Comprehensive laboratory measurements of biomass-burning emissions: 1. Emissions from Indonesian, African, and other fuels

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Abstract

Trace gas and particle emissions were measured from 47 laboratory fires burning 16 regionally to globally significant fuel types. Instrumentation included the following: open-path Fourier transform infrared spectroscopy; proton transfer reaction mass spectrometry; filter sampling with subsequent analysis of particles with diameter <2.5 μm for organic and elemental carbon and other elements; and canister sampling with subsequent analysis by gas chromatography (GC)/flame ionization detector, GC/electron capture detector, and GC/mass spectrometry. The emissions of 26 compounds are reported by fuel type. The results include the first detailed measurements of the emissions from Indonesian fuels. Carbon dioxide, CO, CH_4, NH_3, HCN, methanol, and acetic acid were the seven most abundant emissions (in order) from burning Indonesian peat. Acetol (hydroxyacetone) was a major, previously unobserved emission from burning rice straw (21–34 g/kg). The emission factors for our simulated African fires are consistent with field data for African fires for compounds measured in both the laboratory and the field. However, the higher concentrations and more extensive instrumentation in this work allowed quantification of at least 10 species not previously quantified for African field fires (in order of abundance): acetaldehyde, phenol, acetol, glycolaldehyde, methylvinylether, furan, acetone, acetonitrile, propenenitrile, and propanenitrile. Most of these new compounds are oxygenated organic compounds, which further reinforces the importance of these reactive compounds as initial emissions from global biomass burning. A few high-combustion-efficiency fires emitted very high levels of elemental (black) carbon, suggesting that biomass burning may produce more elemental carbon than previously estimated.

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