Statement of Work

Bountiful City Dichloromethane and Source Apportionment Study

Kerry Kelly (Co-PI), University of Utah
Jaron Hansen (Co-PI), Brigham Young University
Delbert Eatough (Emeritus Professor), Brigham Young University

Project Duration: July 1, 2018 – December 31, 2019

This Statement of Work (SOW) summarizes a source apportionment campaign with an emphasis on determination of the source of dichloromethane in Bountiful City from December 2018-January 2019. Supporting measurements of $PM_{2.5}$ concentration and composition will be provided as part of this effort.

Background:

The Utah Division of Air Quality is charged with protecting Utah's public health through the enforcement of federal and local air quality regulations. The federal government has set standards for a range of gas phase pollutants classified as Hazardous Air Pollutants (HAPs). Most of these pollutants are detected in low concentrations in Utah. Since 2002 the Bountiful monitoring site has served as one location in the nationwide National Ambient Air Toxics Stations network (NAATS). The Utah Division of Air Quality (DAQ) has collected HAP concentrations at the Bountiful site on an every six day, 24-hour basis since 2003, and in 2014 the DAQ conducted a comparison study designed to measure the impact of local industries on a range of HAPs including formaldehyde and dichloromethane. Beginning in 2013, the Bountiful station began to experience elevated levels of formaldehyde during the winter. The mean formaldehyde concentrations at Bountiful exceed both the non-cancer risk threshold and the 1 in 1 million cancer risk threshold. Additionally, the Bountiful mean formaldehyde concentrations are more than double those at the Lindon and West Valley locations based on the DAQ 2014 study.

Beginning in 2008, the Bountiful site has also shown sporadic but high concentrations of dichloromethane. These occur year round, and the concentrations of dichloromethane exceed the health-relevant thresholds in more than 5% of the samples collected in a year. The measurements made in Bountiful were compared to similar measurements made in Phoenix, AZ. Phoenix, AZ was chosen for a comparison city based on its similarity to Utah's climate but absence of oil refining industries that are located in Bountiful. Comparison of these two cities showed the HAP concentrations were similar suggesting that oil refining had little impact on the differences observed in dichloromethane concentrations. Prior to October 2008 concentrations of dichloromethane were all below 0.3 ppb. Evaluation of these data between 2005 and 2015 revealed that after 2008 more than a half of Bountiful's methylene chloride measurements exceeded the cancer risk threshold of 0.3 ppb. On March 28, 2015, methylene chloride levels reached 291 ppbv, nearly 500 times the cancer risk threshold. However, the source of this dichloromethane has not been revealed in special studies completed to date.

Proposed Scope of Work:
We propose a two-part study to explore the use of PMF Source Apportionment to identify the possible source(s) of dichloromethane in Bountiful, UT. Each of the PMF studies will focus on identifying sources of formaldehyde and dichloromethane.

Part 1. The University of Utah (UofU) will perform a PMF analysis of the historical data. Data in the PMF model will include the 24-hour average measurements of dichloromethane, other National Air Toxics Assessment (NATA) measurements, corresponding concentrations of fine particulate material (from FDMS TEOM measurements), fine particulate composition (from SAS measurements) and any gas phase data available (NO_X, NO_2 CO, O_3, etc.). The DAQ will be responsible for providing the data set and will provide guidance to the UofU as they quality assure the data and develop estimates of uncertainty as well as other species that may correlate with dichloromethane and potentially aid in identifying the source. This PMF analysis will evaluate seasonal differences in formaldehyde and dichloromethane. For formaldehyde, it will seek to understand HAP patterns prior to 2013 and after 2013 (until the most recent data available as of y/1/2018). For methylene chloride, it will also seek to understand HAP patterns prior to 2008 (2003 to 2007) and after 2008 (2008 to the most recent data available).

Part 2. Starting about December 2018, BYU will direct a six-week intensive campaign measuring the above plus additional components on an hourly basis. This will include the hourly average measurement of formaldehyde, dichloromethane and other gases (focusing on PAMS compounds) measurable by the GC which DAQ has made available to BYU. Concurrent measurement of a range of gases provides the necessary data for the PMF analysis to identify correlations between emission sources. PMF analysis of this type of data set thus provides power to discern primary and secondary contributions for compounds such as formaldehyde. The PMF analysis will be strengthened by including fine particulate matter in the data set. Including $PM_{2.5}$ in the PMF analysis provides data that can show correlation between gases and PM sources. $PM_{2.5}$ will be measured with an FDMS TEOM, fine particulate composition will be measured with an AIMS (to be run by the DAQ), a Sunset Carbon Monitor, an Aethalometer and a BYU GC-MS Organic Aerosol Monitor system for the determination of fine particulate organic marker compounds. In addition, the concentrations of NO_X, NO_2 and CO will also be measured by the state. To support this part of the study, the DAQ will perform selected back-trajectory calculations.

Dr. Eatough will be responsible for the EPAPMF v5.0 analysis of this data set from Part 2.

Budgets

Item	Amount
K. Kelly (PI, 0.25 months)	2,458
C. Jaramillo (3 months)	16,870
UG student – assist with data cleaning	1,100
Benefits	7,079
BYU subaward[1]	38,809
Consultant - Delbert Eatough[2]	10,000
Direct costs	76,317
IDC	3,751
Total UofU budget	**80,067**

1: Detailed below; 2: PMF analysis of data from Part 2.

BYU subcontract

Personnel: Dr. Jaron Hansen (1 months)	$ 12,939
Fringe Benefits	$ 4,115
[a]Personnel: PhD student Nitish Bhardwaj (12 months half-time support)	$ 12,500
[b]Student insurance & tuition	$3,000
Materials, Supplies	$ 2,500
Travel	$ 500
Total Direct Costs	**$ 35,554**
F&A (Indirect) Costs (at 10%)	**$ 3,255**
TOTAL BYU COSTS	**$ 38,809**

[a] The 12 months of half-time support for a graduate student is equivalent to 20hrs/week for fall semester (16 weeks), winter semester (16 weeks) and spring/summer semester (16 weeks). This equates to 960 hours total and a pay rate of $13.02/hr. or $12,500 for this project.

[b] The BYU Department of Chemistry and Biochemistry provides half tuition for all of its graduate students from departmental funds. All other student support, including the remaining half tuition, is the responsibility of the student's faculty advisor and is included in all grant proposals that pay graduate student stipends. We request $6000 tuition annually per graduate student (full tuition), which covers the typical cost for a full-time graduate student at BYU for all terms in a calendar year.

Deliverables:

- Quarterly reports in a format to be specified by the Division of Air Quality
- Interim Report on Phase 1 (December 31, 2018)
- Final Report (Dec. 31, 2019)
- Compiled and verified digital datasets for each of the above listed tasks in a format to be compatible with DAQ specifications, for ultimate public dissemination