

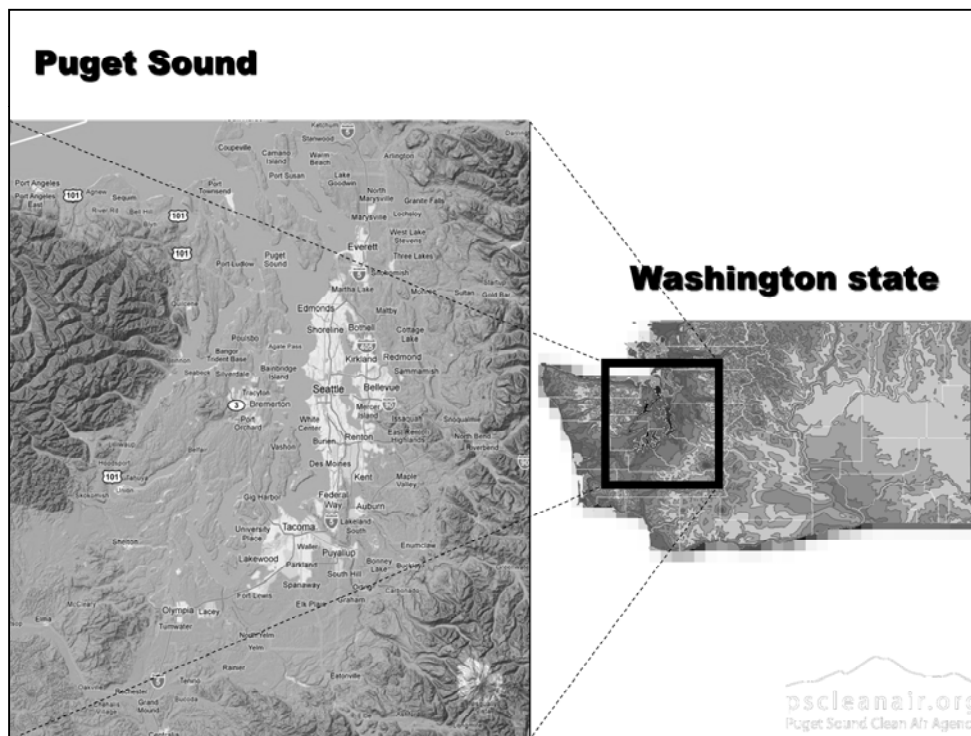


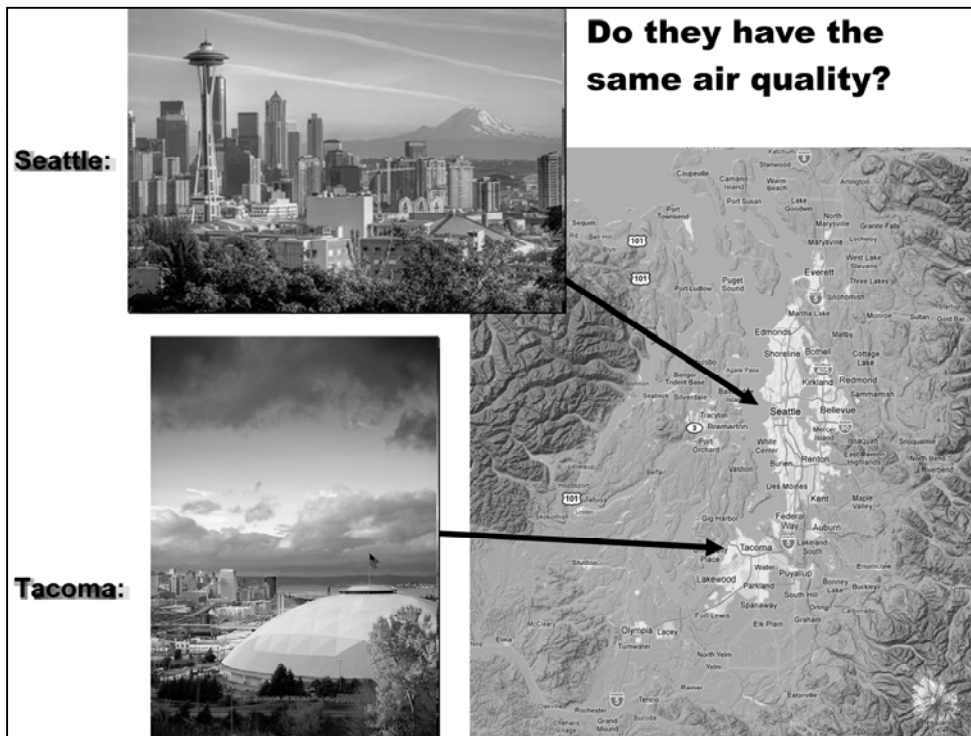
*Working together for clean air*

# **Tacoma and Seattle Air Toxics Study**



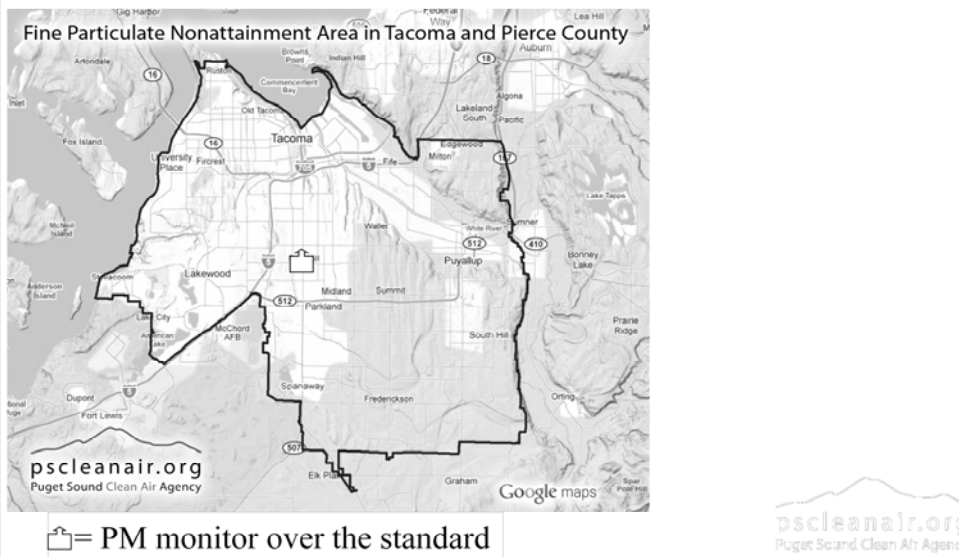
**Puget Sound Clean Air Agency  
Erik Saganic**





## Tacoma Non-Attainment for PM

- 24-hour  $PM_{2.5}$  Non-Attainment Area for Pierce County
- Many stakeholders with concerns



## Two Projects Completed

- **Two Major Questions:**

- Is existing toxics data from Seattle truly reflective of the situation in Tacoma?
- What is the impact of wood smoke, diesel, motor vehicles, trains, marine vessels and industry on our health?

