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# Inferring the theoretical limitations of model structures to simulate runoff observations with a runoff-rainfall (sic!) model

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This contribution presents a method to analyse the theoretical limitations of model structures to map observed runoff. This procedure may precede further meaningful hypothesis testing. Model structures, which do not comply with the precondition to potentially *simulate observed runoff exactly*, can be ruled out beforehand.

For the presented method a runoff-rainfall model is used, as precipitation is modelled from runoff. A conceptual, HBV-type rainfall-runoff model is embedded in an iteration algorithm, in which for every time step a catchment precipitation value is determined, which results in a simulated runoff value that corresponds to the observed value. In this contribution we do not focus on the modelled precipitation, but use the runoff-rainfall model to diagnose model deficits. In the framework of the iteration procedure it is possible to test the hypothesis, whether a model is generally capable of simulating observations exactly.

Hydrological models are abstract and simplified representations of real world systems, with the consequence, that most model parameters cannot be inferred through direct observations in the field, but can only be estimated through a conventional calibration procedure. With these given model parameters, it is assumed, that potentially a perfect agreement between simulated and observed runoff is possible, ignoring possible intrinsic mathematical constraints of the model, to identically simulate observations. At this point, the failure to meet observations could be associated with inadequate model parameters.

With the runoff-rainfall model it is possible to localise the range of model parameters ($\Phi_{Invers}$) which theoretically enable a perfect fit of simulated to observed runoff. Comparing $\Phi_{Invers}$ with model parameters derived in a conventional manner (e.g. with GLUE-type analysis) ($\Phi_{Forward}$) enables the inference, whether the model structure is meaningful or not. Differing parameters between $\Phi_{Invers}$ and $\Phi_{Forward}$ and their linked physical processes can be identified, enabling the diagnosis of model structural deficits.