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Atmospheric Measurement Techniques Discussions

Interactive comment on "A fully automated FTIR system for remote sensing of greenhouse gases in the tropics" *by* M. C. Geibel et al.

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We thank the anonymous Referee No.1 for his helpful comments. Since there were no general formating comments, we respond to the specific suggestions as follows:

A fully automated FTIR system for remote sensing of greenhouse gases in the tropics (remove in the tropics **or focus more on the site in Ascension Island)**

According to the suggestion of the Referee, we changed the title of the paper to: *A new fully automated FTIR system for total column measurements of greenhouse gases*

1 Introduction

Recent analyses of solar spectra obtained by near-infrared Fourier Transform Spectrometers (FTIR) demonstrate that xCO2 can be retrieved with high precision (Washenfelder et al., 2006; Warneke et al., 2005; Dufour et al., 2004; Yang et al., 2002, *Messerschmidt et al. 2010*).

The missing was citation added.

To obtain the column-averaged volume mixing ratio, these values have to be related [*what does "to be related" mean?*] either to surface pressure or measured O2 total column.

The paragraph was rephrased to clarify the calculation of the column-averaged volume mixing ratio: *To obtain the column-averaged volume mixing ratio, these values have to be divided by the total dry air column. The total dry air column can be derived either from surface pressure or from the measured O2 total column.* Further, we added a reference to the equations in section 3.

The Atmospheric Remote Sensing group (ARS) of the Max Planck Institute for Biogeochemistry (MPI-BGC) in Jena, Germany, is currently making the final preparations for installing such an FTIR instrument in the tropics, where such measurements have only been taken within short campaigns *(Petersen et al., 2010 Petersen et al. 2008, Warneke et al, 2010) (statement is wrong: FTS site in Darwin is in the tropics, NDACC site in Reunion as well, even though they do not measure in the NIR range).*

The statement was corrected and Darwin is mentioned as currently the only existing tropical TCCON station. Additionally, we checked the suggested citations and

added Warnecke et al. 2010 to our citation list.

The instrument will be part of the Total Carbon Column Observation Network (TCCON) (Toon et al., 2009, *Wunch et al. 2010*) that will provide ground-truthbased data for satellite validation *(it is not clear if the network or the new FTS system is meant)*.

The suggested citation was added. We modified the sentence to: *The instrument will be part of the Total Carbon Column Observation Network (TCCON) (Wunch et al. 2010, Toon et al. 2009)* ***that provides*** *ground-truth data for satellite validation.* Apart from that, we believe the meaning of the sentence is clear.

2 The MPI-BGC FTIR System

Section 2 was extensively restructured. Misleading statements were clarified and individual paragraphs re-structured. We appended additional information about our individual concept, details of the automation software structure. Also detailed information about the chosen components (manufacturer, model) were added in the text and corresponding tables.

3 First Results 3.1 Instrument Line Shape *(maybe Alignment would be better as title?)*

The section was renamed to Alignment

For the accurate retrieval of total column values, a good alignment of the FTIR is crucial. *The long term stability is not a specific issue of the Jena instrument, but of all Bruker instruments around the world. Therefore I am not sure if this section is necessary, or if they could just state in the introduction part*

that FTS systems are quite stable and refer to some publication within TCCON ?!

The long-term stability is not a specific issue of the Jena instrument but crucial for measurements. Since this paper is about the capabilities of our instrument, we believe the illustration of the stability is to important to be neglected. Nevertheless, this section was restructured.

3.2 Column measurements at Jena Also GFIT has been used for the analysis of spectra from several ground-based FTIR spectrometers (Notholt et al., 1997). In recent years GFIT and has become the standard data analysis tool for TCCON. (*mention Wunch et al. 2010, and publication of Geoffrey Toon*)

Missing citations were added.

Figure 12 shows the change with the solar elevation angle of the GFIT averaging kernel for xCO2 over Jena. These kernels have been determined for the CO2 6220 cm1 band. The averaging kernel represents the change in the retrieved total column abundance with respect to a perturbation of the true profile at a particular level/altitude. *I would delete this paragraph, because the averaging kernel has nothing to do with the automation and is not specific for the site in Jena. It would fit in a general paper about FTS and GFIT retrieval (Wunch et al. 2010)*

Going along with the suggestions of both Referees, the paragraph was deleted.

The diurnal variation of total column xCO2 over Jena (Fig. 13) illustrates the decrease in atmospheric xCO2 over the covered period in more detail. It shows also that the decrease of xCO2 over the day is relatively constant. *(This paragraph is rather short. If the authors would like to present these results,*

they should investigate more into the details, e.g. comparing with models TM3, describing what they would expect and what they got.) (The same comment can be applied for the next paragraph. The comparisons are quite interesting, but to show their value the authors should investigate more. Are there measurements of the Zeilometer to derive the boundary layer?)

This section was rephrased and the discussion of the results extended. Difference of in-situ surface measurements and total column measurements: We added results of high-resolution model simulations to illustrate the agreement of expectations and measurements. Unfortunately, ceilometer measurements were not available for the site.

4 Conclusions and outlook

According to the referees comments, this section was re-structured and more details about the instruments destination (Ascension Island) were added.