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Highlights of PM_{2.5} Continuous Speciation Measurements in NY

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INTRODUCTION

Continuous measurements of major aerosol species (sulfate, nitrate and carbon) are useful in understanding rapid changes during plume events, temporal patterns related to local emission source variation and for health impact studies.

In New York State continuous PM_{2.5} speciation measurements are made at Pinnacle State Park, Whiteface Mountain and the South Bronx, NY. In this poster we show sample data from the South Bronx site.

SOUTH BRONX SITE

Intermediate School 52, 681 Kelly St., South Bronx. Impacted by traffic from nearby highways and Hunts Point Produce Markets.



Continuous SO₂, NO₃, Carbon (EC, OC, BC).

INSTRUMENTS

Thermo 5020 Sulfate Analyzer provides 15 min aerosol sulfate using hot catalytic reduction of SO₃ to SO₂ followed by pulsed fluorescence. R&P 8400N Nitrate Monitor measures aerosol nitrate every 10 min by volatilization of nitrate to NO_x with chemiluminescence detection. A Sunset Labs OC/EC carbon aerosol analyzer provides hourly measurements of EC and OC using thermal optical transmission (TOT). A Magee Scientific Aethalometer provides 5 minute BC concentrations using optical absorption at 880 nm and a calibration factor of 16.6 to convert to BC mass.

RESULTS-Episodic Event

Figure 1 shows a winter episodic event during February 14-17 2006 when the total FRM mass exceeded the 24-hr standard of 35 µg/m³. Peak mass concentrations ~ 50 µg/m³ were observed around 8-9AM on Feb 15th and ~75 µg/m³ from 10-11 AM on Feb 16th. Aerosol nitrate dominated the mass during the peak periods (37-38%) whereas sulfate, organic carbon each averaged ~25% of the combined mass. The 24-hr average TEOM mass is biased low compared to the FRM (approx. 25-30%) and to the sum of species. PBW associated with ammonium sulfate is included. The differences between the sum of species and the FRM are ~5 to 10%. Therefore the continuous speciation measurements can provide a more accurate estimate of FRM mass than the TEOM(50C). This is particularly evident during the cooler months when semi-volatile components represent a larger proportion of the total mass. (See Poster by Dirk Felton)

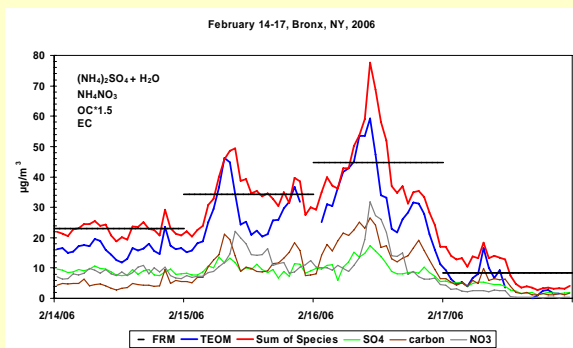


Figure 1. Winter episode showing PM_{2.5} mass from the FRM, TEOM(50C) and sum of major species.

RESULTS-Temporal Patterns in PM_{2.5} Carbon

Average Diurnal February 2006

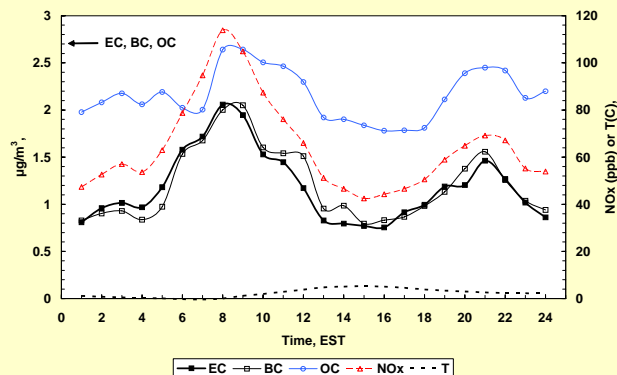


Figure 2. Average EC, BC, OC and NO_x diurnal during winter

In winter elemental carbon, black carbon, NO_x and sometimes organic carbon track throughout the day with peak concentrations during the morning commute. OC is correlated with EC and NO_x during winter months indicating that primary emissions make a significant contribution to OC during this time of year when photochemistry is less pronounced.

Average Diurnal June 2006

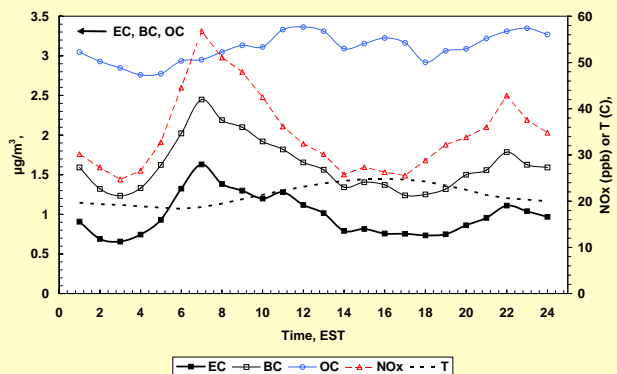


Figure 3. Average EC, BC, OC and NO_x diurnal during summer

EC, BC and NO_x track each other with peak values during the early commute period as observed in winter. OC in summer however is not correlated with these species most likely due to secondary organic aerosol production which masks the primary OC component. OC is correlated with sulfate reflecting a significant regional component. Note that BC is higher than EC in summer because the BC optical technique is sensitive to aerosol loading effects and aerosol composition variations.

EC Weekday vs Weekend at the South Bronx, NY

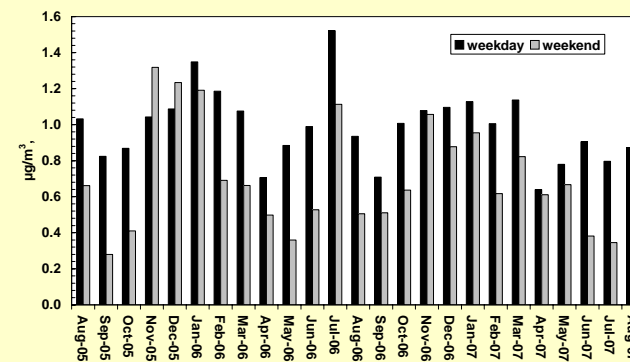


Figure 4. Average monthly EC during weekdays and weekends

EC concentrations are generally higher on weekdays (Mon to Fri) compared to weekends (Sat and Sun) particularly during summer months. Sundays show the lowest concentrations. During winter months however the pattern can be reversed likely due to a change in emissions from mobile dominant to a more mixed mobile/domestic heating source in colder periods.

No particular day of week pattern is observed for OC (not shown) most likely because secondary organic aerosol or biogenic emissions mask the primary mobile OC source.

SUMMARY

Continuous speciation measurements provide important information on plume events and time of day and day of week patterns. Hourly carbon measurements show that EC is correlated with BC and NO_x throughout the year with peak concentrations during the early commute period reflecting the influence from local mobile emissions. Concentrations are generally higher during weekdays compared to weekends particularly in summer. In winter the EC weekday to weekend bias can be different indicating a switch from mobile dominant emissions to a mixed mobile/domestic heating source.

Hourly OC concentrations are sometimes correlated with EC and NO_x particularly during winter indicating primary OC emissions can be important during the cold season. During summer months OC is better correlated with sulfate and PM_{2.5} mass than with primary species indicating that there is a significant regional component most likely secondary organic aerosol (or possibly biogenic) which contributes to the aerosol OC.

Acknowledgments

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