NEW YORK
STATE OF
OPPORTUNITY

Department of
Environmental
Conservation

Peace Bridge Neighborhood Air Quality Study: 3rd Data Review Meeting

Data: 2nd Qtr 2015
Presentation: September 2, 2015

About the Study: Design

One full year of monitoring - August 2014 to (August – September) 2015

Objective: Seasonal pollutant profiles and annual VOC/Carbonyl data
Study goal: to increase understanding of the impact of mobile source emissions (BC, VOCs, Carbonyls and UFP)

Downwind Site - Busti Avenue near Rhode Island Street

Source impact site is within the residential neighborhood

Urban Site - PS198 International Preparatory School

Background site is away from Bridge and within the same community

Community Sampling Effort – Citizen Science

Trained volunteers from Clean Air Coalition of Western New York

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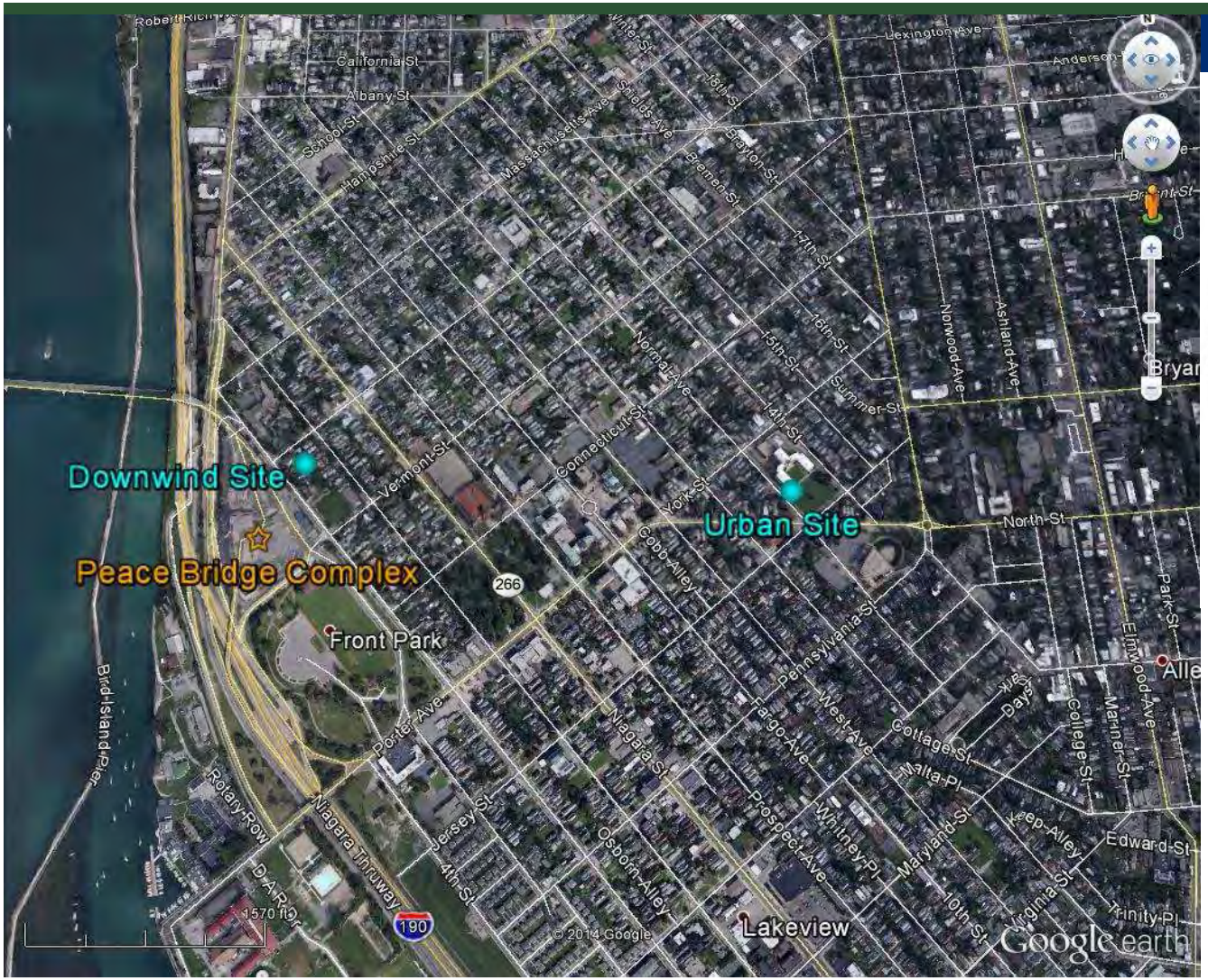

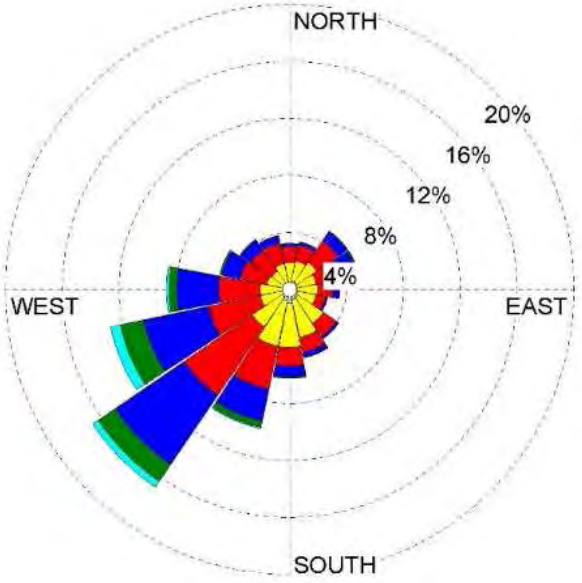

2005-2009 Met Data from Buffalo Airport

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Busti Avenue Downwind Site

The site is now on Google Maps
The shelter is about 40 yards from the Peace Bridge Plaza and more than 200 yards from I-190

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Downwind Site (Busti Ave)

The Peace Bridge has a slow moving “crawl” AADT: 16,556

I-190 AADT: (10% HDD)

78,920 South of the Bridge

67,609 North of the Bridge

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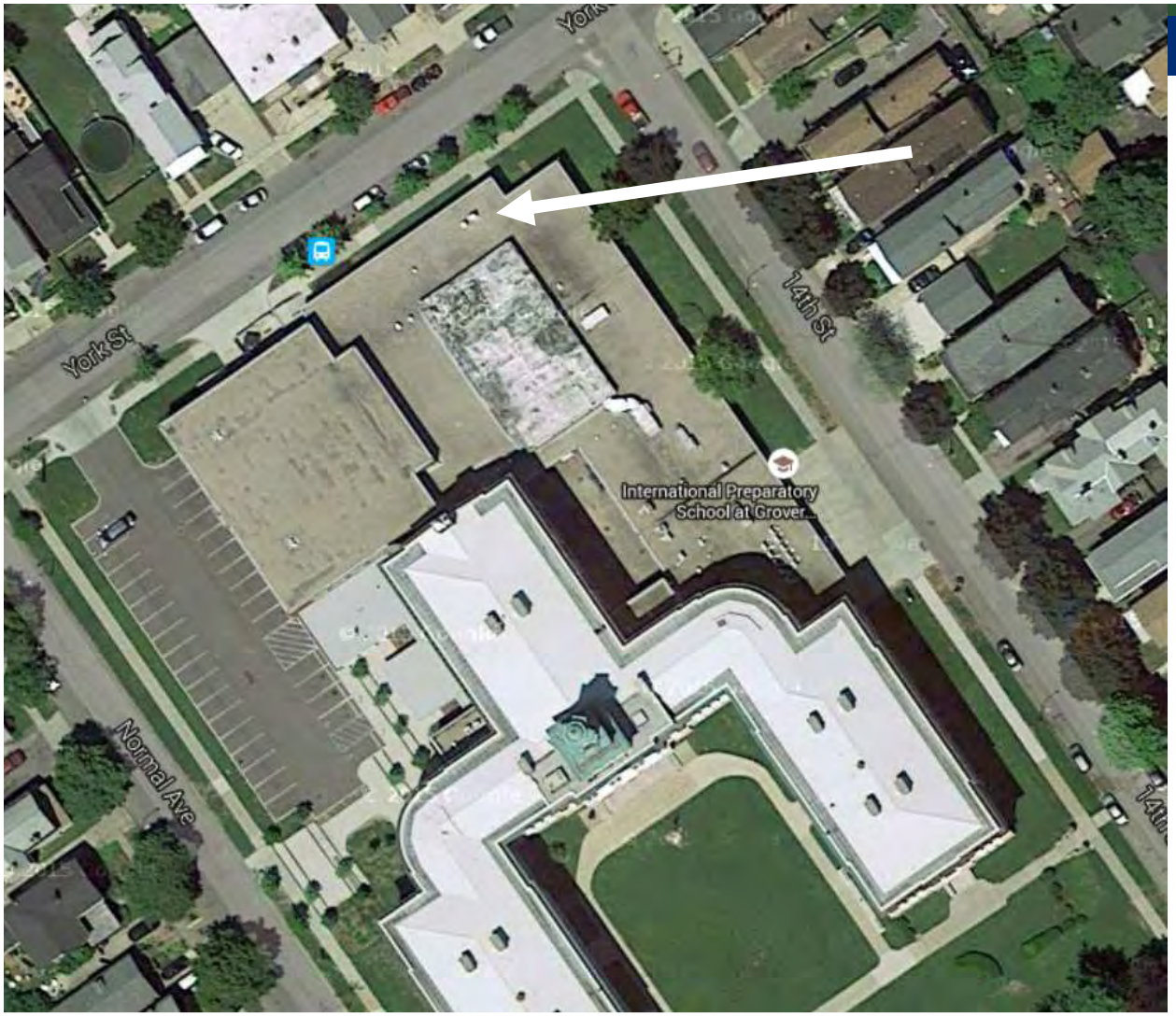

Urban Site at PS198

The site is now on Google Maps
It is on the corner of 14th and York St

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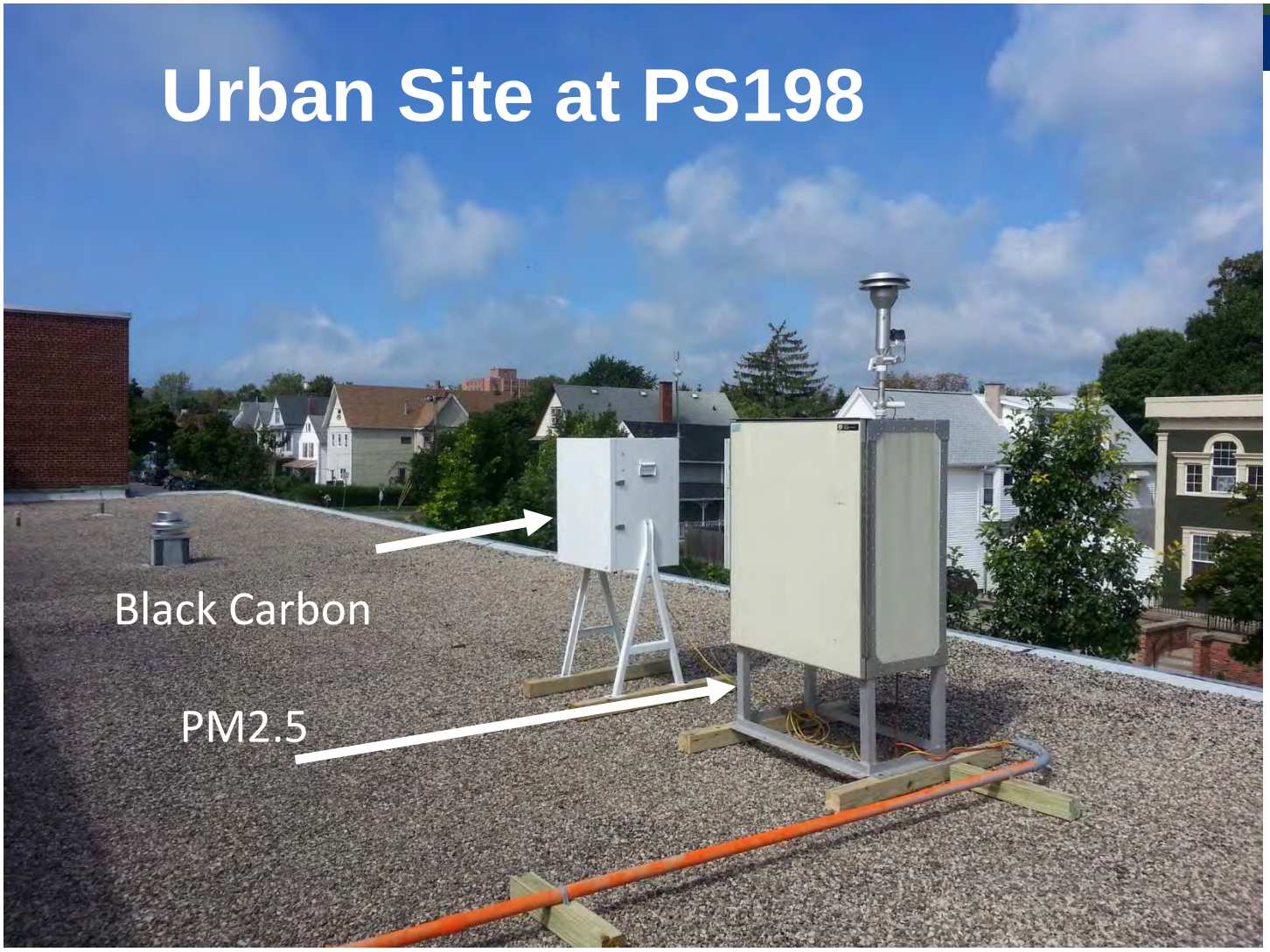
Urban Site at PS198



