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Atmospheric Chemistry and Physics Discussions

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.

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The authors present the results of a retrieval algorithm of the total tropospheric O3 column (TTOC). The use of a large number of satellite observations with a high horizontal resolution provides potentially a very detailed global picture of the TTOC. The procedure that is being followed is based on two different types of satellite observations of O3: TOMS (total columns) and SBUV (profiles). The procedure is to derive the stratospheric O3 column (SOC) from the SBUV profiles, and then subtract this from the total

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O3 column (TOC) from TOMS.

This procedure differs from the one presented by Fishman and Balok [JGR, 1999] because the Logan tropospheric O3 climatology [Logan, JGR, 1999] is also included. The procedure is as follows. The SOC is determined by first empirically adjusting the SBUV-TTOC so that it equals the Logan climatology. Then, the SBUV-TTOC is subtracted from the SBUV-TOC to obtain the SBUV-SOC. After that, the SBUV-SOC is subtracted from TOMS-TOC, and the residual is the TTOC.

Formula-wise: the SBUV-TOC is the sum of the SBUV-SOC and the Logan-TTOC:

SBUV-TOC = SBUV-SOC + Logan-TTOC

TTOC = TOMS-TOC - SBUV-SOC = TOMS-TOC Ű SBUV-TOC + Logan-TTOC.

Now let us assume and ideal case, so that the satellite observations are perfect (no errors). In that case:

SBUV-TOC = TOMS-TOC or SBUV-TOC - TOMS-TOC = 0

And thus

TTOC = [TOMS-TOC - SBUV-TOC] + Logan-TTOC = + Logan-TTOC

Conclusion: for the ideal case what one retrieves is only the Logan-climatology. Furthermore, my interpretation then would be that what is being retrieved is the Logan-climatology modified with the differences between TOMS and SBUV. This would for example explain why the "GHOST" features [Cuavas, JGR, 2001] occur in the TTOC. The "GHOST" feature is a TOMS related features, which could very well be absent in the SBUV retrieval.

I therefor have two questions:

1) is this reasoning correct ? If so, then I would argue that this is not a valid way to retrieve the TTOC.

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2) what is the reason of including the Logan-climatology in the retrieval ?

Apart from these questions about the retrieval concept, there are some other concerns.

In Figure 3 it is shown that in the retrieval surface elevation features can be discerned very well. However, if the retrieval more or less shows the Logan-climatology, This is would be no surprise if in the Logan-climatology the surface were taken into account (which I assume is being done).

Furthermore, in Figure 5 it is shown that there are regions with a very high TTOC during local summer over China and the Ganges Valley in India. The authors link these features to the population density, which in a way is a derivative of surface pollution emissions. Although these features could very well be real, I have concerns about the seasonality of the feature. According to Figure 1 this feature occurs during local summer (JJA). However, as far as I know highest surface O3 concentrations do not occur during local summer, but during local spring (MAM, at least for India an Japan). As an example, during JJA the O3 concentrations over India are low because it is the wet season with strong convective activity over India. The convection removes O3 precursors by wet deposition, limits the photochemical activity because clouds reduce the solar insolation and the air masses are low in O3 to start with, because the convection is fueled by transport of warm humid air masses from the central equatorial Indian Ocean. Furthermore, the strong convection will mix the entire troposphere, hence O3 mixing ratios will be low throughout the column. On the other hand, it is known that during winter free tropospheric O3 concentrations are high over India [see for example: de Laat, ACP, 2002], and only boundary layer O3 concentrations are low. It can therefore be expected that the TTOC is higher during winter or spring than during summer. I am therefore not sure if the observed feature is real.

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