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Comment

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

Anonymous Referee #1

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Review of ACP manuscript 'Record-breaking ozone loss in the Arctic winter 2010/2011: comparison with 1996/1997'

General comments: The main scientific focus of this manuscript is on comparing chemical ozone losses and related chemical and dynamical processes during the Arctic winters 2010/2011 and 1996/1997. Both winters were characterized by fairly late break-downs of the Arctic polar vortex, comparatively low temperatures in the lower polar stratosphere in February and March. In contrast to the winter 2010/2011 the lower stratospheric temperatures in the Arctic vortex were relatively high in December and January in 1996/1997, explaining the markedly smaller chemical ozone losses during the latter winter. The paper provides an interesting overview of the similarities and differences between the two winters studied. The standard diagnostics are applied, the

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chemical ozone loss is determined with the well-established passive tracer technique, and as far as I can tell the methodology is sound and the results can be considered robust. I have no really major objections to the publication of this paper, but ask the authors to consider the specific comments listed below. The paper is generally well written and easy to follow. However, there were several sentences – see specific comments below – whose meaning was not clear to me even after reading them several times. I ask the authors to check the working again carefully and adjust the sentences to make them easier to follow.

Specific comments:

Page 6878, lines 11 – 14: 'This coincides with ... and a ... and about ... and about ... and about' I suggest splitting this sentence in two sentences.

Page 6879, line 26: suggest to add 'a description of' to read 'is succeeded by a description of the data and ..'

Page 6882, line 6: 'cold temperatures'. I believe temperatures can just be high or low, but not warm or cold. Same comment on Page 6883, line 1.

Fig. 3, second panel from top (CIO): There seems to be a discontinuity in the contour plot at 475 K, particularly visible during the period with enhanced CIO between day 30 and 90. Is this supposed to be like that? What may the origin be?

Page 6884, last paragraph and Fig. 4: The MLS ozone observations (middle right panel) show a very strong change in the slope of the contour lines around day 30. What may the origin of this effect be? A similar feature is not present in the Mimoso-Chim ozone at all. A simple explanation would be that not only air masses inside the vortex are used for the MLS mean. I'm also wondering whether the abrupt change in slope around day 30 is possible at all if the data sets are smoothed with a 7-day window? Perhaps I'm missing a point here.

Fig. 4: It would be good to mention in the Fig. caption what the interval between

adjacent contour lines is in case of the bottom panels. I assume the contour line without label is the 0.5 ppmv contour?

Page 6886, lines 13 – 18: I'm not able to fully understand how exactly the PSC sensitivity studies were done. If NAT PSCs are not considered, then a maximum ozone loss of 1.8 ppm is modeled, but what do you mean with 'and a relative loss of about 65 % for the control run'. Perhaps I'm missing a simple point, but I read this sentence many times and it's unclear to me what exactly was done. Please clarify.

Page 6887, line 27: 'However, in February–March 2011, our analyses show exceptional contributions from the ClO-ClO (45 %) and BrO-ClO (35–40 %) cycles in terms of absolute values in the lower stratosphere at 475 K.' Looking at Fig. 6b there are not really large differences in the contributions of the ClO – ClO as well as the BrO – ClO cycle between 1996/1997 and 2010/2011. Therefore the statement appears a little misleading. Or is the statement intended to compare 2010/2011 with other winters (not including 1996/1997) which are not shown in this Figure? Or perhaps the statement actually refers to the absolute losses associated with these reactions? Then, reference to the top panels would perhaps be appropriate. If this is the intended meaning then the statement is not correct for February (looking at the top left panel of Fig. 6a), but only for March.

Page 6888, line 9: 'The contributions of various chemical cycles during the winter 2010/2011 thus stand in contrast to those in other Arctic winters' Please mention what exactly the differences are.

Page 6888, line 11: 'Since these are (presented in Fig. 6b) the fractional contribution of the individual cycles to the cumulative ozone loss that occurred at the respective altitudes, the relative contribution of various chemical cycles in 1996/1997 also shows comparable values to that of other Arctic winters.' The meaning of this sentence is unclear to me. Can you clarify? I'm not sure the logic of this sentence is correct. Moreover, the second part of this sentence appears to contradict the previous sentence

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(my previous point). I apologize if I'm missing an obvious point here.

Page 6889, line 20: Can you offer an explanation for the differences of the results based on total column measurements to all the other (consistent) results mentioned in the previous lines?

Page 6889, line 22: 'by the end of each month .. until mid-April' This is somewhat inconsistent and I suggest changing it.

Page 6890, line 6: Is there a simple explanation why the results published by Balis et al. (2011) differ significantly from all the other studies mentioned?

Section 3.5, Comparison with other Arctic winters: I suggest also mentioning the recent study by Sonkaew et al. in ACP(D)? dealing with ozone loss determination in several Arctic and Antarctic winters using SCIAMACHY ozone data.

Page 6892, line 1: 'We use the same model and Aura MLS measurements' ? What exactly do you mean here?

Typos etc.:

Page 6879, line 24: remove 'a' in 'with a high resolution . . . simulations'

Page 6889, line 17: 'simulated from REPROBUS' -> 'simulated with REPROBUS' ?

Page 6897, line 8: 'Froide- vaux'

Page 6897, line 10: 'Naka- jima'

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

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