Measuring Naphthalene for a Vapor Intrusion Study: Two Methods at a Former Wood Treating Site

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U.S. EPA Region 5

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for

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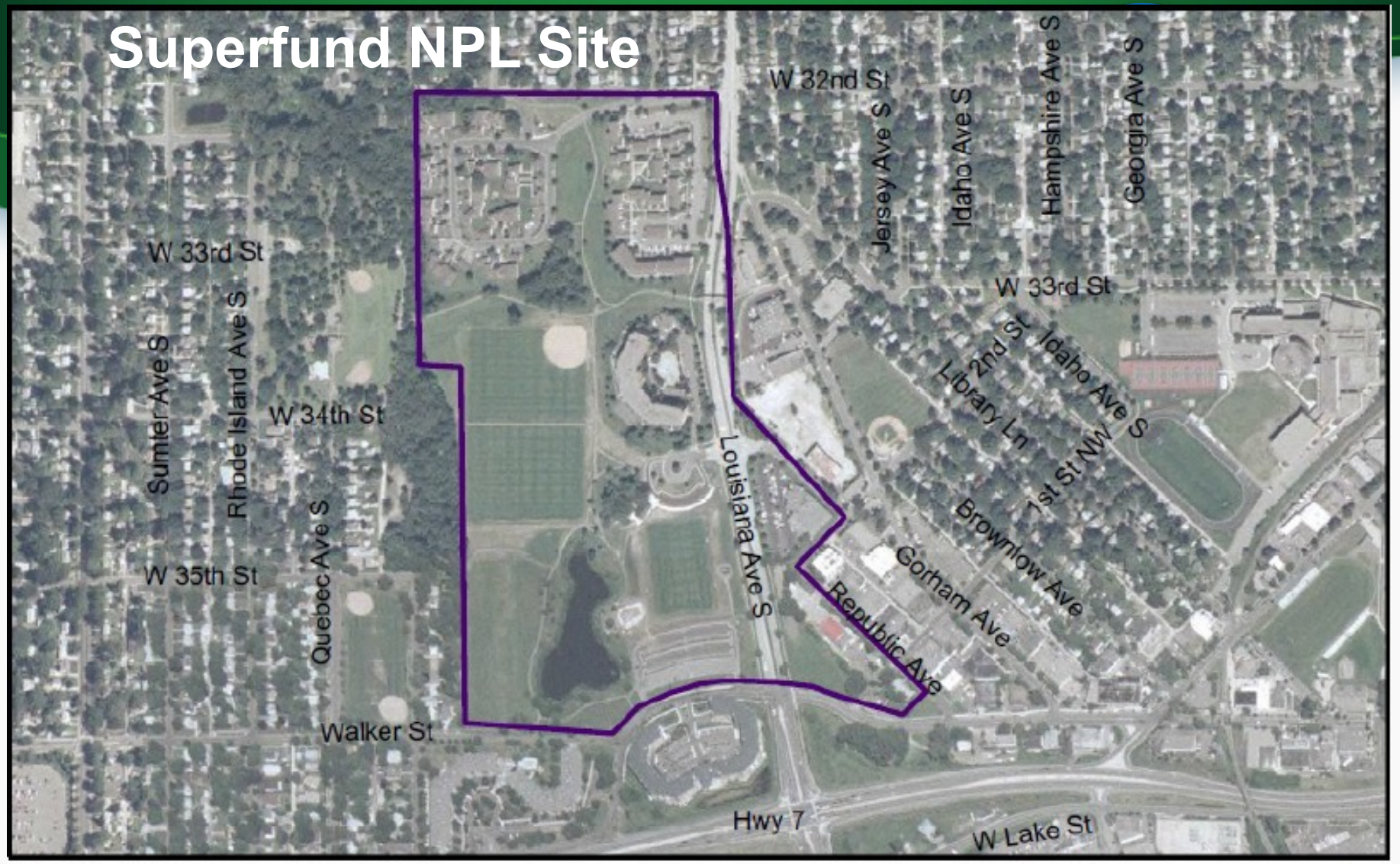
Disclaimer

Information in this report is derived from a variety of references, some of which have been peer-reviewed. Mention of trade names or commercial products or firms does not constitute endorsement or recommendation for use.

The views expressed are those of the author/editor/speaker only and do not necessarily represent those of the United States or the US EPA.

Naphthalene by TO-15 at EPA Chicago Regional Laboratory at the time of this investigation was not fully validated. The results herein are an ancillary study.

Superfund NPL Site



Site

Created by Sarah Backhouse
U.S. EPA Region 5 on 9/22/06
Image Date: 2003

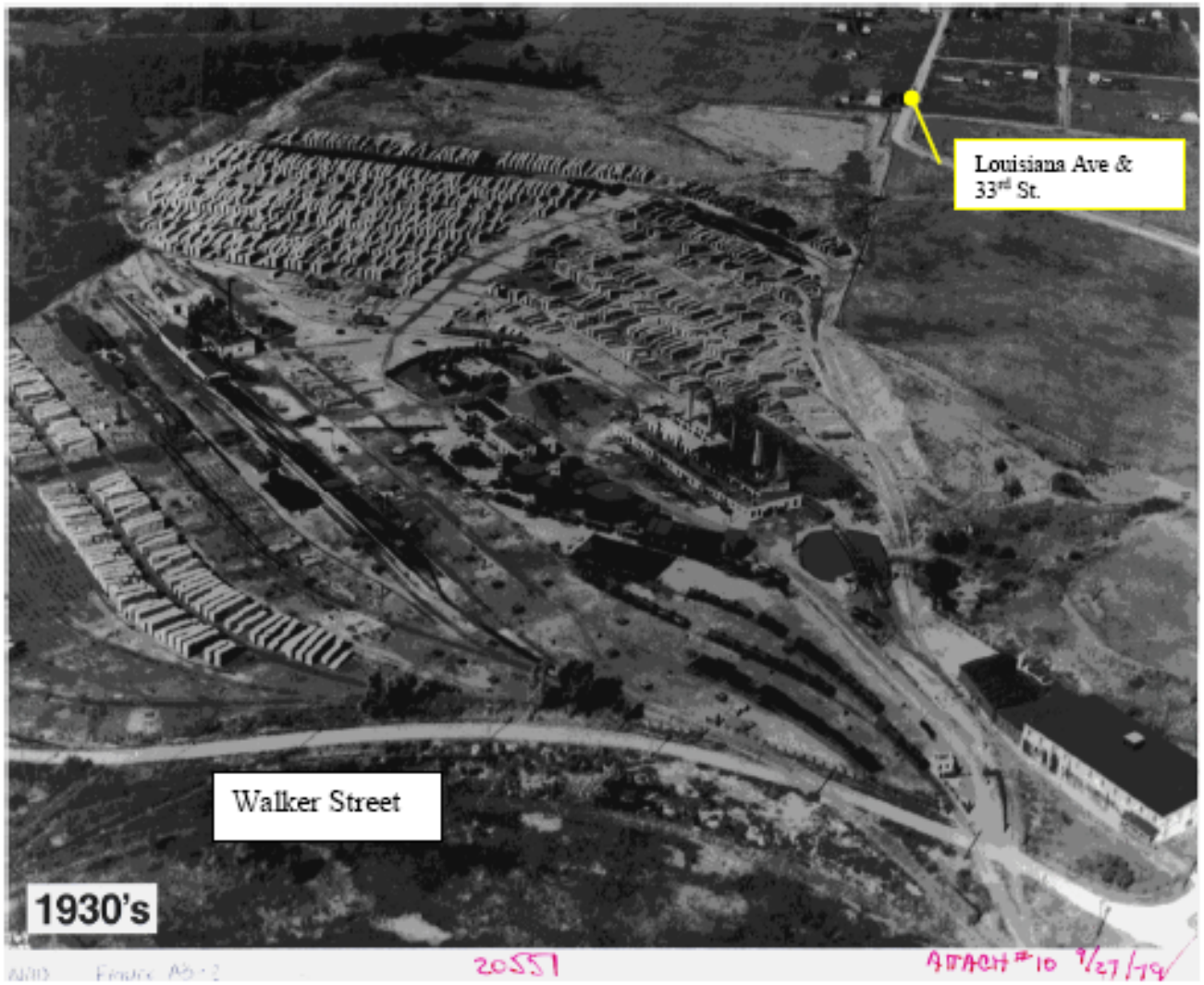
Legend

Reilly Tar and Chemical Corp.

N

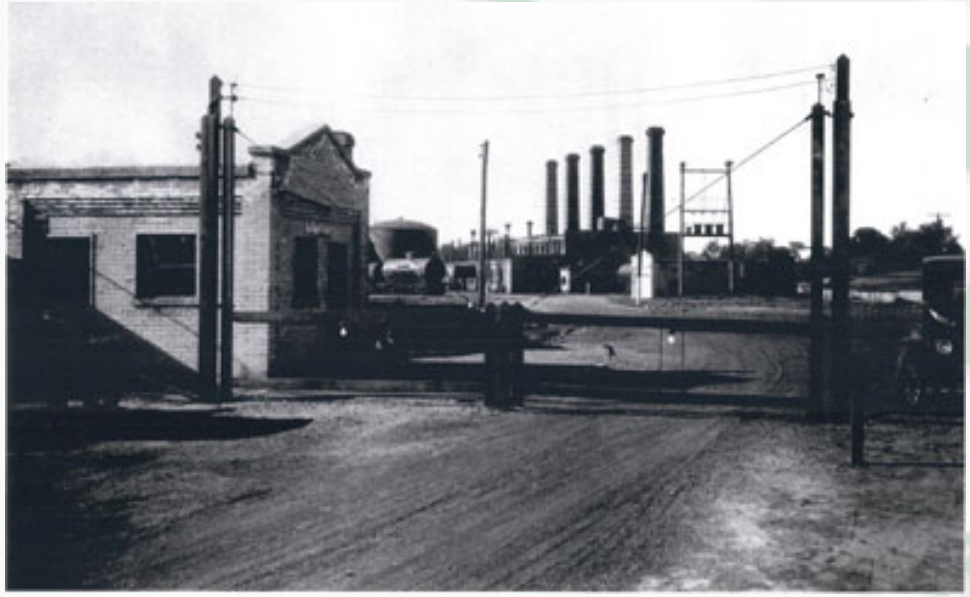
GEOS
Groundwater Evaluation and Optimization System

1930's Aerial Photo of Reilly site, St. Louis Park, MN.