PM-2.5 & BC

This urban background site is away from the Peace Bridge and I-190 but within the community

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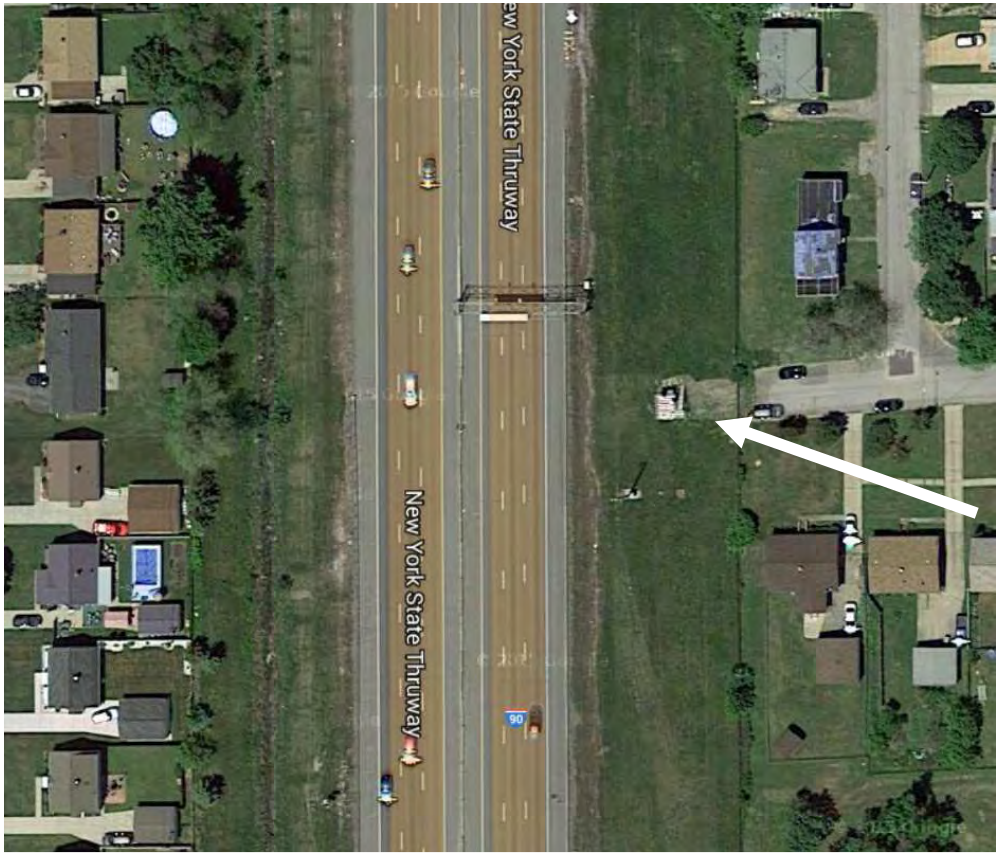
Near Road Site for the Buffalo/Niagara CBSA



The EPA requires a monitor to determine the impact of emissions from motor vehicles in cities with Population > 1 Million

NO_2, PM-2.5 and CO

The site is on I-90 between Exit 51 and 52

AADT is 131,019

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What's New?

An API 651 UFP monitor was added to the Peace Bridge Study urban background site June 11th Data will be collected during the summer when traffic is heaviest on the Peace Bridge

An API 651 was also added to the Buffalo Near Road site on the same day

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Data Collection: Dates in 2014 & 2015

Busti Avenue Site

- PM-2.5, Meteorological, BC: 8/11/14 – 9/30/15
- Ultrafine Particle Data (UFP): 9/24/14 – 9/30/15
- (VOC) and Carbonyl sample collection 8/15/14 – 9/30/15

PS 198

- BC: 8/21/14 – 9/30/15
- PM-2.5: 8/26/14 – 9/30/15
- UFP: 6/11/15 – 9/30/15 (summer deployment – highest bridge traffic)

Peace Bridge and I-190 Traffic

- Vehicle transit and delay data available Monthly

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Instrumentation: Ultrafine Particle Number

UFP (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 was on Loan from the Manufacturer

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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 50^0 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)

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Instrumentation: VOCs, Carbonyls

Volatile Organic Compounds (VOCs) & Carbonyls

- Computer controlled sampler
  - VOC collected with SUMMA canister
  - Carbonyl collected in DNPH cartridge
- 24-hr air sample collected once every 6 days
- Laboratory analysis of sample

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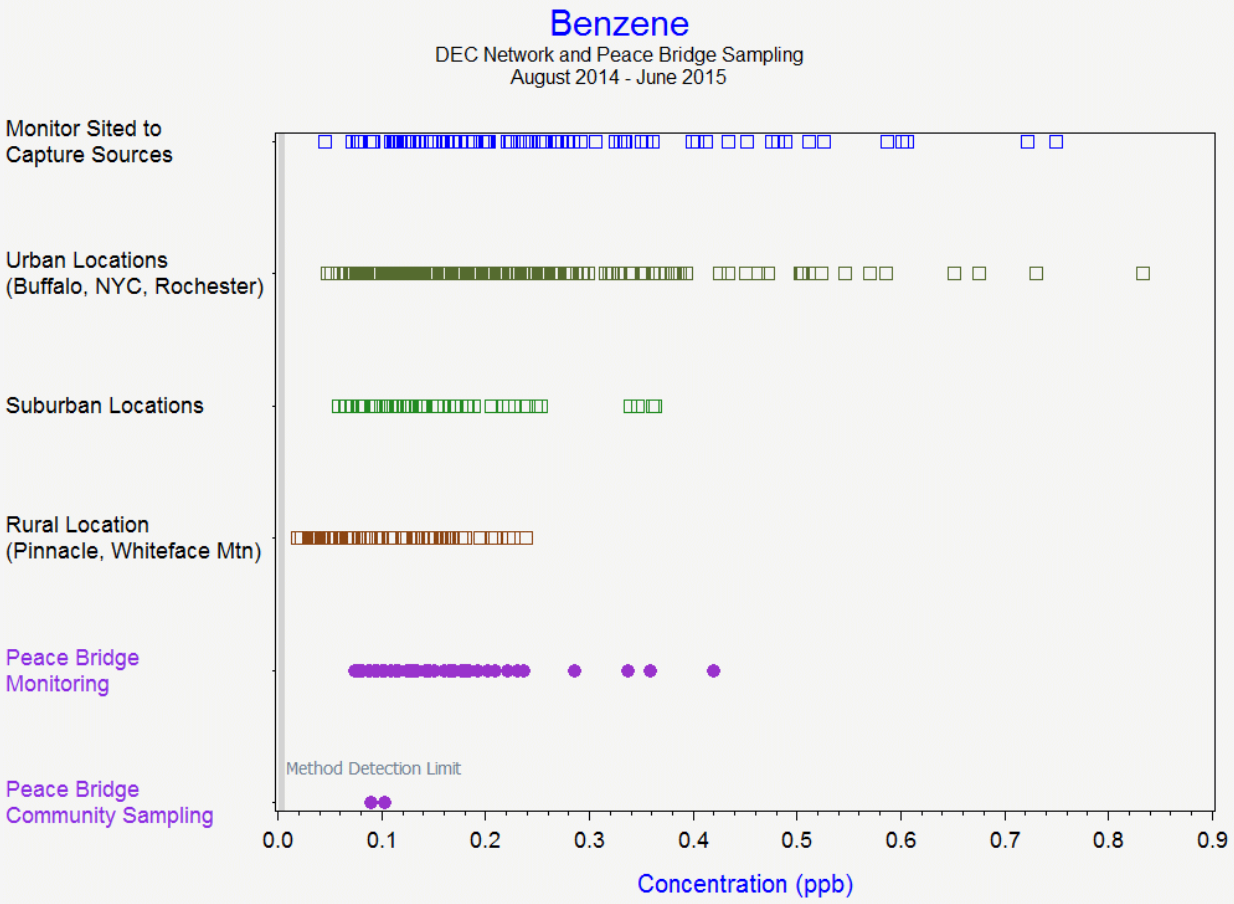

- Benzene primarily from mobile sources
- Concentrations are similar to other urban and suburban areas of the State

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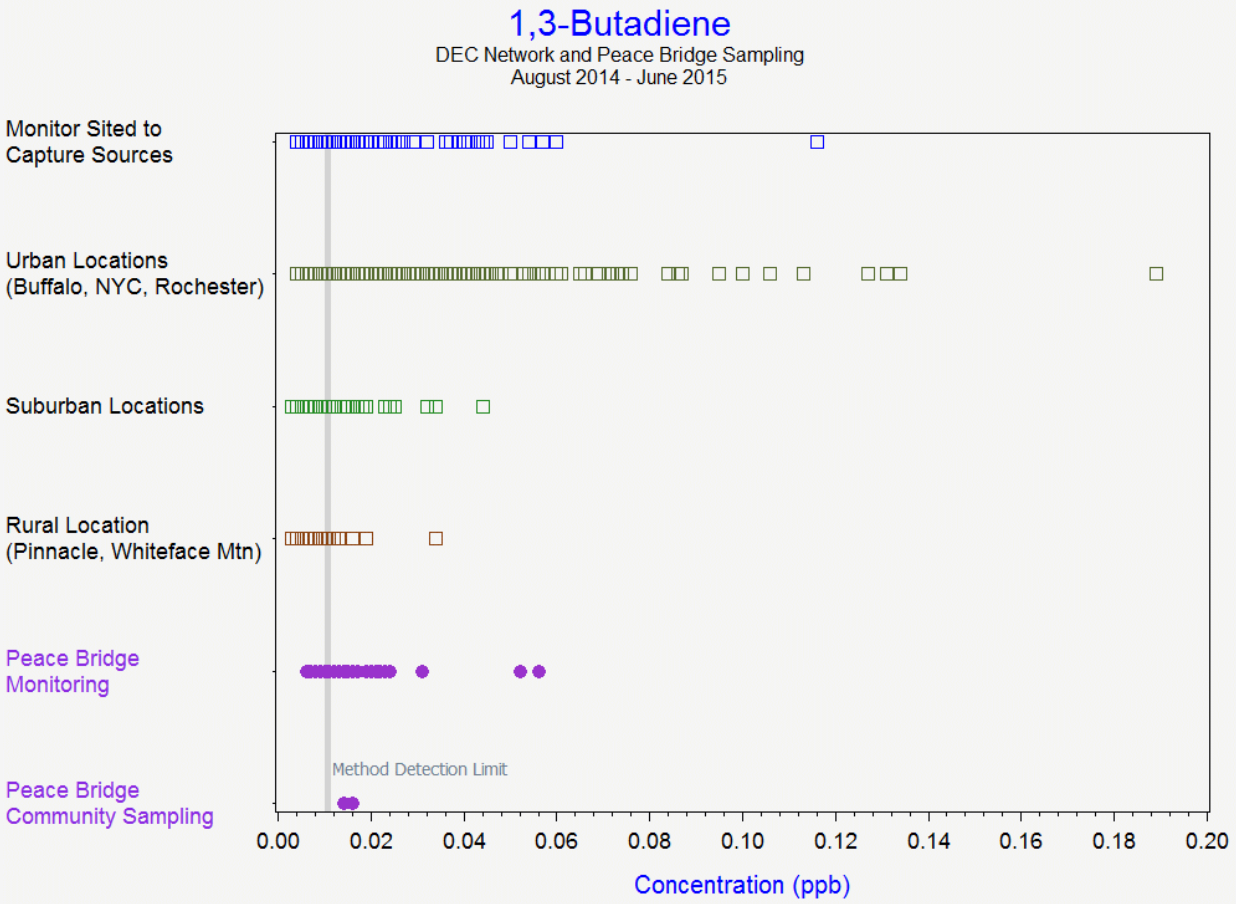

