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Interactive comment on "The Evolution of Zonally Asymmetric Austral Ozone in a Chemistry Climate Model" *by* Fraser Dennison et al.

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Thanks for your comments

Specific comments: introduction The westward shift of planetary wave due to given ozone waves in earlier studies should be mentioned clearly relative to NH and SH including references including the improved NAM and SAM activity in midwinter.

The following additions (bold) have been made to the text:

(pg 2 ln 8)

Zonally asymmetric ozone has also been shown to have an effect in the troposphere. Evtushevsky et al. (2008) find that the tropopause height and sharpness are influenced

by zonally asymmetric ozone during spring, with the below average ozone regions associated with a higher tropopause and a thicker transition layer. Importantly, thickening of the transition layer between the stratosphere and the troposphere likely increases troposphere–stratosphere exchange and mixing activity. **Crook et al. (2008) find a cooling at the surface over the Ross Sea, although they note there is no significant change to the zonal mean temperature or geopotential height in the troposphere. However, in the Northern Hemisphere, zonally asymmetric ozone has been shown to influence the Northern Annular Mode (NAM) (Peters et al. 2015) and North Atlantic Oscillation (NAO) (Gabriel et al. 2012) with significant impacts demonstrated on surface temperatures, precipitation, wind-driven ocean currents and sea ice thickness.**

(pg 3 ln 3)

The relationship between ozone and the tendencies of the vortex in the Northern Hemisphere has also been studied by Peters et al. (2015). In this study a CCM simulation forced by ozone the 40-year reanalysis dataset from the European Centre for Medium-range Weather Forecasts (ERA-40) is compared to a simulation forced with zonally symmetrical ozone over the period 1960 to 1999. It was found that the zonally asymmetry, which increases in amplitude over the course of the simulation, leads to a westward shift of the polar vortex.

discussion it should be mentioned clearly that the findings fit very well to former results mentioned above

(pg 11 ln 32)

The results presented here support those of Grytsai et al. (2017) in that changes in the concentration of ODSs, more so than changes in GHG concentrations, are linked to the shifting zonally asymmetric ozone distribution. However, the approach taken here – the use of elliptical diagnostics – makes the comparison of the particulars of the results somewhat unclear. While this study shows the ellipse centre longitude moves

west and the eccentricity decreases over the 1960-1999 time span while Grytsai et al. (2005, 2007) shows the extra-tropical ozone minima to move eastward and the maxima to be stationary. There is some suggestion of an eastward trend shown for ERA-Interim in Figure 1(b) however this is not significant at the 95% confidence level and is substantially smaller than that reported by Grytsai et al. (2005). The fact that the centre longitude moves in the opposite direction to the extra-tropical ozone minima perhaps indicates that it is the rotation of the ellipse that is more descriptive measure of the ozone distribution at mid-latitudes. It is therefore unfortunate that a reliable measure of the rotation was unable to be obtained here due to the models overly-symmetric simulation of ozone. **Interestingly, the results shown here fit with results from the Northern Hemisphere which reveal a westward shift associated with ozone depletion (Peters et al., 2015).**

to Report 2 (iii) authors comment I do not agree, the shown results for the NH are also relevant for this study, same radiative heating and Dynamics.

We agree that this is a fair point after reflection. Peters et al. (2015) and Gabriel et al . (2012) have now been added (Gabriel et al. 2007. Is also cited).

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