



## Multi-objective design of rainfall network based on information theory for streamflow simulation

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Rainfall networks provide rainfall data needed for water resource management and decision-making. These data are especially important for runoff simulation and forecast when intense rainfall occurs in the flood season. Rainfall networks should, therefore, be carefully designed and evaluated. Information theory-based methods have lately received significant attention for rainfall network design. This study focuses on the integrated design of a rainfall network, especially for streamflow simulation. We proposed a multi-objective rainfall network design method based on information theory and applied it to the Wei River basin in China. The rainfall network design can be viewed as the input for a rainfall-runoff model, as it was intended to consider streamflow data at the outlet hydrometric station. We use the total correlation as an indicator of information redundancy and multivariate transinformation as an indicator of information transfer. Information redundancy refers to the overlapped information between rainfall stations, and information transfer refers to the rainfall-runoff relationship. The outlet hydrometric station (Huaxian station in the Wei River basin) is used as the target station for the streamflow simulation. A non-dominated sorting genetic algorithm (NSGA-II) was used for the multi-objective optimization of the rainfall network design. We compared the proposed multi-objective design with two other methods using an artificial neural network (ANN) model. The optimized rainfall network from the proposed method led to reasonable outlet streamflow forecasts with a balance between network efficiency and streamflow simulation. Our results indicate that the multi-objective strategy provides an effective design by which the rainfall network can consider the rainfall-runoff process and benefit streamflow prediction on a catchment scale.