- **Two EPA grants: Community Monitoring and Methods Development**

- **Partnered with the University of Washington**

- **Sampling Duration: November 2008 to October 2009**

- **Final reports submitted October 2010:**

- [http://epa.gov/ttnamti1/files/20072008csatam/PSCAA\\_CommunityAssessment\\_FR.pdf](http://epa.gov/ttnamti1/files/20072008csatam/PSCAA_CommunityAssessment_FR.pdf)
- [http://www.epa.gov/ttnamti1/files/20072008csatam/PSCAA\\_Methods\\_FR.pdf](http://www.epa.gov/ttnamti1/files/20072008csatam/PSCAA_Methods_FR.pdf)

## 1 Year of Monitoring:

- 4 sites for:

- ▲ Volatile Organic Compounds
- ▲ Carbonyl Compounds
- ▲ Levoglucosan (Wood Smoke Marker)
- ▲ PM<sub>2.5</sub>

- 3 Sites for:

- ▲ Polycyclic Aromatic Hydrocarbons
- ▲ Meteorological Monitoring

- 2 Sites for:

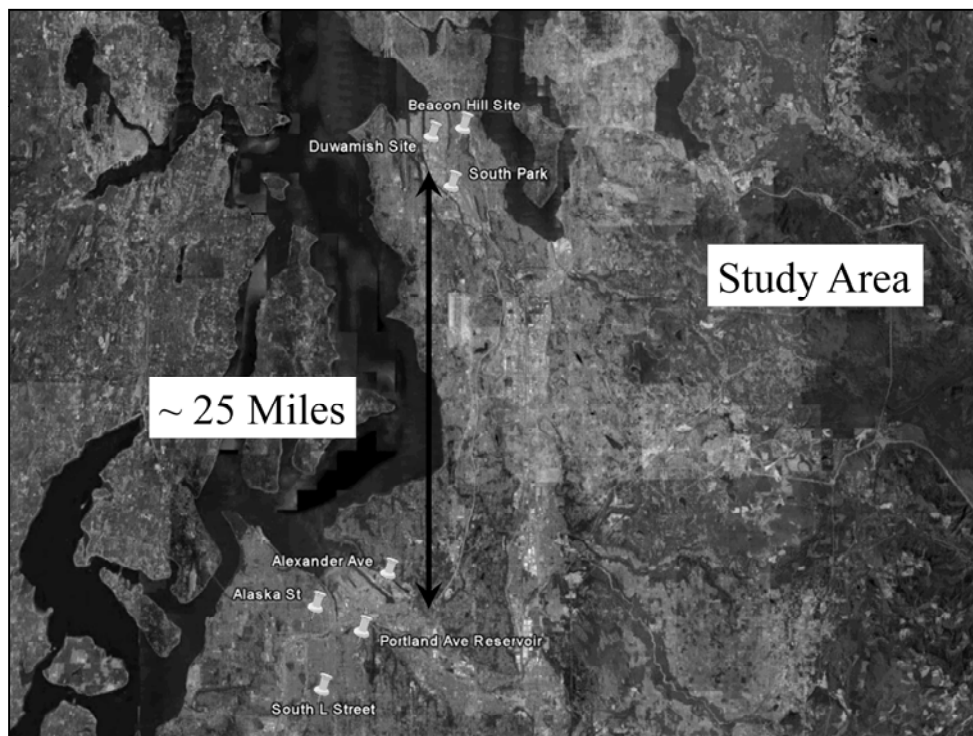
- ▲ Speciation of metals, ions, and carbon

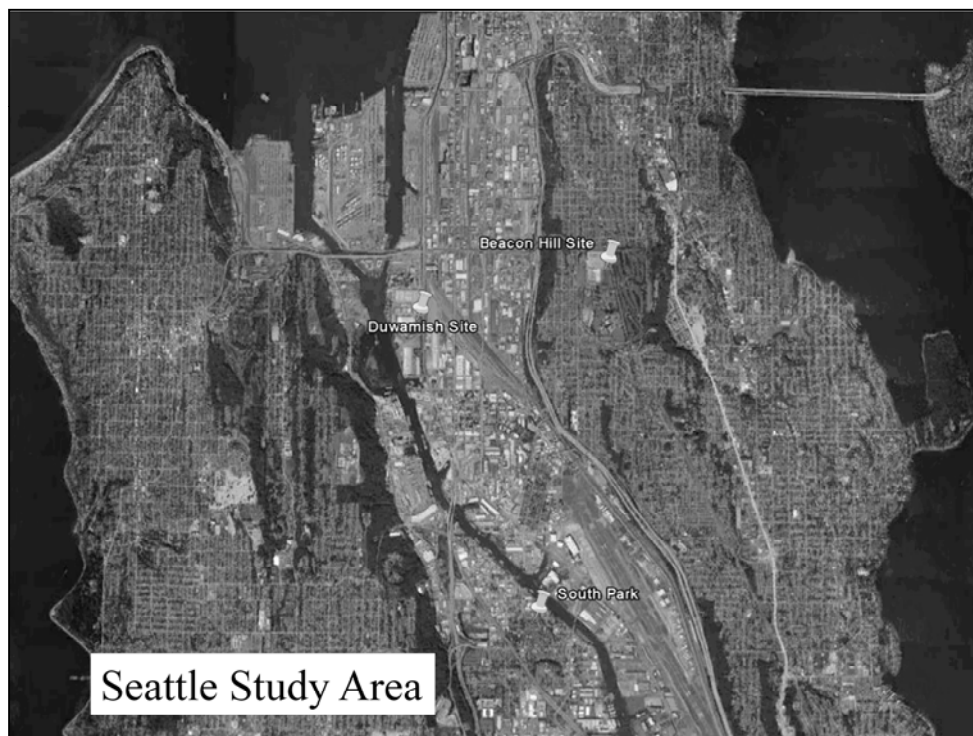
- 1 Site for:

- ▲ 1-nitropyrene (Diesel Marker)
- ▲ Non-methyl organic hydrocarbons (Ozone Precursors)

