# HAP's at Increasing Distances from a High Traffic Highway in New Jersey

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# Introduction

Traffic emissions have lead to elevated concentration of HAPs near highways compared to the average urban background

New Jersey Turnpike

# Objective

- Measure ambient concentration gradients of **$PM_{2.5}$ ,TSP, and PAHs** at different distances from the NJ turnpike.

- Determine how particulate concentration from vehicle emission is affected by **seasons, day and night, traffic flow variations and meteorological conditions**.

- Design and test a **visualization tool** for interactively displaying spatial-temporal patterns of highway Air Quality

# Experimental Design

- **Sampling Periods:**

  Every six days 09/07-09/08

- **Sampling duration:**

  -Long term: 24 hrs (12 months)
  -Intensive: 12 hrs (Two weeks)

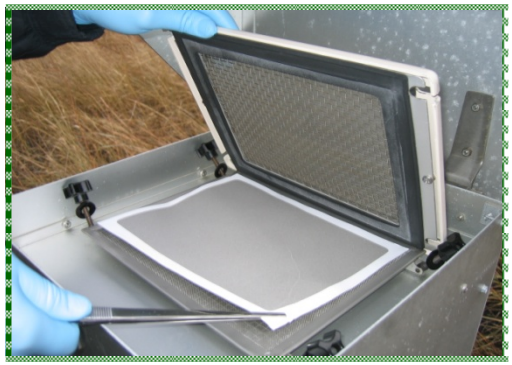
- **Sampling distances:**

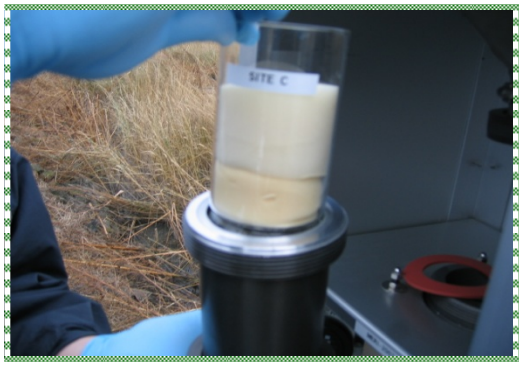
  50, 100 and 150 m

Carlstadt, New Jersey Turnpike

Turnpike

# $PM_{2.5}$, TSP & PAH Samples





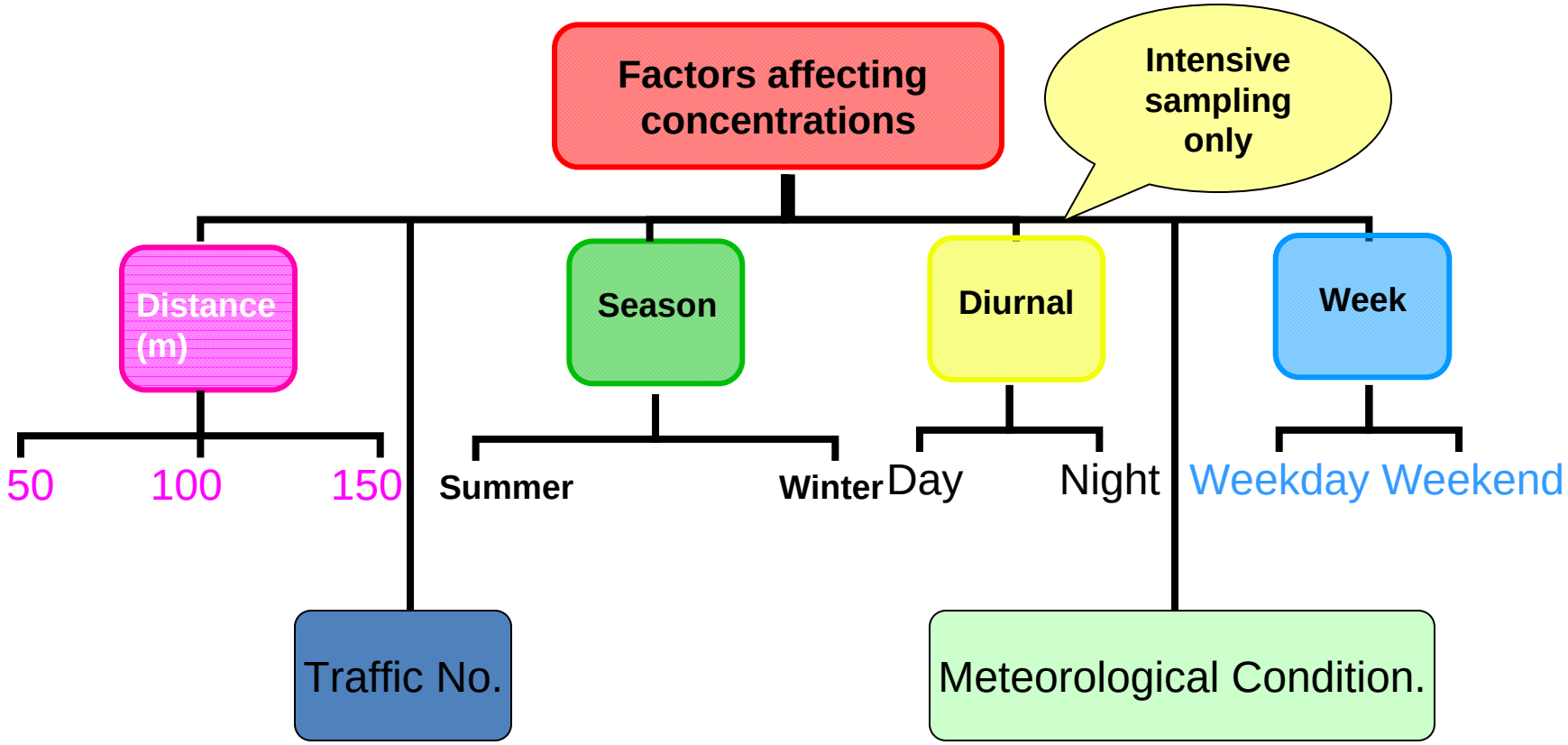

**$PM_{2.5}$ Sampler:**

- Model: Partisol-FRM 2000
- Flow rate: **16.7 L/min**
- Duration: 24 hours
- Media: PTFE filter (47 mm ID)
- Compounds: **$PM_{2.5}$ and Metals**

