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Dealing with input, output and structural uncertainties using Bayesian analysis

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In the standard usage, the calibration of an hydrological model is performed by minimizing the squared difference between measured and modeled outputs. This method, the standard least squares, is derived under the assumption that the input data is exact. In situations were those inputs, precipitations, are incertain, it has been shown that the parameters estimated via the least squares method can be significantly biased, no matter how large the data set [*Kavetski et al.*, 2002].

In response to this situation, the past years have seen the emergence of a variety of model calibration methods designed to deal with input uncertainty. In this presentation, we propose yet another method, based on a Bayesian uncertainty framework defining input, output and structural error models. These error models are grafted to the hydrological model, providing a basis for inference on the model's parameters and allowing a realistic assessment of the parameters "true" value.

Conceptually simple, the framework is however relatively demanding in terms of computational requirements for common hydrological models. Hence, the first application is concerned with "abc", an academic hydrological model possessing analytical properties easing the computations to a manageable level. This example stands as a proof-of-concept as well as a benchmark highlighting the many subtleties associated with input errors : the unintuitive mapping of input uncertainty onto the parameters' uncertainty, and the increased importance of the prior for inputs. If time allows, we will discuss the application of the method to more commonly used models, and the strategy to overcome the many numerical challenges standing before user-friendliness.

Kavetski, D., S. W. Franks, and G. Kuczera (2003), Confronting Input Uncertainty in Environmental Modeling, in *Calibration of Watershed Models, Water Sci. Appl. Ser.*, vol 6, edited by Duan, Q, H.V. Gupta, S. Sorooshian, A.N. Rousseau and R. Turcotte, pp. 49-68, AGU.