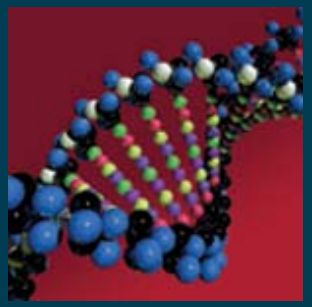
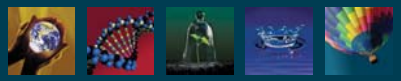
NJDEP TETERBORO AIRPORT AIR QUALITY STUDY


Alan Kao, Principal
ENVIRON International Corporation
Groton, Massachusetts

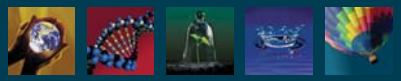
Final Project Presentation
February 11, 2008

ENVIRON



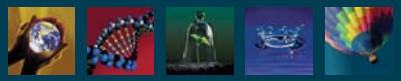
OUTLINE

- Background
- Recap of monitoring program design
  - What we monitored
  - Where we monitored
- Air quality characterization
  - Monitoring data collected at Teterboro Airport
  - Comparison with NJDEP monitoring network and health benchmarks
- Temporal variations
  - VOCs, BC, PM2.5
  - Compare to traffic patterns, airport activity, wind



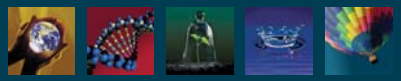
BACKGROUND

- 2001 ENVIRON Screening Study
  - 48-hour monitoring study (June 27-29)
  - The overall results of the Screening Study indicate that airport operations might be affecting ambient air quality in the immediate vicinity.
  - The major limitation of the Screening Study is that its results represent a single point in time, and thus may not reflect long-term conditions
  - Based on the results of the Screening Study, a more extensive study was recommended



BACKGROUND

- 2003 EOHSI Modeling Study
  - Using emissions estimates for various sources in the airport vicinity (e.g., aircraft, mobiles sources, local industry), modeled ambient air concentrations
  - Concluded that airport operations were a minor contributor to local air quality, accounting for 1-5% of air toxics concentrations in ambient air

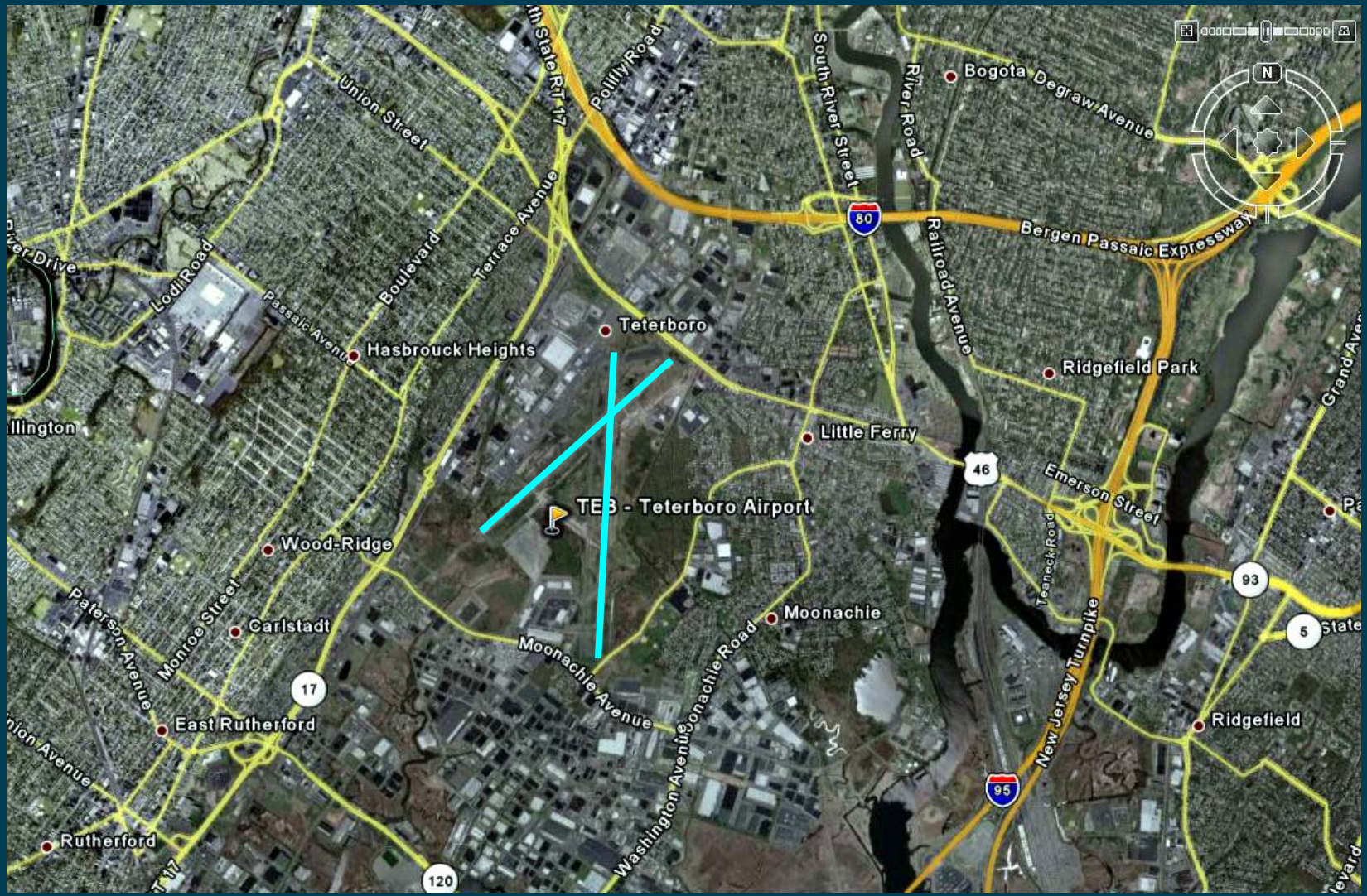


PROJECT OBJECTIVES

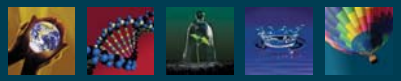
Major Goals of NJDEP/ENVIRON Study:

- Measure ambient concentrations of specific compounds of potential concern over an extended period of time
- Provide monitoring results consistent with other data being collected by NJDEP, which would allow for a comparison of the Teterboro area results to data collected for other locations in New Jersey
- Evaluate whether the target compound emissions from Teterboro Airport have a measurable impact on air quality in the airport vicinity

TETERBORO AIRPORT VICINITY



ENVIRON



WHAT DID WE MONITOR?

Air Pollutants of Concern

Gas phase constituents:

- Volatile organic compounds (VOCs)
  - Benzene, toluene, ethylbenzene, xylenes
  - Carbonyls (e.g., formaldehyde, acetaldehyde)

Particle-phase constituents:

- Fine particles (PM2.5)
- Black carbon

WHAT DID WE MONITOR?

Gas phase constituents:

- Automated canister / cartridge samplers (ATEC Toxic Air Sampler) – discrete measurement of VOCs and carbonyls (24-hour samples every six days)

WHAT DID WE MONITOR?

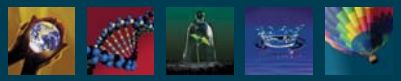
Gas phase constituents:

- Open path DOAS monitoring systems (Cerex Environmental UVSentry) – continuous measurement of certain gaseous pollutants (e.g., VOCs, NO)

WHAT DID WE MONITOR?

Particle-phase constituents

- Beta-attenuation monitors (Met One EBAM) – continuous measurement of fine particulate matter (PM2.5)
- Aethalometers (Magee Scientific) – continuous measurement of black carbon (BC)



WHAT DID WE MONITOR?

Other parameters:

- Meteorological parameters – wind speed and direction
- Traffic flow
- Aircraft landings and takeoffs (provided by TEB)

WHERE DID WE MONITOR?

ENVIRON

WHERE DID WE MONITOR?

- Speciated VOCs
- gases
- BC
- PM2.5
- wind data
- traffic

ENVIRON

WHERE DID WE MONITOR?

- Speciated VOCs
- gases
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ENVIRON

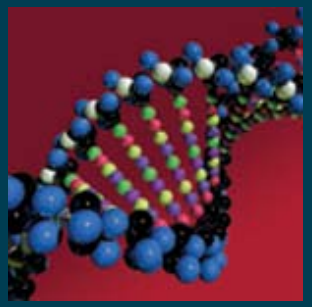
WHERE DID WE MONITOR?

- Speciated VOCs

- Speciated VOCs

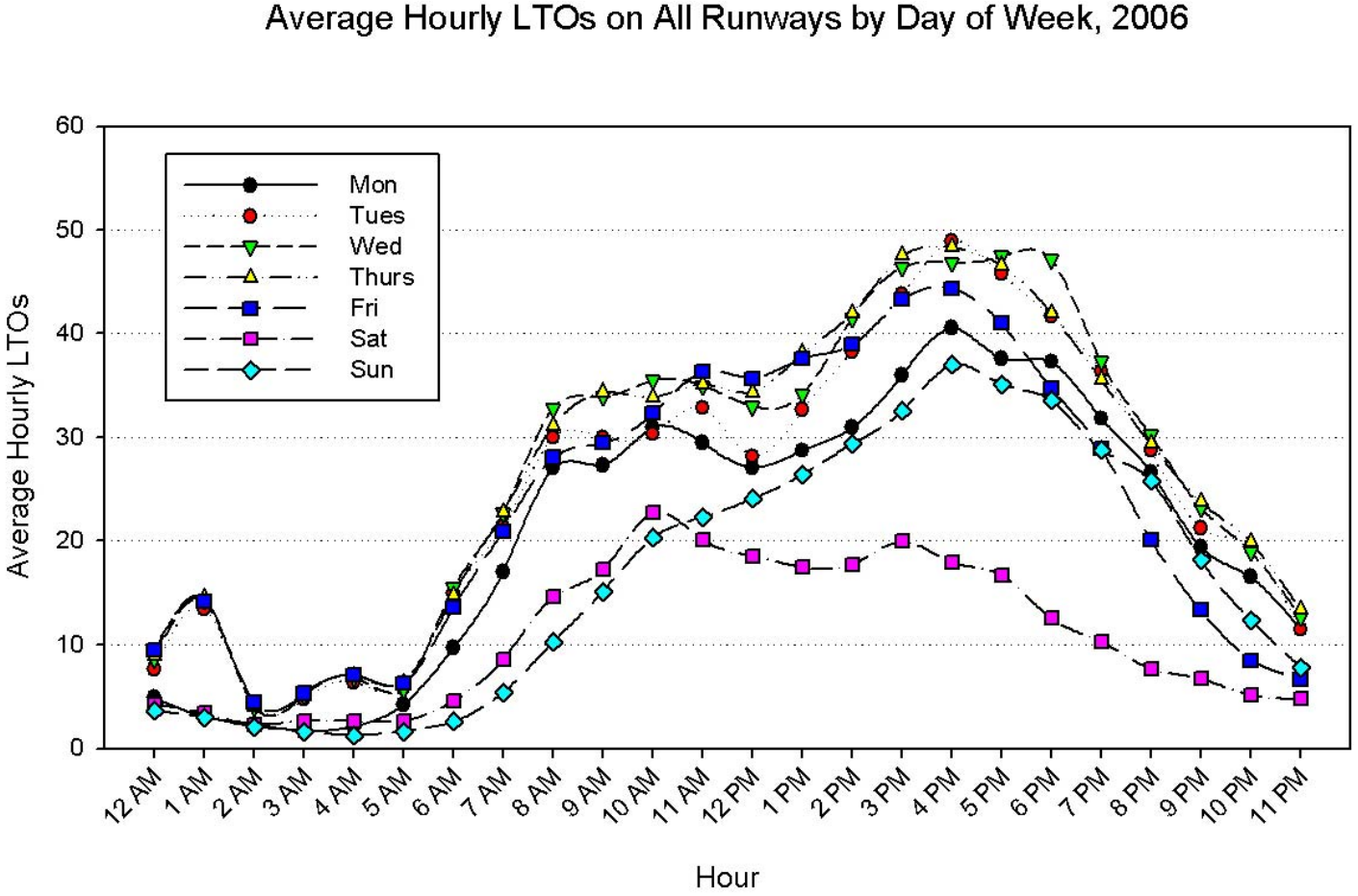
ENVIRON

AIRPORT ACTIVITY AND TRAFFIC MONITORING


- What was happening at the airport?
- What was happening on the roads?

WHAT WAS HAPPENING AT THE AIRPORT?



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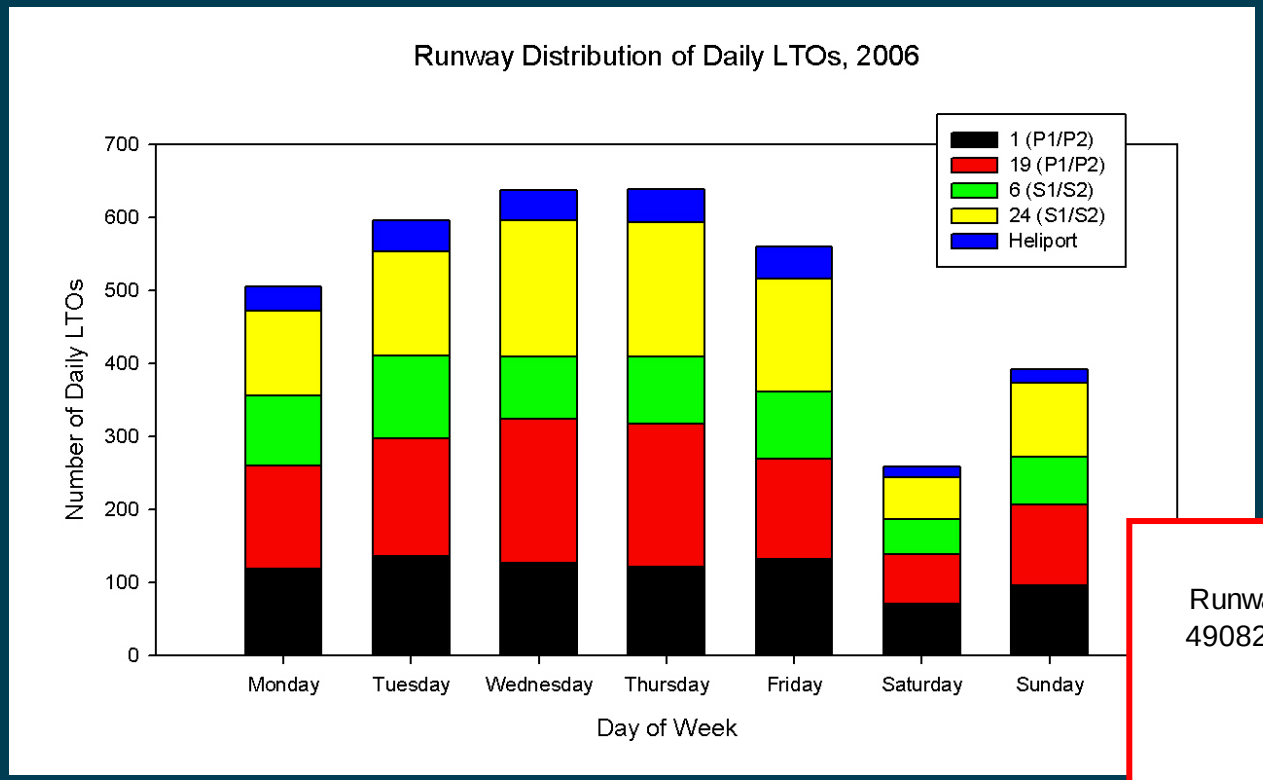

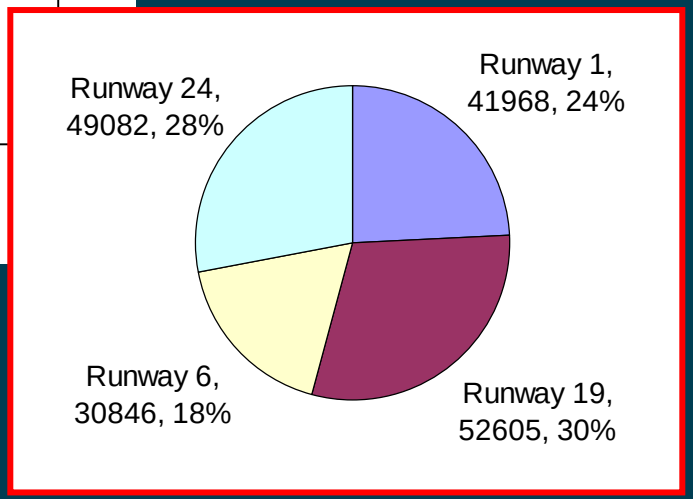

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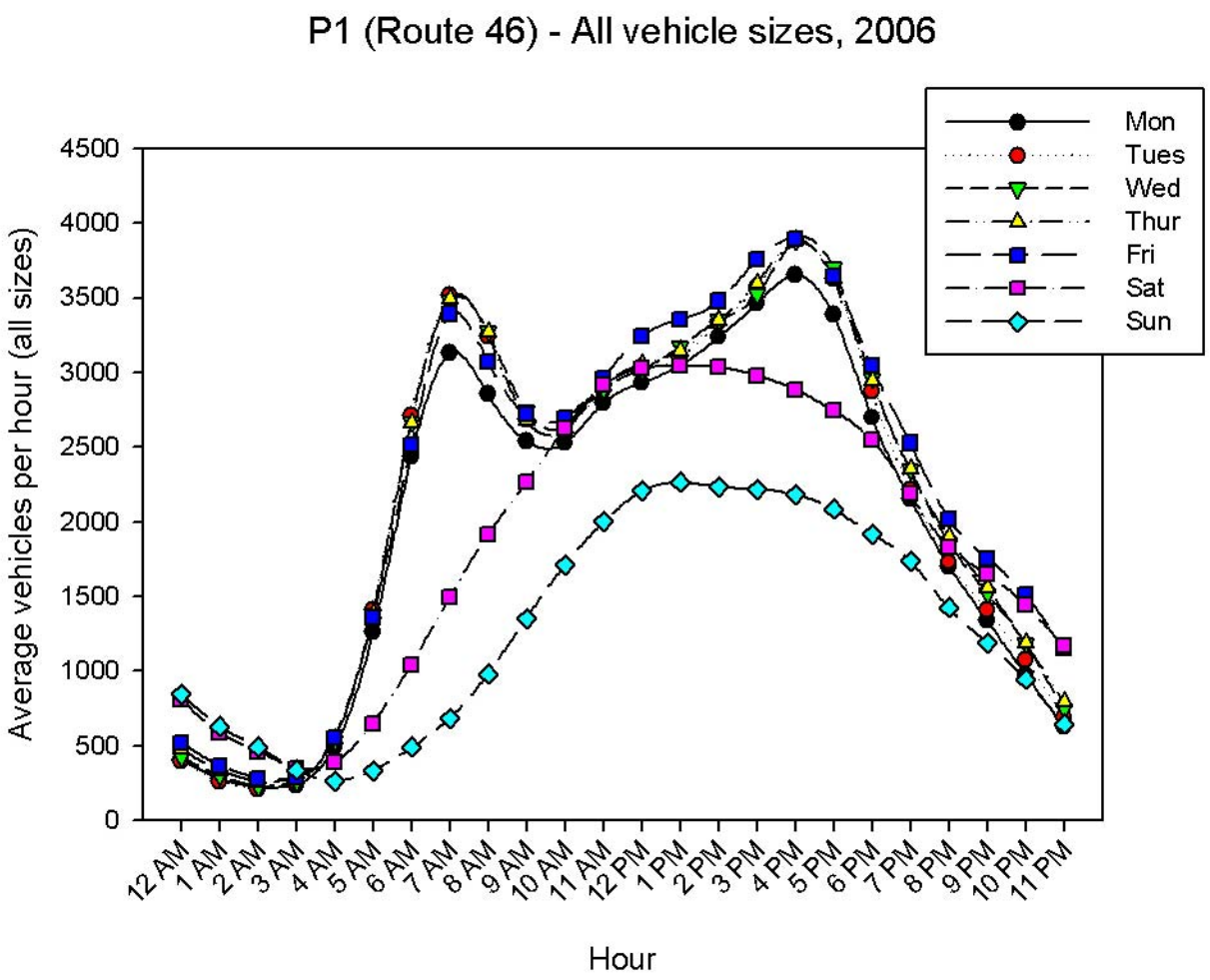
WHAT WAS HAPPENING ON THE ROADS?



