Full Review for AMT-2018-179 (Bessardon et al.)

Title: Evaluation of Windsond S1H2 performance in Kumasi during the 2016 DACCIWA field campaign

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Overall comments:

This paper describes progress towards developing a less expensive but reliable upper-air radiosonde. To evaluate their newly developed S1H2 sonde they compare its data to observations from high-quality Vaisala RS41-SG sondes. The observations were taken from 33 launches during the DACCIWA field campaign in Western Africa. Basically the authors conclude that the S1H2 sonde is a work in progress with the main issues being the poor performance of the GPS sensor leading to questionable winds and the slow response time of the temperature and humidity sensors. It's ironic that an instrument called a "windsond" would do such a poor job measuring winds. They conclude by offering some recommendations for future improvements.

From the limited comparisons shown between RS41 and S1H2 observations, it is hard to properly judge the performance of the windsond. For example, only one intercomparison flight is made for data extending above the boundary layer. Figures 5-7 show data from this one flight. To get meaningful statistics to evaluate the windsond, data from 20 or more flights should be presented as in Jensen et al. (2016) and similar intercomparison studies. For soundings within the boundary layer, analyses are shown from (I believe) eleven flights (Figs. 8-9) and in a format that is difficult to interpret. I would recommend that analyses be presented in a more conventional format as biases and rms differences between the RS41 and windsond (see Fig. 8 of Jensen et al. 2016).

While the paper has some major concerns in the way the analyses are presented, it is still of value in that it is introducing a new instrument with a promising upside that is in the early stages of development. Under major comments below I suggest several areas where paper could be improved.

Major comments:

While the windsond system is being marketed as a less expensive replacement to more conventional sondes, no where is the cost of the sonde system (laptop, antenna, etc.) and sondes mentioned in the paper. Please discuss this information.

Line 24: The vertical resolution is also a function of the sampling rate.

Line 28-33: So the US sites are spending ~$237K per site per year. I would assume that the US sites are some of the more costly ones to maintain around the globe so I would guess your $440M is gross overestimate. You might want to state a range like from $237M to $440M. The statement referencing Martinez (2016) is confusing. It reads as if

you saying that Greenland has 40 operational sites? I'm assuming you mean the Arctic has 40 sites. You may want to reword this statement. Also, is Martinez (2016) a valid reference?

With an operational ceiling of 6 km, it does not seem that the windsond system can be used to replace the sondes currently being used at operational sites which record data to 25 km and higher. With this mind what are the practical research applications of the windsond S1H2 as an upper-air system? Because of its limited range it seems best suited for use in boundary layer studies, however boundary layers are often characterizes with sharp gradients in potential temperature and moisture which the S1H2 has difficulty resolving because of its slow response time. Please discuss.

Are there plans to use improved T and RH sensors with a better response time?

Line 56: Why is the operational ceiling at 8 km? Is this the burst altitude of the party balloon used with the sonde or are there some other considerations?

Figure 4: It's difficult to see the ruler in this picture to get an idea of the length of the sonde.

Line 104: Also mention that the RS41-SG pressure calculation uses the hypsometric equation.

Line 123-124: Please clarify what it means "that the MW41 only produces the highest degree of signal processing". In other places you mentioned RS41 data before and after processing.

Line 126: Please clarify what corrections have been introduced. Have these corrections been implemented in the results from this study?

Line 153: What is experiment 6?

Line 167-168: This discrepancy between sensors at 2000 m is difficult to see in the manner that the data is displayed. Could the data be presented as a function of height or pressure to better show this?

Line 176: Please verify that Vaisala does not use GPS differential correction to compute winds as I thought they did. In fact this statement seems to contradict what is said earlier in lines 111-113. Did you mean the S1H2 does not do differential correction to compute winds. It seems really puzzling why the Windsond winds are of such poor quality. For example the IMET sonde system does not use a differential wind correction and its winds compare quite favorable to the RS41 sonde. Can you give some explanation for the poor performance of the Windsond winds? Is some of this error due to the pendulum motion of the sonde swinging below the balloon which is filtered out in the RS41 processing but not filtered out by S1H2 system?

Line 195: One sounding does not provide statistically significant evidence for this statement. See comments above.

Section 5.2.2. So to clarify are you saying that the results shown for the S1H2 have no post processing and no corrections applied? Can you state what processing and corrections the MW41 performs. You mention smoothing in line 194. Is this smoothing of all fields? Is the balloon pendulum motion only taken out in the MW41 processed data?

Figure 7: It appears that the surface or starting pressure used is different between the systems. Why is this?

Line 207: Does the pressure difference between the two systems continue to increase with altitude?

Line 229: What is a .kml file? Does this need to be mentioned?

Line 232: Are these flashes of light coming from the sonde? Please clarify.

Line 235: Have you considered if a 4m string is long enough to prevent balloon effects on the sonde observations? I believe the Vaisala system uses a much longer string (20-30m) to prevent any balloon impacts on the sonde data.

Line 244: Please clarify what the "data alteration study" is.

Line 285: This is good suggestion and should be a standard practice for all flights (i.e., proper surface base-lining of sondes).

Table 3: Please mention the RH sensor response time.

Listed below are some additional minor suggested changes the authors may want to consider.

Minor comments

Line 48: suggested rewording, "because the LLC cover …"

Line 50: suggested rewording, "boundary layer sounding during …"

Line 69: "Figure 4 shows the Windsond …"

Line 74 "sensor is used in …"

Line 134 and elsewhere like Table 6: mention if time is GMT or LT.

Line 160: “all the assessed meteorological parameters …”
Line 168: “sudden warming …”

Line 171 and 172: change “reply” to “response”

Line 234: “When re-using the sonde …”

Line 256: “for locating soundings …”

Line 289: Seems like “different altitudes” should be “lower altitudes”. This would be a good place to state the specific niche that the Windsond is trying to fill. Certainly in its current configuration it will never be used as an operational sounding.

Line 292: “longer response time …”