

Interactive comment on “A Fourier transform spectroradiometer for ground-based remote sensing of the atmospheric downwelling long-wave radiance” by Giovanni Bianchini et al.

Anonymous Referee #1

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Comments to the authors: I believe that this paper was written to serve as the “instrument paper” for the REFIR-PAD; i.e., the source of all of the technical details needed to understand the instrument, the corrections that are applied to account for instrument artifacts, how it is calibrated, and the uncertainties in its radiance observations. Furthermore, it also provides some examples of level-2 products that can be derived from these observations.

From this perspective, I was expecting a paper to have a lot of details associated with the instrument, especially in sections 2-5. I was also expecting the information to be presented in a similar manner to other interferometer instrument papers (e.g., the

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ARIES paper by Wilson et al in JTECH 1999, the AERI papers by Knuteson et al. in JTECH 2004); in other words, a careful presentation of all of the details so that I understand the instrument, how it is radiometrically and spectrally calibrated, its uncertainties, its operating characteristics, etc. This paper on the REFIR-PAD did provide some of the information, but there was still a lot missing. I will detail some of these areas below.

Generally speaking, more references are needed in this paper. Furthermore, the majority of the references (28 out of 34) were by the authors of this paper; are there no other papers written by outsiders that are relevant to this study?

Page1, Line 40: This is true only in clear sky horizontally homogeneous scenes. This approach will generally not work when there are clouds overhead

Page 3, line 10: “that result critical in the delicate process” is very awkward. Please rephrase

Page 3, line 75: Is the spectral calibration procedure similar to that in Knuteson et al. JTECH 2004? What is the spectral region used for this calibration?

Page 3, line 85: What are the details of this scene mirror? Is it gold plated? What polarization properties?

Page 3, line 85: What are the properties of these blackbodies? Emissivity spectra, operating temperatures, etc. How stable are they? What is the shape, arrangement of the thermistors, gradients, etc?

Page 5, line 68: How high? What is the IWV amount? What does a LBL radiative transfer model suggest the radiance should be for this condition? Is the small bias shown in the figure due to the small amount of atmospheric emission (which could be confirmed by a RT model), or is it a real instrument artifact?

Page 6, line 4 and elsewhere in that paragraph: Should be $\text{mW} / (\text{m}^2 \text{sr cm}^{-1})$.

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Page 6, line 58: What is this chain? Does it use the Revercomb technique to calibrate in complex radiance? How is non-unity emissivity of the BBs handled?

Page 7, line 4: what is “assimilable”? Perhaps you mean “similar” ?

Figure 8 and in the text: Is the imaginary component of the calibrated spectra zero with some noise? Would be good to see that, esp since fig 8 shows some unbalanced spectra with significant phase signals.

What is a typical noise spectrum for a standard radiance measurement?

Page 7, line 28: Are these instrumental parameters (line shape, spectral calibration) not stable with time ? If that is true, why is this so?

Page 7, line 32: How were these number of layers determined; e.g., why a 4pt temperature profile? Turner and Löhnert JAMC 2014 using mid-infrared portion of the spectrum suggest that there is ~ 6 pieces of information on temperature (and similar for water vapor when the IWV is small), so I would have assumed that the REFIR-PAD observations would have had at least this number of pieces, unless the noise level is much larger than the AERI used in the T/L paper (which is why the noise spectrum needs to be shown).

Page 7, line 33: “tipical” is misspelled.

Page 7, line 34: Is the entire spectral range of the REFIR-PAD observations used in the retrieval?

Fig 11: The spectral structure of the radiance observations in the $15 \mu\text{m}$ band suggest that there is an inversion in the purple spectrum, and that the lapse rate is markedly different for the dark green vs. light green profiles. But these characteristics don't show up in these retrieved profiles shown in Fig 11 (or at least are not obvious to my eye). Is this due to the low number of vertical layers?

Page 8, line 6: How were these accuracies determined? Are they just the uncertainties

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from the propagation through the retrieval, or comparison against other obs?

If you are going to talk about the retrievals in this paper, then more information needs to be provided so that the reader does not have to search through all of the references to get this information. Please include a discussion on the basic retrieval framework, what assumptions are made, the forward model used, any prior data used to constrain the solution, etc.

Page 8, line 29: I don't think that an interferometer like REFIR-PAD can be considered a "relatively simple tool". Even compared with other spectroradiometers this instrument is pretty advanced. Now, perhaps its operating characteristics make it easy to deploy and it can run autonomously, and that is what the authors are referring to here. If so, then there is little information in this paper about the long-term calibration stability and responsivity of the instrument, other than the oblique reference that some instrument parameters need to be retrieved (see above) . . .

Page 8, line 34: this instrument cannot "resolve all relevant atmospheric processes". For example, 10-minute resolution is not able to resolve the rapid changes in cloud optical properties as they advect over the sky port of this instrument.

Page 8, line 43: The O_3 , CH_4 , and N_2O retrievals were demonstrated here, and references to papers that show this are few / none.

Page 8, line 47: As indicated above, you haven't spoken about the long-term operations at all, and certainly not the ability to remotely control the instrument (this is the first mention of it). What are the "relevant settings" ?

Page 8, line 55: "aknowledge" is misspelled.

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