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Peace Bridge Neighborhood Air Quality Study: 2nd Data Review Meeting

May 6, 2015

Data Collection: Start Dates in 2014

Busti Avenue Site

- PM-2.5, Meteorological, Black Carbon (BC) started on August 11th
- Ultrafine Particle Data (UFP) valid data started September 24th.
- Volatile Organic Compounds (VOC) and Carbonyl sample collection started August 15th

PS 198

- BC started August 21st
- PM-2.5 started August 26th

Peace Bridge Traffic

- Vehicle transit and delay data available

Instrumentation: Ultrafine Particle Number



UFP range

(0.001-0.1 Microns)

API Model 651, TSI 3783

Water CPC

Lower size cut 7nm

(0.007 microns)

1 Micron Cyclone Inlet

2nd Unit is on Loan from
the Manufacturer

Instrumentation: PM-2.5 and Data Logger



Thermo Environmental Inc. TEOM 1400B

- 1-Hour Data Average
- Near-Real Time data Availability
- 2.5 Micron Cyclone Inlet
- Sample Collection at 50⁰ C

Envidas Data Logger

- Provides data polling, storage and communication with central database



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Instrumentation: Aethalometer for Black Carbon



Magee Scientific Model AE22 and the newer Model AE33

- Measures light attenuation due to particle load on filter tape at 2 or 7 wavelengths
- Near-Real time data availability*
- Data must be post processed
- BC absorbs light 1000x other species
- $UV - BC = DC$ (330 & 880nm)
- DC has been associated with combustion of biomass (indicator for wood smoke)

Instrumentation: VOCs, Carbonyls



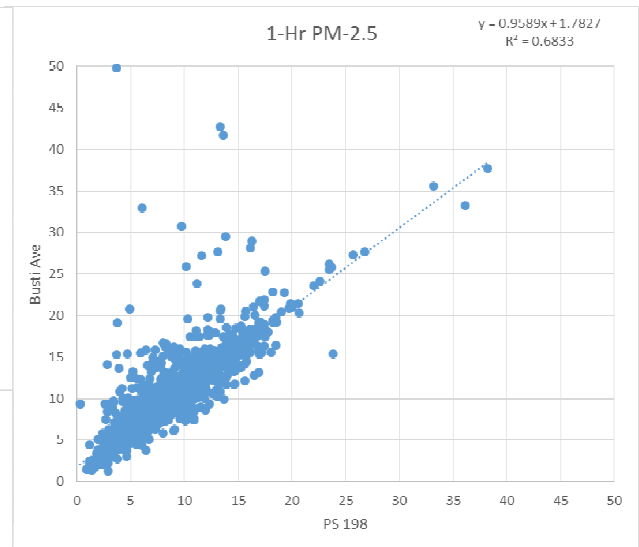
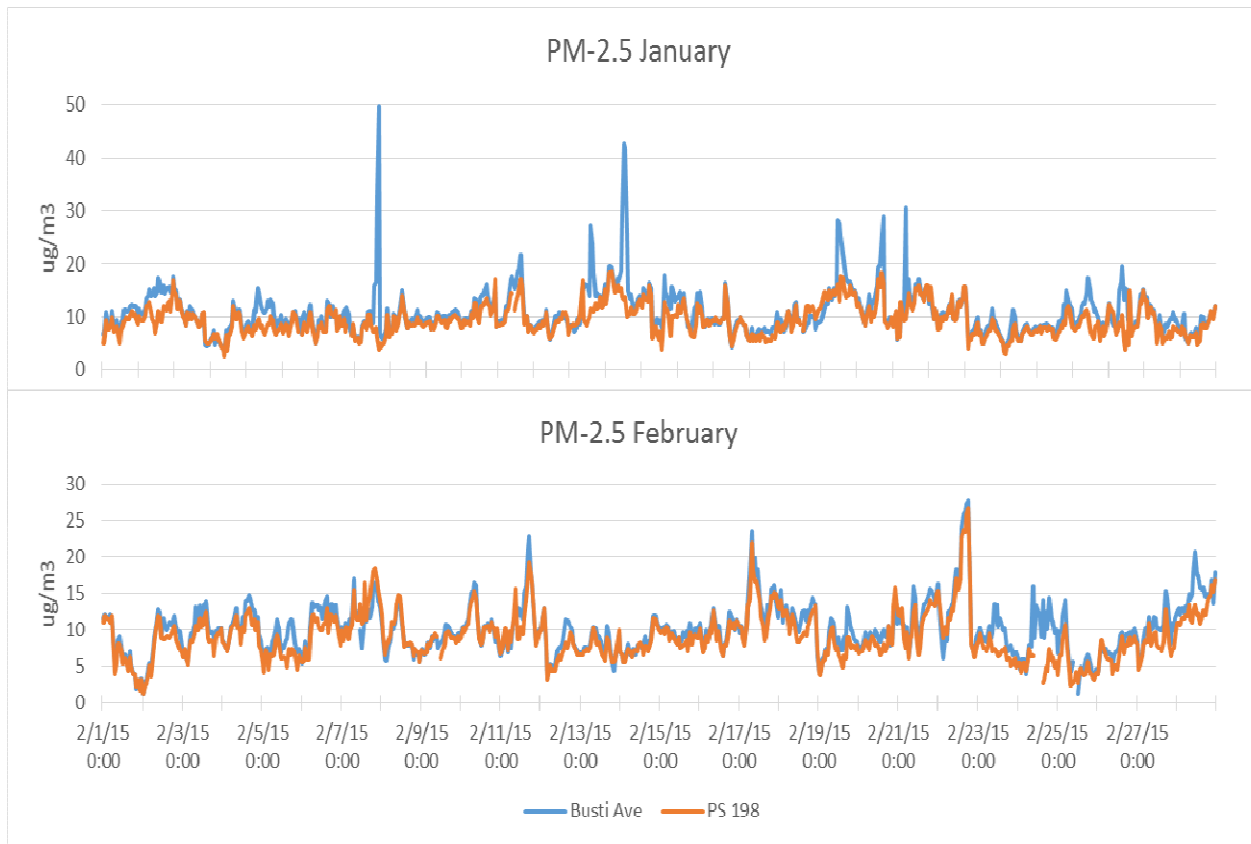
Computer controlled Canister Sampler

- 24-Hr sample collected once every 6 days
- Collects pressurized whole air samples

Computer controlled Carbonyl Sampler

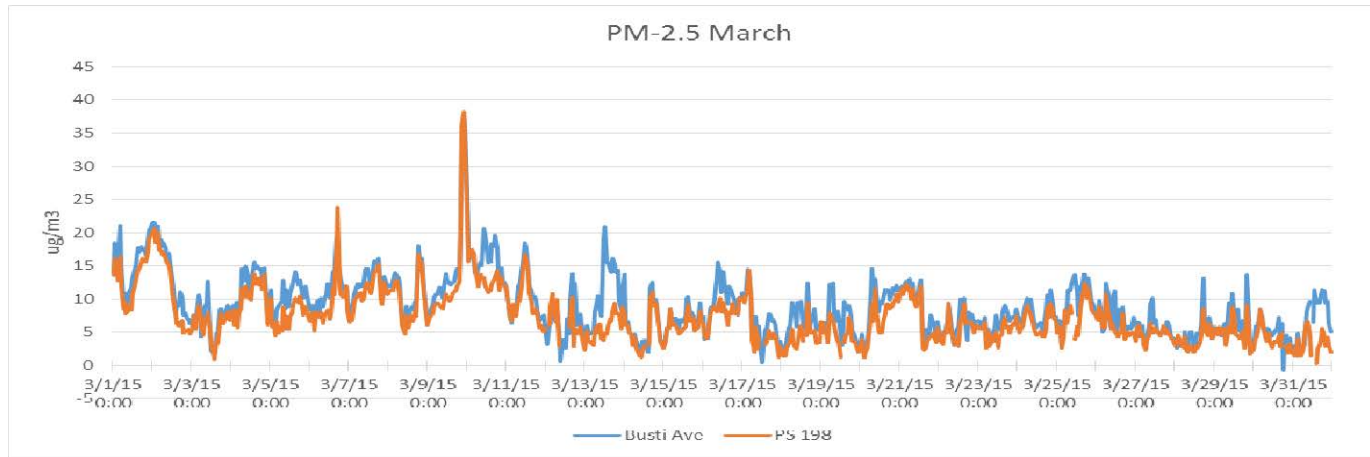
- 24-Hr sample collected once every 6 days
- Captures carbonyls in reaction products in a DNPH cartridge

PM-2.5 Data: 1-Hr Averages



Local Impacts: There were a few high hours at Busti Ave without corresponding values at PS 198

PM-2.5 Data: 1-Hr Averages



1-Hr Max March 9th
(Not Local Event)

Busti Ave 33

PS 198 36

Dingens St 48

Cheektowaga 54

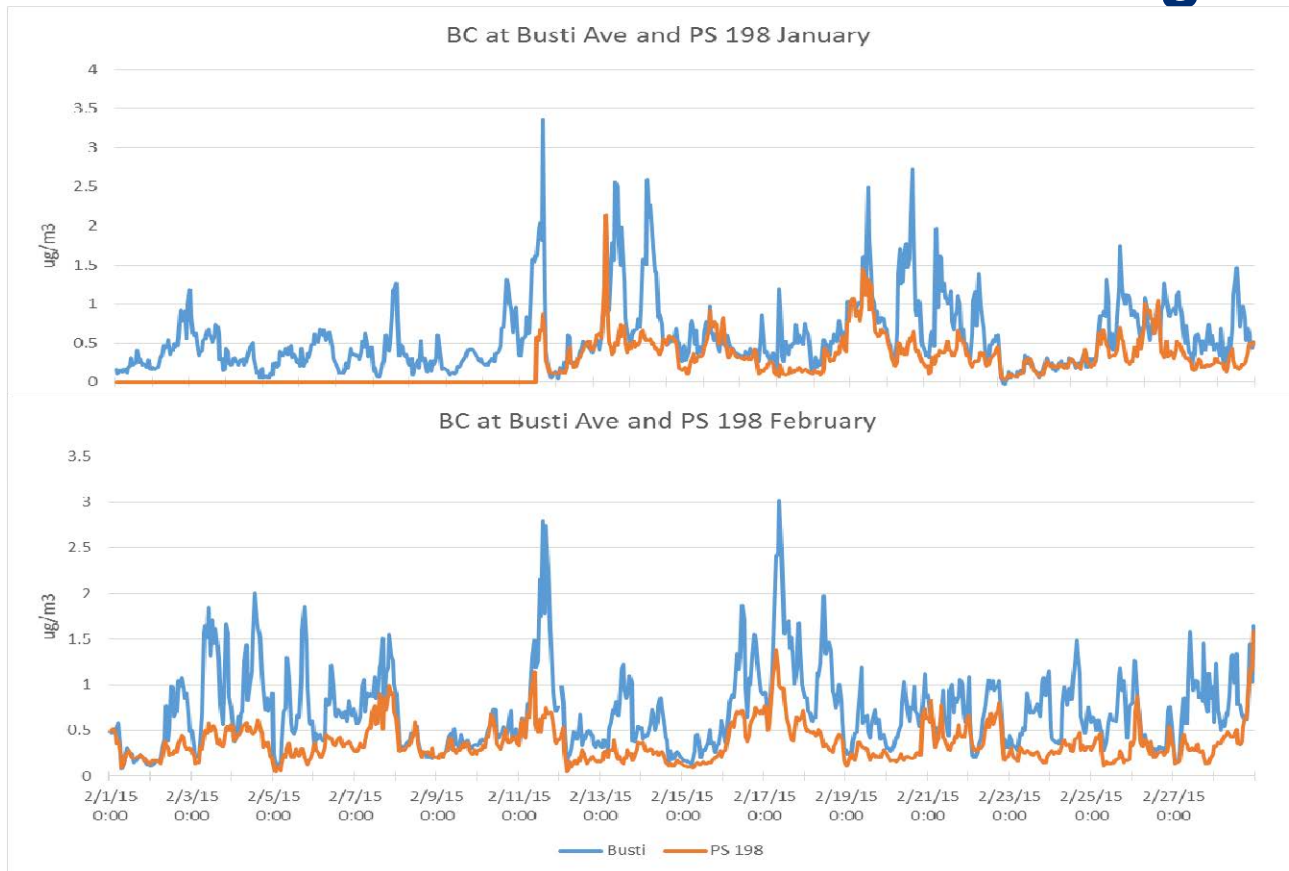
Study Data are well
below NAAQS

1 st Qtr	Average	98 th Percentile
Busti Ave:	10.0 $\mu\text{g}/\text{m}^3$	16.9 $\mu\text{g}/\text{m}^3$
PS 198:	8.6 $\mu\text{g}/\text{m}^3$	14.5 $\mu\text{g}/\text{m}^3$
NAAQS	Annual: 12 $\mu\text{g}/\text{m}^3$	Daily: 35 $\mu\text{g}/\text{m}^3$



