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Puget Sound Clean Air Agency

Working together for clean air

Preliminary
Seattle Near-road Air Toxics Results

Erik Saganic

NW-AIRQUEST Annual Meeting

June 2018

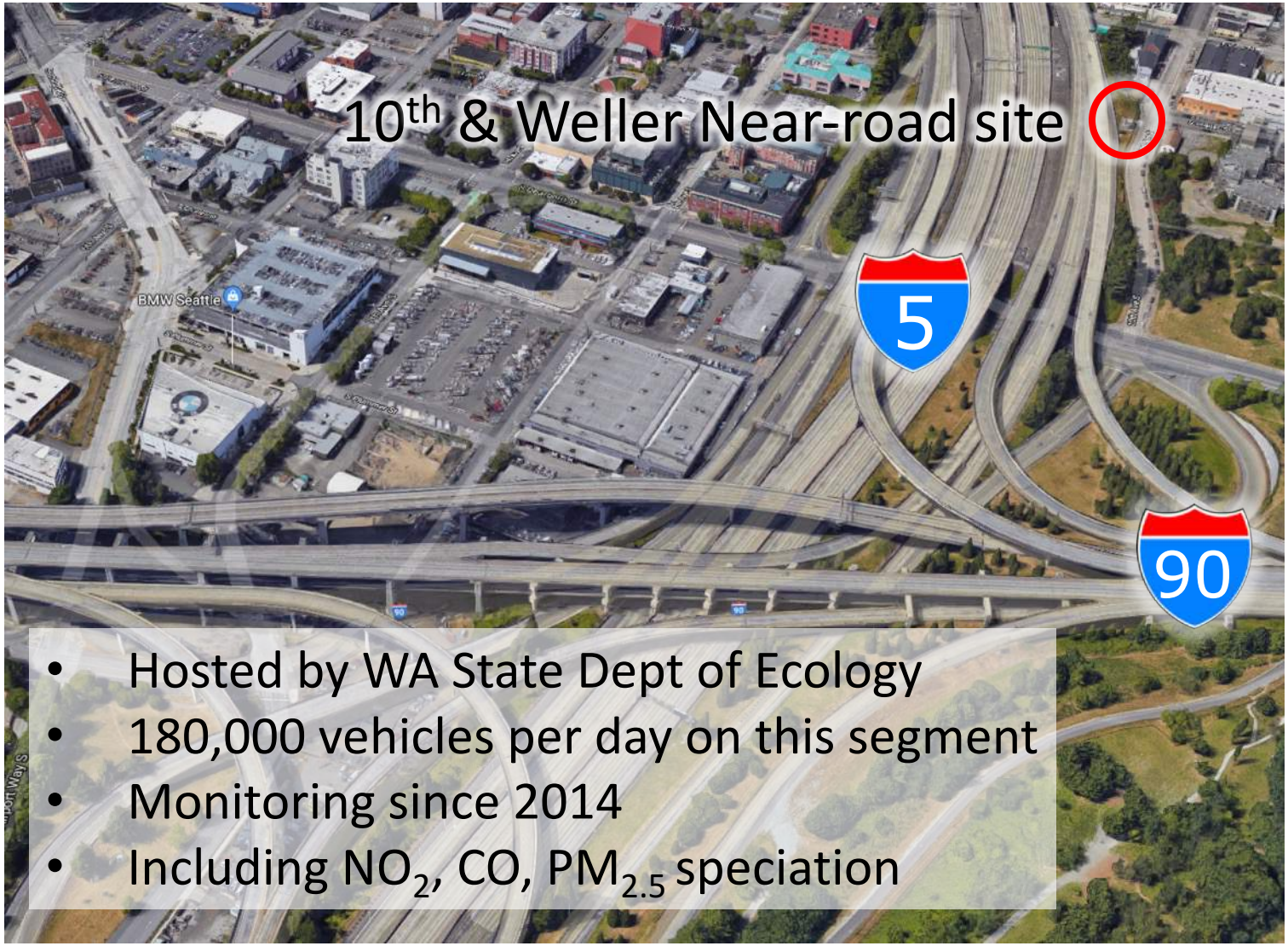
Study location

Chinatown-International District

- **Ranks in the top 1% most impacted by our EJ Mapping Tool (Community Air Tool)**
  - Highest 1% for asthma, cardiac-related, and COPD hospitalization rates in Puget Sound
  - 40% no high school diploma
  - $15K median income
  - 40% limited English proficiency
  - 92% minority race

- **Highest traffic volumes in the PNW**
- **Bisected by I-5 and I-90**

Near-road site



- Hosted by WA State Dept of Ecology
- 180,000 vehicles per day on this segment
- Monitoring since 2014
- Including NO_2, CO, $PM_{2.5}$ speciation

EPA Community Scale Air Toxics Grant

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- **Sept 2015 thru August 2018**
- **Sampling from Sept 2016 - August 2017 (1-year)**
- **$420K funded, $160K matched**

Special thanks to Ecology for loaning air toxics monitors, collocation of equipment, data sharing, etc

Grant objectives

- Estimate potential cancer and non-cancer risk at sites near the road
- Estimate air toxics concentration gradients
- Compare the results to the national network (NATTS)

Grant objectives (page 2)

- Compare air toxics concentrations to 2011 NATA
- Identify & quantify air toxics sources with factor analysis
- Extrapolate risks across our region
- Community-directed sampling

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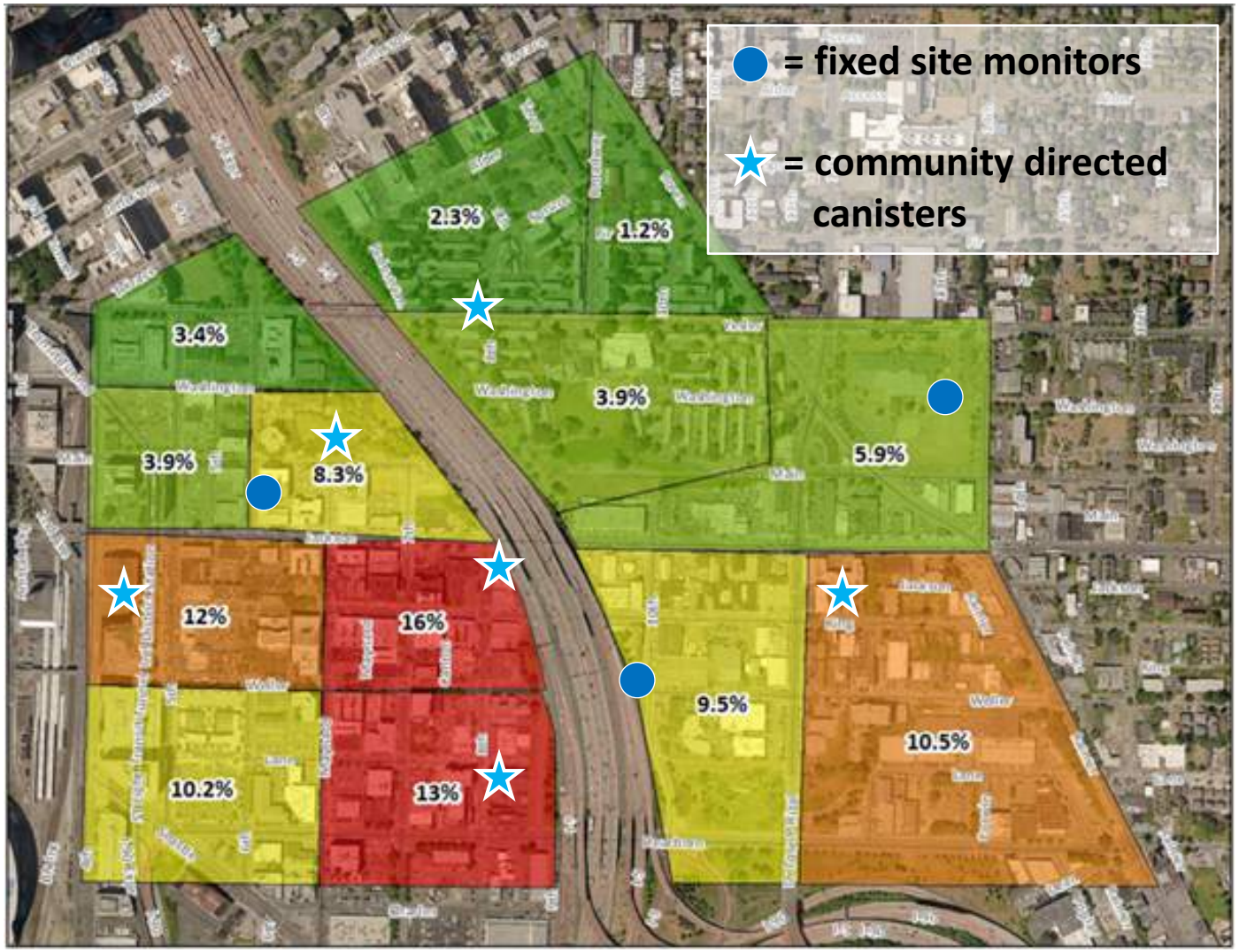
Overview of measurements

