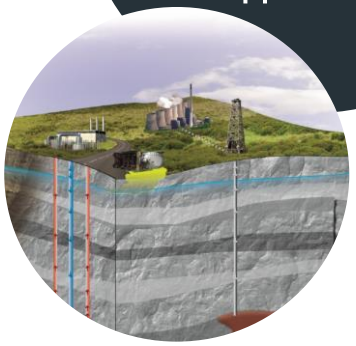
University of Stuttgart
Germany
Department for Stochastic Simulation
and Safety Research for Hydrosystems (LS³)

Response Surface-based Bayesian Model Selection for Environmental Applications

M.Sc. Topic

Society needs a better understanding of the environment to maximize welfare and sustainability in resources management. In particular, the ability to predict how environmental systems change over time or how they will react to planned interventions is indispensable. However, our surroundings behave in complicated manners on various temporal and spatial scales. Moreover, many environmental systems (such as groundwater flow, river flow, carbon dioxide storage, etc.) are heterogeneous, non-linear and dominated by external driving forces. Unfortunately, a complete picture of environmental systems is not available, because many processes cannot be observed directly and only can be characterized by sparse measurements. Still, modeling plays a very important role in reconstructing (as far as possible) the complete and complex picture of environmental systems and offers a unique way to predict behavior of such multifaceted systems. However, many modelling parameters are uncertain due to inconsistent, uncertain or even missing measurement data. Since in the model not every process can be resolved at the smallest scale, the most relevant processes need to be identified. To represent these selected processes, typically several formulations exist (e.g. closure relationships, empirical equations, analytical solutions). The modeller has to choose the most suitable variant carefully in order to reproduce the real behavior of the environmental system. The aim of this project is to employ the Bayesian model selection toolkit to assure an appropriate selection of models under the considered sources of uncertainty. Depending on the type of application, the computational effort to run the models is prohibitively high such that standard implementation of Bayesian model selection is not feasible. In those cases, cheap response surfaces are used as surrogate models instead. Several thesis topics are available that differ in methodological details and test case applications.



Prospective Tasks

- Set up a test case scenario of an environmental problem
- Calibrate a number of models and implement the Bayesian model selection framework
- Identify the most promising model variant(s)
- Visualize and discuss results

General Information

- Advisors: Dr.-Ing. habil. Sergey Oladyshkin, Dr. Anneli Guthke, Prof. Wolfgang Nowak

Desirable skills

- Knowledge of environmental fluid mechanics
- Affinity to numerical simulations, statistics and programming

Apply now!

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