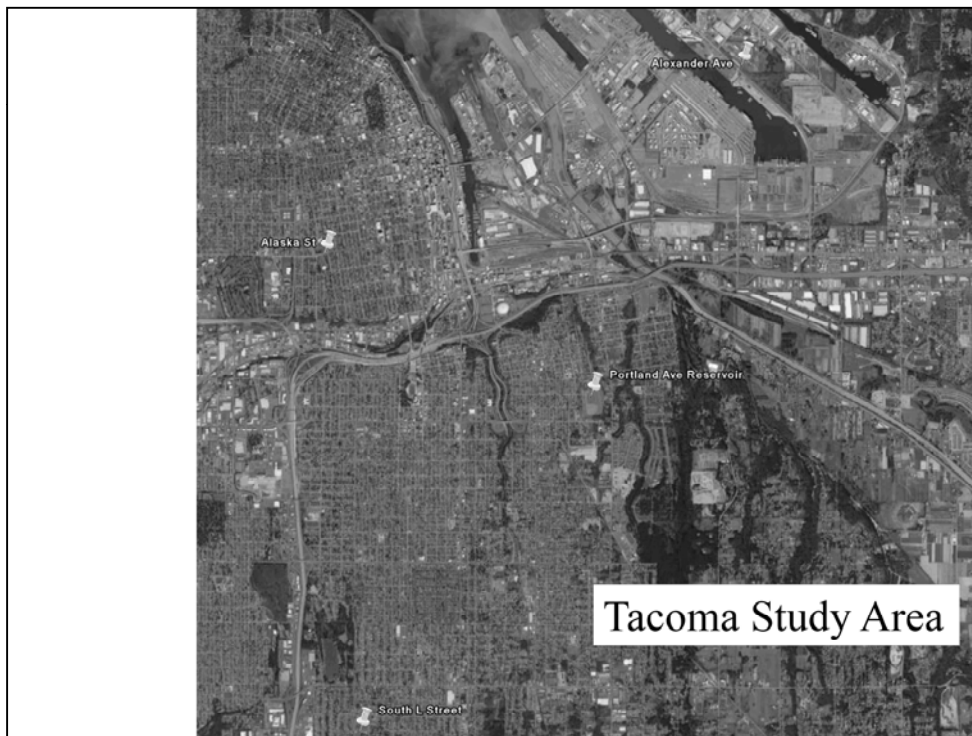
- Mobile Monitoring

- ▲ PM<sub>2.5</sub>, black carbon, BTEX compounds, absorption coefficient



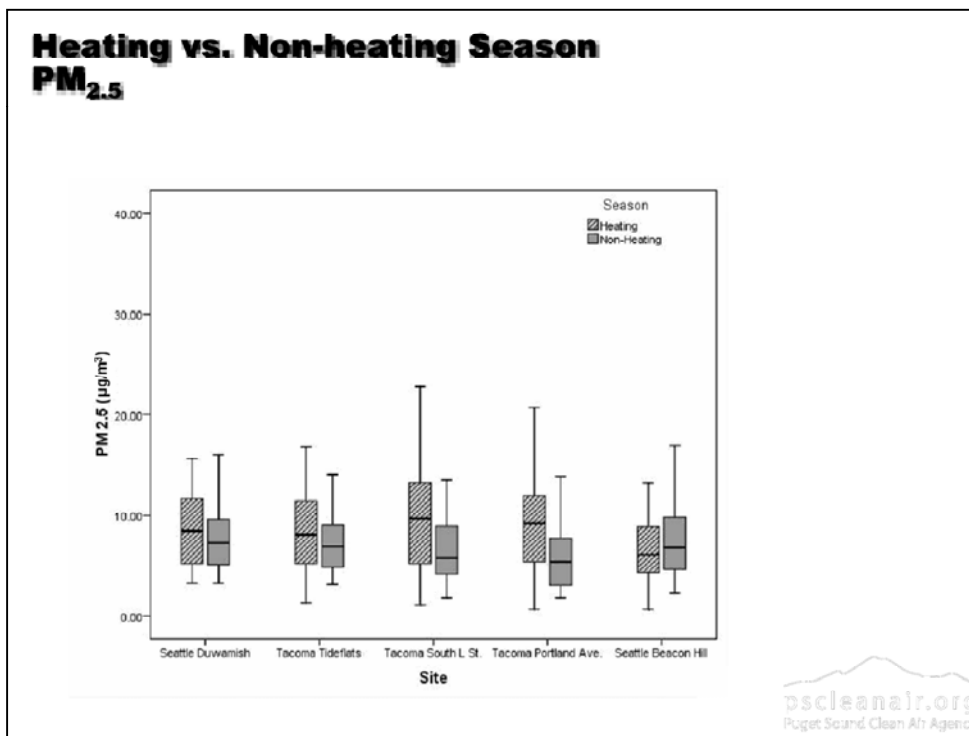


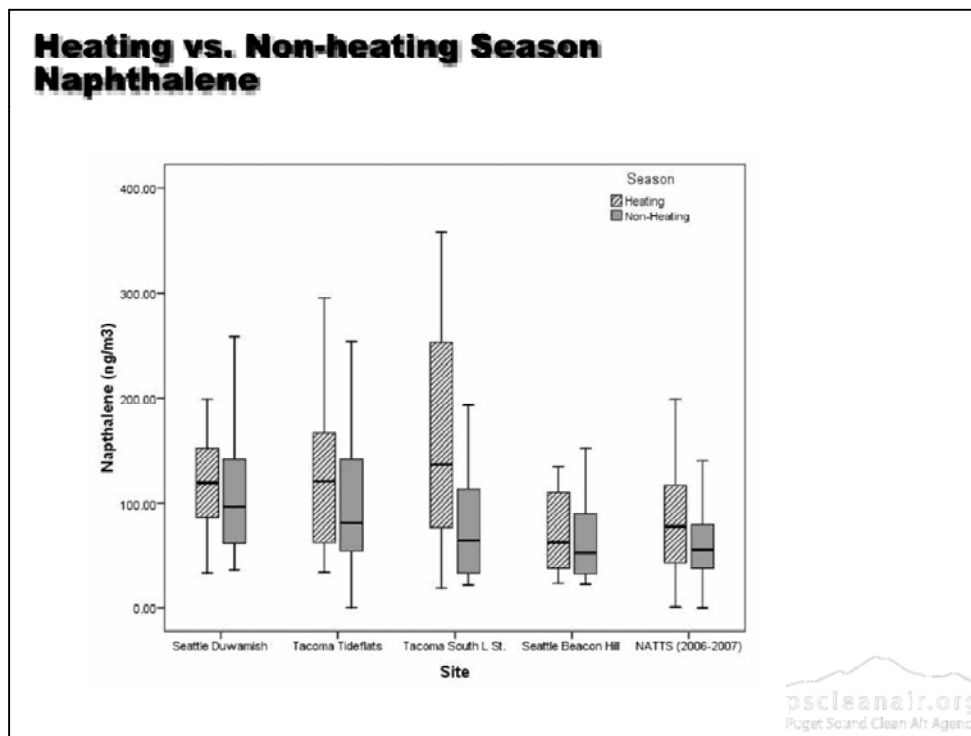




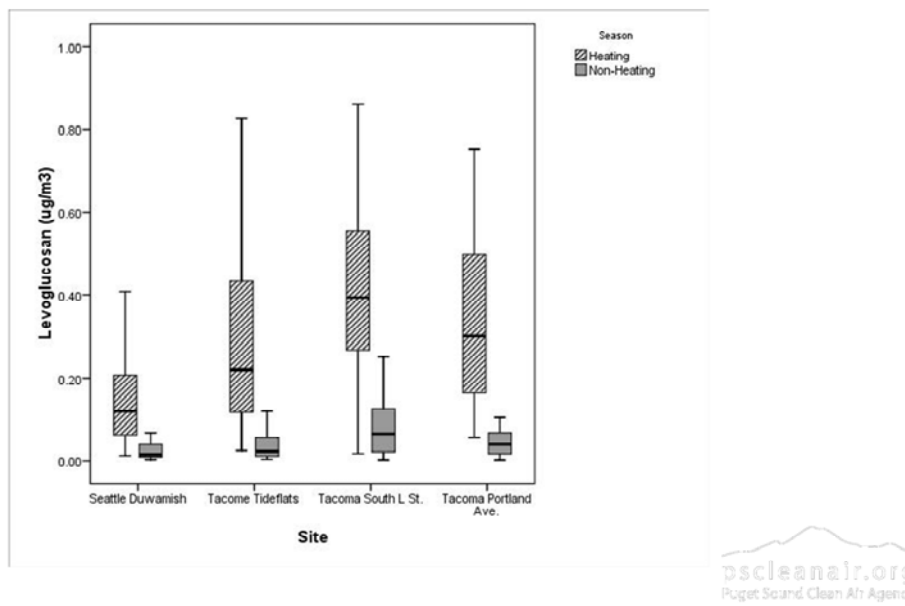
# Results





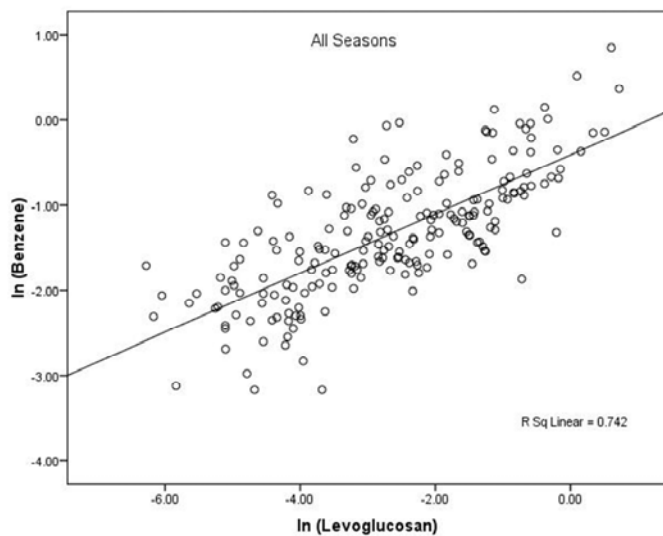


### Heating vs. Non-heating Season Levoglucosan



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### Bivariate Scatter Plot of Benzene and Levoglucosan



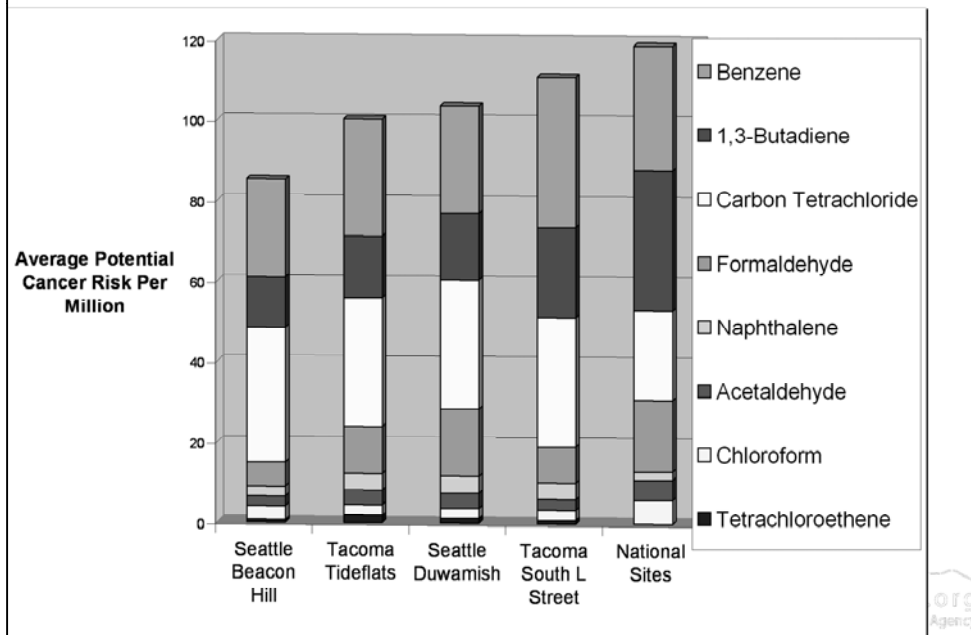
  