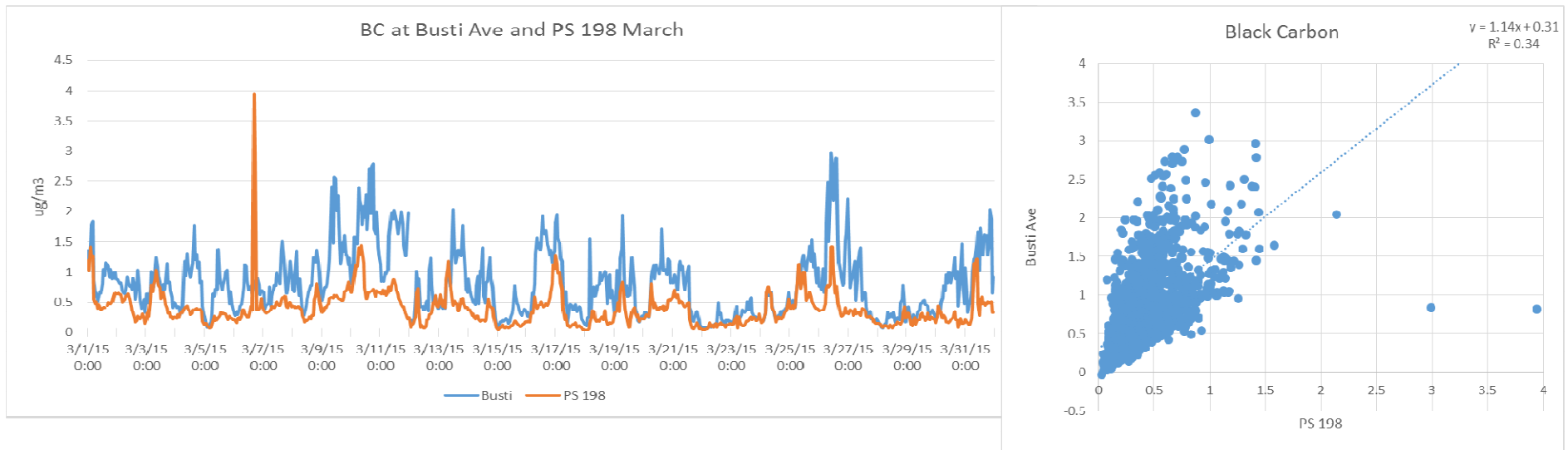
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Black Carbon Data: 1-Hr Averages



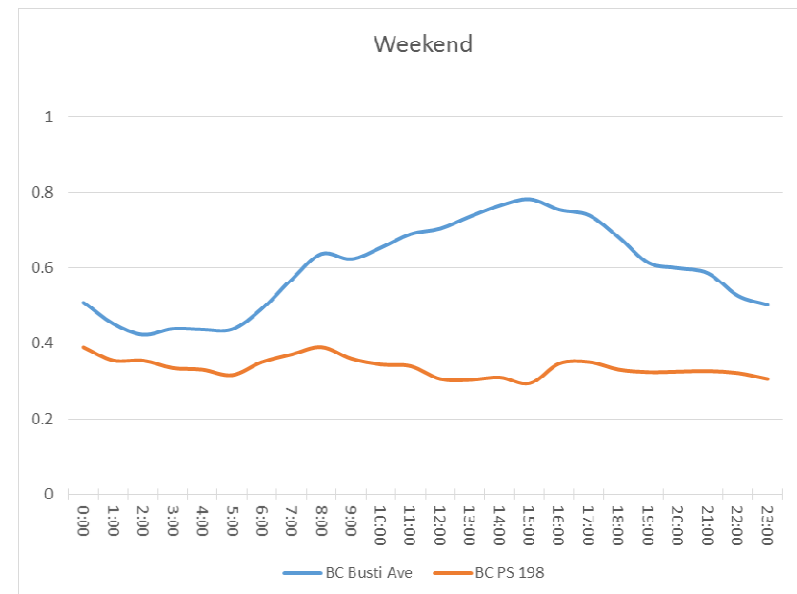
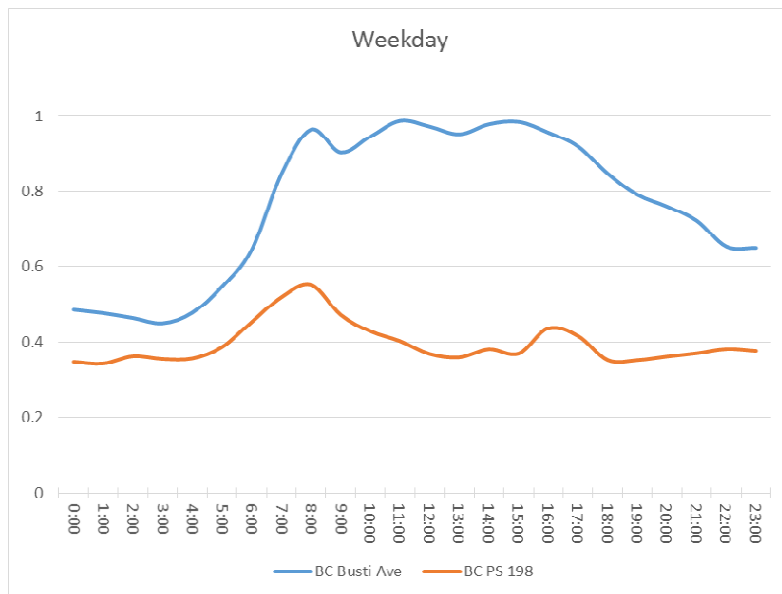
PS 198 had access and temperature problems in January

Black Carbon Data: 1-Hr Averages



1st Qtr	Average
Busti Ave:	0.70 $\mu\text{g}/\text{m}^3$
PS 198:	0.38 $\mu\text{g}/\text{m}^3$

