Towards a New Classification of Rivers based on Generic Gage Height-Discharge Rating Curves for Low-Cost Estimation of Stream Discharge

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Abstract. The development of rating curves for estimating stream discharge from gage height is a major manpower expense. The objective of this research has been to create a new classification of rivers based upon generic rating curves so as to reduce the required number of field measurements. The first step has been to classify rivers according to the uniqueness of the gage height-discharge relationship. The USGS National Water Information System database of 3.7 million pairs of simultaneous measurements of gage height and discharge at 61,240 active and historic gaging stations was imported into a custom Python-driven data manipulation script, which resulted in 15,344 useable gaging stations after removal of incomplete and inconsistent data. At each gaging station, the best-fit linear relationship $z_{\ln(GH)} = mz_{\ln(Q)} + b$ was determined, where $z_{\ln(GH)}$ and $z_{\ln(Q)}$ are the z-scores of the logarithms of gage height and discharge, respectively. Each linear relationship was converted into a normal distribution with mean and standard deviation equal to m and its standard error, respectively. Summation of the normal distributions showed a single peak at m = 0.991, where $m = 1$ indicates a unique gage height-discharge relationship. There are no gaging stations such that $m > 1$, equivalent to no gaging stations where discharge varies without variation in gage height. Over 31% of gaging stations had $m < 0.9$, indicating significant variation in gage height without corresponding variation in discharge. A positive relationship between m and distance to the nearest confluence suggests that non-uniqueness results primarily from reverse flow.