Estimated Monthly Global Emissions of Anthropogenic CO_2 and Their Impact on Calculated Atmospheric CO_2

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Estimates of monthly fossil-fuel carbon emissions for each 1-degree gridsquare of the earth's surface are used in the context of meteorological fields from the NASA GEOS-4 data assimilation system to investigate the influence of seasonal emissions cycles on atmospheric concentrations and transport of CO_2. We find that the use of monthly resolved fluxes makes a significant difference in the seasonal cycle of atmospheric CO_2 in and near those regions where anthropogenic CO_2 is released to the atmosphere. Local variations of 2-6 ppmv CO_2 in the seasonal cycle amplitude are simulated, and larger variations would be expected if smaller source-receptor distances could be more precisely specified using a more refined spatial resolution. We also find that in the mid latitudes near the sources, synoptic scale atmospheric circulations are important in the winter and that boundary layer venting and diurnal rectifier effects are more important in the summer. These findings have implications for inverse-modeling efforts to estimate surface source/sink regions especially when the surface sinks are colocated with regions of strong anthropogenic CO_2 emissions.

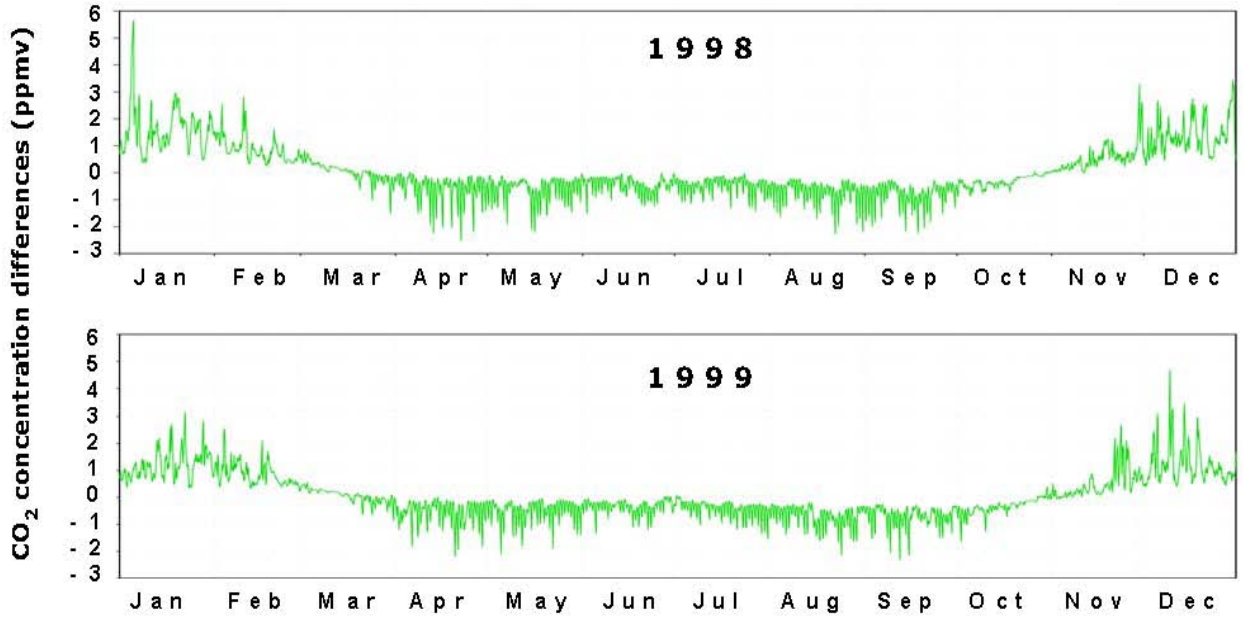

Figure 1. Differences between near-surface atmospheric CO_2 concentrations calculated using varying monthly emissions and using annual emissions distributed equally over all calendar months, for a location about 20 km NE of Philadelphia (40°N, 75°W). Note the consistent seasonal pattern.