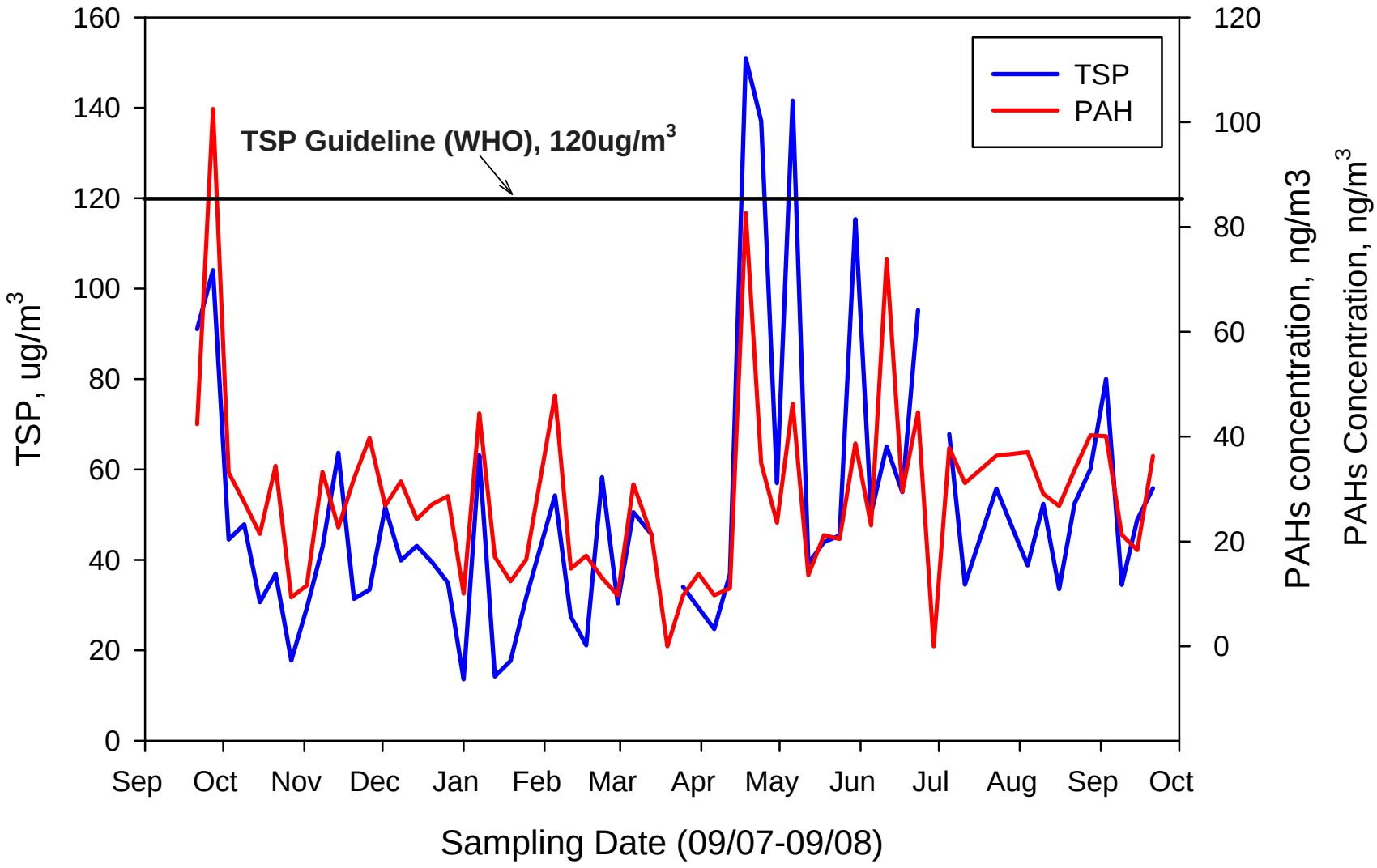
**Hi-vol. Sampler:**

- Model: PNY1123
- Flow rate: **0.5~0.7 $m^3$/min**
- Duration: 24 hours
- Media: Quartz fiber filter (20.3 cm × 25.4 cm) and 2 PUF (3” height) plugs
- Compounds: **TSP, PAH-particle, PAH-gas**

