

Dear Prof. Naoe and co-authors:

Thank you for your revised manuscript (WCD 2025-1148). I am recommending major revisions before the manuscript is accepted for publication, although they are better described as “minor but mandatory” revisions since they don’t require much in the way of analysis. Rather, they are required because the discussion of the response of the Walker circulation should be revisited (see next paragraph), and the abstract and Short Summary still do not reflect the degree to which the models do not simulate the observed teleconnections between the QBO phase and the frequency of SSW in the polar vortex. Finally, I appreciate the additional discussion that offers reasons for why the models have such poor teleconnections to the polar vortex and the subtropical Pacific Jet. Your explanation for both is that the amplitude of the QBO in the lower stratosphere is too weak, and this is a very reasonable and important insight from the QBOi experiments. You should emphasize this in the discussion section and mention it in the abstract.

Please feel free to contact me if you have questions.

Regards, David

Major comments:

Concerning the Walker circulation, the original analysis used a season (JJA) and definition of the QBO that was based on observations and was applied to all models. The results showed little impact of the QBO phase on the Walker circulation (now in Figs. S9-S11). The revised manuscript uses time periods and QBO definitions that maximize the correlation between the QBO phase and the Walker circulation response in each model, and the results show that most models reproduce the observed circulation anomalies over the Indian Ocean and Maritime Continent. What is missing in this discussion is that, the difference in circulation over this region due to QBO-W minus QBO-E for the La Nina conditions is (given the weak statistical significance) basically the same for the El Nino conditions (c.f., Figs. 11 and 12) and (not surprisingly) for the control simulation (c.f., Fig. S12 with Figs. 11 and 12). Hence, it should be noted in the text (and in the abstract) that the impact of QBO phase on the Walker circulation is insensitive to the phase of ENSO. Below, I also suggest a sentence to reflect this result be included in the abstract.

Abstract suggestions (note: all line numbers refer to the revised text, not the Author tracked changes).

- Lines 37-40: change to read “... are found in LN than in LN, **although the differences in frequency are much smaller than that observed. Unlike in the observations, there**

is no discernible difference in the QBO westerly (QBO-W) and QBO easterly (QBO-E) phases. The Asia-Pacific subtropical”

- Sentence starting on line 41 (“The sign and ... phases of ENSO”): delete this line because it is redundant with the sentence starting in the previous line (“IN the tropics...”).
- Lines 45-46, modify to read “...and most models, with the QBO-W phase featuring upper-level westerly and lower-level easterly anomalies over the Indian Ocean-Maritime Continent relative to the QBO-E phase, although its amplitude and timing are model-dependent. In models, the impact of the QBO phase on the Walker circulation is insensitive to the phase of ENSO.

Minor Comments

The colorbar keys in Figure 2 are unreadable, and there are too many contours in the plots. Reduce the number of contours, or consider uneven contour intervals.

Figure caption 3: Delete the line “While for ... multi-model mean” and append this to the figure caption. “The dashed line in panel (a) shows the difference in observations when all years (1959-2022) are included in the analysis.”

There is unnecessary and tedious detail in describing the deficiencies in nearly all the models to reproduce the observed relationship between the QBO phase on the phase of ENSO. Please delete lines 391-397 and replace them with the simple conclusion “Only one model (ECHAMsh) shows the observed relationship between the frequency of minor warmings and the phase of ENSO.”

In Figure 4, please elaborate in the text why there are two (sometimes three) symbols for the same experiment in the GISS models and for the CNT experiment using the MIROC-ESM?

On Lines 540-541, “... and models show a distinct QBO signal between EN and LN experiments.” I don’t see this in Fig. 8. Figure 8 shows none of the models produce a robust precipitation response predicated on the phase of ENSO – anomalies are only a small fraction of those observed, and only (at best) a few percent of climatology.

Lines 612-614: That the observed precipitation response may depend on the sign of ENSO should be the first sentence in Section 5.1. The second line (“Overall, all ... experiments and models”) is redundant with the discussion that immediately precedes it, and it should be deleted.

Figures 11 and 12. Again, the color of the contour lines does NOT match the shading scale in the colorbar; rather, the contour lines are all the same color. Please delete this phrase in both figure captions and indicate in the figure caption the contour interval of the plotted anomalies.

Line 717: ESM2.0 or MRI?

Lines 825-829: It should be noted that the impact of QBO phase on the Walker circulation is insensitive to the phase of ENSO.