ENVIRON

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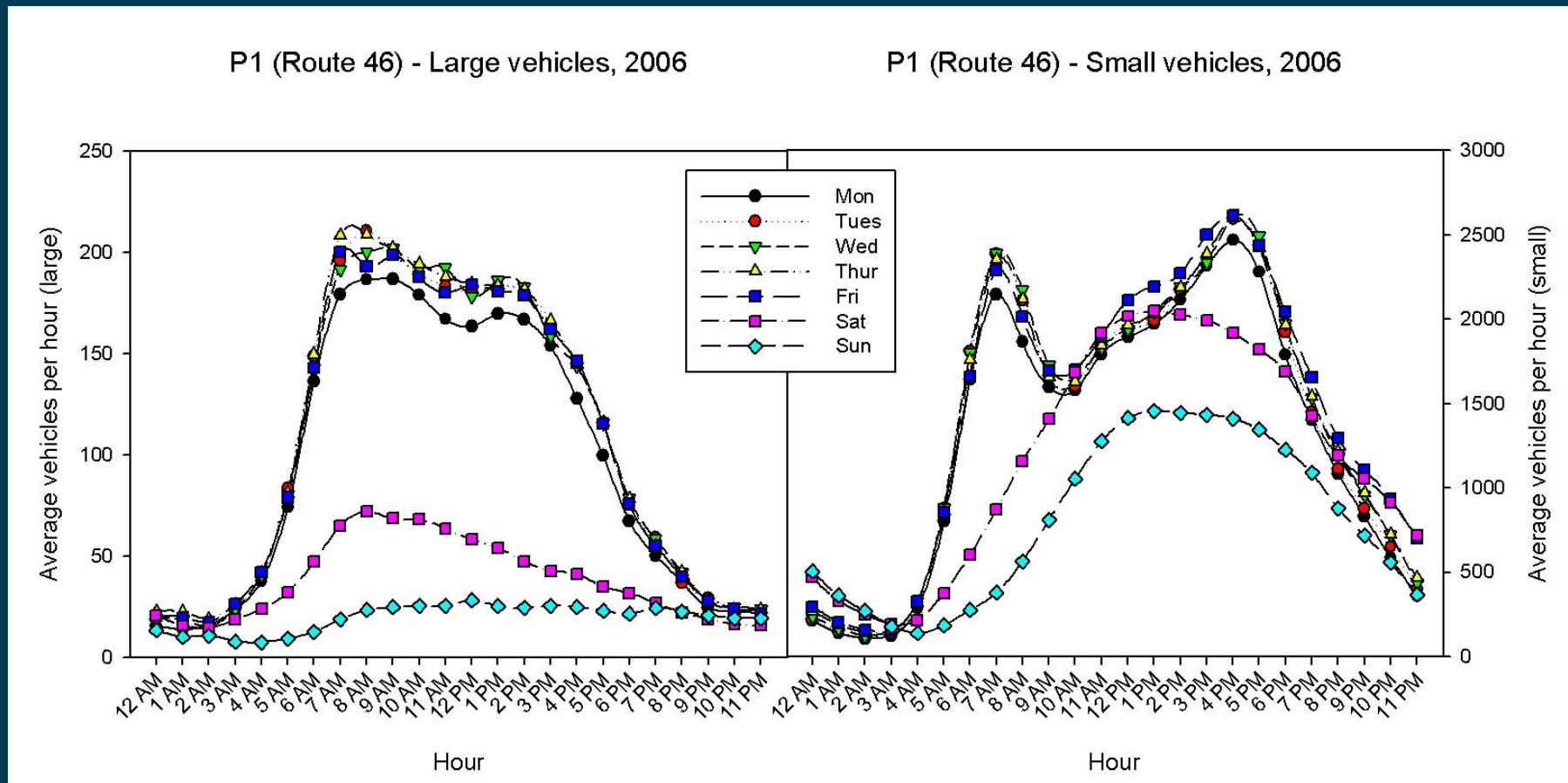

ENVIRON

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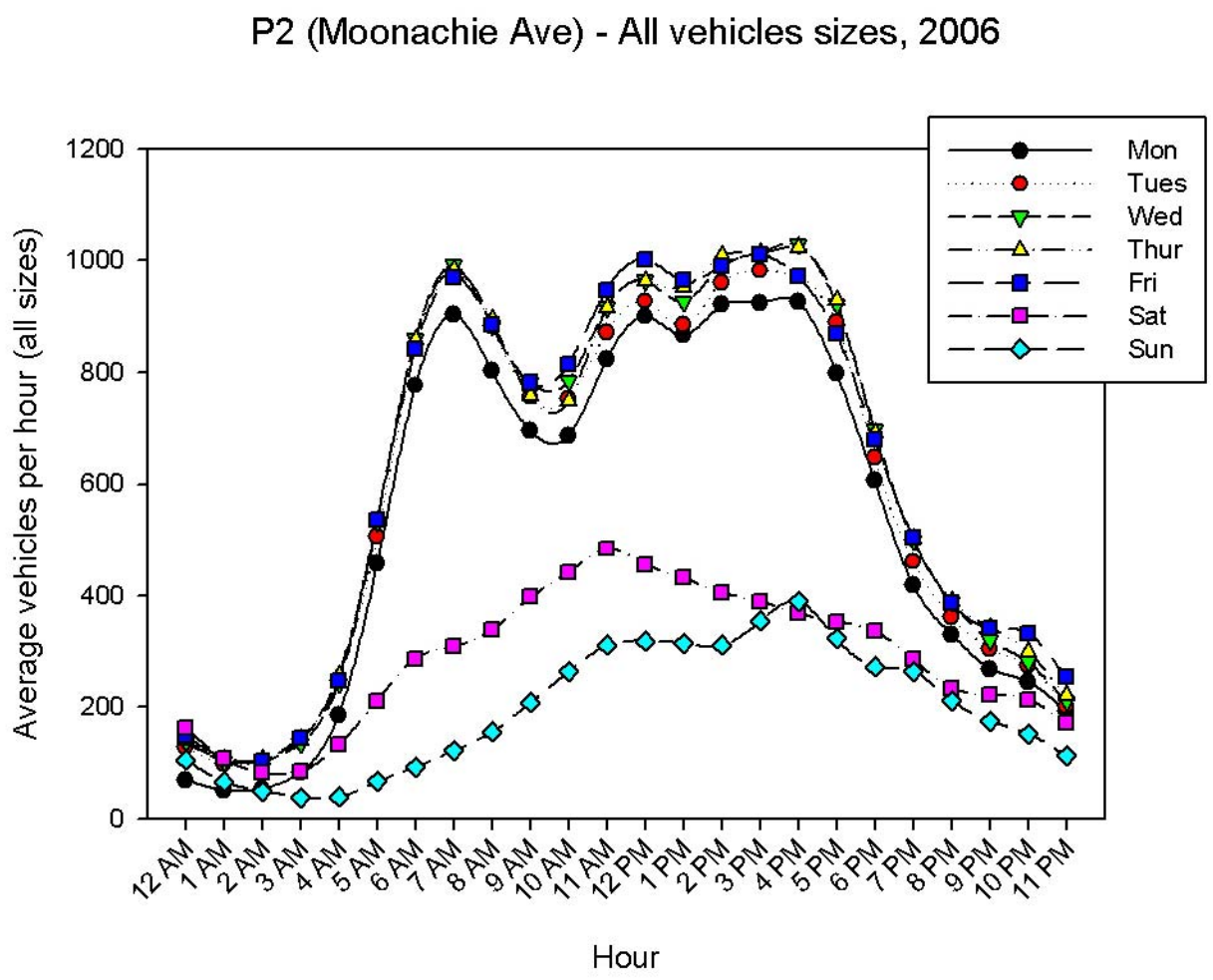

ENVIRON

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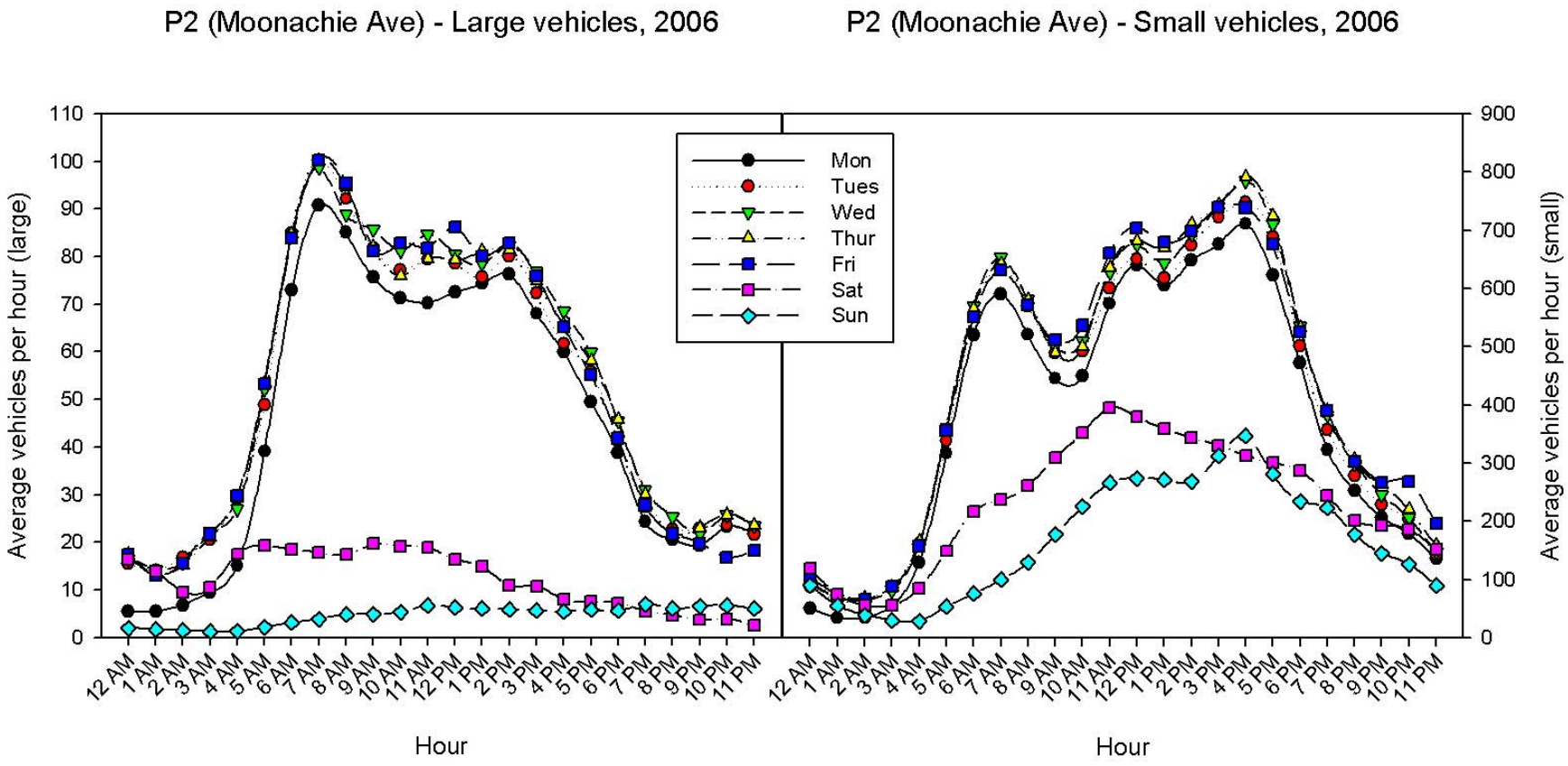

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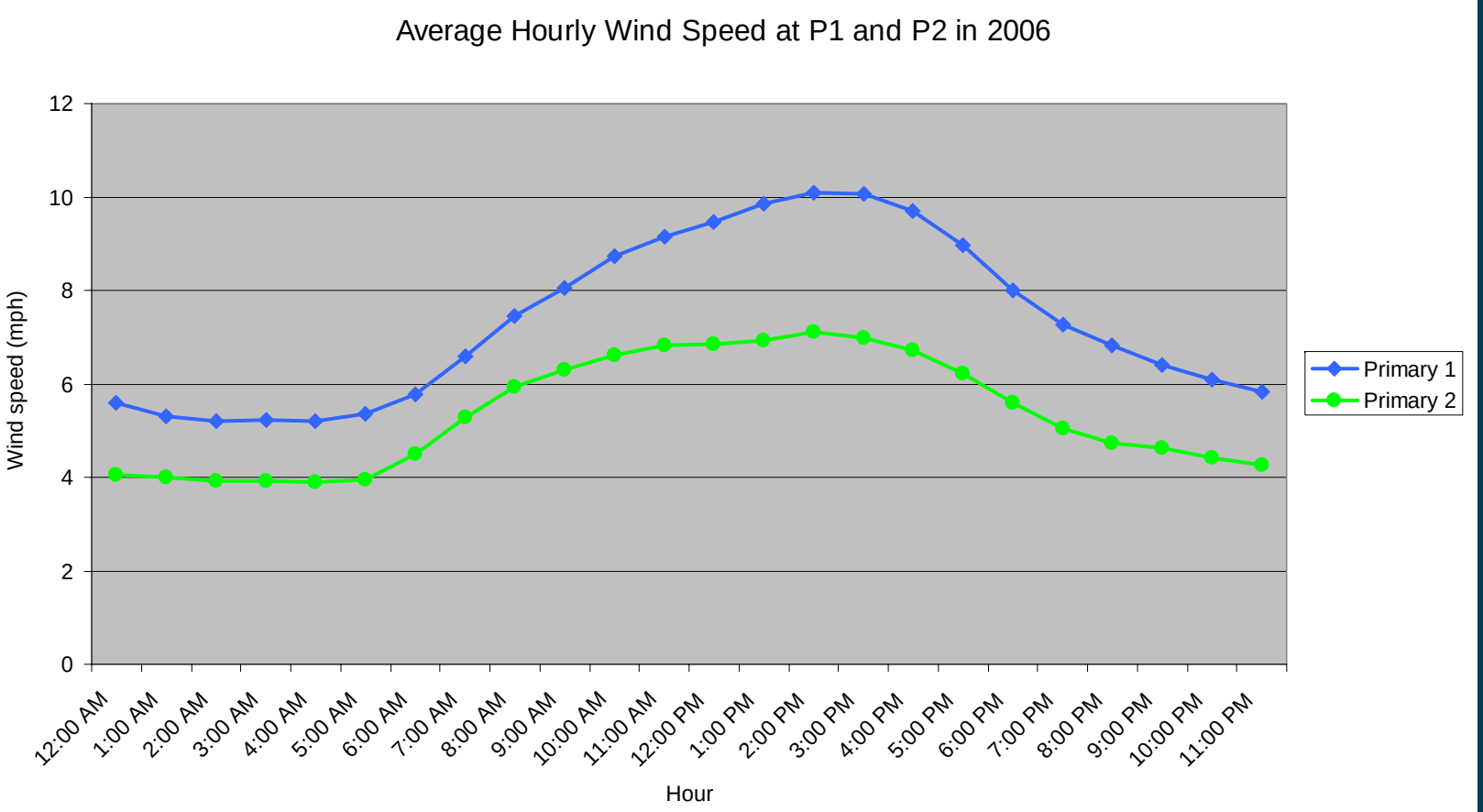
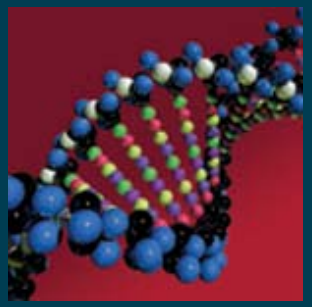
WIND SPEED PATTERN

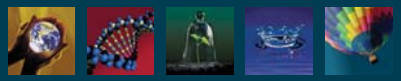


ENVIRON

AIR MONITORING RESULTS


- What's in the air?
- How does it compare with the rest of New Jersey?
- Where is it coming from?



WHAT WAS MEASURED IN THE AIR?

- The following 16 compounds were consistently detected (>70%) in the canister/cartridge samples:
  - **Acetone**
  - **Benzene**
  - **Dichlorodifluoromethane**
  - **Ethylbenzene**
  - **Methyl ethyl ketone**
  - **Methylene chloride**
  - **Toluene**
  - **Trichlorofluoromethane**
  - **Xylenes**
  - **Acetaldehyde**
  - **Benzaldehyde**
  - **Butyraldehyde**
  - **Formaldehyde**
  - **Hexaldehyde**
  - **Propionaldehyde**
  - **Valeraldehyde**
- 13 of these 16 were higher at Teterboro than at other NJ stations

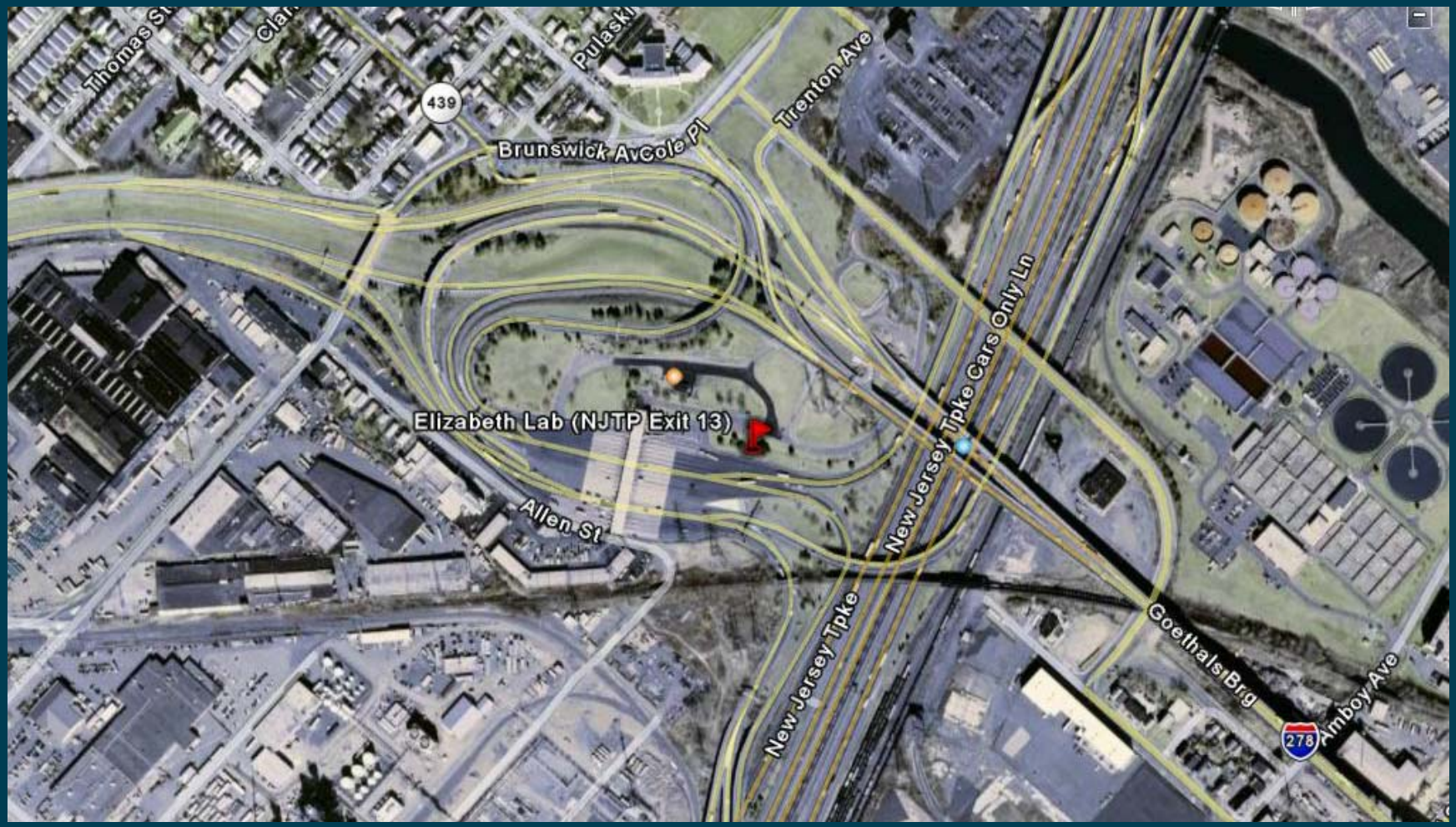
COMPARISON WITH OTHER NJ LOCATIONS

- Camden (urban)
- New Brunswick (suburban)
- Chester (background)
- Elizabeth (mobile source dominated)

