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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Record-breaking ozone loss in the Arctic winter 2010/2011: comparison with 1996/1997" *by* J. Kuttippurath et al.

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The paper describes a comparison of the record Arctic ozone loss winter 2010/11 with the winter 1996/97 based on extensive modeling studies and satellite observations. It gives a detailed overview of the processes (dynamics, chlorine activation on PSCs/aerosol, catalytic cycles) leading to ozone loss at different times of the winter and in different altitude regimes.

The manuscript complements other analyses of the unusual 2010/11 Arctic winter and makes a significant contribution towards understanding the interplay between the various processes leading to such extreme events of Arctic ozone loss. Complete understanding of these complex interactions is a prerequisite in order to recognize

possible future effects of climate change on the stratospheric ozone layer in polar regions. I recommend publication in Atmospheric Chemistry and Physics, but suggest some clarifications and a few technical corrections described below.

Minor issues:

1. It is not entirely clear why you chose the winter 1996/97 for detailed comparison rather than another very cold winter or even a number of cold winters. There is one sentence in the introduction mentioning the long vortex persistence in 1997, and I can think of other reasons to choose this particular winter for the comparison, but would like to see a more elaborate rational from the authors at the end of the introduction.

2. In last paragraph of the introduction, you merely list the headings of the sections and subsections rather than presenting further details or a rational for structuring your manuscript in that particular way. The paper is also not unusually long, so I think you may not need this "written outline" at the end of the introduction.

3. In the last paragraph in Section 3.1, you mention the large size of the vortex 1996/97, but you also state that the 2010/11 vortex formed "with considerable size". It may be worth mentioning that in the later half of the winter (February – April), the 2011 vortex was significantly smaller than the 1997 vortex (and the vortex in some other years) as was shown in Supplementary Figure 2 in the Manney et al. (2011) paper.

4. In Section 3.2.2, for the winter 2010/11, you discuss denitrification, while for the winter 1996/97 in Section 3.2.1 you do not. Is there a reason for doing so? Also it seems strange that the way chosen to order and present the Figures for the two winters (Figures 3 + 4 for 1996/97 and Figure 5 for 2010/11) is different.

5. In the last paragraph of Section 3.2, please restructure the second sentence because it is hard to work out what number belongs to what scenario. Also, can you comment on the strong sensitivity of ozone loss towards NAT in your model being due to heterogeneous activation (NAT vs. binary aerosol) or due to denitrification (I suspect it is the latter)?

6. In Section 3.3 (page 6888, line 5) there is a statement that "the model simulates comparatively higher abundances of NOx at altitudes above 550 K". Does "comparatively" refer to 2011 vs. 1997? In that case, the supplementary figure does not support such a statement: the NOx contours look fairly similar for both winters. In fact, at least throughout April, the 2, 4, and 6 ppb contour lines are slightly shifted to higher altitudes in 2011 suggesting slightly less NOx than in 1997. Please clarify.

7. The discussion on the winters 2003/4 and 2005/6 at the end of Section 3.3 comes a little bit "out of the blue". In the figures and previous discussion, you don't refer to these winters et all. If you keep the discussion, you should start with a statement, why these winters are special or noteworthy with respect to NOx.

Technical corrections:

1. Page 6878, Line 5: insert "of time" after period
2. Page 6878, Line 7: delete "simulations". If you prefer, you could then also replace "Analyses" with "Simulations".
3. Page 6878, Line 8: . . .started in early January. . .
4. Page 6879, Line 2: "In this region" doesn't fit so well here. I suggest: "Since then, cold Arctic winters are prone. . ."
5. Page 6879, Line 5: delete "often" (it's redundant with the word "most" later in the sentence)
6. Page 6879, Line 24: delete "a" (simulations is plural)

7. Page 6881, Line 1: replace "simulated results" with "simulations"
8. Page 6881, Line 2: you use "ozone" several times before, so you may introduce the short O3 earlier.
9. Page 6881, Line 17: ". . . at the Norwegian Institute. . ."
10. Page 6882, Line 4: ". . .to other cold winters. . ."
11. Page 6882, Line 12: "To check for sudden stratospheric warmings, . . ."
12. Page 6882, Line 22: ". . .which was about two weeks earlier. . ."
13. Page 6887, Line 5: you refer to Fig. 6a, not 6b here, right?
14. Page 6891, Lines 6-7: ". . ., we compare the results with the Antarctic ozone loss."
15. Figure 1: legends and the description of colors and linestyles in the caption are somewhat redundant (I would shorten the caption). And I do not see any dashed or dash-dotted lines mentioned in the caption.
16. Figures 3 and 4: Delete the last sentence of the caption (the color bars are enough).
17. Figure 8: for the comparison, it would be more helpful to have the lines for the Antarctic average in the same panel as the profiles from 2010/11 (but in a different color of course).

Interactive comment on Atmos. Chem. Phys. Discuss., 12, 6877, 2012.