Republic Creosoting Inc.

www.stlouispark.org



Workers at Republic Creosoting's wood treatment plant in Saint Louis Park Minnesota. Photo from the 1940's

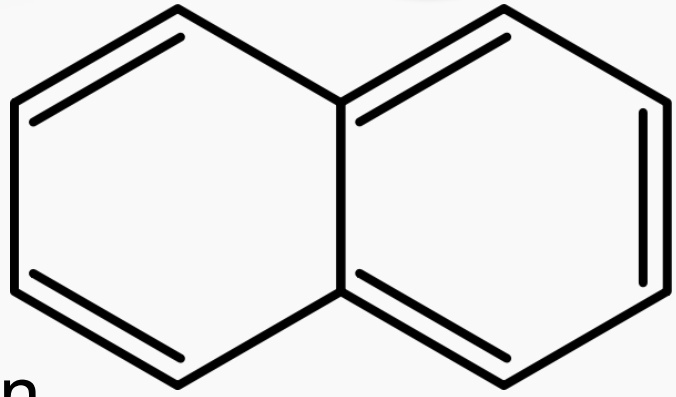
http://www.slphistory.org/creosote.asp

2006 Aerial Photo, Reilly Site at Louisiana Ave & Hwy 7, St. Louis Park, MN.

www.stlouispark.org

US EPA

Naphthalene



- $C_{10}H_8$
- Possible human carcinogen
- Coal tar waste (wood treater, MGP sites)
- B.P. 218°C, Low volatility
- RSL 0.083 µg/m^3 (June 2015, 1.0E-6 risk)
- Study VOCs = BTEX

TO-17 VI[b]	Acenaphthene
TO-17 VI	Fluorene
TO-17 VI	2-methylnaphthalene
TO-17 VI	Naphthalene
TO-17 VI	Pyrene

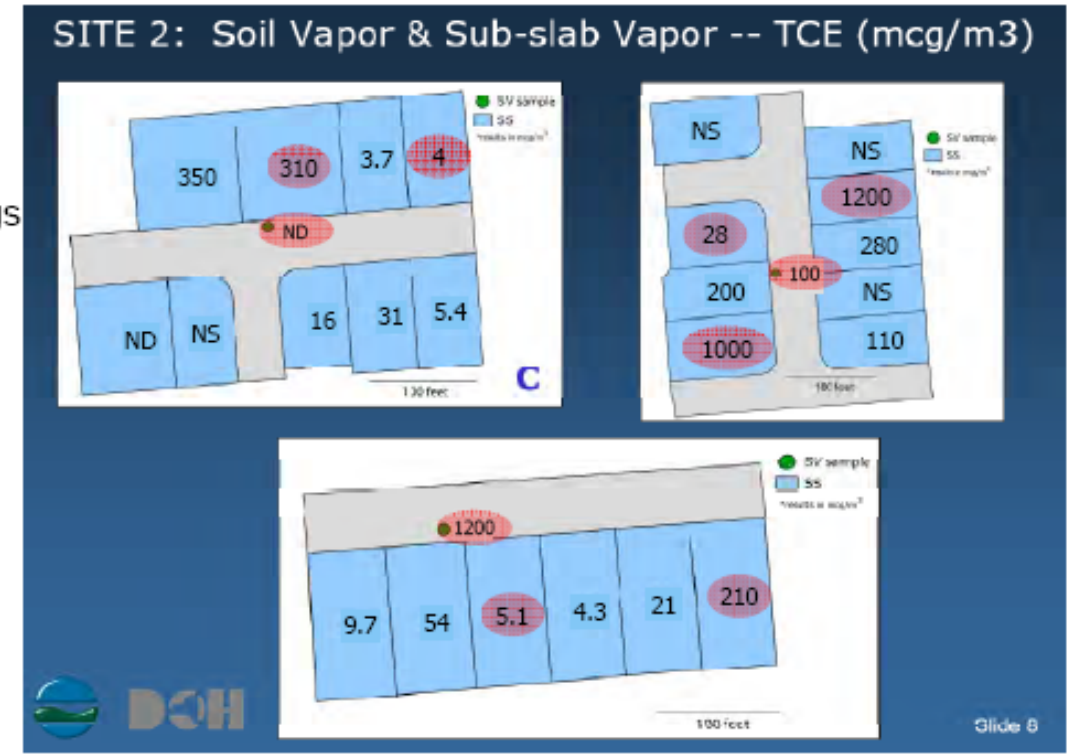
Project Application	TO-15 for VOCs	TO-17 for PAHs
Flow rate	0.69 and 1.88 mL/min	(20 and) 200 mL/min
Collection	Passive, 1440 min	Active, 10 min
Field equipment	Regulator and can/bottle	Perkin Elmer SVI™ multi-bed tube
Lab equipment GC/MS	HP 7890/5975	Agilent 6890/5973
Hold times	30 days, ambient	30 days, 4^{o}C
Sample train	Ambient injection + cold trap dehydration (heated desorb, cold focus, ambient injection)	Thermal desorb + cold trap dehydration (heated desorb, cold focus, ambient injection)
Commercial cost per	$135 + $70/$500	$130 + $30 tube
Reporting limit	0.13-2.69 µg/m^3	0.1 µg/m^3

+ / -

- TO-15 (possible carryover, stability, standards, single can) (Hayes and Benton, 2007)
- TO-17 (recommended, double tubes) (DTSC 2012)

Subsurface Spatial Variability

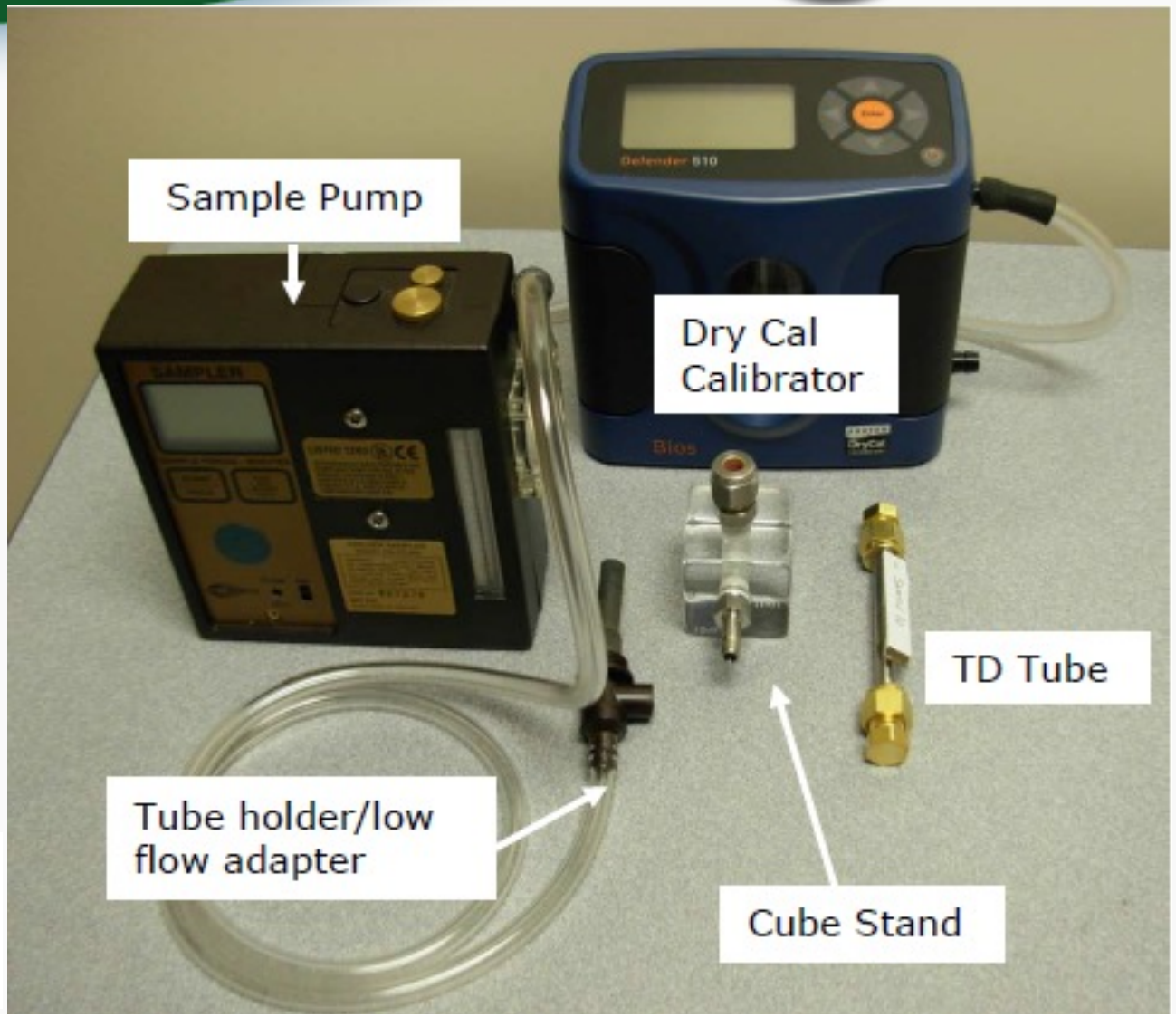
- Sampled residential buildings
- Basements; SV = soil vapor (~8 ft bgs)
- SS = sub-slab



