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Hydrology and Earth System Sciences
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Discussions

Interactive comment on "Influence of initial soil moisture in a Regional Climate Model study over West Africa. Part 2: Impact on the climate extremes" *by* Brahima Koné et al.

Brahima Koné et al.

arona.diedhiou@ird.fr

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Major/Specific Comments: 1. Comments: As noted above, my main concern stems from your year choices. While this results in 6 experiments for comparison, I am not convinced that the results are robust given only a 2 year sample size. Moreover, I'm curious how these years were chosen -are they extreme wet and dry years? How often do years such as these occur? How is "wet" and "dry" defined? Author's response: Thank you for your comment. We re-run the simulations over 5 years (2001 to 2005) during the months of June to September over our West African domain. We superimposed the 5 years and their climatological average in order to analyze the changes in

daily soil moisture over our domain studied (Fig.1). The Fig.1 shows that the weakest and strongest impact of the dry experiments is found for 2003 and 2004 respectively. For a wet year, the impact of drying out soil moisture is quickly erased. While for a dry year the impact of the drying of the soil is accentuated. This meaning that 2003 and 2004 are respectively the wettest and driest years in dry experiment. However, for the wet experiments, the weakest impact is found for 2004, and the strongest impact is found for the years 2001, 2002 and 2004. In a dry year, the impact of soil humidification is very quickly erased, while in a wet year the impact of soil humidification is accentuated. The wet experiments confirm the result obtained in dry experiments, 2003 and 2004 are wettest and driest years respectively. To conduct our analyzing to estimate the limits of the impact of internal soil moisture forcing on the new dynamical core non-hydrostatic of RegCM4, we have been used the two extreme years 2003 and 2004 (resp. the wettest and the driest years) among the 5 years. It is in the same context, several previous studies chosen two extreme years for their sensitivity study of initial soil moisture condition on the models. Hong and al. (2000) use in their study only two years (3 months per year) to investigate the impact of initial soil moisture over the North of America (in the Great Plains) during the two summers, May-June-July (MJJ) 1988 (corresponding to a drought in the Great plains) and MJJ 1993 (correspond to a flooding event). Over Asia, Kim and Hong (2006) in their paper "Impact of Soil Moisture Anomalies on Summer Rainfall over East Asia: A Regional Climate Model Study" used two contrasted years 1997 (below normal precipitation year) and 1998 (above normal precipitation year).

2. Comments from referee 1: I'm not sure I understand why you discard the first 7 days as spin-up – perhaps because I'm used to prediction, where those 7 days are included in the forecast and would show large impacts of soil moisture initialization.

Author's response: Thank you very much. Spin-up is a concern when there is a lack of data or seasonal simulation (Rahman and Lu, 2015). Overestimating the spin-up period would lead to a loss of important information. Likewise, an underestimation will lead to integrate errors in the analysis due to the fact that the model does not reach the dynamical equilibrium between the lateral forcing and the internal physical dynamic of the model. Yes, you're right, Anthes et al. (1989) demonstrated that regional models attain the dynamical equilibrium in 2-3 days spin-up period. However, Kang and al. (2014) by comparing different land surface schemes (BATS and CLM3) and different periods of spin-up to simulate June – July – August precipitations recommended 7 days as spin-up period. In this study, we used CLM4.5 as land surface scheme (Oleson et al., 2013) which has a more complex design. That's why we used 7 days as spin-up period.

3. Comments from referee 1: It would be prudent to discuss the implications of this work beyond a summary, perhaps in the concluding remarks.

Author's response: Thank you for your comment. Please be more specific in this comment to allow us to better understand the concern.

4. Comments from referee 1: You offer a comparison of CHIRPS and TRMM, and find large differences in the two datasets. How does this impact your results?

Author's response: Thank you for your comment. These differences the observation datasets have been revealed in several previous works over West Africa. For instance when comparing TRMM, GPCP and FEWS, Sylla et al. (2013) pointed out significant discrepancies between these products, whilst Nikulin et al. (2012) as well as Diallo et al. (2013) found large differences between gauge-based observations and satellite products. To minimize this impact of these discrepancies on our results we have chosen CHIRPS as a reference because of its high resolution.

5. Comments from referee 1: I have this problem a lot with manuscripts that include extreme indices - there area huge amount of indices to show, and this adds to length and can cause the reader to get lost in the paper as you go through each one. 21 figures is a lot! I like the way that you have isolated each index, but I think you could cut down on the detail slightly to save some words and not have the reader get lost in

the details.

