

## SECTION III

### *Soils*

The total amount of carbon held in the soils of the earth is substantially greater than in either the vegetation or the atmosphere. The authors of the two papers that follow have attempted independent appraisals of the amount of carbon held in soils globally, the releases over the past century due to disturbance by man, and the current rate of release to the atmosphere. Their estimates are close for the contemporary inventory, about  $1500 \times 10^{15}$  g, but their estimates of the rate of release are substantially different. Buringh suggests a most probable global release of  $4.6 \times 10^{15}$  g while Schlesinger's estimate is about one-sixth of Buringh's,  $0.8 \times 10^{15}$  g.

The difference in the estimates is an indication of the need for additional studies. The most conspicuous need is for a better appraisal of the areas affected by human disturbance. We know that the major transition of importance in releasing carbon as  $\text{CO}_2$  from soils to the atmosphere is the replacement of forest by agriculture or grazing (Woodwell *et al.*, 1978, 1983; Moore *et al.*, 1981; Houghton *et al.*, 1983). The data available at present for estimating this transition are at best uncertain (Persson, 1974; Woodwell *et al.*, 1983) because of the difficulties in determining areas on the ground and because of carelessness, confusion or bias in reporting.

There are further uncertainties. One is the rapid development of impoverished lands, especially in the tropics, where agriculture must be abandoned and where the vegetation remains sparse, diminutive or lacking. These lands are usually not tabulated as a part of agricultural or other land-use statistics. Yet they are recognized increasingly as a significant, new class of land.

The problems of measurement set forth by Buringh and by Schlesinger can be resolved in large part by remote sensing. The changes in forest soils follow major changes in the vegetation. These latter changes can be measured directly by remote sensing from aircraft and, occasionally, by satellite imagery. And so, while direct measurements of changes in soils are not usually possible using satellite imagery, indirect appraisals from direct measurements of changes in

major types of vegetation are clearly possible. The papers on soils are included here to emphasize the importance of a systematic approach to improvement in the data on soils for estimation of the total flux of carbon to the atmosphere.

#### REFERENCES

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