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Comment

Interactive comment on “Comparison of profile total ozone from SBUV(v8.6) with GOME-type and ground-based total ozone for 16-yr period (1996 to 2011)” by E. W. Chiou et al.

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Comparison of profile total ozone from SBUV(v8.6) with GOME-type and ground-based total ozone for 16-year period (1996 to 2011)

Response to Comments from Referee #1

The authors would like to thank the reviewer for recommendation that the paper is suitable for publication in AMT.

Response to itemized suggestions:

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(1) Introduction: Reference to previously available merged data sets should be given and briefly discuss where a need for improvements was.

* References to previous GTO data set is already given in section 2.2.

* The following paragraph will be added to paragraph 1 in section 2.1 for additional information regarding previous SBUV-MOD (i.e. v8.0): The previous v8.0 MOD(Merged Ozone Data Set) used measurements from TOMS instruments on the Nimbus-7 and Earth Probe satellites, the Ozone Monitoring instruments(OMI) on the AURA satellite and SBUV integrated column ozone. The newly released SBUV v8.6 MOD used profile total ozone measurements from nine BUV-type instruments. Although modifications in instrument design were made in the evolution from BUV instrument to the modern SBUV(/2) model, the basic principles of the measurements technique and retrieval algorithm remain the same, lending consistency to this record compared to those based on measurements using different instruments.

(2) Section 2.1. The authors should provide some summary information concerning comparison results between v8.0 and v8.6 total ozone estimates.

* The following paragraph will be added to the end of section 2.1: Recent studies of the differences between v8.6 and v8.0 MODs indicate that v8.6 MOD is 0.5 to 1% lower than v8.0 MOD at all times except in the mid-1990s, when v8.6 is 1% higher. The difference in mid-1990 is related to the use of NOAA-14 in the new version rather than the NOAA-9 used in the v8.0 MOD product (no TOMS data are available during this period). The deviation in mid-1982 results from different treatment of the data after the eruption of El Chichon in late March, 1982.

(3) Section 2.3. Line 17. The addition of the zonal climatology, which is based on satellite data, to the zonal deviations of the ground-based data actually removes any possible bias between these two. Is this correct? How independent are then these data sets? Please comment.

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* It is not correct. Zonal climatology is based on exactly the same data as were used to the zonal deviations from ozone climatology of the ground-based data. The ozone climatology used here is based on TOMS data for 1978-1998, not on recent SBUV or GOME data sets. If you remove something and then put it back, the bias would not be affected unless the bias has large longitudinal inhomogeneity. The data sets of deviations from the climatology for ground-based and satellite data are independent. The removal/addition ozone climatology for the ground-based data set is required only to address the issue of data gaps in the records of individual ground-based stations. Since this procedure of total ozone zonal means calculation from ground-based data is more than 20 years old and was widely used before, we do not think it is necessary to explain it further in the text.

(4) Section 3. It would be interesting to show GB-SBUV comparisons for the whole period (1970-2012), since both data sets could be used for trend studies for longer time periods than 1996-2011 and therefore such information would be extremely helpful.

* Some results of such comparison are available from: (a) M. Weber, W. Chehade, V. E. Fioletov, S. M. Frith, C. S. Long, W. Steinbrecht, and J. D. Wild, 2012: [Atmospheric composition] Stratospheric Ozone [in “State of the Climate in 2012”] Bull. Amer. Meteor. Soc., 94 (8), S36–S47. (b) Labow, G.J. et. al., (2013), A comparison of 40 years of SBUV measurements of column ozone with data from Dobson/Brewer network, J.Geophys.Res.Atmos., 118, 7370-7378, doi:10.1002/jgrd.50503.

(5) Section 3.1. There are two issues that certainly affect the GB-satellite comparisons. First, the authors mix Dobson, Brewer and M-124 data, known to have different behavior when compared to individual satellite data sets and second the authors do not discuss the fact that ground-based data use Bass and Paur absorption cross section, while both merged data sets are based on BDM. They should provide some comment how these two issues could affect the GB-sat comparisons relative to the GTO-SBUV ones.

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* The differences between Dobson, Brewer and M-124 data do exist, but on average they are within $\pm 0.5\%$ (see Fioletov et al., 2008, Table 3, top – median value for DS measurements). There are also differences in the ozone seasonal cycle, but they are also not very large. The fact that this comparison of data sets based on different instruments that use different ozone cross sections yields very similar results actually shows that we can measure ozone rather accurately.

