

MEASUREMENTS of PM_{2.5} Carbon in NEW YORK CITY

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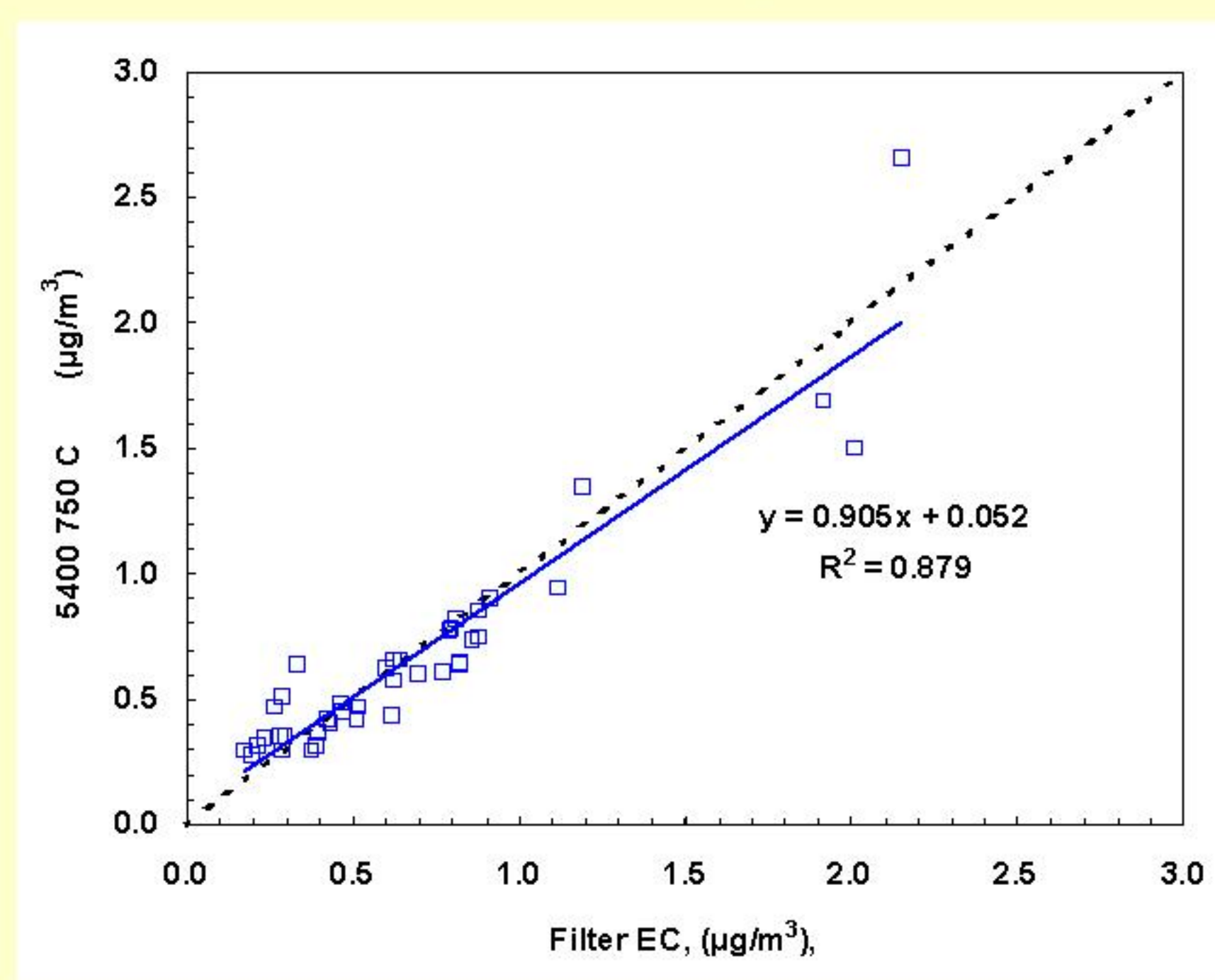


Introduction

Carbon is one of the major components of PM_{2.5}. However, measuring carbon particulate is challenging because of its complex makeup and high volatility, particularly the organic fraction. In addition to filter based methods semi-continuous carbon instruments are currently being used in order to gain temporal information and to help capture more of the volatile components. Here we present results from our semi-continuous R&P 5400 carbon particulate monitor in Queens, and a Magee Scientific, Aethalometer in the South Bronx, NY.

