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Discussions

Interactive comment on "Reference quality upper-air measurements: GRUAN data processing for the Vaisala RS92 radiosonde" *by* R. J. Dirksen et al.

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GENERAL COMMENTS

The goals of the GCOS (Global Climate Observing System) Reference Upper Air Network (GRUAN) are to (i) provide long-term high quality climate records; (ii) constrain and calibrate data from more spatially-comprehensive global observing systems (including satellites and current radiosonde networks); and (iii) fully characterize the properties of the atmospheric column. GRUAN achieves these goals by generating reference quality measurements of upper air essential climate variables. The uniformity and

coherence of standard operating procedures at GRUAN sites and the resultant homogeneity of GRUAN climate data records not only provides a global reference standard for operational upper-air network sites, but improves the detection of changes in the climate of the troposphere and stratosphere. Reference measurements are characterised by being traceable to internationally accepted standards, having had all sources of systematic biases identified and removed, and having well characterized measurement uncertainties. It is essential that the procedures used to generate GRUAN data products are documented in the international peer reviewed literature and are subjected to the scrutiny of the international measurement community. The RS92 radiosonde data products of temperature, pressure, humidity and wind are the first official GRUAN data products and this paper is the seminal document fully describing the processing of the measurements into GRUAN data products. As is appropriate, a significant portion of the paper is dedicated to describing the calculation of the corrections applied to account for systematic biases and the calculation of the measurement uncertainties.

Below we provide some suggested minor corrections and points of clarification which we hope will improve the quality of the paper.

SPECIFIC COMMENTS

1) It would be useful to readers if you could include in the abstract and/or summary the number of GRUAN sites that use Vaisala RS92 radiosondes, and to also mention other radiosondes that are used at GRUAN sites.

2) Page 3732, line 23: The heating of the humidity sensor is switched off below -60°C or above 100hPa. The reason for this could be explained more clearly.

3) A list of collected metadata, or a pointer to a paper/web page where a complete list can be found, would be useful.

4) Page 3737, line 19: If there is a reference to the correlation model it would be good if it was mentioned here.

5) Page 3738, line 24: Refer the modelling of the actinic flux to next section, or mention that this will be explained below.

6) Page 3740, line 7 and line 13: Table 1 shows the elevation angles 90, 72 and 30 degrees for simulations with the Streamer model. The dates are 21st of June for 90 and 72 degrees and 13th of November for 30 degrees. Figure 4 shows vertical profiles of the simulated total actinic flux on the sensor for 21 June for 30, 72 and 90 deg. This might be a little bit confusing and should be mentioned somewhere in the text.

7) Page 3740, line 17: Is the surface albedo of 0.27 used everywhere in the simulations?

8) Page 3749, line 18: This dry bias of 50% at 15 km is very surprising. Does this mean that the humidity sensor never measures humidity above 50%?

9) Page 3750, line 18: It is not clear how the humidity sensor affects the vertical resolution of the radiosonde. It may affect the vertical resolution of the humidity profile but not the vertical resolution of the radiosonde.

10) Page 3752, line 12: The performance of this time-lag correction for the humidity sensor is impressively good.

11) Page 3753, line 3. This division of $\Delta U1$ and $\Delta U2$ by 3 is sufficiently important to warrant just one sentence rather than referring the reader directly to the GUM.

12) Page 3756, line 12: It is stated in line 12 that the night time differences between GRUAN and Vaisala humidity increase from 0% at the surface to approximately 5% at 10km. However, in line 18 it is said that the night time difference is 7%, which is inconsistent with what is said in line 12.

13) Page 3764, line 9: It would be helpful to the reader to understand how the statistical uncertainties δu and δv are obtained and therefore we would recommend referring to the Appendix or to previous sections where the smoothing procedure is explained.

14) Section 9: It would be useful if the authors could say something about how the wind speed and directions are derived.

15) Page 3765 line 4-8: We suggest that the order of the sentences starting with Earlier. . . and A novel aspect. . ., respectively, are switched.

16) Page 3765, line 9: It would be good for understanding when reading the summary to know who performed the laboratory experiments.

17) Page 3766, line 7: It would be helpful if the authors could, again, mention that CFH refers to a frost point hydrometer.

18) Following the results presented in this paper, the authors suggest several improvements that can be made to reference radio soundings which should be followed to reduce the uncertainties on the measurements, to ensure the high quality of the data and reduce systematic effects of instrumental origin. It would have been helpful if the authors would have mentioned that GC25 refers to a calibration unit.

19) The paper finishes with planned future improvements to the GRUAN processing, namely to use the readings during additional ground check in the SHC (standard humidity chamber) to correct the humidity profile and to update the radiation temperature error correction. From the summary it is not clear what the first statement refers to and what it actually means 'to use the readings'.

GRAMMAR AND TYPOGRAPHICAL CORRECTIONS

1) Page 3733, line 4: Change the abbreviation cm to centimetre in the text.

2) Page 3733, line 10: - missing word: Currently, the SHC is in use at several GRUAN stations, and analysis of the SHC measurements showed that at one station the reconditioning of the RS92 was systematically skipped, which lead to a 1–5% RH dry bias.

3) Page 3749, line 7: Replace 'This dry bias and predominantly' with 'This dry bias

predominantly'.

4) Page 3749, line 15: Replace 'dry bias, because' with 'dry bias because'.

5) Page 3755, line 14: Replace 'work opposite' to 'oppose each other'.