

Interactive comment on “Net effect of the QBO in a chemistry climate model” by H. J. Punge and M. A. Giorgetta

Anonymous Referee #3

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General Comments:

This study seeks to understand the climatological effects of the QBO on stratospheric circulation and ozone by comparing ~20 year averages between model experiments with and without a QBO produced by nudging to the Singapore data. The authors also make the claim that because their QBO is nudged to observations, they can make comparisons of winds, temperature and ozone to observations at specific times.

I don't think that the approach the authors take has led to any new information about the QBO and its influence at mid and high latitudes. Also, I think it's unfortunate that the control run does not include the same drivers of variability as the QBO run. It's hard to tell whether the small changes are coming from volcanic eruptions and solar cycle

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variability or from the QBO.

Since the chemistry is interactive, I wonder whether the authors have considered studying how the chemistry interacts with the radiation and circulation.

Specific Comments:

P12118, L2-7 - The model is just nudged to observations in the tropical stratosphere, right? Otherwise, the climate model has it's own variability at mid- and high latitudes? Perhaps a bit more information on this would be helpful here. A claim is made that the model may be more directly compared to observations, yet this might not be true at higher latitudes if the model generates its own variability.

P12120, L 16 - Is there hemispheric asymmetry in the equatorial zonal wind?

P12120, L18-29 - So only 16 years of the QBO experiment is used in analysis rather than 20?

P12121, L 19 - Explain what is meant by "mesospheric overflow".

P12122, L20-22 - Would this imply that the effects of ENSO in the tropical lower stratosphere are overwhelmed by the QBO? In what way could the QBO be important for understanding the impact of ENSO?

P12123, L 6-15- Have the model results also been averaged over 6 years? Also, are the HALOE O3 measurements used in the ERA-40 reanalysis? Why is there there a difference just below 10hPa where the model compares better with HALOE? Also, given the variability in the model, and the short (?) averaging period, are the differences between the QBO and non-QBO profiles significant?

P12123, L25-29 - Why isn't there an eruption signal in the HALOE data?

P12424, L4-5 - Aren't the anomalies out of phase between the upper and lower stratosphere in the non-QBO run? Otherwise, there couldn't be a phase change at 15 hPa. Also, why is the reanalysis so different? Maybe it shouldn't be included in the compar-

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isons in this study.

P 12126, L 24-25 - The definition of photochemical equilibrium is this cancellation.

P12127, L1-4 - Are the NO₂ anomalies in or out of phase with the upwelling? It seems to me that NO₂ should be low when there's upwelling.

P12127, L19-29 - Why was September chose for Figure 6. Given the seasonal synchronization of the QBO and annual cycle, it maybe more interesting to look at NH or SH winter months.

P12131, L19 - Also see references by Hamilton, who proposed the mechanisms by which the QBO and the annual cycle modulate each other.

P12136, L1-10 - The important issue of the different forcings for the QBO and non-QBO is only mentioned here at the end. A more thoughtful and detailed exploration of the effects of these differences should appear somewhere else in the text.

P12136, L16 - What is the "BDC"?

Technical Comments;

P12116, L5 - "QBO-less" P12116, L11-12 - "nitrogen oxides, NO_x, "..... P12117, L5 - "cannot" P12117, L11 - "prominent example of...." P12118, L15 - "considerations of...." P12118, L25 - "stream" P12119, L9 (and throughout) - "QBO's" P12119, L15 - "model's" P12120, L8 - "are relaxed" P12120, L8 - "which are" P12122, L20 - "non-QBO" P12123, L3 - "prominent example of".... P12126, L1 - "produce" P12129, L1,2 - I wouldn't use the term "false detection". How about using "bias"? P12130, L1 - "equinoctal", I think. P12130, L5 - "westerly in both".... P12131, L14 - ... "These..." P12133, L23 - ... " and only differ in how the representation of the QBO was...." P12135, L5 - "nitrogen oxides"

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