



# Semi-Continuous Measurements of PM<sub>2.5</sub> Carbon at the South Bronx, New York: Comparison with Filter Measurements

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New York State DEC - BAQS

Jim Schwab

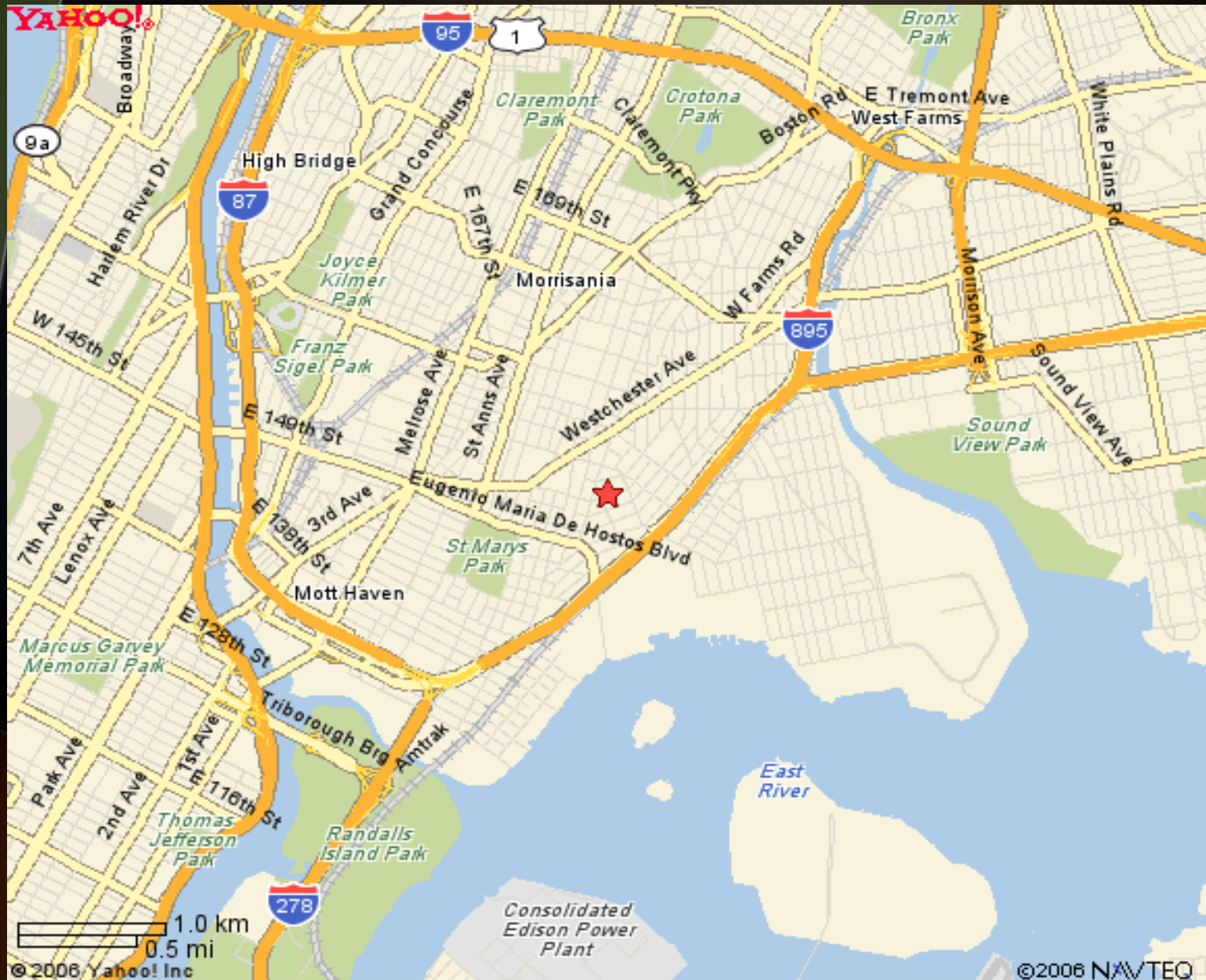
ASRC, University at Albany, SUNY

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# PM<sub>2.5</sub> Carbon

- Constitutes ~30-50% of PM<sub>2.5</sub> mass in New York City.
- Elemental Carbon (EC)-(Black carbon, BC);
  - Direct emission from fuel combustion (pyrolysis of organic carbon). 10-20% of TC.
- Organic Carbon (OC)- Major fraction.
  - *Primary*-direct emission from combustion processes, cooking, industrial processes, biogenic sources
  - *Secondary*-(SOA), VOC photo-oxidation products
- Inorganic Carbon- carbonates, CaCO<sub>3</sub>. (limestone, dust) - not observed in New York City.

# South Bronx, IS52- (681 Kelly St.).





IMPROVE Sampler

STN Sampler (R&P)

Inlets for Semi-Continuous Analyzers



# SUNSET Labs EC/OC Carbon Analyzer



## SUNSET Carbon

- PM2.5 cyclone
- SS Inlet
- Denuder (activated carbon strips)
- Quartz filter collects sample
- Hourly OC, EC
- Thermal conversion to CO<sub>2</sub>
- NDIR Detection



# Filter Measurements

- 24 hr, 1 in 3 Day Schedule, Quartz filter
- R&P 2300 Partisol (end 1/11/06), 10LPM, 14.4 m<sup>3</sup>



Silicon greased impactor

- Met-One SASS ( beg. 1/14/06), 6.7LPM, 9.6 m<sup>3</sup>



sharp cut cyclone

# Flow Characteristics of Sunset Analyzer

- Sunset Labs ECOC, 47 min samples, 8 li/min,  $\sim 0.4 \text{ m}^3$  per sample

## Comparison of Filter Face Velocities

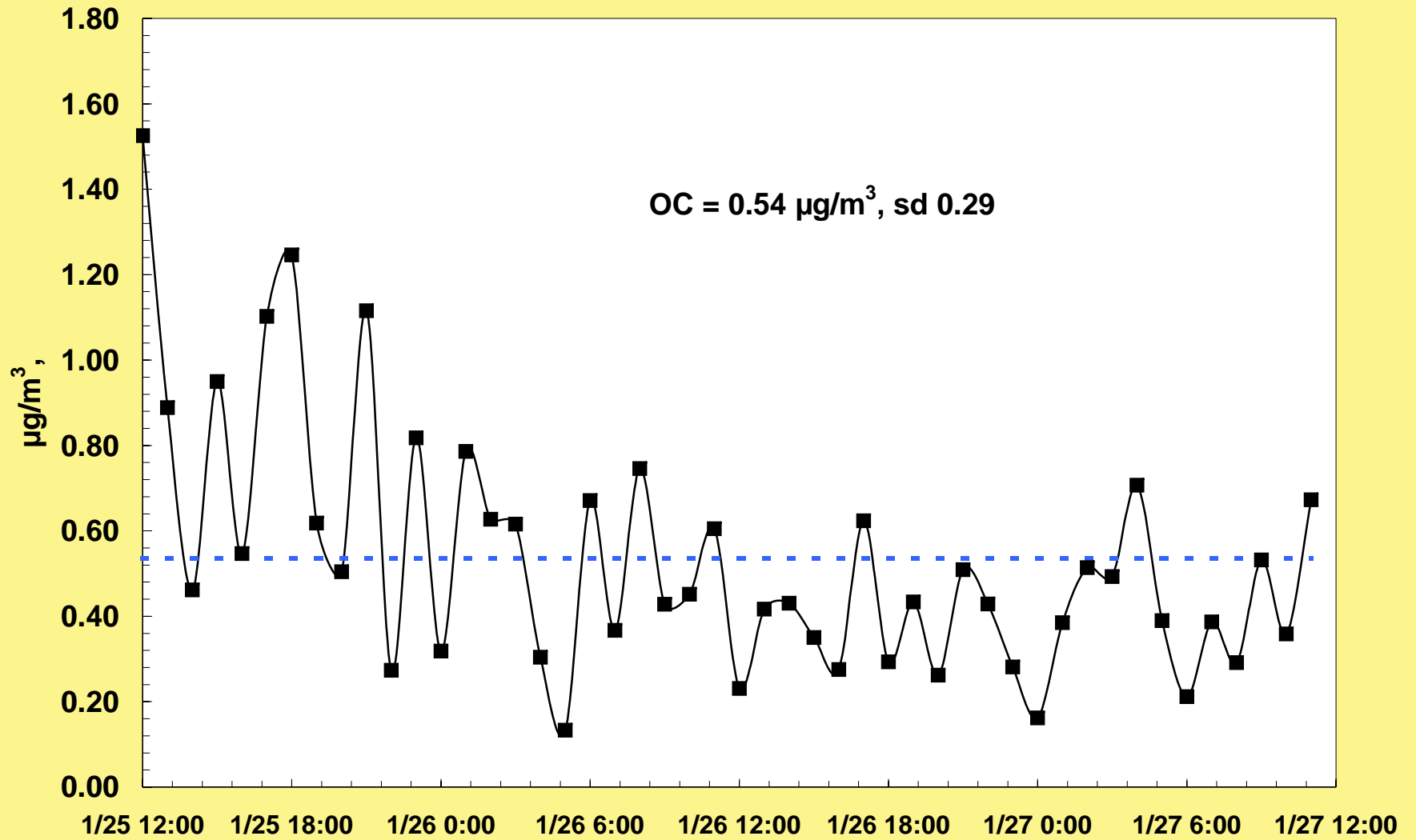
- Sunset:  $\sim 80 \text{ cm/s}$
- R&P Partisol 2300 (24-hr filter):  $\sim 9.6 \text{ cm/s}$
- MetOne SASS (24-hr filter):  $\sim 6.4 \text{ cm/s}$



