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Identification of consistency in rating curve data: Bidirectional Reach (BReach)

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Before calculating rating curve discharges, it is crucial to identify possible interruptions in data consistency. In this research, a methodology to perform this preliminary analysis is developed and validated. This methodology, called Bidirectional Reach (BReach), evaluates in each data point results of a rating curve model with randomly sampled parameter sets. The combination of a parameter set and a data point is classified as non-acceptable if the deviation between the accompanying model result and the measurement exceeds observational uncertainty. Moreover, a tolerance degree that defines satisfactory behavior of a sequence of model results is chosen. This tolerance degree equals the percentage of observations that are allowed to have non-acceptable model results. Subsequently, the results of the classification is used to assess the maximum left and right reach for each data point of a chronologically sorted time series. This maximum left and right reach in a gauging point represent the data points in the direction of the previous respectively the following observations beyond which none of the sampled parameter sets both are satisfactory and result in an acceptable deviation. This analysis is repeated for a variety of tolerance degrees. Plotting results of this analysis for all data points and all tolerance degrees in a combined BReach plot enables the detection of changes in data consistency. Moreover, if consistent periods are detected, limits of these periods can be derived. The methodology is validated with various synthetic stage-discharge data sets and proves to be a robust technique to investigate temporal consistency of rating curve data. It provides satisfying results despite of low data availability, large errors in the estimated observational uncertainty, and a rating curve model that is known to cover only a limited part of the observations.