Mobile monitoring of multi-pollutant mixtures on roadways: Characterizing temporal variation in response to pollutant plumes across multiple instruments.

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Introduction

The UW Center for Clean Air Research (CCAR) focuses on the cardiovascular health effects of near-roadway pollution. It uses a multi-pollutant mixture model, that takes into account the emission source, the atmospheric chemical processes and physical aging of pollutants. This comprehensive approach serves as a stepping stone for further research regarding multi-pollutant relationships and their health effects.

CCAR Project 1 is aimed at exposure mapping and characterization of pollutant mixtures. It employs mobile monitoring that permits a realistic, thorough approach to exposure mapping. The mobile measurement platform houses multiple instruments, which are expected to react differently when challenged with an exhaust plume. This poster captures the instrument responses, allowing for a more accurate characterization of pollution events.

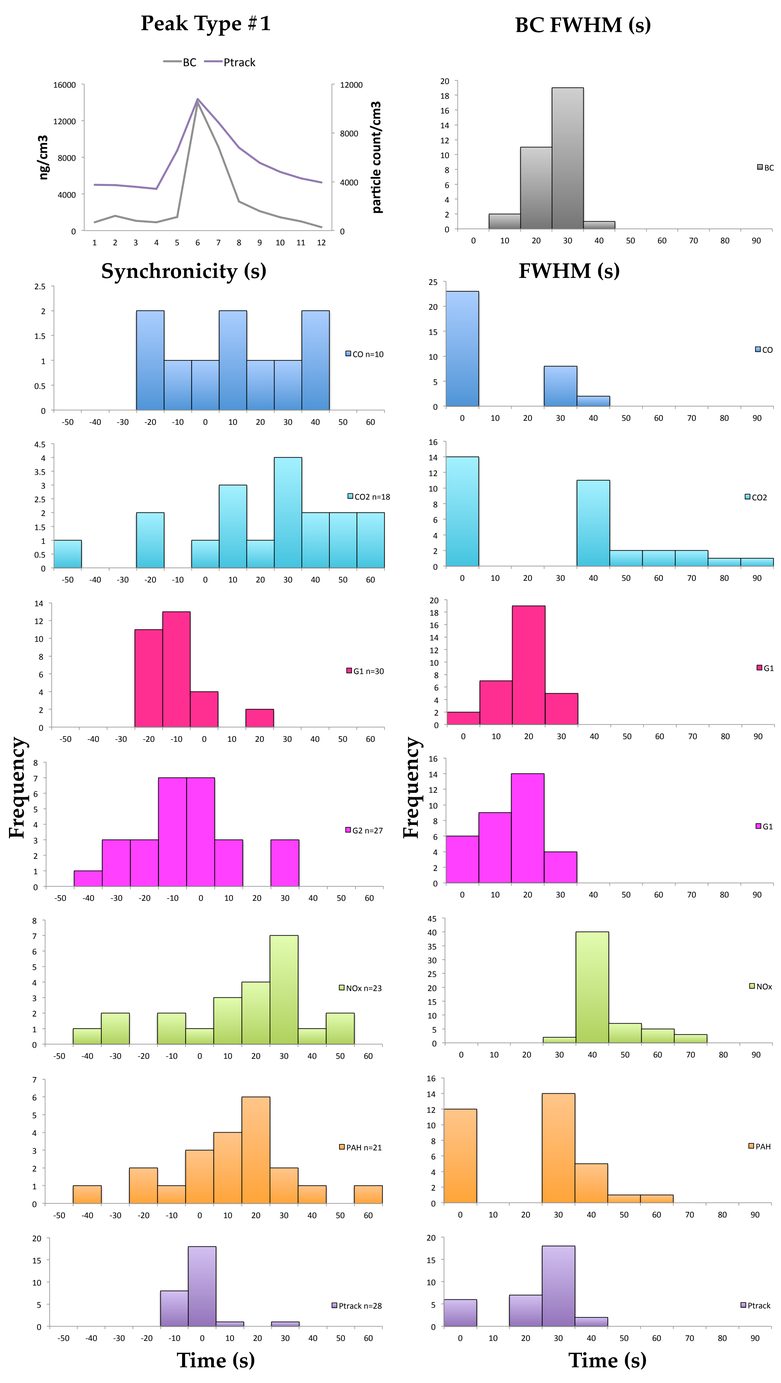
Methods

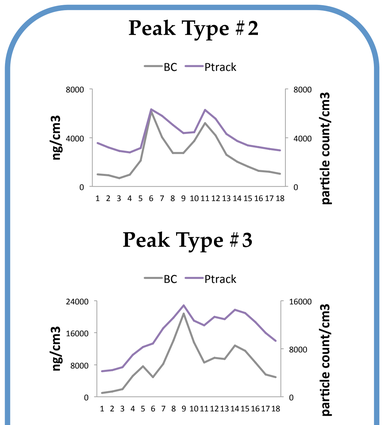
Data from mobile monitoring of Baltimore during the dates (15-28 June, 2012) was analyzed. 7 different instruments were compared, using black carbon (BC) as a reference. 81 peaks were selected from the BC data and classified into three categories. The events from BC type 1 peaks were then used to assess the synchronicity between instruments and event durations as captured by the Full Width at Half Max (FWHM). Some BC peaks did not correspond to an event on another instrument, these have FWHM of zero.

Instruments with the measured pollutant:

Black Carbon	Magee Scientific microAeth model AE52
CO	Langan T15v
CO2	Senseair CO2 Engine k-30-FS Sensor
Particles	Grimm laser aerosol spectrometer 1.109
	Grimm 1 (.025-.3 μm)
	Grimm 2 (.35-1 μm)
NOx	2B Technologies Model 410 Nitric Oxide Monitor
PAH	EcoChem PAS2000
Ptrack	P-TRACK UPC w/diffusion screen

Results





Type #2 peaks in BC are two consecutive sharp peaks that occurred within 30 seconds of each other.
Type #3 peaks in BC are elevated from baseline and contain several local minimums and maximum values.

Synchronicity shows a broad distribution of events, as compared with BC. Ptrack was the only instrument with fairly similar timing to BC. This broad range of responses could be due to the variable nature of pollutant sources, detector response times and the physical arrangement of the instruments in the platform.

FWHM show that the distribution of responses are different, but the modes are similar to the BC channel. This indicates that the instrument responses are similar for the instruments across the platform, with variability likely due to characteristics of the plume. For FWHM all 33 peaks were considered; 0 was assigned to absent peaks.

Discussion

Synchronism required particular attention as offsets of more than a minute were observed. These time-lags could be further analyzed according to atmospheric chemistry and factors not necessarily related to the instruments' performance. In profiling events and characterizing them, synchronism is an important factor that cannot be assumed.

According to the FWHM, the instruments' responses were fairly similar on average, except for Grimm. Variation was also observed within instruments. This contrasts with the peak classification for which 23 peaks (28%) were found to change types in different instruments, which could mean that a certain instrument was sensitive enough to differentiate between two distinct events that happened consecutively while another would present both events as a single, wide peak. Further research related to the instruments' particular mechanisms would be encouraged.

Conclusion

Characterizing temporal variation across instruments in a data set is of particular importance in multi-pollutant research, as these factors complicate the interpretation of roadway sources. This research is the first step in better understanding how pollutant plumes vary in an urban setting.

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