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## Potential Cancer Risk

- Estimate of additional deaths in a lifetime (70 years) per million people
- $(\text{Concentration}) \times (\text{Unit Risk Factor}) = \text{Potential Cancer Risk}$
- Unit risk factors are estimated from human exposure studies or animal studies.

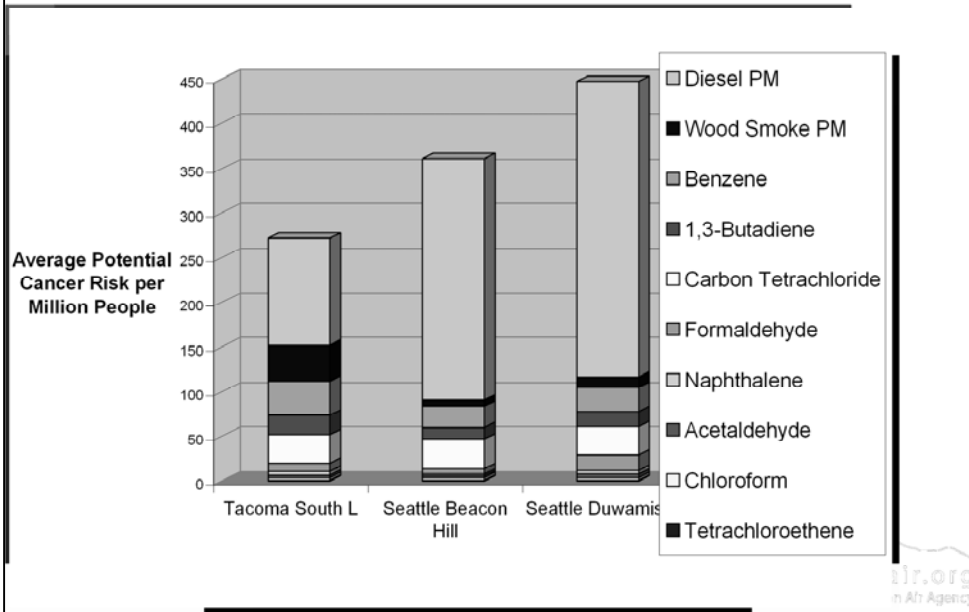


### Results – Fixed Sites





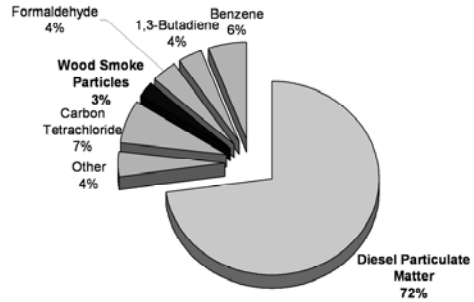
### Results – Fixed Sites with Diesel and Wood Smoke Particulate Matter



