Observations of $^{14}CO_2$ at the Boulder Atmospheric Observatory (BAO)

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Atmospheric radiocarbon (^{14}C) represents an important observational constraint on emissions of fossil-fuel derived carbon into the atmosphere due to the near absence of ^{14}C in fossil fuel reservoirs. The high sensitivity and precision that accelerator mass spectrometry (AMS) affords in atmospheric ^{14}C analysis has greatly increased the potential for using such measurements to facilitate carbon cycle studies and the validation of greenhouse gas emissions inventories. Here we report on the first-ever $^{14}CO_2$ observations from the BAO, located in Erie, CO. The BAO tower is one of the tall towers in the NOAA ESRL greenhouse gas flask sampling network that has recently begun sampling for atmospheric ^{14}C, as well as other trace gases.

We will present observations of Delta ^{14}C in whole air samples collected between June 2009 and September 2010 at BAO. Values ranged from -20‰ (± 1.8 ‰) to +46 ‰ (± 1.8 ‰) corresponding to estimated fossil fuel CO_2 (CO_2ff) concentrations as high as 25 ppm (± 1 ppm) above the background. An analysis of the relationship between CO_2ff and other combustion tracers provides information on the type of combustion contributing to the total fossil fuel signal and on co-located activities, such as oil and gas drilling operations to the northeast. We will focus, in particular, on the correlations of CO_2ff with CO and CH_4. The observed CO to CO_2ff ratio is lower than has been seen in other regions, suggesting a relatively small contribution from mobile sources to total emissions in the region and a greater source from electrical utilities. Differences in the CH_4 to CO_2ff ratio with wind direction indicates a larger source of CH_4 when winds arrive from the northeast, where significant oil and gas drilling operations are located, as opposed to the Denver metro area to the south and southeast.

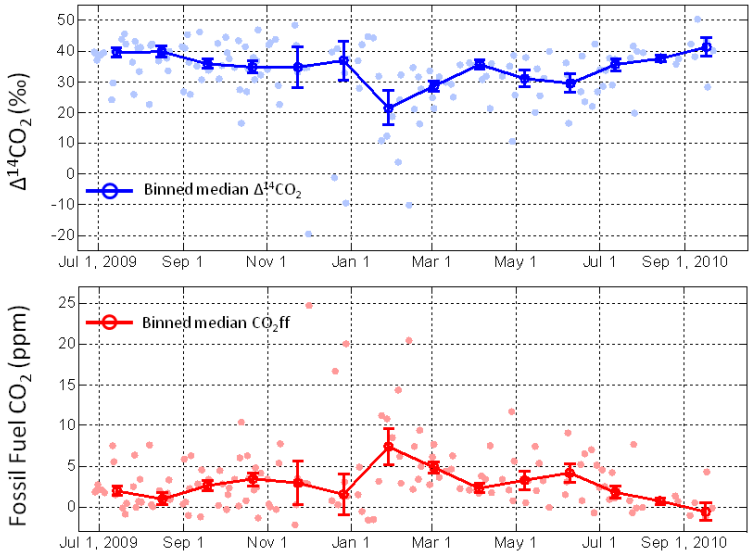

Figure 1. Time series of $\Delta^{14}CO_2$ (top, ‰) and fossil fuel CO_2 (bottom, ppm) observed at the BAO, part of the NOAA Tall Tower Network. Solid circles represent individual measurements from discrete air samples collected at mid-day. Hollow circles are monthly (approx.) binned medians (with error bars representing the standard error of the mean). Fossil fuel CO_2 (CO_2ff) is derived from an isotopic mass-balance equation using observed CO_2 mixing ratios, background [CO_2] and $\Delta^{14}CO_2$ estimated from observations at a nearby high elevation site (Niwot Ridge), an assumed $\Delta^{14}C$ for fossil fuels of -1000 ‰, and estimated respired CO_2 correction ranging from 0.2 ppm (summer) to 0.5 ppm (winter).