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Atmospheric Measurement Techniques Discussions

Interactive comment on "Use of automatic radiosonde launchers to measure temperature and humidity profiles from the GRUAN perspective" *by* Fabio Madonna et al.

Fabio Madonna et al.

fabio.madonna@imaa.cnr.it

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The authors of the manuscript gratefully acknowledge the positive opinion on the manuscript and the helpful comments provided also by the anonymous reviewer #2, which aim at further increasing clarity of the manuscript itself, with a particular focus on the figure and on the outcome of the applied statistical tests. In the new version of the manuscript, all the technical suggestions provided by the reviewer have been included.

Nevertheless, here the authors provide a point-to-point reply to the reviewer suggestions and comments. The authors' response is reported below, always preceded by the letter "R" and in bold.

Line 40: the abbreviation O-B (observation-background) should be defined here.

R: observation-minus-background has been defined in the abstract.

Line 71: what is meant by "basic" equipment here? Does this mean rudimentary, or limited, or less capable (eg lower precision versus equipment in a conventional laboratory environment)? Please clarify.

R: at Line 71 "basic" means limited, for example very often the manual launches are performed using a more basic technology for the control of balloon filling than those available in the Automatic Radiosounding Launchers. To avoid confusion the sentence has been modified removing the second part: "During the preparation and launch phase, many circumstances may interfere with the smooth operation of radiosoundings such as undertaking launches at night, harsh meteorological conditions for balloon train preparation, if any, and safe handling when using hydrogen as balloon gas, and last but not least the risk of errors/mishandling by the operators.".

Line 78: "progress" could be replaced with "innovation" for a better style

R: done.

Line 165: "5% RH for" instead of "5% RH or"

R: done.

Line 191-192: How accurate is this procedure? Eg, how high does the temperature need to rise before the RH is effectively zero relative to the desired calibration threshold?

R: According to the information shared by the manufacturer, the outcome of an uncertainty study of the RS41 relative humidity measurements after ground preparation showed an uncertainty (k = 2) of 0.5–2 % RH at a temperature of 20°C and RH ranging from 0 to 100 % [1], and laboratory test results support the stated uncertainties [2].

[1] Vaisala: Vaisala Radiosonde RS41 Measurement Performance White Paper. Ref.

B211356EN-A © Vaisala, 2013.

[2] Vaisala: Comparison of Vaisala Radiosondes RS41 and RS92 White Paper. Ref. B211317EN – B © Vaisala, Helsinki, Finland, 2014. Vaisala: Vaisala Radiosonde RS41 White Paper – Ground Check Device R141. Ref. B211539EN-A © Vaisala, 2015.

A reference to the two documents above has been added to the manuscript.

Figure 2 top panel: the small white words are very hard to read. Can you enlarge the font?

R: during the writing phase of the manuscript this issue already came out; nevertheless, this picture was kindly provided by Vaisala and should be, according got them, the only one available to describe the size of the interior sectors of the Vaisala Autosonde AS41. As a consequence, the authors apologize but they would prefer to leave Figure 2 in its current shape

Line 254: is there a reference available for the Rotronic HC2A-S probe?

R: https://www.rotronic.com/en/hc2a-s.html. This link has been added at the corresponding line.

Line 284: it is unclear what "a maximum number of 40 sondes adjustable" means, does this mean there is maximum of up to 40 sondes, and the maximum can be adjusted by the user?

R: The word adjustable has been removed.

Lines 304-307: the meaning of this is a little unclear; is it that at this time, Meisei considers the information proprietary, or that additional information is at a preliminary/developing state?

R: Meisei, as well JMA, did not run any parallel sounding to investigate and improve the performance of their system, which is currently commercialized; therefore, a final assessment of the system performance cannot be made available yet. Despite the

limited number of information made available for this manuscript by Meisei, the authors agreed on the importance to report in this work all the information on all the Automated Radiosounding Launchers available on the market.

Figure 5: I'm concerned the font will be illegible due to small size when this is formatted for publication

R: In the new manuscript version, the diagram in Figure 5 has been replaced with a 300dpi version, without modifying its current shape. The printing of the Figure appears to authors readable.

