Assimilation of multi-scale data for prediction of land management change effects on flooding

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Abstract

Severe flooding within the UK in the last decade has prompted increased research into better understanding significant contributing factors to flood risk, and into potential alleviation measures. Land management is one of the focuses of such research, as intensification of agricultural practices over the UK within the last century is perceived to be a possible contributor to the recent floods. However, it has been difficult to verify this from existing data records, due to general data and process uncertainty and the influence of other driving variables such as climate. Therefore targeted data collection and an associated modelling programme are being used to examine whether land use management can substantially affect runoff, with a particular focus on the potential of localised strategic changes to land-use for reduction of flood risk at different spatial scales. A preliminary study within the predominately sheep-grazed Pontbren catchment in mid-Wales indicated that strategically placed, small scale planting of trees could improve the infiltration capacity of grazed permanent pasture (Carroll et al., 2004). Following this, an intensive data collection programme was initiated within the Pontbren and an adjacent catchment, with coverage over a combined area of 13.8 km2. Stream flow, soil water potentials, overland flow and drain flow, precipitation, and other climatic variables are continuously monitored, and data on groundwater levels, interception and soil moisture is also collected. Soil hydraulic properties and runoff processes are being investigated under different land use treatments including woodland buffer strips and no grazing management (see Marshall *et al*., 2006 for further details on the data collection programme). An associated modelling programme uses these data to inform models examining the effects of land use change over differing spatial scales and levels of process representation. A multi-dimensional soil water model with macropore and overland flow representations is used to examine dominant processes at the plot to field scale (Jackson *et al*., 2006). Results at this scale are then used to examine appropriate representations and parameterisation at the field to catchment scale. Upscaling techniques assimilating the small-scale information and ensemble uncertainty into the catchment scale model are being developed, while downscaling work seeks to allow the data to more directly inform the models. Results from both the data collection and modelling programme are presented, and the problem of assimilating the breadth of data (with its associated uncertainty) within the models is discussed.

References

Carroll, Z. L., Bird, S. B., Emmett, B. A., Reynolds, B. and Sinclair, F. L. 2004. Can tree shelterbelts on agricultural land reduce flood risk? *Soil Use Manag,*, **20**, 357-359.

Jackson, B. M., Wheater, H. S., McIntyre, N. R. and Francis, O. J., 2006: The impact of upland land management on flooding; preliminary results from a multi-scale modelling programme, *Proc. BHS symposium*, Durham, September 2006.

Marshall, M., Frogbrook, Z.L., Francis, O.J., Reynolds, B., McIntyre, N., and Wheater, H.S., 2006: The impact of upland land management on flooding; preliminary results from a multi-scale experimental programme*, Proc. BHS symposium*, Durham, September 2006.