

## ***Interactive comment on “Representation of the Tropical Stratospheric Zonal Wind in Global Atmospheric Reanalyses” by Y. Kawatani et al.***

### **Anonymous Referee #4**

Received and published: 17 March 2016

### **General**

This paper is part of a series of papers reporting on the comparison of the representation of different aspects in major global atmospheric reanalysis datasets; here the focus is on the tropical stratospheric zonal wind and the QBO. The paper works out in detail the agreement and disagreement between the reanalyses. It also analyses the impact of different observations on the quality of the reanalysis. I recommend accept-

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ing the paper for publication in ACP, after some critique (see below) has been taken into account in the revised version.

The paper states that most free-running GCMs have problems simulating a realistic QBO. While I agree that the QBO is still a challenge for GCMs, progress has been made in recent years. Models that have addressed the major shortcoming of GCMs in this respect, namely the representation of atmospheric waves that contribute to driving the QBO, in particularly waves with short vertical wavelengths have shown success in allowing a quasi-biennial periodicity to emerge. Of course parametrised wave drag is still required to generate a realistic QBO. I suggest discussing these recent developments (Orr et al., 2010; Anstey et al., 2016) in a bit more detail.

Further, the QBO induces a secondary meridional circulation, i.e. QBO variations in meridional and vertical winds (Punge et al., 2009). As this point is both important for tropical transport and intimately related to the QBO, I suggest extending the analysis in the paper somewhat to cover this aspect. I think this could be an important contribution of this paper.

On many instances the paper points out observations of differences and aspects of the reanalyses that are interesting to note. For example the finding that quasistationary waves differ significantly among reanalyses. However, it is more important to make progress on finding the reasons for differences between reanalyses. Any suggestions in the paper how to make progress in this direction would be very helpful. I believe that it is beyond the scope of the paper to do assimilation experiments removing certain data sets from the analysis and in this way exploring the impact of particular data sets on the “message” of the reanalysis. But such studies have been done. And perhaps this paper could at least suggest ideas how to move forward in this direction in a discussion. For example what could be important and relevant assimilation experiments to perform?

In summary, I think the paper could be improved with respect to some aspects in the revision. I think it will be a valuable contribution to ACP.

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## Minor issues

- p. 3, l 6: ‘most such models’?
- p. 4, l. 5: there are also more recent publications on this point
- p 7., l 17: So is this only an expectation?
- p 7., l 32: off?
- p 9, l 4: if one writes  $-\$$  in  $\LaTeX$ , then one obtains proper minus signs
- p 10, l 7: change ‘represents’ to ‘shows’
- p 10, l. 26: continuous over which time period?
- p 11, l. 12: I agree it is interesting, but what is the conclusion here?
- p 11, l. 20: I agree it is interesting, but what is the conclusion here?
- p 11, l. 23: why is there a drop?
- p 12, l 5: How likely is the possible reason?
- p 12, l 7: change ‘that’ to ‘on’
- p 12, l 8, 9: I think you mean the radiation code of the forecast model here.
- p 12, l 29: Discuss how this could be tested.
- p 13, l 14: the three most modern reanalyses
- p 14, l 4: why only ‘nearly’?
- p 14, l 12: why?

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- p 14, l 17, 18: It also means that the constraint is really necessary. So there are problems with the underlying model, correct?
- p. 16, Durre et al: abbreviate first names Fig 2, bottom panel: lines are difficult to disentangle

## References

- Anstey, J. A., Scinocca, J. F., and Keller, M.: Simulating the QBO in an atmospheric general circulation model: sensitivity to resolved and parameterized forcing, *J. Atmos. Sci.*, 73, 1649–1665, doi: <http://dx.doi.org/10.1175/JAS-D-15-0099.1>, 2016.
- Orr, A., Bechtold, P., Scinocca, J., Ern, M., and Janiskova, M.: Improved middle atmosphere climate and forecasts in the ECMWF model through a nonorographic gravity wave drag parameterization, *J. Climate*, 23, 5905–5926, doi: 10.1175/2010JCLI3490.1, 2010.
- Punge, H. J., Konopka, P., Giorgetta, M. A., and Müller, R.: Effects of the quasi-biennial oscillation on low-latitude transport in the stratosphere derived from trajectory calculations, *J. Geophys. Res.*, 114, D03102, doi: 10.1029/2008JD010518, 2009.

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Interactive comment on *Atmos. Chem. Phys. Discuss.*, doi:10.5194/acp-2016-76, 2016.

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