ENVIRON

COMPARISON WITH OTHER NJ LOCATIONS

Elizabeth Station dominated by mobile sources



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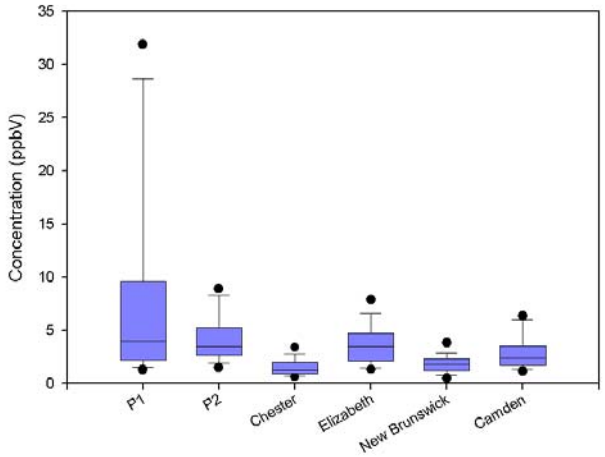
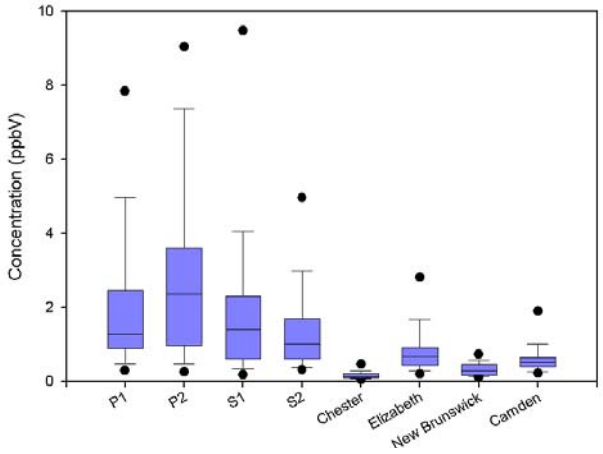
CERTAIN VOCs ARE ELEVATED COMPARED TO OTHER NJ LOCATIONS

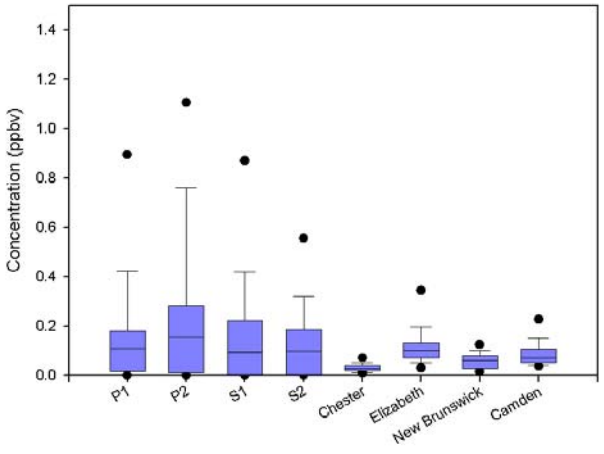
Formaldehyde Concentrations at Teterboro Airport and New Jersey Stations



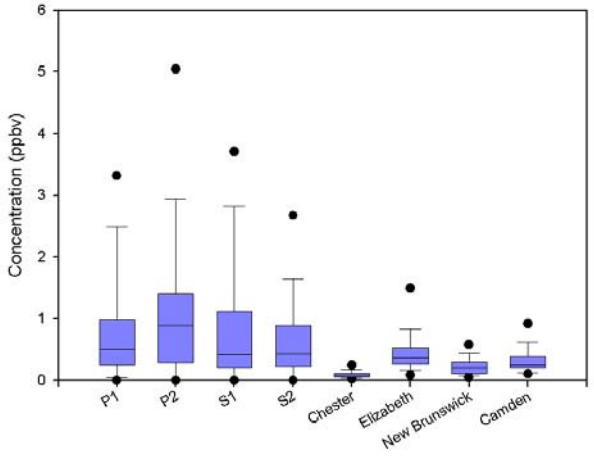
Toluene Concentrations at Teterboro Stations and New Jersey Stations



Ethylbenzene Concentrations at Teterboro Airport and New Jersey Stations

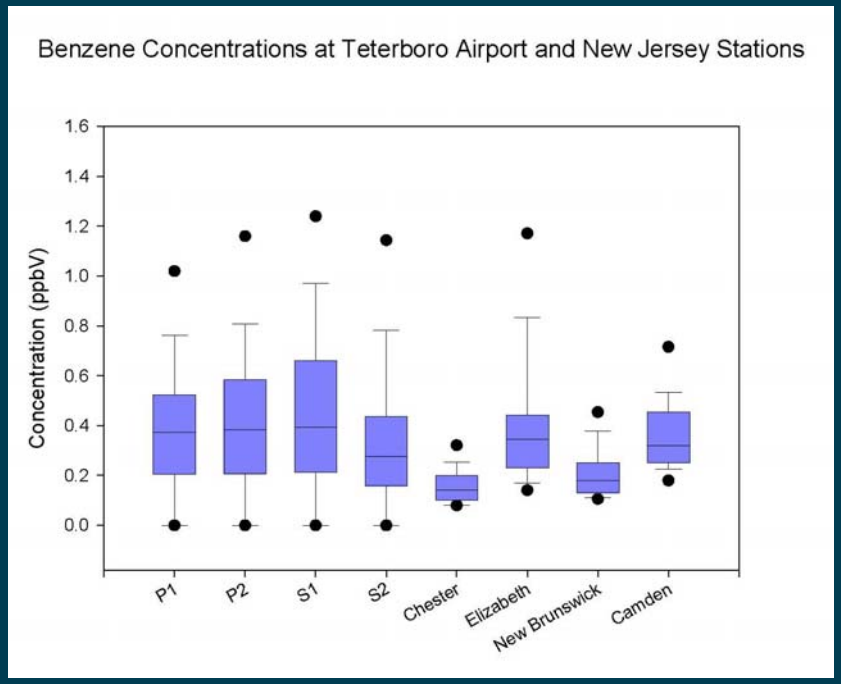


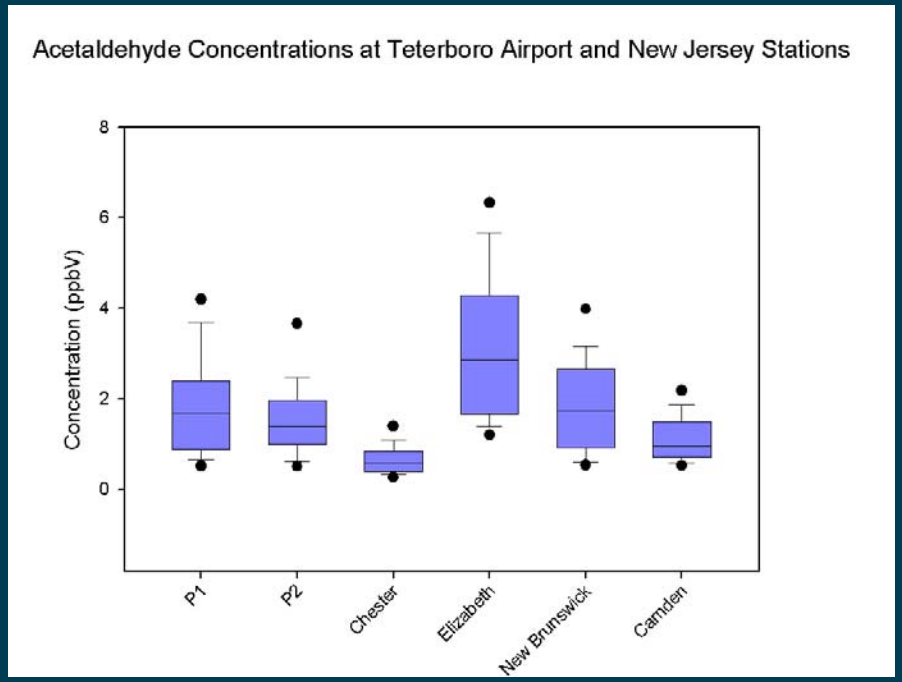
Total Xylenes Concentrations at Teterboro Airport and New Jersey Stations



ENVIRON

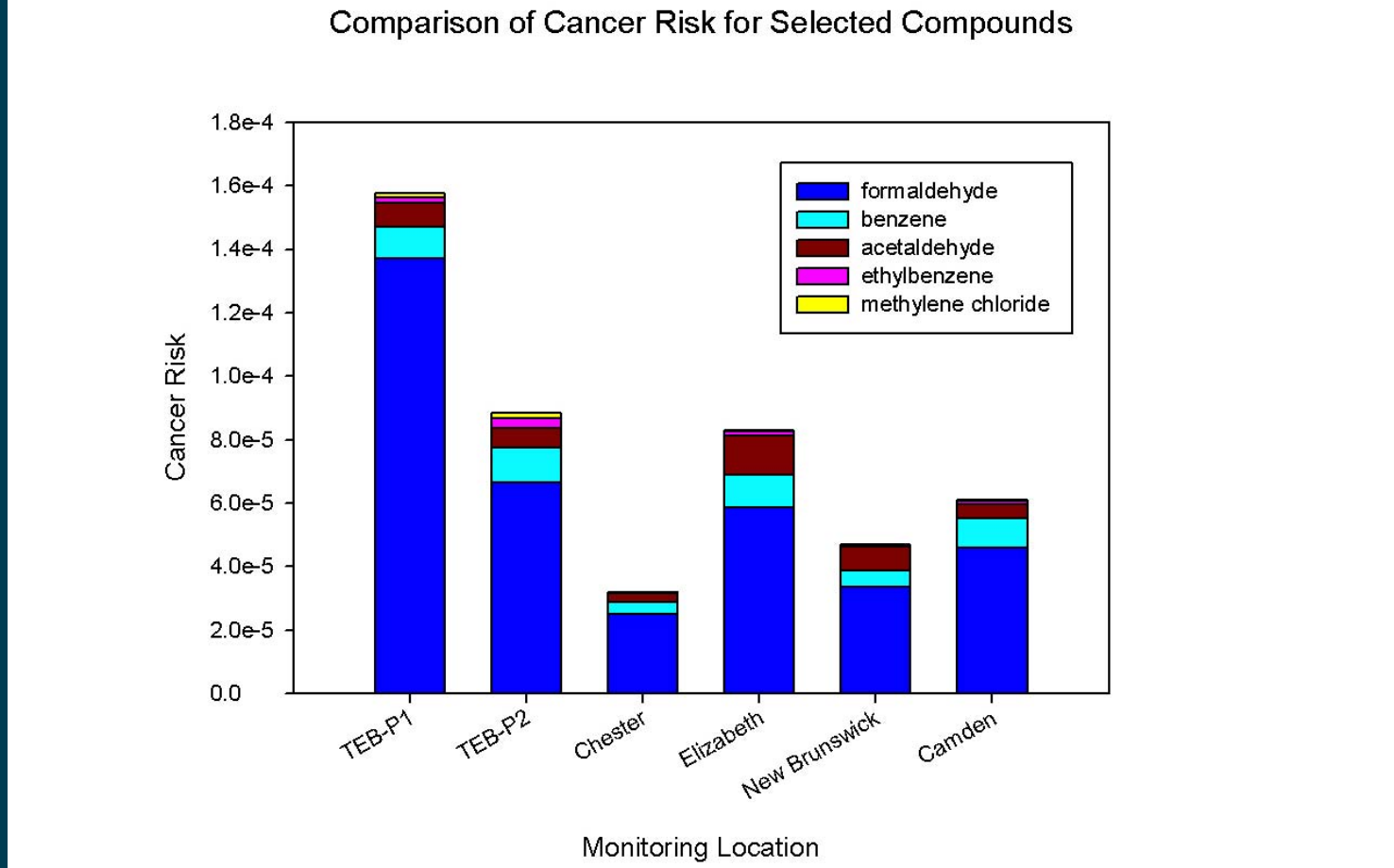
CERTAIN VOCs ARE COMPARABLE OR LOWER THAN AT OTHER NJ LOCATIONS





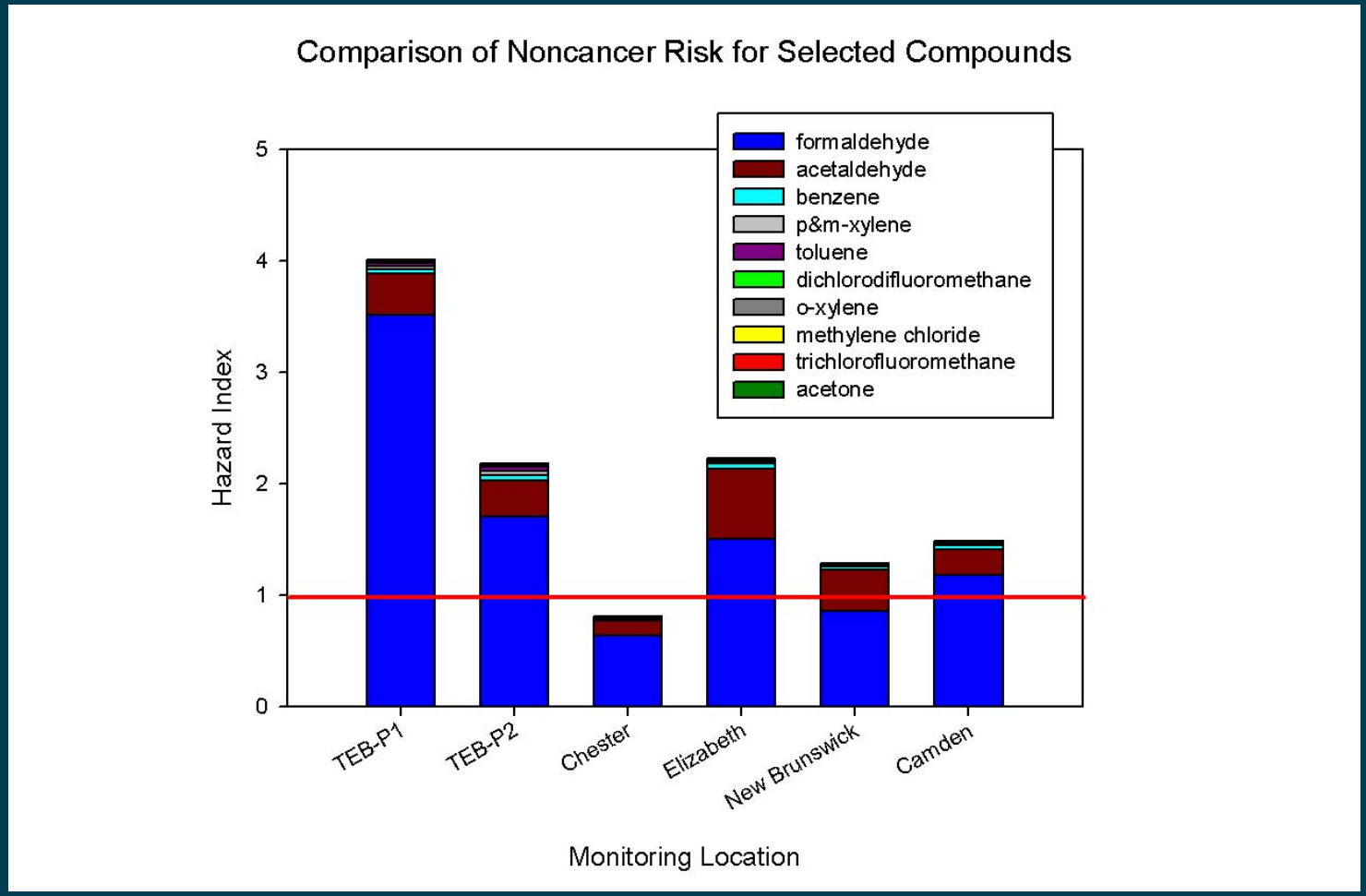
ENVIRON

RISK SCREENING CALCULATIONS



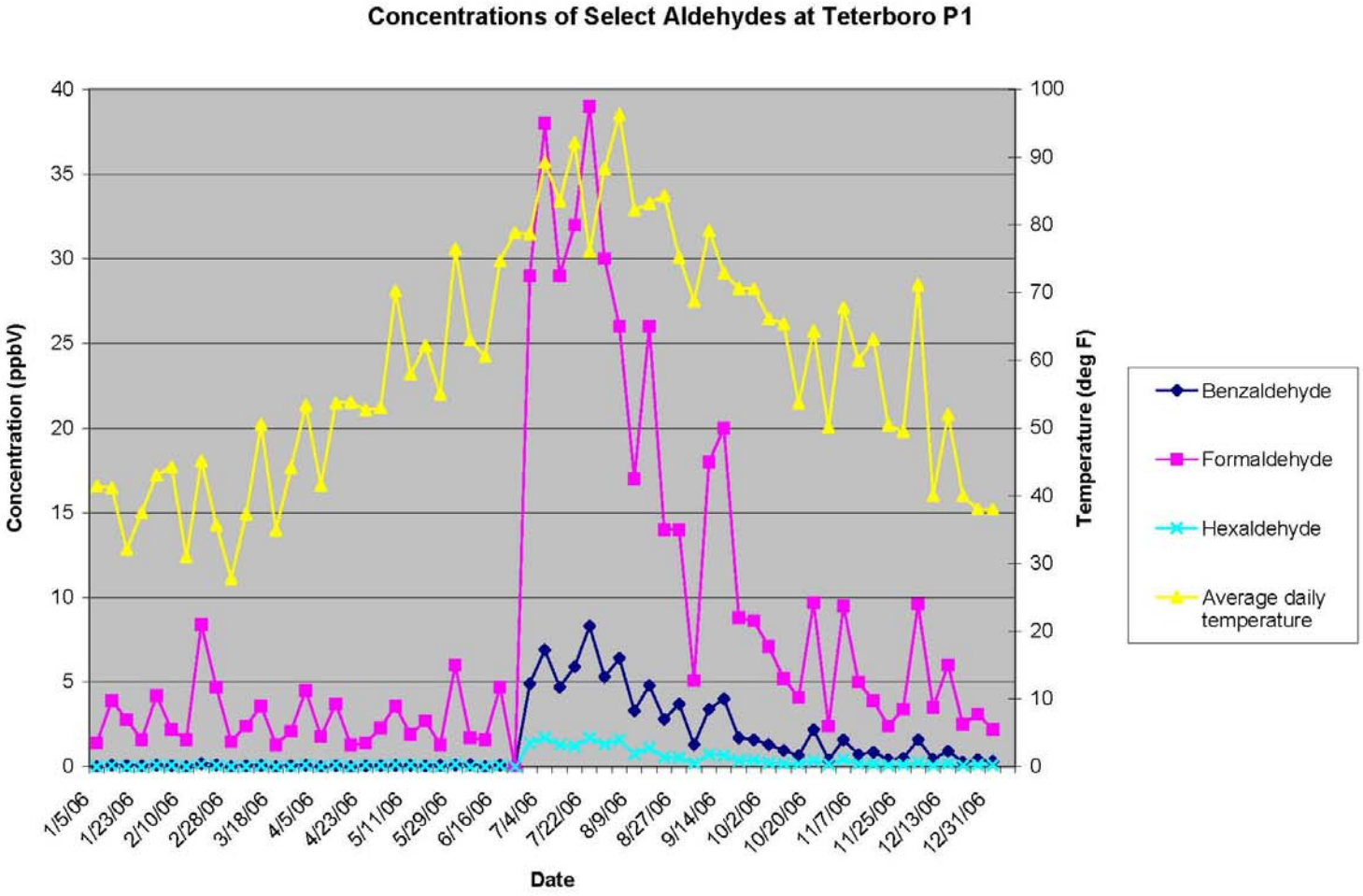
Cancer risks at P2 are comparable to Elizabeth; P1 is about two times higher

