



## **FingerPro mixing model: An R package for sediment tracing**

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Soil erosion is one of the biggest challenges for food production and water bodies siltation around the world. Reliable information on sediment loads transported by water courses is crucial to evaluate this problem. However, determining soil redistribution and sediment budgets is often challenging and costly. To tackle this problem, sediment source fingerprinting offers the potential to identify sediment provenance as a basis to develop management plans to prevent erosion. Sediment source fingerprinting has been developed over the past three decades for catchment sediment and pollutants research as a powerful tool for hazard assessment. The procedure identifies sediment provenance and estimates the relative contribution of each potential source using a variety of selected tracers. Thus, along with the development of the fingerprinting procedure, the number of fingerprint tracers increased. Therefore, the need to rigorously test the ability of individual fingerprinting properties to discriminate between potential sources and to identify the optimum combination of sediment properties became more important.

For this purpose, we developed an R package as a tool to quantify the provenance of the sediments in a catchment or study area. A mixing model algorithm is applied to identify sediment sources and estimate the relative contribution of each potential source using a variety of tracers. The contribution of each potential sediment source is assessed using a standard linear mixing model. All possible combinations of each source contribution are examined in small increments. The proportions that conserves mass balance for all tracers are selected. This procedure is iterated considering the variability of the sediment sources to assess the statistical distribution of the source contributions.

Furthermore, the package includes the option to implement several statistical methods such as discriminant analysis, principal component analysis (PCA) or Kruskal Wallis test to previously select the best subset of optimum fingerprints if it is needed.

The operations are compiled in an Open Source R package called *FingerPro* that provides the users with the tools for: i) Characterising the different sediment properties and the relationships in the study area; ii) help to decide the best tracers and plot the results using state of the art R graphical packages; iii) Unmix one or several sediment mixtures to calculate the percentage of each source apportionment for what previous experience with R is not needed it and iv) visualize and export the results.