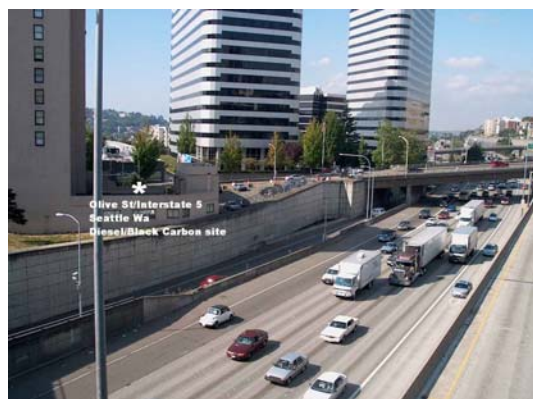




Working Together for Clean Air

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Urban Air Monitoring Strategy



**Preliminary Results Regarding Aethalometer
Carbon Measurement for the Seattle
Metropolitan Area**



- **BC Black Carbon Measurement**
 - We recognize that BC is not the Silver Bullet for DPM; Rather it is an indicator that helps us better understand the urban particulate aerosol.

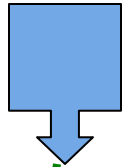
- **Aethalometer Monitoring Strategy for Seattle**

- **Initial Comparison between BC and EC Elemental Carbon Speciation Data**

- **Temporal Patterns**

- **Preliminary observations - UV Channel – Wood Smoke**

BC Measurement



PM 2.5 Head @ 5 LPM

Sampling
Hose



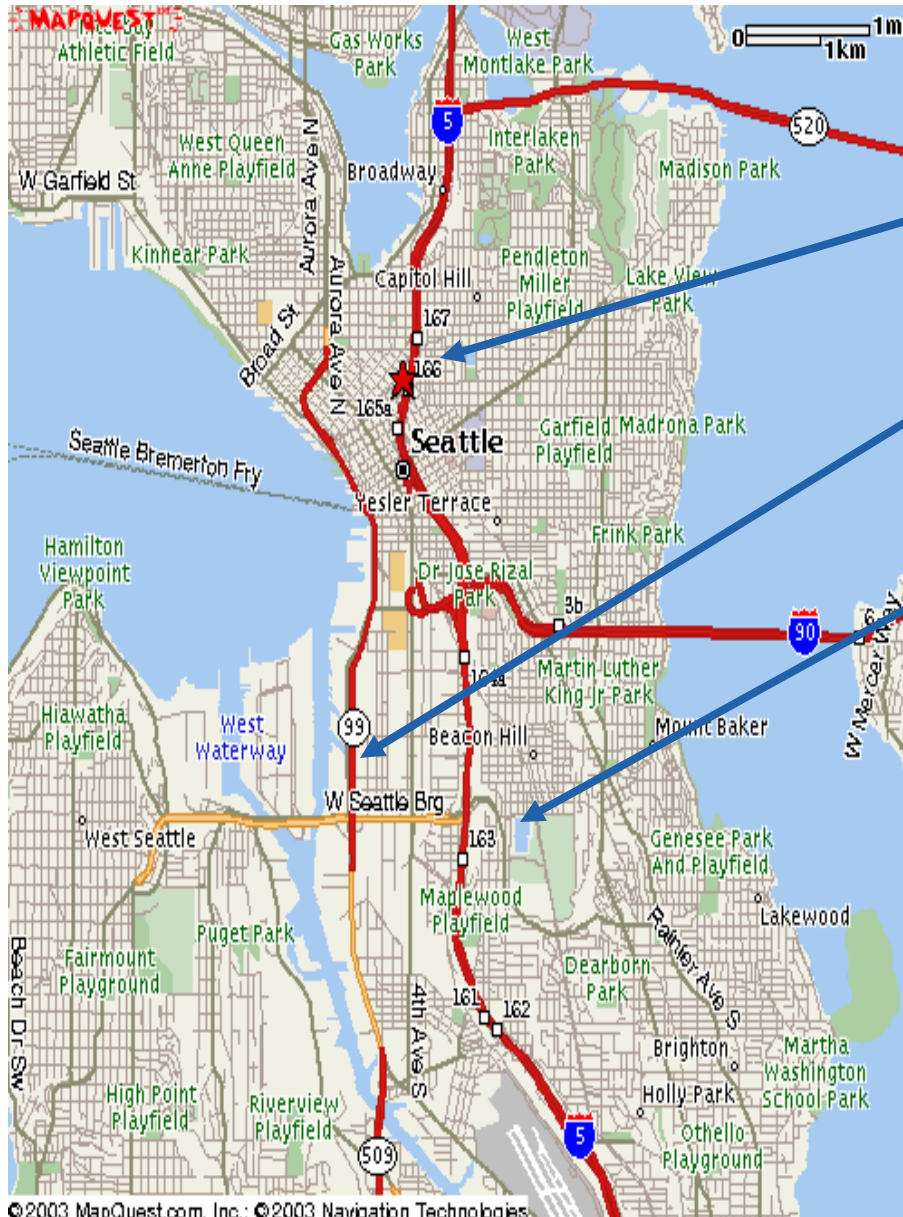
- Magee Scientific Aethalometer™
- BC Channel
- UV Channel

- **Aethalometer (Tape Sampler)**
 - **BC Black Carbon Channel (Absorbance at 880 nm)**
 - **UV Ultraviolet Channel (Absorbance at 370 nm)**
 - **Instrument measures absorbance and applies a calibration factor to determine $\mu\text{g}/\text{m}^3$.**

- **PM 2.5 Speciation Sampling**
 - **EC Elemental Carbon (RTI Methods)**
 - **OC Organic Carbon (RTI Methods)**

- **PM 2.5 Federal Reference Method**
- **“PM 2.5” Nephelometer**
- **PM 2.5 TEOM**