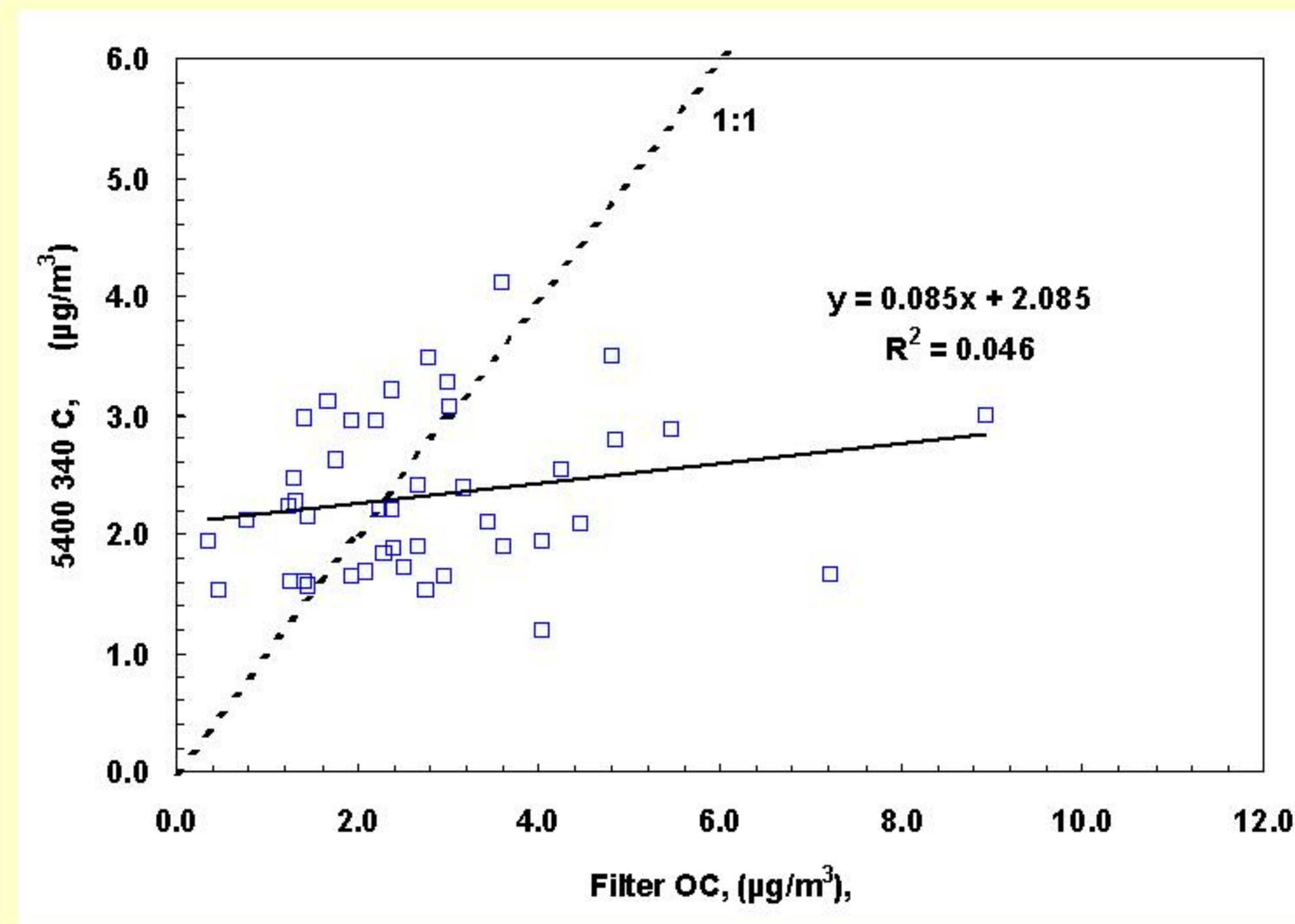
Figure 1. Queens College: PS219

- R&P 5400; Hourly 340, 750 °C burn.
- Impactor cut-point of 0.14 µm at 16.7 L min⁻¹.
- Collocated with 24 hr STN quartz filter and hourly PM_{2.5} and gaseous co-pollutants.
