Response to Reviewer #4 (Prof. David Battisti)

Dear Dr. Andrews,

We have received three thoughtful reviews of "Extratropical teleconnections in a multimodel ensemble nudged towards the observed QBO" (WCD 2026-737). The ball is now in your court to post your response to how you and your co-authors intend to respond to these three reviews. In the way of some guidance, I note that all three reviewers have significant concerns that must be addressed in a revised manuscript for it to be publishable in WCD.

Regards, David Battisti

PS. I include below some of my own comments on the manuscript.

Response: The authors thank Professor Battisti for these positive remarks.

Editor's additional comments:

Figure 2: what months are included in "mid-winter"?

Response: "mid-winter" removed and instead the specific months are now given.

Lines: 283 – 284.

Line 270 and elsewhere: Please provide information on how the BCs differ; how the experimental periods differ; how the models changed. Have they all changed? Are some of the models used in phase 2 identical to that used in phase1? If so, which ones?

Response: The experiment description has been rewritten (Section 2) plus we added reference to the QBOi phase 2 protocol paper (Anstey et al., 2026) which wasn't available in the public domain at the time of submission. We believe that together these changes address all the issues raised here.

Lines: 205 – 246.

Line 285: what is meant by significant? Statistically significant? If so, at what level?

Response: Details of the "significance" is now given.

Lines: 292 – 294.

Line 330: please also state the regression coefficient for the models and for observations.

Response: Thank you for highlighting this important omission. The regression coefficients for the experiments and observations have now been included. They highlight that the strengths of the ensemble-mean QBO-PNJ teleconnections are largely unchanged for Exp1 and Exp1-ObsQBO, and that the improvement is linked to a more realistic amplitude of the nudged QBO. Additional text has been included in section 3, the abstract and conclusions.

Lines: 378 – 384.

Lines 339-41: Rather than look at the relationship in the MMM, perhaps a better indication of how well the models are doing is to string together the time series from all models and then correlate the PNJ with the QBO.

Response: The reason for using the MMM is to eliminate or dampen internal variability. It likely that the correlation for an extended timeseries will already be close to its asymptotic values after 40 years.

Line 390-91: How different are the SSW frequencies in the warm vs. cold phases of ENSO. Please quantify this (in observations and models) by calculating the p value for the difference between two means, taking into account the number of events in QBOE and QBOW. Put 2 sigma uncertainty bars on the mean values for the ERA results, for the ALL ENSO and La Nina cases.

Response: As noted in response to your next comment, Figure 8 has been greatly revised and now shows uncertainties (error bars) on all QBOE-W SSW frequencies. In addition, we have removed parts of the text referenced above which talk about difference in SSW frequencies during different ENSO phases as these were found to be broadly small and insignificant, and, instead, mentioned the neutral-ENSO phase results which were not significant.

Lines: 523 – 533, 467 – 520.

Lines 388-395 and figure 8. In addition to what is shown in this figure, you might consider looking at the difference between the SSW frequencies in QBOE and QBOW for each model, and then plot the model spread in the difference. If it is interesting, you could plot this as panel b in figure 8 (or simply add more columns to the existing figure, but that might be confusing).

Response: Figure 8 has been significantly reworked based on your comment to only show QBOE-QBOW SSW frequency difference for each experiment, for the multi-model ensemble, Holton Tan ensemble (models with a significant HTE), and ERA5. The spread in these values is also shown, using Poisson uncertainty for ERA5 and standard deviations for the multi-model ensembles.

Lines: 523 – 533, 467 – 520.

Figure 12 is difficult to read. Please split the figure into panel a (Exp1) and panel b (Exp1-

ObsQBO) so we can see the difference.

Response: The co-authors prefer the combined version of the figure as it allows a direct comparison of the ensemble mean zonal-wind anomalies between Ex1-ObsQBO and Exp1. We also prefer not to increase the number of figures. We have, in response to a different reviewer comment, flipped the diagram to show QBOE-W which is consistent with the other sections.

Lines: 676 – 682.

Figure 14 and the discussion. I agree with Anonymous Reviewer #2. This figure is very difficult to read, and correlations are very likely not significant. I strongly recommend you remove this figure and the related discussion.

Response: We agree with the suggestion and have removed Figure 14 and associated text.

Lines: 723 – 746.

Additional modifications not directly related to reviewer comments:

Line 51: Minor editorial revision.

Lines 56 – 58: Minor editorial revision.

Line 91: Minor editorial revision.

Lines 184 – 190: Minor editorial revision.

Lines 258 - 259: Minor editorial revision.

Lines 262 – 265: Minor editorial revision.

Line 350: Minor editorial revision.

Line 537: Minor editorial revision.

Lines 458 – 453: Minor editorial revision relating to Figure 7 now showing Exp1-ObsQBO results (which gives similar results for Exp1 and Exp1-NoQBO, Lines 452 – 453).

Lines 453 – 466: Replaced existing text with a more concise analysis relating to ENSO-filtering of SSWs.

Lines 561 – 569: Minor editorial revision.

Lines 625 – 626: Minor editorial revision.

Lines 781 – 782: Minor editorial revision.

Line 841: Minor editorial revision.

Lines 844 - 845: Minor editorial revision.

The ordering of each set of bars for Figures A1 and A2 has been revised to maintain consistency with Figure 9. Lines: 850 – 860.

Lines 933 – 935: Removed reference.

Lines 937 – 939: Added reference.

Lines 950 – 957: Updated Anstey et al., (2026) reference with latest information.

Lines 959 – 960: Removed reference.

Lines 999 – 1000: Added reference.

Lines 1152 – 1153: Added reference.

Lines 1201 – 1202: Removed reference.