

Interactive comment on “LIMS observations of lower stratospheric ozone in the southern polar springtime of 1978” by Ellis Remsberg et al.

Ellis Remsberg et al.

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Reply (in CAPS) to comments of Referee #1

Anonymous Referee #1

GENERAL COMMENTS First, it is great to see that 'old' data such as those obtained from LIMS are still be re- worked and used in analyses. Previous analyses, based on chemistry-climate models (e.g. Langematz et al...), have shown that ozone destruction through heterogeneous halogen-catalysed chemical reactions was occurring over Antarctica well before 1980 which is often (erroneously) considered as when Antarctic ozone depletion started and which is why many studies consider a 'return to 1980 values' as indicative of a recovery of the ozone layer over Antarctica from the effects

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of ozone depleting substances. This is one of the few papers to provide observational evidence of halogen-catalysed ozone depletion occurring over Antarctica prior to 1980. I think that this point should be made more strongly in the paper. It is made, almost in passing, around line 162 but I believe it should be highlighted in the abstract.

WE WRITE IN THE REVISED ABSTRACT AND THE SUMMARY THAT THERE WAS VERY LIKELY SOME HALOGEN-CATALYZED LOSS OF OZONE IN THE SOUTHERN POLAR VORTEX IN WINTER/SPRING OF 1978.

SPECIFIC COMMENTS

Figure 1: I wonder whether this is an older version of the TCO distribution from TOMS on 1 November 1978? It looks different to the file I have on my computer. Sure enough, when I go and download the raw data file from GSFC, here is the header: Day: 305 Nov 1, 1978 Production V70 NIMBUS-7/TOMS OZONE Asc LECT: 11:49 AM Longitudes: 288 bins centered on 179.375 W to 179.375 E (1.25 degree steps) Latitudes : 180 bins centered on 89.5 S to 89.5 N (1.00 degree steps) and here is the data line for 45.5°S:

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3563573563493543543543513553613623603573543513503453453453463433453523523
3573553533543573643723803863943973953963973973983983883783813813833843833
383378387383377376 0360364364363351343336338341342344350350351 0 0 0 0
0 0 0 0353353354355358358359363358356361370372371366367365364359360359
357358364362361363365364364365366366 0 0 0 0 0 0 0368368368365363
3593583573533573513563533503473453483453463453443413473473533563543533473
3433363343333413443473533563673723793914114224184094054144043943763653543
3393363293233233173183213233213223183143102962973063103183233263353433493
3543583693733743773743713623553423393343243113063073103093163173253343373
3373303253223203153153183213243233213173143143153173163183213223223233233
328330333332332339340340 0 0 0359366367376377382383388392400407384360353
346346348347332329335338343343343351347 lat = -45.5 It shows some missing
data but not as much as is apparent in your Figure 1 and cer- tainly no data missing

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just west of the international date line. So why the discrepancy between the TCO field shown in your Figure 1 and the TOMS data stored on the GSFC server?

Line 40: You state that 'Minimum polar ozone is of the order of 250 Dobson units (DU) at (75°S, 270°E) on this day' When I go and look at the actual TOMS data file for that day at 74.5°S and 75.5°S at 270°E (which is 90°W; cell number 72 in TOMS-world) I see values in excess of 400 DU. These are quite different to the value of 250 DU that you are reporting here. What is the source of this difference? Perhaps you mean 90°E, but even then the lowest ozone value is 270 DU.

YOUR DATA SOURCE APPEARS TO BE TOMS VERSION 7 (NOTE PRODUCTION V70 IN HEADER LINE), WHILE WE USE VERSION 8 DATA FOR FIGURE 1–

[HTTPS://ACDISC.GESDISC.EOSDIS.NASA.GOV/DATA/NIMBUS7_TOMS_LEVEL3/TOMSN7L3DTOZ.008/1978/L3_OZONE_N7T_19781101.TXT](https://acdisc.gesdisc.eosdis.nasa.gov/data/nimbus7_toms_level3/tomsn7l3dtoz.008/1978/L3_OZONE_N7T_19781101.TXT)

