# Comment on gmd-2022-57

Anonymous Referee #4

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Referee comment on "Downscaling multi-model climate projection ensembles with deep learning (DeepESD): contribution to CORDEX EUR-44" by Jorge Baño-Medina et al., Geosci. Model Dev. Discuss., https://doi.org/10.5194/gmd-2022-57-RC4, 2022

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general comments

The paper is an important contribution to the methodology of the downscaling of the climate change simulations. The results show that neural networks can bring meaningful regionalized climate change fields that can be a good complement to those obtained from regional climate models. The method works well for precipitation and temperature, but question of its usefulness for other climate fields, specially 3d fields, remains open.

The paper is clearly written and well structured. However, there are a few thinks that can be improved in the paper. In particular, I thing that the answer to this comments could improve the paper.

- with which criteria were chosen the predictand fields?
- how expensive in computer resources is the method?
- Why eobs was used? It is too smooth, what can be seen in the results, specially in places with high topography.
- It seems that the use of more output layers for the precipitation than in temperature makes the biases in the downscaling of precipitation as small as for temperature, but reduces the standard deviation in the downscaling (Figure 3) I think that this fact is related to the methodology and should be commented by the authors.
- Also, the fact that the simulation of R01 in DeepESD is closer to the RCMs that to the GCMs shows the importance of a good simulation of orographic precipitation, while SDII and Mean temperature in DeepESD and GCM are closer, probably reflecting the tuning of the GCMs (which usually is not made in RCMs) and the training with observations in DeepESD. The exception for temperature in ED looks strange for me and would be nice if you explain this behavior.
- Results in figures 3,4 and could be also contributed by the use of stochastic (deterministic) approaches for the precipitation (temperature)

specific comments

A more detailed description of the methodology for not specialists (most of readers, I guess) should be interesting. Can be added as an appendix

How does the interpolation method influences the results?

Why did not used a regional, high resolution reanalysis as predictands?

In the Iberian Peninsula and the Scandinavian peninsula the climate change signal in DeepESD is similar to that of the global models, while the opposite is true in central Europe. Could you elaborate on this?