



## Development of knowledge library for integrated watershed modeling

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The purpose of watershed modeling is to simulate the impacts of different watershed activities on the state of the nearby aquatic ecosystems. This can be a very complex task as it is highly interdisciplinary and includes numerous sectors, such as industry, economy, water, agriculture, etc. Present watershed simulation models typically integrate different process-based models, geographic information system (GIS) tools and data management techniques. The utilization of this kind of models is, however, very difficult because of the broad temporal and spatial scales that must be considered, as well as the large amount of data that has to be pre-processed.

We are addressing these problems by developing a generic modeling knowledge library that covers the domain of the integrated watershed modeling. The modeling knowledge is encoded to a library by using a formalism that supports sufficient knowledge representation for integrated watershed process-based modeling. Moreover, the library includes alternative formulations for encoded watershed processes, which enable selection of the most appropriate model structure for given watershed.

Thus, this research provides an alternative approach to integrated watershed modeling, improving the model structures selection procedure and introducing a methodology for easier construction of integrated watershed models. Namely, formalized modeling knowledge allows for integration with the state-of-the-art automated modeling systems, which enable different levels of model building and can perform different modeling tasks: (1) building models from scratch, i.e. when the modeling goals and basic data are provided, (2) building parts of an existing model, (3) identifying unknown processes' formulations and (4) calibration of unknown parameters in a given model structure (complete or partial).

The knowledge library developed within this research includes typical modules for watershed modeling, i.e. hydrological models based on meteorological data, nutrient loading models considering point and diffuse emission sources, as well as modules for ecological modeling of aquatic ecosystems. The functionality of the library was demonstrated on a semi-hypothetical watershed for generating several types of model structures, i.e. hydrological model combined with nutrient loading model, ecological model of river estuary, and integrated watershed model by combining the two.

Keywords: integrated watershed modeling, knowledge library, process-based modeling