Hydrol. Earth Syst. Sci. Discuss.,
https://doi.org/10.5194/hess-2019-463-RC2, 2019

Hydrology and Earth System Sciences
Discussions

Interactive comment on "Hydrological signatures describing the translation of climate seasonality into streamflow seasonality" *by* Sebastian J. Gnann et al.

Anonymous Referee #2

Received and published: 30 October 2019

Referee report on

Hydrological signatures describing the translation of climate seasonality into stream flow seasonality

by

Gnann, Howden and Woods

In their manuscript the authors analyze how long term (seasonal) variations in precipitation time series translate into (long term) variations in stream flow. To do so the authors decompose the precipitation and corresponding stream flow time series into

their Fourier modes and analyze the mode corresponding to the annual (seasonal) cycle.

The paper is well written and addresses the problem of signal and forcing from a point of view which is more common in electro-technical engineering than in hydrology. Thus the paper may help to stimulate the field by introducing new methods and alternative approaches to analyze the relation between input-output time series.

Below some comments and suggestions which should help the authors to improve and strengthen their manuscript. Abstract: "We approximate [..] by sine waves." Input and output signals are not periodic per se, but show recurring patterns. In order to address this point the authors may simply rephrase the above statement with something like: "In order to analyze the seasonality relations between input [...] and output we represent the two time series by their seasonal (annual) Fourier mode."

Such a formulation avoids the criticism that the signal itself periodic, while keeping all the rest of the analysis unchanged.

Sec 2.2.1: 1 year Fourier mode: It would be interesting to see for an example how the different Fourier modes are represented in the spectrum of the time series. Such a measure would show how "strong" the annual mode is compared to the other modes of the signal.

Line 110: Although notation is an arbitrary choice, I would suggest the authors to use "PET" or at least "E_{PET}" in order to refer to Potential Evapo-Transpiration. Reducing the in-/output signal by putting all weight of the time-series into the single (seasonal) Fourier mode may be problematic for analyzing real world data where: a. It is not per se clear that the overall dominant part of the signal. (Here as mentioned above the spectrum should give insight)

b. Additionally the different modes of the input signal do not necessarily need to be linearly coupled with modes of the same frequency in the output.

Thus, it should be made clear that the description in section 2.1 relies on the assumption of a single wavelength forcing and a linear response system.

Note: Due to linearity, all derivations presented in 2.1 should be valid for any Fourier component of the forcing function with F_n=A_n\exp(i*k*t) where A_n is the amplitude of the corresponding mode in the Fourier series.

Figure 4: As mentioned before it would be interesting to see, how the blue and orange modes are represented in the corresponding spectra. If the seasonal modes are by far the most dominant frequencies in the signal it could help to justify for the single mode forcing model.

Sec. 4.2: Given the heterogeinity of natural systems it is not too surprising that a single linear (reservoir) model is not sufficient.

Fig. 6a and 7a: I would suggest the authors to use a two color divergent color scale to distinguish between negative and positive l_m (blue to white for neg. and white to red for pos values)

Another critique of Figs.6/7 is that the high point density can hide variabilities, especially when the points are plotted in a sorted manner, e.g. sorted by amplitude In order to avoid such a situation one could first randomize the sample with respect to the variable of the color bar.

Section 4.3 requires some more details how the models were set up and parameters were varied/chosen (This can be added to the SI).

Examples are:

Line 333: Running IHACRES with 20 000 parameter sets. - Which are the parameters? - What are the parameter ranges that were varied?

Line 335: The sentence "Plotting curves [...] produced by a certain set ..." needs some clarification. Questions which may arise here are: - How was the parameter set being

chosen? - Was it always the same for all different catchments? - Did the authors perform a parameter sensitivity analysis?

Line 343: "[...] with varying forcing.": Why do the authors introduce here the aridity index AI=PET/P=1-F/P as a nonlinear transformed quantity of F=P-PET rather than using their definition directly.

Alternatively if the aridity dependence is the point to make here the authors should simply say this: "[...] does not vary substantially with varying AI=PET/P=1-F/P."

— I hope that the authors find my comments & suggestions useful to to improve the manuscript and strengthen their arguments.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., https://doi.org/10.5194/hess-2019-463, 2019.