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# Cost-effective gauging strategies for reduction of uncertainty in streamflow estimation

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Obtaining reliable streamflow monitoring data is both costly and time-consuming. It typically takes many years to establish reliable streamflow data at a new hydrological monitoring station using traditional power-law rating curve approaches. This is because many control gaugings of the stage–discharge relation are required. The number of field gaugings and their distributions across the range of flow variability has a large impact on the uncertainty in the estimated rating curve, but there is little guidance on cost-effective gauging strategies in the literature. The aim of this study was to investigate the cost-effectiveness of different gauging strategies and rating-curve estimation methods in terms of leading to low rating-curve uncertainty for a low cost. Apart from traditional power-law rating curves, we assess hydraulic modelling of rating curves, which is a potentially more cost-effective strategy as only a few calibration gaugings are needed.

We compared the RUHM framework for Rating curve Uncertainty estimation using Hydraulic Modelling and the BaRatin power-law method using nine different gauging strategies associated with different costs. The gauging strategies included for example those using only low, middle or high flow gaugings or those using different numbers of gaugings distributed throughout the flow range. We applied both methods to the 584 km2 River Röån station in Sweden, and we tested the BaRatin method for a further catchment, the 326 km2 Blairstown station on the River Paulins Kill in New Jersey, US.

We found that there was a lower uncertainty for the low-cost gauging strategies (fewer gaugings) for the RUHM framework compared to BaRatin, and that there was a similar uncertainty for the high-cost gauging strategy (more gaugings) for the RUHM framework compared to BaRatin. We also found that traditional methods need gaugings with lower probability of occurrence (i.e. covering a larger part of the flow range) than when using hydraulic modelling (already 3–4 low and middle flow gaugings with high probability of occurrence gave good results). Our results suggest that hydraulic modelling of rating curves is a promising alternative for quickly and cost-effectively deriving streamflow data with low uncertainty.