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# Estimation of Urban Biospheric and Anthropogenic $CO_2$ Atmospheric Signals Using CO Tracer Technique

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**Abstract:** Although the continued world urban population growth is responsible for the increasing anthropogenic $CO_2$ emissions, accurate accounting of the partitioning between urban anthropogenic and biospheric $CO_2$ signals is key to effective emission reduction strategies. Furthermore, the partitioning of urban anthropogenic and biospheric $CO_2$ emissions, estimated from ground-based atmospheric measurements can contribute to an independent reporting of local, regional and national $CO_2$ emission inventories. In this study, between the years 2017 to 2019, daily and seasonal ground-based cavity-ring down spectroscopic (CRDS) $CO_2$ measurements were recorded in Cookeville, a medium sized city located within the Eastern highland rim region of the United States (36.1628° N, 85.5016° W). The obtained $CO_2$ signals were partitioned into anthropogenic and biospheric dry mole fractions, utilizing CO as a tracer. The average winter biospheric $CO_2$ dry mole fraction values ranged from -0.65 ± 3.44 ppm to -9.80 ± 8.99 ppm. On the other hand, anthropogenic dry mole fraction $CO_2$ values varied from 10.01 ± 6.53 ppm to 22.88 ± 9.96 during the winter season. During the winter season, the percentage contribution of the oxidation reaction between the OH radical and isoprene ($CH_2$=C($CH_3$)−CH=$CH_2$ + OH) to the total CO budget in Cookeville is negligible. However, during the summertime, the CO from isoprene oxidation was estimated to be significant, although less than 50%, implying that any summertime study based on the CO as a tracer of combustion emission should account for its photochemical production through biogenic volatile organic compounds (VOCs).

**Keywords:** volatile organic compounds; cavity-ring down spectroscopic; oxidation reaction; isoprene; CO budget