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Turbidity-based methods for continuous estimates of suspended sediment, particulate carbon, phosphorus and nitrogen fluxes

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A good evaluation of surface water pollution is mainly limited by the monitoring strategy and sampling frequencies. Carbon and nutrient monitoring at finer time intervals is still very difficult and expensive. Therefore, establishing relationships between grab sampling and continuous commonly available data can be considered as a favorable solution to turn this problem. The aim of this study was to develop a method to continuously estimate instream sediment, carbon, nitrogen and phosphorus concentrations based on high resolution measurement of turbidity, discharge, electrical conductivity and oxygen concentration. To achieve our gaols, high frequency data (30 min interval) were generated during 3 years at the UFZ- TERENO platform Bode (Terrestrial Environmental Observatories). Samples were analysed for suspended sediment concentration (SSC), particulate organic carbon (POC), total organic carbon (TOC), particulate nitrogen (PN) and particulate phosphorus (PP) using simple and multiple linear regression models. For this study, measurements from six sub-catchments with different geographical characteristics were considered. The available data sets were divided into two years (2010-2012) calibration and one year (2012-2013) validation periods.
Results revealed that the turbidity was the most predictor variable in all models, particularly for suspended sediment concentrations. For all gauging stations, the SSC could be explained using simple linear regression model by the turbidity with a lowest correlation coefficient of 0.93. The non-uniqueness of the simple linear equation obtained between the stations reflected the sensitivity of the turbidity signal to the differences in land use and agriculture management between the sub-catchments. Best predictions of POC, TOC, PP and PN were achieved when multiple linear regression models were used including discharge, electrical conductivity and oxygen concentrations as predictor variables in addition to turbidity (lowest correlation coefficient is 0.79). Also, it is important to note that some gaps in the data sets were filled using cross-correlation and multiple linear regression models between the different sub-catchments. The long-term objective is to validate our approach to larger catchment with more challenging environmental features. To this end, we are working on generalising of these relationships in central Germany using unique linear mixed model for each variable where the geographical characteristics of different sub-catchments will be considered. The developed methodology provides a cost-effective technique to obtain continuous, reliable and long-term estimates of sediments and particulates-related pollution in challenging environment.