Abstract

Volatile Organic Compounds (VOCs) play an important role in tropospheric chemistry by changing the OH radical concentration, production of organic acids and photochemical oxidants. In order to develop efficient air pollution abatement strategies, it is important to know the sources and sinks of VOCs, especially in the South Asian region where high level of solar irradiation favours photochemical ozone production and secondary organic aerosol formation. Elevated levels of lower tropospheric ozone are of particular concern since it adversely affects human health, vegetation and materials while aerosol affects health and climate as well. This dissertation characterizes the emission levels of volatile organic compounds (VOCs) at IISER Mohali, a suburban site (30.6794°N, 76.7289°E) in the Indo Gangetic Plain. The VOC measurements were carried out using a high sensitivity proton transfer reaction mass spectrometer (PTR-MS). Ambient air was sampled during the monsoon, post monsoon and winter season at 14 m above ground, from the rooftop of IISER Mohali's Central Analytical Facility (CAF) (30.6794°N, 76.7289°E). The site is located in the Northern Indo Gangetic Plain (IGP) and has a south easterly flow of air masses in the monsoon season which shifts to north westerly after the monsoon. The fast response of the PTR-MS instrument enabled a measurement every minute for a number of VOCs for several weeks in each season. In this work, only m/z ratios for which the identity is well established in the literature have been reported. These are methanol (m/z 33), acetonitrile (m/z 42), acetaldehyde (m/z 45), acetone (m/z 59), isoprene (m/z 69), benzene (m/z 79), toluene (m/z 93), xylene (m/z107) and the sum of monoterpenes (mt)(m/z 137 and m/z 81). The data obtained for these VOCs was grouped according to different seasons (monsoon, clean post monsoon, polluted post monsoon and winter) and both diel and time series plots were interpreted to establish emission activity periods for individual VOCs and classes of VOCs and to infer the commonality of sources. Significant seasonal and diel variability was observed in the VOC emissions profiles. Except for the clean post monsoon season and to some extent the summer monsoon period, which showed characteristic emission profiles for isoprene and monoterpenes at the m/z =69 and m/z= 137 channels, data from the other seasons showed a different profile non synchronous with light or temperature at masses normally attributed to these biogenic VOCs in PTR-MS studies. The profiles of m/z=69 and m/z= 137 in winter and polluted post monsoon period had strong bimodal peaks in the morning and evening hours. Levels of biogenic VOCs generally followed the trend of summer > post monsoon > winter. Remarkably acetaldehyde showed very good correlation with isoprene in the clean post monsoon period. Just after the monsoon period, levels of oxygenated VOCs declined. High inter VOC (volatile organic compound) correlation (> 0.8) for all aromatic compounds indicate that they have common emission sources, most dominant being vehicular traffic emissions in the evening hours. Correlation of methanol with the aromatic VOCs (> 0.6) shows that it has significant source from combustion activities too. Levels of oxygenated VOCs and acetonitrile were high indicating the strong contribution of biomass burning particularly in winter. Only a preliminary analysis of the dataset could be carried out in this work. Even so, the measured dataset highlights the rich VOC chemistry in all three seasons from region where no such measurements or dataset previously existed. Further work should focus on unravelling the reasons for the observed trends and its implications for ozone and aerosol chemistry in the Indo Gangetic Plain (IGP).