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Interactive comment on "The importance of model resolution on simulated precipitation in Europe – from global to regional model" *by* Gustav Strandberg and Petter Lind

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Comments on "The importance of model resolution on simulated precipitation in Europe – from global to regional model" by Gustav Strandberg and Petter Lind

I would like to make a few comments on this article, which is a big piece of effort, is very interesting and complements a similar analysis by Demory et al. (2020). It's always reassuring to have similar results with different pieces of code and types of analysis.

I would like to point at a few differences between your article and Demory et al. (2020):

- Demory et al. analyse precipitation on a 50km scale (except for CMIP5), whereas you mix all model resolutions. Klingaman et al. (2017) emphasize that regridding models changes the precipitation distribution as you point out at lines 128. But they argue that models should be compared on similar grids at different scales: a 12km model is meant to be good at 12km, at 50km and at 200km. A 200km model is not meant to be good at 12km. If you use observations only on a 25km scale (as I believe E-OBS is), you cannot expect CMIP5/6 to be good. Similarly, you show that 12km overestimates intense precipitation but this is compared with E-OBS which has a coarser scale than 12km model. In Demory et al., we showed that 12km models overestimated intense precipitation even when regridded at a 50km scale against observation regridded at 50km. Maybe you should include more discussion on this or deserve a few figures to a comparison of everything on a 200km scale, one on a 50km scale.

- You use averaged distributions across grid-points whereas we first pool the data across the region and then plot the distribution. Both methods are equivalent in a flat homogeneous region but not in region with varied topography. You may be smoothing out more the tail of the distribution than we do. Both methods are valid, I'm just highlighting a difference. - We use a new set of bins compared to Klingaman (2017) and Berthou (2018), defined in Berthou et al. (2019) for two reasons: – we wanted pure exponential increase in the bin size so that all the bins have the same size in a log scale and area below the curve is the mean. It's not quite the case in Klingaman and Berthou but it does not make a huge difference. – The other reason was that the Klingaman method had too many bins at the start of the distribution for E-OBS, which does not have a continuous precipitation distribution. I wonder how you managed to have such a smooth distribution for E-OBS, maybe the newer version is improved. Or the spatial averaging of distributions does the job. The equation and the difference between the two sets of bins is shown in Fig. S5 here: https://agupubs.onlinelibrary.wiley.com/action/downloadSupplement?doi=10.1029%2F2019GL083544&file=grl59801-sup-0001-agusuppinfo_revised.pdf

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- From your explanation in the method section and the y-axis on the ASoP figures, it seems like you are computing the fractional contribution. This would mean that you care about the shape of the distribution only. However, the figures do show some curves almost always above E-OBS and the integral of the differences is not 0 but >0 (e.g. Fig. 2 SC and ME) : this cannot happen if you normalise each curve by mean precipitation, unless you are normalising all curves by mean precipitation in E-OBS? In Demory et al. 2020, we chose to use actual contributions as we wanted information of both mean and distribution at the same time, to show which bins contribute to mean biases. From your discussion, it seems like you are also discussing actual contributions. Please clarify what you did.

- I agree with the sentence lines 19-21 but I think it applies to models of ∼50km: PRIMAVERA-HR, CORDEX-44, CORDEX-11 since you show that CMIP5/6 have very different precipitation distributions and clearly overestimate small intensities. Orographic and coastal regions (AL, FR, IP, MD,) exhibit strong differences (as shown in your Fig. 4). So I would add:

"Once reaching ∼50km resolution, the difference between different models is often larger than between the low- and high-resolution versions of the same model, which makes it difficult to quantify the improvement. In this sense the quality of an ensemble is depending more on the models it consists of rather than the average resolution of the ensemble."

- You could also include CMCC in the PRIMAVERA ensemble

- In the accepted version of Demory et al., we consider 45 CORDEX HR and 26 CORDEX LR, so I think sentence line 24-25 is not valid. However, you have other strengths in your study, e.g. comparing the spread between resolution and between models. I think a strong common conclusion of our studies that you highlighted well is that it is best to carefully design an ensemble (across all high-resolution models available (>=50km)) rather than to take an ensemble of opportunity to have a good representation of precipitation distribution.

- Many of the CMIP6 models have almost not wet days in the IP. Is this a bug or real? In which case it is quite worrying: these models are then very dry in this region.

- You could make use of the E-OBS ensemble rather than just mean in your ASoP figures (although it's already a crowded figure)

References:

Berthou, S., Kendon, E., Rowell, D. P., Roberts, M. J., Tucker, S. O., & Stratton, R. A. (2019). Larger future intensification of rainfall in the West African Sahel in a convectionâĂŘpermitting model. Geophysical Research Letters, 46, 13299– 13307. https://doi.org/10.1029/2019GL083544

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