Monitoring Strategy



● **Freeway Site**

■ **Jan 2003**

● **Industrial Site**

■ **Oct 2002**

● **Urban Background Site**

■ **Jan 2003**

● **Wood Smoke North Site**

■ **Dec 2003**

● **Wood Smoke South Site**

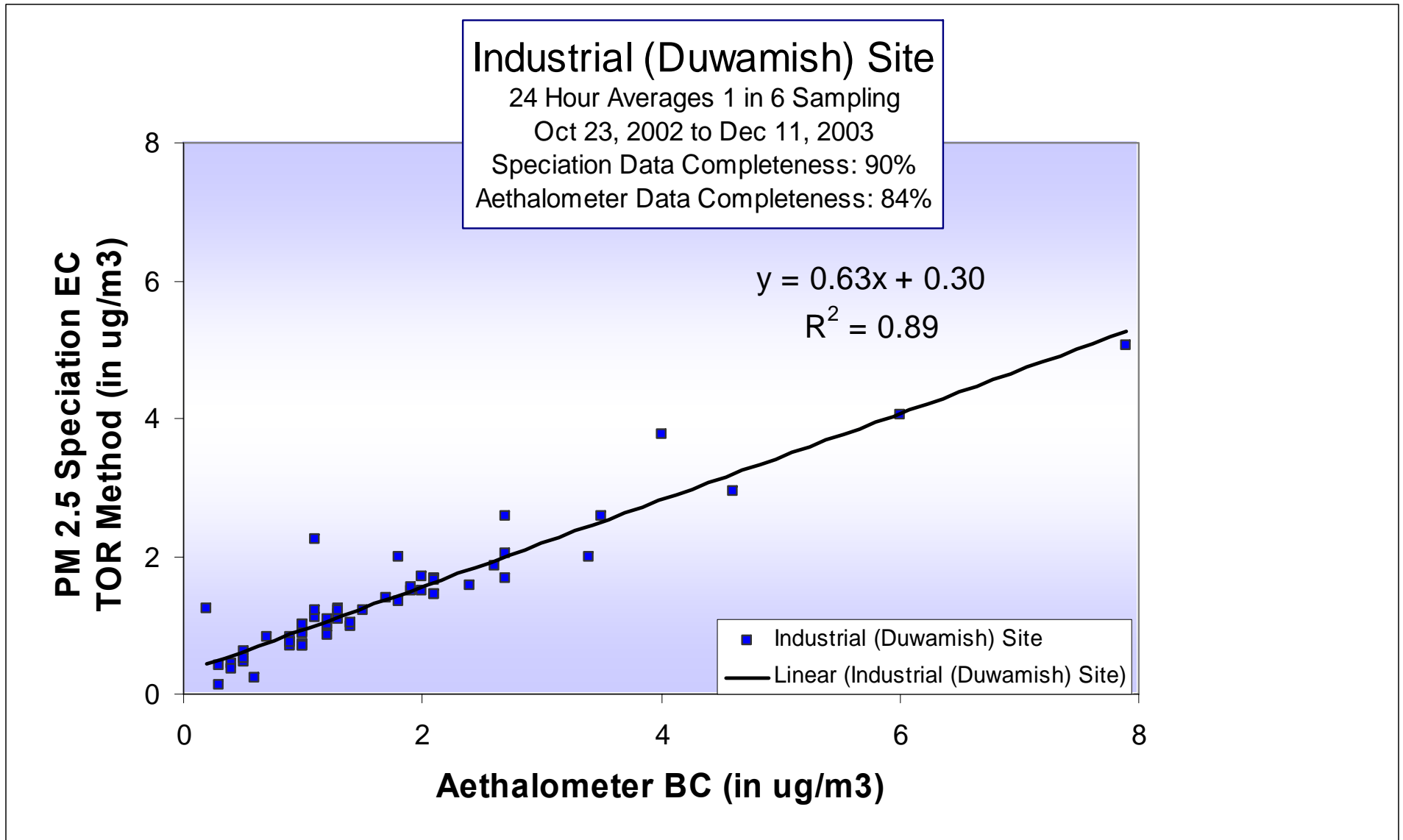
■ **Dec 2003**

Traffic Numbers

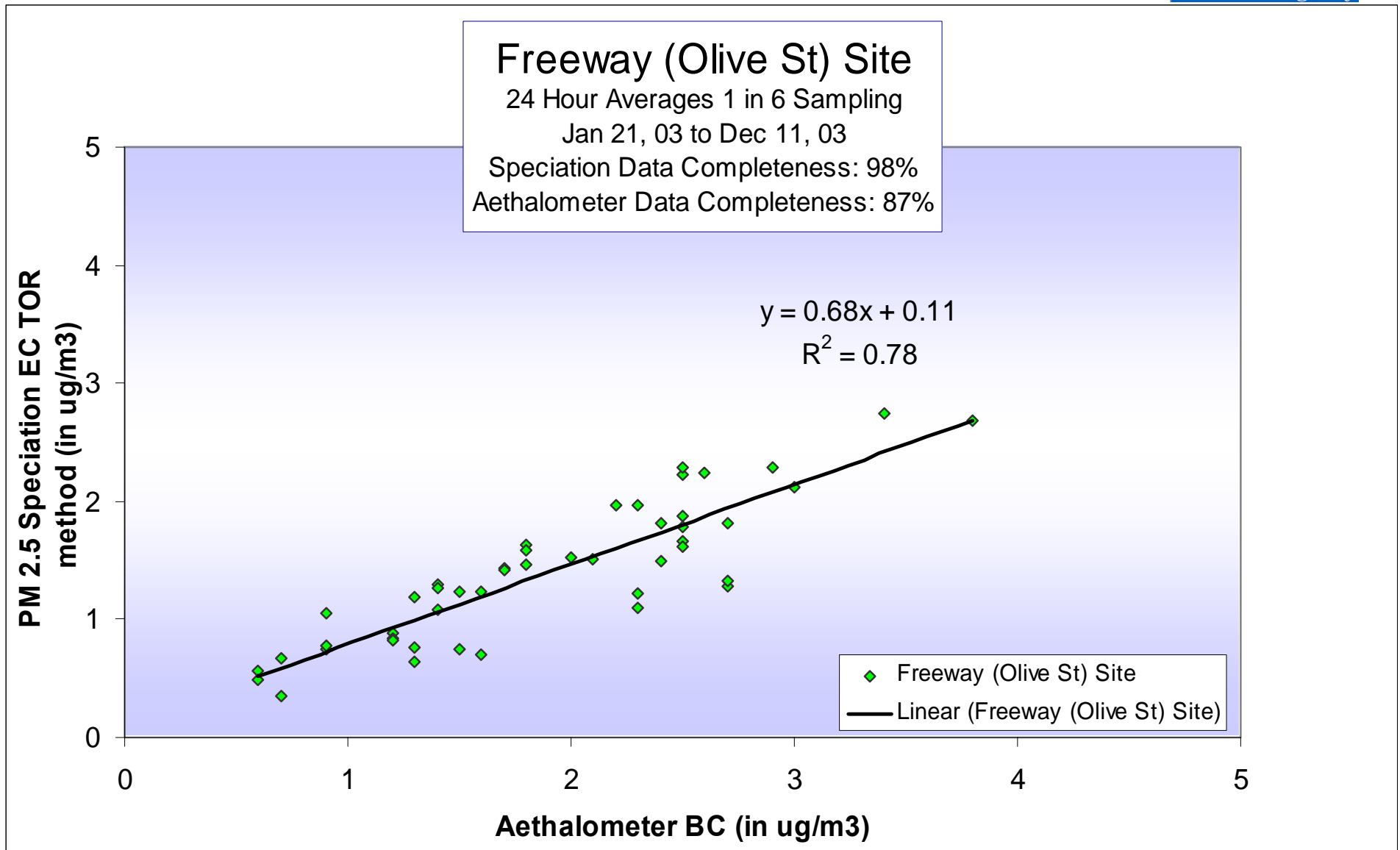


- **Freeway Site – Olive Street at Boren Ave: Located near I-5 in the middle of Seattle Downtown (traffic choke point) micro scale/middle scale**
 - In excess of 200,000 Vehicles per Day
 - ~ 20 Meters from I-5
