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Atmospheric Measurement Techniques Discussions

# *Interactive comment on* "Adapted ECC ozone sonde for long-duration flights aboard boundary-layer pressurized balloons" *by* François Gheusi et al.

**François Gheusi et al.**

francois.gheusi@aero.obs-mip.fr

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We thank the anonymous Referee 1 for his constructive comments, which helped us to significantly improve our manuscript with respect to the version published in AMTD.

Below, we provide point-by-point responses to his comments, most of which having been copied and pasted in the present document, and appearing in italics. Our responses – including details on how the manuscript has been changed – come between the Referee's lines.

**General comments and changes**



*(...)*
*While the body of the paper is mostly acceptable, the authors tend to present rather simple procedures in an unduly complex fashion, introducing symbols and nomenclature to describe straight forward procedures, easily understood without the symbols and formulas I will recommend this paper for publication, after the appendices and superfluous Tables 2, 3 and Figure 3 are removed, and the authors take steps to reduce the com-plexity of the discussion of simple topics and procedures. Some of these places are highlighted below.*

*Aside from these complaints the paper presents some interesting data which may have captured the photochemical production of ozone within a Lagrangian air parcel. If the authors could stick to these results, and the background necessary to confirm the stability of measurements with a duty cycle of 1 minute out of every 15 minutes, then the community would be interested.*

*Even all the space devoted to establishing the accuracy of the measurements is somewhat wasted. All that is really needed is establishing that the measurements are self-consistent for any one instrument. The interesting features of the data are not the absolute accuracy, but the relative variation of ozone measured by any one sonde. It could be argued that the work establishing the absolute accuracy of the measurements is not ultimately that important. A short paper conveying the really interesting and useful results, with a hard look to remove anything that is not really necessary, will always end up being used more in the community.*

As recommended, we removed the appendices, as well as Figure 3 and Tables 3 and 4[1].

While getting rid of the appendices and related Tables 3 and 4, we also removed all

[1]Consistently with what the Referee wrote in a preceding paragraph, and obviously in agreement with his comment, we think that the Referee meant here "Tables 3 and 4" instead of "2 and 3".

information on ECC sonde working principle and preparation that was not specific to our study. The reader is now oriented toward the appropriate references in Section 2.1. Only the formula we used to retrieve ozone mole fractions from measured currents is recalled in this section. Few specific adaptations of the preparation procedure, previously detailed in the appendices, have also been kept and moved to Section 2.1.

Note also that a new article citation (Doerenbecher et al., doi:10.1175/BAMS-D-14-00182.1, 2016) has been added in the revised manuscript (in sections 1 and 2.2.1).

**Specific comments and changes**

*2.21 ... offer a means ...*

This typo has been corrected.

*6.10. Fig. 3 does not show an electronics card, rather the standard cells and pump for an ECC sonde. I don't see the point of showing an electronics card, or the current Fig.3. These instruments are well known.*

We acknowledge that the picture shown in Figure 3 of the AMTD paper was not sufficiently informative. It has been removed.

*6.17-27. This is a rather long winded and much too quantitative way of saying that for every measurement cycle the instrument is warmed up for 60 s, measures for 60 s and then made dormant for a pre-determined interval, typically 1380 s (13 min). For continuous sampling the sleep interval is set to zero. Please take steps to simplify and shorten the paper.*

The text in Section 2.2.2 has been reduced and simplified.

*Fig. 5. This Figure is not useful. All of the interesting features happen between 35 and 45 ppb, yet the figure extends to 60 ppb and the variations over this small range*



*cannot be discerned. Please summarize this information into a three panel figure, with one panel for each rest period, 10, 5, 3 min. In each panel plot one off-on cycle with each of the three lines displaying the average and standard deviation of the 3-7(?) measurements available for each series. Then the reader can really tell how the three measurements compare.*

Figure 5 of the AMTD paper has been removed and replaced by a new 4-panel figure (new Figure 4, see below), composed of:
• the left-hand-side panel of the former Figure 6 (new Figure 4a);
• three panels (new Figure 4b-d) following the Referee's suggestion and showing statistical characteristics (mean and standard deviation) of each measurement series.

As consequence, the text in Section 3.1.1 has also been revised, and the new Figure 5 is now restricted to the right-hand-side panel (b) of the former Figure 6.

Note that in the new figures 4 and 5, the data analysis has been improved as detailed in the next item.

*7.22-28 and Fig. 6b). While the authors use 60 s as the spin up time, the LHS of Fig.6 suggests that 300 s is more appropriate to avoid an overestimation of up to 10% in ozone. Do the authors have any comments on this?*

We thank the referee for this judicious remark which led us to revise our analysis. A linear model is used to estimate the values the experimental sonde is expected to reach after the transient warm-up. In the former version of the paper (AMTD), this model was computed from data taken at least 180 s after motor start. Doing this, almost all data from the second half of the experiment (new Figure 4d) were not taken into account in the model because the run time was only 3 min. This induced a bias in the predicted values for some data series and caused the overestimation raised up in the Referee's comment.In the new version of the paper, we used for the linear model all data recorded at least 60 s after motor start. As a consequence, the linear model is even better ($r^2$

= 0.93), and the overestimation has disappeared as shown in the new Figure 5 (see below).

*8.5-15. Again, this is too much text for the simple procedure of measuring the flow rate of an instrument with a bubble flow meter and a stop watch. There is no reason to define all these variables, to, ti, ...*

The text in Section 3.1.2 has been reduced and simplified.

*9.16. What does "resp." mean?*

This is an abbreviation for "respectively". It has been made explicit throughout the text.

*9.21-22. I don't understand this sentence, "An excess in ... is all the later to appear ..."?*

The sentence has been rephrased (p.9, l.29-30). We hope it is now clear.

*9.26. Why do the authors state that the deviation grows with time, when the graph shows the deviation trending towards zero with time? The spread in the measurements appears to decrease after 3 days, then increase again after 5 days.*

We used the term "increase" because the deviation was negative most of the time of the experiment, and showed a positive trend. We nevertheless acknowledge this term was confusing. The text has been rephrased to avoid confusion (p.9, l.34).

François Gheusi, on behalf of the coautors.

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