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Discussions

Interactive comment on "Methods to homogenize ECC ozonesonde measurements across changes in sensing solution concentration or ozonesonde manufacturer" *by* Terry Deshler et al.

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Anonymous Referee #2 Review of Deshler et al., AMT, 2016. Prepared 10 Feb 17

OVERALL COMMENT & RECOMMENDATION. Transfer functions ("TF") are important for the re-processing of thousands of ozonesonde records and this paper is the first to provide them based on extensive analysis. The paper overall is clearly written and with a few exceptions mentioned below, well-organized, giving TF that the sonde community will accept and use. There is one major short-coming in the paper that needs to be remedied before the paper can be published. There is no uncertainty analysis in the TF, which will propagate to the adjusted ozone reading (refer, for example, to Table 3). .

Thank you for this comment. In answering this comment a small error was found in the way the uncertainty for the linear slopes in Table 3 were calculated. This led to some reduction in the calculated uncertainties and thus some modifications to Table 3. A first estimate of the uncertainties in the transfer functions can be obtained by the weighted uncertainties provided for each box in Table 3. These uncertainties now vary from 0.037 to 0.085, depending on the particular comparison considered. Rather than include these individual uncertainties to create the error bars in Figures 4 and 5, as done in the draft submitted, a more general uncertainty was desired which would apply to all the transfer functions and to the comparison of the manufacturers recommendations, SP1.0 and EN0.5. The number settled on was 0.05 as an uncertainty on the slopes. This is an approximate average of the individual uncertainties. This uncertainty, 0.05, at times over-estimates the variations shown in the data and at times underestimates it, but overall does a reasonable job, Figures 4, 5, and 6.

OTHER COMMENTS. Abstract. Needs an Intro/motivating sentence. Although this is a technical paper in a "measurements" journal, every Abstract needs a "why it matters" opening sentence or two to give context to the study for some of this paper's readers.

Several motivating sentences were added to the beginning of the abstract.

Line 25 – goal of "this study" corrected

Lines 39-40: Although ENSCI and SPC are spelled out in line 21, the abbreviations SP and EN are not yet clearly defined at this point. Please fix. corrected

End of Introduction. An excellent job in describing the motivation and goals but there is not a user-friendly road map of the upcoming Sections at the end. Please add! The prose gets very specialized very fast. A road map is added.

Line 199: All these factor(s) – plural. "superpose" ? corrected factors and added superpose.

Consider that the last two paragraphs of section 2.1 and section 2.4 seem to talk about

the same thing i.e. stoichiometry. Can they be merged or revised? It gets confusing coming back to this topic.

Thank you. The paragraph from section 2.4 was deleted and the paragraph in section 2.1 was embellished.

Section 2.5 should be in the Introduction section. It is actually major motivation and important for putting the study into context. Further, Sec 2.5 is not relevant to this section entitled 'ECC ozonesonde description'.

Thank you for this comment. This section was moved and the introduction subdivided into two sections after the general introduction, this being the second of the two subsections.

Note: Line 307 – besides Smit et al. 2007; Deshler et al., 2008 – the Thompson et al., 2012 paper also shows improvement in sonde precision due to re-processing. The paper was also cited on Line 597. Add the reference. Thompson, A. M., S. K. Miller, S. Tilmes, D. W. Kollonige, J. C. Witte, S. J. Oltmans, B. J. Johnson, M. Fujiwara, F. J. Schmidlin, G. J. R. Coetzee, N. Komala, M. Maata, M. bt Mohamad, J. Nguyo, C. Mutai, S-Y. Ogino, F. Raimundo Da Silva, N. M. Paes Leme, F. Posny, R. Scheele, H. B. Selkirk„ M. Shiotani, R. Stübi, G. Levrat, B. Calpini, V. Thouret, H. Tsuruta, J. Valverde Canossa, H. Vömel, S. Yonemura, J. Andrés Diaz, N, T. Tan Thanh, H. T. Thuy Ha, Southern Hemisphere Additional Ozonesondes (SHADOZ) ozone climatology (2005-2009): Tropospheric and tropical tropopause layer (TTL) profiles with comparisons to OMI-based ozone products. J. Geophys. Res., 117, D23301, doi: 10.1029/2010JD016911, 2012. Reference has been added in both locations.

Section 3 title: Transfer function's' – plural – there is more than one equation derived. corrected

Section 3.1: Be clear up front that only JOSIE data are in controlled environments. The rest of the comparison data came from experiment flown under real atmospheric

conditions. text has been revised to reflect this.

SOPs during these varied dual/gondola flights in space and time must have been different. Is this not an important source of inhomogeneity? Please address clearly. How do you justify using these data to come up with unified transfer functions when SOPs have varied? You mention in Section 2.2, line 20 that "ECC ozonesondes prepared according to the SOPs provide very reproducible (<2-3%) measurements." A section on the impact of varying SOPs should be added, if only to justify the quality of the datasets used.

