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Hydrology and Earth System Sciences
Discussions

Interactive comment on "Formulating and testing a method for perturbing precipitation time series to reflect anticipated climatic changes" *by* Hjalte Jomo Danielsen Sørup et al.

Anonymous Referee #1

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General comments

In the paper the authors propose a method for perturbation of observed sub-daily precipitation time series in order to result in the same changes as given by a climate change scenario. The method is simple, i.e. the observed rainfall events are classified into several (eight in the paper) states and each state is perturbed by its specific change factor. Further the method assumes that extreme precipitation occurs only during summer (but can be easily modified to allow for extremes in different seasons). The method is evaluated on precipitation from 10 stations across Denmark and climate change scenarios of rainfall extremes and seasonal precipitation.

The method can be potentially used in many practical applications, the paper is in

general well written, yet there are some parts needing clarification. In addition I believe the paper could benefit from discussion of alternative approaches, which is not present at all.

Specific comments

1. Though the idea is very simple, the presentation is rather formal and sometimes difficult to follow. I understand that the authors like to present their method correctly, however, I wonder whether it would not be clearer to the reader to avoid formal definition with state spaces, semi-Markov systems, discrete-time counting processes etc. especially when there is no explicit use made from it and the whole trick is in class-based multiplication.

2. The difficult part in the application of the proposed methodology is the identification of event state. This is because there is a mismatch between event definition (based on minimum inter-event time) and definition of climate change scenario (based on maximum intensity). Apparently a single event may include precipitation with different return levels at different time scales. Authors therefore test several approaches to determine the class of the event and evaluate the skill of each variant. Since the determination of event return period is one of the key parts of the study I suggest to formulate the problem more explicitly. As the paper reads now, it is somewhat hidden.

3. I am quite confused with eq. 8, its application in figures 3 and 4, tables 6 and 7 and related text: eq. 8 defines the average percentwise difference between the perturbed return levels $z*$ and their expected values z as $\Phi = 100(1 - -z * /z)$, resulting in 0 if there is perfect fit, negative values if the perturbed changes are larger than expected and positive values otherwise. In contrast to this, authors state in description of fig. 3 showing Φ against duration (p. 11, l. 20) that "100

4. Authors are trying to determine the state of an event on the basis of the return level of precipitation at several (7?) time-scales. Are there (/have authors tried) any other options? Could, for instance, the event change factor be derived from some weighted

combination of relevant factors similarly as in eq.11? Or would not be in general more feasible to define climate change scenarios on the basis of the changes in rain event characteristics (see e.g. Svoboda et al., 2016a, b)?

5. The change factors in Tab. 3 are duration-independent, is it reasonable assumption? Are the changes (after perturbing the observed data) also independent on duration? Could you provide some information, how the values presented in Tab. 3 relate to CORDEX projections?

6. Authors are averaging seasonal changes of RCP2.6 ("low change") and RCP8.5 ("high change") in order to get "mean change" scenario and state that this is in order to correspond to the "average A1B emission scenario". While the A1B was the most frequently used scenario, it is not clear, why it should be average scenario. In fact, e.g. considering the radiative forcing, the A1B scenario is somewhere close to the upper third between RCP2.6 and RCP8.5 in the end of the 21st century. Please find different arguments for the setup of your experiment.

Technical corrections

p. 1, l. 25 – "Climate change impact water management" - change to "Climate change impacts water management" p. 2, l. 8 – delete "sought" between "often" and "solved" p. 3, l. 5 – please define || in |E| p. 3, l. 17 – remove "the" between "that" and "there" p. 5, l. 8 – insert "events" between "between“ and "of" p. 5, l. 13 – change "is" to "are" in "extremes is identified" p. 6, l. 26-29 – please try to write the sentence in standard way p. 7, l. 3 – please specify, how $z*$ is calculated p. 8, l. 3 – please insert "in" between "used" and "this" p. 8, l. 8 – is the reference to submitted paper (from 2009) correct? p. 10, point D – please rephrase

References:

Svoboda, V. et al. (2016a) Projected changes of rainfall event characteristics for the Czech Republic. Journal of Hydrology and Hydromechanics, 64(4), DOI: 10.1515/johh-

2016-0036

Svoboda, V et al. (2016b) Characteristics of rainfall events in RCM simulations for the Czech Republic. Hydrology and Earth System Sciences Discussions, in revision

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