Identification of hydrologically similar basins by means of parameter transfer with a view to regionalization

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In hydrology the transfer of information between basins is the basis for all kinds of regionalization. A supposed hydrological similarity between basins is usually based on similar basin properties or spatial proximity. However, even for gauged basins, knowledge of relevant information that represent similar processes is often lacking.

The spatial transfer of a calibrated model, commonly referred to as regionalization, is based on the assumption that if hydrological characteristics of two catchments are almost identical, their hydrological responses will be similar. We assume that good performing, well calibrated models represent various relevant runoff processes in a sufficient way. The transfer of a calibrated model between gauged basins and the analysis of their performances can thus serve as a diagnostic approach to identify hydrologically similar basins without identifying a priori basin properties.

We calibrate model structures generated with the SUPERFLEX framework for 53 basins in Rhineland Palatinate. Thus, for each basin a calibrated model is represented by a specific model structure and a specific set of model parameters. The use of different model structures avoids model specific results. In a consecutive step, the calibrated models that are run with input data from other basins represent the model transfer. To assess the performance of a model for a single basin we use the Nash and Sutcliffe Efficiency and signature indices derived from the flow duration curve as performance measures.

We assume hydrologic similarity between basin "A" and basin "B" if a model that has been calibrated on "A" and applied (i.e. transferred) to "B" renders a similar performance as the model that is calibrated on "B". A poor performance with the transferred model refers to a dissimilar basin. The next step is to analyse why basins display hydrological similarity by means of model transfer. We look for similarities in runoff behaviour, catchment properties or spatial proximity within groups of similar basins. This leads to an identification of decisive runoff processes represented by a specific model structure. This approach allows for new approaches of identifying similarities between basins that can be used for basin classification and regionalisation.