First Deployment of a New Mobile Laboratory for Greenhouse Gas Attribution Studies

R. Bambha[1], H. Michelsen[1], P. Schrader[1], F. Helsel[2], M.D. Ivey[2], B.D. Zak[2], B. LaFranchi[3], B. Flowers[4], T. Rahn[4], M. Dubey[4], T. Guilderson[3], S. Biraud[5], M. Fischer[5], M. Torn[5] and C. Sweeney[6]

[1]Sandia National Laboratories, 7011 East Ave, Livermore, CA 94550; 925-294-3391, E-mail: rpbambh@sandia.gov
[2]Sandia National Laboratories, Albuquerque, NM 87185
[3]Lawrence Livermore National Laboratory, Livermore, CA 94550
[4]Los Alamos National Laboratory, Los Alamos, NM 87545
[5]Lawrence Berkeley National Laboratory, Berkeley, CA 94720
[6]Cooperative Institute for Research in Environmental Sciences, University of Colorado, Boulder, CO 80309

Anthropogenic sources of carbon dioxide (CO_2) represent a significant portion of the global carbon budget, but partitioning CO_2 measurements into their biogenic and anthropogenic sources has been difficult using only measurements of CO_2 abundances and those of a small number of additional tracers. An intensive field campaign was conducted in Fall 2010 at the Atmospheric Radiation Measurement-Southern Great Plains (ARM-SGP) Central facility near Lamont, OK to measure CO_2 and several tracers for its sources using a new mobile laboratory. Two trucks carrying over fifteen instruments for gases and particles were deployed along with a gas-calibration system. Air was drawn into both trucks from a 10-m tall mast. All measurements were made either from a common inlet or closely located inlets. Instruments were selected to provide measurements of tracers of both biogenic and anthropogenic sources. High-frequency measurements of abundances of CO_2 and its stable isotopologues ($^{13}CO_2$ and $C^{18}OO$) were made simultaneously with measurements of CO, SO_2, NO_x, O_3, CH_4, water vapor isotopologues (H_2O, HDO, and $H_2{}^{18}O$), volatile organic compounds, black and organic carbon aerosol, and particle count. Automated flask samplers collected whole air samples for off-line ^{14}C analysis using accelerator mass spectrometry. Redundancy between CO_2, CH_4, and H_2O measurements provided a valuable crosscheck for the calibrations and the measurements. Good agreement between CO_2 measurements from four different instruments was attained following careful post-processing and calibrations. Similarly good agreement was demonstrated between four instruments that measured water vapor and two instruments that measured CH_4. The agricultural region that surrounds the ARM-SGP site had experienced little rainfall prior to the campaign, and land cover and crop growth were minimal during the period in which measurements were made (3 October - 9 November 2010). Correlations between various tracers and CO_2 provide insight into the different sources, including the anthropogenic component, which includes biomass and fossil fuel combustion.

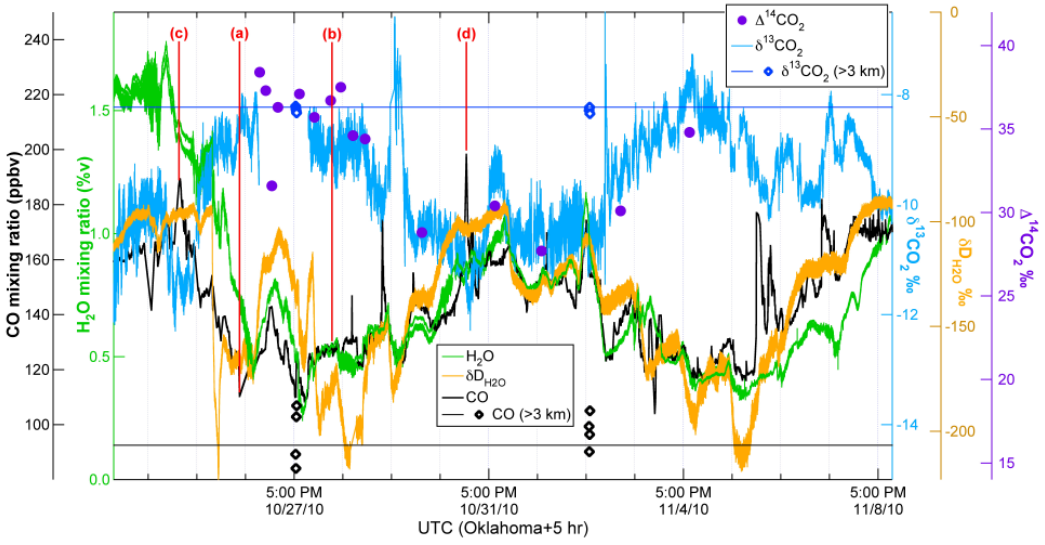

Figure 1. Time series of $\delta^{13}C$ -CO_2, $\Delta^{14}C$-CO_2, δD-H_2O, H_2O, and CO measured during the campaign. High $\delta^{13}C$ and $\Delta^{14}C$ are associated with low CO, δD -H_2O, and H_2O and air from high altitudes. Low $\delta^{13}C$ and $\Delta^{14}C$ and high CO, δD-H_2O, and H_2O are associated with air from low altitudes within the past few days.