Reply to Anonymous Referee #1

Summary

The study "Sensitivity of precipitation and temperature over Month Kenia area to physics parameterization option in a high-resolution model simulation performed with WRFV3.8.1" by Messmer et al. submitted to GCM focuses on the analysis of several sensitivity experiments with the Weather Research and Forecasting model version3.8.1 for Mont Kenia for the year 2008. This work analyzes different parameterization options as well as different nesting strategies (number of nests and nesting ratios). The evaluation of the model performance is carried out in terms of precipitation and temperature by comparing the outputs from the WRF model with observational products from different gridded products but also using observational station datasets.

General comments:

The manuscript is very well written, making it easy to follow. The structure is appropriate with a complete description of the methodology and an adequate list of references. This kind of study is essential before completing climate simulations, being the area of study of high interest as it is a topographically complex region poorly study until now that requires high-resolution climate information to be properly described. In my opinion, the results found in relation to the nesting strategies are very interesting, this being a relevant aspect for properly configuring climate simulations at high resolution. Also, the method used to evaluate the model configurations by comparing the outputs of the model with different observational products seems to be adequate. However, there are several major aspects of the manuscript that should be clarified before its publication.

Thank you for reading our manuscript so carefully and for taking the time to review it. Thank you for asking critical questions, which help us to improve the quality of the paper.

My major concerns are mainly related to two aspects. The first one is the period used to analyze the WRF model performance for the different configuration options. Being the final goal of the study the selection of a "good configuration" to use WRF for climate runs, why did the authors select a 1-year period (the year 2008) to carry out this study? Did the authors test the model performance in other years with different precipitation characteristics? In my opinion, further analyses could be needed in order to corroborate the results from 2008. To do this, analyses for an additional year, for example, a year considered to be a wet year (as 2006) could be carried out.

We have decided to choose one year, as the selected domain setups are computationally quite heavy (38'000 CPU hours per model year and 7 TB of storage space), so we decided to run a large set of experiments, at the expense of a somewhat shorter simulation. We have tested 4 different domain setups and at least 5 parameterization options for each setup, which results in more than 20 years of simulation. This corresponds almost to a full climatology. Owing to the fact that the resolution is very high, longer and more simulations can only be afforded when reducing the number of parameterization options. Nevertheless, we agree that it would be good to have an additional check using a wetter year as well. Hence, we have decided to start one simulation with the year 2006 and the optimal setting for the year 2008.

On the other hand, I am a little bit confused with the "no cumulus" experiment setup. If I understood well, the authors here have used the WRF model with the cumulus parameterization switch off in all domains (from the 27km_D04/25KM_d03 to the finer domain of 1km of spatial resolution), but did the coarser domains (i.e., 27km and25km) also run without convection scheme? I think that more information is required in this regard. Also, why for this parameterization configuration option are there three of the nesting schemes (i.e., 27kmD04, 25kmD03, 9kmD03) instead of the four used in the other cases (i.e., 27kmD04, 25kmD03, 9kmD03, 25kmD02)?

Thank you for pointing out that the description of the "No cumulus" parameterization option is still unclear. For the "No cumulus" simulation we have turned off the cumulus parameterization in all domains, i.e., we have turned it off also in the 27/25 km and 9 km domains, where it is normally suggested to use a cumulus parameterization. Note further that the cumulus scheme is turned off for grid spacings equal or finer than 5 km in all the experiments.

This is also why there is no "No cumulus" parameterization experiment for 5km_D02 setting. As the same parameterizations are used in both "No cumulus" and "Cumulus 3-1Way" except for the cumulus scheme, these two experiments are identical for the 5km_D02 setting since cumulus parameterization is switched off in both setups at that resolution. We understand that the text in the manuscript still leads to some confusion and that is why we will be more precise in describing this experiment in the next version of the manuscript.

Additionally, I think that some analysis concerning the ability of the model at a sub-daily scale would be nice to clarify if the "no cumulus" option provides an added value in relation to the other options used with convection physic schemes at this temporal scale.

This is correct, a sub-daily analysis would be nice to further investigate the skill of each parameterization and in particular for the "No cumulus" parameterization this would be interesting. Since most of the observations are only available on a daily basis, such an analysis is a bit difficult, but we will try to include a sub-daily analysis based on IMERG, as we have 3-hourly data available there.

Specific comments:

L248-250: Please, indicate the method used to interpolate the gridded products.

Bilinear interpolation was applied to the gridded products. This information will be included in the new version of the manuscript.

Figure5: The colors selected for "cumulus3 1-way", "no cumulus", and "ERA5" are hard of difference sometimes, so I would suggest using an additional way (e.g., dotted lines for observations) to clearly show what data are represented in each case.

It is a valid point to add dotted lines for the observations, so we will adapt this figure accordingly.

Figure 6onward: In order to clearly show what option is better, I would suggest adding the correlation patterns between CHIRPS and the different parameterization options, for example, at the bottom of each figure.

Thank you for this suggestion. This is a good idea, and we will include this number as suggested in the next version of the manuscript.

Technical corrections:

L115: Velasquez et al. 2020?

L178: Please, move the Climatic Research Unit (CRU) definition from L215 to L178. It is the first time that CRU is named.

We will address these two technical corrections in the new version of the manuscript as suggested by the reviewer.