within the range of 0.9 to 2.9 Pg C in 1980 (Houghton et al., 1985; Detwiler et al., 1985; and Melillo et al., in press), almost all of which is from the tropics. However, two important processes were not considered in these analyses: (1) increases in carbon storage within existing forests and forest expansion into woodlands and grasslands in the northern hemisphere due to fire suppression, and (2) gradual degradation and the associated reduction of carbon stocks of vegetation and soil from logging, harvesting of fuel wood, deliberate burning, and grazing in tropical open forests.

Four studies have attempted to estimate the net biotic flux based on land-use history since 1860 (Revelle and Munk, 1977; Moore et al., 1981; Houghton et al., 1983; and Richards et al., 1983). In particular, Houghton et al. (1983) built upon the work of Moore et al. (1981) and developed a model that reconstructs yearly changes of carbon in terrestrial ecosystems from 1860 to 1980. That model considers ten geographic regions with up to 14 types of ecosystems, including agroecosystems. The predicted pattern of carbon release to the atmosphere is significantly different than that arrived at by deconvolution. Whether or not closer agreement between estimates from deconvolution and historical reconstruction can be achieved by further refinements of techniques and data is unknown.

Thus, there are great uncertainties in the amount of flux from the terrestrial biosphere to the atmosphere (Table 1). Although current estimates of 0.9 to 2.9 Pg $C \cdot yr^{-1}$ are lower than some earlier estimates, they are still incompatible with estimated ocean model CO_2 uptake.

Because terrestrial ecosystems do not mix or exchange carbon directly, as do different volumes of inter-mixing ocean water, spatial heterogeneity is an important consideration in aggregating the many site-specific measurements of ecosystem carbon dynamics into global models with appropriate dynamics. Recent work has attempted to incorporate spatial detail into analyses. Several global maps of contemporary terrestrial ecosystems at 0.5° latitude by 0.5° longitude resolution have been constructed (Matthews, 1983; and Olson et al., 1983). The relationship between these maps and the reconstruction of land-use based on tabular data by country has not been determined. Satellite imagery also has been used for assessing current vegetation and land-use, although, so far, only for selected areas (Tucker et al., 1985; and Woodwell et al., 1986). Remote sensing has been used to classify current vegetation cover over large areas (Tucker et al., 1985; and Townshend et al., 1986), relate seasonal phenology observed by satellite to atmospheric CO_2 concentration (Tucker et al., 1985), and monitor changes in productivity (Warrick et al., 1986).

Variations in atmospheric CO_2 levels contain information about interactions between the atmosphere and other carbon reservoirs. The amplitude of the seasonal cycle varies from place to place on the surface of the earth. In particular, there is a strong latitudinal pattern, with an amplitude that is very small at the South Pole but that increases northward to a maximum at Pt. Barrow, Alaska (Harris and Bodhaine, 1983; and Gammon et al., 1985). These oscillations are largely due to seasonal patterns of terrestrial vegetation growth and decomposition.