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Can hydraulic-modelled rating curves reduce uncertainty in high flow data?

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Flood risk assessments rely on accurate discharge data records. Establishing a reliable rating curve for calculating discharge from stage at a gauging station normally takes years of data collection efforts. Estimation of high flows is particularly difficult as high flows occur rarely and are often practically difficult to gauge. Hydraulically-modelled rating curves can be derived based on as few as two concurrent stage–discharge and water-surface slope measurements at different flow conditions. This means that a reliable rating curve can, potentially, be derived much faster than a traditional rating curve based on numerous stage–discharge gaugings.

In this study we compared the uncertainty in discharge data that resulted from these two rating curve modelling approaches. We applied both methods to a Swedish catchment, accounting for uncertainties in the stage–discharge gauging and water-surface slope data for the hydraulic model and in the stage–discharge gauging data and rating-curve parameters for the traditional method. We focused our analyses on high-flow uncertainty and the factors that could reduce this uncertainty. In particular, we investigated which data uncertainties were most important, and at what flow conditions the gaugings should preferably be taken.

First results show that the hydraulically-modelled rating curves were more sensitive to uncertainties in the calibration measurements of discharge than water surface slope. The uncertainty of the hydraulically-modelled rating curves were lowest within the range of the three calibration stage–discharge gaugings (i.e. between median and two-times median flow) whereas uncertainties were higher outside of this range. For instance, at the highest observed stage of the 24-year stage record, the 90% uncertainty band was -15% to +40% of the official rating curve. Additional gaugings at high flows (i.e. four to five times median flow) would likely substantially reduce those uncertainties. These first results show the potential of the hydraulically-modelled curves, particularly where the calibration gaugings are of high quality and cover a wide range of flow conditions.