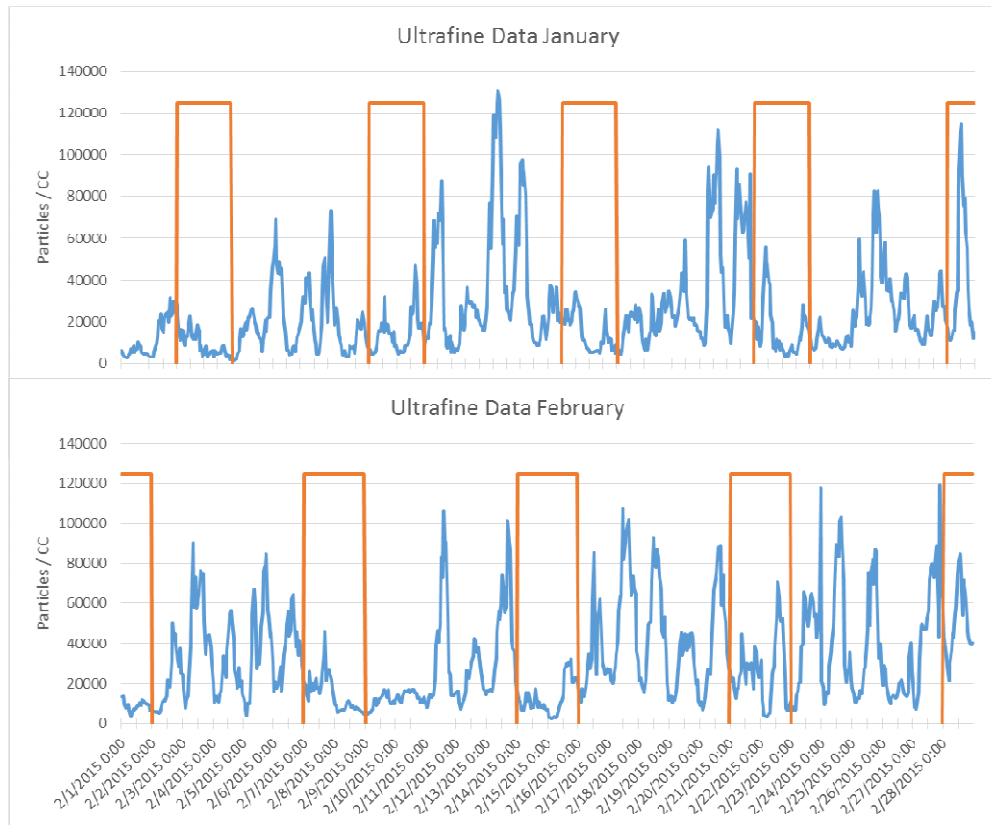
Black Carbon Data: 1-Hr Averages



Diurnal Plot (Time of Day) Profile of Hourly Averages

Data: 1sr Qtr 2015

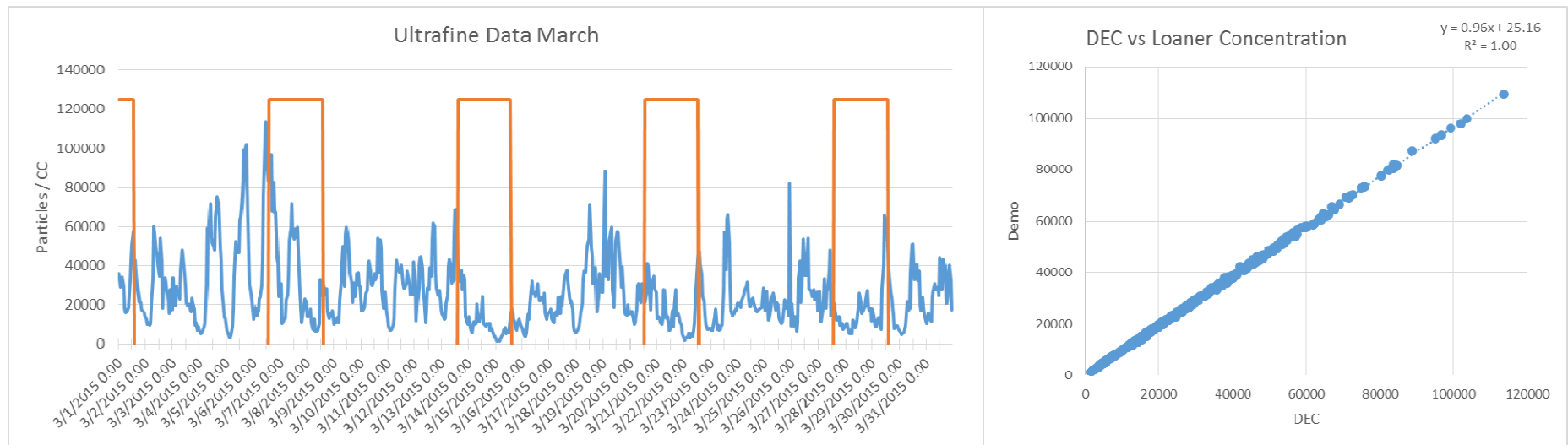
UFP Data: 1-Hr Averages



UFP concentrations are often higher on weekdays

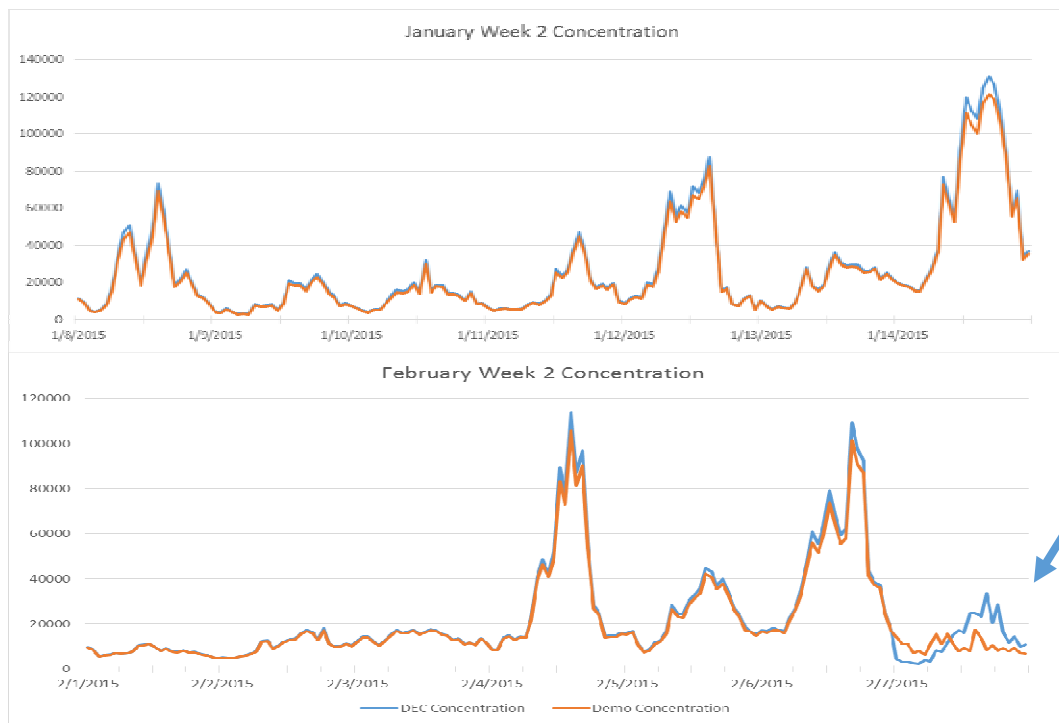
This data has not been sorted by wind direction

UFP Data: 1-Hr Averages



UFP Data: Precision

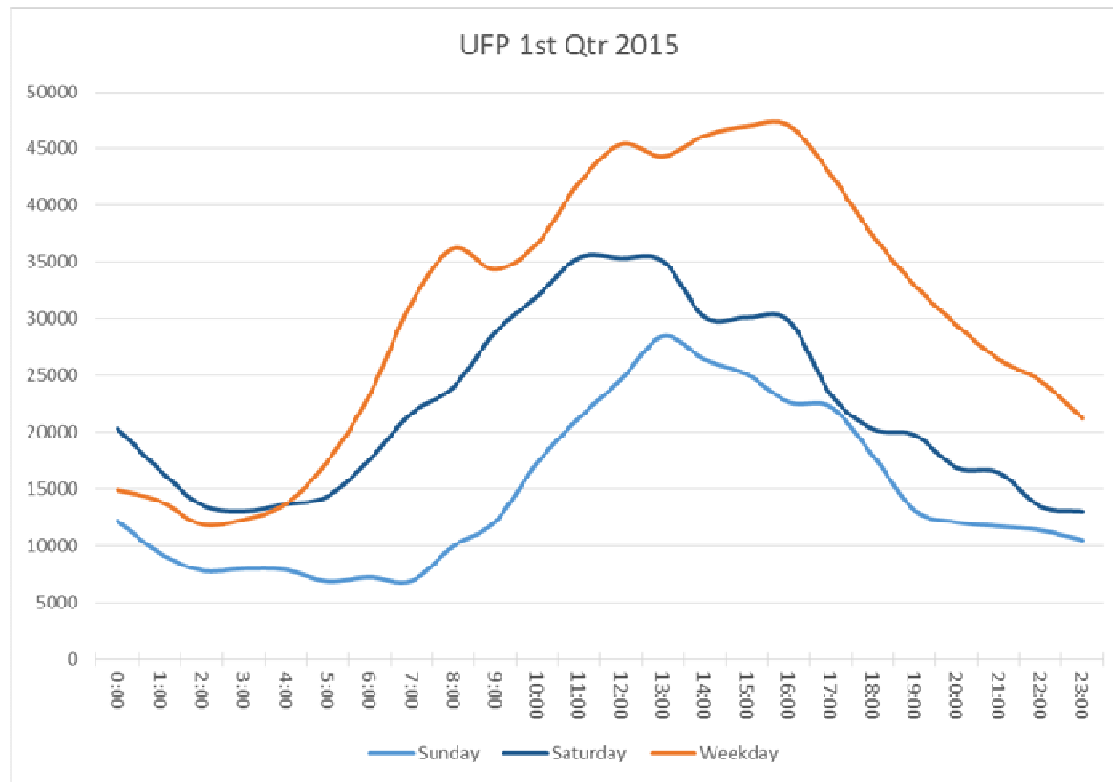
The two instruments demonstrate excellent precision



At very high particle concentrations the DEC instrument is slightly higher

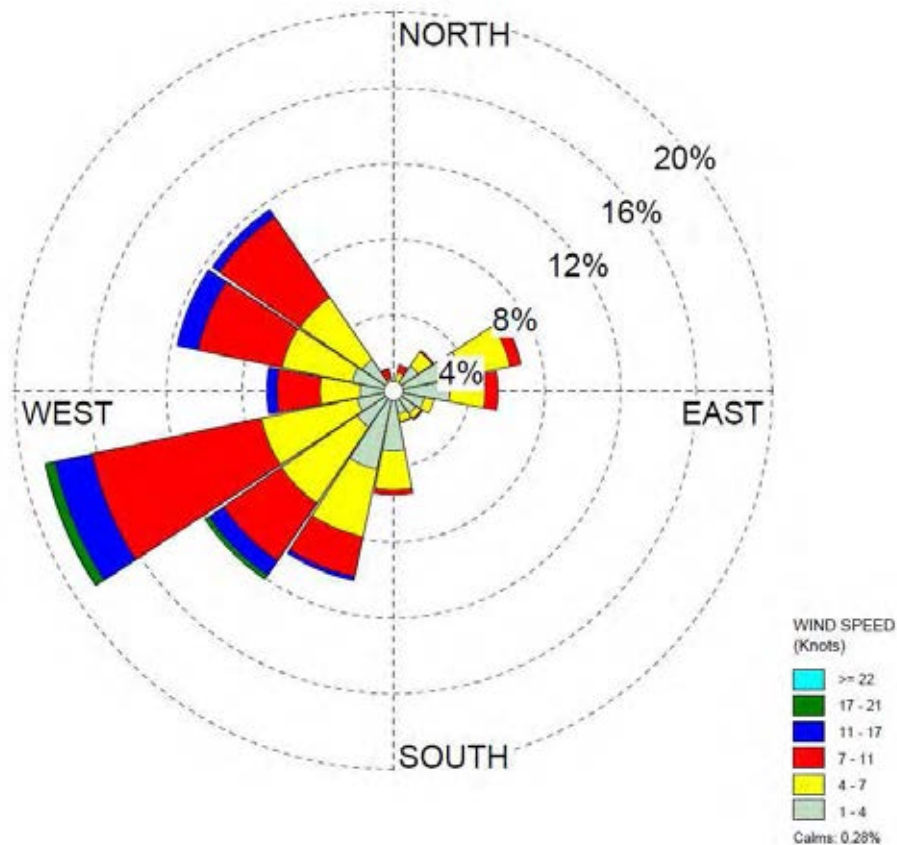
One of the inlets appears to have frozen for a day in February

UFP Data: 1-Hr Averages



Diurnal Plots show that on average UFP concentrations are higher on weekdays and Saturday is higher than Sunday

Meteorological Data: Wind Speed and Wind Direction 1st Qtr 2015

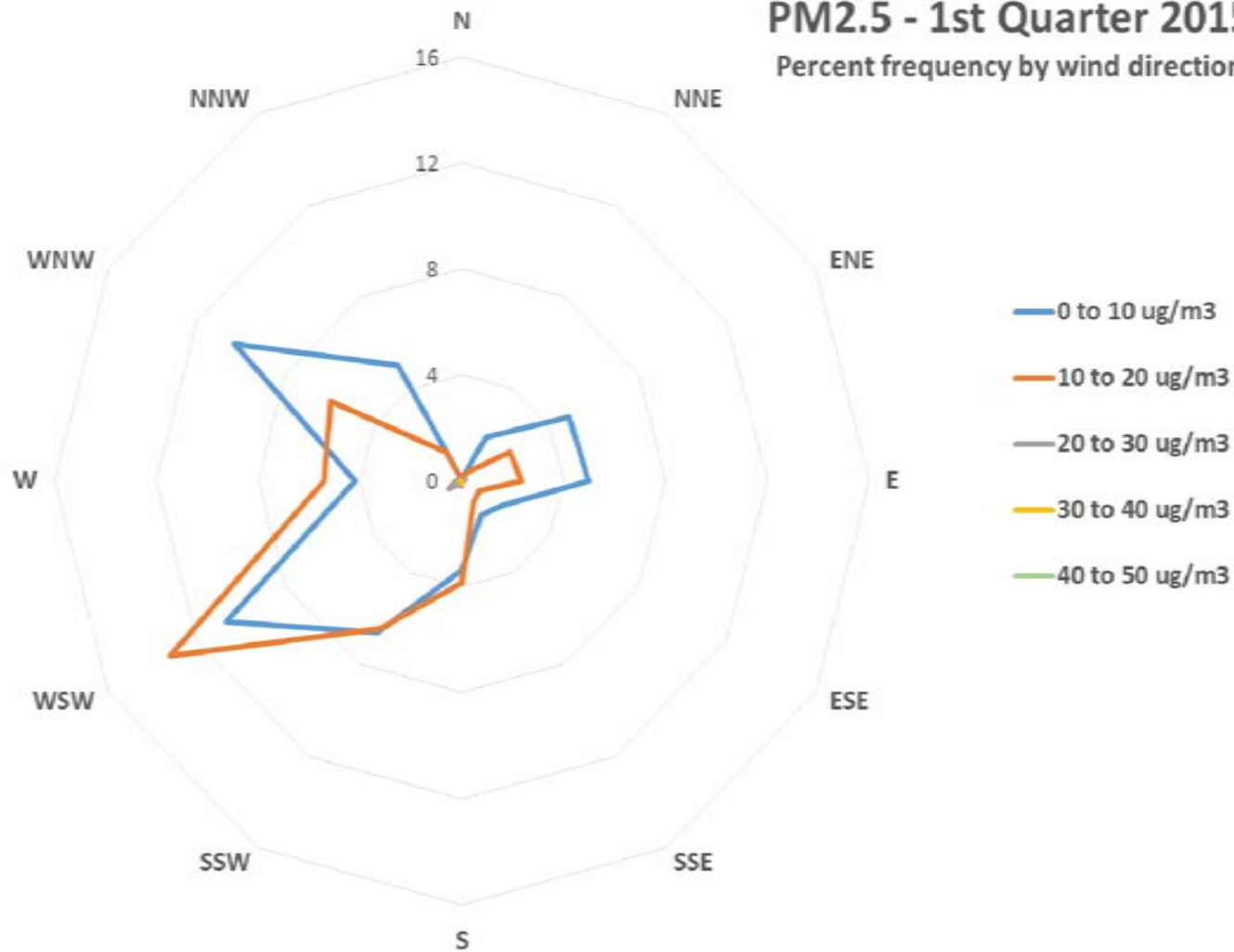


The predominant wind direction is WSW

This is a frequency graph with wind speeds depicted by color

PM2.5 - 1st Quarter 2015

Percent frequency by wind direction



17

Pollution Rose shows % of time in hours when a range of pollutant concentration comes from a direction