- R&P 5400 had frequent maintenance problems, mainly leaks in the pinch valve or the collectors. Only data from Dec 2002 to Apr 2003 is shown.

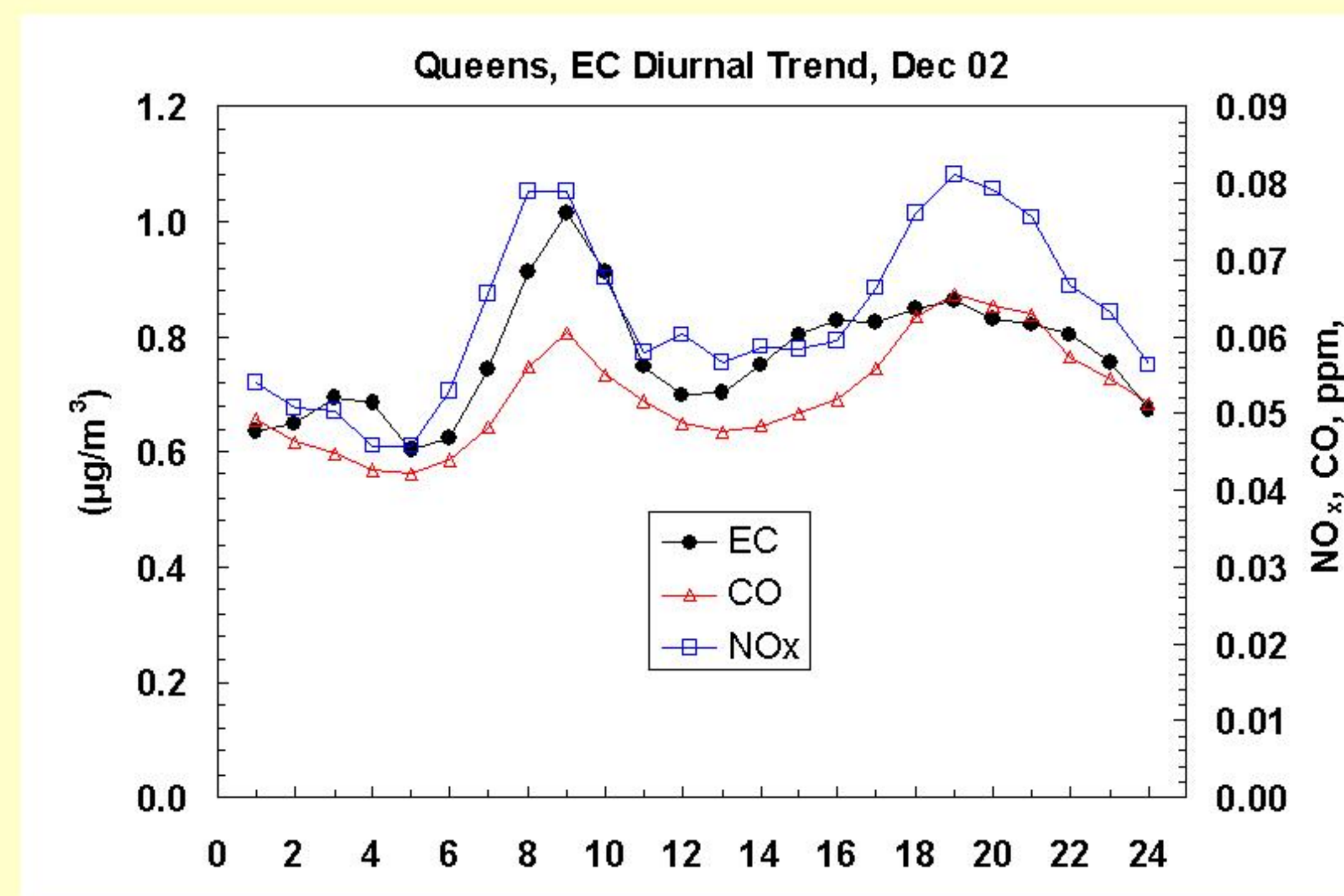
**Figure 2. Elemental Carbon R&P 5400 vs Filter, Dec 2002-Apr 2003.**

