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Fast Optical Sensor System for Mobile In-situ Monitoring of Turbidity and CDOM

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The protection and sustainable use of aquatic resources requires a better understanding of the processes and interactions of limnic and marine ecosystems. Current methods used in applied research are not sufficient to adequately capture the heterogeneity and dynamics of these ecosystems in their complexity. A major engineering challenge is to provide suitable methods and measurement techniques for holistic in-situ monitoring with correspondingly increased spatial and temporal resolution.
This work addresses the fundamental challenge of measuring complex ecosystem processes. On the basis of this consideration, a theorem for the holistic recording of ecosystem state variables is derived, which is called Object Specific Exposure (OSE). It serves to establish a holistic monitoring so that a cohesive system architecture from measurement transformation to information provision is achieved.
Based on this, this work describes a technological approach for monitoring processes in complex ecosystems using an optical sensor system for mobile monitoring applications. For this purpose, a measuring system was developed, which allows a fast in-situ determination of water quality parameters based on the measuring principle of an optical transmission determination using the transmitted light method. This involves a measurement of the transmission in the UV range of the electromagnetic radiation for estimating the content of chromophoric dissolved organic matter (CDOM) and a transmission measurement in the IR range for turbidity correction. In addition the water depth, water temperature and of course the GPS position is being captured and processed for each measurement.
A distinctive feature is based on the service-oriented design of the sensor system. Thus it is possible to collect data in near real time and to visualize them with the help of a web service. This is seen as a great potential for the involvement of local actors and especially for citizens in the context of citizen science.
The proof of function of the sensor system was provided on the basis of laboratory and field tests. Therefore, a mobile monitoring campaign from aboard a small sailing boat along the Warnow river near the City of Rostock to the Baltic Sea estuary (North German Plain) was conducted. The test showed how the technological approach presented in this work can contribute to increase the information content of sensor data collected in the field and at the same time reducing the effort for the user on the basis of the OSE theorem and service-oriented system architecture.