1,3-Butadiene primarily from mobile sources

Concentrations are similar to other suburban areas of the State

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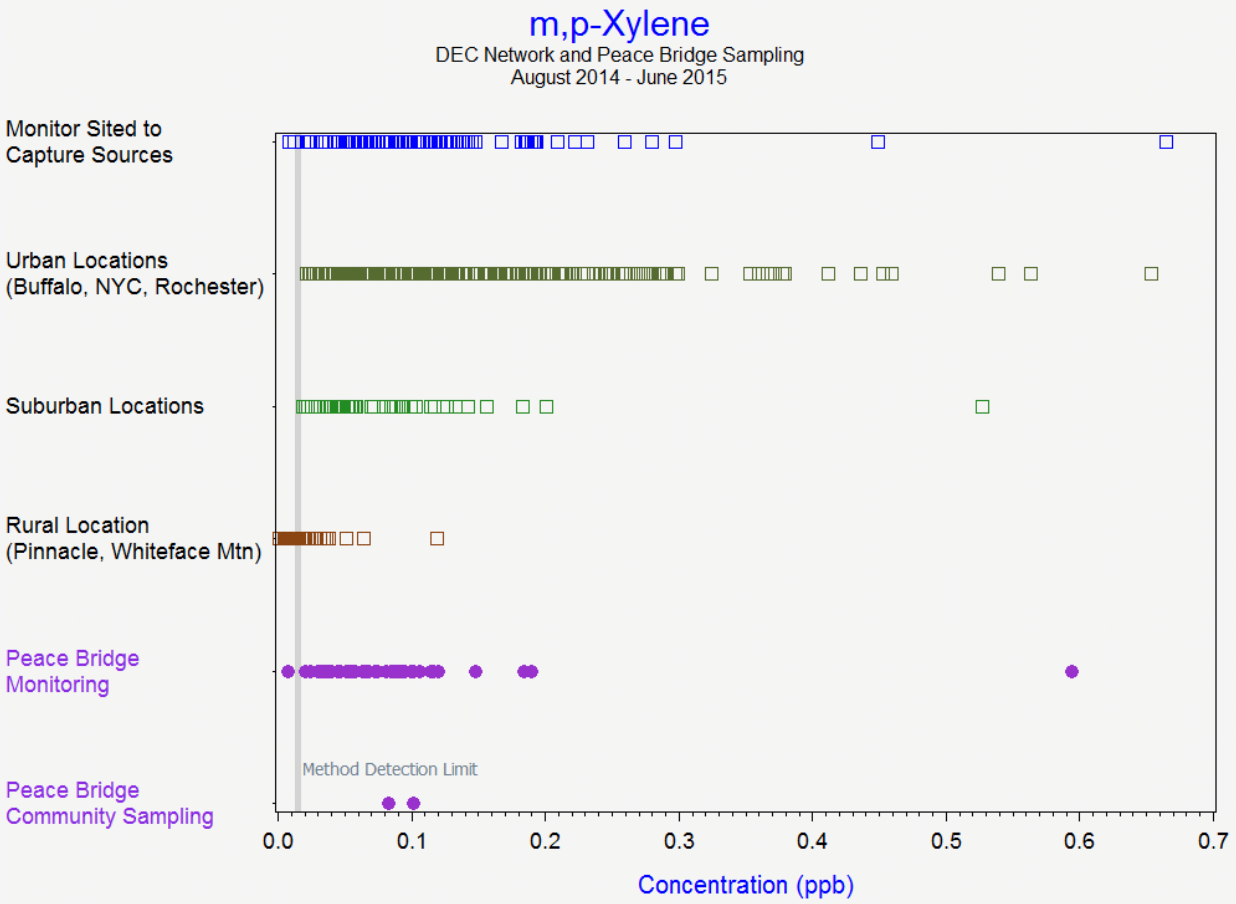

Concentrations are similar to other suburban areas of the State

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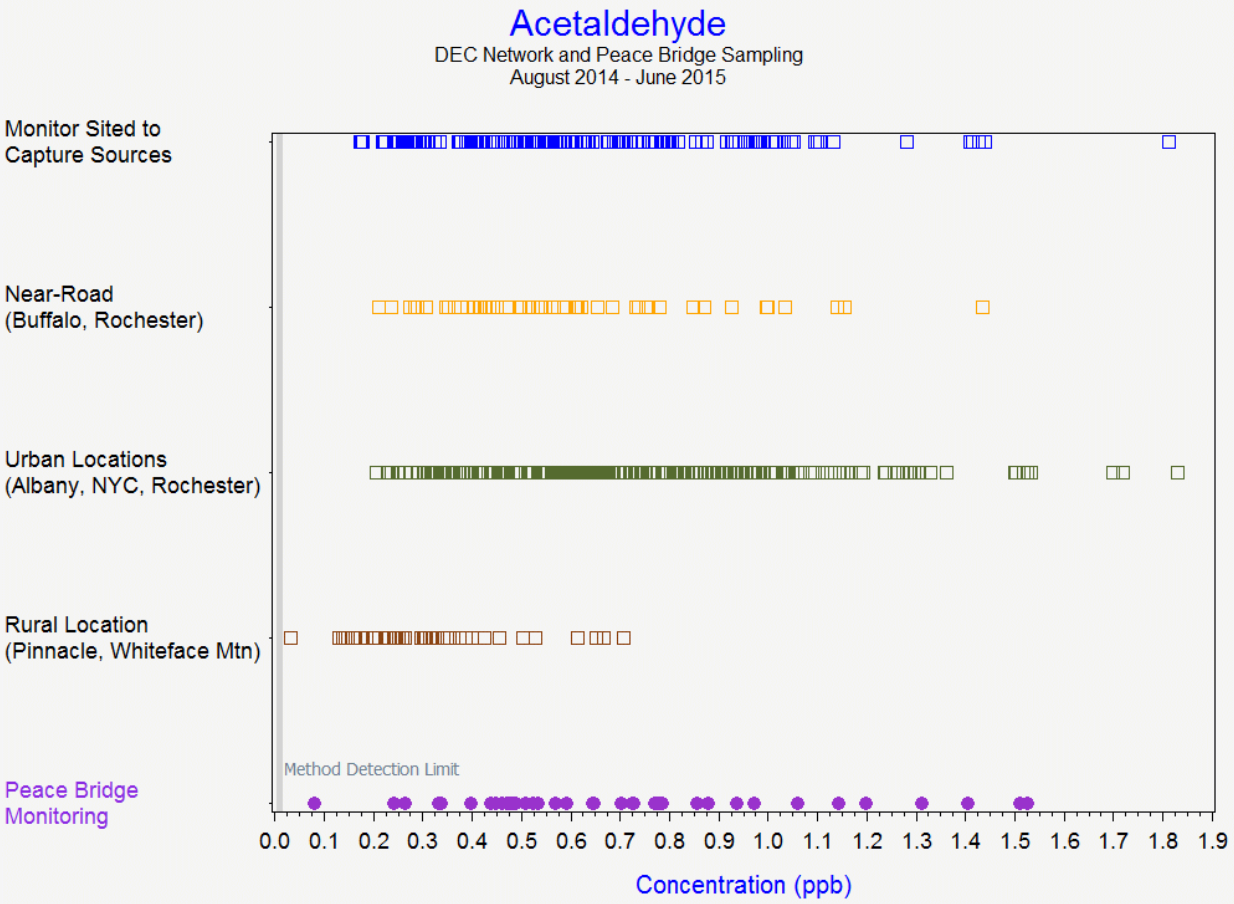

Concentrations are similar to other areas of the State

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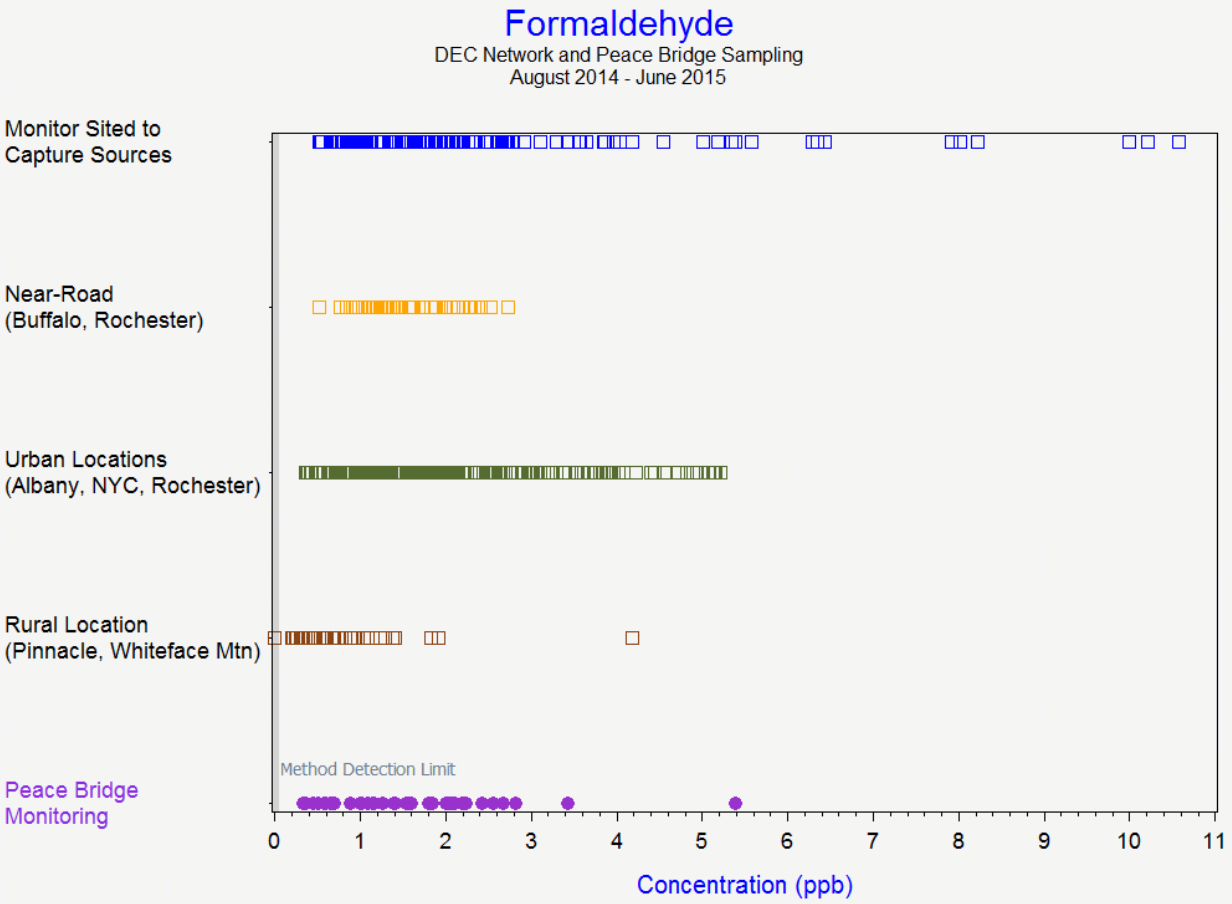

Concentrations are similar to other areas of the State

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2nd Quarter Summary: Averages

	Busti Avenue	PS 198	% Difference
PM-2.5	7.9 µg/m^3	6.3 µg/m^3	22%
BC	0.94 µg/m^3	0.45 µg/m^3	70%

