

Interactive comment on “Propagation of radiosonde pressure sensor errors to ozonesonde measurements” by R. M. Stauffer et al.

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-*This is a preliminary response prior to final edits on this manuscript. Iterative comments are welcome*

-Thank you for taking the time to comment on our paper. We look forward to incorporating your suggestions in the revised version.

General comments The authors present the statistical analysis of the impact of the pressure sensors bias on the ozone mixing ratio profiles. The pressure sensor bias is determined by comparison to the pressure scale estimated from the altitude given by a GPS device and the hydrostatic equation. This pressure error is one of the two less well characterised uncertainty sources for the ozone sondes measurements, the other

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being the pump efficiency correction.

This paper is relevant for the AMT journal and I recommend its publication after the authors have addressed the remarks below.

The authors should comment on their choice to analyse mixing ratio instead of partial pressure which is the physical parameter derived from the ozone sonde measurements. I think that for example fig 10-b gives a clearer message than fig 10-a to illustrate the pressure scale bias consequence, especially if the paper is primarily addressed to the ozone stations manager.

-More text regarding the choice to focus on ozone mixing ratio rather than ozone partial pressure will be added to section 2. We note that the ozone partial pressure will not change for coincident measurements, but only the apparent altitude of those measurements will change as in Fig 10b. Discussing the ozone mixing ratio allows us to describe “coincident” ozone mixing ratios (original and recalculated) at a single altitude measurement, chosen to be the GPS altitude in our paper.

It is common practice in case of a change of sensors to make direct in-flight comparisons of their response and if it is not possible to reconcile the data to calculate a transfer function. In this paper, the GPS altitude data are used to indirectly link different pressure sensors: for example RS80 ,GPS and RS92 , GPS allow to compare indirectly RS80 , RS92 pressure sensors. The authors should comment on the reason why they have not corrected the pressure bias (e.g. fig 4 median bias profiles) at first and estimated the errors in the ozone data in a second step.

-We will comment on this indirectly, in specifying more clearly the scope the paper. Devising transfer functions is beyond the scope of the present study and is being done through collaborative activities like WMO O3S-DQA and SI2N. Appropriate references will be added if available. This paper is meant to point out biases in radiosonde pressure measurements that have cropped up in a number of recent campaigns deploying ozonesondes. It is expected that as the community-wide ozonesonde data “homoge-

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nization process” evolves over the next several years, that new steps will be added to address the radiosonde bias issue as well. This paper will be one of the references contributing to the consensus process in making recommendations. The data here will be available for testing.

Specific comments

Abstract 7772-7: “historical” is a bit misleading since data from 2006 are fairly recent. The question if historical record is not addressed in this paper since no clue is given how to treat historical record going back to 2-3 decades ago.

-We will reword this to make it less confusing/misleading.

7772-9 to 7772-11: all the details on the different sondes could be put in the main text and not in the abstract. One sentence from line 8 to 14 !

-The abstract will be trimmed and this sentence reduced in length.

7772-25 to 7772-29: these statements have to be made with extreme caution. They are valid only if a clear understanding of the data processing (imbedded in the sonde) shows the independence of the pressure sensor and GPS based pressure scales.

-We are in an ongoing dialogue with radiosonde manufacturers to better address these issues and to characterize the radiosondes.

Introduction 7773-8 : the results of the more recent intercomparison are available at the WMO site (INSTRUMENTS AND OBSERVING METHODS REPORT No. 107, WMO INTERCOMPARISON OF HIGH QUALITY RADIOSONDE SYSTEMS, Yangjiang, China, 12 July – 3 August 2010 by J. Nash et al.)

-Thank you for this reference.

7773-25 : the SI2N project could be explicitly mentioned especially if this paper is part of the AMT special issue.

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-The SI2N project will be specifically mentioned in the introduction.

7774-13 : Hurst et al. also report systematic temperature bias that should be discussed in regards to the use of the hydrostatic equation (see for example Richner and Viatte, The Hydrostatic Equation in the Evaluation Algorithm for Radiosonde Data, Journal of Atmospheric and Oceanic Technology, vol. 12, pp 649-656, 1995)

-Radiosonde temperature biases and the effect they have on hydrostatic pressure calculations will be discussed in more detail here. Thank you for this additional reference.

7775-3 : consider the more recent study by Logan et al. (2012), Changes in ozone over Europe: Analysis of ozone measurements from sondes, regular aircraft (MOZAIC) and alpine surface sites, J. Geophys. Res., 117, D09301, doi:10.1029/2011JD016952)

We will consider this. Thank you for the recommendation.

7775-7 : 10 m resolution is valid for fast response sensor like temperature but certainly not for ozone sonde with ~30 sec. response time.

-This will be changed taking into account the ascent rate and the 20-30s response time for the ozonesonde measurements.

Methodology

7776-17 : the data used in the analysis have to be freely available to the scientific community which is not always the case for campaign data. The information on the campaign and the data availability could not be verified due to US government being “on furlough” at the time of the review.

