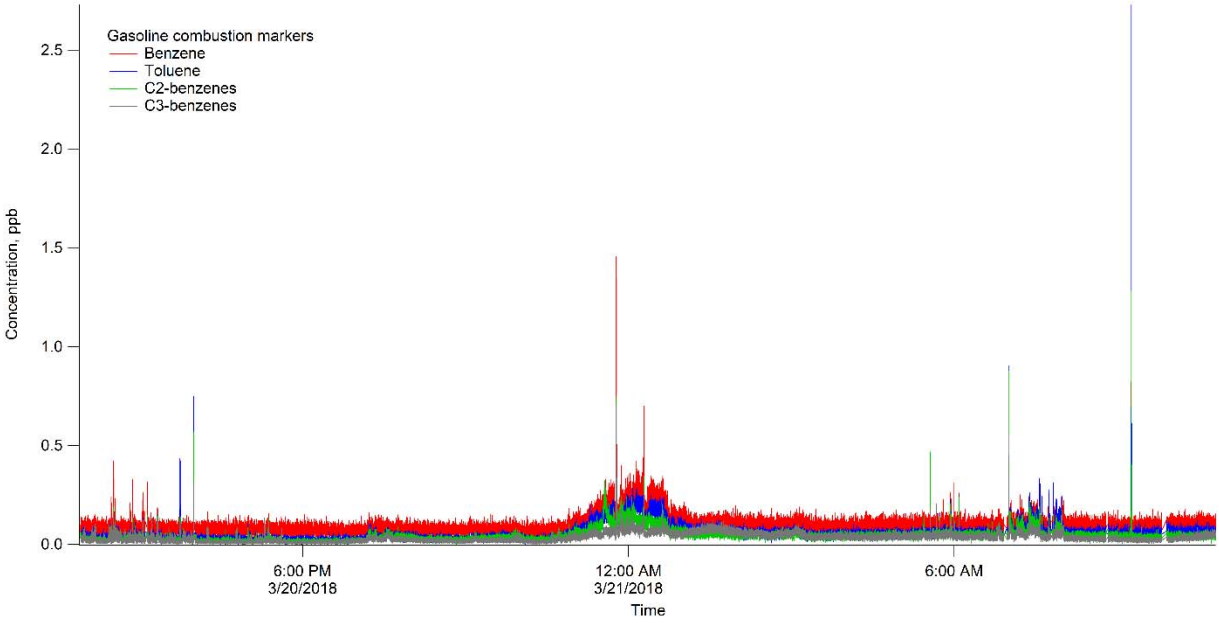


Figure 3-19. Gasoline Combustion Markers.

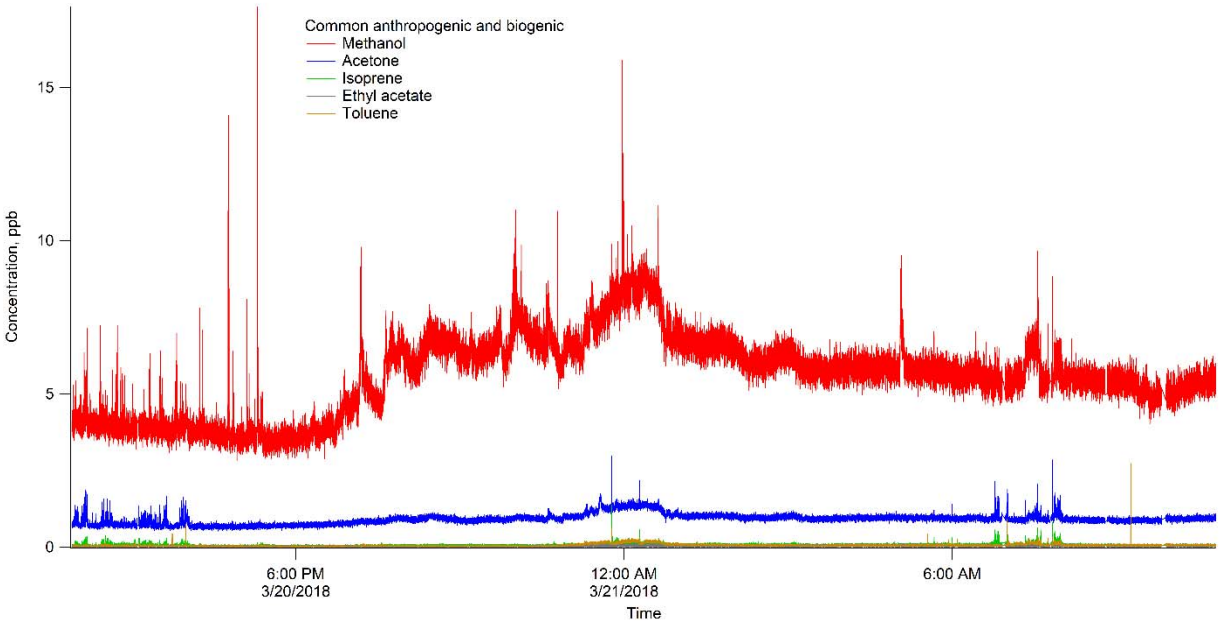


Figure 3-20. Plant and Human Markers.

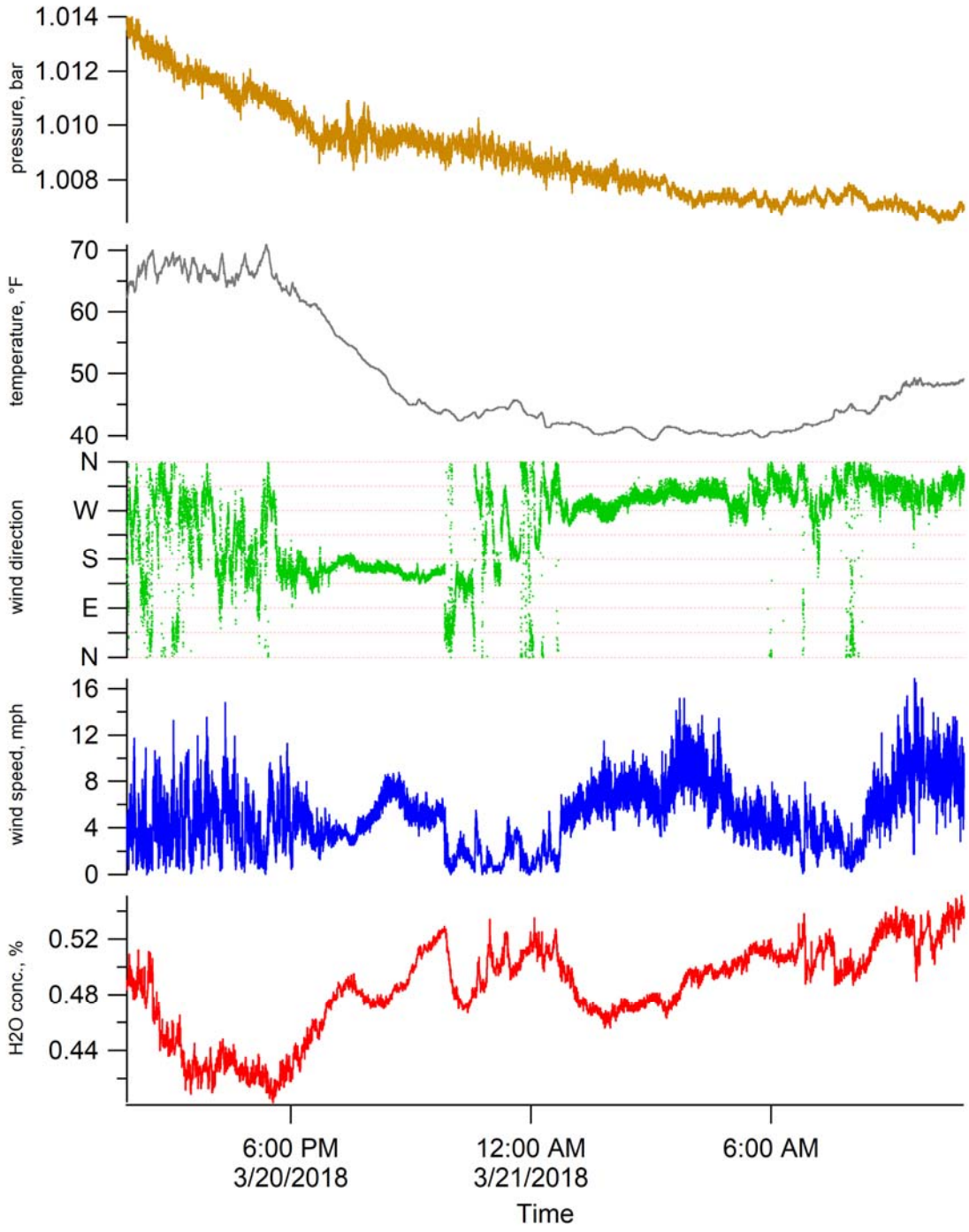


Figure 3-21. Weather Data.

4.0 MARCH 21, 2018 – MARCH 22, 2018 – STUDY SITE #5

4.1 Quality Assessment

Data from March 21, 2018, were transferred to TerraGraphics via the WRPS FTP site on March 26, 2018. Data were assessed using Procedure 17124-DOE-HS-102. A completed Data Exchange Checklist was sent to WRPS on March 28, 2018. The data were accepted by TerraGraphics with the following comments. All startup, shutdown, and calibration procedures were adequately documented and all other checks passed the acceptance limits. No other exceptions besides those below were noted.

Weather station data were missing from 00:00 on March 22, 2018, to 10:46 on March 22, 2018. A CAPA is pending from RJLG to address this issue (CAPA 1812).

Using diesel combustion markers from the PTR-MS and CO_2 from the LI-COR, there is a 2- or 3-second time offset between the CO_2 and PTR-MS data. This was considered a minor error for background study deployment and the data streams were not adjusted. On March 30, 2018, WRPS was notified of this time offset.

4.2 Summary

Adrielle Olson, Robert White, and Anna Woehle performed background sampling using the Mobile Laboratory from March 21, 2018, to March 22, 2018, at Study Site 5. Site 5 is located southeast of the Waste Treatment Facility. This site was chosen as it may provide data related to stack emission dispersion downwind of the tank farm ventilation and as a baseline data point for future reference once the Waste Treatment Facility begins operation. The Mobile Laboratory arrived at Site 5 at 12:45 on March 21, 2018. The initial QA/QC zero air/sensitivity checks were performed on the CO_2 monitor, NH_3 monitor, and the PTR-MS beginning at 12:44. Routine data collection resumed by 13:52. The Mobile Laboratory staff departed the monitoring site after performing the final PTR-MS zero air check for the evening at 14:42. The Thermosorb/N sampling method was modified at 15:00 to incorporate a funnel to keep the sample dry.

The Mobile Laboratory staff had returned to Site 5 and performed a PTR-MS zero air check by 6:46 on March 22, 2018. Exhaust spikes were observed at 07:00 even with the exhaust pipe laid out to full capacity and visibly flowing downwind. CO_2 was showing spikes during this time and there was heavy traffic flow into the WTP facility. Closeout zero air/sensitivity checks were performed at 10:05. The Mobile Laboratory moved to Site 6 by 10:53.



Figure 4-1. Mobile Laboratory Site #5 for the Duration of the Monitoring Period.

4.3 Samples Collected

Continuous air monitoring was performed using the following instrumentation:

- PTR-MS,
- LI-COR CO_2 Monitor,
- Picarro Ammonia Monitor, and
- Weather Station.

Confirmatory air samples were collected as follows.

Table 4-1. Alternative Media Samples Taken.

Site	Date	Sample Type	ID	Start	Stop	Sample Time (min)
5	21-Mar	Thermosorb/N	EL22206	12:54	16:03	188
5	21-Mar	CarboTrap-300	A020883	12:59	14:13	73
5	22-Mar	Thermosorb/N	EL22218	06:43	09:43	183
5	22-Mar	CarboTrap-300	A021986	06:43	07:57	74

Table 4-2 displays the statistical information for the monitoring period of March 21, 2018, to March 22, 2018. By definition, the OEL is an 8-hour, time-weighted average that establishes a limit for personnel exposures to hazardous chemicals. It is the exposure level to which a person may be exposed for 8 hours/day, 40 hours/week for 40 years and have no expectation of adverse health effects. In this study, area vapor concentration measurements were made to better understand the hazardous vapor exposures that workers may receive. These measurements are only compared to OEL concentrations to give them context. It is neither accurate nor appropriate

to interpret these short duration measurements (2 seconds) as worker exposures levels. Since the OEL is defined as a time-weighted average, it is more appropriate to compare them to daily average vapor concentrations. Short duration excursions above the OEL concentration are not significant.

Table 4-2. Statistical Information for the Monitoring Period of March 21, 2018 – March 22, 2018.

COPC #	COPC Name	Reporting Limit (PPB)	OEL (ppb)	Ave. (PPB)	St. Dev. (PPB)	Rel. St. Dev. (%)	Max (PPB)	Median (PPB)	Sec. over 50% OEL	Sec. over OEL
1	ammonia	1	25000	14.67	6.96	47.5%	50.99	13.27	0	0
2	furan	0.09	1	0.046	0.017	77.6%	0.428	0.020	0	0
3	but-3-en-2-one + 2,3-dihydrofuran + 2,5-dihydrofuran	0.22	1	0.113	0.049	104.0%	N/A*	N/A*	N/A	N/A
4	NDMA**	0.06	0.3	0.035	0.027	126.4%	0.170	0.010	40	0
5	2-methylfuran	0.05	1	0.027	0.020	87.0%	0.561	0.020	8	0
6	NEMA	0.02	0.3	0.017	0.018	155.5%	0.111	0.000	0	0
7	2,5-dimethylfuran	0.05	1	0.027	0.017	90.1%	0.373	0.016	0	0
8	NDEA	0.01	0.1	0.007	0.007	215.4%	0.055	0.000	4	0
9	2-propylfuran + 2-ethyl-5-methylfuran	0.02	1	0.013	0.011	109.5%	0.237	0.007	0	0
10	NMOR	0.05	0.6	0.025	0.006	101.8%	0.294	0.005	0	0
11	2-ethyl-2-hexenal + 4-(1-methylpropyl)-2,3-dihydrofuran + 3-(1,1-dimethylethyl)-2,3-dihydrofuran	0.04	1	0.021	0.010	61.8%	0.101	0.014	0	0
12	2-pentylfuran	0.04	1	0.023	0.012	49.4%	0.129	0.022	0	0
13	2-heptylfuran	0.02	1	0.014	0.010	81.5%	0.081	0.010	0	0
14	2-octylfuran	0.01	1	0.005	0.002	204.3%	0.030	0.000	0	0
15	6-(2-furanyl)-6-methyl-2-heptanone	0.01	1	0.005	0.002	157.0%	0.022	0.000	0	0
16	furfural acetophenone	0.07	1	0.035	0.004	58.6%	0.034	0.006	0	0

* The maximum peak value for but-3-en-2-one + 2,3 dihydrofuran + 2,5 dihydrofuran was 1.616 ppb and the median value was 0.036 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 200, 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 each COPC signal, overlaid with the same signal smoothed using a 1-minute moving average, and CO_2, for the monitoring period March 21, 2018 to March 22, 2018.

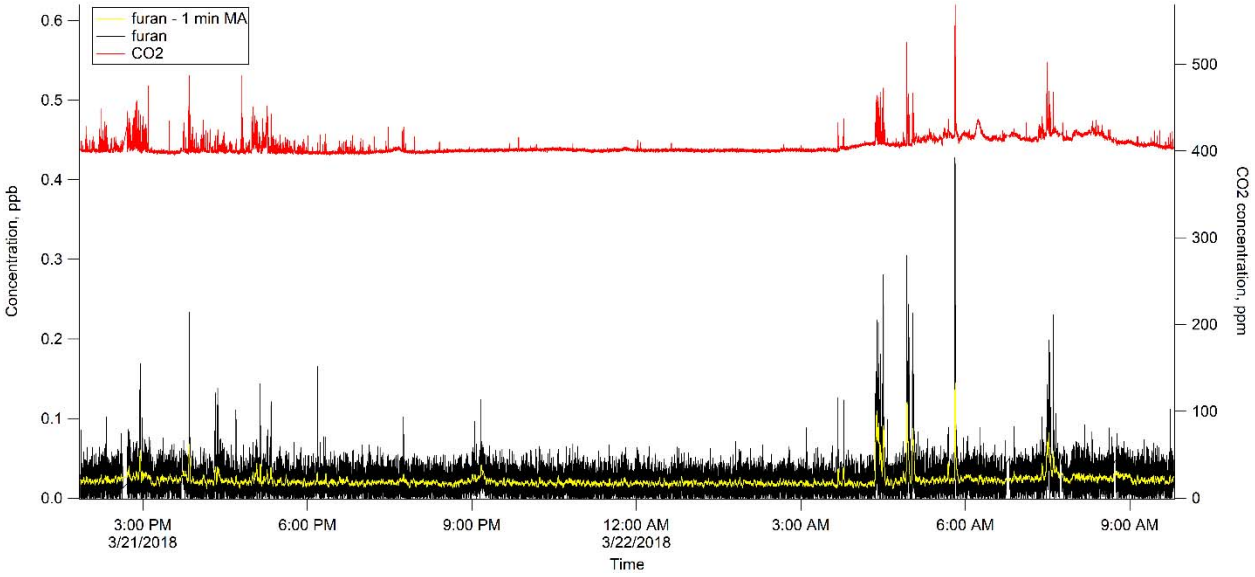


Figure 4-2. Furan.

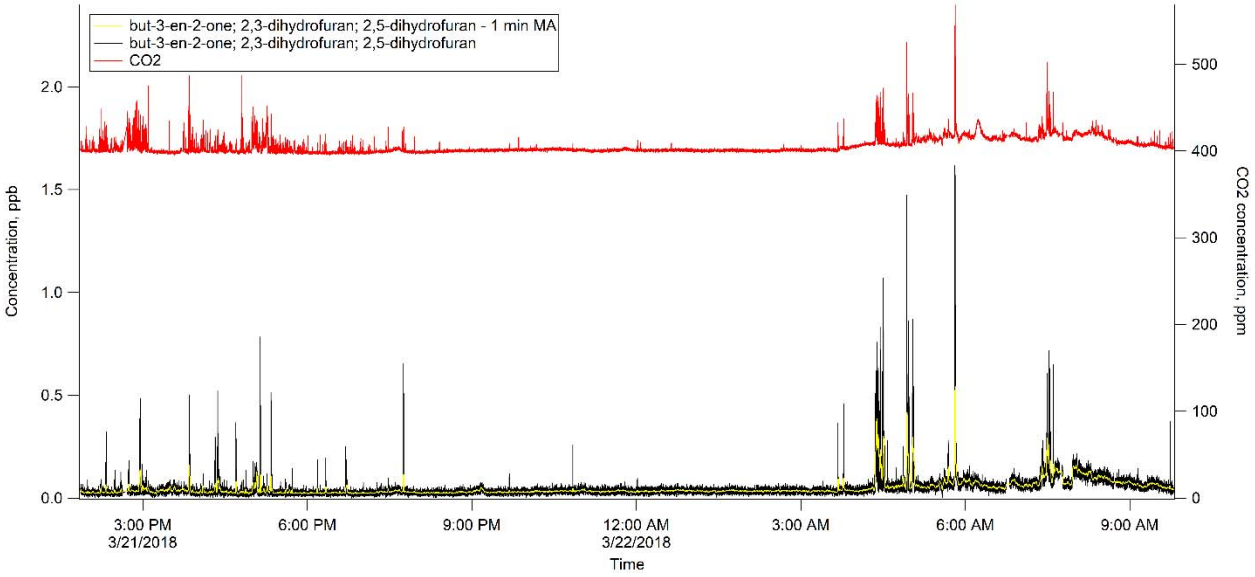


Figure 4-3. -3-en-2-one + 2,3-dihydrofuran + 2,5-dihydrofuran.

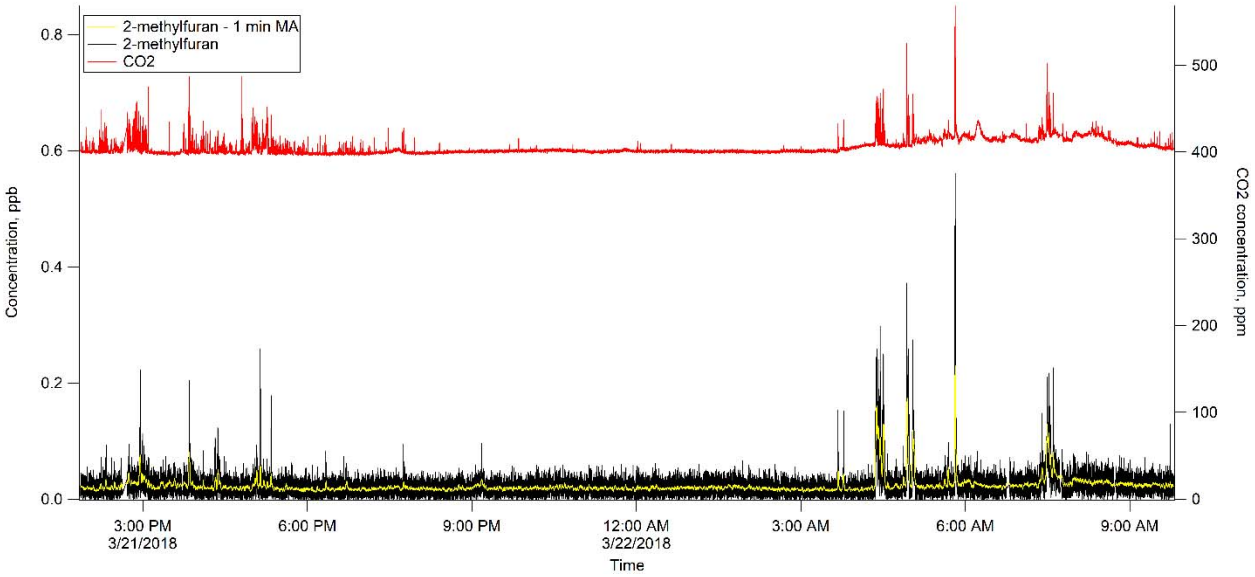


Figure 4-4. 2-methylfuran.

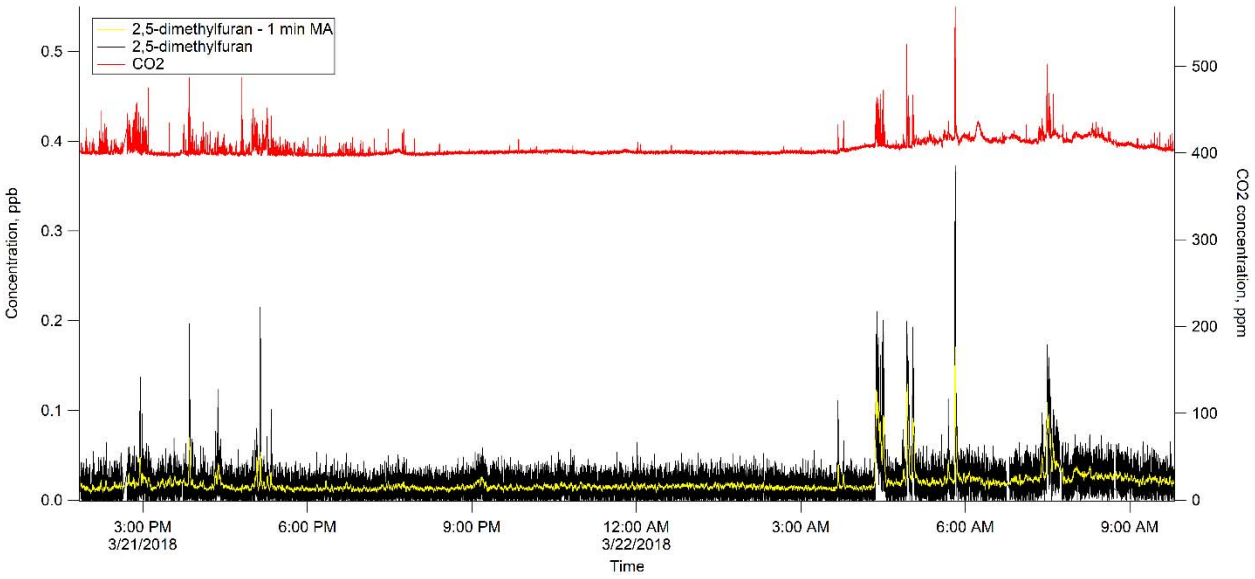


Figure 4-5. 2,5-dimethylfuran.

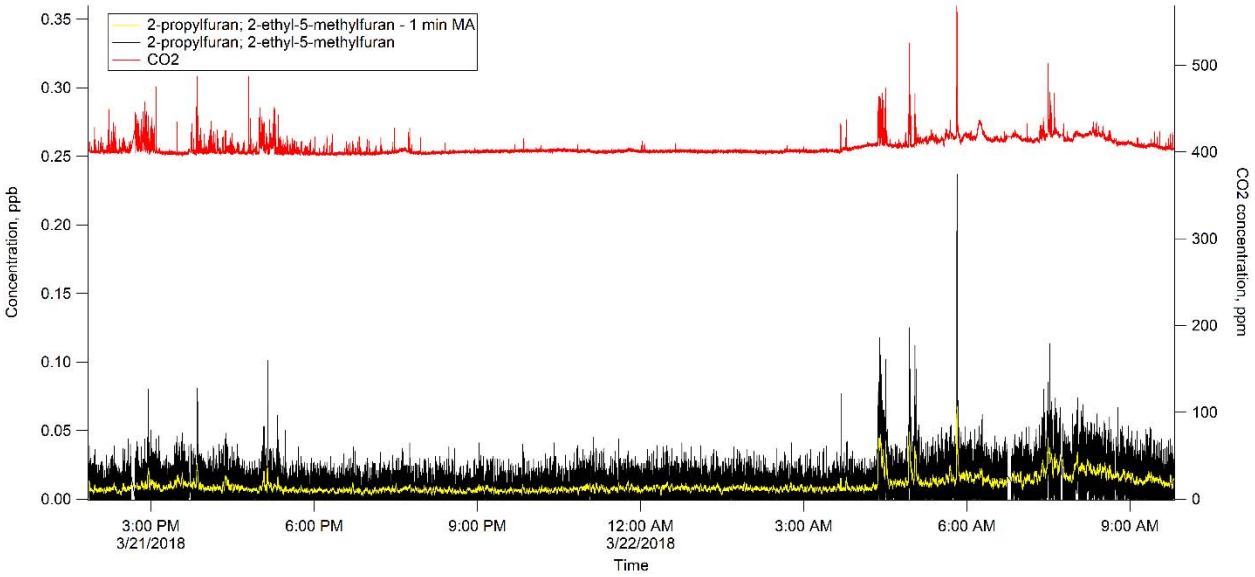


Figure 4-6. 2-propylfuran + 2-ethyl-5-methylfuran.

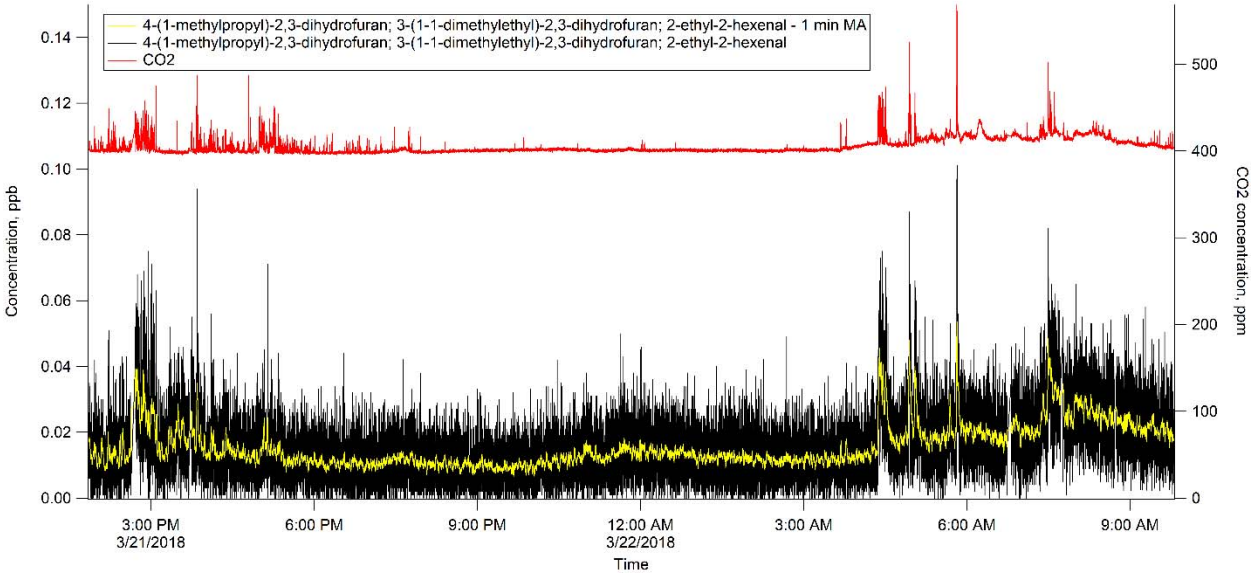


Figure 4-7. 4-(1-methylpropyl)-2,3-dihydrofuran + 3-(1,1-dimethylethyl)-2,3-dihydrofuran + 2-ethyl-2-hexenal.

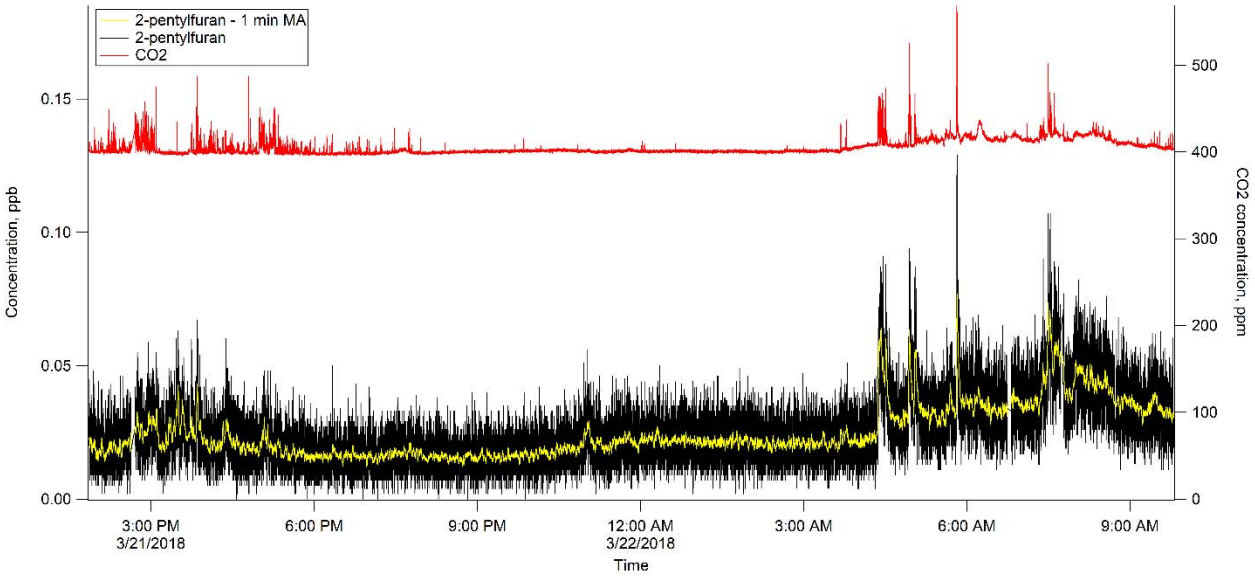


Figure 4-8. 2-pentylfuran.

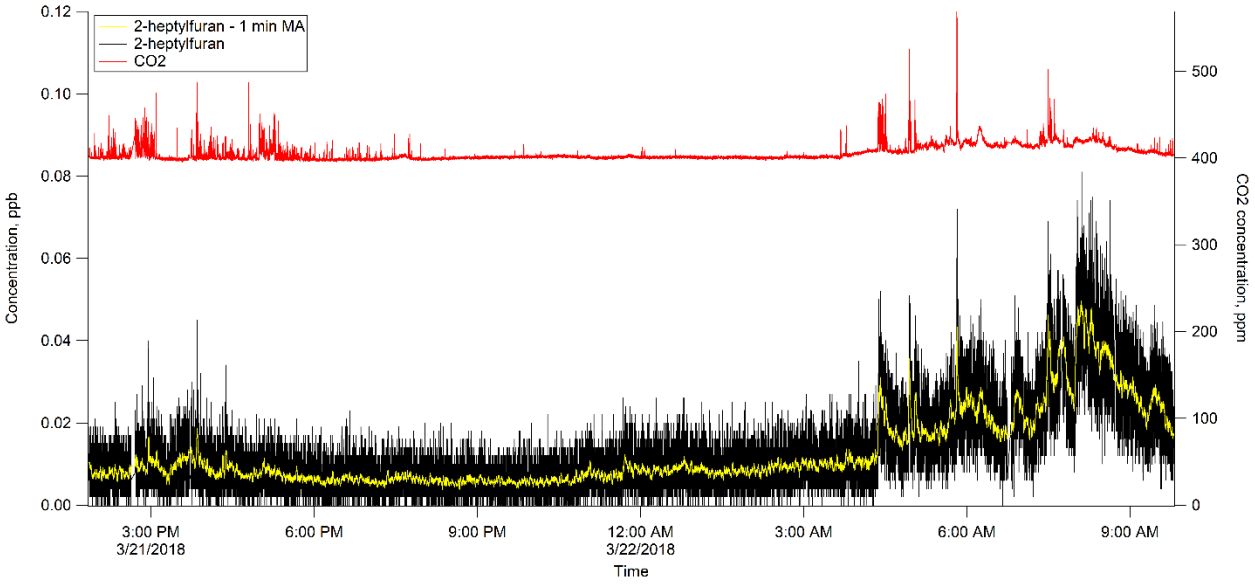


Figure 4-9. 2-heptylfuran.

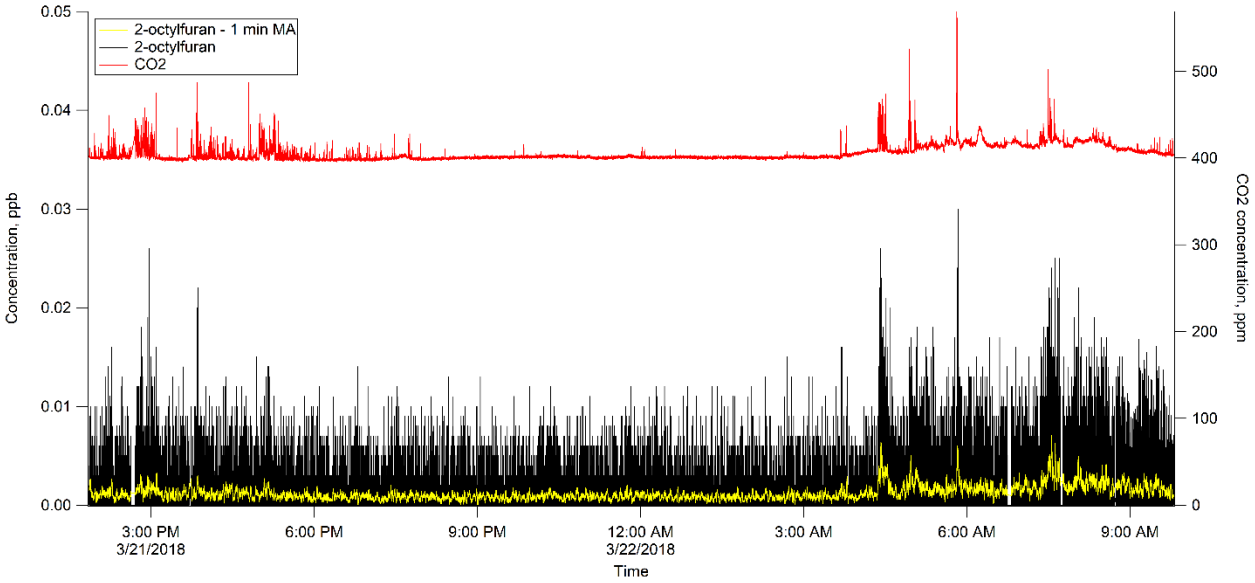


Figure 4-10. 2-octylfuran.

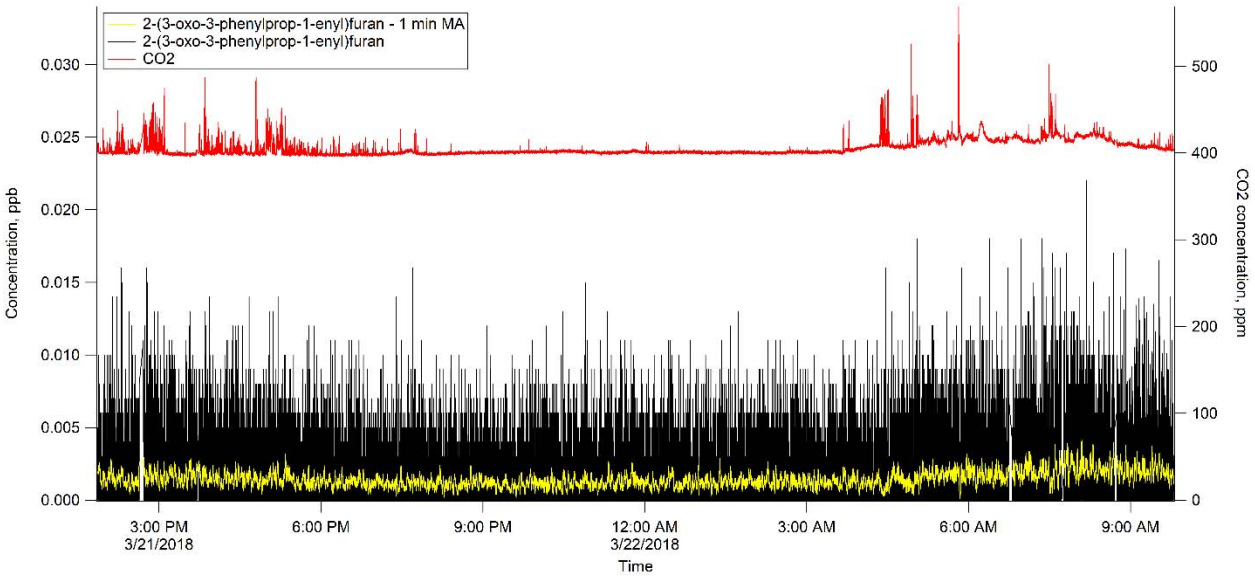


Figure 4-11. 2-(3-oxo-3-phenylprop-1-enyl)furan.

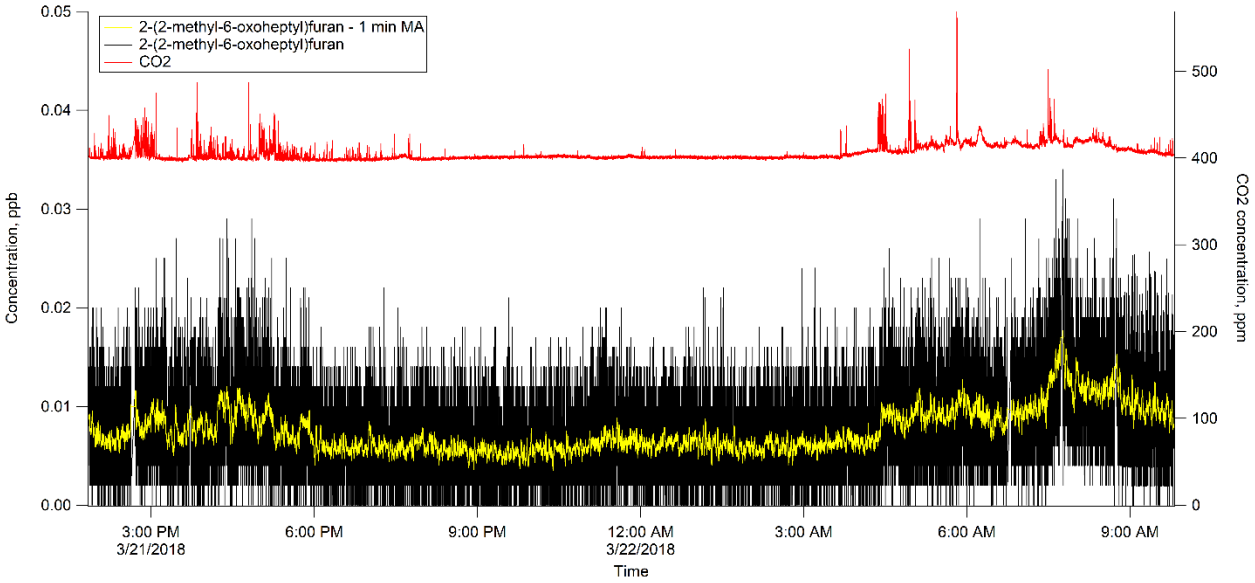


Figure 4-12. 2-(2-methyl-6-oxoheptyl)furan.

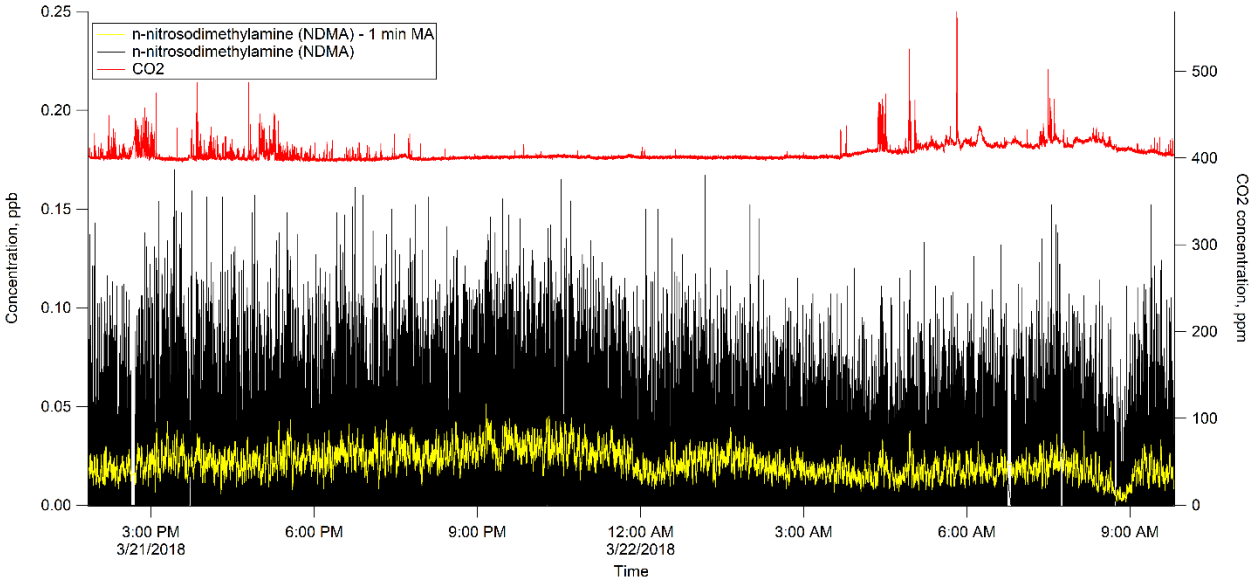


Figure 4-13. N-nitrosodimethylamine (NDMA).

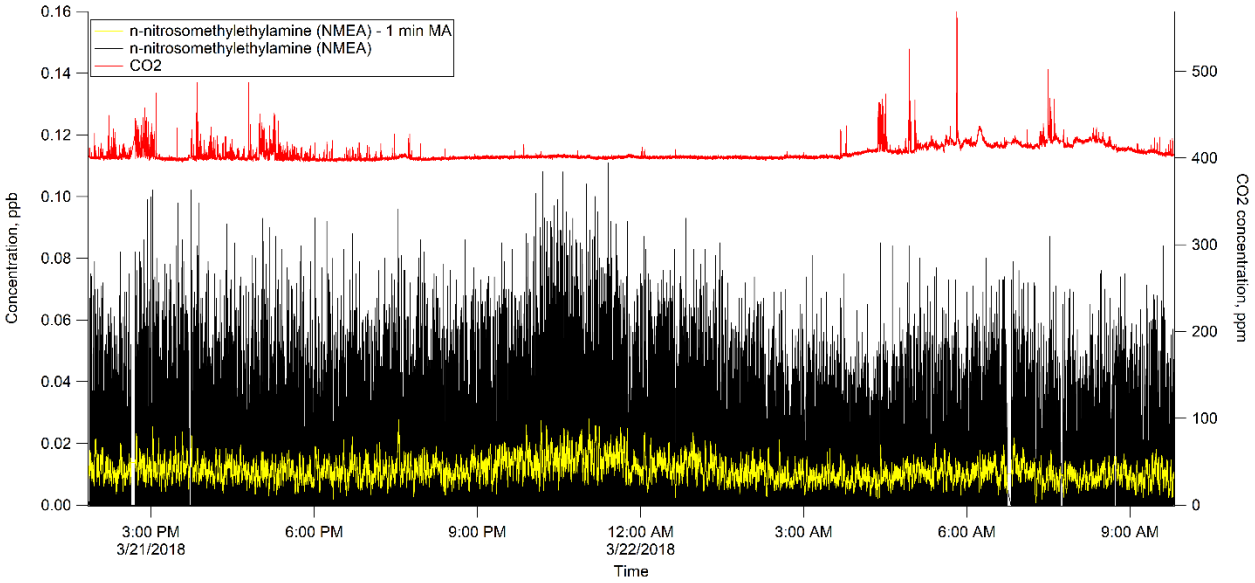


Figure 4-14. N-nitrosomethylethylamine (NMEA).

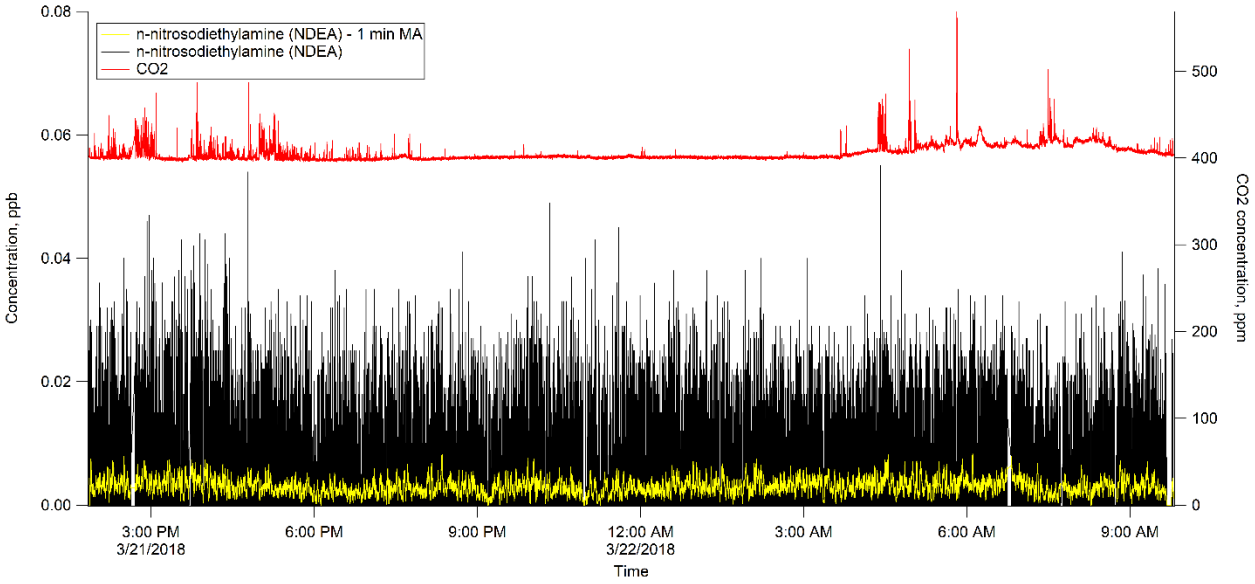


Figure 4-15. N-nitrosodiethylamine (NDEA).

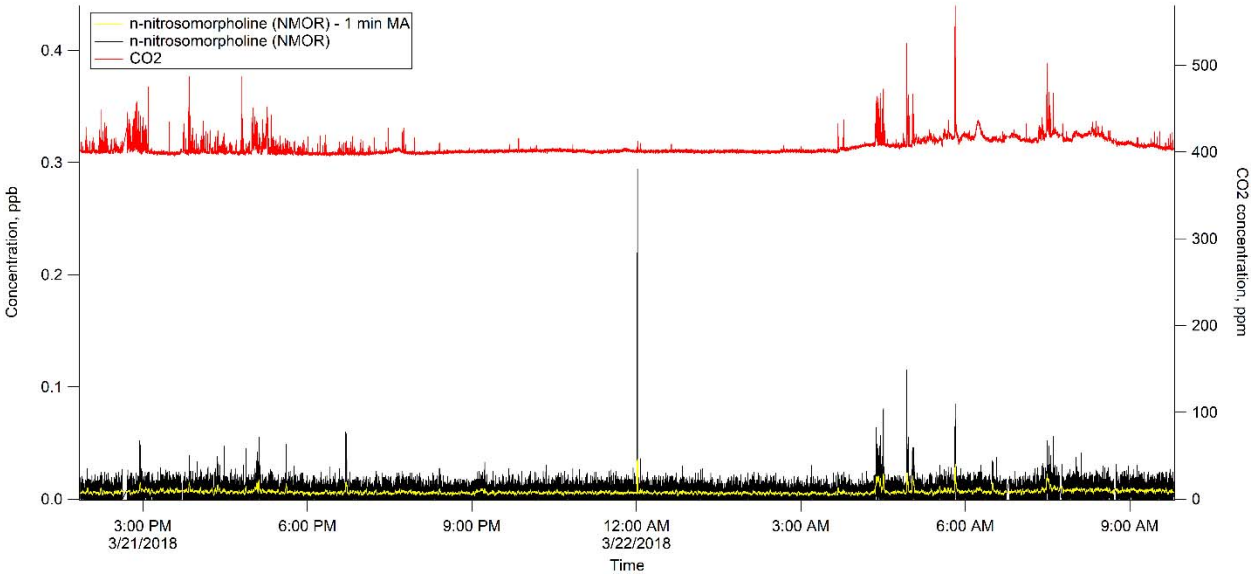


Figure 4-16. N-nitrosomorpholine (NMOR).

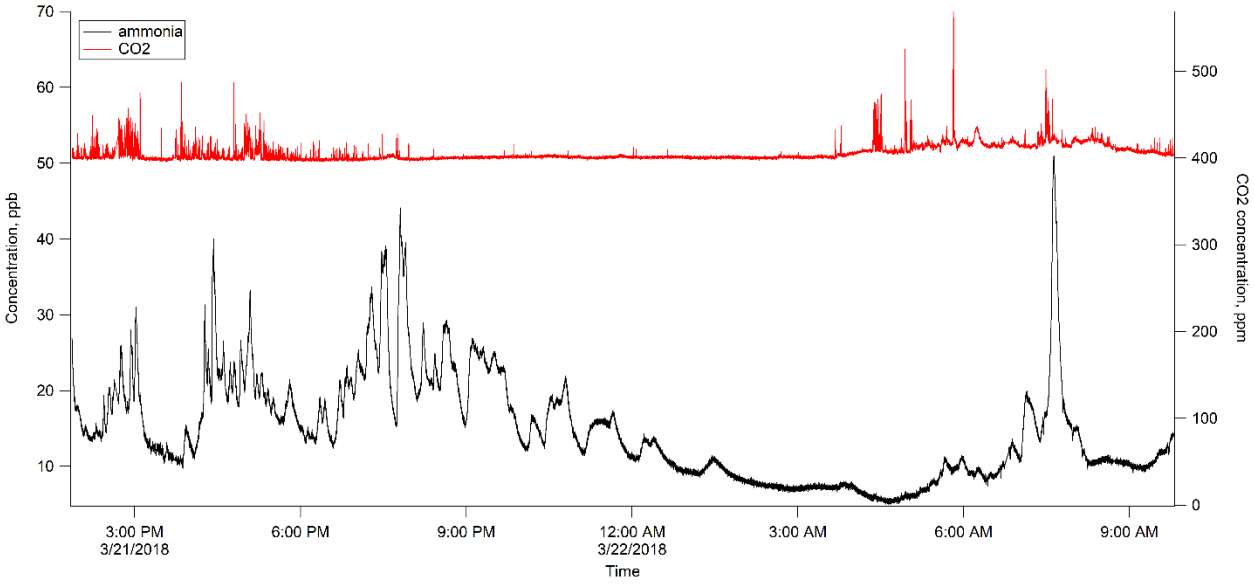


Figure 4-17. Ammonia.

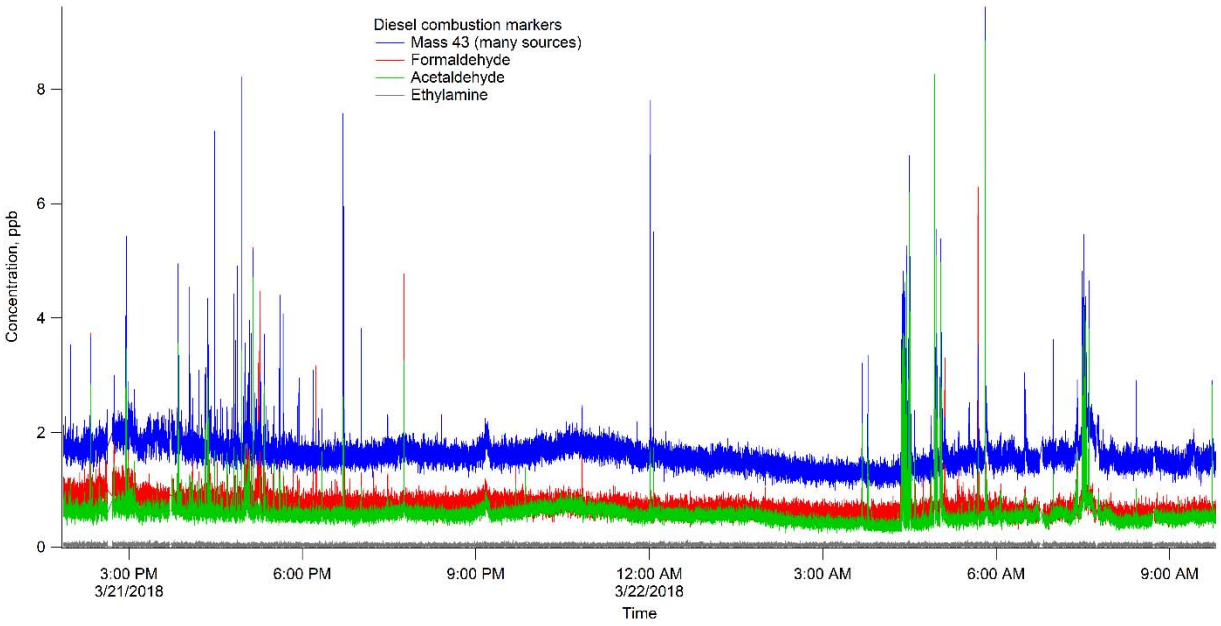


Figure 4-18. Diesel Combustion Markers.

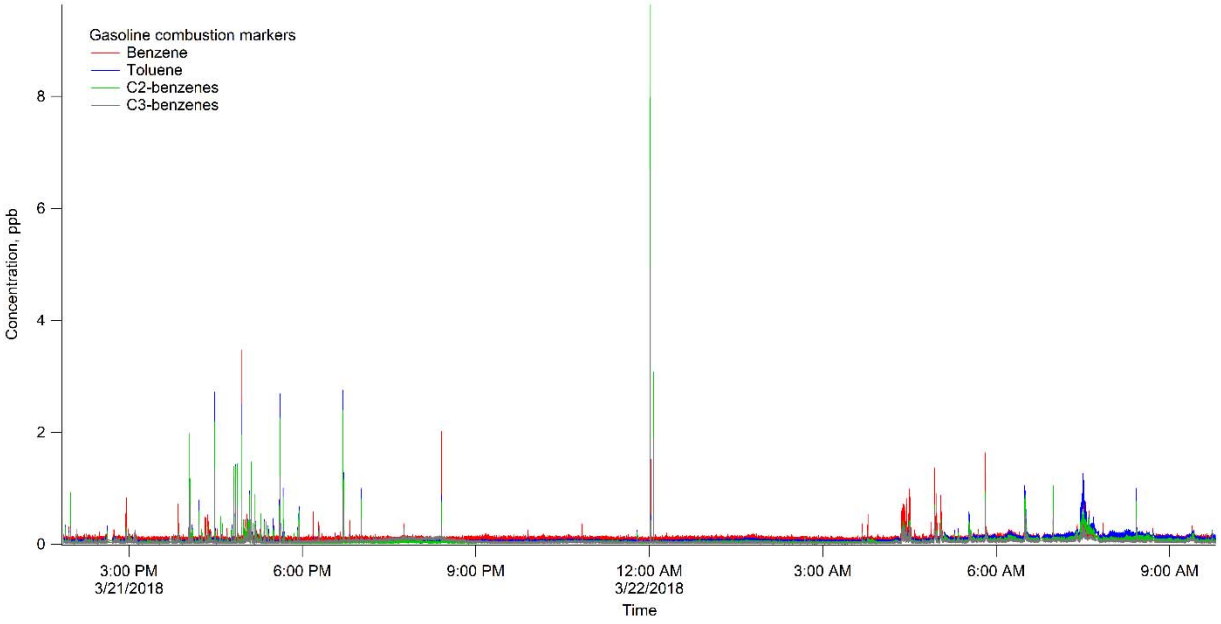


Figure 4-19. Gasoline Combustion Markers.

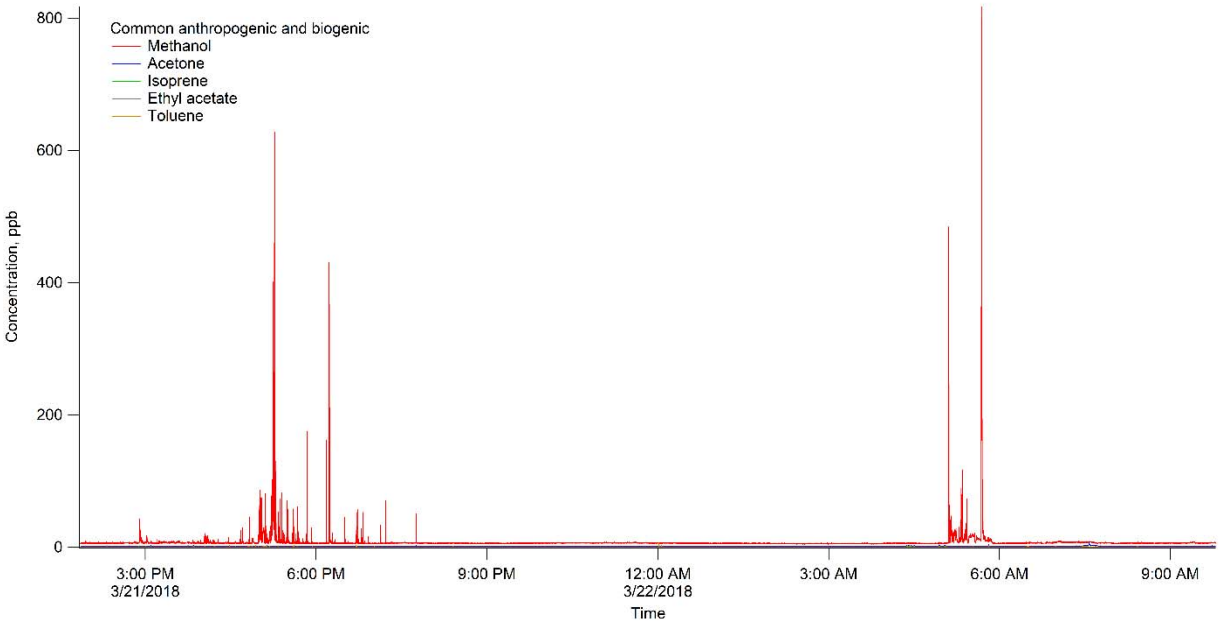


Figure 4-20. Plant and Human Markers.

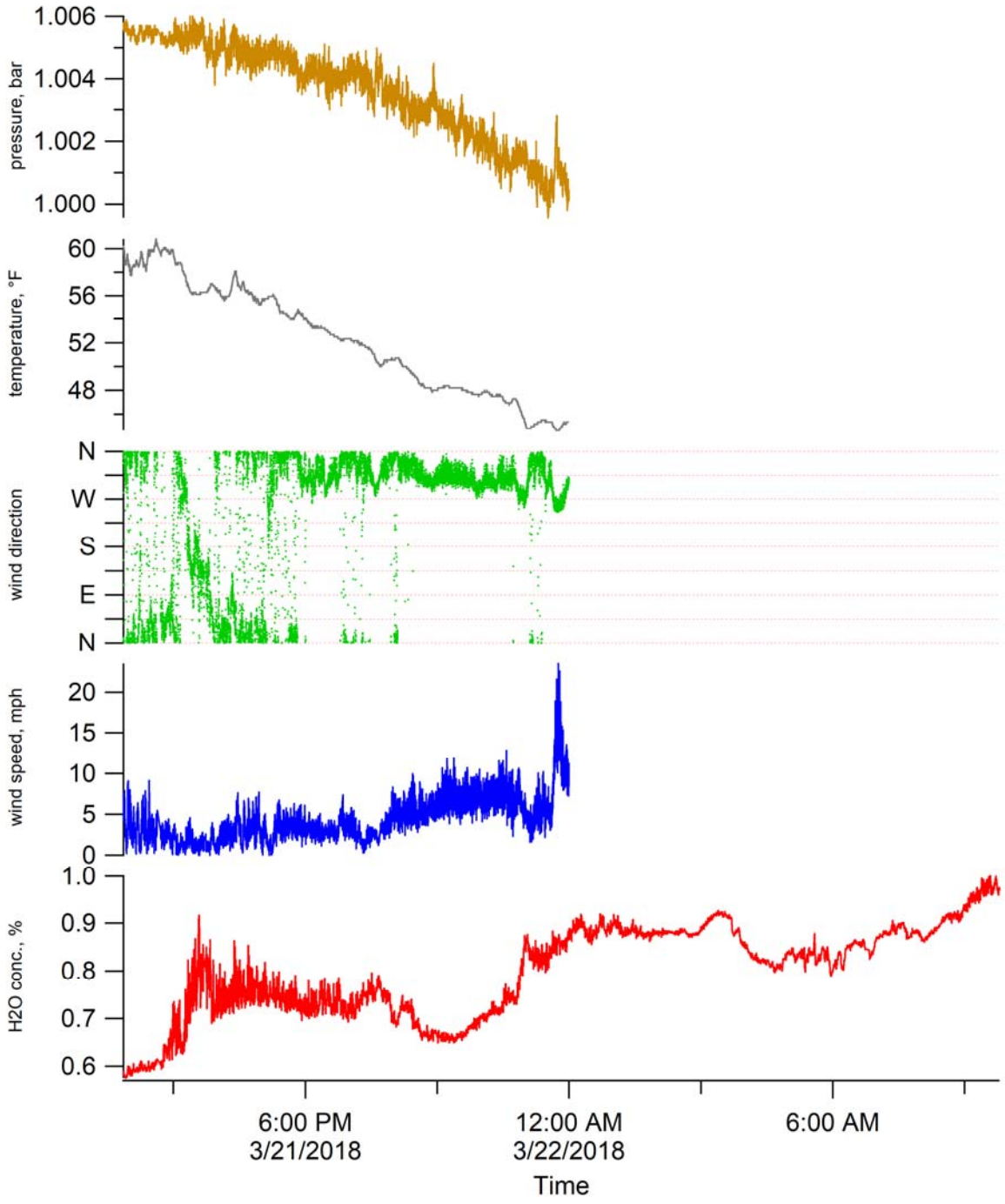


Figure 4-21. Weather Data.

5.0 MARCH 22, 2018 – MARCH 23, 2018 – STUDY SITE #6

5.1 Quality Assessment

Data from March 22, 2018, were transferred to TerraGraphics via the WRPS FTP site on March 27, 2018. Data were assessed using Procedure 17124-DOE-HS-102. A completed Data Exchange Checklist was sent to WRPS on March 29, 2018. The data were accepted by TerraGraphics with the following comments. All startup, shutdown, and calibration procedures were adequately documented and all other checks passed the acceptance limits.

Using diesel combustion markers from the PTR-MS and CO_2 from the LI-COR, the time basis of the two data streams were in perfect alignment. On March 30, 2018, WRPS was notified that the timing errors between CO_2 and the PTR-MS were resolved by this date and no further mention of the offset will be made unless there is an error that requires adjustment.

5.2 Summary

Krystin Riha, Adrielle Olson, and Anna Woehle performed background sampling using the Mobile Laboratory from March 22, 2018, to March 23, 2018, at Study Site 6. Site 6 is located near the intersection of US Highway 395 and Clearwater Avenue in Kennewick, WA. This site was chosen as a representative of commercial and heavy-traffic emissions as it includes heavy traffic patterns of mixed vehicle types and light commercial activity including a variety of eating establishments. The Mobile Laboratory arrived at Site 6 at 10:53 on March 22, 2018. The initial QA/QC zero air/sensitivity checks were performed on the CO_2 monitor, NH_3 monitor, and the PTR-MS beginning at 12:36. Routine data collection resumed by 13:44. The Mobile Laboratory staff departed the monitoring site after performing the final PTR-MS zero air check for the evening at 15:51.

The Mobile Laboratory staff had returned to Site 6 and performed a PTR-MS zero air check by 06:38 on March 23, 2018. A stove pipe effect at the inlet was presumed at 07:00 and when the van door was opened the CO_2 signals came down. Closeout zero air/sensitivity checks were performed at 10:30. The Mobile Laboratory moved to Site 1 by 13:20.

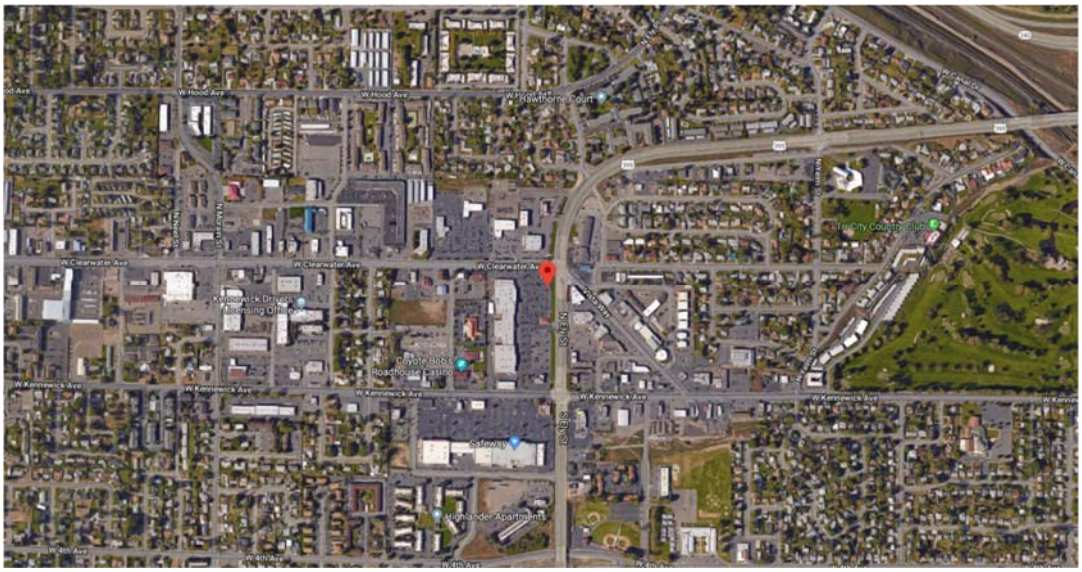


Figure 5-1. Mobile Laboratory Site #6 for the Duration of the Monitoring Period.

5.3 Samples Collected

Continuous air monitoring was performed using the following instrumentation:

- PTR-MS,
- LI-COR CO_2 Monitor,
- Picarro Ammonia Monitor, and
- Weather Station.

Confirmatory air samples were collected as follows.

Table 5-1. Alternative Media Samples Taken.

Site	Date	Sample Type	ID	Start	Stop	Sample Time (min)
6	22-Mar	Thermosorb/N	EL22205	12:42	15:44	183
6	22-Mar	CarboTrap-300	A021312	12:47	13:58	70
6	23-Mar	Thermosorb/N	EL22219	06:29	09:36	186
6	23-Mar	CarboTrap-300	A021996	06:35	07:47	71

Table 5-2 displays the statistical information for the monitoring period of March 22, 2018, to March 23, 2018. By definition, the OEL is an 8-hour, time-weighted average that establishes a limit for personnel exposures to hazardous chemicals. It is the exposure level to which a person may be exposed for 8 hours/day, 40 hours/week for 40 years and have no expectation of adverse health effects. In this study, area vapor concentration measurements were made to better understand the hazardous vapor exposures that workers may receive. These measurements are only compared to OEL concentrations to give them context. It is neither accurate nor appropriate

to interpret these short duration measurements (2 seconds) as worker exposures levels. Since the OEL is defined as a time-weighted average, it is more appropriate to compare them to daily average vapor concentrations. Short duration excursions above the OEL concentration are not significant.

Table 5-2. Statistical Information for the Monitoring Period of March 22, 2018 – March 23, 2018.

COPC #	COPC Name	Reporting Limit (PPB)	OEL (ppb)	Ave. (PPB)	St. Dev. (PPB)	Rel. St. Dev. (%)	Max (PPB)	Median (PPB)	Sec. over 50% OEL	Sec. over OEL
1	ammonia	1	25000	11.46	9.65	84.2%	57.25	7.29	0	0
2	furan	0.09	1	0.046	0.021	74.5%	0.399	0.025	0	0
3	but-3-en-2-one + 2,3-dihydrofuran + 2,5-dihydrofuran	0.22	1	0.111	0.037	102.9%	N/A*	N/A*	N/A	N/A
4	NDMA**	0.06	0.3	0.036	0.028	111.5%	0.224	0.017	74	0
5	2-methylfuran	0.05	1	0.032	0.024	82.8%	0.624	0.023	4	0
6	NEMA	0.02	0.3	0.015	0.016	173.8%	0.206	0.000	10	0
7	2,5-dimethylfuran	0.05	1	0.028	0.019	85.4%	0.411	0.018	0	0
8	NDEA	0.01	0.1	0.007	0.006	209.0%	0.062	0.000	12	0
9	2-propylfuran + 2-ethyl-5-methylfuran	0.02	1	0.014	0.013	110.2%	0.192	0.008	0	0
10	NMOR	0.05	0.6	0.025	0.008	105.2%	0.206	0.006	0	0
11	2-ethyl-2-hexenal + 4-(1-methylpropyl)-2,3-dihydrofuran + 3-(1,1-dimethylethyl)-2,3-dihydrofuran	0.04	1	0.020	0.009	67.7%	0.093	0.011	0	0
12	2-pentylfuran	0.04	1	0.023	0.013	59.7%	0.131	0.018	0	0
13	2-heptylfuran	0.02	1	0.011	0.006	65.7%	0.056	0.008	0	0
14	2-octylfuran	0.01	1	0.005	0.002	209.3%	0.028	0.000	0	0
15	6-(2-furanyl)-6-methyl-2-heptanone	0.01	1	0.005	0.002	163.4%	0.022	0.000	0	0
16	furfural acetophenone	0.07	1	0.035	0.004	62.8%	0.044	0.006	0	0

* The maximum peak value for but-3-en-2-one + 2,3 dihydrofuran + 2,5 dihydrofuran was 1.692 ppb and the median value was 0.027 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 200, 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 each COPC signal, overlaid with the same signal smoothed using a 1-minute moving average, and CO_2, for the monitoring period March 22, 2018, to March 23, 2018.

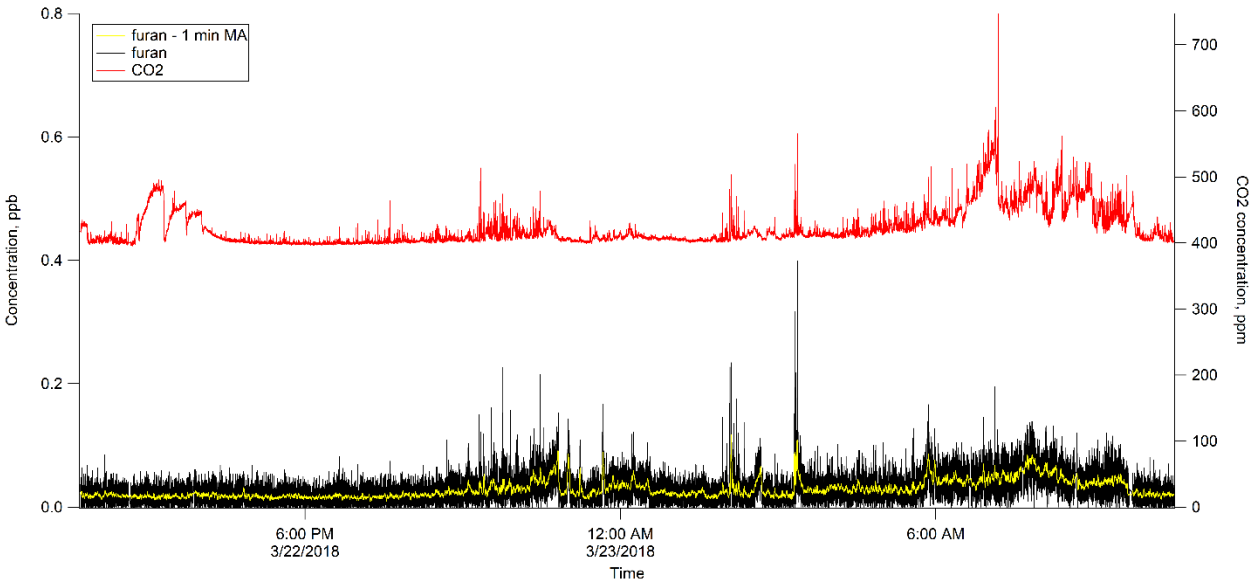


Figure 5-2. Furan.

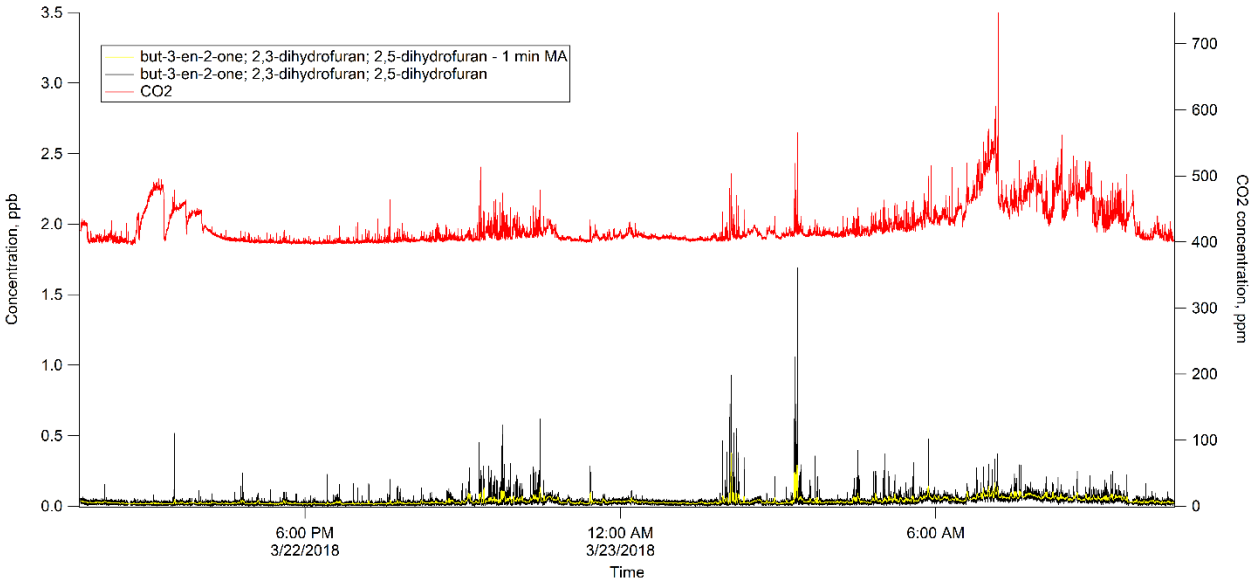


Figure 5-3. -3-en-2-one + 2,3-dihydrofuran + 2,5-dihydrofuran.

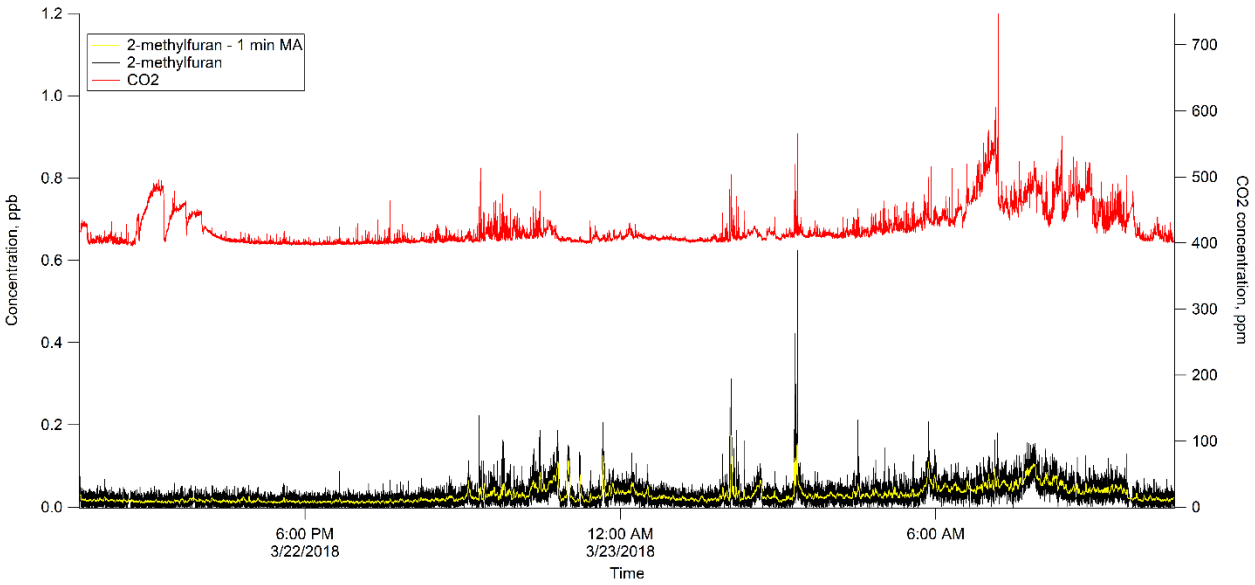


Figure 5-4. 2-methylfuran.

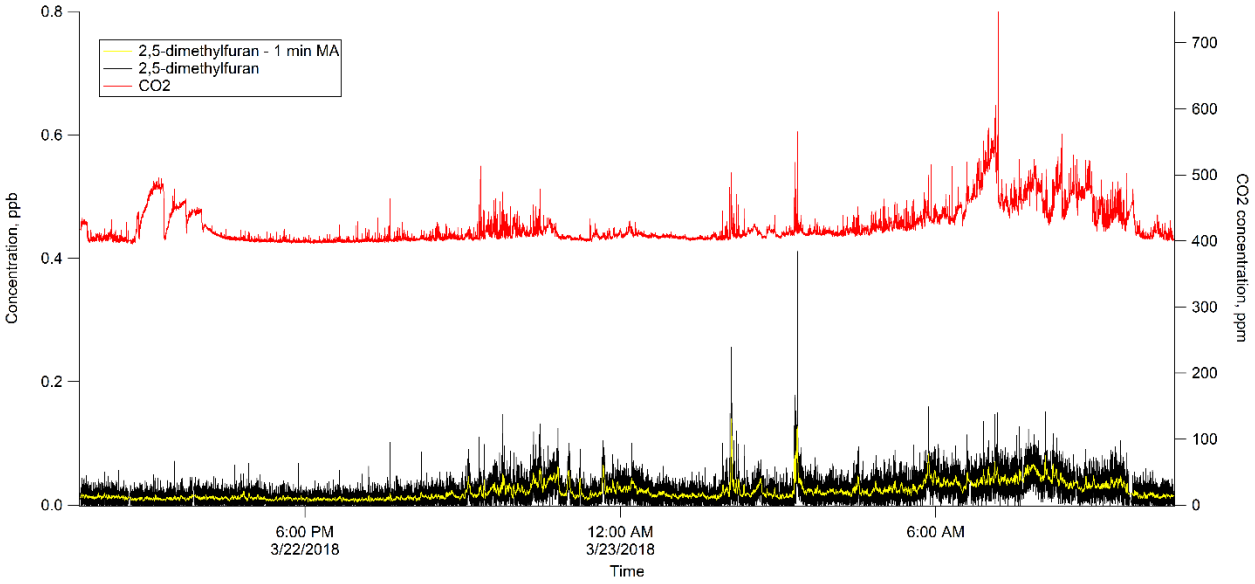


Figure 5-5. 2,5-dimethylfuran.

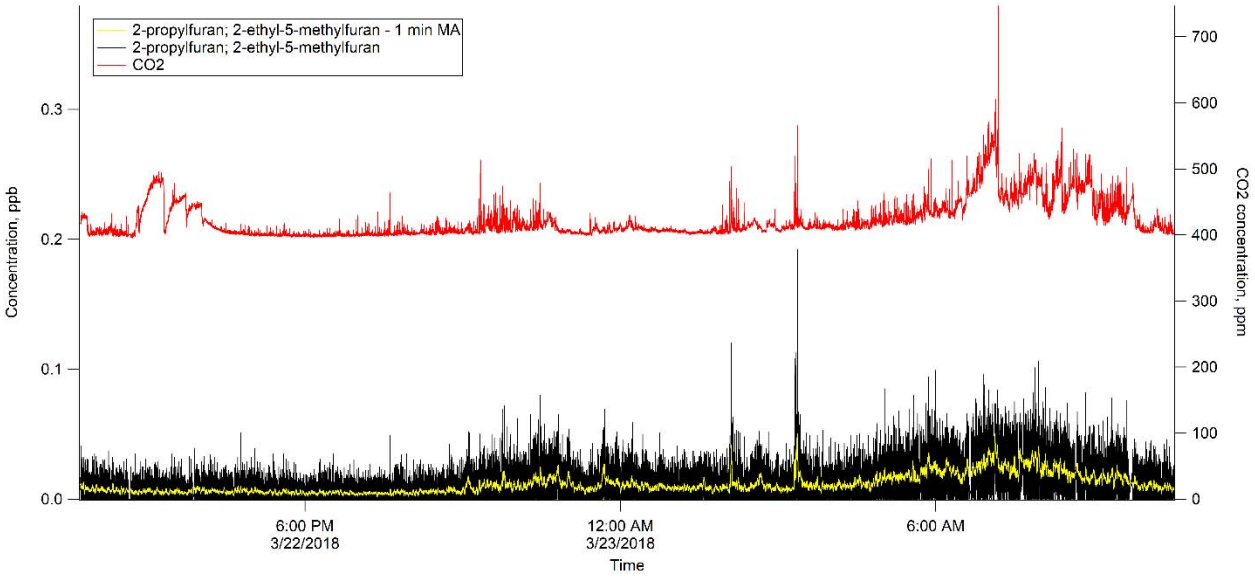


Figure 5-6. 2-propylfuran + 2-ethyl-5-methylfuran.

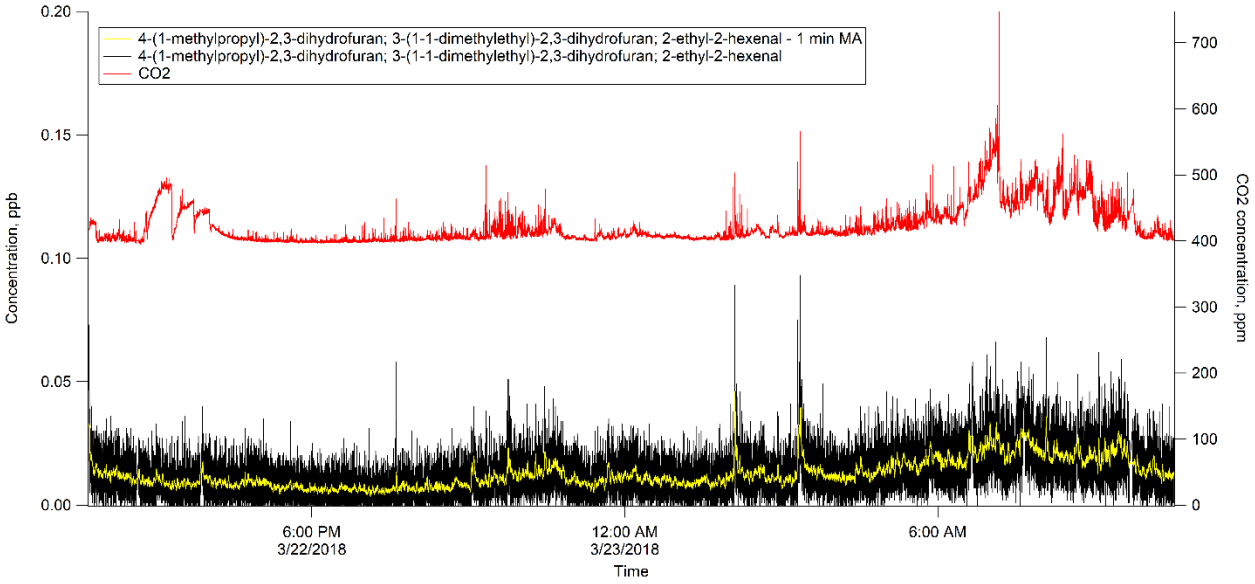


Figure 5-7. 4-(1-methylpropyl)-2,3-dihydrofuran + 3-(1,1-dimethylethyl)-2,3-dihydrofuran + 2-ethyl-2-hexenal.

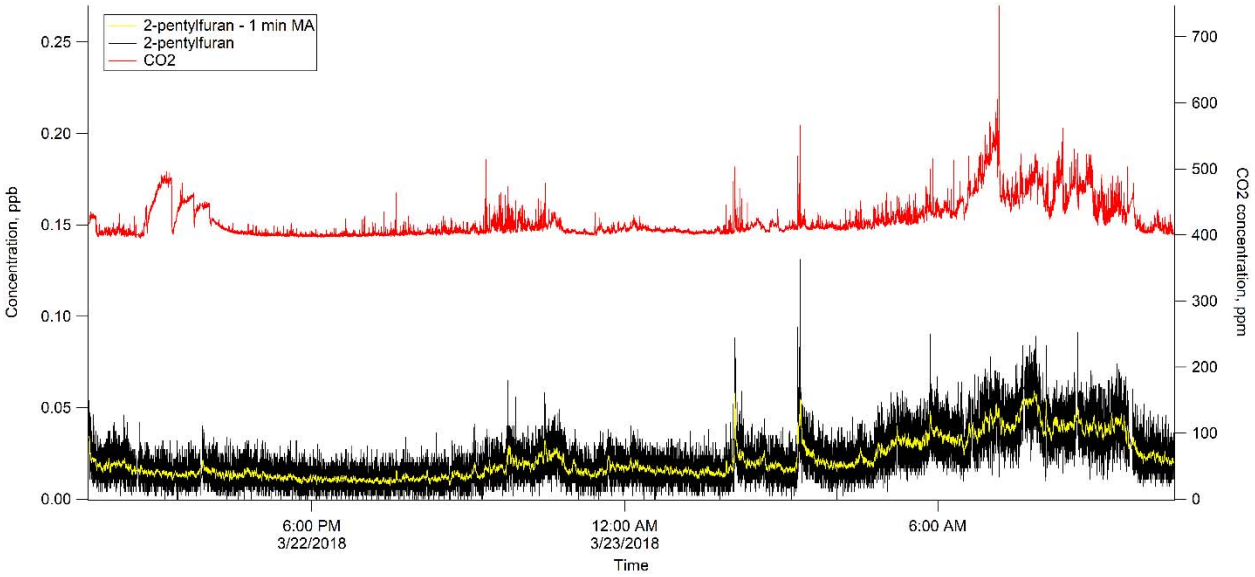


Figure 5-8. 2-pentylfuran.

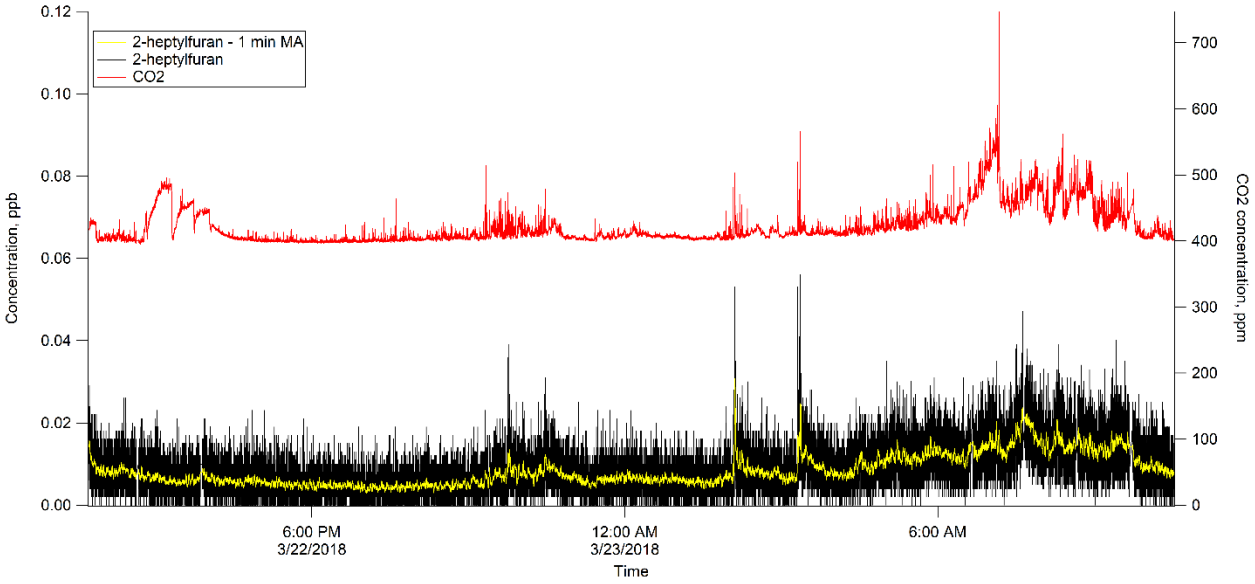


Figure 5-9. 2-heptylfuran.

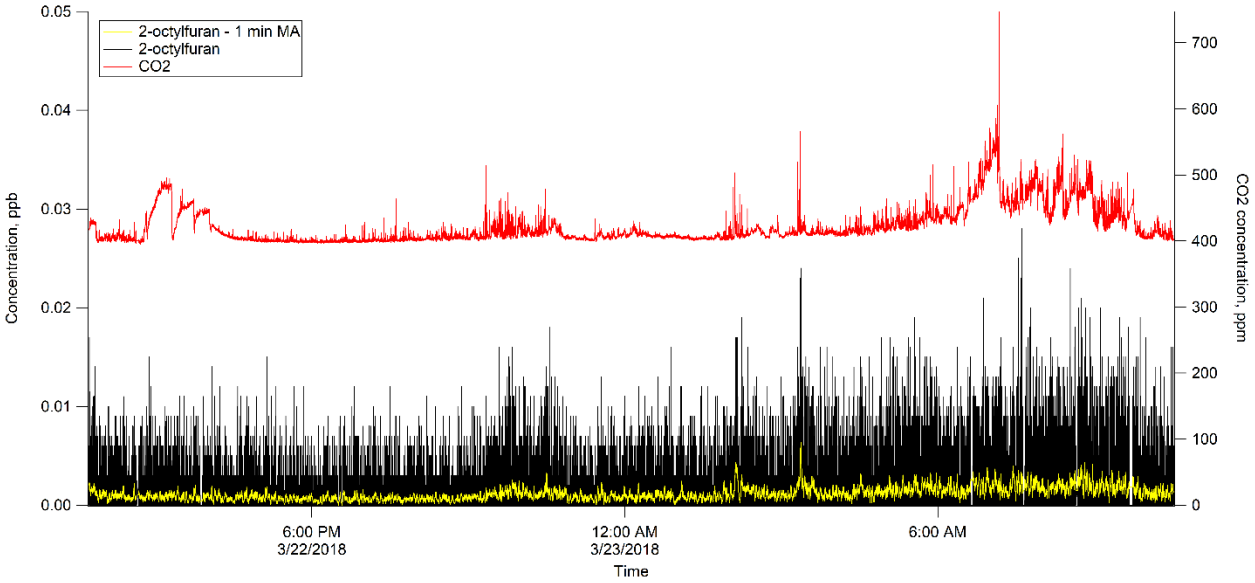


Figure 5-10. 2-octylfuran.

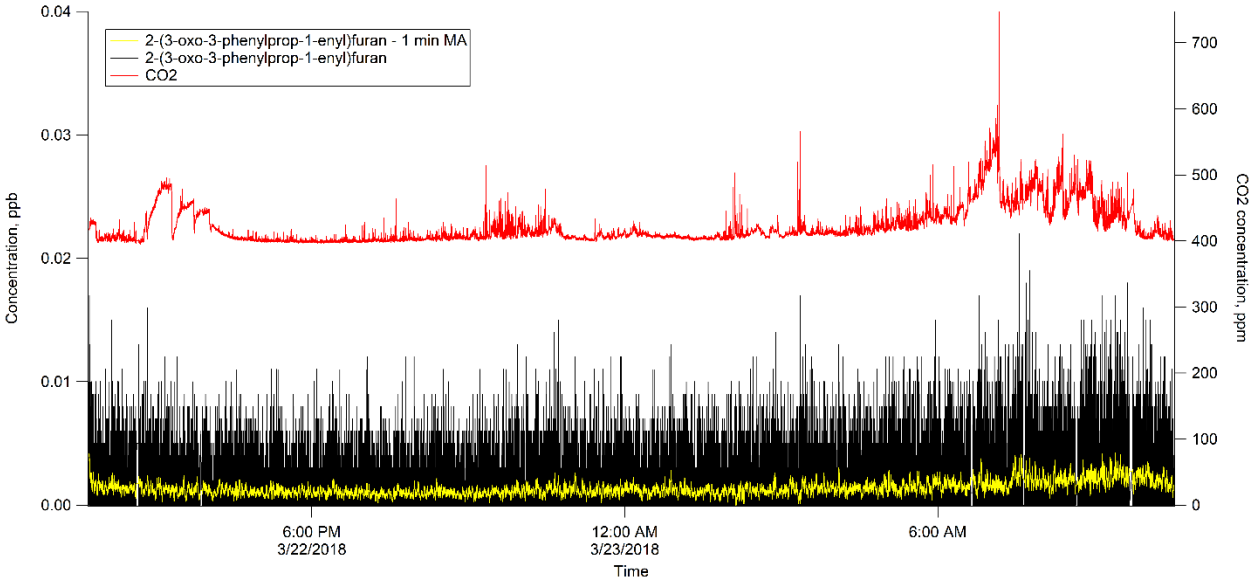


Figure 5-11. 2-(3-oxo-3-phenylprop-1-enyl)furan.

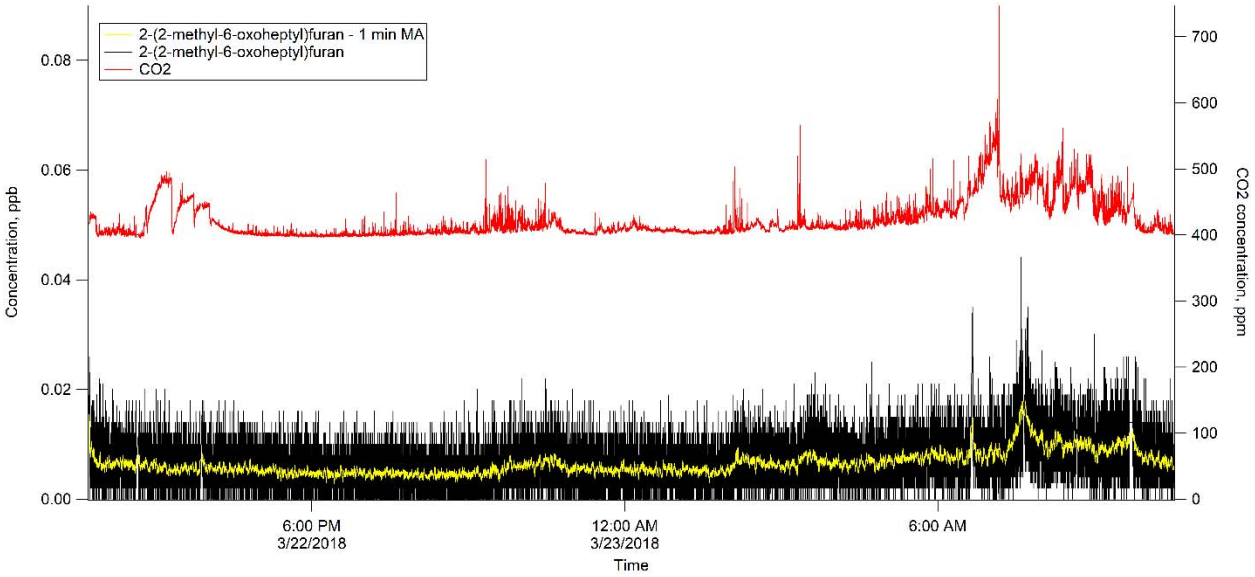


Figure 5-12. 2-(2-methyl-6-oxoheptyl)furan.

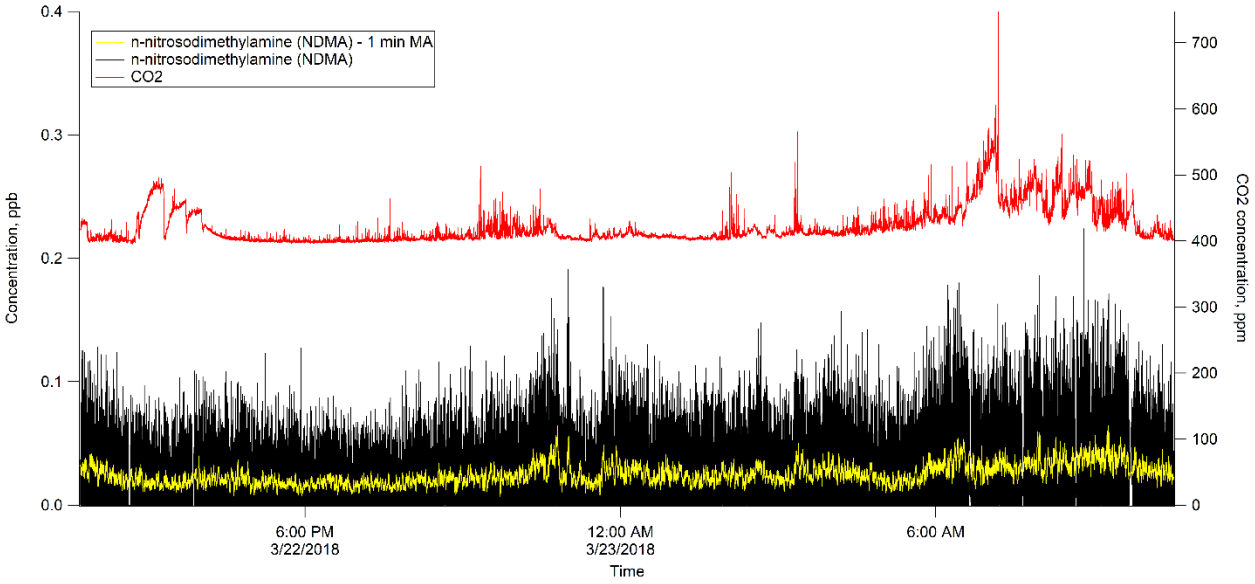


Figure 5-13. N-nitrosodimethylamine (NDMA).

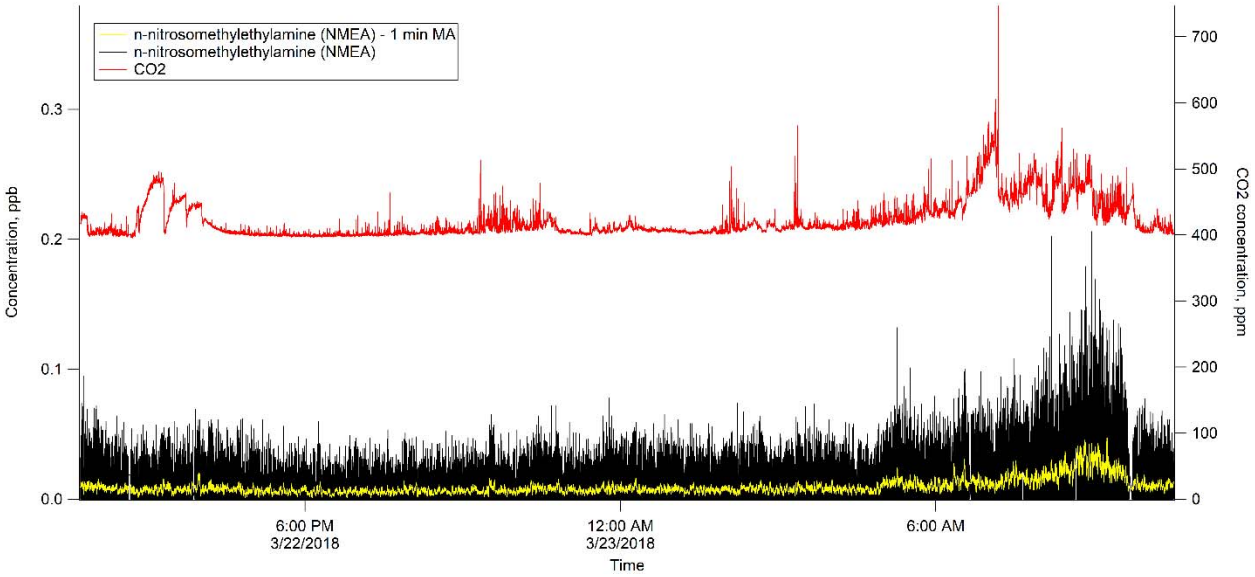


Figure 5-14. N-nitrosomethylethylamine (NMEA).

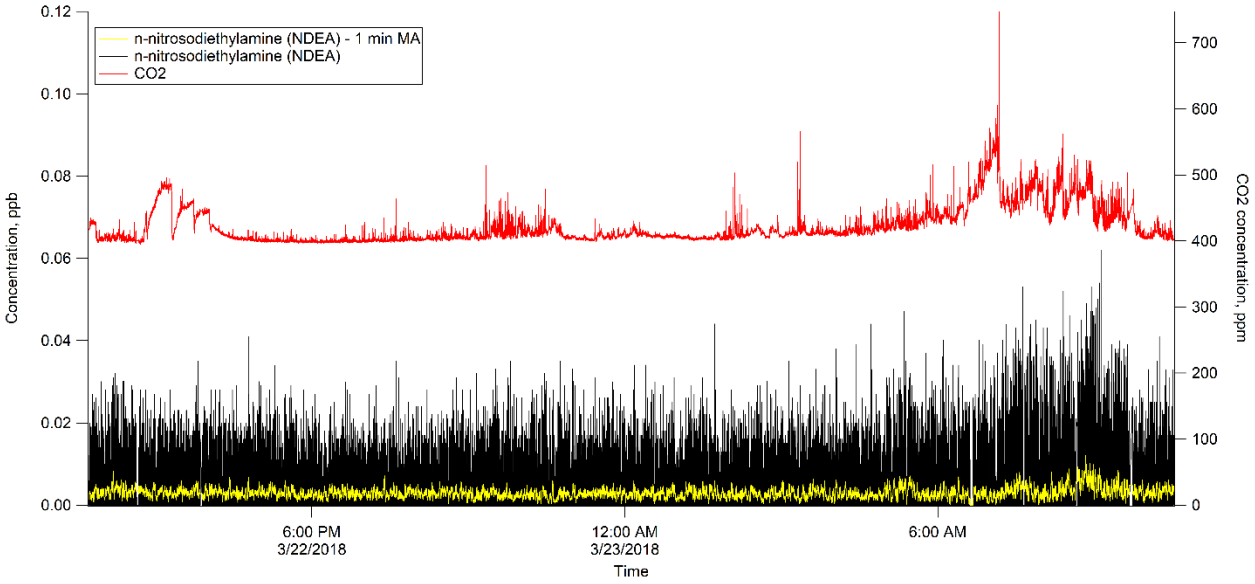


Figure 5-15. N-nitrosodiethylamine (NDEA).

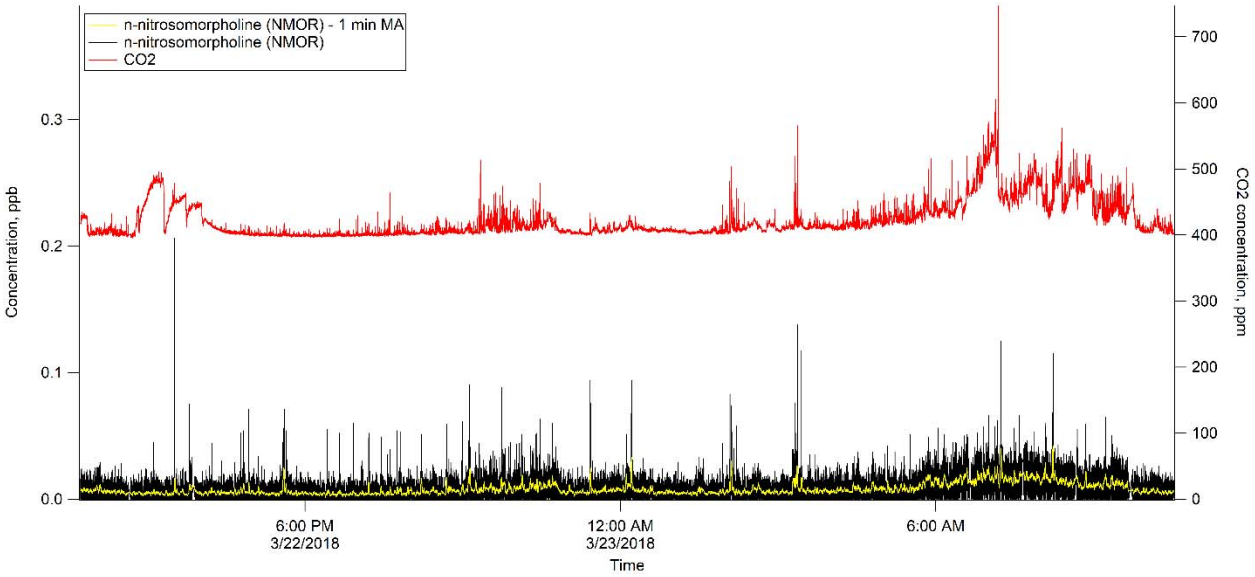


Figure 5-16. N-nitrosomorpholine (NMOR).

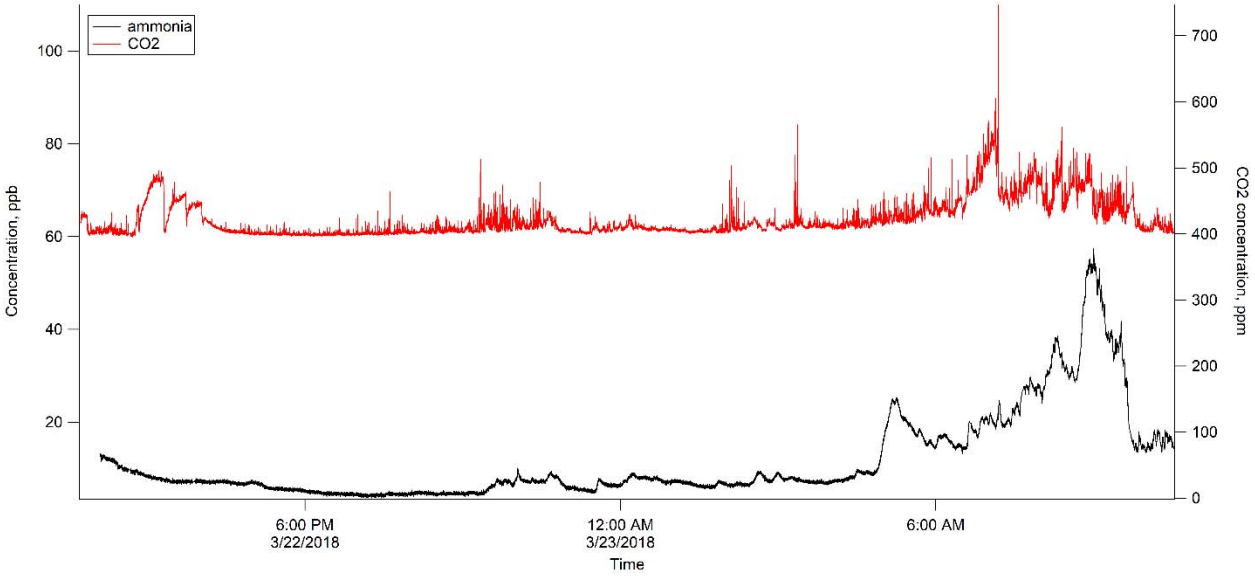


Figure 5-17. Ammonia.

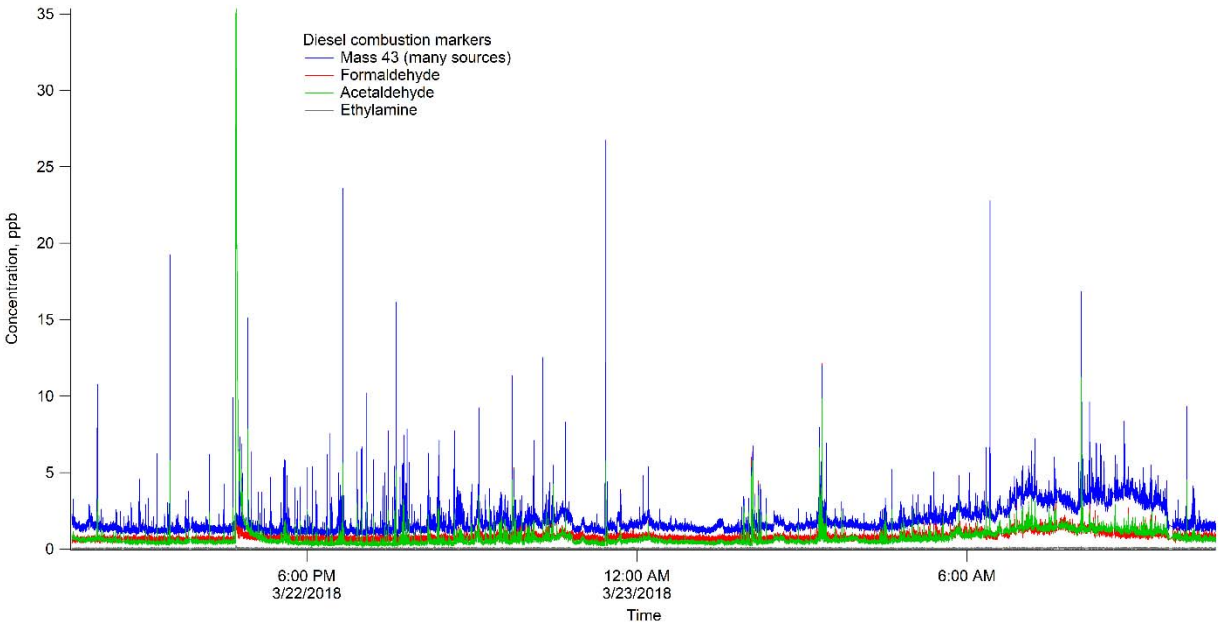


Figure 5-18. Diesel Combustion Markers.

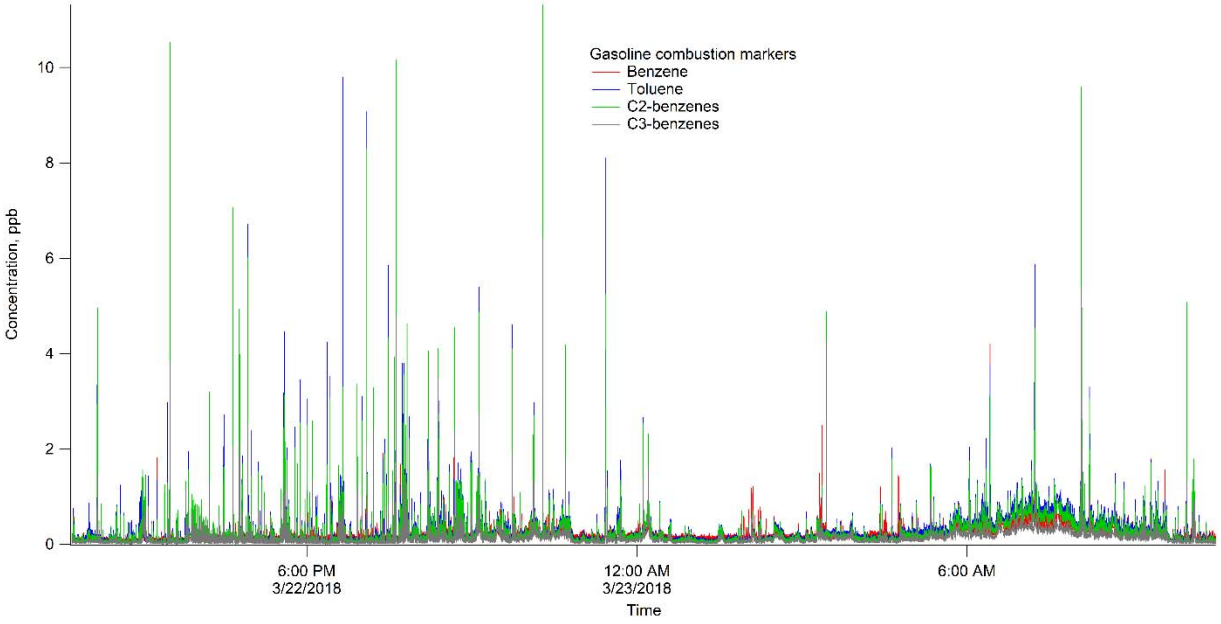


Figure 5-19. Gasoline Combustion Markers.

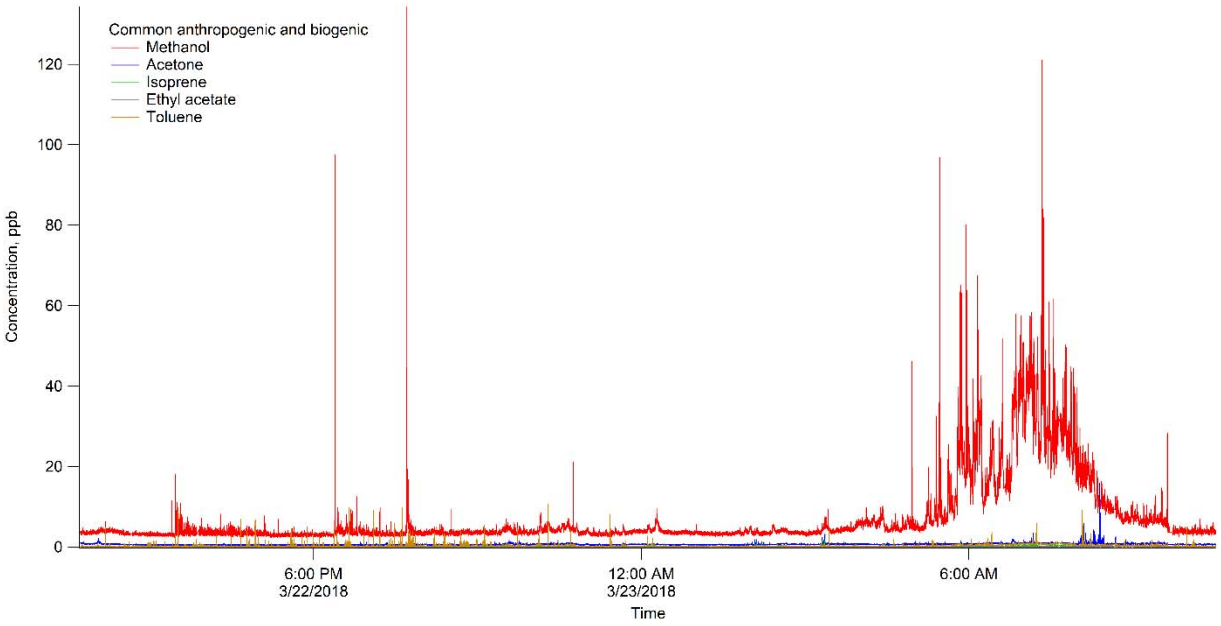


Figure 5-20. Plant and Human Markers.

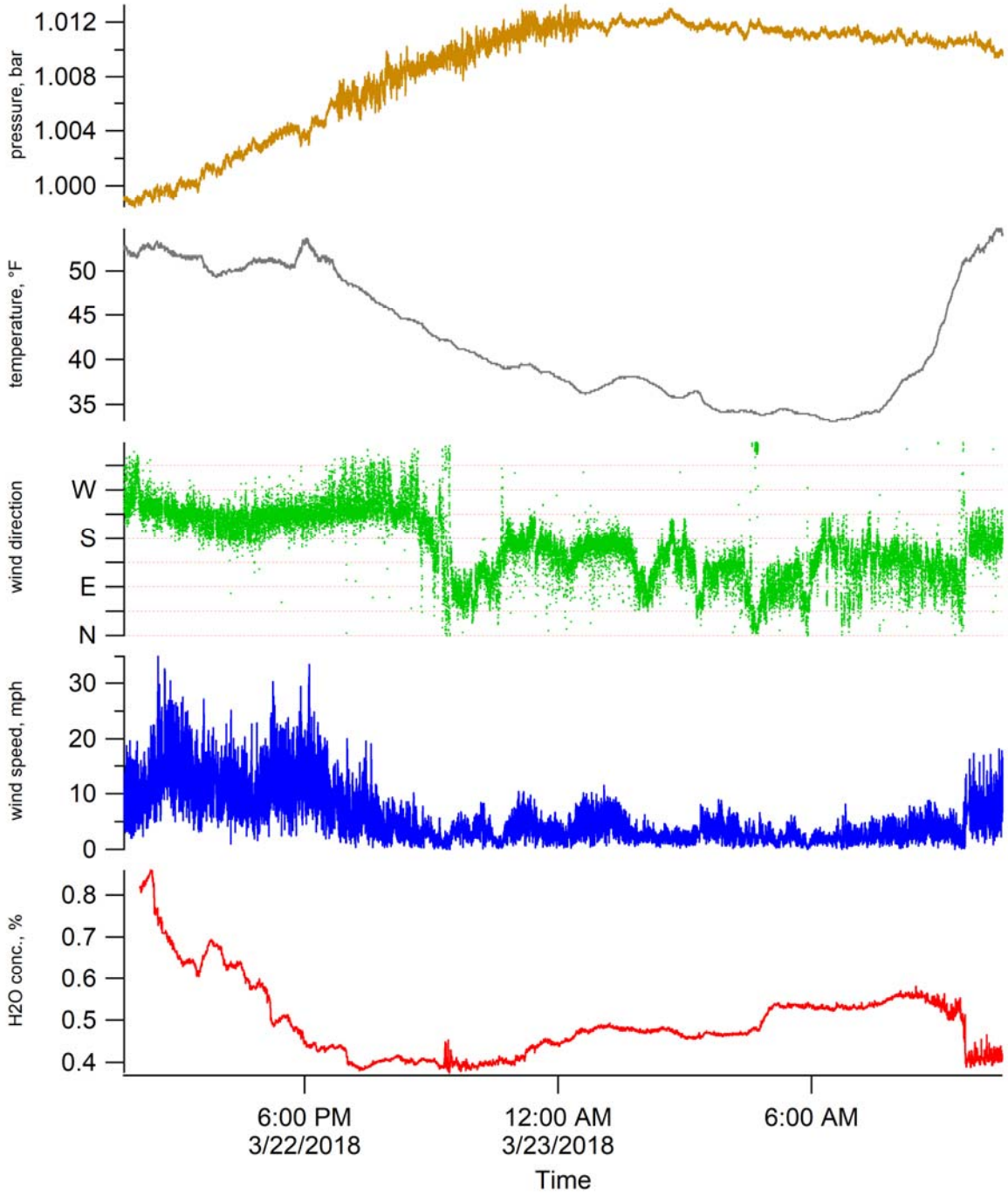


Figure 5-21. Weather Data.

6.0 MARCH 23, 2018 – MARCH 24, 2018 – STUDY SITE #1

6.1 Quality Assessment

Data from March 23, 2018, were transferred to TerraGraphics via the WRPS FTP site on March 27, 2018. Data were assessed using Procedure 17124-DOE-HS-102. A completed Data Exchange Checklist was sent to WRPS on March 29, 2018. The data were accepted by TerraGraphics with the following comments. All startup, shutdown, and calibration procedures were adequately documented and all other checks passed the acceptance limits.

6.2 Summary

Joe Sears, Krystin Riha, and Adrielle Olson performed background sampling using the Mobile Laboratory from March 23, 2018, to March 24, 2018, at Study Site 1. Site 1 is located on the plateau northwest of the 200W Tank Farm operations. This site was chosen as an upwind site from the central Hanford Plateau. The Mobile Laboratory arrived at Site 1 at 13:20 on March 23, 2018. The initial QA/QC zero air/sensitivity checks were performed on the CO_2 monitor, NH_3 monitor, and the PTR-MS beginning at 13:20. Routine data collection resumed by 14:12. The Mobile Laboratory staff departed the monitoring site after performing the final PTR-MS zero air check for the evening at 15:10.

The Mobile Laboratory staff had returned to Site 1 at 06:40 on March 24, 2018, and changed the Site 1 location 200 yards to the north and backed into the road that leads to the Biological Site. Once in the new location, the first PTR-MS zero air check was performed at 06:48. Closeout zero air/sensitivity checks were performed at 10:44. The Mobile Laboratory moved to Site 2 by 12:02.

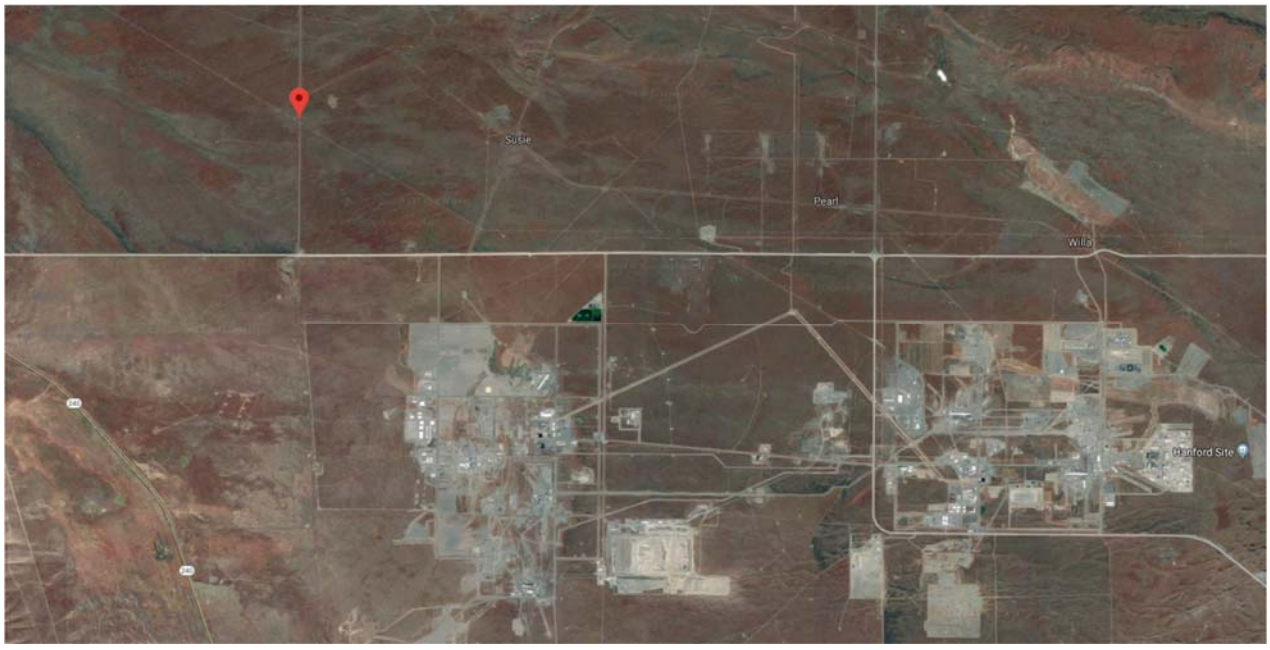


Figure 6-1. Mobile Laboratory Site #1 for the Duration of the Monitoring Period.

6.3 Samples Collected

Continuous air monitoring was performed using the following instrumentation:

- PTR-MS,
- LI-COR CO_2 Monitor,
- Picarro Ammonia Monitor, and
- Weather Station.

Confirmatory air samples were collected as follows.

Table 6-1. Alternative Media Samples Taken.

Site	Date	Sample Type	ID	Start	Stop	Sample Time (min)
1	23-Mar	Thermosorb/N	EL22217	13:27	16:27	180
1	23-Mar	CarboTrap-300	A021304	13:30	14:41	70
1	24-Mar	Thermosorb/N	EL22216	07:02	10:03	180
1	24-Mar	CarboTrap-300	A025998	07:08	08:25	76

Table 6-2 displays the statistical information for the monitoring period of March 23, 2018, to March 24, 2018. By definition, the OEL is an 8-hour, time-weighted average that establishes a limit for personnel exposures to hazardous chemicals. It is the exposure level to which a person may be exposed for 8 hours/day, 40 hours/week for 40 years and have no expectation of adverse health effects. In this study, area vapor concentration measurements were made to better understand the hazardous vapor exposures that workers may receive. These measurements are only compared to OEL concentrations to give them context. It is neither accurate nor appropriate to interpret these short duration measurements (2 seconds) as worker exposures levels. Since the OEL is defined as a time-weighted average, it is more appropriate to compare them to daily average vapor concentrations. Short duration excursions above the OEL concentration are not significant.

Table 6-2. Statistical Information for the Monitoring Period of March 23, 2018 – March 24, 2018.

COPC #	COPC Name	Reporting Limit (PPB)	OEL (ppb)	Ave. (PPB)	St. Dev. (PPB)	Rel. St. Dev. (%)	Max (PPB)	Median (PPB)	Sec. over 50% OEL	Sec. over OEL
1	ammonia	1	25000	4.94	1.42	28.8%	10.64	4.42	0	0
2	furan	0.09	1	0.045	0.012	72.5%	0.202	0.015	0	0
3	but-3-en-2-one + 2,3-dihydrofuran + 2,5-dihydrofuran	0.22	1	0.110	0.020	92.2%	N/A*	N/A*	N/A	N/A
4	NDMA**	0.06	0.3	0.032	0.020	119.3%	0.136	0.009	0	0
5	2-methylfuran	0.05	1	0.025	0.011	83.3%	0.273	0.011	0	0
6	NEMA	0.02	0.3	0.013	0.011	162.2%	0.072	0.000	0	0
7	2,5-dimethylfuran	0.05	1	0.025	0.009	89.2%	0.153	0.009	0	0
8	NDEA	0.01	0.1	0.006	0.005	172.6%	0.043	0.000	0	0
9	2-propylfuran + 2-ethyl-5-methylfuran	0.02	1	0.011	0.007	119.0%	0.097	0.003	0	0
10	NMOR	0.05	0.6	0.025	0.004	110.1%	0.069	0.003	0	0
11	2-ethyl-2-hexenal + 4-(1-methylpropyl)-2,3-dihydrofuran + 3-(1,1-dimethylethyl)-2,3-dihydrofuran	0.04	1	0.020	0.006	73.3%	0.094	0.007	0	0
12	2-pentylfuran	0.04	1	0.020	0.007	51.5%	0.078	0.013	0	0
13	2-heptylfuran	0.02	1	0.010	0.004	65.3%	0.044	0.006	0	0
14	2-octylfuran	0.01	1	0.005	0.002	224.7%	0.019	0.000	0	0
15	6-(2-furanyl)-6-methyl-2-heptanone	0.01	1	0.005	0.002	165.7%	0.016	0.000	0	0
16	furfural acetophenone	0.07	1	0.035	0.003	62.9%	0.022	0.004	0	0

* The maximum peak value for but-3-en-2-one + 2,3 dihydrofuran + 2,5 dihydrofuran was 0.800 ppb and the median value was 0.019 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 200, 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 each COPC signal, overlaid with the same signal smoothed using a 1-minute moving average, and CO_2, for the monitoring period March 23, 2018, to March 24, 2018.

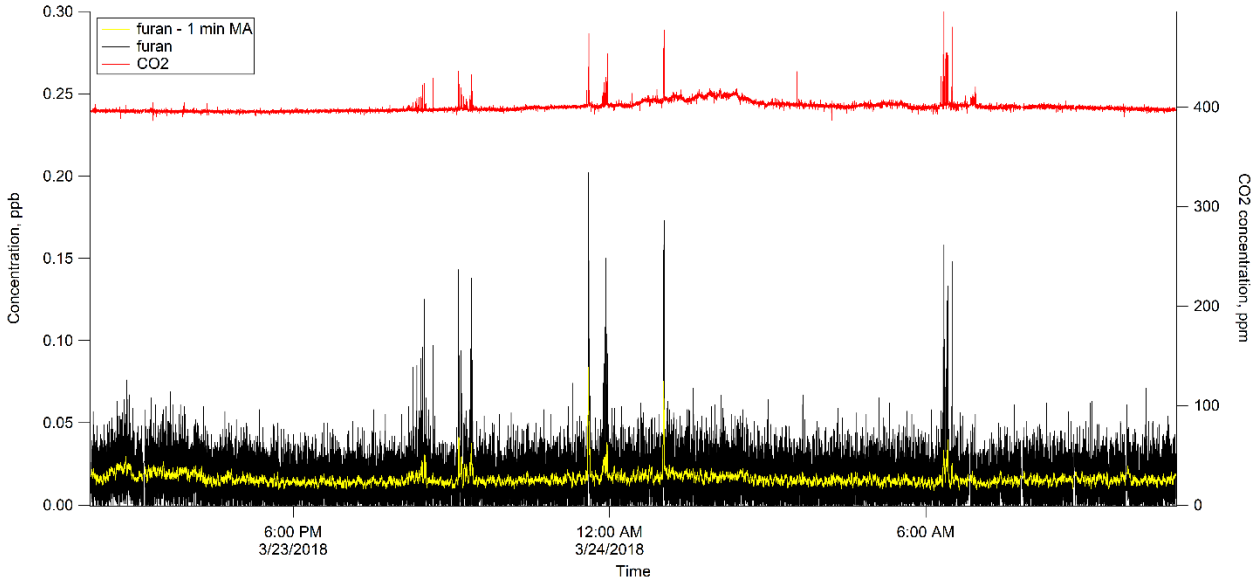


Figure 6-2. Furan.

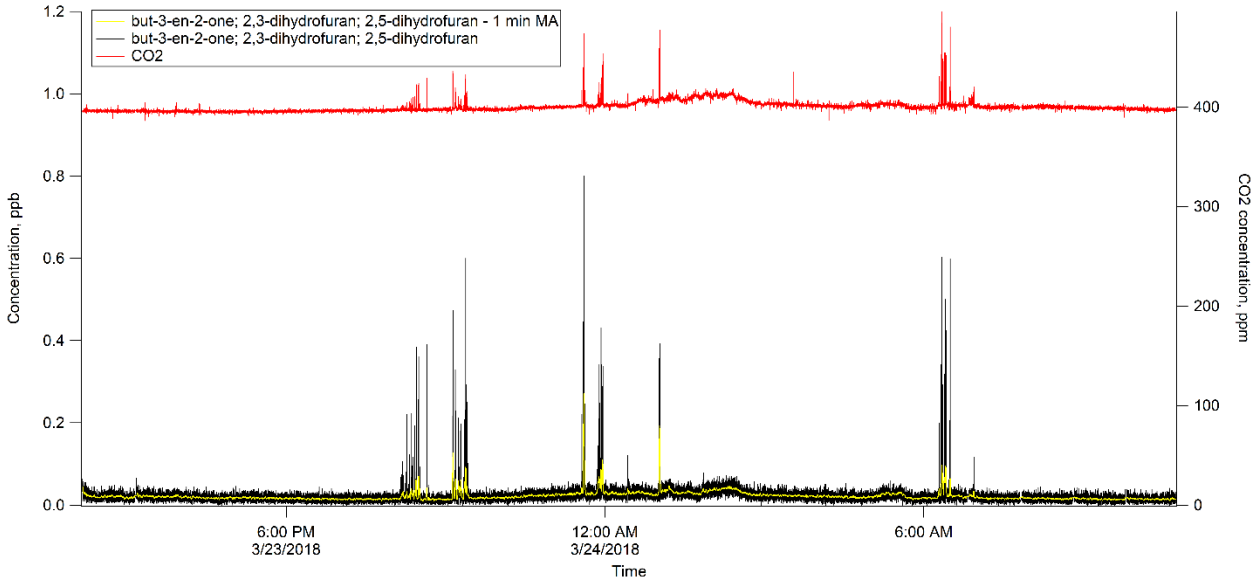


Figure 6-3. -3-en-2-one + 2,3-dihydrofuran + 2,5-dihydrofuran.

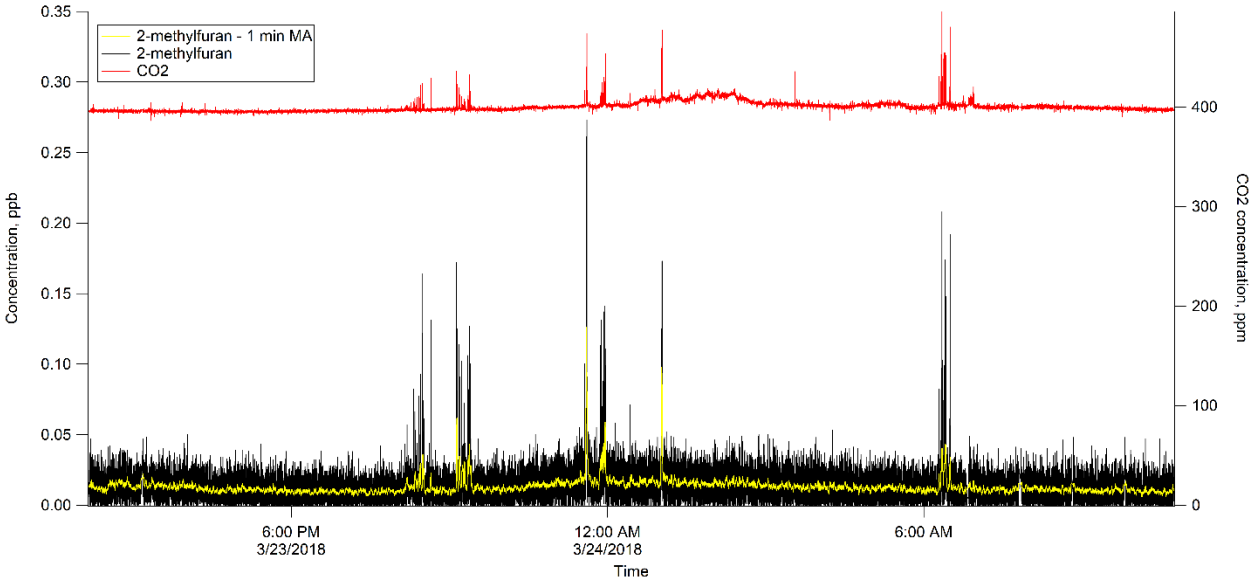


Figure 6-4. 2-methylfuran.

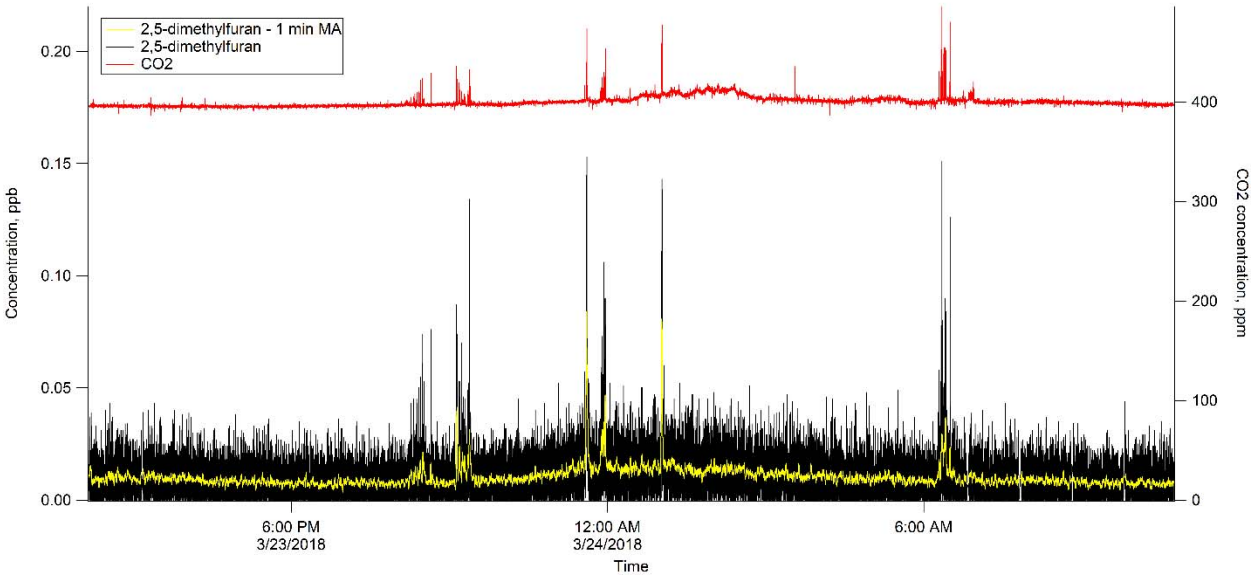


Figure 6-5. 2,5-dimethylfuran.

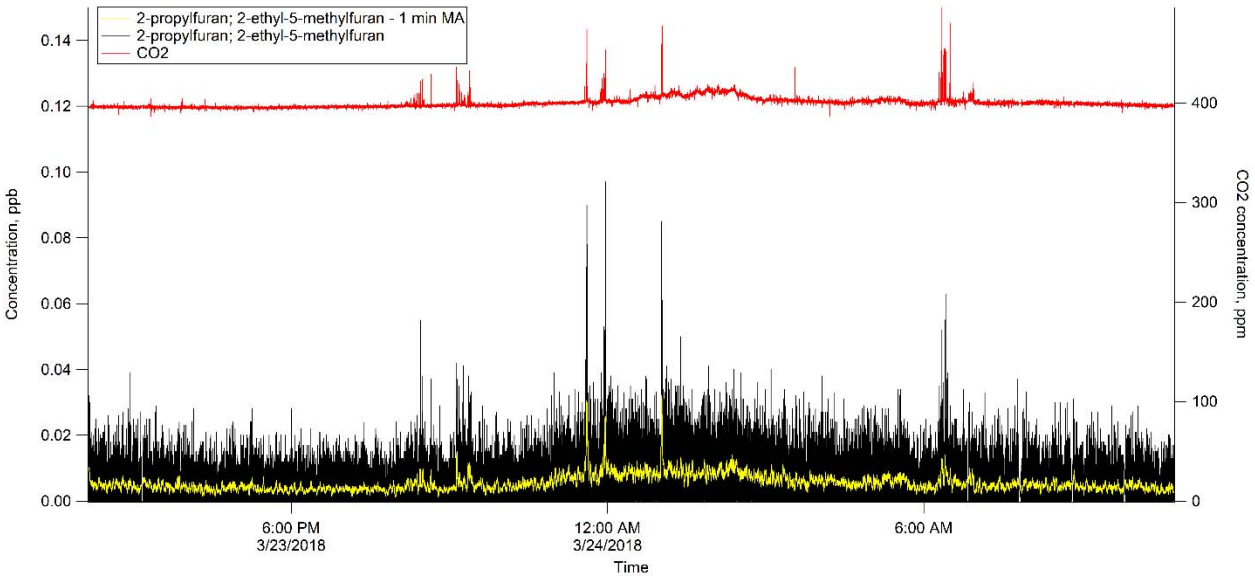


Figure 6-6. 2-propylfuran + 2-ethyl-5-methylfuran.

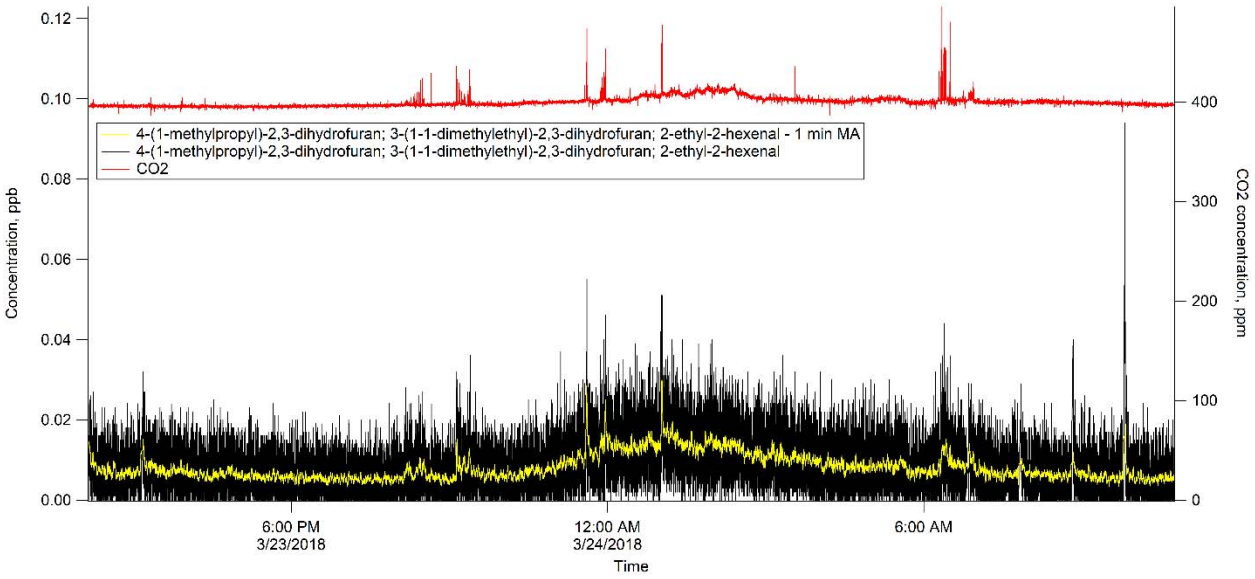


Figure 6-7. 4-(1-methylpropyl)-2,3-dihydrofuran + 3-(1,1-dimethylethyl)-2,3-dihydrofuran + 2-ethyl-2-hexenal.

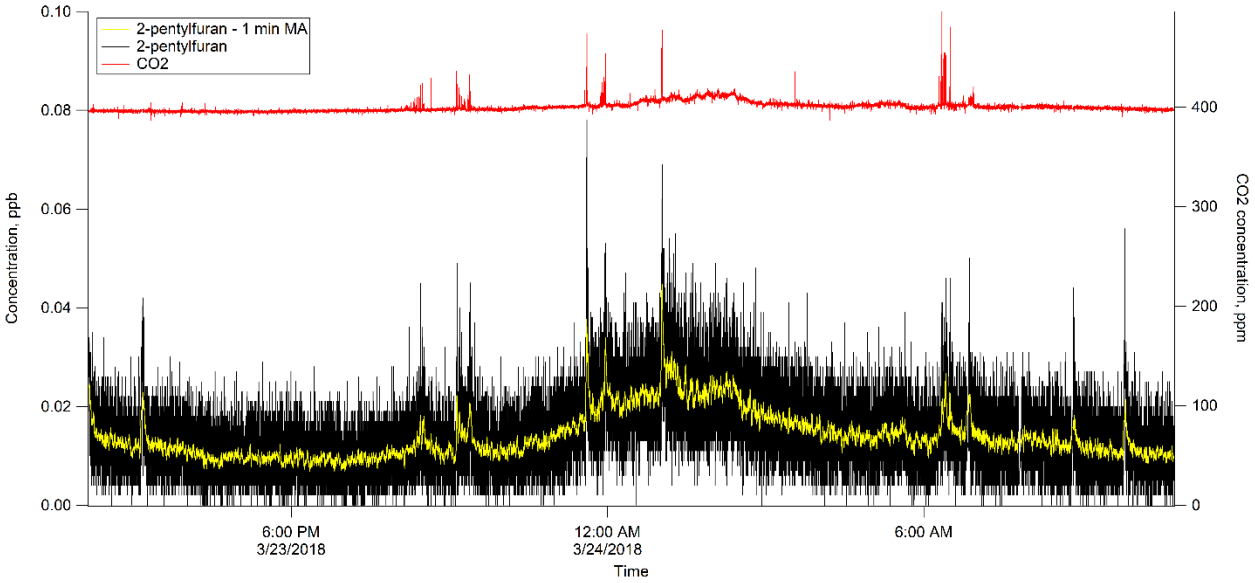


Figure 6-8. 2-pentylfuran.

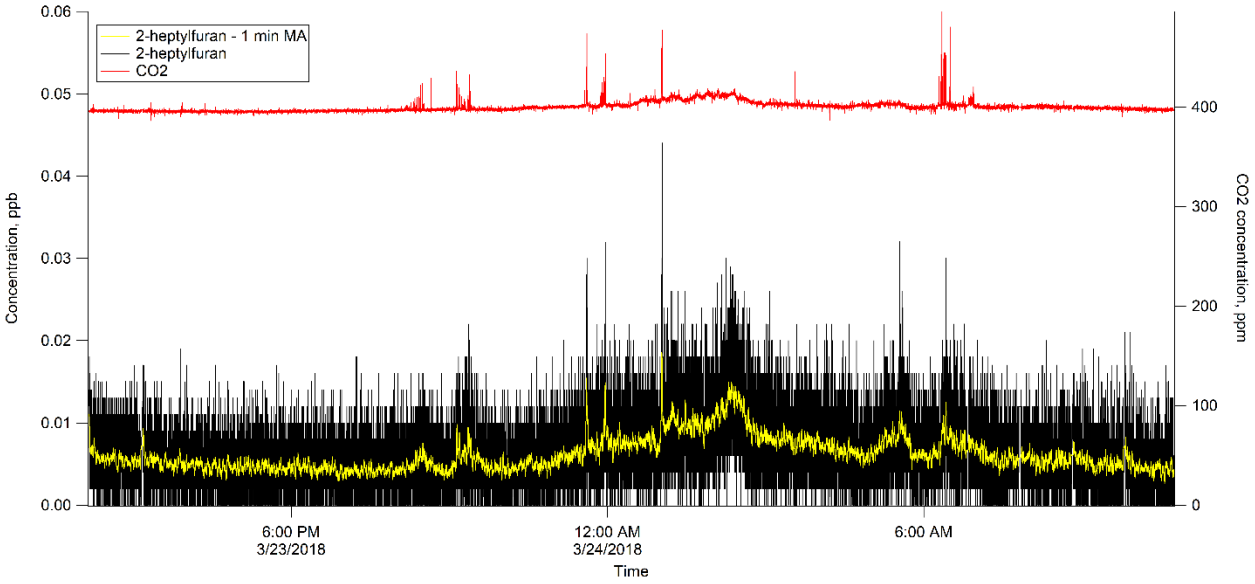


Figure 6-9. 2-heptylfuran.

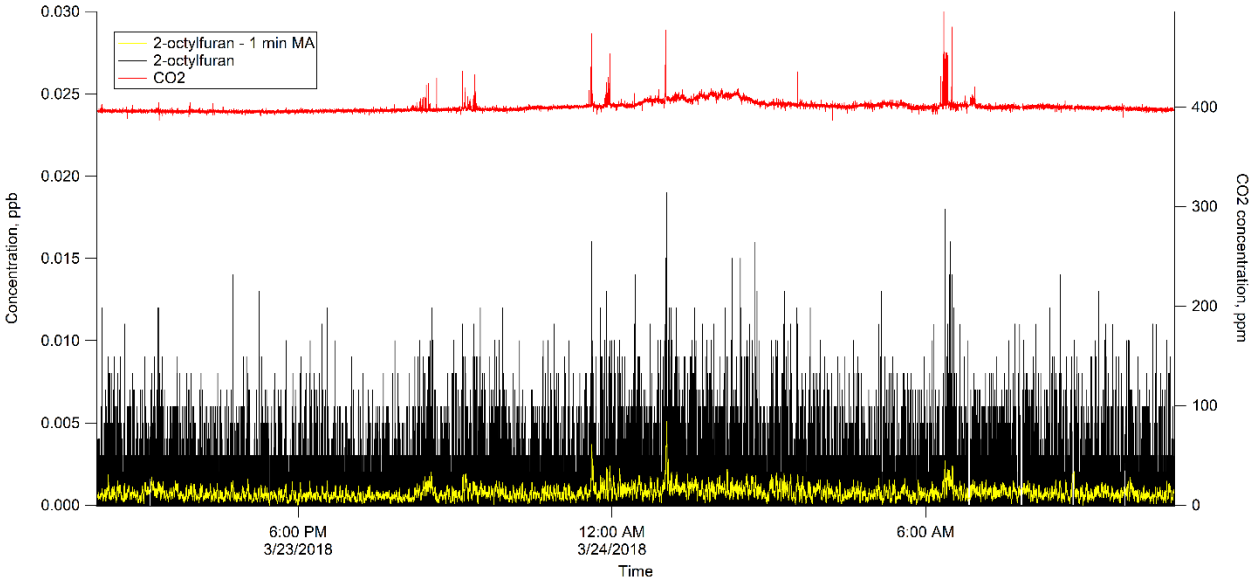


Figure 6-10. 2-octylfuran.

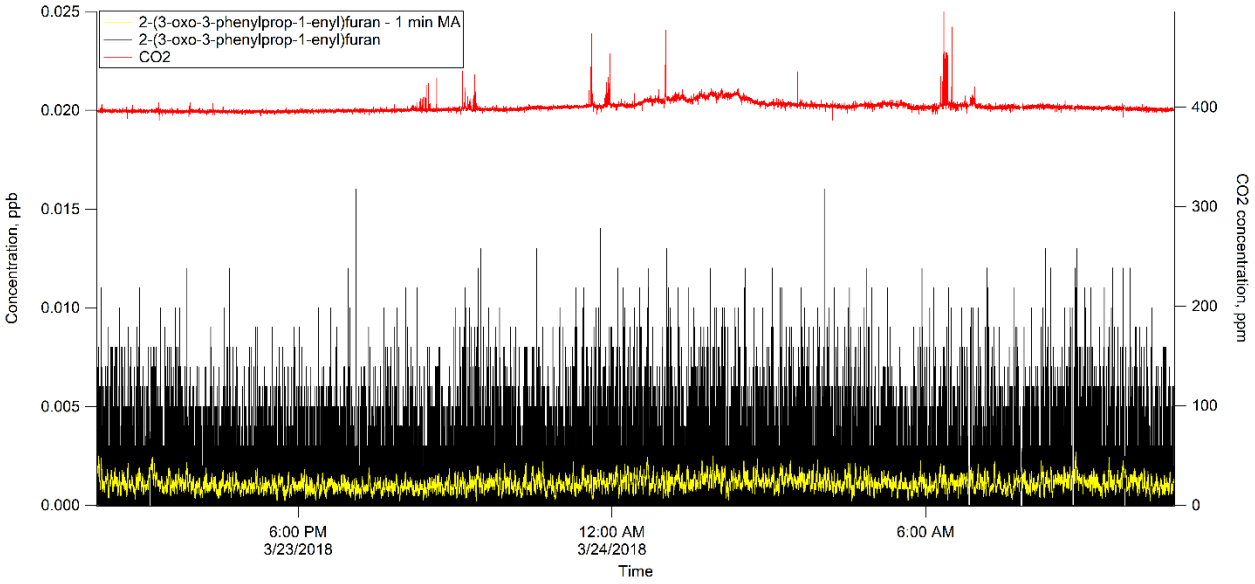


Figure 6-11. 2-(3-oxo-3-phenylprop-1-enyl)furan.

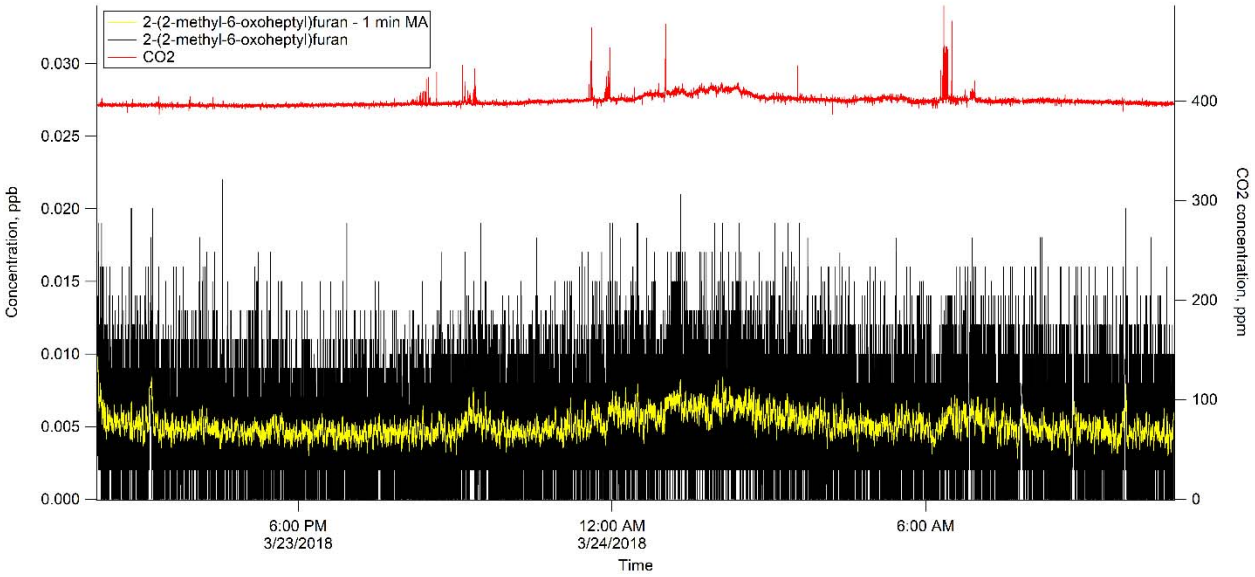


Figure 6-12. 2-(2-methyl-6-oxoheptyl)furan.

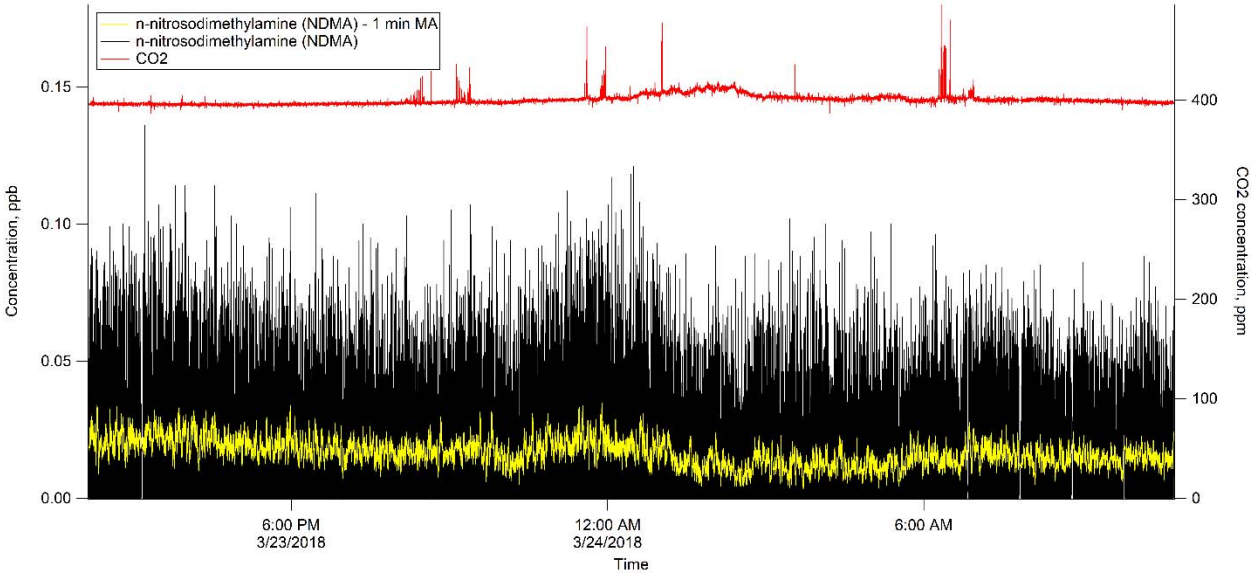


Figure 6-13. N-nitrosodimethylamine (NDMA).

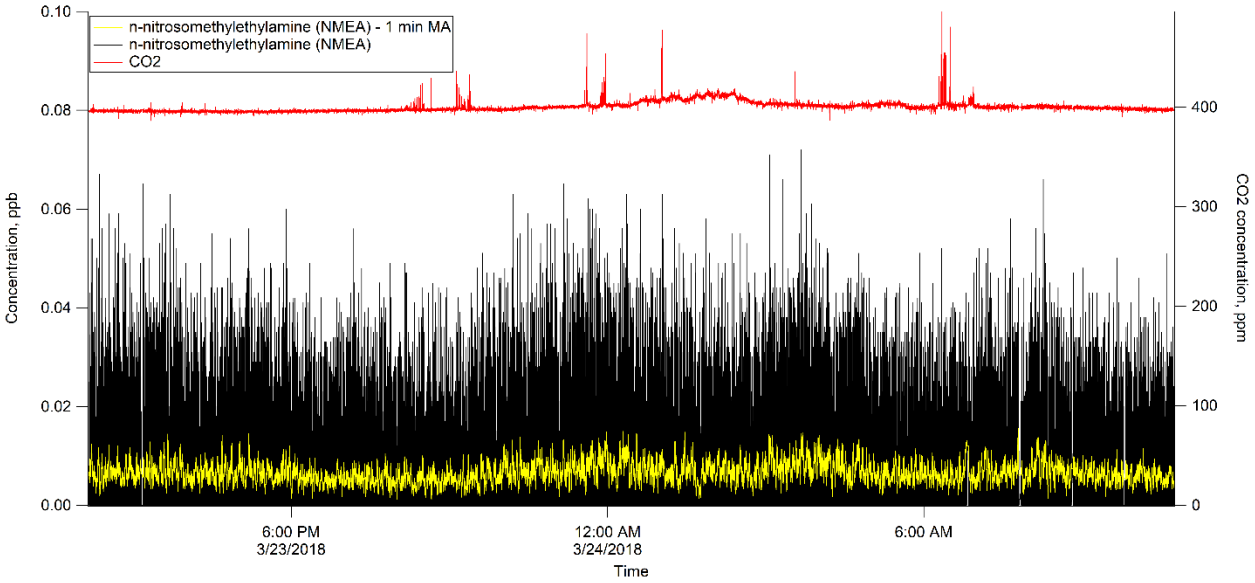


Figure 6-14. N-nitrosomethylethylamine (NMEA).

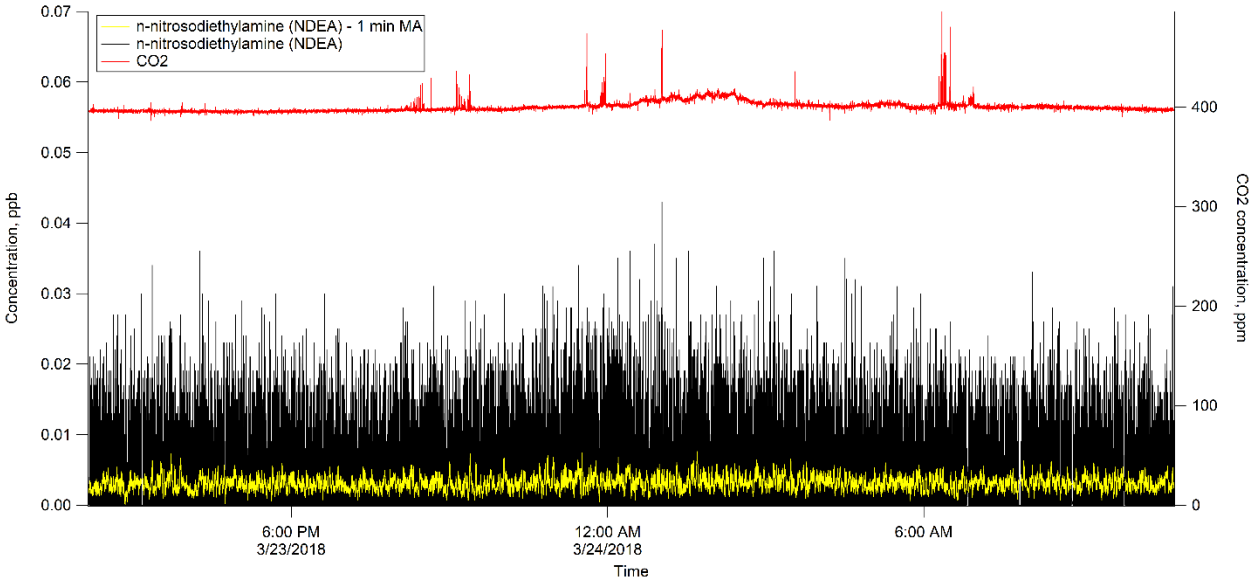


Figure 6-15. N-nitrosodiethylamine (NDEA).

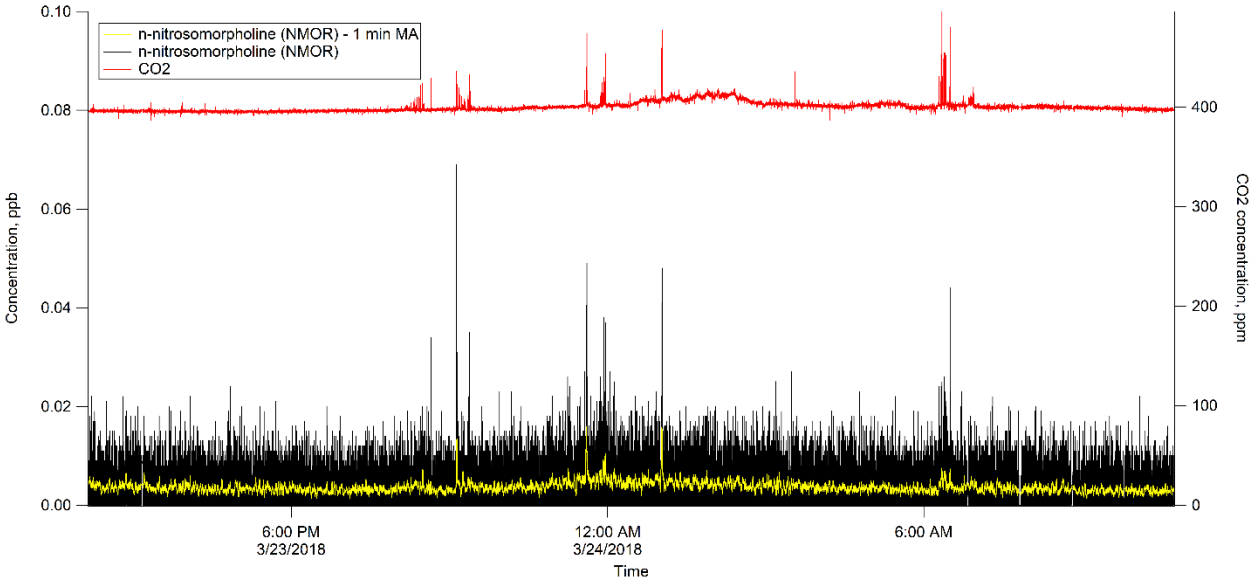


Figure 6-16. N-nitrosomorpholine (NMOR).

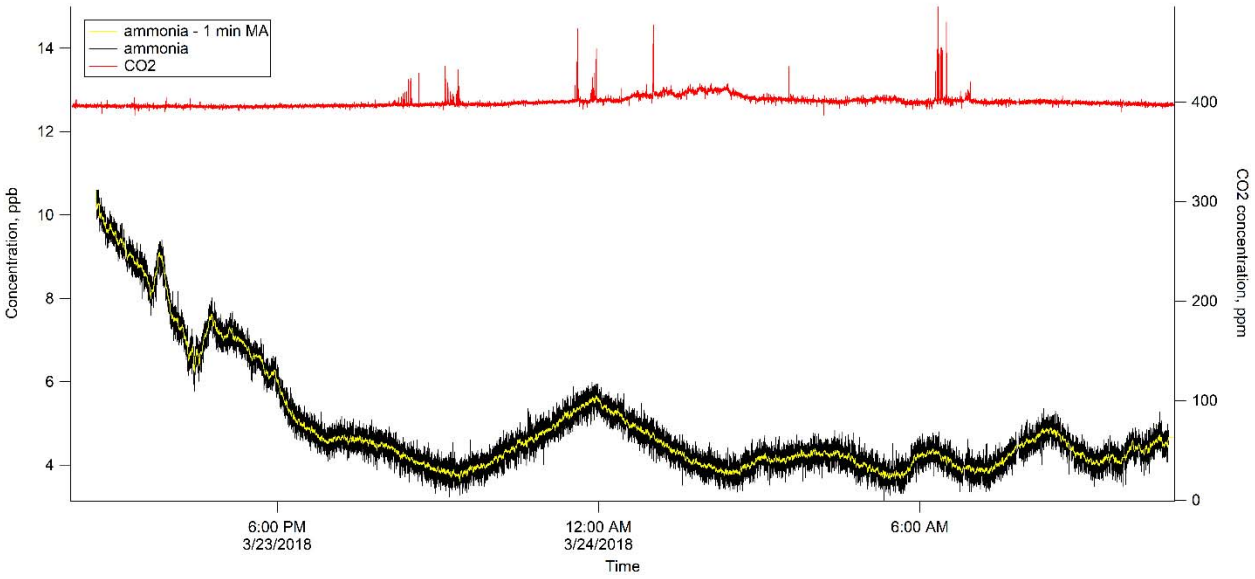


Figure 6-17. Ammonia.

