New approach to characterize CO_2 and CH_4 emissions over Sacramento, California using an airborne aircraft measurement

Ju-Mee Ryoo[1,2], Laura T. Iraci[1], Tomoaki Tanaka[3], Josette Marrero[1,2], Emma Yates[1,3], Inez Fung[4,5] , Warren Gore[1]

[1]Atmospheric Science Branch, NASA Ames Research Center, Moffett Field, CA, USA; [2] Universities Space Research Association; [3]Bay Area Environmental Research Institute, Moffett Field, CA, USA; [4]Department of Earth and Planetary Sciences, University of California, Berkeley, Berkeley, CA 94720; [5]Department of Environmental Sciences, Policy and Management, University of California, Berkeley, Berkeley, CA 94720

Emission fluxes of carbon dioxide (CO_2) and methane (CH_4) over Sacramento, California, USA, are estimated using an aircraft equipped with a cavity ring-down greenhouse gas sensor through the Alpha Jet Atmospheric eXperiment (AJAX). To better quantify the emission fluxes over the entire city and two small point sources within the area, we designed flights in a cylindrical pattern and computed the emission fluxes from 9 flights over all seasons using the Kriging method based on Gauss's divergence theorem. The concentrations at the downwind side of Sacramento show somewhat persistent patterns among the 9 flights, but the magnitudes and locations of the fluxes vary depending on the individual weather conditions and seasonality on a given flight day. The net emission fluxes tend to be smaller in summer (July) than winter (November). Both trace gas mixing ratios as well as the wind speed and direction show high spatial variability both horizontally and vertically.

The local maximum emission fluxes over a landfill and a rice field measured on July 29, 2015, were 2–3 times lower than the maximum measured over the entire city. These low emission fluxes suggest that not only the local source but also the transport of greenhouse gases due to diurnal and seasonal variation in winds have a strong effect on the CO_2 and CH_4 flux estimation of the both local emissions and city-size emissions. Our results highlight that the aircraft-based approach is effective and useful for capturing city-size emission fluxes and estimating the greenhouse gas emissions and its sources.

A045:
Emissions and Tropospheric Photochemistry on the Urban Scale

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Session Description:
Direct action to control emissions as well as high population densities make the urban scale a focus of atmospheric chemistry and fine-scale meteorology. This session welcomes contributions on

- evaluation of emissions and fluxes of short-lived pollutants and greenhouse gases
- photochemistry and air quality
- the impact of processes such as the urban heat island and sea-breeze on the weather and environment.

The session is dedicated to practical application of fundamental physics and chemistry to improve understanding of the processes that generate ozone and other pollutants as well as direct measurement methods for emissions of reactive pollutants (e.g., CO, VOCs, and NOx from vehicles), climate forcing substances (e.g., CO2 , CH4 and black carbon) and circulation drivers on the urban scale.

Primary Convener: Russell R Dickerson, University of Maryland College Park, College Park, MD, United States
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