NYDOH at March 2006 USEPA Workshop

CH2M Hill for US EPA 12/2010 L. Lund

TO-17 Field Equipment



TO-17 Field Equipment

Sample Collection Configuration

Thermal desorption tubes, TO-17 sample method for PAHs

Residential SS sampling using sampling probe and SUMMA canister

Step 1- Sub-Slab Sampling

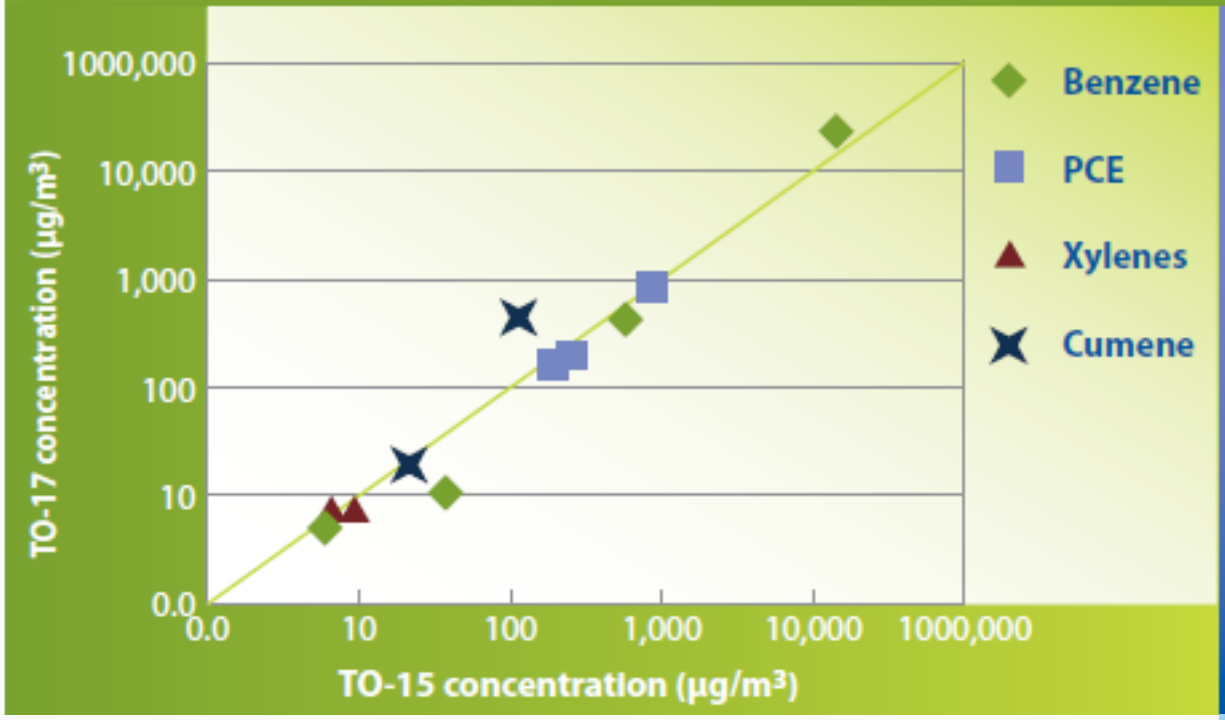
Canister for TO-15 sample method for VOCs

TO-15 and TO-17 sample methods side by side

Gas chromatograph / Mass spectrometer

Example instrument used to analyze samples (GC/MS)

