PROJECT FACTSHEET

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QUICS

Developing a generalised catchment-wide approach to uncertainty assessment for Water Framework Directive implementation studies

Inspiration

The quality of surface water is affected by a complex mix of man-made and natural processes. With increasing citizen demand for water protection, in 2000 the European Union adopted the Water Framework Directive (WFD), which requires EU Member States to work towards achieving good ecological status of all water bodies. Estimates indicate that billions of euros will be spent over the coming decades to implement the WFD, and there is rising concern over these costs.

Integrated water quality models designed to predict the quality of water across the linked urban and rural scales in a catchment are seen as a tool to reduce these costs. Integrated Catchment Modelling is based on linking numerous empirically calibrated sub-models of water quality (WQ) processes to produce WQ predictions. However, current water quality sub-models contain a significant degree of uncertainty and although methods have been developed to quantify uncertainty, little work has been carried out to investigate WQ uncertainty propagation between sub-models.

Innovation

The QUICS project, in which the Luxembourg Institute of Science and Technology (LIST) is a partner, will develop a generalised catchment-wide approach to uncertainty assessment that can then be used in WFD implementation studies. It will address uncertainty propagation at the spatial and temporal scales and develop tools to reduce uncertainty by optimising sampling and monitoring and the objective selection of model structure. QUICS involves collaboration between leading water quality scientists, uncertainty experts and private sector water management practitioners and modellers. It will train researchers in the development and implementation of uncertainty management tools into Integrated Catchment Modelling studies.

LIST will contribute to the project with two PhD projects. One project will focus on the analysis of uncertainty propagation in selected sub-catchments of the Haute-Sûre sewer system, testing both aggregation (upscaling) and disaggregation (downscaling) under uncertainty and identifying the trade-off between model complexity and model accuracy. The second project will focus on the development of methods to reduce a full scale model considering the sensitivity of model states, input/output variables and potential uncertainty of online measurement, especially in the context of a given operational task and the development of methods to link the overall sensitivity analysis of a model to the targeted operational objective, considering the uncertainty propagation from the inputs through to the final control action.

Impact

QUICS will produce guides and protocols to advise end users on what type and complexity of integrated water quality model to select for different purposes. In addition, a range of tools will be developed to allow user specified confidence levels of water quality predictions for a specific catchment to be achieved. This will enable end users to optimise the resources required for data collection and monitoring efforts and to select responses to potential water quality failures while considering all aspects of modelling uncertainty. To this, LIST will contribute a geospatial uncertainty analysis framework, software tools for Spatial Uncertainty Propagation Analysis and a new Model Predictive Control approach.Overall, these tools will reduce uncertainty in WQ predictions and result in better informed investment decisions, which will have a significant impact on WFD implementation across the EU.

Partners

University of Bristol (UK) , Wageningen University (NL) , Université Laval (CA) , Technological Center for Environmental Management - CTGA (PT) , University of Sheffield (UK) , Technical University Delft (NL) , Justus Liebig Universität Giessen (DE) , Universidade De Coimbra (PT) , Swiss Federal Institute of Aquatic Science and Technology - EAWAG (CH) , CH2M Hill (UK) , Ruhr Universität Bochum (DE) , Aquafin (BE) , Waterways (IT)

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