* The effect of applying the new ozone cross sections to SBUV retrievals were discussed by Rich McPeters in a poster paper presented at AGU Spring 2010. The results indicate that ozone profiles are lower in the upper stratosphere and higher in the lower stratosphere and troposphere. As a result, the average differences in total ozone are small, and close to zero in the tropics.

(6) Section 3.2 What is the usefulness of Figure 5? It just shows again that the levels and seasonality are consistent but this is well expected. The authors could just show Figure 6. However the discussion of Figure 6 could be expanded. For instance in the 50S–30S belt there is a trend in the GTO–SBUV in the second half of the period, in 0–30N there are two periods in GB–SBUV with large deviations. I think that this figure is the key figure of the paper and deserves more discussion, apart from providing some summary statistics.

* Since Fig. 6 is shown in terms of percentage differences, the addition of Fig. 5 together with Fig. 6 will help understanding the approximate differences in DU for each of the four latitudinal zones.

* We will also add the following discussions before the last paragraph of section 3.2: In the 50S–30S region, the differences GTO minus SBUV in Fig. 6 show slight increase in the second half of the period. This increase is probably related to the usage of SCIAMACHY with a restricted sampling due to alternating nadir/limb modes. For the Ground-based minus SBUV differences, there are two periods, namely, beginning of 2007 and end of 2009 where the differences show larger deviations in 0–30N. The

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explanation is not readily apparent and further investigation in this regard is worthwhile once revised data records become available in the near future.

(7) Section 3.3 What is the added information of this section, compared to section 3.2? Please justify. In addition it is not clear, as it is written, which 16-year average is subtracted from each data set. The same average, or simply each time series is deseasonalized with its own seasonal cycle? In 10092-lines 1-3, the numbers reported are not justified by any figure, or it is not clear to what they correspond as it is written.

* We think that for the comparisons of 2 or 3 multi-year monthly zonal mean records, analysis of monthly zonal mean anomaly could provide additional information on the consistency of various records in depicting the changes from long-term average (in this case 16-year average). [Fig. 7 should contain additional information to Fig.5].

* In section 3.3 line 20: “For the purpose of our current study,” will be changed to “For each of the three data records”, to clarify that different 16-year averages are used for each individual data record.

* The numbers in 10092-lines 1-3 came from the 3rd and 5th column of entries in Table (5). [There is a typo in Table(5) “7.74” need to be corrected to “5.74”]. Thus, in Table (5), the numbers (2.89, 2.19, 3.53, and 3.19) (in column 3) and (4.35, 6.29, 5.74, 5.79) (in column 5) represent the ranges seen in Figure(8) for the red curve and black curve in the 4 panels.

(8) Section 3.4. When the authors refer to seasonal zonal means, do they mean annual means?

* The following sentence will be added to section 3.4 after line 10 (before the discussion of the results), for clarification: For each of the three data records, (61) season zonal means were computed for March 1996 through May 2011.

(9)Table 8. The information on the significance of trends should be somehow included also in the table.

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* The entries of Table 8 will be revised by adding the estimated errors (uncertainties) for each of the derived trends to illustrate the significance of trends. e.g. $0.05 \pm 0.0098\%$ yr⁻¹; 0.14 ± 0.026 DU yr⁻¹ etc.

(10) Section 3.6 The part of the table that reports on the analysis of the deviations from pre-1980 levels, as it is included in the abstract and in the discussion, seems to be not directly related with the subject of the paper. It is presented very briefly and either it should be removed from the paper or discussed further, since many issues evident in the figures are left without any discussion. For instance there are differences between North and South Hemisphere. In the Southern Hemisphere mainly after 2000 the three data sets seem to slightly diverge. The authors just provide a short summary of the general patterns in page 10094, lines 10-14.

* More detail discussion of the long-term trend or deviations from Pre-1980 levels in total column ozone is NOT the aim of this paper. Such analyses are expected to be reported from the upcoming "Ozone Assessment" efforts. Thus, Section 3.6 just provides our preliminary overall picture based on the limited 16-year period of coverage of the three data records. The results should be useful for comparisons with the future detail trend analysis based on longer-period time series of various available total ozone records.

Interactive comment on Atmos. Meas. Tech. Discuss., 6, 10081, 2013.

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