Benzene TO17 vs. TO15 Soil Gas Comparability Study

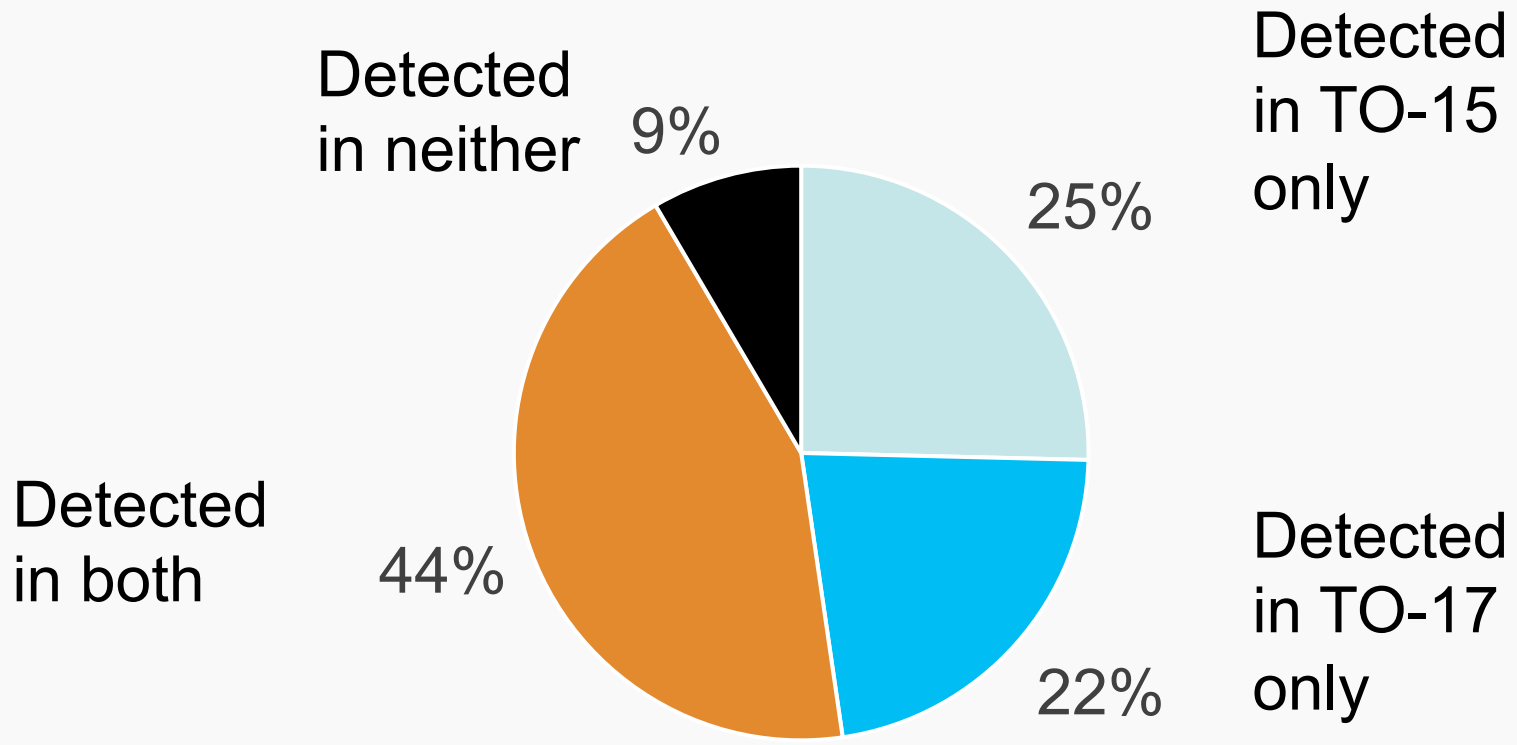


One for one comparability to TO-15 over a wide range of concentrations

U.S. Environmental Protection Agency

Air Toxics LTD.
Always Air, Always Accurate

Results Overview



n=130

Results Overview

- 27 locations, 3 rounds of sampling

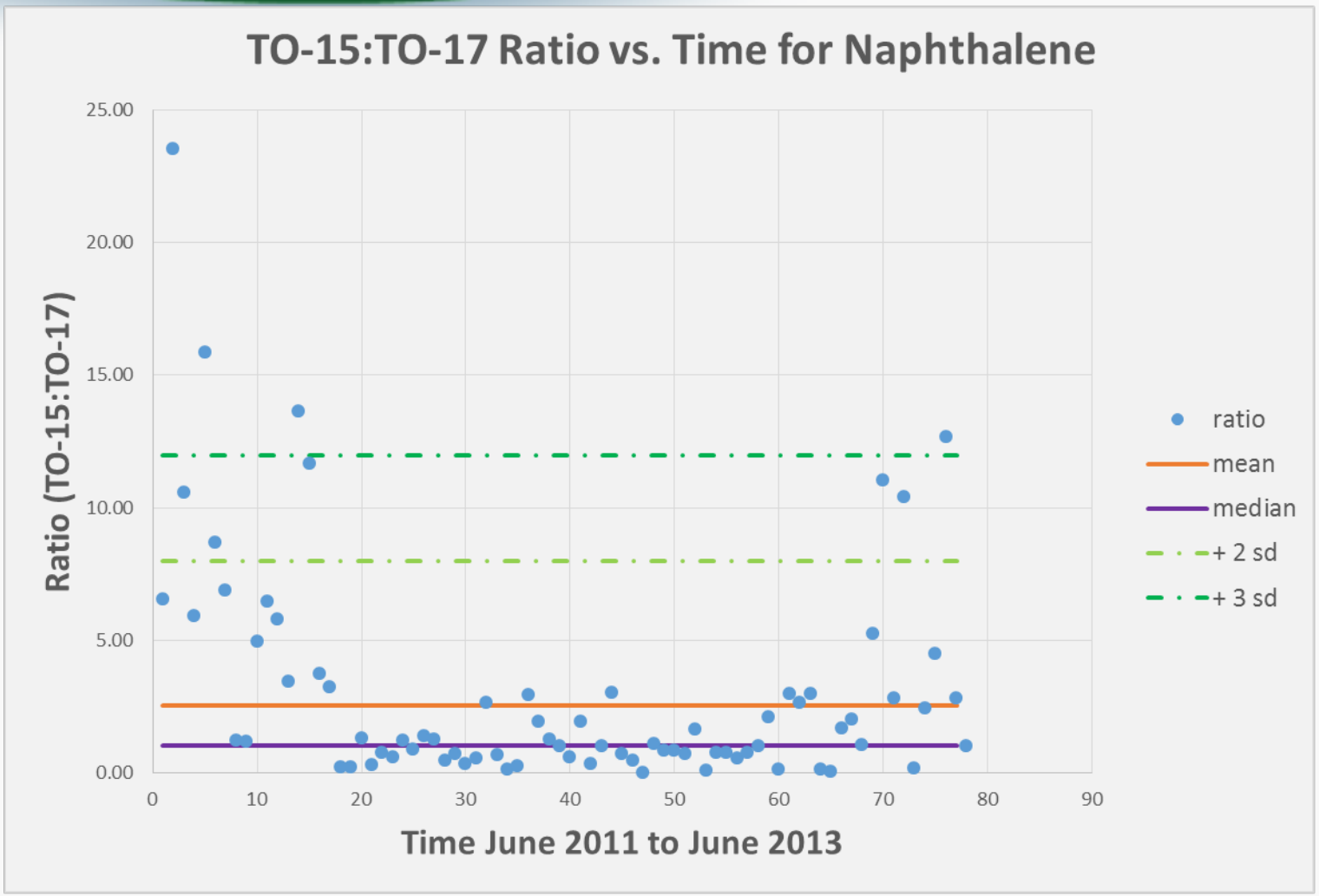
Average Ratio (TO-15 : TO-17) n=96	2.52
Percent of paired samples where TO-15 concentration > TO-17 concentration, n=96	50%
Percent of paired samples where TO-15 concentration < TO-17 concentration, n=96	50%

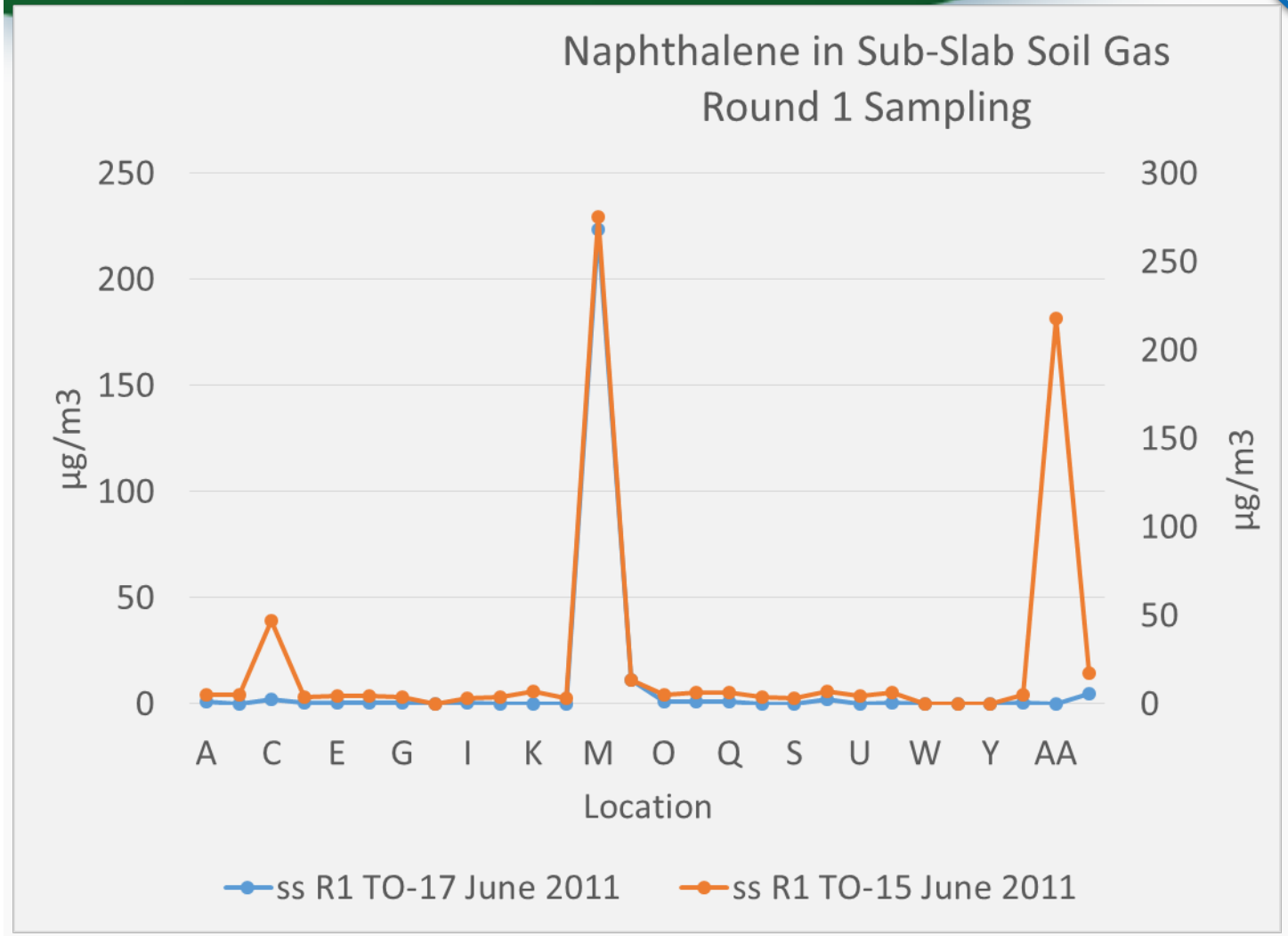
Results Overview

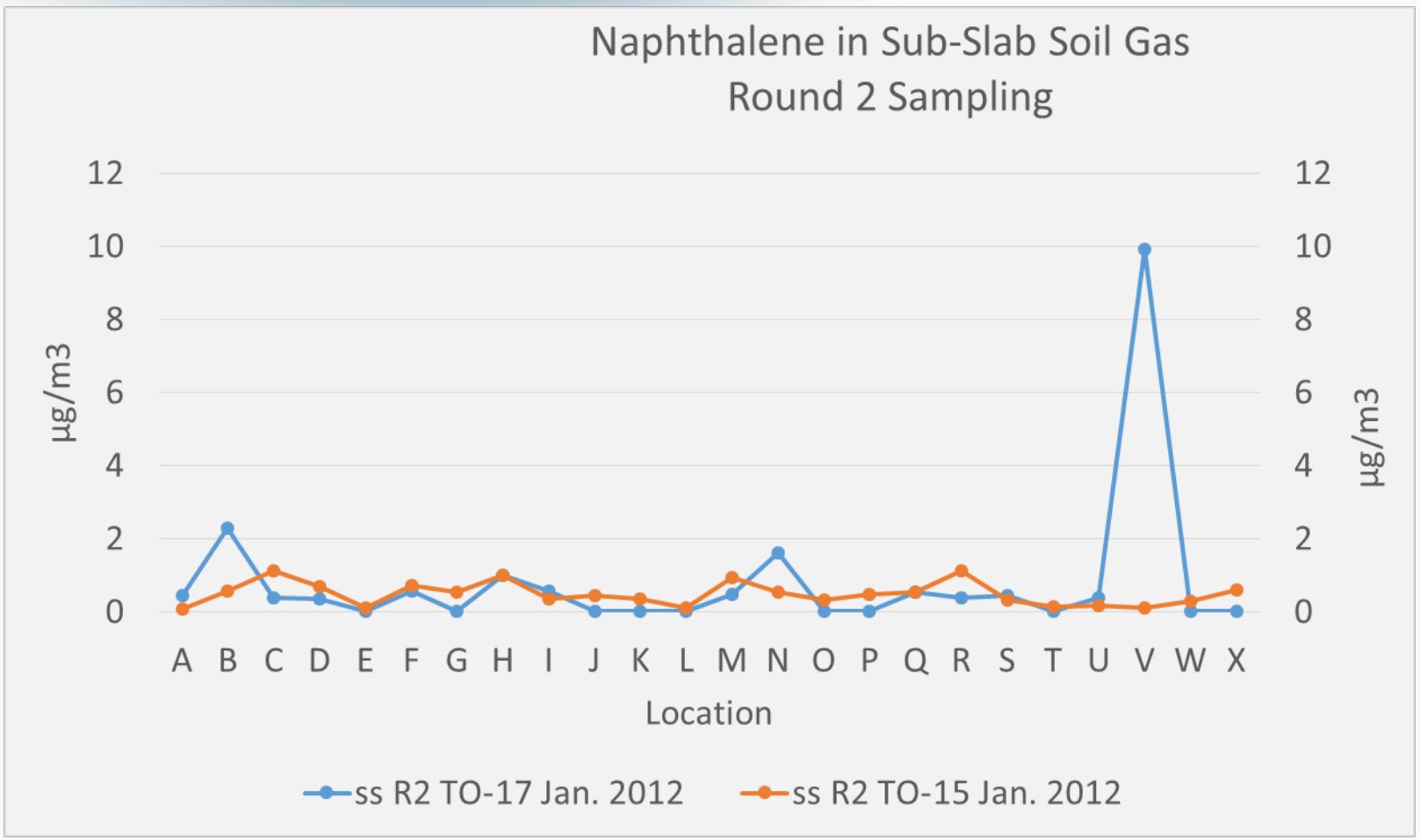
Mean, Non-Zero Relative Percent Differences

