Response to the comments (RC1)

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Thank you very much for your thoughtful comments and suggestions.
Our responses to your comments are as follows:

SPECIFIC COMMENTS

Page 1, line 13: Why were data from only 52 of the flights analysed. Why not all 87 flights? Did the other 35 not pass the quality controls for conversion to a GRUAN data product? If that is the case, perhaps that should be stated.

- The RS-11G GDP was created at Tateno; however, data for 5 flights were not used for the analysis because of the delay in data processing. Therefore 82 RS-11G GDPs were available. Once an RS-11G GDP is created, quality control procedures should be taken; however, the quality control procedures have not been established and are still under consideration. On the other hand, the RS92 GDPs were created at the GRUAN Lead Centre, and quality control procedures were taken; 25 of the RS92 GDPs for the Tateno dual flights failed these procedures and were thus not available at the GRUAN data archive. The quality control procedures for the RS92 GDP are as follows (Dirksen et al., 2014): The first step verifies the results of the ground check procedure; after the GRUAN corrections have been applied to raw RS92 measurements, the second step checks that profile data are within valid ranges to ensure that the estimated uncertainties of GDPs are within the manufacturer-provided uncertainties. Most of the excluded 25 RS92 GDPs have failed the second step of the quality control procedures. Among the remaining 57 sets of dual flight data, 5 were judged as outliers by the results of RS-11G RH measurements or of the temperature differences. We have revised the text in section 3 as follows:

'The RS-11G GDP was created at Tateno for the analysis of this paper. However, among all the 87 dual flights involved, 5 RS-11G flight data were not used due to problems in data processing. Once an RS-11G GDP is created, quality control procedures should be taken; however, the quality control procedures have not been established and are still under consideration. Therefore, 82 RS-11G GDPs were available for this paper. Among the 82 dual flights, 25 RS92 GDPs failed the quality control procedures at the GRUAN Lead Centre and were not available at the GRUAN data archive. The

quality control procedures for the RS92 GDP are as follows (Dirksen et al., 2014): The first step verifies the results of the ground check procedure; after the GRUAN corrections have been applied to raw RS92 measurements, the second step checks that profile data are within valid ranges to ensure that the estimated uncertainties of GDPs are within the manufacturer-provided uncertainties. For one of the 25 RS92 data, there was more than 1.5%RH difference between the two RH sensors at the ground check, while other 24 RS92 data did not have any problem in ground check data. Also, another one of the excluded RS92 had instrumental issues during the flight. Therefore, most of the excluded 25 RS92 have failed the second step of the quality control procedures at the GRUAN Lead Centre. It is noted that two thirds of the excluded 25 RS92 data were daytime observations, and 8 dual soundings had large differences between RS-11G and RS92 (processed at Tateno with the manufacturer's software) in temperature or RH profiles. Furthermore, 5 dual soundings were judged as outliers by the results of RS-11G RH measurements or of the temperature differences. These are the reasons why we only have 52 sets of dual flight data for the data analysis.'

Page 1, line 15: Replace 'were0.4K' with 'were, on average, 0.4K'. They were not always exactly 0.4K lower right? A similar change needs to be made on the next two lines.

-Yes, you are correct. We have revised the text as 'on average, 0.4K', and similarly revised the text for RH.

Page 1, lines 26-27: I don't know what you mean by 'Most night-time temperature differences for pressures of 10hPa were in agreement.'. The differences were in agreement with what? Or do you mean that the measurements (not the differences) were in agreement (which I would then understand). And likewise for the next phrase about the relative humidity differences.

-We have revised the text as "temperature measurements were in agreement".

Page 1, lines 28-29: Similar to my comments above, when you say 'Around half of all daytime temperature differences at pressures of ≤ 150hPa and relative humidity differences around the 500hPa level were not in agreement', this is confusing. The'differences' were not in agreement with what? I can understand the measurements not being in agreement, but a differences is one number and when you say that difference is not in agreement, it begs the question of not being in agreement with what?

-We meant 'measurements were not in agreement', and we have revised the text.

Page 2, line 27: I was surprised to read that the GRUAN data product for the RS-11G was generated at Tateno. I understood that all GRUAN data processing was centralized and was done at the GRUAN Lead Centre?

-Tateno is in charge of generating GRUAN data products for Meisei RS-11G. This is in part to reduce the workload of the GRUAN Lead Centre. When other GRUAN sites start to use Meisei RS-11G, Tateno is going to accept the role of generating their RS-11G GDP. We have added this explanation to Introduction.

Page 3, lines 24-25: You say 'and converted to create the RS-11G GRUAN data product'. Converted in what way, or converted into what? It feels like something is missing here.

-We have revised the text as 'RS-11G observation data are collected at 1-seconod intervals, and the raw data is converted into the RS-11G GRUAN data product.'

Page 3, line 28: I would suggest changing 'Such errors' to 'Such external influences on the temperature measurement' since it describes more specifically what these are, and I am not sure that it is appropriate to refer to these as 'errors'. It is a correct measurement that the temperature sensor is making (there is no error), it just isn't measuring the atmospheric variable you are directly interested in i.e. the ambient air temperature.

-We have revised this part as suggested.

Page 3, line 30: I don't know what a 'minima-pass filter' is. Is this the same as a low-pass filter'? If not, I think that you need to say more about what this filter is and/or cite a paper that describes the functioning of the filter. Similarly, it is not clear to me what you mean by 'minimum filter' on line 15 of page 4.

-We have added the following explanation to the text: 'The minima-pass filtering is applied to the temperature measurements with a certain time window, which picks up only minimum values within the time window (see Kizu et al., 2018).' Also, we have revised line 15 of Page 4 (for Humidity measurements) as 'This type of wet contamination error manifests as spikes in the raw RH profile; therefore, a minimum filter, which is similar to the filter for heat spikes in the temperature measurements, with a window width of pendulum frequency, is applied to the high-frequency components of raw RH data.'.

