

Interactive comment on “Usability of optical spectrum analyzer in measuring atmospheric CO₂ and CH₄ column densities: substantiation with FTS and aircraft profiles in situ” by M. Kawasaki et al.

Anonymous Referee #1

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The topic of the paper is the comparison of a small spectrometer for the measurement of the column abundances of CO₂ and CH₄ with TCCON measurements as well as with aircraft in situ profiling.

A small spectrometer for the measurement of the column abundances of GHG is scientifically very interesting. However, it has to be demonstrated that the retrievals from such a spectrometer have sufficient precision and that no bias is introduced by an instrumental drift of the small instrument. Only if the precision and the drift are well

characterized such spectrometers should be employed. Otherwise they are not useful for satellite validation and source sink estimates derived from them will be distorted. In my opinion the following points have to be addressed before publication in AMT:

1) Overall remarks:

a) TCCON-comparison: Different retrieval codes are used for the TCCON-retrievals and the OSA-retrievals. Besides that the spectral regions for the retrievals are different. Both certainly introduce a bias. I would suggest using the same retrieval code (preferentially the TCCON code) to do the retrievals in the same spectral region. If the difference between the retrievals still exists, reasons should be discussed. In addition an investigation of the impact of the resolution on the retrievals is needed. This could be done with the existing TCCON-spectra, either during the retrieval or by cutting the interferograms.

b) Aircraft comparison: It is important to do a careful estimation of the error, which is introduced by assumptions on the profile above the aircraft ceiling. This has to be shown to introduce a significant error (e.g. Messerschmidt et al., Atmos. Chem. Phys., 11, 10765-10777, 2011)

3) Specific remarks

Title: I would re-think the use of “Substantiation” P1 line 18-20: “The first involved a long term measurement in parallel with a high resolution Fourier transform spectroscopy (FTS) studies at the University of Wollongong in Australia.” Sentence needs re-phrasing.

P2 line 1: “Carbon dioxide and methane have the highest and the second highest contributions of ~ 64 and $3 \sim 18$ %, respectively, to overall global radiative forcing from major greenhouse gases (WMO 2011).” Anthropogenic should be added, because of water.

P4 line 17-20: “The profiles of temperature, pressure and relative humidity against

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altitude are available from the database of National Centers for Environmental Prediction/National Center for Atmospheric Research (NCEP/NCAR) to calculate the column of H₂O.” Why is the water not retrieved from the spectra?

P5 line 1-2: “The averages between 10:00 - 14:00, while the solar intensity is stable, were plotted with the standard deviations.” Why limit only to these times? The intensities should be stable during the scan, but there is no reason that the intensities are comparable between the retrievals.

P6 line 19-21: “The column density of $(8.339 \pm 0.061) \times 10^{21}$ molecules/cm² measured by the OSA at UoW (34.406 S, 150.879 E: 30 m a.s.l.) in the same period is thus directly comparable with that at JAXA in Tsukuba: . . .” This is not true. The column density varies due to pressure and therefore only the XGas values should be compared.

Figures: The figure captions should always state, which scaling factor has been used.

Figure 3: Add error bars to OSA-data

Figure 6: Add error bars to the aircraft data

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