

Response to the referees of the manuscript “An energetic perspective on the impact of the Atlantic Multidecadal Variability on the West African Monsoon”

Dear co-editor,

Please find below the detailed point-by-point response to the comments of the two referees who suggested further modifications to the manuscript. In this response, we specify the changes made to address them using the line numbers in the marked-up manuscript where they can be found. We would like to thank the three reviewers for their time and effort invested in helping us to improve the manuscript.

Comments from reviewer 1 (Report #2)

General

This is my second review of the this work, in which the authors study the influence of Atlantic Multidecadal Variability (AMV) on the West African Monsoon (WAM) in a suite of simulations. The energetic framework utilized to analyze the relation of AMV and WAM successfully captures this relation, and is consistent with previous work showing that the Saharan Heat Low acts as a mitigating element on the African monsoon. The authors have adequately addressed my comments and I would recommend the paper be accepted. However, I still find that the authors can do a better job of explaining the energetic framework as it applies to regional variations. Some minor comments are provided below.

We thank the reviewer for these comments.

Comments by line number in the tracked changes pdf

63 AMV on the WAM

75 of the AMV (and elsewhere: the article ‘the’ is generally not used before acronyms)

We thank the reviewer for their careful reading of the manuscript. We have consulted the Chicago Manual of Style (2024) on this matter. The manual distinguishes between acronyms and initialisms. The former refers to terms based on the initial letters of their elements and read as single words (e.g., AIDS, NASA), while the latter refers to terms that read as a series of letters (e.g., IRS, NBA). The manual explains that acronyms, as they are read as a single word, are not normally preceded by an article (a, an, the), except when used adjectivally. However, initialisms, which are read as a series of letters, are often preceded by the definite article. Even here, it acknowledges that whether to include the article may depend on established usage. If there is no established usage, it recommends using the definite article if it would be used with the spelt-out form.

We understand the abbreviations used in our manuscript (AMV, WAM, ITCZ, AEJ, SHL, SMC ...) as initialisms rather than acronyms. For instance, one reads AMV as “AY-EM-VEE”. Given that in the spelt-out form we would use the definite article to refer to the Atlantic Multidecadal Variability, we have not removed the article “the” as suggested.

229 Here, again, the role of equatorial/tropical NEI, which dictates the amplitude of ITCZ migrations in response to hemispherically asymmetric heating, should not be a-priori ignored (e.g., Shekhar and Boos 2017, Adam et al. 2019)

We thank the reviewer for pointing out this fact. Changes in equatorial NEI could also modulate ITCZ shifts. This was actually not the case in our simulations, as shown in our last response. However, as the reviewer rightly points out, this possibility should be mentioned at the beginning of the section. To take this comment into account, we made the following modifications to the manuscript:

- Include in the line highlighted by the reviewer the role of equatorial NEI for modulating ITCZ migrations. The new sentence reads (lines 225-227): *“The energetic framework has established a clear link between similar ITCZ shifts and changes in the cross-equatorial atmospheric energy transport, modulated by the inverse of the net energy input into the atmosphere (NEI) in the equatorial region (Donohoe et al., 2014; Adam et al., 2016a, b, 2019; Shekhar and Boos, 2017).”*
- Add as a point of analysis the equatorial NEI anomalies in the following sentence (lines 228-229): *“It is therefore of interest to investigate whether the identified rainfall changes at Sahel longitudes are related to corresponding changes in cross-equatorial energy transport and equatorial NEI modifications.”*
- Include a comment on the equatorial NEI anomalies in our simulations (lines 231-232): *“In response to a positive AMV, changes in equatorial NEI at Sahel longitudes are small (Fig 4a) and show no consistent alignment with Sahel rainfall changes (not shown).”*

235-236 You are invoking arguments suited for the zonally averaged circulation, which are not necessarily adequate for regional circulations (cf. Adam et al. 2016b). Instead of ‘typically’ please explain that the regional Meridional Overturning Circulation (MOC) is consistent with the zonally averaged paradigm, which, in turn, means that sector-mean zonal energy fluxes can be neglected.

We thank the reviewer for this remark. We have rephrased the last two sentences of the paragraph, so that the distinction between zonally averaged energetic arguments and the regionally constrained evaluation is now more clearly separated. The text now reads (lines 234-240): *“Provided gross moist stability does not change (Kang et al., 2009), the zonally averaged southward energy transport is realised through a northward displacement of the ascending branch of the Hadley circulation (Donohoe et al. 2014). The simulated increase in Sahel rainfall and associated ITCZ northward shift together with the anomalous southward energy transport at the Sahel longitudes are consistent with the zonally averaged paradigm, suggesting sector-mean zonal energy fluxes are of second-order relevance (Adam et al. 2019b).”*

340 (Eq. 1)

Corrected, thanks!

351 Please provide supporting literature for this claim.

We have added a reference to the work of Neelin and Held (1987), where the eddy transports of dry static stability and moisture over the tropics are discussed (see line 352).

References

Adam, O., Schneider, T., Enzel, Y., & Quade, J., 2019: Both differential and equatorial heating contributed to African monsoon variations during the mid-Holocene. Earth and Planetary Science Letters, 522, 20-29

Comments from reviewer 2 (Report #3)

I think the paper is now ready to be published.

Before publication, the reference for gross moist stability may need to be changed. GMS from Raymond et al. 2009 is not for describing the energy transport and circulation anomaly related to the ITCZ shift. For this purpose, Kang et al. 2009 uses the concept of GMS first. Dr. Issac Held is co-author of this paper, who invented the concept of original GMS at Neelin and Held 1987.

Kang, S. M., Frierson, D. M. W. & Held, I. M. The Tropical Response to Extratropical Thermal Forcing in an Idealized GCM: The Importance of Radiative Feedbacks and Convective Parameterization. Journal of the Atmospheric Sciences 66, 2812–2827 (2009).

We thank the reviewer for this suggestion. We agree that the effect of modifications of gross moist stability is more clearly exemplified by the work of Kang et al. (2009). We therefore change the reference from Raymond et al. (2009) to Kang et al. (2009) in the new version. The change can be found in line 235 of the marked-up manuscript.

Other than this, the paper is elegantly written and ready to be published. It's my honor and pleasure to encounter such a great paper. Thank you!

We are deeply honoured by this review. We express our gratitude to the reviewer for their careful reading and constructive comments and suggestions provided.

Further changes made to the text:

We have added a new affiliation for the first author, following her recent incorporation with the Instituto de Geociencias (IGEO).

References:

- Neelin, J. D. and Held, I. M.: Modeling tropical convergence based on the moist static energy budget, Monthly Weather Review, 115, 3–12, [https://doi.org/https://doi.org/10.1175/1520-0493\(1987\)115<0003:MTCBOT>2.0.CO;2](https://doi.org/https://doi.org/10.1175/1520-0493(1987)115<0003:MTCBOT>2.0.CO;2), 198
- The Chicago Manual of Style, 18th ed. University of Chicago Press, 2024. <https://doi.org/10.7208/cmos18>