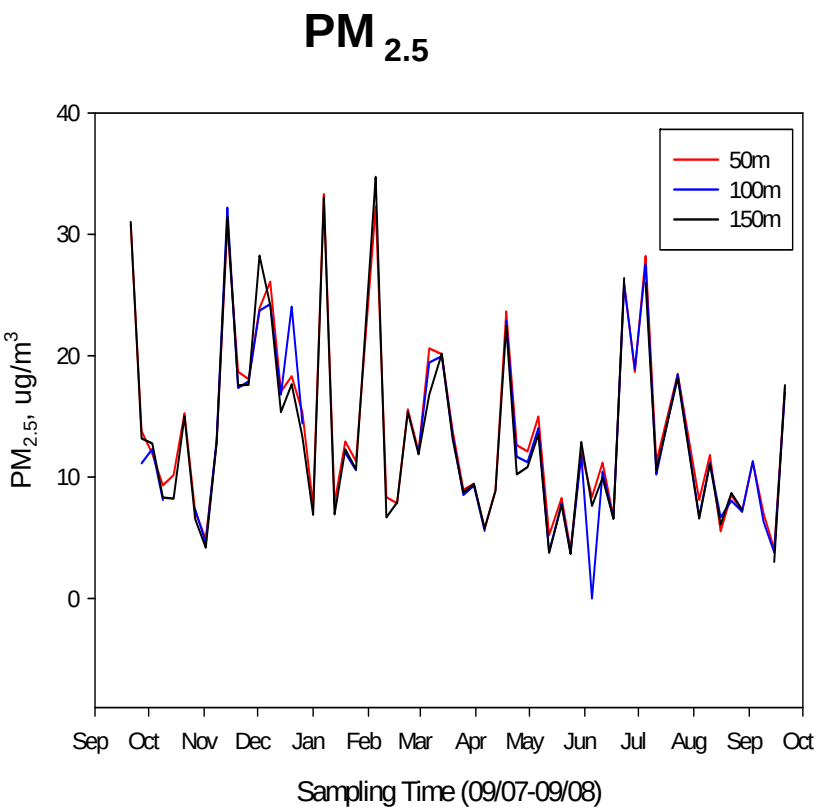
# Analysis Factors

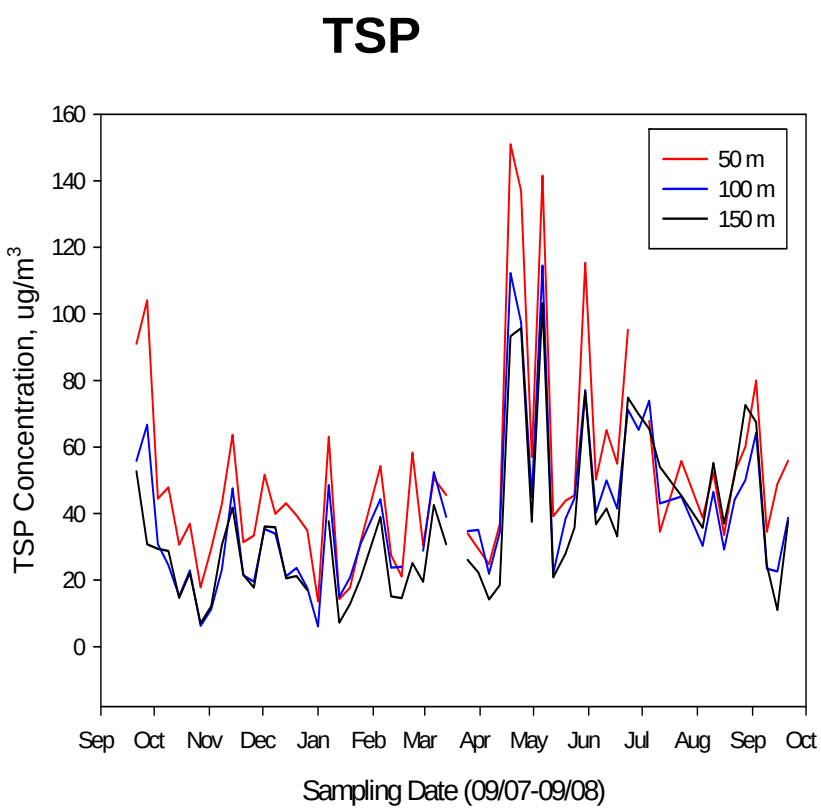


# PAHs, TSP and PM2.5 Concentration in the Ambient Air at Site A.



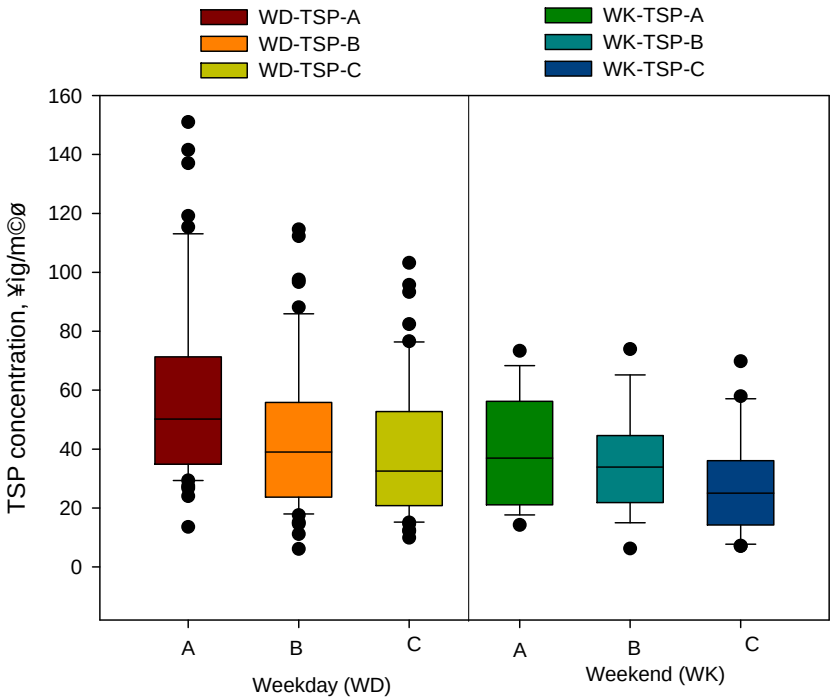
# Effect of Distance From Traffic



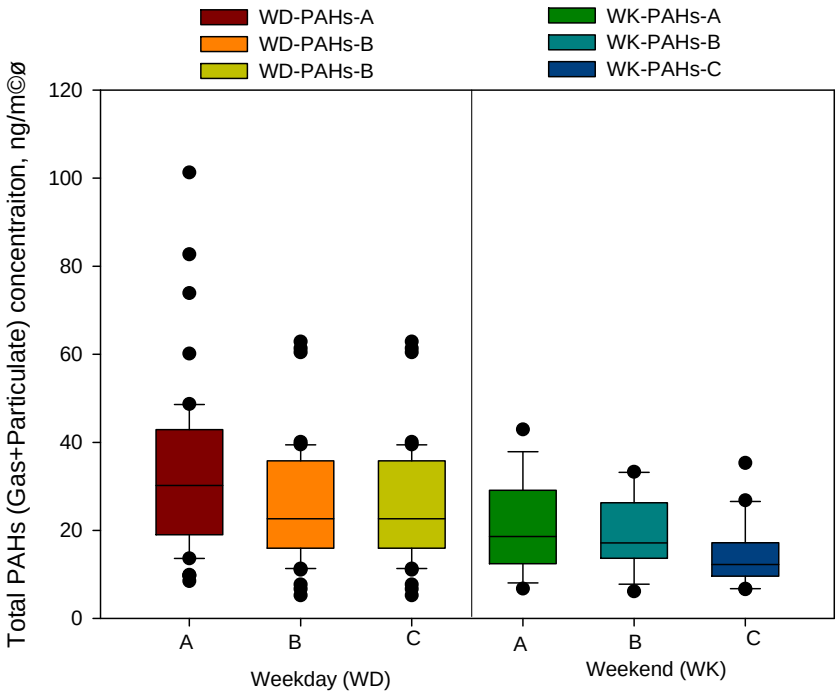



