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Improving hypothesis testing through the application of flexible model structures

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Flexible model structures simplify the model building process, therefore facilitating hypothesis testing, which is particularly useful in the context of conceptual hydrological modelling. The recently introduced flexible framework SUPERFLEX is based on generic elements which can be customized and assembled to generate different model configurations. We here show how this framework can be used to characterize important aspects of catchment functional response, which, when combined with existing experimental knowledge about the catchment structure, help catchment characterization. The case study is based on a set of Luxembourgish catchments located in different geologies, which are perceived to behave differently based on previous fieldwork experience. The comparison of the performance of different model structures elucidates different aspects of catchment response associated to the various catchments, such as linear vs. nonlinear behaviour, or horizontal vs. vertical preferential flow pathways. We show how the synthesis of the modelling and experimenting experiences provides a more robust understanding of catchment behaviour than it could be achieved by any individual perspective.