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Atmospheric Measurement Techniques Discussions
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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 #1

Received and published: 24 April 2017

Title: Comparison of Vaisala radiosondes RS41 and RS92 in the oceans ranging from the Arctic to tropics

Authors: Yoshimi Kawai et al., 2017, AMTD

General Comments:

This study evaluates measurements taken by Vaisala RS92 and RS41-SGP model radiosondes. The twin sounding launches, performed in both tropical and arctic locations, is especially important considering the number of scientific applications (e.g. climate studies and modeling) that rely on radiosonde data. The methodology is very clear, and I particularly like the conciseness of the explanations and results. This study is relatively unique in that it compares two widely used radiosondes in distinct climate locations during the same experiment. I have a few comments that I would like to see

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addressed.

Specific Comments:

1. Lines 101-103: Even though you did not use the GPS-derived pressure and height measurements, I think it would be good in this study to mention what the RS41 GPS-derived pressure and height measurements are. Comparing these measurements to the in-situ measured pressure would strengthen the claim that the pressure bias is real – considering the GPS-derived pressure and in-situ measured pressure are literally on the same instrument. It would also be good to make sure that the GPS-derived pressure and height measurements are the same between the RS41 and RS92.

2. Figure 2, and general comment about the pressure bias: Compared to Jensen et al., 2016, the twin soundings are literally attached together. I think the pressure bias may have inadvertently been caused by drag created by the balloon above it. To explain further, you noted that the pressure bias was larger above 4.5 km and was especially noticeable during the day. During ascent, the balloon itself expands, thus creating a larger object displacing the air above it. Similar to how a falling raindrop has a local high pressure at the base of the drop and a local negative pressure at the "tail" of the drop, perhaps the balloon itself is creating a local minimum pressure tendency below the balloon (i.e. in the same area the twin sondes are located)? I included a sketch on the last page to help explain this. GPS measurements, of course, should be unaffected by this. If the pressure bias is indeed created by drag, then that also adds some credence to using a bar (like in Jensen et al., 2016) to horizontally hang the twin sensors, as opposed to attaching them together by tape – the sondes hung on the edges of the bar would be further away from the area of maximum local negative pressure tendency induced by the drag. It would also be worthwhile to mention in your conclusions that a comparison of the in-situ silicon sensor vs. the GPS-derived pressure on the same balloon should be done – this could either confirm or eliminate the possibility of air drag affecting the in-situ pressure measurement. With this idea in mind, it is very well possible that the pressure sensor is affected by solar heating as well, especially since

pressure is measured by a capacitive element.

3. Lines 236-238: The reason the RS92 solar radiative dry bias was absent in the two papers you cited is because they used the relative humidity correction scheme according to Wang et al. (2013; citation provided below). Please include this citation here, and clarify this sentence by mentioning that the absent dry-bias is because this RH correction scheme was implemented.

Wang, J., Zhang, L., Dai, A., Immler, F., Sommer, M., and Vömel, H., 2013: Radiation dry bias correction of Vaisala RS92 humidity data and its impacts on historical radiosonde data. Journal of Atmospheric and Oceanic Technology, 30, 197-214.

4. Lines 226 and 242: In addition to the Wang et al. (2013) and Yu et al. (2015) studies already mentioned above or cited already, you may want to consider including these additional citations, as they all expand upon the solar radiative dry bias at high altitudes and discuss various approaches to correcting (and independently validating) the solar radiative induced RH dry bias. The Miloshevich et al. (2009) paper has a very thorough discussion in Section 4.2 on nighttime RH measurements and may be relevant to your discussion on Figure 7. All of these studies also use precipitable water vapor (PWV) as a reference measurement, and it would be good to include measurements of PWV (perhaps from GPS or microwave radiometer retrievals) to show how much poorer the RS92 RH measurements are compared to the RS41, if its even significant at all.

Miloshevich, L. M., H. Vömel, D. N. Whiteman, and T. Leblanc, 2009: Accuracy assessment and correction of Vaisala RS92 radiosonde water vapor measurements, J. Geophys. Res., 114, D11305, doi:10.1029/2008JD011565.

Dzambo, A. M., Turner, D. D., and Mlawer, E. J., 2016: Evaluation of two Vaisala RS92 radiosonde solar radiative dry bias correction algorithms, Atmos. Meas. Tech., 9, 1613-1626, doi:10.5194/amt-9-1613-2016, 2016.

