3.127 Direct OH reactivity measurements show agricultural crop residue fires fuel large missing OH reactivity associated with rapid photochemical formation of reactive nitrogen organics.

Presenting Author:

Vinayak Sinha, Department of Earth and Environmental Sciences, Indian Institute of Science Education and Research Mohali, Sector 81, S. A. S. Nagar, Manauli PO, Punjab, India 140306, profvsinha@gmail.com

Co-Authors:

Vinod Kumar, Department of Earth and Environmental Sciences, Indian Institute of Science Education and Research Mohali, Sector 81, S. A. S. Nagar, Manauli PO, Punjab, India 140306

B.P. Chandra, Department of Earth and Environmental Sciences, Indian Institute of Science Education and Research Mohali, Sector 81, S. A. S. Nagar, Manauli PO, Punjab, India 140306

Abstract:

Biomass fires impact global atmospheric chemistry. The reactive compounds emitted and formed due to biomass fires drive ozone and organic aerosol formation, affecting both air quality and climate. Direct ambient OH reactivity measurements provide a robust measure of the total reactive pollutant loading. Here, we quantified the magnitude and composition of total OH Reactivity in the north-west Indo-Gangetic Plain, where greater than 80% of the land use is agricultural in nature. We discovered greater than two-fold increase in the total measured OH reactivity (28 s^{-1} to 64 s^{-1}) of summertime air influenced by the open crop residue fires. Surprisingly, the missing OH reactivity fraction changed from no significant missing OH reactivity to 40 % missing OH reactivity, while accounting for the same set of OH reactants and oxidation products during the pre-harvest and post-harvest fire influenced periods. In particular, the biomass burning tracer compound of acetonitrile, primary emissions such as aromatic compounds and compounds with a strong photochemical source such as acetaldehyde, acetone, hydroxyacetone, nitromethane, amides, isocyanic acid exhibited enhancements ranging from 30 to 120% in their ambient mixing ratios between the two periods. We show that rapid photochemical formation of some rare organic compounds associated with reactive alkyl amine precursor compounds contributed majorly to the increased missing OH reactivity between the pre and post- harvest summertime periods. Currently, even the most detailed state-of-the art atmospheric chemistry models do not consider formamide, acetamide, nitromethane and isocyanic acid and their highly reactive precursor alkylamines (e.g. methylamine, ethylamine, dimethylamine, trimethylamine) in their parameterization schemes. We suggest that for improved understanding of atmospheric chemistry-air quality-climate feedbacks in biomass-fire impacted atmospheric environments, future studies should include measurements of these rare compounds and include them in models that investigate secondary pollutant formation across different scales in biomass fire impacted ecosystems.