Interactive comment on “Homogenizing and Estimating the Uncertainty in NOAA’s Long Term Vertical Ozone Profile Records Measured with the Electrochemical Concentration Cell Ozoneonde” by Chance W. Sterling et al.

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The authors would like to thank the referees for the constructive criticism of our manuscript. We have outlined our responses to the reviewers’ comments as well as the subsequent changes to the manuscript in the following response.

Anonymous Referee #1 Received and published: 22 December 2017

GENERAL COMMENTS: The paper describes the homogenization process (including uncertainty estimation) of the NOAA network of ozonesonde stations. I really enjoyed reading the very well written manuscript (although it is somewhat lengthy at some places). The authors give a nice historical overview of the ozonesonde measurements and describe in a very clear way the different instrumental effects that have to be taken into account in the homogenization process. The uncertainty analysis, developed within the O3SDQA activity, has been applied on the profiles recorded at the NOAA network and has been presented extensively. The impact of the homogenization of the ozonesonde data record has been assessed with Dobson total ozone data and with SBUV profile measurements. So, the research is really well established. One of the major new achievements of the paper is the proposed approach of taking the measured (higher than the historical) pump flowrate corrections and correcting for the ozone sensor efficiency, which is derived from the comparisons of ozonesondes and the reference UV photometer at JOSIE campaigns. This is an alternative approach as the current O3S-DQA guidelines, which have set two standards (SPC 1% KI 1.0B and EN-SCI 0.5%KI 0.5B), which, with two different (historical, low) pump flowrate corrections, are within a few percent from the UV photometer at JOSIE. The authors argue that, a positive bias in the ozone sensor measurements, created by side reactions of the phosphate buffers, has to be compensated by using too low pump flowrate corrections. However, as these guidelines are still in use today, I would propose that the authors apply the O3S-DQA corrections strictly for the Eras in which one of those standards is used at NOAA sites (parts of Eras 1, 2, 3 are using the SPC 1% KI 1.0B) –so using the Komhyr (1986) pump flow correction factors – and compare those corrections with their proposed corrections (applying Eq. (15), which is based on 6 simulated flights during JOSIE 1996). By e.g. showing the average (and standard deviations) of the differences between the vertical profiles corrected by either approach, the authors should be able to demonstrate that their approach is equivalent to the O3S-DQA guidelines.

Authors’ Response: The reviewer makes a good point about a difference in the processing methods of NOAA and other ozonesonde sites during Eras 1, 2, and 3. NOAA desires to be consistent with its processing methods throughout the record, so chooses to keep the Johnson 2002 pump efficiencies and ozone sensor efficiency based on the
cumulative ozone exposure. To assess the difference in the processing techniques, Era 3 for Boulder, CO and Hilo, HI were processed with each processing technique and compared. Two new figures (Figures S1 and S2) have been included in the supplementary material as well as a new sentence discussing the difference in the 1986 Komhyr processing method and the NOAA Accumulating Buffer Bias Correction. The figure plots the average Boulder and Hilo ozone profiles processed with both methods and a % Difference plot for each. The difference is less than the uncertainty for these data, so we have deemed it negligible. Additionally, the 1986 Komhyr processing method would increase the partial pressure of ozone in comparison to the NOAA approach. This increase would make the comparison with the ozone photometer at JOSIE worse and the comparison with the SBUV measurements worse. What is now Page 15 Line 4 now includes, “NOAA’s approach (ozone sensor efficiency) differs from the ASOPOS standard processing for SPC ozonesondes paired with 1.0% KI, 1.0X Buffer Solution (1986 Komhyr corrections) in Eras 1, 2, and 3. To compare the two processing methods, the average profiles for Boulder and Hilo for Era 3 are shown in panel A of Figures S1 and S2, respectively, processed with the NOAA approach and the ASOPOS approach. The percent difference is included on panel B of the plots and the difference is less than the uncertainty of the ozone measurement for these eras.”

correction is dependent on the climatological range of these factors. Please mention in which range the University of Wyoming and the Japanese Meteorological Agency pump efficiency correction factors lie. Authors’ Response: On what is now Page 12 line 3, the sentenced has been updated to read, “These PCF’s agree nicely with the Johnson et al. (2002), Wyoming (Harder, 1987) and Japan Meteorological Agency’s PCF’s (Private communication, Tatsumi Nakano) of 1.145, 1.120, and 1.122 at 10 hPa and 1.260, 1.224, and 1.213 at 5 hPa respectively.”

Authors’ Response: A new table has been added, Table 3, which shows the ozonesonde types and sensing solutions with their corresponding ozone sensor efficiency. A new sentence was added on what is now Page 15, Line 28. “Table 3 summarizes the ozone sensor efficiencies used for all ozonesonde type and sensing solution pairings.”

Authors’ Response: The uncertainty estimates does come from Smit, H. G. J. and the O3S-DQA-Panel (Ozone Sonde Data Quality Assessment): Guidelines for homogenization of ozonesonde data, SI2N/O3S-DQA activity as part of “Past changes in the vertical distribution of ozone assessment” document on the NDACC webpage. The citation has now been included for these estimates.

Authors’ Response: The total relative uncertainty of ozone with altitude are similar in shape and comparable in magnitude to other recent ozonesonde uncertainty estimates, Van Malderen et al. 2016, Tarasick et al. 2016, and Witte et al. 2017b.”

Authors’ Response: Yes, that is what was meant and is corrected in manuscript.

TECHNICAL CORRECTIONS: “based on the JOSIE and BESOS intercomparisons” instead of “based on the WMO and JOSIE intercomparisons” Authors’ Response: Corrected in manuscript. “cannot be measured directly” instead of “cannot me measured directly” Authors’ Response: Corrected in manuscript. “of the data quality assessment project” instead of “of the homogenization project”? Authors’ Response: Corrected in manuscript. “of Evans et al., 2017” instead of “of Evans et al., 1017”. I don’t think Bob is that old. Authors’ Response: Corrected in manuscript. “Figures 11 and S7” instead of “Figures 9 and S2” Authors’ Response: Corrected in manuscript. “(Layer 10 – Figure 14)” instead of “(Layer 10 – Figure S1)” Authors’ Response: Corrected in manuscript. “ Histogram of all cell current backgrounds from Boulder, South Pole and Hilo broken into four time periods. A) Eras 1 and 2 B) Era 3 C) Era 4 D) Era 5”

Authors’ Response: The authors would like to again thank the reviewers for doing a thorough job of reviewing the manuscript. It improved the paper a great deal. A few other grammatical and formatting errors that did not change the meaning or intention of the text were found and corrected during the process of responding to the reviews.
Fig. 1. Figure 1: The eight long-term NOAA ozonesonde stations with Latitude, Longitude, # of Profiles, and launch period.
Fig. 2. Figure S1: Average Boulder profile for Era 3 processed with the 1986 Komhyr processing and the NOAA ozone sensor efficiency processing techniques, Panel A. The percent difference in the two processing.

Fig. 3. Figure S2: Average Hilo profile for Era 3 processed with the 1986 Komhyr correction and the NOAA ozone sensor efficiency correction, Panel A. The percent difference in the two processing is shown in Panel B.