

## ***Interactive comment on “Return levels of sub-daily extreme precipitation over Europe” by Benjamin Poschlod et al.***

**Anonymous Referee #1**

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The authors propose to use simulations of a climate model, in this case the CRCM, to obtain sub-daily precipitation series, that is, the frequency of extreme precipitation events. With these series the authors intend to obtain the 10-years return periods, for Europe (16 countries), in the period 1980-2009. The authors think that using model outputs will surpass the dispersion of observation data, the irregular spatial distribution and the difficulty to obtain publicly available data. The proposed method consists of an ensemble with 50 runs of the same model, with a resolution of 12.5 km, to estimate the frequency of extreme precipitation events in 30 years, corresponding to 1500 years of precipitation data. The model is validated with observations comparing the simulated return periods with the observed return periods (from compiled and homogenized database). The authors claim that CRCM5 return periods can reproduce the

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spatial pattern of extreme precipitation for all sub-daily to daily scales. The intensity of precipitation observed is in the interval of simulated precipitation for more than 50% of the area per time interval. The results present a negative (positive) bias of precipitation per hour (daily). The manuscript is well structured, easy to read and interpret, but there are some more confusing parts than others. The objectives fall within the scope of the publication. The methods are adequate, and the main conclusions fit the methodology, however there are some points that can benefit from further explanations. See the comments section for a more detailed explanation. In my opinion, the manuscript is suitable for publication after clarifying of some parts of the text (major review).

Major Comments Numerical models present important limitations impacting the results, including: an incomplete understanding of the climate system, an imperfect ability to transform our knowledge into accurate mathematical equations, the limited power of computers, the models' inability to reproduce important atmospheric phenomena, and inaccurate representations of the complex natural interconnections. In addition, it is commonly recognized that numerical models present recurrent spurious precipitation from the numerical processes. The authors present a very good discussion in section 5. Another issue arises from converting station data (point point) to grid data. Given all that has been stated, what is your degree of confidence in the validation of the model and your results? In the manuscript are presented elements that do not appear referenced in the text. For example, Table 3, Figure 5, and Figure 6.

Minor Comments L 100 and from this line forward. The acronym CRCM-LE appears. What is LE? Each word or phrase should have only one meaning, and should be used consistently throughout the documentation. L123 – size of the window? L275- L290 This paragraph is confusing for the reader. Please clarify what Figure 1 shows: if the medians of the sums (L283) if the sums (L279). We are directed to a similar figure - Berg (2009) - referring to summer precipitation. Please clarify whether in Figure 1 we are analyzing summer or another season. In the caption of Figure 1 include the clarifications made, to help the reader in interpreting the figure more easily. L 291-

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See the comments in the previous paragraph. L 300 " From this line to the end of the paragraph. These text is confusing and needs clarification. First, it is necessary that the authors clearly identify which figures are under analysis. This block of text is close to imperceptible without the clear identification of the figures. Analyze the figures in the same order as they are presented (Figure 2, text; Figure 3, text, and so on). L 305. what is the figure under discussion? Figure 4? In relation to Figure 4, the authors explain well the deviation in Norway and the Netherlands but what about southern europe? Table 1 ???? Figure 5/6 is presented, but the analysis is missing. Figure 2. This is not Europe; this is some regions of Europe.

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