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Calibrating a hydrological model without a rating curve; reducing discharge uncertainty

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Direct measurement of river discharge is time consuming and financially demanding. Therefore stage discharge relations are determined by fitting a curve to a limited number of points (hi, Qi), whereby hi and Qi represent stage and discharge measured in a certain cross section of a river at a fixed geographical location. Commonly these points (hi, Qi) originate from measurements done under regular flow conditions, due to which a considerable part of the curve is based on interpolation and extrapolation. Therefore the uncertainty in the rating curve particularly during floods can be considerable, which directly translates into uncertainty in the flow data.

This research shows an approach whereby a conceptual rainfall runoff model is calibrated on the basis of stage data only. In addition to the existing conceptual model parameters, extra parameters are added that define the rating curve. A stepwise calibration method is applied whereby first the rating curve parameters are determined and subsequently the remaining model parameters. Once the rating curve parameters are fixed, the reanalyzed hydrograph is fixed, after which the modelling is done by conventional methods.

In this research these methods are applied to the Endau river catchment, located in the South-East of peninsula Malaysia. The initial results are promising. When comparing the reanalyzed rating curve with the original rating curve it can be seen that the initial part of the rating curve overlaps, corresponding with the most reliable part of the original rating curve. When comparing the reanalyzed rating curve with the discharge measurements performed a high correspondence is observed, while the similarity between the measurements and the original rating curve is very low. Finally the modeled hydrographs are relatively well able to mimic the reanalyzed hydrograph, while it was impossible to find a proper model for the original hydrograph.

Investigation of the sensitivity of the calibrated rating curve to model structure and model forcing (potential evaporation and precipitation), shows that the calibrated rating curve is relatively insensitive to model structure and relatively sensitive to model forcing.