LCLUC Abstract

Sources and Sinks of Carbon in Land-Use Change

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This proposal seeks support for improving historic and current (to 1995) estimates of the annual net flux of carbon between terrestrial ecosystems and the atmosphere as a result of changes in land use. Although the land-use flux is only a portion of the total net flux of carbon between terrestrial ecosystems and the atmosphere, it is a major component, it can be calculated directly, and it helps constrain, temporally and spatially, the so-called "missing sink". We propose to improve and update estimates of flux in those regions with a potential for large changes in carbon storage. The approach, using a bookkeeping model, will be similar to our earlier research. The calculated flux of carbon will be that attributable to changes in land use, not to changing environmental conditions. The goal of this work is to keep the land-use component of carbon flux separate from fluxes attributable to other factors.

The work involves, first, updating a previous global estimate of flux (Houghton 1999) with results from two regions where analyses were recently completed: the United States (Houghton et al. 1999) and the Brazilian Amazon (Houghton et al. 2000). Reanalysis of the U.S. increased the estimated annual releases of carbon during the nineteenth century and increased the estimated annual sink of carbon over the last three decades. The changes are of interest in that they show the carbon sink attributable to land-use change to be a significant fraction of the sink calculated on the basis of forest inventories. Thus, (past) changes in land use (agricultural abandonment, fire suppression, and logging) explain a portion of the sink actually measured in U.S. forests. Additional factors, such as CO_2 fertilization or N deposition, may also be required to explain the observed sink.

The net release of carbon from deforestation and secondary forest growth in the Brazilian Amazon was found to be smaller than previously estimated and largely offset by a carbon sink in natural or undisturbed forests (Tian et al. 1999). This finding supports those global analyses that find the tropics to be nearly neutral with respect to carbon flux and the northern mid-latitudes to be a small sink. In contrast, other analyses suggest a large net source from the tropics and a large sink in northern mid-latitudes. The new, lower estimate for the Brazilian Amazon, along with the slightly larger sink determined for the U.S., lowers the previous global estimate of flux by about 0.3 PgC yr^{-1}. Reduced rates of deforestation in the first half of the 1990s (FAO 1997) suggest that global emissions declined between 1989 and 1996.

Current work is focusing on a re-analysis of historic and current rates of land-use change in China and on calculation of annual sources and sinks of carbon there.