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Applying a new procedure to assess the controls on aggregate stability – including soil parent material and soil organic carbon concentrations – at the landscape scale

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Aggregate stability is an important physical indicator of soil quality and influences the potential for erosive losses from the landscape, so methods are required to measure it rapidly and cost-effectively. Previously we demonstrated a novel method for quantifying the stability of soil aggregates using a laser granulometer (Rawlins *et al.*, 2012). We have developed our method further to mimic field conditions more closely by incorporating a procedure for pre-wetting aggregates (for 30 minutes on a filter paper) prior to applying the test. The first measurement of particle-size distribution is made on the water stable aggregates after these have been added to circulating water (aggregate size range 1000 to 2000 µm). The second measurement is made on the disaggregated material after the circulating aggregates have been disrupted with ultrasound (sonication). We then compute the difference between the mean weight diameters (MWD) of these two size distributions; we refer to this value as the disaggregation reduction (DR; µm). Soils with more stable aggregates, which are resistant to both slaking and mechanical breakdown by the hydrodynamic forces during circulation, have larger values of DR. We made repeated analyses of DR using an aggregate reference material (RM; a paleosol with well-characterised disaggregation properties) and used this throughout our analyses to demonstrate our approach was reproducible. We applied our modified technique – and also the previous technique in which dry aggregates were used – to a set of 60 topsoil samples (depth 0-15 cm) from cultivated land across a large region (10 000 km^2) of eastern England. We wished to investigate: (i) any differences in aggregate stability (DR measurements) using dry or pre-wet aggregates, and (ii) the dominant controls on the stability of aggregates in water using wet aggregates, including variations in mineralogy and soil organic carbon (SOC) content, and any interaction between them. The sixty soil sampling locations were selected based on the quantities of SOC from previous analysis (on samples collected at sites across the entire region). We chose the samples to encompass a wide range of SOC concentrations (1.2-7%) within each of six strongly contrasting soil parent material (PM) groups (sandstone, mudstone, clay, chalk, limestone and marine alluvium).

The DR values (calculated using re-scaled size distributions for particle diameters < 500 µm) ranged from 17 to 151 µm. The co-efficient of variation for DR analyses using fourteen aliquots of the RM was reasonably small (21 %). The PM groups accounted for a larger proportion of the variation in DR than SOC concentrations; together they accounted for around 50% of the variation in DR values. There was no evidence to include an interaction term between PM and SOC concentration. The proportion of clay-sized particles in the material after sonication was not a statistically significant predictor of DR. Pre-wetting the aggregates typically resulted in substantially smaller values of DR by comparison to using air-dried aggregates in our test. We suggest that the effects of differential clay swelling as a disruptive force during the wetting stage are greater than those associated with slaking (fragmentation due to trapped air). We believe this rapid (duration after the wetting procedure is 10 minutes), reproducible test could could be an effective means to monitor changes in this important soil property and improve predictions of soil erosion.

Reference: Rawlins, B. G., Wragg, J. & Lark, R. M. 2012. Application of a novel method for soil aggregate stability measurement by laser granulometry with sonication. *European Journal of Soil Science*, **64**, 92-103.