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A data-driven open-source architecture for service-oriented observation methods and in-stream process modeling of turbidity and dissolved organic matter

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The conservation and long-term protection of our environment require a better understanding of ecosystems through cross-domain integration of data and knowledge from different disciplines. Current methods used in applied environmental research and scientific surveys are not sufficient to address the heterogeneity and dynamics of ecosystems appropriately. To this end, an urgent need is seen in introducing new technology and methods for a service-oriented and holistic in-situ monitoring with increased spatio-temporal resolution and cutting edge functionalities. Recent developments in the field of digital information processing, the internet of things (IoT) or the the analysis of complex datasets are opening up new possibilities for data-based environmental research. This rapidly developing fields are calling for a disruptive paradigm shift towards a service-oriented earth observation (smart monitoring). To this end, future earth observation approaches will have a much stronger coupling between the modeling and the data acquisition. The development, implementation and evaluation of such an interface is one of the overall objectives of this project. To achieve this goal, a basic data model and a special hardware architecture must be defined. A realistic application scenario will be used to demonstrate the advantages of developing a monitoring strategy that is no longer based on static data collection but on the coupling of modeling and empiricism using integrated sensors for an advanced modeling. Since current methods have so far failed to allow a holistic assessment of varying, large-scale environmental phenomena there is a corresponding need for capable hardware which is specialized for exactly this purpose.

The project aims to introduce an integrated sensor system for advanced modeling of turbidity and dissolved organic matter using miniaturized optical sensors in the ultraviolett and infrared range. Moreover, a data-driven, open-source architecture for service-oriented observation methods and in-stream process modeling close to real-time was developed. In addition to the hardware-related requirements of such a sensor system, the creation of an interface between the physical environment (sensor level) or abstracted model assumption (model level) is a particular focus of the research project. A sampling theorem, the predictive object specific exposure (POSE), is introduced as an underlying measurement paradigm and data model. This allows to consider not

only the measured value in the evaluation but also accompanied parameters, which is called the context of a measurement. The development and provision of a first adaptive sensor concept resulted in promising prototype enabling the possibility to record environmental data depending on decision criteria such as location, time or context. Thus, the project is representing an interesting practical contribution to Digital Earth.