

Interactive comment on “XCO₂-measurements with a tabletop FTS using solar absorption spectroscopy” by M. Gisi et al.

Anonymous Referee #2

Received and published: 19 October 2012

General Comments

This is a nicely written paper that describes a new instrument for measuring the column average dry-air mole fraction, XCO₂. The instrument consists of the low-resolution Bruker EM27 Fourier transform spectrometer, integrated with a custom-built suntracker, and operated in solar absorption mode. Side-by-side measurements with a Bruker IFS125HR high-resolution spectrometer are made for a total of 26 days, and the data are processed and compared in four ways, using the PROFFIT and GFIT retrieval algorithms. These comparisons demonstrate that the EM27 spectra, when analyzed with PROFFIT, yield XCO₂ with a mean difference of $0.12\% \pm 0.08\%$ relative to the 125HR spectra analyzed with GFIT following TCCON protocols, which is within the TCCON

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accuracy of 0.25%. The authors thus demonstrate that this compact and portable instrument is suitable for monitoring total columns of CO₂. The paper is well organized and the authors provide clear descriptions of the instrumentation, its characteristics (ILS and GPR), the retrieval approach, and the results of the intercomparison. The results should of interest to the greenhouse gas measurement community, including TCCON. I recommend publication in AMT after the minor comments below are addressed.

Specific Comments

Page 5697, para 2: Explain how the solar beam reaches the suntracker camera when it appears to be behind the off-axis paraboloid mirror.

Page 5700, line 22: The caption of Fig. 4 refers to Norton-Beer apodization – explain here the difference between the two spectra (0.5 and 1.0 cm⁻¹) and why N-B apodization was applied? Or explain on page 5702, line 17, where Norton-Beer-Medium apodization is first mentioned in the text; why were the IFGs apodized?

Page 5700, line 28: Give models and accuracies of sensors used for temperature and pressure measurements.

Page 5701, Section 4.2 (and page 5703, line 2): This manuscript was submitted shortly before a short document “PROFFIT-GFIT Comparison Results” by Debra Wunch, Paul Wennberg, Geoff Toon, Susanne Dohe, Frank Hase, Michael Gisi, and Thomas Blumenstock (July 27, 2012) was circulated to the TCCON community. This document discussed and resolved the reasons for some discrepancies between retrievals obtained with PROFFIT and GFIT, attributing them to the code used to generate spectra from interferograms and to the correction for source intensity variation. In light of that, it might be useful to give more detail on the preprocessing used in this work.

Page 5701, line 17: Give references for the O₂ line list and a priori profiles.

Page 5702, line 1: Could provide a bit more detail about the spatial interpolation along

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the solar slant path. Why approximate?

Page 5703, line 2: What are the GGG IFG preprocessing routines? What preprocessing is applied?

Page 5705, line 26: Specify what the GFIT-specific post-corrections are, in addition to the airmass-dependent correction.

Page 5707, lines 7-8: Clarify what is meant by "grouped in single days" for the data in Fig. 10. Are these average differences on each day? It is not clear what is meant here.

Page 5707, line 1: Why were 3 EM27 spectra averaged rather than 6, which would give a duration (204 s) almost equal to that of the HR (212 s)? Also on page 5708, lines 18-19, the recording time is now given as 34 s per EM27 datapoint (10 scans), while that for the HR is still 212 s. What is meant by a datapoint (same meaning as datapoints in an interferogram on page 5709, line 4?) and a scan? How does this compare to 102 s for 3 spectra of 10 IFGs? Clarify.

Technical Corrections

Page 5692, lines 2, 7, 8, 26, etc.: Here and elsewhere, hyphens are unnecessary and also not applied consistently throughout the manuscript (Fourier-Transform-Spectrometer, FTIR-spectrometer, TCCON-results, CO2-total). I recommend deleting them throughout when connecting stand-alone nouns.

Page 5692, line 18: column-averaged (does need a hyphen here)

Page 5692, line 20: SCIAMACHY

Page 5692, line 20: Why give the website for OCO and not the other missions?

Page 5692, line 21-22: OCO-2 is scheduled for launch in 2014.

Page 5692, line 24: 23 TCCON sites are listed at <https://tcon-wiki.caltech.edu/Sites>

Page 5693, line 1: 0.25% (% used elsewhere)

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Page 5693, line 11: Despite its outstanding

Page 5693, line 13: change downsides to limitations?

Page 5693, lines 14, 27: on the order of

Page 5693, line 14: mass (kg) not weight?

Page 5694, line 2: the usage . . . was recently investigated to assess the ability

Page 5694, line 7: This sentence could be clarified ("instruments with lower requirements to the ambient temperatures"). Does this mean lower (more relaxed) requirements on the range of ambient temperatures in which the instrument can work, or on the temperature stability during a measurement?

Page 5694, line 23: long-term stability and present

Page 5694, line 25: precision of 0.08%

Page 5695, line 11: weighs

Page 5695, line 15: allows the tracker to be used for other kinds of observations

Page 5695, line 25: Fig. 3 is referenced before Fig. 2. Swap these two figures.

Page 5696, line 17: weighs

Page 5697, line 8: Does semi field-of-view mean half of the angle subtended by the FOV? Clarify. Also field-of-view is not hyphenated here, but is elsewhere (e.g., page 5698, line 7).

Page 5697, line 6: use degree symbols instead of "degrees" as elsewhere?

Page 5697, line 12: allowing corrections for

Page 5698, line 7: calculated easily using the spectrometer's field-of-view

Page 5698, line 24: Could note that these are (presumably) the modulation efficiencies

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at maximum optical path difference.

Page 5699, line 5699: Define IFG.

Page 5699, line 15: in the spectral

Page 5699, line 22-23: F. Hase is second author on the manuscript. Is it appropriate to cite him as personal communication?

Page 5700, line 7: its storage place

Page 5701, line 23: MERRA model data (could also define acronym)

Page 5702, lines 16, 19, 21, 25: change wavenumber to cm⁻¹

Page 5703, lines 12, 13 and caption of Fig. 5: The use of residuum instead of residual is unusual. The OED defines residual as resulting from subtraction of one quantity from another, while residuum/residua is related to a residue.

Page 5703, line 18: delete by

Page 5704, line 3: why exemplary? Just delete

Page 5704, line 7: Figures 6 and 7 show the O₂ and CO₂ columns

Page 5706, lines 2, 22: intra-day here, but intraday elsewhere

Page 5706, line 6: unsuspicious

Page 5706, line 21: define the error bars – are they 1-sigma on the means?

Page 5708, line 9: low-resolution

Page 5708, line 14: More accurate to say a running average was applied, rather than a smoothed curve being laid on the data.

Page 5708, line 16: calculated the scatter of the data

Page 5709, line 2: Signal-to-Noise Ratio (SNR)

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Page 5709, line 19: algorithms

Page 5709, line 22: delete high (applicability)

Page 5709, line 25: candidate for an instrument

Page 5710, References: Do IRWG/TCCON talks qualify as References for AMT?

Page 5715, Figure 3 caption: Images of the solar disk

Page 5715, Figure 4 caption: Not clear what is meant by “As for the evaluation of the low-resolution spectra, a Norton-Beer apodization function was applied.” See comments on related text too.

Page 5715, Figure 6: The upper panel shows SZA start, min, end as 14, 60, and 7 degrees. How is this possible in one day? The SZA values in the lower panel (71, 46, 79) make more sense.

Interactive comment on Atmos. Meas. Tech. Discuss., 5, 5691, 2012.