

Geosci. Model Dev. Discuss., author comment AC1
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Reply on RC1

João António Martins Careto et al.

Author comment on "Added value of EURO-CORDEX high-resolution downscaling over the Iberian Peninsula revisited – Part 2: Max and min temperature" by João António Martins Careto et al., Geosci. Model Dev. Discuss., <https://doi.org/10.5194/gmd-2021-208-AC1>, 2021

General comments to Referee #1

AC: We are very grateful for your kind and positive comments and suggestions. We appreciate all of them. We sincerely think that your revision allowed an overall improvement of the manuscript

RC1: This study presents a comprehensive assessment about the added value of 2m minimum and maximum temperature dynamically downscaled regional climate model (RCM) simulations from EURO-CORDEX initiative. To quantify and spatially characterize RCMs performance compared to the corresponding lower-resolution global scale driving fields, Authors take advantage of a distribution-based metric (DAV) previously introduced and presented in Soares and Cardoso (2018). The evaluation regards all the available ERA- Interim reanalysis and global climate models (GCM) driven RCM simulations corresponding to the Hindcast (1989-2009) and Historical (1971-2005) experiments respectively. All the simulations considered refer to the Iberian Peninsula domain and an observational-based Iberian Gridded Dataset (IGD).

As already mentioned for the precipitation-based part-I of the study, the present research involves a relevant research question namely if and eventually at what extent downscaled simulations can improve the large-scale forcing signal. This represents a very important point as RCMs are extensively used by a broad range of end users belonging to climate impacts and climate services communities.

The main value of the study is to consider the largest dataset of RCMs available and to consider a simple and straightforward metric identifying RCMs potential added value over the entire statistical distribution.

It follows some line-specific, minor remarks:

RC1: Line 33-35. This statement is not clear. Please rephrase.

AC: Corrected. We merged these two sentences to: "Over the years, with the increasing public attention and motivated by the Intergovernmental Panel on Climate Change (IPCC),

tools were developed for assessing past, present and future climate conditions, the so-called Global Climate Models (GCM).”.

RC1: Line 46. I would remove “or”.

AC: We thank the reviewer for the suggestion. However, we decided to change “or” to “and” as we mean the variables in an individual way and also the underlying processes.

RC1: Line 266. I would use “largest differences” instead of “most range”.

AC: We thank the reviewer for the suggestion and changed accordingly.

RC1: Line 301. “span” instead of “spam”.

AC: Corrected.

RC1: Line 301. The statement: “all PDFs still reveal a close representation to each other” is not clear. Do they present smaller variability across different RCMs?

AC: We thank the reviewer for pointing out this issue. Here we meant the similarity between all the PDFs from the EURO-CORDEX models in terms of location and shape between themselves and the observations. We changed the sentence by removing “in particular for TASMING” and adding “, in terms of close location and shape parameters, indicating a good overlapping of all PDFs.”

RC1: Line 375. “The interpolation of the IGD causes a slight deterioration of the PDF, particularly for the extremes”. It is not clear to which is referred the deterioration mentioned.

AC: We thank the reviewer for the note and changed the sentence to: “The interpolation of the IGD reduces the variability, thus the probability of extremes is lower.”

RC1: Line 376. Please remove the comma.

AC: Corrected.

RC1: Line 413. “For the heat and cold extremes, the results are more limited, namely for TASMING.” This sentence is not clear, please rephrase it more clearly.

AC: Corrected. We changed “heat and cold” to “...maximum and minimum temperature...”.

RC1: Lines 426-428. This is a very relevant point. The added value of downscaled RCMs seems, to some extent, clustering as function of driving GCM, though differently if we consider the entire distribution or only PDF's tails. Here I would add a few further considerations about why the added value of RCMs can depend on the GCM considered. Here we are not considering the well-known dependency of RCM capability of reproducing observed values as function of the GCM "quality" but about the RCM capability of improving GCM signal. The fact that this feature is sometimes more GCM- than RCM- depending it is a relevant

AC: We thank the reviewer for the suggestion. As with precipitation, the performance of the forcing simulation can affect the overall DAVs of the RCMs. If a model has a very high score, it will be very difficult for the RCMs to improve the temperature from the lower resolution, at least regarding the probability density functions. Of course, factors such as the land-atmosphere feedbacks (soil-moisture-temperature coupling, doi: <https://doi.org/10.1029/2018JD028378>) may have a significant impact. Other relevant point may be related to storm tracks. If a GCM has a too southward or northward placement, the regional models will not be able to improve this signal from the lower resolutions. To account for this, we added sentences in L360 and on the conclusions section, we kindly ask the reviewer to read down below in order to check if we fulfilled the request.

L360 from the track changes document: "For temperature, the effect of the orographic correction with a constant lapse rate in the interpolation may also be a relevant factor affecting the individual DAV. In the end, the scores obtained for the low-resolution might dictate the ability for RCMs to improve the signal. For instance, at the annual scale, the RCMs driven by GCMs with high Perkins skill score, such as CNRM with 0.84, reveal lower DAVs in comparison with other pairs. While at the same time, RCMs forced by GCMs also with high scores, such as MOHC with 0.85 or NCC with 0.86 still reveal noteworthy added value. This suggest that other factors may play a relevant role, such as storm tracks. If a GCM reveal a too northern mean storm track, this implies a dryer and colder weather in winter. While if a GCM has a too southern mean storm track, a more humid and warmer climate in the winter seasons is expected. An RCM driven by a low-resolution which reveals such biases will not be able to correct this signal. In fact, following Zappa et al (2013) ICHEC and MOHC GCMs reveal a correct placement of the storm tracks relative to the ERA-Interim reanalysis. On the other end, CNRM has a too southward placement, while the other models tend to have a too zonal storm-track."

L485 from the track changes document: "Another factor that may play a major role is related to how well do GCMs represent storm tracks. If a GCM is not able to properly represent storm tracks, then the downscaling RCMs will inherent these issues."