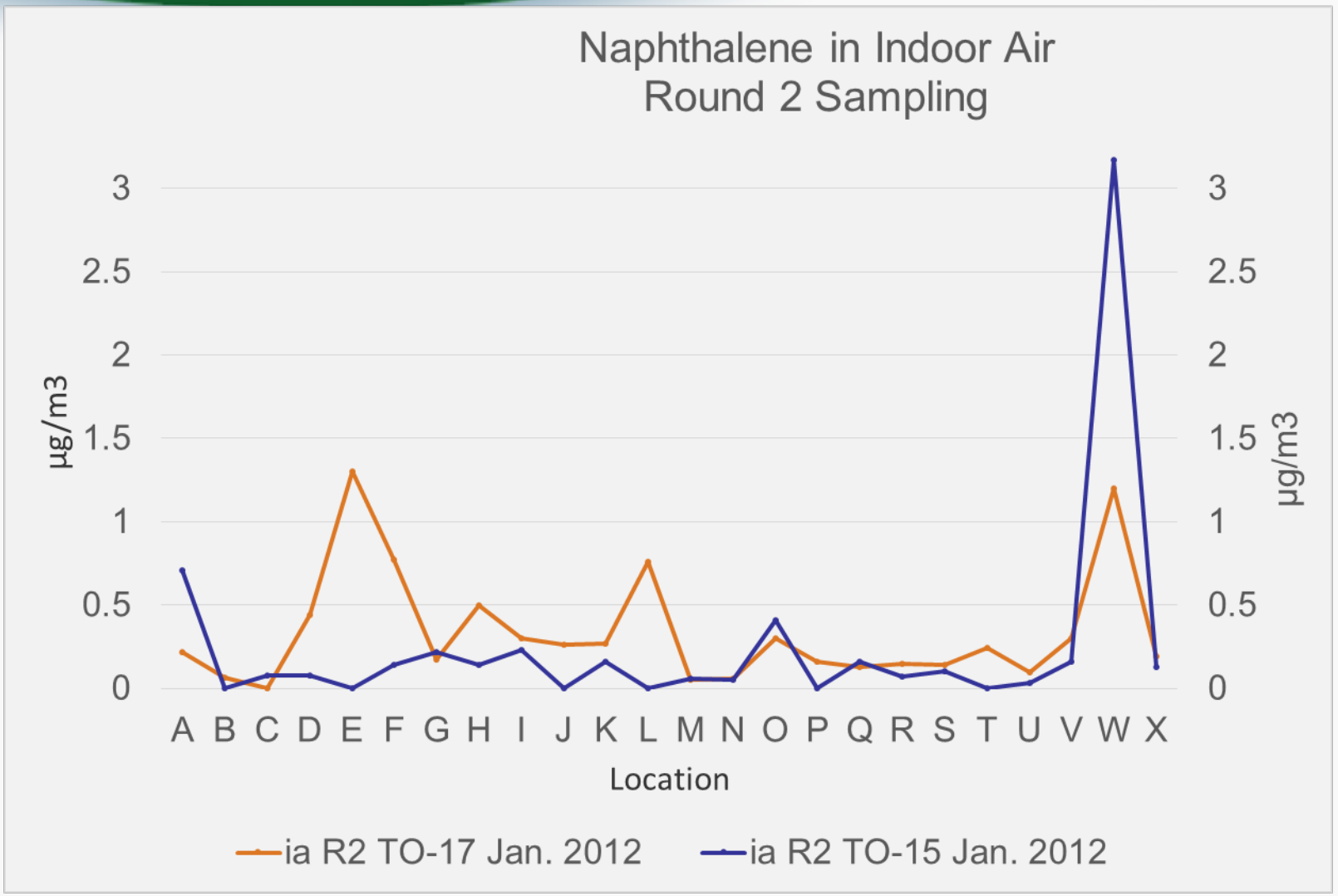
Sampling	Sub-Slab	Indoor Air
Round 1	133%	NA
Round 2	58%	20%
Round 3	100%	28%

