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Atmospheric Measurement Techniques Discussions

# *Interactive comment on* "Consistency between GRUAN sondes, LBLRTM and IASI" *by* Xavier Calbet et al.

**Anonymous Referee #1**

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GENERAL COMMENTS

This is a concise paper that takes advantage of the high quality, and resolved measurement uncertainties, provided by the GCOS Reference Upper-Air Network (GRUAN) to demonstrate that top of the atmosphere radiances calculated using the LBLTRM radiative transfer model using GRUAN temperature and water vapour profiles as input, are consistent with top of the atmosphere outgoing infra-red radiances measured by IASI. The paper also provides some evidence that the water vapour values measured by GRUAN are dry by about 2.5%. The paper will be of interest to the readers of AMT and will be suitable for publication in AMT after the issues highlighted below have been addressed. The required changes are relatively minor.

SPECIFIC COMMENTS



Page 1, line 4: I thought that LBLRTM was a radiative transfer model so I don't see how it can constitute a reference measurement?

Page 1, line 7: This statement is a little misleading, and could even be confusing for readers, given that LBLRTM and IASI do not measure relative humidity in the upper troposphere.

Page 1, line 19-20: This sentence makes no sense. Do you mean that it is mandatory (and for whom?) to ensure that satellite radiance measurements are consistent with profile measurements of ECVs in the nadir air column below the satellite? If that's what you mean then perhaps that's what you should say.

Page 2, line 2: Performed independently of what?

Page 2, line 3: What, exactly, is assimilated into short and medium range weather forecasting models? It is not at all clear from what you have written.

Page 2, line 7: Do you mean the top of the atmosphere radiance measurements or do you mean retrieved temperature or water vapour profiles?

Page 2, line 13: What is the difference between reproducible and comparable in this context?

Page 2, line 22: Which measurement process? Do you mean the radiosonde measurement process?

Page 3, line 6: Should this be laboratory measurements of gas absorption *spectra*?

Page 3, line 9: I think that you will need to be more specific what you mean by 'keeping the chain of traceability unbroken'.

Page 3, line 12: A retrieval and data assimilation are two completely different things and it is incorrect to present them as somehow being equivalent. A retrieval typically uses optimal estimation to infer atmospheric state variables and/or trace gas concentrations from spectral measurements while data assimilation uses those measurements

to nudge a model to a state closer to the true atmosphere as it runs, typically using variational data assimilation or ensemble Kalman filter approaches.

Page 3, line 19: Do you rather mean an ill-constrained problem?

Page 3, line 21: I don't think that it is so much more convenient to perform the comparisons in radiance space but rather a most robust process performing the comparisons in radiance space.

Page 4, line 3: I assume that you describe somewhere how you have quantified the collocation uncertainty to obtain a value for sigma?

Page 4, line 12: Do you think that a sentence is required to describe the units for spectral measurements as brightness temperatures for readers who may be more used to measurements in W/mˆ-2 sr cmˆ-1?

Page 4, line 13: You say 'with a relatively high vertical resolution and high degree of accuracy' but just on the previous page you say 'very different atmospheric profiles can lead to the same radiances measured at the top of the atmosphere'. These two sentences appear to communicate very different messages.

Page 4, line 27: In what sense are the calculated spectra 'accurate'? Surely they're just what they are given the input temperature, water vapour and ozone (?) profiles?

Page 5, line 11: This is not the primary goal for GRUAN as stated in the GRUAN literature. As detailed in GCOS-112, the purpose of GRUAN is 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.

Page 6, line 10: Noting that you are using data at 1 km resolution for your cloud screening, it makes me wonder if and how you have accounted for the fact that the radiosonde drifts quite far from its launch location during its flight.



Table 2: There are many columns in Table 2 that are unnecessary since they all contain the same entry. Please delete them and include this constant information in the Table caption (if necessary).

Page 6, line 18: The usability for what purpose?

Page 6, line 22: The phrase 'when they are below 100 hPa' is ambiguous. Do you mean at pressures below 100 hPa or at altitudes below 100 hPa?

Page 6, line 24: Are the balloons thicker or larger? I always thought that the thickness was the same and the size changes, but I may be wrong.

Page 6, line 30: How are any discontinuities between the temperature and water vapour profiles obtained from GRUAN and those obtained from the ECMWF reanalyses dealt with?

Page 7, line 2: I am not sure what you mean by 'takes as practical the Hyland and Wexler (1983) curve'.

Page 7, line 5: Too noisy in what regard?

Page 7, line 6: If IASI measured radiances or retrievals are not sensitive to particular small scales in the vertical, then it should not be necessary to smooth the GRUAN profiles. How different would the results of this study be if the profiles are not smoothed? If it makes no difference, then it would be better not to smooth the profiles since it would be essentially unnecessary. If to does make a difference, it would be very interesting to know how and why?

Figure 2: I don't understand the large leftward excursion of the green trace in this figure. Is this the temperature trace or the dew point temperature trace? Did the ECMWF reanalyses assimilate the Manus Island radiosonde data?

Page 8, line 2: How many times is several times? I would have thought that for Monte Carlo it would have to be several hundred times?

Page 8, line 9: Do you mean 'perturbed by plus one GRUAN standard deviation'? This is not very clearly worded and may confuse some readers.

Page 8, line 27: Rather than just saying that the match is 'quite remarkable' can you provide a quantitative metric (maybe the k value) the describes how good the match is.

page 8, line 32: Can a value for sigma in equation 1 be provided?

Figure 6: Just to confirm, the dotted line in Figure 6 is the k=2 line correct? I think that this should be stated clearly somewhere.

Page 10, line 5: But isn't it possible that the GRUAN humidity measurements are affected by the sonde passing through clouds and that would not be picked up in your analysis?

GRAMMAR AND TYPOGRAPHICAL ERRORS

I understand that the author's first language is not English. There are a number of grammatical errors in the paper, only a few of which I have documented below, that will need to be fixed and I would encourage the authors to find someone to very carefully proof read this paper and correct these errors - they do tend to detract from the excellent quality of the science. I am very surprised that the co-authors, whose first language is English, consented to this paper being submitted in this state.

Page 1, line 9: Replace 'ECV' with 'ECVs'.

Page 1, line 14: Replace 'are shown' with 'is shown'.

Page 2, line 15: Replace 'are assured' with 'is assured'.

Page 2, line 28: Replace 'the accurate' with 'an accurate'.

Page 3, line 6: Replace 'perform its calculations' with 'perform their calculations'.

Page 4, line 19: The CNES acronym needs to be expanded.

Page 6, line 6: Replace 'leaving 76 clear cases' with 'leaving 76 clear sky cases' and



likewise a few lines later.

Page 7, line 13: Either 'These spectra' or 'This spectrum'. Likewise elsewhere. Spectrum is the singular and spectra is the plural.

Page 10, line 22: Replace 'will kill the consistency results' with 'will adversely affect the consistency results'.

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