# Effect of Day-of-Week on TSP and PAHs

## TSP

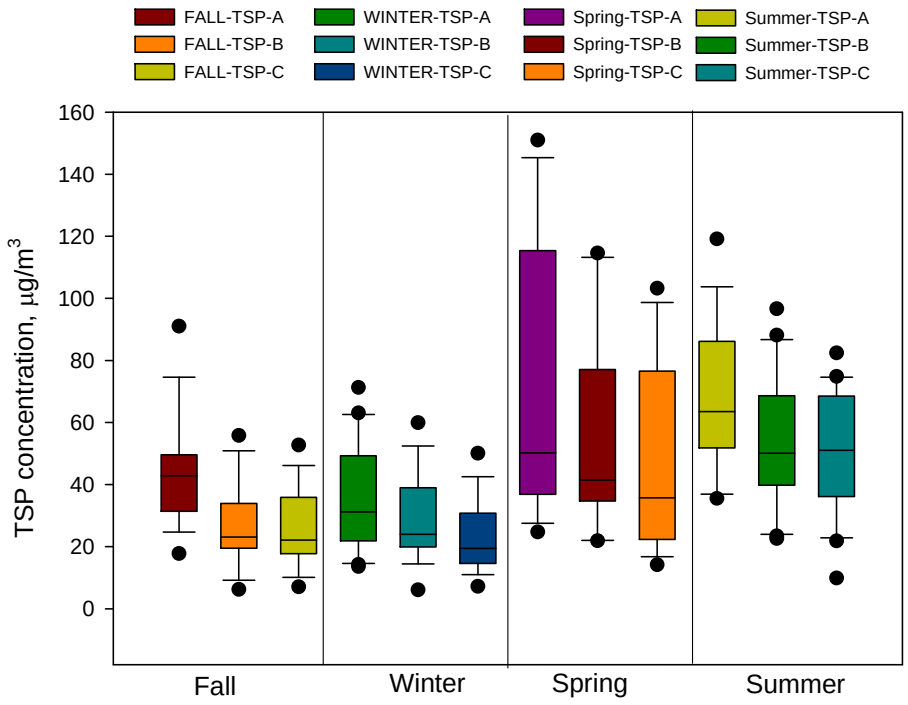



## PAHs

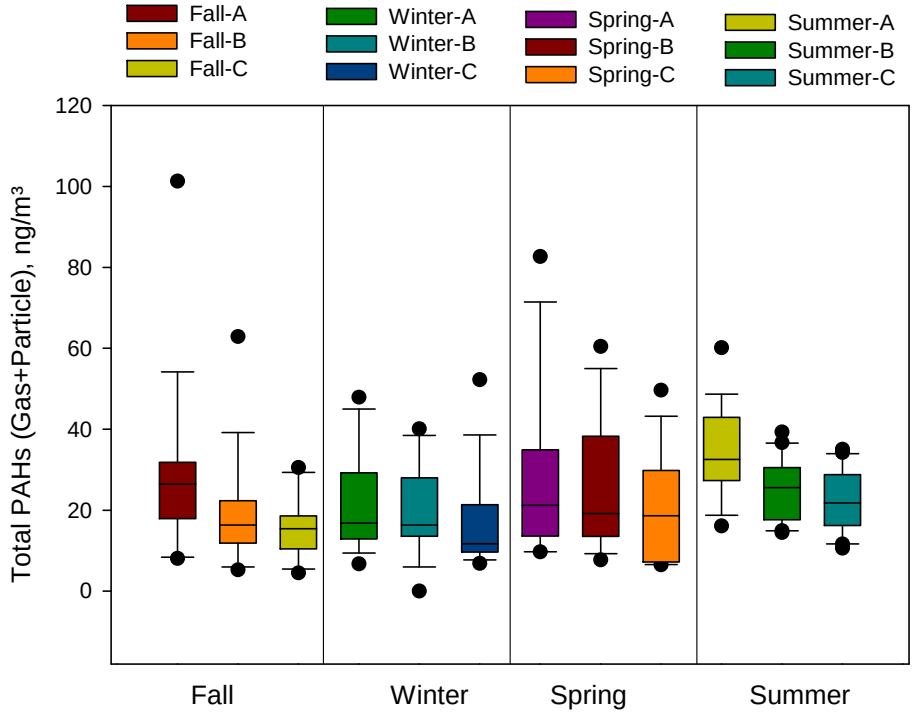


# Seasonal Effect on TSP and PAHs

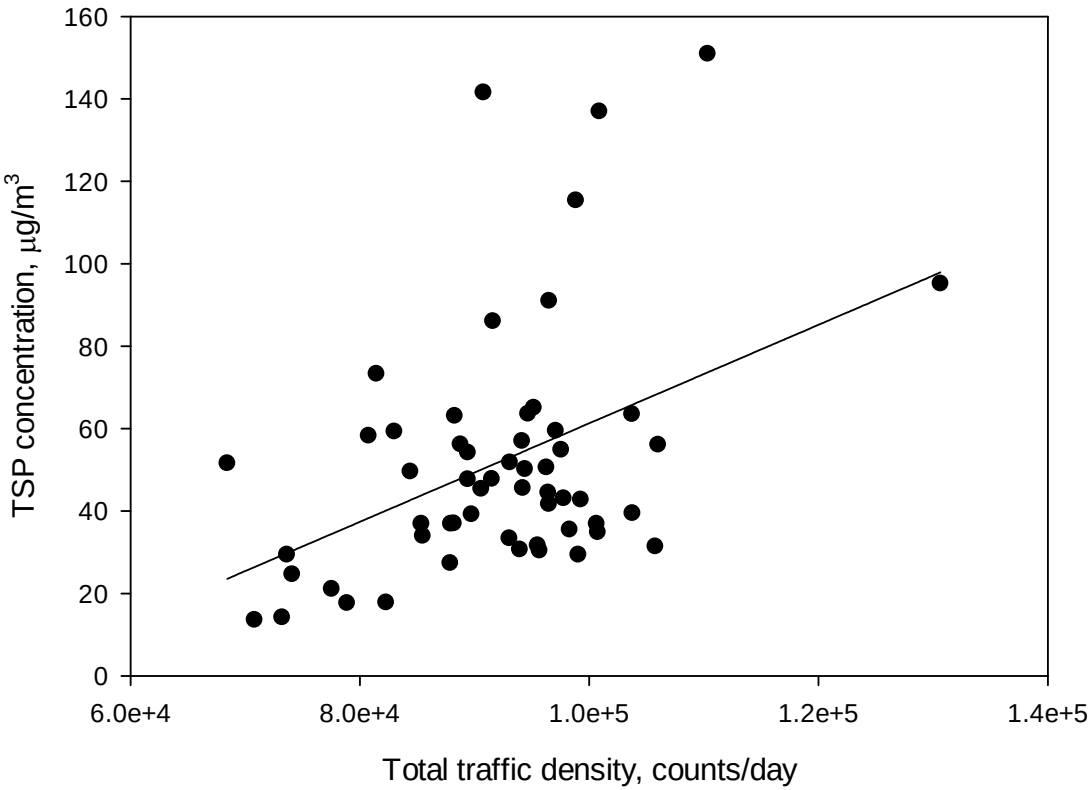
## TSP




## PAHs

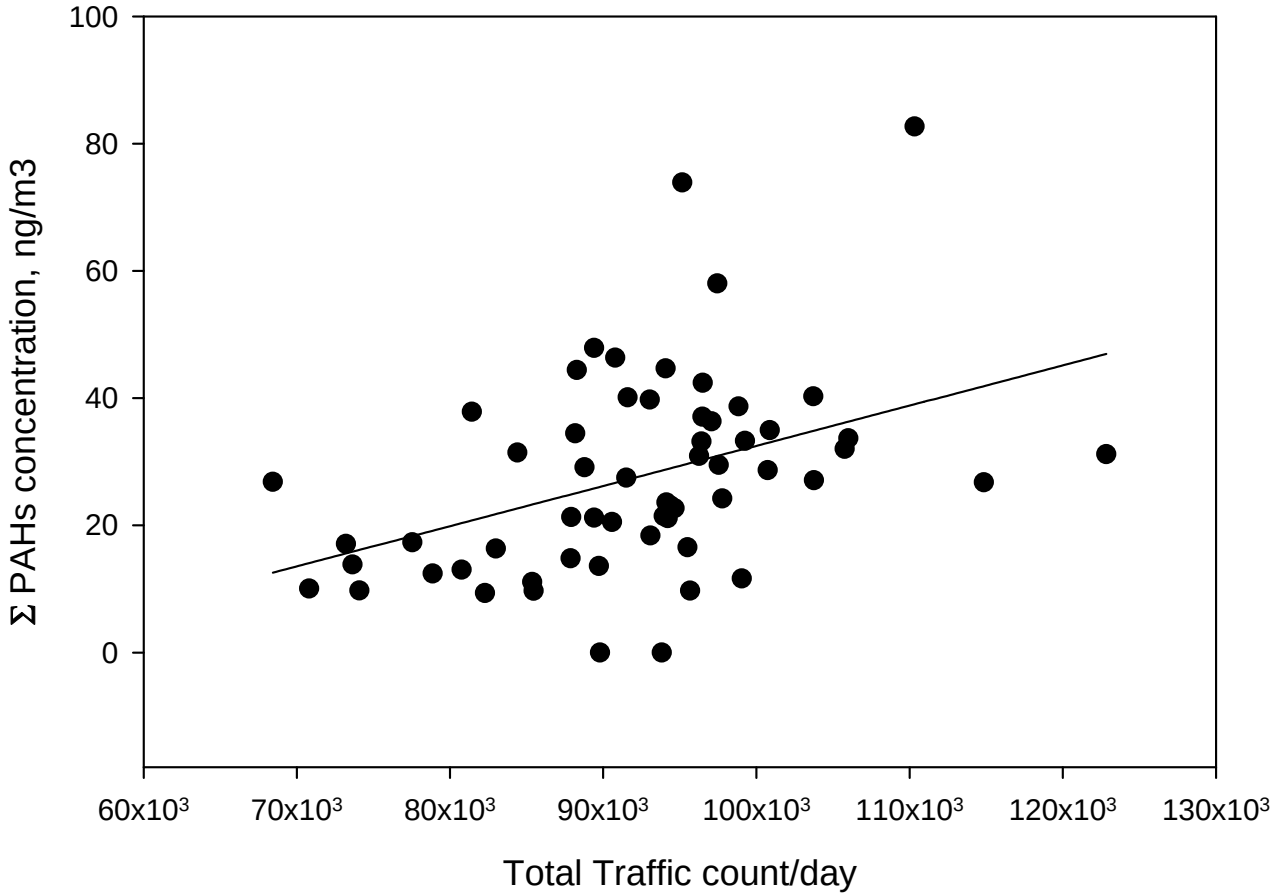


