

## ***Interactive comment on* “Stochastic simulation of streamflow and spatial extremes: a continuous, wavelet-based approach” by Manuela I. Brunner and Eric Gilleland**

### **Anonymous Referee #1**

Received and published: 29 January 2020

GENERAL COMMENTS The manuscript proposes a wavelet-based phase randomization approach to generate multisite hydrological extremes, which is argued to be able to capture both spatial dependencies and non-stationarities. The stochastic simulated data is reconstructed with the same values as original data in another temporal order, and this assures the reproduction of temporal dependence, extremes and non-stationarities. In addition, the multiplication of the same set of random phases to all the investigated sites ensures spatial dependences. The paper is clearly written, and the idea is well explained. However, I have listed some comments below which needs to be addressed before the manuscript is considered further for publications.

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Major comments: COMMENT1: The spatial dependence can be simulated by using the same randomized phases for multiple time series among sites. You claimed this in your introduction and Section 3.2 step 1 without detailed explanation and references. From my understanding, the phases represent the time of the timing of changes or variations (in your case, it is extreme events), so if you use the same randomized phases, it is expected that there will be spatial dependence of extremes among the sites you investigated. Thus, could you give explanations or illustrations on this statement.

COMMENT2: Section 3.2, step 1 shows how the random phases are computed from a random discharge time series from a normal distribution with mean 0 and standard deviation 1. Could you explain the specific reason to choose normal distribution or have you tested with other distribution for example, gamma and kappa distribution? Another similar question is about the selection of wavelet family and scale. In this study, you use Morlet wavelet, what is the specific reason to use this wavelet family, and how about other wavelet families, e.g., Paul, DOG and Marr (Torrence and Compo, 1998)? The sensitivity of your approach to the selection of wavelet family and scale? For the application of wavelet method in real world, the selection of wavelet family and scales is of great importance.

Additionally, I am unable to visualise where exactly the random phases go back into equation 3? What should have been the values of these phases with the observed data in the first place? Why should these phases be the same? I suspect the only impact these phases have is on spatial dependence. In that case why are the majority of results that are presented focussing on temporal dependence attributes? Figure 6 gives some flavour of the multi-suite stochastic generation. It looks troublingly similar to the observations. What would happen if non-identical phases used across all the sites? These questions are important to address to establish the contribution here is an improved representation of spatial dependence compared to other alternatives. Regarding other alternatives, is there a possibility of comparing this method with the commonly used spatial stochastic generators such as SPIGOT or other equally worthy

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alternatives? I would like to see the variogram figure possibly expanded to also show alternate outcomes using other formulations of spatial dependence (ie different ways of specifying phases).

COMMENT3: Section 3.2, step 4 mentions how the reconstruction is done by using the inverse wavelet transform (Eq. (3)) combining the derived random phases and the amplitudes in previous steps. Could you write the combination explicitly in the form of the equation (i.e., include the random phases in the Eq. (3))?

Minor comments: Line 147:  $h=100$  wavelet scales, I think you mean number of wavelet scales is 100, not the scale itself equals 100. Wavelet scales should be  $h_j = h_0 \cdot 2^{(j \cdot dj)}$ ,  $j=0, 1, \dots, J$ . Or is this some parameter that is specific to a continuous wavelet transform? Why is it of relevance, what impact does it make, and why use the same value for all locations is something that should be discussed. TORRENCE, C. & COMPO, G. P. 1998. A Practical Guide to Wavelet Analysis. Bulletin of the American Meteorological Society, 79, 61-78.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., <https://doi.org/10.5194/hess-2019-658>, 2020.

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