Hydrology and
Earth System
Sciences
Discussions

Interactive comment on "Evaluating Hydrological Model Performance using Information Theory-based Metrics" by Y. A. Pachepsky et al.

Anonymous Referee #3

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This paper presented some interesting results about information based model performance metrics. However, it was not well written and makes me uncomfortable to read. I also met some problems about the 4 kinds of information metrics. Although these metrics have been applied to many cases in ecology and hydrology, I think they are inappropriate for hydrological time series. See my comments below.

1. Line 24, page 4

The description of the approach is not clear for me. Please add an example. The methodology of computing information content and complexity metrics is very important because your method in some way determines the results and conclusions you finally achieved. Please add some formal peer-reviewed papers or books instead of the informal 'manuscripts'.

If I understand correctly, the hydrological time series can be transformed to a '01...' string (Fig 1 in [Pachepsky 2006]) and the information content/complexity metrics are computed with the binary string. I would challenge this approach because quite a lot of information is lost in this procedure. Let me give a simple example: $y = \sin(x) + e$, $e \sim N(0, \sigma)$. The median of y is 0 and e is the Gaussian error with std variance sigma. In this simple example, the string is all 0 and the entropy, information and complexity metrics are all 0, no matter how large the error is. Practical hydrological cases are far more 'complex' that can not be fully described by such an over simplified binary string, i.e. the magnitude of peak flow, the recession curve, the flow duration curve... In my opinion, this approach can only identify the fluctuation over and below the median, which is fundamentally flawed and incomplete for the complex, nonlinear hydrological process.

2. Line 5, page 5

The equations 3,4,5 are consistent with [Pachepsky 2006], but I still have a lot of questions. Could you provide some formal references in English? In [Pachepsky 2006] and other similar papers I was referred to [Wolf, 1999]. Is it a PhD thesis in Germany?

Eq 3: Why the subscript of the formal p is 'ij' but the later is 'i->j'? How did you derive that?

Eq 4: Why squared? What is the unit of FC after squared p ratio? bit/nat?

Eq 5: Three subscripts of p are different, why?

Could you provide an appendix about how do you define these information and complexity metrics? It will be very helpful for the readers.

3. Line 1, page 7

Do the MIG, FC and EMC have the same unit (bit, in this paper)? Why added the information content MIG with the complexity metrics FC and EMC? Why added them separately? Why not add them together (MIG + FC +EMC)?

The 'distance' metrics were defined in the main body but the results were put in the supplement, confusing! Please move the two tables to the main body and give a comprehensive discussion. Or you should remove the definition of 'distance'.

4. Line 22, page 7

As I have mentioned previously, the methodology in this paper is fundamentally flawed and incomplete. I would argue that the word length might have significant impact to the final conclusions of this paper, and choosing another word length can probably lead to totally different conclusions. In my opinion, it's necessary to solve the problem of methodology before applying it to practical problems.

5. Table 2

Did you calibrate the parameter of these models with some optimization methods? Or use some physically based parameterization scheme? Or specify the parameter values arbitrarily? It has been a common sense that parameter specification has very significant influence to the model performance, but the authors did not provide any information about the parameters. I'm quite skeptical about the final conclusion because it can easily be contaminated by inappropriate parameterization.

6. Figure 2 and 3

Figure 2: Missing labels for each sub-figure.

Figure 3 and 4: Use point symbols instead of numbers to avoid overlapping. Please provide labels for each sub-figures.

Figure 4: EMC => FC