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Hydrology and Earth System Sciences
Discussions

Interactive comment on "Evaluation of statistical methods for quantifying fractal scaling in water quality time series with irregular sampling" *by* Qian Zhang et al.

Anonymous Referee #1

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The study performs a comparative evaluation of statistical methods available in the literature using as benchmark test the quantification of fractal scaling in water quality time series with irregular sampling.

While lacking technical novelty, the manuscript is written in a sober, careful manner, aptly guiding the reader throughout the key arguments, methodologies and procedures, and presenting the results in a clear and concise manner.

This being said, I raise four fundamental concerns:

1) The paper is a pure statistical exercise. It would thus benefit from a physical interpretation of the methodological structure and results: namely, discussing possible

physical mechanisms responsible for the statistical signatures detected in the analysis, along with their physical consistency.

For instance, whether a trend is physically sustainable and realistic in terms of system energetics, what physical mechanisms sustain the power laws detected in the data, and what physically entails the fractal behaviour. Fractals and scaling are well understood in the physical sciences but the HESS readers will be happy to learn this in the hydrological context.

In doing so, the authors will be able to strengthen their arguments and diffuse concerns about whether there is any realism underlying the signatures detected in the analysis.

2) Monte Carlo simulations can be structured and tuned for essentially any purpose and to yield any outcome, relying on wise choices made in the methodological setup and the generating system, based on the researchers' understanding or conception of its behaviour.

If the methodological setup is entirely data-based, i.e. learn from some statistic or machine learning procedure derived from dataset records, there will always be a degree of case-specific empiricism that is not straightforwardly generalisable, unless there is a fundamental principle beneath. This again links to concern 1.

Therefore, it is important to thoroughly provide a solid background to all the assumptions supporting the choices made in the methodological setup and operation.

3) The paper does not introduce any methodological novelty. In fact, there is a vast literature on statistics of irregularly sampled series (also known as unevenly spaced time series). Therefore, I strongly encourage the authors to look into the literature outside of hydrology, e.g. in astrophysics, neurosciences, paleoclimatology, where they will find a rich diversity of sophisticated and long-proven methods that already tackle the same problems.

In doing so, the authors will necessarily tone down the false claims about novelty in

new methods and frameworks, when in reality the only novelty is the application of existing methods to hydrological case studies.

The key merit of the paper is essentially the comparative evaluation of well known statistical methods and their application to the hydrological sciences, namely relevant water quality issues.

As such, this is a purely applied paper and should be clearly presented as such. This brings me to the fourth concern.

4) There are no novel hydrological insights in the paper. While the statistical messages are useful (albeit not technically novel), it would be essential to bring out a substantial advance in the understanding of the hydrological and earth systems. After all, HESS is not merely a journal of applied statistics but rather one in which there should be something to be learnt in the functioning of the hydrological system.

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