Monitoring BTEX concentrations at bus stops in Taipei, Taiwan with portable VOC analyzers

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Introduction

- Traffic emission is the major source of air pollution in many metropolis.
- Volatile organic compounds (VOCs), like Benzene, Toluene, Ethylbenzene and Xylenes (BTEX) are important components of traffic emissions.
- Encouraging the usage of public transportation is an effective way to reduce air pollution in urban areas.
- The objective of this study is to evaluate the levels of commuters' exposures to VOCs at bus stops.

Methods

- Target compounds
  - benzene, toluene, ethylbenzene, m-,p-xylene and o-xylene (BTEX)
- Instrument
  - MiTAP, Tricorntech Corp., Taiwan
  - Continuously sampling
  - One reading per 30 minutes
- Sampling sites (Figure 1.A).
  - 6 bus stops in 2 bus lanes with different directions
  - 3 sites as a group:
    - V1, V3 and V5
    - V2, V4 and V6
  - Simultaneously monitoring for a week per group
  - Hourly VOCs results from Taiwan EPA Photochemical Assessment Monitoring Stations (PAMS) (about 2.5 km away from the bus lane)
- Sampling configuration (Figure 1.B).
  - The height of the sampling inlet was set at 1.8 m at the bus stop

Figure 1 (A) Sampling sites; V# and P represent the sampling sites and PAMS, respectively; (B) Instrument setup

Results

I. Concentrations at bus stops vs. at PAMS (Table 1)

Table 1 Summary statistics of MiTAP and EPA PAMS (Unit: ppb)

Compounds	Mean	Std	Median	Min	Max
MiTAP					
Benzene	2.27	2.06	1.68	0.10	23.8
Toluene	5.77	5.96	4.00	0.10	46.7
Ethylbenzene	1.49	2.21	0.80	0.10	42.2
m,p-Xylene	3.12	3.16	2.10	0.10	22.9
o-Xylene	1.37	1.34	0.90	0.10	10.1
EPA					
Benzene	0.88	0.73	0.63	0.17	4.41
Toluene	4.92	6.90	2.28	0.35	55.5
Ethylbenzene	0.50	0.56	0.29	0.04	3.27
m,p-Xylene	1.70	1.99	0.91	0.08	11.6
o-Xylene	0.60	0.68	0.34	0.03	4.03

- Concentrations were generally higher at bus stops than at PAMS (in terms of mean, median and max)

II. Correlations between VOCs at bus stop and at PAMS (Table 2, Figure 2)

Table 2 Summary of R^2 between VOCs at bus stops and at PAMS

R^2	Benzene	Toluene	Ethylbenzene	m-,p-Xylene	o-Xylene
V1	0.62	0.72	0.37	0.66	0.07
V3	0.05	0.09	0.08	0.02	0.00
V5	0.31	0.37	0.22	0.28	0.28
V2	0.10	0.31	0.11	0.01	0.13
V4	0.53	0.79	0.43	0.56	0.49
V6	0.26	0.54	0.22	0.18	0.31

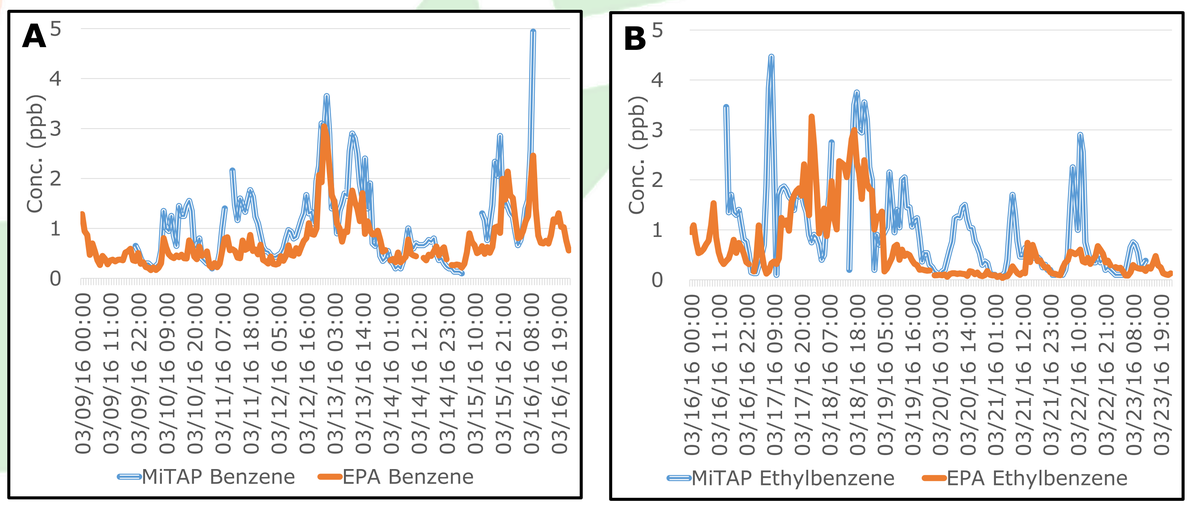

Figure 2 Time series plots of VOCs at bus stops and at PAMS; (A) An example of high correlation (MiTAP at V1 vs. at PAMS); (B) An example of low correlation (MiTAP at V6 vs. at PAMS)

- Large variation of R^2 were observed, indicating the influences from site-specific events.

III. Correlations between VOCs at different bus stops

- The trends of time series concentrations among the three sites monitored in the same week have various correlations with each other (R^2=0.09 – 0.63)
- Suggesting influences from site-specific events.

Conclusion

- VOCs at centrally located monitoring sites can not represent the exposure at bus stop.
- Future analysis will focus on evaluating the effects of traffic flow on the exposure levels.