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Geoscientific Model Development Discussions

Interactive comment on "HCLIM38: A flexible regional climate model applicable for different climate zones from coarse to convection permitting scales" *by* Danijel Belušić et al.

Anonymous Referee #1

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This paper aims at explaining the set-up of HCLIM, a regional climate modelling system developed by a consortium of national meteorological institutes and based on the HARMONIE-AROME numerical weather prediction system. It also provides examples of its use and added value in different regional set-ups. I find the manuscript well-written and clear in terms of explanation of the model set-up. It is an impressive effort to gather pieces of work by different groups and institutes over different regions. However, I find it a bit disappointing that the metrics used between regions are very often completely different. The only exception is Germany and the Netherlands, and even then the percentiles used are not the same. It makes the comparison of performance between regions impossible, which is a shame given the use of a similar model set-

up. If some of the metrics, such as FLDMAX could be produced over all the regions where AROME is used, it would be great. Also, it would be nice to show whether the CPRCMs have decent mean precipitation/temperature in summer, as it has been shown that other CPRCMs have dry biases in summer due to different interactions between stronger rainfall rates and the soil scheme (Liu et al. 2017, Berthou et al. 2018). This would be important, as the inclusion of SURFEX in the climate set-up is key, and as you mention the inclusion of groundwater in the future, which actually solved the WRF warm/dry bias in the US (work by M. Barlage). This could be done by including a similar plot as Fig. 2 but showing ALADIN and AROME for the subregions analysed here (Norway, the Netherland, Germany, Eastern Spain), for example in the same plot.

Major comments:

- Regarding the comparison between RCM and CPRCMs, I find it unfair to compare ALADIN at 12km with station data. As mentioned in the Netherland part of the article, it is alright to compare FLDMEAN of the radar and two models, but not FLDMAX: by design, ALADIN produces 12kmx12km mean precipitation, not point data, so I think it is wrong to include ALADIN in the FLDMAX plots. However, it is fantastic that AROME reproduces this metric so well. If you want to include ALADIN in plots, just use FLDMEAN or FLDMAX on similar areas as ALADIN by aggregating the radar and AROME at its resolution. This is also true for the metric used in Spain.
- Fig. 6a: could you use 90th/99th percentile of FLDMAX to be consistent with Fig. 5a (or the other way round?)
- Fig. 7: again for the intensity metric, I would not use ALADIN in these plots, as it is unfair (see first comment). It would be so much easier for the reader to have the same metrics for Spain as for Germany and the Netherlands (also it takes a bit of time to understand this new metric!). Since you have hourly gauges available

there, I guess it would be possible? Would you also be able to find hourly gauges in Norway to also do the same plot?

- For Spain, why are you not using SON, which is much more convective than JJA? (e.g. like Fumiere et al. (2019). A comparison with their results for southern France could be interesting: they found that AROME has a very good distribution but underestimates the strongest and rarest rain rates.)
- In general, how are the simulations performing for lower precipitation values? (e.g. Berthou et al. (2018) found an underestimation of low-value precipitation in UKMO and to a lesser extend ETH-COSMO. These values are important to get a good climatology and often underestimated by convection-permitting models, which can also lead to soil moisture depletion in summer. It seems from Fig. 5c that there is a dry bias in the model?

Minor comments:

- P6 – lines 1-2: "this helps in decreasing...": the atmospheric models at 12 and 2.5km have very different rain rates (as you show later), so I doubt that the soil spin-up inherited from the 12km model actually helps: would you be able to show that your soil moisture is not drifting in the 2.5km simulations? You don't actually mention how long a spin-up you use for the 2.5km models.
- It is worth mentioning that results from Fig. 6 (overestimation of intense precipitation (10-40mm/h) are consistent with the analysis of the UKMO/ETH-COSMO models in Berthou et al. (2018) for Germany.
- P10Lines15-17: which confidence interval are you using from the bootstrap resampling? Can you expand the method a bit?

- P12 Lines17-20: "This indicates that observations... -> This indicates that the ALADIN biases in the distribution are probably larger than inter-decadal variability in the distribution.
- P13, Lines 9-11: this is valid for all the simulations, move this to the start of section 3 (or remove it).
- P13, Lines 32-33: does this mean that the biases are in a temperature range where actually it does not impact melting, or that diurnal cycle changes balance mean monthly changes? Can you expand a bit on this?

Fumière, Q., Déqué, M., Nuissier, O., Somot, S., Alias, A., Caillaud, C., ... Seity, Y. (2019). Extreme rainfall in Mediterranean France during the fall: added value of the CNRM-AROME Convection-Permitting Regional Climate Model. Climate Dynamics. https://doi.org/10.1007/s00382-019-04898-8

Liu, C., Ikeda, K., Rasmussen, R., Barlage, M., Newman, A. J., Prein, A. F., ... Yates, D. (2016). Continental-scale convection-permitting modeling of the current and future climate of North America. Clim. Dyn., 1–25. https://doi.org/10.1007/s00382-016-3327-9

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