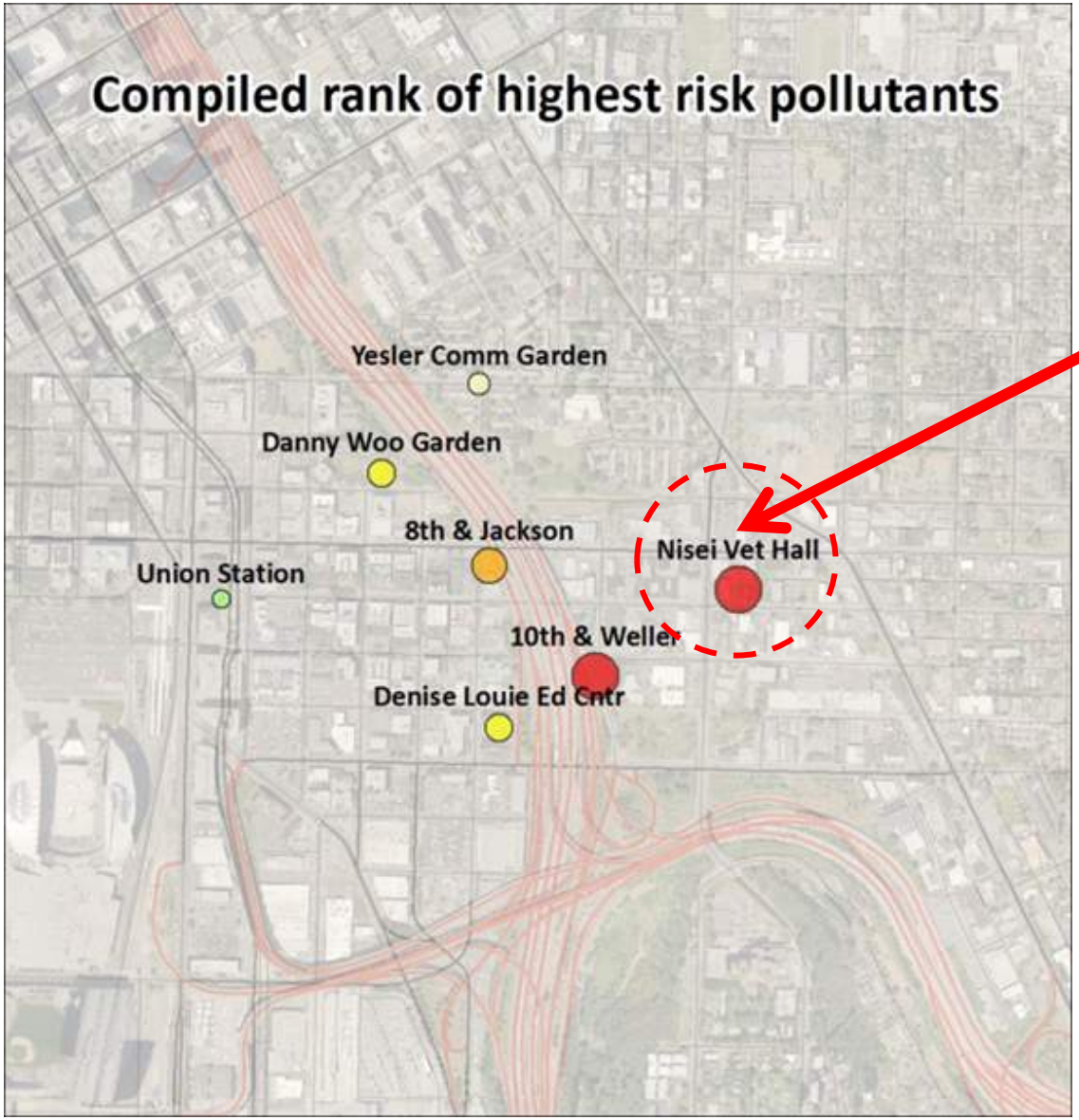
Sites	Measured parameters (from this grant and *leveraged*)	Monitoring duration or frequency
Seattle-10th & Weller (current near-road NO_2 site)	Full suite of VOCs, PAHs, aldehydes, PM_{10} metals, *NO_2, NO_x, NO, CO, BC, $PM_{2.5}$ speciation, $PM_{2.5}$, temperature, winds, traffic counts*	Daily samples every six days for one year
Seattle Beacon Hill (current NATTS site)	*Full suite of VOCs, PAHs, aldehydes, PM_{10} metals, NO_2, NO_x, NO, SO_2, CO, BC, $PM_{2.5}$ speciation, $PM_{2.5}$, temperature, winds*	Daily samples every six days for one year
Seattle-6th & Jackson -on east-side of I-5	Benzene, 1,3-butadiene, formaldehyde, acetaldehyde, NO, CO, BC, $PM_{2.5}$	Daily samples every six days for one year
Seattle-Yesler Way (Bailey Gatzert) - further west of I-5	Benzene, 1,3-butadiene, formaldehyde, acetaldehyde, NO, CO, BC, $PM_{2.5}$	Daily samples every six days for one year
6 other Community Directed locations	Full suite of VOCs	Run over 3 to 5 days, in-sync with the other one every six day schedule
Mobile monitoring	Total VOCs, NO, CO, *BC, $PM_{2.5}$, particle counts*	5-10 days out of the one-in-six day sampling schedule

