Quantification of Emissions from Methane Sources in Indianapolis Using an Aircraft-Based Platform

M.O. Cambaliza[1], P. Shepson[1], B. Stirm[2], A. Karion[3], C. Sweeney[3], J. Turnbull[3], K. Davis[4], T. Lauvaux[4], S. Richardson[4], N. Miles[4], D. Caulton[1] and R. Svetanoff[1]

[1]Department of Chemistry, Purdue University, West Lafayette, IN 47907; 765-496-2404, E-mail: mcambali@purdue.edu
[2]Department of Aviation Technology, Purdue University, West Lafayette, IN 47907
[3]Cooperative Institute for Research in Environmental Sciences, University of Colorado, Boulder, CO 80309
[4]Department of Meteorology, Pennsylvania State University, University Park, PA 16802

Methane is an important greenhouse gas that is 20 times more potent than an equivalent amount of carbon dioxide. Because of its relatively short lifetime and large global warming potential, reductions in its emission may lead to a considerable effect in the near-term. Urban city centers have been shown to be significant sources of anthropogenic methane with emissions much larger than currently reported in emission inventories. This discrepancy suggests that there remain a number of insufficiently characterized methane sources in urban environments. Using cavity ring-down spectroscopy, discrete flask sampling, and a mass balance approach, we determine methane emission fluxes directly downwind from the city of Indianapolis with an aircraft-based platform. By flying perpendicular to the prevailing wind direction in a horizontal flight transect across the city (Figure 1a), the methane distribution as a function of height above the ground and the horizontal distance is quantified (Figure 1b). Also shown in Figure 1b are methane hot spots that correspond to particular point sources within the city. In this work, we will describe in detail our approach to determine the city-wide emission flux as well as the source-specific methane emissions and show initial results from three flight experiments. Emission rates from specific sources of methane (e.g. landfill and wastewater treatment plants) will be investigated and quantified to determine the importance of each source to the total area-wide emission flux. As part of a collaborative effort called the Indianapolis Flux Experiment, this study will help us gain understanding into the nature of urban methane sources, specifically the magnitude of source-specific emissions, as well as the potential energy equivalent of these biogas emissions should they be captured and used to generate heat or electricity.

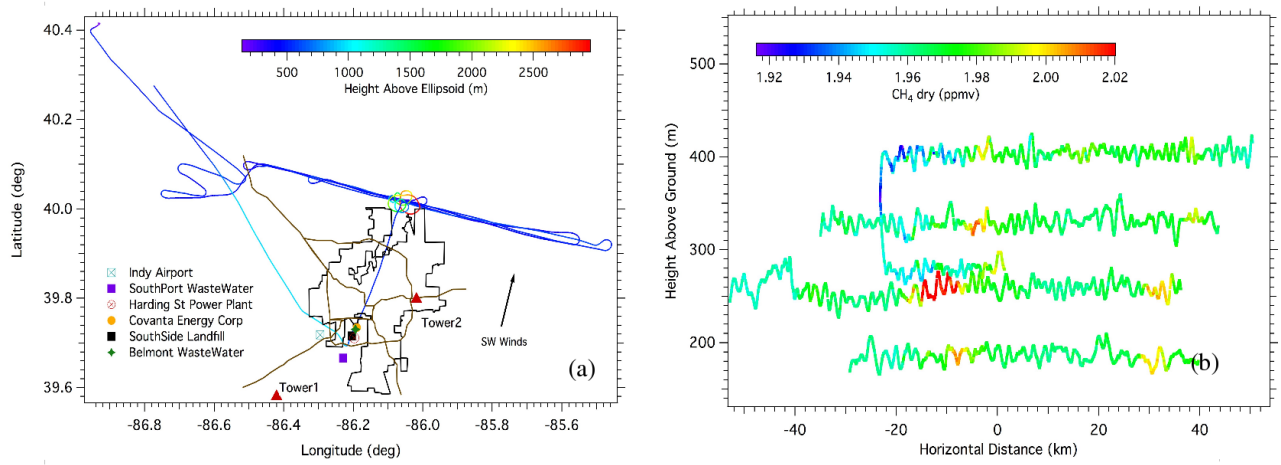

Figure 1. (a) Flight path on March 1, 2011, showing the horizontal flight segments perpendicular to the wind direction; also shown are the locations of potential methane sources in the city of Indianapolis. (b) Methane distribution as a function of the height above the ground and horizontal distance along the curtain flight segments; methane hot spots are observed at specific coordinates along the curtain flight segment.