

Answers to the Reviewer 2

We would like to thank the reviewer for his helpful suggestions and remarks. Please, find below, in red, your comments, and in purple, our answers to your comments.

RC2: 'Comment on esd-2021-46', Anonymous Referee #2, 17 Sep 2021

Review of the manuscript ESD-2021-46, “Weakened impact of the Atlantic Niño on the future equatorial Atlantic and Guinean Coast rainfall”, by Koffi Worou, Hugues Goosse, Thierry Fichefet, and Fred Kusharski.

The submitted manuscript explores the rainfall annual cycle in the Guinea Coast, gives a detailed analysis of the future changes in the Atlantic Niño and their impact on the rainfall, and the modulation of the Bjerknes feedback in the future climate change projection. The investigation is based in 31 historical simulations from General Circulation Models of CMIP6 with some observations and reanalysis. The authors found that these models are able to simulate reasonably well the rainfall annual cycle in the Guinea Coast with a wet bias in boreal summer (July-August-September). They also found a rainfall decrease in the Tropical Atlantic region due to a weakening of the Bjerknes feedback over the equatorial Atlantic in future climate projection. This work will be a valuable contribution to Earth System Dynamics journal after some revisions.

The paper is well written, well documented, easy to follow and understand from the beginning up to section 4. In section 5, there are lots of information, and it's a bit dense. Please, what is the purpose of defining all the groups you defined? I am referring to group GC+, GC-, GC+-, GC++, OC+, OC-, ect...

By defining these different groups, we aim to understand if different group of models simulate the rainfall pattern related to the Atlantic Niño over the equatorial Atlantic and the Guinea Coast in different ways and in particular if a different simulation of the current state has some implications on the simulated future changes in rainfall patterns. We also aimed to highlight the differences in the key physical mechanisms between the groups. Focusing on the Guinea Coast for example, we first identify the climate models which are able to simulate realistically the observed rainfall pattern related to the Atlantic Niño in the Guinea Coast over the past decades (the group GC+). In observations, a positive rainfall anomaly over Guinea Coast is related to a warm phase of the Atlantic Niño (and vice versa). The group GC- indicates models which presents a negative rainfall pattern associated with a warm phase of the Atlantic Niño. For the future changes in the ATL3-related rainfall pattern over Guinea Coast, we separated models which present and enhancement of the positive rainfall pattern (GC++) from models which present a weakening of the rainfall pattern (GC+-). Then we tried to understand the reasons of these changes and the differences between the different categories. A similar argument is applied to the ocean. However, in the revised version of the paper, we will focus our analyses on the Guinea Coast rainfall changes related to the Atlantic Niño. We will reduce the number of groups to three: GC++, GC+-, and the multi-model ensemble mean (EnsMean).

It will be nice if you could resume your findings about the previous mentioned groups in a table. Moreover, it is better to name the figure you are referring too early in the text than in the middle or at the end of a paragraph.

We will resume our findings about the different groups in a table, as suggested.

We will also name the figure early as suggested.

Minor

Line 35: “deepens” not “deepen”

Thank you for this correction. It will be taken into account in the revised manuscript.

Please, add a figure in the supplement material to show the different boxes of Table 2.

The different boxes will be added in the Figure 2 of the first version of the manuscript, as suggested by the reviewers 4 and 5. If needed, we will add a new figure in the supplementary material as suggested.

Provide a statement on how the data used for the study could be accessed.

The CMIP6 data and the reanalysis ERA5 will be used in the revised manuscript. We will specify how to retrieve these datasets.

Line 68: Precise the figure you refer to after giving the interval of the RMSE.

We were referring to the figure (1a). However, this figure will be put in the supplementary material in the revised version of the paper.

Line 160 and line 193: Which figures are you referring to? If it is not shown, please precise.

We were referring to the figure (1a), which will be put in the supplementary material in the revised manuscript.

Line 197: Why you did not represent the bias relative to ERA5 instead of the mean state?

We did not represent the bias relative to ERA5 for each model because we already showed the multi-model ensemble mean of the model biases in Fig. 2.

Line 216: The multimodel mean “underestimates” the SST STD in relation to ERA5 in the time period you have highlighted. Compared to other observations, the multimodel underestimates the SST STD in May-June and overestimates it the rest of the year.

Thank you for this correction, we will take it into account in our revision.

L256-259: There are 24 GC+ and 6 GC- models. It seems like 1 model is missing because there are 31 GCMs in total.

Yes, the model GISS-E2-1-G is discarded, because it has no significant sign-dependent average of the rainfall anomalies related to the Atlantic Niño over Guinea Coast. However, in the revised manuscript, we will discard this model, so the total number of models will be 30.

Title of figure 6d: It is better to write ERA5 (ORAS5) than ERA5/ORAS5, or use only ORAS5, because it is confusing.

We will use ERA5 (ORAS5) in the title, thank you for the suggestion.

L260: Please, precise "not shown" after "nor in the observations".

It was shown in Fig. (5a) on the CMAP-HADISST and GPCP-ERSST maps. However, we will remove these maps in the revised manuscript, and will precise "not shown" as suggested. Thank you.

L282: Please, precise the figure you are referring too at the end of the sentence (Fig. A4?).

Yes, we are referring to Fig. A4. We will precise this figure at the end of the sentence as suggested. In addition, this section will be profoundly modified in the revised manuscript, as suggested by one reviewer.

Caption of figure A4, add the color of the box for each region.

This information will be added in the revised manuscript.

L295: "The models show a poor to modest spatial correlation with ERA5, which ranges from -0.4 to 0.6". Precise the figure you are referring to, is it (Fig. 5a?)

We are referring to the Fig. (5b).

L298: Is OC+ the sum of GC+ and GC- when referring to EAB region?

Yes, OC+ is the sum of GC+ and GC-.

You did not use Figure A6. Please, remove the figure if it is not needed.

Figure A6 will be removed, as it is not needed. Thank you for the suggestion.

Figure 7b: Please, keep the same color in (a) and (b) for the period 2015-2039, 2040-2069, and 2070-2099.

The same colors will be kept for the same periods as suggested.

L320: Refer the figure after 0.32°C.

We will refer to the Fig. (8a) in the revised manuscript.

L397: Remove one "zonal".

Thank you for this correction, it will be removed.