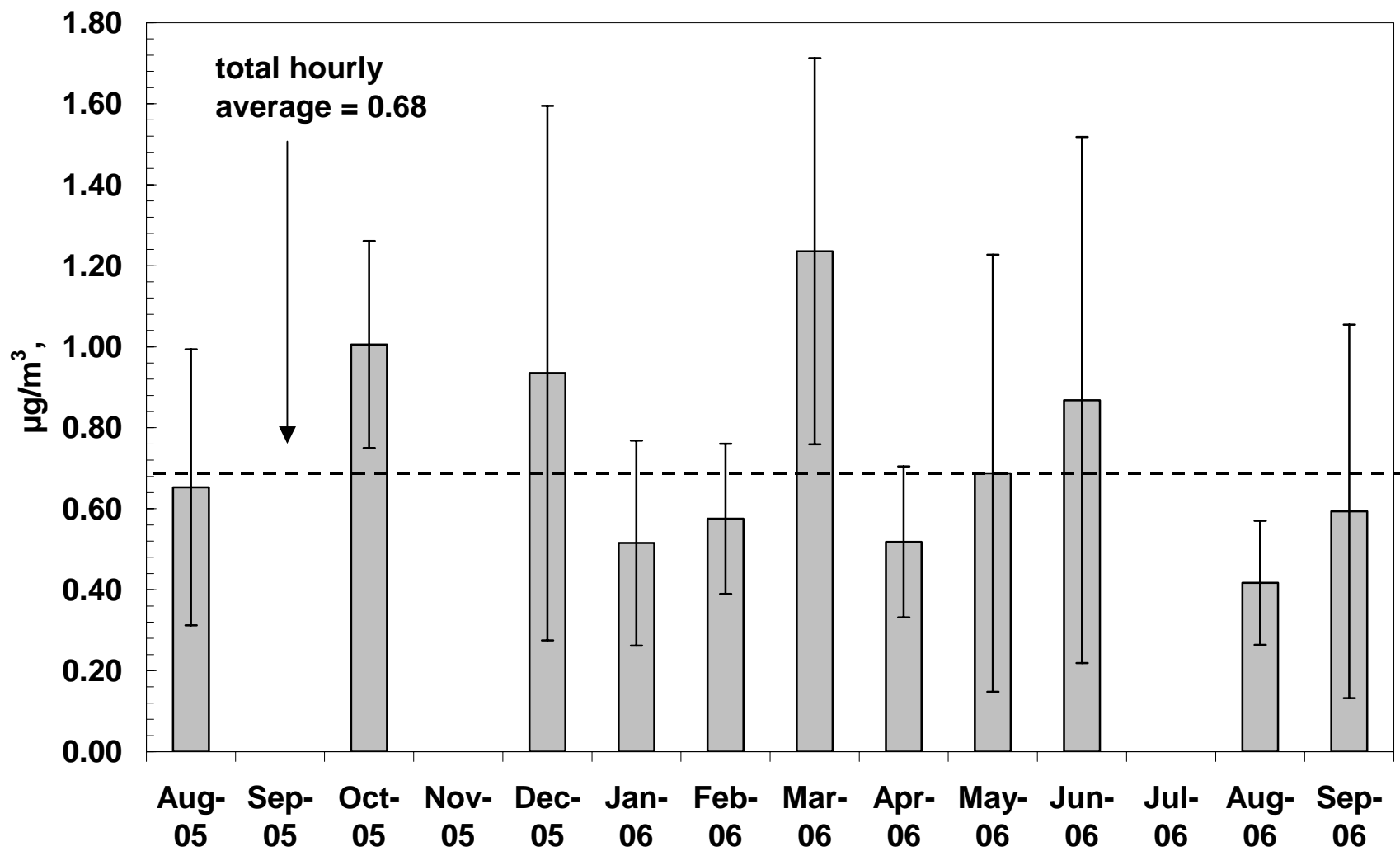
Measurement of "blank" or  
positive artifact for Sunset