# Total Traffic Count  Effects on TSP



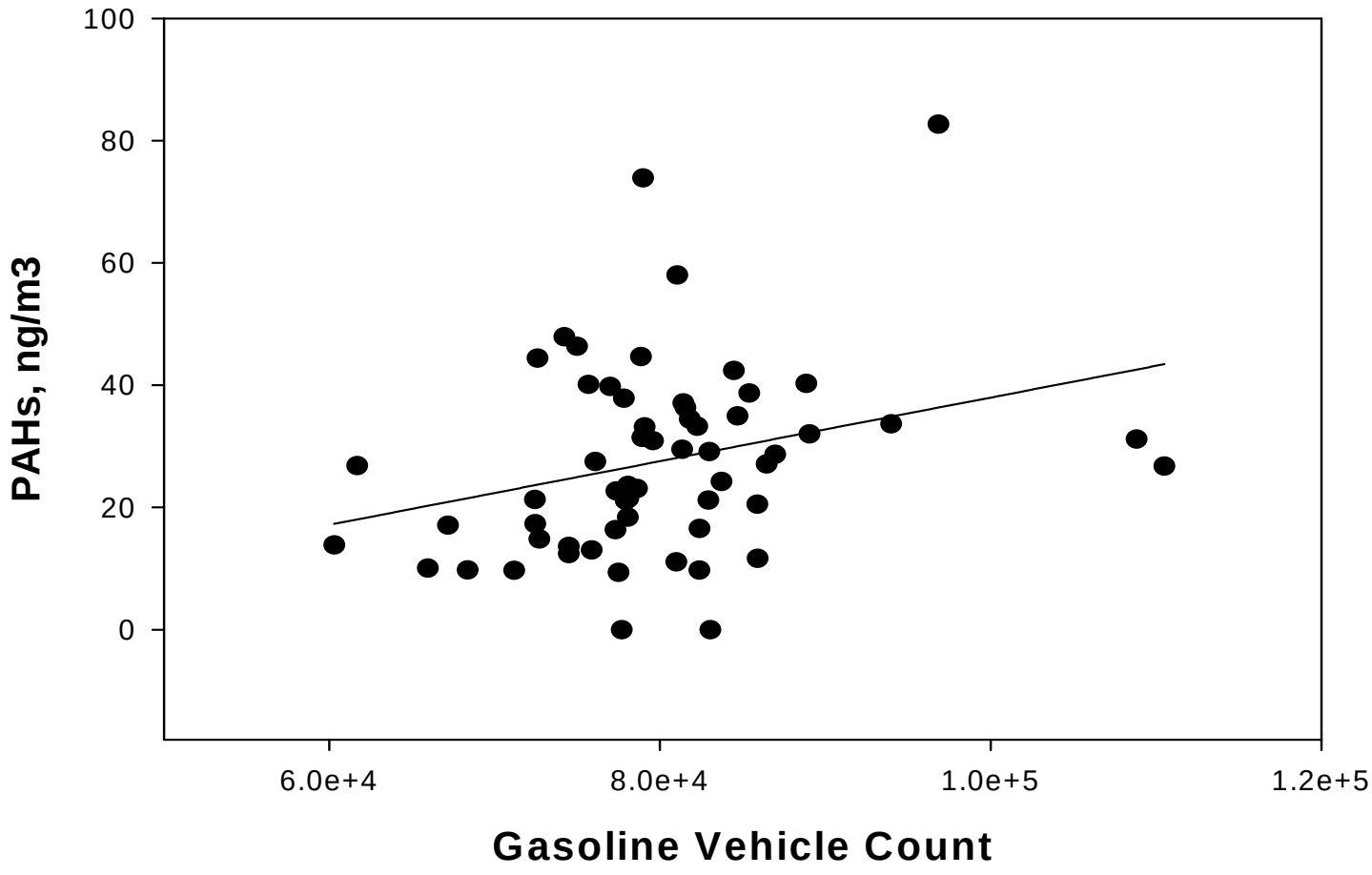

**TSP=0.0012×Traffic-58.26 ($r^2$=0.18, $p<0.001$)**

# Total Traffic Count  Effects on PAH



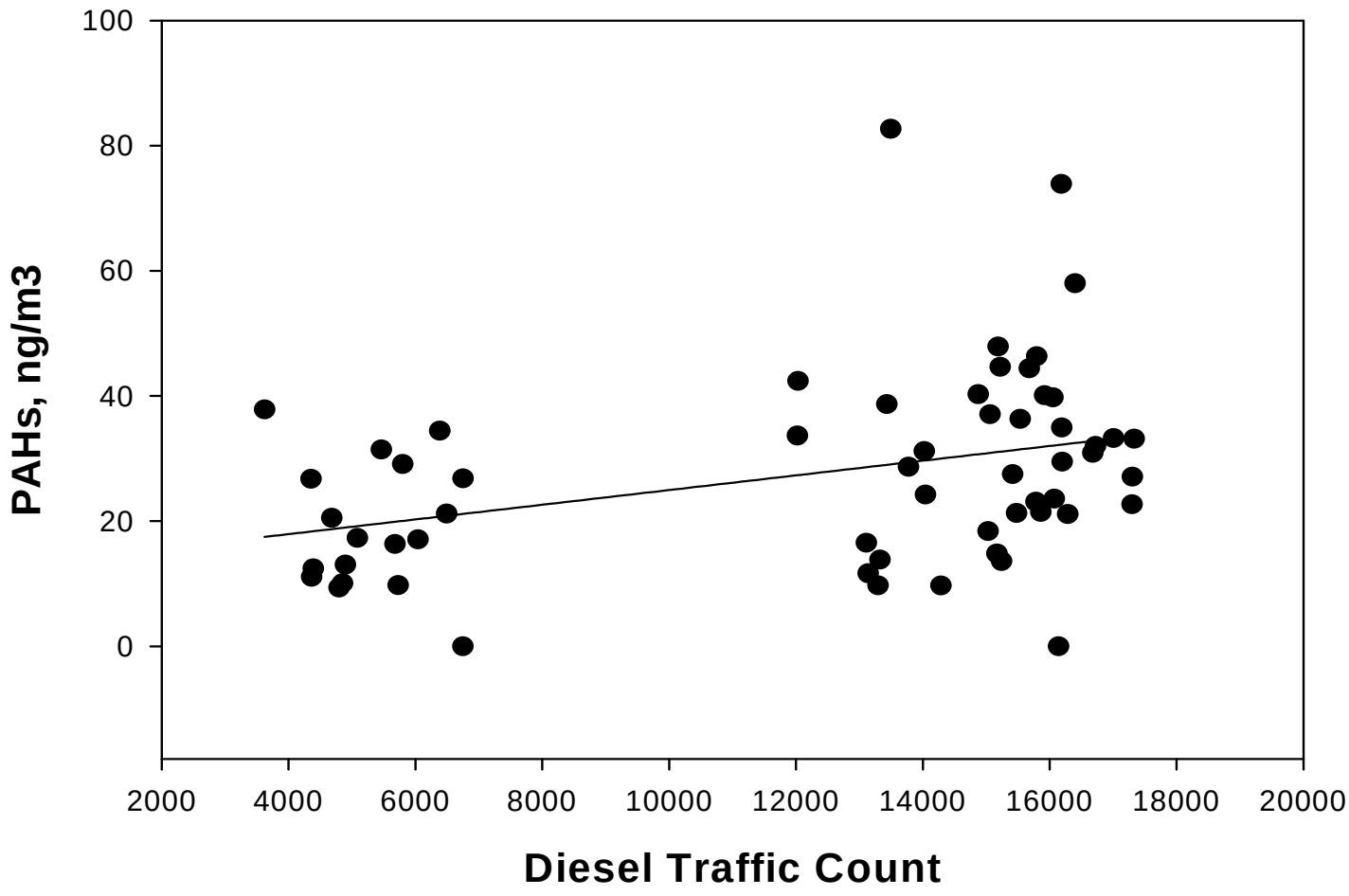

**$\Sigma_{16}$PAH=0.0007×Traffic-31.91 ($r^2$=0.23, $p<0.001$)**