### Potential Cancer Risk Contribution



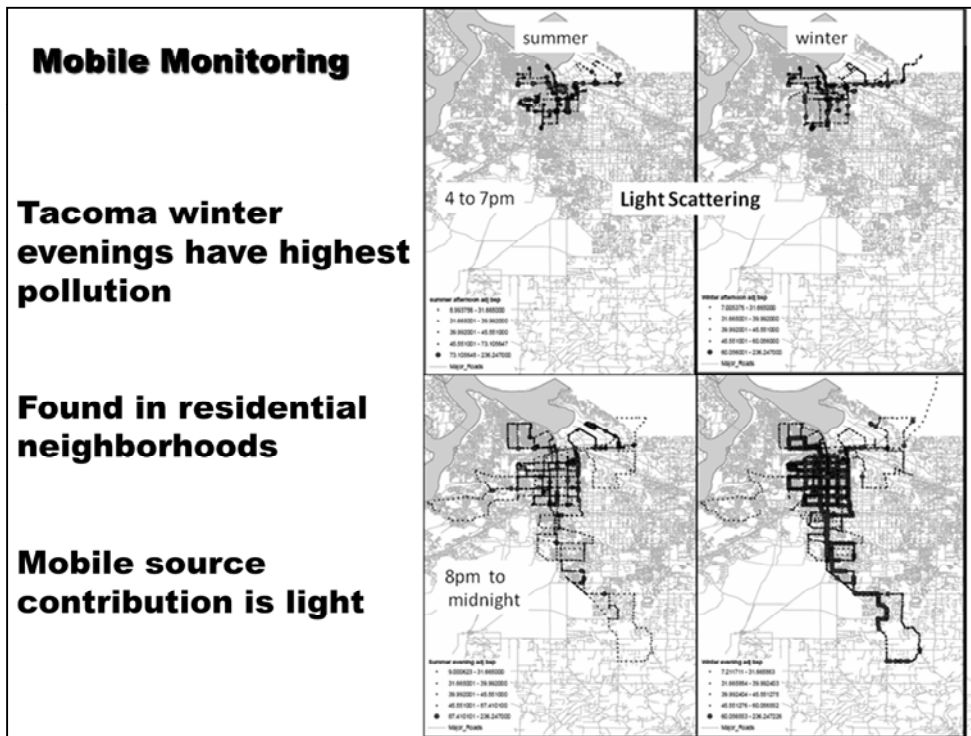
Tacoma South L Street Site



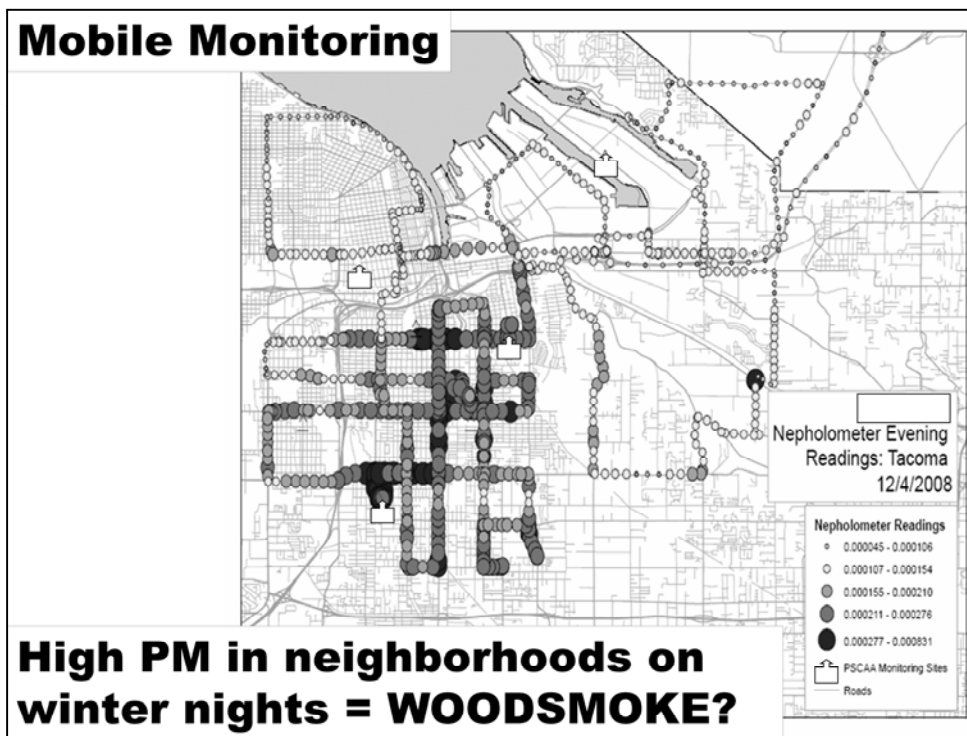
Seattle Duwamish Site

- Mobile Sources
- Wood Combustion
- Both Mobile Source and Wood Combustion
- Other





Highway contribution



# Principle Component Analysis

Factor Loadings after Varimax rotation for the concurrent particle and benzene data. These concurrent data were mainly taken in the evening.

	Factor 1	Factor 2	Factor 3
$b_{sp}$	0.74	0.09	0.48
PAH	0.10	0.96	0.22
$b_{sp}$	0.17	0.28	0.92
Benzene	0.93	0.12	0.08



Figure 3.3.4: Spatial Distribution of Woodstove Use Survey Data versus winter, nighttime contributions from a multivariate factor derived from principal component analysis

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## Model to Monitor Comparison

Table 5.1.1: Model-to-Monitor Ratios Using the 2002 NATA and the Study Monitor Results\*

Pollutant	Seattle Duwamish	Tacoma Tide Flats	Tacoma South L St	Tacoma Portland Ave Reservoir	Seattle Beacon Hill
1,3-Butadiene	8.5	3.0	1.1	1.7	3.3
Acetaldehyde	3.8	2.4	2.5	N/A	4.1
Acrolein	1.0	0.5	0.4	N/A	0.5
Benzene	13.0	4.6	2.0	2.8	5.7
Carbon Tetrachloride	0.8	0.8	0.8	0.8	0.8
Chloroform	1.3	1.1	0.8	N/A	1.1
Diesel Engine Emissions*	6.3	N/A	3.1	N/A	2.3
Formaldehyde	2.0	2.0	1.6	N/A	2.7
Naphthalene	2.3	0.9	0.4	N/A	1.7
Tetrachloroethylene	1.1	0.5	0.8	0.7	1.5

\*The study results for diesel emissions for South Tacoma are derived from the 2009 WA State Dept of Ecology Source Apportionment analysis<sup>7</sup> and the diesel emissions for Seattle Duwamish and Beacon Hill are derived from Kim, Hopke, 2008.<sup>47</sup>

### **Main findings**

- **Residential neighborhoods with elevated PM have elevated air toxics – due to wood smoke**
- **Port/industrial areas similar in Seattle and Tacoma**
- **Diesel PM still contributes most to potential cancer risk**



### **Main findings (contd.)**

- **Mobile sources and wood burning devices contribute most to potential cancer risk from air toxics in the Puget Sound area**
- **Air toxics concentrations have decreased since 2000**
- **On average, our sites have lower potential cancer risk due to air toxics than other urban areas**





### **How do these projects fit in with our priorities?**

- **We already have active programs that reduce emissions from priority air toxics sources:**
  - Diesel Solutions
  - Wood smoke measures – changeouts, curtailments, etc.
  - Industrial source permitting
  
- **This study highlights co-benefits of programs/actions – they reduce both air toxics and criteria pollutants**