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Pollution Rose

PM-2.5

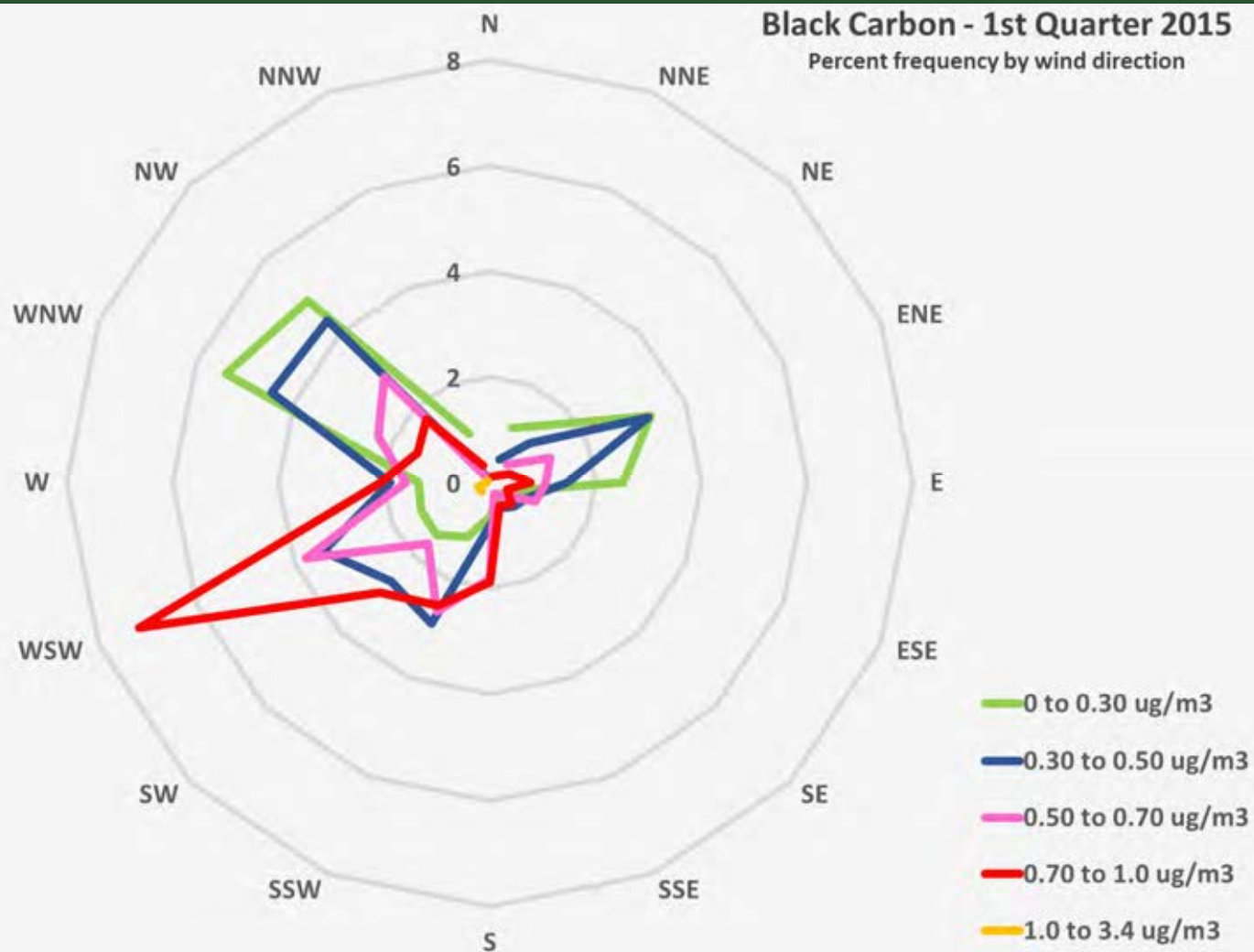
The highest concentrations come from the prevailing wind direction



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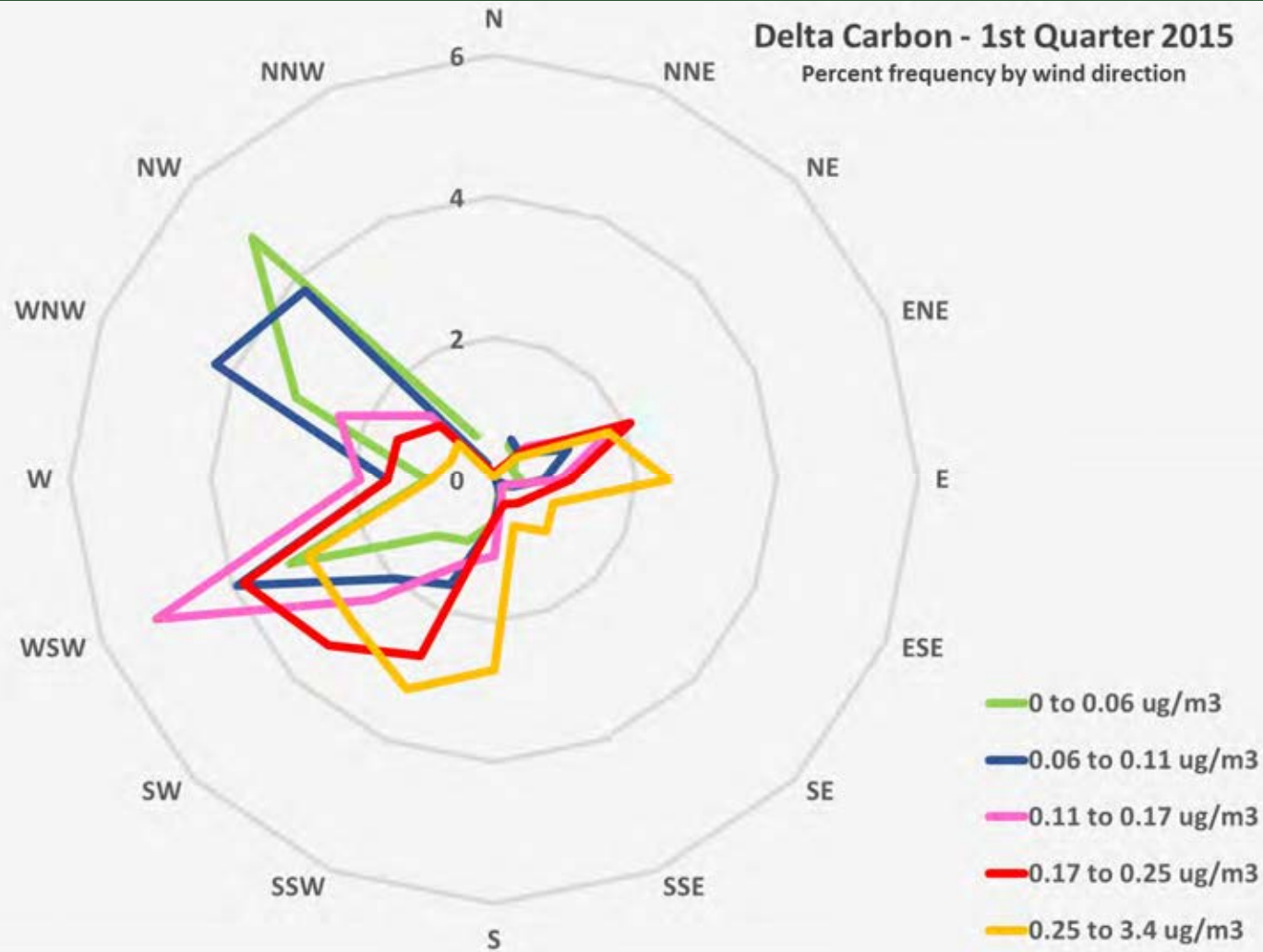
Black Carbon - 1st Quarter 2015

Percent frequency by wind direction



Delta Carbon - 1st Quarter 2015

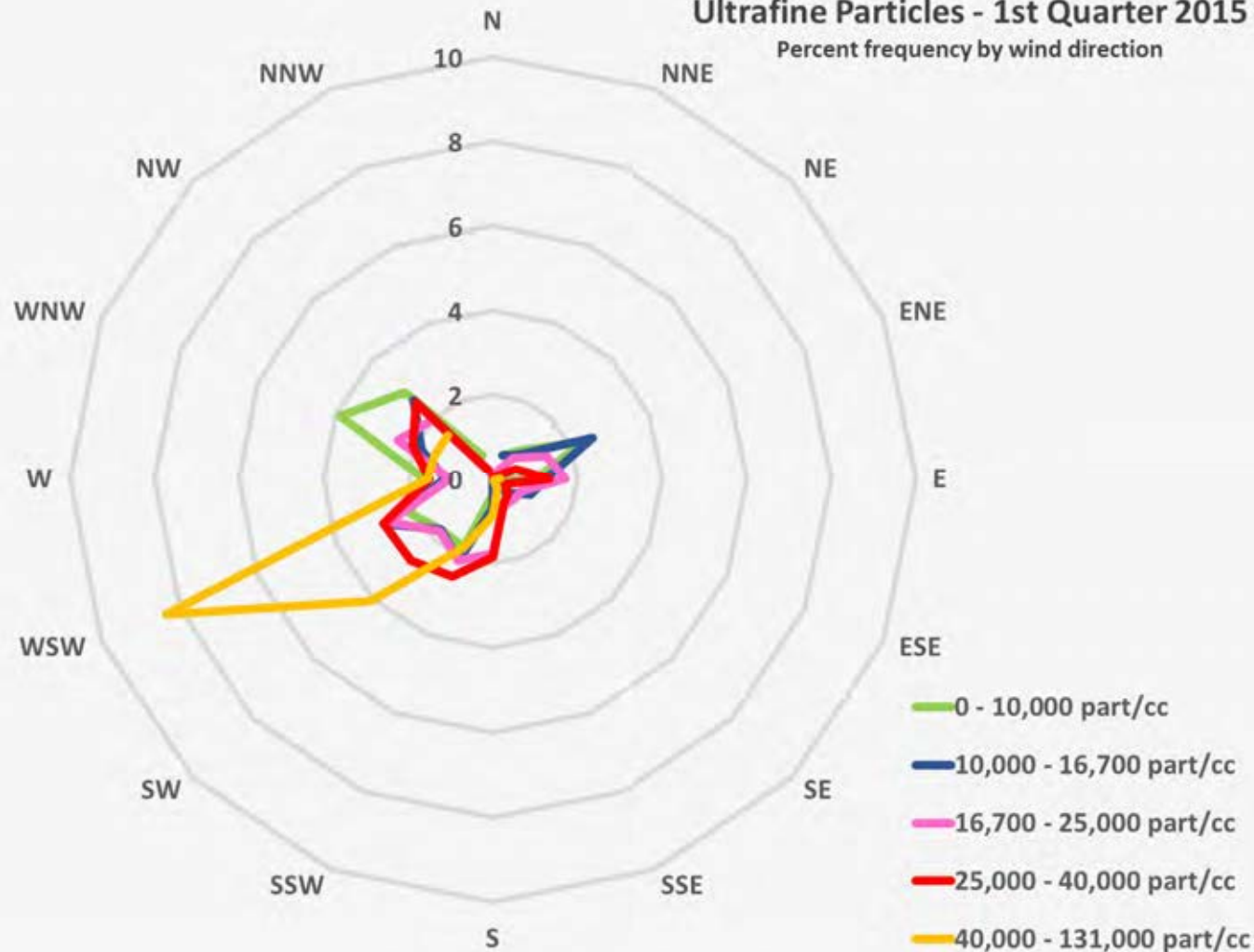
Percent frequency by wind direction



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Ultrafine Particles - 1st Quarter 2015

Percent frequency by wind direction



21

The lower UFP range comes from 3 directions WNW, WSW and ENE but the highest only comes from the WSW



