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Geoscientific Model Development Discussions

Interactive comment on "Defining metrics of the Quasi-Biennial Oscillation in global climate models" *by* Verena Schenzinger et al.

Anonymous Referee #3

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The QBO is the primary mode of variability in the Tropical stratosphere. The current paper aims to establish a set of standard metrics that comprehensively characterize the QBO. Subsequently the metrics are applied to 10 global circulation models, observations and reanalysis.

This paper is a very useful contribution, however I have some concerns and hence recommend major revisions.

Major Concerns:

1) The primary goal of this paper is to establish a standard set of metrics that can be used in the future. Ideally, the paper should include codes for calculating the metrics, so they are easily reproducible by other groups – hence point to a website from which such a diagnostic package can be downloaded. At the very least include very clear, step-by-

step instructions on how the metrics were calculated should be included (without any ambiguity). The metrics presented here are reasonably well described, however there are lots of details in calculations, especially related to calculating the Fourier spectrum (step 1) which are omitted.

2) The paper somewhat lacks a description of what are the science goals motivating these metrics. The presented metrics seem useful to the general assessment of the representation of the QBO in global models, however they do not address aspects related to studying QBO related phenomena, such as QBO teleconnections for example. Hence, the use of these metrics is somewhat limited.

3) The Fourier analysis is useful in certain respects for the assessment of the QBO (such as hmax, mean period), however from the mean and min/max QBO period values presented in Table 3 it is difficult to assess whether a model is getting the correct period distribution. The periods of the QBO vary between 20 and 35 months, and a simple histogram showing the number of times each period occurs would be more helpful in comparing observations to model output.

4) It would be nice to see all the diagnostics for all the models in the appendix (ie.: Figure 2, Figure 4, Figure 6). The multi-model mean is nice to see and the numerical diagnostics are listed in Table 3, but the figures contain so much more information - it would be nice to see the complete set of metrics for all the models.

5) The metrics do not address the forcings of the QBO: gravity waves, resolved waves, vertical advection. It is possible for the QBO characteristics to be very close to observations, and for the forcing mechanisms to be unrealistic (ie.: lack of contribution from resolved waves, etc). Hence the addition of metrics addressing the momentum driving of the QBO would be a very important metric to add.

Minor Comments:

1) Page 2, Line 23: There is an inconsistency between 'four CMIP5 models, and 5

CCMVAL models' here and Table 1. In Table 1 only 3 models are listed as part of CMIP5: MIROC-ESM-CHEM, MPI-ESM-MR and HadGEM2-CC ; I believe the CMCC-CMS should be included in the list of CMIP5 models in the caption of Table 1.

2) Page 3, Line 3: 'the period of the oscillation. . .' - this should say 'the mean period of the oscillation' - it is well know that the period varies quite a bit as noted further in that paragraph

3) Figure 2 caption: What is hmax ?

4) Page 5, Line 5: 'eleven models' – aren't there only 10 in Table 4?

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