

Modelling land cover change effects on catchment-to-lake sediment transfer

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Measurements of catchment soil erosion and sediment transfer to streams and lakes are limited and typically short duration (< 10 y). Such data are highly dependent on the specific climatic conditions during these short periods. This hinders investigations of the impacts of land cover change or management initiatives designed to reduce sediment pollution because of difficulties in evaluating the effectiveness of such changes across a wider range of hydro-climatic conditions. We urgently require longer-term, baseline information on catchment erosion and sedimentation against which to assess future changes and support management planning to mitigate impacts and protect water resources. Here, we present an approach for reconstructing a century of land cover change based on physical and social records coupled with high-resolution, sub-annual simulations of catchment-to-lake soil erosion and sedimentation. This choice of modelling period represents a compromise between the length of record and data availability for model parameterisation. We combine historic datasets for climate and land cover from four lake catchments in Britain with a fully revised catchment-scale modelling approach based on the Morgan-Morgan-Finney model, called MMF-TWI, that incorporates new elements representing plant growth, soil water balance and variable runoff and sediment contributing areas. The catchments comprise an intensively-farmed lowland agricultural catchment and three upland catchments. Historic change simulations were compared with sedimentation rates determined from multiple dated cores taken from each lake. Our revised modelling approach produced generally comparable rates of lake sediment flux to those based on sediment archives. Moreover, these centennial scale records form the basis for examining hypothetical scenarios linked to changes in crop rotation (lowland) and riparian re-afforestation (uplands), as well as providing an extended historic baseline against which to compare future climate effects on runoff, erosion and lake sediment delivery.