Community outreach: AQ education and location survey

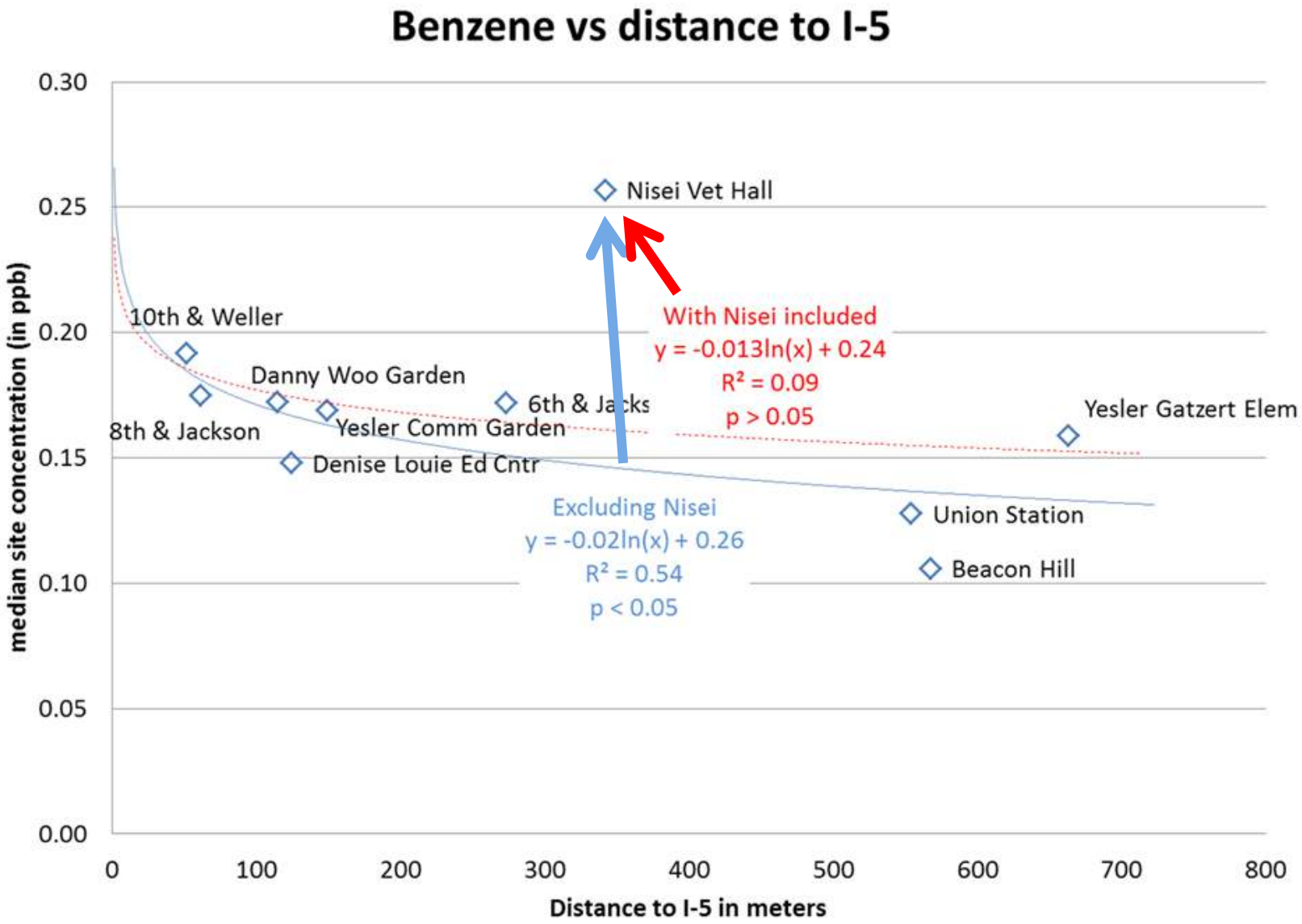
Siting based on community input



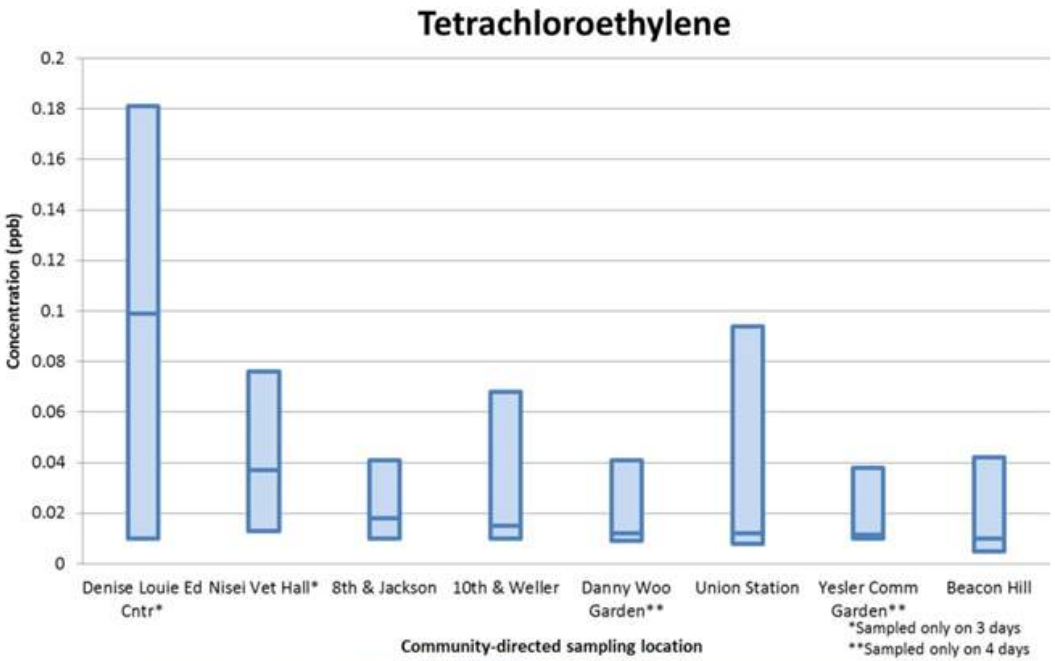
Community-directed results

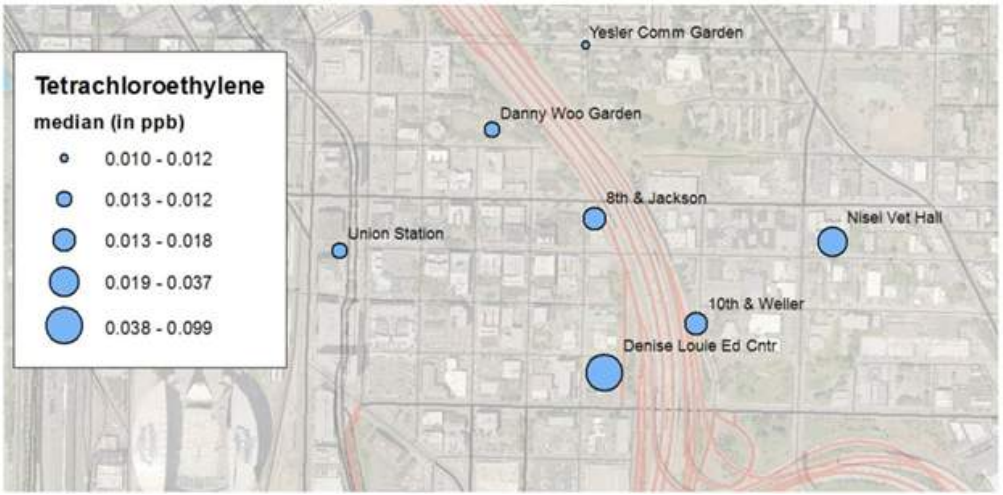


Likely from cigarette smoke

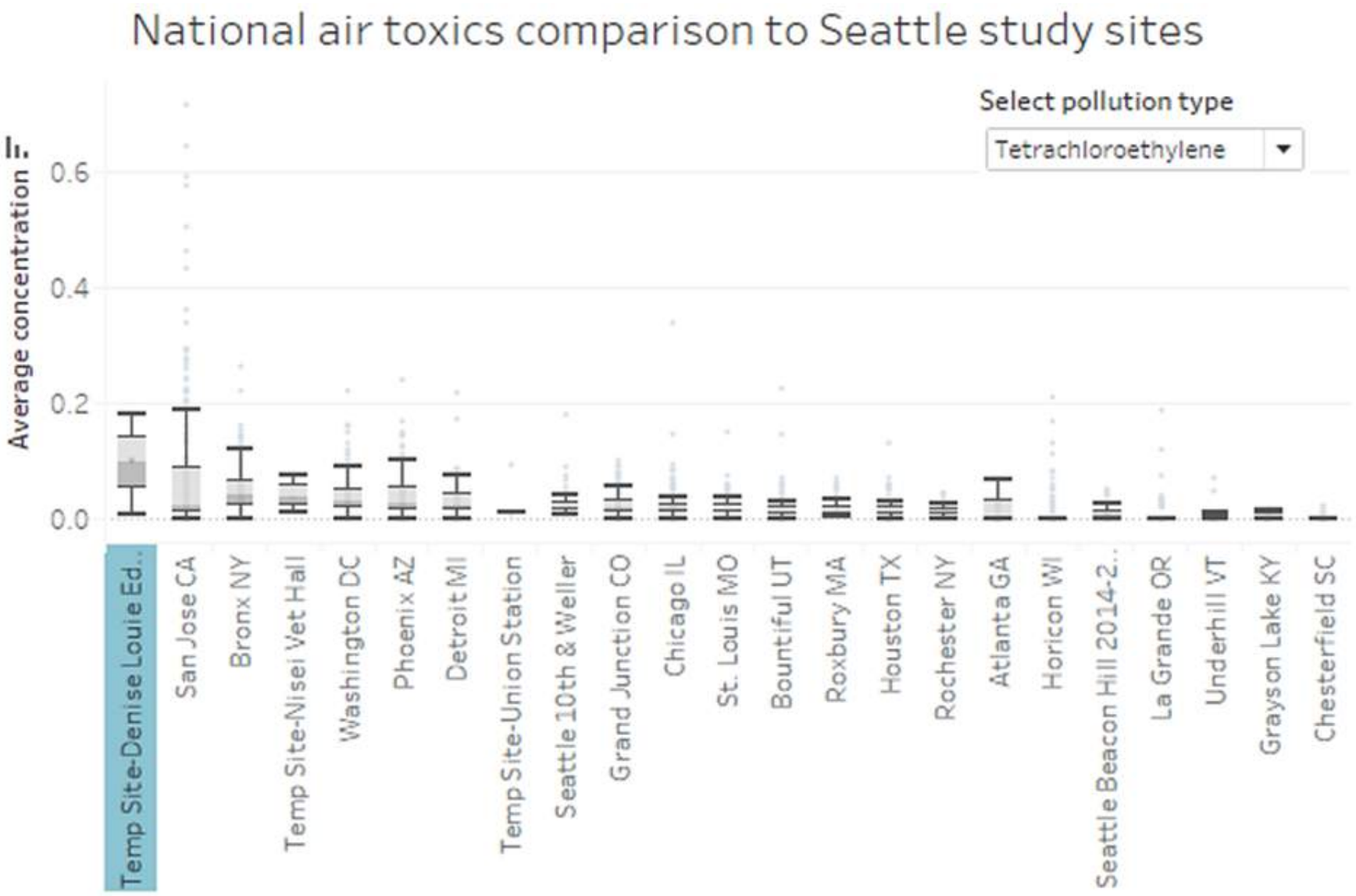

Benzene vs distance to I-5
median site concentration (in ppb)
0.30
0.25
0.20
0.15
0.10
0.05
0.00
0
100
200
300
400
500
600
700
800
Distance to I-5 in meters
Nisei Vet Hall
10th & Weller
Danny Woo Garden
6th & Jacks
Yesler Comm Garden
8th & Jackson
