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Quantifying the uncertainty in discharge data using hydraulic knowledge and uncertain gaugings: a Bayesian method named BaRatin

Jérôme Le Coz (1), Benjamin Renard (1), Laurent Bonnifait (2), Flora Branger (1), Raphaël Le Boursicaud (1), Ivan Horner (1), Valentin Mansanarez (1), Michel Lang (1), and Sylvain Vigneau (1)

(1) UR HHLY, Irstea, Lyon, France (jerome.lecoz@irstea.fr), (2) CEREMA, Trappes, France (laurent.bonnifait@cerema.fr)

River discharge is a crucial variable for Hydrology: as the output variable of most hydrologic models, it is used for sensitivity analyses, model structure identification, parameter estimation, data assimilation, prediction, etc. A major difficulty stems from the fact that river discharge is not measured continuously. Instead, discharge time series used by hydrologists are usually based on simple stage-discharge relations (rating curves) calibrated using a set of direct stage-discharge measurements (gaugings).

In this presentation, we present a Bayesian approach (cf. Le Coz et al., 2014) to build such hydrometric rating curves, to estimate the associated uncertainty and to propagate this uncertainty to discharge time series. The three main steps of this approach are described:

(1) Hydraulic analysis: identification of the hydraulic controls that govern the stage-discharge relation, identification of the rating curve equation and specification of prior distributions for the rating curve parameters;

(2) Rating curve estimation: Bayesian inference of the rating curve parameters, accounting for the individual uncertainties of available gaugings, which often differ according to the discharge measurement procedure and the flow conditions;

(3) Uncertainty propagation: quantification of the uncertainty in discharge time series, accounting for both the rating curve uncertainties and the uncertainty of recorded stage values. The rating curve uncertainties combine the parametric uncertainties and the remnant uncertainties that reflect the limited accuracy of the mathematical model used to simulate the physical stage-discharge relation.

In addition, we also discuss current research activities, including the treatment of non-univocal stage-discharge relationships (e.g. due to hydraulic hysteresis, vegetation growth, sudden change of the geometry of the section, etc.).

An operational version of the BaRatin software and its graphical interface are made available free of charge on request to the authors.

J. Le Coz, B. Renard, L. Bonnifait, F. Branger, R. Le Boursicaud (2014). Combining hydraulic knowledge and uncertain gaugings in the estimation of hydrometric rating curves: a Bayesian approach, Journal of Hydrology, 509, 573–587.