Global Carbon Monoxide Fluxes: Inappropriate Measurement Procedures

Bartholomew and Alexander have calculated (1) that the global CO uptake by soil is 4.1 × 10^14 g/year. Although we should be satisfied to see Seiler’s earlier estimates (2) confirmed, we are deeply concerned about the experimental procedure used by Bartholomew and Alexander (1) and what we feel are misquotations from Seiler’s earlier paper (2). Their calculation is based on laboratory experiments that represent disturbed conditions, whereas our experiments are based on measurements made in the field under natural conditions. We are also concerned about the application of an unrealistically high CO mixing ratio of 3 parts per million by volume (ppmv) and the use of the radiotracers technique with 14CO as the tracer.

The CO uptake depends on concentration and, observed ambient CO mixing ratios in the lower troposphere are of the order of 0.05 to 0.30 part per million (ppm); thus reported uptake rates based on mixing ratios of 3 ppm must be overestimated by approximately one order of magnitude. Furthermore, the report by Bartholomew and Alexander totally neglects the fact that CO is not only destroyed but also produced in soil. In summer at high soil surface temperatures and ambient CO mixing ratios (≤ 0.30 ppmv), the production sometimes exceeds the destruction. Under these conditions the soil acts as a source of atmospheric CO. Extrapolation of results obtained at 3 ppm to low ambient mixing ratios, however, indicates that the soil is always a net sink, an incorrect generalization.

The existence of simultaneous production and destruction of CO by different processes in the soil clearly demonstrates the inapplicability of a radiotracer technique that measures only the oxidation of 14CO to CO2 and not the production of CO by soil. The use of 14CO is therefore inappropriate for the determination of the CO net flux between the soil and atmosphere. Thus we feel that agreement between Seiler’s earlier data and those obtained by Bartholomew and Alexander (1) is fortuitous.

The global CO uptake rate of 5 × 10^14 g/year (2) is based on in situ measurements carried out under ambient natural conditions, different types of soil, and different seasons and weather conditions, covering soil temperatures of 3° to 50°C. This is well documented in (2); we therefore do not understand the statement of Bartholomew and Alexander that Seiler’s estimate is based on “measurements of a few European soils in the laboratory” and “multiplying the average uptake rate of a few soils at 15°C.”

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