

## ***Interactive comment on “Response of Trace Gases to the Disrupted 2015–2016 Quasi-Biennial Oscillation” by Olga V. Tweedy et al.***

**Anonymous Referee #2**

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Response of Trace Gases to the Disrupted 2015–2016 Quasi-Biennial Oscillation

**O.V. Tweedy, N.A. Kramarova, S.E. Strahan, P.A. Newman, L. Coy, W.J. Randel, M. Park, D.W. Waugh, and S. Frith**

This paper examines the impact of the 2016 QBO disruption on stratospheric temperature, residual (vertical) circulation and distribution of trace gases (esp. ozone) from the equator to mid-latitudes. The paper highlights circulation and transport characteristics being dynamically consistent with the QBO anomaly. These impacts include an anomalous reduction in total ozone out to mid-latitudes (during April and August anyway) which are at near record lows. This has implications for trends in downwelling UV, if similar events were to recur more frequently in the future. The authors also highlight the possible signature of the QBO disruption in tropical cold-point tropopause

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temperature and UTLS water vapor.

This is a very well written paper and does a great job of highlighting those points it considers important, without the distraction of unnecessary details. I would hope the points below can be addressed quickly as I recommend prompt publication.

### **Main Points:**

I. Effect of strong polar vortex: What effect will the unusually strong polar vortex, occurring from early-mid winter 2015/2016, have on the Brewer-Dobson circulation and the redistribution of ozone? Presumably, it would create a weaker BDC and reduced downwelling outside the tropics, and so (vertical) transport of ozone at mid-latitudes. I think the conclusions of the paper also need to reflect these other environmental influences, especially as statements of attribution are being made. Here is a suitable reference for the strong vortex (and AO in general) and perhaps other conditions relevant to the 2016 QBO disruption (and redistribution of ozone):

*Cheung HHN, Zhou W, Leung MYT, Shun CM, Lee SM, Tong HW. A strong phase reversal of the Arctic Oscillation in midwinter 2015/2016: Role of the stratospheric polar vortex and tropospheric blocking. J Geophys Res Atmos. 2016; 10.1002/2016JD025288*

*Scaife AA, Comer R, Dunstone N, Fereday D, Folland C, Good E, et al. Predictability of European winter 2015/2016. Atmos Sci Lett. 2017 Feb;18(2):38–44. doi:10.1002/asl.721*

II. Effect of ENSO and subsequent interpretation of CPT and [H<sub>2</sub>O] (figure 7). The authors should acknowledge the possible influence of the 2015/2016 El Niño and the perhaps recent trends in CP temperature and pressure. One possible reference might include:

*Hu D, Tian W, Guan Z, Guo Y, Dhomse S. Longitudinal Asymmetric Trends of Tropical Cold-Point Tropopause Temperature and Their Link to Strengthened Walker Circula-*

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tion. *J Clim.* 2016 Nov; 29(21):7755–71. doi:10.1175/JCLI-D-15-0851.1

III. How much of the 2016 QBO wind (during disruption) is accounted for by the first 2 EOFs (in  $u$ )? In this regard, how meaningful is it to show PC1 and PC2 during these times?

**Minor Points:**

(line 104) One for the editorial team: superscript asterisk for TEM residual vertical velocity. Also, a reference for the TEM residual vertical velocity should be added (e.g. AHL, 1987)

(figure 2 caption) “spacial”->“spatial” deriv. spatium (latin).

(figure 7) The HALOE H2O measurements show a jump around 2001. Where does this come from? Does it affect the (statistical) significance of your results.

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