Averaged 24 hr elemental carbon (750 °C burn) from the R&P 5400 shows good agreement with the collocated STN Quartz filters (slope = 0.91, intercept = 0.05 and R² = 0.88). The filter data has been corrected for the blank.

Queens College Carbon

**Figure 3. Organic Carbon R&P 5400 vs STN Quartz Filter**

The data in general is scattered about the 1:1 line but the correlation is poor (R² = 0.05). Organic carbon measurements are particularly sensitive to adsorption and evaporative processes. OC measured by the R&P 5400 is often less than the 24 hr STN filter data, particularly for high concentrations. R&P recommends that the 5400 collectors be kept at 50 °C to avoid moisture condensation. This can lead to significant carbon loss compared to the STN filter sampler. Elemental carbon data was not affected because it requires several 100 °C to vaporize EC. Filter data was adjusted for the blank.

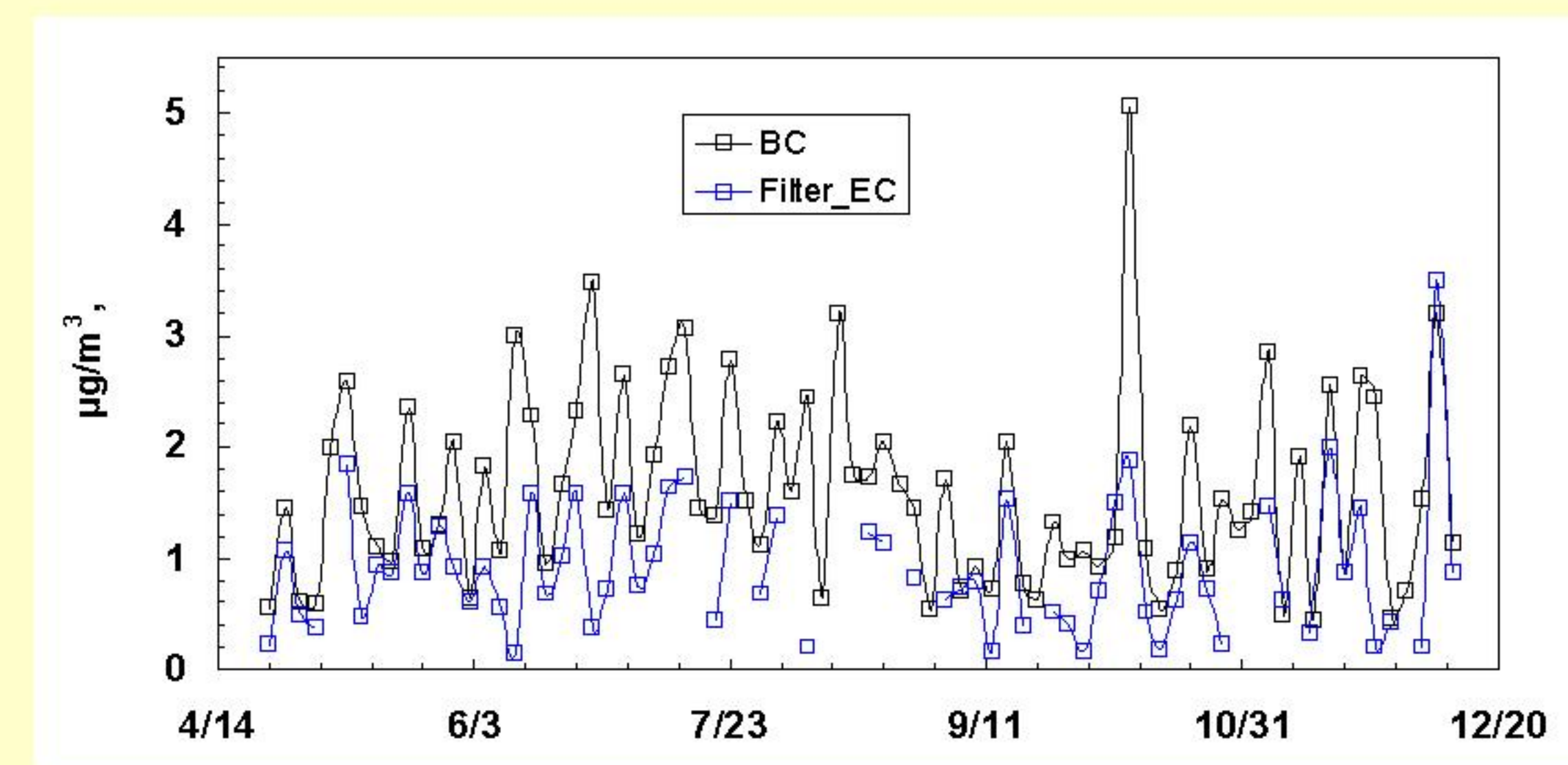
**Figure 4: Monthly Diurnal R&P 5400 Elemental Carbon, CO and NO_x, December 2002, Queens College, NY.**

