

Interactive comment on “Altitude misestimation caused by the Vaisala RS80 pressure bias and its impact on meteorological profiles” by Y. Inai et al.

Anonymous Referee #3

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Review for Inai et al. (2015), “Altitude misestimation caused by the Vaisala RS80 pressure bias and its impact on meteorological profiles”

Synopsis:

This manuscript by Inai and coauthors takes an approach similar to that of Stauffer et al. (2014) to radiosonde pressure biases and errors, and how they affect dependent atmospheric variables such as geopotential altitude and O₃ mixing ratio. Inai et al. analyzed 30+ soundings of SOWER radiosonde, ozonesonde, and cryogenic frost point hygrometer data and discovered RS80 radiosonde pressure biases of -0.4 ± 0.2 hPa in the stratosphere. The pressure biases led to errors in geometric altitude of hundreds of meters, and errors of a few percent in O₃ mixing ratio and water vapor mixing ratio.

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Temperature errors of about -0.2 to -0.3 K were found in the stratosphere resulting from the profile shift caused by the pressure bias.

Summary of Recommendation:

Much space is spent discussing the methodology, which already exists in published literature (e.g. Inai et al., 2009; Stauffer et al., 2014), for correcting radiosonde biases using GPS data. Thus, there not much new information presented here. The one unique aspect of this paper appears to be the choice of the vertical coordinate when reporting measurement errors. Inai et al. attempt to put the results of their study in the context of reported trends in O₃, temperature, and water vapor in existing literature, but do not carry out potential applications of their results. These applications would need to be executed to make this work publishable. The pressure bias of RS80 radiosondes has been quantified in several recent publications. The Inai et al. manuscript provides additional motivation to the radiosonde/ozonesonde community for reprocessing of data, and analysis of stratospheric water vapor measurements from frost point hygrometers. However, other than Inai and coauthors' choice of vertical coordinate, this paper offers no real unique contributions to the study of radiosonde pressure biases.

This paper in its current form requires substantial additions to the text and analyses if it is to be published. This manuscript is not yet suitable for AMT given the lack of unique contributions to this area of study. Major issues involve further expanding upon unique aspects of this paper and differences between this manuscript and Stauffer et al. (2014), execution of potential analyses implied by the Discussion section of this paper, and explicit recommendations to the radiosonde/ozonesonde community to reprocess data sets.

Major Comments:

1) One of the major goals of Stauffer et al. (2014) is to motivate the reprocessing of ozonesonde data when GPS measurements are available. Stauffer et al. (2014) demonstrate improvements from recalculating dependent variables based on pressure

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derived from GPS altitude. To reprocess ozone and radiosonde data in Stauffer et al. (2014), coincident measurements are considered and a recalculation of variables in the data files themselves is performed. Stauffer et al. (2014) then present biases as a function of GPS altitude, which undergoes no changes during reprocessing. Conversely, in the present study, Inai and coauthors map data from the GPS and radiosonde to the same altitudes to derive biases. The methods here and in Stauffer et al. (2014) are nearly identical as stated by the authors in Section 3, except when the unique aspect of the Inai et al. study – the mapping of GPS and radiosonde measurements to the same altitude – is introduced. This altitude mapping apparently leads to most of the differences in reported biases between Stauffer et al. (2014) and the present study. Regardless of how the biases in radiosonde data are reported, the goal of motivating reprocessing radiosonde data sets with GPS data must be clearly and explicitly stated in this paper.

2) Section 3 should be shortened given that the pressure recalculation techniques are already found in multiple publications. Section 2 and 3 could also be grouped into a combined “Data/Methods” section.

3) There are figures in the Inai et al. paper that resemble those published in Stauffer et al. (2014). Figure 2 in this study is similar to the RS80 panel of Figure 4 in Stauffer et al. (2014). Figure 5 in this study is a replication of the style of Figure 10 in Stauffer et al. (2014). However, mapping of GPS and radiosonde measurements to the same altitude makes these unique (e.g. Inai et al. Figure 5, right panel) and acceptable for eventual publication.

4) The stratospheric pressure bias of the RS80 is reported as approximately -1.0 hPa in Stauffer et al. (2014) (Figure 4, RS80 panel), which is cited in the current study and is much larger than the pressure bias reported in this study (approximately -0.4 hPa). The authors of this study quality checked the data, and eliminated 5 outlier profiles from analysis before presenting it here. That would contribute to differences in reported pressure biases compared to Stauffer et al. (2014). The authors compare

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results with the Stauffer et al. (2014) study which applied no initial corrections. This difference should be described.

5) The authors should make clear the RS80 pressure biases are not constant with altitude, particularly in the troposphere. This is implied when the authors apply a constant pressure correction as described in the Appendix, which does not eliminate pressure biases. This shows that one cannot simply input a surface pressure correction prior to launch that will fix the entire profile for RS80 radiosondes. This should be discussed in the paper.

6) The discussion in Section 5 provides the motivation for the analyses necessary to make this paper impactful. At present, Section 5 mostly reviews recent trends papers, and includes one concluding sentence that briefly mentions the subject of data reprocessing/correction. Analyses and comparisons between existing trends papers and trends calculated using reprocessed data should be expanded upon in the text and figures. These results would be of great interest to the ozone and TTL water vapor trends community.

7) These data are of interest to the ozonesonde community, particularly since this study presents evidence of necessary reprocessing. Are these data publicly available? The SOWER website does not appear to make the data available (<http://sower.ees.hokudai.ac.jp/data.html>).

Minor Comments/Corrections:

Is it correct to say that because of the altitude mapping, and the fact that the radiosonde pressure altitude is almost always higher than GPS in the stratosphere, that there are radiosonde observations near the top of the profile with which there are no GPS data to compare?

Page 2194, Line 19-23: Are you suggesting an attempt to correct data without GPS information? If so, how might this be accomplished?

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Page 2195, Line 21-22: This sentence belongs in the introduction section.

Page 2197, Line 8-10: The 1 minute data smoothing is another distinguishing characteristic from the Stauffer et al. (2014) study that should be pointed out. Stauffer et al. (2014) presented much of the results in 1 km median values due to noisy data; the 1 minute smoothing employed here appears to produce a similar effect.

Page 2197, Line 16-20: The RS80s in Stauffer et al. (2014) were launched from 2005-2011, with no bias dependency on launch year (used as a proxy for production date) detected. In that work, the RS80 pressure biases were almost universally negative in the stratosphere.

Page 2198, Line 18-21: The relationship between the altitude shift, the change in the variable of interest, and the local gradient in the variable of interest makes sense, and is a good point that should be retained.

Page 2200, Line 20-22: The method with which one calculates O3 mixing ratio or any of the errors reported here is ultimately somewhat subjective and reflects the intended use of the results. Again, motivation should be the reprocessing of data, which requires consideration of coincident measurements.

Page 2201, Line 15 (Figure 7): What was the altitude difference at balloon burst for BI048? It looks almost negligible. Are there other cases with chilled mirror water vapor measurements that have a larger bias that might be more suitable for this figure?

Page 2206 Section 6 (Summary): This is essentially a copy of the abstract. Some parts of Sections 5 and 6 could be combined to provide better discussion and motivation for reprocessing ozone and radiosonde data.

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