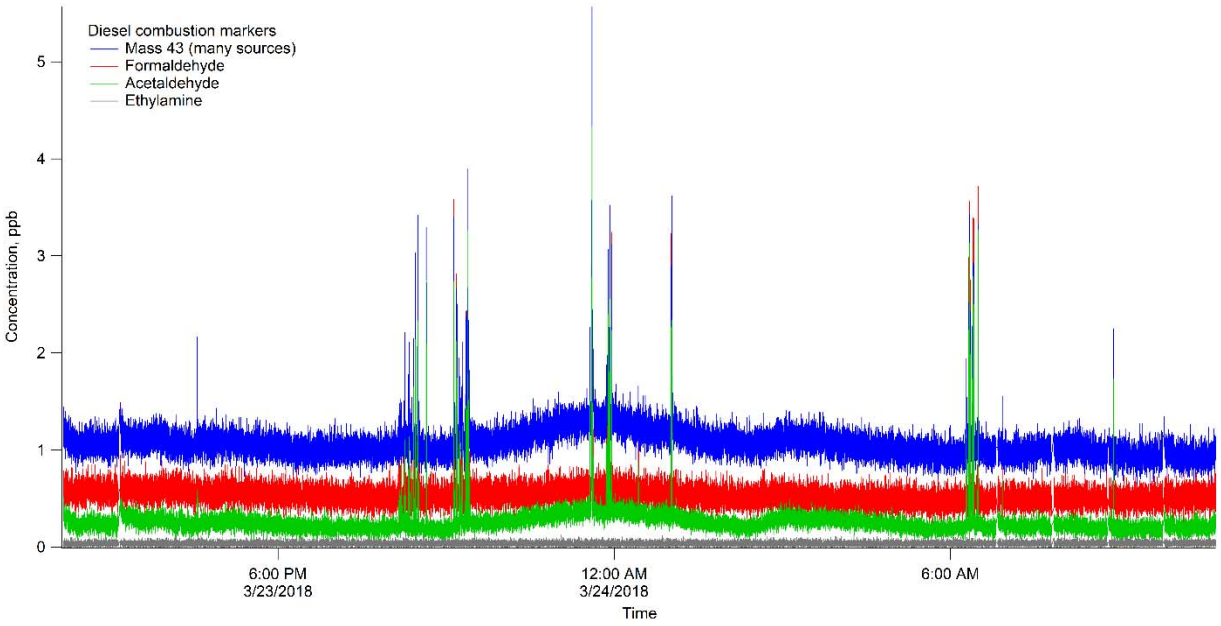


Figure 6-18. Diesel Combustion Markers.

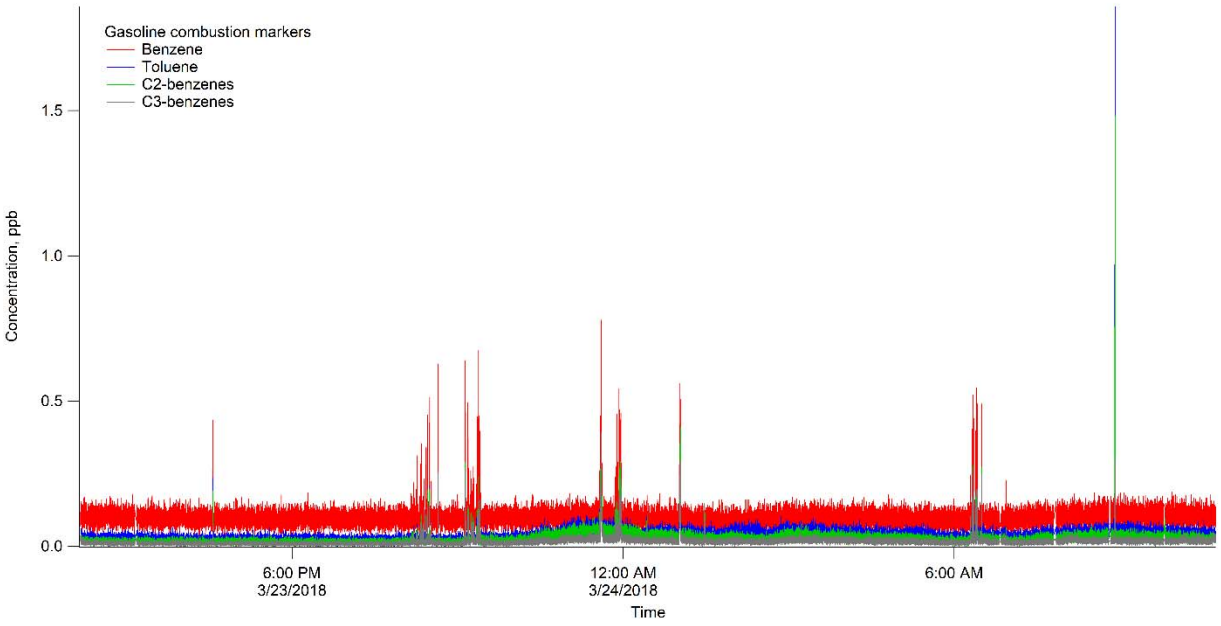


Figure 6-19. Gasoline Combustion Markers.

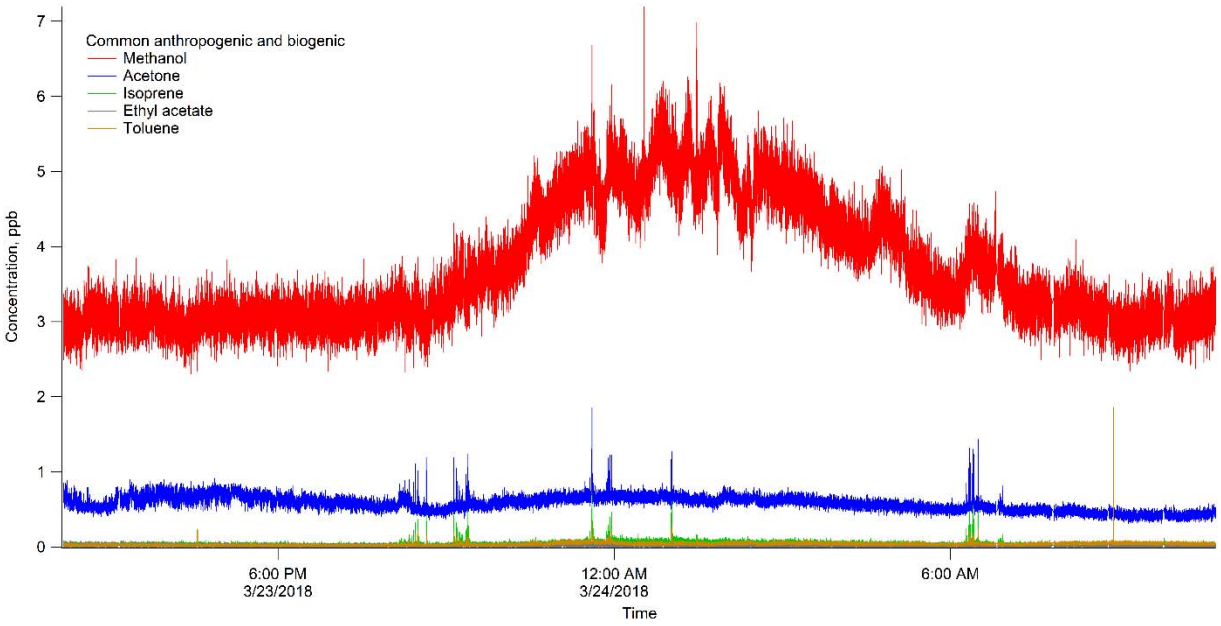


Figure 6-20. Plant and Human Markers.

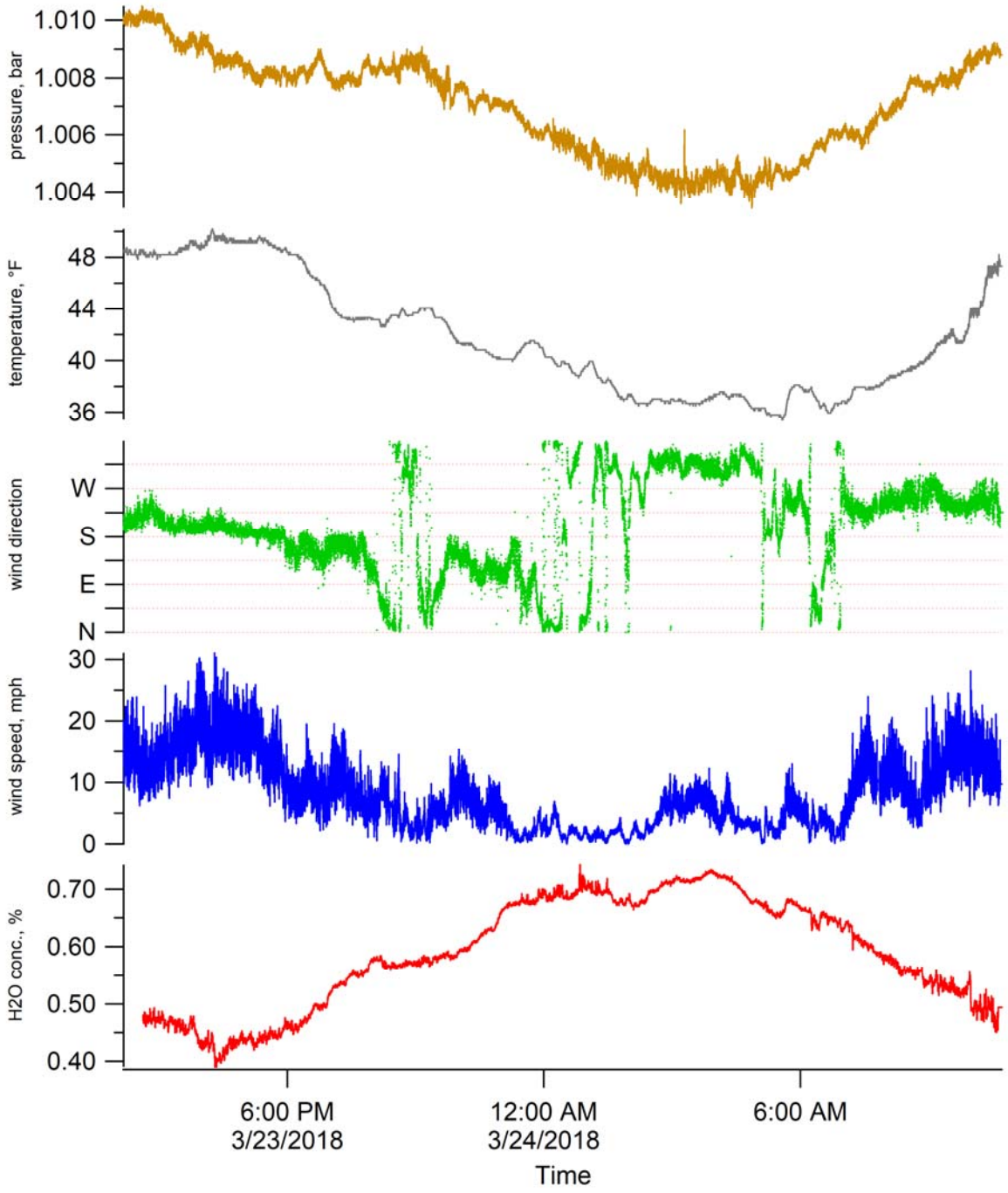


Figure 6-21. Weather Data.

7.0 MARCH 24, 2018 – MARCH 25, 2018 – STUDY SITE #2

7.1 Quality Assessment

Data from March 24, 2018, were transferred to TerraGraphics via the WRPS FTP site on March 27, 2018. Data were assessed using Procedure 17124-DOE-HS-102. A completed Data Exchange Checklist was sent to WRPS on March 29, 2018. The data were accepted by TerraGraphics with the following comments. All startup, shutdown, and calibration procedures were adequately documented and all other checks passed the acceptance limits.

7.2 Summary

Joe Sears, Krystin Riha, and Adrielle Olson performed background sampling using the Mobile Laboratory from March 24, 2018, to March 25, 2018, at Study Site 2. Site 2 is located near the northern end of the 200W Tank Farms. The Mobile Laboratory arrived at Site 2 at 12:02 on March 24, 2018. The initial QA/QC zero air/sensitivity checks were performed on the CO_2 monitor, NH_3 monitor, and the PTR-MS beginning at 12:05. Routine data collection resumed by 13:11. The Mobile Laboratory staff departed the monitoring site after performing the final PTR-MS zero air check for the evening at 15:55.

The Mobile Laboratory staff had returned to Site 2 and performed a PTR-MS zero air check by 06:42 on March 25, 2018. Closeout zero air/sensitivity checks were performed at 10:42. The Mobile Laboratory moved to Site 3 by 11:50.



Figure 7-1. Mobile Laboratory Site #2 for the Duration of the Monitoring Period.

7.3 Samples Collected

Continuous air monitoring was performed using the following instrumentation:

- PTR-MS,
- LI-COR CO_2 Monitor,
- Picarro Ammonia Monitor, and
- Weather Station.

Confirmatory air samples were collected as follows.

Table 7-1. Alternative Media Samples Taken.

Site	Date	Sample Type	ID	Start	Stop	Sample Time (min)
2	24-Mar	Thermosorb/N	EL22204	12:15	15:18	182
2	24-Mar	CarboTrap-300	A022003	12:17	13:32	75
2	25-Mar	Thermosorb/N	EL22202	06:52	09:52	180
2	25-Mar	CarboTrap-300	A021985	06:58	08:08	70

Table 7-2 displays the statistical information for the monitoring period of March 24, 2018, to March 25, 2018. By definition, the OEL is an 8-hour, time-weighted average that establishes a limit for personnel exposures to hazardous chemicals. It is the exposure level to which a person may be exposed for 8 hours/day, 40 hours/week for 40 years and have no expectation of adverse health effects. In this study, area vapor concentration measurements were made to better understand the hazardous vapor exposures that workers may receive. These measurements are only compared to OEL concentrations to give them context. It is neither accurate nor appropriate to interpret these short duration measurements (2 seconds) as worker exposures levels. Since the OEL is defined as a time-weighted average, it is more appropriate to compare them to daily average vapor concentrations. Short duration excursions above the OEL concentration are not significant.

Table 7-2. Statistical Information for the Monitoring Period of March 24, 2018 – March 25, 2018.

COPC #	COPC Name	Reporting Limit (PPB)	OEL (ppb)	Ave. (PPB)	St. Dev. (PPB)	Rel. St. Dev. (%)	Max (PPB)	Median (PPB)	Sec. over 50% OEL	Sec. over OEL
1	ammonia	1	25000	4.91	2.15	43.8%	12.99	3.99	0	0
2	furan	0.09	1	0.045	0.013	89.2%	0.283	0.013	0	0
3	but-3-en-2-one + 2,3-dihydrofuran + 2,5-dihydrofuran	0.22	1	0.111	0.032	179.6%	N/A*	N/A*	N/A	N/A
4	NDMA**	0.06	0.3	0.031	0.018	111.5%	0.108	0.010	0	0
5	2-methylfuran	0.05	1	0.026	0.014	120.3%	0.390	0.009	0	0
6	NEMA	0.02	0.3	0.012	0.009	160.5%	0.058	0.000	0	0
7	2,5-dimethylfuran	0.05	1	0.026	0.011	127.2%	0.278	0.007	0	0
8	NDEA	0.01	0.1	0.006	0.005	170.6%	0.038	0.000	0	0
9	2-propylfuran + 2-ethyl-5-methylfuran	0.02	1	0.010	0.006	145.3%	0.114	0.002	0	0
10	NMOR	0.05	0.6	0.025	0.004	124.2%	0.068	0.002	0	0
11	2-ethyl-2-hexenal + 4-(1-methylpropyl)-2,3-dihydrofuran + 3-(1,1-dimethylethyl)-2,3-dihydrofuran	0.04	1	0.020	0.006	111.3%	0.385	0.005	0	0
12	2-pentylfuran	0.04	1	0.020	0.006	56.2%	0.080	0.010	0	0
13	2-heptylfuran	0.02	1	0.010	0.003	75.3%	0.043	0.004	0	0
14	2-octylfuran	0.01	1	0.005	0.002	243.1%	0.021	0.000	0	0
15	6-(2-furanyl)-6-methyl-2-heptanone	0.01	1	0.005	0.002	174.7%	0.016	0.000	0	0
16	furfural acetophenone	0.07	1	0.035	0.003	67.5%	0.024	0.004	0	0

* The maximum peak value for but-3-en-2-one + 2,3 dihydrofuran + 2,5 dihydrofuran was 1.254 ppb and the median value was 0.015 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 200, 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 each COPC signal, overlaid with the same signal smoothed using a 1-minute moving average, and CO_2, for the monitoring period March 24, 2018, to March 25, 2018.

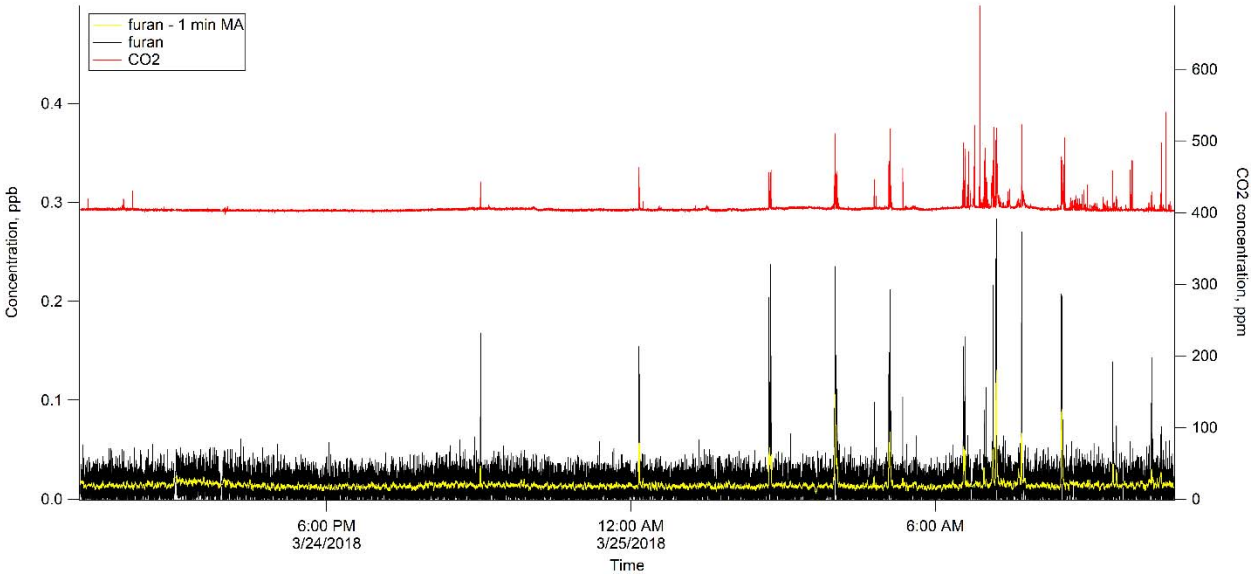


Figure 7-2. Furan.

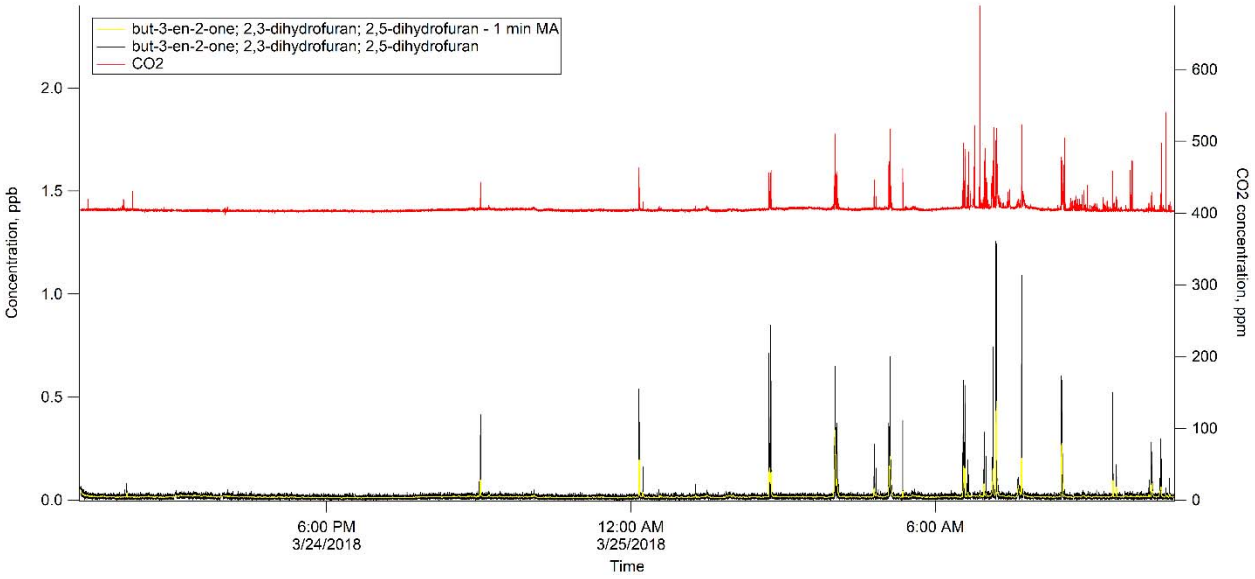


Figure 7-3. -3-en-2-one + 2,3-dihydrofuran + 2,5-dihydrofuran.

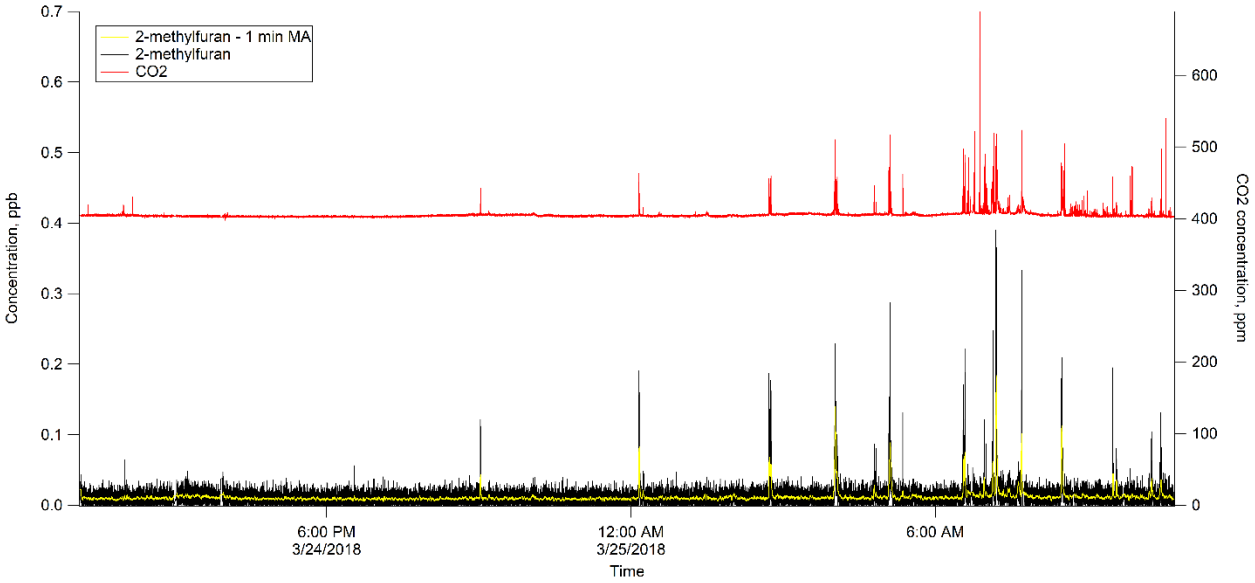


Figure 7-4. 2-methylfuran.

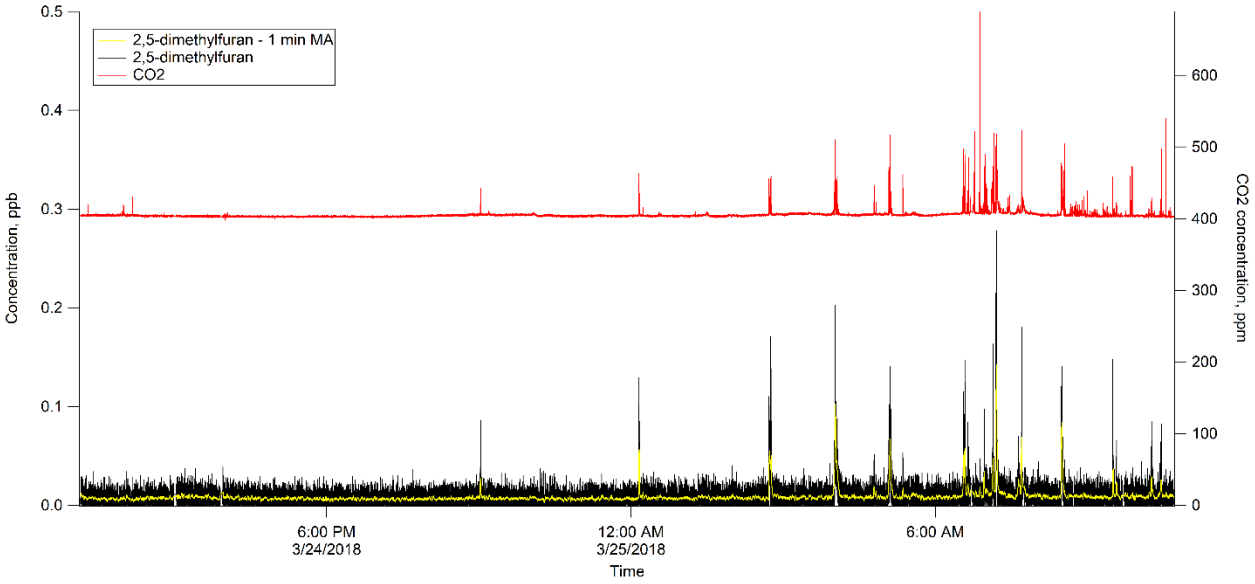


Figure 7-5. 2,5-dimethylfuran.

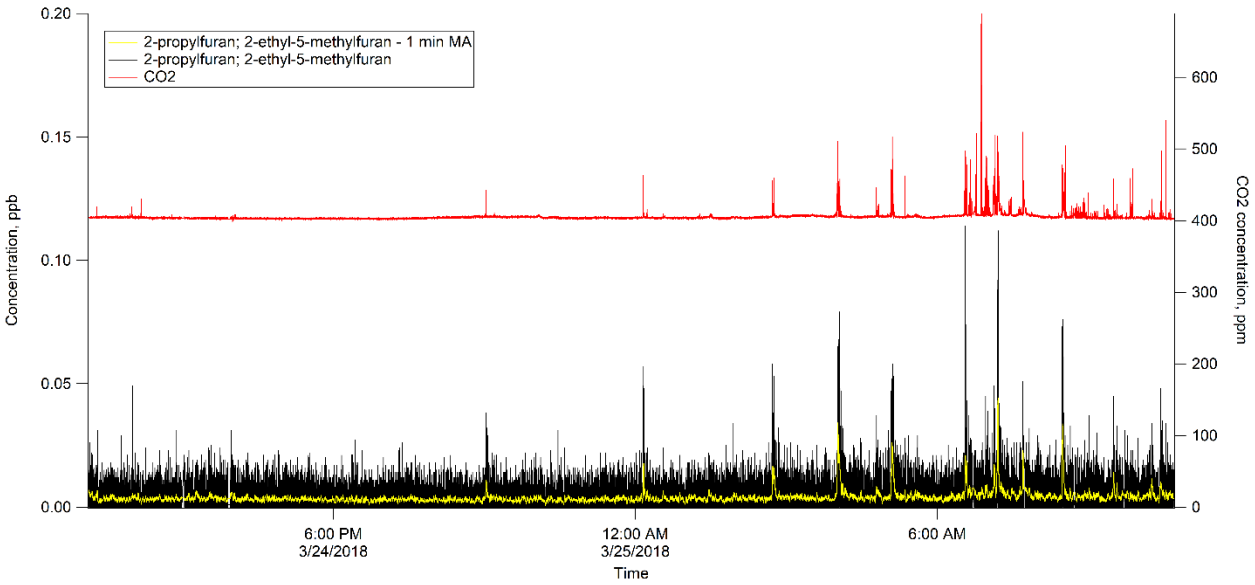


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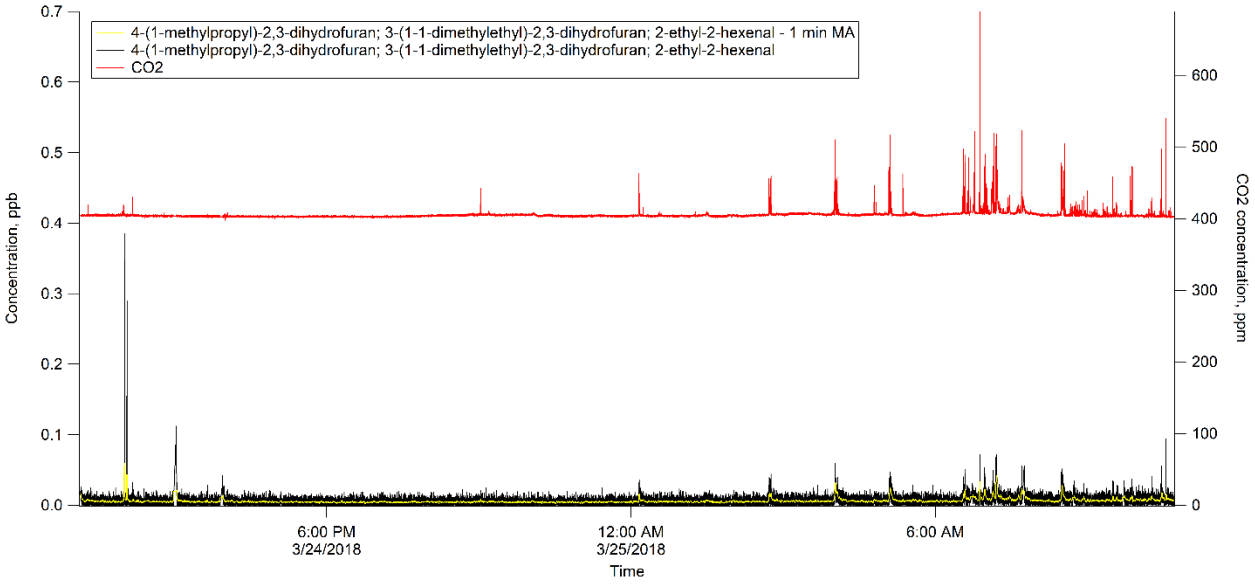


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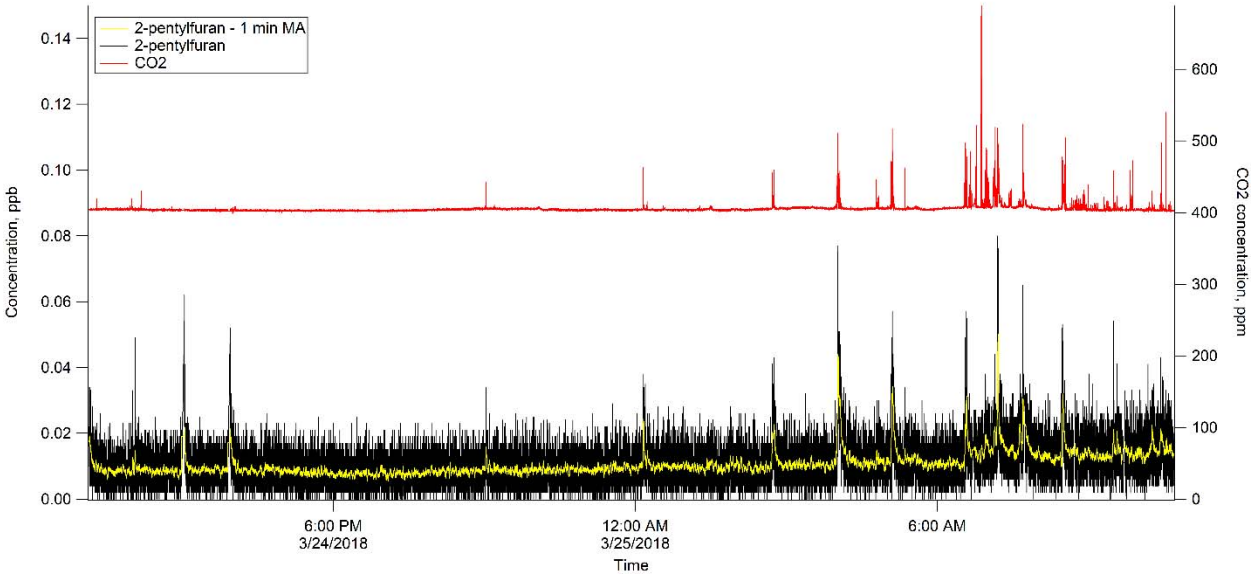


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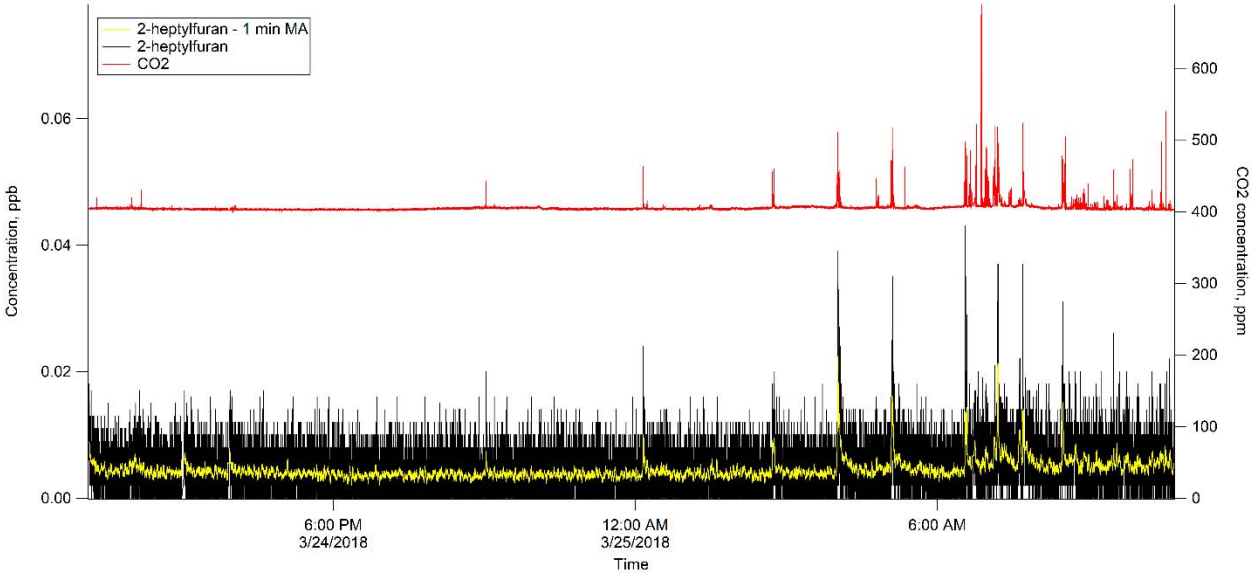


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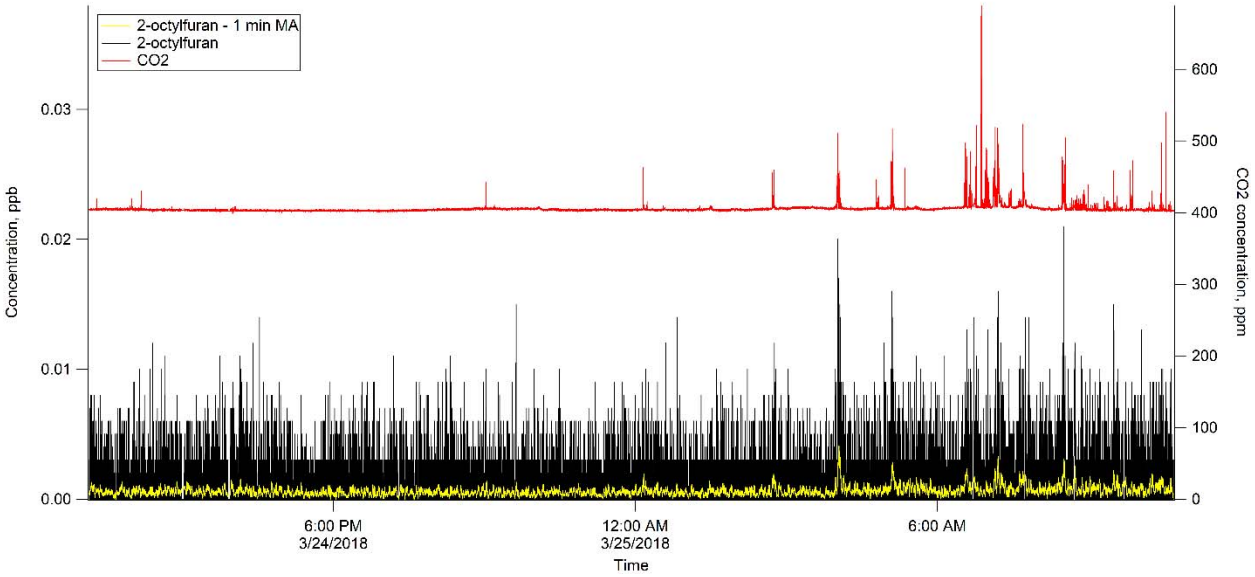


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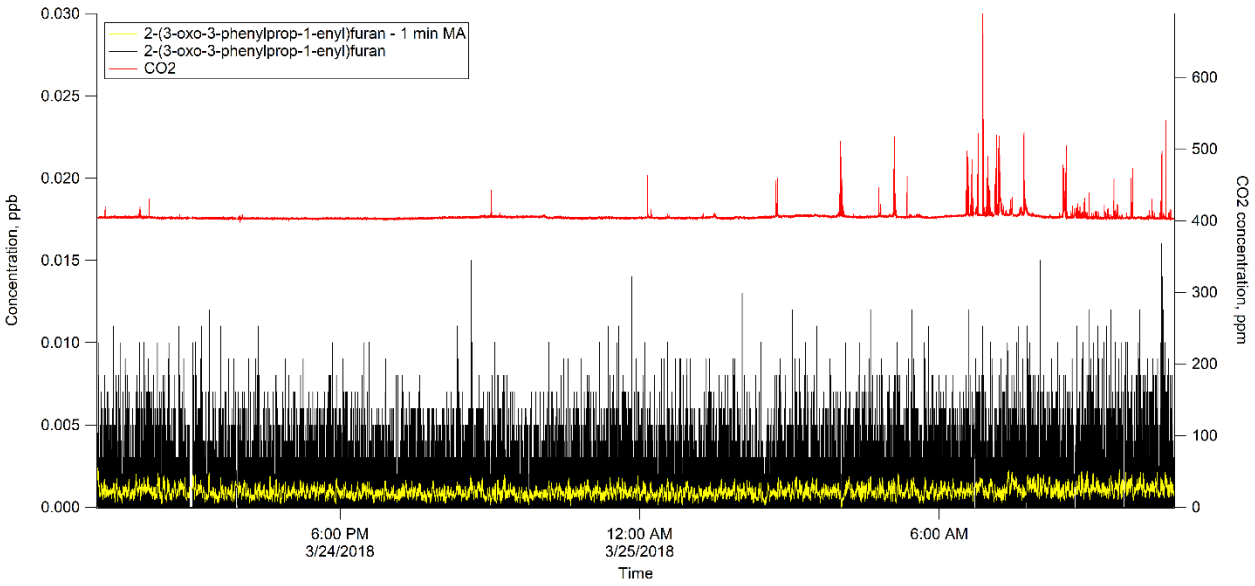


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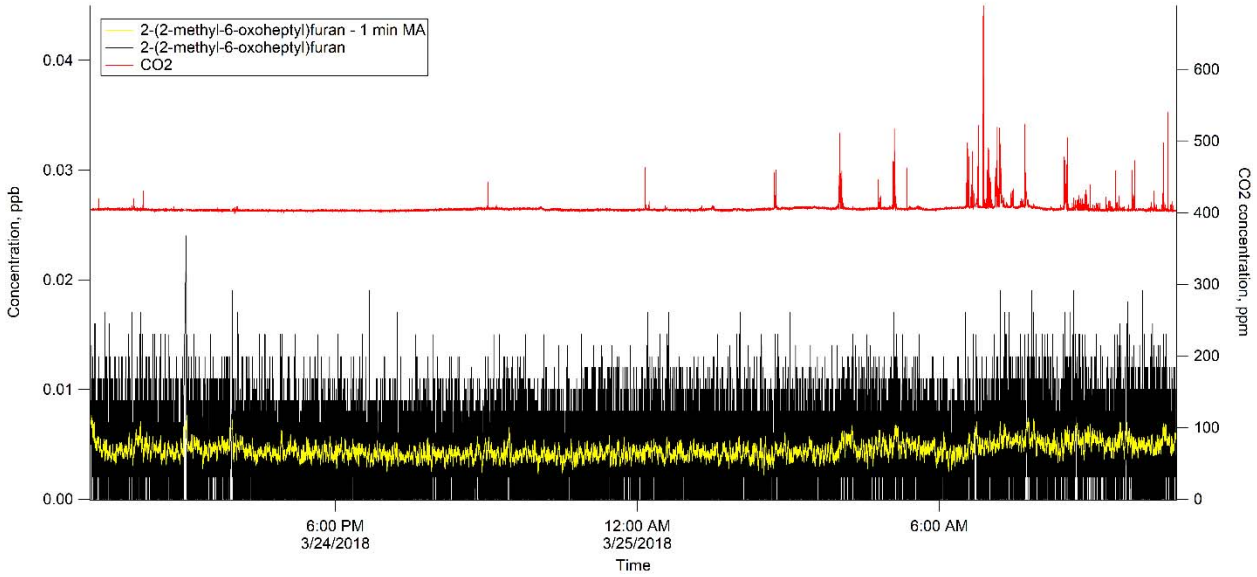


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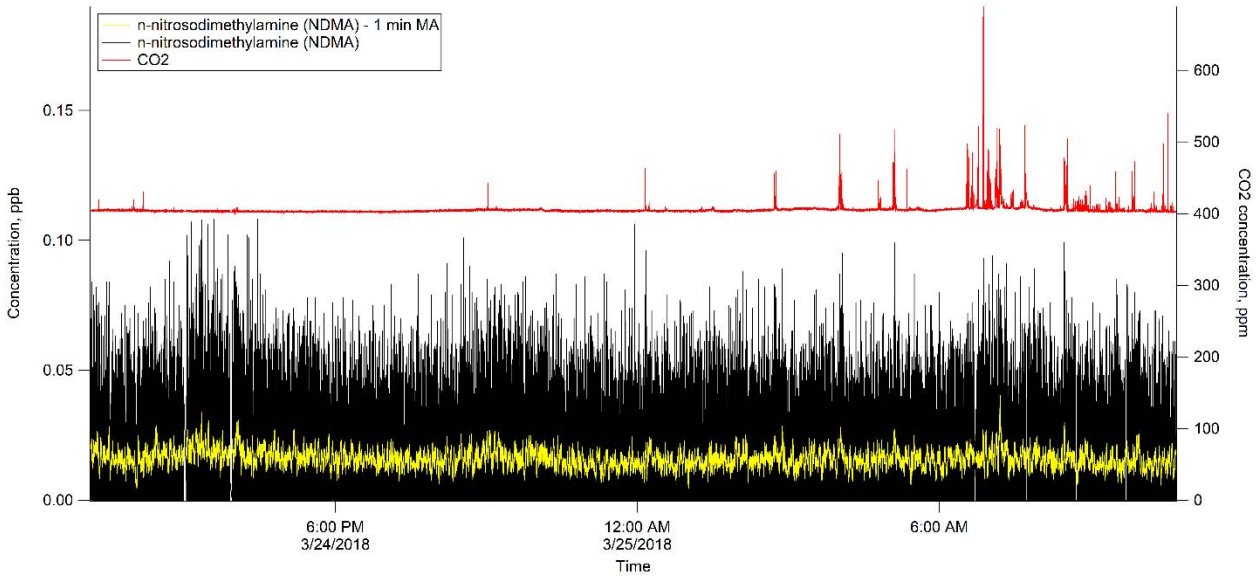


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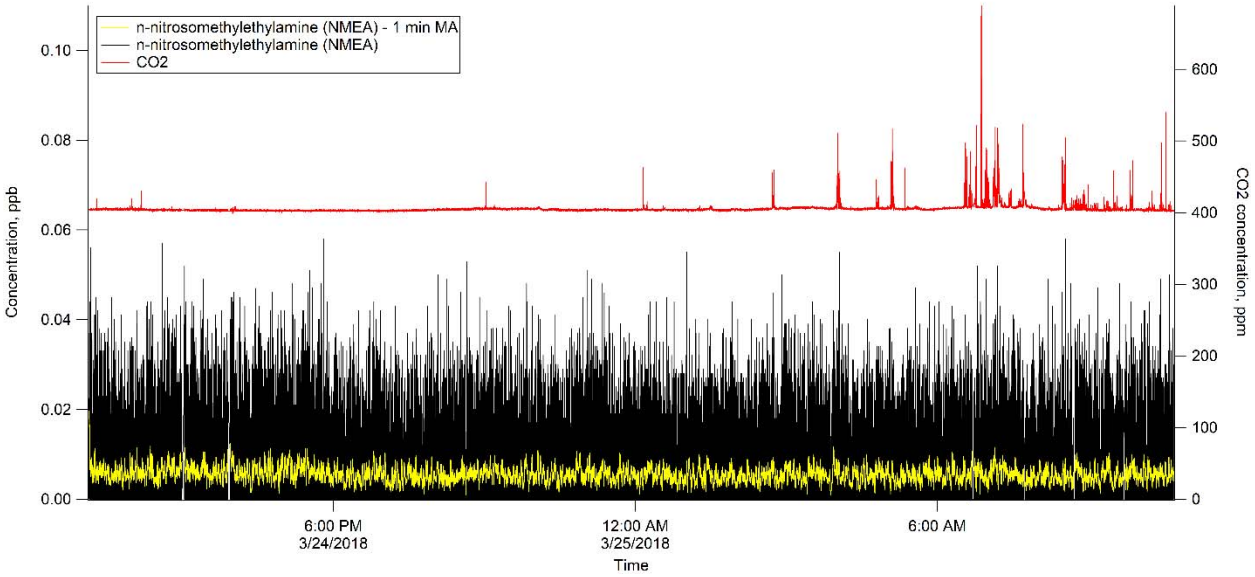


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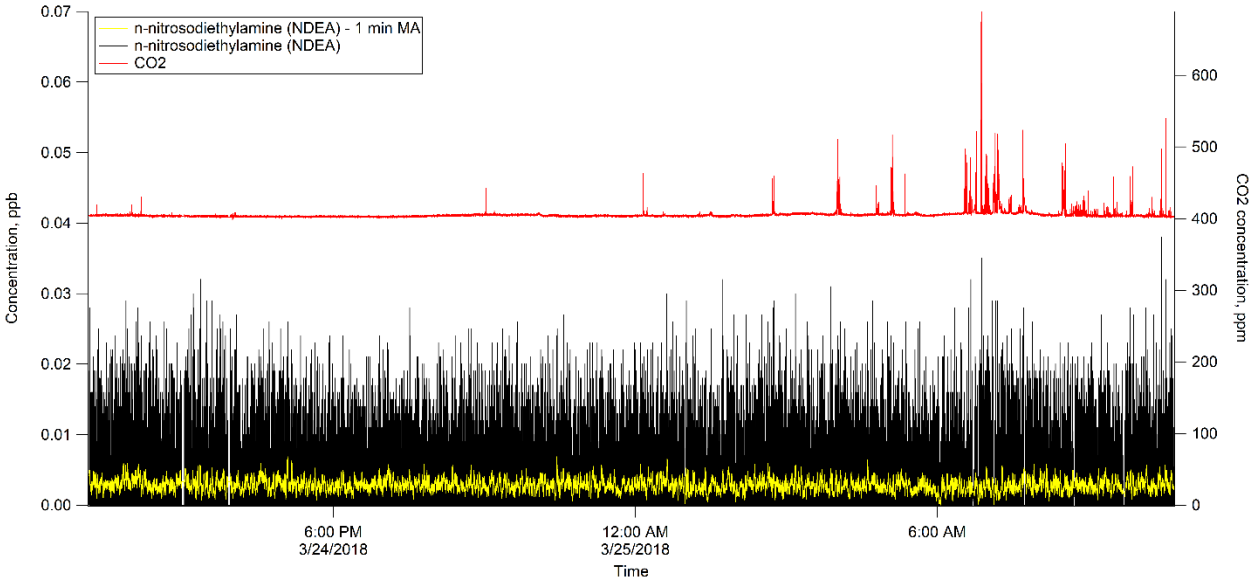


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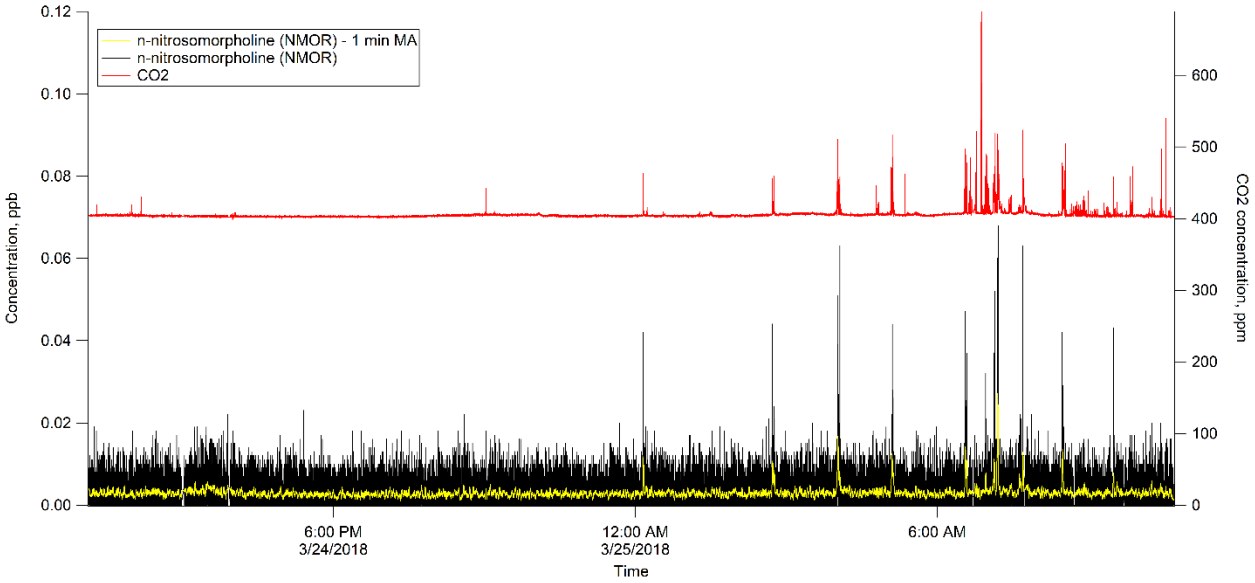


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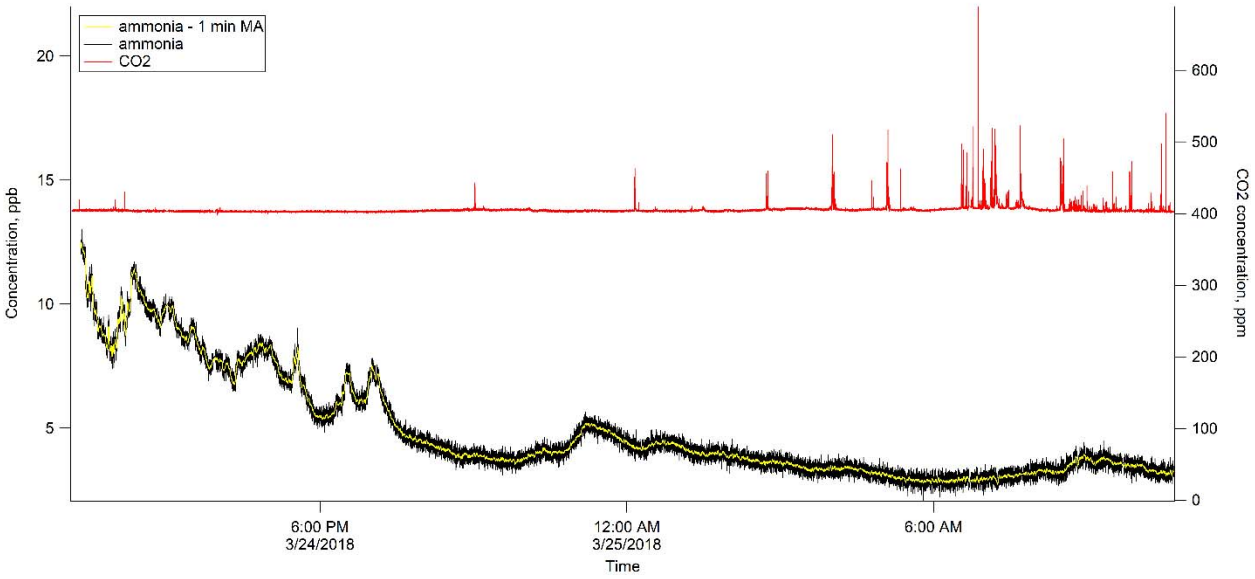


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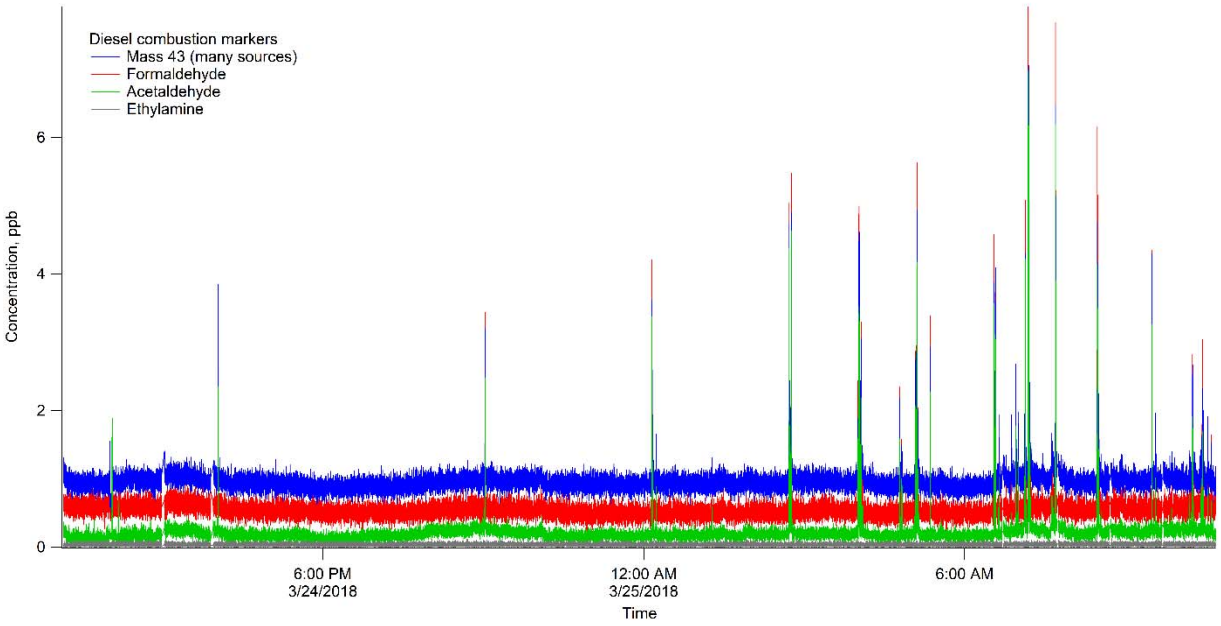


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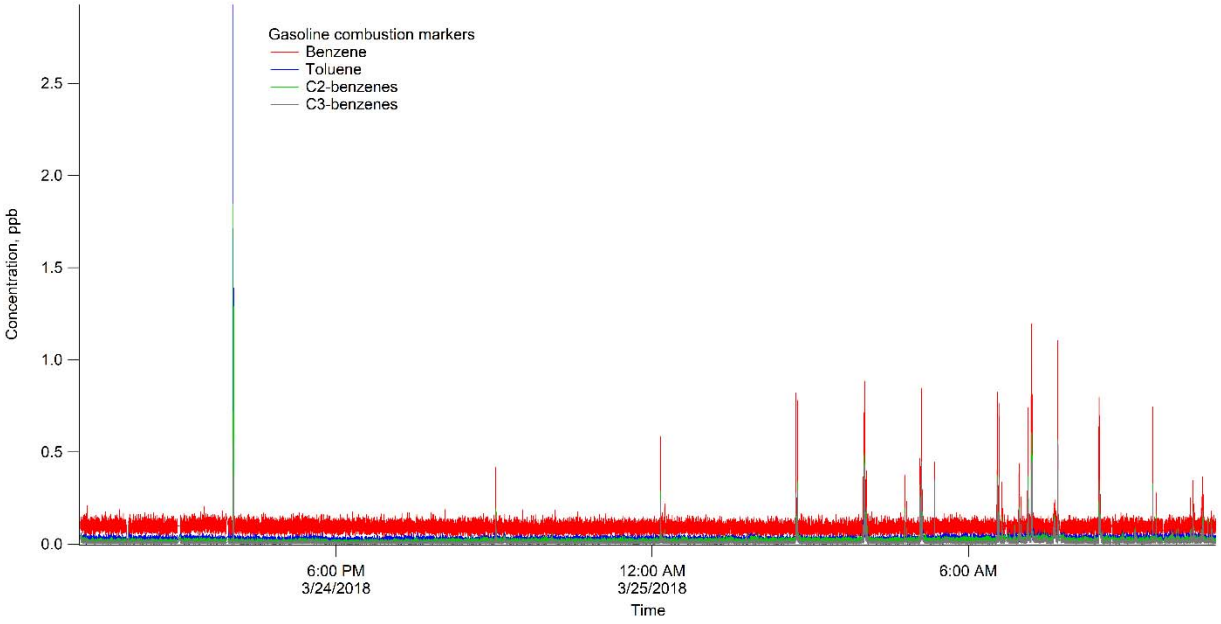


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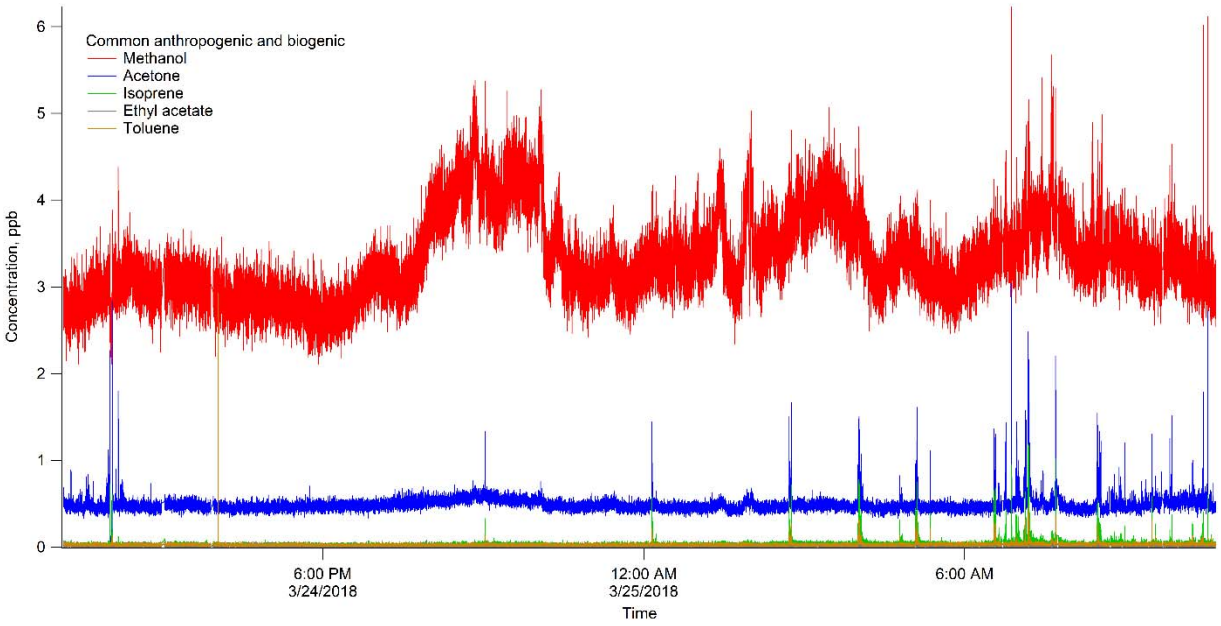


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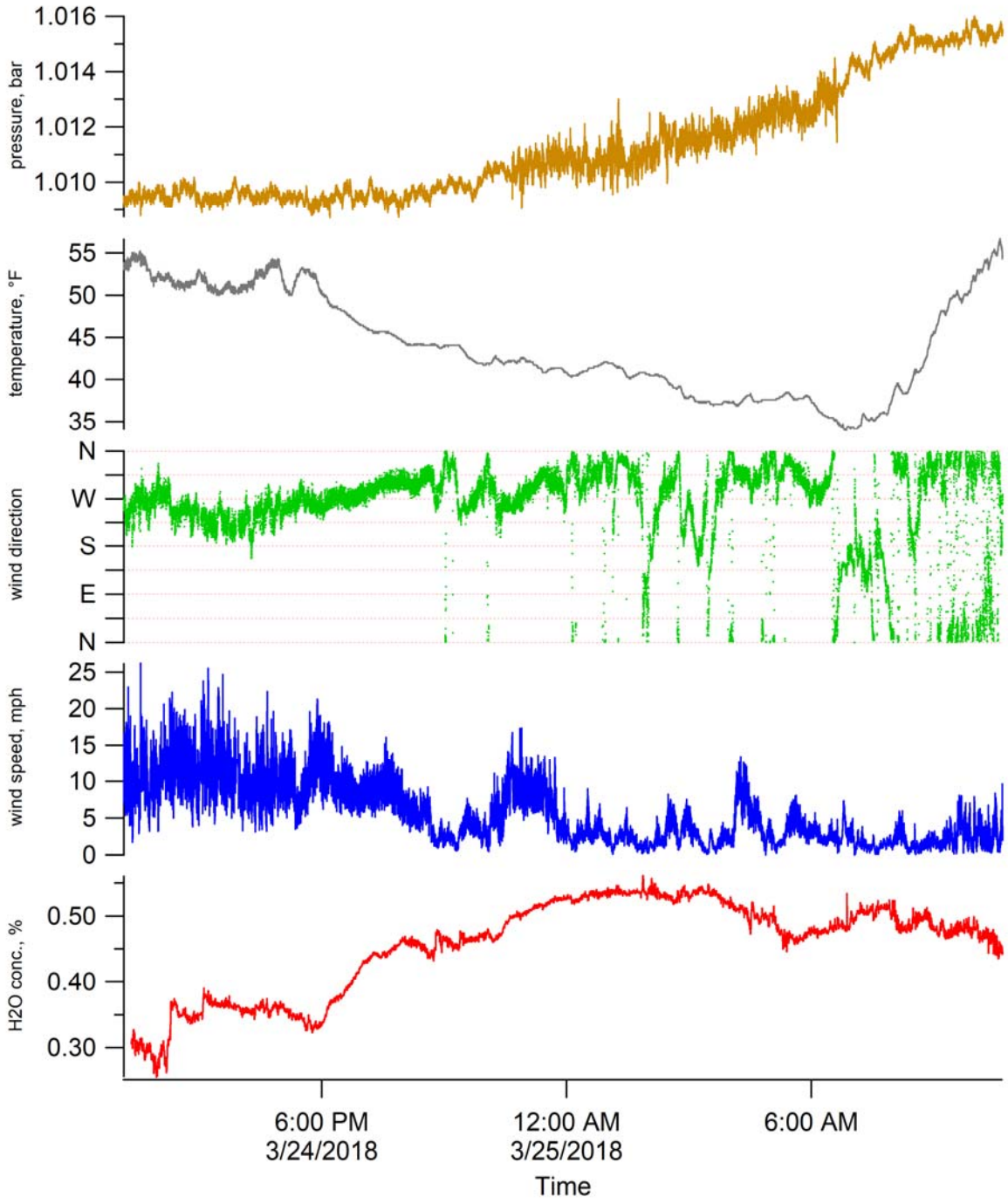


Figure 7-21. Weather Data.

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Procedure 17124-DOE-HS-102, 2018, "Mobile Laboratory Data Processing – Analysis," Revision 0, TerraGraphics Environmental Engineering, Inc., Pasco, Washington.

WEEKLY REPORT FOR WEEK 3
(MARCH 25, 2018 – MARCH 31, 2018)

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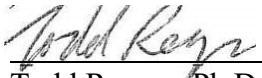
Prepared by:



Date: 5/3/2018

Matt Erickson, Ph.D.

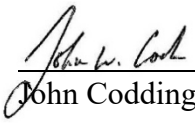
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Date: 5/3/2018

Todd Rogers, Ph.D.

Approved by:



Date: 5/3/2018

John Coddington, Ph.D.

Record of Revision

Revision	Date	Pages/Sections Changed	Brief Description
0	05/2018	N/A	Initial release.

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Acronyms

CAPA	Corrective and Preventative Action
COPC	Chemical of Potential Concern
FTP	File Transfer Protocol
NDMA	N-nitrosodimethylamine
NMEA	N-nitrosomethylethylamine
NMOR	N-nitrosomorpholine
OEL	Occupational Exposure Limit
PTR-MS	Proton Transfer Reaction – Mass Spectrometer
QA	Quality Assurance
QC	Quality Control
WRPS	Washington River Protection Solutions, LLC

1.0 MARCH 25, 2018 – MARCH 26, 2018 – STUDY SITE #3

1.1 Quality Assessment

Data from March 25, 2018, were transferred to TerraGraphics via the Washington River Protection Solutions, LLC (WRPS) File Transfer Protocol (FTP) site on March 28, 2018. Data were assessed using Procedure 17124-DOE-HS-102, "Mobile Laboratory Data Processing – Analysis." A completed Data Exchange Checklist was sent to WRPS on April 2, 2018. The data were accepted by TerraGraphics with the following comments. All startup, shutdown, and calibration procedures were adequately documented and all other checks passed the acceptance limits.

1.2 Summary

Joe Sears and Adrielle Olson performed background sampling using the Mobile Laboratory from March 25, 2018, to March 26, 2018, at Study Site 3. Site 3 is located near the corner of 4th and Buffalo just to the west of the 242-A Evaporator. This site historically has seen the occurrence of several AOP-15 events (reports of unusual odors). The Mobile Laboratory arrived at Site 3 at 11:50 on March 25, 2018. The initial quality assurance/quality control (QA/QC) zero air/sensitivity checks were performed on the CO_2 monitor, NH_3 monitor, and the Proton Transfer Reaction – Mass Spectrometer (PTR-MS) beginning at 11:55. Routine data collection resumed by 13:43. The Mobile Laboratory staff departed the monitoring site after performing the final PTR-MS zero air check for the evening at 15:51.

The Mobile Laboratory staff had returned to Site 3 and performed a PTR-MS zero air check by 06:30 on March 26, 2018. The exhaust was moved at 06:39 to the west side of the Mobile Laboratory due to variable wind direction from the east. At 08:06, the exhaust line was moved to the east side of the Mobile Laboratory due to wind shift resulting in wind from the NW. Closeout zero air/sensitivity checks were performed at 10:43. The Mobile Laboratory moved to Site 4 by 12:20.



Figure 1-1. Mobile Lab Site #3 for the Duration of the Monitoring Period.

1.3 Samples Collected

Continuous air monitoring was performed using the following instrumentation:

- PTR-MS,
- LI-COR®[1] CO_2 Monitor,
- Picarro Ammonia Monitor, and
- Weather Station.

Confirmatory air samples were collected as follows:

Table 1-1. Alternative Media Samples Taken.

Site	Date	Sample Type	ID	Start	Stop	Sample Time (min)
3	25-Mar	Thermosorb®[2]/N	EL22200	12:05	15:05	180
3	25-Mar	CarboTrap®[3]-300	A046070	12:08	13:18	70
3	26-Mar	Thermosorb/N	EL22214	06:40	09:39	180
3	26-Mar	CarboTrap-300	A046075	06:43	07:53	70

Table 1-2 displays the statistical information for the monitoring period of March 25, 2018, to March 26, 2018. By definition, the occupational exposure limit (OEL) is an 8-hour, time-weighted average that establishes a limit for personnel exposures to hazardous chemicals. It is the exposure level to which a person may be exposed for 8 hours/day, 40 hours/week for 40 years and have no expectation of adverse health effects. In this study, area vapor concentration measurements were made to better understand the hazardous vapor exposures that workers may receive. These measurements are only compared to OEL concentrations to give them context. It is neither accurate nor appropriate to interpret these short duration measurements (2 seconds) as worker exposure levels. Since the OEL is defined as a time-weighted average, it is more appropriate to compare them to daily average vapor concentrations. Short duration excursions above the OEL concentration are not significant.

[1] LI-COR is a registered trademark of LI-COR, Inc., Lincoln, Nebraska.
[2] Thermosorb is a registered trademark of Ellutia Limited Company, Cambridgeshire, United Kingdom.
[3] CarboTrap is a registered trademark of Sigma-Aldrich Co., LLC, St. Louis, Missouri.

Table 1-2. Statistical Information for the Monitoring Period of March 25, 2018 – March 26, 2018.

COPC #	COPC Name	Reporting Limit (ppb)	OEL (ppb)	Ave. (ppb)	St. Dev. (ppb)	Rel. St. Dev. (%)	Max (ppb)	Median (ppb)	Sec. over 50% OEL	Sec. over OEL
1	ammonia	1	25000	4.19	2.548	60.8%	22.79	3.06	0	0
2	furan	0.09	1	0.045	0.014	85.5%	0.231	0.014	0	0
3	but-3-en-2-one + 2,3-dihydrofuran + 2,5-dihydrofuran	0.22	1	0.111	0.032	136.1%	N/A*	N/A*	N/A	N/A
4	NDMA**	0.06	0.3	0.031	0.019	112.4%	0.117	0.011	0	0
5	2-methylfuran	0.05	1	0.026	0.015	103.7%	0.252	0.011	0	0
6	NEMA	0.02	0.3	0.012	0.009	159.7%	0.061	0.000	0	0
7	2,5-dimethylfuran	0.05	1	0.026	0.012	110.3%	0.195	0.008	0	0
8	NDEA	0.01	0.1	0.006	0.005	168.8%	0.037	0.000	0	0
9	2-propylfuran + 2-ethyl-5-methylfuran	0.02	1	0.011	0.007	137.1%	0.086	0.003	0	0
10	NMOR	0.05	0.6	0.025	0.004	117.4%	0.057	0.002	0	0
11	2-ethyl-2-hexenal + 4-(1-methylpropyl)-2,3-dihydrofuran + 3-(1,1-dimethylethyl)-2,3-dihydrofuran	0.04	1	0.020	0.006	82.0%	0.067	0.006	0	0
12	2-pentylfuran	0.04	1	0.020	0.007	55.7%	0.206	0.011	0	0
13	2-heptylfuran	0.02	1	0.010	0.004	71.2%	0.036	0.004	0	0
14	2-octylfuran	0.01	1	0.005	0.002	228.4%	0.023	0.000	0	0
15	6-(2-furanyl)-6-methyl-2-heptanone	0.01	1	0.005	0.002	171.6%	0.017	0.000	0	0
16	furfural acetophenone	0.07	1	0.035	0.003	65.5%	0.023	0.004	0	0

* The maximum peak value for but-3-en-2-one + 2,3 dihydrofuran + 2,5 dihydrofuran was 0.898 ppb and the median value was 0.017 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 200, 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 each chemical of potential concern (COPC) signal, overlaid with the same signal smoothed using a 1-minute moving average, and CO_2, for the monitoring period March 25, 2018, to March 26, 2018.

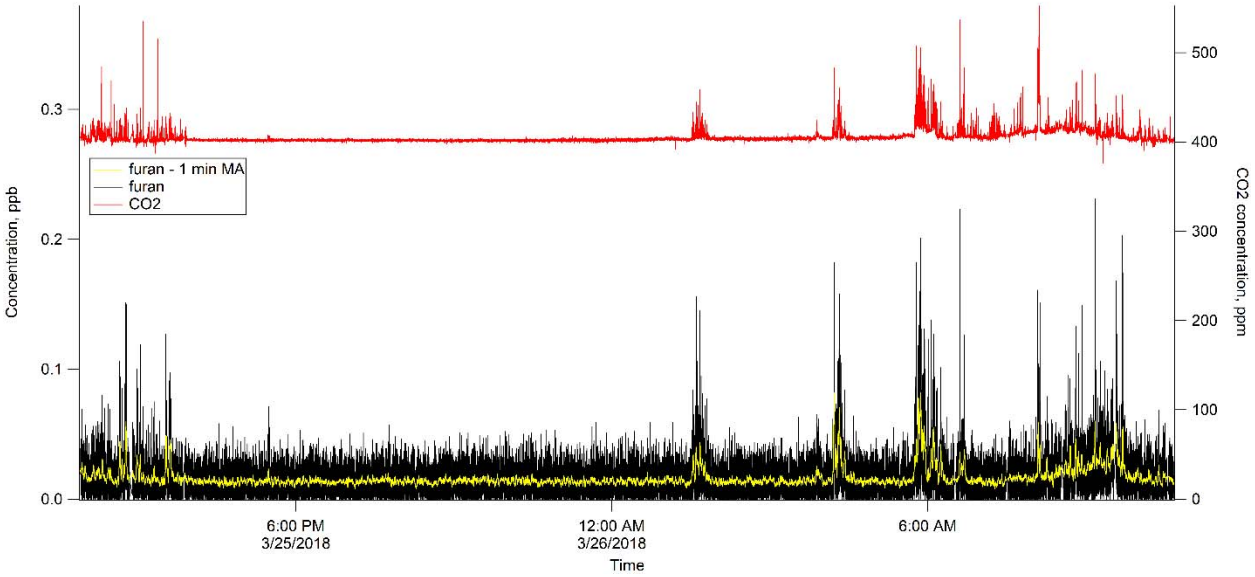


Figure 1-2. Furan.

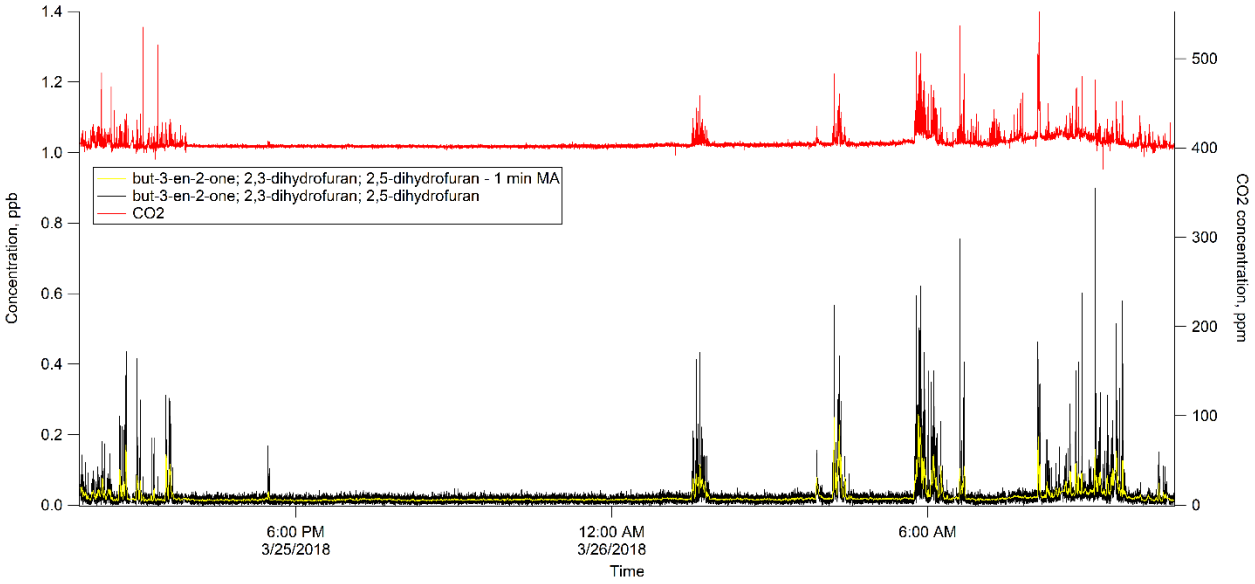


Figure 1-3. but-3-en-2-one + 2,3-dihydrofuran + 2,5-dihydrofuran.

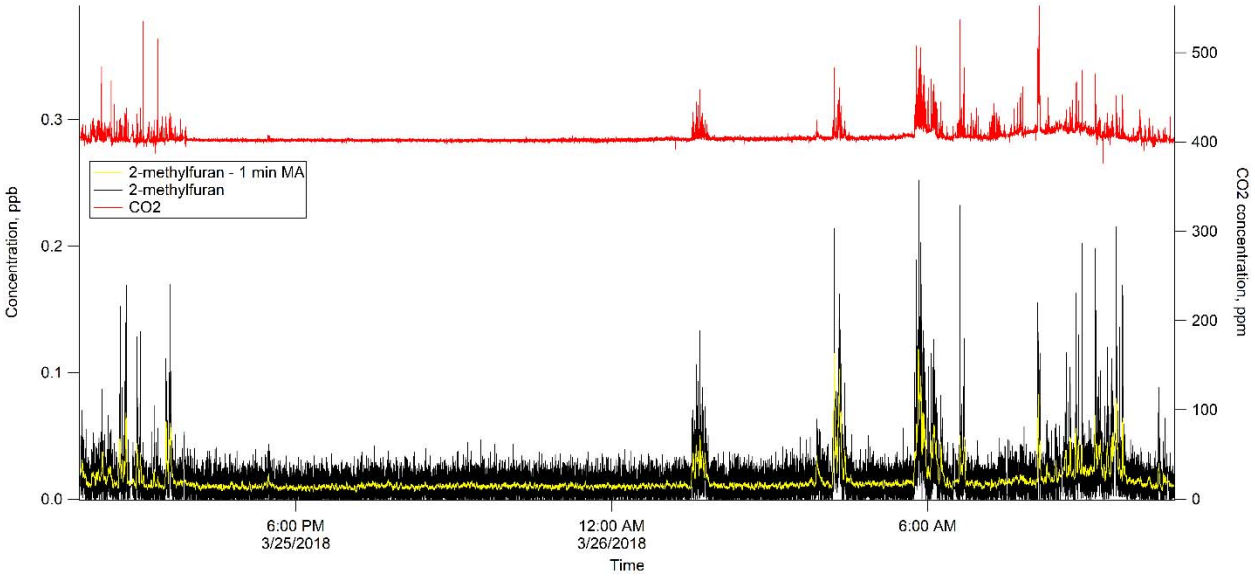


Figure 1-4. 2-methylfuran.

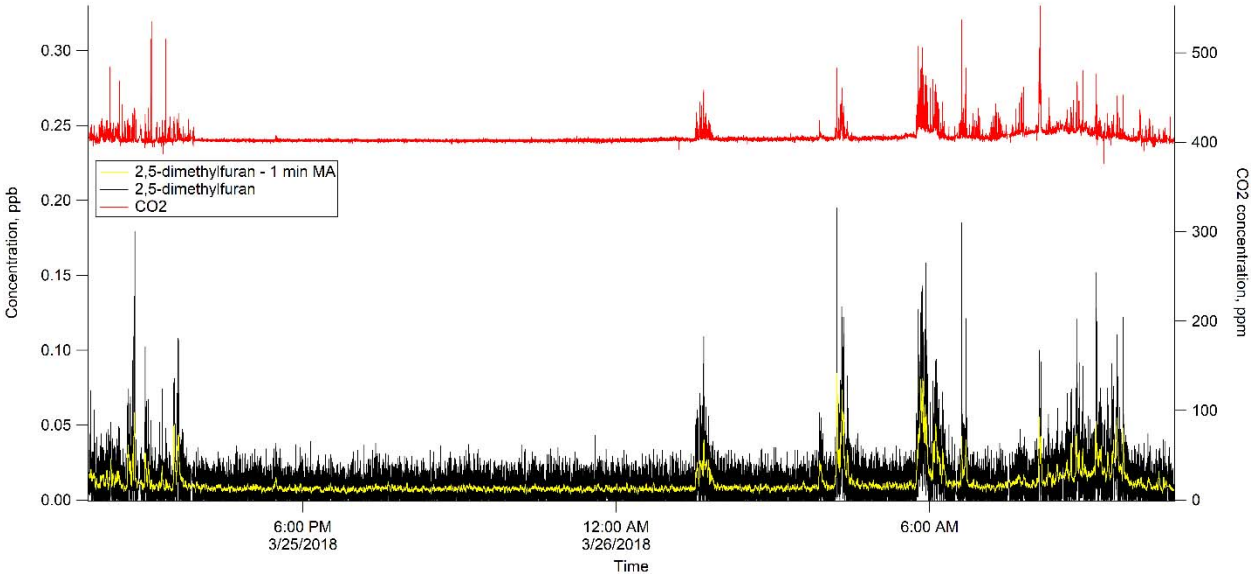


Figure 1-5. 2,5-dimethylfuran.

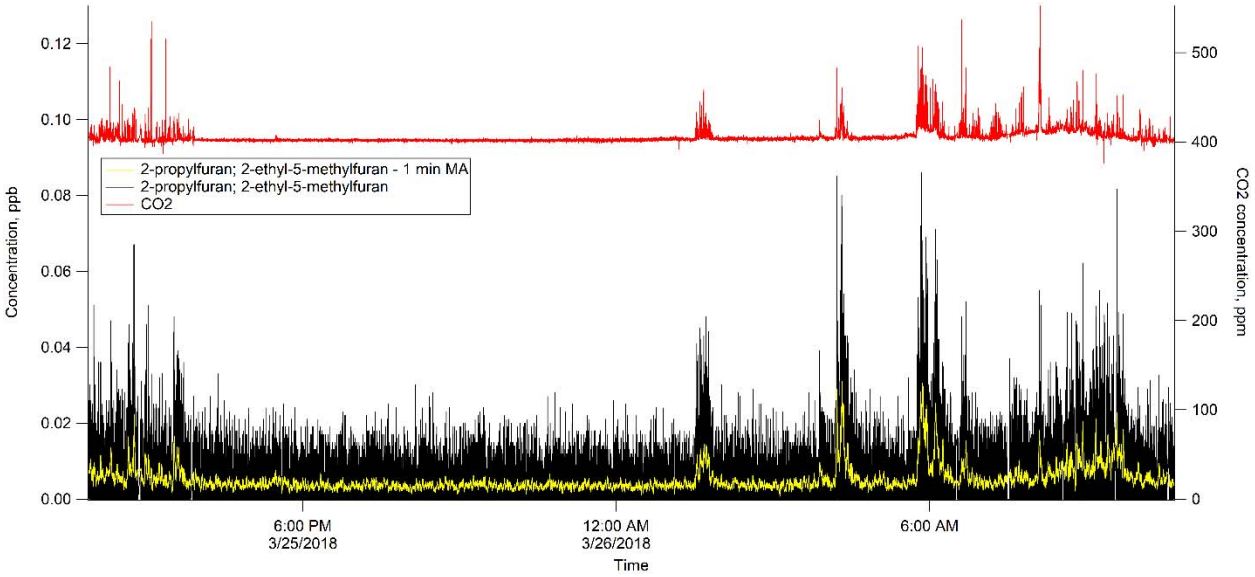


Figure 1-6. 2-propylfuran + 2-ethyl-5-methylfuran.

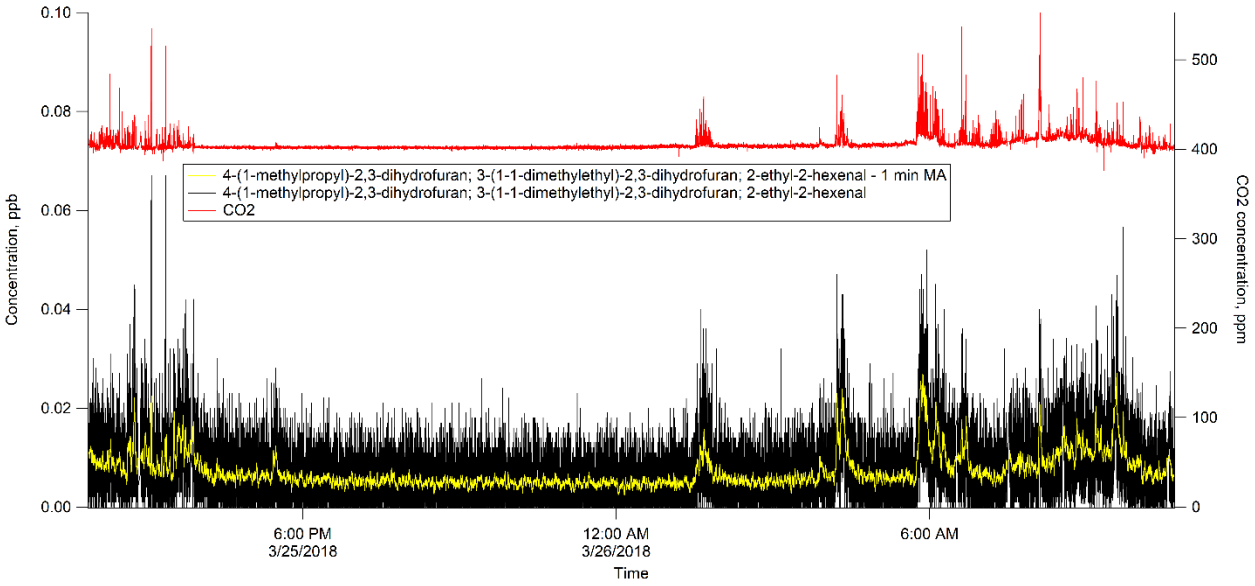


Figure 1-7. 4-(1-methylpropyl)-2,3-dihydrofuran + 3-(1-1-dimethylethyl)-2,3-dihydrofuran + 2-ethyl-2-hexenal.

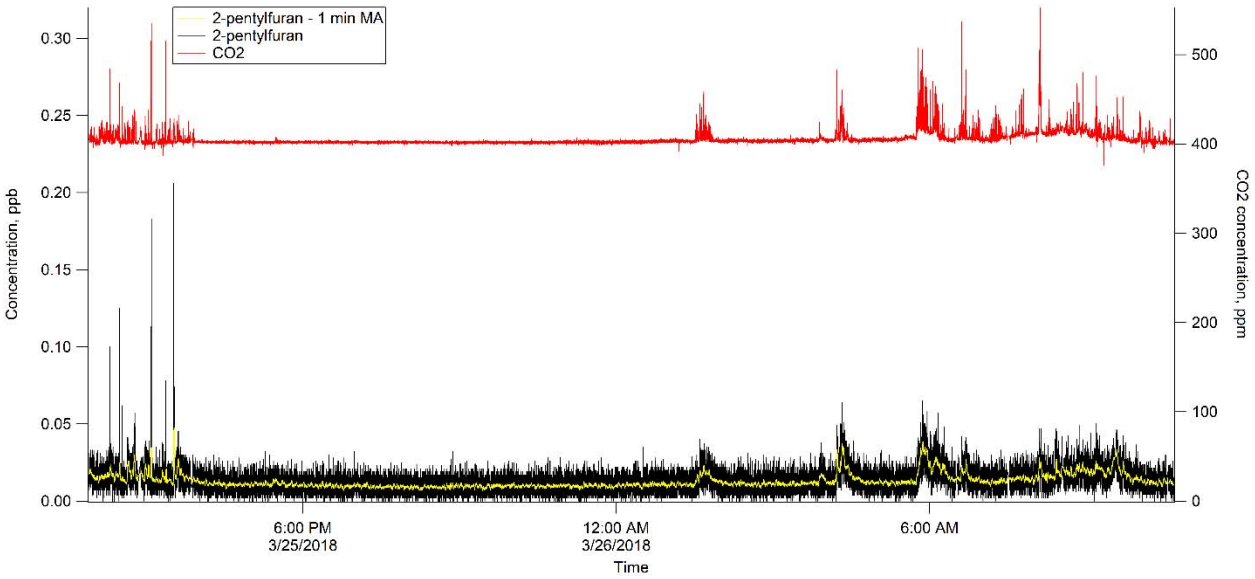


Figure 1-8. 2-pentylfuran.

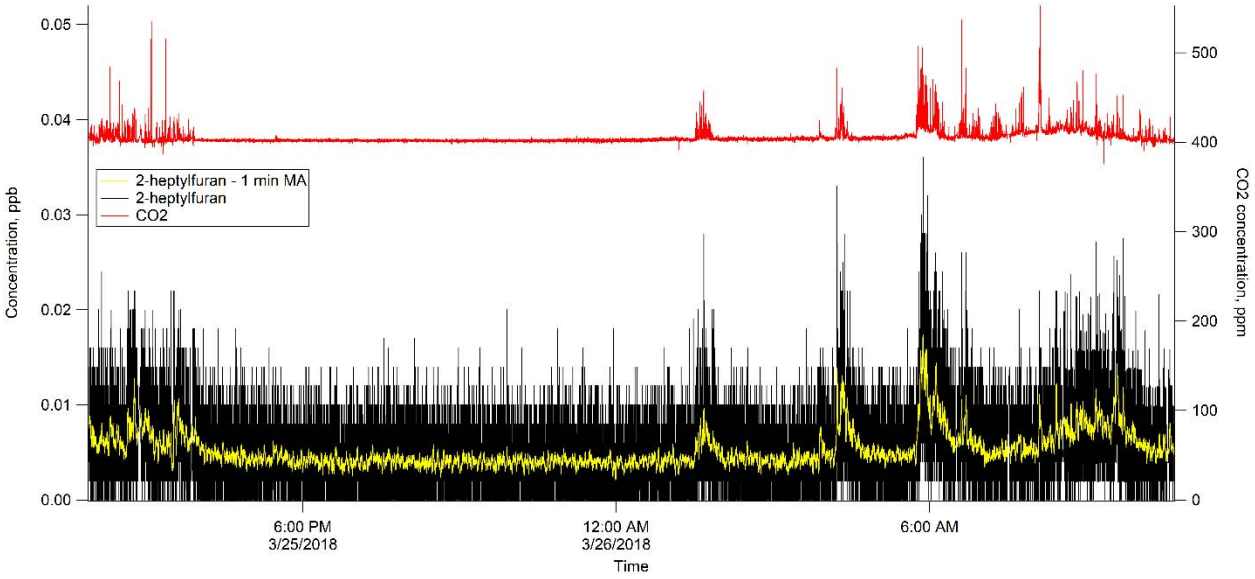


Figure 1-9. 2-heptylfuran.

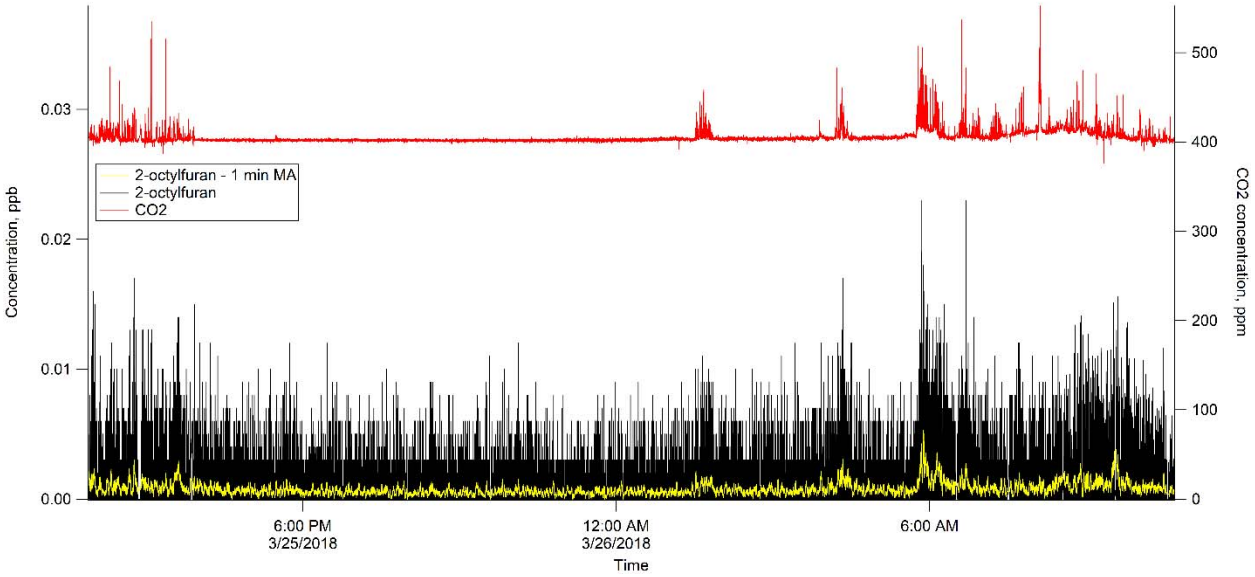


Figure 1-10. 2-octylfuran.

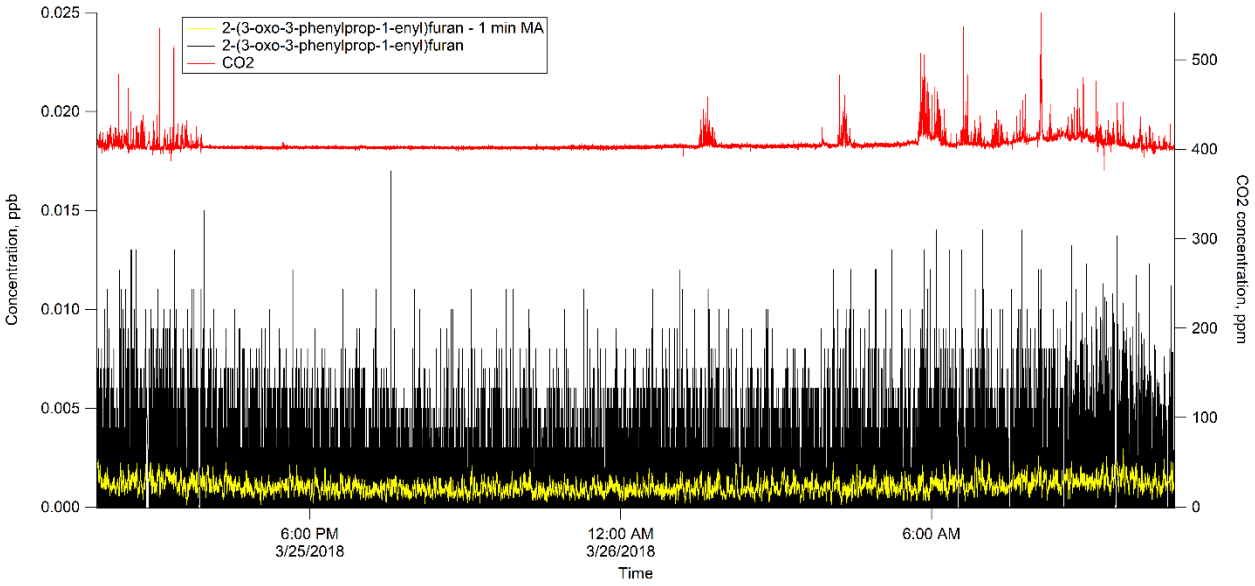


Figure 1-11. 2-(3-oxo-3-phenylprop-1-enyl)furan.

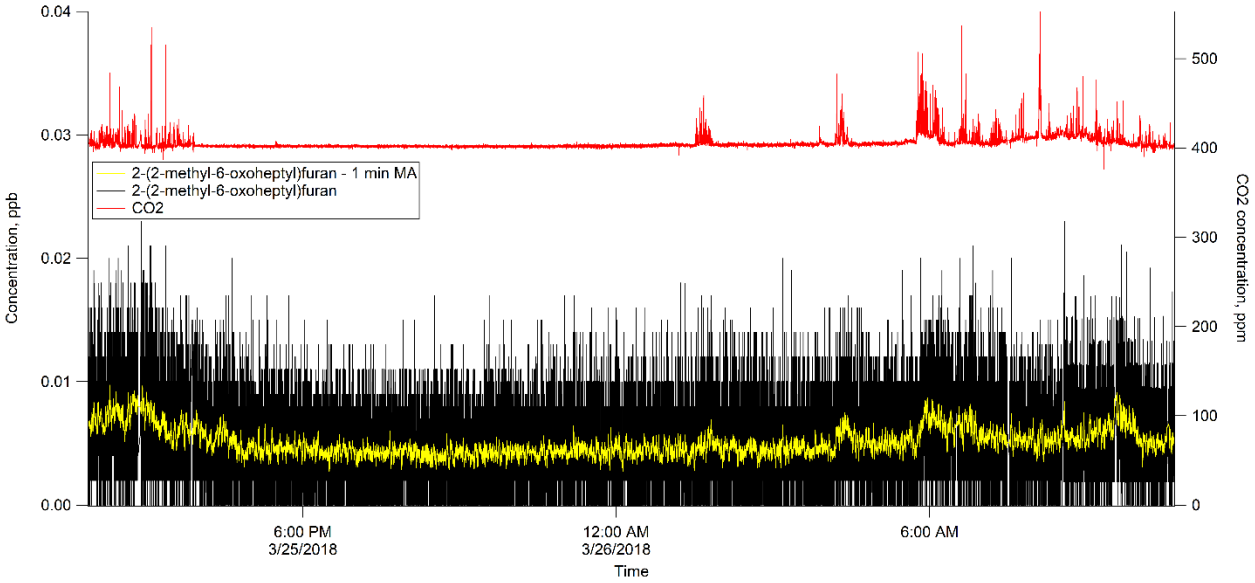


Figure 1-12. 2-(2-methyl-6-oxoheptyl)furan.

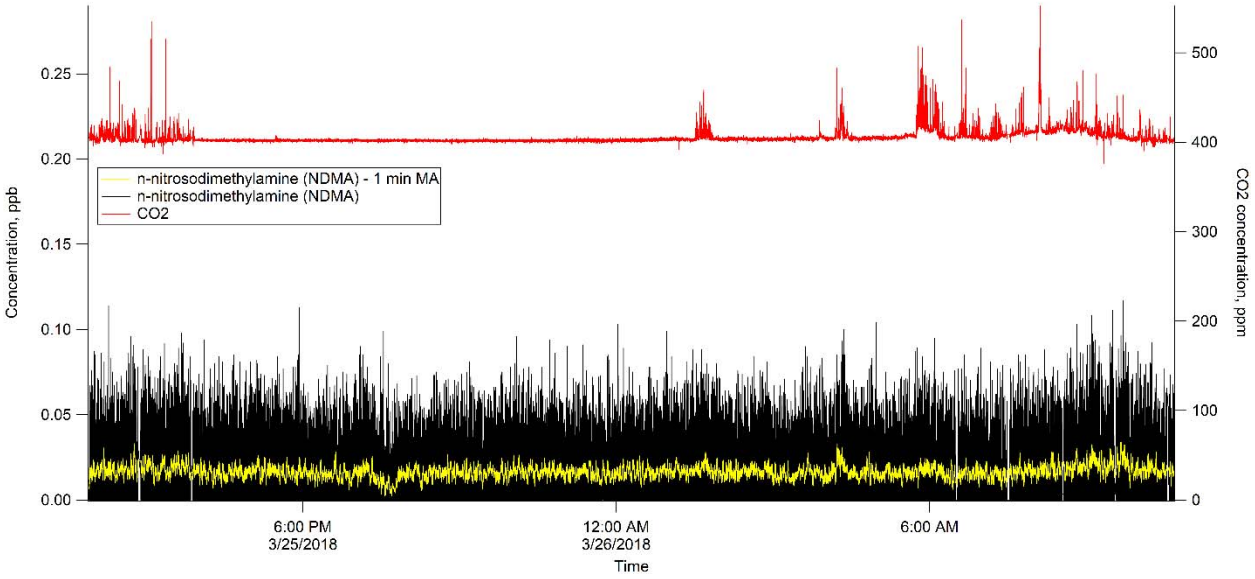


Figure 1-13. N-nitrosodimethylamine (NDMA).

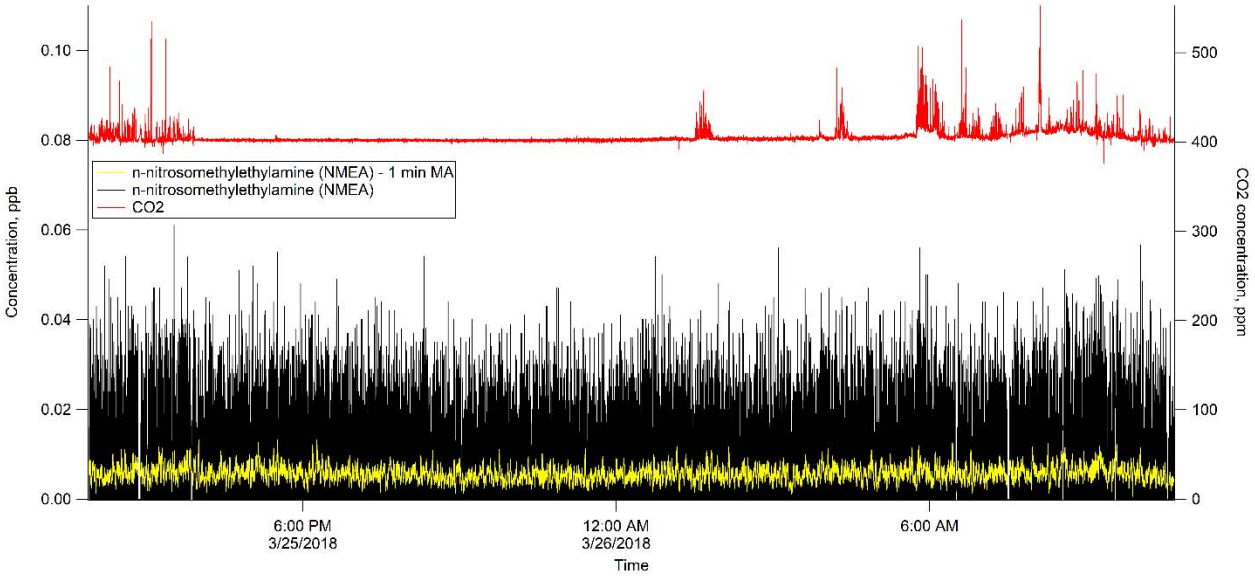


Figure 1-14. N-nitrosomethylethylamine (NMEA).

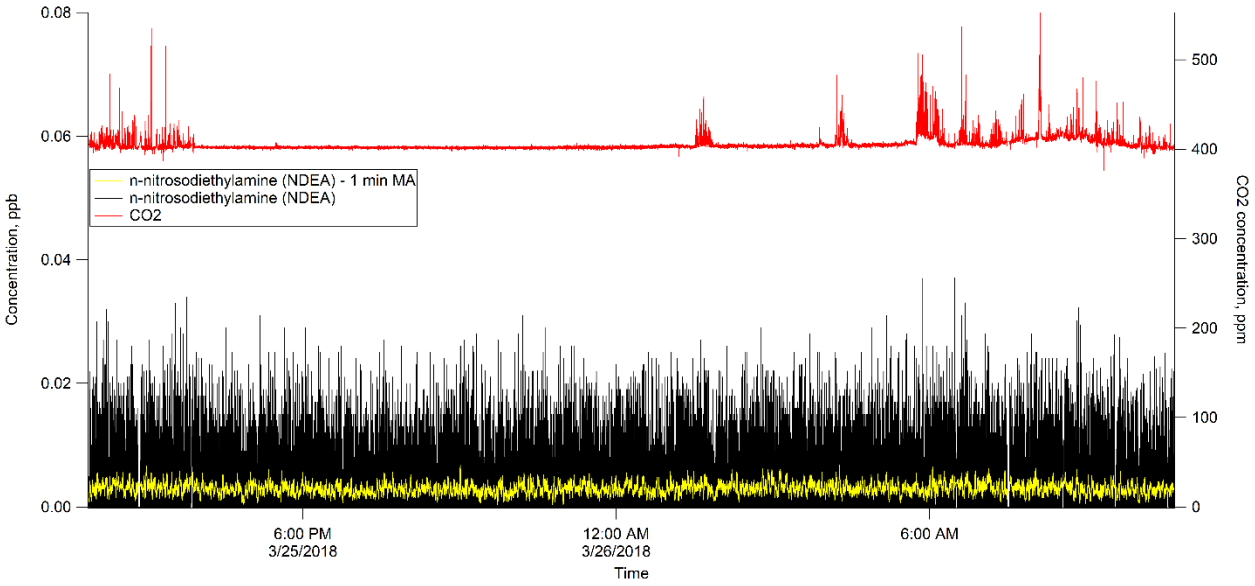


Figure 1-15. N-nitrosodiethylamine (NDEA).

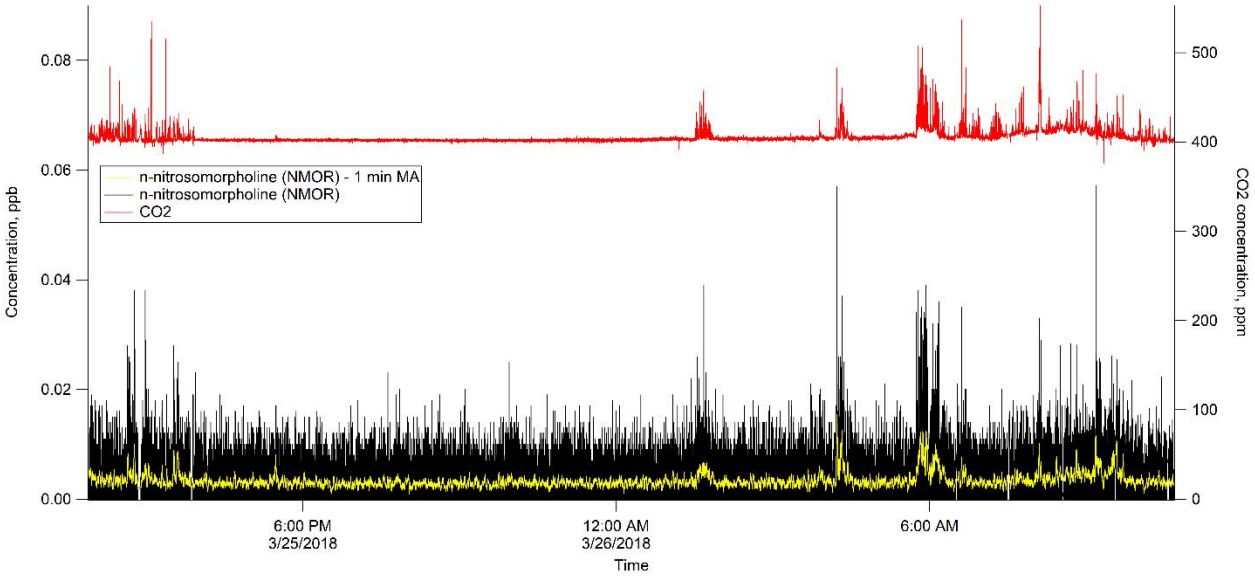


Figure 1-16. N-nitrosomorpholine (NMOR).

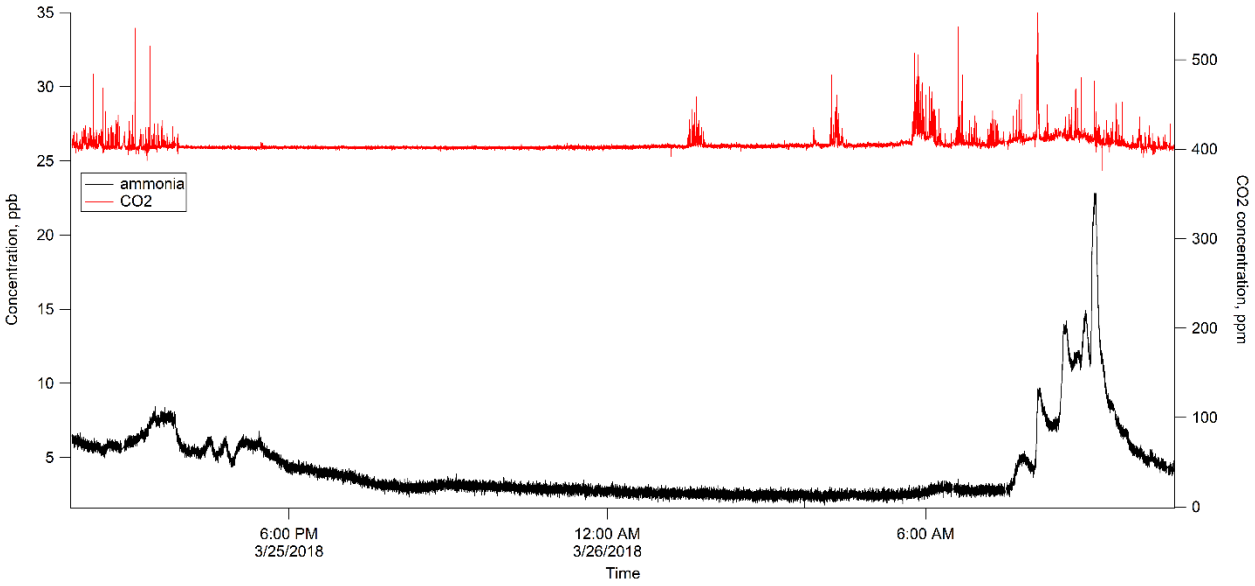


Figure 1-17. Ammonia.

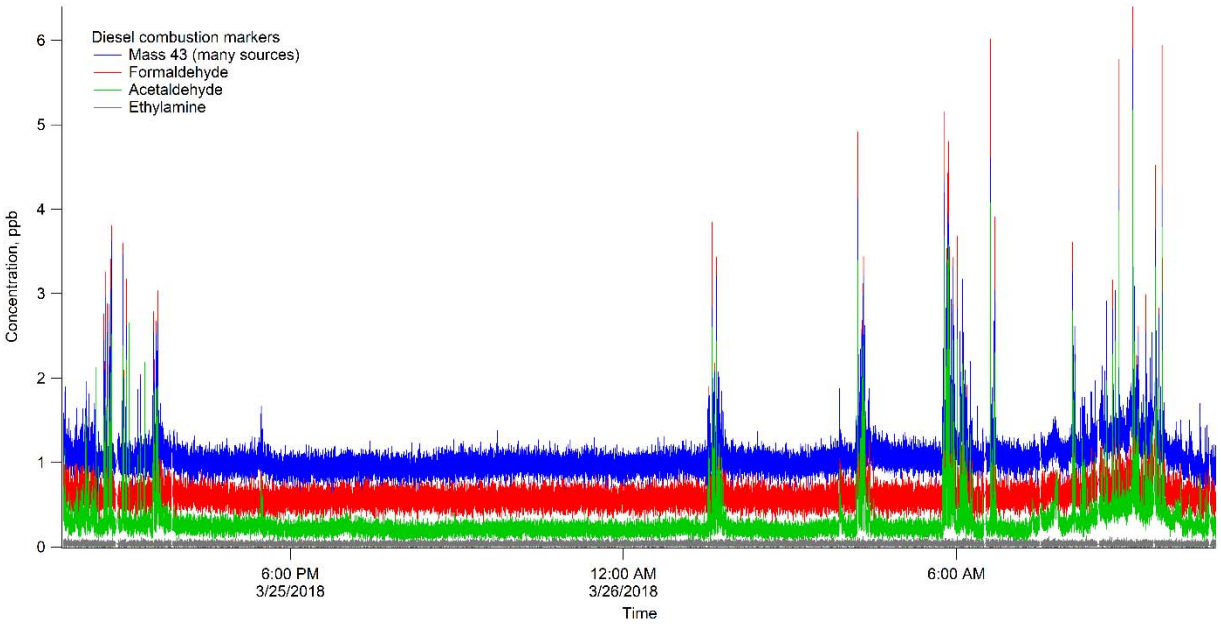


Figure 1-18. Diesel Combustion Markers.

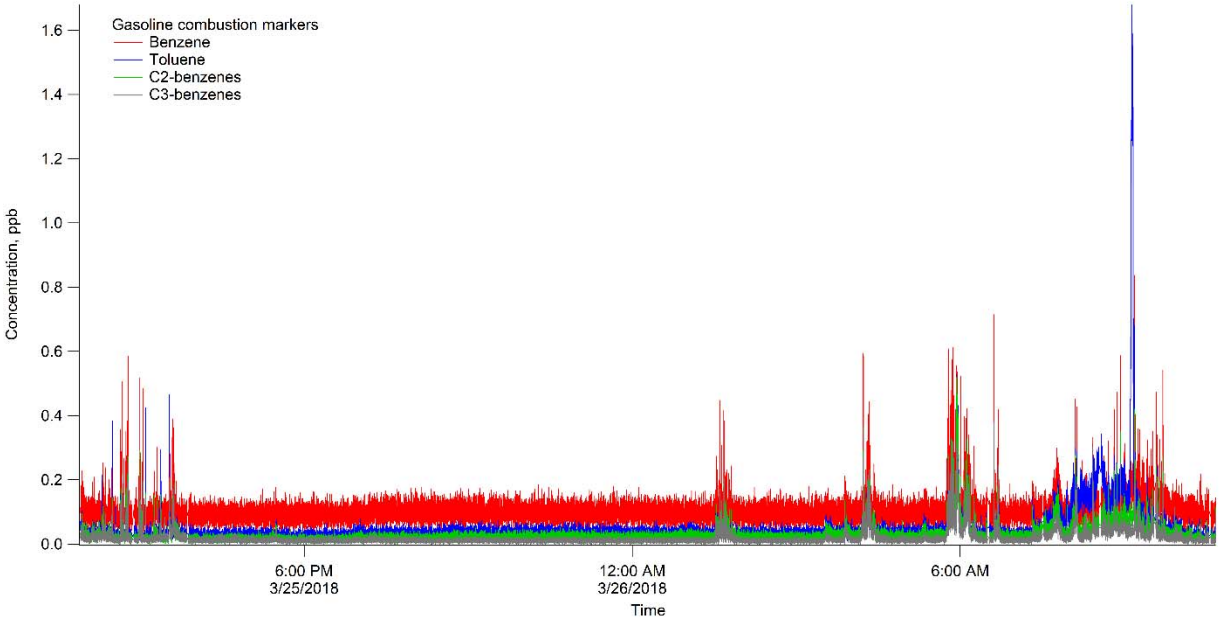


Figure 1-19. Gasoline Combustion Markers.

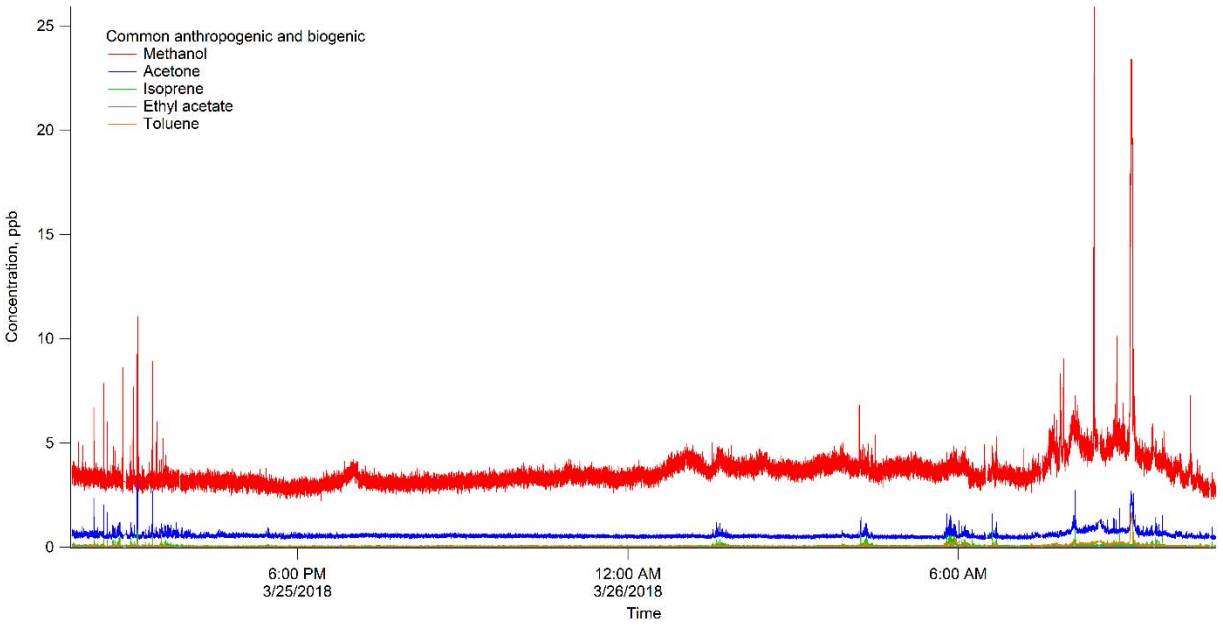


Figure 1-20. Plant and Human Markers.

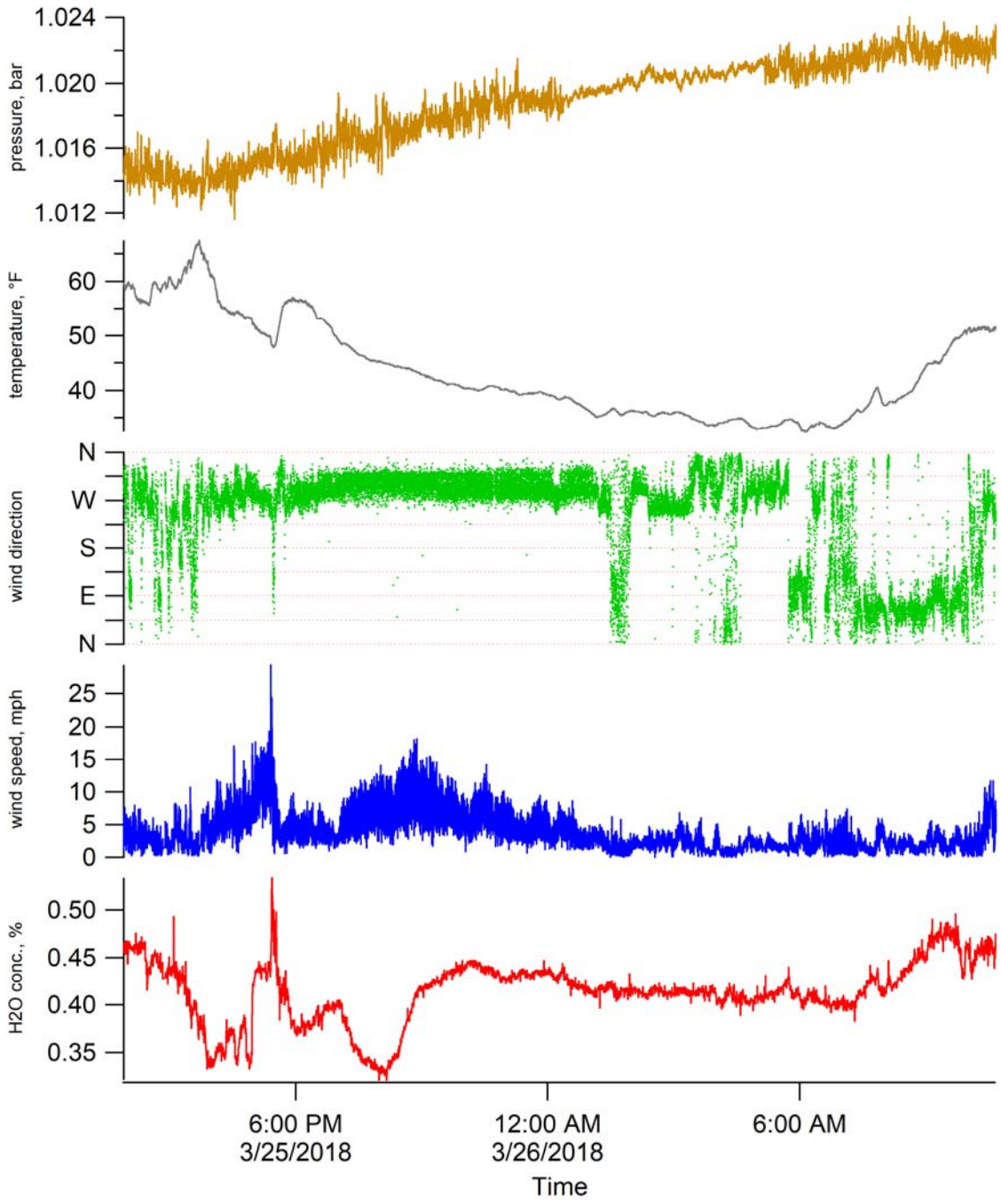


Figure 1-21. Weather Data.

2.0 MARCH 26, 2018 – MARCH 27, 2018 – STUDY SITE #4

2.1 Quality Assessment

Data from March 26, 2018, were transferred to TerraGraphics via the WRPS FTP site on March 29, 2018. Data were assessed using Procedure 17124-DOE-HS-102. A completed Data Exchange Checklist was sent to WRPS on April 2, 2018. The data were accepted by TerraGraphics with the following comments. All startup, shutdown, and calibration procedures were adequately documented and all other checks passed the acceptance limits.

2.2 Summary

Joe Sears, Robert White, and Adrielle Olson performed background sampling using the Mobile Laboratory from March 26, 2018, to March 27, 2018, at Study Site 4. Site 4 is located down wind of the AN Tank Farm. The Mobile Laboratory arrived at Site 4 at 12:20 on March 26, 2018. The initial QA/QC zero air/sensitivity checks were performed on the CO_2 monitor, NH_3 monitor, and the PTR-MS beginning at 12:23. Routine data collection resumed by 14:01. The Mobile Laboratory staff departed the monitoring site after performing the final PTR-MS zero air check for the evening at 15:40.

The Mobile Laboratory staff had returned to Site 4 and performed a PTR-MS zero air check by 06:51 on March 27, 2018. Closeout zero air/sensitivity checks were performed at 10:50. The Mobile Laboratory moved to Site 5 by 12:05.



Figure 2-1. Mobile Laboratory Site #4 for the Duration of the Monitoring Period.

2.3 Samples Collected

Continuous air monitoring was performed using the following instrumentation:

- PTR-MS,
- LI-COR CO_2 Monitor,
- Picarro Ammonia Monitor, and
- Weather Station.

Confirmatory air samples were collected as follows.

Table 2-1. Alternative Media Samples Taken.

Site	Date	Sample Type	ID	Start	Stop	Sample Time (min)
4	26-Mar	Thermosorb/N	EL22211	12:30	15:30	180
4	26-Mar	CarboTrap-300	A048103	12:33	13:46	72
4	27-Mar	Thermosorb/N	EL22193	07:02	10:04	182
4	27-Mar	CarboTrap-300	A046031	07:05	08:18	73

Table 2-2 displays the statistical information for the monitoring period of March 26, 2018, to March 27, 2018. By definition, the OEL is an 8-hour, time-weighted average that establishes a limit for personnel exposures to hazardous chemicals. It is the exposure level to which a person may be exposed for 8 hours/day, 40 hours/week for 40 years and have no expectation of adverse health effects. In this study, area vapor concentration measurements were made to better understand the hazardous vapor exposures that workers may receive. These measurements are only compared to OEL concentrations to give them context. It is neither accurate nor appropriate to interpret these short duration measurements (2 seconds) as worker exposures levels. Since the OEL is defined as a time-weighted average, it is more appropriate to compare them to daily average vapor concentrations. Short duration excursions above the OEL concentration are not significant.

Table 2-2. Statistical Information for the Monitoring Period of March 26, 2018 – March 27, 2018.

COPC #	COPC Name	Reporting Limit (ppb)	OEL (ppb)	Ave. (ppb)	St. Dev. (ppb)	Rel. St. Dev. (%)	Max (ppb)	Median (ppb)	Sec. over 50% OEL	Sec. over OEL
1	ammonia	1	25000	7.48	2.686	35.9%	25.38	6.86	0	0
2	furan	0.09	1	0.045	0.011	76.0%	0.490	0.014	0	0
3	but-3-en-2-one + 2,3-dihydrofuran + 2,5-dihydrofuran	0.22	1	0.110	0.021	111.1%	N/A*	N/A*	N/A	N/A
4	NDMA**	0.06	0.3	0.031	0.018	111.4%	0.118	0.011	0	0
5	2-methylfuran	0.05	1	0.025	0.010	85.0%	0.504	0.011	2	0
6	NEMA	0.02	0.3	0.012	0.010	157.7%	0.069	0.000	0	0
7	2,5-dimethylfuran	0.05	1	0.025	0.009	95.7%	0.421	0.008	0	0
8	NDEA	0.01	0.1	0.006	0.005	187.5%	0.037	0.000	0	0
9	2-propylfuran + 2-ethyl-5-methylfuran	0.02	1	0.010	0.005	125.1%	0.155	0.003	0	0
10	NMOR	0.05	0.6	0.025	0.004	112.9%	0.074	0.002	0	0
11	2-ethyl-2-hexenal + 4-(1-methylpropyl)-2,3-dihydrofuran + 3-(1,1-dimethylethyl)-2,3-dihydrofuran	0.04	1	0.020	0.005	77.3%	0.094	0.005	0	0
12	2-pentylfuran	0.04	1	0.020	0.005	45.8%	0.092	0.010	0	0
13	2-heptylfuran	0.02	1	0.010	0.003	67.6%	0.057	0.004	0	0
14	2-octylfuran	0.01	1	0.005	0.001	229.1%	0.021	0.000	0	0
15	6-(2-furanyl)-6-methyl-2-heptanone	0.01	1	0.005	0.002	172.5%	0.013	0.000	0	0
16	furfural acetophenone	0.07	1	0.035	0.003	64.9%	0.020	0.004	0	0

* The maximum peak value for but-3-en-2-one + 2,3 dihydrofuran + 2,5 dihydrofuran was 1.639 ppb and the median value was 0.017 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 200, 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 each COPC signal, overlaid with the same signal smoothed using a 1-minute moving average, and CO_2, for the monitoring period March 26, 2018, to March 27, 2018.

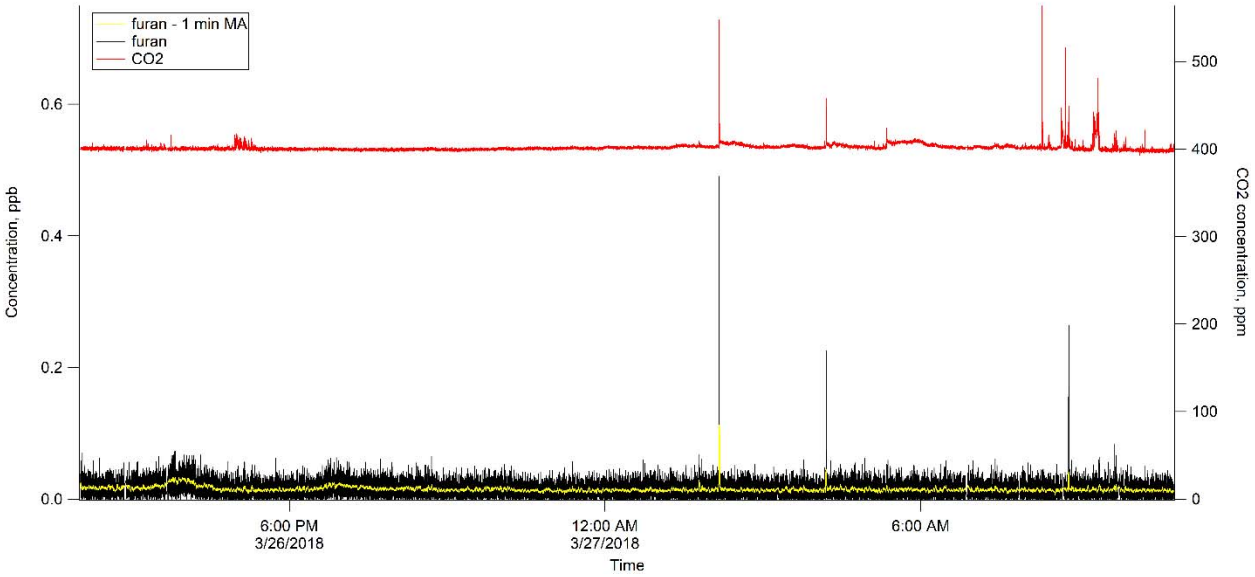


Figure 2-2. Furan.

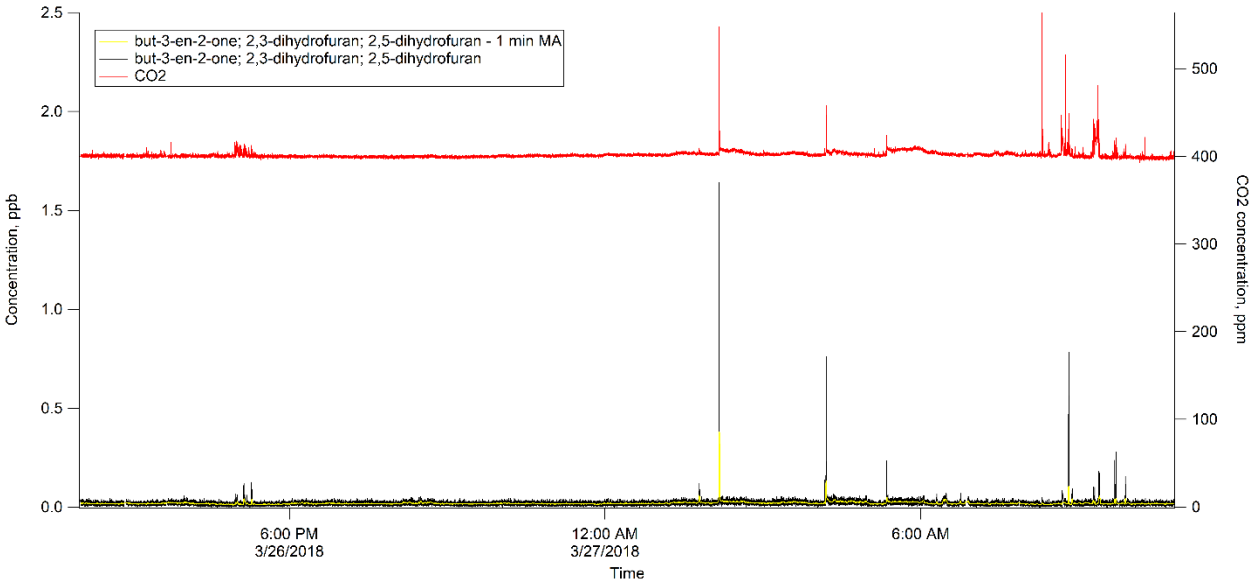


Figure 2-3. but-3-en-2-one + 2,3-dihydrofuran + 2,5-dihydrofuran.

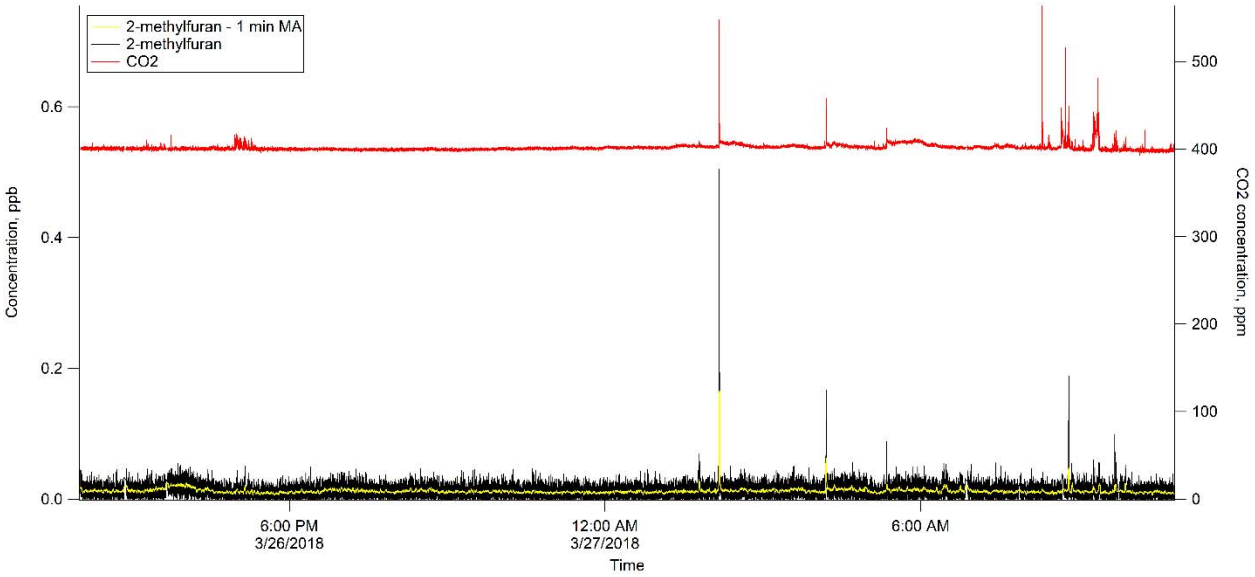


Figure 2-4. 2-methylfuran.

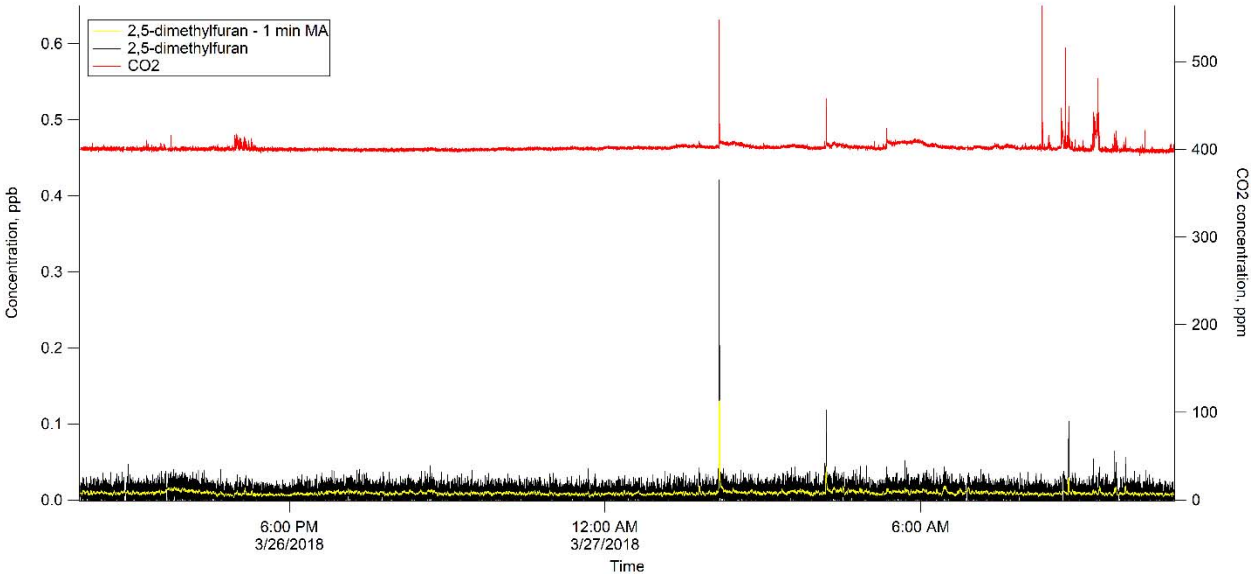


Figure 2-5. 2,5-dimethylfuran.

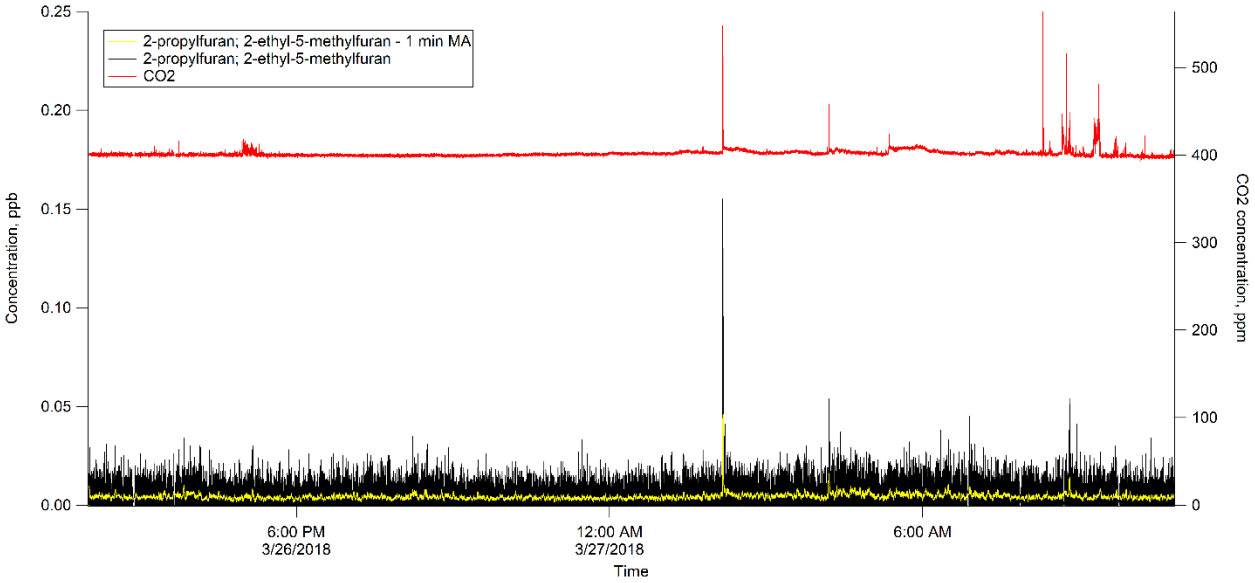


Figure 2-6. 2-propylfuran + 2-ethyl-5-methylfuran.

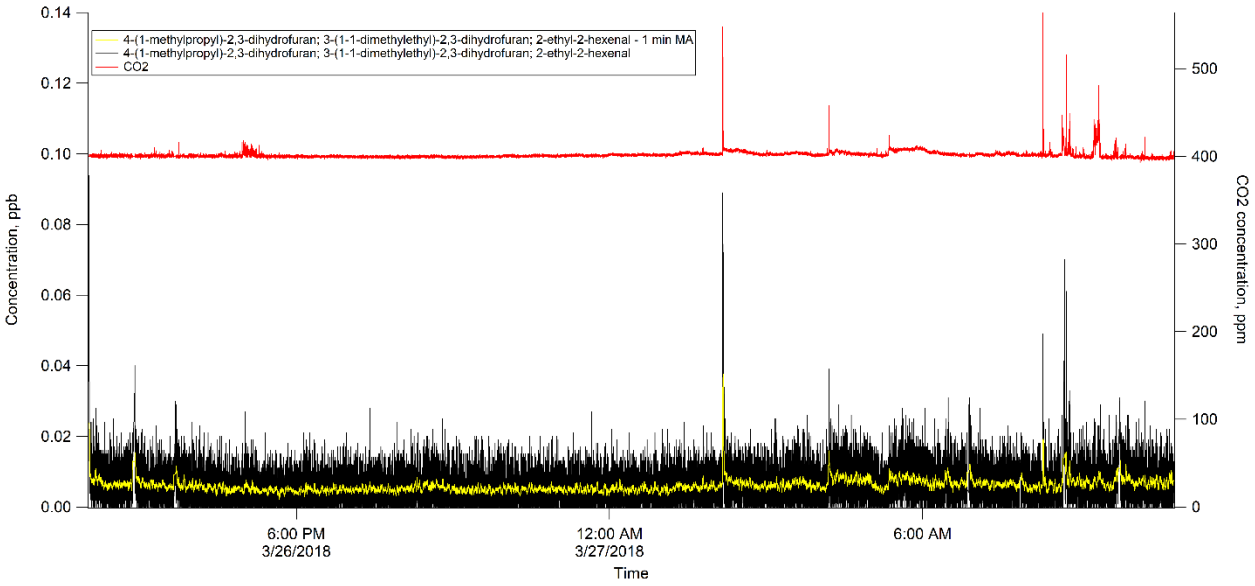


Figure 2-7. 4-(1-methylpropyl)-2,3-dihydrofuran + 3-(1-1-dimethylethyl)-2,3-dihydrofuran + 2-ethyl-2-hexenal.

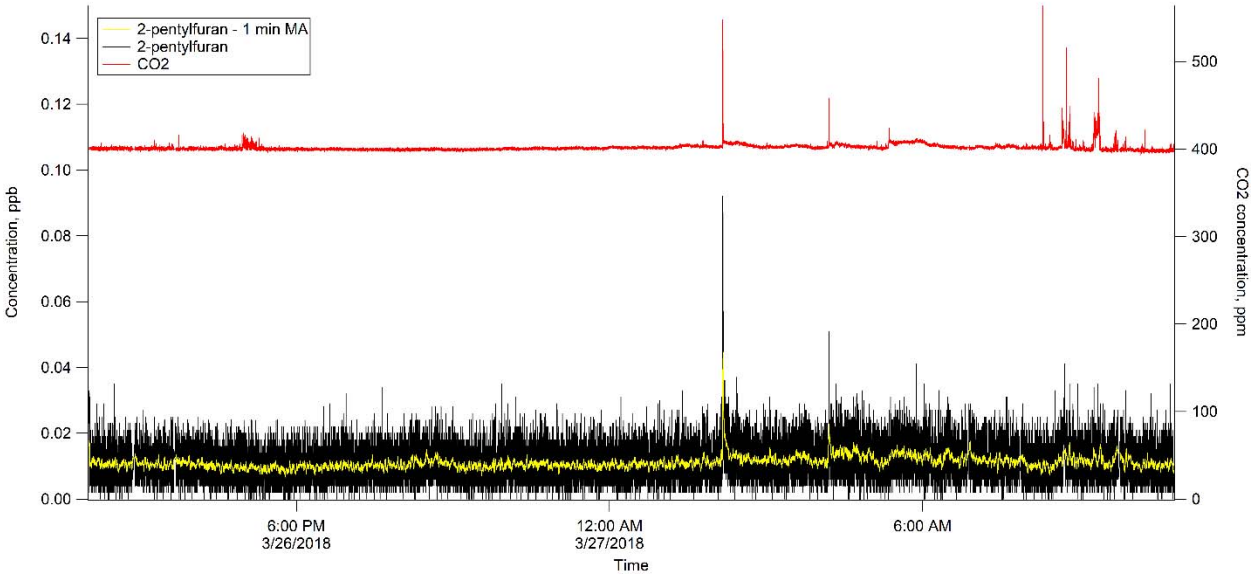


Figure 2-8. 2-pentylfuran.

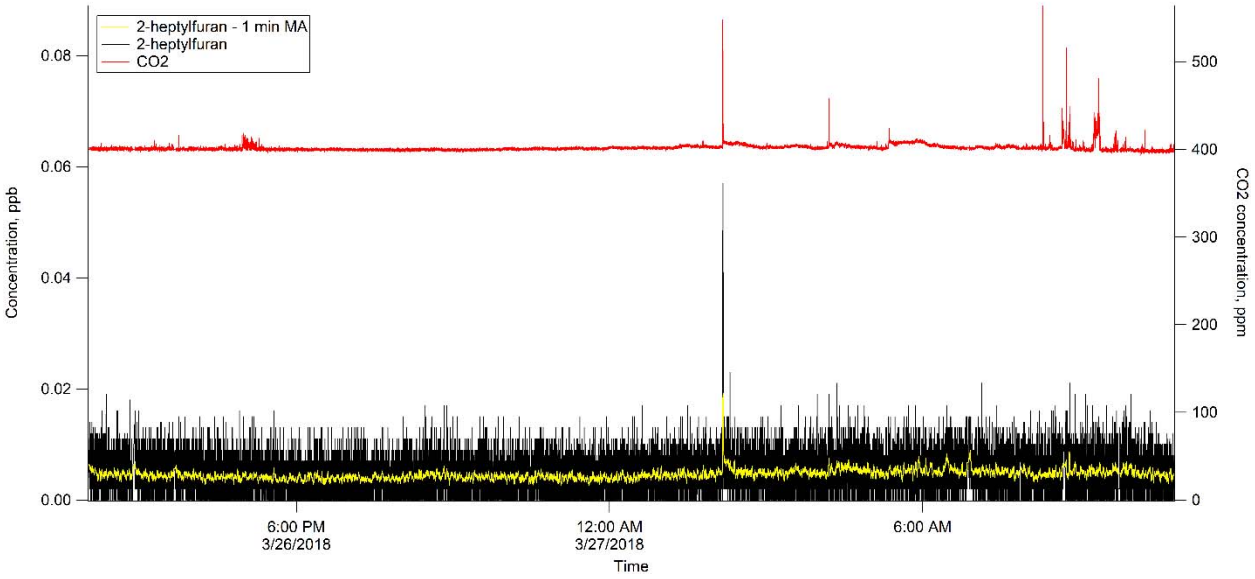


Figure 2-9. 2-heptylfuran.

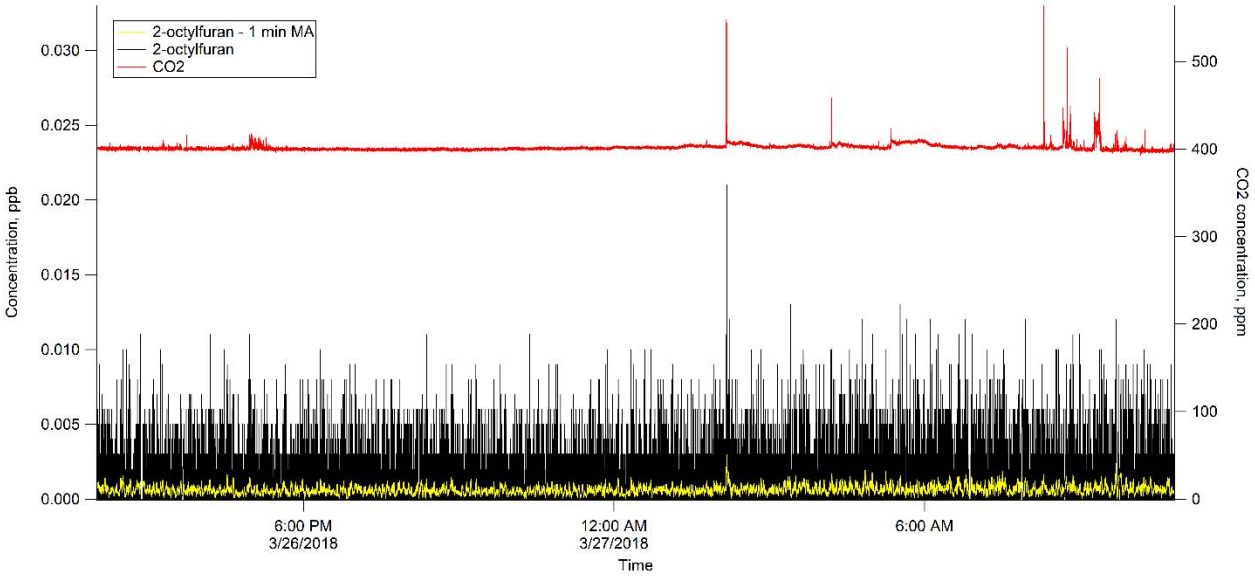


Figure 2-10. 2-octylfuran.

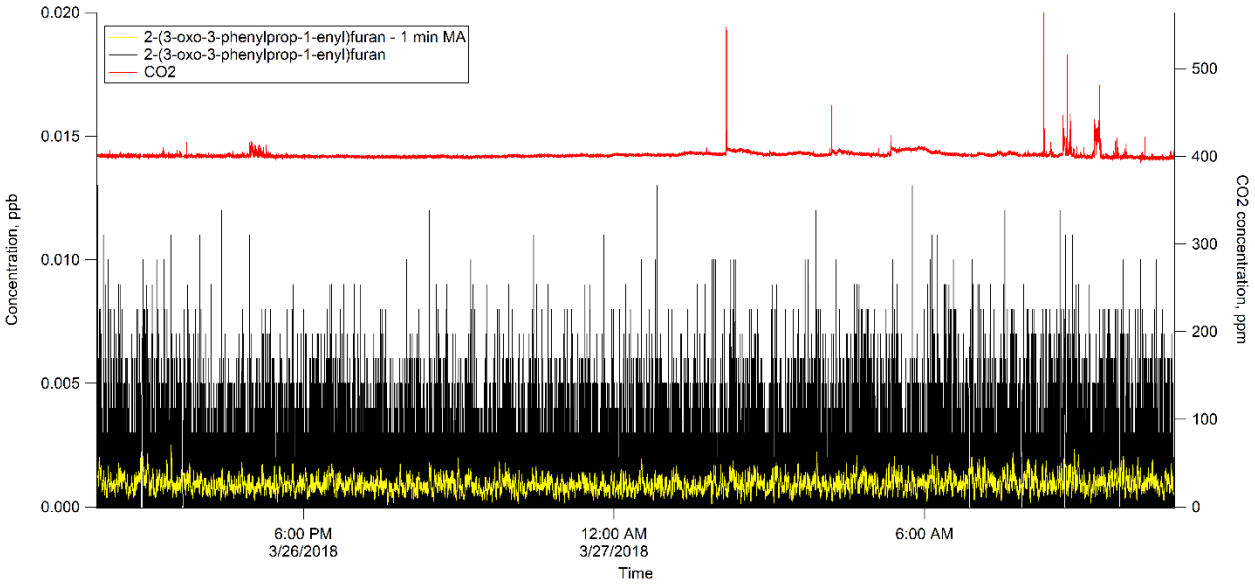


Figure 2-11. 2-(3-oxo-3-phenylprop-1-enyl)furan.

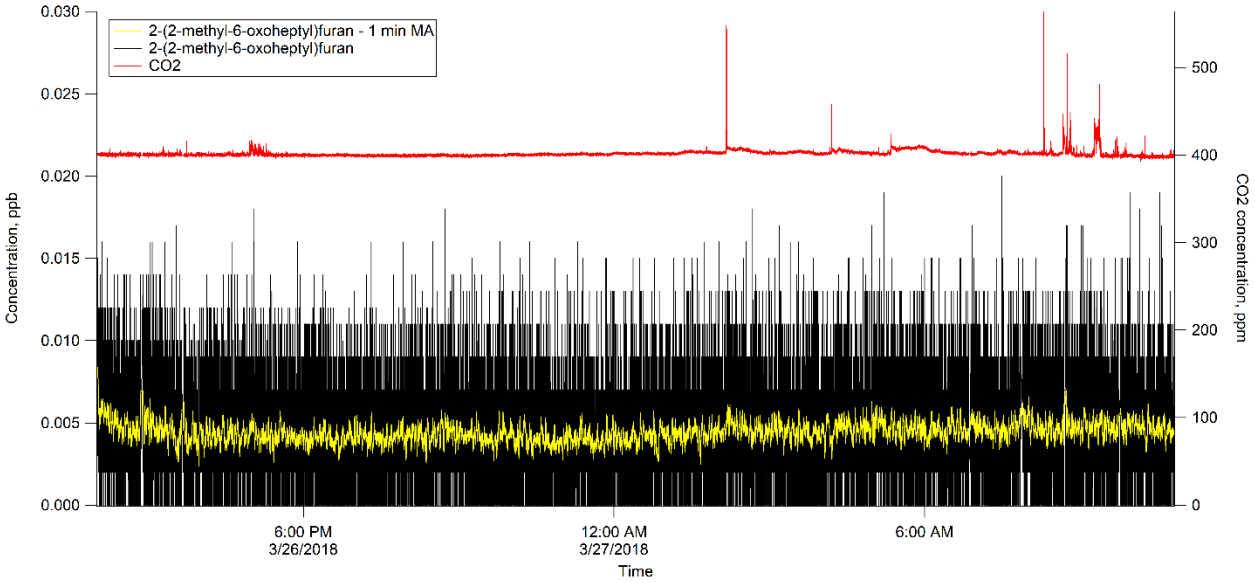


Figure 2-12. 2-(2-methyl-6-oxoheptyl)furan.

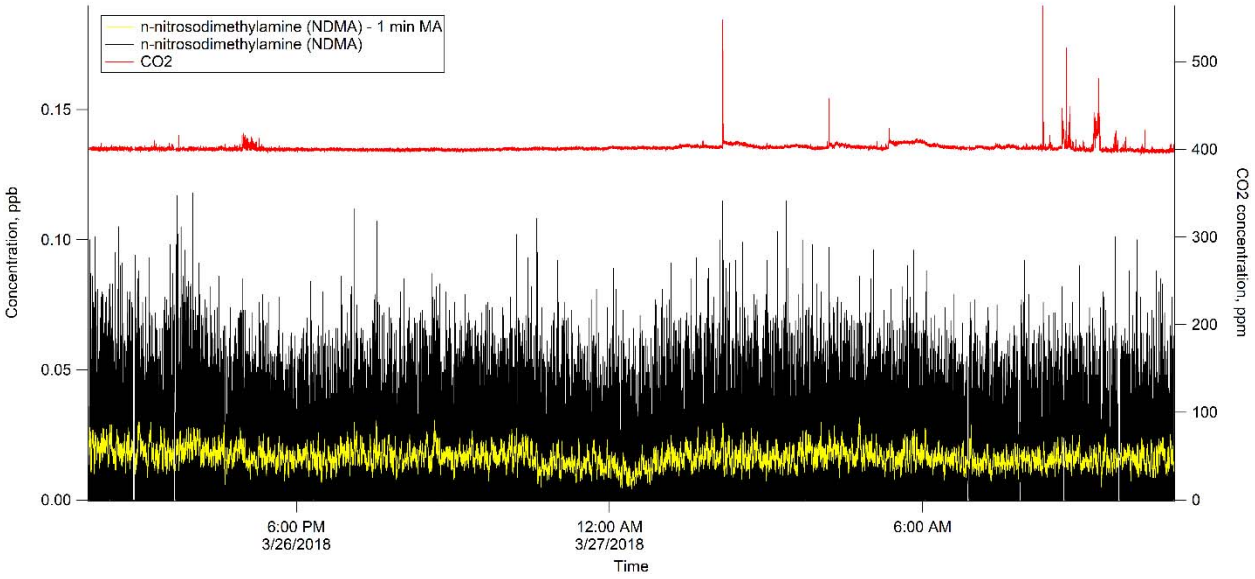


Figure 2-13. N-nitrosodimethylamine (NDMA).

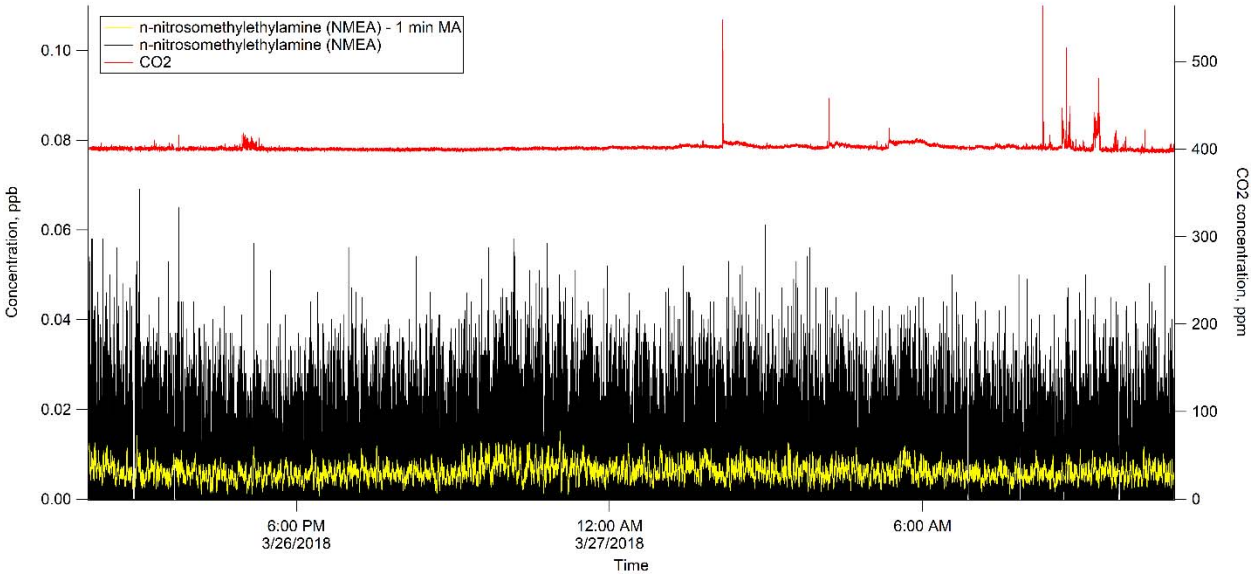


Figure 2-14. N-nitrosomethylethylamine (NMEA).

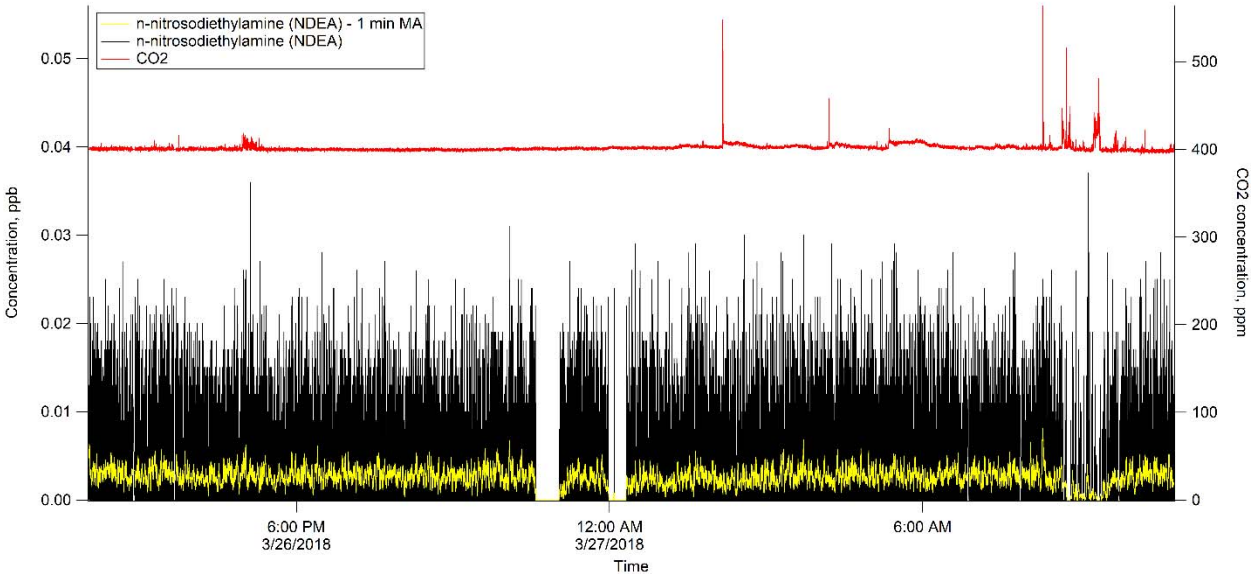


Figure 2-15. N-nitrosodiethylamine (NDEA).

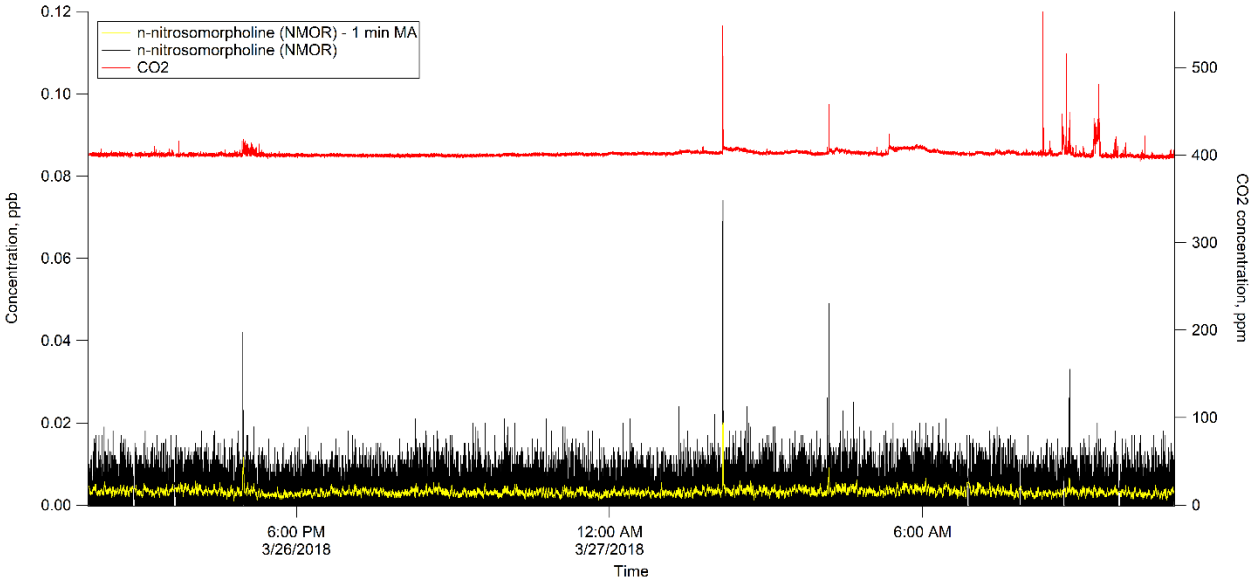


Figure 2-16. N-nitrosomorpholine (NMOR).

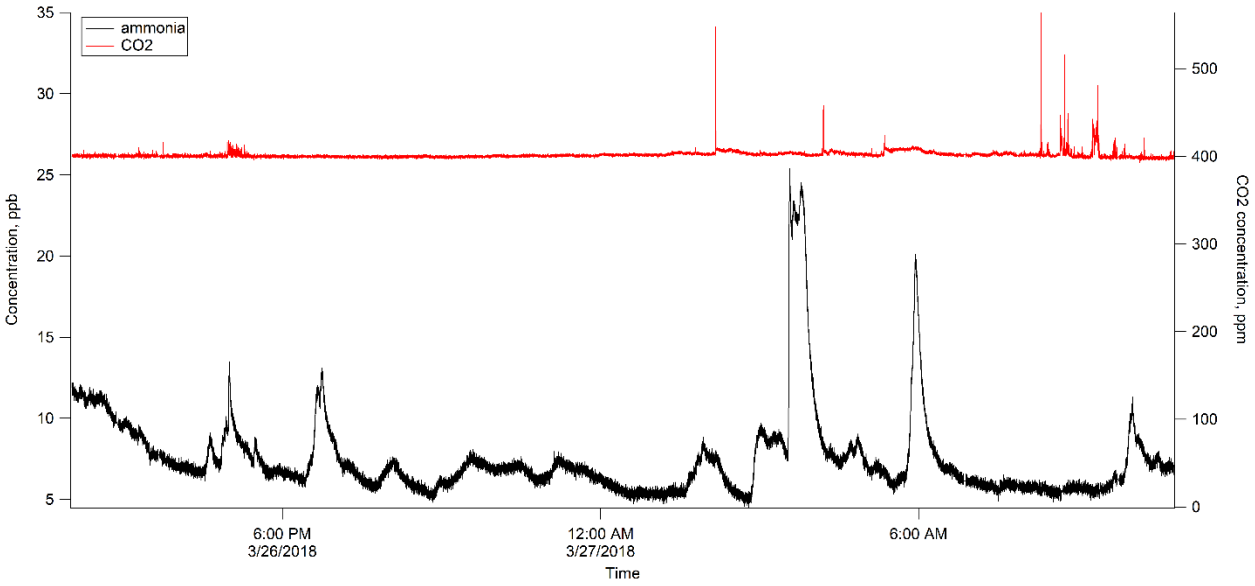


Figure 2-17. Ammonia.

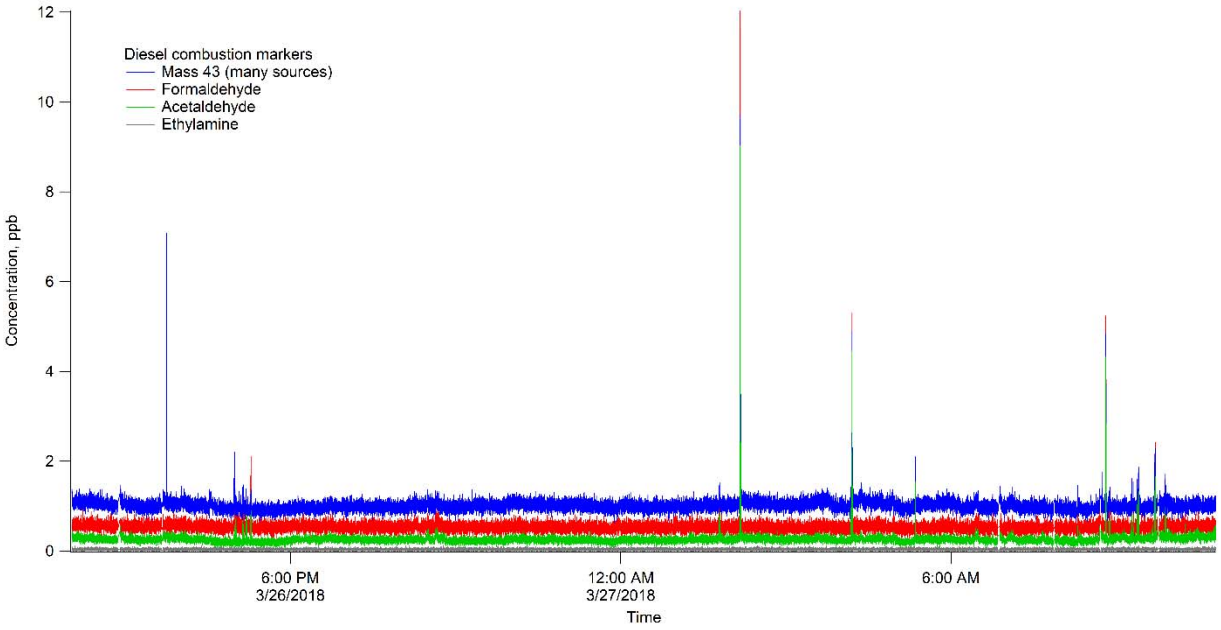


Figure 2-18. Diesel Combustion Markers.

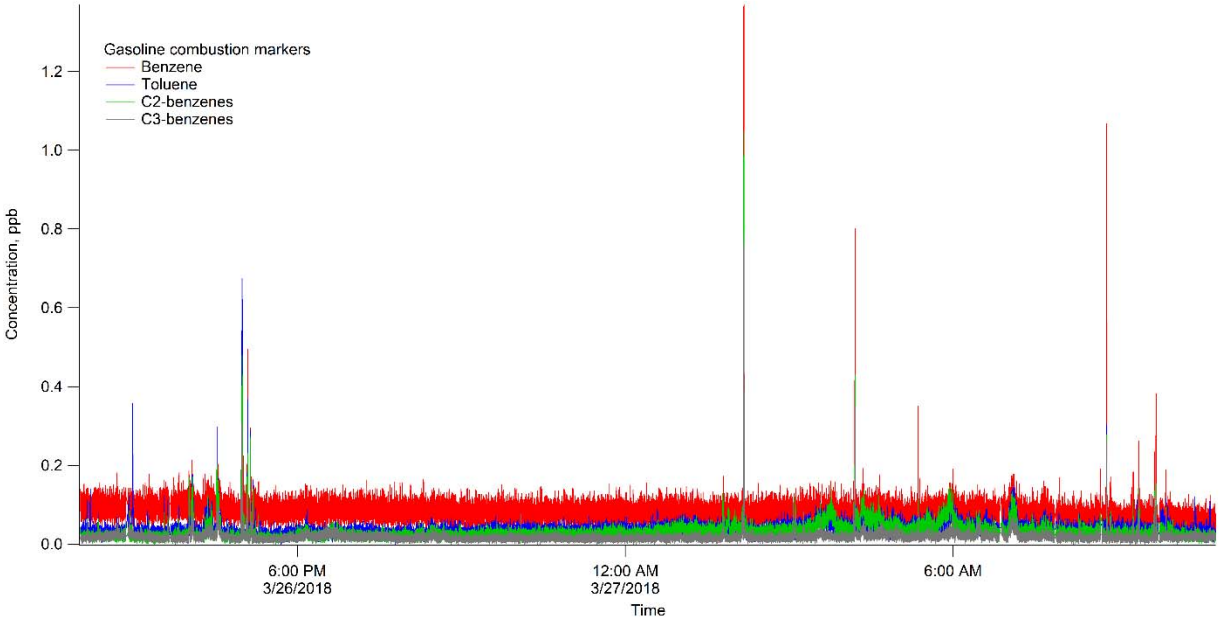


Figure 2-19. Gasoline Combustion Markers.