- **Industrial/Arterial Site – Duwamish Valley Site: Over 20 registered sources located within 10 miles. Located near the Port of Seattle Truck Distribution Center. Neighborhood Scale**
 - 65,000 to 75,000 Vehicles per Day
 - ~ 40 Meters from Hwy 99
- **Traffic Data is available for both sites**

BC and EC Data



BC and EC Data

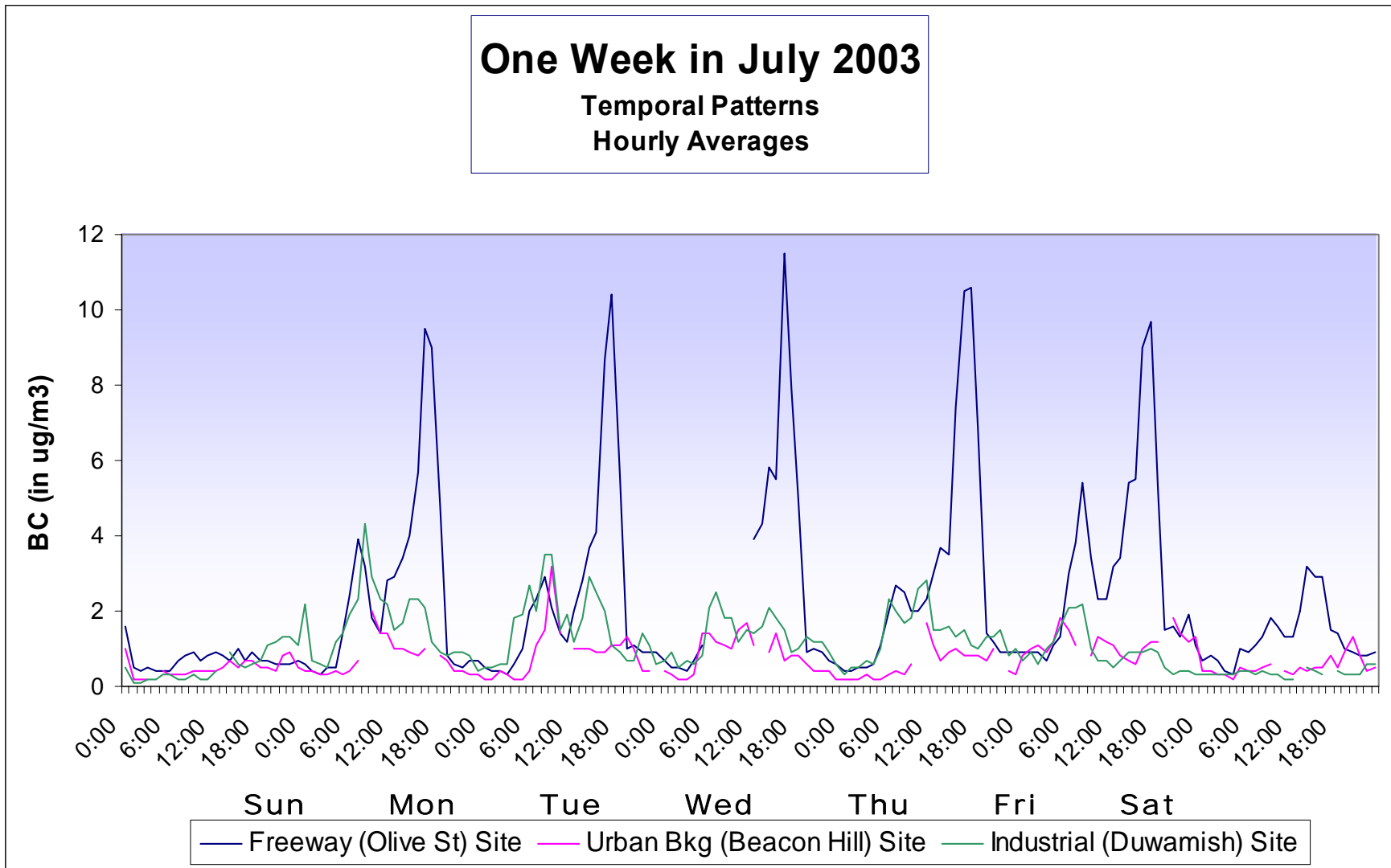


Compare our results to ETV Results



	ETV Program Results	Slope	Y Intercept	R2
Pittsburgh, PA	Monitor 1	.815 (.280)	0	.590
	Monitor 2	.791 (.270)	0	.593
Fresno, CA	Monitor 1	.711 (.031)	.54 (.25)	.930
	Monitor 2	.735 (.031)	.47 (.25)	.934
	PSCAA Results	Slope	Y Intercept	R2
Seattle, WA	Industrial/Arterial Site	.63	.30	.89
	Freeway Site	.68	.11	.78

