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Inter- and Intra- Field variations in soil compaction levels and subsequent impacts on hydrological extremes

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The rural landscape in the UK is dominated by pastoral agriculture, with about 40% of land cover classified as either improved or semi-natural grassland according to the Land Cover Map 2007. Intensification has resulted in greater levels of compaction associated with higher stocking densities. However, there is likely to be a great amount of variability in compaction levels within and between fields due to multiple controlling factors. This research focusses in on two of these factors; firstly animal species, namely sheep, cattle and horses; and secondly field zonation e.g. feeding areas, field gates, open field.

Field experiments have been conducted in multiple fields in the River Skell catchment, in Yorkshire, UK, which has an area of 140km². The effect on physical and hydrologic soil characteristics such as bulk density and moisture contents have been quantified using a wide range of field and laboratory based experiments. Results have highlighted statistically different properties between heavily compacted areas where animals congregate and less-trampled open areas.

Furthermore, soil compaction has been hypothesised to contribute to increased flood risk at larger spatial scales. Previous research (Pattison, 2011) on a ~40km² catchment (Dacre Beck, Lake District, UK) has shown that when soil characteristics are homogeneously parameterised in a hydrological model, downstream peak discharges can be 65% higher for a heavy compacted soil than for a lightly compacted soil. Here we report results from spatially distributed hydrological modelling using soil parameters gained from the field experimentation. Results highlight the importance of both the percentage of the catchment which is heavily compacted and also the spatial distribution of these fields.