Earth Syst. Sci. Data Discuss., referee comment RC3
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Comment on essd-2020-377

Anonymous Referee #3

Referee comment on "Observations of the downwelling far-infrared atmospheric emission at the Zugspitze observatory" by Luca Palchetti et al., Earth Syst. Sci. Data Discuss., https://doi.org/10.5194/essd-2020-377-RC3, 2021

This paper describes a dataset of infrared downwelling radiation measured with two FTS at the Zugspitze Observatory in Winter 2018 / 2019 together with further measurements of atmospheric parameters. It is a valuable dataset, covering a large spectral range from 100 to 1800 cm-1. Instruments and field campaign are in general well described, and the new FIRMOS instrument is successfully validated against the established E-AERI instrument.

With the focus on the calibrated spectra of infrared downwelling radiation, there are, however, some issues that should be clarified and discussed in more detail (see below).

I had some trobules when trying to work with the dataset. It is very cumbersome to download the complete dataset via the web page that was given for the review process; I am not sure if this is better via the ESA website. But I would stronlgy recommend to re-structure the data or enable an FTP access such that one does not have to click on each and every file for download (maybe there is a better way to get the data, but I did not find it).

Specific comments:

Line 76: The authors give a spectral resolution of 0.3 cm-1 for FIRMOS and 0.5 cm-1 for E-AERI. No information is given on apodization and the definition of resolution. Is it defined as the FWHM of a delta line or something else? In the readme.aeri file it is said that the OPDmax is about 1.04 cm, and the instrumental line shape is an ideal sinc. I have not found the corresponding information for FIRMOS. Please indicate the maximum optical path difference and the applied apodization (if any) for both instruments in the text and comment on how the spectral resolution is defined.

Line 145: I am puzzled about the strong spectral structure in the calculated NESR. From all I know about FTS, I would expect a rather smooth curve, governed by the shape of the broadband instrument gain function. I am not fully convinced that the calculated NESR is in good agreement with the standard deviation of subsequent sky measurements. I tried to reproduce the comparison by taking 8 subsequent clear sky spectra, calculating the standard deviation and calculating the mean of the NESR given in the data. When comparing this NESR to the standard deviation, I find that the stadard deviation is generally smaller (as it can also be seen in Fig. 6 above 700 cm-1) and that the sharp lines below 350 cm-1 are way smaller in the standard deviation than in the NESR (which cannot be seen in Fig. 6, because the standard deviation is hidden behind the NESR in this range). Please explain in more detail why the NESR has these strong spectral features (way stronger than in the standard deviation) and tends to be larger than the standard deviation of subsequent measurements at high wavenumbers.

Line 154: It is stated that both instruments have a spectral calibration error of about 50 ppm. Since it is obviously possible to determine this error and to correct for it, why is this not done for the complete dataset but only for the comparison? A good spectral calibration would enhance the quality of the data.

Line 158: This is again in the context about resolution and apodization: Here it is said that the spectra are brought to the same spectral resolution of 0.5 cm-1 by applying a Norton-Beer strong apodization. If you apply a Norton-Beer strong apodization to an interferogram with an OPDmax of 1.04 cm (in the case of E-AERI), the resolution in the sense of the FWHM is clearly larger than 0.5 cm-1.

Line 160: The authors state that the FIRMOS and E-AERI measurements are in good agreement within the average CalErr estimate. In the dataset I found a note on an a-posteriori bias correction of the FIRMOS data, where the bias was determined from the difference between the FIRMOS and the E-AERI data. I think it is very important to make clear that the FIRMOS data has already been corrected using E-AERI data, because with this correction, the data is not independent anymore. Therefore this bias correction should be presented in the paper and it should be discussed how this bias shall be handled in future measurements when there is no E-AERI next to FIRMOS for comparison. Is this bias expected to be constant in time and under all conditions?

Line 163: Part of the difference between FIRMOS and E-AERI is explained by a non-compensated phase error in the FIRMOS data. Are there plans to compensate for this phase error in the future? If not, why not? If it will not be compensated, this error should be added to the estimated systematic error (CalErr).

Figure 2, lower panel: It would be interesting to see the residual in the overlapping range.

Figure 5: The center picture is not very informative without additional explanations. The right figure is very hard to read. I suggest to use different colors and/or symbols for the

different measurements together with a legend indicating the measurement dates.

Table 1: Add dates of measurements for DUFISS

Snow Data: I am missing a readme file with the relevant information (including a contact person), instead I found some notes of a progress meeting which are only little helpful for understanding the data. In the data I did not find the error bars shown in figure 5, and it is not clear to me how to use the calibs.csv and the mV_g.csv files. In the file SSA_rho.csv I found the data points shown in the figure, but for 18-1751 it says (nan,nan), while I find some values in the figure. Please provide some more information along with the data.

Technical corrections:

line 121: remove the point after "properties"

line 147: blackbodies -> blackbody

line 150: the procedure

line 157: within 10 minutes

Figure 6: acquired on (remove "at")

Table 1: add a comma between H2O and O3 in the line of dedicated RS