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Discussions

Interactive comment on "LIMS observations of lower stratospheric ozone in the southern polar springtime of 1978" *by* 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

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 45.5âŮęS:
356357356349354354354351355361362360357354351350345345345346343345352352335735535335435736437238038639439739539639739739839838837838138138338438333833783873833773760360364364363351343336338341342344350350351 0 0 0 0 0 0 035335335435535835835936335835636137037237136636736536435936035935735836436236136336536436436536636 6 0 0 0 0 0 0 0 036836836836536335935835735335735135635335034734534834534634534434134734735335635435334733433363343333413443473533563673723793914114224184094054144043943763653543339336329323323317318321323321322318314310296297306310318323326335343349335435836937337437737437136235534233933432431130630731030931631732533433733373303253223203153153183213243233213173143143153173163183213223223233233283303333323323393403400 0 0359366367376377382383388392400407384360353346346348347332329335338343343343351347 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

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 (75âŰęS, 270âŰęE) on this day' When I go and look at the actual TOMS data file for that day at 74.5âŰęS and 75.5âŰęS at 270âŰęE (which is 90âŰęW; 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 90âŰęE, 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

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.

354354350344347352351349354362364361358357353352347346343340337339346347335335335335635636337437638539539739840040039839739538737537937937837938031838438938337136 0364369368365351338332336339340341346346347 0 0 0 0 0 0 0 0348348348348353354356359356353356363365362360358357359353352353352352358357356359359359359358359360 0 0 0 0 0 0 0 0363363363360357353354352351355355351351344341342342340340342341341346347352355352349346339335334332340342341351358368373382393411421415406402410400391374361351333313223163173143173223233213193173153052932953053113223263283353443533

353354364374377376372368361354342339332324309303302307305310311321330330333330323318318312310313317321322317315314314316317317318322324322320322332738328933033033733833900 0 0356359359373375376378381384395403379357345340346334337314317327332339336344344342 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 = 2.687×10ËĘ20 molecules/mËĘ2.

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

GRAMMAR AND TYPOGRAPHICAL ERRORS

Line 105: 59.5âŮęS not just 59.5âŮę

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.

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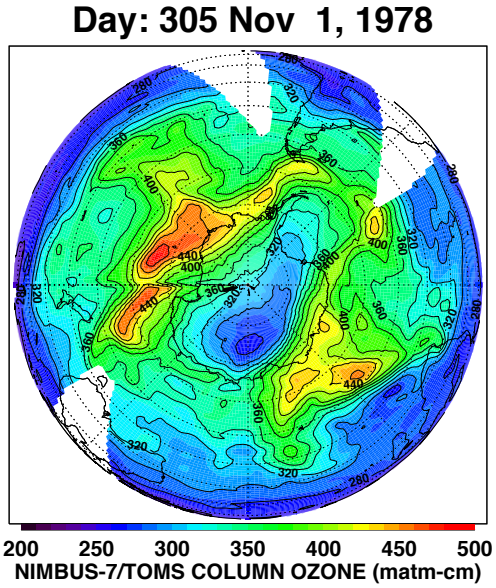
Day: 305 Nov 1, 1978
200 250 300 350 400 450 500
NIMBUS-7/TOMS COLUMN OZONE (matm-cm)

Fig. 1.