Denise Louie Ed Cntr
Yesler Gatzert Elem
Union Station
Beacon Hill
With Nisei included
y = -0.013ln(x) + 0.24
R² = 0.09
p > 0.05
Excluding Nisei
y = -0.02ln(x) + 0.26
R² = 0.54
p < 0.05

PERC

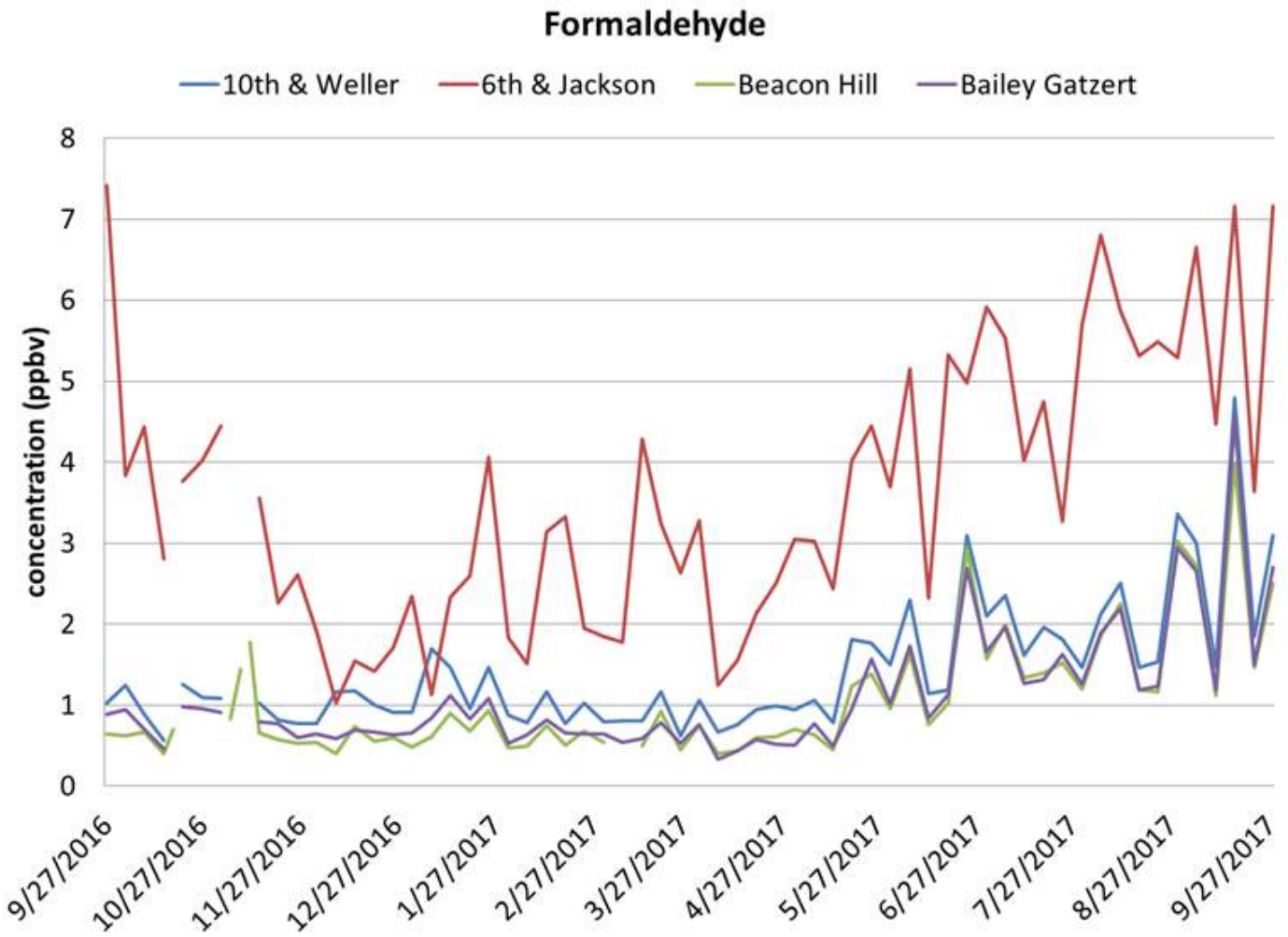

Tetrachloroethylene
Concentration (ppb)
0.2
0.18
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
Denise Louie Ed Cntr*
Nisei Vet Hall*
8th & Jackson
10th & Weller
Danny Woo Garden**
Union Station
Yesler Comm Garden**
Beacon Hill
Community-directed sampling location
*Sampled only on 3 days
**Sampled only on 4 days