# Gasoline Traffic Counts Effects on Total PAHs



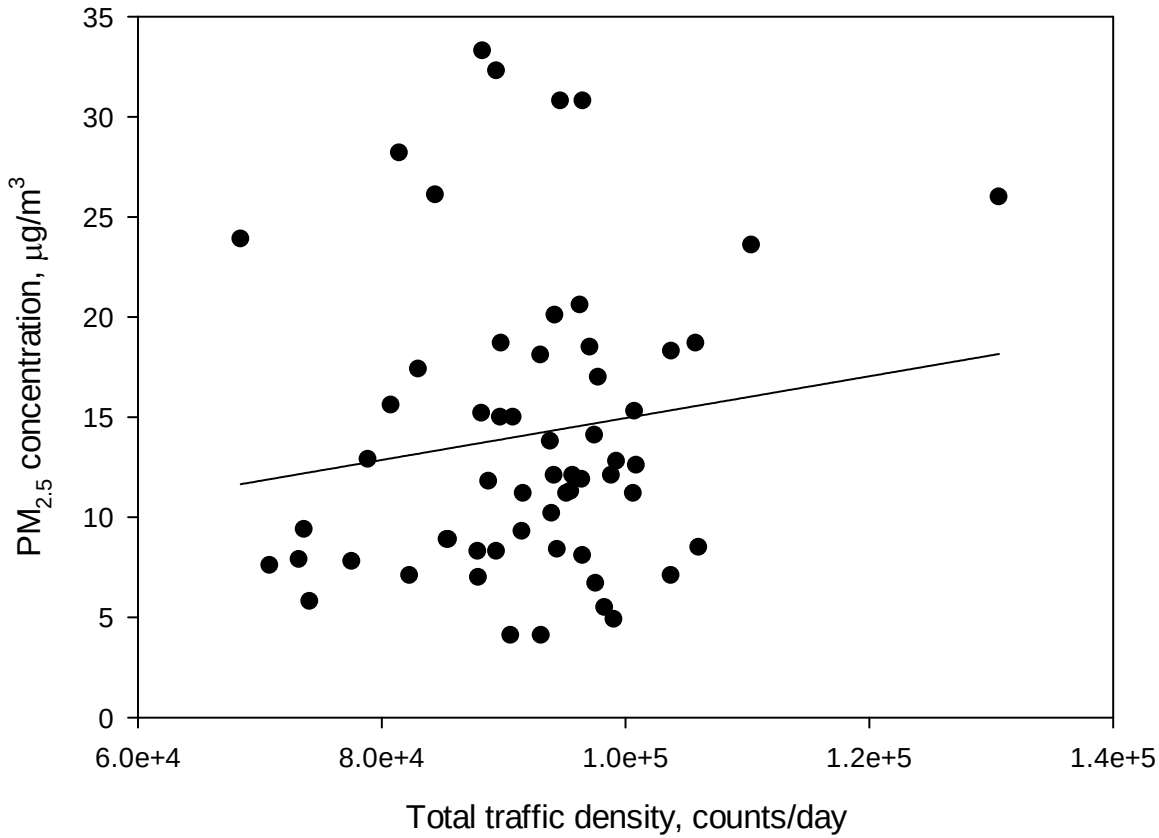

$\Sigma_{16}$PAH=0.0005×gasoline-14.05 ($r^2$=0.085)

# Diesel Traffic Counts Effect on Total PAHs



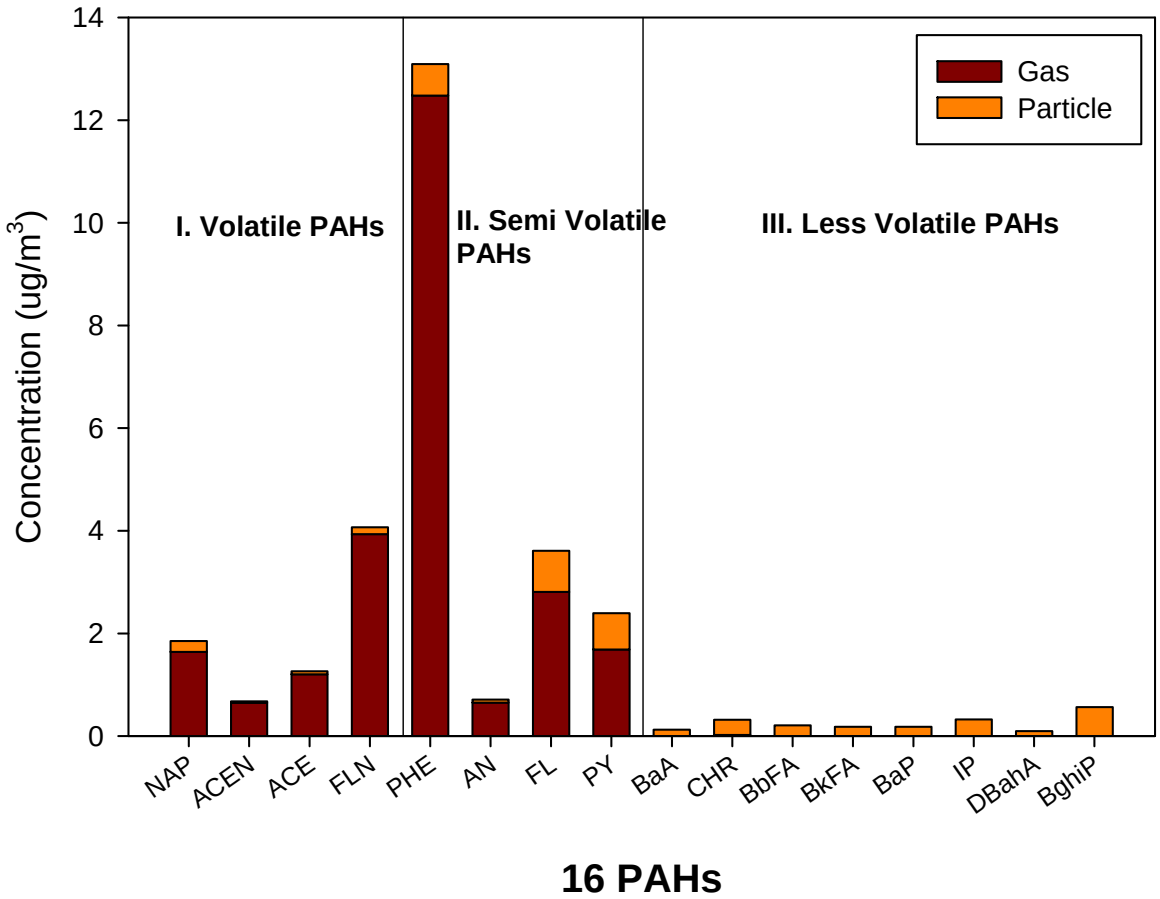

$\Sigma_{16}$PAH=0.001×diesel+13.24.05 ($r^2$=0.126)

