Assessment of uncertainties on stage-discharge raging curves: A large scale application to Québec hydrometric network

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Point-by-point reply to editor and reviewers' comments

A point-by point response to editor and reviewer's comments is provided in the following with corresponding references to the revised version of the manuscript. Since the numbering of the lines changed, we indicate in each case the new line numbers where revised text appears. Please note that the changes in the 'marked' version are indicated in green.

RC Specific comments

Comment # 1

Lines 100 – 108: It is not correct that uncertainties in model parameters of rating curve models are accounted for in residual distributions. The residuals account mainly for the uncertainties in the flow, that is, the measurement error in the flow. Discrepancy between the true flow and the proposed mathematical model ends up in the residuals along with the measurement error in the flow. Uncertainty due to measurement error in stage also ends up in the residuals**.**

Statistically, the residuals can only provide information about the value of the variance of the error terms explained about (assuming constant variance for the error term in the logarithmic transformed discharge rating curve model). The residuals alone cannot provide information about the uncertainties of the parameters of the discharge rating curve model. The structure of the discharge rating curve model and the probability model for the observed discharge and stage pairs are needed. Uncertainty in the model parameters has an effect on rating curve predictions, these predictions will have wider prediction intervals when parameter uncertainty is taken into account.

It would be helpful for the readers to know that uncertainty in the model parameters is not addressed. The reasons for not addressing this uncertainty should be given, e.g., this makes the method more robust or this saves computation time. Please do not state that uncertainty in model parameters is accounted for in residual distributions. Also, please state that uncertainty in the model parameters is not addressed in the proposed method and the reasons for that.

Response: The reviewer is right, incorrect statements about uncertainties were made in the manuscript. To comply with the reviewer's comments, the text on lines 103-106 was changed.

Comment #2

2) Lines 134 – 141: I agree that Mean Square Relative Error (MSRE) is a commonly known formula. However, a minimum justification for using MSRE in the context of fitting rating curves is to note that it has been used before in the literature and appropriate reference or references. The power function is a commonly known and frequently used

model for rating curves. It is introduced in eq. (1) and there a reference is cited. Please consider citing a reference for eq. (2), e.g. Gupta et al. (2009).

Reference: Gupta, H.V., Kling, H. Yilmaz, K.K., Martinez, G.F. (2009). Decomposition of the mean squared error and NSE performance criteria: Implications for improvinghydrological modelling, *J. Hydrol*. 377 (1-2): 80-91. DOI: 10.1016/j.jhydrol.2009.08.003.

Response We added the reference to Gupta et al. (2009) on line 136

RC Technical corrections

1) Lines 92 – 95: I was actually referring to the paper Petersen-Øverleir A (2004). The paper Reitan, T., and Petersen-Øverleir, A. (2006) does not discuss the estimation of the variance or standard deviation of the error terms, so, it should not be used in lines 92 – 95.

Reference: Petersen-Øverleir A (2004). Accounting for heteroscedasticity in rating curve estimates. Journal of Hydrology Volume 292, Issues 1–4, 15 June 2004, Pages173-181 (https://doi.org/10.1016/j.jhydrol.2003.12.024)

Response: The reference has been changed on line 107 and added in the bibliography (lines 521-522).