THE HEADER LINES ON ITS .TXT FILE FOR NOVEMBER 1 ARE

DAY: 305 NOV 1, 1978 NIMBUS-7/TOMS NRT OZONE GEN:04.119 V8 ALECT: 11:49 AM LONGITUDES: 288 BINS CENTERED ON 179.375 W TO 179.375 E (1.25 DEGREE STEPS) LATITUDES : 180 BINS CENTERED ON 89.5 S TO 89.5 N (1.00 DEGREE STEPS). THE DATA FOR -45.5 ARE BELOW AND ARE VERY SIMILAR TO, BUT NOT EXACTLY AS FROM YOUR SOURCE.

354354350344347352351349354362364361358357353352347346343340337339346347349
353353353356356363374376385395397398400400398397395387375379379378379380380
381384389383371369 0364369368365351338332336339340341346346347 0 0 0 0
0 0 0 0348348348348353354356359356353356363365362360358357359353352353
352352358357356359359359358359360 0 0 0 0 0 0 0 0363363363360357
353354352351355355351351344341342342340340342341341346347352355352349346342
339335334332340342341351358368373382393411421415406402410400391374361351341
333331322316317314317322323321319317315305293295305311322326328335344353354

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353354364374377376372368361354342339332324309303302307305310311321330330332
333330323318318312310313317321322317315314314316317317318322324322320322324
327328329330330337338339 0 0 0356359359373375376378381384395403379357345
340346334337314317327332339336344344342 LAT = -45.5

HOWEVER, WE DID NOTICE THAT THERE SHOULD BE ONLY THREE DISCRETE DATA VOID REGIONS AT THIS LATITUDE. WE CHECKED ON OUR CODE AND FOUND A BUG IN THE WAY WE HANDLED THE ZEROS. OUR REVISED FIGURE 1 (SEE BELOW) IS MORE IN LINE WITH THE TCO VALUES FROM YOUR V7 DATA SOURCE. WITH REGARD TO YOUR COMMENT ABOUT OUR SENTENCE AT LINE 40, WE AGREE THAT WE SHOULD HAVE SAID THAT THE MINIMUM OZONE IS 270 DU AND IS LOCATED NEAR 75°S, 90°E. THANK YOU FOR CHECKING ABOUT FIGURE 1 AND FOR ASKING WHETHER WE MADE AN ERROR.

Lines 82-83: When you say that 'We note that daily plots of GPH are also available from LIMS V6' do you mean that LIMS also retrieves temperature and pressure profiles from which GPH fields are calculated? or do you mean that GPH fields are provided (from some other source) along with the LIMS data? If the latter, can you please describe the source of those GPH fields. Thank you.

THE LIMS V6 GPH FIELDS AT 50 HPA ARE FROM CPC ANALYSES PROVIDED TO THE NIMBUS 7 PROJECT. THOSE CPC 50 HPA FIELDS REPRESENTED A BASE LEVEL FOR THE PREVIOUS LIMS V5 PRODUCT, AND THOSE SAME FIELDS PROVIDE A SCALING FOR BOTH THE GEOMETRIC AND GEOPOTENTIAL HEIGHTS FOR THE V6 PROFILES (SEE REMSBERG ET AL., JQSRT, 2004). HEIGHTS AND GPH PROFILES ABOVE AND BELOW THE 50-HPA LEVEL ARE OBTAINED HYDROSTATICALLY USING THE LIMS RETRIEVED T(P) PROFILES. WE ARE ADDING COMMENTS TO MAKE THIS CLEARER IN THE REVISED MANUSCRIPT.

Lines 93-95: You may also find the following paper relevant and of interest: Hassler, B., G. E. Bodeker, S. Solomon, and P. J. Young (2011), Changes in the polar vortex: Ef-



fects on Antarctic total ozone observations at various stations, Geophysical Research Letters, 38, L01805, doi:01810.01029/02010GL045542.

THIS PAPER IS DEFINITELY PERTINENT AND WE REFER TO ITS FINDINGS IN SECTION 3 OF THE REVISED MANUSCRIPT. THANK YOU FOR BRINGING IT TO OUR ATTENTION.

