

Interactive comment on “Instrumental characteristics and Greenhouse gases measurement capabilities of the Compact High-spectral Resolution Infrared Spectrometer: CHRIS” by Marie-Thérèse El Kattar et al.

Anonymous Referee #2

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The paper introduces a new portable Fourier Transform Spectrometer (FTS) with a higher resolution than other commercially available portable FTS instruments. The characteristics of the instruments are described in detail and methods for spectral and radiometric calibration are implemented. The information content to retrieve the vertical profile information of CO₂ and CH₄ and the associated errors are explained and compared to two other FTS instruments that are widely used within the remote sensing community. The optimized number of channels to retrieve CO₂ and CH₄ are carried out at the end.

C1

The work presented in the manuscript is within the scope of AMT. The text sometimes becomes unclear and hard to follow. I suggest reviewing the transitions between topics and fleshing out when a new topic is introduced to make it easier for the readers to follow along.

Here are some general comments:

1. The MAGIC campaign has been brought up a few times in the manuscript, however, it's unclear when exactly that campaign took place? How many days of measurement are available from each instrument involved?
2. The title of the manuscript suggests "greenhouse gas measurement capabilities" of the instrument are discussed in the paper. However, the main focus of the paper is on the information that could be obtained for the vertical profiles of CO₂ and CH₄ and there's no presentation of retrieved column values. Given that two other instruments (125-HR and EM27/SUN) were measuring at the same time as CHRIS, comparison of CO₂ and CH₄ column values between the three instruments could be proving the "greenhouse gas measurement capabilities" of CHRIS. GGG could easily used perform the retrievals.
3. In section, 2.2.1 it is mentioned that 50, 100 spectra are coadded for CO₂ and CH₄ measurements. My calculations using the laser frequency and scanner velocity suggests a single scan time of about 0.7 s. Can you confirm this number? If that's the case, coadding 100 spectra is still fast enough not to worry about changes in the atmosphere and also stability of the laser.
4. Although H₂O absorption lines are present in almost all spectral windows, water vapour mole fractions are not retrieved in the analysis. Is it because of the certain meteorological conditions in Izaña that leads to stable water vapour values? Bringing some evidence to prove that's the case would be helpful.

C2

5. In section 3.1, it is mentioned the apriori profiles (I am guessing of CO₂ and CH₄), temperature and humidity are used for the analysis. Could you please specify where these information are obtained from?
6. Page 13, the last paragraph, you mention that calculation of X_G using O₂ column values done by EM27/SUNs allows comparisons with satellite data and it's not possible for CHRIS. This statement contradicts the point made earlier in the introduction where you suggest CHRIS could be used for satellite validation. In fact, retrieval of X_G values are possible for CHRIS if surface pressure and water vapour measurements are used as described by Wunch et al., 2010.

Minor corrections and comments:

- Please use EM27/SUN all over the text as EM27 might be mistaken by the other Bruker instrument.
- Line 18: I think you mean InfraRed High Spectral Resolution "Spectroscopy"
- Line 29: There are currently more than 30 125HRs running if you check <https://tcccon-wiki.caltech.edu/Sites> and <http://www.ndaccdemo.org/stations>.
- Section 2.2.3: could you specify by a subtitle to show which parts are about spectral calibration and which parts are for radiometric calibration?
- Line 135: "This reference wavelength...." Consider rewording this sentence. Changes in pressure and temperature cause the refractive index to change and as a consequence the reference wavelength will change.
- Line 157: Could you specify which two temperatures you used for the black body for calibration?

C3

- Figure 4: I suggest you separate each panel by a frame and label it with the name of the corresponding band.
- Figures 5,6,8 and 9: Please add a legend to specify the colors for the averaging kernel plots.
- Line 322: The same number of columns? Do you mean the same number of vertical layers?
- Line 325: This is not quite right. CH₄ for both 125HR and EM27/SUN are retrieved from microwindows around 6000 cm⁻¹.
- Line 383: Define K.
- Section 4: You specify the number of channels used for each species can you also specify where the centre of the band is?
- Figure 10: caption. CH₄ (green line).

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C4