**Atmospheric
Chemistry
and Physics
Discussions**

Interactive comment on "**Stratospheric ozone chemistry in the Antarctic: what controls the lowest values that can be reached and their recovery?**" *by* J.-U. Grooß et al.

Anonymous Referee #1

Received and published: 29 September 2011

This paper shows the ozonesonde data at the South Pole station reaches as low as ~10 ppbv by late September/early October then increase to the pre-ozone hole values in December at 70 hPa. The aim of this paper is to investigate the chemical processes controlling this low local ozone mixing ratio and ozone increase in the Antarctic polar region from CLaMS chemical transport model. The authors also describe comprehensive sensitivity studies of processes responsible for Antarctic ozone depletion using the CLaMS box model. This is interesting work and some conclusions are also important. Overall, the paper is well organized and written. However, some figures are not clear and section 3.1 is not easy to follow (see specific comments below). The paper should be published in ACP after the revisions.

Specific comments:

1) The paper mainly focuses on chemistry of the Antarctic ozone hole. It would be good to mention or show how good the modelled chemical species (i.e., HCl, ClO, ClONO2) are from CLaMS 3D-CTM in the Antarctic polar region.

2) The box model simulation is based on one trajectory in 2003 (Figure 2, 4) but it seems to me that the result is very sensitive to the chosen trajectory by looking at Fig. 9. The simulated ozone from box model run is similar at 400 K but there are large differences at 375 K and 450 K if we look at the red lines in Fig. 9.

3) In Figure 9, it looks that the CLaMS 3D CTM largely underestimates the observed ozone in the lowermost stratosphere (375 K and 400 K) early August (i.e, the ozonesonde data shows ozone value is about 1 ppmv at 375 K and over 1 ppmv at 400 K early August but the modelled ozone from CLaMS 3D-CTM is about 0.4 ppmv at 375 K and 1 ppmv at 400 K). It would be better to explain this in the paper.

4) Figure 1. The low ozone mixing ratio value (0.4 ppmv) around 1 July between 2000-2004 period can not be found from Figure 7a of Solomon et al. (2005). I think your ozonesonde data from the South pole station at 70 hPa should have the same source for the periods 1990-1999 and 2000-2004 as Solomon et al. (2005). Please double check the data.

5) Figure 2.

The caption of panel (c) is wrong. You also need to add "solid line for O2+hv, dot line for P(O$_3$)" in Fig.2 (g). Is it possible to get the time series of PV values from this trajectory? Can you also explain why the simulated ClONO2 field is always near zero during the simulation period from the box model run? Why there is still some activation rate mid October since ClOx is near zero since early October?

6) Figure 3.

It would be better to move Figure 3 before Figure 2. Then move the sentences in P22177-P22178 "Figure 3 shows......" after line 6 page 22176.

7) Figure 5.

The sensitivity of ozone initialisation values shown in Figure 5 are 2.3-2.6 ppmv which is not consistent with text in the paper (2.6-3.2ppmv) (Line 3 page 22180).

8) Figures 6 and 7.

It will be better to remove "Climatological Ozone Profile" and "Reduced Ozone Profile" in the Figures 6 and 7 and mention it in the captions.

Minor correction:

1) P22174 Abstract Line 2:

This paper just shows the ozonesonde data from the South Pole station. Therefore, it should be "..... from the South Pole station..."

2) P22174 Abstract Line 6: "20 yr" to "20 years"

3) P22174 Abstract Line 12: "PSC" to "Polar stratospheric cloud (PSC)"

4) P22174 Abstract Line 13: "minimum" to "minimum ozone"

5) P22174 Line 25: Figure 1 just shows one level. Therefore, you need to change "at these altitudes" to "at this level". Or you can change the previous sentence as "Figure 1 shows an example of the ozone observations from the South Pole station at the 70

hPa level."

6) P22175 Line 14: It should cite Grooß et al., 2005a first then 2005b in Page 22176 Line 24. Therefore, your need to change the order of references Grooß et al., 2005a and 2005b.

7) P22175 Lines 25-27:

How often is the photolysis rates updated here? It also should be mentioned the gas phase chemical data is taken from JPL or somewhere else here.

8) P22176 Line3:

How do you define the liquid aerosols fields in the model? Is it from SAGE-II H2SO4 measurement?

9) P22176 Line 22.

You need to specify which observations are used for the CLaMS initialisation. Which ECMWF analyses are used to force the CLaMS model?

10) P22177 Line 26.

add "via PSCs" before "from ...."

11) P22178 Lines 19-20: The word "evident" is too strong. Maybe it will be better to use "clear" or "obvious". "Obviously, the modelled HCl increases rapidly until..... in significant amounts when ozone value is below 0.1 ppmv.".

12) P22179 Line 19:

Should it be "Fig. 2g an Fig. 4e"?

13) P22180 Line 3:

Should it be " 2.3 and 2.6 ppmv."?

14) P22182 Line 3: Change "on" to "along".

15) P22182 Line 6:

Why choose "1 ppbv ozone" rather than "10 ppbv ozone"? Based on the Abstract and Figure 1, 2,4 and 5, it would be better to choose "10 ppbv ozone value" for Figures 6-8.

16) P22186 Line 15: Change "eludicated" to "elucidated".

17) P22192: Change "Sketch" to "Schematic".