1.034 Identification and implications of biomarkers related to transboundary peat-forest smoke in urban environment.

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Abstract:

Concurrent peat-forest (PF) burning smoke in the Maritime Continent substantially degrades air quality affecting >75 million people in Southeast Asia, and imposes serious burden on global carbon footprint. Integrating laboratory mechanistic studies and field measurements, we investigate a suite of six organic markers in >150 $PM_{2.5}$ (daily 24-hour) samples to quantitatively evaluate how transboundary PF smoke increases pollutant burden in an urban environment (Singapore). A tracer of pyrolysis of biomass, levoglucosan, and its photooxidation daughter compounds (ribonic acid lactone and malic acid) are identified in laboratory studies and quantified in field samples affected by transboundary PF smoke. Relative to ~60 non-smoke dominant (NSD) $PM_{2.5}$ samples, the concentration of levoglucosan, ribonic acid lactone and malic acid during the longest smoke episode in 2015 increased by factors of > 10, 19, and 5, respectively. Our field measurements also quantify three secondary biogenic organic compounds (SBOCs, 3-hydroxyglutaric acid, 3-hydroxy-2,2-dimethyl glutaric acid, 2-methylglyceric acid) originating through atmospheric photooxidation of biogenic volatile organic compounds (BOVC, isoprene and alpha-pinene). On average, the three SBOCs together in the receptor urban environment increased almost 10 times during the smoky period, exhibiting temporal trends close to the “levoglucosan family” introduced by PF burning smoke. Nevertheless, unlike the abundant levoglucosan family, little SBOCs were found close to PF burning sites. Although these SBOCs can also be formed through photooxidation of PF smoke during atmospheric transport, preliminary statistical analyses suggest that they were more associated with local sources. This implies that increased SBOC concentrations at the receptor site could be yielded from transformation of surged BVOC released by local vegetation undergoing significant abiotic disturbance (e.g. transboundary PF smoke). Further statistical analyses and BVOCs measurements are needed to verify whether higher concentrations in the three SBOCs may serve as indicators of stronger “stress” experienced by the receptor environment.