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Hydrology and Earth System Sciences Discussions

Interactive comment on "Possibilistic uncertainty analysis of a conceptual model of snowmelt runoff" *by* A. P. Jacquin

Anonymous Referee #1

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The paper presents an application of possibility theory to assess the uncertainty associated to a snowmelt runoff model. Various possibility distributions are built according to different information sources (i.e., REP, REVF, MSE), and associated uncertainty bounds are computed for various combinations of these sources.

The application seems interesting, and possibility theory may be a proper choice, especially if uncertainty is due to parameter ill-known values or to model structure. However, there are many technical aspects that are left unspecified, and it is not crystal-clear how possibility theory is used exactly.

Here is a list of the major technical (and, to some extent, philosophical) deficiencies present in the paper:

- The vocabulary used by the authors is sometimes improper and may be misleading to readers that are non-experts in uncertainty theories. Authors should pay a close attention to the vocabulary and the concepts they explain, and illustrate them with concrete examples. I think it to be important if authors want the readers to be interested. Here are some examples:
    1. It is often unclear (see introduction, start of page 2057) whether the authors speak about possibility distribution values (i.e., possibility values on singletons or elementary sets) or possibility measures induced by the distribution.
    2. Authors should be clear about what they consider as epistemic and subjective, as they are two different concepts. Uncertainty can be epistemic and not subjective (e.g., imprecision due to sensor).
    3. While authors speak about updating (referring to a prior and a posterior), what they really use in my opinion is an information fusion tool aiming at fusing different information source.
- It is quite surprising that authors, in their introduction and short bibliographical review, do not speak about recent developments of uncertainty theories such as imprecise probability theory (especially since they speak about subjective probability theory).
- There is a need to formally introduce different basic concepts of possibility, in addition to the (sometimes difficult to follow) explanation of the authors. In particular, the authors never introduce possibility and necessity measures, and the notion of α-cuts (page 2059, first lines) is only informally described. A proper notation would help. This is also true for other equations or concepts. For instance, what are the 16 parameters the authors talk about? Are they encompassed in θ (which in this case is a vector)? Are the model Q and the extension principle ever used (Authors only speak of θ afterward)?

- How simulations are performed should be explained clearly, as I did not understand whether Monte-Carlo simulations were performed on the parameter space to evaluate the possibility distributions (propagated through extension principle?) or to possibility distributions (simulating intervals) to achieve the extension principle level-wise?
- In general, more figures/algorithms to illustrate the mathematical details could help, especially since the intended audience are non-experts. For example, a figure picturing a possibility distribution and an α-cut could be helpful.
- the author should also pay attention to the way they write sentences. The english used is sometimes cryptic and the meaning of some sentences difficult to catch.

I now give comments regarding more particular aspects:

1. Introduction

- P2054, L-3: I am not sure that "certitude" is a proper english word
- P2056, L8: parenthesis for Jacquin and Shamdeldin, 2007 are only around the year. This happens at other places and for other references, please check.

2. Possibilistic method for uncertainty analysis

- P2057, L1: a possibility distribution is not an indication of credibility, but rather of plauisbility. A necessity measure (that is not introduced) would be an indication of credibility.
- P2057, L4-5: please define clearly (formally) what is meant by α possibility bounds. If they correspond to α-cut bounds, why not say so?

- P2057, L6-7: in fact, α-cuts can be given a frequentist flavour (as an interval in which the true value may fall with a lower probability of 1-α), by considering a possibility measure as an upper probability (see the paper of Dubois-Prade, "when upper probabilities are possibility measures").
- P2058, L1: what are performance criteria? Do they correspond to different modelling of the snowmelt?
- P2058, L11: again, I'm not convinced by the use of posterior/prior here, as in my opinion what is performed is information fusion here, not the counterpart of a statistical inference scheme.
- P2059, L5: I did not fully understood the sentence.

3. Model description

- P2059, L15: it is claimed that the 16 variables are independent of each others. How is it taken into account in the propagation?
- Perhaps Section 4 and section 3 could be blend together, as both are quite short?

5. Methodology

- P2062, Eq. 4: where is θ in the right-hand part of the equation??? Same remark for the other equations.
- It is not clear at all how the extension principle is applied to these possibility distributions (all the same for the 16 parameters θ?), or is it already applied somehow?

6. Results

- The shown results seem good, however it is really difficult to judge their relevance given the fact that the process through which they are obtained (i.e., the final possibility distributions) remain quite cryptic.
- Are 0% possibility bounds equal to the α-cut of level 0 (corresponding to a confidence level of 1)? I think that for usual readers it may be counter-intuitive to see that intervals decrease in size as "confidence" percentage increase, hence the need to really introduce necessity measures of α-cuts.
- P2069, L19: possibility

I would suggest to the authors to read the two following papers (and some reference therein):

- Oberguggenberger, M., King, J., and Schmelzer, B. 2009. Classical and imprecise probability methods for sensitivity analysis in engineering: A case study. Int. J. Approx. Reasoning 50, 4
- Cedric Baudrit, Didier Dubois: Comparing Methods for Joint Objective and Subjective Uncertainty Propagation with an example in a risk assessment. ISIPTA 2005: 31-40

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