Climatic and Biospheric Effects of Changing Patterns of Fossil-fuel CO_2 Emissions

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Climate warming and population shifts to warmer climates have resulted in an increasing percentage of the USA population living in a warmer environment. In addition, there has been an increasing reliance on air conditioning in all regions of the country. The result is an increase in energy demands for summer cooling and a decrease in energy demands for winter heating, along with corresponding seasonal trends in fossil-fuel CO_2 emissions. When winter decreases are combined with summer increases, the net contribution to USA fossil-fuel carbon emissions is relatively small and negative, but is projected to change sign before 2025, so as to contribute to projected increases.

An important result for carbon-cycle modeling is that an increasing fraction of annual fossil-fuel CO_2 emissions is being emitted during the growing season (Figure 1), when the terrestrial biosphere removes CO_2 from the atmosphere via photosynthesis. At the global scale, these anthropogenic changes in atmospheric CO_2 are very small compared to the natural variations due to photosynthetic removal each summer. However, most fossil-fuel CO_2 emissions occur over a very small percentage of the earth's surface, so the greatest ecological effects of changing the temporal distribution of fossil-fuel CO_2 emissions are expected to occur near the emissions sources, where the CO_2 emissions are most highly concentrated. This partly explains the need to understand the processes involved at very small time and space scales, and to integrate the results, in order to balance the global carbon budget.

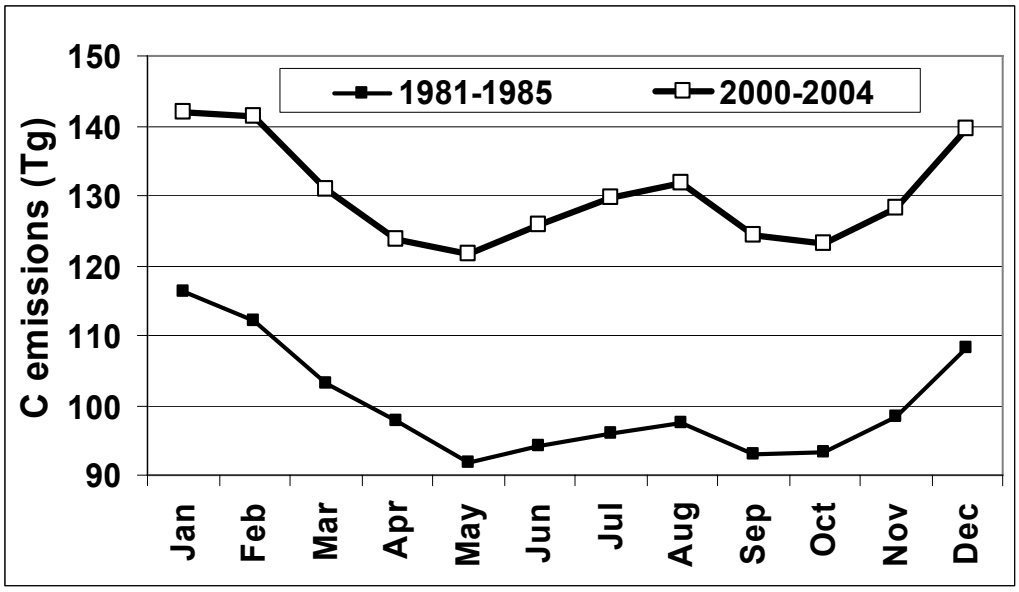

Figure 1. Five-year averages of monthly carbon emissions (as CO_2) for early and recent periods, showing increased peaking during the summer months.

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