Page 4, line 17: But you say nothing about the functional form of the curve fitted to the data. Is it possible to cite an example of a correction curve to the data characterizing the temperature-dependence of the thin-film polymer RH sensors?

-We have cited Figure 3.19 of Kizu et al. (2018) as follows: 'The temperature-dependence of thin-film polymer RH sensors in colder environments was evaluated under laboratory conditions by comparison with reference values from a chilled mirror hygrometer, and a correction curve was developed using the least squares method. The RH sensor has wet

biases between -60°C and 40°C, and dry biases below -60°C. Further details of the temperature dependence correction of RH sensor can be found in Kizu et al. (2018, Figure 3.19).'

Page 7, lines 11-23: This information should be in a table rather.

-We have added a new Table for information about the bins of 13 pressure layers instead of these lines.

Page 9, lines 15-16: You state that 'Temperature differences also influence pressure differences' but this is only true in cases where the pressure is derived from GPS altitude and temperature profiles right?

-This sentence indicates the pressure differences in stratosphere. We have revised the sentence as 'Temperature differences also influence pressure differences particularly in the stratosphere, because both radiosondes use temperature, relative humidity, and GPS height data to derive pressure data.'

GRAMMAR AND TYPOGRAPHICAL ERRORS

Page 1, lines 14-15: Just a suggestion –> Replace 'The authors then quantified differences in the performance of the radiosondes using GRUAN data products' with 'Differences in the performance of the radiosondes were then quantified using the GRUAN data products'.

Page 1, lines 19-21: Again just a suggestion to write in the third person rather than referring to 'The authors' –> Replace 'The authors additionally investigated the RS-11G minus RS92-SGP difference of temperature and relative humidity based on combined uncertainties to clarify major influences behind the difference with 'Differences between the RS-11G and RS92-SGP temperature and relative humidity measurements, based on combined uncertainties, were also investigated to clarify major influences behind the differences'.

Page 1, line 22: Replace 'in RS92-SGP' with 'in the RS92-SGP'.

Page 1, line 23: Replace 'source for RS-11G' with 'source of uncertainty for RS-11G'.

Page 1, line 24: Replace 'and temperature-humidity' with 'and the temperature-humidity'.

Page 2, line 3: Replace 'JMA's 'with 'JMA'.

Page2, line5: Replace 'Upper Air' with 'Upper-Air' i.e. as you have it in the abstract.

Page 2, line 10: Replace 'height' with 'altitude'.

Page 2, lines 11-12: Replace 'temperature and RH measurement has been improved' with 'the quality of the temperature and RH measurements have been improved'.

Page 2, line 14: Replace 'GRUAN will provide' with 'GRUAN is providing'.

Page 2, line 14: Delete 'for levels'.

Page 2, line 15: Replace 'will be' with 'are'.

Page 2, line 16: Replace 'will have' with 'have'.

Page 2, line 20: I would suggest changing 'habitually' to 'regularly'.

Page 2, line 25: I would suggest changing 'elevated change' to 'heightened likelihood'.

Page 3, lines 8-9: I would suggest changing 'The former is operated with a Vaisala DigiCora Sounding System III, and the latter is operated with a Meisei MGPS2' to 'The ground-station for the RS92 was a Vaisala DigiCora Sounding System, while the ground-station for the RS-11G was a Meisei MGPS2'.

Page 3, line 20: I would suggest changing 'for SHC' to 'inside the SHC' for clarity.

Page 3, line 23: Replace 'temperature measurement values' with 'temperature values'.

Page 3, line 29: Given what is displayed in Figure 1, I would suggest changing 'may be too' to 'is too'.

Page 3, line 31: Replace 'theoretically estimated' with 'estimated theoretically'.

Page 4, line 6: Replace 'measurement values' with 'measurements'. And likewise on line29.

Page 4, line 12: Replace 'involves the use of' with 'uses the'.

Page 4, line 27: Replace 'height data' with 'altitude data'. And likewise on line31.

Page 5, line 29: Replace 'is sufficient' with 'is sufficiently good'.

Page 6, lines 25-27: I would suggest changing this to 'Temporally simultaneous observations were compared, using the statistical approach adopted by Kobayashi et al.(2012), to evaluate differences in sensors and correction methods'.

Page 8, line 15: Replace 'a reference' with 'the reference'.

Page 9, line 20: When you say 'much larger than others' what does the 'others' refer to?

Page 9, line 30: Replace 'checking' with 'comparing'.

Page 10, line 13: Replace 'RH measurement' with 'the RH measurement'.

Page 10, line 33: 'few %RH degrees' sounds confusing. Is the 'degrees' necessary?

Page 11, line 4: Replace 'quantitated' with 'quantified'.

Page 12, line 9: Replace 'as per' with 'as for'.

Page 12, line 13: Replace 'the purpose of utilization' with 'use'.

Page 13, line 4: Replace 'generally corresponded' with 'generally agree well'.

-We have revised the text as suggested.

For Page 9, line 20, we have revised as 'The daytime standard deviation in spring at pressures ≤ 30 hPa is much larger than the standard deviation in other seasons'. Also, we have deleted the term 'degrees' for Page 10, line 33.

Thank you very much again for your valuable comments and suggestions.

Reference

Dirksen, R. J., Sommer, M., Immler, F. J., Hurst, D. F., Kivi, R., and Vömel, H.: Reference quality upper-air measurements: GRUAN data processing for the Vaisala RS92 radiosonde, Atmos. Meas. Tech., 7, 4463-4490, 2014.