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Quantifying spatial patterns and timescales of fine sediment redistribution in river basins: application of a sediment budget model with fallout radionuclide tracers

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Improved understanding of fine sediment and associated contaminant redistribution within river basins requires information on the sources and rates of sediment supply alongside the timescales of downstream sediment transfer. Sediment budgets are an effective tool for examining these patterns. While small, intensively monitored research catchments may provide such information, the examination of larger scale patterns of sediment transfer often requires the use of modelling-based approaches. Furthermore, knowledge of timescales of fine sediment transfer in river basins is limited. Few studies link sediment budgets with explicit information on the residence or travel times of fine sediment. This information is essential for understanding contemporary patterns of river basin sediment redistribution, and has implications for predicting possible recovery times of rivers affected by contaminated sediment from historic or recent pollution. Against this background, we aim to quantify the spatial patterns and timescales of suspended sediment transfer through a river basin (917 km2) situated in south-west England. We apply a spatially-distributed sediment budget model (SedNet) in conjunction with high-resolution spatial data and long-term rainfall and river flow measurements. Model outputs provide an indication of mean annual patterns of sediment redistribution and yields, which were computed for three land cover surveys. This modelling was coupled with techniques for estimating fine sediment residence times, which are based on differences in the decay rates of three fallout radionuclides (Be-7, excess Pb-210 and Cs-137). Findings from this study demonstrate the need for more integrated approaches to better understand spatial patterns and timescales of sediment redistribution in river basins.