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Sources of formaldehyde and their contributions to photochemical O_3 formation at an urban site in the Pearl River Delta, southern China

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Identification and quantification of the contributions of primary emissions and secondary formation of formaldehyde (HCHO) are prerequisite for the formulation and implementation of control measures of HCHO, which play an important role in the atmospheric photochemistry and are hazardous materials having detrimental effects on human health. In this study, two models (the Positive Matrix Factorization (PMF) model and a photochemical box model with Master Chemical Mechanism (PBM-MCM)) were applied to analyze the HCHO data collected in July 2006 at an urban site (GPEMC) in the Pearl River Delta (PRD), southern China. Three major HCHO sources (secondary formation, vehicular exhaust, and solvent usage) were identified and they were found to contribute in average 53%, 31% and 16% respectively to the total HCHO loading in the PRD region. Among the identified secondary HCHO precursors, isoprene was the most important biogenic contributor, while the main anthropogenic counterparts were attributed to cis-2-butene, m-xylene, toluene, ethene and propene. Secondary HCHO contributed to 7 ppbv ground-based measured O_3 at GPEMC, higher than those from the other two sources (vehicular exhaust, 4 ppbv; solvent usage, 2 ppbv). The contributions of HCHO to the HO_x (HO_x = HO_2 + OH) radical loading were found to be more dominant from secondary formation (57%) than the others as well (vehicular exhaust, 30%; solvent usage, 13%). Our results highlight the importance of secondary HCHO formation for both photochemical formation of ozone and the oxidative capacity of the atmosphere in this region. It is hence critical for policy makers to propose strategies for controlling VOCs from biogenic and vehicular emissions in order to reduce secondary HCHO formation. Our results also have important implication for improving the understanding of the source apportionments of HCHO and their contributions to photochemical pollution in the PRD region in China.