Moradi, I., B. Soden, R. Ferraro, P. Arkin, and H. Vömel, 2013: Assessing the quality of

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humidity measurements from global operational radiosonde sensors, J. Geophys. Res. Atmos., 118, 8040–8053 doi:10.1002/jgrd.50589.

5. Lines 243-246: The reason the values in your Figure 8 agree better than Figure 6 in Vömel et al. (2007) is likely because Figure 6 compares Vaisala RS92 data (before DigiCora v. 3.64 data) to cryogenic frost point hygrometer data, which is widely regarded as one of the best reference instruments in developing RH correction algorithms. In your Figure 8, you compare RS92 DigiCora v. 3.64 data to RS41 data, both of which are much better at measuring relative humidity. You should note, perhaps at the end of this sentence, that the values in Fig. 8 are less than Fig. 6 in Vomel et al. (2007) because the RS92 DigiCora v. 3.64 RH data and RS41 RH data are already inherently better.

Technical Comments:

1. Line 165: Change "... radiosonde tended to record a higher mean relative humidity than the..." to "... radiosonde recorded a higher mean relative humidity relative to the..."

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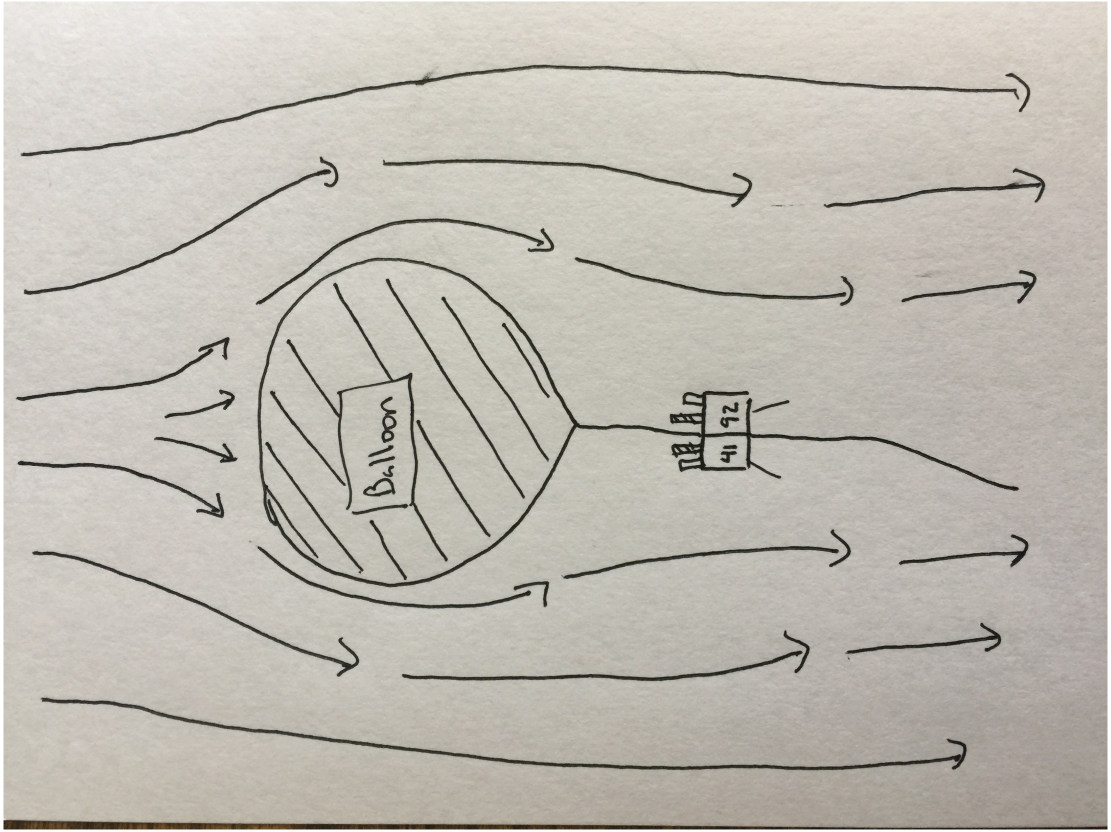

Fig. 1.