Both sites are well below the Annual NAAQS for PM-2.5 (12 µg/m^3)

BC has a stronger gradient and is a better indicator of mobile source emissions

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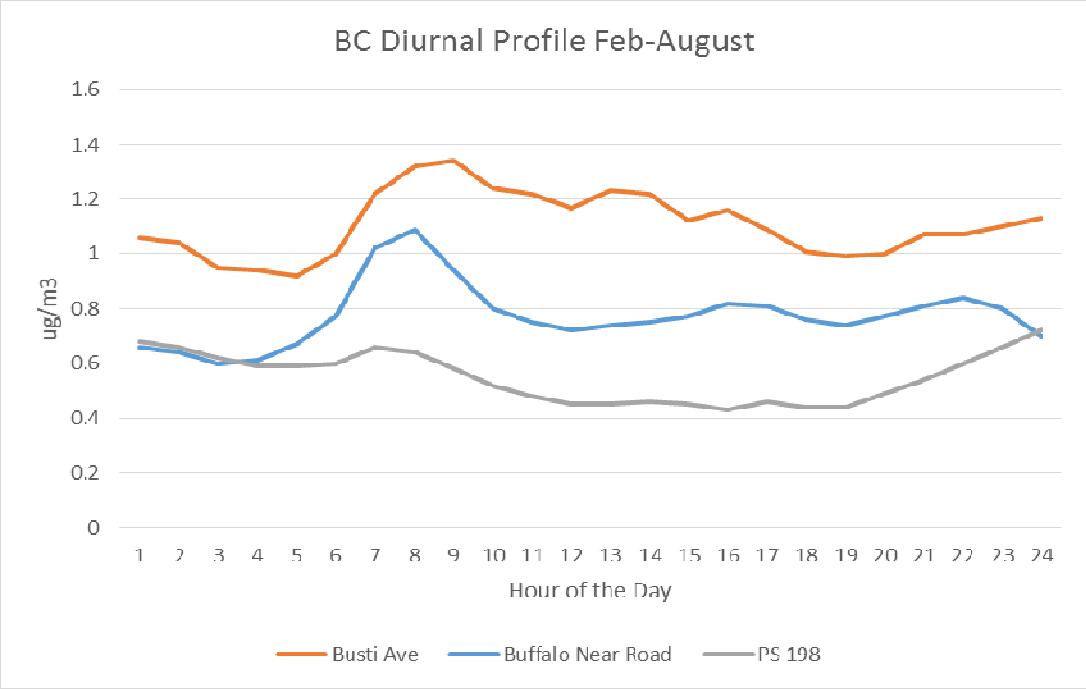
BC Data: Peace Bridge & Near Road Comparison



The time of day plot shows that BC at Busti Avenue is higher than the Near Road site and PS 198

Peace Bridge traffic is approx. 30% Trucks
Near Road traffic on I-90 is approx. 4% Trucks

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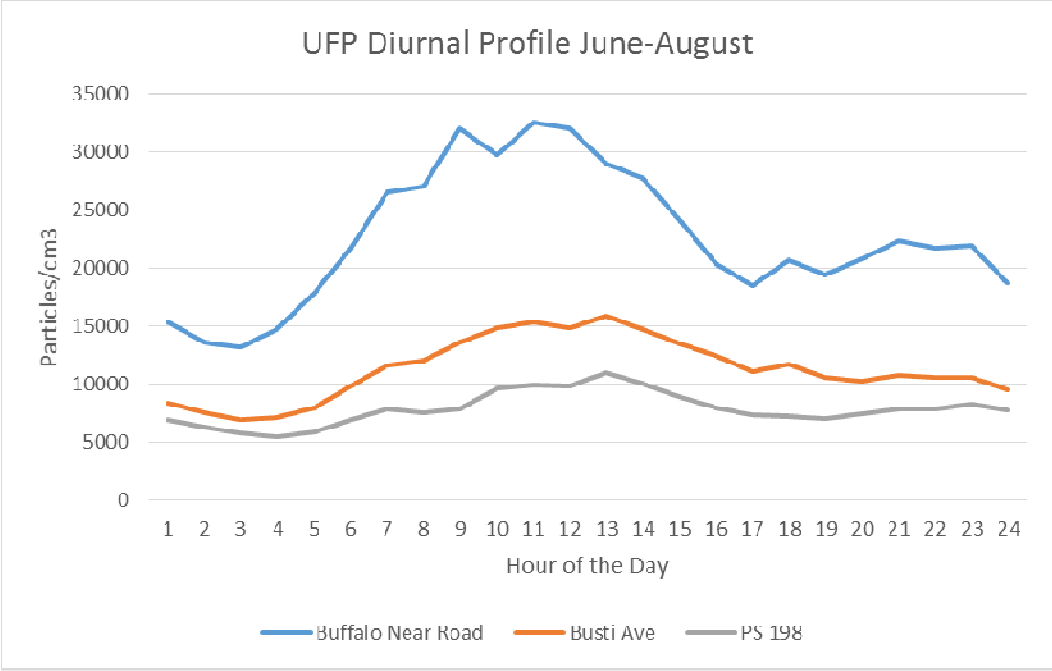
UFP Data: Peace Bridge & Near Road Comparison



The time of day plot shows that UFP is considerably higher at the Near Road site than at Busti Avenue and PS 198

The Near Road site is much closer to the source of emissions than Busti Ave

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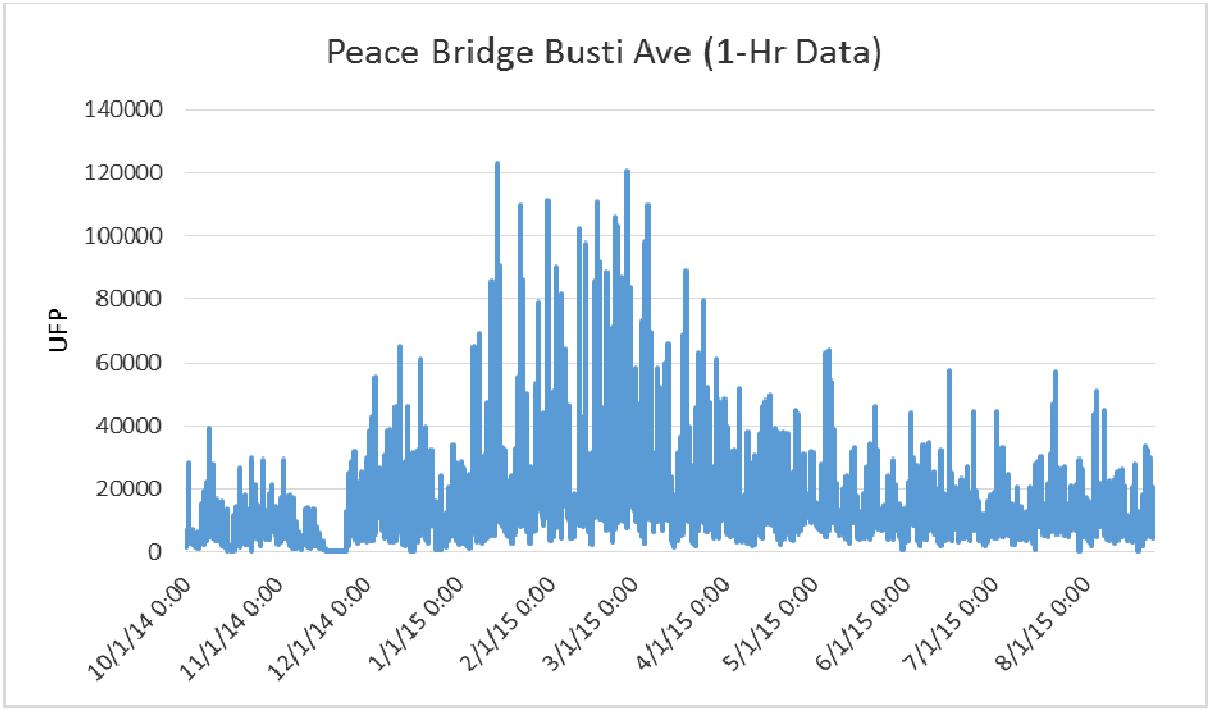
The Behavior of Mobile Source Emissions Tracers

Why is BC higher at Busti Avenue and
UFP higher at the Near Road Site?

BC is emitted and it disperses in the environment
- BC particles are relatively unreactive

UFP are emitted and disperse and quickly undergo transformations – UFP evaporate or agglomerate
- UFP do not last long so concentrations are highest very close to the source of emissions

Busti Av. UFP: Seasonal Time Series



Data are presented with Winter in the Center of the plot

UFP are more stable in cold temps

< Evaporation

< Humidity

< Particle Growth also Low B Layer

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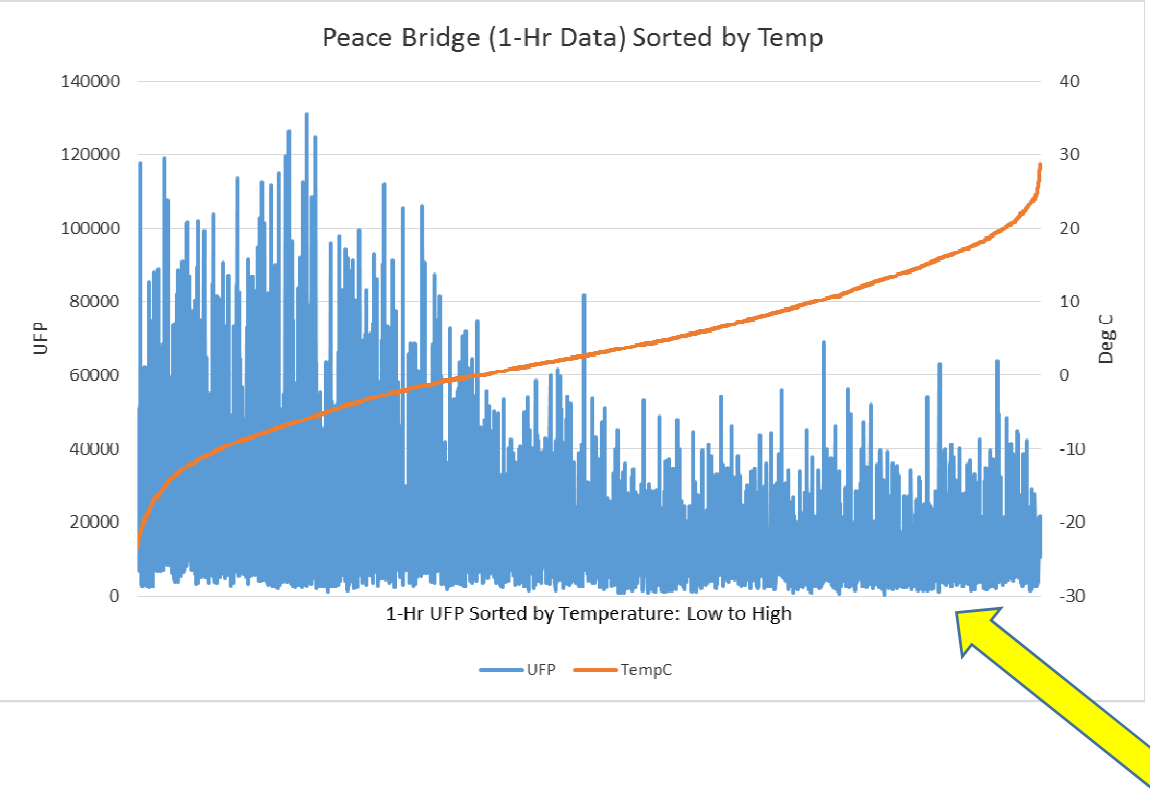
Busti Av. UFP: Sorted by Temp (Deg C)



At colder temps, the UFP range is higher but the low values are similar year round

