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Application of a non-parametric regionalization technique to a rainfall runoff model

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Current regionalization techniques for conceptual rainfall-runoff models employ linear/non-linear regression functions. Model parameters are described as functions (assumed a priori) of catchment descriptors. As hydrological systems are highly non-linear and complex, a priori parametric functions cannot be a holistic or near-reality representation of the core underlying hydrological processes. In addition, interdependencies between model parameters are not taken into consideration in a regression-based regionalization.

A Nearest Neighbor Method (NNM) is applied to compensate for the limitations associated with regression-based regionalization methods. The proposed NNM is essentially a non-parametric approach. It is used to categorize hydrological units based on their similarities or distances. The distance considered is not geo-physical but one in a transformed space. The categorization is established by searching for a transformation matrix through optimization towards a globally optimal objective function. The optimization is carried out by a simulated annealing algorithm. Non-apparent similarities between pairs of catchments are thus revealed with the help of the transformation matrix. When the output of any hydrological unit is to be predicted, its neighbors' outputs are made use of by taking a regression or kriging over a group of 'close' neighbors or simply the output of the 'closest' neighbor.

The proposed technique is initially tested with a modified research version of the HBV-IWS model. A number of catchments within the Rhine Basin are selected as the candidate hydrological units. Furthermore, a modified Xin'anjiang model is applied to the same catchments to check if the similarities between catchments examined through the

proposed regionalization technique are only dependent on the catchments' characteristics or influenced by a specific conceptual model. The technique is finally extended to identify linkages between model parameters and catchment descriptors.