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An objective identification technique for potential vorticity structures associated with African Easterly Waves

The manuscript is well-structured, introducing a new identification and tracking approach for African easterly waves (AEWs) that incorporates the 3-D PV structure of the waves. The tracker is promising and provides a new method for analyzing AEWs. It is great to see the authors sharing this tool with the community. Nevertheless, this reviewer has a few major concerns that must be addressed for publication. I encourage the authors to view these comments as an opportunity for improvement.

One significant concern is that, while the authors do include a review of existing trackers, the introduction lacks references and discussion of more recent trackers. This reviewer suggests that the authors expand on the applications of the trackers already mentioned and incorporate additional references to recent trackers along with their applications. Below are a few references the authors should include:

AEW tracker by Lawton: https://doi.org/10.1175/MWR-D-21-0321.1

Lawton's AEW tracker applied: https://doi.org/10.1175/MWR-D-23-0005.1

Tropical easterly wave tracks by M. Hollis: https://doi.org/10.1007/s00382-023-07025-w

Alan Brammer's AEW tracker: https://doi.org/10.1175/MWR-D-15-0106.1

Brammer's AEW tracker applied:

https://doi.org/10.1175/MWR-D-20-0152.1, https://doi.org/10.1175/JAS-D-20-0339.1

Monsoon low-pressure system tracker by Hurly and Boss 2015: https://doi.org/10.1002/qj.2447

Another concern is that merely comparing the identified and tracked features to climatology is not sufficient for the proper evaluation and validation of this unique identification and tracking method. This reviewer recommends that the authors incorporate a sensitivity test and compare this identification and tracking scheme to at least one other algorithm or tracker. A simple sensitivity test, where the authors can compare differences in frequency, intensity, splits, mergers, initiation, and termination, would be highly valuable for the AEW-analyzing community and would support the validity of the proposed technique. The authors do not necessarily need to run the algorithms for the entire climatology, but adding a section that intercompares them for a small period would certainly be insightful. This type of analysis aligns with current trends in the community, where it is becoming more common to evaluate multiple object-based tools. For reference, see Prein et al. 2024 for an MCS intercomparison study: https://doi.org/10.22541/essoar.169841723.36785590/v1. The authors have a unique opportunity here to compare their results to another tracking algorithm.

Given the intrinsic relationship between PV structures and convection/diabatic heating, this reviewer anticipated the inclusion of figures related to convection, such as diabatic heating profiles or Outgoing Longwave Radiation (OLR). It would enhance the reader's understanding of this relationship and its significance if the authors incorporated such an analysis in climatology.

Furthermore, it would be beneficial for the authors to include a discussion (aside from what is already presented in the conclusions) regarding the tracker and its potential role in distinguishing between developing and non-developing African Easterly Waves (AEWs).

Specific comments:

Line 23: AEWs are known to also initiate over high topography, especially over eastern Africa (and thus, the Ethiopian Highlands (Hamilton et al., 2020, Rajarsee et al., 2023 as well as others). Moreover, AEWs that initiate over eastern Africa are more likely to become TC in the eastern Atlantic (i.e., Núñez Ocasio et al., 2021). Please include these references and other relevant references.

Line 27: AEWs are also related to the West African offshore rainfall maximum (i.e., Hamilton et al. 2017).

Line 53: Please rephrase “theoretical perspective” as the other references also incorporate theories in their analysis. Dunkerton et al., 2009 proposed a simpler ‘geometrical’, forecaster-friendly idea.

Tracking: It is unique that the authors incorporate MCS tracking methods into the tracking of AEWs. Both overlapping (Houze, Evans, and Shemo, PyFLEXTRKR by Z. Feng, TAMS by Núñez Ocasio, and MOAAP by Andreas Prein) and graph theory (Kim Whitehall) are used to track MCSs. Please make a point of this and include references.

Line 150: What features do the authors refer to? It is more likely for convection or PV features to split and merge than the actual AEW splitting and merging. Please clarify.

Line 206: And how do you account for these artifacts?

Figure 3: Is shading height or PVU contours? Please clarify and add units.

Line 227: As well as thermodynamic constraints (Núñez Ocasio and Rios Berrios 2023). Please add.

Lines 360: The AEJ was not studied in detail and so it is a speculation. Remove or add such analysis.