Local mobile source emissions are fairly consistent year-round

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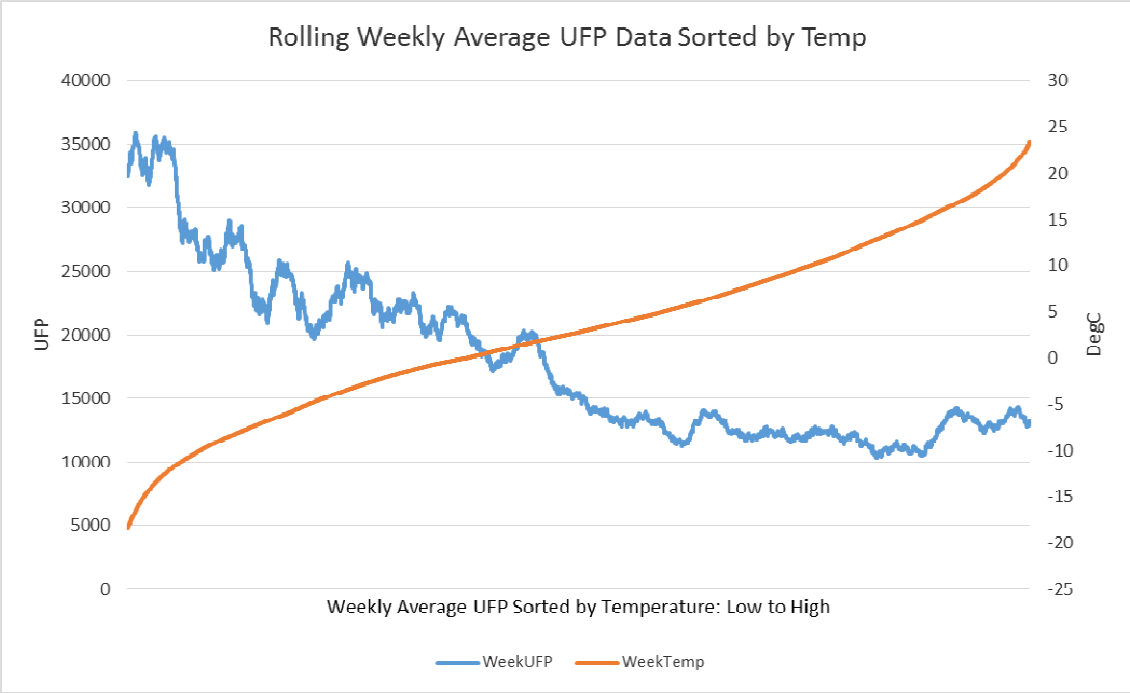
Rolling Weekly Ave. UFP and Temp (Deg C)



At colder temps, the average UFP is 2 to 3 times higher than the average during hot weather

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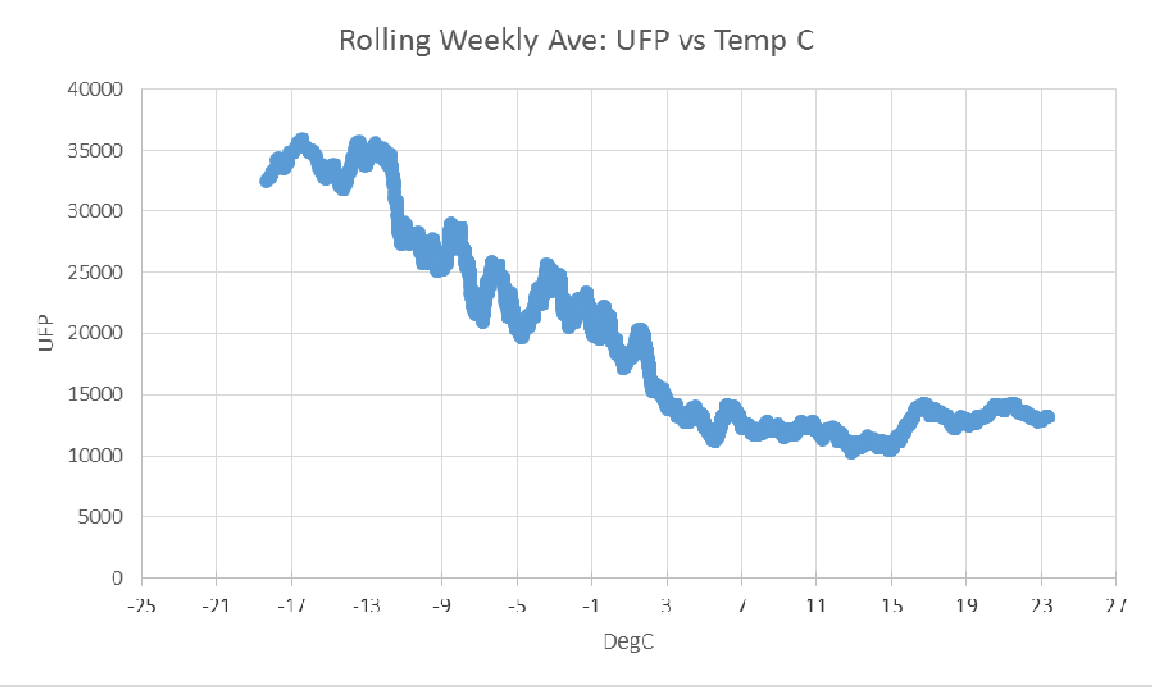
Rolling Weekly Ave. UFP vs Temp (Deg C)



Peace Bridge Study
Busti Avenue

XY Plot

(UFP vs Temp ºC) shows the relationship between UFP and temp at this location

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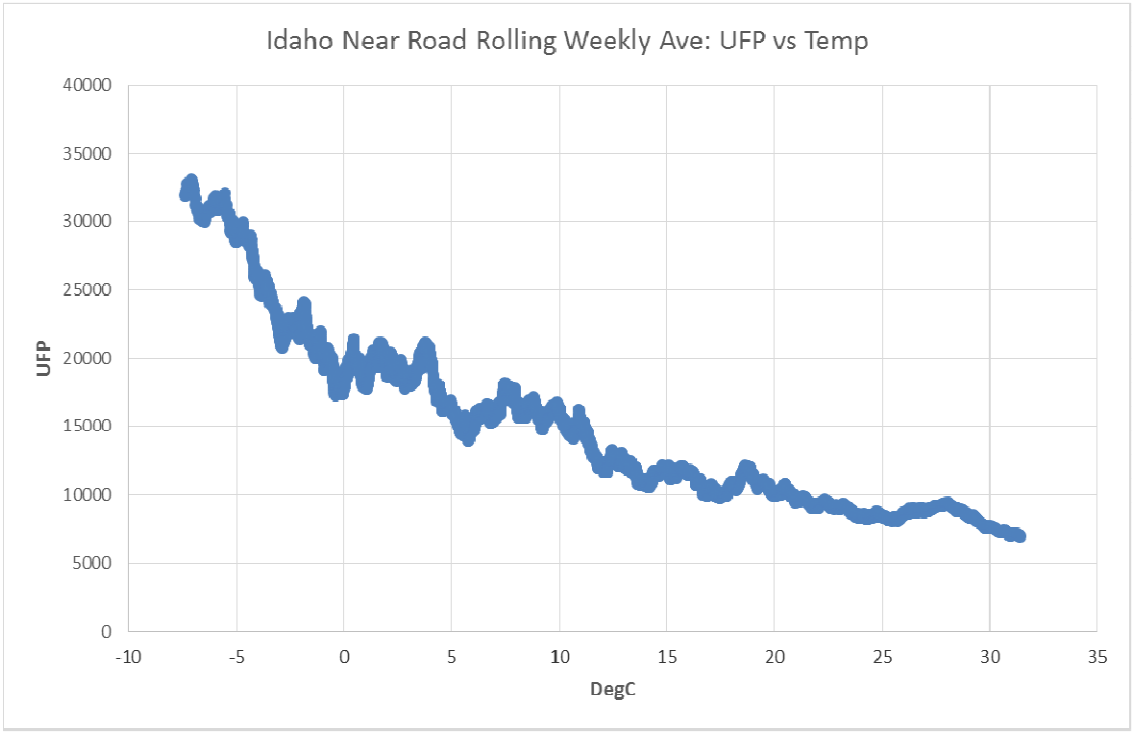
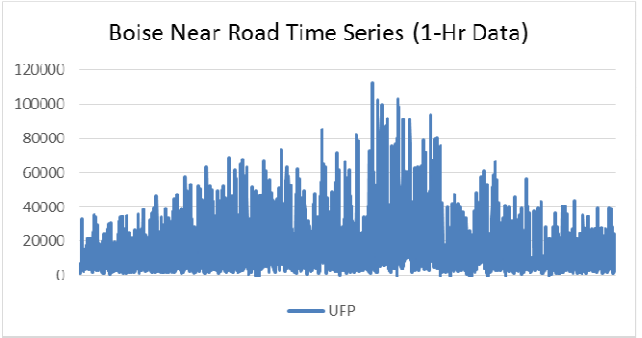
Rolling Weekly Ave. UFP vs Temp (Deg C)



Boise, Idaho
Near Road 2012 Data
Winter in Center of time series plot



Boise Near Road AADT: 103,000 FE-AADT: 162,000

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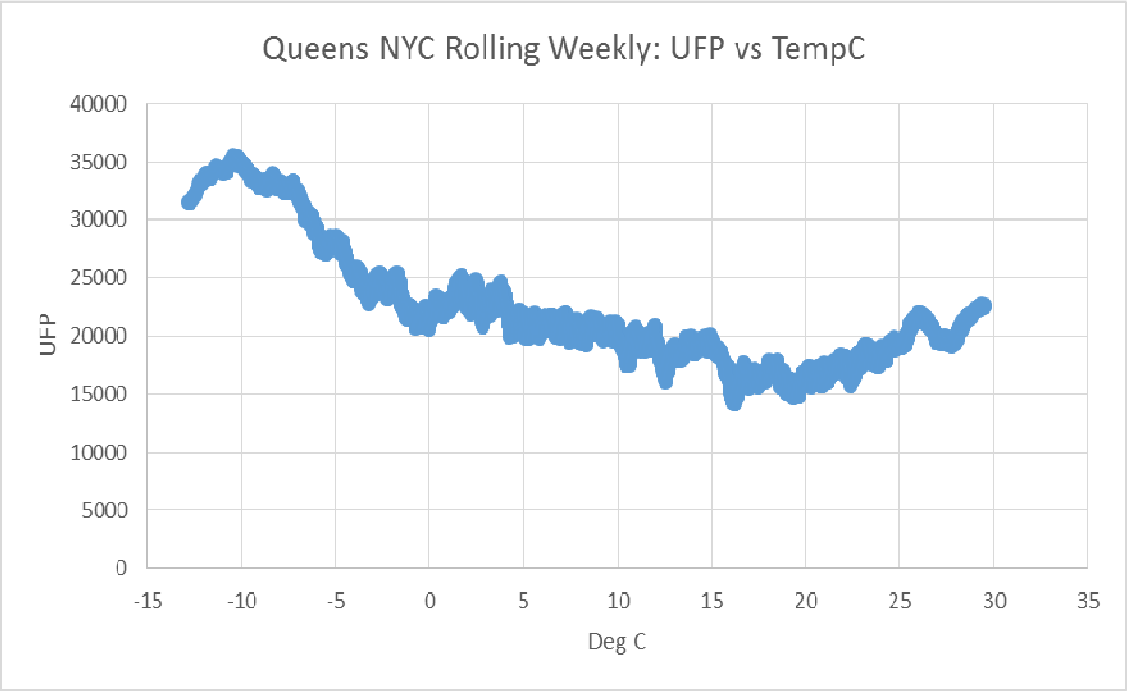
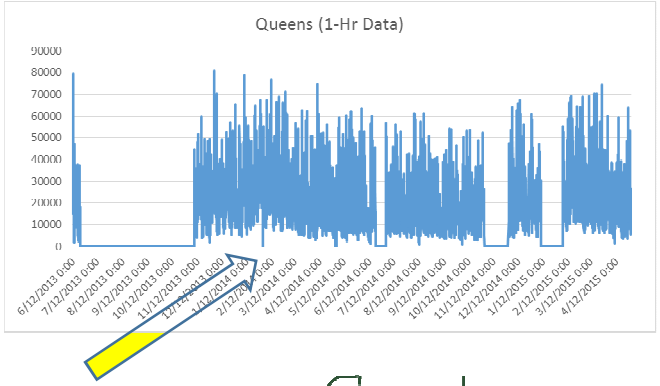
Rolling Weekly Ave. UFP vs Temp (Deg C)