**Contact us:**

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● [www.pscleanair.org](http://www.pscleanair.org)

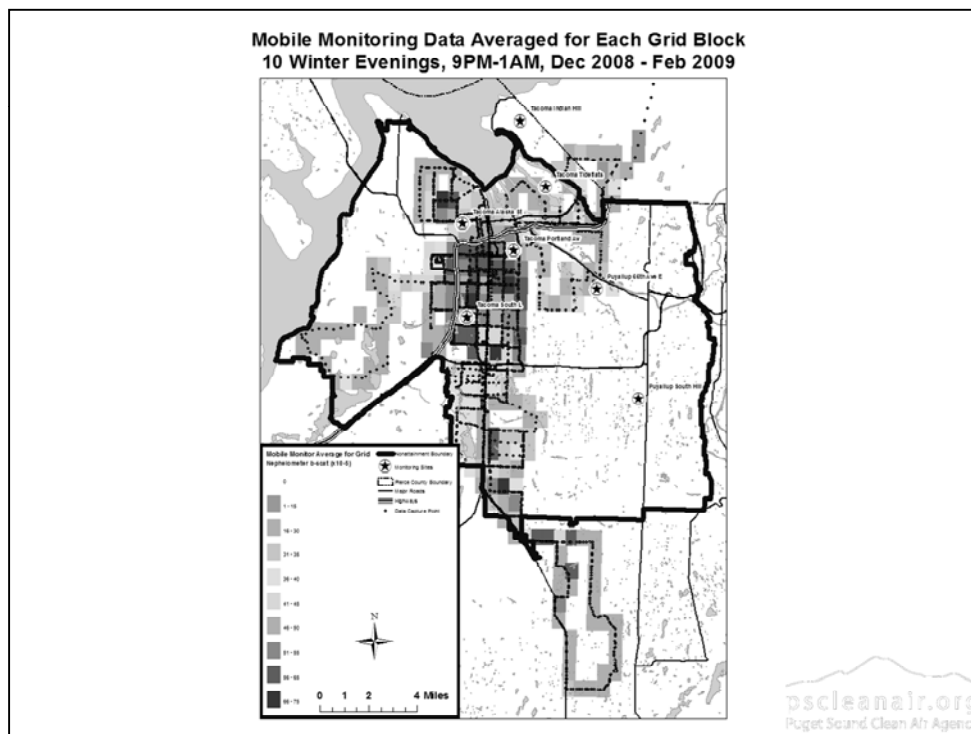


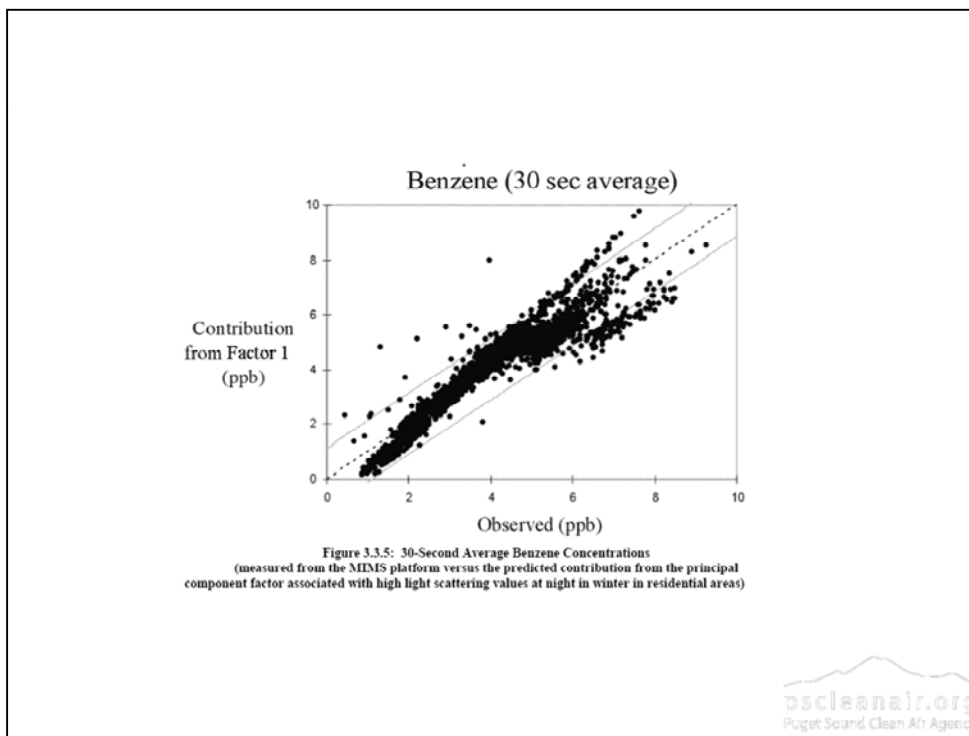
**Questions**



**EXTRA SLIDES**







## **Funding**

- **We applied for two EPA grants**
  - **Community Scale Monitoring - \$541,217**
  - **Methods Development - \$346,841**
  - **Agency contribution/resources - \$185,000**
  - **University of Washington is a critical resource**



## **Communication**

- **Press release**
- **Able to promote our wood stove changeout program**





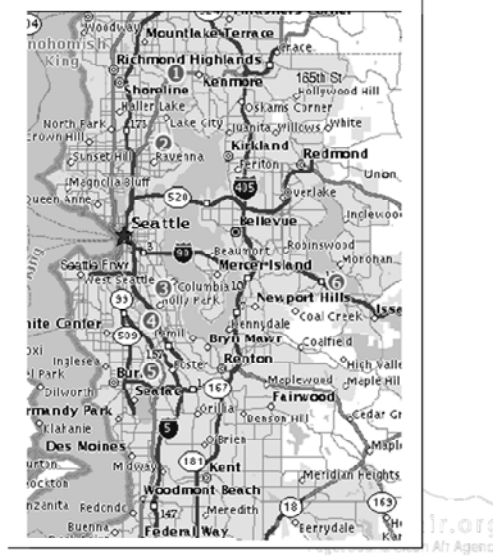
### What did we already know about air toxics in the Puget Sound area?