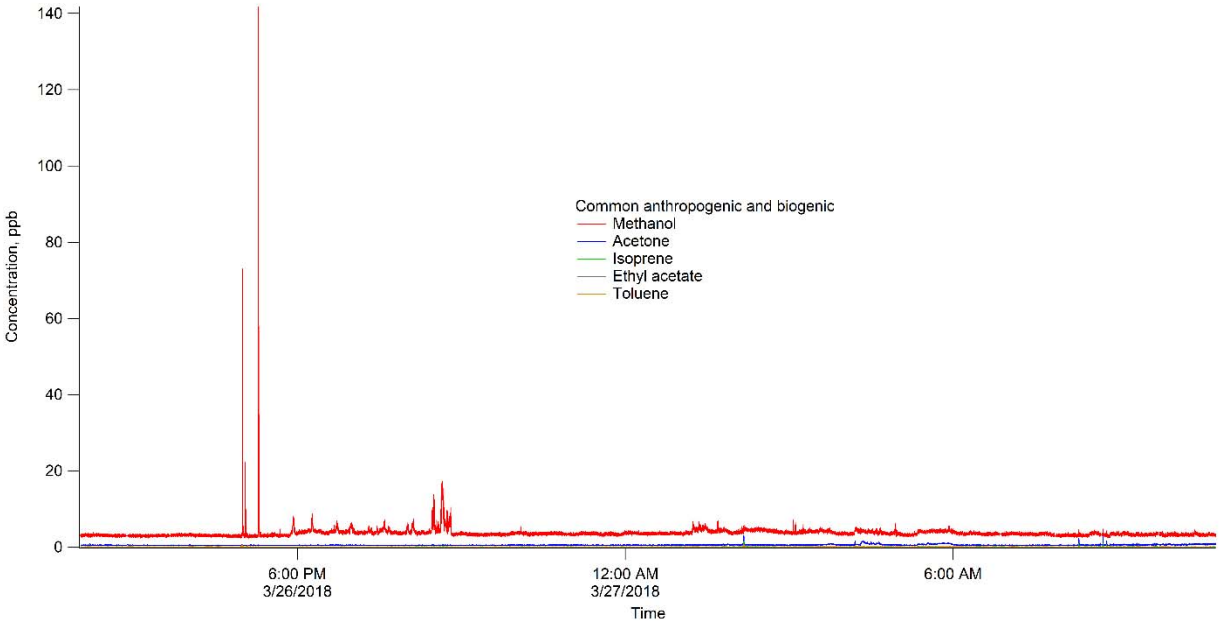


Figure 2-20. Plant and Human Markers.

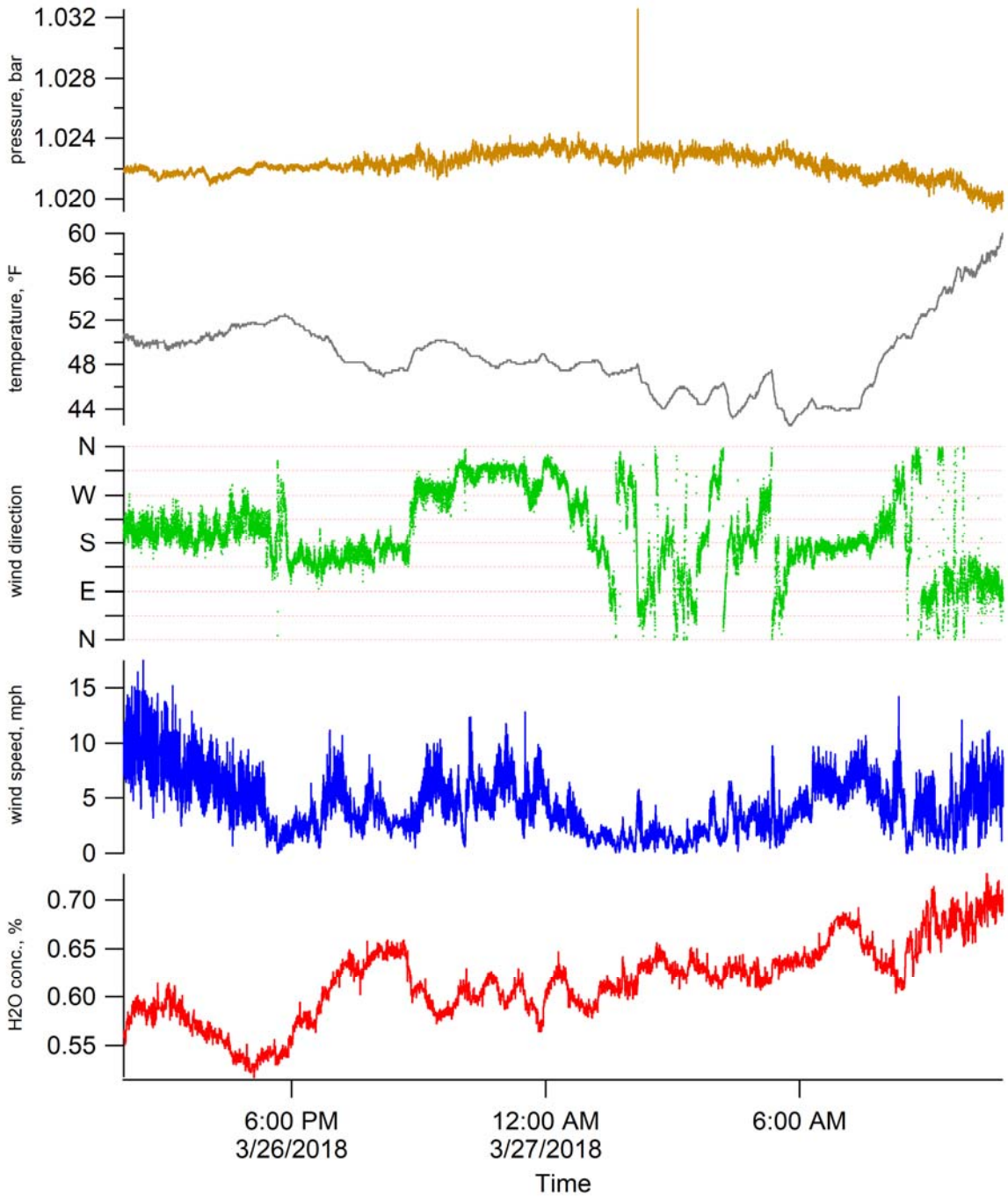


Figure 2-21. Weather Data.

3.0 MARCH 27, 2018 – MARCH 28, 2018 – STUDY SITE #5

3.1 Quality Assessment

Data from March 27, 2018, were transferred to TerraGraphics via the WRPS FTP site on March 30, 2018. Data were assessed using Procedure 17124-DOE-HS-102. A completed Data Exchange Checklist was sent to WRPS on April 4, 2018. The data were accepted by TerraGraphics with the following comments. All startup, shutdown, and calibration procedures were adequately documented and all other checks passed the acceptance limits. No other exceptions besides those below were noted.

Ammonia final check/zero data file stated in the procedure as AED2077-20180327-200625Z starting at 10:50 on March 27, 2018 to 04:06 on March 28, 2018, was missing from the FTP. Corrective and Preventative Action (CAPA) 1814 was generated by Yemane Yohannes on April 4, 2018. The originally delivered data file was not the correct ammonia file from the "Ammonia-Synch" folder. The correct file was 20180827-17923Z and has been uploaded to the FTP.

3.2 Summary

Krystin Riha, Robert White, and Adrielle Olson performed background sampling using the Mobile Laboratory from March 27, 2018, to March 28, 2018, at Study Site 5. Site 5 is located southeast of the Waste Treatment Facility. This site may provide data related to stack emission dispersion downwind of the tank farm ventilation and as a baseline data point for future reference once the Waste Treatment Facility begins operation. The Mobile Laboratory arrived at Site 5 at 12:05 on March 27, 2018. The initial QA/QC zero air/sensitivity checks were performed on the CO_2 monitor, NH_3 monitor, and the PTR-MS beginning at 12:11. Routine data collection resumed by 13:06. The Mobile Laboratory staff departed the monitoring site after performing the final PTR-MS zero air check for the evening at 15:40.

The Mobile Laboratory staff had returned to Site 5 and performed a PTR-MS zero air check by 06:37 on March 28, 2018. Closeout zero air/sensitivity checks were performed at 10:33. The Mobile Laboratory moved to Site 6 by 11:03.



Figure 3-1. Mobile Laboratory Site #5 for the Duration of the Monitoring Period.

3.3 Samples Collected

Continuous air monitoring was performed using the following instrumentation:

- PTR-MS,
- LI-COR CO_2 Monitor,
- Picarro Ammonia Monitor, and
- Weather Station.

Confirmatory air samples were collected as follows:

Table 3-1. Alternative Media Samples Taken.

Site	Date	Sample Type	ID	Start	Stop	Sample Time (min)
5	27-Mar	Thermosorb/N	EL22192	12:21	15:27	186
5	27-Mar	CarboTrap-300	A048082	12:23	13:35	71
5	28-Mar	Thermosorb/N	EL22199	06:51	09:52	180
5	28-Mar	CarboTrap-300	A045496	06:55	08:06	71

Table 3-2 displays the statistical information for the monitoring period of March 27, 2018, to March 28, 2018. By definition, the OEL is an 8-hour, time-weighted average that establishes a limit for personnel exposures to hazardous chemicals. It is the exposure level to which a person may be exposed for 8 hours/day, 40 hours/week for 40 years and have no expectation of adverse health effects. In this study, area vapor concentration measurements were made to better understand the hazardous vapor exposures that workers may receive. These measurements are only compared to OEL concentrations to give them context. It is neither accurate nor appropriate

to interpret these short duration measurements (2 seconds) as worker exposures levels. Since the OEL is defined as a time-weighted average, it is more appropriate to compare them to daily average vapor concentrations. Short duration excursions above the OEL concentration are not significant.

Table 3-2. Statistical Information for the Monitoring Period of March 27, 2018 – March 28, 2018.

COPC #	COPC Name	Reporting Limit (ppb)	OEL (ppb)	Ave. (ppb)	St. Dev. (ppb)	Rel. St. Dev. (%)	Max (ppb)	Median (ppb)	Sec. over 50% OEL	Sec. over OEL
1	ammonia	1	25000	9.30	4.765	51.2%	22.50	8.27	0	0
2	furan	0.09	1	0.045	0.010	75.6%	0.157	0.012	0	0
3	but-3-en-2-one + 2,3-dihydrofuran + 2,5-dihydrofuran	0.22	1	0.110	0.018	106.2%	0.704	0.015	N/A	N/A
4	NDMA**	0.06	0.3	0.031	0.018	115.9%	0.200	0.010	4	0
5	2-methylfuran	0.05	1	0.025	0.010	85.3%	0.223	0.010	0	0
6	NEMA	0.02	0.3	0.012	0.009	162.4%	0.068	0.000	0	0
7	2,5-dimethylfuran	0.05	1	0.025	0.008	96.8%	0.135	0.007	0	0
8	NDEA	0.01	0.1	0.006	0.005	184.8%	0.041	0.000	0	0
9	2-propylfuran + 2-ethyl-5-methylfuran	0.02	1	0.010	0.005	128.8%	0.080	0.002	0	0
10	NMOR	0.05	0.6	0.025	0.004	134.8%	0.195	0.002	0	0
11	2-ethyl-2-hexenal + 4-(1-methylpropyl)-2,3-dihydrofuran + 3-(1,1-dimethylethyl)-2,3-dihydrofuran	0.04	1	0.020	0.006	90.0%	0.088	0.005	0	0
12	2-pentylfuran	0.04	1	0.020	0.005	49.8%	0.048	0.010	0	0
13	2-heptylfuran	0.02	1	0.010	0.003	68.4%	0.030	0.004	0	0
14	2-octylfuran	0.01	1	0.005	0.001	231.0%	0.019	0.000	0	0
15	6-(2-furanyl)-6-methyl-2-heptanone	0.01	1	0.005	0.002	171.6%	0.017	0.000	0	0
16	furfural acetophenone	0.07	1	0.035	0.003	66.0%	0.022	0.004	0	0

* The maximum peak value for but-3-en-2-one + 2,3 dihydrofuran + 2,5 dihydrofuran was 0.704 ppb and the median value was 0.015 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 200, 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 each COPC signal, overlaid with the same signal smoothed using a 1-minute moving average, and CO_2, for the monitoring period March 27, 2018, to March 28, 2018.

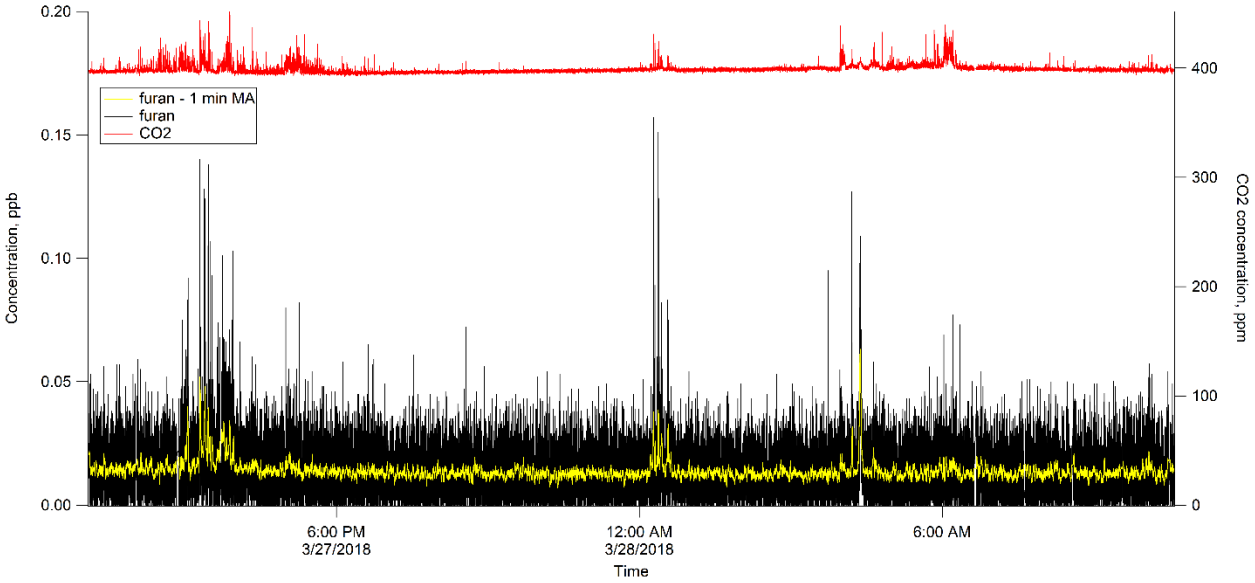


Figure 3-2. Furan.

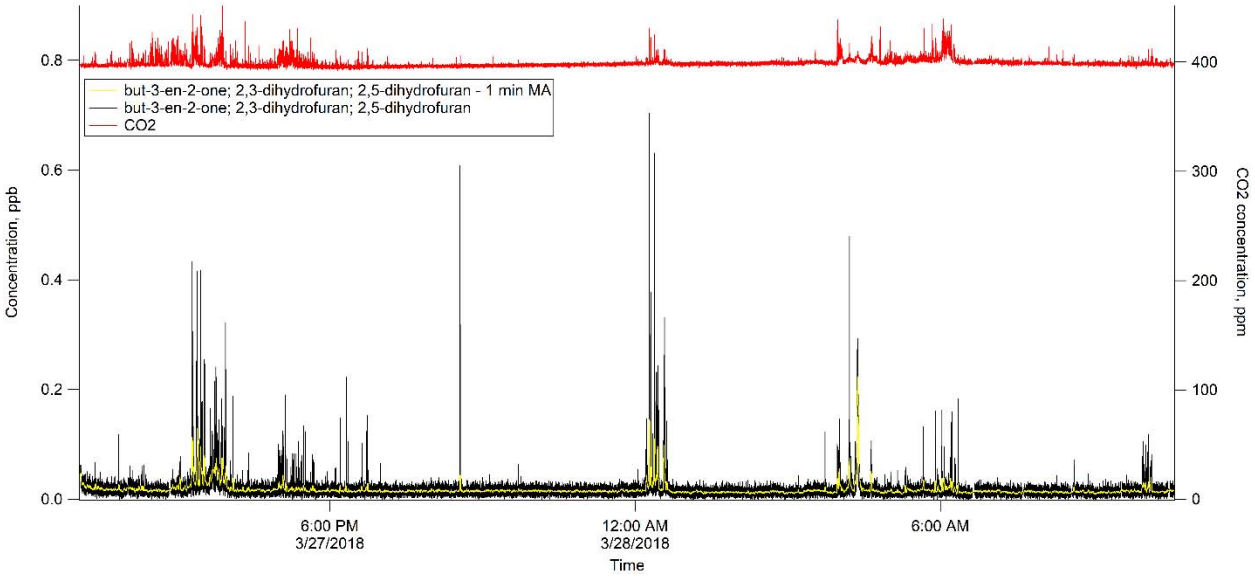


Figure 3-3. but-3-en-2-one + 2,3-dihydrofuran + 2,5-dihydrofuran.

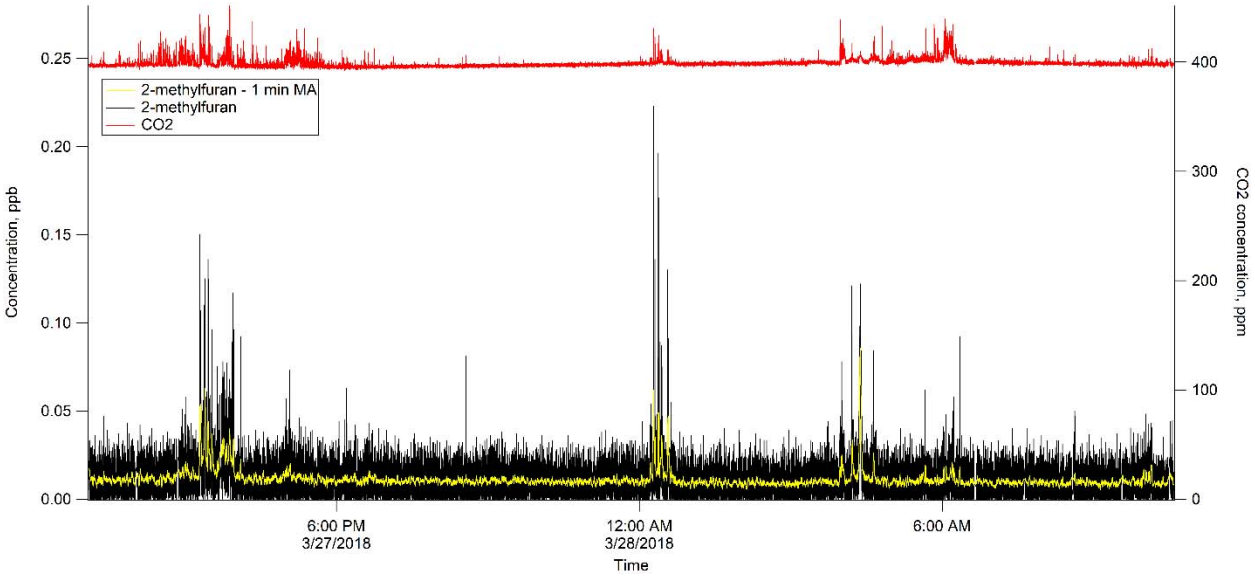


Figure 3-4. 2-methylfuran.

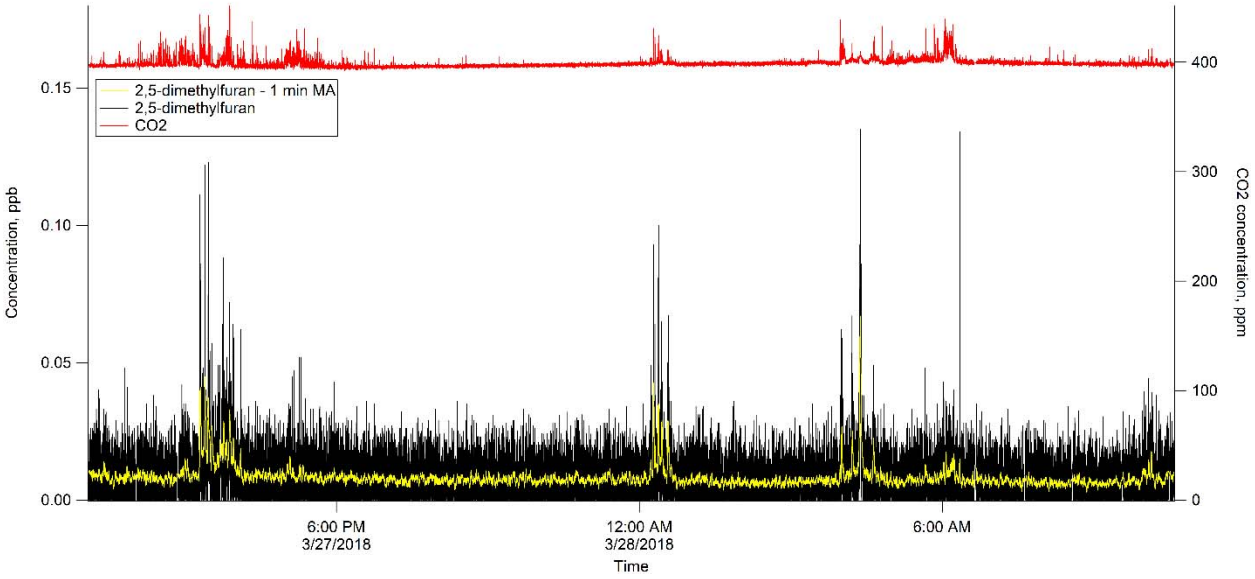


Figure 3-5. 2,5-dimethylfuran.

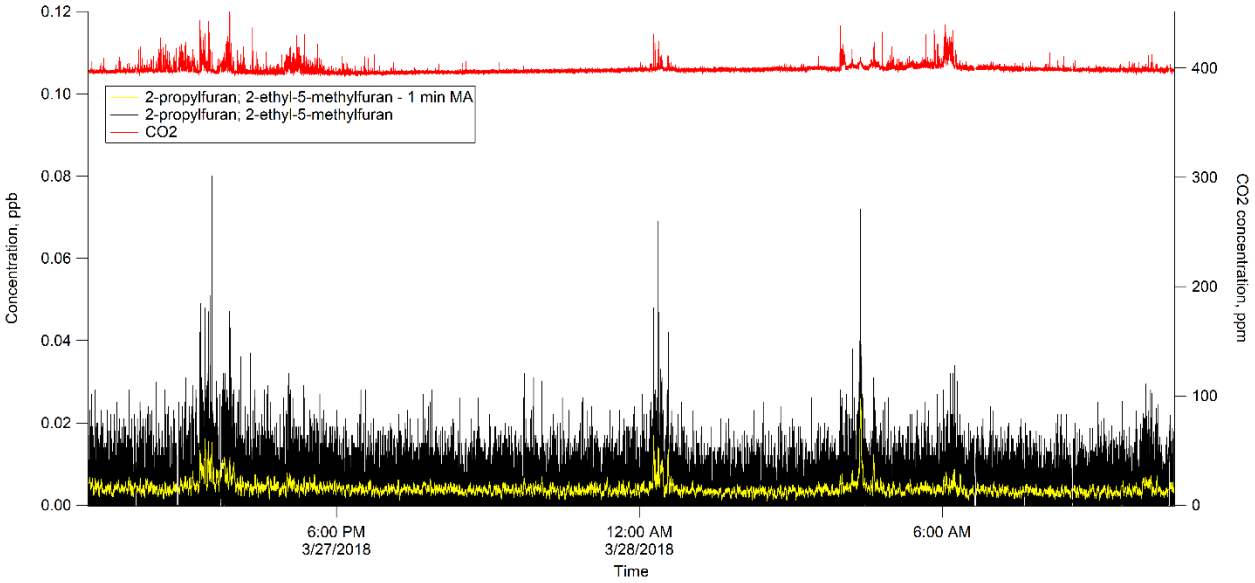


Figure 3-6. 2-propylfuran + 2-ethyl-5-methylfuran.

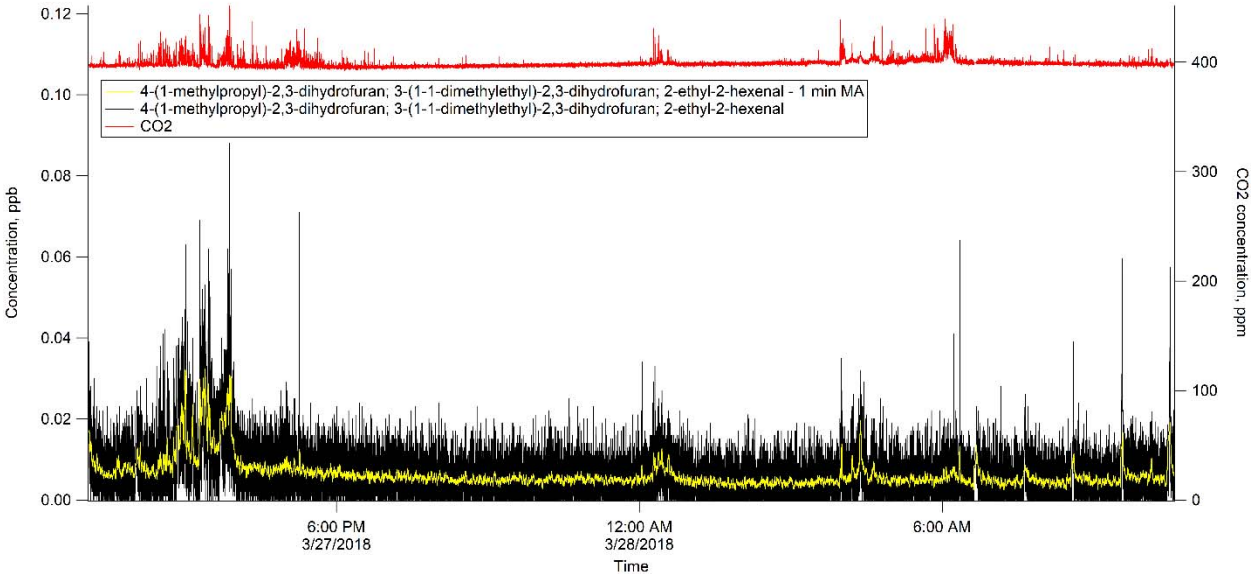


Figure 3-7. 4-(1-methylpropyl)-2,3-dihydrofuran + 3-(1-1-dimethylethyl)-2,3-dihydrofuran + 2-ethyl-2-hexenal.

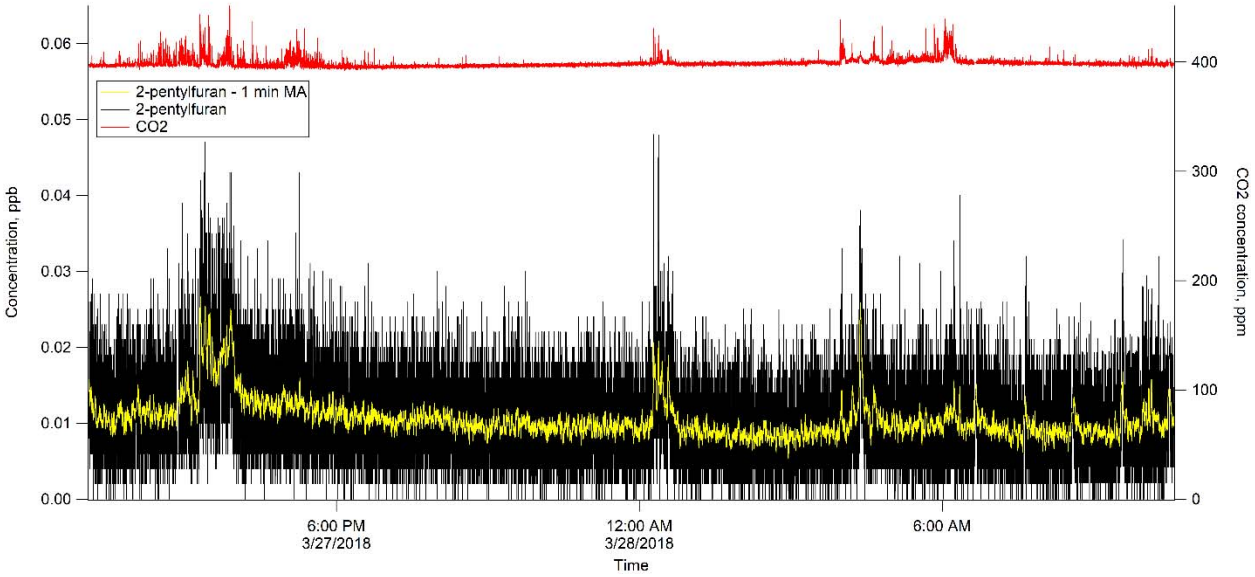


Figure 3-8. 2-pentylfuran.

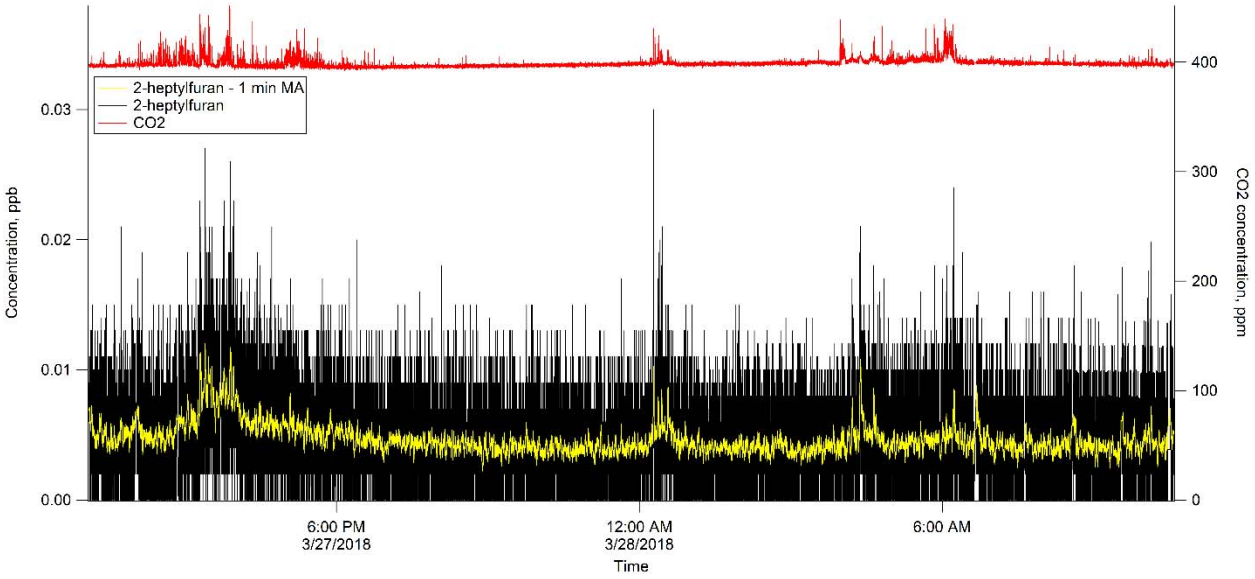


Figure 3-9. 2-heptylfuran.

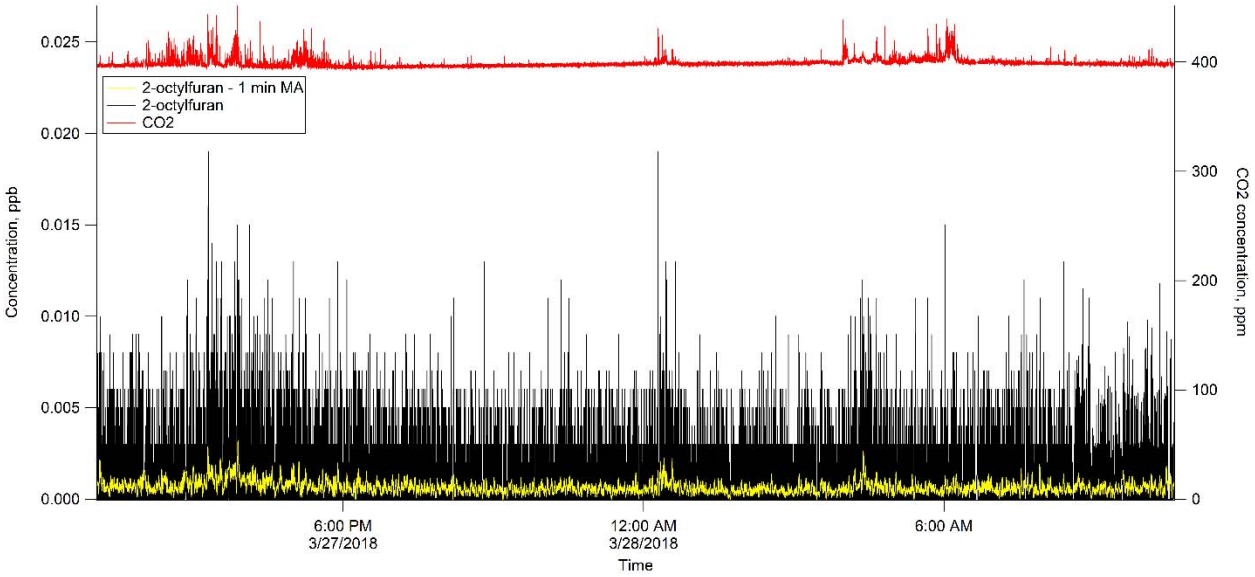


Figure 3-10. 2-octylfuran.

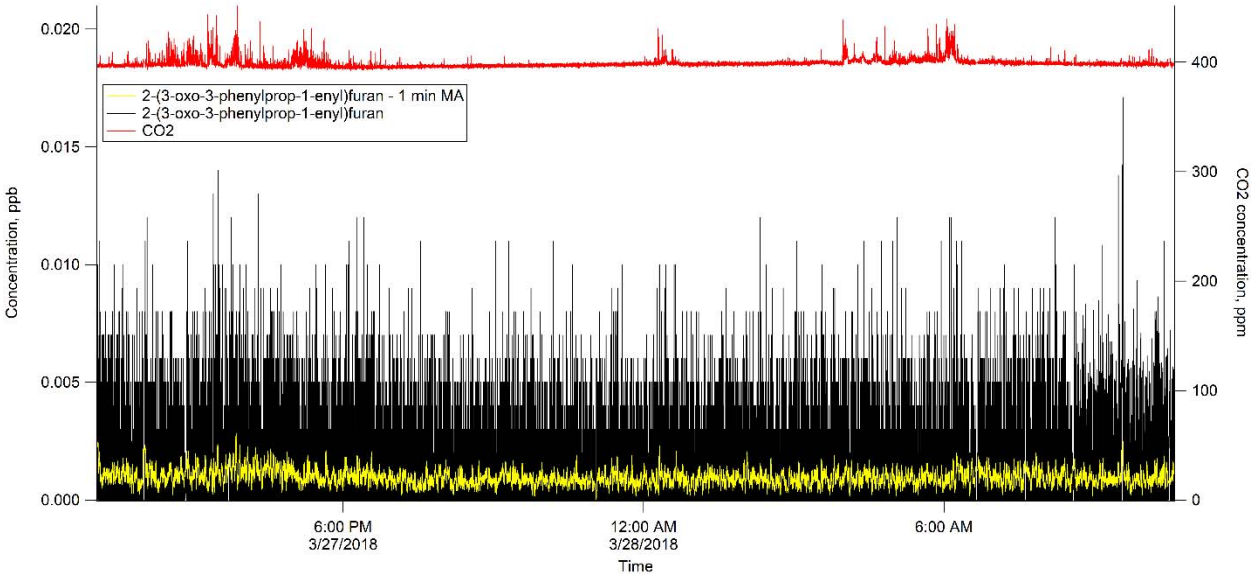


Figure 3-11. 2-(3-oxo-3-phenylprop-1-enyl)furan.

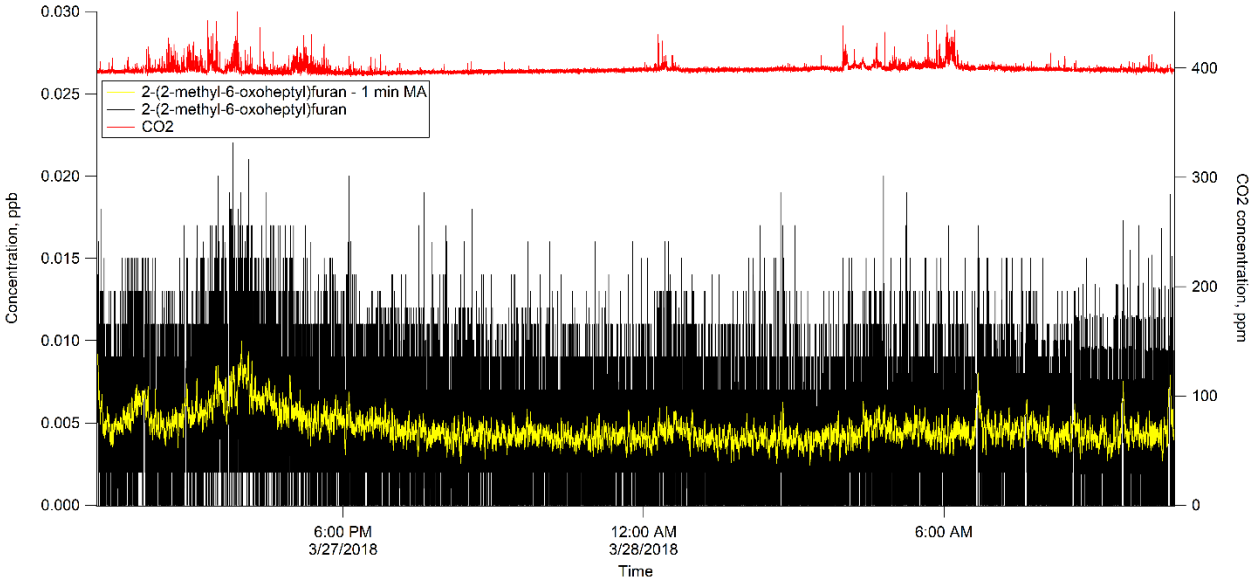


Figure 3-12. 2-(2-methyl-6-oxoheptyl)furan.

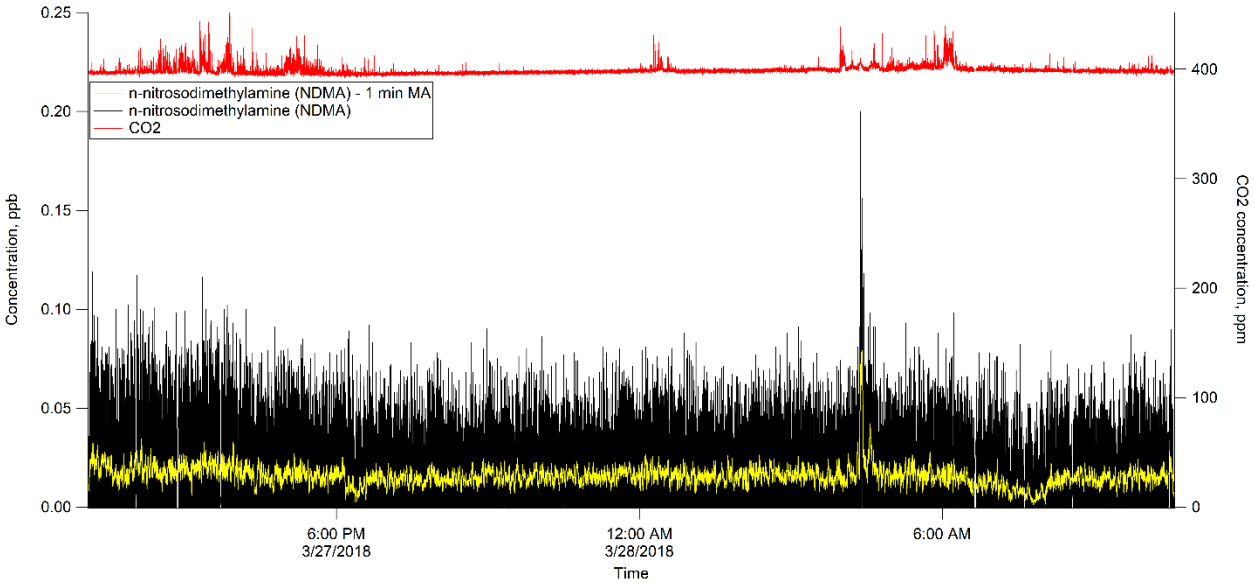


Figure 3-13. N-nitrosodimethylamine (NDMA).

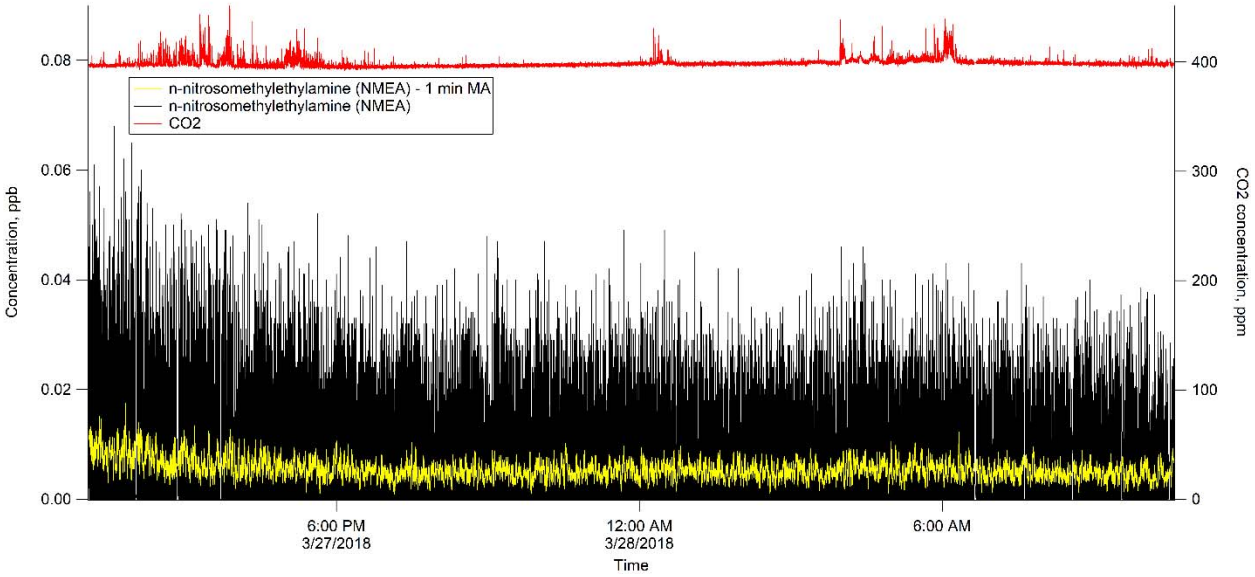


Figure 3-14. N-nitrosomethylethylamine (NMEA).

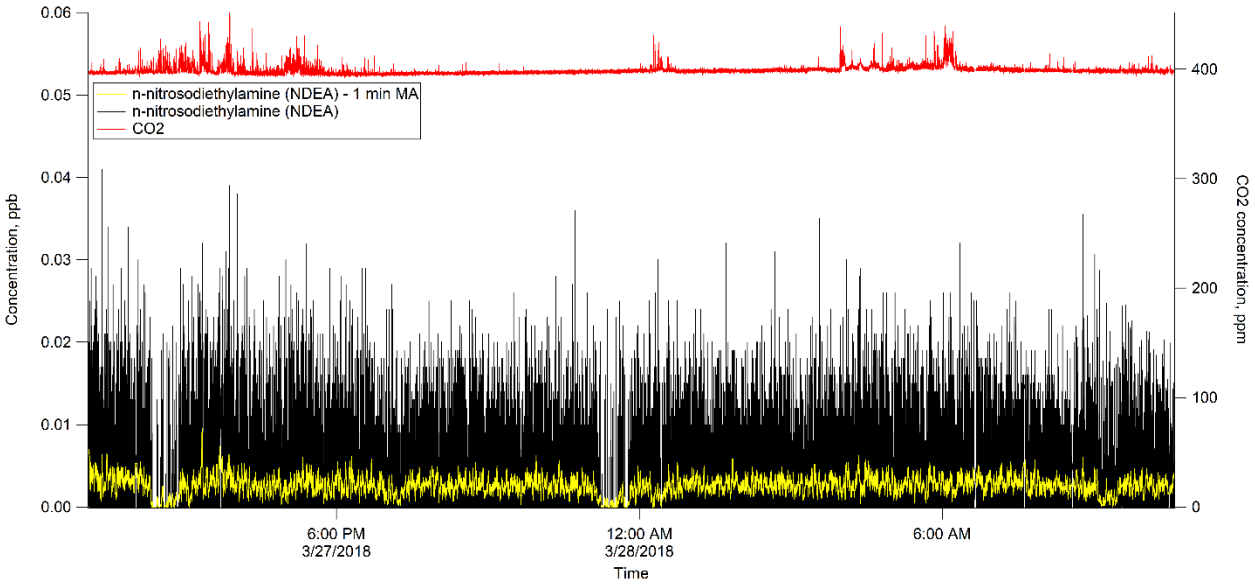


Figure 3-15. N-nitrosodiethylamine (NDEA).

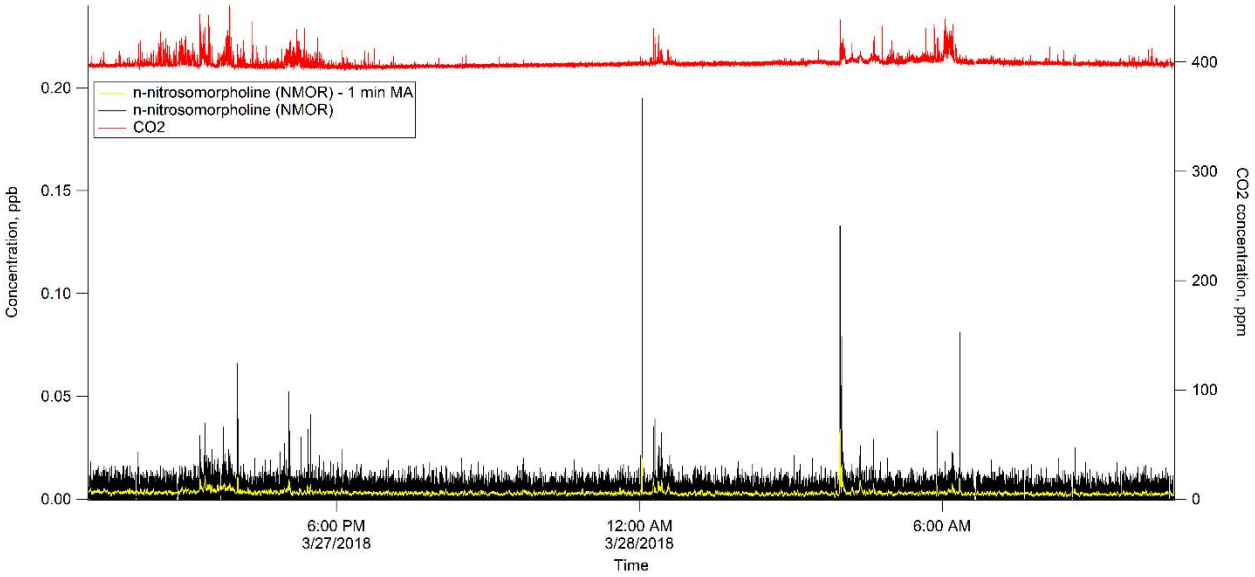


Figure 3-16. N-nitrosomorpholine (NMOR).

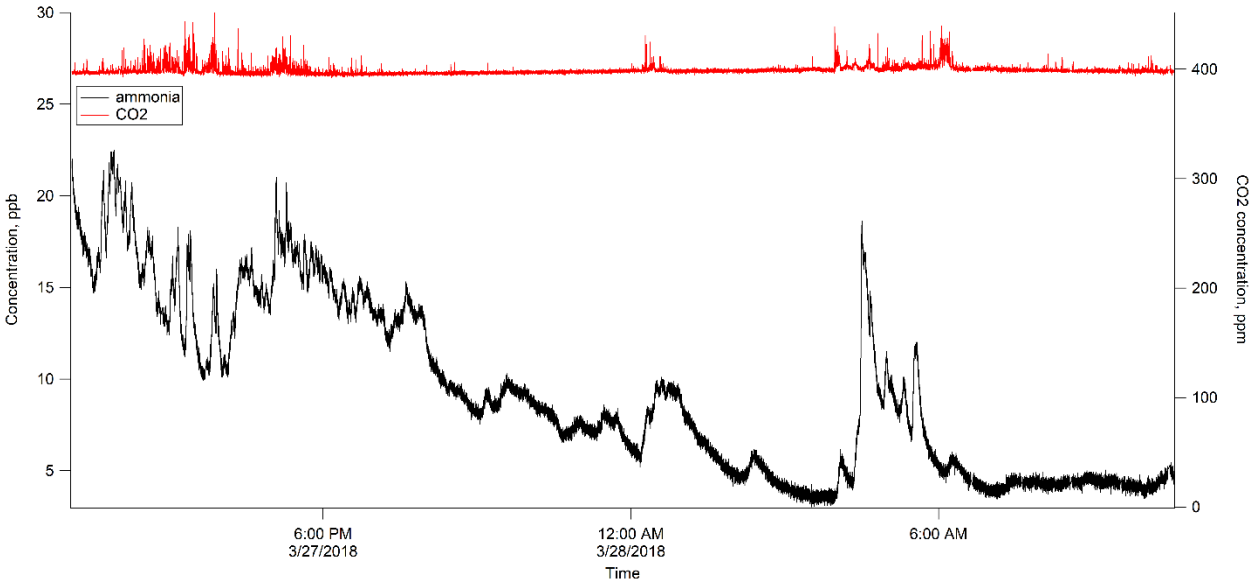


Figure 3-17. Ammonia.

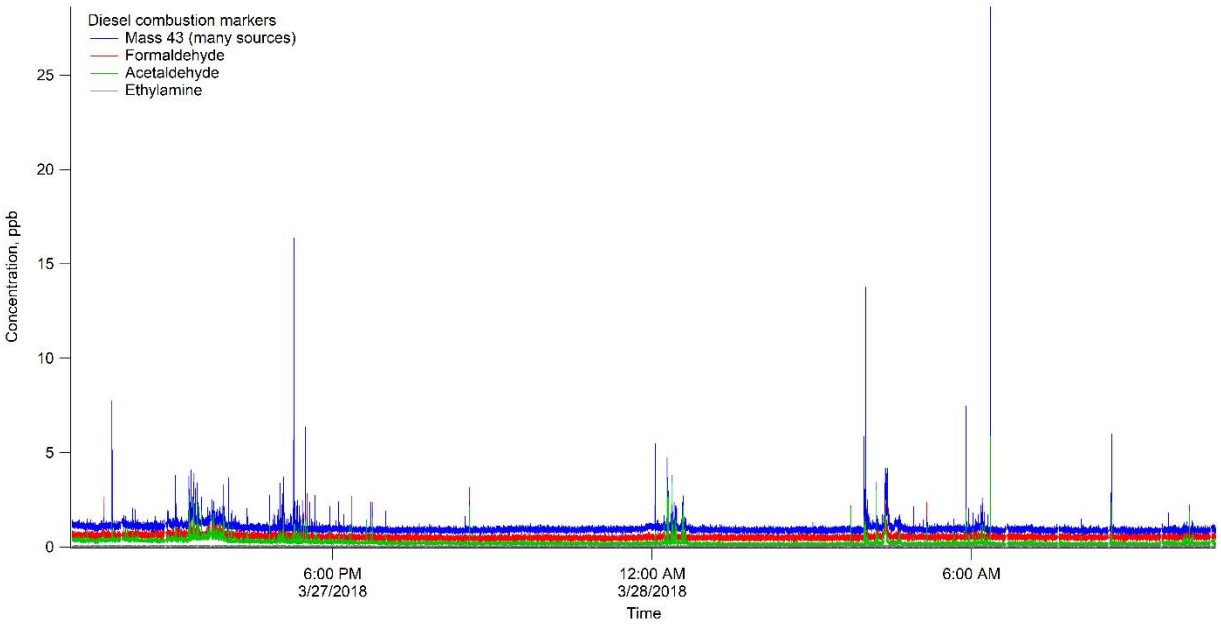


Figure 3-18. Diesel Combustion Markers.

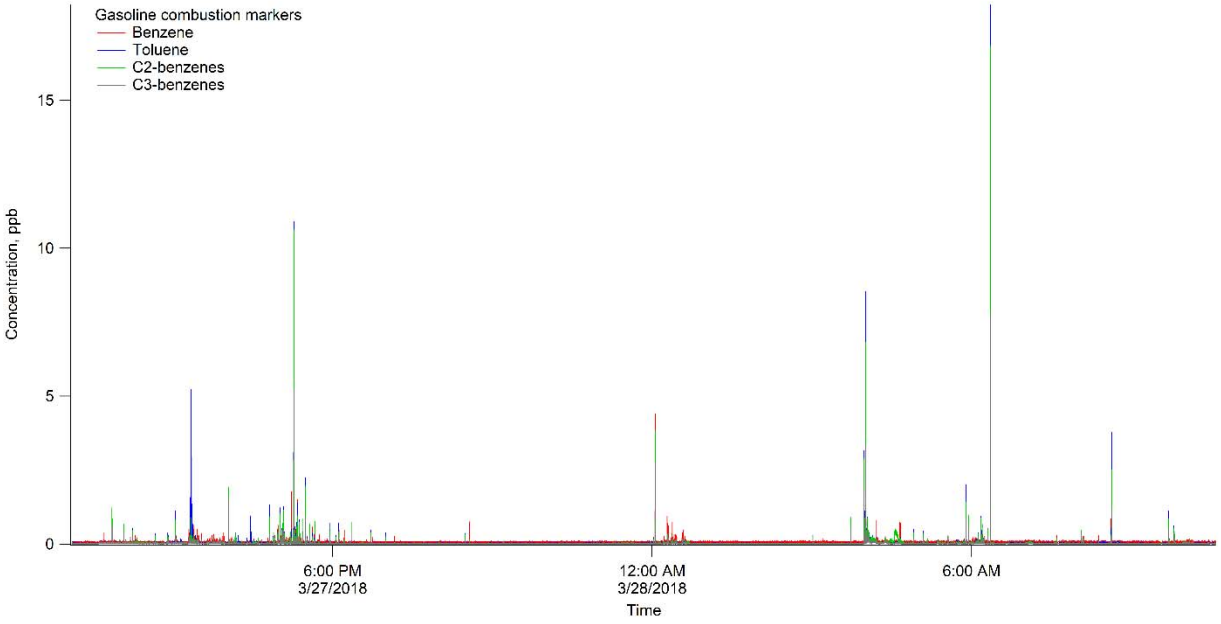


Figure 3-19. Gasoline Combustion Markers.

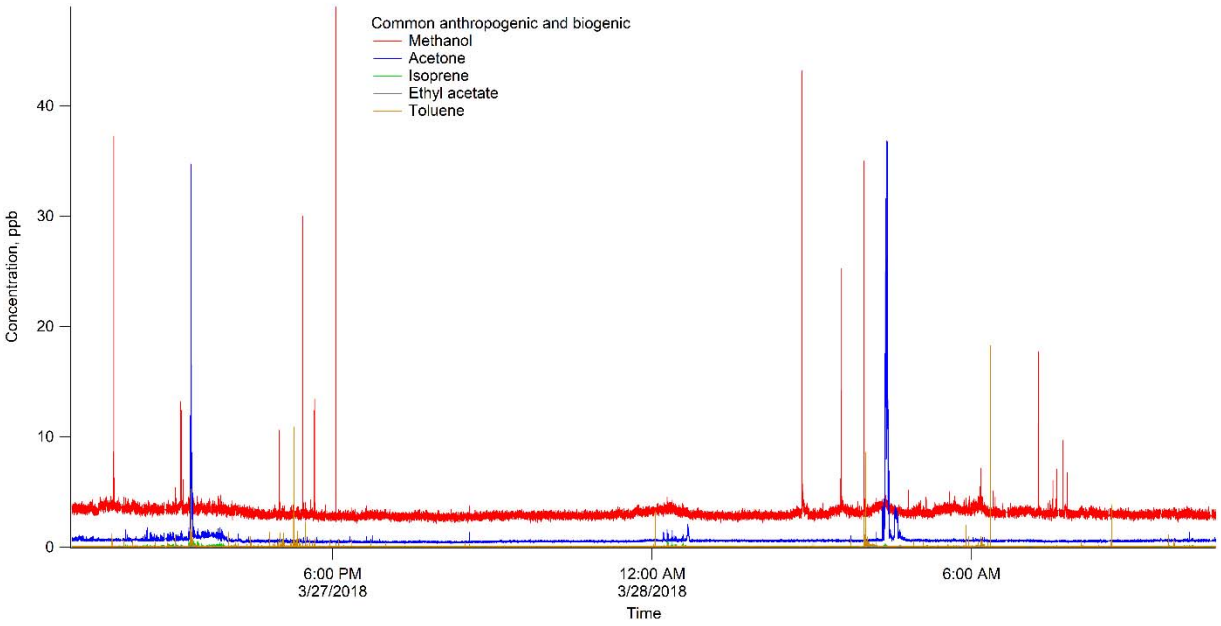


Figure 3-20. Plant and Human Markers.

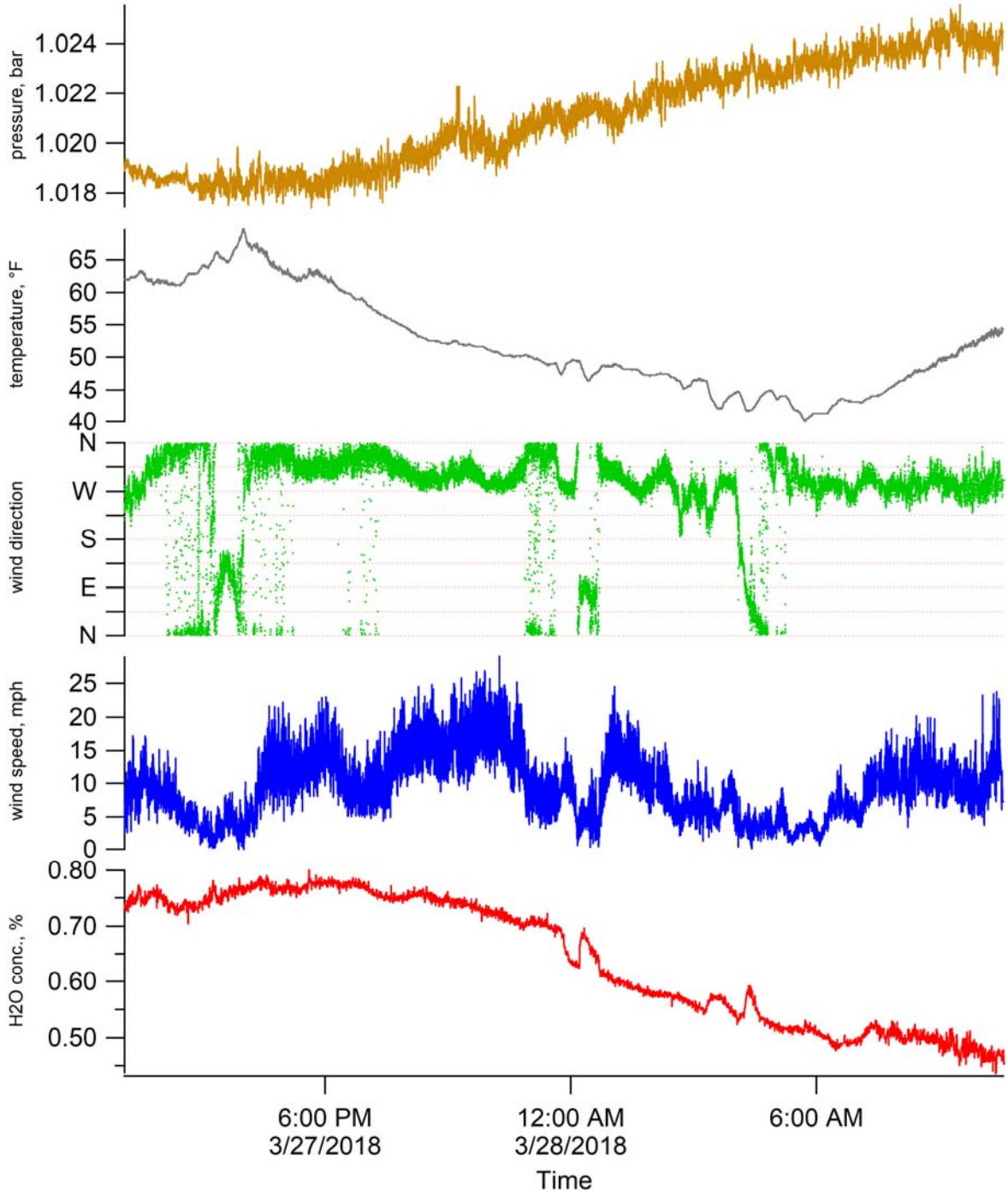


Figure 3-21. Weather Data.

4.0 MARCH 28, 2018 – MARCH 29, 2018 – STUDY SITE #6

4.1 Quality Assessment

Data from March 28, 2018, were transferred to TerraGraphics via the WRPS FTP site on April 2, 2018. Data were assessed using Procedure 17124-DOE-HS-102. A completed Data Exchange Checklist was sent to WRPS on April 4, 2018. The data were accepted by TerraGraphics with the following comments. All startup, shutdown, and calibration procedures were adequately documented and all other checks passed the acceptance limits.

4.2 Summary

Krystin Riha, Robert White, and Adrielle Olson performed background sampling using the Mobile Laboratory from March 28, 2018, to March 29, 2018, at Study Site 6. Site 6 is located near the intersection of US Highway 395 and Clearwater Avenue in Kennewick, WA. It is represented by heavy traffic patterns of mixed vehicle types and light commercial activity including a variety of eating establishments. The Mobile Laboratory arrived at Site 6 at 11:03 on March 28, 2018. The initial QA/QC zero air/sensitivity checks were performed on the CO_2 monitor, NH_3 monitor, and the PTR-MS beginning at 12:30. Routine data collection resumed by 13:20. The Mobile Laboratory staff departed the monitoring site after performing the final PTR-MS zero air check for the evening at 15:26.

The Mobile Laboratory staff had returned to Site 6 and performed a PTR-MS zero air check by 06:10 on March 29, 2018. Closeout zero air/sensitivity checks were performed at 10:34.

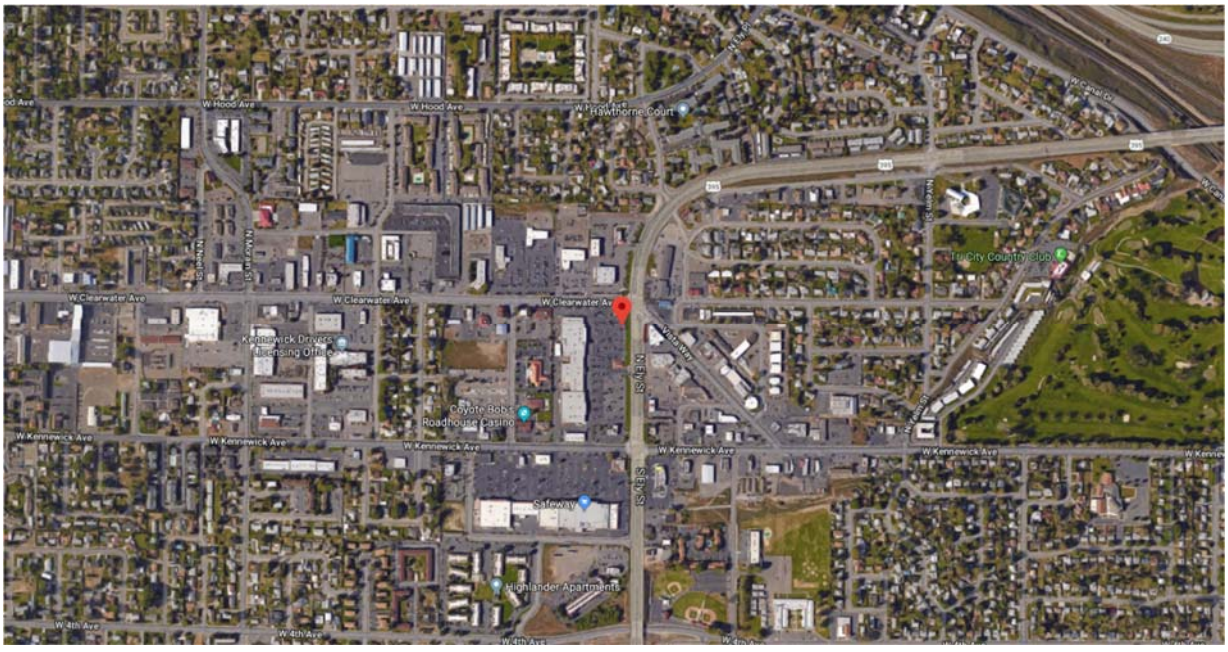


Figure 4-1. Mobile Laboratory Site #6 for the Duration of the Monitoring Period.

4.3 Samples Collected

Continuous air monitoring was performed using the following instrumentation:

- PTR-MS,
- LI-COR CO_2 Monitor,
- Picarro Ammonia Monitor, and
- Weather Station.

Confirmatory air samples were collected as follows.

Table 4-1. Alternative Media Samples Taken.

Site	Date	Sample Type	ID	Start	Stop	Sample Time (min)
6	28-Mar	Thermosorb/N	EL22198	12:37	15:38	181
6	28-Mar	CarboTrap-300	A021301	12:40	13:51	71
6	29-Mar	Thermosorb/N	EL22182	06:22	09:23	180
6	29-Mar	CarboTrap-300	A048105	06:25	07:37	71

Table 4-2 displays the statistical information for the monitoring period of March 28, 2018, to March 29, 2018. By definition, the OEL is an 8-hour, time-weighted average that establishes a limit for personnel exposures to hazardous chemicals. It is the exposure level to which a person may be exposed for 8 hours/day, 40 hours/week for 40 years and have no expectation of adverse health effects. In this study, area vapor concentration measurements were made to better understand the hazardous vapor exposures that workers may receive. These measurements are only compared to OEL concentrations to give them context. It is neither accurate nor appropriate to interpret these short duration measurements (2 seconds) as worker exposures levels. Since the OEL is defined as a time-weighted average, it is more appropriate to compare them to daily average vapor concentrations. Short duration excursions above the OEL concentration are not significant.

Table 4-2. Statistical Information for the Monitoring Period of March 28, 2018 – March 29, 2018.

COPC #	COPC Name	Reporting Limit (ppb)	OEL (ppb)	Ave. (ppb)	St. Dev. (ppb)	Rel. St. Dev. (%)	Max (ppb)	Median (ppb)	Sec. over 50% OEL	Sec. over OEL
1	ammonia	1	25000	8.13	2.076	25.5%	18.96	7.35	0	0
2	furan	0.09	1	0.045	0.016	80.4%	0.306	0.018	0	0
3	but-3-en-2-one + 2,3-dihydrofuran + 2,5-dihydrofuran	0.22	1	0.112	0.058	182.7%	N/A*	N/A*	N/A	N/A
4	NDMA**	0.06	0.3	0.036	0.028	105.2%	0.374	0.020	144	4
5	2-methylfuran	0.05	1	0.028	0.020	95.6%	0.475	0.017	0	0
6	NEMA	0.02	0.3	0.014	0.014	156.2%	0.107	0.000	0	0
7	2,5-dimethylfuran	0.05	1	0.026	0.014	94.5%	0.389	0.013	0	0
8	NDEA	0.01	0.1	0.007	0.006	192.0%	0.047	0.000	0	0
9	2-propylfuran + 2-ethyl-5-methylfuran	0.02	1	0.012	0.009	113.7%	0.194	0.006	0	0
10	NMOR	0.05	0.6	0.025	0.010	175.3%	0.703	0.004	12	4
11	2-ethyl-2-hexenal + 4-(1-methylpropyl)-2,3-dihydrofuran + 3-(1,1-dimethylethyl)-2,3-dihydrofuran	0.04	1	0.020	0.007	66.5%	0.196	0.010	0	0
12	2-pentylfuran	0.04	1	0.020	0.008	46.7%	0.305	0.016	0	0
13	2-heptylfuran	0.02	1	0.010	0.004	59.8%	0.063	0.006	0	0
14	2-octylfuran	0.01	1	0.005	0.002	209.6%	0.020	0.000	0	0
15	6-(2-furanyl)-6-methyl-2-heptanone	0.01	1	0.005	0.002	161.9%	0.017	0.000	0	0
16	furfural acetophenone	0.07	1	0.035	0.003	57.7%	0.026	0.005	0	0

* The maximum peak value for but-3-en-2-one + 2,3 dihydrofuran + 2,5 dihydrofuran was 4.279 ppb and the median value was 0.025 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 200, 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 each COPC signal, overlaid with the same signal smoothed using a 1-minute moving average, and CO_2, for the monitoring period March 28, 2018 to March 29, 2018.

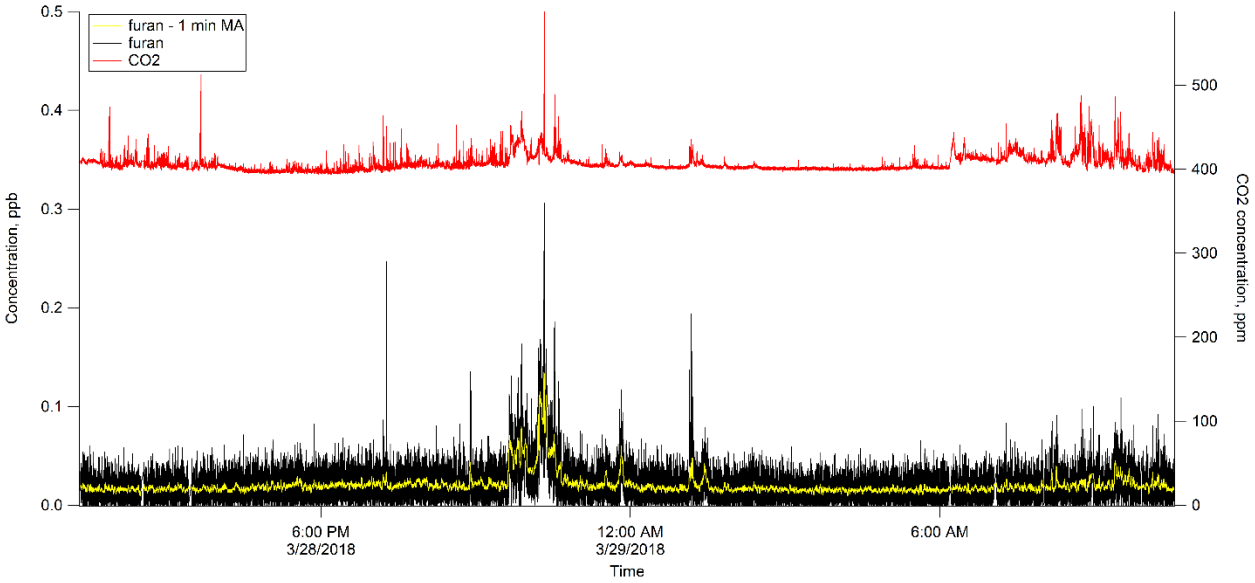


Figure 4-2. Furan.

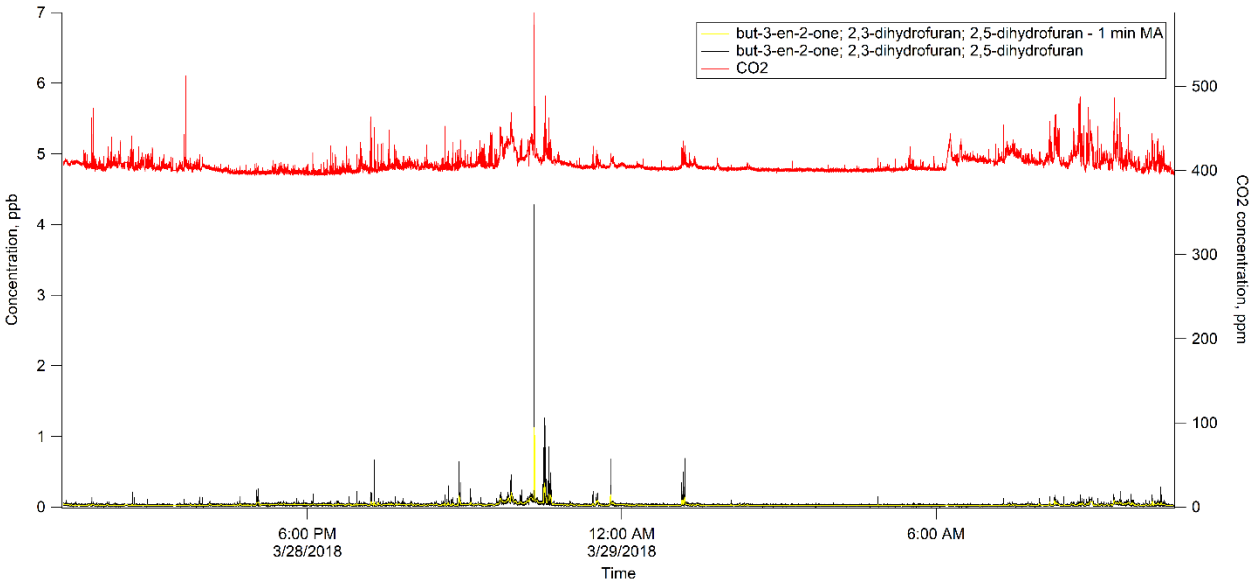


Figure 4-3. but-3-en-2-one + 2,3-dihydrofuran + 2,5-dihydrofuran.

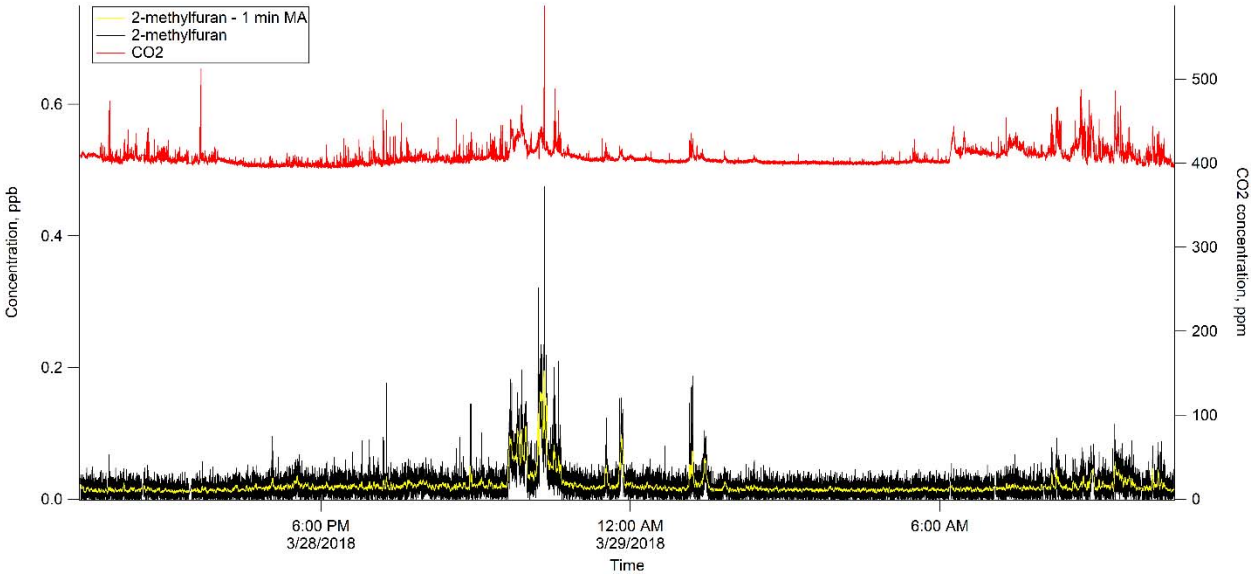


Figure 4-4. 2-methylfuran.

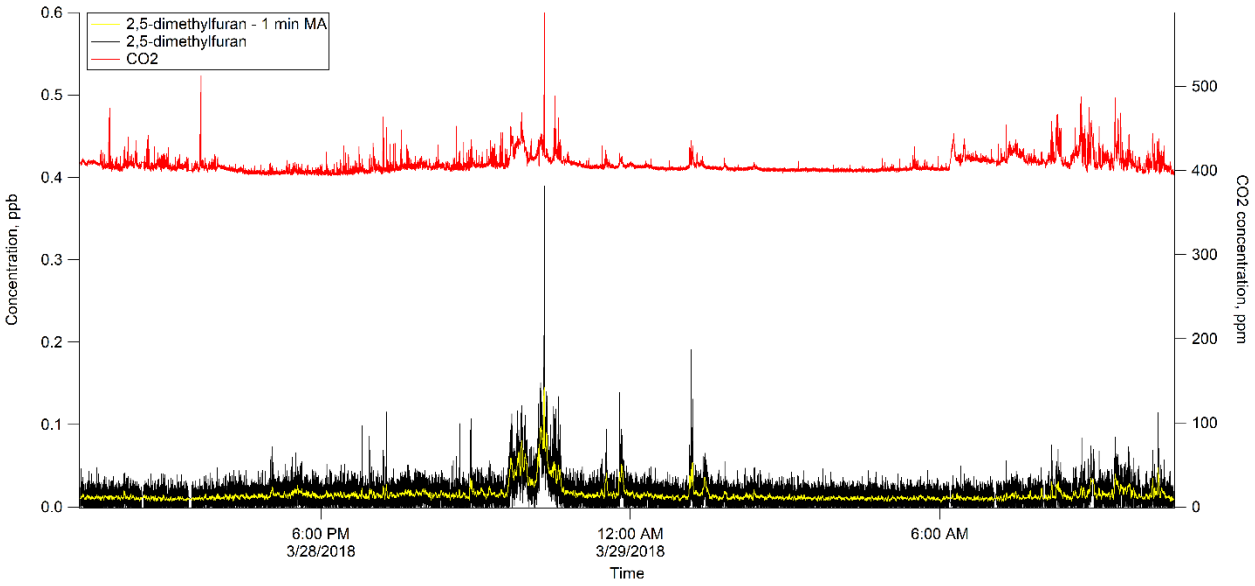


Figure 4-5. 2,5-dimethylfuran.

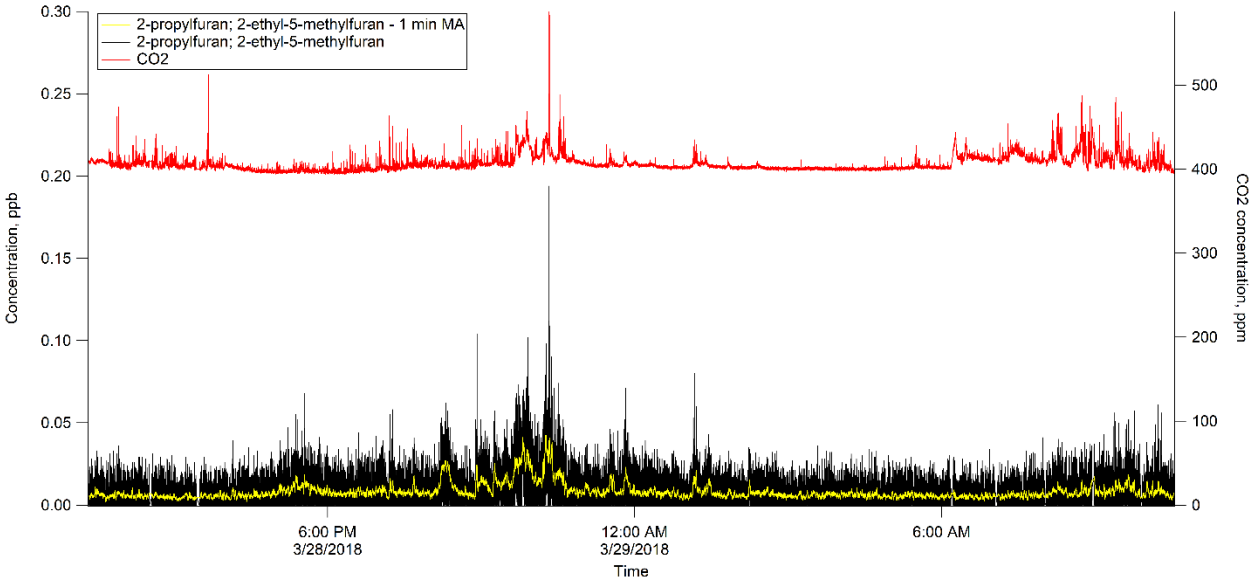


Figure 4-6. 2-propylfuran + 2-ethyl-5-methylfuran.

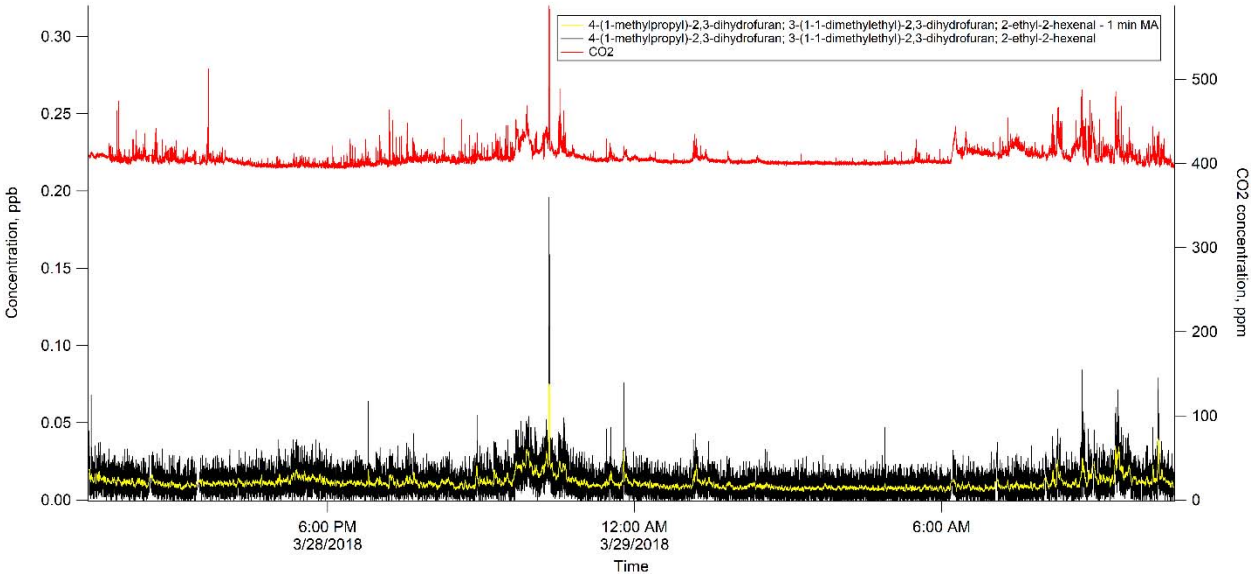


Figure 4-7. 4-(1-methylpropyl)-2,3-dihydrofuran + 3-(1-1-dimethylethyl)-2,3-dihydrofuran + 2-ethyl-2-hexenal.

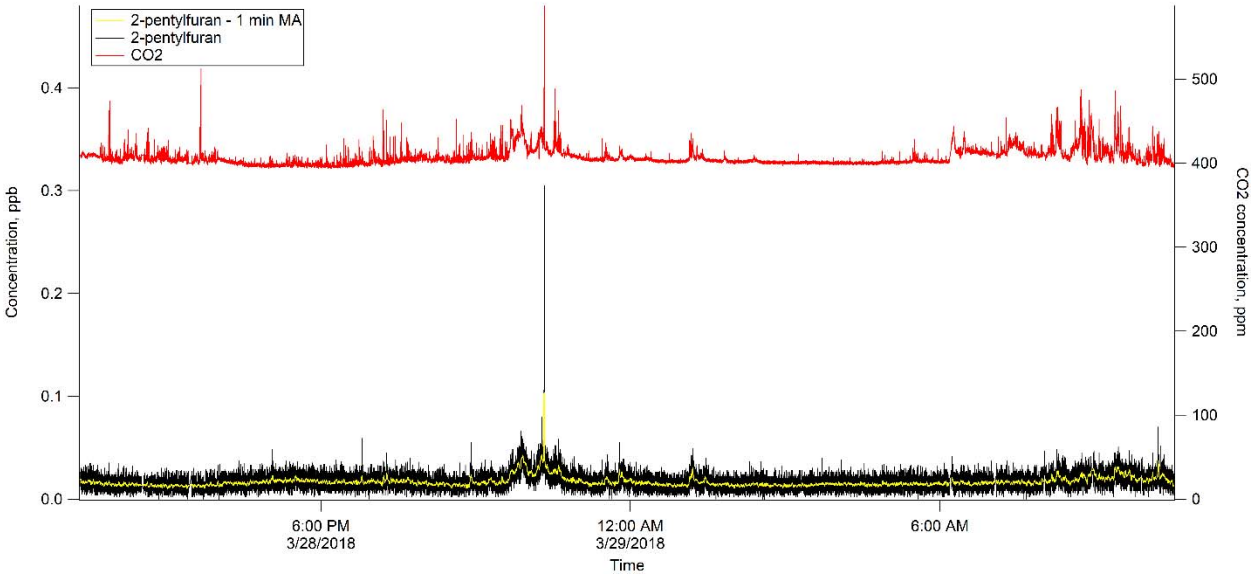


Figure 4-8. 2-pentylfuran.

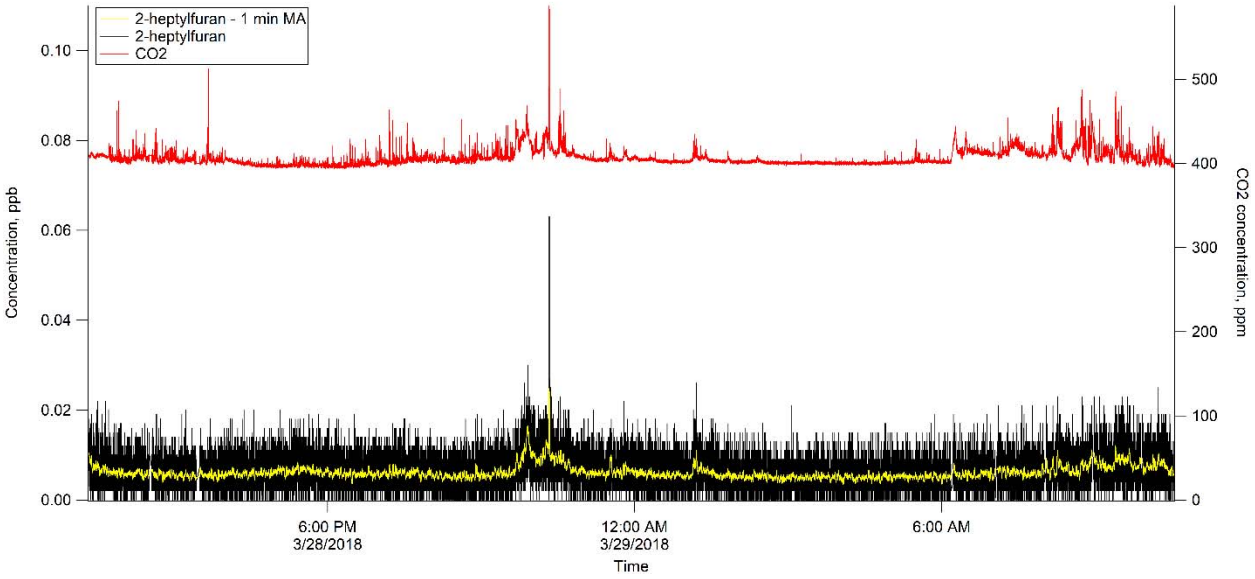


Figure 4-9. 2-heptylfuran.

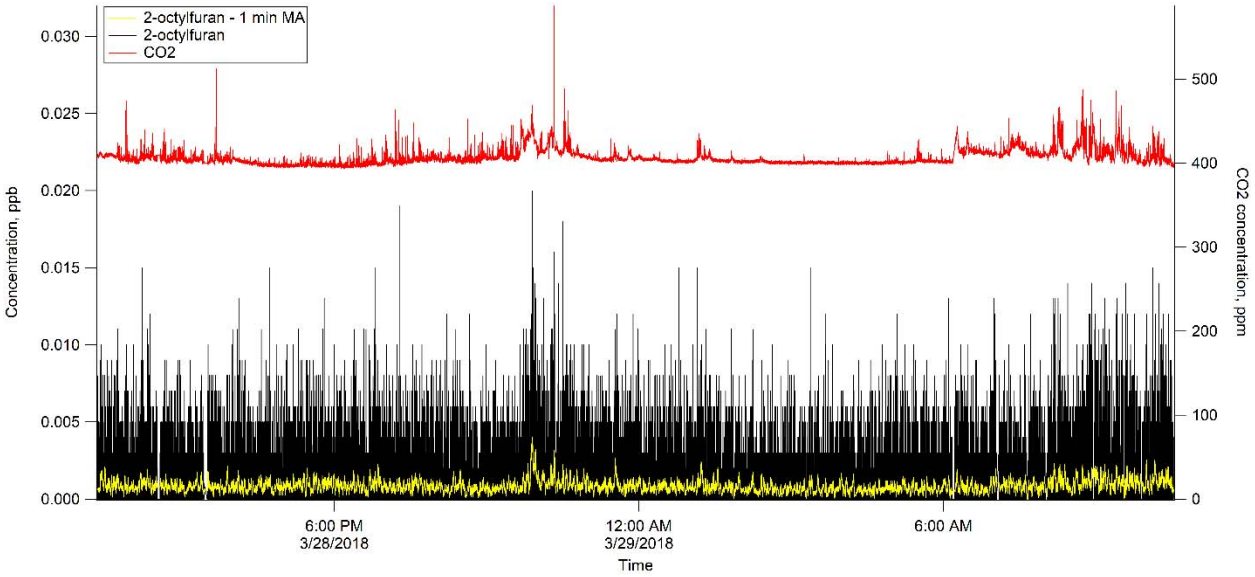


Figure 4-10. 2-octylfuran.

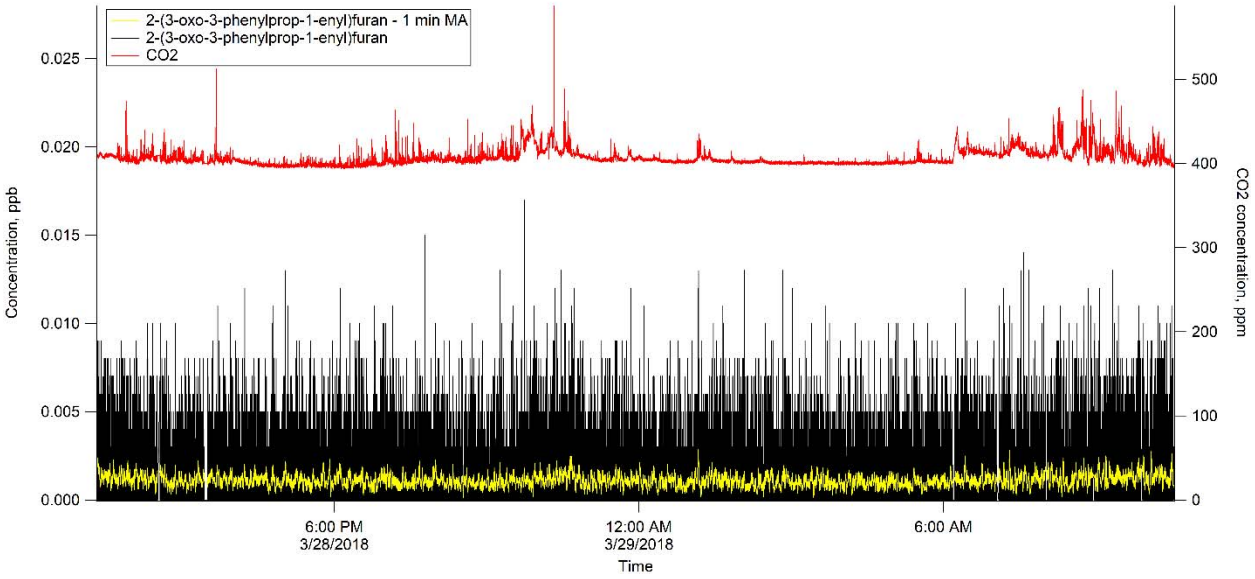


Figure 4-11. 2-(3-oxo-3-phenylprop-1-enyl)furan.

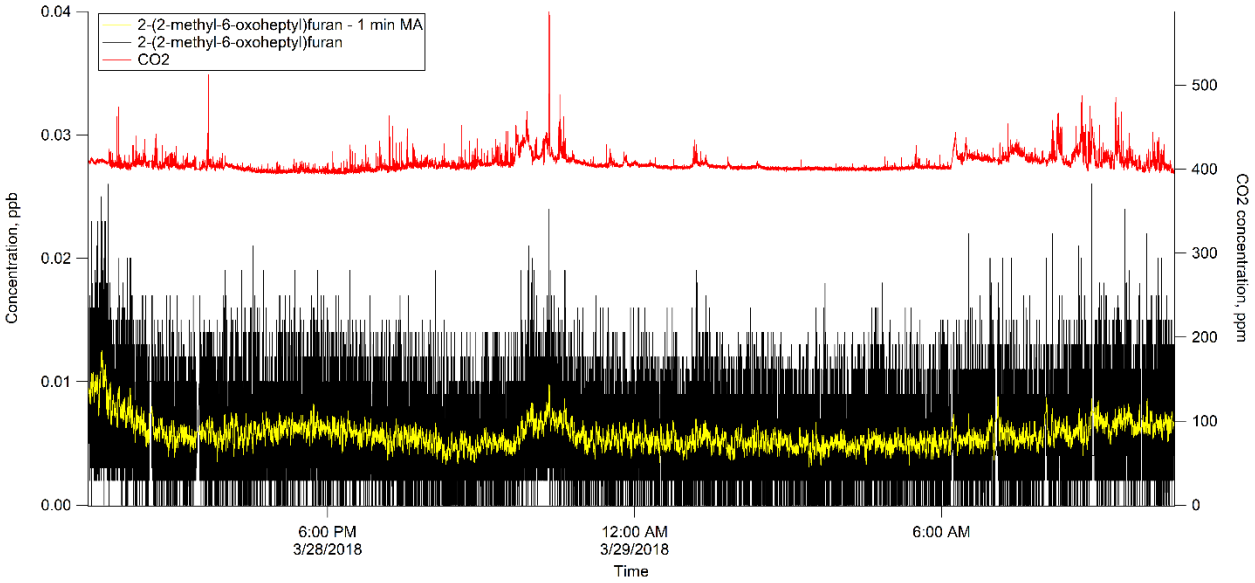


Figure 4-12. 2-(2-methyl-6-oxoheptyl)furan.

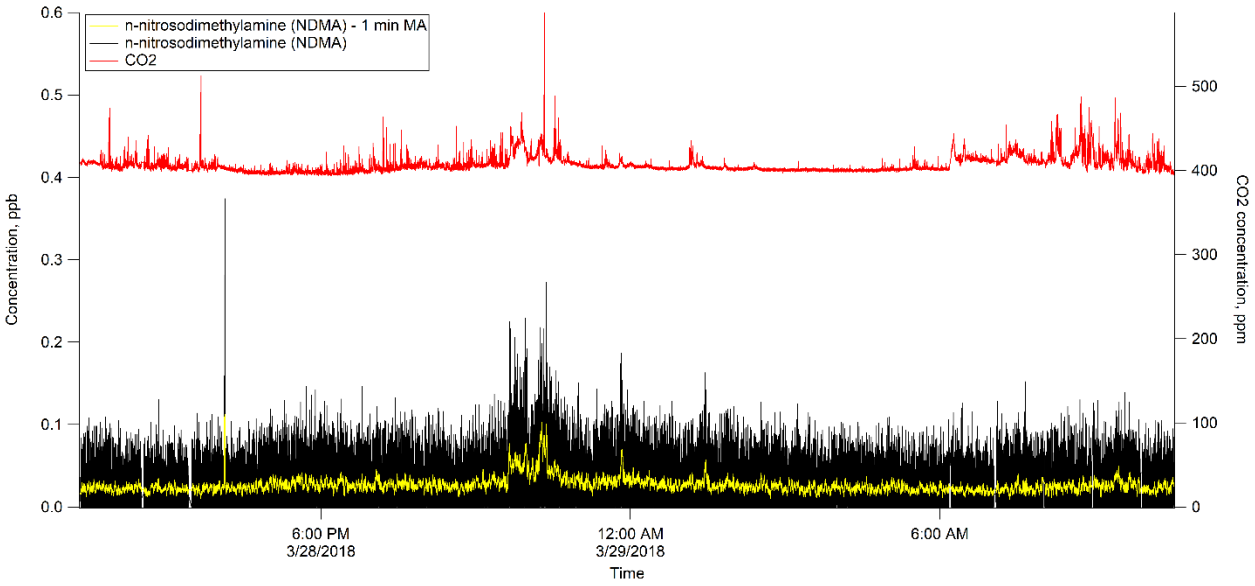


Figure 4-13. N-nitrosodimethylamine (NDMA).

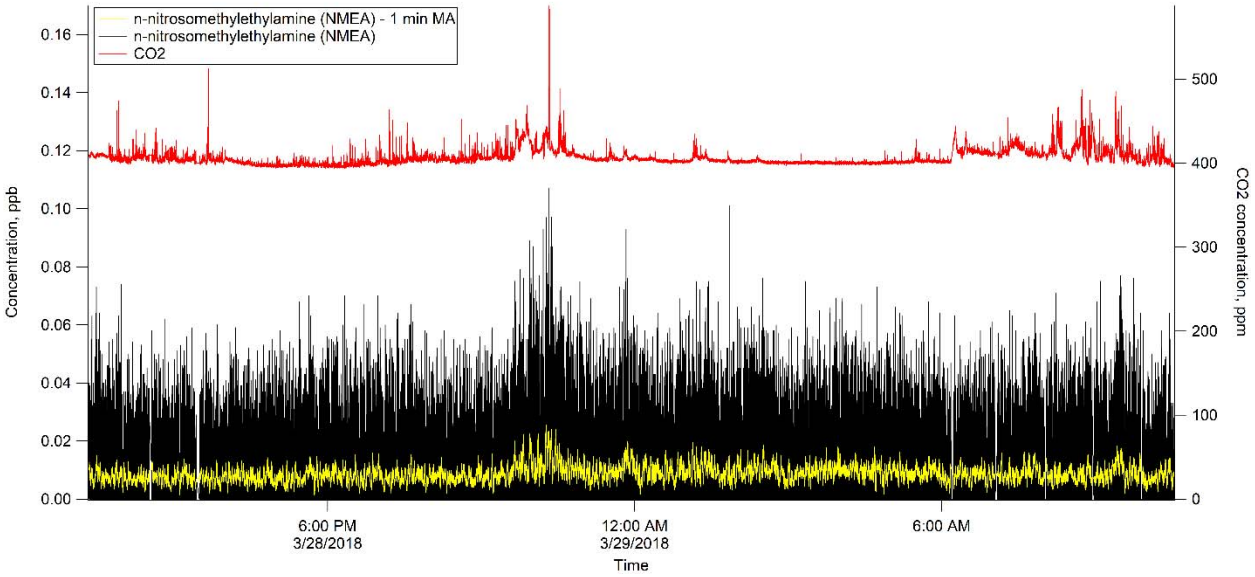


Figure 4-14. N-nitrosomethylethylamine (NMEA).

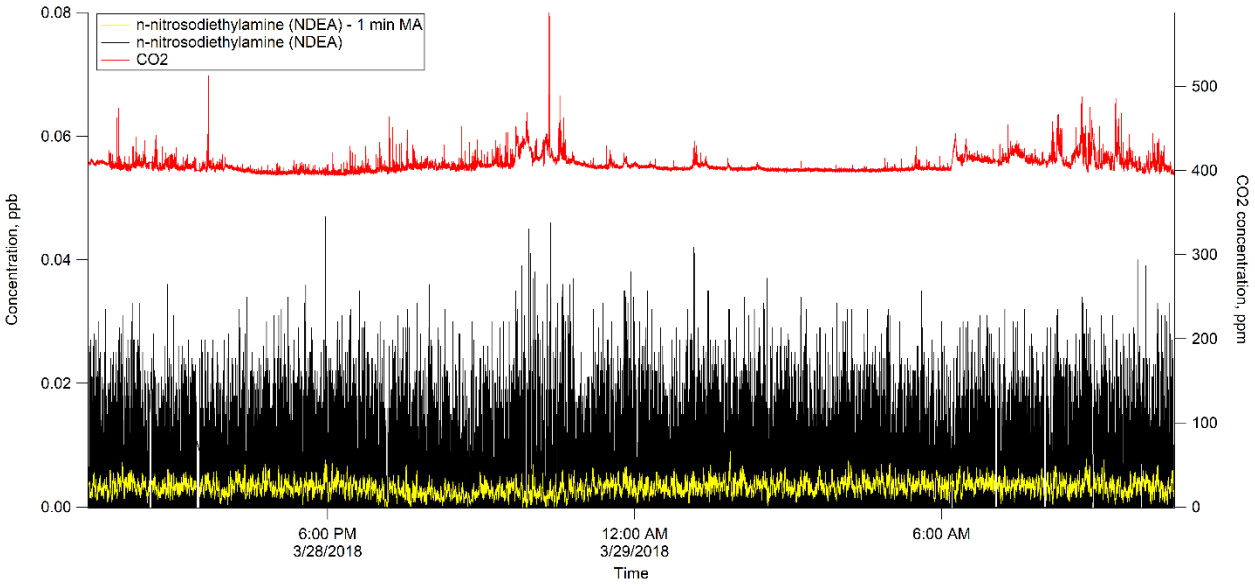


Figure 4-15. N-nitrosodiethylamine (NDEA).

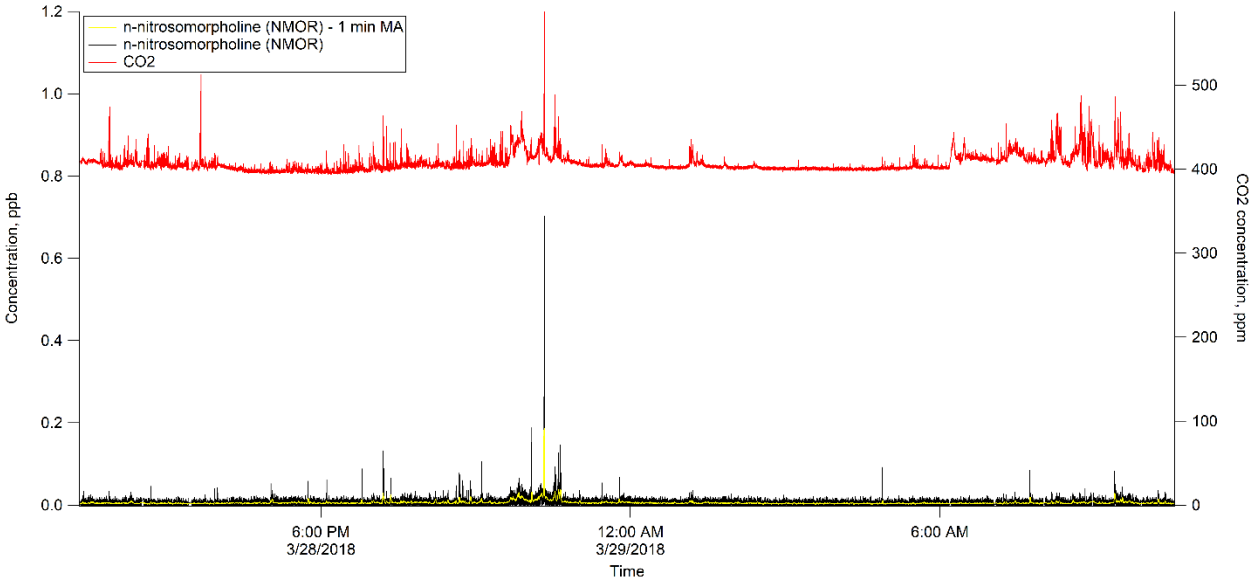


Figure 4-16. N-nitrosomorpholine (NMOR).

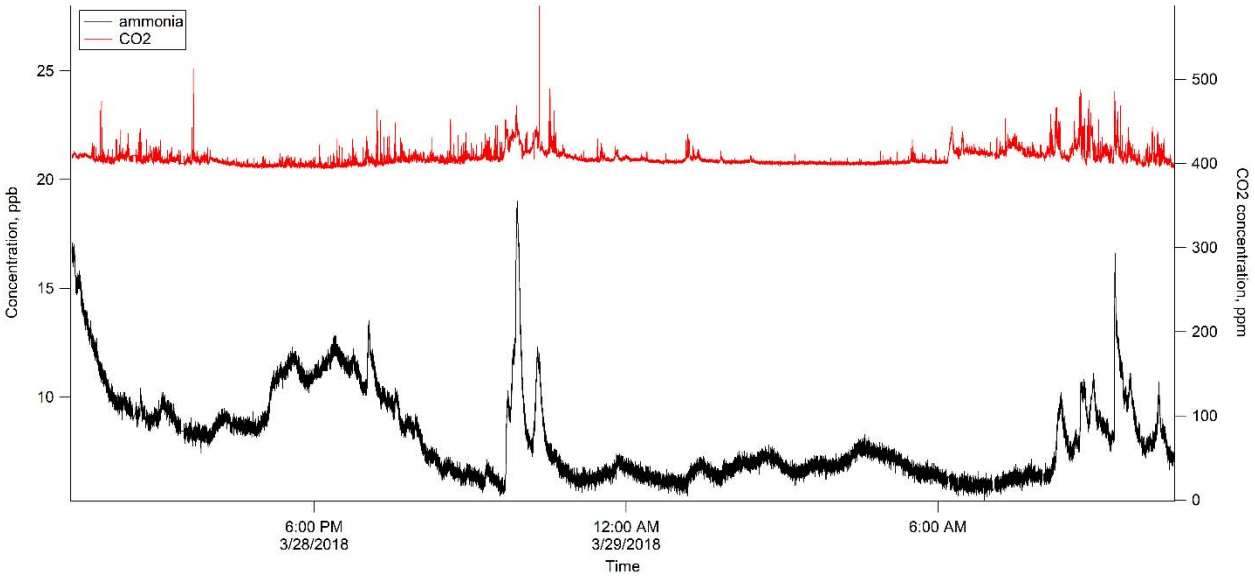


Figure 4-17. Ammonia.

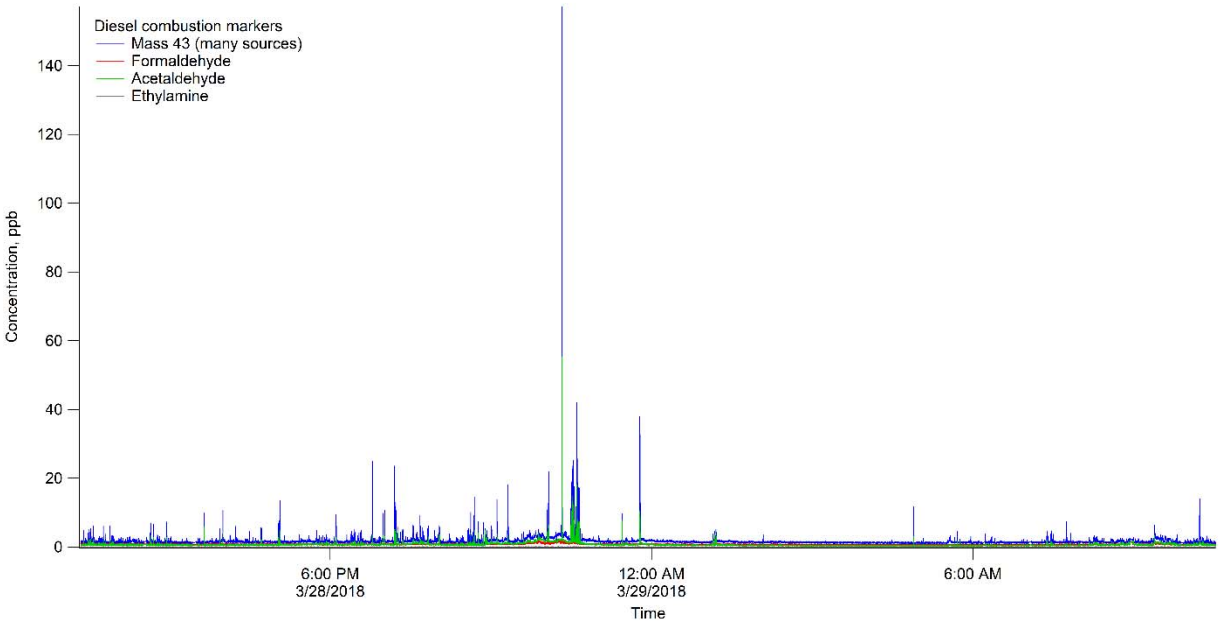


Figure 4-18. Diesel Combustion Markers.

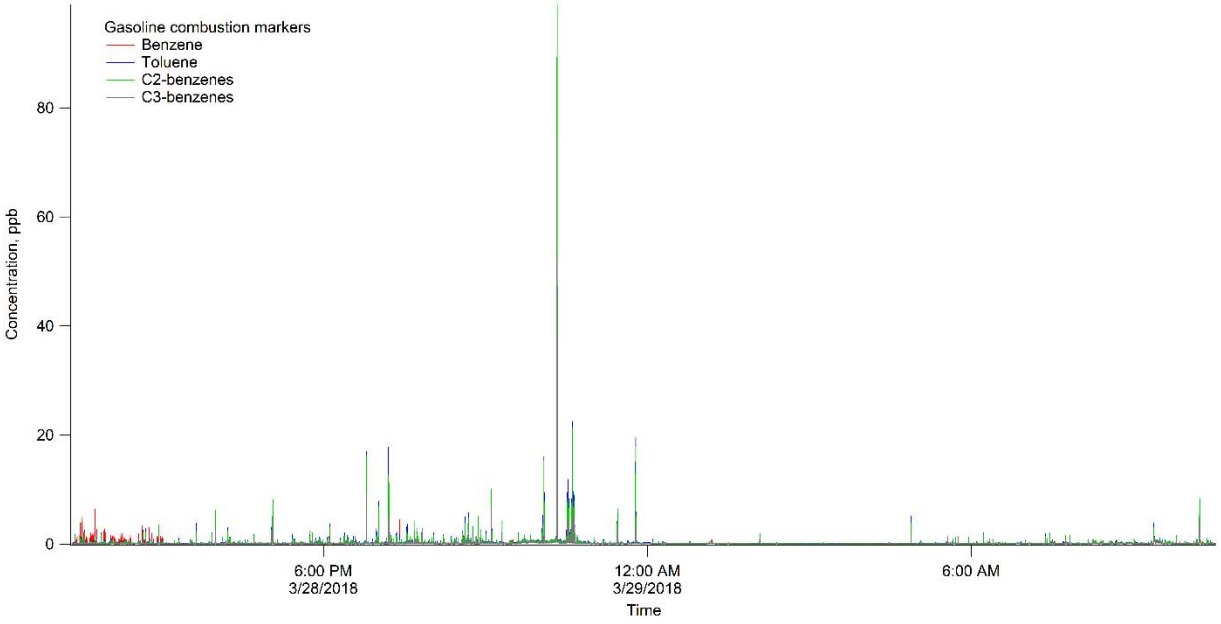


Figure 4-19. Gasoline Combustion Markers.

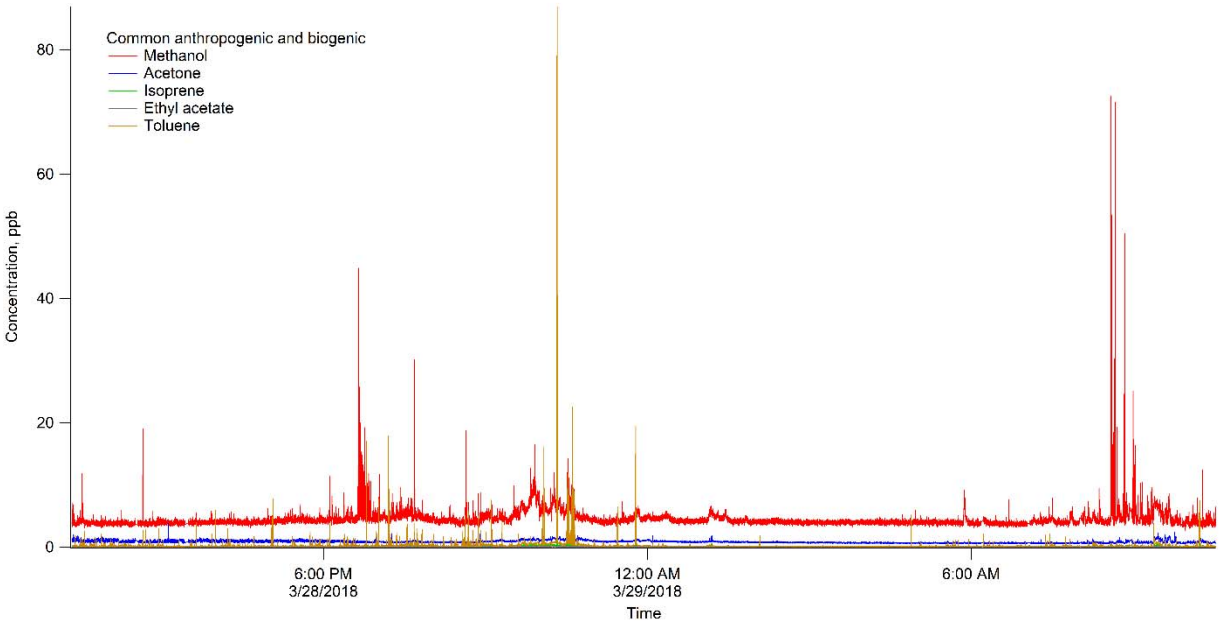


Figure 4-20. Plant and Human Markers.

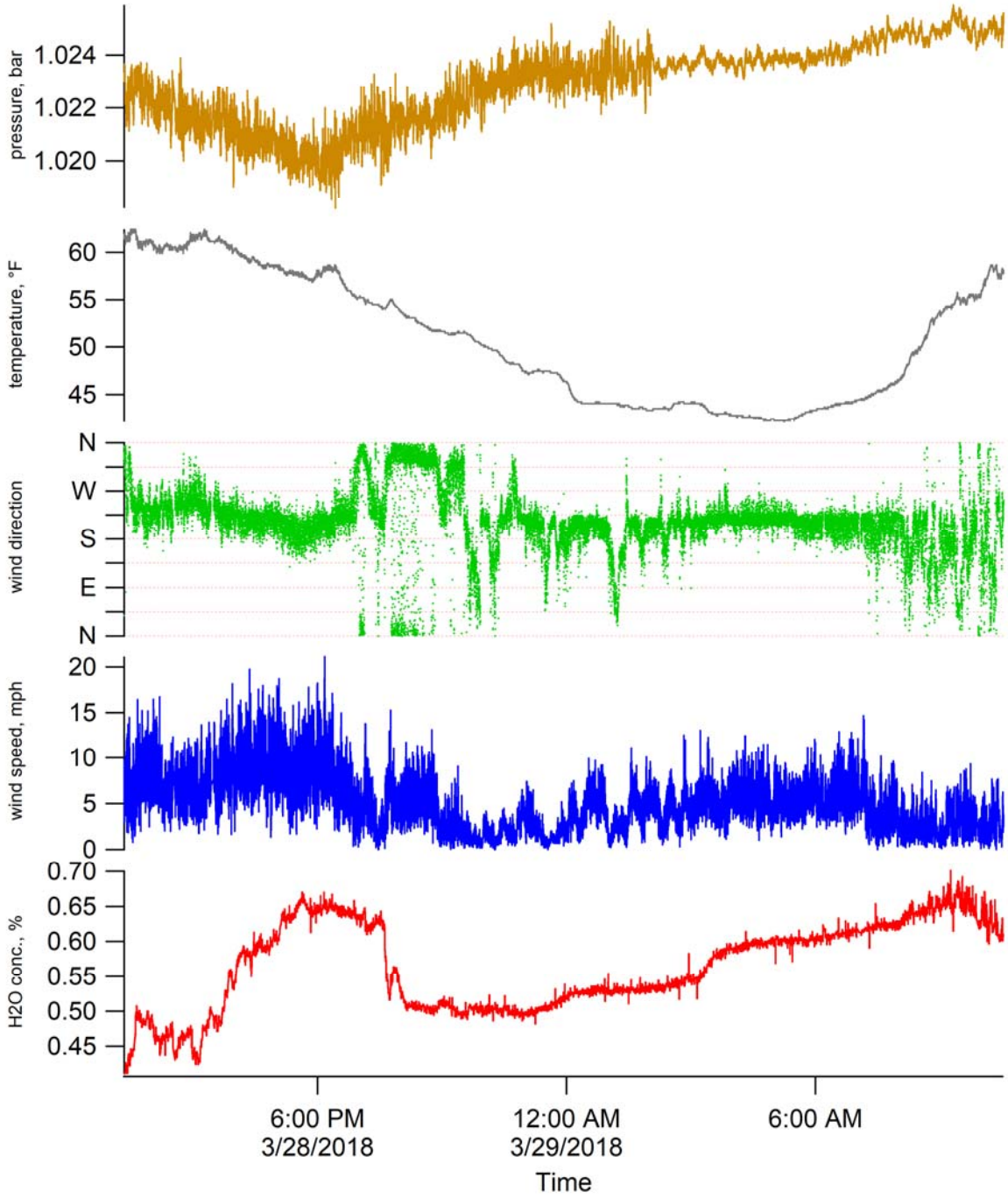


Figure 4-21. Weather Data.

5.0 REFERENCES

Procedure 17124-DOE-HS-102, 2018, "Mobile Laboratory Data Processing – Analysis," Revision 0, TerraGraphics Environmental Engineering, Inc., Pasco, Washington.

WEEKLY REPORT FOR WEEK 4
(APRIL 1, 2018 – APRIL 7, 2018)

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May 2018

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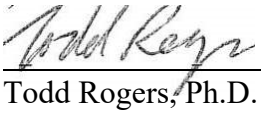
Prepared by:



Date: 5/3/2018

Matt Erickson, Ph.D.

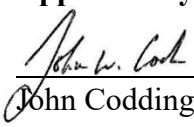
Reviewed by:



Date: 5/3/2018

Todd Rogers, Ph.D.

Approved by:



Date: 5/3/2018

John Coddington, Ph.D.

Record of Revision

Revision	Date	Pages/Sections Changed	Brief Description
0	05/2018	N/A	Initial release.

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Acronyms

CAPA	Corrective and Preventative Action
COPC	Chemical of Potential Concern
FTP	File Transfer Protocol
NDMA	N-nitrosodimethylamine
NMEA	N-nitrosomethylethylamine
NMOR	N-nitrosomorpholine
OEL	Occupational Exposure Limit
PTR-MS	Proton Transfer Reaction – Mass Spectrometer
QA	Quality Assurance
QC	Quality Control
WRPS	Washington River Protection Solutions, LLC

1.0 APRIL 7, 2018 – APRIL 8, 2018 – STUDY SITE #1

1.1 Quality Assessment

Data from April 7, 2018, were transferred to TerraGraphics via the Washington River Protection Solutions, LLC (WRPS) File Transfer Protocol (FTP) site on April 12, 2018. Data were assessed using Procedure 17124-DOE-HS-102, "Mobile Laboratory Data Processing – Analysis." A completed Data Exchange Checklist was sent to WRPS on April 16, 2018. The data were accepted by TerraGraphics with the following comments. All startup, shutdown, and calibration procedures were adequately documented and all other checks passed the acceptance limits. No other exceptions besides those below were noted.

Extra data fields were stored with weather station data and Corrective and Preventative Action (CAPA) 1820 was issued on April 9, 2018. Upon reinstallation of the weather station, extra data fields were not turned off which caused several other data fields to be stored with weather station data. This may cause issue upon data interpretation depending on how sophisticated the algorithm is for pulling out pertinent weather station data sentences. If the weather station is reinstalled in the future, all other data fields will be turned off and saved to avoid convoluted weather data review.

During the end of the day validation checks for the Mobile Laboratory the TeamViewer®[1] software was not operating correctly and a verbal validation had to be performed. CAPA 1822 was issued on April 9, 2018. The license was expired for quality assurance (QA) personnel and would no longer enable them to connect to multiple instruments in the Mobile Laboratory for verification. Pictures of the instruments will supplement the use of TeamViewer for the end of the day validation checks until QA personnel can become added to the global TeamViewer license. The practice of taking pictures for verification was approved by the client on April 7, 2018.

1.2 Summary

Joe Sears and Krystin Riha performed background sampling using the Mobile Laboratory from April 7, 2018, to April 8, 2018, at Study Site 1. Site 1 is located on the plateau northwest of the 200W Tank Farm operations. This is an upwind site from the central Hanford Plateau. The Mobile Laboratory arrived at Site 1 at 12:29 on April 7, 2018. The initial QA/quality control (QC) zero air/sensitivity checks were performed on the CO_2 monitor, NH_3 monitor, and the Proton Transfer Reaction – Mass Spectrometer (PTR-MS) beginning at 12:34. The data file names were confirmed and routine data collection resumed by 13:49. The Mobile Laboratory staff departed the monitoring site at 16:10.

The Mobile Laboratory staff had returned to Site 1 at 06:46 on April 8, 2018, and began confirmatory sample collection by 06:55. Closeout zero air/sensitivity checks were performed at 10:40. The Mobile Laboratory moved to Site 2 by 12:07.

[1] TeamViewer is a registered trademark of TeamViewer GmbH, Goeppingen, Germany.

Use of a new lower concentration Ammonia standard was implemented. It was prepared from the 100,000 ppbv NH_3 standard (CBAL-451-74B) to create a new 10,000 ppbv NH_3 standard (CBAL-451-85A). The new standard will be used until it fails the percent recovery criteria.

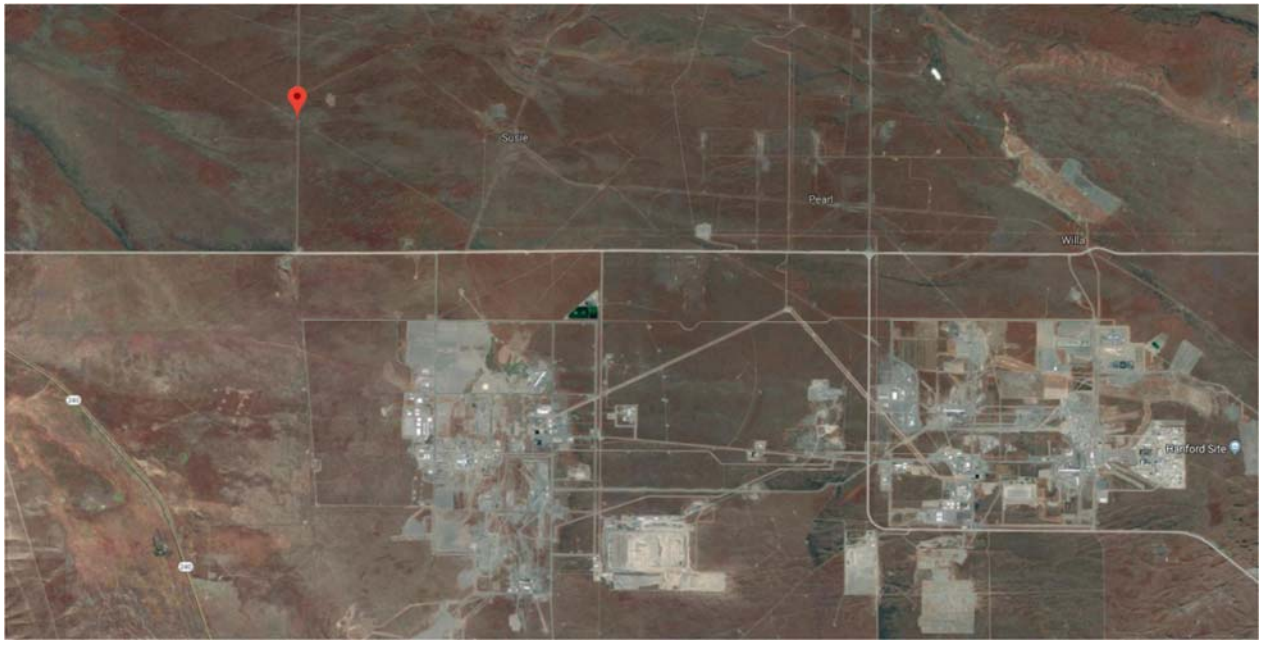


Figure 1-1. Mobile Lab Site #1 for the Duration of the Monitoring Period.

1.3 Samples Collected

Continuous air monitoring was performed using the following instrumentation:

- PTR-MS,
- LI-COR®[2] CO_2 Monitor,
- Picarro Ammonia Monitor, and
- Weather Station.

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

Confirmatory air samples were collected as follows:

Table 1-1. Alternative Media Samples Taken.

Site	Date	Sample Type	ID	Start	Stop	Sample Time (min)
1	7-Apr	Thermosorb®[3]/N	EL22184	12:46	15:46	180
1	7-Apr	CarboTrap®[4]-300	A046038	12:59	14:12	72
1	8-Apr	Thermosorb/N	EL22189	06:55	10:10	194
1	8-Apr	CarboTrap-300	A048159	07:05	08:16	70

Table 1-2 displays the statistical information for the monitoring period of April 7, 2018, to April 8, 2018. By definition, the occupational exposure limit (OEL) is an 8-hour, time-weighted average that establishes a limit for personnel exposures to hazardous chemicals. It is the exposure level to which a person may be exposed for 8 hours/day, 40 hours/week for 40 years and have no expectation of adverse health effects. In this study, area vapor concentration measurements were made to better understand the hazardous vapor exposures that workers may receive. These measurements are only compared to OEL concentrations to give them context. It is neither accurate nor appropriate to interpret these short duration measurements (2 seconds) as worker exposure levels. Since the OEL is defined as a time-weighted average, it is more appropriate to compare them to daily average vapor concentrations. Short duration excursions above the OEL concentration are not significant.

[3] Thermosorb is a registered trademark of Ellutia Limited Company, Cambridgeshire, United Kingdom.
[4] CarboTrap is a registered trademark of Sigma-Aldrich Co., LLC, St. Louis, Missouri.

Table 1-2. Statistical Information for the Monitoring Period of April 7, 2018 – April 8, 2018.

COPC #	COPC Name	Reporting Limit (ppb)	OEL (ppb)	Ave. (ppb)	St. Dev. (ppb)	Rel. St. Dev. (%)	Max (ppb)	Median (ppb)	Sec. over 50% OEL	Sec. over OEL
1	ammonia	1	25000	6.77	1.741	25.7%	12.60	6.35	0	0
2	furan	0.09	1	0.045	0.015	58.1%	0.124	0.024	0	0
3	but-3-en-2-one + 2,3-dihydrofuran + 2,5-dihydrofuran	0.22	1	0.110	0.015	47.1%	N/A*	N/A*	N/A	N/A
4	NDMA**	0.06	0.3	0.033	0.023	122.3%	0.154	0.010	2	0
5	2-methylfuran	0.05	1	0.026	0.014	62.1%	0.108	0.020	0	0
6	NEMA	0.02	0.3	0.012	0.010	237.3%	0.099	0.000	0	0
7	2,5-dimethylfuran	0.05	1	0.025	0.010	70.9%	0.077	0.013	0	0
8	NDEA	0.01	0.1	0.006	0.006	263.5%	0.060	0.000	10	0
9	2-propylfuran + 2-ethyl-5-methylfuran	0.02	1	0.012	0.009	105.1%	0.065	0.006	0	0
10	NMOR	0.05	0.6	0.025	0.006	93.8%	0.048	0.006	0	0
11	2-ethyl-2-hexenal + 4-(1-methylpropyl)-2,3-dihydrofuran + 3-(1,1-dimethylethyl)-2,3-dihydrofuran	0.04	1	0.023	0.015	78.1%	0.112	0.015	0	0
12	2-pentylfuran	0.04	1	0.022	0.011	51.2%	0.097	0.019	0	0
13	2-heptylfuran	0.02	1	0.011	0.006	62.5%	0.048	0.009	0	0
14	2-octylfuran	0.01	1	0.005	0.002	207.4%	0.025	0.000	0	0
15	6-(2-furanyl)-6-methyl-2-heptanone	0.01	1	0.005	0.003	143.1%	0.024	0.000	0	0
16	furfural acetophenone	0.07	1	0.035	0.006	61.7%	0.047	0.009	0	0

* The maximum peak value for but-3-en-2-one + 2,3 dihydrofuran + 2,5 dihydrofuran was 0.113 ppb and the median value was 0.029 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 200, 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 each chemical of potential concern (COPC) signal, overlaid with the same signal smoothed using a 1-minute moving average, and CO_2, for the monitoring period April 7, 2018, to April 8, 2018.

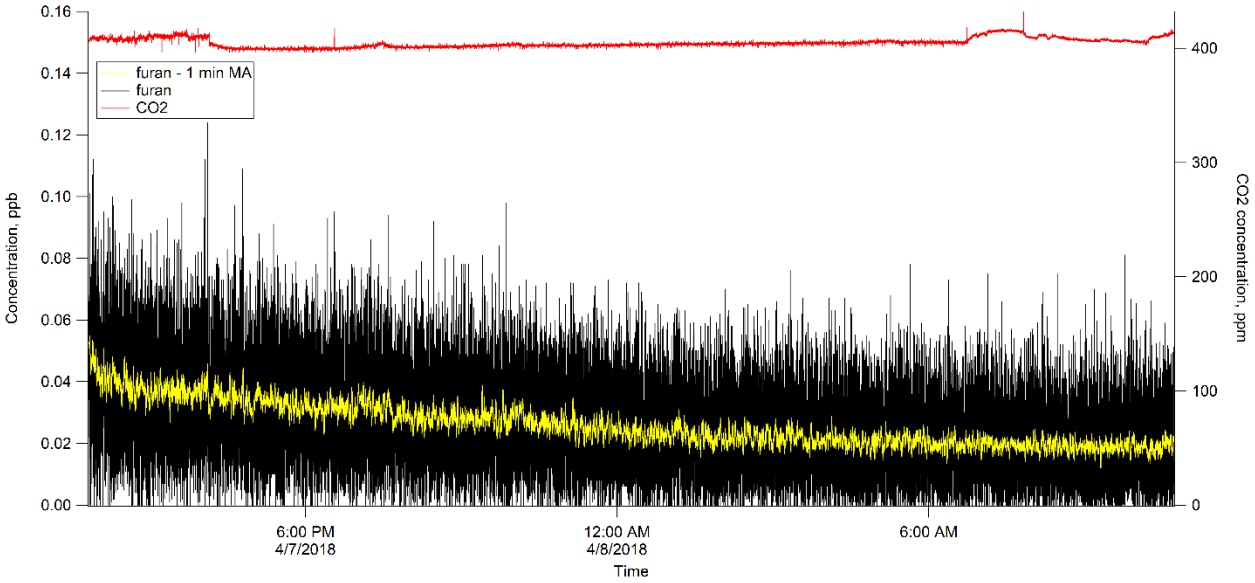


Figure 1-2. Furan.

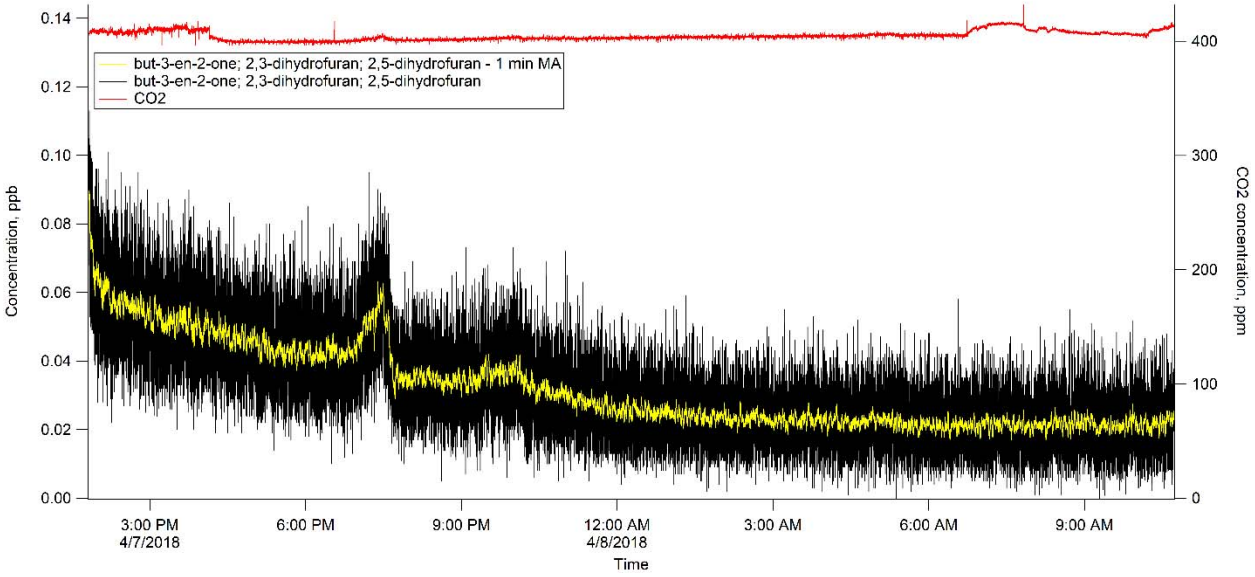


Figure 1-3. but-3-en-2-one + 2,3-dihydrofuran + 2,5-dihydrofuran.

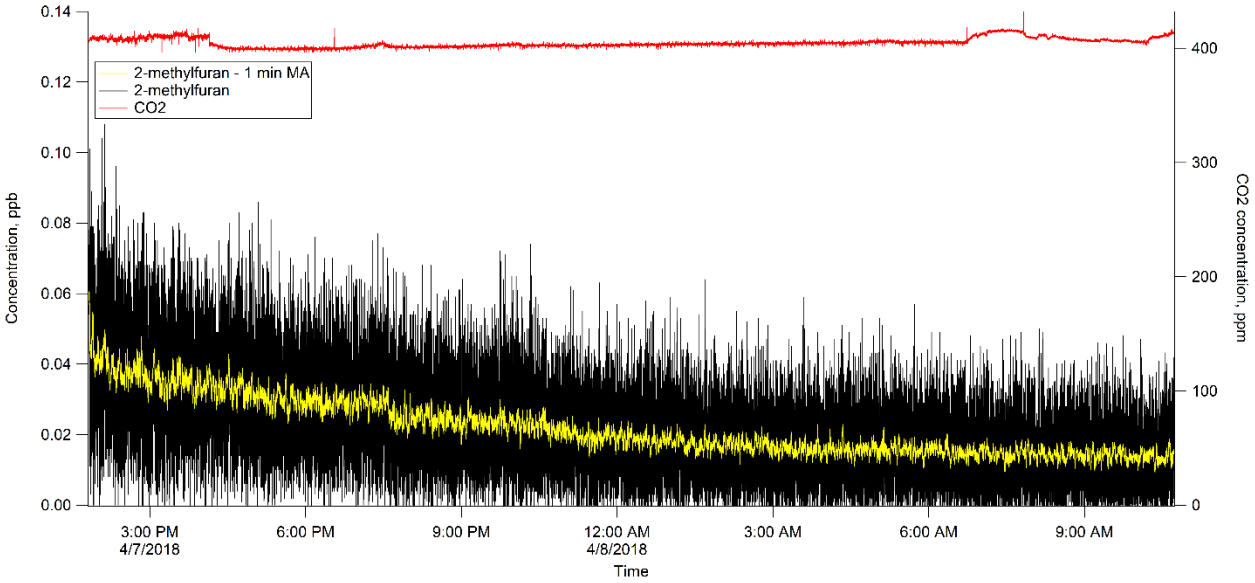


Figure 1-4. 2-methylfuran.

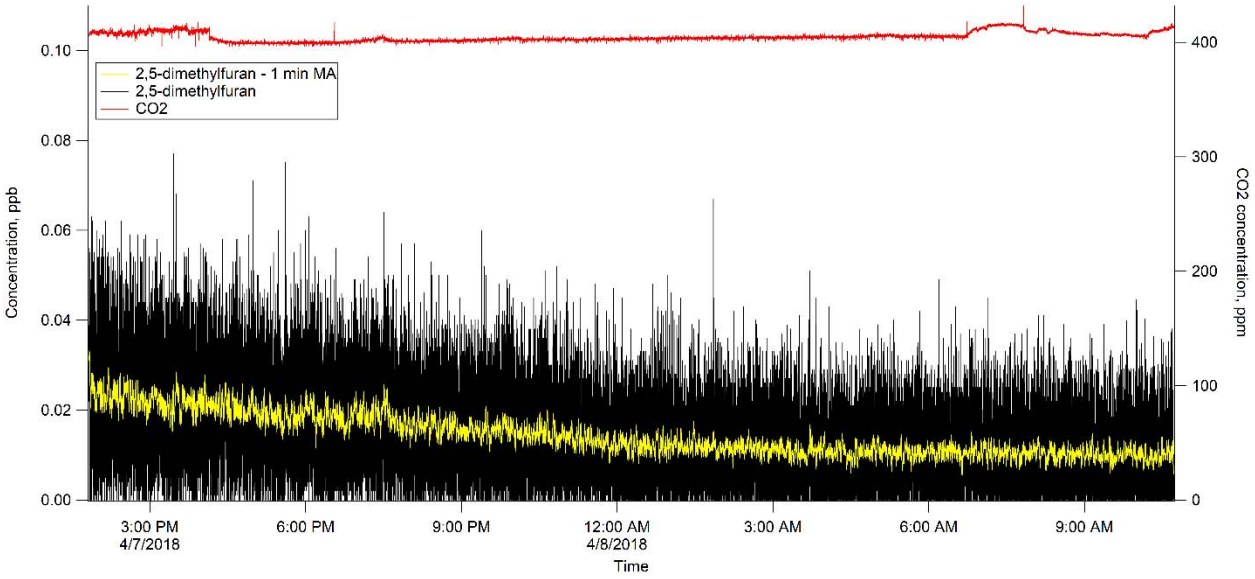


Figure 1-5. 2,5-dimethylfuran.

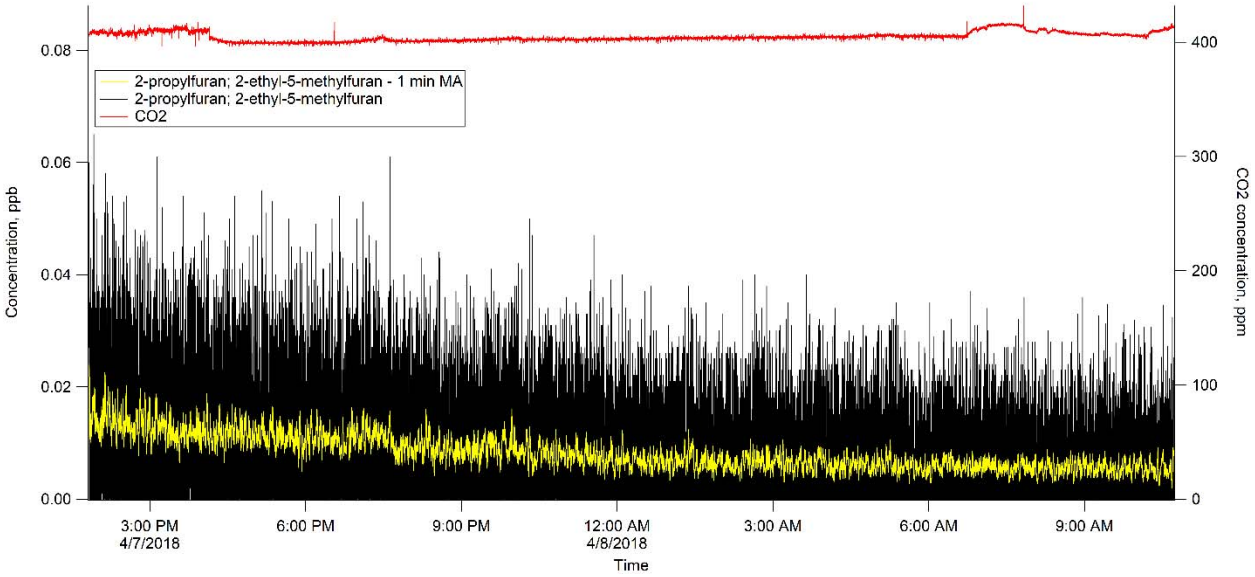


Figure 1-6. 2-propylfuran + 2-ethyl-5-methylfuran.

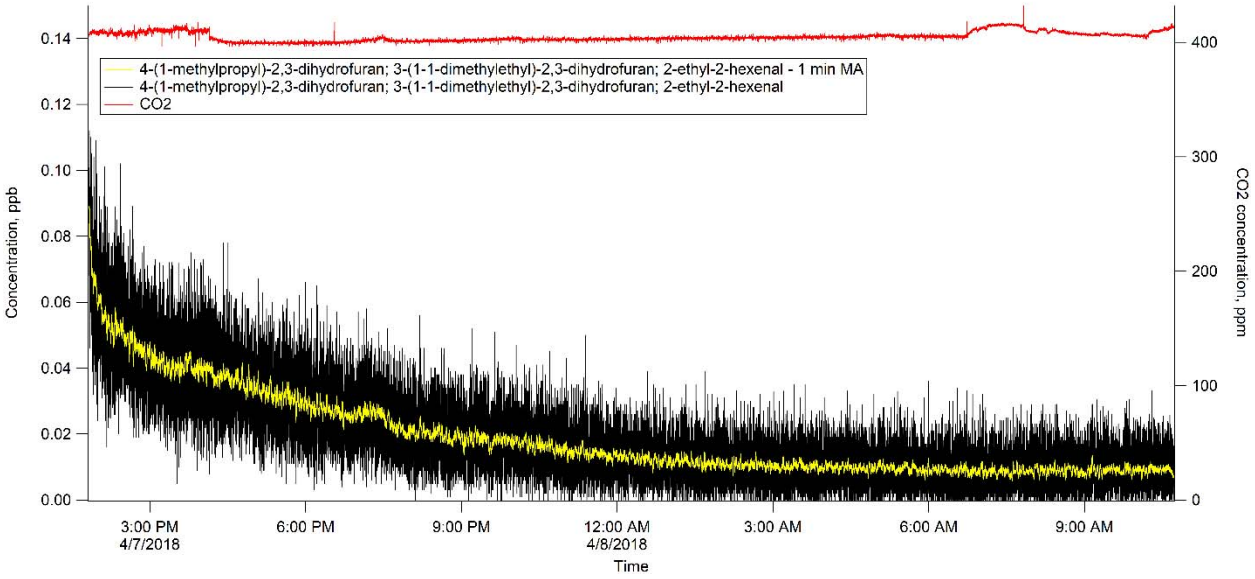


Figure 1-7. 4-(1-methylpropyl)-2,3-dihydrofuran + 3-(1-1-dimethylethyl)-2,3-dihydrofuran + 2-ethyl-2-hexenal.

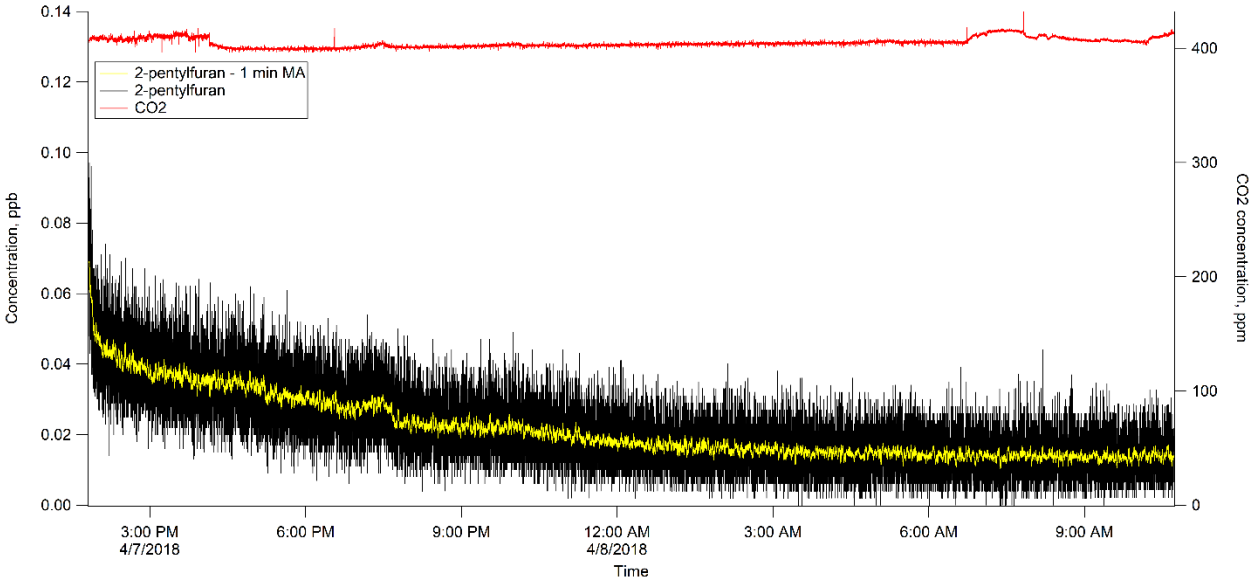


Figure 1-8. 2-pentylfuran.

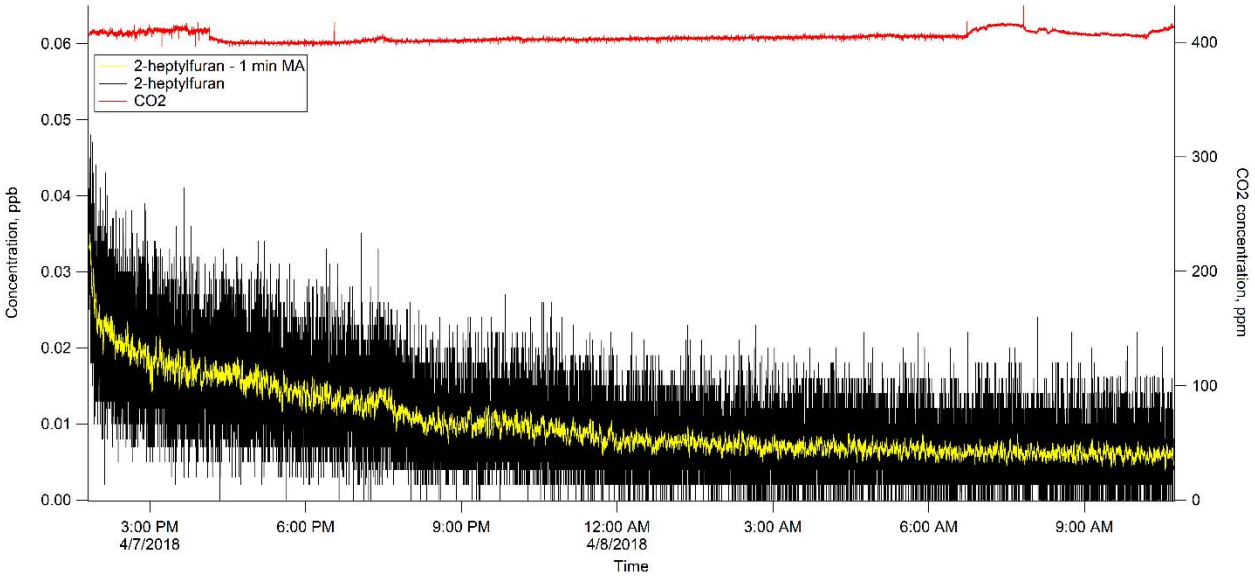


Figure 1-9. 2-heptylfuran.

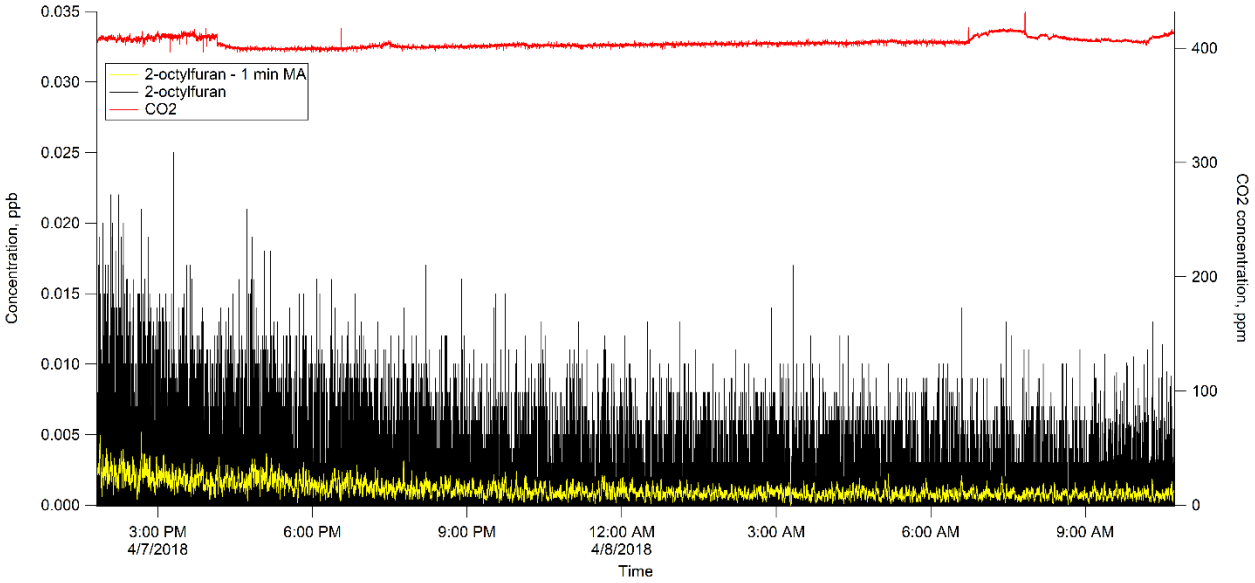


Figure 1-10. 2-octylfuran.

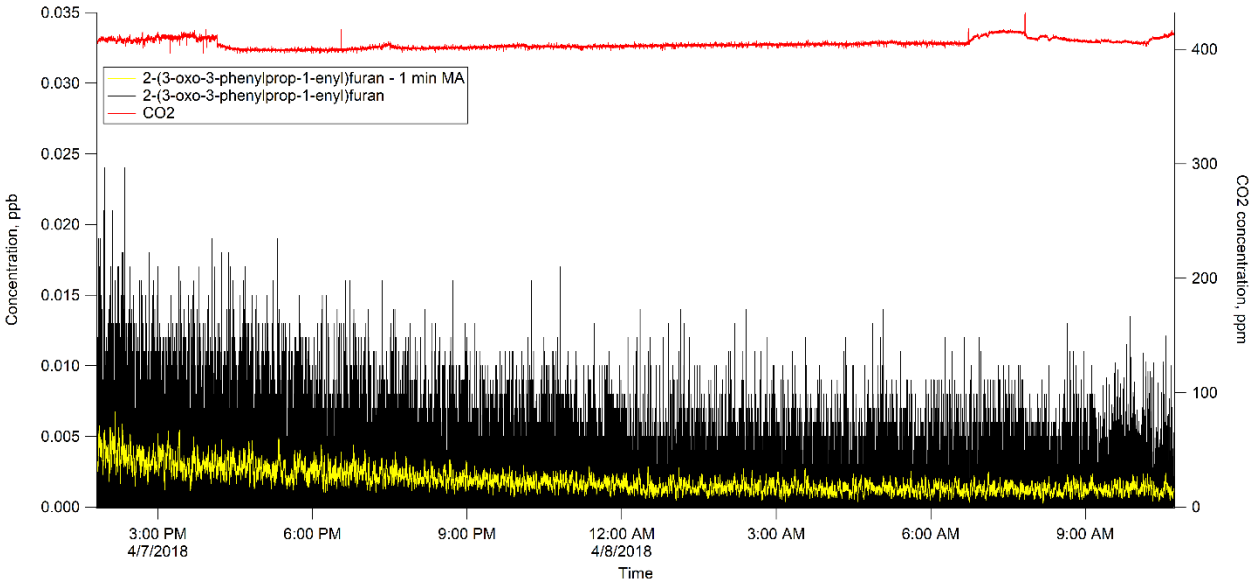


Figure 1-11. 2-(3-oxo-3-phenylprop-1-enyl)furan.

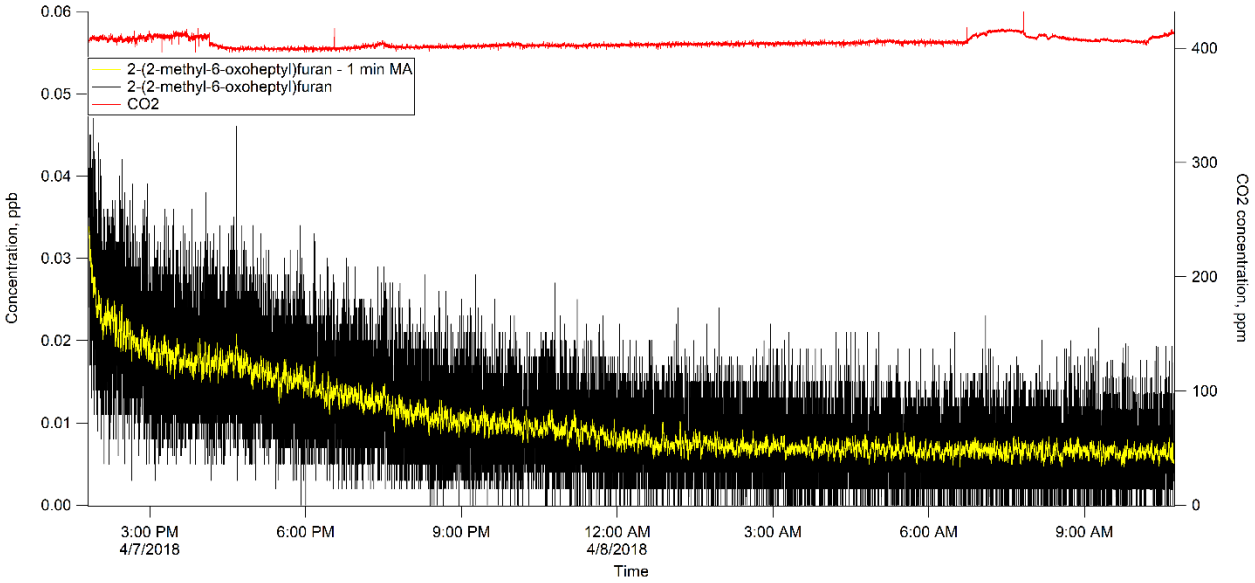


Figure 1-12. 2-(2-methyl-6-oxoheptyl)furan.

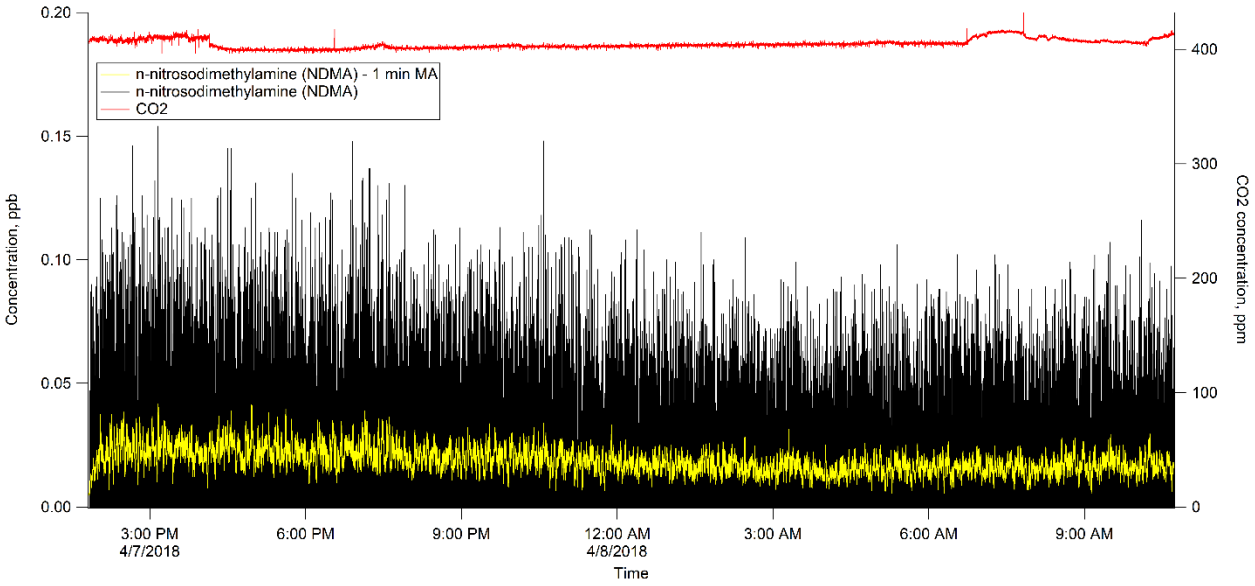


Figure 1-13. N-nitrosodimethylamine (NDMA).

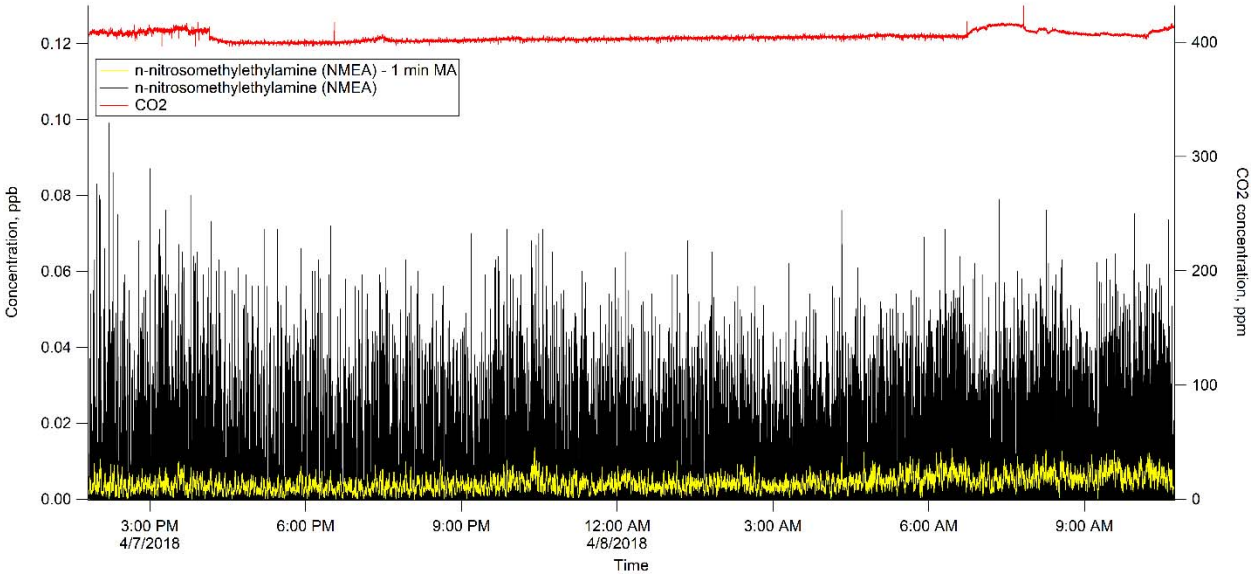


Figure 1-14. N-nitrosomethylethylamine (NMEA).

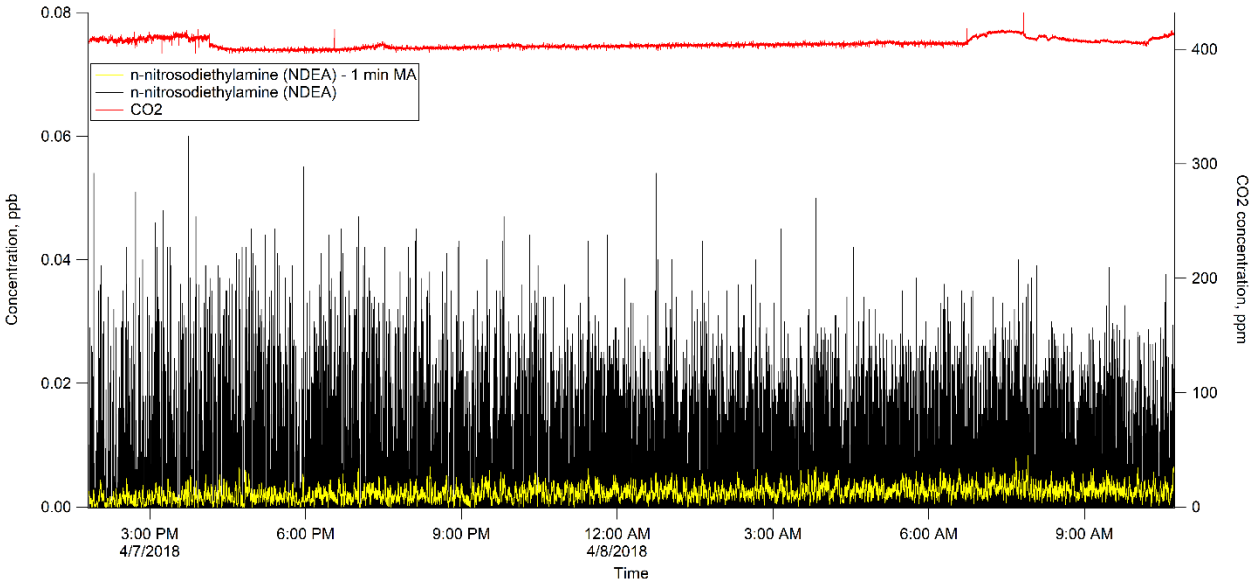


Figure 1-15. N-nitrosodiethylamine (NDEA).

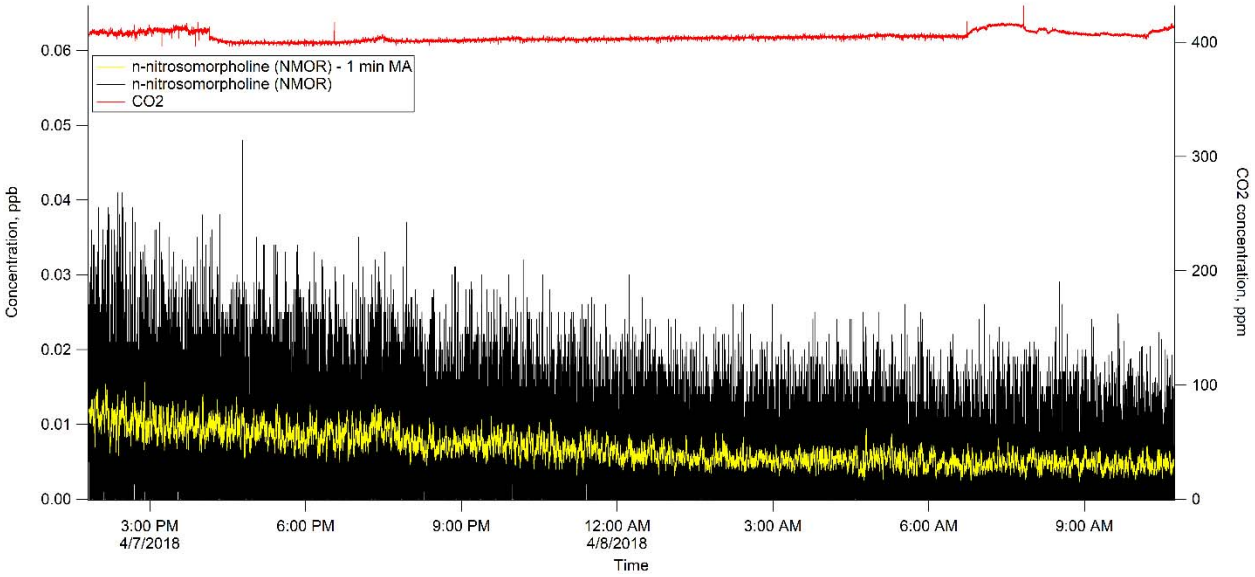


Figure 1-16. N-nitrosomorpholine (NMOR).

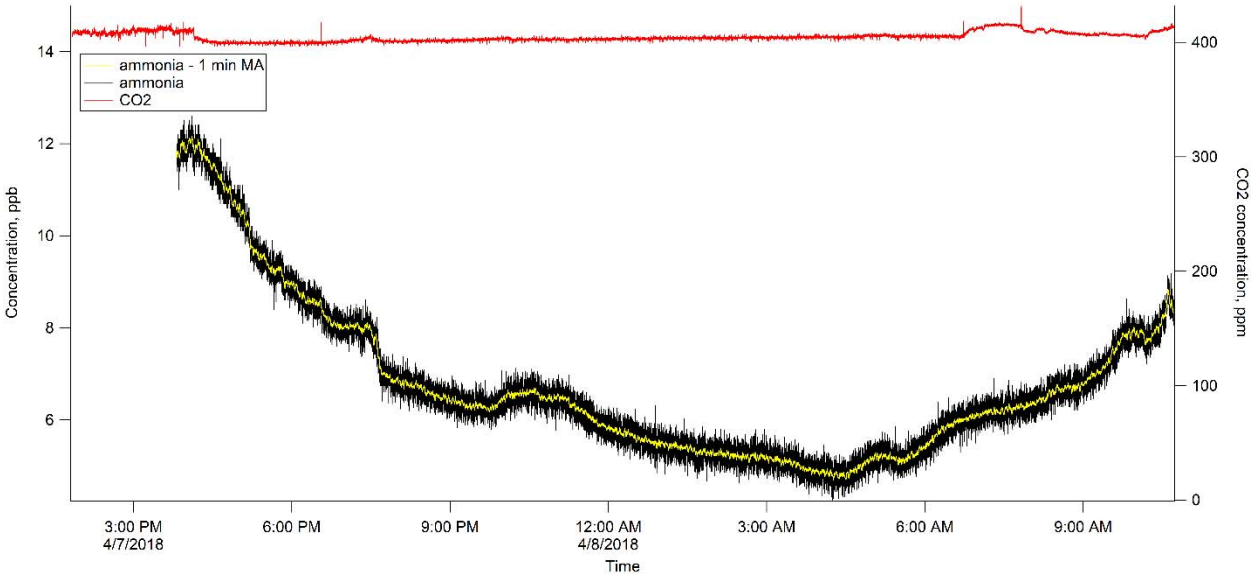


Figure 1-17. Ammonia.

