Review of

African Easterly Waves in an Idealized General Circulation Model: Instability and Wave Packet Diagnostics
by
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RECOMMENDATION: Accept after only minor revisions.

OVERVIEW

This is an interesting study that advances understanding of the evolution of African easterly wave (AEW) packets in zonally varying African easterly jets (AEJs). At the heart of the study is the examination of how the zonal extent of the AEJ affects the growth of the AEWs. This study builds on prior work by Hall et al. (2006), Thorncroft (2008), and Leroux and Hall (2005), who showed that in a zonally varying AEJ, realistic boundary layer damping suppresses, and even reverses, the normal mode growth rates of the AEWs. These studies, however, did not consider how the zonal extent of the AEJ affected the growth rates and longevity of the AEWs.

To carry out the analysis, the authors employ an idealized general circulation model with realistic boundary layer damping; the basic states are constructed from global reanalysis fields. The central result of the numerical results is that irrespective of the length of the AEJ, the AEW packets grow and remain confined to the AEJ, which is reminiscent of absolute instability, as discussed heuristically by the authors. The authors find that for most basic states the AEWs are damped, though for some basic states the AEWs are able to grow exponentially. The connection between the lifetimes of the packets, which are distinguished as short, medium and long based on criteria defined by the authors, provides further insights into the AEJ-AEW connection.

The hypotheses that motivate the study are clear, the experiments are well designed, and the analyses are comprehensive.

COMMENTS

Comment A: It seems to me that it would be instructive to have a quantitative measure for the limited zonal extent of the AEJ. The authors could then quantitatively compare its zonal extent with the amplification and longevity of the AEWs. In fact, dynamically, comparison between the potential vorticity (PV) gradient and the longevity of the waves would be the most insightful. Say, for example, the meridional gradient of PV changes sign in a zonally limited section of the jet. How does the zonal length of the sign reversal region relate to the longevity of the waves? Perhaps the authors could comment on this.

Lines 45: The term “antifriction” is a bit unclear, although this term is commonly used in engineering when referring to lubricants in bearings, for example. I am unaware of it being used in an atmospheric context. Perhaps the subsection heading could be: *The destabilizing influence of moist convection and dust aerosol loading.*

Line 47: The first sentence of the paragraph states: “…two critical aspects of the dynamics are missing in their simulations.” It might be clearer to start the next sentence as: “First, their model has no…” Then the next paragraph, **line 55**, could perhaps start with: The other aspect that was not considered in the simulations of Hall et al. (2006) and Hall (2009) were the feedbacks associated with aerosol loading…

Line 153: Perhaps make this question a little clearer by writing: What mediates the vacillation of AEW activity?

Lines 154-155: When the authors state the slowly varying background flow alternates aperiodically…" do they mean that it alternates aperiodically in time or space, or both. Also, how do the authors define "slowly varying?

Comment B: For my eyes, the figures are too small. Perhaps they can be enlarged so that the axis notation and wind contours are more easily seen.

Line 238: The authors state: "Importantly, as seen in observations, the AEW wavepacket…" It would be helpful if a couple of references could be provided regarding the observations. Also, "AEW wavepacket" should perhaps be "AEW packet", here and elsewhere.

Line 347: "…basic states considered here are associated with reversal in potential vorticity gradients,…" Are the reversal in PV gradients over the entire zonal extent of the jet or only over a portion? In either case, what are the physical implications?