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**Interactive
comment**

Interactive comment on "20 Years of ClO Measurements in the Antarctic Lower Stratosphere" *by* Gerald E. Nedoluha et al.

Anonymous Referee #2

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This paper uses long-term observations from a ground-based instrument and satellite to study trends in ClO in the Antarctic lower stratosphere. The ClO observations are adjusted for temperature effects and trends in inorganic chlorine are derived.

Overall, I think that the authors have a powerful dataset but more work is needed before the paper would be acceptable for ACP (i.e. major revisions). I think that they can address these points and a useful paper will result. My comments are summarised below.

Major comments.

1. The aim of the study needs to be clarified. Polar ozone loss is a 'mature' topic and some simple qualitative results are not an advance. It seems that the aim is to use the ClO to derive underlying Cly trends. The motivation for this needs to be made up front.

Why can't we just observe Cly? Why do we need to know what Cly is doing? Is there any implication for detection of polar ozone recovery? Would you expect the same Cly trend in different latitudes (which the abstract implies)?

2. Effect of temperature on ClO. Temperature could affect ClO levels both by changing the extent of chlorine activation (conversion of HCl or ClONO2) or by changing the partitioning of ClOx. There is also the impact of short-term dynamics (vortex movement). The abstract says that ClO is anti-correlated with T both on a daily and interannual timescale. You should explain the mechanisms for this. Specifically, I thought about how T changes might change ClOx partitioning, but T increases would increase ClO and decrease Cl2O2. Daytime ClOx is mostly ClO but there could be a small effect. In any case, it is up the authors to explain (and quantify) how T might affect ClOx so that the temperature correction can be seen to be robust.

3. What about other atmospheric changes contributing to ClO trends? There is a paper by Solomon et al (literally just published) which argues for changes aerosol loading affecting polar ozone loss (and presumably ClO). How big an effect is that?

4. Anti-correlation of ClO and T. Although this is expected qualitatively, I found it interesting how linear this is, especially for the larger scale MLS data. In fact, the scientific interest is not that it occurs but how strong this anti-correlation is. I think that this is what the abstract should emphasise.

Other specific comments

Title: The current title does not give any indication of the scientific message of the paper. This should be modified to indicate what the 20 years of ClO data are used for. . .

Abstract: Lines 15-16. Give the dates covered by the data.

Abstract. Line 29. Define Cly.

Page 2. Line 6. What is the most important cycle? I know it is ClO + ClO in the

Antarctic, but ClO is also involved in ClO + BrO, which is number two. So this is not clear.

Page 2. Section 1. I think this introduction needs a paragraph on the processes involved in polar ozone depletion where you can explain the role of temperature, PSCs, HCl as a reservoir etc. At present little bits of this information is used bit-by-bit in the results and overall it will be confusing to a non-expert.

Page 3. Line 8. Need to define ClOx. The normal definition is Cl + ClO +2Cl2O2, in which case ClO -> Cl2O2 is a repartitioning within ClOx, not a conversion from ClOx.

Page 3. Line 15. Give altitude at which this SZA is sunset.

Page 3. Line 31. Example of information which needs to be in an introductory paragraph on polar processes.

Page 4. Line 4. Where is Mauna Kea? I do know but this is another example of where the authors have not thought about the non-expert readers.

Page 4. Line 5. Change 'will be' to 'are' – that tense fits the paper better.

Page 4. Figure 1. Use (a), (b), (c) for the panels. The way the panels are laid out, it is not clear if there are two or three.

Page 5. Line 24. Does the comparison change if you subsample the ChlOE data to match the MLS time period?

Page 6. Figure 3. There are no error bars or estimate of uncertainty in the figure. What could be added to inform the comparison of the different datasets?

Page 6. Figure 3 caption. You need to say where this plot is for! I.e.the Scott Base station (with latitude details etc). Say that MLS is sampled at station.

Page 7. Line 8. What does 'were consistent' mean quantitatively?

Page 7. Line 15. This is a long way into the paper to state what the primary goal is!

The introduction should state this (and it should be reflected in the title and abstract content).

Page 9. Figure 5 caption. This says both 'annual' and 'each year'. It is not an annual average.

Page 9.Line 10 onwards. It would be helpful to give the correlation coefficients on the plot (with a legend for the lines).

Page 9. Line 17. Another example of background polar chemistry that should be stated earlier. . .

Page 9. Line19. '3D single layer'? I think that SLIMCAT is a 3D model and that SLIMCAT is just a name, not an acronym. In any case, this paragraph does not say anything. What did this studies show which is relevant here?

Page 11. Figure 6 caption. Met. reanalyses should not be classed as 'measurements'.

Page 12. Line 7. 'or more properly' – just say what it really is. Choose one way of saying it.

Page 14. Line 8. Why not reduce power of 10 and remove some decimal places?

Page 17. Line 10. This is a Summary or Conclusions. It is the final section and it does not add any more discussion. The lack of a conclusions section gives the impression that in this draft the authors were clear about their main scientific message.