Queens, NYC
2013 - 2015 Data
Winter in Center of time series plot



UFP rarely approaches zero at this site, note incr UFP at higher temps

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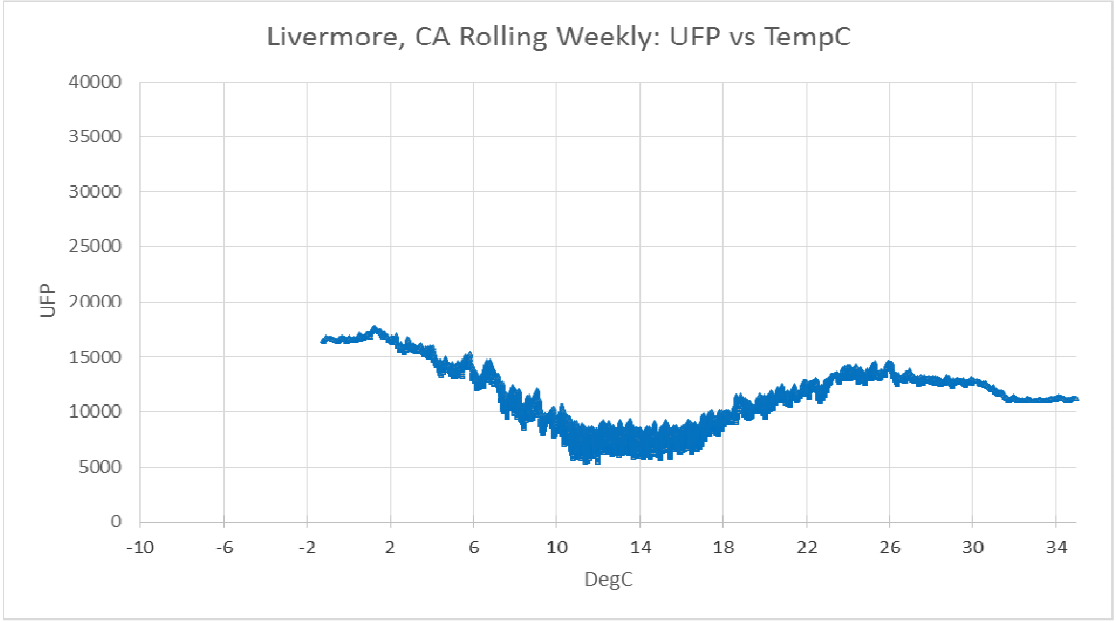
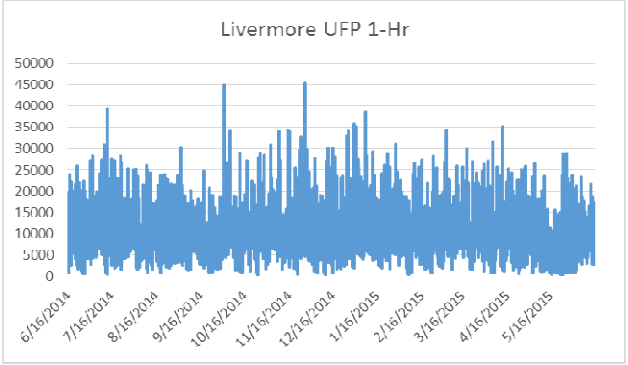
Rolling Weekly Ave. UFP vs Temp (Deg C)



Livermore, CA
2014/15 Data
Winter in Center of time series plot



UFP increases by a factor of 2-3 during cold temps
UFP increases by a factor of 2 during hot temps

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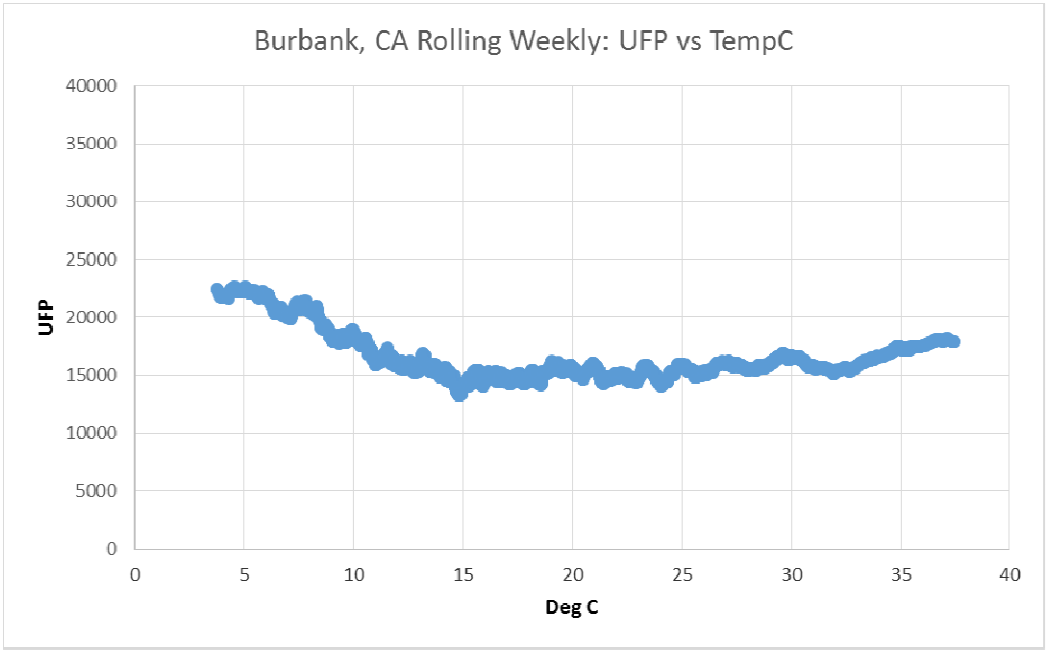
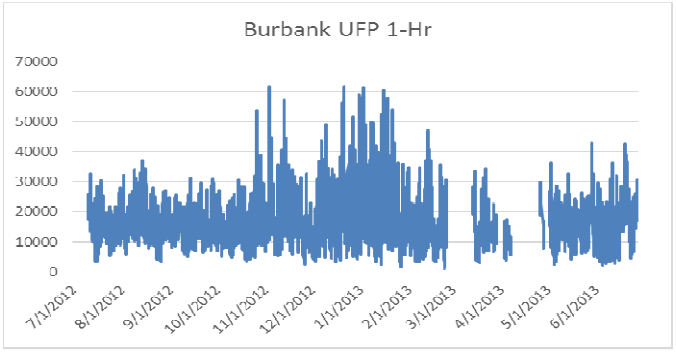
Rolling Weekly Ave. UFP vs Temp (Deg C)



Burbank, CA
2012/13 Data
Winter in Center of time series plot



CA recently completed an Air Toxics study with UFP monitors at 6 sites around Los Angeles

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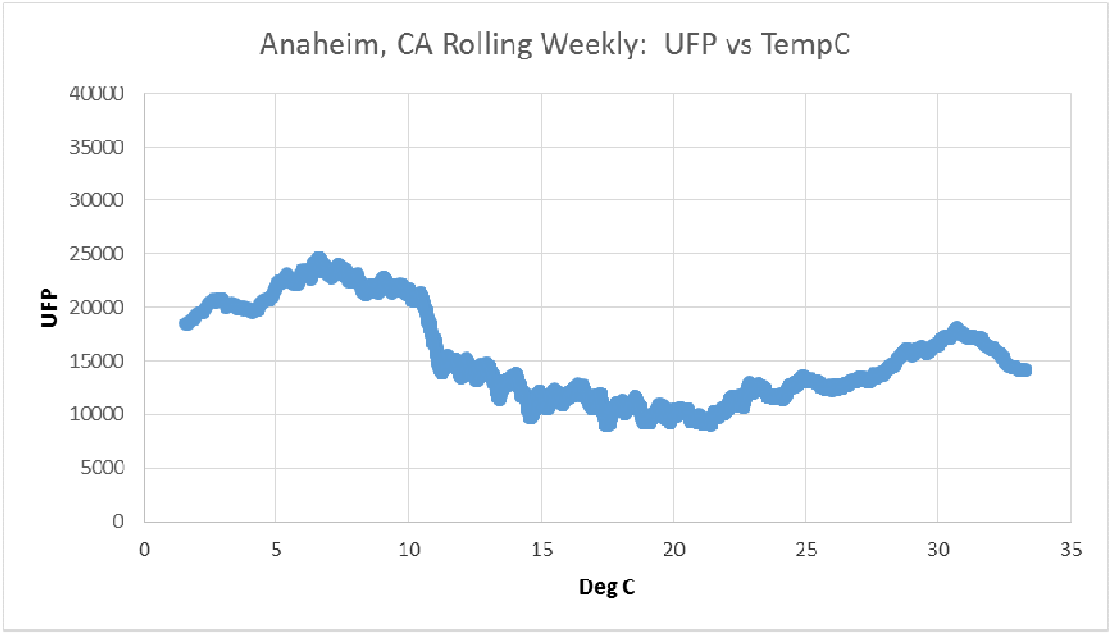
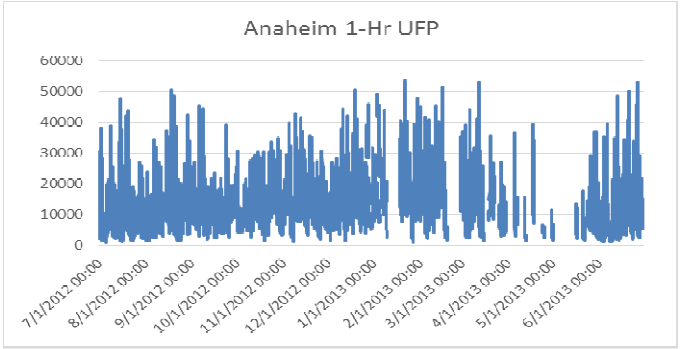
Rolling Weekly Ave. UFP vs Temp (Deg C)



Anaheim, CA
2012/13 Data
Winter in Center of time series plot



UFP increases by a factor of 2-3 at low temps
UFP increases by 45% at high temps

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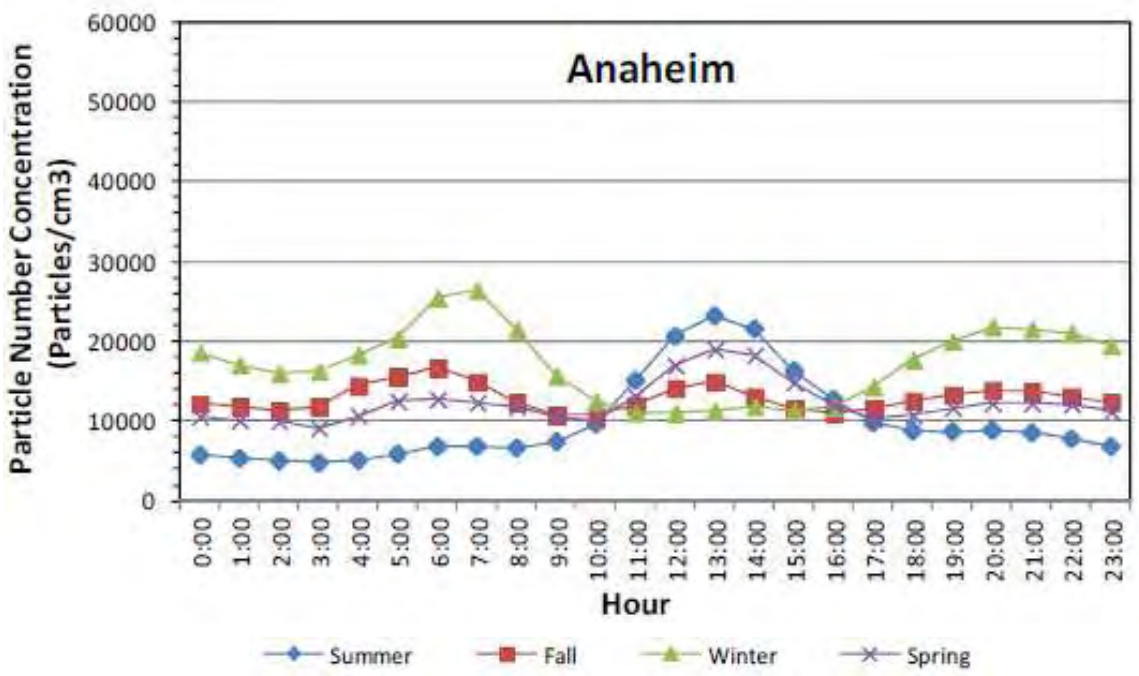
Seasonal Diurnal UFP: Anaheim, CA