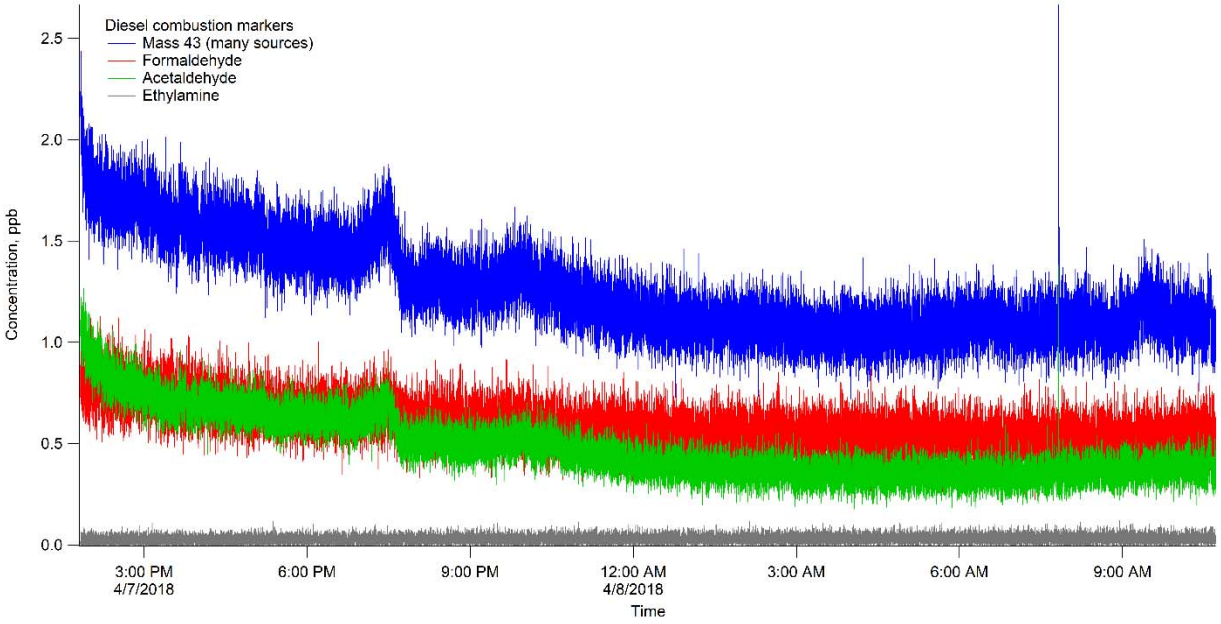


Figure 1-18. Diesel Combustion Markers.

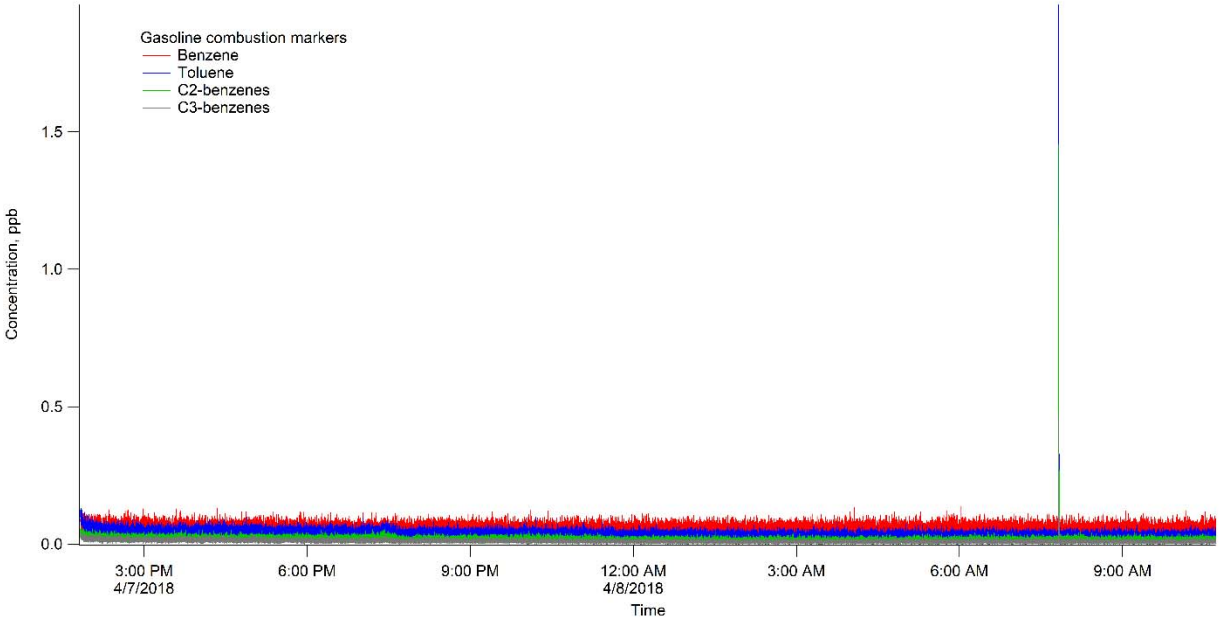


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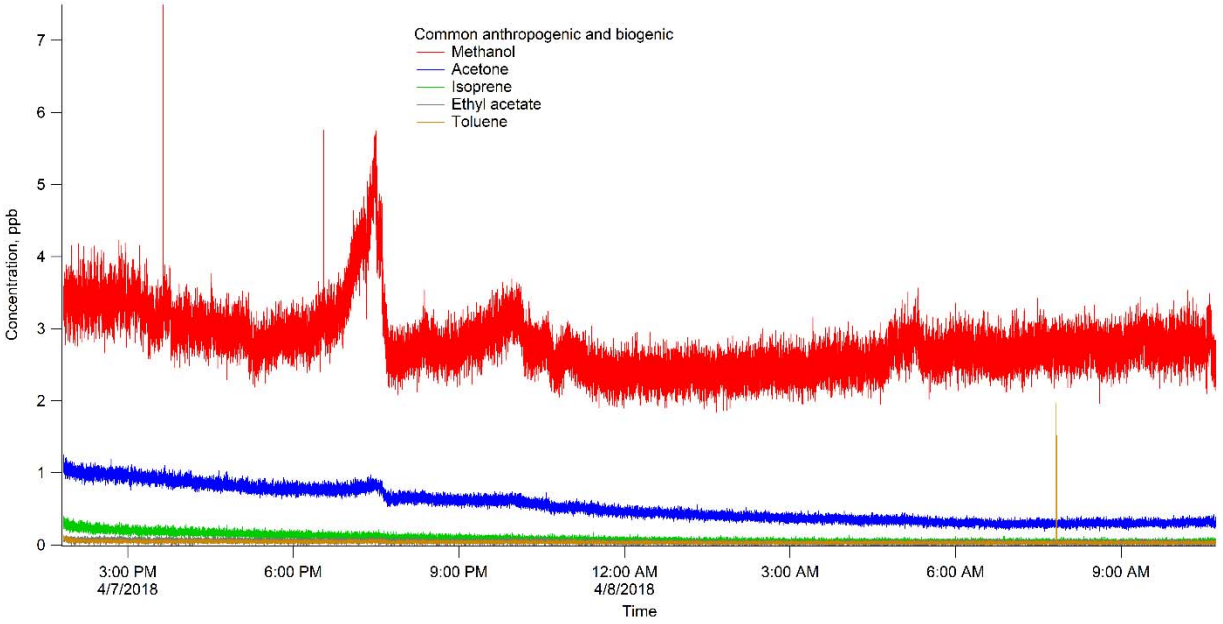


Figure 1-20. Plant and Human Markers.

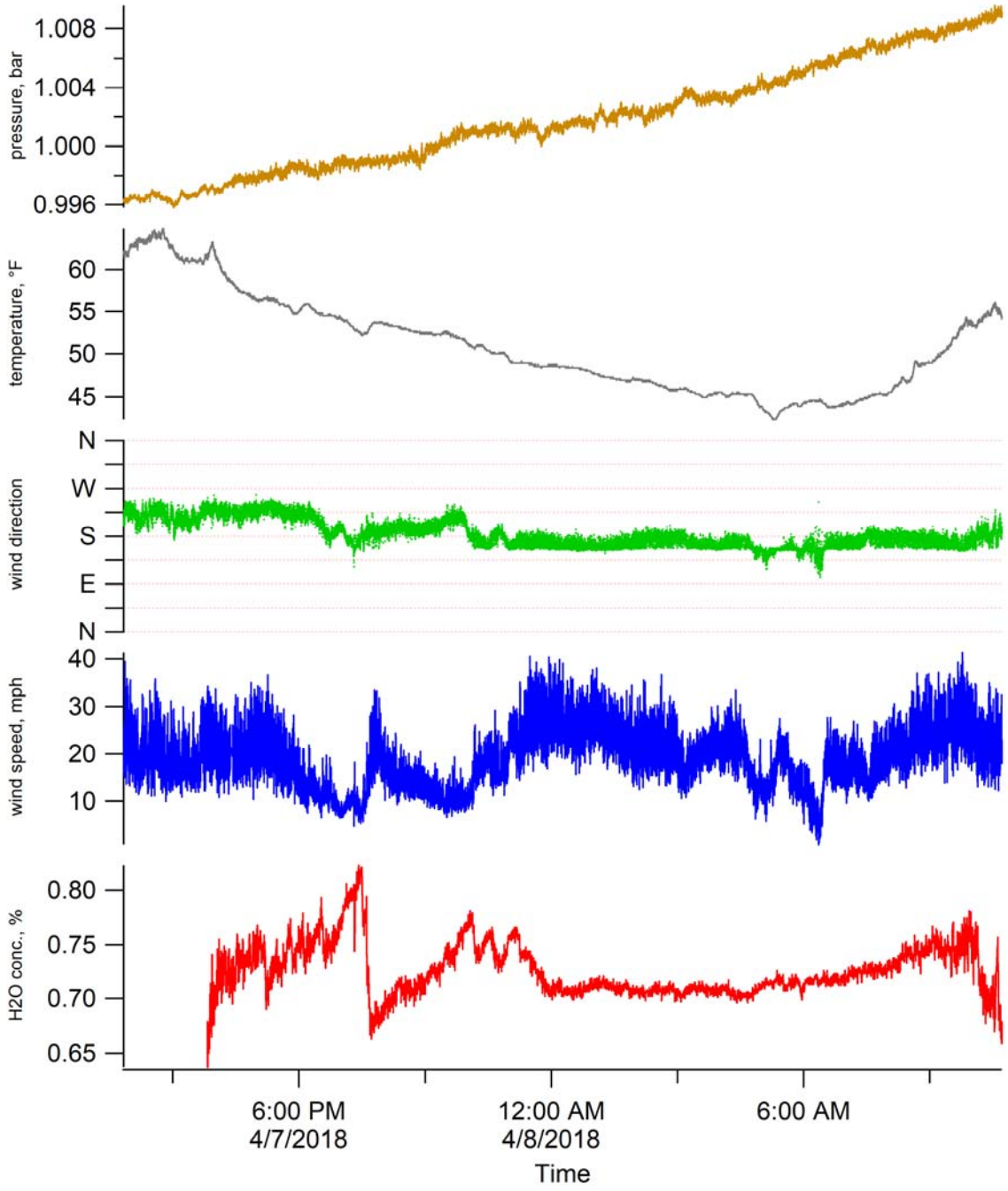


Figure 1-21. Weather Data.

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Procedure 17124-DOE-HS-102, 2018, "Mobile Laboratory Data Processing – Analysis," Revision 0, TerraGraphics Environmental Engineering, Inc., Pasco, Washington.

WEEKLY REPORT FOR WEEK 5
(APRIL 8, 2018 – APRIL 14, 2018)

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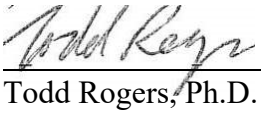
Prepared by:



Date: 5/4/2018

Matt Erickson, Ph.D.

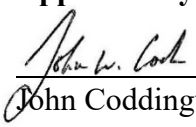
Reviewed by:



Date: 5/4/2018

Todd Rogers, Ph.D.

Approved by:



Date: 5/4/2018

John Coddington, Ph.D.

Record of Revision

Revision	Date	Pages/Sections Changed	Brief Description
0	05/2018	N/A	Initial release.

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Acronyms

CAPA	Corrective and Preventative Action
COPC	Chemical of Potential Concern
FTP	File Transfer Protocol
NDMA	N-nitrosodimethylamine
NMEA	N-nitrosomethylethylamine
NMOR	N-nitrosomorpholine
OEL	Occupational Exposure Limit
ppb	parts per billion
PTR-MS	Proton Transfer Reaction – Mass Spectrometer
QA	Quality Assurance
QC	Quality Control
WRPS	Washington River Protection Solutions, LLC

1.0 APRIL 8, 2018 – APRIL 9, 2018 – STUDY SITE #2

1.1 Quality Assessment

Data from April 8, 2018, were transferred to TerraGraphics via the Washington River Protection Solutions, LLC (WRPS) File Transfer Protocol (FTP) site on April 12, 2018. Data were assessed using Procedure 17124-DOE-HS-102, "Mobile Laboratory Data Processing – Analysis." A completed Data Exchange Checklist was sent to WRPS on April 16, 2018. The data were accepted by TerraGraphics with the following comments. All startup, shutdown, and calibration procedures were adequately documented and all other checks passed the acceptance limits. No other exceptions besides those below were noted.

The generator exhaust line blew off of the Mobile Laboratory on April 8, 2018, and Corrective and Preventative Action (CAPA) 1821 was issued on April 9, 2018. Due to high winds, the exhaust line blew off the Mobile Laboratory in the evening or during the night of April 8, 2018. In the future, when expecting high winds or other dramatic weather events, Mobile Laboratory personnel will take necessary precautions to secure the exhaust line prior to leaving the Mobile Laboratory for the day.

1.2 Summary

The Mobile Laboratory personnel performed background sampling using the Mobile Laboratory from April 8, 2018, to April 9, 2018 at Study Site 2. Site 2 is located near the northern end of the 200W Tank Farms. The Mobile Laboratory arrived at Site 2 at 11:59 on April 8, 2018. The initial quality assurance/quality control (QA/QC) zero air/sensitivity checks were performed on the CO_2 monitor, NH_3 monitor, and the Proton Transfer Reactor – Mass Spectrometer (PTR-MS) beginning at 12:12. The data file names were confirmed and routine data collection resumed by 13:12. The Mobile Laboratory staff departed the monitoring site at 15:45.

The Mobile Laboratory staff returned to Site 2 at 06:52 on April 9, 2018, and began confirmatory sample collection by 06:58. Due to variable wind, the exhaust line was repositioned several times between 08:00 and 10:00 to minimize influence on measurements. Closeout zero air/sensitivity checks were performed at 10:41. The Mobile Laboratory moved to Site 3 by 12:18.



Figure 1-1. Mobile Lab Site #2 for the Duration of the Monitoring Period.

1.3 Samples Collected

Continuous air monitoring was performed using the following instrumentation:

- PTR-MS,
- LI-COR®[1] CO_2 Monitor,
- Picarro Ammonia Monitor, and
- Weather Station.

Confirmatory air samples were collected as follows:

Table 1-1. Alternative Media Samples Taken.

Site	Date	Sample Type	ID	Start	Stop	Sample Time (min)
2	8-Apr	Thermosorb®[2]/N	EL22188	12:20	15:20	180
2	8-Apr	CarboTrap®[3]-300	A007213	12:28	13:38	70
2	9-Apr	Thermosorb/N	EL22197	06:58	10:00	181
2	9-Apr	CarboTrap-300	A020988	07:07	08:17	70

[1] LI-COR is a registered trademark of LI-COR, Inc., Lincoln, Nebraska.
[2] Thermosorb is a registered trademark of Ellutia Limited Company, Cambridgeshire, United Kingdom.
[3] CarboTrap is a registered trademark of Sigma-Aldrich Co., LLC, St. Louis, Missouri.

Table 1-2 displays the statistical information for the monitoring period of April 8, 2018, to April 9, 2018. By definition, the occupational exposure limit (OEL) is an 8-hour, time-weighted average that establishes a limit for personnel exposures to hazardous chemicals. It is the exposure level to which a person may be exposed for 8 hours/day, 40 hours/week for 40 years and have no expectation of adverse health effects. In this study, area vapor concentration measurements were made to better understand the hazardous vapor exposures that workers may receive. These measurements are only compared to OEL concentrations to give them context. It is neither accurate nor appropriate to interpret these short duration measurements (2 seconds) as worker exposure levels. Since the OEL is defined as a time-weighted average, it is more appropriate to compare them to daily average vapor concentrations. Short duration excursions above the OEL concentration are not significant.

Table 1-2. Statistical Information for the Monitoring Period of April 8, 2018 – April 9, 2018.

COPC #	COPC Name	Reporting Limit (ppb)	OEL (ppb)	Ave. (ppb)	St. Dev. (ppb)	Rel. St. Dev. (%)	Max (ppb)	Median (ppb)	Sec. over 50% OEL	Sec. over OEL
1	ammonia	1	25000	5.46	1.607	29.4%	9.99	4.72	0	0
2	furan	0.09	1	0.045	0.015	77.5%	0.309	0.017	0	0
3	but-3-en-2-one + 2,3-dihydrofuran + 2,5-dihydrofuran	0.22	1	0.112	0.033	126.6%	N/A*	N/A*	N/A	N/A
4	NDMA**	0.06	0.3	0.032	0.020	122.9%	0.132	0.008	0	0
5	2-methylfuran	0.05	1	0.026	0.016	94.2%	0.340	0.015	0	0
6	NEMA	0.02	0.3	0.012	0.010	190.2%	0.073	0.000	0	0
7	2,5-dimethylfuran	0.05	1	0.026	0.013	101.6%	0.246	0.011	0	0
8	NDEA	0.01	0.1	0.006	0.006	214.5%	0.047	0.000	0	0
9	2-propylfuran + 2-ethyl-5-methylfuran	0.02	1	0.011	0.008	119.7%	0.141	0.004	0	0
10	NMOR	0.05	0.6	0.025	0.005	104.9%	0.064	0.003	0	0
11	2-ethyl-2-hexenal + 4-(1-methylpropyl)-2,3-dihydrofuran + 3-(1,1-dimethylethyl)-2,3-dihydrofuran	0.04	1	0.020	0.007	63.9%	0.099	0.010	0	0
12	2-pentylfuran	0.04	1	0.020	0.008	45.1%	0.124	0.017	0	0
13	2-heptylfuran	0.02	1	0.010	0.004	61.4%	0.048	0.006	0	0
14	2-octylfuran	0.01	1	0.005	0.002	215.8%	0.029	0.000	0	0
15	6-(2-furanyl)-6-methyl-2-heptanone	0.01	1	0.005	0.002	159.2%	0.017	0.000	0	0
16	furfural acetophenone	0.07	1	0.035	0.004	55.2%	0.026	0.006	0	0

* The maximum peak value for but-3-en-2-one + 2,3 dihydrofuran + 2,5 dihydrofuran was 0.949 ppb and the median value was 0.022 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 200, 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 each chemical of potential concern (COPC) signal, overlaid with the same signal smoothed using a 1-minute moving average, and CO_2, for the monitoring period April 8, 2018, to April 9, 2018.

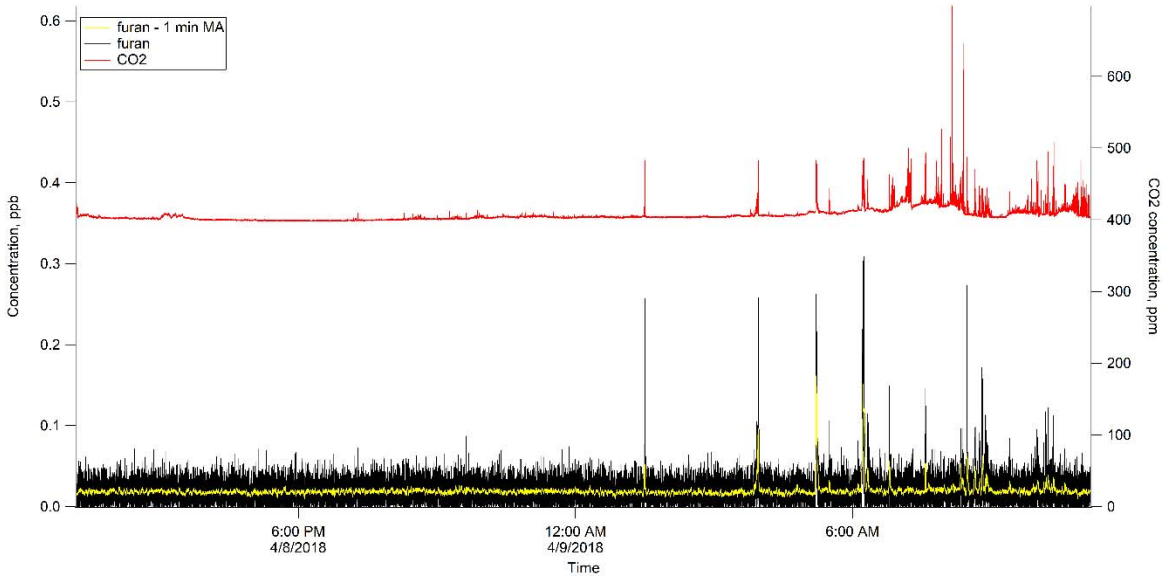


Figure 1-2. Furan.

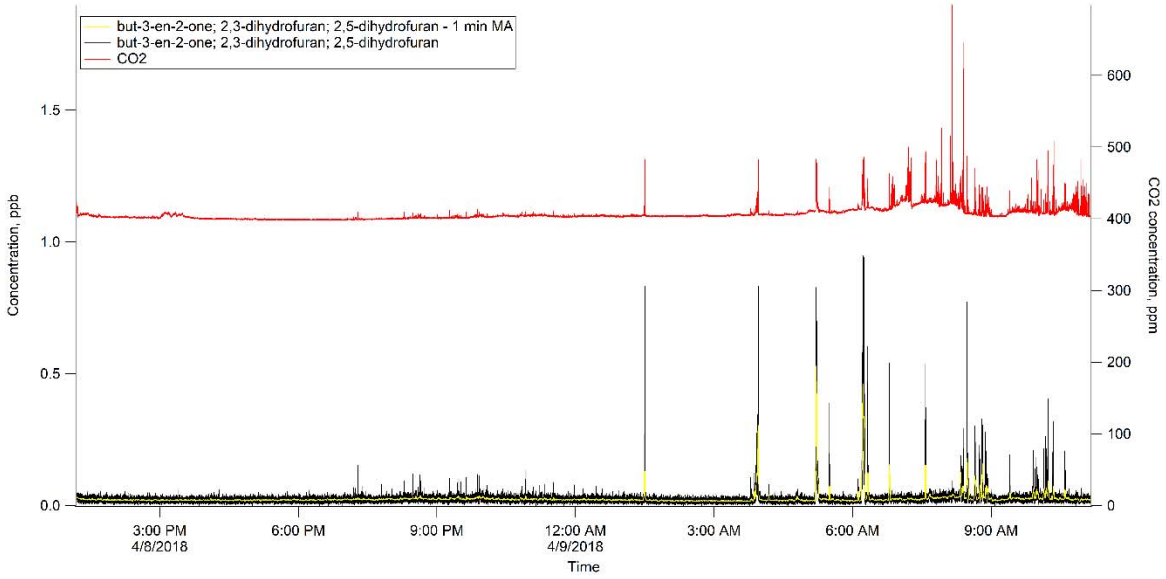


Figure 1-3. but-3-en-2-one + 2,3-dihydrofuran + 2,5-dihydrofuran.

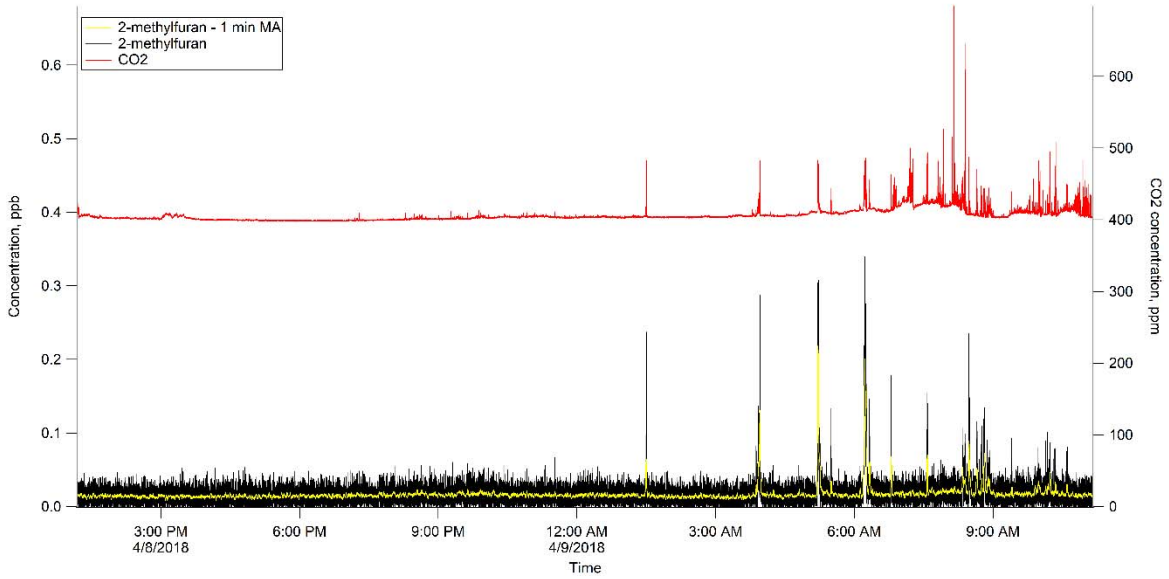


Figure 1-4. 2-methylfuran.

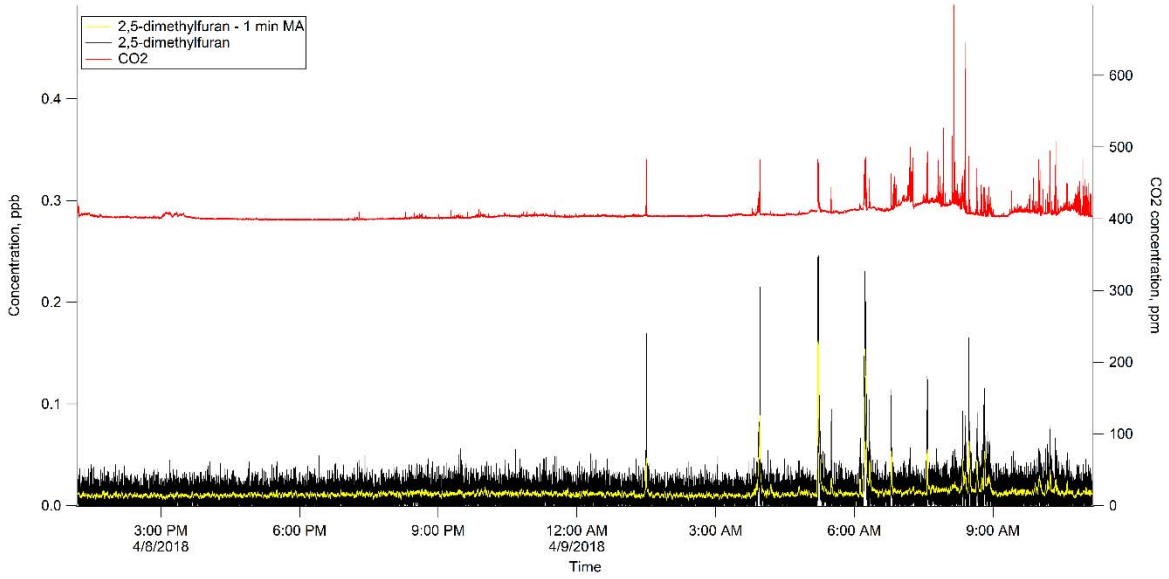


Figure 1-5. 2,5-dimethylfuran.

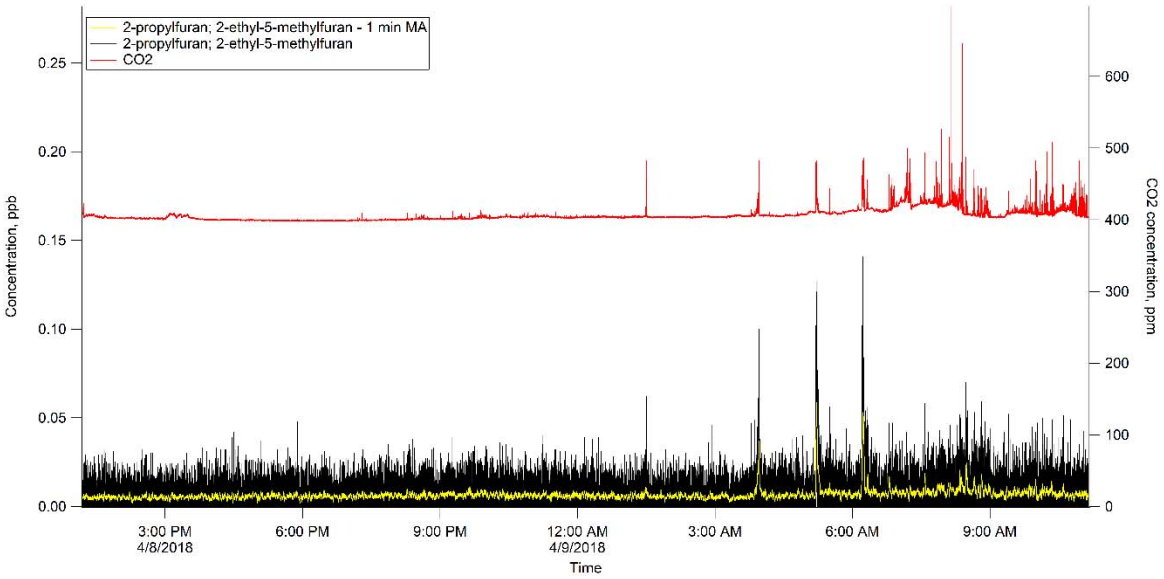


Figure 1-6. 2-propylfuran + 2-ethyl-5-methylfuran.

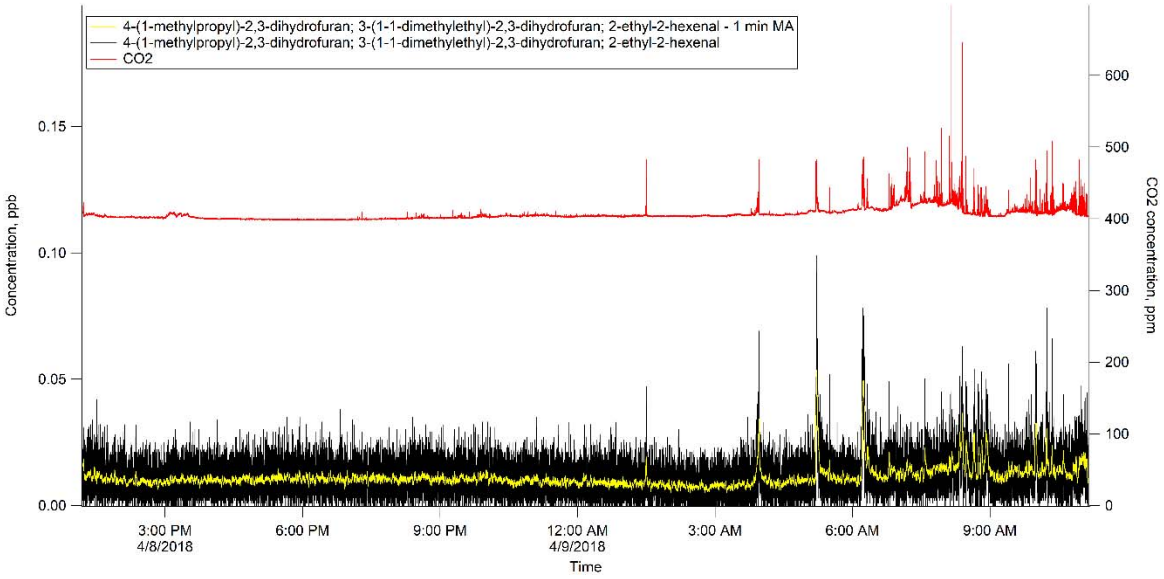


Figure 1-7. 4-(1-methylpropyl)-2,3-dihydrofuran + 3-(1-1-dimethylethyl)-2,3-dihydrofuran + 2-ethyl-2-hexenal.

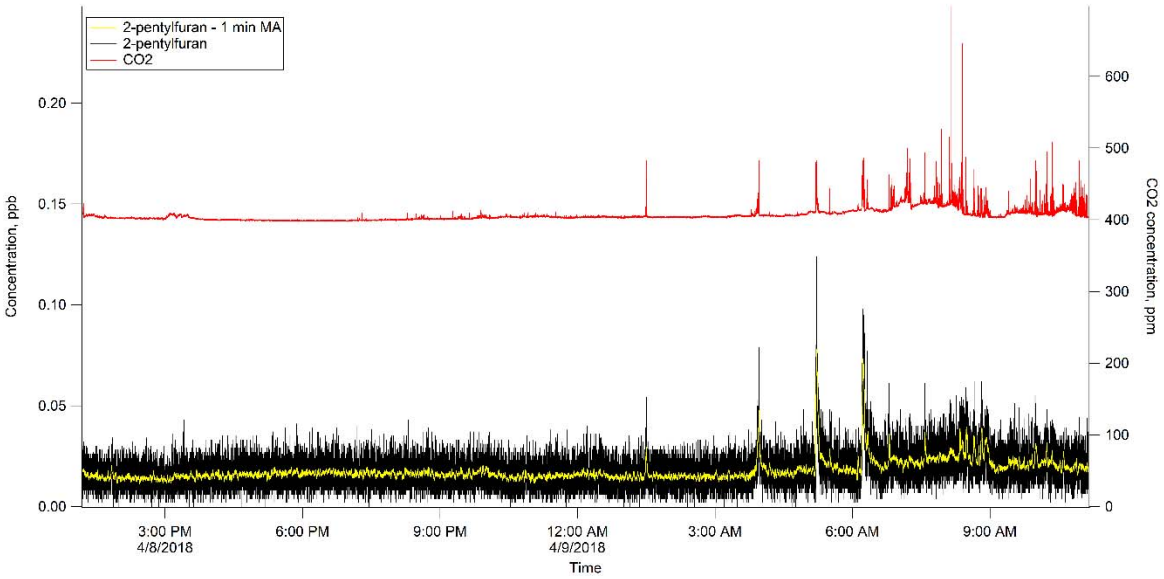


Figure 1-8. 2-pentylfuran.

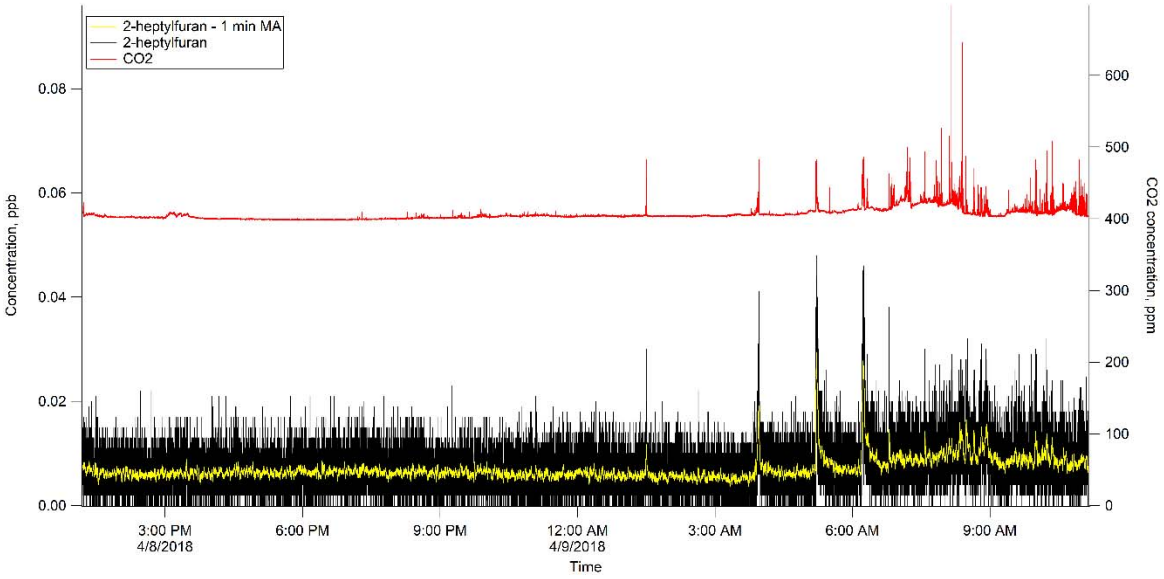


Figure 1-9. 2-heptylfuran.

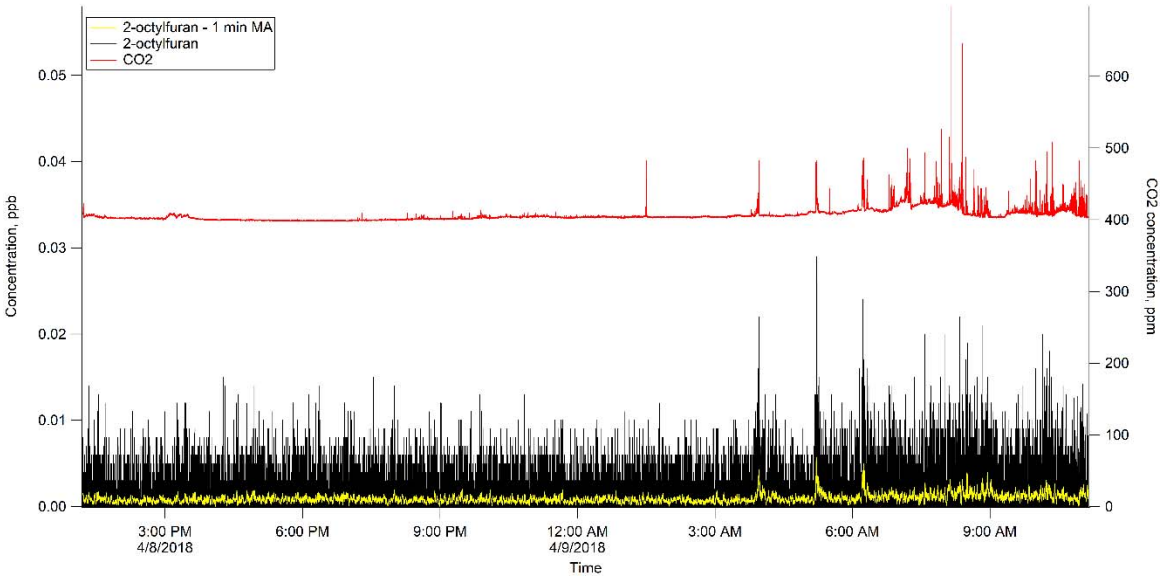


Figure 1-10. 2-octylfuran.

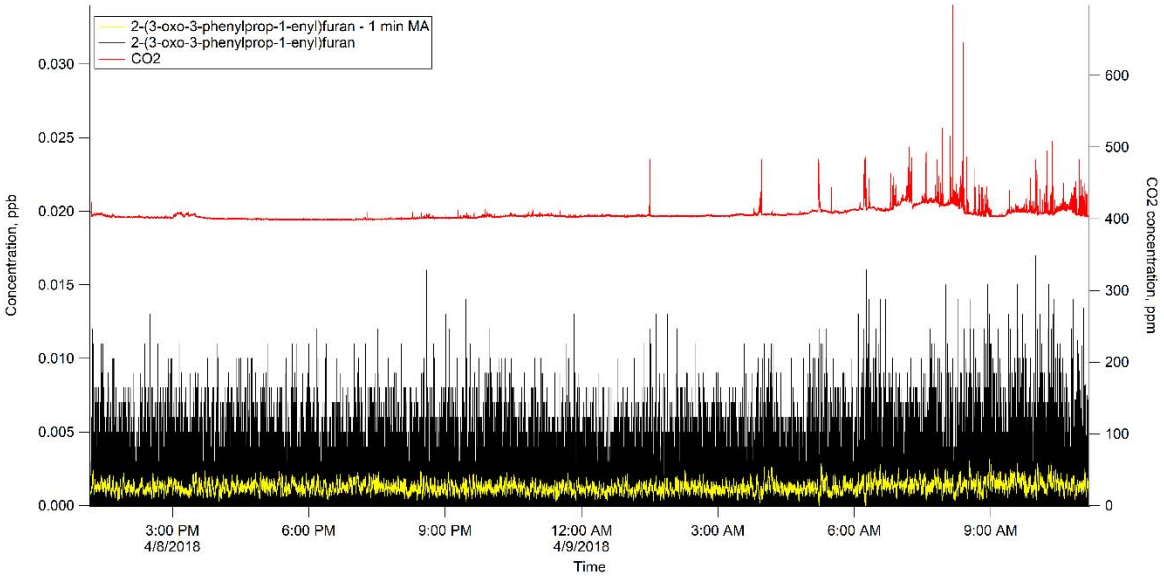


Figure 1-11. 2-(3-oxo-3-phenylprop-1-enyl)furan.

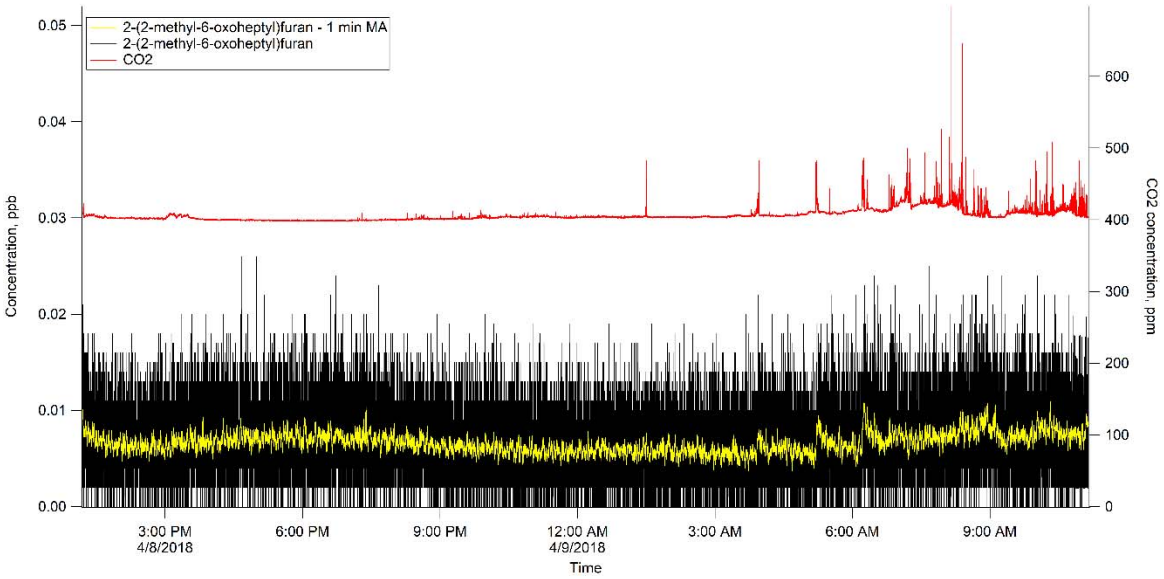


Figure 1-12. 2-(2-methyl-6-oxoheptyl)furan.

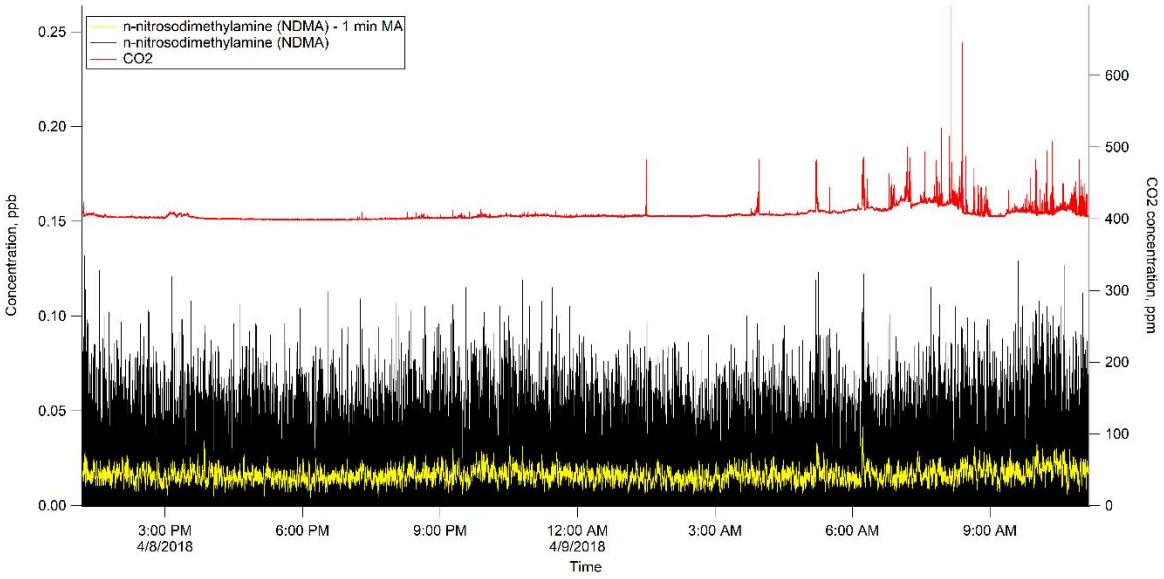


Figure 1-13. N-nitrosodimethylamine (NDMA).

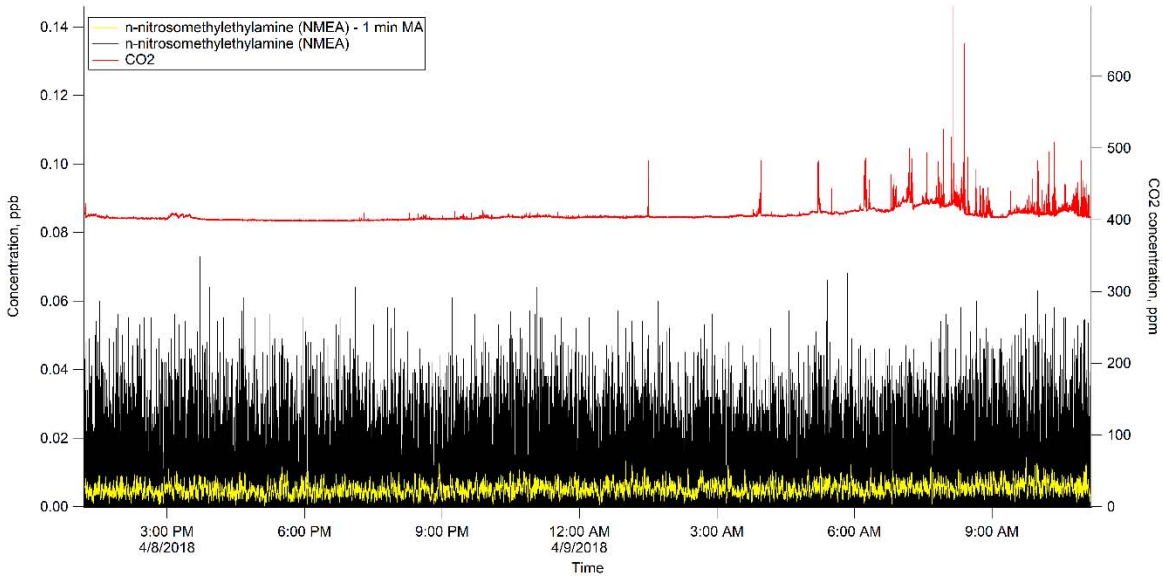


Figure 1-14. N-nitrosomethylethylamine (NMEA).

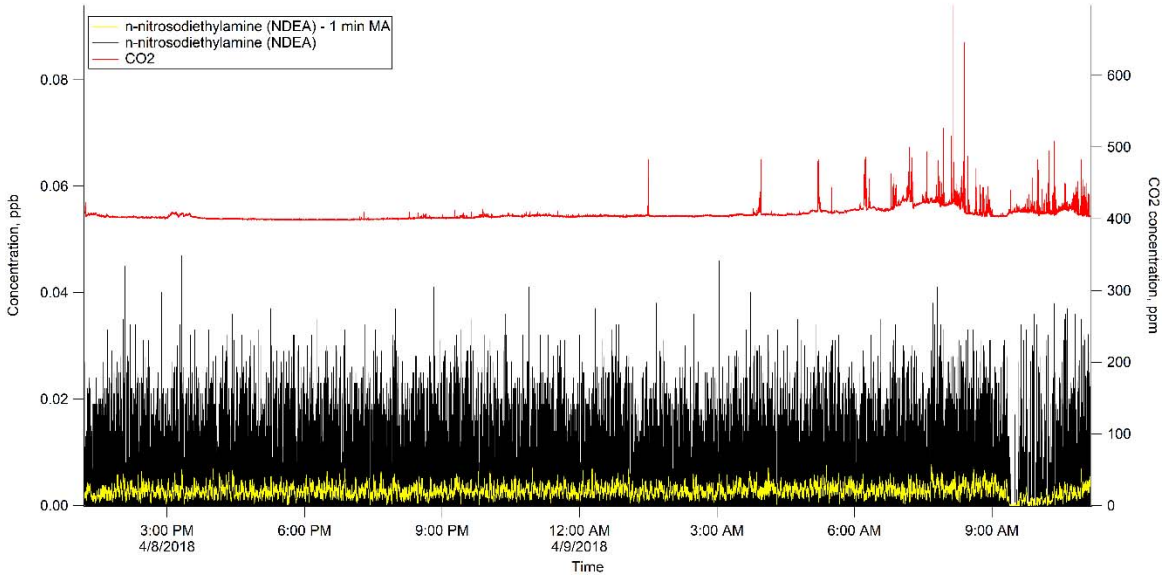


Figure 1-15. N-nitrosodiethylamine (NDEA).

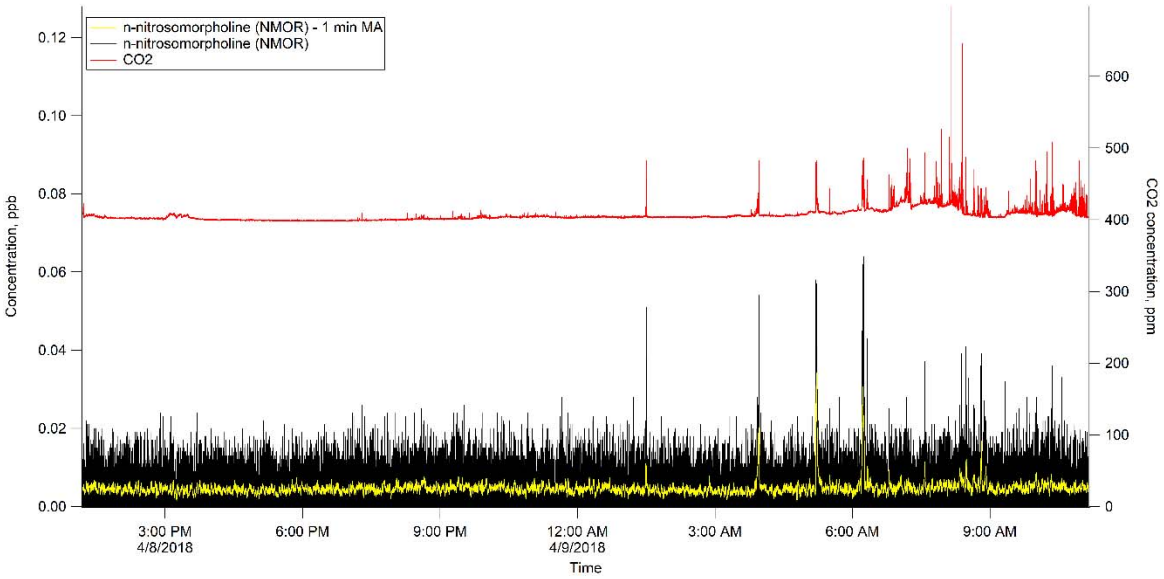


Figure 1-16. N-nitrosomorpholine (NMOR).

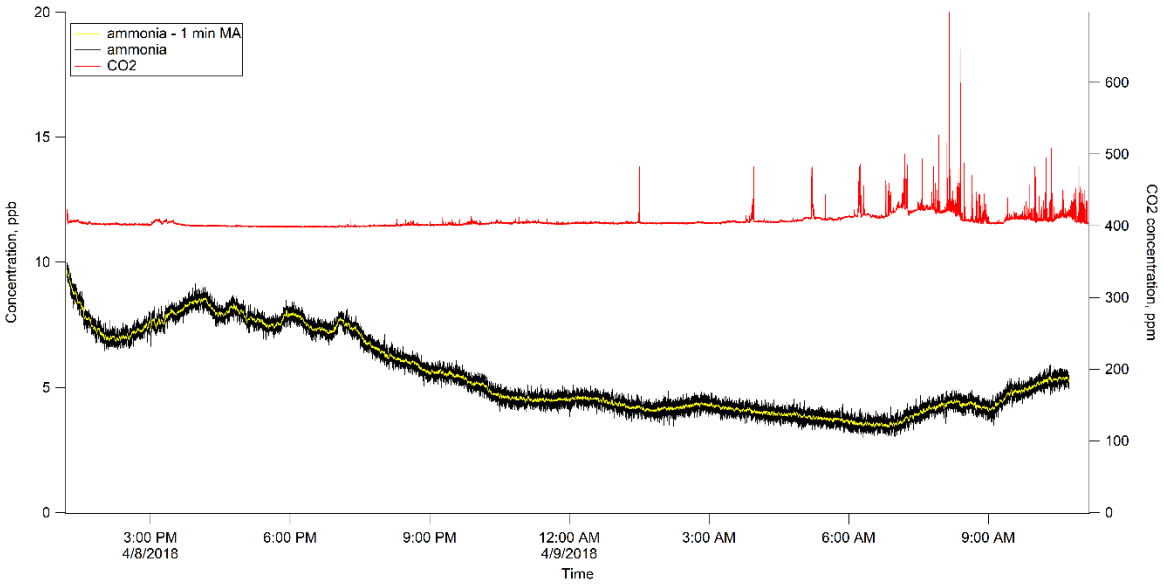


Figure 1-17. Ammonia.

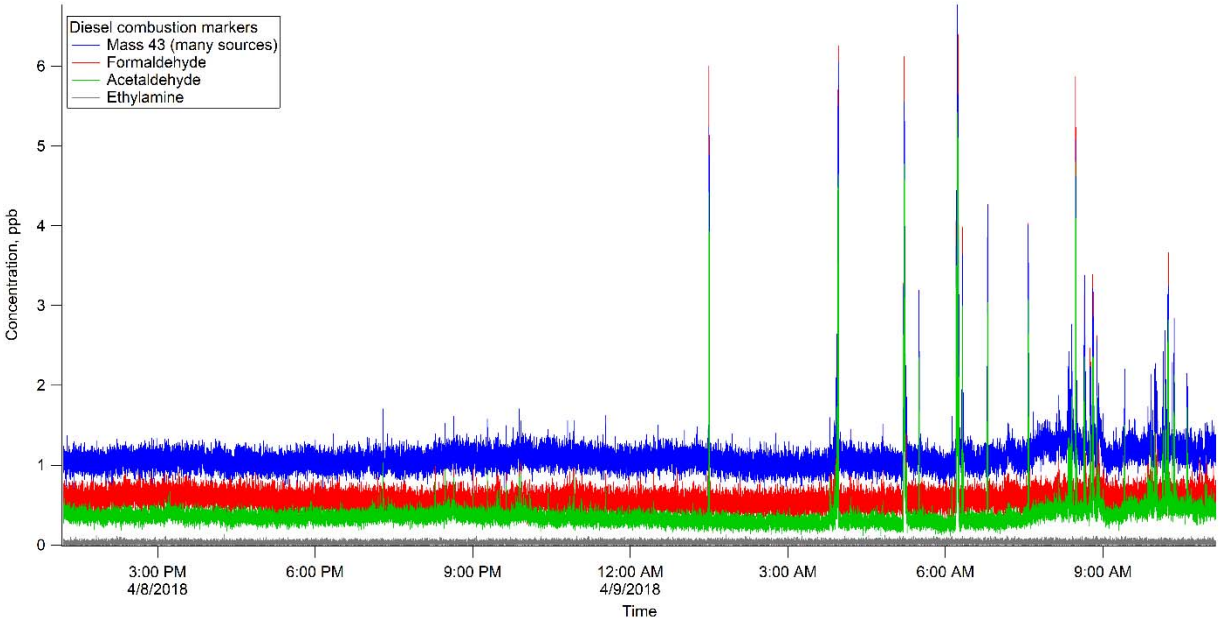


Figure 1-18. Diesel Combustion Markers.

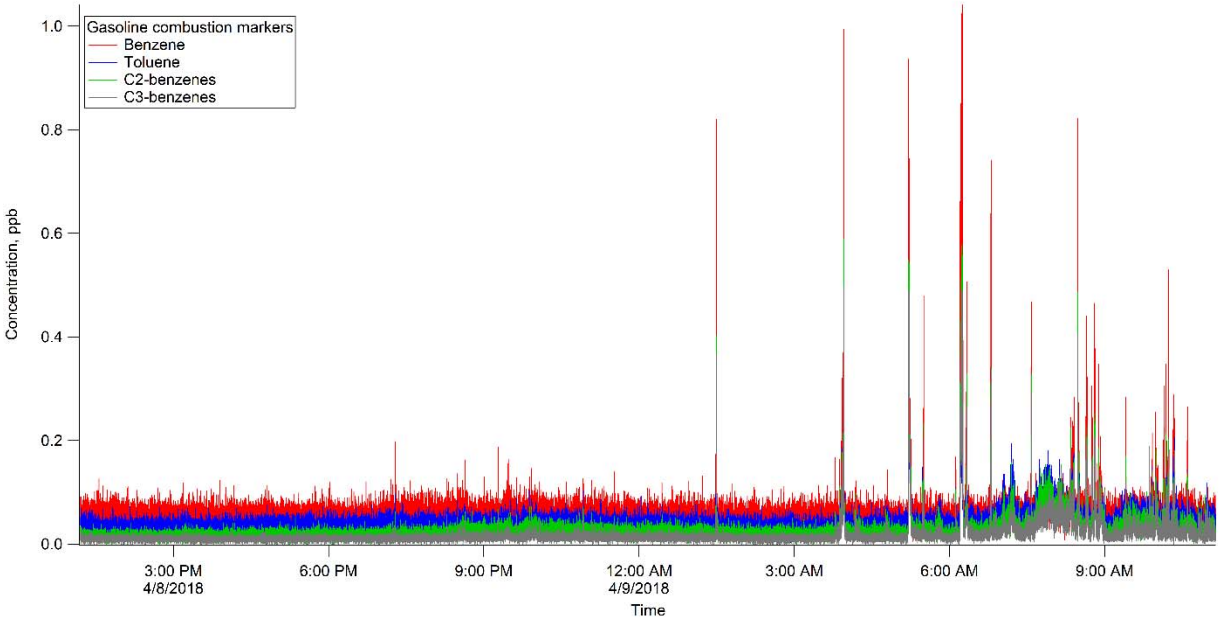


Figure 1-19. Gasoline Combustion Markers.

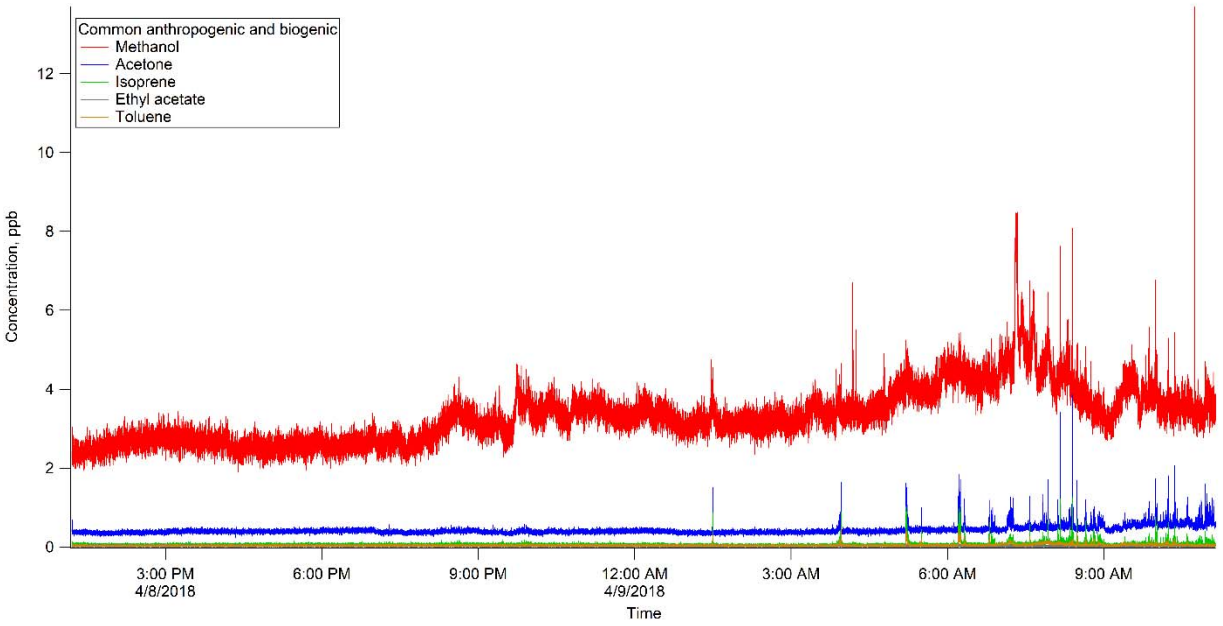


Figure 1-20. Plant and Human Markers.

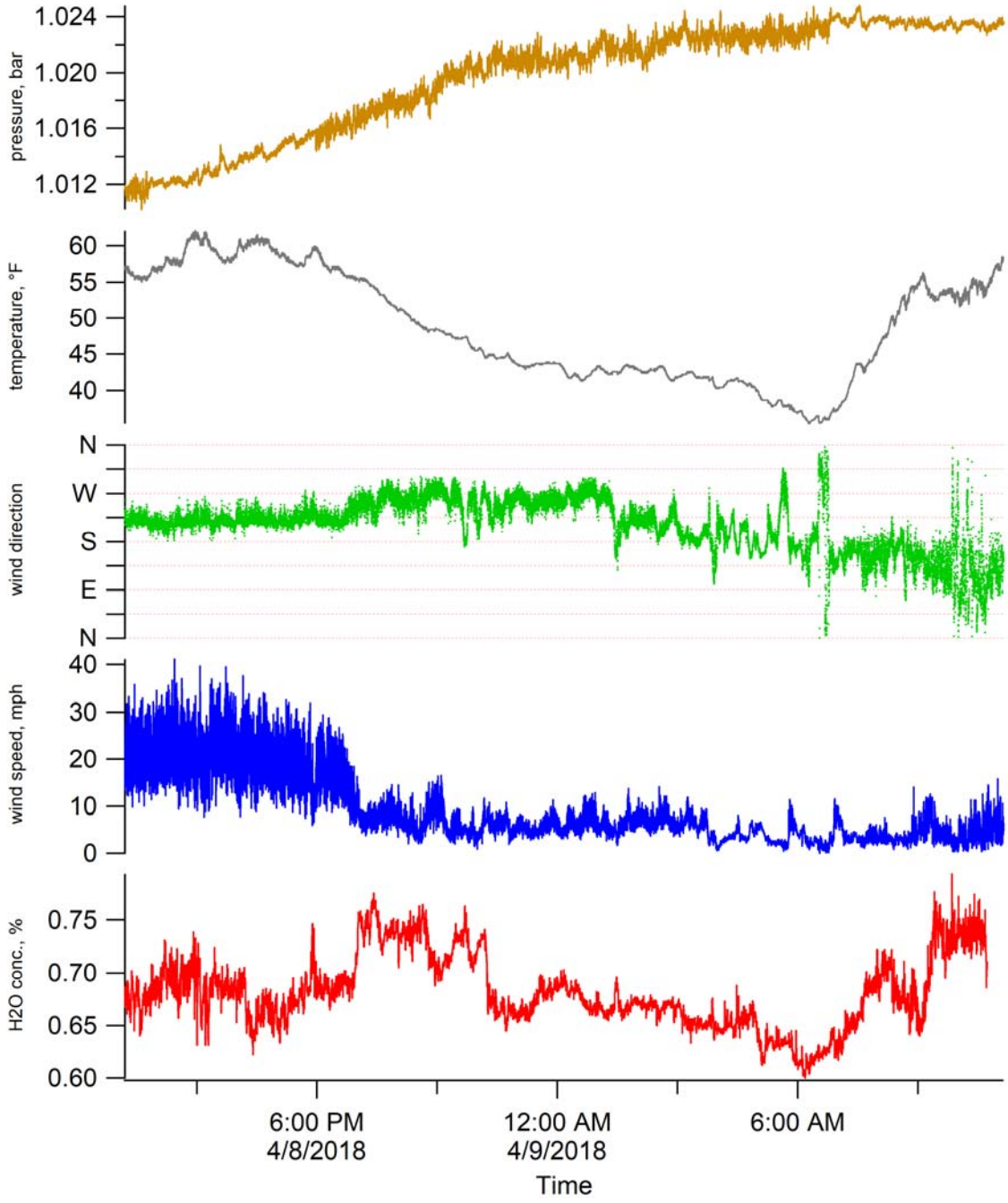


Figure 1-21. Weather Data.

2.0 APRIL 9, 2018 – APRIL 10, 2018 – STUDY SITE #3

2.1 Quality Assessment

Data from April 9, 2018, were transferred to TerraGraphics via the WRPS FTP site on April 17, 2018. Data were assessed using Procedure 17124-DOE-HS-102. A completed Data Exchange Checklist was sent to WRPS on April 17, 2018. The data were accepted by TerraGraphics with the following comments. All startup, shutdown, and calibration procedures were adequately documented and all other checks passed the acceptance limits. No other exceptions besides those below were noted.

2.2 Summary

The Mobile Laboratory personnel performed background sampling using the Mobile Laboratory from April 9, 2018, to April 10, 2018 at Study Site 3. Site 3 is located near the corner of 4th and Buffalo just to the west of the 242-A Evaporator. This site historically has seen the occurrence of several AOP-15 events (reports of unusual odors). The Mobile Laboratory arrived at Site 3 at 12:10 on April 9, 2018. The initial QA/QC zero air/sensitivity checks were performed on the CO_2 monitor, NH_3 monitor, and the PTR-MS beginning at 12:20. The data file names were confirmed and routine data collection resumed by 13:30. The exhaust line was moved at 14:09 and 14:15 to account for shifting winds. The Mobile Laboratory staff departed the monitoring site at 15:35.

The Mobile Laboratory staff returned to Site 3 at 06:25 on April 10, 2018, and began confirmatory sample collection by 06:42. Data collection was stopped briefly at 06:26 to fix 4-second data discrepancies. Rain at 07:30 prompted a call to Mr. George Weeks to approve the use of a funnel to protect sample collection. Due to variable wind, the exhaust line was repositioned several times between 08:00 and 10:00 to minimize influence on measurements. Closeout zero air/sensitivity checks were performed at 10:43. The Mobile Laboratory moved to Site 4 by 12:08.



Figure 2-1. Mobile Lab Site #3 for the Duration of the Monitoring Period.

2.3 Samples Collected

Continuous air monitoring was performed using the following instrumentation:

- PTR-MS,
- LI-COR CO_2 Monitor,
- Picarro Ammonia Monitor, and
- Weather Station.

Confirmatory air samples were collected as follows:

Table 2-1. Alternative Media Samples Taken.

Site	Date	Sample Type	ID	Start	Stop	Sample Time (min)
3	9-Apr	Thermosorb/N	EL22196	12:28	15:30	181
3	9-Apr	CarboTrap-300	A048104	12:38	13:50	71
3	10-Apr	Thermosorb/N	EL22195	06:42	09:44	181
3	10-Apr	CarboTrap-300	A001331	06:50	08:05	75

Table 2-2 displays the statistical information for the monitoring period of April 9, 2018, to April 10, 2018. By definition, the OEL is an 8-hour, time-weighted average that establishes a limit for personnel exposures to hazardous chemicals. It is the exposure level to which a person may be exposed for 8 hours/day, 40 hours/week for 40 years and have no expectation of adverse health effects. In this study, area vapor concentration measurements were made to better understand the hazardous vapor exposures that workers may receive. These measurements are only compared to

OEL concentrations to give them context. It is neither accurate nor appropriate to interpret these short duration measurements (2 seconds) as worker exposure levels. Since the OEL is defined as a time-weighted average, it is more appropriate to compare them to daily average vapor concentrations. Short duration excursions above the OEL concentration are not significant.

Table 2-2. Statistical Information for the Monitoring Period of April 9, 2018 – April 10, 2018.

COPC #	COPC Name	Reporting Limit (ppb)	OEL (ppb)	Ave. (ppb)	St. Dev. (ppb)	Rel. St. Dev. (%)	Max (ppb)	Median (ppb)	Sec. over 50% OEL	Sec. over OEL
1	ammonia	1	25000	5.82	0.491	8.4%	7.51	5.80	0	0
2	furan	0.09	1	0.046	0.021	71.5%	0.467	0.026	0	0
3	but-3-en-2-one + 2,3-dihydrofuran + 2,5-dihydrofuran	0.22	1	0.114	0.058	87.0%	N/A*	N/A*	N/A	N/A
4	NDMA**	0.06	0.3	0.037	0.030	115.7%	0.290	0.016	134	0
5	2-methylfuran	0.05	1	0.036	0.027	75.5%	0.603	0.030	4	0
6	NEMA	0.02	0.3	0.015	0.016	179.0%	0.113	0.000	0	0
7	2,5-dimethylfuran	0.05	1	0.031	0.022	77.0%	0.366	0.024	0	0
8	NDEA	0.01	0.1	0.007	0.007	230.9%	0.056	0.000	8	0
9	2-propylfuran + 2-ethyl-5-methylfuran	0.02	1	0.015	0.013	102.7%	0.186	0.009	0	0
10	NMOR	0.05	0.6	0.025	0.007	88.6%	0.109	0.007	0	0
11	2-ethyl-2-hexenal + 4-(1-methylpropyl)-2,3-dihydrofuran + 3-(1,1-dimethylethyl)-2,3-dihydrofuran	0.04	1	0.021	0.010	51.5%	0.155	0.019	0	0
12	2-pentylfuran	0.04	1	0.024	0.012	42.1%	0.166	0.028	0	0
13	2-heptylfuran	0.02	1	0.012	0.006	52.1%	0.075	0.011	0	0
14	2-octylfuran	0.01	1	0.005	0.003	184.4%	0.029	0.000	0	0
15	6-(2-furanyl)-6-methyl-2-heptanone	0.01	1	0.005	0.003	156.3%	0.020	0.000	0	0
16	furfural acetophenone	0.07	1	0.035	0.004	45.3%	0.044	0.009	0	0

* The maximum peak value for but-3-en-2-one + 2,3 dihydrofuran + 2,5 dihydrofuran was 1.394 ppb and the median value was 0.050 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 200, 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 each COPC signal, overlaid with the same signal smoothed using a 1-minute moving average, and CO_2, for the monitoring period April 9, 2018, to April 10, 2018.

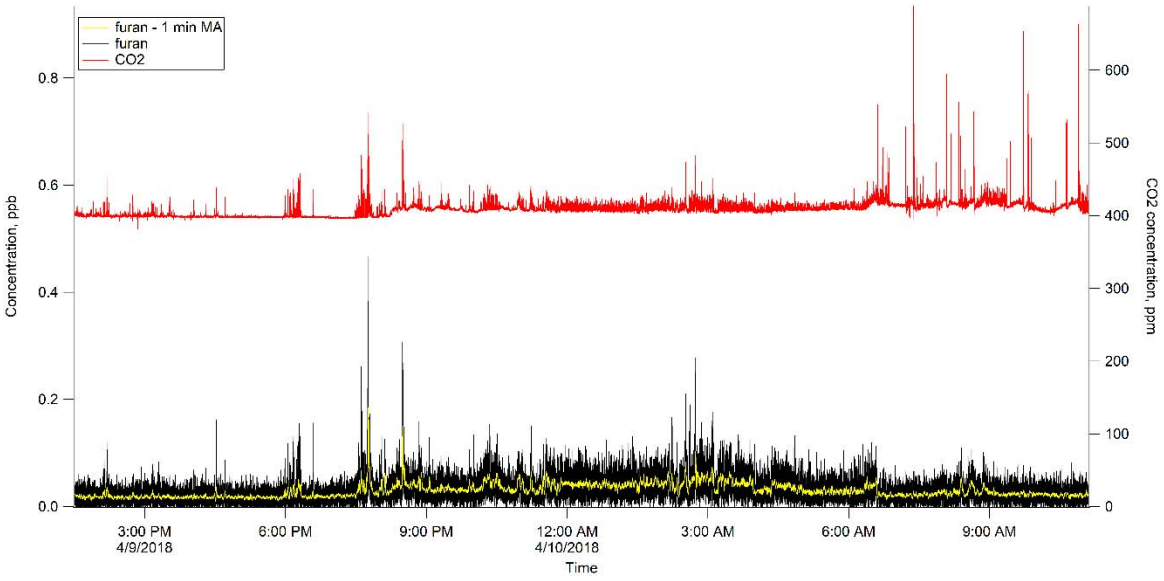


Figure 2-2. Furan.

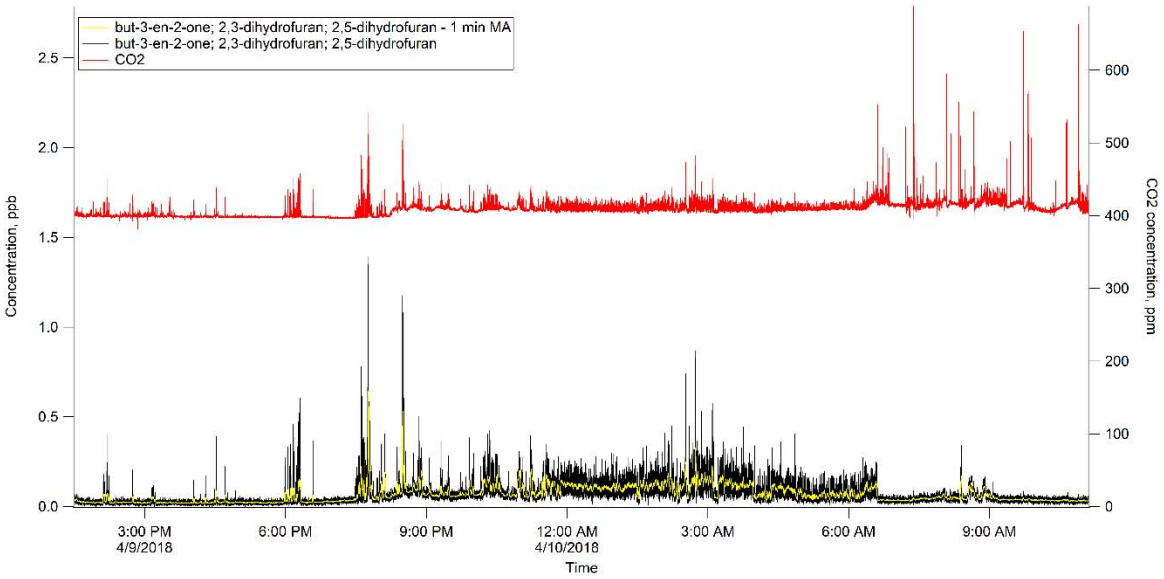


Figure 2-3. but-3-en-2-one + 2,3-dihydrofuran + 2,5-dihydrofuran.

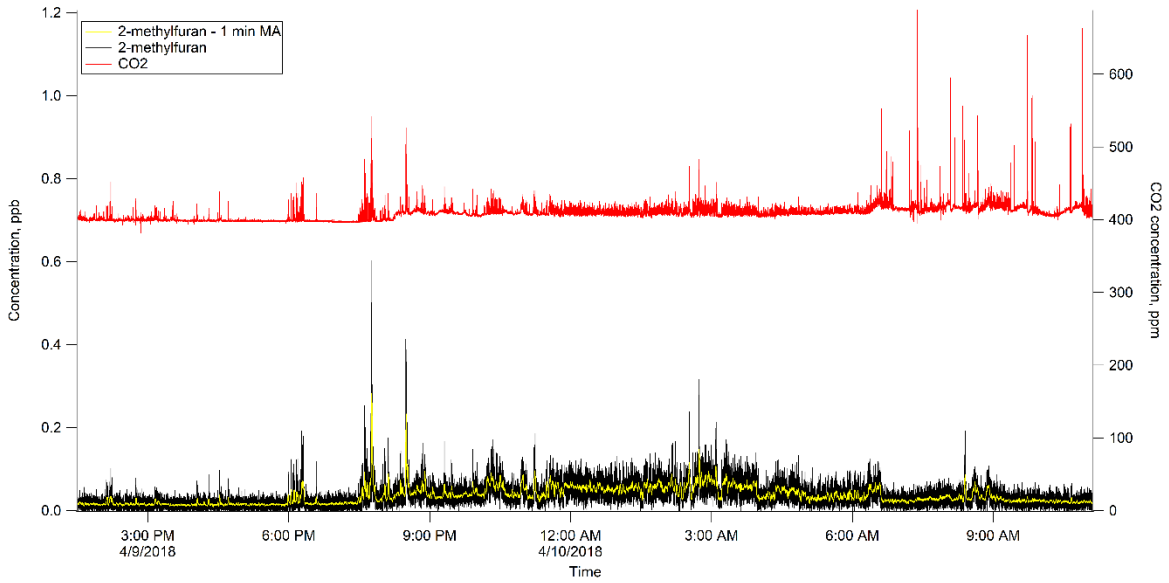


Figure 2-4. 2-methylfuran.

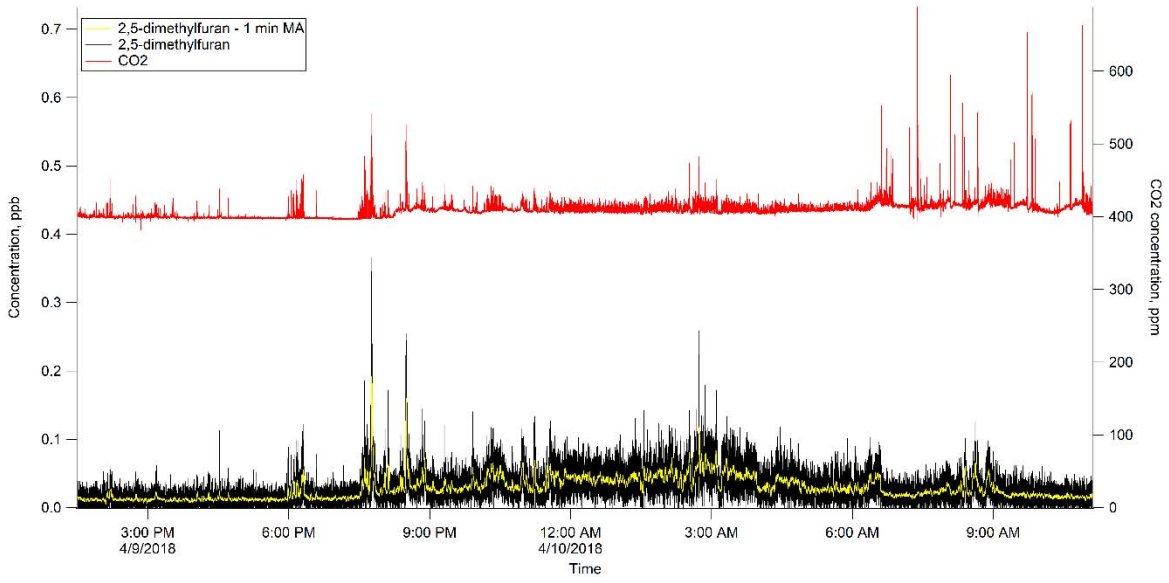


Figure 2-5. 2,5-dimethylfuran.

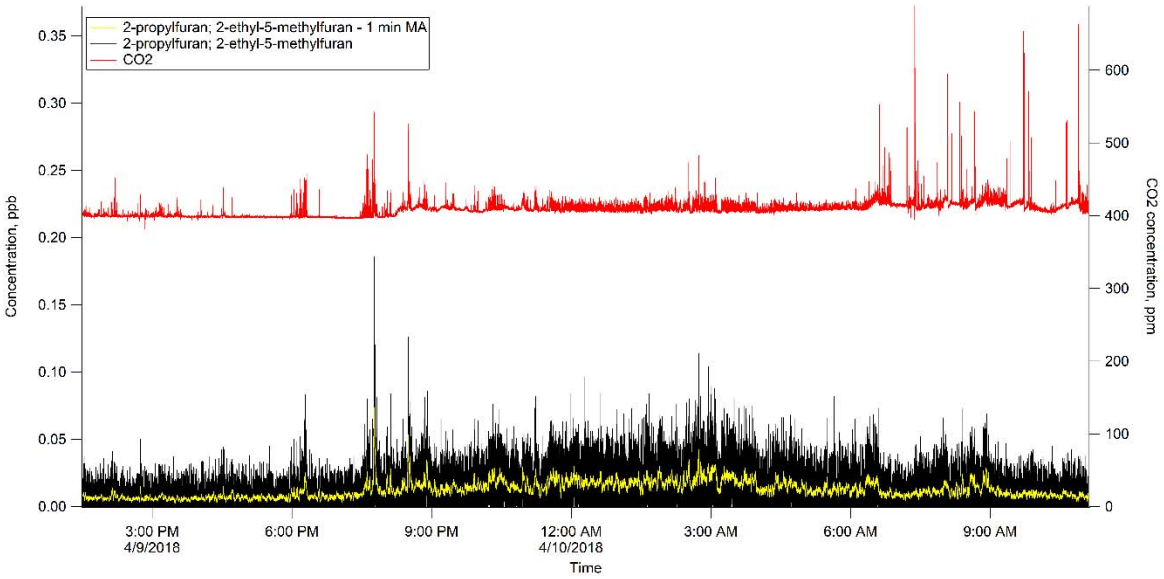


Figure 2-6. 2-propylfuran + 2-ethyl-5-methylfuran.

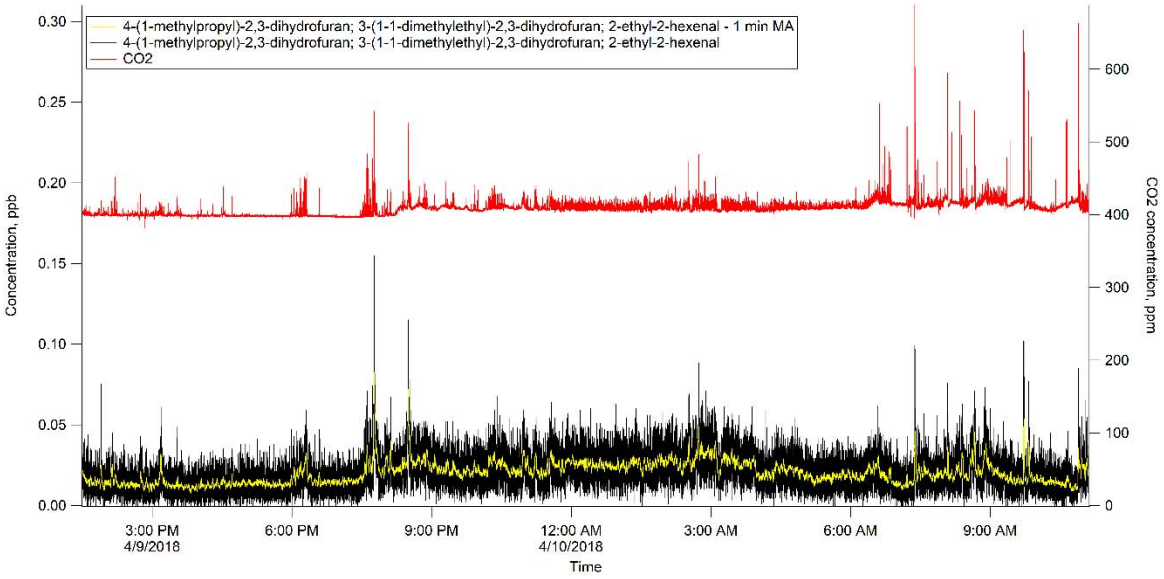


Figure 2-7. 4-(1-methylpropyl)-2,3-dihydrofuran + 3-(1-1-dimethylethyl)-2,3-dihydrofuran + 2-ethyl-2-hexenal.

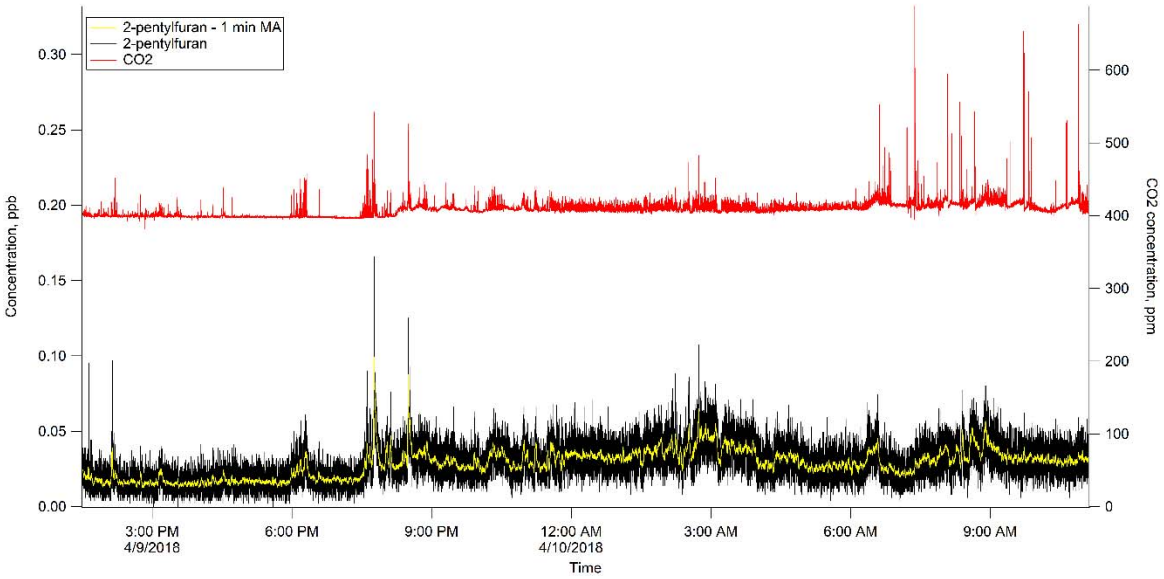


Figure 2-8. 2-pentylfuran.

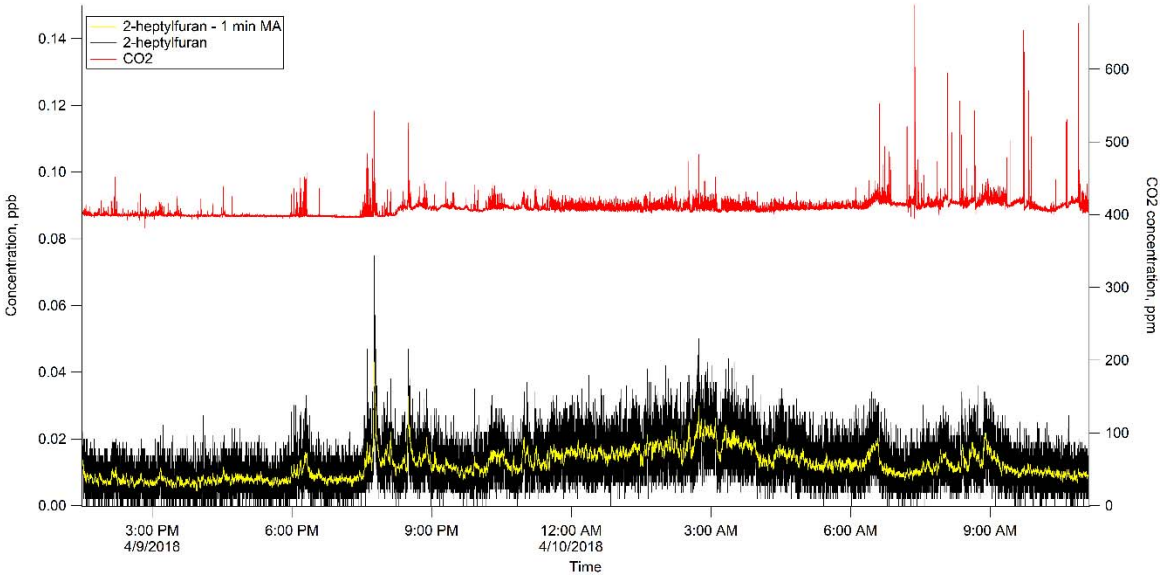


Figure 2-9. 2-heptylfuran.

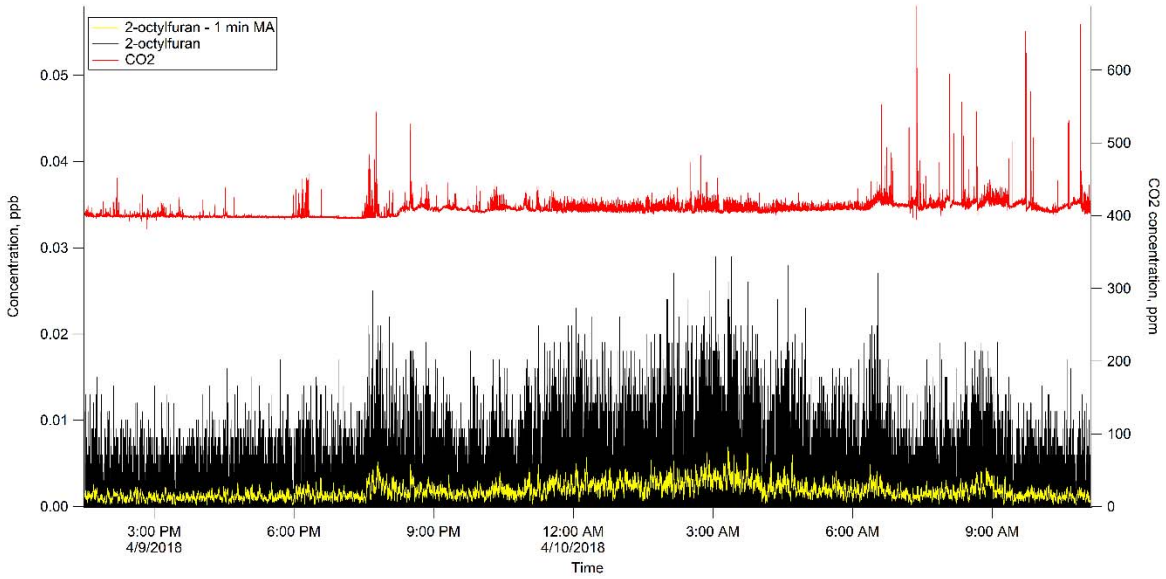


Figure 2-10. 2-octylfuran.

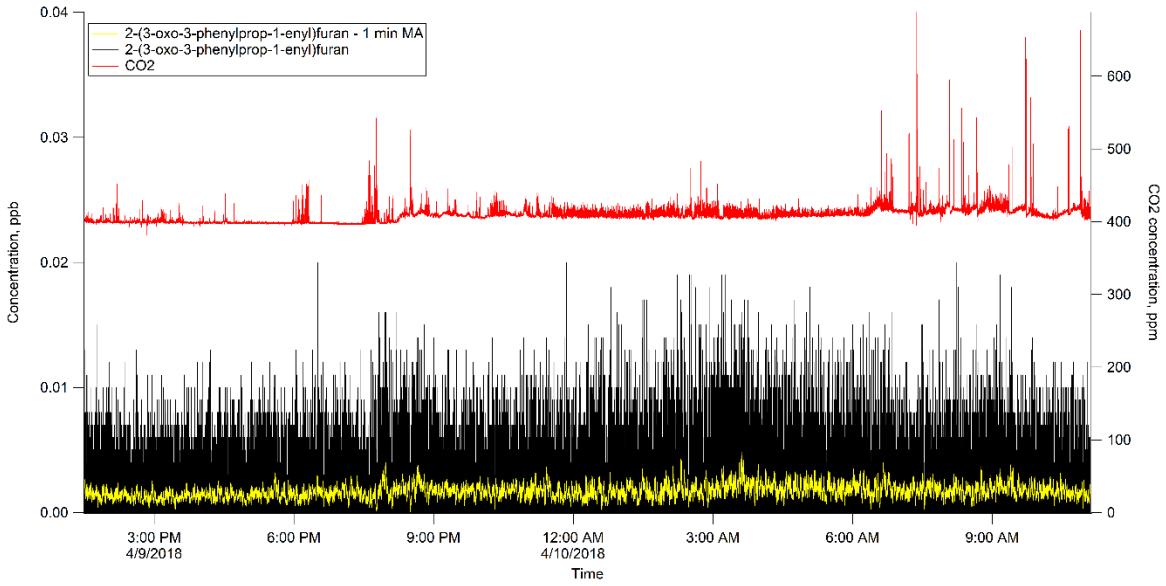


Figure 2-11. 2-(3-oxo-3-phenylprop-1-enyl)furan.

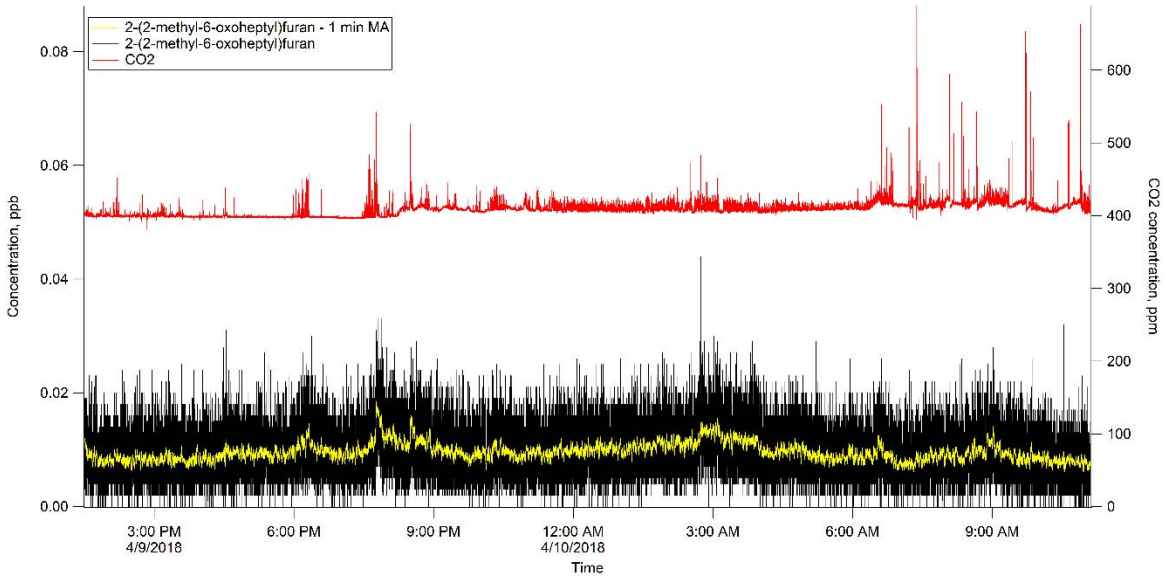


Figure 2-12. 2-(2-methyl-6-oxoheptyl)furan.

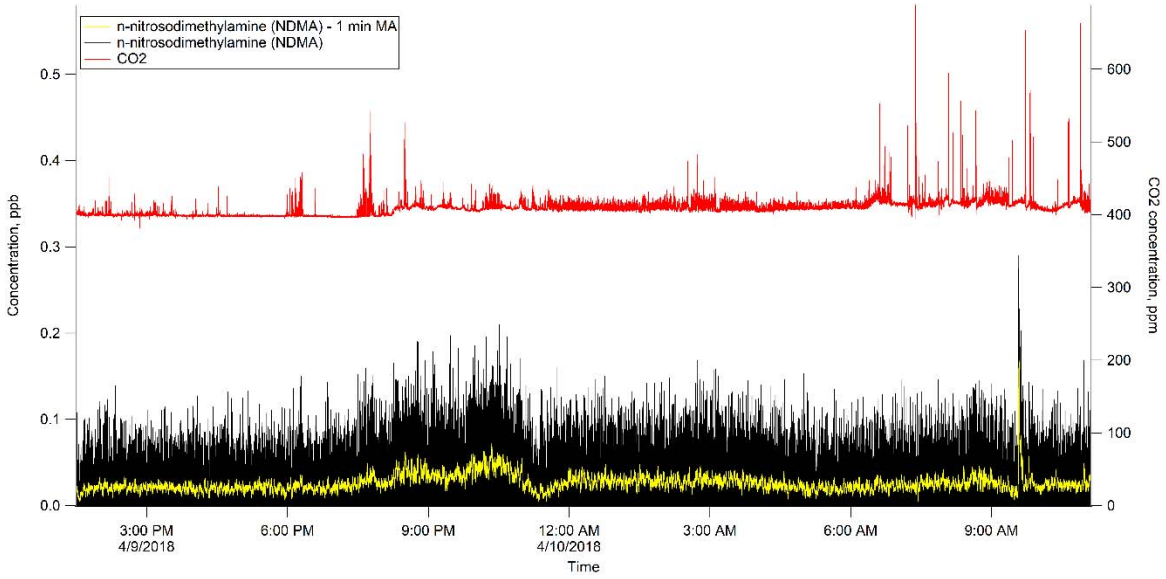


Figure 2-13. N-nitrosodimethylamine (NDMA).

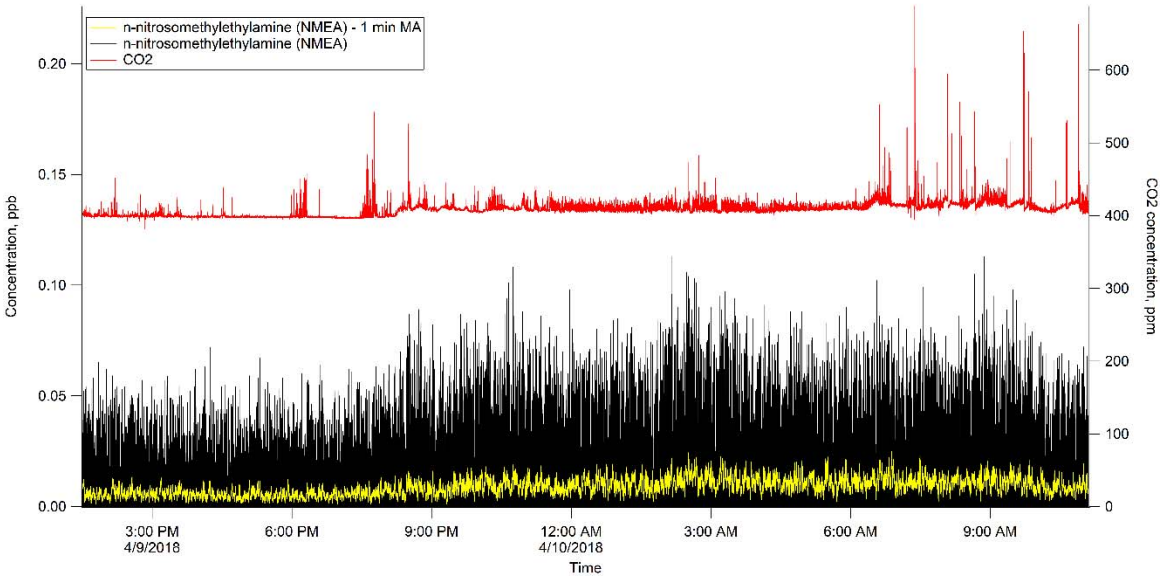


Figure 2-14. N-nitrosomethylethylamine (NMEA).

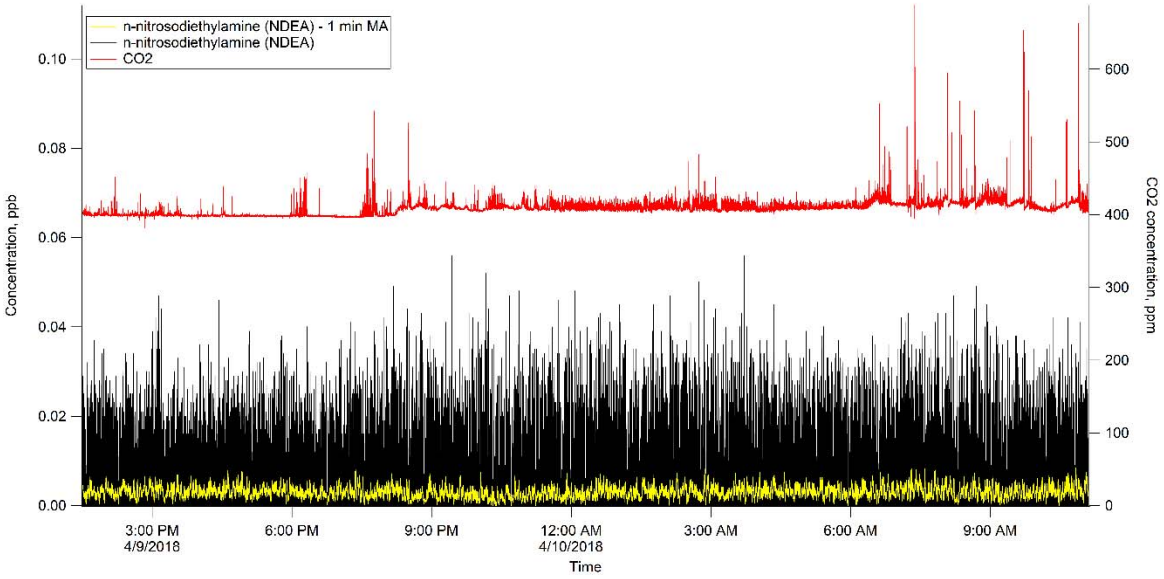


Figure 2-15. N-nitrosodiethylamine (NDEA).

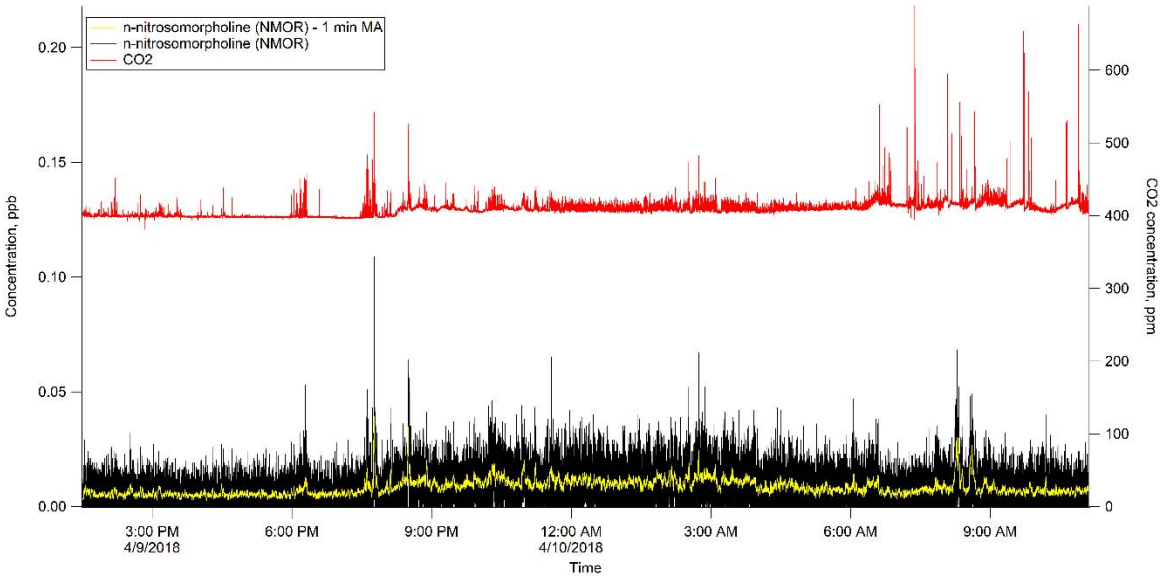


Figure 2-16. N-nitrosomorpholine (NMOR).

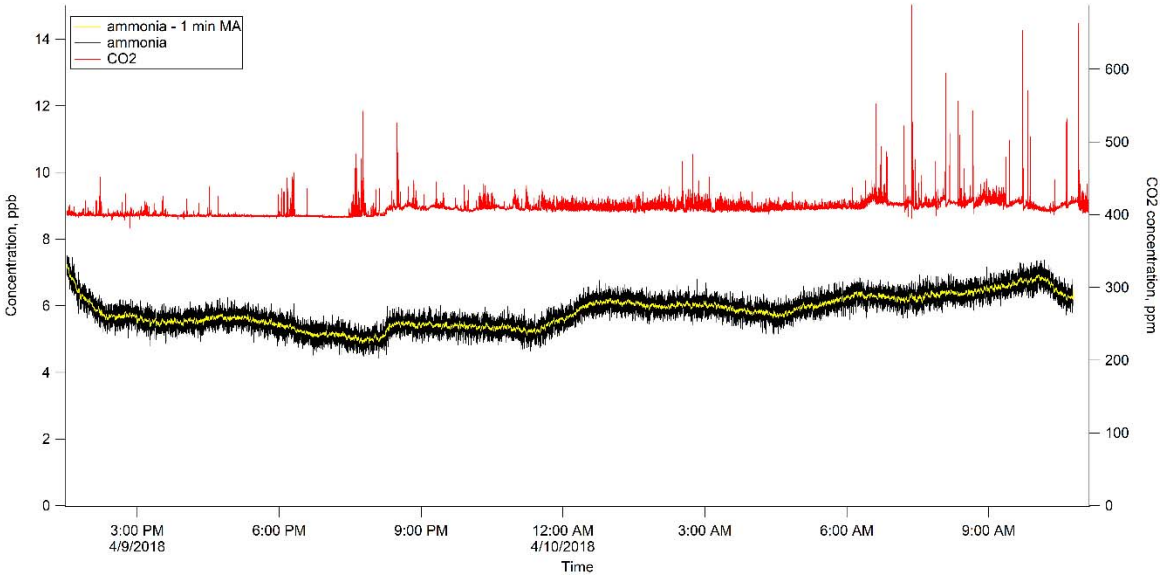


Figure 2-17. Ammonia.

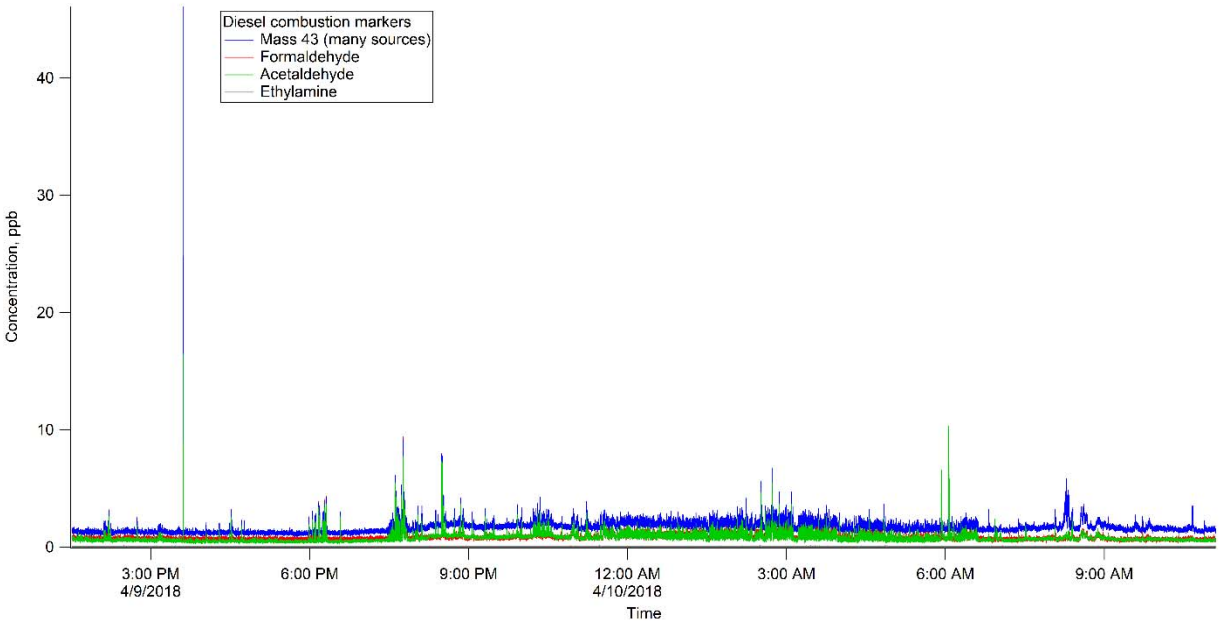


Figure 2-18. Diesel Combustion Markers.

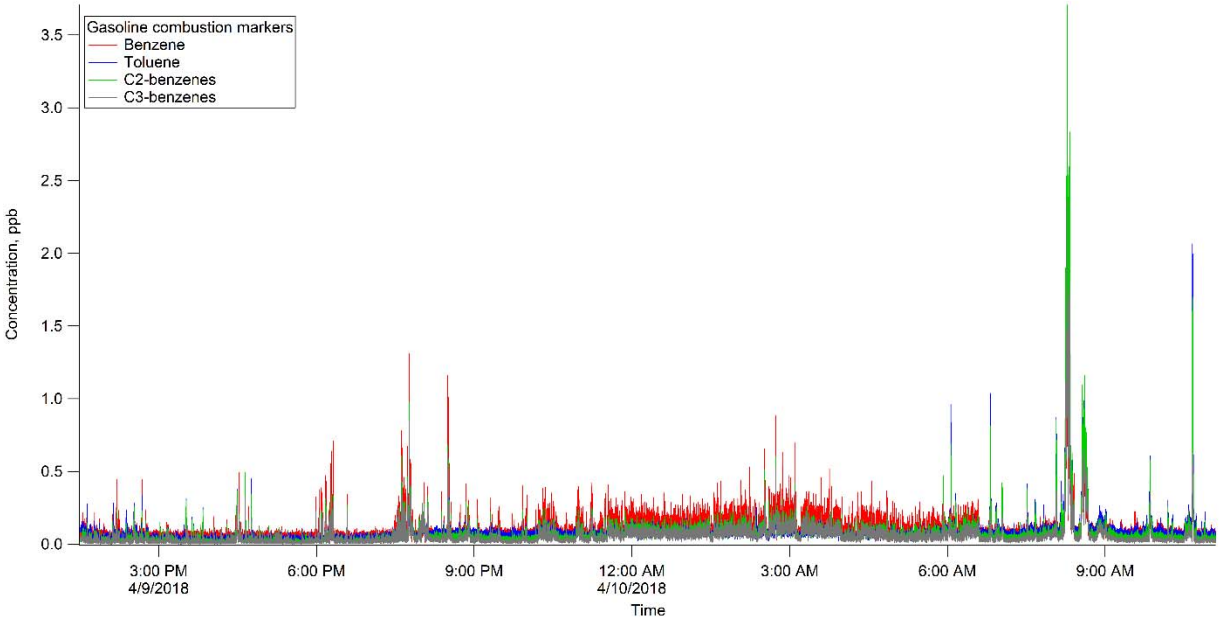


Figure 2-19. Gasoline Combustion Markers.

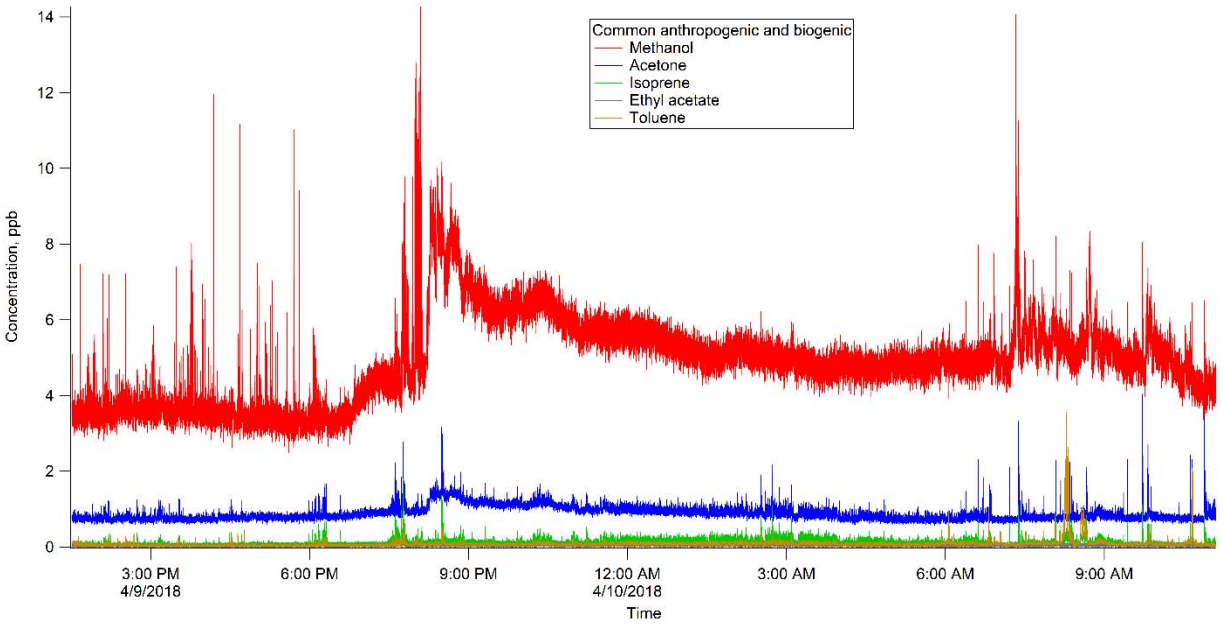


Figure 2-20. Plant and Human Markers.

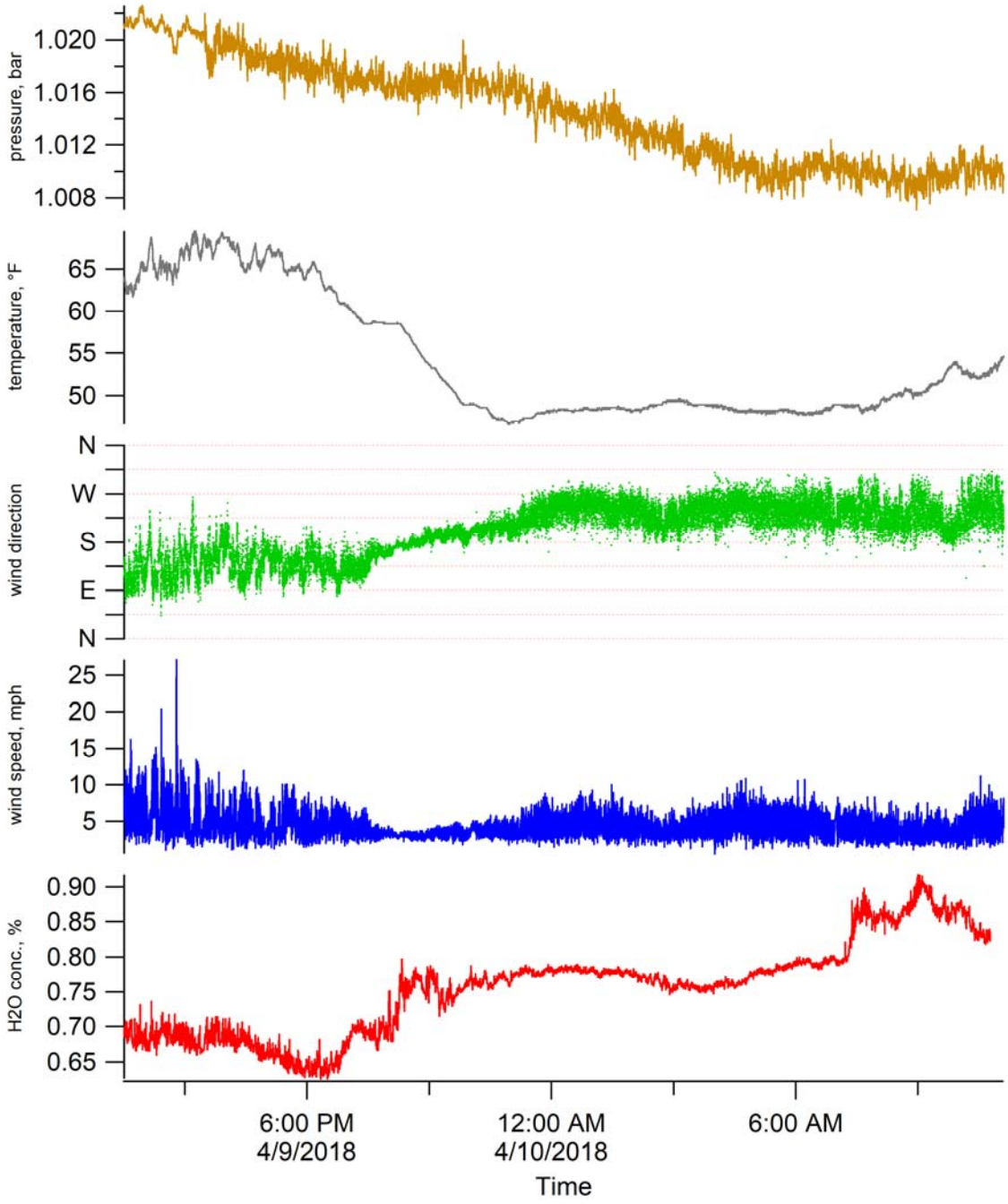


Figure 2-21. Weather Data.

3.0 APRIL 11, 2018 – APRIL 12, 2018 – STUDY SITE #5

3.1 Quality Assessment

Data from April 11, 2018, were transferred to TerraGraphics via the WRPS FTP site on April 18, 2018. Data were assessed using Procedure 17124-DOE-HS-102. A completed Data Exchange Checklist was sent to WRPS on April 23, 2018. The data were accepted by TerraGraphics with the following comments. All startup, shutdown, and calibration procedures were adequately documented and all other checks passed the acceptance limits.

3.2 Summary

The Mobile Laboratory personnel performed background sampling using the Mobile Laboratory from April 11, 2018, to April 12, 2018 at Study Site 5. Site 5 is located SE of the Waste Treatment Facility. This site may provide data related to stack emission dispersion downwind of the tank farm ventilation and as a baseline data point for future reference once the Waste Treatment Facility begins operation. The Mobile Laboratory arrived at Site 5 at 12:30 on April 11, 2018. The initial QA/QC zero air/sensitivity checks were performed on the CO_2 monitor, NH_3 monitor, and the PTR-MS beginning at 12:37. The data file names were confirmed and routine data collection resumed by 13:33. The Mobile Laboratory staff departed the monitoring site after 15:00.

The Mobile Laboratory staff returned to Site 5 at 06:44 on April 12, 2018, and began confirmatory sample collection by 06:50. Closeout zero air/sensitivity checks were performed at 10:42. The 10,000 ppbv NH_3 standard (CBAL-451-85A) failed percent recovery criteria so the Mobile Laboratory staff switched back to the 100,000 ppbv NH_3 standard (CBAL-451-74A) as discussed. The Mobile Laboratory moved to Site 6 by 12:49.



Figure 3-1. Mobile Lab Site #5 for the Duration of the Monitoring Period.

3.3 Samples Collected

Continuous air monitoring was performed using the following instrumentation:

- PTR-MS,
- LI-COR CO_2 Monitor,
- Picarro Ammonia Monitor, and
- Weather Station.

Confirmatory air samples were collected as follows:

Table 3-1. Alternative Media Samples Taken.

Site	Date	Sample Type	ID	Start	Stop	Sample Time (min)
5	11-Apr	Thermosorb/N	EL22190	12:43	15:43	180
5	11-Apr	CarboTrap-300	A046028	12:50	14:01	71
5	12-Apr	Thermosorb/N	EL22191	06:50	09:53	181
5	12-Apr	CarboTrap-300	A0221875	06:58	08:12	72

Table 3-2 displays the statistical information for the monitoring period of April 11, 2018, to April 12, 2018. By definition, the OEL is an 8-hour, time-weighted average that establishes a limit for personnel exposures to hazardous chemicals. It is the exposure level to which a person may be exposed for 8 hours/day, 40 hours/week for 40 years and have no expectation of adverse health effects. In this study, area vapor concentration measurements were made to better understand the hazardous vapor exposures that workers may receive. These measurements are only compared to OEL concentrations to give them context. It is neither accurate nor appropriate to interpret these short duration measurements (2 seconds) as worker exposure levels. Since the OEL is defined as a time-weighted average, it is more appropriate to compare them to daily average vapor concentrations. Short duration excursions above the OEL concentration are not significant.

Table 3-2. Statistical Information for the Monitoring Period of April 11, 2018 – April 12, 2018.

COPC #	COPC Name	Reporting Limit (ppb)	OEL (ppb)	Ave. (ppb)	St. Dev. (ppb)	Rel. St. Dev. (%)	Max (ppb)	Median (ppb)	Sec. over 50% OEL	Sec. over OEL
1	ammonia	1	25000	7.09	3.902	55.0%	19.14	5.68	0	0
2	furan	0.09	1	0.045	0.012	66.3%	0.188	0.017	0	0
3	but-3-en-2-one + 2,3-dihydrofuran + 2,5-dihydrofuran	0.22	1	0.110	0.020	62.9%	N/A*	N/A*	N/A	N/A
4	NDMA**	0.06	0.3	0.032	0.022	118.1%	0.135	0.011	0	0
5	2-methylfuran	0.05	1	0.025	0.011	66.8%	0.258	0.015	0	0
6	NEMA	0.02	0.3	0.013	0.011	180.7%	0.084	0.000	0	0
7	2,5-dimethylfuran	0.05	1	0.025	0.009	76.0%	0.167	0.011	0	0
8	NDEA	0.01	0.1	0.006	0.006	206.4%	0.045	0.000	0	0
9	2-propylfuran + 2-ethyl-5-methylfuran	0.02	1	0.011	0.008	105.4%	0.110	0.005	0	0
10	NMOR	0.05	0.6	0.025	0.005	100.9%	0.083	0.004	0	0
11	2-ethyl-2-hexenal + 4-(1-methylpropyl)-2,3-dihydrofuran + 3-(1,1-dimethylethyl)-2,3-dihydrofuran	0.04	1	0.020	0.008	65.2%	0.094	0.011	0	0
12	2-pentylfuran	0.04	1	0.020	0.008	43.7%	0.108	0.018	0	0
13	2-heptylfuran	0.02	1	0.012	0.007	62.4%	0.057	0.010	0	0
14	2-octylfuran	0.01	1	0.005	0.002	207.9%	0.028	0.000	0	0
15	6-(2-furanyl)-6-methyl-2-heptanone	0.01	1	0.005	0.002	155.9%	0.016	0.000	0	0
16	furfural acetophenone	0.07	1	0.035	0.004	55.7%	0.032	0.006	0	0

* The maximum peak value for but-3-en-2-one + 2,3 dihydrofuran + 2,5 dihydrofuran was 0.765 ppb and the median value was 0.029 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 200, 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 each COPC signal, overlaid with the same signal smoothed using a 1-minute moving average, and CO_2, for the monitoring period April 11, 2018, to April 12, 2018.

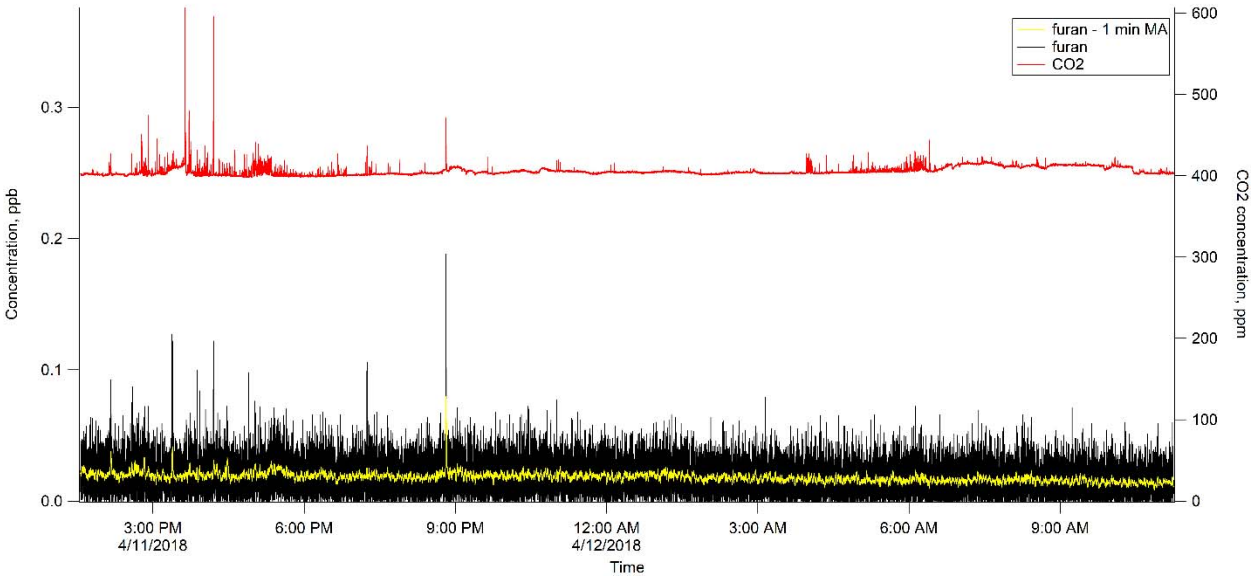


Figure 3-2. Furan.

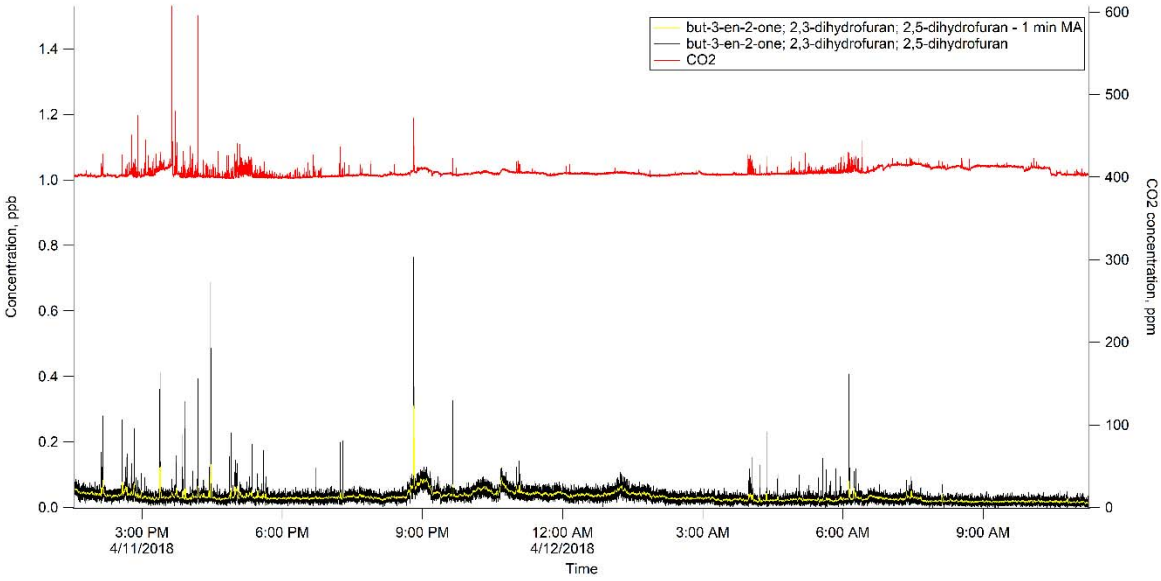


Figure 3-3. but-3-en-2-one + 2,3-dihydrofuran + 2,5-dihydrofuran.

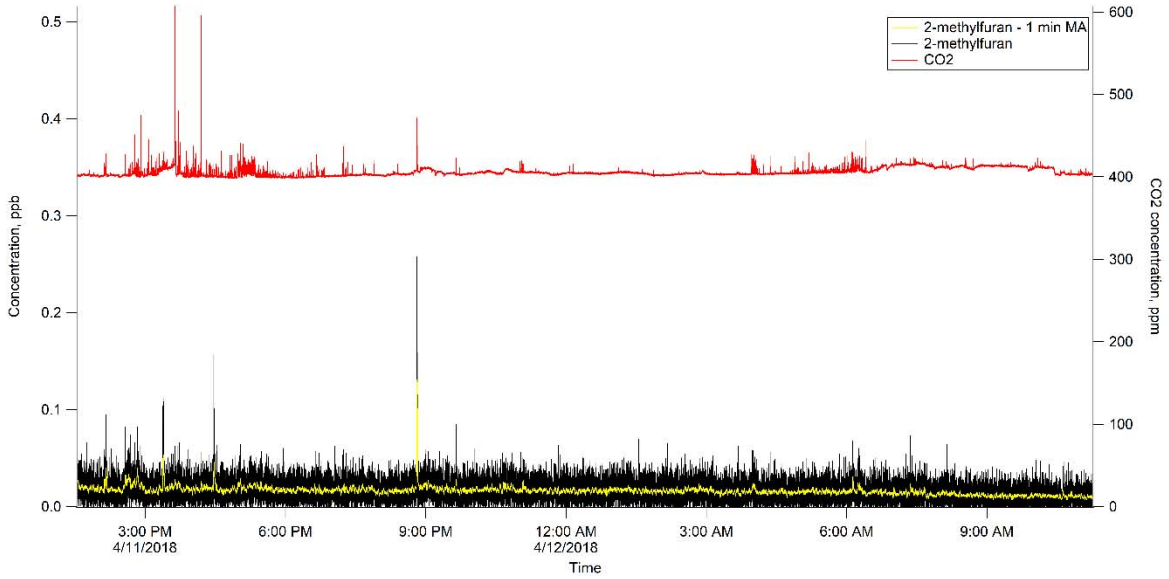


Figure 3-4. 2-methylfuran.

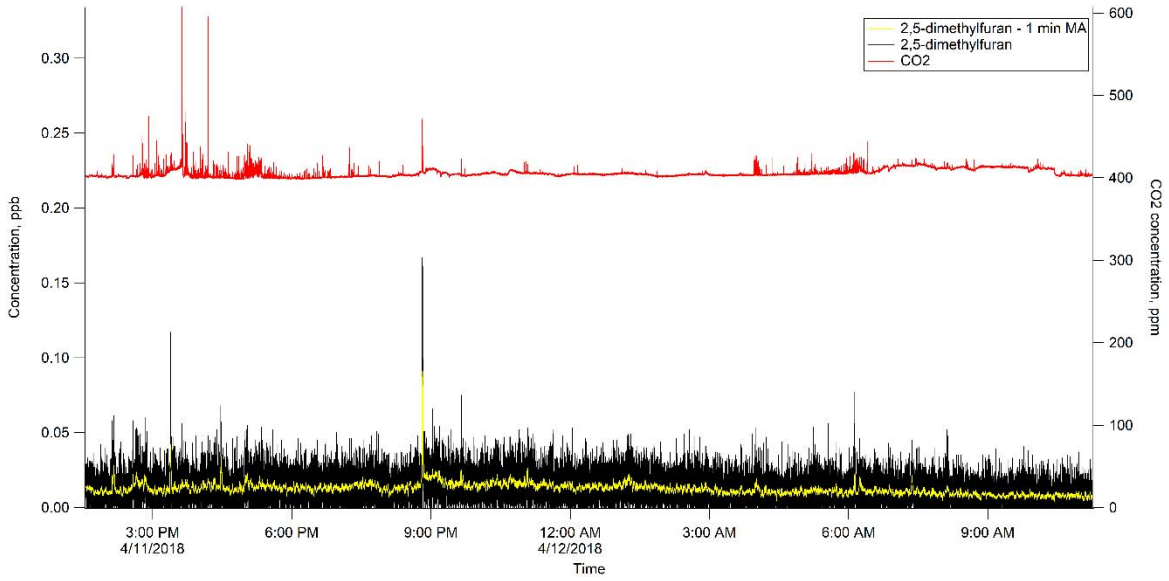


Figure 3-5. 2,5-dimethylfuran.

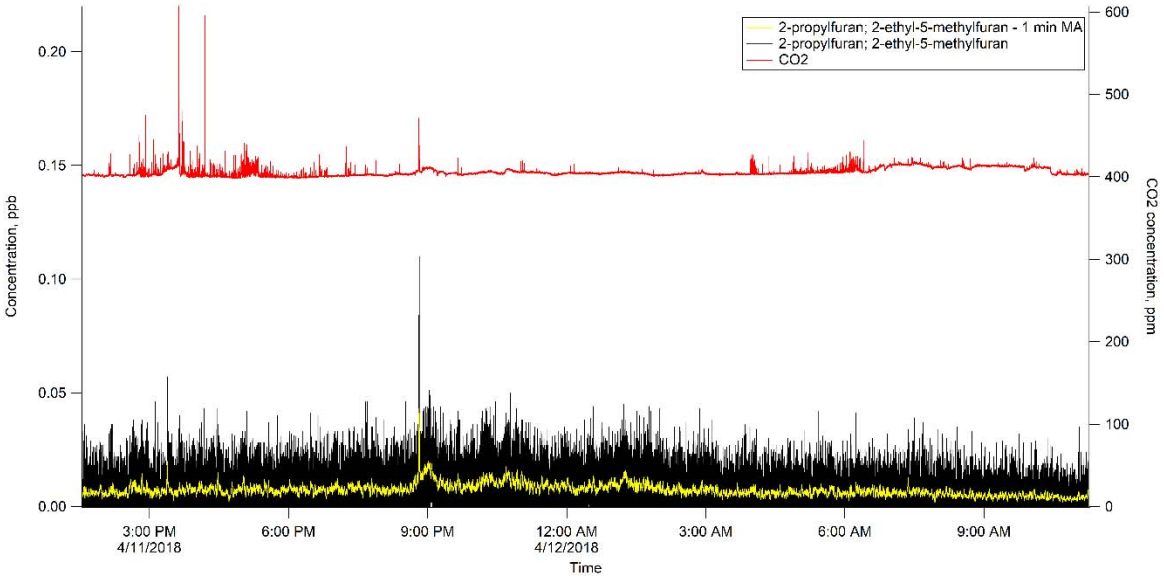


Figure 3-6. 2-propylfuran + 2-ethyl-5-methylfuran.

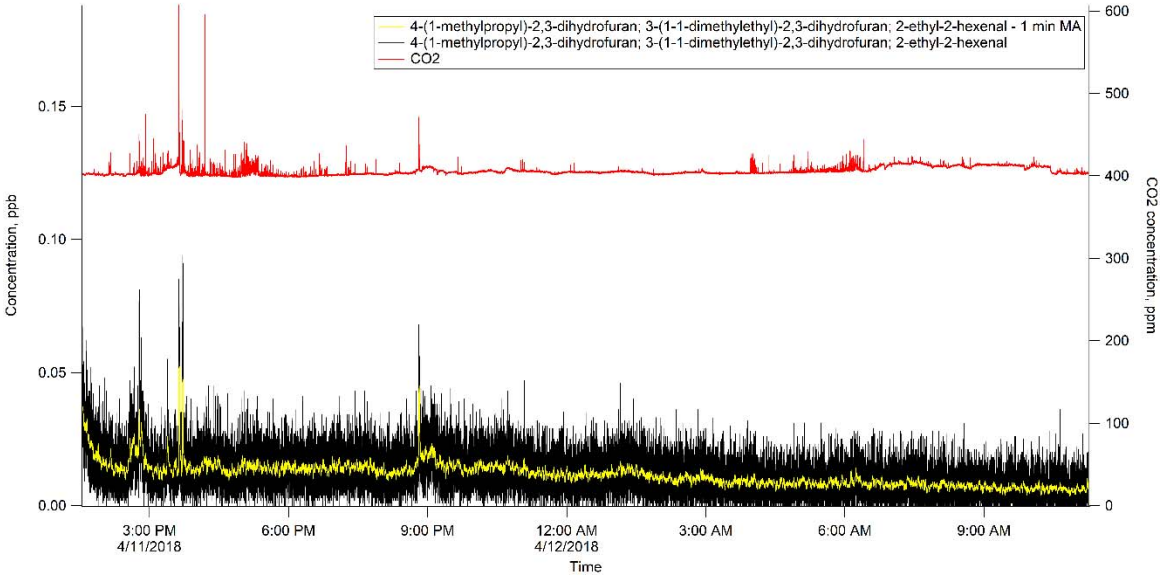


Figure 3-7. 4-(1-methylpropyl)-2,3-dihydrofuran + 3-(1-1-dimethylethyl)-2,3-dihydrofuran + 2-ethyl-2-hexenal.

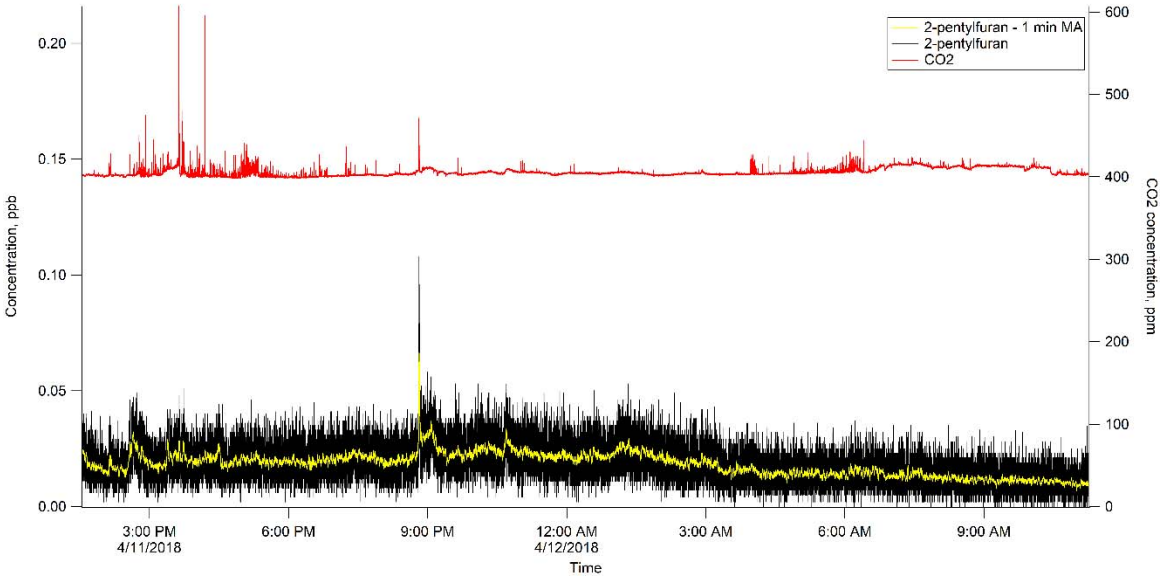


Figure 3-8. 2-pentylfuran.

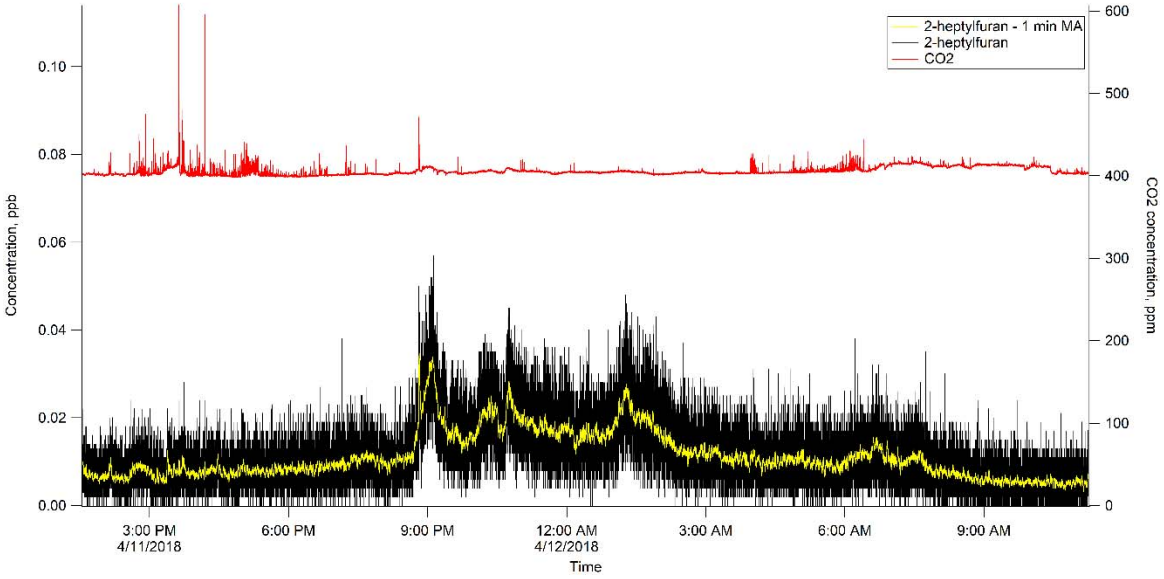


Figure 3-9. 2-heptylfuran.

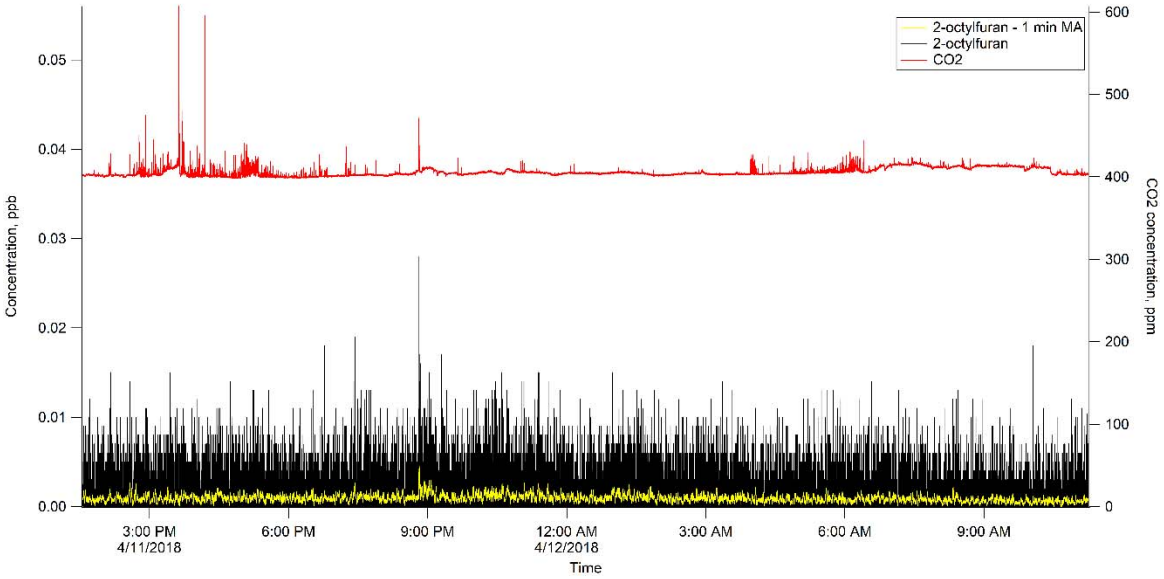


Figure 3-10. 2-octylfuran.

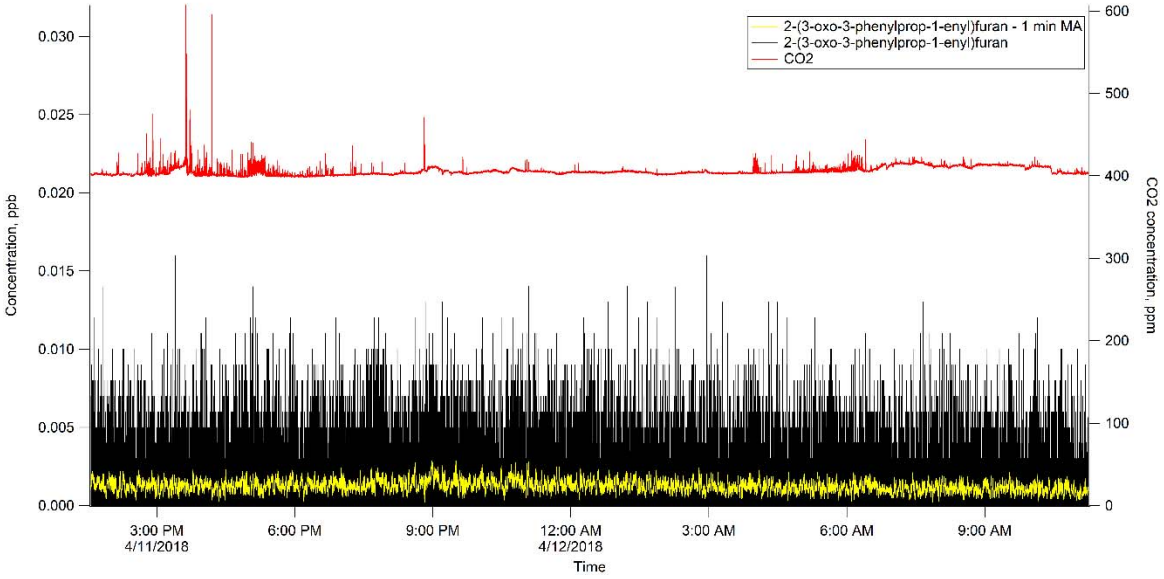


Figure 3-11. 2-(3-oxo-3-phenylprop-1-enyl)furan.

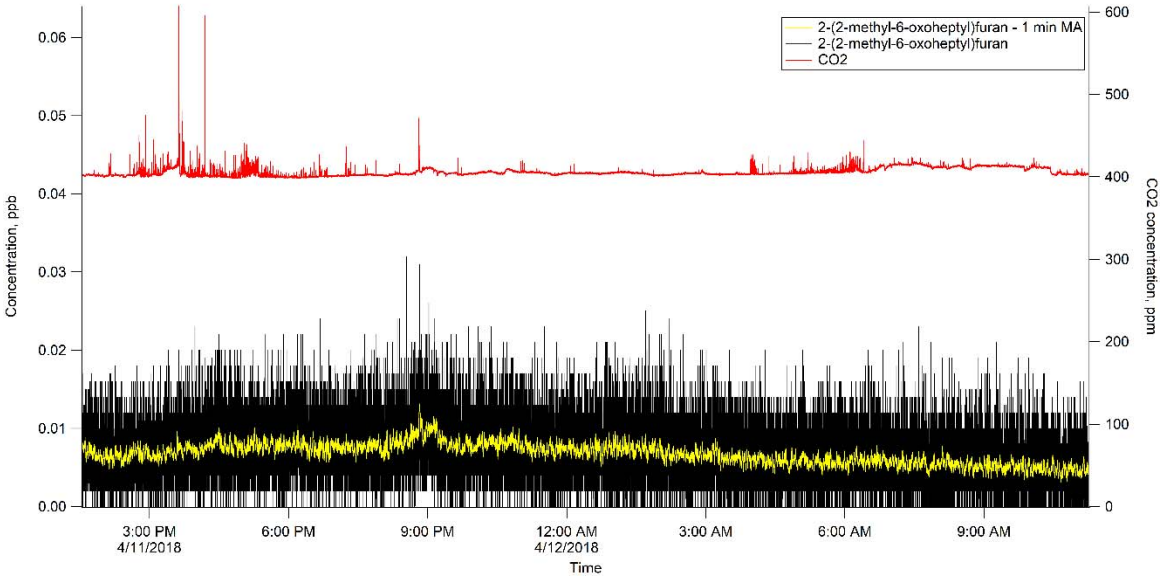


Figure 3-12. 2-(2-methyl-6-oxoheptyl)furan.

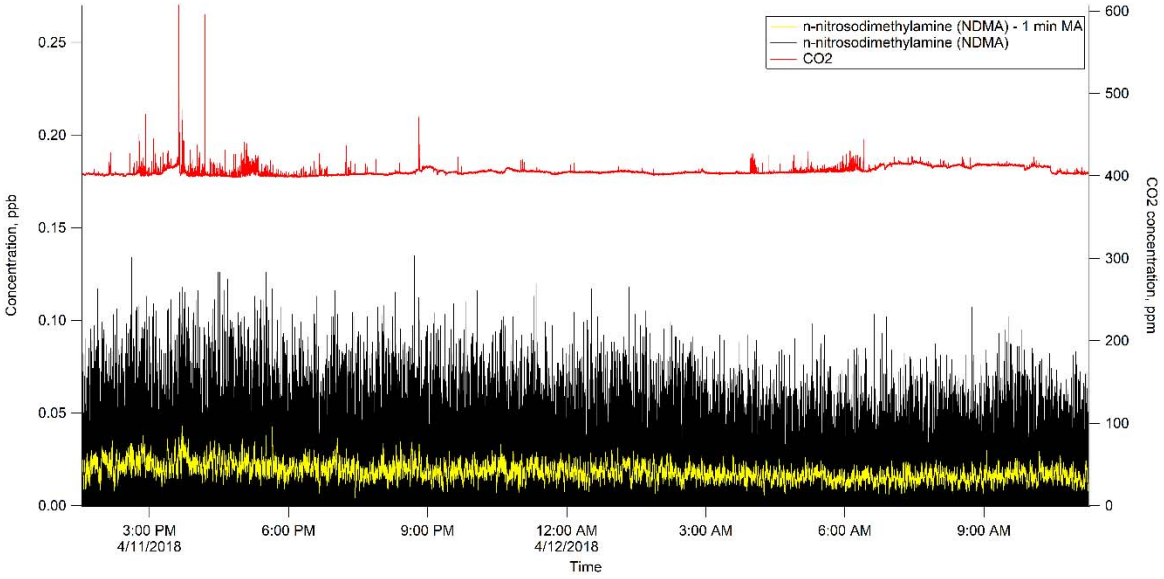


Figure 3-13. N-nitrosodimethylamine (NDMA).

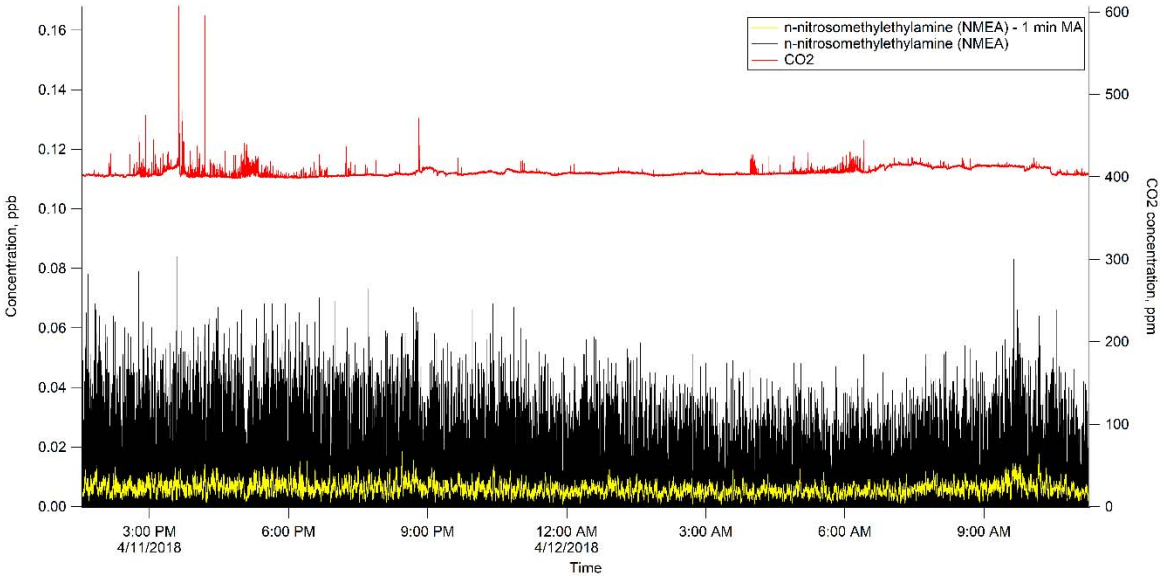


Figure 3-14. N-nitrosomethylethylamine (NMEA).

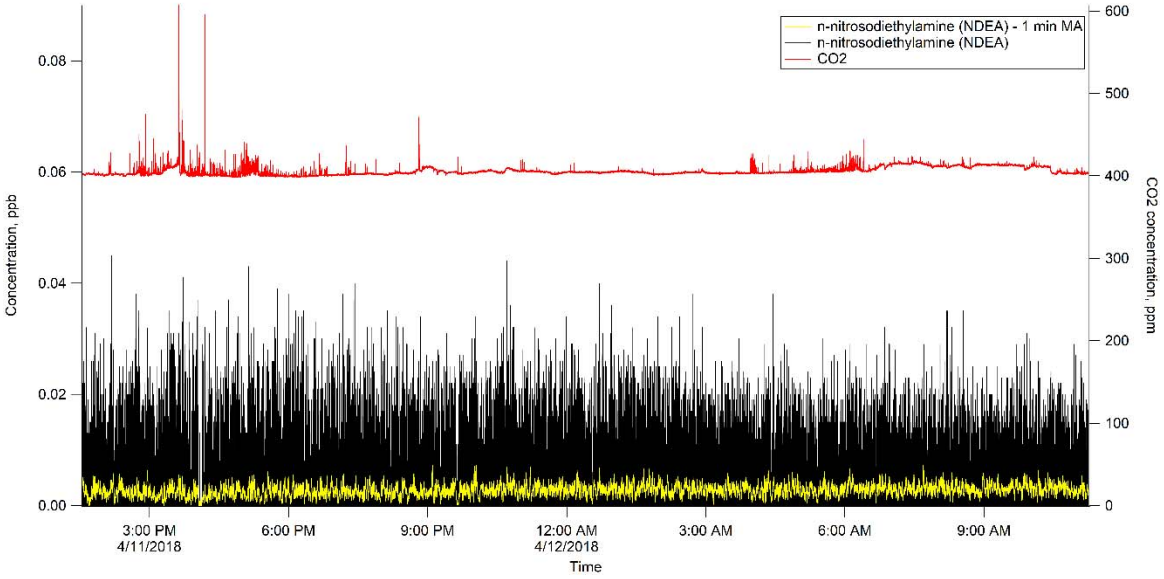


Figure 3-15. N-nitrosodiethylamine (NDEA).

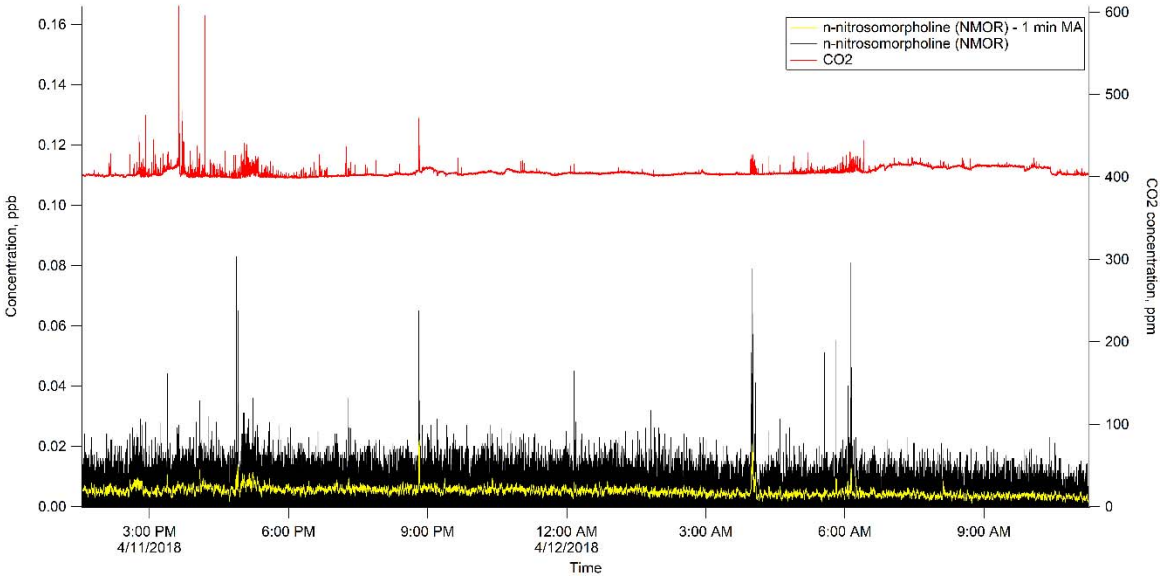


Figure 3-16. N-nitrosomorpholine (NMOR).

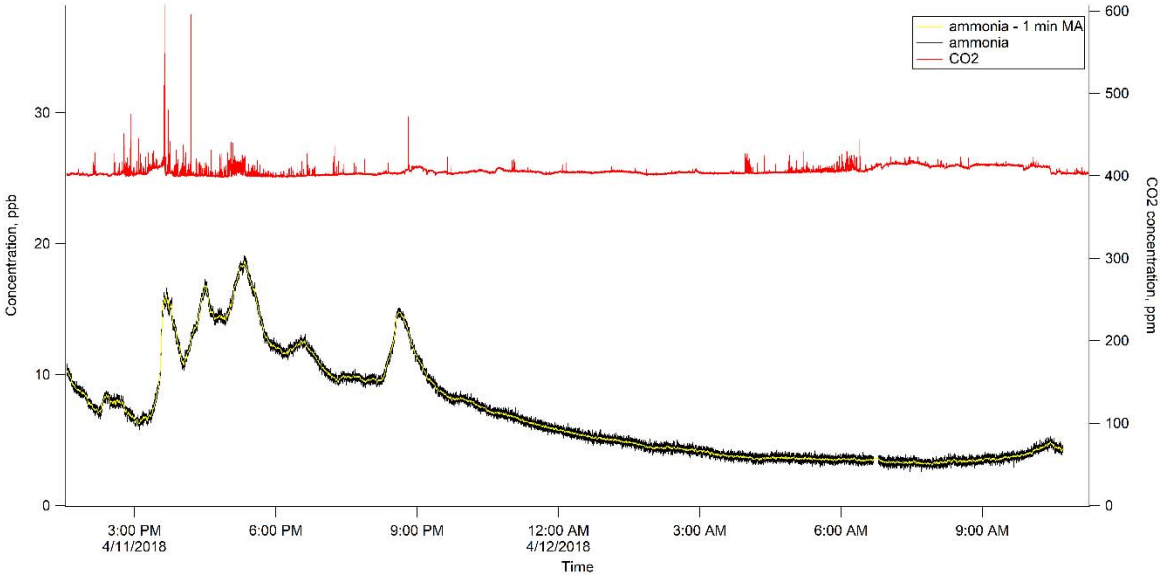


Figure 3-17. Ammonia.

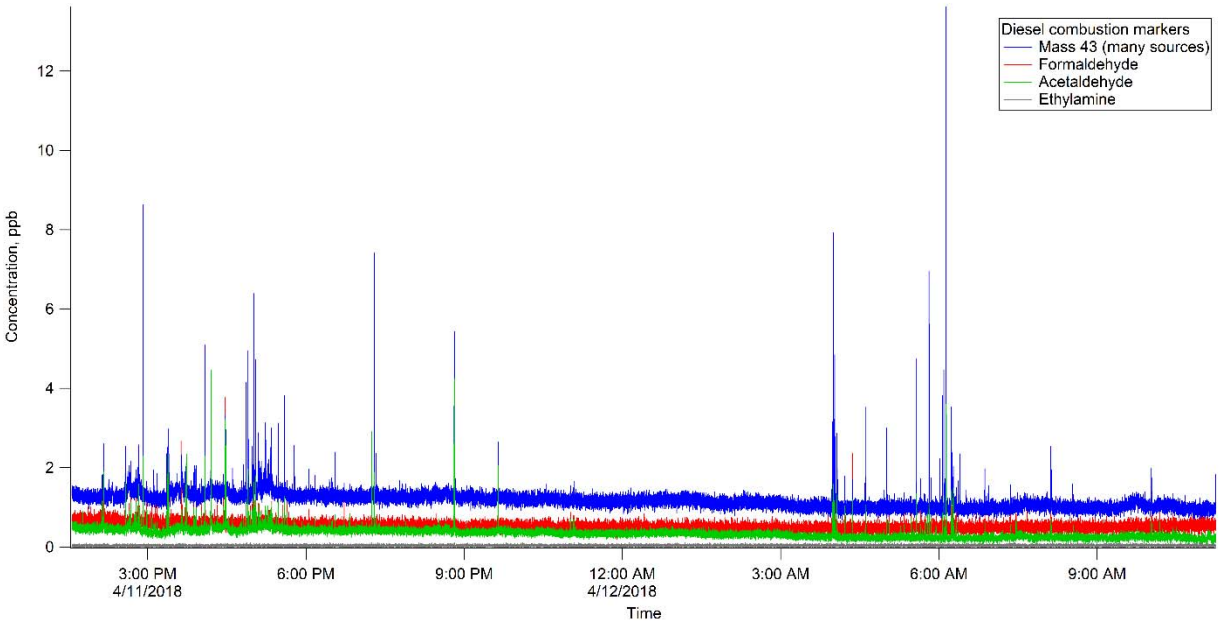


Figure 3-18. Diesel Combustion Markers.

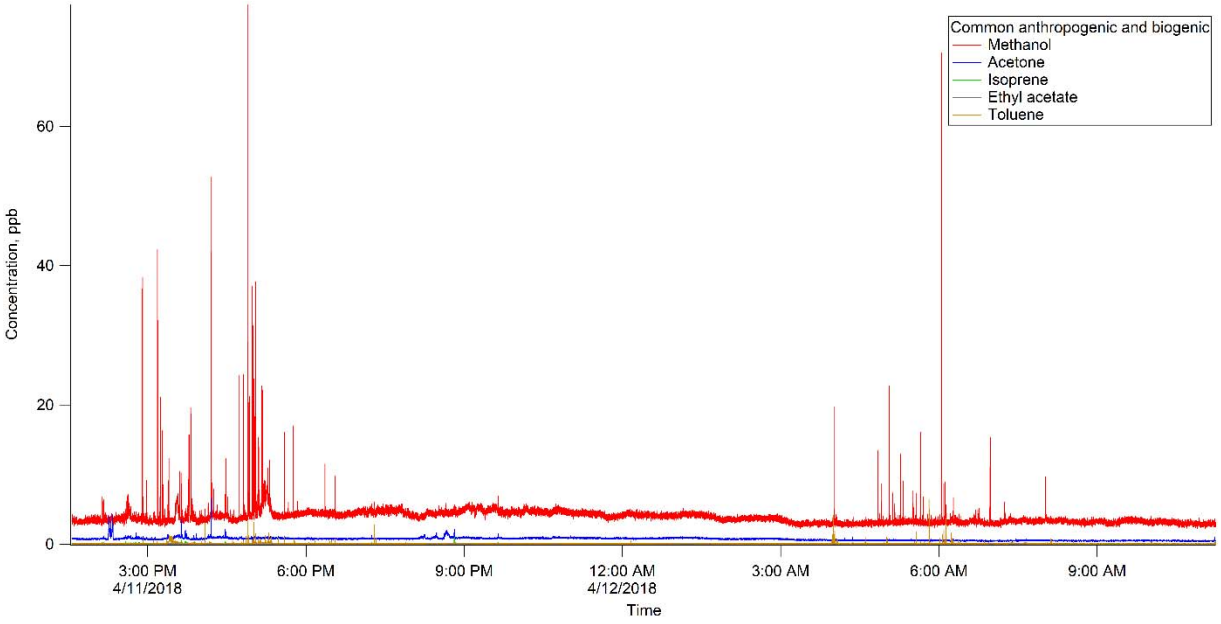


Figure 3-19. Gasoline Combustion Markers.

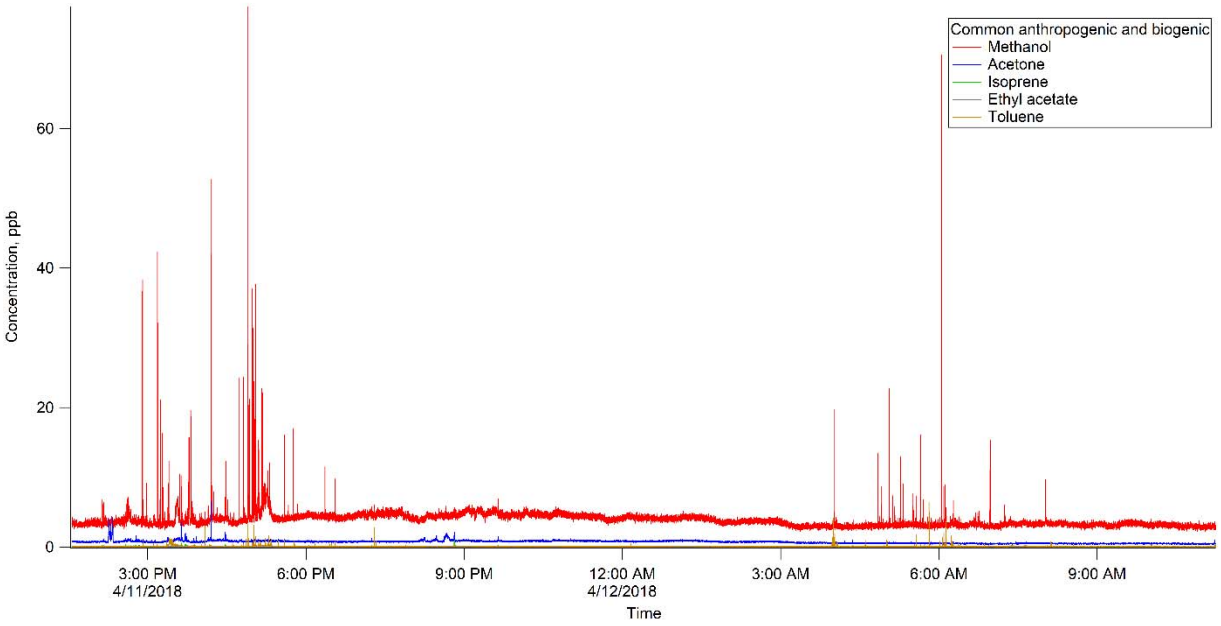


Figure 3-20. Plant and Human Markers.

