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Propagation of stage measurement uncertainties to streamflow time series

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Streamflow uncertainties due to stage measurements errors are generally overlooked in the promising probabilistic approaches that have emerged in the last decade. We introduce an original error model for propagating stage uncertainties through a stage-discharge rating curve within a Bayesian probabilistic framework. The method takes into account both rating curve (parametric errors and structural errors) and stage uncertainty (systematic and non-systematic errors). Practical ways to estimate the different types of stage errors are also presented: (1) non-systematic errors due to instrument resolution and precision and non-stationary waves and (2) systematic errors due to gauge calibration against the staff gauge.

The method is illustrated at a site where the rating-curve-derived streamflow can be compared with an accurate streamflow reference. The agreement between the two time series is overall satisfying. Moreover, the quantification of uncertainty is also satisfying since the streamflow reference is compatible with the streamflow uncertainty intervals derived from the rating curve and the stage uncertainties.

Illustrations from other sites are also presented. Results are much contrasted depending on the site features. In some cases, streamflow uncertainty is mainly due to stage measurement errors. The results also show the importance of discriminating systematic and non-systematic stage errors, especially for long term flow averages.

Perspectives for improving and validating the streamflow uncertainty estimates are eventually discussed.