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Test of a new stable isotopic fingerprinting technique (i.e. Compound Specific Stable Isotope) in an Austrian sub-catchment to establish agricultural soil source contribution to deposited sediment

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In order to test and refine the use of compound-specific stable isotope (CSSI) as a fingerprinting technique, an innovative study was conducted in a sub-catchment dominated by C3 plants located 60 km north of Vienna. This experimental site consists of 4 different contributing sources (i.e. 3 agricultural fields and one grassed waterway) and one sediment mixture in which the δ^{13}C values of the bulk soil carbon and of various fatty acids (FAs) were analysed after a cost effective sampling strategy.

Bi-scatterplots of all possible combinations of δ^{13}C FAs including the bulk soil carbon δ^{13}C showed that bulk soil carbon δ^{13}C is a strong discriminant among the other FAs. Moreover, bulk soil carbon δ^{13}C values highlighted the highest difference between the four sources and the δ^{13}C values of C_{24} indicated significant differences for all sources while δ^{13}C of C_{22} did not exhibit a significant difference between the two first sources.

An additional correlation analysis revealed that the highest significant linear dependencies are between $\delta^{13}C_{16}$ & $\delta^{13}C_{18} >$ $\delta^{13}C_{18}$ & $\delta^{13}C_{24} >$ $\delta^{13}C_{16}$ & $\delta^{13}C_{24}$. Among the variables, the bulk soil carbon δ^{13}C was found to be the least correlated parameter, confirming that it is the most reliable discriminator to determine the sediment origins in the mixture.

To summarize, only the long chain FAs (i.e. C_{22} and C_{24}) as well as the bulk soil carbon δ^{13}C succeeded in fulfilling our multivariate statistical tests. These findings were confirmed by the mixing polygon tests and Principal Component Analysis.

Using three different mixing models (i.e. Iso-source, CSSIAR v1.0 and MIXSIAR), the contribution of the different sources to the mixture were evaluated. All models highlighted that the third source (field having C3 and C4 plants in rotation) and the grassed waterway were the main contributing agricultural area representing 25-31% and 50-57% of the deposited sediment constituting the mixture, respectively.