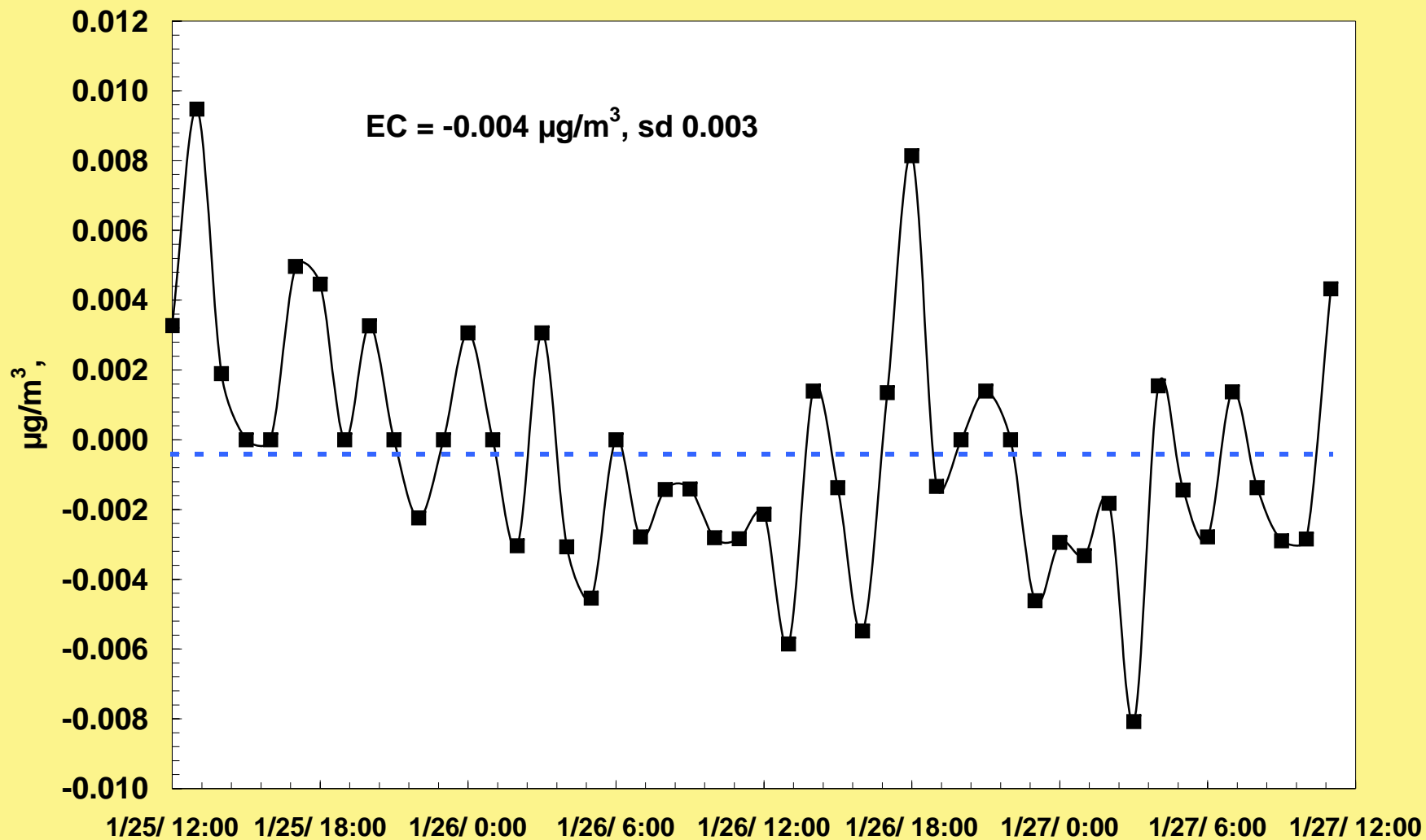
# Organic Carbon Blank, Jan 25-27, 2006



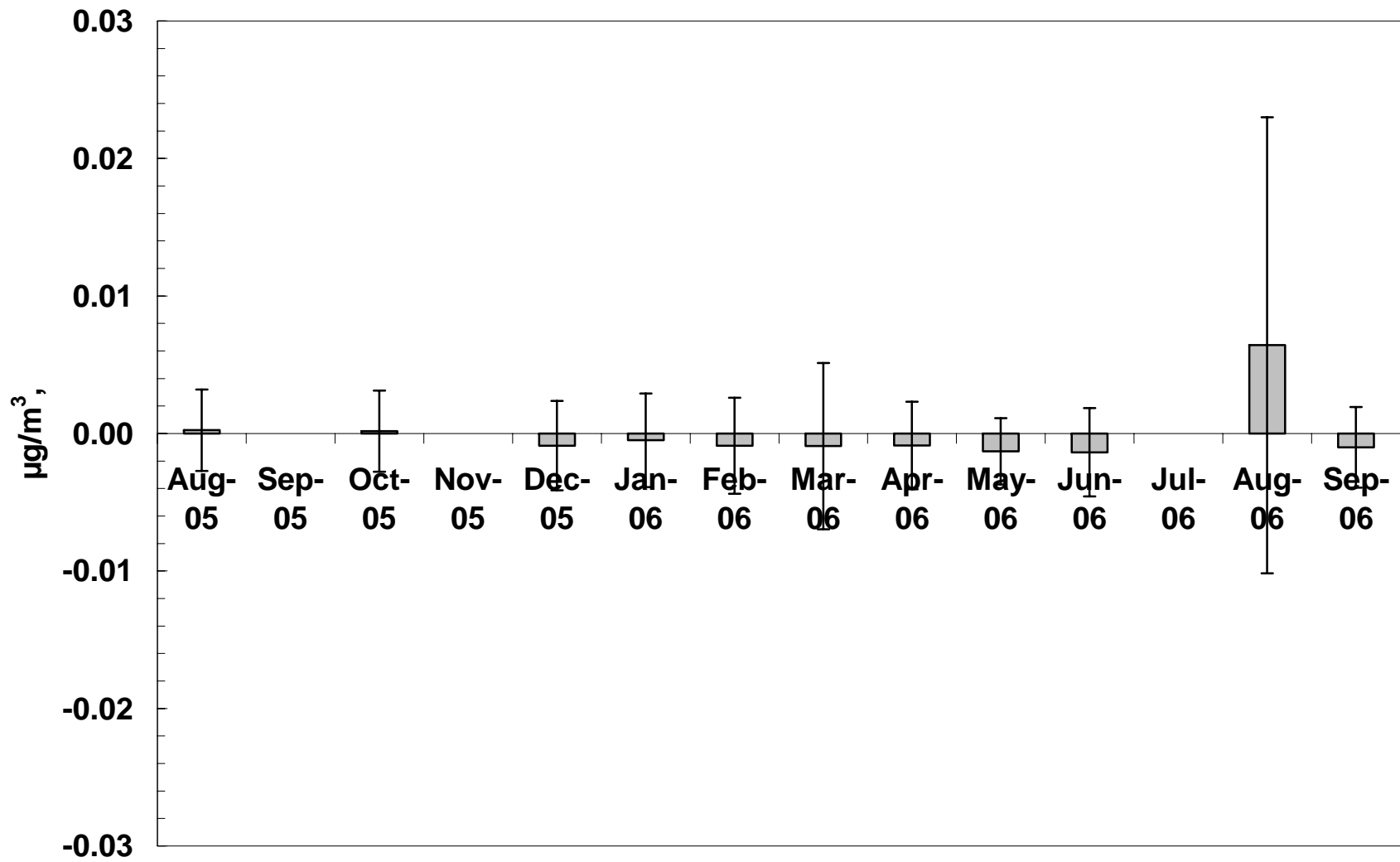
## Mean and Std Dev. SUNSET Hourly OC Blanks, South Bronx