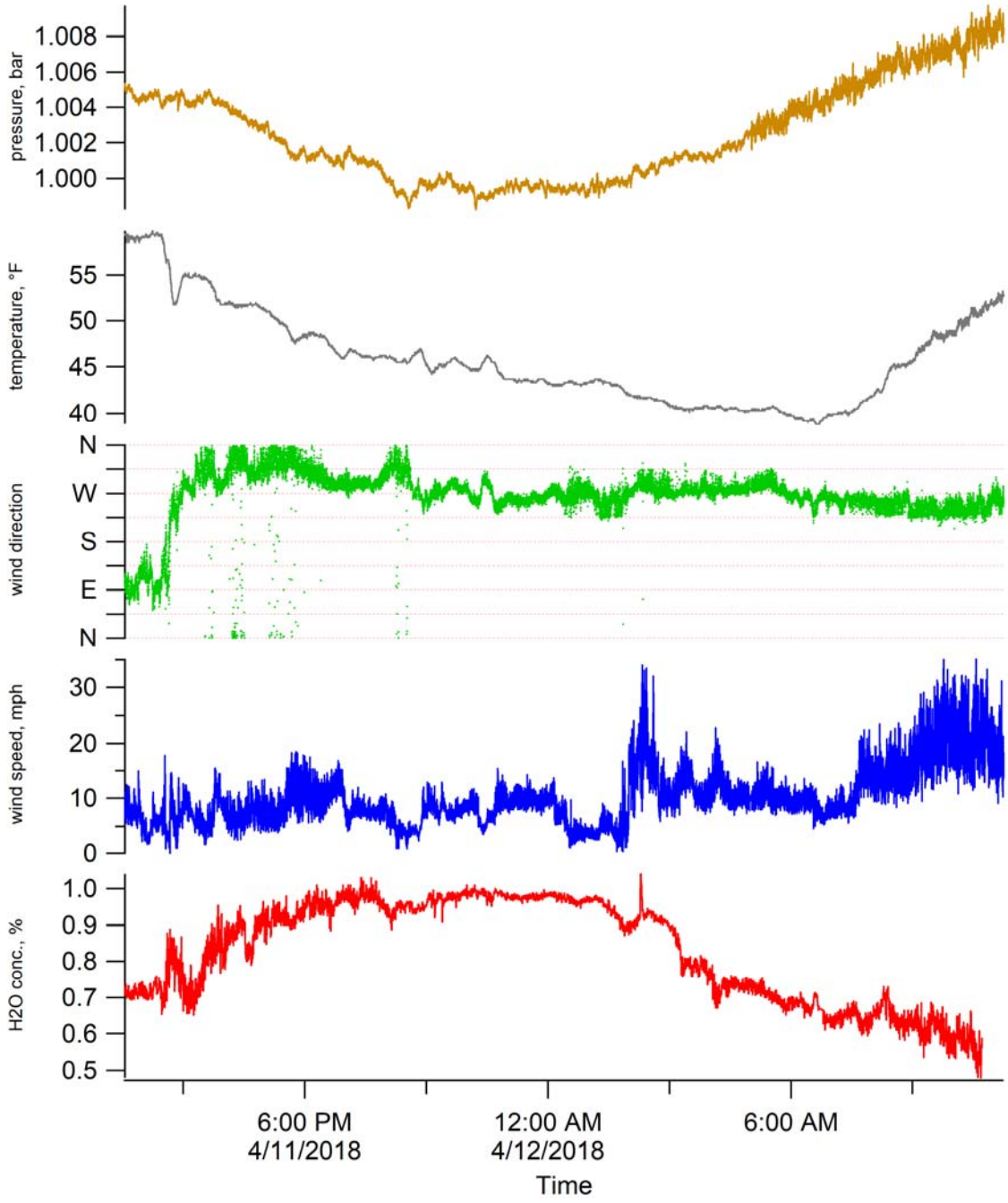


Figure 3-21. Weather Data.

4.0 APRIL 12, 2018 – APRIL 13, 2018 – STUDY SITE #6

4.1 Quality Assessment

Data from April 12, 2018, were transferred to TerraGraphics via the WRPS FTP site on April 19, 2018. Data were assessed using Procedure 17124-DOE-HS-102. A completed Data Exchange Checklist was sent to WRPS on April 23, 2018. The data were accepted by TerraGraphics with the following comments. All startup, shutdown, and calibration procedures were adequately documented and all other checks passed the acceptance limits.

At 13:40 on April 12, 2018, Anna arrived on-site to perform a brief surveillance (ID: ML-18-004) of activities and to perform the weekly Measurement and Test Equipment validations. The two MesaLabs®[4] digital flow meters, the two liquid calibration unit mass flow controllers, and the TSI Incorporated digital flow meter were checked against QA/QC reference flow meter.

4.2 Summary

The Mobile Laboratory personnel performed background sampling using the Mobile Laboratory from April 12, 2018, to April 13, 2018 at Study Site 6. Site 6 is located near the intersection of US Highway 395 and Clearwater Avenue in Kennewick, WA. This site is represented by heavy traffic patterns of mixed vehicle types and light commercial activity including a variety of eating establishments. The Mobile Laboratory arrived at Site 6 at 12:49 on April 12, 2018. The initial QA/QC zero air/sensitivity checks were performed on the CO_2 monitor, NH_3 monitor, and the PTR-MS beginning at 12:50. The data file names were confirmed and routine data collection resumed by 14:10. The Mobile Laboratory staff departed the monitoring site at 16:00.

The Mobile Laboratory staff returned to Site 6 at 06:23 on April 13, 2018, and began confirmatory sample collection by 06:30. A new 10,000 ppbv standard CBAL-451-74B was prepared from CBAL-451-92A and installed the new standard at 06:55 on April 13, 2018. Closeout zero air/sensitivity checks were performed at 10:48. The Mobile Laboratory moved to Site 1 by 12:45.

[4] MesaLabs is a registered trademark of Mesa Laboratories, Inc., Lakewood, Colorado.

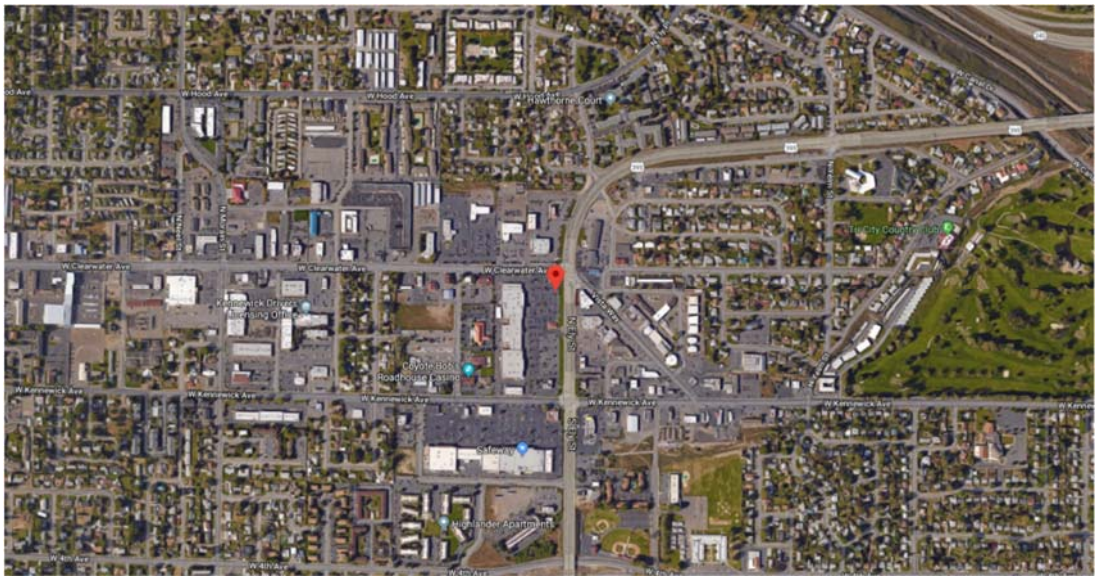


Figure 4-1. Mobile Lab Site #6 for the Duration of the Monitoring Period.

4.3 Samples Collected

Continuous air monitoring was performed using the following instrumentation:

- PTR-MS,
- LI-COR CO_2 Monitor,
- Picarro Ammonia Monitor, and
- Weather Station.

Confirmatory air samples were collected as follows:

Table 4-1. Alternative Media Samples Taken.

Site	Date	Sample Type	ID	Start	Stop	Sample Time (min)
6	12-Apr	Thermosorb/N	EL22194	12:57	15:47	177
6	12-Apr	CarboTrap-300	A022023	13:04	14:15	70
6	13-Apr	Thermosorb/N	EL22180	06:30	09:30	180
6	13-Apr	CarboTrap-300	A020890	06:33	07:46	71

Table 4-2 displays the statistical information for the monitoring period of April 12, 2018, to April 13, 2018. By definition, the OEL is an 8-hour, time-weighted average that establishes a limit for personnel exposures to hazardous chemicals. It is the exposure level to which a person may be exposed for 8 hours/day, 40 hours/week for 40 years and have no expectation of adverse health effects. In this study, area vapor concentration measurements were made to better understand the hazardous vapor exposures that workers may receive. These measurements are only compared to OEL concentrations to give them context. It is neither accurate nor appropriate

to interpret these short duration measurements (2 seconds) as worker exposure levels. Since the OEL is defined as a time-weighted average, it is more appropriate to compare them to daily average vapor concentrations. Short duration excursions above the OEL concentration are not significant.

Table 4-2. Statistical Information for the Monitoring Period of April 12, 2018 – April 13, 2018.

COPC #	COPC Name	Reporting Limit (ppb)	OEL (ppb)	Ave. (ppb)	St. Dev. (ppb)	Rel. St. Dev. (%)	Max (ppb)	Median (ppb)	Sec. over 50% OEL	Sec. over OEL
1	ammonia	1	25000	4.49	1.674	37.3%	11.30	3.88	0	0
2	furan	0.09	1	0.045	0.012	73.5%	0.231	0.014	0	0
3	but-3-en-2-one + 2,3-dihydrofuran + 2,5-dihydrofuran	0.22	1	0.110	0.013	66.6%	N/A*	N/A*	N/A	N/A
4	NDMA**	0.06	0.3	0.031	0.019	121.2%	0.150	0.009	2	0
5	2-methylfuran	0.05	1	0.025	0.010	72.4%	0.130	0.012	0	0
6	NEMA	0.02	0.3	0.012	0.010	165.8%	0.083	0.000	0	0
7	2,5-dimethylfuran	0.05	1	0.025	0.008	84.0%	0.111	0.009	0	0
8	NDEA	0.01	0.1	0.006	0.006	181.3%	0.045	0.000	0	0
9	2-propylfuran + 2-ethyl-5-methylfuran	0.02	1	0.011	0.006	118.0%	0.072	0.003	0	0
10	NMOR	0.05	0.6	0.025	0.008	183.0%	0.725	0.003	10	2
11	2-ethyl-2-hexenal + 4-(1-methylpropyl)-2,3-dihydrofuran + 3-(1,1-dimethylethyl)-2,3-dihydrofuran	0.04	1	0.020	0.006	70.6%	0.085	0.007	0	0
12	2-pentylfuran	0.04	1	0.020	0.006	47.8%	0.089	0.011	0	0
13	2-heptylfuran	0.02	1	0.010	0.003	65.8%	0.027	0.004	0	0
14	2-octylfuran	0.01	1	0.005	0.002	229.7%	0.016	0.000	0	0
15	6-(2-furanyl)-6-methyl-2-heptanone	0.01	1	0.005	0.002	169.7%	0.016	0.000	0	0
16	furfural acetophenone	0.07	1	0.035	0.003	62.0%	0.028	0.005	0	0

* The maximum peak value for but-3-en-2-one + 2,3 dihydrofuran + 2,5 dihydrofuran was 0.673 ppb and the median value was 0.018 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 200, 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 each COPC signal, overlaid with the same signal smoothed using a 1-minute moving average, and CO_2, for the monitoring period April 12, 2018. to April 13, 2018.

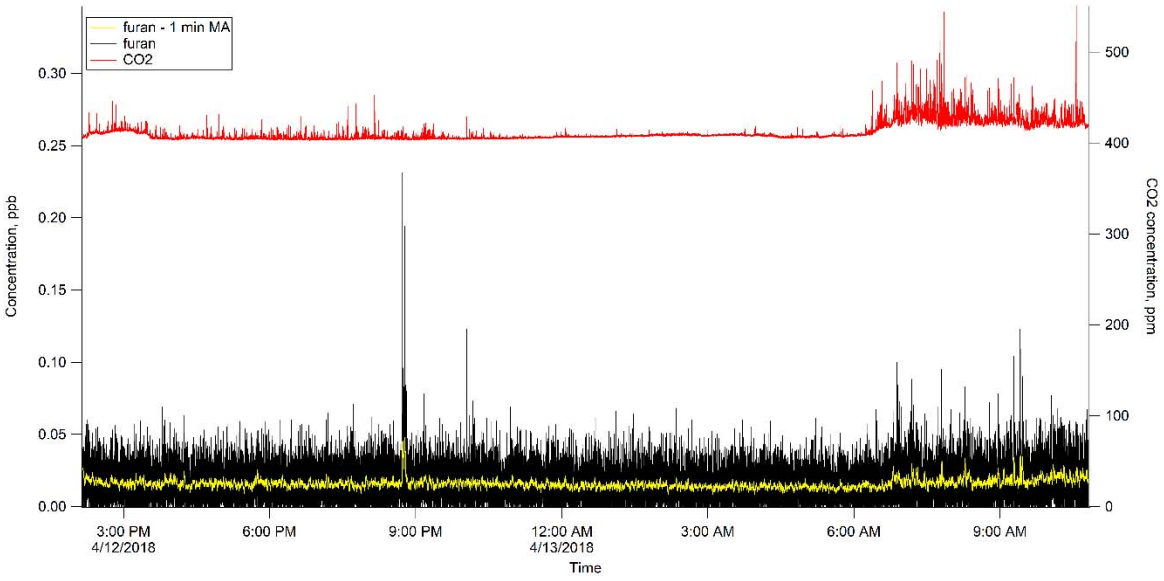


Figure 4-2. Furan.

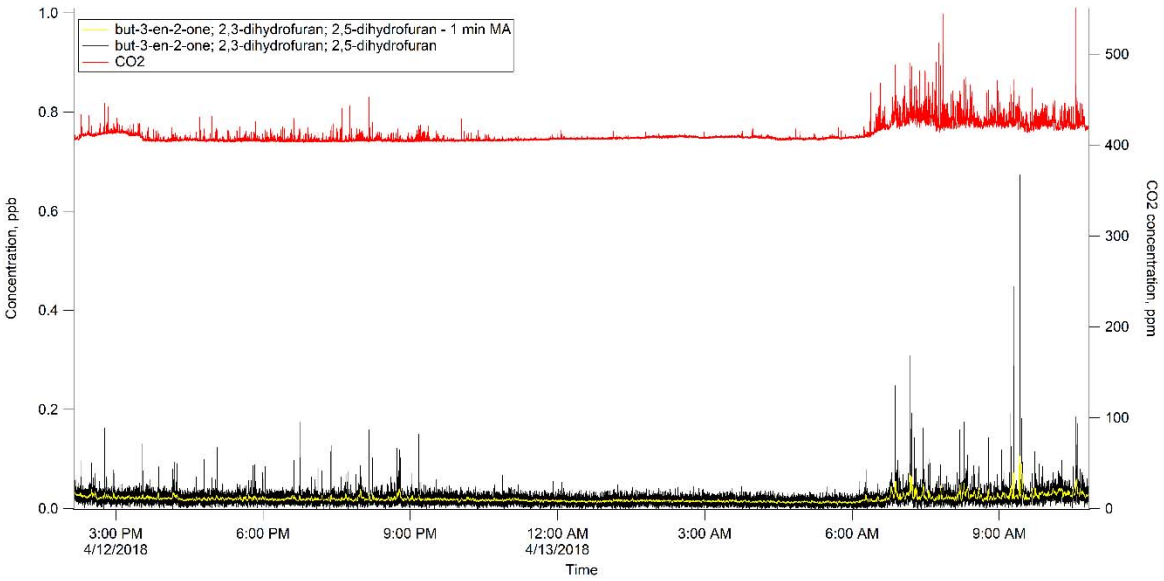


Figure 4-3. but-3-en-2-one + 2,3-dihydrofuran + 2,5-dihydrofuran.

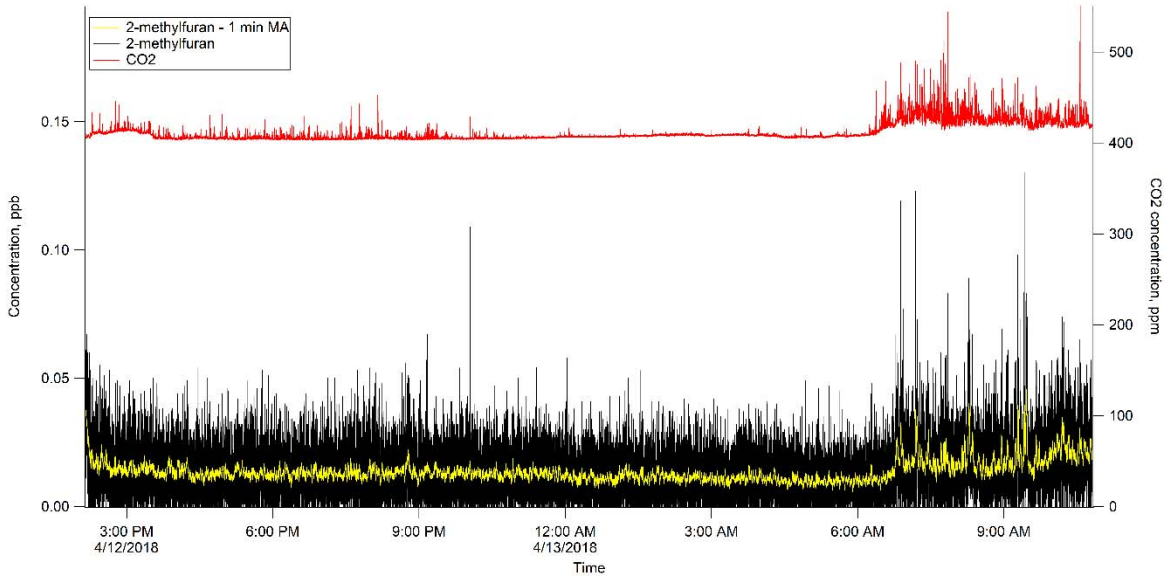


Figure 4-4. 2-methylfuran.

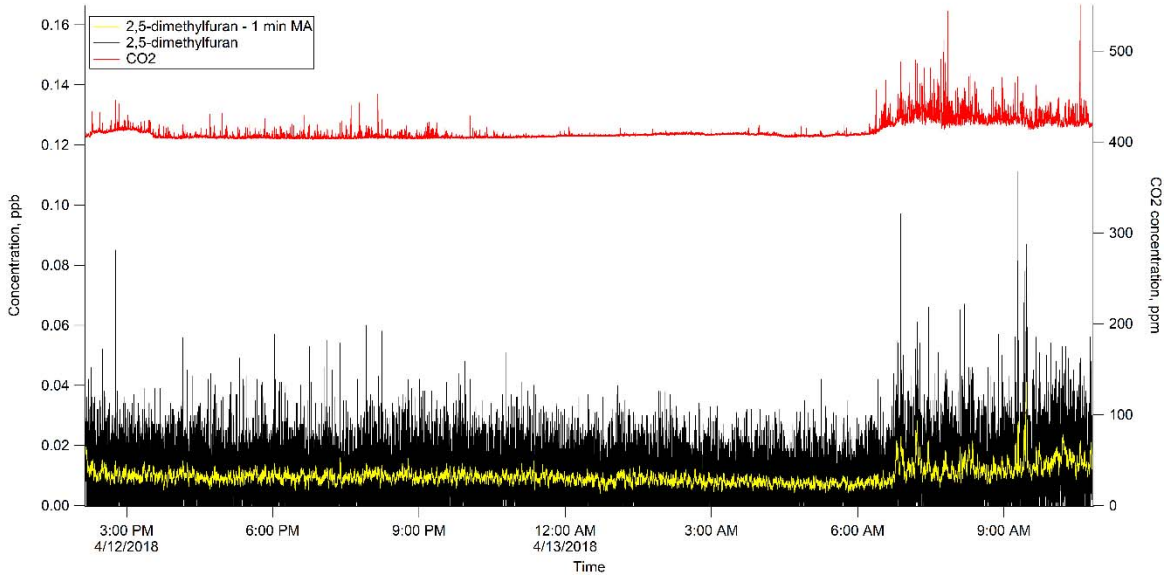


Figure 4-5. 2,5-dimethylfuran.

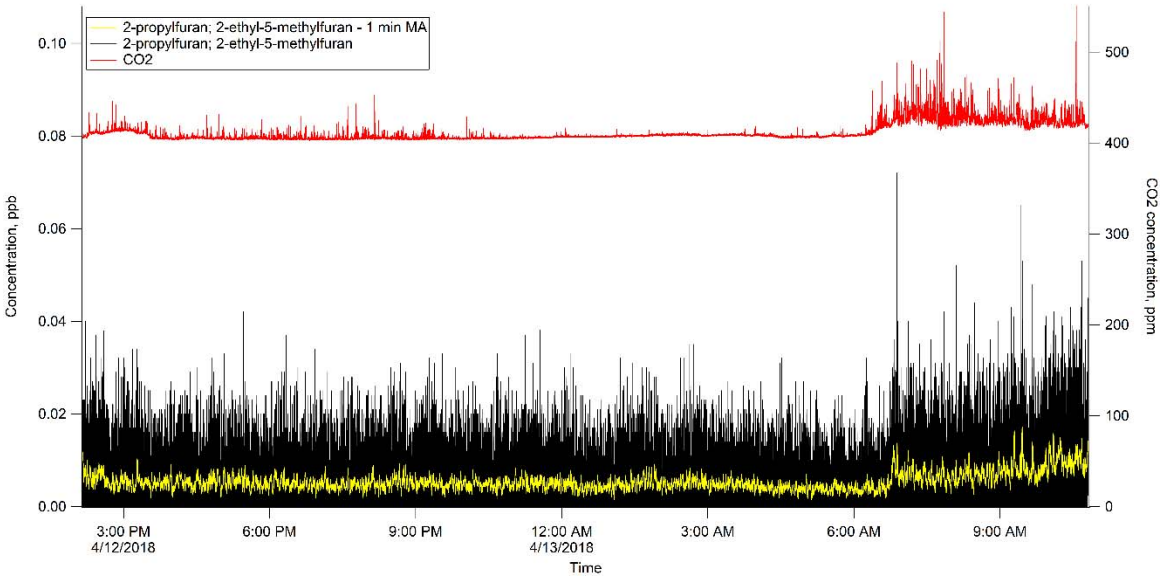


Figure 4-6. 2-propylfuran + 2-ethyl-5-methylfuran.

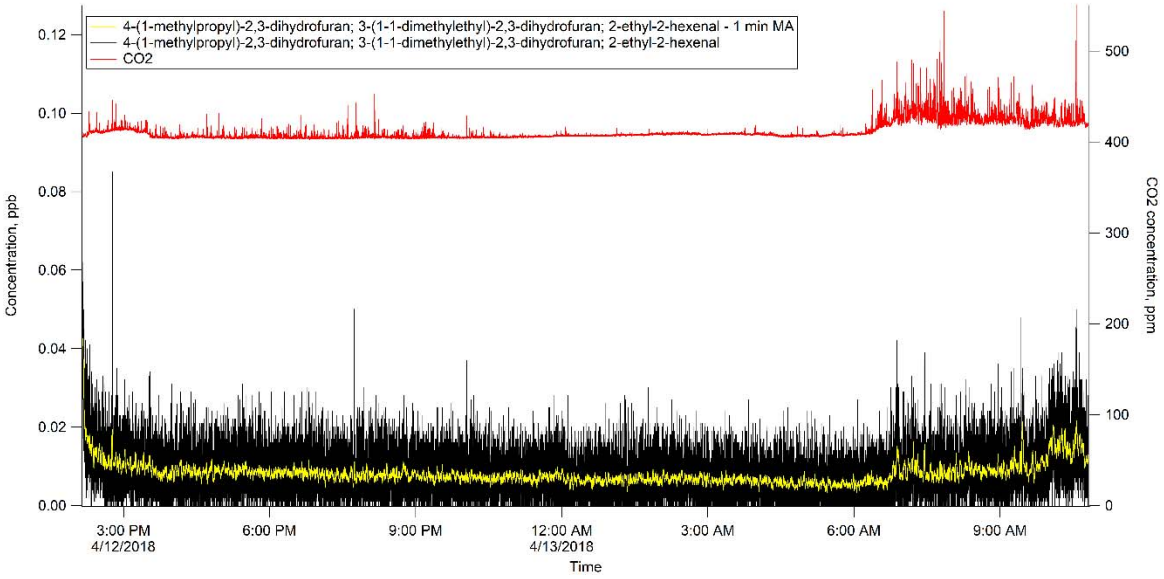


Figure 4-7. 4-(1-methylpropyl)-2,3-dihydrofuran + 3-(1-1-dimethylethyl)-2,3-dihydrofuran + 2-ethyl-2-hexenal.

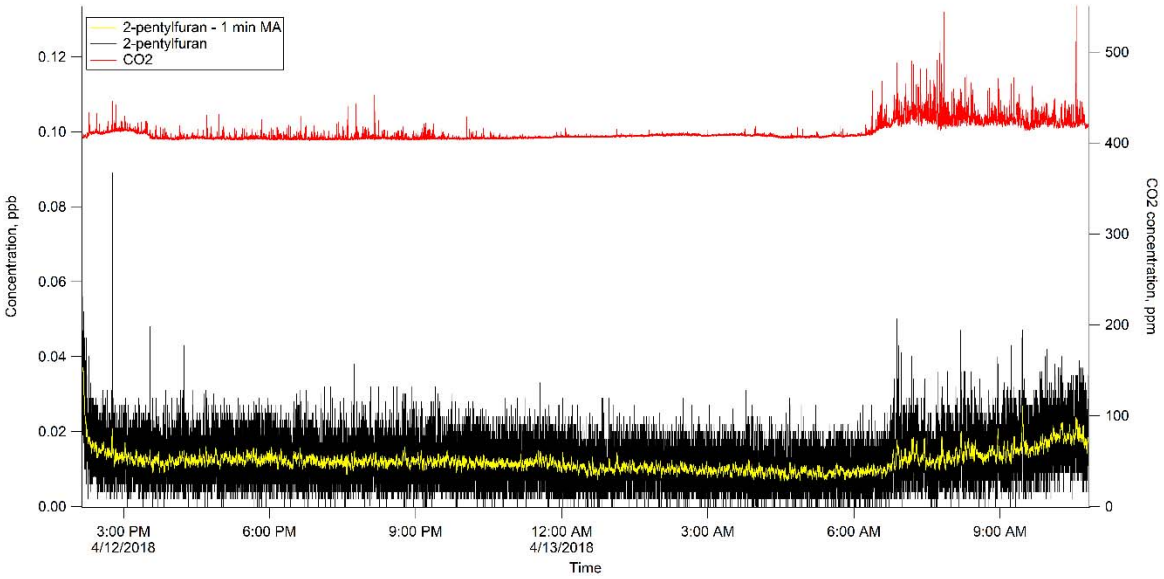


Figure 4-8. 2-pentylfuran.

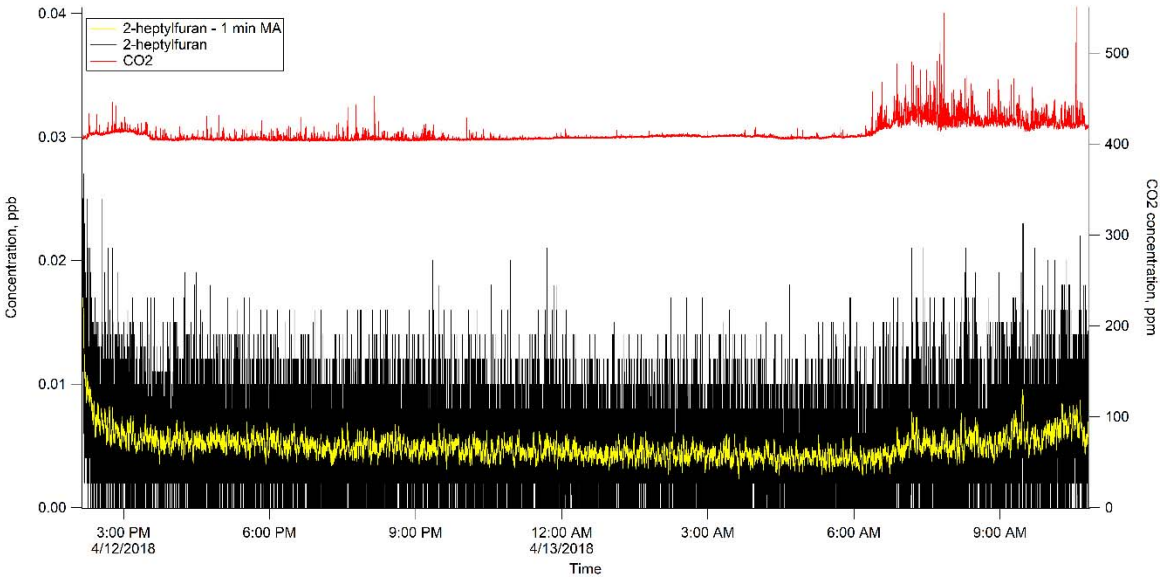


Figure 4-9. 2-heptylfuran.

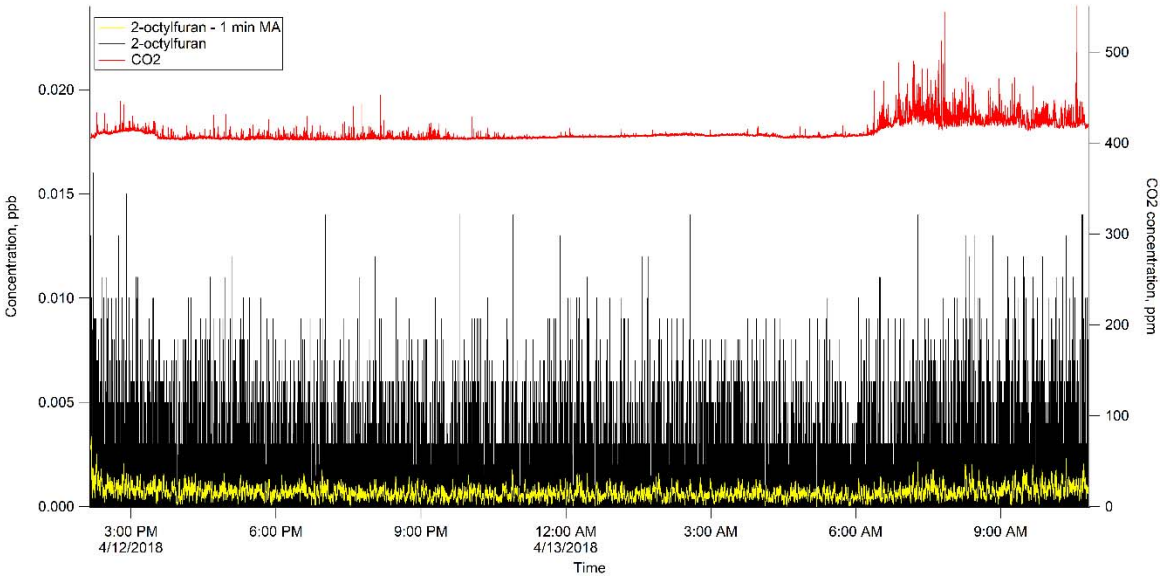


Figure 4-10. 2-octylfuran.

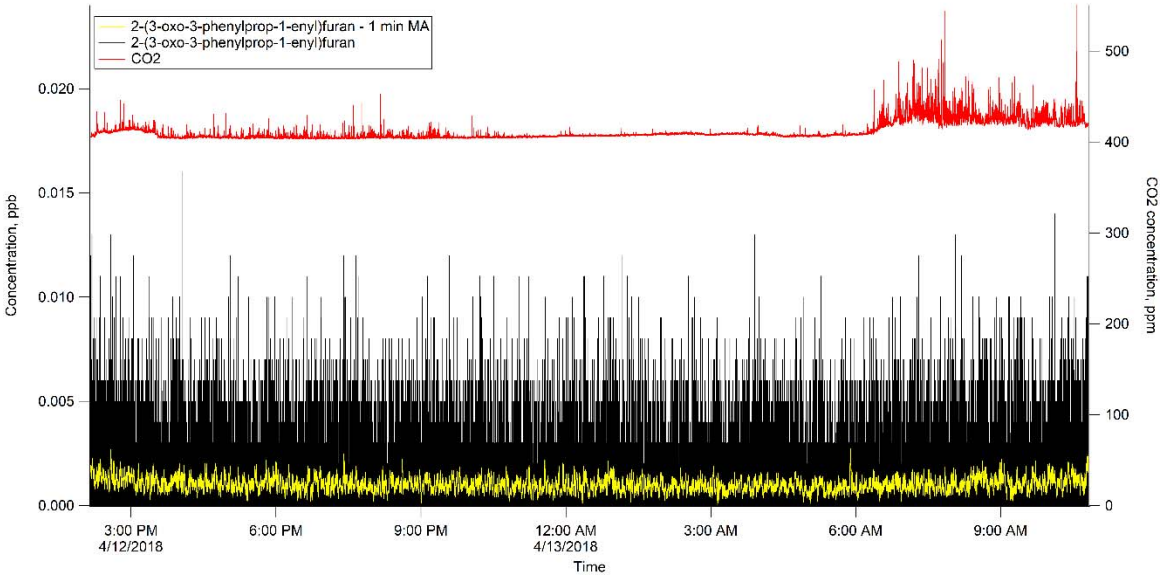


Figure 4-11. 2-(3-oxo-3-phenylprop-1-enyl)furan.

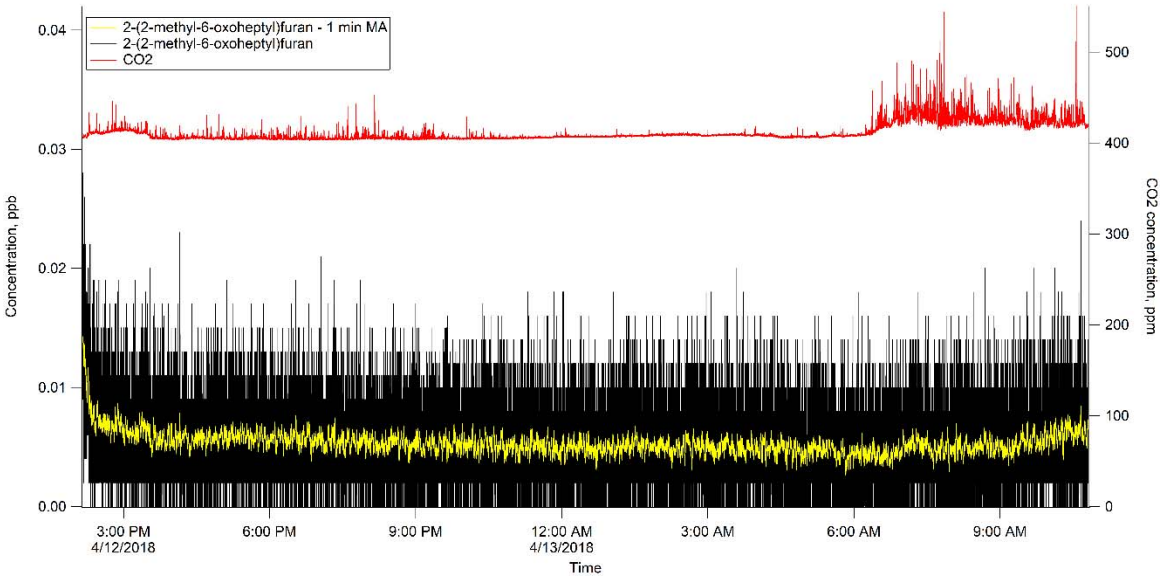


Figure 4-12. 2-(2-methyl-6-oxoheptyl)furan.

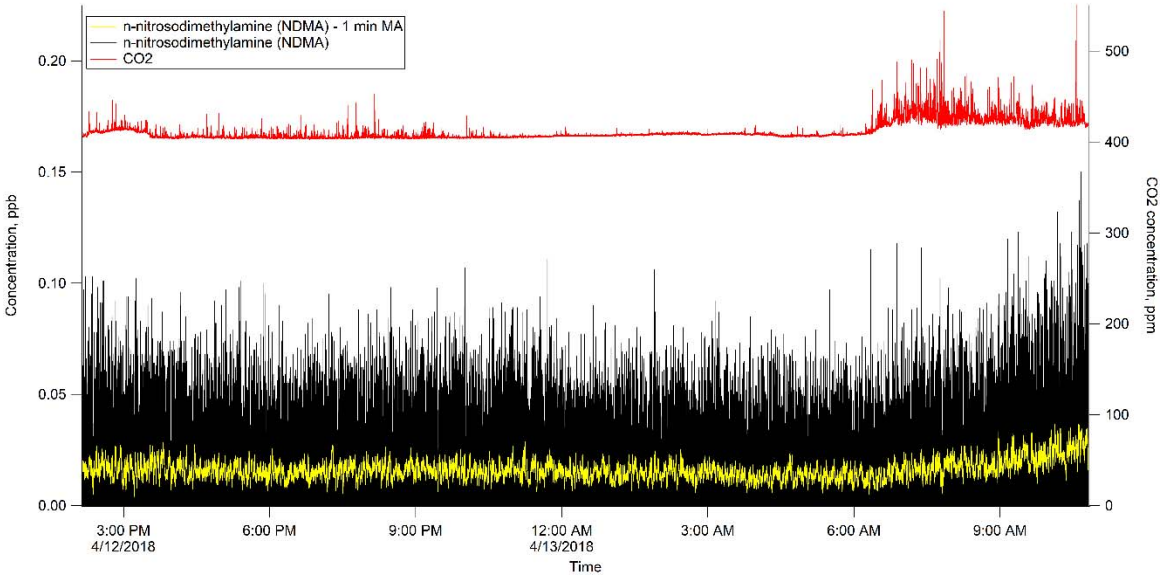


Figure 4-13. N-nitrosodimethylamine (NDMA).

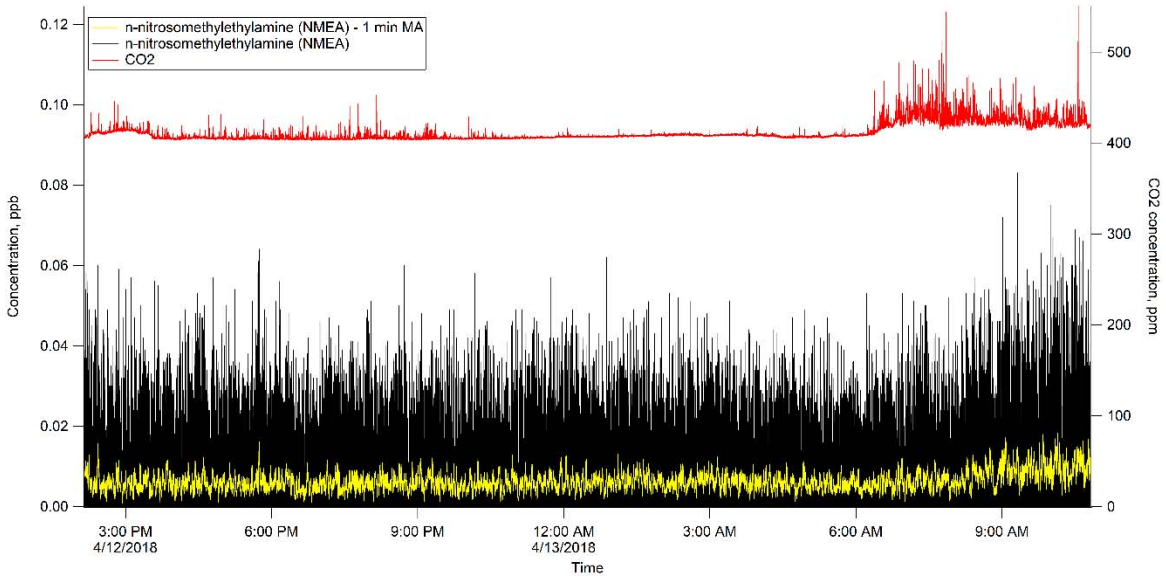


Figure 4-14. N-nitrosomethylethylamine (NMEA).

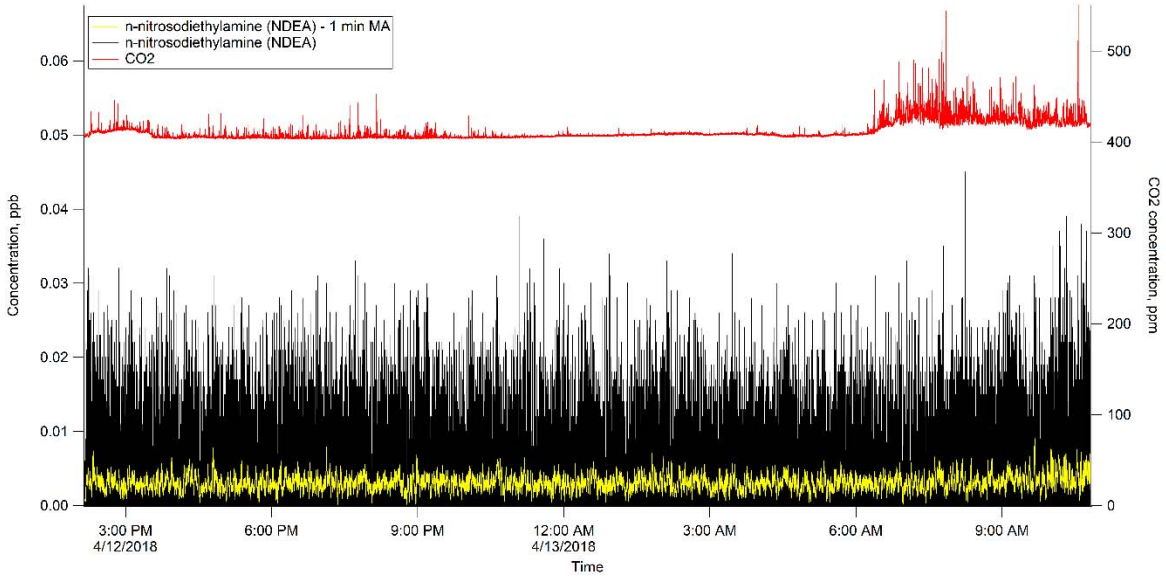


Figure 4-15. N-nitrosodiethylamine (NDEA).

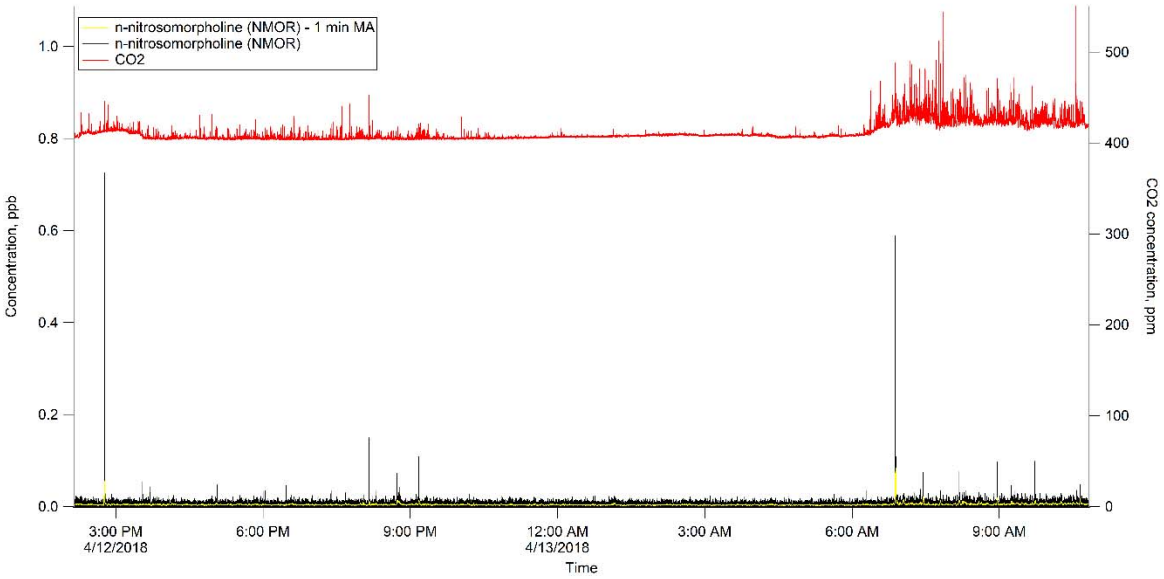


Figure 4-16. N-nitrosomorpholine (NMOR).

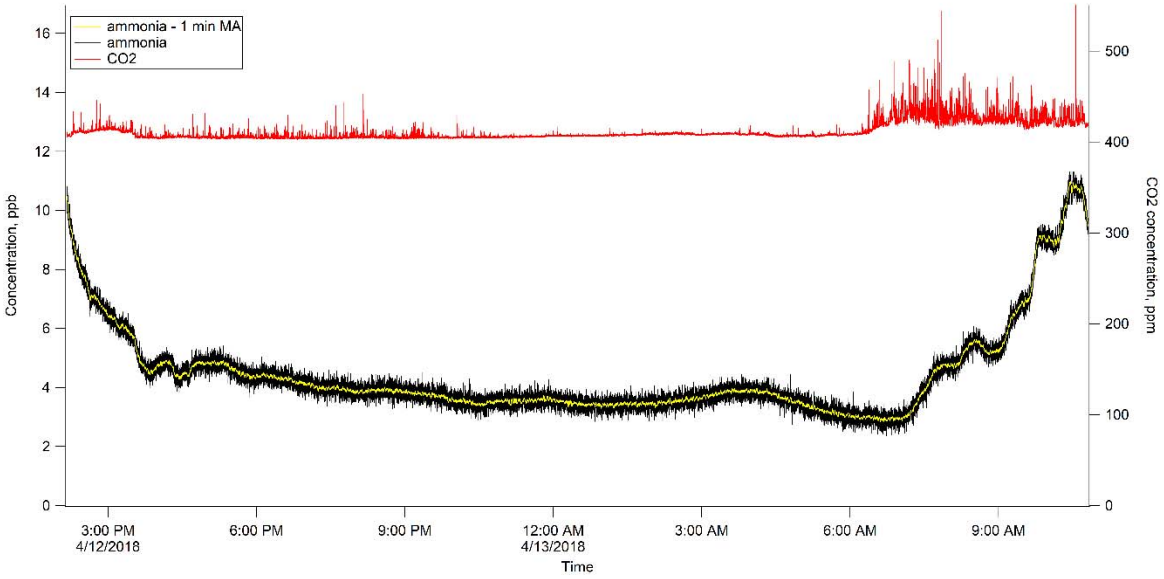


Figure 4-17. Ammonia.

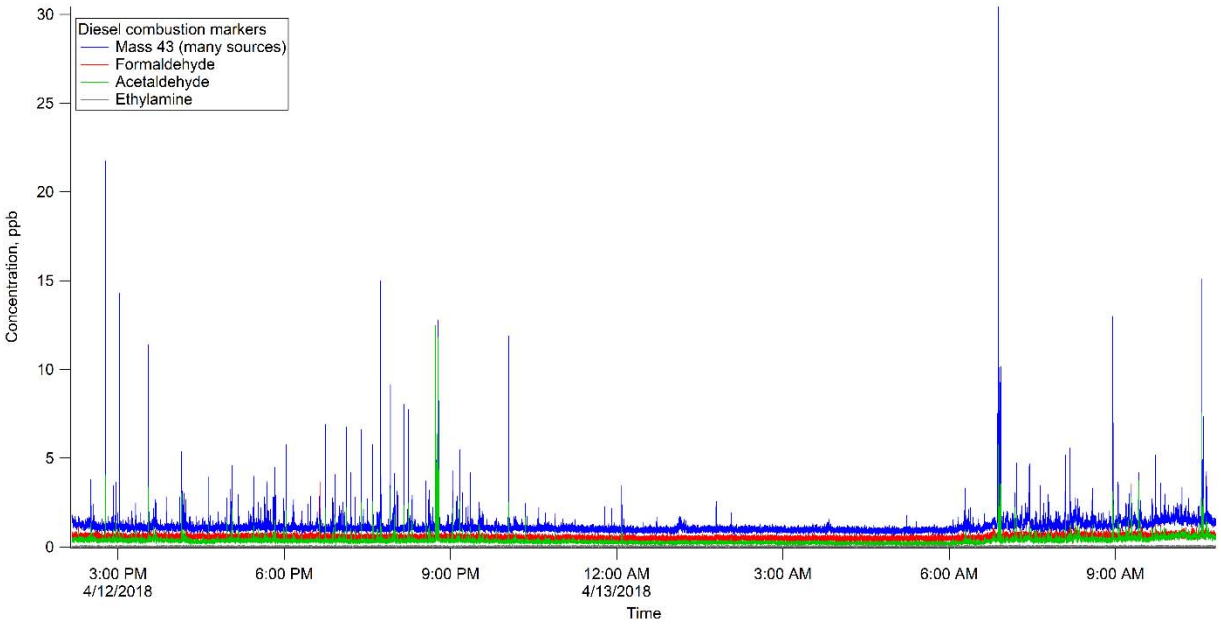


Figure 4-18. Diesel Combustion Markers.

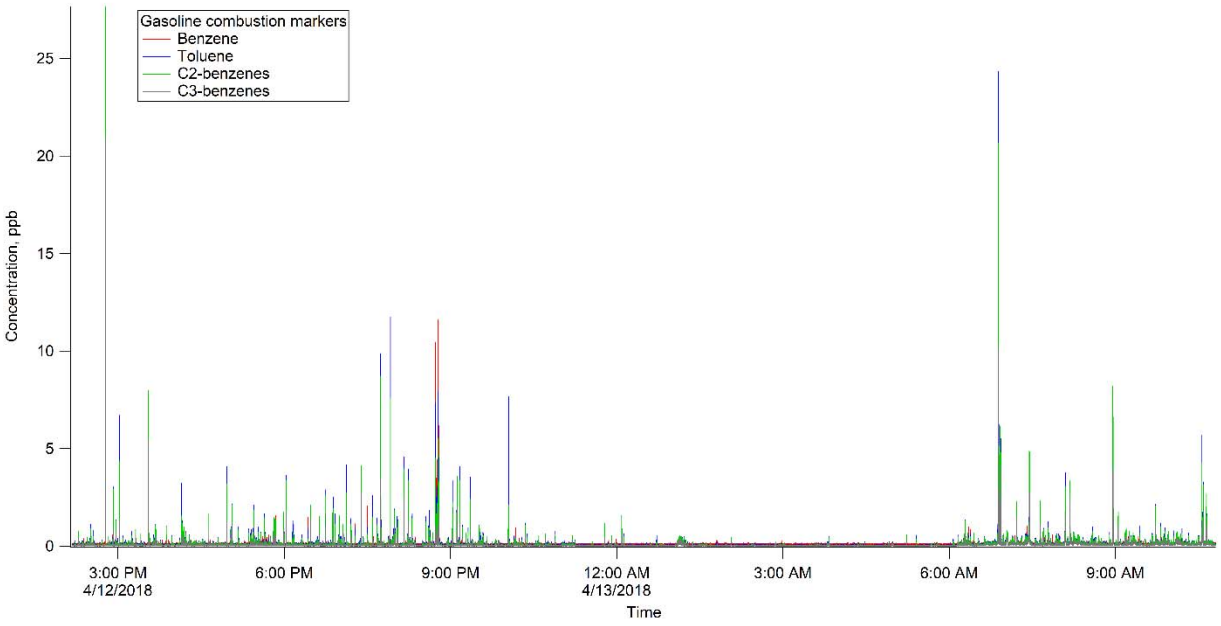


Figure 4-19. Gasoline Combustion Markers.

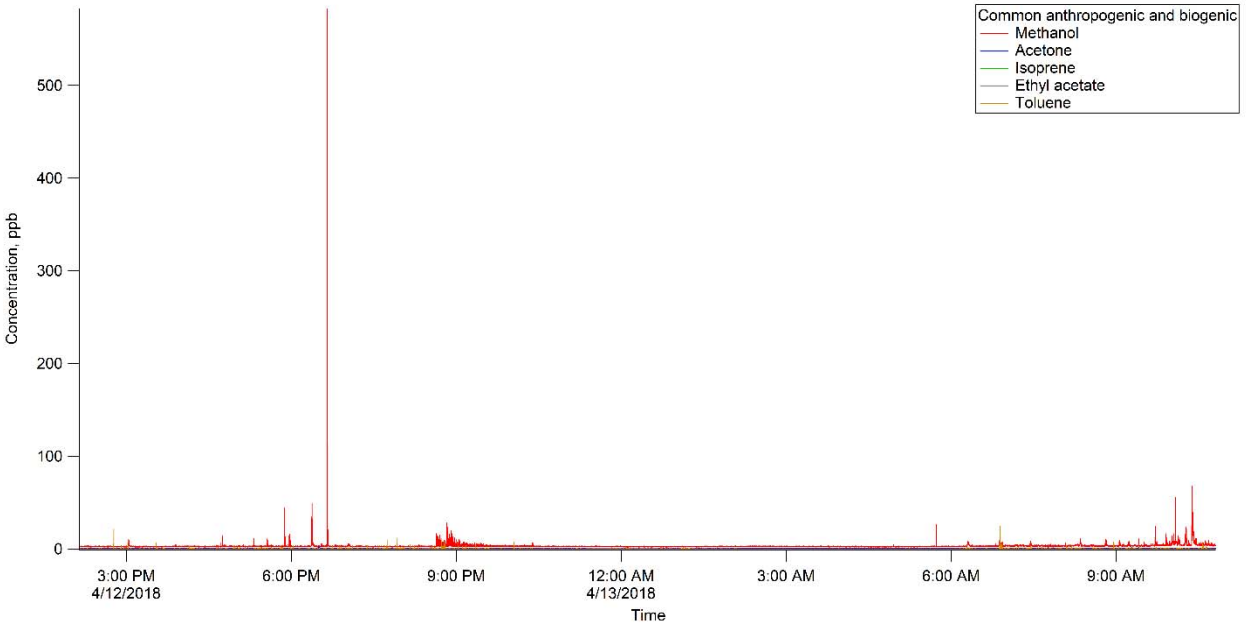


Figure 4-20. Plant and Human Markers.

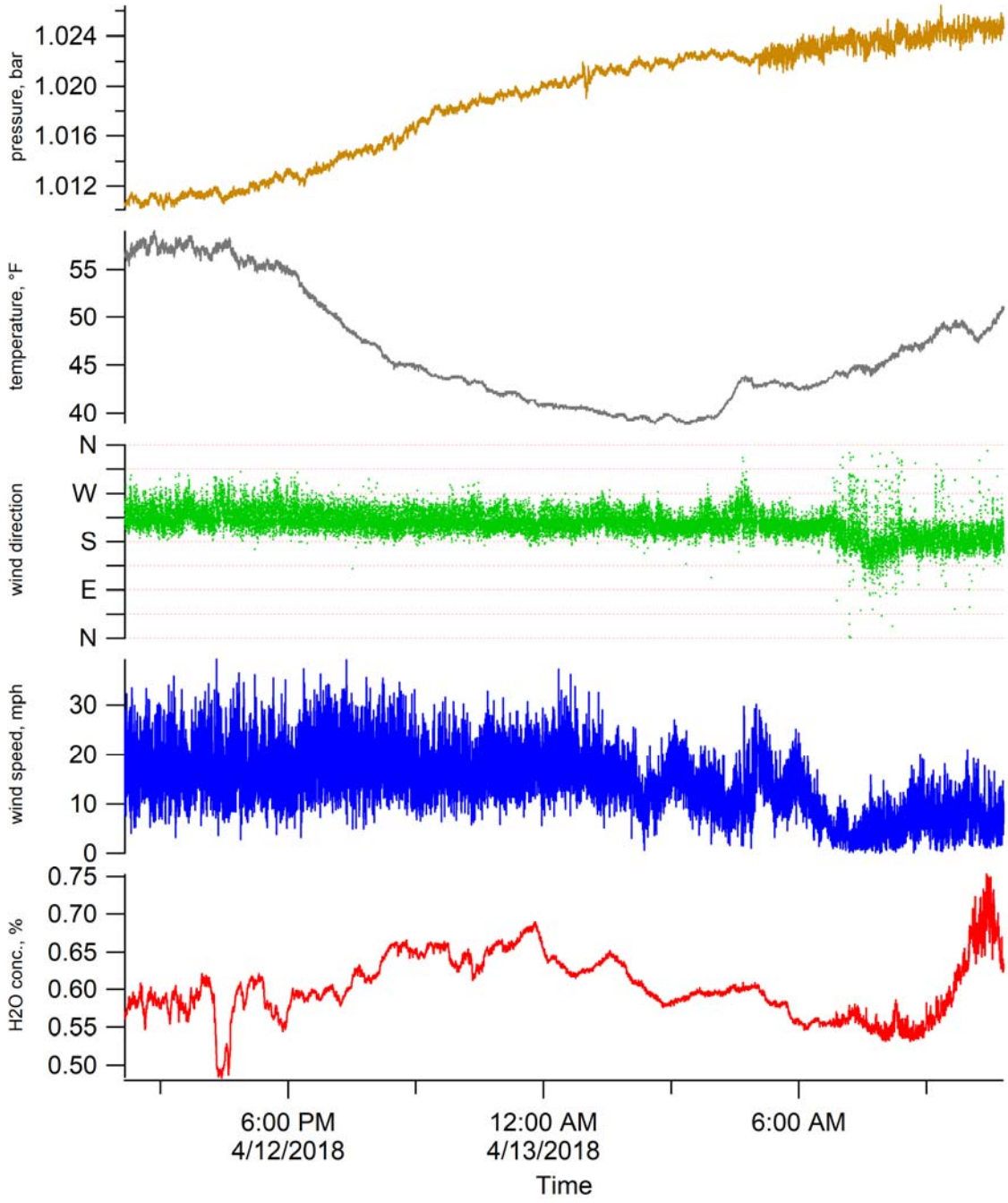


Figure 4-21. Weather Data.

5.0 APRIL 13, 2018 – APRIL 14, 2018 – STUDY SITE #1

5.1 Quality Assessment

Data from April 13, 2018, were transferred to TerraGraphics via the WRPS FTP site on April 19, 2018. Data were assessed using Procedure 17124-DOE-HS-102. A completed Data Exchange Checklist was sent to WRPS on April 23, 2018. The data were accepted by TerraGraphics with the following comments. All startup, shutdown, and calibration procedures were adequately documented and all other checks passed the acceptance limits.

5.2 Summary

The Mobile Laboratory personnel performed background sampling using the Mobile Laboratory from April 13, 2018, to April 14, 2018, at Study Site 1. Site 1 is located on the plateau northwest of the 200W Tank Farm operations. This is an upwind site from the central Hanford Plateau. The Mobile Laboratory arrived at Site 1 at 12:45 on April 13, 2018. The initial QA/QC zero air/sensitivity checks were performed on the CO_2 monitor, NH_3 monitor, and the PTR-MS beginning at 12:45. The data file names were confirmed and routine data collection resumed by 13:43. The Mobile Laboratory staff departed the monitoring site at 16:05.

The Mobile Laboratory staff returned to Site 6 at 06:40 on April 13, 2018, and began confirmatory sample collection by 06:49. Closeout zero air/sensitivity checks were performed at 10:37. The Mobile Laboratory moved to Site 2 by 11:46.

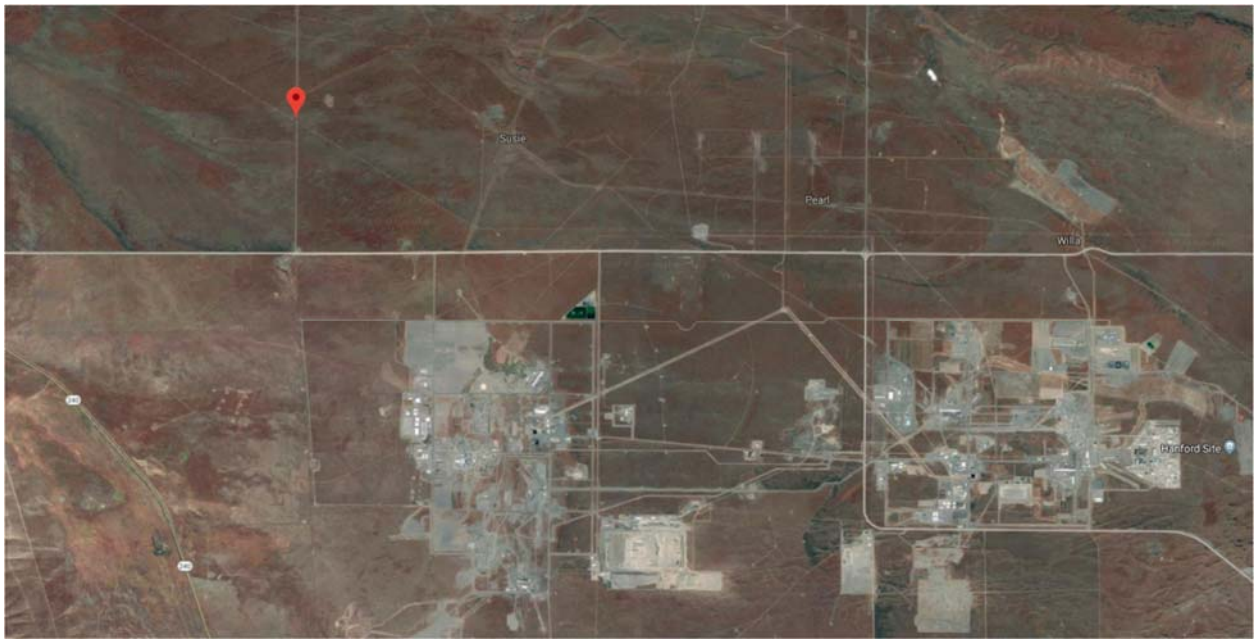


Figure 5-1. Mobile Lab Site #1 for the Duration of the Monitoring Period.

5.3 Samples Collected

Continuous air monitoring was performed using the following instrumentation:

- PTR-MS,
- LI-COR CO_2 Monitor,
- Picarro Ammonia Monitor, and
- Weather Station.

Confirmatory air samples were collected as follows:

Table 5-1. Alternative Media Samples Taken.

Site	Date	Sample Type	ID	Start	Stop	Sample Time (min)
1	13-Apr	Thermosorb/N	EL22183	12:52	15:50	177
1	13-Apr	CarboTrap-300	Y51109	13:01	14:11	71
1	14-Apr	Thermosorb/N	EL22181	06:49	09:49	180
1	14-Apr	CarboTrap-300	A020973	06:55	08:06	71

Table 5-2 displays the statistical information for the monitoring period of April 13, 2018, to April 14, 2018. By definition, the OEL is an 8-hour, time-weighted average that establishes a limit for personnel exposures to hazardous chemicals. It is the exposure level to which a person may be exposed for 8 hours/day, 40 hours/week for 40 years and have no expectation of adverse health effects. In this study, area vapor concentration measurements were made to better understand the hazardous vapor exposures that workers may receive. These measurements are only compared to OEL concentrations to give them context. It is neither accurate nor appropriate to interpret these short duration measurements (2 seconds) as worker exposure levels. Since the OEL is defined as a time-weighted average, it is more appropriate to compare them to daily average vapor concentrations. Short duration excursions above the OEL concentration are not significant.

Table 5-2. Statistical Information for the Monitoring Period of April 13, 2018 – April 14, 2018.

COPC #	COPC Name	Reporting Limit (ppb)	OEL (ppb)	Ave. (ppb)	St. Dev. (ppb)	Rel. St. Dev. (%)	Max (ppb)	Median (ppb)	Sec. over 50% OEL	Sec. over OEL
1	ammonia	1	25000	5.07	0.825	16.3%	9.48	4.81	0	0
2	furan	0.09	1	0.045	0.010	70.1%	0.077	0.013	0	0
3	but-3-en-2-one + 2,3-dihydrofuran + 2,5-dihydrofuran	0.22	1	0.110	0.007	41.5%	N/A*	N/A*	N/A	N/A
4	NDMA**	0.06	0.3	0.033	0.022	112.6%	0.148	0.013	0	0
5	2-methylfuran	0.05	1	0.025	0.008	70.7%	0.059	0.010	0	0
6	NEMA	0.02	0.3	0.013	0.012	161.4%	0.086	0.000	0	0
7	2,5-dimethylfuran	0.05	1	0.025	0.007	84.0%	0.050	0.007	0	0
8	NDEA	0.01	0.1	0.006	0.006	177.1%	0.042	0.000	0	0
9	2-propylfuran + 2-ethyl-5-methylfuran	0.02	1	0.010	0.005	120.0%	0.039	0.002	0	0
10	NMOR	0.05	0.6	0.025	0.004	108.7%	0.027	0.003	0	0
11	2-ethyl-2-hexenal + 4-(1-methylpropyl)-2,3-dihydrofuran + 3-(1,1-dimethylethyl)-2,3-dihydrofuran	0.04	1	0.020	0.005	74.8%	0.065	0.006	0	0
12	2-pentylfuran	0.04	1	0.020	0.005	45.4%	0.045	0.011	0	0
13	2-heptylfuran	0.02	1	0.010	0.003	68.0%	0.023	0.004	0	0
14	2-octylfuran	0.01	1	0.005	0.001	237.6%	0.016	0.000	0	0
15	6-(2-furanyl)-6-methyl-2-heptanone	0.01	1	0.005	0.002	171.7%	0.015	0.000	0	0
16	furfural acetophenone	0.07	1	0.035	0.003	64.1%	0.024	0.004	0	0

* The maximum peak value for but-3-en-2-one + 2,3 dihydrofuran + 2,5 dihydrofuran was 0.074 ppb and the median value was 0.016 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 200, 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 each COPC signal, overlaid with the same signal smoothed using a 1-minute moving average, and CO_2, for the monitoring period April 13, 2018, to April 14, 2018.

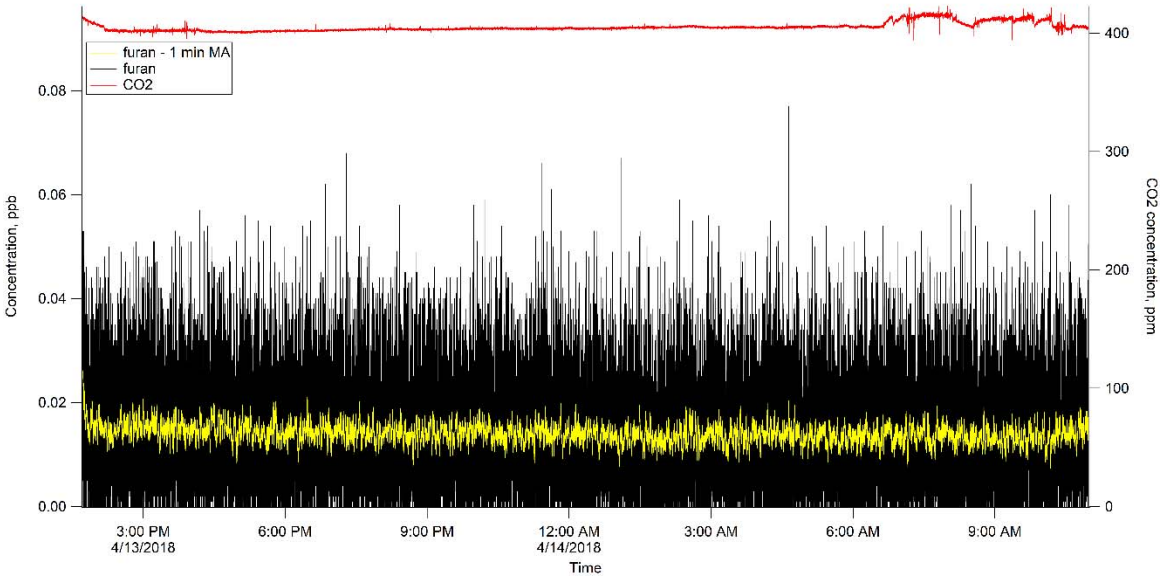


Figure 5-2. Furan.

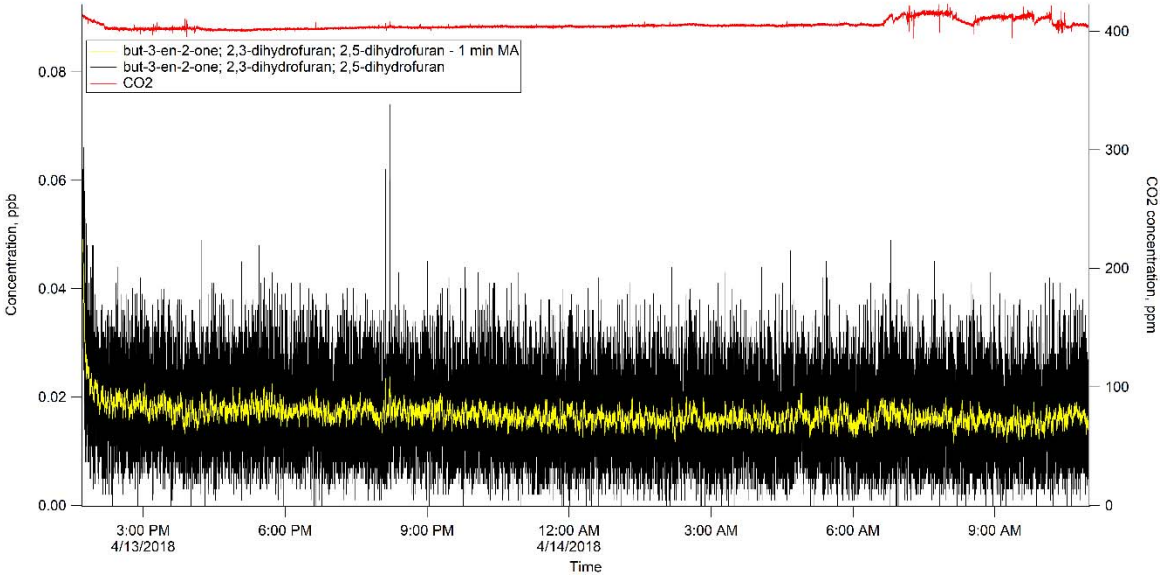


Figure 5-3. but-3-en-2-one + 2,3-dihydrofuran + 2,5-dihydrofuran.

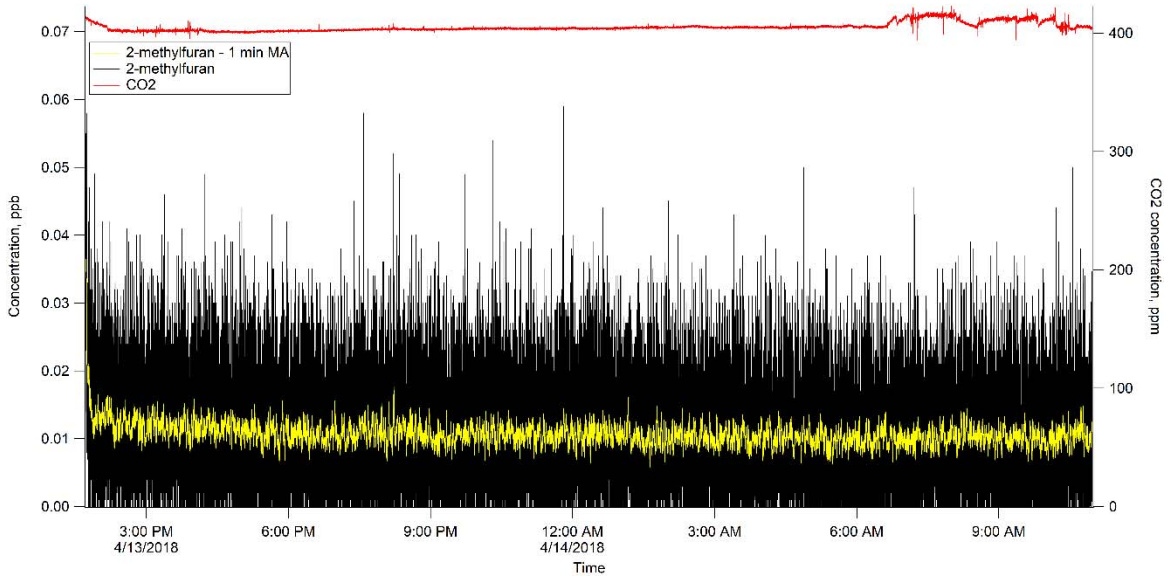


Figure 5-4. 2-methylfuran.

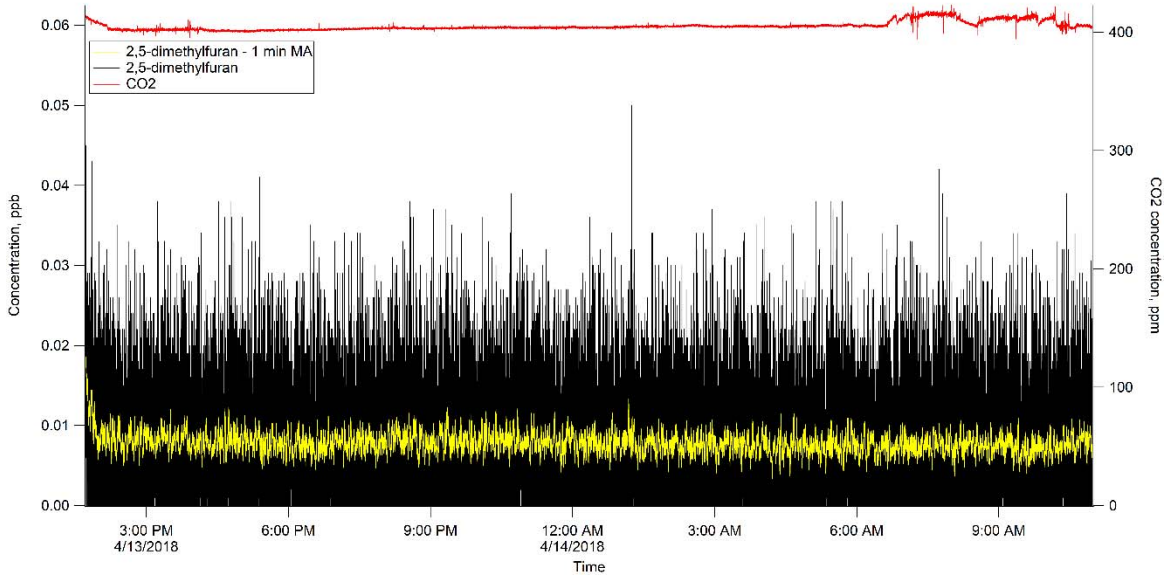


Figure 5-5. 2,5-dimethylfuran.

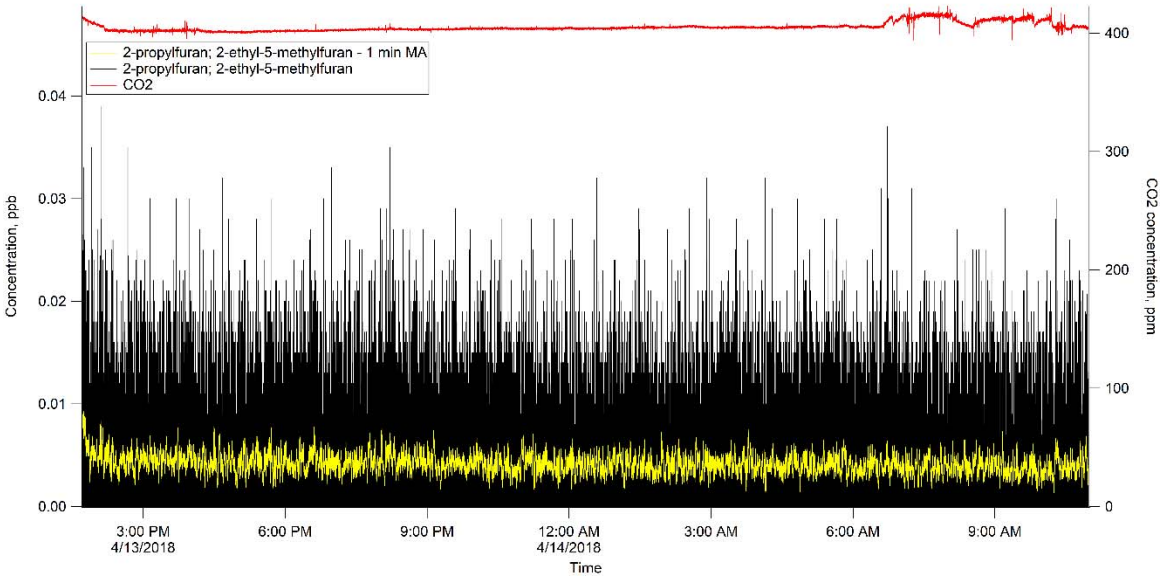


Figure 5-6. 2-propylfuran + 2-ethyl-5-methylfuran.

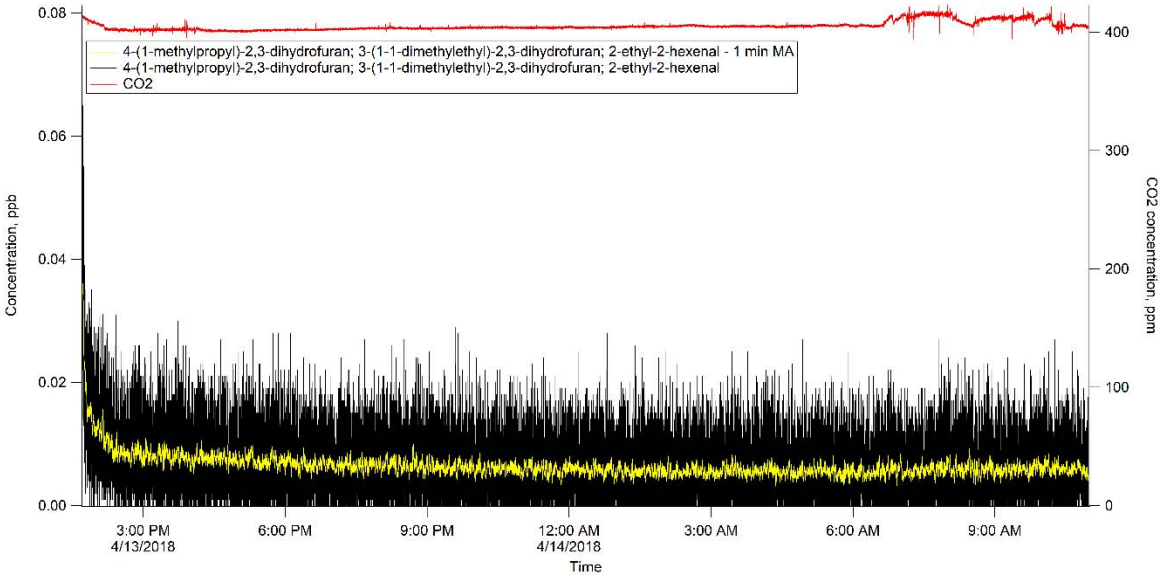


Figure 5-7. 4-(1-methylpropyl)-2,3-dihydrofuran + 3-(1-1-dimethylethyl)-2,3-dihydrofuran + 2-ethyl-2-hexenal.

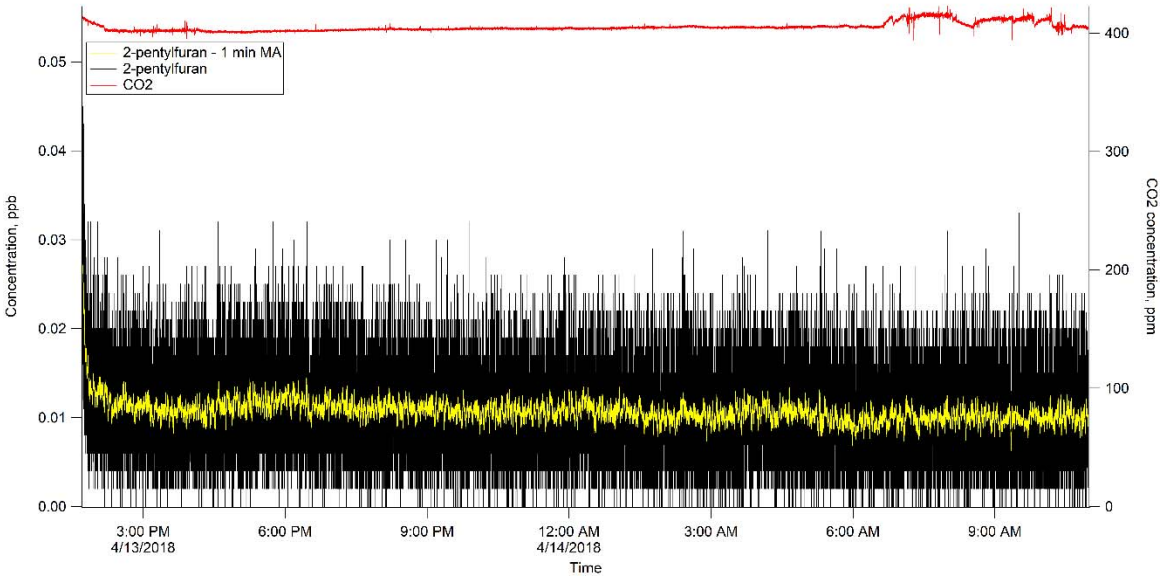


Figure 5-8. 2-pentylfuran.

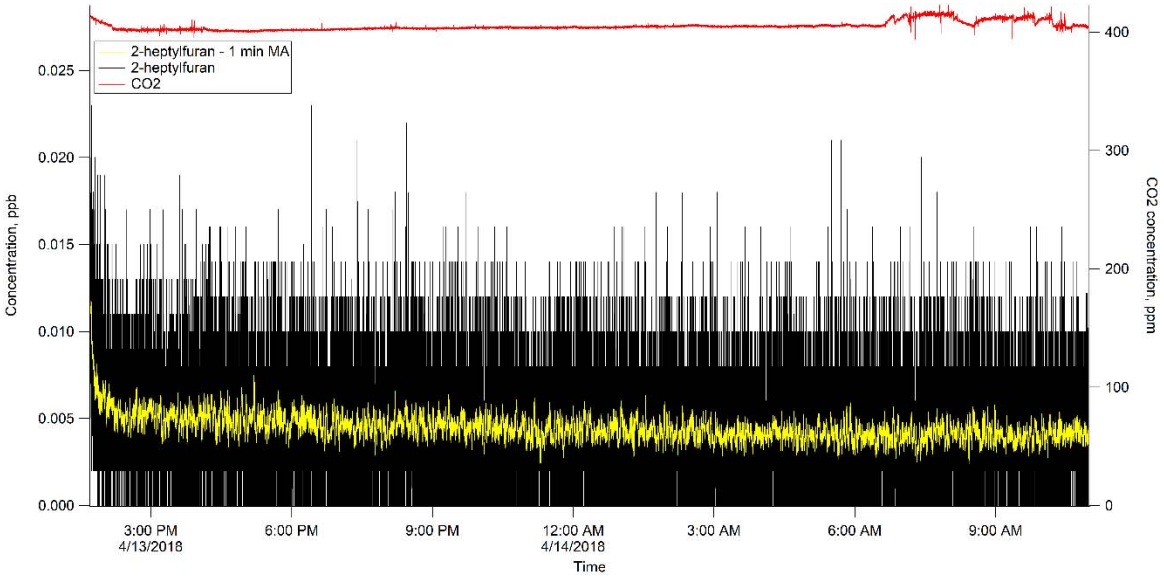


Figure 5-9. 2-heptylfuran.

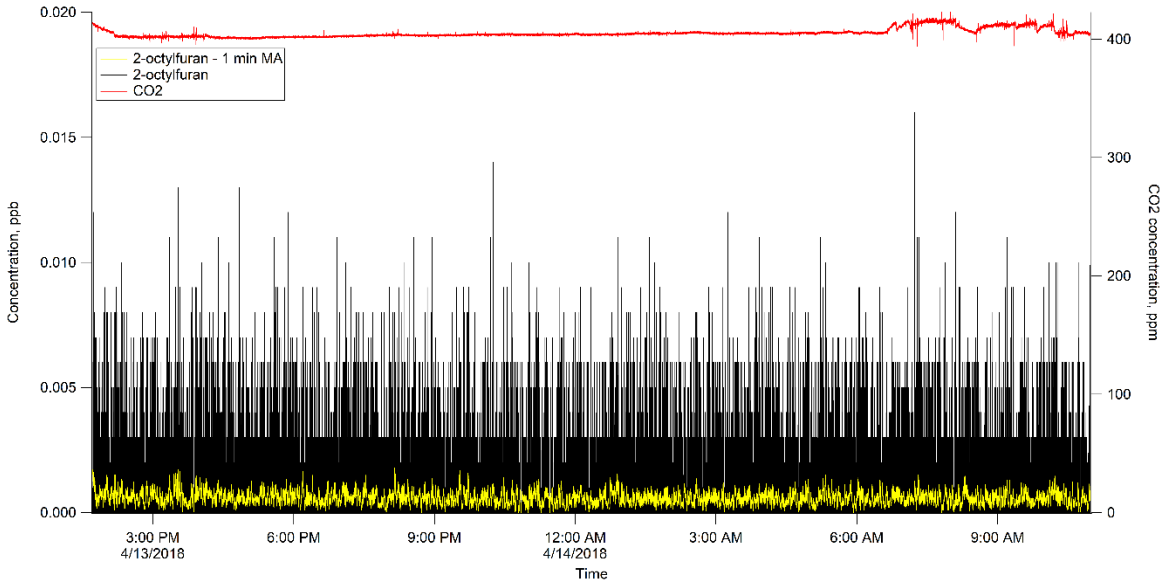


Figure 5-10. 2-octylfuran.

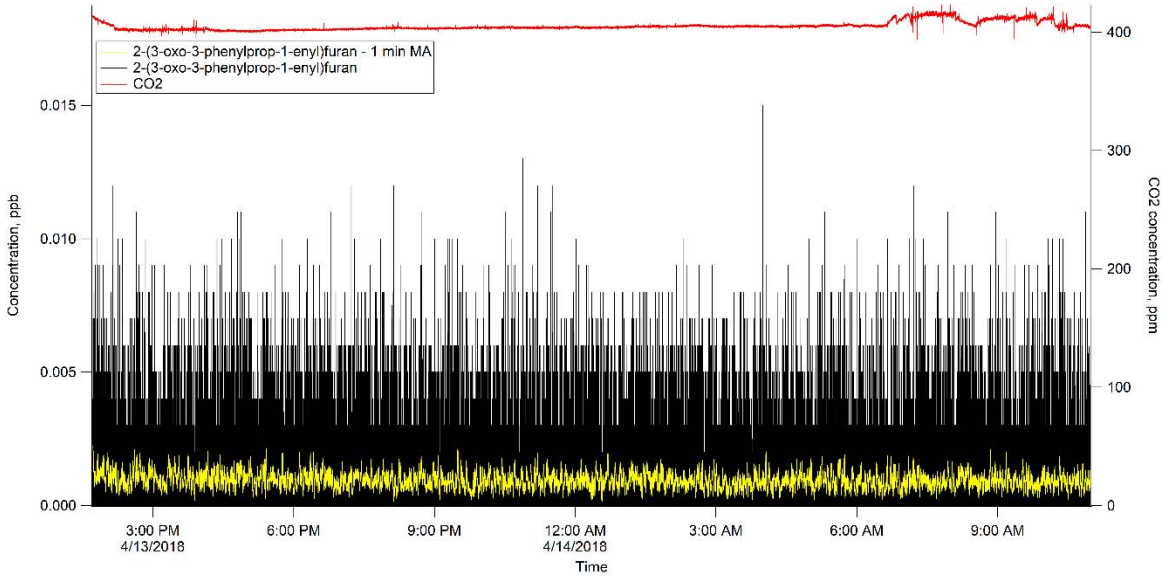


Figure 5-11. 2-(3-oxo-3-phenylprop-1-enyl)furan.

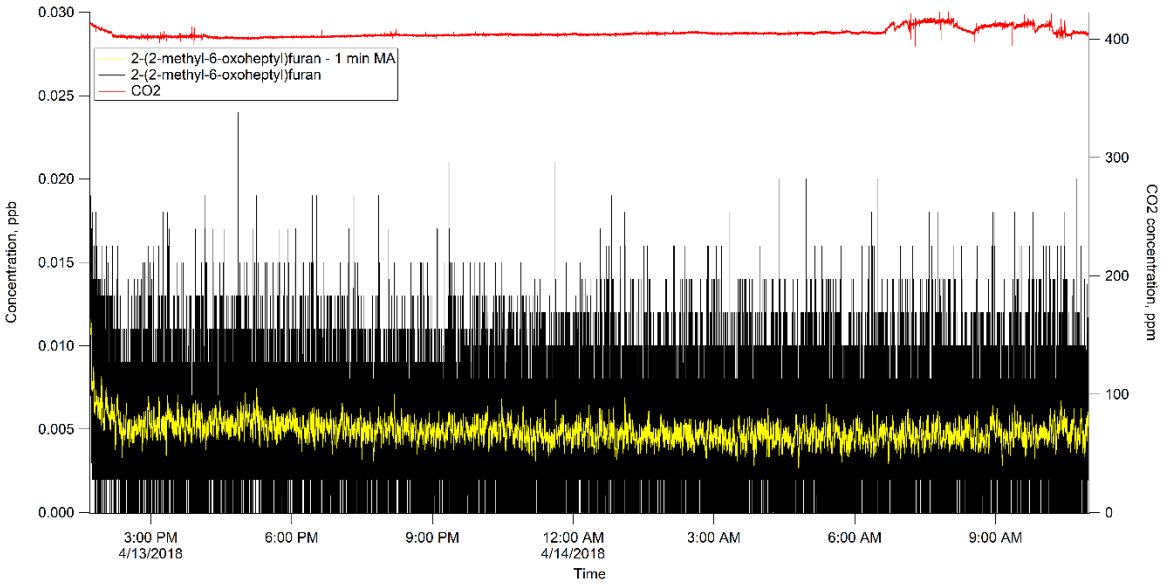


Figure 5-12. 2-(2-methyl-6-oxoheptyl)furan.

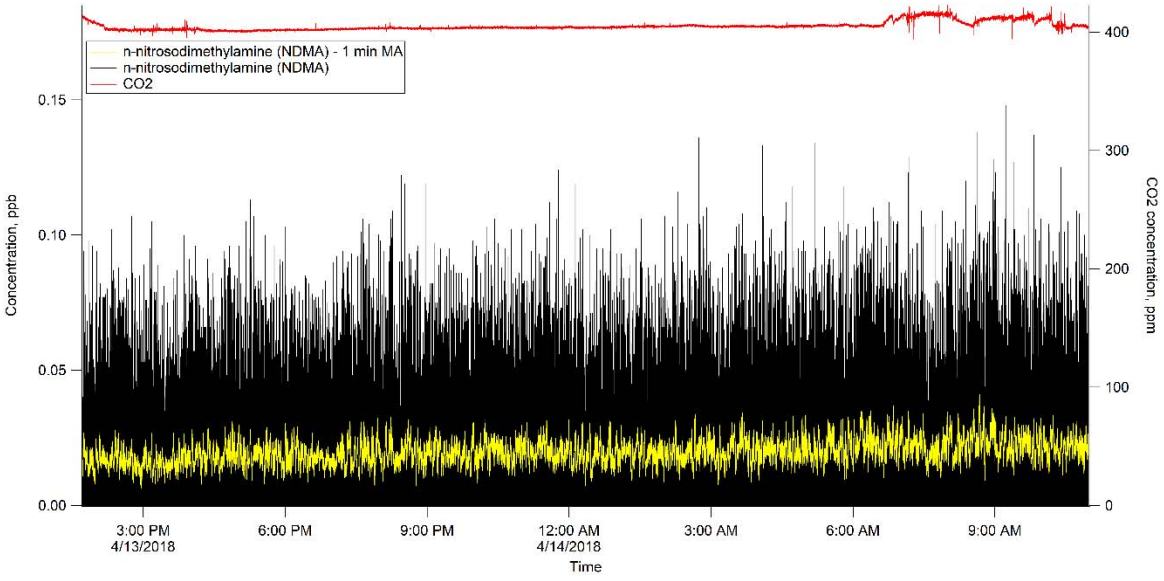


Figure 5-13. N-nitrosodimethylamine (NDMA).

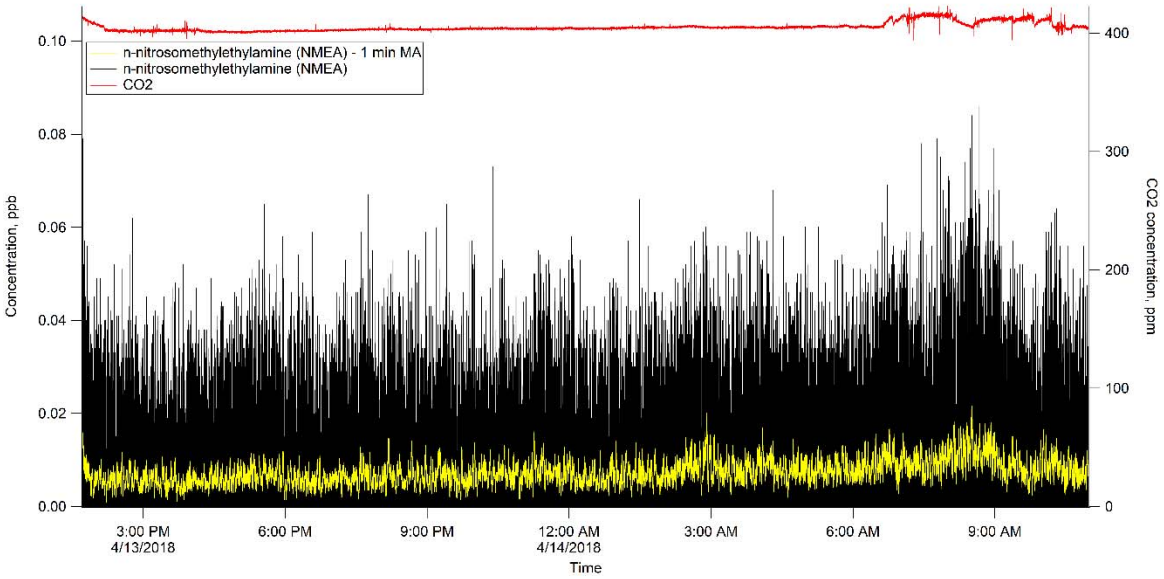


Figure 5-14. N-nitrosomethylethylamine (NMEA).

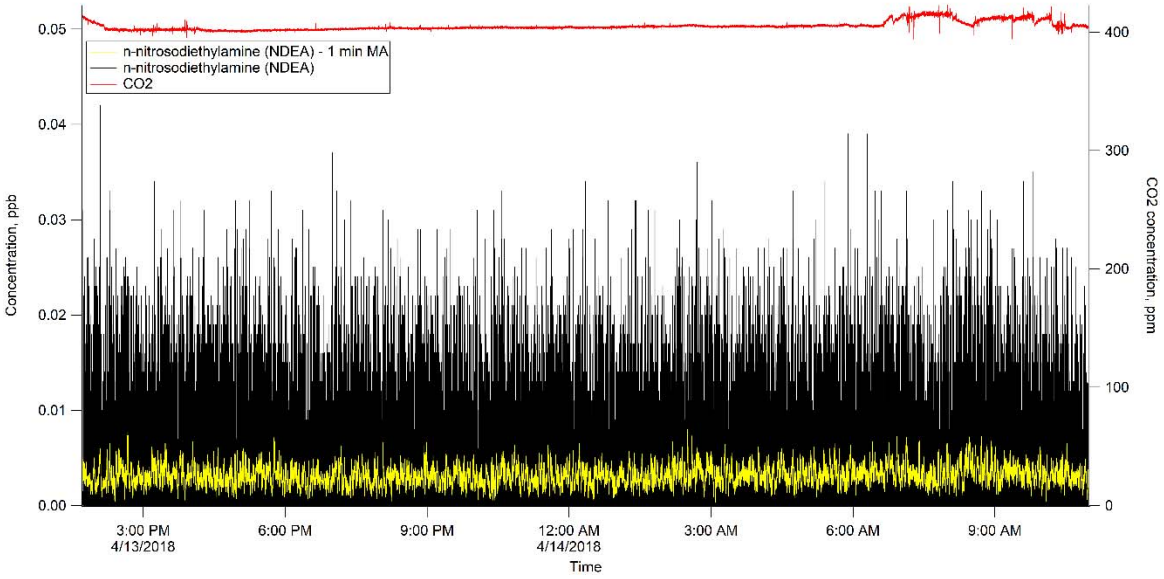


Figure 5-15. N-nitrosodiethylamine (NDEA).

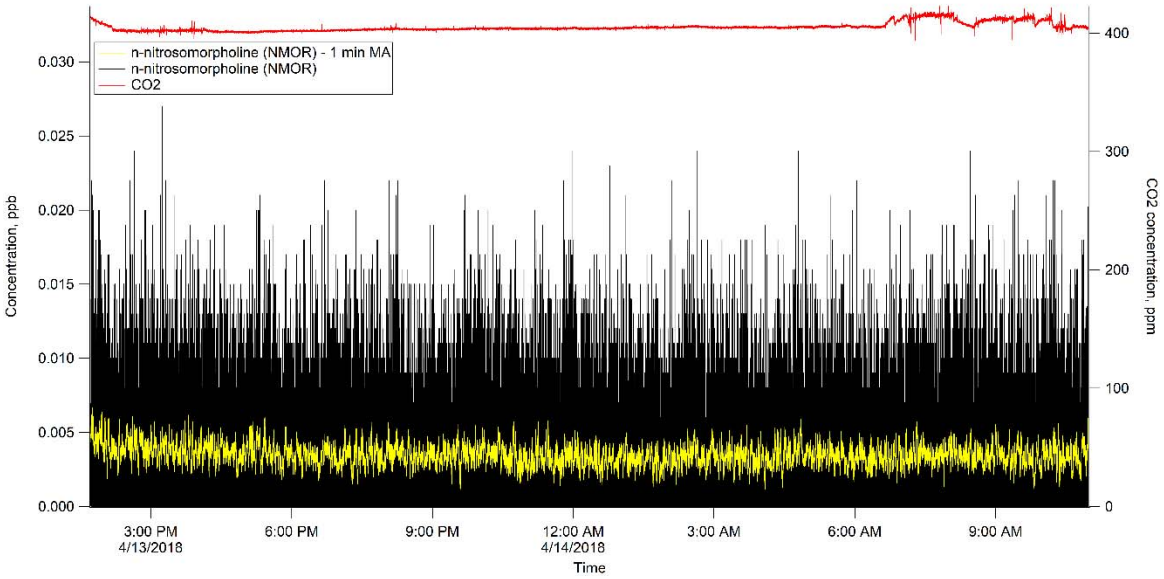


Figure 5-16. N-nitrosomorpholine (NMOR).

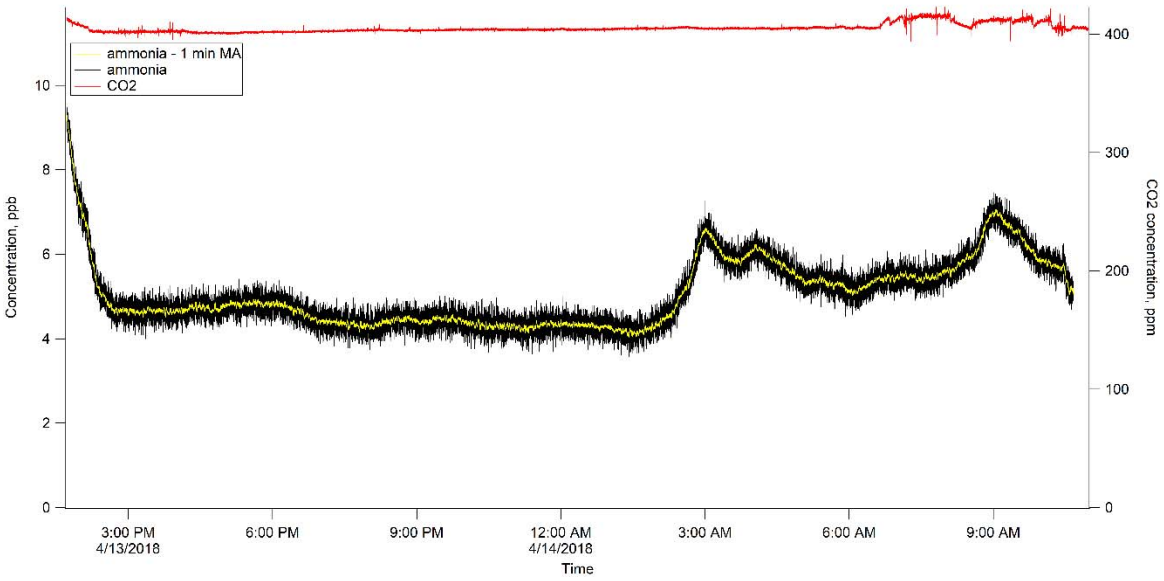


Figure 5-17. Ammonia.

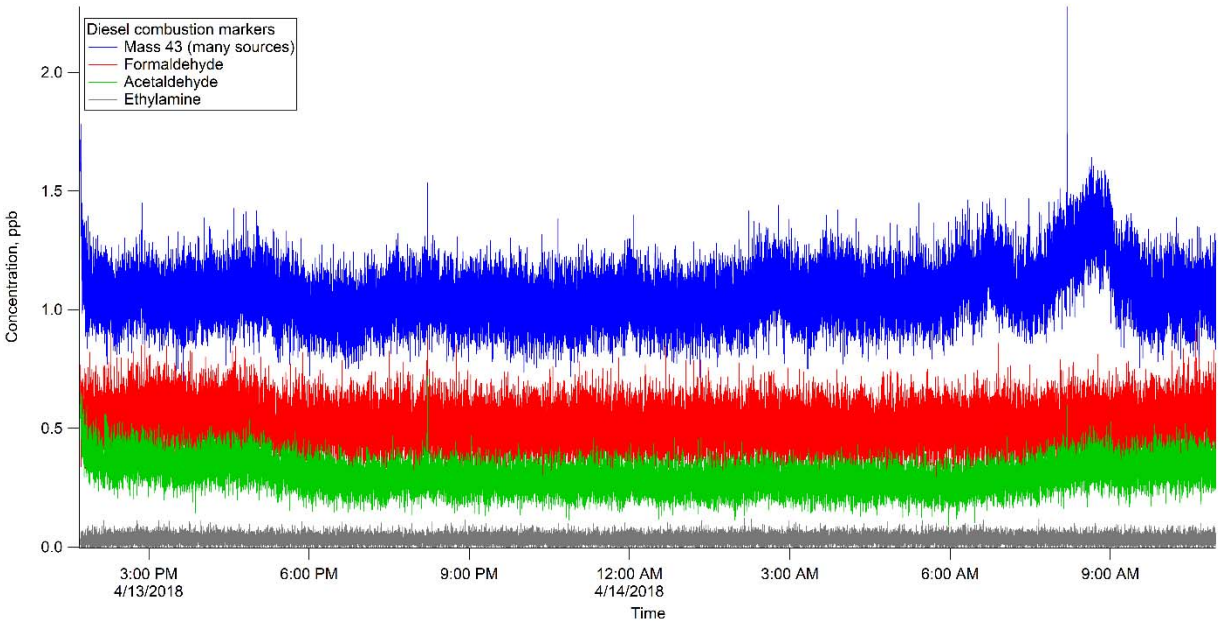


Figure 5-18. Diesel Combustion Markers.

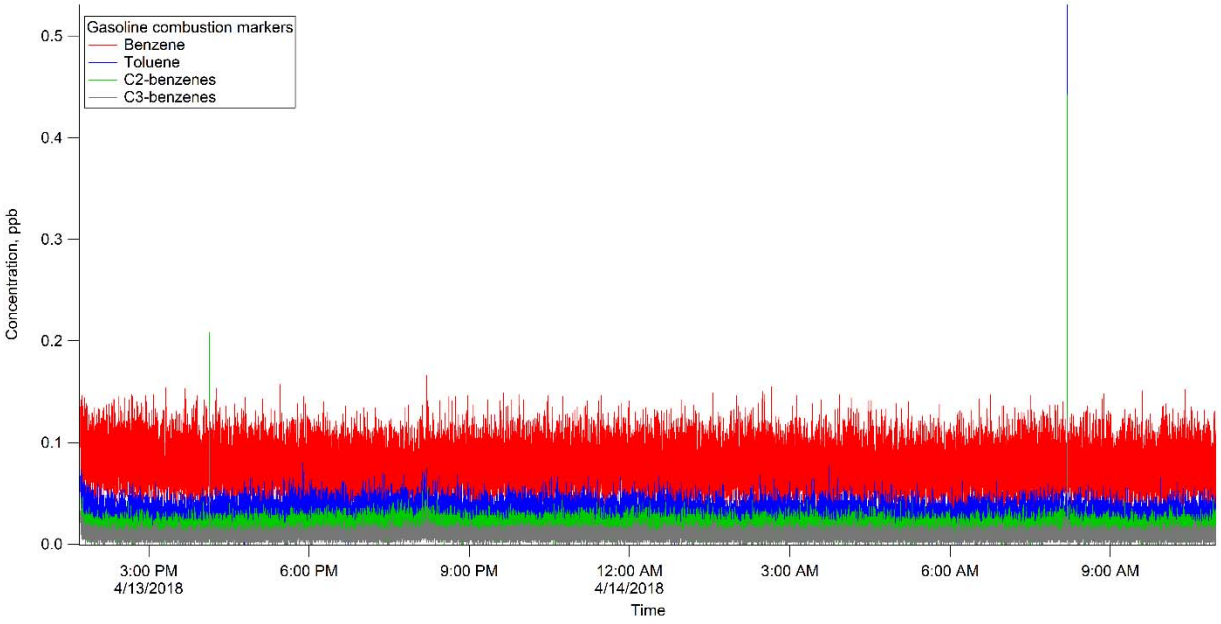


Figure 5-19. Gasoline Combustion Markers.

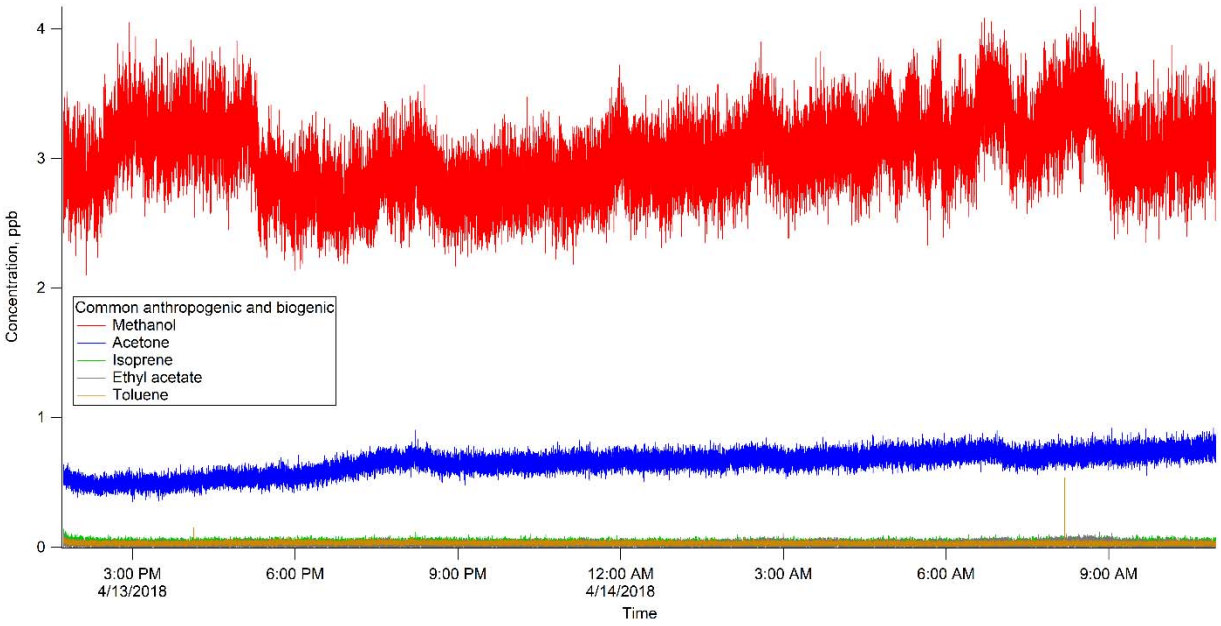


Figure 5-20. Plant and Human Markers.

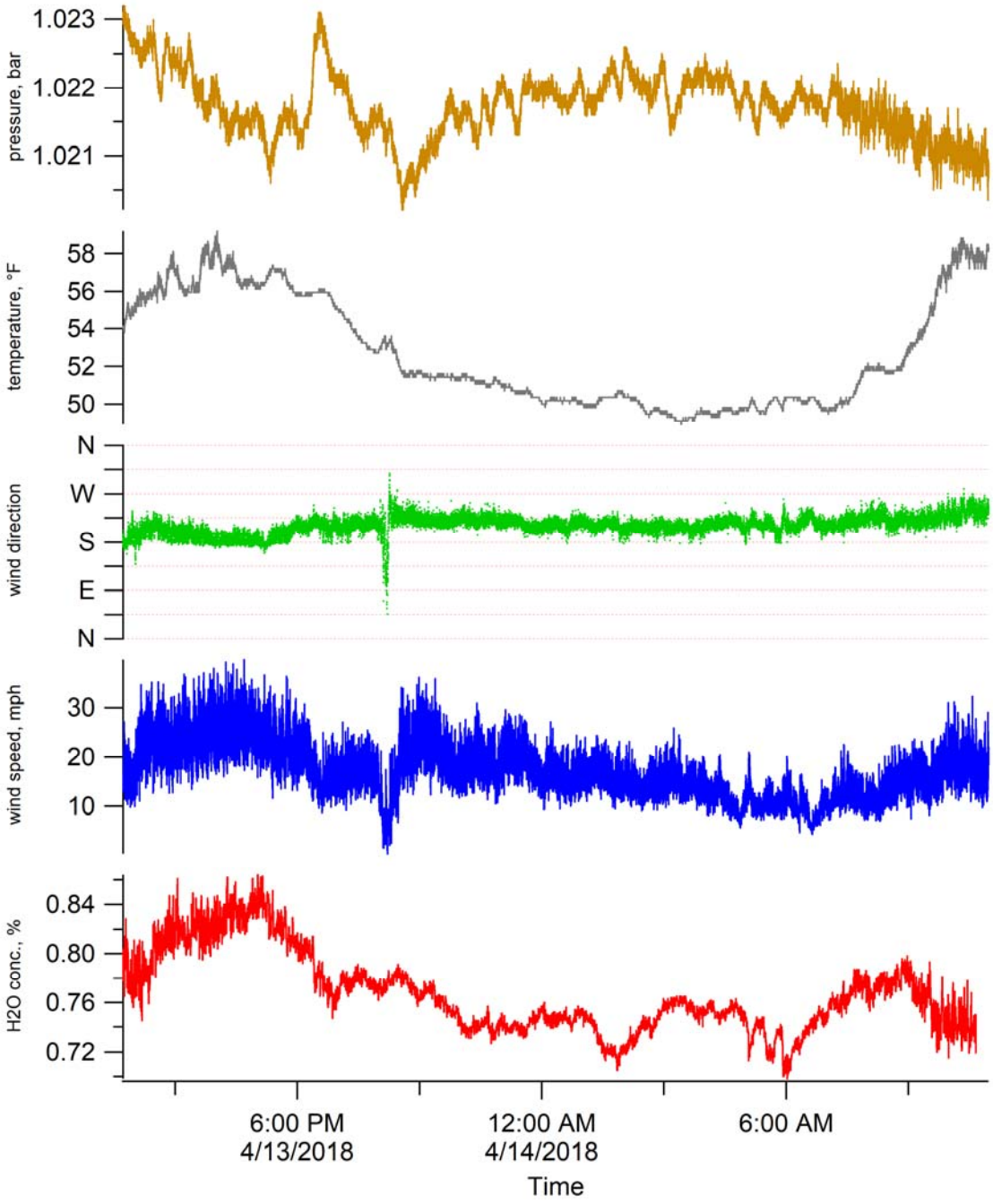


Figure 5-21. Weather Data.

6.0 APRIL 14, 2018 – APRIL 15, 2018 – STUDY SITE #2

6.1 Quality Assessment

Data from April 14, 2018, were transferred to TerraGraphics via the WRPS FTP site on April 19, 2018. Data were assessed using Procedure 17124-DOE-HS-102. A completed Data Exchange Checklist was sent to WRPS on April 23, 2018. The data were accepted by TerraGraphics with the following comments. All startup, shutdown, and calibration procedures were adequately documented and all other checks passed the acceptance limits.

6.2 Summary

The Mobile Laboratory personnel performed background sampling using the Mobile Laboratory from April 14, 2018, to April 15, 2018, at Study Site 2. Site 2 is located near the northern end of the 200W Tank Farms. The Mobile Laboratory arrived at Site 2 at 11:46 on April 14, 2018. The initial QA/QC zero air/sensitivity checks were performed on the CO_2 monitor, NH_3 monitor, and the PTR-MS beginning at 11:46. The data file names were confirmed and routine data collection resumed by 12:36. The Mobile Laboratory staff departed the monitoring site at after 15:00.

The Mobile Laboratory staff returned to Site 2 at 06:55 on April 15, 2018, and began confirmatory sample collection by 07:01. Closeout zero air/sensitivity checks were performed at 10:40. The Mobile Laboratory moved to Site 3 by 11:30.



Figure 6-1. Mobile Lab Site #2 for the Duration of the Monitoring Period.

6.3 Samples Collected

Continuous air monitoring was performed using the following instrumentation:

- PTR-MS,
- LI-COR CO_2 Monitor,
- Picarro Ammonia Monitor, and
- Weather Station.

Confirmatory air samples were collected as follows:

Table 6-1. Alternative Media Samples Taken.

Site	Date	Sample Type	ID	Start	Stop	Sample Time (min)
2	14-Apr	Thermosorb/N	EL22185	11:55	14:55	180
2	14-Apr	CarboTrap-300	A022018	12:03	13:13	70
2	15-Apr	Thermosorb/N	EL22238	07:01	10:01	180
2	15-Apr	CarboTrap-300	A007574	07:05	08:15	70

Table 6-2 displays the statistical information for the monitoring period of April 14, 2018, to April 15, 2018. By definition, the OEL is an 8-hour, time-weighted average that establishes a limit for personnel exposures to hazardous chemicals. It is the exposure level to which a person may be exposed for 8 hours/day, 40 hours/week for 40 years and have no expectation of adverse health effects. In this study, area vapor concentration measurements were made to better understand the hazardous vapor exposures that workers may receive. These measurements are only compared to OEL concentrations to give them context. It is neither accurate nor appropriate to interpret these short duration measurements (2 seconds) as worker exposure levels. Since the OEL is defined as a time-weighted average, it is more appropriate to compare them to daily average vapor concentrations. Short duration excursions above the OEL concentration are not significant.

Table 6-2. Statistical Information for the Monitoring Period of April 14, 2018 – April 15, 2018.

COPC #	COPC Name	Reporting Limit (ppb)	OEL (ppb)	Ave. (ppb)	St. Dev. (ppb)	Rel. St. Dev. (%)	Max (ppb)	Median (ppb)	Sec. over 50% OEL	Sec. over OEL
1	ammonia	1	25000	5.59	1.402	25.1%	11.48	5.58	0	0
2	furan	0.09	1	0.045	0.010	69.0%	0.099	0.014	0	0
3	but-3-en-2-one + 2,3-dihydrofuran + 2,5-dihydrofuran	0.22	1	0.110	0.008	45.5%	N/A*	N/A*	N/A	N/A
4	NDMA**	0.06	0.3	0.034	0.024	111.1%	0.163	0.014	12	0
5	2-methylfuran	0.05	1	0.025	0.008	67.5%	0.068	0.011	0	0
6	NEMA	0.02	0.3	0.013	0.012	164.1%	0.083	0.000	0	0
7	2,5-dimethylfuran	0.05	1	0.025	0.007	80.9%	0.065	0.008	0	0
8	NDEA	0.01	0.1	0.007	0.006	182.2%	0.042	0.000	0	0
9	2-propylfuran + 2-ethyl-5-methylfuran	0.02	1	0.010	0.005	117.3%	0.042	0.003	0	0
10	NMOR	0.05	0.6	0.025	0.004	106.2%	0.033	0.003	0	0
11	2-ethyl-2-hexenal + 4-(1-methylpropyl)-2,3-dihydrofuran + 3-(1,1-dimethylethyl)-2,3-dihydrofuran	0.04	1	0.020	0.005	66.1%	0.053	0.007	0	0
12	2-pentylfuran	0.04	1	0.020	0.006	43.0%	0.046	0.013	0	0
13	2-heptylfuran	0.02	1	0.010	0.003	64.8%	0.026	0.004	0	0
14	2-octylfuran	0.01	1	0.005	0.001	231.2%	0.013	0.000	0	0
15	6-(2-furanyl)-6-methyl-2-heptanone	0.01	1	0.005	0.002	169.7%	0.016	0.000	0	0
16	furfural acetophenone	0.07	1	0.035	0.003	61.9%	0.026	0.004	0	0

* The maximum peak value for but-3-en-2-one + 2,3 dihydrofuran + 2,5 dihydrofuran was 0.242 ppb and the median value was 0.017 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 200, 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 COPC signal, overlaid with the same signal smoothed using a 1-minute moving average, and CO_2, for the monitoring period April 14, 2018, to April 15, 2018.

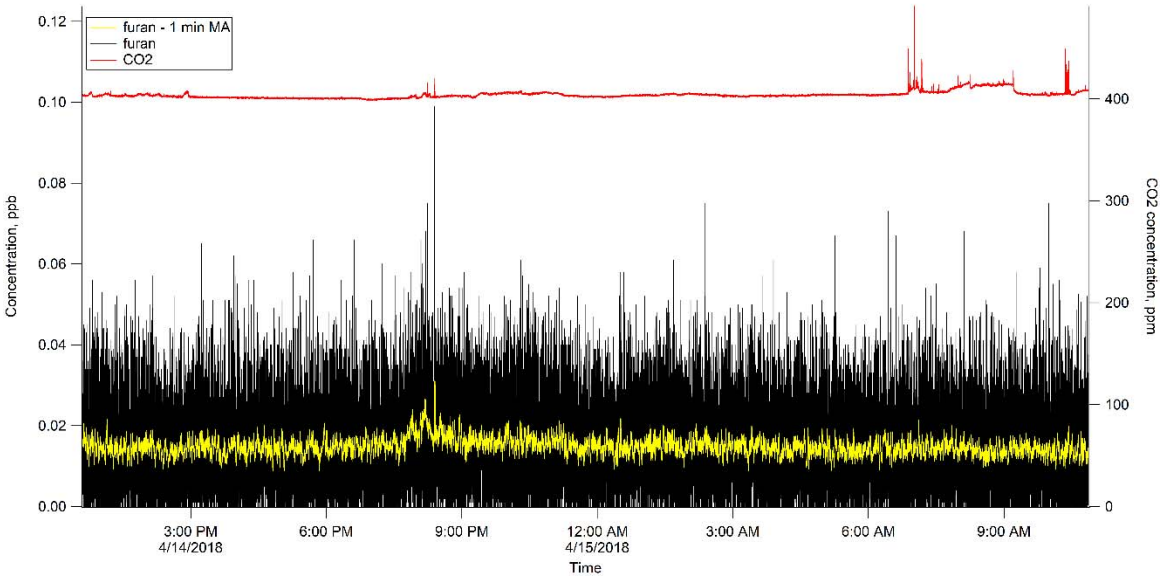


Figure 6-2. Furan.

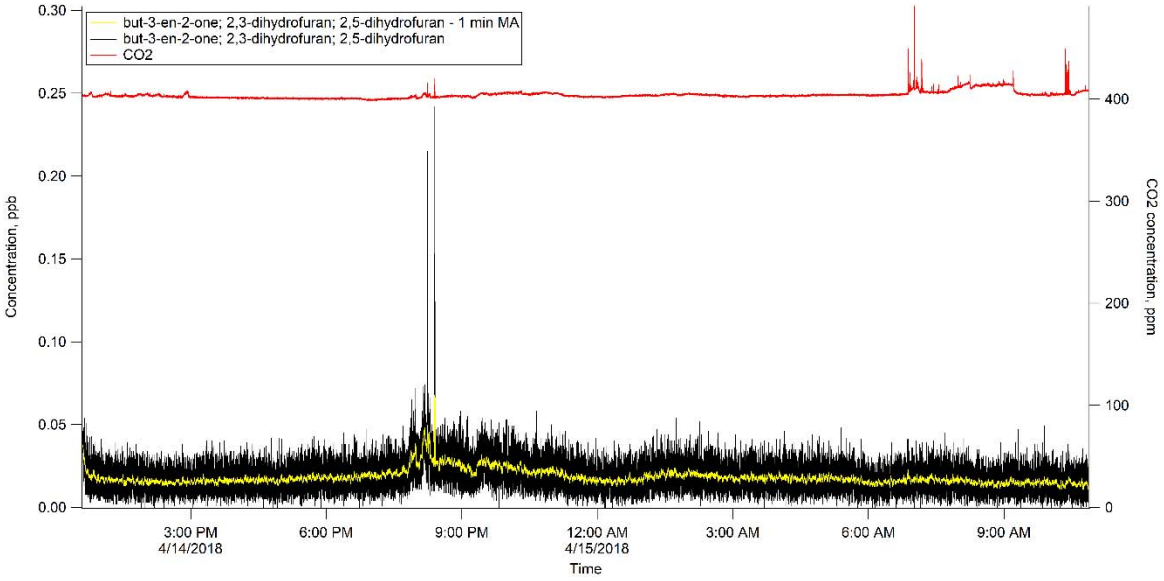


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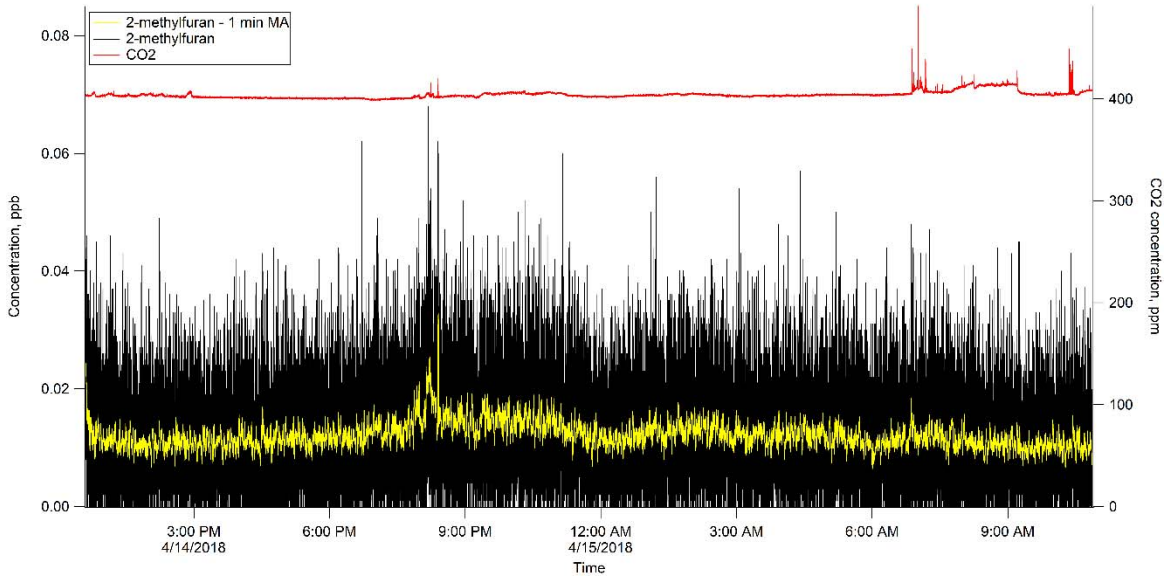


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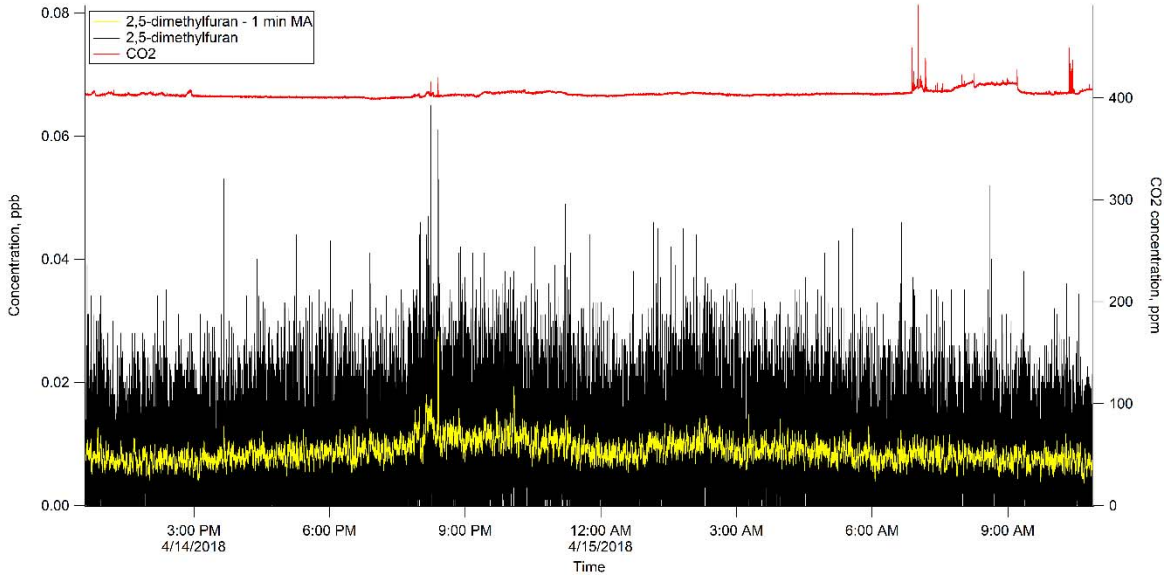


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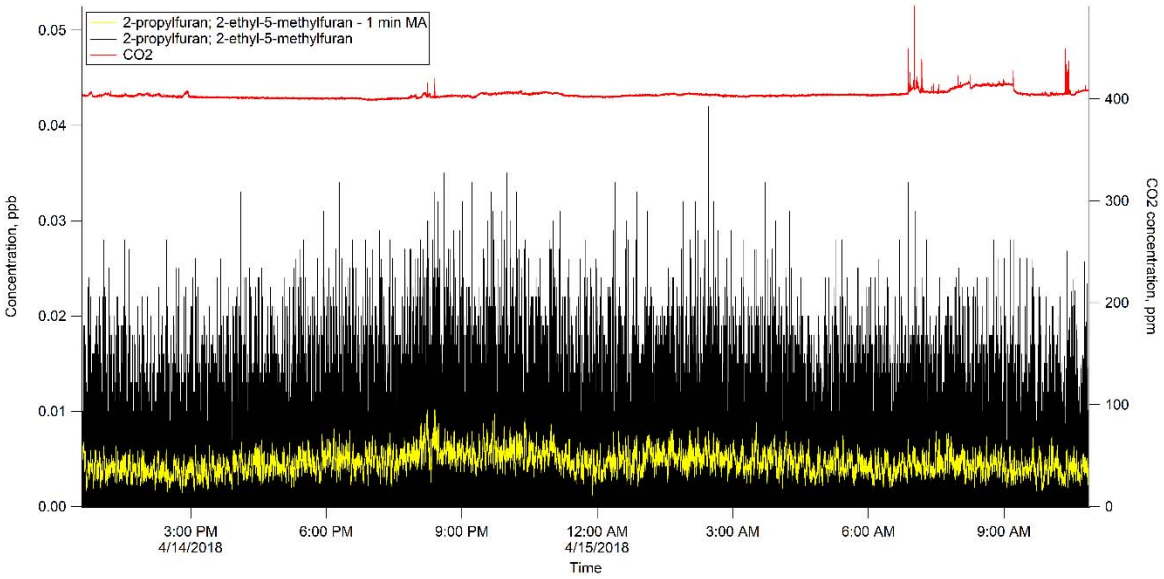


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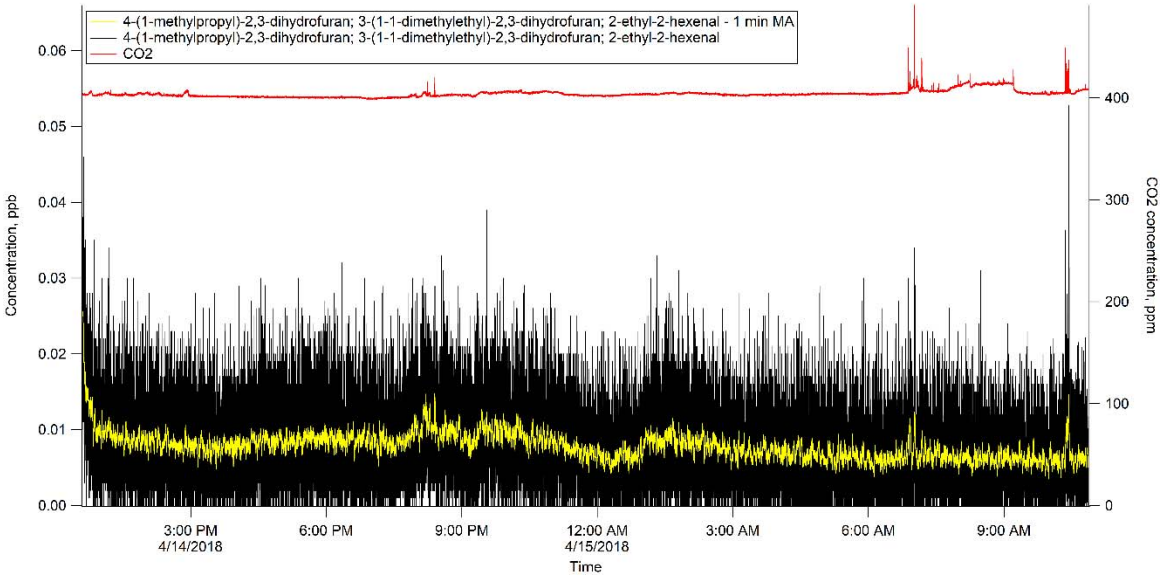


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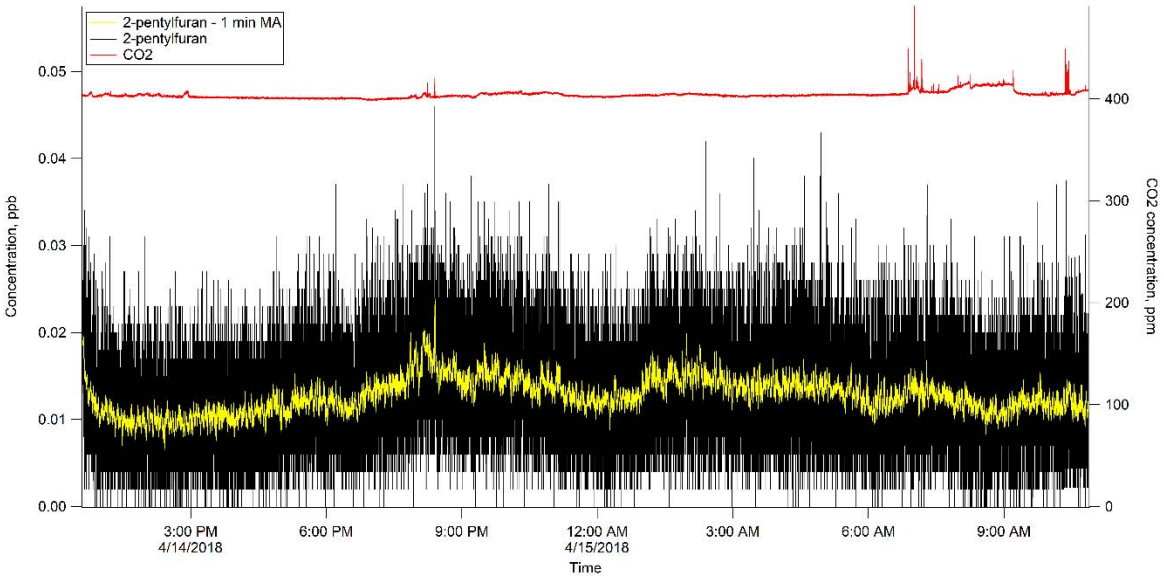


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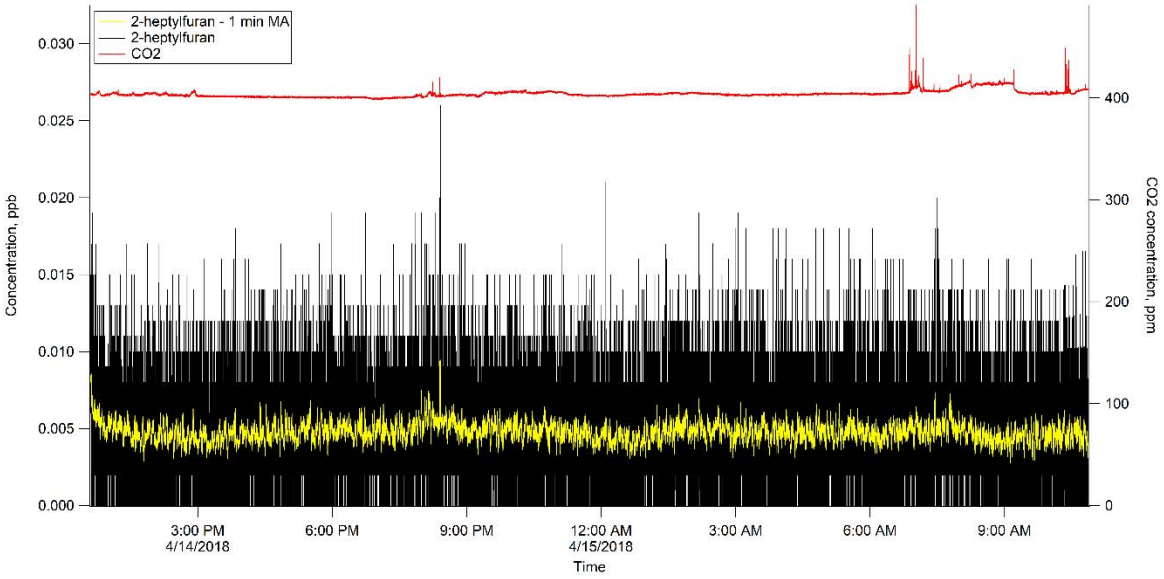


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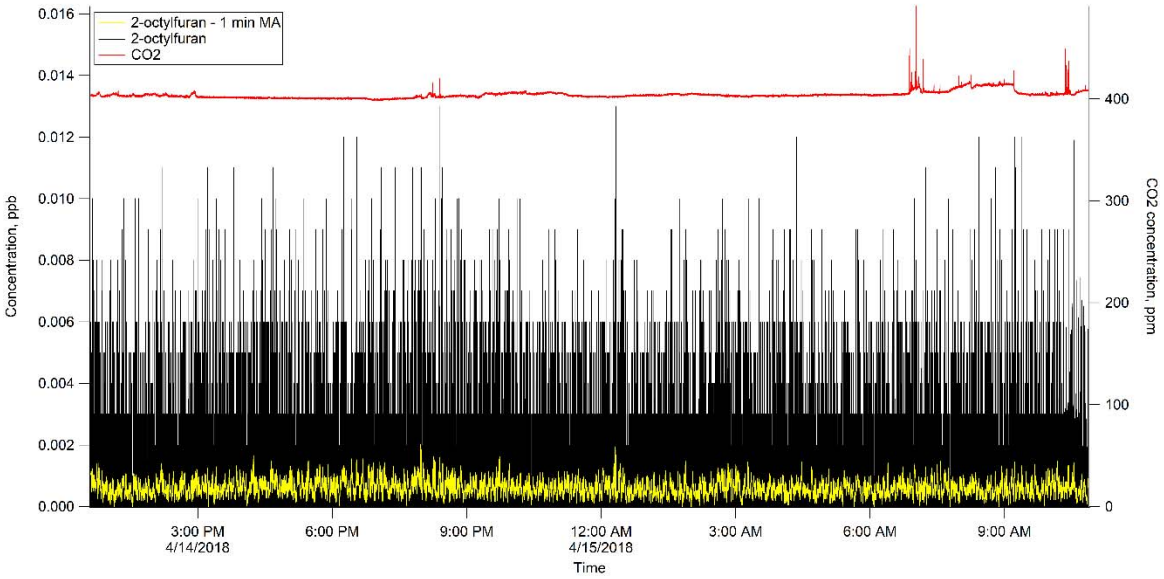


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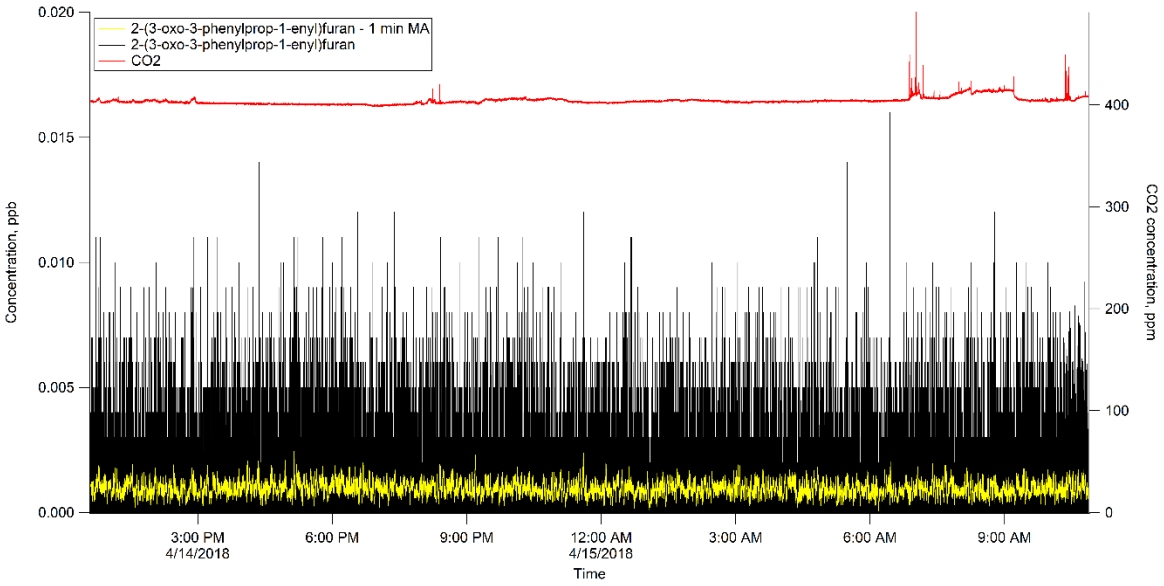


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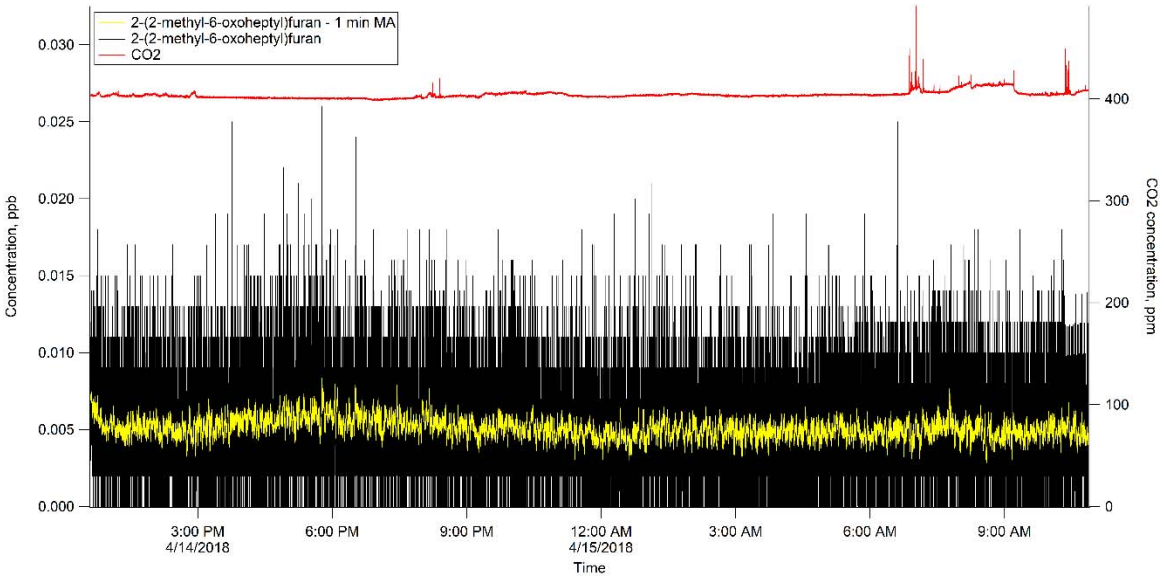


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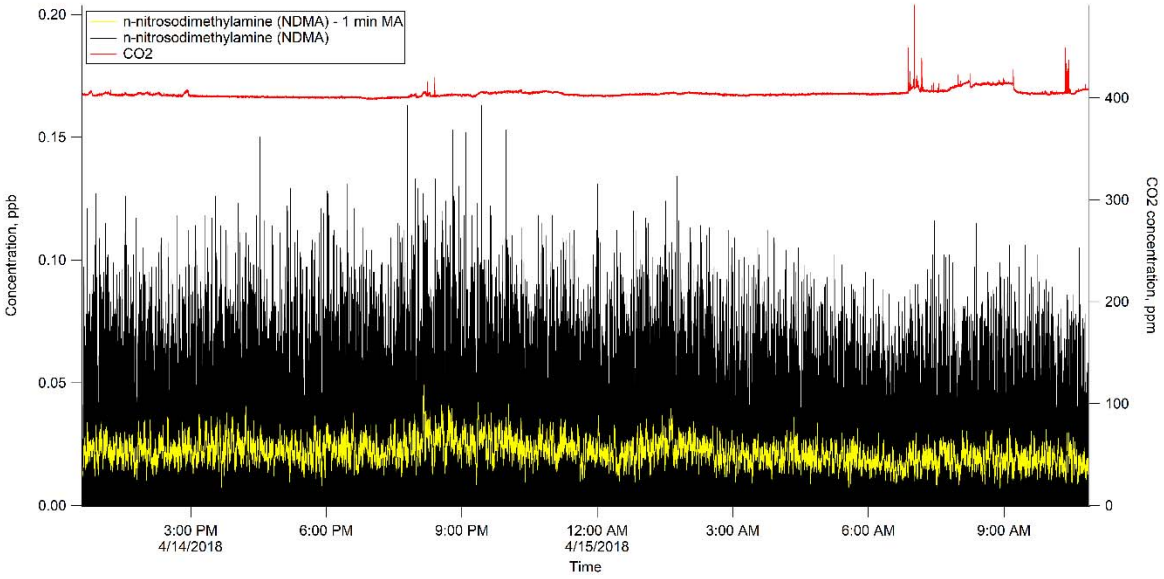


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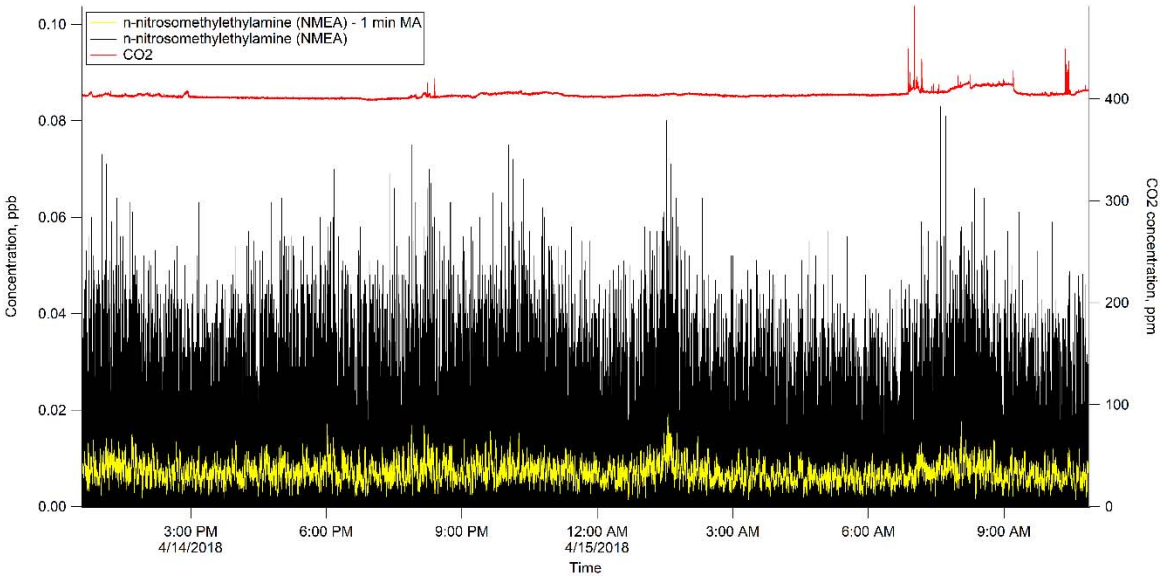


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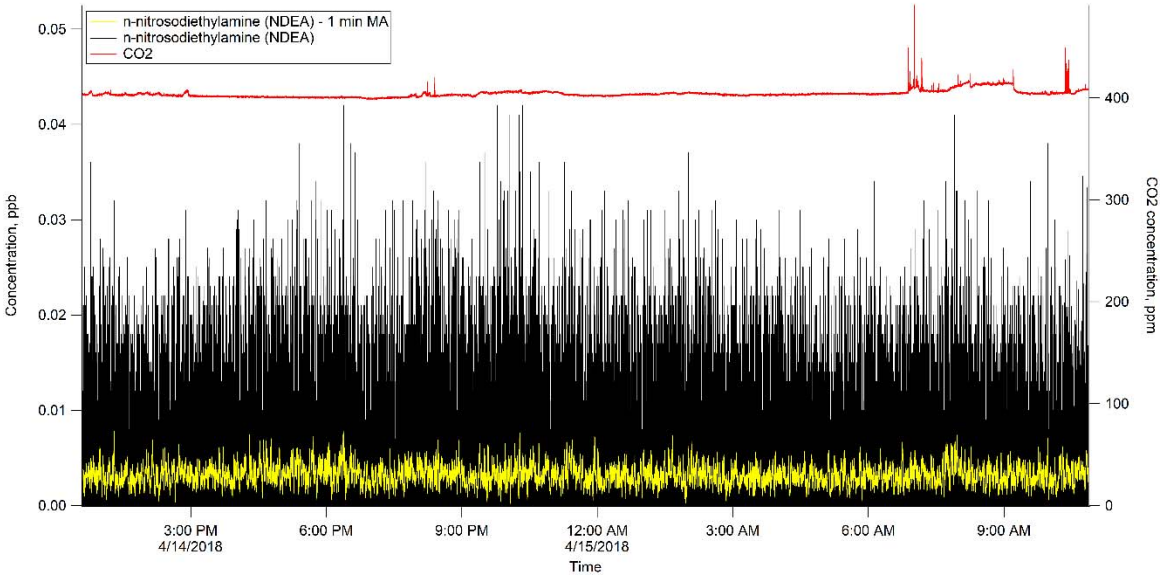


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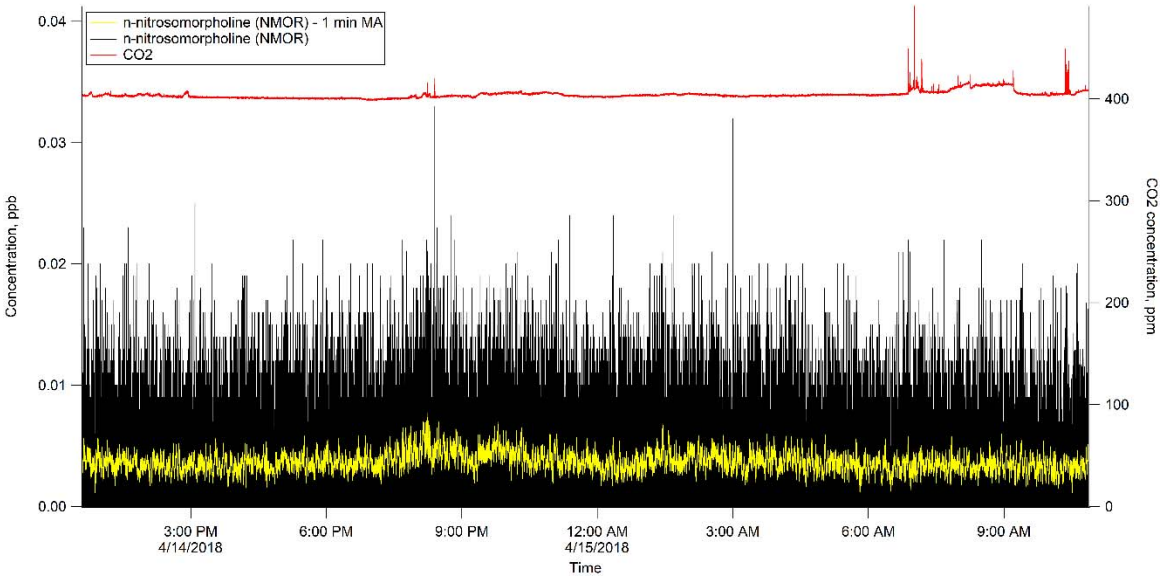


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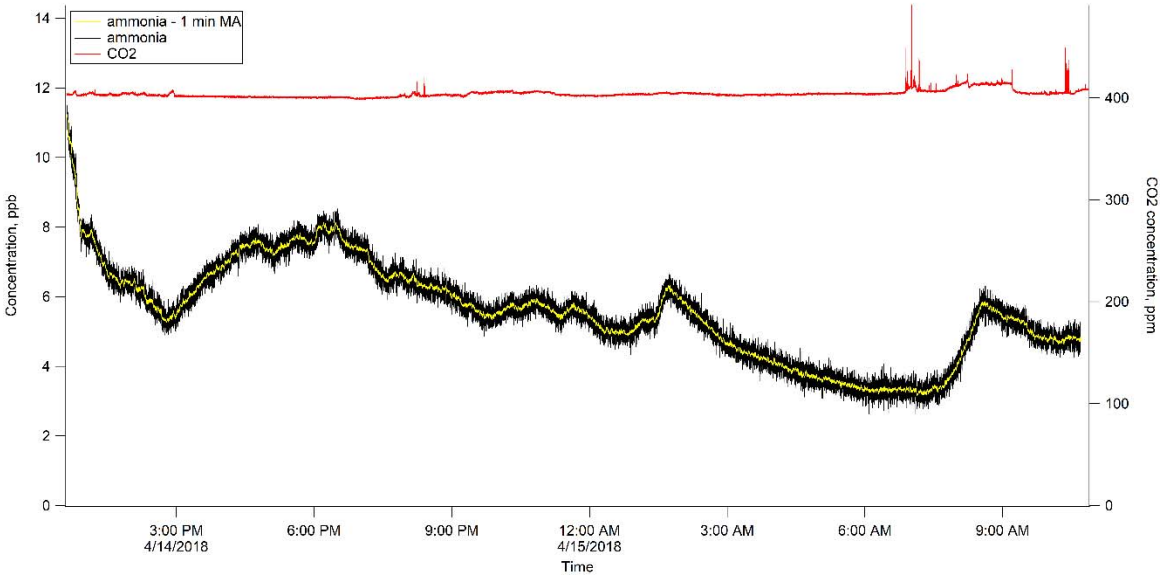


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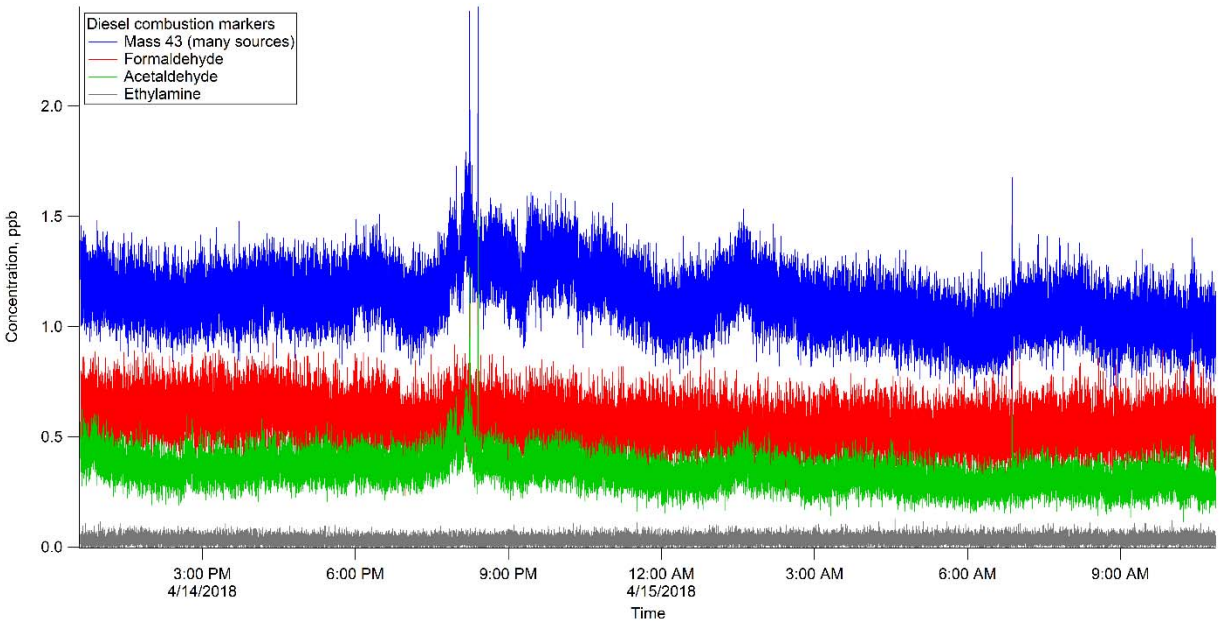


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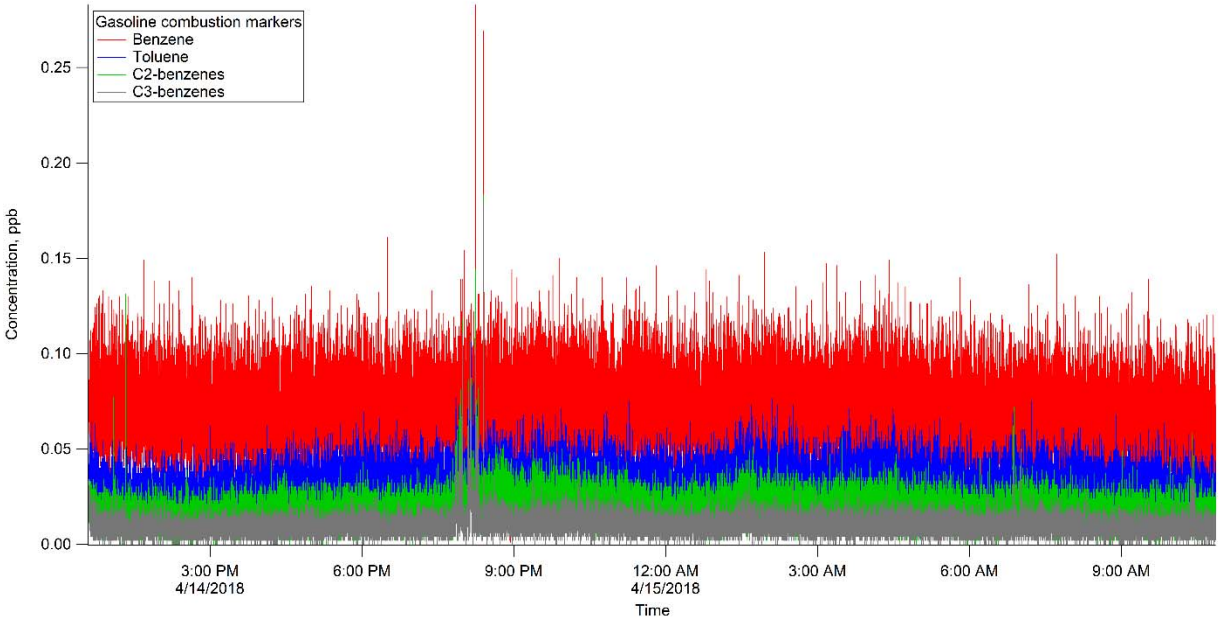


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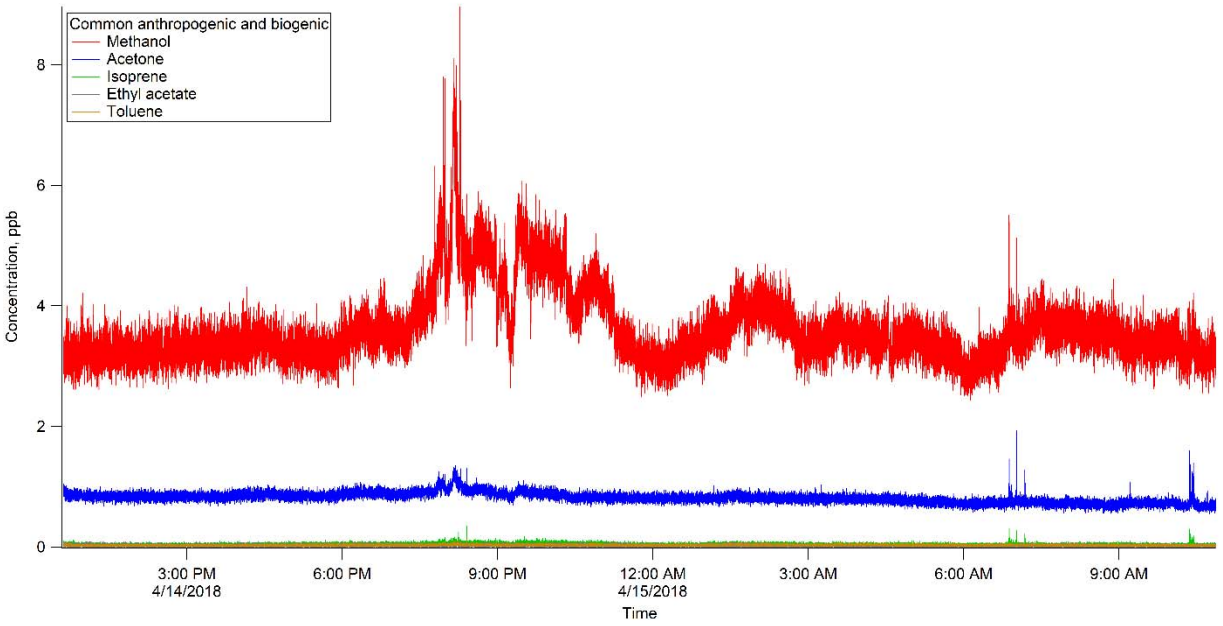


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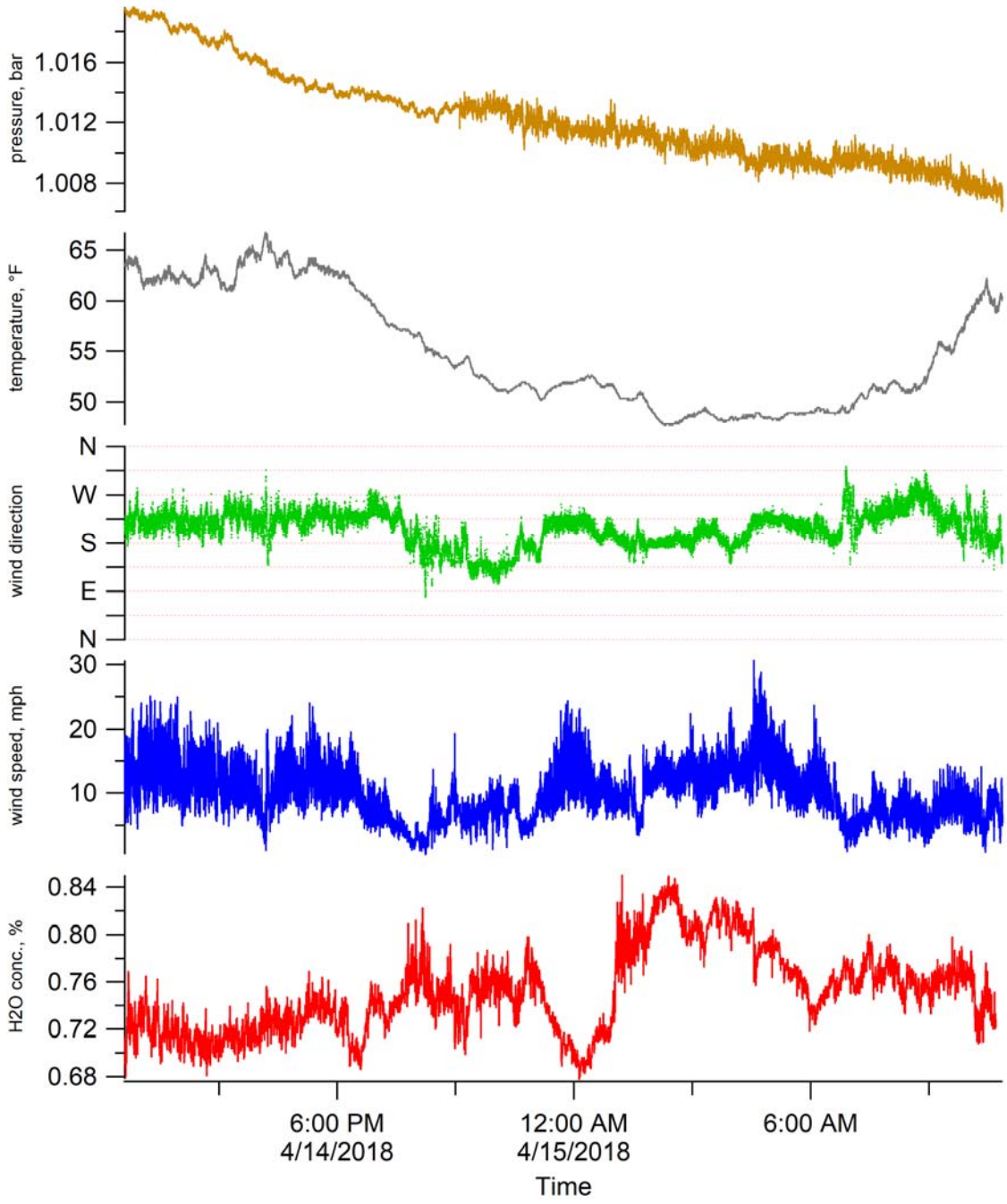


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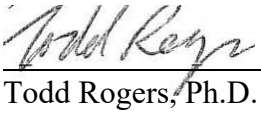
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Date: 5/18/2018

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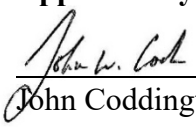
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Approved by:



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John Coddington, Ph.D.

Record of Revision

Revision	Date	Pages/Sections Changed	Brief Description
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Acronyms

CAPA	Corrective and Preventative Action
CBAL	Columbia Basin Analytical Laboratories
COPC	Chemical of Potential Concern
FTP	File Transfer Protocol
NDMA	N-nitrosodimethylamine
NMEA	N-nitrosomethylethylamine
NMOR	N-nitrosomorpholine
OEL	Occupational Exposure Limit
PTR-MS	Proton Transfer Reaction – Mass Spectrometer
QA	Quality Assurance
QC	Quality Control
WRPS	Washington River Protection Solutions, LLC

1.0 APRIL 15, 2018 – APRIL 16, 2018 – STUDY SITE #3

1.1 Quality Assessment

Data from April 15, 2018, were transferred to TerraGraphics via the Washington River Protection Solutions, LLC (WRPS) File Transfer Protocol (FTP) site on April 23, 2018. Data were assessed using Procedure 17124-DOE-HS-102, "Mobile Laboratory Data Processing – Analysis." A completed Data Exchange Checklist was sent to WRPS on April 25, 2018. The data were accepted by TerraGraphics with the following comments. All startup, shutdown, and calibration procedures were adequately documented and all other checks passed the acceptance limits.

1.2 Summary

The Mobile Laboratory personnel performed background sampling using the Mobile Laboratory from April 15, 2018, to April 16, 2018 at Study Site 3. Site 3 is located near the corner of 4th and Buffalo just to the west of the 242-A Evaporator. This site historically has seen the occurrence of several AOP-15 events (reports of unusual odors). The Mobile Laboratory arrived at Site 3 at 11:52 on April 15, 2018. The usual site was occupied by construction equipment; therefore, the Mobile Laboratory personnel moved Site 3 monitoring approximately 200 yards north on Buffalo and parked on west side of Buffalo across from MO-193. The Mobile Laboratory was parked at the fence line separating AY from AZ at 12:17. The initial quality assurance/quality control (QA/QC) zero air/sensitivity checks were performed on the CO_2 monitor, NH_3 monitor, and the Proton Transfer Reactor – Mass Spectrometer (PTR-MS) beginning after the new site was established. The data file names were confirmed and routine data collection resumed by 12:36. Wind was constantly shifting direction from 13:00 to 15:00. The Mobile Laboratory was moved once and the exhaust line adjusted eight times in an attempt to direct diesel exhaust away from the Mobile Laboratory. The Mobile Laboratory staff departed the monitoring site after 15:00.

The Mobile Laboratory staff returned to Site 3 at 06:25 on April 16, 2018, and began confirmatory sample collection by 06:38. Closeout zero air/sensitivity checks were performed at 10:40. At 11:20, the Mobile Laboratory battery was nearly dead and personnel were unable to start the vehicle. The battery compartment was almost impossible to get to and requires Mercedes-Benz®[1] service to change the battery. Battery cables were retrieved from Columbia Basin Analytical Laboratories (CBAL) and a jump start was performed at 13:00. The Mobile Laboratory moved to Site 4 by 13:20.

[1] Merecedes-Benz is a registered trademark of Daimler AG Corporation, Fed Rep Germany.



Figure 1-1. Mobile Lab Site #3 for the Duration of the Monitoring Period.

1.3 Samples Collected

Continuous air monitoring was performed using the following instrumentation:

- PTR-MS,
- LI-COR®[2] CO_2 Monitor,
- Picarro Ammonia Monitor, and
- Weather Station.

Confirmatory air samples were collected as follows:

Table 1-1. Alternative Media Samples Taken.

Site	Date	Sample Type	ID	Start	Stop	Sample Time (min)
3	15-Apr	Thermosorb®[3]/N	EL22226	11:59	15:01	181
3	15-Apr	CarboTrap®[4]-300	A020872	12:02	13:12	70
3	16-Apr	Thermosorb/N	EL22230	06:38	09:38	180
3	16-Apr	CarboTrap-300	A045499	06:41	07:51	70

[2] LI-COR is a registered trademark of LI-COR, Inc., Lincoln, Nebraska.
[3] Thermosorb is a registered trademark of Ellutia Limited Company, Cambridgeshire, United Kingdom.
[4] CarboTrap is a registered trademark of Sigma-Aldrich Co., LLC, St. Louis, Missouri.

Table 1-2 displays the statistical information for the monitoring period of April 15, 2018, to April 16, 2018. By definition, the occupational exposure limit (OEL) is an 8-hour, time-weighted average that establishes a limit for personnel exposures to hazardous chemicals. It is the exposure level to which a person may be exposed for 8 hours/day, 40 hours/week for 40 years and have no expectation of adverse health effects. In this study, area vapor concentration measurements were made to better understand the hazardous vapor exposures that workers may receive. These measurements are only compared to OEL concentrations to give them context. It is neither accurate nor appropriate to interpret these short duration measurements (2 seconds) as worker exposure levels. Since the OEL is defined as a time-weighted average, it is more appropriate to compare them to daily average vapor concentrations. Short duration excursions above the OEL concentration are not significant.

Table 1-2. Statistical Information for the Monitoring Period of April 15, 2018 – April 16, 2018.

