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Combining colour and magnetic properties with geochemical tracers to improve discrimination of sediment sources in the Conceição River Catchment, Southern Brazil

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An important step in the sediment source fingerprinting approach is the selection of the appropriate tracing parameters to maximise source discrimination. In order to reduce uncertainties and increase discrimination between sources it may be necessary to use multiple tracing parameters. Accordingly, this study investigates the discrimination and apportionment of sediment sources in a rural agricultural catchment obtained by combining colour, magnetic, and geochemical fingerprinting approaches. The Conceição River catchment (804 km^2) has predominantly deep and highly weathered Ferralsols with land-use consisting of croplands (73%), pastures (18%), forests (8%) and other uses (1%). A total of 189 samples were taken from the main sediment sources, including: Croplands (CR, n=78), pastures (P, n=24), unpaved roads (UR, n=38), gullies (G, n=15) and stream bank (SB, n=34). Sediment samples were taken from the surface bed (n=10) of the river and with time integrated samplers (n=4). Twenty-two geochemical tracers, 6 magnetic properties and 24 colour parameters were analyzed. Tracers were selected following a three step procedure, including: (i) a conservative range test (95% confident interval), (ii) a Kruskal–Wallis H test, and (iii) discriminant function analysis (DFA). The DFA was performed using four different sets of variables: (i) geochemical variables only (G); (ii) geochemical+magnetic+colour (GMC); (iii) geochemical+colour (GC); (iv) geochemical+magnetic (GM). The selected tracers were introduced into a modified version of the classical Solver-based mixing model that in order to determine the relative contribution of different sources to in-stream sediment through simultaneously minimizing mixing model difference. The G and GC DFAs both resulted 69% of samples correct classified (SCC) as no colour parameters were selected by the DFA. The GMC and GM approaches improved the discrimination, both resulting in 76% of SCC. For the G and GC approaches, the average source contribution for the 12 sediment samples were P 47%, SB 29%, CR 19%, UR 5% and G 0%. For the GMC and GM approaches, the contribution of each source was P 41%, SB 37%, CR 14%, UR 8% and G 0%. These results are counterintuitive to field observations where cropland is anticipated to contribute more sediment than pastures. Future research should use artificial mixtures to validate these results. Both magnetic and colour parameters hold potential to improve discrimination between sources, particularly magnetic parameters in catchments with high weathered soils.