Hydrol. Earth Syst. Sci. Discuss., 7, C2430–C2435, 2010
www.hydrol-earth-syst-sci-discuss.net/7/C2430/2010/

Hydrology and Earth System Sciences Discussions

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

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Received and published: 23 September 2010

Referee 2 is gratefully acknowledged for his/her insightful comments. In the following, his/her comments are reported in italic interspersed by our responses.

GENERAL COMMENTS

1) . . . *in all Extreme Frequency Analysis the classical graphical comparison between plotting positions and the fitted function in probabilistic scale (usually Gumbel scale) is done. ...However, this graphical comparison is subjective and better objective method should be used. . .. it would be needed some critical . . . comments in the Introduction to this classical method.*

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Interactive Discussion

Discussion Paper

A general comment will be added in the introduction about the merits and drawbacks of the probability charts, in response to the suggestion of Referee 2 to add some critical comments to this classical approach. The text that we will add is reported hereinafter: "A simple approach to the validation of the probabilistic model in hydrology is based on plotting the data on probability charts (e.g., Stedinger et al., 1992) and verifying if the observations fall approximately on a straight line. The major problems with this approach are (1) the subjectivity inherent in the visual verification of the alignment of the empirical points, and (2) the fact that the method is available only for two-parameter distributions."

2) *Last sentence in conclusion is on one hand pessimistic, because (following the Parsimonious Principle) it is never recommended to use the GEV (3 parameters) and with more reasons the TCEV (4 parameters) with a sample of less than 20 data. On the other hand, this type of test can be very useful with the TCEV in a regional framework (large sample) to detect locally (short sample) the extraordinary events and to proceed with the regionalization, fitting a Gumbel to the local ordinary events, as it was done at least by Frances (1998)...*

The point raised by Referee 2 on the inopportunity to use 3 and 4 parameter distributions with small samples is probably due to a lack of clarity in the conclusive part of our manuscript. In fact, our recommendation when the test hypothesis is falsified (i.e., the candidate model is not EV1) is not to adopt the (un)known parent distribution, but rather to resort to other solutions as, for example, regional analysis or, if possible, trying to collect more (systematic or not) data. We will better clarify this point in the revised version of the paper. For the sake of clarity we will also change the title of section 3 from "Application" to "Assessment of the power of the test through synthetic data".

3) ...*In this case, author used the the skewness test, originally for outliers elimination, described by Kottegoda (1984). In this way, last general question of Referee 1 can be partially answered.*

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The use of the sample skewness coefficient as the test statistic measuring the departure from normality dates back to Fisher (1930). The use of the same test statistic has been proposed for outlier detection by Ferguson (1961), and has been subsequently applied to the detection of hydrologic outliers by Kottegoda (1984). A difficulty with the use of this test statistic (both for goodness-of-fit purposes and for outlier detection) is that it is well suited to recognize departures from normality, while it requires preliminary transformations of the data when the parent is supposed to be non-normal (see Kottegoda, 1984, pp 114-115); the main problem when dealing with real data is that the form of the transformation (e.g., logarithmic transformation, or cube-root transformation) is itself unknown (because the parent is unknown), so that the application of this procedure often leaves much to the subjectivity of the user.

4) *Question to the scientific community: it is really needed to write in Oxford English?*

We leave to the scientific community the answer to this question. As we also act sometimes as reviewers and associate editors, we only observe that well-written papers tend to have an advantage in the review phase, because a bad English grammar or style may be easily (mis)interpreted as a lack of care by the Authors in preparing their manuscripts.

MINOR CORRECTIONS/COMMENTS

- *In the introduction, a critical short abstract (pros and cons) of the D'Agostino and Stephens book, should be added.*

We interpret this recommendation by the referee as motivated by some confusion we could have raised with the sentence at lines 4858: 5-8. In this sentence we were not referring to MV test, which is not treated by D'Agostino and Stephens (1986), but to a generic property of testing procedures. We will modify the text as follows: "...when parameters are estimated from the same sample used for verification, the limiting values for the goodness-of-fit testing (...) should be suitably recalculated; this is a general requirement for all goodness of fit tests, see D'Agostino and Stephens (1986) and Laio

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(2004), among others, for details."

- *It seems the term MV test is used sometimes referring to the modified MV test (or MV test with censored parameters). . . Unify terminology for the two tests.*

Referee 2 is right when he points out that the terminology used to refer to the standard and modified MV test may induce some confusion. In the revised version of the manuscript we will use exclusively the two definitions: standard MV test (or SMV test) and modified MV test (or MMV test).

- *P58L19 The "of course" for this fact is not as obvious for me as authors claim. Would you mind to give more explanations to affirm this significant increase of bias?*

If one takes out the maximum value from a sample, all moments and L-moments estimates will be negatively biased, due to the fact that the larger value in the sample (and not a value taken at random) is excluded from the sample. We will delete the "of course" and add few words to the manuscript to clarify this point.

- *P58L20 As referee 1, I think authors need to justify strongly the selection of the median as an estimator.*

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. We will try to stress this motivation in the revised manuscript.

- *P62L18 The first time terms "systematic" and "non-systematic" data were used in the proper context of different sources of information was in Frances (1998).*

We were not aware of this fact. A reference to the work by Frances (1998) will be added.

- *P62 To be clearer, I will add at the end of section 2 how to apply the modified MV test using eq (8) and the parameters estimated with eqs 13, 14 and 16.*

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We will recall the steps needed to apply the MMV test at the beginning of section 3

- *P63L6 To improve the impression of applicability, justify the use of GEV and TCEV, here or better in the introduction. For example, making a short review of the use of these distributions in literature. In the case of the TCEV, specifically show it not only works with Italian extreme precipitation and flood data.*

GEV and TCEV are here used as examples of parent distributions. We will better justify their use by providing some references testifying their widespread use in statistical hydrology

- *It is not usual to add dots and commas at the end of equations. Consider their elimination.*

We believe that even though displayed math is separated by space from the running text it is still a part of that text and needs to be punctuated accordingly (see http://rmp.aps.org/files/rmpguide.pdf , page 19, for more details).

- *Use systematically one term: Gumbel or EV1.*

Right: in the revised paper we will use systematically EV1 to refer to the Gumbel distribution

All other technical corrections will be amended in the manuscript.

REFERENCES

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Fisher, R.A. (1930), The moments of the distribution for normal samples of measures of departure from normality, Proceedings of the Royal Society, A, 130, 16-28.

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Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 7, 4851, 2010.