- **One monitor on Beacon Hill in Seattle**

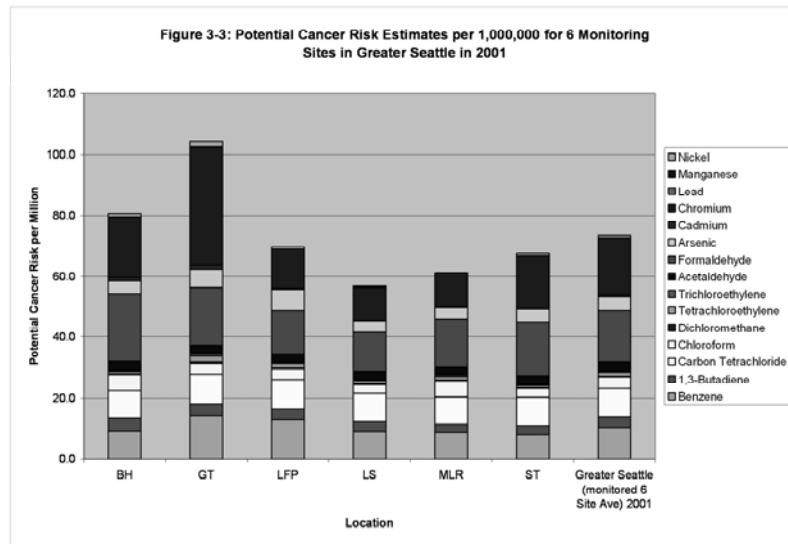
- **Funded by EPA**
- **Data since 2000**

- **2001 monitoring at five additional Seattle-area sites through EPA grant**

- **Department of Ecology operated monitors**



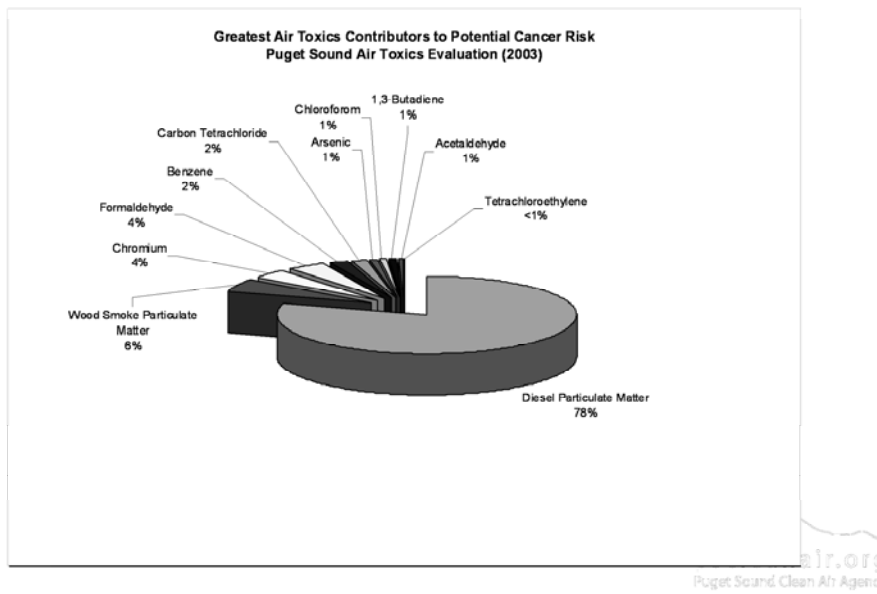
### What did we already know about air toxics in the Puget Sound area?



*2001 study informed spatial variability*

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### What did we already know about air toxics in the Puget Sound area?



## Site selection Seattle Duwamish

- Industrial/port area
- Seasonal wind shifts
- Established monitor
  - Elevated fine particle levels
  - Neighborhood scale



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## Site Selection Tacoma Tideflats

- **Industrial/port area**
- **Seasonal wind shifts**
- **Established monitor**
  - **Elevated fine particle levels**
  - **Neighborhood scale**



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## Site Selection Tacoma South L

- Largely residential area
- Residential and roadway impacts
- Established monitor
  - Elevated fine particle levels
  - Neighborhood scale
  - Environmental Justice component



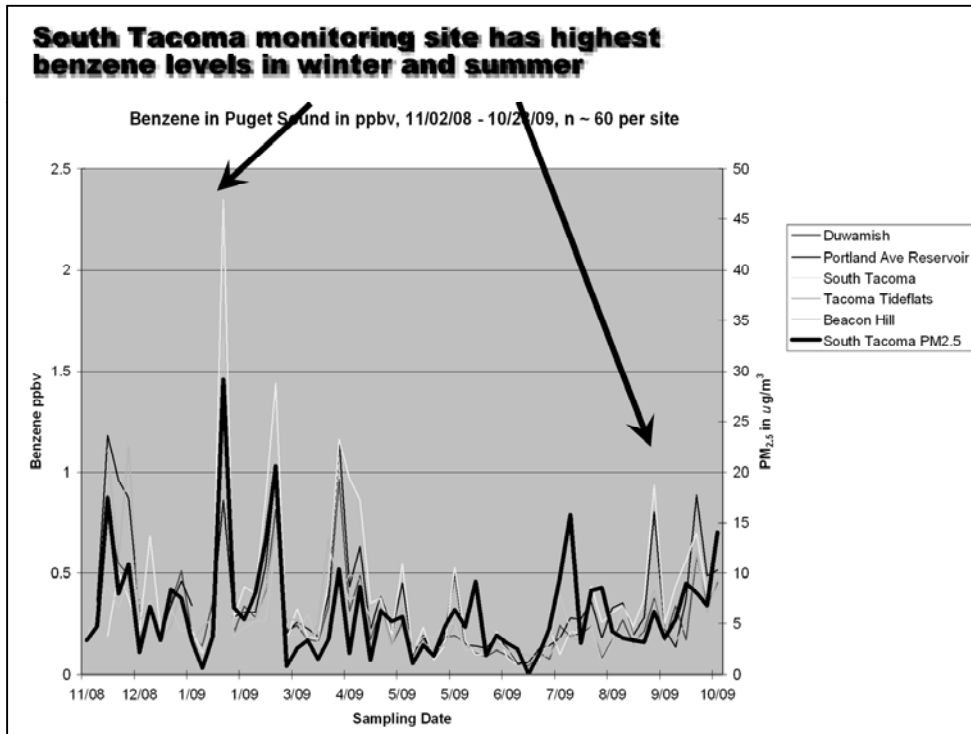
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## Site Selection Hilltop Area

- Residential area
- Variety of sources
- Environmental Justice
- Provides geographic coverage



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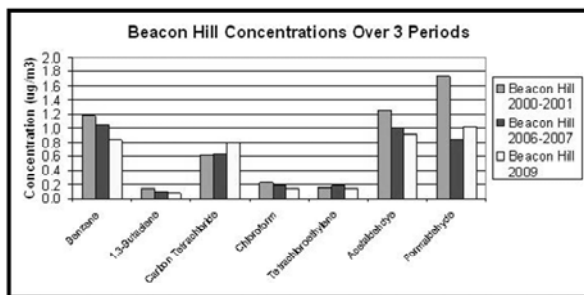




### Toxics Potential Cancer Risk Table

	Average Potential Cancer Risk per Million					5-site mean	All NATTS
	Duwamish	BH	South L	Portland	Alexander		
Benzene	27	24	38	34	29	30	31
Carbon Tetrachloride	32	33	32	31	32	32	22
1,3-Butadiene	17	13	22	18	15	17	35
Formaldehyde	17	6	9	n/a	12	11	18
Acetaldehyde	4	2	3	n/a	4	3	5
Naphthalene	4	2	4	n/a	4	4	2
Chloroform	3	3	3	n/a	3	3	6
Tetrachloroethene	1	1	1	1	2	1	n/a
Total Risk	104	85	111	84	100	97	119