# Elemental Carbon Blank, Jan 25-27, 2006



### Mean and Std. Dev. SUNSET Hourly EC Blank, South Bronx

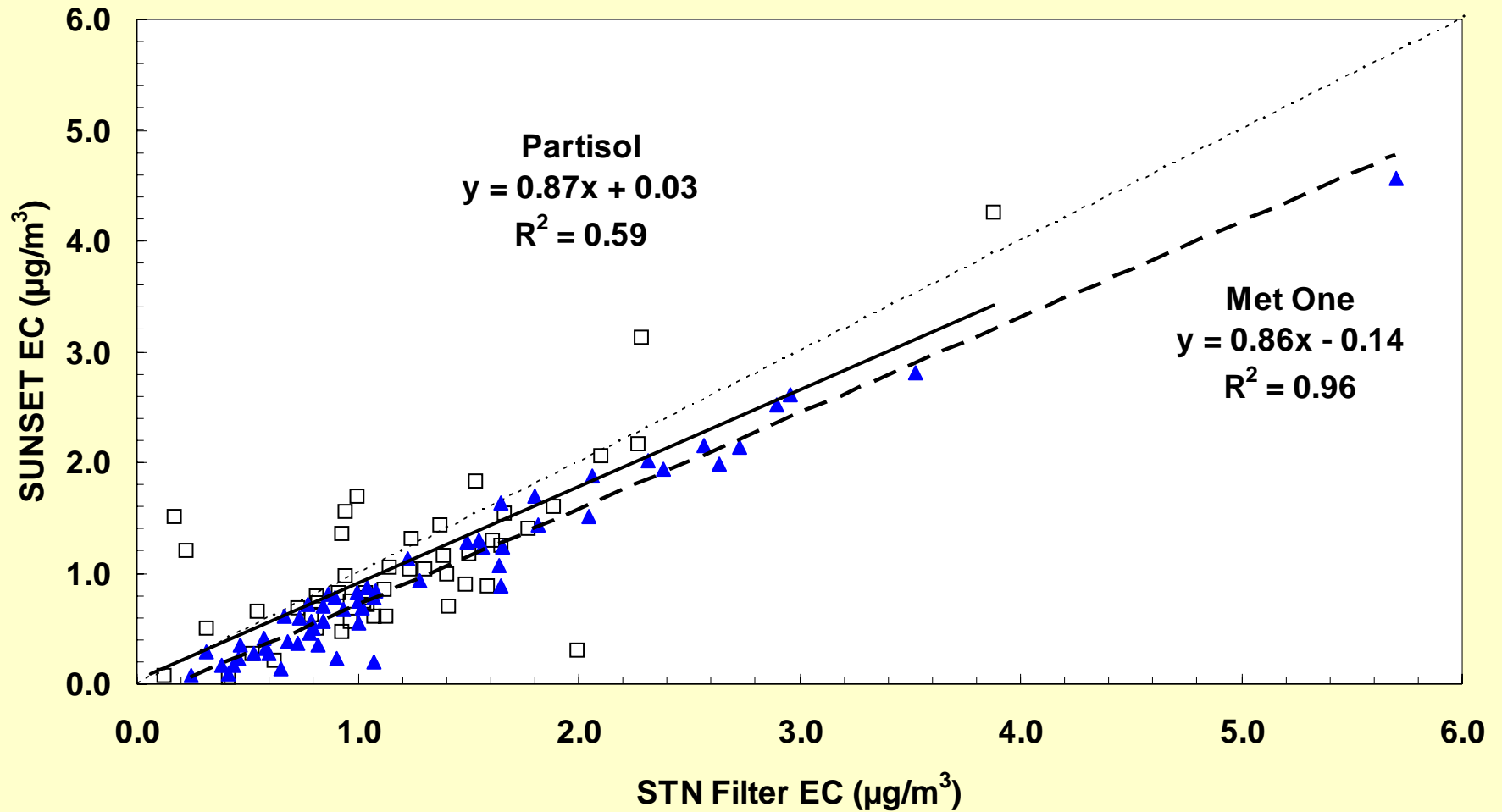




# Comparison of Semi-Continuous Sunset to STN Filter Measurements of EC & OC

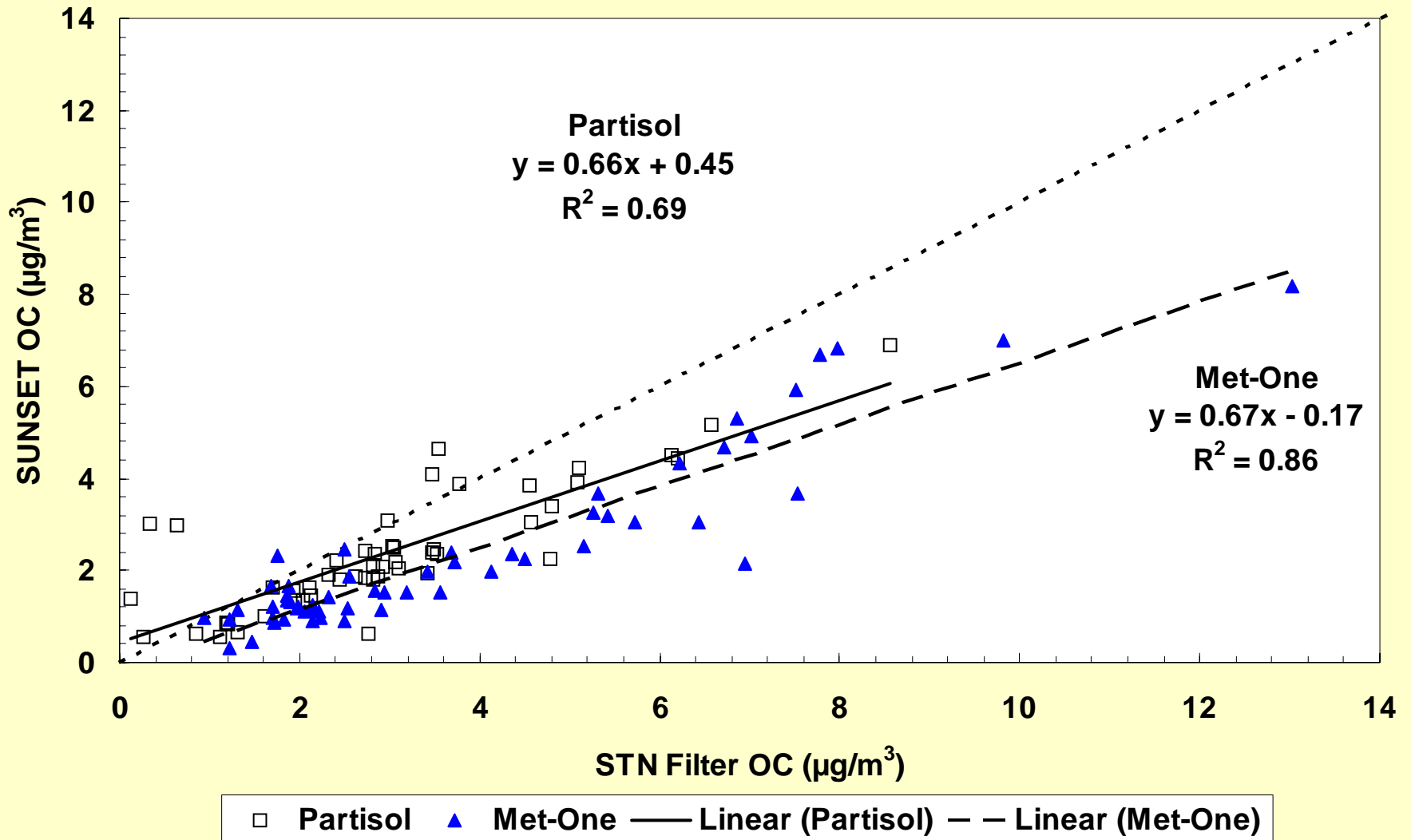
Blank or positive artifact corrections are applied to the STN data based on averages of field and trip blanks at the South Bronx site. (Averages are done separately for R&P and MetOne samplers.)

