Methane Emissions Estimates from Oil and Natural Gas Production Using Atmospheric Measurements

A. Karion[1], C. Sweeney[1], G. Petron[1], E. Kort[2], C. Rella[3], P. Shepson[4], S. Conley[5], S. Wolter[1], T. Newberger[1], M. Trainer[6], T. Lavoie[4], M. Cambaliza[4], T. Yacovitch[7] and S. Herndon[7]

[1]Cooperative Institute for Research in Environmental Sciences (CIRES), University of Colorado, Boulder, CO 80309; 303-497-6668, E-mail: Anna.Karion@noaa.gov
[2]University of Michigan, Ann Arbor, MI 48109
[3]Picarro Inc, Santa Clara, CA 94054
[4]Purdue University, West Lafayette, IN 47907
[5]Cooperative Institute for Research in Environmental Sciences (CIRES), University of Colorado, and University of California at Davis, Boulder, CO 80309
[6]NOAA Earth System Research Laboratory, Boulder, CO 80305
[7]Aerodyne Research Inc., Billerica, MA 01821

The recent development of horizontal drilling technology has fueled a production boom in domestic oil and natural gas, which has led to widespread interest from the policy and scientific communities in quantifying the climate impact of the use of natural gas as an energy source. Quantifying this climate impact requires an understanding of methane emissions from natural gas and oil operations, because methane, the primary component of natural gas, is also a powerful greenhouse gas.

Several recent scientific field studies have focused on using atmospheric measurements to estimate natural gas methane emissions in different production basins. Ethane and carbon isotope measurements can be used to differentiate natural gas emissions from methane emissions that do not contain any non-methane hydrocarbons and have a different isotopic signature. We will present estimates of methane emissions from natural gas and oil production in two different unconventional basins in the U.S.: the Uintah (in Utah) and the Denver-Julesburg (in Colorado), along with preliminary results from a more recent measurement campaign in the Barnett Shale (in Texas). We find that current emissions inventories for the first two regions may be underestimated by a factor of two, indicating that further study is needed to identify the sources of the discrepancies between inventories and top-down estimates based on atmospheric measurements.

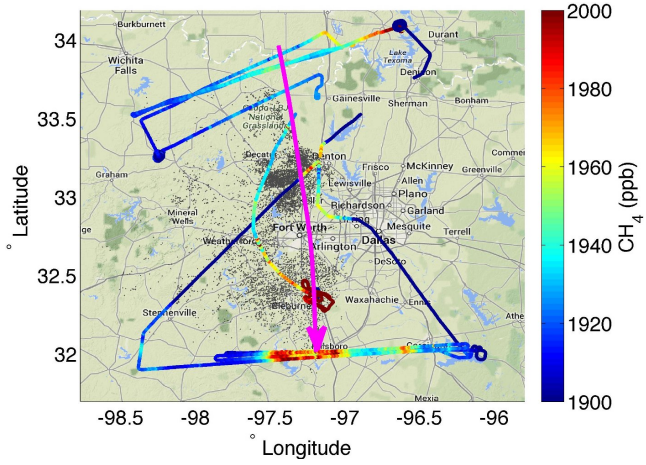

Figure 1. Map of aircraft flight path over the Barnett region gas wells (dark gray dots) colored by methane mole fraction. Map combines flight paths from two different aircraft on October 19, 2013. Magenta arrow indicates mean wind speed and direction.

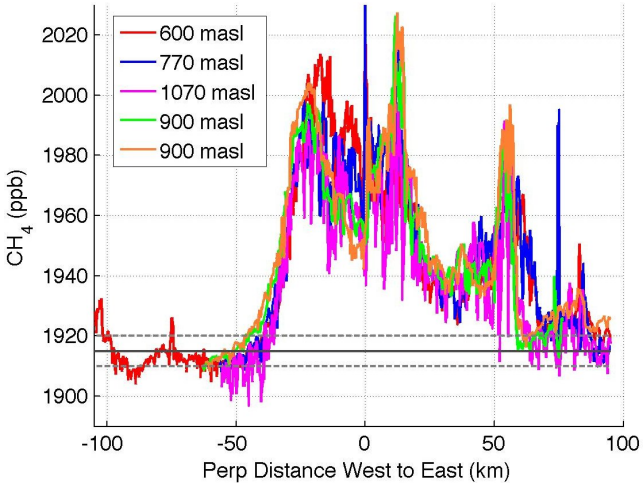

Figure 2. Methane mole fraction as a function of distance perpendicular to the average wind direction on October 19, 2013. Five passes were made in the downwind plume from the gas field at different aircraft altitudes (each differently colored in the figure). The average background condition is shown by the black line.