Quantifying Sources of Methane Using Light Alkanes in the Los Angeles Basin, California


1Cooperative Institute for Research in Environmental Sciences, University of Colorado, Boulder, CO 80309; 303-497-4849, E-mail: jeff.peischl@noaa.gov
2NOAA Earth System Research Laboratory, Boulder, CO 80305
3University of Miami, Rosenstiel School of Marine and Atmospheric Sciences, Miami, FL 33173
4University of California at Irvine, Department of Chemistry, Irvine, CA 92697
5Harvard University, Cambridge, MA 02138
6University of California at Berkeley, Berkeley, CA 94720
7Department of Earth and Planetary Sciences and the Division of Engineering and Applied Sciences, Harvard University, Cambridge, MA 02138

Methane (CH4), carbon dioxide (CO2), carbon monoxide (CO), and C2–C5 alkanes were measured throughout the Los Angeles (L.A.) Basin in May and June 2010. We use these data to show that the emission ratios of CH4/CO and CH4/CO2 in the L.A. Basin are larger than expected from population-apportioned bottom-up state inventories, consistent with previously published work. We use experimentally determined CH4/CO and CH4/CO2 emission ratios in combination with annual State of California CO and CO2 inventories to derive a yearly emission rate of CH4 to the L.A. Basin. We further use the airborne measurements to directly derive CH4 emission rates from dairy operations in Chino, and from the two of the largest landfills in the L.A. Basin, and show these sources are accurately represented in the California Air Resources Board greenhouse gas inventory for CH4. We then use measurements of C2–C5 alkanes to quantify the relative contribution of other CH4 sources in the L.A. Basin, with results differing from those of previous studies. The atmospheric data are consistent with the majority of CH4 emissions in the region coming from fugitive losses from natural gas in pipelines and urban distribution systems and/or geologic seeps, as well as landfills and dairies. The local oil and gas industry also provides a significant source of CH4 in the area. The addition of CH4 emissions from natural gas pipelines and urban distribution systems and/or geologic seeps and from the local oil and gas industry is sufficient to account for the differences between the top-down and bottom-up CH4 inventories identified in previously published work.

Figure 1. a) Results from a linear least squares solution to a combination of six sources and seven trace gas species in the SoCAB. The thick black line represents the estimated total annual emission to the SoCAB for seven hydrocarbons (CH4 and C2–C5). The colored bars represent the fraction of the total contributed by each of the six source sectors used in the linear analysis. CH4 emissions are written above the bar. b) Pie charts for the same data in (a) showing the relative contributions from each source for each of seven alkanes, colored as in part (a). The white region in the i-butane pie chart represents the 11% shortfall between our source attribution and our estimated emission to the SoCAB, though it is within the uncertainties of these two values. The total emission of the alkane to the SoCAB is given to the right of each pie chart.