Reviewer 1 (Ashish Sharma)

My congratulations to the authors on this excellent paper. Very glad to see a clever adopted to frequency domain alternatives in formulating a stochastic streamflow generator. My comments below are aimed to enhance the presentation and I am in support of publication once these have been addressed. Comments are:

Reply: *Thank you for acknowledging the value of our work and for the constructive comments, which help to enrich the introduction and discussion section.*

line 2/9 - The authors are missing the works by Keylock (10.1029/2012WR011923). This work performed resampling to an existing time series using phase randomization in the frequency domain. If I remember correctly, it had some nice inclusion of ICA to tackle the multivariate issue, and wavelets to get around nonstationarity in the data that cannot be handled using a fourier transformation alone. I think they need to read those papers (I am familiar with the above one but there may be more since) and acknowledge them here, and also try and show how their work distinguishes itself from the above paper.

Reply: *The work by Keylock (2007) indeed shows many parallels to the approach presented in this paper. His approach is not directly based on the Fourier transformation but rather based on the wavelet decomposition of a signal. Instead of the phases of the Fourier transform, the wavelet coefficients are (partly) randomized. The randomized series are then backtransformed to the time domain by using a rank-ordering procedure as presented in the approach used in our manuscript. Keylock (2012) later extended the procedure to the joint simulation at multiple sites. The work by Keylock will be acknowledged in the introduction and discussion section.*

line 3/21: I think the work by Mehrotra (10.1029/2005JD006637) should be acknowledged here as it represents essentially something analogous to a ARMAX type of a model even though it is cast as a stochastic downscaling approach. A mention should be made on the ability to preserve low frequency variability, which I believe the proposed approach will be able to address as well.

Reply: *The work by Mehrotra and Sharma (2006) will be acknowledged as an approach allowing for the extension of Markov chains to multiple sites by using spatially correlated random numbers.*

Line 3/35: Even though it relates to the problem of correcting systematic biases, given the use of phase transformation (not randomisation), the approaches of Nguyen should perhaps be acknowledged for completeness. The rationale behind these approaches and the one here has a lot in common. (10.1007/s00382-018-4191-6, 10.1016/j.jhydrol.2016.04.018).

Reply: *Thank you for pointing out these references. We will acknowledge the work of Nguyen et al. (2019) in the discussion section where we talk about options of how to improve the representation of the cross-correlation in simulated series.*

line 5/21: The authors may want to look through the details of (10.1007/s00382-018-4191-6, 10.1016/j.jhydrol.2016.04.018) as they performed another level of preprocessing - they fit a Thomas Feiring type model to the monthly data and after that structure was removed, the Fourier transformation was performed. This was done after trying with the steps referred to above, as it was found to exhibit clear advantages.

Reply: *We experimented with different types of deseasonalization techniques and found that the normalization at daily scale served the purpose of removing seasonality in the data well. Compared to using a Thomas-Fiering model, the approach used here is non-parametric and does not assume any temporal seasonality structure. Deseasonalizing by a Thomas-Fiering model and re-adding this seasonality at the end, might be valuable if the reproduction of the lag-1 autocorrelation was an issue, which was not the case here.*

However, it requires the fitting of a parametric model which is data dependent. Our routine works independent of the time resolution of the data and is easily adjustable to different contexts. We show that the ACF of the observed data is nicely preserved by the approach employed in our study.

line 6/21: Setting negatives to zero is not a clean option. Please refer to the Keylock paper above again on how they restricted their approach to resampling to avoid having to set negatives to zero.
Reply: *We agree that setting negative values to zero is indeed not very elegant. We will change the algorithm in order to avoid this. Instead of replacing negative values by zero, we will replace these values by a value sampled from a uniform distribution in the interval [0, min(Q_obs_day)], where min(Q_obs_day) represents the minimum of the observed values corresponding to the day under consideration.*

line 11/10: Underestimation of cross-correlations is I think addressed well in (10.1007/s00382-018-4191-6). The trick that is used is to not randomly generate phases for all variables, but for a "key" variable (say biggest streamflow mean location). And then maintain the phase difference between alternate sites. The phase difference in space helps capture the cross-dependence attributes.
Reply: *The approach proposed by Nguyen et al. (2019) for a good representation of the cross-correlation between two or multiple time series in the context of bias correction could also be adopted in the stochastic simulation framework presented in our manuscript. The discussion section will be extended by the phase-difference correction functions introduced by Nguyen et al. (2019).*

Lastly, I feel not addressing the issue of non-stationarity in a stochastic generation paper under our present climate should be discouraged. The issue of nonstationarity can be addressed in the sense of a discussion by thinking of adding an exogenous predictor variable set in the formulation, which can impart the changes needed. Some discussion to that effect would be good to include in the paper before it is published.
Reply: *We agree that addressing non-stationarity, if present, is important. The manuscript therefore contains a note stating that the stochastic generator could be applied using discharge time series simulated with a hydrological model driven by meteorological data simulated with a GCM (and RCM) (p 13. L20-22 in the original manuscript). We will slightly extend the discussion by discussing more options of how to adjust the phase randomization approach to non-stationary conditions.*