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Rural Land Management: Simultaneous benefits for both floods and droughts?

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The UK is experiencing a greater frequency of flow extremes, illustrated by the low river flows early in 2012 followed by widespread flooding. It is therefore key that floods and droughts are not investigated separately but studied as a continuum. The primary drivers of flow extremes are the climate and weather patterns, but the impact can be modified by catchment processes such as rural land management. However, the effect of rural land management on flow regimes is highly uncertain, especially at larger spatial scales. This is due to (a) the diffuse nature of land use; (b) the propagation of runoff through the network; and (c) the competing effects of different land uses in different locations.

This study focuses on landscape scale scenarios of soil compaction and agricultural and forestry land covers. A physically based continuous simulation hydrological model, CRUM3, is used to consider the impact of these scenarios on both high and low river flows. This model also allowed the results to be interpreted in terms of the driving hydrological processes operating throughout the catchment. It was applied to the Dacre Beck (38 km2) sub-catchment with the larger Eden catchment (2400 km2), Cumbria, UK.

It was found that reducing the level of soil compaction has a significant impact on both high and low river flows. Using a linear scale of compaction level, where low compaction took typical parameters for a natural soil, heavy compaction produced a peak discharge 65% higher than light compaction and the minimum flow was 86.8% lower for the heavily compacted soil. These results were explained by a combination of antecedent conditions and the partitioning of the rainfall into sub-surface and surface runoff. It was also found that the coniferous woodland and pastoral farming land covers produced the lowest minimum flows and well as the highest maximum flows. It therefore seems that rural land management of both soil properties and vegetation covers could be used to mitigate both floods and droughts simultaneously. This preliminary finding adds weight to the multiple benefits of rural land management and its potential widespread adoption.