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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Surface ozone in the southern hemisphere: 20 years of data from a site with a unique setting in El Tololo, Chile" *by* Julien G. Anet et al.

Anonymous Referee #1

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General Comments:

In general the manuscript titled "Surface ozone in the southern hemisphere: 20 years of data from a site with a unique setting in El Tololo, Chile" present a very high quality of science. It is well written and organized.

This study brings a very important contribution to the community about the influence of anthropogenic emission, biomass burning and the stratosphere-to-troposphere transport on tropospheric ozone in the south hemisphere.

The introduction is very clear and allows the reader to really appreciate how a mountain site in the south hemisphere such as El Tololo, Chile is essential for the long-term time

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survey of tropospheric ozone. The data and methods are thoroughly detailed and it is very much appreciated. The results, the discussion and the conclusions are clear and easy to read.

Nevertheless, I have some specific comments and technical corrections (see below). Once these corrections are made, I would be favorable for the publication of the manuscript.

Specific Comments:

- Section 1 - Introduction: For the discussion about the seasonal cycle of tropospheric ozone with maximum in spring or in summer Cooper et al., 2014 (section 4) showing seasonal cycle by hemisphere with a maximum in spring for the south hemisphere using OMI/MLS tropospheric column ozone should be cited.

- Section 3.3 - Methods: Is it possible to further justify the 4 ppbv threshold used to exclude high changes between one hour and the next?

- Section 3.3 - Methods: Would the authors confirm that 8.9% represents data influenced by local pollution and missing data? Does it give a first element that ozone at El Tololo is unlikely driven by local pollution?

- Section 3.3 - Methods: Make clear that the trajectories data set are provided by Skerlak et al.

- Section 3.3 - Methods: Would the authors write the definition of the max flux more explicitly as a mathematical formulae? That would be easier for the reader.

- Section 4.1 - Trends: the authors are using Figure 10: Time of the year for which the maximum of zone, STE trajectories and STE mass flux into PBL is reached, to argue in favor of the role of ozone STE max flux in tropospheric ozone seasonal changes and changes in time. This paragraph needs to be clarify. The time periods used to assess the changes of the seasonal cycle of tropospheric ozone over time are 1996-2000 and 2011-2015, whereas the time period in Figure 10 ends in 2013. The shift of ozone

maximum from October to August seems to be seen on Figure 10 but not on Figure 5, why?

I would suggest to add the specific humidity in the study. It can be added on Figure 10 and its seasonal cycle could be shown as well. It will give more evidence of the impact of stratospheric ozone on tropospheric ozone changes.

- Section 4.1 - Trends: The authors are pointing out a shift of two months between maximum of STE flux (Figure A9) and maximum of ozone mixing ratio (Figure 5). This is true for the time period 2011-2015 but not for 1996-2000. In 1996-2000, the STE max flux shows two maxima. This paragraph needs to be clarified.

- Section 4.1 - Trends: Factors influencing the trend in austral fall could be biomass burning in Australia and south of Africa (Cooper et al., 2014), more than Southeast Asia as biomass burning in this region occur mostly in the northern hemisphere.

- Section 4.3 - Large-Scale influences at TLL: As said above, Figure 10 shows time series from 1996 to 2013 and not 2015. Would it be possible to extent the time period to 2015?

- Section 4.3 - Large-Scale influences at TLL: The shift in the seasonal cycle has been discussed in section 4.1 - Trends. I would suggest to move the paragraph of the section 4.1 to the section 4.3, otherwise it is confusing for the reader.

- Section 4.3 - Large-Scale influences at TLL: Instead of discuss the relative humidity, I would suggest to discuss the specific humidity which is the absolute value of humidity in the air.

- Figures 8 and 10: on the y or x-axis, I would suggest to give the month associated to the given week or day of the year. It will help the reader to follow the analysis which is often based on season or month in the text.

- Table 1: I would suggest to add the 95% confidence limit and the p-value

Technical corrections:

- I would suggest to add the longitude and latitude of El Tololo in the title

- L.5 p.3: Change “Unites” to “United”

- L.8 p.7: Change “Stratosphere-Troposphere-Transport” to “Stratosphere-Troposphere-Exchange”

- L.19-20 p.9: I would link both paragraphs (no enter)

- L.22 p.9: Change “positive deviations” to “increase”

- L.23 p.9: Change “During the remaining of the year” to “For the other months of the year”

- L.29 p.9: I would suggest to remove “The attentive reader may have realized that” and start the sentence directly by “The maximum of STE. . .”

- L.30 p.9: Change “ration” to “ratio”

- L.13 p.10: “biomass burning in ...” a word is missing?

- L.29 to 30 p.: I would suggest to remove this paragraph as everything is already written in the caption of the figure

- Figure 3: I would suggest to change “(a&b)” to “(a) DJF, b) JJA)”, same for “(c & d)” and “(e & f)”

- Figure 4: I would suggest to add minor ticks to show all the years

- Figure 5: I would suggest to add minor ticks to show all the months

- Figure A4: I would suggest to change the caption of the figures in order to have the consistent name of the season related to the month: Fall (MAM). It is quite common to order the season as followed: winter, spring, summer, and fall

- Figure A6: I would suggest to follow the common order: winter (JJA), spring (SON),

summer (DJF), and fall (MAM)

- Figure A7: I would suggest to add dash lines for the three panels as in Figure 4 and add minor ticks to show all the years

- Figure A9: I would suggest to add minor ticks to show all the month

- In general be careful with the use of “STE” and “STT”. STE = stratosphere - troposphere exchange, STT = stratosphere to troposphere transport

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