COPC #	COPC Name	Reporting Limit (ppb)	OEL (ppb)	Ave. (ppb)	St. Dev. (ppb)	Rel. St. Dev. (%)	Max (ppb)	Median (ppb)	Sec. over 50% OEL	Sec. over OEL
1	ammonia	1	25000	4.42	1.521	34.4%	10.35	4.60	0	0
2	furan	0.09	1	0.046	0.020	106.5%	0.573	0.016	6	0
3	but-3-en-2-one + 2,3-dihydrofuran + 2,5-dihydrofuran	0.22	1	0.114	0.059	179.5%	N/A*	N/A*	N/A	N/A
4	NDMA**	0.06	0.3	0.033	0.023	116.0%	0.153	0.012	4	0
5	2-methylfuran	0.05	1	0.028	0.025	136.6%	0.595	0.014	18	0
6	NEMA	0.02	0.3	0.013	0.011	172.8%	0.089	0.000	0	0
7	2,5-dimethylfuran	0.05	1	0.027	0.020	133.8%	0.468	0.012	0	0
8	NDEA	0.01	0.1	0.007	0.006	189.6%	0.049	0.000	0	0
9	2-propylfuran + 2-ethyl-5-methylfuran	0.02	1	0.012	0.011	132.4%	0.237	0.005	0	0
10	NMOR	0.05	0.6	0.025	0.006	120.2%	0.120	0.003	0	0
11	2-ethyl-2-hexenal + 4-(1-methylpropyl)-2,3-dihydrofuran + 3-(1,1-dimethylethyl)-2,3-dihydrofuran	0.04	1	0.021	0.012	88.2%	0.196	0.011	0	0
12	2-pentylfuran	0.04	1	0.022	0.014	69.8%	0.254	0.018	0	0
13	2-heptylfuran	0.02	1	0.013	0.009	79.3%	0.127	0.009	0	0
14	2-octylfuran	0.01	1	0.005	0.003	214.9%	0.044	0.000	0	0
15	6-(2-furanyl)-6-methyl-2-heptanone	0.01	1	0.005	0.002	159.0%	0.021	0.000	0	0
16	furfural acetophenone	0.07	1	0.035	0.005	60.0%	0.043	0.007	0	0

* The maximum peak value for but-3-en-2-one + 2,3 dihydrofuran + 2,5 dihydrofuran was 1.892 ppb and the median value was 0.024 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 200, 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 each chemical of potential concern (COPC) signal, overlaid with the same signal smoothed using a 1-minute moving average, and CO_2, for the monitoring period April 15, 2018, to April 16, 2018.

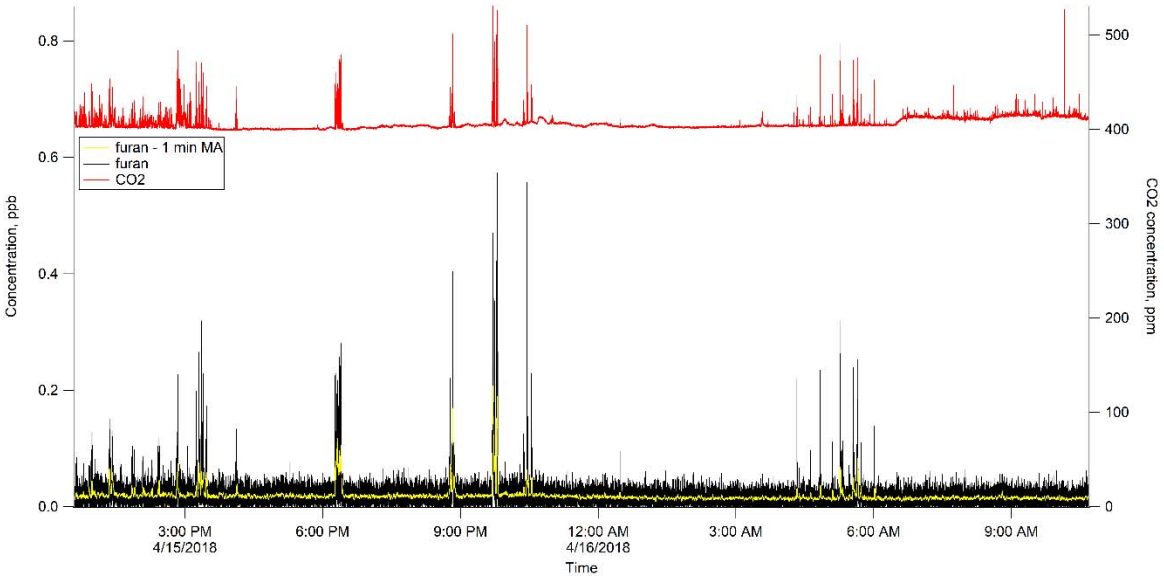


Figure 1-2. Furan.

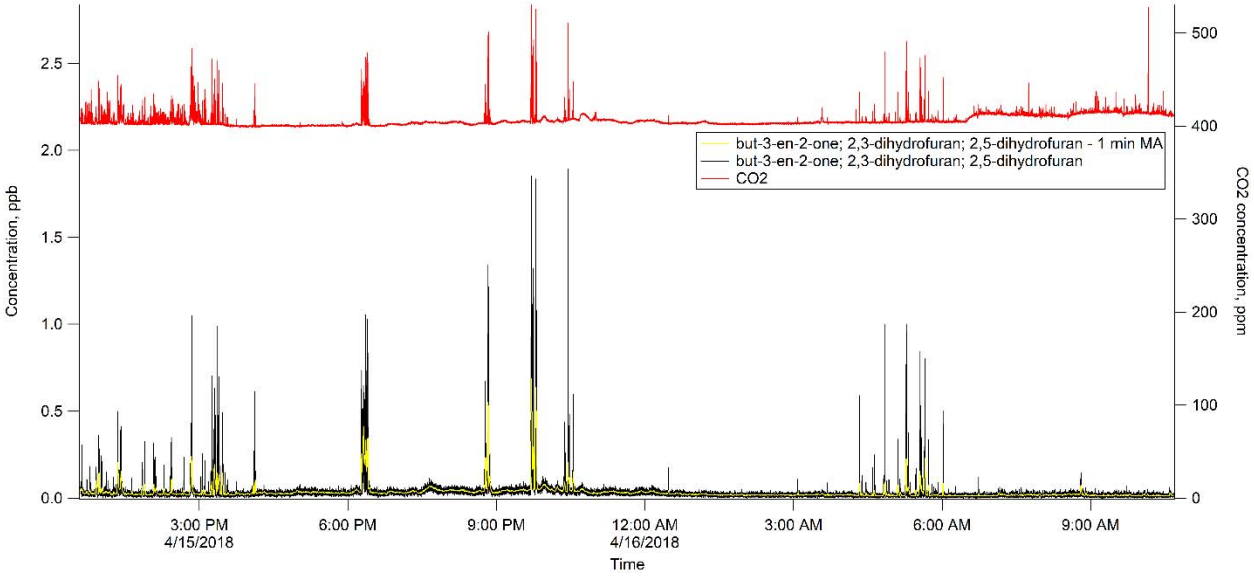


Figure 1-3. but-3-en-2-one + 2,3-dihydrofuran + 2,5-dihydrofuran.

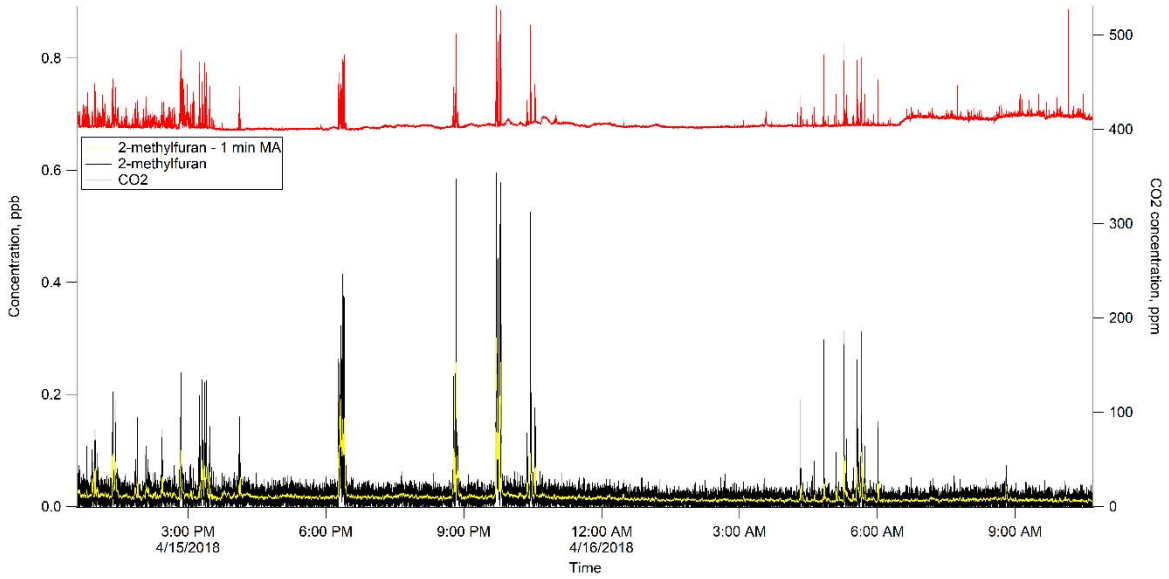


Figure 1-4. 2-methylfuran.

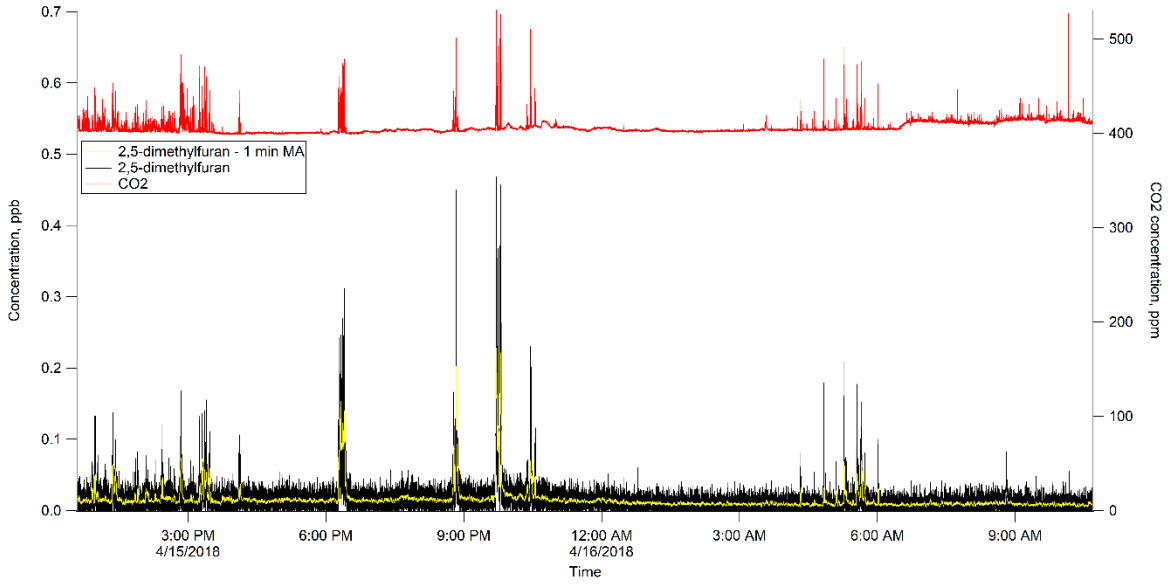


Figure 1-5. 2,5-dimethylfuran.

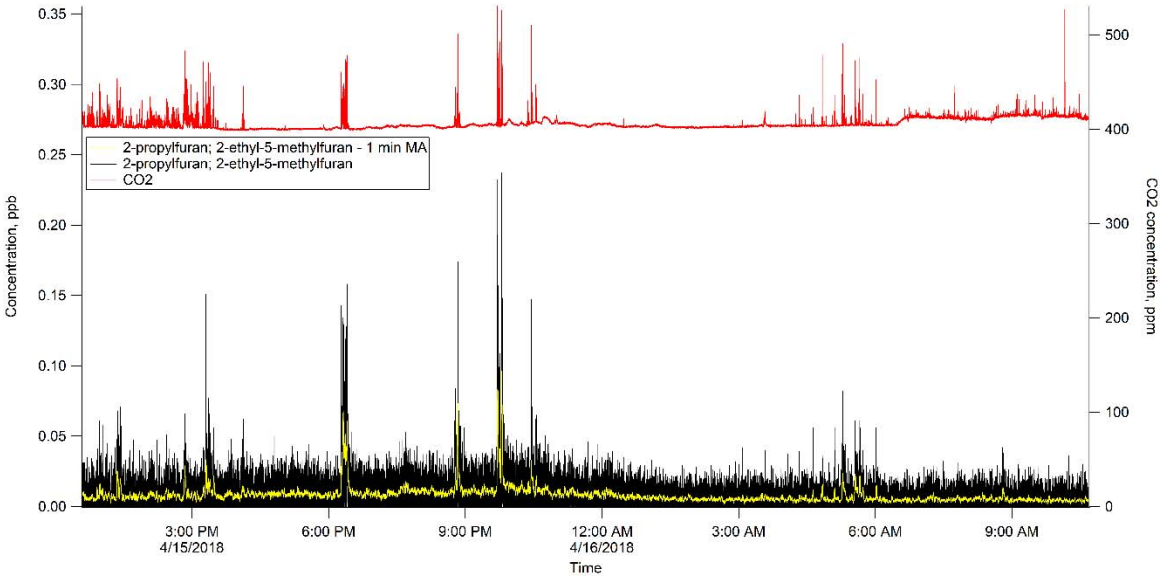


Figure 1-6. 2-propylfuran + 2-ethyl-5-methylfuran.

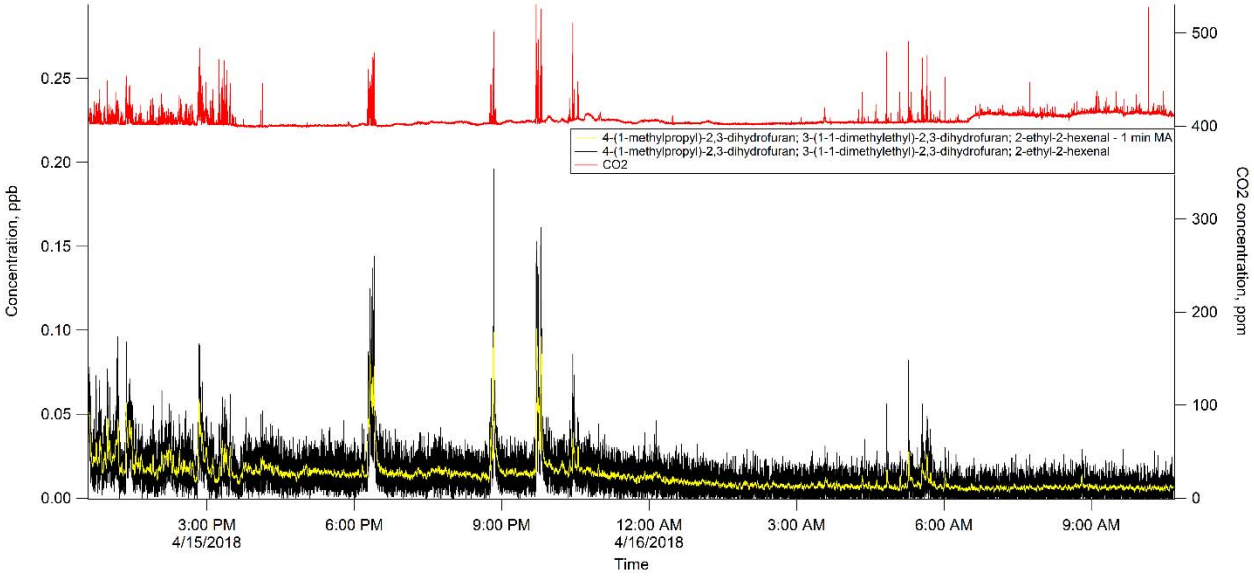


Figure 1-7. 4-(1-methylpropyl)-2,3-dihydrofuran + 3-(1-1-dimethylethyl)-2,3-dihydrofuran + 2-ethyl-2-hexenal.

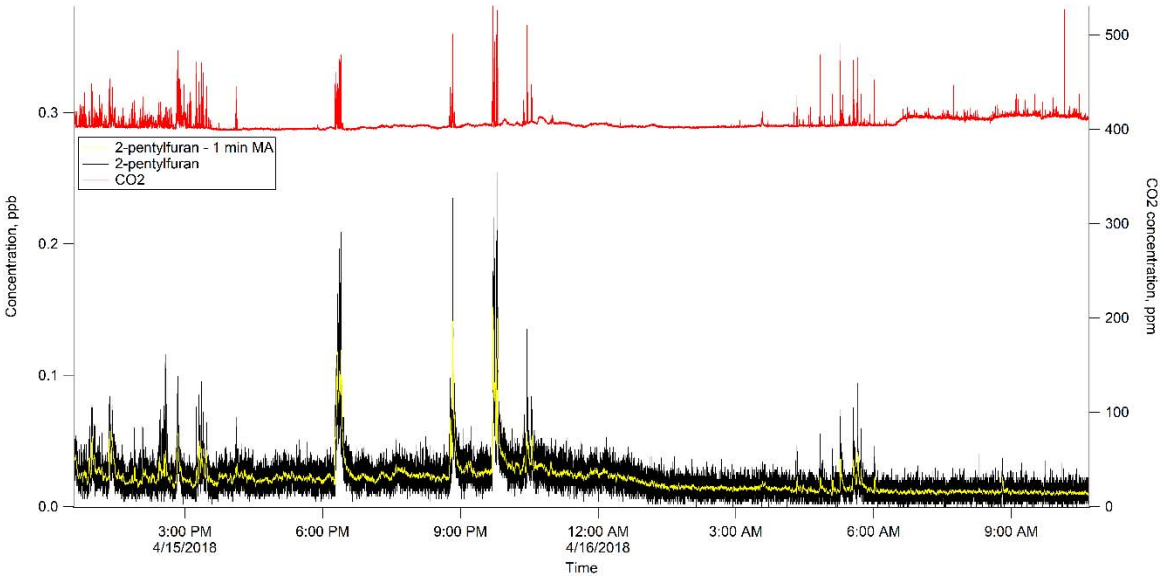


Figure 1-8. 2-pentylfuran.

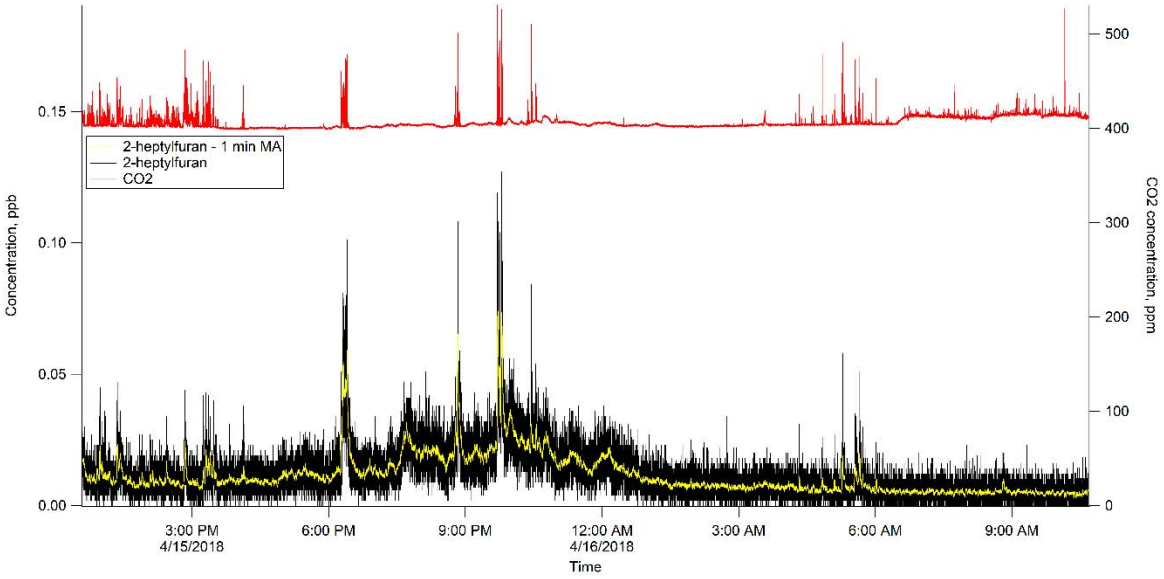


Figure 1-9. 2-heptylfuran.

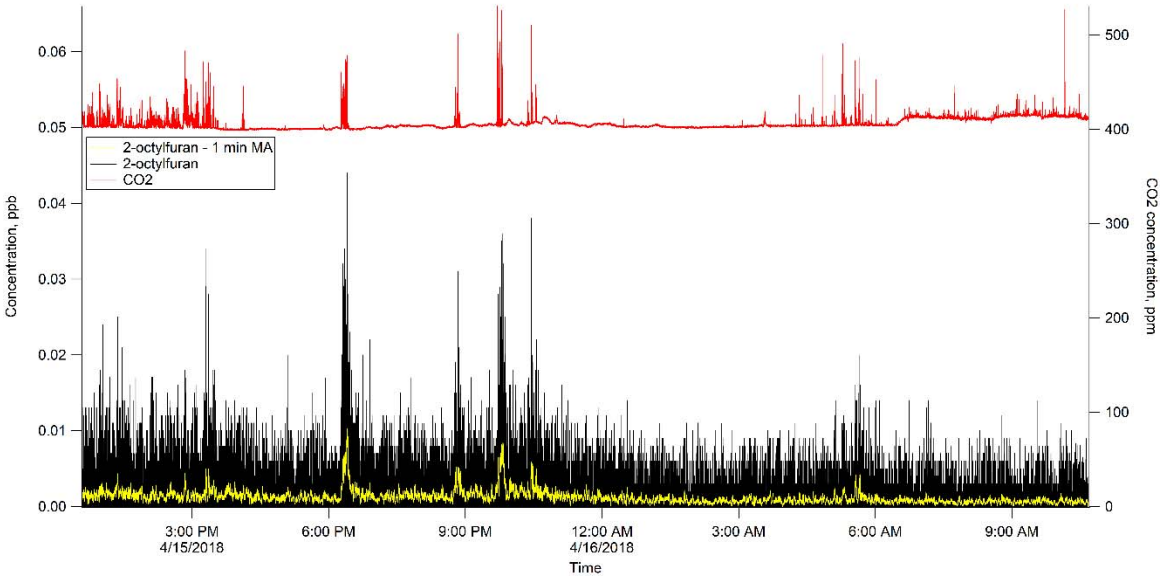


Figure 1-10. 2-octylfuran.

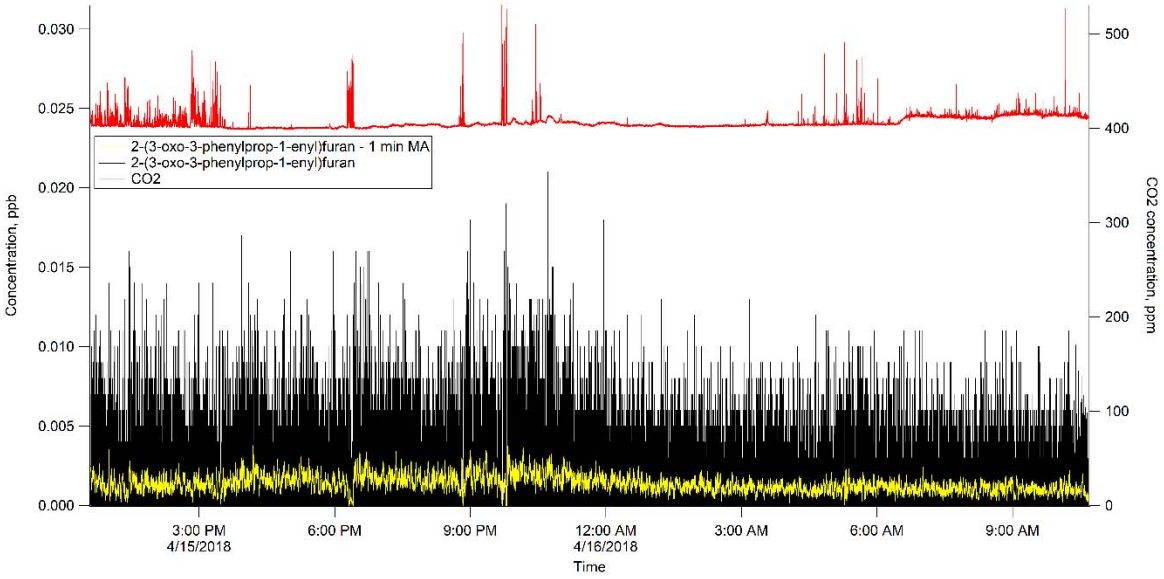


Figure 1-11. 2-(3-oxo-3-phenylprop-1-enyl)furan.

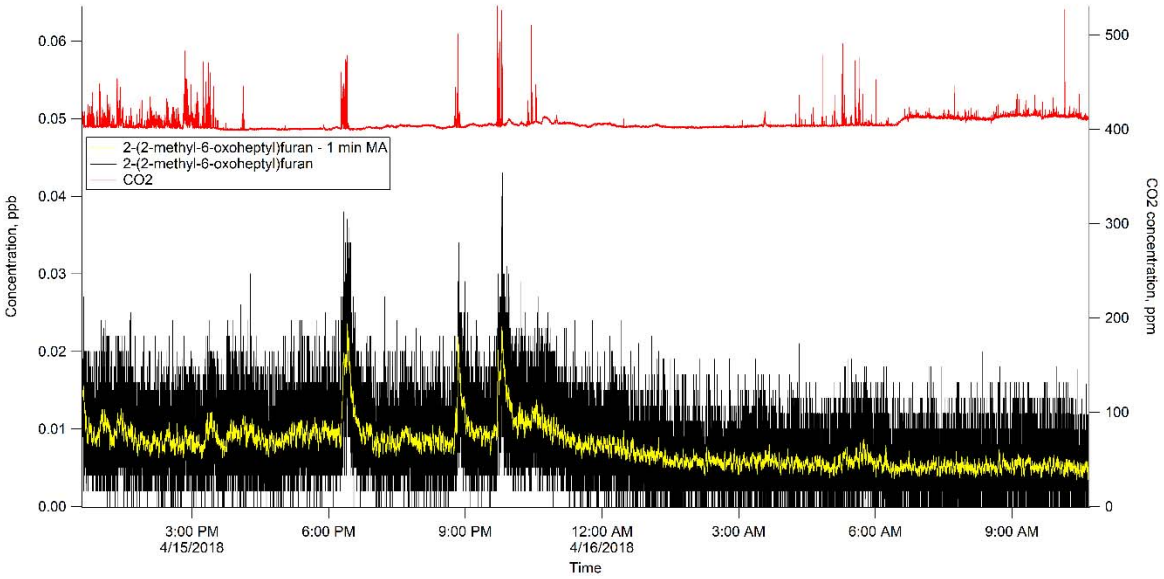


Figure 1-12. 2-(2-methyl-6-oxoheptyl)furan.

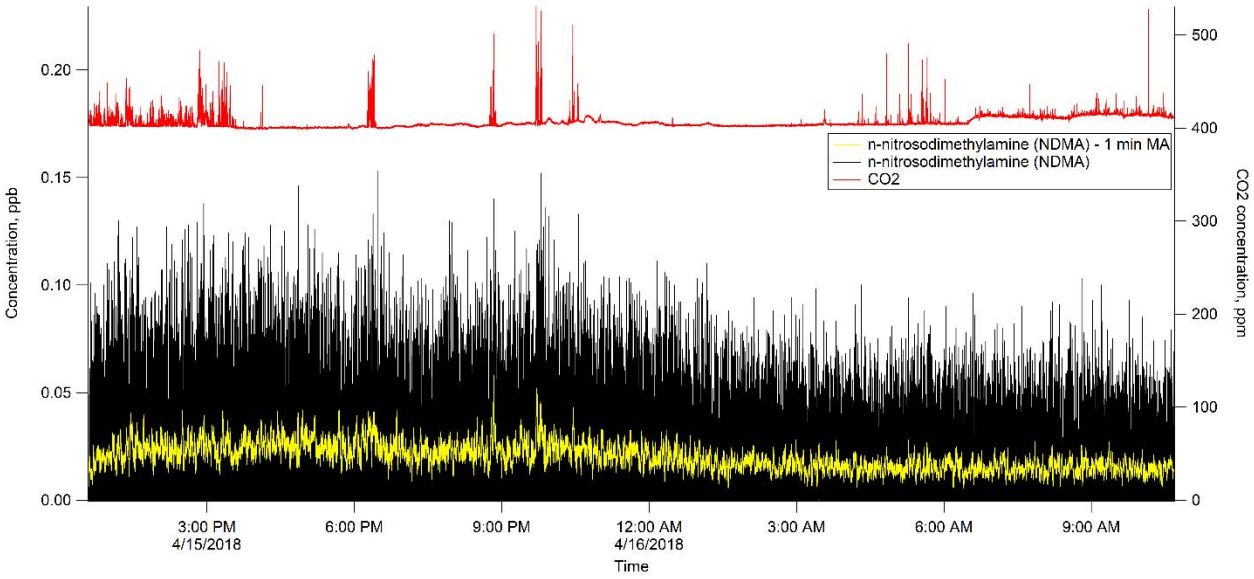


Figure 1-13. N-nitrosodimethylamine (NDMA).

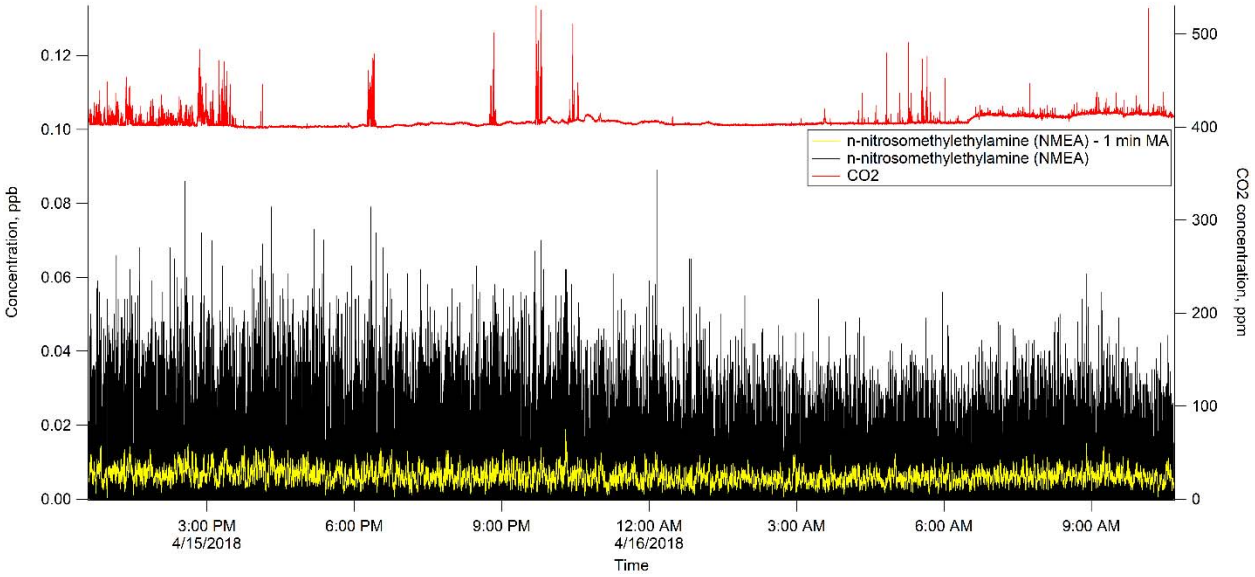


Figure 1-14. N-nitrosomethylethylamine (NMEA).

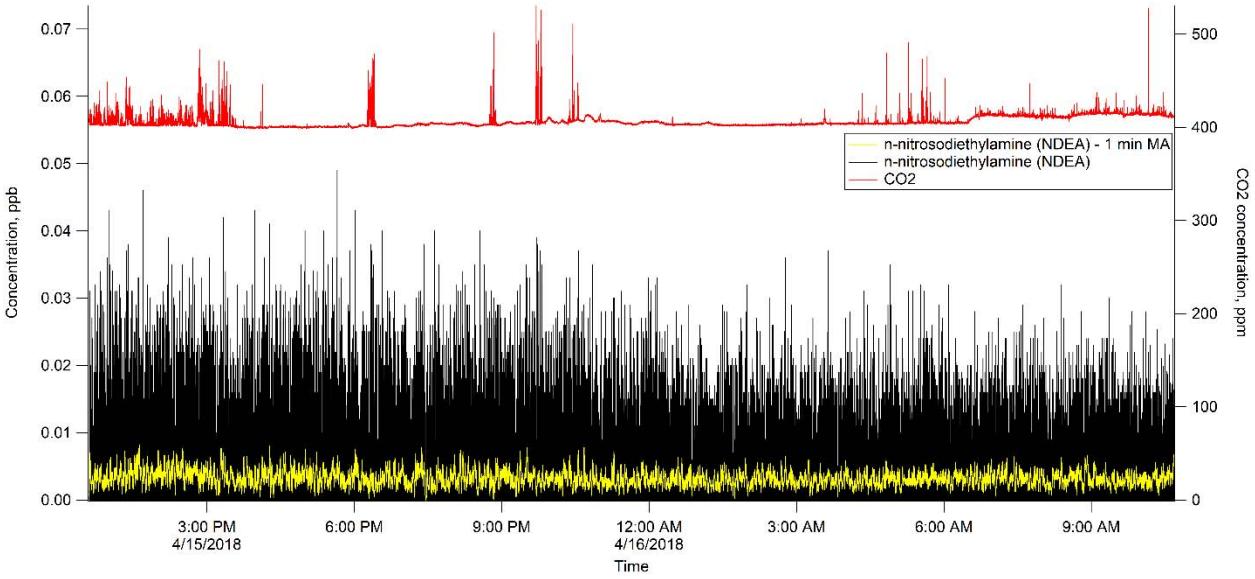


Figure 1-15. N-nitrosodiethylamine (NDEA).

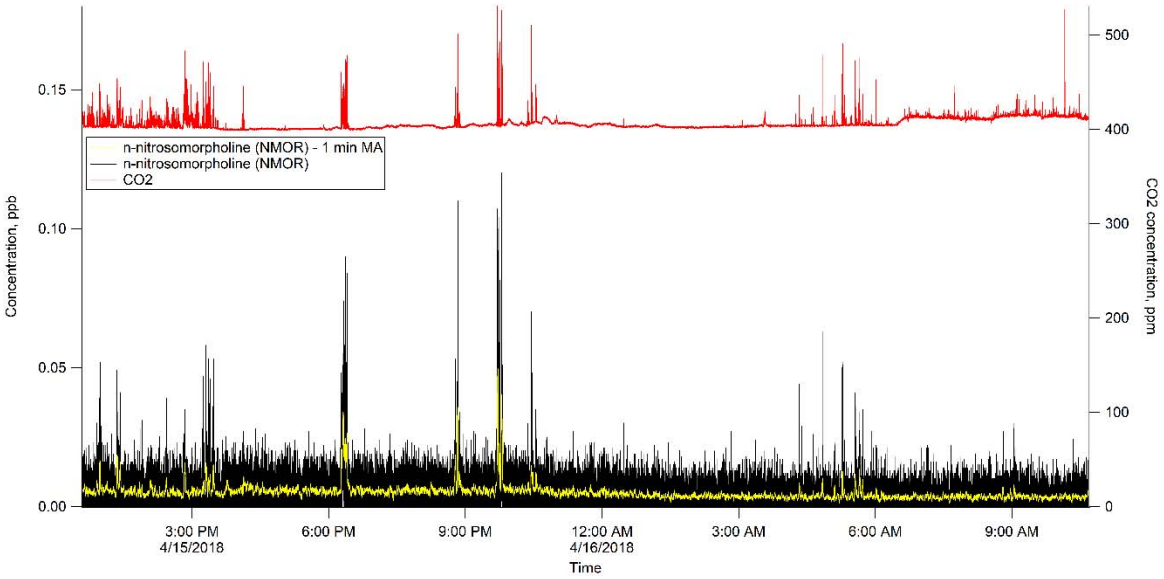


Figure 1-16. N-nitrosomorpholine (NMOR).

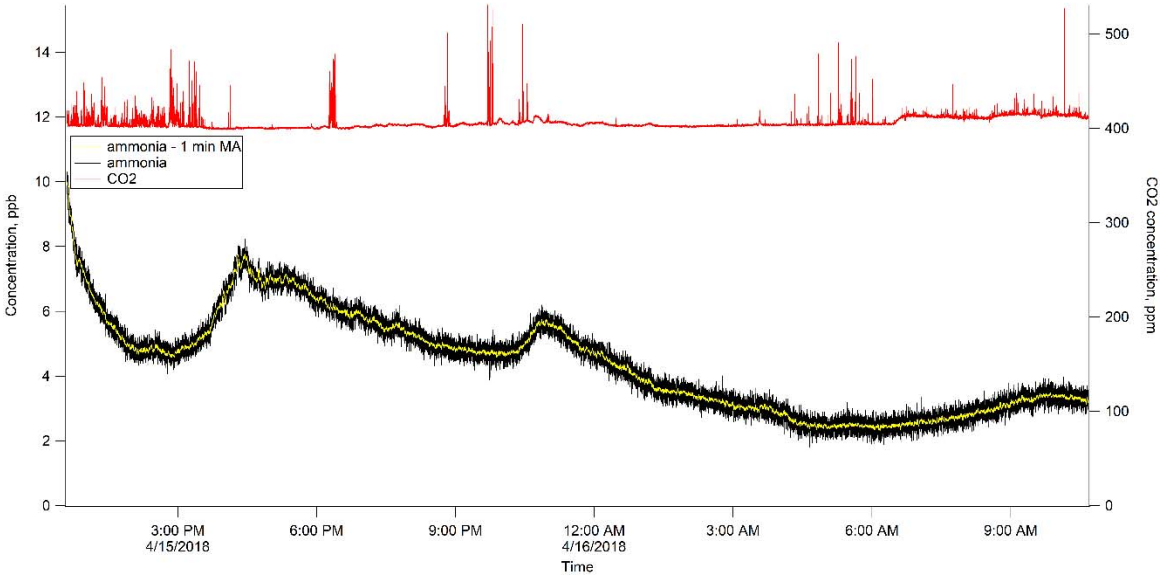


Figure 1-17. Ammonia.

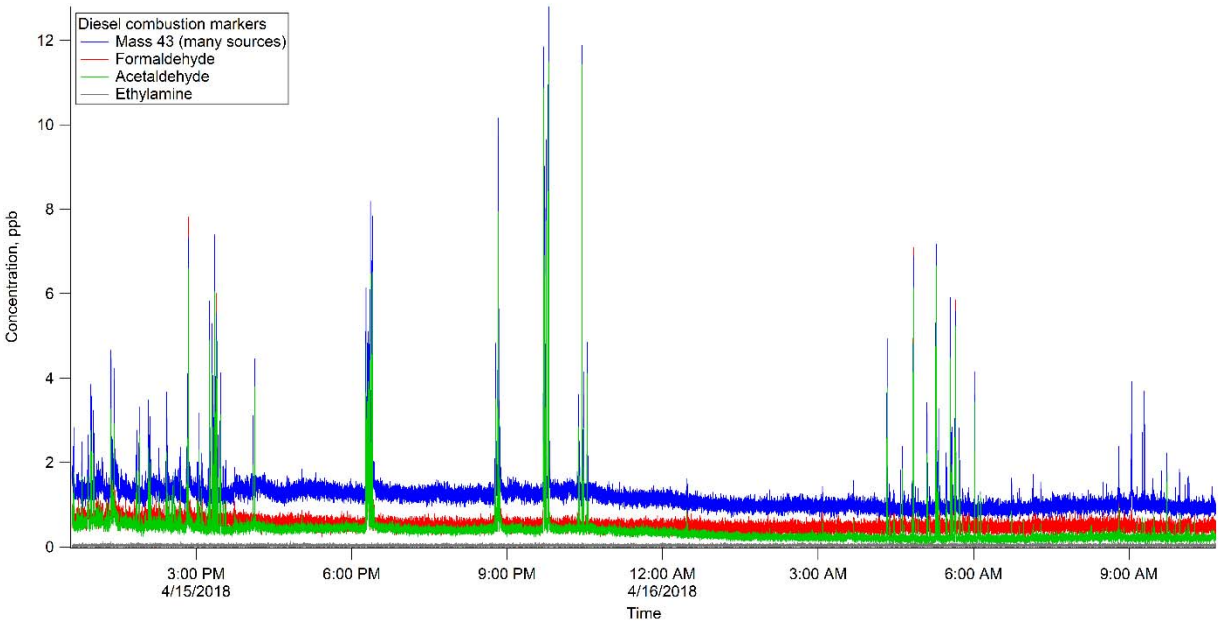


Figure 1-18. Diesel Combustion Markers.

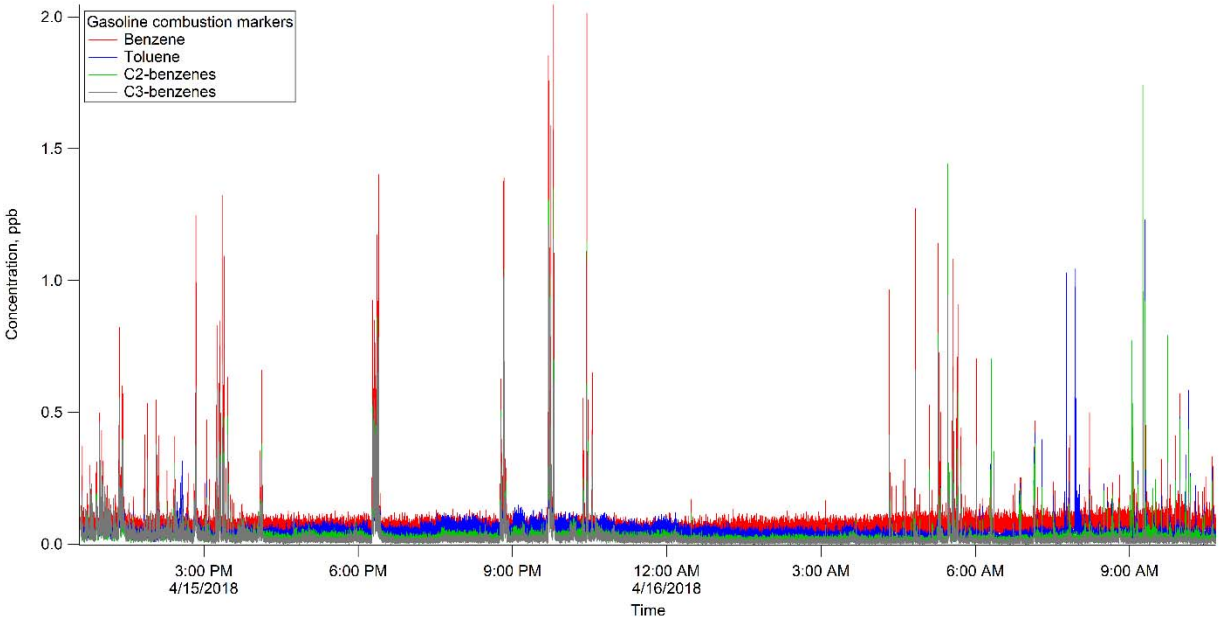


Figure 1-19. Gasoline Combustion Markers.

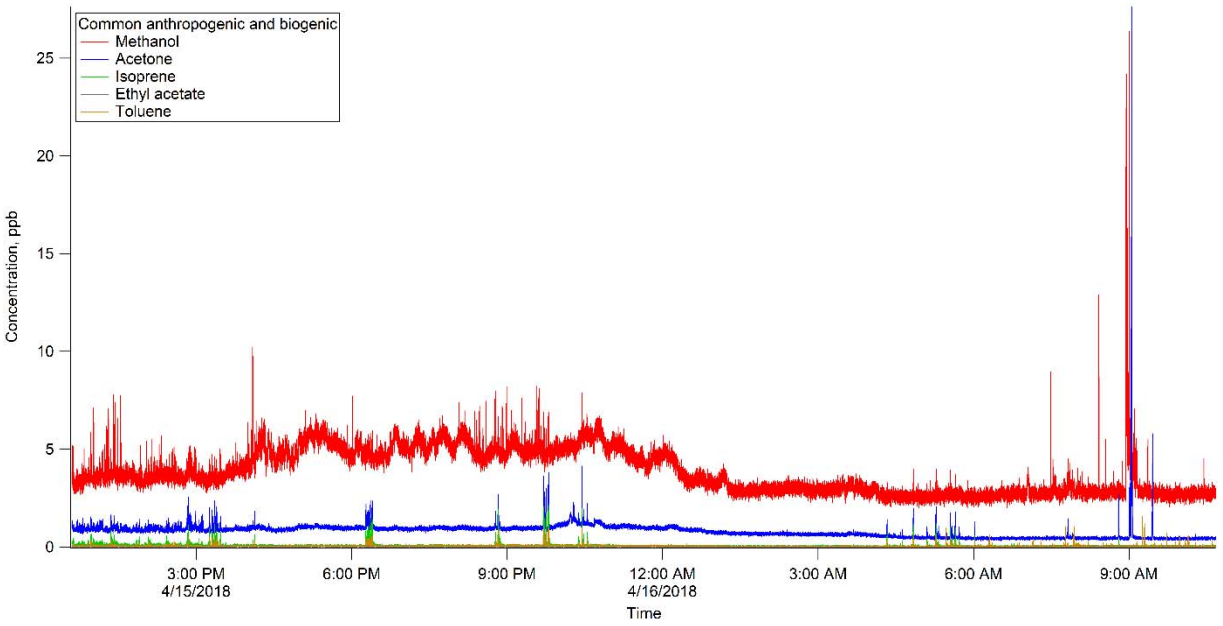


Figure 1-20. Plant and Human Markers.

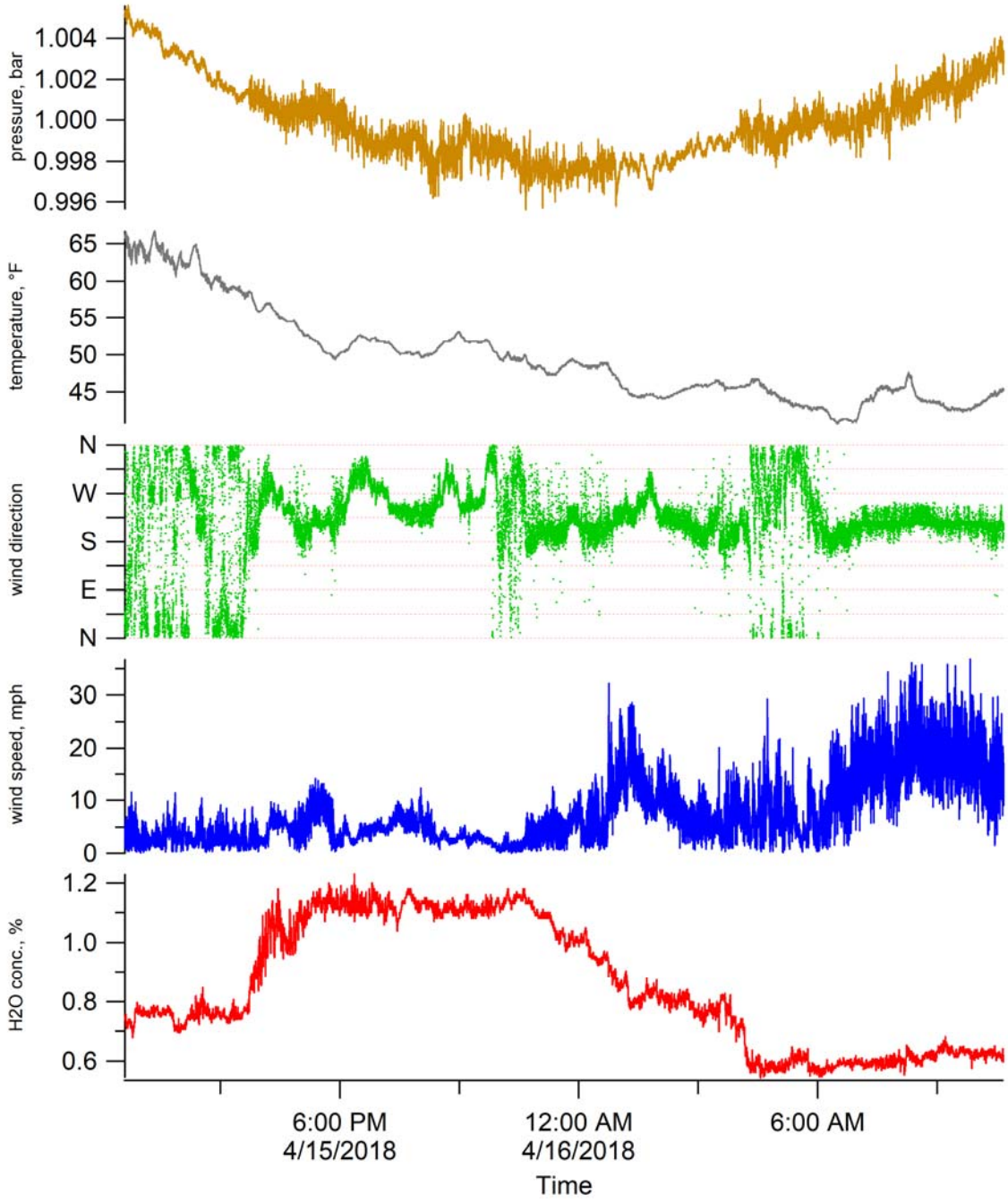


Figure 1-21. Weather Data.

2.0 APRIL 16, 2018 – APRIL 17, 2018 – STUDY SITE #4

2.1 Quality Assessment

Data from April 16, 2018, were transferred to TerraGraphics via the WRPS FTP site on April 23, 2018. Data were assessed using Procedure 17124-DOE-HS-102. A completed Data Exchange Checklist was sent to WRPS on April 25, 2018. The data were accepted by TerraGraphics with the following comments. All startup, shutdown, and calibration procedures were adequately documented and all other checks passed the acceptance limits. No other exceptions besides those below were noted.

On April 16, 2018, the battery in the Mercedes-Benz sprinter van did not have sufficient charge to allow the van to start and the Mobile Laboratory could not move from Site 3 to Site 4 at the scheduled time. Corrective and Preventative Action (CAPA) 1825 was issued on April 16, 2018. Jumper cables were taken to the Mobile Laboratory at 13:00 on April 16, 2018, and the van was moved to Site 4.

2.2 Summary

The Mobile Laboratory personnel performed background sampling using the Mobile Laboratory from April 16, 2018, to April 17, 2018, at Study Site 4. Site 4 is located down wind of the AN Tank Farm. The Mobile Laboratory arrived at Site 4 at 13:20 on April 16, 2018. The initial QA/QC zero air/sensitivity checks were performed on the CO_2 monitor, NH_3 monitor, and the PTR-MS beginning at 13:04, prior to Site 4 arrival. The data file names were confirmed and routine data collection resumed by 13:58. The Mobile Laboratory staff departed the monitoring site at 16:28.

The Mobile Laboratory staff returned to Site 4 at 06:34 on April 17, 2018, and began confirmatory sample collection by 06:40. At 08:40, there was a large CO_2 spike of approximately 540 ppm resulting from opening the van door under the cold temperature. At 09:53, the personnel noticed the weather station lost signal briefly. Closeout zero air/sensitivity checks were performed at 10:30. The Mobile Laboratory moved to Site 5 by 11:36.



Figure 2-1. Mobile Lab Site #4 for the Duration of the Monitoring Period.

2.3 Samples Collected

Continuous air monitoring was performed using the following instrumentation:

- PTR-MS,
- LI-COR CO_2 Monitor,
- Picarro Ammonia Monitor, and
- Weather Station.

Confirmatory air samples were collected as follows:

Table 2-1. Alternative Media Samples Taken.

Site	Date	Sample Type	ID	Start	Stop	Sample Time (min)
4	16-Apr	Thermosorb/N	EL22225	13:26	16:16	170
4	16-Apr	CarboTrap-300	A020844	13:28	14:40	72
4	17-Apr	Thermosorb/N	EL22233	06:40	09:41	182
4	17-Apr	CarboTrap-300	A007101	06:42	07:55	70

Table 2-2 displays the statistical information for the monitoring period of April 16, 2018, to April 17, 2018. By definition, the occupational exposure limit (OEL) is an 8-hour, time-weighted average that establishes a limit for personnel exposures to hazardous chemicals. It is the exposure level to which a person may be exposed for 8 hours/day, 40 hours/week for 40 years and have no expectation of adverse health effects. In this study, area vapor concentration measurements were made to better understand the hazardous vapor exposures that workers may receive. These measurements are only compared to OEL concentrations to give them context. It

is neither accurate nor appropriate to interpret these short duration measurements (2 seconds) as worker exposure levels. Since the OEL is defined as a time-weighted average, it is more appropriate to compare them to daily average vapor concentrations. Short duration excursions above the OEL concentration are not significant.

Table 2-2. Statistical Information for the Monitoring Period of April 16, 2018 – April 17, 2018.

COPC #	COPC Name	Reporting Limit (ppb)	OEL (ppb)	Ave. (ppb)	St. Dev. (ppb)	Rel. St. Dev. (%)	Max (ppb)	Median (ppb)	Sec. over 50% OEL	Sec. over OEL
1	ammonia	1	25000	5.98	1.330	22.2%	11.09	6.00	0	0
2	furan	0.09	1	0.045	0.010	72.1%	0.076	0.012	0	0
3	but-3-en-2-one + 2,3-dihydrofuran + 2,5-dihydrofuran	0.22	1	0.110	0.007	46.9%	N/A*	N/A*	N/A	N/A
4	NDMA**	0.06	0.3	0.031	0.019	112.0%	0.141	0.011	0	0
5	2-methylfuran	0.05	1	0.025	0.007	72.6%	0.055	0.009	0	0
6	NEMA	0.02	0.3	0.012	0.009	156.6%	0.064	0.000	0	0
7	2,5-dimethylfuran	0.05	1	0.025	0.006	86.8%	0.043	0.006	0	0
8	NDEA	0.01	0.1	0.006	0.005	164.8%	0.040	0.000	0	0
9	2-propylfuran + 2-ethyl-5-methylfuran	0.02	1	0.010	0.005	123.8%	0.038	0.002	0	0
10	NMOR	0.05	0.6	0.025	0.003	115.1%	0.040	0.002	0	0
11	2-ethyl-2-hexenal + 4-(1-methylpropyl)-2,3-dihydrofuran + 3-(1,1-dimethylethyl)-2,3-dihydrofuran	0.04	1	0.020	0.005	76.8%	0.048	0.005	0	0
12	2-pentylfuran	0.04	1	0.020	0.005	46.6%	0.036	0.009	0	0
13	2-heptylfuran	0.02	1	0.010	0.003	68.6%	0.024	0.004	0	0
14	2-octylfuran	0.01	1	0.005	0.001	236.1%	0.013	0.000	0	0
15	6-(2-furanyl)-6-methyl-2-heptanone	0.01	1	0.005	0.002	175.3%	0.013	0.000	0	0
16	furfural acetophenone	0.07	1	0.035	0.003	65.4%	0.020	0.004	0	0

* The maximum peak value for but-3-en-2-one + 2,3 dihydrofuran + 2,5 dihydrofuran was 0.194 ppb and the median value was 0.013 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 200, 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 each COPC signal, overlaid with the same signal smoothed using a 1-minute moving average, and CO_2, for the monitoring period April 16, 2018, to April 17, 2018.

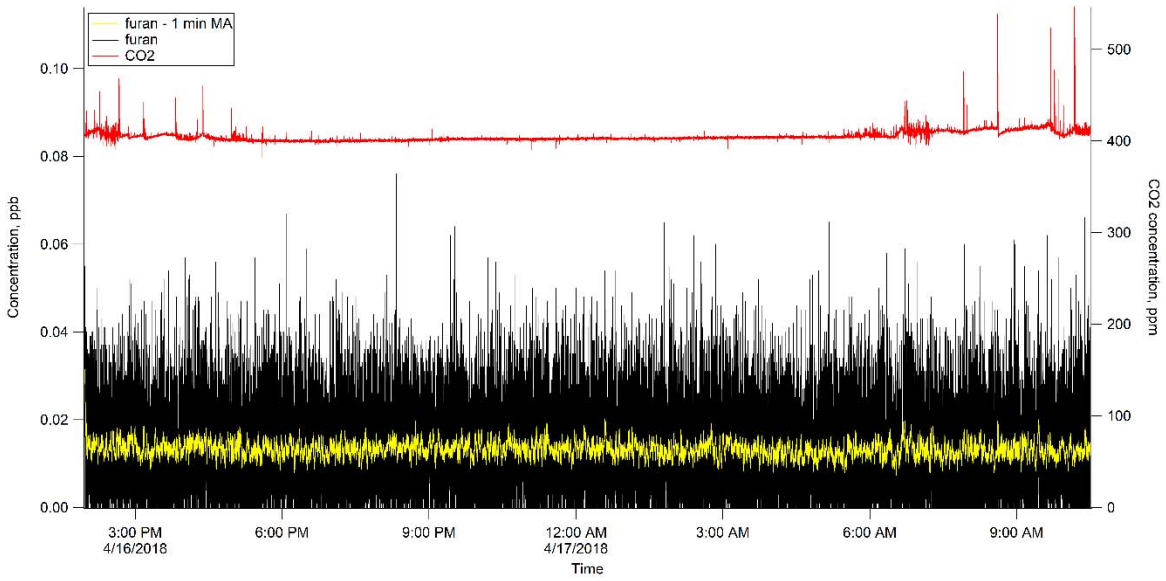


Figure 2-2. Furan.

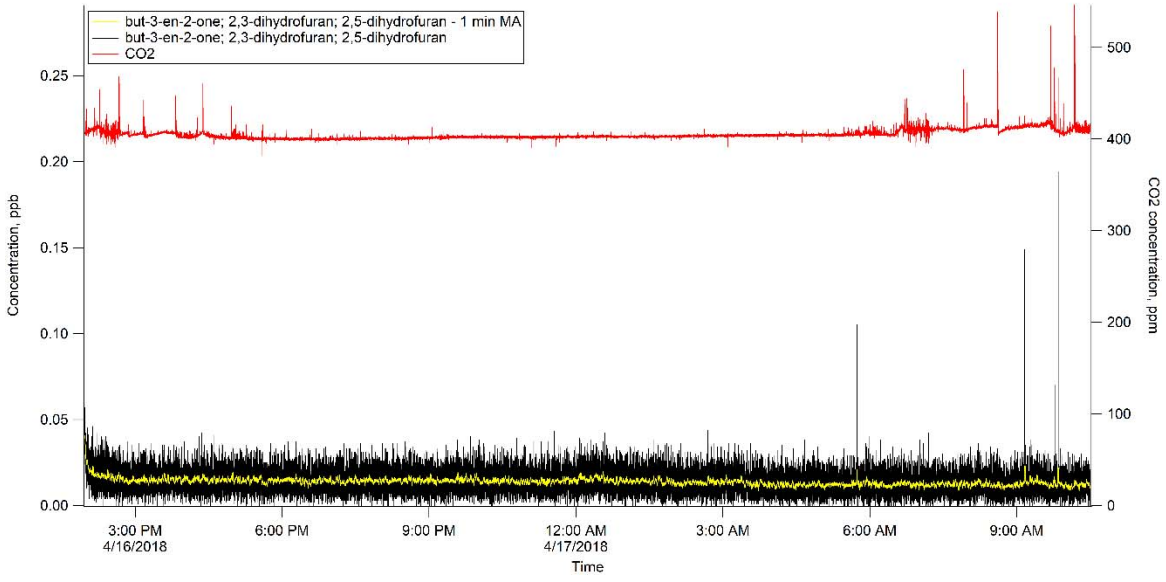


Figure 2-3. but-3-en-2-one + 2,3-dihydrofuran + 2,5-dihydrofuran.

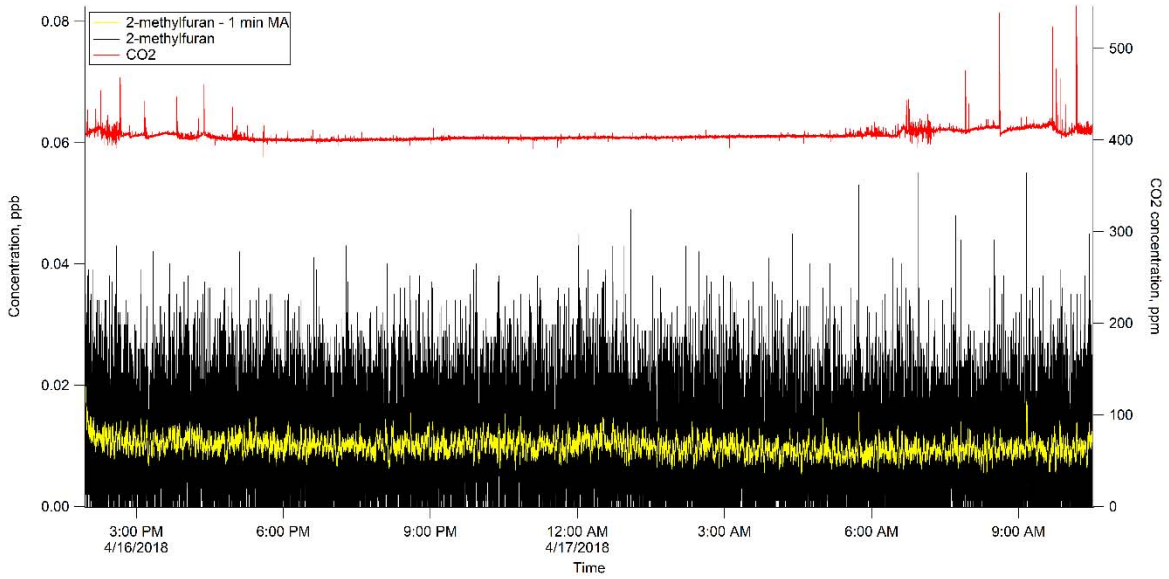


Figure 2-4. 2-methylfuran.

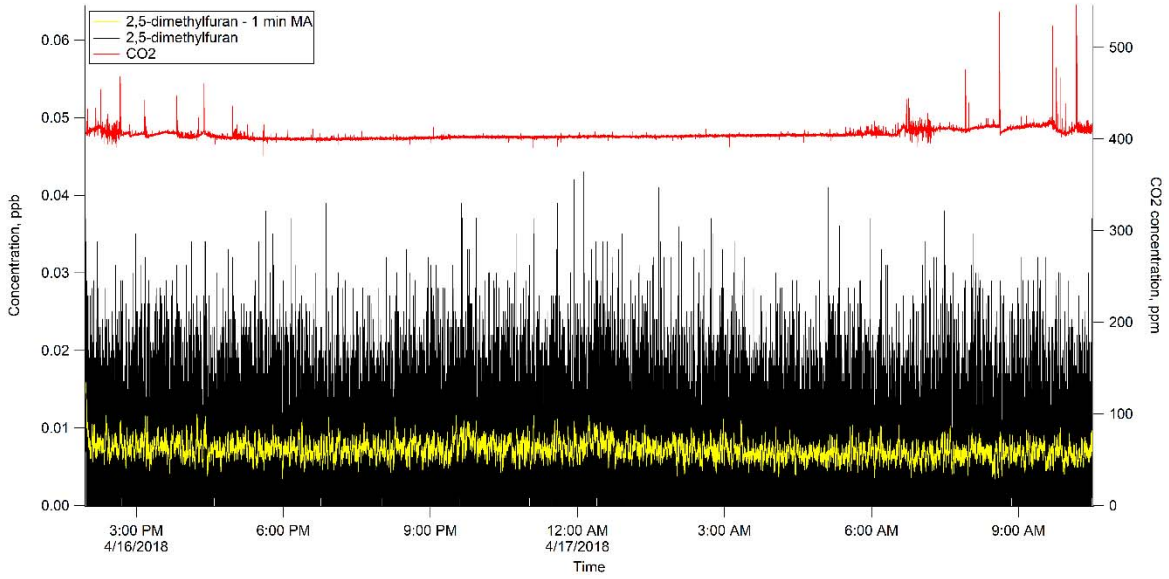


Figure 2-5. 2,5-dimethylfuran.

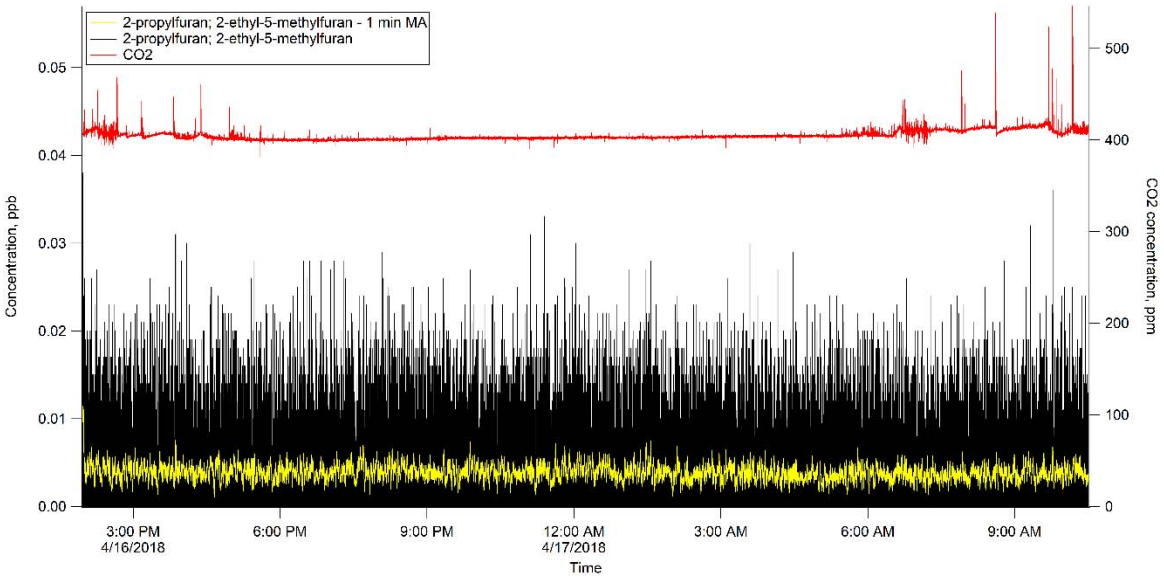


Figure 2-6. 2-propylfuran + 2-ethyl-5-methylfuran.

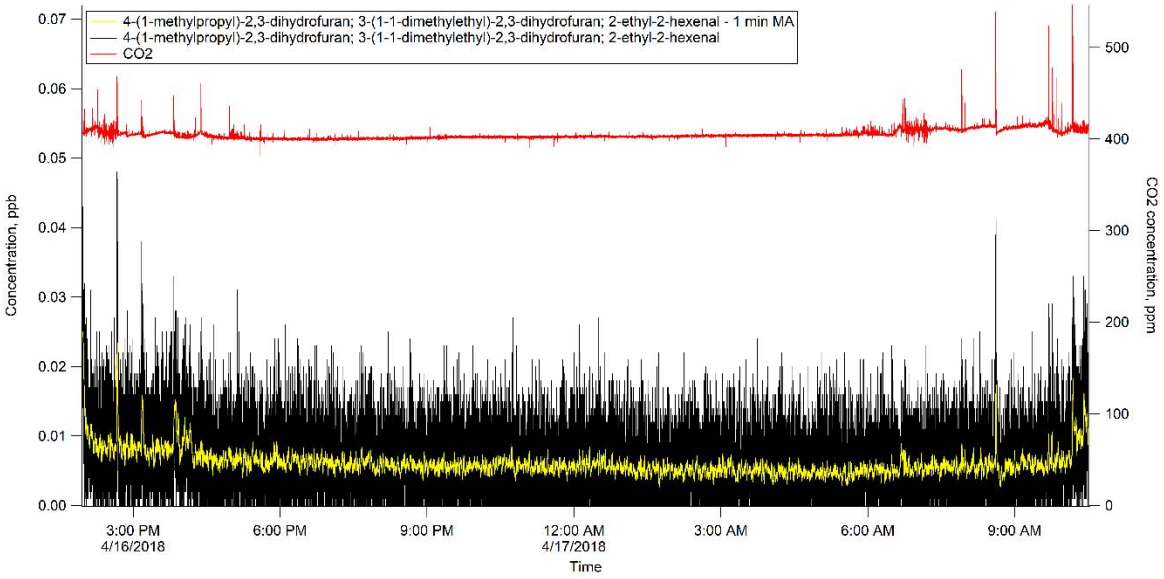


Figure 2-7. 4-(1-methylpropyl)-2,3-dihydrofuran + 3-(1-1-dimethylethyl)-2,3-dihydrofuran + 2-ethyl-2-hexenal.

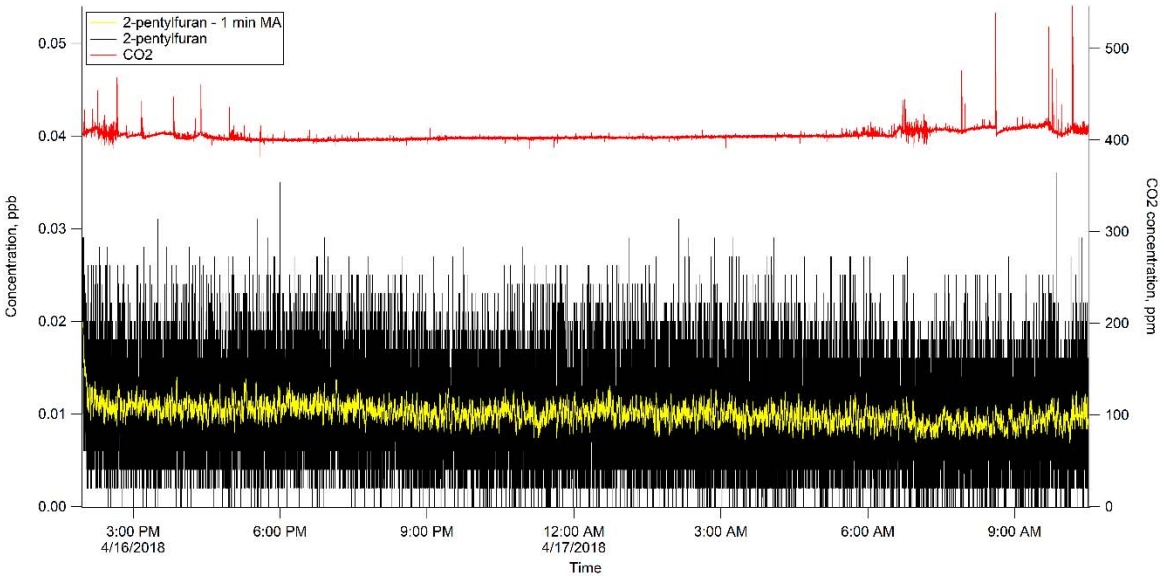


Figure 2-8. 2-pentylfuran.

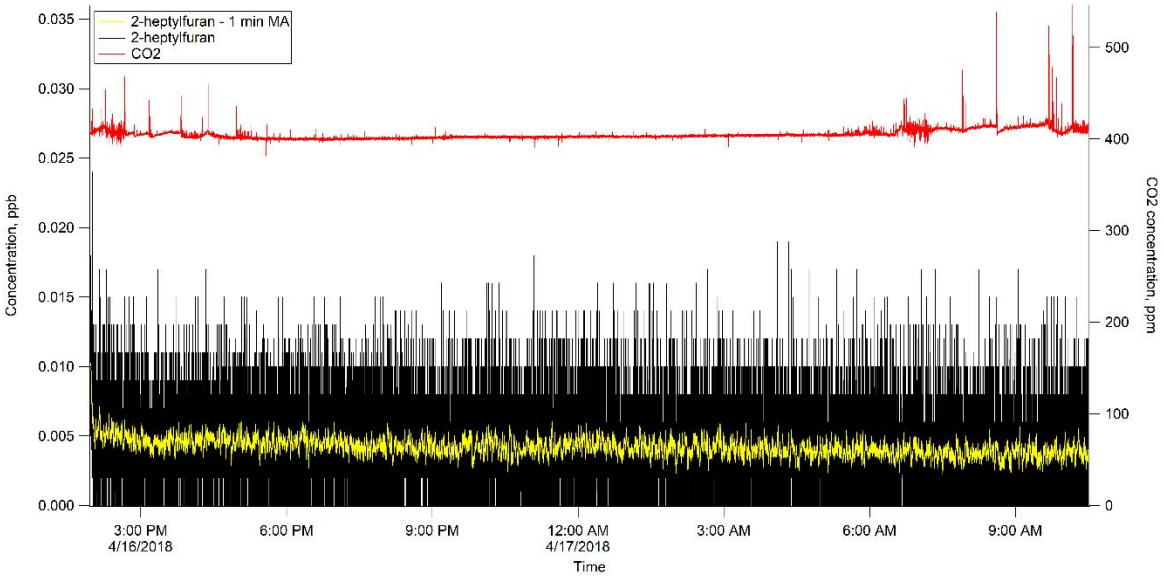


Figure 2-9. 2-heptylfuran.

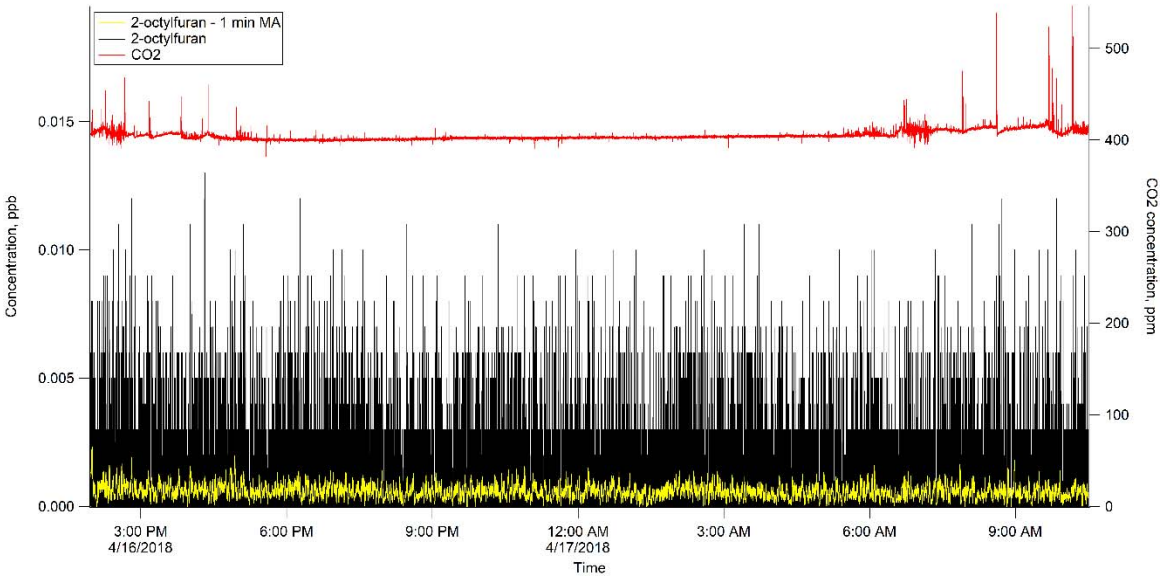


Figure 2-10. 2-octylfuran.

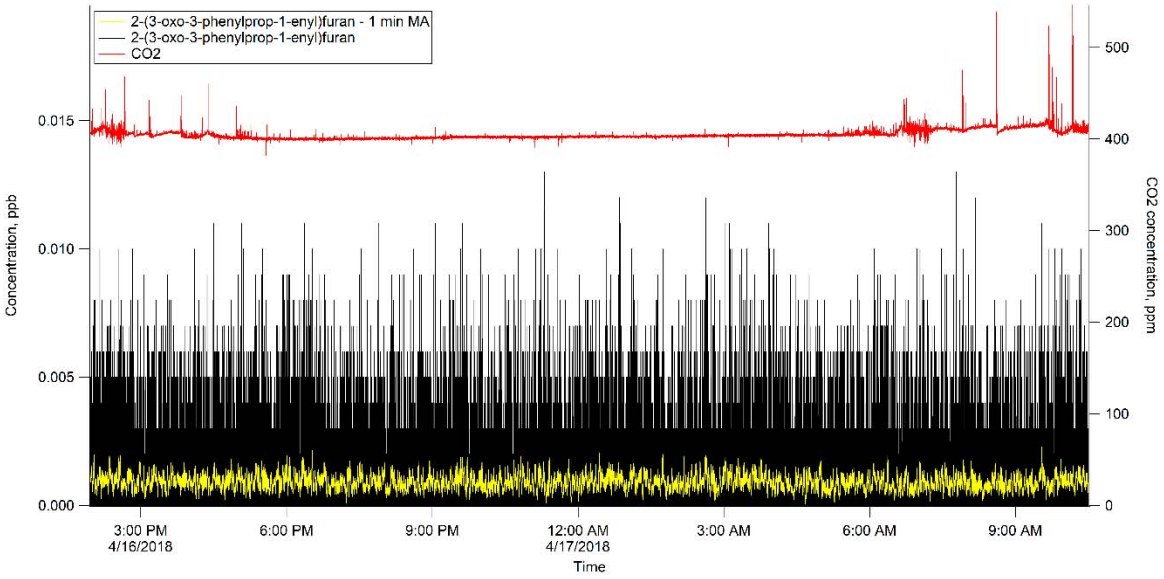


Figure 2-11. 2-(3-oxo-3-phenylprop-1-enyl)furan.

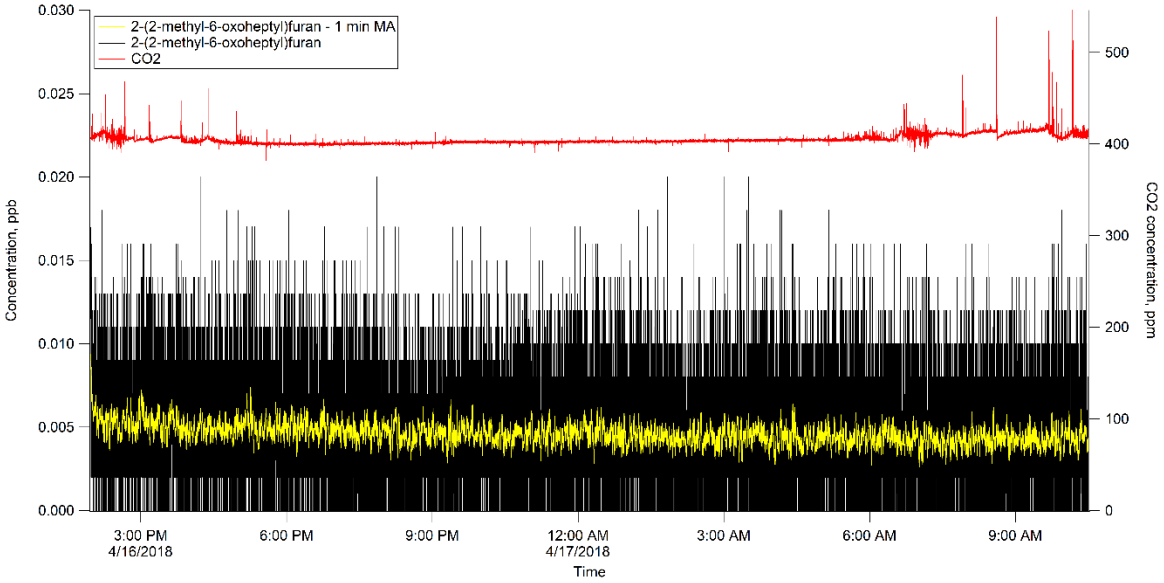


Figure 2-12. 2-(2-methyl-6-oxoheptyl)furan.

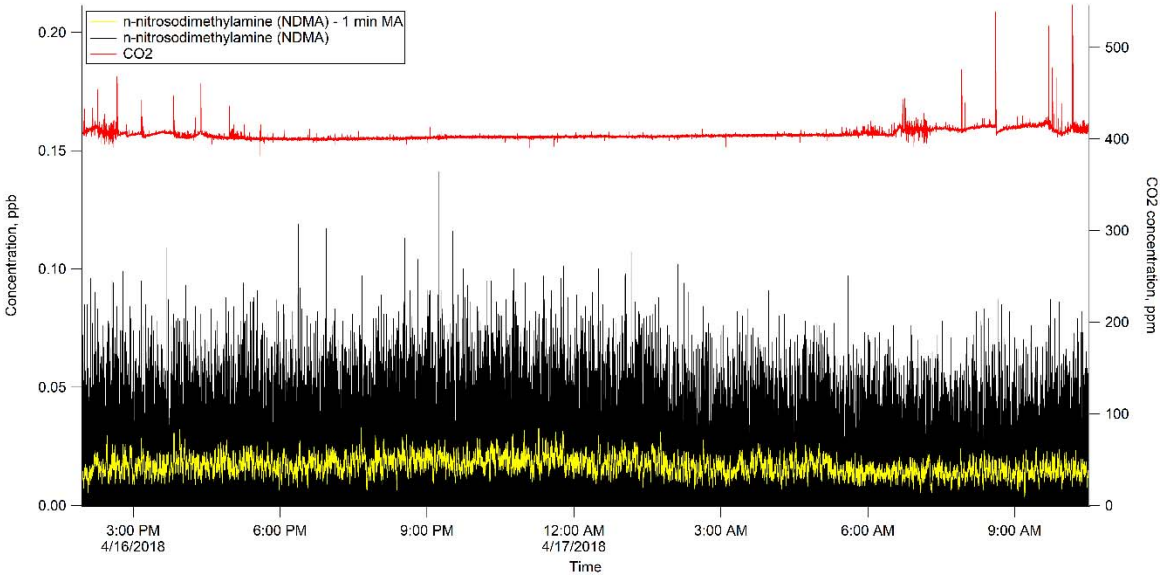


Figure 2-13. N-nitrosodimethylamine (NDMA).

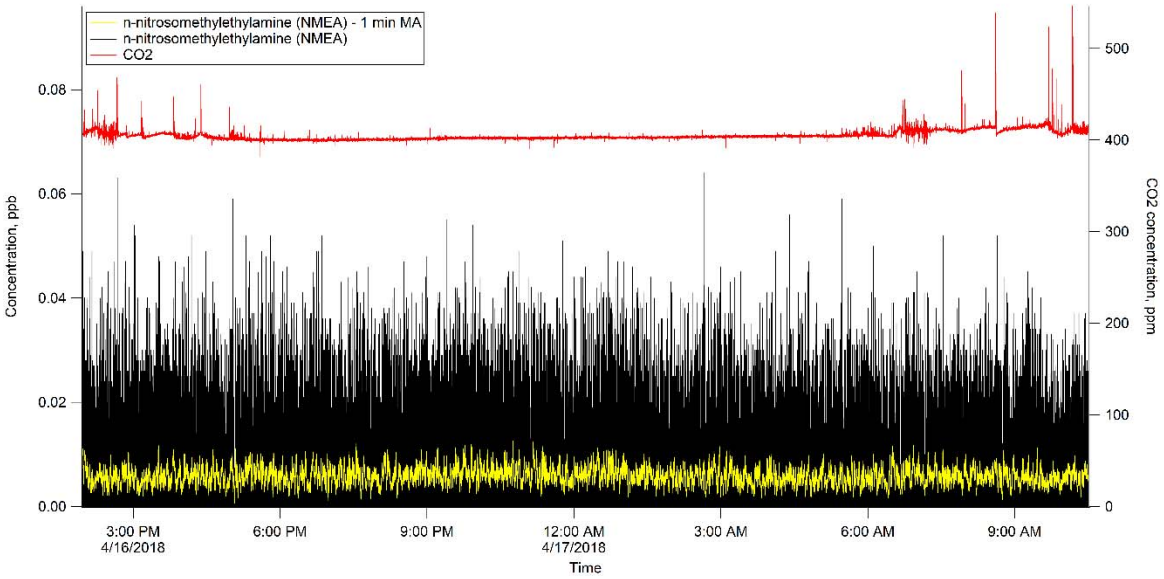


Figure 2-14. N-nitrosomethylethylamine (NMEA).

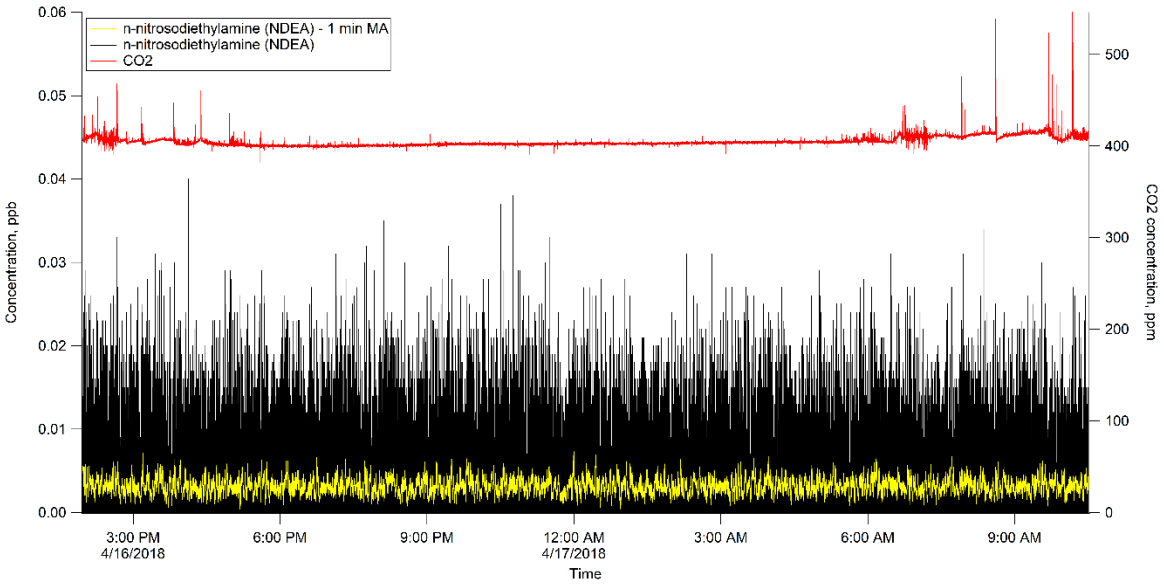


Figure 2-15. N-nitrosodiethylamine (NDEA).

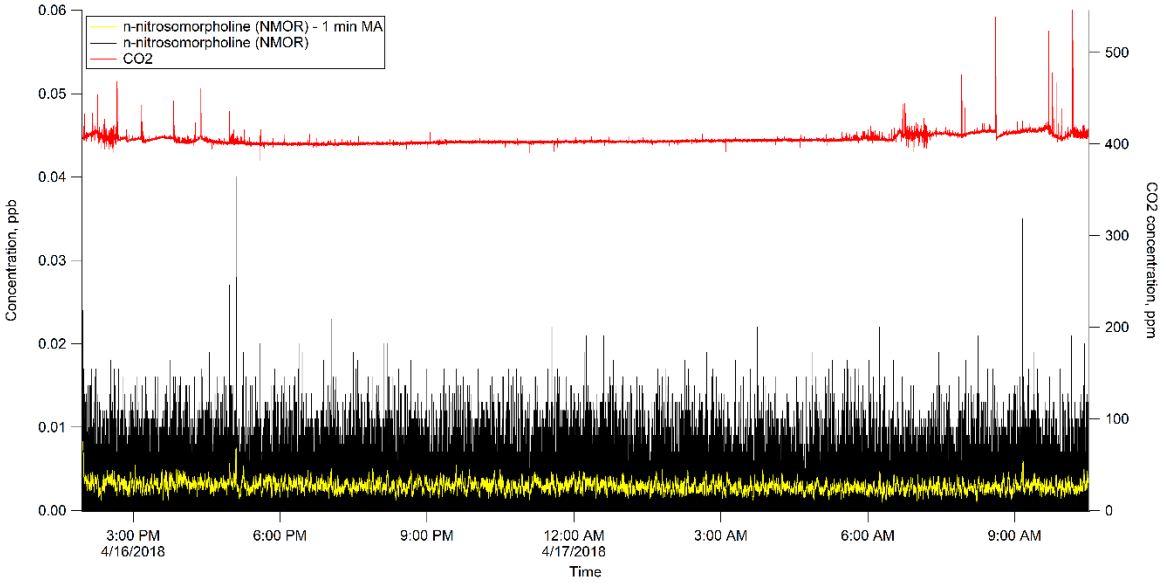


Figure 2-16. N-nitrosomorpholine (NMOR).

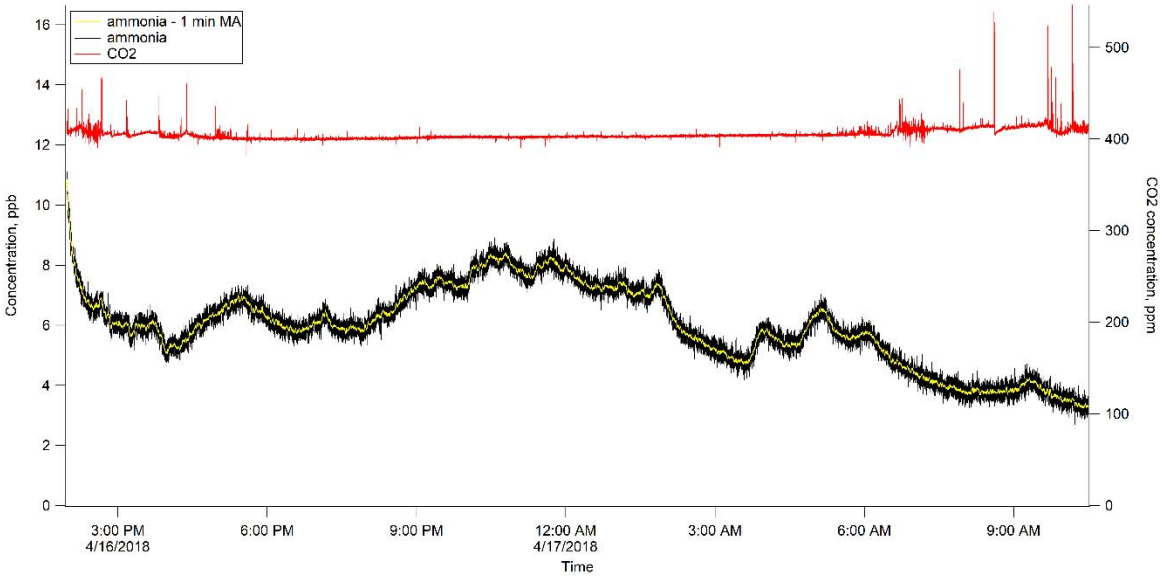


Figure 2-17. Ammonia.

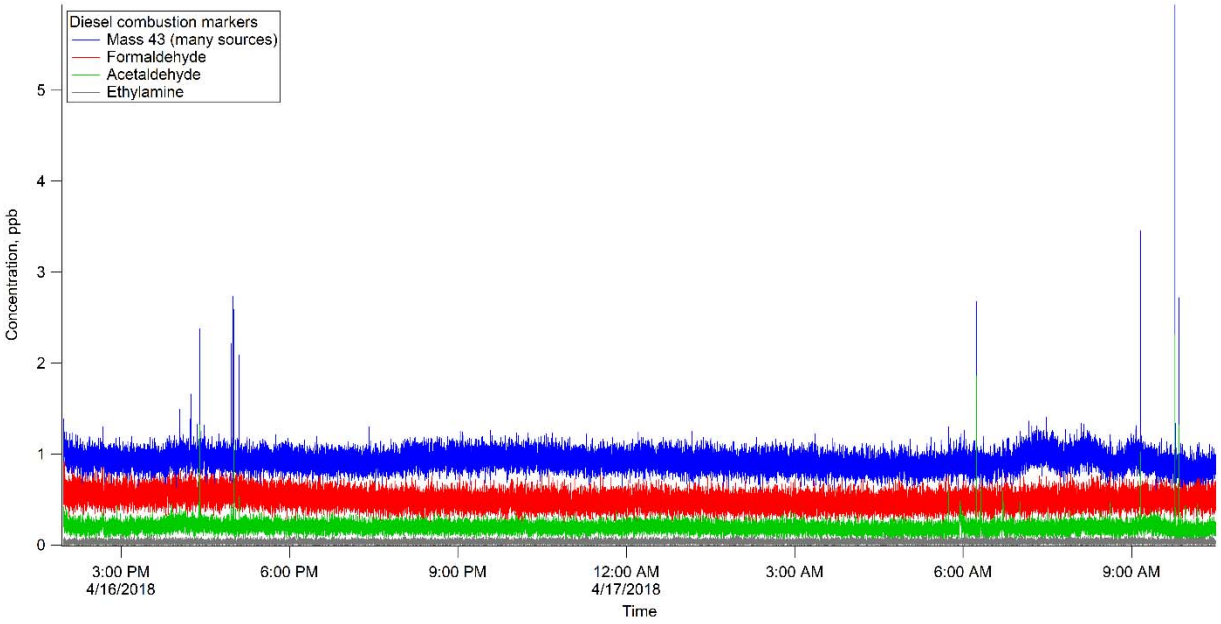


Figure 2-18. Diesel Combustion Markers.

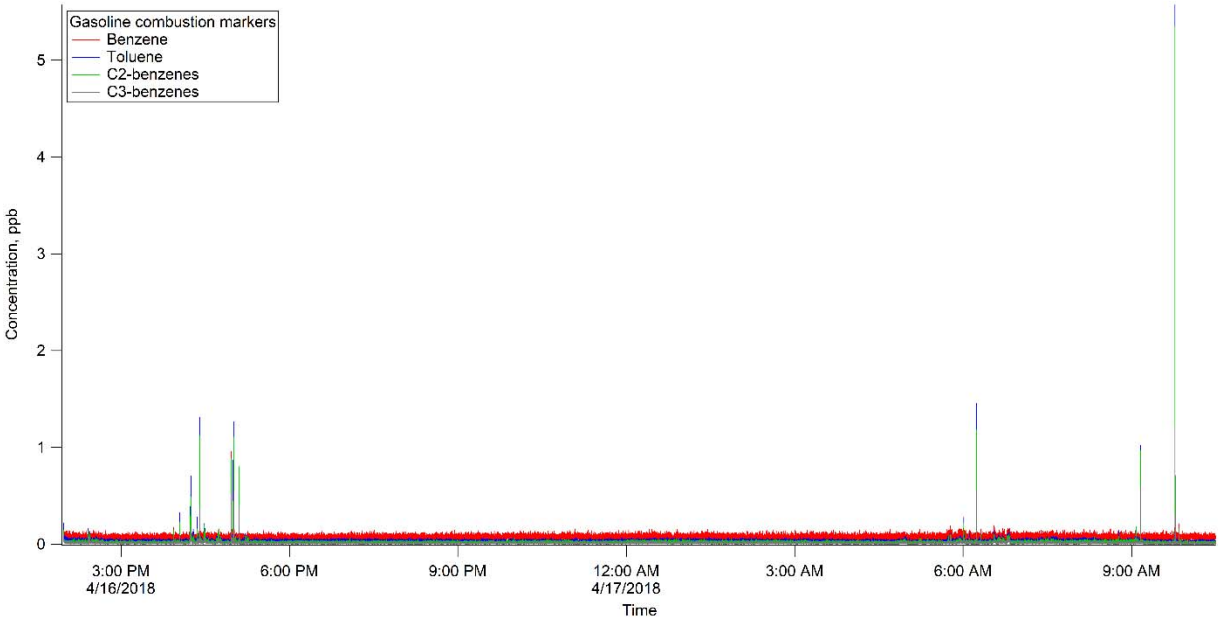


Figure 2-19. Gasoline Combustion Markers.

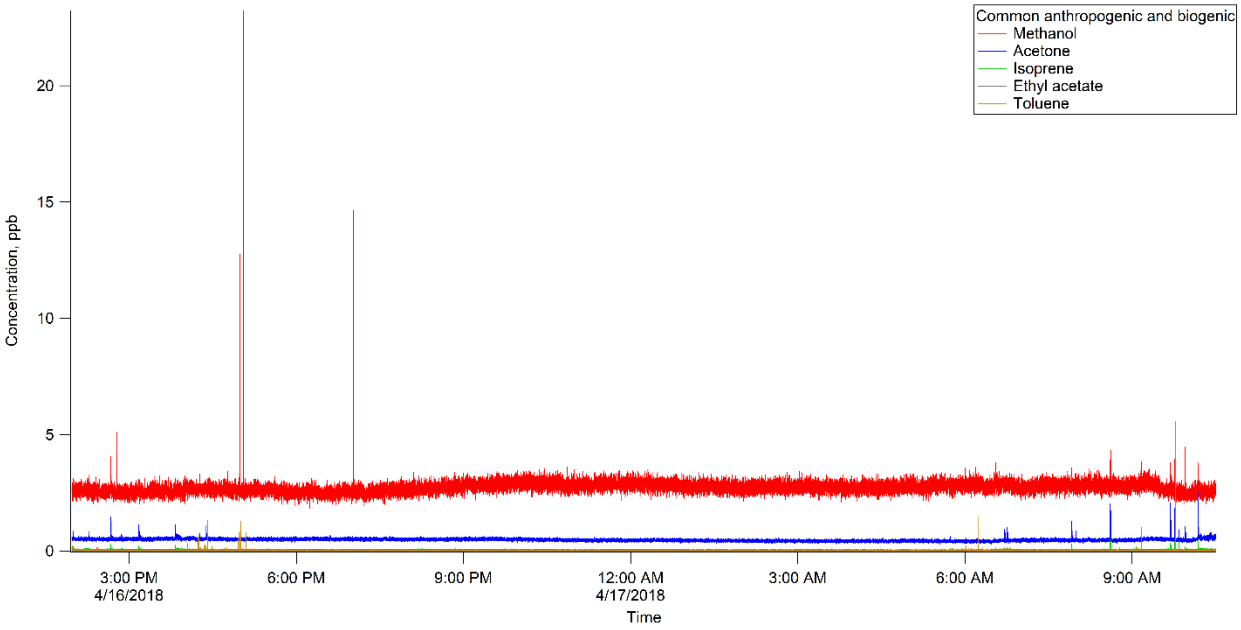


Figure 2-20. Plant and Human Markers.

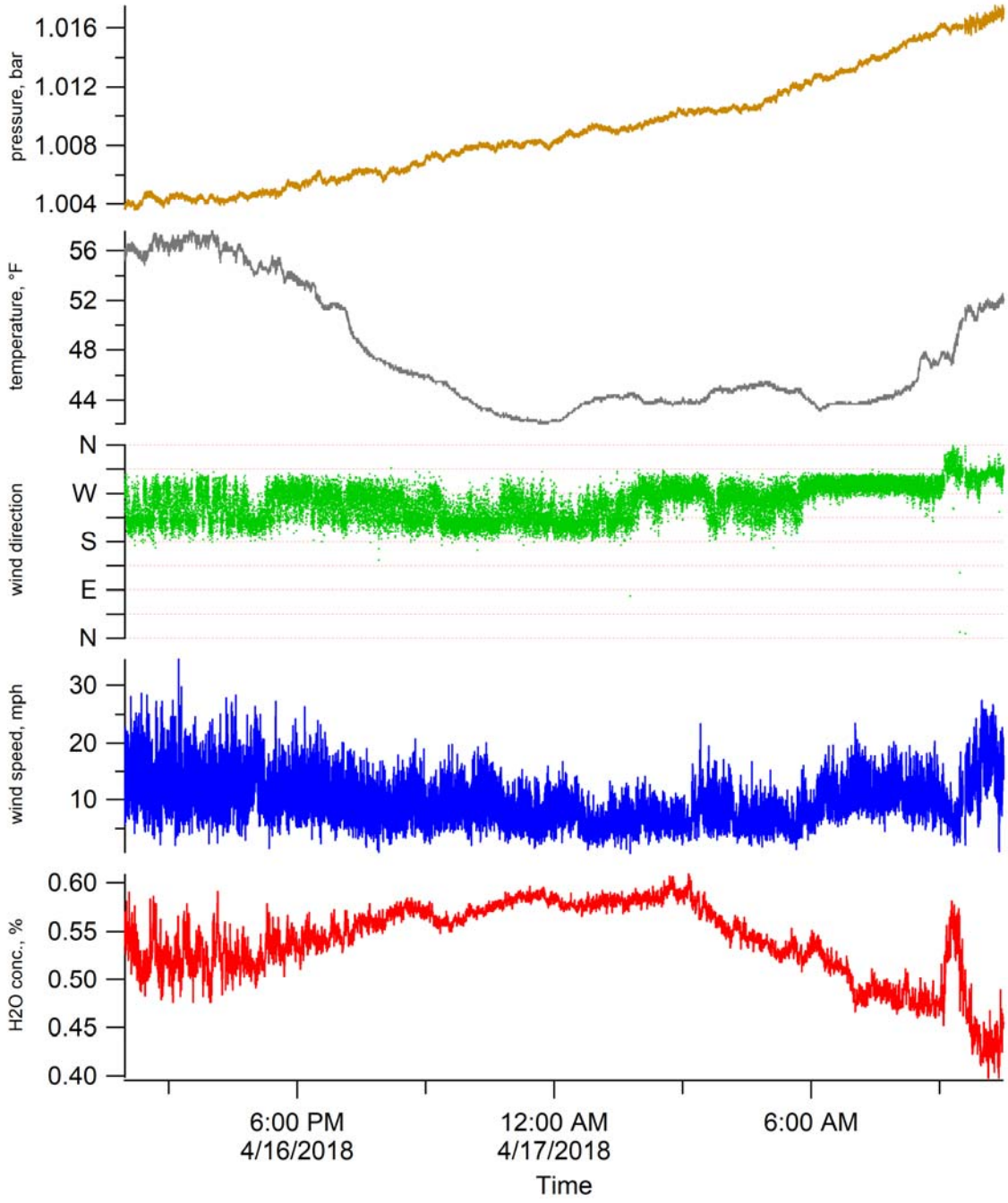


Figure 2-21. Weather Data.

3.0 APRIL 17, 2018 – APRIL 18, 2018 – STUDY SITE #5

3.1 Quality Assessment

Data from April 17, 2018, were transferred to TerraGraphics via the WRPS FTP site on April 23, 2018. Data were assessed using Procedure 17124-DOE-HS-102. A completed Data Exchange Checklist was sent to WRPS on April 25, 2018. The data were accepted by TerraGraphics with the following comments. All startup, shutdown, and calibration procedures were adequately documented and all other checks passed the acceptance limits.

3.2 Summary

The Mobile Laboratory personnel performed background sampling using the Mobile Laboratory from April 17, 2018, to April 18, 2018 at Study Site 5. Site 5 is located southeast of the Waste Treatment Facility. This site may provide data related to stack emission dispersion downwind of the tank farm ventilation and as a baseline data point for future reference once the Waste Treatment Facility begins operation. The initial QA/QC zero air/sensitivity checks were performed on the CO_2 monitor, NH_3 monitor, and the PTR-MS beginning at 11:36. Around 12:00, the Mobile Laboratory was parked across 274 AW for a tour with WRPS that occurred at 12:30. The Mobile Laboratory moved to Site 5 after the tour was complete. The data file names were confirmed and routine data collection resumed by 15:47. The Mobile Laboratory staff departed the monitoring site at 16:00.

The Mobile Laboratory staff returned to Site 5 at 06:35 on April 18, 2018, and began confirmatory sample collection by 06:46. A new 10,000 ppb NH_3 standard (CBAL-451-96A) was prepared from CBAL-451-74B and used for sensitivity checks. Changing wind direction prompted a move of the exhaust line at 07:00 and 07:58. The weather station lost satellite connection briefly from 09:39 to 09:41. Closeout zero air/sensitivity checks were performed at 10:38. The Mobile Laboratory moved to Site 6 by 12:33.



Figure 3-1. Mobile Lab Site #5 for the Duration of the Monitoring Period.

3.3 Samples Collected

Continuous air monitoring was performed using the following instrumentation:

- PTR-MS,
- LI-COR CO_2 Monitor,
- Picarro Ammonia Monitor, and
- Weather Station.

Confirmatory air samples were collected as follows:

Table 3-1. Alternative Media Samples Taken.

Site	Date	Sample Type	ID	Start	Stop	Sample Time (min)
5	17-Apr	Thermosorb/N	EL22227	11:43	14:58	194
5	17-Apr	CarboTrap-300	A045494	13:24	14:54	90
5	18-Apr	Thermosorb/N	EL22224	06:46	09:47	180
5	18-Apr	CarboTrap-300	A007514	06:49	08:10	80

Table 3-2 displays the statistical information for the monitoring period of April 17, 2018, to April 18, 2018. By definition, the OEL is an 8-hour, time-weighted average that establishes a limit for personnel exposures to hazardous chemicals. It is the exposure level to which a person may be exposed for 8 hours/day, 40 hours/week for 40 years and have no expectation of adverse health effects. In this study, area vapor concentration measurements were made to better understand the hazardous vapor exposures that workers may receive. These measurements are only compared to OEL concentrations to give them context. It is neither accurate nor appropriate to interpret these short duration measurements (2 seconds) as worker exposure levels. Since the OEL is defined as a time-weighted average, it is more appropriate to compare them to daily average vapor concentrations. Short duration excursions above the OEL concentration are not significant.

Table 3-2. Statistical Information for the Monitoring Period of April 17, 2018 – April 18, 2018.

COPC #	COPC Name	Reporting Limit (ppb)	OEL (ppb)	Ave. (ppb)	St. Dev. (ppb)	Rel. St. Dev. (%)	Max (ppb)	Median (ppb)	Sec. over 50% OEL	Sec. over OEL
1	ammonia	1	25000	5.81	3.499	60.2%	35.49	4.51	0	0
2	furan	0.09	1	0.046	0.018	92.5%	0.558	0.017	2	0
3	but-3-en-2-one + 2,3-dihydrofuran + 2,5-dihydrofuran	0.22	1	0.113	0.049	138.0%	N/A*	N/A*	N/A	N/A
4	NDMA**	0.06	0.3	0.034	0.024	110.7%	0.189	0.015	6	0
5	2-methylfuran	0.05	1	0.028	0.022	111.6%	0.609	0.017	6	0
6	NEMA	0.02	0.3	0.014	0.013	159.9%	0.086	0.000	0	0
7	2,5-dimethylfuran	0.05	1	0.027	0.018	115.3%	0.357	0.012	0	0
8	NDEA	0.01	0.1	0.007	0.007	180.0%	0.061	0.000	2	0
9	2-propylfuran + 2-ethyl-5-methylfuran	0.02	1	0.012	0.010	125.2%	0.174	0.006	0	0
10	NMOR	0.05	0.6	0.025	0.006	116.0%	0.163	0.004	0	0
11	2-ethyl-2-hexenal + 4-(1-methylpropyl)-2,3-dihydrofuran + 3-(1,1-dimethylethyl)-2,3-dihydrofuran	0.04	1	0.021	0.009	74.7%	0.116	0.011	0	0
12	2-pentylfuran	0.04	1	0.022	0.012	65.2%	0.180	0.016	0	0
13	2-heptylfuran	0.02	1	0.011	0.006	76.3%	0.078	0.006	0	0
14	2-octylfuran	0.01	1	0.005	0.002	219.0%	0.034	0.000	0	0
15	6-(2-furanyl)-6-methyl-2-heptanone	0.01	1	0.005	0.002	160.1%	0.021	0.000	0	0
16	furfural acetophenone	0.07	1	0.035	0.004	60.1%	0.033	0.006	0	0

* The maximum peak value for but-3-en-2-one + 2,3 dihydrofuran + 2,5 dihydrofuran was 1.988 ppb and the median value was 0.028 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 200, 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 each COPC signal, overlaid with the same signal smoothed using a 1-minute moving average, and CO_2, for the monitoring period April 17, 2018, to April 18, 2018.

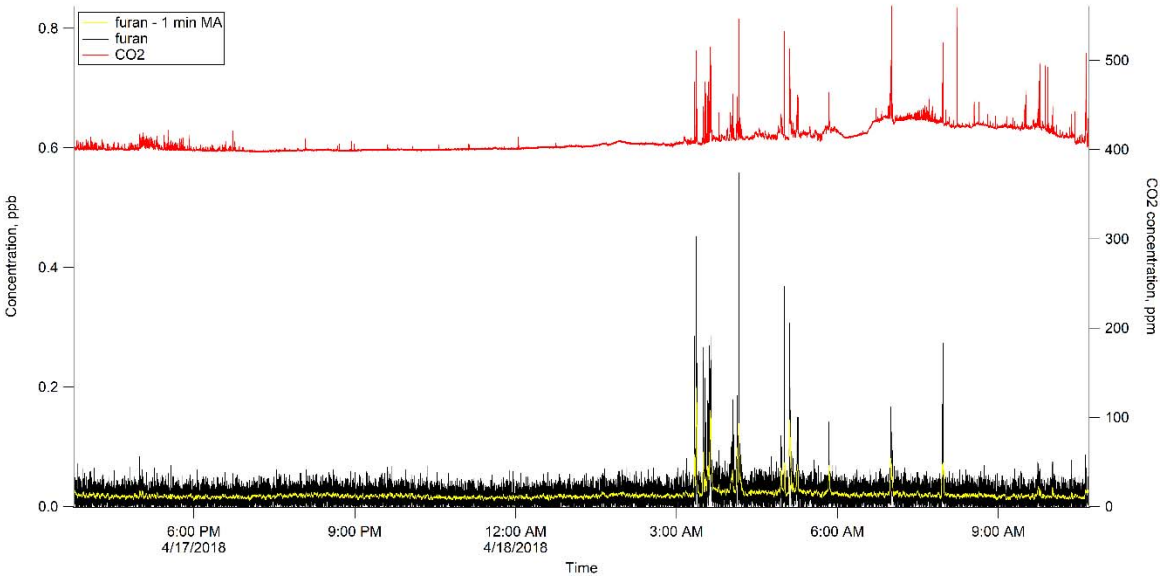


Figure 3-2. Furan.

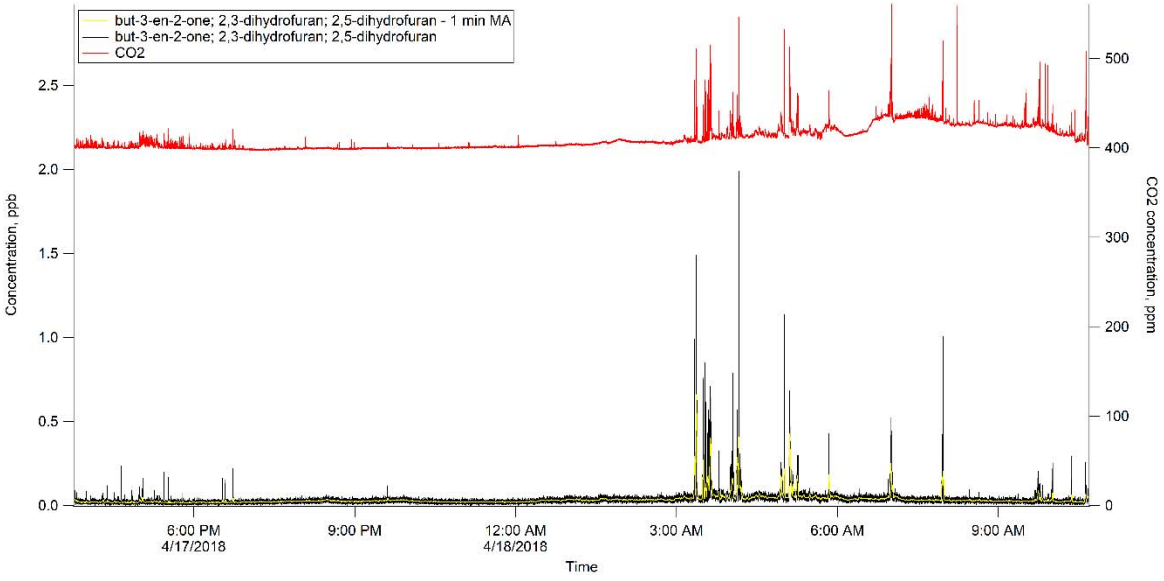


Figure 3-3. but-3-en-2-one + 2,3-dihydrofuran + 2,5-dihydrofuran.

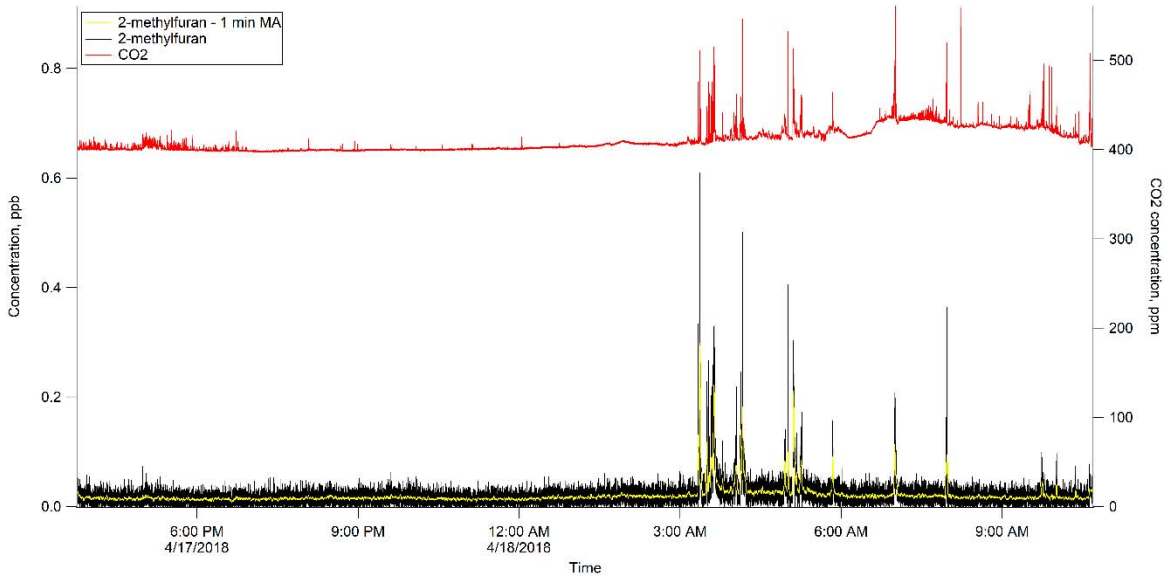


Figure 3-4. 2-methylfuran.

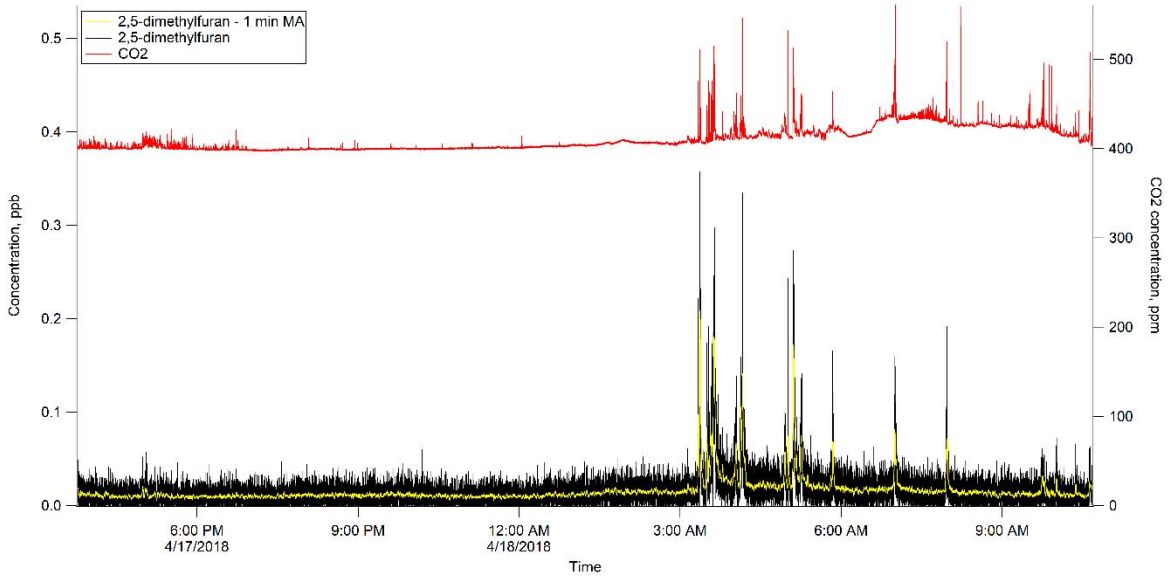


Figure 3-5. 2,5-dimethylfuran.

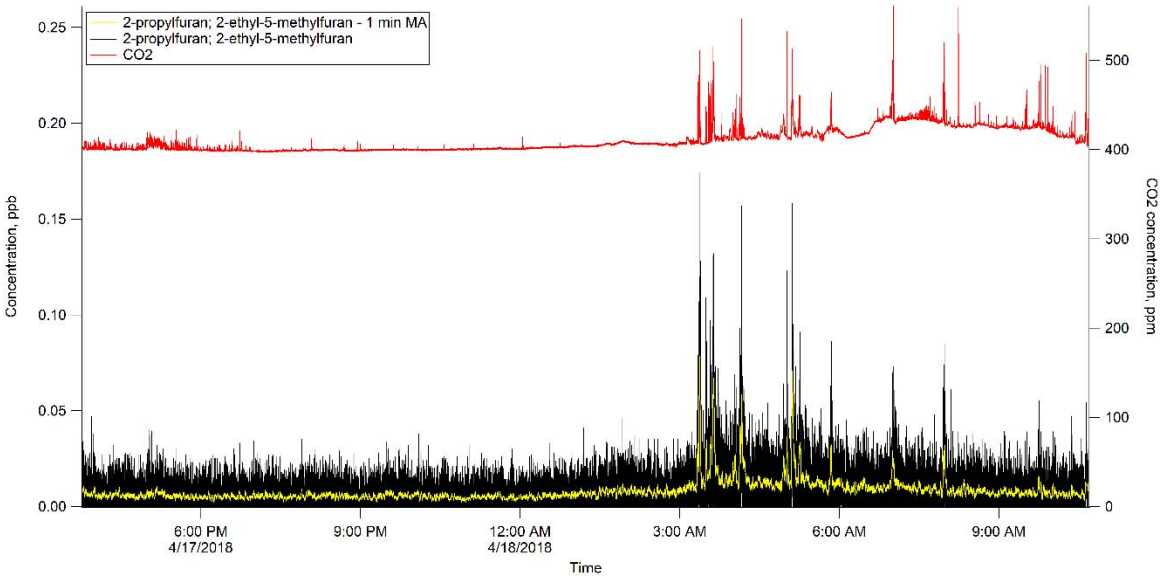


Figure 3-6. 2-propylfuran + 2-ethyl-5-methylfuran.

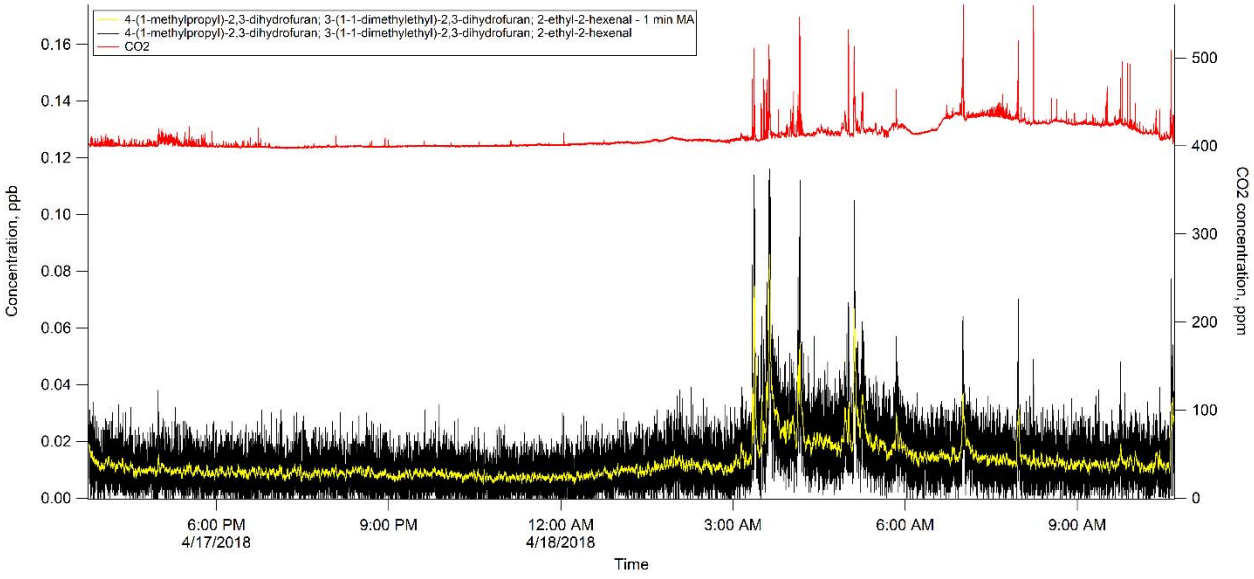


Figure 3-7. 4-(1-methylpropyl)-2,3-dihydrofuran + 3-(1-1-dimethylethyl)-2,3-dihydrofuran + 2-ethyl-2-hexenal.

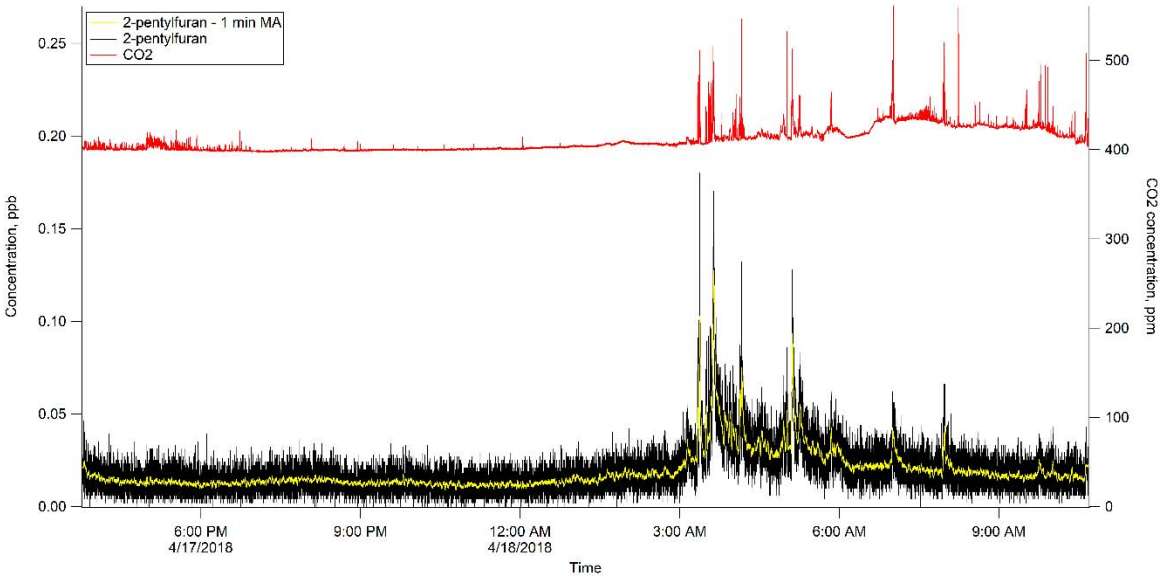


Figure 3-8. 2-pentylfuran.

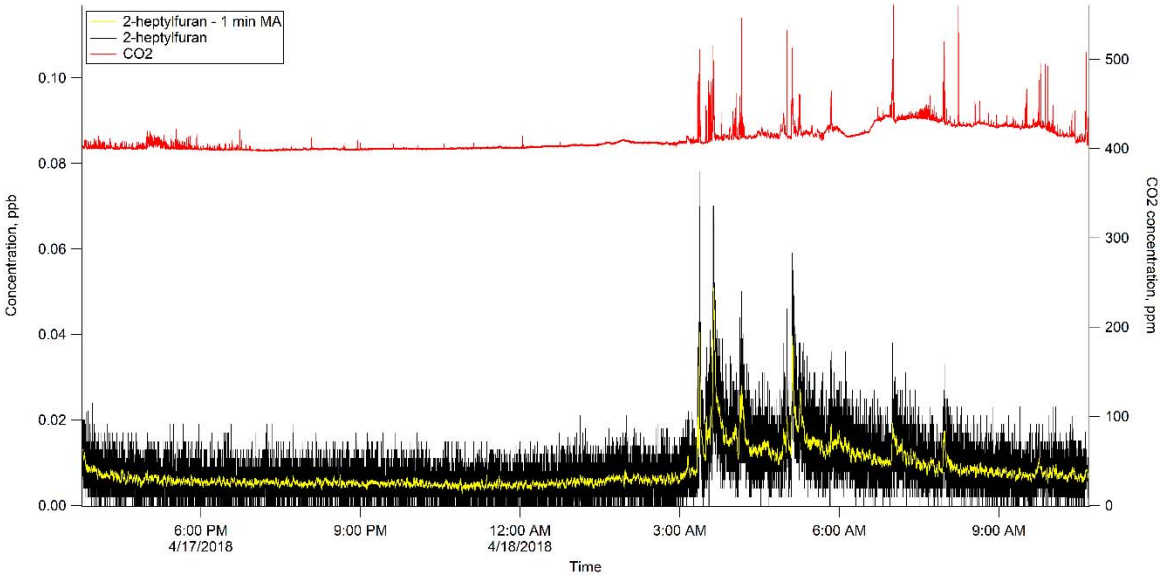


Figure 3-9. 2-heptylfuran.

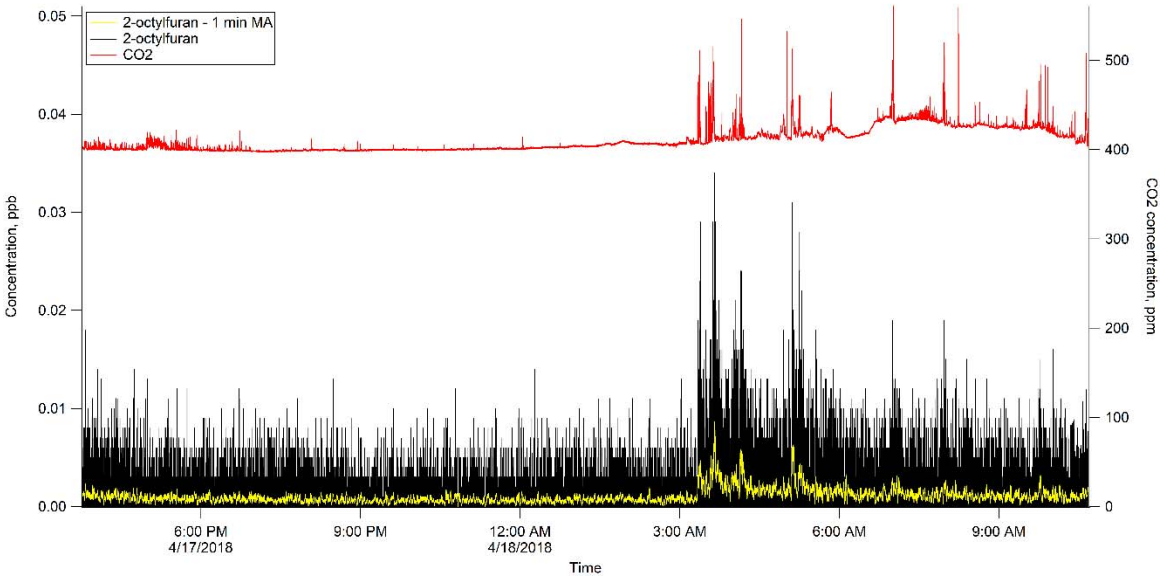


Figure 3-10. 2-octylfuran.

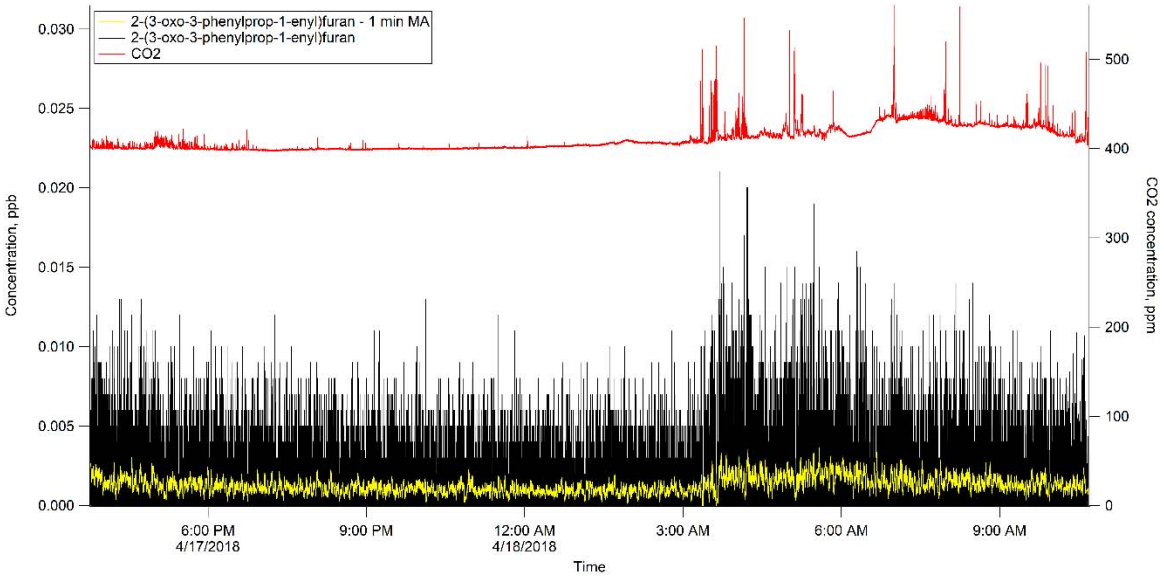


Figure 3-11. 2-(3-oxo-3-phenylprop-1-enyl)furan.

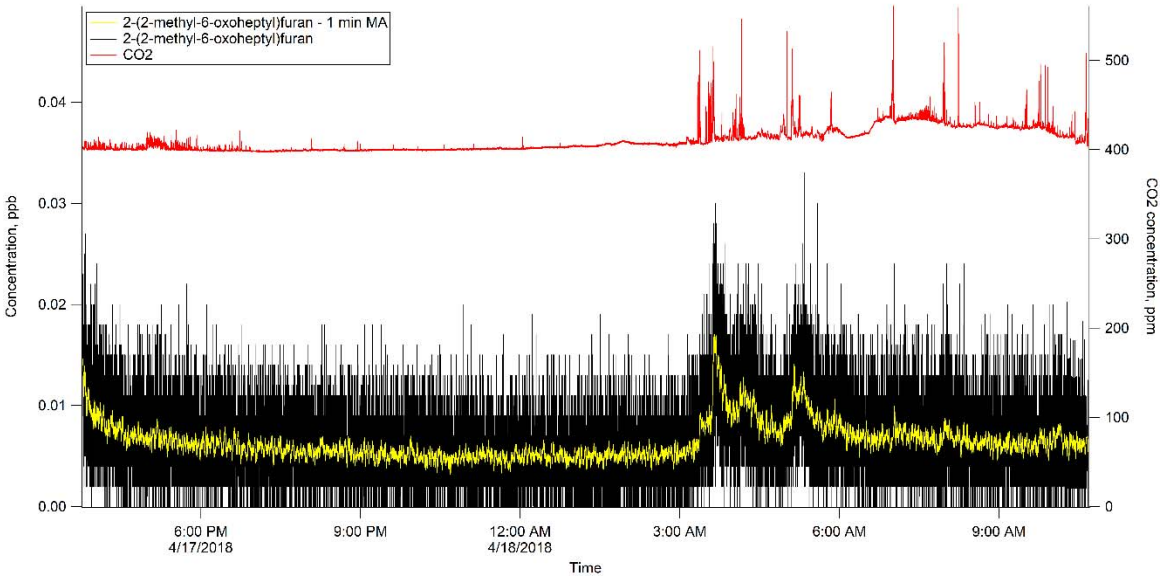


Figure 3-12. 2-(2-methyl-6-oxoheptyl)furan.

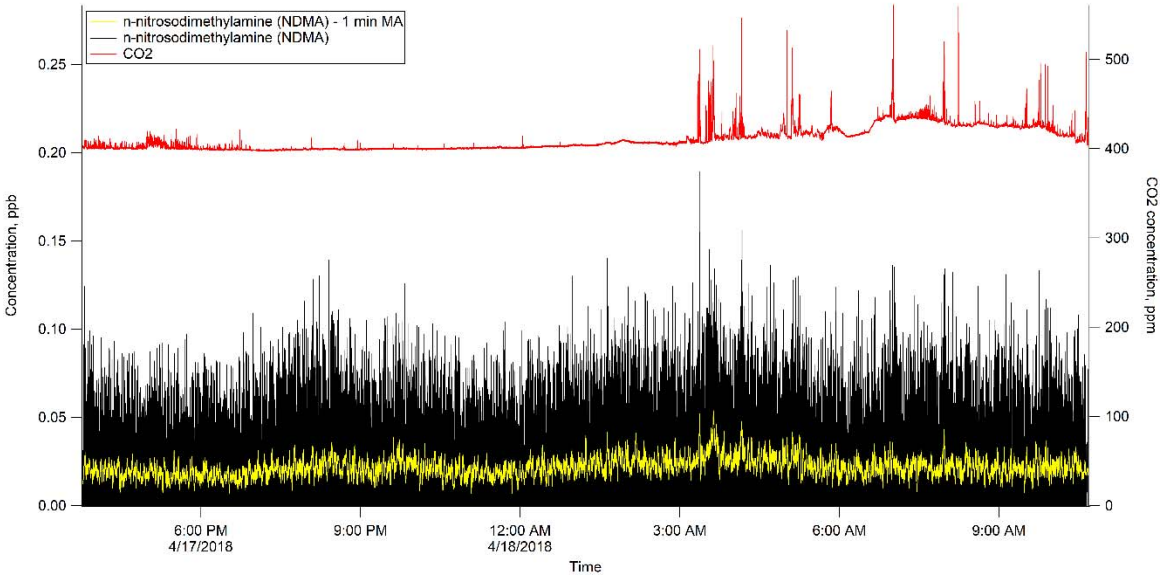


Figure 3-13. N-nitrosodimethylamine (NDMA).

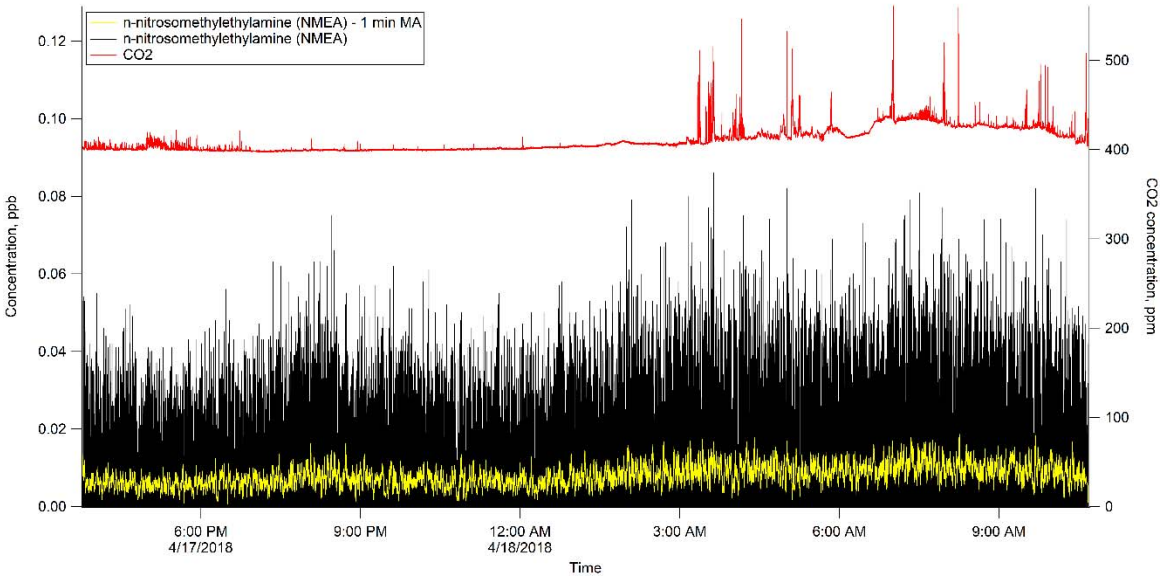


Figure 3-14. N-nitrosomethylethylamine (NMEA).

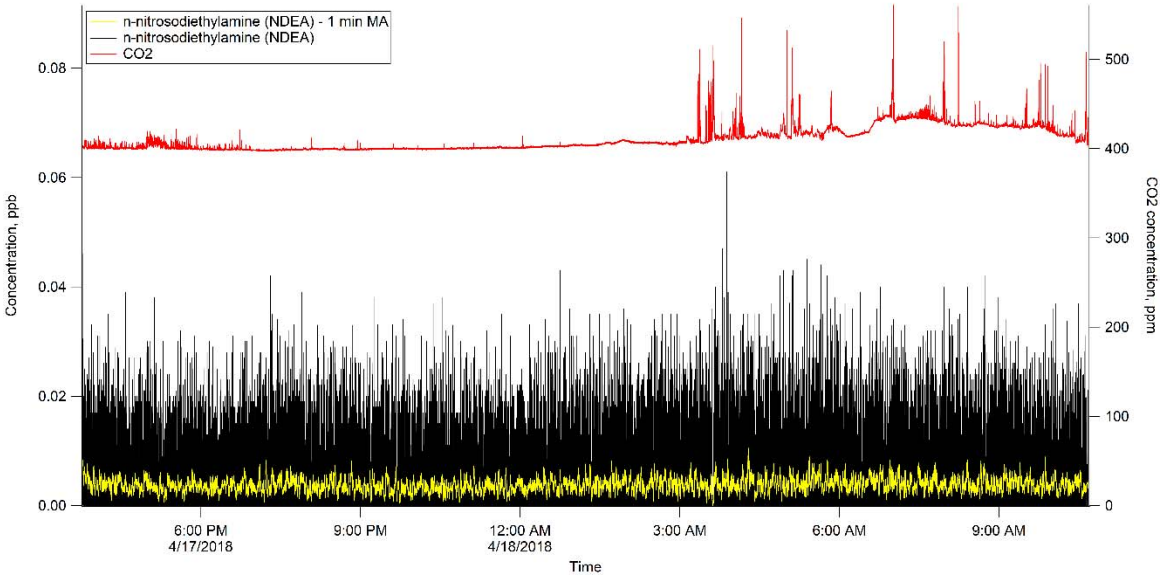


Figure 3-15. N-nitrosodiethylamine (NDEA).

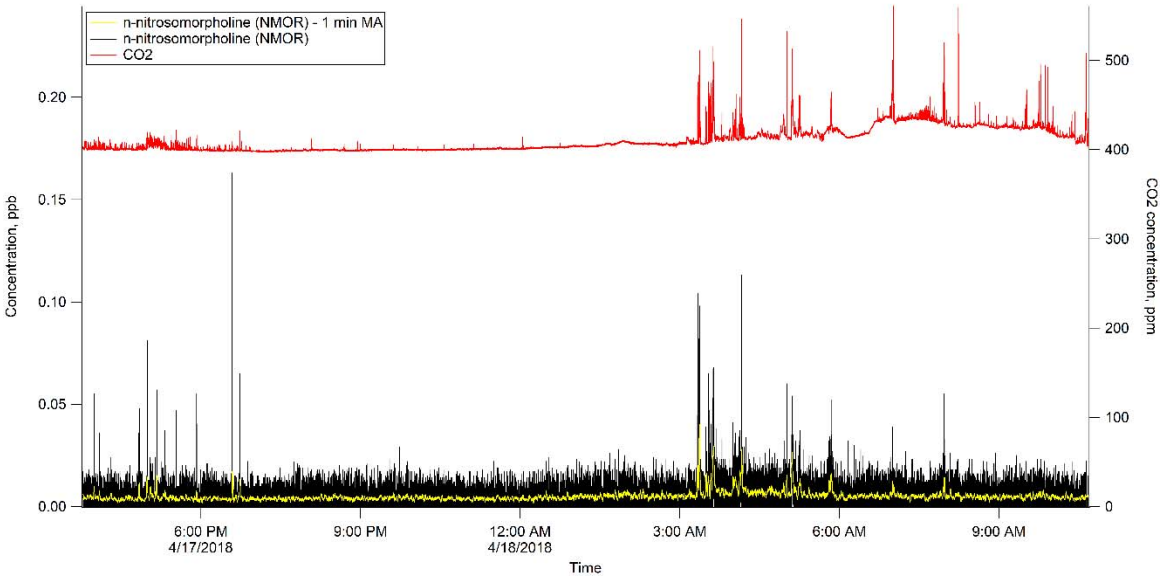


Figure 3-16. N-nitrosomorpholine (NMOR).

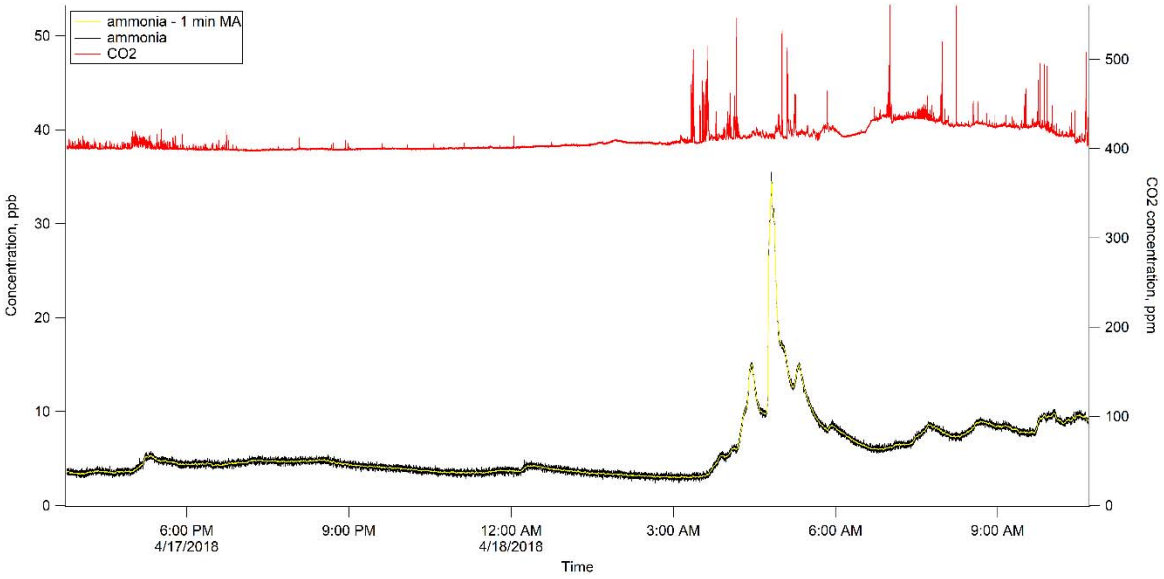


Figure 3-17. Ammonia.

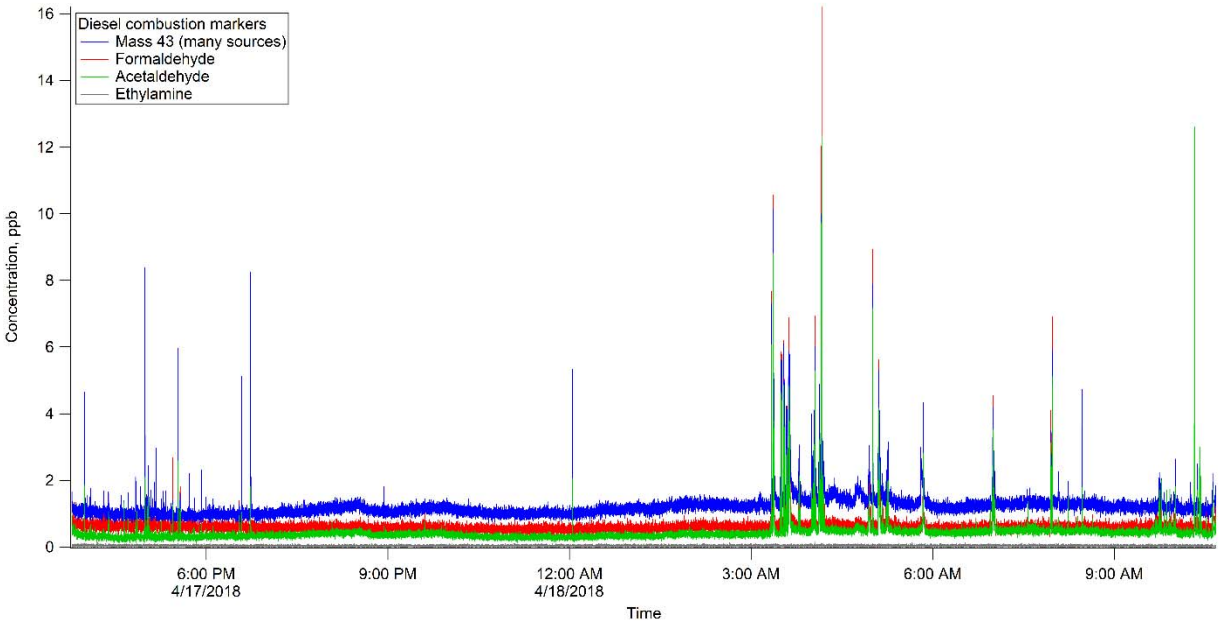


Figure 3-18. Diesel Combustion Markers.

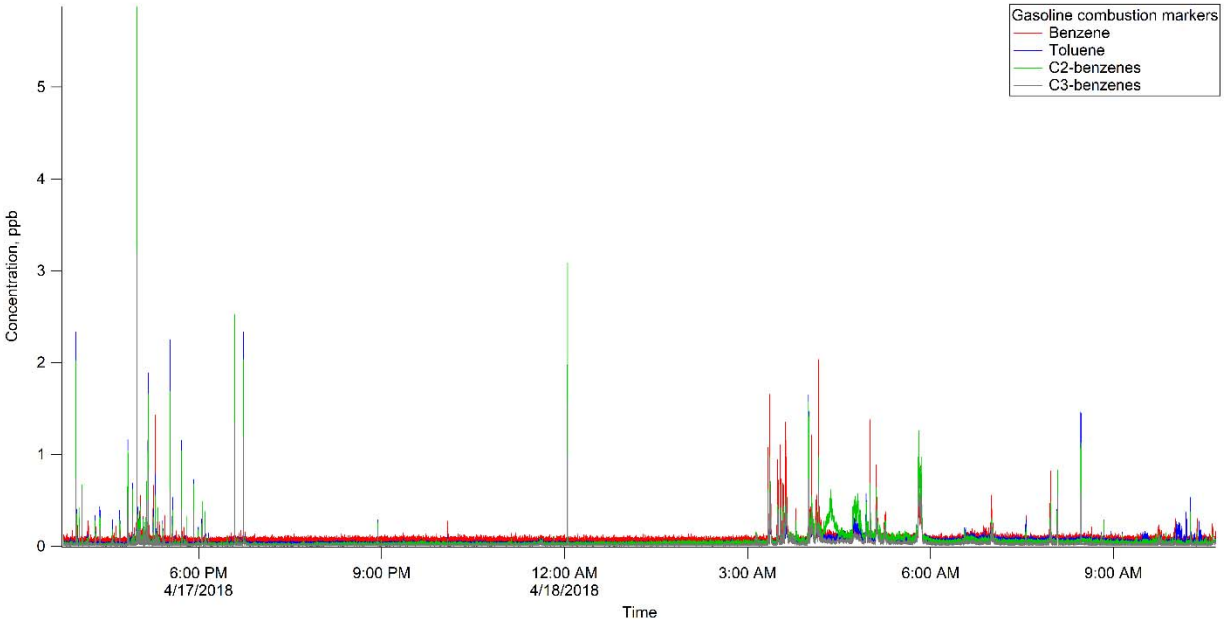


Figure 3-19. Gasoline Combustion Markers.

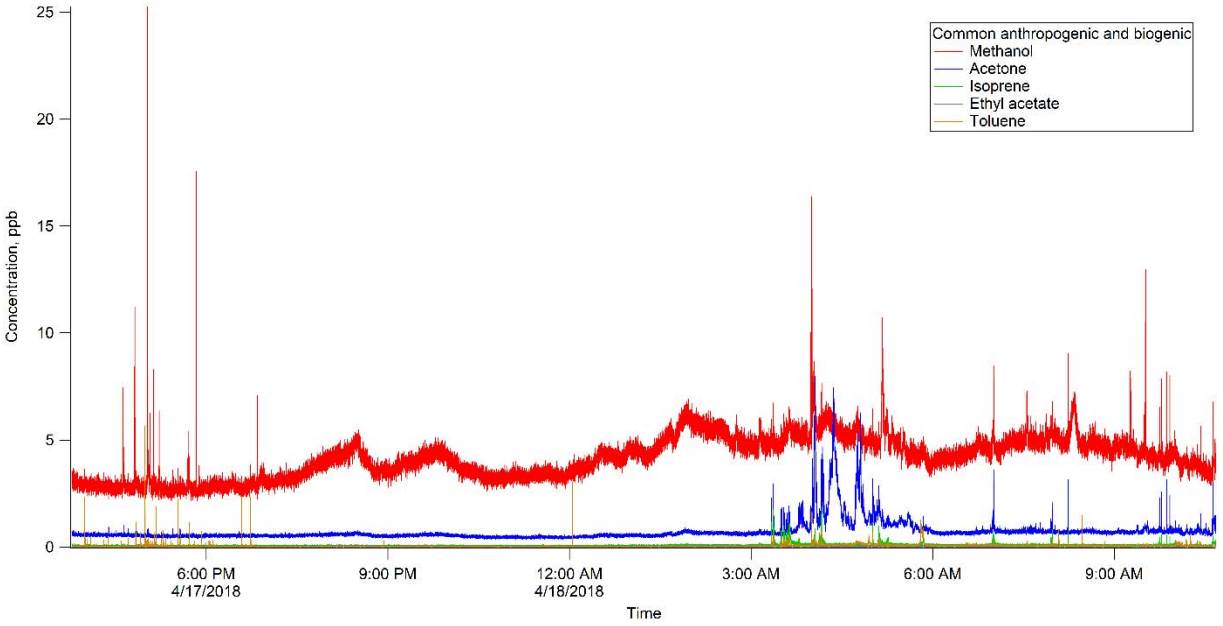


Figure 3-20. Plant and Human Markers.

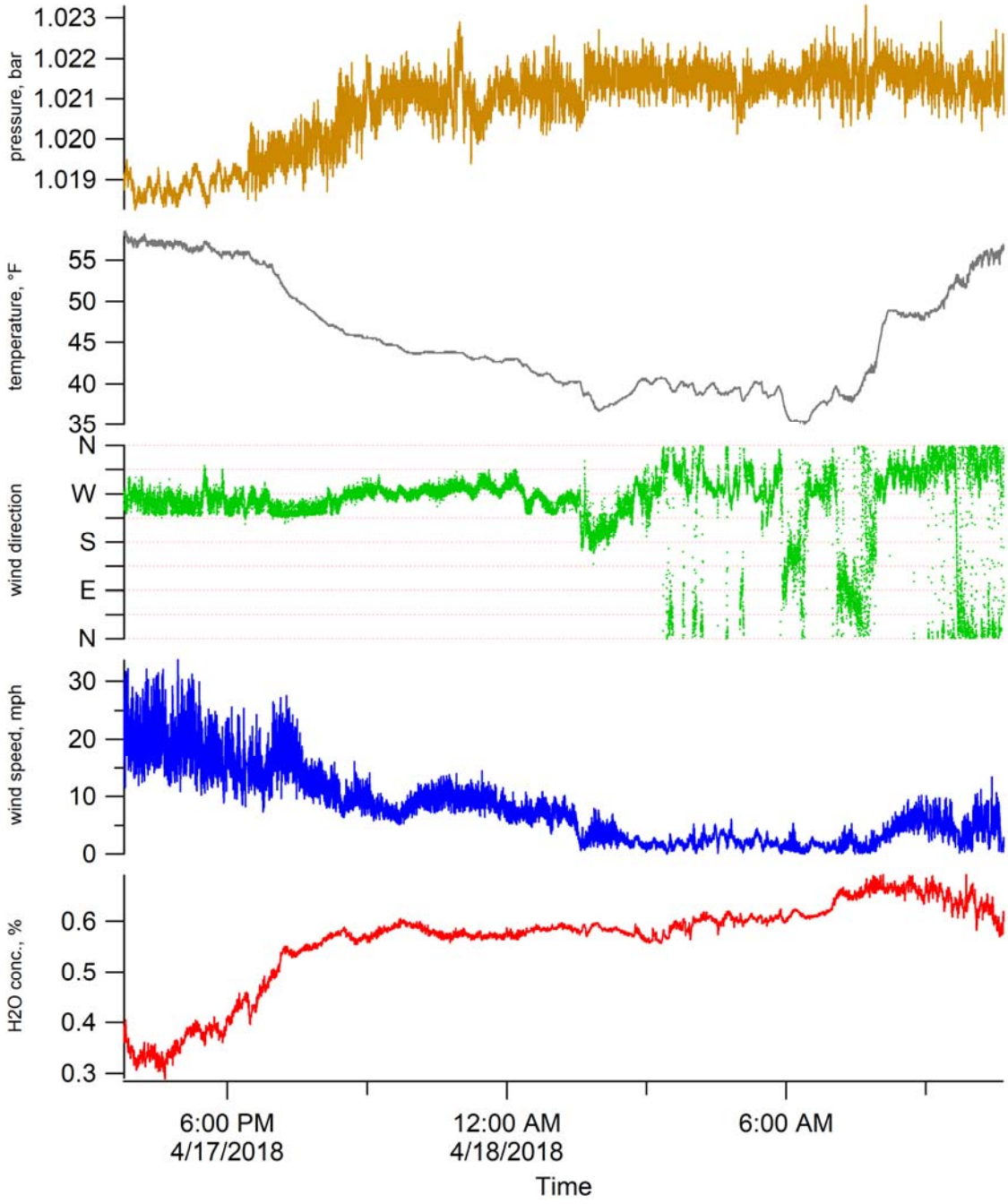


Figure 3-21. Weather Data.

4.0 APRIL 18, 2018 – APRIL 19, 2018 – STUDY SITE #6

4.1 Quality Assessment

Data from April 17, 2018, were transferred to TerraGraphics via the WRPS FTP site on April 23, 2018. Data were assessed using Procedure 17124-DOE-HS-102. A completed Data Exchange Checklist was sent to WRPS on April 25, 2018. The data were accepted by TerraGraphics with the following comments. All startup, shutdown, and calibration procedures were adequately documented and all other checks passed the acceptance limits. No other exceptions besides those below were noted.

Weather station data were not collected for 35 minutes from 13:57 to 14:32 on April 18, 2018, and CAPA 1826 was issued. The laptop for the weather station froze during this 35 minutes. It appeared to be an anomaly for the weather station laptop and personnel will monitor the computer more frequently.

Mobile Laboratory personnel noticed the PTR-MS was not updating with live data. The TOF acceleration current was lost. The power supply module on the instrument temporarily went out/lost reference signal. CAPA 1827 was issued and data were not collected from 06:26 thru 07:00 on April 19, 2018. The PTR-MS was restarted at the time of the power supply issue by selecting the stop/start data acquisition button.

4.2 Summary

The Mobile Laboratory personnel performed background sampling using the Mobile Laboratory from April 18, 2018, to April 19, 2018 at Study Site 6. Site 6 is located near the intersection of US Highway 395 and Clearwater Avenue in Kennewick, WA. This site is represented by heavy traffic patterns of mixed vehicle types and light commercial activity including a variety of eating establishments. The Mobile Laboratory arrived at Site 6 at 12:33 on April 18, 2018. The initial QA/QC zero air/sensitivity checks were performed on the CO_2 monitor, NH_3 monitor, and the PTR-MS beginning at 12:33. The data file names were confirmed and routine data collection resumed by 14:33. The Mobile Laboratory staff departed the monitoring site at 15:45.

The Mobile Laboratory staff returned to Site 6 at 5:55 on April 19, 2018, and began confirmatory sample collection by 06:07. Closeout zero air/sensitivity checks were performed at 10:40. A new PTR-MS standard (CBAL-451-69C) was implemented at 11:00. The Mobile Laboratory moved to Site 4 by 13:30.

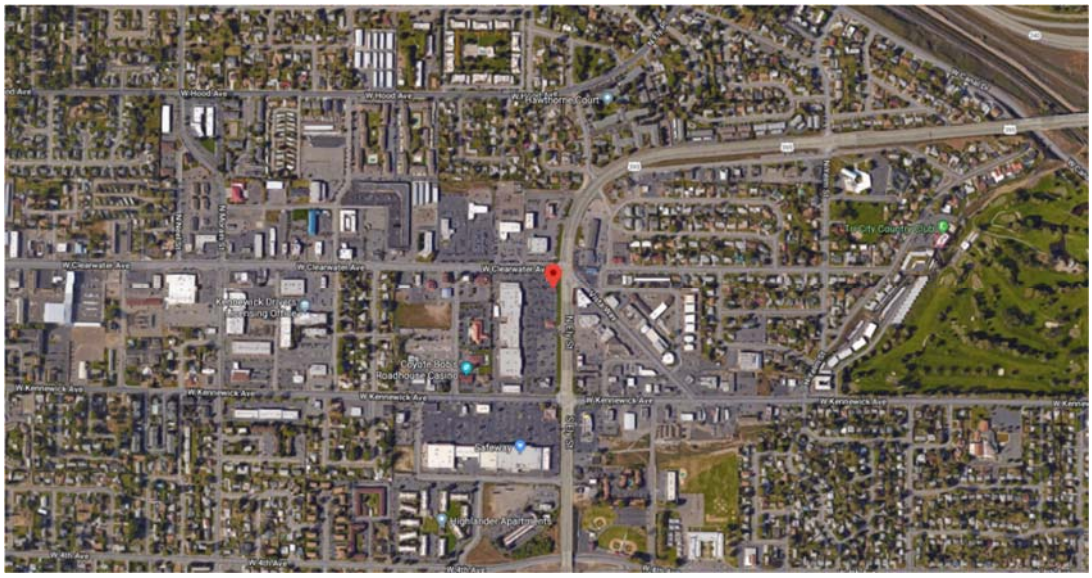


Figure 4-1. Mobile Lab Site #6 for the Duration of the Monitoring Period.

4.3 Samples Collected

Continuous air monitoring was performed using the following instrumentation:

- PTR-MS,
- LI-COR CO_2 Monitor,
- Picarro Ammonia Monitor, and
- Weather Station.

Confirmatory air samples were collected as follows:

Table 4-1. Alternative Media Samples Taken.

Site	Date	Sample Type	ID	Start	Stop	Sample Time (min)
6	18-Apr	Thermosorb/N	EL22237	12:40	15:39	180
6	18-Apr	CarboTrap-300	A048154	12:42	13:55	73
6	19-Apr	Thermosorb/N	EL22223	06:07	09:07	180
6	19-Apr	CarboTrap-300	A046030	06:10	07:20	70

Table 4-2 displays the statistical information for the monitoring period of April 18, 2018, to April 19, 2018. By definition, the OEL is an 8-hour, time-weighted average that establishes a limit for personnel exposures to hazardous chemicals. It is the exposure level to which a person may be exposed for 8 hours/day, 40 hours/week for 40 years and have no expectation of adverse health effects. In this study, area vapor concentration measurements were made to better understand the hazardous vapor exposures that workers may receive. These measurements are only compared to OEL concentrations to give them context. It is neither accurate nor appropriate

to interpret these short duration measurements (2 seconds) as worker exposure levels. Since the OEL is defined as a time-weighted average, it is more appropriate to compare them to daily average vapor concentrations. Short duration excursions above the OEL concentration are not significant.

Table 4-2. Statistical Information for the Monitoring Period of April 18, 2018 – April 19, 2018.

COPC #	COPC Name	Reporting Limit (ppb)	OEL (ppb)	Ave. (ppb)	St. Dev. (ppb)	Rel. St. Dev. (%)	Max (ppb)	Median (ppb)	Sec. over 50% OEL	Sec. over OEL
1	ammonia	1	25000	9.12	2.152	23.6%	14.23	9.22	0	0
2	furan	0.09	1	0.045	0.013	65.4%	0.134	0.018	0	0
3	but-3-en-2-one + 2,3-dihydrofuran + 2,5-dihydrofuran	0.22	1	0.110	0.016	50.5%	N/A*	N/A*	N/A	N/A
4	NDMA**	0.06	0.3	0.038	0.029	102.6%	0.166	0.021	38	0
5	2-methylfuran	0.05	1	0.026	0.012	56.2%	0.145	0.020	0	0
6	NEMA	0.02	0.3	0.017	0.018	162.7%	0.796	0.000	20	8
7	2,5-dimethylfuran	0.05	1	0.025	0.010	68.3%	0.135	0.014	0	0
8	NDEA	0.01	0.1	0.007	0.006	244.4%	0.061	0.000	6	0
9	2-propylfuran + 2-ethyl-5-methylfuran	0.02	1	0.012	0.008	99.0%	0.066	0.007	0	0
10	NMOR	0.05	0.6	0.025	0.007	105.5%	0.181	0.005	0	0
11	2-ethyl-2-hexenal + 4-(1-methylpropyl)-2,3-dihydrofuran + 3-(1,1-dimethylethyl)-2,3-dihydrofuran	0.04	1	0.020	0.007	55.4%	0.096	0.012	0	0
12	2-pentylfuran	0.04	1	0.020	0.006	35.1%	0.072	0.018	0	0
13	2-heptylfuran	0.02	1	0.010	0.003	54.9%	0.028	0.006	0	0
14	2-octylfuran	0.01	1	0.005	0.002	201.6%	0.017	0.000	0	0
15	6-(2-furanyl)-6-methyl-2-heptanone	0.01	1	0.005	0.002	160.2%	0.014	0.000	0	0
16	furfural acetophenone	0.07	1	0.035	0.003	55.0%	0.025	0.005	0	0

* The maximum peak value for but-3-en-2-one + 2,3 dihydrofuran + 2,5 dihydrofuran was 0.929 ppb and the median value was 0.030 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 200, 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 each COPC signal, overlaid with the same signal smoothed using a 1-minute moving average, and CO_2, for the monitoring period April 18, 2018 to April 19, 2018.

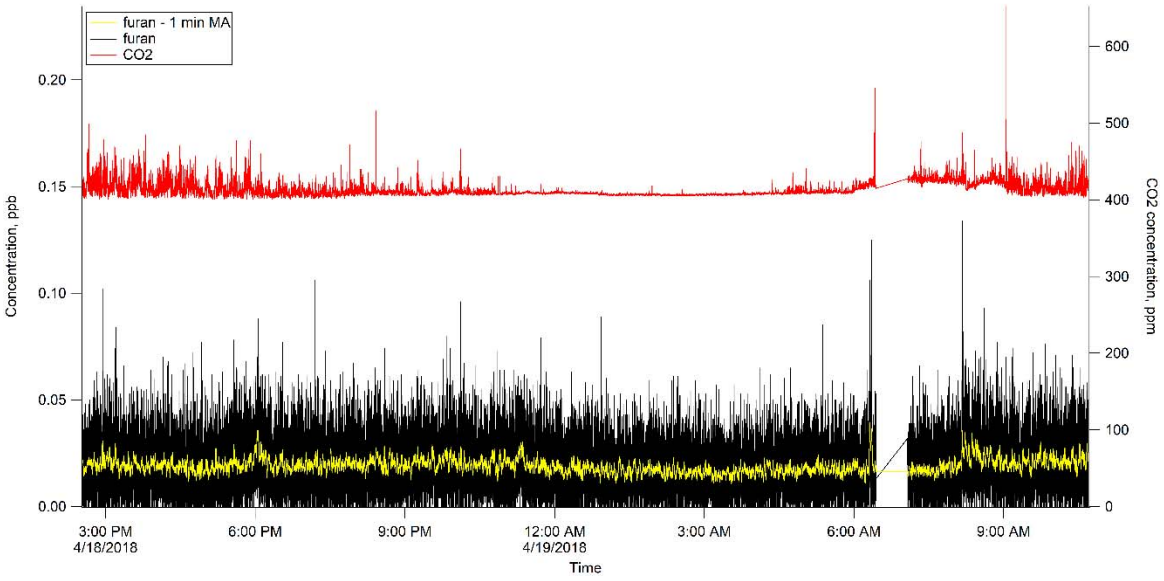


Figure 4-2. Furan.

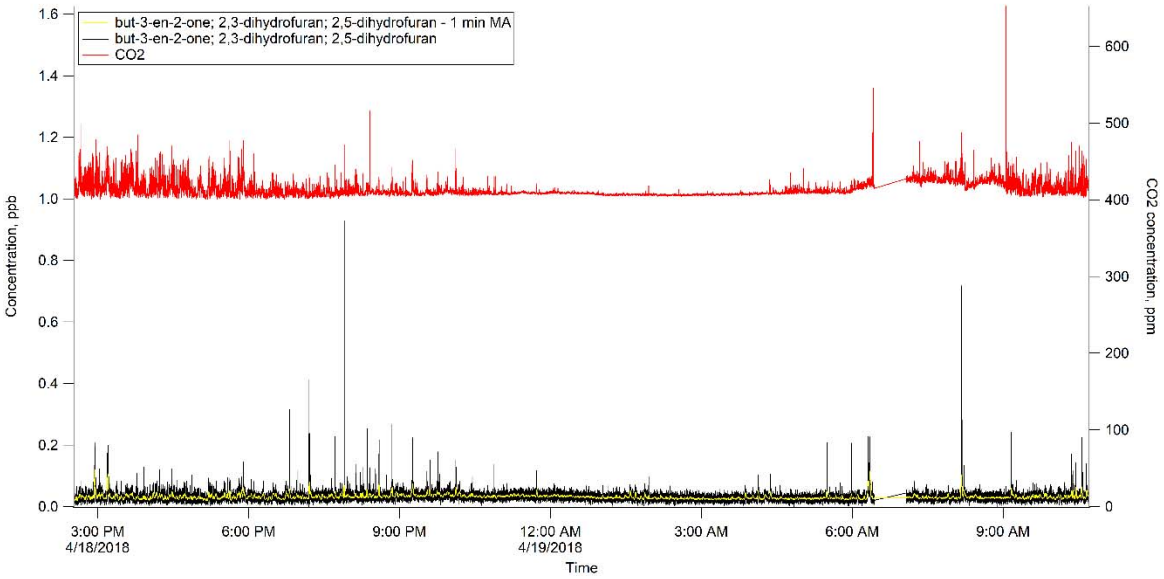


Figure 4-3. but-3-en-2-one + 2,3-dihydrofuran + 2,5-dihydrofuran.

