



## Impacts of Land Use Management in Extreme Flood Events

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It is increasingly recognised internationally that the management of land and water is strongly interdependent, and that integrated management approaches are needed. There is evidence that modern land management practices have caused an increase in flood risk in rural upland areas, so there is the potential to use land management control as a tool in flood risk mitigation programmes. Flooding from historical extreme rainfall events must be considered when designing mitigation programmes, especially if the designs have to take into account the possibility that such extreme events will become more frequent in the future.

The largest 90 minute rainfall ever recorded in the UK was 117mm, in 1967 in the Dunsop catchment, NW England (25 km<sup>2</sup>). Extensive land management changes have recently been made in the catchment, including peat restoration, tree planting and reductions in sheep stocking density, and the analysis of the flooding in 1967 was undertaken as part of a wider study on the potential impact of the recent changes.

An important part of the work on the 1967 flood was the separation of the various roles played in flood generation; particularly the roles played by runoff generation from the hillslopes and flow through the drainage/river network. A novel approach has been developed, for role separation, which involves tracking the downstream propagation of information through the catchment. This is achieved using reverse algorithmic differentiation (adjoint modelling) of a gridded catchment model that includes a detailed hydraulic model for the flow drainage/river network. Results will be shown for how various information and sensitivities vary spatially across the catchment, allowing conclusions to be drawn about the potential for using land management control in flood risk mitigation programmes.