## 24Hr SUNSET vs STN Filter Elemental Carbon

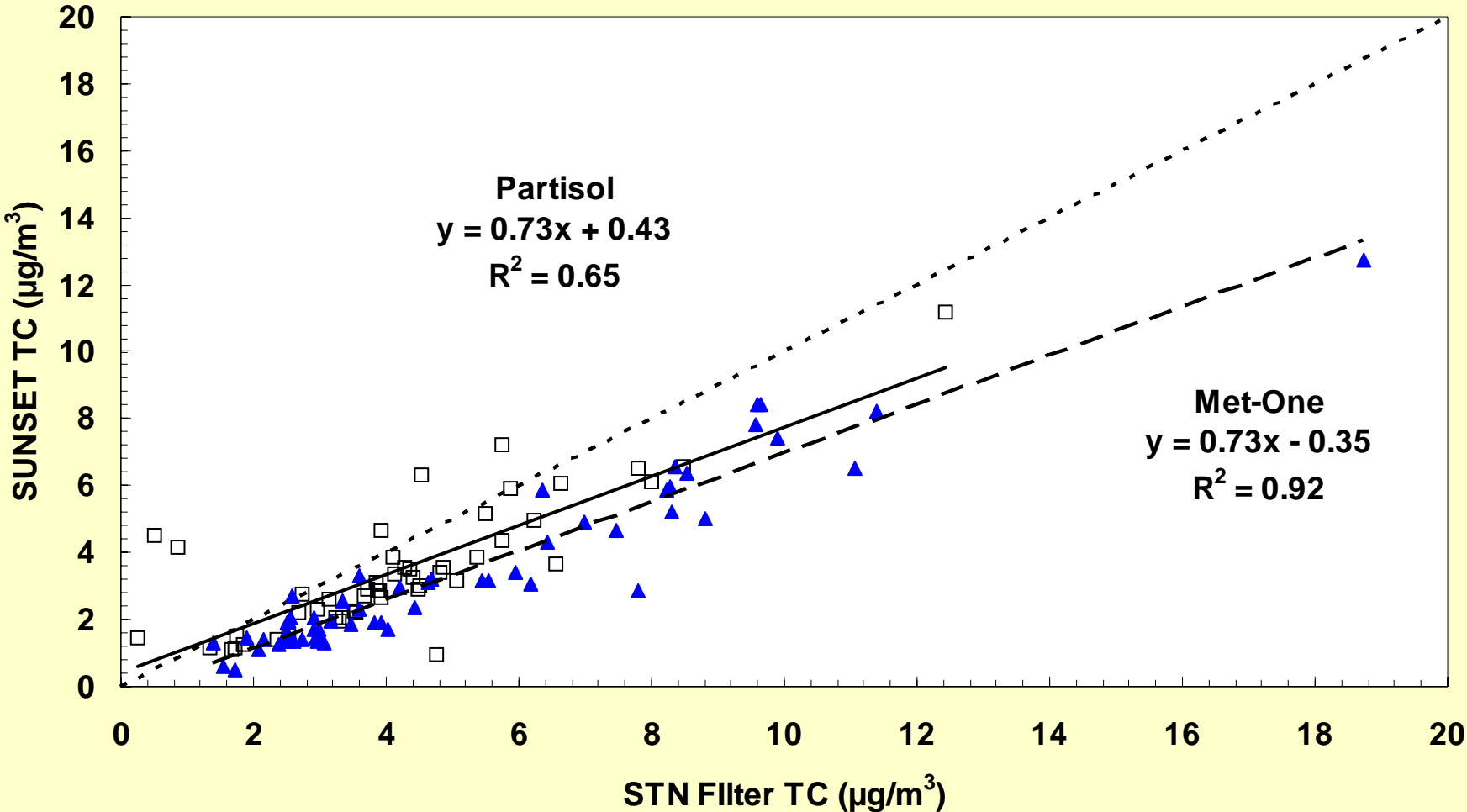


□ Partisol    ▲ Met-One    — Linear (Partisol)    - - Linear (Met-One)

## 24 hr SUNSET vs STN Filter Organic Carbon



### 24 hr SUNSET vs STN Filter Total Carbon



□ Partisol    ▲ Met-One    — Linear (Partisol)    - - Linear (Met-One)