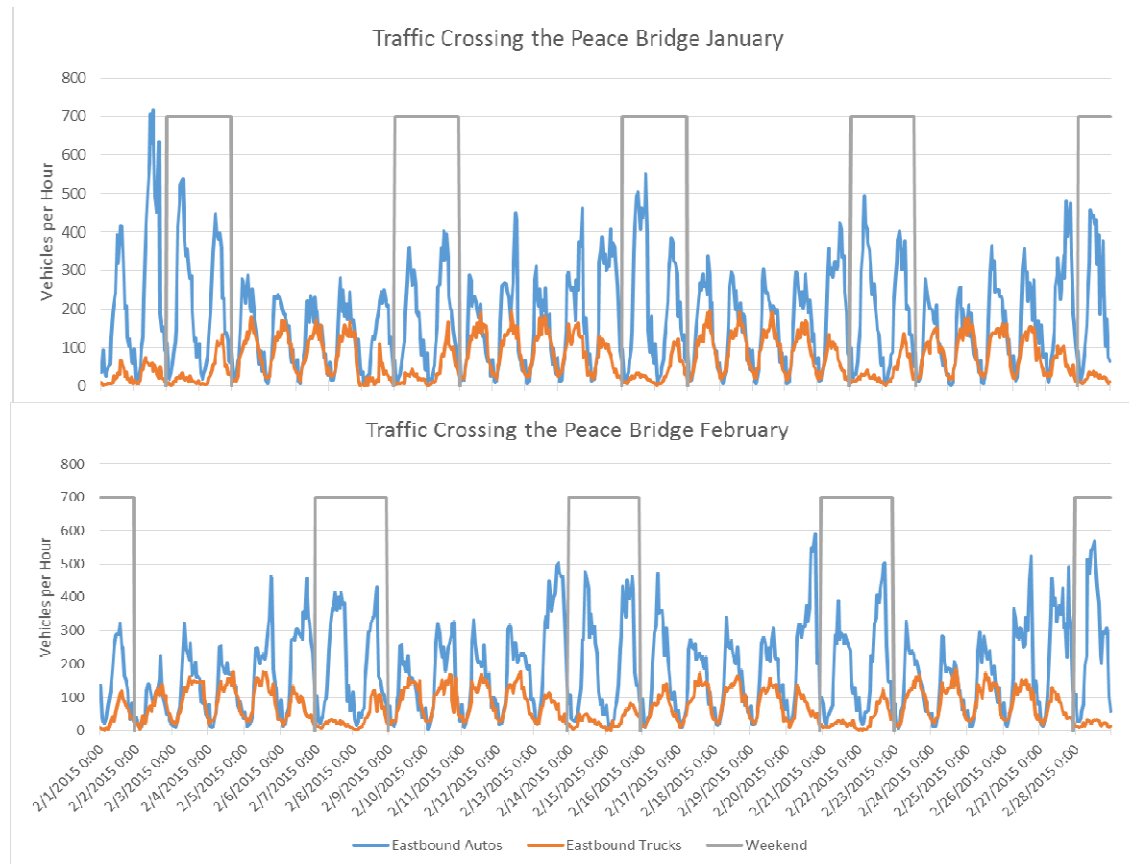
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What are the Local Sources of Vehicle Emissions

Area Traffic: Annual Average Daily Traffic: AADT

- I-190 has an AADT of 78,920 South of the Bridge and 67,609 North of the Bridge (Highway Speed)
- The Peace Bridge has an AADT of 16,556 (Creeping Speed)
- Busti Ave has an AADT of 1,724 (Slow Speed)
- Porter Ave has an AADT of 7,190 (Slow Speed)

Traffic crossing the Peace Bridge Eastbound



Truck traffic is heaviest on weekdays and low on the weekends – the number of trucks is very stable from week to week and month to month

Car traffic is often higher on weekends and is more variable

How do we Interpret Peace Bridge Traffic Data?

Available Data:

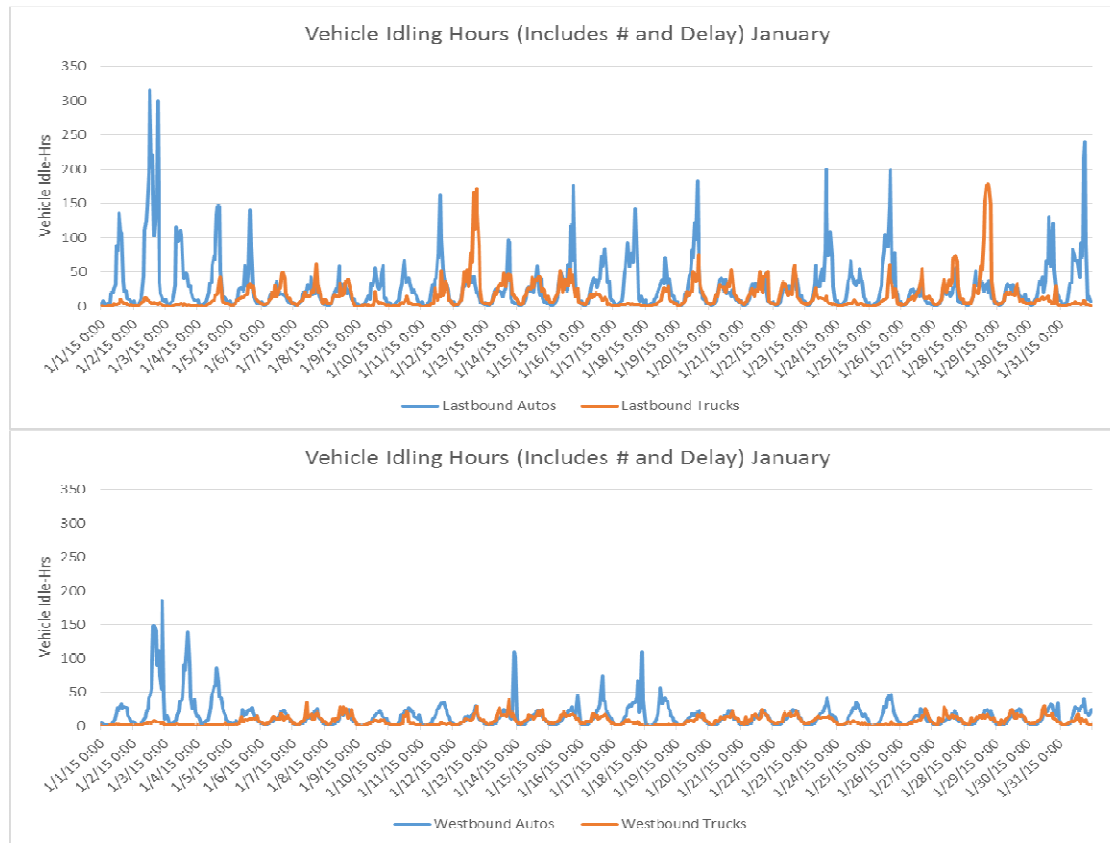
- 1-Hr Average Eastbound and Westbound Car, Truck and Bus transit data (# of vehicles crossing)
- 1-Min Average Car Truck and NEXUS Delay Time East and Westbound
- Percentage of cars using NEXUS lanes
- Average transit time without delay

How do we Interpret Bridge Traffic Data?

Vehicle Transit time data and Delay data can be combined for each direction, vehicle class and hour

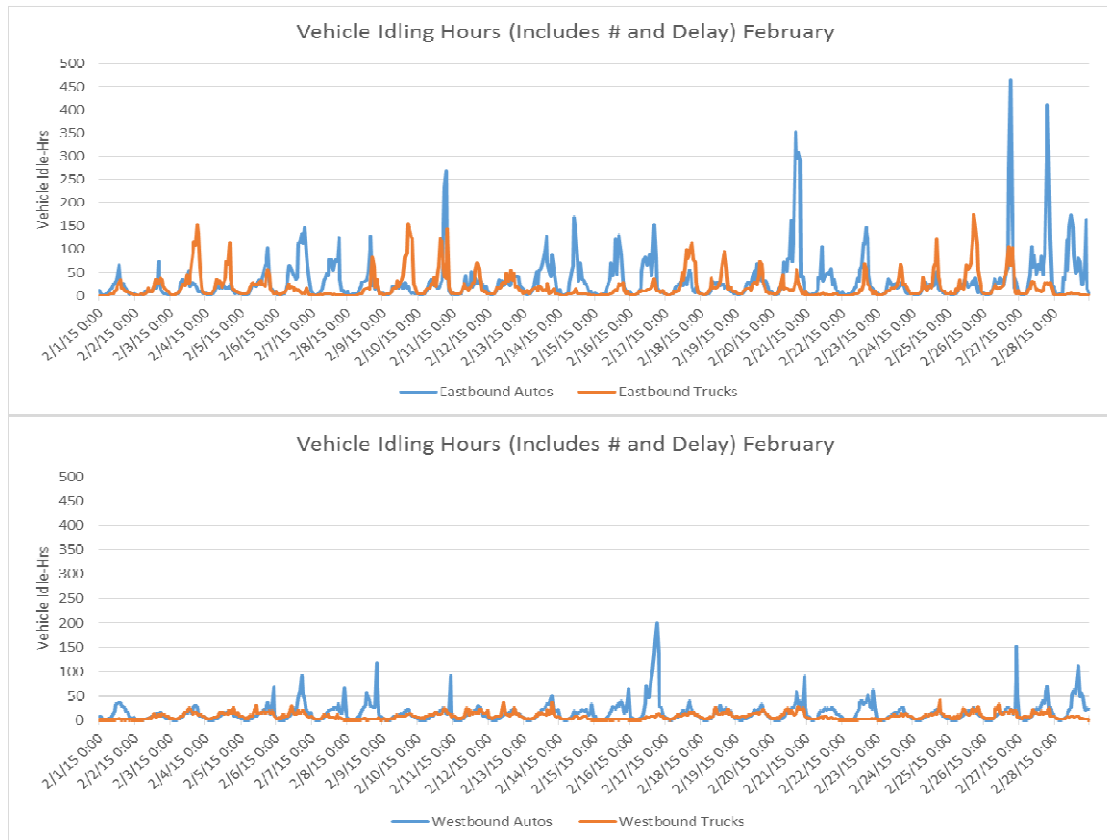
- Multiply number of Vehicles per hour x Delay (hrs) and add the Transit time
- Result = number of idling/creeping vehicles by class, direction, hour
- Result is in units of “idle-hrs/hr”

Autos and Trucks Delay and Transit Time January



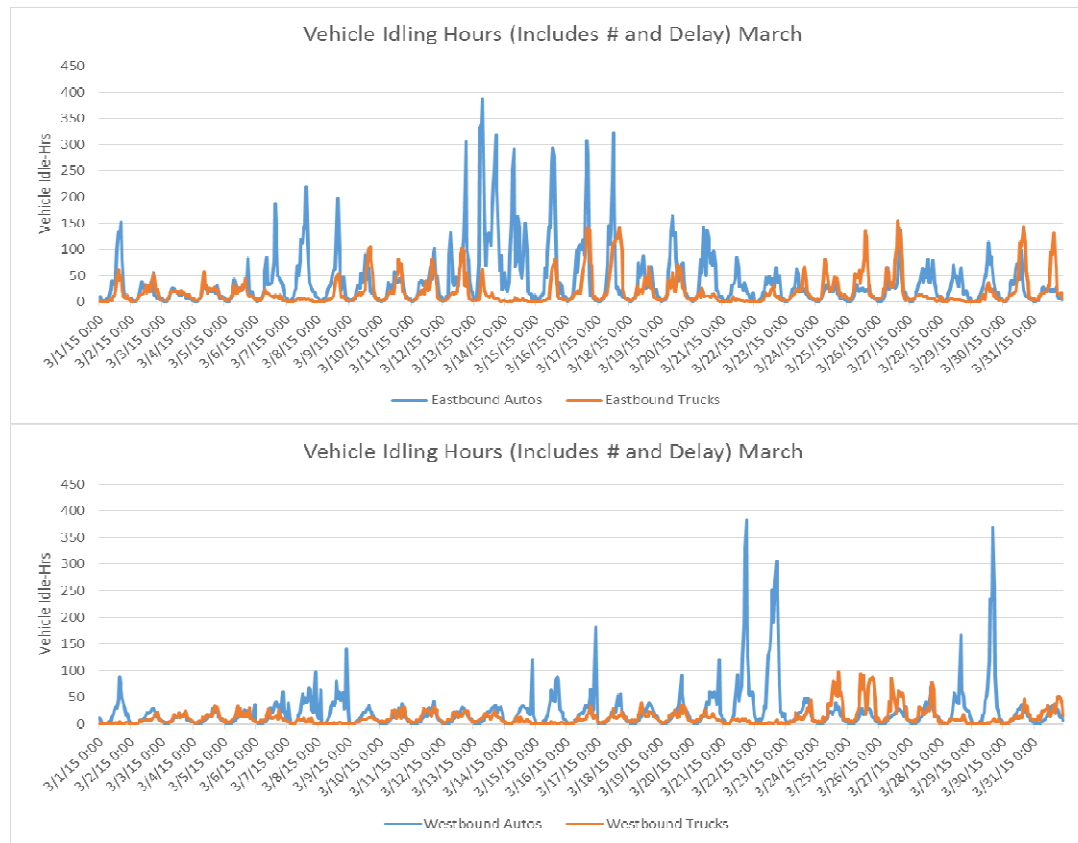
Delays can occur on any day of the week though for cars delays are more prevalent on weekends

