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Interactive comment on "A classification algorithm for selective dynamical downscaling of precipitation extremes" *by* Edmund P. Meredith et al.

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The manuscript presents a very interesting contribution to combine dynamical downscaling approaches with a statistical classification procedure in order to save computational costs. The approach aims at extreme precipitation events and is restricting the dynamical downscaling to those days, in which the probability of extreme events is enhanced. For this reason, the concept of Potential Extreme Days (PEDs) is introduced, which is based on a classification approach of synoptic circulation patterns. The manuscript is well written and understandable in general. The procedure is scientifically sound and clearly described. However, there are concerns in terms of its

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[Discussion paper]

"applicability" and "usefulness". In order to deserve publication, the following aspects need to be considered and elaborated.

My main points center around the efforts required to restrict the dynamical downscaling (in convection-permitting resolution) to selected events only and the credibility of the results obtained:

- First, I do not see clearly a potential application behind (at least it is not clearly described in the manuscript). Please elaborate clearly which kind of research and practical application can be considered with this in hydrological modelling.

- In addition, it might be difficult for hydrological models to deal with non-continuous data (time series) focusing on the extreme events only. In particular, issues may arise in calibration/validation of such process-based hydrological models based on extreme precipitation events only, i.e. the credibility might be limited if these models are calibrated based on extremes exclusively.

- The efforts of the classification to identify the PEDs are high. The results depend on the selected domain, number of clusters, selected predictors, selected threshold values, etc. It seems that this is not as straightforward and to be implemented as described in the manuscript. For instance, a predictor screening must be undertaken if the approach is transferred to other regions. Please elaborate and discuss further.

- From regional climate modelling perspectives, I have concerns in selecting single days only instead of performing continuous simulations. I am referring to the initial conditions, when a new simulation is initiated. It is well-known that these are rather imperfect. This is less problematic for the atmospheric compartment of the RCMs (because of the relatively short memory), however, the terrestrial compartments such as e.g. soil moisture need a certain time to reach equilibrium. For this reason, spin-up periods of several days to weeks might be necessary, which limits the benefit of the presented approach tremendously. In addition to that, time requirements to set-up and submit and control multiple short-term simulations are high.

- The application of the classification for the past is well justified, however, it might be very limited for the future ("stationarity" assumption). As correctly mentioned, it can be expected that certain extremal circulation patterns change or other patterns might become more important for extreme events. This is more likely for periods in the far future, e.g. the time slice towards the end of this century, as used in this study. For periods in the far future, I would trust more to the pure dynamical downscaling.

Another concern is the validation of the identified PEDs (section 3.2). I would suggest to check not only the occurrence frequencies, but also the timing of the extremes using the reanalyses data. These can be checked with the timing of the extremes based on station data for the catchment. The frequency is not a good performance criterion to my opinion.

Minor issues:

- I suggest to leave out the code fraction (page 8)

- Section 3.3 (Page 13): The authors claim that they perform a performance testing on continuous simulations, but the tests are restricted to the summer periods. I also understood that the RCM downscaling is done only for the summer periods, but maybe I misunderstood this. Anyway, I think it is confusing and the term "continuos" should be omitted.

- Please check the brackets given after high-resolution data (abstract, line 1, introduction, lines 21 and 23; Page 18, line 2, etc.)