Atmospheric Measurements of the Global Carbon Cycle

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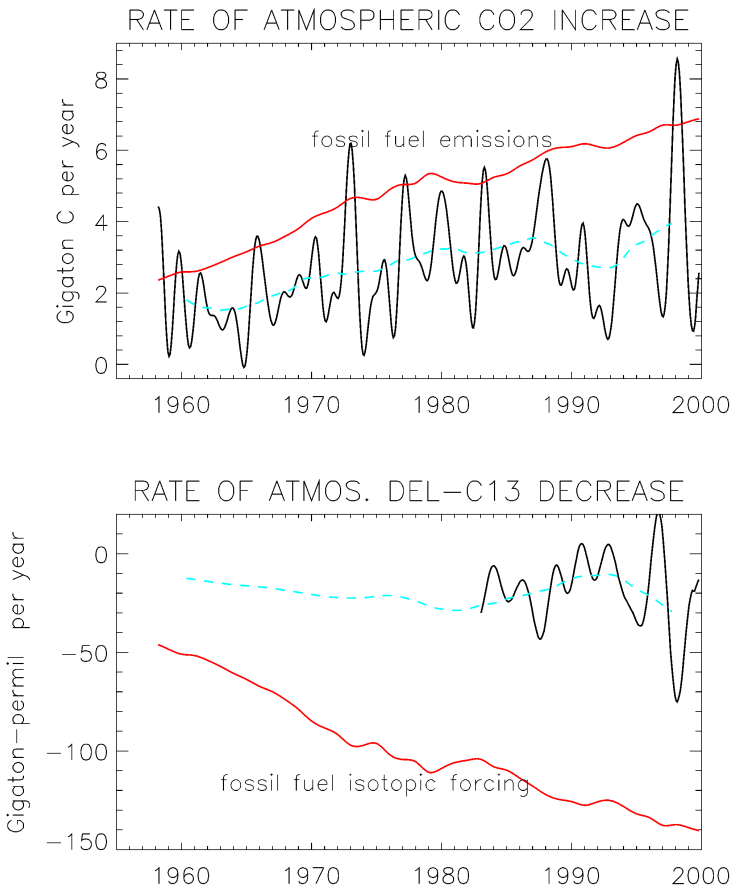
The major anthropogenic climate-forcing agent is carbon dioxide. The removal time of the excess CO_2 injected into the atmosphere by the burning of fossil fuels is very long, and as a consequence, the atmospheric concentration of CO_2 will keep increasing as long as we continue to burn coal, oil, and natural gas. There is still substantial uncertainty about the partitioning between the oceans and the terrestrial biosphere of the CO_2 that does not remain in the atmosphere. The driving or rate-limiting mechanisms are poorly understood or quantified. Projections of future climate forcing due to enhanced CO_2 are uncertain, because the carbon cycle is not likely to continue to operate as it has done in the recent past but will respond to climate change itself.

The historical growth of CO_2, the development of the latitude gradient, isotopic ratios of CO_2, the decrease in atmospheric O_2, and sea surface pCO_2 data have allowed us to conclude that there is, on average, a surprisingly large sink of CO_2 into terrestrial ecosystems at temperate latitudes in the northern hemisphere. Substantial interannual variation of sources and sinks in large latitudinal zones is evident from the data obtained in the global sampling network. The observed spatio-temporal patterns of the concentration are translated into patterns of sources and sinks by using atmospheric inverse models. Other gaseous species such as CH_4, CO, H_2, N_2O, and SF_6 are measured in the global sampling network, and relationships of the concentrations with biomass burning and with climate anomalies are seen. Isotopic ratios of CO_2 and CH_4 are measured to improve the attribution to specific types of sources/sinks.



Last year CMDL participated in the COBRA campaign, a set of flights over North America designed to study how the signal produced by photosynthetic and respiratory surface fluxes propagates in the atmosphere, or how we can "read" the atmosphere to obtain quantitative information about net ecosystem exchange on a regional scale. CMDL also participates in NASA's LBA-Ecology project by collecting regular vertical profiles of our standard suite of trace gases inside and upwind of the Amazon basin. Measurements were commenced at a new, very tall tower site near Waco, Texas, to constrain estimates of sources/sinks in the southwestern part of the United States.