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Atmospheric Chemistry and Physics Discussions

Interactive comment on "First spectral measurement of the Earth's upwelling emission using an uncooled wideband Fourier transform spectrometer" *by* L. Palchetti et al.

Anonymous Referee #2

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General:

The authors present first balloon-borne observations with the REFIR instrument that is capable of measuring the Earth's emitted radiation to space in the broad spectral range of 100 to 1400 cm-1 at a spectral resolution of 0.5 cm-1. The instrument is innovative in two aspects, first it covers the important Far IR spectral region for which no Nadir measurements have been available so far from balloon or space platforms, second it is minimized in terms of volume and weight and does not need cooling, neither of the optics nor of the detectors. These characteristics are major advantages towards an operation of this instrument type in space. The spectral region covers a large fraction

of the Earth's upwelling thermal radiation. High-quality measurements in this spectral range would make major contributions to Earth radiation balance and composition-climate coupling issues. While the authors have demonstrated the potential scientific progress based on their observations from the FIR to the MIR with the first balloon-borne operation of REFIR, they have failed in proving the scientific value of this data. Hence, a substantial and original contribution to scientific progress within the scope of Atmospheric Chemistry and Physics is not obvious. Instead, I recommend to publish the manuscript as Technical Note as it presents significant advances and novel aspects of techniques and methods relevant for scientific investigations within the journal scope. Also, the length of the manuscripts fits much better into this category. The paper is presented generally in a clear and well structured way.

Major comments:

- Instrument performance and data quality: Very little is said about the instrument characterization and calibration. Major issues pertinent to balloon-borne Fourier transform spectrometers like potential detector non-linearity, instrumental line shape, radiometric accuracy, phase correction, line-of-sight stability etc. are not or hardly discussed. Major steps of the data processing from level-0 (raw data) to level-1 (radiometrically and spectrometrically calibrated spectra) are not described. The evaluation of the instrument performance (e.g. NESR) was based on measurements of the hot BB (working at ˜ 350 K) whereas typical atmospheric brightness temperatures for Nadir measurements are between 200 K and 290 K , i.e. far from the input of the hot BB. This approach needs to be justified. Figure 3 is not sufficient in quality to allow the reader evaluating the claimed radiometric accuracy.

- Comparisons with IASI-balloon data: Having in mind the differences in spectral resolution and IFOV between both instruments we would like to see a more detailed description how the measurements have been selected/treated to make them comparable. Was the IFOV of the two instruments aligned? How did the authors ensure that a constant scene was observed while the balloon was moving by several kilometers

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during the acquisition time of 10 interferograms (clouds, vegetation, topography)?

- Comparisons to atmospheric radiative transfer calculations: This comparison is very qualitative and unsatisfactory in the sense that obviously there was no attempt to use the best available atmospheric data. E.g., using the old FASCOD climatological data set for species like N2O and CH4 means that invalid (not trend-corrected) data were used. Various radiosonde data from different stations for temperature or ECMWF temperature fields should have been used to assess the gradients in temperature and to allow sensitivity calculations to figure out how this uncertainty did affect quantitatively the comparisons. The authors mention that the water vapour profile was fitted with a non-linear least square fit, but they do not specify what data they have used for that (REFIR or IASI-balloon) and how reliable these H2O retrievals have been.

- On p. 4065 it is stated that the instrument has achieved the 'required' noise performance, but nowhere the rationale behind this requirement is explained. The reader is left alone to assess whether the achieved NESR and radiometric accuracy of +/- 1K are sufficient to meet the scientific objectives.

Minor comments:

- Table 2 should be skipped since it does not give any additional information to the text

- Fig.2: Use a concise Y scale (decade by decade)

- Fig.3: The figure does not allow the reader to comprehend the statements in the text. I suggest to include lines with denote the NESR and expand the y scale for selected spectral regions. The non-flat baseline in the deep space spectrum needs to be explained.

- p. 4064, line 12: raw instead of row

- References: please order citations alphabetically

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