Winter am peak is evidence of Local Primary emissions
Summer afternoon Peak is evidence of Local Secondary UFP production

Elevated UFP in the Winter occurs in the morning
Elevated UFP in the Summer occurs in the afternoon

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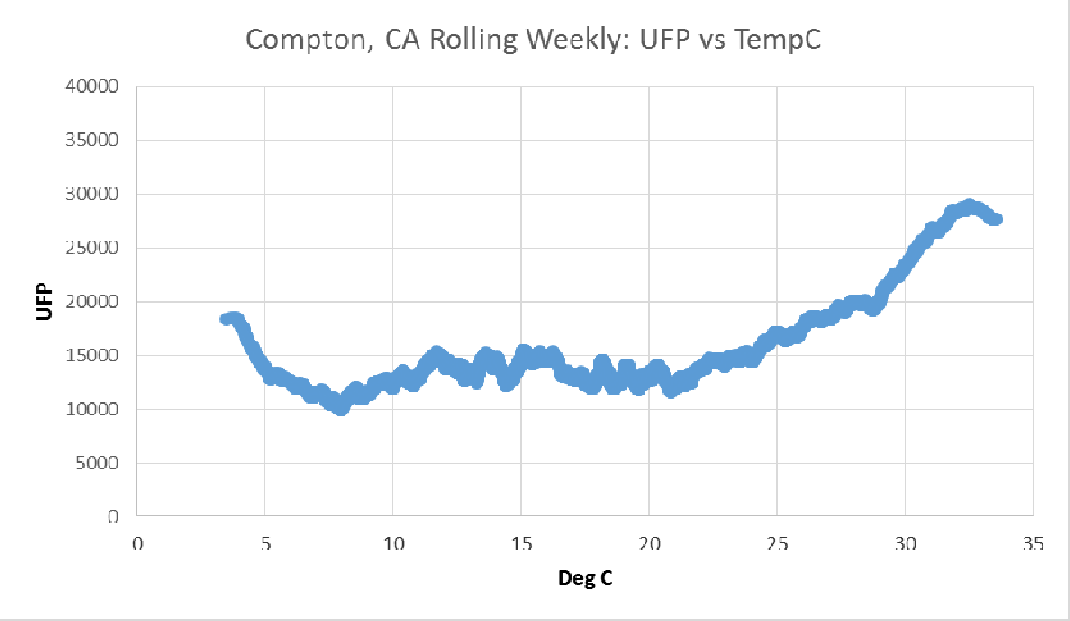
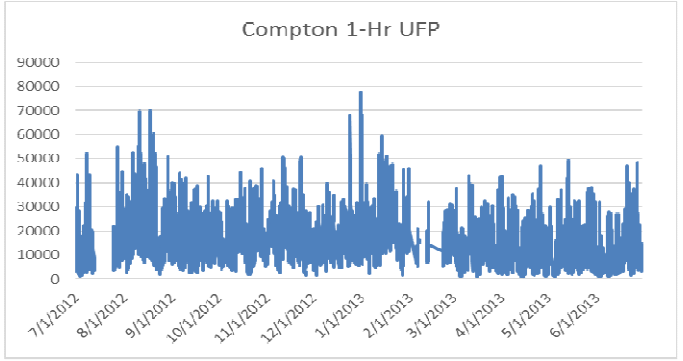
Rolling Weekly Ave. UFP vs Temp (Deg C)



Compton, CA
2012/13 Data
Winter in Center of time series plot



UFP increases by 16% - 45% at low temps
UFP is increased by a factor of 2 at high temps

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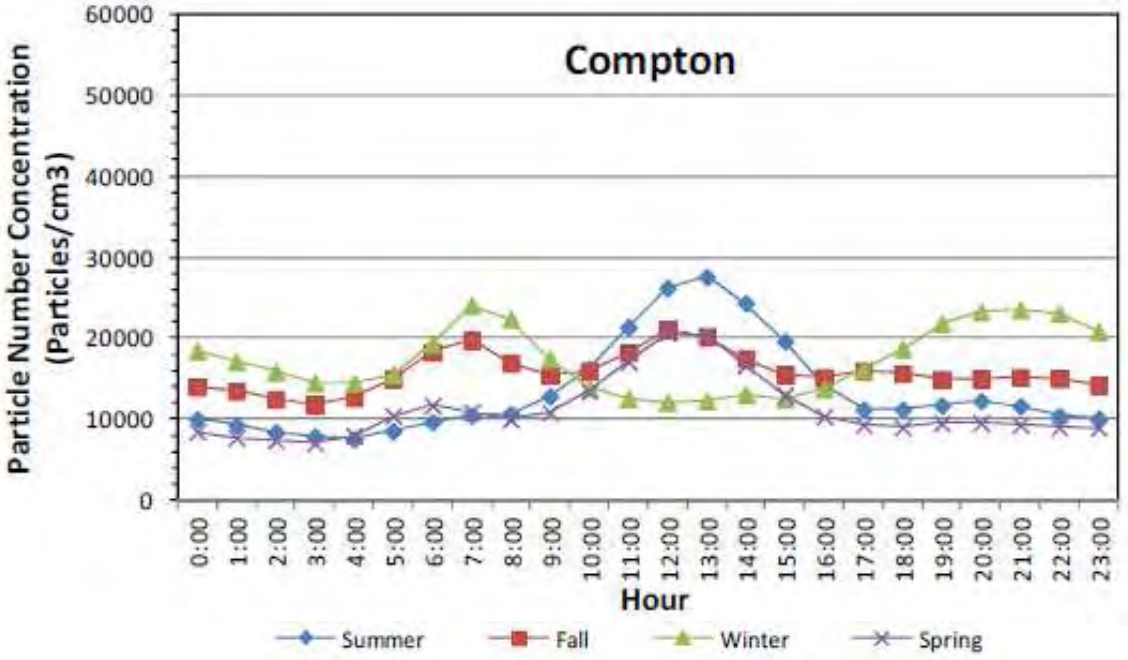
Seasonal Diurnal UFP: Compton, CA



Summer afternoon Peak is evidence of Local Secondary UFP production

Elevated UFP in the Summer occurs in the afternoon

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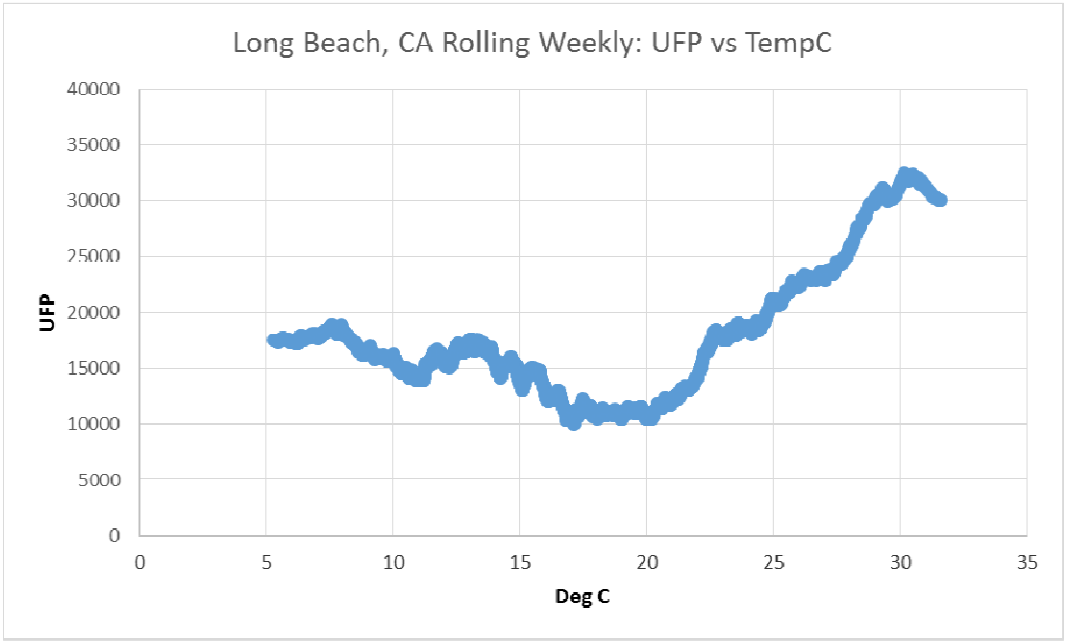
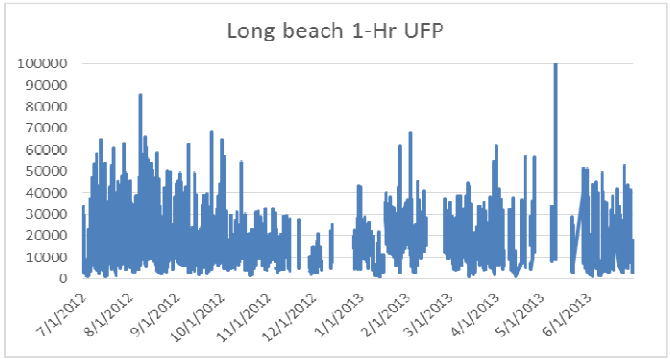
Rolling Weekly Ave. UFP vs Temp (Deg C)



Long Beach, CA
2012/13 Data
Winter in Center of time series plot



UFP increases by 20% - 40% at low temps
UFP is increased by a factor of 3 at high temps

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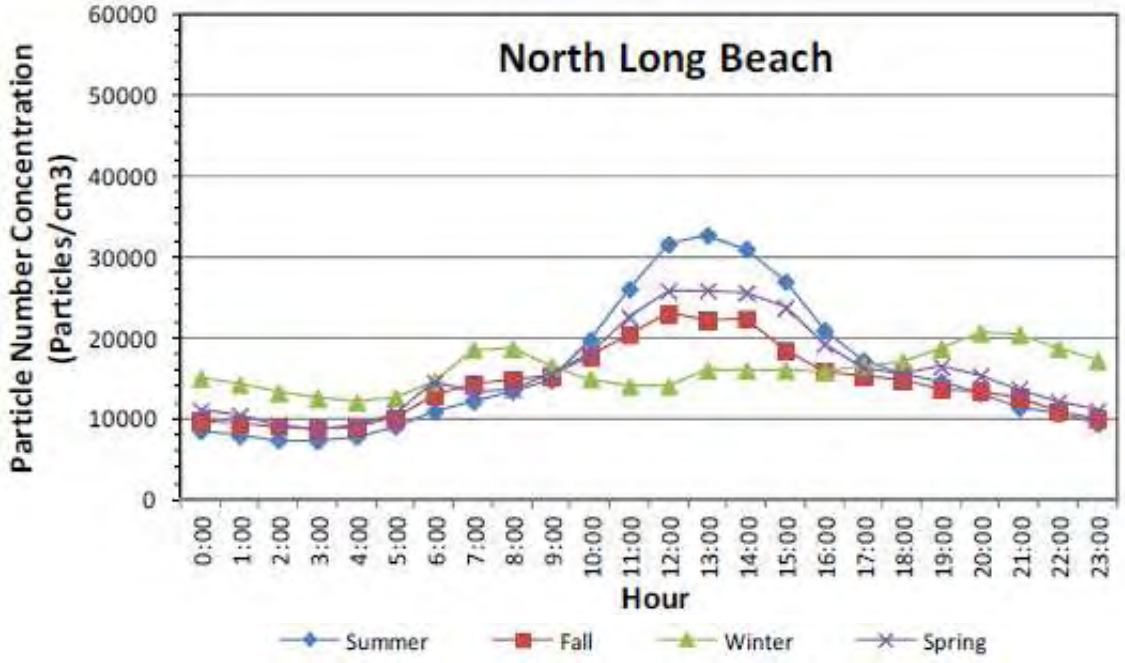
Seasonal Diurnal UFP: Long Beach, CA



Summer afternoon peak dominates UFP at this location. This is evidence of Local Secondary UFP production

