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Sensitivity of fine sediment source apportionment to mixing model assumptions

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Mixing models have become increasingly common tools for quantifying fine sediment redistribution in river catchments. The associated uncertainties may be modelled coherently and flexibly within a Bayesian statistical framework (Cooper et al., 2015). However, there is more than one way to represent these uncertainties because the modeller has considerable leeway in making error assumptions and model structural choices.

In this presentation, we demonstrate how different mixing model setups can impact upon fine sediment source apportionment estimates via a one-factor-at-a-time (OFAT) sensitivity analysis. We formulate 13 versions of a mixing model, each with different error assumptions and model structural choices, and apply them to sediment geochemistry data from the River Blackwater, Norfolk, UK, to apportion suspended particulate matter (SPM) contributions from three sources (arable topsoils, road verges and subsurface material) under base flow conditions between August 2012 and August 2013 (Cooper et al., 2014).

Whilst all 13 models estimate subsurface sources to be the largest contributor of SPM (median ∼76%), comparison of apportionment estimates reveals varying degrees of sensitivity to changing prior parameter distributions, inclusion of covariance terms, incorporation of time-variant distributions and methods of proportion characterisation. We also demonstrate differences in apportionment results between a full and an empirical Bayesian setup and between a Bayesian and a popular Least Squares optimisation approach.

Our OFAT sensitivity analysis reveals that mixing model structural choices and error assumptions can significantly impact upon fine sediment source apportionment results, with estimated median contributions in this study varying by up to 21% between model versions. Users of mixing models are therefore strongly advised to carefully consider and justify their choice of model setup prior to conducting fine sediment source apportionment investigations.

References

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