Sources and Photolysis of Atmospheric Formaldehyde (HCHO) in New York City

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The SUNY Mobile Laboratory simultaneously measured HCHO, NO, NO_2, O_3 and CO_2 at the Queen site of New York City from July 14 to August 3 2009. During the same period, the mobile observatory also investigated the emission rates of vehicle combustion from Long Island Expressway (LIE). This paper reported the characteristics of ambient HCHO and discussed the source of HCHO in New York City during the summertime. 10-min data showed that HCHO mixing ratios ranged from 0.4 - 6.8 ppb with a mean value of 2.2 ppb. Typically, high HCHO concentrations were observed near the midday with a good correlation between HCHO and Ox (NO_2+O_3), suggesting that the high HCHO levels at the midday was probably from the photochemical oxidations. Roadside measurements near LIE revealed that HCHO strongly correlated with NO_2, NOx and CO_2 in some traffic plumes, indicating that primary emissions from automotive exhaust can be a major contributor to observed HCHO in the urban area. The emission rates for HCHO of LIE was 0.0204 ± 0.0098 mole HCHO/mole CO_2. This value was much lower than that of compressed natural gas (CNG) buses, but comparable to those measured from mixed traffic conditions in California. The ratios of HCHO to NOx in the fresh plumes was 0.0106 ± 0.002 mole HCHO/mole NOx. This emission ratio could be used to partition primary and secondary HCHO at Queen site. The result showed that primary HCHO was predominated over this region from evening to early morning. After sunrise, the increase of secondary HCHO was observed with the maximum at midday (75 %). The measured VOC data was also used to investigate the production rate and source of secondary HCHO during the sampling period. The production rate of secondary HCHO averaged 2.15 ppb/hr. Isoprene is the major source of secondary HCHO, accounting for 51 % of the total production rate, followed by methane (22 %), alkanes (21 %) and alkenes (7 %). Furthermore, the photolysis rate of HCHO was also estimated in this study. On a daily basis, the daily HOx productions from HCHO was 4.4 ppbv/day, which was the major source of the OHx in the urban area.

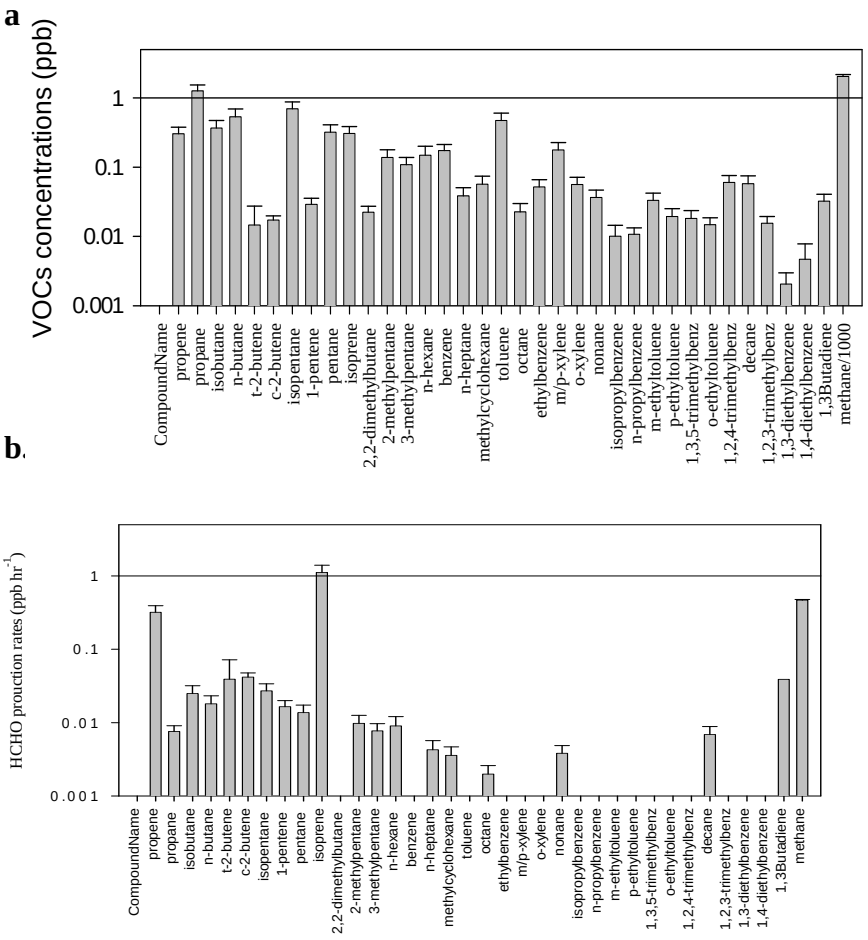
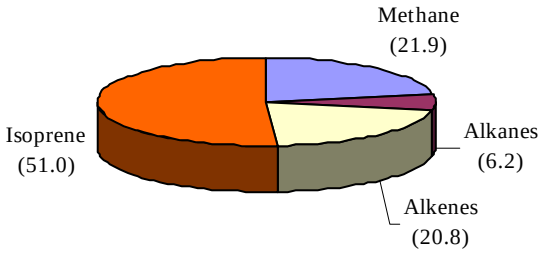


Fig 1
(a) Atmospheric VOC concentrations and (b) HCHO formation rates at Queen site from July 14 to August 3 2009.



d[HCHO]/dt = 2.15 ppb hr^{-1}

Fig. 2
Relative contributions of methane, alkanes, alkenes and isoprene to HCHO productions, calculating using [OH] = 1×10^7 molecules/cm^3. Numbers in parentheses represent the percentage.