Hydrology and Earth System Sciences Discussions

Hydrol. Earth Syst. Sci. Discuss., referee comment RC2
https://doi.org/10.5194/hess-2022-16-RC2, 2022

Comment on hess-2022-16

Anonymous Referee #2

Referee comment on "Technical note: c-u-curve: A method to analyse, classify and compare dynamical systems by uncertainty and complexity" by Uwe Ehret and Pankaj Dey, Hydrol. Earth Syst. Sci. Discuss., https://doi.org/10.5194/hess-2022-16-RC2, 2022

The technical note is on the topic of applying information theory to the analysis of observed hydrometeorological time series (precipitation and flow).

The method contributed here (as far as I understand) consists of computing the entropy over many slices (windows) of the original time series varying the width of the slices.

These entropies are seen as measures of system uncertainty. A separate measure of system complexity is defined by the "entropy of entropies".

The "system uncertainty" is graphed versus "system complexity" and this curve is given the term "c-u curve". This analysis is applied to several time series including from general dynamic systems (Lorenz attractor) and from hydrological systems (basin streamflow).

I believe the proposed ideas hold merit and can potentially make a valuable contribution to data analysis in hydrology.

However the current presentation and its format make it difficult to ascertain the contributions.

The paper is submitted in the format of a "technical note", but it gives the impression of a full paper with the introduction / literature review essentially missing, and with important method descriptions referenced to a Zenodo archive (line 64) which is not a peer-reviewed publication. As such the entire literature review seems limited to 4-5 lines (lines 48-52). This would seem insufficient for a publication claiming to provide a general method for

analysis of dynamic systems.

The intended scope of the contributed method is also not clearly defined. If the claimed contribution is for general systems, then the literature review should be far more general than the hydrological literature. Otherwise if the contribution is made in the context of hydrological data analysis then the title and abstract should be toned down and made more specific.

In terms of previous work, the c-u method looks similar to the "Multiscale Entropy" methods which also look at entropies for a range of time resolutions, and also define terms of uncertainty, complexity, etc. For example a quick search indicates:

Hu, M., Liang, H. (2017). Multiscale Entropy: Recent Advances.

https://sapienlabs.org/lab-talk/understanding-multiscale-entropy/

Wu et al (2013) Entropy, 15(3), 1069-1084; "Time Series Analysis Using Composite Multiscale Entropy; https://doi.org/10.3390/e15031069

I am not implying the methods are the same, however as a reviewer I believe if a journal paper (regardless of its format as full paper or technical note) claims as its contribution a new way of using entropy to quantify uncertainty-complexity of general dynamical systems then the onus is on the authors to conduct a thorough literature review, define the scope of the innovation, discuss advantages and disadvantages with respect to existing approaches, etc.

The results section where the method is applied to basin precipitation and flow provides interesting ideas regarding the controls on streamflow complexity, for example lines 220-245 where the complexity is contrasted for two basins.

For the benefits of the HESS audience, I would suggest more emphasis on this type of understanding would be useful. Readers without a strong background in information theory would also benefit from some help on how to interpret information-theory concepts, for ex the axis scale in "bits" (eg Fig 3) and how to relate it to more common hydrological units.

I would also suggest helping the reader through the results and discussion sections. Perhaps identify in advance some aims for this analysis and then follow them thru.

Otherwise these sections are quite monolythic and a bit hard to follow.

Overall I recommend a major revision to address these issues and produce a clearer and stronger contribution.