Site is near a major Port with high proportion of HDD emissions

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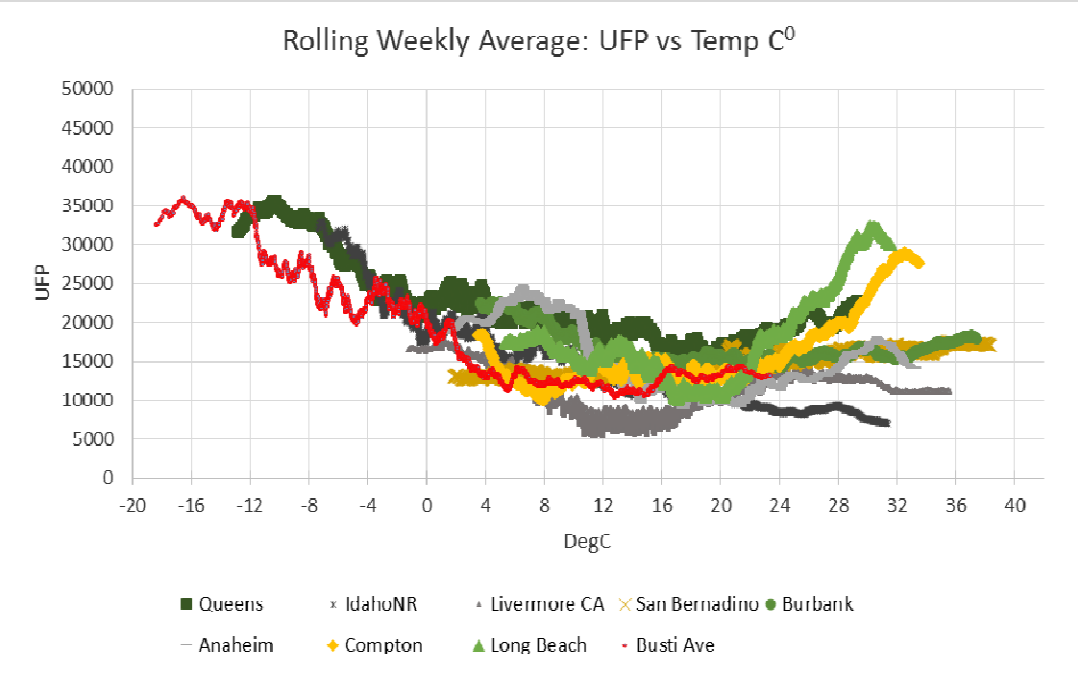
All Sites: Rolling Weekly Ave. UFP vs Temp



UFP from Busti Avenue, Queens, IdahoNR, San Francisco and four Los Angeles sites

UFP > low temps: all sites

UFP > high temps: at some very urban and Industrial sites

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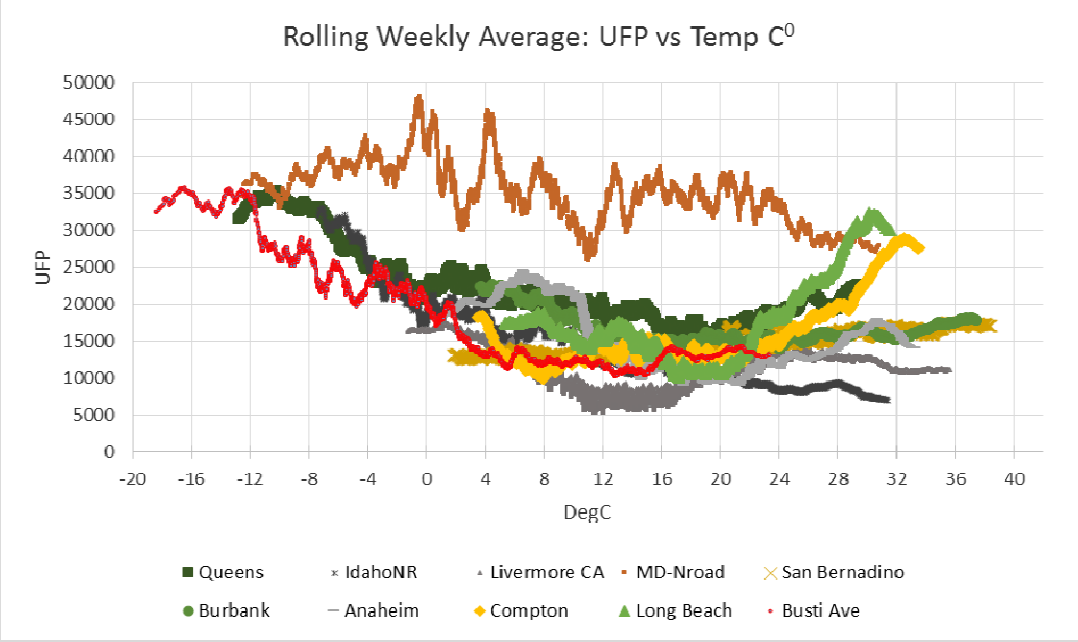
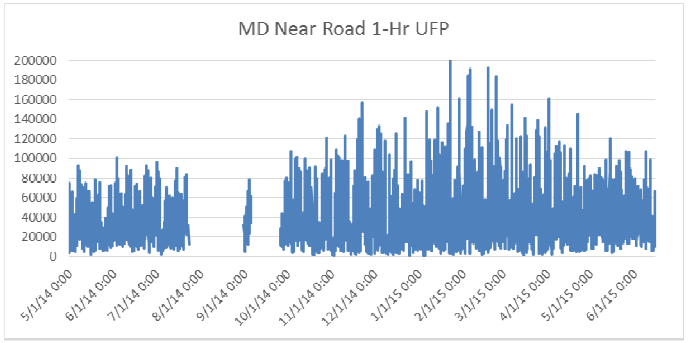
Rolling Weekly Ave. UFP vs Temp (Deg C)



MD Near Road Site elevated UFP with less temperature dependence



UFP Axis is now 50K on XY Plot and 200K on Time Series Plot
MD is missing much of the Summer which may lower values slightly

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MD Near Road Site

I-95 between Baltimore and Washington, DC

AADT: 192,401

FE-AADT: 452,309

29% HDD

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MD Near Road Site

Monitor is 16 m from highway between off and on ramp for a rest stop (Max Near Road emissions - Not a residential Area)

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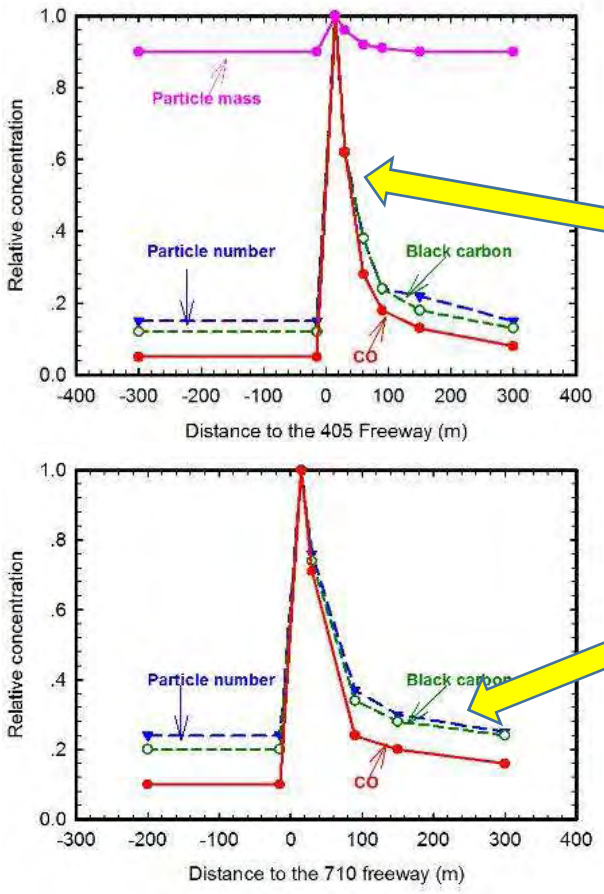

Zhu et al., JAMA 2002, Atm. Env., 2002

Why is MD UFP Data Different?

MD: The <u>average</u> UFP data are within the steep part of the roadway emissions gradient (16 m from source)

Buffalo, Boise, Livermore, Los Angeles: The <u>average</u> UFP are on the flatter part of the gradient - Suggests weaker or intermittent local source or monitor located further from the roadway

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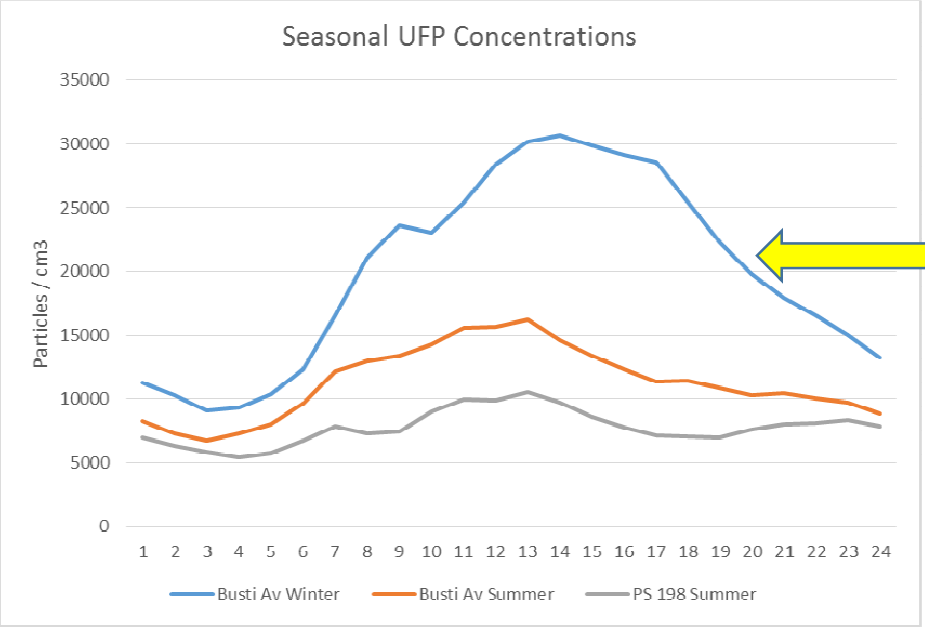
What happens when it is cold?



The emission sources (traffic) in the area are relatively consistent throughout the year

UFP concentration is higher in cold weather

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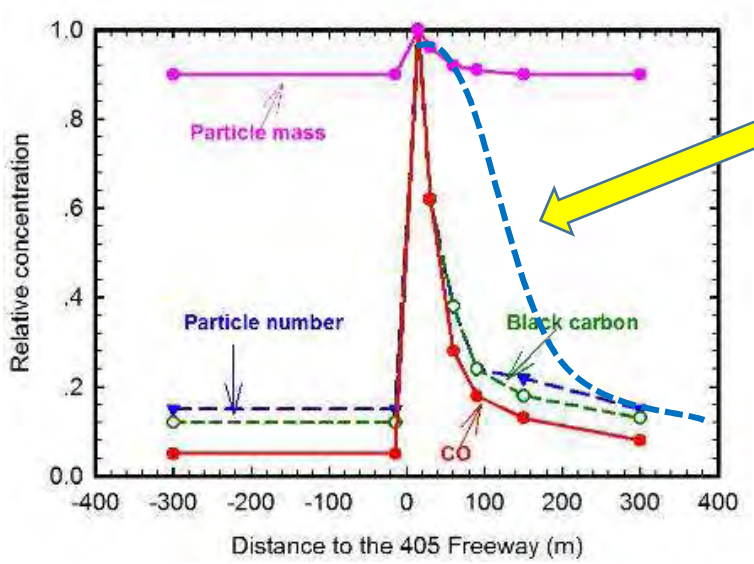
What happens when it is cold?



Zhu et al., JAMA 2002, Atm. Env., 2002

The stability (persistence) of UFP in cold weather reduces the gradient as you move away from the source

This increases the distance UFP can travel from source areas

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Observations

- UFP and BC are better indicators of mobile source emissions than PM-2.5

  UFP decrease more quickly than BC

- UFP are enhanced at lower temperatures and at high temperatures in areas with strong local sources
- This study is increasing our understanding of mobile source emissions as they disperse and transform

  Gas ↔ Particle Winter ↔ Summer

Conclusions

- The Near Road site in Cheektowaga as expected has higher UFP and will successfully represent the worst case near road emissions for the Buffalo-Niagara region
- The study data will be available to the EPA and other researchers. Tentative EPA database Site IDs are:

  Busti Avenue: 36-029-024

  PS 198: 36-029-025

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Thank You

- Dirk Felton,
- Randi Walker,
- Oliver Rattigan
- William Scheider

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