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A comparison of PAMS and air toxics measurements

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Abstract

One of the requirements of the 1990 Clean Air Act Amendments (CAA) is that 1-h ozone nonattainment areas that are classified severe or higher category are required to operate a network of photochemical assessment monitors (PAMS) to provide hourly measurements of volatile organic compounds (VOCs) comprising of Carbon number <12 (C2–C12), along with carbonyl measurements at 3-h intervals during the summer ozone season. Often collocated with PAMS are 24-h-integrated canister and cartridge-based measurements of selected air toxic compounds, thereby providing an opportunity for inter-comparison and validation of both sets of data. In this study, we report such a comparison and estimates of trend for benzene, *m*-, *p*- and *o*-xylene, toluene, ethylbenzene, 1,2,4-trimethylbenzene, formaldehyde and acetaldehyde at Bronx, NY. The analysis shows that hourly PAMS and 24-h-integrated air toxics are in good agreement with each other exhibiting similar trends and that the PAMS with the higher temporal resolution offers information on excursions of the toxic compounds that would be quite useful in assessment of acute health effects. These findings were also found to be applicable to other locations such as South De Kalb, GA; Gary, IN and Lynn, MA.

Keywords: PAMS; Air toxics; Benzene; Carbonyls; Trends; New York City

1. Introduction

The Clean Air Act Amendments of 1990 initiated the monitoring of speciated ambient volatile organic compounds (VOCs) utilizing the photochemical assessment monitoring Stations (PAMS) in those areas that are in violation of the 1-h ozone National Ambient Air Quality Standard (NAAQS). One such area is the New York Consolidated Metropolitan Statistical Area (NY CMSA) comprising portions of the states of Connecticut, New Jersey and New York. The CMSA has three operational PAMS and in this study, we compare the PAMS measurements taken at Bronx, NY with a collocated New York Toxics (NYTOX) monitor for a set of selected common compounds. The NYTOX program (previously called Toxics Air Monitoring System) (TAMS) was established in 1990 by the New York State Department of Environmental Conservation (NYSDEC) for the measurement of air toxic compounds both in urban and rural areas of the state with the goal of gaining a better understanding of the baseline ambient concentration levels and contributing sources, for use in the development of appropriate mitigation programs. While prior data validation methods have utilized the ratios of compounds with similar reactivity (Parrish et al., 1998) or inter-relationships developed between the PAMS compounds (Main and O'Brien, 2001;

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Hafner et al., 2004), in this study, we compared a set of common compounds measured by the two monitoring programs to provide a measure of validation and confidence in the speciated VOC data, an issue identified by the PAMS review group (USEPA, 1998a; Demerjian, 2000). We also note that use of concentration ratios based on PAMS (Fortin et al., 2005) may not be suitable approach for estimation of trend, but demonstrate that trend estimates based on individual compounds of PAMS and NYTOX are found to be in agreement with each other. Similar results were found for benzene and formaldehyde measurements at South De Kalb, GA; Gary, IN; and Lynn, MA.

2. Database and analysis

The PAMS utilized in this study is located at the Bronx Botanical Garden in Bronx, NY (AIRS ID 36-005-0083) along with a collocated NYTOX monitor, which are identified in this analysis as NYBG_PAMS and NYBG_TOX, respectively. The area surrounding these monitors is characterized by industrial, commercial and business operations as well as residential neighborhoods and expressways thus reflecting the influence of a wide variety of emissions sources on the measured data. The PAMS protocol calls for hourly sampling during the summer season months of June, July and August, and year round 1-in-6-day 24-h-integrated canister that is analyzed for both the PAMS target list as well as 40 or so compounds that are mostly chlorinated species identified under NYTOX program. The PAMS 55 target compounds measured were from carbon number 2 through 12 (C2 to C12) and are commonly referred to as nonmethane organic compounds (NMOCs). The analytical techniques utilized followed EPA protocol (USEPA, 1998b). The hourly samples were analyzed using gas chromatography with flame ionization detection (GC/FID) system and the 24-h-integrated samples were analyzed using NIST traceable standards for the PAMS and TO-15 for the toxics. The NYTOX program was designed for long-term monitoring, and the parameters measured are optimized for linearity and reliability and are not necessarily setup for maximum sensitivity.

The PAMS program also required measurement of carbonyls utilizing cartridges at 3- or 6-h sampling interval. The schedule for carbonyl sampling varied over the years ranging from daily to 1-in-3 days to on an episode basis. The carbonyl measurement program was terminated in 2005. The measurements followed the standard EPA protocol

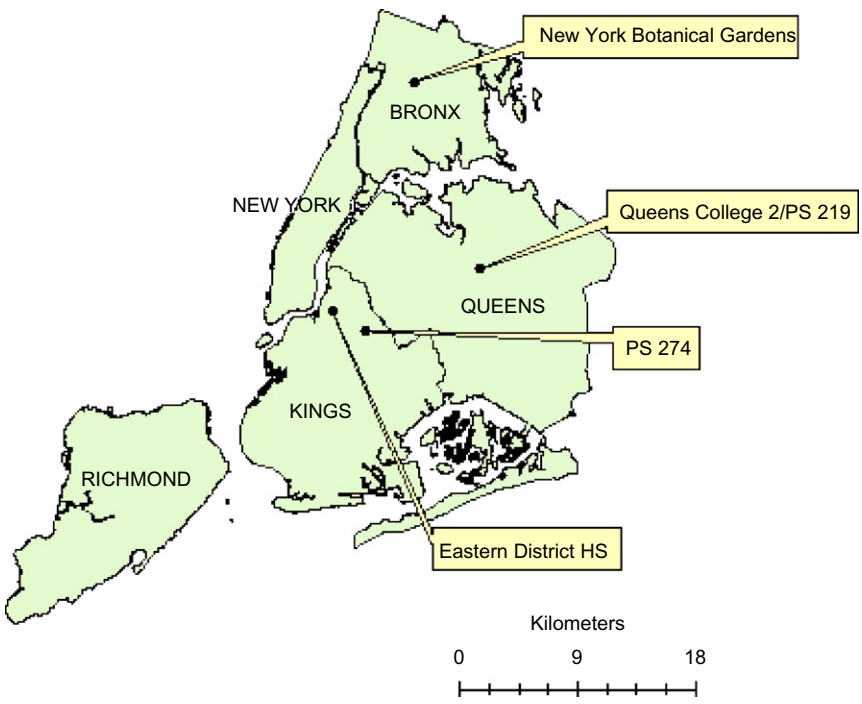

Fig. 1. Location of PAMS and NYTOX monitoring stations in New York City, NY, used in this study.