RISK SCREENING CALCULATIONS



Noncancer risks at P2 are comparable to Elizabeth; P1 is about two times higher

SUMMERTIME INCREASE IN ALDEHYDES



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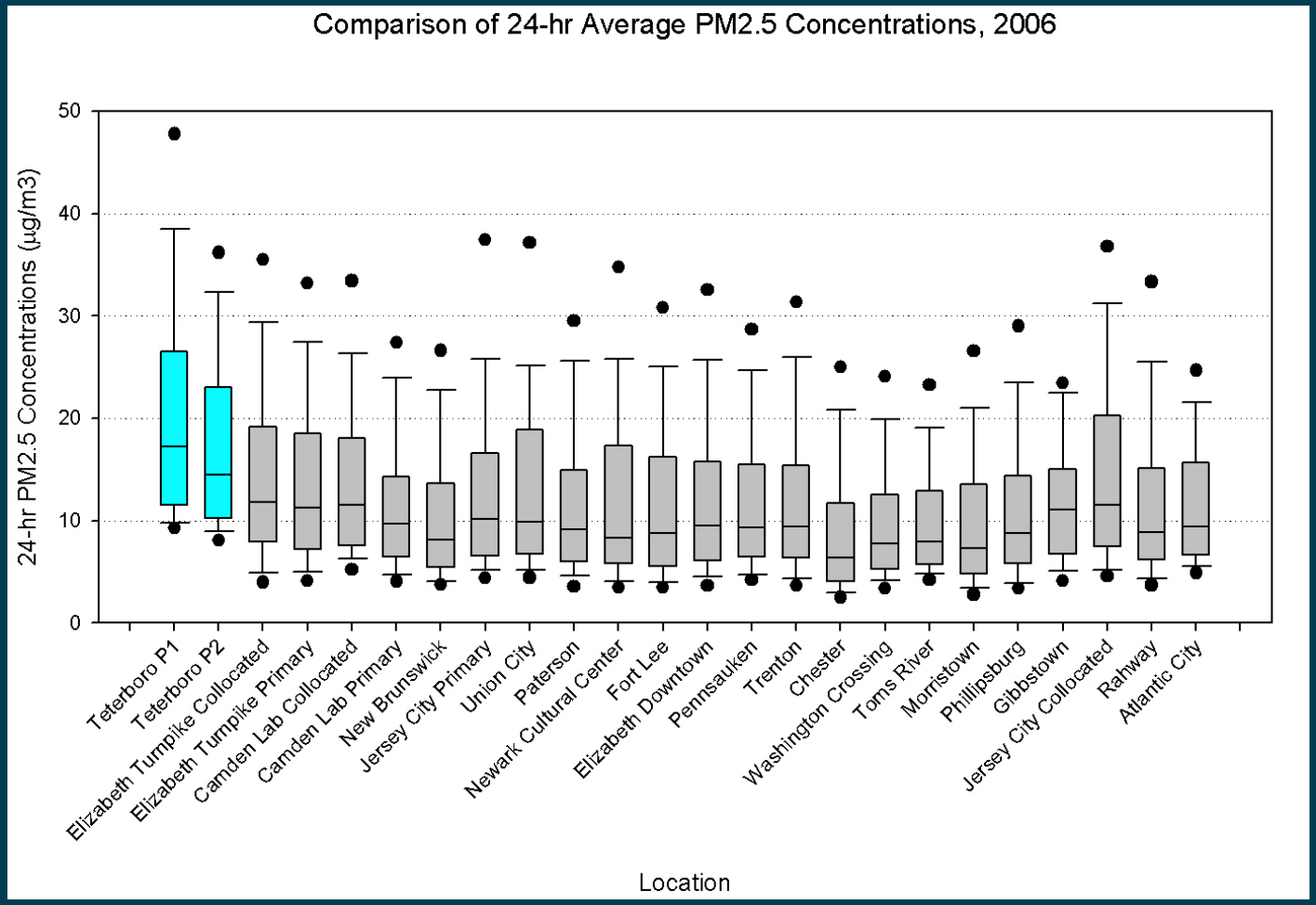
PM2.5 IS ELEVATED COMPARED TO OTHER NJ LOCATIONS



BUT method used in this study for PM2.5 is different than method used by NJDEP

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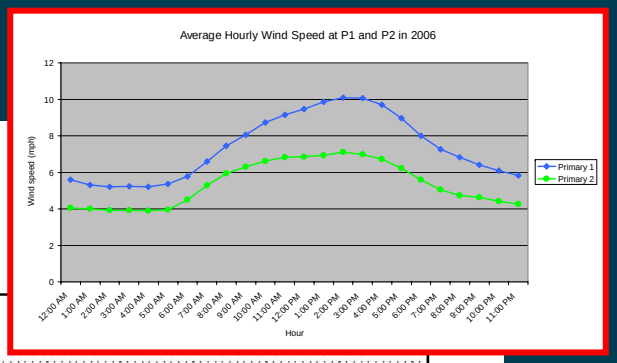
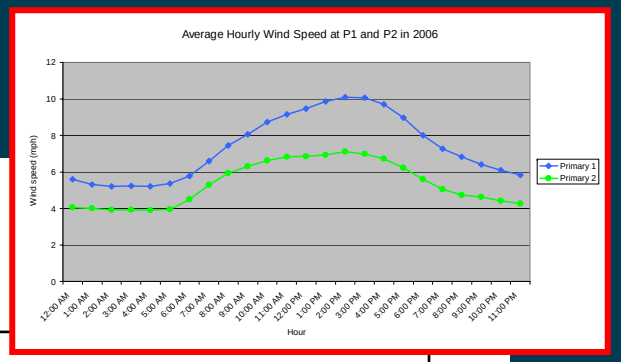
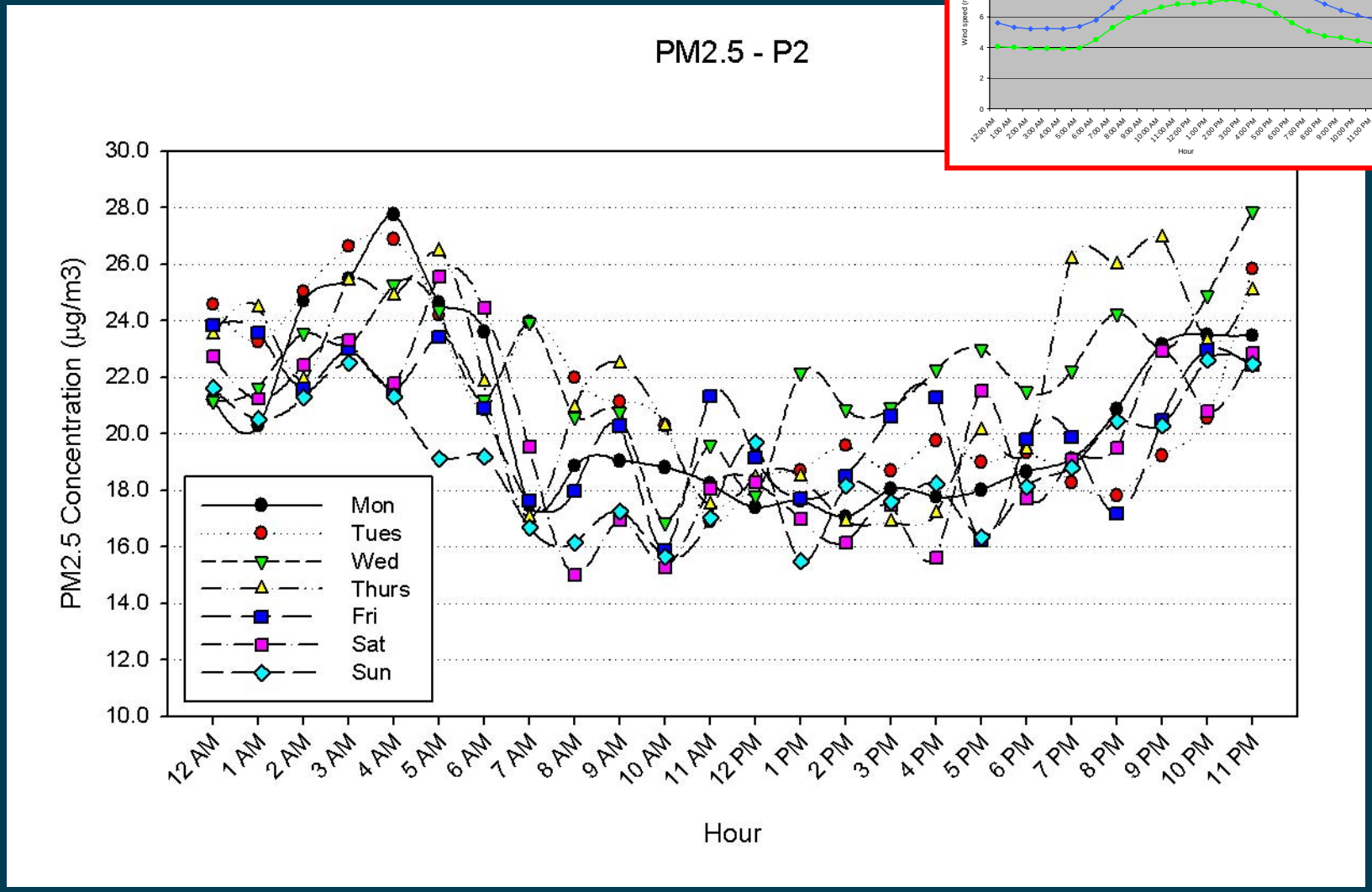
PM2.5 TRENDS – P1



ENVIRON

PM2.5 TRENDS – P2





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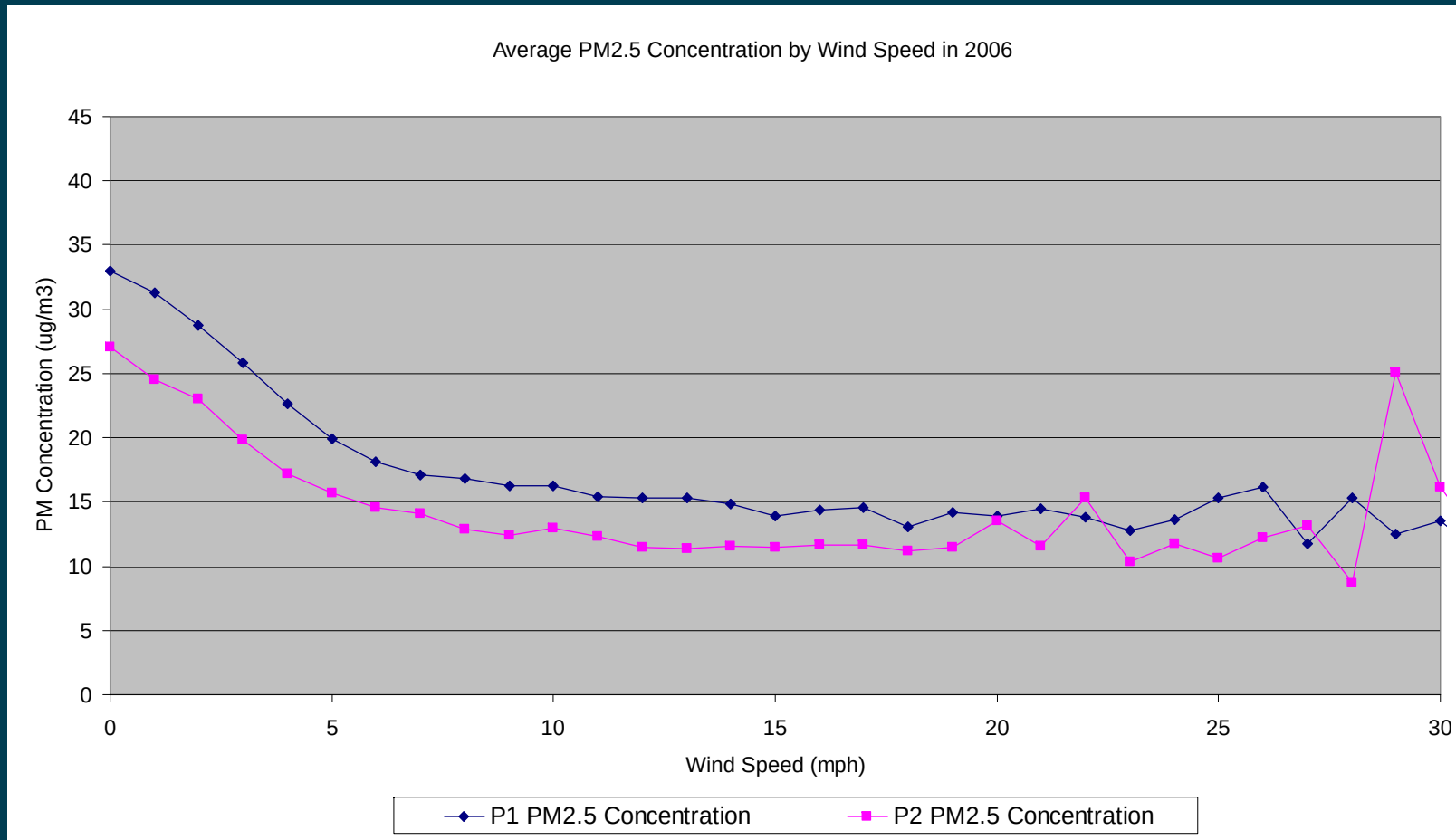
PM2.5 CONCENTRATION IS RELATED TO WIND SPEED



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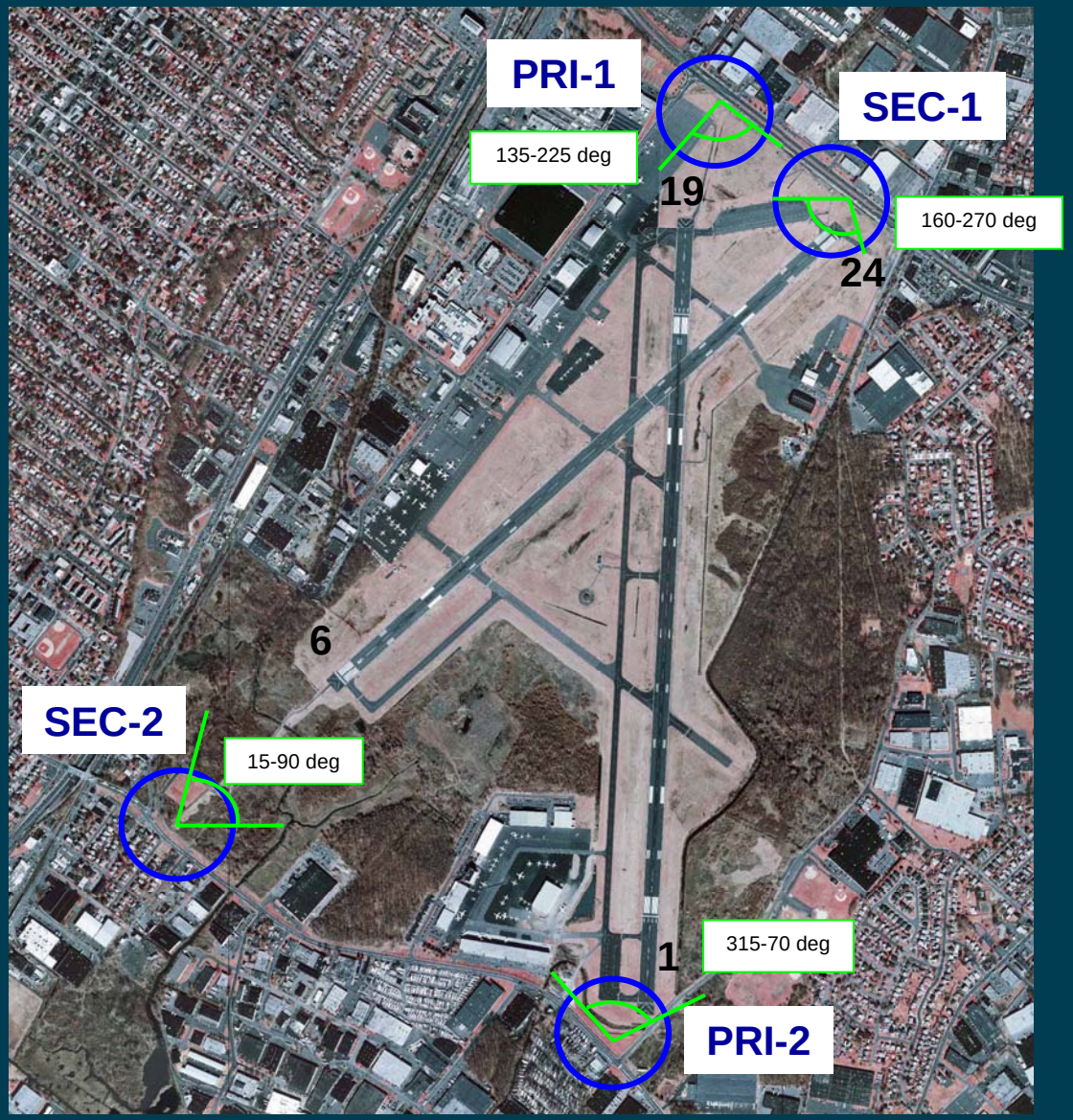
EVALUATION OF WIND-FILTERED DATA



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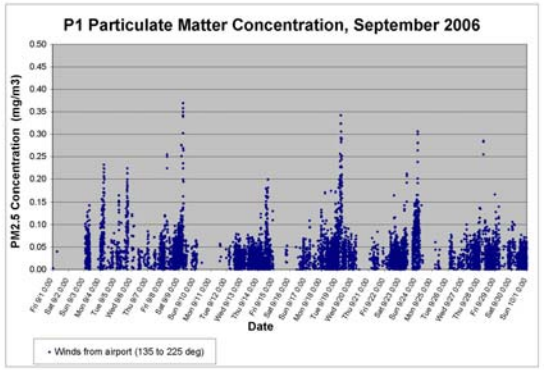
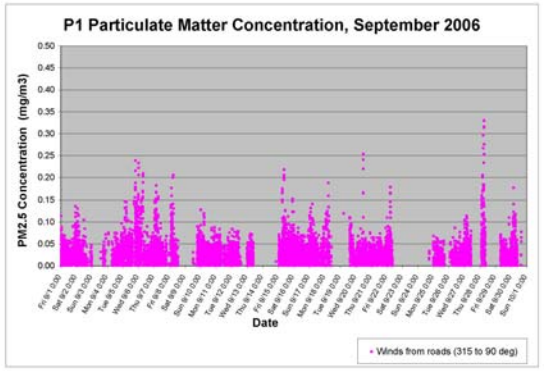
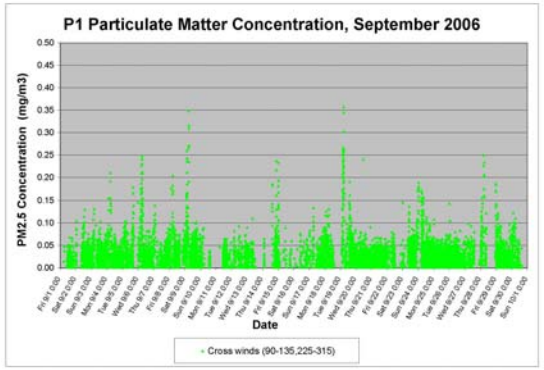
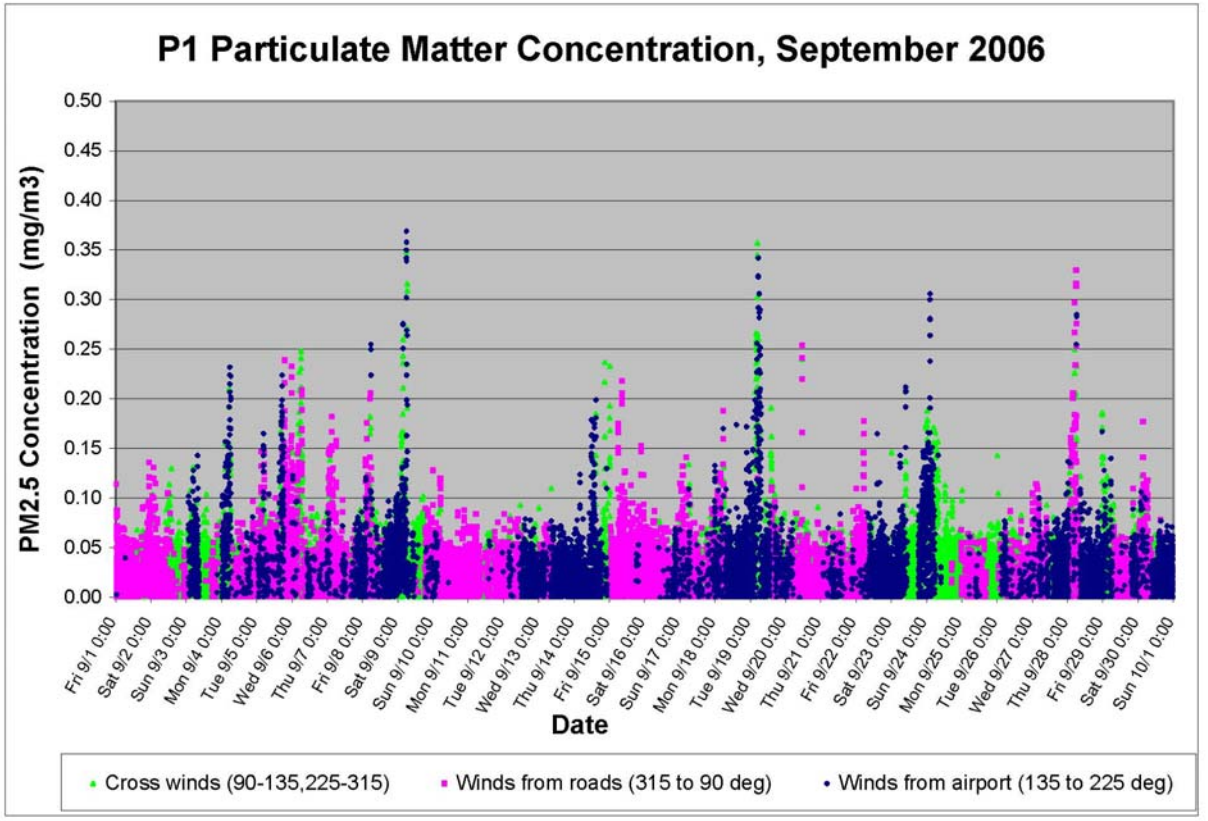
PM2.5 OBSERVED WHEN WIND IS FROM BOTH AIRPORT AND ROADWAYS









