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Comparison of soil erosion data at field slope, experimental plot and individual aggregate scales.

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Direct extrapolation of erosion data from one spatial scale to another is fraught with error and uncertainty, because of the underlying differences in erosion processes operating and the different research techniques used to generate the data at different scales. There are no rules as to the scaling up or down of erosion data. However, many erosion models use such extrapolations despite the known errors and variability associated with data from different spatial scales. To date there have been few studies which simultaneously investigate erosion processes operating at different spatial scales.

This paper reports on work undertaken for the SOWAP project (www.sowap.org), whereby soil erosion was quantified at the following spatial scales: field slope (= FS; area = $>500m^2$), experimental plot (= EP; area = $<2m^2$) and individual soil aggregate (= SA; area = mm^2). The study was carried out at two UK sites, in Leicestershire (Loddington) and Somerset (Tivington) over four crop seasons (2003-06). Eroded sediment in surface runoff generated from natural rainfall was directed into collection tanks installed at the bottom of the FS plots and was quantified following erosion events. Each field plot measured approximately 65m $\times$ 10m (l $\times$ w). Simulated rainfall was applied to the experimental plots (EP) on a biannual basis, in the spring and autumn. Each rainfall simulation was run for around 30 minutes at 36 mm hr^{-1}. These plots (measuring 1.5m $\times$ 1m; l $\times$ w) were installed adjacent to the field slope (FS) plots. The stability of individual soil aggregates was tested twice a year from three replicate soil samples taken adjacent to each EP rainfall simulation trial. Soil aggregate stability was tested by three different methods; the rain drop impact method (gravity fed rain tower) and two immersion based methods (wet sieving apparatus and a field test kit). All of these techniques allowed direct measurement of soil erosion via the collection of eroded sediment.

The study was undertaken on three different soil management treatments; one form of conventional management and two forms of conservation soil management. The treatments were used to assess if relative erosion rates for each treatment remained the same at each spatial scale of investigation. Results for both sites, at each spatial scale were compared over the whole duration of the project and also on a seasonal basis.

This study concurs with previous studies showing that small scale assessments of soil erosion cannot be used to predict field scale erosion losses. The results from this study have not been able to give a conclusive answer as to whether aggregate or experimental plot scale assessments of erosion can be used to predict the relative ranking of treatment soil loss from the field plot scale. However, better agreement is obtained on a seasonal basis and on sites with a higher risk to erosion, but there is still a great deal of uncertainty. Small scale assessment of susceptibility to erosion using a laboratory-based, gravity fed rainfall simulator gave similar, and in some cases better, comparisons with results obtained from the field slope scale compared to the experimental plot scale. This is an important finding for many researchers, who still extrapolate erosion from one scale to another, especially through the use of models.

The problems of comparing erosion data at different spatial scales are discussed, with reference to the findings of the study. This discussion includes the role of rainfall characteristics (natural v. simulated events), size of experimental area, and how these all affect the erosion processes operating, as well as the techniques used to collect results data. The dilemma for soil erosion researchers and scientists is this: Whilst better control of

variables, ease of replication and understanding of erosion processes can be gained at the smallest spatial scale (e.g. individual aggregate), this scale excludes many of the factors affecting the true rates of erosion (e.g. slope topography) as observed at a larger spatial scale in the field.