Tetrachloroethylene
median (in ppb)
0.010 - 0.012
0.013 - 0.012
0.013 - 0.018
0.019 - 0.037
0.038 - 0.099
Yesler Comm Garden
Danny Woo Garden
8th & Jackson
Nisei Vet Hall
Union Station
10th & Weller
Denise Louie Ed Cntr

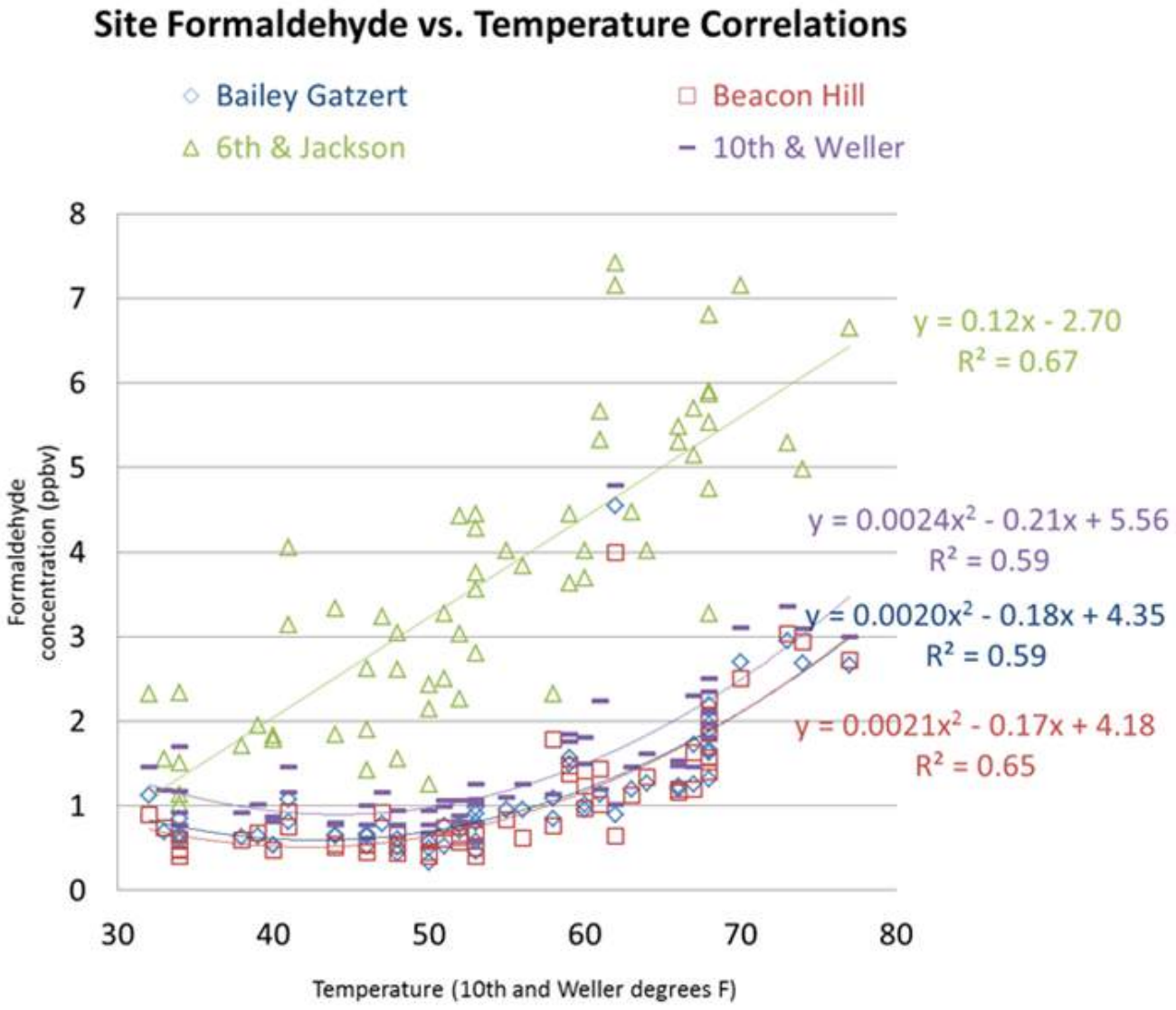
PERC


National air toxics comparison to Seattle study sites
Select pollution type
Tetrachloroethylene
Average concentration
0.6
0.4
0.2
0.0
Temp Site-Denise Louie Ed..
San Jose CA
Bronx NY
Temp Site-Nisei Vet Hall
Washington DC
Phoenix AZ
Detroit MI
Temp Site-Union Station
Seattle 10th & Weller
Grand Junction CO
Chicago IL
St. Louis MO
Bountiful UT
Roxbury MA
Houston TX
Rochester NY
Atlanta GA
Horicon WI
Seattle Beacon Hill 2014-2..
La Grande OR
Underhill VT
Grayson Lake KY
Chesterfield SC

