

Responses to EC1:

Among the comments on this paper is a community comment by Dr. Paul Pukite. This comment proposes a new theory for the generation of the QBO which does not involve wave/mean flow interactions - the theory which has been accepted for over 40 years by the atmospheric community. As this comment involves a new idea that has not been published in a recognized journal and received peer review, it should be addressed in a separate paper where its scientific quality and relevance can be appropriately evaluated. This could either be led by Dr. Pukite, or the authors of this paper in collaboration with Dr. Putike should they feel it to be a valuable contribution to the field. In this respect, the recent review on the QBO by Anstey et al. (Nat Rev Earth Environ 3, 588–603 (2022). <https://doi.org/10.1038/s43017-022-00323-7>) and references therein might prove useful as an indication of the physical mechanisms currently associated with understanding this phenomenon.

Response: Thanks for your good suggestions. Anstey et al. (2022) reviewed the QBO on the aspects of its impacts (teleconnections), governing processes in physical models, projected changes in climate, and some uncertainties in modeling QBO. The consensus for the generation of the QBO is the wave–mean flow interactions. The waves include Kelvin waves, mixed Rossby and gravity waves, and inertial-gravity waves.

Following your suggestion, we will address the community comment by Dr. Paul Pukite in future work.

Moreover, in the second paragraph of Section 1, this point has been revised as “the QBO (quasi-biennial oscillation) in the tropical regions has periods of 2–3 years due to wave-mean flow interactions in the tropical regions. These waves include Kelvin waves, mixed Rossby and gravity waves, and inertial-gravity waves (Baldwin et al., 2001; Anstey et al., 2022)”.

Anstey, J. A., Osprey, S. M., Alexander, J., Baldwin, M. P., Butchart, N., Gray, L., Kawatani, Y., Newman, P. A., and Richter, J. H.: Impacts, processes and projections of the quasi-biennial oscillation, Nat. Rev. Earth Environ., 3, 588–603, <https://doi.org/10.1038/s43017-022-00323-7>, 2022.