Measurement of Volatile Organic Compounds using Trigger Sampling in the Southeast Asia during Biomass Burning Season

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Springtime elevated CO & PM
Seven South East Asian Studies (7-SEAS)

- Investigate the impacts of aerosol particles on weather and the total SE Asian environment
- In order to do this, we need input from seven science areas:
  - Aerosol lifecycle and air quality
  - Tropical meteorology
  - Radiation and heat balance
  - Clouds and precipitation
  - Land processes and fire
  - Oceanography (phys. and bio.)
  - Verification, analysis, and prediction
Doi Ang Khang (DAK) weather station
(19.93°N, 99.05°E, 1536 m a.s.l.)
Strategy

- **Trigger sampling**
  - CO acted as a trigger for biomass burning indication
  - Sampling was triggered if the CO concentration $> 1$ ppm
  - Required time $= 5$ s to avoid false triggering due to any random surge of noise
  - Sampling period $= 1$ hour (controlled by MFC)

- **Chemical analysis**
  - Canister air samples were analyzed using GC/MS/FID and CRDS in Taiwan
  - About 100 compounds were analyzed, e.g. non-methane hydrocarbons, halogenated compounds, and greenhouse gases
Sampling & analysis

Wang et al., 2012.
CO measurements at DAK

\[ N = 26 + 3 \]
Greenhouse gases at DAK

Mean $\Delta$CO$_2$/ΔCO = $6.5 \pm 3.9 \times 10^{-3}$ (ppm/ppb)  
$R^2 = 0.58$

Mean $\Delta$CH$_4$/ΔCO = $6.4 \pm 3.2 \times 10^{-4}$ (ppm/ppb)  
$R^2 = 0.61$

Mean CO$_2$ = 407.9±2.8 ppm  
Mean CH$_4$ = 1.95±0.02 ppm

N = 26
Halocarbons at DAK

$\Delta \text{CH}_3\text{Cl} = 173.8 \text{ ppt}$

$\text{CH}_3\text{Cl} = 722.3 \text{ ppt (LLN)}$
Halocarbons at LLN

CH$_3$Cl = 722.3 ppt
CFC-12 = 515.3 ppt
CFC-11 = 232.6 ppt
CCl$_4$ = 85.1 ppt
CFC-113 = 74.2 ppt
NMHCs in the air samples
NMHC / ethyne ratios

@DAK (BB characteristics)
- CO (ppm) (slope = 0.18; $r^2 = 0.84$)
- ethane (slope = 0.93; $r^2 = 0.48$)
- ethene (slope = 2.32; $r^2 = 0.74$)
- benzene (slope = 0.30; $r^2 = 0.86$)

@Taipei in Rush Hours
- ethane (slope = 2.83; $r^2 = 0.43$)
- ethene (slope = 0.69; $r^2 = 0.75$)
- benzene (slope = 0.09; $r^2 = 0.81$)
Distribution of NMHCs

Triggered Cases @DAK

- Alkanes: 45%
- Alkenes: 23%
- Alkynes: 7%
- Aromatics: 5%
- Ketones: 20%

Rush hours @TPE

- Alkanes: 46%
- Alkenes: 17%
- Alkynes: 15%
- Aromatics: 20%
- Ketones: 2%
Ketones at DAK

Slope = 0.0477
R² = 0.66

Slope = 0.1293
R² = 0.88

Slope = 0.0178
R² = 0.46
Summary

- 26 triggered samples for measuring BB VOCs by high CO at DAK.

- Enhanced level of 173.8 ppt CH$_3$Cl was measured during the observation period.

- Correlations and factors between trace gases are found, e.g. greenhouse gases, light non-methane hydrocarbons, and ketones.