Temporal Patterns - Freeway Site



Annual Averages



- **Puget Sound Clean Air Agency “Air Toxics Evaluation” report predicted:**
 - **Annual average of 1.4 $\mu\text{g}/\text{m}^3$ of “DPM” at Beacon Hill.**



Data from 2003 indicates:

Schedule	Daily BC	1/6 EC
	Aethalometer	Speciation
Beacon Hill	.4 $\mu\text{g}/\text{m}^3$.59 $\mu\text{g}/\text{m}^3$
Duwamish	1.7 $\mu\text{g}/\text{m}^3$	1.32 $\mu\text{g}/\text{m}^3$
Olive St.	2.0 $\mu\text{g}/\text{m}^3$	1.44 $\mu\text{g}/\text{m}^3$

Wood Smoke Site Descriptions



- **Wood Smoke North**

- **Long History of wood burning**
- **Near to significant arterials**

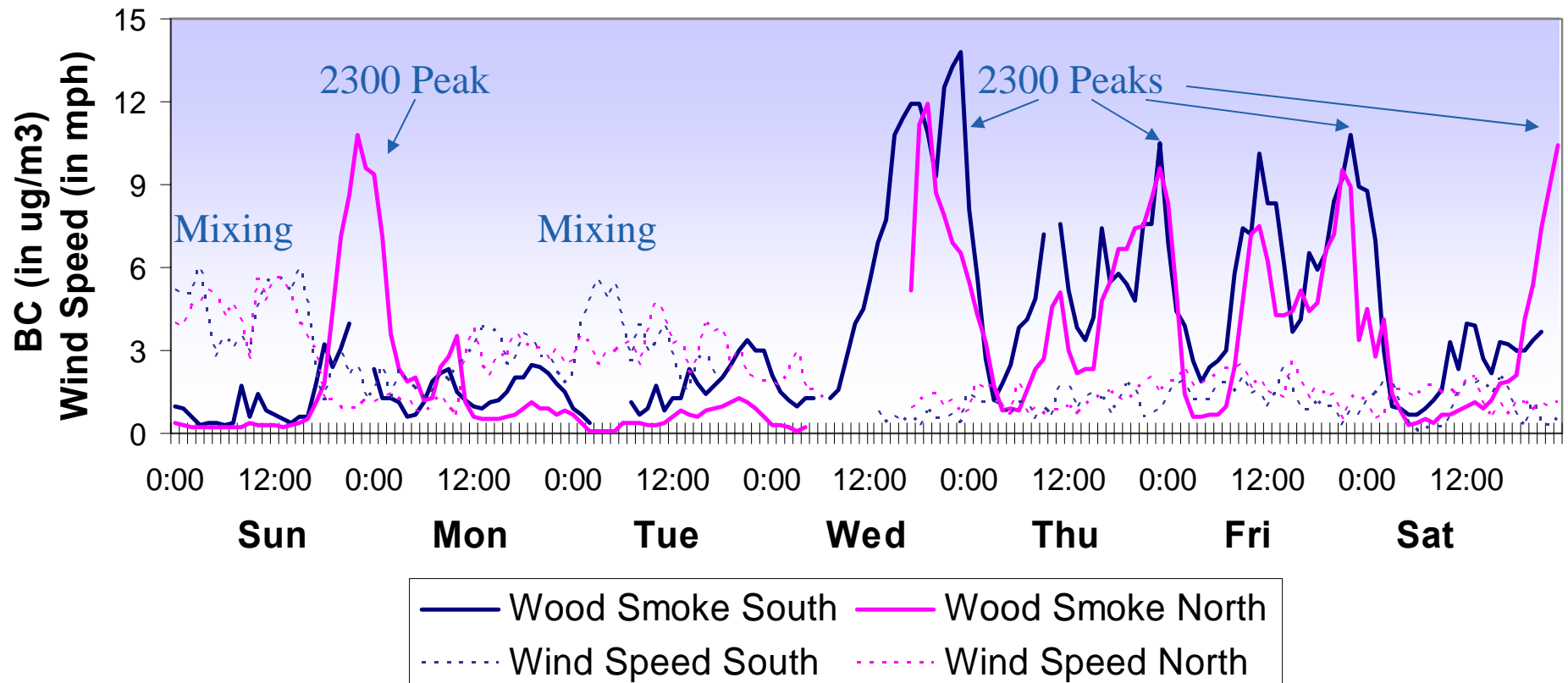
- **Wood Smoke South**

- **Max PM2.5 24 hour site**
 - ▲ **Exceeded the NAAQS**
- **~.6 km from Interstate or Arterials**
- **Wind flow parallel to site from roadways**

