Radiative closure tests of collocated hyperspectral microwave and infrared radiometers, by Lei Liu et al.

This is an interesting work which describes a radiative closure experiment in clear sky conditions performed by using collocated measurements collected with the HiSRAMS radiometers and the AERI Fourier transform spectroradiometer. Measurements were performed during three field campaigns: in 2021 and 2022 from ground, while in 2023 both from airborne and from ground. HiSRAMS is composed of two FTS radiometers operating in the oxygen band between 49 – 58 GHz and the water vapor band between 176 – 183 GHz; AERI is a well known Fourier spectroradiometer operating in the far and mid infrared portion of the Earth's emission spectrum, between 500 and 1800 cm^{-1}. The observations took place in zenith-pointing view with AERI from ground, and both in zenith- and nadir-pointing view with HiSRAMS. Simultaneous collocated radiosoundings were launched during the three campaigns to measure the vertical profiles of temperature and water vapor. Simulations were performed by the authors to mimic the measurements of HiSMRAMS radiometers by using a validate code (Bliankinshtein et al. 2019) that uses the Rosenkranz gas absorption parameterization, and the well known code LBLRTM (Claugh et al. 2005) to mimic the AERI measurements. To estimate possible biases, the differences between the measurements and simulations were calculated with the associate standard deviations by propagating, respectively, the spectral measurements uncertainties and the errors on the radiosondes, accounting also for the spatial inhomogeneity. The closure is well reached in the spectral bands below 800 cm^{-1} and above 1200 cm^{-1} simulating the AERI observations and in the weak absorption bands of Oxygen (50-54 GHz) and Water Vapor (176-181 GHz), even though for water vapor the differences remains inside the 3-σ error. The bias with AERI comparison is attributed to the presence of very optically thin cirrus clouds or aerosols, the latter is attributed to the calibration procedure in zenith-pointing observations.

The paper is well structured and written, even though I suggest few corrections to enhance the clarity:

1) Lines 92-94. I would change the sentences in : "The small fluctuations in the temperature and water vapor profiles have a negligible effect in AERI and HiSRAMS detected radiances".

2) Lines 95-99. I would improve the discussion about the temperature inversions shown in the inset of Fig. 2a, if the authors want to mentioned it, it is fine but I think the description should be more accurate. For instance, from FC2021 (blu profiles) to me seems there are more than two temperature inversion, at least one at around 2.5 km (T starts to increase again) stronger than the one at 1.2 km. Also, for FC2022 I can see at least two inversions, one at 0.5 km as pointed out, but also one at 2.5 km, similar to 2021, etc.. Maybe, if you could increase the grid vertical resolution on the y axes in both figures 2a and 2b would be helpful.

3) Line 119, "against" → "pointing"

4) I think it would be clearer indicating the actual radiance unit in all figures for AERI, I assume they are mW/(m2 sr cm-1), but it would be clearer if it would specified, in particular for me it is more helpful when I have to quantify the biases.

5) Section 2.2.1. Just a curiosity, I was wandering why you did not used the latest version 12.15 of LBLRTM, with the updated continuum 4.1 version?

6) Line 103, please write the coordinates in the standard form such as: [45.32° N, 75.66° W]

7) Line 112, “..200 level are inputs..” → “..200 levels are provided in inputs..”

8) Line 220, “errors” → “those” , “..inputs..”, → “.. input profiles..”

9) Equations (1) and (2), I think it would be clearer if you could replace the x parameter with R_v to indicate the vector of the radiances or brightness temperatures. Also, please shift the x → R_v = Radiance of BT to the right side. Since the uncertainty of the measurements play a key role in the study and discussion of a radiative closure experiment, I suggest to explain in detail the components of the errors, for instance, from lines 220-222 I assume that the standard deviation on the model is obtained by summing in quadrature the 1-σ error on the radiosondes profiles due to the instrumental error and that one due to spatial variability, is it so? In this is the case it would be really helpfull to follow if the authors could write the formulas for the errors propagation used.

10) I suggest to indicate the average biases arising for both instruments.

11) Figure 9, I suggest to exchange figure 9c with 9b and viceversa to be coherent with the next figure 8. Also it would be really helpfull to indicate O_2 and WV band at the top of the two columns and zenit and nadir views horizontally.

12) Line 301, do not indicate Fig. 10a because I think is misleading here.

13) Line 313, “, the measurements uncertainty ..” → “, both the contribution of the simulation and measurement uncertainty is not negligible..”

14) In Figure 12, please add the correlation coefficients.

References:

Bliankinshtein, N., Gabriel, P., Huang, Y., Wolde, M., Olvhammar, S., Emrich, A., Kores, M., and Midthassel, R.: Airborne Measurements of Polarized Hyperspectral Microwave Radiances to Increase the Accuracy of Temperature and Water Vapor Retrievals: an Information Content Analysis, AGU Fall Meeting Abstracts, A13K-2959, 2019

Clough, S. A., Shephard, M. W., Mlawer, E. J., Delamere, J. S., Iacono, M. J., Cady-Pereira, K., Boukabara, S., and Brown, P. D.: Atmospheric radiative transfer modeling: a summary of the AER codes, Journal of Quantitative Spectroscopy and Radiative Transfer, 91, 233-244, 10.1016/j.jqsrt.2004.05.058, 2005.