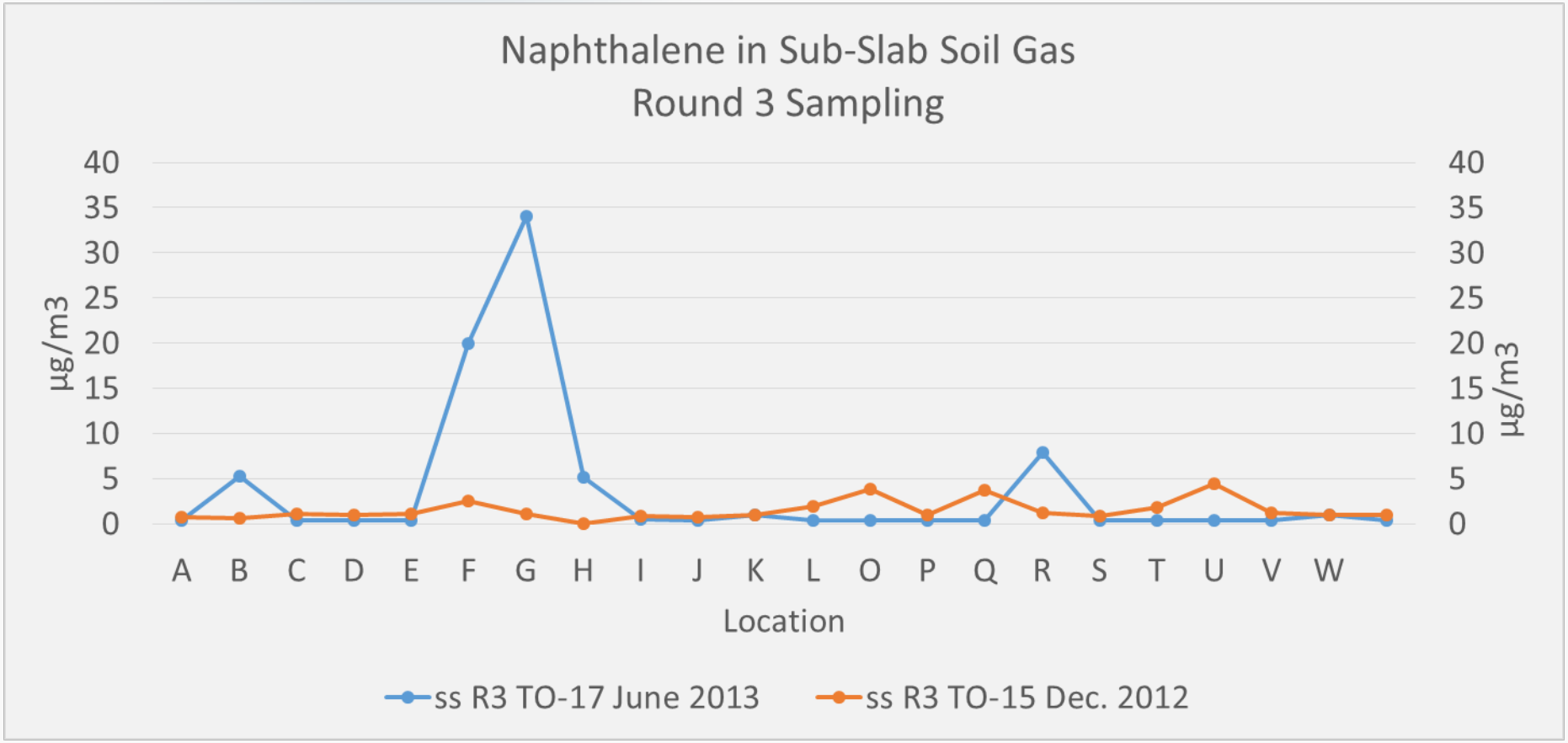
n=56

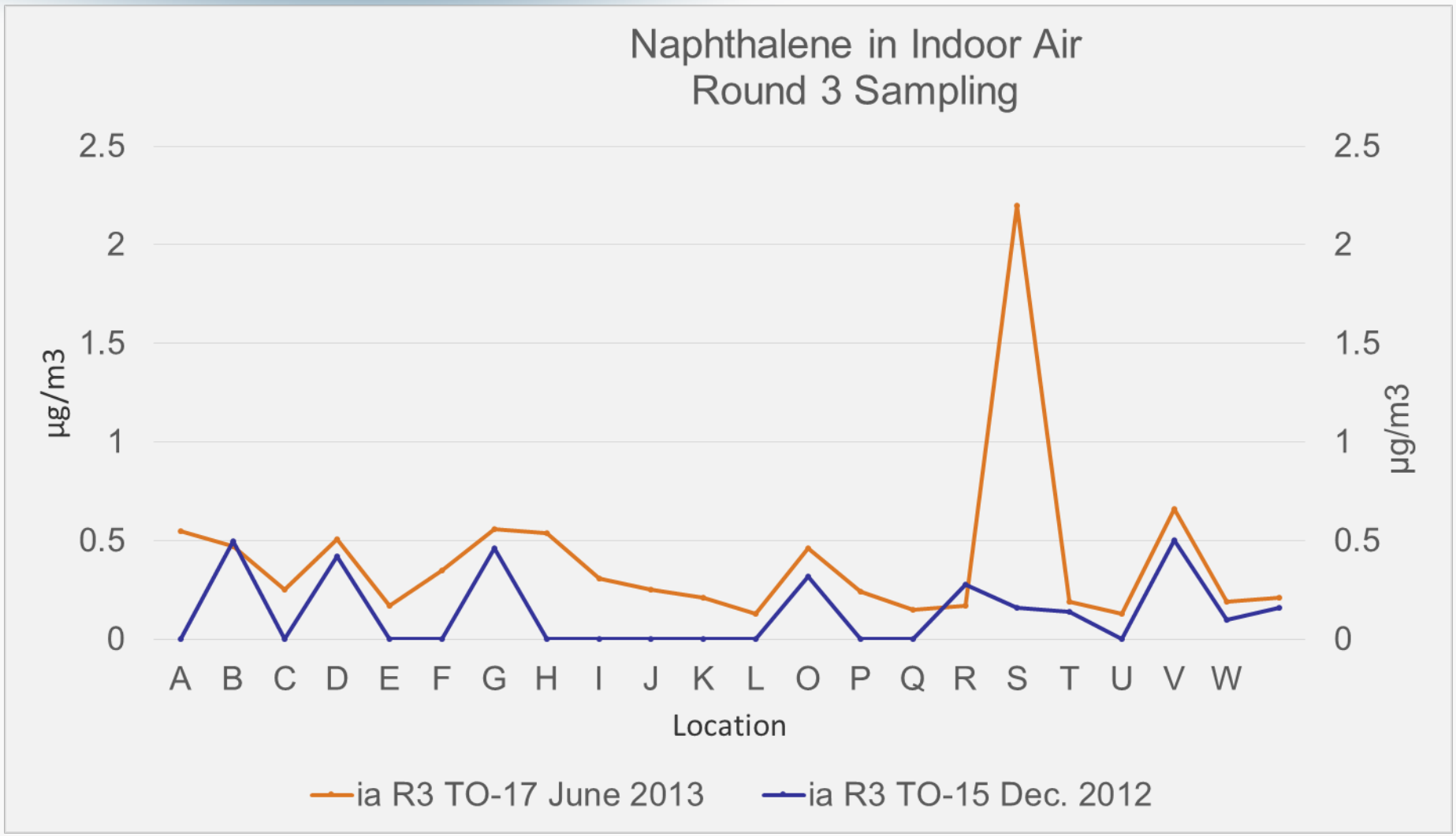

TO-15:TO-17 Ratio vs. Time for Naphthalene
Ratio (TO-15:TO-17)
25.00
20.00
15.00
10.00
5.00
0.00
0
10
20
30
40
50
60
70
80
90
Time June 2011 to June 2013
ratio
mean
median
+ 2 sd
+ 3 sd

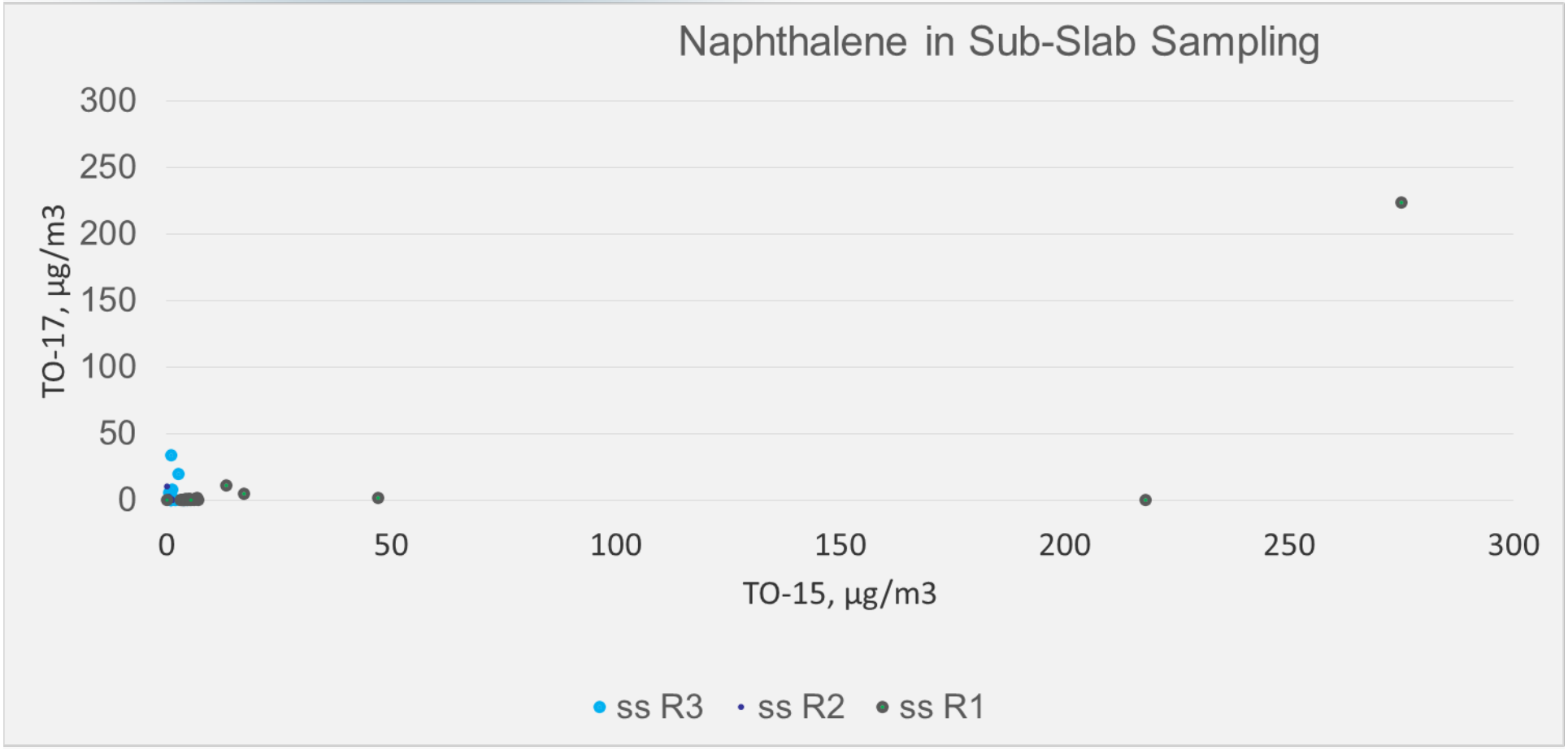

Naphthalene in Sub-Slab Soil Gas
Round 1 Sampling
250
200
150
100
50
0
µg/m3
300
250
200
150
100
50
0
µg/m3
A C E G I K M O Q S U W Y AA
Location
ss R1 TO-17 June 2011
ss R1 TO-15 June 2011

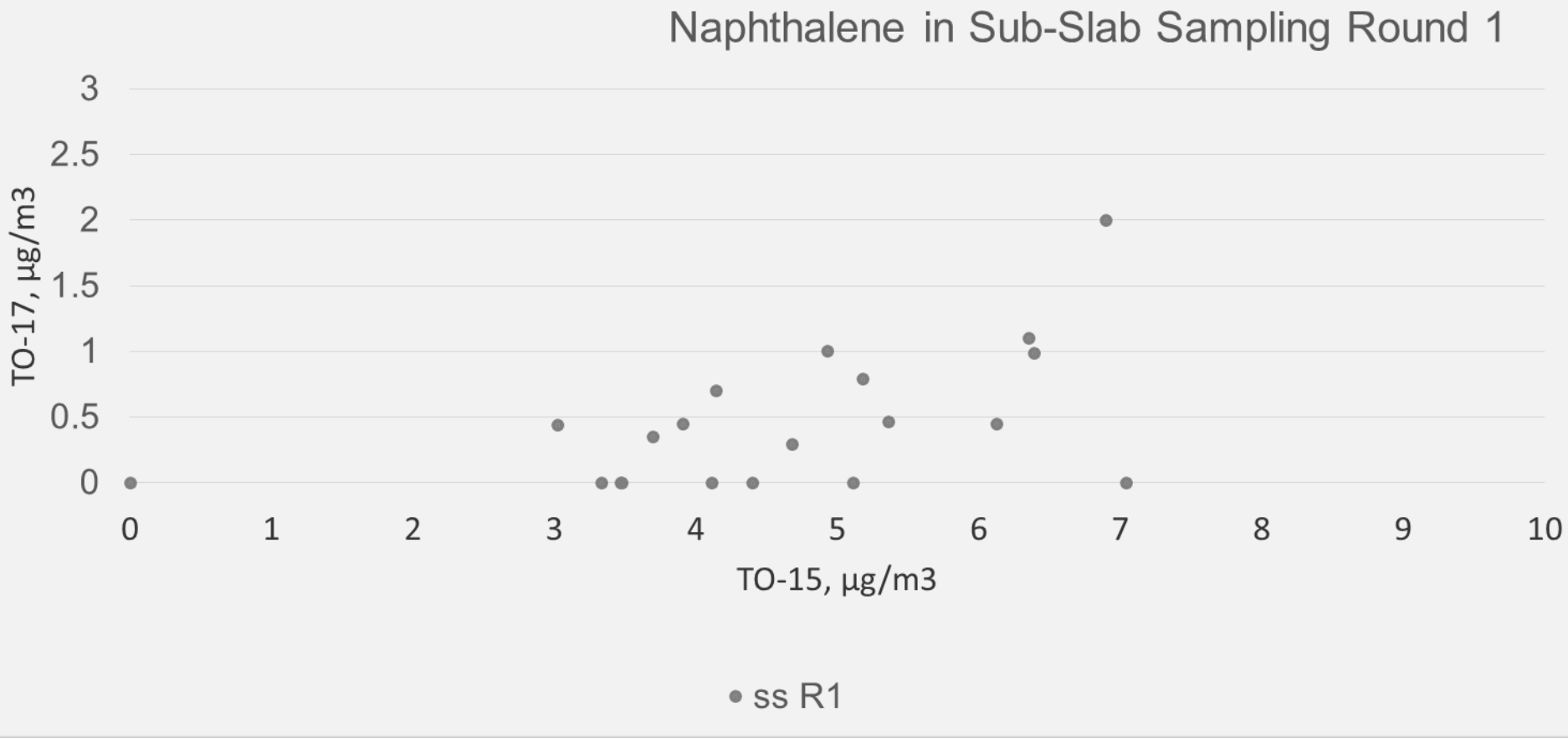

Naphthalene in Sub-Slab Soil Gas
Round 2 Sampling
µg/m3
12
10
8
6
4
2
0
A B C D E F G H I J K L M N O P Q R S T U V W X
Location
ss R2 TO-17 Jan. 2012
ss R2 TO-15 Jan. 2012

