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The impacts of tracer selection and corrections for organic matter and particle size on the results of quantitative sediment fingerprinting. A case study from the Nene basin, UK.

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In recent years, sediment fingerprinting methodologies have gained widespread adoption when tracing sediment provenance in geomorphological research. A wide variety of tracers have been employed in the published literature, with corrections for particle size and organic matter applied when the researcher judged them necessary. This paper aims to explore the errors associated with tracer use by a comparison of fingerprinting results obtained using fallout and lithogenic radionuclides, geochemical, and mineral magnetic tracers in a range of environments located in the Nene basin, UK. Specifically, fingerprinting was undertaken on lake, reservoir and floodplain sediment cores, on actively transported suspended sediment and on overbank and channel bed sediment deposits. Tracer groups were investigated both alone and in combination to determine the differences between their sediment provenance predictions and potential causes of these differences. Additionally, simple organic and particle size corrections were applied to determine if they improve the agreement between the tracer group predictions.

Key results showed that when fingerprinting contributions from channel banks to actively transported or recently deposited sediments the tracer group predictions varied by 24% on average. These differences could not be clearly attributed to changes in the sediment during erosion or transport. Instead, the most likely cause of differences was the pre-existing spatial variability in tracer concentrations within sediment sources, combined with highly localised erosion. This resulted in the collected sediment source samples not being representative of the actual sediment sources. Average differences in provenance predictions between the different tracer groups in lake, reservoir and floodplain sediment cores were lowest in the reservoir core at 19% and highest in some floodplain cores, with differences in predictions in excess of 50%. In these latter samples organic enrichment of the sediment, selective transport of fine particles and post-depositional chemical changes to the sediment were determined to be the likely cause of the differences. It was determined that organic and particle size corrections made the differences between tracer groups larger in most cases, although differences between tracer group predictions were reduced in two of the four floodplain cores.