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Progressive evaluation of incorporating information into a model building process: from scratch to FLEX-TOPO

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Although different strategies have demonstrated that incorporation of expert and a priori knowledge can help to improve the realism of models, no systematic strategy has been presented in the literature for constraining the model parameters to be consistent with the (sometimes) patchy understanding of a modeler regarding how the real system might work. Part of the difficulty in doing this is that expert knowledge may not always consist of explicitly quantifiable relationships between physical system characteristics and model parameters; rather, it may consist of conceptual understanding about consistency relationships that must exist between various model parameter or behavioral relationships that must exist among model state variables and/or fluxes.
Apart from aforementioned constraints, a unified strategy for measurement of information content in hierarchal model building seems lacking. Firstly the model structure is built by its building blocks (control volumes or state variables) as well as interconnecting fluxes (formation of control volumes and fluxes). Secondly, parameterizations of model are designed, as an example the effect of a specific type of stage-discharge relation for a control volume can be explored. At the final stage the parameter values are quantified. In each step and based on assumptions made, more and more information is added to the model.
In this study we try to construct (based on hierarchal model building scheme) and constrain parameters of different conceptual models built on landscape units classified according to their hydrological functions and based on our logical considerations and general lessons from previous studies across the globe for a Luxembourgish catchment. Based on the result, including our basic understanding of how a system may work into hydrological models appears to be a powerful tool to achieve higher model realism as it leads to models with higher performance. Progressive measurement of performance and uncertainty indicates which of the structural elements, parameterization or constraints contributes significantly in capturing the system behavior. Moreover, this attempt can be seen as a platform which brings the opportunity for both modelers and experimentalists to better communicate and test their hypothesis and assumptions.