Diurnal and Seasonal Variations in the Sources of Anthropogenic CO_2 Emissions Over Two Years in the Los Angeles Megacity from Atmospheric Measurements

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Human activities in urban regions are the largest contributors to anthropogenic greenhouse gas emissions, with carbon dioxide (CO_2) being the dominant species emitted, creating large variations that are easily observed. As governments sign treaties limiting emissions in order to curb global warming, they must understand the temporal distribution of the signals. Inventory based data (bottom-up) account for emissions at all times of day from various sectors but are based only on economic data, with no observational confirmation. Atmospheric observations (top-down) from satellites generally record variations at one time of day only a few times per month for any given location. Therefore we must use long-term *in situ* measurements to develop higher temporal resolution data sets. Attributing the observed emissions to different sources requires modeling using bottom-up emission data products and/or isotopic and tracer/tracer ratio measurements. Here we extend our 8-year analysis of CO_2 emissions due to fossil fuel combustion from flask sampling to results of two years (June 2013 – June 2015) of hourly average measurements of carbon monoxide (CO), CO_2, and delta thirteen carbon ($\delta^{13}C$) from Pasadena, CA, to examine diurnal and seasonal variations in emissions from the biosphere and from natural gas and petroleum combustion. COxs/CO_2xs (excess over background) values can be used to determine the amount of fossil fuel-derived CO_2 relative to that from the biosphere. We calibrate this with mid-afternoon data using radiocarbon data from flask samples. We then use continuous measurements of $\delta^{13}C$ to differentiate between petroleum and natural gas combustion, which are characterized by distinct isotopic compositions. The results of this study show that the relative amounts of emissions of the three sources are different at different times of day as well as different times of year. We discuss the possible causes for these variations.

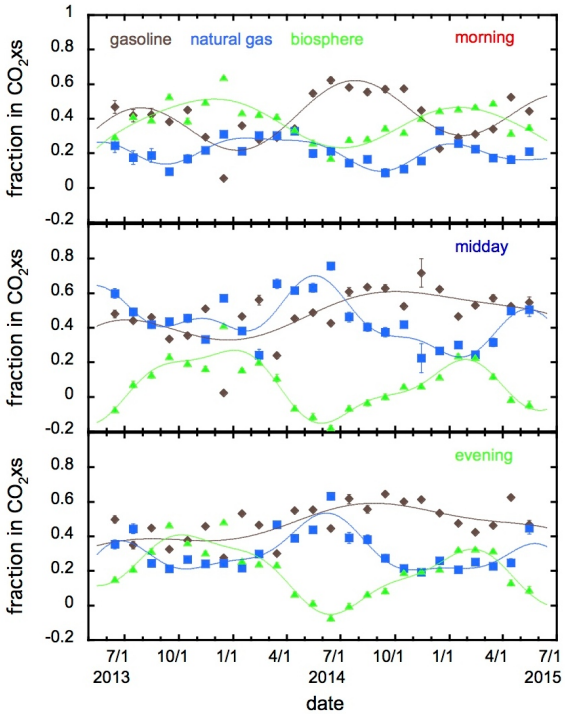

Figure 1. Source allocation of CO_2 excess over background (CO_2xs), as fraction of CO_2 from petroleum combustion, natural gas combustion, or the biosphere, in the local contribution to the atmosphere.