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Toy models for increasing the understanding on stochastic process-based modelling

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Montanari and Koutsoyiannis (2012) have introduced a novel blueprint for hydrological modelling with the aim to integrate deterministic process-based modelling and uncertainty quantification within a stochastic framework (hereafter "bMK"). The outcome of this integration is referred to as "stochastic process-based modelling", while the term "stochastic" conjointly represents probability, statistics and stochastic processes. The bMK is provided by an analytically derived theoretical scheme for the quantification of the global uncertainty in the output of deterministic models. The analytical formulation of this theoretical scheme can be replaced in practice by a Monte Carlo simulation algorithm, which simulates the stochastic model comprising the deterministic one and is a part of a larger algorithmic approach. The adopted methodological tools and assumptions within a specific approach can largely affect the quality of the provided solution. Therefore, any possible algorithmic procedure for the implementation of the bMK should be thoroughly examined. Herein, we adopt the toy model research method to conduct several controlled experiments of large scale. These experiments focus on specific research questions, all of them aiming to increase the understanding on the theoretical scheme under discussion. This understanding is fundamental for dealing with the additional theoretical, algorithmic and computational requirements implied by the choice to perform stochastic process-based modelling, instead of deterministic process-based modelling.

Reference

Montanari A, Koutsoyiannis D (2012) A blueprint for process-based modeling of uncertain hydrological systems. Water Resources Research 48(9):W09555. doi:10.1029/2011WR011412