Detailed comments on the manuscript "Variability of Antarctic ozone loss in the last decade (2004-2013): High resolution model simulations compared to Aura MLS observations" by Kuttippurath et al.

In this study the variability of Antarctic ozone loss in the last decade is analyzed by Aura MLS observations and simulations with the CTM Mimosa-Chim. The spatial and temporal evolution of the ozone loss is analyzed for each year and related to the meteorological conditions. As expected the largest loss is found in cold winters and the smallest loss in warm winters. Interesting results are shown for the vertical profiles of ozone loss and trace gases.
This manuscript is well written, however, it is required that the authors point out the main goals and the new findings of this study more clearly. Furthermore, I suggest reorganizing the paper a little bit (see general comments). I recommend publication after my comments are properly addressed.

General comments:

- The method of calculating the ozone loss quantities from model simulations and observations is not sufficiently explained and discussed. If the ozone loss from observations is calculated as difference between the passive ozone tracer from the model and the observed ozone, how reliable is the result for the observations if the model transport and thus the passive ozone tracer has a bias?
- It would be helpful if you include a figure of the temporal evolution of the (e.g. vortex averaged, or minimum) temperature for each year for the model simulations and the observations. Then the reader will more easily be able to follow the classification of very cold, moderately cold and warm winters.
- The description of the results is focused on the model simulations. Since you highlight the highly resolved observational data from "one of the best satellite instruments" in the introduction I expected a more detailed description of the measurements. Therefore I suggest reorganising the paper and starting with a description of the observed ozone loss, followed by the analysis if the model can reproduce the observations.
  However, if you decide not to change this because your main focus is on the model results, please point out more clearly why these simulations allow a new insight in this topic. And please address the following specific comments on this section.
- The section 3.3 "Interannual variations" is started with "Chlorine activation". I think that since the main focus of this study is to analyse the interannual variability of ozone loss, it would be better to start with the analyses of the loss variability and explain the results with the help of the analysis of the chlorine activation and so on. If you decide not to change this, you have to give a short motivation in section 3.3 why you start with chlorine activation here.

Specific comments:

Introduction:

- General: The introduction is very short. I think it would be worth to include some more background information on ozone chemistry (e.g. chlorine activation,..) and dynamics for the southern polar region.

- Line 72ff: ".. with such high resolution measurements with high spatial and temporal coverage .." : I suggest: with such high resolution measurements that have a high spatial

and temporal coverage inside the Antarctic vortex.

- Line 83: Please include here "chemical transport model": .. the Mimosa-Chim chemical transport model is used ..
- Line 86: ".. average ozone loss evolution ..": Which dimension is averaged? The time? Please clarify this.

Simulations and measurements:

- You start the model runs at 1 May and show the complete timeseries in the figures. Do the simulations need no spin-up time?
- Line 128: Is it H2SO or H2SO4?
- Line 128ff: "In the denitrification module ..": This sentence is hard to read. Please rephrase it!
- Line 134: Is there a reference for the Aura MLS version 3.3, that you use?
- Line 134ff: Which time resolution do the measurements have?

Results and discussion:
3.1
- Line 155: Here you use the quantity "chemical loss" which is explained by "passive ozone minus ozone". I think you should give a short explanation in section 2 what is meant with "passive ozone" and "ozone" and how the ozone loss is calculated for the model and the observations (see general comment and comment to line 187).
- Line 155: In Fig. 1 this is already shown for May. In June levels above 450 K show an ozone loss different from zero in the model. Please write May here.
- Line 159: "The loss increases again in August ..": As far as I can see from the Figure, the loss increases in all EqLs from May to September. I think the word "again" is confusing. I suggest "The loss continues to increase in August .."
- Line 166: ".. is found around 500 K ..": The maximum is rather at 550 K than at 500 K
- Line 169: " .. very large loss .." Please remove "very"
- Line 171: As far as I can see from the Figure it is not the EqL range 75°-83°S but 77°-83°S that peaks in the middle stratosphere.
- Line 172: ".. it peaks in the middle stratosphere.. " I suggest: ".. it peaks in the middle stratosphere (600K) .."
- Line 174: ".. while other EqLs show their peak loss in the lower stratosphere, below 575K". I suggest: "while other EqLs show their peak loss below 575K"
- Line 182: ".. show ozone losses below 500 K that are about the same as at 500K." This statement is imprecise since the loss below 450 K is clearly lower than that at 500 K. Please rewrite this sentence.
- Line 187: What exactly is the cumulative ozone loss? Is it the cumulative loss over one day or month? Please note this in section 2 (see comment to line 155).
- Line 189: What do you mean with the "normal" chlorine activation period?
- Lines 191ff: From Fig 1 I would rather state that the latitude dependency and evolution with time of the ozone loss in the model is below 500 K in good agreement with the measurements. I suggest that you rewrite this passage.
- Line 195: ".. and the model-measurement differences are relatively larger in September." Larger than what? Please rewrite this sentence.
- Line 197: "The ozone loss deduced from measurements.." This sentence is hard to read. I suggest: The ozone loss of about 0.05-0.08 ppmv that is derived from the measurements in May at 360-370 K is within the estimated error bars of the measurements and therefore insignificant.

