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In-situ UV-Visible spectrometry as an alternative to determine solute concentrations at high temporal frequency in organic-rich stream waters

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In-situ monitoring of the temporal variation of solutes' (nutrients and metals) concentrations as tracers can enhance knowledge of the hydrological and biogeochemical behavior of catchments. UV-Visible spectrometry represents a relatively inexpensive and easily used tool to explore how those concentrations vary in time at high temporal frequency. However, it is not yet clear which are the best calibration methods and which solutes can be modeled with this approach. In this investigation we explored the relationship between solutes' concentrations and wavelength absorbance in the UV-Visible range to find the best calibration method and to identify solutes that could be effectively predicted. To this end, we installed a UV–Visible spectrometer probe in a high-altitude and organic-rich tropical Andean (Páramo) stream to record the wavelength absorbance at a 5-min temporal resolution from December 2017 to March 2019. Simultaneously, we sampled stream water at 4-hour frequency for subsequent determination of solutes via ICP-MS in the laboratory. Our results show that multivariate statistical methods outperformed simpler calibration strategies to model the solutes' concentrations that could be effectively predicted using calibration and validation datasets. Eleven out of 21 evaluated solutes (Al, DOC, Ca, Cu, K, Mg, N, Na, Rb, Si and Sr) were successfully calibrated (NSE > 0.50). This finding suggests the possibility of calibrating solutes (i.e., metals) that had not previously been calibrated through UV-Visible spectrometry in the field. Interestingly, the calibration was feasible for all solutes that presented a statistically significant correlation with dissolved organic carbon. The findings of this research provide insights into the value of in-situ operation of spectrometers to monitor water quality in organic-rich streams (e.g., peatlands). This research contributes to our understanding of aquatic ecosystems alongside assessing catchment hydrological functioning and also can enhance the protection of human water supplies.