Author's response regarding the manuscript "Characteristics of precipitation extremes over the Nordic region: added value of convection-permitting modeling "

We thank both reviewers for their comments and suggestions (in blue). Please find our detailed point-by-point responses below (in black).

In addition, we have clarified and corrected some sentences. The list of changes (outside the reviewer's comments) can be found at the end of this document. The page and line numbers refer to the ones used in the revised track-changes version.

Anonymous Referee #1

General remark:

- The paper contains a lot of information and sometimes it is a bit challenging to follow, but this is mainly due to the variety of metrics and data sets used in this study.
- I recommend to accept the paper, if the ambiguous formulation mentioned under specific comment is taken care of.

We acknowledge that the various metrics and datasets can be difficult to follow, but we see that each metric and dataset is relevant for this study, and thus, we prefer to keep them as is. However, we have emphasized the use of various datasets in the abstract:

"The HCLIM simulations are evaluated against a unique and comprehensive set of gridded and in situ observations for the warm season from April to September regarding their ability to reproduce sub-daily and daily heavy precipitation statistics across the Nordic region."

We have taken care of the specific comment as indicated below.

Specific comment:

- In line 97 the "analyzed sub-domain" is discussed. Does this refer to HCLIM3? Maybe this can be reformulated to make it more clear.

Thank you for pointing this out, this could indeed be formulated more clearly. We have added the sub-domain borders in Figure 1 and clarified this in the text.

Anonymous Referee #2

Review on Médus et al: Characteristics of precipitation extremes over the Nordic region: added value of convection-permitting modelling

The paper addresses the added value of convection permitting simulations for the representation of daily and hourly precipitation extremes over complex terrain.

The manuscript is well written. It provides many useful aspects to the topic of the added value of simulations with an explicit treatment of deep convection. Very valuable is the comprehensive comparison of the simulations with various observation and reanalysis data sets and their thoroughly discussion of their characteristics and limitations. The results fit well to the findings of other papers in that field. Their conclusions are well supported by the material and not overstated.

I recommend the paper for publication.

We thank the reviewer for the positive review.

Minor point:

Line 420: The reference to Figure S5 should be correctly to Figure S4 c,d

Thank you for spotting this. We have changed the reference accordingly.

List of other minor changes

- P2 L48 & P2 L54: explicit convection → explicit deep convection

- P2 L64 & P3 L66: 20-year-long → 21-year-long

- P3 L80: Termonia et al. 2018 → Termonia et al., 2018

- P3 L83: 12 km grid resolution → 12 km horizontal grid resolution

- P3 L84: Bengtsson et al., 2017; Seity et al., 2011 → Seity et al., 2011; Bengtsson et al., 2017

- P3 L85: in HCLIM → in HCLIM38

- P4 L115: ...data sets E-OBS and Nordic Gridded Climate Dataset (NGCD) → ...datasets, E-OBS and Nordic Gridded Climate Dataset (NGCD),

- P4 L117: ERA5 reanalysis → the ERA5 reanalysis dataset

- P5 L149: 1km → 1 km

- P6 L157: in-situ → in situ

- P6 L179: compared to daily datasets, such as E-OBS → compared to their corresponding daily records

- P6 L182: removed: "further"

- P6 L187: the precipitation → precipitation

- P6 L187: Estimates → The estimates

- P7 L197: tens of kilometers or lower → tens of kilometers or below

- P7 L200: when → if

- P7 L201: Figure S1b shows the locations of the stations that were available during the entire period in question... → Figure S1b shows the locations of the stations that were used for geographic sampling and that were available during the entire period in question…

- P7 L214: (2018) → (2020)

- P8 L226: from 1st of April to 30th of September → from the 1st of April to the 30th of September

- P8 L239: General Extreme Value → generalized extreme value

- P9 L265: daily extreme precipitation → daily heavy precipitation

- P9 L275: The average bias over the domain → The average bias of R20mm over the domain

- P10 L276: Negative biases near the coastal regions → Negative biases of both $p99.9_{avg}$ and R20mm near the coastal regions

- P10 L279: extreme precipitation cases → extreme precipitation events

- A clarification added to the caption of Fig. 2: "*The NGCD and HCLIM data were remapped onto E-OBS's grid prior to the analysis. Fldmean represents the average bias over the domain, and the values in brackets show the average bias over the NGCD domain.*"

- P10 L291: 95th and 99.9th percentiles → the 95th and 99.9th percentiles

- P10 L296: 3–11 % → 3–13 % (based on Table S1)

- A correction to the caption of Fig. 3: Q3+3IQR → Q3+1.5IQR

- P11 L316: 3–24 % → 4–24 % (based on Table S1)

- P12 L321: 22–200 % → 22–206 % (based on Table S1)

- P12 L338: Lundquist et al. (2020) → Lundquist et al. (2019)

- P12 L347: modeled and observed data → modeled and observed return values

- P13 L359: the model → this model setup

- P14 L368: an underestimation of -5.8 % → an underestimation of 6 % (rounding and removing the minus sign)

- P14 L370: around 50 % → around 60 % (based on Table S2)

- P14 L372: for values → for hourly values

- A correction to the caption of Fig. 5: Sampled → 'Sampled'

- P15 L393: selecting observational grid cells with stations → selecting only grid cells with stations

- P15 L406: the KLIMAGRID data → the observational Klimagrid data

- P15 L407: Fig. S4 → Fig. S4 b

- P16 L423: Moved the place of one sentence: "*While HCLIM12 does not show any clear peaks, ERA5 shows too early peaks in Sweden and Norway.*"

- P16 L426: ERA5 also underestimates → HCLIM12 and ERA5 also underestimate

- P16 L443: The mean bias decreases → The mean bias in HCLIM3 decreases

- P16 L444: added: (Table S2)

- P16 L447: KLIMAGRID → Klimagrid

- P17 L450: 51–62 % → 48–62 % (based on Table S2)

- P17 L466: ... in Norway. The model produces… → in Norway, while the model produces

- P17 L471: removed: ", in review"

- P18 L484: a 20 year → a 21 year

- P18 L485: 20 summers → 21 summers

- P18 L487: in → of

- A clarification added to the caption of Fig. 9: "*'Sampled' refers to the results with geographic sampling.*"

- P20 L509: extreme precipitation → heavy and extreme precipitation

- P20 L509: 20-year long → 21-year-long

- P20 L537: the geographic sampling → the sampling

- P21 L546: explicitly simulated convection → explicitly simulated deep convection

- P21 L549: high-resolution climate models → high-resolution convection-permitting climate models

- P21 L551: northern Europe → Northern Europe

- P21 L571: seasonal → seasonality

- P26 L708: 2017 → 2019

- P26 L731: 2020 → 2019