Author's response: Thank you for your comment. We cut down on the detail in our analyzing in the revised manuscript.

Minor/Technical Comments:

1. Comments from referee 1: I noticed a number of grammatical and spelling errors in the manuscript, I suggest having someone read and edit the manuscript specifically for editorial remarks such as these. Author's response: Thank you for your comment. We did our best to improve the revised manuscript.

2. Comments from referee 1: You use a number of parenthetical references such as "impacts of the wet (dry) soil moisture on wet (dry) years etc." - I do not mind these at all, but sometimes the text is very difficult to read when they are used in excess. For example, line 464-468.

Author's response: Thank you for your comment. We reduce this style of writing in the revised version and make it easier to read.

3. Comments from referee 1: Define the lat and lon range of your domain(s).

Author's response: West Africa simulation domain Grid coordinates: 1: points=20748 (182x114) lon : -20 to 19.82 by 0.22 degrees_east lat: 0 to 24.86 by 0.22 degrees_north

Author's changes in manuscript: We did this following modification in the manuscript at Section 2.1 line 93 to 95: The integration of RegCM4 over the West African domain is shown in Fig. 1 with 18 vertical levels and 25 km (182x114 grid points; from 20°W-20°E and 5°S-21°N) of horizontal resolution.

4. Comments from referee 1: Line 102: Does this contradict your statement on line 23 of part 1? Perhaps rewording is necessary.

Author's response: Thank you for your comment. We rewrote the sentence.

Author's changes in manuscript: We did this following modification in the manuscript at Section 2.1 line 103: The sensitivity of initial soil moisture is not exceeded four months (Hong and Pan., 2000; Kim and Hong, 2006).

5. Comments from referee 1: Line 138 to 147: I believe you're talking about autocorrelation - neighboring grid points are spatially dependent. You do not necessarily need to resample, but you can estimate your n given autocorrelation - sometimes called effective sample size. I think you're using NCL in much of this manuscript (at least, your Figures look like NCL!), which has functions to calculate sample autocorrelation and equivalent sample size.

Author's response: Thank you for your comment. We do not seek to resample our data. We used the student t test to investigate the statistically significant differences between the control and the wet/dry sensitivity experiments at each grid cell as did by Liu and al (2014) in similar work over Asia. Due to the multiplicity problem of independent tests and the spatial dependency of neighboring grid points, the signiïňĄcant results can only be seen as a crude estimate. To justify this, Jager and Senviratne said that more reliable estimates of signiïňĄcance could be obtained using resampling methods proposed by Wilks (1997) for auto-correlated Fields. However, this is not feasible in our case due to the computational constraints associated with the size of our domain studied.

Author's changes in manuscript: We rewrote it to make it more comprehensive. We did this following modification in the manuscript at Section 2.1 line 140 to 146: The statistically signiïňĄcant differences has been tested between the control and the sensitivity experiments, we perform the two-tailed of the student's t-distribution at every grid points as did by Liu et al. (2014) in a similar work over Asia. Due to the multiplicity problem of independent tests and the spatial dependency of neighboring grid points, the signiïňĄcant results can only be seen as a crude estimate. Therefore, we perform the land point's area-weighted fraction with statistical significance of 10% level and we display the seasonally extreme indices maps during the years 2003 and 2004.

6. Comments from referee 1: Line 198: "Indicating that the number of wet days occurrence are occurred more likely not only in wet experiments but also in the dry experiments." I do not understand this sentence.

Author's response: Thank you for your comment. We would like to say that the number of wet days occurrence occurred not only in wet experiments but also in the dry experiments. Author's changes in manuscript: We did this following modification in the manuscript at Section 3.1 line 198 to199: Indicating that the number of wet days occurrence occurred not only in wet experiments but also in the dry experiments.

7. Comments from referee 1: I noticed that sometimes your section summaries only include some of your results - is there a way to make these more comprehensive without adding to length?

Author's response: Thank you for your comment. We rewrote these section summaries to make them more comprehensive. Please see through the revised manuscript.

References

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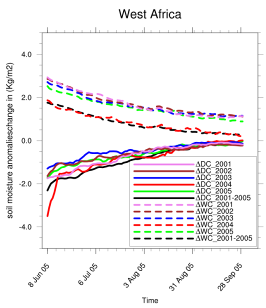

Fig. 1: Changes in daily soil moisture for 5 years (2001 to 2005) and their climatological mean during JJAS over West African domain, from dry (ΔDC) and wet (ΔWC) experiments with respect to their corresponding control experiment.

Fig. 1.