- Line 276: Is HCl not a large part of Cly? Why is Cly lower and HCl larger due to the slower descent?

3.2

- How are the rates of the single chemical cycles calculated? Is it a model output or did you calculate the rates of the limiting steps offline? What about the reaction $OH+O_3$?
- Line 204-206: Please write: "... to the ozone loss in 2004-2013 in the model simulations."
- Line 210: You state that 90% of the ozone loss is controlled by the ClO-ClO reaction. It would be helpful if you include the total ozone loss from the model in Fig. 2. Is it fully explained by the 5 cycles?
- Please compare your results with the literature.
- Line 212: ".. with a maximum of about 0.5 ppbv/sh in August.." Does the number refer to the total ozone loss or to the contribution from ClO-ClO? Please clarify this.
- Line 222ff: I agree that the rate of reactions with atomic oxygen depend on the available O-atoms, but I don't understand why the HOx cycle which has according to your table the rate limiting step HO_2+O_3, depends on the O-atoms. Please clarify this.
- Line 224: "Contributions of these cycles .." Which cycles are meant here?
- Line 231: How did you show that the magnitude of ozone loss depends on dynamics?

3.3
- I suggest changing the title of section 3.3.1 to "Activated chlorine" .
- Line 234ff: "We have already discussed .." I suggest: "We have discussed the general features of the observed and modeled ozone loss evolution in the Antarctic stratosphere as well as the related chemical cycles."
- Line 251ff: Chlorine activation depends not only on the temperature and the occurrence of PSC, but also on the available amount of chlorine reservoir species which can vary from year to year. You discuss this later to explain the results, but I suggest including this here as well.
- Line 282: I don't understand why you tested the different rate since you explained earlier that the differences are caused by transport. Please explain this.

- Line 316: How do you define the "onset of ozone loss"? If the loss is larger than 1 ppmv?
- Line 331: Please remove "Relatively"
- Why is the observed ozone loss in 2007, a moderately cold winter (Line 340), larger than the observed ozone loss in the very cold winter 2005?
- Line 349: Which years are meant here? In the observations the years 2006 and 2007 have the largest loss, however, in the model the 4 years 2005 to 2008 show similar large ozone loss.
- I miss a statement about the year to year variability of the ozone loss. As far as I can see from figure 5, the difference between the largest maximum ozone loss and the smallest maximum ozone loss derived from observations is larger than shown by the model simulations. This means that the year-to-year variability is smaller in the model. I think this is an important result and should be discussed.
- Lines 350-360: Here, you discuss that the model ozone loss is overestimated due to the slower descent in the middle stratosphere. However, since you use the passive tracer from the model to derive the observed ozone loss, I think, that the ozone loss derived from observations is underestimated. Please consider this in your discussion.
- Line 357: Unfortunately, I don't find a supplementary figure in the manuscript version that I have.

- Line 375: Why is the analysis of the partial column ozone loss important for this study? Do you expect new results or is it for comparison with other studies? Please motivate shortly at the beginning of the section why you included this analysis in the study.
- Line 446: Please change "model tracer" in "passive model tracer"
- Table 2: I suggest including a figure with the information of table 2. This is more illustrative than the bunch of numbers.
- Line 283ff: In 2006 the ozone loss in the 350-850K region is smaller than in 2005 also from observations. Please rewrite this sentence.
- Line 418/19: Please remove "relatively".

- Line 447: Please insert "in the model simulations" in the first sentence of section 3.3.4
- Line 455: "natural" is not the correct word here. I suggest "photochemical".

Conclusion

- Line 505-509: This sentence is too imprecise, since you always have a coldest winter in a ten year period. Please rewrite the sentence.
- Line 528: Please remove "relatively".
- Line 540-542: Is this a new result?
- Line 545: ".. the Antarctic ozone hole will continue to occur for the next few decades.. " I think, this statement is too superficial, since you don't say anything about the extent of future ozone holes. Here, I would expect a statement to the actual discussion if the last years with small ozone hole areas already indicate a recovery or if this is rather an issue of variability.

Figures:

In general: You write "Potential Temperature/K " as well as "ppbv/sh" at the Y-axes. I suggest: Potential Temperature in K and ppbv/sh. In the Figures 3-5 you show daily cumulative ozone loss. Why is the unit ppmv and not ppmv/day?

Figure 2: Please change NO+NO2 in NOx consistent with the caption of table 1. Why do you use a logarithmic Y-scale here (and in the following figures), but a linear scale in Fig. 1?

Figure 5: You show daily cumulative ozone loss in this figure, please note this in the caption. Please add the information which altitude in km corresponds to 500K and 675K approximately.