Hydrol. Earth Syst. Sci. Discuss.,
doi:10.5194/hess-2017-71-RC1, 2017

Hydrology and Earth System Sciences
Discussions
Open Access
EGU

Interactive comment on "Event-based stochastic point rainfall resampling for statistical replication and climate projection of historical rainfall series" *by* Søren Thorndahl et al.

P. Willems (Referee)

patrick.willems@kuleuven.be

Received and published: 26 May 2017

This paper describes a new approach for prolongation of rainfall series by resampling. The method can be applied, among other applications, on the basis of climate change impact analysis (statistical downscaling based on resampling). The approach is interesting but the paper needs strong revision. Some parts of the methodology are not fully clear, and the method has important limitations, which need further discussion.

Major comments:

Critical notes reg. the method:

Resampling from a (relatively short) historical time series has the disadvantage that

Printer-friendly version

Discussion paper

the same events may be taken several times. This may be problematic for the higher events; rainfall intensities for return periods longer than the length of the available historical times series will be underestimated by the proposed method. It will underestimate the tail of the extreme value distribution. The same problem holds for any statistical downscaling method based on resampling. It therefore would be good to test the accuracy for the high return periods, which was not done.

Page 7 - lines 31-32: "rather than a continuous function predicting the climate change factor, few intervals are required ...": Again, this may lead to an approach that is "too deterministic" in view of the higher extremes (underestimation of the higher extremes). Why didn't the authors opt for a continuous function (could be a function with few parameters)? Is the monotonously change (growth) in change factor with increasing intensity interval guaranteed by the method proposed by the authors?

Page 7 - lines 14-15: "The duration of each event is not alternated under impact of climate change, since there is presently no evidence that single events will become shorter or longer in the future": There appears to be an inconsistency in the approach. By changing the parameters of the GPD for the inter-event time, the duration of the dry periods will change. At the same time the authors assume no change in the duration of the wet periods!?

On the clarity of the presentation:

Page 7 - lines 19-32: The method for applying the climatic change factors is unclear and confusing. As indicated in Table 3, the authors applied only change factors for events with return periods of 2, 10 and 100 years. Were only these factors used? Or, were also the seasonal change factors (Table 1) and the change factors in Table 10 used? At which time scale do the authors determine the return period of the event?

On the applicability of the method:

Page 10 - lines 19-20: "Out of the 10,000 realizations of simulated series, 113 (1.1 %)

are accepted": 10000 time series for 32 years and only 113 time series are accepted. Apparently, the stochastic process involves large uncertainties... How many time series would be needed for a 100-year historical time series?

On the accuracy of the method:

Figure 5: Given that the intensities are plotted on a log-scale, the differences between the historical and resampled values are very huge for some durations, esp. for the 10-year return period.

Figure 4: It is unclear what the vertical black lines for "Historical resampled (accepted)" and "Climate projected (accepted)" exactly represent. Does it represent (for the top figure) the +/- standard deviation intervals for the mean annual precipitation depth based on the 10000 series? Their length is in any case very large, esp. given that this is for the annual precipitation depth and for 30-year data. Same figure - vertical black lines for "Climate projected (accepted)": These lines are very large, esp. given that the climate model and RCP uncertainty are not explicitly considered and that the change factors are derived from a relatively small ensemble of 14 RCM runs only.

Figure 4: It is a big surprise that the uncertainty on the d60T10 (vertical black line shown for "Climate projected (accepted)" is relatively small, esp. in comparison with the uncertainty on the annual precipitation depth (top figure).

Table 5: It would be useful to evaluate as well the wet day frequency, and the duration of wet and dry spells. This would also provide more insight in the accuracy of the annual/seasonal precipitation depths. Table 5: Are the mean and standard deviation reported in the table based on all stochastic series (10 000)?

Other comments:

Introduction section - page 3: The authors make an overview of the different existing methods, but the overview is not fully correct. Lines 13-14 tend to indicate that the "delta change method" belongs to the class of "resampling and weather typing meth-

ods" which is not true. The method by Ntegeka et al. (2014) is the quantile perturbation methods which can be classified as an advanced "delta change method". Lines 15-16: "without alternating the temporal variability": this is not fully true. Willems and Vrac (2011) and Ntegeka et al. (2014) also change the number of dry and wet days in the time series.

Another drawback of the paper is that it makes use of the old generation RCMs and greenhouse gas scenarios (SRES; and only 1 SRES scenario was considered: A1B). Since several years, newer generation RCMs and greenhouse gas scenarios are available (EURO-CORDEX, CMIP5 based; RCP scenarios based). However, given that the paper focuses on presenting and testing a new methodology, this does not pose a real problem, but it is a pity that the older generation models and greenhouse gas scenarios were considered. Page 4 - lines 15-16: The authors claim that "there are not currently a sufficient number of simulated regional models of the RCP-scenarios ...": This is not true. The authors consider 14 RCM runs from the ENSEMBLES project, but 14 RCM runs (and even more) are also available in the EURO-CORDEX database (based on the RCP scenarios).

The inter-event times are described by the GPD distribution. It is a surprise that this distribution was selected. The GPD is typically valid and applied for extreme (POT/PDS) values (e.g. rainfall intensities), whereas inter-event times typically follow an exponential or Gamma type of distribution. Have these distributions (exponential, Gamma, two-component exponent) been tested? Page 6 - line 20: "outperformed": how was this evaluated? Page 6 - lines 20-21: "other similar distributions": which ones were tested? Figure 3: I suggest to change the plot where the vertical axis is log-transformed. If -ln(exceedance probability) of ln(return period) is plotted vertically, the deviation from the exponential distribution can be better evaluated (deviation from linearity). The current plot does not allow a proper evaluation of the goodness-of-fit.

Minor comments:

Page 1 - Line 30: "... Global Circulation Models (GCMs) or Regional Climate Models (RCMs) ...": change "or" to "and/or"; approaches exist where climate factors are derived and applied from both GCMs and RCMs

Page 2 - line 5: change "large historical records" to "long historical records"

Page 2 - line 7: change "various types of statistical downscaling" to "various types of statistical downscaling assumptions and methods"

Page 3 - line 2: use a better word for "likely"

Page 3 - line 3: change "in a finer temporal resolution" to "at a finer temporal resolution"

Page 3 - line 4: change "1 to 10 minute" to "1 to 10 minutes"

Page 3 - line 5: change "Since, interested ..." to "Since we are interested ..."

Page 3 - line 6: change "is rejected as ..." to "is rejected here as ..."

Page 4 - lines 7-8: These two lines do not fit with this section about "Data".

Page 4 - line 25: It is unclear at this stage what exactly is meant by "events": number of events, or rainfall intensity of these events?

Page 5 - line 3: change "includes large uncertainties, it is ..." to "involve large uncertainties. It is ..."

Page 5 - line 6: change "the network Water Pollution Committee of ..." to "the monitoring network of the Water Pollution Committee (WPC) of ..."

Page 5 - line 21: change "assumed not to contain climate change" to "assumed to be stationary in terms of climate properties"

Page 5 - line 23: change "in two sections the resampling of ..." to "in two sections: the resampling of ..."

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., doi:10.5194/hess-2017-71, 2017.