

The Annual Cycle of Fossil-Fuel CO₂ Emissions from the United States

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Carbon-cycle modeling on a seasonal basis and the identification of changes in the amplitude of the annual cycle of atmospheric CO₂ concentration have both prompted the quantification of the annual cycle of anthropogenic CO₂ sources. Fossil-fuel combustion is the largest anthropogenic source of atmospheric CO₂, and the United States is the world's largest fossil-fuel consumer, being responsible for about 23% of the world total consumption as of 1999. Calculations of monthly CO₂ emissions from fossil fuels in the United States reveal a clear annual pattern in total emissions, as well as in the respective percentages attributable to coal, oil, and natural gas. The latter result is suggestive of an annual pattern in the $\delta^{13}\text{C}$ signature of emissions, which could be useful in carbon tracking. We believe our results are generally indicative of fossil-fuel carbon emissions from industrialized nations in the northern hemisphere, which includes most of the total fossil-fuel emissions. An increase in CO₂ emissions of about 20%, mostly due to coal and oil consumption, has occurred in the United States since 1981 (Figure 1). This increase is most evident in summer, which is the low part of the annual cycle, so the amplitude of the annual cycle appears to be decreasing. Increased energy consumption for air conditioning appears to be at least partly responsible. Emissions estimates are based on energy data from the U.S. Department of Energy, Energy Information Administration.

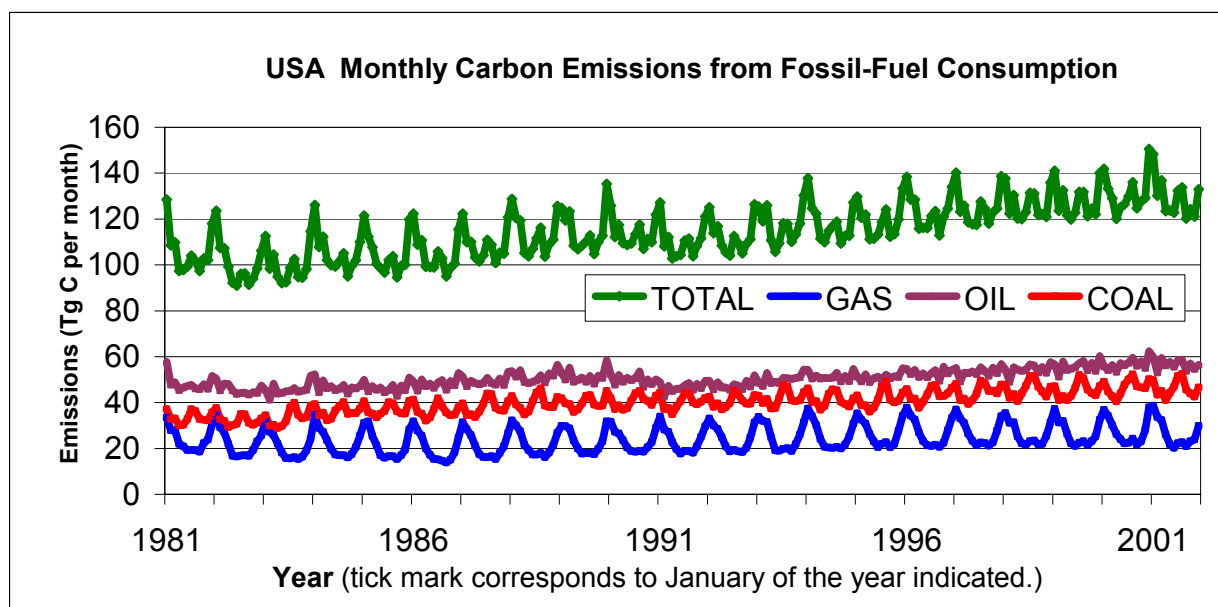


Figure 1. CO₂ emissions from combustion of coal, oil, and natural gas in the United States over the last 20 years. The annual cycle is dominated by natural-gas combustion. Emissions from coal combustion show peaks in summer and winter, and emissions from natural-gas combustion show a small summer peak in recent years. These emissions constitute over 20% of the global total.