Referee #3

Review of manuscript "Laboratory characterisations and intercomparison sounding test of du al thermistor radiosondes for radiation correction" by Sang-Wook Lee, et al., AMT-2021-343

Synopsis: The authors describe a detailed metrological characterization of a dual thermistor radiosonde and how the difference between thermistors can be used for the radiation error affecting both. The result is a quite simple multilinear model for correction, based just on the differences between thermistors. The characterization methods appear quite solid. Only the comparison with the de facto standard (RS41) has been performed using too small samples.

→ We thank the Reviewer for providing valuable comments. We have addressed his/her comments as below.

Major comments:

I was a bit surprised to learn that the temperature was varied only between -70 and 20 deg, since in the tropics and over Antarctica temperatures below -90 degrees are not uncommon. This seems important since in Fig. 4, there are substantial variations of resistance reading at -70 deg. Does the instrument fail at even lower temperatures? Perhaps this is a wrong impression because of the y axis being linear, not logarithmic.

→ The lowest limit of the temperature of the climate chamber used for the calibration of thermistors in Figure 4 is -75 °C. This is the typical temperature limit of commercially-available climate chambers. We know the importance of the sensor calibration down to -90 °C to measure the temperature of upper air globally. Unfortunately, it is not feasible in our system at the moment. We have mentioned this point clearly in the revised manuscript.

The resistance of the negative temperature coefficient (NTC) thermistors used in this work is changed from 10 kΩ to 700 kΩ when the temperature is varied from 20 °C to -70 °C, respectively, as shown in the x-axis of Fig. 4(b). Although the absolute difference between the reference and radiosonde reading is accordingly increased at -70 °C, the residual of converted temperature is not increased as shown in Fig. 4(c). The y-axis cannot be changed into logarithmic scale because some of the data is negative.

Added statement (Line 140-142): Although the calibration range should be extended to −90 °C to cover temperatures over tropic and polar regions, it is not feasible using the climate chamber because the typical lowest temperature limit is more or less −80 °C.

The comparison with the current de fact standard RS41 should be more comprehensive. In Fig. 9 it is not clear how many radiosondes were launched in parallel. This is very important to have a robust estimate of differences. Somewhere in the text it is written N=12 for daytime and N=6 for nighttime. That should be also in the caption. The same applies to the sounding test described in section 8. It appears it was only one ascent?

→ More information on soundings is added.

Added statement (Line 319-322): One, two, or three DTRs were tested in parallel with a RS41 in a single flight. The number of comparison (N) was $N = 12$ at daytime and $N = 6$ at nighttime from 7 and 3 soundings, respectively. The daytime sounding was performed from 11:00 am to 5 pm local time while the nighttime sounding was from 12:00 am to 4 am. The sky was normally cloudy.

There is a lot of redundancy in the formulae. Why do you specify S_0 = 960 W/m^2 all the time in formulae 2-19. It is given in the text and does never change. The same is true for v_0. Personally I would also recommend writing fractions as with – as divisor, not / in numbered formulae.

→ Equations are simplified, for example, by removing the redundancy such as S_0 and v_0. In the fractions, '$^{-1}$' is used instead of '/' as suggested.

Before: $(T_{\mathrm{B\_on}} - T_{\mathrm{W\_on}})_{\mathrm{UAS}} = T_0(T_{\mathrm{W\_on}}) + A_0(T_{\mathrm{W\_on}})\cdot\exp(-P/P_0(T_{\mathrm{W\_on}})) + A_1(T_{\mathrm{W\_on}})\cdot\exp(-P/P_1(T_{\mathrm{W\_on}}))$, $S_0 = 960\ \mathrm{W\cdot m^{-2}}$,

After (Eq. (2)): $(T_{\mathrm{B\_on}} - T_{\mathrm{W\_on}})_{\mathrm{UAS}} = T_0(T_{\mathrm{W\_on}}) + A_0(T_{\mathrm{W\_on}})\cdot\exp(-P\cdot P_0(T_{\mathrm{W\_on}})^{-1}) + A_1(T_{\mathrm{W\_on}})\cdot\exp(-P\cdot P_1(T_{\mathrm{W\_on}})^{-1})$,

Before: $S = S_0 \times (T_{\mathrm{B\_on}} - T_{\mathrm{W\_on}})_{\mathrm{UAS}} / [T_0(T_{\mathrm{W\_on}}) + A_0(T_{\mathrm{W\_on}})\cdot\exp(-P/P_0(T_{\mathrm{W\_on}})) + A_1(T_{\mathrm{W\_on}})\cdot\exp(-P/P_1(T_{\mathrm{W\_on}}))]$, $S_0 = 960\ \mathrm{W\cdot m^{-2}}$