Line 410: why was the switch made to Totex? Is there a cost or supply or reliability reason the switch wasn't made earlier?

R: Since September 2015, HWOYEE 600 balloon were replaced by Totex TX1000 at Trappes station. This change is simply explained by the result of a call for tenders made by MeteoFrance for the renewal of the balloon purchasing framework at the end of 2013.

Figure 5: why is the % successful flights based only on 2018, when there are >2.5 years of previous data? Was the equipment/equipment operation not optimized until 2018?

R: The authors suspect that the comment provided by the reviewer refers to Table 5 and not to Figure 5. If this is the case, The % successful flights in the presented statistics refer to one year only (2018) to consider a period of the same length as that considered for the statistics presented for the Payerne Vaisala ARL. This study can be considered fully is representative of the 2.5 years of data collected with the Meteomodem ARL.

Lines 518-520: more (but brief) information on what the Wilcoxon Rank Sum Test, and why it was used, would be good here. It's better described later in the text (eg around line 692).

R: At lines 518-520, the following text has been added: "The Wilcoxon Rank Sum Test

is a non-parametric test of the null hypothesis that it is equally likely that a randomly selected value from one population will be less than or greater than a randomly selected value from a second population. If the null hypothesis is rejected, that there is evidence that the medians of the two populations differ. In this study, the Wilcoxon Rank Sum Test has been used instead of the Z-test due to its robustness in case of a small observations sample (i.e. small number of parallel launches) and to avoid assumptions on the underlying data distribution (e.g. data distribution skewed or non-normal)."

Line 524: right panel of Figure 9 should say "shows" (grammar)

R: Fixed.

Lines 525-527: although the test data for Sondakyla are not shown, can you briefly summarize the outcome?

R: The additional test data for Sodankylä, mentioned in the manuscript, refers to a very long storage-time and the test was made in a similar manner to the one shown in Figure 10. In this case, the radiosondes used for the test were not launched in parallel to the manual launches as done instead for the dataset shown in Figure 9. The test was carried on performing a first ground check, then the sonde was left on a tray of the ARL for up to one month period and after that another ground check was made. The ground check showed almost identical values even after a long tray time. As a consequence, to avoid misunderstandings, the authors decided to remove the sentence at lines 525-527.

Figure 9: the noise in the profile plots makes them somewhat hard to grasp and interpret; would it be possible to replace by bar graphs binned by altitude for 3-5 altitude bins?

R: In the new version of the manuscript, a bar plot has replaced the line plot. The text has been refined accordingly.

Lines 544-553: this text is repeated, please delete

R: done.

Figure 18: why does the difference grow rapidly with height from 5-15 km and then stabilize? Is there just more variability in upper troposphere winds vs lower troposphere, and then calmer winds in stratosphere?

R: In Figure 18, it is shown the horizontal distance calculated for the balloons of the 21 parallel soundings performed at Faa'a station. The horizontal distance of two parallel soundings is mainly determined in troposphere by advection, turbulence, the time difference between the two launches and the balloon filling which determines the ascending speed. The latter is very important to determine the balloon motion if combined with the effect of horizontal winds. The distance may also increase quickly depending on the combination of the described factors. In lower stratosphere, winds are a laminar flow (i.e. there is small turbulence) and this combined also with a slower ascending speed due to the balloon deformation at lower pressure does not increase the balloon distance as in the troposphere.

lines 788-795: is the probability close between the daytime and nighttime launches? It looks like the daytime launches differ more than the nighttime launches between ARL and manual.

R: The probability calculated for the balloon burst altitude dataset at Faa's station is obtained applying the Wilcoxon Rank Sum Test to night (11 launches) and daytime data (10 launches) together. Beyond the small size of the dataset, the objective of the test was to compare the overall performance for the entire dataset. If we separate daytime and night time, considering the smaller size of the two datasets, the median values show a larger difference during daytime than at night time. Nevertheless, the results of a statistical test would be more affected by the size of the dataset and the authors prefer to apply the Wilcoxon Rank Sum Test on the entire dataset. The text at lines 788-795 has been slightly modified to clarify.

Figure 6: what does the abbreviation "nb" mean?

R: “nb” stands for “number”. To avoid misunderstandings, this has been specified in the figure caption.

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