

## ***Interactive comment on “Weather extremes over Europe under 1.5 °C and 2.0 °C global warming from HAPPI regional climate ensemble simulations” by Kevin Sieck et al.***

### **Anonymous Referee #2**

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The paper investigates the impacts of 1.5°C and 2.0°C global warming on temperature and precipitation extremes over Europe. With this aim, the authors use an ensemble of dynamically downscaled simulations from the HAPPI project. The analysis focusses on four climate indices from ETCCDI.

The paper covers an interesting and relevant topic that could be a useful addition to the literature. Unfortunately, several aspects in terms of methods, analyses and results are unclear and need further explanation. In fact, the manuscript needs a lot of improvement in order to increase the clarity and readability. Please refer to the main points and specific comments below. In particular, the authors do not provide enough convincing

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evidence to prove the benefits of their method. Nevertheless, I suppose that there are sufficient arguments for it. Therefore, I suggest a major revision for this manuscript.

## MAIN POINTS

1) Text: The whole manuscript needs a thorough proofreading and language check. Some sentences are incomprehensible; others are just too long and should be split in two to enhance readability. In addition, several phrases/descriptions are not consistent throughout the paper and therefore may confuse the reader. Please also refer to specific comments below.

2) Figures: The figures and their captions need some general improvement.

2a) Why are some land areas in Figures 2-4 grey?

2b) You should use the same format for all spatial plots, e.g. \* One colour bar including units \* Label individual plots \* Same domain \* Add more information in the figure itself (warming level, ensemble, ...).

2c) Figure 6: The bars are difficult to distinguish. Non-overlapping bars might be preferable. The distributions for both GCMs are very different. For NorESM, they are quite narrow, while they are much broader for ECHAM6. What are the implications of such large discrepancies? Please discuss. Why do you measure consecutive dry days in weeks?

3) Is the main objective of this paper to present a new data set or to present mainly new results? Either way, both are not properly presented and need more details.

4) Missing details/explanations: Some points (especially in the Methods section) need a better/more detailed explanation to be understandable. Your descriptions are too short and raise more questions than they answer.

4a) L58/59: Why did you use 20 years for the pre-industrial period, but only 10 years for all other simulations? From a climatological perspective, 10 years are rather short

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to enable a climatological view.

4b) L58: Which period did you use for the future climate simulations? There are a few references given, but it should be specifically described which methods have been used here and how they are applied.

4c) Did you compare the simulation for a current decade to observations and/or reanalyses to check how realistic they are? This would be very important.

4d) L59-61: How are the warming levels (1.5 and 2.0) calculated? Did you use RCP2.6 for 1.5° warming and RCP4.5 for 2.0°C warming?

4e) L73: The regional ensemble consists of 125 members, correct?

4f) L122-124: How exactly did you define CDD? Why did you calculate the CDD for the PRUDENCE regions and not on grid-point basis as the other indices? Is CDD the maximum number per year or over the 10-year period?

4g) L130-145: Why did you choose different statistical methods to investigate the individual climate indices?

4h) L130-145: The application of the significance measures is unclear, please rewrite. There are two methods used for two different parameters (ATG28 and RX5day). There seems to be some confusion on what is used for CDD (L143 says CDD similar to ATG28, but the method for CDD seems to be similar to RX5day, namely Mann-Whitney). No information is given for RI50yr. Anyway, the paper provides only information on the significant changes for CDD, but not for the other parameters. This should be remedied.

4i) Why do you think that all differences between the two ensembles are due to the different ensemble sizes (e.g. L172-175)? They could also result from the driving GCMs. It might be useful to include the results for the smaller sub-sample of ECHAM6 that you mentioned in the text.

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4j) Table 1: Partly, the smaller ensemble (NorESM) generates more significant results. How does this relate to the hypothesis that a larger ensemble size is beneficial?

4k) Compare your results to previous studies (see interactive comment by Laura Suarez-Gutierrez for more details).

4l) The authors should not oversell their results (or should argue more convincingly). E.g. Impact of the ATG28 increase (L241-246): What does such a change really mean w.r.t health issues? I assume that the number of days above the threshold is already high around the Mediterranean? Does a change of O(10days) drastically change the base level and/or the potential health impacts in this region? Furthermore, is a resolution of 50km sufficient to derive change estimates for local adaptation measures? The authors do not provide enough convincing evidence for the benefits of their method. Nevertheless, I suppose that there are sufficient arguments for it, but this should be better phrased.

#### SPECIFIC COMMENTS

Data set, dataset or data-set?

NOResm or NorESM?

L17: “measures at a” – Delete “a”.

L20-22: This sentence is incomprehensible, especially the first part.

L25: “current generation global climate simulations” → “current generation of global climate simulations”

L45-47: Please rephrase sentence.

L55-56: You cannot downscale an RCM using GCM simulations.

L59: What does “CMIP5 mean SST anomaly” actually mean? All CMIP5 models and members, or just some, only ECHAM6/NorESM? Is there a reference?

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L66/67: “from the core domain defined by CORDEX the entire domain has 121x129 grid boxes” – Please reword.

L94: “recommend” → “recommended”

L97-100: You defined an abbreviation for each climate index. Use them more consequently throughout the text.

L99: “precipitation intensity at the 50-yr return period” – Do you mean precipitation intensity with a 50-yr return period? Please use a consistent explanation throughout the text.

L111: What do you mean with “annual sum maximum”?

L121: “between 100 and 100 years” – Please correct.

L130: What do you mean with “historical”? Pre-industrial or current? Same in L141, L205, L215.

L132: “Only areas with more than 20 non-zero data points” – Isn’t the calculation done at every single grid point?

L152: “in the median around the Mediterranean” – Please reword.

L154: Is a spatial resolution of  $0.44^\circ$  high enough to resolve complex topography? What about EUR-11?

L176: “interior of the simulation domain” – Please reword.

L190-191: Please reword sentence.

L204: You never defined/explained p-values.

L204: “Both the distributions  $1.5^\circ\text{C}$  and  $2.0^\circ\text{C}$ ” – Please reword.

L215: “shift towards longer periods of dry days” – This depends on your definition of CDD. If CDD is the maximum number of consecutive dry days, your results only show

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that the longest dry period is getting longer in a warmer climate. That does not mean that all dry periods will be longer.

L216: “the Alps and Eastern European region” → “the Alps and Eastern Europe”

L218: “suffer from more frequent and longer drought periods” – Again, this depends on your definition of CDD. If you used the common one (CDD being the length of the longest dry period), you cannot say anything about the frequency of dry periods.

L222: “adaption” should be “adaptation”

Figure 6: Use ECHAM6 instead of ECHAM.

L235: “10 x 100 years” → “100 x 10 years”

L247: “RX5day” → “(RX5day)”

L251: “such precipitation extremes” → “such as precipitation extremes”

L263: “historically similar” – Strange wording.

L263-264: “pre-industrial period” – I thought you were calculating differences between future and current climate and not between future and pre-industrial?

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