ENVIRON

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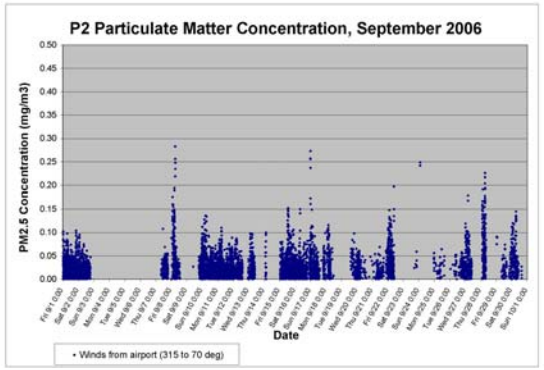

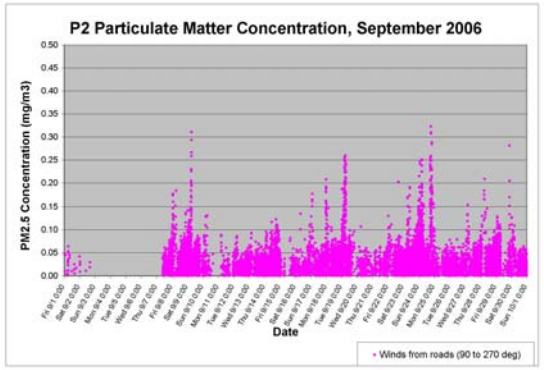

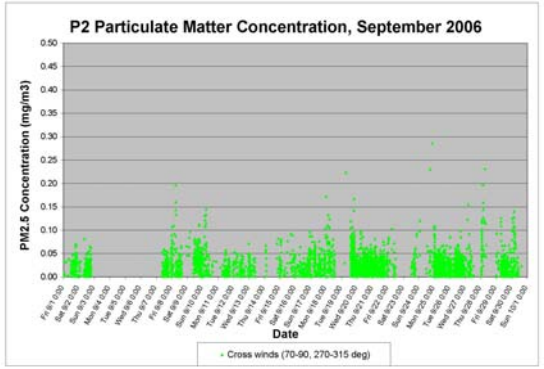

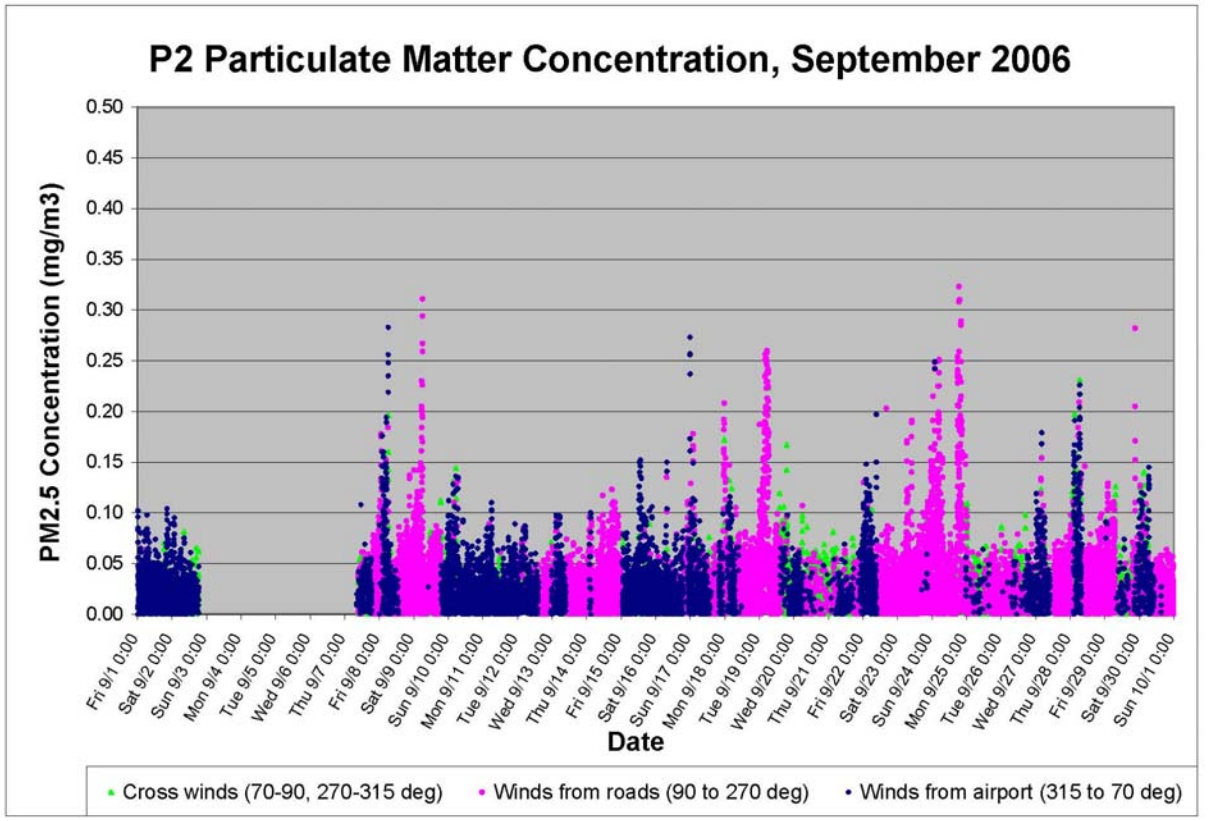

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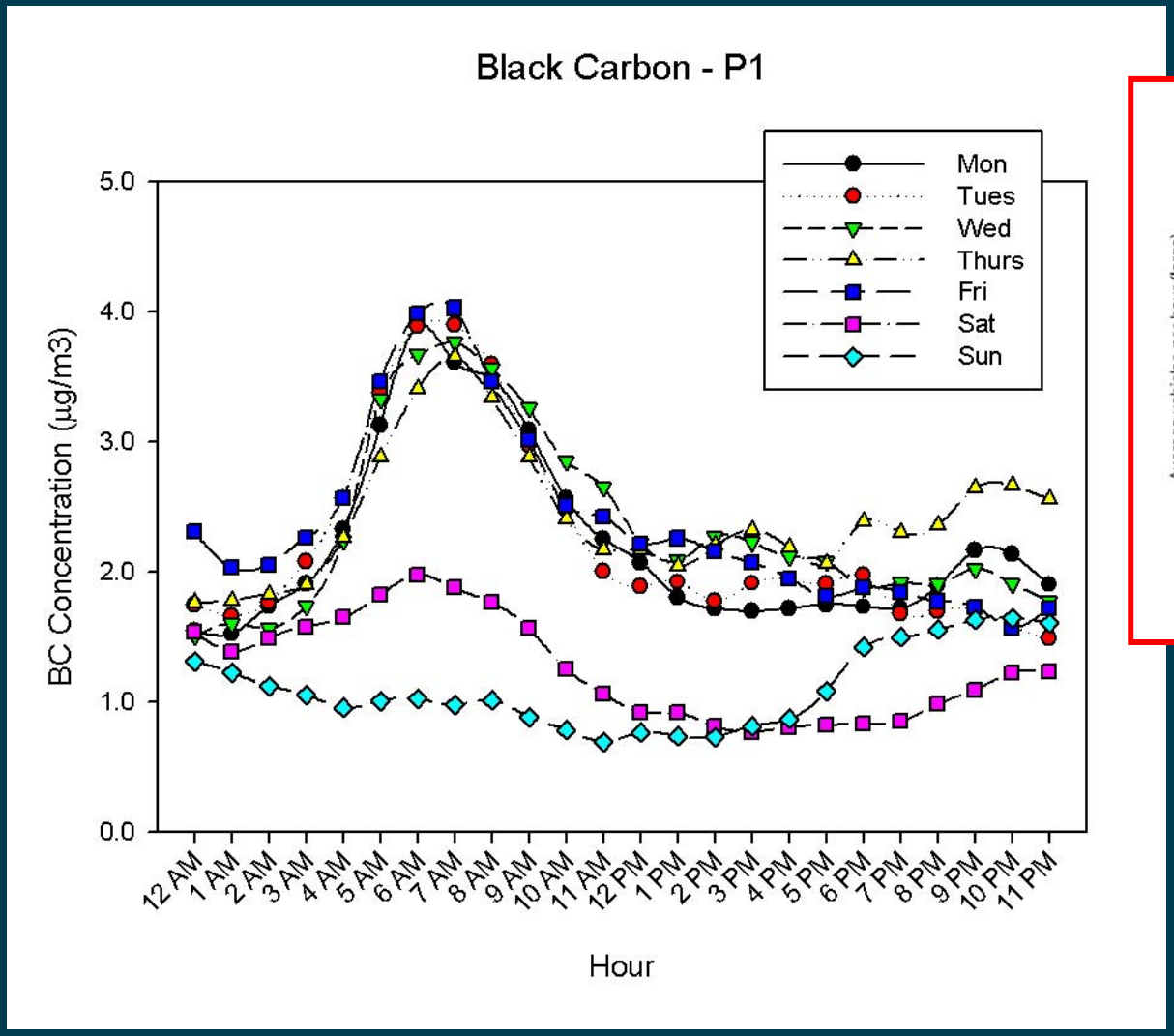
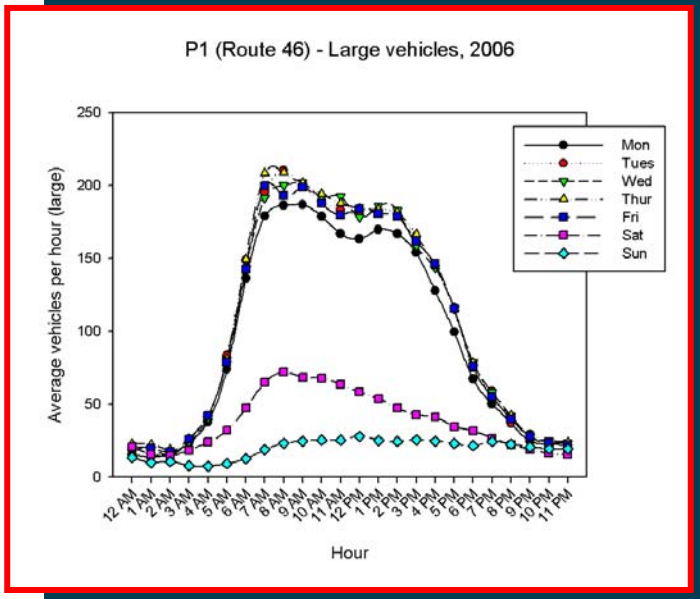
BLACK CARBON TRENDS – P1





Day-of-week temporal pattern for BC is similar to large vehicle automotive traffic

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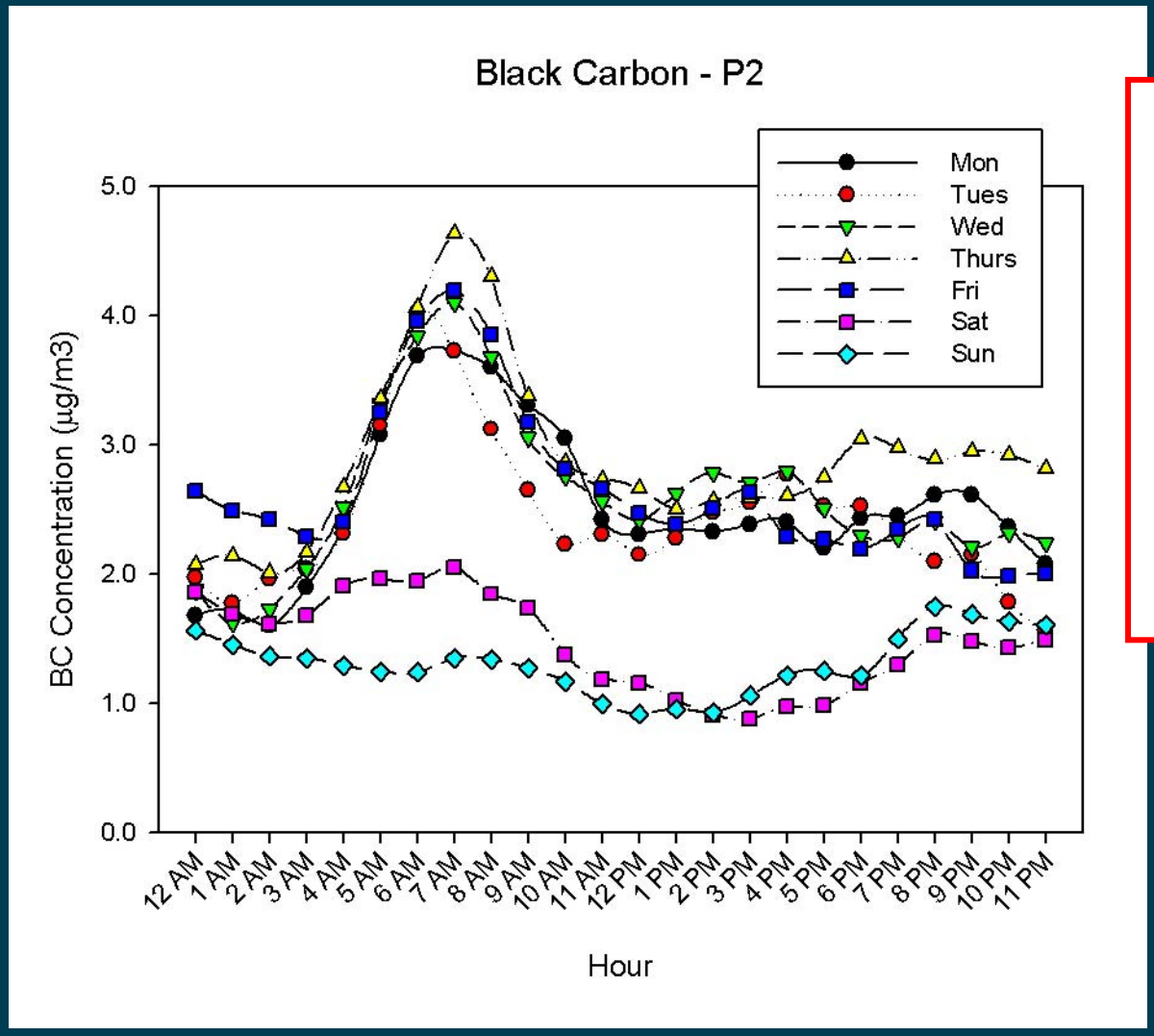
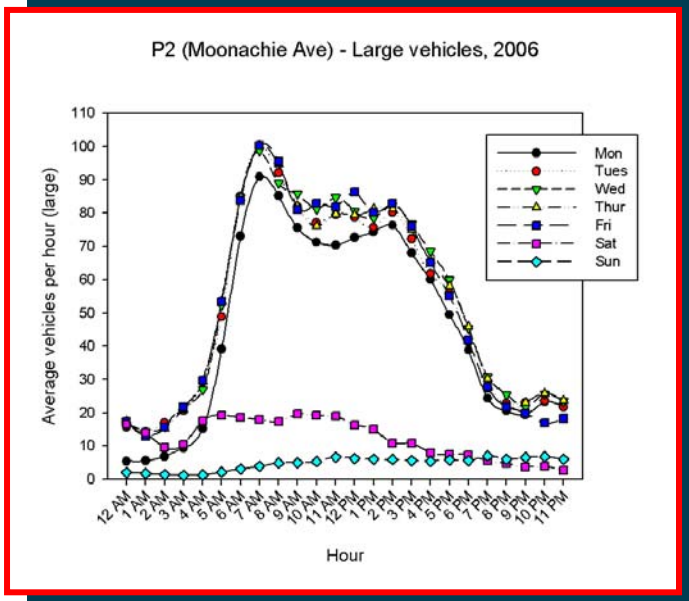
BLACK CARBON TRENDS – P2





Day-of-week temporal pattern for BC is similar to large vehicle automotive traffic

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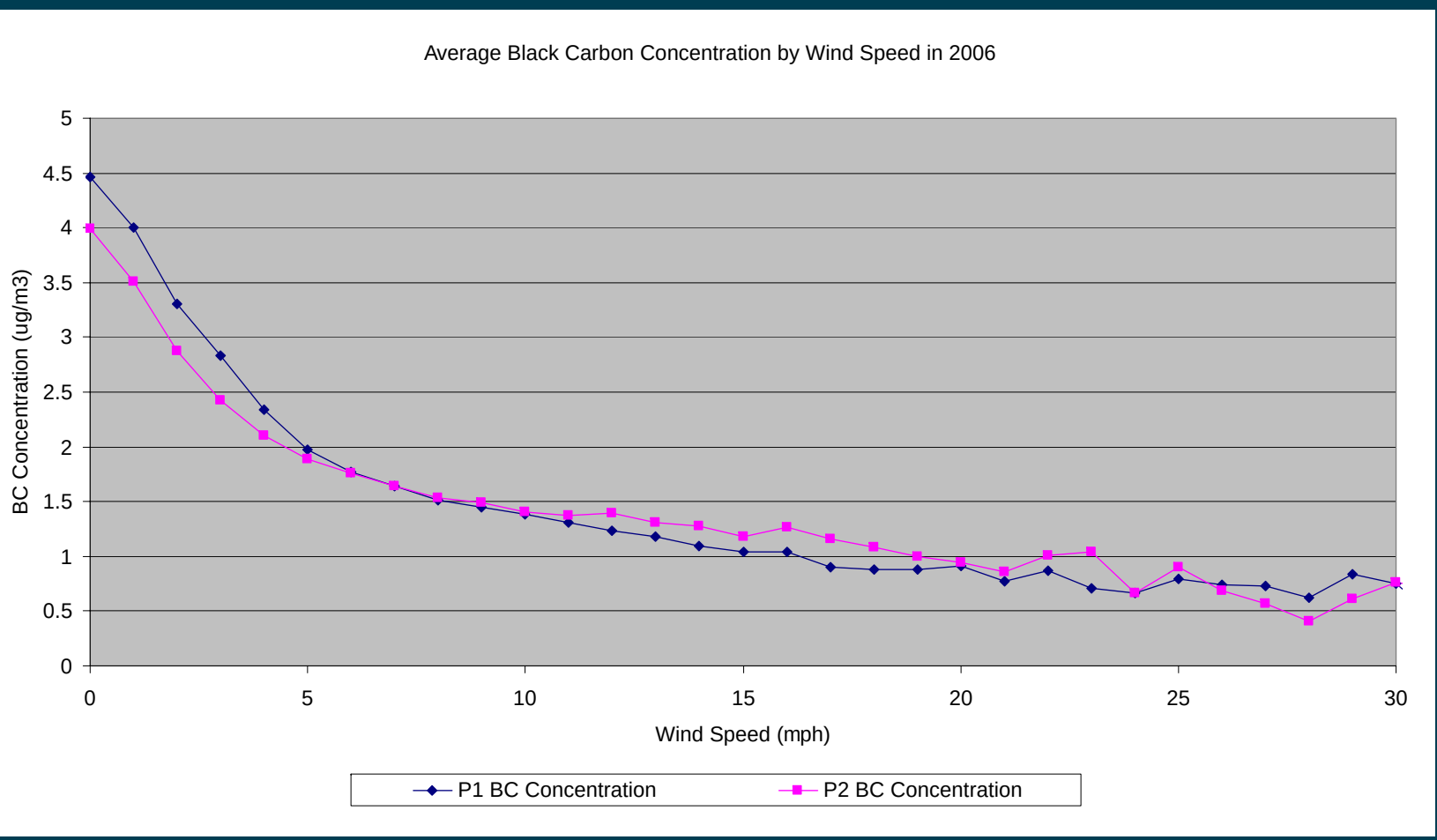
BLACK CARBON CONCENTRATION IS RELATED TO WIND SPEED



