

Review comments for "The importance of model resolution on simulated precipitation in Europe – from global to regional model" by G. Strandberg and P. Lind

I would like to thank the authors for taking into account my comments and responding accordingly. The paper is now much clearer, and the results more robust now that the analyses are also performed on a common grid.

I list below a few additional minor comments. In addition to revising the clarity of the entire manuscript, I would particularly recommend to revise the abstract carefully, clarify its sentences (and correct the typos) so it summarises the findings of this study clearly. I wrote a few suggestions below. I also still found a few typos in the text.

Once again, thanks for constructive comments

L. 12: remove 'weather and', as NWP models are not the scope of this paper

Changed as suggested.

L. 13: 'to represent it': what does 'it' refer to? Precipitation processes, or the changes in precipitation? I would suggest to clarify the entire sentence.

"it" means here precipitation generally. "it" is replaced by "precipitation" and the whole sentence is reformulated to: "Still, due to the complexity of precipitation processes and their large variability in time and space, weather and climate models struggle to represent precipitation accurately."

L. 14: 'in a range of' -> replace by 'in available'

Changed as suggested.

L. 15-17: again here, the word resolution is used when it actually refers to grid spacing. Please specify at which latitude the grid spacing is given.

This seems to have slipped through by mistake. "Resolution" is changed to "grid spacing" and the latitude is specified. This also means that low/high (resolution) is changed to sparse/dense (grid spacing). The sentence now reads: "The ensembles used are: Global climate models (GCMs) from CMIP5 and CMIP6 (~100-300 km horizontal grid spacing at mid-latitudes), GCMs from the PRIMAVERA project at sparse (~80-160 km) and dense (~25-50 km) grid spacing and CORDEX regional climate models (RCMs) at sparse (~50 km) and dense (~12.5 km) grid spacing."

L. 23-24: 'where the largest contribution... and lowest': Does that refer to the differences? I would suggest to clarify.

The sentence is rephrased to: "Overall, in all seasons and regions the largest differences between resolutions are seen for moderate and high precipitation rates, where the largest precipitation rates are seen in the RCMs with highest resolution (i.e. CORDEX 12.5 km) and smallest in the CMIP GCMs."

L. 38: actually, according to Fig 11 and Fig 12, this is also true for PRIMAVERA, but it depends on the index considered. I would suggest to make the sentence more specific to the results shown in the paper.

Not sure what is meant here, both PRIMAVERA and CORDEX is mentioned in this context. Nevertheless, a sentence is added to make it more specific: "For indices describing precipitation days and heavy precipitation (RR1, R20mm, SDII, RX1day) the difference

between two models can be twice as large as the difference between two resolutions, in both the PRIMAVERA and CORDEX ensembles.”

L. 39: replace 'higher' by 'increasing'

Changed as suggested.

L. 40: remove 'most often'

Changed as suggested

L. 46: remove 'similar'

Changed as suggested

L. 43-46: it depends on seasons. I would suggest to clarify the whole paragraph based on the results shown.

See answer to comment below

L 46: 'as different CORDEX RCMs driven by the same GCM may give different results' -> they do give different results, but again 1 RCM driven by different GCMs also do give different results (as shown in Fig 11), so do the differences between the RCM and the driving GCM really depend more on the RCM? From Fig 11, it doesn't seem to be the case, both play a role, with more or less impact depending on the regions and seasons. See also results from Vautard et al, 2020, now in press:

Vautard, R., Kadyrov, N., Iles, C., Boberg, F., Buonomo, E., Bülow, K., et al. (2020). Evaluation of the large EURO-CORDEX regional climate model ensemble. *Journal of Geophysical Research: Atmospheres*, 125, e2019JD032344. Accepted Author Manuscript. <https://doi.org/10.1029/2019JD032344>

To be clear, we are not saying the simulated climate depends solely on the RCM, we do write: “The result of an RCM simulation depends on the driving GCM”. Our point is rather that the difference between the RCM and the driving GCM is not only a result of the higher resolution itself, but also a result of the physics in the RCM. Since this paper is about grid spacings it could easily happen that the reader gets the impression that the change in grid spacing changes everything. If that were the case, then the choice of RCM would be less important; but we do indeed see that the choice of RCM do have an effect. This is not disapproved by the fact that one RCM with several GCMs will also give different results. Since our formulation obviously led to some confusion, and since a proper explanation, like the one above, would be too long for an abstract we removed this sentence.

We added a reference to Vautard et al., 2020 to the Discussion.

L. 47: remove that sentence, as the other studies also look at the spread. The strength of this study is that it looks at many other indices, and includes CMIP6, as well as PRIMAVERA LR, so it adds information on CMIP6 versus CMIP5, and the impact of increasing resolution solely in an ensemble of GCMs.

Changed as suggested.

L. 99: Note that Demory et al do not only compare with E-OBS but also with high resolution observations based on high density network. The published version is:

Demory, M.-E., Berthou, S., Fernández, J., Sørland, S. L., Brogli, R., Roberts, M. J., Beyerle, U., Seddon, J., Haarsma, R., Schär, C., Buonomo, E., Christensen, O. B., Ciarlo, J. M., Fealy, R., Nikulin, G., Peano, D., Putrasahan, D., Roberts, C. D., Senan, R., Steger, C.,

Teichmann, C., and Vautard, R.: European daily precipitation according to EURO-CORDEX regional climate models (RCMs) and high-resolution global climate models (GCMs) from the High-Resolution Model Intercomparison Project (HighResMIP), *Geosci. Model Dev.*, 13, 5485–5506, <https://doi.org/10.5194/gmd-13-5485-2020>, 2020.

We make this clearer by this (new words in italic):

*“The results show that precipitation increases with resolution and that, when compared to a mixture of E-OBS and high spatial-resolution gridded national datasets”*

L. 153: add 50 km mid-latitude grid spacing

Changed as suggested.

L. 930: 'is given in the same format as'

Changed as suggested.

Table 2: institue -> institute; Euro-CORDEX-> EURO-CORDEX

Changed as suggested.

Fig. 2 and 3: specify in the caption that it is now the median which is shown.

Changed as suggested.

Pay also attention to the use of the word 'different/difference', it is used many times in single sentences (e.g. L. 18, L. 554, many others) and makes the sentences hard to read.

We see what you mean. Some of these “different/difference” are removed when they are not really needed and just add confusion; some others are replaced by other words when possible.