Answers to the Reviewer 4

We would like to thank the reviewer for the evaluation of our study, the comments and suggestions. Please, find below our response to your comments, on a point by point basis. Your comments are recalled in red and our responses are written in purple.

RC4: <u>'Comment on esd-2021-46'</u>, Anonymous Referee #4, 20 Sep 2021

General comments:

This paper investigates the present and future characteristics of the Atlantic Niño and its influence in the Gulf of Guinea and Equatorial Atlantic precipitation, using CMIP6 simulations. It shows that models project a weakening in the variability of the ATL3 region which would then lead to a weakening in the rainfall variability in the equatorial Atlantic and Guinean Coast.

In my opinion the paper has valuable information that is within the scope of ESD and deserves publication after the some revisions.

The paper has a lot of information that not always is presented in the clearest way. Specially when the authors divide the 31 models in different groups (GC+, GC-, OC+). I fell that the group OC+ is not at all necessary in section 4, and makes the discussion of the results a bit messy. Also section 5 is hard to follow in some places.

Thank you for this general comment. We will follow the suggestion and reduce the number of groups of models in the revised version as detailed below.

Specific comments:

Introduction:

ATL3 is an index that reflects the variability of the Atlantic Niño region, but I don't think it is correct to use ATL3 acronym to refer to the Atlantic Niño.

We will keep ATL3 acronym for the Atlantic Niño region. The Atlantic equatorial mode acronym (AEM) will be used instead, to refer to the Atlantic Niño.

Data and methods:

Why do you perform a quadratic detrend of the data?

JAS ATL3 index: anomalies, linear and quadratic trends for the 1985-2014 period



Figure R 1 Linear (in blue) and quadratic (in orange) trends of the JAS ATL3 index (in green) from 30 CMIP6 models and ERA5. Time series are displayed for the 1985-2014 period.

We performed the quadratic trend because in the CMIP6 models, the trend of the JAS ATL3 index is not linear all the time (e.g. GFDL-ESM4, Fig. R6). By plotting both linear and quadratic trends, we noticed that when the trend is linear, both trends are similar, whereas in other cases, the quadratic trend departs from the linear trend. However, we now plot the residuals from the detrended SST (Fig. R7) and rainfall data and we note very small differences which do not justify the use of the quadratic trend. Therefore, the revised manuscript will be based on the linearly detrended monthly data (see also comments to the reviewer 1).

JAS ATL3 index residuals from linear and quadratic trends for the 1985-2014 period



Figure R 2 Residuals of the linearly (blue curves) and quadratically (orange curves) detrended JAS ATL3 index of 30 CMIP6 models and ERA5 over the 1985-2014 period.

Section 3.1:

Figure 2: I don't understand the wind pattern. It is not consistent with Richter and Tokinaga (2020).

The inconsistency of the wind pattern comes from the difference in the vertical level in Richter and Tokinaga (2020), compared to the level used in our study. We used the 850 hPa horizontal wind (around 1.5 km) in our study, against the 10 m level in Richter and Tokinaga (2020). Moreover, in Figure R8, we show that the JAS 10m horizontal wind biases are consistent with Richter and Tokinaga (2020). We will add this figure to the supplementary material.



Figure R 3 Ensemble mean of the JAS SST (in colors), rainfall (in contours) and 10 wind (arrows) biases relative to ERA5 over 1985-2014. Theses biases are computed from 23 GCMs

Please add in figure 2 or in any additional figure the boxes defined in table 2.

We will add the boxes in the Figure 2 as suggested.

Section 3.2:

L. 213: I think that the statement "the winter Atlantic Niño has greatly influenced the ENSO events" is a bit too strong.

We will rewrite this sentence, by suppressing the adverb "greatly".

Also you should refer to Okumura and Xie (2006) when talking about the winter Atlantic Niño for the first time.

We will refer to this article when talking about the winter Atlantic Niño for the first time.

Okumura, Y., & Xie, X. (2006). Some overlooked features of tropical atlantic climate leading to a new Nino-like phenomenon. Journal Of Climate, 19, 5859-5874. doi:10.1175/JCLI3928.1

Section 4:

I would reorganize this section. I fell that section 4.1 belongs to section 3, in which the model performance of the patterns are described. Then, in section 4, the authors can focus in the impact of the Atlantic Niño on rainfall.

Thank you for this comment. In the revised manuscript, the section 3 will talk about the seasonal mean rainfall in Guinea Coast (section 3.1) and seasonal SST in the ATL3 region (section 3.2). We

will move the annual cycle discussion to the supplementary material. Then, we will add the model performance on the representation of the Atlantic Niño SST patterns (section 3.3).

The authors jump from figure 5 to figure 6 and back in a confusing way.

We will take this remark into account, by improving the text in the revised version of the manuscript.

I don't think that the analysis of OC+ models is necessary here.

The OC+ group will be removed from the main discussions, thank you for this suggestion.

Section 5:

Again is difficult to follow. I would rearange figures 8 an 9 by areas, to make the discussion in the section easier to follow.

In the revised manuscript, figure 9 will be removed, as suggested by the reviewer 5. This will make the discussion easier to follow. In figure 8, five panels among 6 are about the ATL3 region, while the remaining panel concerns the Guinea Coast region, and we think that there is no other optimal way to rearrange the main panels by area. We will keep this figure and will improve the text.

I would talk about OC+ models only from section 5.3 onwards. I doesn't seem necessary before and makes the discussion hard to follow.

The OC+ group will no longer be in the main discussion. This would easier the discussion to follow.

Figure 7: Please use the same colors for each period in (a) and (b).

We will keep the same colors for the different periods in (a) and (b).

L. 406: I don't agree with the sentence "The projected ATL3-rainfall signal in the GC+- group is ... hardly robust over the Guinea Coast". I see a very robust decreas of rainfall over the green box in figure 10a.

There is a confusion due to incomplete information provided in the submitted mansucript. We were not talking about the changes of the rainfall pattern in the GC+- group, which is a robust decrease as you stated. Rather, we were talking about the rainfall pattern associated with the Atlantic Niño over the 2070-2099 period, as displayed in Fig. A9. We will refer to this map in our revised manuscript.

Supplementary material:

Figure A6 is not discussed in the text

We will remove this useless figure in the revised manuscript. Thank you for this remark.

Technical corrections:

L. 23: Please replace "has moved" by "moves".

This section will be rewritten, to clarify some points highlighted by the reviewer 1. We will take your correction into account. Thank you.

L. 45: Losada et al. 2009 should be Losada et al. 2010a.

Thank you for this remark, it will be taken into account in our revision.

L. 143 to 145: I find this description of the sign-dependent average a bit confusing.

We will improve the description of the sign-dependent average in the revised manuscript.

L. 248: Change "Mohino and Losada (2015)" by "Mohino and Losada (2015), among others".

We will add "among others" to the sentence.

L. 355: Pleas move the sentence "This indicates a weakening... in the eastern equatorial Atlantic" to the end of the paragraph.

We will move the sentence to the end of the paragraph as suggested, thank you.