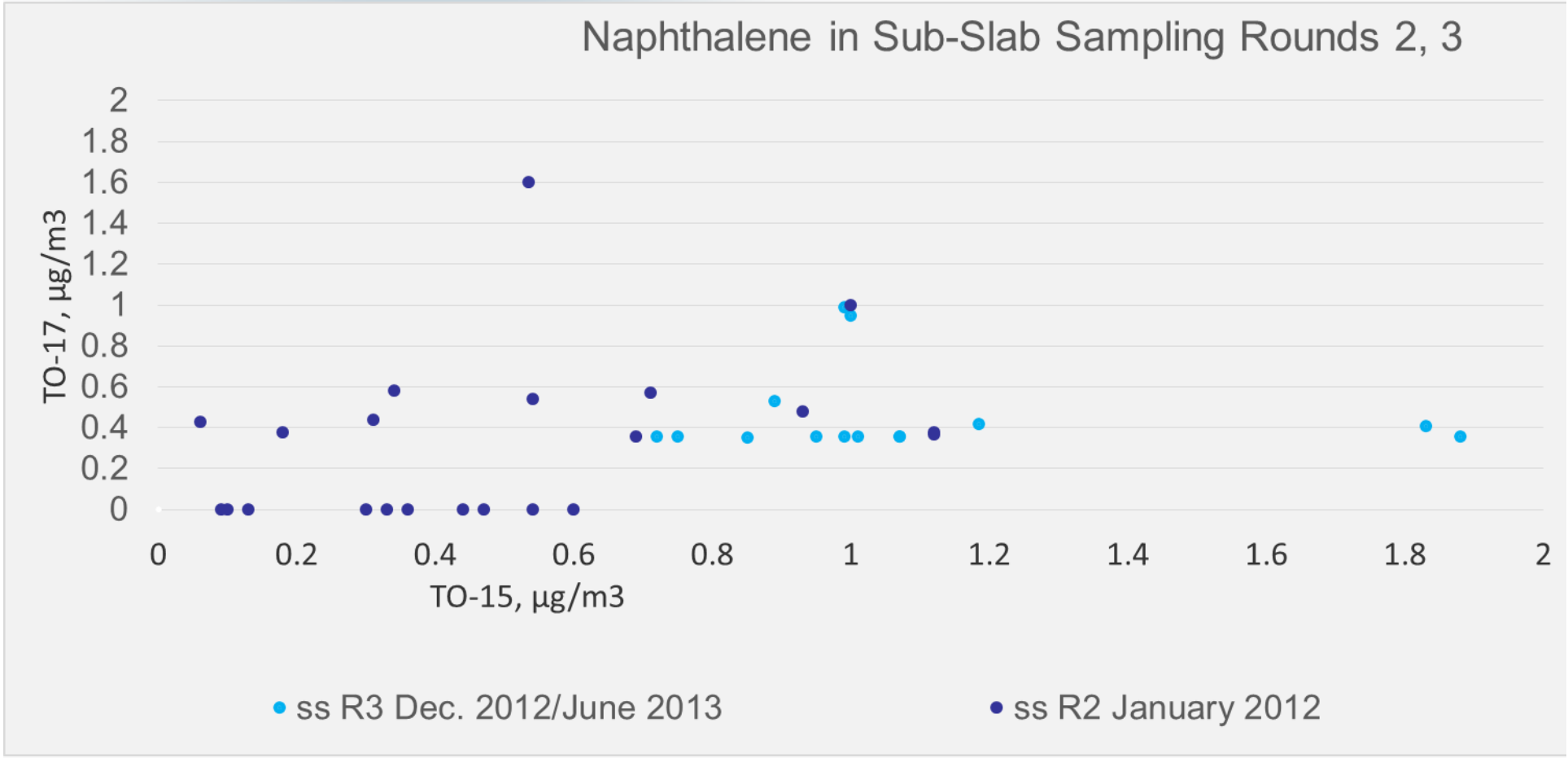

Naphthalene in Indoor Air
Round 2 Sampling
µg/m3
3
2.5
2
1.5
1
0.5
0
A B C D E F G H I J K L M N O P Q R S T U V W X
Location
ia R2 TO-17 Jan. 2012
ia R2 TO-15 Jan. 2012

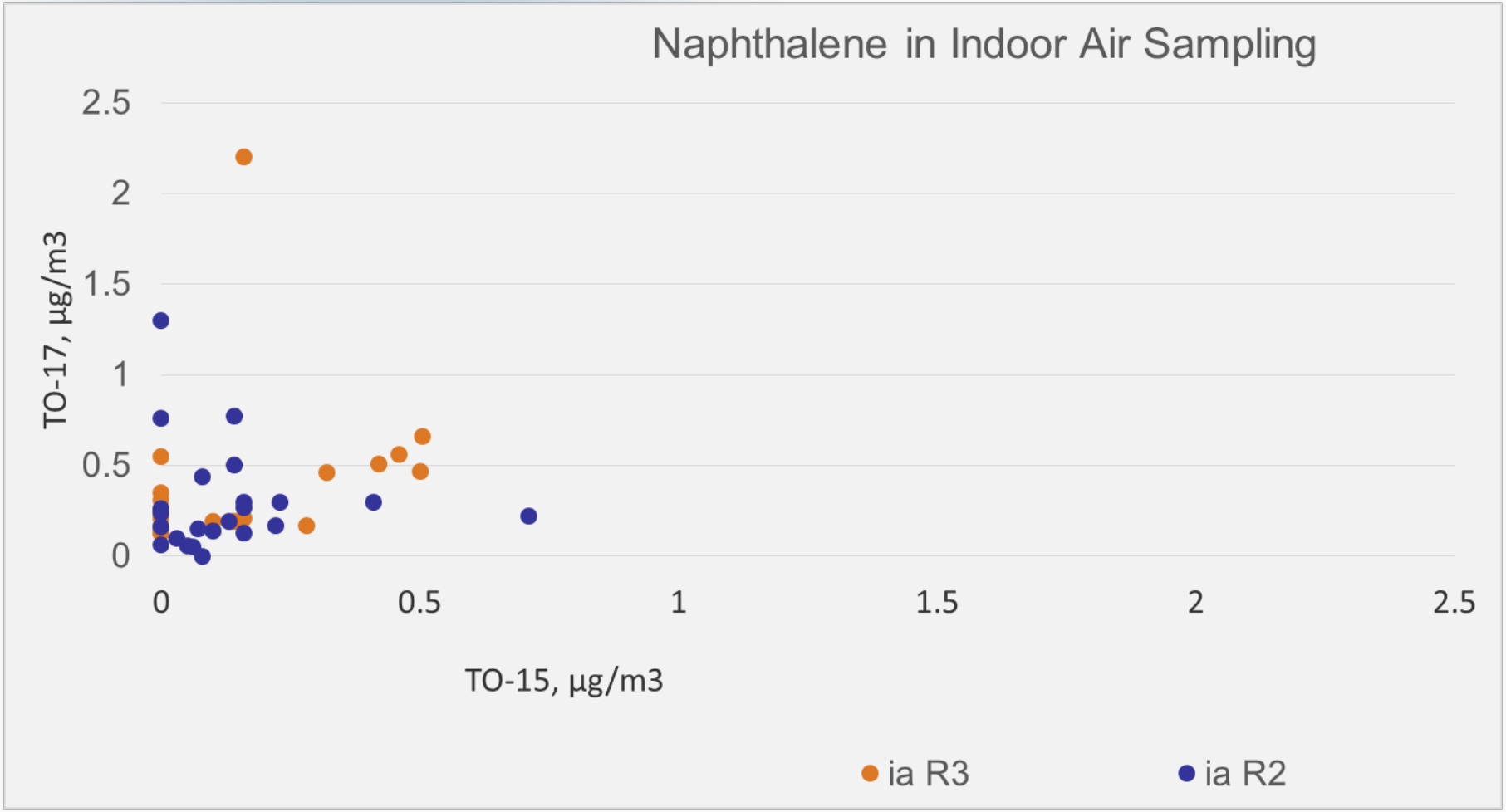

Naphthalene in Sub-Slab Soil Gas
Round 3 Sampling
µg/m3
40
35
30
25
20
15
10
5
0
A B C D E F G H I J K L O P Q R S T U V W
Location
ss R3 TO-17 June 2013
ss R3 TO-15 Dec. 2012

