Hydrol. Earth Syst. Sci. Discuss.,
https://doi.org/10.5194/hess-2018-350-RC1, 2018

Hydrology and Earth System Sciences
Discussions

Interactive comment on "Stochastic reconstruction of spatio-temporal rainfall pattern by inverse hydrologic modelling" *by* Jens Grundmann et al.

Anonymous Referee #1

Received and published: 9 July 2018

My comments are in the order I read the paper:

p2l3 - spelling mistake - "generall" p3l3 - some grammar issue - please check p6 - in my understanding, the approach is roughly along the following lines - first transformed empirical CDFs are ascertainedand used to create equivalent Normal observed rainfalls donated as w. line 11 says Gaussian copula is fitted to describe spatio-temporal dependence structure - a few lines of what this entails should be provided for completeness - in my reading this step seems independent of what is described next in the paper but if I am wrong this should be corrected. I am guessing the w_j,i is not from this copula but from equation 4 for each site and time step. So you have L se-

quences and the aim is to fine alpha_I such that there is some minimal deviation with the transformed normal rainfall at each location and timestep. So I guess the idea here is to keep generating fields until they match the observed rainfalls transformed to Normal. If that happens then you will have L=J and all the alpha's being equal to 1/L. And since there is spatial dependence, you would kind of expect L<J if this works fine. Am I correct? May be good to spell this out a bit more. P6l23 - what are homogenous conditions? I didnt understand what i meant by Uk(x_j,t_i)=0 - please clarify what this is and why is it needed. p7l2 - this is starting to become confusing now. Where did the covariance matrix come from? covariance of what? if W* represents more or less the transformed observed precipitation field (from what I could gather), is this W_lambda some randomised representation of that? If you are adding positive random values to this, arent you changing the probability distribution of W_lambda from uniform to something shifted/tending to Gaussian? P7l7 - I presume this is a minimisation being performed which I think should attain a minimum value if the W* is representing the observed precipitation field and the scaling weight k(lambda) equals zero. I am unclear about this approach - this is attempting to create the observed rainfall sequence instead of doing a stochastic generation as far as I can figure this out. P7l12 - the authors are saying multiple sequences are created by generating new random fields VI and enabling something called uncertainty quantification - please explain what this means. I am very curious how different the sequences end up being - and when they are really different, whether their probability distributions are consistent with the observed series that was used. Also - am I correct in stating that the timing of these sequences will be fairly similar to the observed sequence - hence the final sequences will be representing uncertainty about each observed value more than representing a stochastic system that is generating equally plausible sequences (a bit like a weather generator does conditional to exogenous inputs, compared to a stochastic generator where no two sequences have any exogenous binding variable). p7l15 - Am I correct in interpreting that the ranfall is generated known the marginal distribution at each pixel of the 118km2 catchment? Or is it based on the 6 hours of rainfall at the 10 monitoring

stations alone? If it is the latter, assumptions must have been made to spatially interpolate/extrapolate the rainfall to other pixels. Please state these. If it is the former, this is a limitation I believe as you need to be sure about the spatio-temporal structure of your storm to help refine it further using the flows. P7l26 - some mention of the number of time steps in the observed record for rainfall and flows should be provided - there is a mention of 6 hours but I wasnt sure if that is the time step of the duration. P9fig6 - I see all hydrographs are having roughly the same timing of the peak. So what I suspected about the time sequences of the rainfall is most likely correct. The differences across the storms would not be significant in terms of the spatial or the temporal pattern uncertainty that exists in real cases. I think this could be a limitation if the approach were being pitched as a stochastic generator - but could form an interesting way to generate alternate realisations of a storm sampled at specified point locations alone. And the need for having an accurate hydrologic model is a big limitation too as the uncertainty that arises from this can be significant.

On the whole, I am unclear how I would use an approach such as this for my modelling application. I will need to have a fairly good idea of the spatio-temporal nature of the storm system to put this into use - along with having point rainfalls and modelled flow time series to help ascertain which sequences are good. I think the authors need to add more examples of this in their revision to establish a clear scenario how users will put their method into use. And some details of the tolerences etc that are used to make this stochastic should be added as I think they are not stated in the paper very clearly. Some indication of how this might perform over long storms/large catchments/very few point locations etc will really help readers.

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