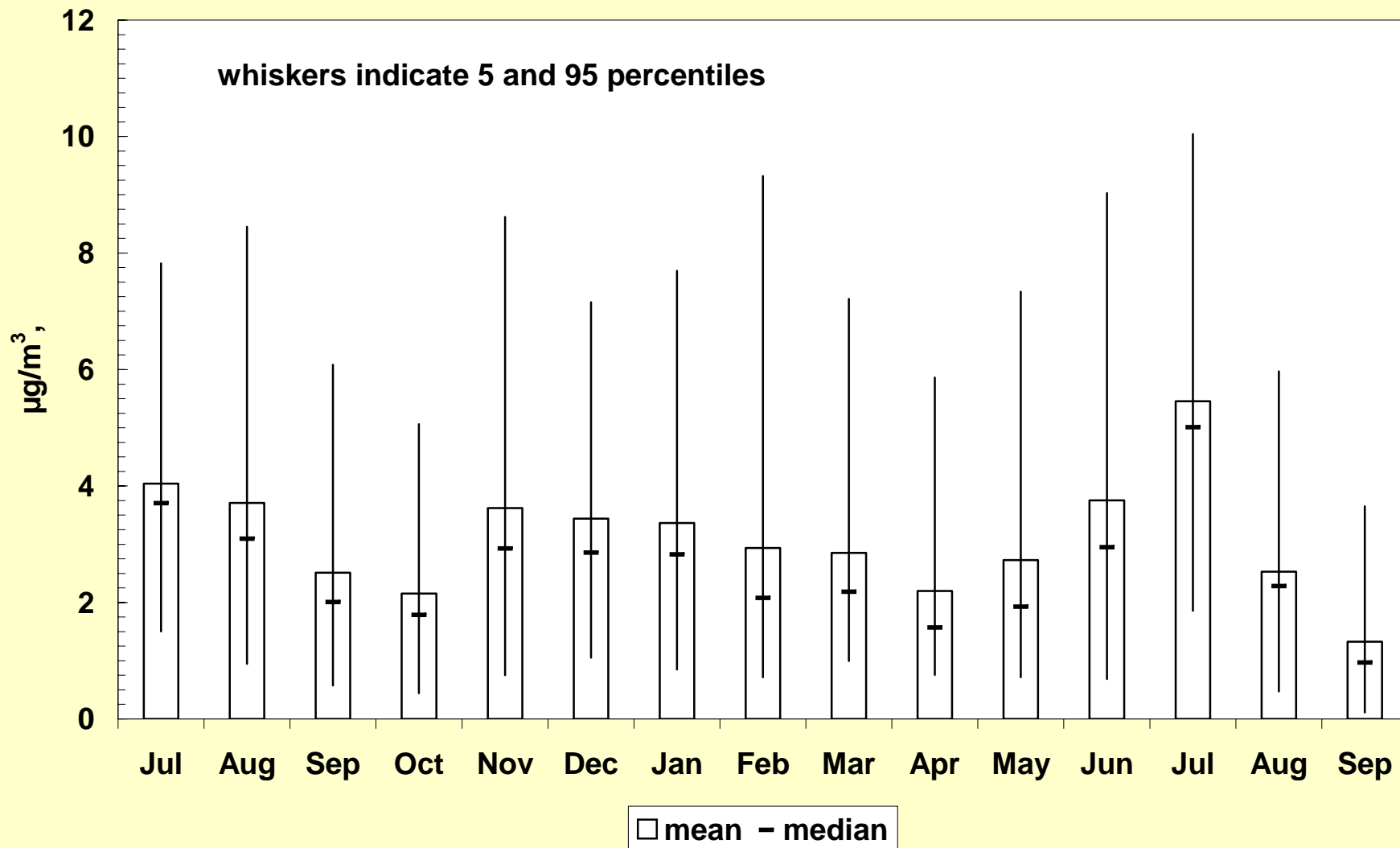




# Seasonal and Day-of-Week Patterns from Sunset Data

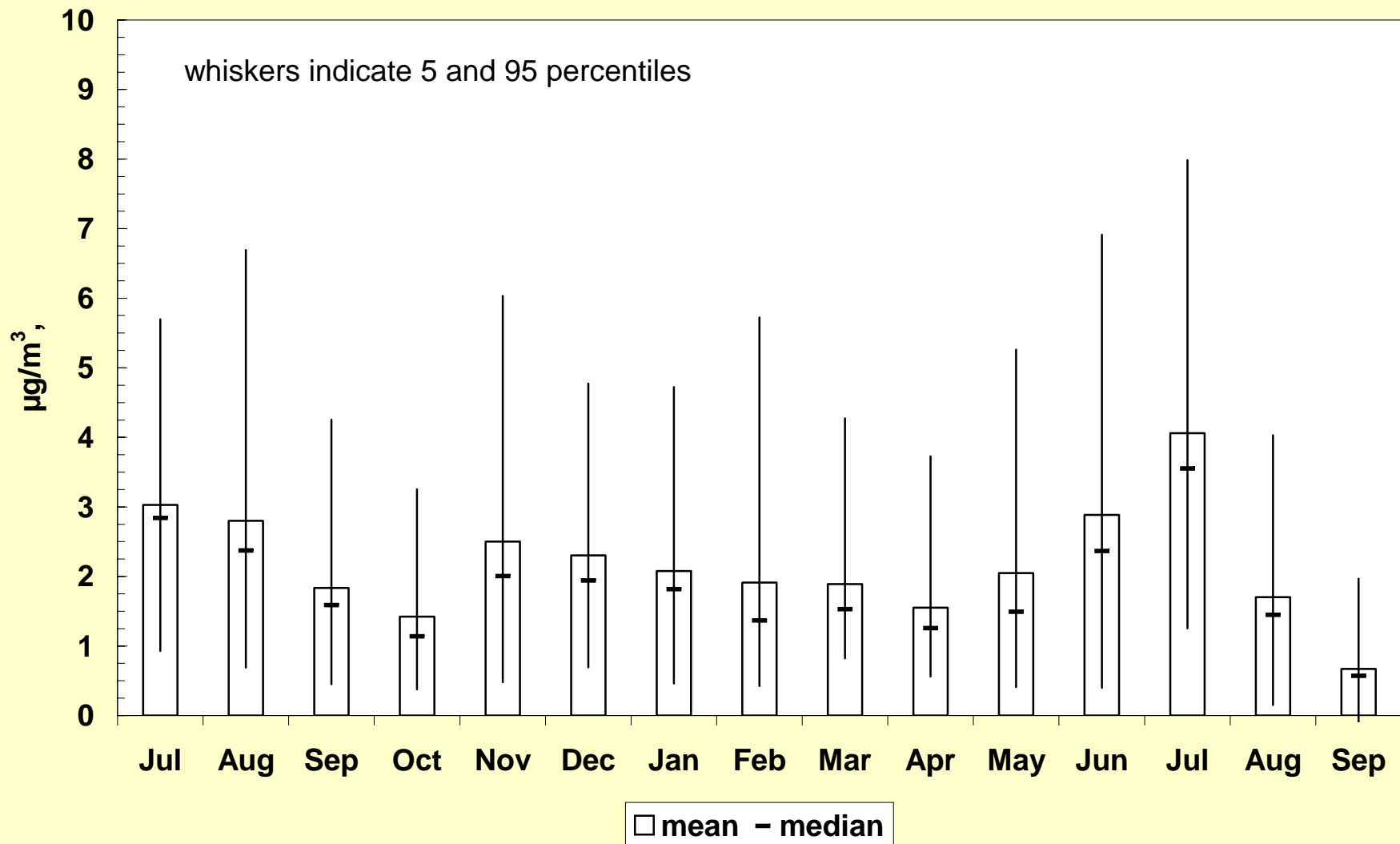
# Seasonal Variation

## Monthly SUNSET Total Carbon, South Bronx, 2005-2006



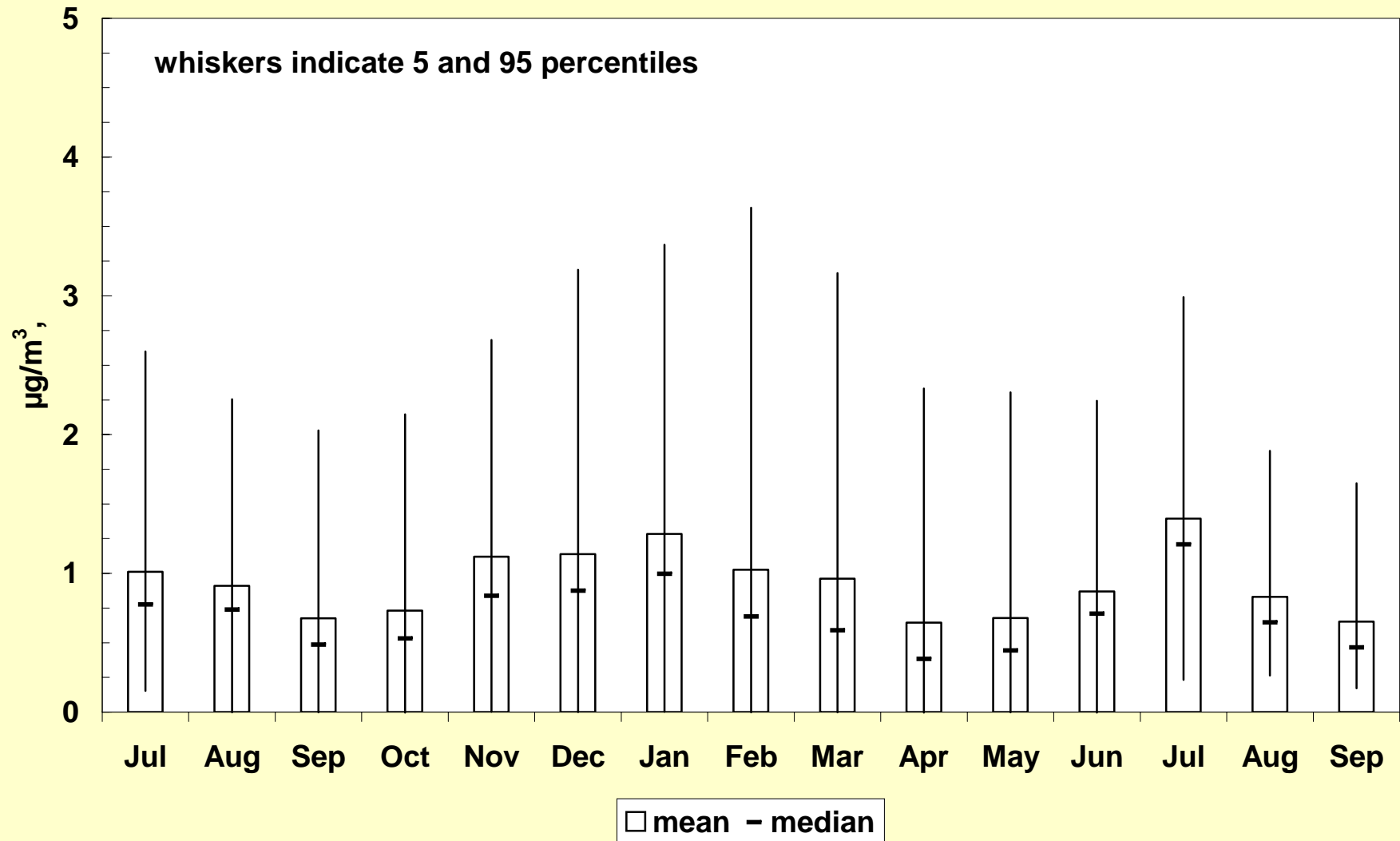
# Seasonal Variation

## Monthly SUNSET OC, South Bronx, 2005-2006



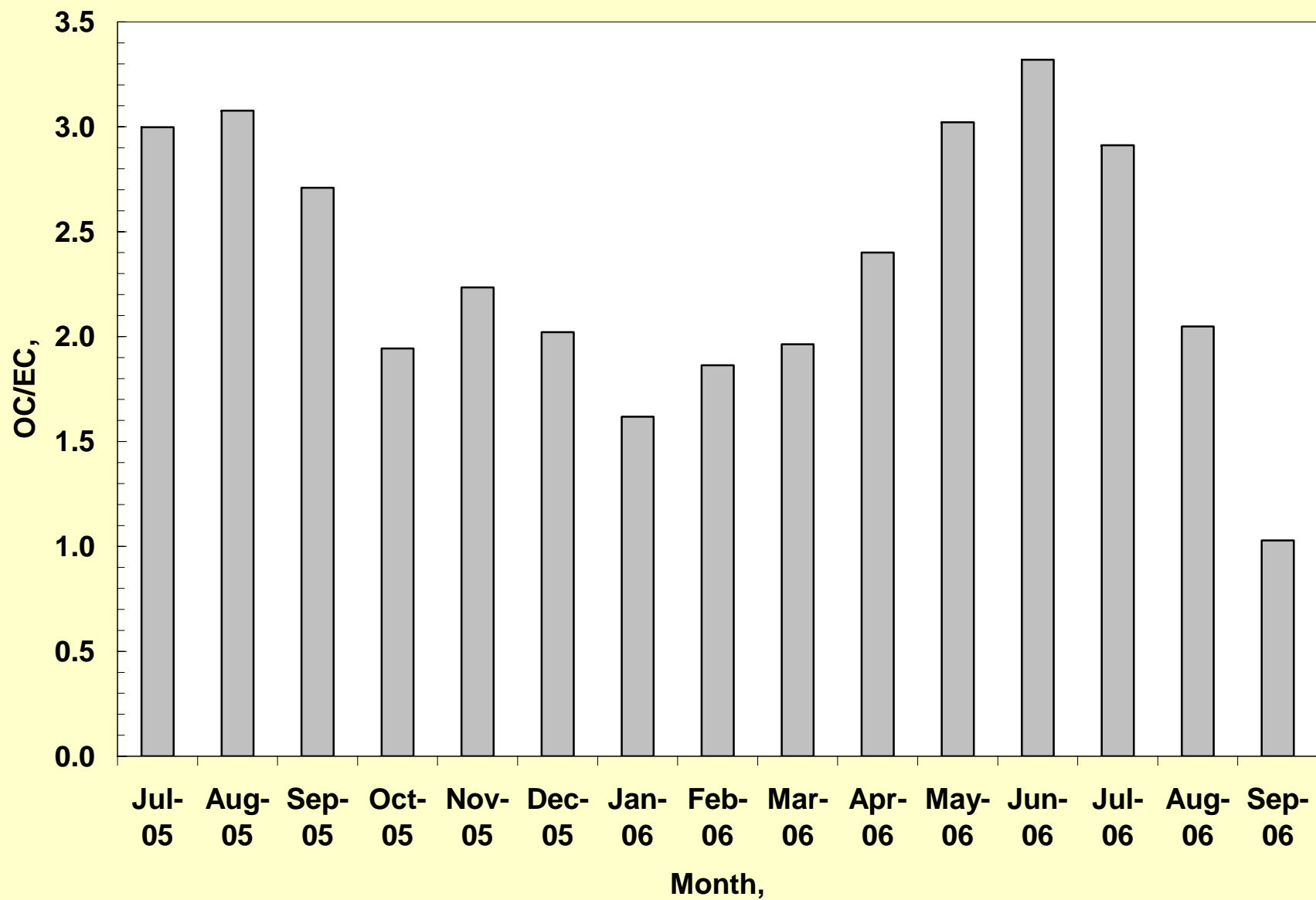
# Seasonal Variation

## Monthly SUNSET EC, South Bronx, 2005-2006



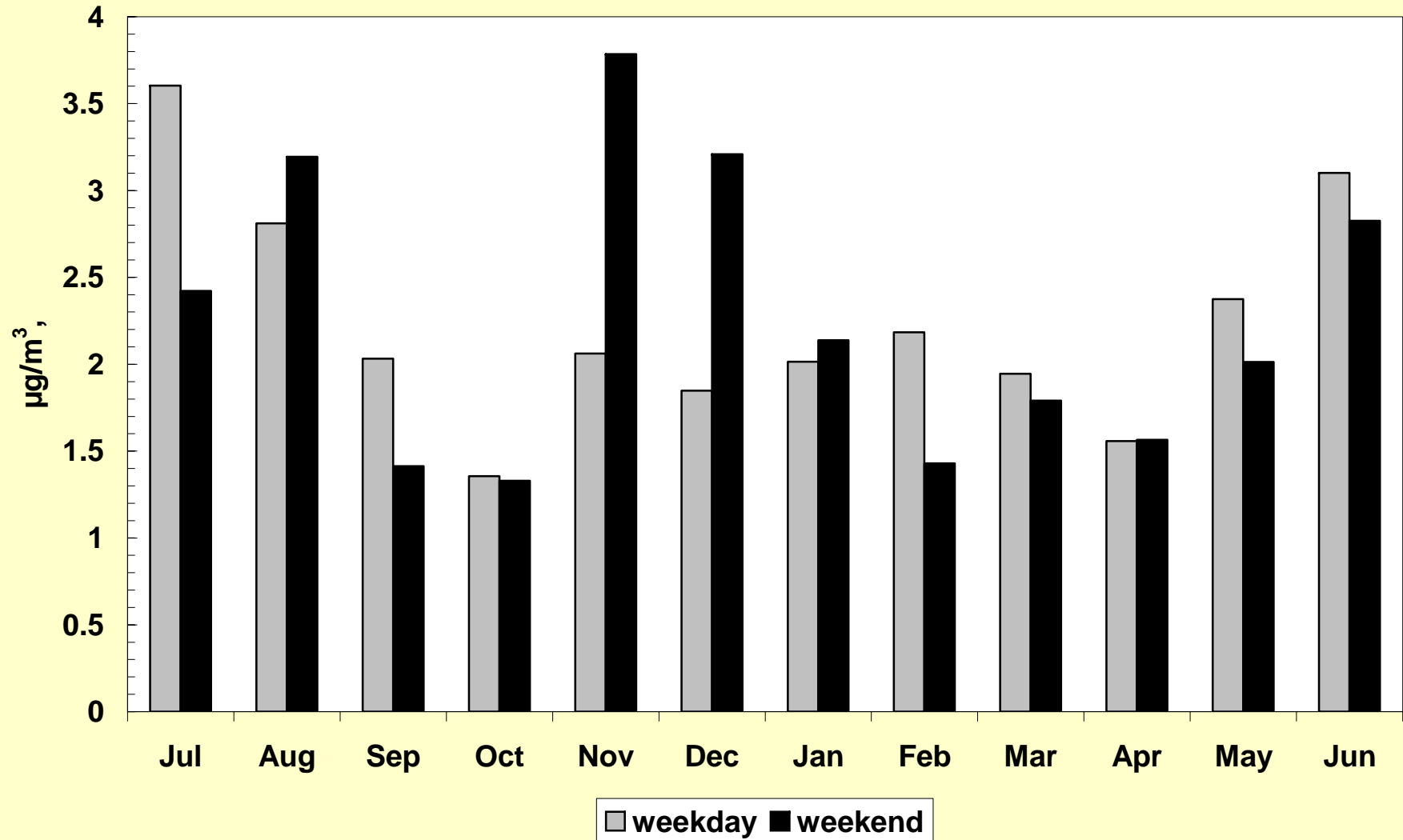


## Ratio OC/EC 2005-2006, South Bronx



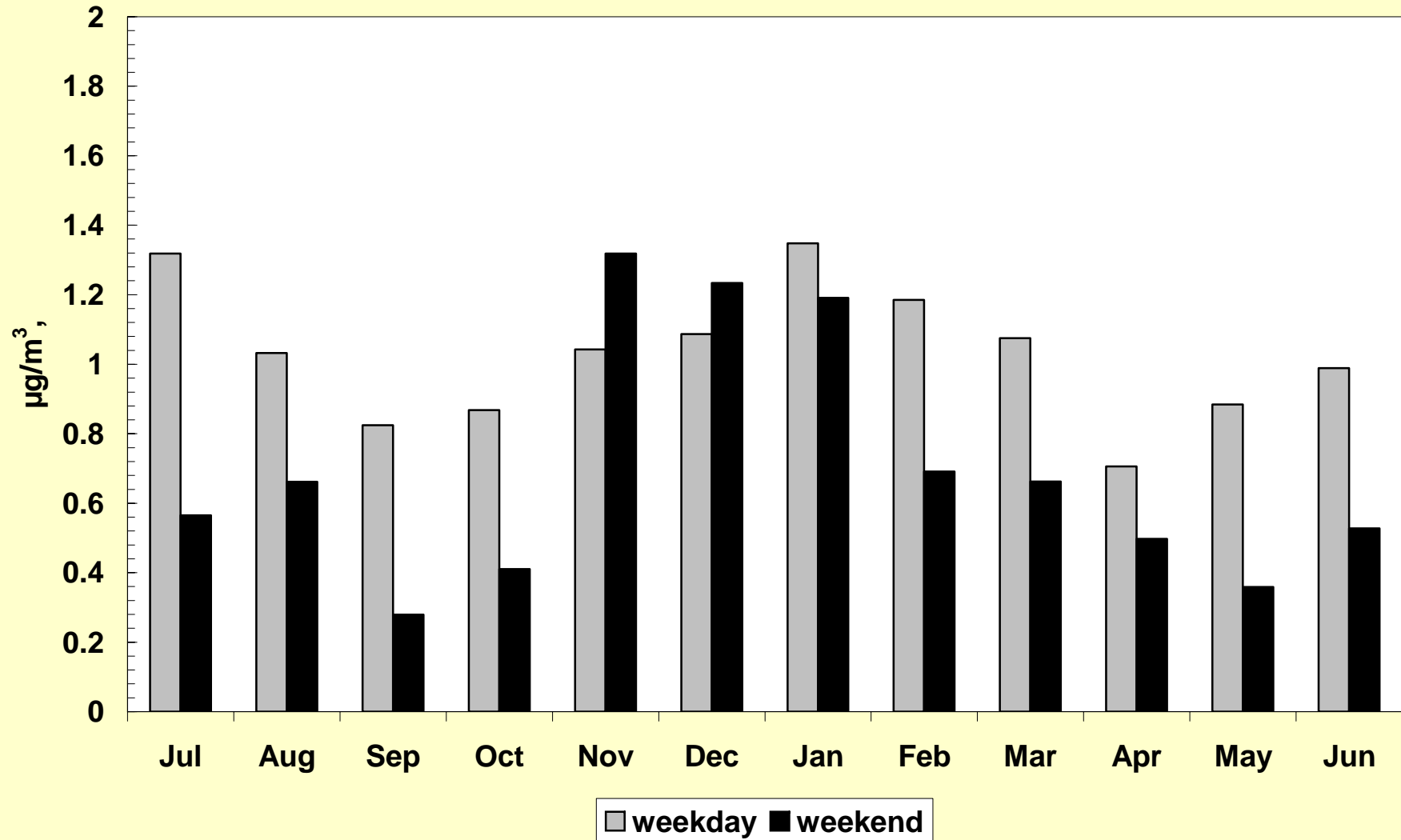
# Day-of-Week Variation

Organic Carbon, 2005-2006, South Bronx



# Day-of-Week Variation

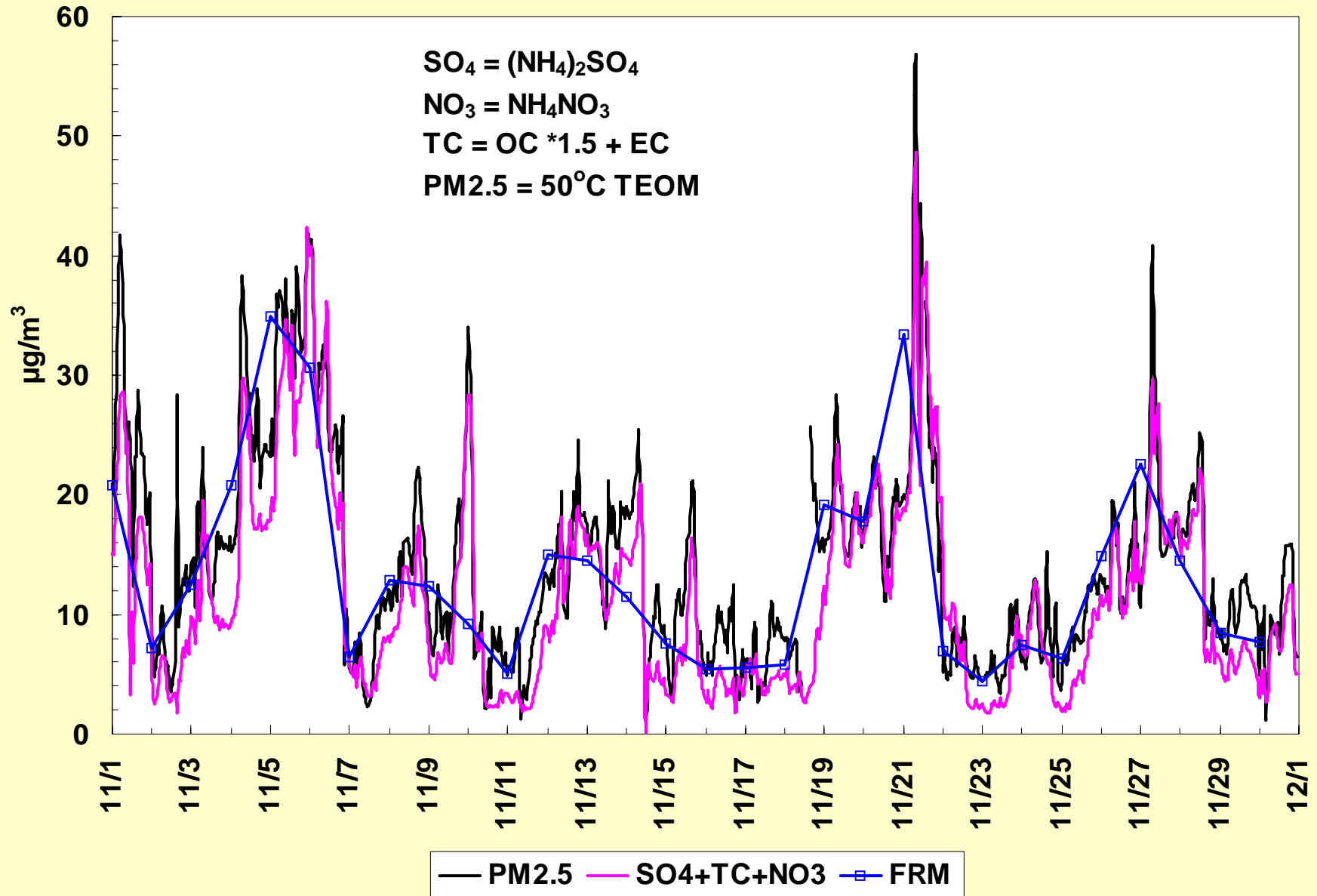