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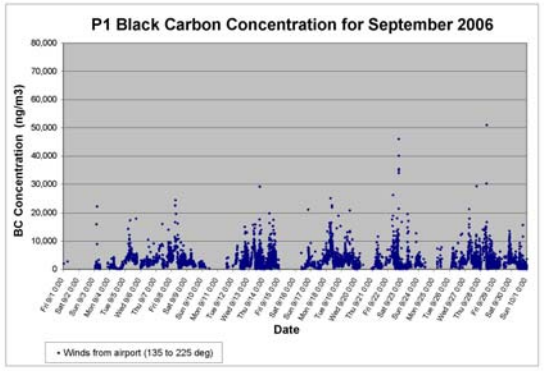
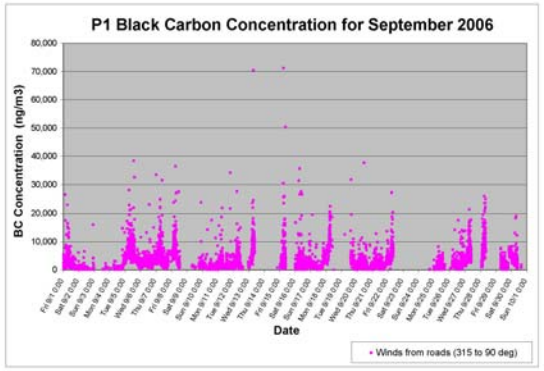
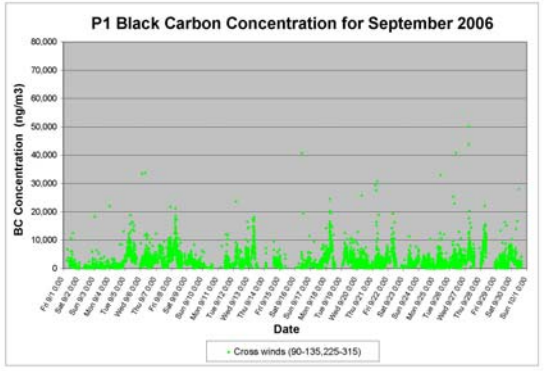
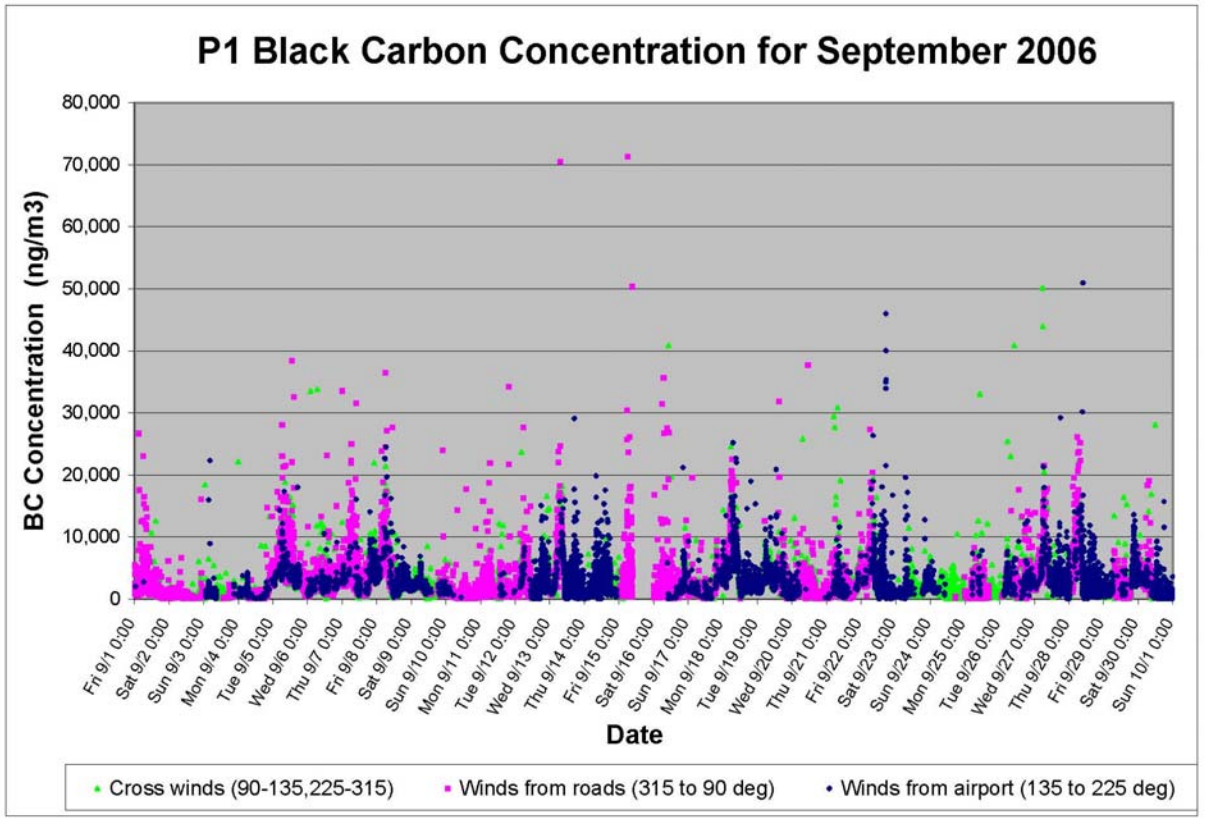
BLACK CARBON OBSERVED WHEN WIND IS FROM BOTH AIRPORT AND ROADWAYS



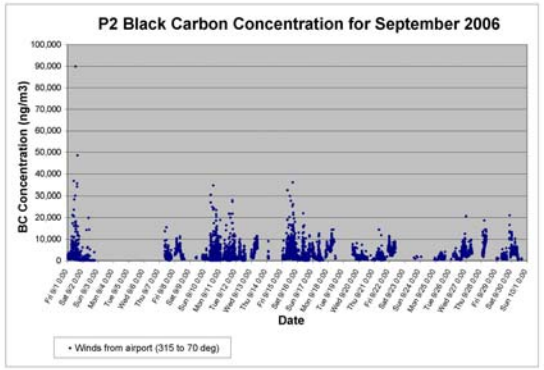


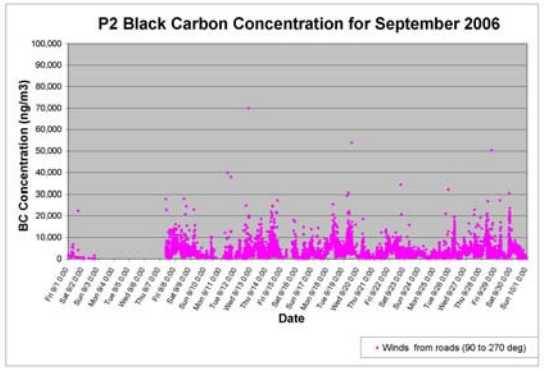


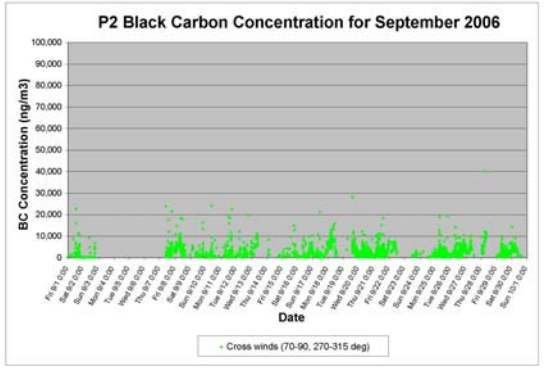


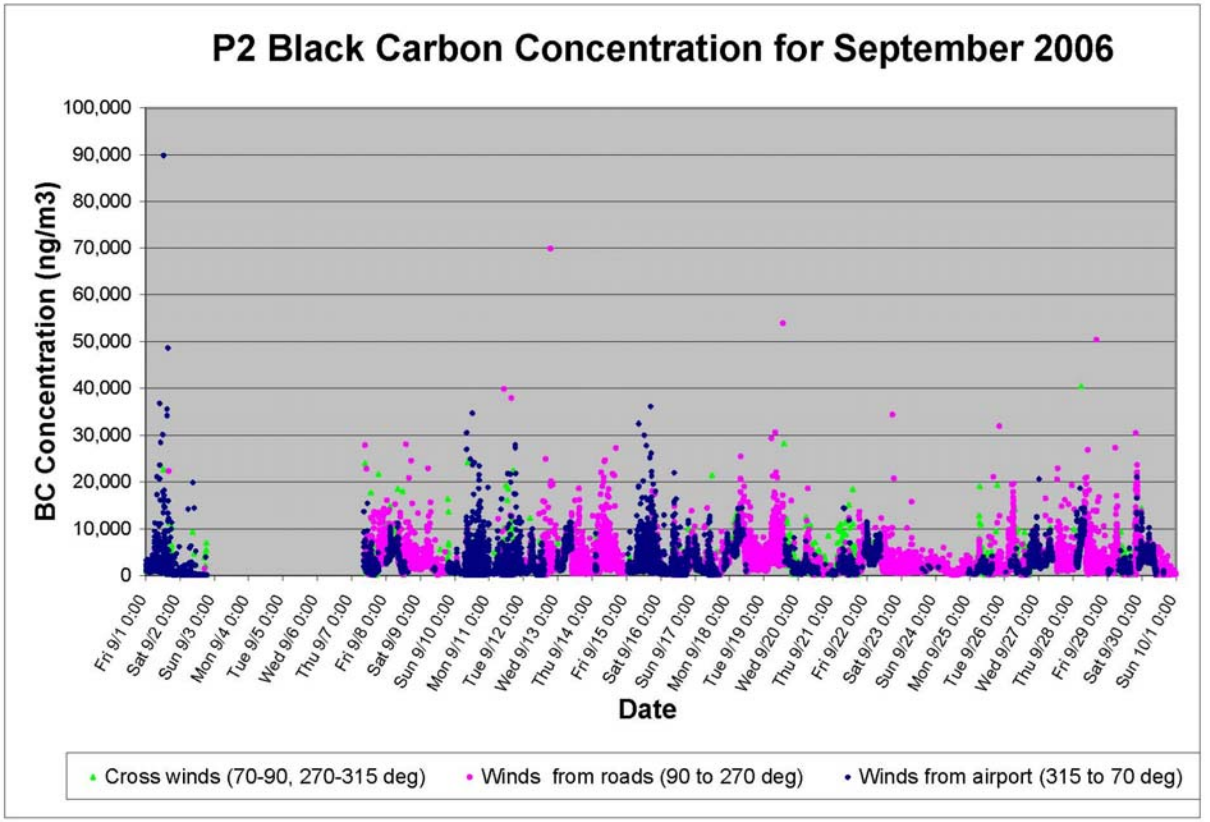
ENVIRON

BLACK CARBON OBSERVED WHEN WIND IS FROM BOTH AIRPORT AND ROADWAYS



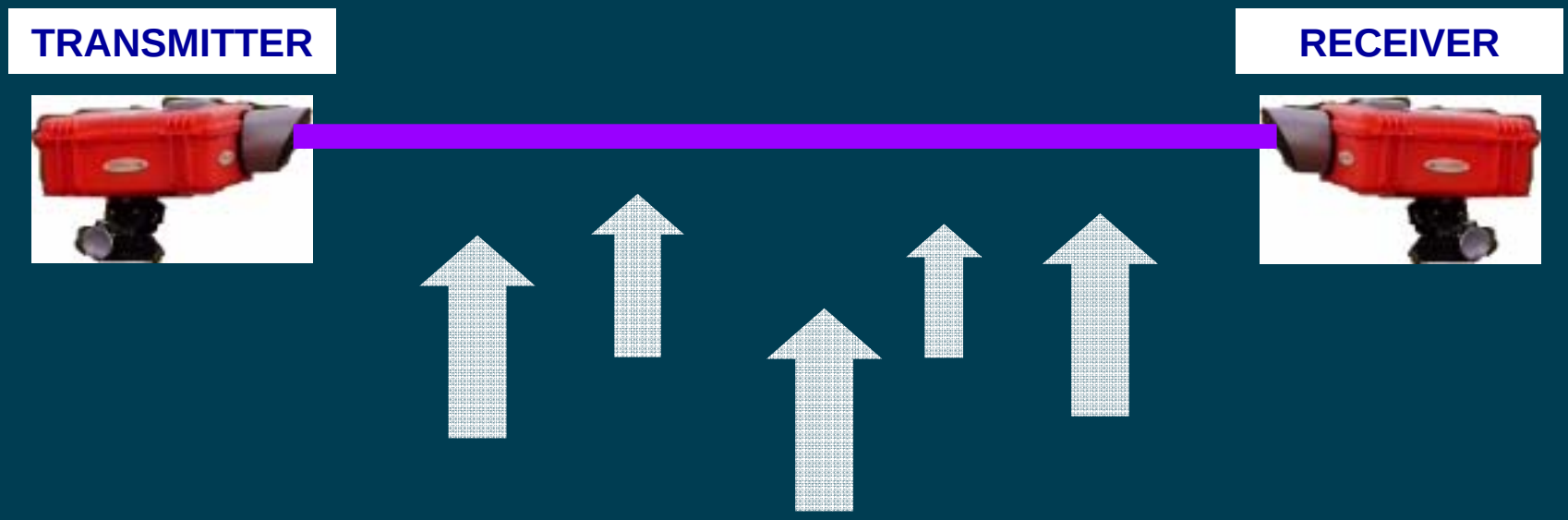




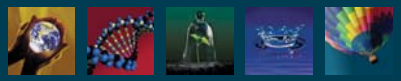


ENVIRON

OPEN PATH SYSTEM – OVERVIEW



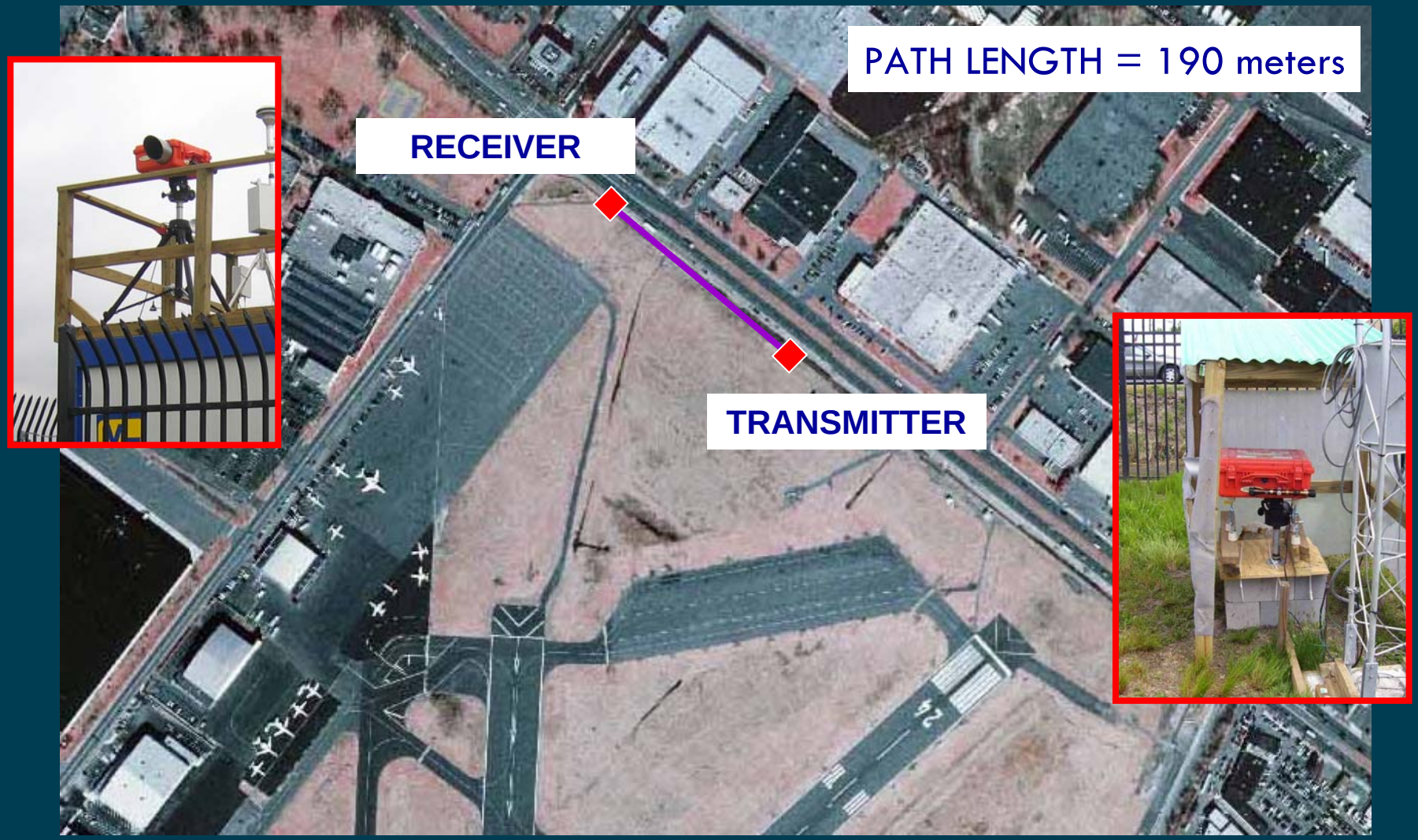
- When some gases are exposed to UV light, they will absorb specific wavelengths of light. Measure of total absorption is called "DUV Intensity".



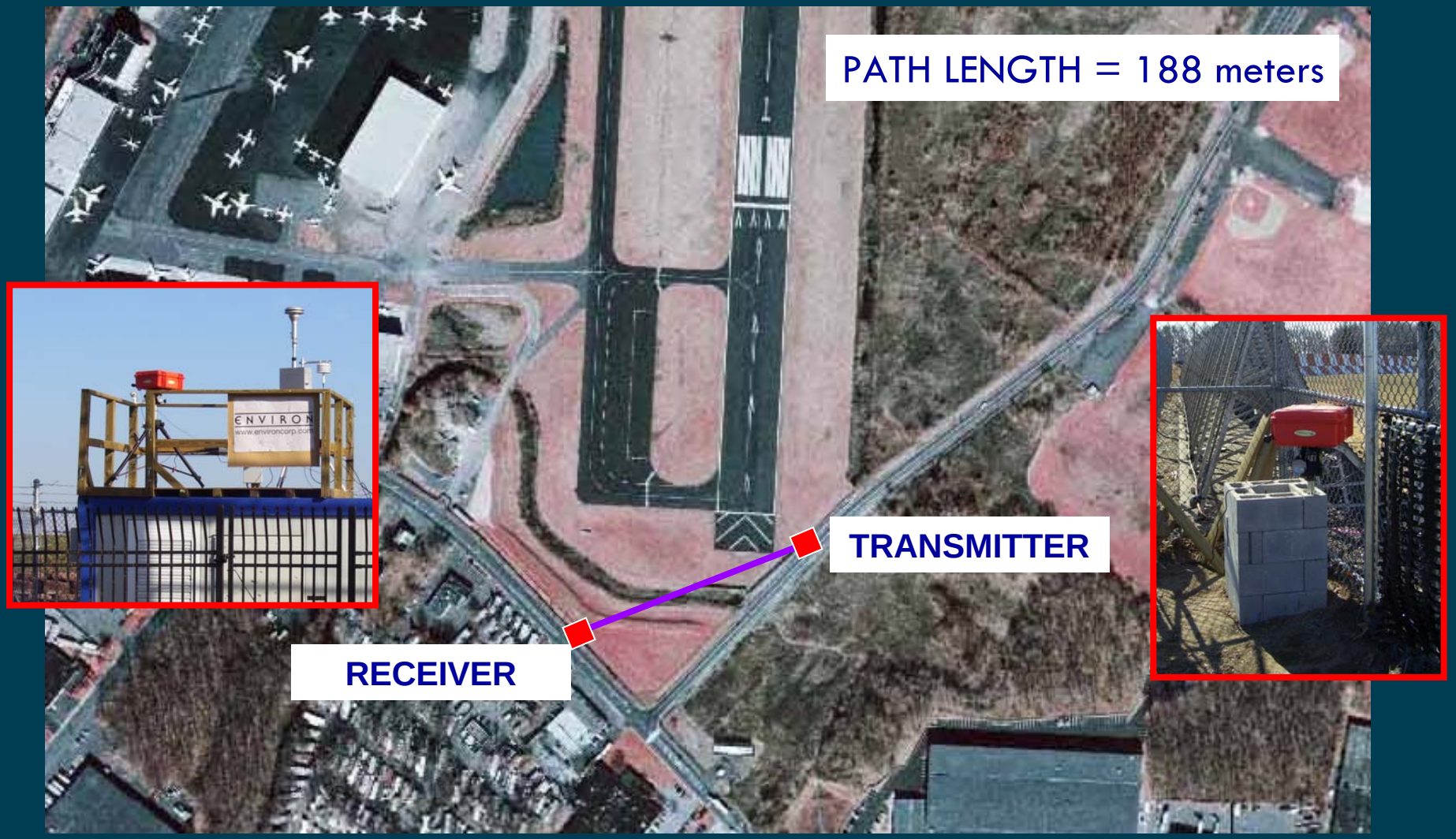
OPEN PATH SYSTEM – OVERVIEW

- DUV Intensity represents all gases that absorb in certain wavelengths, including hazardous and nonhazardous compounds
- Methods are still under development to identify specific individual compounds (e.g., NO)
- NOTE: This is an experimental technique; has not been officially validated or approved by USEPA or other regulatory agencies