Line 101: I would suggest replacing 'is now in terms of partial pressure' with 'is now presented in units of partial pressure'.

WE MADE THIS CHANGE.

Line 107: Are formally derived uncertainties on the LIMS measurements available? If so they should be quoted here.

REMSBERG ET AL. (2007, TABLE 1, ROW G) CONTAINS ESTIMATES OF ACCURACY FOR THE V6 OZONE PROFILES. THEY ARE OF ORDER 14% AT 10 HPA, 26% AT 50 HPA, AND 34% AT 100 HPA. WE MAKE NOTE OF THAT IN THE REVISED MANUSCRIPT.

Line 117: For clarity I suggest replacing 'for it' with 'for indication of denitrification'.

WE MADE THIS CHANGE.

Line 128: I always thought that the chlorine activation threshold on PSCs was 195K not 193K?

WE DECIDED TO CITE A TEMPERATURE THRESHOLD OF 195 K, BASED ON FIG. 4-1 OF WMO (2018), ALTHOUGH DRDLA AND MÜLLER (2012) INDICATE THAT IT IS EVEN LOWER THAN THAT IN THE PRESENCE OF STS PARTICLES.

Line 147: It was not clear to me what was meant by 'remains good'? Can you please describe that more specifically.

WE NOW WRITE "REDUCED CONCENTRATIONS OF THOSE SPECIES ARE

PRESENT INSIDE THE VORTEX UNTIL ABOUT NOVEMBER 25”...

Line 149: By 'lowest heights' to you mean 'lowest amplitudes' of the wave-1?

WE CORRECT THE SENTENCE TO READ “AND WHERE THE HEIGHT IS LOWEST NEAR 0°E”.

Line 272: Would it not be better here to state that $1DU = 2.687 \times 10^{20}$ molecules/m².

THE NUMERICAL VALUE AND UNITS FOR DU ARE NOW IN THE FIGURE CAPTION.

GRAMMAR AND TYPOGRAPHICAL ERRORS

Line 105: 59.5µS not just 59.5µ

Line 109: Should this be 'ozonesonde' rather than just 'sonde'?

Line 127: Replace 'no colder than' with 'no lower than'. I was always taught 'the air is cold - temperatures are low'. There can be no more a cold temperature than a heavy temperature.

Line 144: Replace 'lowest species values' with 'lowest species concentrations' and again on line 147.

Line 170: Replace 'ECC ozone' with 'ECC ozonesonde ozone'.

WE MADE ALL THE ABOVE CHANGES.

Interactive comment on Atmos. Chem. Phys. Discuss., <https://doi.org/10.5194/acp-2019-1086>, 2019.

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Day: 305 Nov 1, 1978

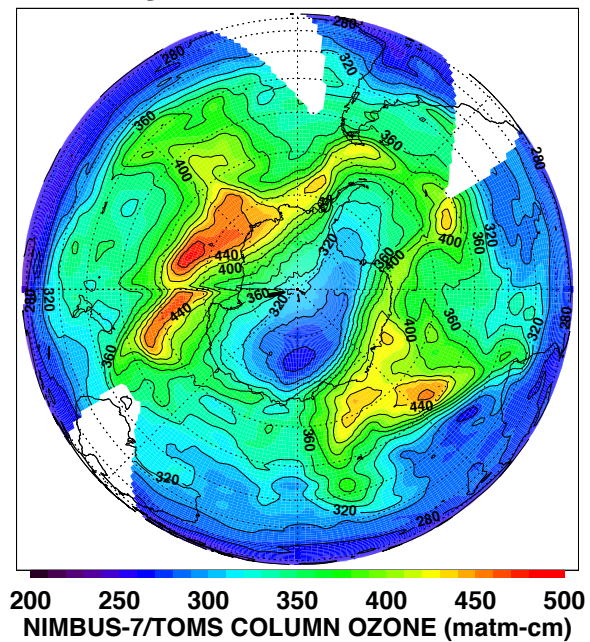


Fig. 1.

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