Earth System Dynamics Discussions

Earth Syst. Dynam. Discuss., referee comment RC3
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Comment on esd-2021-46

Anonymous Referee #3

Referee comment on "Weakened impact of the Atlantic Niño on the future equatorial Atlantic and Guinea Coast rainfall" by Koffi Worou et al., Earth Syst. Dynam. Discuss., https://doi.org/10.5194/esd-2021-46-RC3, 2021

- **General Comments**

The authors of this manuscript investigate the present-day and future boreal summer (JAS) rainfall and sea surface temperature (SST) variability in the eastern and equatorial Atlantic using 31 historical and scenario simulations from the sixth phase of the Coupled model Intercomparison Project (CMIP6). They show that the rainfall annual cycle, computed for the period 1985-2014, in the Guinea Coast is generally well simulated. Yet, a wet bias persists in boreal summer due to a large SST bias in the eastern equatorial Atlantic and south Atlantic regions. The rainfall variability is strongly linked to the SST variability in this region and therefore the SST variability in the eastern equatorial Atlantic is also investigated. The authors show that relative to the present-day situation, in a climate with a high anthropogenic emission of greenhouse gases, the eastern equatorial Atlantic JAS SST variability weakens. They show that the reduced SST variability in the equatorial Atlantic could be due to a weakening of the Bjerknes feedback. As a result, relative to the present-day situation, in the future they also find a reduction of the rainfall variability over the equatorial Atlantic Ocean and Guinea coast in a majority of the CMIP6 considered.

The article is well written and addresses an important topic with detailed results. In my view the results are within the scope of ESD and therefore, I recommend minor revision before publication following the different aspects provided bellow.

- **Specific Comments**

Abstract

L3. I would state that both historical and scenario (SSP5-8.5) simulations from 31 GCMs from CMIP6 are used throughout the study.

L6. Add "boreal" to the sentence "This bias is associated with too high mean summer SSTs"

Introduction

L31. The acronym ATL3 is used in this study to refer to the Atlantic Niño. It is generally more used to define the region where the Atlantic Niños occur (20Ë□W-0Ë□; 3Ë□S-3Ë□N). The authors have defined this region with the acronym ATL3B in Table 2 but ATL3B is never used in the manuscript.

Data and methods

L132. Please, can you explain how the anomalies were computed. Do you remove the climatological monthly-mean seasonal cycle?

Section 3.2

L200. The title of the section says "JAS mean" but the JAS mean is not discussed.

L214. "The winter Atlantic Niño" was defined as the "Atlantic Niño II" by Okumara and Xie (2006).

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

Figures 1 and 3:

I would like to see the cross-correlation between the GC rainfall anomalies and ATL3 SST anomalies. As in the CMIP6 ensemble, both the ATL3 SST variability and the GC rainfall variability peak in JJA and assuming that the maximum of correlation is found at 0 lag then why not regressing JJA SST (rainfall) anomalies on the standardized JJA ATL3 index in Figure 4 (Figure 5)?

Section 4.1:

To investigate the boreal summer Atlantic Niño pattern why not regressing the JJA SST anomalies onto the standardized JJA ATL3 index?

As shown and discussed in section 3.2 the ATL3 variability peaks in JJA in the CMIP6 ensemble corresponding to the Atlantic Niño activity in the ATL3 region. Therefore, when looking at future Atlantic Niño changes, I would recommend to use JJA and not JAS.

Figure 4: One could draw the TAB1 and TAB2 boxes on Figure 4 if it stays legible.

Section 4.2:

L241. Should be: "Figure 5(a) displays the regression maps of the JAS rainfall anomalies onto the standardized JAS ATL3 index", correct?

L254-L256: 31 models are present on Figures 4, 5 and 6 but only 30 models are in the GC groups (24 + 6).

Figure 6. caption: Should "associated with the standardized ATL3 index" be "associated with the JAS standardized ATL3 index"?

Section 5.1:

Figure 7: From (a) to (b) I recommend the authors to keep the same color for the different periods.

Figure 9 caption: Should "Rainfall anomalies associated with ATL3" be "JAS rainfall anomalies associated with JAS standardized ATL3 index"? Same question for the rest of the subpanels.

L384. Should "First, the GC+ group (the 24 models in Sect. 4.2 which simulate a realistic GCB rainfall associated with one standard deviation of the ATL3)" be "First, the GC+ group (the 24 models in Sect. 4.2 which simulate a realistic JAS GCB rainfall associated with the standardized JAS ATL3 index)"?

Section 5.2:

Throughout this section, the authors should state that they investigate the JAS rainfall, SST, 850 hPa zonal wind, moisture flux associated with the JAS standardized ATL3 index.

Figure 10 caption: Should "Long-term changes of the JAS rainfall (a-e), SST (f-j), 850 hPa zonal wind (k-o), sea surface height (p-t), moisture flux (vectors) and moisture flux divergence (in colors) (u-y) regression patterns associated with the standardized ATL3 index " be "Long-term changes of the JAS rainfall (a-e), SST (f-j), 850 hPa zonal wind (k-o), sea surface height (p-t), moisture flux (vectors) and moisture flux divergence (in colors) (u-y) regression patterns associated with the standardized JAS ATL3 index"?

Appendix:

Figure A8, A9, A10. caption: Should "regression maps of rainfall anomalies onto the standardized ATL3 index" be "regression maps of the JAS rainfall anomalies onto the JAS standardized ATL3 index"?

Figure A6 is not discussed.