Initial Atmospheric Fossil-fuel CO_2 Estimates from the Los Angeles Megacity Project

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The Megacities Carbon Project (megacities.jpl.nasa.gov) is a multi-national, multi-institution project aimed at measuring carbon emissions from large urban areas. Cities account for ~70 % of all fossil fuel-CO_2 emissions. With the population of cities projected to grow from 54% of global population today to 66% by 2050 (an absolute increase of ~2 billion people), it will become imperative to accurately account for urban emissions. The internationally accepted method for calculating fossil fuel-CO_2 emissions (typically at the national level) is by using economic statistics like petroleum, coal and natural gas imports and exports. While at national scales these methods are believed to be quite accurate – ~5% for developed countries and ~10-15% for developing ones – the quality of emissions estimates at urban scales is unknown. Therefore it is important to develop independent methods of estimating emissions for cities. The strategy of the Megacities Carbon Project is to create atmospheric monitoring networks for CO_2 and carbon monoxide (CO) in and around megacities in order to detect emissions.

Here, we report initial results of newly deployed radiocarbon (^{14}C) measurements in the Los Angeles Megacity network. $^{14}CO_2$ is the gold standard atmospheric tracer for identifying the contribution of CO_2 derived from fossil fuel combustion, because fossil fuels are completely devoid of ^{14}C (in contrast to oceanic and terrestrial biospheric carbon sources, which are very close to equilibrium with the atmosphere.) The Los Angeles ^{14}C (LAC) measurements are part of a larger effort to measure radiocarbon for fossil fuel-CO_2 identification at regional (~10^2 – 10^3 km) scales throughout the U.S., but the LAC observations exhibit much bigger signals than any other measurement site. Despite the large enhancements, initial analysis of the CO_2 and $^{14}CO_2$ data (Figure 1) reveals that only about 75% of the CO_2 enhancements above background results from fossil fuel combustion, with the remaining 25% coming from biospheric sources. While up to 10% of the total enhancement is expected to be biospheric due to mandated use of ethanol in gasoline, the remaining 15% is likely net respiration from the urban biosphere. We will discuss the implications of these results for urban emissions monitoring and also explore the use of combining CO_2, CO and $^{14}CO_2$ for improved detection of fossil fuel emissions.

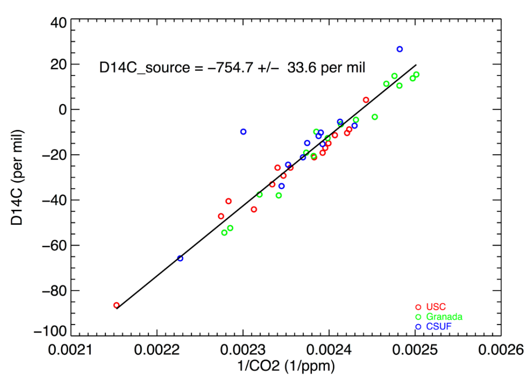

Figure 1. “Keeling Plot” of November, 2014 through January, 2015 CO_2 and $^{14}CO_2$ data from three sites in the Los Angeles Basin. The $D^{14}C$_source value (the y-intercept of the regression) for purely fossil fuel-CO_2 additions to background would be -1000 per mil; the less negative source signature of -750 per mil indicates additions of sources with isotopic ratios close to that of the atmosphere (i.e. ~ 0 per mil).