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Application of Optical Sensors To Study Turbidity and DOC Dynamics of the Fyrisån Catchment, Uppsala, Sweden

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Traditional measurements of dissolved organic carbon (DOC) performed in the laboratory are usually costly in terms of time and money. In recent years this led to an increasing interest in DOC estimations based on optical observations. Absorbance measured at 254 nm and the fluorescing part of dissolved organic matter (fDOM) have frequently been used to estimate DOC. Furthermore, high-frequency sampling is possible if applied as in-situ sensors. This is of importance for monitoring water quality and managing water treatment processes to capture sudden extreme events such as flushes of organic matter and/or high turbidity as a result of high-intensity rainfall and runoff.

Two optical sensors measuring every 15th minute absorbance spectra in the range 220-720 nm and fDOM at an excitation of 365 nm and emission of 480 nm were deployed for eight months in the river Fyrisån near Uppsala, Central Sweden. Simultaneous measurements by temperature and turbidity sensors as well as DOC analysis (grab samples) provided the necessary data for the correction of the fDOM signal. Supplementary experiments improved the calibration and allowed the generation of an algorithm to estimate DOC and turbidity from the spectral absorbance data. In attempt to compare the sensor's estimation of DOC, correlations between sensor-based data and laboratory measurements were constructed for both sensors.

The results suggest that the approximations are reasonably accurate as long as there is no change in the composition of the organic matter. During the dry period between April and October the fDOM signal decreased whereas DOC values remained constant. Changes of spectral properties of DOC as indicated by a change of specific absorbance spectra over time (absorbance at 254 nm DOC-1) and thus variations in organic matter (OM) quality will however result in systematic errors of predicted DOC. Sensitivity analyses of the signal of the two sensors demonstrate which parameters affect the measurements most. This allows drawing conclusion whether it is the OM composition or the instruments precision that cause the largest error at a given moment.