Atmos. Meas. Tech. Discuss., 5, C2656–C2660, 2012
www.atmos-meas-tech-discuss.net/5/C2656/2012/

Atmospheric Measurement Techniques Discussions

Interactive comment on "XCO_2-measurements with a tabletop FTS using solar absorption spectroscopy" *by* M. Gisi et al.

M. Gisi et al.

michael.gisi@kit.edu

Received and published: 24 October 2012

Dear Anonymous Referee #2

First we would like to thank you for the very useful comments and detailed corrections, which we found very constructive and helpful to improve our manuscript. We included nearly all of the suggested technical corrections.

In the following we list our changes in the manuscript according to the "Specific Comments".

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

lowing sentence in the caption of the figure containing the spectrometer's schematics: "The camera is not in the same plane as the mirror, instead it observes the field stop by a small angle from above."

Q: "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?" A: We added following sentences at the end of section 4.2: "The EM27 and HR_Reduced low resolution spectra were generated from the interferograms after applying the Norton-Beer-Medium function. In low-resolution spectra, omitting the numerical apodization would introduce significant sidelobes around all spectral lines. As these fade away slowly, modeling of these artifacts would complicate the calculation of the model spectra considerably. The Norton-Beer-Medium apodization is a good compromise between sufficiently effective suppression of sidelobes and degradation of spectral resolution."

Q: "Page 5700, line 28: Give models and accuracies of sensors used for temperature and pressure measurements." A: We added the following details: "The ground pressure sensor is a BM35–barometer from meteolabor with a stated accuracy of +-0.05\,hPa. The temperature is acquired from the PT100 sensor (Type 2015) from the company "Theodor Firedrichs & Co". It's accuracy is stated as 0.1°C + 0.005*T, with T in degrees Celsius."

Q: "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."

A: The reasons for the mentioned discrepancies became known before this work has been submitted, all GFIT-values were obtained by re-processing of the interferograms and the retrievel with corrected source intensity variations settings according to the study you mention.

Q: "Page 5701, line 17: Give references for the O2 line list and a priori profiles." A: We used the official TCCON retrieval procedures (incl. linelists, a-prioris,...) contained in the 2012 software release including the April update. We clarified this in the manuscript.

Q: "Page 5702, line 1: Could provide a bit more detail about the spatial interpolation along the solar slant path. Why approximate?" A: We changed the sentences describing the creation of the pressure and temperature profiles from the 8 daily availabe MERRA model datasets: "For each of these times, the solar position is calculated and the pressure and temperature values along the unrefracted path of the solar radiation are retrieved from the model data. These profiles are then used as an input for the PROFFIT retrieval. The profile which is used for the evaluation of a spectrum recorded at a specific time is calculated by PROFFIT by applying a linear interpolation between two temporally adjacent profiles. "

Q: "Page 5703, line 2: What are the GGG IFG preprocessing routines? What preprocessing is applied?" A: We added some further information on the relevant preprocessing steps ("correction of solar intensity variations and determination of the phase spectrum used for the FFT") in the text.

Q: "Page 5705, line 26: Specify what the GFIT-specific post-corrections are, in addition to the airmass-dependent correction." A: We added the following sentences collecting our understanding of the relevant post-processing steps: "This includes an averaging of the 2 CO$_2$ column values as two separate spectral windows are evaluated (see Sec. 4.3). In this averaging, a multiplicative bias between the 2 spectral windows is corrected for, which is determined from the whole available dataset. In

the next step, the XCO$_2$ values are calculated according to eqn. 1 and an empirical airmass-dependent correction factor is applied. Further details can be found in \citep{wunch2011TCCON} and on the TCCON wiki webpage \url{https://tccon-wiki.caltech.edu}."

Q: "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." A: Yes, these are averages of daily differences between 2 retrieval schemes. We clarified this in the text: "In Fig. 6 the statistical behavior of the O_2-column differences for each measurement day are collected. The mean difference, and the 1-σ error bar according to the intraday scatter is shown."

Q: "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." A: We added in section 5.4: "As we alternately recorded 0.5cmˆ-1 and 1cmˆ-1 spectra as described in sec. 4.1, these 3 EM27 0.5cmˆ-1 measurements span about the same time period as the time interval of a single HR-datapoint (average of 2 forward and 2 backward IFGs)."

In section 4.1 we added: "We chose the alternately 0.5cmˆ-1 and 1cmˆ-1 recording scheme, to maintain the option for evaluating the spectrometer’s capabilities with 1cmˆ-1 resolution, and to check for differences in the single-sided and double-sided recording scheme. However, since we restricted the analysis to the 0.5cmˆ-1 resolution spectra, the effective duty-cycle of the EM27 is 50%."

The number of IFGs contained in the figures vary between the chapters, which is now clarified in the caption of each graph, such as: "The number of interferograms and respective recording interval contained in a single datapoint of each type are the fol-

lowing: EM27: 10 IFGs, 34 s; HR_Reduced: 4 IFGs, 34 s; HR_High: 4 IFGs, 212 s; GFIT: 2 IFGs, 206 s." In the plots showing the intra-day variation, a GFIT-datapoint corresponds to an average of 2 IFG, which is the standard output of GFIT for our IFGs. In section 5.3 (comparisons), the GFIT-datapoints correspond to an average of 2 forward and 2 backward IFGs. As we record the IFS125HR IFGs in the scheme fwd-bwd-fwd-bwd, the forward and backward IFG recording times are overlapping, so that comparisons with temporally coincinding EM27 values are easier when averaging the 4 IFGs.

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