# Total Traffic Count Effects on $PM_{2.5}$



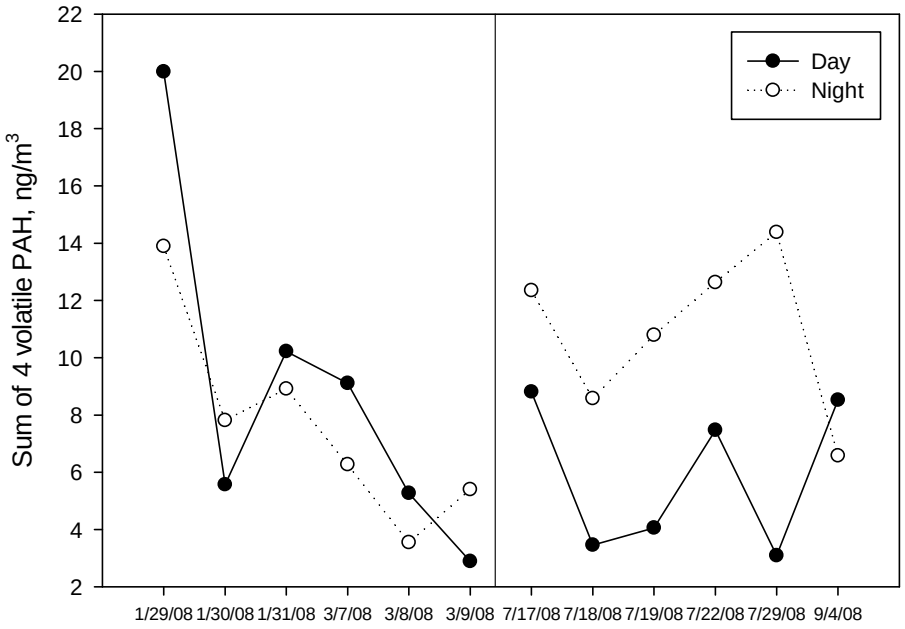

**$PM_{2.5}$=0.0001×Traffic-4.50 ($r^2$=0.02, p>0.05)**

# Gas and Particle Partitioning of PAHs



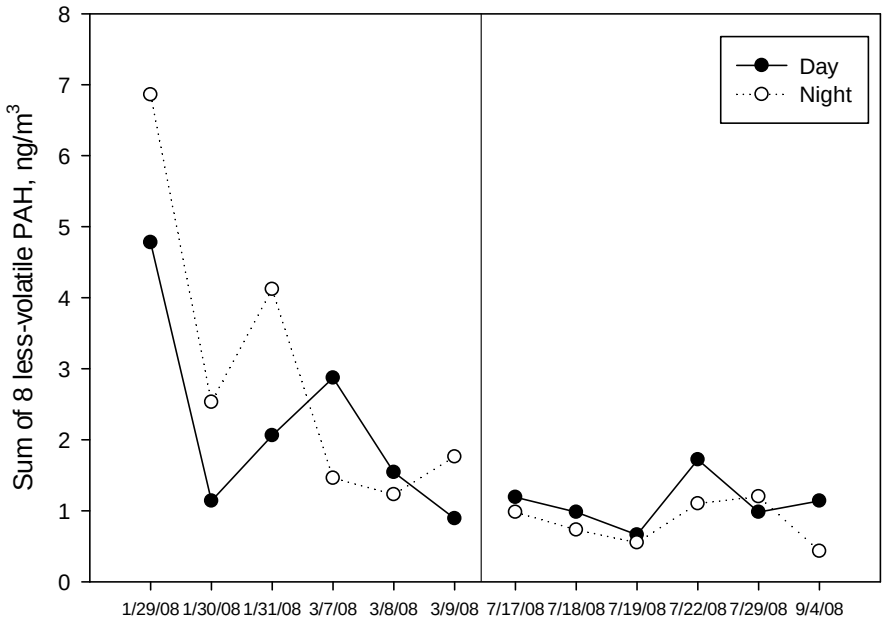
# Day/Night Effects
# (Intensive sampling)

## Σ4 PAH Volatile




**Winter** **Summer**

## Σ8PAHless volatile




**Winter** **Summer**

# Summary of Regression Models for Long Term Study

- **PM2.5 =** 10.66081 + 0.18679 Humidity – 12.53252 wind_high – 6.75168 wind_low – 4.64261 spr_ind – 1.78163 Precipitationt – 4.25155 sum_ind **($r^2$ = 0.22)**

- **TSP =** 55.52157 + 0.73510 Temperature – 0.40189 Humidity + 13.96973 d_50 – 20.32050 wind_low – 36.60680 wind_high + 12.14171 spr_ind + 1.79765 TotalDiesel – 9.51175 fall_ind – 13.64450 day_ind **($r^2$ = 0.58)**

- **Total PAH** = 2.50953 + 0.33610 TSP + 0.34562 TotalDiesel + 0.54219 Temperature – 7.98892 spr_ind – 9.88044 sum_ind + 3.25094 d_50 **($r^2$ = 0.59)**

# Data Visualization Demo

# Conclusion

- There was no difference in $PM_{2.5}$ concentration by distance.
- The concentrations of TSP at 50 m were higher than at 100 and 150 m.
- The concentrations of Total PAHs at 50 m were higher than at 150 m.

# Conclusion

- There was no statistically significant differences in seasonal $PM_{2.5}$ concentration ($p > 0.05$).
- The higher TSP concentration was observed in the spring and summer, compared the fall and the winter ($p < 0.05$).
- The higher total PAHs concentration was observed in the summer compared to winter at site A ($p < 0.05$).