Autos and Trucks Delay and Transit Time February



The worst hour in February for autos was 2/26 at 6:00 pm when 464 autos were idling

Autos and Trucks Delay and Transit Time March

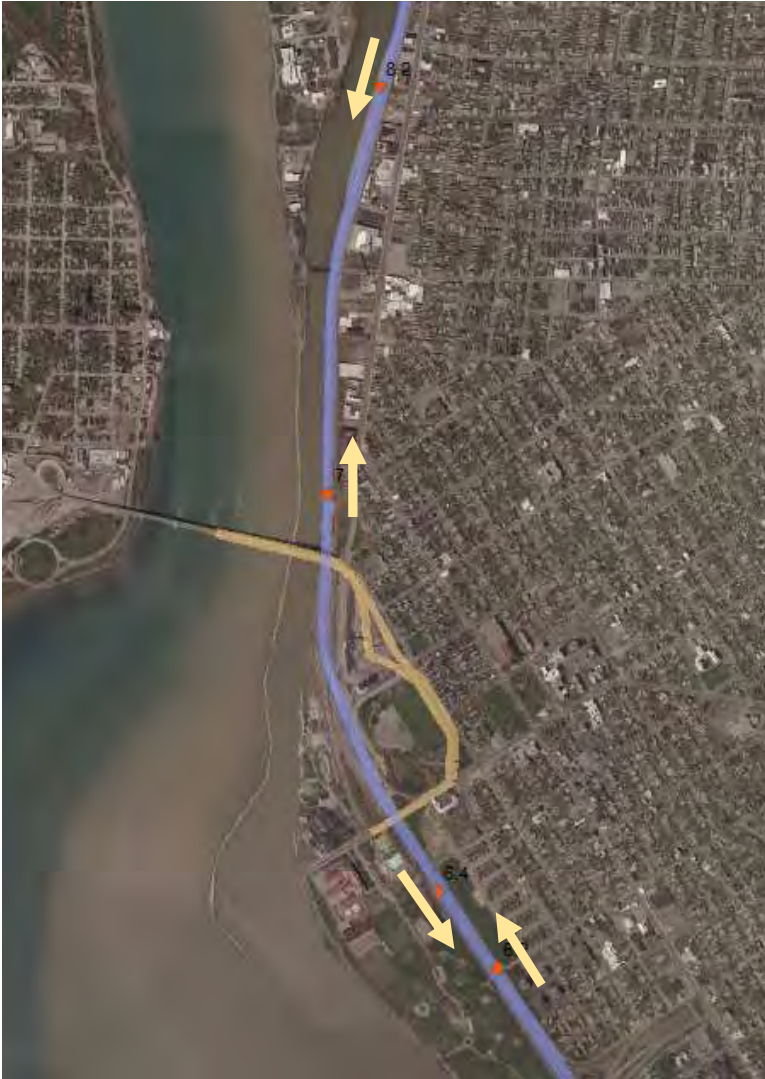

















There were heavy delays for eastbound autos March 13-17

How do we Interpret I-190 Traffic Data?

1-Hr vehicle count by lane and by vehicle length are available Northbound and Southbound from locations above and below the bridge

The data are provided by the Thruway Authority



FHWA Vehicle Classifications				
1. Motorcycles 2 axes, 2 or 3 tires 	2. Passenger Cars 2 axes, can have 1- or 2-axle trailers 	3. Pickups, Panels, Vans 2 axes, 4-tire single units Can have 1 or 2 axle trailers 	4. Buses 2 or 3 axes, full length 	
5. Single Unit 2-Axle Trucks 2 axes, 6 tires (dual rear tires), single-unit 	6. Single Unit 3-Axle Trucks 3 axes, single unit 	7. Single Unit 4 or More-Axle Trucks 4 or more axes, single unit 	8. Single Trailer 3- or 4-Axle Trucks 3 or 4 axes, single trailer 	
9. Single Trailer 5-Axle Trucks 5 axes, single trailer 		10. Single Trailer 6 or More-Axle Trucks 6 or more axes, single trailer 		
11. Multi-Trailer 5 or Less-Axle Trucks 5 or less axes, multiple trailers 			12. Multi-Trailer 6-Axle Trucks 6 axes, multiple trailers 	
13. Multi-Trailer 7 or More-Axle Trucks 7 or more axes, multiple trailers 				

Truck or Car?

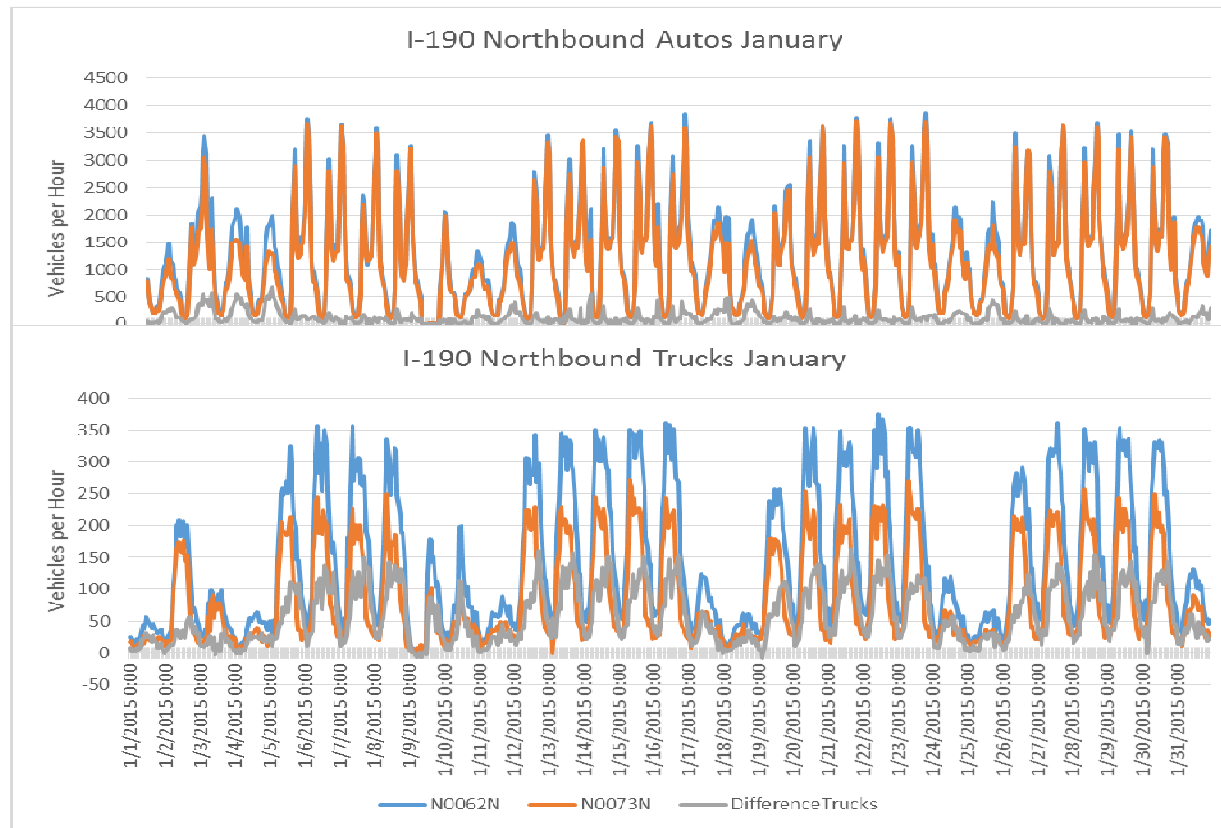
The NYSDOT and other highway agencies use 12 classes to describe vehicle type.

For this study, any vehicle longer than 20' is a truck



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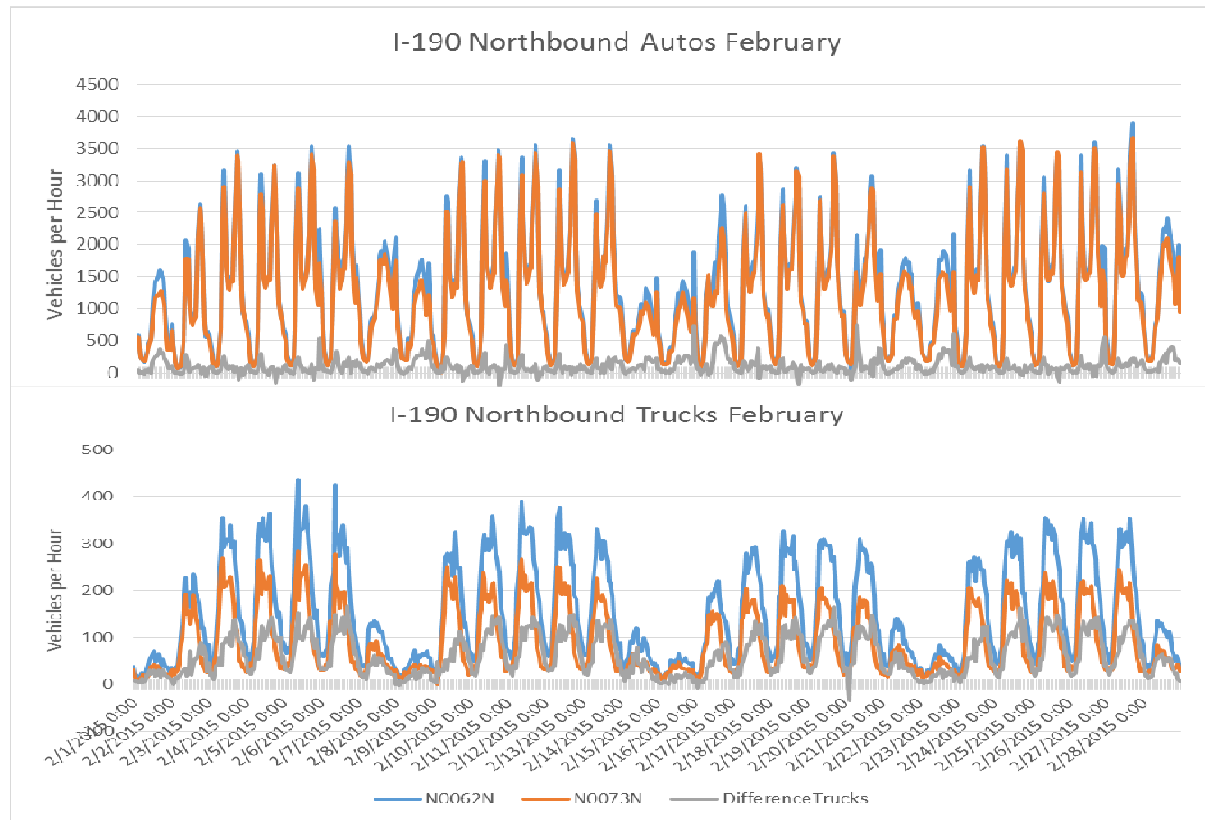
Autos and Trucks 1 hour Traffic on I-190 January



