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Discussions

Interactive comment on "Technical note: Stochastic simulation of streamflow time series using phase randomization" *by* Manuela I. Brunner et al.

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This is only a very short suggestion about preserving ACF/CCF.

As the Authors recognize, "This underestimation can be explained by the fact that phase randomization preserves the cross-correlation in the normal domain but not necessarily in the domain of the original distribution."

Indeed, in my understanding the algorithm works like classical ARMA modelling procedures used in hydrological applications (replacing (stationary Gaussian) ARMA simulation with phase randomization).

Of course, a (strictly monotonic) marginal transformation preserves rank auto/cross-correlations but not the linear ACF/CCF of the target process (flow). An approach, which should not be computationally expensive (in principle), is to suitably inflate the spectrum of the "parent" Gaussian process. Since the ACF of a signal is the inverse Fourier transform of the power spectrum, such an inflated spectrum can result from suitably inflated ACF/CCF, which in turn can be obtained using the procedure described by Papalexiou (2018) and references therein. Such a technique only requires the solution of a simple double integral over a finite set of ACF/CCF values.

Therefore, in principle, it is possible to define the ACF/CCF terms (and thus the spectrum terms) of a parent Gaussian process yielding the required ACF/CCF of the target process, avoiding brute-force procedures. Compared with Papalexiou's procedure, in the present case, you only need an additional transformation (from Gauss inflated (empirical) ACF to Gauss inflated (empirical) spectrum) in order to use phase randomization instead of VAR(p) models (applied by Papalexiou), but I think that this is a matter of technicalities.

Sincerely,

Francesco

PS: the Authors can also be interested in Koutsoyiannis (2019), discussing the problem of temporal asymmetry, which is related to more realistic stream flow simulations and is in line with recent Andras' works on the topic, I think.

References

Koutsoyiannis D. (2019) Time's arrow in stochastic characterization and simulation of atmospheric and hydrological processes, Hydrological Sciences Journal, doi:10.1080/02626667.2019.1600700.

Papalexiou, S. M. (2018). Unified theory for stochastic modelling of hydroclimatic processes: Preserving marginal distributions, correlation structures, and intermittency.

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