# Acknowledgement

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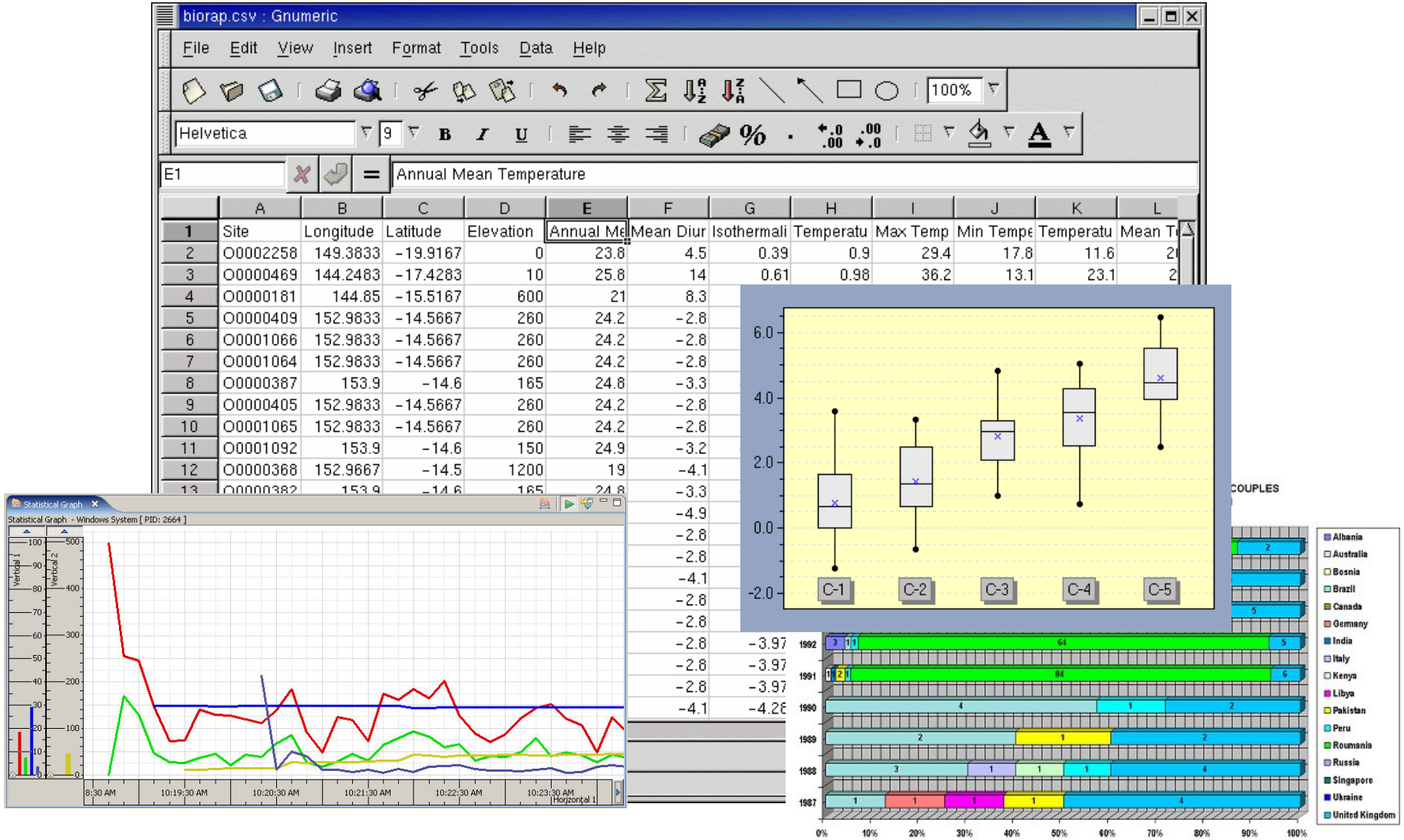
# Air quality data visualization

- Key: simple, easy, fun, …
- Considerations:
  - Large amount of data
  - Animation is good, and can represent lots of data!
  - However, we have very limited, short-term visual memory---we can only absorb very limited information from visual stimuli
  - And if there're multiple variables……

# Traditional presentations of results

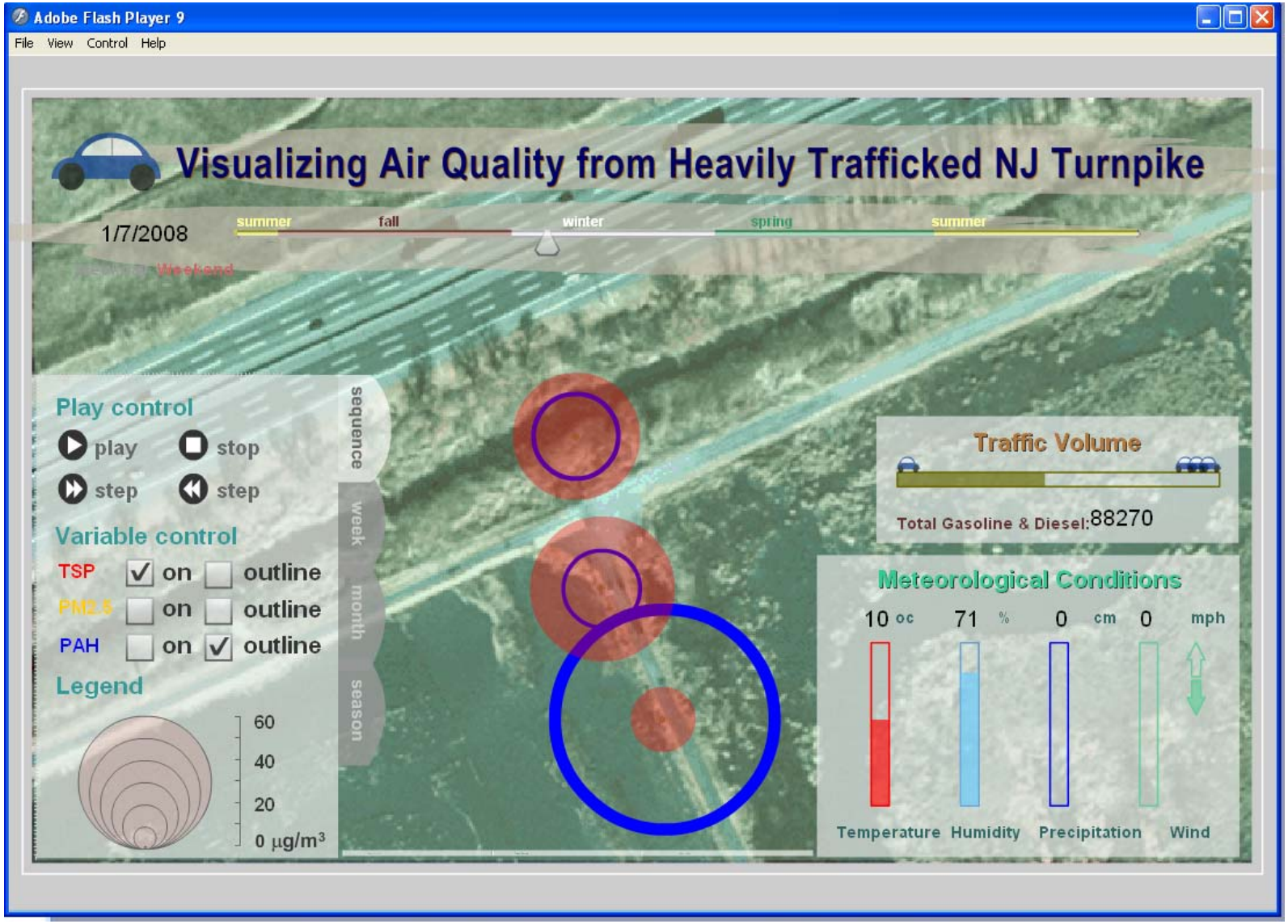


# Traditional presentations of results

- Key words:
  - Interesting?
  - Engaging?
  - Simple?
  - Easy?
- Key words:
  - Public communication
    - Simple Animation
    - Interaction

# Air quality data visualization

- Exploratory Data Analysis (EDA) methods
  - Temporal brushing
  - Temporal re-expression (DiBiase)
  - Cross-variable referencing
  - Benchmarking (Harrower)
  - Google finance charts
  - ……

  - To help common users ‘distill’ information (knowledge discovery by common users)

# The animated sequence