Recent Variations in the Atmospheric CO_2 Growth Rate

T.J. Conway[1], P.P. Tans[1], P.M. Lang[1], K.A. Masarie[1], K. Thoning[1], N. Paynter[1,2], D. Kitzis[1,2], J. White[3], and B. Vaughn[3]

[1]NOAA Climate Monitoring and Diagnostics Laboratory, 325 Broadway, Boulder, CO 80305;
303-497-6681, Fax: 303-497-6290, E-mail: tconway@cmdl.noaa.gov
[2]Cooperative Institute for Research in Environmental Sciences, University of Colorado,
Boulder, 80309
[3]Institute for Arctic and Alpine Research, University of Colorado, Boulder, 80309

While many issues concerning global climate change are hotly debated, two things are known with a high degree of certainty: the Earth's surface warmed significantly during the past century, and the amount of carbon dioxide in the Earth's atmosphere has increased by almost 30%. Long-term measurements from CMDL's global cooperative air sampling network show significant interannual variability in the CO_2 growth rate but little change in the decadal mean: 1.5 ppm yr^{-1} in the 1970s, 1.4 ppm yr^{-1} in the 1980s, and 1.5 ppm yr^{-1} in the 1990s. The late 1990s exemplify the variability with a globally averaged increase of 3.1 ppm from 1997 to 1998 and only 1.3 ppm from 1999 to 2000.

Since 1990 CMDL, in cooperation with the Institute for Arctic and Alpine Research (INSTAAR), has used measurements of $^{13}C/^{12}C$ of CO_2 to attempt a separation of the CO_2 sink into marine and terrestrial components. On average, the terrestrial sink (~1.4 Gt C yr^{-1}) is smaller than the marine component (~2.0 Gt C yr^{-1}). While both are variable, the terrestrial sink variability is greater, ranging from ~3 Gt C yr^{-1} in 1996 to actually being a source of 0.1 Gt C to the atmosphere in 1998.

Understanding the processes responsible for the variability of carbon sinks is a major challenge for carbon-cycle research, one with implications for policy and society at large. The global CO_2 growth rate is significantly correlated with global temperature anomalies (figure), but, interestingly, CO_2 variations lead temperature by ~4 months. When the CO_2 growth rate and temperature anomalies are examined in five broad latitude zones, the correlation breaks down, contrary to our expectation.