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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.

Anonymous Referee #2

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Referee comments: A Fully automated FTIR system for remote sensing of greenhouse gases in the tropics by M C Geibel, C Gerbig and D G Feist

General comments. This paper is a technical description of a Fourier Transform solar spectrometer for remote sensing of CO2 and other greenhouse gases. The spectrometer is built into a standard shipping container and is designed for unattended operation over long periods with remote communications. It is intended for operation in the Atlantic tropics (Ascension Island) but in principle suited to most environments. It will form part of the Total Carbon Column Observing Network (TCCON). The paper describes the principles, design and construction of the instrument and container, with a few indicative results obtained at its home base, Jena, Germany.

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Interactive Discussion
Discussion Paper

The production and editorial quality is excellent and needs very little work. The paper is suited for publication in AMT, and will be of interest to readers building their own remote sensing equipment, or interpreting results which will ultimately flow from the instrument. However for a paper with a very technical focus and only a few results, there is a lack of actual detail, and as a general point the paper needs to be expanded to include more specific details of equipment and construction to warrant publication. This would be very useful for the target audience, and is indeed necessary to justify publication. I make some suggestions in the following specific comments, but encourage the authors to expand on these.

Specific comments

Abstract

The authors refer to seasonal and diurnal cycles observed, but in fact the observations are for only part of one year, and the mornings of individual days. They have not really observed these cycles, only a time of day and time of year dependence.

Introduction.

The consensus and more consistent naming convention for “XCO2” is I believe capital<X>-subscript<CO2>

P3069, line 25 et seq. This is not the only tropical TCCON station - the Darwin TCCON station is in the tropics and runs continuously and unattended (Deutscher 2010). A new paper by Wunch et al (Proc Roy Soc, 2010) should be published before this paper is finalised and describes TCCON in some detail – more reference to this paper could be made here, also to the original Washenfelder 2006 in JGR.

P3070 Line 9. Many TCCON stations are reasonably autonomous (Park Falls, Darwin, Lamont operated by Caltech, Orleans and Biyalistock by Univ. Bremen). This sentence is misleading.

2.1 Container

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From here I believe there should be more details given of the actual construction, components used etc. I make some suggestions but the authors might flesh out the details further than just these suggestions: - Container manufacturer/adapting it as a laboratory - Power system - Power consumption/requiremnts - Airconditioning - 2.2 FTIR

Line 20 – The spectrometer covers a bandwidth to <1800cm-1, limited by the beamsplitter. The restriction to 3800cm-1 is only due to the InGaAs detector. Line 1 – pump manufacturer and model? Why does the vacuum operation improve temperature stability? Line 5: "For accurate measurements accurate alignment is required, and the monitoring of instrument lineshape is necessary. - Describe the size and fill pressure of the HCl cell. Where is it located in the beam? Resolution: the definition of resolution is ambiguous, what is the optical path difference? The TCCON standard is 45cm, a "resolution" by the Bruker definition of 0.2 cm-1. Why is the quoted resolution higher? Are the forward-backward pair of scans coadded and transformed, transformed separately and averaged, or transformed and reported separately?

2.3.2 shutter and Figure 4. Figure 4b is not needed, I find it quite hard to visualise, while 4a and 4c (elevation and plan) are clear. 2.4.1 Weather station, and Table 1. Please list make and model of all sensors, this is essential and useful information. The thesis by Zoephel is probably not readily available. 2.4.2 PLC. How is communication between the PLC and remote user structured. Can the remote user view the PLC screen? 2.4.3 Dual PC Give make and model of the PC boards and computing peripherals. The tracker PC is first mentioned here – it is not clear that the tracker has its own separate PC. Line 11 – Would this better read "For high accessibility the container. . ."? Line 17 – what is "high availability applied to a RAID system?

3.1 Instrument lineshape Figure 9 needs explanation, particularly the lower panel – what is the x-axis?

3.2 Column measurements at Jena. Here the paper by Wunch et al 2010 could be referenced. Line 19 – the wavenumber figures are the centres of the analysed windows,

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NOT the respective vibration band centres (eg the CH4 windows are all in the same band). Figure 11 also plots N2O and HF, which are not mentioned in the text. Analysis window details should be included in Table 2 (or referenced to Wunch et al if they are identical). There does not seem to be a reference to Figure 11 in the text. This figure also has a single logarithmic scale for all species which does not allow variability to be seen or assessed, it has very little information, and could be replotted with independent yaxis scales for each species. Line 12 – the use of O2 column to calculate XCO2 minimises systematic errors, but probably doesn't eliminate them. I do not think the averaging kernel plot (Figure 12) is needed in the context of this paper. Diurnal and seasonal variability: The data cover neither a whole year nor whole days, so this is overstating the case. It would be useful to give and discuss the scatter in the results on a given day (precision of the retrieval). Is the change with time of year and drop in the morning CO2 consistent with modelled expectations? Please discuss. P3074 Line 24. Since this paper is about testing and proving the instrument, it is false logic to assume that the constant total columns as the boundary layer elevated concentrations break up in the morning are correct. The discussion could be extended here to further explain and justify the difference between column and in situ measurements. This is indeed one very important reason for making column measurements!

Figure 16. The TM3 model results seem to slightly underestimate the seasonal change from the measurements. Similar results have been seen at Park Falls. A brief discussion would be appropriate.

P3081 line 13. Give author and journal for the IMECC campaign paper.

Interactive comment on Atmos. Meas. Tech. Discuss., 3, 3067, 2010.