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Interactive Comment

Interactive comment on "Global distribution of tropospheric ozone from satellite measurements using the empirically corrected tropospheric ozone residual technique: Identification of the regional aspects of air pollution" *by* J. Fishman et al.

J. Fishman et al.

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We appreciate the discussion brought forth by de Laat and supply the following dialogue to help clarify what was done in our paper to calculate the empirically-corrected TOR. Hopefully, this discourse will provide a clear understanding of the empirical-correction method.

The assumption that the SOC is determined by first empirically adjusting the SBUV-TTOC so that it equals the Logan climatology is not correct, where SOC (in the de Laat comment) is the definition of the stratospheric ozone column (equivalent to what we

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call the SCO in our paper) and SBUV-TTOC is his definition of what we call the TOR (tropospheric ozone residual) in our paper and in the following discussion. The SCO in our calculation uses two observed quantities: The total ozone amount from the SBUV data archive and the integrated ozone in the lowest three levels (Level A: 1000 hPa-253 hPa; Level B: 253 hPa-126 hPa; and Level C: 126 hPa-63 hPa) of the SBUV profile (i.e., S[A+B+C]). Fishman and Balok (1999) showed that the latter quantity, S[A+B+C], agreed well with available ozonesonde measurements; ozonesonde data were one of the primary data sources used to generate the Logan (1999) climatology. There is no constraint that the TOR from TOMS and SBUV (or SBUV-TTOC, as stated by de Laat) equal any specific value.

The derivation of the TOR is a two-step process. First, the empirically corrected SCO(SBUV) is calculated using three inputs: 1. Total O3 column from SBUV; 2. The integral of ozone layer amounts in three lowest layers, S[A+B+C], from SBUV; and 3. the Logan (1999) climatological tropospheric ozone distribution between the surface and 100 hPa, partitioned into sub-layers that correspond closely with the SBUV sub-layers: Layer X (1000 hPa-250 hPa), Layer Y (250 hPa-125 hPa), and Layer Z (125 hPa-100hPa).

The initial part of this procedure is extending the Logan climatology to a pressure level of 63 hPa which is done by assuming that the sum of the ozone in the three layers from the SBUV measurements is correct (Fishman and Balok, 1999); this extension yields the new integrated layer values X, Y, and Z*, where Z* is the amount of ozone in the layer between 126 hPa and 63 hPa. The next step is to generate a new ratio for each of the three layers X, Y, and Z* to the sum of the three layers (S[A+B+C]). These three ratios, R1, R2, and R3, are derived from a knowledge of the Logan climatology. The product of the two numbers results in the new quantities A*, B* and C*, which are then used in the calculation of SCO(SBUV).

To calculate the SCO(SBUV), we must also know the height of the tropopause, which is obtained from the archived NCEP/NCAR reanalysis, and the fraction of either layer

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B or C that is defined as tropospheric using the equation:

(1) SCO(SBUV) = [Total O3](from SBUV) - cC* - bB* - A*

If the tropopause height does not lie within Layers B and C, the SCO(SBUV) is not calculated. If the height of the tropopause (ztrop) is above 126 hPa (i.e., within Layer C), then all of Layer B is in the troposphere and the fractional coefficient, b, is one; if ztrop is within Layer B, then Layer C is entirely stratospheric and c equals zero.

The SCO(SBUV) from (1) is then subtracted from the TOMS total ozone value to derive the TOR:

(2) TOR = [Total O3](from TOMS) - SCO(SBUV)

Thus, the only measurement information from SBUV are S[A+B+C] and the total ozone column. The original archived values of the three lowest levels (A, B, and C) are never used to derive the TOR. Because the data density of SBUV is relatively sparse (compared with TOMS), five days of SCO values are used to derive the SCO field for the central day of that 5-day period. The SCO field is still relatively smooth and the spatial density of the TOR field is determined from the data density of the TOMS data used for that day. The measurements are never constrained by the Logan climatology and there is no reason to assume that the Logan product and the TOR fields we produce are the same. The Logan integrated ozone distribution at middle latitudes in the Northern Hemisphere is nearly zonal and none of the regional enhancements highlighted and discussed in the current study are present.

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