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Geoscientific Model Development Discussions

Interactive comment on "Overview of experiment design and comparison of models participating in phase 1 of the SPARC Quasi-Biennial Oscillation initiative (QBOi)" *by* Neal Butchart et al.

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This study introduces the model integrations performed as part of the first phase of the QBOi, a model inter comparison project that hopes to shed light on the processes that lead to a spontaneous QBO and how they will change in the future. Such a project is sorely needed in our field, and I look forward to reading future papers that utilize this model output. I have only a few minor comments, and after the authors address them the paper will be ready for publication.

>Again the authors thank the referee for kindly reviewing this manuscript.

1. Figure 2: The use of filled black patches for the "mean annual cycle" forcing is visually confusing. I suggest a thick line.

>The suggested change has been made.

2. It is too late to correct this, but in retrospect there probably should have been guidance for the ozone profile to be used for models without interactive chemistry. There are ozone-temperature feedbacks in this region that will differ among models, and unraveling the causes of these feedbacks will likely be hard. Again, I don't think it is worth rerunning experiments, and hopefully the archived ozone will suffice.

>The experimental protocol has already been agreed and can not be changed for phase 1 of QBOi, however in the closing remarks we allow for the possibility of testing the QBO's sensitivity to ozone in the next phases of QBOi. As noted also in our response to reviewer #2, in phase 1 of QBOi the models are tuned to give the "best" QBO and sensitivity to the precise details of the ozone profile was not considered important provided that, for each model, the same ozone profile was used across all experiments. This is now spelt out more clearly in the revised subsection on ozone.

3. The numerical, thermal, and mechanical dissipation used by each model likely differs, and these three sources of dissipation might be important for the QBO momentum budget in some models (e.g. Yao and Jablonowski,2015, already cited). I have two suggestions: first, please ask the models to submit their wind and temperature tendencies due to these three sources of dissipation (or at least the total tendency due to dissipation)! Zonal and monthly mean is probably good enough. Second, please add a column to table 6 or 7 (or a new table) where each model reports on how it implements numerical, thermal, and mechanical dissipation. It might also be helpful for each model to state which advection scheme/dynamical core it uses.

>We have added a new table (Table 7 in the new manuscript) in which each model reports its advection scheme and artificial dissipation processes. Again the data request has already been agreed and groups have mostly finished uploading their output.

Nonetheless we note and agree with the referee's suggestion for archiving tendency terms and will try to include these in all future QBOi data requests.

4. Figure 7, top left panel: I suggest writing the model names in color. Also, two colors appear to be used for more than one model (at least to this reviewer's mildly color-blind eye). Specifically, the shade of red used for MIROC-ESM (F-H) and HadGEM2-AC (P-WM) is very similar. Similarly, the shade of green used for LMDz6 (P-L) and EMAC (F-H) is very similar. Please adjust the colors to add more contrast.

>For consistency with the other figures, we have not written the model names in color, however labelling has been improved in this figure (and Figures 4 & 6) by increasing the size of the line segments in the legend. The grey of the wind profile has also been lightened so it doesn't conflict with the legend text as harshly. Model color allocation has been agreed for all the phase 1 QBOi papers and therefore changing it in this figure is perhaps not a good idea. It is rather difficult finding 17 distinct colors and we accept that this sometimes makes it difficult to distinguish models but on our careful checking it is always possible for the figures in this paper.

5. Page 23, line 4 "between" is misspelled.

>Corrected.

6. Table 4: it would be helpful if one level near 200hPa was also included, as one might want to compare the upper tropospheric resolved wave spectrum (i.e. Wheeler and Kiladis 1999 diagrams) among models. That is, the resolved wave spectrum near the top of convection will differ among the models (possibly due to different convection schemes used by each model), and it might be interesting to relate any differences in QBO morphology to differences in tropospheric wave generation that are in turn related to convection schemes. This additional level will also allow one to study the affect of vertical resolution in the TTL on resolved wave vertical propagation – it is conceivable that models with coarser vertical resolution will have stronger degradation in their resolved wave fluxes between âĹij200hPa and âĹij100hPa.

>Again the data request has already been agreed and groups have uploaded data. Nonetheless we agree with the reviewer's suggestion and will consider adding upper tropospheric levels to future QBOi data requests.

7. The native vertical levels of each model (i.e. the data underlying figure 4) should be made accessible, perhaps as a data supplement or hosted on the QBOi website.

>The location of the native vertical levels of each model is now in indicated in Figure 4b by the very thin horizontal lines.

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