## Elemental Carbon, 2005-2006, South Bronx



# Example of the Power of Continuous Measurements for PM<sub>2.5</sub> Mass Reconstruction

- PM<sub>2.5</sub>: TEOM - 50° C "standard"
- Sulfate: Thermo 5020 - Values x 1.375 to account for ammonium
- Nitrate: R&P/Thermo 8400N - Values x 1.29 to account for ammonium
- OM: OC x 1.5
- EC: used as measured

# Nov 2005



## Method Issues - Sunset

- Stable measurement of positive artifact ("blank") requires ~24 hours
- Variability of OC positive artifact - use annual, seasonal, or monthly values?
- Collection of SVOC - front oven cool down time, and ~30° C Filter Temp.
- Carbon paper denuder - are activated carbon monoliths more appropriate?
- Should we use Optical or Thermal EC? What do we do with the other?

# Conclusions - Artifacts

- Artifacts (blanks) are an issue
- No clear solution:
  - Improve "correction" scheme
  - Improve method (i.e., eliminate issue)
  - ???

# Conclusions – Filter Comparisons

- Mixed results
  - EC okay (<15% difference)
  - OC less good (>30% difference)
- How do we know which is right? (i.e., STN or Sunset)
  - STN - no denuder
  - Sunset - SVOC loss?
  - Need calibration “standards”
- Is there a “monitoring” method that can quantitatively collect SVOC?



# Conclusions - Observations

- OC concentrations are highest from June to August
- EC appears to be a little higher in winter (as expected)
- Day-of-week dependence is weaker than expected. EC shows greater contrast for most months.

# Acknowledgements

- Rich Colas and Sergio Fleishaker for help with instrument operation at IS52
- ASRC colleagues Ken Demerjian and Olga Hogrefe