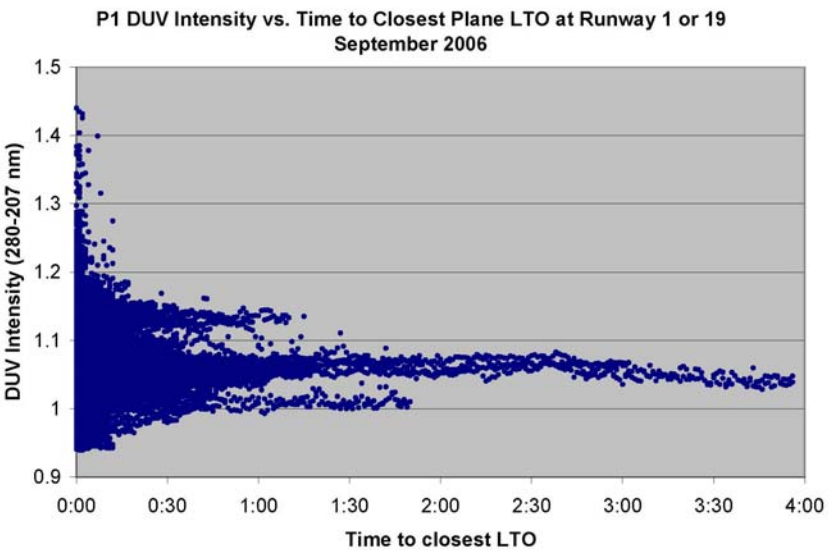
DUV-DOAS OPEN PATH SYSTEM – P1

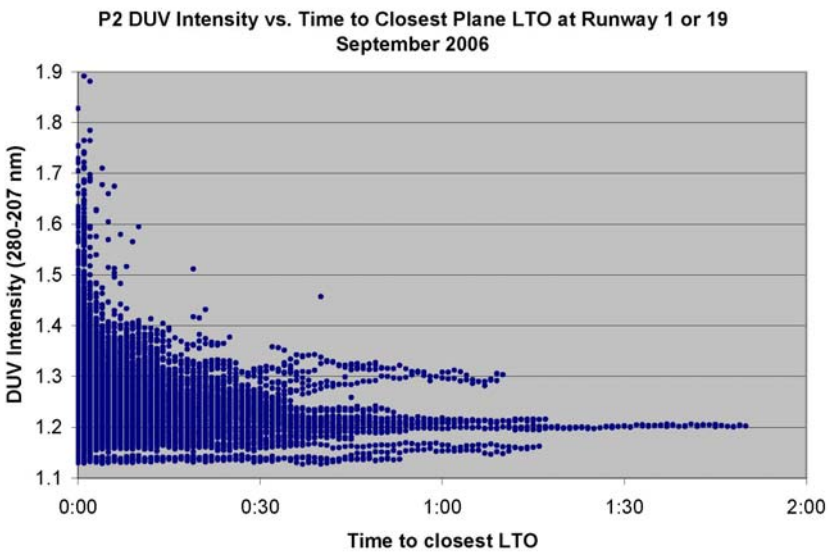


DUV-DOAS OPEN PATH SYSTEM – P2



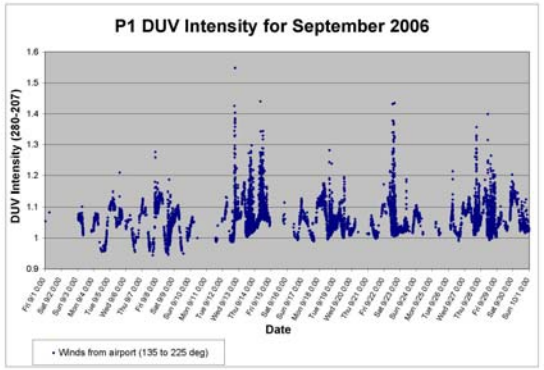
DUV SIGNAL DROPS WITH TIME FROM LTO

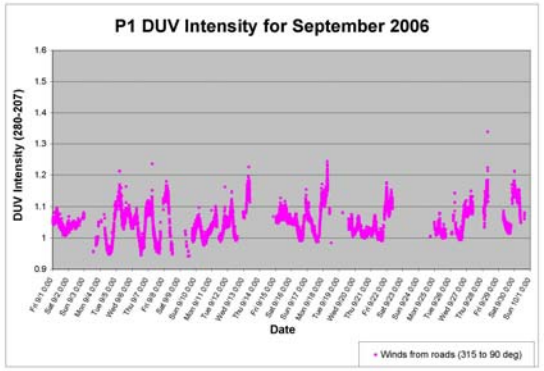


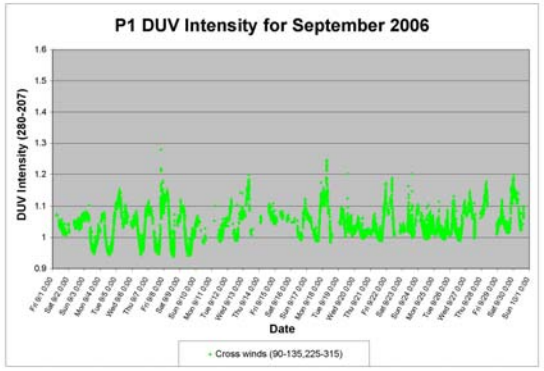


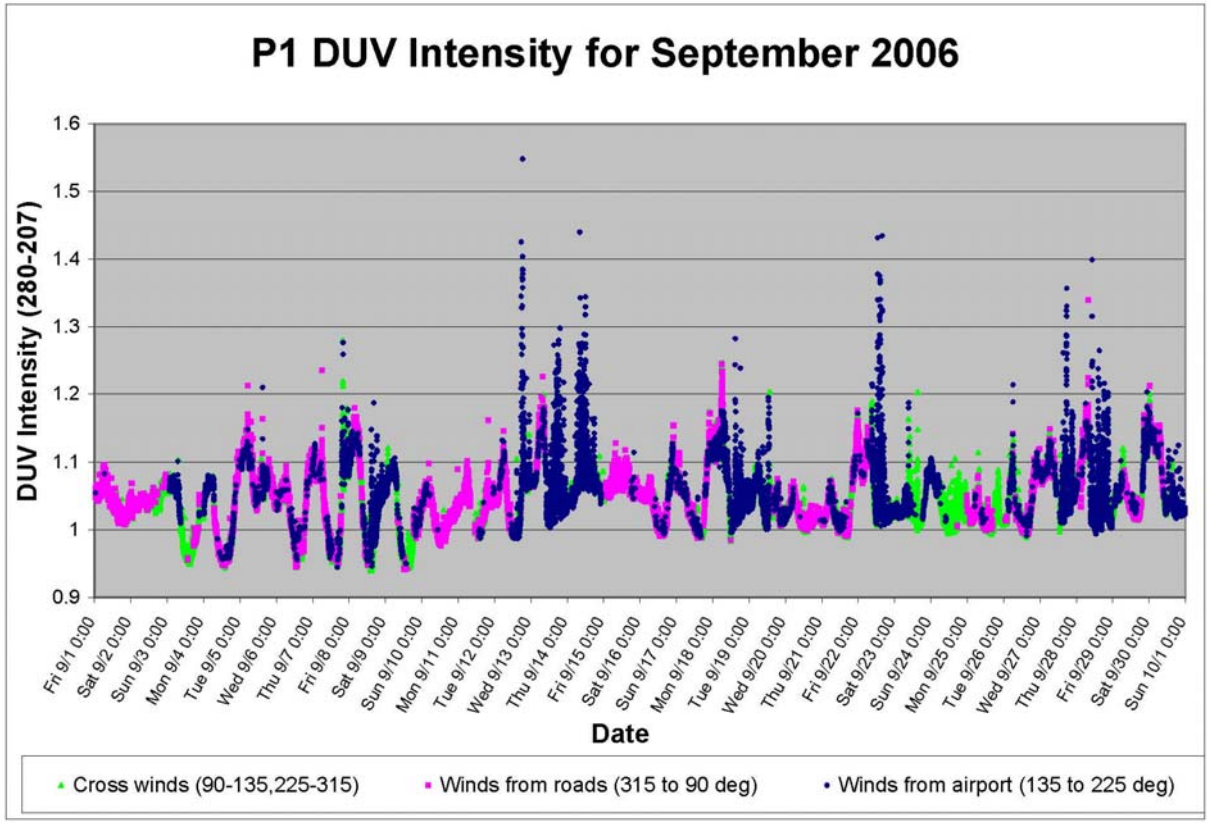
ENVIRON

DUV SIGNAL OBSERVED WHEN WIND IS FROM BOTH AIRPORT AND ROADWAYS









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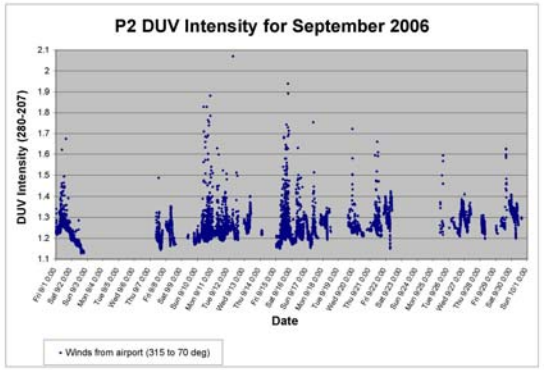
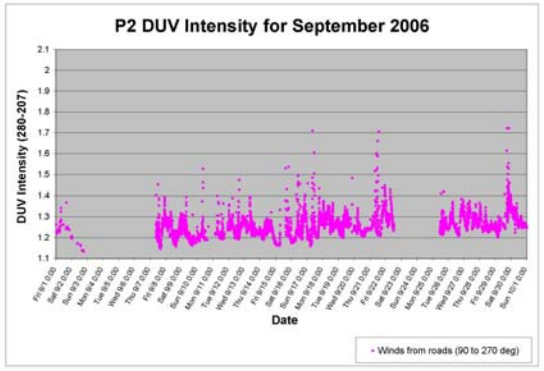
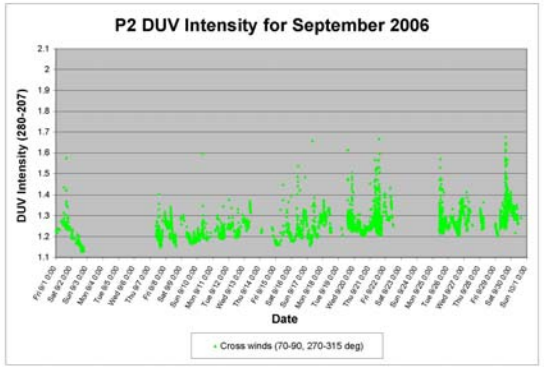
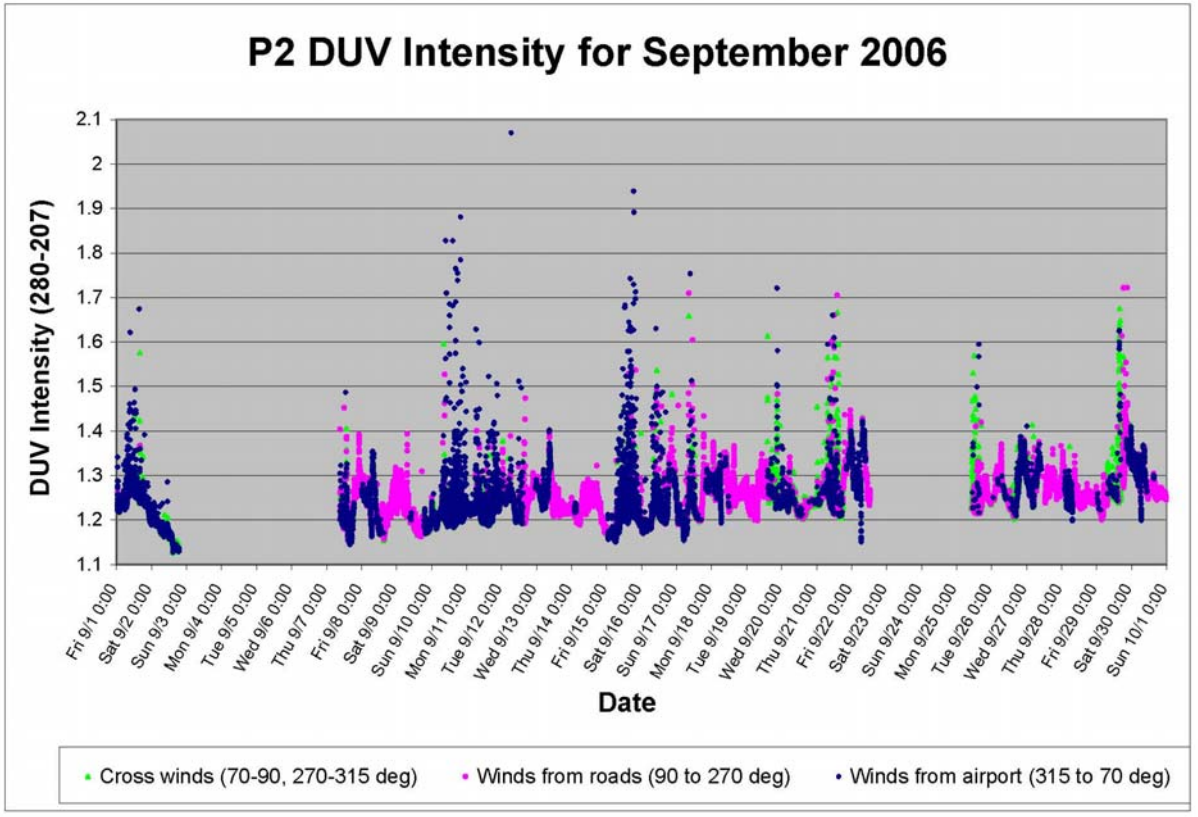


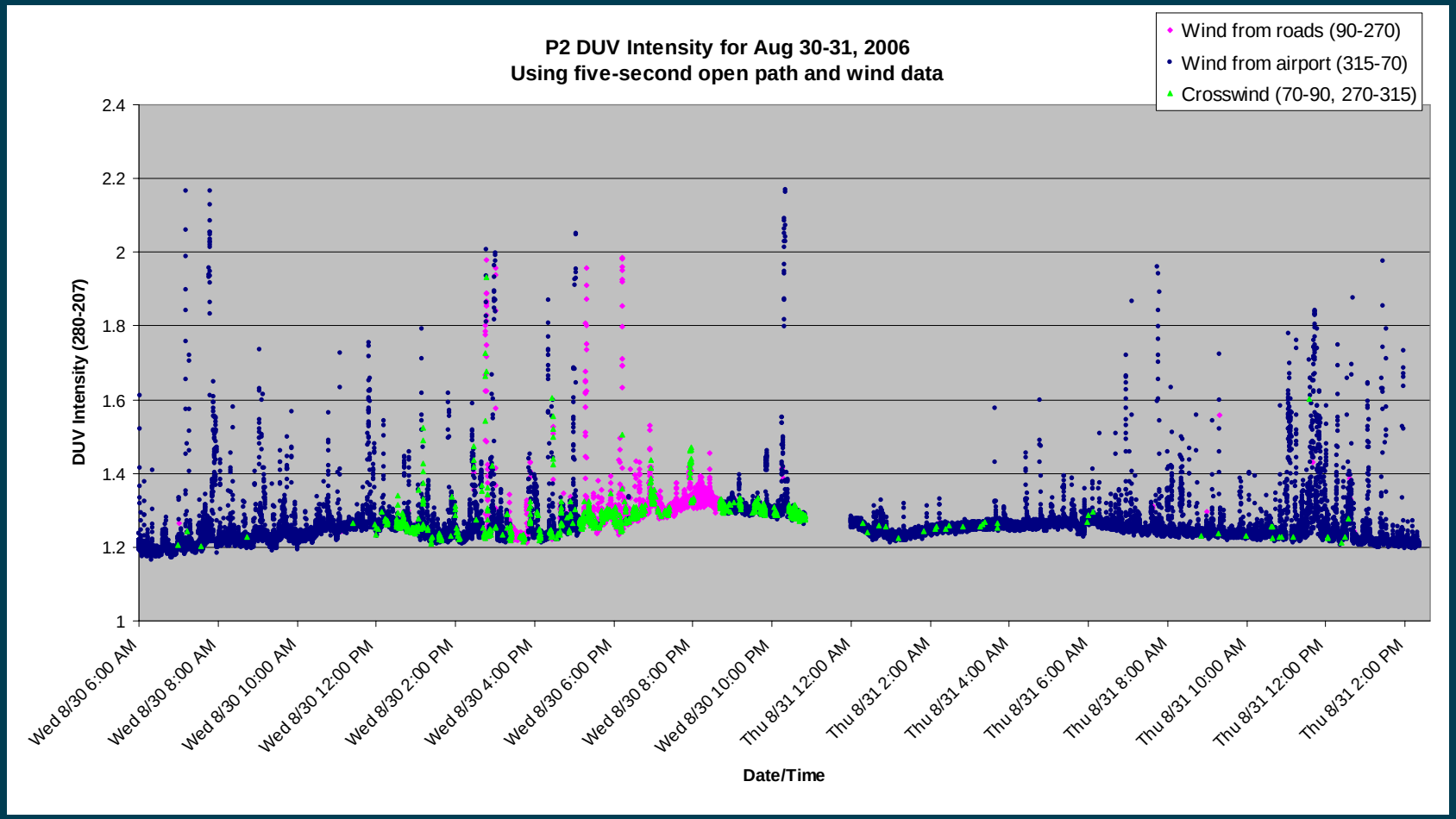






ENVIRON

DUV SIGNAL FROM AIRPORT



ENVIRON

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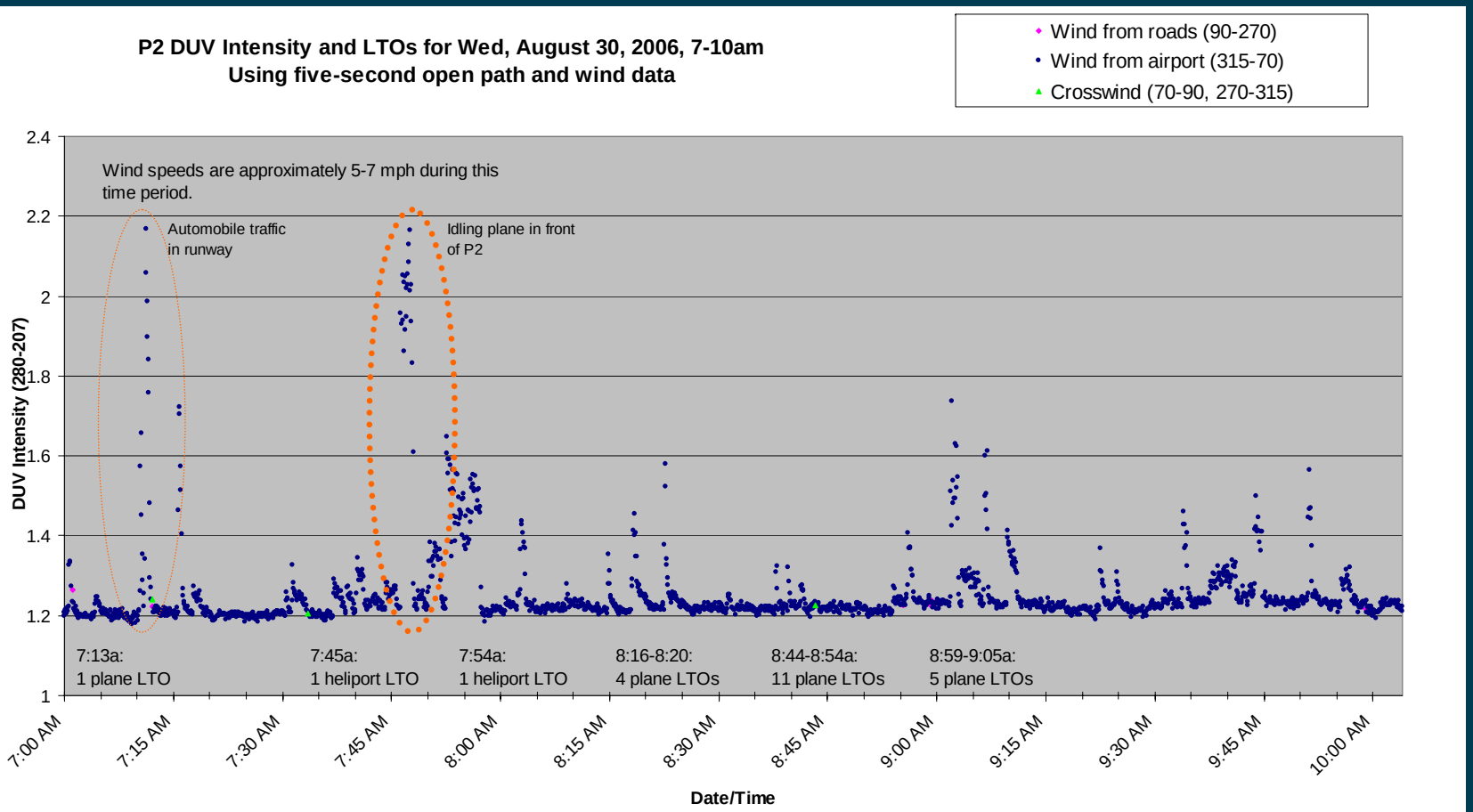