Elemental carbon at Queens, NY typically peaks in the morning from 6 to 10 am with a broader peak in the evening coinciding with peak NO_x and CO consistent with peak traffic volume. A similar behavior is also observed at the Bronx site.

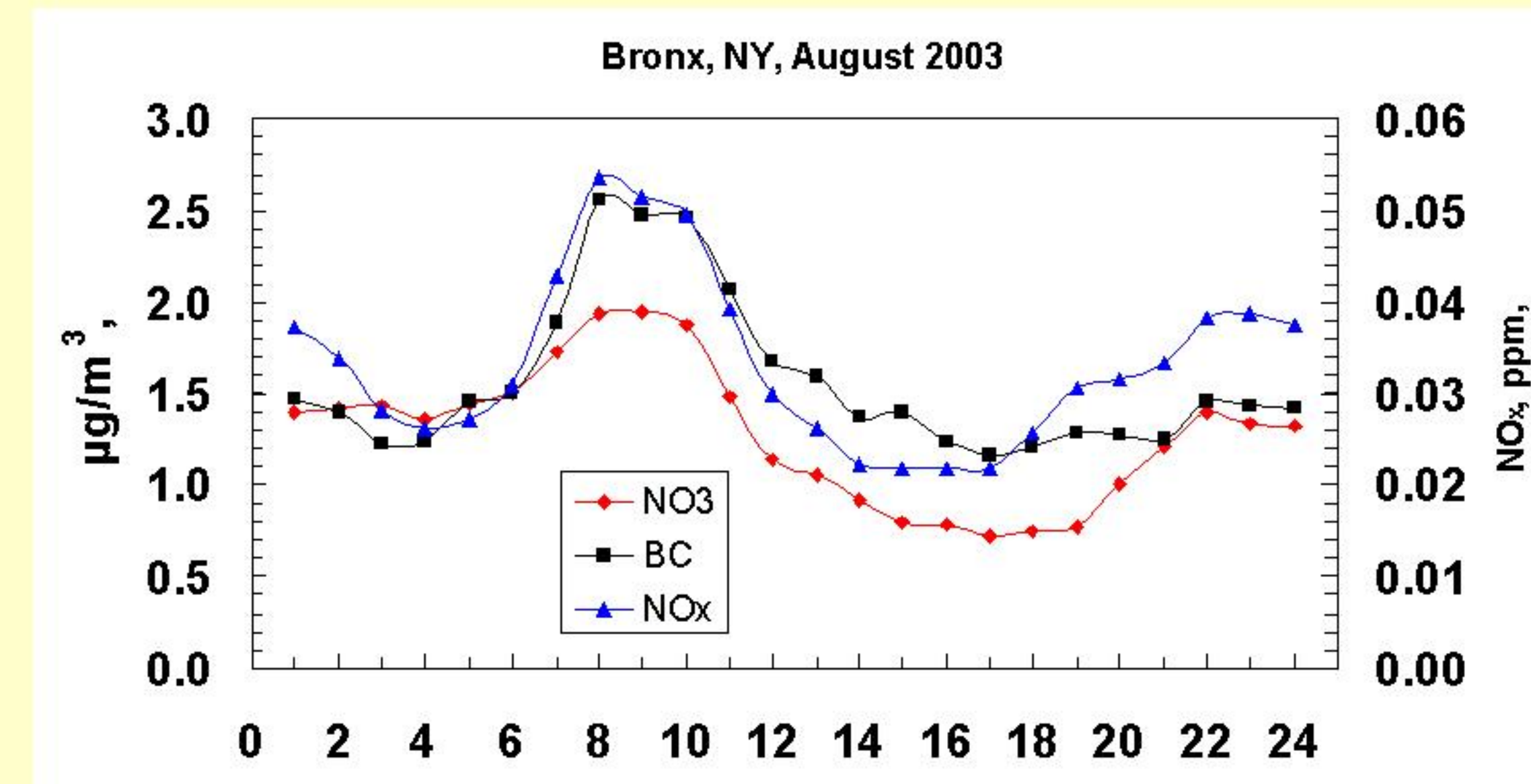
Monthly mean R&P 5400 EC and OC at Queens, NY

	EC	Min	Max	OC	Min	Max
	µg/m ³			µg/m ³		
Dec-02	0.77	0.08	5.31	1.83	0.64	5.23
Jan-03	0.62	0.08	4.49	1.97	0.82	5.27
Feb-03	0.62	0.13	3.24	2.15	0.58	4.8
Mar-03	0.69	0.05	4.16	2.71	0.59	6.46
Apr-03	0.54	0.11	4.74	2.96	1.1	6.23

Bronx Carbon data

**Figure 5. Comparison of Aethalometer Black Carbon and STN Quartz Filter Elemental Carbon.**

Aethalometer data frequently tracks the quartz filter data but there are significant differences as shown above and in the linear regression (R² = 0.36, slope = 0.91, intercept = 0.81). The aethalometer measures the optical density on a filter which can depend on the aerosol composition (an absorption coefficient of 16.6 was used). The STN filter data is a direct mass measurement. Differences in collection techniques (impactor vs filter) and sample flow rates for these instruments may also affect the collection efficiencies.

**Figure 6. Diurnal BC, NO_x and NO₃, Aug 2003, South Bronx, NY.**

Aethalometer Black carbon in the south Bronx peaks in the early morning from 6-10 am and tracks NO_x and Nitrate concentrations. This trend is similar to that observed at the Queens site and is most likely influenced by local mobile emission sources.

Summary

The R&P 5400 appears to provide reasonable elemental carbon measurements compared to quartz filter data. However, the R&P 5400 organic carbon measurements were not as consistent probably because of significant losses from the heated collectors. In addition, much of the R&P 5400 data was invalid because of frequent maintenance problems. The Aethalometer can provide useful temporal information on black carbon which appears to track mobile emissions although it is not equivalent to quartz filter measured elemental carbon.

Acknowledgments

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