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Atmospheric Chemistry and Physics Discussions

Interactive comment on "The Quasi-biennial Oscillation and annual variations in tropical ozone fromSHADOZ and HALOE" *by* J. C. Witte et al.

Anonymous Referee #1

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Review of "The Quasi-biennial Oscillation and annual variations in tropical ozone from SHADOZ and HALOE" by Witte et al.

GENERAL COMMENTS

This is a good paper that presents an analysis of coherent variations in ozone, temperature and wind shear in the equatorial region from two different data sources. I have a few suggested changes to the paper and once these have been addressed the paper will be suitable for publication. The paper does contain a lot of repetition and the same information is presented more than once in different places. The writing needs to be tightened up.

SPECIFIC COMMENTS

Page 1, line 15: Is it true that the resolution of HALOE becomes coarse around the tropopause region? I thought that because HALOE was a solar occultation instrument that the vertical resolution was fixed and that retrievals in the lower stratosphere and/or upper troposphere become unreliable simply because the optical depth becomes too great.

Page 1, line 17: You say that 'Strong annual signals of alternating positive and negative ozone anomalies are observed' but isn't an alternating positive and negative anomaly the very definition of an annual signal? Surely this sentence says nothing more that 'Annual cycles in ozone and temperature are well correlated'?

Page 1, line 23: How does it happen that the ozone QBO precedes the QBO in the winds? I thought the QBO in the winds drives the QBO in ozone? In that case I would have expected that the QBO in the winds would precede the QBO in ozone.

Page 1, line 24: You may need to choose your wording more carefully here. It's not entirely clear to me how an annual cycle can have a horizontal length scale. I can guess, but I shouldn't need to.

Page 2, line 12: You say that 'The BDC ... is stronger during northern hemisphere winter' but compared to what? Do you mean it's stronger than in the northern hemisphere summer or stronger than in the southern hemisphere winter, or both? You may need to expand on that statement a bit.

Page 2, line 18: Is it true that radiative heating rates determine the strength of the residual circulation? I thought that the strength of the residual circulation was determined by mid-latitude planetary wave activity and the extra-tropical 'pump' i.e. as proposed by Holtan and Tan.

Page 2, line 20: Have the meridional length scales of the QBO and BDC only ever been previously calculated theoretically? The way this sentence is worded it sounds like this is the first study to provide an analysis of these length scales based on observations.

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Is that the case?

Page 3, line 3: Doesn't it go without saying that if you have nine years of data that you can capture nine annual cycles?

Page 3, line 16: Is the instrument precision 5% throughout the profile? Papers such as:

Smit, H. G. J. and Kley, D.: Juelich Ozone Sonde Intercomparison Experiment (JOSIE), 5 February–8 March 1996, WMO Report No. 130, 108 pp., 1996.

and

Komhyr, W. D., Oltmans, S. J., Chopra, A. N., and Franchois, P. R.: Performance characteristics of high-altitude ECC ozonsondes, in: Atmospheric Ozone, Proceedings of the Quadrennial Ozone Symposium, Greece, 1985.

suggest ozonesonde precision varies with altitude.

Page 3, line 22: It is not true that the ozone QBO signal is narrowly confined to the same equatorial region. It is quite easy to detect the influence of the QBO in mid-latitude ozone.

Page 4, line 5: It seems to me that this is the wrong way around. I thought you would have subtracted calendar month means from the monthly averaged profiles so that when ozone is anomalously high your anomaly is positive.

Page 5, line 11: Do you definitely mean 'monthly zonal mean wind shear' and not 'monthly zonal mean wind' i.e. did you take the first derivative in the vertical of the monthly mean zonal mean wind to derive the wind shear?

I am a little confused by what is shown in Figure 1. The solid and dashed contours show the zonal mean zonal wind shear. So if moving vertically you are shifting from westerly winds to easterly winds this would be plotted as negative wind shear and vice versa. That's all well and good. But then you say 'Solid lines indicate positive (westerly)

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wind regime and dashed lines indicate negative (easterly) wind regime'. Now you can't use the contours to show both the wind shear and the wind. Surely solid lines indicate positive wind shear and not a westerly wind regime. Also the last line of the figure caption should say 'data are' and not 'data is'.

Figure 2: I am surprised that the change of resolution in the SHADOZ profiles from 0.25 to 2 km causes a uniform reduction in the profile. Why is that?

Page 4, line 21: Is this an altitude registration issue for HALOE? How much would the derived altitude for the HALOE profiles need to be changed to bring HALOE into agreement with the ozonesondes?

The caption for Figure 3 needs to say that these are ozone anomalies and not ozone mixing ratios.

Page 5, line 6: You have to be very careful with your wording here. A positive lag indicates that the ozone precedes the wind shear, not the wind. The distinction is very important.

Page 5, line 20: You say that 'The zonal averaging of the SHADOZ data apparently diminishes any ENSO signal...'. Can't you test this easily enough by not calculating zonal means and just look at some individual SHADOZ stations? You could then be more certain than 'apparently'.

Page 6, line 13: I think that you need to cite a paper here that supports your statement that the annual variations in temperature and ozone are driven entirely by the BDC.

Page 7, line 7: When you say 'the QBO easterly wind regime' do you mean 'the QBO easterly wind shear regime'.

Page 7, line 18: So that apparent null point at 30km in the power spectrum fields simply results from the fact that the QBO tends to lift or lower the ozone profile as a whole. A lowering of the ozone profile would cause ozone increases below the ozone maximum and ozone decreases above the ozone maximum. That's why you get signals there. At

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the ozone maximum however, raising or lowering the whole profile by a km or two has almost no effect. You should see opposite phase in your QBO power spectrum at say 33km compared to 26km. Does the ozone profile vertical gradient maximize at 26km?

Page 7, line 21: How can it be an extension of the QBO signal when they are of totally different periods?

Page 8, line 1: Just to confirm, the length scale here refers to the latitude range over which the QBO and/or BDC is active, right?

Page 8, line 29: I thought the change in ozone preceded the passage of the shear zone?

Page 9, line 9: When you say 'about the equator', I assume that you mean 'either side of the equator'. I think that you need to use more precise wording here.

GRAMMAR AND TYPOGRAPHICAL ERRORS

Some of these suggested changes are very much just suggestions and may just reflect my personal writing style. You should feel free to accept or reject these suggestions as you wish.

Page 1, line 11: Replace 'lengthy time series' with 'long time series'.

Page 2, line 26: Replace 'outside 20 degrees of the equator' with 'further than 20 degrees from the equator'.

Page 3, line 1: replace 'within 10 degrees north and south of the equator' with 'within 10 degrees of the equator'.

Page 4, line 4: By 'perturbations' do you mean 'anomalies'? If so, then I think that you should use the word 'anomalies' since that is more precise.

Page 4, line 7: It might be better to be more precise here and say 'Temporal gaps' rather than just 'Gaps' so that its clear that you are not talking about spatial interpolation.

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Page 7, last line: I think there is an extra z in there.

Figure 7 caption: replace ’at the vertical resolution the QBO winds’ with ’at the vertical resolution of the QBO winds’.

Page 8, line 16: Replace ’are due’ with ’is due’.

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Interactive Comment