Temporal Patterns – Wood Smoke Site



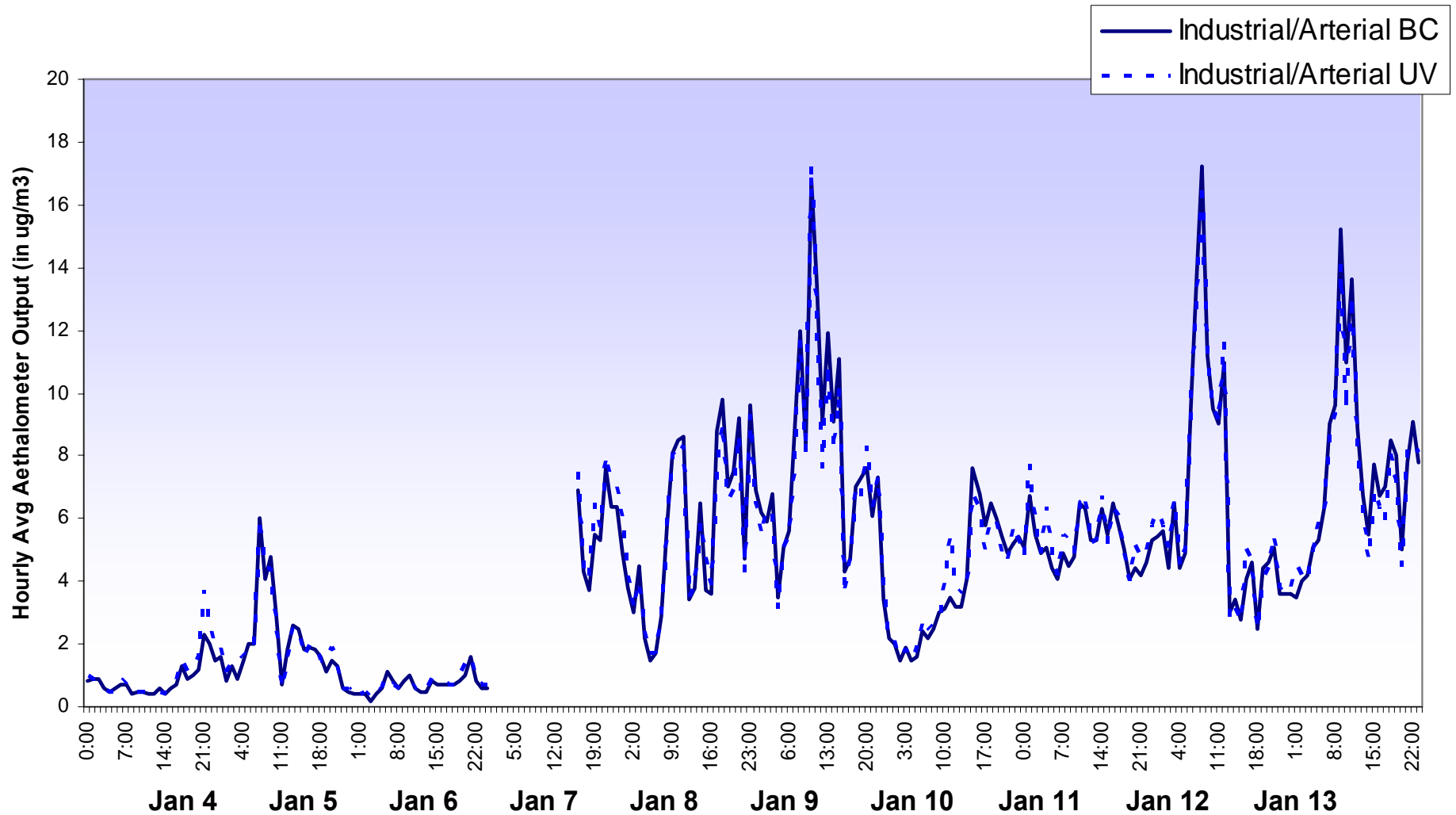
Wood Smoke Temporal Patterns
Hourly Averages
Jan 4 - 10, 2004



UV Channel Observations



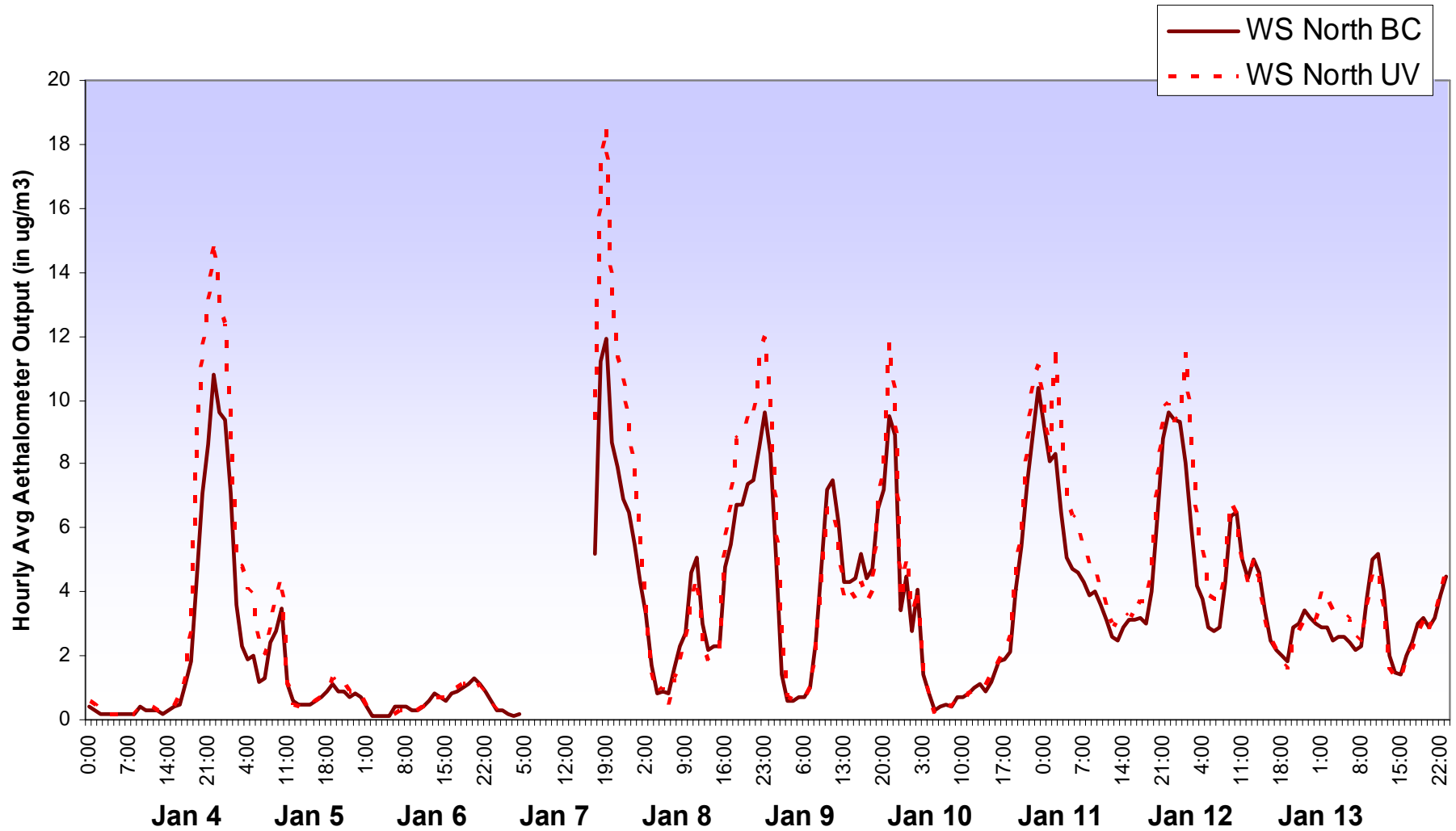
BC Channel and UV Channel Signature at Industrial/Arterial Site