In fact the investigators were all careful to follow the WMO SOPs for the preparation of the dual ozonesonde comparisons. This point is now made in a second paragraph added to section 3.1.

Section 3.1.1 Were all JOSIE measurements used (including the tropical simulations)? All other dual/gondola flight were flown in mid to polar latitude locations so the assumption here is that one would use similar latitude profiles.

All the JOSIE data that compared SP/EN at one KI concentration and SP or EN at 0.5/1.0 concentration were used. We did not remove any tropical profiles, nor should we have. The transfer functions are meant to apply throughout the ozonesonde ozone concentration range. Similarly data from McMurdo under ozone hole conditions were used.

Figure 1: Why are there negative backgrounds currents at Wallops? Is that an error? Please explain. The latter background currents show large variations from negative to -0.05uA to close to 1.0. Isn't the legitimacy of the transfer functions affected by variations on background current? Why do you not use one background current for all the data to remove this artifact and recalculate the transfer functions? What is the dependence of background current on solution, manufacturer, and ground-station equipment to produce zero-ozone? It is understood that backgrounds are poorly understand and that there is a dearth of literature that focuses on this very topic.

The negative background currents indicated are included as these were what was reported at the time. Text is added to comment on these negative values. The station manager at the time commented on these values as follos: "During the period July 1995 to late 1999 Wallops experienced about 25 percent negative background currents. At the time, and being new to ozone, I accepted the view of the technician preparing our ECC's that negative BG currents were acceptable." In any case since similar background currents would affect both ozonesondes in a comparison the effect on the analysis is negligible. The other questions raised by the reviewer here are interesting, but beyond the scope of the analysis presented in this paper. As pointed out in the paper several times, backgrounds between comparison pairs of ozonesondes were usually quite similar, thus changing these numbers in some uniform fashion, such as one background for all comparisons, would have no impact on the analysis. The differences between ozonesondes of different type or concentration are much bigger than the $0.1 - 0.2$ mPa of ozone represented by the background currents, which is less than the minimum ozone measurement considered in the analysis.

Figure 5: 'DP'– is that data points? Yes, a note has been added to the caption to clarify this.

Table 2 – Add the sample size whether by profile number or data points - It is worthwhile to add that information here, more so than to the figure: one can save space and increase the font size for clarity(?)

This sounds much easier than it is. To do this would require adding four additional columns to the table, one for the number of data points for each pressure interval. This would make the table unwieldly. The number of data points is added to the figure to give the reader the idea of the number of data points which went into each comparison. It is not meant to be comprehensive nor to provide the number of data points for each comparison.

Since you refer in detail to this table in term of 'boxes' - suggest adding another column

numbering them.

Such a column was added and the text changed accordingly in reference to Table 2.

Section 4.1 Were the outliers observed and noted in Figure 6 included in developing the transfer functions? If so, why? Outliers denote error or responses outside the norm. By how much would the transfer functions change if outliers were removed? If it is negligible, it should be calculated and noted, even if not included.

The only data that were removed were measurements when either measurement of a pair were < 0.5 mPa. Thus some, but far from all, the data in the gray hashed areas in Figure 6 were removed. Thus a significant fraction of the outliers noted were included in the analysis, but their effect was negligible due to the large number of comparisons.

Paragraph on line 511. This sentence is long, convoluted, and unclear. The meaning comes across but the sentence (s) can be written better. The long sentence has been split into 2 sentences.

Line 628. The Logan references (appropriate on Line 302) do not belong here. We've removed the Logan references from this line.

Figure 8 – Use the same x-axis scale as Figures 6 and 7. Done

Section 4.4 Are you are applying the ENSCI/1.0% to ENSCI/0.5% transfer function and this is equation 6? This is mentioned nowhere in this section. The error bars should not change as you are merely shifting the profile. The key is that the distribution now centers closer to zero.

Yes we are applying the EN1.0 to EN0.5 transfer function, which is Eq. 5, and this is stated in this section, "This data set is used here to illustrate the application of the transfer function OZconc defined in Eq. 5." In fact, the error bars do not change they are just shifted to a new center point.

Line 756. After SHADOZ stations [Thompson et al., 2012; Witte et al., 2016] where

Witte et al is: J. C. Witte, A. M. Thompson, H. G. J. Smit, M. Fujiwara, F. Posny, G. J. R. Coetzee, E. T. Northam, B. J. Johnson, C. W. Sterling, M. Mohammed, S-Y. Ogino, A. Jordan, F. Raimundo daSilva, Z. Zainel, First reprocessing of Southern Hemisphere ADditional OZonesondes (SHADOZ) profile records (1998-2015) 1: Methodology and evaluation, J. Geophys. Res., submitted, 2016. These references have been added.

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