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***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 #2

Received and published: 30 September 2011

Review of "Stratospheric ozone chemistry in the Antarctic: what controls the lowest values that can be reached and their recovery?" by Grooß et al.

GENERAL COMMENTS

This paper fills an important gap in our understanding of the seasonal evolution in ozone over Antarctica. The paper elucidates the chemical processes that halt ozone destruction and the processes that lead to ozone increases after seasonal minimum ozone levels have been reached. This is potentially a very good paper but I was somewhat disappointed by its quality. I expected better from such a high profile author group. In many cases the writing lacks clarity such that it is not easy to understand

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exactly what was done or what the results mean. I have pointed out a number of such instances in my comments below. The quality of the writing must be improved when this paper is resubmitted. The paper is certainly suitable for publication in ACP once the comments below have been addressed.

SPECIFIC COMMENTS

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Line 2: In this first sentence of the abstract, it might be worth mentioning that the ozone mixing ratios measured by the ozonesondes are essentially below the detection limit of the instruments and so it is quite likely that the ozone concentration is actually zero.

Line 4: This is a bit ambiguous. I think that it would make more sense to say "increase to above 1 ppm".

Line 9: I think this could be expressed more clearly as "We discuss the processes which terminate catalytic ozone destruction cycles".

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Lines 1 to 3: Even though I read this sentence a couple of times I couldn't quite figure out what it was trying to say.

Line 9: I don't think that it is accurate to say that the ozone depletion is limited to values near 10 ppb. This is almost certainly close to or below the detection limit of the ozonesonde. So the ozone may well have gone to zero. And then of course no explanation is needed as to why ozone doesn't go below zero. Maybe the simple story is that well known chemistry drives ozone to zero concentration. I don't think that you need to make a big story about that. But what causes the ozone to increase after the first week of October (given that the vortex is pretty much still intact for a couple more weeks at levels where that ozone depletion has taken place, is the key result of your study.

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Line 22: How were the temperature data used to calculate the trajectories? More importantly, what diabatic ascent/descent rates were used in the trajectory calculations? Were these also obtained from ECMWF?

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Line 14: I am not sure what the 'long time span' refers to? Is this the months over which the trajectory calculations are made?

Line 21: I am not sure what you mean by 'and are continued until the end of December in this work'? Do you mean to the end of December 2003, assuming that the diploma thesis did not investigate the entire period?

Figure 2 caption: The first sentence doesn't make sense. What does 'Trajectory simulations through ozone sonde' mean? The caption refers to 'ozone (green)' in panel (c). There is no green trace in panel (c). The ClONO₂ concentration in panel (e) seems to be uniformly zero. Why not just leave it off the plot and say that it is zero.

Figure 2 is too small to see the details. I hope it is made much bigger in the production version of the paper.

Page 22177

Line 14: But quite a few days after the ozonesonde showed the 10 ppb value.

Page 22178

Line 3: Regarding 'occurs in the short time period of only about one day'. This point has already been made in the paragraph above.

Line 28: You need to specify here that these are the ozone mixing ratios that you are referring to.

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Line 8: Why is this a positive feedback? I thought it would be a negative feedback

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i.e. as ozone decreases the deactivation of chlorine into HCl increases, taking chlorine out of the system. This would then slow ozone depletion not accelerate it. This is a negative feedback not a positive feedback.

Line 9: Regarding 'In other words, the low ozone mixing ratios drive the chlorine deactivation'. You have already made this point twice in this paragraph. I don't think that you need to belabor it to this extent.

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Line 3: You state 'between 2.6 and 3.2 ppmv' but in Figure 5 I see 2.2 to 2.6 ppm?

Page 22181

Line 1: I don't know what you mean by 'on other prerequisites as the initial chlorine activation'? I guess it is the use of the word prerequisites that confuses me. Do you mean that the simulated ozone mixing ratios depend on factors other than just the degree of chlorine activation?

Page 22185

Line 14: I really don't understand this sentence. You say 'It is caused by the fact that due to the annual cycle of the temperatures, data on different potential temperature levels are compared over the course of the season in Fig. 1'. I read the sentence 4 or 5 times and I still don't understand what is causing the additional ozone increase in November and December. I don't know what you are trying to say but this needs to be expressed more clearly.

Line 22: I don't agree with this assumption that 'to first order, similar ozone loss would be expected for an air parcel starting at the pole and ending at latitude x compared with an air parcel starting at latitude x and ending at the pole for the same time period'. A parcel starting at the South Pole and ending at x would experience much more irradiance than a parcel starting at x and ending at the South Pole.

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GRAMMAR AND TYPOGRAPHICAL ERRORS

I understand that the author's first language may not be English but there are authors on this paper for whom English is their first language. The writing style and grammatical errors unfortunately frequently detract from the scientific quality of the work. The author could have at the very least run a spell-checker over the manuscript before submitting it. I would strongly recommend that the paper be thoroughly proof read before resubmission.

Page 22174

Line 6: Are you really so pressed for space that you have to abbreviate year to yr?

Line 11: Replace 'or by temperatures increasing' with 'or when temperatures increase'.

Line 22: Replace 'as observed in observations of ozone sondes' with 'as observed in measurements by ozonesondes'. I'm not sure if there is a convention as to whether ozonesondes should be written as 1 or 2 words but I think it is almost always written as one word. I note that in some places you have even spelled it as ozone-sonde. At least be consistent.

Page 22175

Line 13: You've just defined the CLaMS acronym in the previous sentence. Why not use it here?

Page 22176

Line 9: I think this would read better as 'Since no denitrification parameterisation was used in the box-model mode, the chemical consequences...'

Line 17: Replace 'reaches low mixing ratios' with 'reaches low ozone mixing ratios'.

Line 22: It is not clear what the 'They' refers to so I would suggest that this is reworded as 'The CLaMS simulations were initialised'.

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Page 22177

Line 4: Replace 'in the pressure level' with 'at the pressure level'

Line 19: This would read better as 'on a very short time scale of about 1 day'.

Line 20: Bad grammar. Replace 'thus chlorine' with 'such that chlorine'.

Line 25: Bad grammar. Replace this with 'The main chlorine activation reaction is $\text{ClONO}_2 + \text{HCl}$ which produces Cl_2 . Photolysis of Cl_2 then produces ClOx '.

Page 22178

Line 8: Replace 'It is visible that' with 'It is apparent that'.

Line 20: Replace 'no other chlorine compounds than' with 'no chlorine compounds other than'.

Page 22179

Line 13: Replace 'changes of the chemical' with 'changes to the chemical'.

Page 22180

Line 4: Replace 'four simulations shows both, very' with 'five simulations shows both very'.

Line 14: Replace 'also the formation of HCl is increasingly' with 'the formation of HCl is also increasingly'.

Line 16: Replace 'air parcel trajectory is identical' with 'air parcel trajectories are identical'.

Line 24: Replace 'the last days' with 'through the last days'.

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Line 21: Replace 'a slower increase in the rate in ozone' with 'a slower rate of increase

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in ozone’.

Page 22183

Line 16: Replace ‘in the presence PSCs’ with ‘in the presence of PSCs’.

Page 22185

Line 3: Replace ‘we show now box’ with ‘we now show box’.

Replace all instances of ‘South pole’ with ‘South Pole’.

Line 29: Replace ‘In the 375 K and 400 K levels’ with ‘At the 375 K and 400 K levels’.

Page 22186

Line 12: Replace ‘ozone productions’ with ‘ozone production’.

Page 22186: Replace ‘is be mostly’ with ‘is mostly’.

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