Unexpected and Significant Biospheric CO_2 Fluxes in the Los Angeles Basin Indicated by Atmospheric Radiocarbon ($^{14}CO_2$)

J.B. Miller[1], S. Lehman[2], K.R. Verhulst[3], V. Yadav[3], C. Miller[3], R. Duren[3], S. Newman[4] and C. Sloop[5]

[1]NOAA Earth System Research Laboratory, Global Monitoring Division (GMD), Boulder, CO 80305; 303-497-7739, E-mail: john.b.miller@noaa.gov
[2]Institute of Arctic and Alpine Research (INSTAAR), University of Colorado, Boulder, CO 80309
[3]NASA Jet Propulsion Laboratory, California Institute of Technology, Pasadena, CA 91109
[4]California Institute of Technology, Pasadena, CA 91125
[5]Earth Networks, Inc., Germantown, MD 20876

Cities account for about 70% of global fossil fuel-carbon dioxide (CO2) emissions, and with urban populations rising, it will become imperative to accurately account for urban emissions. Fossil fuel-CO2 emissions are typically estimated using economic statistics on fuel consumption, and while accurate at national and annual scales, the errors are unknown at urban scales. It is therefore important to develop independent methods of estimating emissions for cities. Atmospheric CO2 measurement networks in several urban areas have recently been established, but CO2 alone can not distinguish biospheric and fossil contributions. Using measurements of atmospheric 14CO2, the gold standard for identifying fossil fuel emissions in the atmosphere, we will show that CO2-only methods can lead to substantial biases in fossil fuel-CO2 emissions detection.

Here, we report results of an air sampling network for radiocarbon (14C) measurements within the Los Angeles monitoring network. These 14CO2 measurements are part of NOAA's larger effort to measure radiocarbon for fossil fuel-CO2 identification at regional (~102 – 103 km) scales throughout the U.S., but the Los Angeles sites are concentrated spatially and exhibit much larger CO2 and 14CO2 signals than at any other measurement site. Mid-day CO2 enhancements above background at our three sites in Los Angeles averaged 16 ppm, but 14CO2 data reveal that only ~ 75% of the enhancement resulted from fossil fuel combustion. Thus, the remaining 25% originated from biospheric sources. We will quantify the contributions of possible sources to this unexpectedly large (and seasonally varying) biospheric contribution. Finally, we will discuss the implications of these results for urban emissions monitoring using surface and space-based approaches and also explore the benefits of improving fossil fuel detection by using atmospheric measurements of CO2, CO, 14CO2, and other tracers.

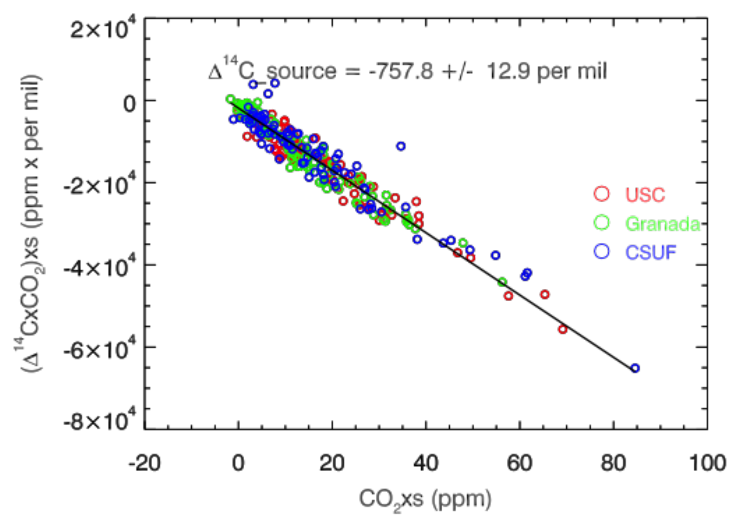

Figure 1. Correlation between enhancements over background of CO2 and 14CO2 at three sites in the Los Angeles Basin: U. of Southern California, Granada Hills, and Cal. State Fullerton. The slope of the correlation should be -1000 for a purely fossil fuel CO2 signal, but the deviation shows a ~ 25% contribution from biospheric sources.