1.030 Effects of Transboundary Peat-forest Smoke on Acidity of Receptor Urban PM2.5 in Maritime Continent.

Early Career Scientist

Presenting Author:
Yang Lan, Department of Civil and Environmental Engineering, National University of Singapore, Singapore, e0054304@u.nus.edu

Co-Authors:
Shiguo Jia, Department of Civil and Environmental Engineering, National University of Singapore, Singapore
Jeffery S. Reid, Naval Research Laboratory, Monterey, California, USA
Choon Nam Ong, Saw Swee Hock School of Public Health; NUS Environmental Research Institute (NERI), National University of Singapore, Singapore
Liya E. Yu, Department of Civil and Environmental Engineering, National University of Singapore, Singapore

Abstract:

This is the first multi-year study in the Maritime Continent, Southeast Asia demonstrating that transboundary peat forest (PF) burning smoke lessens acidity of $PM_{2.5}$ in an urban receptor environment. Acidity of more than 450 urban $PM_{2.5}$ (daily 24-hour) samples collected during 2011–2015 were investigated by coupling chemical characterization with thermodynamic Extended Aerosol Inorganics Model (E-AIM) simulation. The average in-situ pH (pH_{IS}) increased by 30% from 1.2 in non-smoke dominant (NSD) $PM_{2.5}$ to 1.6 in smoke dominant (SD) samples, and elevated up to 2.4 during an episodic smoke event in June 2013, demonstrating that transboundary PF smoke increased alkalinity of urban $PM_{2.5}$. Enhancement in particulate ammonium (1.7 – 2.1 folds), outweighing the increment in sulfate (1.2 – 1.6 folds), was the dominant factor increasing alkalinity in SD and episodic $PM_{2.5}$. The increased ammonium in $PM_{2.5}$ was concurred by surged concentrations in gaseous ammonia during SD and episodic period; the concentration of $NH_{3(g)}$ was enriched up to 8.5 folds of NSD periods, larger than the increment in other acidic gases (SO_2, HNO_3, and HCl). Statistical analyses demonstrate that a minimum of 86 NSD samples are required to show inorganic ionic concentrations differing from 117 SD samples at a power (confidence) of 90%. Nevertheless, such sample sizes remain insufficient, rendering biased lower pH_{IS} as if PF smoke acidified urban $PM_{2.5}$. Our results also show that >100 NSD $PM_{2.5}$ samples are needed to represent local environment as a proper baseline, which is critical for assessing impact of transboundary PF smoke on receptor urban environment in the Maritime Continent.