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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Ozone zonal asymmetry and planetary waves characterization during Antarctic spring" *by* I. Ialongo et al.

Anonymous Referee #1

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General Comments:

The authors examine the structure and temporal behaviour of zonally asymmetric ozone in the southern hemisphere during spring, based on different recent satellite data (OMI, GOMOS, Aura-MLS). From my point of view the paper gives new and important aspects for understanding the southern hemispheric ozone variability and, in agreement with the authors, for future climate studies. Overall the paper is well-written and worthwhile to be published in ACP. However, I have some few specific questions, and I recommend some few minor improvements before final publication.

Specific comments:

1) P. 32338, l. 10: Relative amplitudes (here: 50%) can lead to misleading interpreta-

tions if absolute values are not provided. I suggest specifying the absolute amplitudes, for example in DU as done in Section 4.2. Please check this point throughout the text. In particular, some absolute values should be given in Section 4.3 when discussing the relative amplitudes in the ozone profiles (see specific comment 6 below).

2) P. 32343, ll. 16-22., Fig. 2: I see a pronounced interannual variability with stronger amplitude during 2005, 2007 and 2009, and weaker amplitude during 2006, 2008 and 2010. This variation might be related to the Quasi-Biennal Oscillation (as far as I know the years 2005 and 2007 are characterized by easterly phase of OBO, but the years 2006 and 2008 by the westerly phase). Could you give some comments or discussion on a possible modulating influence of the QBO, here and/or at some other places (e.g., in the discussions at P. 32344, ll. 10-16, or P. 32345, ll. 13-19, or P. 32347, ll. 3-4).

3) P. 32344, l. 16-17: The weakening of the amplitude in early November before increasing again is an interesting point (also mentioned at P. 32347, ll. 19-20, and at P. 32348, ll. 26-27). Do you have an explanation for this feature? One could assume some kind of reinforcement of the polar vortex due to the photo-chemical ozone depletions and associated radiative cooling potentially, at least leading to a delayed polar vortex break-up. However, perhaps it is just unclear and further research is needed to clarify the involved processes.

4) P. 32345, ll. 9-11: I do not really understand what you want to say with this sentence. Do you mean that strong local maximum ozone values are correlated with strong zonal mean values and that therefore strong local minimum ozone values are also correlated with strong zonal mean ozone values? Please reformulate this sentence.

5) P. 32345, ll. 21-23: The effect of photo-chemical processes on zonally asymmetric ozone is indeed important, but this requires, as a prerequisite, planetary wave patterns in temperature or in other trace gas constituents. Therefore, if I understand you right, it would be more precisely to say that zonally asymmetric ozone is defined not only by transport due to planetary waves, but also by zonal asymmetries in photochemical

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processes due to planetary waves.

6) P. 32346, ll. 1-12, Figure 6: The pictures show only relative amplitudes without a relation to absolute values. Therefore large amplitudes in % could be not significant in regions of very weak ozone concentrations, for example those of ozone number density in regions above the stratopause. This problem holds also for Fig. 7 and Fig. 8. Therefore some absolute values of zonally asymmetric ozone have to be provided, or some information for the reader where these absolute values can be found. I also suggest providing some absolute values for zonally asymmetric temperature. For example, a very easy way would be just including two additional sub-figures in Fig. 6, one for the absolute values in ozone number density and one for those of ozone mixing ratio. Then Fig. 6 but also Figures 7 and 8 become more understandable. However, some more specifications in the text might be sufficient.

7) P. 32346, ll. 7-10: Based on the pictures I conclude that the perturbations in zonally asymmetric ozone number density and in air density are in phase only above a height of about 25 km. Here it is somewhat difficult to follow your argumentation. Do you want to say that the wave pattern in ozone number density is related to that in air density (indicating the polar low and high anomalies)? However, both of these wave patterns are related to that of temperature. I think it would be advisable to reformulate or to extend this sentence to make your argumentation somewhat clearer.

8) P. 32346, ll. 19-26: In the context of specific comment 6, it would be more precisely to use here the terminus “relative” wave amplitudes.

9) P. 32347, ll. 22-23: Where exactly is this visible? Do you mean the disturbed line of downward propagating dark blue area located approximately 5-10 km above the red area?

10) P. 32347, ll. 23-25: In contrast to this statement, but in agreement with the discussion in Sect. 4.2, I see a significant year-to-year variability also for September and October.

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11) P. 32348, ll. 10-11: The link to the maximum in polar vortex jet stream intensity occurs somewhat abrupt. Could you give some more explanation on this link?

12) P. 32348, ll. 17-18: Based on the results it is not really evident why the decrease in altitude location of greatest amplitude in time is related to the effect of vertical transport in the polar region. Could you give some more explanation or a reference?

Technical corrections:

1) P. 32339, ll. 27: A relation is missed, I suggest "... in a warmer Antarctic stratosphere in comparison to a three-dimensional ozone field."

2) P. 32344, l. 3: The related pre-ozone hole values are not given. Can you specify these values?

3) P. 32348, l. 15: It extends up to altitudes 60-65 km only for the relative amplitude in ozone number density.

4) Figures: In the print-version provided by ACPD, Figures 2, 4 and 8 are too small. I suggest enlarging the figures as given in the manuscript I got for the initial review

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Interactive Comment