

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

Anonymous Referee #1

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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 O3S-DQA activity, has been applied on the profiles recorded at the NOAA network and has

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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.

SPECIFIC COMMENTS

◦ Page 3: lines 22-26: Some more recent papers (as the ones mentioned) describe results from homogenized (according to the O3S-DQA guidelines) ozonesonde data: Van Malderen, R., Allaart, M. A. F., De Backer, H., Smit, H. G. J., and De Muer, D.: On instrumental errors and related correction strategies of ozonesondes: possible effect on calculated ozone trends for the nearby sites Uccle and De Bilt, *Atmos. Meas. Tech.*, 9, 3793-3816, <https://doi.org/10.5194/amt-9-3793-2016>, 2016 (for Uccle and De Bilt)

and Christiansen, B., Jepsen, N., Kivi, R., Hansen, G., Larsen, N., and Korsholm, U. S.: Trends and annual cycles in soundings of Arctic tropospheric ozone, *Atmos. Chem. Phys.*, 17, 9347-9364, <https://doi.org/10.5194/acp-17-9347-2017>, 2017 (for Scoresby-sund, Ny Ålesund, Sodankylä, Eureka, and Ørland)

◦ Page 6, lines 2 and 6: please use consistently either hPa or mb through the manuscript. I would propose to use hPa.

◦ Page 7, line 12: “Figure 1 shows the many changes to the NOAA ozonesonde record.” As a matter of fact, Figure 1 does not show all those changes, but just gives an idea of the length of and gaps in the time series of the different NOAA stations. It would be nice to have a graphical or tabular overview of those different changes, see my next point.

◦ Page 7, lines 15-25: the definition of the different Eras is described here, but a separate table (or graph) presenting the different characteristics of each Era is really needed, and not hidden as legends in Fig. 2 for example. This separate table (or graph) will make it also easier to follow the discussion of the homogenization, uncertainty analysis and comparison with Dobson and SBUV throughout the paper.

◦ Page 10, lines 28-31: Before making this statement, please refer to Figure 3 (“Figure 3 shows the different climatological flowrate corrections CPF,SM, expressed in percentages.”) . To me, it seems that in Figure 3, only for Boulder , the flowrate corrections w/ Dry Air (please spell out “with”) are more stable than those obtained without the Drierite air purifier/desiccant filter. But Figure 3 is very tiny, and it is hard to distinguish between the different symbols (circles and diamonds) and between some colours (Boulder/Samoa & South Pole/Huntsville).

◦ Page 11, lines 26-27: Please mention in which range the University of Wyoming and the Japanese Meteorological Agency pump efficiency correction factors lie.

◦ Page 15, lines 8-10: it should be nice to have an overview here of which ozone sensor

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efficiencies are used for which combinations of ozonesonde types and sensing solution strengths. I had to read this sentence several times before I understood its meaning, referring to some kind of table would help a lot, I suppose.

- Page 17, lines 24-28: where do these uncertainty estimates come from? Is there consistency with the document linked at on the NDACC web page (http://www-das.uwyo.edu/~deshler/NDACC_O3Sondes/NDACC_O3sondes_WebPag.htm)?
- In section 5, and in figures 6, 7, 8. How do the resulting relative uncertainties compare with the relative uncertainties obtained in Van Malderen et al., 2016 & Tarasick et al., 2016, Witte et al., 2017b (???) for sites at similar latitudes? Of course, the approach in Tarasick et al., 2016 is different from the O3S-DQA uncertainty guidelines.
- Page 20, lines 4-5: I guess you mean here “If the balloon burst at a pressure smaller than 7 hPa, the residual column ozone was calculated from 7 hPa”.

TECHNICAL CORRECTIONS

- Page 3, line 20: “based on the JOSIE and BESOS intercomparisons” instead of “based on the WMO and JOSIE intercomparisons”
- Page 6, line 25: “cannot be measured directly” instead of “cannot me measured directly”
- Page 18, line 9: “of the data quality assessment project” instead of “of the homogenization project”?
- Page 20, line 6: “Evans et al., 2017” instead of “Evans et al., 1017”. I don’t think Bob is that old.
- Page 21, line 4: “Figures 11 and S7” instead of “Figures 9 and S2”
- Page 21, line 5: “(Layer 10 – Figure 14)” instead of “(Layer 10 – Figure S1)”
- Page 21, line 7: “(Figure 13)” instead of “(Figures 8 & 9)”

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- Page 28, line 28: the Thompson et al. JGR 2017 paper is now published
- Page 31, caption Figure 2: please add that those histograms are taken for the measurements at the sites Boulder, South Pole & Hilo

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