Incremental model breakdown to assess the multi-hypotheses problem

Florian Ulrich Jehn (1), Lutz Breuer (1,2), Tobias Houska (1), Konrad Bestian (1), and Philipp Kraft (1)

(1) Institute for Landscape Ecology and Resources Management (ILR), Research Centre for BioSystems, Land Use and Nutrition (iFZ), Justus Liebig University , Giessen, Germany, (2) Centre for International Development and Environmental Research (ZEU), Justus Liebig University, Giessen, Germany

The ambiguous representation of environmental processes have led to the formulation of the multiple hypotheses approach in hydrology, which requires new ways of model construction. However, most recent studies focus only on the comparison of predefined model structures or building a model step-by-step. We tackled the problem the other way around: We started with one complex model structure, which included all processes deemed important for the catchment. Next, we created 13 additional simplified models, where some of the processes from the starting structure were disabled. The performance of those models was evaluated using three objective functions (logarithmic Nash-Sutcliffe, percentage bias and the ratio between root mean square error to the standard deviation of the measured data). Through this, we identified which processes were the most important ones for the model and which restrained it. This allowed to construct a more streamlined subsequent 15th model with improved model performance, less uncertainty and higher efficiency. We benchmarked the original Model 1 with the final Model 15 and found that the incremental model breakdown led us to a structure with good performance and fewer processes and parameters. Overall, this method enables to scrutinize existing models and to improve their structure to capture all relevant environmental processes. The methodology, results and the conclusion are presented.