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Comment

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

L. Palchetti et al.

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Reply to specific comments:

1. We did not give many details on the detector subsystem since it has already been described in Palchetti et al., 2005. However, more information about the uncooled pyroelectric detectors is added in the revised text.

This Referee comment addresses some issues which deserve the following clarifications.

All detectors need some type of chopping, however, in the case of fast scanning FTS instruments this function is provided by the interferometric modulation.

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Concerning the weight and size, the use of uncooled pyroelectrics is also an advantage for a satellite instrument. The current space IR spectrometers operate in the spectral range covered with MCT detectors, which typically do not measure above 15 μm and with difficulty can reach wavelengths above 20 μm . MCT detectors are usually cooled down to liquid nitrogen temperature and for space applications an active cooler is required. Referring to the AIRS experiment, the spectrometer is passively cooled to 155 K and operates in the range of 3.7–15.4 μm with the MCT assembly cooled to 58 K. Furthermore, above 20 μm there is no detector working with moderate cooling. Bolometers and liquid helium temperature are usually required to detect far IR radiation. This kind of detectors is a complication in the case of aircraft or balloon-based measurements and its use is quite impossible on-board of a long lifetime space mission. Cooling requirements are, therefore, an important issue also for observations from space.

Pyroelectrics are currently the only feasible alternative to avoid cooling. The lower performances of these detectors can be regained by optimising the optical design as it was done with REFIR-PAD. The spectrometer of REFIR-PAD does not require either cooling or temperature stabilisation since the double input / double output configuration allows to control all the input sources. Only the detector unit must be stabilised, but the temperature involved is in the range of 25–30 °C and the implementation of the control system is very easy. For comparison it can be noted that AIRS is a 256 W / 166 kg cooled instrument and REFIR-PAD is a 50 W / 55 kg uncooled instrument.

2. The instrument performances described in Sect. 3.1 refers to the first version of the prototype and the first measurement balloon campaign. We identified some components that can be optimised in future flights. Mainly they are the substrate type and planarity of beam splitters, and the coupling of detectors with Winston cones. Furthermore during the flight the instrument underwent a 10 °C variation of temperature which caused an interferometric misalignment and a loss of efficiency at high frequency. As a consequence the calibration function varied among measurements and no averaging

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could be used in the data analysis. We expect that solving temperature dependence alignment will increase further the instrument radiometric performance.

This information has been added in the revised text.

3. The statement at p.4067, line 11 is a general consideration to inform the reader that REFIR-PAD and IASI-balloon do not always measure the same signal. The different fields of view do not imply a different radiative transfer in the atmosphere (the atmosphere can be assumed to be horizontally uniform and the slant angle is always small enough to be neglected). However different cloud coverage and different surface footprints are observed by the two instruments. Only in a few occasions it was possible to find homogeneous view conditions. Some detail has been added also considering the related following point 4.

4. The condition of a homogeneous scene was found just at the end of the flight when clear sky and uniform land coverage occurred during the measurements. In the earlier part of the flight, the comparison is still good in the CO₂ region (where the same atmosphere is observed) but in the atmospheric window the emitted radiance depends on the surface characteristics and on the scattered low-altitude clouds, and differences are observed between the measurements of the two instruments. The larger difference that appears in the 1300-1400 cm⁻¹ range is a random effect and it is mainly due to the reduced performances of REFIR-PAD. Indeed, above 1250 cm⁻¹ the beam splitter efficiency reduction, caused by both absorption bands of the Mylar substrate and the planarity error, reduced the instrument performances with an increment of the NESR.

Some further detail, which can help the reader, has been added in the revised version.

5. The paper is focused on the announcement that OLR spectral measurements were acquired and Figure 6 shows just the consistency of these measurements with modelling. This comparison shows a general agreement and the residual discrepancies are the indication that either the modelling or the atmospheric parameters (temperature and water vapour profiles coming from sondes) are not sufficiently accurate to describe

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the measurements. The assessment of the relative relevance of modelling and atmospheric features can not be performed by testing different temperature profiles, indeed it will require a comprehensive work with a retrieval analysis of temperature and water vapour profiles, which is beyond the aim of this paper.

Interactive comment on Atmos. Chem. Phys. Discuss., 6, 4061, 2006.

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