The Latitude Gradients of CO_2 and $^{13}C/^{12}C$

P. Tans[1], E. Dlugokencky[1], T. Conway[1], P. Lang[1], L. Bruhwiler[1], J. White[2], and B. Vaughn[2]

[1]NOAA Climate Monitoring and Diagnostics Laboratory, 325 Broadway, Boulder, CO 80305;
303-497-6678, Fax: 303-497-6290, E-mail: Pieter.Tans@noaa.gov
[2]Institute of Arctic and Alpine Research, University of Colorado, Boulder 80309

The large-scale north-south gradient of carbon dioxide and its carbon isotopic ratio is dominated by the combustion of fossil fuels, which is most strongly concentrated at midlatitudes of the northern hemisphere. Sulfur hexafluoride (SF_6) is a manmade compound mostly used to prevent fires in high-voltage electricity distribution systems. The chemical lifetime of SF_6 is a thousand years or more, and it is not significantly removed by dissolution in ocean waters. The spatial and temporal pattern of SF_6 emissions is very similar to that of CO_2. We use that similarity to remove the direct influence of fossil fuel combustion from the observed latitudinal CO_2 gradient, leaving the imprint of other processes, such as net uptake and loss in the oceans and the terrestrial biosphere (Figure 1). The impact of the (relatively minor) mismatch between fossil fuel CO_2 emissions and SF_6 emissions will be quantified. The fossil-fuel-corrected latitudinal gradient of $\delta^{13}C$ is quite different from that of CO_2, which reflects isotopic exchange processes between the oceans and terrestrial biosphere and the atmosphere. The two fossil-fuel-corrected latitudinal gradients may pose a strong constraint on parameterizations of air-sea gas exchange.

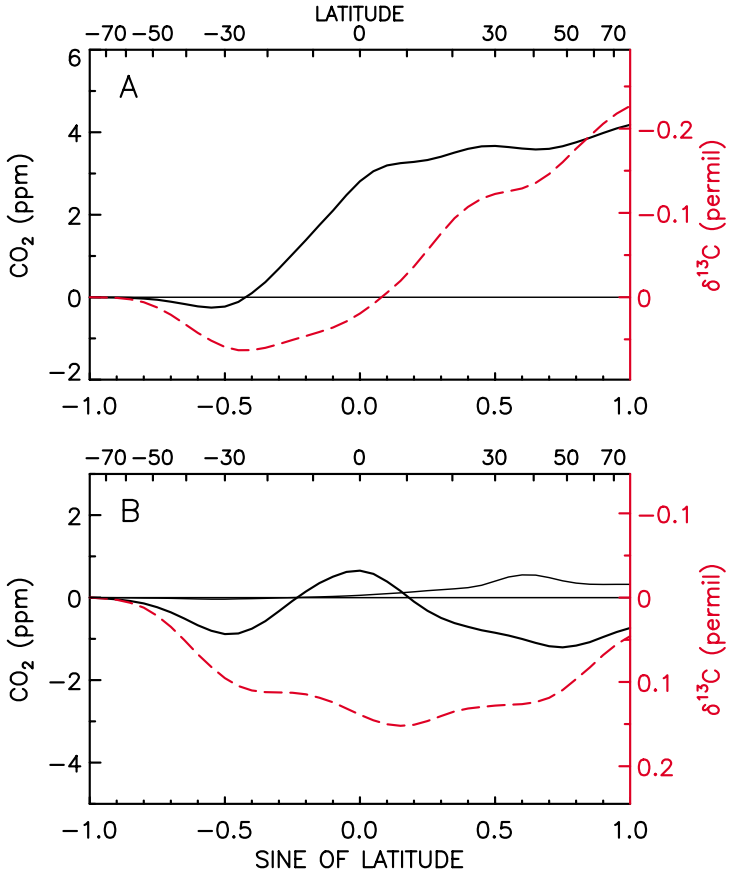

Figure 1. Top: Observed latitudinal gradients of CO_2 and $\delta^{13}C$ at CMDL sites located in the marine boundary layer. The $\delta^{13}C$ scale is plotted upside down. Bottom: Same as in the top frame after subtracting the contribution of fossil fuel burning, based on the observed SF_6 gradient.