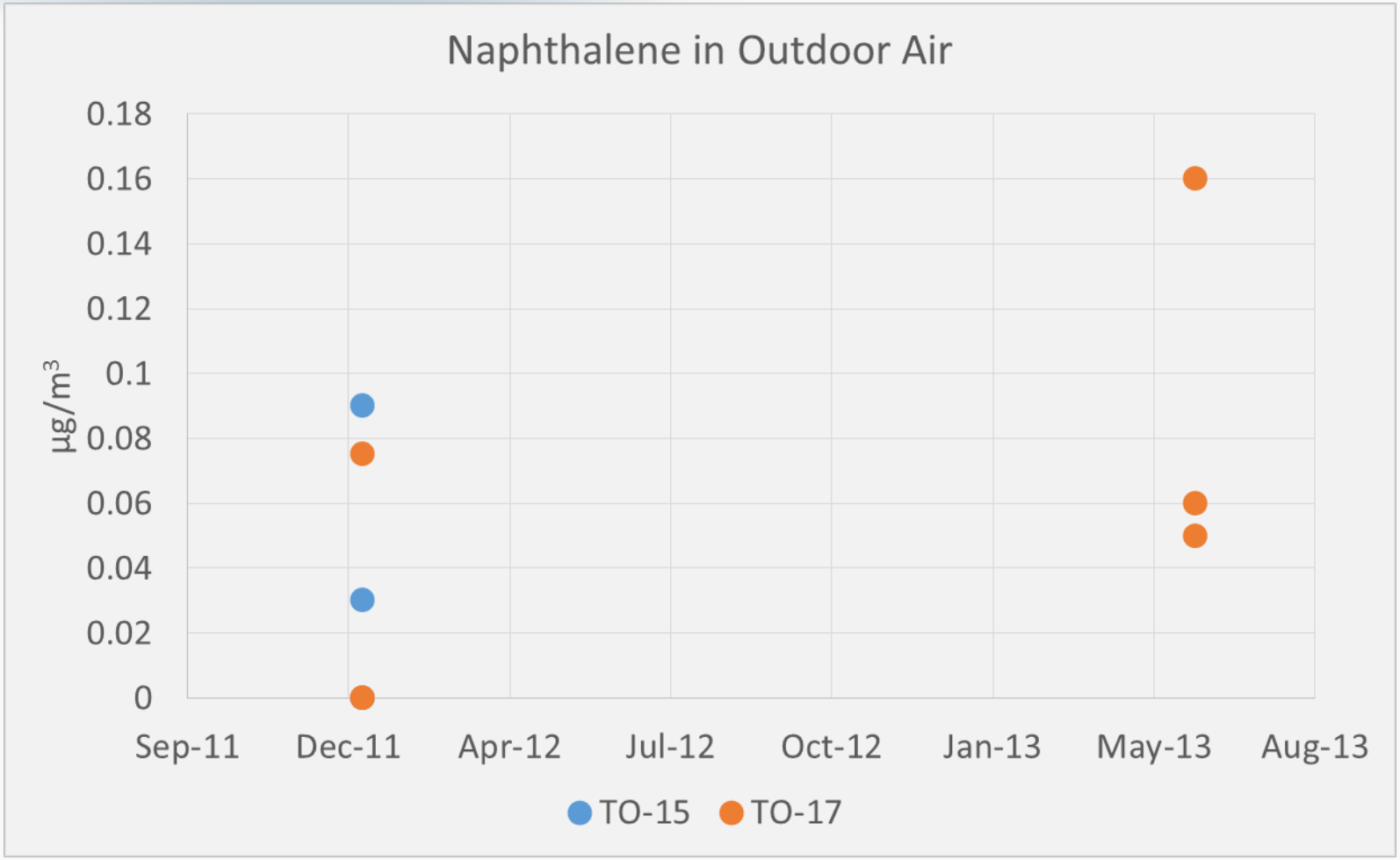

Naphthalene in Indoor Air
Round 3 Sampling
2.5
2
1.5
1
0.5
0
µg/m3
A B C D E F G H I J K L O P Q R S T U V W
Location
ia R3 TO-17 June 2013
ia R3 TO-15 Dec. 2012

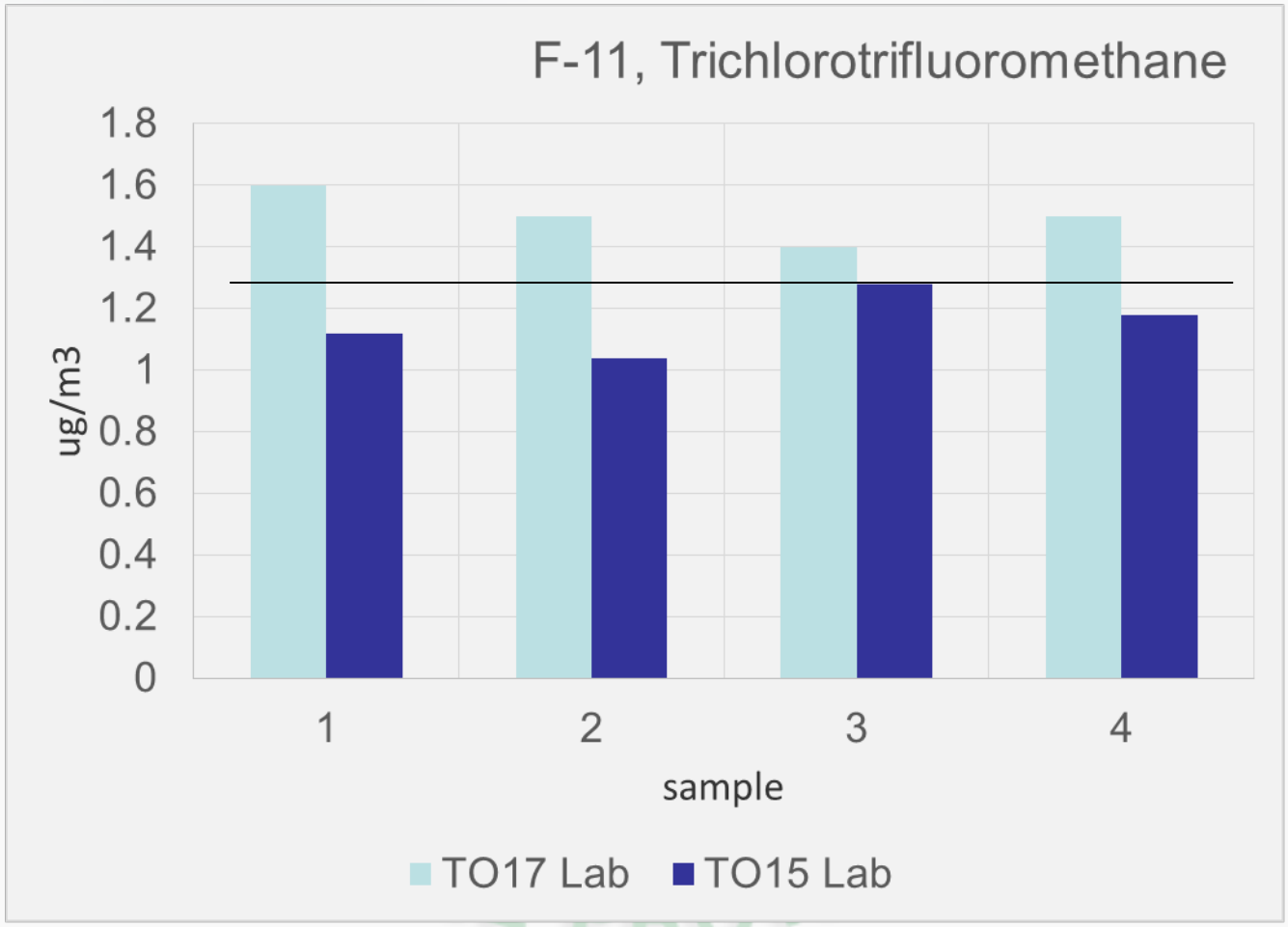

Naphthalene in Sub-Slab Sampling
300
250
200
150
100
50
0
TO-17, µg/m3
0
50
100
150
200
250
300
TO-15, µg/m3
ss R3
ss R2
ss R1


Naphthalene in Sub-Slab Sampling Round 1
TO-17, µg/m3
3
2.5
2
1.5
1
0.5
0
0
1
2
3
4
5
6
7
8
9
10
TO-15, µg/m3
ss R1


Naphthalene in Sub-Slab Sampling Rounds 2, 3
TO-17, µg/m3
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
TO-15, µg/m3
ss R3 Dec. 2012/June 2013
ss R2 January 2012


Naphthalene in Indoor Air Sampling
2.5
2
1.5
1
0.5
0
TO-17, µg/m3
0
0.5
1
1.5
2
2.5
TO-15, µg/m3
ia R3
ia R2


Naphthalene in Outdoor Air
0.18
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
µg/m3
Sep-11
Dec-11
Apr-12
Jul-12
Oct-12
Jan-13
May-13
Aug-13
TO-15
TO-17


F-11, Trichlorotrifluoromethane
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
ug/m3
1
2
3
4
sample
TO17 Lab
TO15 Lab

NOAA (2015)

Summary

- **Naphthalene by TO-15 appears to yield higher results quantitatively**, but this is uncertain because half the results were higher, half lower in this data set.
- Results from each method **generally track one another qualitatively**.
- **No discernable comparative trends** apparent, best matches in R1 SS and R2 IA. More **sub-slab variability**.
- This is a **study within a study** (analyte validation, sampling program variations).

Acknowledgements

- EPA Region 5
  - Chicago Regional Lab (Matt Kobus, Wayne Whipple, George Schupp, Amanda Wroble)
  - Superfund Division (Keith Fusinski, Don Bruce, Tom Short, Sonia Vega, Leah Evison)
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- CH2M Hill (Renee Hunt, Jim Mallison, Loren Lund, Ike Johnson)
- Eurofins Air Toxics
- Minnesota Pollution Control Agency (Dave Scheer, Nile Fellows)

Thank You!

Community Outreach Video

https://www.youtube.com/watch?v=LSA6FFUsyv0

Questions?

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