Title:	Probing wintertime air pollution sources in the Indo-Gangetic Plain through 52 hydrocarbons measured rarely at Delhi & Mohali
Authors:	Kumar, Ashish (/jspui/browse?type=author&value=Kumar%2C+Ashish) Hakkim, Haseeb (/jspui/browse?type=author&value=Hakkim%2C+Haseeb) Sinha, Vinayak (/jspui/browse?type=author&value=Sinha%2C+Vinayak)
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Abstract:	During wintertime, the Indo-Gangetic Plain suffers from severe air pollution affecting several hundred million people. Here we present unprecedented measurements and source analyses of 52 NMHCs (25 alkanes, 16 aromatics, 10 alkenes and one alkyne) in the cities of Delhi and Mohali (300 km north of Delhi) during wintertime (Dec 2016–Jan 2017). NMHCs were measured using a thermal desorption gas chromatograph equipped with flame ionisation detectors with data traceable to WMO standards. The ten most abundant NMHCs that were measured were the same at both Delhi and Mohali: propane, n-butane, acetylene, ethane, toluene, i-butane, ethene, i-pentane, benzene and propene and accounted for >50% of total measured NMHC mass concentration (137 ± 5.8 μg m−3 in Mohali and 239 ± 7.7 μg m−3 in Delhi). Ambient NMHCs and calculated hydroxyl radical reactivity were approximately twice as high in Delhi relative to Mohali, and 2–12 times higher than most other mega-cities, except Lahore and Karachi. Using chemical source signatures, traffic and LPG usage emissions were identified as the major contributor of these reactive NMHCs at both sites during nighttime, with additional minor contributions of garbage burning in Mohali, and evaporative fuel and biomass burning emissions in Delhi. Comparison of NMHC/CO and NMHC/C2H2 ratios over Mohali and Delhi, to other cities, suggested gasoline/petrol-fuelled vehicles were major NMHC emitters within the traffic source. The data from both Mohali and Delhi suggest that a large fraction of the fleet comprised vehicles with older emission control in both Mohali and Delhi. Analyses revealed poor representation of propene, ethene and trimethylbenzenes in the emission inventory (EDGARv4.3.2) over Mohali and Delhi. This study provides key data and new insights into the sources of reactive NMHCs (lifetime < few days) that drive regional wintertime pollution through direct effects and the formation of secondary pollutants.
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