There are typically 10 times more autos than trucks on I-190

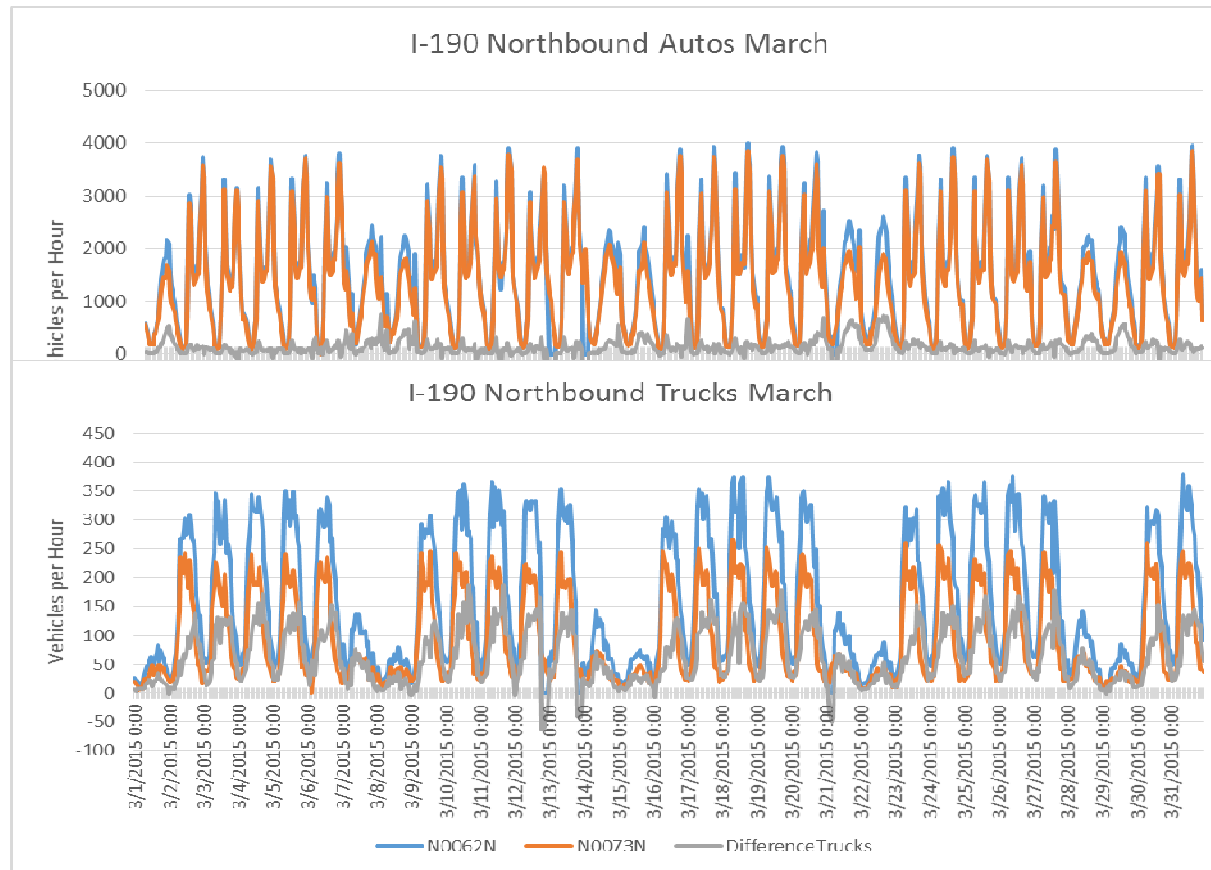
Southbound plots are similar

Autos and Trucks 1 hour Traffic on I-190 February



A higher percentage of trucks are exiting at the Peace Bridge

Autos and Trucks 1 hour Traffic on I-190 March



The number of autos is lower on weekends

The number of trucks on weekends is much lower



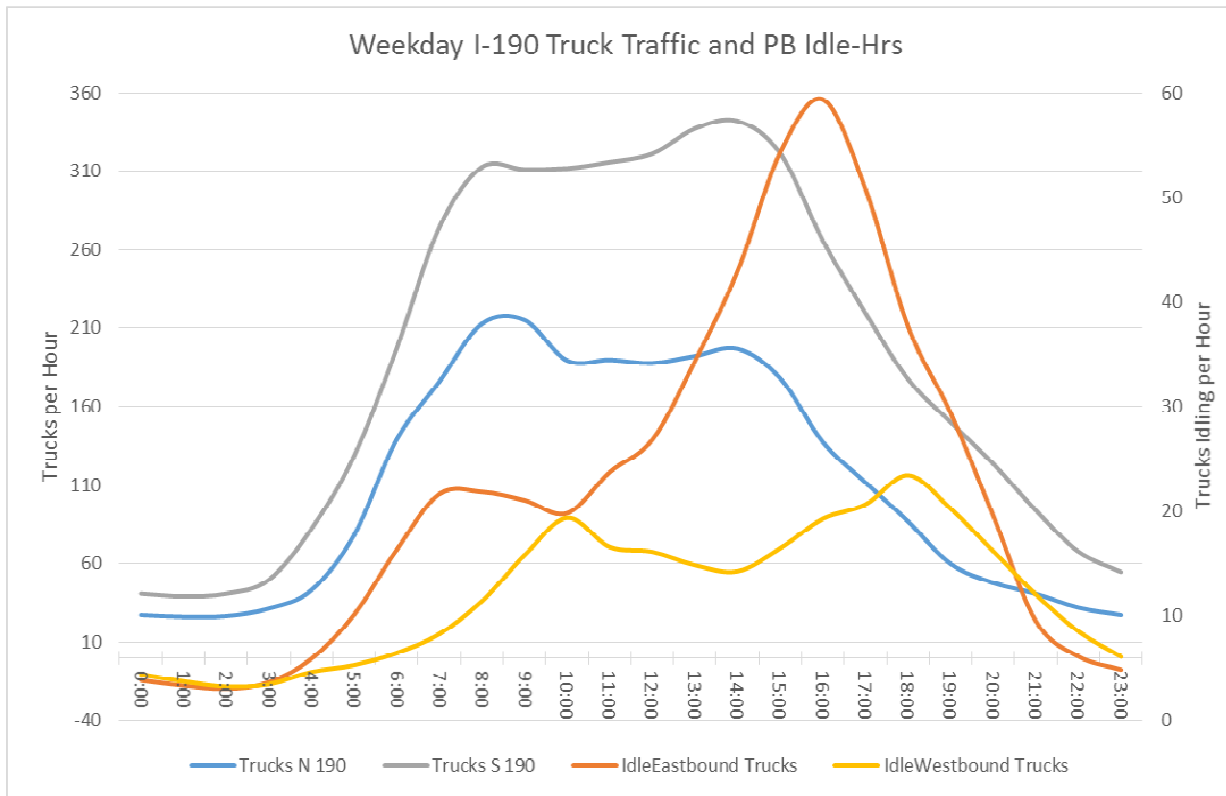
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Air Quality and Traffic Analysis

- Peace Bridge traffic and delay patterns are highly variable and different from normal commuting patterns
- Average traffic and average air pollutant concentrations are not likely to provide an adequate assessment of sources
- 1-Hour vehicle data can be correlated with air pollutant concentrations and WS and WD data
- 1-Hour data allows for analysis of episodes

Episodes: Traffic & air quality

Weekday Average Truck Traffic by Time of Day



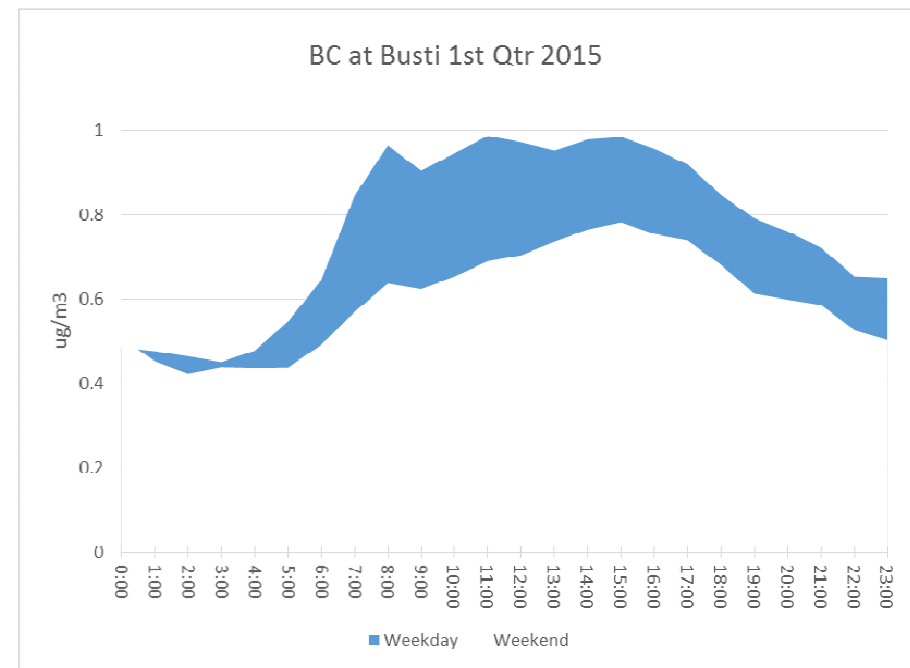
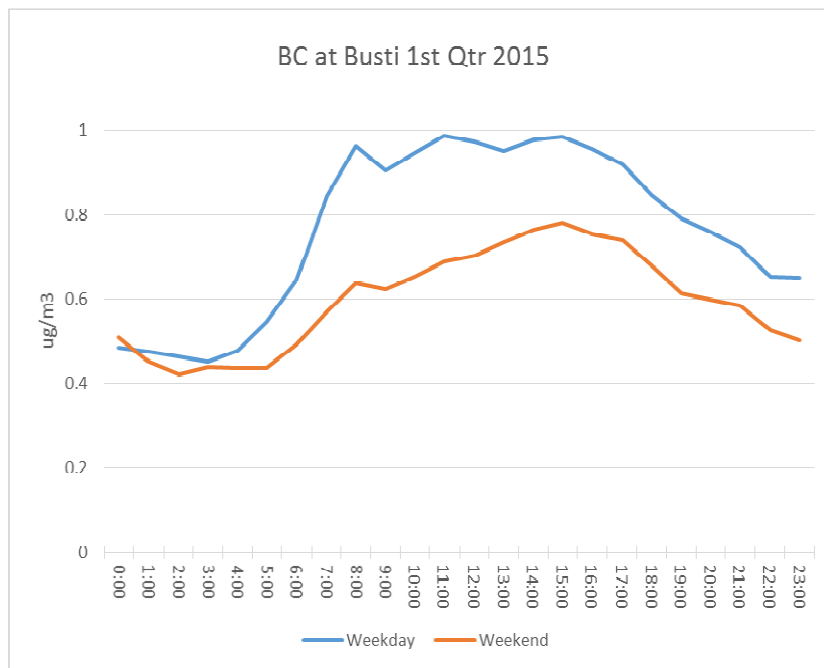
I-190 traffic quickly passes through the neighborhood

Peace Bridge traffic creeps slowly across the bridge and through the customs and inspection area



