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Combining Two Filter Paper-Based Analytical Methods to Monitor Temporal Variations in Fluvial Suspended Solid Properties

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Many of the commonly used analytical techniques for assessing the properties of fluvial suspended solids are neither cost-effective nor time-efficient, making them prohibitive to long-term high-resolution monitoring. We propose a novel methodology utilising two types of spectroscopy which, when combined with automatic water samplers, can generate accurate, high-temporal resolution sediment property data, inexpensively and non-destructively, directly from sediment covered filter papers. A dual X-ray fluorescence spectroscopy (XRFS) and diffuse reflectance infrared Fourier transform spectroscopy (DRIFTS) approach is developed to estimate concentrations for a range of elements (Al, Ca, Ce, Fe, K, Mg, Mn, Na, P, Si, Ti) and compounds (organic carbon, Aldithionate, Aloxalate, Fedithionate, and Feoxalate) within sediments trapped on quartz fibre filters at masses as low as 3 mg. Calibration models with small prediction errors are produced for a total of 16 elements and compounds for which the geochemical signal is demonstrated to be time stable enabling samples to be stored for several weeks prior to analysis. Spectral pre-processing methods are shown to enhance the reproducibility of results for some compounds, whilst corrections for sediment mass retention are derived, and the importance of filter paper selection and homogeneous sample preparation in minimising spectral interference are emphasized. The results presented here demonstrate the potential for a combined XRFS and DRIFTS analysis of sediment covered filter papers to be utilized under a range of in-stream hydrological conditions where there is an environmental requirement for high-resolution monitoring of suspended solid properties.