Continental-Scale Trace-Gas Measurements over the United States During COBRA 2000

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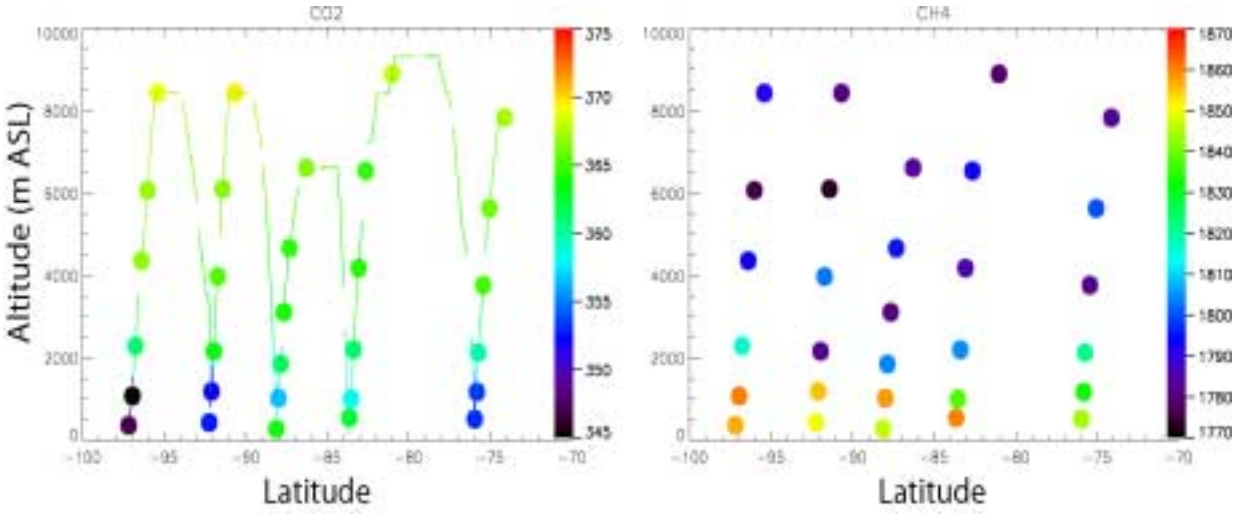
During August 2000 the CMDL Carbon Cycle Greenhouse Gases Group participated in the CO_2 Budget and Rectification Airborne (COBRA) study together with groups from Harvard University, University of North Dakota, and Scripps Institution of Oceanography. The COBRA study is the first continental-scale survey of trace gas mole fractions and isotope ratios. During the COBRA study CO_2, CO, CH_4, N_2O, SF_6, H_2, and $\delta^{13}CO_2$ were measured between the surface and 10,000 m in the eastern two thirds of the coterminous United States. Both continuous and flask measurements of CO_2 show strong terrestrial uptake of CO_2 in the northern half of the country but seem to indicate a small source of CO_2 south of about 40ºN. In addition, higher levels of CO_2 uptake were observed east of 100ºW, which correlate well with large-scale precipitation and temperature patterns for summer 2000. CO measurements show the influence of both urban pollution and biomass burning. Biomass burning signals from the western United States and Canada are evident as far east as Boston. Using CO and SF_6 as tracers for the biomass burning (CO) and urban pollution (both CO and SF_6) components of CO_2 mole fractions, the influence of terrestrial biology on the CO_2 measurements can be calculated. Knowing the fossil fuel, biomass burning, and biologically derived fractions of CO_2 will allow us to compare modeled and observed CO_2 mole fractions over the United States during August 2000.

Spatial patterns present in $\delta^{13}C$ and other trace gases will also examined. The combined CO_2 and $\delta^{13}C$ data sets can yield information on the type of plants responsible for CO_2 exchange with the atmosphere. Measurements indicate surface sources of both CH_4 and N_2O, and a surface sink for H_2, although the anthropogenic and natural fractions of these fluxes are unknown at present.



CO_2 and CH_4 mole fractions over the northern part of the United States measured during a flight on August 19, 2000. CO_2 measurements (in ppm; circles = flask measurements, lines = continuous measurements) exhibit strong gradients indicating uptake, except over the region around the Great Lakes. CH_4 measurements (in ppb) exhibit gradients opposite in sign to CO_2, indicating a surface source.