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BC: Weekday and Weekend

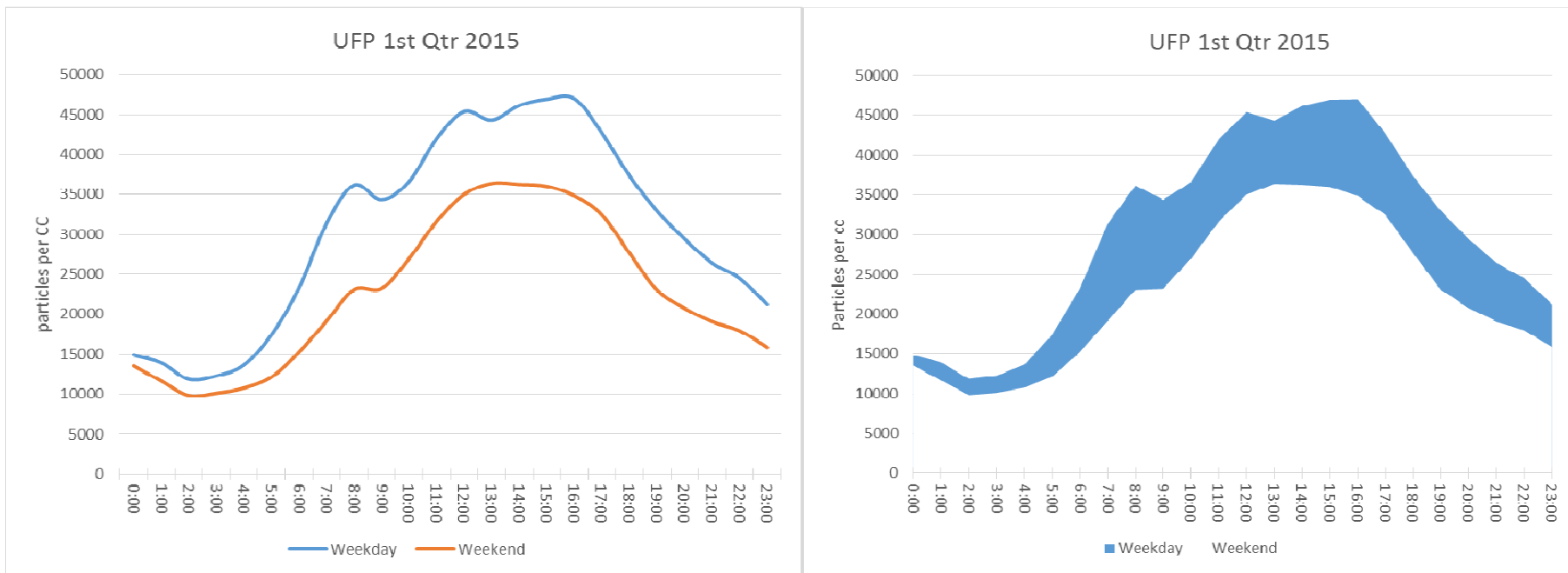


Shaded area due to Weekday primary emissions



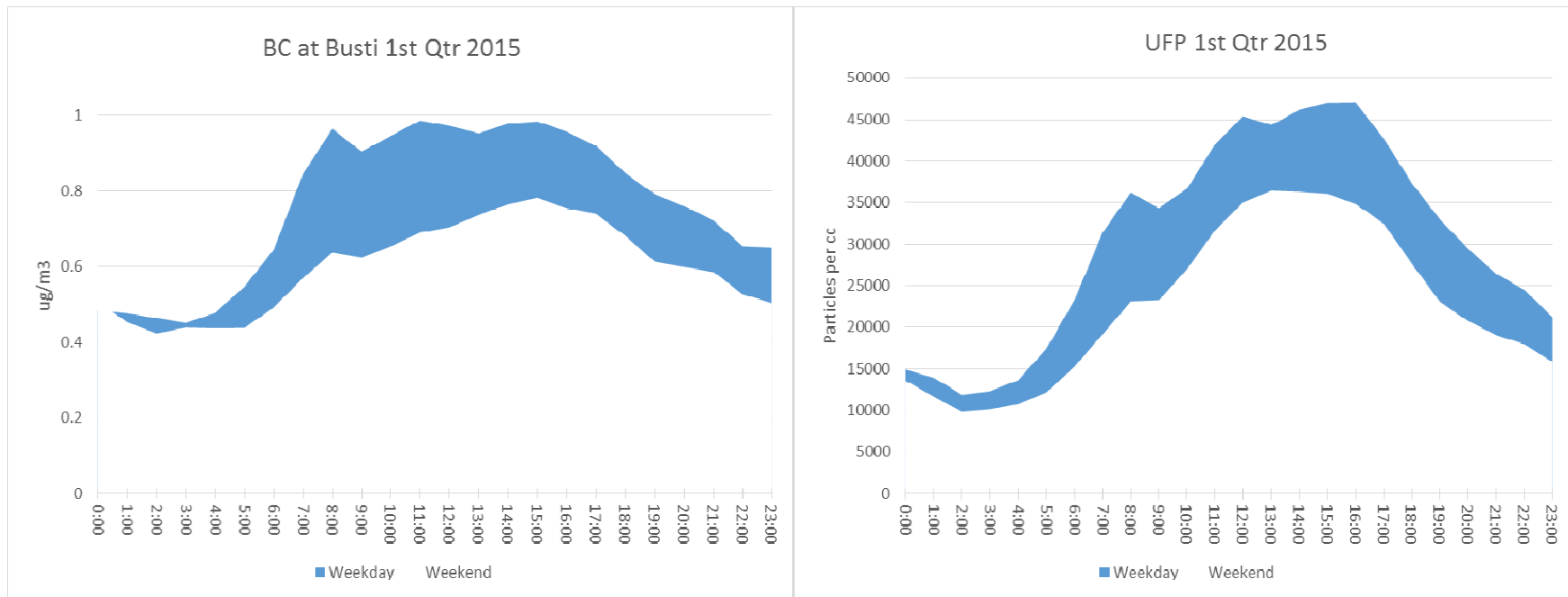
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UFP: Weekday and Weekend



Secondary formation increases in afternoon

Weekday Weekend Differences BC and UFP

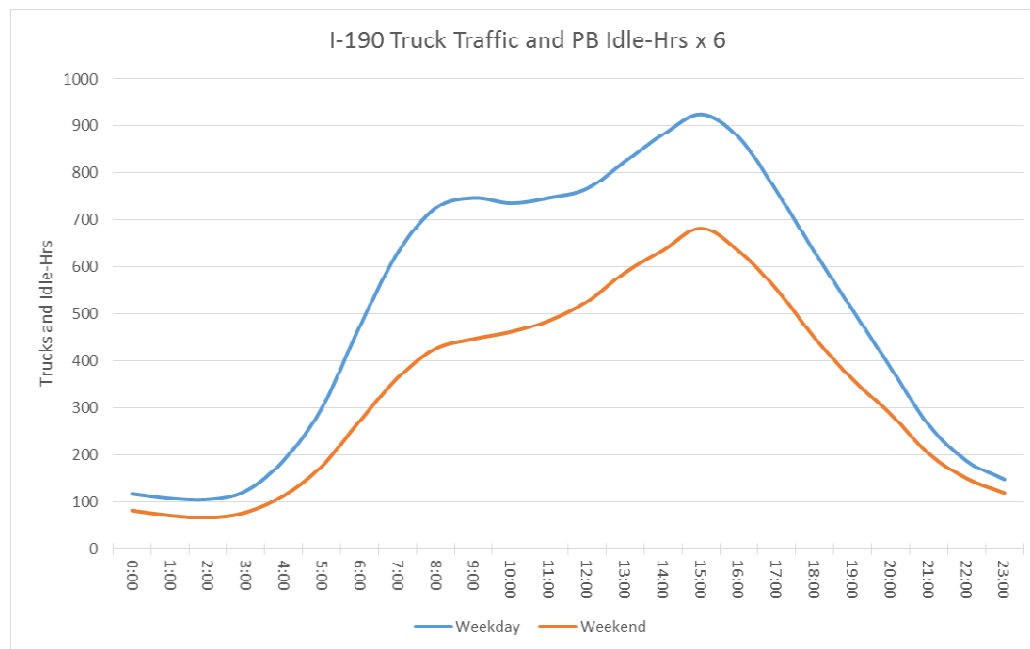


Shaded area represents additional weekday pollutant concentration



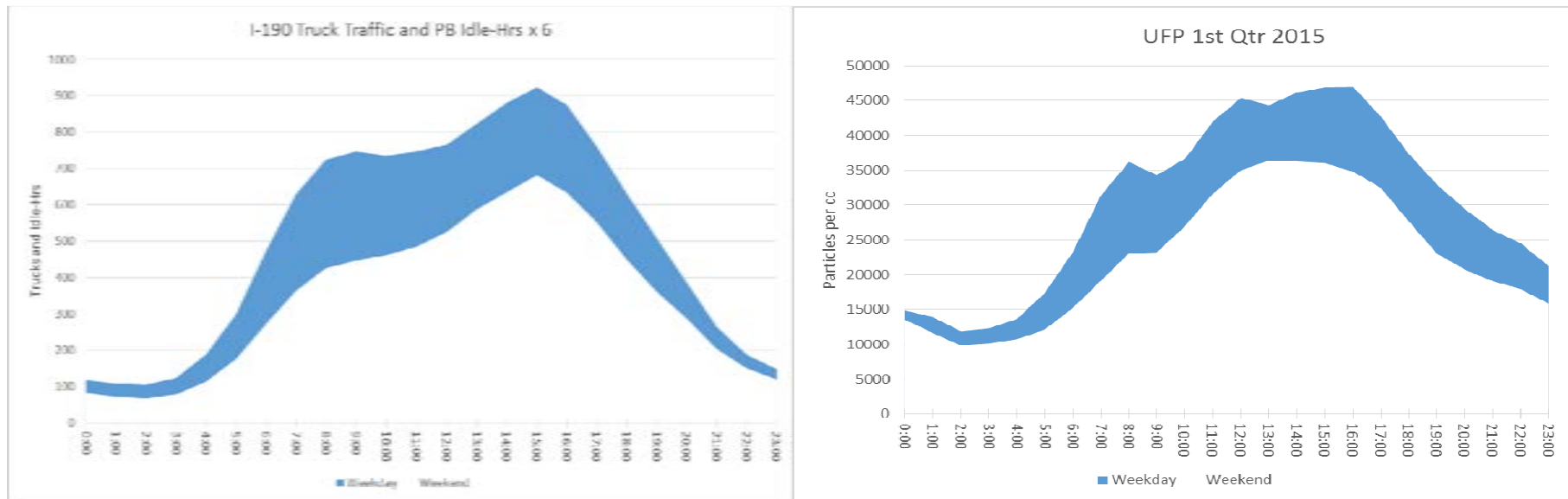
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Truck Traffic: Weekday and Weekend



Sum of truck source
The plots are the I-190
trucks North and
Southbound added to 6
times the Peace Bridge
Idle hours

Truck source compared to UFP: Weekday and Weekend



Summary

- The monitoring program is going well and all pollutants are being successfully monitored
- The 1st Qtr gradient Busti Ave to PS 198 is slightly larger than what was measured in the fall
- The time of day plots can be used as a first cut to see if pollutants are related to traffic and other environmental conditions.
- Further data analysis including binning the data by WD and WS will be necessary to show if the relationships hold

Recent Publications on Related Monitoring



Contents lists available at ScienceDirect

Science of the Total Environment

journal homepage: www.elsevier.com/locate/scitotenv

A field application of a personal sensor for ultrafine particle exposure in children

Patrick H. Ryan^{a,b,*}, Sang Young Son^c, Christopher Wolfe^b, James Lockey^{d,e},
Cole Brokamp^b, Grace LeMasters^{b,f}



Recent Publications on Related Monitoring



Personal exposure monitoring of PM_{2.5} in indoor and outdoor microenvironments

Susanne Steinle ^{a,b,i,*}, Stefan Reis ^{a,c}, Clive E. Sabel ^h, Sean Semple ^{d,e}, Marsailidh M. Twigg ^a, Christine F. Braban ^a, Sarah R. Leeson ^a, Mathew R. Heal ^f, David Harrison ^g, Chun Lin ^f, Hao Wu ^{a,f}



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EPA Citizen Science Training Event: Webinar



Community Air Monitoring Training: A Glimpse into EPA's Air Sensor Toolbox

Thursday July 9, 2015
9:00 AM to 12:30 PM EDT

The U.S. Environmental Protection Agency is hosting a training webinar to share tools used to conduct citizen science projects involving Next Generation Air Monitoring (NGAM) technology and to educate interested groups and individuals on best practices for successful air monitoring projects.

<http://www.epa.gov/heasd/airsensortoolbox/>



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Neighborhood Data Collection

(PTRAK): 10/23, 11/5, 11/9, 11/16, & 11/20

Thank You

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