UV Channel Observations



**BC Channel and UV Channel Signature
at the Wood Smoke North Site**



Delta (UV – BC)



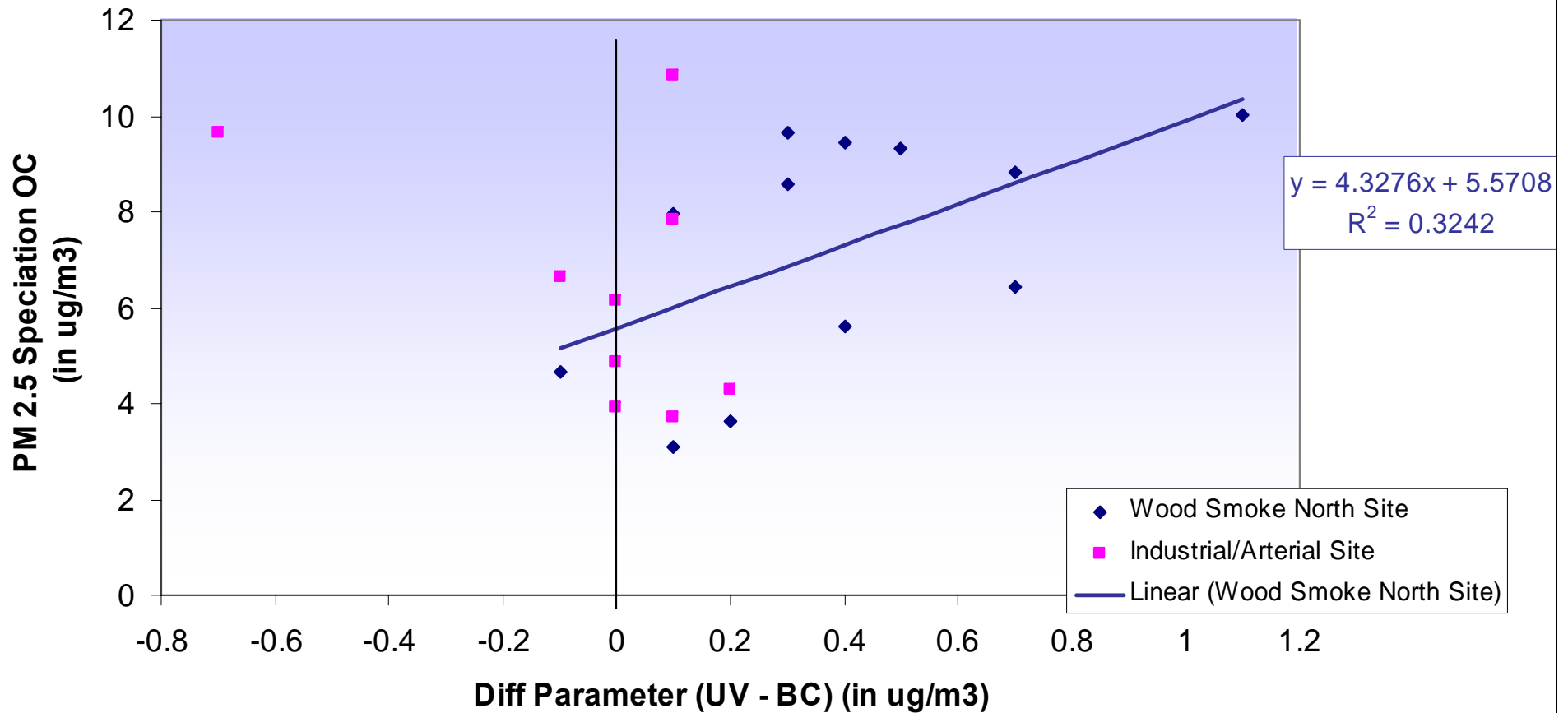
- **Interpretation of Optical Attenuation in the Near-Ultraviolet: Definition of “UVPM”**
- **Absorption cross section of compounds that absorb light in the “UV” channel (370 nm) is highly variable. So this parameter Delta (UV – BC) has no physical engineering units that compare in terms of $\mu\text{g}/\text{m}^3$.**
- **We only use this term because it is “convenient.”**
- **High Delta episodes theoretically indicate that pollutants are present that absorb light in the “UV” channel.**
- **In this case, we are looking to see if wood smoke is being indicated.**

