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Interactive comment on "The monsoon hydroclimates in HadGEM3 model configurations GA3.0 and GA4.0: Impact of remote versus local circulations errors and horizontal resolution" *by* Wilfran Moufouma-Okia et al.

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Dear Reviewer RC2, We are grateful for your careful thoughts and comments and suggestion to implove the paper. Please find below our proposed strategy for revising accordingly the manuscript entitled "The monsoon hydroclimates in HadGEM3 model configurations GA3.0 and GA4.0: Impact of remote versus local circulations errors and horizontal resolution".

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Discussion paper

Moufouma-Okia et al examined the fidelity of the Met Office Unified Model (MetUM) in simulating the global monsoons climatological features. They have considered the MetUM third and fourth generations Global Atmosphere models and compared the results against multiple observational datasets as well as several atmospheric-only GCMs simulations from the CMIP5 experiments. The improved understanding of the GCM performance is important for studying the variability and projections of global monsoon changes. This is an interesting study on how the remote versus local circulations errors; and the horizontal resolutions of the model influencing the monsoon circulation and related precipitation. However, I would like the authors to address some of my concerns.

Major Comments:

One of the major conclusions given in the abstract and conclusions about the poor simulations of Asian summer monsoon (ASM) by the model which was attributed to excessive precipitation over the southwest equatorial Indian Ocean, rather than to remote tropical atmospheric responses of varying forcing fields, such as SST over the Arabian Sea, aerosols, and growing greenhouse gas emissions. However, this statement was not supported by any kind of analysis. There is no such analysis for the SST over the Arabian Sea, aerosols, and growing greenhouse gas emissions are presented in this manuscript. Also, how the excessive precipitation over the southwest equatorial Indian Ocean contributed to poor simulations of the ASM are not explained.

It is interesting to note that HadGEM3 performance improves significantly over ASM with atmospheric circulations constrained realistically over the tropics, West African and Asian summer monsoon domains. However, it is not clear how exactly that contributed to such performance improvement. Is this due to the improvement of regional low-level circulation or due to the improvement in simulating the vertical wind shears? Are there any differences in the local circulations observed for ASM when atmospheric circulations constrained over the tropics, West African and Asian summer monsoon domains?

Again, you state that the increasing spatial resolution or improving the sub-grid scale parameterizations improves the model simulations (L327-330). This is not always true as in certain cases in your results the simulation doesn't improve even with a higher spatial resolution. The authors need to elaborate more on this.

Answer: We fully agree we the major comments and will amend the text, analysis, conclusion and abstract accordingly.

Minor comments:

Answer: We agree we the minor comments and will amend the text accordingly.

L222: Here it is mentioned that the nudging experiments are carried out through 1982-2008, but you have shown in Table 1 that the integration period for the nudging experiments are 1990-2008. Which is correct? L82-83: "South African monsoon" – is this monsoon over the country South Africa or over the South African region? L260: why do you focus the results only for the period 1984-2005 although your simulation periods are for the period 1982-2008? Fig. 2: Mean and Median of the models - is this the mean for all the CMIP5 models only or the mean for both CMIP5 models and HadGEM3 experiments Fig. 5: Are these results statistically significant? L346-347: "In west Africa, a region. . .." - give a reference. Fig. 8: What does the grey shade indicate? L360-370: Why did you focus only three monsoon regions here? L453: "There is clear benefit in increasing horizontal resolution" – this is not always true. Please explain what exactly improved? Whether the increased horizontal helped improving the simulated precipitation patterns, intensity, etc. Fig. 9 and related results discusses only about the differences in the circulation characteristics, but how do such differences influence the simulated precipitation strength in the models are not discussed. Is the regional monsoon precipitation (e.g. seasonal cycle) in this study calculated only over land or both over land/ocean? Fig. 12: Domain Def: Psummer – Pwinter > 2. Is this 2.5 instead of 2 as per L78?

Please also note the supplement to this comment:
https://wcd.copernicus.org/preprints/wcd-2020-38/wcd-2020-38-AC2-supplement.pdf

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