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Progressive evaluation of incorporating information into a model building process

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Catchments are open systems meaning that it is impossible to find out the exact boundary conditions of the real system spatially and temporarily. Therefore models are essential tools in capturing system behaviour spatially and extrapolating it temporarily for prediction. In recent years conceptual models have been in the center of attention rather than so called physically based models which are often over-parameterized and encounter difficulties for up-scaling of small scale processes. Conceptual models however are heavily dependent on calibration as one or more of their parameter values can typically not be physically measured at the catchment scale.

The general understanding is based on the fact that increasing the complexity of conceptual model for better representation of hydrological process heterogeneity typically makes parameter identification more difficult however the evaluation of the amount of information given by each of the model elements, control volumes (so called buckets), interconnecting fluxes, parameterization (constitutive functions) and finally parameter values are rather unknown. Each of the mentioned components of a model contains information on the transformation of forcing (precipitation) into runoff, however the effect of each of them solely and together is not well understood.

In this study we follow hierarchal steps for model building, firstly the model structure is built by its building blocks (control volumes) as well as interconnecting fluxes. The effect of adding every control volumes and the architecture of the model (formation of control volumes and fluxes) can be evaluated in this level. In the second layer the parameterization of model is evaluated. As an example the effect of a specific type of stage-discharge relation for a control volume can be explored. Finally in the last step of the model building the information gained by parameter values are quantified. In each development level the value of information which are added by any constraints, physical laws such as mass balance and hydrologically meaningful logics, have been evaluated.

Our result shows that the model architecture alone will contains much of the information which is needed to simulate consistent hydrographs. Moreover our result support the idea of “more complexity of model, more uncertainty in the parameters’ values”. Our study shows making a model more and more complex mean using more and more information to capture the observed hydrograph however less information will be encapsulate by parameter values which eventually shows itself in uncertainty of the parameter values.