6th & Jackson formaldehyde high



Linear temperature dependence at 6th & Jackson



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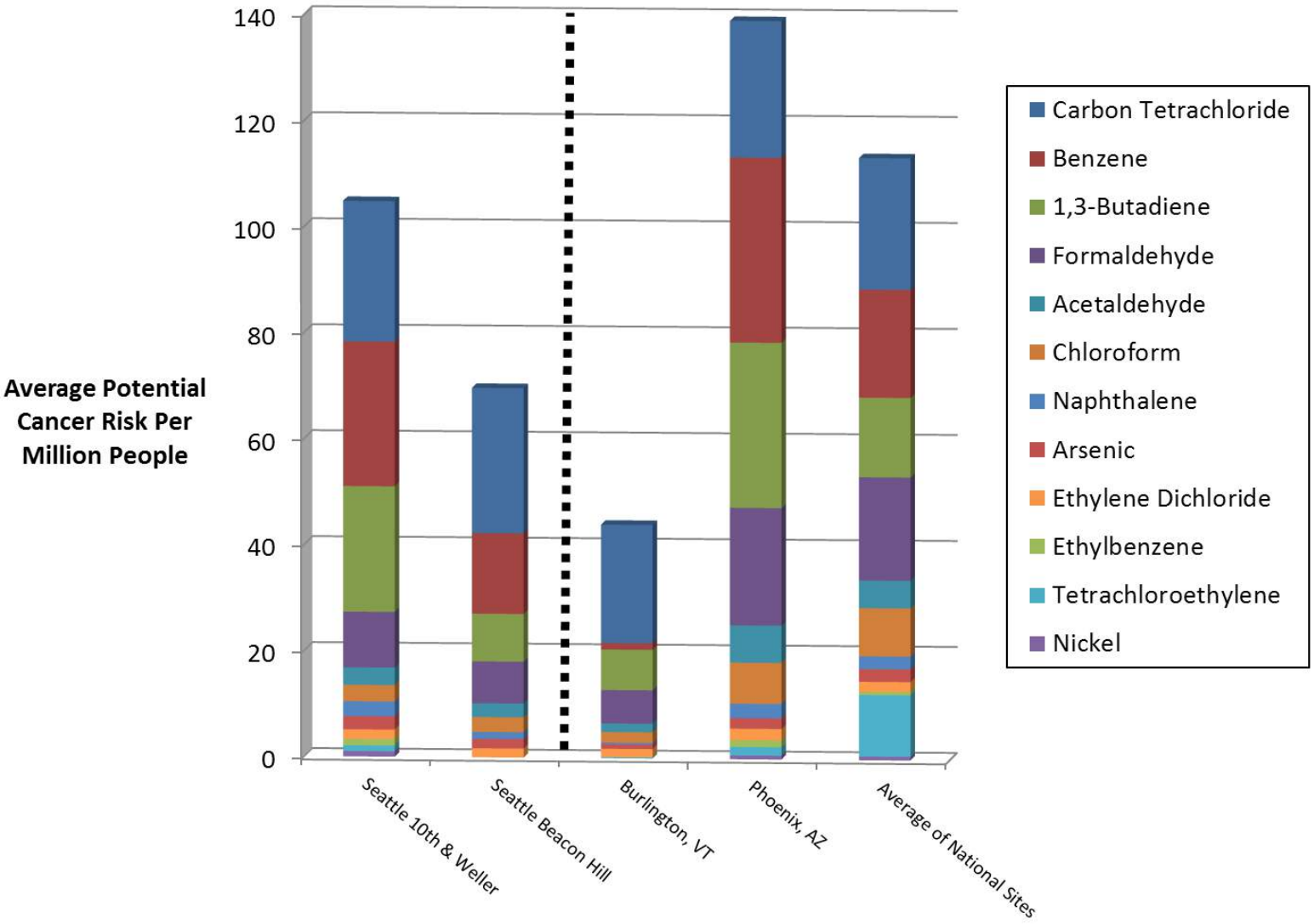
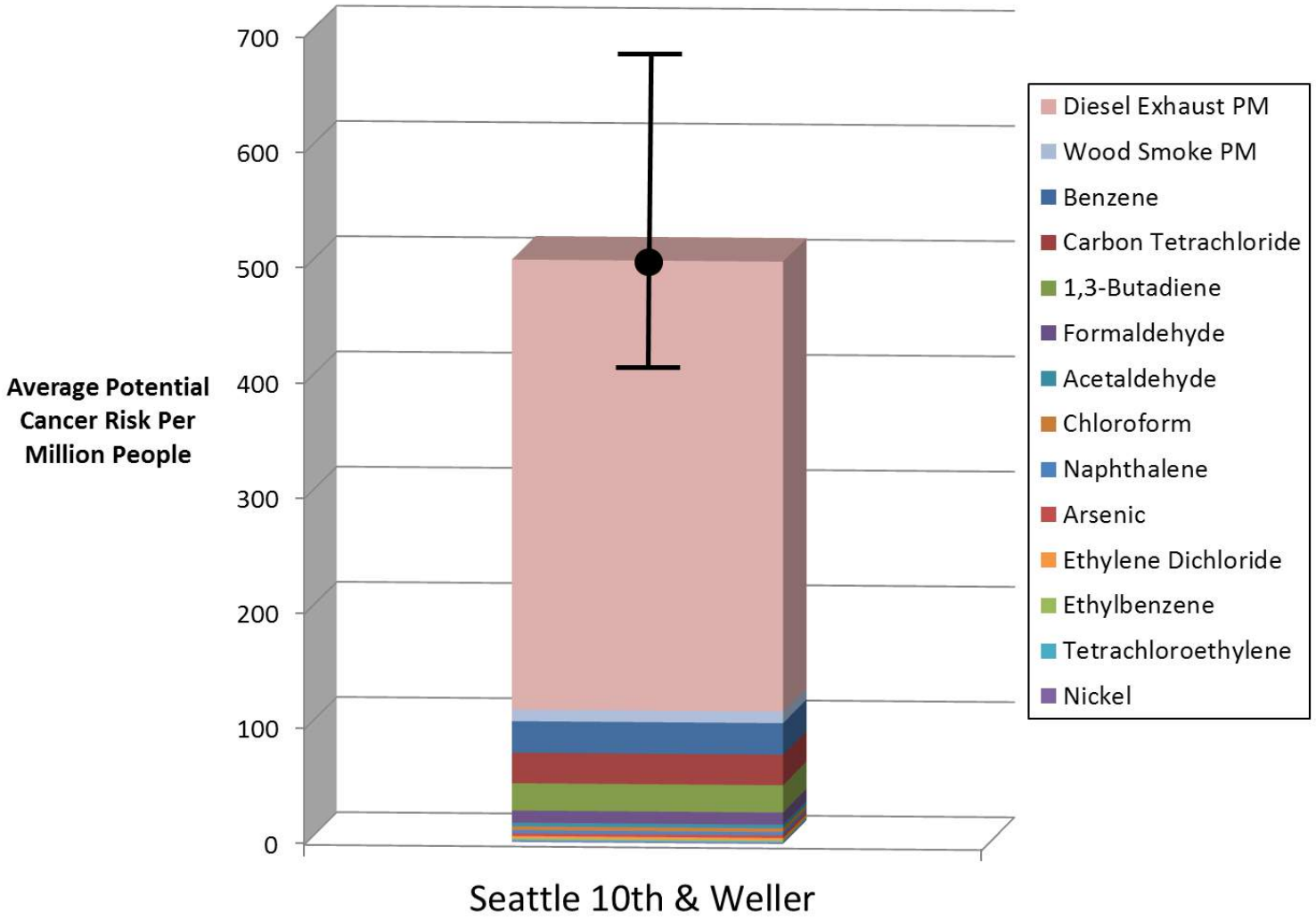
Potential cancer risk from monitored air toxics
(excludes diesel exhaust and wood smoke PM)

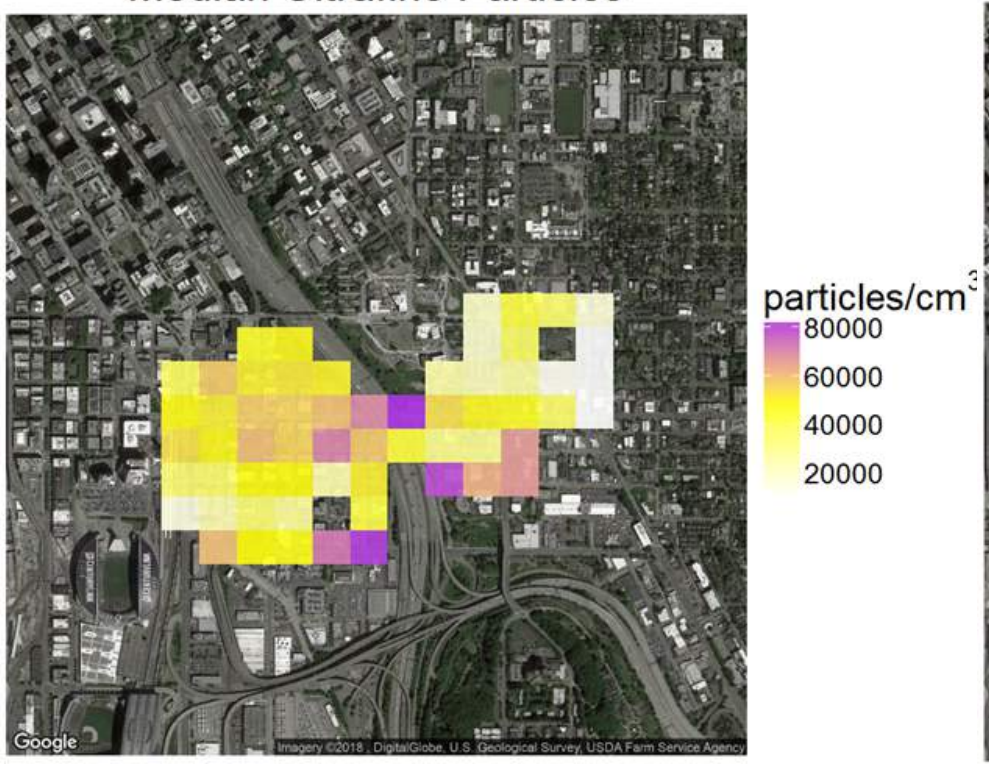


Potential cancer risk at 10th & Weller
(including diesel and wood smoke estimates)



