Molecular Characterization of Gaseous Organic Acids and Nitrogen-Containing Compounds from Crop Straw and Wood Burning

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Abstract

Biomass burning serves as important sources of volatile organic compounds (VOCs), yet our understanding of the molecular characteristics of oxygenated volatile organic compounds (OVOCs) from fresh emissions remains limited. In this study, gaseous organic compounds in fresh smokes from burning typical Chinese crop straws and woods are measured using an iodide time-of-flight chemical ionization mass spectrometer. Approximately 750 molecular formulas are identified, with CHO compounds containing carbon, hydrogen and oxygen atoms accounting for 77%–95% of the total. C1–C3 organic acids and dicarboxylic acids dominate the total CHO signal intensities by 27%–48%, while well-known molecular markers of biomass burning, such as monosaccharide, guaiacol and syringol derivatives, contribute 7%–17%. Notably, crop straw and wood burning emit a higher abundance of guaiacol than syringol derivatives by a factor of 5. Additionally, a variety of nitrogen-containing compounds (mainly in the CHON group) is identified, including isocyanate, amide, amino acids, and pyridine. The mass spectral profiles of organic compounds are largely similar between crop straw and wood burning fuels, although wood burning produces higher contributions of compounds with carbon atoms numbers >10. The saturation concentrations of organic compounds are estimated using molecular formula-based volatility parameterization, revealing that semi-volatile and intermediate VOCs (S/intermediate volatility organic compounds (IVOCs)) predominate smoke releases by 35%–60% and 20%–43%, respectively, with only a small fraction of low-volatility compounds. Given the widespread nature of biomass burning in winter China, our results may have significant implications for interpreting secondary organic aerosol formation through gas-particle partitioning or aqueous-phase reactions.

Early Career Scientist

NO, I am not an early career scientist.

IGAC Activities

BBURNED: Biomass Burning Uncertainty: ReactioNs, Emissions and Dynamics

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