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# How is the size of a stage-discharge data set affecting the derived uncertainty

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A commonly used practice for the estimation of discharges is the use of rating curves. As the calibration of a relation between stage and discharge measurements is often based on only a limited number of simultaneous stage-discharge measurements, it is a relatively budget-friendly method for discharge assessment in rivers. Such a measurement approach requires a well-developed gauging strategy that provides in new measurement campaigns when flow conditions in a river alter. During periods with more stable flow conditions, it must guarantee a sound balance between reliability of the rating curve and required measurement effort. Therefore, it is important to understand how the size of a stage-discharge data set can affect its derived uncertainty.
In this research, a Bayesian approach (Le Coz et al., 2014) is used to assess discharge uncertainty. A large consistent stage-discharge data set is used to derive multiple random subsets with a range of different sizes. Three different functions are further used to estimate the standard deviation of a general model error term (remnant error) that is assumed to be normally distributed. For each run, resulting (posterior) parameter sets are used to test the validity of these assumed remnant error distributions.
Results show that for small data sets, calculated discharge uncertainties are large and strongly dependent on the size of the stage-discharge data set. These results are related to the formulation of the likelihood in the Bayesian approach, which results in more informative likelihood values for larger data sets.
When testing the validity of the assumed remnant error distribution, the size of a data set also plays an important role. For small subsamples, it is often not possible to reject distributions that are erroneous for nearly all larger subsamples.
These results are specific for the chosen measurement location, the governing flow situation and the applied rating curve model. Nevertheless, they show that at other locations, a similar test based on multiple subsets of a consistent stage-discharge data set could indicate a critical sample size above which derived discharge uncertainties and test results of assumed remnant error distributions do not vary significantly. This information can improve the development of efficient gauging strategies.

References:
Le Coz, J., Renard, B., Bonnifait, L., Branger, F., and Le Boursicaud, R.: Combining hydraulic knowledge and uncertain gaugings in the estimation of hydrometric rating curves: A Bayesian approach, J. Hydrol., 509, 573–587, https://doi.org/10.1016/j.jhydrol.2013.11.016, 2014.