Site Aerosol Differences



Diff Parameter (UV-BC) vs OC

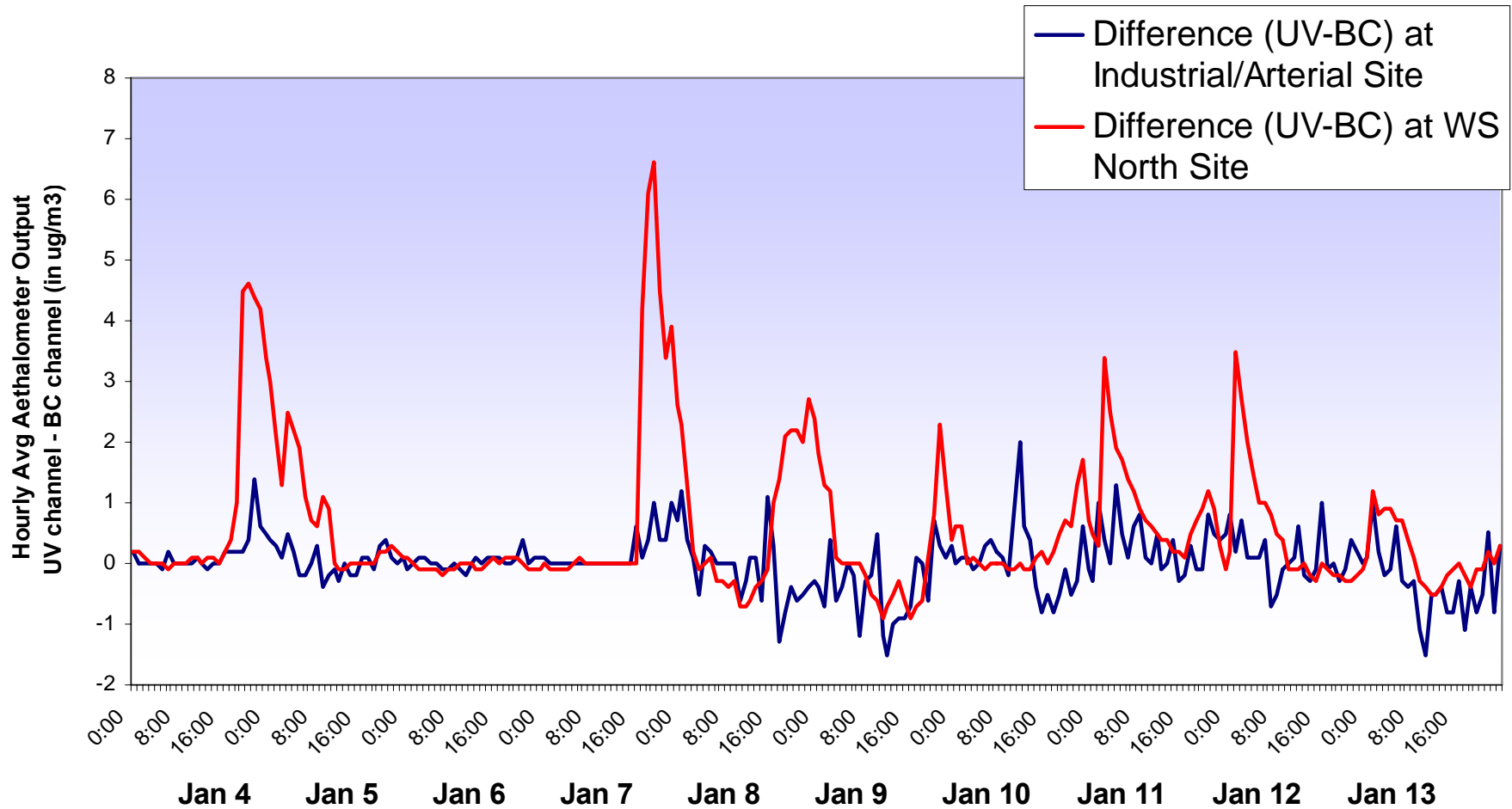
Wood Smoke North
November 03 to February 04



