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Hydrology and Earth System Sciences
Discussions

Interactive comment on "Process-Based Flood Frequency Analysis in an Agricultural Watershed Exhibiting Nonstationary Flood Seasonality" *by* Guo Yu et al.

Anonymous Referee #3

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General comments:

The authors apply a stochastic rainfall generator to provide input for derived flood frequency analyses (DFFA). The rainfall generator uses the storm transposition technique (SST) with the advantage to trade space for time to compile a large enough sample of rainfall events. They combine a continuous hydrologic simulation using observed rainfall time series with an event based simulation using stochastic rainfall events. The former provides realistic initial conditions for the event based runs with the stochastic data. The authors conclude that a) short rainfall observation period can provide reliable flood frequency estimates using SST for contemporary conditions, that b) the

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non-stationarity in seasonality can be handled well and that c) inadequate model representations lead to errors.

This combination of continuous and event based modelling is a quite novel idea and provides a flexible framework for DFFA. The application of the methods seems sound, the research is done systematically and the paper reads quite well. However, I do have some concerns regarding the selection of the hydrological model, the selection of two precipitation data sets and some of the conclusions. I will detail these below in the major comments, followed by some minor comments. The paper is worth to be published after major revision.

Major comments:

1) The selection of the lumped HBV model is not plausible to me, especially given that a) the snow routine is not working and b) the high resolution Stage IV rainfall data cannot be utilized by this lumped model.

2) The application of two rainfall data sets is not plausible and also quite confusing for the reader since a) the Stage IV rainfall data observation period (2002-2016) is covered also by the CPC rainfall data observation period (1948-2016), b) a lumped hydrological model cannot really benefit from high resolution rainfall data (see 1) and c) the hydrological simulation results for both rainfall data sets seem to be very similar (as the authors state on page 16, lines 12-13). I would recommend to do all the simulations with the CPC rainfall if the hydrological model is not changed. If a more suitable hydrological model is selected the two data sets might be kept in the study but the differences in hydrological response using the two data sets for the same time period (2002-2016) need also to be demonstrated and discussed.

3) The application of a model without snow routine for a catchment with significant snow processes doesn't make sense to me. This way the advantage of process based flood frequency analysis (FFA) is partly lost; obtaining the correct hydrological response for the wrong reason is not satisfying. I am not convinced that the non-stationarity in

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seasonality is only due to changed soil moisture conditions from rainfall. Temporarily shifted snow dynamics might play a role as well.

4) I would be careful with the conclusion, that only with this DFFA method non-stationarity in seasonality can be handled well. Also, non-stationary seasonal FFA approaches are available employing mixed distributions for getting final design values. This needs to be briefly discussed.

5) This combination of continuous and event based modelling is a good idea. However, there is an important limitation which should at least be mentioned. The framework provides only one possible realisation of initial conditions. Nature is more variable. Stochastic rainfall models producing continuous rainfall don't pose this limitation on hydrology.

Minor comments:

1. Page 2, line 4: This sentence is confusing. I am assuming you mean '. . .. statistical analysis of observed streamflow, design storms !and! continuous simulation !or! other so called "derived" or "process based" methods.'

2. Page 4, lines 15-17: This sentence seems not to be complete.

3. Page 10, steps 3 and 4: I would stress that the 30 storms per year are randomly transposed over the domain, only sometimes hitting the catchment and sometimes not. They are not all transposed on the catchment, which would lead to an overestimation of the flood frequency. The reader not familiar with your method might misunderstand that.

4. Page 11, lines 8-9: The selection of the largest event per year for FFA might also be mis-understood. Here, it also needs to be considered that many of the 30 events do not produce any flood if they do not hit the catchment (see comment 3).

5. Page 14: line 2: Should it not be ". . . but overestimates for pe<0.3 . . ."

6. Fig. 5: Why did you select the period 1990 – 2016 and not 1980 or 1970 as starting year? This needs to be justified.

7. Fig. 5: I would also add a statistical analysis (Bull 17.b) for the contemporary period (1990-2016) for comparison.

8. Fig. 6: There is no description neither in legend nor in figure caption about the source of the two figures. I assume they stem from different precipitation data sets?

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