### Air Toxics Over Time



## MIMS

- **BTEX Compounds Measured**

- **Routes:**

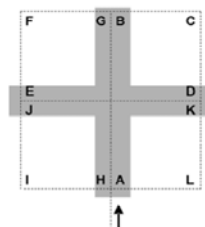
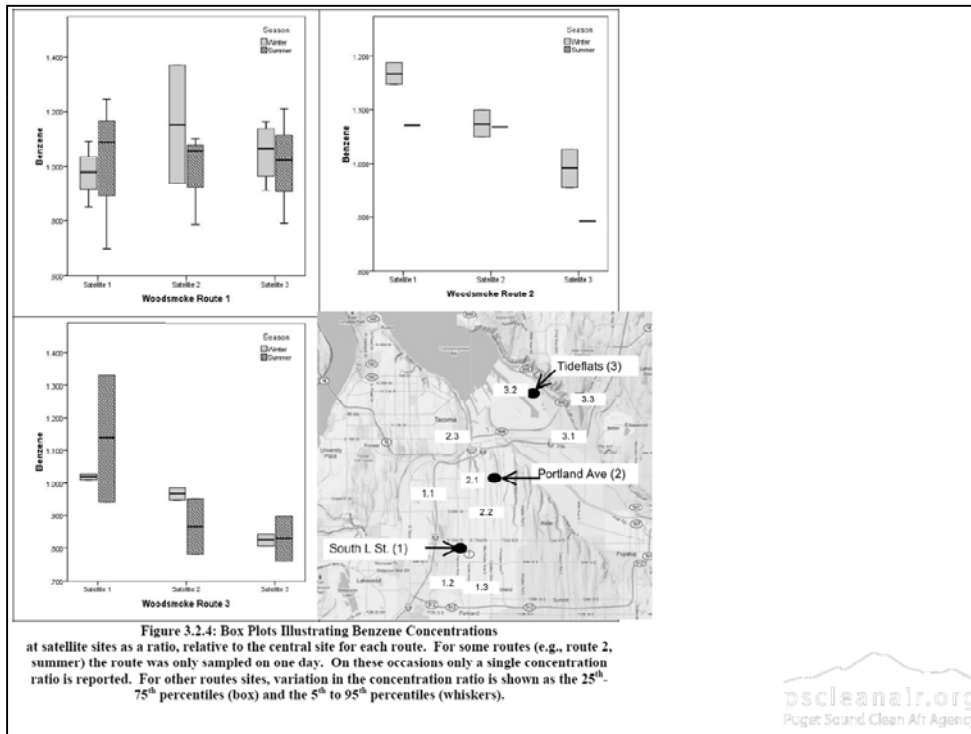


Figure D.2. Cloverleaf pattern traversed by the vehicle at an intersection: vehicle enters intersection at A and moves to locations in alphabetical order, returning to A.



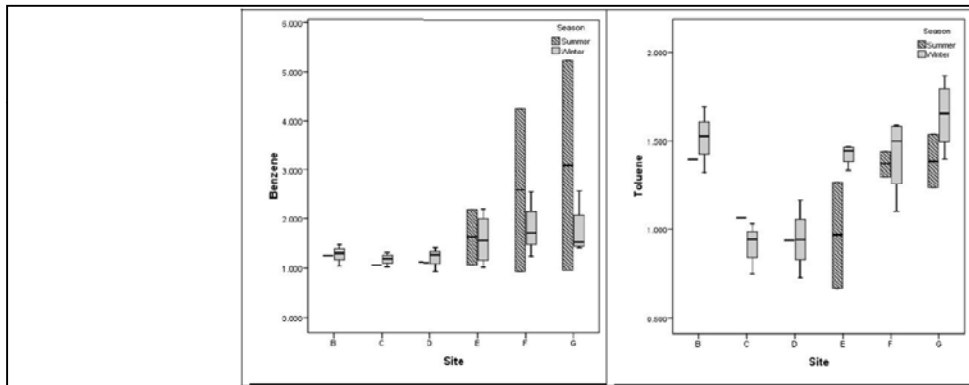


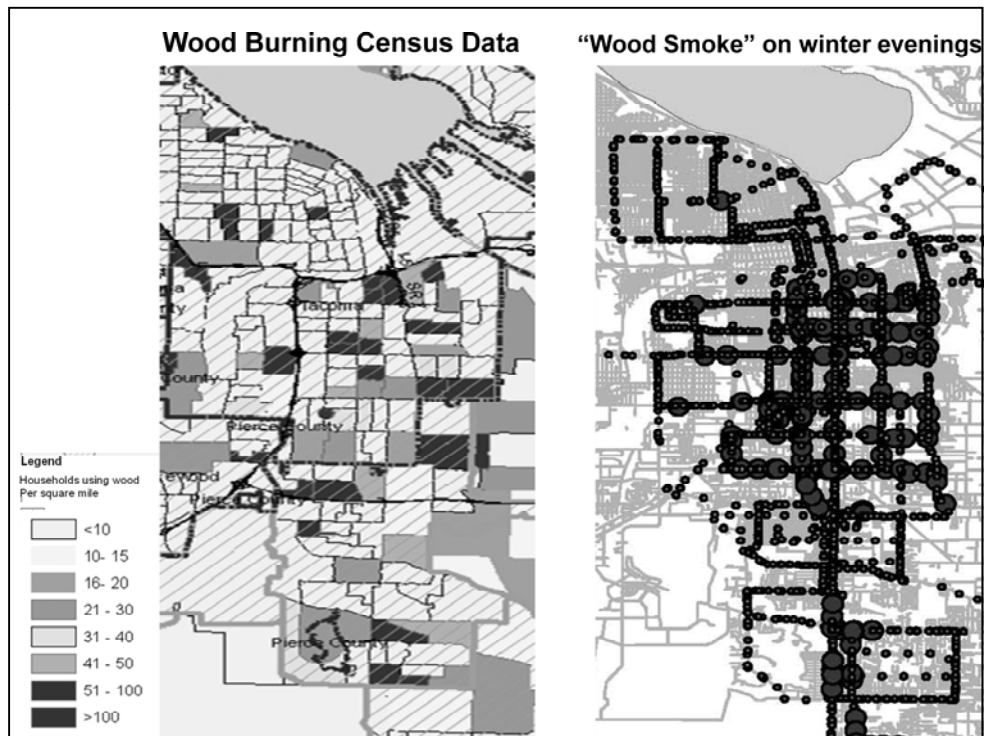
Figure 3.2.5: Box Plots Illustrating Benzene and Toluene Concentrations measured at the traffic sites as a ratio, relative to the Tacoma Portland Ave central site. For some sites (e.g., B, C, and D, summer) the route was only sampled on one day. On these occasions only a single concentration ratio is reported. For other routes' sites, variation in the concentration ratio is shown as the 25<sup>th</sup>-75<sup>th</sup> percentiles (box) and the 5<sup>th</sup> to 95<sup>th</sup> percentiles (whiskers).



### Where did we monitor?



Include mobile references



Now the first image is census data of households that use wood as a source of heat. The image on the left is our "wood smoke factor" and there are striking similarities that help demonstrate that the series of compounds we used is in fact wood smoke.

Additionally, I just want to highlight how using wood burning census data can be a good predictor of air quality and can be helpful in determining site locations and potential problems.

There is one more item that I want to show that highlights some of the differences between our heaviest industrial area to the South Tacoma non-attainment monitor.