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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.

L. Palchetti et al.

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Reply to general:.
- The paper provides a substantial and significant contribution to scientific progress by reporting the first wideband spectral measurement of the upwelling Earth radiation with an uncooled FTS covering the important far IR spectral region. High quality measurements in this spectral range would make major contribution to Earth radiation balance and composition-climate coupling issues, as stated by the Referee and discussed in several of the papers referred in the paper Introduction. It is true that the scientific exploitation of these measurements is not performed in this paper which has instead the objective of quickly reporting an important new measurement which can change our observation strategies. We believe that this objective is well beyond those

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of a technical note.

Reply to major comments:
- The instrument characterisation in the laboratory is extensively performed in the referred paper by L.Palchetti et al., 2005. An in-flight characterisation of the instrument is probably recommended by the Referee and would be in line with a technical note on the measurements. However, as stated above, the objective of the paper is to report a new measurement and only the main technical features that are important for the characterisation of the novelty of the measurement are discussed. As far as the comparison of Fig. 2 between the NESR measured in laboratory and in-flight is concerned, the objective is to verify that in the operational observations at nadir the required radiometric performances are met. To this purpose the spectral variance of the nadir measurements (with all the possible instabilities of real measurements) is compared with the variance of the measurements made in stable laboratory conditions (under vacuum in a controlled environment). It is true that the source temperature is different in the two measurement sets, but in the case of detectors operating at about 300 K the different photon noise is not a cause of concern. A sentence about this detector property has been added in the revised text.

As far as Figure 3 is concerned, some further statements have been added in the revised text in order to clarify how this figure contributes to the evaluation of the radiometric accuracy.

- The measurements for comparison with IASI-balloon were selected near the end of flight when uniform scene conditions were found, see also reply to Referee #1, point 4. The IASI data were degraded to the resolution of REFIR-PAD. This latter information has been added in the revised text. As described in the text (Sect. 3.2), the IFOVs of the two instrument were co-aligned with each other and with an IR camera before the flight. The IR images have allowed the selection of measurements in which

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the two co-aligned FOVs observe an uniform scene which ensures equal averages. The horizontal speed of the balloon is quite slow, about 5 m/s. Also considering the integration time required for 10 spectra of a complete nadir sequence, the horizontal displacement is of the order of 1.5 km, small enough to allow to see a constant surface properties, as occurred when we did the comparison. This information has been added in the revised text.

- The comparison with the ARTS radiative transfer simulation is just a verification of consistency. As already mentioned in the reply to Referee #1, point 5, this comparison shows a general agreement and the discrepancies still present 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 the measurements. The assessment of the relative relevance of modelling and atmospheric features will require a comprehensive work with a retrieval analysis of temperature and water vapour profiles, which is beyond the aim of this paper.

The relevant updates to the forward model have been made with the trend-corrected CO_2 concentration; N_2O and CH_4 have a small effect in nadir measurements and a trend correction was found not to be significant.

The water vapour was fitted using the REFIR-PAD data because sounding measurements were found to have a too large error. This information has been added in the revised text.

- The NESR and radiometric requirements come from the scientific objectives stated in the REFIR feasibility study of the space mission. The scientific objectives require the measurement of vertical profiles of temperature and H_2O with 2 km resolution and with 20 % and 1-2 K accuracy, respectively. Sensitivity tests of retrieval performances have allowed to identify the requirement of SNR$>$100 and a radiometric accuracy of 0.5 K, see Ref. Rizzi et al., 2002a and 2002b. This information has been

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added in the revised text.

Concerning the absolute calibration accuracy, the values measured during the flight has a peak-to-peak oscillation of ± 1 K (see Fig.4) around 0 K. The mean value is not too far from the requirement of 0.1 K identified by Goody et al. (Ref. Goody, R., J. Anderson, and G. North, "Testing Climate Models: An Approach", Bull. Amer. Meteor. Soc., 79, 2541-2549, 1998) for the identification of climatological fingerprints. A sentence about this requirement has been added in the revised text.

Reply to minor comments.
The following Referee suggestions are all included in the revised text.

- Table 2 was removed from the revised version.

- Fig. 2 was updated with a more appropriate Y scale.

- The text describing Fig. 3 has been clarified. An explanation has been added on how the calibration of deep space measurement can be used to assess the calibration accuracy.

- p.4064, line 12: the word "row" was corrected with "raw".

- The reference Lubrano et al., 2000 has been moved in the right alphabetical order.

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