In-Situ Greenhouse Gas Measurements from Boreal Alaska

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The Carbon in Arctic Reservoirs Vulnerability Experiment (CARVE) was designed to use a variety of measurements, including *in situ* greenhouse gas measurements, from aircraft and a ground station to understand and quantify emissions and changes in emissions of carbon to the atmosphere from arctic and boreal Alaska over several years. Arctic and boreal carbon sources and sinks are expected to be sensitive to the rapidly warming climate in these regions. The measurements described here are an example of the kind of monitoring that will be required to detect the impact of climate change on biosphere-atmosphere gas exchange. Here we describe the *in situ* greenhouse gas measurement record that started in October 2011 at the NOAA tower in Fox, AK (64.986 N, 147.598 W, elevation 611 m; NOAA site code CRV) to support CARVE. The site was selected for its sensitivity to regional scale signals from boreal/interior Alaska as well as its proximity to ongoing long-term measurements at the Bonanza Creek Long-Term Ecological Research site (BNZ LTER) and the NOAA/GMD aircraft network site at Poker Flats (site code PFA). Measurements from the 32-m tower include continuous *in situ* carbon dioxide (CO_2), methane (CH_4), carbon monoxide (CO), and water vapor. Discrete air samples are collected in programmable flask packages daily during the CARVE flight season (April – October) and weekly during the remainder of the year (November – March). Additionally, measurements of the carbon-14 (^{14}C) content of methane ($^{14}CH_4$) are made from large volume (~1000 L) whole air samples collected biweekly. Here we present analysis of CO_2, CH_4 and CO measurements as they compare with background air coming into Alaska from the west. We also present the region of influence for the tower measurements during 2012-2014, calculated using high-resolution meteorological fields generated for the CARVE project for Alaska from 2012-2014 coupled with a Lagrangian particle dispersion model. We use the model influence functions (footprints) to constrain average land-based CH_4 fluxes for the time period. In addition, we find that CO_2 enhancements at the site can be reproduced fairly well using the modeled footprints convolved with the Polar Vegetation Photosynthesis and Respiration Model (*Luus and Lin*, 2015).

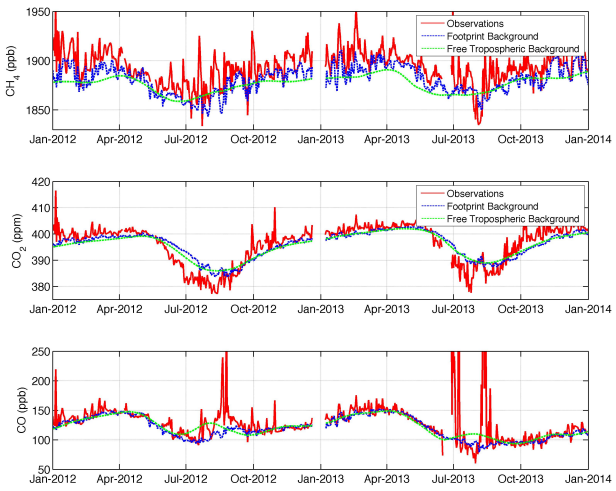

Figure 1. Time series of CH_4 (top), CO_2 (center), and CO (bottom) measurements over two years at the CARVE tower (NOAA/GMD site code: CRV) outside of Fairbanks, Alaska. Red line indicates the observations, the blue line is a background condition for the site derived from particle back-trajectories and an empirical background pacific curtain derived from NOAA/GMD measurements. The green line indicates the free-tropospheric mole fractions at 65 N from the same empirical curtain.