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Atmospheric Measurement Techniques Discussions

Interactive comment on "Comparison of Vaisala radiosondes RS41 and RS92 in the oceans ranging from the Arctic to tropics" *by* Yoshimi Kawai et al.

Anonymous Referee #2

Received and published: 29 March 2017

Overall comments:

This paper compares the Vaisala RS92 sondes with the latest generation Vaisala sondes, the RS41. The comparison is based on 36 intercomparison launches conducted over the oceans ranging from the Arctic to the Tropics. This study is relevant on many levels: (1) the wide use of these sonde types, (2) the broad (arctic to tropics) oceanic sampling which is different from previous Vaisala intercomparison studies , and (3) their unique findings from a research vessel which will be useful to future field campaigns involving ship-based sounding operations. In the minor comments section below a number of comments are listed which, if addressed, should improve the manuscript. In particular, the authors assume that differences in humidities are the result of biases in the RS92 sonde. Is there any independent evidence for this assertion? Also including differences in PW, CAPE and CIN from each launch would be instructive.

The paper is reasonably well written buy could use clarification in a number of areas indicated below. Also listed are a few minor grammatical changes the authors may want to consider.

Minor comments

Suggested title change: "Comparison of Vaisala RS41 and RS92 radiosondes launched over the oceans from the Arctic to the Tropics"

Line 18: suggested rewording, "RS41-SGP, sonde version with pressure sensor, . . ."

Line 29-30: suggested change, "discrepancies presumably caused by the "wet-bulbing" effect on the RS92 sonde and the stagnation . . ."

Line 40: suggested rewording, "are operationally conducted . . ."

Line 43: suggested rewording, " with helium or hydrogen gas."

Line 50: suggested rewording, "Efforts to improve the quality of . . ."

Line 53: suggest you add reference to the end of this sentence to (Wang et al. 2013) Reference is: Wang, J., L. Zhang, A. Dai, F. Immler, M. Sommer, and H. Vömel, 2013: Radiation dry bias correction of Vaisala RS92 humidity data and its impacts on historical radiosonde data. J. Atmos. Oceanic Technol., 30, no. 2, 197-214.

Line 95-98: Is this special note really needed? I would suggest you eliminate this but then say: "All RS92 sonde data used in this study were processed with DigiCORA software v3.64 which includes humidity corrections for solar radiation dry bias and time-lag errors due to the slow response of the humidity sensors (Dirksen et al., 2014)." Reference is: Dirksen, R. J., M. Sommer, F. J. Immler, D. F. Hurst, R. Kivi, and H. Vömel, 2014: Reference quality upper-air measurements: GRUAN data processing for the Vaisala RS92 radiosonde. Atmos. Meas. Tech., 7, 4463-4490.

Line 128: Suggest you start paragraph with a introductory sentence something like: "A number of issues were addressed in post-processing the sounding data."

Line 129: Suggested rewording: “the radiosondes oscillated vertically about the 0°C level likely due to icing on the balloon, and hence only . . .”

Line 152 and following: Is it possible to compute pressure from the RS41 GPS height data similar to what is done with RS41 SG sondes, that is sondes without a pressure sensors? Would this GPS computed pressure lead to an improved comparison with pressure from the RS92 sondes as found in Jensen 2016. If there is an improved comparison using GPS computed pressure, this could be a useful recommendation for future use.

Following section 3.1: It would be useful to see how these pressure difference translate into geopotential height differences. I would suggest adding another panel to Fig. 3 where you show the height differences.

Line 200: In discussing Fig. 6a and the differences in the T and RH profiles between the sondes, can you speculate which sonde would be less prone to errors due to poor ventilation? Why?

Line 201 and following regarding Figs. 6b and 6c: The large temperature differences seen at low-levels would likely results in significant differences in CAPE and CIN. It would be informative to list these CAPE and CIN differences as additional motivation for better understanding this issue.

Line 217: Are the noisier wind speed data in this study compared to Jensen’s related to the observations being taken on a ship and hence ship motion? Also is there an explanation for the large mean wind differences above 27 km in Figs 3d and 3e?

Line 241: suggested rewording: “bias was generally absent from later observations processed with V3.64 software (Ciesielski . . .).

Line 251 and following: It seems you are assuming that the moisture biases between the sondes are always related to issues with the RS92 sonde. Is there any independent confirmation you can provide (GPS or microwave PW estimates or preferably snow

white chilled mirror soundings) that in fact show the RS92 sondes having the poorer performance. Can you discount the fact that the RS41 doesn’t have slight moist bias? Regarding this, it would be instructive if you could produce a similar diagram to Fig. 18 in Jensen et al (2016) which showed PW estimates from both the RS41, RS92 and some independent estimate and then discuss the findings. Jensen et al. (2016) claim their comparison between sonde and MWR PW may have been affected by spatial moisture gradients near the launch site. Spatial moisture gradients should not be as much of an issue for your oceanic soundings, such that a PW comparison between sondes and some independent estimate could be quite instructive. Finally, if you are including PW estimates from the RS41 and RS92 sondes, it would be useful to also see CAPE and CIN differences (either in tabular or graphical form) for each sonde launch.

Line 251: You note that there is a residual day-time dry bias in the RS92 data but there also appears to be a night-time dry bias (at least between 3-13 km). This nighttime difference is certainly not caused by differences in the radiation correction schemes in the sonde software. Please comment?

Line 254: “proposed by Nuret et al. (2008) . . .” Reference is Nuret, M., J.-P. Lafore, F. Guichard, J.-L. Redelsperger, O. Bock, A. Agusti-Panareda, and J.-B. N’Gamini, 2008. Correction of humidity bias for Vaisala RS80-A sondes during the AMMA 2006 observing period. J. Atmos. Oceanic Technol., 25, 2152-2158.

It would be useful to include local time and precipitable water (PW) in table 2. The PW values would allow one to better gauge the range of moisture conditions the sondes were launched in. If you show PW values in a separate figure (see comments above) then putting them in table 2 would not be necessary. If more room is needed, the lat/lon values can be truncated to 1 or 2 decimal places.

Figure 3, panels (b) and (c) appear to be switched in this figure caption. However you may want to switch these panels to make them consistent with Jensen’s Fig. 8.

Minor grammatical comments:

Line 26: suggested rewording, “4.5 km, suggesting that there . . .”

Line 37: “further studies on the causes . . .”

Line 143: “To facilitate comparison . . .”

Line 267: “range of temperatures and relative humidities”

Line 269: “was largest . . .”

Tabel 2: “Wind dir.”

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