Mobile monitoring – ultrafines and BC

Median Ultrafine Particles



Median Black Carbon

Ratio of 2011 NATA to observed

2011 NATA biased high

Analyte	10th and Weller	Beacon Hill	6th & Jackson	Bailey Gatzert
1,3-Butadiene	3.4	6.3	5.5	5.0
Acetaldehyde	2.9	3.2	*1.8**	3.1
Arsenic	1.0	0.6		
Benzene	4.4	5.3	6.1	5.1
Carbon Tetrachloride	0.9	0.8		
Chloroform	0.01	0.01		
Ethylbenzene	1.7	1.5		
Ethylene Dichloride	*0.05***	*0.04***		
Formaldehyde	2.0	2.3	*0.8**	2.4
Naphthalene	2.7	4.4		
Nickel Compounds	8.1	4.3		
Tetrachloroethylene	*3.3***	*2.7***		
Vinyl Chloride	*0.003**,****	*0.03**,****		

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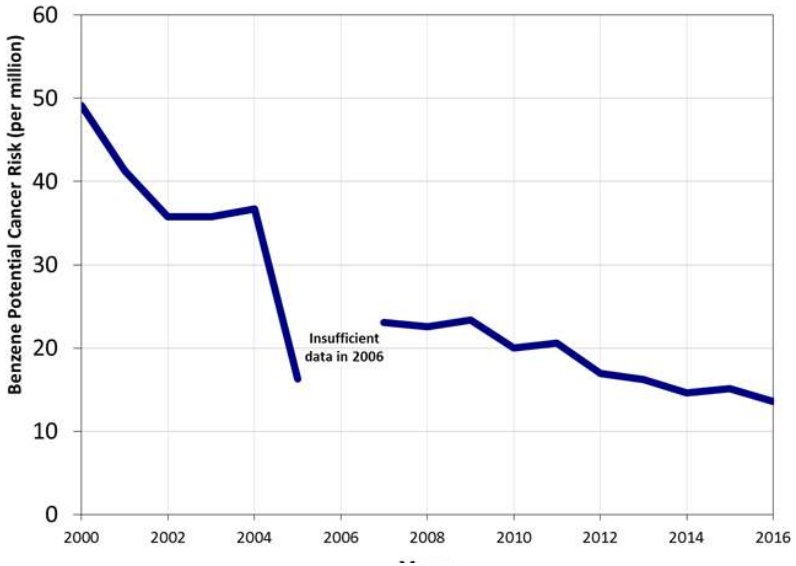
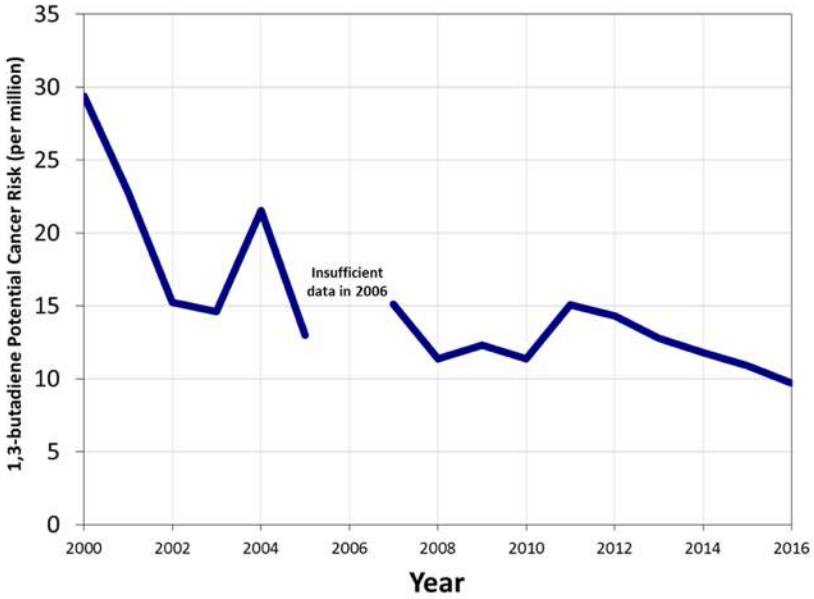
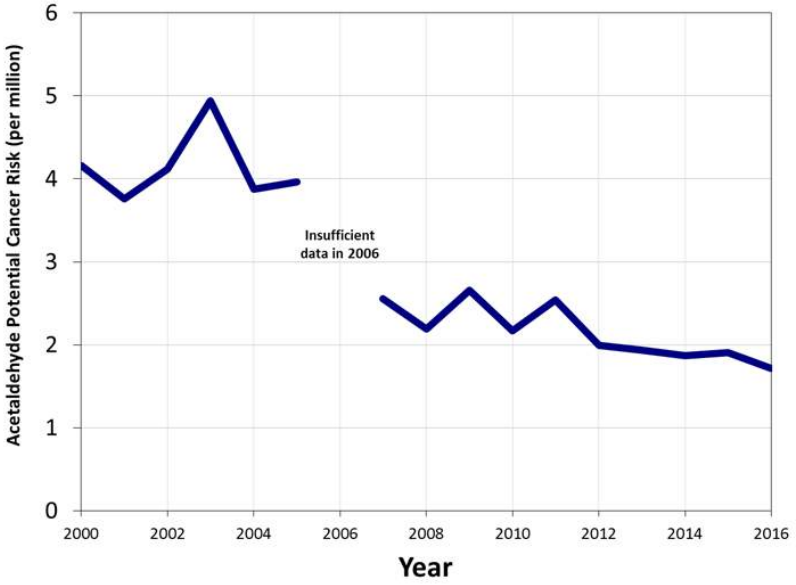
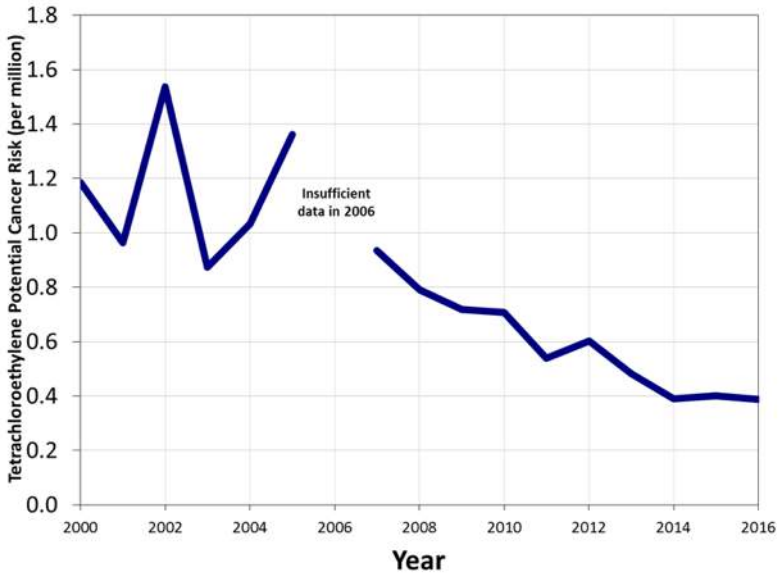
Air toxics have been heading down

