Title:	Chemical composition of pre-monsoon air in the Indo-Gangetic Plain measured using a new air quality facility and PTR-MS: high surface ozone and strong influence of biomass burning
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Abstract:	One seventh of the world's population lives in the Indo-Gangetic Plain (IGP) and the fertile region sustains agricultural food crop production for much of South Asia, yet it remains one of the most under-studied regions of the world in terms of atmospheric composition and chemistry. In particular, the emissions and chemistry of volatile organic compounds (VOCs) that form surface ozone and secondary organic aerosol through photochemical reactions involving nitrogen oxides are not well understood. In this study, ambient levels of VOCs such as methanol, acetone, acetaldehyde, acetonitrile and isoprene were measured for the first time in the IGP. A new atmospheric chemistry facility that combines India's first high-sensitivity proton transfer reaction mass spectrometer, an ambient air quality station and a meteorological station, was used to quantify in situ levels of several VOCs and air pollutants in May 2012 at a suburban site in Mohali (northwest IGP). Westerly winds arriving at high wind speeds (5-20 m sg-1) in the pre-monsoon season at the site were conducive for chemical characterization of regional emission signatures. Average levels of VOCs and air pollutants in May~2012 ranged from 1.2 to 2.7 nmol molg-1 for aromatic VOCs, 5.9 to 37.5 nmol molg-1 for the oxygenated VOCs, 1.4 nmol molg-1 for acetonitrile, 1.9 nmol molg -1 for isoprene, 567 nmol molg-1 for carbon monoxide, 57.8 nmol molg-1 for ozone, 11.5 nmol molg-1 for nitrogen oxides, 7.3 nmol molg-1 for sulfur dioxide, 104 µg mg-3 for PM2.5 and 276 µg mg-3 for PM10. By analyzing the one-minute in situ data with meteorological parameters and applying chemical tracers (e.g., acetonitrile for biomass burning) and inter-VOC correlations, we were able to constrain major emission source activities on both temporal and diel scales. Wheat residue burning caused massive increases (> 3 times the baseline values) for all the measured VOCs and primary pollutants. Other forms of biomass burning at night were also a significant source of oxygenated VOCs and isoprene (r2 with acetonitrile ≥0.5 for nighttime data), which is remarkable in terms of atmospheric chemistry implications. Surface ozone exceeded the 8 h national ambient air quality limit of 100 µg O3 mg-3 (~50 ppbv) on a daily basis, except for 17 May 2012, when a severe dust storm event (PM2.5 > 800 µg mg-3; PM10 > 2700 µg mg-3) characterized by long-range transport from the west impacted the site. The novel data set and results point to the occurrence of high primary emissions of reactive VOCs. They also highlight the urgent need for establishing more comprehensive observational facilities in the IGP to constrain the spatial and seasonal variability of atmospheric chemical constituents. Such efforts will enable a mechanistic-level understanding of the in situ chemical processes controlling the formation of surface ozone, a necessary step for effective ozone mitigation and improvement of the regional air quality.ozone

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