Title:	Emission drivers and variability of ambient isoprene, formaldehyde and acetaldehyde in north-west India during monsoon season
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Abstract:	Isoprene, formaldehyde and acetaldehyde are important reactive organic compounds which strongly impact atmospheric oxidation processes and formation of tropospheric ozone. Monsoon meteorology and the topography of Himalayan foothills cause surface emissions to get rapidly transported both horizontally and vertically, thereby influencing atmospheric processes in distant regions. Further in monsoon, Indo-Gangetic Plain is a major rice growing region of the world and daytime hourly ozone can frequently exceed phytotoxic dose of 40 ppb O3. However, the sources and ambient variability of these compounds which are potent ozone precursors are unknown. Here, we investigate the sources and photochemical processes driving their emission/formation during monsoon season from a sub-urban site at the foothills of the Himalayas. The measurements were performed in July, August and September using a high sensitivity mass spectrometer. Average ambient mixing ratios (±1σ variability) of isoprene, formaldehyde, acetaldehyde, and the sum of methyl vinyl ketone and methacrolein (MVK+MACR), were 1.4 ± 0.3 ppb, 5.7 ± 0.9 ppb, 4.5 ± 2.0 ppb, 0.75 ± 0.3 ppb, respectively, and much higher than summertime values in May. For isoprene these values were comparable to mixing ratios observed over tropical forests. Surprisingly, despite occurrence of anthropogenic emissions, biogenic emissions were found to be the major source of isoprene with peak daytime isoprene driven by temperature ($r \geq 0.8$) and solar radiation. Photo-oxidation of precursor hydrocarbons were the main sources of acetaldehyde, formaldehyde and MVK+MACR. Ambient mixing ratios of all the compounds correlated poorly with acetonitrile ($r \leq 0.2$), a chemical tracer for biomass burning suggesting negligible influence of biomass burning during monsoon season. Our results suggest that during monsoon season when radiation and rain are no longer limiting factors and convective activity causes surface emissions to be transported to upper atmosphere, biogenic emissions can significantly impact the remote upper atmosphere, climate and ozone affecting rice yields.
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