-The campaign-based data in this version of the paper are available or will be next year at NASA archives. Data from Houston, Sapporo, Idabel, Valparaiso, and Las Tablas are available at: <http://physics.valpo.edu/ozone/index.html>

7777-8 : the difference between iMet sondes types is not explained in the paper and since this manufacturer is not common within the European aerological stations net-

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work, some explanation is required.

-Our understanding is that no significant hardware changes have occurred, only firmware upgrades. This will be part of our continuing conversation with the manufacturers.

7777-26 : see General comments, second §. 7778-22 : refer to 7774-13 comment. Interactive Discussion Discussion Paper 7779-3 : better refer to actual comparison (if available) than specifications (see ref. under 7773-8).

-We will reference the results in the WMO comparison report in this section.

7779-8 : please quantify the statement “: : : considered quite small : : :” (see 7774-13)
Results

-Figures will be presented to the reviewer in the final response along showing the effects of changing the virtual temperature on the pressure calculations, simulating a temperature and humidity bias in the radiosondes. The differences will be given quantitatively relative to the differences between the measured radiosonde pressure and the GPS-calculated pressure.

7780-27 : a comment is necessary regarding the ozone sondes and data processing used at UH and RBH (e.g. manufacturer, solution concentration, PCF, normalisation).

-This will be verified and added to the text.

7781-6: is this improved agreement corroborated by a similar comparison of the temperature profiles comparison ? This would give a convincing argument since the temperature sensors are responding faster than ozone sondes.

-Your point is taken. We will add text and a figure for the reviewer in the final response.

7781-10 : in reference to the comment 7772-25: is it clear enough that Vaisala internal software do not apply any correction explaining this convergence ? (see same argument at 7772-25)

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-We will continue to pursue explanations from the radiosonde manufacturers on this issue.

7781-17 : considering that table 3 contain the numbers, the parenthesis are not necessary (same comment apply to coordinates at lines 7776-21 / 22)

-These redundancies will be removed.

7781 – 20 : on fig 5, the addition of the values at each 0.5 hPa for the different series goes up to 100% except for RS92 apparently. Please check.

-This was an error and will be updated. The 26km pressure offset peak in the histogram is 78.45% in the 0-0.5hPa bin, 18.78% in the -0.5-0hPa bin, and 1.1% in the 0.5-1.0hPa bin, with very few on the tails of the histogram.

7782-4 : fig A2 should appear close to fig 6 (in the main text) since it shows the relatively low impact of a +/- 2hPa offset on the altitude below 15 km.

-We will revise accordingly

7782-25/26 : reverse left and right-

This will be fixed.

7783-13 : fig 8, use the same y-scales between A and B (e.g. -30 to 50 DU). The points above 100 DU are not useful to display or if they illustrate something important, adding a comment would be more appropriate.

-The 100+ DU differences were extreme outliers from Las Tablas, Panama. One of them displayed a burst pressure of 3.45 hPa at 38.4 km whereas we calculated a 7.09 hPa burst from the GPS altitude of 33.75 km. These outliers will be removed.

7783-15 : the assessment that the O3 column is “: : : too high : : :” require the comparison to an independent column measurement (e.g. Dobson, Brewer) and not assuming a priori that the column calculated with pGPS gives the true value. This

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remark is valid for the whole discussion in this paragraph.

-The wording will be changed to reflect the recalculated sonde-only column is higher than the original sonde-only ozone column from the radiosonde pressure measurements, and not that it is being compared in a validation sense to a satellite, etc.

7784-23 : in fig. 10 caption, the pressure offset of this particular case should be given. This is also valid for fig. 3.

-Sticking with the numbers we cite in the statistics, we will add the 26 km median pressure offset to the captions for these cases.

7786-21 : recommendation 1 doesn't help for historical data !

-Thank you for the recommendation. We are considering removing this.

7786-21 : recommendation 2 is only valid if a proof is given that pGPS is definitively a better pressure scale (see 7783-15).

-We will consider editing these recommendations.

7787-2 : recommendation 4 makes sense in the light of the point mentioned in the last paragraph under "General comments". Otherwise the authors should give more details on the recalculation procedures they have in mind.

-See response to General Comment regarding scope of the paper and role in the ozonesonde "data homogenization."

Appendix A 7787-5 to 11 : this part of the appendix discussing a technical point is not useful and can be suppressed.

-It is likely parts of the Appendix will be moved or removed.

7787-12 to 16 : see comment 7782-4

7787-18 : for figures A3 and A4, I suggest a different order e.g. column of "RS92"-stations, column of "RS80"-stations, column of "IMet"-stations and finally Houston and C2960

"all" figures. This would ease the identification of the bias profile according to sonde type.

-This may be useful since Houston is the only station launching both RS80s and iMet sondes. We will work on updating this figure and determine if it does in fact make interpretation easier.

Interactive comment on Atmos. Meas. Tech. Discuss., 6, 7771, 2013.