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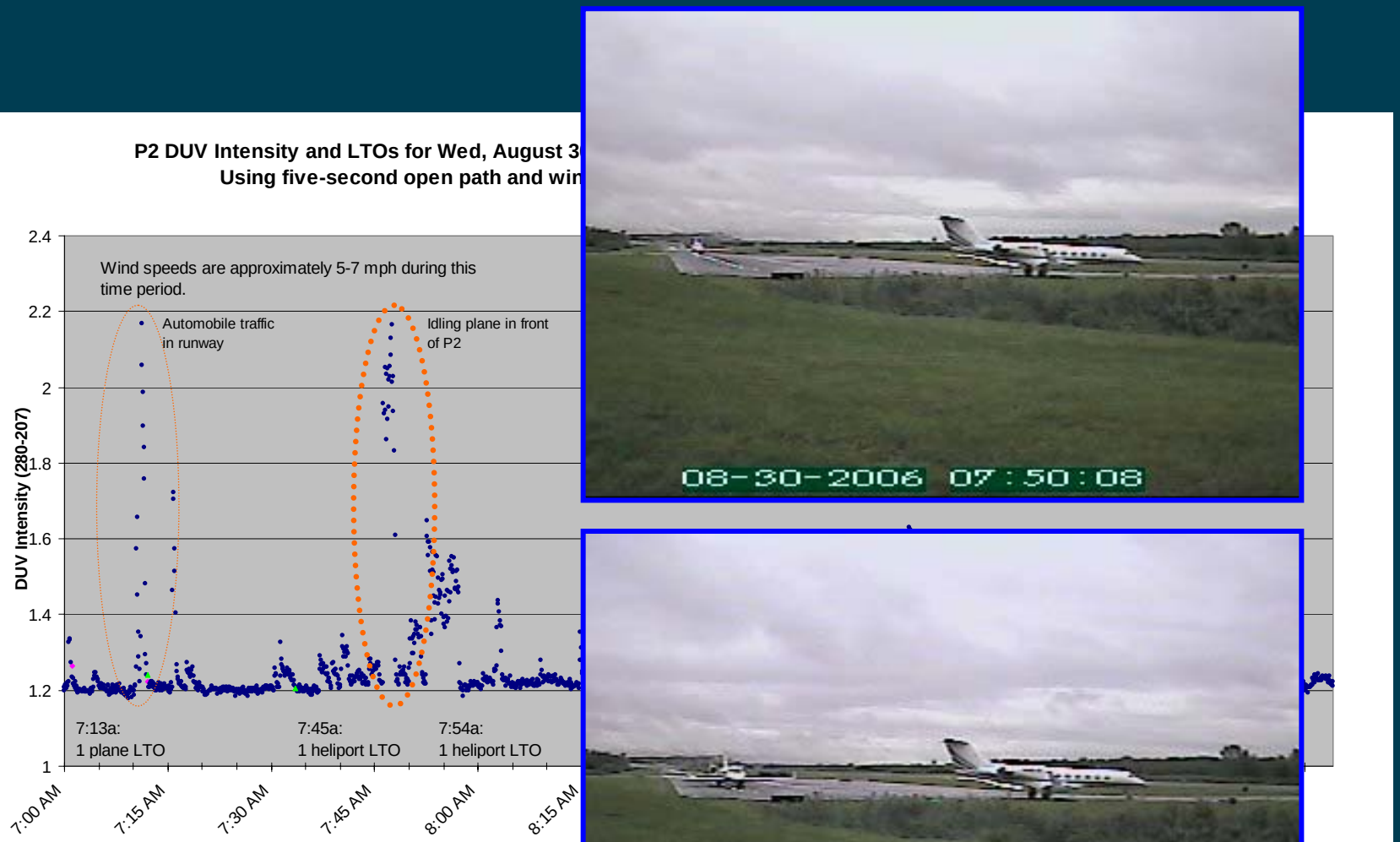
DUV SIGNAL FROM AIRPORT



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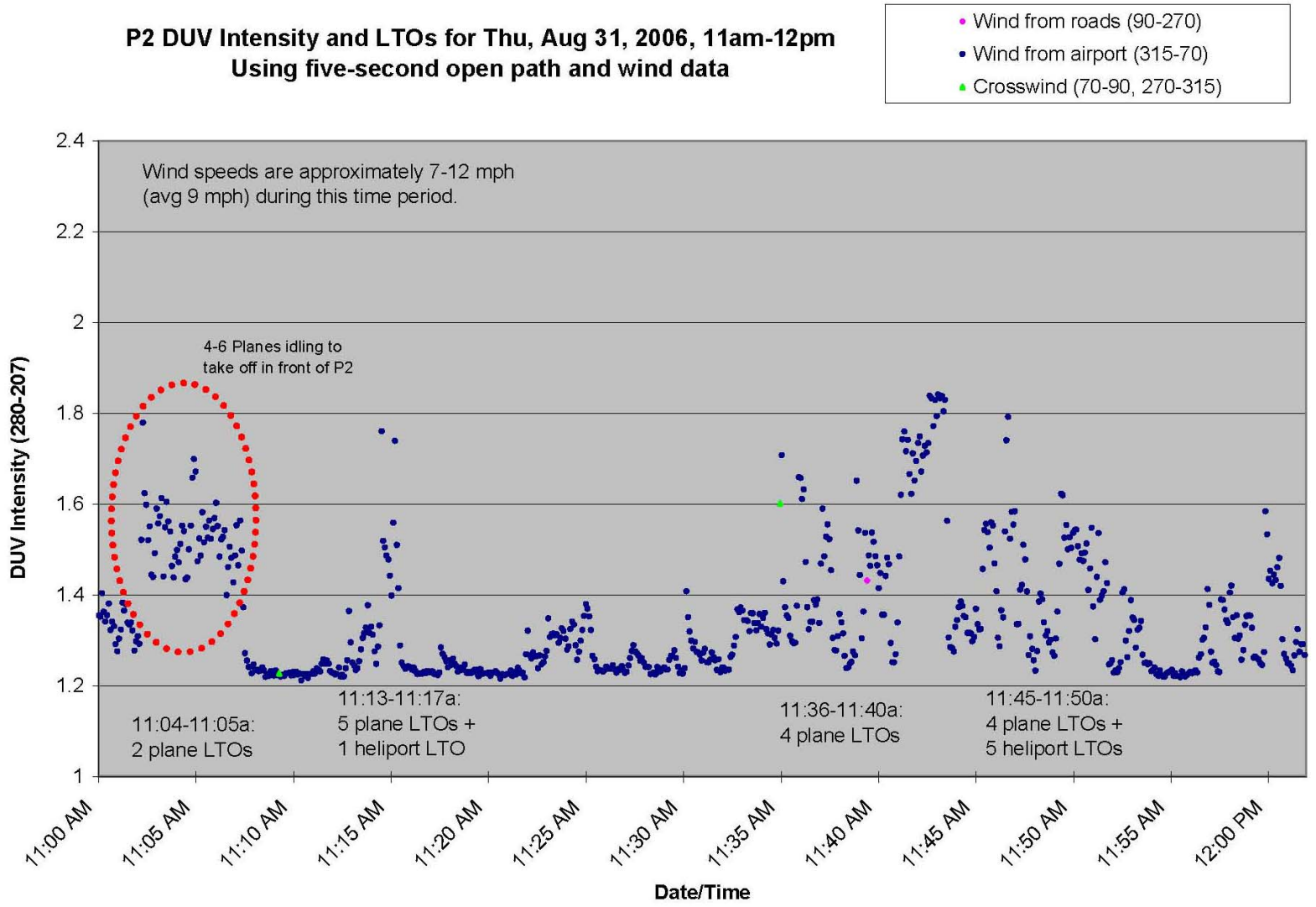
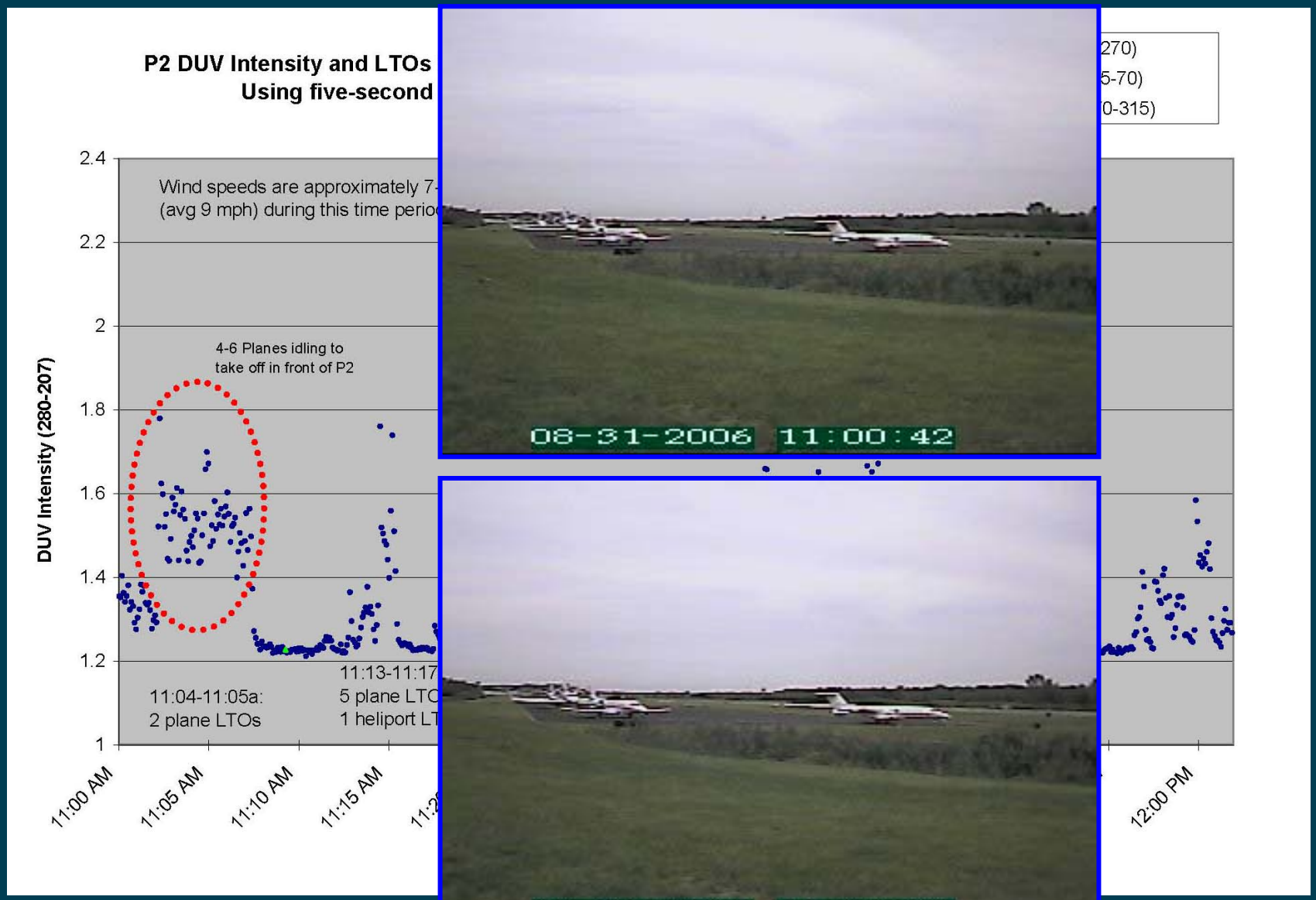
DUV SIGNAL FROM AIRPORT



ENVIRON

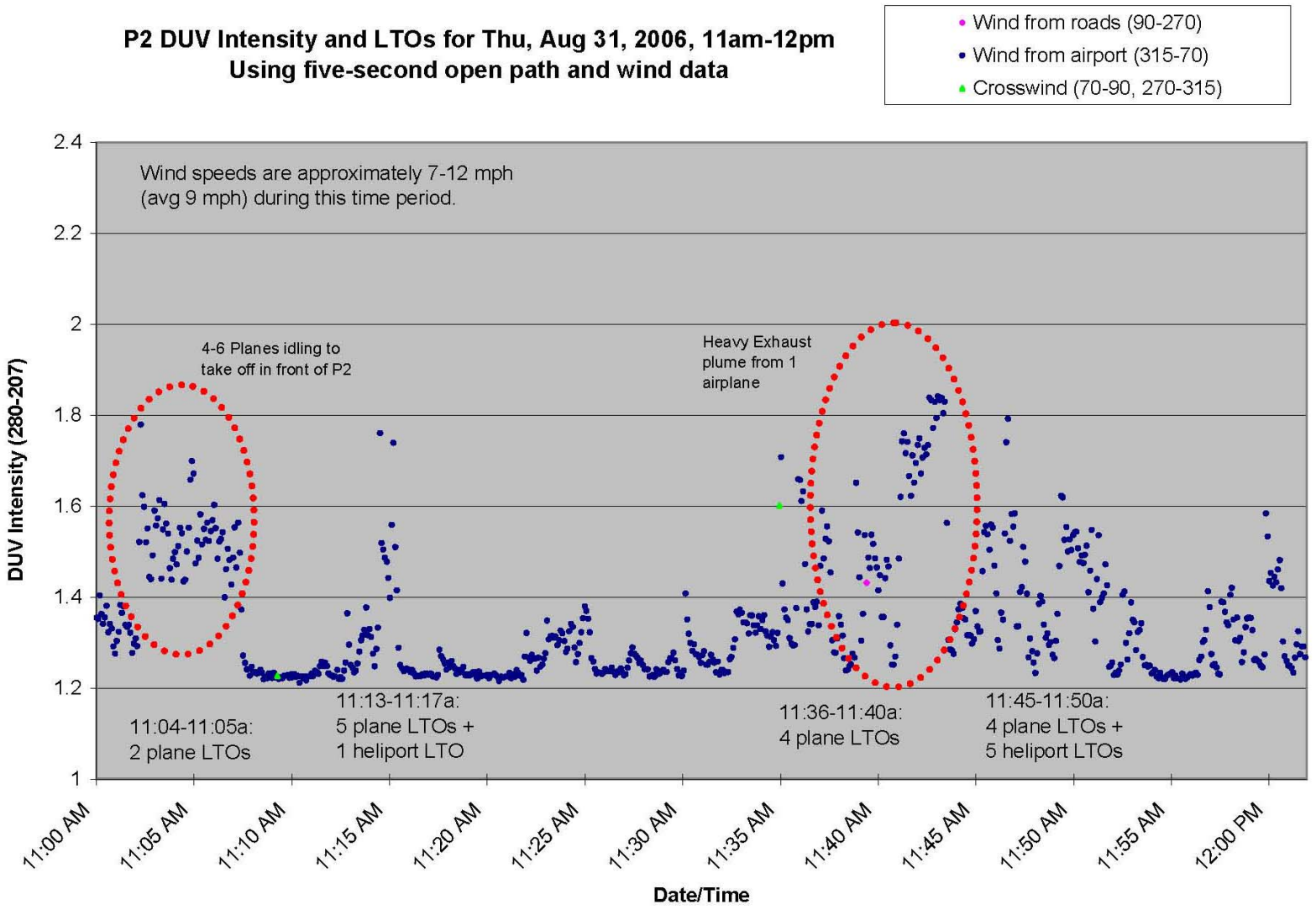
DUV SIGNAL FROM AIRPORT



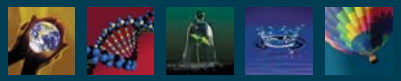
ENVIRON

DUV SIGNAL FROM AIRPORT

DUV SIGNAL FROM AIRPORT



ENVIRON

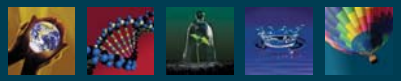


CONCLUSIONS

IS THE AIR NEAR THE AIRPORT WORSE THAN THE REST OF THE STATE?

- Certain VOCs were detected at parts of Teterboro Airport at higher concentrations than other "representative" locations in New Jersey (e.g., formaldehyde, toluene); other VOCs (e.g., benzene, acetaldehyde) were comparable to other NJ locations.

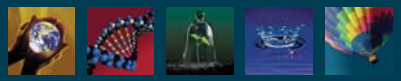
- PM2.5 measured around Teterboro Airport appears to have been higher than other NJ monitoring locations in 2006, although the method used to measure PM2.5 around Teterboro Airport in this study typically yields higher results than the method used at the other NJ locations.



CONCLUSIONS

IS THE AIR NEAR THE AIRPORT HAZARDOUS TO MY HEALTH?

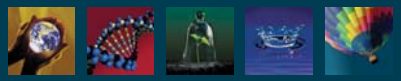
- Risks associated with the concentrations of VOCs consistently detected around parts of Teterboro Airport are higher than other "representative" locations in New Jersey (based on conservative risk screening calculations intended to overestimate exposures and be health protective).
- Similar to other locations in New Jersey, risks around Teterboro Airport exceed health benchmarks. These exceedances are typical of urban areas in the U.S.



CONCLUSIONS

IS THE AIRPORT AFFECTING THE LOCAL AIR QUALITY?

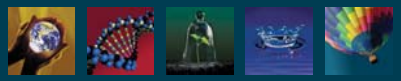
- Airport activities have a measurable effect on local air quality, as do other sources. PM2.5 and DUV intensity signal were observed to come from both roadways and the airport. These conclusions are supported by temporal and wind direction-filtered analyses, as well as review of videotapes.
- Black carbon was also observed to come from both roadways and the airport operations, although to a lesser extent. Stronger contributions of BC appear to be coming from large vehicles.



CONCLUSIONS

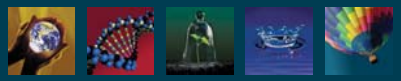
HOW MUCH IS THE AIRPORT AFFECTING THE LOCAL AIR QUALITY?

- Although the data indicate that airport activities have a measurable effect on local air quality, the data were insufficient to quantify the contribution from airport activities. However, the prevalence of these measurable impacts suggests that the airport is not an insignificant source with respect to the local air quality.
- Airport contributions appear to be highly dependent on wind direction and wind speed, as well as airport activity.



RECOMMENDATIONS

- Additional study is needed to identify and quantify potential emission sources of certain detected VOCs and carbonyls, such as formaldehyde. In particular, the summertime increase in formaldehyde concentrations should be further evaluated to understand why it was elevated at P1 but not at other locations.
- Other VOC sources in the airport vicinity should be identified and their emissions quantified.
- PM2.5 and black carbon concentrations and emission sources should be further evaluated.



RECOMMENDATIONS

- The DUV-DOAS open path system appears to be a promising tool for evaluating airport impacts on local air quality; more research is needed to develop this technology and to characterize DUV compounds.
- Additional study is needed to understand the impact of airport operations on the local community.
  - Perimeter monitoring around the airport coupled with neighborhood monitoring, particularly at times when jet fuel odors are apparent
  - Short-term sampling (e.g., three hours or less) when winds are steady to quantify upwind and downwind concentrations.
  - Short-term VOC monitoring to evaluate temporal trends