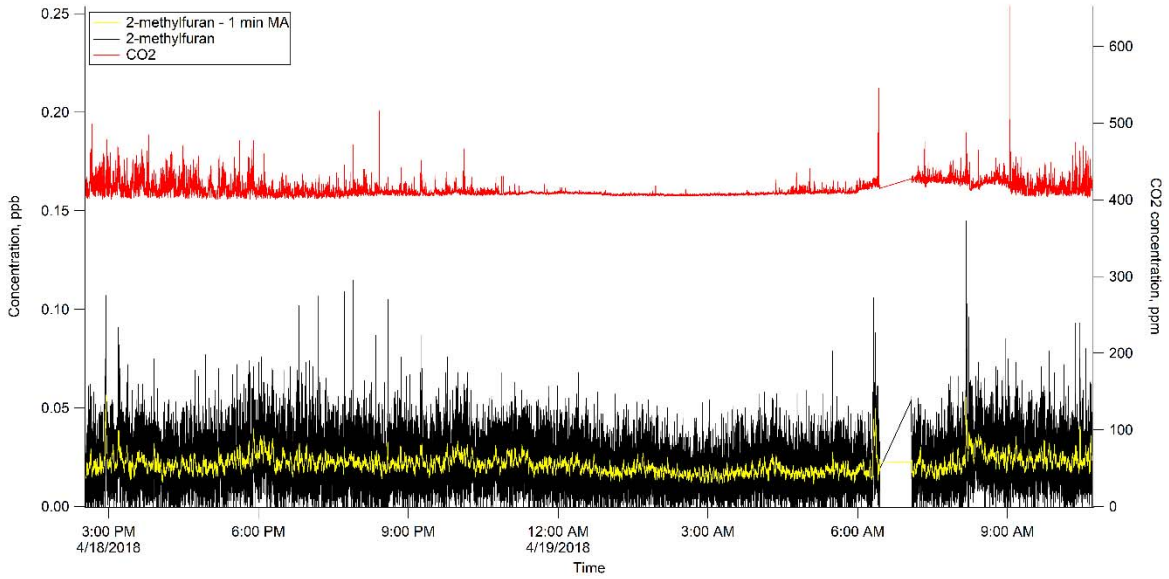


Figure 4-4. 2-methylfuran.

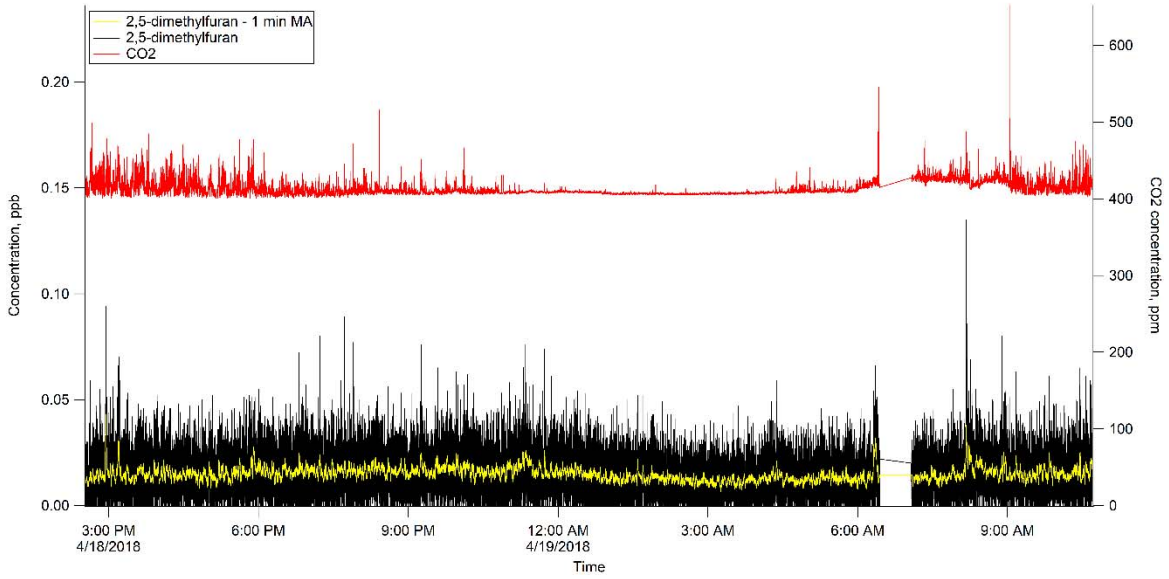


Figure 4-5. 2,5-dimethylfuran.

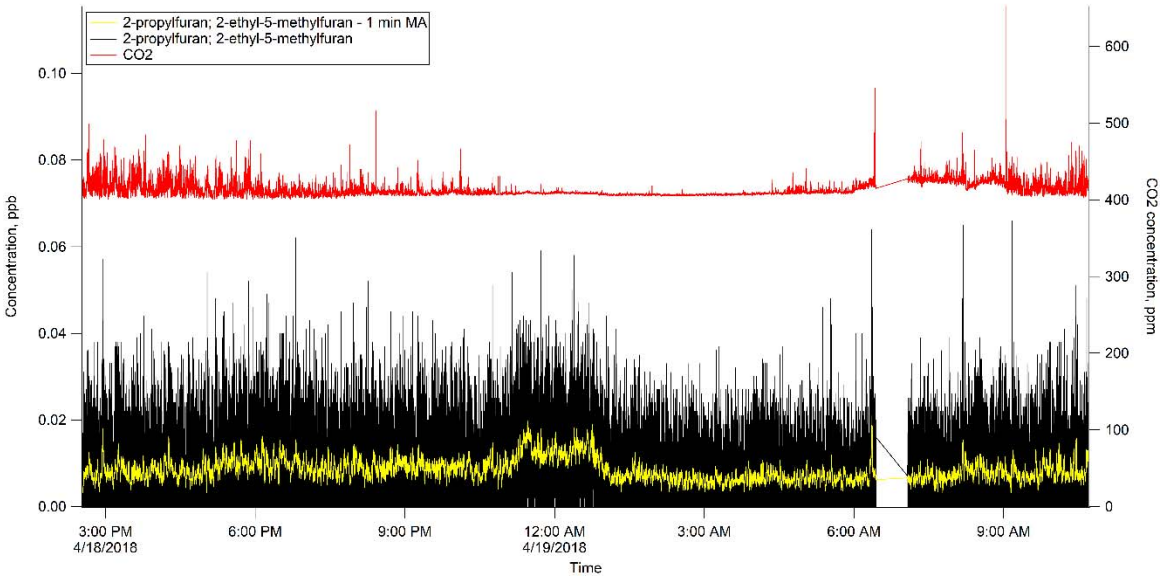


Figure 4-6. 2-propylfuran + 2-ethyl-5-methylfuran.

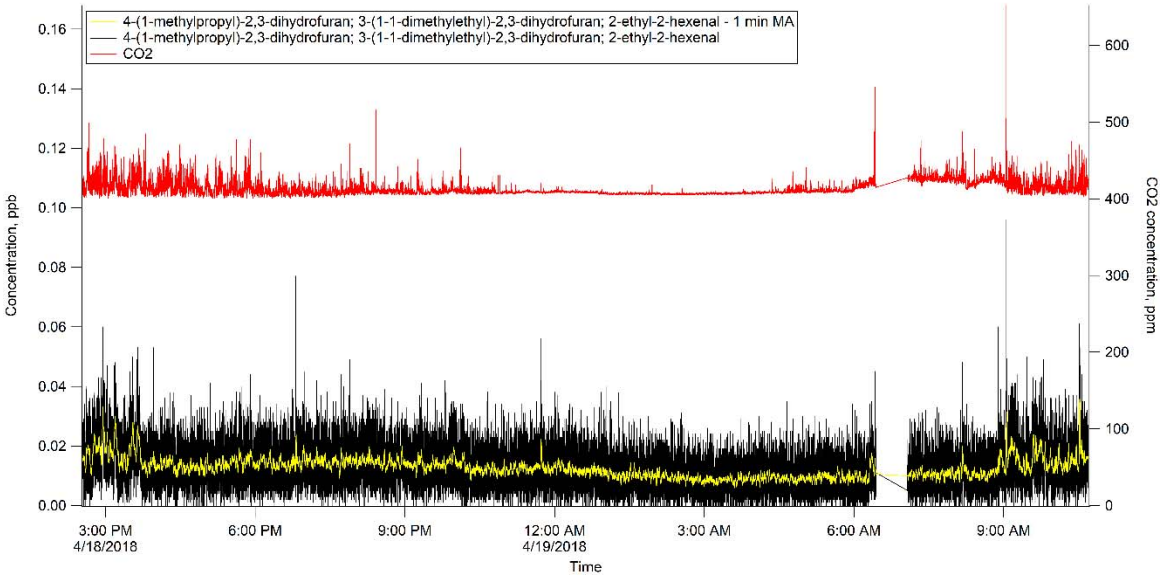


Figure 4-7. 4-(1-methylpropyl)-2,3-dihydrofuran + 3-(1-1-dimethylethyl)-2,3-dihydrofuran + 2-ethyl-2-hexenal.

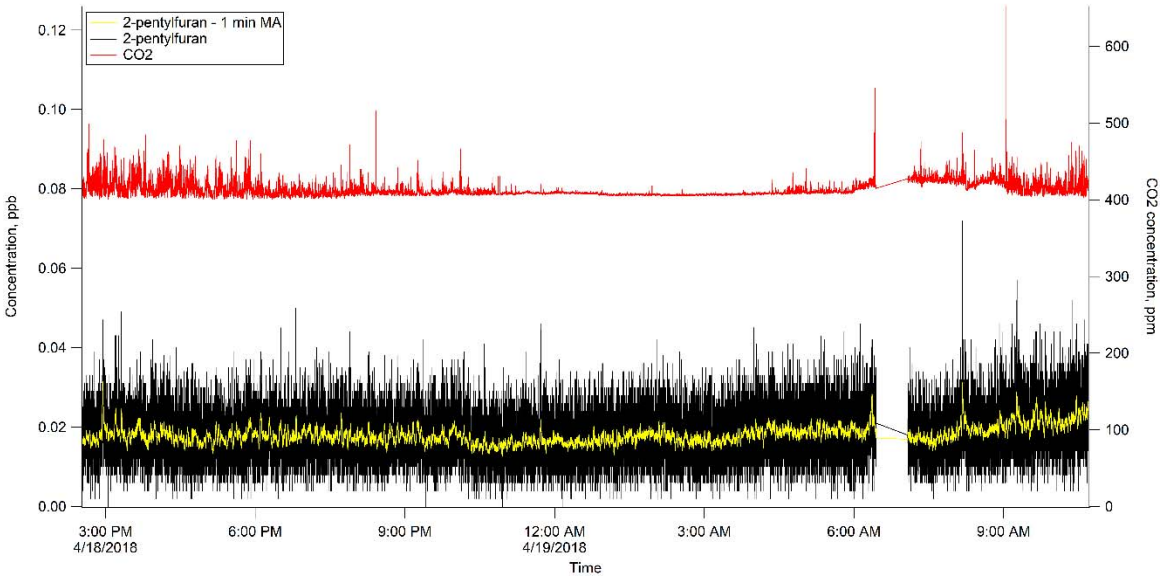


Figure 4-8. 2-pentylfuran.

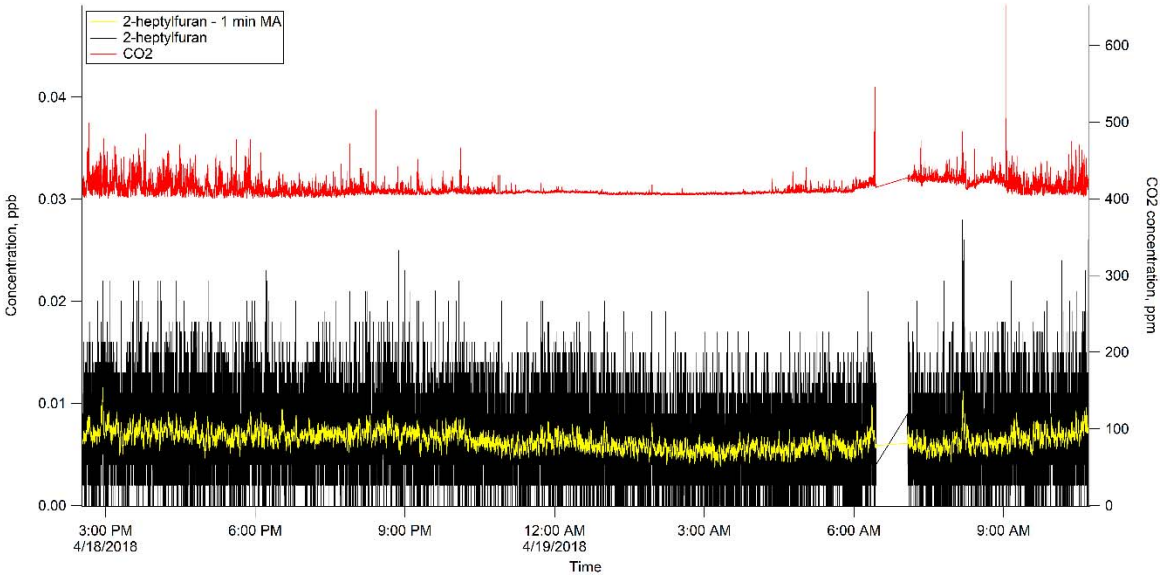


Figure 4-9. 2-heptylfuran.

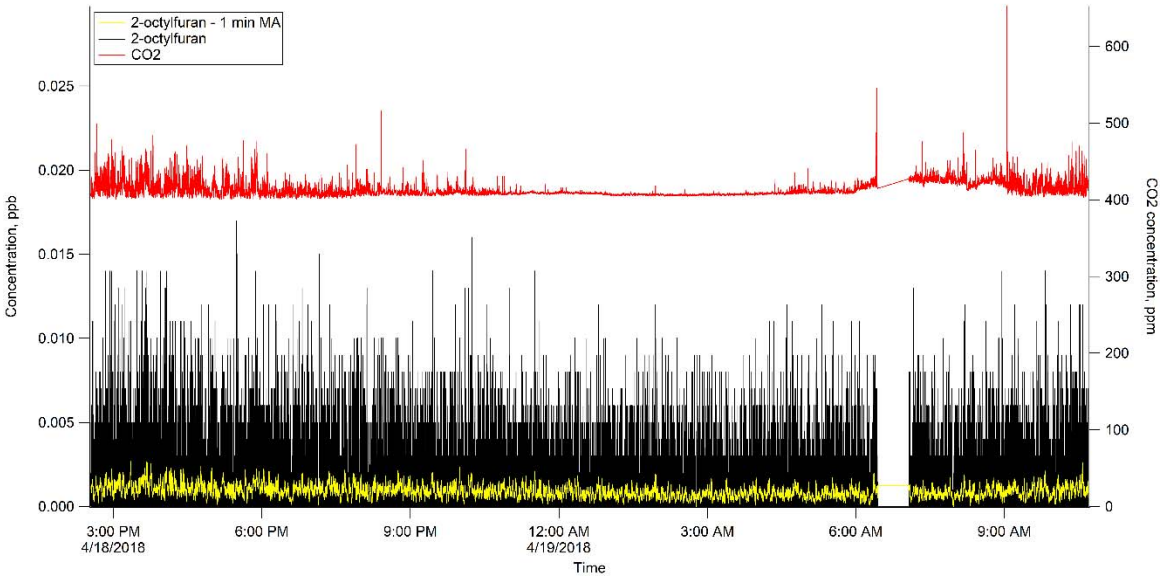


Figure 4-10. 2-octylfuran.

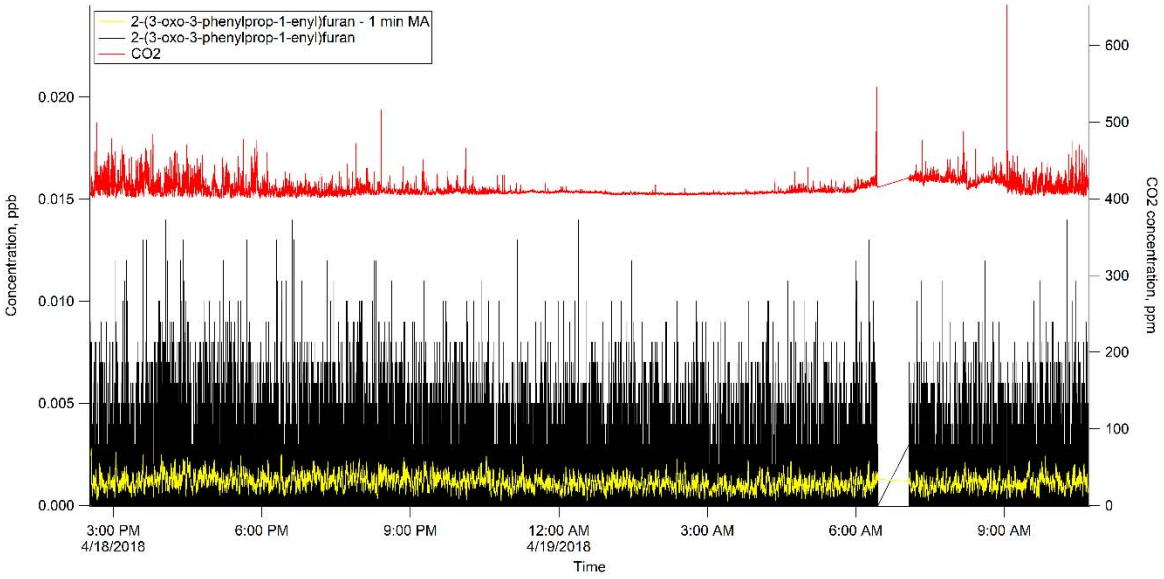


Figure 4-11. 2-(3-oxo-3-phenylprop-1-enyl)furan.

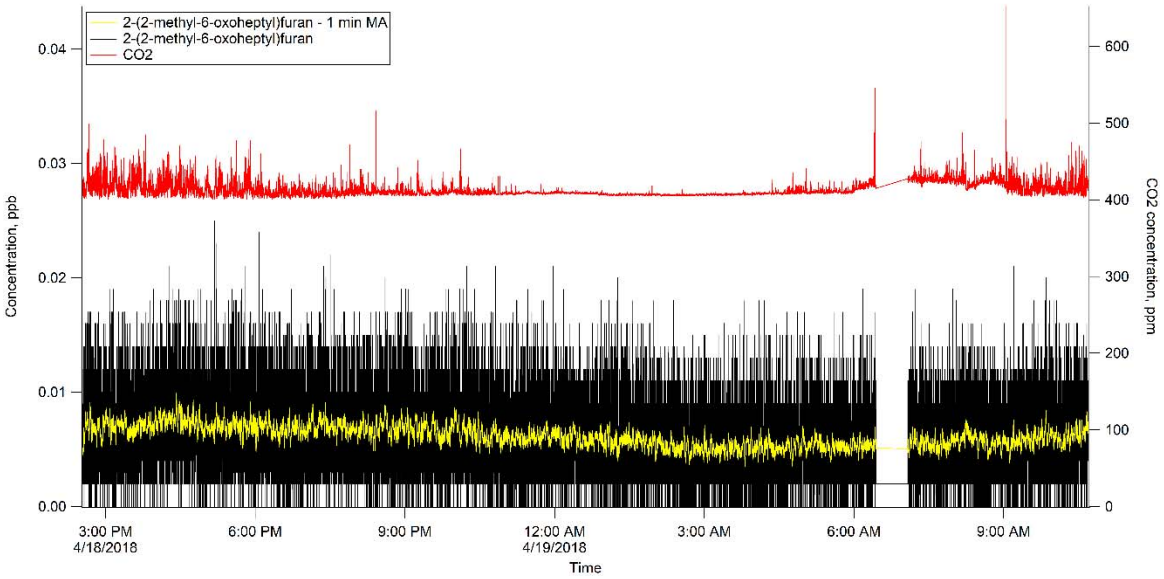


Figure 4-12. 2-(2-methyl-6-oxoheptyl)furan.

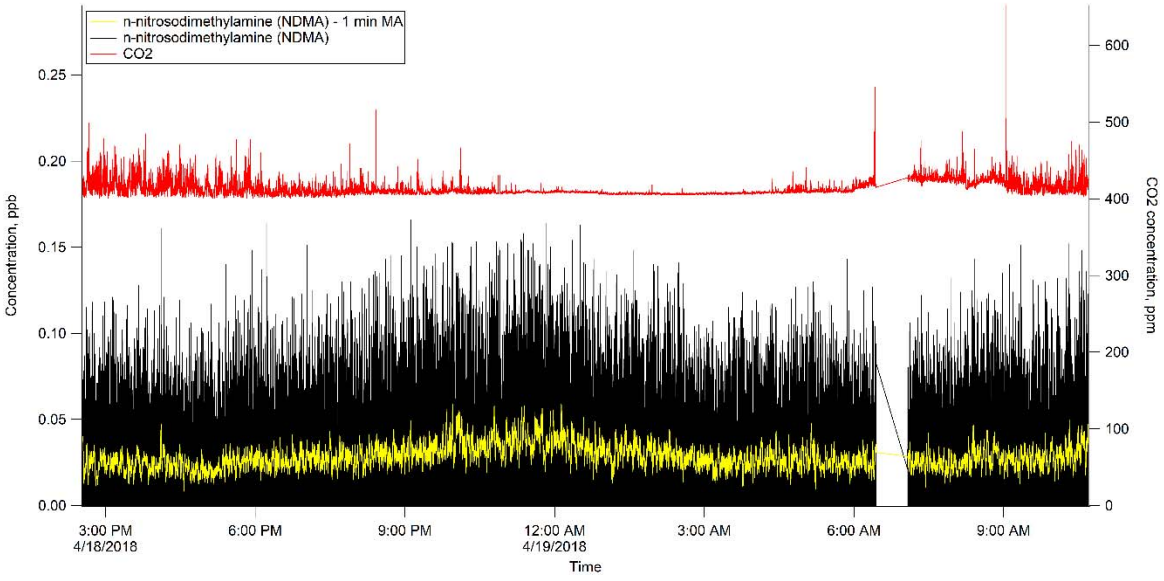


Figure 4-13. N-nitrosodimethylamine (NDMA).

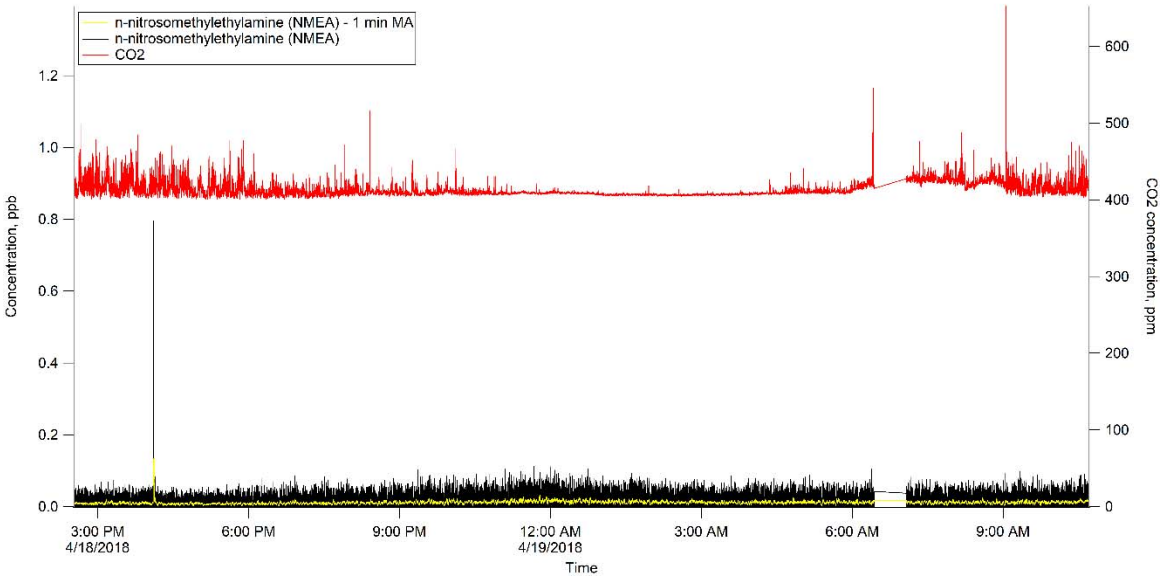


Figure 4-14. N-nitrosomethylethylamine (NMEA).

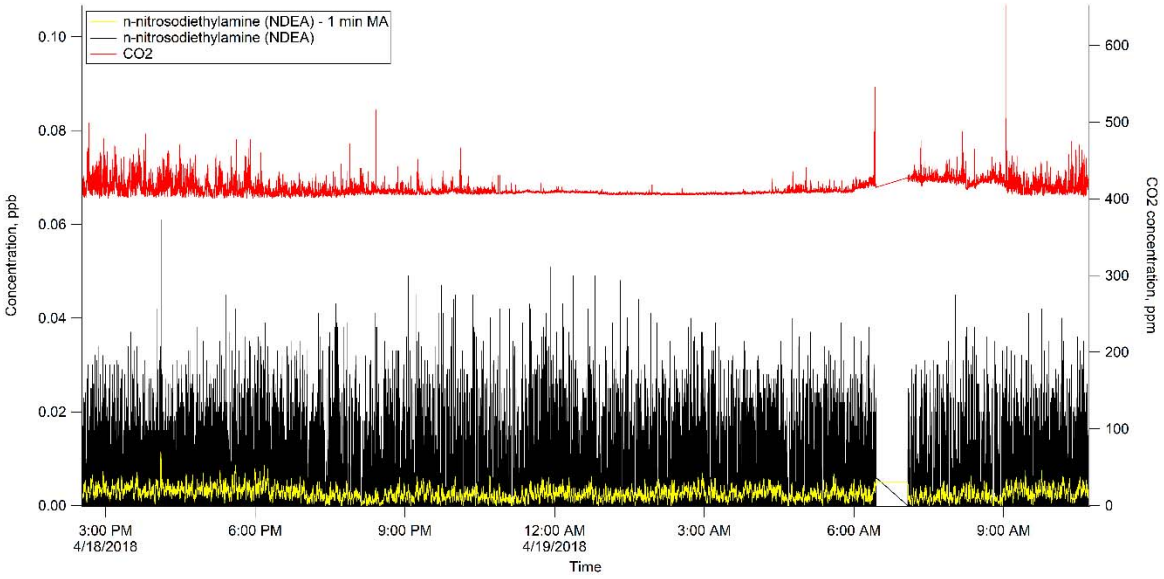


Figure 4-15. N-nitrosodiethylamine (NDEA).

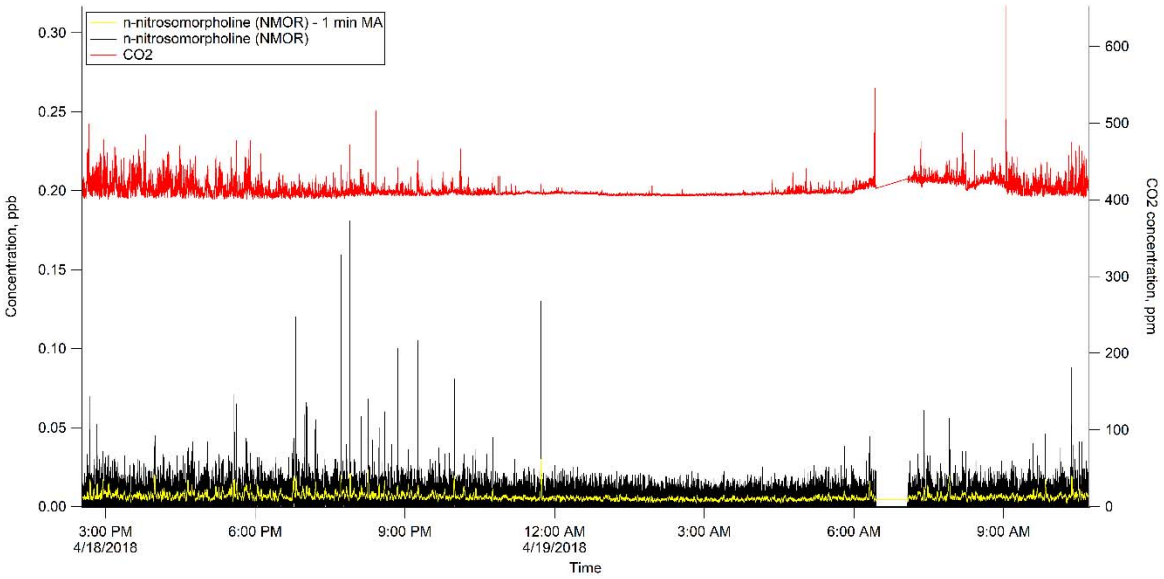


Figure 4-16. N-nitrosomorpholine (NMOR).

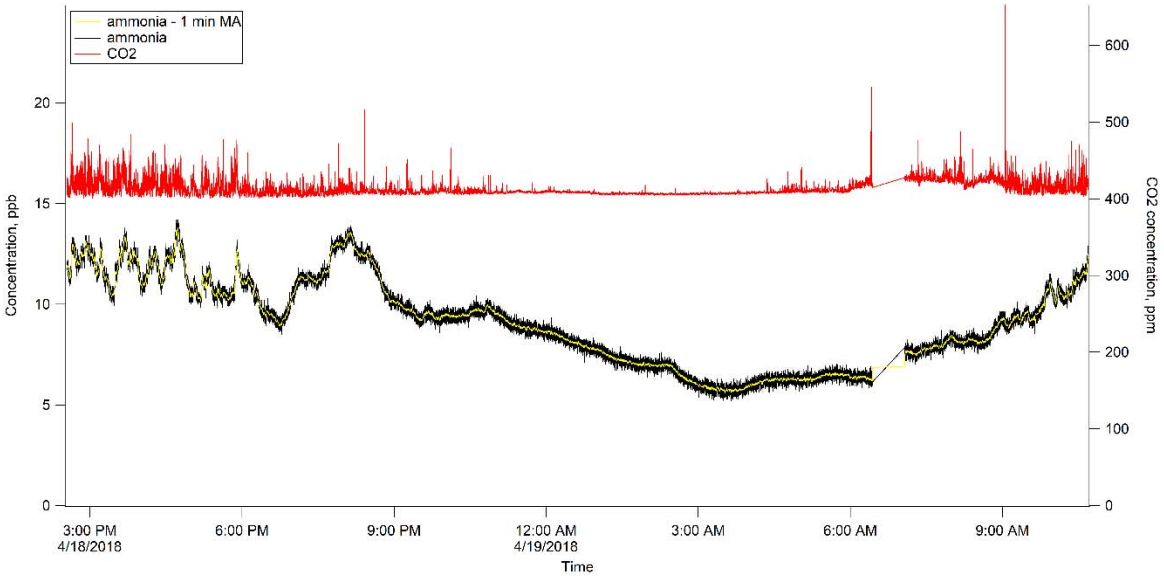


Figure 4-17. Ammonia.

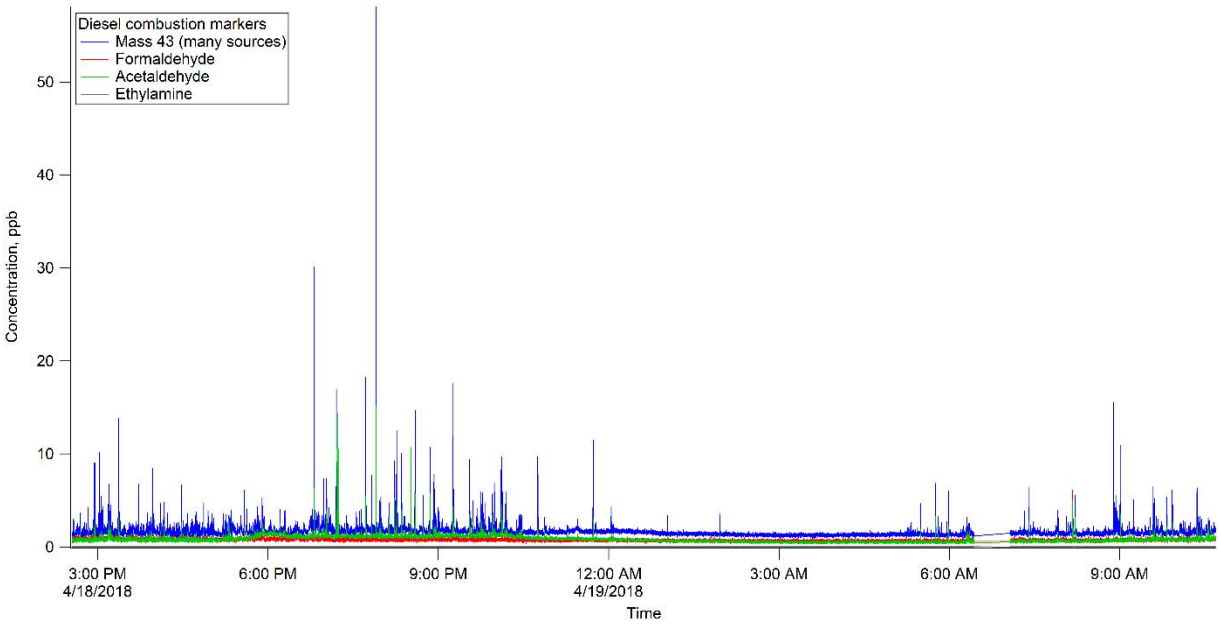


Figure 4-18. Diesel Combustion Markers.

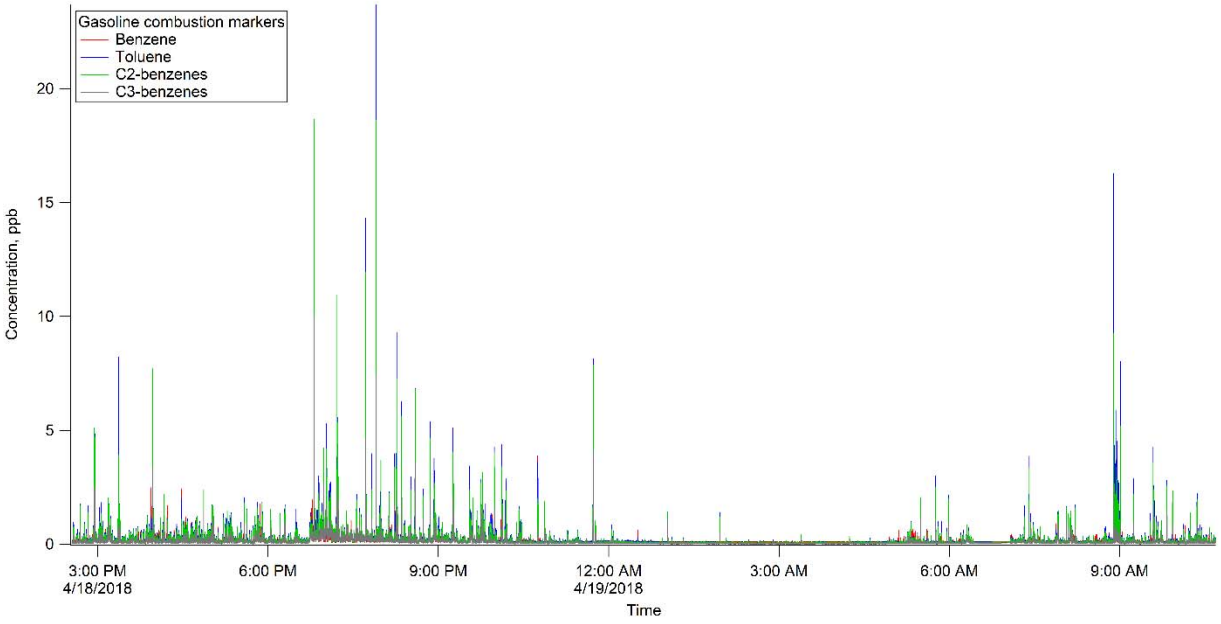


Figure 4-19. Gasoline Combustion Markers.

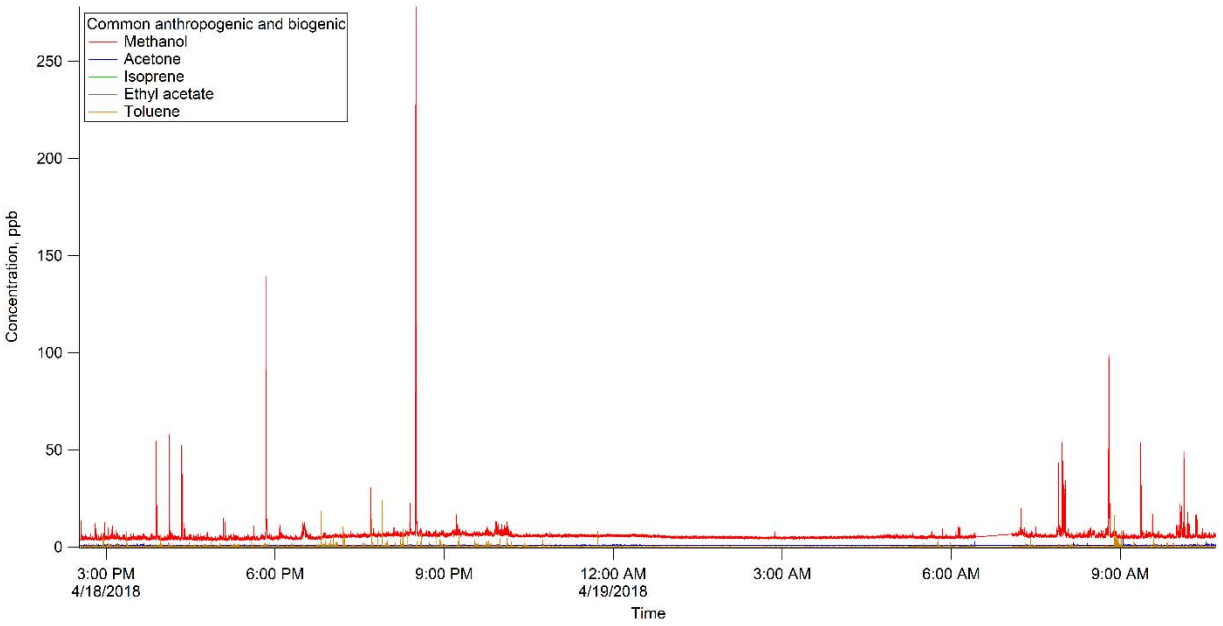


Figure 4-20. Plant and Human Markers.

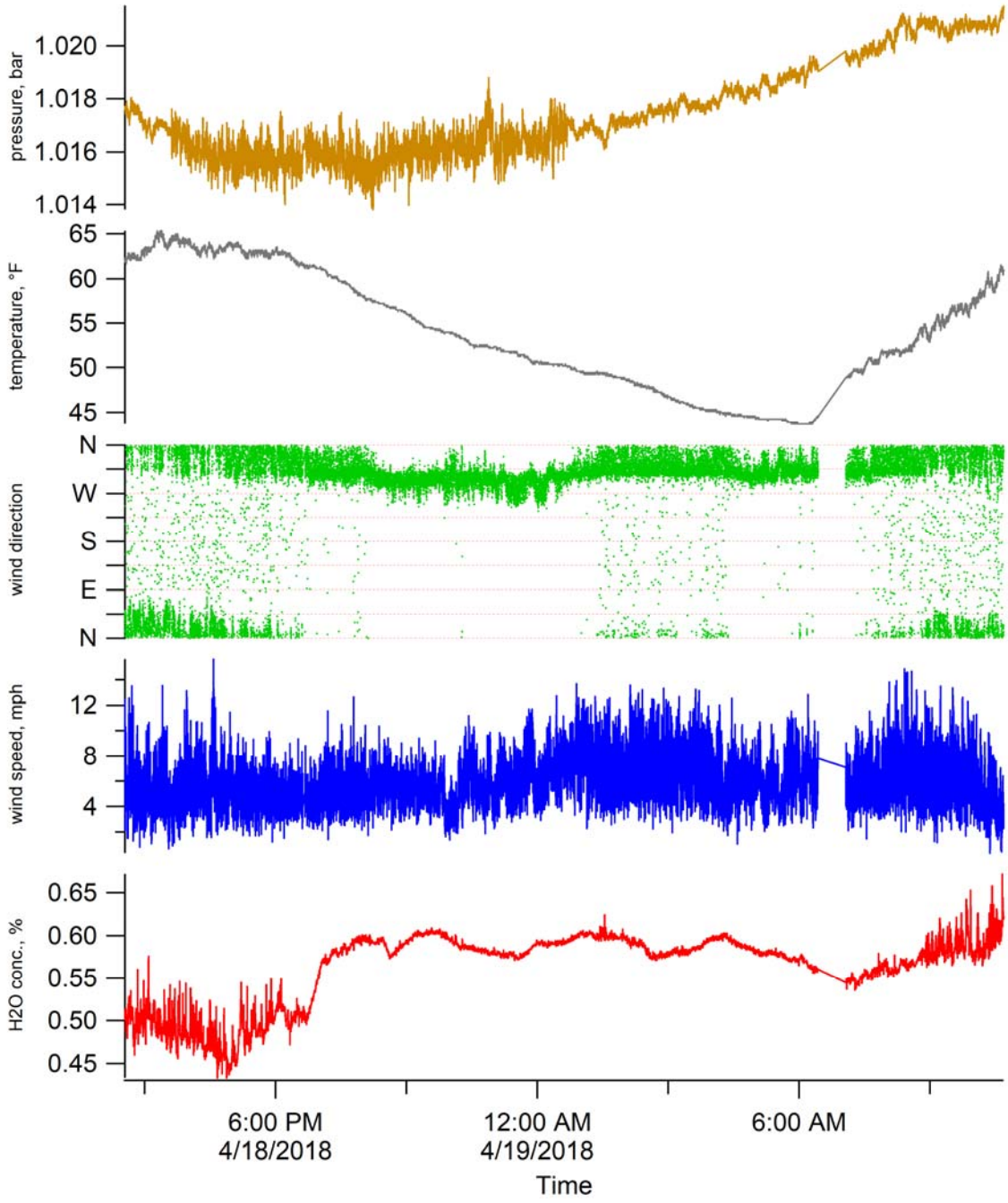


Figure 4-21. Weather Data.

5.0 APRIL 19, 2018 – APRIL 20, 2018 – STUDY SITE #4

5.1 Quality Assessment

Data from April 19, 2018, were transferred to TerraGraphics via the WRPS FTP site on April 23, 2018. Data were assessed using Procedure 17124-DOE-HS-102. A completed Data Exchange Checklist was sent to WRPS on April 25, 2018. The data were accepted by TerraGraphics with the following comments. All startup, shutdown, and calibration procedures were adequately documented and all other checks passed the acceptance limits.

5.2 Summary

The Mobile Laboratory personnel performed background sampling using the Mobile Laboratory from April 19, 2018, to April 20, 2018 at Study Site 4. Site 4 is located down wind of the AN Tank Farm. The Mobile Laboratory arrived at Site 4 at 13:30 on April 19, 2018. The initial QA/QC zero air/sensitivity checks were performed on the CO_2 monitor, NH_3 monitor, and the PTR-MS beginning at 13:38. The data file names were confirmed and routine data collection resumed by 14:31. The Mobile Laboratory staff departed the monitoring site after 15:00.

The Mobile Laboratory staff had returned to Site 4 at 06:30 on April 20, 2018, and began confirmatory sample collection by 06:45. Weather station lost satellite connection from 07:00 to 07:10. Light and variable winds at 07:30 prompted moving the exhaust line. Closeout zero air/sensitivity checks were performed at 10:33. The Mobile Laboratory moved to Site 1 by 11:30.



Figure 5-1. Mobile Lab Site #4 for the Duration of the Monitoring Period.

5.3 Samples Collected

Continuous air monitoring was performed using the following instrumentation:

- PTR-MS,
- LI-COR CO_2 Monitor,
- Picarro Ammonia Monitor, and
- Weather Station.

Confirmatory air samples were collected as follows:

Table 5-1. Alternative Media Samples Taken.

Site	Date	Sample Type	ID	Start	Stop	Sample Time (min)
4	19-Apr	Thermosorb/N	EL22220	13:46	16:47	180
4	19-Apr	CarboTrap-300	A022007	13:50	15:00	70
4	20-Apr	Thermosorb/N	EL22228	06:45	09:46	180
4	20-Apr	CarboTrap-300	A048371	06:48	07:58	70

Table 5-2 displays the statistical information for the monitoring period of April 19, 2018, to April 20, 2018. By definition, the OEL is an 8-hour, time-weighted average that establishes a limit for personnel exposures to hazardous chemicals. It is the exposure level to which a person may be exposed for 8 hours/day, 40 hours/week for 40 years and have no expectation of adverse health effects. In this study, area vapor concentration measurements were made to better understand the hazardous vapor exposures that workers may receive. These measurements are only compared to OEL concentrations to give them context. It is neither accurate nor appropriate to interpret these short duration measurements (2 seconds) as worker exposure levels. Since the OEL is defined as a time-weighted average, it is more appropriate to compare them to daily average vapor concentrations. Short duration excursions above the OEL concentration are not significant.

Table 5-2. Statistical Information for the Monitoring Period of April 19, 2018 – April 20, 2018.

COPC #	COPC Name	Reporting Limit (ppb)	OEL (ppb)	Ave. (ppb)	St. Dev. (ppb)	Rel. St. Dev. (%)	Max (ppb)	Median (ppb)	Sec. over 50% OEL	Sec. over OEL
1	ammonia	1	25000	5.88	1.421	24.2%	12.79	6.04	0	0
2	furan	0.09	1	0.045	0.014	74.6%	0.273	0.016	0	0
3	but-3-en-2-one + 2,3-dihydrofuran + 2,5-dihydrofuran	0.22	1	0.111	0.027	86.4%	N/A*	N/A*	N/A	N/A
4	NDMA**	0.06	0.3	0.038	0.029	100.1%	0.201	0.023	44	0
5	2-methylfuran	0.05	1	0.026	0.014	77.0%	0.357	0.016	0	0
6	NEMA	0.02	0.3	0.014	0.014	162.3%	0.099	0.000	0	0
7	2,5-dimethylfuran	0.05	1	0.026	0.012	84.8%	0.246	0.012	0	0
8	NDEA	0.01	0.1	0.007	0.007	197.1%	0.076	0.000	6	0
9	2-propylfuran + 2-ethyl-5-methylfuran	0.02	1	0.011	0.008	112.5%	0.101	0.005	0	0
10	NMOR	0.05	0.6	0.025	0.005	101.8%	0.065	0.004	0	0
11	2-ethyl-2-hexenal + 4-(1-methylpropyl)-2,3-dihydrofuran + 3-(1,1-dimethylethyl)-2,3-dihydrofuran	0.04	1	0.020	0.008	63.1%	0.162	0.012	0	0
12	2-pentylfuran	0.04	1	0.021	0.009	46.3%	0.237	0.018	0	0
13	2-heptylfuran	0.02	1	0.010	0.004	61.0%	0.052	0.006	0	0
14	2-octylfuran	0.01	1	0.005	0.002	208.6%	0.027	0.000	0	0
15	6-(2-furanyl)-6-methyl-2-heptanone	0.01	1	0.005	0.002	161.9%	0.017	0.000	0	0
16	furfural acetophenone	0.07	1	0.035	0.004	56.3%	0.027	0.005	0	0

* The maximum peak value for but-3-en-2-one + 2,3 dihydrofuran + 2,5 dihydrofuran was 0.848 ppb and the median value was 0.027 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 200, 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 each COPC signal, overlaid with the same signal smoothed using a 1-minute moving average, and CO_2, for the monitoring period April 19, 2018 to April 20, 2018.

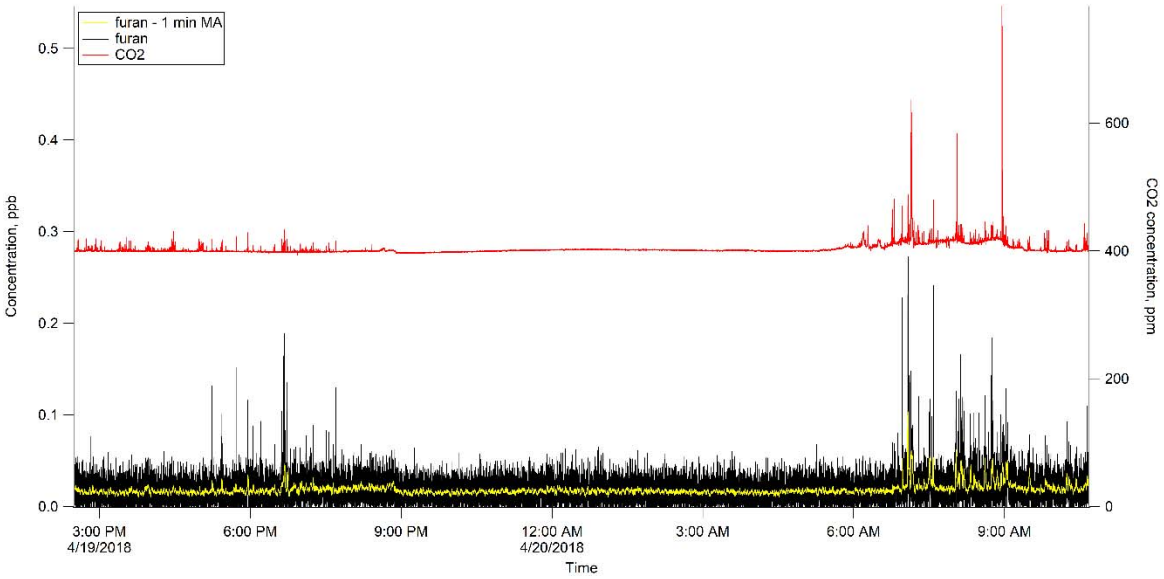


Figure 5-2. Furan.

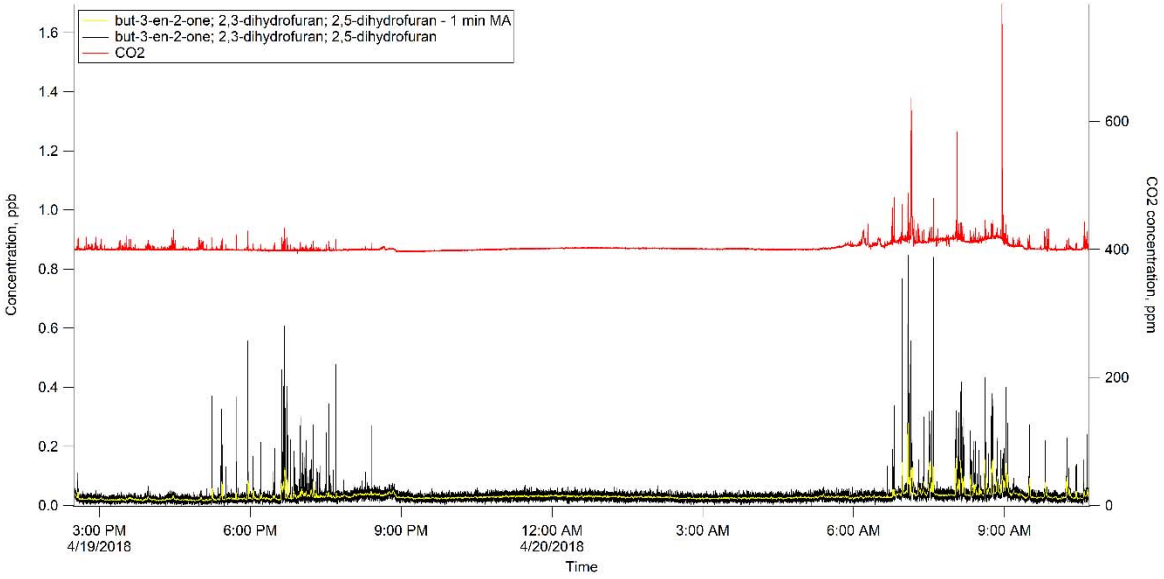


Figure 5-3. but-3-en-2-one + 2,3-dihydrofuran + 2,5-dihydrofuran.

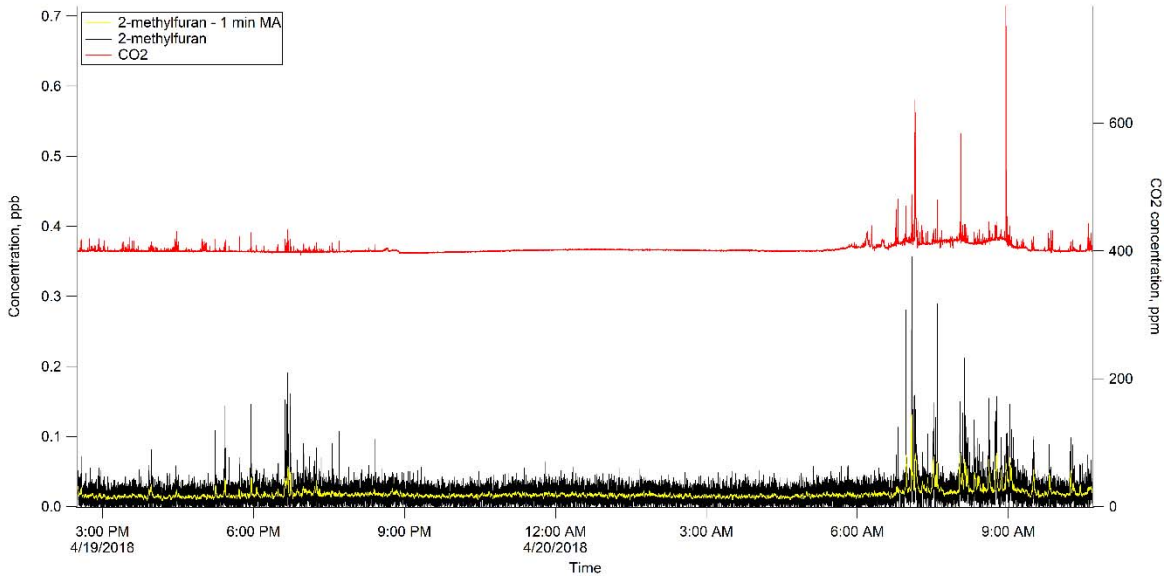


Figure 5-4. 2-methylfuran.

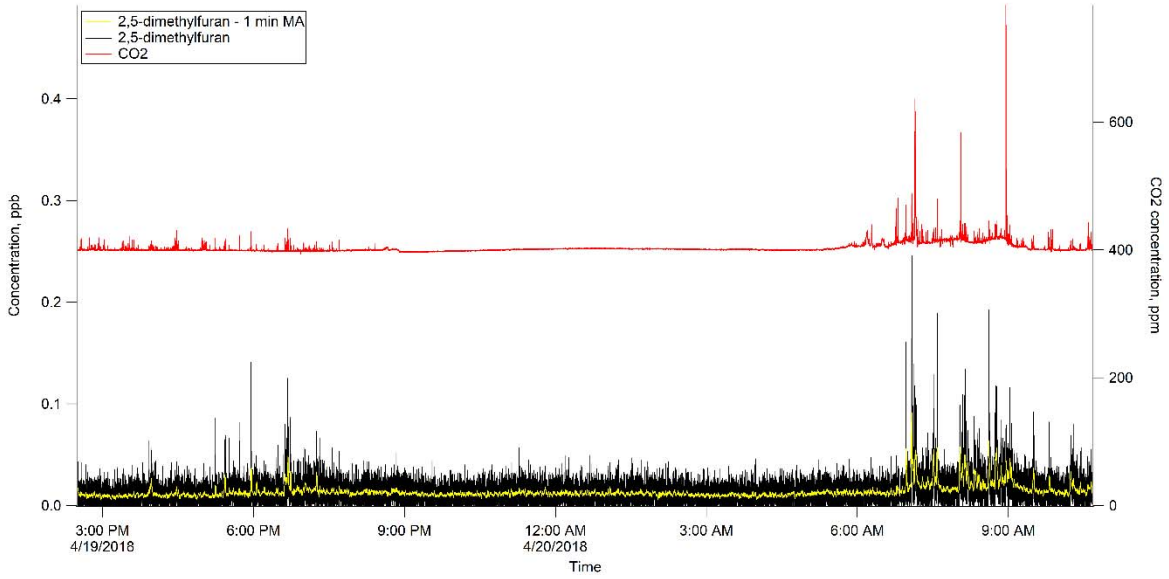


Figure 5-5. 2,5-dimethylfuran.

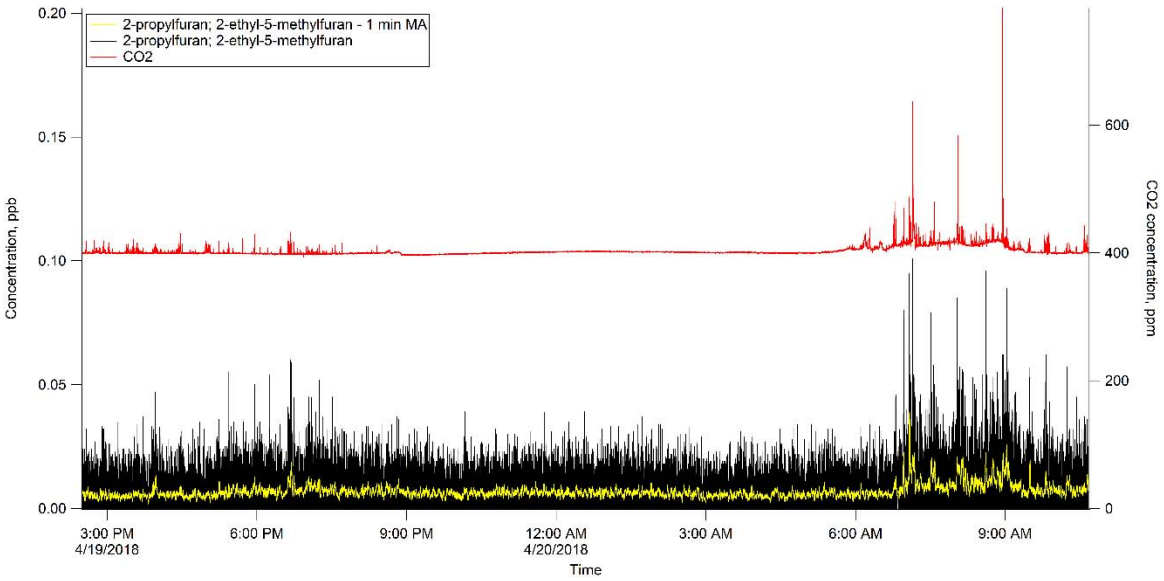


Figure 5-6. 2-propylfuran + 2-ethyl-5-methylfuran.

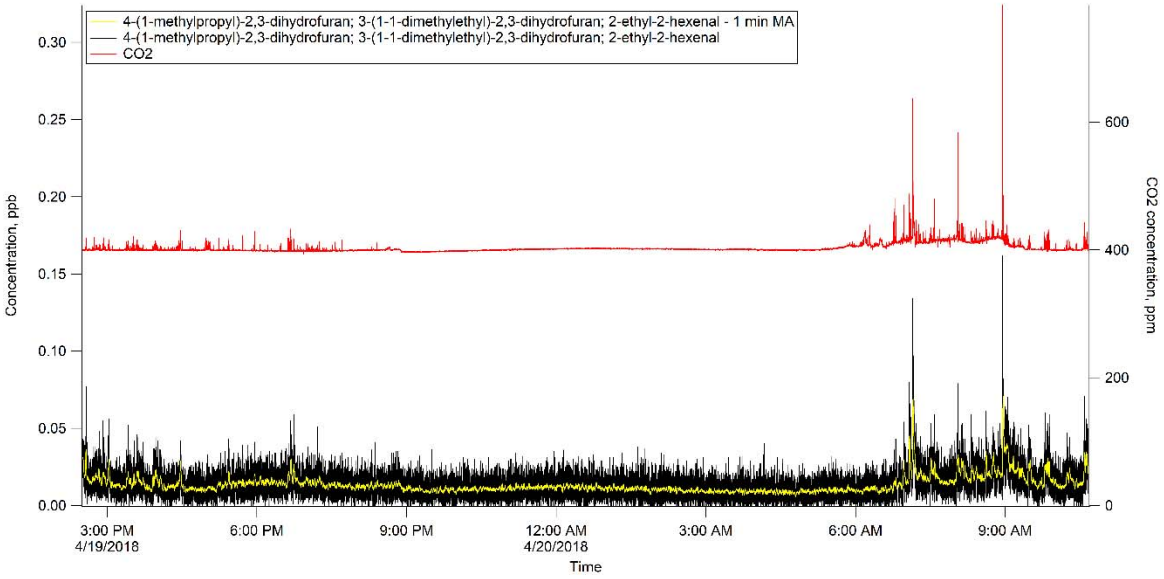


Figure 5-7. 4-(1-methylpropyl)-2,3-dihydrofuran + 3-(1-1-dimethylethyl)-2,3-dihydrofuran + 2-ethyl-2-hexenal.

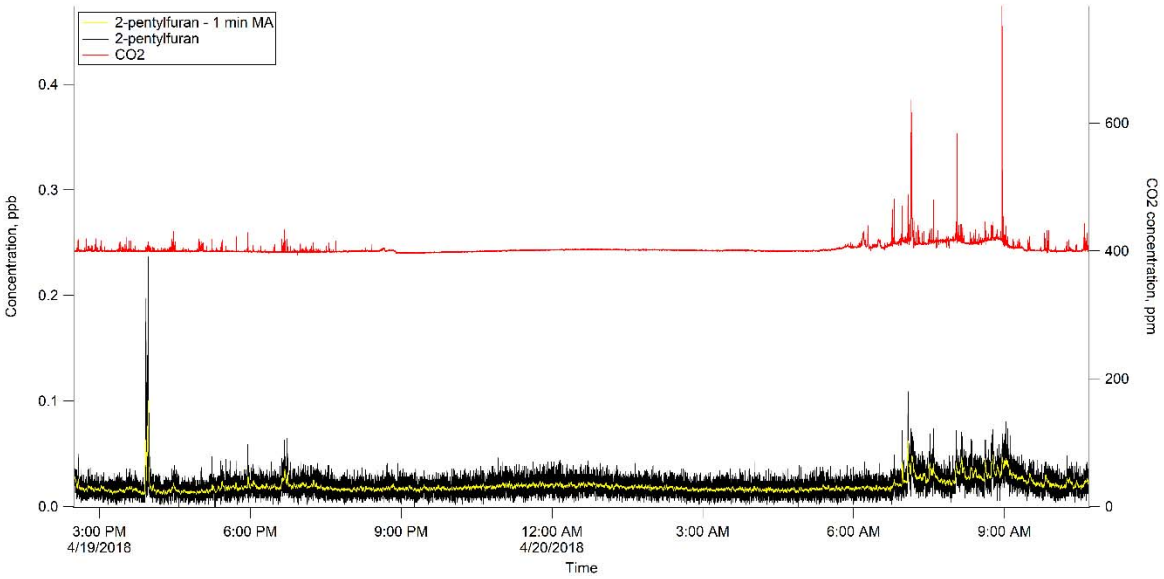


Figure 5-8. 2-pentylfuran.

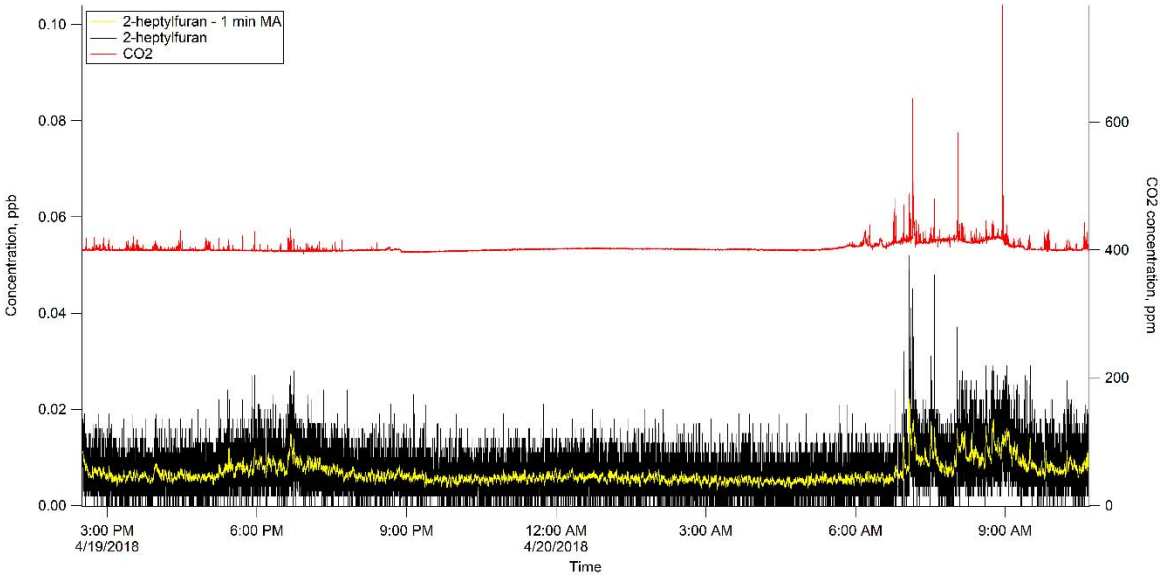


Figure 5-9. 2-heptylfuran.

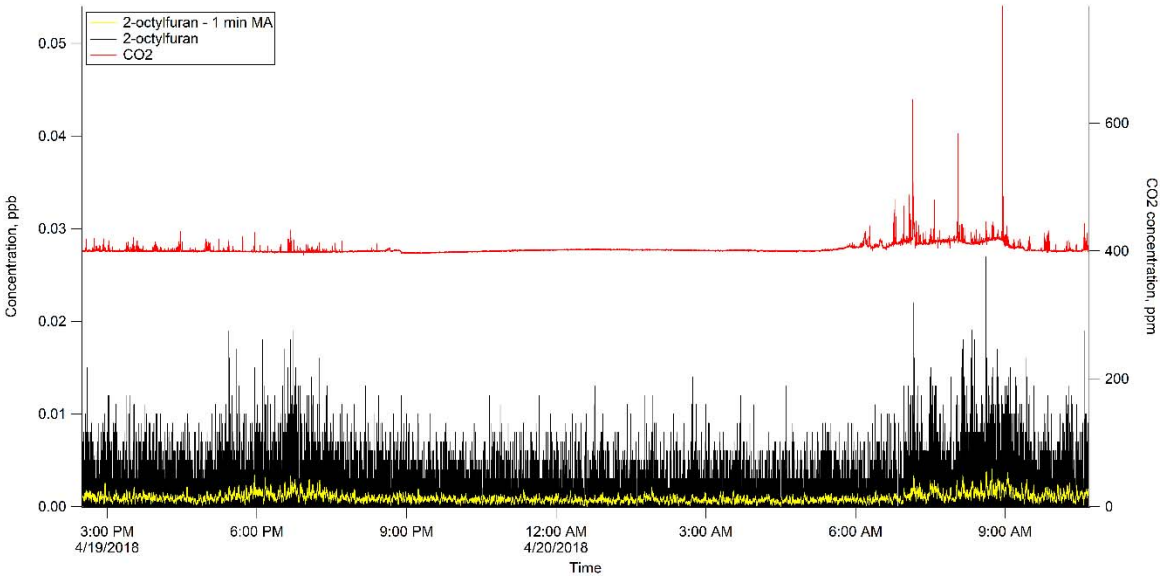


Figure 5-10. 2-octylfuran.

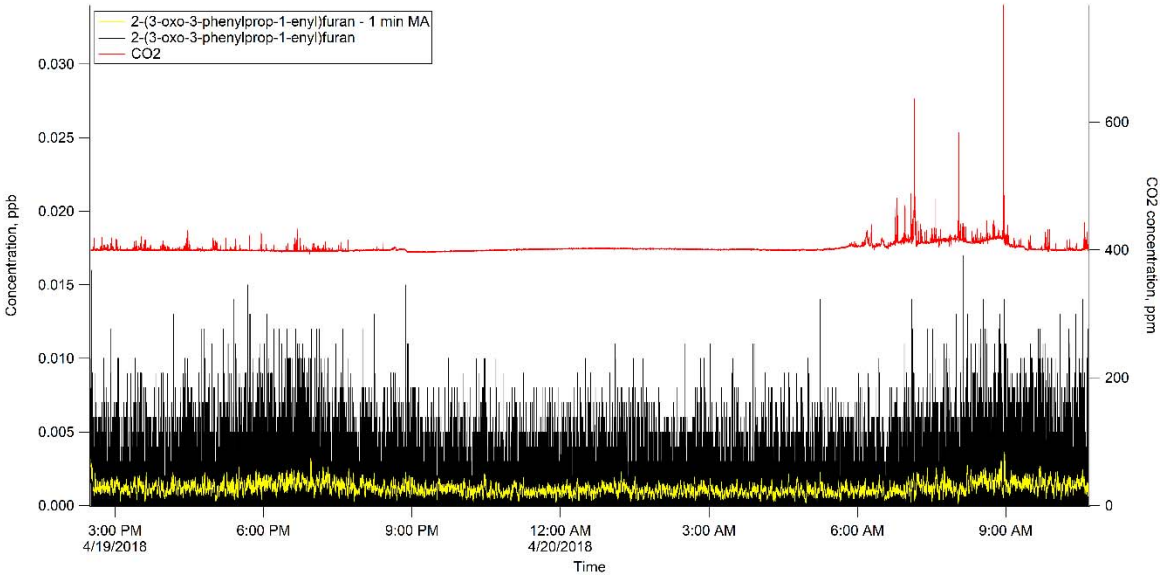


Figure 5-11. 2-(3-oxo-3-phenylprop-1-enyl)furan.

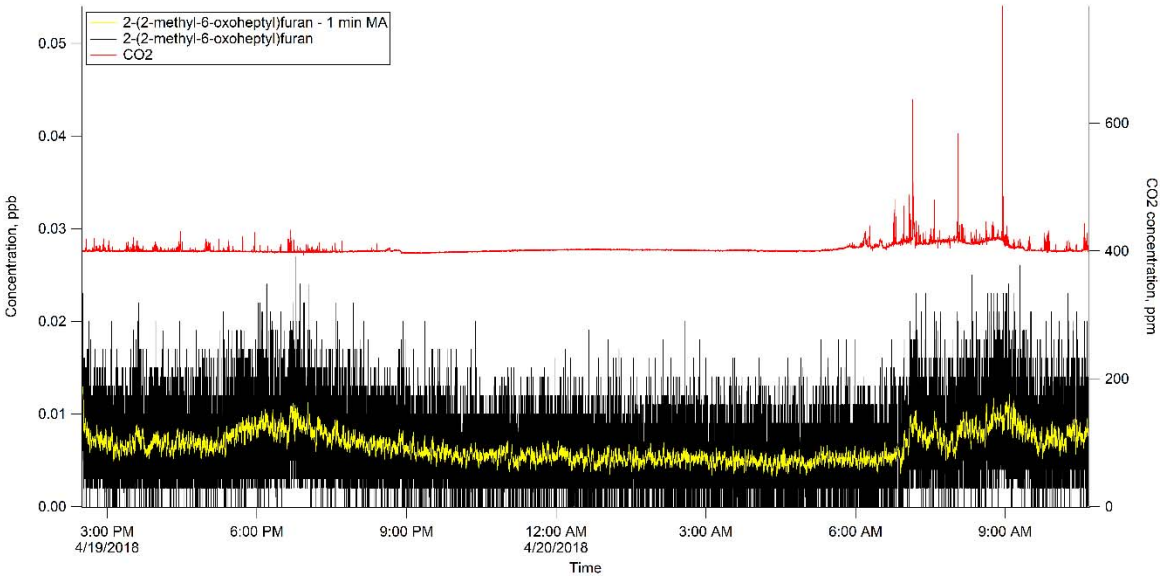


Figure 5-12. 2-(2-methyl-6-oxoheptyl)furan.

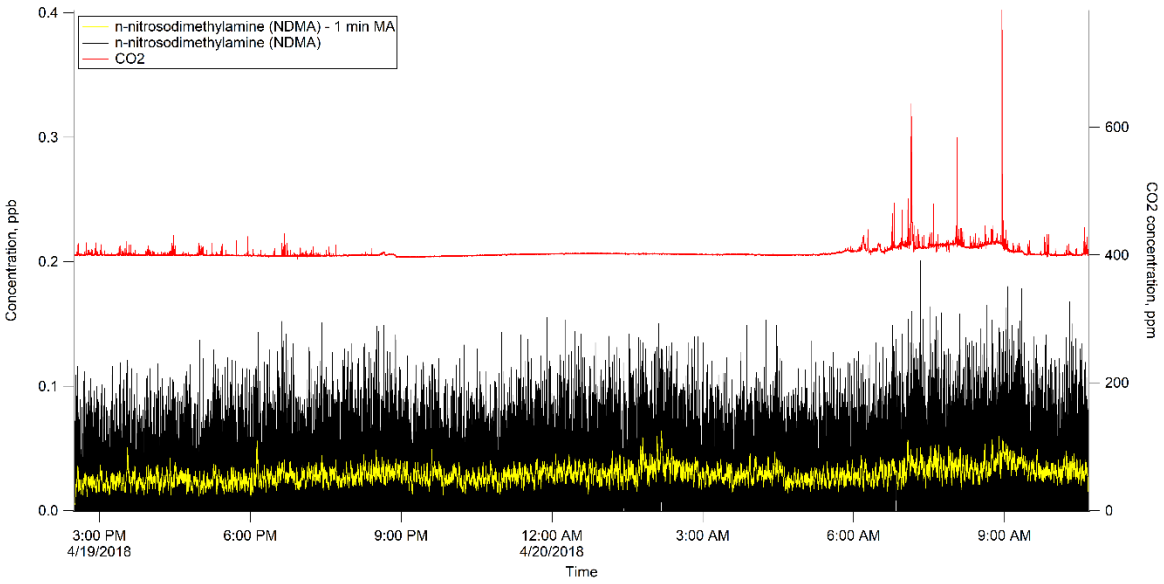


Figure 5-13. N-nitrosodimethylamine (NDMA).

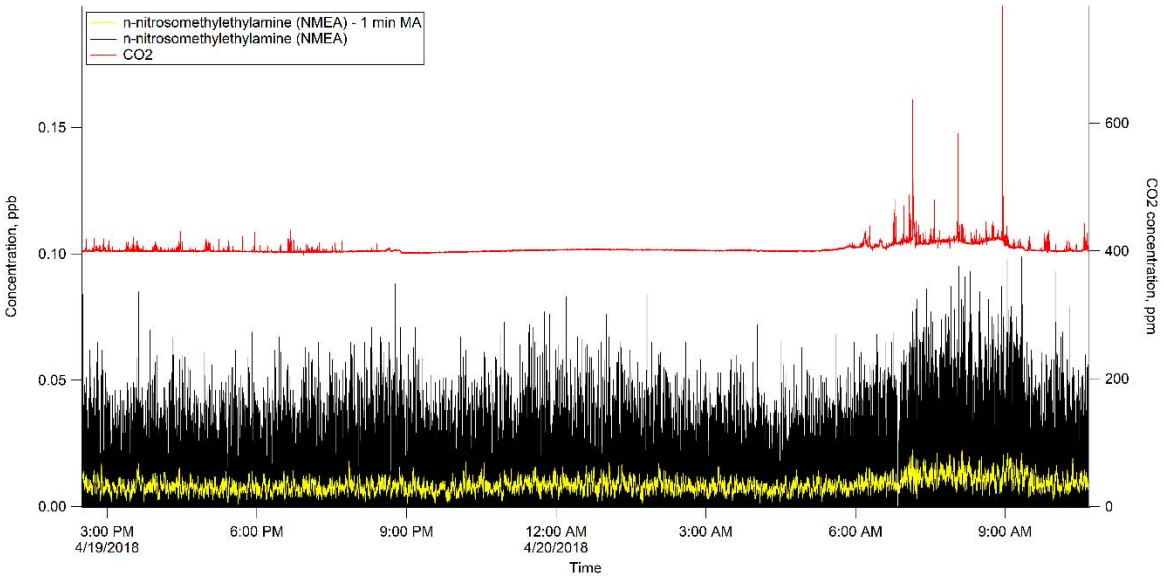


Figure 5-14. N-nitrosomethylethylamine (NMEA).

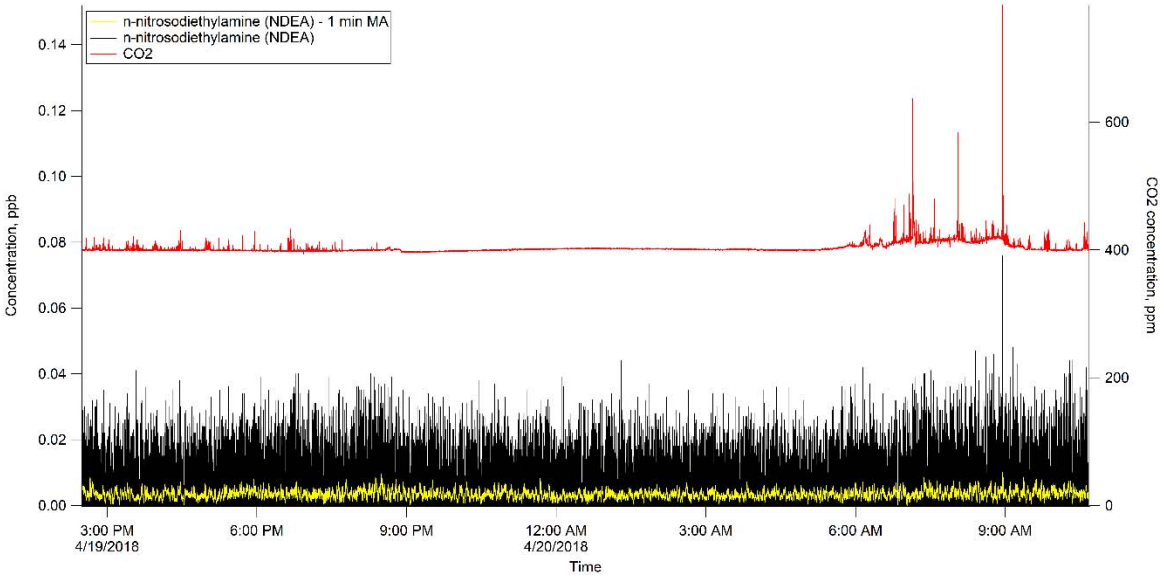


Figure 5-15. N-nitrosodiethylamine (NDEA).

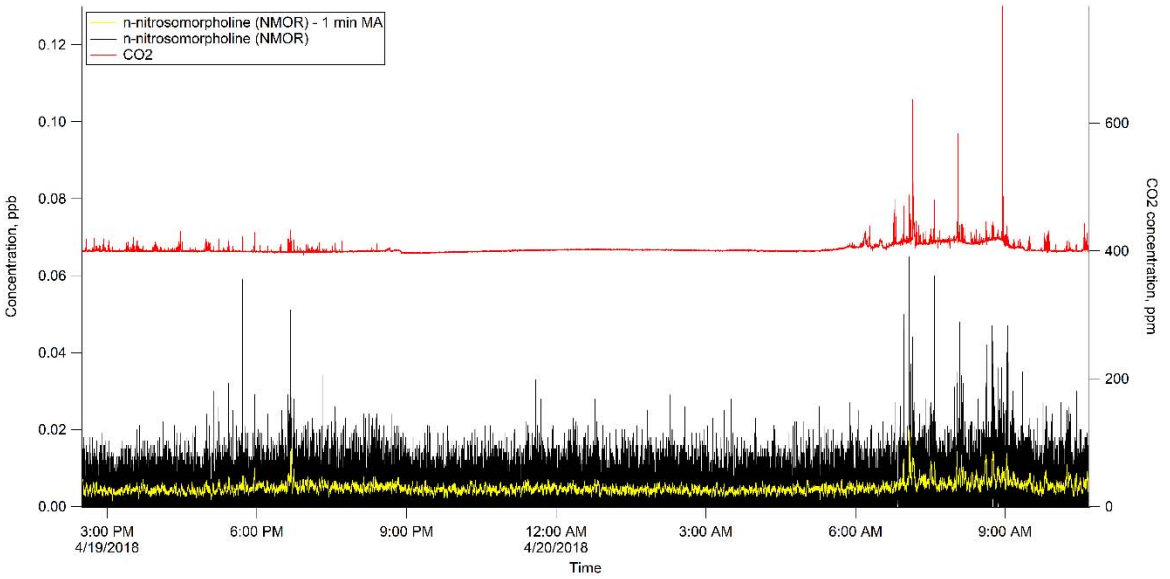


Figure 5-16. N-nitrosomorpholine (NMOR).

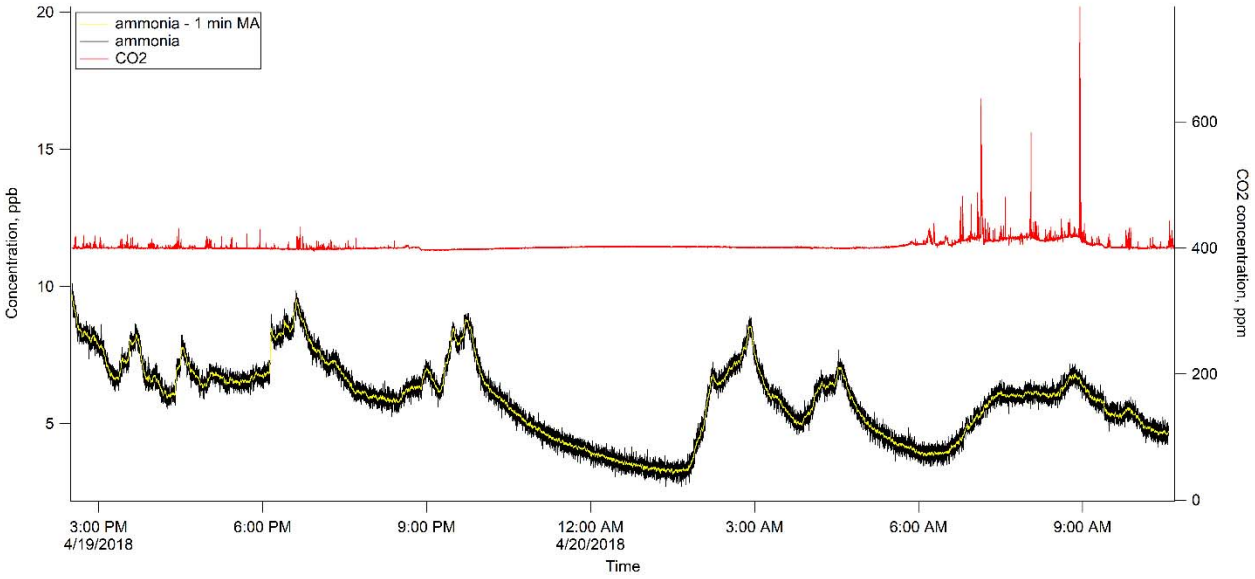


Figure 5-17. Ammonia.

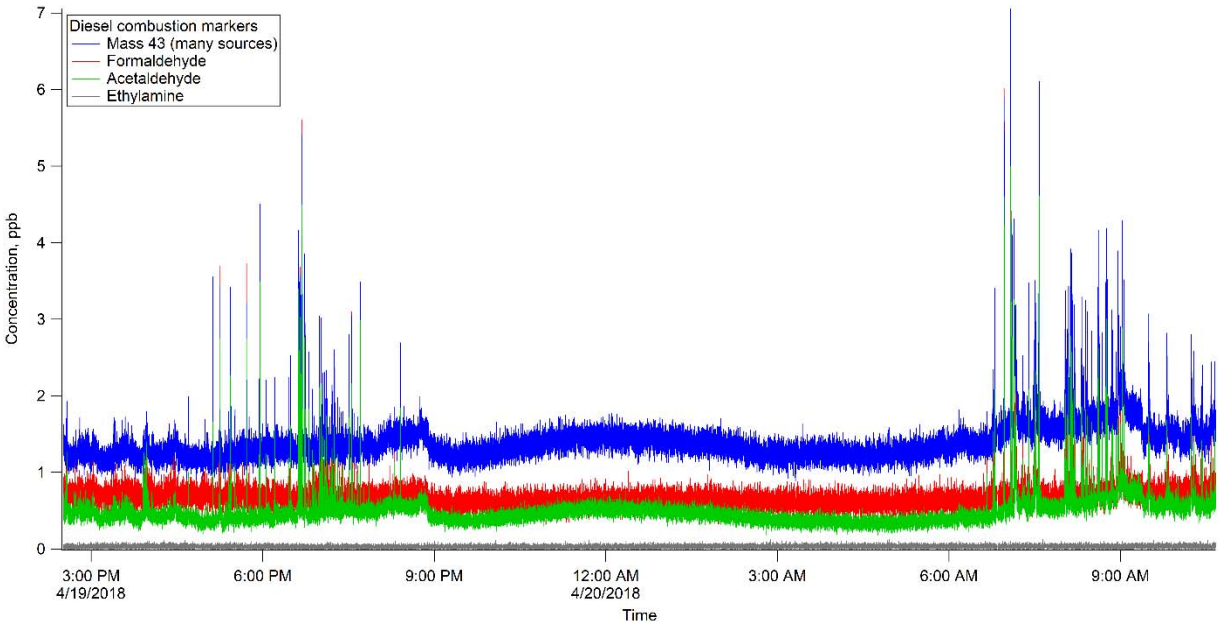


Figure 5-18. Diesel Combustion Markers.

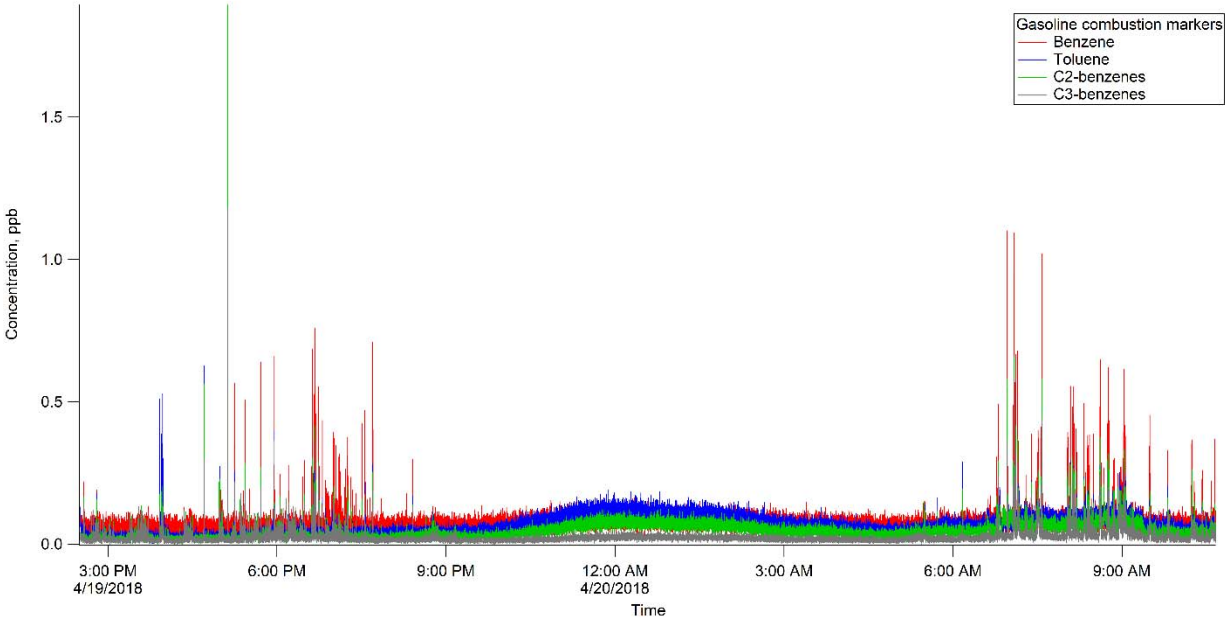


Figure 5-19. Gasoline Combustion Markers.

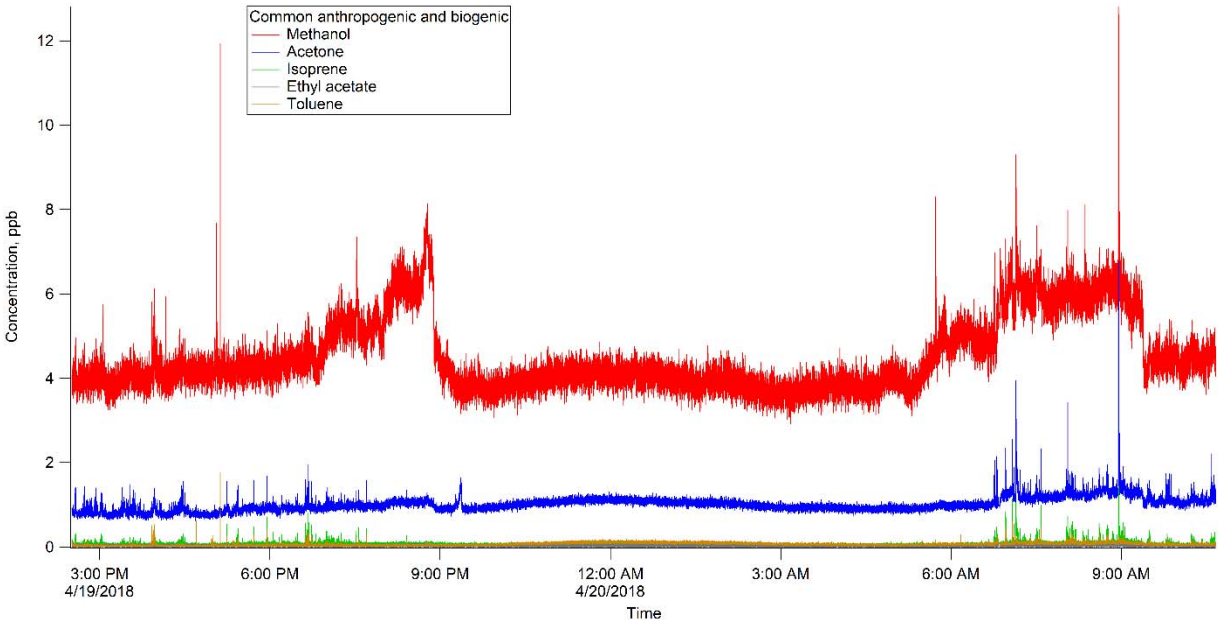


Figure 5-20. Plant and Human Markers.

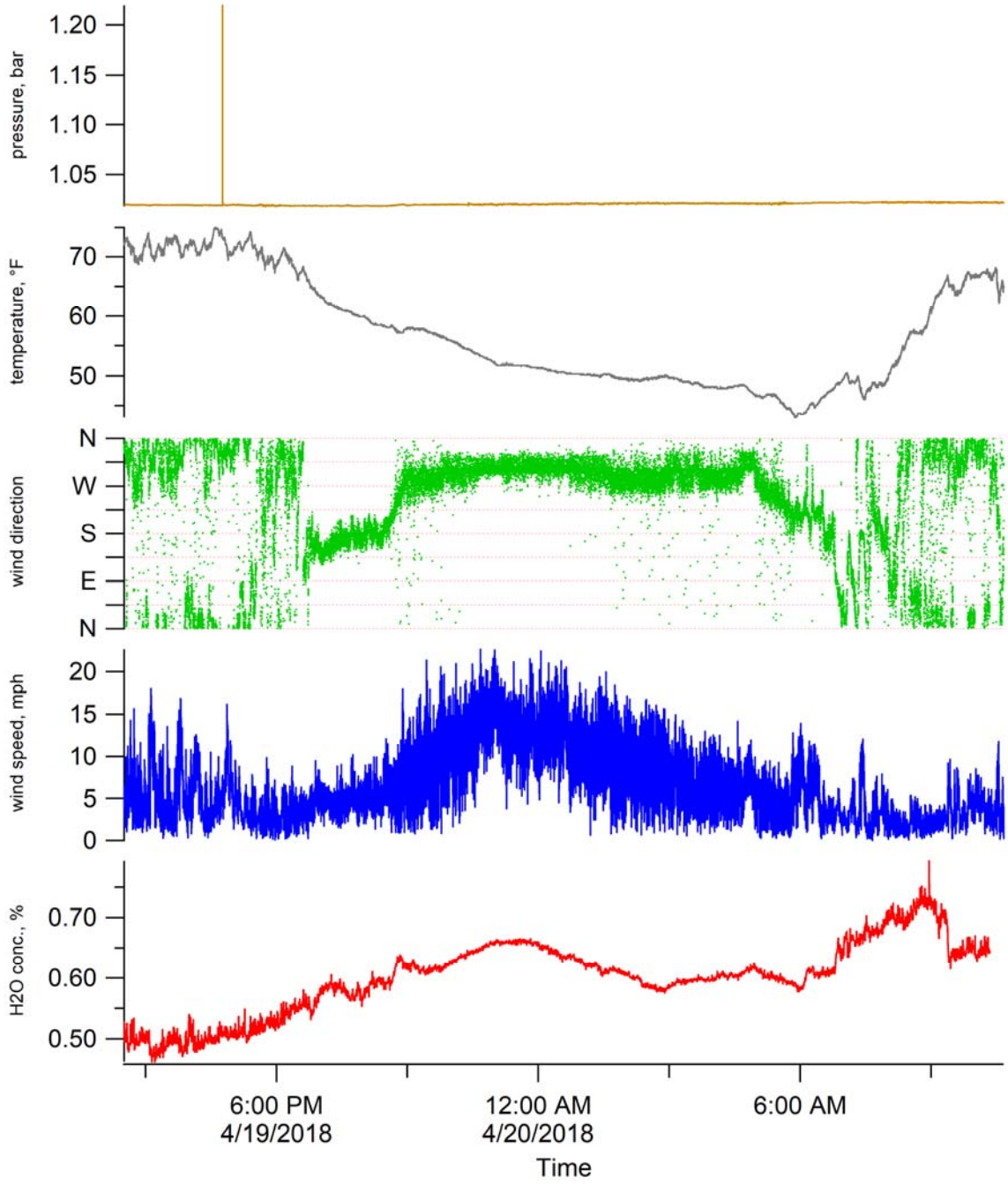


Figure 5-21. Weather Data.

6.0 APRIL 20, 2018 – APRIL 21, 2018 – STUDY SITE #1

6.1 Quality Assessment

Data from April 20, 2018, were transferred to TerraGraphics via the WRPS FTP site on April 23, 2018. Data were assessed using Procedure 17124-DOE-HS-102. A completed Data Exchange Checklist was sent to WRPS on April 25, 2018. The data were accepted by TerraGraphics with the following comments. All startup, shutdown, and calibration procedures were adequately documented and all other checks passed the acceptance limits.

6.2 Summary

The Mobile Laboratory personnel performed background sampling using the Mobile Laboratory from April 20, 2018, to April 21, 2018, at Study Site 1. Site 1 is located on the plateau northwest of the 200W Tank Farm operations. This is an upwind site from the central Hanford Plateau. The Mobile Laboratory arrived at Site 1 at 11:30 on April 20, 2018. The initial QA/QC zero air/sensitivity checks were performed on the CO_2 monitor, NH_3 monitor, and the PTR-MS beginning at 11:30. The data file names were confirmed and routine data collection resumed by 13:02. At 13:20, light and variable winds prompted moving the exhaust line. The Mobile Laboratory staff departed the monitoring site at 15:00.

The Mobile Laboratory staff returned to Site 1 at 06:37 on April 21, 2018, and began confirmatory sample collection by 06:50. Closeout zero air/sensitivity checks were performed at 10:40. The Mobile Laboratory concluded the background study at 11:32 on April 21, 2018.

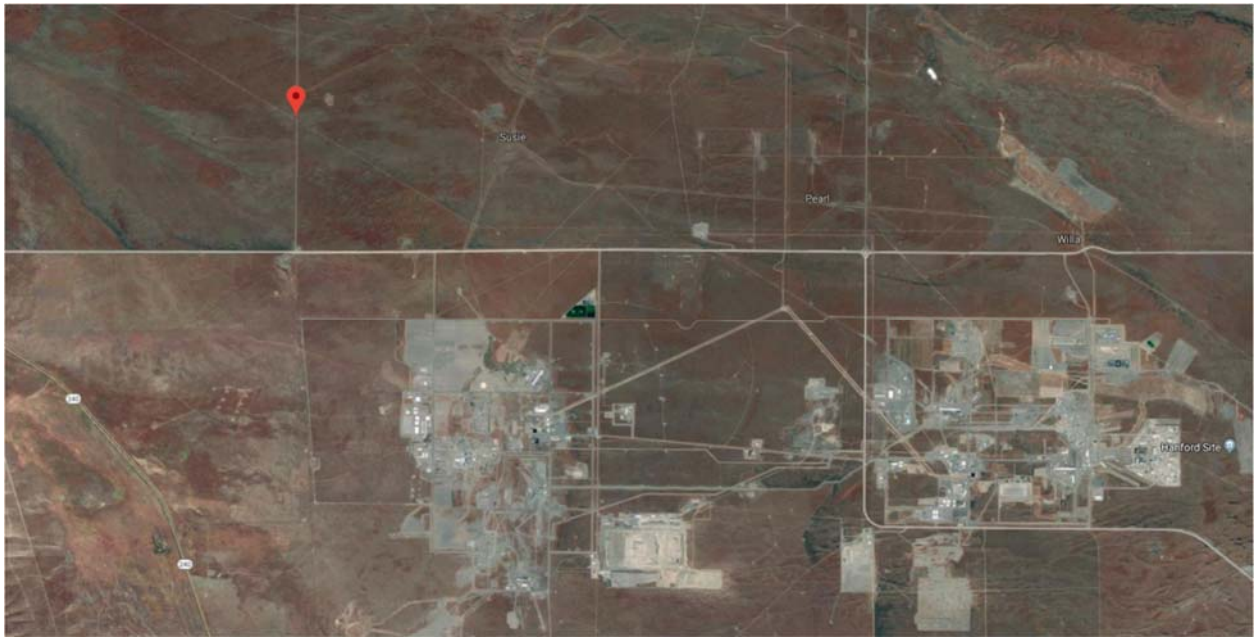


Figure 6-1. Mobile Lab Site #1 for the Duration of the Monitoring Period.

6.3 Samples Collected

Continuous air monitoring was performed using the following instrumentation:

- PTR-MS,
- LI-COR CO_2 Monitor,
- Picarro Ammonia Monitor, and
- Weather Station.

Confirmatory air samples were collected as follows:

Table 6-1. Alternative Media Samples Taken.

Site	Date	Sample Type	ID	Start	Stop	Sample Time (min)
1	20-Apr	Thermosorb/N	EL22229	11:38	14:40	180
1	20-Apr	CarboTrap-300	A048112	12:32	13:43	71
1	21-Apr	Thermosorb/N	EL22222	06:50	09:54	182
1	21-Apr	CarboTrap-300	A021978	06:56	08:37	99

Table 6-2 displays the statistical information for the monitoring period of April 20, 2018, to April 21, 2018. By definition, the OEL is an 8-hour, time-weighted average that establishes a limit for personnel exposures to hazardous chemicals. It is the exposure level to which a person may be exposed for 8 hours/day, 40 hours/week for 40 years and have no expectation of adverse health effects. In this study, area vapor concentration measurements were made to better understand the hazardous vapor exposures that workers may receive. These measurements are only compared to OEL concentrations to give them context. It is neither accurate nor appropriate to interpret these short duration measurements (2 seconds) as worker exposure levels. Since the OEL is defined as a time-weighted average, it is more appropriate to compare them to daily average vapor concentrations. Short duration excursions above the OEL concentration are not significant.

Table 6-2. Statistical Information for the Monitoring Period of April 20, 2018 – April 21, 2018.

COPC #	COPC Name	Reporting Limit (ppb)	OEL (ppb)	Ave. (ppb)	St. Dev. (ppb)	Rel. St. Dev. (%)	Max (ppb)	Median (ppb)	Sec. over 50% OEL	Sec. over OEL
1	ammonia	1	25000	5.15	1.790	34.7%	18.90	4.75	0	0
2	furan	0.09	1	0.045	0.015	80.7%	0.299	0.016	0	0
3	but-3-en-2-one + 2,3-dihydrofuran + 2,5-dihydrofuran	0.22	1	0.111	0.032	96.1%	N/A*	N/A*	N/A	N/A
4	NDMA**	0.06	0.3	0.038	0.030	107.0%	0.240	0.021	260	0
5	2-methylfuran	0.05	1	0.026	0.014	81.1%	0.346	0.015	0	0
6	NEMA	0.02	0.3	0.014	0.014	166.3%	0.111	0.000	0	0
7	2,5-dimethylfuran	0.05	1	0.025	0.012	87.8%	0.260	0.011	0	0
8	NDEA	0.01	0.1	0.007	0.007	193.4%	0.058	0.000	6	0
9	2-propylfuran + 2-ethyl-5-methylfuran	0.02	1	0.011	0.008	111.7%	0.107	0.005	0	0
10	NMOR	0.05	0.6	0.025	0.005	109.8%	0.095	0.003	0	0
11	2-ethyl-2-hexenal + 4-(1-methylpropyl)-2,3-dihydrofuran + 3-(1,1-dimethylethyl)-2,3-dihydrofuran	0.04	1	0.020	0.008	74.3%	0.103	0.010	0	0
12	2-pentylfuran	0.04	1	0.020	0.008	45.7%	0.141	0.016	0	0
13	2-heptylfuran	0.02	1	0.010	0.004	64.9%	0.051	0.005	0	0
14	2-octylfuran	0.01	1	0.005	0.002	211.9%	0.025	0.000	0	0
15	6-(2-furanyl)-6-methyl-2-heptanone	0.01	1	0.005	0.002	160.7%	0.016	0.000	0	0
16	furfural acetophenone	0.07	1	0.035	0.004	59.0%	0.030	0.006	0	0

* The maximum peak value for but-3-en-2-one + 2,3 dihydrofuran + 2,5 dihydrofuran was 0.902 ppb and the median value was 0.026 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 200, 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 each COPC signal, overlaid with the same signal smoothed using a 1-minute moving average, and CO_2, for the monitoring period April 20, 2018 to April 21, 2018.

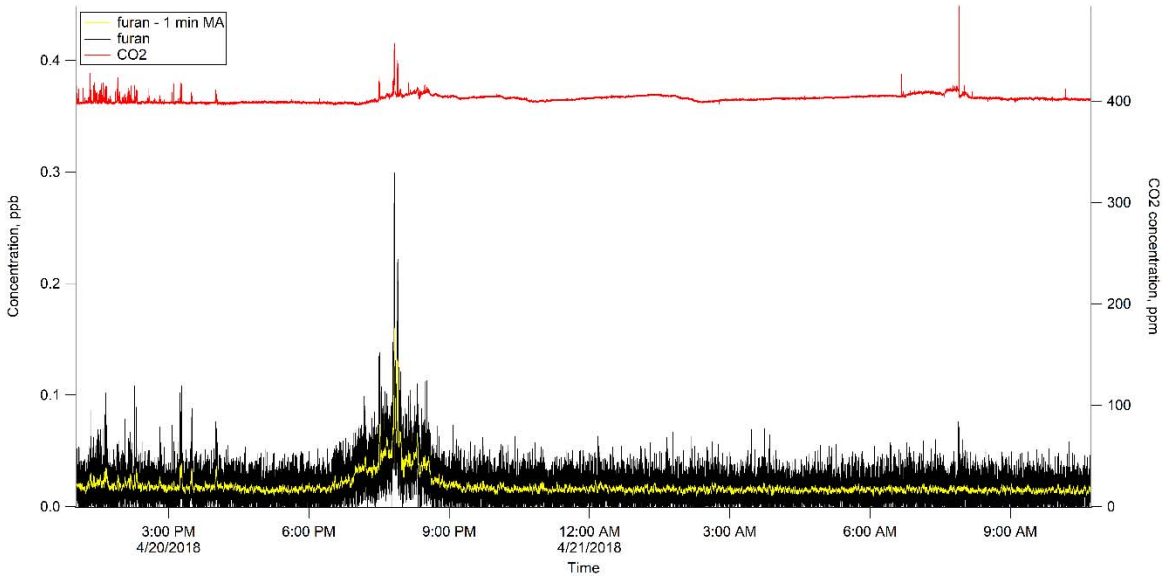


Figure 6-2. Furan.

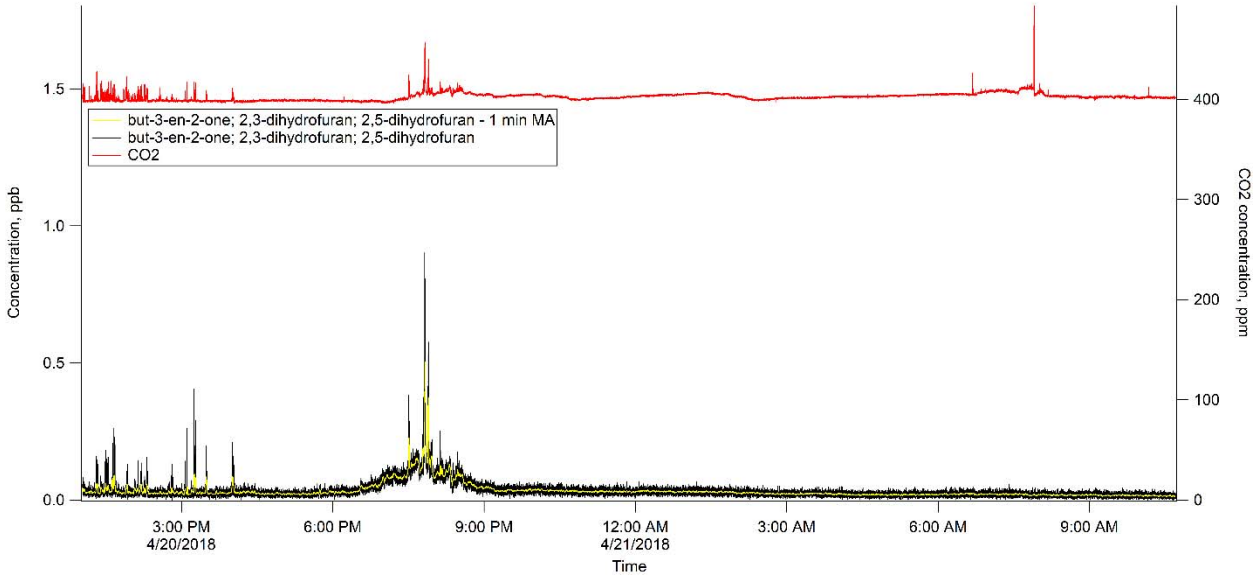


Figure 6-3. but-3-en-2-one + 2,3-dihydrofuran + 2,5-dihydrofuran.

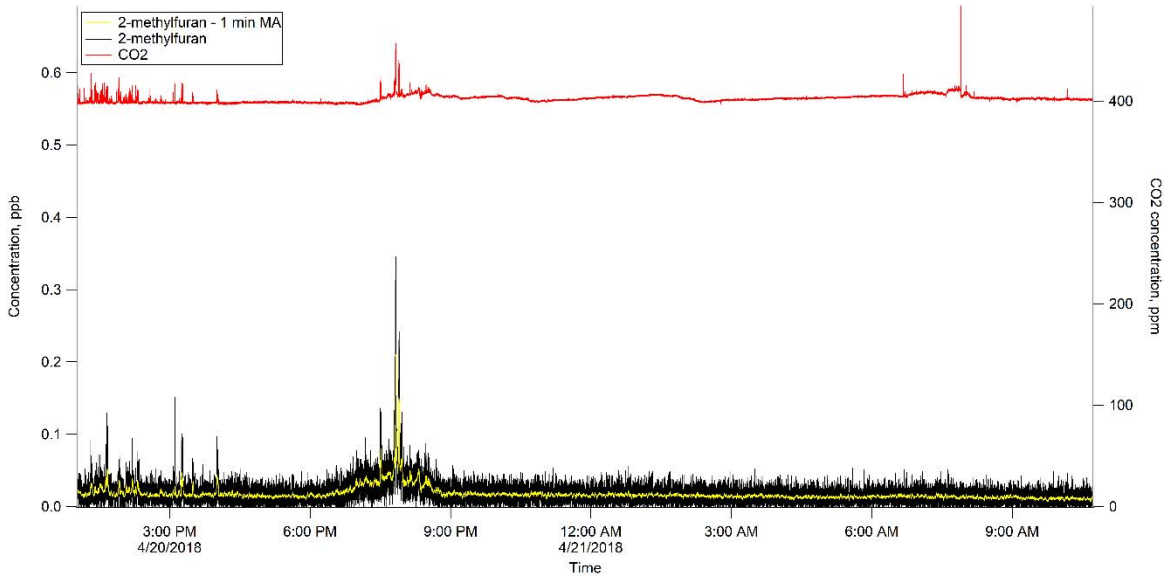


Figure 6-4. 2-methylfuran.

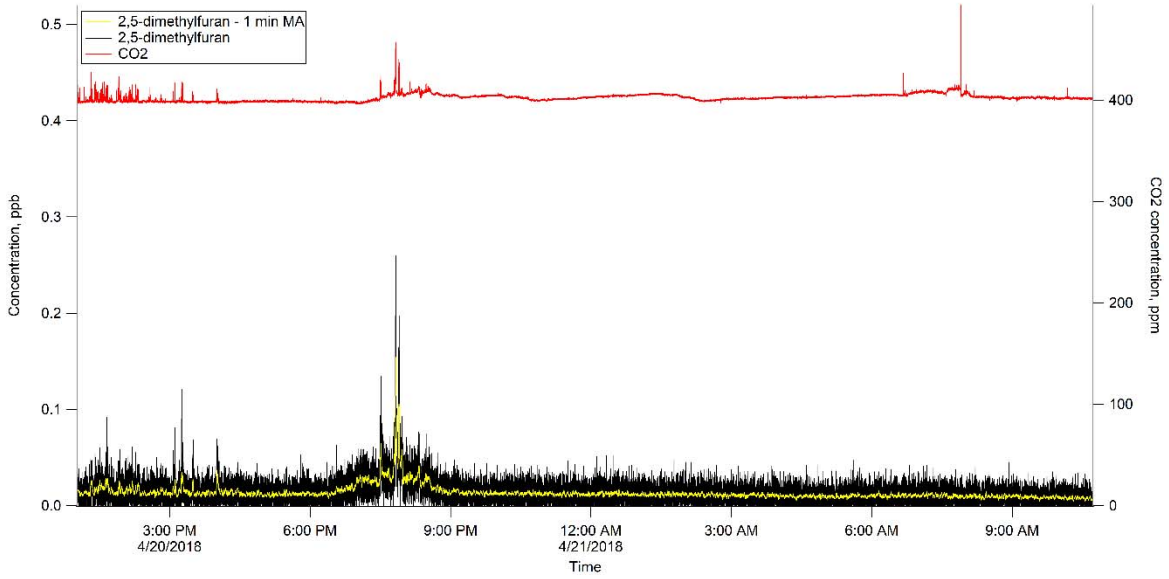


Figure 6-5. 2,5-dimethylfuran.

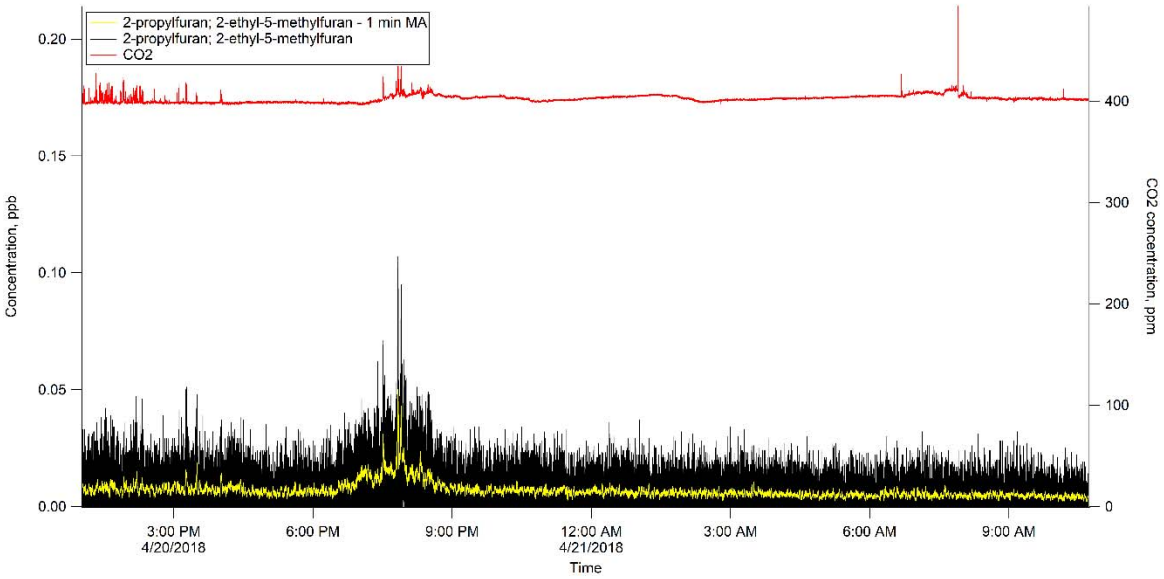


Figure 6-6. 2-propylfuran + 2-ethyl-5-methylfuran.

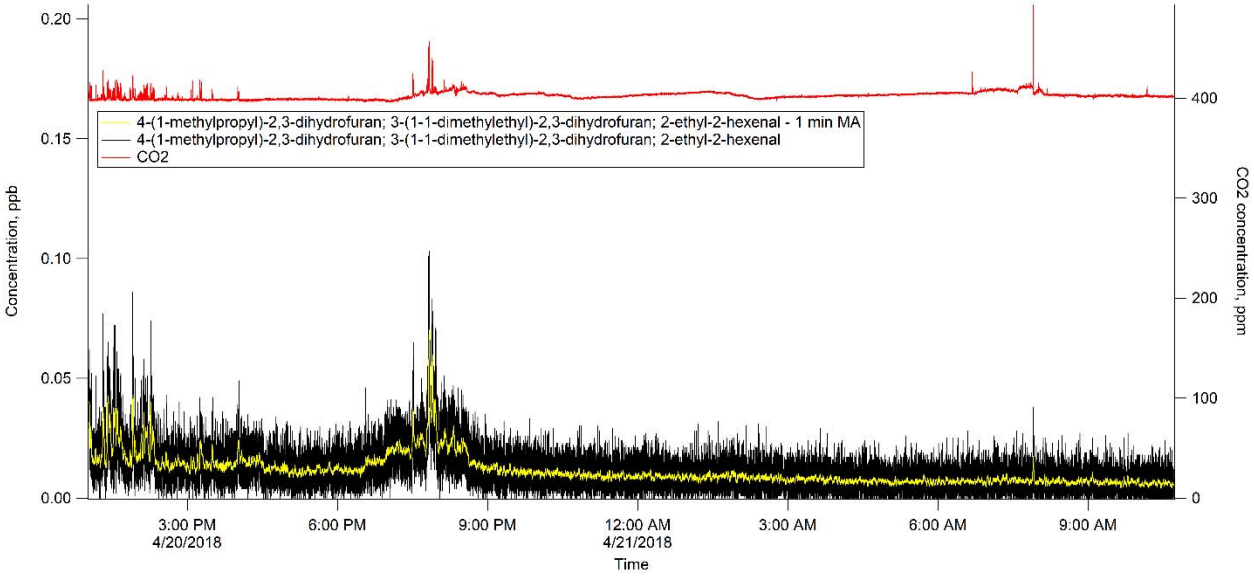


Figure 6-7. 4-(1-methylpropyl)-2,3-dihydrofuran + 3-(1-1-dimethylethyl)-2,3-dihydrofuran + 2-ethyl-2-hexenal.

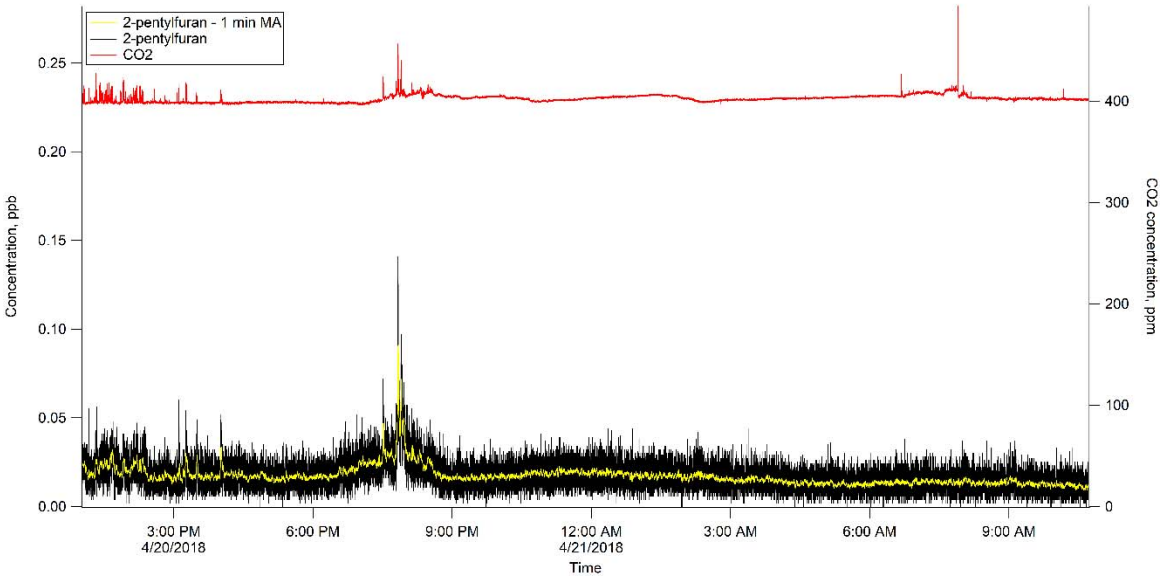


Figure 6-8. 2-pentylfuran.

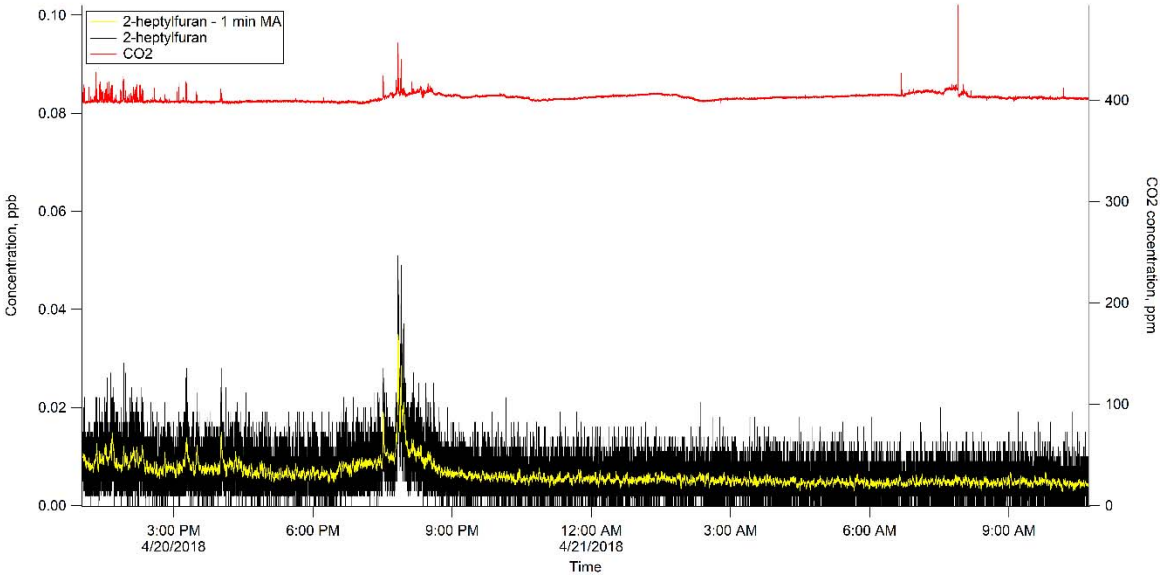


Figure 6-9. 2-heptylfuran.

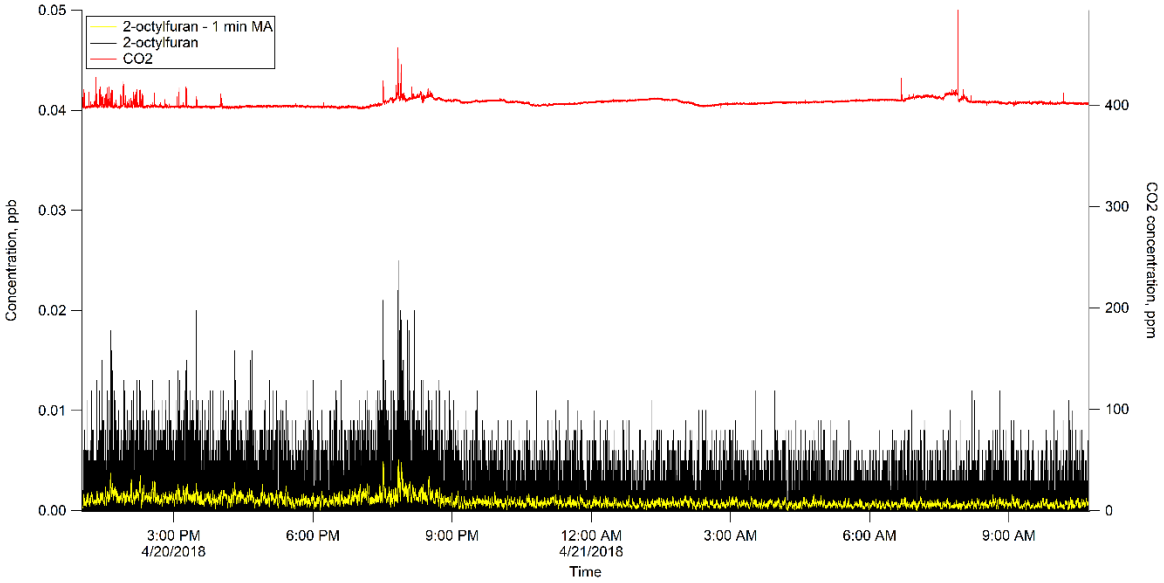


Figure 6-10. 2-octylfuran.

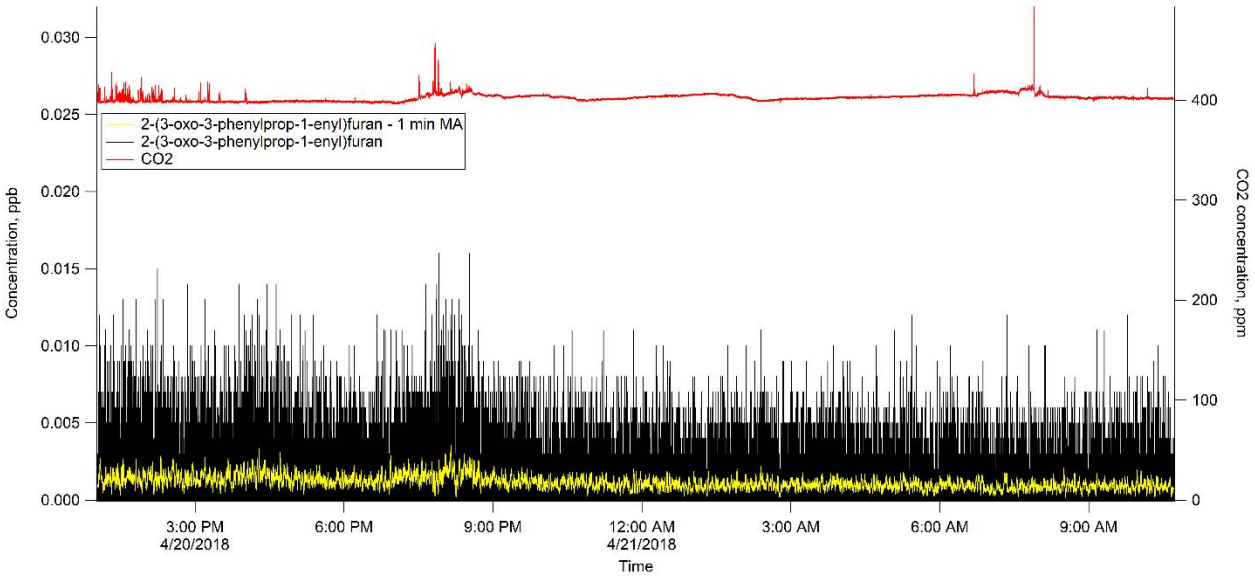


Figure 6-11. 2-(3-oxo-3-phenylprop-1-enyl)furan.

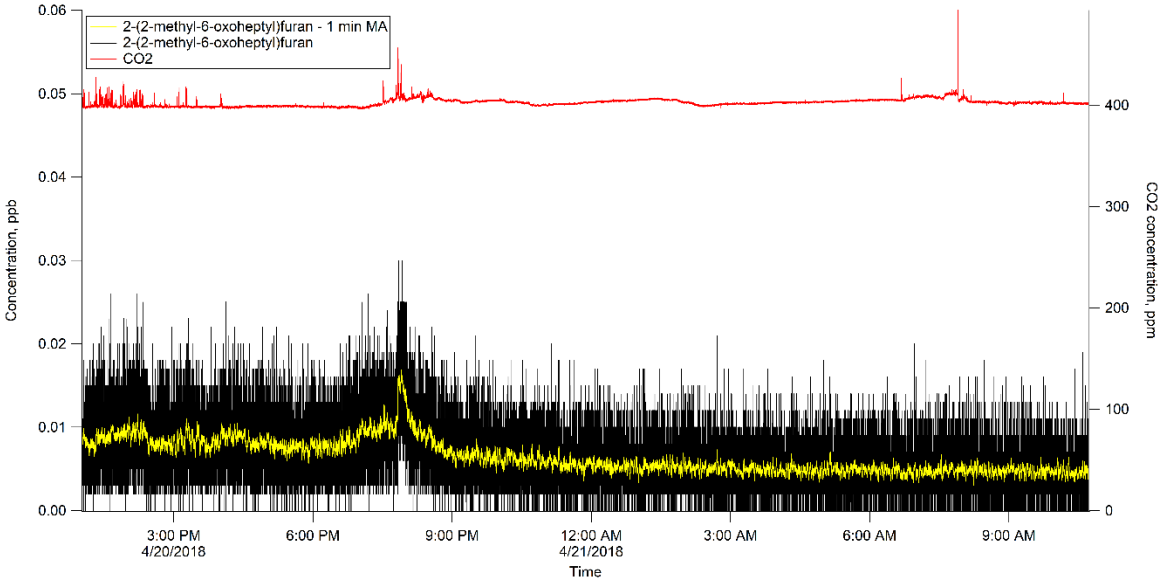


Figure 6-12. 2-(2-methyl-6-oxoheptyl)furan.

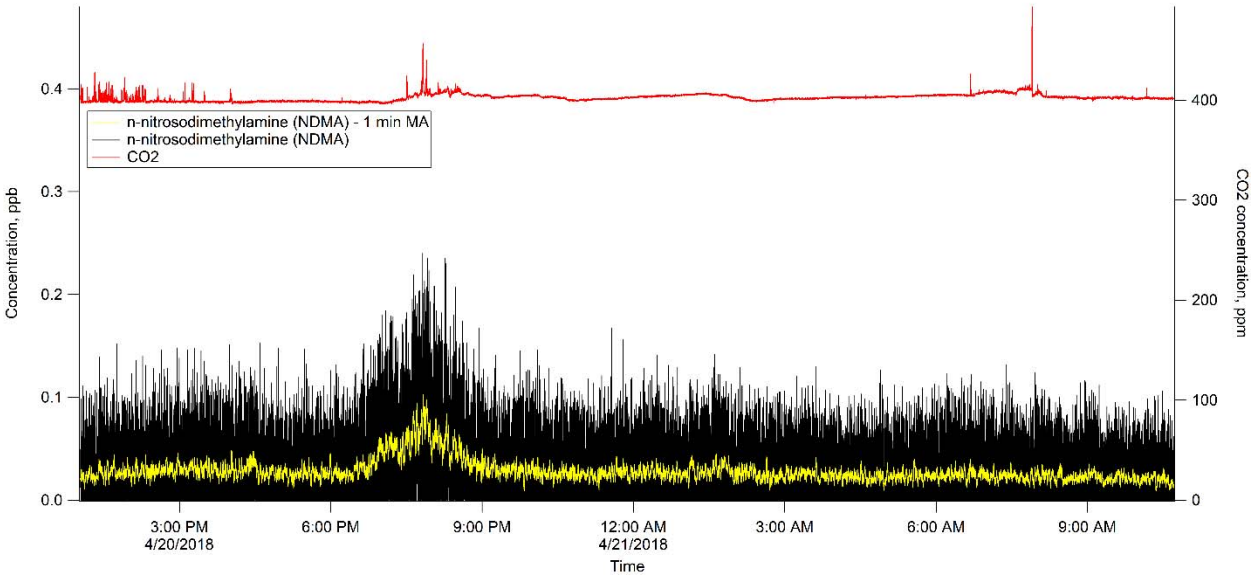


Figure 6-13. N-nitrosodimethylamine (NDMA).

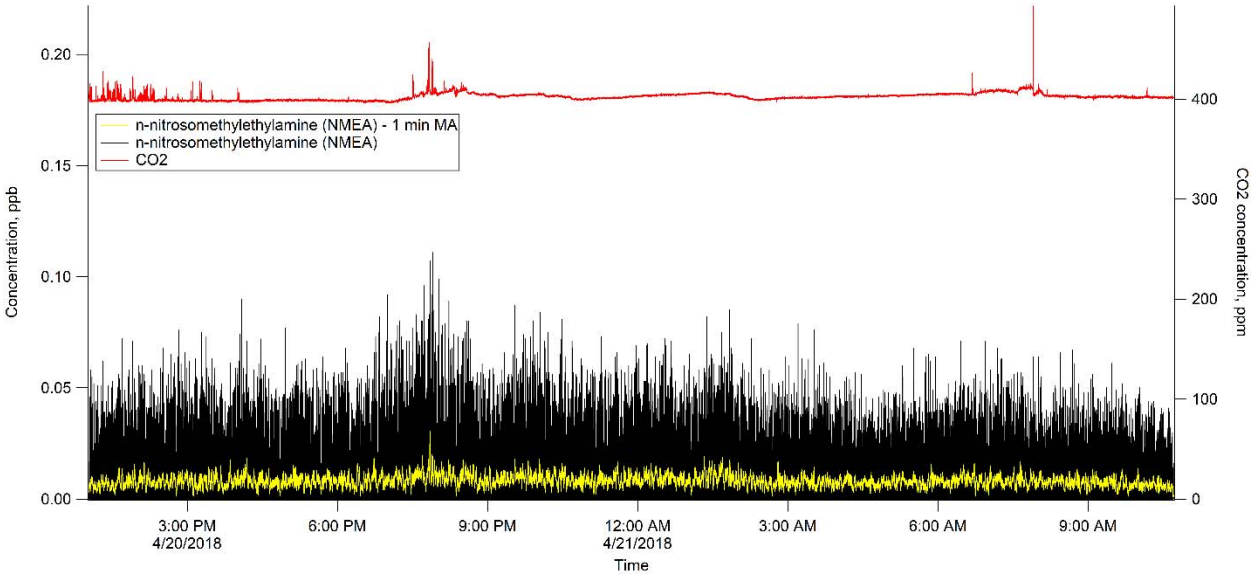


Figure 6-14. N-nitrosomethylethylamine (NMEA).

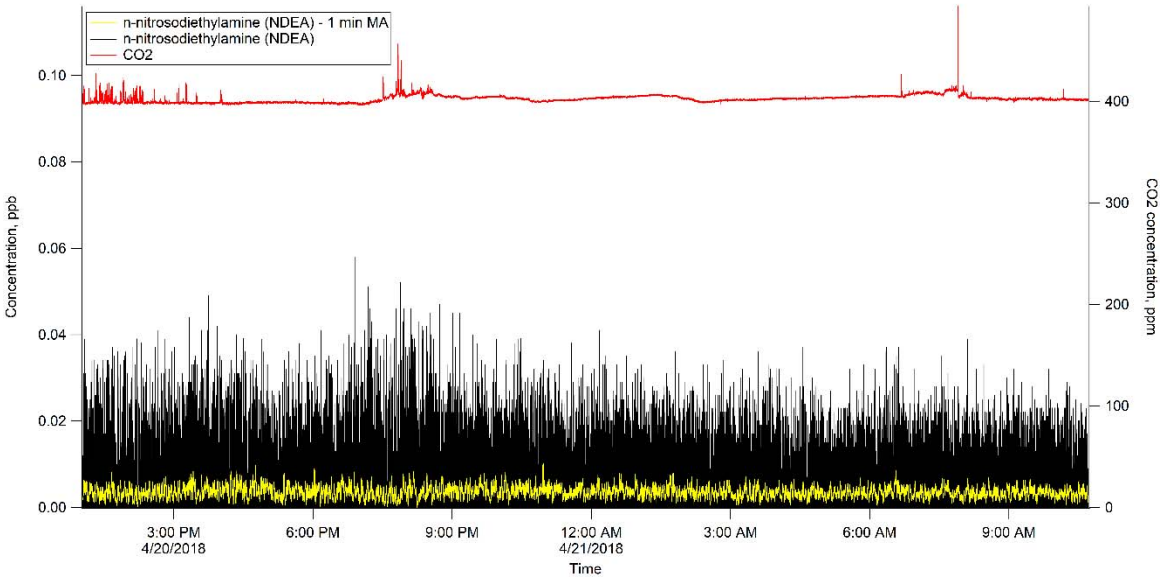


Figure 6-15. N-nitrosodiethylamine (NDEA).

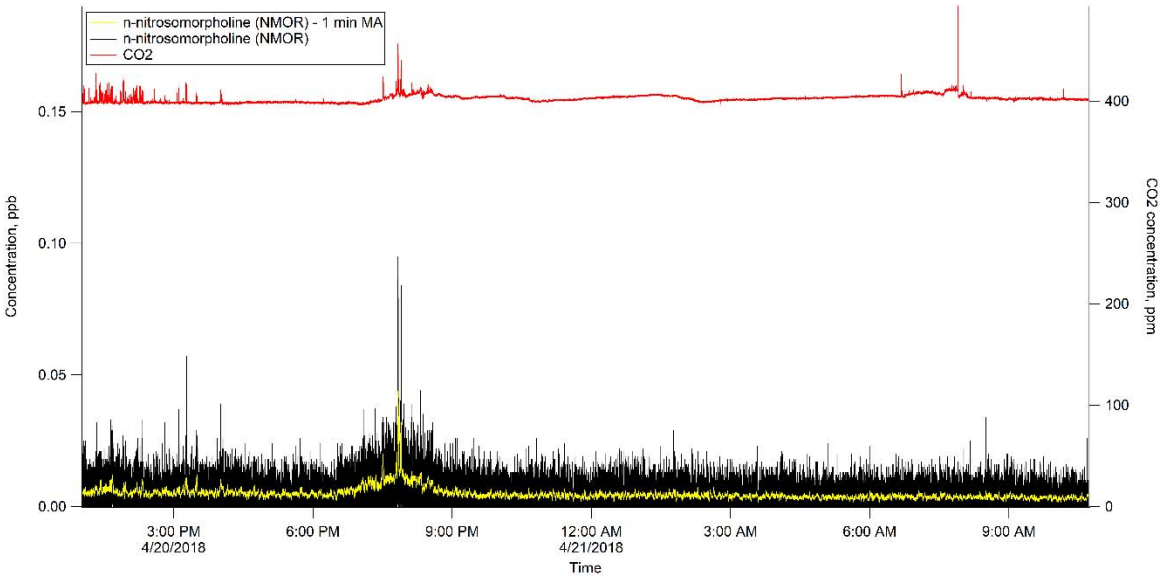


Figure 6-16. N-nitrosomorpholine (NMOR).

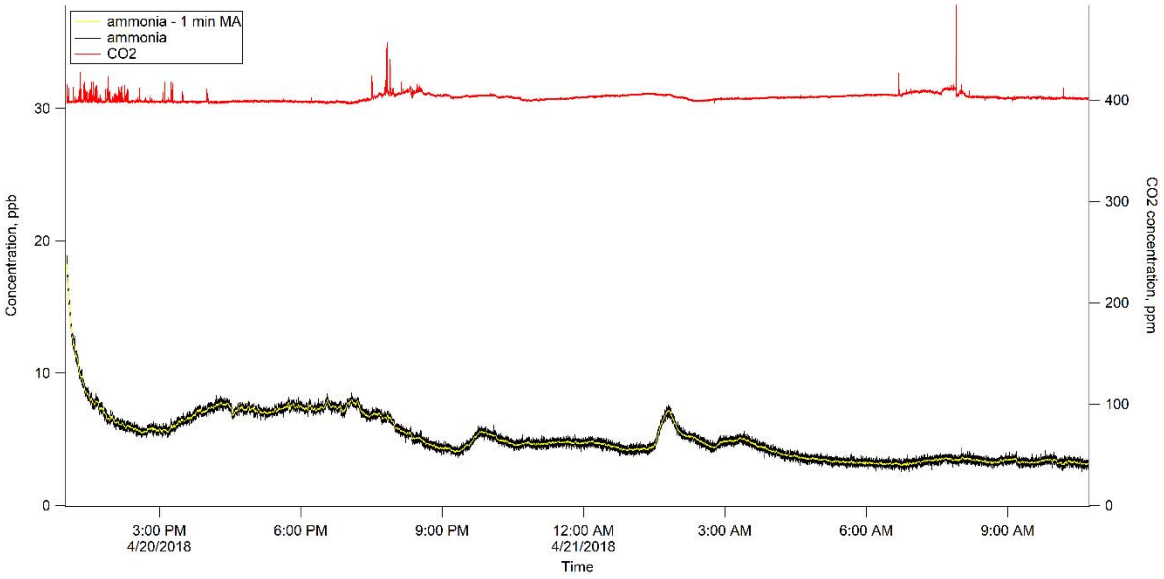


Figure 6-17. Ammonia.

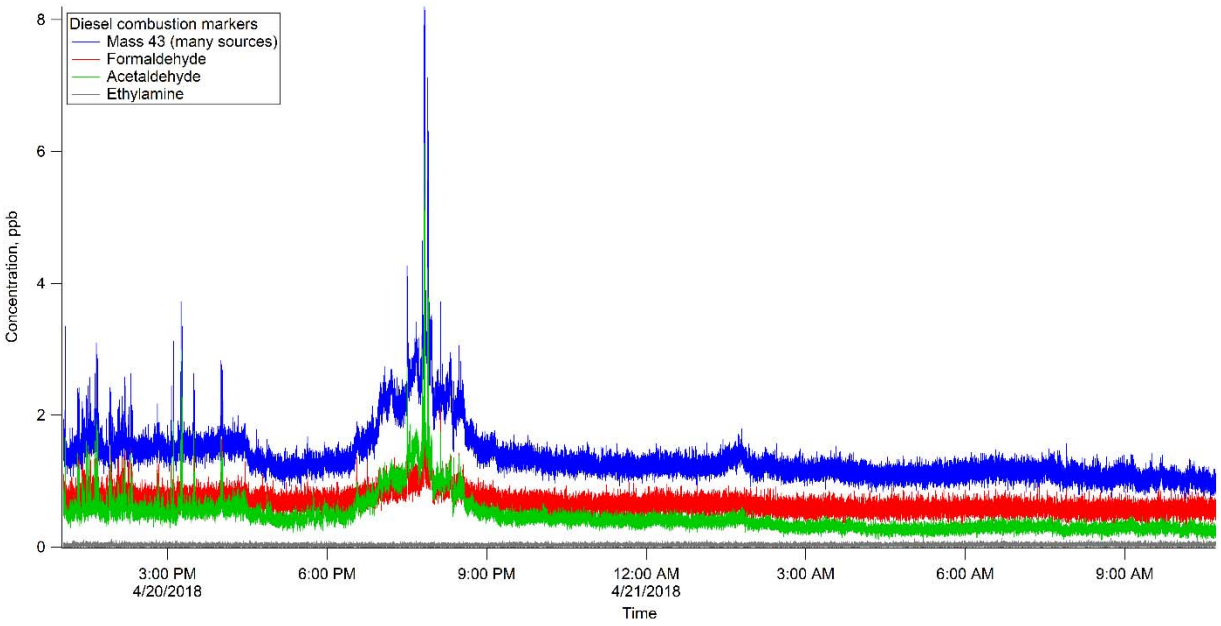


Figure 6-18. Diesel Combustion Markers.

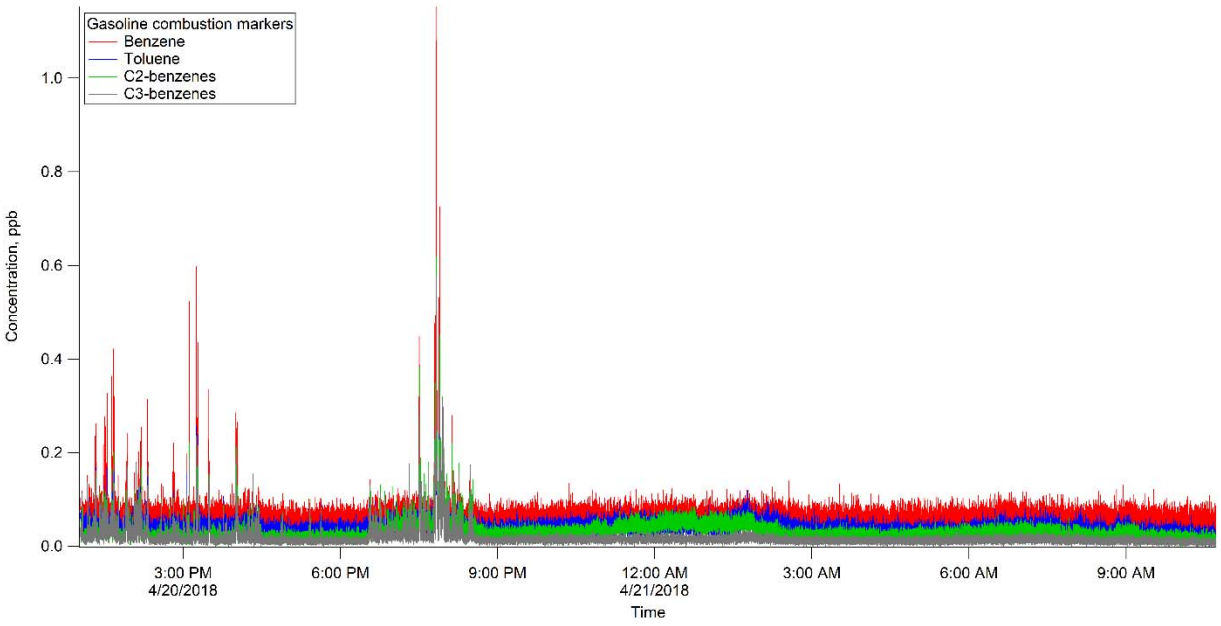


Figure 6-19. Gasoline Combustion Markers.

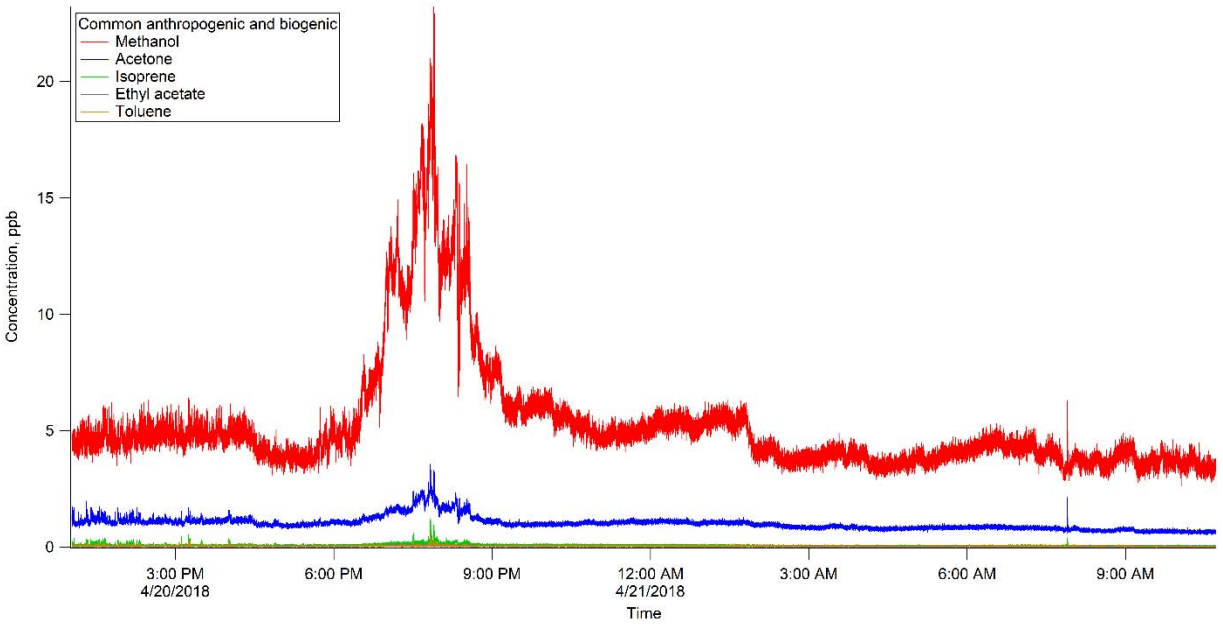


Figure 6-20. Plant and Human Markers.

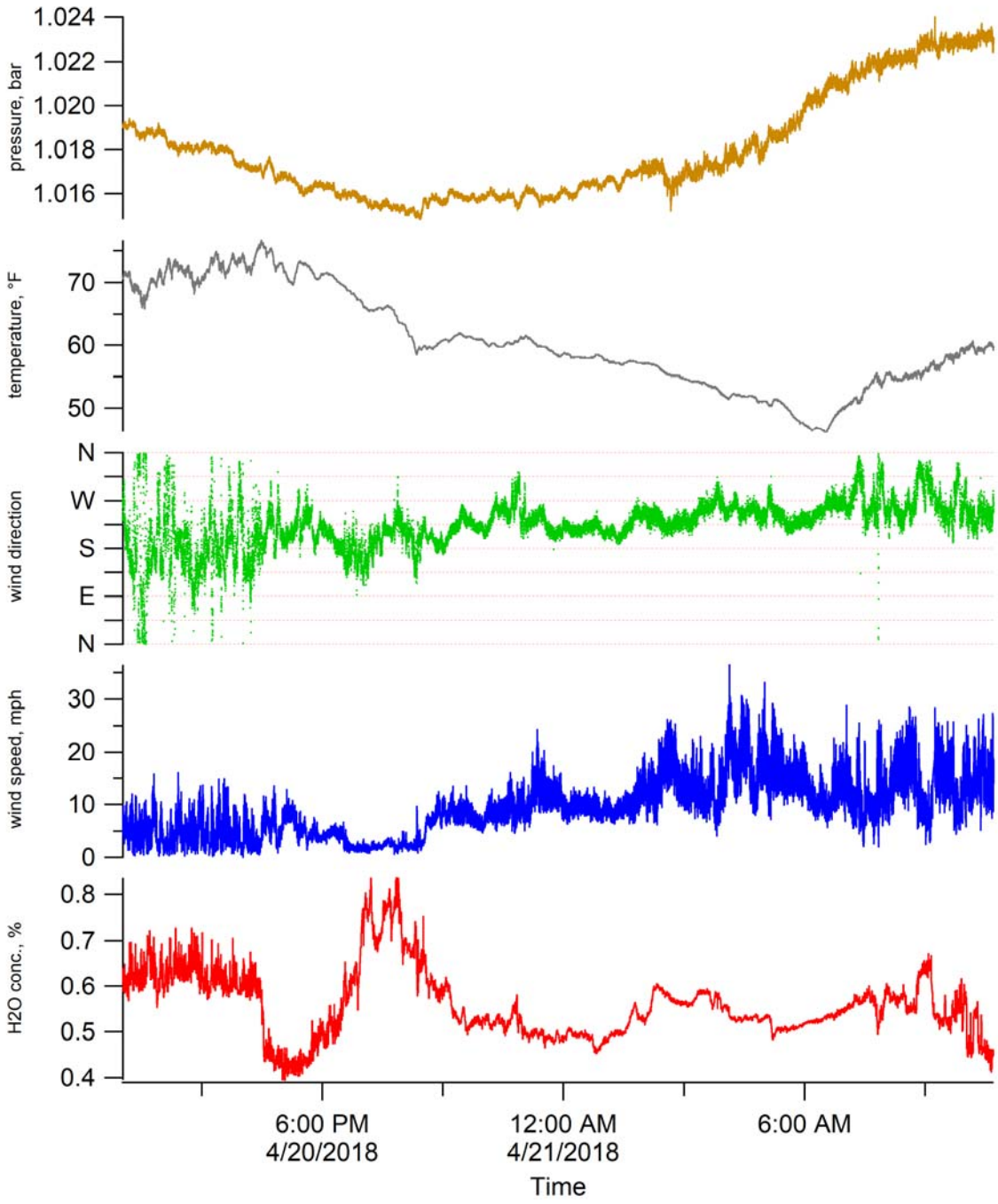


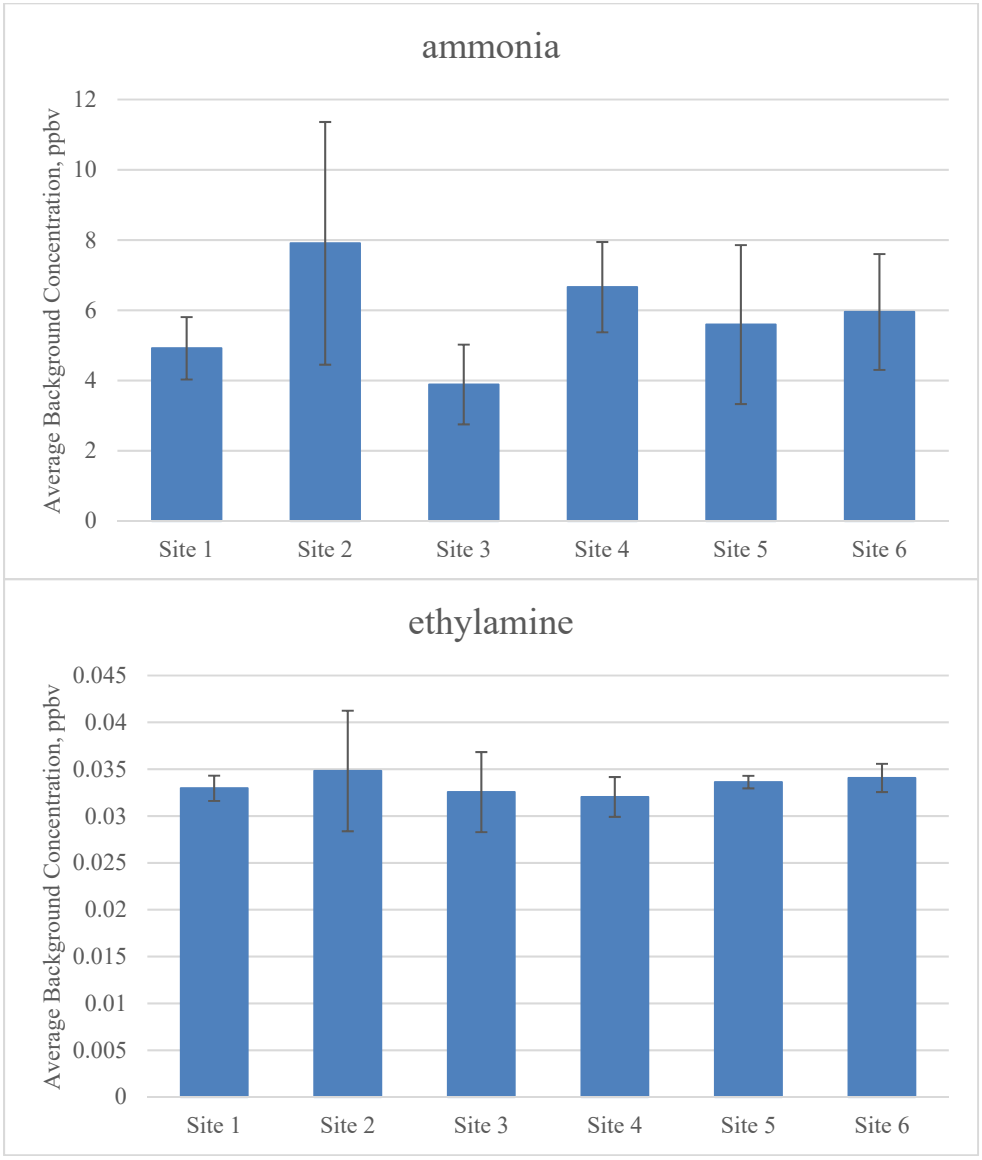
Figure 6-21. Weather Data.

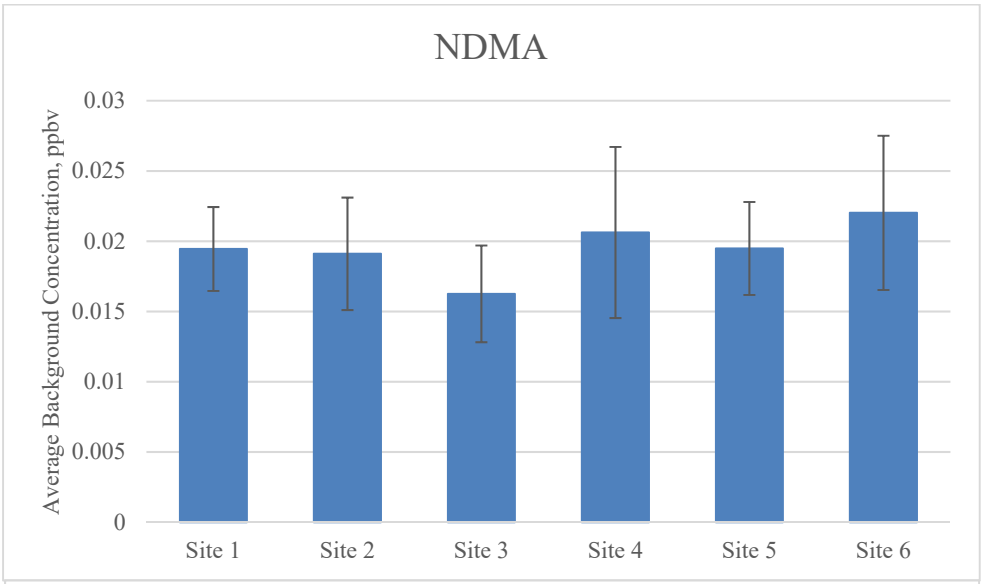
7.0 REFERENCES

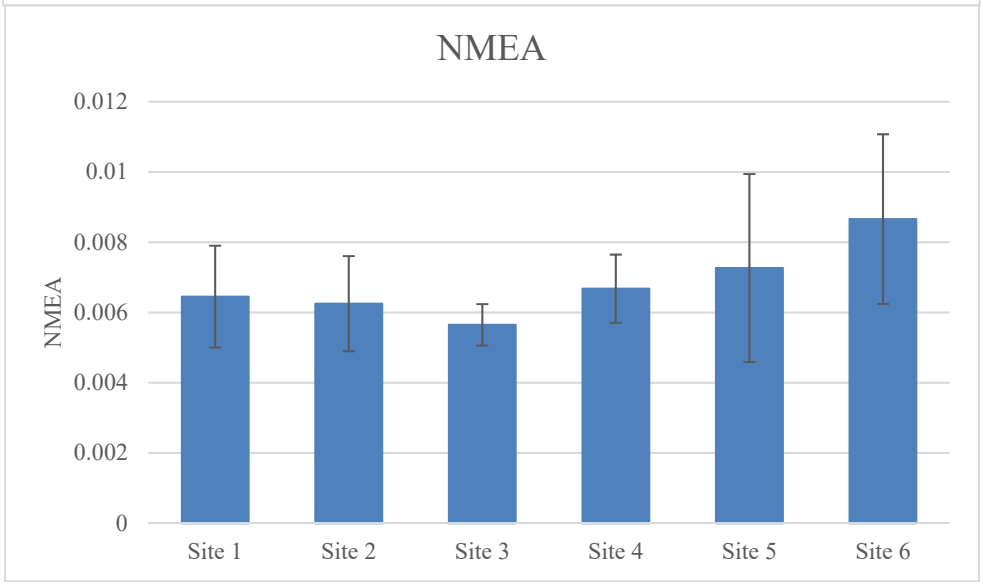
Procedure 17124-DOE-HS-102, 2018, "Mobile Laboratory Data Processing – Analysis," Revision 0, TerraGraphics Environmental Engineering, Inc., Pasco, Washington.