Beacon Hill 2000-2016









Questions

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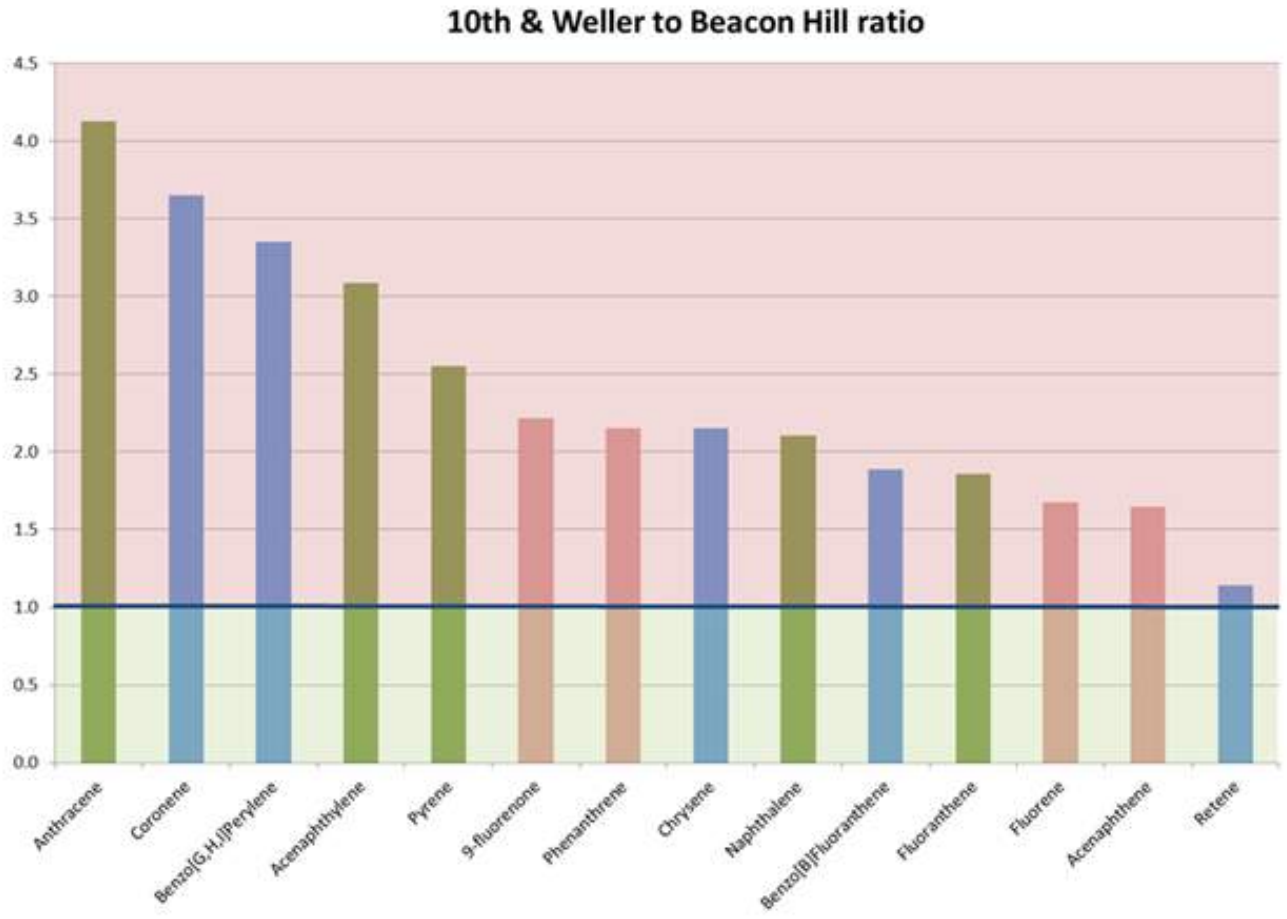
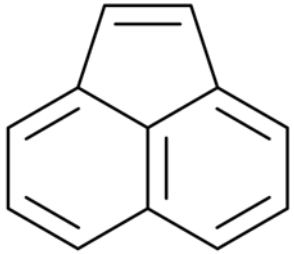
extra

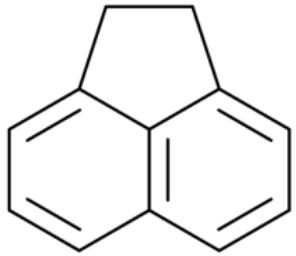
Near road vs urban background PAHs

= higher in the summer
= no seasonality
= higher in the winter

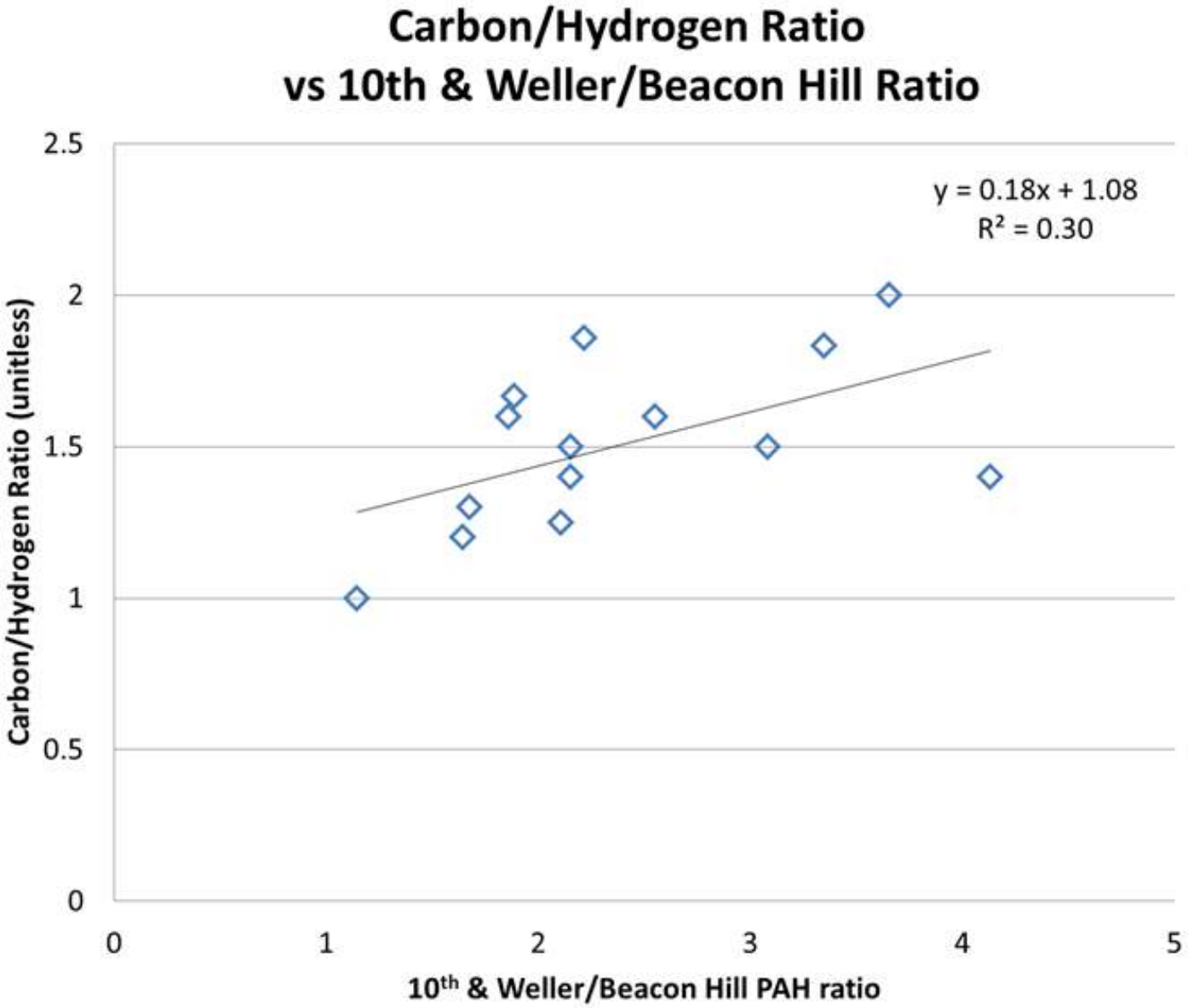




Acenaphthylene



Acenaphthene


Carbon/Hydrogen Ratio
vs 10th & Weller/Beacon Hill Ratio
y = 0.18x + 1.08
R² = 0.30
Carbon/Hydrogen Ratio (unitless)
2.5
2
1.5
1
0.5
0
0
1
2
3
4
5
10th & Weller/Beacon Hill PAH ratio

"Fresh"
More reactive

"Aged"
Less reactive