After (Eq. (9)): $S = S_0 \times (T_{\mathrm{B\_raw}} - T_{\mathrm{W\_raw}}) \cdot (T_{\mathrm{B\_on}} - T_{\mathrm{W\_on}})_{\mathrm{UAS}}^{-1}$,

Before: $S = S_0 \times (T_{\mathrm{B\_on}} - T_{\mathrm{W\_on}})_{\mathrm{UAS}} / [T_0(T_{\mathrm{W\_on}}) + A_0(T_{\mathrm{W\_on}})\cdot\exp(-P/P_0(T_{\mathrm{W\_on}})) + A_1(T_{\mathrm{W\_on}})\cdot\exp(-P/P_1(T_{\mathrm{W\_on}})) - 0.08\cdot(v - v_0)]$, $S_0 = 960\ \mathrm{W\cdot m^{-2}}$ and $v_0 = 5\ \mathrm{m\cdot s^{-1}}$

After (Eq. (10)): $S = S_0 \times (T_{\mathrm{B\_raw}} - T_{\mathrm{W\_raw}}) \cdot [(T_{\mathrm{B\_on}} - T_{\mathrm{W\_on}})_{\mathrm{UAS}} - 0.08\cdot(v - v_0)]^{-1}$,

Before: $(T_{\mathrm{W\_on}} - T_{\mathrm{W\_off}})_{\mathrm{UAS}} = T_1(T_{\mathrm{W\_on}}) + A_2(T_{\mathrm{W\_on}})\cdot\exp(-P/P_2(T_{\mathrm{W\_on}})) + A_3(T_{\mathrm{W\_on}})\cdot\exp(-P/P_3(T_{\mathrm{W\_on}}))$, $S_0 = 960\ \mathrm{W\cdot m^{-2}}$,

After (Eq. (11)): $(T_{\mathrm{W\_on}} - T_{\mathrm{W\_off}})_{\mathrm{UAS}} = T_1(T_{\mathrm{W\_on}}) + A_2(T_{\mathrm{W\_on}})\cdot\exp(-P\cdot P_2(T_{\mathrm{W\_on}})^{-1}) + A_3(T_{\mathrm{W\_on}})\cdot\exp(-P\cdot P_3(T_{\mathrm{W\_on}})^{-1})$,

Before: $(T_{\mathrm{W\_on}} - T_{\mathrm{W\_off}})_{\mathrm{UAS}} = (S/S_0) \times [T_1(T_{\mathrm{W\_on}}) + A_2(T_{\mathrm{W\_on}})\cdot\exp(-P/P_2(T_{\mathrm{W\_on}})) + A_3(T_{\mathrm{W\_on}})\cdot\exp(-P/P_3(T_{\mathrm{W\_on}}))]$, $S_0 = 960\ \mathrm{W\cdot m^{-2}}$,

After (Eq. (18)): $(T_{\mathrm{W\_raw}} - T_{\mathrm{W\_cor}}) = (S\cdot S_0^{-1}) \times (T_{\mathrm{W\_on}} - T_{\mathrm{W\_off}})_{\mathrm{UAS}}$,

Before: $(T_{W\_on} - T_{W\_off})_{UAS} = (S/S_0) \times [T_1(T_{W\_on}) + A_2(T_{W\_on})\cdot\exp(-P/P_2(T_{W\_on})) + A_3(T_{W\_on})\cdot\exp(-P/P_3(T_{W\_on})) - 0.1\cdot(v - v_0)]$, $S_0 = 960\ \mathrm{W\cdot m^{-2}}$ and $v_0 = 5\ \mathrm{m\cdot s^{-1}}$ (19).
After (Eq. (19)): $(T_{W\_raw} - T_{W\_cor}) = (S\cdot S_0^{-1}) \times [(T_{W\_on} - T_{W\_off})_{UAS} - 0.1\cdot(v - v_0)]$,

-Formula (25) holds only if errors are independent.

→ Each parameter is controlled independently while others are fixed using the upper air simulator and the corresponding uncertainty is analyzed.

Minor comments:

L69: different emissivities

→ The word is changed

Before: difference emissivities

After (Line 75-76): different emissivities

Fig. 6, 7: A logarithmic y axis would be very helpful, and is also more suitable to the paramet erization you give in Formula (2), which consists of exponential functions.

→ Logarithmic scale is used for Figs. 6 and 7.

Modified Figures (Figures 6 & 7): Logarithmic scale is used for x-axis of Figures 6 and 7.