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Methodological uncertainties associated with the suspended sediment fingerprinting approach

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The suspended sediment fingerprinting approach has now been applied in numerous studies for establishing suspended sediment provenance at catchment scale. However, despite the widespread application of mixing models for sediment source ascription, relatively little attention has been paid to the quality of the statistical models developed and to the methodological uncertainties associated with the approach. Indeed, using a hypothetical fingerprinting model with no uncertainty it would be possible to determine exactly the amount of sediment contributed by each source. However, with an uncertain model, the results obtained would be influenced by the assumptions made beforehand, for example source-river connectivity, perfect mixing, perfect linear additive tracer behaviour during mixing, or the representativity of source material. Thus, potential error sources appear in all the steps of the approach: (1) sediment and source sampling, (2) geochemical measurements in the laboratory, and (3) during the modelling process.

The main purpose of the study is to identify the methodological uncertainties associated with the sediment fingerprinting approach. Furthermore, uncertainty associated with model predictions was assessed using the Generalized Likelihood Uncertainty Estimation (GLUE) approach, incorporating tracer property variability using a Monte Carlo simulation technique. We have tried to determine the relative contribution to the uncertainty associated with the model output of (1) the number and type of tracers included in the mixing model, and (2) the spatial variability of the tracer signatures of individual sources.

Preliminary results obtained showed that the main source of uncertainty was the number of tracers included in the model, and the spatial variability of the tracer signatures associated with an individual source, whereas the types of tracers included were shown to be of lesser importance. The various assessments of the uncertainty associated with sediment fingerprinting were, however, conditioned by the assumptions made.