

Interactive comment on “Fast-response high-resolution temperature sonde aimed at contamination-free profile observations” by K. Shimizu and F. Hasebe

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Minor comments

Title: “contamination-free” is maybe too strong since you can only reduce the contamination but no measurement will be free of any contamination.

Reply: The Referee is right in that no measurement will be free from any contamination. The use of the term “aimed at” reflects our recognition of the fact. We believe the ultimate goal is to develop a sensor that provides data in which the

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users no longer need to worry about the observational errors. Admitting that it is a difficult job, we appreciate at the same time that the new tungsten sonde has made a good progress. So we would like to retain this title.

Abstract: Line 1: “ultra thin” is not very precise; there are other temperature probes with much smaller diameter – I suggest deleting the word “ultra” and providing numbers.

Reply: As far as we are aware, there is no radiosonde temperature sensor thinner than the present one. We would like to maintain the term “ultra thin” by adding the diameter. The revised sentence will read “an ultra thin tungsten wire (10 μm in diameter)” (line 2 of page 3294).

Abstract: Line 12: “noise” is misleading and suggests something like uncorrelated fluctuations/errors.

Reply: The sentence has been simplified by eliminating the term. The revised sentence will be “although the use of a long suspension line will be effective.” (lines 11 to 12 of page 3294).

Abstract: Line 18: to suggest that the new probe should serve as international standard is going too far.

Reply: The text is modified to “Our tungsten sonde that scarcely relies on the ambiguous correction procedures will be ideal for serving as a kind of an international reference.” (line 18 of page 3294).

Page 3295, line 5: “radiatively active minor constituents” – what do you mean?

Reply: They are those species that absorb and transmit radiation. “such as ozone and water vapor” has been inserted in the text (line 5 of page 3295).

Page 3295, line 24: change “corrections” with something like “influence” or so.

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Reply: The “radiation correction” has been applied to every radiosonde temperature measurement to compensate for the radiative heating to the sensor body. It expresses “any adjustment of observed values necessary to compensate for the radiative heating to the sensor.” Although the magnitude of correction has great ambiguity, it is an established term. We believe the use of “radiation correction” in this sentence is justified.

Page 3295, line 29: again I would delete the part where the new probe is suggested as a new standard.

Reply: The sentence has been modified to “a new temperature sonde intended to serve as an international reference.” (line 1 of page 3296).

Page 3297, line 6: “atm” is no SI-unit; the mentioned tick marks in the label of Fig. 1 are non-visible in my copy.

Reply: “1013.25 hPa” has been inserted. The tick marks are rewritten in different color for visual clarity.

Page 3297, line 27: the second part of this sentence is not clear to me. Why can a fast response sensor minimize corrections? Do you mean that the influence of radiation on a fast response sensor is small and corrections can be avoided?

Reply: According to Eqs. (1) and (2), $T_s - T_a$ becomes small as τ becomes small. Thus, the influence of radiation and the required correction can be reduced by using first response sensor. “since $T_s - T_a$ is proportional to the response time τ as can be seen from Eqs. (1) and (2).” is inserted after “as well” (line 1, page 3298).

Page 3298, line 2: please specify the “upgrade” and how this upgrade can reduce the radiation influence on the temperature measurement. (I think with “correction” you mean “influence” here?)

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Reply: The upgrade is (1) improvement of reflectivity $1 - \alpha$, and (2) reduction of applied current I in Eq. (1). Both will reduce the value of the right hand side of Eq. (1).

“by improving the surface reflectivity and reducing the applied current” has been inserted between “an upgrade” and “in May 2010” (line 2, page 3298).

Page 3298, line 13: What is a “good agreement”?

Reply: It means all three temperature profiles agree with each other below 5 km during the day (left) and below 15 km during the night (right) in Fig. 3.

Page 3298, line 23: Can you provide more details about how the data of conventional radiosondes are processed?

Reply: The data processing includes interpolations of missing data, some radiation correction, and smoothing to reduce noise. The details will depend on the manufacturer and the version of processing software.

“are the processed product suitable for operational use.” (line 23, page 3298) has been changed to “are the processed product. They are suitable for operational use on the one hand but insufficient for research purpose on the other as the details of processing are not well-documented.”

Second part of Section 3: This part is a little bit confusing to me since the authors jump a little bit between own work and “standard radiosonde measurements”.

A schematic of the setup could help to understand the set-up and situation described in the last part of Section 3.1.

Reply: All the statements except for the last sentence are concerned with conventional sondes including RS06G. The last sentence starting from “In the present study” (line 3 of page 3299) is made to constitute an independent paragraph to avoid confusion. Following modifications are also made.

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- Page 3298, line 26: “They are removed” is changed to “They have been removed”.
- Page 3299, line 2: “the filter is designed” is changed to “the filter has been designed”.

A schematic of the setup has been described by modifying Fig. 4.

Section 4, page 3303, line 1: again the word “radiation correction” is misleading; can you really correct for the 0.4 K or is it just the error in the measurement due to the radiation effect?

Reply: The word “radiation correction” has been used irrespective of the correctness. Actually it is “just the error in the measurement due to the radiation effect” as the Referee wrote. As the term is well-established, however, we would like to retain as it is.

Section 4, page 3303, line 17: why not using a simple de-spiking algorithm such as a running median, which can remove the spikes? Of course this is only possible if you have high-resolution data (as yours) that can resolve the spikes.

Reply: We agree with the Referee that the running median is one of the effective methods of removing artificial spikes. However, we would like to retain as it is as this sentence is intended to list implications found from this study.

Page 3304, line 4: again I would avoid the word “noise” – maybe the word “perturbations” is better in this context.

Reply: Revised as suggested.