The need for operational reasoning in data-driven rating curve prediction of suspended sediment

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ABSTRACT
The use of data-driven modelling techniques to deliver improved suspended sediment rating curves has received considerable interest in recent years. Studies indicate an increased level of performance over traditional approaches when such techniques are adopted. However, closer scrutiny reveals that, unlike their traditional counterparts, data-driven solutions commonly include lagged sediment data as model inputs, and this seriously limits their operational application. In this paper, we argue the need for a greater degree of operational reasoning underpinning data-driven rating curve solutions and demonstrate how incorrect conclusions about the performance of a data-driven modelling technique can be reached when the model solution is based upon operationally invalid input combinations. We exemplify the problem through the re-analysis and augmentation of a recent and typical published study, which uses gene expression programming to model the rating curve. We compare and contrast the previously published solutions, whose inputs negate their operational application, with a range of newly developed and directly comparable traditional and data-driven solutions, which do have operational value. Results clearly demonstrate that the performance benefits of the published gene expression programming solutions are dependent on the inclusion of operationally limiting, lagged data inputs. Indeed, when operationally inapplicable input combinations are discounted from the models and the analysis is repeated, gene expression programming fails to perform as well as many simpler, more standard multiple linear regression, piecewise linear regression and neural network counterparts. The potential for overstatement of the benefits of the data-driven paradigm in rating curve studies is thus highlighted.

KEYWORDS:
Data-driven; Modelling; Operational validity; Rating curve; Suspended sediment

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