Author reply to RC2 (wcd-2022-11)

Major Comment

The main aim of this work is the evaluation of COSMO-CLM simulations at different resolutions, to assess the scale-dependency of thermodynamical processes influencing extreme precipitation. This topic is very interesting, since the assessment of very high-resolution climate simulation is a challenging area in the climate community. However, before I can recommend publication, there are some issues that must be addressed, mainly related to formal aspects and not to the scientific content, which is relevant.

As a general comment, in some points the English style is poor and must be improved, especially from Section 4 onward. I suggest a general review by a qualified in English support officer.

We thank the reviewer for the valuable comments and suggestions to improve the manuscript. We acknowledge that the English language can be improved we will revise the language carefully.

From the title, the reader would expect that general conclusions about regional modelling have been drawn but then, moving throughout the text, he realizes that only one regional model has been considered. As the authors properly say (line 525), the present conclusions cannot be generalized to other regional models. So, I suggest to add "COSMO-CLM" in the title. Moreover, the RCM used (i.e. COSMO) is neither specified in the introduction. Please add a few descriptive lines about this model in the Introduction.

We will include COSMO CLM in the title. In addition, we will compare our findings with other results from the FPS Convection to draw more generalised conclusions for some aspects. Also the COSMO-CLM model will be presented in the description.

The captions of many figures are too long and descriptive. I suggest to shorten them and to explain in the caption only what is really shown in the figures, moving the other considerations to the text. For example, in the caption of Figure 10, the sentence "The precipitation days are selected as those over one standard deviation of the Principal Components for EOF-1 shown in Fig. 9" can be removed and included in the main text.

We agree with the reviewer and follow the suggestion.

Regarding the conclusions, I think that bullets a, b and c are not so relevant and can be merged into a single bullet.

Following remarks from other reviewers, the conclusions will be revised. We will take this remark into consideration. Bullets a, b and c will be merged into one.

I would remove Table 1 and 2, since all the information contained are already provided in the text.

We thank the reviewer for this suggestion and agree that the observational datasets and our simulations are described in the text. However, we believe Tables 1 and 2 are a good summary for those readers that want to capture information at first glance and a good visual summary of the description in the text.

Moreover, some reviewers focused on this table for relevant information and we would like to keep them as we believe they can be useful.

Specific comments

Line 57: Probably "of" is missing between "development" and "Convection"

Corrected.

Lines 90-93: I would avoid using direct questions in an Introduction

We agree. They will be rephrased as aims of the text.

Line 94: I suggest to add: "This paper is organized as follows:", before of "In Sect. 2".

We change it accordingly.

Line 115: I do not understand the need of comparing HYRAS with ERA5 here, since ERA5 is mentioned here for the first time. If you want to keep this sentence, please add more details about ERA5 and a proper reference.

The reviewer is correct and we follow the suggestions.

Line 120: Probably "was" is missing between "MSWEP" and "obtained"

Corrected.

Line 125: change "high" with "higher"

Corrected.

Line 128: "distance of 250 km". Distance from what?

Distance between radiosonde launching stations. It has been corrected.

Line 135 and 283: "recent". Since the period starts in 1961, it is not so recent. Please use another adjective.

We agree. We now explicitly mention the considered period.

Line 154: I do not think that you can talk of "small inconsistencies" between the simulations, as the domains are different, the forcing are different, and the resolutions are different.

We re-write this part and better explain how the high-resolution simulations are used in this specific context. Reviewer 1 also pointed out that these cannot be called "small inconsistencies.

Line 282-283: It is useless to write the whole name of the model again here. Use only COSMO-CLM.

The reviewer is correct. We change it.

Line 293-295: "This not imply…compared to RCM". This sentence is not clear, probably some commas are missing. If I well understand, you claim that CPM performs better than RCM according with literature study. Anyway, your conclusions must be based on the present results and not on literature ones.

We agree with the reviewer. We will only describe our own results here. Our claim that CPM performs better than RCM is further supported in Sect. 5.1 where we validate specific events using two metrics.

Line 305-306: "The improvement…in a climatology". There is something wrong in the English.

We will rephrase this sentence. Now it reads:

"The improvement shown by CPM with respect to RCM shows the added value of high-resolution in detecting extreme precipitation events in a climatology".

Line 307: change "show" with "shows".

Corrected.

Line 309: "shows"... "showing"…. Avoid using the verb "show" too many times

We follow this suggestion.

Line 316: "al" ?

Corrected.

Line 334-335: what do you mean "for its part" ?

Corrected.

Line 339: remove comma after 2007.

Corrected.

Line 341: change "larg" with "large"

Corrected.

Line 363: Avoid using the word "bias" twice

We follow this suggestion.

Line 363: The bias is 0.5° also below 925 hPa. Please rephrase.

We have rephrased this sentence.

Line 364: "close to 2°". The bias is larger than 2° below 700 hPa.

We will change the wording and shorten the caption.

Lines 367-371: This paragraph (and Figure 8) is quite confusing and must be rephrased. It is not clear if you are talking of spatially averaged or temporal averaged bias. Moreover, in the caption of Figure 8, explain better what is shown.

We will follow the suggestion and revise the pararagraph and the caption of Fig. 8. In any case we are referring to temporally averaged bias. It is the mean bias of all events being validated.

Line 398-399: probably the verb "explaining" is not correct. Moreover, there is a closed bracket after CPM that was never open.

We will remove the bracket and rephrase the sentence.

Figure 9. The caption is not clear. Explain clearly what is shown in each panel (a, b… etc).

We will revise the caption. Moreover, following reviewer 1 comments' we will revise this section as we will try to fine-tune the method of EOFs and principal components.

Lines 403-406. It is not clear why red color is referred to CPM and blue to RCM. Probably these maps show the difference between CPM and RCM, but please explain better what is shown and what are you describing.

The reviewer is correct that the difference is shown (as mentioned in line 403). We will revise the text to clarify it better.

Line 411-412: "low terrain"? do you mean "low heights"?

Correct. We will change it, accordingly. We refer to low altitude terrain.

Line 418: "to be the main precursors of the differences". This sentence is stand-alone and I do not understand what you mean.

We agree that the wording of the sentence is not clear. Also, by suggestion of Reviewer 1 we are reviewing this aspect for our conclusions. The message of this paragraph is that we believe that the precipitation differences come mainly from the different representation of the dynamic convective processes, e.g., intensification of vertical updraughts and larger triggering of convective cells.

We will rephrase the paragraph to better clarify the findings.

Line 423: The concept of "preconditioning" is used in numerical analysis. I understand what you mean in this context, but I recommend to use and alternative term here (e.g. pre-existing).

We will rephrase the sentence. We meant that the differences of the environmental conditions prior to the event. We change it to pre-existing conditions.

Line 428: "in compared"? Probably "in" must be removed.

Corrected.

Line 431: Explain also here what "theta" represents.

The parameter "Equivalent Potential Temperature at 850 hPa" was introduced in line 429, but not connected to the symbol. We change that.

Lines 459-460: "The analysis… processes". The English style is poor.

We will rephrase the sentence.

Line 467-468: Again, I believe that "preconditioned" is not the appropriate verb.

We will revise the sentence to clarify it. We change it for pre-existing conditions.

Line 471: change "differences" with "different".

Corrected.

Line 471: "RCM evaporates more moisture"? RCM is a numerical model and does not evaporate anything.

The reviewer is of course correct and we will change this wording.

Line 511: In a similar manner, RCM does not emit sensible heat flux.

We will change it here, as well.