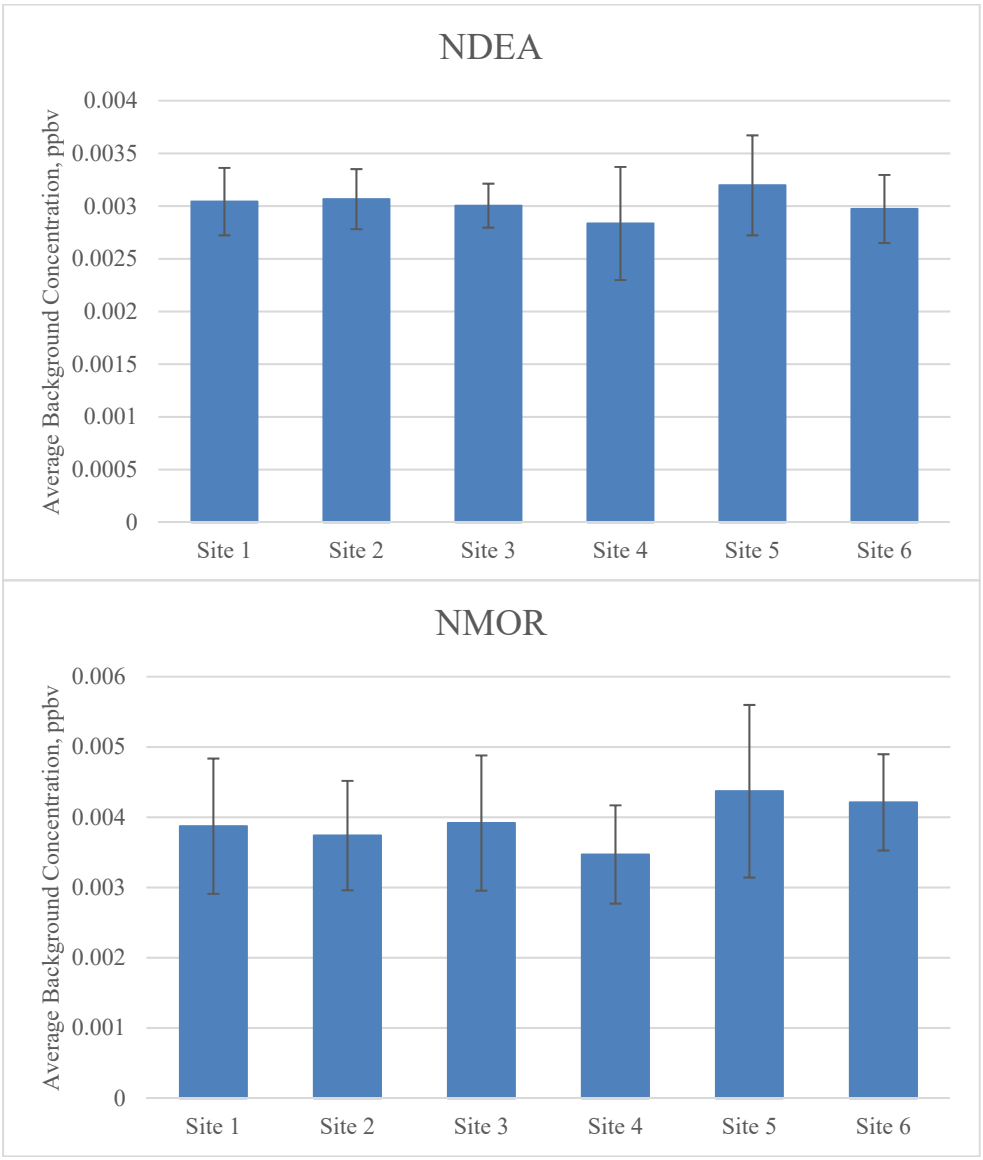
APPENDIX B

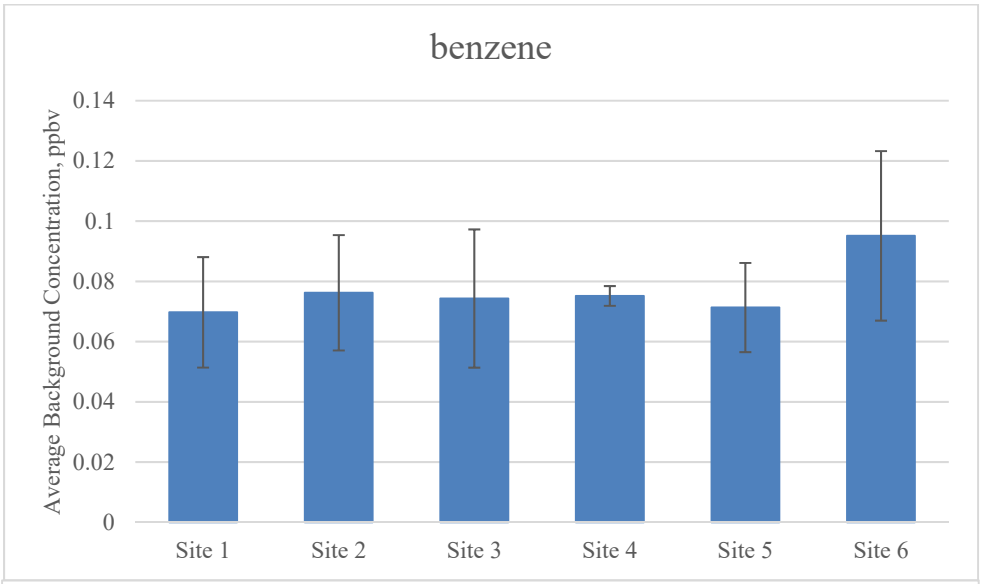
SITE COMPARISONS ADDITIONAL PLOTS

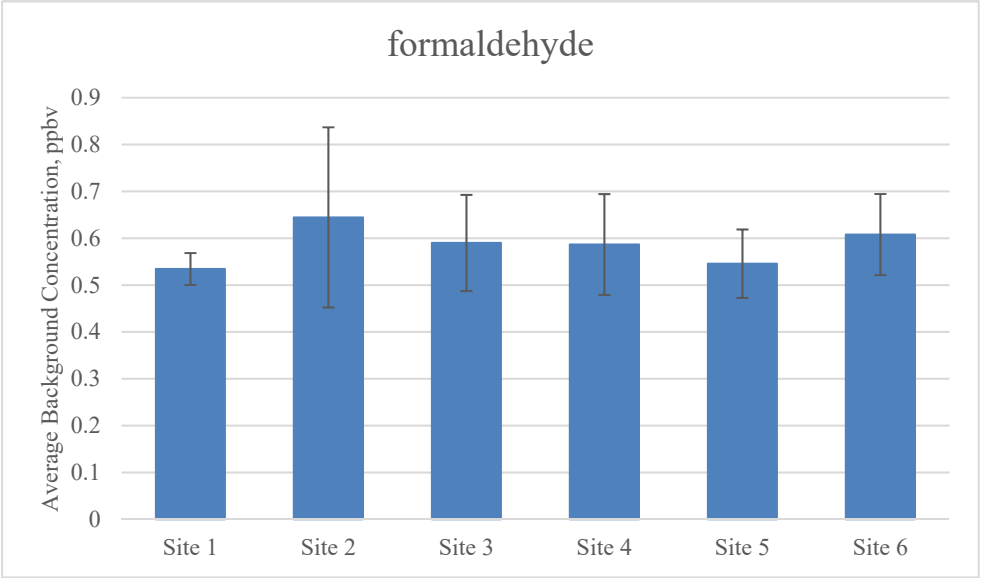

ammonia
Average Background Concentration, ppbv
12
10
8
6
4
2
0
Site 1
Site 2
Site 3
Site 4
Site 5
Site 6
ethylamine
Average Background Concentration, ppbv
0.045
0.04
0.035
0.03
0.025
0.02
0.015
0.01
0.005
0
Site 1
Site 2
Site 3
Site 4
Site 5
Site 6

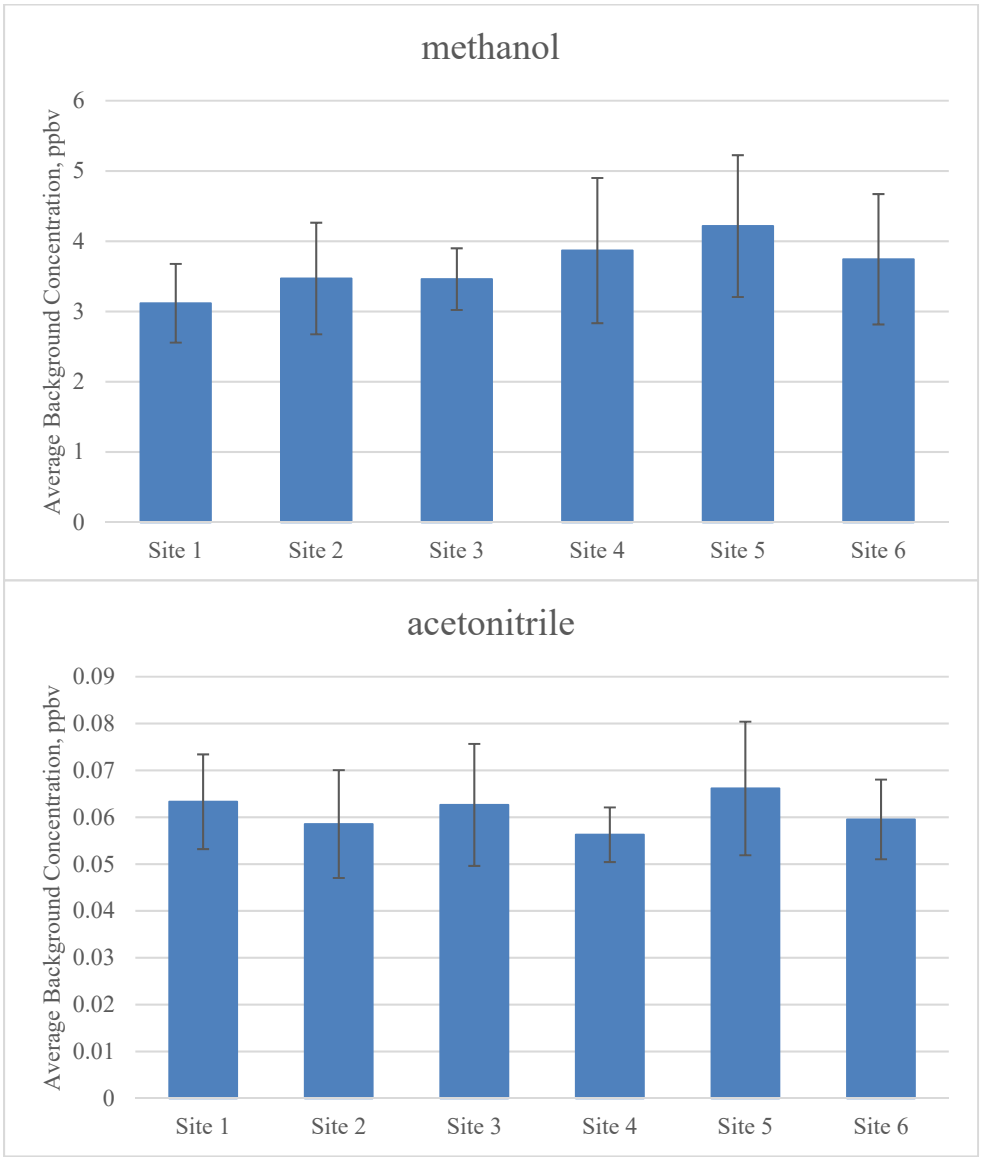

NDMA
Average Background Concentration, ppbv
0.03
0.025
0.02
0.015
0.01
0.005
0
Site 1
Site 2
Site 3
Site 4
Site 5
Site 6

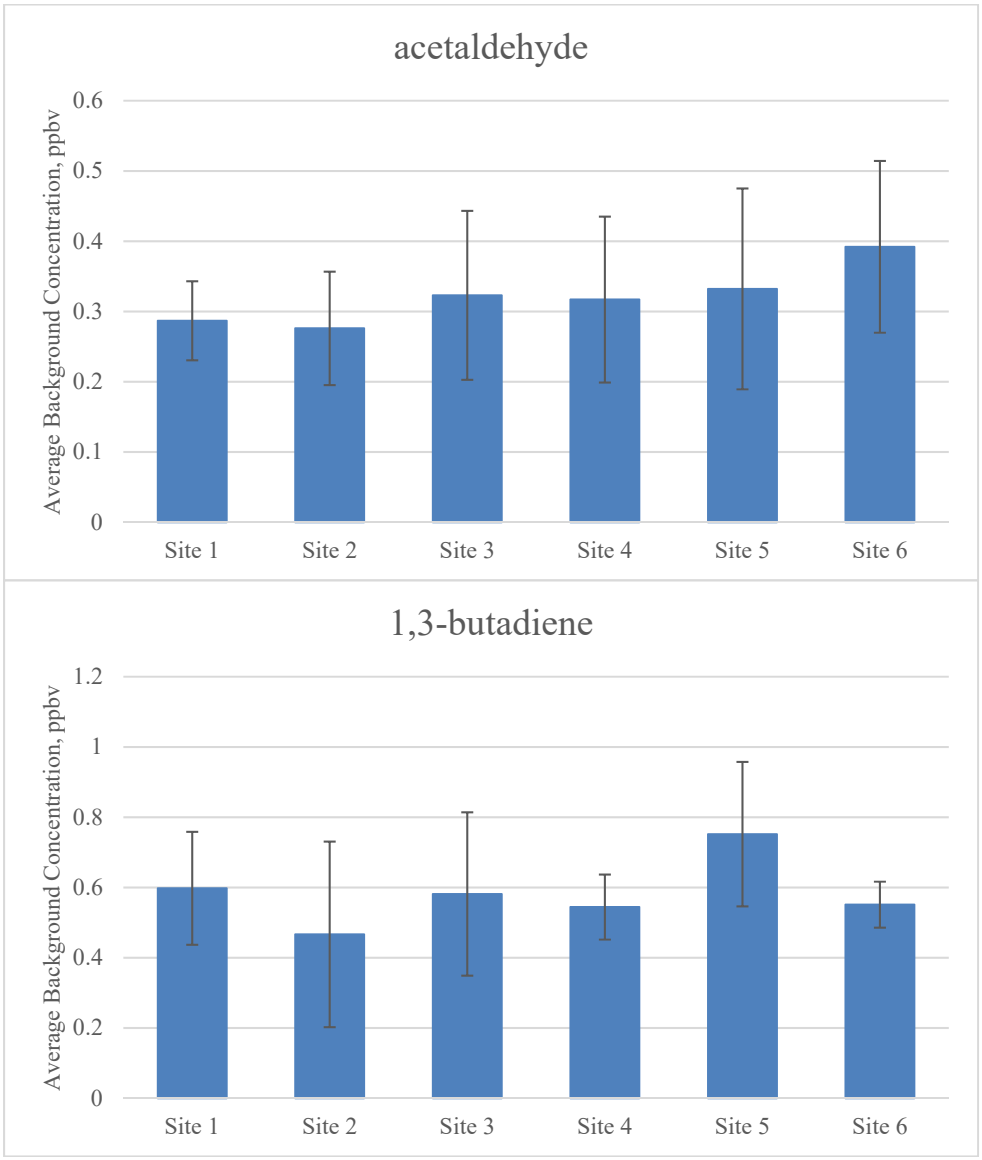

NMEA
NMEA
0.012
0.01
0.008
0.006
0.004
0.002
0
Site 1
Site 2
Site 3
Site 4
Site 5
Site 6

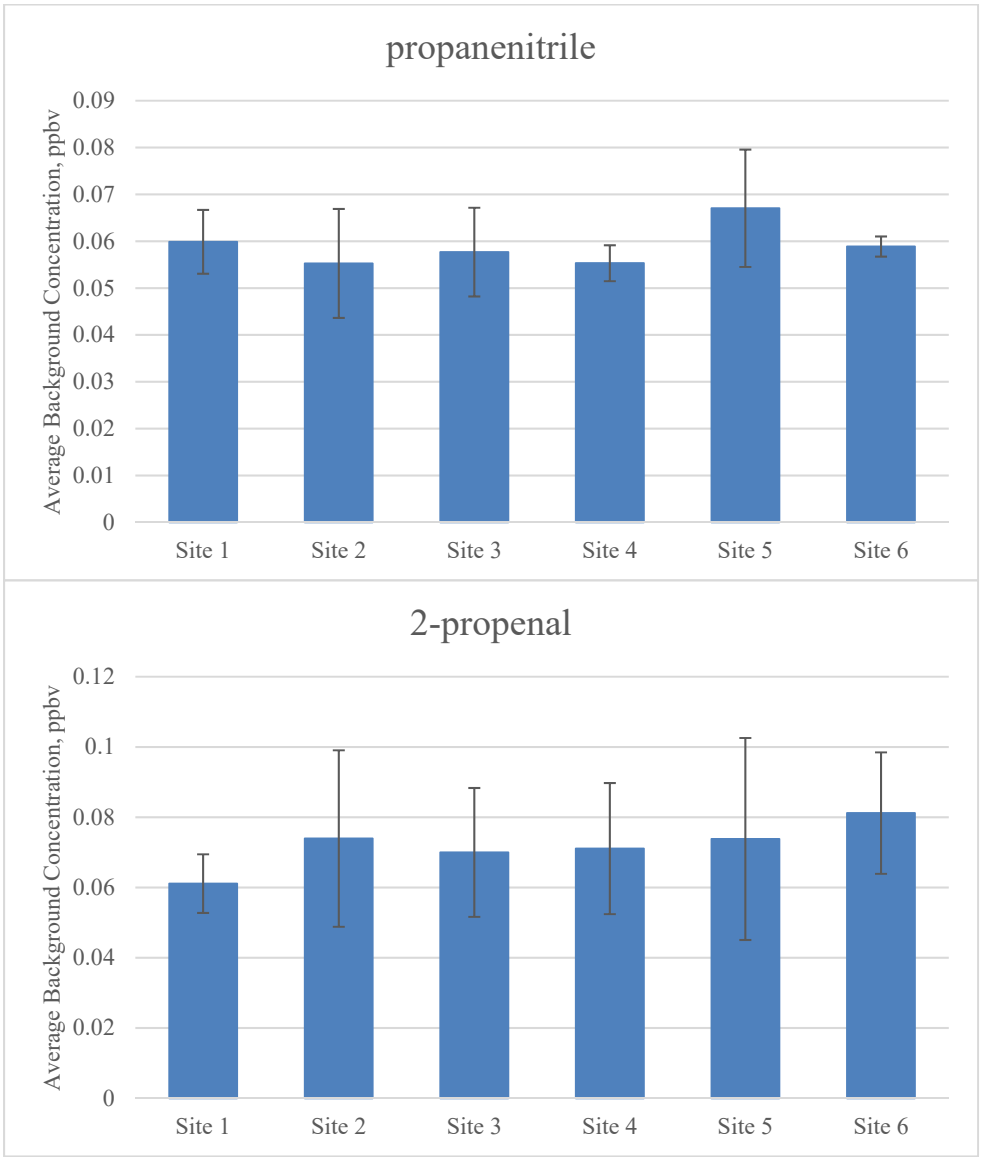

NDEA
Average Background Concentration, ppbv
0.004
0.0035
0.003
0.0025
0.002
0.0015
0.001
0.0005
0
Site 1
Site 2
Site 3
Site 4
Site 5
Site 6
NMOR
Average Background Concentration, ppbv
0.006
0.005
0.004
0.003
0.002
0.001
0
Site 1
Site 2
Site 3
Site 4
Site 5
Site 6

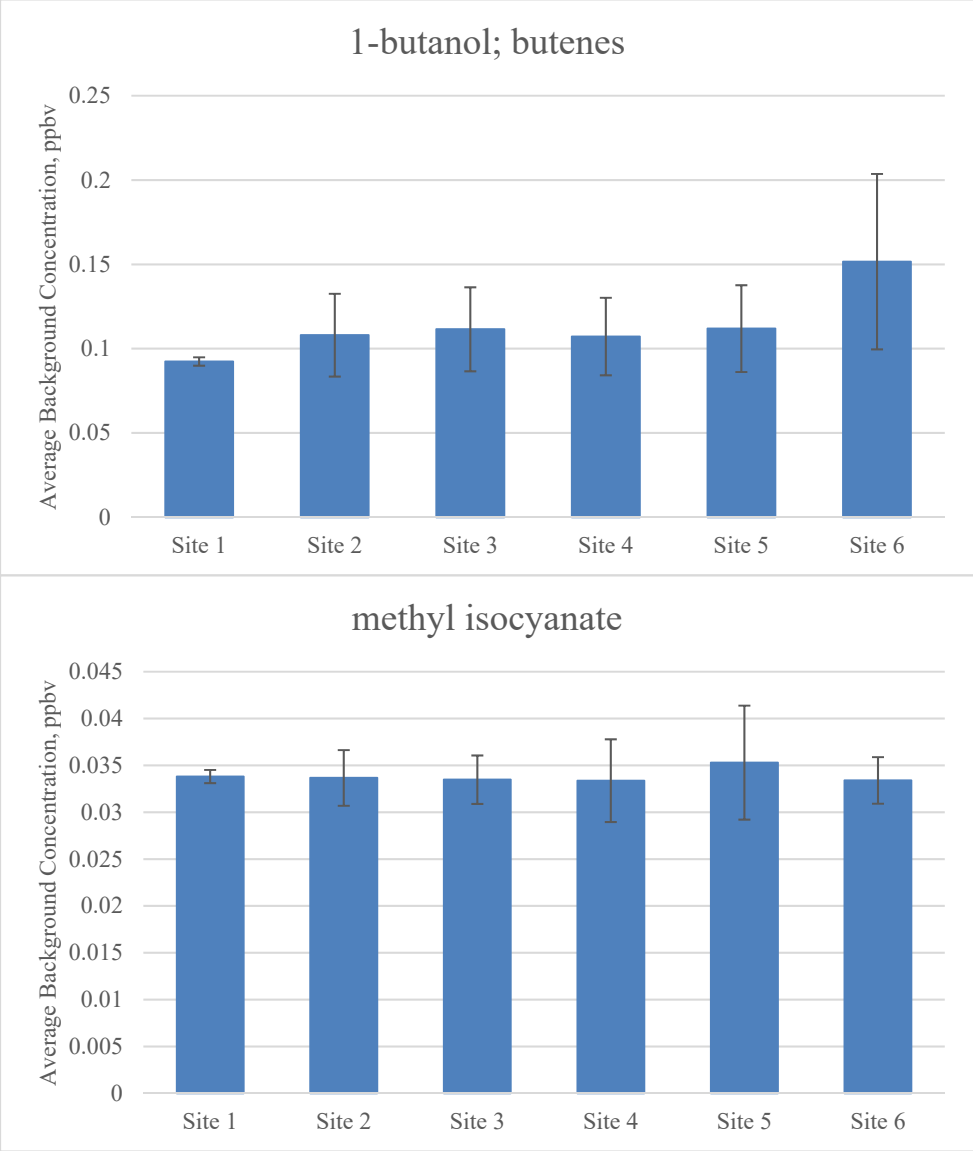

benzene
Average Background Concentration, ppbv
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
Site 1
Site 2
Site 3
Site 4
Site 5
Site 6

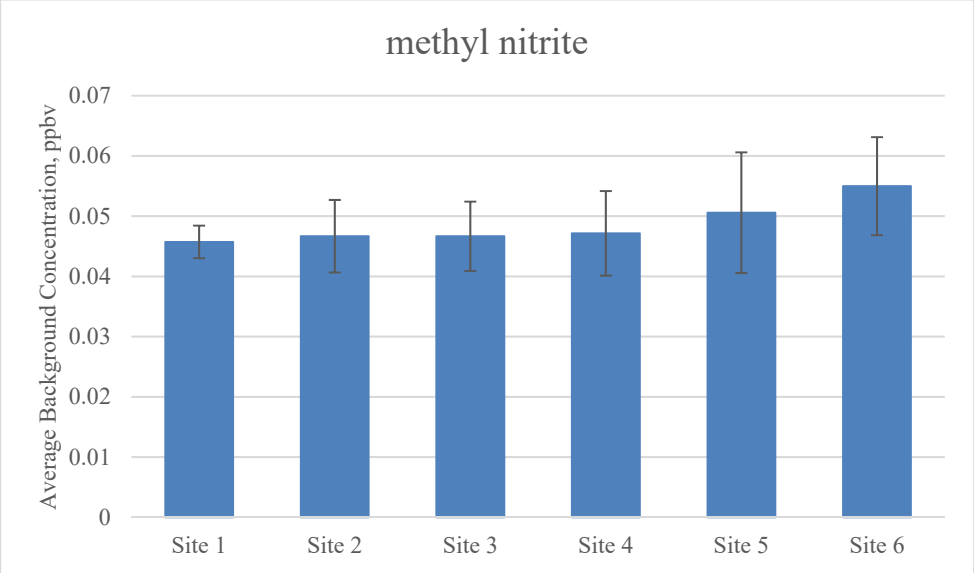

formaldehyde
Average Background Concentration, ppbv
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
Site 1
Site 2
Site 3
Site 4
Site 5
Site 6

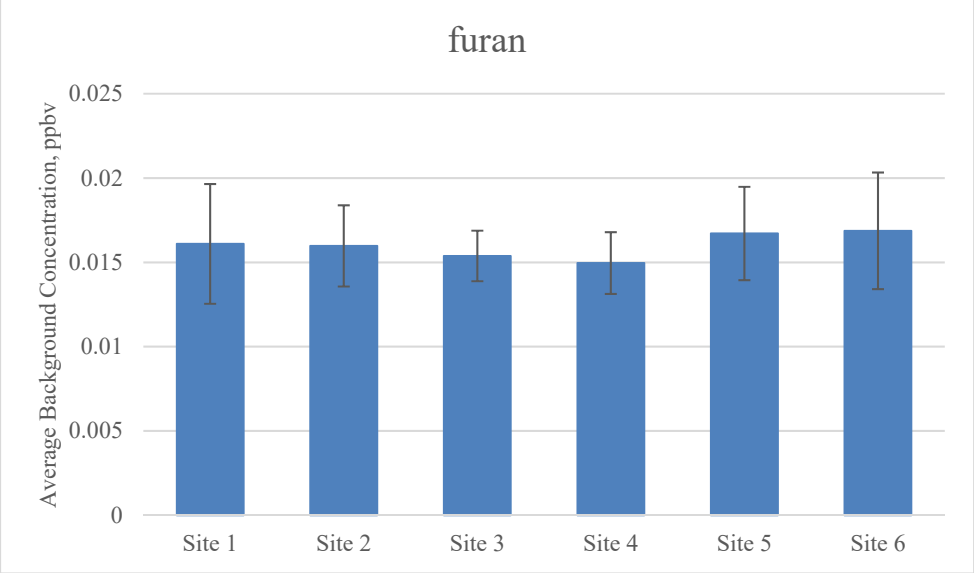

methanol
Average Background Concentration, ppbv
0
1
2
3
4
5
6
Site 1
Site 2
Site 3
Site 4
Site 5
Site 6
acetonitrile
Average Background Concentration, ppbv
0
0.01
0.02
0.03
0.04
0.05
0.06
0.07
0.08
0.09
Site 1
Site 2
Site 3
Site 4
Site 5
Site 6

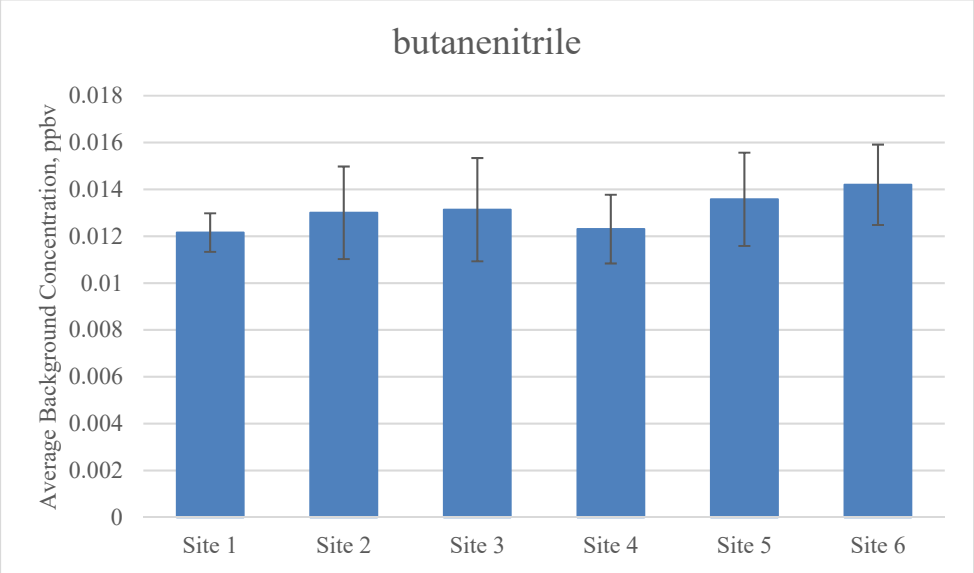

acetaldehyde
Average Background Concentration, ppbv
0.6
0.5
0.4
0.3
0.2
0.1
0
Site 1
Site 2
Site 3
Site 4
Site 5
Site 6
1,3-butadiene
Average Background Concentration, ppbv
1.2
1
0.8
0.6
0.4
0.2
0
Site 1
Site 2
Site 3
Site 4
Site 5
Site 6

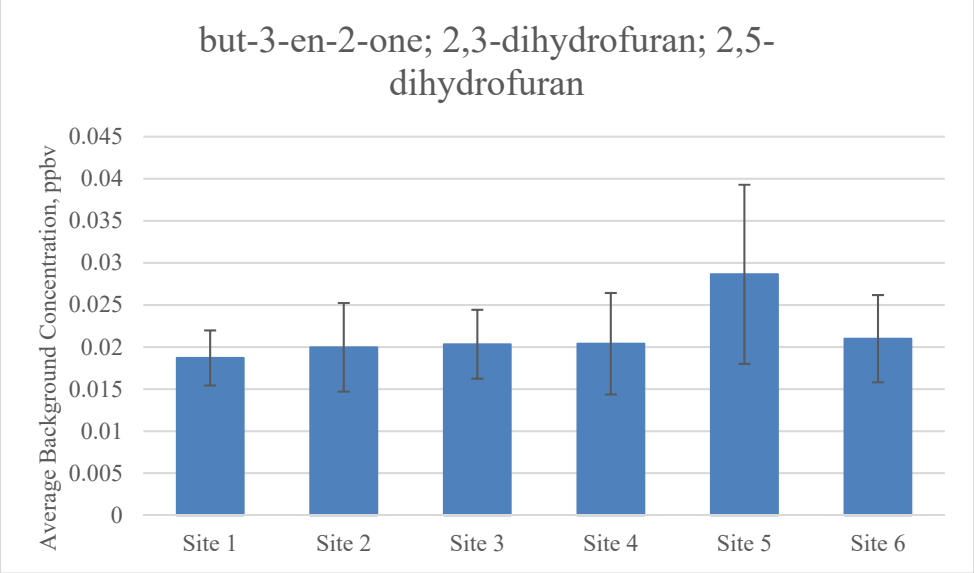

propanenitrile
Average Background Concentration, ppbv
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
Site 1
Site 2
Site 3
Site 4
Site 5
Site 6
2-propenal
Average Background Concentration, ppbv
0.12
0.1
0.08
0.06
0.04
0.02
0
Site 1
Site 2
Site 3
Site 4
Site 5
Site 6

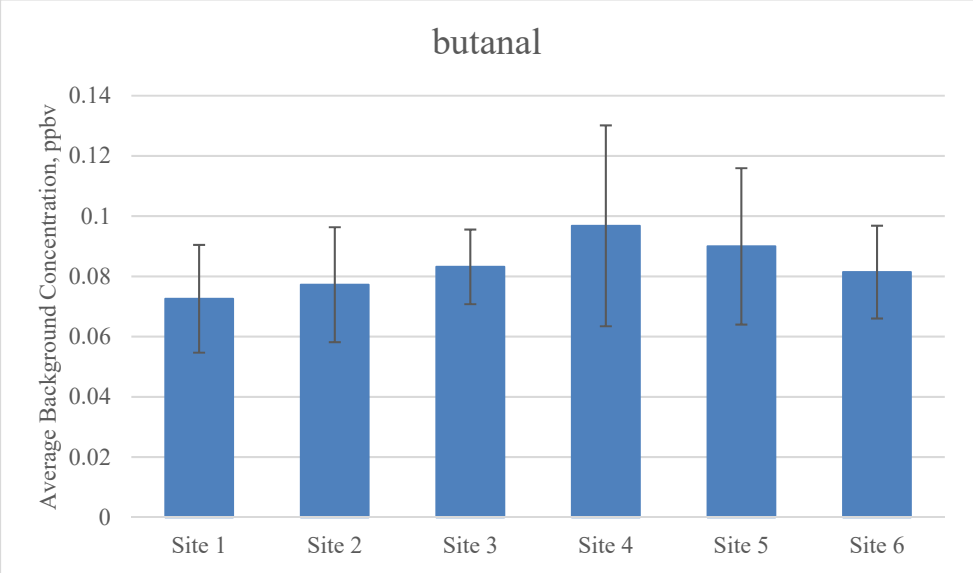

1-butanol; butenes
Average Background Concentration, ppbv
0.25
0.2
0.15
0.1
0.05
0
Site 1
Site 2
Site 3
Site 4
Site 5
Site 6
methyl isocyanate
Average Background Concentration, ppbv
0.045
0.04
0.035
0.03
0.025
0.02
0.015
0.01
0.005
0
Site 1
Site 2
Site 3
Site 4
Site 5
Site 6

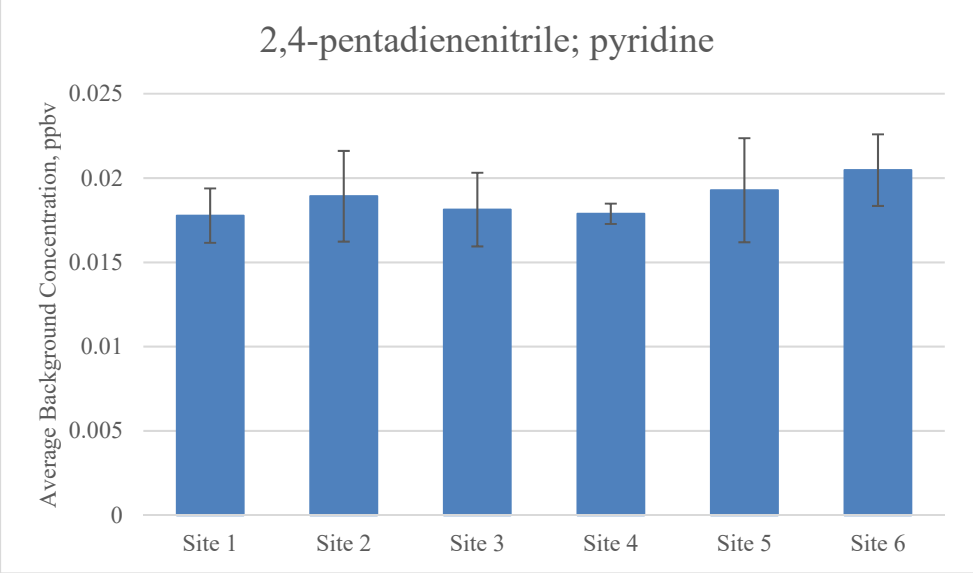

methyl nitrite
Average Background Concentration, ppbv
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
Site 1
Site 2
Site 3
Site 4
Site 5
Site 6

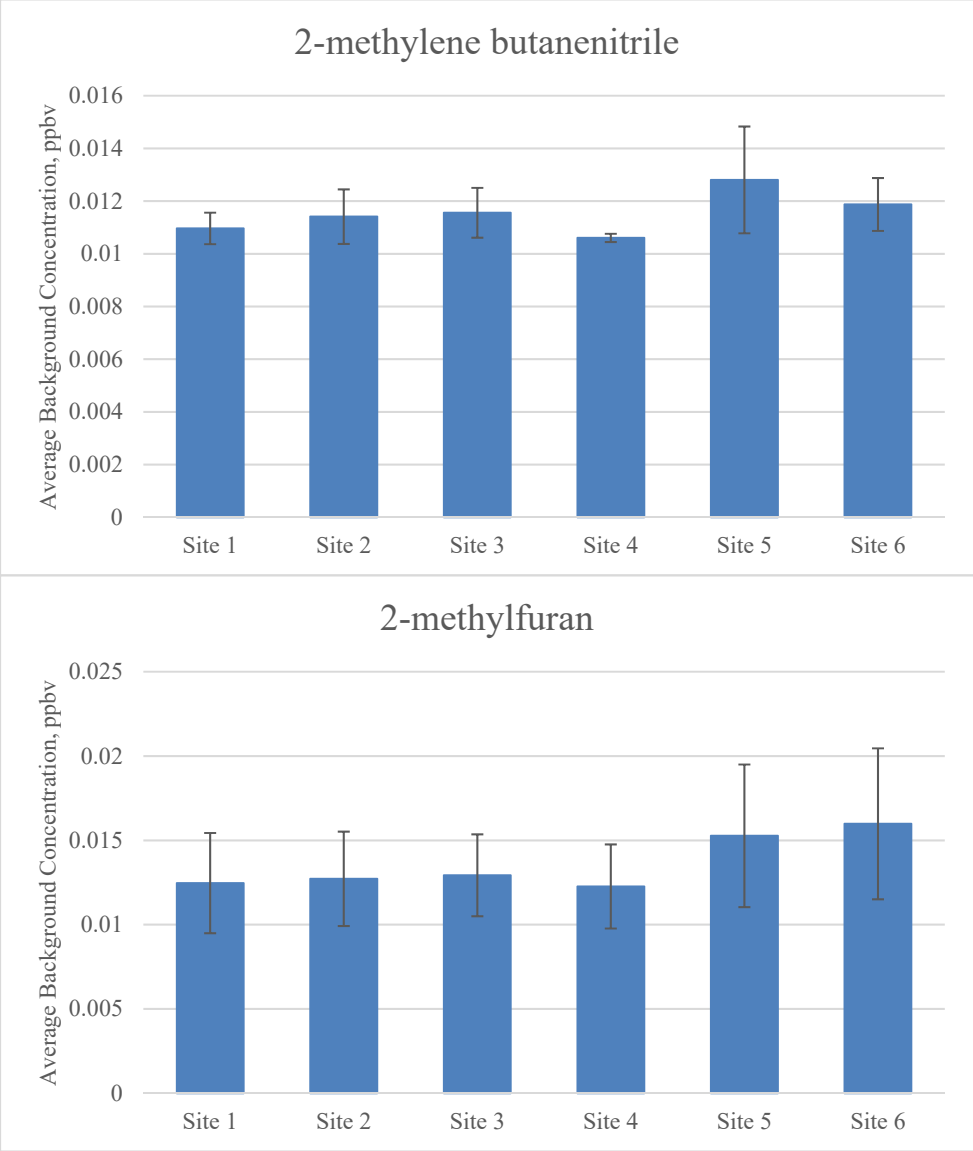

furan
Average Background Concentration, ppbv
0.025
0.02
0.015
0.01
0.005
0
Site 1
Site 2
Site 3
Site 4
Site 5
Site 6

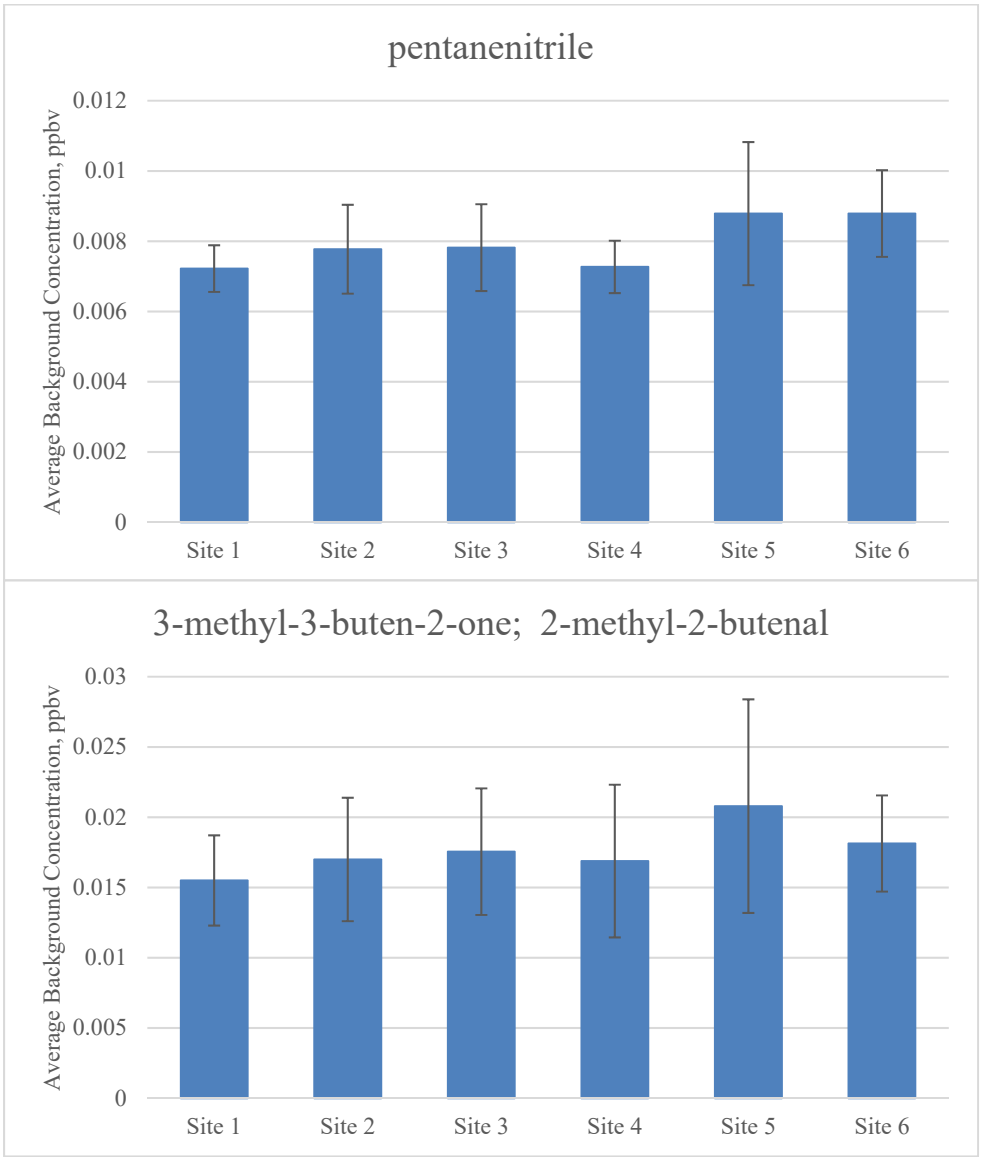

butanenitrile
Average Background Concentration, ppbv
0.018
0.016
0.014
0.012
0.01
0.008
0.006
0.004
0.002
0
Site 1
Site 2
Site 3
Site 4
Site 5
Site 6

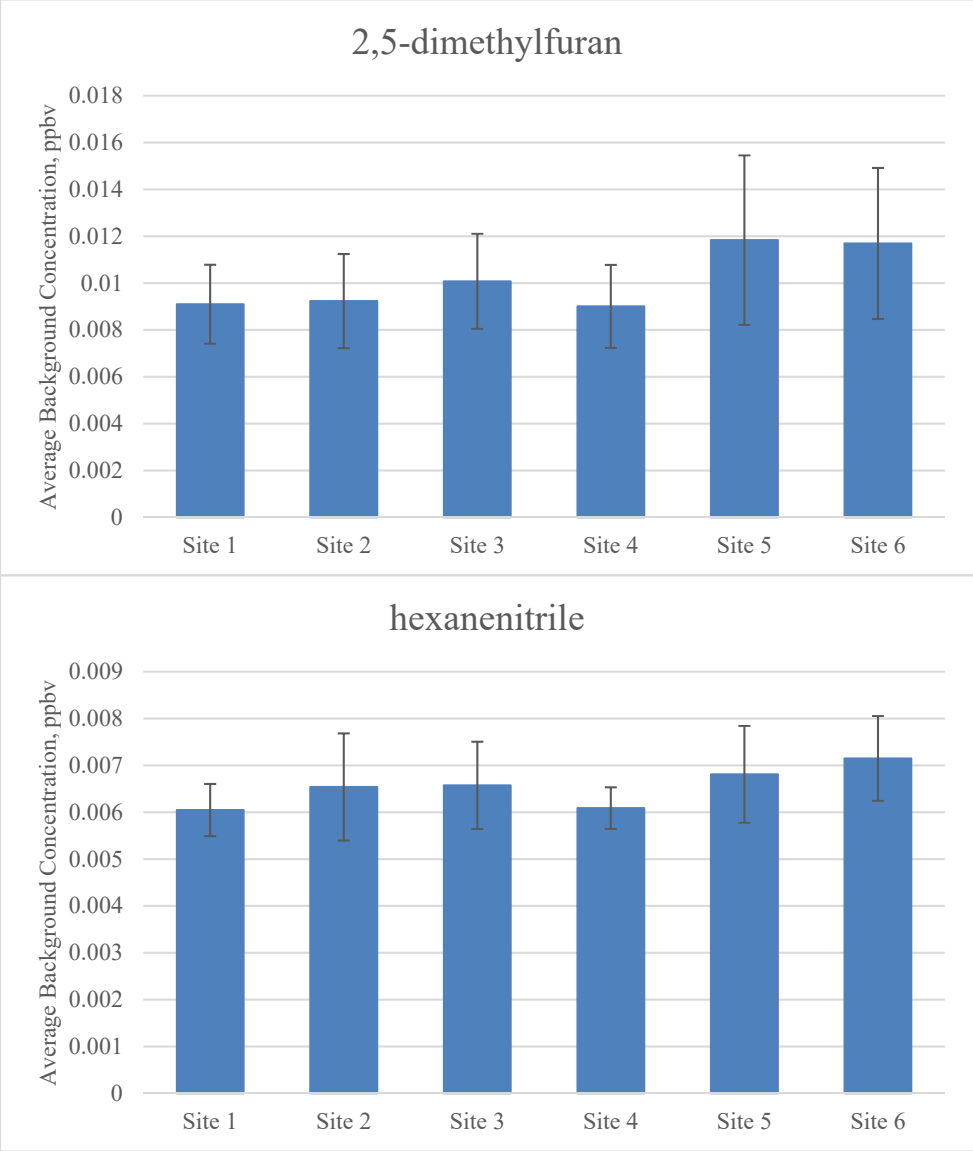

but-3-en-2-one; 2,3-dihydrofuran; 2,5-dihydrofuran
Average Background Concentration, ppbv
0.045
0.04
0.035
0.03
0.025
0.02
0.015
0.01
0.005
0
Site 1
Site 2
Site 3
Site 4
Site 5
Site 6

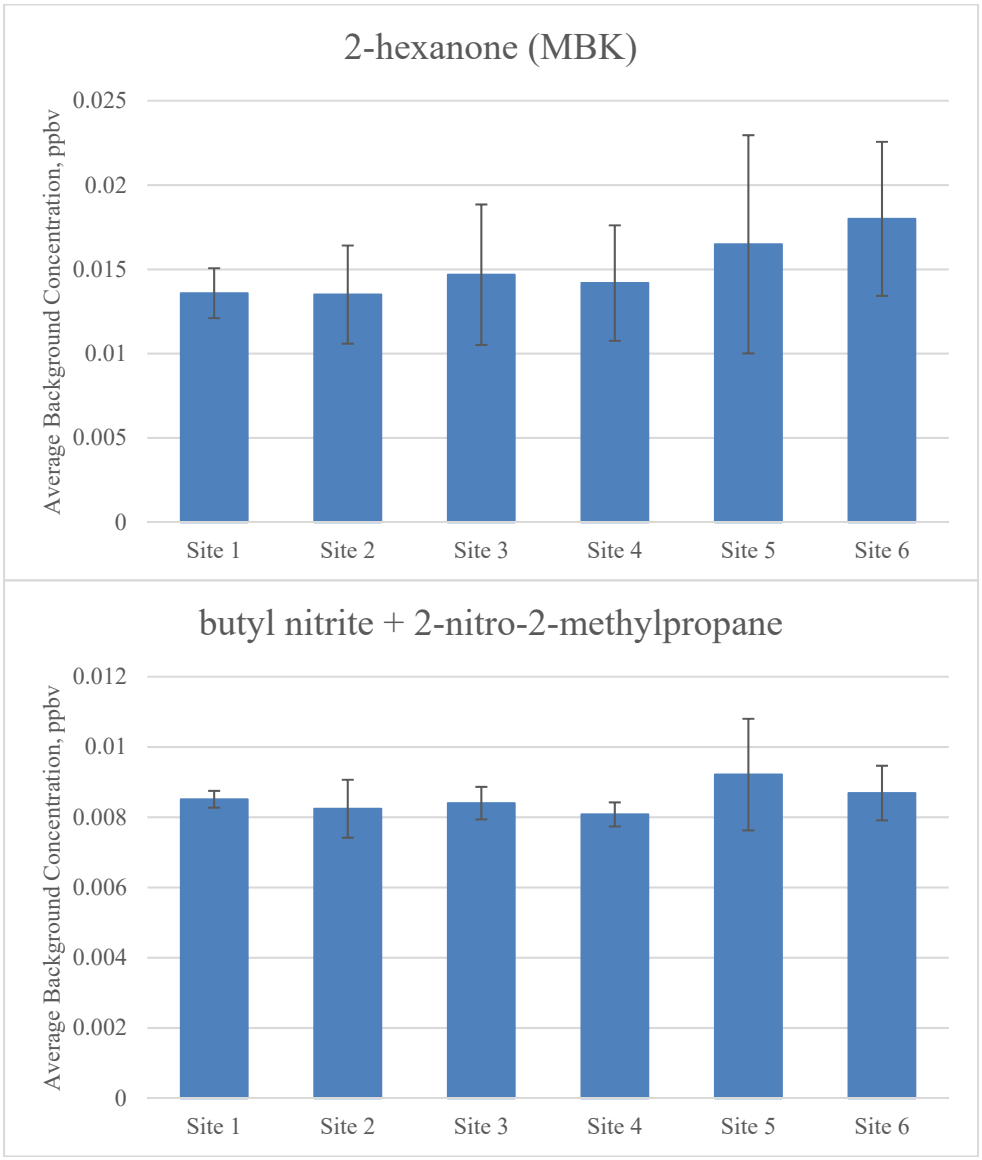

butanal
Average Background Concentration, ppbv
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
Site 1
Site 2
Site 3
Site 4
Site 5
Site 6

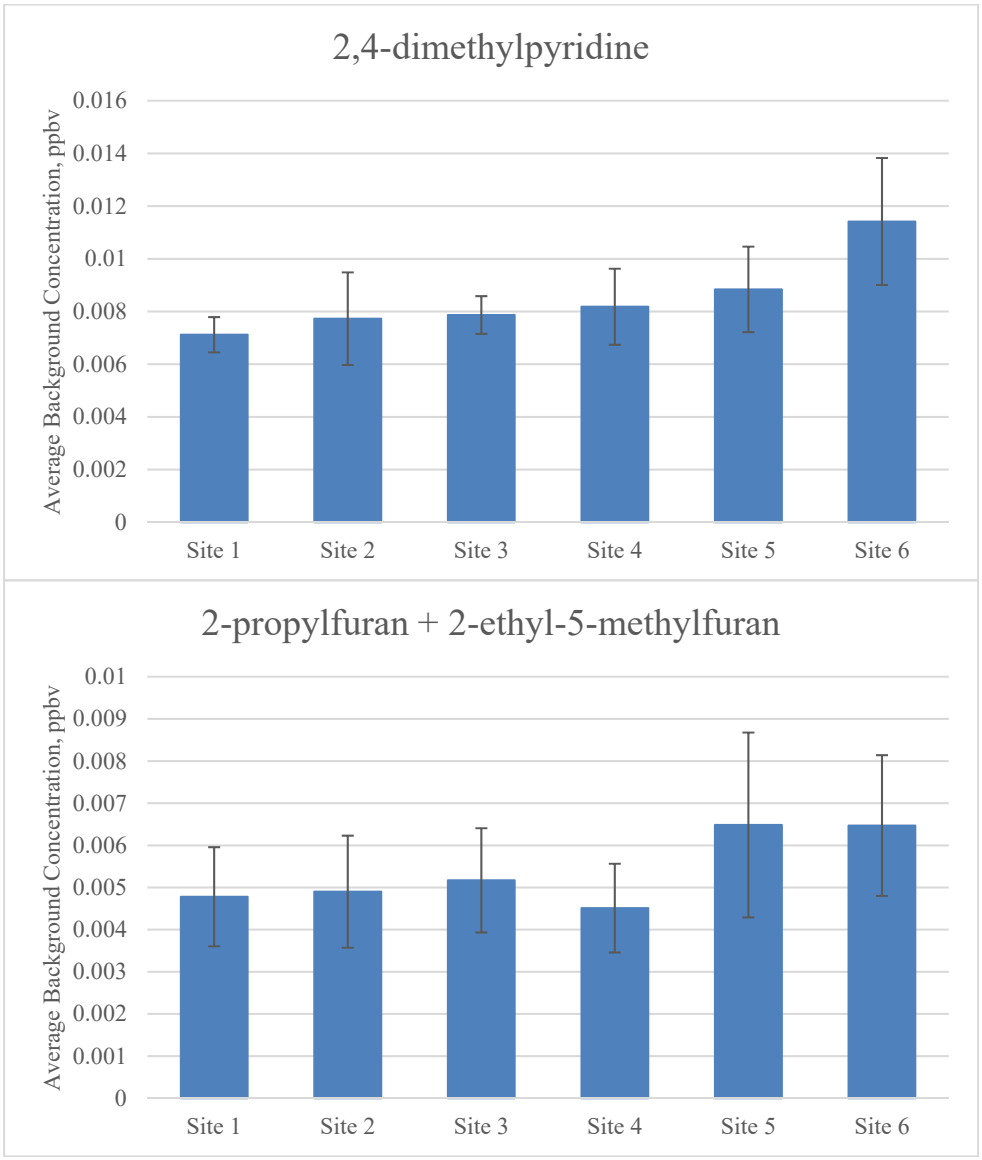

2,4-pentadienenitrile; pyridine
Average Background Concentration, ppbv
0.025
0.02
0.015
0.01
0.005
0
Site 1
Site 2
Site 3
Site 4
Site 5
Site 6

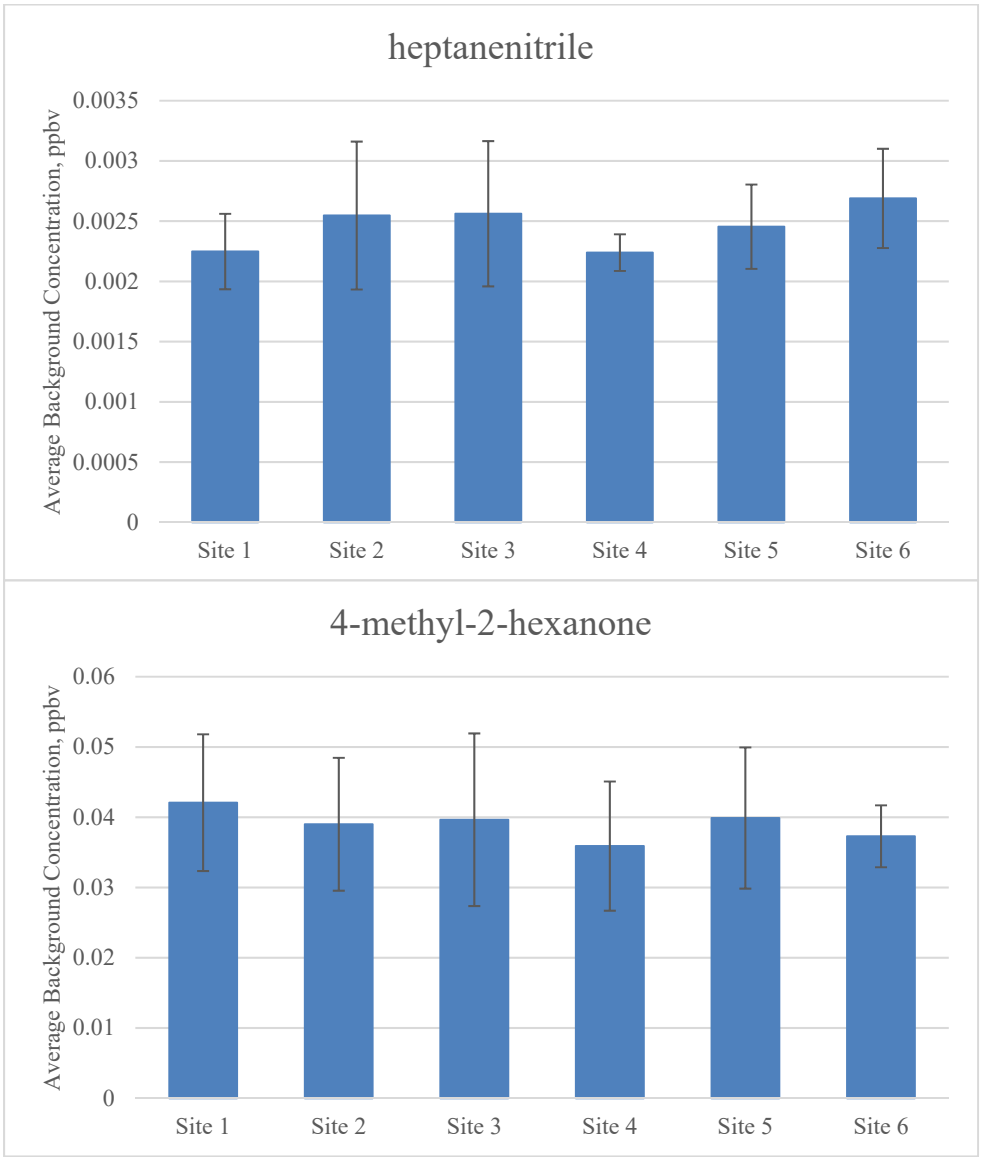

2-methylene butanenitrile
Average Background Concentration, ppbv
0.016
0.014
0.012
0.01
0.008
0.006
0.004
0.002
0
Site 1
Site 2
Site 3
Site 4
Site 5
Site 6
2-methylfuran
Average Background Concentration, ppbv
0.025
0.02
0.015
0.01
0.005
0
Site 1
Site 2
Site 3
Site 4
Site 5
Site 6

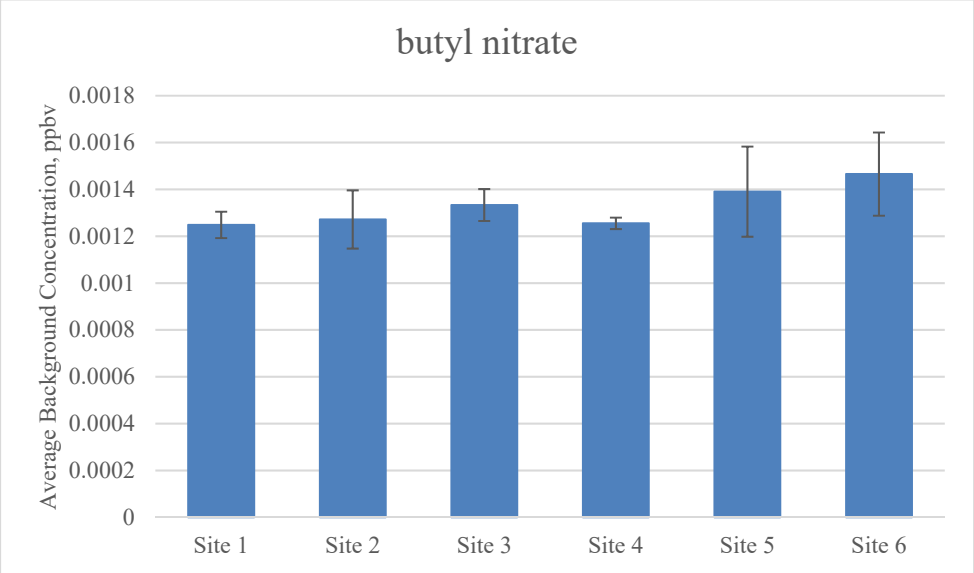

pentanenitrile
Average Background Concentration, ppbv
0.012
0.01
0.008
0.006
0.004
0.002
0
Site 1
Site 2
Site 3
Site 4
Site 5
Site 6
3-methyl-3-buten-2-one; 2-methyl-2-butenal
Average Background Concentration, ppbv
0.03
0.025
0.02
0.015
0.01
0.005
0
Site 1
Site 2
Site 3
Site 4
Site 5
Site 6

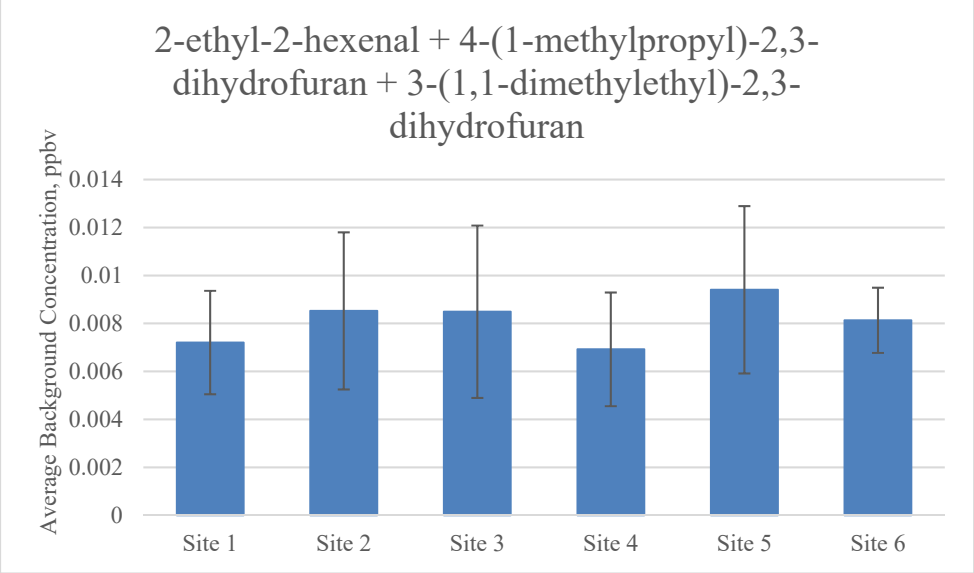

2,5-dimethylfuran
Average Background Concentration, ppbv
0.018
0.016
0.014
0.012
0.01
0.008
0.006
0.004
0.002
0
Site 1
Site 2
Site 3
Site 4
Site 5
Site 6
hexanenitrile
Average Background Concentration, ppbv
0.009
0.008
0.007
0.006
0.005
0.004
0.003
0.002
0.001
0
Site 1
Site 2
Site 3
Site 4
Site 5
Site 6

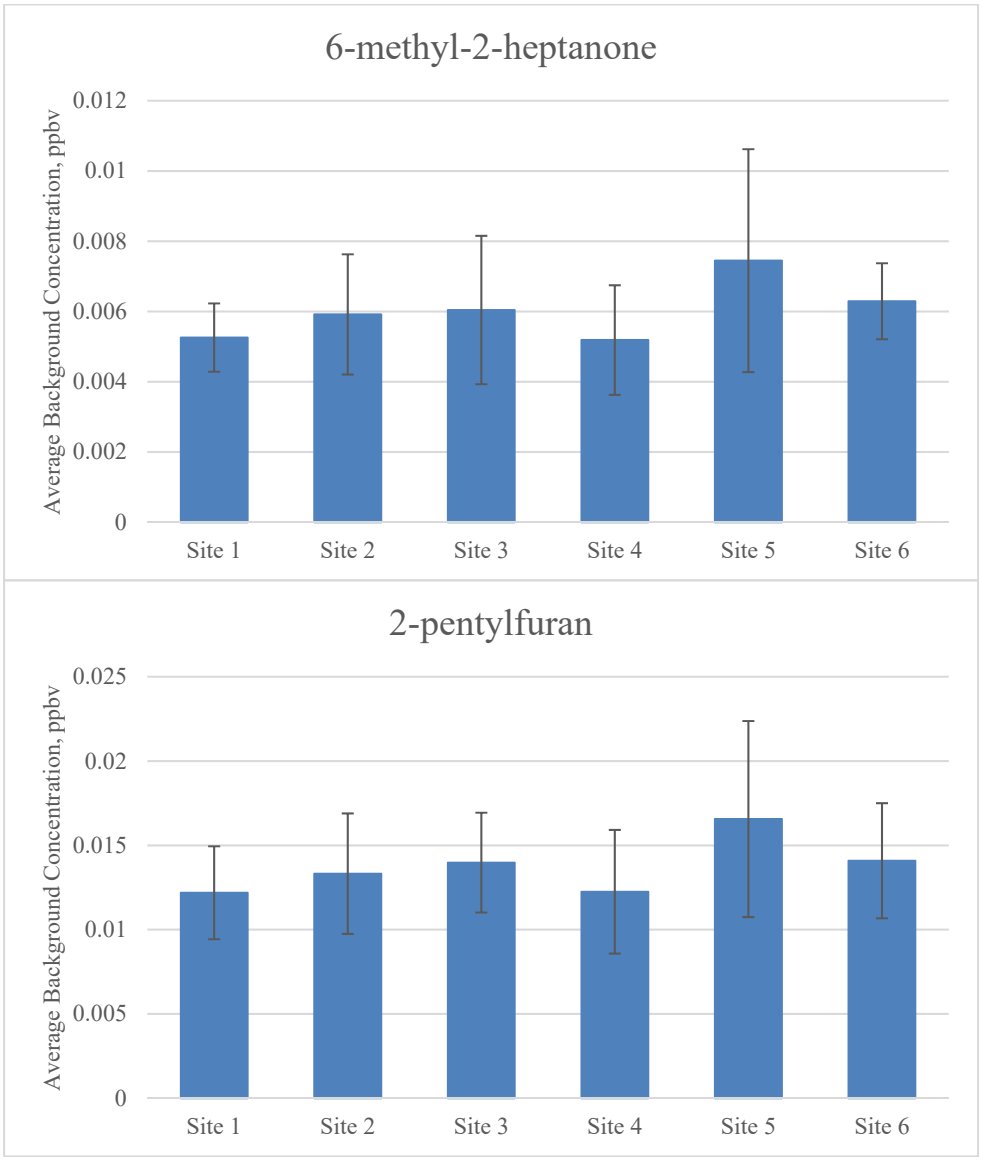

2-hexanone (MBK)
Average Background Concentration, ppbv
0.025
0.02
0.015
0.01
0.005
0
Site 1
Site 2
Site 3
Site 4
Site 5
Site 6
butyl nitrite + 2-nitro-2-methylpropane
Average Background Concentration, ppbv
0.012
0.01
0.008
0.006
0.004
0.002
0
Site 1
Site 2
Site 3
Site 4
Site 5
Site 6

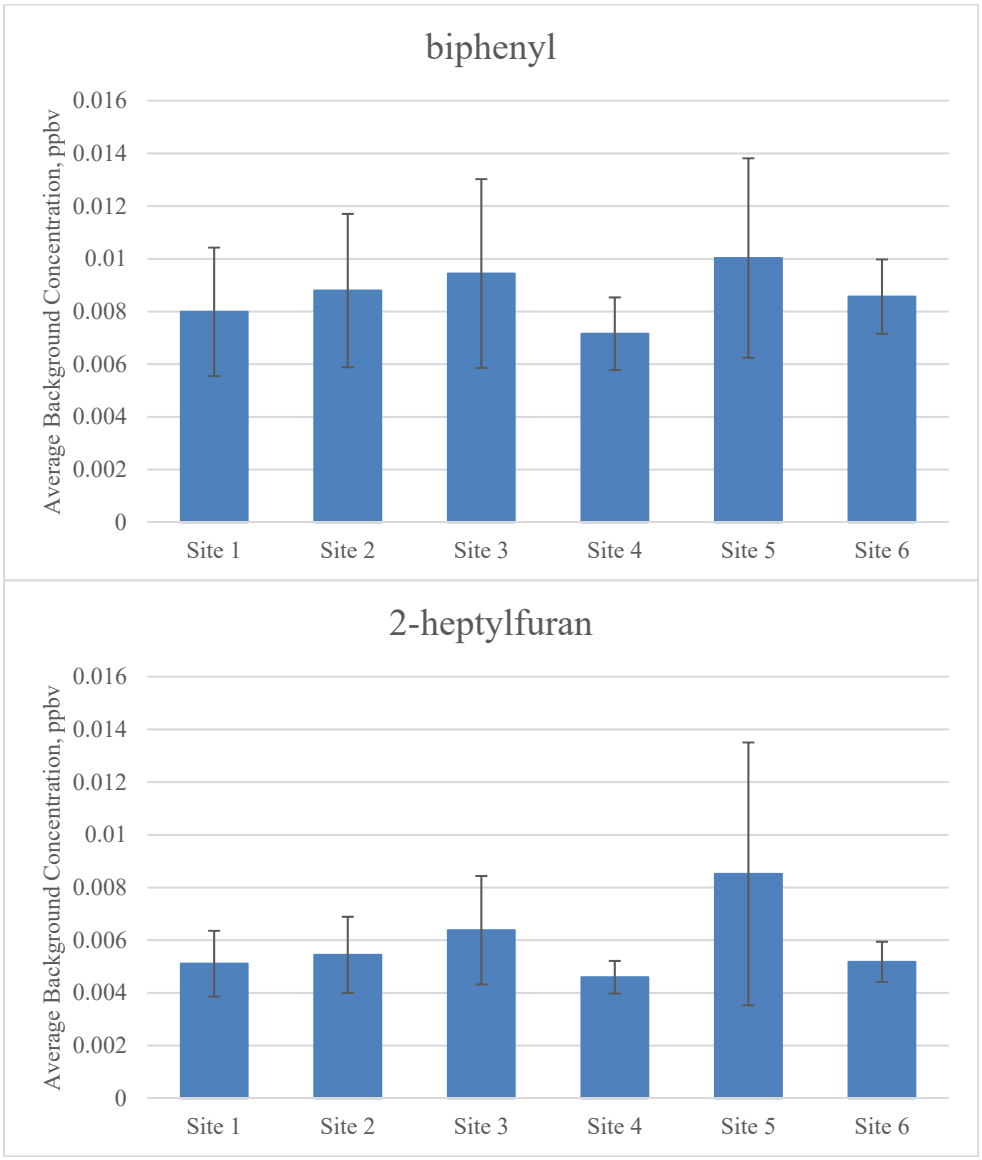

2,4-dimethylpyridine
Average Background Concentration, ppbv
0.016
0.014
0.012
0.01
0.008
0.006
0.004
0.002
0
Site 1
Site 2
Site 3
Site 4
Site 5
Site 6
2-propylfuran + 2-ethyl-5-methylfuran
Average Background Concentration, ppbv
0.01
0.009
0.008
0.007
0.006
0.005
0.004
0.003
0.002
0.001
0
Site 1
Site 2
Site 3
Site 4
Site 5
Site 6

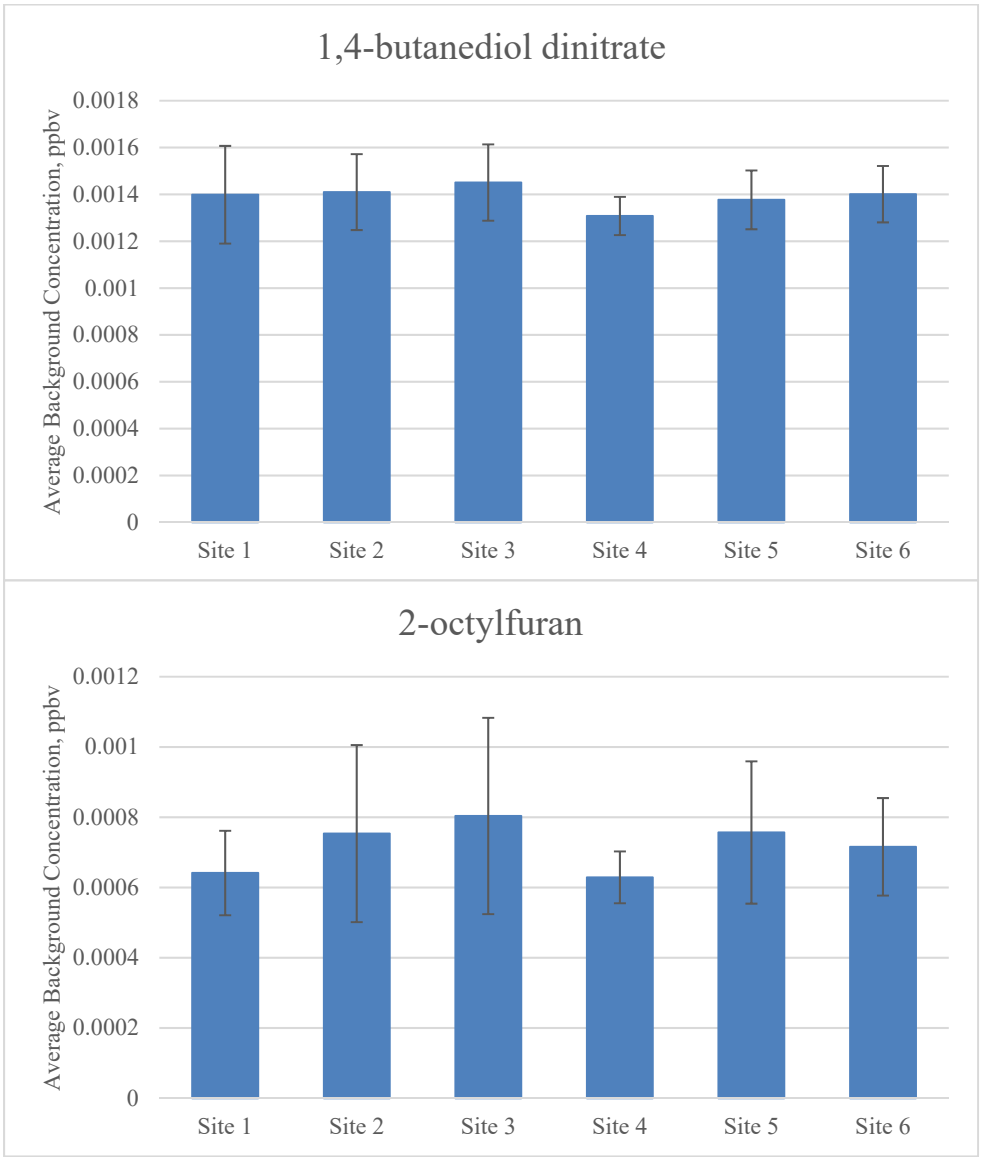

heptanenitrile
Average Background Concentration, ppbv
0.0035
0.003
0.0025
0.002
0.0015
0.001
0.0005
0
Site 1
Site 2
Site 3
Site 4
Site 5
Site 6
4-methyl-2-hexanone
Average Background Concentration, ppbv
0.06
0.05
0.04
0.03
0.02
0.01
0
Site 1
Site 2
Site 3
Site 4
Site 5
Site 6

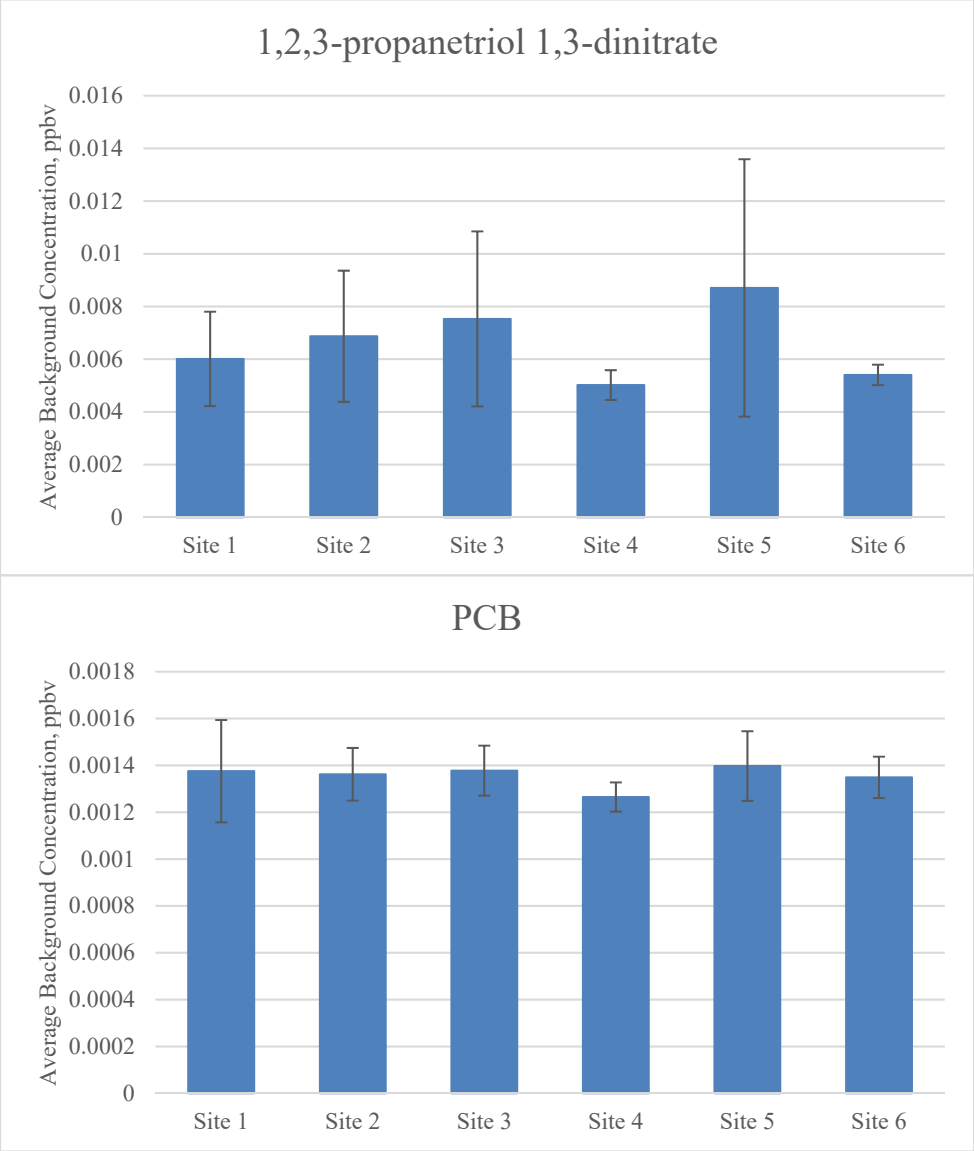

butyl nitrate
Average Background Concentration, ppbv
0.0018
0.0016
0.0014
0.0012
0.001
0.0008
0.0006
0.0004
0.0002
0
Site 1
Site 2
Site 3
Site 4
Site 5
Site 6

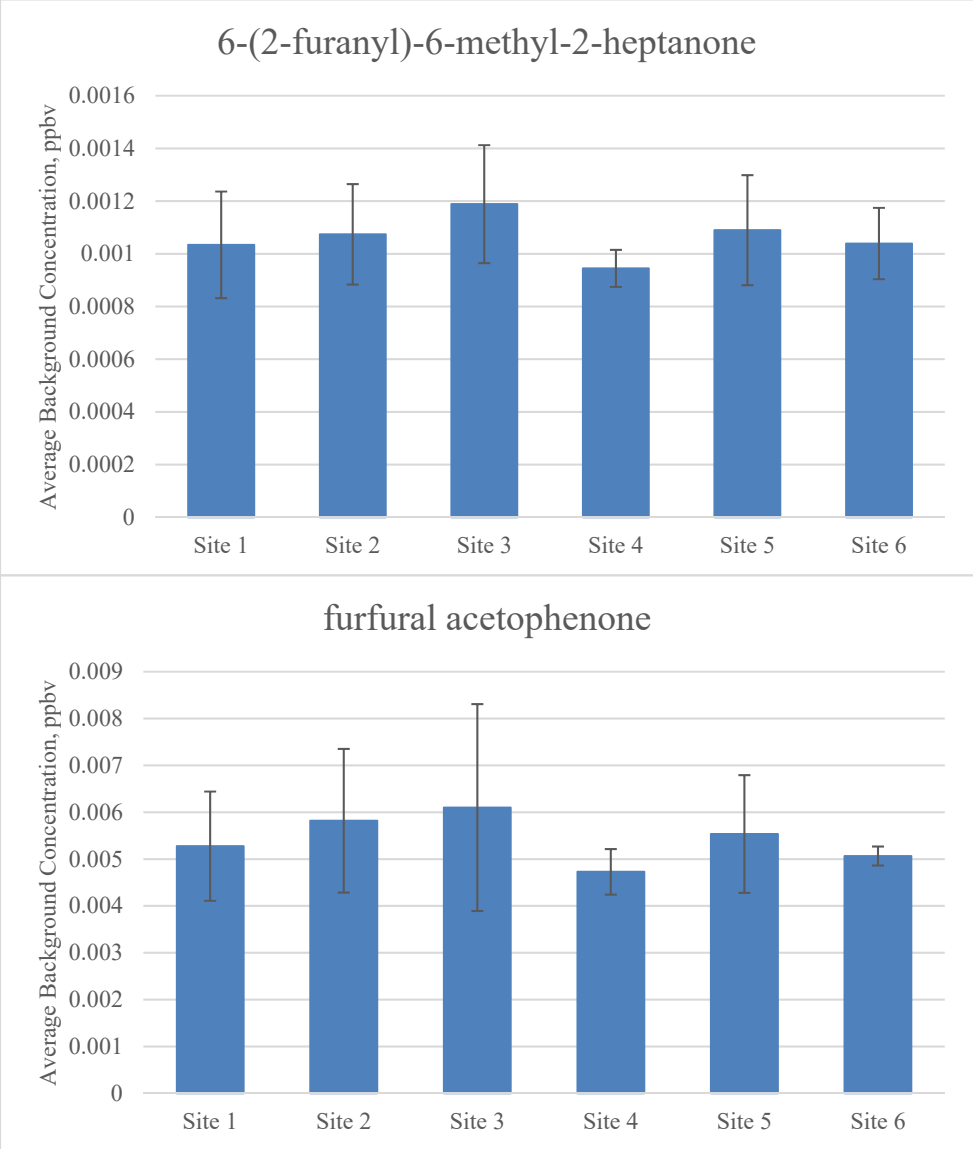

2-ethyl-2-hexenal + 4-(1-methylpropyl)-2,3-dihydrofuran + 3-(1,1-dimethylethyl)-2,3-dihydrofuran
Average Background Concentration, ppbv
0.014
0.012
0.01
0.008
0.006
0.004
0.002
0
Site 1
Site 2
Site 3
Site 4
Site 5
Site 6

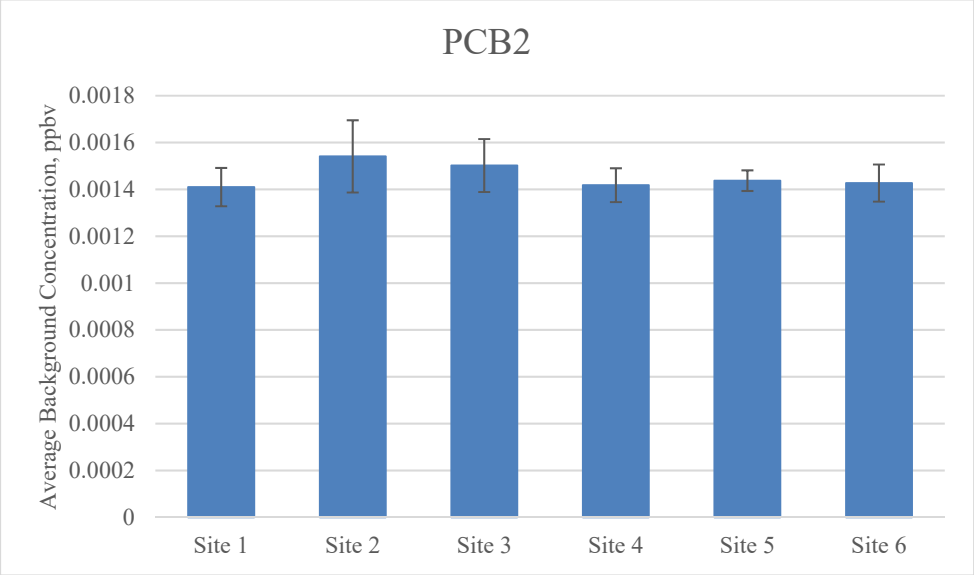

6-methyl-2-heptanone
Average Background Concentration, ppbv
0.012
0.01
0.008
0.006
0.004
0.002
0
Site 1
Site 2
Site 3
Site 4
Site 5
Site 6
2-pentylfuran
Average Background Concentration, ppbv
0.025
0.02
0.015
0.01
0.005
0
Site 1
Site 2
Site 3
Site 4
Site 5
Site 6


biphenyl
Average Background Concentration, ppbv
0.016
0.014
0.012
0.01
0.008
0.006
0.004
0.002
0
Site 1
Site 2
Site 3
Site 4
Site 5
Site 6
2-heptylfuran
Average Background Concentration, ppbv
0.016
0.014
0.012
0.01
0.008
0.006
0.004
0.002
0
Site 1
Site 2
Site 3
Site 4
Site 5
Site 6


1,4-butanediol dinitrate
Average Background Concentration, ppbv
0.0018
0.0016
0.0014
0.0012
0.001
0.0008
0.0006
0.0004
0.0002
0
Site 1
Site 2
Site 3
Site 4
Site 5
Site 6
2-octylfuran
Average Background Concentration, ppbv
0.0012
0.001
0.0008
0.0006
0.0004
0.0002
0
Site 1
Site 2
Site 3
Site 4
Site 5
Site 6

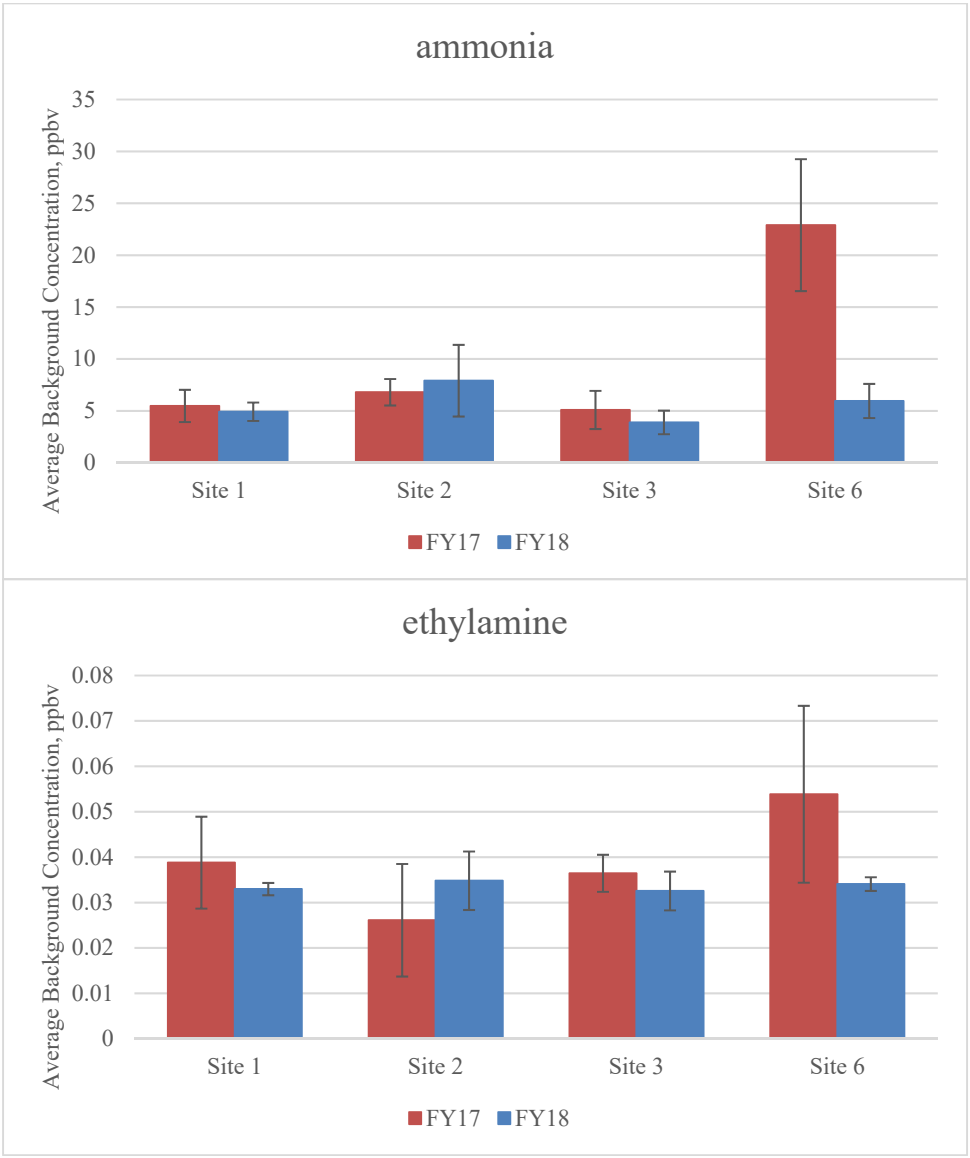

1,2,3-propanetriol 1,3-dinitrate
Average Background Concentration, ppbv
0.016
0.014
0.012
0.01
0.008
0.006
0.004
0.002
0
Site 1
Site 2
Site 3
Site 4
Site 5
Site 6
PCB
Average Background Concentration, ppbv
0.0018
0.0016
0.0014
0.0012
0.001
0.0008
0.0006
0.0004
0.0002
0
Site 1
Site 2
Site 3
Site 4
Site 5
Site 6

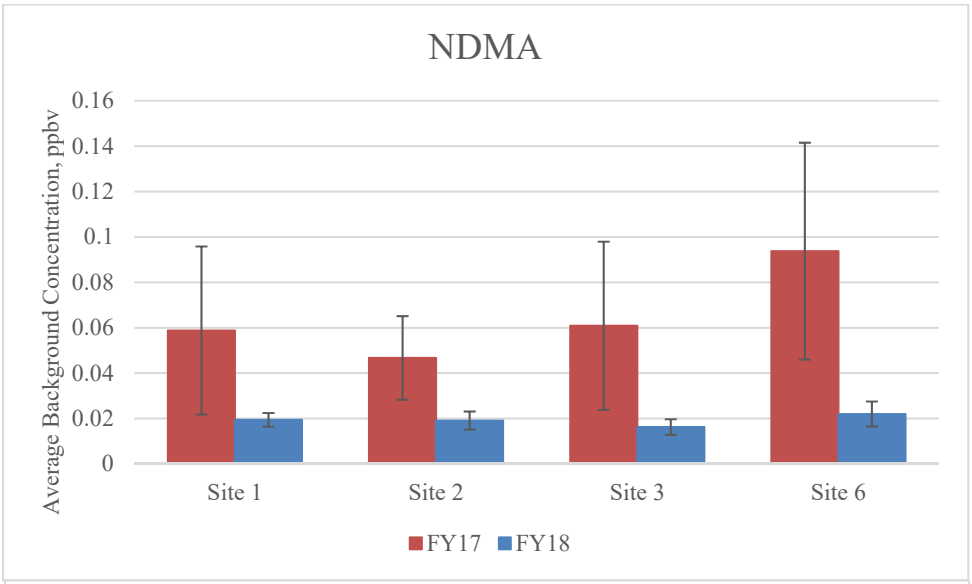

6-(2-furanyl)-6-methyl-2-heptanone
Average Background Concentration, ppbv
0.0016
0.0014
0.0012
0.001
0.0008
0.0006
0.0004
0.0002
0
Site 1
Site 2
Site 3
Site 4
Site 5
Site 6
furfural acetophenone
Average Background Concentration, ppbv
0.009
0.008
0.007
0.006
0.005
0.004
0.003
0.002
0.001
0
Site 1
Site 2
Site 3
Site 4
Site 5
Site 6

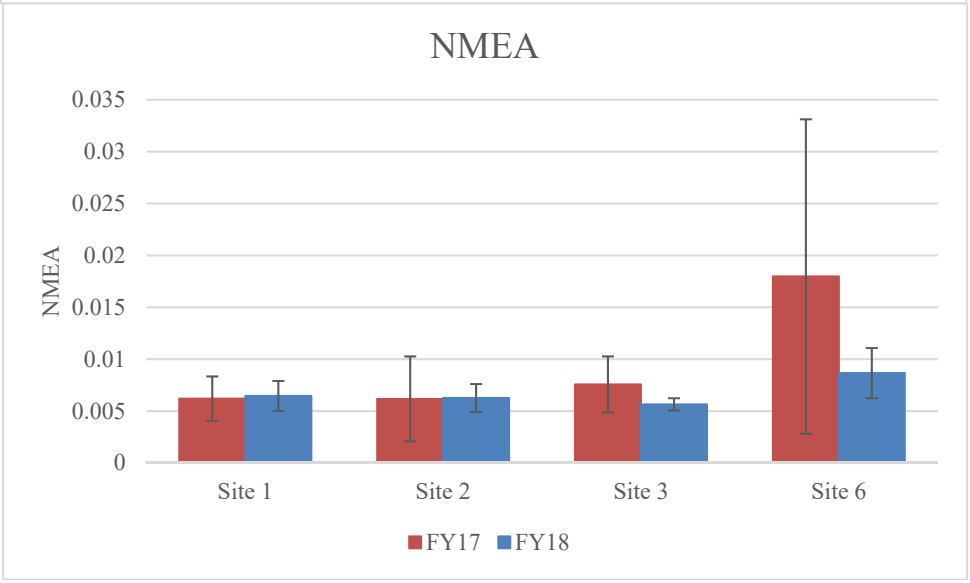

PCB2
Average Background Concentration, ppbv
0.0018
0.0016
0.0014
0.0012
0.001
0.0008
0.0006
0.0004
0.0002
0
Site 1
Site 2
Site 3
Site 4
Site 5
Site 6

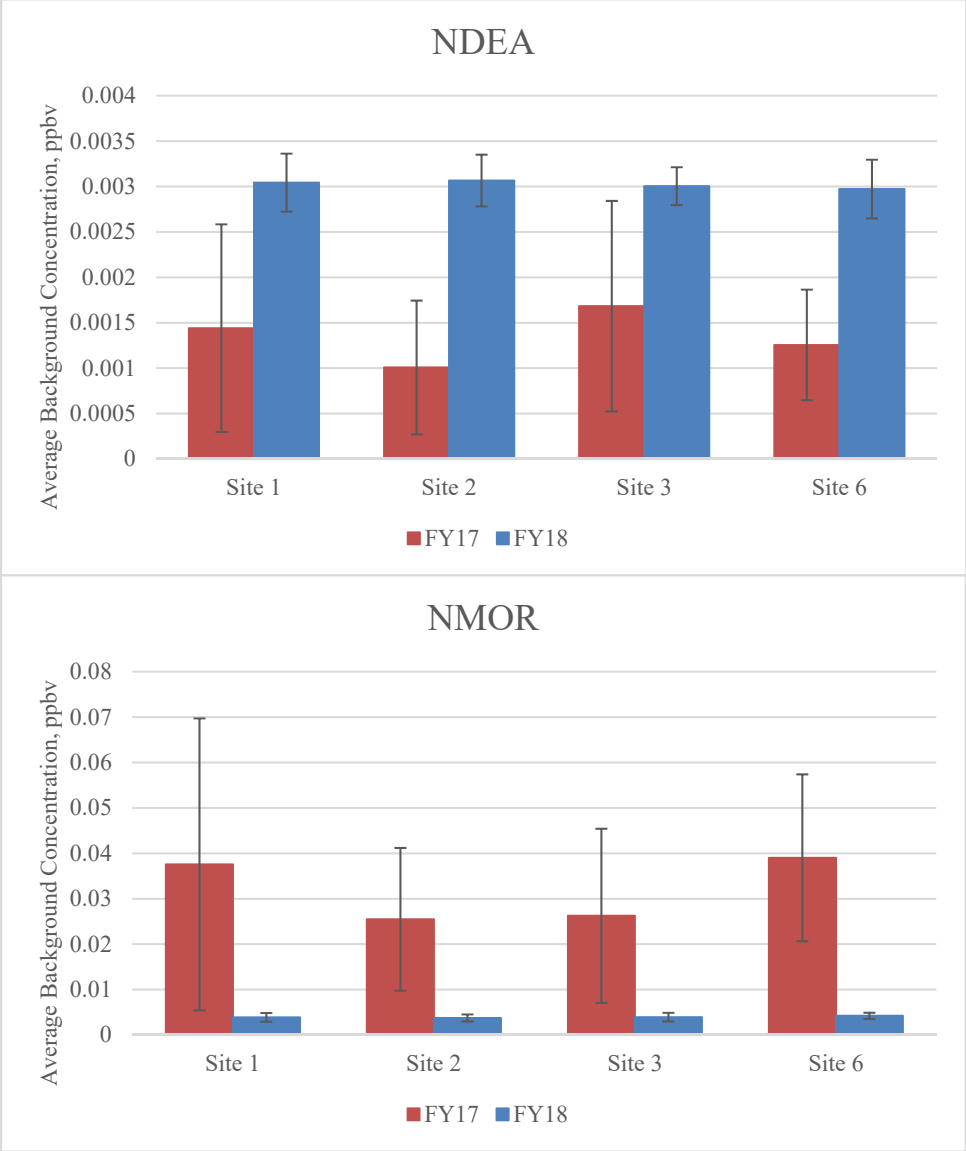
APPENDIX C

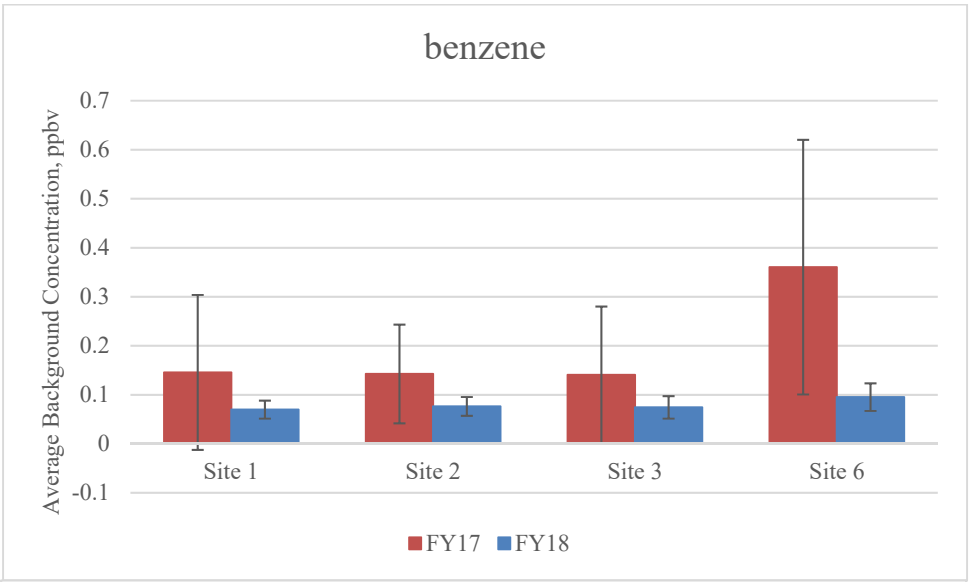
COMPARISON TO FY17 STUDY ADDITIONAL PLOTS

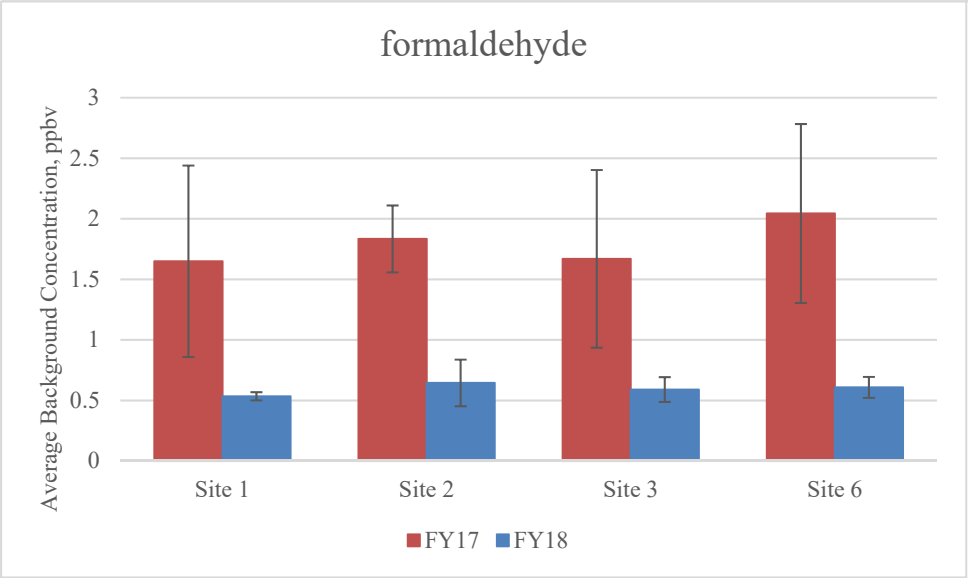

ammonia
Average Background Concentration, ppbv
35
30
25
20
15
10
5
0
Site 1
Site 2
Site 3
Site 6
FY17
FY18
ethylamine
Average Background Concentration, ppbv
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
Site 1
Site 2
Site 3
Site 6
FY17
FY18

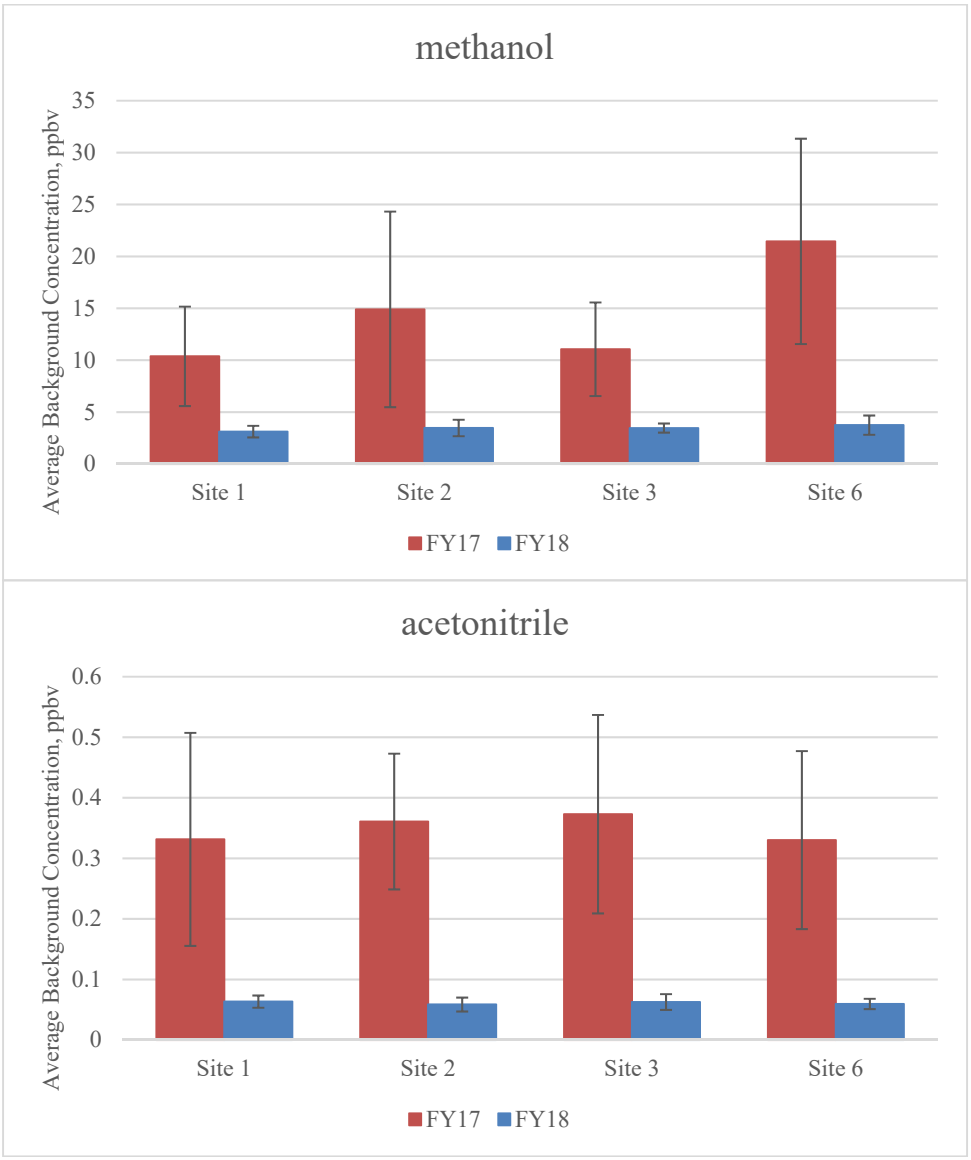

NDMA
Average Background Concentration, ppbv
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
Site 1
Site 2
Site 3
Site 6
FY17
FY18

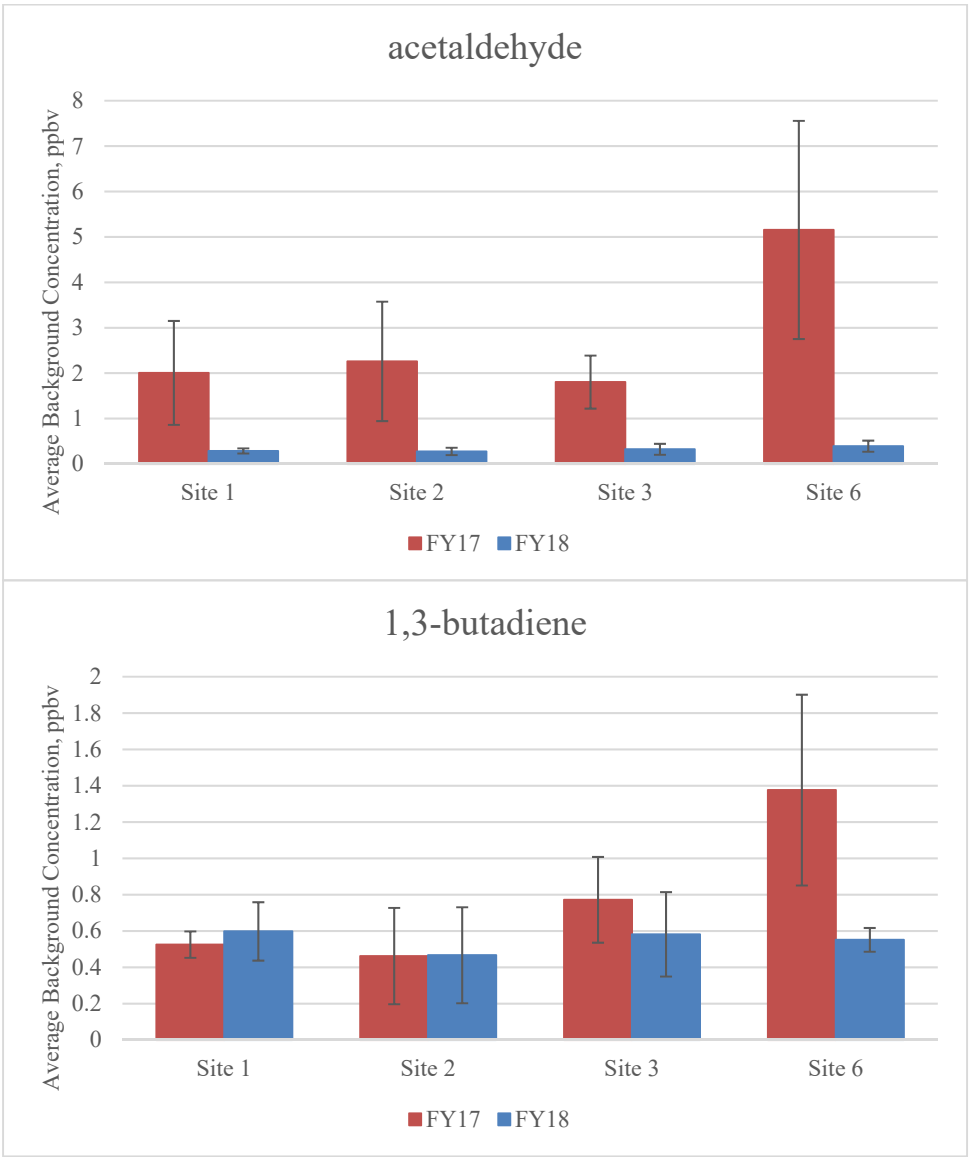

NMEA
NMEA
0.035
0.03
0.025
0.02
0.015
0.01
0.005
0
Site 1
Site 2
Site 3
Site 6
FY17
FY18

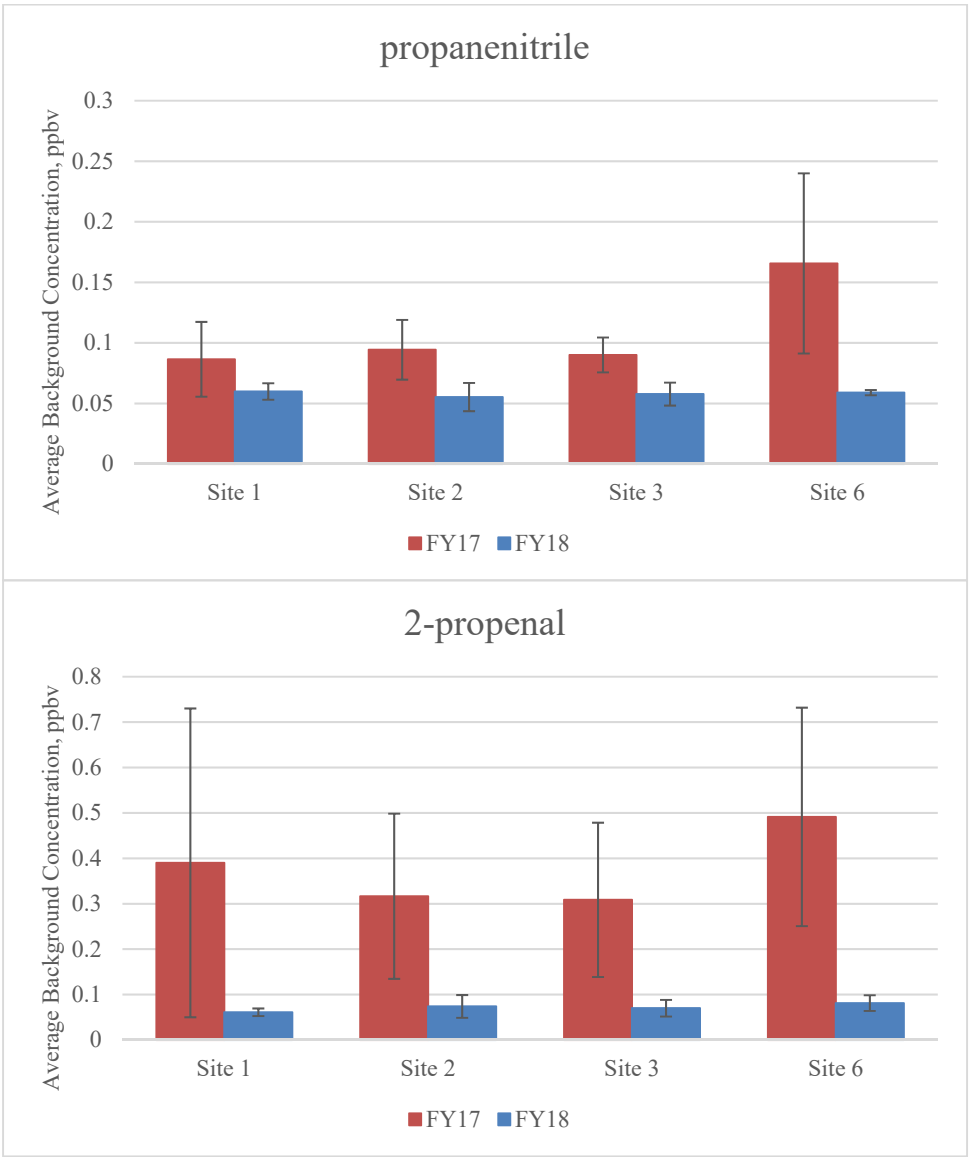

NDEA
Average Background Concentration, ppbv
0.004
0.0035
0.003
0.0025
0.002
0.0015
0.001
0.0005
0
Site 1
Site 2
Site 3
Site 6
FY17
FY18
NMOR
Average Background Concentration, ppbv
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
Site 1
Site 2
Site 3
Site 6
FY17
FY18

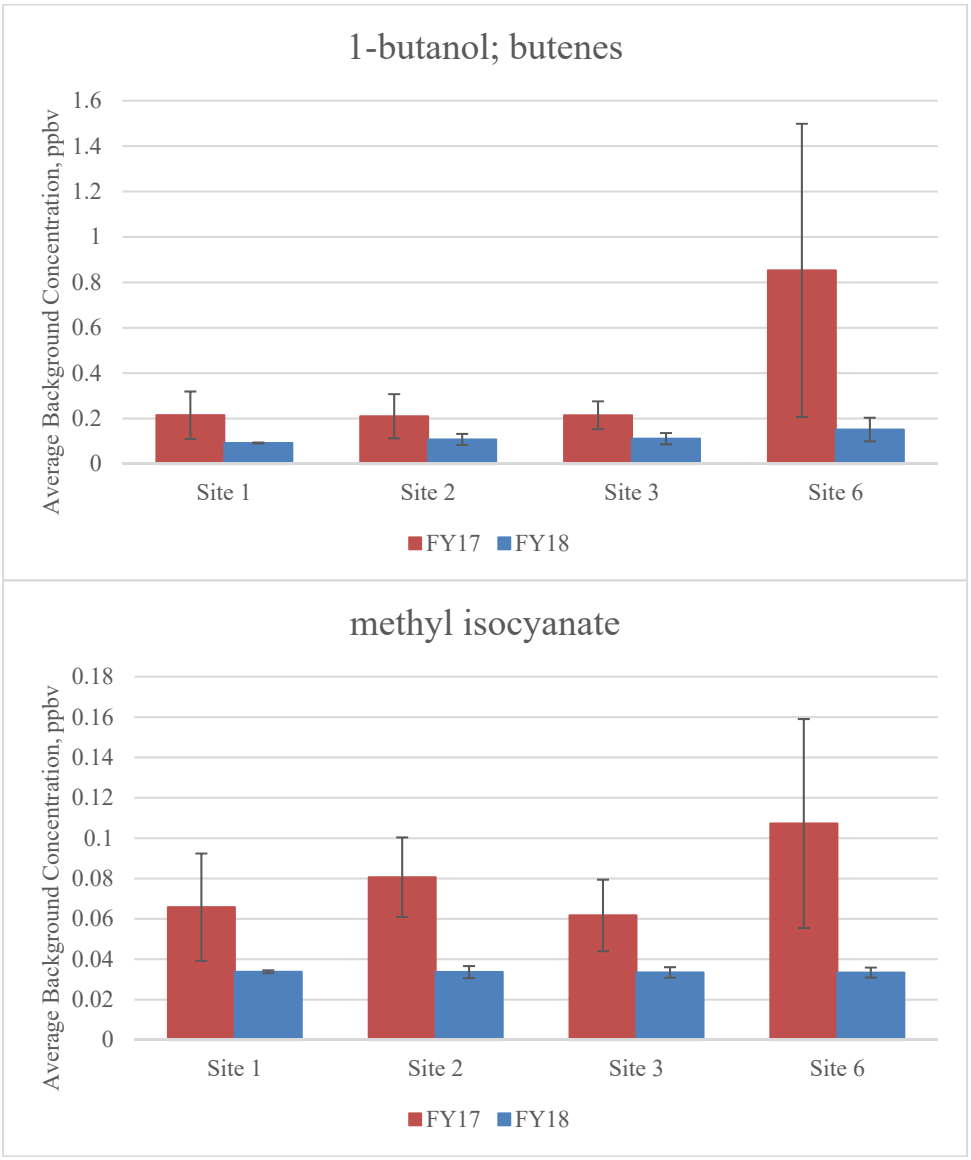

benzene
Average Background Concentration, ppbv
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
-0.1
Site 1
Site 2
Site 3
Site 6
FY17
FY18

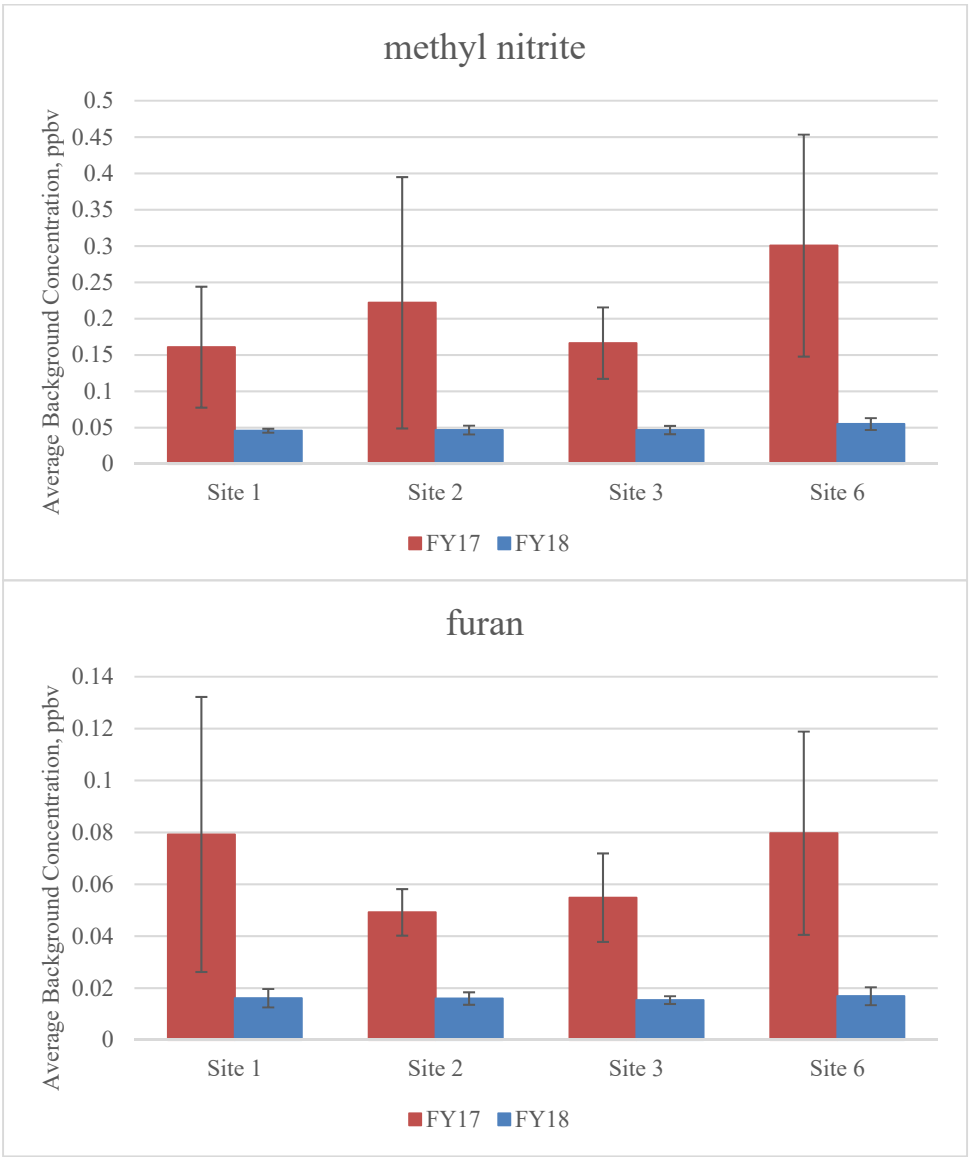

formaldehyde
Average Background Concentration, ppbv
3
2.5
2
1.5
1
0.5
0
Site 1
Site 2
Site 3
Site 6
FY17
FY18

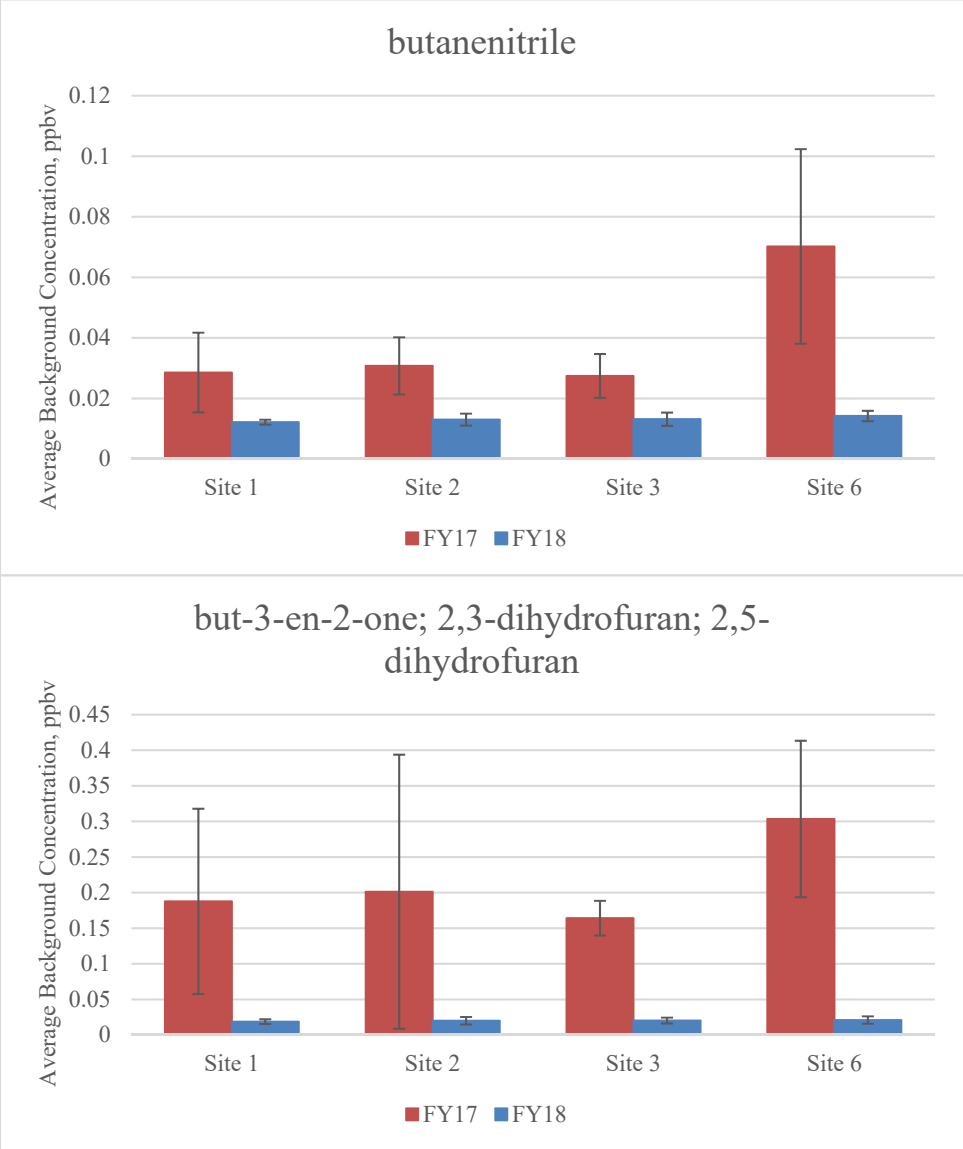

methanol
Average Background Concentration, ppbv
35
30
25
20
15
10
5
0
Site 1
Site 2
Site 3
Site 6
FY17
FY18
acetonitrile
Average Background Concentration, ppbv
0.6
0.5
0.4
0.3
0.2
0.1
0
Site 1
Site 2
Site 3
Site 6
FY17
FY18

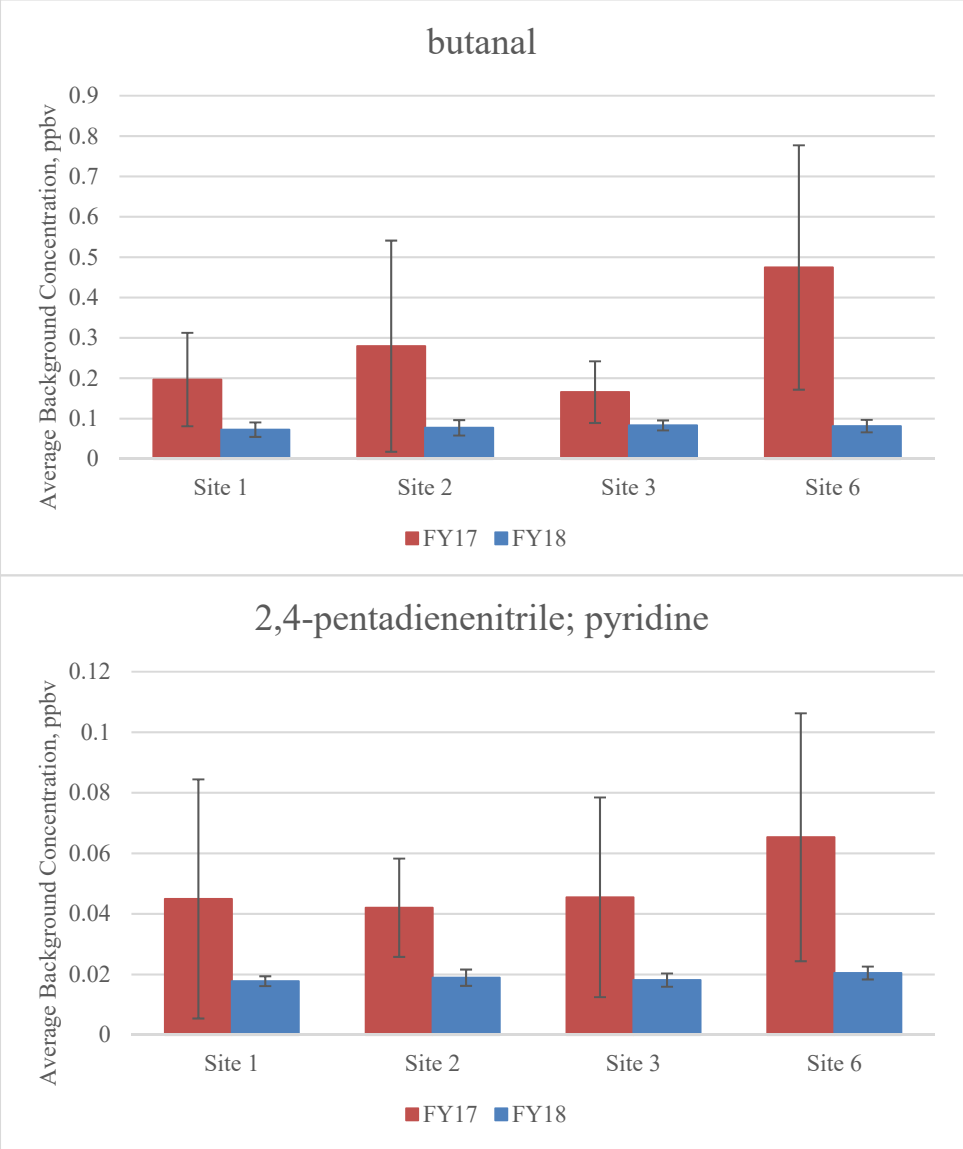

acetaldehyde
Average Background Concentration, ppbv
0
1
2
3
4
5
6
7
8
Site 1
Site 2
Site 3
Site 6
FY17
FY18
1,3-butadiene
Average Background Concentration, ppbv
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
Site 1
Site 2
Site 3
Site 6
FY17
FY18

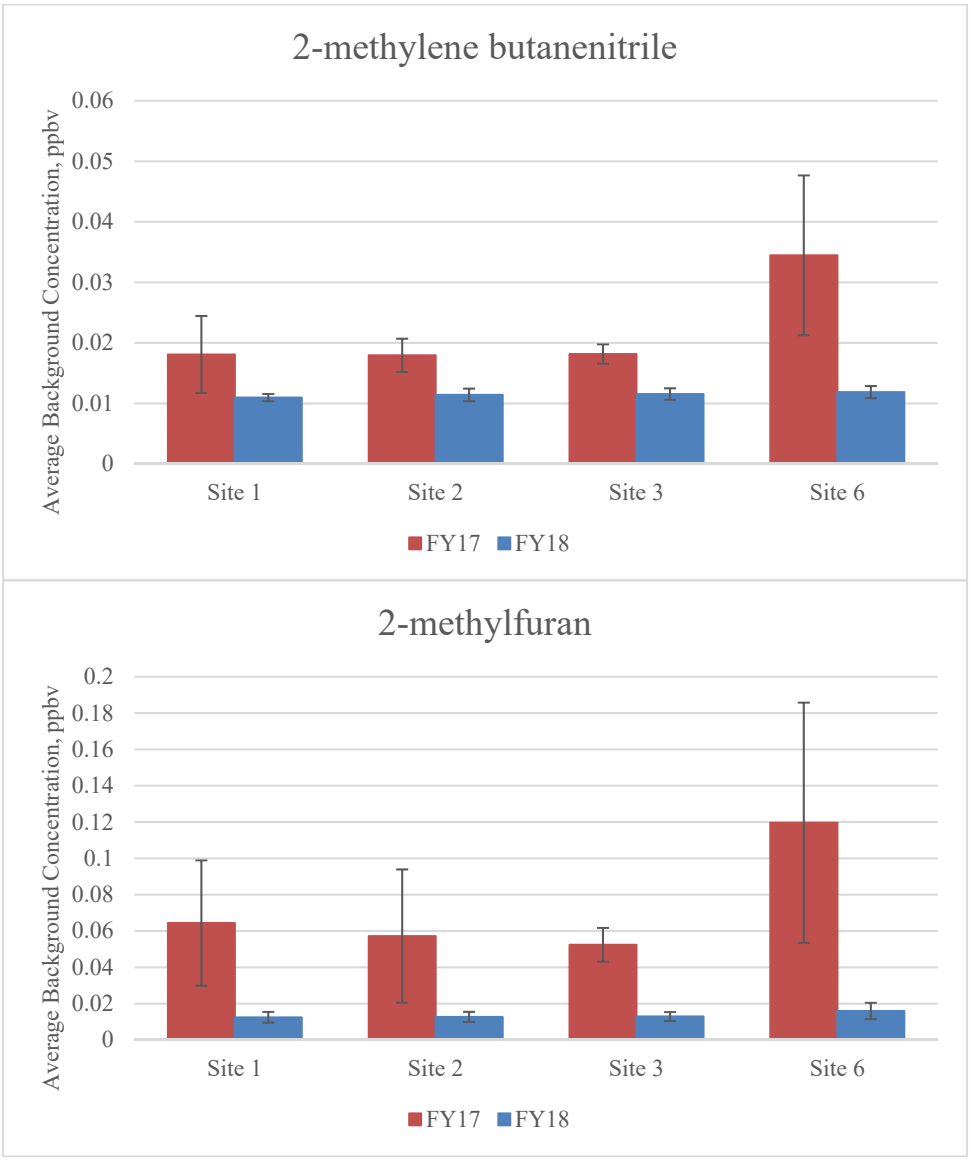

propanenitrile
Average Background Concentration, ppbv
0.3
0.25
0.2
0.15
0.1
0.05
0
Site 1
Site 2
Site 3
Site 6
FY17
FY18
2-propenal
Average Background Concentration, ppbv
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
Site 1
Site 2
Site 3
Site 6
FY17
FY18

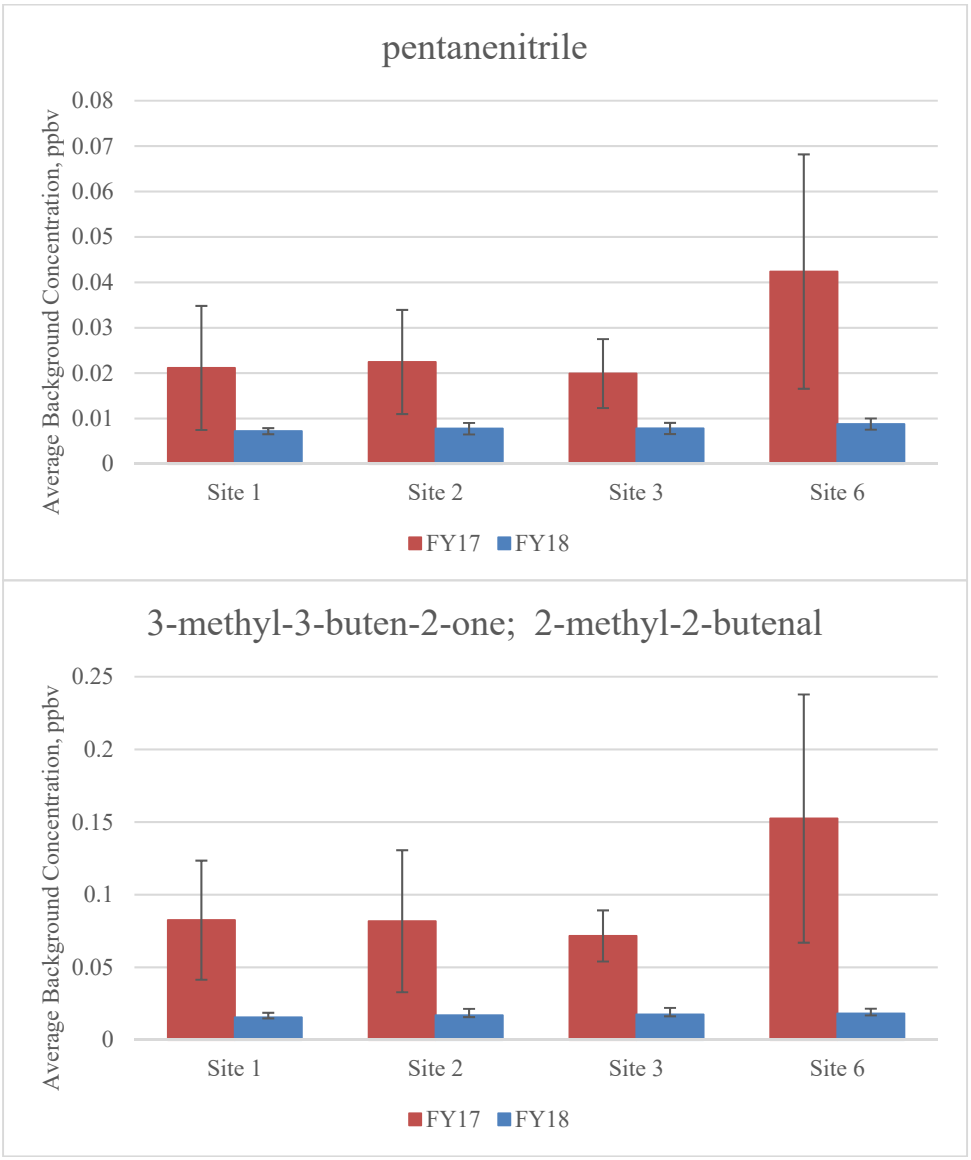

1-butanol; butenes
Average Background Concentration, ppbv
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
Site 1
Site 2
Site 3
Site 6
FY17
FY18
methyl isocyanate
Average Background Concentration, ppbv
0.18
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
Site 1
Site 2
Site 3
Site 6
FY17
FY18

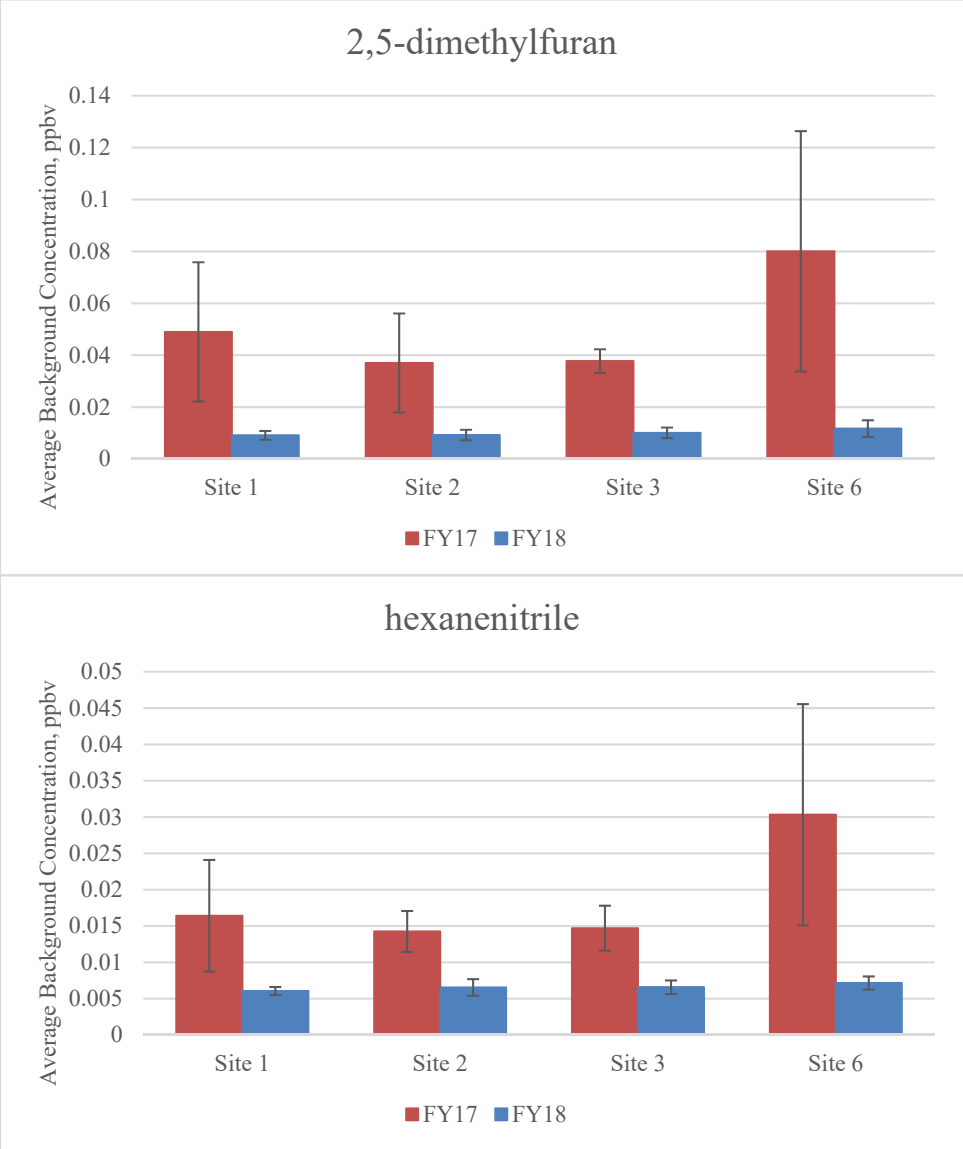

methyl nitrite
Average Background Concentration, ppbv
0.5
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
Site 1
Site 2
Site 3
Site 6
FY17
FY18
furan
Average Background Concentration, ppbv
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
Site 1
Site 2
Site 3
Site 6
FY17
FY18

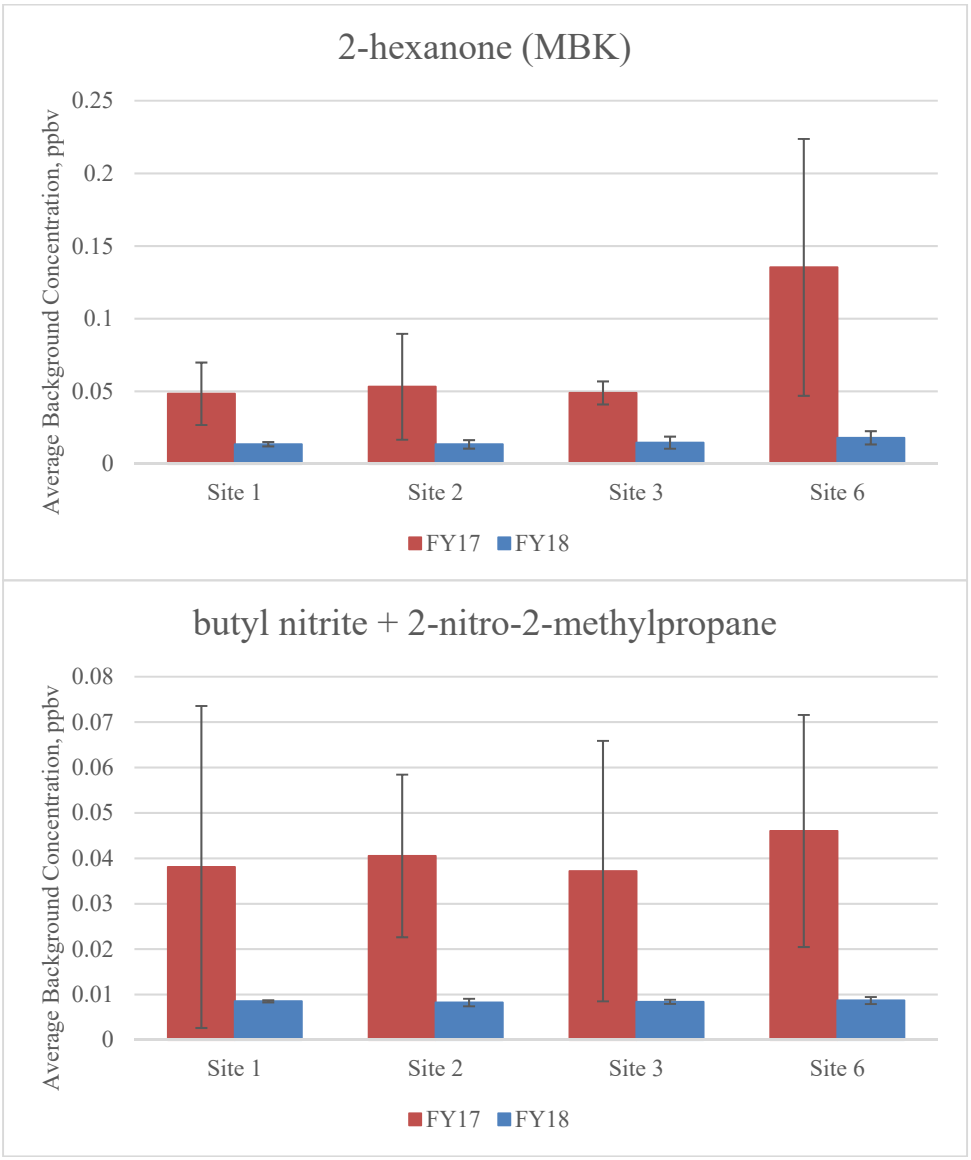

butanenitrile
Average Background Concentration, ppbv
0.12
0.1
0.08
0.06
0.04
0.02
0
Site 1
Site 2
Site 3
Site 6
FY17
FY18
but-3-en-2-one; 2,3-dihydrofuran; 2,5-dihydrofuran
Average Background Concentration, ppbv
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
Site 1
Site 2
Site 3
Site 6
FY17
FY18

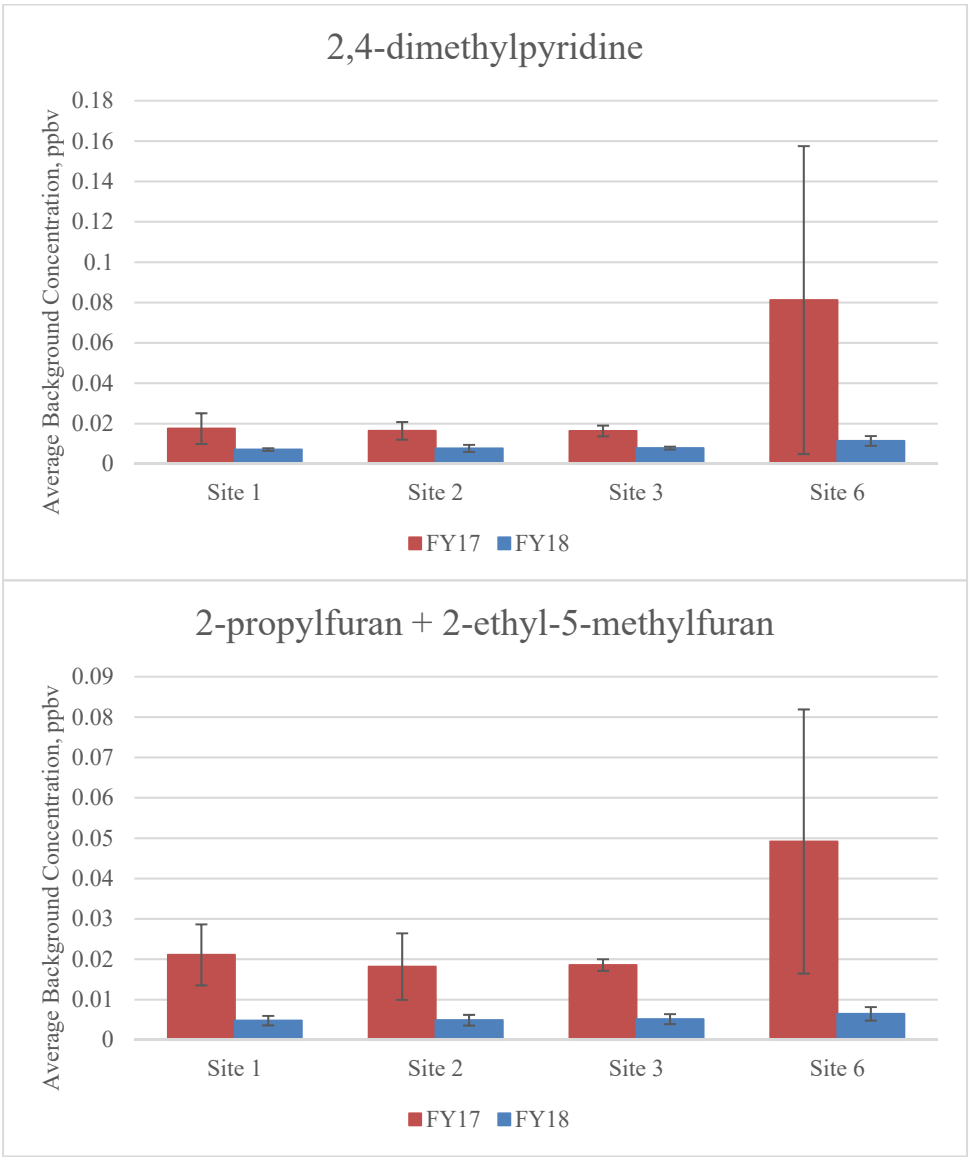

butanal
Average Background Concentration, ppbv
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
Site 1
Site 2
Site 3
Site 6
FY17
FY18
2,4-pentadienenitrile; pyridine
Average Background Concentration, ppbv
0.12
0.1
0.08
0.06
0.04
0.02
0
Site 1
Site 2
Site 3
Site 6
FY17
FY18

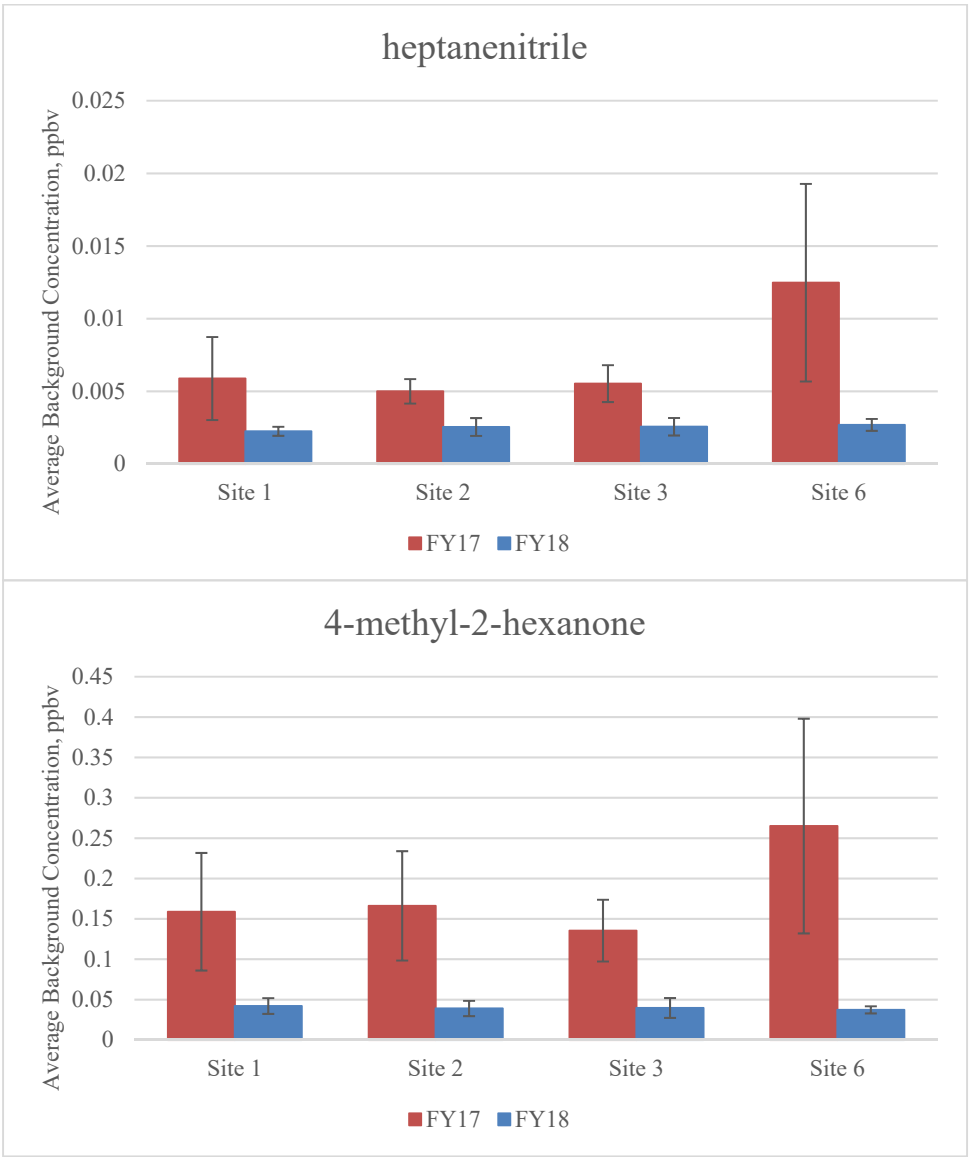

2-methylene butanenitrile
Average Background Concentration, ppbv
0.06
0.05
0.04
0.03
0.02
0.01
0
Site 1
Site 2
Site 3
Site 6
FY17
FY18
2-methylfuran
Average Background Concentration, ppbv
0.2
0.18
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
Site 1
Site 2
Site 3
Site 6
FY17
FY18

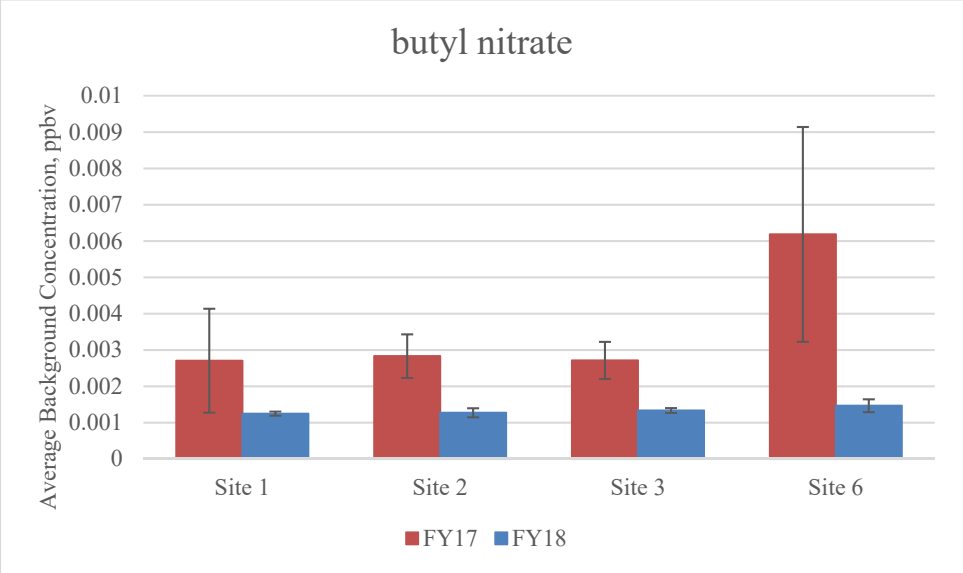

pentanenitrile
Average Background Concentration, ppbv
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
Site 1
Site 2
Site 3
Site 6
FY17
FY18
3-methyl-3-buten-2-one; 2-methyl-2-butenal
Average Background Concentration, ppbv
0.25
0.2
0.15
0.1
0.05
0
Site 1
Site 2
Site 3
Site 6
FY17
FY18

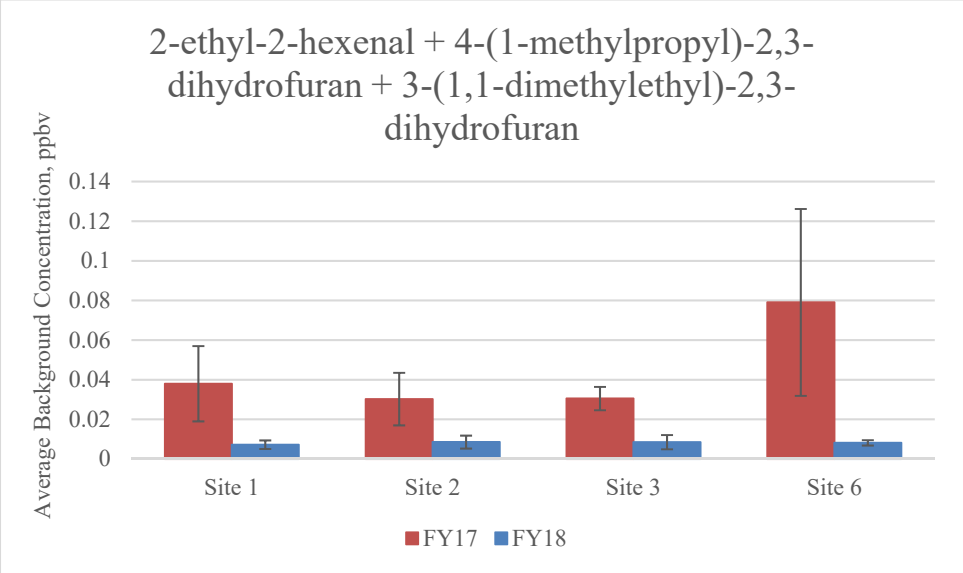

2,5-dimethylfuran
Average Background Concentration, ppbv
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
Site 1
Site 2
Site 3
Site 6
FY17
FY18
hexanenitrile
Average Background Concentration, ppbv
0.05
0.045
0.04
0.035
0.03
0.025
0.02
0.015
0.01
0.005
0
Site 1
Site 2
Site 3
Site 6
FY17
FY18

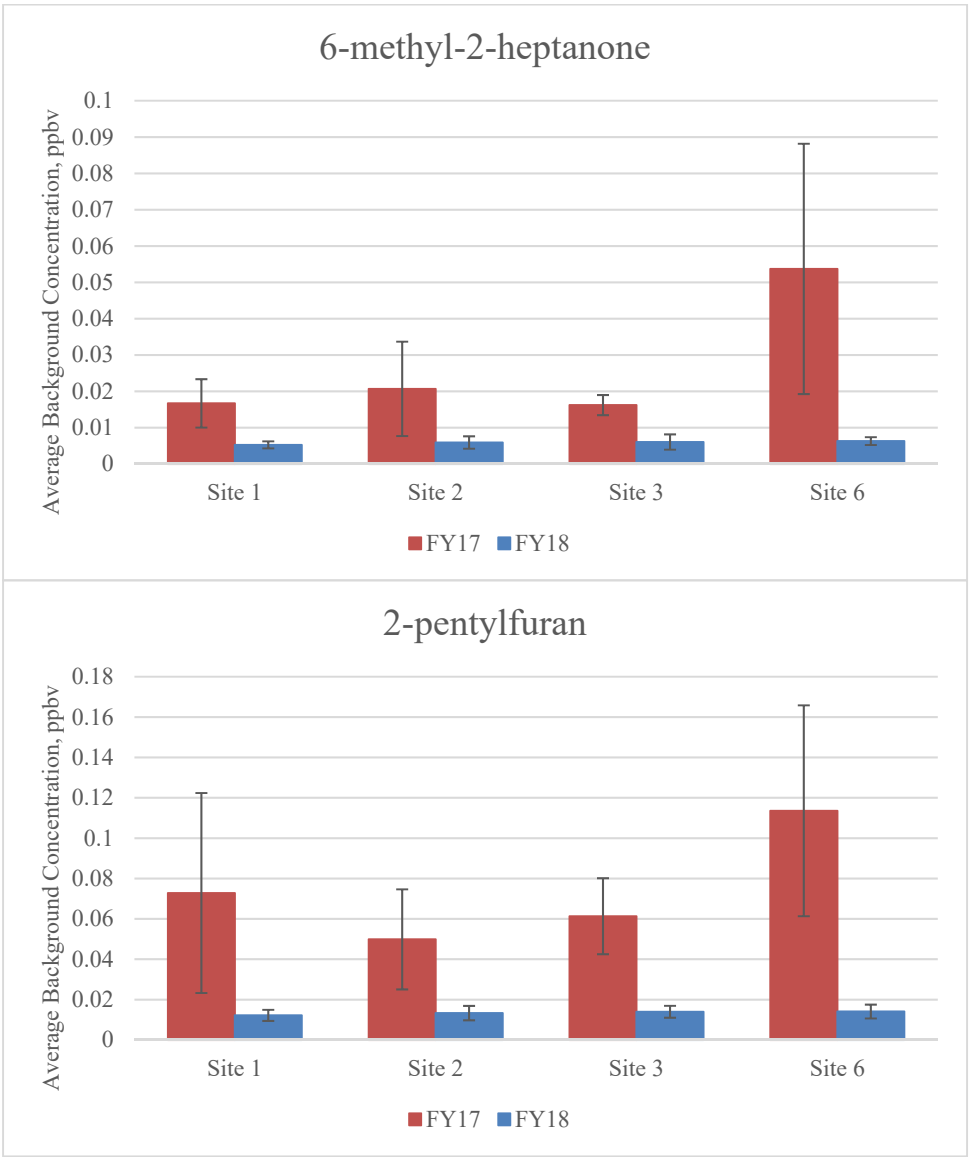

2-hexanone (MBK)
Average Background Concentration, ppbv
0.25
0.2
0.15
0.1
0.05
0
Site 1
Site 2
Site 3
Site 6
FY17
FY18
butyl nitrite + 2-nitro-2-methylpropane
Average Background Concentration, ppbv
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
Site 1
Site 2
Site 3
Site 6
FY17
FY18

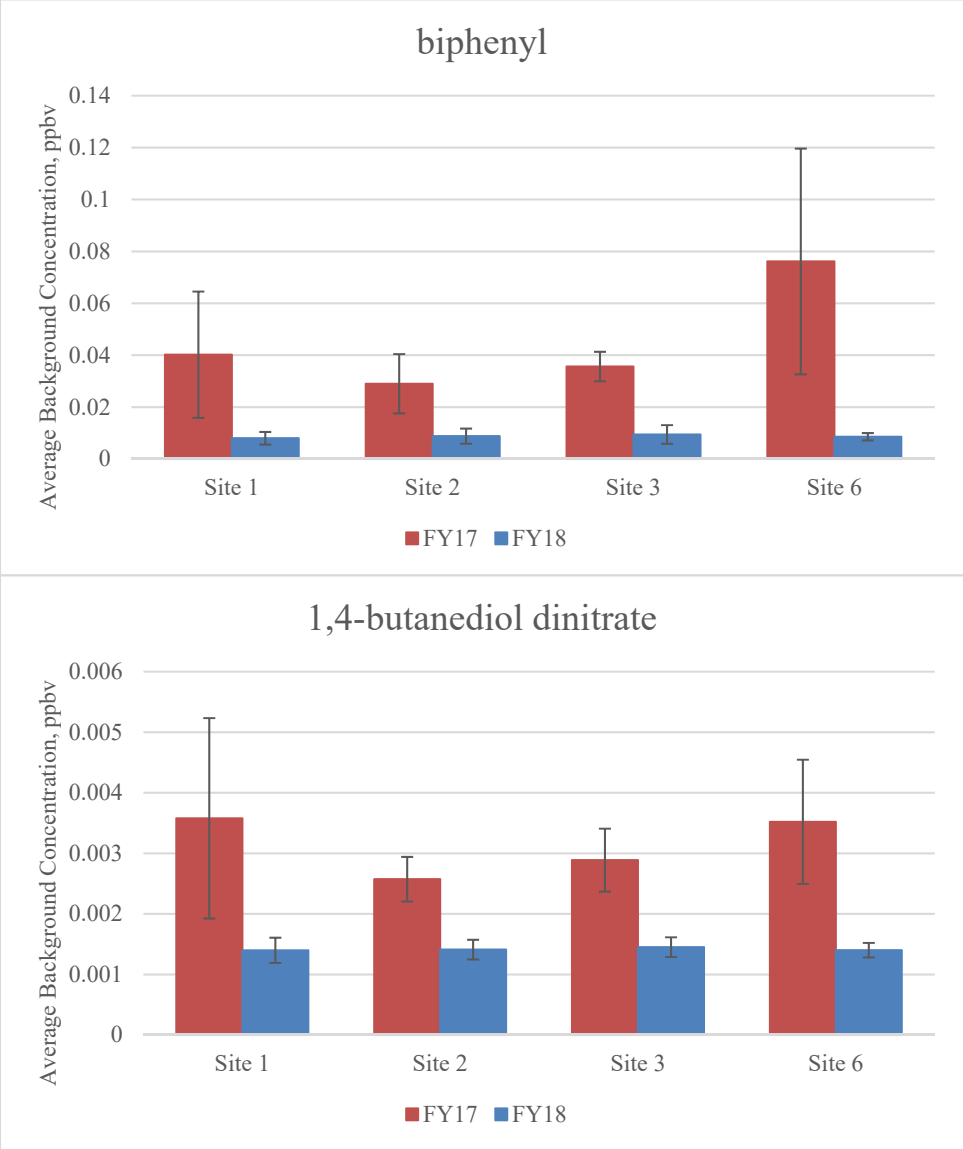

2,4-dimethylpyridine
Average Background Concentration, ppbv
0.18
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
Site 1
Site 2
Site 3
Site 6
FY17
FY18
2-propylfuran + 2-ethyl-5-methylfuran
Average Background Concentration, ppbv
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
Site 1
Site 2
Site 3
Site 6
FY17
FY18

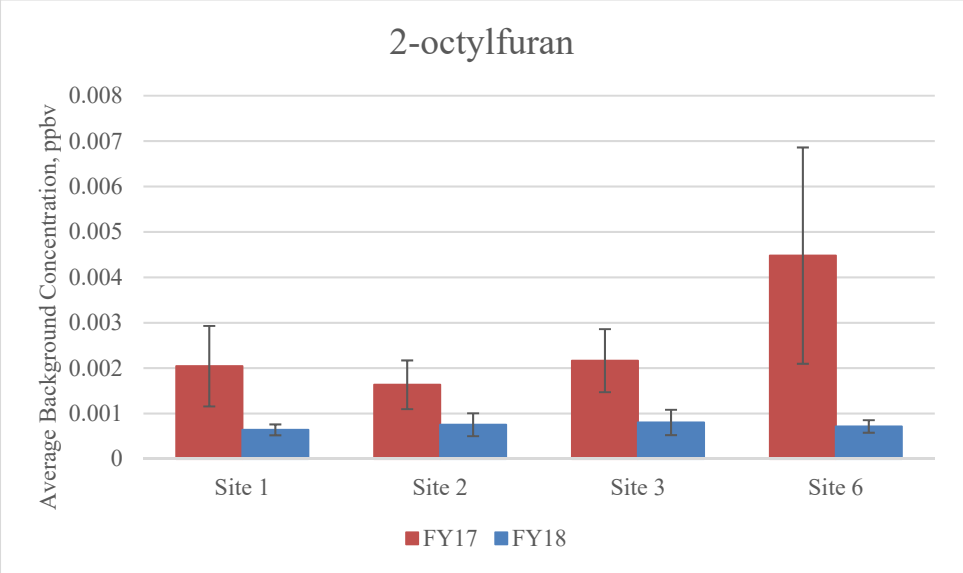

heptanenitrile
Average Background Concentration, ppbv
0.025
0.02
0.015
0.01
0.005
0
Site 1
Site 2
Site 3
Site 6
FY17
FY18
4-methyl-2-hexanone
Average Background Concentration, ppbv
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
Site 1
Site 2
Site 3
Site 6
FY17
FY18

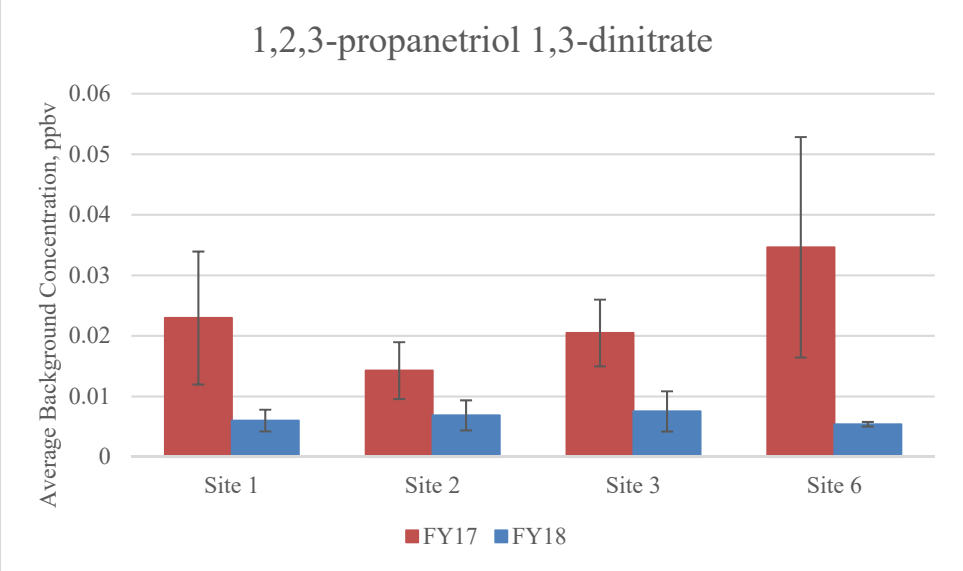

butyl nitrate
Average Background Concentration, ppbv
0.01
0.009
0.008
0.007
0.006
0.005
0.004
0.003
0.002
0.001
0
Site 1
Site 2
Site 3
Site 6
FY17
FY18

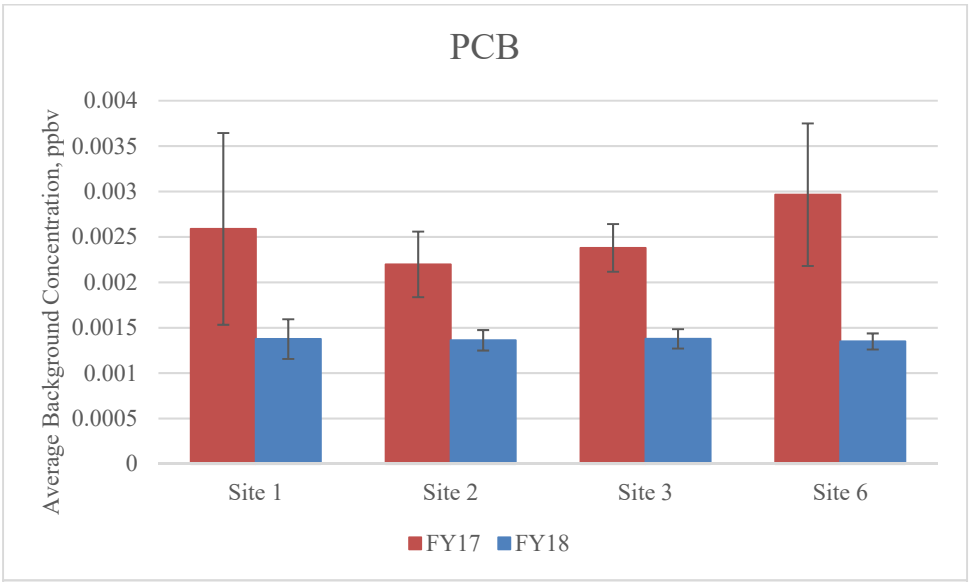

2-ethyl-2-hexenal + 4-(1-methylpropyl)-2,3-dihydrofuran + 3-(1,1-dimethylethyl)-2,3-dihydrofuran
Average Background Concentration, ppbv
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
Site 1
Site 2
Site 3
Site 6
FY17
FY18

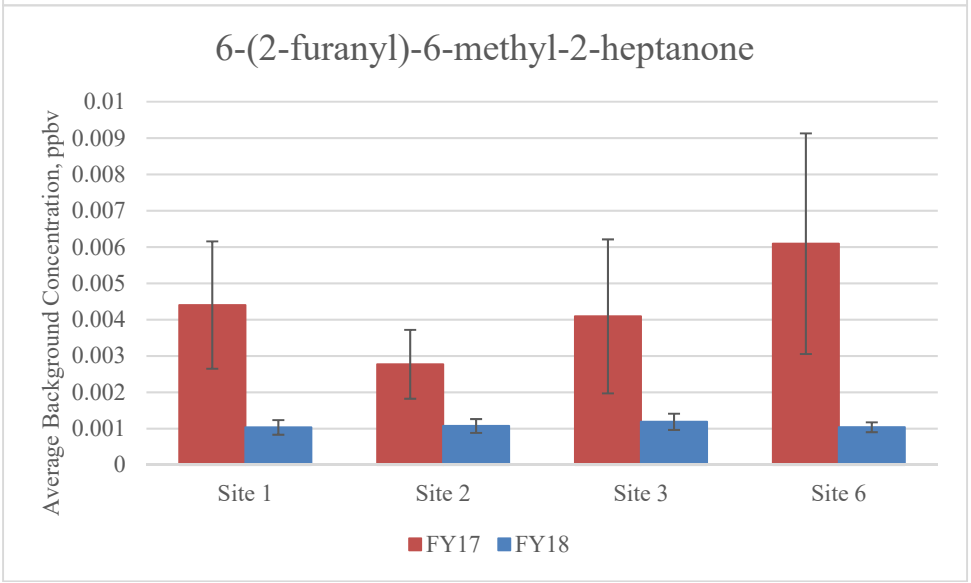

6-methyl-2-heptanone
Average Background Concentration, ppbv
0.1
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
Site 1
Site 2
Site 3
Site 6
FY17
FY18
2-pentylfuran
Average Background Concentration, ppbv
0.18
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
Site 1
Site 2
Site 3
Site 6
FY17
FY18

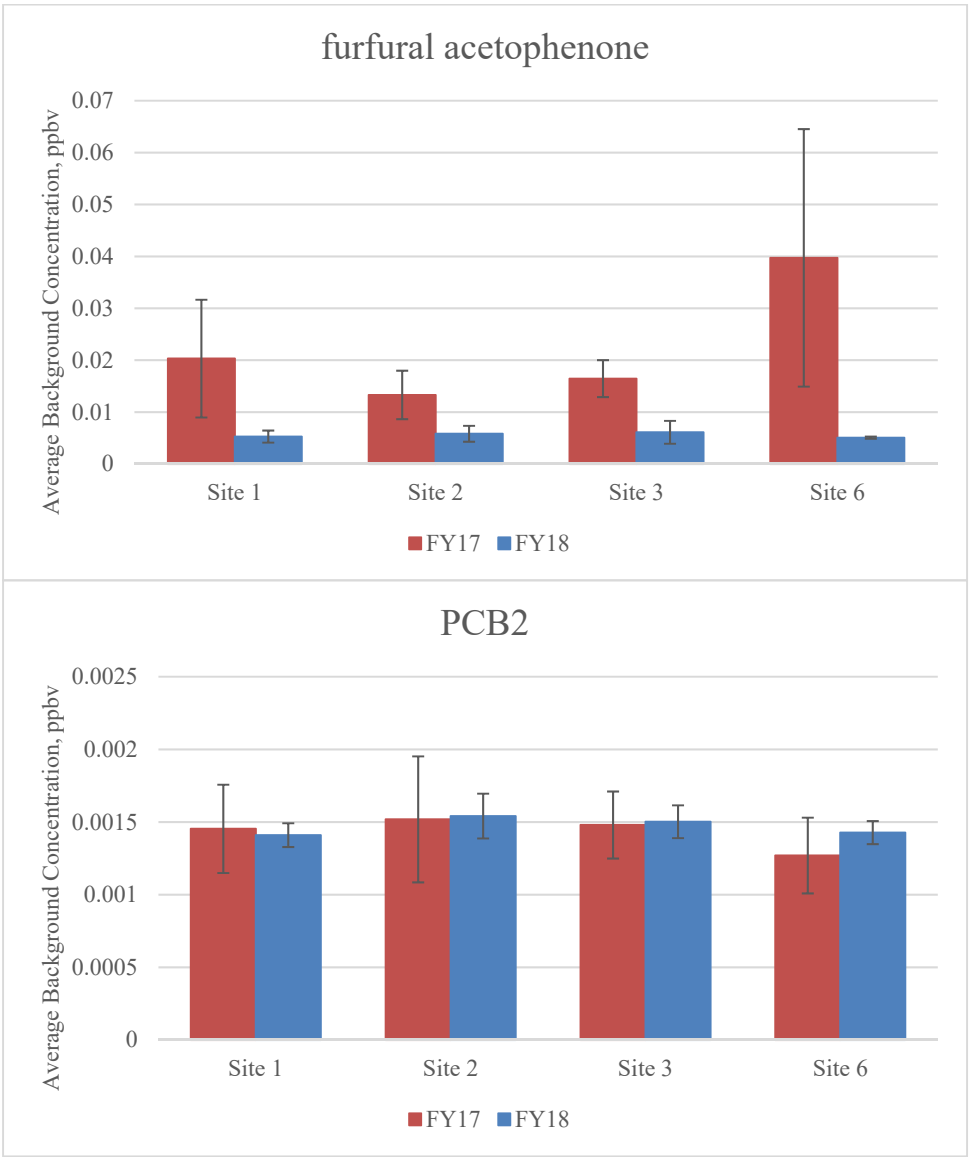

biphenyl
Average Background Concentration, ppbv
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
Site 1
Site 2
Site 3
Site 6
FY17
FY18
1,4-butanediol dinitrate
Average Background Concentration, ppbv
0.006
0.005
0.004
0.003
0.002
0.001
0
Site 1
Site 2
Site 3
Site 6
FY17
FY18

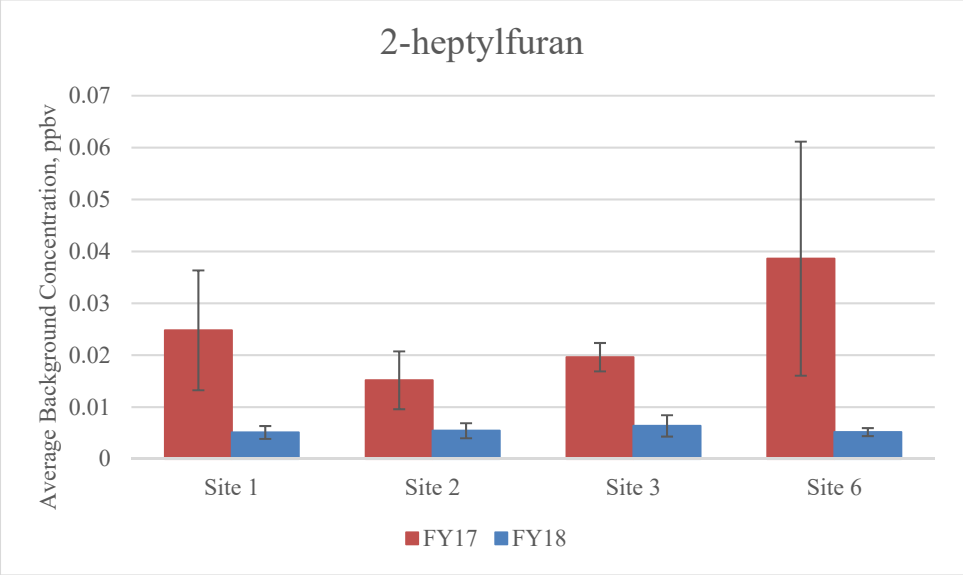

2-octylfuran
Average Background Concentration, ppbv
0.008
0.007
0.006
0.005
0.004
0.003
0.002
0.001
0
Site 1
Site 2
Site 3
Site 6
FY17
FY18


1,2,3-propanetriol 1,3-dinitrate
Average Background Concentration, ppbv
0.06
0.05
0.04
0.03
0.02
0.01
0
Site 1
Site 2
Site 3
Site 6
FY17
FY18


PCB
Average Background Concentration, ppbv
0.004
0.0035
0.003
0.0025
0.002
0.0015
0.001
0.0005
0
Site 1
Site 2
Site 3
Site 6
FY17
FY18


6-(2-furanyl)-6-methyl-2-heptanone
Average Background Concentration, ppbv
0.01
0.009
0.008
0.007
0.006
0.005
0.004
0.003
0.002
0.001
0
Site 1
Site 2
Site 3
Site 6
FY17
FY18


furfural acetophenone
Average Background Concentration, ppbv
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
Site 1
Site 2
Site 3
Site 6
FY17
FY18
PCB2
Average Background Concentration, ppbv
0.0025
0.002
0.0015
0.001
0.0005
0
Site 1
Site 2
Site 3
Site 6
FY17
FY18


2-heptylfuran
Average Background Concentration, ppbv
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
Site 1
Site 2
Site 3
Site 6
FY17
FY18