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Testing the use of compound-specific stable isotope analysis of n-alkanes for river sediment source apportionment

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The application of plant-specific lipids, including fatty acids and n-alkanes, for sediment source apportionment in river catchments is a growing area of active research. In this study, we tested the applicability of n-alkanes alone and in combination with their compound-specific isotopic signatures (CSSI) to distinguish between sediment sources in a medium-sized agricultural catchment in north-east Scotland. The Tarland Burn catchment (74km^2) supports mixed land uses, including arable, temporary and permanent grassland, mixed and conifer woodland and upland moorland. Time-integrated suspended sediments were collected in sediment trap devices and collected bi-monthly at 7 nested locations from headwaters to the catchment outlet between June 2017 and April 2018, resulting in 42 suspended sediment samples. Replicated composite soil samples were collected from each land cover type (arable, temporary and permanent grassland, heather moorland, mixed and conifer woodland and riparian strip) to characterise the sediment sources (a total of 48 source samples). The plant-specific tracers comprised n-alkane chain lengths C_{21}-C_{35}, their CSSI signatures and n-alkane ratios (PAQ, $\%C_{27}$, $\%C_{29}$, $\%C_{31}$, C_{27}/C_{31}). Modelling results to date, using PCA and the Bayesian mixing model SIAR, indicate that n-alkanes and their ratios allow sediments derived from arable, grassland, mixed forest, coniferous forest and upland moorland land cover types to be clearly distinguished. Some uncertainty of estimated source apportionment was associated with the downstream catchment locations which were dominated by intensive agricultural land use such as arable, temporary grassland and riparian strips, with better constrained model predictions associated with mixed land cover (arable, grassland, woodland, moorland) in both upstream and downstream nested locations. Ongoing modelling will evaluate alternative modelling strategies and examine the temporal sediment dynamics at the nested locations.