UV Channel Observations



**Difference (UV - BC) Channel Signature
Between Industrial/Arterial Site and WS Site
Hourly Averages**



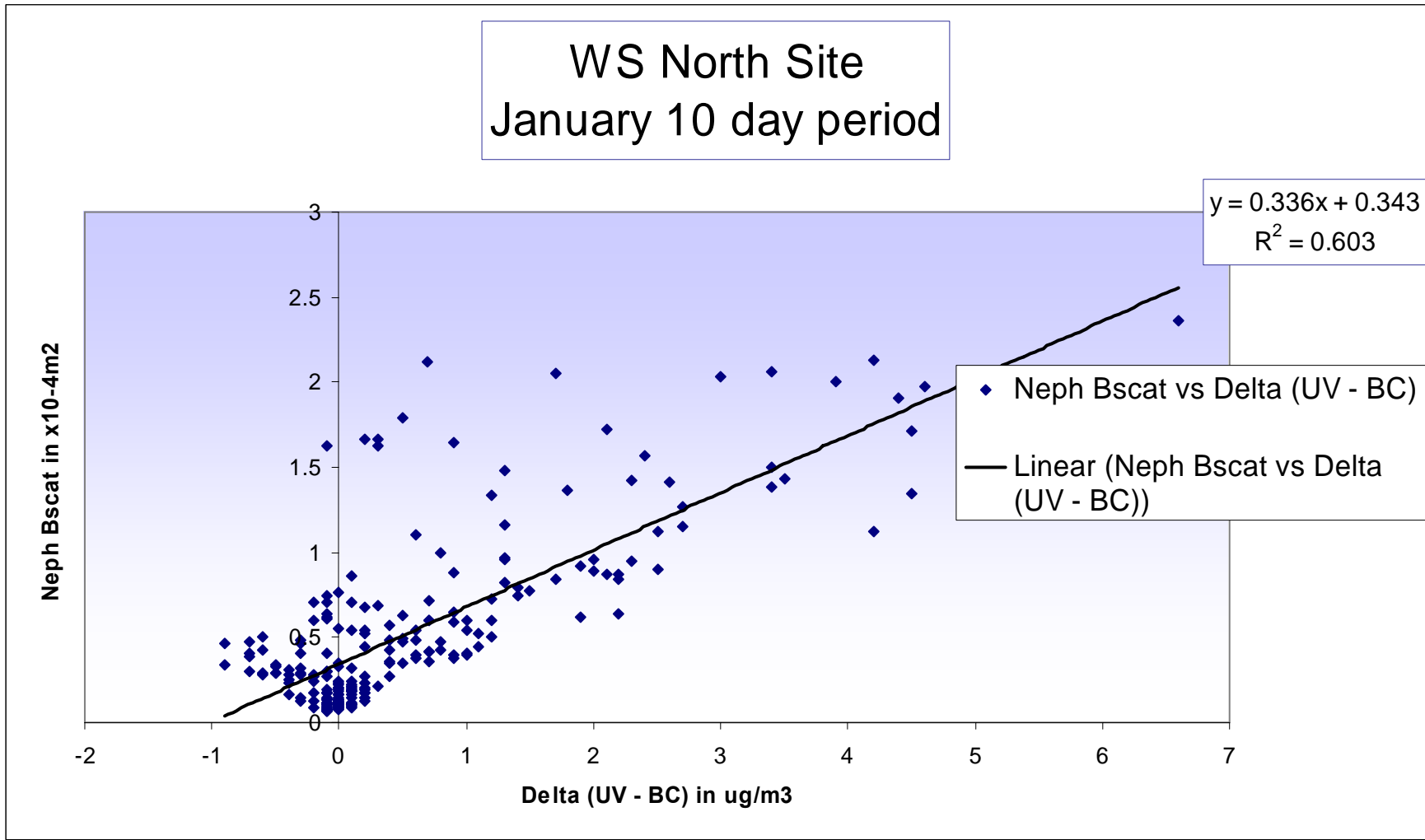
Delta (UV - BC) Statistics



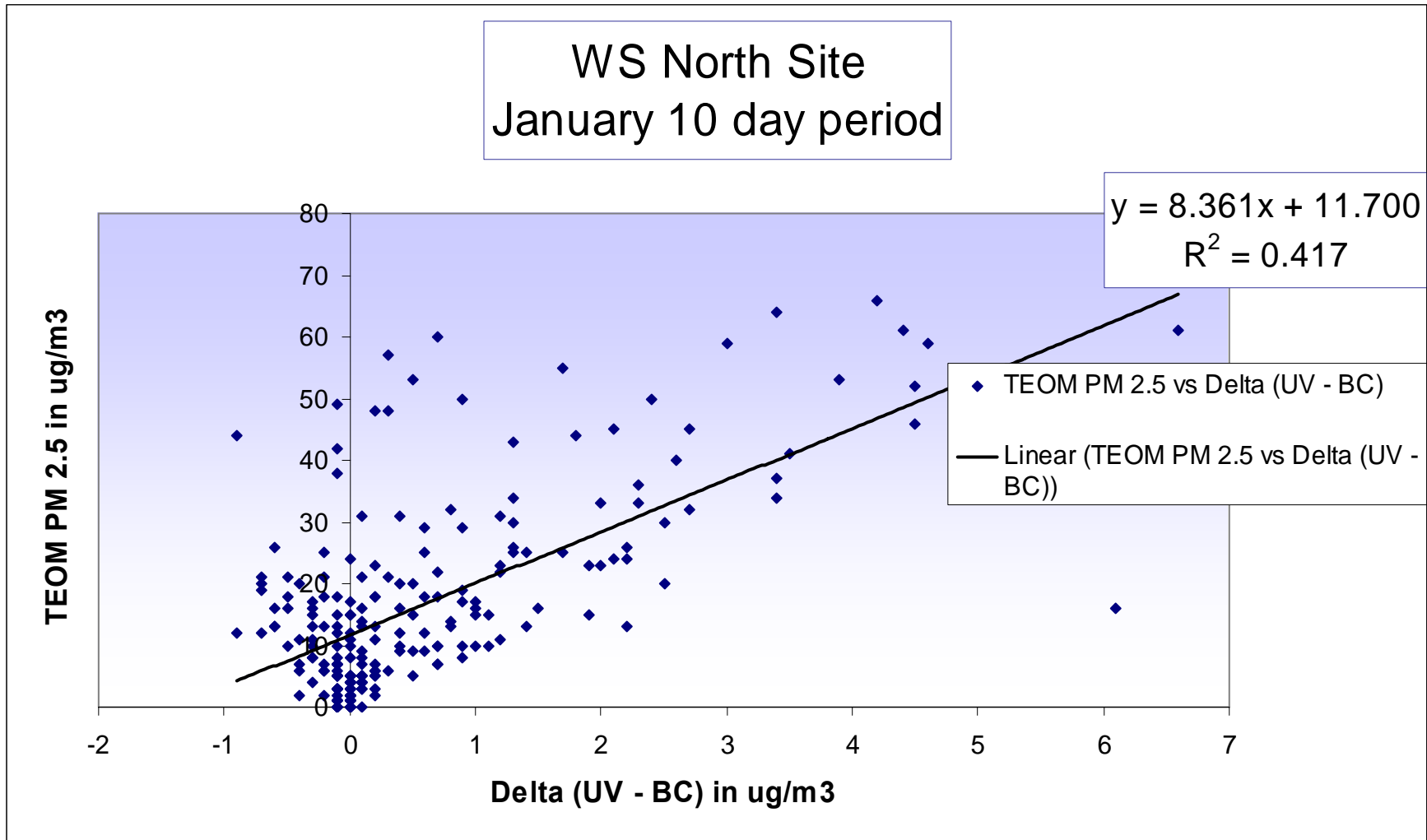
	Industrial/Arterial Site	Wood Smoke North Site
Mean Delta (UV - BC)	0.009 $\mu\text{g}/\text{m}^3$	0.554 $\mu\text{g}/\text{m}^3$
<u>Time Resolved</u>		
0000 to 0559	0.139 $\mu\text{g}/\text{m}^3$	0.787 $\mu\text{g}/\text{m}^3$
0600 to 1159	-0.062 $\mu\text{g}/\text{m}^3$	0.115 $\mu\text{g}/\text{m}^3$
1200 to 1759	-0.145 $\mu\text{g}/\text{m}^3$	0.035 $\mu\text{g}/\text{m}^3$
1800 to 2359	0.102 $\mu\text{g}/\text{m}^3$	1.267 $\mu\text{g}/\text{m}^3$

- **We correlated the Difference (UV-BC) parameter versus**
 - **Nephelometer PM 2.5**
 - **TEOM PM 2.5**

Nephelometer



TEOM PM 2.5



Preliminary Conclusions



- **We recognize that BC is not a surrogate for DPM or WS; rather it is an indicator that helps us better understand the urban particulate aerosol.**
- **We have seen initial correlations between the BC continuous device and the EC speciation method.**
 - **May be useful to enhance or replace EC speciation data for annual averages.**
- **BC shows us temporal patterns. UV shows us an indicator of WS in that temporal pattern.**

Next Steps



- **Incorporate more specific traffic data**
 - Hourly patterns
- **Complete Seasonal evaluation of UV data**
 - In Summer, Wood Smoke Season is over.
- **Conduct more in depth comparison of Speciated Data**
 - Use OC as a specific parameter to evaluate Wood Smoke
 - Incorporate different parameters from Air Toxics/Speciation Networks for Diesel PM
- **Develop network comparisons between our sites**
- **Cooperate with other Urban Agencies to compare results in different cities.**

Acknowledgements



- **Puget Sound Clean Air Agency**
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- **Tony Hansen- Magee Scientific Inc.**

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