Comment on “Carbon Movement in Runoff and Erosion under Simulated Rainfall Conditions”

In a recent article Lowrance and Williams (1988) use simulated rainfall on 40-m² plots with four different soil cover conditions and monitor outputs of water, sediment and C. Several omissions of relevant data and a focus on output data from the plots limits the interplot comparability and prevents further modeling.

Rainfall was simulated at an intensity of 6.35 cm h⁻¹ for 30 min with an event erosion index of 403 MJ mm ha⁻¹ h⁻¹. However, no information is provided concerning the return period of the rainfall event (cf. Dunne and Leopold, 1978). This information is essential for the reader to assess whether high magnitude, low frequency events were simulated. Output data from an event with a recurrence interval of less than 1 yr will be drastically different from one which occurs on average once every 5 to 10 yr.

Runoff and sediment output were compared between plots for each simulation event, the hypothesis being that variations in runoff and sediment output would reflect differences in surface cover conditions. However, the reader was given no information on the antecedent moisture content (AMC) of the plot soils. No mention was made of whether the plots were covered during natural rainfall events, as was done by Andraski et al. (1985), to ensure consistent AMC among all test areas. Thus the reader is not sure whether runoff and sediment variation between plots reflects differences in cover condition or differences in AMC. As Luk (1985) correctly states, the AMC is a significant factor contributing to variations in rainwash erosion and runoff.

The bare bedded plots generally produced the most runoff (see their Fig. 1 and Table 3; note data from September 1985 were excluded). The mean runoff coefficient, runoff depth/rainfall depth (~31.8 mm), for the bare bedded plot was 38%, compared to 22%, 14% and 11% for the two-row peanuts, four-row peanuts, and the continuous fallow, respectively. Data for the two successive storm events on September 1985 (separated by 10 min) were distinctly different from the other runoff events. Runoff depth from the bare bedded plot (Run 1) was approximately 20 to 25% of the mean for the other runs, and there was no runoff from the bare bedded plot during Run 2. These results are anomalous and need some elaboration, because one would expect significant increases in runoff under high AMC, as was shown for the other plots. In addition, an increase in sediment output would be expected at high AMC due to the reduction of soil shear strength. No mention of these rather unusual results was made, however, and they were also excluded from further analyses. Why?

Meaningful comparisons between plots are limited by the authors’ monitoring framework. Their study is an example of the “lumped” or “black-box” approach to erosion monitoring. The focus on output limits the understanding of the spatial variability of erosion and deposition processes, and a realization of the importance of storages within a system. Mean runoff from the small plots per event were approximately greater than the average long term con- wershed Z (6.5%). In addition, the larger plots have an increased opportunity for deposition on and losses from the plots.

Following two consecutive simulations, high-magnitude storms were simulated (March 1985 and July 1985). These earlier simulations may have removed the available erodible sediment from the plots. In other words, runoff may have depleted sediment concentrations.

The final criticism focuses on the extremely low mean C load per mm of runoff for three simulation events from 40 m² plots to a field of 3400 m² (Simulation from limited data on small plots to a watershed) almost two orders of magnitude inappropriate. As Sutherland (1988) states, extrapolation of results from small-scale plots to watersheds requires an understanding of the spatial variability of erosion processes, and a realization of the importance of storages within a system. Mean runoff from the small plots per event were approximately greater than the average long term con- wershed Z (6.5%). In addition, the larger plots have an increased opportunity for deposition on and storages within a system.