

Interactive comment on “Stratospheric Variability at a glance – Analysis of the intra decadal timescale and the QBO” by Duy Cai et al.

Reply Anonymous reviewer 3#

We want to thank Anonymous Referee #3 for the comments. Indeed, the finding of a vertical threshold for the vertical resolution of GCMs are well known. However, to our opinion our manuscript presents different aspects and novel approach to achieve this well known conclusion. May we briefly summarize these aspects and explain our approach.

We started with the analysis of the intra decadal power spectrum and could show the domination of the QBO in the spectrum. To our knowledge this is the first time that the relevance of the QBO has been addressed by power spectral analysis for the intra decadal time scale. The decadal time scale is our motivation, and therefore the title and introduction could mislead the reader. So in a revised version we would make this more clear.

The missing QBO signal in the lower resolution model for the intra decadal power spectrum is expected due to the fact that the vertical model resolution is coarser than 2 km. Also the followed analyses using the method of Wheeler and Kiladis (1999) of symmetric and antisymmetric power spectrum is not novel. However, we now can point out that a low vertical resolution of the model lacks of representing the antisymmetric wave spectra, in particular the power of the MRG waves were under represented. From ERAI data we derived the statistically relevant waves in the antisymmetric wave spectrum. Following linear wave theory these relevant waves are characterized by a certain range of equivalent depth. This certain range of equivalent depth we use as input for our calculation for the vertical wavelenghts of MRG waves. With this calculation we can show that the wave spectrum of MRG waves derived from ERAI, needs at least to resolve waves with a vertical wave length of 2 km. For all numerical models in general, this means that the vertical model discretisation need to be less than 1 km in order to resolve the relevant wave spectrum of MRGW. These aspects of MRG waves, the approach which lead to this finding is new and so far not documented. For a revised version we need to pin point these new aspects more clearly.

Regarding subgrid scale waves, i.e. parametrized gravity waves our discussion sector need to be expanded and will be added in a revised version.

We do not agree with the reviewer criticism not showing new results.

Reply for comments by line number:

90-106: The power spectral method is not clearly described. It's not explained why the calculation is done for 10-year segments in continuously shifting windows. At line 105, it's not clear what "indepedent realizations" means in this context.

We meant statistically independent. Will be revised.

153-154: Why is a statistical significance test used (for ERA-Interim, Fig 2)? It's reasonably well established that the QBO exists.

True. However, it is no clear whether the QBO signal is statistically distinguishable from the background noise on a intra decadal time scale. This is an important question and not answered yet.

178: How big is a "significant fraction" of the zonal momentum forcing? Why is there no mention of gravity waves?

Aspects parametrization of gravity waves in the model will be added in a revised version.

331: "To conclude, this work shows that in the context of decadal predictions the QBO has an important role." Decadal predictions of what? If the troposphere, this has not been shown.

Will be made clearer in a revised version