Utilization of CH_4:CO_2 and CO:CO_2 Correlations in Deciphering Temporal Changes in Urban CH_4 and CO Emissions

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The continued measurements of urban CH_4 and CO_2 atmospheric signals at local, regional, and global levels have continued to enhance our understanding and interpretation of carbon and methane cycles. In this study, the seasonal correlation between CH_4 and CO_2 (CH_4: CO_2) and CO and CO_2 (CO: CO_2) are evaluated within an urban setting. The linear regression analysis is used to determine seasonal correlations between the respective tracer gas and CO_2. The NOAA HYSPLIT model is utilized in determining the origin of the air masses that contribute to the observed emission ratios and the consistent diurnal mixing ratio patterns throughout the year. These mixing ratio measurements are simultaneously and continuously taken at a site near the Cookeville city (36.1628° N, 85.5016° W), which is located within the greater Eastern Highland Rim region of Tennessee. Both the correlation coefficient (R^2) and emission ratios (ppb:ppm^{-1}) of CO and CO_2 for the winter season are reasonably high compared to all the other seasons, which is indicative of elevated anthropogenic emissions during the winter that are supplemented by high winter respiratory fluxes. For the years 2017 and 2018, CO:CO_2 winter emission ratio values were about five times higher than in the summer. Even though the CH_4 mixing ratios are different for each season, the calculated CH_4:CO_2 seasonal emission ratios do not show any significant difference throughout the year, with monthly averaged seasonal values ranging between 4.85 to 4.93 ppb:ppm^{-1}.

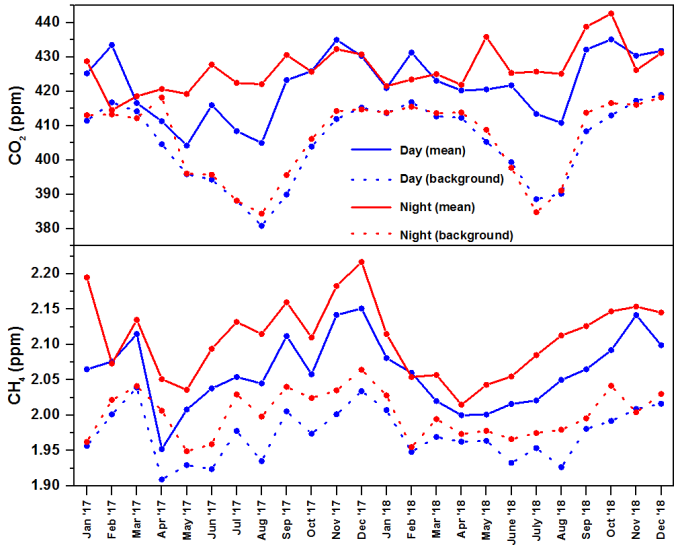

Figure 1. Day-night CO_2 and CH_4.

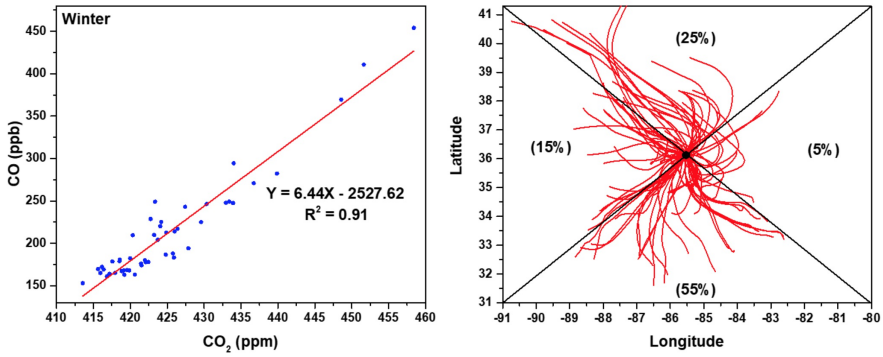

Figure 2. Correlation of CO_2 and CO in winter.