

## ***Interactive comment on “Exploiting the information content of hydrological “outliers” for goodness-of-fit testing” by F. Laio et al.***

**F. Laio et al.**

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Referee 1 is gratefully acknowledged for his/her insightful comments. In the following, the responses to the question he/she raised are reported.

1) The point raised by Referee 1 on the rigorousness of the statement at page 4850, lines 5-7 is a very good one. In fact, while the independence of new parameters estimators on  $x_{(n)}$  is preserved asymptotically, some residual dependence persists for sample sizes of the same order of magnitude of the ones that we consider. We will better specify this part of the paper (also lines 4862: 12-14) by suitably modifying the text and adding a reference to the paper pointed out in the Referee’s comment. However, this aspect has a minor effect on the result that we present in the manuscript. This is

demonstrated in the graph reported hereinafter (Fig. 1), where the power of the classical and modified maximum value test are represented for different sample sizes for a case when the same distribution (a Gumbel distribution) is used both as the parent and as the hypothetical distribution. If the test statistic were completely independent of  $x_{(n)}$ , the power of the test would have converged to the significance level for any sample size (10% significance level, dashed line in the graph), because the hypothetical distribution coincides with the parent. On the contrary, it is observed that the power of the test is systematically below the significance level for the MV test applied with the classical L-moments estimators (MV err in the graph), which are heavily dependent on  $x_{(n)}$ , while the performance improves significantly for the modified test (MV). The effect of the residual dependence on  $x_{(n)}$  pointed out by Referee 1 is probably responsible for the tendency of the test power to remain slightly below the significance level. This effect, however, is negligible for practical purposes. Similar results are obtained when using other distributions as parents.

2) Equation 8 expresses the condition required by the Maximum Value Test to verify if a sample is consistent with the hypothesis that it was sampled from a prescribed parent distribution. This test was originally proposed by Grubbs (1969) in the form expressed by Eq. 8, as stated at page 4854: 1-5, whereas the references that we provide at page 4858 after Eq. 8 are general references for the maximum value distribution in the form  $[F_X(x|\Theta)]^n$ . We will try to better clarify this point in the revised version of the manuscript. The Maximum Value Test is indeed scarcely referenced in the scientific literature but it is widely applied in engineering practices, hence the motivation of our analyses.

3) Page 4858: 19, 20 - the decision of using the median of the hypothetical maximum value distribution as an estimator of  $x_{(n)}$  comes from the possibility to obtain analytically explicit results. The same was not guaranteed by the mean.

4) Recommended uses of the method, currently cited in the discussion and pointed out in the conclusion, are: goodness-of-fit testing when the parent distribution is supposed

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to be similar to the distribution being tested (for example, when one suspects the parent to be a GEV distribution with  $\theta_3$  close to zero, but wants to test if a Gumbel distribution would also be adequate to represent the data), and in particular when small samples ( $n < 20$ ) are available. We will try to better clarify these recommendations in the revised manuscript. In the revised version of the manuscript we will also devote more space to list the future developments of this work that are, among others: - further investigation of the problem of the residual dependence on  $x_{(n)}$ ; - application of the test to the case when non systematic data (e.g., derived from occasional measurements of significant events) are available.

5) Page 4852: 12 - What we mean is that in one case the distribution of the test statistic is obtained through numerical simulation (i.e., MonteCarlo simulations), in the other case it is obtained analytically.

All other technical correction will be amended in the manuscript.

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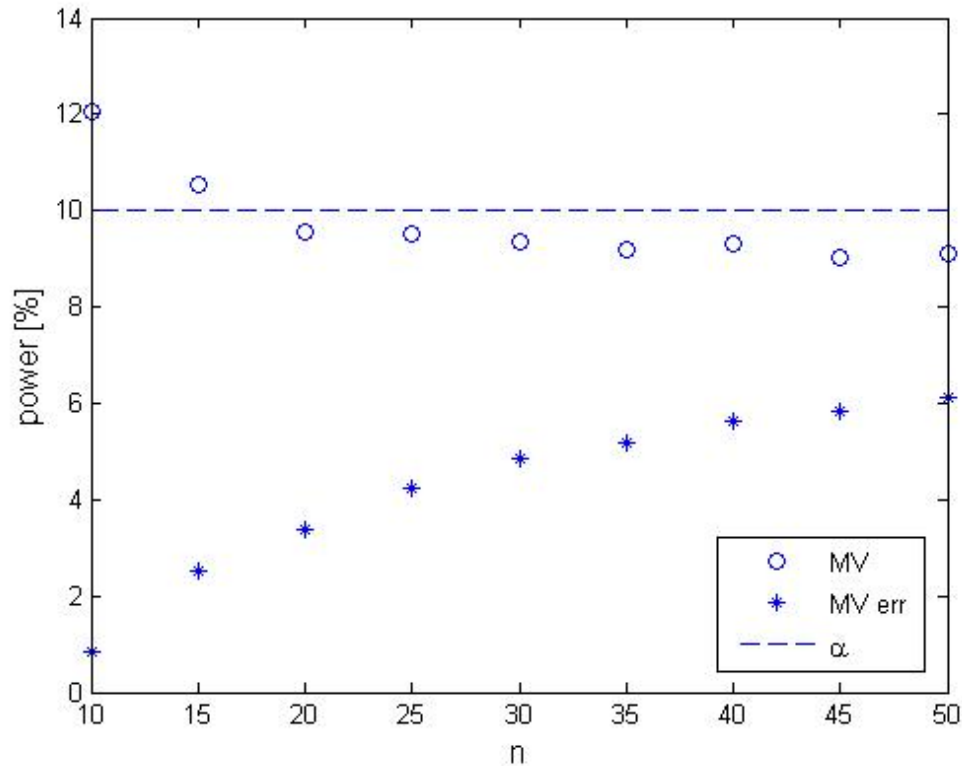
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**Fig. 1.** Power of the classical (stars) and modified (circles) maximum value test for different sample sizes ( $n$ ) for a case when a Gumbel distribution is used both as parent and hypothetical distribution

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