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Testing the plausibility of several a priori assumed error distributions for discharge measurements

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Hydrologic measurements are used for a variety of research topics and operational projects. Regardless of the application, it is important to account for measurement uncertainty. In many projects, no local information is available about this uncertainty. Therefore, error distributions and accompanying parameters or uncertainty boundaries are often taken from literature without any knowledge about their applicability in the new context.
In this research, an approach is proposed that uses relative differences between simultaneous discharge measurements to test the plausibility of several a priori assumed error distributions. For this test, simultaneous discharge measurements (measured with one type of device) from nine different Belgian rivers were available. This implies the assumption that their error distribution does not depend upon river, measurement location and measurement team. Moreover, it is assumed that the errors of two simultaneous measurements are not mutually dependent.
This data set does not allow for a direct assessment of measurement errors. However, independently of the value of the real discharge, the relative difference between two simultaneous measurements can be expressed by their relative measurement errors. If a distribution is assumed for these errors, it is thus possible to test equality between the distributions of both the relative differences of the simultaneously measured discharge pairs and a created set of relative differences based on two equally sized samples of measurement errors from the assumed distribution. If the assumed error distribution is correct, these two data sets will have the same distribution. In this research, equality is tested with a two-sample nonparametric Kolmogorov-Smirnov test. The resulting p-value and the corresponding value of the Kolmogorov-Smirnov statistic (KS statistic) are used for this evaluation.
The occurrence of a high p-value (and corresponding small value of the KS statistic) provides no confirmation of the null hypothesis and it is possible that many other hypotheses lead to similar p-values. Nevertheless, the value of the KS statistic provides information not only about differences in central tendency but about any difference in the empirical cumulative distribution functions. In this research, the KS statistic is used to evaluate the behavior of different error distributions types (each with widely sampled parameters) that are a priori chosen based on currently available knowledge, without excluding the plausibility of other, unexplored error distributions.