

Interactive comment on “Occurrence of ozone anomalies over cloudy areas in TOMS version-7 level-2 data” by X. Liu et al.

Anonymous Referee #2

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General Comments: This manuscript presents the results of an investigation into anomalous ozone distributions over cloudy areas from Nimbus-7 (N7) and Earth-Probe (EP) TOMS version-7 level-2 data and analyzes the possible causes for the ozone anomaly formations. Overall, I thought the manuscript was very good, especially in its attempt to diagnose the difficult issue of clouds and satellite retrieval of ozone. I thought the explanation of ozone anomalies in the tropics was very good; however the section that describes the mid-latitude ozone retrieval-cloud issues was less clear. I've listed several comments that should be considered before publication in ACP.

Specific Comments:

1. Introduction, 1st paragraph, 2nd sentence: A statement or explanation should be considered regarding what the latitudinal dependence of cloud-top pressure (CTP) is

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and why it is considered oversimplified.

2. Section 2: A general comment about the resolution (spatial and temporal) of the level-2 TOMS data should be considered. I know that the data is getting binned into 5x5 boxes, but I think it would help the reader(s) to know the density of the data points.

3. Section 2, 2nd paragraph: This section discusses figure 1 and refers to "anomalous ozone distributions", however in the figure it states "total ozone distribution". I believe it is total ozone distribution, can you please clarify.

4. Section 2, 2nd paragraph: One of the criteria that you are using for binning the level-2 data is reflectivity of $\approx 30\%$. What is this criteria based on?

5. Section 2, 3rd paragraph: This section states "There is a significant fraction of large negative or positive correlation coefficients". What makes the amount significant and above what threshold are you considering it to be large? It then goes on to discuss the selection of a correlation coefficient of ± 0.5 , which defines whether it is a positive or negative ozone anomaly, respectively. What level of significance does a correlation coefficient of 0.5 represent? It would give the reader a yardstick to know what 0.5 means in terms of statistical significance.

6. Section 3, 1st paragraph: The authors make the statement that a significant portion of ozone anomalies occur in coastal areas and attempts to explain why this may be occurring. Have you checked into some work done by Cuevas (Cuevas et al., 2001) that deals with the Ghost (global hidden ozone structures from TOMS) effects of TOMS. It may be contributing to some of the enhanced coastal anomalies that you are seeing.

7. Section 3, 2nd paragraph: Here the authors mention the N7/EP TOMS bias. Is the bias, that is referred to, the 5 DU increase in the N7 data versus the EP data stated in the next sentence? You might want to include a statement that clearly states the bias.

8. Section 3, 3rd paragraph: This section discusses Figure 5. I am not sure what this figure is trying to show other than that the ozone is more variable across the midlat-

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itudes than across the tropics. In the case of a positive anomaly during cloudy conditions (reflectivity of 100%), it appears that there is an overestimation of the amount of ozone by the amount shown. While in the case of the slope of a negative ozone anomaly, it appears that it shows an underestimation of that amount of ozone. Is this the correct interpretation or am I missing something? Also, the NOAs for both N7 and EP look very similar, while the ozone fraction of N7 and EP (Figure 4) do not look very similar. Can you please explain?

9. Section 3, 4th paragraph: Here the authors look at ozone anomalies relative to two different El Niño periods. In the text, you say that Fig 6 compares the average fraction of ozone anomalies during non-El Niño periods and El Niño periods. The figure only focuses on negative ozone anomalies. You should clarify, in the text, that you are only looking at negative ozone anomalies.

10. Section 4.1, 1st paragraph: In this section, the authors discuss the utilization of the THIR data to help analyze errors in assumed monthly mean CTPs from the ISCCP cloud data. Some references should be considered that exhibit the utilization of the THIR data for such analyses and also discuss what the THIR data is and its limitations. As far as Fig 7, I understand what the figure is saying. However, I think a statement about what the 14 points represent (such as certain pressure levels or layers) should be considered.

11. Section 4.1, 1st paragraph: Here the authors mention the δP correction from Newchurch et al. 2001. A statement that briefly describes what this correction is would help the reader to better assimilate what you're trying to show and why it applies to this investigation. I think it's an important piece of information that should be included in the text versus just referencing it.

12. Section 4.1, 3rd paragraph: The last sentence talks about the use of the ISCCP cloud climatology for the 86-87 and 91-92 El Niño events, which is contributing to the smaller differences. However, doesn't the cloud climatology only run through 1990? I

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think this should be clarified.

13. Section 4.1, 4th paragraph: In this paragraph, the authors discuss the use of tropospheric ozone climatologies. It's confusing since, up until now, you've been discussing total column ozone (TCO). In this discussion of tropospheric ozone climatology you have four references and state that there is an incorrect tropospheric ozone climatology being used. Which climatology are you referring to?

14. Section 4.3, 2nd paragraph: The 2nd sentence in this paragraph states that earlier surface observations indicate that the TOC at mid-latitudes is usually correlated with the surface pressure and upper tropospheric pressure. I think you need a reference here. Are you talking about earlier in the paper or the sentence before this one or what? The next sentence states that high ozone is usually associated with cyclones and low ozone with anticyclones. At the surface, high ozone is usually associated with anticyclones. I think the increase in ozone you're referring to is when an upper tropospheric trough digs south (in latitude) and allows the transport of ozone-rich stratospheric or high latitude air to mix into the upper troposphere or lower latitudes. This then allows the column of tropospheric ozone (in the midlatitudes) to increase, but not necessarily impacting the surface. The whole paragraph seems to move between the surface and total column. The increase in the ozone that you're referring to does occur in the mid-latitudes and is common in the winter and spring seasons, however it's more a function of increase in the total column ozone in the midlatitudes. Stating that high ozone is usually associated with surface lows in the mid-latitudes is not always the case and can sound confusing or contradictory. I understand the upper tropospheric trough connection to increased total ozone. However I think this paragraph needs to be reworked to clarify the difference between increase in total ozone and its connection with surface low and high pressure systems, since surface systems can contribute differently to surface ozone.

15. Section 4.4, 1st paragraph: The last two sentences make reference to Shadowz. I think you need to reference it here. Since you are using it to conjecture about the re-

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relationship between tropospheric ozone and marine stratocumulus clouds, a statement about this particular effort and what it found would go along way to allowing the reader to make this connection.

16. Section 4.4, 2nd paragraph: The explanation concerning Figure 12 (a) is a little confusing. You say that tropospheric ozone at Ascension ranges from 29.0 DU in April to 48.7 DU in October. However, the figure gives 50-hPa layer ozone amounts. So is the 29.0 in April an integral of each of the 50 hPa layers shown in the profile from 1000-100 hPa? If that is the case, I think a description that better explains how you interpret this figure should be considered in this paragraph.

17. Section 4.4, 4th paragraph: The authors should consider using the term q° photolysis rate q° instead of q° -value q° when talking about the production of ozone above low-altitude clouds, since it is a more readily identifiable term.

Interactive comment on Atmos. Chem. Phys. Discuss., 3, 187, 2003.

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