

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

Anonymous Referee #1

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Referee report on the manuscript

Net effect of the QBO in a Chemistry Climate Model

by

H. J. Punge and M. A. Giorgetta

I suggest to publish the manuscript in Atmospheric Chemistry and Physics after addressing some minor comments and suggestions given below.

General comments

The authors investigate the impact of the QBO on stratospheric ozone and on the circulation with a chemistry climate model. They present a comparisons of pairs of model

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runs with and without nudging of zonal winds to observations from radiosondes for the 20 year periods 1980-1999 and 2000-2019. The authors conclude that most of the QBO effect can be attributed to changes in the meridional circulation and that accurate modeling of the stratosphere requires an accurate representation of the QBO in chemistry climate models. The paper is written well and clearly. Some minor comments and suggestions are given in the specific comments.

* The ozone distribution is used as input for the radiation calculations in your model (Sect. 2). Can you give an estimate to what extent changes in temperature fields and thus changes in the circulation between QBO and nonQBO model simulations are caused by changes in the distribution of radiatively active trace gases such as ozone? Do you expect this feedback to be important? Please give a brief statement on this issue.

* Compared to ERA-40 data, SAO is captured by the nonQBO model run better than by the QBO run. What does this imply for your results in the upper stratosphere? Please give a brief comment on whether you expect this might bias your budget analyses.

* You say diffusion plays an important role. Is diffusion included in the advection terms of your budget analyses (e.g. Fig. 6)? What is the relative contribution of diffusion to these budgets? Do you expect this to change significantly when going to a higher vertical resolution such as in ECHAM5 reducing the numerical diffusion?

Specific comments

* p. 12117, line 20-21, "...which may lead to significant deficiencies in the results of these models.": Please be more specific, give examples.

* p. 12118, line 5: I suggest to delete "the higher resolved and improved" and insert "with higher vertical resolution" after "ECHAM5 based simulations". According to the authors, (p. 12119, line 3, "...when used with a high vertical resolution grid...") increasing the number of vertical layers from 39 to 90 levels is more important than going from

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T30 to T42.

* p. 12121, line 17-18, "...the SAO westerlies are suppressed in the QBO experiment when there are westerlies at 20 hPa.": Do you mean at 2 hPa? I suggest to add "in the ERA-40 data" after "hPa"

* p. 12123, line 10-12, "The model run with QBO is slightly closer to the HALO data than the nonQBO run at most levels, indicating that there is a net effect of the QBO.": As you have shown in your study, there is a net effect of the QBO on stratospheric ozone, but I doubt that this can be concluded from the ozone profiles shown in Fig. 3. The differences between the QBO and the nonQBO model runs appear to be very small. What is the interannual variability? Are these differences statistically significant?

Technical corrections

* p. 12118, line 8, "largely": Please insert a cross reference to Sect. 2

* p. 12118, line 11, "longer times": Please be more precise.

* p. 12118, line 25: Change "strem" to "stream"

* p. 12121, line 16: "SAO" has not been defined

* p. 12126, line 1: Change "produceee" to "produce"

* p. 12126, line 14: Delete "and second"

* p. 12131, line 23: "anomlies" —> "anomalies"

* p. 12131, line 24: Delete "fall" after "The cold"

* p. 12132, line 27: Change "higher" to, for instance, "enhanced"

* p. 12132, line 27: "tranport" —> "transport"

* p. 12134, line 7-8: Delete "does not", change "show" to "shows", delete "mid-latitude", replace "1980-1999" with "2000-2019"

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- * p. 12134, line 11: "CFC" has not been defined
- * p. 12135, line 5: Change "mitrogen" to "nitrogen"
- * p. 12135, line 20: Change "higher" to, for instance, "enhanced"
- * p. 12135, line 22: I suggest to insert "of oxygen" after "photolysis rates" to be more precise and clearer to the reader.
- * p. 12136, line 16: Please define "BDC"
- * p. 12144, line 13 (Steil et al., 1998): Change "Brüh1" to "Brühl"
- * p. 12151, line 1 (caption of Fig. 6): Insert "of" after "Contributions"
- * p. 12160-12162, Fig. A1-A3: The figures are too small and the labels are barely readable. Please consider enlarging these figures.

Interactive comment on Atmos. Chem. Phys. Discuss., 8, 12115, 2008.

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